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Equalizer®
Administration Guide

EQ/OS 10
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Coyote Point Systems
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Millerton, NY 12546

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Chapter 1

Introduction

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Chapter Summary

Equalizer is designed to be administered equally as well from either a console Command Line Interface or a browser-based Administrative Interface. This guide describes both administrative environments.

Within this guide, the Command Line Interface or **eqcli** is referred to as the “CLI”. The web-based Administrative Interface is referred to as “GUI”. EQ/OS 10 is a major revision of Equalizer software.

Please ensure that any Equalizer documentation you are reading is written specifically for EQ/OS 10 before using it to modify the configuration of an EQ/OS 10 system.This has been changed.

This guide contains the following chapters:

- *Introduction*- contains an overview of this guide, a chapter summary, a description of the WebHelp system, descriptions of the differences between EQ/OS 10 and EQ/OS 8.6 and typographical conventions used throughout.
- *Equalizer Overview* - -contains detailed descriptions of Equalizer concepts and terminology. This chapter includes information to help you plan your Equalizer configuration.
- *Installation* – provides hardware installation instructions and specifications.
- *First Time Configuration Using EQ OS 10* - - provides instructions for first time configuration of Equalizer with an example.
- *Upgrading and Downgrading* - - includes instructions for upgrading Equalizer from the Version 8.6 platform to EQ/OS 10. Also includes instructions for downgrading from EQ/ OS 10 and upgrading to the latest releases.
- *Licensing Equalizer* - - provides instructions for Equalizer licensing through the CLI and throughout the GUI.
- *Configuring Access* - - provides instructions for configuring Equalizer for access using serial and network access.
- *Network Configuration* – describes adding Equalizer to your network, VLAN and switch port configuration, source routing scenarios and how to define static routes on Equalizer.
- *Working in the CLI* – provides instructions for starting the Equalizer Command Line Interface, a description of the command interpreter environment, the context hierarchy, and an example of a complete CLI session in which we configure a new Equalizer with two real servers, a server pool, four clusters, and two responders.
- *Using the GUI* – discusses how to use Equalizer’s HTML-based Administrative Interface, or GUI.
- *Configuring an IPv6 Tunnel* -- describes how you can set up an IPv6 tunnel using the Hurricane Electric IPv6 Tunnel Broker.
- *Server Pools and Server Instances* – describes Server Pool management using both the GUI and CLI.
- *Servers* – describes Server Configuration constraints, configuring routing on servers and server management.

- *Clusters* – tells you how to add and remove virtual clusters and servers, changing load balancing options, and shutting down servers.
- *Match Rules* – shows you to create match rules that distribute requests based on a request's attributes.
- *Automatic Cluster Responders* – this section describes the configuration of and use of automatic cluster responders and association with match rules.
- *Configuring Server Connections* – this section describes HTTP multiplexing, outbound NAT and the configuration of DSR (Direct Server Return).
- *Server Health Check Probes* – this section describes how Equalizer uses health check probes to ensure server availability and how you can set probe parameters and options to tailor probes for your specific configuration and applications.
- *Logging* – this section describes the use of Equalizer logs that can be displayed in both the CLI and the GUI.
- *Reporting*– this section describes Equalizer's reporting methods including the statistics reported as well as descriptions of the plotting features used on the GUI.
- *Failover* – this section provides descriptions of failover and the configuration failover between two Equalizer. It provides instructions for the configuration of failover between a version 8.6 and a version 10 system and configuration between two version 10 systems.
- *Alerts* – this section describes alerts and the actions that occur whenever an event of a particular type occurs on a particular Equalizer object.
- *SNMP Traps*– this section describes the process of setting up SNMP Traps or alerts.
- *User and Group Management* – this section provides procedures for adding additional users and groups to your configuration as well as guidelines to establish object permissions that will be effective and easy to manage.
- *Using Envoy®* – shows you how to use the optional Envoy product to add and remove geographic clusters and sites and change geographic load balancing and targeting options.
- *Backup and Restore* – this section provides instructions for backing up Equalizer's user-configured objects and parameters to a file that can be uploaded and later restored to another Equalizer.
- *How to Use Regular Expressions* – discusses Equalizer's regular expressions, components, formats, and usage.
- *Physical Dimensions*– this section states the physical sizing of Equalizer.
- *Using the File Editor*– this section describes how to edit files using the ee file editor in the CLI.
- *EQ/OS 8.6 to EQ/OS 10 Configuration Converter* -- describes the process of migrating an EQ/OS 8.6 configuration into an EQ/OS 10 configured Equalizer.

- *Equalizer OnDemand* – discusses the differences between Equalizer OnDemand and Equalizer hardware, prerequisite requirements, installation and use of EQoD.

- *Glossary* -- A glossary of common load balancing terminology in addition to Equalizer-specific terminology.

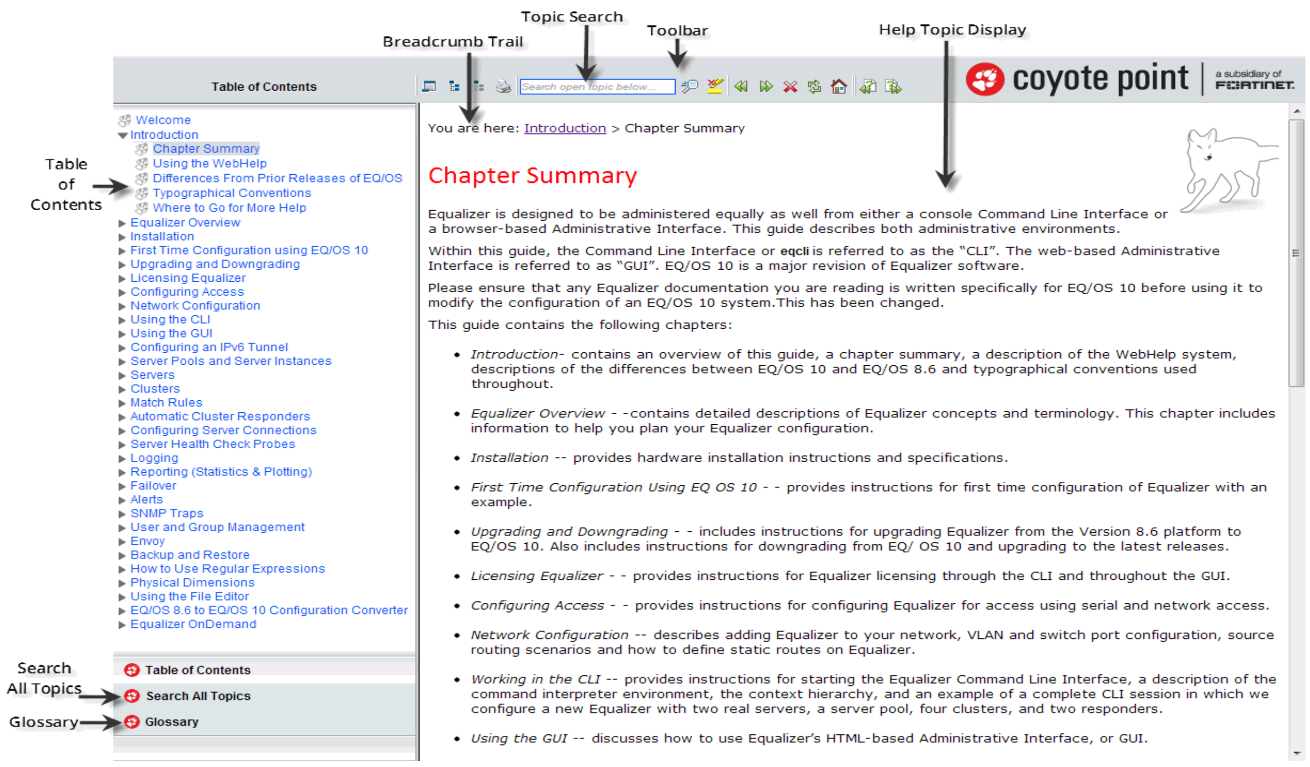
Using the WebHelp

Installed on your Equalizer is an html-based WebHelp system that is fully functional in all web browsers. It provides descriptions of how to manage EQ/OS 10 through the Command Line Interface (CLI) and the Graphical User Interface (GUI).

The PDF file of the *Equalizer Administration Guide* is still available for download from the EQ OS 10 Support Page. It is synchronized with the same revision as the WebHelp and contains the same information.

The Equalizer GUI features context-sensitive help. When you click on the **Help** button and select **Context Help**, or simply press **F1** on your keyboard, this WebHelp system will be activated in a new browser window. If you are currently browsing an Equalizer configuration screen and select **Context Help** or press **F1**, the help topic associated with the configuration screen will be displayed.

The following is an overall description of the WebHelp workspace and some basic instructions for its use.



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Chapter Summary

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- *Using the GUI* -- discusses how to use Equalizer's HTML-based Administrative Interface, or GUI.

Help Topic Display

This is the area where the selected topic's content is displayed.

Breadcrumb Trail

Displays a "trail of breadcrumbs" composed of the table of contents (Table of Contents) entries above the current topic in the Table of Contents hierarchy.

Topic Search

This text entry box is where you can enter a search term to search the open topic for specific details. Click on after you have entered a search term.

Toolbar

The toolbar contains buttons for quick navigation, display options, topic printing, highlighting and a search area. Enter a search term in this box and the open topic will be searched. If the search yields results, they will be highlighted on the page.

- Click on after you have entered a **Topic Search** item in the search box.
- Click on if you would like to remove the search highlighting after you have used the search feature
- Click on or to navigate to the previous or next topic of a viewing sequence.
- Click on to return to the WebHelp home page.
- Click on or to navigate to the previous or next topic in the Table of Contents.
- Click on to hide the navigation panel on the left.
- Click on or to collapse or expand to topic branches in the Table of Contents.
- Click on to print the selected topic.

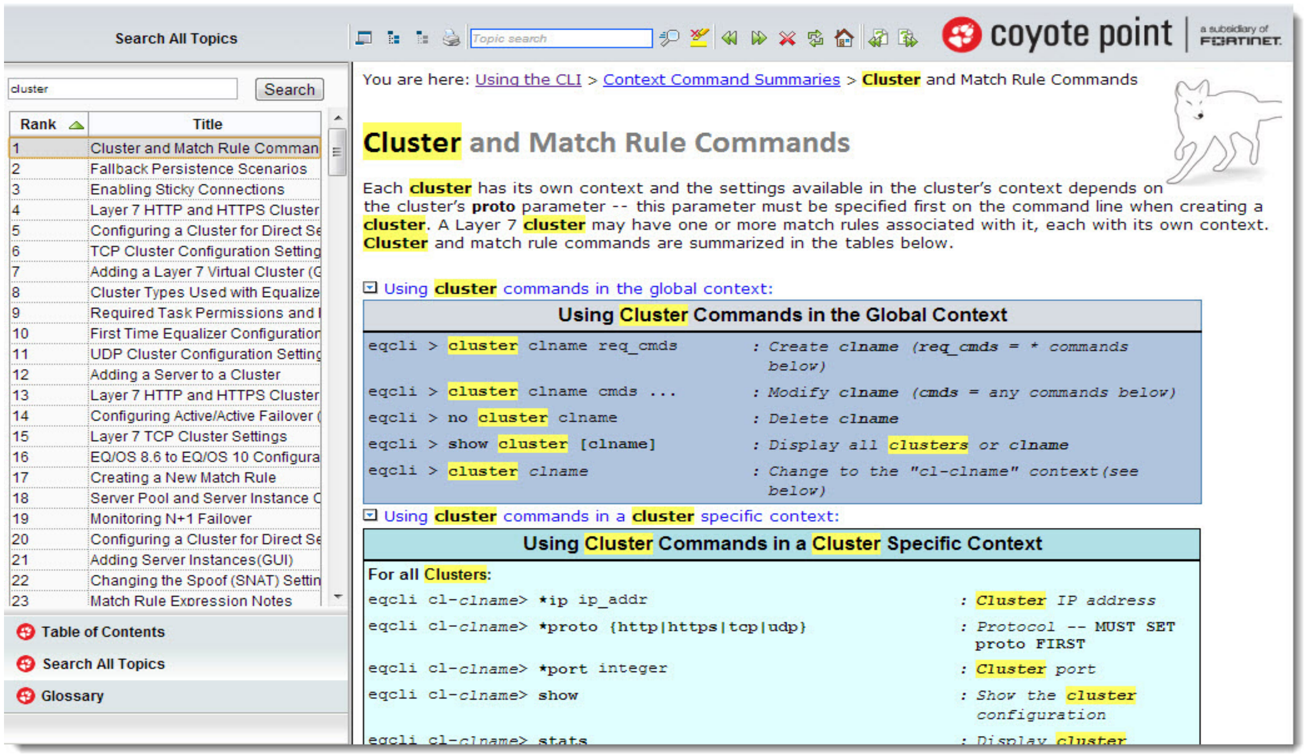
Table of Contents

Select the **Table of Contents** accordion tab to display of Table of Context. Click on ▶ to expand each branch.

Search All Topics

Click on the **Search All Topics**accordion tab to open a Search pane. Enter a term in the at the top of the pane and click on **Search**. A list of results from the entire WebHelp system will be displayed.

Click on each item in the list to navigate to the applicable topic in the WebHelp. All of the found terms will be highlighted.



Search All Topics

cluster Search

Rank	Title
1	Cluster and Match Rule Comman
2	Fallback Persistence Scenarios
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4	Layer 7 HTTP and HTTPS Cluster
5	Configuring a Cluster for Direct Se
6	TCP Cluster Configuration Setting
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9	Required Task Permissions and I
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12	Adding a Server to a Cluster
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16	EQ/OS 8.6 to EQ/OS 10 Configura
17	Creating a New Match Rule
18	Server Pool and Server Instance C
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23	Match Rule Expression Notes

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Cluster and Match Rule Commands

Each cluster has its own context and the settings available in the cluster's context depends on the cluster's **proto** parameter -- this parameter must be specified first on the command line when creating a cluster. A Layer 7 cluster may have one or more match rules associated with it, each with its own context. Cluster and match rule commands are summarized in the tables below.

Using cluster commands in the global context:

Using Cluster Commands in the Global Context

```
eqcli > cluster clname req_cmds          : Create clname (req_cmds = * commands
                                           below)
eqcli > cluster clname cmds ...          : Modify clname (cmds = any commands below)
eqcli > no cluster clname                : Delete clname
eqcli > show cluster [clname]            : Display all clusters or clname
eqcli > cluster clname                   : Change to the "cl-clname" context(see
                                           below)
```

Using cluster commands in a cluster specific context:

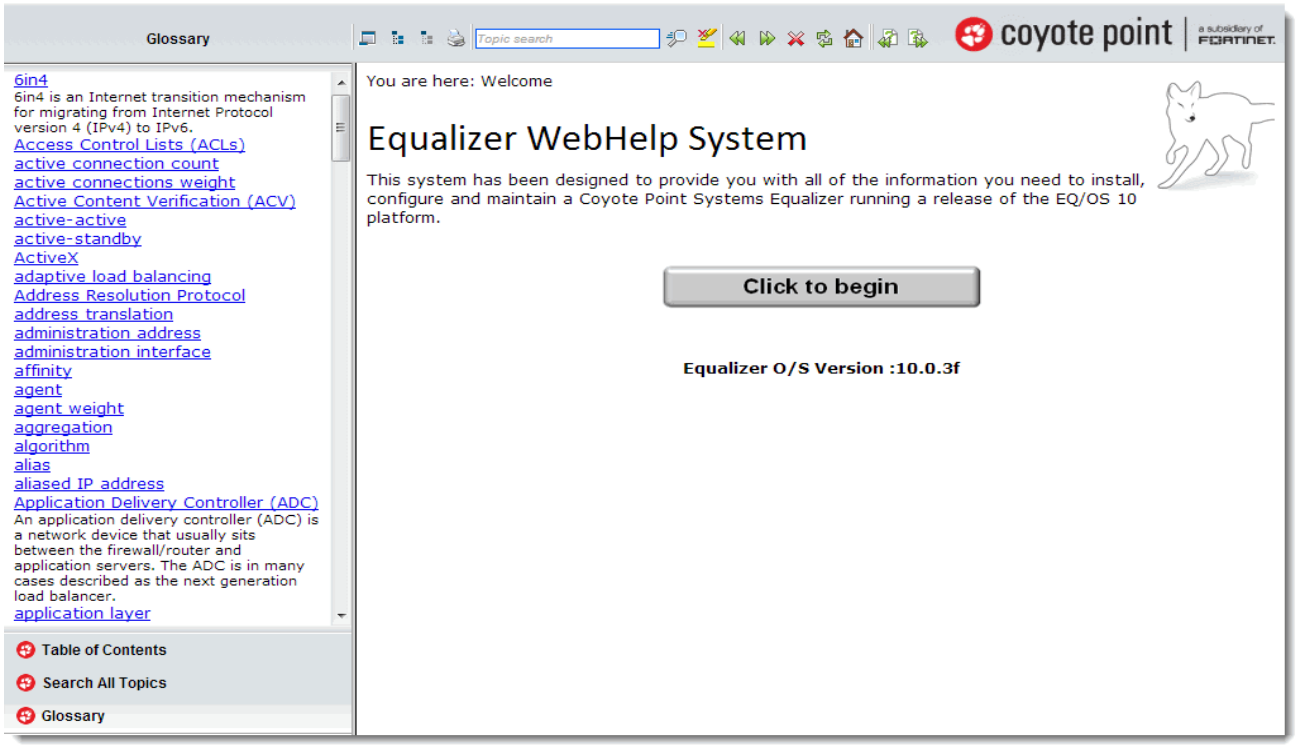
Using Cluster Commands in a Cluster Specific Context

For all Clusters:

```
eqcli cl-clname> *ip ip_addr                          : Cluster IP address
eqcli cl-clname> *proto {http|https|tcp|udp}          : Protocol -- MUST SET
                                                        proto FIRST
eqcli cl-clname> *port integer                        : Cluster port
eqcli cl-clname> show                                 : Show the cluster
                                                        configuration
eqcli cl-clname> stats                                : Display cluster
```

Glossary

Select the **Glossary** accordion tab to access a glossary of load balancing and Equalizer-specific terminology. Click on each term to display a definition.



Glossary

6in4
6in4 is an Internet transition mechanism for migrating from Internet Protocol version 4 (IPv4) to IPv6.
Access Control Lists (ACLs)
active connection count
active connections weight
Active Content Verification (ACV)
active-active
active-standby
ActiveX
adaptive load balancing
Address Resolution Protocol
address translation
administration address
administration interface
affinity
agent
agent weight
aggregation
algorithm
alias
aliased IP address
Application Delivery Controller (ADC)
An application delivery controller (ADC) is a network device that usually sits between the firewall/router and application servers. The ADC is in many cases described as the next generation load balancer.
application layer

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You are here: Welcome

Equalizer WebHelp System

This system has been designed to provide you with all of the information you need to install, configure and maintain a Coyote Point Systems Equalizer running a release of the EQ/OS 10 platform.

Click to begin

Equalizer O/S Version :10.0.3f

Differences From Prior Releases of EQ/OS

The following are differences from previous versions of EQ/OS:

New Command Line Interface

The Equalizer Command Line Interface, CLI, gives you complete administrative control over Equalizer and is one of the major new features in EQ/OS 10. The GUI is also available to view and modify the configuration, however, not all administrative options have been enabled in the GUI.

"eqadmin" Console Command No Longer Supported

All of the functionality that was available in previous releases using the **eqadmin** console command is now provided in the CLI.

No Default Match Rules

In previous releases, some cluster flags and options appeared both in the cluster configuration screens and in a "Default" match rule that could not be changed. In EQ/OS 10, there are no Default match rules. All cluster flags and options are set in the cluster context, and match rules are only needed if you want to override one or more of the options set in the cluster context. Otherwise, match rule processing occurs in the same fashion as in previous releases.

Load Balancing Policy Specified on Server Pools

In version 8.6, you can use a match rule to select a new load balancing policy. This works differently in EQ OS 10 because of the re-architecture of server pools. In EQ/OS 10, the load balancing policy is specified on a server pool, and a server pool is attached to a match rule. If you want to assign a different load balancing policy on a match rule, you can create a different server pool with a different policy and attach that server pool to the match rule.

Capability of Adding Responders to Clusters

A responder can now be added directly to a cluster; this responder is used if none of the servers in the server pool specified in the cluster context are available. Responders cannot be added to match rules, as in previous releases.

VLANs and Subnets

In previous releases, only one subnet was permitted in a VLAN. In EQ/OS 10, multiple subnets can be assigned to a single VLAN.

VLAN/Subnet Routing

In previous releases, VLAN traffic was forwarded between ports by default. For example, if a packet tagged for VLAN_2 arrived on a port configured only for VLAN_1, the packet for VLAN_2 would be forwarded to other ports instead of being dropped. In EQ/OS 10, packet forwarding between VLANs is disabled by default, and must be enabled by adding entries to the "permit" list for the appropriate VLAN subnets.

Servers Are Now Global Objects

In previous releases, *servers* were defined directly within *clusters*. In EQ/OS 10, servers are global objects in the object tree (as displayed in the left navigational pane of the GUI interface) and are associated with clusters via *server pools*. *Server pools* are new in EQ/OS 10 and are also global objects in the tree. In general, you create objects in this order:

1. Create servers -- use the IP addresses and ports of the real servers behind Equalizer.
2. Create server pools -- set load balancing parameters that will apply to a group of real servers.
3. Associate servers with server pools -- associate real server names with the server pool, creating a *server instance*, and set options on the server instance.
4. Associate server pools with clusters.

This allows administrators to define real servers once and use them in multiple server pools (and, hence, clusters) with distinct operating characteristics specific to each server pool. The following table summarizes the attributes assigned to servers, server pools, and server instances.

Server Settings	Server Pool Settings	Server Instance Settings
IP address Port Protocol Probes (health checks) Max Connections Reuse Connection Timeout	Load Balancing Algorithm Load Balancing Responsiveness Active Content Verification (ACV) TCP Multiplexing	Hot Spare Persist Quiesce Max Connections Initial Weight

"SSL Unclean Shutdown" behavior is now the default for HTTPS clusters

In EQ/OS 8 and earlier releases, the default behavior for HTTPS clusters when closing a client connection was to wait for the client to respond before closing the connection. This works for most non-browser environments. Some browsers, however, would close their connection to the cluster in an "unclean" fashion, such that processes on Equalizer were left waiting for a client response, potentially impacting cluster performance.

Previously the "SSL Unclean Shutdown" HTTPS cluster option could be enabled to work around this issue. When enabled, this option caused client connections to be closed without waiting for the client to respond. Enabling this option meant that no processes on Equalizer would be left waiting for a client response when closing a connection, generally improving cluster performance.

In Version 10, the "SSL Unclean Shutdown" behavior described above is the default behavior for HTTPS clusters, and cannot be disabled.

Typographical Conventions

The following typographical conventions appear throughout this guide:

- Text in “double quotes” indicates the introduction of a new term.
- *Italic* text is used primarily to indicate variables in command lines, and is also used to emphasize concepts while discussing Equalizer operation.
- **Boldface** text highlights GUI interface screen elements: labels, buttons, tabs, icons, etc., as well as data the user must type into a GUI element.
- `Courier` text denotes computer output: messages, commands, file names, directory names, keywords, and syntax exactly as displayed by the system.

- **`Bold courier`** text is text the user must type at the CLI prompt. Bold courier text in brackets -- indicates a keyboard key or key sequence that must be typed.
- Bold text sequences such as "**Equalizer > Status > Event Log**" are used to indicate the GUI controls a user needs to click to display the GUI form relevant to the task at hand. In the above example, the user would click on the Equalizer host name displayed at the top of the left navigational tree , click on the **Status** tab in the right pane, and then click on the **Event Log** tab.

1. Numbered lists show steps that you must complete in the numbered order.

- Bulleted lists identify items that you can address in any order.

Note - A note box in the margin cites the source of information or provides a brief explanation that supports a specific statement but is not integral to the logical flow of the text.

A Coyote Paw in the margin emphasizes a critical note or caution.

Where to Go for More Help

These instructions are part of the product documentation delivered with Equalizer's browser-based GUI. You can display the appropriate manual section for any interface screen by selecting **Help > Context** help from the menu at the top of the interface. The Help menu also contains links to the Release Notes for the currently running software version, and other documentation.

Hard copy documentation provided with every Equalizer includes the *Getting Started Guide* and the *Basic Configuration Guide*. These two documents are designed to help you get Equalizer out of the box and working with your first virtual clusters. The *Basic Configuration Guide* also contains a **Resource CD** with copies of all product documentation, including support documents that help you configure Equalizer for a variety of environments. The latest Resource CD content is available on the web at:

http://docs.coyotepoint.com/eqos10

Customer Support contact information is available from:

http://www.coyotepoint.com/support.php

Register today to get access to the **Coyote Point Support Portal:**

http://support.coyotepoint.com

Registration provides you with a login so you can access these benefits:

- **Support FAQs**: answers to our customer's most common questions.
- **Moderated Customer Support Forum**: ask questions and get answers from our support staff and other Equalizer users.
- **Software upgrades and security patches**: access to the latest software updates to keep your Equalizer current and secure.

- **Online device manuals, supplements, and release notes**: the latest Equalizer documentation and updates.
- **Links to additional resources**, and more.

Chapter 2

Equalizer Overview

Sections within this chapter include:

About Equalizer

Equalizer is a high-performance content switch that features:

- Intelligent load balancing based on multiple, user-configurable criteria.
- Non-stop availability with no single point of failure, through the use of redundant servers in a cluster and the optional addition of a failover (or backup) Equalizer.
- Layer 7 content-sensitive routing.
- Connection persistence using cookies or IP addresses.
- Real-time server and cluster performance monitoring.
- Server and cluster administration from a single interface.
- SSL acceleration (on Equalizer models with Xcel SSL Hardware Acceleration).
- Data compression (on Equalizer models with Express Hardware GZIP Compression).
- Geographic load balancing (with the optional Envoy software add-on).

This section is an introduction to Equalizer's basic load balancing and application acceleration capabilities for those who have some networking experience but may not have previously used an appliance like Equalizer.

Intelligent Load Balancing

Equalizer functions as a gateway to one or more sets of servers organized into virtual clusters. When a client submits a request to a site that Equalizer manages, Equalizer identifies the virtual cluster for which the request is intended, determines the server in the cluster that will be best able to handle the request, and forwards the request to that server for processing.

To route the request, Equalizer modifies the header of the request packet with the appropriate server information and forwards the modified packet to the selected server. Depending on the cluster options chosen, Equalizer may also modify the headers in server responses on the way back to the client.

Equalizer support clusters that route requests based on either *Layer 4* (TCP or UDP) or *Layer 7* (HTTP or HTTPS) protocols. Layer 4 is also referred to as the *Transport Layer*, while Layer 7 is referred to as the *Application Layer*. These terms come from the OSI and TCP/IP Reference Models, abstract models for network protocol design.

In general, Layer 4 clusters are intended for configurations where routing by the destination IP address of the request is sufficient and no examination of the request headers is required. Layer 7 clusters are intended for configurations where routing decisions need to be made based on the content of the request headers. Equalizer evaluates and can modify the content of request headers as it routes packets to servers; in some cases, it can also modify headers in server responses on their way back to the client.

The table below summarizes the basic capabilities of the cluster types supported by Equalizer.

Feature	**Cluster Type**			
	L4 UDP	**L4, L7 TCP**	**L7 HTTP**	**L7 HTTPS**
Load balancing policies	Round Robin, Static Weight, Adaptive, Fastest response, Least Connections, Server Agent, Custom			
Server failure detection (probes)	ICMP, TCP, Health Check	ICMP, TCP, ACV, Health Check		
Persistence	Based on IP		Using Cookies	
Server selection by request content (i.e., Match Rules)	No; load is balanced according to current load balancing policy.		Yes; load is balanced according to decisions made by examining request content.	
Load balanced protocols	Ideal for stateless UDP-based protocols, such as DNS and RADIUS; WAP gateways; NFS server clusters that provide a single-system image.	Ideal for stateful TCP-based protocols, such as HTTP, HTTPS, SMTP, FTP, LDAP/LDAPS and others.	HTTP	HTTPS
NAT and spoofing	Yes			

Regardless of cluster type, Equalizer uses intelligent load balancing*algorithms* to determine the best server to receive a request. These algorithms take into account the configuration options set for the cluster and servers, real-time server status information, and information from the request itself. For Layer 7 clusters, user-defined match rules can also be used to determine the route a packet should take.

Load Balancing Configuration

When you configure a virtual cluster, you can select one of the following load-balancing algorithms to control how Equalizer balances the load across your servers: **round robin**, **static weight**, **adaptive**, **fastest response**, **least connections**, **server agent**, or **custom.**

When you configure the servers in a virtual cluster, you assign an *initial weight* between 0 and 200 for each server. When you select one of the adaptive load-balancing algorithms (i.e., any algorithm other than round robin), Equalizer uses the servers' initial weights as a starting point to determine the percentage of requests to route to each server. Each server handles a percentage of the total load based on its fraction of the total weights in the server cluster. Equalizer dynamically adjusts server weights according to real-time conditions to ensure that Equalizer routes requests to the server that is best able to respond. A server with a weight of zero (0) is considered down or unavailable, and Equalizer does not route requests to servers in this state.

Real-Time Server Status Information

Equalizer gathers real-time information about a server's status using ICMP Probes, TCP Probes, Active Content Verification (ACV), and Server Agents. ICMP and TCP Probes are the default probing methods.

ICMP Probes uses the Internet Control Message Protocol to send an "Echo request" to the server, and then wait for the server to respond with an ICMP "Echo reply" message (like the Unix **ping** command). ICMP is a Layer 3 protocol. ICMP probes can be disabled via a global flag.

TCP Probes establish (and tear down) a TCP connection between Equalizer and the server, in a typical Layer 4 exchange of TCP SYN, ACK, and FIN packets. If the connection cannot be completed, Equalizer considers the server down and stops routing requests to it. TCP probes cannot be disabled.

Equalizer's *Active Content Verification (ACV)* provides an optional method for checking the validity of a server's response using Layer 7 network services that support a text-based request/response protocol, such as HTTP. When you enable ACV for a cluster, Equalizer requests data from each server in the cluster (using an ACV Probe string)and verifies the returned data (against anACV Response string). If Equalizer receives no response or the response string is not in the response, the verification fails and Equalizer stops routing new requests to that server. (Note that ACV is not supported for Layer 4 UDP clusters.) For more information, see "Active Content Verification (ACV) Probes" on page 373.

Server AgentProbes enable Equalizer to communicate with a user-written program (the *agent*) running on the server. A server agent is written to open a server port and, when Equalizer connects to the port, the server agent responds with an indication of the current server load and performance. This enables Equalizer to adjust the dynamic weights of the server according to detailed performance measurements performed by the agent, based on any metrics available on the server. If the server is overloaded and you have enabled **server agent** load balancing, Equalizer reduces the server's dynamic weight so that the server receives fewer requests. The interface between Equalizer and server agents is simple and well-defined. Agents can be written in any language supported on the server (e.g., perl, C, shell script, javascript, etc.). For more information see "Simple Health Checks and Load Balancing Policies" on page 382.

For those who have one or more VMware ESX Servers, *Equalizer VLB* can be configured to use VMware's status reporting to determine server status, and can also be configured to automatically manage VMware servers based on status information obtained from VMware.

Network Address Translation and Spoofing

The servers load balanced by Equalizer provide applications or services on specific IP addresses and ports, and are organized into virtual clusters, each with its own IP address. Clients send requests to the cluster IP addresses on Equalizer (instead of sending them to the IP addresses of the servers).

Central to the operation of any load balancer is the Network Address Translation (NAT) subsystem. On Equalizer, NAT is used in the following ways:

1. When Equalizer receives a client packet, it *always* translates the destination IP (the cluster IP) to the IP address of one of the server instances in a server pool. The server IP used is determined by the cluster's load balancing settings.

2. Depending on the setting of the cluster **spoof** option, Equalizer may also perform *Source NAT*, or *SNAT*.

   When the **spoof** option is *enabled*, then SNAT is *disabled*: the NAT subsystem leaves the client IP address as the source IP address in the packet it forwards to the server. For this reason, the servers in a cluster with **spoof** enabled are usually configured to use Equalizer's IP as their default gateway, to ensure that all responses go through Equalizer (otherwise, the server would attempt to respond directly to the client IP).

   When the **spoof** option is *disabled*, then SNAT is *enabled*. Equalizer translates the source IP (the client IP) to one of Equalizer's IP addresses before forwarding packets to a server. The servers will send responses back to Equalizer's IP (so it is usually not necessary to set Equalizer as the default gateway on the servers when **spoof** is disabled).

Match rules can be used to selectively apply the **spoof** option to client requests. This is sometimes called *selective SNAT*. See the section "Changing the Spoof (SNAT) Setting Using Match Rules" on page 340 .

3. When a server sends a response to a client request through Equalizer, the NAT subsystem *always* translates the source IP in the response packets (that is, the server IP) to the cluster IP to which the client originally sent the request. This is necessary since the client sent its original request to the cluster IP and will not recognize the server's IP address as a response to its request -- instead, it will drop the packet.

4. NAT can also be enabled for packets that *originate* on the servers behind Equalizer and are destined for subnets other than the subnet on which the servers reside -- on Equalizer, this is called *outbound NAT*. This is usually required in dual network mode when reserved IP addresses (e.g., 10.x.x.x, 192.168.x.x) are being used on the internal interface, so that the recipients do not see reserved IP addresses in packets originating from the servers. When the global **outbound NAT** option is enabled, Equalizer translates the source IP in packets from the servers that are not part of a client connection to the Equalizer's Default VLAN IP address (the external interface IP address on the E250GX and legacy 'si' systems), or to the address specified in the server's **Outbound NAT** tab. Enabling **outbound NAT,** as a result, has a performance cost since Equalizer is examining every outbound packet.

Note - When Equalizer is in single network mode, outbound NAT should be *disabled*. Since Equalizer resides on a single subnet, outbound NAT is not needed, and may cause unexpected behavior.

Note that when Equalizer receives a packet that is not destined for a virtual cluster IP address, a failover IP address, a client IP address on an open connection, or one of its own IP addresses, Equalizer passes the packet through to the destination network unaltered.

- For more information about setting NAT and spoofing options, see "Clusters" on page 259.

How a Server is Selected

The main functionality of Equalizer is to load-balance-- that is that when a request is received from a client an appropriate server for to connect the request with. The "appropriate" server is usually selected as part of a proprietary load balancing algorithm or via round-robin. Another factoring into server selection is "persistence". If a client connection has persistence associated with it, the server to which the persists should be selected for load balancing If the server selected by persistence is not available, Equalizer uses load balancing policy to select an alternate server.

Load Balancing

Load balancing is based on the policy selected. The policies can be split up into two categories - round robin and everything else. The round robin simply selects the next server in the list with no regard for how busy that server may be. The other load balancing policies use proprietary algorithms to compute the load of a server and then select the server with the least load server.

Although the load balancing policies are proprietary, they use the following factors in their calculation:

- **Active connections** - The number of connections a server currently has active and the number of connections that it tends to have open.
- **Connection latency** - The amount of time that it takes a server to respond to a client request.
- **Health check performance values** - Depending on the health checks configured, this may be not used at all, or it can completely define how the load is calculated.

Once a load is calculated, Equalizer distributes incoming requests using the relative loads as weights.

sv00 Load = 50	sv01 Load = 50	sv02 Load = 50

Equal calculated loads, so the request distribution will be approximately equal

sv00 Load = 100	sv01 Load = 50	sv02 Load = 25

Uneven loads. sv01 is twice as loaded as sv02, so it will receive about half the requests.

The load calculations happen approximately every 10 seconds and server weights are adjusted accordingly. During that 10 second interval, the relative server loads remain the same, but probe and health check information is collected about the servers so that it can be used for the next calculation.

The load calculation works the same for Layer 4 and Layer 7 clusters (at the server-pool level - and these can be shared between all cluster types).

There are two additional variables for load balancing:

- **Hot spare** - if a server is marked as a hot spare, it is not included in the pool of servers to select from unless every other non-hot-spare server is down. If a connection persists to this server, it will be placed back on this server.
- **Quiesce** - If a server has been quiesced, it will not be included in the pool of servers to select from. Only previously existing (persistent) connections will be made to this server.

Layer 7 Load Balancing and Server Selection

Equalizer's support for Layer 7 content-sensitive load balancing enables administrators to define rules for routing HTTP, HTTPS, and special Layer 7 TCP requests, depending on the content of the request. Layer 7 load balancing routes requests based on information from the application layer. This provides access to the actual data payloads of the TCP/UDP packets exchanged between a client and server. For example, by examining the payloads, a program can base load-balancing decisions for HTTP requests on information in client request headers and methods, server response headers, and page data.

Equalizer's Layer 7 load balancing allows administrators to define rules in the administration interface for routing HTTP and HTTPS requests according to the request content. These rules are called *match rules*. A match rule might, for example, route requests based on whether the request is for a text file or a graphics file:

- load balance all requests for text files (html, etc.) across servers A and B
- load balance all requests for graphics files across servers C, D, and E

- load balance all other requests across all of the servers

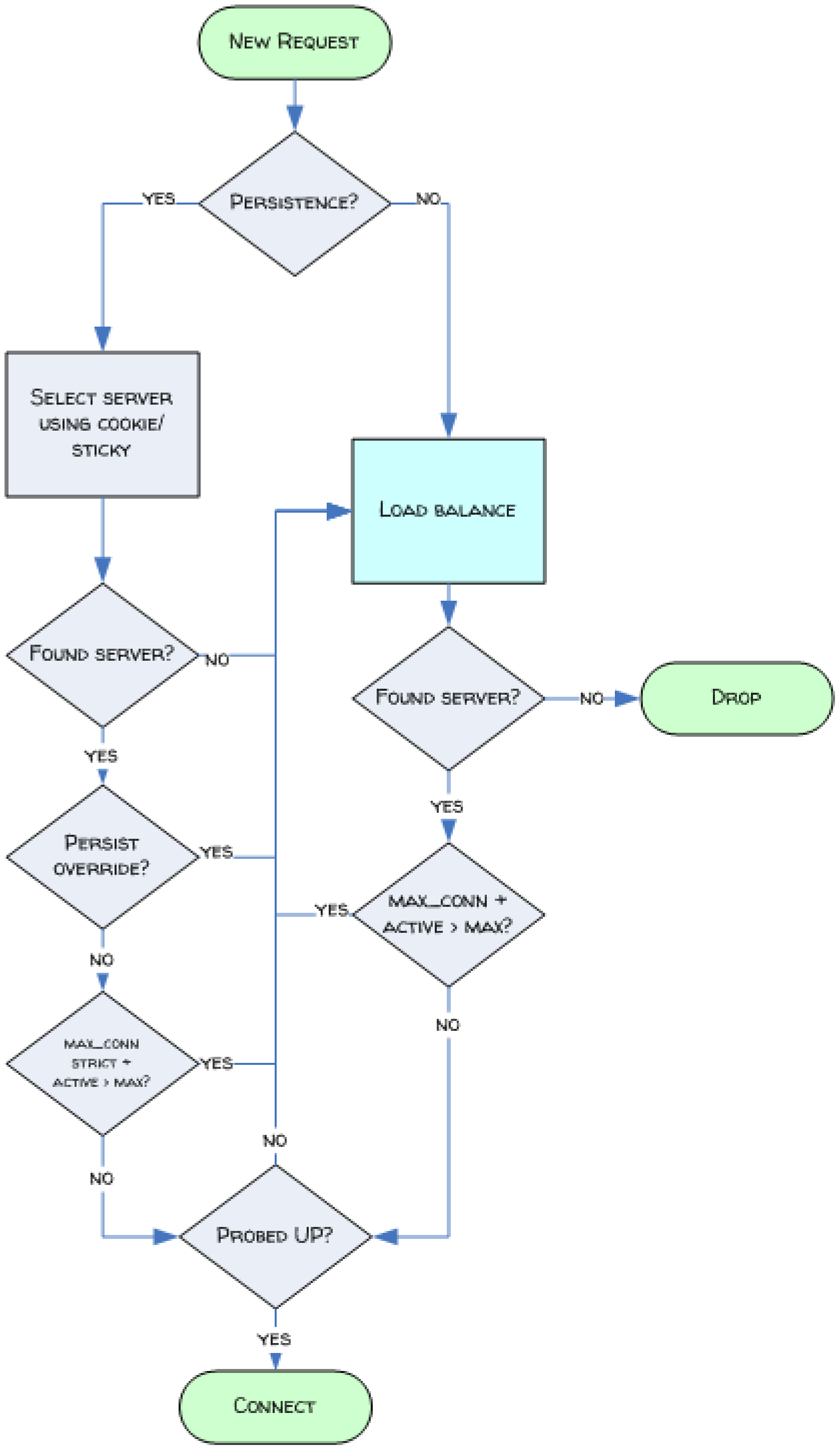
Match Rules are constructed using match functions that make decisions based on the following:

- HTTP protocol version; for HTTPS connections, the SSL protocol level the client uses to connect.
- Client IP address
- Request method (GET, POST, etc.)
- All elements of the request URI (host name, path, filename, query, etc.)
- Pattern matches against request headers

Match functions can be combined using logical constructs (AND, OR, NOT, etc.) to create extremely flexible cluster configurations. See "Using Match Rules" on page 318 for an overview of Match Rules, a complete list of match functions, and usage examples.

Server Selection Process Flow

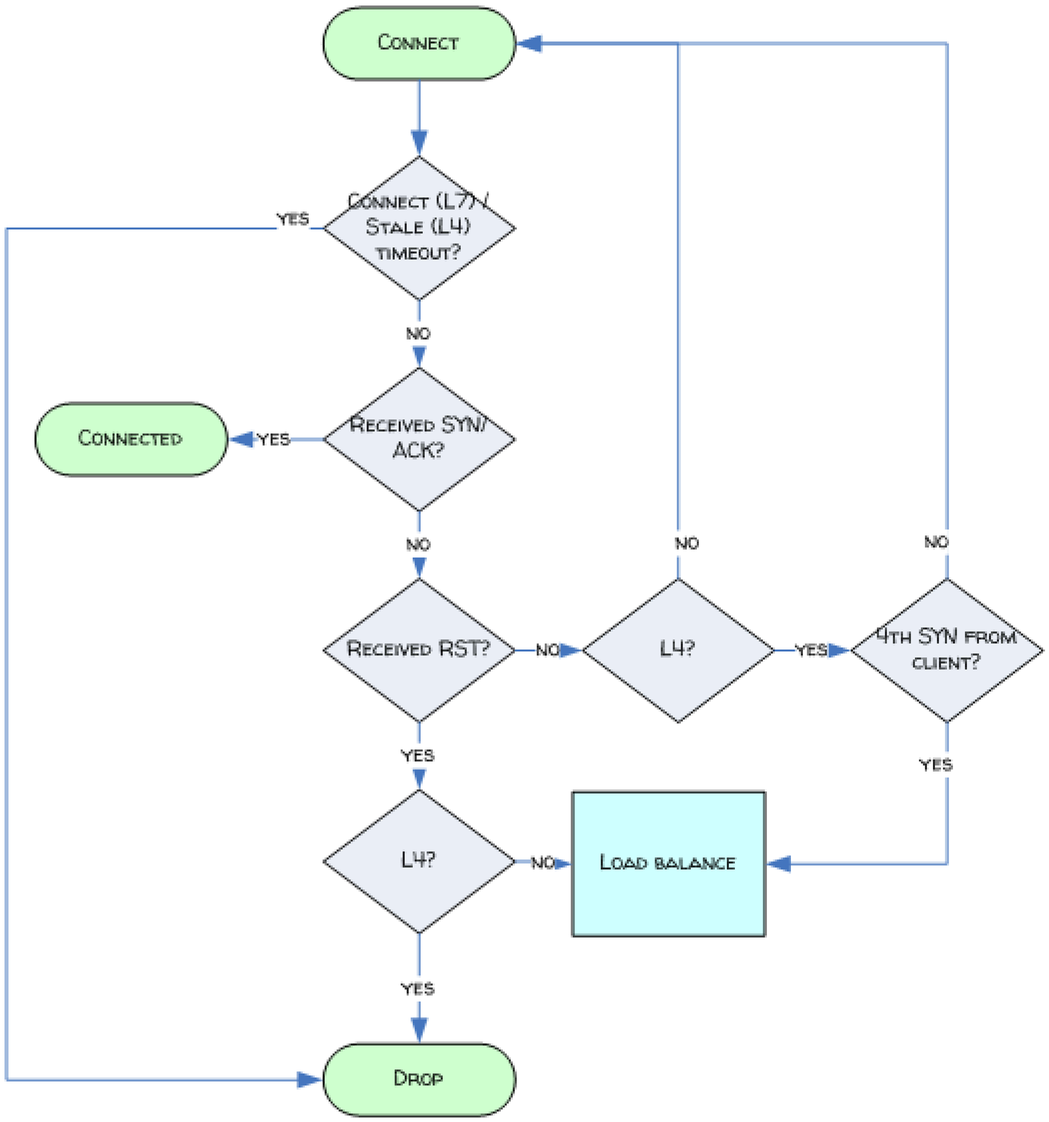
The figure below shows the server selection process. As describe above, this process depends on whether persistence is in use. Once a server is selected, Equalizer verifies that it isn’t too busy (based on **max_ connections**) and that it has been probed up. Then Equalizer tries to connect to it.



The figure below shows the connection establishment and server failover mechanism.

For Layer 7 clusters, the connection must be established within the **connect_timeout**. If we receive an active refusal (RST) from a server, we will repeat the load balancing process and choose another server. Otherwise we will continue trying to connect to the same server until the connect timeout expires.

Fore Layer 4 clusters, the connection must be established within the **stale_timeout**. Here, Equalizer retries the same server 3 times, and then chooses another server on the 4th attempt. If Equalizer receives an active refusal (RST) from a server, the connection is dropped.



Persistence

The *persistence* of *session data* is important when a client and server need to refer to data previously generated again and again as they interact over more than one transaction, possibly more than one connection. Whenever a client places an item in a shopping cart, for example, session data (the item in the cart, customer information, etc.) is created that potentially needs to persist across many individual TCP connections before the data is no longer needed and the session is complete.

It’s important to note that *session persistence* is managed by the server application, not Equalizer. Equalizer provides *server persistence* so that a *persistent connection* between a particular client and a particular server can be maintained; this supports a client-server session where session data is being maintained on the server for the life of the connection. In other words, whether you need to enable persistence on Equalizer depends on the application you are load balancing.

Equalizers have no knowledge of the fact that the user has placed something in a shopping cart, logged into a web application, requested a file from shared storage, or made a "post" in a front end presentation server that has been written to a database. Basically, a "state" has been created in the load balanced application of which Equalizer is not aware. What Equalizer *does* know is that a specific client has been load balanced to a specific server in one of its virtual clusters. With this knowledge, Equalizer can track that information and send that client back to the same server they were connected the first time.

Layer 7 Persistence

Equalizer provides server or connection persistence using cookies in Layer 7 HTTP and HTTPS clusters, and using the client IP address in Layer 4 TCP and UDP clusters. The following sections explain connection persistence provided by Equalizer, and its relationship to session persistence.

When a request from a client that has not previously connected to this cluster is received by Equalizer, it is load balanced according to the current server load values as described in "Load Balancing" on page 33.

However, when a client has existing persistence to a server, Equalizer attempts to put the client back on that server.

Equalizer can use cookies or a server's IP address to maintain a persistent session between a client and a particular server. A cookie, used in Equalizer HTTP and HTTPS clusters contains the identity of the server that should be used. When a client connects to the cluster for the first time, Equalizer injects this cookie into the response data. The client's browser is then responsible for presenting this cookie back to Equalizer. If Equalizer finds this cookie in the client's request, it connects to the server listed.

Source IP persistence or sticky persistence can be used in all kinds of Equalizer clusters. When a client connects for the first time, a "sticky record" is created within Equalizer's memory. For every subsequent connection, Equalizer finds this record and uses the information stored there to choose the same server.

EQ/OS 10 features "fallback persistence" where Equalizer provide a secondary persistence option where if, for example, a cookie response is not received, a secondary, or "fallback" option can be used. As an example, if two persist methods are listed (e.g., **Cookie 1:Cluster IP, Server IP /Port** and **Source IP**)- if a cookie is found- the cookie will be used, otherwise the Source IP will be embedded in the response header back to the client.If the server with which a client has a persistent session is unavailable, Equalizer automatically selects a different server. Then, the client must establish a new session; Equalizer stuffs a new cookie in the next response.

Layer 4 Persistence

For Layer 4 TCP and UDP clusters, Equalizer supports IP address based persistent connections. With the sticky connection feature enabled, Equalizer identifies clients by their IP addresses when they connect to a cluster. Equalizer then routes requests received from a particular client during a specified period of time to the same server in the cluster.

A sticky timer measures the amount of time that has passed since there was a connection from a particular IP address to a specific cluster. The sticky time period begins to expire as soon as there are no longer any active connections between the client and the selected cluster. Equalizer resets the timer whenever a new connection occurs. If the client does not establish any new connections to the same cluster, the timer continues to run until the sticky time period expires. At expiration, Equalizer handles any new connection from that client like any other incoming connection and routes it to an available server based on the current load balancing policy.

To correctly handle sticky connections from ISPs that use multiple proxy servers to direct user connections, Equalizer supports sticky network aggregation, which uses only the network portion of a client's IP address to maintain a persistent connection. Sticky network aggregation directs the user to the same server no matter which proxy he or she connects through.

You can also configure Equalizer to ensure that it directs requests from a particular client to the same server even if the incoming connection is to a different virtual cluster. When you enable intercluster stickiness for a cluster, Equalizer checks the cluster for a sticky record as it receives each connection request, just like it does for ordinary sticky connections. If Equalizer does not find a sticky record, Equalizer proceeds to check all of the other clusters that have the same IP address. If Equalizer still does not find a sticky record, it connects the user based on the current load balancing policy.

Why a Server May Not Be Selected

There are several reasons that a server may not be selected by Equalizer:

1. The various configured health checks within Equalizer have detected that this server is "down". If a server is marked down by a health check, it is immediately removed from the pool of servers available for load balancing.

2. For Layer 4 clusters, if health checks have not yet detected that a server is down, and Equalizer is unable to establish a cluster connection with the server, it will keep retrying the same server until the 4th SYN packet received from the client and then use load balancing to select a new server. The whole connection establishment must complete within **stale_timeout** seconds or the connection is dropped. If Equalizer chooses a different server than the persistence record, it overwrites the persistence record to use the new server for next time.

Note - Most clients will not have time to retry 3 times (send a 4th SYN packet) within the default 10 second stale timeout window. Therefore the connection will be dropped and we will start the process over again when the next SYN is received. (The 1st SYN would be at time 0, the 2nd at time 3, the 3rd at time 9... so the 4th would not happen before 10 seconds).

3. For Layer 7 clusters, if health checks have not yet detected that the server is down but Equalizer is unable to establish a cluster connection with the server, it will wait for **connect_timeout** seconds and then drop the connection so that the client can retry. If it receives an active refusal from the server (RST packet), Equalizer will choose a different server and overwrite the persistence record to use the new server for next time.

4. Maximum connections - If the maximum connections option is used for a server instance, and this server already has that many active connections, it will not be used. This means that it will not be included in the list of servers to select for load balancing. If persistence is in use, the **strict_max_connections** flag specifies whether to persist to a server which already has more active connections than **max_connections** or to load balance to a new server.

5. If the **persist_override** flag is selected in a server instance, and that server is selected by load balancing, the client will not persist to this server even if persistence is enabled at the cluster level.

Geographic Load Balancing

The optional Envoy add-on enables requests to be automatically distributed across Equalizer sites in different physical locations. An Equalizer site is a cluster of servers under single Equalizer’s control. A GeoCluster is a collection of sites that provide a common service, such as Web sites. The various sites in a geographic cluster can be hundreds or even thousands of miles apart. For example, a geographic cluster might contain two sites, one in the east coast of the U.S. and one on the west coast of the U.S.

Geographic load balancing can dramatically improve reliability by ensuring that your service remains available even if a site-wide failure occurs. Equalizer can also improve performance by routing requests to the location with the least network latency.

A discussion about Geographic Load Balancing and Envoy is provided in "Envoy" on page 514.

Sizing of Equalizer Objects

The following table lists the maximum number of each object that can currently be defined on Equalizer:

Object	**Size**
Match Rule Expressions	1024 characters
Server Pools	256 total
Server Instances	512 per Server Pool
Health Check Instances	16 per Server Instance
VLANs	999 total
Subnets	999 per VLAN
Envoy Resources	256 total
Total Equalizer Objects[1]	1200

[1]The limitation on the total number of Equalizer objects is a restriction of the statistics gathering subsystem, and will be addressed in a future release

Chapter 3

Installation

Subsections in this chapter include:

Warnings and Precautions

Short-Circuit Protection

Warning This product relies on the building's installation for short-circuit (overcurrent) protection. Ensure that a fuse or circuit breaker no larger than 120 VAC, 15A U.S. (240 VAC, 10A international) is used on the phase conductors (all current-carrying conductors).

Attention Pour ce qui est de la protection contre les courts-circuits (surtension), ce produit dépend de l'installation électrique du local. Vérifier qu'un fusible ou qu'un disjoncteur de 120 V alt., 15 A U.S. maximum (240 V alt., 10 A international) est utilisé sur les conducteurs de phase (conducteurs de charge).

Warnung Dieses Produkt ist darauf angewiesen, daß im Gebäude ein Kurzschluß- bzw. Überstromschutz installiert ist. Stellen Sie sicher, daß eine Sicherung oder ein Unterbrecher von nicht mehr als 240 V Wechselstrom, 10 A (bzw. in den USA 120 V Wechselstrom, 15 A) an den Phasenleitern (allen stromführenden Leitern) verwendet wird.

Power Supply Cord

CAUTION: THE POWER SUPPLY CORD IS USED AS THE MAIN DISCONNECT DEVICE, ENSURE THAT THE SOCKET-OUTLET IS LOCATED/INSTALLED NEAR THE EQUIPMENT AND IS EASILY ACCESSIBLE.

ATTENTION: LE CORDON D'ALIMENTATION EST UTILISÉ COMME INTERRUPTEUR GÉNÉRAL. LA PRISE DE COURANT DOIT ÊTRE SITUÉE OU INSTALLÉE À PROXIMITÉ DU MATÉRIEL ET ÊTRE FACILE D'ACCÉS.

Warnung: Das Netzkabel dient als Netzschalter. Stellen Sie sicher, das die Steckdose einfach zugänglich ist.

Installation into an Equipment Rack

When operating the unit in an equipment Rack, take the following precaution:

- Make sure the ambient temperature around the unit (which may be higher than the room temperature) is within the limit specified for the unit.
- Make sure there is sufficient airflow around the unit.
- Make sure electrical circuits are not overloaded - consider the nameplate rating of all the connected equipment, and make sure you have over current protection.
- Make sure the equipment is properly grounded.
- Make sure no objects are placed on top of the unit.

Battery

A lithium battery is included in this unit. Do not puncture, mutilate, or dispose of the battery in a fire. There is a danger of explosion if the battery is incorrectly replaced. Replace only with the same or equivalent type, as recommended by the manufacturer. Dispose of a used battery according to the manufacturer’s instructions and in accordance with your local regulations.

Chassis Warning–Rack-Mounting and Servicing

Warning To prevent bodily injury when mounting or servicing this unit in a rack, you must take special precautions to ensure that the system remains stable. The following guidelines are provided to ensure your safety:

- This unit should be mounted at the bottom of the rack if it is the only unit in the rack.
- When mounting this unit in a partially filled rack, load the rack from the bottom to the top with the heaviest component at the bottom of the rack.
- If the rack is provided with stabilizing devices, install the stabilizers before mounting or servicing the unit in the rack.

Attention Pour éviter toute blessure corporelle pendant les opérations de montage ou de réparation de cette unité en casier, il convient de prendre des précautions spéciales afin de maintenir la stabilité du système. Les directives ci-dessous sont destinées à assurer la protection du personnel :

- Si cette unité constitue la seule unité montée en casier, elle doit être placée dans le bas.
- Si cette unité est montée dans un casier partiellement rempli, charger le casier de bas en haut en plaçant l'élément le plus lourd dans le bas.
- Si le casier est équipé de dispositifs stabilisateurs, installer les stabilisateurs avant de monter ou de réparer l'unité en casier.

Warnung Zur Vermeidung von Körperverletzung beim Anbringen oder Warten dieser Einheit in einem Gestell müssen Sie besondere Vorkehrungen treffen, um sicherzustellen, daß das System stabil bleibt. Die folgenden Richtlinien sollen zur Gewährleistung Ihrer Sicherheit dienen:

- Wenn diese Einheit die einzige im Gestell ist, sollte sie unten im Gestell angebracht werden.
- Bei Anbringung dieser Einheit in einem zum Teil gefüllten Gestell ist das Gestell von unten nach oben zu laden, wobei das schwerste Bauteil unten im Gestell anzubringen ist.
- Wird das Gestell mit Stabilisierungszubehör geliefert, sind zuerst die Stabilisatoren zu installieren, bevor Sie die Einheit im Gestell anbringen oder sie warten.

Power Requirements

The unit’s power supply is rated at 100-240 VAC auto selecting 60/50 Hz @ 4.0A.

Power Consumption

Use the following power consumption information to determine how many units can be connected to available power circuits without overload. The information shown in the tables below was captured during the following operational stages of the product:

- **Rush-in** -- when the product is powered ON
- **No Load** -- when the product is booted from OS but no resource-hungry process is running
- **100% CPU** -- when 100% processor load is emulated on the product

The following data is captured during the test, at both 110V and 220V:

- **Watts** -- total power consumed by product
- **PF** -- Power Factor (a ratio of the real power and apparent power consumed by the product)
- **Volts** -- test voltage
- **Amp** -- total current consumed by product

110V Test Results

Model	110V/60Hz	Watts	PF	Volts	Amps
E370LX	Rush-in	70.7	0.984	121.5	0.591
	No Load	61.7	1.000	121.6	0.505
	100% CPU	84.1	1.000	121.3	0.682
E650GX	Rush-in	112.5	1.000	118.9	0.954
	No Load	112.2	1.000	118.7	0.943
	100% CPU	145.0	1.000	118.2	1.222
E450GX	Rush-in	112.5	1.000	118.9	0.954
	No Load	112.2	1.000	118.7	0.943
	100% CPU	145.0	1.000	118.2	1.222
E350GX	Rush-in	76.7	0.993	119.9	0.644
	No Load	70.9	0.992	119.7	0.597
	100% CPU	99.5	1.000	119.6	0.831
E250GX	Rush-in				
	No Load				
	100% CPU				

220V Test Results

Model	220V/50Hz	Watts	PF	Volts	Amps
E370LX	Rush-in				
	No Load				
	100% CPU				

Model	220V/50Hz	Watts	PF	Volts	Amps
E650GX	Rush-in	109.1	0.645	224	0.752
	No Load	109.9	0.925	222	0.536
	100% CPU	140.5	0.943	222	0.671
E450GX	Rush-in	109.1	0.645	224	0.752
	No Load	109.9	0.925	222	0.536
	100% CPU	140.5	0.943	222	0.671
E350GX	Rush-in	74.6	0.877	445	0.378
	No Load	68.5	0.862	225	0.354
	100% CPU	96.3	0.923	224	0.466
E250GX	Rush-in				
	No Load				
	100% CPU				

Operating Environment

- **Temperature**: 40 - 105 °F, 5 - 40 °C. (GX Series)| 32 - 104°F, 0 - 40°C (E370LX)
- **Humidity**: 5 - 90%, non-condensing.

Regulatory Certification

Please see the product data sheets on the Coyote Point Website (www.coyotepoint.com) for product certification details.

Hardware Installation

To install Equalizer, follow these steps:

1. Carefully remove the Equalizer rack-mount enclosure and cables from the shipping container.

   Save the original packaging in case you need to ship the Equalizer for any reason, such as sending it in for warranty service. The Equalizer chassis does not contain any parts that you can service. If you open the chassis or attempt to make repairs, you may void your warranty.

2. Place the Equalizer in its intended position in an EIA equipment rack or on a flat surface.

3. Connect a serial terminal or a workstation running terminal emulator software to the serial port on the front panel of the Equalizer. The serial cable supplied with Equalizer.

4. Connect Equalizer to the network with a quality category 5 network cable:

To use Equalizer as an intermediary between an external and internal network, connect Equalizer to the external network using one of the RJ-45 ports labeled 1 or 2 on the front panel. Connect Equalizer to the internal network using one or more of the ports numbered 3 and above.

For a single-network (one subnet) topology, connect Equalizer to the network and the servers using one of the numbered RJ-45 ports numbered 3 and above on the front panel of the Equalizer .

5. Connect Equalizer to an appropriate power source using the supplied power cord, which plugs into the 3-pin connector on the rear of the Equalizer enclosure. This system uses an auto-sensing power supply that can operate at 50Hz or 60Hz, 110-240 VAC input.

6. Turn on the power using the switch on the rear panel. After Equalizer boots up the following link lights should be visible. Refer to "Interfaces" on page 215 or "Interface Commands" on page 160 for additional information on the interface lights and settings.

Setting Up a Terminal or Terminal Emulator

After the Equalizer hardware, you need to directly connect a terminal to Equalizer to complete the hardware configuration.

Serial Connection

When you set up Equalizer for the first time, you must use a serial connection in order to configure Equalizer's network with the **eqcli** interface. Connect the serial port on the Equalizer to the serial port on a terminal, or any system (such as a Windows or Unix PC) running terminal emulation software.

Configure your terminal or terminal emulator software to use the following settings:

- 9600 baud (GX Series) 38400 (LX Series)
- 8 data bits

- no parity
- one stop bit
- VT100 terminal emulation
- ignore hang-ups (if supported); this allows a single terminal session to continue running even if Equalizer restarts

On Windows systems, you can use the Windows built-in terminal emulator, **HyperTerminal**, or the **Tera Term Pro** terminal emulator to log in to Equalizer over the serial port. On Unix systems, you can use the **cu**(1) command or any other Unix serial communication program.

If you use **HyperTerminal**, in addition to the settings shown above, select **File > Properties > Settings** from HyperTerminal's menu, select **VT100** in the **Emulation** drop-down box, and then **Terminal Setup** to enable these options:

- keyboard application mode
- cursor keypad mode

Tera Term is freely available at:

```
http://hp.vector.co.jp/authors/VA002416/teraterm.html
```

Chapter 4

First Time Configuration Using EQ OS 10

Sections within this chapter include:

First Time VLAN Configuration Example

Follow the steps below to get Equalizer onto your network and start using the (CLI and GUI).

1. Log in using the default administrative user name, **touch**:

```
Equalizer -- EQ/OS 10.0.4c

Username: touch
Password:

Login successful.
12008239: There are Envoy geocluster configured. These are automatically
disabled until an Envoy license is loaded.

          EQ/OS 10.0.2f

          Copyright 2013 Fortinet, Inc.
          Welcome to Equalizer!

eqcli >
```

2. Change the password for the ‘touch" login. Enter:

```
eqcli > user touch passwd
```

Follow the command prompts to create a new password.

3. Configure a VLAN for SSH and GUI management, as in this example. It should be noted that the E250GX Equalizer has two non-switched ports and the E370LX Equalizer has 6 non-switched ports. Since they are non-switched they have separate interfaces and allow 1 port per VLAN. The example below shows switched ports - meaning that the Equalizer being configured can use multiple ports on a VLAN:

```
eqcli > vlan 172net vid 1 untagged_ports 1,2
```

4. Create a VLAN subnet. For our example, we’ll enable SSH login and the GUI over HTTP on the **172net** VLAN. We’ll also set the **def_src_addr** flag so this subnet’s IP address will be used as the source address for outgoing packets. If you want to license the system online (see the next section, below), you must define a subnet that has Internet connectivity.

```
eqcli > vlan 172net subnet sn01 ip 172.16.0.200/21 default_route 172.16.0.1
services ssh,http flags def_src_addr
```

5. Connect Equalizer to your network using the VLAN ports that you set up in Step 3. You should now be able to display the Equalizer GUI by pointing a browser at this URL:

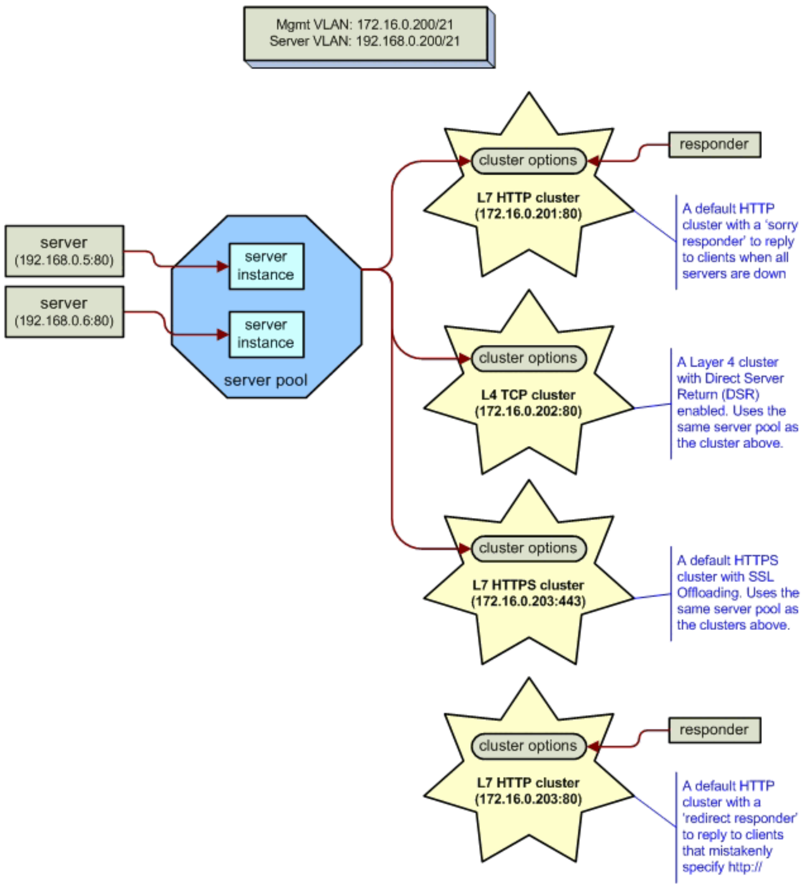
   `http://VLAN_IP_addr`

   Substitute the VLAN IP address you used in Step "Quick Start" on page 50 for VLAN_IP_addr, as in this example using the IP address from Step 4.

   `http://172.16.0.200`

Sample Equalizer Configuration

This section shows you how to configure Equalizer for the first time using CLI, and assumes that Equalizer is in a "factory installed" state: no customer configuration has been performed on the unit. The sample configuration we'll create is pictured in the illustration below:


Mgmt VLAN: 172.16.0.200/21
Server VLAN: 192.168.0.200/21
server (192.168.0.5:80)
server (192.168.0.6:80)
server instance
server instance
server pool
responder
cluster options
L7 HTTP cluster (172.16.0.201:80)
A default HTTP cluster with a 'sorry responder' to reply to clients when all servers are down
cluster options
L4 TCP cluster (172.16.0.202:80)
A Layer 4 cluster with Direct Server Return (DSR) enabled. Uses the same server pool as the cluster above.
cluster options
L7 HTTPS cluster (172.16.0.203:443)
A default HTTPS cluster with SSL Offloading. Uses the same server pool as the clusters above.
responder
cluster options
L7 HTTP cluster (172.16.0.203:80)
A default HTTP cluster with a 'redirect responder' to reply to clients that mistakenly specify http://

The procedure below shows you how to use one line commands in the global context to set up the configuration illustrated above.

1. Power on Equalizer and enter the CLI, as shown in "Starting the CLI" on page 128.
2. Configure a VLAN for the GUI, SSH, and cluster IP addresses:

```
    eqcli > vlan 172net vid 2 untagged_ports 1,2
```

3. Create a VLAN for servers on the remaining ports (in this example, we're configuring an E450GX with a total of 12 ports):

```
    eqcli > vlan 192net vid 3 untagged_ports 3,4,5,6,7,8,9,10,11,12
```

4. Configure default routes and services on the Default subnet of each VLAN. For our example, we'll enable SSH login and the GUI over HTTP on the **172net** VLAN.

```
    eqcli > vlan 172net subnet sn01 ip 172.16.0.200/21 default_route 172.16.0.1
    services ssh,http
    eqcli > vlan 192net subnet sn01 ip 192.168.0.200/21 default_route 192.168.0.1
```

5. Connect Equalizer to your network on the VLANs that you set up in the previous steps, using the appropriate front panel ports. You should now be able to ping Equalizer's IP address on each VLAN. If Equalizer does not respond on a VLAN, you may need special routes on the default router, or on the next-hop gateway for a particular VLAN.
6. Set the timezone. Enter:

```
eqcli > timezone?
```

7. Locate your timezone in the displayed list and press **`q`** to quit out of the list. Then, type in your timezone number and press **`<Enter>`**, as in this example for the "America/New York'" time zone:

```
eqcli > timezone 161
```

8. If Equalizer can reach the Internet, add a name server so that NTP will work and time will be the same across all Equalizers:

```
    eqcli > name-server IP_address
```

Otherwise, set the time manually on all systems to the current time:

```
eqcli > date HHmmss
```

9. Create two real servers:

```
eqcli > server sv01 proto tcp ip 192.168.0.5 port 80
eqcli > server sv02 proto tcp ip 192.168.0.6 port 80
```

10. Create a server pool:

```
eqcli > srvpool sp01 policy adaptive respv 3
```

11. In server pool **sp01**, create server instances for the servers created in Step 6.

```
eqcli > srvpool sp01 si sv01 weight 100
eqcli > srvpool sp01 si sv02 weight 100
```

12. Create a Layer 7 HTTP cluster:

```
eqcli > cluster cl01 proto http ip 172.16.0.201 port 80 srvpool sp01
```

13. Create a Layer 4 TCP cluster using server pool **sp01**, with DSR enabled:

```
eqcli > cluster cl02 proto tcp ip 172.16.0.202 port 80 srvpool sp01 flags dsr
```

14. Add an SSL certificate store (for the HTTPS cluster we'll create later). Enter:

```
eqcli > certificate ct01
```

15. Import the certificate and its associated private key using either of the following methods:

    If the certificate resides on an FTP site, enter commands like the following, substituting the IP address and path on your FTP site from which the certificate and private key can be downloaded:

```
    eqcli > certificate ct01
    eqcli-cert> certfile ftp://10.0.0.21/certfile.pem
    eqcli-cert> keyfile ftp://10.0.0.21/keyfile.pem
```

If you want to cut and paste the certificate and key using an editor, use commands like the following:

```
    eqcli > certificate ct01 certfile edit
    eqcli > certificate ct01 keyfile edit
```

Certificates and keys must be downloaded separately, in PEM format. If a chain of certificates and keys must be uploaded, ensure that all the certificates are in one file and all the private keys are in another.

16. Create a Layer 7 HTTPS cluster using server pool **sp02** and associate certificate **ct01** with the cluster:

```
eqcli > cluster cl03 proto https ip 172.16.0.203 port 443 srvpool sp01
certificate ct01
```

17. Create a Layer 7 HTTP cluster -- do not specify a server pool, since this cluster will be used only to redirect clients to **cl03**:

```
    eqcli > cluster cl04 proto http ip 172.16.0.203 port 80
```

18. Add a sorry responder that will be used to display a web page that asks the user to try again later:

```
    eqcli > resp Sorrycl01 type sorry html edit
```

An editor is launched so that you can enter the HTML for the responder page. For example, you can enter Once you are done, type **<Esc><Enter>** and then **<Enter>** to save the HTML you entered.

19. Add the responder created in the previous step to cluster **cl01**:

```
eqcli > cluster cl01 resp Sorrycl01
```

The effect of adding this responder to **cl01** is that if all the servers in server pool **sp01** are unavailable, clients making requests to cluster **cl01** will receive an automatic response asking them to try again later.

20. Add a redirect responder that will redirect all requests coming into the same cluster IP as **cl03** on *port 80* (via HTTP); the responder will be configured to redirect these requests to **cl03** on port 443 (via HTTPS).

    Since some of the arguments to this command are longer than one line, we'll add the responder using multiple command lines to make the input clearer:

```
eqcli > resp Redircl04
eqcli rsp-Red*> type redirect
eqcli rsp-Red*> statcode 301
eqcli rsp-Red*> statdesc "Moved Permanently"
eqcli rsp-Red*> regex "http://clustercl03.example.com/([^ \r]+)?"
eqcli rsp-Red*> url "https://clustercl03.example.com/$1"
eqcli rsp-Red*> exit

eqcli: 12200287: Operation successful
eqcli >
```

    Note the following:

    The regular expression used in the **regex** parameter contains a single space between the caret (**^**) and backslash (****) characters.

    The FQDN used in the **regex** and **url** parameters (e.g., **cluster-cl03.example.com**) must match the FQDN used by clients to connect to cluster **cl03**.

21. Add the responder created in the previous step to cluster **cl01**:

```
eqcli > cluster cl04 resp Redircl04
```

    Since **cl04** has no associated server pool specified in its configuration, all requests coming in to **cl04** will be redirected to **cl03** by the responder.

Chapter 5

Upgrading and Downgrading

Sections within this chapter include:

Version 8.6 Upgrade Procedure

1. Connect Equalizer with a serial console. Refer to "Setting Up a Terminal or Terminal Emulator" on page 46 .

2. Set up a local FTP server that can be accessed by Equalizer. This will be used during the upgrade process to save a Version 8.6 system image that can be used to restore Equalizer to Version 8.6. The creation of the restore image is required in order to be able to downgrade Equalizer back to Version 8.6.

3. ***The Version 8.6 system must have the latest release of Version 8.6 on both disk partitions, running the same configuration.*** To accomplish this, do one of the following:

- If you are already running the latest 8.6 release, simply upgrade to the same version of 8.6 again.

- If you are not running the latest 8.6 release, upgrade to the latest 8.6 release, reboot, and then upgrade to the latest 8.6 release again.

4. ***Equalizer must be running from the first disk partition when you begin the upgrade.*** The easiest way to ensure this is to reboot the unit and press **F1** (the first function key on the keyboard) when the following prompt appears:

```
F1  FreeBSD
F2  FreeBSD

Default: F1
```

The "`Default:`" line above may contain "`F1`" or "`F2`". Press **F1** regardless of what is displayed on the "`Default:`" line.]

5. Log into the Version 8.6 console as **root** using the serial port on Equalizer's front panel. [An upgrade to Version 10 cannot be performed using the Version 8.6 GUI, nor can it be performed over an SSH connection. You must login using the serial console interface.]

6. At the system prompt, enter:

```
eqadmin
```

The **eqadmin** interface menu is displayed.

7. Select option "**8 Upgrade**" by pressing the "**8**" key followed by "**Enter**" on the console keyboard.

8. Do *one* of the following:

- Press "**1**" followed by "**Enter**" to download the upgrade image from the Coyote Point web site.

- Press "**2**" followed by "**Enter**" to download the upgrade image from a local server.

8. Enter the upgrade URL using the Version 8.6 syntax and press "**Enter**". For example, the following URL downloads the image from a local server:

```
ftp://10.0.0.121/pub/patches/upgrades/10.0.0/os8upgrade/upgrade.tgz
```

9. Once the upgrade image is downloaded, the following prompt is displayed:

```
EQUALIZER OS 8.6 -> OS 10.x UPGRADE SCRIPT

This script will COMPLETELY REMOVE your existing Equalizer configuration
and replace it with a blank (unconfigured) installation of EQ/OS version
10.

If you proceed further, load balancing will be disabled on this
Equalizer until it is next rebooted, even if the upgrade fails.

Continue with upgrade [Y/N]?
```

   Press "**Y**" and then "**Enter**".

10. The following prompt is displayed:

```
Requesting pid 460 to terminate.

It is safest to proceed only on a system with an active support
contract. It is recommended that you verify that your support
status by re-licensing this system using the online license
server now.

If this is not possible because your system does not have
Internet access, please contact Coyote Point or your Coyote
Point distributor to confirm active support status.

This Equalizer has serial number A09BA-16003.

Re-license system now [Y/N]?
```

   Do *one* of the following:

   If your network configuration will not allow Equalizer to contact the Coyote Point license server over an internet connection, please call Coyote Point Support or your local distributor to confirm your support status. Then, press "**N**" and "**Enter**" to proceed with the upgrade. Two confirmation messages are displayed; to proceed, press "**Y**" and then "**Enter**" at each prompt to proceed with the upgrade.

   Otherwise, press "**Y**" and then "**Enter**" to request a new license. If successful, the following message is displayed and contains Equalizer’s serial number:

```
Successfully re-licensed e450gx-1 serial_number.
```

11. The following message is displayed:

```
PERMANENTLY upgrade this system to EQ/OS 10 [Y/N]?
```

    Press "**Y**" and then "**Enter**" to proceed with the upgrade.

12. The user is now prompted for the second stage upgrade URL:

```
This installer uses a 2-stage process. You must enter the URL for
the second-stage install bundle. It is usually the same URL from
which you retrieved the first-stage installer, except without the
last component.

For example, if you retrieved this installer from:
http://www.coyotepoint.com/example/upgrade.tgz

Then the second-stage install bundle URL would be:
http://www.coyotepoint.com/example/

Enter the URL:
```

    Enter the second stage URL and press "**Enter**" to continue with the upgrade. In our example, the second stage URL would be:

```
ftp://10.0.0.121/pub/patches/upgrades/10.0.0/os8upgrade
```

13. After the second stage upgrade files are downloaded, verified, and unpacked, you are asked to create a restore image:

```
Upgrade bundle is version 10.0.2a.

Checking that bundle is EQ/OS 8 to EQ/OS 10 type.
Retrieving autobuilds/folsomBuilds/18288/i386/binary/os8upgrade//is-os8
100% 11 00:00 ETA
It is very important to create a restore image of this Equalizer
running the current EQ/OS 8 software. This is not a standard
backup of the EQ/OS 8 system but an image which will allow you
to downgrade this particular system from EQ/OS 10 should you
so desire.

Without a restore image, this system can not be downgraded to
EQ/OS 8.

The restore image will require approximately 200MB of free space
on an FTP server to which you can upload files.

Do you want to create a restore image [Y/N]?
```

Press "**Y**" and then "**Enter**" to create a restore image.

14. The system then prompts you to enter a URL for the restore image as well as a username and password to :

```
Do you want to create a restore image [Y/N]? ^Cy
Cleaning up log and temporary files before restore imaging process.
Flushing disk write cache.
Building restore image.
3891+0 records in.1 MiB / 242.1 MiB = 0.348 1.2 MiB/s 3:23
3891+0 records out
255000576 bytes transferred in 204.873566 secs (1244673 bytes/sec)
100 % 85.3 MiB / 243.2 MiB = 0.351 1.2 MiB/s 3:24
Taking fingerprint of restore image.
Sending restore image to remote FTP server.
Enter URL for path to which to send restore image.
Example: ftp://ftp.coyotepoint.com/my_images/
```

15. You are now prompted for an FTP server to which the encrypted restore image can be transferred:

```
Sending restore image to remote FTP server.
Enter URL for path to which to send restore image.
Example: ftp://ftp.coyotepoint.com/my_images/

Enter URL:
Enter Username for file upload:
Enter Password for file upload:
```

Enter the **URL**, and then a **Username** and **Password** to log into the FTP server.

16. After you supply the FTP login information, Equalizer uploads the image to the FTP server, and then downloads it to verify that it is correct. If the verification succeeds, Equalizer continues with the upgrade and reboots automatically after displaying this prompt:

```
Activating second stage install partition for next reboot.
rebooting -- this may take up to a full minute.
```

17. After rebooting, the system will automatically continue the upgrade by booting from the second partition. DO NOT PRESS ANY KEYS WHEN THE BOOT MENU IS DISPLAYED. Wait for the system to boot automatically. Once the system boots, it unpacks the Version 10 upgrade image and creates the appropriate file systems. When it is done, the following prompts are displayed:

```
The operating system has halted.
Please press any key to reboot.
```

18. Press any key to reboot the system.

19. As the system reboots, you may see prompts indicating that the front panel switch firmware needs to be upgraded:

```
Switch firmware is down-level.
WARNING: This upgrade contains firmware which requires
an immediate reboot after installation, which will be
automatically performed.
```

The switch firmware is automatically upgraded if required. This process can take several minutes.

Caution – DO NOT INTERRUPT THE SWITCH FIRMWARE UPGRADE IN ANY WAY. This includes power cycling the unit. Interrupting the switch firmware upgrade can leave your system in an inoperable state.

- After successfully upgrading and validating the switch firmware, the system reboots automatically. Once the system finishes rebooting, the console displays the Version 10 CLI "Username:" prompt. You can now log into the CLI and configure Equalizer into your network.

  See "Quick Start" on page 50 for the basics of creating a VLAN over which you can access the GUI and use SSH to log into the console.

  See "First Time Equalizer Configuration" on page 51 for a brief tutorial that explains how to perform additional configuration tasks (creating servers, clusters, etc.) using the CLI.

Downgrading to Version 8.6

If you upgraded Equalizer from Version 8.6 to Version 10, you can later downgrade Equalizer back to the release that was running when you upgraded. You can downgrade any Equalizer in the GX series. You cannot downgrade LX series Equalizers.

This procedure requires the following:

- A saved restore system image created during the upgrade to Version 10.
- The password for the saved system image.

If you did not record the password or have lost it, contact Coyote Point Support for help.

Note - The downgrade process requires a restore image created during the upgrade of the unit from Version 8.6 to Version 10. If you later choose to downgrade a Version 10 Equalizer back to Version 8.6, you must use a restore image that was created during the upgrade of that unit to Version 10. The file name used to save a restore image is the serial number of the unit on which it was created, and this restore image can only be used to restore the Equalizer with the same serial number. On Version 10, you can use the CLI command to display Equalizer’s serial number, or check the serial number tag on Equalizer’s back panel.

1. Connect Equalizer with a serial console. Refer to "Setting Up a Terminal or Terminal Emulator" on page 46.
2. Log into the CLI.
3. At the global context prompt, enter:

```
eqcli > upgrade URL
```

The URL is an unadorned `ftp://` or `http://` URL that completely specifies the path to the downgrade directory, as in this example:

```
eqcli > upgrade
ftp://ftp.coyotepoint.com/pub/patches/upgrades/10.0.2/os8downgr
ade
```

4. The downgrade software is downloaded, unpacked, and run. The following prompt is displayed:

```
Please enter the URL for the the system restore image for THIS SYSTEM.

If a username and/or password is required in order to retrieve the
file, the username (and optionally the password) must be embedded in
the URL using standard URL syntax.

For example, if the file is at:
ftp://www.coyotepoint.com/example/Z20CA-31337.xrb

And you use username 'user' and password 'pass' to access that site,
then use URL:
ftp://user@www.coyotepoint.com/example/Z20CA-31337.xrb
or URL:
ftp://user:pass@www.coyotepoint.com/example/Z20CA-31337.xrb
to retrieve the file.

Please enter the URL:
```

Enter the URL where you saved the restore system image created during the upgrade to Version 10, as in this example:

```
ftp://ftp@10.0.0.21/folsom/A107A-17004.xrb
```

5. The downgrade script then retrieves, decrypts, and installs the restore image from the URL you provided. During this process you are asked to enter the restore image password. At the

prompts indicated in the sample output below, enter the restore image password (restore_password) and press the **Enter** key to continue:

```
Retrieving expected SHA1 signature for restore image file. Computing SHA1
signature of restore image file.
If you were prompted (and re-prompted) to enter a restore image
password when you created the restore image, then the image was
encrypted.
Was the restore image encrypted [Y/N]?
```

If the restored image was originally encrypted with a password, you will be prompted with the following after selecting “`Y`”.

```
Enter your restore image password: restore_password
Enter your restore image password again: restore_password
Password: restore_password
```

In either case the following will be displayed as the system restores the image.

```
Formatting target filesystem.
/dev/rwd0a: 207.4MB (424680 sectors) block size 8192, fragment size 1024
using 5 cylinder groups of 41.48MB, 5309 blks, 10304 inodes.
32,
84976,
169920,
254864,
339808,
Installing restore environment onto target filesystem.
Decrypting image restore data onto target filesystem.
Password: restore_password
Writing secondary boot configuration.
Updating primary bootblock version table.
Performing automatic reboot. System will reboot to
image extraction environment.
Halt NOW!
```

6. As the system reboots, *do not press any keys*. After the following prompt is displayed:

```
IMAGE RESTORE DOWNGRADE IN PROGRESS, DO NOT CUT SYSTEM POWER
```

The system boots and copies the restore image onto disk:

```
    Beginning image restore process.
    /tmp/restore.img.xz  (1/1)
```

Once the image is restored, the system reboots again. After the reboot is complete, the Version 8.6 login prompt is displayed.

Upgrading to the Latest Release

To upgrade a system that is already running Version 10 to the latest release using the CLI, do the following:

1. Ensure that the upgrade image is available on an FTP or HTTP server that is accessible to Equalizer. This can be either the Coyote Point Upgrade server or a local server.

2. Log in to the Equalizer CLI using the serial console or via SSH on a VLAN that is configured for SSH access.

3. At the eqcli prompt, enter:

```
eqcli > upgrade URL
```

   The URL is an unadorned `ftp://` or `http://` URL that completely specifies the path to the upgrade image *directory*, as in this example:

```
eqcli > upgrade ftp://10.0.0.21/pub/patches/upgrades/10.0.0/upgrade
```

4. Equalizer downloads the upgrade files automatically, unpacks them, and then begins the upgrade. No user intervention is required.

   When the upgrade is complete, the following messages are displayed:

```
Upgrade successfully completed. New version is default at next system boot.
```

5. To reboot the system and run the newly installed version, enter:

```
eqcli > reboot
```

Refer to "Manage Software" on page 211 for instructions on upgrading using the GUI.

Chapter 6

Licensing Equalizer

Sections within this chapter include:

Licensing Equalizer

Equalizer can be configured without a license, but will not process any cluster traffic until it is licensed. These instructions are for hardware Equalizers.

Refer to "Licensing Equalizer OnDemand" on page 573 for instructions for the Equalizer OnDemand virtual load balancer.

1. Obtain the **Serial Number** of your Equalizer from the tag on the back of the unit.

2. Display the **System ID** and copy it for use later in these procedures.

Adding and Removing Licenses (CLI)

1. Log in to Equalizer using the CLI as described in "Starting the CLI" on page 128

2. Enter the following:

```
eqcli > version
```

3. Register your copy of Equalizer OnDemand on the Coyote Point Registration site.

   Go to:

   http://www.coyotepoint.com

   Click **Support > Register Your Product** to open the registration form.

   Enter your System ID and your system serial number (see the **Note** above).

   Click continue.

   Follow the prompts to complete registration.

4. If Equalizer cannot reach the Internet over the configured VLAN, go to the next step to license your unit offline.

   To license your unit online over an Internet connection, enter the following CLI command:

```
eqcli > license getserver <IP_addr> name
```

   Equalizer connects to the Coyote Point license server and automatically downloads a license. Your system is now licensed and you can skip the next step.

5. To license your system offline, do the following:

a. Log into the CLI.

b. Enter:

```
license genreq
```

c. Copy the output of the above command into an email and send it to support@coyotepoint.com, requesting an offline license for Equalizer OnDemand.

d. Once you receive an email from Coyote Point Support containing your license, enter the following command:

```
license upload
```

e. Copy the license information from the email sent by Coyote Point Support and paste it into the CLI.

f. Press **<Enter>**.

g. Use the global **show license** command to confirm your license status, as in this example:

```
eqcli > show license

Name Product Valid

02-01-2012.01-44-38.1 E450GX YES
```

Removing Licenses

To remove licenses using the following commands in the CLI:

1. Remove all invalid licenses by entering:

```
eqcli > no license
```

2. Remove specific licenses by entering:

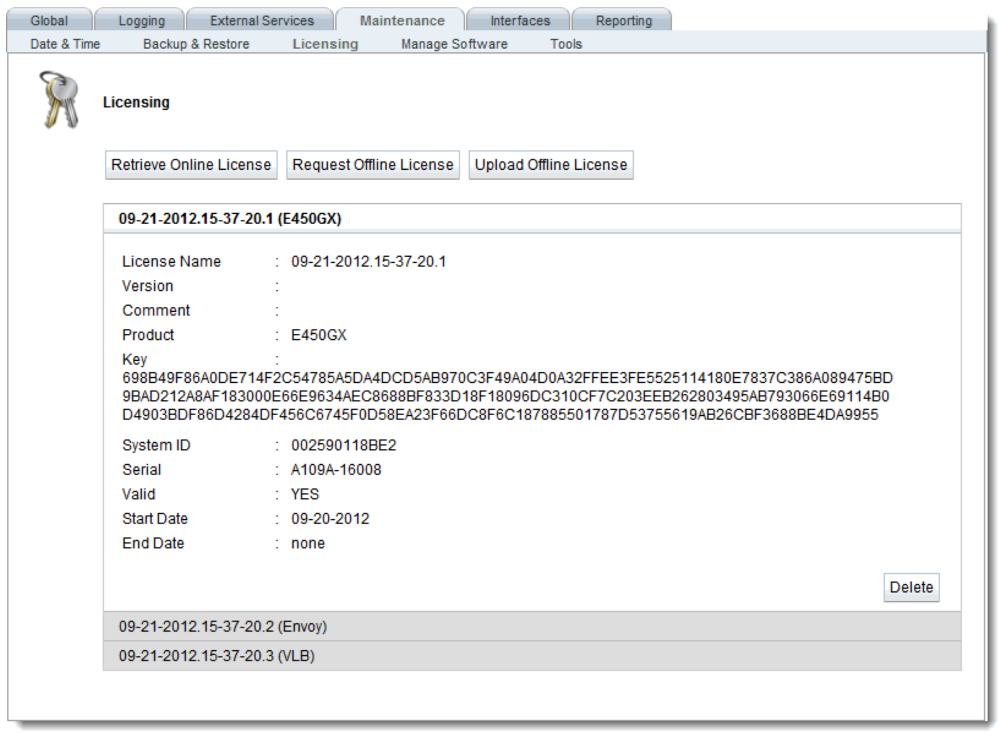
```
eqcli > no license name
```

3. Remove all valid and invalid licenses by entering:

```
eqcli > no license force
```

Adding and Removing Licenses (GUI)

1. Log in to the GUI as described in "Logging In" on page 192.
2. Click on the host name on the left navigation pane.
3. Select the **Maintenance** tab and then **Licensing** to display the following.



09-21-2012.15-37-20.1 (E450GX)

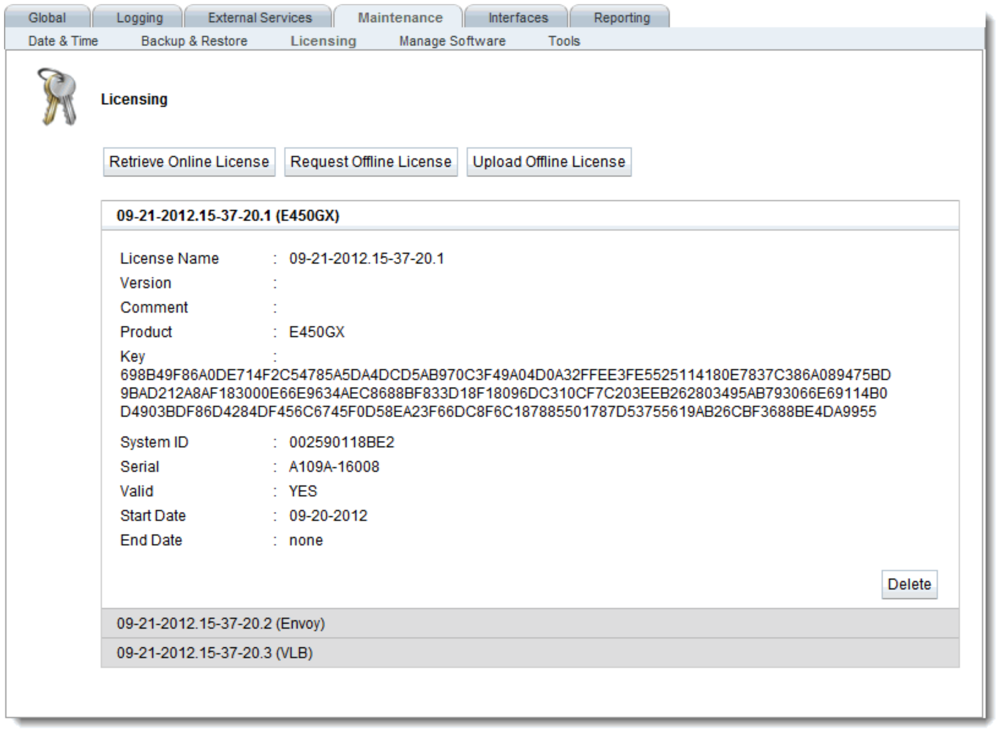
```
License Name    :  09-21-2012.15-37-20.1
Version         :
Comment         :
Product         :  E450GX
Key             :
698B49F86A0DE714F2C54785A5DA4DCD5AB970C3F49A04D0A32FFEE3FE5525114180E7837C386A089475BD
9BAD212A8AF183000E66E9634AEC8688BF833D18F18096DC310CF7C203EEB262803495AB793066E69114B0
D4903BDF86D4284DF456C6745F0D58EA23F66DC8F6C187885501787D53755619AB26CBF3688BE4DA9955
System ID       :  002590118BE2
Serial          :  A109A-16008
Valid           :  YES
Start Date      :  09-20-2012
End Date        :  none
```

09-21-2012.15-37-20.2 (Envoy)

09-21-2012.15-37-20.3 (VLB)

4. To retrieve an Online License:

   Click on the **Retrieve Online License** button to connect with the licensing server. After the license is loaded onto Equalizer the details of the license including the **License Name**, **Product** and **Key** can be viewed by clicking grayed license listing:



Licensing

09-21-2012.15-37-20.1 (E450GX)

```
License Name   :  09-21-2012.15-37-20.1
Version        :
Comment        :
Product        :  E450GX
Key            :
698B49F86A0DE714F2C54785A5DA4DCD5AB970C3F49A04D0A32FFEE3FE5525114180E7837C386A089475BD
9BAD212A8AF183000E66E9634AEC8688BF833D18F18096DC310CF7C203EEB262803495AB793066E69114B0
D4903BDF86D4284DF456C6745F0D58EA23F66DC8F6C187885501787D53755619AB26CBF3688BE4DA9955
System ID      :  002590118BE2
Serial         :  A109A-16008
Valid          :  YES
Start Date     :  09-20-2012
End Date       :  none
```

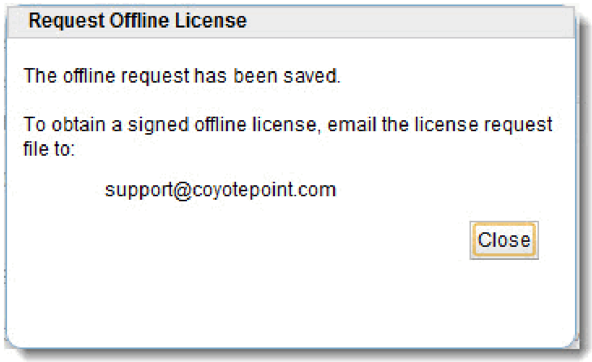
09-21-2012.15-37-20.2 (Envoy)

09-21-2012.15-37-20.3 (VLB)

5. To request an Offline License:

Note - When generating an offline license for upload to Equalizer, be sure that the last line in the file is a blank line.

Click on the **Request Offline License** button. An `LIC_REQ.cps` file will be downloaded locally to the directory specified by your web browser and a diaglogue will appear with instructions.



Request Offline License

The offline request has been saved.

To obtain a signed offline license, email the license request file to:

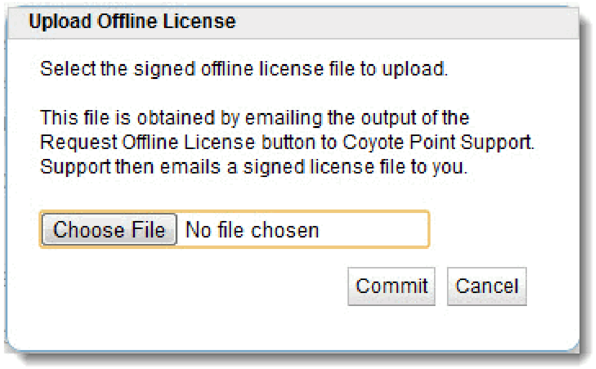
support@coyotepoint.com

Email the downloaded license request file to the address specified and click **OK**.

Once you receive an email from Coyote Point Support containing your license proceed with the following to **Upload an Offline License.**

6. To upload an Offline License:

   a. Click on the **Upload Offline License** button and the following will be displayed.



Upload Offline License

Select the signed offline license file to upload.

This file is obtained by emailing the output of the Request Offline License button to Coyote Point Support. Support then emails a signed license file to you.

b. Click on **Choose File** to locate and select the file received from Coyote Point Support.

c. Click on **Commit** to upload the file to Equalizer. The details of the license including the **License Name**, **Product** and **Key** can be viewed by clicking grayed license listing.

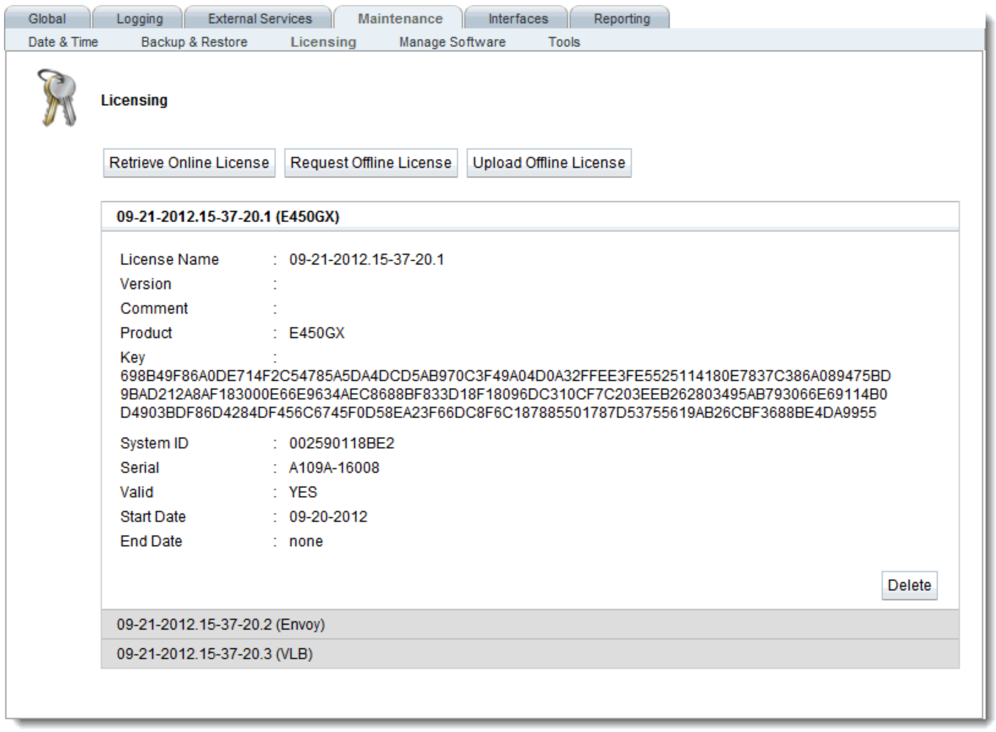
Removing Licenses

To remove licenses using the GUI:

1. Log in to the GUI as described in "Logging In" on page 192.

2. Click on the host name on the left navigation pane.

3. Select the **Maintenance** tab and then **Licensing** to display the following.



09-21-2012.15-37-20.1 (E450GX)

```
License Name    :  09-21-2012.15-37-20.1
Version         :
Comment         :
Product         :  E450GX
Key             :
698B49F86A0DE714F2C54785A5DA4DCD5AB970C3F49A04D0A32FFEE3FE5525114180E7837C386A089475BD
9BAD212A8AF183000E66E9634AEC8688BF833D18F18096DC310CF7C203EEB262803495AB793066E69114B0
D4903BDF86D4284DF456C6745F0D58EA23F66DC8F6C187885501787D53755619AB26CBF3688BE4DA9955
System ID       :  002590118BE2
Serial          :  A109A-16008
Valid           :  YES
Start Date      :  09-20-2012
End Date        :  none
```

09-21-2012.15-37-20.2 (Envoy)

09-21-2012.15-37-20.3 (VLB)

4. Select the license that you would like to remove and click on the **Delete** button.

Chapter 7

Configuring Access

Sections within this chapter include:

Default Login

The “`touch`“ login (password: “`touch`“) is the default Equalizer administrative login for both the CLI and the GUI.

For security, you should change the login for the `touch` user the first time you log in. You can do this by logging into the CLI, entering the following command, and following the command prompts:

```
eqcli > user touch password
```

Creating Additional Logins

You can create additional administrative logins and assign specific permissions to individual logins, if desired. See "Best User and Group Management Practices" on page 500.

Serial Access

Serial access is provided via the serial port onEqualizer’s front panel. The serial connection is required for activities during which Equalizer may lose network connectivity. This includes activities such as:

- Configuring Equalizer and its network connectivity for the first time
- Performing upgrades of the EQ/OS software and switch firmware
- Re-configuring network access for services such as HTTP and SSH, when you cannot login over the network interfaces currently configured or you are changing the network interfaces that will provide those services

Accessing the serial console is described in "Serial Connection" on page 46.

Network Access

In order to access Equalizer over the network, network services must be enabled globally (that is, for all subnets) and on the specific subnets over which you want to provide access.

Global Services

By default, all services are enabled globally:

- In the CLI, global services settings are managed using the global **services** parameter (see "Global Commands" on page 141).
- In the GUI, global services settings appear on the **Equalizer > Global > Parameters** tab.

The global services settings provide a convenient way to enable and disable services on all subnets, should the need arise. For example, when you are upgrading or performing a system backup, it may be desirable to use the serial connection and disable all network services to ensure that no other administrative users are accessing the system.

The following global services settings are supported:

CLI	GUI	Global Service
http	**HTTP**	HTTP GUI service; when enabled, the Equalizer GUI will listen on all subnets on which HTTP services are enabled.
https	**HTTPS**	HTTPS GUI service; when enabled, the Equalizer GUI will listen on all subnets on which HTTPS services are enabled.
ssh	**SSH**	SSH login service; when enabled, SSH login will be permitted on all subnets on which SSH services are enabled.
snmp	**SNMP**	SNMP (Simple Network Management Protocol) service; when enabled, SNMP will accept connections on all subnets on which SNMP services are enabled.
envoy	**Envoy**	Envoy DNS service; when enabled, Envoy will accept DNS lookup connections on all subnets on which Envoy services are enabled.
envoy_ agent	**Envoy Agent**	Envoy Agent health check service; when enabled, Envoy health checks will be performed on all subnets on which Envoy Agent services are enabled.

VLAN Subnet Network Services

By default, no network services are enabled when a VLAN subnet is created. They must be specifically enabled before you can access Equalizer over a subnet:

- In the CLI, subnet network services are enabled using the **services** parameter in the **subnet** context. See "VLAN and Subnet Commands" on page 186.
- In the GUI, click **VLANs > VLAN_name > subnet_name**, where **VLAN_name** is the name of the VLAN and **subnet_name** is the name of the subnet. This opens the **Configuration** tab for the subnet.

The following subnet network services settings are supported:

CLI	GUI	Network Service
`http`	**HTTP**	HTTP GUI service; when enabled, the Equalizer will listen for HTTP connections on Equalizer's IP address on the subnet. The global HTTP GUI service must also be enabled.
`fo_http`	**Failover HTTP**	Failover HTTP GUI service; when enabled, the Equalizer will listen for HTTP connections on Equalizer's Failover IP address (if configured) on the subnet. The global HTTP GUI service must also be enabled.
`https`	**HTTPS**	HTTPS GUI service; when enabled, the Equalizer will listen for HTTPS connections on Equalizer's IP address on the subnet. The global HTTPS GUI service must also be enabled.

CLI	GUI	Network Service
`fo_https`	**Failover HTTPS**	Failover HTTPS GUI service; when enabled, the Equalizer will listen for HTTPS connections on Equalizer's Failover IP address (if configured) on the subnet. The global HTTPS GUI service must also be enabled.
`ssh`	**SSH**	SSH log in service; when enabled, SSH log in will be permitted on Equalizer's IP address on the subnet. The global SSH service must also be enabled.
`fo_ssh`	**Failover SSH**	Failover SSH log in service; when enabled, SSH log in will be permitted on Equalizer's Failover IP address (if configured) on the subnet. The global SSH service must also be enabled.
`snmp`	**SNMP**	SNMP (Simple Network Management Protocol) service; when enabled, SNMP will accept connections on Equalizer's IP address on the subnet. The global SNMP service must also be enabled.
`fo_snmp`	**Failover SNMP**	Failover SNMP service; when enabled, SNMP will accept connections on Equalizer's Failover IP address (if configured) on the subnet. The global SNMP service must also be enabled.
`envoy`	**Envoy**	Envoy DNS service; when enabled, Envoy will accept DNS lookup connections on Equalizer's IP address on the subnet. The global Envoy service must also be enabled.
`fo_envoy`	**Failover Envoy**	Failover Envoy DNS service; when enabled, Envoy will accept DNS lookup connections on Equalizer's Failover IP address (if configured) on the subnet. The global Envoy service must also be enabled.
`envoy_agent`	**Envoy Agent**	Envoy Agent health check service; when enabled, Envoy health checks will be performed on the subnet using Equalizer's IP address on the subnet as the source IP. The global Envoy Agent service must also be enabled.
`fo_envoy_agent`	**Failover Envoy Agent**	Failover Envoy Agent health check service; when enabled, Envoy health checks will be performed on the subnet using Equalizer's Failover IP address on the subnet as the source IP. The global Envoy Agent service must also be enabled.

Chapter 8

Network Configuration

Sections in this chapter include:

Networking Conventions

Several conventions are used within this section:

- Network addresses are represented in Classless Inter-Domain Routing (CIDR) notation, an IP addressing scheme in the form A.B.C.D/X where X is the number of bits in the subnet mask.
- Subnets are referenced by the name of the VLAN which contains them, followed by the subnet name. For example, internal:net means VLAN internal, subnet net.
- All VLAN configurations presented are untagged. The configurations and concepts in this document applies for tagged VLANs as well.
- This section uses examples that are for IPv4 networking. However, the configuration for IPv6 networking would be identical- with a couple of exceptions. These exceptions are identified - where applicable.
- This section uses examples from an Equalizer OnDemand system using untagged VLANs. If your configuration uses tagged networks or Equalizer physical appliances, the network interfaces displayed here will not match your configuration. This is normal and remainder of the section still applies

Networking Technologies

There are several networking technologies described herein that apply to Equalizer installations. They are summarized below, however, specific rules and commands will be described in more detail as each networking scenario is described in further detail.

Destination Routing: This is standard routing, as performed by any networking device. The device determines how to send a packet to its destination by evaluating the destination IP address. If that IP address is on a local network, the device sends the packet directly using the Ethernet layer. If, however, that IP address is on a remote network, the device consults its *routing table* to determine how to send it. The routing table consists of a set of entries in the form:

```
IP/NETMASK || GATEWAY
```

The device searches the routing table in a *most specific* to *least specific* manner in order to find the most appropriate route to use. For example, if one entry is for the network 10.0.0.0/8 and another is for the network 10.0.0.0/24, a packet destined for the IP address 10.0.0.1 would use the /24 entry because it is *more specific.* However, a packet destined for 10.0.1.1 would use the /8 entry because the /24 entry does not apply to this destination. Once a matching route is found, the device sends the packet on to the gateway (or router) that is specified in this route. It is then this gateway's job to get the packet closer to its final destination.

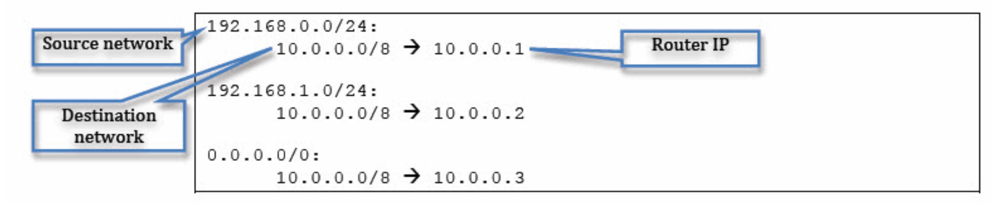
Source-Based Routing: This concept is not unique to Equalizer, however the behavior of each device that implements Source-based Routing can be different. The definition of source-based routing is simply that the *source IP address is used in the routing decision*. For Equalizer, this means that rather than having a single destination routing table, the system actually has a set of destination routing tables, each used only when the source IP address of a packet matches a particular network. A source-based routing table contains entries in the form:

```
(SOURCE IP/NETMASK,DESTINATION IP/NETMASK) || GATEWAY
```

If the destination IP address is on a local network, source-based routing is not used. The packet is sent to the destination system via Ethernet.

If the destination IP address is on a local network, source-based routing is not used by default. The packet is sent to the destination system via Ethernet. However, administrators can configure their routing tables to override the local entries for particular networks, in which case Equalizer will prefer a source route over a local network route. If configured in this manner, Equalizer will send the packet to an IP gateway associated with the source route rather than simply using the ARP address of the destination system to send the packet over Ethernet directly.

3If the destination IP address is on a remote network, the device trying to send a packet performs a most-specific to least-specific search for the source IP network. If a matching source route is found within the routing table, any routing table entries that contain that source IP network are used as a destination routing table. For example:



```
192.168.0.0/24:
      10.0.0.0/8 → 10.0.0.1

192.168.1.0/24:
      10.0.0.0/8 → 10.0.0.2

0.0.0.0/0:
      10.0.0.0/8 → 10.0.0.3
```

This source-based routing table shows three source routes. If a packet sent to 10.0.0.100 is coming from the 192.168.0.0/24 network, Equalizer will use 10.0.0.1 as the gateway. If it is coming from the 192.168.1.0/24 network, Equalizer will use 10.0.0.2 as the gateway. If it is coming from any other network, Equalizer will use 10.0.0.3 as the gateway.

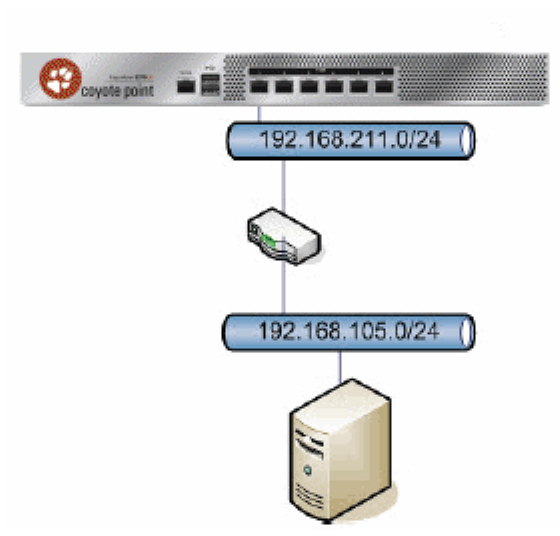
The IP 0.0.0.0/0 is the least specific that a network entry can be - it matches every IP address. However, because of the most-specific to least-specific search that Equalizer performs, the 0.0.0.0/0 source route is not used unless none of the other routes match.

Also note that in this configuration, any packets that have a destination IP address other than a network local to Equalizer (presumably 192.168.0.0/24, 192.168.1.0/24 and 10.0.0.0/8), a route would not be found and the packet would be dropped by the system. To prevent this from happening, most configurations include a default route in the form (0.0.0.0/0, 0.0.0.0/0) || GATEWAY.

Local Networks: Any network that has been added as an Equalizer subnet is considered local to Equalizer. When a subnet is configured, an Administrator assigns an IP address (potentially more than one) that is Equalizer's IP presence on this subnet. When an Equalizer is referred to as being in *single-network* mode or *dual-network* mode, this is the number of local networks.

Remote Networks: Any network that is not a local network. This means that Equalizer needs to perform routing to communicate with a device on this network.

Destination Networks: A specific remote network that has been configured by the Administrator as *connected* to a local network of Equalizer. This means that if Equalizer needs to send packets to this network, it should do so from an IP address on the local network and use the router of the local network. For example:



In this configuration, 192.168.211.0/24 is a local network for Equalizer, configured by adding a subnet to the configuration. 192.168.105.0/24 can be configured as a destination network of the 192.168.211.0/24 network. When adding a destination network, the administrator is configuring several things:

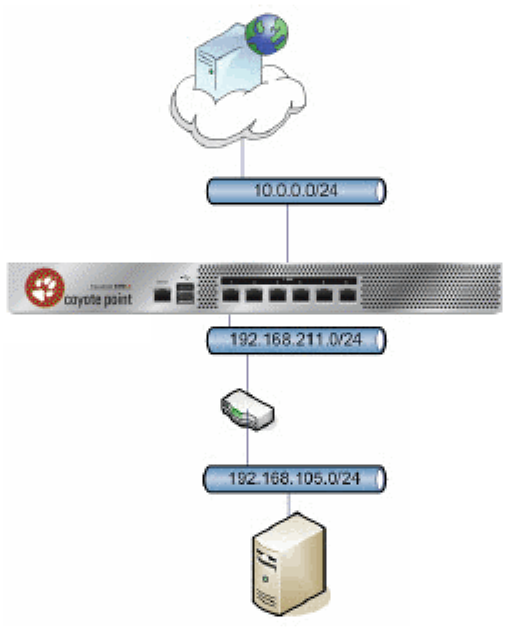
- In order to send packets from Equalizer to the destination network, Equalizer should use its IP address on the local network. This how Equalizer selects an IP address to use when sending a packet to the destination network. In order to do this, Equalizer actually sorts all of the destination networks it knows about in most-specific to least-specific order. It then chooses an appropriate IP address to use based on the first destination network to match.

- Normally, Equalizer would not allow any packets that do not have a source IP address on the local network. Adding the destination network means that Equalizer will now allow packets from this network to be routed with the same rules as packets from the local network.

- Similarly, Equalizer will automatically add source routes for packets from the destination network that match existing source routes for the local network.

- If outbound NAT has been configured for the local network, analogous rules are added for the destination network.

Outbound NAT: NAT, or Network Address Translation, is a common concept for most network administrators. Equalizer administrators usually need to enable NAT when a server on an "internal" (non-public, DMZ) network needs to access resources on the Internet or another public network. This internal network can be either a local network or a destination network for Equalizer. In this scenario, the administrator enables outbound NAT and selects the local network that should be used to NAT packets from the internal network. For example:



In this example, neither the 192.168.211.0/24 nor the 192.168.105.0/24 networks can access the Internet directly. The administrator configures Equalizer to provide outbound NAT service for these networks by using an IP address on the 10.0.0.0/24 network when these internal networks need to talk to the Internet.

When configuring outbound NAT, the internal local network that is being configured for outbound NAT must use the routing information for the external network which it is using NAT through. In the example above, the default gateway for the 192.168.211.0/24 network will really be on the 10.0.0.0/24 network.

This is logical when you remember it this way: If Equalizer is sending a packet from the 192.168.211.0/24 network to a host on the Internet, it has to be sent through the gateway of the external network, rather than the internal network.

When Outbound NAT is enabled for a local network that contains attached destination networks, the destination networks automatically inherit the same outbound NAT configuration.

Note - Outbound NAT is not supported for IPv6.

Network Permissions: Local networks configured in Equalizer use a *default deny* permission scheme. This means that if an Administrator wants to route between two networks using Equalizer, they must explicitly enable permissions between that pair of networks.

Note that permissions are not symmetrical: it is possible to configure a solution where one network can talk to another but not vice-versa. For most configurations, permissions are necessary on both networks: if network 'A' needs to route to network 'B', a permission must be added to 'A' for 'B' and another permission must be added to 'B' for 'A'.

Permissions are only necessary when using Equalizer to route packets. They are not required for Application Traffic Management. That is, when an Equalizer cluster is paired with a server (by adding a server pool containing that server to the cluster), Equalizer knows that any packets associated with a connection for that cluster should be allowed on the server network.

Common Equalizer Networking Scenarios

This section describes individual networking scenarios that can be used to build up a large, more complicated configuration for Equalizer . Each section starts at a specific pre-configured configuration, and references the section which helps set up that configuration.

Blank Configuration

When the Equalizer configuration does not contain any subnets, the networking configuration should also be blank:

```
eqcli > show sbr
IPv4 Default Source Selection Table:

IPv6 Default Source Selection Table: Source Routing Table:
IP Filter Rules:
empty list

IP NAT Rules:
List of active MAP/Redirect filters:

List of active sessions:
```

Single VLAN/Subnet

One of the most common scenarios used by customers is a single network configuration. In this setup, Equalizer is placed into an existing network, so all servers, internal clients, and external routers are on the same VLAN. (This usually means special routing on the servers or the use of **no spoof** for Equalizer clusters. See "Cluster Types and How They're Used with Equalizer" on page 260.

Here we add a single VLAN (port 2, untagged), and configure a subnet on this VLAN:

```
eqcli > vlan internal vid 1 untagged_ports 2

eqcli: 12000287: Operation successful
eqcli > vlan internal subnet net ip 192.168.211.8/24 eqcli: 12000287: Operation
successful
```

There are no differences to the DSS, routing, and NAT tables, since we haven't explicitly added any entries to them. However, the IP Filters table has been updated by the system:

```
IP Filter Rules:
```

```
IPv4 Rules:
1: pass on interface lo0 all hits: 0 bytes: 0


2: pass on interface wm1 hits: 227 bytes: 7025
From To
192.168.211.0/24 -> 192.168.211.0/24

3: block all hits: 26 bytes: 2579


IPv6 Rules:
1: pass on interface lo0 all hits: 0 bytes: 0

2: pass hits: 0 bytes: 0
From To
fe80::/10 -> any

3: block all hits: 0 bytes: 0
```

The new rule shows that packets from network internal:net are allowed into the system if they are being sent to the same network. Without this rule, the newly added IP address could not be reached from the rest of the network.

Also note that IPv4/6 rule 1 allows Equalizer traffic if it is on the localhost interface (lo0), and IPv4/6 rule 3 blocks all traffic which didn't fall into one of the previous rules. This is the *default deny* rule. IPv6 rule 2 is an automatically-added rule for link-local IPv6 addresses, which is always there if any networks are configured.

If all of the clients and servers for this Equalizer are on the internal:net network, we're done, however, most installations have customers which are on a different network, usually the Internet.

Single VLAN/Subnet with a Default Gateway

We can connect the system to the Internet by adding a default route (the newly-added rules are in *italics*) because there is only a single Equalizer local network,

```
eqcli > vlan internal subnet net default_route 192.168.211.1 eqcli: 12000287:
Operation successful
```

```
Source Routing Table:


   192.168.211.0/24:
            default via 192.168.211.1
```

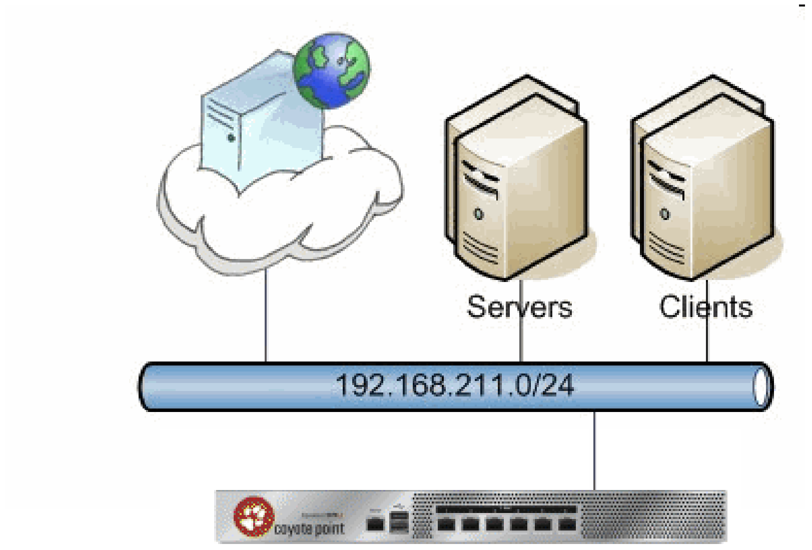
```
IP Filter Rules:

IPv4 Rules:
1: pass on interface lo0 all hits: 0 bytes: 0


2: pass on interface wm1 hits: 32 bytes: 1368
                From To
    192.168.211.0/24 -> 192.168.211.0/24


3: block on interface wm1 hits: 0 bytes: 0
                From To
    192.168.211.0/24 -> 192.168.211.0/24


4: pass on interface wm1 hits: 0 bytes: 0
                From To
    192.168.211.0/24 -> any


5: pass on interface wm1 hits: 0 bytes: 0
                From To
                 any -> 192.168.211.0/24


6: block all hits: 7 bytes: 799



IPv6 Rules:
1: pass on interface lo0 all hits: 0 bytes: 0


2: pass hits: 0 bytes: 0
                From To

  fe80::/10 -> any
```

Now that we have a non-blank routing configuration, we can see that the source routing table reflects the change, and that we have a couple of routing-specific IP Filter rules:

Rule 3 is inserted immediately after any 'pass' rules for this subnet. Because there aren't any other subnets except this one, this rule will not be used (the previous rule allows all packets that this rule would block).

Rules 4 and 5 allow traffic from non-Equalizer networks into Equalizer and from Equalizer to non-Equalizer networks. These are the rules that allow routing through the default gateway to work.

The configuration presented in this section corresponds to the following scenario:



Dual VLAN/Network

Another typical configuration is to have two networks connected to Equalizer:

1. One for external connectivity (this is where the Equalizerclients and clusters are)

2. One for internal resources (this is where the servers are)

We start with a single-VLAN configuration with no default route (See "Single VLAN/Subnet" on page 82) and add a second network for external connectivity, along with a default route for that network, as shown below.

```
eqcli > vlan external untagged_ports 1 vid 2 eqcli: 12000287: Operation
successful
eqcli > vlan external subnet net ip 10.0.0.68/24 default_route
10.0.0.254
eqcli: 12000287: Operation successful
```

The IP Filter configuration is updated as shown below:

```
Source Routing Table:
        10.0.0.0/24:
             default via 10.0.0.254

IP Filter Rules:

IPv4 Rules:

1: pass on interface lo0 all hits: 0 bytes: 0
```

```
2: pass on interface wm1 hits: 36 bytes: 1608
                From To
    192.168.211.0/24 -> 192.168.211.0/24


3: pass on interface wm0 hits: 48 bytes: 2926
                From To
         10.0.0.0/24 -> 10.0.0.0/24


4: block on interface wm0 hits: 0 bytes: 0
                From To
         10.0.0.0/24 -> 192.168.211.0/24
                           10.0.0.0/24


5: pass on interface wm0 hits: 27 bytes: 4916
                From To
         10.0.0.0/24 -> any


6: pass on interface wm0 hits: 0 bytes: 0
                From To
                 any -> 10.0.0.0/24

  7: block all hits: 1 bytes: 328
```

The 192.168.211.0 network rules remain unchanged. We have new rules for the 10.0.0.0 network:

Rule 3 is for sending packets on the external network interface (wm0 in this case) to the 10.0.0.0 network from the 10.0.0.0 network.

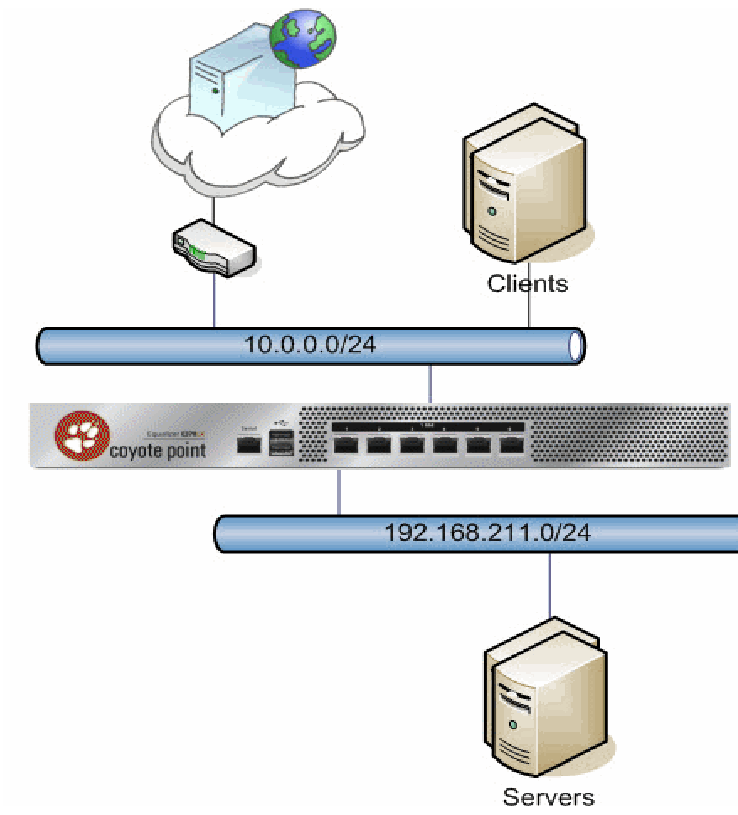
Rules 5 and 6 for packets between the 10.0.0.0 network to any other network.

Note that *Rule 4* is a block rule which prevents traffic between the 10.0.0.0 network and all subnets known to the system. Such a rule doesn't exist for the 192.168.211.0 network because we have not enabled routing for it.

Since the new *external* network is the one is used for sending packets to the Internet, we also make it the default network for sourcing packets by setting the **def_src_addr** flag:

```
eqcli > vlan external subnet net flags def_src_addr eqcli: 12000287: Operation
successful

eqcli > show sbr
IPv4 Default Source Selection Table:
0/0 10.0.0.68
```

We see that setting this flag has created a DSS table entry. This entry is a definition for the 0/0 destination network, which specifies that the *external* VLAN is the one connected to this network, and when Equalizer needs to send packets to this network, it should use the 10.0.0.68 IP address. This setup is sufficient for most dual-network configurations:



With this configuration, clients can connect to cluster IP addresses on the 10.0.0.0 network, and Equalizer will send the requests to the servers on the 192.168.211.0 network.

Looking at the rest of the show sbr output, we see that the rules look the same as the standard configuration in Dual VLAN/Network, but we now mirror all of the rules for the 10.0.0.0/24 network for the 0.0.0.0/0 destination network that was created when we set the **def_src_addr** flag.

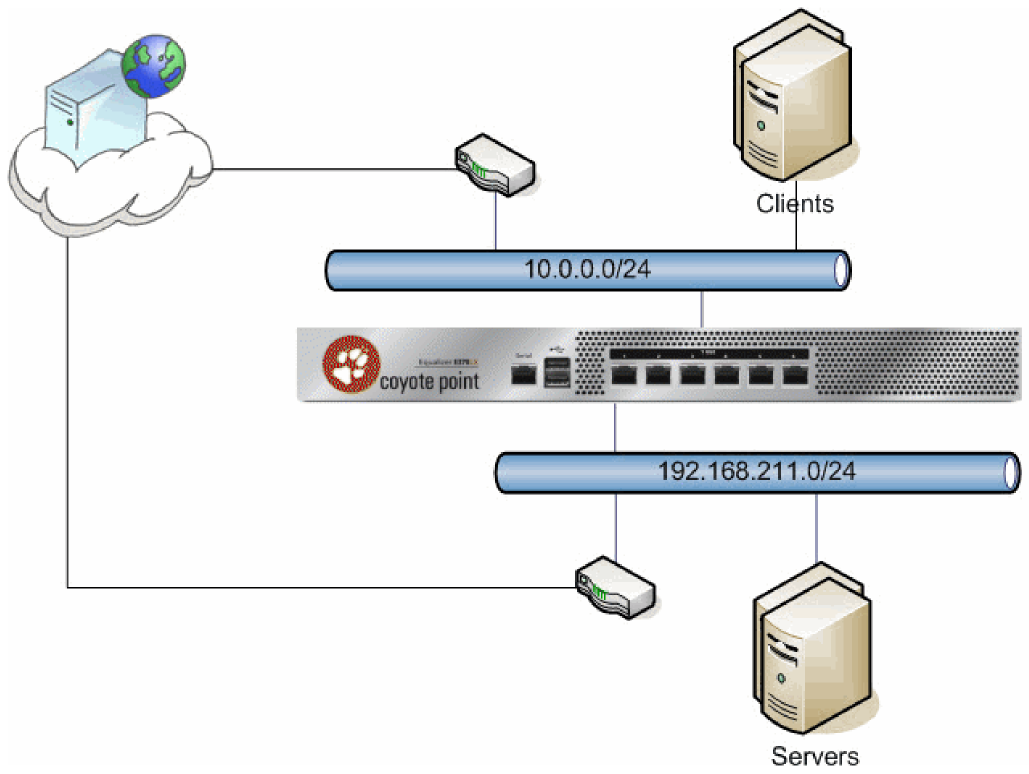
```
Source Routing Table:
          0.0.0.0/00:
               default via 10.0.0.254

         10.0.0.0/24:
               default via 10.0.0.254
IP Filter Rules:
IPv4 Rules:
1: pass on interface lo0 all hits: 0 bytes: 0
```

```
2: pass on interface wm1 hits: 141 bytes: 7025
                  From To
    192.168.211.0/24 -> 192.168.211.0/24

3: pass on interface wm0 hits: 5 bytes: 399
                  From To
          10.0.0.0/24 -> 10.0.0.0/24
            0.0.0.0/0 0.0.0.0/0
```

```
4: block on interface wm0 hits: 0 bytes: 0
                  From To
          10.0.0.0/24 192.168.211.0/24
                          -> 10.0.0.0/24
                                 0.0.0.0/0
5: pass on interface wm0 hits: 4 bytes: 756
                  From To
          10.0.0.0/24 -> any

6: pass on interface wm0 hits: 0 bytes: 0
                  From To
                   any -> 10.0.0.0/24
                                 0.0.0.0/0

   7: block all hits: 0 bytes: 0
```

Dual VLAN/Network with 2 Gateways

Imagine a scenario very similar to the one described in Dual VLAN/Network, but the *internal network* is also able to route to the Internet:



As far as Equalizer is concerned, the configuration doesn't have to change at all from the previous scenario. There is still a single destination network (the Internet), and Equalizer is statically configured to use the 10.0.0.0 network to communicate with this destination network.

The administrator can set up the servers on the 192.168.211.0 network to use their router when sending packets to the Internet, and to use the Equalizerwhenever sending packets to clients. However, in order to do this on a server, the administrator would need to statically define which portions of the Internet should use which gateway (the router or the Equalizer). This can be configured very simply on Equalizer, instead:

```
eqcli > vlan internal subnet net default_route 192.168.211.2 eqcli: 12000287:
Operation successful
```

This command adds a default route for the *internal* network that is different than the external default route. This means that any traffic coming from the internal network will be source routed through the 192.168.211.2 gateway, while any other traffic will still be routed through the 10.0.0.254 gateway as configured for the *external* network.

This can be verified by looking at the show sbr output:

```
Source Routing Table:

0.0.0.0/00:
   default via 10.0.0.254

192.168.211.0/24:
   default via 192.168.211.2

10.0.0.0/24:
   default via 10.0.0.254
```

The IP Filter rules are updated as well, analogous to the rules which were created when we added routing in Single VLAN/Subnet with a Default Gateway. The new rules allow routing from the internal network.

```
 IPv4 Rules:

 1: pass on interface lo0 all hits: 0 bytes: 0

 2: pass on interface wm1 hits: 39 bytes: 1368
                   From To
     192.168.211.0/24 -> 192.168.211.0/24

 3: pass on interface wm0 hits: 12 bytes: 624
                   From To
           10.0.0.0/24 -> 10.0.0.0/24
             0.0.0.0/0 0.0.0.0/0

 4: block on interface wm1 hits: 0 bytes: 0
                   From To
     192.168.211.0/24 192.168.211.0/24
                           -> 10.0.0.0/24
                                  0.0.0.0/0

 5: pass on interface wm1 hits: 0 bytes: 0
                   From To
192.168.211.0/24 -> any

 6: block on interface wm0 hits: 0 bytes: 0
                   From To
           10.0.0.0/24 192.168.211.0/24
```

```
                             -> 10.0.0.0/24
                                    0.0.0.0/0
 7: pass on interface wm0 hits: 4 bytes: 756
                   From To
          10.0.0.0/24 -> any

8: pass on interface wm1 hits: 0 bytes: 0
                   From To
                    any -> 192.168.211.0/24

 9: pass on interface wm0 hits: 0 bytes: 0
                   From To
                    any -> 10.0.0.0/24
                                    0.0.0.0/0
10: block all hits: 1 bytes: 328
```

It can also be verified using the traceroute tool, available in most Operating Systems. If a traceroute is performed from the server, a different second-hop gateway is used than the first-hop gateway on the Equalizer traceroute:

```
freebsd# traceroute 64.13.152.126
traceroute to 64.13.152.126 (64.13.152.126), 64 hops max, 40 byte
packets
1 192.168.211.8 (192.168.211.8) 0.576 ms 0.799 ms 0.241 ms
2 192.168.211.2 (192.168.211.2) 0.522 ms 0.547 ms 0.334 ms

EQUALIZER# traceroute -n 64.13.152.126
traceroute to 64.13.152.126 (64.13.152.126), 64 hops max, 40 byte
packets
1 192.168.8.2 1.653 ms 1.342 ms 1.225 ms
```

In the example above, the server ("freebsd") uses the Equalizer (192.168.211.8) as its gateway, and the Equalizer sends the packet on the 192.168.211.2 gateway. However, when the Equalizer performs a traceroute to the same location, it uses the 192.168.8.2 gateway.

Dual VLAN/Network with Outbound NAT

If we start with the configuration in Dual VLAN/Network, it should be noted that this configuration is not sufficient if the servers on the internal network require Internet connectivity. Equalizer will properly send traffic from the internal network to the Internet, but because the internal network is non-routable, hosts on the Internet will not be able to respond. One way to solve this problem is to have a separate NAT gateway for the server network, as described in Dual VLAN/Network with 2 Gateways. However, because most locations have a single outbound link, configurations with only a single gateway must use Outbound NAT.

Note - The Outbound NAT feature is not available for IPv6 on Equalizer.

Outbound NAT allows the administrator to associate two subnets together using the outbound_nat parameter. This parameter is configured on the internal network, and is set to one of the Equalizer IP addresses of the external network.

```
eqcli > vlan internal subnet net outbound_nat 10.0.0.68 eqcli: 12000287:
Operation successful
```

This command can be read as "when sending packets from the internal network to any network which is reached through the external network, use the IP address 10.0.0.68 instead of the original source IP address of the packet".

Two additional features must be configured before Outbound NAT will function properly.

First, because the packets are still coming from the internal network, source routing for this network must be adjusted to really use the gateway of the external network:

```
eqcli > vlan internal subnet net default_route 10.0.0.254 eqcli: 12000287:
Operation successful
```

Second, Outbound NAT means that now we are taking packets from the internal network and sending them out of the external network. This means that the packets are routed, and we need to enable permissions between the networks:

```
eqcli > vlan internal subnet net permit external:net eqcli: 12000287:
Operation successful
```

```
eqcli > vlan external subnet net permit internal:net eqcli: 12000287: Operation
successful
```

Note that the permissions need to be set on both sides - the internal network is configured to allow traffic from the external network, and the external network is configured to allow traffic from the internal network.

Now we can analyze the changes to the running configuration that we have made. First, we enabled Outbound NAT:

```
IP NAT Rules:
List of active MAP/Redirect filters:
map wm0 192.168.211.0/24 -> 10.0.0.68/32 proxy port ftp ftp/tcp
map wm0 192.168.211.0/24 -> 10.0.0.68/32 portmap tcp/udp auto
map wm0 192.168.211.0/24 -> 10.0.0.68/32
```

All three rules are created for the single NAT change that we made. They can be read as "whenever traffic is leaving through the wm0 interface, if it has a 192.168.211.0 network source IP address, change the source IP address to 10.0.0.68".

Second, we changed the default gateway:

```
Source Routing Table:


 0.0.0.0/00:
    default via 10.0.0.254


192.168.211.0/24:
    default via 10.0.0.254


 10.0.0.0/24:


    default via 10.0.0.254
```

Both networks now use the same default gateway, since all traffic will be sent through that router.

Third, we added permit rules for the networks:

```
IPv4 Rules:

1: pass on interface lo0 all hits: 0 bytes: 0

2: pass on interface wm1 hits: 90 bytes: 4156
                  From To
     192.168.211.0/24 192.168.211.0/24
                          -> 10.0.0.0/24
                                 0.0.0.0/0

3: pass on interface wm0 hits: 6 bytes: 295
                  From To
          10.0.0.0/24 10.0.0.0/24
            0.0.0.0/0 -> 0.0.0.0/0
                                 192.168.211.0/24
4: block on interface wm1 hits: 0 bytes: 0
                  From To
      192.168.211.0/24 192.168.211.0/24
                          -> 10.0.0.0/24
```

```
                                    0.0.0.0/0
  5: pass on interface wm1 hits: 0 bytes: 0
                    From To
        192.168.211.0/24 -> any

  6: block on interface wm0 hits: 0 bytes: 0
                    From To
              10.0.0.0/24 192.168.211.0/24
                           -> 10.0.0.0/24
                                  0.0.0.0/0
  7: pass on interface wm0 hits: 3 bytes: 517
                    From To
              10.0.0.0/24 -> any
  8: pass on interface wm0 hits: 0 bytes: 0
                    From To
                     any 192.168.211.0/24
                           -> 10.0.0.0/24
                                  0.0.0.0/0
 9: block all hits: 0 bytes: 0
```

The main difference between these rules and those in Dual VLAN/Network with 2

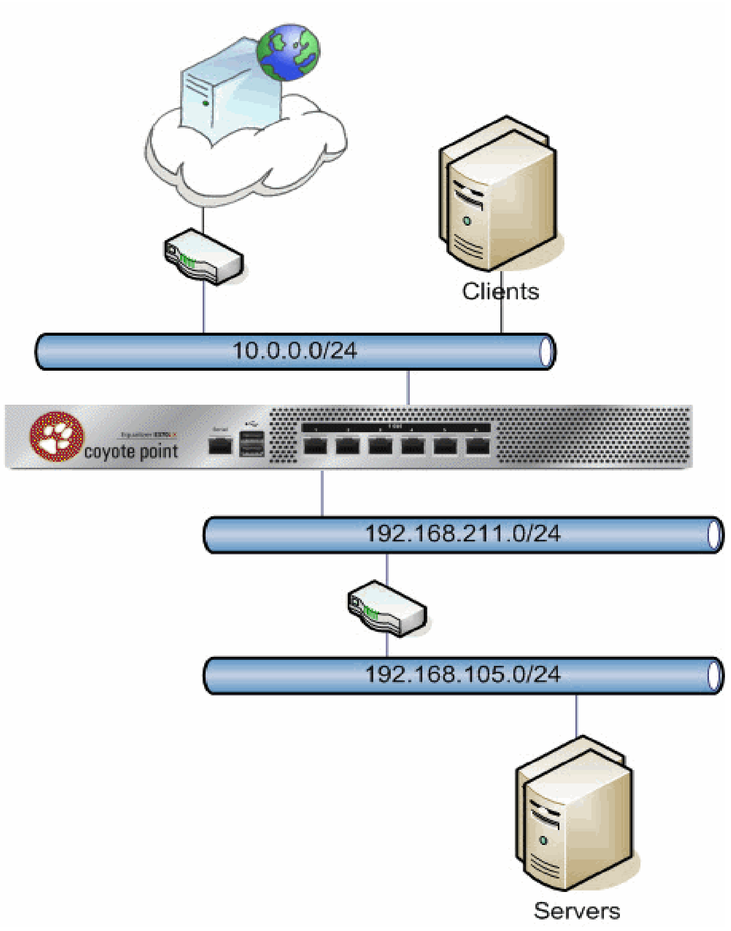
Gateways is that because of the new permissions, Rules 2 and 3 now include both networks in them, meaning that traffic can be sent to either network rather than just one. Additionally, rule 8 has replaced two separate rules, because all traffic coming from the Internet will now enter Equalizer through the wm0 interface.

This configuration corresponds to the same scenario as Standard Dual Network configuration, but with the requirement that the internal servers are required to be able to access the Internet.

Dual VLAN/Network with Multiple Destination Networks

The scenario above is sufficient if the servers are directly connected to (or are within the same broadcast domain) as the internal network of the Equalizer. However, if there are servers that are connected to the internal network of Equalizer through a router, additional configuration steps are necessary.

This corresponds to the following scenario:



Any time devices are connected to Equalizer through a router, a destination network definition is required. In Single VLAN/Subnet with a Default Gateway, we used the shortcut method for specifying a destination network: because the network was the 0/0 network (meaning everything that is not directly connected to Equalizer), we simply used the def_src_addr flag inside of the external subnet. Now we need to specify a second destination network, so we need to do so manually. (If the def_src_addr flag is set on any subnet, it must be removed before manual DSS configuration can be performed).

We start with the configuration in Dual VLAN/Network with Outbound NAT.

```
eqcli > vlan external subnet net flags !def_src_addr eqcli: 12000287: Operation
```

```
    successful

    eqcli > vlan external subnet net destination 0.0.0.0/0gw10.0.0.68
    12000287: Operation successful

    eqcli > vlan external subnet net route 192.168.105.0/24gw192.168.211.2 eqcli:
    12000287: Operation successful
```

The first two commands simply replace the **def_src_addr** flag with the same rule but entered manually. This will allow us to enter manual rules for the internal network later.

The third command adds a source route for the external network to use the internal network when sending packets to the new destination network. Without this source route, all traffic from the *external* network would be sent to the 10.0.0.254 gateway.

Now the internal network configuration:

```
    eqcli > vlan internal subnet net route 192.168.105.0/24gw192.168.211.2 eqcli:
    12000287: Operation successful

    eqcli > vlan internal subnet net destination 192.168.105.0/24
    192.168.211.8
    eqcli: 12000287: Operation successful
```

The first command creates a source route which Equalizer will use when talking to the new destination network from the internal network. (The previous source route was for talking to the destination network from the external network).

The second command defines the destination network itself.

```
  eqcli > show sbr
 IPv4 Default Source Selection Table:
        192.168.105/24 192.168.211.8
                     0/0 10.0.0.68


 IPv6 Default Source Selection Table: Source
 Routing Table:
           0.0.0.0/00:
        192.168.105.0/24 ‘ via 192.168.211.2
               default via 10.0.0.254


    192.168.211.0/24:
        192.168.105.0/24 via 192.168.211.2
               default via 10.0.0.254
    192.168.105.0/24:
        192.168.105.0/24 via 192.168.211.2
               default via 10.0.0.254

         10.0.0.0/24:
        192.168.105.0/24 via 192.168.211.2
               default via 10.0.0.254
IP Filter Rules:
IPv4 Rules:
1: pass on interface lo0 all hits: 0 bytes: 0

2: pass on interface wm1 hits: 92 bytes: 3700
                  From To
    192.168.211.0/24 192.168.211.0/24
    192.168.105.0/24 -> 192.168.105.0/24
                                 10.0.0.0/24
                                 0.0.0.0/0

3: pass on interface wm0 hits: 7 bytes: 435
                  From To
          10.0.0.0/24 10.0.0.0/24
            0.0.0.0/0 -> 0.0.0.0/0
                                  192.168.211.0/24
                                  192.168.105.0/24
4: block on interface wm1 hits: 0 bytes: 0
                  From To
     192.168.211.0/24 192.168.211.0/24
                          -> 192.168.105.0/24
                                 10.0.0.0/24
                                 0.0.0.0/0

5: pass on interface wm1 hits: 0 bytes: 0
                  From To
     192.168.211.0/24 -> any

6: block on interface wm0 hits: 0 bytes: 0
                  From To
          10.0.0.0/24 192.168.211.0/24
                          -> 192.168.105.0/24
                           10.0.0.0/24
                                 0.0.0.0/0
```

```
7: pass on interface wm0 hits: 6 bytes: 956
                  From To
          10.0.0.0/24 -> any

8: pass on interface wm0 hits: 0 bytes: 0
                  From To
                   any 192.168.211.0/24
                          -> 192.168.105.0/24
                                 10.0.0.0/24
                                 0.0.0.0/0
9: block all hits: 0 bytes: 0

IP NAT Rules:
List of active MAP/Redirect filters:
map wm0 192.168.211.0/24 -> 10.0.0.68/32 proxy port ftp ftp/tcp
map wm0 192.168.211.0/24 -> 10.0.0.68/32 portmap tcp/udp auto
map wm0 192.168.211.0/24 -> 10.0.0.68/32
map wm0 192.168.105.0/24 -> 10.0.0.68/32 proxy port ftp ftp/tcp
map wm0 192.168.105.0/24 -> 10.0.0.68/32 portmap tcp/udp auto
map wm0 192.168.105.0/24 -> 10.0.0.68/32
```

The DSS Table contains the two destination networks that we have configured: the 'internal' destination network and the Internet. It specifies that when communicating with the 192.168.105/24 network, Equalizer should send traffic from the local network with IP address 192.168.211.8, and if a packet needs a source IP address, this is the IP address that should be used. Likewise, when communicating with the rest of the Internet, Equalizer should send packets from the local network with IP address 10.0.0.68, and this is the IP address that should be used if a source IP address is needed.

Note that the DSS Table is sorted such that the more specific entries are above less specific entries. When Equalizer is processing this table, the first entry to match is the one that will be used.

The source routing table now has source entries for two local networks configured in the system, as well as the two destination networks. The destination routing tables for each source look almost identical: Whenever talking to the 192.168.105.0/24 network, the gateway is 192.168.211.2 and whenever talking to anywhere else, the gateway is 10.0.0.254.

Note - Destination network source routing entries are created automatically based on the destination network configurations: a source route entry is created for every destination network with the same destination routes as the local network it is attached to.

Any rules that previously included only a local network have been updated to also include the destination network attached to that local network.

Equalizer Use of VLAN Technology

Equalizer models E350GX, E450GX, E650GX support tagged and untagged VLANs on all front panel interface ports. This section provides a basic technical introduction to VLAN technology.

Many networking technologies use a technique called *broadcasting* to provide services on a Local Area Network (LAN). Like traditional television or radio signals that are broadcast over the airwaves, broadcast network transmissions are received by every node on the same LAN segment, or *broadcast domain*. The Address Resolution Protocol (ARP), the Dynamic Host Configuration Protocol (DHCP), and the Router Information Protocol (RIP) are all examples of protocols that provide network services through broadcasting.

A LAN is a single broadcast domain composed of all the systems that are physically connected to the same switches, hubs, and other devices that communicate at the Data Link Layer (Layer 2) of the OSI Networking Model. These devices communicate using Layer 2 protocols, like Ethernet and ARP.

Virtual Local Area Network (VLAN) technology was developed to overcome these physical limitations of traditional LAN technology. A VLAN is essentially a means of grouping systems at the Data Link Layer (Layer 2 of the OSI networking model), using methods that are independent of the physical connection of the device to the network.

By exchanging *broadcast packets* -- packets that are essentially sent to all systems connected to a Layer 2 switching device -- switches can maintain a list of all MAC addresses connected to them and to the other switches to which they are connected. A set of Layer 2 devices and the systems connected to them form a *broadcast domain* -- meaning that all the systems can talk to one another using broadcast packets.

Conversely, broadcast packets are not forwarded beyond the boundaries of the broadcast domain. For example: if two LANs are connected by a router (a Network Layer, or Layer 3, device), the broadcast traffic for one LAN is never forwarded to the other LAN. The layout of a traditional LAN is therefore restricted to those systems that can be wired together using Layer 2 devices -- a physically distant system that requires connectivity to the LAN would require special routing and address translation (at Layer 3) in order to reach the LAN.

The dependence of LAN technology on physical connectivity at Layer 2 leads to two basic difficulties:

- Broadcasts are received by all systems in the broadcast domain - and if there is sufficient broadcast traffic, it can significantly reduce the overall performance of the LAN, to the point where some services may simply not be able to function properly due to latency or other factors introduced by a high level of broadcast traffic.

- If you want to include a system that is not physically connected to the LAN in the LAN’s broadcast domain, you need to physically connect the system to the LAN.

One problem with broadcasting is that lots of broadcast traffic on a LAN can slow network traffic down, as well as slow individual systems down. If there is so much broadcast traffic on the LAN that other non-broadcast traffic is significantly delayed (or never delivered), this is called a *broadcast storm*. Broadcast storms typically arise when network loops are created through faulty network configuration, but can also happen as the result of a malicious attack. For example, a classic Denial of Service attack is to send an ICMP echo request ("ping") over the LAN that specifies the source address of a system and a broadcast address for the destination. Every system receiving the ping will respond to it -- flooding the system specified as the source of the ping with ICMP echo replies.

There are also other security concerns associated with broadcasting. Since all the systems in the broadcast domain can see broadcast packets, the information in them is susceptible to discovery, intercept, and modification. This is of particular concern in industrial Ethernet environments (where, for example, manufacturing processes are controlled directly by computers) and in any environment (such as government and finance) where sensitive data is regularly transmitted over the LAN.

A number of methods can be used to mitigate problems and threats associated with large broadcast domains, including broadcast filtering and physically separating large broadcast domains into smaller domains. The problem with these solutions is that the are typically implemented at the Network Layer (Layer 3), and require Layer 3 devices (such as routers and firewalls) to implement them. These Layer 3 devices require separate subnets, and themselves emit a significant amount of broadcast traffic.

What we really want is a way of abstracting the idea of a LAN so that large broadcast domains can be separated into smaller domains *without requiring any network rewiring or physical movement of systems*. We'd also like the ability to extend broadcast domains across Layer 3 devices to physically remote systems.

With a VLAN, the broadcast domain for a particular system is determined by the *software settings on the Layer 2 switch port to which the system is connected*.

So, for example, in a traditional LAN, all the systems connected to Switch A would be part of Broadcast Domain A. If the switch is a VLAN-capable switch, then it is possible to configure several ports on the switch for VLAN A, several others to VLAN B, others to VLAN C, and so on.

This allows you to both:

- reduce the number of devices in local broadcast domains
- extend broadcast domains across devices separated by more than one switch

The predominant VLAN standard is 802.1q. This standard adds a VLAN tag to the information in the Ethernet packet. Since they operate at the switching level, VLANs are Layer 2 technologies -- though they are often confused with Layer 3 subnetting, because in many configurations there is one VLAN configured per subnet. This is usually done for the practical purpose of allowing the systems on a VLAN to be managed as a group by other network management devices/software that work by IP address ranges, for example, rather than VLAN tags.

Configuring VLANs

The following table shows you how to perform VLAN tasks using the CLI and the GUI:

It should be noted that on switch less Equalizers (the E250GX hardware and the Equalizer OnDemand virtual platform), only one port can be assigned to a VLAN. On Equalizers with a front-panel switch (E350GX, E450GX, E650GX), multiple ports can be assigned to a VLAN.

Note - The **VID** values must be between 1 and 4094.

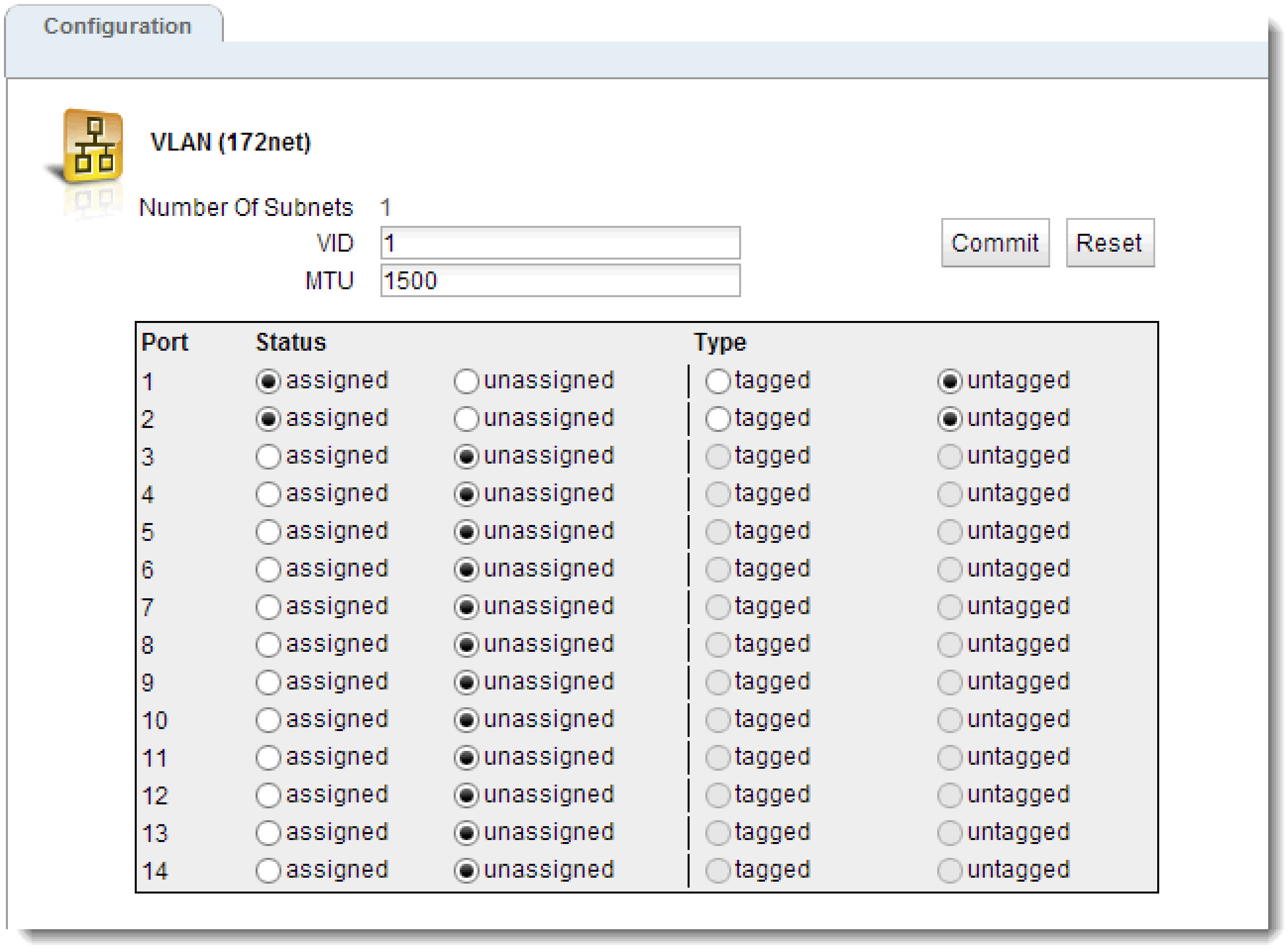
CLI and GUI VLAN Commands

Task	Command / Procedure	
Add a VLAN	**CLI**	eqcli > vlan *name* vid *VLAN_ID* [*parameters*]
	GUI	1. Right-click **VLANs** in the left frame. 2. Select **Add VLAN** from the popup command menu. 3. Enter a **VLAN Name** and **VID** (VLAN ID). 4. Click **Commit.**
Remove a VLAN	**CLI**	`eqcli > `**`no vlan`** ***`name`***

Task		Command / Procedure
	GUI	1. Expand the **VLANs** node in the left frame. 2. Right-click the name of the VLAN you want to delete. 3. Select **Delete VLAN** from the popup command menu. 4. Click **Confirm.**
Modify a VLAN	CLI	`eqcli > vlan name [parameters]`
	GUI	1. Expand the **VLANs** node in the left frame. 2. Click the name of the VLAN you want to modify. The VLAN configuration tabs appear in the right frame. 3. Edit the VLAN configuration using the controls on each tab. Click **Commit** before navigating away from a tab to apply your changes.
Disable a VLAN	CLI	`eqcli > vlan name flags disable`
	GUI	1. Expand the **VLANs** node in the left frame. 2. Click the name of the VLAN you want to disable. The VLAN configuration tabs appear in the right frame. 3. Turn on the **Disable** check box and click **Commit.**
Display summary of all VLANs	CLI	`eqcli > show vlan`
	GUI	Click the **VLANs** node in the left frame object tree.
Display details for a VLAN	CLI	`eqcli > show vlan name`
	GUI	1. Expand the **VLANs** node in the left frame. 2. Click a VLAN name to display the configuration tabs for that VLAN in the right frame.

VLAN Port Assignment Using the GUI

The VLAN Port Assignment Configuration Screen is used to assign ports, specify whether a VLAN is tagged or untagged and specify MTU. It is accessed by clicking on a VLAN on the left navigational pane of on the GUI.



VLAN (172net)

Number Of Subnets 1

VID 1

MTU 1500

Port	Status		Type	
1	● assigned	○ unassigned	○ tagged	● untagged
2	● assigned	○ unassigned	○ tagged	● untagged
3	○ assigned	● unassigned	○ tagged	○ untagged
4	○ assigned	● unassigned	○ tagged	○ untagged
5	○ assigned	● unassigned	○ tagged	○ untagged
6	○ assigned	● unassigned	○ tagged	○ untagged
7	○ assigned	● unassigned	○ tagged	○ untagged
8	○ assigned	● unassigned	○ tagged	○ untagged
9	○ assigned	● unassigned	○ tagged	○ untagged
10	○ assigned	● unassigned	○ tagged	○ untagged
11	○ assigned	● unassigned	○ tagged	○ untagged
12	○ assigned	● unassigned	○ tagged	○ untagged
13	○ assigned	● unassigned	○ tagged	○ untagged
14	○ assigned	● unassigned	○ tagged	○ untagged

- **VID** - A unique integer identifier for the VLAN, between 1 and 4094.
- **MTU** - MTU can be specified for tagged and untagged VLANs on all switched systems (E350GX, E450GX, E650GX)for tagged VLANs on non-switched systems (E250GX, Equalizer OnDemand. The MTU is set on the VLAN, and the values you can set depend on the Equalizer model and the subnet configuration of the VLAN, as follows:
    - For the E350GX, E450GX and E650GX, the maximum MTU value is 1500.
    - For E250GX models and Equalizer OnDemand, the maximum MTU is 9000.
    - For VLANs with only IPv4 subnets, the minimum MTU is 576.
    - For VLANs with an IPv6 subnet, the minimum MTU is 1280.

  If you modify the MTU on a VLAN to a value that is lower than the currently set value, you must reboot Equalizer to ensure proper network interface operation.
- **Status** - assign a port status on the VLAN using the radio buttons.
- **Type** - VLANs can either be **tagged** or **untagged** and set for the port on the VLAN using the appropriate radio button:

- **tagged** - **Tagged** ports can be assigned to more than one VLAN.
- **untagged** - **Untagged** ports can be assigned to exactly one VLAN.

Click on **Commit** to save your settings or **Reset** to revert to the previous settings.

VLAN Port Assignment Using the CLI

Refer to "VLAN and Subnet Commands" on page 186.

Configuring Subnets

The following table describes how to perform subnet tasks using the CLI and the GUI:

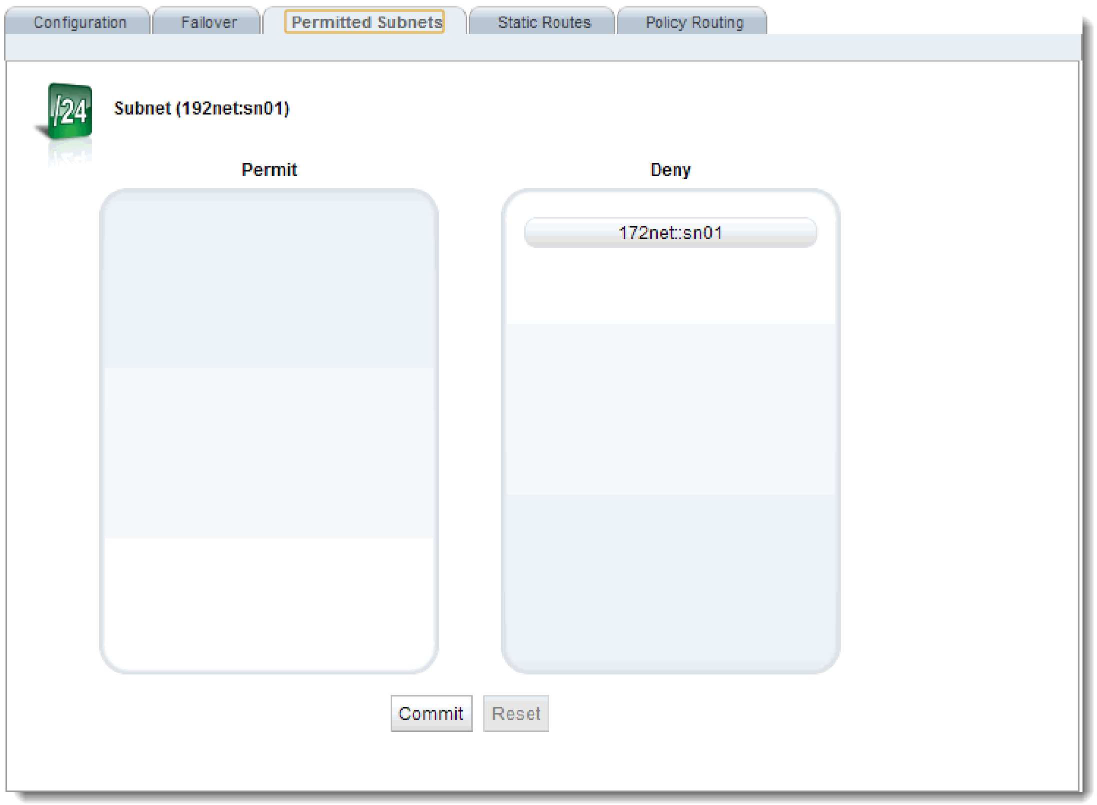
Task	Command / Procedure	
Add a subnet	**CLI**	`eqcli > vlan name subnet name [parameters]`
	GUI	1. Expand the **VLANs** node in the left frame. 2. Right-click a VLAN name 3. Select **Add Subnet** from the popup command menu. 4. Enter a **VLAN Name** and **VID** (VLAN ID). 5. Click **Commit**.
Remove a subnet	**CLI**	`eqcli > no vlan name subnet name`
	GUI	1. Expand the **VLANs** node in the left frame. 2. Click a VLAN name. 3. Right-click the name of the subnet you want to delete. 4. Select **Delete Subnet** from the popup command menu. 5. Click **Confirm**.
Modify a subnet	**CLI**	`eqcli > vlan name subnet name [parameters]`
	GUI	1. Expand the **VLANs** node in the left frame. 2. Click a VLAN name. 3. Click the name of the subnet you want to modify. The configuration tabs appear in the right frame. 4. Edit the subnet configuration using the controls on each tab. Click **Commit** before navigating away from a tab to apply your changes.
Display summary of all subnets in a	**CLI**	`eqcli > show vlan name subnet`

Task	Command / Procedure	
VLAN		
	GUI	1. Expand the **VLANs** node in the left frame object tree. 2. Expand a VLAN. 3. Click the **Subnets** node for that VLAN.
Display details for a subnet	**CLI**	`eqcli > `**`show vlan`** ***`name`*** **`subnet`** ***`name`***
	GUI	1. Expand the **VLANs** node in the left frame object tree. 2. Expand a VLAN. 3. Expand the **Subnets** node for that VLAN. 4. Click a subnet name to display the configuration tabs for that subnet in the right frame.

About Permitted Subnets

By default, each VLAN will not forward packets for any other subnet unless they are specifically designated in the **Permitted Subnets** screen-- sometimes referred to as a "subnet access control list". When a new subnet is added it will be automatically be added to the **Deny** pane on this screen.

If you would like to allow packets from any other subnet to be forwarded they must be added to the **Permit** pane on this screen. Using drag and drop functionality, drag a **Subnet** from the **Deny** pane and drop it in the **Permit** pane to allow packet forwarding on the subnet. Similarly, if you would like to remove a subnet from the **Permit** pane, you can drag and drop to the **Deny** pane.



Click on **Reset** to revert to the default permissions. Click on **Commit** to save any subnet permission changes made.

See "VLAN and Subnet Commands" on page 186 for commands used in permitted subnets using the CLI.

Configuring Outbound NAT

Enabling outbound NAT allows servers on a non-routable network to communicate with hosts on the internet by mapping the server's IP address to another IP address that is routable on the internet. On Equalizer, this is disabled by default. Enabling this option has a performance impact, since Equalizer needs to modify every packet sent and received on server subnets.

Outbound NAT can be configured to map the server's IP address to any Equalizer IP address on the outbound subnet. This includes the main IP address, Failover IP address or any cluster IP address on that subnet.

Note - Because outbound NAT is configured on a subnet basis, individual servers cannot be set up for different outbound NAT IP addresses unless they are in different subnets.

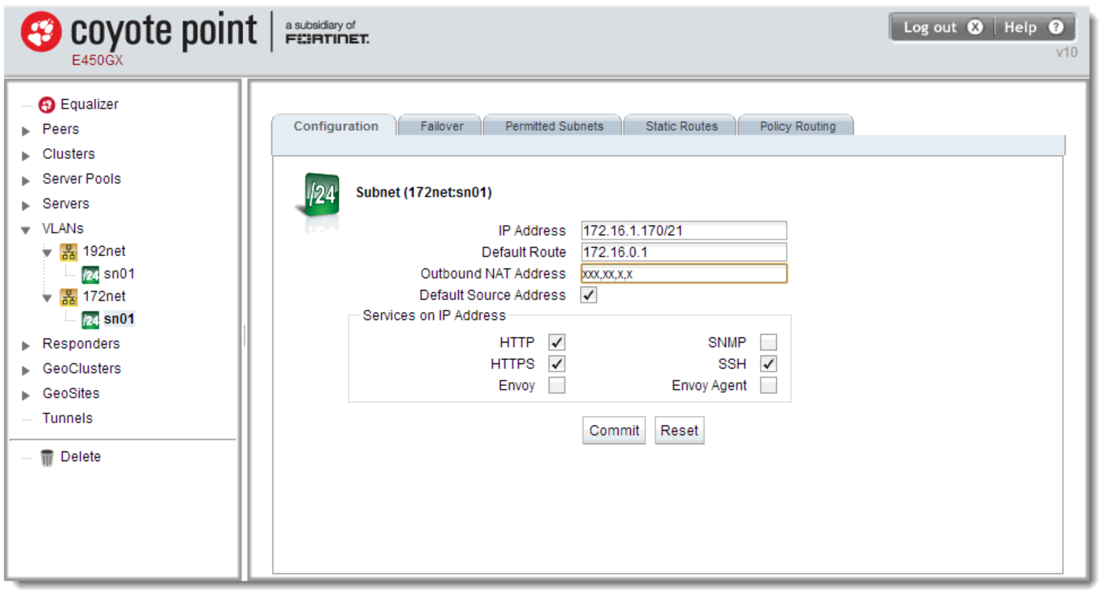
When outbound NAT is enabled on a server subnet, the system treats packets on that subnet as if they are part of the external subnet through which they are being NAT' d. Because of this, in addition to enabling the outbound NAT parameter on the internal subnet, the routing configuration of the internal subnet must match that of the external subnet.

Enabling Outbound NAT

To enable outbound NAT on a multi VLAN configuration using the GUI:

1. Log into the GUI using a login that has add/del access for global parameters (See "Logging In" on page 192)

2. Click on **Equalizer** in the left navigational pane and select the subnet of the internal or server VLAN. The subnet configuration screen will be displayed as shown below.



Subnet (172net:sn01)

IP Address 172.16.1.170/21
Default Route 172.16.0.1
Outbound NAT Address xxx.xx.x.x
Default Source Address ✓

Services on IP Address
HTTP ✓ SNMP
HTTPS ✓ SSH ✓
Envoy Envoy Agent

3. Enter an **Outbound NAT Address** that should be used for this subnet when communicating with hosts on the Internet. This address should be the main IP, failover IP, or cluster IP address present on the Equalizer on your external subnet.

4. Enter a **Default Route** that is the same as the Default Route of the external subnet.

5. If there are any static routes configured for the external network, click on the **Static Routes** tab and replicate the static routing configuration for that network on the server subnet. (See "Configuring Subnet Destination Routes" on page 111)

6. Click on **Commit** to save your settings.

To enable outbound NAT on a multi VLAN configuration using the CLI:

1. Log in to eqcli as described in "Starting the CLI" on page 128.

2. Assign an Outbound NAT address on the internal (server) subnet that should be used when communicating with hosts on the Internet. This address should be the main IP, failover IP, or cluster IP address present on the Equalizer on your external subnet.

```
eqcli > vlan [internal vlan name] subnet [internal subnet name] outbound_
nat [IP address]
```

3. Enter a Default Route that is the same as the Default Route of the external subnet.

```
eqcli > vlan [internal vlan name] subnet [internal subnet name] default_
route [IP address]
```

4. If there are any static routes configured for the external network, replicate that static routing configuration on the internal (server) subnet.(See "Configuring Subnet Destination Routes" on page 111).

Managing Interface Ports

All Equalizer GX models have two Ethernet adapters on the motherboard.

On the E350GX, E450GX, and E650GX, the interface ports on the front panel are connected to both adapters. This allows any port to be configured to work with either adapter. There is no default VLAN port configuration in Version 10 -- you can create VLANs and assign ports to them as you like using the CLI or the GUI, as described in the previous sections of this chapter.

The E250GX does not support VLANs. The E250GX has two ports, each of which is connected to one of the Ethernet adapters on the motherboard. A single port-based (untagged) VLAN can be configured on each interface.

Configuring Front Panel Ports

Front panel ports are configured using the either the CLI or GUI.

By default, all switch ports are configured as follows:

- full duplex
- full autonegotiation (Equalizer will attempt to auto negotiate the highest available speed with the unit on the other end of the connection)

If needed, ports can be configured to match specific port settings required by the server connection. For example, you could use the switch interface to configure a particular switch port to be 100Mb/s and half-duplex to accommodate older hardware.

Viewing Link Status and Port Settings

Viewing Link Status and Port Settings(CLI)

The current link status of each port as well as the current settings, use the "show interface" command as in this example from an E450GX:

```
eqcli > show interface

Interface  Autonegotiation Mode  Duplex Mode  Speed  Status

swport01   full                  full         1000   Link Up
swport02   NA                    NA           NA     Link Down
swport03   full                  full         1000   Link Up
swport04   NA                    NA           NA     Link Down
swport05   NA                    NA           NA     Link Down
swport06   NA                    NA           NA     Link Down
swport07   NA                    NA           NA     Link Down
swport08   NA                    NA           NA     Link Down
swport09   NA                    NA           NA     Link Down
swport10   NA                    NA           NA     Link Down
swport11   NA                    NA           NA     Link Down
swport12   NA                    NA           NA     Link Down
eqcli >
```

The same information for a single port can be displayed by specifying the port name:

```
eqcli > show interface swport03

Interface Number : swport03
Autonegotiation mode : full
Duplex mode : full
Link Speed : 1000
Link Status : Link Up
Maximum MTU : 0

eqcli >
```

Port settings are as follows:

- **Autonegotiation Mode -** One of the following:

  full - Full autonegotiation at all supported speed and duplex settings.

  select - Autonegotiation at the current **speed** and **duplex** parameter settings only.

  force - Set the port to the current **speed** and **duplex** parameter settings with no autonegotiation.

  Whether you choose **full, select,** or **force** depends on the operating characteristics of the device on the other end of the connection. Check the documentation for the other device and try to match the settings as much as possible on both sides of the connection.

- **Duplex Mode -** If the port status is Link Up, this is the current port duplex setting. If the status is Link Down, this is either the highest duplex that can be negotiated, or the force setting. Can be set to full or half.

- **Link Speed -** If the port status is **Link Up**, this is the current port speed. If the status is **Link Down**, this is the highest speed that can be negotiated, or the **Force** setting. Can be set to **10, 100,** or **1000** Mbits.

- **MTU** - MTU can be specified for tagged and untagged VLANs on all switched systems (E350GX, E450GX, E650GX)for tagged VLANs on non-switched systems (E250GX, Equalizer OnDemand. The MTU is set on the VLAN, and the values you can set depend on the Equalizer model and the subnet configuration of the VLAN, as follows:
    - For the E350GX, E450GX and E650GX, the maximum MTU value is 1500.
    - For E250GX models and Equalizer OnDemand, the maximum MTU is 9000.
    - For VLANs with only IPv4 subnets, the minimum MTU is 576.
    - For VLANs with an IPv6 subnet, the minimum MTU is 1280.

  If you modify the MTU on a VLAN to a value that is lower than the currently set value, you must reboot Equalizer to ensure proper network interface operation.
- **Link Status -** Displays **Link Up** if the port has an active link, **Link Down** if not.

See "Interface Commands" on page 160 for a full list of the commands supported in the **Interface** context.

Viewing Link Status and Port Settings(GUI)

Refer to "Viewing Link Status and Port Settings" on page 215 for details on using the GUI for this function.

Displaying Port Statistics

Displaying Port Statistics (CLI)

Use the interface context stats command to display statistics for a particular port, as in this example:

```
eqcli > interface swport01 stats
Interface Status : Link Up
In Octets : 21988039
Out Octets : 27032753
Good Broadcast/Multicast Packets received : 54252
Good Unicast Packets received : 1
Packets dropped (no receive buffer) : 111023
Packets dropped (egress congestion) : 54255
Packets dropped (CRC, alignment error) : 1
Total Packets dropped (receive) : 165279
Bad packets received : 111023
Good Broadcast/Multicast Packets transmitted : 2533
Good Unicast Packets transmitted : 0
Packets dropped (no transmit buffer) : 80834
Packets dropped (excessive collision, frame aging) : 2535
Total Packets dropped (transmit) : 83369
Bad packets transmitted : 80836
```

Displaying Port Statistics (GUI)

Refer to "Displaying Port Statistics" on page 218 for details on using the GUI for this function.

Policy Routing

Routing is the process of selecting the network path to use when one device (the source) sends a packet to another device (the destination) on the network. The other device can be on a subnet that is directly connected to Equalizer, or it may be on a remote subnet.

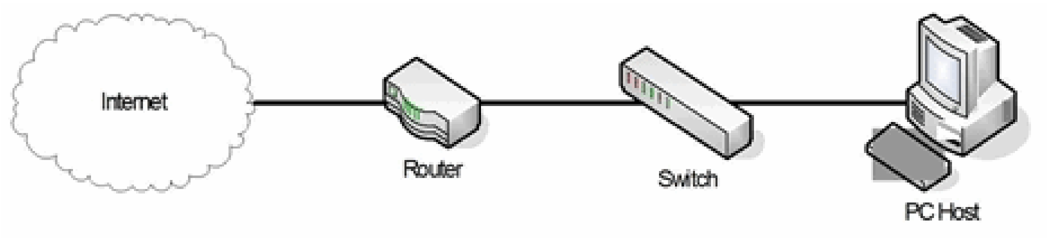
To communicate with a device that resides on a directly connected IP subnet (that is, both devices are in the same *broadcast domain*), any network device uses the information in its Address Resolution Protocol (ARP) table to send packets directly to the destination IP address.

In order to send packets to a destination on a different network, the packet is instead sent a “next-hop” device, usually a router, that determines how to forward it further. If the routing device is present on the same network as the destination, it can send the packet directly to the destination. Otherwise, it forwards it on to another router, and the process continues.

Equalizer provides the ability to configure routing to match network topologies from the simplest to the very complex through *policy routing*. Policy routing gives the administrator the ability to completely define routing behavior for each subnet, based on either the *destination IP address* or the *source IP address* of the packet leaving Equalizer.

Destination and Source Based Routing

The figure below represents a basic IP network routing path where data packets traverse to and from hosts, switches and routers. Policies are configured through administrative control to route packets through the desired devices over subnets and on to servers and clients.



When a device needs to send an IP packet to a different device, it performs the following:

1. If the destination address is located locally (on the sender device) it sends the packet using the Operating System and not the network.

2. If the packet isn't intended for this device the system routing table is checked for instructions on how to deliver the packet, usually through a routing table.

Routing tables are searched in a *most-specific* to *least-specific* manner. If no packet delivery rules are found, a packet will be discarded. The least-specific entry in a routing table is usually the default route, which essentially provides a route to use if no specific matching entry has been found.

Most network devices route packets solely on the basis of the destination address in the packets. Some devices, like Equalizer, can route packets based on the source address as well, and can completely specify the network path a packet will take. This is called source-based routing.

Equalizer uses a combination of source routing tables and the cluster spoof option to route packets through the network. Possible routing schemes are presented herein describing packet source-based routing and how they are routed from Equalizer based on each scenario. Refer to"How Spoof Influences Routing" on page 245 for additional information on spoofing and "Source Based Routing Scenarios" on page 113 for details on Source Routing with Equalizer.

Configuring Subnet Destination Routes

Subnet *destination routes* (also commonly called "static routes") are commonly used to specify routes to destination IP addresses via gateways other than the subnet's default route (also called a *default gateway*). They are called destination routes, since they are used to make routing decisions based on a packet's destination IP address.

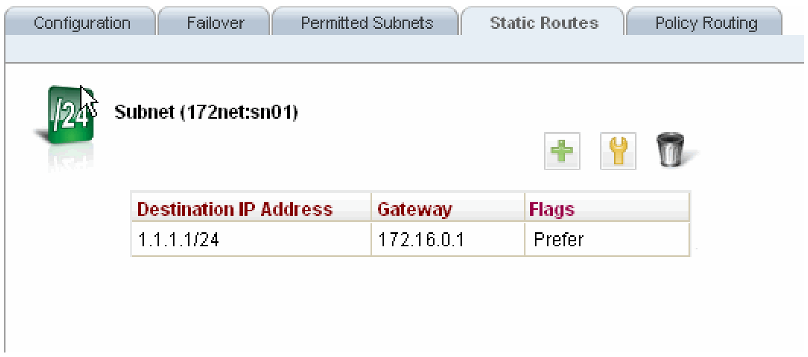
In Version 10, a default route can be specified for every subnet (previous releases supported a single global default route). If you need to access systems on another subnet that cannot be reached via this gateway, then you need to specify a static route to those systems through the gateway for that subnet. Refer to "Enabling DNS" on page 121 for descriptions of 3 typical routing scenarios.

In Version 10, each subnet also has its own subnet-specific static route table. Subnet static routes can be specified via the CLI or the GUI.

Also refer to "Source Based Routing Scenarios" on page 113 a description of source-based routing scenarios.

Subnet Static Routes (GUI)

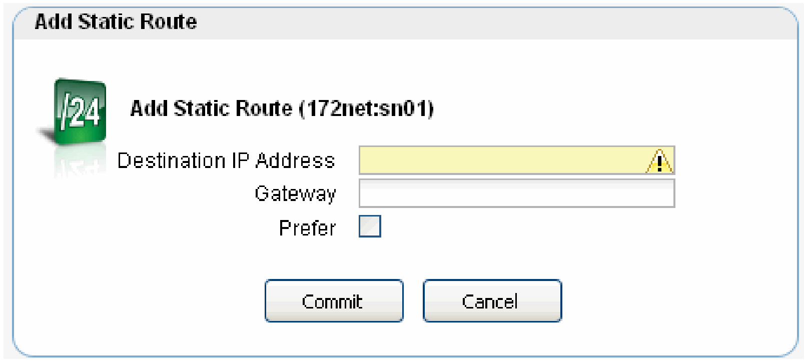
In the GUI, expand a VLAN in the left navigational pane on the **VLANs** list. Click on the name of a subnet and open the **Static Routes** tab. The table shows any existing static routes. The following will be displayed.



Subnet (172net:sn01)

Destination IP Address	Gateway	Flags
1.1.1.1/24	172.16.0.1	Prefer

To add a static route, click the ➕ icon. The following will be displayed:



Add Static Route (172net:sn01)

Destination IP Address	
Gateway	
Prefer	☐

Specify the **Destination IP Address** and the **Gateway**

- **Destination IP Address -** The IP address for the host or subnet. For IPv4, specified as a Classless Internet Domain Routing (CIDR) address (e.g. 192.168.1.0/24). For IPv6, specified using IPv6 subnet notation.
- **Gateway -** The IP address of the gateway used to reach the host or subnet.
- **Prefer** - Enabling this flag allows you to specify the "preferred" route to be used for any matching destination - even if the destination address is on a subnet that is defined on Equalizer. One **Prefer** flag is allowed for each subnet is allowed at this time, however, this can be enabled on as many static routes as necessary.

To modify a static route, highlight the route in the table and click the **Modify** icon . Change the parameters and click **commit**.

To delete a static route, highlight the route in the table and click the **Delete** icon .

Subnet Static Routes (CLI)

Static routes are specified in the subnet context (See "VLAN and Subnet Commands" on page 186).

To display the static route for a subnet, use the **show** command:

```
eqcli > show vlan vlan_name subnet subnet_name
```

To add a static route from the global context, enter:

```
eqcli > vlan vlan_name subnet subnet_name route IP_addr gateway
```

The parameters are explained as follows:

- **vlan_name -** The name of the VLAN.
- **subnet_name -** The name of the subnet.
- **IP_addr -** The IP address for the host or subnet. For IPv4, specified as a Classless Internet Domain Routing (CIDR) address (e.g. 192.168.1.0/24). For IPv6, specified using IPv6 subnet notation.
- **gateway -** The IP address of the gateway used to reach the host or subnet.

Note - the "prefer" flag, which allows you to specify the "preferred" route to be used for any matching destination - even if the destination address is on a subnet that is defined on Equalizer- is not available using eqcli at this time.

To modify a static route, specify the same **IP_Addr** in the above command line.

To delete a static route, use the **no** form of the **route** command:

```
eqcli > no vlan vlan_name subnet subnet_name route IP_addr gateway
```

Source Based Routing Scenarios

Source routing allows the originator of a packet to partially or completely specify the path that a packet will take through a network, as well as the return path. In contrast, non-source-routing devices determine that path based on the packet's destination. Source routing allows:

- Easier troubleshooting
- Improved traceroute
- Enables a node to discover all the possible routes to a host.
- Allows a source to directly manage network performance by forcing packets to travel over one path to prevent congestion on another.

Source routing requires careful management by the administrator when building the source address selection and source routing tables to ensure a coherent overall routing strategy. For this reason, it is often called *policy routing*, since routing behavior is determined by a collection of routing tables built by the administrator.

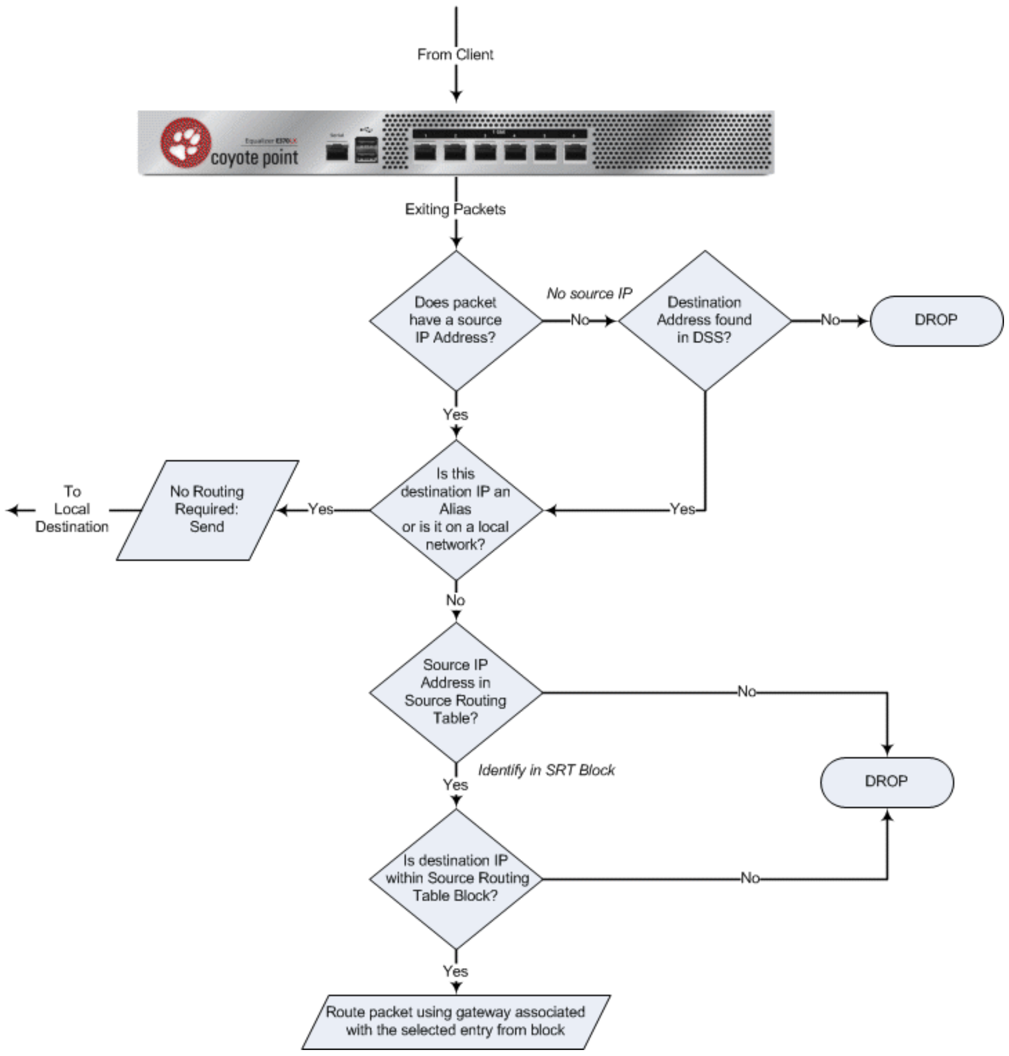
Source Selection

As a load balancing device Equalizer may change the source address in a packet, the destination address in a packet, or both, before sending a packet on to the next-hop gateway. In doing so, Equalizer will perform source address selection to determine the appropriate source address to use when a packet is sent out on the network. In previous Equalizer versions, only a single system-wide default source address was used.

Equalizer is frequently required to choose from a number of possible source addresses when sending packets. An example is when Equalizer sends a probe to a server behind it. Some servers will be on a network that is local to Equalizer, and so Equalizer will chose its IP address on the appropriate VLAN to use as the source address in a probe packet. If the server is not located on a network that is local to Equalizer, then Equalizer will consult the source address selection table to choose a source address, and route the packet according to the information in the source routing table.

Refer to "Network Configuration" on page 77for a detailed discussion of VLANs and configuration with Equalizer.

The figure below shows the general flow of a packet through Equalizer, demonstrating the various check points and destination selection techniques that are used. In "Source Routing Scenarios" on page 115 practical scenarios are presented in “Road Map” style to demonstrate the routing selection used.


From Client
coyote point
Exiting Packets
Does packet have a source IP Address?
No source IP
No
Destination Address found in DSS?
No
DROP
Yes
Yes
Is this destination IP an Alias or is it on a local network?
Yes
No Routing Required: Send
To Local Destination
No
Source IP Address in Source Routing Table?
No
DROP
Identify in SRT Block
Yes
Is destination IP within Source Routing Table Block?
No
Yes
Route packet using gateway associated with the selected entry from block

Source Routing Scenarios

The following are possible scenarios for load balancing source-based routing through Equalizer:

Scenario	Source	Destination	DSS Used
Spoof Load Balancing Toward Server 1. Local Server, Local Client 2. Routed Server, Local Client 3. Local Server, Remote Client 4. Remote Server, Remote Client	Client	Server	No
Non-Spoof Load Balancing Toward Server	Equalizer	Server	Yes
Spoof Load balancing Toward Client 1. Local Destination 2. Remote Destination	Cluster	Client	No
Non-Spool Load Balancing Toward Client 1. Local Destination 2. Remote Destination	Cluster	Client	No
Source, Destination Specified 1. Equalizer as Router	Source	Destination	No
Generated by Equalizer 1. IP Generated by Equalizer	Equalizer	Destination	Yes

Spoof Load Balancing Toward Server

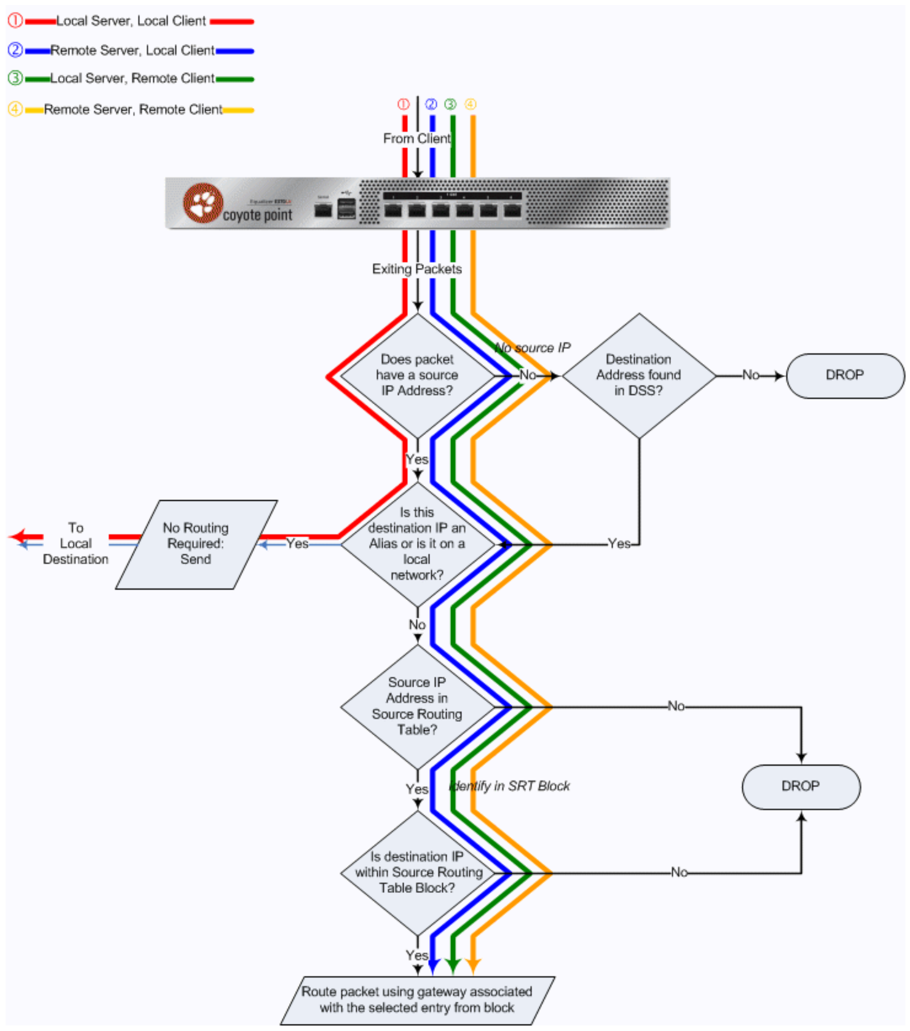
In the load balancing source-based routing scenario presented below, spoofing is enabled so that the source is specified by a client and the destination is a server. As indicated in the table above, four scenarios are possible:

1. Local Server, Local Client - In this case the server is local and the client is local so no routing will be required. Since the packet has a source address and destination address has either an alias on Equalizer or is on the local network, the packets will be sent to the destination without routing.

2. Remote Server, Local Client - In this case the server is outside of the local network with a client that is local. The packet has a local source IP address. The server is not on the local network and therefore needs to be evaluated by the routing table to determine if the destination IP address is within the source routing table block. If it does lie within the block it will have a specific routing gateway associated with that block and will be routed using that gateway. If the destination does not lie within the source routing table block it will be dropped.

3. Local Server, Remote Client - In this case a server IP address lies within the local network while the client IP address is not within the local network.

4. Remote Server, Remote Client - In this case both the server and the client lie outside of the local VLAN.

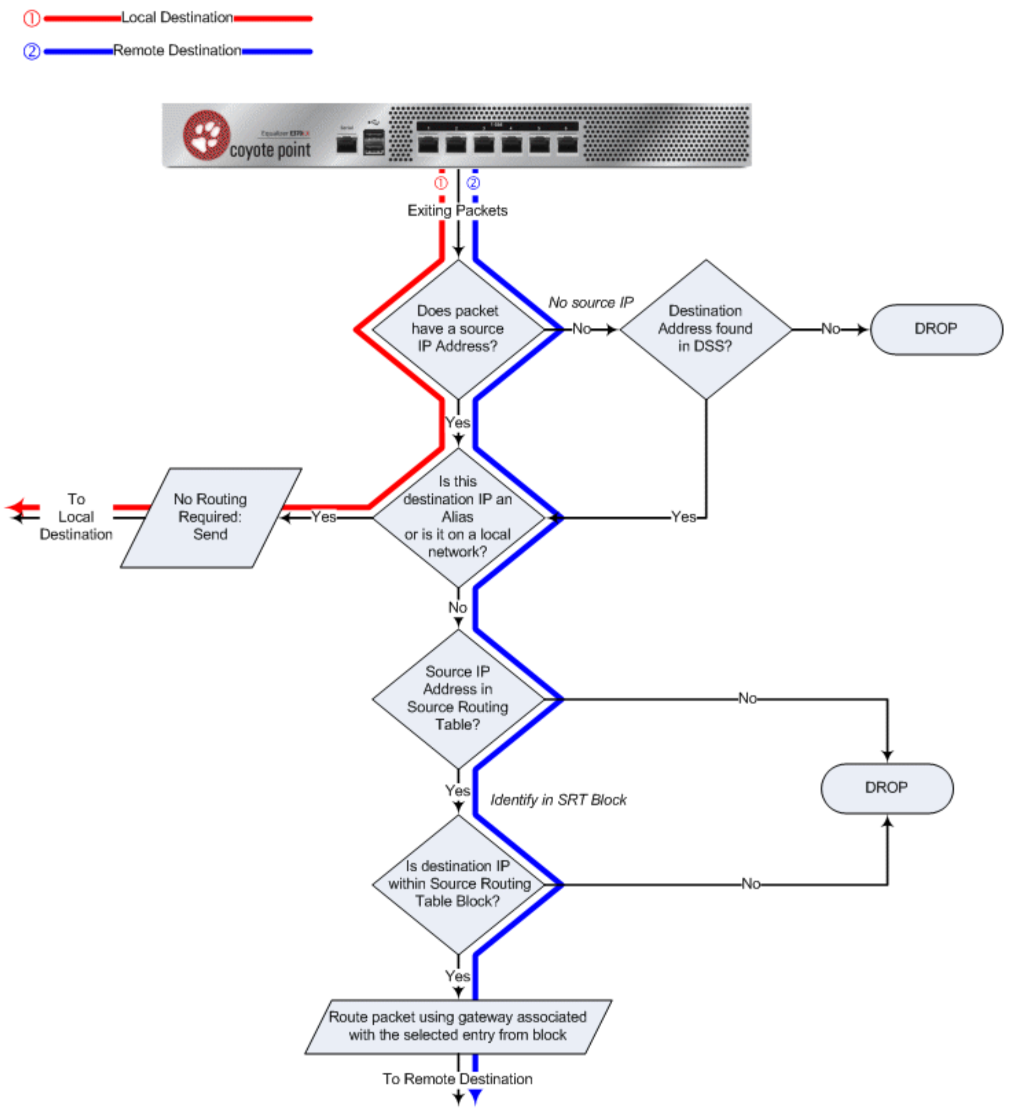

① Local Server, Local Client
② Remote Server, Local Client
③ Local Server, Remote Client
④ Remote Server, Remote Client
From Client
coyote point
Exiting Packets
Does packet have a source IP Address?
No source IP
No
Destination Address found in DSS?
No
DROP
Yes
Is this destination IP an Alias or is it on a local network?
Yes
No Routing Required: Send
To Local Destination
Yes
No
Source IP Address in Source Routing Table?
No
Yes
Identify in SRT Block
DROP
Is destination IP within Source Routing Table Block?
No
Yes
Route packet using gateway associated with the selected entry from block

Spoof Load Balancing Toward Client

In the load balancing source-based routing scenario presented below, spoofing is enabled so that the source is specified by a cluster and the destination is a server. Two scenarios are possible:

1. Local Destination- in this case the packets originating from a cluster and destined for a client has a source IP address and the destination IP address is on a local VLAN. No routing is required for the packet and is simply sent to the local address on the VLAN.

2. Remote Destination- in this case a packet originating from a cluster and destined for a remote client does have a local IP address yet the destination is not on a local VLAN. The packet will be evaluated to see whether the source address/destination pairing is identified in a source routing table block. if it is not in the routing table the packet will be dropped. If the destination IP is identified in the source routing table then the packet will be sent using the gateway associated with the entry in the routing table.



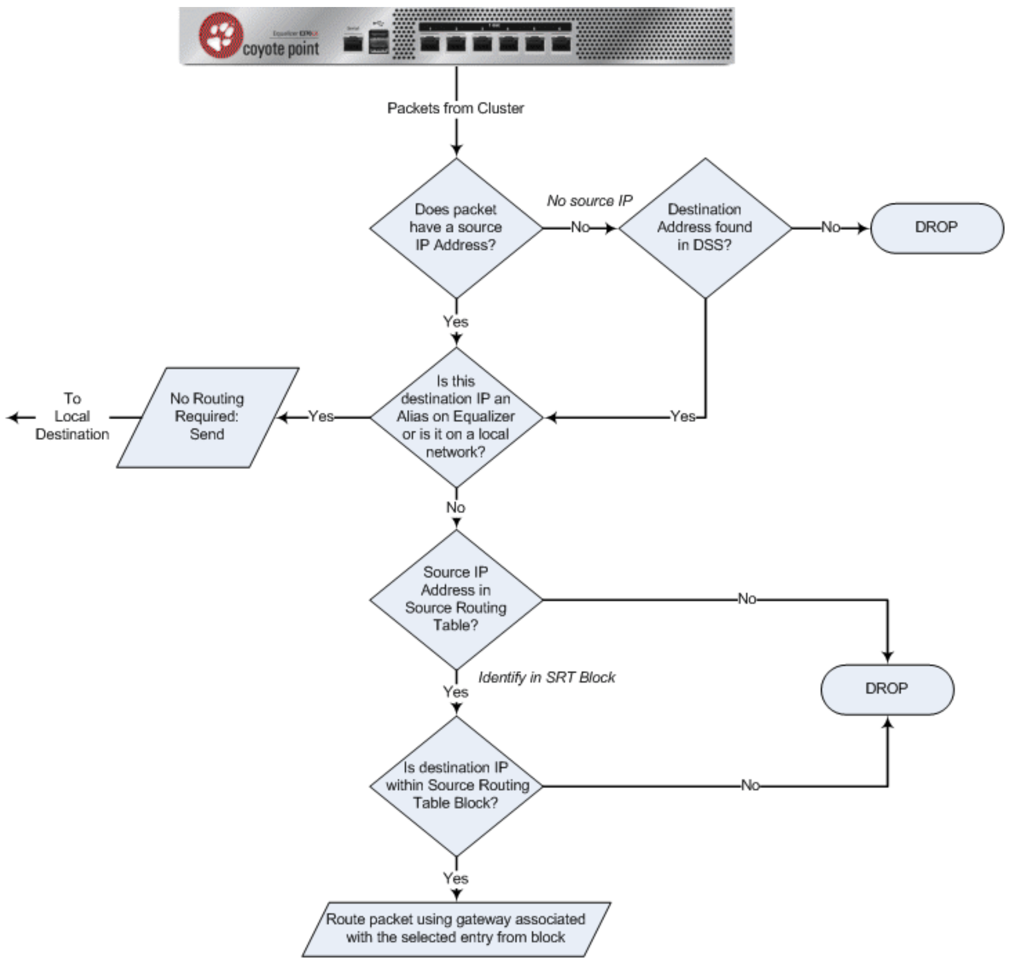
① Local Destination
② Remote Destination
coyote point
Exiting Packets
Does packet have a source IP Address?
No source IP
No
Destination Address found in DSS?
No
DROP
Yes
Is this destination IP an Alias or is it on a local network?
Yes
No Routing Required: Send
To Local Destination
Yes
No
Source IP Address in Source Routing Table?
No
DROP
Yes
Identify in SRT Block
Is destination IP within Source Routing Table Block?
No
Yes
Route packet using gateway associated with the selected entry from block
To Remote Destination

Non-Spoof Load Balancing Toward Client

This scenario is the same as "Spoof Load Balancing Toward Client" however, spoofing is disabled and the source is a cluster IP address and the destination is a client. Two scenarios are possible:

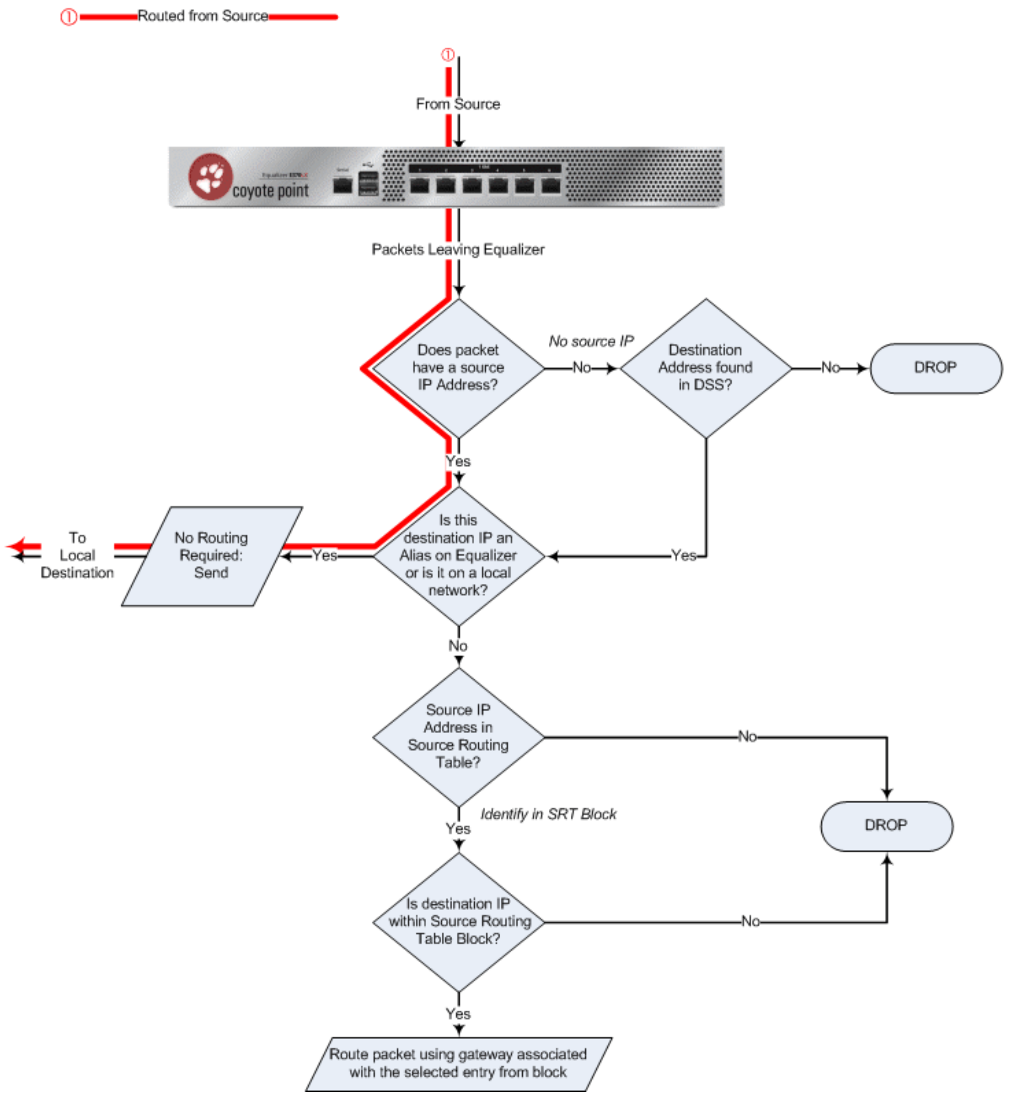
1. Local Destination- in this case the packet originating from a cluster and destined for a client has a source IP address and the destination IP address is on a local VLAN. The packet requires not routing and is simply sent to the local address on the VLAN.

2. Remote Destination- in this case the packet originating from a cluster and destined for a remote client does have a local IP address yet the destination is not on a local VLAN. The packet will be evaluated to see whether the source address/destination pairing is identified in a source routing table block. If it is not in the routing table the packet will be dropped. If the destination IP is identified in the source routing table then the packet will be sent using the gateway associated with the entry in the routing table.


coyote point
Packets from Cluster
Does packet have a source IP Address?
No source IP
No
Destination Address found in DSS?
No
DROP
Yes
Is this destination IP an Alias on Equalizer or is it on a local network?
Yes
Yes
No Routing Required: Send
To Local Destination
No
Source IP Address in Source Routing Table?
No
DROP
Identify in SRT Block
Yes
Is destination IP within Source Routing Table Block?
No
Yes
Route packet using gateway associated with the selected entry from block

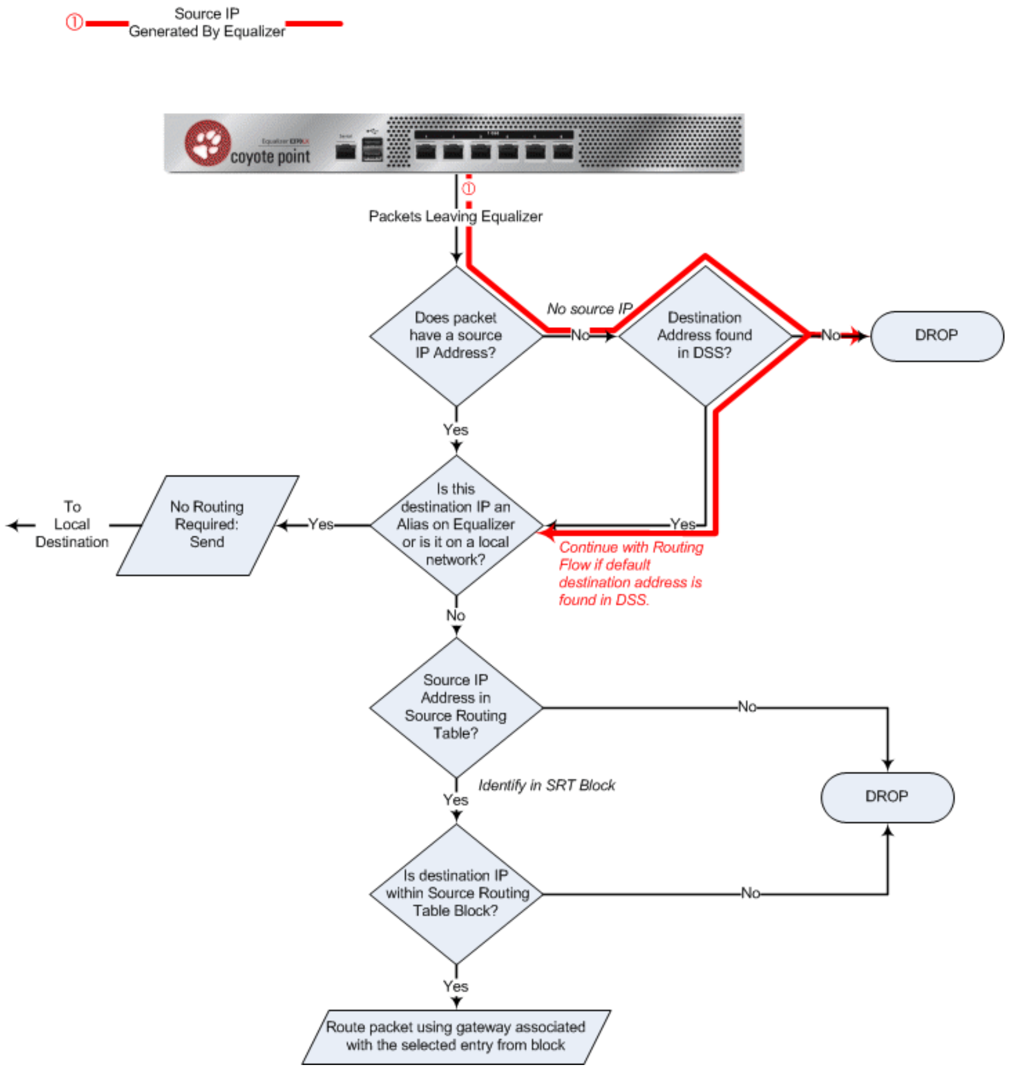
Source, Destination Specified

In this scenario, the source and destination are both specified by the client. Equalizer will function as a router to send the packet directly to the addresses specified.


① Routed from Source
①
From Source
coyote point
Packets Leaving Equalizer
Does packet have a source IP Address?
No source IP
No
Destination Address found in DSS?
No
DROP
Yes
Is this destination IP an Alias on Equalizer or is it on a local network?
Yes
No Routing Required: Send
Yes
To Local Destination
No
Source IP Address in Source Routing Table?
No
DROP
Identify in SRT Block
Yes
Is destination IP within Source Routing Table Block?
No
Yes
Route packet using gateway associated with the selected entry from block

Generated by Equalizer

This scenario is typically used for administrative and probing purposes. It can also be used for upgrades, pinging and Equalizer image updates. As shown below, a packet will be dropped if no source IP address is found. As shown below, the packet routing will be determined by the default gateway specified in the DSS table.


①
Source IP Generated By Equalizer
coyote point
①
Packets Leaving Equalizer
Does packet have a source IP Address?
No source IP
No
Destination Address found in DSS?
No
DROP
Yes
Yes
Is this destination IP an Alias on Equalizer or is it on a local network?
Yes
No Routing Required: Send
To Local Destination
Continue with Routing Flow if default destination address is found in DSS.
No
Source IP Address in Source Routing Table?
No
DROP
Identify in SRT Block
Yes
Is destination IP within Source Routing Table Block?
No
Yes
Route packet using gateway associated with the selected entry from block

Enabling DNS

To enable the Domain Name Service (DNS), add a name server to the configuration. Name servers are added to the **name-server** list one at a time, with a maximum of three name servers in the list. The following table shows you how to perform DNS tasks using the CLI and the GUI:

Task	Command / Procedure	
Add a DNSserver	**CLI**	eqcli > name-server *name*
	GUI	Not implemented.
Remove an DNS server	**CLI**	`eqcli > no name-server name`
	GUI	Not implemented.
Remove all DNS servers	**CLI**	`eqcli > no name-server`
	GUI	Not implemented.
Disable DNS	**CLI**	`eqcli > no name-server`
	GUI	Not implemented.
Display DNS servers	**CLI**	`eqcli > show`
	GUI	Not implemented.

Note that removing all name servers from the name server list disables DNS.

Configuring NTP

Network Time Protocol, or NTP is a protocol designed to synchronize the clocks of computers over a network. NTP on Equalizer is compatible with servers running versions 1, 2, 3, or 4 of the NTP protocol. An RFC for NTPv4 has not been written; NTPv3 is described in RFC 1305.

On Equalizer, NTP is used primarily to time various operations, to ensure accurate timestamps on log entries (with respect to server and client log timing), and to allow for examination of the timing of log entries on two Equalizers in a failover configuration.

NTP on Equalizer works by polling an NTP server defined through the GUI. The time between polls of the NTP server is controlled by the **minpoll** and **maxpoll** NTP parameters, which default to 64 seconds (1 min 4 sec) and 1024 seconds (~17 mins), respectively. The behavior of NTP is to poll with a frequency starting at **minpoll** and then decrease polling frequency over time to **maxpoll**, as the accuracy of the local clock approaches the accuracy of the remote server clock. The time it takes for the polling delay to increase from **minpoll** to **maxpoll** will vary based on a number of factors, including the accuracy of the clocks on the client and server, network latency, and other timing factors.

NTP calculates when the local and remote system clocks are sufficiently in sync to begin increasing the polling delay towards **maxpoll**. When the accuracy of the two clocks is significantly different, or there is significant latency, for example, the two clocks may never be in sufficient agreement to increase the delay towards **maxpoll**. In this case, Equalizer will continue to sync approximately every 64 seconds. This behavior indicates that a different NTP server should be chosen.

NTP packets are very small and should not cause any problems with Equalizer or network operation, except as described in the following section on NTP and plotting.

NTP and Plotting

When you initially configure NTP, this may effectively disable plotting until NTP completes the initial synchronization of Equalizer's system clock with the NTP server -- which may take from several hours to several days. This is because plotting depends on accurate timestamps in the plot log. Since initially NTP is adjusting the time at frequent intervals, the timestamps in the plot log may become out of sync with the system clock, and so no plot data may be returned. Once NTP is no longer making adjustments to the system clock, plotting will function normally.

Default NTP Configuration

Equalizer is delivered with a default Network Time Protocol (NTP) configuration: the NTP daemon (**ntpd**) is enabled by default and the NTP server is set to **pool.ntp.org**. However, NTP will not be able to synchronize time with an NTP server until DNS is configured and working.

Rather than point at a single NTP server, most organizations use an NTP server pool defined by the NTP Pool Project.

Selecting an NTP Server

We recommend that you specify NTP pool servers appropriate for your geographic location. Selecting a pool server means that you are specifying an alias that is assigned by the NTP Pool Project to a list of time servers for a region. Thus, NTP pool servers are specified by geography. The following table shows the naming convention for servers specified by continent:

- **Worldwide -** pool.ntp.org
- **Asia -** asia.pool.ntp.org
- **Europe -** europe.pool.ntp.org
- **North America -** north-america.pool.ntp.org
- **Oceania -** oceania.pool.ntp.org
- **South America -** south-america.pool.ntp.org

To use the continent-based NTP pool servers for Europe, for example, you could specify the following pool servers in Equalizer's time **Configuration** screen (tab):

```
0.europe.pool.ntp.org
1.europe.pool.ntp.org
2.europe.pool.ntp.org
```

You can also specify servers by country. So, for example, to specify a UK based time server pool, you would use:

```
0.uk.pool.ntp.org
1.uk.pool.ntp.org
2.uk.pool.ntp.org
```

Or, for the US, you would use:

```
0.us.pool.ntp.org
1.us.pool.ntp.org
2.us.pool.ntp.org
```

Be careful when using country based NTP pool servers, since some countries contain a very limited number of time servers. In these cases, it is best to use a mix of country and continent based pool servers. If a country has only one time server, then it is recommended you use a time server pool based in another nearby country that supports more servers, or use the continent based server pools.

For example, Japan has 6 (six) time servers as of the date this document was published. The organization that maintains time server pools recommends using the following to specify time server pools for Japanese locations:

```
2.jp.pool.ntp.org
0.asia.pool.ntp.org
2.asia.pool.ntp.org
```

For more information on choosing NTP pool servers, please see the NTP pool server web pages at:

http://support.ntp.org/bin/view/Servers/NTPPoolServers

For general information on the NTP Pool Project, please go to the project home page:

http://www.pool.ntp.org/

Managing NTP

The following table shows you how to perform NTP tasks using the CLI and the GUI:

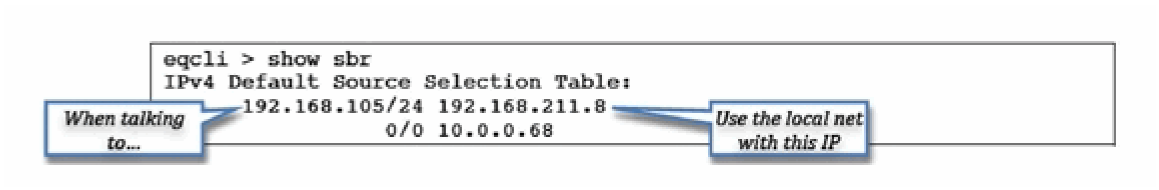
Task	Command / Procedure	
Add an NTP server	**CLI**	`eqcli > ntp-server` *`name`* The ***name*** parameter can be an NTP server name or an NTP pool name.
	GUI	Click **Hostname> Maintenance > NTP**. Enter an **NTP Server** or pool name. Click **Commit**.
Remove the NTP server	**CLI**	`eqcli > no ntp-server`
	GUI	Not implemented.
Disable NTP	**CLI**	`eqcli > ntp disable`
	GUI	Not implemented.
Enable NTP	**CLI**	`eqcli > ntp enable`
	GUI	Not implemented.
Display NTP server	**CLI**	`eqcli > show`
	GUI	Not implemented.

Default Source Selection

The DSS, or Default Source Selection table is a listing of all destination networks configured in Equalizer , and a mapping of the IP addresses that Equalizer should use when communicating with these networks. The local network that the destination network is attached to can be inferred from the IP addresses. The DSS table can be viewed by entering:

```
eqcli > show sbr
```

The display will be as follows:



```
eqcli > show sbr
IPv4 Default Source Selection Table:
    192.168.105/24 192.168.211.8
               0/0 10.0.0.68
```

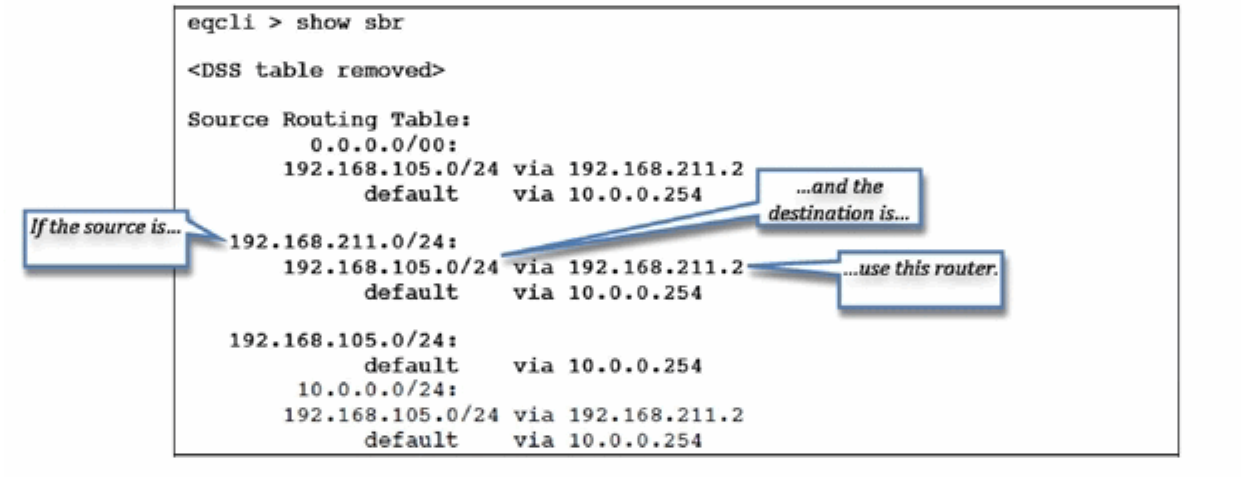
In the example above the DSS table contains two rules:

1. One for the 192.168.105/24 destination network, which is connected to the 192.168.211/24 local network (and will use IP address 192.168.211.8 to communicate with this network),

2. One for any other remote networks, connected to the 10.0.0/24 network (and will use the 10.0.0.68 IP address to communicate with them).

Source Routing Table

The *sroute* table, or *Source Routing Table* is an excellent tool for identifying how a packet should be sent by the system. It can be displayed using the **`show sbr`** command from the Equalizer**eqcli** as shown below:



```
eqcli > show sbr

<DSS table removed>

Source Routing Table:
         0.0.0.0/00:
       192.168.105.0/24 via 192.168.211.2
             default    via 10.0.0.254

   192.168.211.0/24:
       192.168.105.0/24 via 192.168.211.2
             default    via 10.0.0.254

   192.168.105.0/24:
             default    via 10.0.0.254
        10.0.0.0/24:
       192.168.105.0/24 via 192.168.211.2
             default    via 10.0.0.254
```

In the example above traffic that is sourced from all local networks is sent through the 10.0.0.254 gateway, unless it is destined for the 192.168.105.0/24 destination network. Because the default gateway for the 192.168.211.0/24 local network is on the 10.0.0/24 local network, there is an outbound NAT configuration between these two networks.

IP Filter Rules

To view the current IP Filter rules, the `show sbr` command can once again be used. The example below is shortened due to its length.

```
 IP Filter Rules:


 IPv4 Rules:
 1: pass on interface lo0 all hits: 287 bytes: 14900


2: pass on interface wm1 hits: 11394 bytes: 326068
                  From To
     192.168.211.0/24 192.168.211.0/24
     192.168.105.0/24 -> 192.168.105.0/24
                                10.0.0.0/24
                                0.0.0.0/0


 3: pass on interface wm0 hits: 120406 bytes: 7689819
                  From To
           10.0.0.0/24 10.0.0.0/24
             0.0.0.0/0 -> 0.0.0.0/0
                                192.168.211.0/24
192.168.105.0/24


 4: block on interface wm1 hits: 0 bytes: 0
                  From To
     192.168.211.0/24 192.168.211.0/24
                         -> 192.168.105.0/24
                                10.0.0.0/24
                                0.0.0.0/0
```

The example above shows each filter rule, along with the groups of networks that the rule applies to, and the number of times each rule has been used (and bytes that have been received using this rule).

Each column of From and To addresses can be viewed as an "or" group. For example, rule #3 can be read as:

“Allow traffic on interface wm0 which is from either the 10.0.0.0/24 network or the 0.0.0.0/0 network, and is destined for either the 10.0.0.0/24, the 0.0.0.0/0, the 192.168.211.0/24, or the 192.168.105.0/24 network.”

Rules are processed (and must be read) in order, from first to last. This means that as soon as a packet matches a particular rule it is used and Equalizer either passes or allows that packet, depending on the rule.

The individual rules are somewhat complicated and will be explained in "Network Configuration" on page 77

To summarize, rules are processed in numerical order by the packet filter. *Pass* rules cause packets to be allowed into the system and *block* rules are ones that explicitly block traffic from entering the system. The last rule is *block in all* which means that if a *pass* rule has not yet matched this particular packet, it will be dropped.

Using this command while trying to establish a connection that may not be working can be a good method of finding out what is wrong. In this example, 0 packets were blocked by the filter in rule 4 because rules 2 and 3 allowed all packets needed. If there is a misconfiguration, seeing packets being blocked can be a hint of what is wrong.

IP NAT Rules

Equalizer performs outbound NAT by creating IP NAT rules. These rules are processed when a packet is exiting the system -unlike IP Filter rules which are processed when a packet is entering the system.

These rules can be displayed using the show sbr command from the **eqcli** as well:

```
IP NAT Rules:

List of active MAP/Redirect filters:
map wm0 192.168.211.0/24 -> 10.0.0.68/32 proxy port ftp ftp/tcp
map wm0 192.168.211.0/24 -> 10.0.0.68/32 portmap tcp/udp auto
map wm0 192.168.211.0/24 -> 10.0.0.68/32
map wm0 192.168.105.0/24 -> 10.0.0.68/32 proxy port ftp ftp/tcp
map wm0 192.168.105.0/24 -> 10.0.0.68/32 portmap tcp/udp auto
map wm0 192.168.105.0/24 -> 10.0.0.68/32

List of active sessions:
```

Three rules are added for each outbound NAT mapping. In this example, there are two mappings: one for the 192.168.211.0/24 local network and the other for the 192.168.105.0/24 destination network.

In this example, the rules specify that any packets that are leaving the system through the `wm0` interface with a source IP address on either the 192.168.211.0/24 or 192.168.105.0/24 network should instead be sent with a source IP address of 10.0.0.68.

If there are any NAT connections active, they will be displayed in the list of active sessions.

Network Troubleshooting Tools

There are several tools useful for troubleshooting networking configurations on Equalizer. To simplify troubleshooting, Equalizer includes a single **eqcli** command (**`show sbr`**) that displays the output of these tools.

There are other ways to view the same information in **eqcli**, however, the show sbr command displays the actual running state of the system, whereas commands such as show vlan [X] subnet[*Y]* show the configuration information and not necessarily the running data if there is a problem.

Chapter 9

Working in the CLI

Sections in this chapter include:

Starting the CLI

The Equalizer Command Line Interface, CLI, gives you complete administrative control over Equalizer and is one of the major new features in EQ/OS 10. The GUI is also available to view and modify the configuration, however, not all administrative options have been enabled in the GUI.

The CLI can be used over either a serial connection or an SSH connection.

Logging In to the CLI Over a Serial Connection

To start the Equalizer CLI over a serial connection:

1. Connect the supplied serial cable to Equalizer’s front panel serial port and to a properly configured terminal or terminal emulator, as described in "Quick Start" on page 50.

2. Press the <Enter> key to display the login prompt:

```
Equalizer -- EQ/OS 10
Username:
```

3. Log in using an Equalizer user name and password. If this is the first time you are logging in, use the default administrative user name and password as shown below:

```
Username: touch
Password: touch
Login successful.

 EQ/OS 10

 Copyright 2013 Fortinet, Inc.
 Welcome to Equalizer!

eqcli >
```

See the section "Working in the CLI" on page 130 to begin familiarizing yourself with the CLI command environment.

Logging In to the CLI Over an SSH Connection

To start the Equalizer CLI over an SSH connection:

1. Ensure that SSH login is enabled for the VLAN and subnet over which you want to establish an SSH connection.

2. Use SSH client software to open a connection with Equalizer using the enabled VLAN IP address and port 22. Specify the login **eqadmin**, as shown in the example command line below:

```
$ssh eqadmin@172.16.0.200
```

3. Upon successful SSH login, Equalizer displays the **Username** prompt. Enter an Equalizer login, such as the default login, **touch**:

```
Username: touch
```

4. Enter the password for the user name specified in the previous step:

```
Password: touch
```

1. If the user name and password is correct, Equalizer responds with:

```
Login successful.

EQ/OS 10

Copyright 2013 Fortinet, Inc.

Welcome to Equalizer!

eqcli >
```

See "Working in the CLI" on page 130 to begin familiarizing yourself with the CLI command environment.

Exiting the CLI

You must exit the CLI from the global context prompt (`eqcli >`):

- Enter `exit` or `<ctrl-d>` to exit and commit any queued changes.
- Enter `quit` to exit and discard all queued changes.

If you are in a lower context, repeatedly enter one of the above commands, as appropriate, until you exit the CLI. Once you exit the CLI, the login prompt is displayed.

Working in the CLI

The Equalizer command line interface, or CLI, was developed to be an easy to use, intuitive, and flexible command line interface. It was patterned after CLIs used in other common networking equipment, so if you've used a CLI on another network device (such as a router), you should quickly feel comfortable using eqcli.

The CLI provides a number of features that are designed to make working at the command line easier and more effective, as described in this section.

CLI Contexts and Objects

The Equalizer CLI is a context oriented command interface. This means that the commands available at any time (and the objects they affect) depend on the current context. The current command context is always indicated in the CLI prompt. When you start the CLI, the command prompt looks like this:

```
eqcli >
```

This indicates that you are in the global context -- all commands available in the CLI for all objects can be executed from this context, and you can also set parameters for global services (such as NTP, DNS, etc.). You can also change to other contexts, whose scope is limited to a specific object. For example, you can enter the cluster specific context for a cluster named **cl01** by typing:

```
eqcli > cluster cl01
eqcli cl-cl01>
```

The prompt above indicates that the cluster specific context for **cl01** is the current context. In this context, the only commands available are those that affect cluster **cl01**.

Note that only the first 4 characters of an object name appear in the eqcli prompt. For example, if you have a cluster named **mycluster**, then you would enter the cluster specific context for this cluster by typing:

```
eqcli > cluster mycluster
eqcli cl-myc*>
```

The asterisk (*) in the prompt indicates that there are more than 4 characters in the cluster name. To display the complete object name in any context, use the **context** command:

```
eqcli cl-myc*> context
The current context is: 'mycluster'
eqcli cl-myc*>
```

In each context, you can perform operations on the objects and parameters that exist in that context (e.g., create, delete, modify, display, set). When you change to another context, the eqcli prompt changes to include the suffix indicated in the chart above for each context. For example, when you change to the server context, the eqcli prompt changes from "`eqcli` >" to "`eqcli sv>`".

Within each context shown above, you can also type in the name of an object (existing or new) to enter an object specific context that will allow you to edit only that object's settings.

So, for example, you can start eqcli and type **server** to change to the server context -- as indicated by the prompt, which changes to "`eqcli sv>`". Now, you can use the **list** command to list all the existing servers. If you then type in the name of one of the existing servers while in the server context, you will enter the server specific context for that existing server -- the prompt changes to "`eqcli sv-server_name>`" to indicate that you are in the server specific context for the server with the name `server_name`. You could also do this directly from the global context by typing:

```
eqcli > show server
eqcli > sv-server_name show
```

Note that the eqcli prompt reserves only four characters for object names. So, for example, if you have a server named **sv02**, the entire server name will be displayed in the prompt, as shown in this example:

```
eqcli > server sv02
eqcli sv-sv02>
```

If the object name is longer than four characters, eqcli displays the first three characters and an asterisk (*) to show that the name is longer than four characters. For example, if you have a server named **Server2**, the prompt will look as follows when you change to the **Server2** specific context:

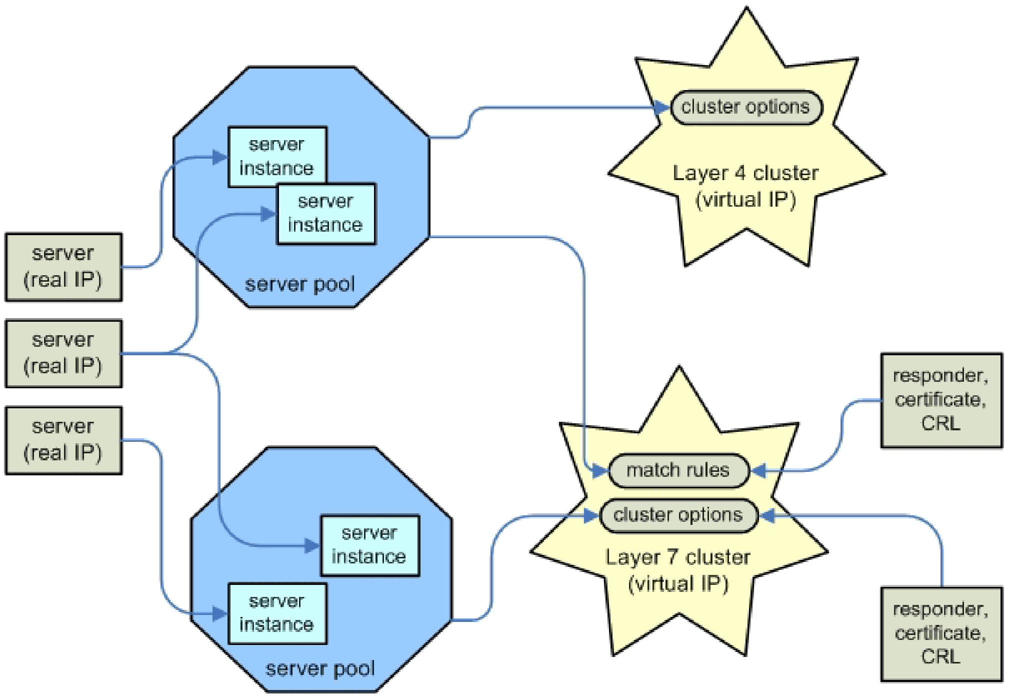
```
eqcli > server Server2
eqcli sv-Ser*>
```

The complete current context can always be displayed using the context command, as in this example:

```
eqcli > server Server2
eqcli sv-Ser*> context
The current context is: Server2
eqcli sv-Ser*>
```

Object Relationships

Most contexts in the CLI correspond to an Equalizer object -- **servers**, **server instances**, **server pools**, **clusters**, **match rules**, **responders, CRLs, certificates.** The following diagram shows the relationships among these objects.



On Equalizer, a **server** corresponds to a real server hosting an application behind Equalizer. Each server has an IP address that Equalizer uses to send client requests to the server. This IP address is sometimes called a “real IP” because it corresponds to a real server.

A server must be assigned to a **server pool** before it can be associated with a cluster. When you assign a server to a server pool, you create a **server instance** of that server in the server pool. The server instance definition specifies operating parameters for the real server that are effective only within that server pool. This allows you the flexibility to associate a single physical server with multiple server pools, and set different server instance options within each server pool.

A server pool in turn is assigned to a **cluster**. Client requests are sent to a cluster IP address (often called a “virtual IP”) assigned to Equalizer and then routed to the server pool instance selected by the load balancing algorithm and other options. In all clusters, a server pool is assigned directly to the cluster. For Layer 7 clusters, additional alternate server pools, as well as other objects and options, can be assigned to one or more **match rules**.

A match rule is processed before cluster settings are processed, and behaves like an if-then statement: if a client request’s content matches the conditional expression set in the match rule, then the options and objects specified in the match rule are used. If the expression in the match rule is not matched by the client request, then the next match rule is processed. If all match rules defined in the cluster are processed and none of them match the incoming request, then the objects and options set on the cluster are used to process the request.

The objects that can be selected by match rules include server pools, responders (used when no servers in a server pool are available), SSL certificates, and certificate revocation lists (CRLs). Many cluster options can also be specified in a match rule, including persistence settings and load balancing policy.

Supported operations on all objects are explained in "Context Command Summaries" on page 140.

Command Line Editing

Use the key sequences below to edit the current command line

ctrl-a **ctrl-e**	Move the cursor to the beginning of the line Move the cursor to the end of the line
ctrl-b **ctrl-f**	Move the cursor one character to the left Move the cursor one character to the right
esc-b **esc-f**	Move the cursor one word to the left (also left arrow) Move the cursor one word to the right (also right arrow)
ctrl-h **ctrl-k** **esc-d** **ctrl-u**	Delete the character to the left of the cursor Delete all characters from the cursor to the end of the line Delete the word to the right of the cursor Delete the entire line
ctrl-y	Inserts previously deleted text starting at the cursor
ctrl-t	Transpose the character under the cursor and the character to the left of the cursor
ctrl-l	Redraw the line
ctrl-n **ctrl-p**	Display next command from history (also up arrow) Display last command from history (also down arrow)

Entering Names for Equalizer Objects

Equalizer identifies administrative objects, such as clusters and servers, by name. The characters used in names are limited to standard ASCII letters ("A" through "Z" and "a" through "z"), numbers (0 through 9), and the characters "**.**" (period), "**-**" (dash) and "**_**" (underscore), (*) asterisk, (@) "at" sign, and (/) backslash.

- The first character in a name must be a letter.
- Names can be at most 65 characters long.
- The readability of lists presented in the interface is increased by using short names that use as many unique characters at the beginning of the name as possible.

Using White Space in a Command Line

The CLI uses white space (i.e., one or more tab or space characters) as a delimiter between command line elements. To include spaces within a command line element (such as a string, a list of objects, or multiple flags), the entire element must be contained in double quotes. For example, this command line uses a space between the two server instances and two flags specified:

```
eqcli > srvpool sp01 si “sv01, sv02” flags “hot_spare, quiesce”
```

Enabling and Disabling Flags

Most objects have a flags keyword that is followed by one or more keywords that enable and disable particular object behavior. A single flag is specified as in this example:

```
eqcli> srvpool sp01 si sv01 flags hot_spare
```

Multiple flags in a command line can be separated using either a comma (**,**) or a vertical bar (**|**) between each flag. For example, all the following commands turn on the **hot_spare** and **quiesce** flags on a server instance:

```
eqcli> srvpool sp01 si sv01 flags hot_spare,quiesce
eqcli> srvpool sp01 si sv01 flags “hot_spare, quiesce”
eqcli> srvpool sp01 si sv01 flags hot_spare|quiesce
eqcli> srvpool sp01 si sv01 flags “hot_spare | quiesce”
```

Flags are disabled using the negate operator (the exclamation point character):

! Negates (turns off) the option that immediately follows it. No spaces are allowed between the negation operator and the option that follows.

For example, the following command disables the hot_spare option and quiesce options:

```
eqcli> srvpool sp01 si sv01 flags !hot_spare,!quiesce
```

A flag can be enabled and disabled in the object specific context or from any higher context. For example, you can type any of the following three command sequences to disable the **spoof** option on match rule **ma00** in cluster **cl00**:

```
eqcli > cluster cl00 match ma00

eqcli cl-cl00-match-ma00> flags !spoof # match rule specific context

eqcli > cluster cl00

eqcli cl-cl00> match ma00 flags !spoof # cluster context

eqcli > cluster cl00 match ma00 flags !spoof # global context
```

Command Abbreviation and Completion

You do not need to type an entire command name in order to execute a command. If you type enough characters to uniquely identify a command and then type a `<space>` or `<tab>` character, eqcli will automatically display the remainder of the command name.

For example, if in the global context you type `cert` and then press the space bar:

```
eqcli > cert<space>
```

The CLI fills in the rest of the command line for you, followed by a space:

```
eqcli > certificate<space>
```

This also works with multiple keywords on the same command line. So, for example, you can type the following:

```
eqcli > sh<space>cl<space>
```

And the CLI will expand this to:

```
eqcli > show<space>cluster<space>
```

If the string that you type before pressing `<space>` or `<tab>` does not uniquely identify a command, then the CLI displays a list of all the commands that match the string you entered, and then re-displays the string that you typed. For example:

```
eqcli > c<space>
certificate cluster context crl
eqcli > c
```

Detection of Invalid Commands and Arguments

Invalid commands and invalid arguments for specific commands are detected before they are committed and appropriate error messages are displayed.

Specifying Multiple Server Instances

When specifying server instances on the command line, the user can specify either a single object or a comma separated list of objects. For example, to create server instances of two servers (**sv01** and **sv02**) in an existing server pool (**sp01**), you could enter:

```
eqcli> srvpool sp01 si sv01,sv02
eqcli sp-sp01-si-sv01*>
```

When you enter multiple server instances as in the command above, eqcli enters a special combined context that applies commands to all of the specified objects. For example, after entering the example command above, eqcli enters the "`sv01,sv02`" context and the CLI prompt changes to include the first four letters of the combined context, "`sv01*`". To display the full current context, use the following command:

```
eqcli sp-sp01-si-sv01*> context
The current context is: 'sv01,sv02'
eqcli sp-sp01-si-sv01*>
```

Using the no Form of a Command

Most commands that create objects and set parameters have a **no** form that you can use to delete an object or reset a parameter to its default value. The general format of the **no** command is:

```
no [keywords] {object|parameter}
```

The **no** keyword must be followed by a complete object context that specifies the object to delete or the parameter to reset:

- If the object or parameter is defined in the current context, then you do not need to specify any keywords.
- If the object or parameter is defined in a lower level context, then specify the appropriate contexts before the object or parameter name.

So, for example, type the following to delete cluster **cl00**:

```
eqcli > no cluster cl00
```

For objects and parameters that have lower object contexts (i.e., match rules, server instances, and subnets), you can use the no form at either the global context or in the lower object specific context:

```
eqcli > no cluster cl00 match ma00
eqcli > cluster cl00
eqcli cl-cl00> no match ma00
```

For parameters, the **no** form requires the complete command used to set the parameter, minus the argument setting the value. So, for example, to reset the value of the **resp** (responder) parameter on match rule **ma00** in cluster **cl00**, you can type any of the following:

```
eqcli > no cluster cl00 match ma00 resp
eqcli > cluster cl00
eqcli cl-cl00> no match ma00 resp
eqcli > cluster cl00 match ma00
eqcli cl-cl00-ma-ma00> no resp
```

The operation specified by the **no** form of a command takes effect immediately, even in explicit commit mode. In other words, a **no** command form never needs to be followed by a **commit**, **exit**, or **<ctrl-d>** command; it is committed to the configuration file immediately.

In all cases, the **no** form of a command always returns to the current context after completion.

Queued Commands

CLI commands that specify changes to the current configuration will either be committed to the configuration file as soon as they are entered, or queued to be committed using the **commit**, **exit**, or **<ctrl-d>** commands.

- If a *complete* command is executed for an object in a lower context, the command is committed to the configuration immediately. The current command context is not changed after the command is entered. A “complete” command is one that specifies all parameters required to add or modify the object.

For example, entering the following command to create a server creates the server immediately, and leaves eqcli in the global context:

```
eqcli > server sv01 proto tcp ip 192.168.0.210 port 80
eqcli >
```

- If an *incomplete* command is executed for an object in a lower context, the command is queued to be committed to the configuration until a **commit**, **exit**, or **<ctrl-d>** command is entered. The current command context changes to the context of the object argument of the incomplete command. An “incomplete" command is one does not include one or more parameters required to add or modify the object.

For example, if the server **sv01** does not exist, entering the following **server** command in the global context queues the command and leaves eqcli in the relevant context; an explicit **commit** is needed to create the server:

```
eqcli > server sv01 proto tcp ip 192.168.0.210 port 80
eqcli sv-sv01> commit
eqcli sv-sv01>
```

- If a command is entered that affects only the object associated with the current context, the command is queued to be committed to the configuration until a **commit**, **exit**, or **<ctrl-d>** command is entered. The current command context does not change.

For example, if **sv01** exists and the current context is “**sv-sv01**”, then the following commands are queued until a **commit**, **exit**, or **<ctrl-d>** command is entered:

```
eqcli > server sv01
eqcli sv-sv01> ip 192.168.0.211
eqcli sv-sv01> port 8080
eqcli sv-sv01> commit
```

Queued commands can be committed or discarded using the following commands:

- **commit -** Commits all queued commands; does not change the current context.
- **exit <ctrl-d> -** Commits all queued commands and changes to the next highest context in the hierarchy (if executed in the global context, either of these commands exits eqcli).
- **discard -**Discards all queued commands; does not change the current context.
- **quit -**Discards all queued commands and changes to the next highest context in the hierarchy (if executed in the global context, this command exits eqcli).

Note that the following commands always take effect immediately and do not change the current command context:

- A command that sets a global parameter (see "Global Commands" on page 141).
- The **no** form of a command (see"Using the no Form of a Command" on page 136).
- The **show** command in any context.

Context Help

You can type <**?**> in a number of situations to display context help:

- If you type **<?>** at the CLI prompt, a list of commands that are valid in the current context is displayed. For example, this command displays help for all global commands as shown in "Global Commands" on page 141:

```
eqcli >?
```

Entering the following two commands displays help for all the commands available in the **cluster cl01** specific context, as shown in "Cluster and Match Rule Commands" on page 146.

```
eqcli > cluster cl01
eqcli cl-cl01>?
```

- If you type the complete name of a command that is valid in the current context and type **<?>**, context help for that command is displayed. For example:

```
eqcli > cluster cl01
eqcli cl-cl01> clientto?
clientto: Set the client timeout for this cluster.

Syntax: cluster <cluster name> clientto <value>
Warning: Only valid for proto http or https.
```

- If you type a partial command name and type **<?>**:

If there is only one command that matches the string entered, context help for that command is displayed.

If there are multiple commands that begin with the string entered, the names of all the matching commands are displayed.

Global Parameters

Global or System Parameters include Probes and Networking. Most clusters will work with the default values on these tabs. To view or modify the default global parameter values:

1. Start the Equalizer CLI and log in.
2. Enter the following:

```
eqcli > show
```

The following will summary will be displayed that shows the global parameters that are configured on Equalizer. Refer to "Global Commands" on page 141 for descriptions of each parameter.

```
eqcli > show

Variable          Value
recv_timeout      1
conn_timeout 1
hb_interval       2
retry_interval    5
strike_count      1
icmp_interval     15
icmp_maxtries 3
hostname          Equalizer
```

```
date Tue Apr 2 18:39:36 UTC 2013
timezone UTC
locale                  en
global services          http, https, ssh, snmp, envoy, envoy_agent
name-servers            10.0.0.120
ntp-server pool.         ntp.org - Enabled
syslog-server           None
GUI logo                Coyote Point Systems Inc.
boot image              Equalizer Image B EQ/OS Version 10.0.4a (Build 22939)

eqcli >
```

Context Command Summaries

This section contains a table for each CLI context that summarizes all the commands that can be executed in each context. The following typographical conventions are used when describing command syntax and usage.

`eqcli>`	`Regular constant width type` is used for the eqcli command prompt and messages.
`eqcli> vlan list`	**`Bold constant width type`** is used for commands you type.
`eqcli> vlan vlname show`	***`Bold italic constant width type`*** is used for command elements that you must specify, such as an object name or a parameter value.
`{option | option...}`	A series of elements in braces ("{", "}"), separated by vertical bars ("|"), means you must choose one of the options between the braces. The braces are not typed on the command line.
`{option,option...}`	A series of elements in braces ("{", "}"), separated by commas (","), means you may chose more than one of the options between the braces. Separate multiple options on the command line using either commas or vertical bars. If you use white space in the string of options, the entire string must be surrounded by quotes. The braces are not typed on the command line.
`[option]`	Square brackets ("[", "]") indicate optional command elements. The brackets are not specified on the command line.
`eqcli vlan> *ip ip_addr`	An asterisk (*****) before a parameter indicates that the parameter must be set before the associated object can be created.
`# Text in the right margin`	Text in italic font following the pound character (#) in the right margin is a comment indicating the purpose of the command and should not be typed onto the command line. Details appear in notes following each table.

Global Commands

The table below lists the global configuration commands that are available in the global context of the CLI. These commands allow you to:

- Configure, enable, and disable settings such as Equalizer's hostname, NTP, and DNS.
- Perform system operations, such as upgrading and rebooting Equalizer.

Global Commands	
eqcli > **backup**	: *Upload a system backup to remote FTP.*
eqcli > **boot**	: *Set the EQ/OS image (A or B) to use on at next boot.*
eqcli > **certificate**	: *Add or modify an SSL certificate.*
eqcli > **cfg_convert**	: *Converts an EQ/OS 8.6 configuration file or the backup file to an EQ/OS 10 eqcli script.*
eqcli > **conn_timeout**	: *Set the Failover connect timeout (msec)*
eqcli > **context**	: *Display the current command context.*
eqcli > **crl**	: *Add or modify a Certificate Revocation List (CRL).*
eqcli > **date**	: *Set the system time.*
eqcli > **edit *filename***	: *Edit a file in the datastore.*
eqcli > **ext_services**	: *Add or modify a mail server in the 'ext_ services' context.*
eqcli > **exit**	: *Commit all pending configuration changes and exit eqcli.*
eqcli > **files download *ftp_url***	: *Download a file onto the Equalizer. <url> := url of file to download.*
eqcli > **files edit *name***	: *Edit a datastore file.*
eqcli > **files ftp *file server***	: ***file** is the file name. **server** - url of the FTP server onto which the file should be copied. ftp://[username:password@]hostname[/path]/*
eqcli > **geocluster**	: *Add or modify a GeoCluster or a GeoSite instance.*
eqcli > **geosite**	: *Add or modify a GeoSite.*
eqcli > **guilogo**	: *Change the GUI logo of the Equalizer.*
eqcli > **halt**	: *Shutdown Equalizer.*
eqcli > **hb_interval**	: *Set the Failover heartbeat interval (seconds).*
eqcli > **Hostname**	: *Set the system hostname.*
eqcli > **icmp_interval**	: *Set the ICMP probe interval for servers (seconds).*

Global Commands	
eqcli > **icmp_maxtries**	: *Set the maximum number of ICMP probes in a probe interval*
eqcli > **interface**	: *Modify an interface.*
eqcli > **keywords**	: *Display reserved keywords. These can not be used as names in eqcli.*
eqcli > **license**	: *Get the online or offline license.*
eqcli > **locale**	: *Set the locale of the system.*
eqcli > **name-server**	: *Add a DNS name server entry. One IP address can be specified on the command line. A total of 3 IP addresses can be added. DNS is enabled as long as there is one entry in the list.*
eqcli > **no**	: *Reset a parameter or delete an object.*
eqcli > **ntp**	: *Enable or disable NTP (without changing the NTP configuration).*
eqcli > **ntp-server**	: *Set the NTP server name.*
eqcli > **peer**	: *Add or modify a failover peer.*
eqcli > **ping**	: *Send ICMP or ICMPv6 ECHO_REQUEST packets to a host.*
eqcli > **quit**	: *Discards the entered configuration changes and exits eqcli.*
eqcli > **rebalance**	: *Rebalance clusters among failover group members. Each cluster will be re-started on its 'preferred peer'.*
eqcli > **reboot**	: *Reboot Equalizer.*
eqcli > **recv_timeout**	: *Set the Failover receive timeout (msec)*
eqcli > **restore**	: *Restore a system backup from remote FTP.*
eqcli > **retry_interval**	: *Set the Failover retry interval (msec)*
eqcli > **run_script**	: *Run an eqcli command script.*
eqcli > **services [!]http,[!]https, {!]ssh,[!]snmp**	: *Set the default GUI and SSH access. These settings apply if 'services' is not set in a VLAN configuration.*
eqcli > **show**	: *Display configuration information. With no arguments, displays global parameters. Otherwise, displays either a list of all objects of one type (for example, 'cluster', 'srvpool', 'vlan') or the configuration of a specific object.*
eqalic > **snmp**	: *Add SNMP parameters.*
eqcli > **stats**	: *Display global statistics.*
eqcli > **strike_count**	: *Set the Failover strike count*

Global Commands	
eqcli > **syslog**	: *Enable or disable remote logging.*
eqcli > **syslog-server**	: *Set the syslog server IP address*
eqcli > **timezone**	: *Set the system timezone.*
eqcli > **traceroute**	: *Trace the network path to a host using UDP packets.*
eqcli > **tunnel**	: *Set the tunnel.*
eqcli > **upgrade**	: *Load an EQ/OS upgrade image.*
eqcli > **user**	: *Create or modify a user object.*
eqcli > **version**	: *Show detailed system and version information.*
eqcli > **vlan**	: *Add or modify a VLAN or subnet.*

Licensing Commands

The table below shows licensing commands.

Licensing Commands	
eqcli > l**icense get *server IP_addr name***	: *Get a license from the online license server.*
eqcli > **license genreq**	: *Generate an offline license request and email it to Coyote Point Support*
eqcli > **license upload**	: *Upload a signed license obtained from Coyote Point Support*

Certificate Commands

Each SSL certificate installed on Equalizer has a CLI context that provides commands for managing the certificate and its associated private key. Certificates, private keys, and CRLs (see the following section) are used by Equalizer to provide SSL offloading for HTTPS clusters.

In SSL offloading, Equalizer terminates the SSL connection with the client, decrypts the client request using a certificate and key, sends the request on to the appropriate server, and encrypts the server response before forwarding it on to the client.

Certificates are uploaded to Equalizer and then associated with one or more clusters. Two types of certificates may be used to authenticate HTTPS cluster connections:

- A *cluster certificate* is required to authenticate the cluster to the client and to decrypt the client request (these are also called *server certificates*). For cluster certificates, both a certificate file and a private key file must be uploaded to Equalizer.
- A cluster may also be configured to ask for, or require, a *client certificate* -- a certificate used to authenticate the client to Equalizer. For client certificates, only a certificate file is uploaded to Equalizer(no keyfile is used).

Supported certificate commands are shown in the following tables.

Using Certificate Commands in Global Context

Using Certificate Commands in Global Context	
`eqcli > certificate certname [cmd ...]`	: *Create certname (**req_cmds** = * commands below)*
`eqcli > certificate certname cmd ...`	: *Modify certname (**cmd** = any commands below)*
`eqcli > no certificate certname`	: *Delete **certname***
`eqcli > show certificate [certname]`	: *Display all certificates or **certname***
`eqcli > certificate certname`	: *Change to "cert-certname" context (see below)*

Using Certificate Commands in Certificate Context

Using Certificate Commands in Certificate Context	
`eqcli cert-certname> certfile {edit|url}`	: *Upload SSL certificate*
`eqcli cert-certname> keyfile {edit|url}`	: *Upload private key*
`eqcli cert-certname> show`	: *Display the certificate configuration.*

The arguments to the **certfile** and **keyfile** commands are:

edit - Launch an editor to supply the content of the certificate or key file.

url - Download the certificate or key file from the **ftp://** or **http://** protocol URL supplied on the command line.

Certificate Revocation List Commands

The **crl** context provides commands for managing Certificate Revocation Lists (or CRLs). CRLs can be used to verify that the certificates used by Equalizer are valid and have not been compromised. A CRL is uploaded to Equalizer using commands in the **crl** context, and then associated with one or more clusters in the cluster specific context. Whenever a certificate is used to authenticate a connection to the cluster, the CRL is checked to make sure the certificate being used has not been revoked. The supported commands in the **crl** context are shown in the following tables.

Note - If a CRL attached to a cluster was generated by a Certificate Authority (CA) different from the CA used to generate a client certificate presented when connecting to the cluster, an error occurs. The CRL and client certificate must be signed by the same CA.

Using CRL Commands in the Global Context

```
eqcli > certificate certname [cmd ...]        : Create certname (req_cmds = *
                                                commands below)
eqcli > certificate certname cmd ...          : Modify certname (cmd = any
                                                commands below)
eqcli > no certificate certname               : Delete certname
eqcli > show certificate [certname]           : Display all certificates or
                                                certname
eqcli > certificate certname                  : Change to "cert-certname"
                                                context (see below)
```

Using CRL Commands in a CRL specific Context

```
eqcli crl-crlname> crlfile {edit|url}          : Upload the CRL
eqcli crl-crlname> show                        : Display CRL crlname
```

The arguments to the **crlfile** command are:

- **edit -** Launch an editor to supply the content of the CRL file.
- **url -** Download the CRL file from the **ftp://** or **http://** protocol URL supplied on the command line.

Cluster and Match Rule Commands

Each cluster has its own context and the settings available in the cluster's context depends on the cluster's **proto** parameter -- this parameter must be specified first on the command line when creating a cluster. A Layer 7 cluster may have one or more match rules associated with it, each with its own context. Cluster and match rule commands are summarized in the tables below.

Using Cluster Commands in the Global Context	
eqcli > **cluster *clname req_cmds***	: *Create **clname** (**req_cmds** = * commands below)*
eqcli > **cluster *clname*** **cmds ...**	: *Modify **clname** (**cmds** = any commands below)*
eqcli > **no cluster *clname***	: *Delete **clname***
eqcli > **show cluster [*clname*]**	: *Display all clusters or **clname***
eqcli > **cluster *clname***	: *Change to the "cl-clname" context(see below)*

Using Cluster Commands in a Cluster Specific Context	
For all Clusters:	
eqcli cl-*clname*> ***ip *ip_addr***	: *Cluster IP address*
eqcli cl-*clname*> ***proto *{http|https|tcp|udp}***	: *Protocol --* **MUST SET proto FIRST**
eqcli cl-*clname*> ***port *integer***	: *Cluster port*
eqcli cl-*clname*> **show**	: *Show the cluster configuration*
eqcli cl-*clname*> **stats**	: *Display cluster statistics*
For Layer 7Clusters:	
eqcli cl-*clname*> **age *integer***	: *Cookie age in seconds (0 [default] to 31536000 -- one year)*
eqcli cl-*clname*> **clientto *integer***	: *Client connection timeout*
eqcli cl-*clname*> **compress_min *integer***	: *Minimum bytes to compress (0 to 1073741824 -- default 1024)*
eqcli cl-*clname*> **compress_types *string***	: *Mime types to compress*
eqcli cl-*clname*> **connto *integer***	: *Server connection timeout*
eqcli cl-*clname*> **custhdr *string***	: *Custom request header*
eqcli cl-*clname*> **domain *string***	: *Cookie domain*
eqcli cl-*clname*> **flags**	: *Disable and enable flags*
For Layer 7 Http Clusters:	
{[!]always,[!]compress, [!]disable,[!}allow_utf8	

Using Cluster Commands in a Cluster Specific Context

```
   [!]ignore_case,[!]insert_client_ip,
   [!]no_header_rewrite, [!]once_only,
   [!]spoof,[!]tcp_mux}
```

For Layer 7 https clusters:

```
  {[!]allow_sslv2,[!]allow_sslv3,
   [!]always,[!]compress,
   [!]disable,[!]ignore_case,
   [!]insert_client_ip,[!]once_only,
   [!]push_client_cert,[!]require_client_cert,
   [!]rewrite_redirects,[!]spoof,
   [!]strict_crl_chain,[!]tcp_mux,
   [!]allow_utf8,[!]ics,[!]ignore_critical_extns

   [!]software_ssl_only,[!]allow_tls10,[!]allow_tls11
```

```
eqcli cl-clname> gen integer                : Cookie generation (0 to 65535).

eqcli cl-clname> match maname               : Change to the maname match context

eqcli cl-clname> match cmds                 : Execute match commands

eqcli cl-clname> no match maname            : Delete match maname

eqcli cl-clname> no                         : Reset the specified parameter
{age|clientto|connto
|custhdr|domain |gen|path|resp|scheme
|serverto|srvpool}

eqcli cl-clname> path string                : Cookie path

eqcli cl-clname> range                      : Set the cluster port range.

eqcli cl-clname> resp rname                 : Responder name

eqcli cl-clname> scheme integer             : Cookie scheme (0,1,2)

eqcli cl-clname> serverto integer           : Server response timeout

eqcli cl-clname> sni sni-name               : Server Name Indication name

eqcli cl-clname> sni-name sni_svname        : Add the server name or list of
servername                                    server names in sni.

eqcli cl-clname> srvpool spname             : Server pool name

eqcli cl-clname> stats                      : Display the statistics for cluster

eqcli cl-clname> staleto                    : Set the stale timeout for a
                                              cluster.

eqcli cl-clname> stickyto                   : Set the sticky timeout for a
                                              cluster.

eqcli cl-clname> stickynetmask              : Set the sticky netmask for a
                                              cluster.

eqcli cl-clname> cipherspec                 : Set the cipherspec for an HTTPS
{url|edit|enter}                              cluster.

eqcli cl-clname> clientca certname          : Attach a client certificate to an
                                              HTTPS cluster.

eqcli cl-clname> clflags
```

Using Cluster Commands in a Cluster Specific Context

```
   {[!]allow_sslv2,[!]allow_sslv3,
    [!]push_client_cert,[!]require_client_cert,
   [!]strict_crl_chain}

eqcli cl-clname> crl crlname

eqcli cl-clname> no {cert|cipherspec        : Reset the parameter to its default
|clientca|crl|valdepth}                       value

eqcli cl-clname> valdepth}                  : Set validation depth for cluster.

eqcli cl-clname> preferred_peer             : Set the preferred peer

eqcli cl-clname> persist type               : Set the persist type

 {[!]none,[!]source_ip,
      [!]coyote_cookie_0,

     [!]coyote_cookie_1,

      !]coyote_cookie_2
```

For Layer 7 TCP Clusters (proto = tcp):

```
eqcli cl-clname> flags
     {[!]disable,[!]spoof,
      [!]delayed_binding,[!]abort_server,
      [!]ics

eqcli cl-clname> stickyto                   : Set the sticky timeout for a
                                              cluster.

eqcli cl-clname> stickynetmask              : Set the sticky netmask for a
                                              cluster.

eqcli cl-clname> srvpool spname             : Server pool name

eqcli cl-clname> preferred_peer             : Set the preferred peer

eqcli cl-clname> clientto integer           : Client connection timeout

eqcli cl-clname> serverto integer           : Server response timeout

eqcli cl-clname> connto integer             : Server connection timeout
```

For Layer 4 Clusters (proto = tcp or udp):

```
eqcli cl-clname> eqcli cl-clname> flags

    {[!]dsr,[!]ics!]spoof,
     [!]disable}

eqcli cl-clname> idleto integer             : Set the connection idle timeout

eqcli cl-clname> no {idleto|stickyto        : Reset specified parameter to
                                              default value

eqcli cl-clname> range integer              : Upper limit of port range

eqcli cl-clname> stickyto integer           : Set the connection sticky timeout

eqcli cl-clname> stickynetmask              : Set the sticky netmask for a
                                              cluster.
```

Using Match Rule Commands in the Global Context	
eqcli > **cluster *clname* match *maname* *req_cmds***	: *Create **maname** (**req_cmds** = * commands below)*
eqcli > **cluster *clname* match *maname* *cmd* ...**	: *Modify **maname** (**cmds** = any commands below)*
eqcli > **no cluster *clname* match *maname***	: *Delete match rule* **maname**
eqcli > **show cluster [*clname*]**	: *isplay all match rules or* **maname**
eqcli > **cluster *clname* match *maname***	: *Change context to a match rule context*

Using Match Rule Commands in a Match Rule Specific Context	
eqcli cl-*clname*-ma-*maname*> **{disable|enable}**	: *Disable match rule*
eqcli cl-*clname*-ma-*maname*> **age integer**	: *Cookie age in seconds (0 to 31536000 -- one year)*
eqcli cl-*clname*-ma-*maname*> **compress_min *integer***	: *Minimum bytes to compress (0 to 1073741824 -- default 1024)*
eqcli cl-*clname*-ma-*maname*> **compress_types *string***	: *Mime types to compress*
eqcli cl-*clname*-ma-*maname*> **domain *string***	: *Cookie domain*
eqcli cl-*clname*-ma-*maname*> **expression *string***	: *Match expression*
eqcli cl-*clname*-ma-*maname*> **flags**	: *Enable/disable Flags*
[!]abort_server,[!]always, [!]client_ip,[!]compress, [!]ignore_case,[!]no_header_rewrite, [!]once_only,[!]persist, [!]spoof,[!]tcp_mux}	:
eqcli cl-*clname*-ma-*maname*> **gen integer**	: *Cookie generation (0 to 65535)*
eqcli cl-*clname*-ma-*maname*> ***nextmatch *maname***	: *Next match in list*
eqcli cl-*clname*-ma-*maname*> **no {age|domain|expression|gen |path|resp|scheme|srvpool}**	: *Reset parameter*
eqcli cl-*clname*-ma-*maname*> **path *string***	: *Cookie path*
eqcli cl-*clname*-ma-*maname*> **resp *rname***	: *Set Responder name*
eqcli cl-*clname*-ma-*maname*> **scheme integer**	: *Cookie scheme (0, 1, 2)*
eqcli cl-*clname*-ma-*maname*> **show**	: *Show configuration*
eqcli cl-*clname*-ma-*maname*> **srvpool *spname***	: *Server Pool name*
eqcli cl-*clname*-ma-*maname*> **stats**	: *Display statistics*

Cluster and Match Rule Command Notes

- When creating a cluster, the list of available parameters depends on the protocol selected for the cluster. As a result, the **proto** parameter must be specified *before* any other cluster parameters on the command line.
- Layer 7 clusters can have one or more match rules that override the options set on the cluster when the expression specified in the match rule matches an incoming client request. (Layer 4 clusters do *not* support match rules.)
- The cluster flags supported for a particular cluster depend on the setting of the cluster **proto** parameter, as shown in the table below.

Cluster Flags

A flag may be turned off by prefixing with "!".

Cluster 'proto'	**Flag**	**Description**
tcp and udp	dsr	Enables "direct server return" -- servers respond directly to clients rather than through Equalizer.
	ics	Enables "inter-cluster sticky" -- Layer 4 persistence is preserved across clusters and server ports.
	spoof	Disables Source NAT (SNAT) -- the client IP address is used as the source IP in packets sent to servers.
http and https	abort_server	Close server connections without waiting.
	always	Always insert a cookie into server responses.
	client_ip	Include the client IP address in headers.
	compress	Compress server responses. (E650GX Only)
	ignore_case	Do not consider case when evaluating a match rule.
	no_header_rewrite	Do not rewrite Location headers in server responses.
	once_only	Evaluate the first set of headers in a client connection only.
	persist	Insert a cookie in server responses if the server did not.
	spoof	Use the client IP as source IP in packets sent to servers.
	tcp_mux	Enables TCP multiplexing for a cluster. TCP multiplexing must also be enabled on at least one server instance in the server pool assigned to the cluster (or one of its match rules). See the section.

https only	allow_sslv2	Enable SSLv2 for client connections.

	allow_sslv3	Enable SSLv3 for client connections.

	push_client_cert	Send the entire client certificate to the back-end server. This allows the server to confirm that the client connection is authenticated without having to do a complete SSL renegotiation.
	require_client_cert	Require that clients present certificates.
	software_ssl_only	When **disabled** (the default), an HTTPS cluster performs hardware SSL acceleration using the version of OpenSSL supported in previous releases. When **enabled**, an HTTPS cluster uses the updated version of OpenSSL (1.0.1e). This option applies only to E450GX and E650GX model Equalizers.
	allow_tls10	Enables and disables TLS / SSL protocol versions in the updated OpenSSL 1.0.1e. When enabled, If TLS 1.0. is checked, only TLS 1.0. will be used. The other version will be ignored.
	allow_tls11	This option is disabled, by default. It enables and disables TLS / SSL protocol versions in the updated OpenSSL 1.0.1e. When enabled, If TLS 1.1. is checked, only TLS 1.1. will be used. The other version will be ignored. The **software_ssl_only flag** must be enabled for this option to be selected and is therefore only applicable to E450GX and E650GX model Equalizers.
	rewrite_redirects	When enabled, forces Equalizer to pass responses from an HTTPS cluster’s servers without rewriting them. In the typical Equalizer setup, you configure servers in an HTTPS cluster to listen and respond using HTTP; Equalizer communicates with the clients using SSL. If a server sends an HTTP redirect using the Location: header, this URL most likely will not include the https: protocol. Equalizer rewrites responses from the server so that they are HTTPS. You can direct Equalizer to pass responses from the server without rewriting them by enabling this option.
	ignore_critical_extns	Control whether Equalizer will process "CRL Distribution Point" extensions in client certificates. This option only affects the processing of the "CRL Distribution Point" extension in client certificates: When **Ignore Critical Extensions** is disabled, a client certificate presented to Equalizer that includes any extension will be rejected by Equalizer. This is the behavior in previous releases. When **Ignore Critical Extensions** is enabled (the default), a client certificate presented to Equalizer that has a CRL Distribution Point extension will be processed and the CRL critical extension will be ignored. Note, however, that if other extensions are present in a client certificate they are not ignored and will cause the client certificate to be rejected by Equalizer.
	strict_crl_chain	Check the validity of all certificates in a certificate chain against the CRL associated with the cluster. If any of the certificates in the chain cannot be validated, return an error. If this option is *disabled*

		(the default), only the last certificate in the chain is checked for validity.

External Services Commands

Using External Services Commands in the Global Context

eqcli > **ext_services**	: *Add or modify a mail server in the'ext_services' context.*
eqcli > **show ext_services**	: *Display the configured external services.*

External Services Context Commands

eqcli *xs*> **no *smtp_relay name***	: *Delete the specified SMTP Relay mail server.*
eqcli *xs*> **show *smtp_relay name***	: *Display a list of SMTP Relay mail servers, or detail for the specified SMTP Relay mail server.*
eqcli *xs*> **smtp_relay *name***	: *Add or modify a SMTP Relay (mail server).*
eqcli *xs*> **no *vlb_manager name***	: *Delete the specified VLB Manager.*
eqcli *xs*> **show *vlb_manager name***	: *Display a list of VLB Managers*
eqcli *xs*> **vlb_manager *name***	: *Add or modify a VLB Manager.*

Using SMTP Relay Commands in SMTP Relay Context

eqcli xs-smtp-*smtpname* > ***Port***	: *Set the SMTP mail server port*
eqcli xs-smtp-*smtpname* > ***Server***	: *Set the SMTP mail server IP address. Required.*

Using VLB Manager Commands in VLB Manager Context

eqcli xs-vlb-*vlbmgrname* > **flags {[!]disable}**	
eqcli xs-vlb-*vlbmgrname* > **password**	: *Set the password for authenticating a user.*
eqcli xs-vlb-*vlbmgrname* > ***timeout***	: *Set the number of elapsed seconds for connection timeout.*
eqcli xs-vlb-*vlbmgrname* > ***url***	: *Set the URL used to connect to the VLB Manager.*
eqcli xs-vlb-*vlbmgrname* > ***username***	: *Set the user name for authenticating a user.*

GeoCluster and GeoSite Instance Commands

Envoy provides cluster load balancing between Equalizers running at two or more geographically distributed locations -- called GeoSites. Each GeoSite is configured with a cluster that is capable of responding to requests for the same content. A GeoCluster is a collection of GeoSites that act together to determine the "best" GeoSite to respond to a particular request.

Envoy works together with special entries in the Domain Name System (DNS) configuration of the authoritative name server for a website.

Both GeoClusters and GeoSites are top-level objects in the CLI. In general:

1. Create a GeoCluster for your website (see below).
2. Create GeoSites (see "GeoSite Commands" on page 159
3. Add GeoSite Instances to GeoClusters (see below).

Using GeoCluster Commands in the Global Context	
`eqcli >` **`geocluster`** ***`gcname req_cmds`***	*: Create geocluster (see below for **cmds**)*
`eqcli >` **`geocluster`** ***`gcname cmds`***	*: Modify geocluster (see below for **cmds**)*
`eqcli >` **`no geocluster`** ***`gcname`***	*: Delete geocluster*
`eqcli >` **`show geocluster`**	*: Display geocluster summary*
`eqcli >` **`show geocluster`** ***`gcname`***	*: Display geocluster details*
`eqcli >` **`geocluster`** ***`gcname`***	*: Change context to "gcl-gcname"*

GeoCluster Context Commands	
`eqcli` *`gcl-gclname>`* **`flags {[!]icmp}`**	*: geocluster flags*
`eqcli` *`gcl-gclname>`* **`fqdn`*****`fqdn name`***	*: FQDN for the geocluster website*
`eqcli` *`gcl-gclname>`* **`gsi`** ***`gsiname`***	*: Change to the geosite instance context*
`eqcli` *`gcl-gclname>`* **`gsi`** ***`gsiname cmds`***	*: Execute geosite instance commands*
`eqcli` *`gcl-gclname>`* **`mx`**	*: Set the GeoCluster Mail Exchange FQDN.*
`eqcli` *`gcl-gclname>`* **`mrmax`**	*: Maximum number of allowable resource records that will be returned in a DNS response*
`eqcli` *`gcl-gclname>`* **`policy`** ***`policy`***	*: GeoCluster Load Balancing policy*
`eqcli` *`gcl-gclname>`* **`stats`**	*: Display the statistics for the GeoCluster.*
`eqcli` *`gcl-gclname>`* **`respv`** ***`integer`***	*: Load balancing policy*

GeoCluster Context Commands	
	responsiveness
`eqcli gcl-gclname> ttl integer`	: *DNS cache lifetime for Envoy responses*

Using Geosite Instance Commands in the Global Context	
`eqcli > geocluster gclname gsi gsiname req_cmds`	: *Create a geosite instance*
`eqcli > geocluster gclname gsi gsiname cmds`	: *Modify a geosite instance*
`eqcli > no geocluster gclname gsi gsimaname`	: *Delete a geosite instance*
`eqcli > show geocluster gsi`	: *Display geosite instance summary*
`eqcli > show geocluster gclname gsi`	: *Display geosite instance details*
`eqcli > cluster clname match maname`	: *Change to geosite instance context*

Geosite Instance Context Commands	
`eqcli gcl-gclname-gsi-gsiname> load_weight`	: *GeoSite Instance weight (0-200)*
`eqcli gcl-gclname-gsi-gsiname> flags [!]default,[!]disable, [!]hot_spare,[!]preferred}`	

GeoCluster **flags** can be either **icmp** (enable ICMP triangulation) or **autof** (automatic fallback). [The **autof** option is not yet implemented.]

Geosite Instance Flags

A flag may be turned off by prefixing with "!".

default	When enabled, designates this GeoSite instance as the default GeoSite instance for the GeoCluster. Envoy load balances to the default GeoSite instance whenever it cannot choose a GeoSite instance based on probe responses. [This can happen, for example, when probe responses are not received from any site, when the resource (cluster) is down at all available sites, etc.] If no default GeoSite instance is selected for a GeoCluster and all GeoSites are down, then Envoy sends a null response to the client DNS.
disabled	When enabled, this GeoSite instance will not be selected as a response to a DNS query.
hot_spare -	When enabled, indicates that this GeoSite instance will be selected only when no other sites are available.
preferred	When enabled, indicates that this GeoSite instance will always be selected if it is available.

GeoSite Commands

A GeoSite definition points to an Equalizer running Envoy and a cluster defined on that Equalizer. GeoSites are associated with GeoClusters by using the GeoSite name when creating a GeoSite Instance. See "GeoCluster and GeoSite Instance Commands" on page 156.

Using GeoSite Commands in the Global Context	
eqcli > **geosite *gsname* *req_cmds***	: *Create geosite (see below for **req_cmds**)*
eqcli > **geosite *gsname* *cmds***	: *Modify geosite (see below for **cmds**)*
eqcli > **no geosite *gsname***	: *Delete geosite*
eqcli > **show geosite *gsname***	: *Display one or all geosites*
eqcli > **geosite *gsname***	: *Change to geosite instance context*

GeoSite Commands in GeoSite Context	
eqcli gs-*gsname*> **address *addr[,addr]***	: *GeoSite address (max: 1 IPv4 and 1 IPv6)*
eqcli gs-*gsname*> **agent *addr***	: *IP address of Envoy site*
eqcli gs-*gsname*> **resource *clname***	: *Cluster name at GeoSite*

Interface Commands

The **interface** context commands let you configure and manage Equalizer's front panel interface ports. There is a separate context corresponding to each front panel port. Ports are created automatically by the system and cannot be deleted. To view a summary of the current port configuration and status, enter:

```
eqcli > show interface
```

The name of each port is displayed, along with the port's current autonegotiation, duplex, speed, and link status.

Using Interface Commands in the Global Context
`eqcli > `**`interface port`** ***`cmds`***
`eqcli > `**`show interface`**
`eqcli > `**`show interface`** ***`port`***
`eqcli > `**`interface`** ***`port`***

Port Context Commands
`eqcli if-port> `**`autonegotiation {force|full|select}`**
`eqcli if-port> `**`duplex {full|half}`**
`eqcli if-port> `**`speed {10|100|1000}`**
`eqcli if-port> `**`show`**
`eqcli if-port> `**`stats`**

For command usage, see "Interfaces" on page 215 for additional information.

Interface Command Notes

Port Statistics

The following statistics can be displayed for a selected port using the **`stats`** command. Select a port on the Equalizer display to display statistics the port. The tables below show a typical port statistics displays for both switched and non-switched systems.

For switched systems, (E350GX, E450GX, E650GX)

Transmit Counters	
Number of good and bad packets	The total number of packets, good or bad, transmitted by Equalizer.
Number of good broadcasts and multicasts	The total number of good broadcast/multicast (e.g., ARP) packets transmitted by this port.
Number of bad packets transmitted	The total number of bad packets transmitted by this port.

Number of transmitted QoS Class 3 frames	The total number of received Quality of Service (QoS) Class 3 frames transmitted by this port
Total number of dropped frames on egress path	The total number of packets that were dropped (e.g., lack of transmit buffer , collision detection). These packets are not transmitted by the port.
Total transmitted octets	The total number of bytes (8 bits) transmitted by this port.
Receive Counters	
Number of good and bad packets	The total number of packets received, good or bad, by this port.
Number of good broadcasts and multicasts	The total number of good broadcast/multicast (e.g., ARP) packets received on this port.
Number of bad packets received	The total number of bad packets (e.g., CRC errors, alignment errors, too short) received on this port.
Number of received QoS Class 3 frames	The total number of received Quality of Service (QoS) Class 3 frames received by this port.
Total number of dropped frames on ingress path	The total number of packets that were dropped (e.g., lack of receive buffer, congestion, invalid classification, e.g., tagged frame received on untagged port) by the receiving port.
Total received octets	The total number of bytes (8 bits) received by this port.

For non-switched systems (EQoD, Envoy SAE OnDemand, , E250GX, E370LX):

Transmit Counters	
Packets	The total number of transmitted packets on this interface.
bytes	The total number of bytes transmitted on this interface
multicasts	The total number of good broadcast/multicast (e.g., ARP) packets transmitted by this interface.
errors	The total number of bad packets transmitted by this interface.
collisions	The total number of packets that were dropped (e.g., lack of transmit buffer , collision detection). These packets are not transmitted by the interface.
Receive Counters	
Packets	The total number of packets received on this interface.
bytes	The total number of bytes received on this interface.
multicasts	The total number of good broadcast/multicast (e.g., ARP) packets received on this interface.

errors	The total number of bad packets (e.g., CRC errors,, alignment errors) received on this interface.
drops	The total number of packets that were dropped (e.g., lack of receive buffer, congestion, invalid classification, e.g., tagged frame received on untagged port) by the receiving interface.
unknown protocol	Tot total number of packets received on this interface that used an unknown protocol.

Object List Commands

Object lists make it easier to manage user permissions by allowing an administrator to assign user permissions via list of objects.

An entry in an object list is an "object type" and "object name" pair. Once an object list is created, object list names are used as arguments to user context commands (see "User Commands" on page 180) to give a user permission to access objects in the list.

Using Object List Commands in the Global Context

eqcli > **objlist *olname***	: *Create an object list, or if it exists change context*
eqcli > **objlist *olname* cmds**	: *Modify an object list (see below for cmds)*
eqcli > **no objlist *olname* [*force*]**	: *Delete an object list*
eqcli > **show objlist [*olname*]**	: *Display all object lists, or the one specified*

Object List Context Commands

eqcli obj-olname> ***type object***	: *Remove the specified object*
eqcli obj-olname> **no type *object***	: *Add an object to the list*
eqcli obj-olname> **show**	: *Display object list*

Object List Notes

- Only a user with the **admin** flag enabled can create, modify, or delete object lists.
- The **type** argument must be one of the following object types: **cert**, **cluster**, **crl**, **geocluster**, **geosite**, **port**, **responder**, **server**, **srvpool**, **subnet**, or **vlan**.
- The **object** argument must be the name of an existing object of the specified **type**. (Object list names and the keyword **all** are not allowed.)
- The **no** form of the **objlist** command is immediately executed; no **commit** is required.

Specifying an Object List When Creating or Modifying an Object

An **objlist** argument is optional when creating (or modifying) an Equalizer object, and adds an entry for the object to the specified object list. To add an entry to an object list, the user must have permission to create objects of the specified type in that object list.

Permission to create objects in an object list is given by the `permit_objlist` command, as outlined in "User Permissions" on page 183.

read and **write** permissions on both the object list and the object to be added to the list (or have the **admin** flag set on the user definition).

Note - When a user creates an object, that user is given **read**, **write**, and **delete** permissions on that object.

Peer Commands

Peer context commands are used to manage the configuration of failover peers, including the failover peer configuration for this Equalizer, which is created when the system is booted for the first time. The default peer name for the Equalizer you are logged into is of the form:

eq_sysid

The *sysid* above is Equalizer's "**Peer sysid**" (or system ID), as displayed in the peer configuration; for example:

```
eqcli > show peer

Peer Name Type     Flags     F/O Mode      Error ?
eq_001FD01F34D4 (Local) OS/10                Standalone No

Flags Key:
       F/O => failover
       A/A => active-active
       P/P => preferred_primary
       xfr => fo_config_xfer

eqcli > show peer eq_001FD01F34D4
eq_001FD01F34D4
Peer Name                : eq_001FD01F34D4
Peer signature           :
1RBCD1AF6E690485D28418176ED6A07925B243462D5FAC100064
Peer sysid               : 001FD01F34D4
Flags                    :
OS/8 Internal IP         :
Number of Interfaces      : 1

eqcli >
```

Using Peer Commands in the Global Context	
eqcli > **peer *peername* *[cmds]***	: *Create peer (see below for* **cmds***)*
eqcli > **peer *peername* *cmds***	: *Modify peer (see below for* **cmds**
eqcli > **no peer *peername* [*force***	: *Delete peer*
eqcli > **show peer [*peername*]**	: *Display all peers or a specific peer*
eqcli > **peer *peername***	: *Change to a peer-specific context*

Peer Context Commands	
`eqcli peer-peer> debug`	*: Set the debug level*
`eqcli peer-peer> flags [!]failover|fo_config_xfer| [!]os8|[!]preferred_primary [!]active-active`	*: Set peer flags (see below)*
`eqcli peer-peer> os8_intip`	*: V8.5 Equalizer Internal IP address*
`eqcli peer-peer> name`	*: Display object list*
`eqcli peer-peer> show`	*: Display object list*
`eqcli peer-peer> signature`	*: Display object list*
`eqcli peer-peer> stats`	*: Display object list*

Peer Context Command Flags

A flag may be turned off by prefixing with "!".

failover	Adds peer to failover group
fo_config_xfer	Enable config transfer between peers
os8	Defines peer as OS8 peer
Preferred_primary	Sets peer as preferred primary
active-active	Enable active/active failover mode

See "Understanding Failover" on page 424 for a complete failover setup procedure.

Responder Commands

Responders are global objects in the sense that a single responder can be assigned to multiple clusters. They are used when no servers in the associated server pool are available:

- A responder can be added in the cluster context, in which case it is used when no servers in the server pool defined for the cluster are available.
- A responder can also be assigned to a cluster in a match rule context, in which case the responder is used when no servers in the server pool defined for the match rule are available.

Using Responder Commands in the Global Context	
`eqcli > resp rname req_cmds`	`: Create rname (req_cmds = * commands below)`
`eqcli > resp rname cmd ...`	`: Modify rname (cmds = any commands below)`
`eqcli > no resp rname`	`: Delete rname`
`eqcli > show resp [rname]`	`: Display all responders or rname`
`eqcli > resp rname`	`: Change to the "rsp-rname" context (see below)`

Using Reponder Comoands in a Responder Specific Context	
`eqcli rsp-rname> stats`	`: Display responder statistics`
`eqcli rsp-rname> *type {sorry|redirect}`	`: (R) MUST SET type FIRST`
type = redirect:	
`eqcli rsp-rname> regex "expr"`	`: Set redirect regular expression`
`eqcli rsp-rname> *statcode {301|302|303|307}`	`: Set redirect status code`
`eqcli rsp-rname> *statdesc "desc"`	`: Set redirect status description`
`eqcli rsp-rname> *url "url"`	`: Set redirect URL`
type = sorry:	
`eqcli rsp-rname> *html {edit|url}`	`: Set HTML for "sorry" responder`

When creating a responder, you must specify the **type** parameter first on the command line, and then the parameters required for that type. The supported responder types are:

- **redirect** - A standard "HTTP Redirect" response that specifies a return code (**statcode**), description (**statdesc**), and redirect URL (**url**). When the client receives this page, it is automatically redirected to the redirect URL. Redirect pages can be configured to use parts of the request URL in the HTTP Redirect response (using an optional regular expression).

- **sorry -** A customized HTML “sorry page” that can, for example, ask the client to retry later or go to another URL

For example, the following command creates a **sorry** responder named **Sorry01**, and downloads the redirect URL from the URL specified on the command line:

```
eqcli > resp Sorry01 type sorry html
ftp://mylocalftpserver/redirect.html
```

The contents of the file *redirect.html* will be used as the redirect URL for the responder.

The **html** parameter can be specified on the command line as follows:

html	`edit`	Launch an editor to supply the HTML for the sorry page.
	`“url”`	Download the redirect URL from the ftp:// or http:// protocol URL supplied on the command line (quotes are optional).

Regular Expressions in Redirect Responders

For a discussion of regular expressions and how they can be used in redirect type responders, see "How to Use Regular Expressions" on page 547

Server Commands

In the server context, you define a real server using a minimal set of parameters (IP address, port, protocol, etc.). Once defined, a real server can then be associated with one or more server pools, which in turn are associated with one or more Layer 4 clusters or Layer 7 match rules.

Using Server Commands in the Global Context

eqcli > **server svname *req_cmds***	: *Create **svname** (**req_cmds** = ***** commands below)*
eqcli > **server svname *cmds***	: *Modify **svname** (**cmds** = any commands below)*
eqcli > **no server *svname***	: *Delete **svname***
eqcli > **show server [*svname*]**	: *Display all servers or **svname***
eqcli > **server svname**	: *Change to the "sv-svname" context (see below)*

Using Server Commands in a Server Specific Context

eqcli sv-svname> ***ip *ip_addr***	: *Server IP address*
eqcli sv-svname> **no *{max_reuse_conn|reuse_conn_to}***	: *Reset the parameter to its default value*
eqcli sv-svname> ***proto *{tcp|udp}***	: *Server protocol*
eqcli sv-svname> ***port *integer***	: *Server port*
eqcli sv-svname> **show**	: *Show server configuration*
eqcli sv-svname> **stats**	: *Display server statistics*
eqcli sv-svname> **flags**	: *Server flags*
[!]probe_l3	
eqcli sv-svname> **max_reuse_conn *integer***	: *Maximum number of connections to this server*
eqcli sv-svname> **reuse_conn_to *integer***	: *Timeout for connection re-use*
eqcli sv-svanme> **uuiduuidname**	: *Associate a virtual machine with the server.*
eqcli sv-svanme> **vlb_manager *vlbmgrname***	: *Attach a VLB Manager for the associated virtual machine.*
eqcli sv-svanme> **vms**	: *List all the virtual machines from the VLB Manager.*

The **max_reuse_conn** and **reuse_conn_to** are used to set operating parameters for HTTP multiplexing. HTTP multiplexing is disabled by default, and is turned on/off using the **tcp_mux** cluster flag. Refer to "HTTP Multiplexing" on page 360 for additional information.

Server Pool and Server Instance Commands

A server is attached to a cluster via a *server pool*. A server pool is a collection of server definitions, each of which has additional parameters assigned to it in the server pool -- these additional parameters are organized by the server's name and are referred to as *server instances* within the server pool context. This allows you to associated a distinct set of server instance options (weight, flags, maximum number of connections), to multiple instances of the same real server in different server pools.

Using Server Pool Commands in the Global Context	
eqcli > **srvpool spname *req_cmds***	: *Create **spname** (**req_cmds** = * commands below)*
eqcli > **srvpool *spname* cmds**	: *Modify **spname** (**cmds** = any commands below)*
eqcli > **no srvpool *spname***	: *Delete **spname***
eqcli > **show srvpool [*spname*]**	: *Display all server pools or spname*
eqcli > **srvpool *spname***	: *Change to the "sp-spname" context (see below)*

Using Server Pool Commands in a Server Pool Specific Context	
eqcli sp-*spname*> **acvq *string***	: *Set the ACV query string*
eqcli sp-*spname*> **acvr *string***	: *Set the ACV response string*
eqcli sp-*spname*> **custom_actconn *percent***	: *Custom LB policy - active connections percentage*
eqcli sp-*spname*> **custom_delay *percent***	: *Custom LB policy - server delay percentage*
eqcli sp-*spname*> **no {acvq | acvr}**	: *Set the specified ACV string to null*
eqcli sp-*spname*> **no si *siname***	: *Delete server instance **siname***
eqcli sp-*spname*> **health_check *hcname***	: *Change to the command context for the specified health_ check.*
eqcli sp-*spname*> ***policy *policyname***	: *Load balancing policy.*
eqcli sp-*spname*> **probe_cto *seconds***	: *Server probe connection timeout.*
eqcli sp-*spname*> **probe_dto *seconds***	: *Server probe data timeout.*
eqcli sp-*spname*> **probe_gto *seconds***	: *Server probe global timeout.*
eqcli sp-*spname*> **probe_interval *seconds***	: *Server probe interval.*
eqcli sp-*spname*> **probe_maxtries *integer***	: *Maximum number of server probes in one interval.*
eqcli sp-*spname*> ***respv *integer***	: *LB policy responsiveness:* **1** =

Using Server Pool Commands in a Server Pool Specific Context

	*slowest,***5** *= fastest. Default =* **3***.*
eqcli sp-*spname*> **show**	: *Show the server pool configuration*
eqcli sp-*spname*> **si *siname***	: *Enter the server instance context*
eqcli sp-*spname*> **si <u>*cmd*</u>**	: *Execute a server instance command*
eqcli sp-*spname*> **stats**	: *Display server pool statistics*
eqcli sp-*spname*> **test**	: *Test the ACV probing on specified server instance or on all server instances.*

Using Health Check Commands in a Server Pool Specific Context

eqcli sp-*spname*-hc-*hcname*> **healthy *value***	: *Set the healthy value for the server instance. 'healthy' is a floating-point value.*
eqcli sp-*spname*-hc-*hcname*> **loaded *value***	: *Set the loaded value for the server instance. 'loaded' is a floating-point value.*
eqcli sp-*spname*-hc-*hcname*> **no**	: *Delete a health_check or reset a health_check parameter to its default value.*
eqcli sp-*spname*-hc-*hcname*> **probe_port *port***	: *Set the port number for probing the server.*
eqcli sp-*spname*-hc-*hcname*> **probe_cto *connection timeout***	: *Set the health check probe connect timeout (in seconds).*
eqcli sp-*spname*-hc-*hcname*> **probe_dto *data timeout***	: *Set the health check probe data timeout (in seconds).*
eqcli sp-*spname*-hc-*hcname*> **probe_gto *global timeout***	: *Set the health check probe global timeout (in seconds).*
eqcli sp-*spname*-hc-*hcname*> **probe_interval *probe interval***	: *Set the interval between health check probes (in seconds).*
eqcli sp-*spname*-hc-*hcname*> **probe_maxtries *max tries per interval***	: *Set the maximum number of attempts per interval before marking a server*

Using Health Check Commands in a Server Pool Specific Context

	'down'.
`eqcli sp-`*`spname`*`-hc-`*`hcname`*`>` **`stimulus`** ***`stimulus`***	: *Set the stimulus string for the health check probes.*
`eqcli sp-`*`spname`*`-hc-`*`hcname`*`>` **`type`** ***`health_check type`***	: *Set the type for the health check probes. Required.*
`eqcli sp-`*`spname`*`-hc-`*`hcname`*`>` **`weight`** ***`value`***	: *Set the weight for the health check measurement.*

Using Server Instance Commands in the Global Context

`eqcli >` **`srvpool`** ***`spname`*** **`si`** ***`siname req_cmds`***	: *Create siname (req_cmds = * commands below)*
`eqcli >` **`srvpool`** ***`spname`*** **`si`** ***`siname cmds`***	: *Modify siname (cmds = any commands below)*
`eqcli >` **`no srvpool`** ***`spname`*** **`si`** ***`siname`***	: *Delete siname*
`eqcli >` **`show srvpool`** ***`spname`*** **`si [siname`**`]`	: *Display all server instances or siname*
`eqcli >` **`srvpool`** ***`spname`*** **`si`** ***`siname`***	: *Change to a server instance context*

Using Server Instance Commands in a Server Instance Specific Context

`eqcli sp-`*`spname`*`-si-`*`siname`*`>` **`flags {[!]hot_spare,[!]persist_override, [!]quiesce,[!]probe_l4, [!]strict_maxconn}`**	
`eqcli sp-`*`spname`*`-si-`*`siname`*`>` **`maxconn`** ***`integer`***	: *Set the max number of open connections to* ***integer***
`eqcli sp-`*`spname`*`-si-`*`siname`*`>` **`no maxconn`**	: *Set max connections to default (0)*
`eqcli sp-`*`spname`*`-si-`*`siname`*`>` **`show`**	: *Show the server instance settings*
`eqcli sp-`*`spname`*`-si-`*`siname`*`>` **`stats`**	: *Display server instance statistics*
`eqcli sp-`*`spname`*`-si-`*`siname`*`>` **`*weight`** ***`integer`***	: *Set the server instance weight to*

Server Instance Flags

A flag may be turned off by prefixing with "!".

hot_spare	Enable the hot spare check box if you plan to use this server as a backup server, in case the other server instances in a server pool on the cluster fail. Enabling hot spare forces Equalizer to direct incoming connections to this server only if all the other servers in the cluster are down. You should only configure one server in a cluster as a hot spare.**persist_override** - Disables persistence for the server when the persist flag (Layer 7 cluster) or a non-zero sticky time (Layer 4 cluster) is set on a cluster. For a Layer 7 cluster, this means that a cookie will not be inserted into the response header when returned to the client. No sticky record is set for a Layer 4 cluster. This flag is usually used to disable persistence for a hot spare.
quiesce	When enabled, Equalizer avoids sending new requests to the server. This is usually used in preparation for shutting down an HTTP or HTTPS server, and is sometimes also called "server draining".
probe_l4	This flag enables or disables Layer 4 TCP and ACV probes for this server. By default this flag is enabled.
strict_maxconn	This flag allows you to customize the behavior of the max connections parameter

Using Health Check Instance Commands in a Server Instance Specific Context

```
eqcli sp-spname-si-siname-hci-hciname> flags
        {[!]require_response

eqcli sp-spname-si-siname-hci-hciname> vlb_param            : Set the VLB
                                                              Parameter for
                                                              health check
                                                              instance.
```

Health Check Instance Flags

A flag may be turned off by prefixing with "!".

require_response	When the require_response flag is disabled (the default) and no response is received from the server application, then load balancing decisions are made without considering the health check's returned load value. When the require_ response flag is enabled and no response is received from the server application, then the server is marked down and no cluster traffic is sent to it.

Server Pool and Server Instance Command Notes

The following flags can be set on server instances:

abort_server	Close server connections without waiting.
always	Always insert a cookie into server responses.
client_ip	Include the client IP address in headers.
compress	Compress server responses.
ignore_case	Do not consider case when evaluating a match rule.
no_header_rewrite	Do not rewrite headers in server responses.

once_only	Evaluate the first set of headers in a client connection only.
persist_override	If cluster **persist** is enabled, disable it for this server.
spoof	Use the client IP as source IP in packets sent to servers.
tcp_mux	Enable/disable HTTP multiplexing. See "HTTP Multiplexing" on page 360.

Server instance specific commands can be applied to multiple server instances by entering a comma-separated list of server instance names on the command line. For example, to set the weight to 125 on three server instances (sv01, sv02, sv03) in server pool sp01, you could enter a command like this:

```
eqcli > srvpool sp01 si sv01,sv02,sv03 weight 125
```

You can also change to an aggregate context that applies to multiple server instances, that allows you to display and modify the parameters for all the server instances. For example, you could change to an aggregate context for the three server instances in the previous example above using a command like the following:

```
eqcli > srvpool sp01 si sv01,sv02,sv03
eqcli sp-sp01-si-sv0*>
```

The CLI is now in the aggregate server instance context "**sv01,sv02,sv03**" -- only the first three characters of which are displayed in the command line. To see the entire context name, use the **context** command:

```
eqcli sp-sp01-si-sv0*> context
The context is "sv01,sv02,sv03".
eqcli sp-sp01-si-sv0*>
```

In an aggregate server instance context, the **show** command will display the configuration of all the server instances in the context.

Load Balancing Policies

Equalizer supports the following load balancing policies, each of which is associated with a particular algorithm that Equalizer uses to determine how to distribute requests on a server pool in the cluster:

Load Balancing Policy	**Description**
round robin	**round robin** load balancing distributes requests on the server pool in the cluster. Equalizer dispatches the first incoming request to the first server, the second to the second server, and so on. When Equalizer reaches the last server, it repeats the cycle. If a server in the cluster is down, Equalizer does not send requests to that server. This is the default method. The round robin method does not support Equalizer's adaptive load balancing feature; so, Equalizer ignores the servers' initial weights and does not attempt to dynamically adjust server weights based on server performance.

Load Balancing Policy	**Description**
static weight	**static weight** load balancing distributes requests among the servers depending on their assigned initial weights. A server with a higher initial weight gets a higher percentage of the incoming requests. Think of this method as aweighted round robin implementation. Static weight load balancing does not support Equalizer's adaptive load balancing feature; Equalizer does not dynamically adjust server weights based on server performance.
adaptive	**adaptive** load balancing distributes the load according to the following performance indicators for each server. **Server response time** is the length of time for the server to begin sending reply packets after Equalizer sends a request. **Active connection count** shows the number of connections currently active on the server. **Server agent value** is the value returned by the server agent daemon (if any) running on the server.
fastest response load balancing	**fastest response load balancing**dispatches the highest percentage of requests to the server with the shortest response time. Equalizer does this carefully: if Equalizer sends too many requests to a server, the result can be an overloaded server with slower response time. The fastest response policy optimizes the cluster-wide response time. The fastest response policy also checks the number of active connections and server agent values (if configured); but both of these have less of an influence than they do under the adaptive load balancing policy. For example, if a server's active connection count and server agent values are high, Equalizer might not dispatch new requests to that server even if that server's response time is the fastest in the cluster.
least connections load balancing dispatches	**least connections load balancing dispatches**the highest percentage of requests to the server with the least number of active connections. In the same way as Fastest Response, Equalizer tries to avoid overloading the server so it checks the server's response time and server agent value. Least Connections optimizes the balance of connections to server pool in the cluster.
server agent load balancing dispatches	**server agent load balancing dispatches**the highest percentage of requests to the server with the lowest server agent value. In a similar way to Fastest Response, Equalizer tries to avoid overloading the server by checking the number of connections and response time. This method only works if server agents are running on the server pool in the cluster.

Equalizer's Load Balancing Response Settings

The **responsiveness** setting controls how aggressively Equalizer adjusts the servers' dynamic weights. Equalizer provides five response settings: Slowest, Slow, Medium, Fast, and Fastest. The response setting affects the dynamic weight spread, weight spread coefficient, and optimization threshold that Equalizer uses when it performs adaptive load balancing:

- **Dynamic Weight Spread** indicates how far a server's dynamic weight can vary (or *spread*) from its initial weight.

- **Weight Spread Coefficient** regulates the speed of change to a server's dynamic weight. The weight spread coefficient causes dynamic weight changes to happen more slowly as the difference between the dynamic weight and the initial weight increases.

- **Optimization Threshold** controls how frequently Equalizer adjusts dynamic weights. If Equalizer adjusts server weights too aggressively, oscillations in server weights can occur and cluster-wide performance can suffer. On the other hand, if Equalizer does not adjust weights often enough, server overloads might not be compensated for quickly enough and cluster-wide performance can suffer.

Aggressive Load Balancing

After you fine-tune the initial weights of each server in the cluster, you might discover that Equalizer is not adjusting the dynamic weights of the servers at all: the dynamic weights are very stable, even under a heavy load. In this case, you might want to set the cluster’s load balancing response parameter to fast so that Equalizer tries to optimize the performance of your servers more aggressively. This should improve the overall cluster performance.

Dynamic Weight Oscillations

If you notice a particular server’s dynamic weight oscillates (for example, the dynamic weight varies from far below 100 to far above 100 and back again), you might benefit by choosing slow response for the cluster. You should also investigate the reason for this behavior; it is possible that the server application is behaving erratically.

SNMP Commands

The parameters in the SNMP context specify return values for the following Object IDs (OIDs) in the Equalizer SNMP Management Information Base (MIB):

OID	Parameter	Default Value	Description
	community	Equalizer	Any SNMP management console needs to send the correct community string along with all SNMP requests. If the sent community string is not correct, Equalizer discards the request and will not respond.
	contact	public	Contact is the name of the person responsible for this unit.
	description	Equalizer	This is the user-assigned description of the Equalizer.
	location	location	Location describes Equalizer's physical location.
	name	Equalizer	This is the name assigned to the system. By default it is Equalizer .
	serverip	VLAN IP	To configure the SNMP agent to listen and respond on a particular IP address, enter the address.
	serverport	162	This is optional. If not entered, the default trap server port (162) will be used.

The following tables list the SNMP context commands:

Using SNMP Commands in the Global Context

```
eqcli > no snmp cmd               : Reset the specified parameter to its default
                                    value

eqcli > show snmp                 : Display SNMP parameter settings

eqcli > snmp                      : Change to the "snmp" context (see below)
```

SNMP Context Commands

```
eqcli snmp> community string            : Set the SNMP community address.

eqcli snmp> contact string              : Set the SNMP contact address.

eqcli snmp> context string              : Display the current command
                                          context.

eqcli snmp> description string          : Set the SNMP description

eqcli snmp> location string             : Set the SNMP location.

eqcli snmp> name string                 : Set the SNMP name.

eqcli snmp> serverip ip                 : Set an snmp trap server IP.

eqcli snmp> serverport port             : Set an snmp trap server port.

eqcli snmp> show                        : Display SNMP parameter
                                          configuration
```

Enabling SNMP (CLI)

By default, SNMP is a globally enabled service -- meaning that it will run on any subnet that is configured to offer the SNMP service. You must specifically enable SNMP on the subnet or subnets on which you want it to listen for SNMP MIB browser and management station connections.

SNMP can be enabled on *at most* one IPv4 subnet address/port and one IPv6 subnet address/port. SNMP runs on Equalizer's IP address on the configured subnet. Currently, SNMP runs on the default SNMP port (161) only.

To enable SNMP, you must enable it at the global level, and then enable it on any single IPv4 subnet, any single IPv6 subnet, or both. For this procedure, we assume the existence of a properly configured VLAN (172net) and its Default subnet.

1. In the global CLI context, confirm that SNMP is globally enabled:

```
    eqcli > show
```

   You should see a line that looks like the following:

```
eqcli > show

Variable Value
recv_timeout       2
conn_timeout 1
hb_interval        2
retry_interval 5
strike_count 3
icmp_interval      15
icmp_maxtries 3
hostname           Equalizer
date               Thu Sep 13 11:49:09 UTC 2012
timezone           UTC
locale             en
global services     http, https, ssh, fo_snmp, snmp, envoy, envoy_agent
name-servers       None
ntp-server pool.ntp.org - Unavailable: name-server undefined
syslog-server       None
GUI logo           Coyote Point Systems Inc.
boot image         Equalizer Image B EQ/OS Version 10.0.2f (Build 19121)

eqcli >
```

   In `global servicessnmp` means that SNMP is globally enabled for any Equalizer subnet

IP address. "`fo_snmp`" means that SNMP is globally enabled for any subnet failover IP address. If either of these keywords has a preceding exclamation point (**!**), then SNMP is disabled for that class of IP addresses. You can enable and disable these flags using the services command, as shown in "Global Commands" on page 141.

2. Now, enable SNMP on the desired VLAN subnet, on either the subnet IP address or the subnet failover (aka "virtual") IP address. In this example, we enable it on the subnet IP address:

```
eqcli > vlan 172net subnet Default services snmp
```

SNMP is now enabled and will respond to MIB browser requests received on the **172net:Default** subnet IP address (port 161).

Before accessing Equalizer via SNMP, download and install the Equalizer MIB files into your MIB browser, as explained in the following section.

Refer to "SNMP" on page 198 for details on setting SNMP parameters using the GUI.

Downloading Equalizer MIB Files

The MIB files can be downloaded from Equalizer using a browser pointed at:

```
http://<equalizer>/eqmanual/<mibname>.my
```

Tunnel Commands

Use tunnel context commands to configure Equalizer to access the IPv6 Internet via an IPv6 “6in4” tunnel. Note that you must first request a tunnel configuration from a tunnel broker before setting up the tunnel endpoint on Equalizer. See"Configuring an IPv6 Tunnel" on page 225 for more information.

Using Tunnel Commands in the Global Context

eqcli > **tunnel *tname [cmds]***	: *Create tunnel **tname** (see below for **cmds**)*
eqcli > **tunnel *tname cmds***	: *Modify tunnel **tname** (see below for cmds)*
eqcli > **no tunnel *tname***	: *Delete tunnel **tname***
eqcli > **show tunnel[*tname*]**	: *Display all tunnels or a specific tunnel*
eqcli > **tunnel *tname***	: *Change to a tunnel context (see below)*

Tunnel Context Commands

eqcli tl-*tname*> ***local_address *ipv6_addr***	: *Local IPv6 address from broker*
eqcli tl-*tname*> ***local_endpoint *ipv4_addr***	: *Local IPv4 address*
eqcli tl-*tname*> ***remote_address *ipv6_addr***	: *Remote IPv6 address from broker*
eqcli tl-*tname*> ***remot_endpoint *ipv4_addr***	: *Remote IPv4 address from broker*
eqcli tl-*tname*> **show**	: *Display tunnel settings*
eqcli tl-*tname*> ***type *ipip***	: *Tunnel type (only ipip supported)*

User Commands

Using "User" Comands in the Global Context	
eqcli > **user *uname* [*cmds*]**	*: Create user* ***uname*** *(see below for* ***cmds****)*
eqcli > **user *uname* cmds**	*: Modify user* ***uname*** *(see below for cmds)*
eqcli > **no user *uname***	*: Delete user* ***uname***
eqcli > **show user [*uname*]**	*: Display all users or a specific user*
eqcli > **user *uname***	*: Change to the "user-login" context (see below)*

"User" Context Comands	
eqcli user-*uname* > **alert *alert name***	*: Set a user alert.*
eqcli user-*uname* > **duration *seconds***	*: Set the idle login timeout*
eqcli user-*uname* > **flags {[!]admin, [!]read_global, [!]write_global**	*: Administrator Read global settings Modify global settings*
eqcli user-*uname* > **no duration**	*: Set default duration (0)*
eqcli user-*uname* > **no permit_object *perm type object***	*: Remove permission on object*
eqcli user-*uname* > **no permit_objlist *perm type objlist***	*: Remove perm from objlist*
eqcli user-*uname* > **password**	*: Change user password*
eqcli user-*uname* > **permit_object perm type object**	*: Add permission on object*
eqcli user-*uname* > **locale {[!]en,**	*: To set English locale*
[!]ja}	*: To set Japanese locale*
eqcli user-*uname* > **show**	*: Display user settings*

User flags

A flag may be turned off by prefixing with "!".

admin	Administrator
read_global	Read global setting
write_global	Modify global settings

Using User-alert context commands:

User-alert Context Commands	
eqcli > **user-*uname-alertname*** > ***alert-typealert flags*** **{[!]exception, [!]state_change}**	: *Set the alert type. Required.*
eqcli > **user-*uname-alertname*** > ***from email address***	: : *Set the from email address.*
eqcli > **user-*uname-alertname*** > ***notify_ type notify_flags*** **{[!]email,[!]ui,[!]snmp, [!]syslog}**	: *Set the alert notify flags. Required.*
eqcli > **user-*uname-alertname*** > ***fully-qualified-object_name***	: *Set the object fully-qualified object name. Required.* *The object name is the name of an object, existing in the* *configuration, for which this alert definition is to be applied.*
eqcli > **user-*uname-alertname*** > **object_ type *object-type***	: *Set the object type. Required.* *Object type can be server, cluster, match, srvpool, si, resp, peer, vlan, subnet, geocluster, geosite, gsi, interface, user, certificate, crl, route, tunel, license, health_check, hci, vlb_manager, resource, ri, external_ services, smtp_relay,* *fogrp*
eqcli > **user-*uname-alertname*** > quit	: *Discard all pending alert configuration changes and exit to the user context.*
eqcli > **user-*uname-alertname*** > show	: *Display the alert details.*
eqcli > **user-*uname-alertname*** > **subject *user string***	: *Set the subject.* *User string is any (up to 256) characters the user wishes to* *enter. It must be surrounded by quotes if it has embedded blanks. Its usage depends upon the notify_type.*
eqcli > **user-*uname-alertname*** > ***to email addresses***	: *Set the email address(es).* *Email addresses are email1,email2,...emailx, where:* ***email= user@<domain***

User Alert Notify Type Flags

A flag may be turned off by prefixing with "!".

email	When enabled, sends an email to the specified recipients, using a specified SMTP relay mail server. When this notification type is used, an email address is also required. A subject line for the email is optional
ui	When enabled this notifies users of an alert in the CLI.
snmp	When enabled, allows SNMP traps to enable an agent to notify a management station of significant events by way of unsolicited SNMP messages.
syslog	When enabled, sends an alert message to the system log

User Flags

User flags are used to override permissions checks, as follows:

admin	All permissions checks are overridden for the user (including **read_ global** and **write_global**). The user has complete administrative control over the system. Only users with the admin flag can: **read**, **write**, and **delete** any object on which they do not have explicit permission **write**, **create**, and **delete** object lists and user definitions (with the exception of a user changing their own password) **read_global** - User can do a show in the global context.
write_global	User can modify global parameters and execute global commands other than show in the global context.

Setting the Locale

You can set the locale for Equalizer to either English or Japanese (2 available options at this time). The default locale is “en” for English.

For English enter the following:

```
eqcli user-uname> locale en
```

For Japanese enter the following:

```
eqcli user-uname> local ja
```

Creating a User

When a user name is created:

- A default user (i.e. "touch") is assigned a **`duration`** of 0 seconds . When additional users are created the default **`duration`** value is 3600 seconds.
- The user creating the new user name is prompted for a password (regardless of whether they specified the **`password`** keyword on the command line) .

Deleting a User

The **`no user`** command is immediately executed and the user name is removed, with one exception: if the user name is the only one with the **`admin`** flag enabled, the user name is not removed.

User Passwords

The **`password`** command allows a logged in user to change the password for their user name. A user name with the **`admin`** flag can modify the password for any user name. The password itself is not permitted on the command line, and is not displayed by a user context **`show`** command (or any eqcli command).

User Permissions

When a user attempts to access an object (cluster, server, server pool, VLAN, etc.) on Equalizer, the system determines whether the user has permission to access the object as follows:

1. If the user's definition has the **`admin`** flag enabled, then access is granted.
2. Otherwise, the user must have specific permission granted on the object for the access mode being attempted. For example, if the user attempts to display a cluster, then the user must have **`read`** permission on the cluster.

Permission to access an object is granted in one of two ways:

- The **`permit_object`** command gives the user the specified access permissions on the specified object.
- The **`permit_objlist`** command gives the user access permissions on all objects of a particular type as listed in the object list specified on the command line.

Note - The **`permit_object`** and **`permit_objlist`** commands:

- can be used only on existing user logins.

- must be entered one at a time, on a line by themselves, with no other user context commands on the command line

So, for example, you cannot modify a user's **`duration`** parameter and in the same command line include a **`permit_object`** or **`permit_objlist`** command.

Using permit_object to Assign User Permissions on a Single Object

The **`user`** context **`permit_object`** command has the following syntax:

```
permit_object perm type object_name
```

The command assigns the given permission on the given object in the user context. The command arguments are as follows:

- **`perm -`** One or more of the following permissions: **`read`**, **`write`**, **`delete`**. Multiple permissions must be separated by commas. If spaces are included, the entire list of permissions must be enclosed in quotes.

- **type -** One of the following object types: **cert**,**cluster**,**crl**,**geocluster**,**geosite**,**port**,**server**,**srvpool**,**subnet**,**user**,**vlan**.
- **object_name –** The name of an existing object of the *type* given on the command line.

For example, the following command executed in the global context assigns **read** and **write** permission to the server **sv00** for the existing login **user1**:

```
eqcli > user user1 permit_object read,write server sv00
```

Using permit_objlist to Assign User Permissions on a Group of Objects

The **user** context **permit_objlist** command has the following syntax for assigning **read**, **write**, and **delete** permissions:

```
permit_objlist perm type objlist_name
```

This form of the **permit_objlist** command assigns the given permission (**perm**) on all objects of the specified **type** that appear in the object list specified by **objlist_name**. The command arguments for assigning permission to objects in an object list are as follows:

- **perm -** One or more of the following permissions: **read**, **write**, **delete**. Multiple permissions must be separated by commas. If spaces are included, the entire list of permissions must be enclosed in quotes.
- **type -** One of the following object types: **cert**,**cluster**, **crl**,**geocluster**,**geosite**,**port**,**server**,**srvpool**,**subnet**,**user**,**vlan**.
- **objlist_name –** The name of an existing object list.

For example, the following command executed in the global context assigns **read** and **write** permission to all of the servers listed in the object list **objlist1** for the login **user1**:

```
eqcli > user user1 permit_objlist read,write server objlist1
```

For more information on object lists, please see "Object List Commands" on page 163.

Using permit_objlist to Allow a User to Create Objects

The **user** context **permit_objlist** command has the following syntax for assigning the **create** permission to a user:

```
permit_objlist create type {default | objlist_name}
```

- This form of the **`permit_objlist`** command allows the user to **`create`** objects of the specified **`type`**. The command arguments for assigning permission to objects in an object list are as follows:
- **`type -`** One of the following object types: **`cert`**,**`cluster`**,**`crl`**,**`geocluster`**,**`geosite`**,**`port`**,**`server`**, **`srvpool`**,**`subnet`**,**`user`**,**`vlan`**.
- **`default -`** Specifies that objects created by this user will only be visible to the user creating the object and any user with the **`admin`** flag set.
- **`objlist_name -`** Specifies that the user can supply the given object list name as an argument when creating objects of the specified **`type`**. An entry for the created object is placed in the object list. Objects created in this manner will be visible to other users who have permission to use this object list.

For example, the following command executed in the global context allows **`user1`** to create servers that other non-admin users cannot access:

```
eqcli > user user1 permit_objlist create server default
```

The following command allows **`user1`** to create servers and specify the **`objlist1`** object list when creating a server, thus adding the new server to **`objlist1`**:

```
eqcli > user user1 permit_objlist create server objlist1
```

User Permissions Assigned on Object Creation

When an object is created, the user creating the object is given **`read`**, **`write`**, and **`delete`** permissions for the object.

Displaying User Information

In the **`user`** context, a **`show`** command displays the user settings for **`duration`** and **`flags`**, followed by the user permission list.

VLAN and Subnet Commands

Using VLAN Commands in the Global Context	
eqcli > **vlan *vlname req_cmds***	: *Create* ***vlname (req_cmds*** *= * commands below)*
eqcli > **vlan *vlname cmds***	: *Modify* ***vlname (cmds*** *= any commands below)*
eqcli > **no vlan *vlname***	: *Delete* ***vlname***
eqcli > **show vlan *[vlname*]**	: *Display all VLANs or* ***vlname***
eqcli > **vlan *vlname***	: *Change to the "vl-vlname" context (see below)*

VLAN Specific Context Commands	
eqcli vl-*vlname*> **show**	: *Display VLAN configuration*
eqcli vl-*vlname*> **subnet *subname***	: *Change to subnet specific context*
eqcli vl-*vlname*> **subnet *subname cmd***	: *Execute subnet specific command*
eqcli vl-*vlname*> **tagged_ports *port* *[,port...*]**	: *Set list of tagged ports*
eqcli vl-*vlname*> **untagged_ports *port* *[,port...*]**	: *Set list of untagged ports*
eqcli vl-*vlname*> **mtu** [***mtuvalue***]	: *Set the vlan MTU.*
eqcli vl-*vlname*> ***vid *integer***	: *Set VLAN ID.(Value between 1 and 4094)*

Using Subnet Commands in the Global Context	
eqcli > **vlan *vlname* subnet *subname req_cmds***	: *Create* **subname (req_cmds** *= * commands below)*
eqcli > **vlan *vlname* subnet *subname cmds***	: *Modify* **subname (cmds** *= any commands below)*
eqcli > **no vlan *vlname* subnet *subname***	: *Delete* **subname**
eqcli > **show vlan *vlname* subnet [*subname*]**	: *Display all subnets or* **subname**
eqcli > **vlan *vlname* subnet *subname***	: *Change to a subnet context.*

Subnet Specific Context Commands

eqcli vl-*vlname*-sn-*subname*> **default_route *ip_addr***	: *Set default route*
eqcli vl-*vlname*-sn-*subname*> **flags {[!]command,[!]def_src_addr, [!]heartbeat}**	: *Set subnet flags*
eqcli vl-*vlname*-sn-*subname*> ***ip *cidr_addr***	: *Subnet IP address*
eqcli vl-*vlname*-sn-*subname*> **no *parameter***	: *Reset parameter*
eqcli vl-*vlname*-sn-*subname*> **no permit**	: *Set list to null*
eqcli vl-*vlname*-sn-*subname*> **no permit *vlname*:*subname***	: *Remove permit entry*
eqcli vl-*vlname*-sn-*subname*> **no route *src dest***	: *Remove a route*
eqcli vl-*vlname*-sn-*subname*> **outbound_nat *cidr_addr***	: *Set NAT address*
eqcli vl-*vlname*-sn-*subname*> **permit vlname:*subname***	: *Add permitted subnet*
eqcli vl-*vlname*-sn-*subname*> **probe_interval *seconds***	: *Set the heartbeat probe interval for a subnet.*
eqcli vl-*vlname*-sn-*subname*> **route *src dest***	: *Add a route*
eqcli vl-*vlname*-sn-*subname*> **services {!] http,[!]https, [!]ssh, [!]snmp, [!]envoy, [!]envoy_agent, [!]fo_http, [!]fo_https, [!]fo_ssh,[!]fo_snmp, [!]fo_envoy,[!]fo_envoy_agent}**	: *Subnet Services (see below)*
eqcli vl-*vlname*-sn-*subname*> **show**	: *Display subnet*
eqcli vl-*vlname*-sn-*subname*> **strike_count *integer***	: *Set the strike count threshold for a subnet. When the number of strikes detected on this subnet exceeds this value, the subnet has failed. A value of 0 indicates this subnet will never be considered failed.*
eqcli vl-*vlname*-sn-*subname*> **virt_addr *cidr_addr***	: *Failover IP address*

VLAN Subnet Flags

A flag may be turned off by prefixing with "!".

command	Designates this subnet as the subnet over which the configuration file transfers (between preferred primary and preferred backup) can occur.

def_src_addr	Stipulates that this subnet is to be used for the default equalizer source IP.
heartbeat	Allows the failover peers to probe one another over the subnet. At least one subnet must have a Heartbeat flag enabled.

VLAN Subnet Services

Services may be turned off by prefixing with "!".

http	When enabled, the Equalizer will listen for HTTP connections on Equalizer’s IP address on the subnet. The global HTTP GUI service must also be enabled.
https	When enabled, the Equalizer will listen for HTTPS connections on Equalizer’s IP address on the subnet. The global HTTPS GUI service must also be enabled.
ssh	When enabled, SSH login will be permitted on Equalizer’s IP address on the subnet. The global SSH service must also be enabled.
snmp	When enabled, SNMP will accept connections on Equalizer’s IP address on the subnet. The global SNMP service must also be enabled.
envoy	When enabled, Envoy will accept DNS lookup connections on Equalizer’s IP address on the subnet. The global Envoy service must also be enabled.
envoy_agent	When enabled, Envoy health checks will be performed on the subnet using Equalizer’s IP address on the subnet as the source IP. The global Envoy Agent service must also be enabled.
fo_http	When enabled, the Equalizer will listen for HTTP connections on Equalizer’s Failover IP address (if configured) on the subnet. The global HTTP GUI service must also be enabled.
fo_https	When enabled, the Equalizer will listen for HTTPS connections on Equalizer’s Failover IP address (if configured) on the subnet. The global HTTPS GUI service must also be enabled.
fo_ssh	When enabled, SSH login will be permitted on Equalizer’s Failover IP address (if configured) on the subnet. The global SSH service must also be enabled.
fo_snmp	When enabled, SNMP will accept connections on Equalizer’s Failover IP address (if configured) on the subnet. The global SNMP service must also be enabled.
fo_envoy	When enabled, Envoy will accept DNS lookup connections on Equalizer’s Failover IP address (if configured) on the subnet. The global Envoy service must also be enabled.
fo_envoy_agent	When enabled, Envoy health checks will be performed on the subnet using Equalizer’s Failover IP address on the subnet as the source IP. The global Envoy Agent service must also be enabled.

VLAN and Subnet Command Notes

The **vlan** context defines Equalizer’s network connectivity. Each VLAN definition defines the front panel ports that are configured for the VLAN, the VLAN ID (VID), and the subnets that belong to the VLAN.

VLAN Subnets

A single VLAN can have more than one subnet assigned to it. In most configurations, there is a one-to-one relationship between VLANs and subnets, but some practical problems are sometimes solved by adding an additional subnet to a VLAN. For example, if all the IP addresses on the subnet assigned to a VLAN are exhausted, the easiest way to add more IP addresses without reconfiguring the network is to add an additional subnet to the VLAN.

VLAN IP Addresses

A VLAN IP address is defined on all subnets in a VLAN and is Equalizer's IP address on that subnet. Subnet IP addresses must be specified in CIDR format (e.g. 172.16.0.200/21). A VLAN can contain multiple subnets with a mix of IPv4 and IPv6 addresses on different subnets in the same VLAN.

VLAN Services

A VLAN can have several **services** running on it: the GUI can be available on the VLAN IP address via HTTP and/or HTTPS; and, SSH login on the VLAN IP can be enabled as well. It is not required that any of these services be enabled on any VLAN.

If **services** are enabled on the VLAN, they must also be enabled in the global context in order to be functional on the VLAN. See the **services** command in "Global Commands" on page 141.

Routing Between VLANs

By default, packets are not routed between VLANs. In other words, if a packet for a destination address that is configured on **vlan2** arrives at a port that is configured for **vlan1** *only*, the packet is dropped. Routing from **vlan1** to **vlan2** is configured by adding **vlan2** to the list of permitted VLANs for **vlan1**.

For example, let's say port 1 is configured for **vlan1** and subnet 10.10.10.0/24; port 2 is configured for **vlan2** and subnet 172.16.0.0/24. If servers are connected to both ports, and these servers need to communicate with one another through Equalizer, you would execute the following commands to enable routing between **vlan1** and **vlan2**:

```
eqcli > vlan vlan1 permit vlan2
eqcli > vlan vlan2 permit vlan1
```

Using the **permit** command in the **vlan** context, as above, enables packet forwarding between *all* the subnets defined in the current VLAN context, and the VLAN specified as an argument to **permit**.

Routing Between Specific VLAN Subnets

In most cases, there is a one-to-one relationship between VLANs and subnets -- i.e., a VLAN in most configurations is associated with one subnet. There are, however, situations in which an administrator will associate more than one subnet with a VLAN. If multiple subnets are defined within a VLAN, you can optionally specify a subnet as an additional argument to the **permit** command, as in this example:

```
eqcli > vlan vlan1 permit vlan2:sn03
```

The above command enables ports configured for **vlan1** to route packets with a destination address on subnet **sn03** defined in **vlan2**. Packets addressed to other subnets configured on **vlan2** will be dropped.

Similarly, you'll need to specify the reverse route: let's say you only want to route packets to **vlan1** from ports configured for **vlan2** *if they originated on subnet* **sn03**. To accomplish this, you'll need to specifically add that VLAN/subnet combination to the permitted VLAN list for **vlan2**:

```
    eqcli > vlan vlan2 subnet sn03 permit vlan1
```

Source IP Address for Outbound Packets

When Equalizer originates connections to other hosts (for example, when Equalizer sends out probes, queries an NTP or DNS server, etc.), the source IP address used in the outbound packets will be the IP address for the VLAN with the **def_src_addr** flag set. There can be only one VLAN with this flag set.

Note - The above means of determining the IP address to use for Equalizer originated connections applies to the Beta product only. The final EQ/OS release will use a different mechanism.

Subnet Routes and Global Default Route

Each subnet has a complete routing table. There is no explicit global default route setting that applies to all subnets. To configure a global default route, you must define the same default route on all subnets.

Chapter 11

Using the GUI

Sections in this chapter include:

Logging In

The Equalizer Administrative Interface, here inafter referred to as the "GUI" is a browser based interface. In general, the GUI should function properly using any browser that:

- Is enabled for JavaScript (required)
- Has an Adobe PDF viewer plug-in or extension installed (required to view the manual and online help)

1. Using your browser, type one of the following into the browser's address bar:

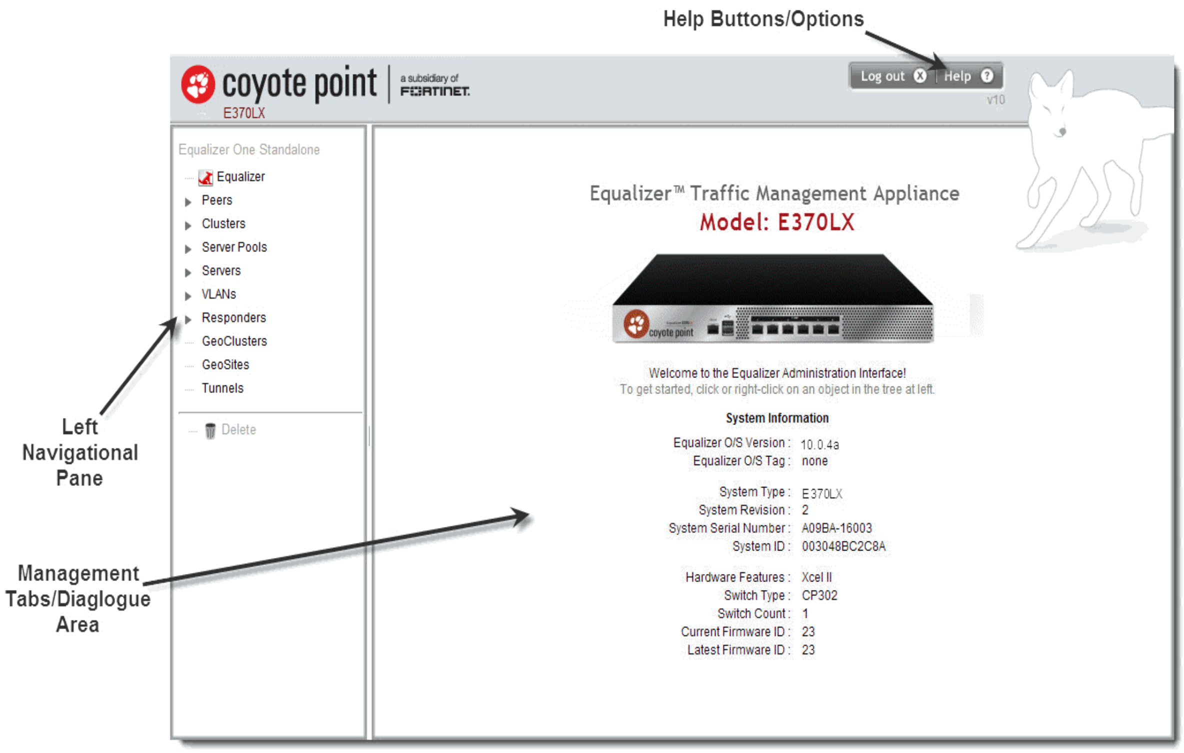
   http://<Equalizer_IP_address>

   `https://<Equalizer_IP_address>`

   Substitute Equalizer's IP address on a VLAN subnet that is enabled for HTTP or HTTPS, as appropriate (see "Network Access" on page 74 .)

   Equalizer displays the login screen.

2. Enter an existing login as well as the login password, and click Login. The **Welcome** screen will be displayed.(See "Logging In" on page 192)



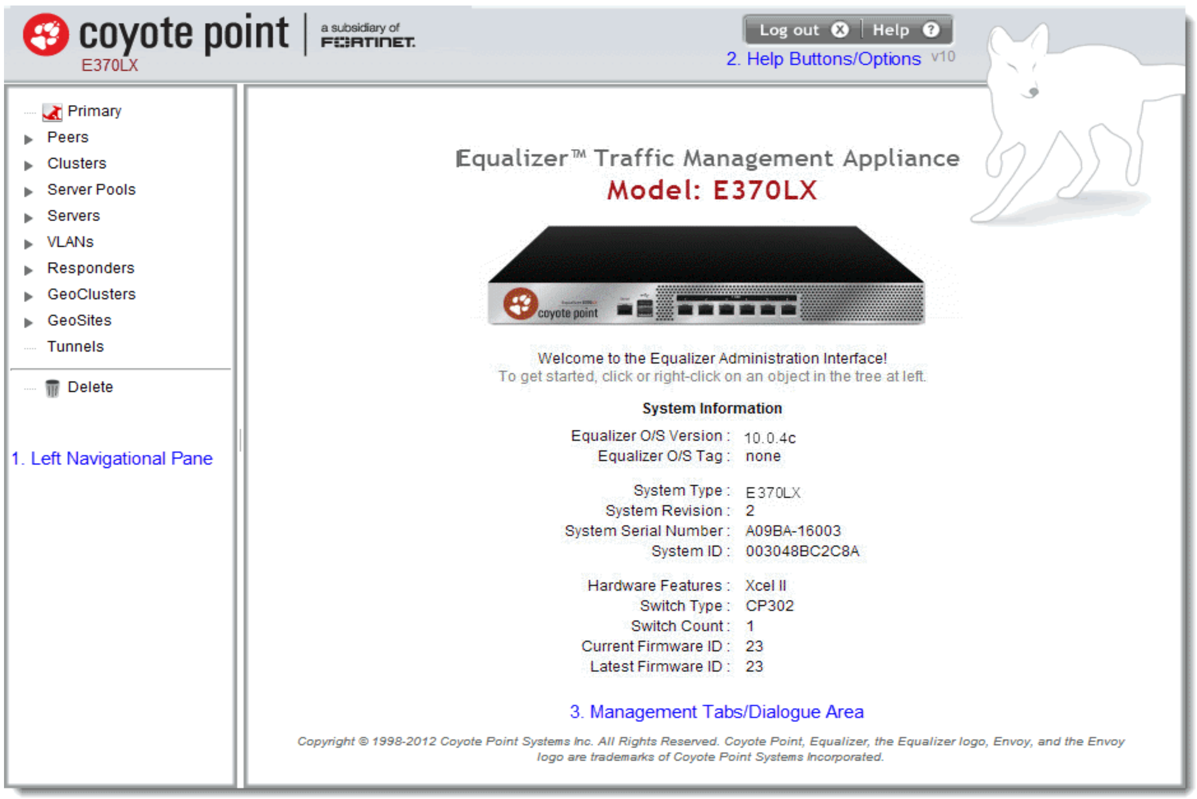
Welcome to the Equalizer Administration Interface!
To get started, click or right-click on an object in the tree at left.

System Information

Equalizer O/S Version :	10.0.4a
Equalizer O/S Tag :	none
System Type :	E370LX
System Revision :	2
System Serial Number :	A09BA-16003
System ID :	003048BC2C8A
Hardware Features :	Xcel II
Switch Type :	CP302
Switch Count :	1
Current Firmware ID :	23
Latest Firmware ID :	23

Navigating Through the Interface

The Equalizer Administration Interface is divided into three major sections:



Welcome to the Equalizer Administration Interface!
To get started, click or right-click on an object in the tree at left.

System Information

Equalizer O/S Version :	10.0.4c
Equalizer O/S Tag :	none
System Type :	E370LX
System Revision :	2
System Serial Number :	A09BA-16003
System ID :	003048BC2C8A
Hardware Features :	Xcel II
Switch Type :	CP302
Switch Count :	1
Current Firmware ID :	23
Latest Firmware ID :	23

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1. Left Navigational Pane

Current Host Name	Click this item to manage global parameter settings, display the system log, and perform general system maintenance.
	Click this item to manage global parameter settings, display the system log, and perform general system maintenance.
	Right-click this item to display the global command menu.
Peers	Click this item to display a Failover summary.
	Right-click this item to enter a new Failover configuration

Clusters	Click this item to display the Cluster Summary.
	Right-click this item to display the cluster command menu.
	If clusters are defined, click the triangle to display all existing clusters.
	Click a cluster name to open the cluster configuration tabs.
	Right-click on a cluster name to display the cluster specific command menu.
	If a cluster is a Layer 7 cluster and has match rules defined, click the triangle next to the cluster name to display the match rules.
	Click a match rule name to open the match rule configuration tabs.
	Right-click on a match rule name to display the match rule command menu.
Server Pools	Click this item to display the Server Pool Summary.
	Right-click this item to display the server pool command menu.
	If server pools are defined, click the triangle to display all existing server pools.
	Click a server pools name to open the server pool configuration tabs.
	Right-click on a server pool name to display the server pool specific command menu.
	If a server pool has server instances defined, click the triangle next to the server pool name to display the server instances.
	Click a server instance name to open the server instance configuration tabs.
	Right-click on a server instance name to display the server instance command menu.
Servers	Click this item to display the Server Summary.
	Right-click this item to display the server command menu.
	If servers are defined, click the triangle to display all existing servers.
	Click a server name to open the server configuration tabs.
	Right-click on a server name to display the server specific command menu.

VLANs	Click this item to display the VLAN Summary.
	Right-click this item to display the VLAN command menu.
	If VLANs are defined, click the triangle to display all existing VLANs.
	Click a VLAN name to open the VLAN configuration tabs.
	Right-click on a VLAN name to display the VLAN specific command menu.
	If a VLAN has subnets defined, click the triangle next to the VLAN name to display the subnets.
	Click a subnet name to open the subnet configuration tabs.
	Right-click on a subnet name to display the subnet command menu.
Responders	Click this item to display the Responder Summary.
	Right-click this item to display the responder command menu.
	If responders are defined, click the triangle to display all existing responders.
	Click a responder name to open the responder configuration tabs.
	Right-click on a responder name to display the responder specific command menu.
GeoClusters	Click on this item to display a GeoCluster Summary.
	Right-click on this item to enter a new GeoCluster.
GeoSites	Click on this item to display a GeoSite Summary.
	Right-click on this item to enter a new GeoSite.
Tunnels	Click on this item to display a Tunnel Summary.
	Right-click on this item to add a new Tunnel.

2. Help Buttons/Options

Log Out	Logs you out of the GUI.
Help	Displays a sub-menu of commands: •**Context Help** -Displays the section in the Help that corresponds to the screen currently displayed in the right frame •**Refresh** - Refreshes the current GUI display. •**About** - Opens the **Welcome** screen (also displayed when you first log into the GUI).

3. Management Tabs/Dialogue Area

The right hand side of the GUI initially displays the **Welcome** screen however it is designed to display all configuration, management and dialogue associated with the objects in the left navigational pane.

Click on any item in the left pane, or right click to choose a command for that object. The right pane will display the management tabs for the object or the appropriate command dialog.

The easy-to-use management tabs organize configuration information into forms and tables that make configuring Equalizer simple. Sub-tabs provide a second level of organization within top-level tabs.

Entering Names for Equalizer Objects

Equalizer identifies administrative objects, such as clusters and servers, by name. For example, object names and icons are displayed in a hierarchy in the GUIs left frame as described earlier in this chapter. Keep in mind the following guidelines when typing in a name for an object:

- The characters used in names are limited to standard ASCII letters ("A" through "Z" and "a" through "z"), numbers (0 through 9), and the characters "**.**" (period), "**-**" (dash) and "**_**" (underscore).
- The first character in a name must be a letter.
- Names can be at most 47 characters long.
- The readability of lists presented in the interface is increased by using short names that use as many unique characters at the beginning of the name as possible.

Global Settings

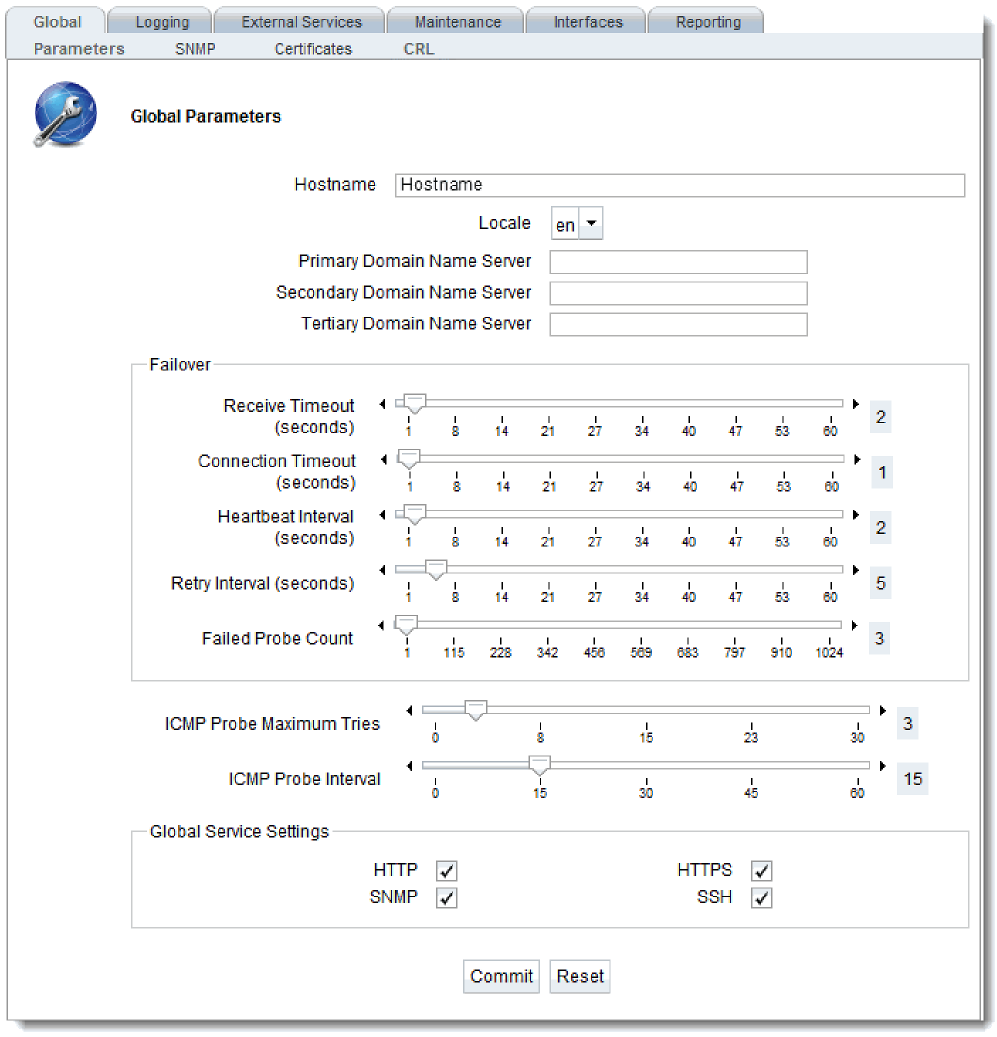
Global or System Parameters include Probes and Networking. Most clusters will work with the default values on these tabs. To view or modify the default global parameter values:

1. Log into the GUI.
2. Click on the host name on the left navigational pane. "Parameters" on page 196 will be displayed.

The related topics describe the global probe and networking parameters.

Parameters

After selecting the host name from the left navigational pane the **Global > Parameters** screen (tab) will be displayed as shown below.



Hostname: Hostname
Locale: en
Primary Domain Name Server
Secondary Domain Name Server
Tertiary Domain Name Server

Failover
Receive Timeout (seconds): 2
Connection Timeout (seconds): 1
Heartbeat Interval (seconds): 2
Retry Interval (seconds): 5
Failed Probe Count: 3

ICMP Probe Maximum Tries: 3
ICMP Probe Interval: 15

Global Service Settings
HTTP ✓ HTTPS ✓
SNMP ✓ SSH ✓

The following Global Parameters are configured on this screen (tab). Click on **Commit** to save your parameters or Reset to return the default values.

Hostname	This is Equalizer's host name (default: Equalizer).
Locale	Sets the Equalizer locale. **en** to set english locale. **ja** to set japanese locale.
Domain Name Server (1,2 or 3)	If using a Domain Name Server, the Domain Name Server Equalizer will use.

Failover Section

Receive Timeout (ms)	This is the failover timeout (in ms) for receiving peer data.
Connection Timeout (ms)	This is the failover timeout (in ms) for peer connections.
Heartbeat interval	The target interval between TCP probes of a cluster that has been marked *failing* in the load balancing daemon's internal tables. If the server does not respond to **strikeout threshold** (see below) additional TCP probes after it is marked *failing*, then the server is marked down. These additional probes are at

	least **probe interval** seconds apart. This value is solely a target; the monitoring process adjusts itself based on a number of factors, including system load. The default value is 20 seconds.
Retry Interval (ms)	This is the time (in ms) between failed failover peer probes.
Failed Probe Count	This is the maximum number of failed failover peer probes. The global **Failed Probe Count** is not used until ALL heartbeating subnets have at least one strike. Once each subnet has a strike, we fail over when the number of failed heartbeats across all heartbeating subnets is equal to or greater than the global **Failed Probe Count**. (Refer to "Configuring VLAN (Subnet) Failover Settings (GUI)" on page 441 and "Configuring VLAN (Subnet) Failover Settings (CLI) " on page 439.
ICMP Probe Maximum Tries	Enables probing servers using ICMP echo (ping) probes. These probes are 5 seconds apart. If a server does not respond to an ICMP prebend it has attempted to probe the number of times specified, it is marked *down* only if there are no other probes (TCP, ACV, or server agent) active for the cluster.

Global Service Settings Flags

These are the Set the globally permitted VLAN services. (**HTTP**, **HTTPS, SNMP**, **SSH**) Use the checkboxes to enable.

SNMP

The Simple Network Management Protocol (SNMP) is an internet standard that allows a management station to monitor the status of a device over the network. SNMP organizes information about the Equalizer and provides a standard way to help gather that information. Using SNMP requires:

- An SNMP agent running on the system to be monitored.
- A Mangement information Base (MIB) database on the system to be monitored.
- An SNMP management station running on the same or another system.

An SNMP agent and MIB databases are provided on Equalizer Models E350GX and above, implemented for SNMPv1 and SNMPv2c. If using a MIB browser, use SNMPv2c to ensure returned statistics.

A management station is not provided with Equalizer and must be obtained from a third party supplier. The management station is often used primarily to browse through the MIB tree, and so is sometimes called a MIB browser. One such management station that is available in a free personal edition is the iReasoning MIB Browser, available from www.ireasoning.com.

A MIB database is a hierarchical tree of variables whose values describe the state of the monitored device. A management station that want to browse the MIB database on a device sends a request to the SNMP agent running on the device. The agent queries the MIB database for the variables requested by the management station, and then sends a reply to the management station.

With SNMP, you can monitor the following information from the Equalizer MIBs:

Static configuration information, such as:

- Device name and Model
- Software version
- Internal and External IP addresses and netmasks
- Default gateway
- Failover alias

Equalizer's failover details

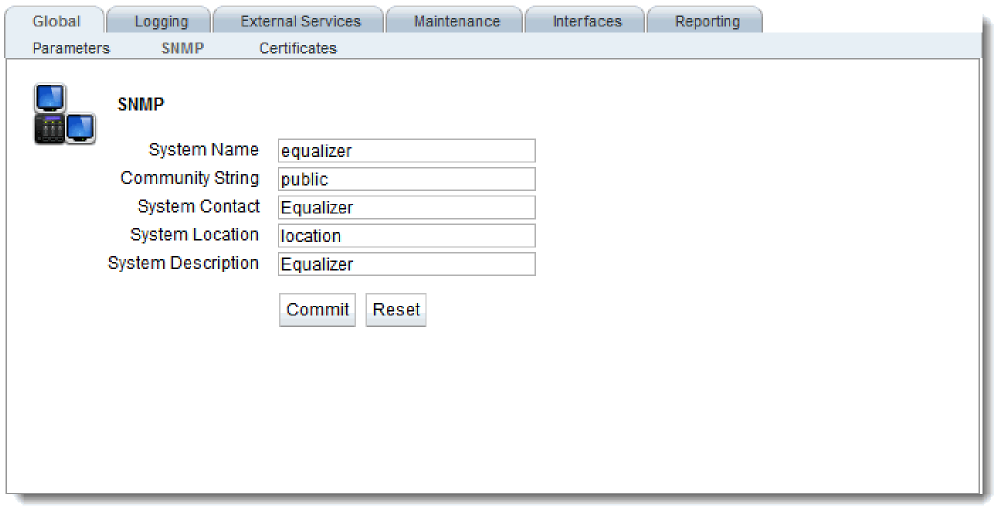
- Sibling Name
- Sibling Status (Primary or Secondary)

Dynamic configuration information, such as:

- Failover Status (Primary or Secondary)
- NAT enabled
- L4 configuration state
- L7 configuration state
- Server Health check status
- Email status notification
- Cluster parameters (timeouts, buffers)
- Server parameters Equalizer status
- L4 Statistics
- L7 Statistics Equalizer cluister
- L4 or L7 protocol of cluster
- Load balancing policy for cluster
- IP address and port (or range)
- Sticky time and inter cluster sticky
- Cookie On or Off

By default, SNMP is a globally enabled service -- meaning that it will run on any subnet that is configured to offer the SNMP service. You must specifically enable SNMP on the subnet or subnets on which you want it to listen for SNMP MIB browser and management station connections.

SNMP parameters are displayed on the GUI by clicking on the **hostname** on the left navigational panel, selecting **Global** tab and then selecting SNMP and will be displayed as follows:



System Name	equalizer
Community String	public
System Contact	Equalizer
System Location	location
System Description	Equalizer

The parameters are as follows:

System Name - this is the name assigned to the system. By default it is **Equalizer**.

Community String - Any SNMP management console needs to send the correct community string along with all SNMP requests. If the sent community string is not correct, Equalizer discards the request and will not respond.

System Contact - Contact is the name of the person responsible for this unit.

System Location - Location describes Equalizer's physical location.

System Descriptions - this is the user-assigned description of the Equalizer.

Click on **Commit** to save your changes.

MIB Compliance

EQ/OS 10 fully supports these proprietary Coyote Point Systems Equalizer MIBS:

- CPS-EQUALIZER-v10-MIB
- CPS-REGISTRATIONS-v10-MIB
- cpsSystemEqualizerv10Traps

Note - In Equalizer Version 8.6 the names of the MIBs were CPS-REGISTRATIONS-MIB and CPS-EQUALIZER-MIB; their filenames were cpsreg.my and cpsequal.my, respectively. Substantial changes were made to the MIBs for EQ/OS 10. Therefore, the MIB names and filenames are changed for EQ/OS 10. Version 8.6 MIBS will not work with Version 10 MIBS.

EQ/OS 10 provides partial support for these standard MIBS:

RFC1213-MIB (RFC1213)

System	tcp: *tcpInSegs, tcpOutSegs, tcpRetransSegs, tcpInErrs, tcpOutRsts; and tcpConnTable*
Interfaces	udp
IP: *ipForwarding, ipDefaultTTL, ipInReceives, ipInHdrErrors, ipInAddrErrors, ipForwDatagrams, ipInUnknownProtos, ipInDiscards, ipInDelivers, ipOutRequests, ipOutDiscards, ipOutNoRoutes, ipReasmReqds, ipReasmOKs, ipReasmFails, ipFragOKs, ipFragFails, ipFragCreates; ipAddrTable and ipNetToMediaTable*	snmp
icmp	***The remaining objects are not supported***

HOST-RESOURCES-MIB (RFC2790)

hrSystemUptime	hrProcessorLoad
hrSystemDate	hrNetworkTable
hrStorage	***The remaining objects are not supported.***
hrDeviceTable	

MIB Files

All MIBs referenced by the supported MIBs are included on Equalizer.

The MIB filenames comprise the MIB name plus the filename extension ".my":

```
CPS-EQUALIZER-v10-MIB.my
CPS-REGISTRATIONS-v10-MIB.my
HOST-RESOURCES-MIB.my
HOST-RESOURCES-TYPES.my
IANAifType-MIB.my
IF-MIB.my
INET-ADDRESS-MIB.my
IP-MIB.my
RFC1155-SMI.my
RFC1213-MIB.my
SNMPv2-CONF.my
SNMPv2-MIB.my
SNMPv2-SMI.my
SNMPv2-TC.my
TCP-MIB.my
UDP-MIB.my
```

The MIB files can be downloaded from Equalizer using a browser pointed at:

```
http://<equalizer>/eqmanual/<mibname>.my
```

Certificates

Each SSL certificate installed on Equalizer includes a certificate and its associated private key.

In SSL off loading, Equalizer terminates the SSL connection with the client, decrypts the client request using a certificate and key, sends the request on to the appropriate server, and encrypts the server response before forwarding it on to the client.

Certificates are uploaded to Equalizer and then associated with one or more clusters. Two types of certificates may be used to authenticate HTTPS cluster connections:

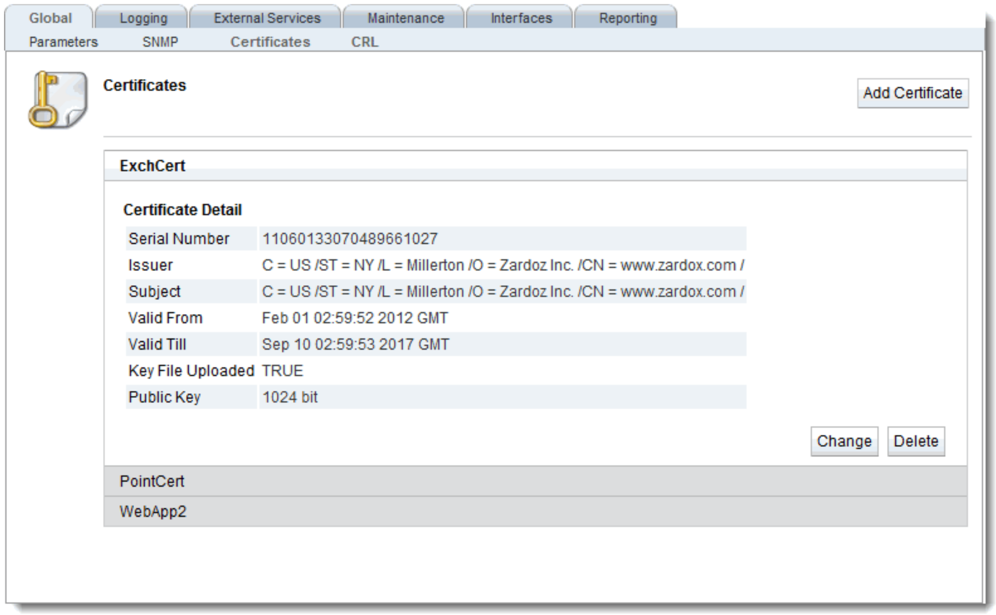
- A *cluster certificate* is required to authenticate the cluster to the client and to decrypt the client request (these are also called server certificates). For cluster certificates, both a certificate file and a private key file must be uploaded to Equalizer.

- A cluster may also be configured to ask for, or require, a client certificate -- a certificate used to authenticate the client to Equalizer. For client certificates, only a certificate file is uploaded to Equalizer (no keyfile is used).

Installing a Certificate

To install an SSL certificate:

1. Click on the host name at the top of the left navigational pane and then click on **Global > Certificates** to display the following.



Certificates

ExchCert

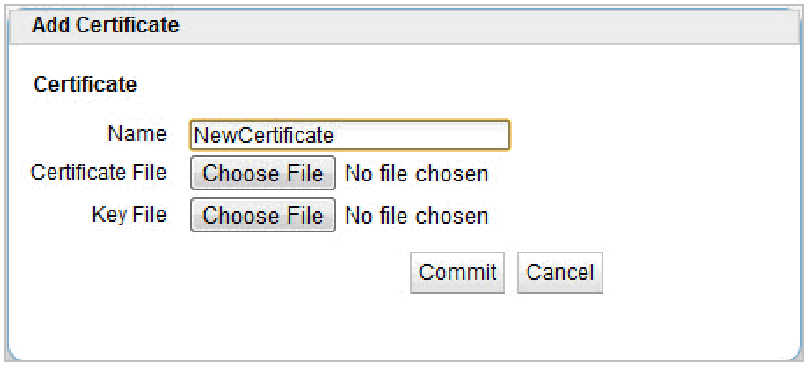
Certificate Detail

Serial Number	11060133070489661027
Issuer	C = US /ST = NY /L = Millerton /O = Zardoz Inc. /CN = www.zardox.com /
Subject	C = US /ST = NY /L = Millerton /O = Zardoz Inc. /CN = www.zardox.com /
Valid From	Feb 01 02:59:52 2012 GMT
Valid Till	Sep 10 02:59:53 2017 GMT
Key File Uploaded	TRUE
Public Key	1024 bit

PointCert

WebApp2

2. Click on **Add Certificate** to display the **Add Certificate** dialogue form as shown below.



Add Certificate

Certificate

Name	NewCertificate
Certificate File	No file chosen
Key File	No file chosen

3. Click on **Choose File** to select a locally stored **Certificate File**. Repeat the same for adding a locally stored **Key File**.

4. Click on **Commit** to save the upload the new **Certificate File** and **Key File**.

Certificate Revocation Lists

The Certificate Revocation List (CRL) can be used to verify that the certificates used by Equalizer are valid and have not been compromised. A CRL is uploaded to Equalizer and then associated with one or more clusters in the cluster specific context. Whenever a certificate is used to authenticate a connection to the cluster, the CRL is checked to make sure the certificate being used has not been revoked.

Equalizer provides support for Certificate Revocation Lists (CRLs) using a central CRL store to which CRLs can be uploaded and then associated with as many clusters as required.

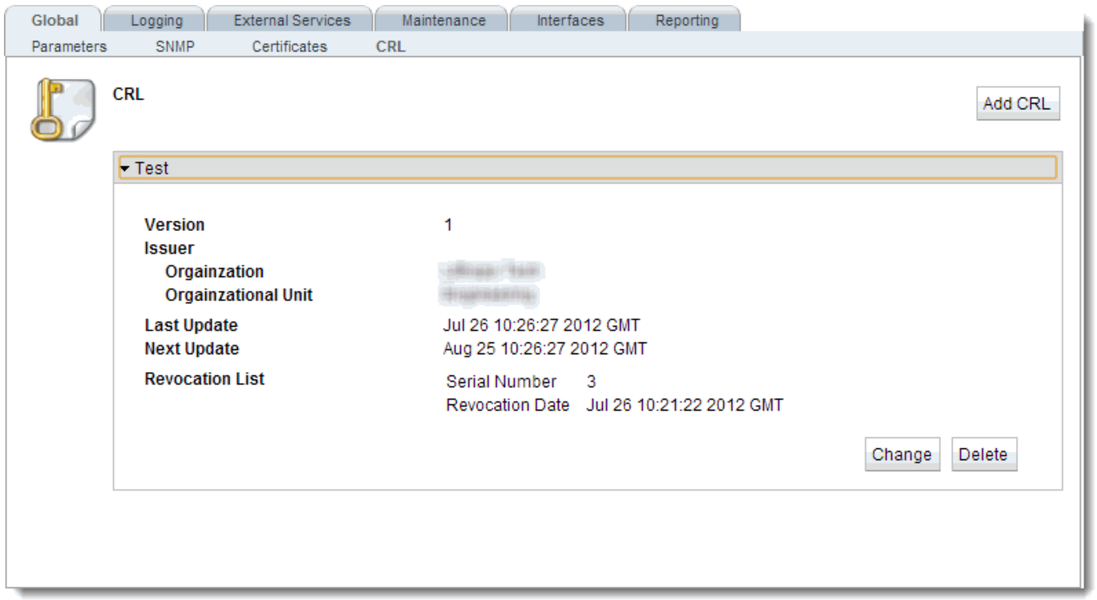
If a CRL attached to a cluster was generated by a Certificate Authority (CA) different from the CA used to generate a client certificate presented when connecting to the cluster, an error will occur, The CRL and client certificate must be signed by the same CA.

Installing a Certificate Revocation List (CRL)

Installed CRLs will be displayed in an accordion style list. Click on each list item to expand it and display the contents of the CRL.

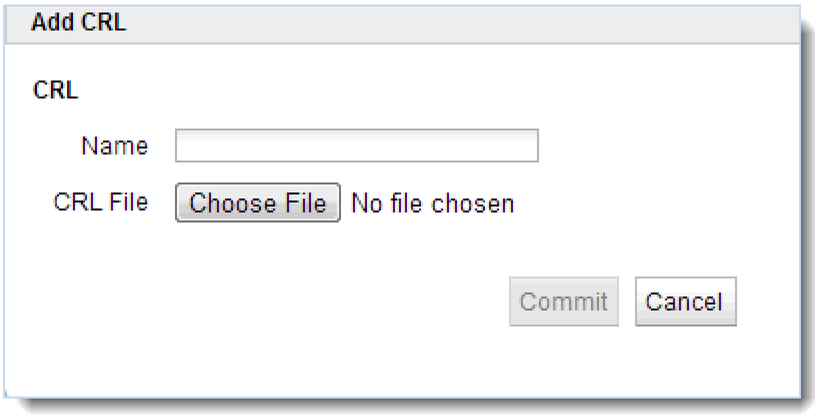
Proceed with the following to install a CRL:

1. Click on the host name at the top of the left navigational pane and then click on **Global > CRL** to display the following.

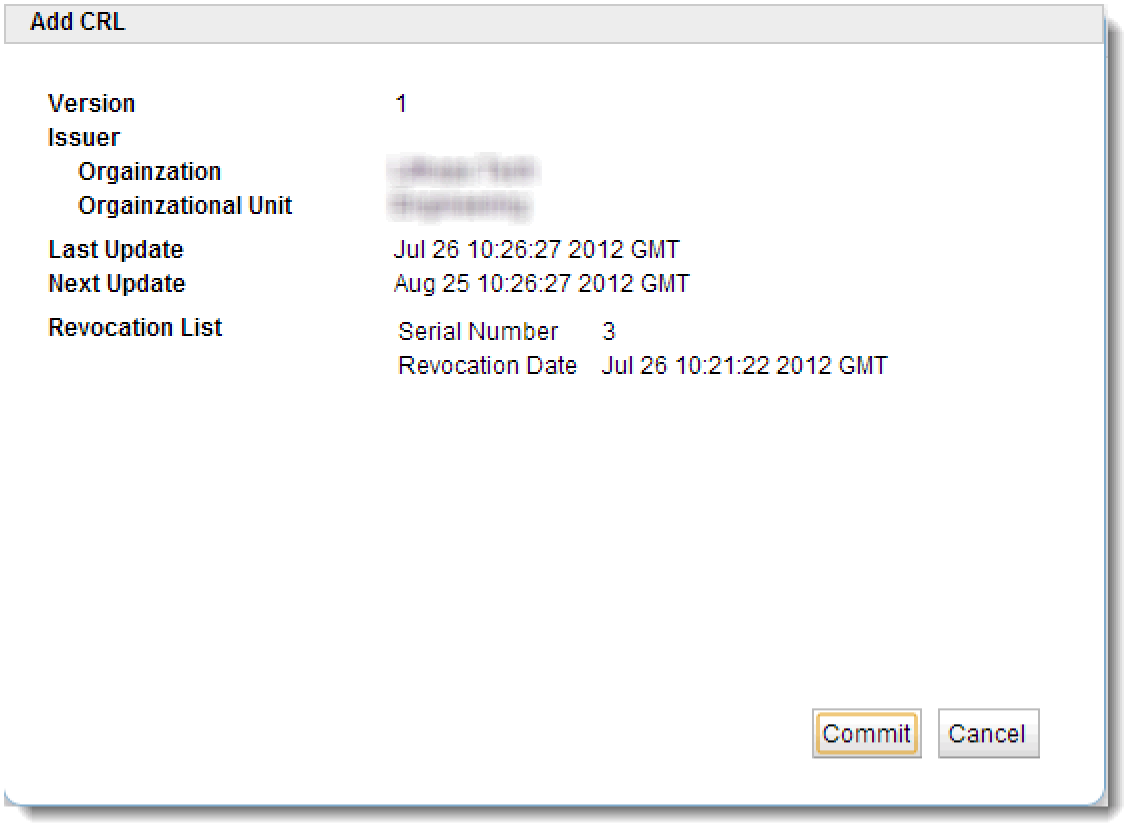


Version	1
Issuer	
Orgainzation	[illegible]
Orgainzational Unit	[illegible]
Last Update	Jul 26 10:26:27 2012 GMT
Next Update	Aug 25 10:26:27 2012 GMT
Revocation List	Serial Number 3
	Revocation Date Jul 26 10:21:22 2012 GMT

2. Click on **Add CRL** to display the **Add CRL** dialogue screen as shown below.



3. Click on **Choose File** to select a CRL file to upload to Equalizer. Select a ***.crl** file to upload, enter a **Name**, and then click on **Commit**. A confirmation screen will appear as follows:



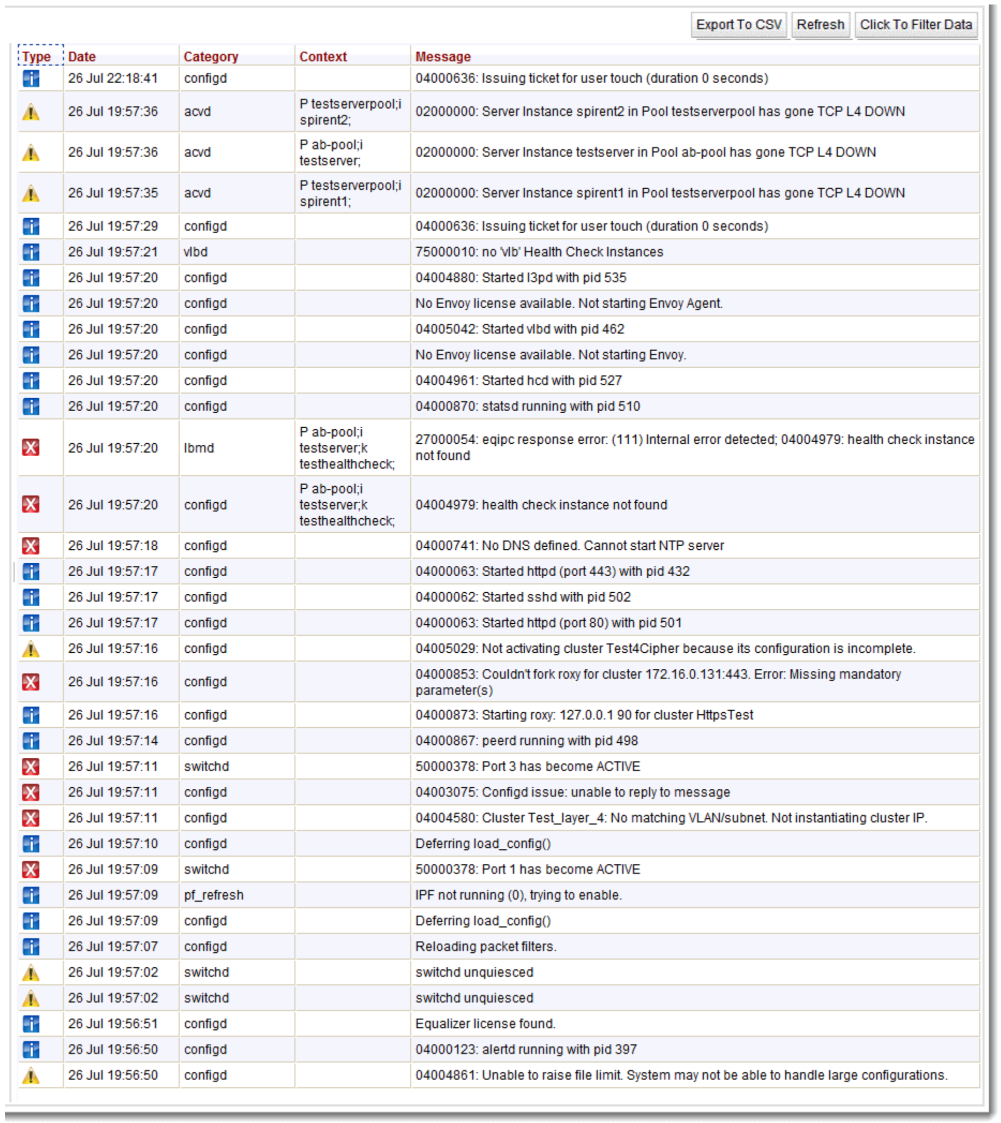
Add CRL

Version	1
Issuer	
Orgainzation	[illegible]
Orgainzational Unit	[illegible]
Last Update	Jul 26 10:26:27 2012 GMT
Next Update	Aug 25 10:26:27 2012 GMT
Revocation List	Serial Number 3 Revocation Date Jul 26 10:21:22 2012 GMT

Click on **Commit** if the **CRL** is the one you would like to upload to Equalizer. The CRL file will be uploaded to Equalizer and will appear on the **Global > CRL** screen as shown above.

Events Log

The events log displays events for each element configured on the Equalizer. This includes Clusters, Server Pools, Servers and Responders. It is accessed by clicking on the **hostname** on the left navigational pane on the GUI and clicking on the **Status** tab. An example of a display is shown below.



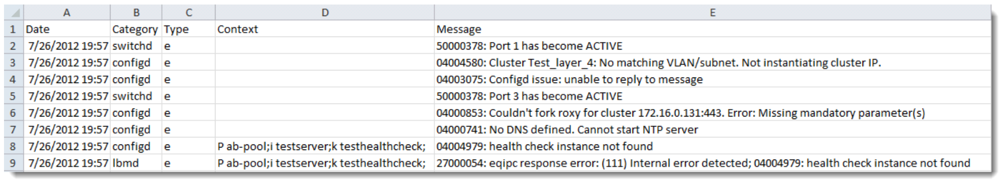
Type	Date	Category	Context	Message
ℹ	26 Jul 22:18:41	configd		04000636: Issuing ticket for user touch (duration 0 seconds)
⚠	26 Jul 19:57:36	acvd	P testserverpool;i spirent2;	02000000: Server Instance spirent2 in Pool testserverpool has gone TCP L4 DOWN
⚠	26 Jul 19:57:36	acvd	P ab-pool;i testserver;	02000000: Server Instance testserver in Pool ab-pool has gone TCP L4 DOWN
⚠	26 Jul 19:57:35	acvd	P testserverpool;i spirent1;	02000000: Server Instance spirent1 in Pool testserverpool has gone TCP L4 DOWN
ℹ	26 Jul 19:57:29	configd		04000636: Issuing ticket for user touch (duration 0 seconds)
ℹ	26 Jul 19:57:21	vlbd		75000010: no 'vlb' Health Check Instances
ℹ	26 Jul 19:57:20	configd		04004880: Started l3pd with pid 535
ℹ	26 Jul 19:57:20	configd		No Envoy license available. Not starting Envoy Agent.
ℹ	26 Jul 19:57:20	configd		04005042: Started vlbd with pid 462
ℹ	26 Jul 19:57:20	configd		No Envoy license available. Not starting Envoy.
ℹ	26 Jul 19:57:20	configd		04004961: Started hcd with pid 527
ℹ	26 Jul 19:57:20	configd		04000870: statsd running with pid 510
✖	26 Jul 19:57:20	lbmd	P ab-pool;i testserver;k testhealthcheck;	27000054: eqipc response error: (111) Internal error detected; 04004979: health check instance not found
✖	26 Jul 19:57:20	configd	P ab-pool;i testserver;k testhealthcheck;	04004979: health check instance not found
✖	26 Jul 19:57:18	configd		04000741: No DNS defined. Cannot start NTP server
ℹ	26 Jul 19:57:17	configd		04000063: Started httpd (port 443) with pid 432
ℹ	26 Jul 19:57:17	configd		04000062: Started sshd with pid 502
ℹ	26 Jul 19:57:17	configd		04000063: Started httpd (port 80) with pid 501
⚠	26 Jul 19:57:16	configd		04005029: Not activating cluster Test4Cipher because its configuration is incomplete.
✖	26 Jul 19:57:16	configd		04000853: Couldn't fork roxy for cluster 172.16.0.131:443. Error: Missing mandatory parameter(s)
ℹ	26 Jul 19:57:16	configd		04000873: Starting roxy: 127.0.0.1 90 for cluster HttpsTest
ℹ	26 Jul 19:57:14	configd		04000867: peerd running with pid 498
✖	26 Jul 19:57:11	switchd		50000378: Port 3 has become ACTIVE
✖	26 Jul 19:57:11	configd		04003075: Configd issue: unable to reply to message
✖	26 Jul 19:57:11	configd		04004580: Cluster Test_layer_4: No matching VLAN/subnet. Not instantiating cluster IP.
ℹ	26 Jul 19:57:10	configd		Deferring load_config()
✖	26 Jul 19:57:09	switchd		50000378: Port 1 has become ACTIVE
ℹ	26 Jul 19:57:09	pf_refresh		IPF not running (0), trying to enable.
ℹ	26 Jul 19:57:09	configd		Deferring load_config()
ℹ	26 Jul 19:57:07	configd		Reloading packet filters.
⚠	26 Jul 19:57:02	switchd		switchd unquiesced
⚠	26 Jul 19:57:02	switchd		switchd unquiesced
ℹ	26 Jul 19:56:51	configd		Equalizer license found.
ℹ	26 Jul 19:56:50	configd		04000123: alertd running with pid 397
⚠	26 Jul 19:56:50	configd		04004861: Unable to raise file limit. System may not be able to handle large configurations.

If you clicking on each individual **Clusters**, **Server Pools**, **Servers** or **Responders** the objects to the left of events table will display events for the object selected.

The log can be sorted by **Type**, **Date**, **Category**, **Context** and **Message** by clicking on the column heading on your browser.

Export to CSV

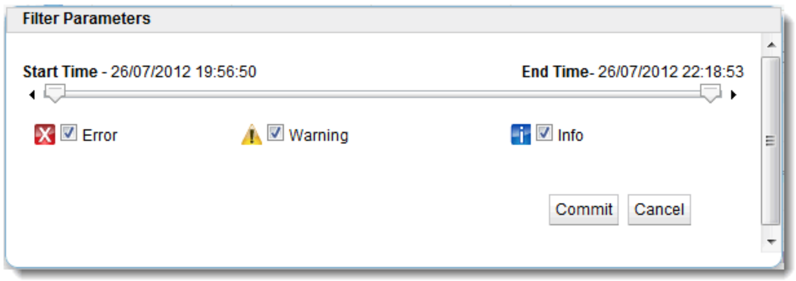
Click on the **Export to CSV** button to download the load in comma separated values (*.csv) format. The file name will be in the format **equalizer-mon-dd[time frame]EventLog.csv**. An example is shown below. This is an example of a change added to this document.



	A	B	C	D	E
1	Date	Category	Type	Context	Message
2	7/26/2012 19:57	switchd	e		50000378: Port 1 has become ACTIVE
3	7/26/2012 19:57	configd	e		04004580: Cluster Test_layer_4: No matching VLAN/subnet. Not instantiating cluster IP.
4	7/26/2012 19:57	configd	e		04003075: Configd issue: unable to reply to message
5	7/26/2012 19:57	switchd	e		50000378: Port 3 has become ACTIVE
6	7/26/2012 19:57	configd	e		04000853: Couldn't fork roxy for cluster 172.16.0.131:443. Error: Missing mandatory parameter(s)
7	7/26/2012 19:57	configd	e		04000741: No DNS defined. Cannot start NTP server
8	7/26/2012 19:57	configd	e	P ab-pool;i testserver;k testhealthcheck;	04004979: health check instance not found
9	7/26/2012 19:57	lbmd	e	P ab-pool;i testserver;k testhealthcheck;	27000054: eqipc response error: (111) Internal error detected; 04004979: health check instance not found

Filtering Status Details

After displaying events for all of Equalizer's configured objects or individual objects, the events displayed in the table can be filtered by specifying **Start Times** and **End Times**. Click on **Click to Filter Data** to display the **Filter Parameters** dialogue as shown below

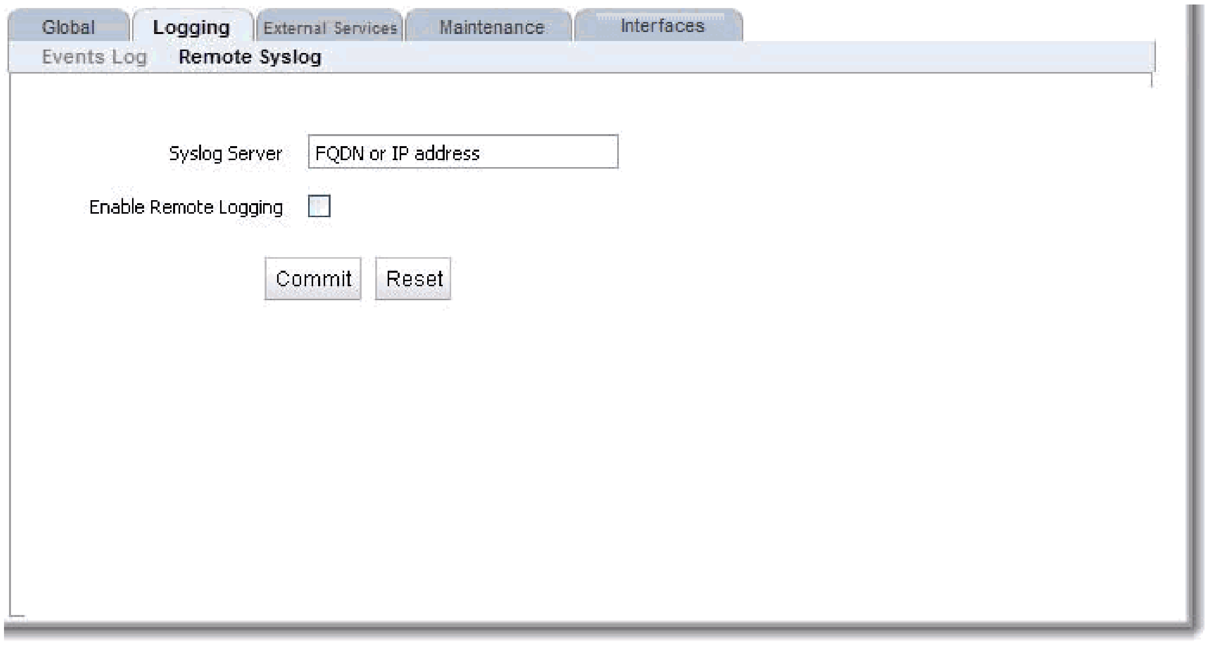

Filter Parameters
Start Time - 26/07/2012 19:56:50
End Time- 26/07/2012 22:18:53
Error
Warning
Info
Commit
Cancel

Use the sliders to specify **Start Time** and **End Time** to display events within a time frame on the Events log table.

The **Error**, **Warning** and **Info** flags can be selected to display those selected events within the time frame selected with the silders . After selecting these display options click on **Commit** to redisplay the even log.

Remote Syslog

The Remote Syslog screen allows you to specify a remote Syslog Server and to enable the logging of events for this remote host. It is accessed by clicking on the host name on the left navigational pane on the GUI and clicking on the **Logging** tab and then **Remote Syslog**. An example of a display is shown below.



Syslog Server: FQDN or IP address

Enable Remote Logging

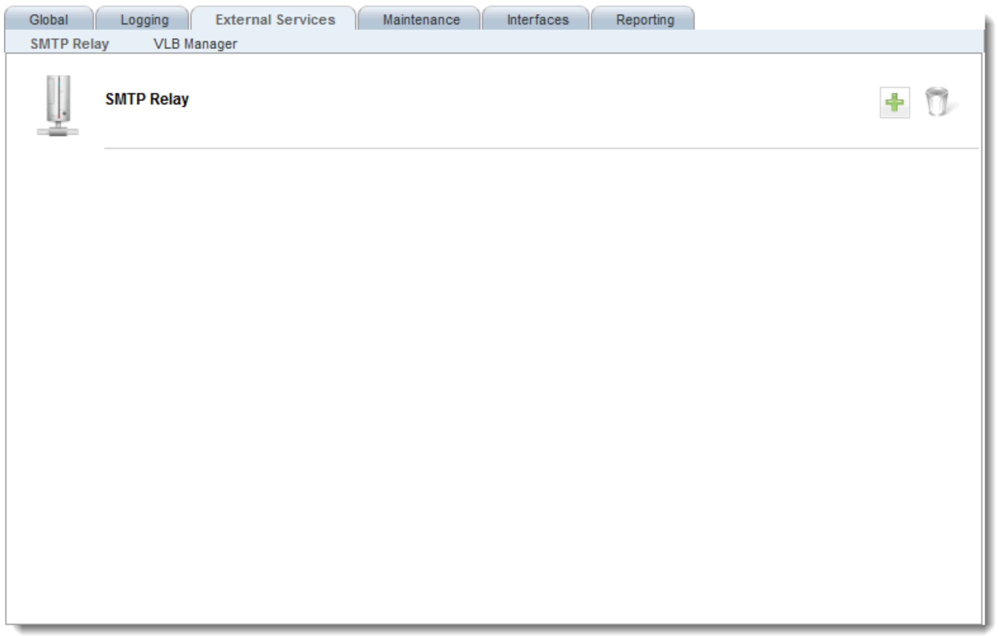
Enter a name of the **Remote Syslog** server and enable the logging by checking the **Enable Remote Logging** checkbox. Click on **Commit** to save the entry.

External Services

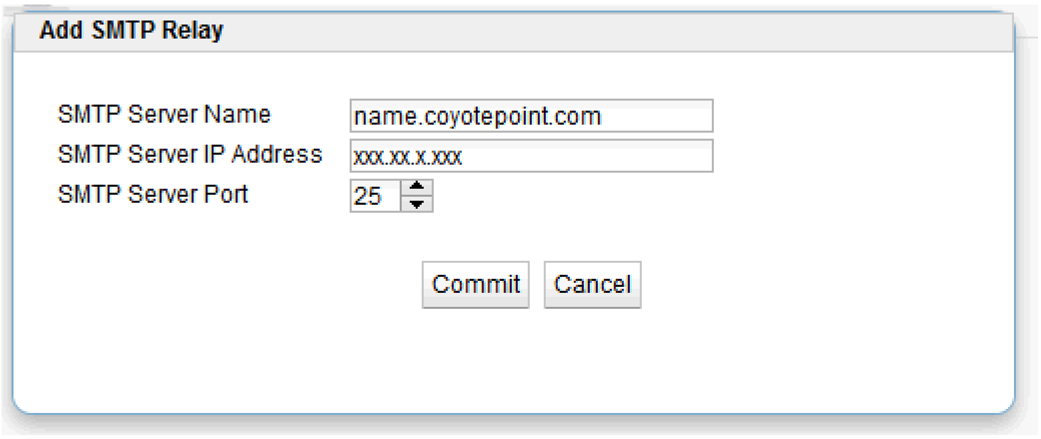
SMTP Relay

The **SMTP Relay** screen is used to specify an SMTP Relay Server and specify an IP address and Equalizer port to use. It is accessed by clicking on the host name on the left navigational pane and selecting the **External Services** tab.

Currently, only one SMTP relay is supported.



To add and SMTP relay, click on ✚ to display the **Add SMTP Relay** form as shown below:



SMTP Server Name	name.coyotepoint.com
SMTP Server IP Address	xxx.xx.x.xxx
SMTP Server Port	25

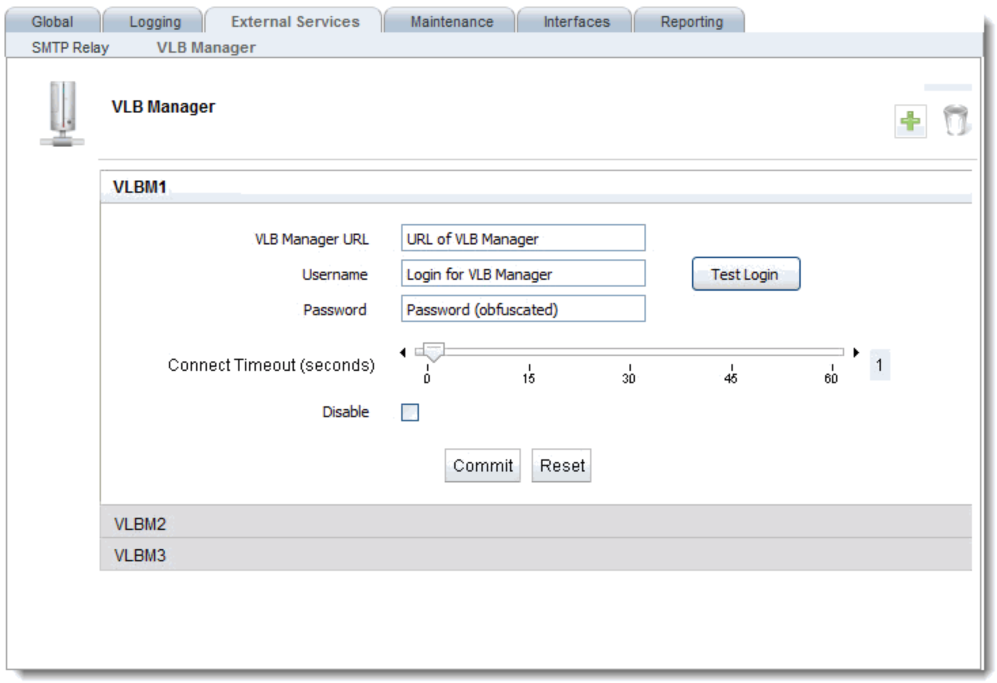
Enter an IP Address for the SMTP Relay in the **SMTP Server IP Address** field. Specify an Equalizer port to use using the **SMTP Server Port** selection. The **Port** defaults to **25** and can range from 1 to 65535.

Click on **Commit** to save the entries.

To delete an STMP relay, select the relay and click on the 🗑 icon.

VLB Manager

In order to obtain VMware virtual machine information, Equalizer needs access information for the vCenter console (or ESX server) managing the virtual machines. To enable communication between Equalizer and a vCenter console, the **External Services VLB Manager** configuration screen is used to set up communication login credentials to VMware using saved configurations that allow easy communication between Equalizer and VMware. In the figure below three saved configurations are shown.



VLB Manager URL: URL of VLB Manager
Username: Login for VLB Manager
Password: Password (obfuscated)
Connect Timeout (seconds): 1
Disable: ☐

- Click on the appropriate label at the bottom of the screen to expand the screen so that you can edit parameters on any of the existing connections.
- Click on the "+" sign to add a new VLB Manager.
- Click on delete icon ("trash can") to delete the displayed VLB Manager.

Enter the following details for each VLB used:

URL - The URL configured on the system running vCenter (or on an ESX Server) for VMware API connections. By default, this is an https:// URL using the IP address of the vCenter system followed by /sdk, as in:

```
https://192.168.1.50/sdk
```

Username - The VMware user account that you normally use to log into the vCenter or ESX Server that manages your VMware configuration.

Password - The password for your VMware user account. (Note that this text box is blank when you open the tab, even if a password has been previously saved.)

When enabled, this allows Equalizer to communicate with virtual machines and to log into VMware automatically and enable virtual machines in clusters. If the **Disable** option is selected, no connections to Virtual Center will be made.

The **Connect Timeout** slider is used to set the allowable time to make a connection. If a connection to the VMware is NOT made within the time configured, a “failure” message will be displayed. The default **Connect Timeout** is 1 second.

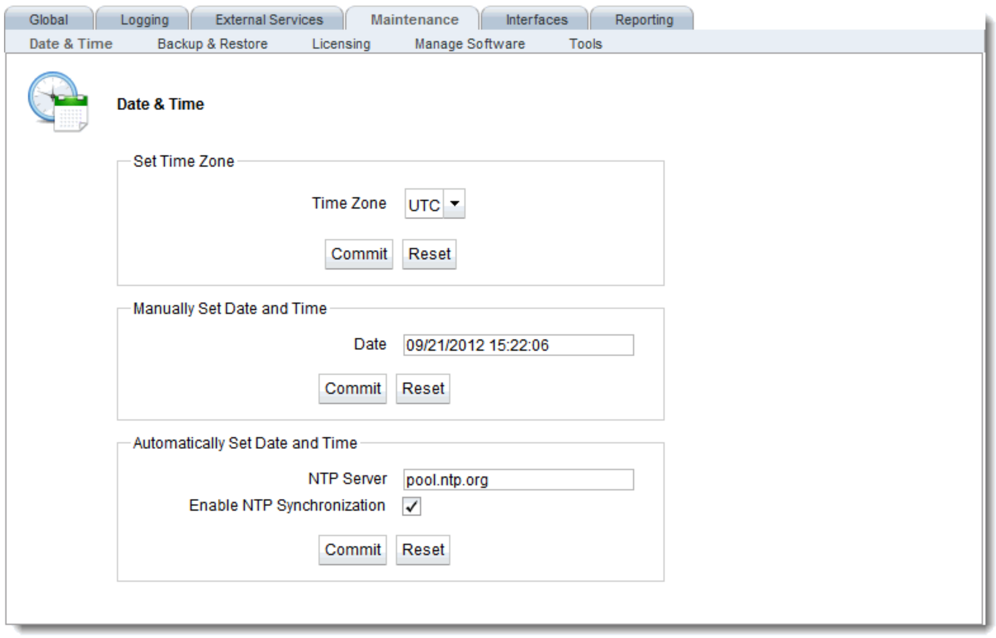
Clicking on the **Test Login** button will attempt to log in to the displayed virtual machine using the credentials you specified. After clicking a “success” or “failure” response will be displayed.

Maintenance

The Maintenance screen (tab) allows you to access the sections in the related topics.

Setting Date and Time

The System time setting screen is used to manually enter the current system date and time. This is accessed by selecting Equalizer on the left navigational pane and selecting the **Maintenance** (tab) and then selecting **Date & Time** to display the following.



Date & Time

Set Time Zone

Time Zone: UTC

Manually Set Date and Time

Date: 09/21/2012 15:22:06

Automatically Set Date and Time

NTP Server: pool.ntp.org

Enable NTP Synchronization: ✓

Set Time Zone

Use the Time Zone drop down list to set the Time Zone. Click on **Commit** to save the settings. Click on **Reset** to reset all the newly entered values to the previous values.

Manually Set Date and Time

Enter the current date and time in the **Date** field in the format: `mm/dd/yyyy hh:mm:ss` Click on **Commit** to save the settings.Click on **Reset** to reset all the newly entered values to the previous values.

Automatically Set Date and Time

Network Time Protocol (NTP) is a protocol and software implementation for synchronizing the clocks of computer systems. It provides Coordinated Universal Time (UTC) including scheduled leap second adjustments and will be used to synchronize the clock in Equalizer. Select the **Enable NTP Synchronization** option to enable this feature. Click on **Commit** to save the settings.

Refer to "Selecting an NTP Server" on page 122 for additional information about the NTP servers.

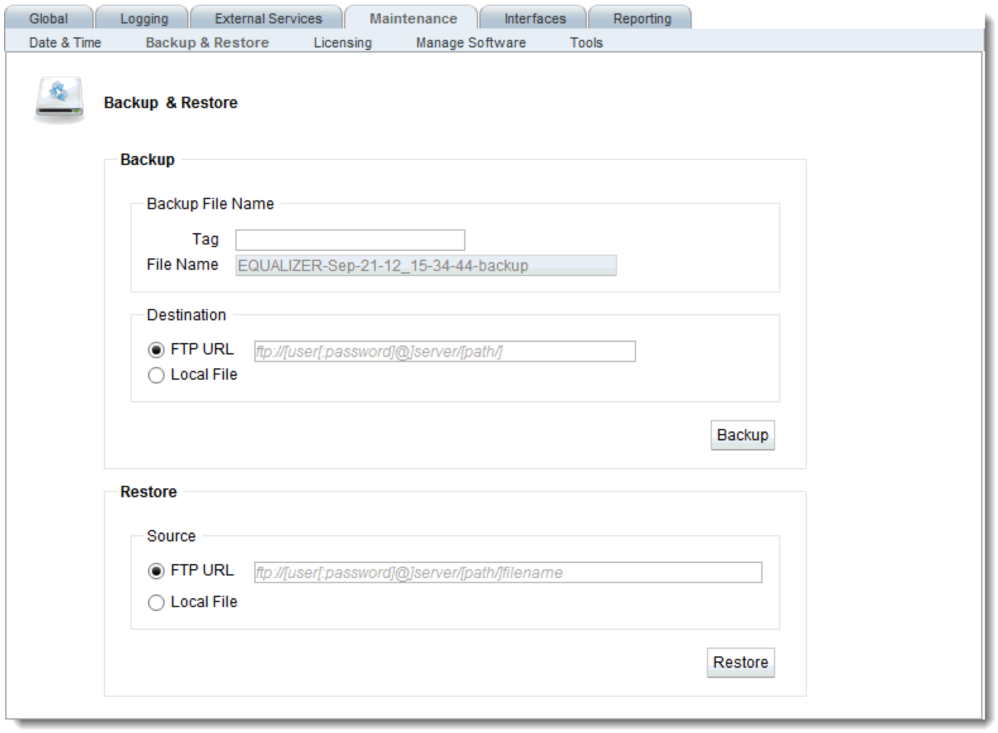
Backup and Restore

The Backup feature allows you to back up an Equalizer's user-configured objects and parameters to a file that can be uploaded and later restored to another Equalizer. Backup files may be uploaded to an FTP site or saved locally.

The Restore feature allows you to restored a previous backup file containing user-configured objects and parameters to another Equalizer. Restored files may be uploaded to an Equalizer through FTP or from a locally saved backup file.

Backup and Restore procedures can be performed using with eqcli or the GUI. Refer to "Backup and Restore" on page 541 for procedures.

The GUI configuration of Backup and Restore is accomplished by clicking on Equalizer, the Maintenance tab and then Backup and Restore to display the following:



File Name: EQUALIZER-Sep-21-12_15-34-44-backup

Destination: FTP URL: ftp://[user[:password]@]server/[path/]

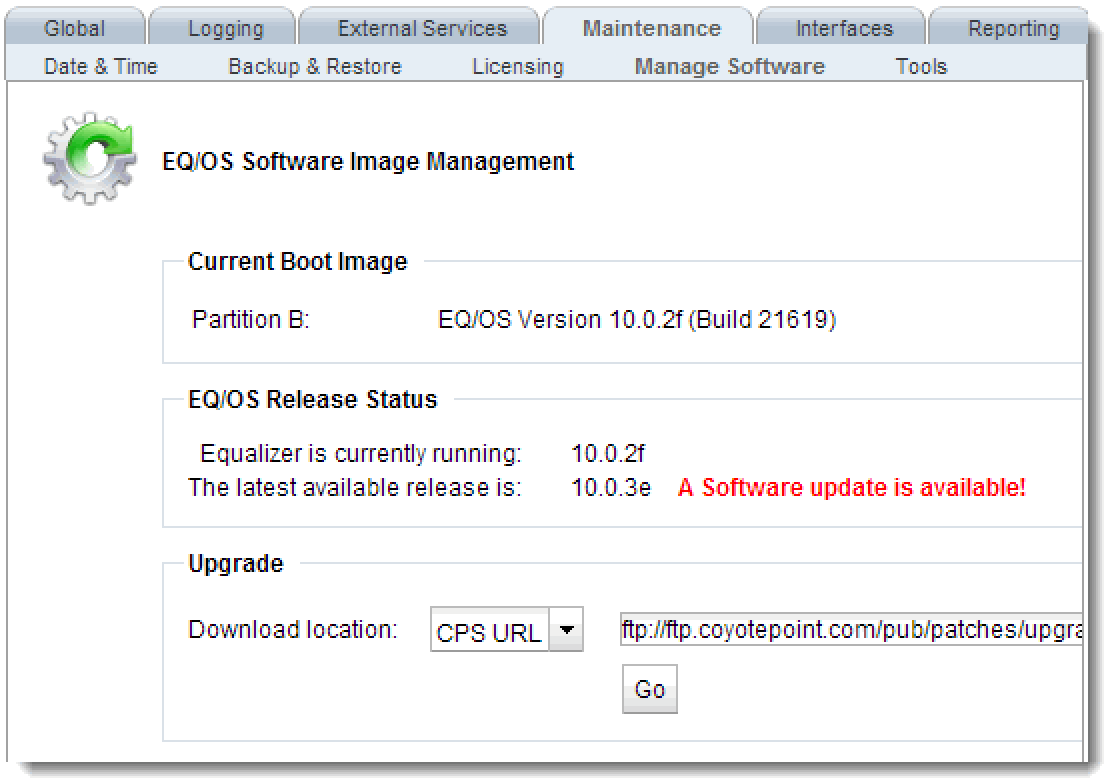
Source: FTP URL: ftp://[user[:password]@]server/[path/]filename

Licensing

Refer to "Licensing Equalizer" on page 68 for descriptions.

Manage Software

You can upgrade your version of EQ OS 10 using the **EQ/OS Software Manage Software** screen on the GUI. This is accessed by clicking on the hostname at the top of the left navigational pane and selecting **Maintenance >** .



EQ/OS Software Image Management

Current Boot Image

Partition B: EQ/OS Version 10.0.2f (Build 21619)

EQ/OS Release Status

Equalizer is currently running: 10.0.2f

The latest available release is: 10.0.3e A Software update is available!

Upgrade

Download location: CPS URL ftp://ftp.coyotepoint.com/pub/patches/upgra

Current Boot Image

The current boot image and the partition where it resides is displayed.

EQ/OS Release Status

When you select the upgrade tab the GUI downloads the well-known page on our website and retrieves the current release and URL information. If the release running on your Equalizer is older than the latest version available on the Coyote Point website, then the red bold text with a message *"A software update is available"* will be displayed. If your browser cannot download the well-known page, then the **Latest available release is** indication will display *"Connection to CPS website unsuccessful."* and a URL to the download site will be displayed in the **CPS download URL** space.

Upgrade

To download and install an image, select the download location using the drop down list.

If **Local File** is selected you will be prompted for the location of the local file. When a file is selected the path and file name will be displayed.

If **CPS URL** is selected the CPS download URL pointing to **the latest available release** shown in the **EQ/OS Release Status** pane will automatically be displayed on the right.

If **User URL** is selected you will need to manually enter a URL in the text box on the right that points to a single-file download image.

After selecting the **Download Location** click on **Go** to begin the upgrade. If successfully a *"GUI Installation successfully completed"* message will be displayed.

If the upgrade does not complete successfully, verify your network connectivity and the location of the upgrade file and attempt the upgrade again.

Tools

The Tools screen provides three useful utilities that includes:

- A **Halt/Shutdown** command, allows you to turn your Equalizer "off" from directly in the GUI.
- A **Reboot System** command, allows you to reboot your Equalizer from directly in the GUI.
- A **Save System State** feature, that allows you to create an archive of your various configuration files, logs and other details used to help in diagnosing any issues that may arise.

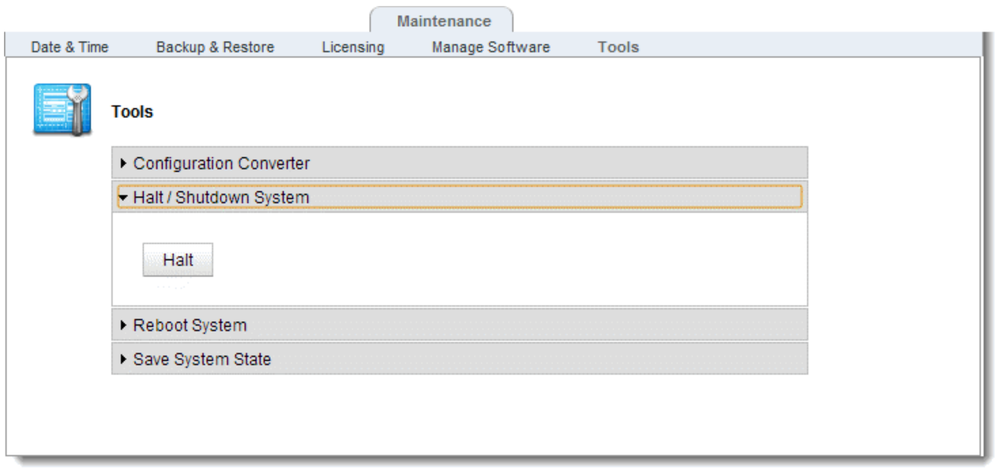
Access any of the tools by selecting the appropriate accordion tab to display the commands/details.

Configuration Converter

See "EQ/OS 8.6 to EQ/OS 10 Configuration Conversion Process" on page 560.

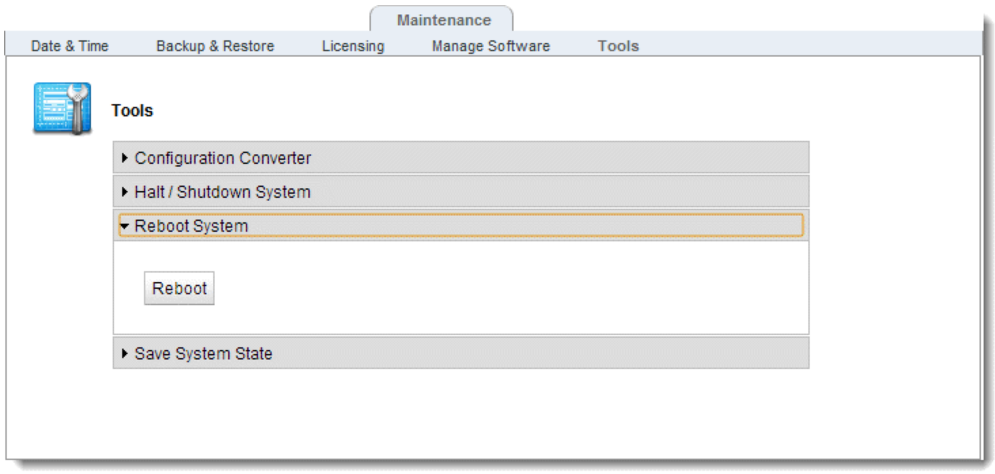
Halt/Shutdown System

Click on the **Halt/Shutdown System** accordion tab to display the following. Click on the **Halt** button to shut down your Equalizer.



Reboot System

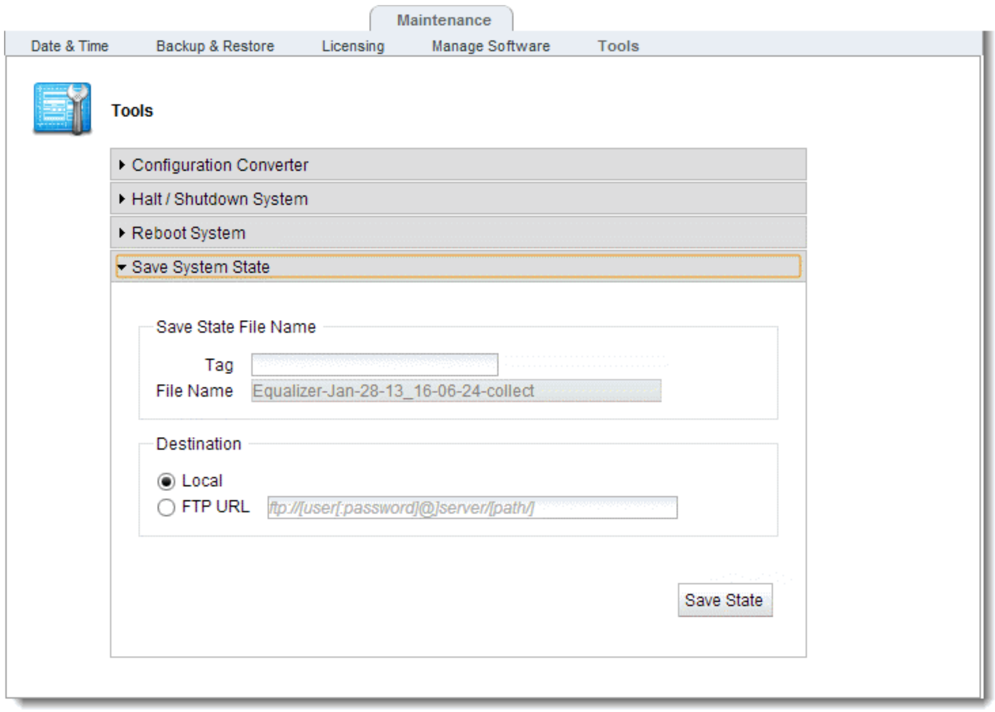
Click on the Reboot System accordian tab to display the following. Click on the **Reboot** button to reboot your Equalizer.



Save System State

Click on the **Save System State** accordian tab to display the following. In this screen you can set up a Save State or system information archive that contains various configuration files, logs, and other information used by Coyote Point Support to help diagnose problems you are having with Equalizer. The file can be saved locally or uploaded to an FTP server.

1. Click on the **Maintenance** tab and then **Save State** to display the following:



File Name Equalizer-Jan-28-13_16-06-24-collect

(● Local) FTP URL ftp://[user[:password]@]server/[path/]

2. Enter a **File Name** for the archive. This should be in the format: ***`hostname-tag-date_time-collect.tbz`*** If desired, enter a unique **`tag`** for the archive file name in the **Tag** field which will be included in the archive file name. If a tag is not entered, the file name will be in the format specified, however, without that **`tag`** element.

3. Select either the **Local** or **FTP URL** option in the **Destination** pane.

a. If you select **Local**, the archive will be saved in the default "save" directory specified in your web browser options.

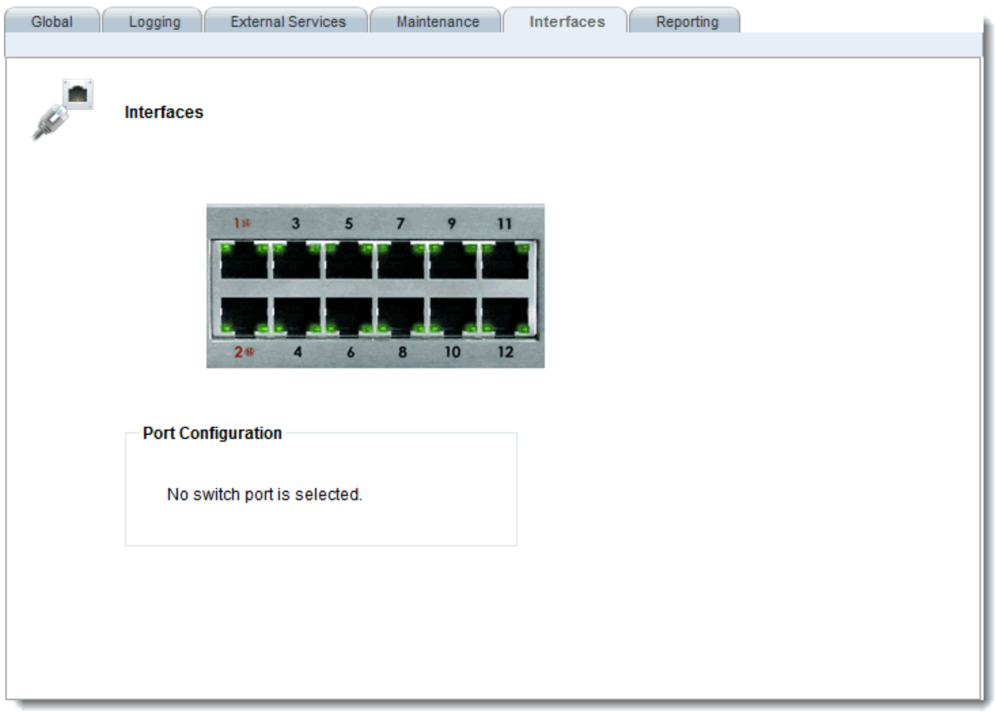
b. If you select **FTP URL**, enter the URL of the FTP site on which you will upload the archive file.The URL should be in the format: ***`ftp://[user[:password]@]server/[path/].`***

4. Select the **Save State** button to create the archive. Once Equalizer collects the information for the archive, a dialog box is displayed by your browser to open or save the archive.

5. If you require technical support, open your email client and send the file you saved to **support@coyotepoint.com** as an attachment or provide the URL (with credentials) for the FTP site on which the archive now resides. Explain the nature of your problem in the email, or just include the support ticket number you were given previously by Coyote Point Support.

Interfaces

You can display Link Status and Port settings for Equalizer by selecting the host name on the left navigational pane and then selecting the **Interfaces** tab. The following will be displayed.



Port Configuration

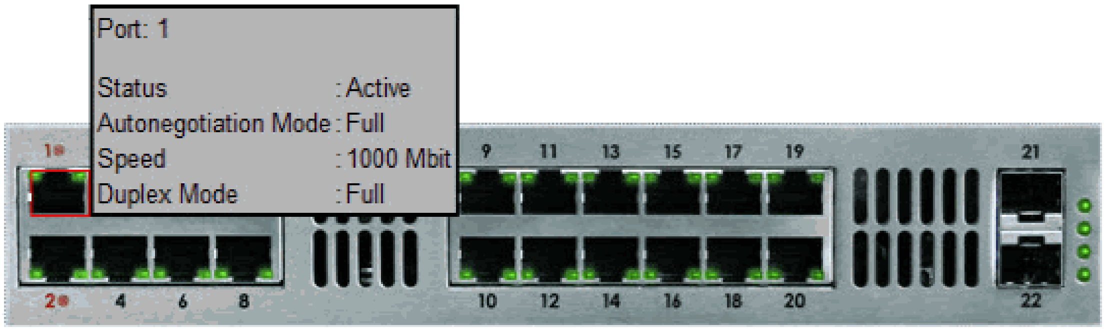
No switch port is selected.

Refer to "Viewing Link Status and Port Settings" on page 215, "Modifying Port Settings" on page 217, and "Displaying Port Statistics" on page 218 for additional options using **Interfaces**.

Viewing Link Status and Port Settings

Select a port on the Equalizer display to display statistics the port. When you select a port a pop up will be displayed as shown below indicating the **Status**, **AutonegotiationMode**, **Speed** and **DuplexMode** information.

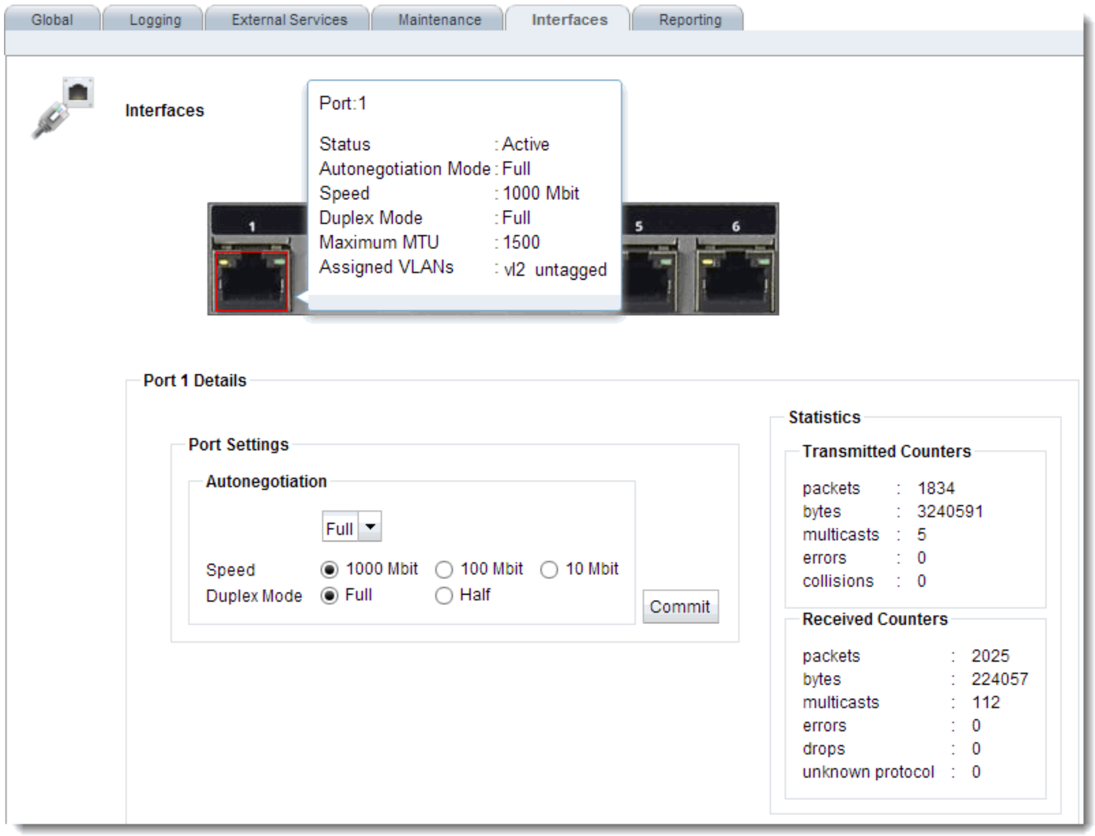
The following is en example of a switched system, Equalizer E650GX. The E350GX and E450GX are also switched systems.



Port: 1

Status : Active
Autonegotiation Mode : Full
Speed : 1000 Mbit
Duplex Mode : Full

The following is an example of an non switched system, Equalizer E370LX. The E250GX is also non switched.



Interfaces

Port:1

Status : Active
Autonegotiation Mode : Full
Speed : 1000 Mbit
Duplex Mode : Full
Maximum MTU : 1500
Assigned VLANs : vl2 untagged

Port 1 Details

Port Settings

Autonegotiation

Full

Speed [✓ 1000 Mbit] 100 Mbit 10 Mbit

Duplex Mode [✓ Full] Half

Statistics

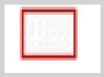
Transmitted Counters

packets	:	1834
bytes	:	3240591
multicasts	:	5
errors	:	0
collisions	:	0

Received Counters

packets	:	2025
bytes	:	224057
multicasts	:	112
errors	:	0
drops	:	0
unknown protocol	:	0

The following symbols will be displayed, indicating status:

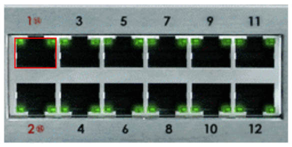
	Red box indicates that the port has been selected, which will display the Port Configuration pop up as shown above.
	Link, VLANs Assigned.
	No Link, VLANs Assigned.

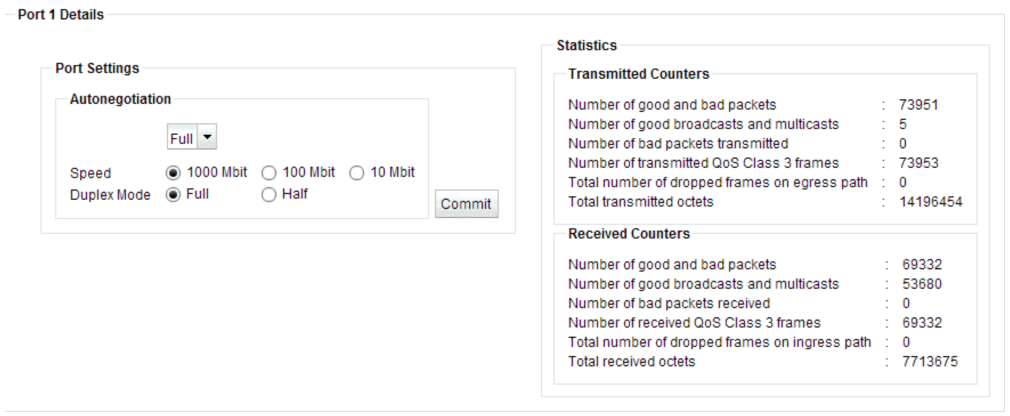
⚠	
■	No Link, No VLANs Assigned.
✖	Administratively Disabled.

Modifying Port Settings

You modify settings for any selected port using the GUI by selecting **Equalizer** on the left navigational pane and then selecting the **Interfaces** tab.

Select a port on the Equalizer display to modify as shown below.





Port 1 Details

Port Settings

Autonegotiation: Full

Speed: [✓ 1000 Mbit] 100 Mbit 10 Mbit

Duplex Mode: [✓ Full] Half

Commit

Statistics

Transmitted Counters

Number of good and bad packets	:	73951
Number of good broadcasts and multicasts	:	5
Number of bad packets transmitted	:	0
Number of transmitted QoS Class 3 frames	:	73953
Total number of dropped frames on egress path	:	0
Total transmitted octets	:	14196454

Received Counters

Number of good and bad packets	:	69332
Number of good broadcasts and multicasts	:	53680
Number of bad packets received	:	0
Number of received QoS Class 3 frames	:	69332
Total number of dropped frames on ingress path	:	0
Total received octets	:	7713675

Port Configuration - the following options are available:

Autonegotiation	If the you select **Full** from the drop down list, the **Speed** and **Duplex** selections are not available. If **Select** or **Force** are selected, you can then set the desired speed/duplex. Whether you choose full, select, or force depends on the operating characteristics of the device on the other end of the connection. Check the documentation for the other device and try to match the settings as much as possible on both sides of the connection.
Full	if you select this option from the drop down list Equalizer will attempt to auto negotiate the highest available speed with the unit on the other end of the connection.
Select	**Autonegotiation** at the current speed and duplex parameter settings only.
Force	Set the port to the current **speed** and **duplex** parameter settings with no

	autonegotiation.
Duplex Mode	If the port status is Link Up, this is the current port duplex setting. If the status is Link Down, this is either the highest duplex that can be negotiated, or the force setting. Can be set to **Full** or **Half**.
Speed	If the **Port Status** is **Link Up**, this is the current port speed. If the **Port Status** is **Link Down**, this is the highest speed that can be negotiated, or the force setting. Can be set to **10**, **100**, or **1000** Mbits. On the GX series, the link light on Equalizer's ports will be displayed in green ● when connected at 1000 Mbit and amber ● when connected at 100 Mbit. On the E370LX Equalizer, the link light will be displayed in amber ● when connected at 1000 Mbit and green ● when connected at 100 Mbit.

Displaying Port Statistics

The following statistics can be displayed for a selected port. Select a port on the Equalizer display to display statistics the port. The tables below show a typical port statistics displays for both switched and non-switched systems.

For switched systems, (E350GX, E450GX, E650GX)

Transmit Counters	
Number of good and bad packets	The total number of packets, good or bad, transmitted by Equalizer.
Number of good broadcasts and multicasts	The total number of good broadcast/multicast (e.g., ARP) packets transmitted by this port.
Number of bad packets transmitted	The total number of bad packets transmitted by this port.
Number of transmitted QoS Class 3 frames	The total number of received Quality of Service (QoS) Class 3 frames transmitted by this port
Total number of dropped frames on egress path	The total number of packets that were dropped (e.g., lack of transmit buffer , collision detection). These packets are not transmitted by the port.
Total transmitted octets	The total number of bytes (8 bits) transmitted by this port.
Receive Counters	
Number of good and bad packets	The total number of packets received, good or bad, by this port.

Number of good broadcasts and multicasts	The total number of good broadcast/multicast (e.g., ARP) packets received on this port.
Number of bad packets received	The total number of bad packets (e.g., CRC errors, alignment errors, too short) received on this port.
Number of received QoS Class 3 frames	The total number of received Quality of Service (QoS) Class 3 frames received by this port.
Total number of dropped frames on ingress path	The total number of packets that were dropped (e.g., lack of receive buffer, congestion, invalid classification, e.g., tagged frame received on untagged port) by the receiving port.
Total received octets	The total number of bytes (8 bits) received by this port.

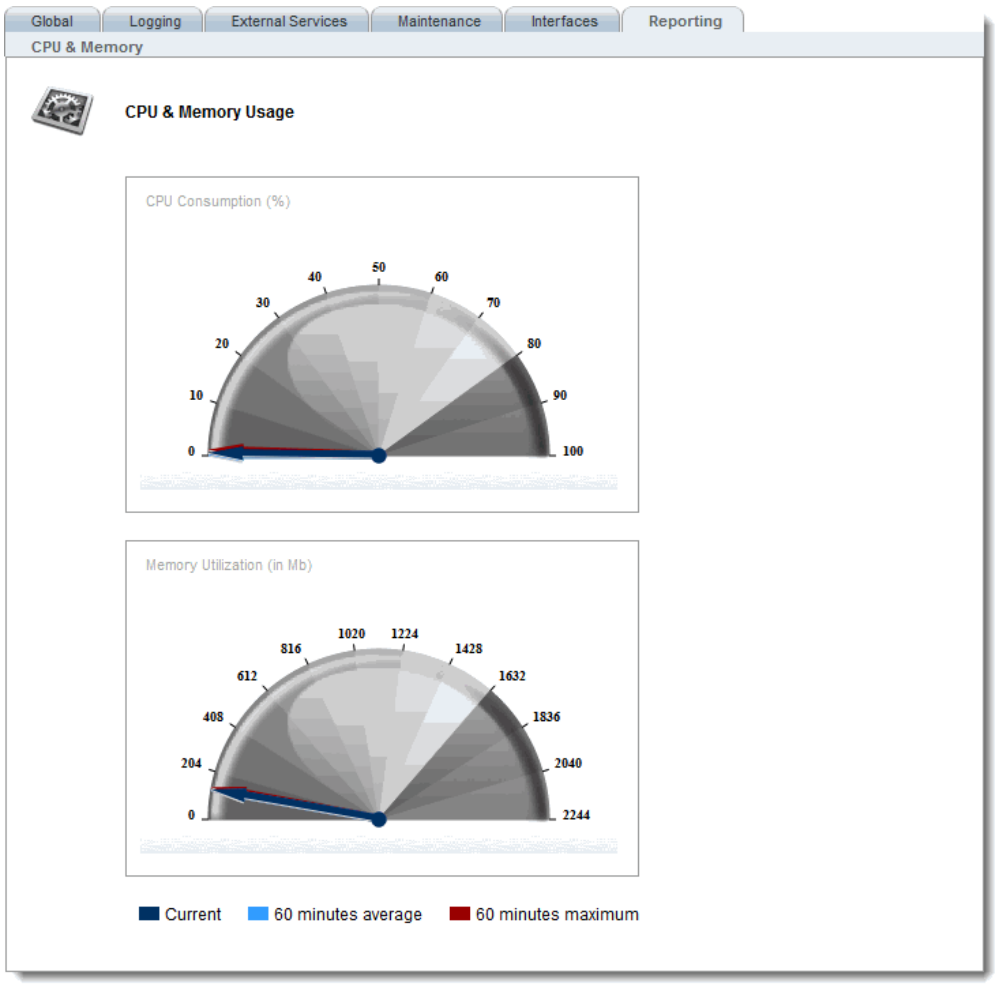
For non-switched systems (EQoD, Envoy SAE OnDemand, E250GX, E370LX):

Transmit Counters	
Packets	The total number of transmitted packets on this interface.
bytes	The total number of bytes transmitted on this interface
multicasts	The total number of good broadcast/multicast (e.g., ARP) packets transmitted by this interface.
errors	The total number of bad packets transmitted by this interface.
collisions	The total number of packets that were dropped (e.g., lack of transmit buffer , collision detection). These packets are not transmitted by the interface.
Receive Counters	
Packets	The total number of packets received on this interface.
bytes	The total number of bytes received on this interface.
multicasts	The total number of good broadcast/multicast (e.g., ARP) packets received on this interface.

errors	The total number of bad packets (e.g., CRC errors,, alignment errors) received on this interface.
drops	The total number of packets that were dropped (e.g., lack of receive buffer, congestion, invalid classification, e.g., tagged frame received on untagged port) by the receiving interface.
unknown protocol	Tot total number of packets received on this interface that used an unknown protocol.

Reporting

After selecting the host name from the left navigational pane , click on the **Reporting** tab to display the **CPU & Memory** screen as shown below.



This screen displays the **Current** and **60-minute averages** of CPU Consumption percentage and Memory Utilization in Mb.

Additional Equalizer Objects on the GUI

The Equalizer Command Line Interface eqcli or “CLI” is a major new feature in EQ/OS 10. In addition to configuration using the GUI Equalizer can be configured using the CLI. Since the additional Equalizer Objects that appear on the left navigational pane of the GUI can be configured using the CLI as well as the GUI, they are described within their own sections of this Guide.

For **Peers** - See "Failover" on page 423

For **Clusters** - See "Clusters" on page 259

For **Server Pools** - See "Server Pools and Server Instances" on page 229

For **Servers** - See "Servers" on page 243

For **VLANs** and VLAN configuration- See "Equalizer Use of VLAN Technology" on page 99.

For **Responders** - See "Automatic Cluster Responders" on page 347

For **GeoClusters** - See "Configuring GeoClusters" on page 518.

For **GeoSites** - See "Configuring GeoSites" on page 526.

For **Tunnels** - See "IPv6 Tunnel Overview" on page 224.

Chapter 12

Configuring an IPv6 Tunnel

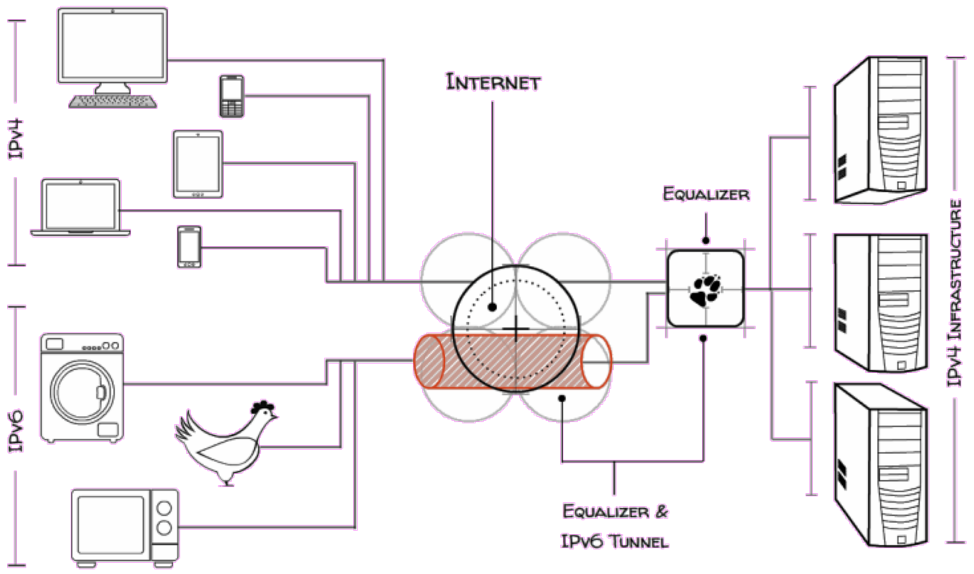
Sections in this chapter include:

IPv6 Tunnel Overview

Every network administrator needs to have a strategy to address the transition to the IPv6 Internet. Various *transition mechanisms* have been defined that are intended to make it as easy as possible for organizations to get on the IPv6 Internet using their current IPv4 network infrastructure. For many organizations, the easiest and fastest way to get applications up and running on the IPv6 Internet is to use a transition mechanism called an *IPv6 tunnel*.

One of the most common issues when an organization begins to support IPv6 is how to allow IPv6 enabled devices to communicate over those portions of the network that are not IPv6 enabled. This can include both portions of a corporate intranet as well as Internet connections managed by an Internet Service Provider (ISP) that does not yet provide IPv6 connectivity.

An *IPv6 tunnel* solves this issue by encapsulating IPv6 packets inside IPv4 packets for transmission over IPv4-only connections.



An IPv6 tunnel is obtained through an IPv6 *tunnel broker*. An IPv4 connection is established between a system at your site (in this case, an Equalizer) and a system at the tunnel broker's site. Clusters on Equalizer are assigned IPv6 addresses within the subnet assigned by the tunnel broker. Clients can then access the IPv6 cluster address through the tunnel.

There are a number of tunnel brokers providing IPv6 tunnels to various geographical regions. In general, you should pick a tunnel broker that maintains tunnel servers that are geographically close to your location for best performance.

This chapter describes how you can set up an IPv6 tunnel using the **Hurricane Electric IPv6 Tunnel Broker**. Coyote Point has partnered with Hurricane Electric (HE), one of the leading IPv6 tunnel brokers, to provide an easy way to configure a tunnel that uses the *6in4tunneling protocol*. Note that a 6in4 tunnel from any tunnel broker can be used and requires the same basic commands on Equalizer to establish your tunnel -- only the required setup on the tunnel broker's website will be different. Hurricane Electric offers an easy to use web interface that allows you to request and configure a tunnel usually within a few hours.

Note that a number of different tunneling protocols exist, and the tunneling protocols supported vary between tunnel brokers, so check a tunnel broker's website to be sure they support 6in4 tunnels before you request one.

For example, Hurricane Electric provides what they call “regular” tunnels and “BGP” tunnels. For Equalizer, you would choose a “regular” Hurricane Electric tunnel, which is a 6in4 tunnel.

A 6in4 tunnel allows a user to access the IPv6 internet by tunneling over an existing IPv4 connection from an IPv6-enabled host to one of Hurricane Electric's IPv6 routers on the internet. Once a tunnel is established, the IPv6 enabled host sends IPv6 traffic over the local IPv4 network by encapsulating IPv6 packets inside IPv4 packets. These packets are sent to the IPv6 routers operated by the tunnel broker, unencapsulated, and then the IPv6 packets are forwarded to the IPv6 internet.

Note - You can use IPv6 cluster addresses without establishing a tunnel on Equalizer if your organization already has established an IPv6 tunnel and Equalizer can send IPv6 traffic through the local tunnel endpoint. In this configuration, you would simply assign cluster IPv6 addresses from the subnet associated with the already established tunnel and route the IPv6 traffic through the tunnel endpoint. This is done with the standard subnet configuration commands.

Configuring an IPv6 Tunnel

Setting up an IPv6 tunnel on Equalizer is basically a two step process:

1. Configure a VLAN over which Equalizer can reach the IPv4 Internet, and request a "6in4" tunnel from a tunnel broker.

2. After you receive the tunnel configuration information from the broker, set up the tunnel endpoint on Equalizer.

Once the tunnel is configured, you can perform additional tasks required to get Equalizer clusters on the IPv6 Internet, including:

- Assigning cluster IPv6 addresses from the subnet address range provided by the tunnel broker.

- Updating DNS to point to the tunnel broker’s DNS servers.

Creating a "6in4" IPv6 Tunnel (CLI)

1. Configure a VLAN and subnet to use as the local IPv4 endpoint for the tunnel using VLAN context commands (See "VLAN and Subnet Commands" on page 186). Note the following:

- The IPv4 address assigned to the subnet must either be a routable IPv4 address or resolve to a routable IPv4 address via Network Address Translation (NAT) on another device.

- The routable IPv4 address associated with this VLAN is the one that is supplied to the tunnel broker as the local endpoint of the tunnel. Changes to this address must be coordinated with the tunnel broker.

- The ports (both tagged and untagged) that are assigned to this VLAN are the ports on which the IPv6 address block assigned by the tunnel broker will be accessible.

2. Request a "regular" tunnel using Hurricane Electric’s website at:

   `http://www.tunnelbroker.net`

   When providing the local IPv4 endpoint address, use the IPv4 address assigned to the VLAN subnet created in Step 1, or its routable NAT address.

Hurricane Electric will set up the tunnel and provide you with the following information:

- The IPv4 and IPv6 addresses for the Hurricane Electric tunnel endpoint.
- The IPv6 address of the default route for the tunnel.
- The IPv6 address block assigned by Hurricane Electric (a /64 prefix subnet).
- The IP addresses of Hurricane Electric's IPv6 and IPv4 DNS servers. (See the section, "Configuring DNS for IPv6 Tunnels" on page 227 for how to configure DNS for your tunnel.)

3. Create the tunnel on Equalizer using the information from the previous step. [For illustration, we use the multi-line command format below; the **tunnel** command can also be entered on a single line.] Enter:

```
eqcli> tunnel HE1
eqcli tl-HE1> type ipip
eqcli tl-HE1> local_endpoint ipv4_addr
eqcli tl-HE1> remote_endpoint ipv4_addr
eqcli tl-HE1> local_address ipv6_addr
eqcli tl-HE1> remote_address ipv6_addr
eqcli tl-HE1> commit
```

The parameter arguments are as follows:

- **type -** Currently, **ipip** is the only permitted tunnel type.
- **local_endpoint -** The IPv4 address provided to the tunnel broker as the Equalizer endpoint for the tunnel. It is the IP address that the tunnel broker will use to reach Equalizer. This is either Equalizer’s VLAN IP on the subnet created in Step 1 or the IP address with which Equalizer’s VLAN IP is associated via Network Address Translation (NAT).
- **remote_endpoint -** The IPv4 address of the tunnel broker side of the tunnel as provided by the tunnel broker.
- **local_address -** The IPv6 address of the Equalizer side of the tunnel; this is assigned by the user and must be within the address range provided by the tunnel broker.
- **remote_address -** The IPv6 address of the tunnel broker side of the tunnel as provided by the tunnel broker.

4. If it does not already exist, configure the VLAN presence on the Equalizer for this tunnel:

```
eqcli> vlan vlan_name vid VLAN_ID flags tunnel
eqcli> vlan vlan_name subnet subnet_name ip local_address default_route ipv6_addr
```

Note the following:

- You can choose any names for the VLAN and subnet.
- The VLAN ID (**vid**) supplied must be appropriate for your network configuration.
- The IPv6 address used for the subnet **ip** parameter must be the same as the **local_address** specified for the **tunnel** command in the previous step.
- The **default_route** parameter must be set to the IPv6 address provided by the tunnel broker as the default tunnel route.
- The VLAN parameters **untagged_ports** and **tagged_ports** are not required when the **tunnel** flag is specified on the **vlan** command line. If they are specified, they will be ignored. [The front panel ports on which the tunnel is accessible are the ports defined for the VLAN that we set up in Step 1.]

You should now be able to assign IPv6 addresses from the tunnel's IPv6 address block as cluster IP addresses on Equalizer, and clients from the IPv6 Internet should be able to connect to them using the cluster's IPv6 address.

To configure DNS for IPv6, see the following section.

Configuring DNS for IPv6 Tunnels

The Domain Name System (DNS) is used by both IPv4 and IPv6 systems to provide name to address mapping, and address to name mapping. Systems that support both IPv4 and IPv6 will require DNS entries that describe the mappings for each protocol.

A new DNS record type, AAAA (sometime referred to as "quad-A"), has been defined for IPv6 name to address mappings (see RFC 3596). AAAA records contain a single IPv6 address mapped to a fully qualified domain name (FQDN). The assigned value for this record type is 28 (decimal). You will need to create AAAA records on your authoritative DNS server in order to access IPv6-enabled systems using their FQDN.

In addition, a special domain rooted at ".IP6.ARPA" is defined in RFC 3596 to provide a way of mapping an IPv6 address to a host name. This is commonly called "DNS reverse lookup", and is specified in your authoritative DNS server's reverse lookup files using PTR (or "pointer") records.

Please refer to the DNS documentation appropriate for your network configuration for more information on adding IPv6 AAAA and PTR records.

Chapter 13

Server Pools and Server Instances

Sections in this chapter include:

Managing Server Pools

A server is attached to a cluster via a server pool. A server pool is a collection of server definitions, each of which has additional parameters assigned to it in the server pool -- these additional parameters are organized by the server's name and are referred to as server instances within the server pool context. This allows you to associated a distinct set of server instance options (weight, flags, maximum number of connections), to multiple instances of the same real server in different server pools.

The following subsections describe Server Pool management using both the GUI and CLI.

Configuring Server Pool Load-Balancing Options

Configure load balancing policy and response settings for each server pool independently. Multiple clusters do not need to use the same load balancing configuration even if the same physical server machines host them. For example, if one cluster on port 80 handles HTML traffic and one on port 8000 serves images, you can configure different load balancing policies for each server pool.

When you use adaptive load balancing (that is, you have *not* set the cluster's load balancing policy to round robin or static weight), you can adjust Equalizer to optimize performance.

Equalizer's Load Balancing Policies

Equalizer supports the following load balancing policies, each of which is associated with a particular algorithm that Equalizer uses to determine how to distribute requests among the servers in the server pool:

- **Round-robin** load balancing - distributes requests equally on the server pool in the cluster. Equalizer dispatches the first incoming request to the first server, the second to the second server, and so on. When Equalizer reaches the last server, it repeats the cycle. If a server in the cluster is down, Equalizer does not send requests to that server. This is the default method.

  The round robin method does not support Equalizer's adaptive load balancing feature; so, Equalizer ignores the servers' initial weights and does not attempt to dynamically adjust server weights based on server performance.

- **Static** load balancing - distributes requests among the servers depending on their assigned initial weights. A server with a higher initial weight gets a higher percentage of the incoming requests. Think of this method as a *weighted round robin* implementation. Static weight load balancing does not support Equalizer's adaptive load balancing feature; Equalizer does not dynamically adjust server weights based on server performance.

  - **Adaptive** load balancing - distributes the load according to the following performance indicators for each server.

  - **Server response time** is the length of time for the server to begin sending reply packets after Equalizer sends a request.

  - **Active connection count** shows the number of connections currently active on the server.

  - **Server agent value** is the value returned by the server agent daemon (if any) running on the server.

- **Response** load balancing - dispatches the highest percentage of requests to the server with the shortest response time. Equalizer does this carefully: if Equalizer sends too many requests to a server, the result can be an overloaded server with slower response time. The fastest response policy optimizes the cluster-wide response time. The fastest response policy also checks the number of active connections and server agent values (if configured); but both of these have less of an influence than they do under the adaptive load balancing policy. For example, if a server's active connection count and server agent values are high, Equalizer might not dispatch new requests to that server even if that server's response time is the fastest in the cluster.

- **Least Cxns** (least connections) load balancing - dispatches the highest percentage of requests to the server with the least number of active connections. In the same way as Fastest Response, Equalizer tries to avoid overloading the server so it checks the server's response time and server agent value. Least Connections optimizes the balance of connections to servers in the cluster.

- **Server Agent** load balancing - dispatches the highest percentage of requests to the server with the lowest server agent value. In a similar way to Fastest Response, Equalizer tries to avoid overloading the server by checking the number of connections and response time. This method only works if the server agents are running on every server instance in the server pool.

- **Custom** load balancing - If custom is selected, you can adjust the load balancing policy parameters:

    - **Delay weight** The relative influence on the policy of the current response time between Equalizer and the server.

    - **Active Connections Weight** - The relative influence on the policy of the number of active connections currently open to a server

    - **Agent Weight**- The relative influence on the policy of the return value of a server agent (if any) running on the servers in the cluster.

    - **VM CPU** - For servers that are associated with VMware Virtual Machines, the relative influence on the policy of the VM CPU usage status returned by VMware. Displayed only if VLB Advanced is licensed and VLB is enabled for this cluster

    - **VM RAM** - For servers that are associated with VMware Virtual Machines, the relative influence on the policy of the VM RAM usage status returned by VMware. Displayed only if VLB Advanced is licensed and VLB is enabled for this cluster.

Equalizer's Load Balancing Response Settings

The **Responsiveness** setting controls how aggressively Equalizer adjusts the servers' dynamic weights. Equalizer provides five response settings: **Slowest**, **Slow**, **Medium**, **Fast**, and **Fastest**. The response setting affects the dynamic weight spread, weight spread coefficient, and optimization threshold that Equalizer uses when it performs adaptive load balancing:

- **Dynamic Weight Spread** indicates how far a server's dynamic weight can vary (or *spread*) from its initial weight.

- **Weight Spread Coefficient** regulates the speed of change to a server's dynamic weight. The weight spread coefficient causes dynamic weight changes to happen more slowly as the difference between the dynamic weight and the initial weight increases.
- **Optimization Threshold** controls how frequently Equalizer adjusts dynamic weights. If Equalizer adjusts server weights too aggressively, oscillations in server weights can occur and cluster-wide performance can suffer. On the other hand, if Equalizer does not adjust weights often enough, server overloads might not be compensated for quickly enough and cluster-wide performance can suffer.

Aggressive Load Balancing

After you fine-tune the initial weights of each server in the cluster, you might discover that Equalizer is not adjusting the dynamic weights of the servers at all: the dynamic weights are very stable, even under a heavy load. In this case, you might want to set the cluster's load balancing response parameter to *fast*. Then Equalizer tries to optimize the performance of your servers more aggressively; this should improve the overall cluster performance. For more information about setting server weights, see "Adjusting a Server's Initial Weight" on page 253.

Dynamic Weight Oscillations

If you notice a particular server's dynamic weight oscillates (for example, the dynamic weight varies from far below 100 to far above 100 and back again), you might benefit by choosing *slow* response for the cluster. You should also investigate the reason for this behavior; it is possible that the server application is behaving erratically.

Using Active Content Verification (ACV)

Active Content Verification (ACV) is a mechanism for checking the validity of a server. When you enable ACV for a server pool, Equalizer requests data from each server in the server pool and verifies that the returned data contains a character string that indicates that the data is valid. You can use ACV with most network services that support a text-based request/response protocol, such as HTTP. Note, however, that you cannot use ACV with Layer 4 UDP clusters.

ACV checking is performed as part of the high-level TCP probes that Equalizer sends to every server by default. To enable ACV, you specify an **ACV response** string for a server pool. Equalizer which will then search for the **ACV response** string in the first 1024 characters of the server's response to the high-level TCP probes. If the ACV response string is not found, the server is marked down. An ACV probe can be specified if the service running on the server's **probe port** requires input in order to respond.

How ACV works is best explained using a simple example. The HTTP protocol enables you to establish a connection to a server, request a file, and read the result.

`> telnet www.myserver.com 80 >>>>`	User requests connection to server.
`Connected to www.myserver.com >>>>`	Telnet indicates connection is established.
`> GET /index.html >>>>`	User sends request for HTML page.
`<HTML> >>>>>`	Server responds with requested page.
`<TITLE>Welcome to our Home Page </TITLE>`	
`</HTML>`	
`Connection closed by foreign host >>>>`	Telnet indicates server connection closed.

Equalizer can perform the same exchange automatically and verify the server's response by checking the returned data against an expected result.

Specifying an *ACV probe string* and an *ACV response string* basically automates the above exchange. Equalizer uses the probe string to request data from each server. To verify the server's content, Equalizer searches the returned data for the response string. For example, you can use "`GET /index.html`" as the *ACV probe string* and you can set the response string to some text, such as "`Welcome`" appears on the home page.

Similarly, if you have a Web server with a PHP application that accesses a database, you can use ACV to ensure that all the components of the application are working. You could set up a PHP page called **test.php** that accesses the database and returns a page containing "ALL OK" if there are no problems.

Then you would enter and ACV Query and an ACV Response String using either the CLI or GUI. :

If the page that is returned contains the correct response string in the first 1000 characters, including headers) the server is marked "up"; if "ALL OK" were not present, the server is marked down.

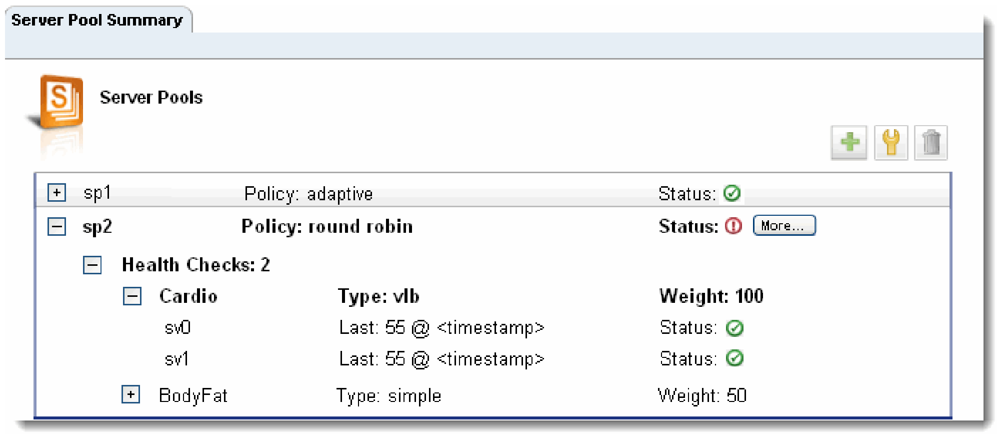
The response string should be text that appears only in a valid response. This string is case-sensitive. An example of a poorly chosen string would be "HTML", since most web servers automatically generate error pages that contain valid HTML.

For more information on probing, see "Active Content Verification (ACV) Probes" on page 373.

Server Pool Summary (GUI)

When you click on **Server Pools** from the left navigational pane on the GUI the Server Pool Summary screen shown below will be displayed in the right frame. It displays the health checks defined for each configured server pool, the server instances using the health checks, status icons and the option to add new health checks and the ability to add new server pools as described in "Adding and Configuring a Server Pool (GUI)" on page 234.

For details on configuring health checks refer to "Configuring VLB Health Check Probe Parameters" on page 386.



sp1	Policy: adaptive	Status: ✓
sp2	Policy: round robin	Status: !
Health Checks: 2		
Cardio	Type: vlb	Weight: 100
sv0	Last: 55 @ <timestamp>	Status: ✓
sv1	Last: 55 @ <timestamp>	Status: ✓
BodyFat	Type: simple	Weight: 50

Clicking on the ✚ icon will activate the shown on where you can add a new server pool to your Equalizer configuration. This is the same as if you selected **Add Server Pool** to the **Server Pool** branch on the left navigational pane.

Clicking on the 🔧 icon while a server pool is selected will activate the *Server Pool Configuration Required Screen* shown on where the server pool configuration parameters can be edited.

Clicking on the icon will delete the currently selected server pool.

In addition to the names of the server pool on the expandable table the following is also displayed:

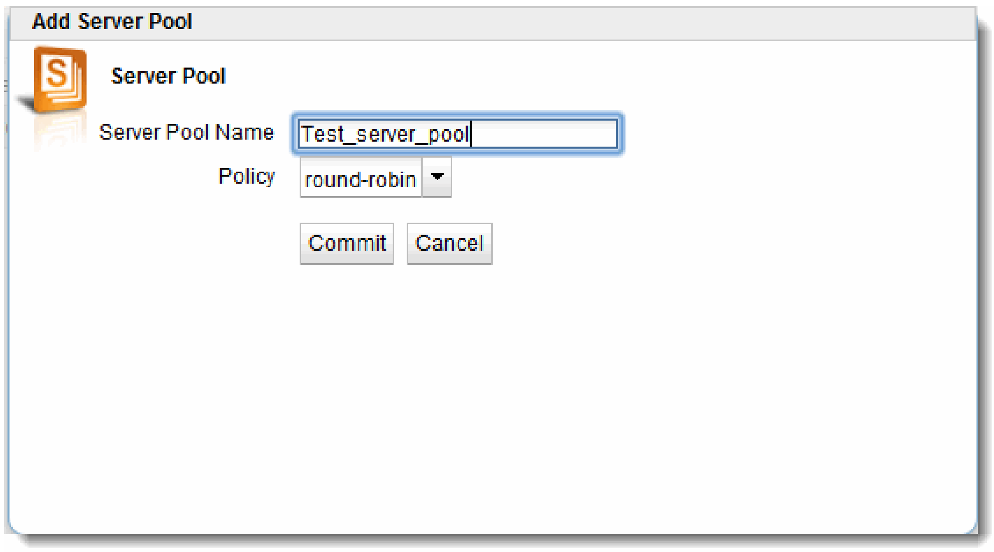
Policy	Displays the load balancing policy used with the server pool.
Status	The **Status** icons display the same conditions that are displayed next the the server pool name on the left navigational pane. In this case, however, you can click on the **More** button to display a pop up listing of all of the problem conditions.
Health Checks	Click on each server pool displayed to expand the accordion frame containing all of currently defined health checks as well as each listing's **Type** and **Weight**. When a Health Check is expanded, all of the server instances that use the selected health check are listed, with the last value returned by the server instance, the time/date that the last value was returned and the status information.

Adding and Configuring a Server Pool (GUI)

To add and configure a server pool using the GUI proceed with the following:

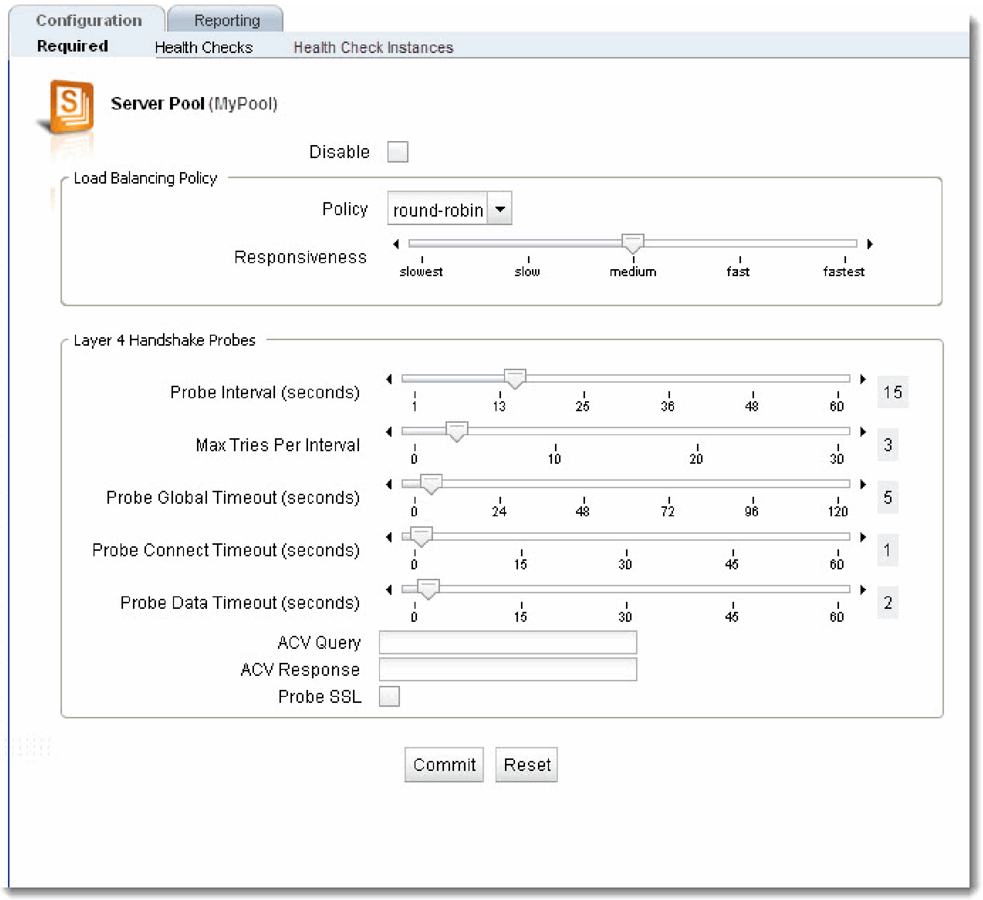
1. Log in to the GUI as described in "Logging In" on page 192.

2. Right click on Equalizer at the top of the tree on the left navigational pane and select **Add Server Pool**. The following will be displayed.



Server Pool Name: Test_server_pool
Policy: round-robin

3. Add a name for the server pool in the **Server Pool Name** field and select the load balancing policy (see "Equalizer's Load Balancing Policies" on page 230) using the **Policy** drop-down list. Click on **Commit** to save the Server Pool. It will appear on the Server Pool tree on the left navigational pane.



Server Pool (MyPool)

Disable

Load Balancing Policy

Policy: round-robin

Responsiveness: slowest, slow, medium, fast, fastest

Layer 4 Handshake Probes

Probe Interval (seconds)	15
Max Tries Per Interval	3
Probe Global Timeout (seconds)	5
Probe Connect Timeout (seconds)	1
Probe Data Timeout (seconds)	2
ACV Query	
ACV Response	
Probe SSL	

4. Configure the **Handshake Probes**as described in "Health Check Timeouts" on page 394.

5. Configure the load balancing options as described above in "Configuring Server Pool Load-Balancing Options" on page 230.

6. Click on **Commit** to save the configuration.

Adding and Configuring a Server Pool (CLI)

To add and configure a server pool using the CLI proceed with the following:

1. Log in to the CLI as described in "Starting the CLI" on page 128 .

2. Enter the new server pool details in the following format at the command line to create a server pool:

```
eqcli > srvpool spname req_cmds
```

3. Use the load balancing options as described above in "Configuring Server Pool Load-Balancing Options" on page 230 and the "Server Pool and Server Instance Commands" on page 169 to configure the other server pool parameters.

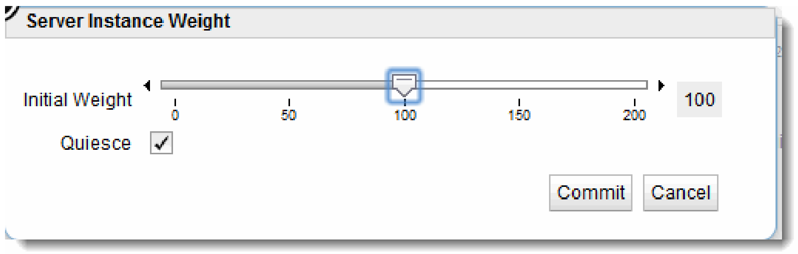
Adding Server Instances(GUI)

A server pool is a collection of server definitions, each of which has additional parameters assigned to it in the server pool -- these additional parameters are organized by the server's name and are referred to as *server instances*. Add server instances as follows:

1. Verify that you are logged into the GUI. If not, log in as described in "Logging In" on page 192.

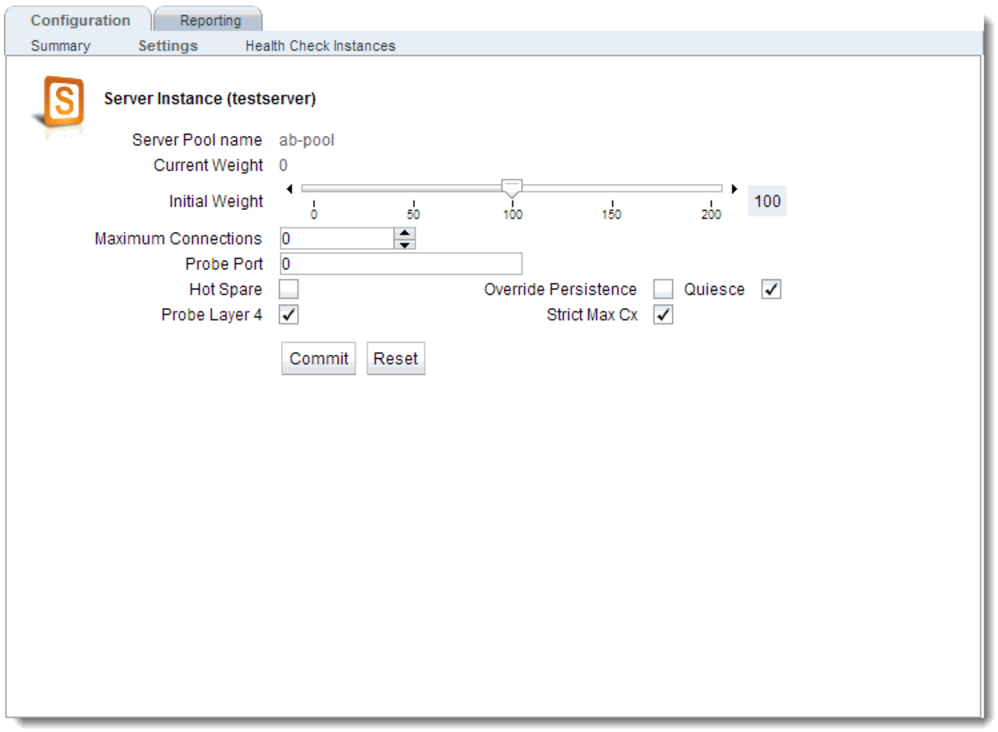
2. Add a server pool as described in the procedures above.

3. Select one of the servers in the list of servers on the tree on left navigational pane. While holding your mouse key down, drag and drop the server into the desired server pool on the server pool branch of the tree. The figure below will be displayed.



Initial Weight 100
Quiesce ✓

4. Select the initial weight for the server instance using the slider control. If desired, disable the **Quiesce** check box. By default, this option is enabled and causes server pool to ignore this server for new connections. If the server is already configured and ready to accept connections, disable this option. Otherwise, leave this option enabled and disable it once the server is ready. Click **Commit**. The figure below will be displayed.



Server Instance (testserver)

Server Pool name ab-pool

Current Weight 0

Initial Weight 100

Maximum Connections 0

Probe Port 0

Hot Spare ☐

Probe Layer 4 ✓

Override Persistence ☐

Quiesce ✓

Strict Max Cx ✓

5. Configure the server instance using the following parameters:

Note - For servers in Layer 7 HTTPS clusters, set the probe port to something other than 443, since Equalizer communicates with the servers via HTTP. In many configurations, it is set to the server port. The server agent port, set on the cluster, remains a separate port that is used only for server agent communication.)

Initial Weight	An number between 0 and 200 that indicates a server's processing power relative to the other servers in a cluster. The default is 100. A value of 0 disables the server (no traffic will be routed to the server). For information about selecting an appropriate initial weight, refer to "Adjusting a Server's Initial Weight" on page 253.
Maximum Connections	Sets the maximum number of permitted open connections for the server. Once this limit is reached, no more traffic is routed to the server until the number of open connections falls below this limit. This limit is set by default to 0, which means that there is no maximum connections limit on the server. Refer to "Setting Maximum Connections per Server" on page 254 for more information.
Probe Port	By default, the server probe port field is set to zero and the Equalizer uses the server's port field value for all TCP and ACV probes. If probe port is not zero, Equalizer uses the value specified as the port for all TCP and ACV probes.
Hot Spare	Enable the hot spare check box if you plan to use this server as a backup server, in case the other server instances in a server pool on the cluster fail. Checking hot spare forces Equalizer to direct incoming connections to this server only if all the other servers in the cluster are down. You should only configure one server in a cluster as a hot spare.

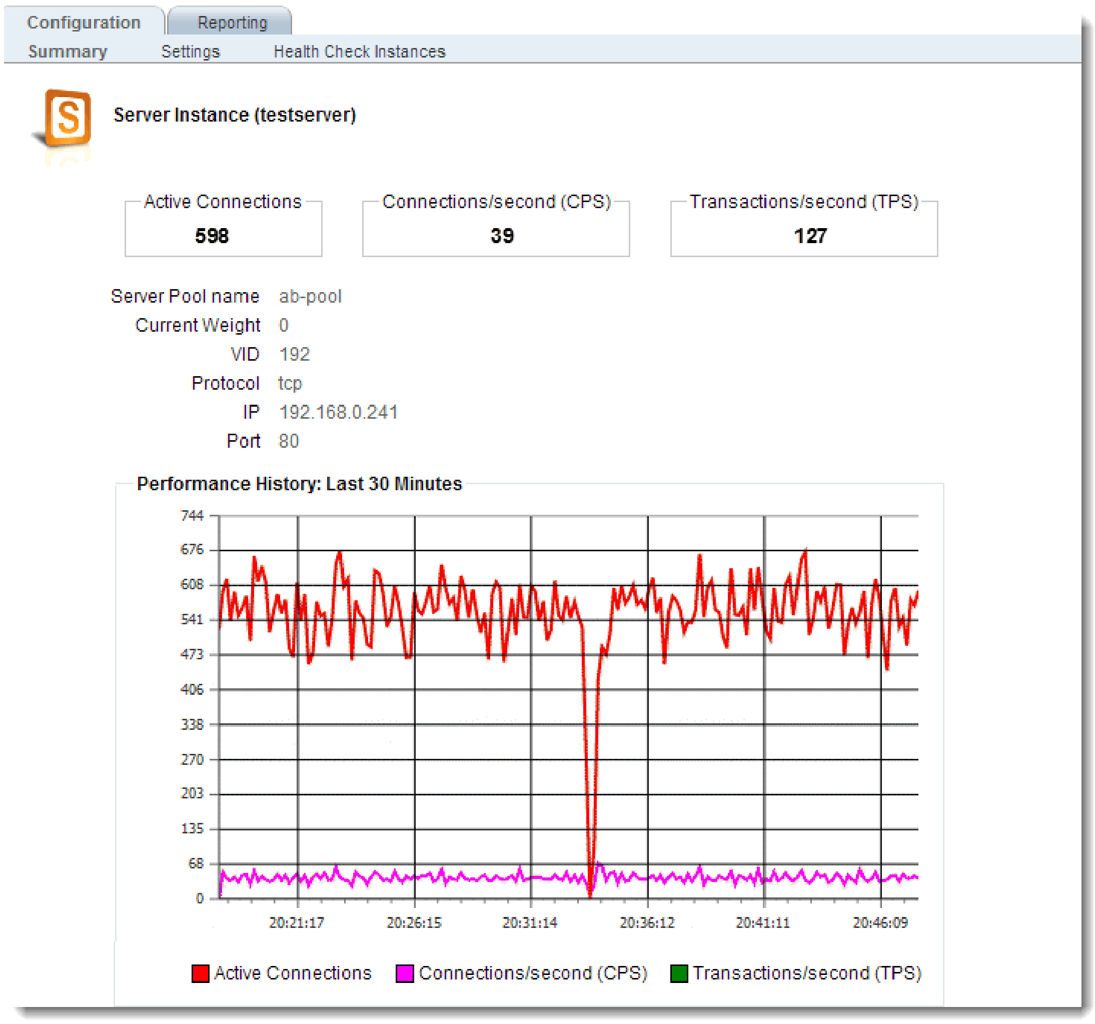
	For example, you might configure a server as a hot spare if you are using licensed software on your servers and the license allows you to run the software only on one node at a time. In this situation, you could configure the software on two servers in the cluster and then configure one of those servers as a hot spare. Equalizer will use the second server only if the first goes down, enabling you to make your application available without violating the licensing terms or having to purchase two software licenses.
Override Persistence	Disables persistence for the server when the persist flag (Layer 7 cluster) or a non-zero sticky time (Layer 4 cluster) is set on a cluster. For a Layer 7 cluster, this means that a cookie will not be inserted into the response header when returned to the client. No sticky record is set for a Layer 4 cluster. This flag is usually used to disable persistence for a hot spare.
Quiesce	When enabled, Equalizer avoids sending new requests to the server. This is usually used in preparation for shutting down an HTTP or HTTPS server, and is sometimes also called "server draining". Refer to "Shutting Down a Server Gracefully" on page 256.
Probe Layer 4	This flag enables or disables Layer 4 TCP and ACV probes for this server. By default this flag is enabled.
Strict Max Cx	This flag allows you to customize the behavior of the max connections parameter (see above). When **Strict Max Cx** is enabled (the default), the max connections parameter is interpreted as a strict maximum and is never overridden. If a client attempts to connect to a server that has a number of connections equal to the max connections setting, then the connection is refused. When **Strict Max Cx** is disabled, the max connections setting will be overridden in any of the following circumstances:

- A client attempts to connect to a server with the hot spare flag enabled - this allows hot spares to service more than the max connections setting of connections.
- A client attempting to connect to a Layer 7 cluster has a persistence cookie and the server identified in the cookie has already reached its max connections limit.
- A client attempting to connect to a Layer 4 cluster has an existing sticky persistence connection to a server and that server has already reached its max connections limit.

6. Repeat step 3 to add additional server instances to a server pool.

Server Instance Summary Screen

The **Server Instance Summary Screen** is displayed when a server instance is selected from the left navigational pane. It displays Server Instance details such as **Active Connections**, **Connections/second** and **Transactions per second** as well as server pool configuration parameters and a graphical representation of performance history from the last 30 minutes.



Server Instance (testserver)

Active Connections	Connections/second (CPS)	Transactions/second (TPS)
598	39	127

Server Pool name	ab-pool
Current Weight	0
VID	192
Protocol	tcp
IP	192.168.0.241
Port	80

Performance History: Last 30 Minutes

Adding Server Instances (CLI)

Server instance specific commands can be applied to multiple server instances by entering a comma-separated list of server instance names on the command line. For example, to set the weight to 125 on three server instances (sv01, sv02, sv03) in server pool sp01, you could enter a command like this:

```
eqcli > srvpool sp01 si sv01,sv02,sv03 weight 125
```

You can also change to an aggregate context that applies to multiple server instances, that allows you to display and modify the parameters for all the server instances. For example, you could change to an aggregate context for the three server instances in the previous example above using a command like the following:

```
eqcli > srvpool sp01 si sv01,sv02,sv03
eqcli sp-sp01-si-sv0*>
```

The CLI is now in the aggregate server instance context "**sv01,sv02,sv03**" -- only the first three characters of which are displayed in the command line. To see the entire context name, use the **context** command:

```
eqcli sp-sp01-si-sv0*> context
```

The context is "sv01,sv02,sv03".

```
eqcli sp-sp01-si-sv0*>
```

In an aggregate server instance context, the `show` command will display the configuration of all the server instances in the context.

Testing ACV on a Server Instance

A test function is available where you can test the functionality of an ACV probe. It is performed on a server pool that must have server instances configured in the pool. All the uncommitted CLI parameters are used when running the test, including the ACV query strings, response strings, timeouts, etc. The idea is to test the proposed configuration before it is committed.

You have the option of specifying a server instance to test or you can test all of the server instances in a server pool. A response is received indicating whether probing is successful or if it fails.

In the example below, a server instance is being tested. Enter the following:

```
eqcli sp-spname> test acv si name

[si name] ACV probe successful!
```

If you do not specify a server instance in a server pool, all of the server instances will be tested. For example:

```
eqcli sp-spname> test acv

[si name] ACV probe successful
[si name] ACV probe failed.
[si name] ACV probe successful
```

If no server instances are attached to the server pool you will receive a message:

```
eqcli sp-spname> test acv
12020289: There are no server instances in the server pool to test.
```

Associate a Server Pool with a Cluster (GUI)

1. To associate a server pool with a cluster proceed with the following:
2. Verify that you are logged into the GUI. If not, log in as described in "Logging In" on page 192.
3. Verify that you have successfully created a server pool as described in the procedures above.
4. Select a cluster from the tree on the left navigational pane. The **Configuration>Required** screen (tab) will be displayed.
5. Select a server pool from the **Server Pool** drop down list.
6. Refer to "Clusters" on page 259and make any additional changes to the cluster configuration if necessary.
7. Click on **Commit** to save new server pool association with the cluster.

Associate a Server Pool with a Cluster (CLI)

To associate a server pool with a cluster proceed with the following:

1. Access the CLI as described in "Starting the CLI" on page 128.
2. Use the following format to enter the cluster context.

```
eqcli> cluster clname
```

3. In the cluster context enter details in the following format:

```
eqcli cl-clname> srvpool spname
```

Deleting a Server Pool (GUI)

To remove a server pool proceed with the following:

1. Verify that you are logged into the GUI. If not, log in as described in "Logging In" on page 192
2. Right click on the server pool to be deleted from the **Server Pool** branch of the tree on the left navigational

pane and select **Delete Server Pool**.

3. Click on **Confirm** when prompted on the **Delete Server Pool** dialogue form.

Deleting a Server Pool (CLI)

To remove a server pool proceed with the following:

1. Access eqcli as described in "Starting the CLI" on page 128 .
2. Use the following format to enter the cluster context.

```
eqcli> cluster clname
```

3. In the cluster context enter details in the following format:

```
eqcli cl-clname> no  srvpool spname
```

Chapter 14

Servers

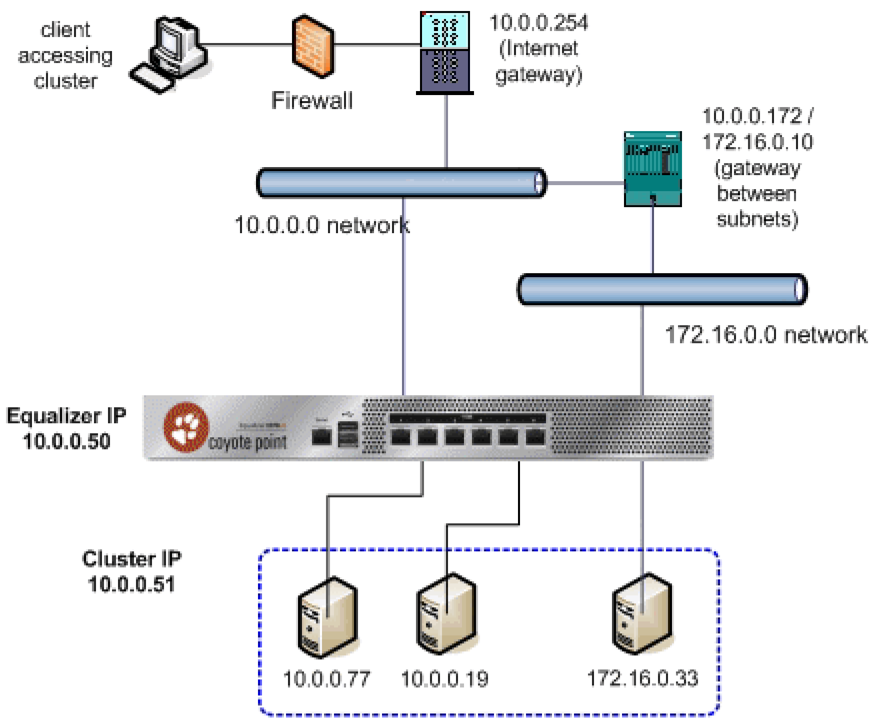
Sections within this chapter include:

Server Configuration Constraints

When configuring servers on Equalizer, you must observe the following constraints:

- In general, there must be no Layer 3 devices (e.g., such as a router) between a server and Equalizer in order for health check probes to work correctly.
- Equalizer operation depends on reliable communication between Equalizer and the servers behind it. The latency introduced by Layer 3 devices such as routers can, for example, result in connection time-outs even when the server is available.
- If you require remote servers in your clusters, you must be very careful to configure network routes that allow Equalizer and the server to communicate. It may also be necessary to reconfigure probe time-outs in order to account for network latency.

An example of a configuration with both directly connected servers and remotely accessible servers is illustrated in the diagram below.



The configuration shown above is an example of a single VLAN configuration, where Equalizer communicates with all servers and clients via the same subnet. The example cluster shown above contains three servers, two on the local 10.0.0.0 subnet, and one on another subnet.

In this example, a static route would be needed on Equalizer to forward all packets for the 172.16.0.0 network to the gateway at 10.0.0.172. Similarly, the server at 172.16.0.33 would need a static route that forwards all traffic for the 10.0.0.0 network through 172.16.0.10, the gateway address for the 10.0.0.0 network.

Configuring Routing on Servers

The way you configure routing on servers behind Equalizer depends largely on whether Equalizer's **spoof** option is enabled on a cluster.

Spoof Controls SNAT

If **spoof** is *disabled*, SNAT (Source Network Address Translation) is performed on client requests before sending them on to the server -- the source address used in the packet sent to the server is Equalizer's IP address on the VLAN used to communicate with the server.

If **spoof** is *enabled*, SNAT is *not* performed on client requests before sending them on to the server -- the source address used in the packet sent to the server is the *client's* IP address.

How Spoof Influences Routing

When **spoof** is *disabled*, special routing is usually not required on servers, since they will respond to Equalizer's IP address on the appropriate VLAN.

When **spoof** is *enabled*, you should configure your servers so that Equalizer gateways the packets the servers send to clients. If you do not adjust the routing on your servers when the **spoof** option is enabled, servers will not route responses through Equalizer and clients receiving such responses directly from servers will drop the responses and the client connection will time out. An easy way to do this is to configure the server's default gateway to be an address on an Equalizer subnet. If this is not possible, then static routes should be used to properly route client requests back to Equalizer.

Direct Server Return (DSR) configurations with Layer 4 clusters are an exception to this rule. In DSR configurations, client requests coming through Equalizer are routed to servers, which then respond directly back to the clients without going through Equalizer. Therefore, servers in a DSR configuration typically have a default gateway other than Equalizer.

In non-DSR clusters with **spoof** enabled, you should use one of the following Equalizer addresses as the default gateway on the server (for the server instance on the server pool in the cluster):

- **If the servers are connected to a single (standalone) Equalizer**, the *default* gateway IP address that you should use on the server is Equalizer's IP address on the VLAN associated with the Equalizer front-panel port to which the server is connected.

- **If the servers are connected to two Equalizers in a failover configuration**, the *default* gateway IP address that you should use on the server is always Equalizer's failover IP address on the VLAN associated with the Equalizer front-panel port to which the server is connected.

The commands or utilities that you use to configure routing on a server depends on the server's operating system, but usually involves some form of the route command. Check your server operating system documentation. To verify that you have configured a server's routing correctly, trace the route from the server to a destination address outside the internal network to ensure that Equalizer gets used as a gateway. On UNIX systems, use the traceroute utility; on Windows, use tracert.

Note that you should configure routing on each server from the server's system console, not through a telnet session. This will avoid any disconnects that might otherwise occur as you adjust the network settings on the server.

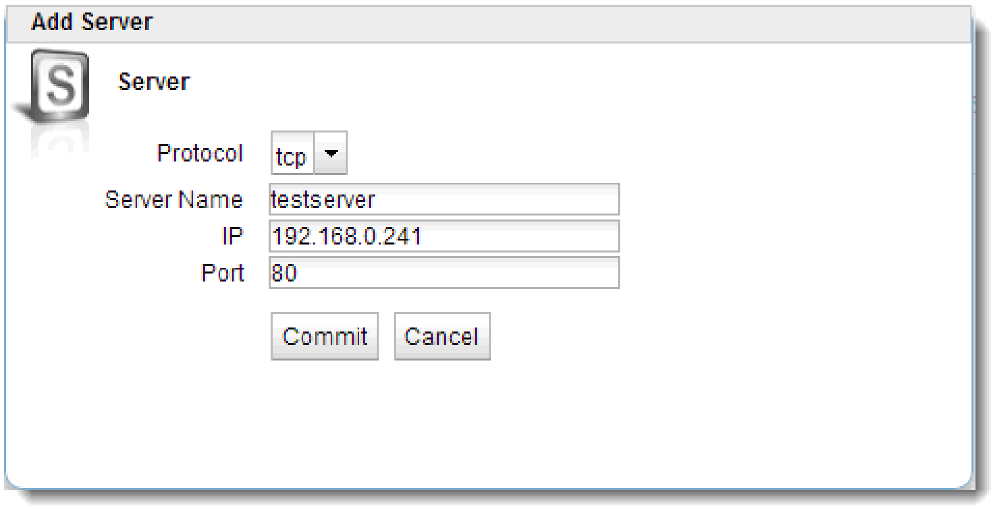
Managing Servers

The sections in the Related Topics discuss viewing, adding, and deleting servers, as well as server configuration options:

Adding a Server (GUI)

Perform this procedure once for each real server that you want to add to Equalizer.

1. Right-click on **Servers** in the left navigational pane and select **Add Server**. This will open the **Add Server** dialogue as follows:



Protocol: tcp
Server Name: testserver
IP: 192.168.0.241
Port: 80

2. Select **UDP** or **TCP** from the drop down list and enter a descriptive **Server Name**.

3. Enter an **IP** address for the server.

4. Enter a **Port** for the server. For HTTP, this is typically port 80. For HTTPS, port 443. For generic TCP and UDP services, use the port appropriate for that service. Whatever port you enter, it must match the port set on the real server.

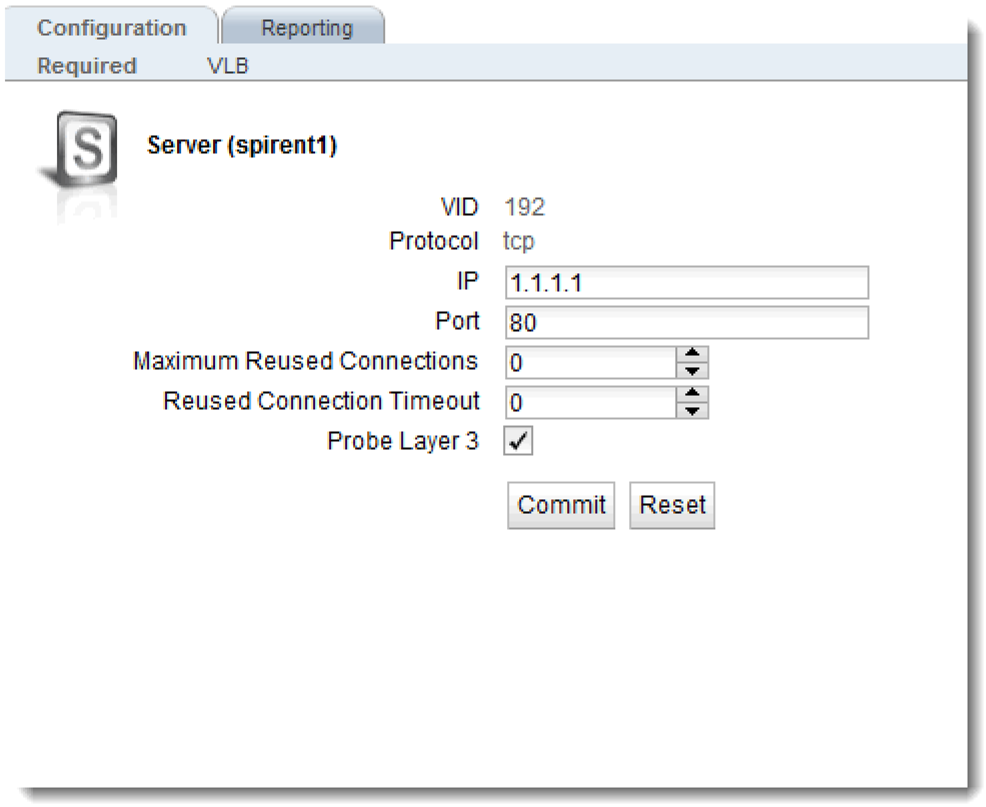
5. Click on **Commit** to confirm the values you selected. You will be taken to the Server Configuration tab and the new server will appear on the Server branch on the left navigational pane. The server **IP** address and **Port** will be visible in the **Server Configuration** screen.

Modifying a Server (GUI)

The configuration tabs for a server are displayed automatically when a server is added to the system, or by selecting the server name from the left navigational pane.

1. Log into the GUI using a login that has at least **write** access for the cluster that contains the server (See "Logging In" on page 192.) The following will be displayed.

2. In the left frame, select the name of the server to modify. The server **Configuration** tab opens in the right frame:



Server (spirent1)

VID	192
Protocol	tcp
IP	1.1.1.1
Port	80
Maximum Reused Connections	0
Reused Connection Timeout	0
Probe Layer 3	✓

Note - *For servers in Layer 7 HTTPS clusters*, set **Port** to something other than 443, since Equalizer communicates with the servers via HTTP. In many configurations, it is set to the server **Port**.

The **server agent port**, set on the cluster, remains a separate port that is used only for server agent communication.)

ip_addr -	The dotted decimal IP address of the server. This is the address Equalizer uses to communicate with the server.
Port -	Enter the numeric port number on the Equalizer to be used for traffic between Equalizer and the server. The default is port 80. (Note that in *Layer 7 HTTPS* clusters, the server port should be set to something other than 443 since Equalizer communicates with servers in an HTTPS cluster via HTTP.) For L4 UDP and L4 TCP protocol clusters, a cluster *port range* can be defined. These are the ports on the Equalizer to be used to send traffic to the server pool in the cluster. Port ranges allow Equalizer users to create a single cluster to control the traffic for multiple, contiguous ports. The **Port** defined for a *server* in the cluster for which a port range is defined indicates the port on the server that starts the range of ports to be opened.

Maximum Reused Connections -	Sets the maximum number of permitted open connections for the server. Once this limit is reached, no more traffic is routed to the server until the number of open connections falls below this limit. This limit is set by default to 0, which means that there is no maximum connections limit on the server. See "Maximum Connections Limits, Responders, and Hot Spares" on page 255 for more information.
Reused Connection Timeout	The number of seconds after which a connection record for an idle server connection in the reusable connection pool is removed, and the connection closed. The default value is 0 seconds, which means that records in the reusable connections pool never expire.
Probe Layer 3 (flag)	(flag) - Enabling this option sets up an alert on the server allows you to send email, log a message to the system log, or both, whenever the server is marked up or down by Layer 3 health check probes.

If you made any changes to the default configuration values, click on the **Commit** button to save your changes.

Adding a Server (CLI)

Perform this procedure once for each real server that you want to add to Equalizer.

Enter the following:

```
eqcli > server [server name] proto tcp ip xxx.xxx.x.x port xx
```

where:

proto	The server protocol
ip	The dotted decimal IP address of the server. This is the address Equalizer uses to communicate with the server.
port	The numeric port number on the Equalizer to be used for traffic between Equalizer and the server. The default is port 80. (Note that in *Layer 7 HTTPS* clusters, the server port should be set to something other than 443 since Equalizer communicates with servers in an HTTPS cluster via HTTP.) For L4 UDP and L4 TCP protocol clusters, a cluster *port range* can be defined. These are the ports on the Equalizer to be used to send traffic to the server pool in the cluster. Port ranges allow Equalizer users to create a single cluster to control the traffic for multiple, contiguous ports. The **Port** defined for a *server* in the cluster for which a port range is defined indicates the port on the server that starts the range of ports to be opened.

Note - *For servers in Layer 7 HTTPS clusters*, set **Port** to something other than 443, since Equalizer communicates with the servers via HTTP. In many configurations, it is set to the server **Port**.

The **server agent port**, set on the cluster, remains a separate port that is used only for server agent communication.)

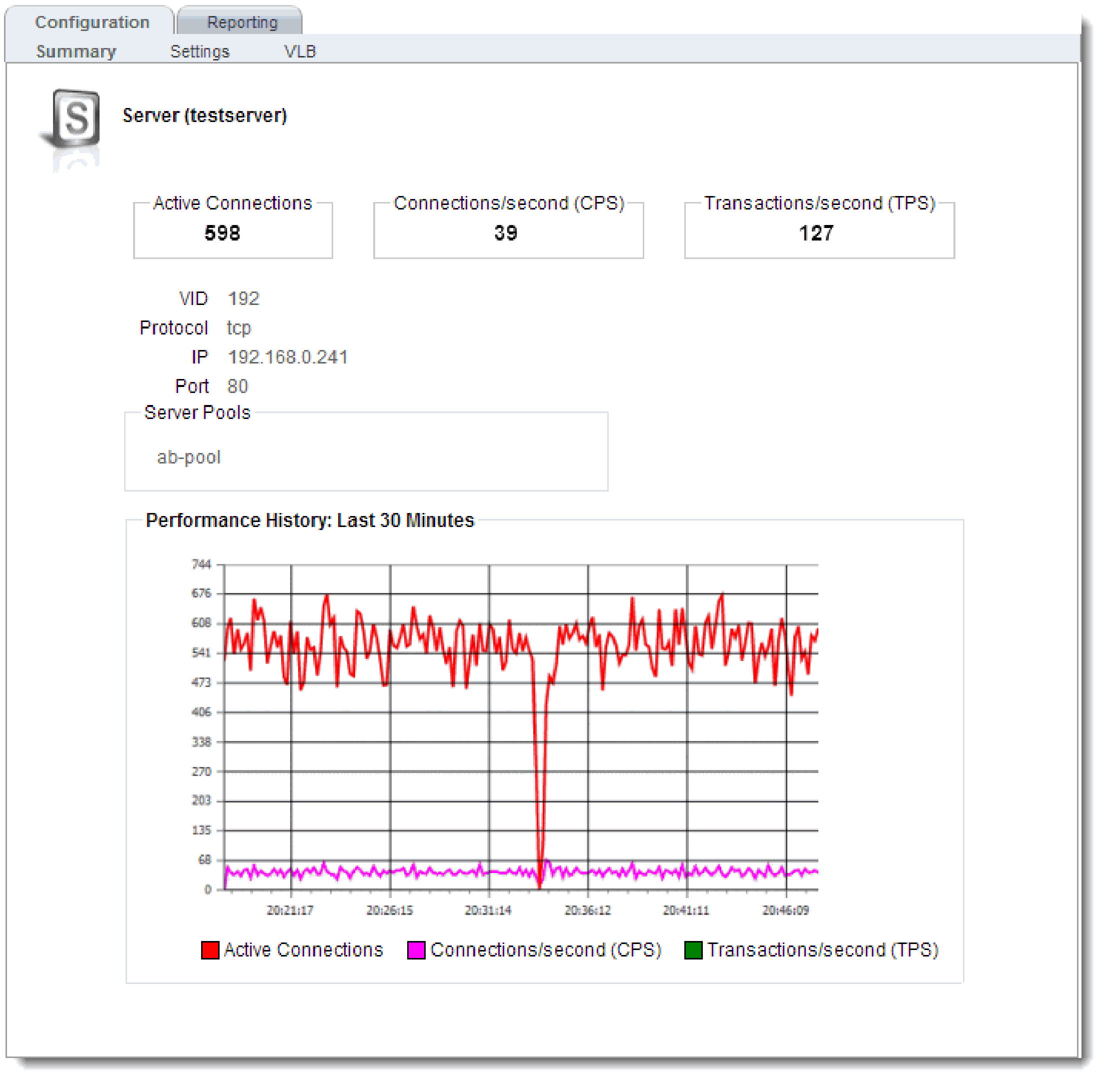
Modifying a Server (CLI)

Create a server and enter parameters for each server.Refer to "Server Commands" on page 168 for CLI commands and use.

max_reuse_conn -	Sets the maximum number of permitted open connections for the server. Once this limit is reached, no more traffic is routed to the server until the number of open connections falls below this limit. This limit is set by default to 0, which means that there is no maximum connections limit on the server. See "Maximum Connections Limits, Responders, and Hot Spares" on page 255 for more information.
reuse_conn_to	The number of seconds after which a connection record for an idle server connection in the reusable connection pool is removed, and the connection closed. The default value is **0** seconds, which means that records in the reusable connections pool never expire.
probe_l3 (flag)	Enabling this option sets up an alert on the server allows you to send email, log a message to the system log, or both, whenever the server is marked up or down by Layer 3 health check probes.

Server Summary Screen

Clicking on a **Server** on the **Server** branch displays the **Server Summary Screen** that displays active connection information as well as parameters and a graphical display of traffic from the previous thirty minutes.



Server (testserver)

Active Connections 598

Connections/second (CPS) 39

Transactions/second (TPS) 127

VID 192
Protocol tcp
IP 192.168.0.241
Port 80

Server Pools
ab-pool

Performance History: Last 30 Minutes

🟥 Active Connections 🟪 Connections/second (CPS) 🟩 Transactions/second (TPS)

Server Software Configuration

Please observe the following guidelines and restrictions when configuring the software on your servers:

Spoof

- If the **spoof** flag is turned on for a cluster (the default), you should configure your network topology so that Equalizer is the gateway for ***all*** traffic for its virtual clusters. In most cases, this means that each server in a cluster should be configured to use Equalizer as its default gateway, so that all packets that come through Equalizer from clients will pass back through Equalizer and then to the clients.

- You do *not* need to configure Equalizer as the gateway for the servers if you have *disabled* the IP **spoof** flag for the cluster.

Header Limit

- Server responses (and client requests) must contain 64 or fewer headers; any packet that contains more than 64 headers is dropped by Equalizer (along with the connection), and a message like the following is printed to Equalizer's event log:

```
Warning: Dropping connection from ip-address -- too many headers
```

Make sure that your server software is configured to return 64 headers or less in any response it sends back through Equalizer. Be aware, however, that this has no effect on the client side; any packets from the client with more than 64 headers will still be dropped by Equalizer (and a warning appended to the event log). In most cases, client requests do not include that many headers.

Adding a Server to a Cluster

To add a server to a virtual cluster, follow these steps:

1. Log into the GUI using a login that has add/del access for the cluster (see "Logging In" on page 52).
2. In the left frame, right-click the name of the cluster to be configured and select the **Add Server** command from the menu.
3. Enter the following information:

- **Server Name -** The logical name for the server, or accept Equalizer's default. Each server must have a unique name in the cluster that begins with an alphabetical character (for example, *CPImages)*.
- **Server IP Address -** Enter the dotted decimal IP address of the server. This is the address Equalizer uses to communicate with the server.
- **Server Port -** Enter the numeric port number on the Equalizer to be used for traffic between Equalizer and the server. For Layer 7 clusters, the default server port is 80.

Note - In *Layer 7 HTTPS* clusters, Equalizer performs all the SSL encryption and decryption and forwards traffic to the servers using the HTTP protocol. This is why when you add servers to an HTTPS cluster, the default server port is 80 (and should always be a port other than port 443).

For L4 UDP and L4 TCP protocol clusters, a cluster *port range* can be defined. These are the ports on the Equalizer to be used to send traffic to the server pool in the cluster. Port ranges allow Equalizer users to create a single cluster to control the traffic for multiple, contiguous ports. The **Server Port** defined for a *server* in the cluster for which a port range is defined indicates the port on the server that starts the range of ports to be opened (see below).

- **Associate with Virtual Machine -** When enabled, this option leads you through the process of associating this server with a VMware Virtual Machine. This option is disabled by default.
- **Quiesce on creation -** When enabled (the default), this option prevents any traffic from being routed to the server by enabling the **quiesce** option on the server. Once the server is functional, you can disable the

quiesce option on the server's **Configuration** tab. If the server is already configured for operation when you add it to Equalizer, you can disable this option.

Unless you want to set up port redirection, you can accept the default value; to redirect to a port other than the cluster port, enter the appropriate value for **Server Port**.

If a *port range* has been defined for the Layer 4 cluster to which the server is being added, the **Server Port** field refers to the first port on which to start servicing the cluster's port range. For example:

Cluster Port Range	Server Port	Port Mapping (cluster to server)
start port = 80 end port = 90	80	80 to 80 81 to 81 ... 90 to 90
start port = 80 end port = 90	100	80 to 100 81 to 101 ... 90 to 110

If there is no service running on one or more ports in the port range, Equalizer will still attempt to forward traffic to that port and return an error code to the client, just as if the client was connecting to the server directly.

Note - For any server in a Layer 4 TCP or UDP cluster, port 20 can only used for FTP traffic in an FTP cluster (see "Providing FTP Services on a Virtual Cluster" on page 141). Port 20 can be used as part of a cluster port range starting below port 20 and ending above port 21, but port 20 will not work -- that is, a service cannot be defined on port 20.

Click the **Next** icon.

- A confirmation screen appears; click **commit** to create the server with the parameters shown.
- The **Configuration** tab for the new server is opened. See the following section for an explanation of the server configuration parameters.

Adjusting a Server's Initial Weight

Equalizer uses a server's initial weight as the starting point for determining the percentage of requests to route to that server. As Equalizer gathers information about the actual performance of a server against client requests, it adjusts the server's current weight so that servers that are performing well receive a higher percentage of the cluster load than servers that are performing at a slower rate.

When you install servers, set each server's initial weight value in proportion to its "horsepower." All the initial weights in a cluster do not need to add up to any particular number; *it's the ratio of the assigned server weight for a server to the total of all the server weights that determines the amount of traffic sent to a server*.

For example, you might assign a server with 4 dual-core 64-bit processors operating at 3.40GHz a value of 100 and a server with 2 dual-core 64-bit processors operating at 1.86GHz a value of 50. The first server will initially receive approximately 66% (100 divided by 150) of the traffic. The second server will initially get about 33% (50 divided by 150) of the traffic. It's important to note that setting the initial weights of these servers to 100 and 50 is equivalent to setting the initial weights to 180 and 90.

Values for server weights can be in the range 0-200, with 0 meaning that no new requests will be routed to the server, essentially disabling the server for subsequent requests. In general, you should use higher initial weights. When the load balancing policy is ***not*** set to round robin or static weight, using higher initial weights will produce finer-grained load balancing. Higher weights enable Equalizer to adjust server weights more gradually; increasing the weight by 1 produces a smaller change if the starting weight is 100 than it does if the starting weight is 50.

However you set the initial weights, Equalizer will adjust the weight of servers dynamically as traffic goes through the cluster. Dynamic server weights might vary from 50-150% of the statically assigned values. To optimize cluster performance, you might need to adjust the initial weights of the server instance in a server pool based on their performance.

Note - Equalizer stops dynamically adjusting server weights if the load on the cluster drops below a certain threshold. For example, if web traffic slows significantly at 4:00 AM PST, Equalizer will not modify server weights until traffic increases again. Because a server's performance characteristics can be very different under low and high loads, Equalizer optimizes only for the high-load case. Keep this in mind when you configure new Equalizer installations; to test Equalizer's ALB performance, you'll need to simulate expected loads.

Setting Initial Weights for Homogenous Clusters

If all the servers in a cluster have the same hardware and software configurations, you should set their initial weights to the same value initially. We recommend that you use a initial weight of 100 and set the load-balancing response parameter to *medium*.

As with any new configuration, you will need to monitor the performance of the servers under load for two to three hours. If you observe that the servers differ in the load they can handle, adjust their initial weights accordingly and again monitor their performance. You should adjust server weights by small increments; for example, you might set the initial weight of one server to 110 and the other to 90. Fine-tuning server weights to match each server's actual capability can easily improve your cluster's response time by 5 to 10%.

Note - A change to a server's initial weight is reflected in cluster performance only after Equalizer has load balanced a significant number of new client requests for up to 30 minutes against the cluster in which the servers reside. When testing initial weights, it is most useful to use a load-generating tool to run typical client requests against the cluster to determine appropriate server initial weights.

Setting initial Weights for Mixed Clusters

Equalizer enables you to build heterogeneous clusters using servers of widely varying capabilities. Adjust for the differences by assigning initial weights that correspond to the relative capabilities of the available servers. This enables you to get the most out of existing hardware, so you can use an older server side-by-side with a new one.

After you assign relative initial weights, monitor cluster performance for two to three hours under load. You will probably fine-tune the weights and optimize performance of your cluster two or three times.

Continue monitoring the performance of your cluster and servers and watch for any trends. For example, if you notice that Equalizer *always* adjusts the dynamic weights so that the weight of one server is far below 100 and the weight of another is far above 100, the server whose dynamic weight is consistently being reduced might have a problem.

Setting Maximum Connections per Server

By default, the **max connections** server option is set to 0, which means that Equalizer will route traffic to the server whenever the server is selected by the current load balancing settings. If **max connections** is set to a value greater than 0, then Equalizer limits the total number of simultaneously open connections to the server to that value. This restriction applies regardless of the persistence options set on the cluster.

The **max connections** option can be set in Layer 4 TCP, Layer 7 HTTP, and Layer 7 HTTPS clusters. When a server reaches the specified limit, requests will not be routed to that server until the number of active connections falls below the limit.Typical reasons to set a maximum number of connections include:

- implementing a connection limit that is required due to software limitations, such as an application that can service a limited number of concurrent requests
- implementing license restrictions that are not enforced by software; such as limiting the number of active connections to an application that is licensed for a limited number of concurrent connections
- setting a threshold that will limit resource utilization on the server

To set **max connections** on a server:

1. Log into the GUI using a login that has add/del access for the cluster that contains the server (See "Logging In" on page 192)
2. Do ***one*** of the following:
    a. Create a new server: right-click a cluster name in the left frame and select **Add Server**. After you enter and **commit** the basic information, you'll be taken to the server **Configuration** tab, where you can set max connections as shown in Step 2.
    b. Modify an existing server: click on the server name in the left frame to display the server's **Configuration** tab in the right frame.
    c. Set **Max Connections** to a positive integer between 0 and 65535. A zero (the default) means that no connection limit is set for this server. (Set other parameters and flags for the server as desired; see "Cluster Types and How They're Used with Equalizer" on page 260, for more details.)

d. Click on **Commit** to save your changes to the server configuration.

Maximum Connections Limits, Responders, and Hot Spares

When a maximum connections limit is set on all the servers in a cluster, it is often desirable to define either a responder or a hot spare server for the cluster, so that any attempted connections to the cluster that occur after the **max connections** limit has been reached are directed to the responder or hot spare instead of being refused or sent to the server anyway because of a persistent connection.

In general, a Responder is easier to configure than setting up a separate server as a hot spare, since the responder runs on Equalizer. However, while Responders are capable of returning only a single HTML page, a hot spare can be configured to return multiple HTML pages and images. See "Cluster Types and How They're Used with Equalizer" on page 260 for information on configuring a responder.

To use a hot spare, you would usually configure it on Equalizer as follows:

1. Set **Max Connections** to zero (0), so that all connection requests sent to the hot spare are accepted.
2. Enable the **Hot Spare** flag. This specifies that any requests refused by all the other server instances in a server pool because they reached their **Max Connections** limit (or are down) will be forwarded to the hot spare server.
3. Enable the **Dont Persist** flag so that connections made to the hot spare don’t persist. Each connection to the cluster must first be load balanced amongst the other servers in the cluster and only go to the hot spare if all the other servers have reached their **Max Connections** limit.

Interaction of Server Options and Connection Processing

Server option settings have a direct influence on connection and request processing, particularly Layer 4 and Layer 7 persistence. (Note that persistence is set at the cluster level, but can be disabled for individual servers using the **Dont Persist** option.) The hierarchy of server option settings is shown in the table below:

- **Server disabled (initial weight = 0) -** An **initial weight** of **0** tells Equalizer that no traffic should be sent to the server, disabling the server. This option setting takes precedence over all other options (including persistence, hot spare, etc.).
- **Max Connections > 0 -** If set to a non-zero value, Equalizer limits the total number of simultaneously open connections to the server to that value. This limit is not overridden if the **Hot Spare** option is enabled on a server, and is not overridden by a Layer 4 sticky record or Layer 7 persistence cookie for the server in an incoming request.
- **Quiesce Enabled** - The server is *not* included in load balancing decisions, so that no *new* connections will be made to this server. If a request in an incoming connection has an existing Layer 4 sticky record or Layer 7 cookie for a server, however, the request will be sent to that server even when **Quiesce** is enabled.

Note - If **dont persist** is also enabled on the server, the sticky record or cookie is ignored.

- **Hot Spare Enabled -** The server is *not* included in load balancing decisions, so that traffic is sent to this server *only* when no other server in the cluster is available to accept client connections. If a request in an incoming connection has an existing Layer 4 sticky record or Layer 7 cookie for a server, however, the request will be sent to that server even when **hot spare** is enabled.

Note - If **dont persist** is also enabled on the server, the sticky record or cookie is ignored.

Shutting Down a Server Gracefully

To avoid interrupting user sessions, make sure that a server to be shut down or deleted from a cluster no longer has any active connections. When a server's initial weight is zero, Equalizer will not send new requests to that server. Connections that are already established continue to exist until the client and server application end them or they time out because they are idle.

To shut down servers in a generic TCP or UDP (L4) cluster, you can set the server's weight to zero and wait for the existing connections to terminate. However, you need to quiesce servers in HTTP and HTTPS (L7) clusters to enable servers to finish processing requests for clients that have a persistent session with the server.

When you quiesce a server, Equalizer does not route new connections from new clients to the server, but will still send requests from clients with a persistent session to the quiescing server. Once all the persistent sessions on the server have expired, you can set the server's initial weight to zero; then Equalizer will not send additional requests to the server.

Note that while a server instance is quiescing, it will still receive new requests *if all of the other server instances in a server pool are unavailable*. This behavior prevents any new requests from being refused, but may lengthen the time needed to terminate all active persistent connections.

Removing a Layer 7 Server from Service

To remove a Layer 7 server from service, follow these steps:

1. In the left frame, click the name of the server to be quiesced. The server's parameters appear in the right frame.

2. Check the **quiesce** checkbox; then click **commit** to save your changes.

3. Click on **Equalizer > Status > Cluster Summary** and click the cluster name in the table. Watch the quiescing server's number of **active connections**. Once there are no active connections shown, click the server name in the left frame and set the server's weight to zero; click **commit** to save the change.

4. Click on the server name in the left frame and open the **Reporting** tab. Check the number of **total connections** (click the server name to refresh). If this number does not go to zero after a reasonable period of time, then there are clients that still have open persistent connections to the server. To make sure that these connections are not dropped, but are renegotiated after you take the server down, you can increment the cluster's **cookie generation** parameter. Click on the cluster name in the left frame and open the **Persistence** tab. Increment the **cookie generation** parameter by 1; then click **commit**.

To ensure that no cookie ever persists beyond a given time period, you can change the **cookie age** cluster parameter from the default of 0 to some number of seconds that is reasonable for your application. Then, you only need to wait that number of seconds after quiescing the server and changing its weight to 0 before it's safe to take the server down. Note that this only applies to cookies created after the change is committed.

Removing a Layer 4 Server from Service

To remove a Layer 4 server from service, follow these steps:

1. In the left frame, click the name of the server to be removed. The server’s parameters appear in the right frame.

2. Set the server’s weight to zero; Click on **Commit** to save the change. This action prevents Equalizer from routing new connections to the server.

3. Click on **Equalizer > Status > Cluster Summary** and click on the cluster name in the table. Watch the server’s number of **active** and **sticky** connections. Once both of these numbers are **0**, click on the server name in the left frame and check the number of total connections (click the server name to refresh). Once that number is **0** and the server’s **idle time** is greater than your application’s session lifetime, you can take the server offline.

Deleting a Server

To delete a server from a virtual cluster, follow these steps:

1. Log into the GUI using a login that has add/del access for the cluster that contains the server (See "Logging In" on page 192)

2. If necessary, shut the server down gracefully before taking it out of service, as shown in the section "Shutting Down a Server Gracefully" on page 256 . This is particularly important if the server is in a Layer 4 cluster and may have active connections; see Step 4.

3. In the left frame, right-click the name of the server to be removed and select the **Delete Server** command from the menu.

4. When prompted, click **Delete** to confirm that you want to remove the server from the cluster. Clicking **Delete** removes the server from the configuration immediately. To cancel the deletion, click **Cancel.** If you attempt to delete a server that has active connections:

    a. If the server is being deleted from a Layer 4 cluster, clicking delete removes the server from the configuration and immediately terminates all active connections for that cluster IP and server.

    b. If the server is being deleted from a Layer 7 cluster, clicking delete removes the server from the configuration, but does not terminate any active connections. Active connections for that cluster IP and server will remain open until they are completed or reach the appropriate timeout.

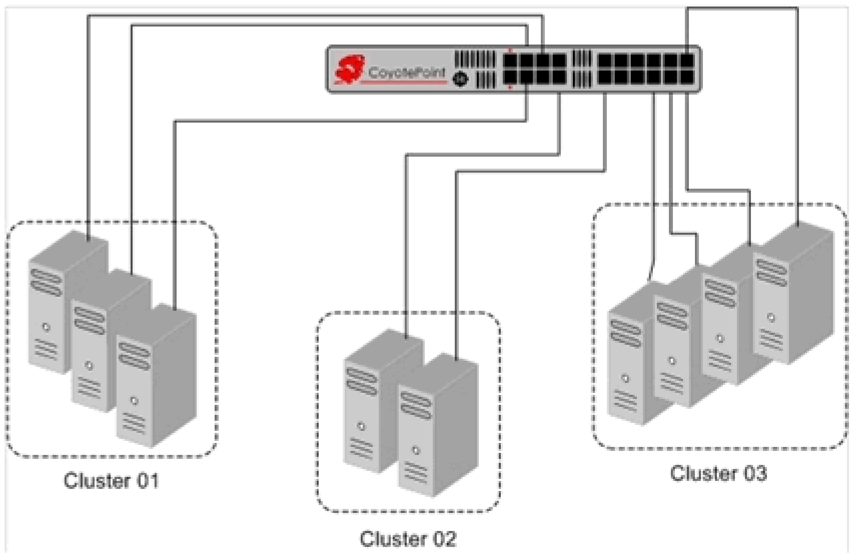
Chapter 15

Clusters

Sections in this chapter include:

Cluster Types and Use with Equalizer

A virtual cluster is a collection of server pools with a single network-visible IP address. All client requests come into Equalizer through a cluster IP address, and are routed by Equalizer to an appropriate server, according to the load balancing options set on the cluster. The figure below shows a conceptual diagram of an Equalizer with three clusters.



Each cluster must be assigned at least one server pool, a grouping of real servers that will be used to respond to incoming client requests. Servers in a server pool are called 'server instances', to distinguish them from the real server definitions with which they are associated (refer to "Server Pools and Server Instances" on page 229 for more information).

The parameters you specify when setting up a virtual cluster determine how client and server connections are managed, and how requests are load balanced among the server instances in a server pool.

Before beginning to define a cluster, you need to do the following:

1. Determine the **IPaddresses** to use for each cluster, and the IP addresses to use for all of your real servers.

2. Determine the cluster types appropriate for your configuration.

There are five cluster types supported, and their basic capabilities are summarized in the following table:

Cluster Type	Layer 4 TCP (tcp)	Layer 7 TCP (l7tcp)	Layer 4 UDP (udp)	Layer 7 HTTP (http)	Layer 7 HTTPS (https)
Load Balanci-ng Decisio-ns	Based on configured load balancing criteria, the IP address, and the port number. The content of	Same as Layer 4 TCP.	Same as Layer 4 TCP.	Based on configured load balancing criteria, the IP address, the port number, and the content of the request. Load	Same as Layer 7 HTTP.

	the request is not examined.			balancing decisions can be based on application specific criteria through the use of "Match Rules" on page 317.)	
IP Addressi-ng	IPv4	IPv4 / IPv6	IPv4	IPv4 / IPv6	IPv4 / IPv6
Protocol-s	Any TCP protocol.	Any TCP protoco-l.	Any UDP protocol.	HTTP	HTTPS

Notes:

- The Layer 4 TCP and UDP clusters can use only IPv4 cluster addresses and can only be used with servers that have IPv4 addresses.
- The Layer 7 TCP cluster is used to provide IPv6 addressing for Layer 4 protocols, and can support IPv4 and IPv6 addressing for clusters and servers. The functionality is very much like Layer 4 TCP clusters. This type of cluster should be used when IPv6 addressing is required for a TCP protocol other than HTTP or HTTPS.
- L4 UDP clusters are appropriate for connectionless (stateless) applications, such as DNS, TFTP, Voice over IP (VoIP), and streaming applications -- any application that exchanges short packets with many clients, and where dropped packets are preferred to delayed packets (i.e., the highest possible network performance is required). Layer 4 UDP clusters do not currently support IPv6 addressing.
- Layer 7 HTTPS clusters also provide SSL Offloading: all SSL certificate operations are performed by the cluster, not by the servers behind the cluster, thus improving overall cluster performance.

After you decide on the cluster types you need, you'll then need to determine the additional settings and flags to be used on the cluster and its server pools. For most configuration, it is often a good idea to start with the defaults and make incremental changes as you examine traffic passing through your clusters.

Cluster Connection Timeouts

Layer 7 clusters (HTTP / HTTPS) and Layer 4 clusters (TCP / UDP) each use a different set of timeout parameters as described below.

Note - Setting cluster timeouts to arbitrarily high values can have an adverse effect on cluster performance, and can result in the cluster no longer processing traffic. We recommend that you start with default timeout values and adjust the timeouts one by one, in small increments, until you get the timeout behavior that you desire.

HTTP and HTTPS Connection Timeouts

Connections to HTTP and HTTPS clusters are managed closely by Equalizer from the client request to the response from the server. Equalizer needs to manage two connections for every Layer 7 connection request: the client connection from which the request originates, and the connection to the server that is the final destination of the request (as determined by the load balancing policy).

1. Equalizer has an idle timer for the established client connection, a connect timer to establish a server connection, and an idle timer for the established server connection. Only one timeout is in use at any given time. This is a summary of how timeouts are used when a client connects to Equalizer:

2. When a client successfully connects to a Virtual Cluster IP, the client timeout applies from the time the connection is established until the client request headers are completely transmitted. Equalizer parses the client's request, and verifies that the request is a valid HTTP request and that the information needed for load balancing is obtained. In general, this happens at the time that the client headers are completed -- which is indicated by the client sending two blank lines for HTTP 1.0 or 1.1; one blank line for HTTP 0.9. Once the headers are completely transmitted to Equalizer, the client timeout is no longer used.

3. As soon as the Equalizer is done examining the header data, it makes a connection to a server, as determined by the load balancing policy, persistence, or a match rule hit. The amount of time that the Equalizer tries to establish a connection to the server is the connect timeout. Once the server connection is established, the connect timeout is no longer used.

4. After Equalizer establishes a connection with a server, the server timeout is the amount of time Equalizer waits for the next bit of data from the server. Any response from the server restarts the server timeout.

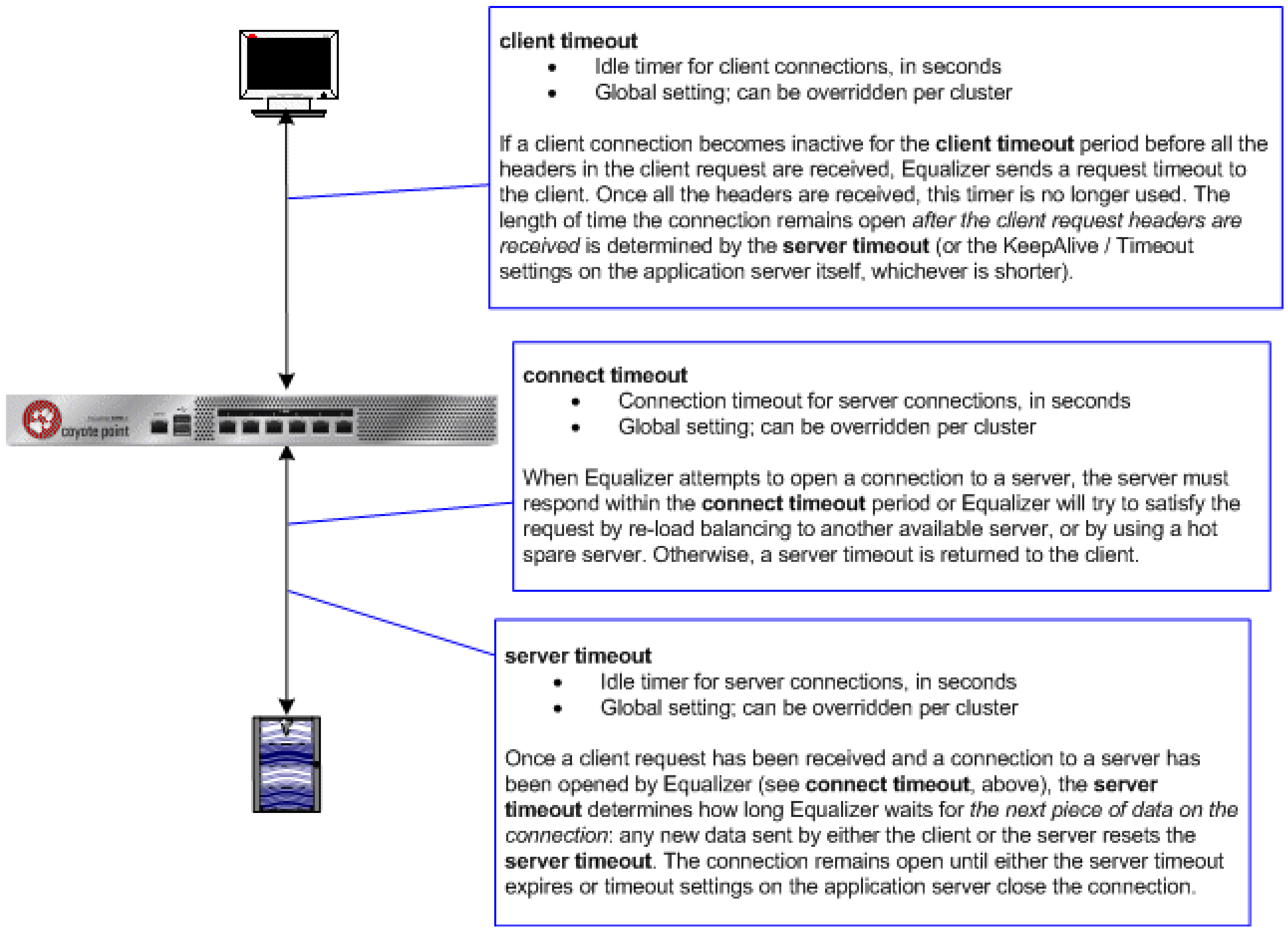
The important distinction between the client timeout and the server timeout is that the client timeout is a “hard” timeout -- the client has the number of seconds specified to transmit all of its headers to Equalizer before Equalizer times out. This is done mainly for security considerations to prevent malicious clients from creating a large number of partial connections and leaking data slowly over the connection, possibly causing resource exhaustion or other undesirable effects on Equalizer.

The **server timeout** by contrast is a “soft” timeout -- the server has the number of seconds specified to send the next piece of information (e.g., the next packet in the sequence). Whenever the client or the server sends a piece of data on the connection, the server timeout is reset. This allows the server to send large data streams in small pieces without timing out, and then close the connection once all the data is sent.

For example, when a client sends a POST operation in a request, the client timeout is used up until the time that the POST headers have all been received. The connect timeout is used until a connection with the server is established. Then, once the connection is established, the server timeout is used for the POST data itself and the subsequent response from the server.

Note that there is the chance that a client will connect, send its headers, and then send continuous data to Equalizer that repeatedly resets the server timeout. This vulnerability is usually avoided by setting a hard client timeout on the application server itself (see "Cluster Connection Timeouts" on page 266).

The figure below summarizes the connection timeout parameters Equalizer uses for Layer 7 client and server connections.



client timeout

- Idle timer for client connections, in seconds
- Global setting; can be overridden per cluster

If a client connection becomes inactive for the **client timeout** period before all the headers in the client request are received, Equalizer sends a request timeout to the client. Once all the headers are received, this timer is no longer used. The length of time the connection remains open *after the client request headers are received* is determined by the **server timeout** (or the KeepAlive / Timeout settings on the application server itself, whichever is shorter).

connect timeout

- Connection timeout for server connections, in seconds
- Global setting; can be overridden per cluster

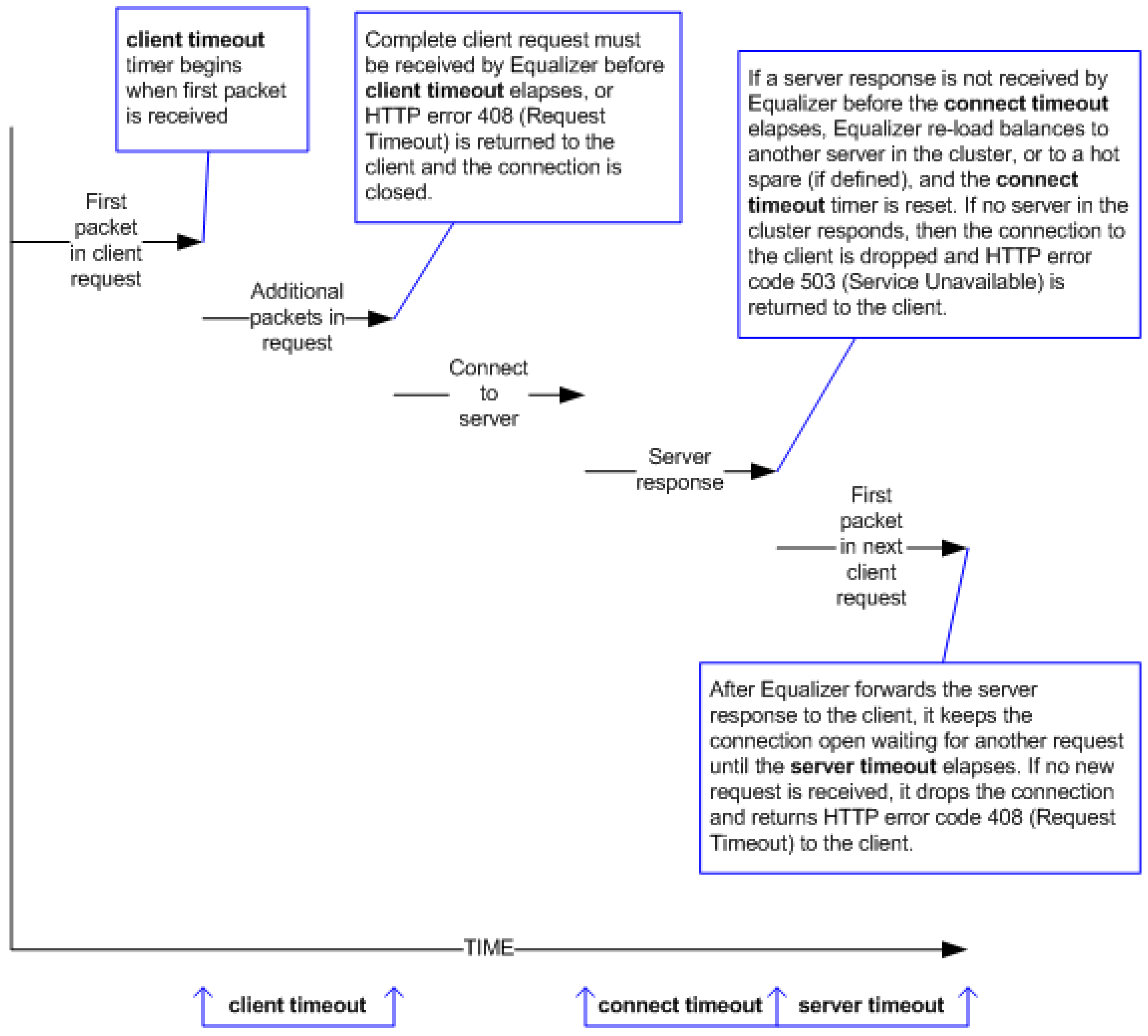
When Equalizer attempts to open a connection to a server, the server must respond within the **connect timeout** period or Equalizer will try to satisfy the request by re-load balancing to another available server, or by using a hot spare server. Otherwise, a server timeout is returned to the client.

server timeout

- Idle timer for server connections, in seconds
- Global setting; can be overridden per cluster

Once a client request has been received and a connection to a server has been opened by Equalizer (see **connect timeout**, above), the **server timeout** determines how long Equalizer waits for *the next piece of data on the connection*: any new data sent by either the client or the server resets the **server timeout**. The connection remains open until either the server timeout expires or timeout settings on the application server close the connection.

The timeline below shows the sequence of timeout events when a new connection is received by Equalizer.


client timeout timer begins when first packet is received
Complete client request must be received by Equalizer before **client timeout** elapses, or HTTP error 408 (Request Timeout) is returned to the client and the connection is closed.
If a server response is not received by Equalizer before the **connect timeout** elapses, Equalizer re-load balances to another server in the cluster, or to a hot spare (if defined), and the **connect timeout** timer is reset. If no server in the cluster responds, then the connection to the client is dropped and HTTP error code 503 (Service Unavailable) is returned to the client.
First packet in client request
Additional packets in request
Connect to server
Server response
First packet in next client request
After Equalizer forwards the server response to the client, it keeps the connection open waiting for another request until the **server timeout** elapses. If no new request is received, it drops the connection and returns HTTP error code 408 (Request Timeout) to the client.
TIME
client timeout
connect timeout
server timeout

The following table shows the value range for the Layer 7 HTTP / HTTPS connection timeouts.

Parameter	Minimum	Default	Maximum	Units
client timeout	1.0	5.0	64535.0	seconds
server timeout	1.0	60.0	2147483647.0	seconds
connect timeout	1.0	10.0	60.0	seconds

The default timeout values are sufficient for many common applications. If timeouts are occurring using the default values, adjust the server timeout to the amount of time you expect your application server to respond to a client request, plus 1 second. If there is high latency between Equalizer and the servers in your cluster, then you may need to increase the connect timeout. The client timeout usually does not need to be changed, but in some situations, HTTPS clusters will require a client timeout between 15 and 30 seconds for best performance. If you do need to increase the client timeout, use the lowest value possible for your configuration to perform well; high values for client timeout increase the risk of denial of service (DoS) attacks.

Once Only Option and HTTP / HTTPS Timeouts

The previous sections describe how the connection timeouts work when the once only flag is disabled on a cluster; that is, when Equalizer is examining every set of headers received on a connection. The once only option, when enabled, specifies that Equalizer will examine only the first set of headers received on a connection. This has the following effects on connection timeouts:

- If you have once only enabled, as soon as the initial transaction (client request and server response) on a connection completes, the connection goes into “streaming” mode and the client timeout is no longer used for this connection. Equalizer does not parse any additional client requests received on the connection. The server timeout is used for the remainder of the connection, and is reset whenever data is received from either side of the connection.

- If you have once only disabled as described in the previous sections, and multiple requests are being sent on the same connection, the client timeout starts counting down again as soon as a new request is received from the client.

Layer 4 Connection Timeouts

Connections to Layer 4 clusters are received by Equalizer and forwarded with little processing. Equalizer simply rewrites the source and/or the destination IP addresses, as appropriate for the cluster, and sends the packet to the server specified by the cluster’s load balancing policy. For Layer 4 TCP clusters, a connection record is kept for each connection so that address translation can be done on the packets going between the servers and clients. The Layer 4 connection timeouts specify how long a connection record is kept by Equalizer.

Layer 4 TCP clusters use the idle timeout and stale timeout parameters. The idle timeout can be set at the global and cluster levels, while stale timeout can be set at the global level only. The parameters affect how Equalizer manages Layer 4 connection records:

- Connection records need to be removed in cases where the connection is not closed by the client or server, and is left idle. If no data has been received on a connection from either the client or the server after the time period specified by the idle timeout has elapsed, then Equalizer removes the connection record for that connection. Any data received from either client or server resets the idle timer.

  Note that when using Direct Server Return (DSR), the time that a connection record is maintained is determined by adding the idle timeout for the cluster to the sticky time . This additional time is necessary when using DSR, since no server responses are routed through Equalizer (and therefore cannot restart the idle timeout to keep the connection open). For more information on DSR, see "Configuring Direct Server Return" on page 313.

- In other cases, a connection may be initiated but never established, so the connection record goes “stale” and must be removed. If a client fails to complete the TCP connection termination handshake sequence or sends a SYN packet but does not respond to the server’s SYN/ACK, Equalizer marks the connection as incomplete. The stale timeout is the length of time that a connection record for an incomplete connection is maintained.

When Equalizer reclaims a connection, it sends a TCP RST (reset) packet to the server, enabling the server to free any resources associated with the connection. (Equalizer does not send a TCP RST to the client when reclaiming a connection.)

Reducing the stale timeout can be an effective way to counter the effects of SYN flood Denial of Service attacks on server resources. A stale timeout of 10.0 (see table below) would be an appropriate value for a site under SYN flood attack.

Parameter	Minimum	Default	Maximum	Units
idle timeout	0	0	2147483647.0	seconds
stale timeout	1.0	15.0	120.0	seconds

Note that if you change the stale timeout setting while partially established Layer 4 connections are currently in the queue, those connections will be affected by the new setting.

Application Server Timeouts

Keep in mind that the application server running on the physical servers in your cluster may have its own timeout parameters that will affect the length of time the server keeps connections to Equalizer and the client open. For example, an Apache 2 server has two related timeout directives: **TimeOut and KeepAliveTimeout**:

1. The **TimeOut** directive currently defines the amount of time Apache will wait for three things:
    a. The total amount of time it takes to receive a GET request.
    b. The amount of time between receipt of TCP packets on a POST or PUT request.
    c. The amount of time between ACKs on transmissions of TCP packets in responses.
2. The **KeepAliveTimeout** directive specifies the number of seconds Apache will wait for a subsequent request before closing the connection. Once a request has been received, the timeout value specified by the Timeout directive applies.

In general, if you want Equalizer to control connection timeouts, you must make sure that any timeouts set on the application server are of longer duration than the values set on Equalizer.

For example, with respect to the Apache server timeouts above, the client timeout (for Layer 7 connections) or the idle timeout (for Layer 4 connections) should be of shorter duration than the timeouts set for Apache.

Similarly, the Layer 7 server timeout and connect timeout on Equalizer should be of shorter duration than the TCP connection timeouts set on the servers.

Connection Timeout Kernel Variables

Equalizer uses a number of kernel variables to track connection timeouts, as shown in the table below. You can use the sysctl command to display kernel variables. The two basic formats of this command are:

`sysctl variable_name` Displays the kernel variable variable_name.

`sysctl -a > file` Displays all kernel statistics. This is a long list, so we recommend capturing the list to a file.

eq.idle_timeout	The current setting of the Layer 4 global networking idle timeout parameter.
eq.idle_timedout_count	A Layer 4 counter incremented when a connection is terminated because the idle timeout expired.
eq.stale_timeout	The current setting of the Layer 4 global networking stale timeout parameter.
eq.l7lb.timeouts	The total number of Layer 7 connections dropped because a connection timer expired.

eq.l7lb.http.client_timeouts	The total number of Layer 7 (HTTP and HTTPS) connections that were terminated because the client timeout expired.
eq.l7lb.http.connect_timeouts	The total number of Layer 7 (HTTP and HTTPS) connections that were terminated because the connect timeout expired.
eq.l7lb.http.server_timeouts	The total number of Layer 7 (HTTP and HTTPS) connections that were terminated because the server timeout expired.

Note that there are also some kernel variables associated with Secure Socket Layer (ssl) client connections, such as when someone logs into Equalizer over an SSH connection. These variables are not incremented by HTTPS connections:

```
eq.l7lb.ssl.total_clients
eq.l7lb.ssl.current_clients
eq.l7lb.ssl.max_clients
eq.l7lb.ssl.requests
```

Adding and Deleting Clusters

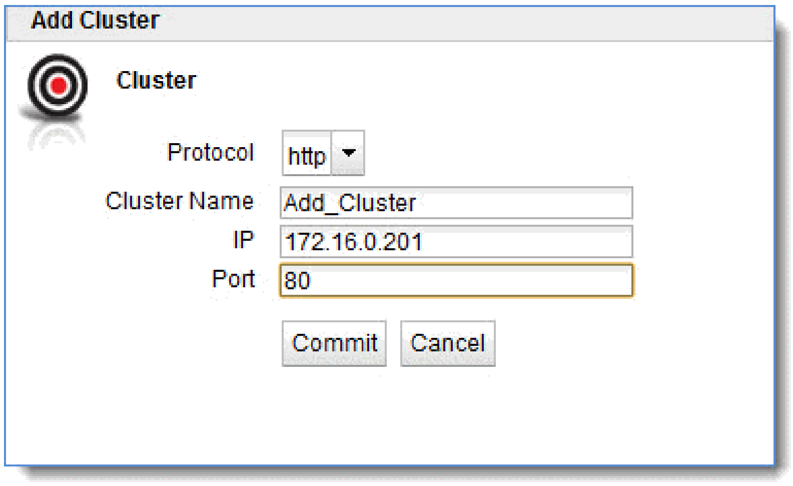
Add and delete clusters as follows:

Using the GUI:

Follow these steps to add a new Layer 7 or Layer 4 virtual cluster using the GUI:

1. Log into the GUI using a log in that has add/del access for global parameters (See "Logging In" on page 192)

2. Right click on Equalizer at the top of the left frame, and select Add Cluster from the menu that appears. The **Add Cluster** form appears as shown below.


Add Cluster

Cluster

Protocol: http
Cluster Name: Add_Cluster
IP: 172.16.0.201
Port: 80

3. Select **http**, **https, tcp, L7tcp**or **udp** from the **Protocol** drop down list.

4. Enter the following on the form:

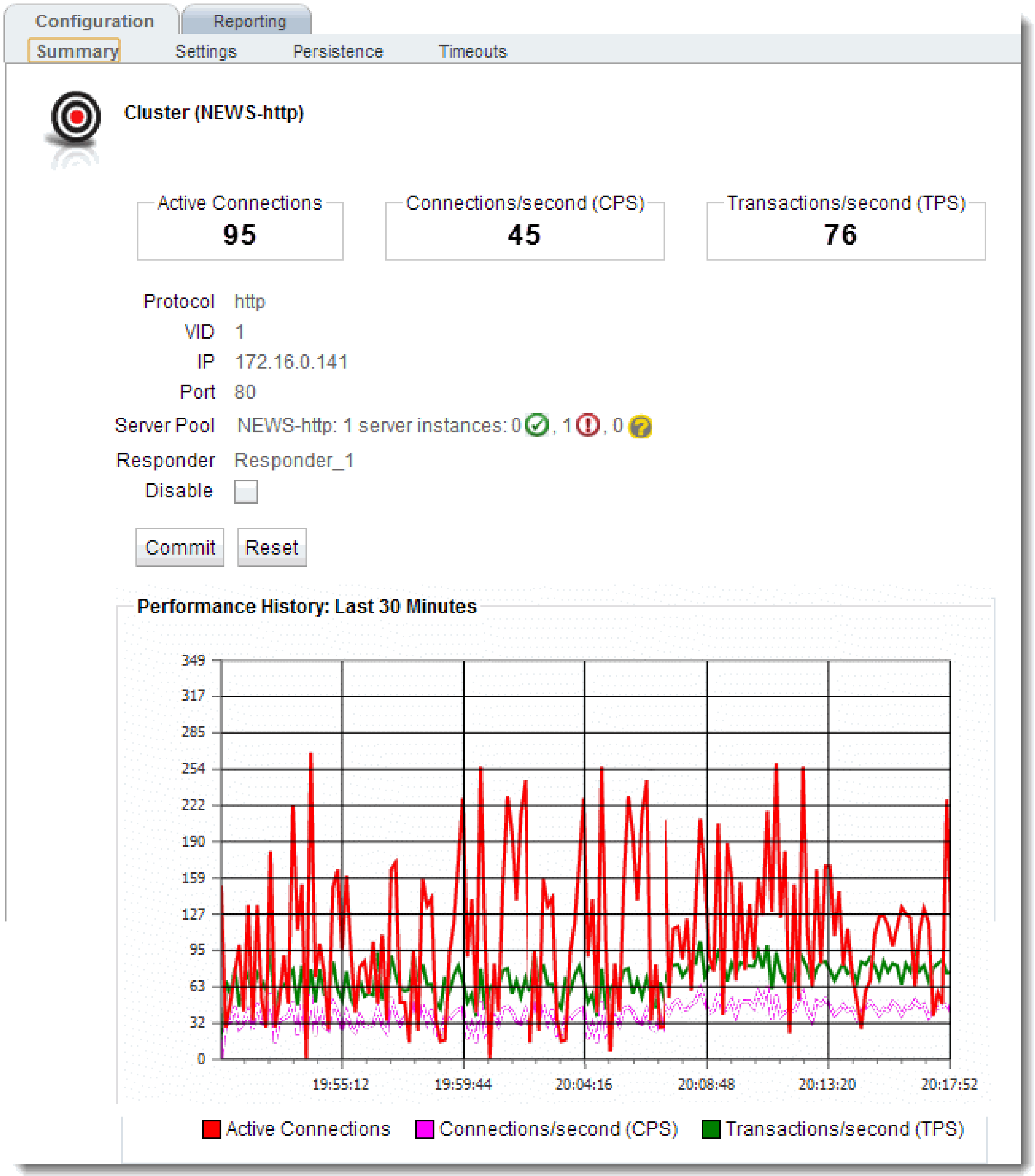
Cluster Name - The logical name for the cluster, or accept Equalizer's default. Each cluster must have a unique name that begins with an alphabetical character. The cluster name is limited to 63 characters.

Cluster IP Address - Enter the IP address, which is the dotted decimal IP address of the cluster. The IP address of the cluster is the external address (for example, 172.16.0.201) with which clients connect to the cluster.

Cluster Port - Enter the port: the numeric port number on the Equalizer to be used for traffic between the clients and the cluster. For HTTP clusters, the cluster port defaults to 80. For HTTPS clusters, the cluster port defaults to 443. For TCP ports the cluster port defaults to 88. For UDP ports the cluster port defaults to 53.

5. Click on **Commit** to save the cluster. The new cluster will appear on the **Cluster** branch of the left navigation pane of the GUI.

6. Clicking on each cluster on the Cluster branch of the navigation pane will display the **Configuration>Summary**. An example is shown below (showing connection and transaction information and plotting).



Cluster (NEWS-http)

Active Connections	Connections/second (CPS)	Transactions/second (TPS)
95	45	76

Protocol	http
VID	1
IP	172.16.0.141
Port	80
Server Pool	NEWS-http: 1 server instances: 0 ✓, 1 ❗, 0 ?
Responder	Responder_1
Disable	☐

🟥 Active Connections 🟪 Connections/second (CPS) 🟩 Transactions/second (TPS)

Follow these steps to delete a new Layer 7 or Layer 4 virtual cluster using the GUI:

1. Log into the GUI using a login that has add/del access for global parameters (See "Logging In" on page 192)

2. Do one of the following:

    a. Right click on a cluster on the left navigational pane and select **Delete Cluster**.

    b. Click on a cluster on the left navigational pane and drag to the **Delete** (Trash) icon.

Using the CLI:

Add a cluster using eqcli as follows. In this example a Layer 7 HTTPS cluster is created. Since the protocol is HTTPS, port 443 is used.

1. Log in to eqcli as described in "Starting the CLI" on page 128.

2. Enter the following at the CLI prompt:

```
eqcli > cluster [clustername] proto protocol ip [xxx.xx.x.xxx] port xxx
```

Do the following to delete a cluster using eqcli as follows:

1. Enter the following at the CLI prompt:

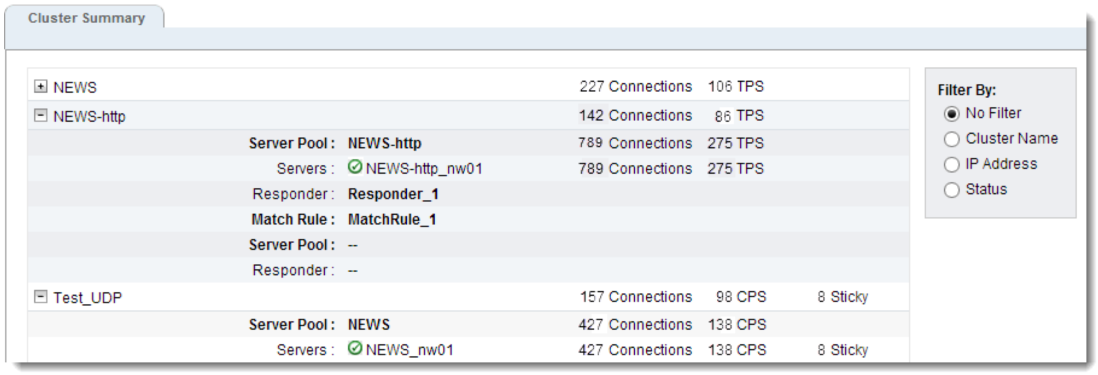
```
eqcli > no cluster [clustername]
```

Cluster Summary

A summary of cluster connection statistics can be displayed using either the GUI or CLI:

Cluster Summary using the GUI:

The example of a Cluster Summary screen shown below displays an expandable, sortable summary listing of all of the clusters configured on your Equalizer.This table displays basic status and statistics for the currently configured clusters, their associated server pools, and Layer 7 match rules. Click on **Clusters** on the left navigational pane to display this summary screen.



Cluster Summary

⊞ NEWS		227 Connections	106 TPS	
⊟ NEWS-http		142 Connections	86 TPS	
Server Pool :	**NEWS-http**	789 Connections	275 TPS	
Servers :	✓ NEWS-http_nw01	789 Connections	275 TPS	
Responder :	**Responder_1**			
Match Rule :	**MatchRule_1**			
Server Pool :	--			
Responder :	--			
⊟ Test_UDP		157 Connections	98 CPS	8 Sticky
Server Pool :	**NEWS**	427 Connections	138 CPS	
Servers :	✓ NEWS_nw01	427 Connections	138 CPS	8 Sticky

Filter By:
[✓ No Filter]
Cluster Name
IP Address
Status

Status Indicators

✓ This icon indicates that the server instances in the attached server pool are up and running.

! This icon indicates that one or more of the server instances in the attached server pool are down.

Numerical Statistics Displayed

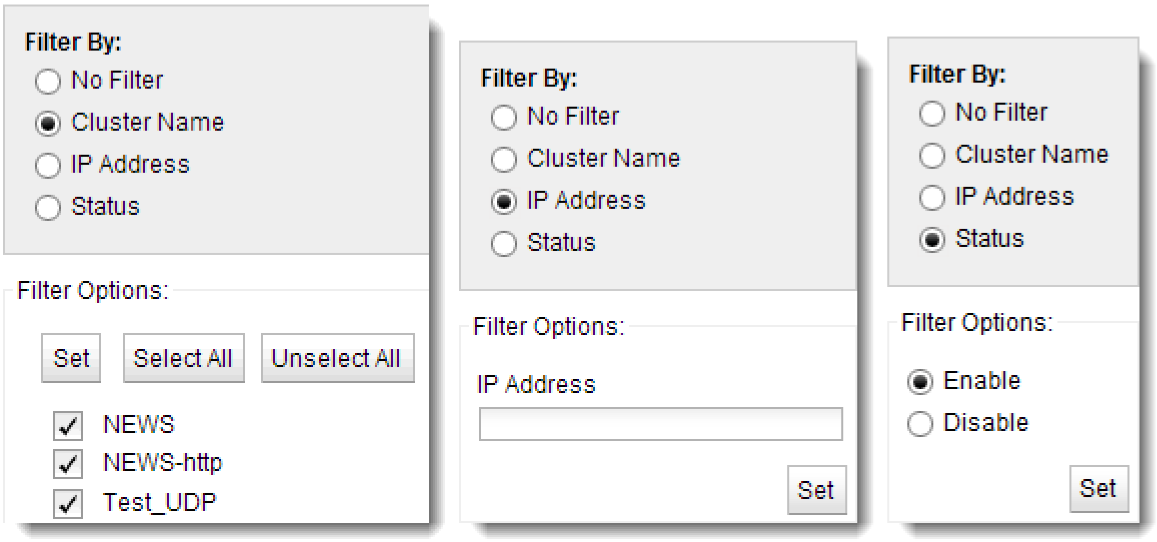
Connections - The number of active (current) connections to this cluster.

TPS - The number of Transactions Per Second being processed by the cluster or match rule.

Sticky - For Layer 4 clusters only. This is the number of entries in the "sticky table" for each server.

Customizing the Display

The cluster summary has 3 display options as shown below:



Filter By: No Filter [✓ Cluster Name] IP Address Status
Filter Options: Set Select All Unselect All
✓ NEWS
✓ NEWS-http
✓ Test_UDP

Filter By: No Filter Cluster Name [✓ IP Address] Status
Filter Options: IP Address Set

Filter By: No Filter Cluster Name IP Address [✓ Status]
Filter Options: [✓ Enable] Disable Set

No Filter - selecting this option will display a cluster summary for all of the clusters configured on your Equalizer.

Filter by Cluster Name - selecting this option will display the cluster summary based on the cluster names that you select with the checkboxes. Use the **Select All** or **Unselect All** buttons as necessary.

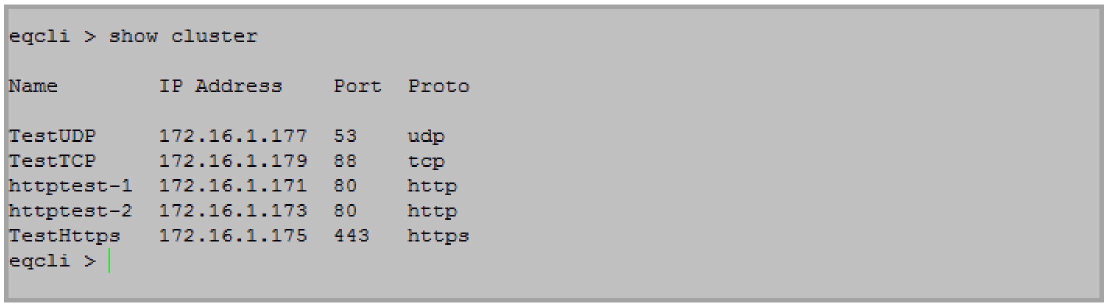
Filter by IP Address - selecting this option will display the entered IP address of the cluster(s) that you would like displayed. For example if you would like to display cluster summary for IPv4 clusters with IP addresses beginning with "172" you would enter "172.*.*.*" - using a wildcard character (*). For IPv6 clusters you would enter prefix specification such as "2001:218:420::/64". After clicking on the **Set** button, the details for those clusters alone will be displayed.

Filter by Status - selecting this option will display will activate the **Enable**/**Disable** options. Selecting **Enable** will display only those clusters that do not have problem icons associated with them. Selecting **Disable** will display only those clusters that have problem icons associated with them.

Cluster Summary using the CLI:

The Cluster Summary screen shown below displays a summary listing of all of the clusters configured on your Equalizer.

Enter the following:

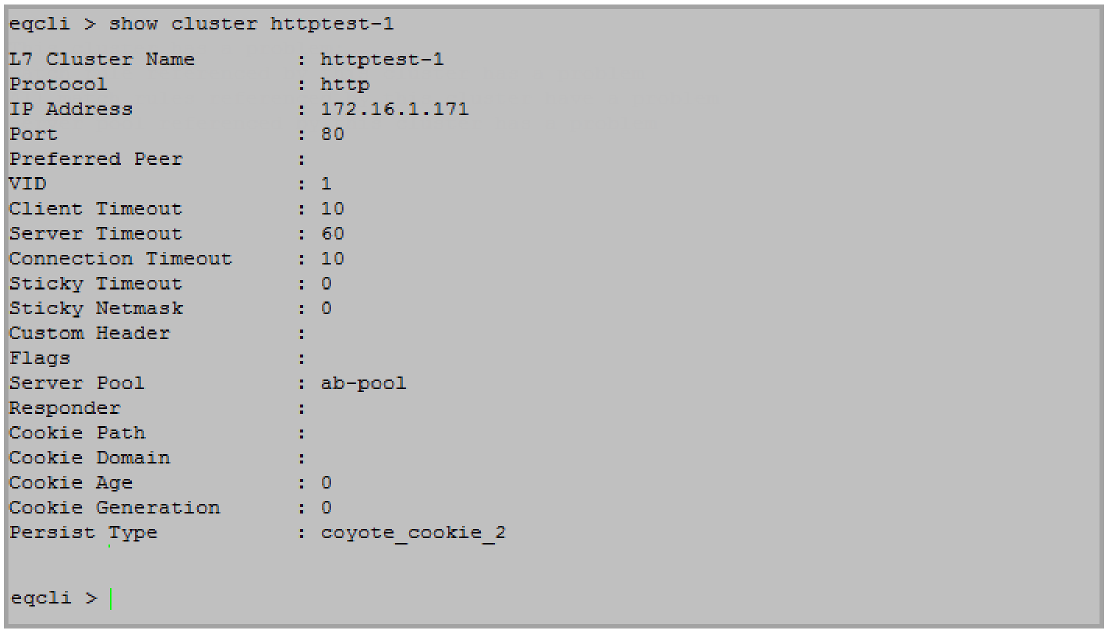


```
eqcli > show cluster

Name         IP Address    Port  Proto

TestUDP      172.16.1.177  53    udp
TestTCP      172.16.1.179  88    tcp
httptest-1   172.16.1.171  80    http
httptest-2   172.16.1.173  80    http
TestHttps    172.16.1.175  443   https
eqcli >
```

To display the cluster summary for specific clusters enter

```
eqcli > show cluster httptest-1
```

The following is an example of the http cluster summary display. It is different than the GUI display in that it reflects only information such as the cluster settings, timeouts, responders and persistence.



```
eqcli > show cluster httptest-1
L7 Cluster Name        : httptest-1
Protocol               : http
IP Address             : 172.16.1.171
Port                   : 80
Preferred Peer         :
VID                    : 1
Client Timeout         : 10
Server Timeout         : 60
Connection Timeout     : 10
Sticky Timeout         : 0
Sticky Netmask         : 0
Custom Header          :
Flags                  :
Server Pool            : ab-pool
Responder              :
Cookie Path            :
Cookie Domain          :
Cookie Age             : 0
Cookie Generation      : 0
Persist Type           : coyote_cookie_2

eqcli >
```

Modifying a Layer 4 TCP or UDP Cluster

The configuration tabs for a cluster are displayed automatically when a cluster is added to the system, or by selecting the cluster name from the left frame Configuration Tree.

To update the settings on any tab, make changes and select the **commit** button to save them.

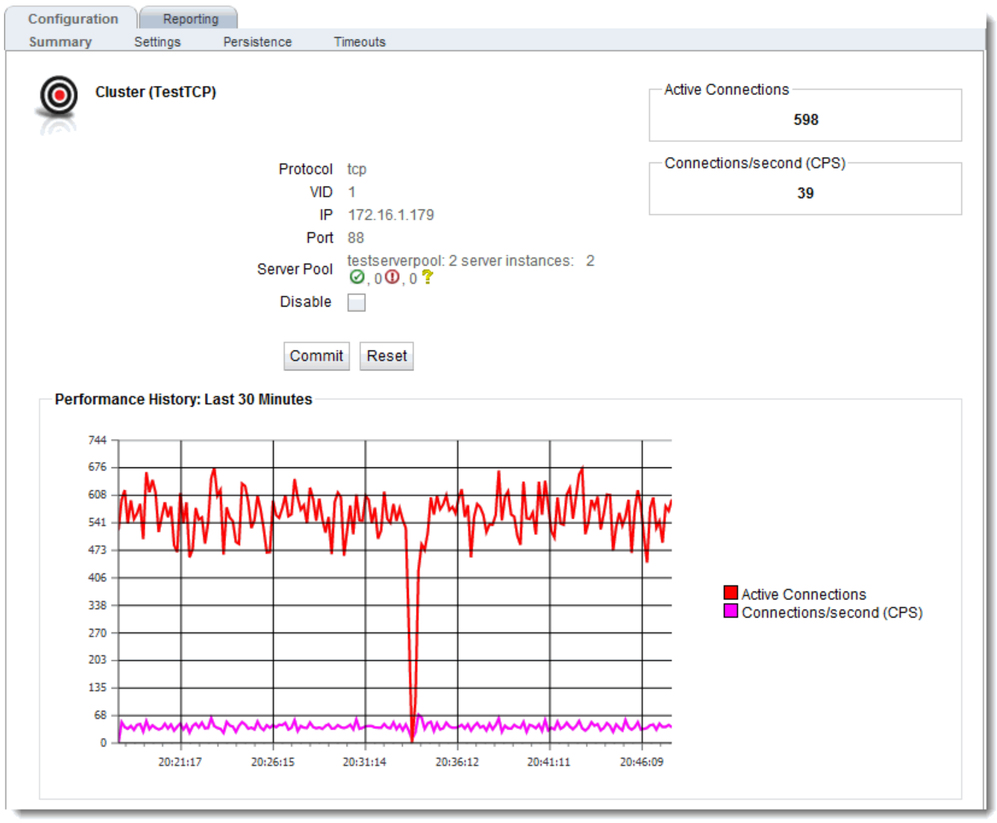
TCP Cluster Configuration Summary

The **TCP Cluster Configuration Summary** screen is displayed automatically when a cluster is added to the system, or by selecting the cluster name from the Cluster branch on the left navigation pane and selecting the **Configuration > Summary** tabs. This screen displays a snapshot of the cluster and all of its associated objects (i.e., server pools, server instances and responders), the status of the objects, the Active Connections, Connections/Second and Transactions/Second.

A graphical plot is also displayed showing the traffic flow through the cluster from the past 30 minutes.

In addition you have the option to **Disable** the cluster by selecting the **Disable** checkbox.

Sample of a TCP Cluster Configuration Summary Screen



Cluster (TestTCP)

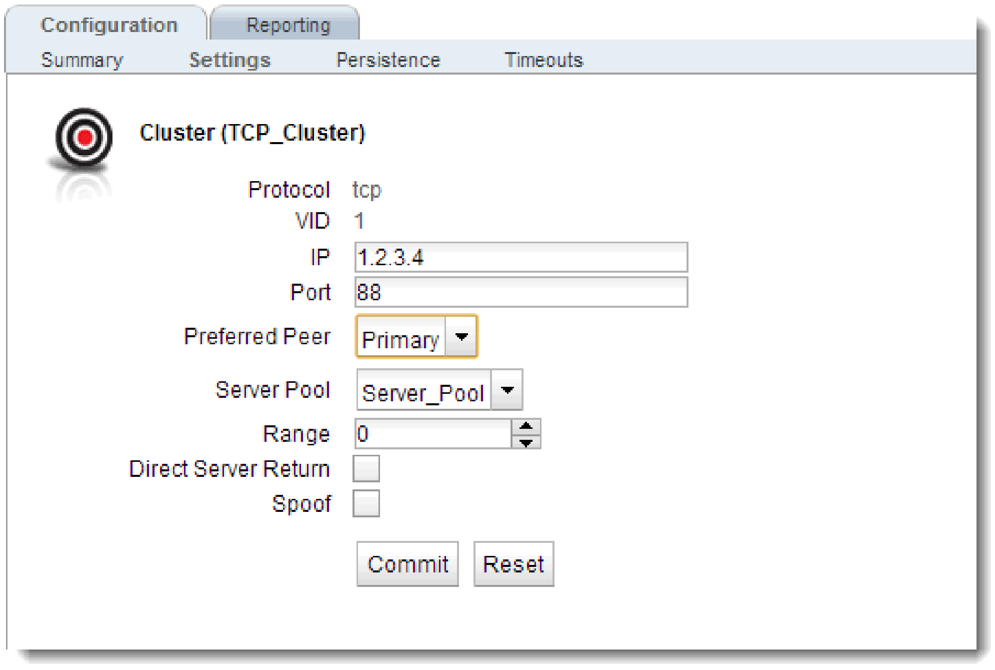
Active Connections: 598

Connections/second (CPS): 39

Protocol	tcp
VID	1
IP	172.16.1.179
Port	88
Server Pool	testserverpool: 2 server instances: 2 ✓, 0 ⓘ, 0 ?
Disable	☐

TCP Cluster Configuration Settings

The TCP Cluster Settings screen for a TCP cluster is displayed by selecting a cluster and from the left navigational pane and then selecting the **Configuration>Settings** tabs.



Cluster (TCP_Cluster)

Protocol tcp
VID 1
IP 1.2.3.4
Port 88
Preferred Peer Primary
Server Pool Server_Pool
Range 0
Direct Server Return
Spoof

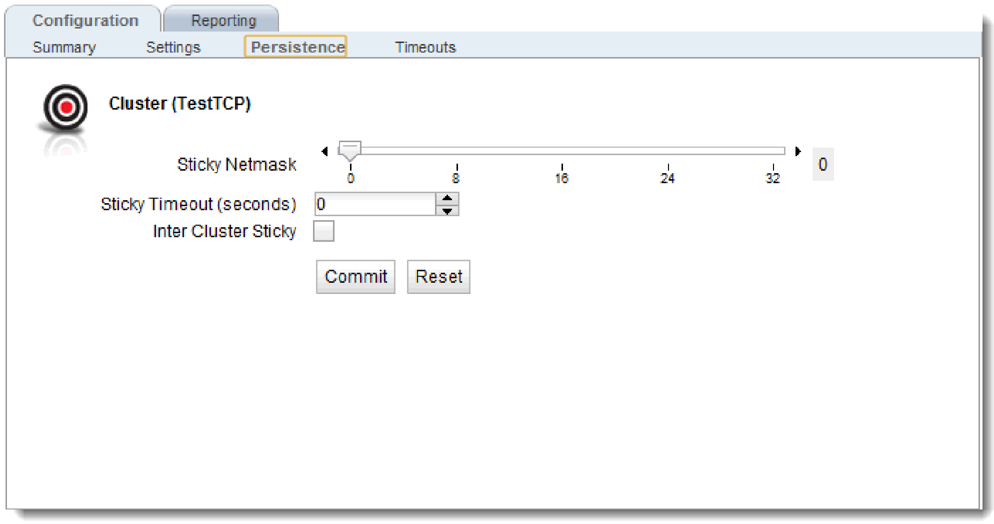
Protocol	The protocol used for the cluster.
VID	The VLAN ID number. This is an integer between 1 and 4095.
IP	Enter the **IP address**, which is the dotted decimal IP address of the cluster. The IP address of the cluster is the external address (for example, `199.146.85.0`) with which clients connect to the cluster.
Port	For TCP protocol clusters the numeric port number on the Equalizer to be used for traffic between the clients and the cluster. This port also becomes the default port for servers added to the cluster (though servers can use a different port number than the one used by the cluster).
Preferred Peer	Used with N+1 Failover Configuration. (See "Configuring N+1 Failover Between Two EQ/OS 10 Systems" on page 460)
Server Pool	The drop down list selects the **Server Pool** (grouping of server instances) to be associated with the TCP cluster.
Range	For L4 UDP and L4 TCP protocol clusters, a port **Range** can be defined by entering a value higher than the L4 port configured for the cluster. This range allows Equalizer users to create a single cluster to control the traffic for multiple, contiguous ports.
Direct Server Return	When enabled, Equalizer forwards packets to the server in such a way that the server responds directly to the client, rather than through Equalizer. This option requires special configuration on the cluster; see "Configuring Direct Server Return" on page 313 before enabling this option. The **spoof** option must also be enabled when this option is enabled.

Spoof	When the **Spoof** option is enabled on a cluster, Equalizer uses the client's IP address as the source IP address in all packets sent to a server in that cluster. When **Spoof** is enabled, all server responses to client requests that came through the Equalizer cluster IP address must be routed by the server back to the client through Equalizer. In many cases, the easiest way to do this is to set the default gateway on the server instances in the server pool on a cluster to Equalizer's IP address on the server VLAN. If this is not possible, you can establish static routes on the server to send responses to specific client IP addresses to Equalizer's IP address on the VLAN. If you disable **Spoof**, the server receiving the request will see Equalizer's IP address as the client address because the TCP connection to the client is terminated when the request is routed. The server will therefore send its response back to Equalizer's IP address. When the **Spoof** flag is *disabled* on a Layer 4 cluster: If there is more than one VLAN defined, all server instances on a server pool *must* be located on the second defined VLAN in the configuration (the VLAN that appears after the **Default** VLAN in the GUI, in **ifconfig** output, and in the configuration file), so that source NAT will work correctly. This is because the source IP address used when **spoof** is disabled is the Equalizer IP address on that VLAN.

Click on the **Commit** button after making changes.

TCP Cluster Persistence

The TCP Cluster Configuration Persistence screen is used to configure Sticky Netmask values, Timeouts and assign the Inter Cluster sticky flag to the selected TCP cluster. It can be accessed by selecting a cluster from the left navigational pane and selecting the **Configuration > Persistence** tabs.



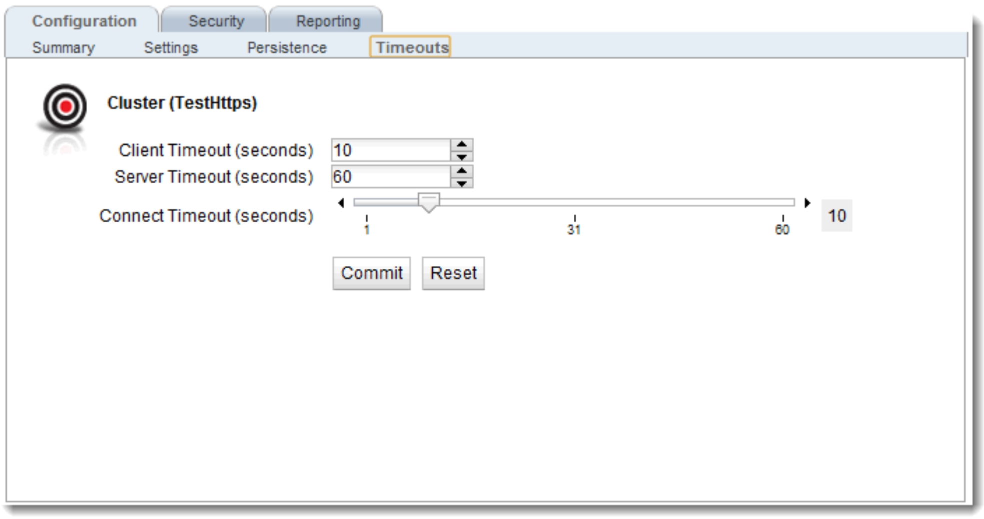
Sticky Netmask: 0
Sticky Timeout (seconds): 0
Inter Cluster Sticky: ☐

Sticky Netmask	Enables sticky network aggregation for a subnet. Sticky network aggregation is applicable for Layer 4 and Layer 7 clusters. Sticky network aggregation enables Equalizer to correctly handle sticky connections from ISPs that use multiple proxy servers to direct user connections. When you enable sticky network aggregation, all the connections coming from a particular network are directed to the same server. (Typically, all the servers in a proxy farm are on the same network.) The sticky netmask value indicates which portion of the address Equalizer should use to identify particular networks. Values are: **0-32** for IPV4 clusters (default=32) **0-128** for IPV6 clusters
Inter-Cluster Sticky	With the **inter-cluster sticky** option, you can configure Equalizer to direct requests from a client to the same server on any available port that has a current persistent connection *in any cluster*.Inter-Cluster Sticky is a Layer 4 option that allows you to extend Layer 4 persistence across multiple server ports.
Sticky Time Out	Sticky Timeout is the number of seconds that Equalizer should "remember" connections from clients. Valid values are from 0 (which disables sticky connections) to 1073741823 seconds (or over 34 years). For more information, refer to "Enabling Sticky Connections" on page 303.

Click on the **Commit** button after making changes to the settings.

TCP Cluster Timeouts

The TCP Cluster Configuration Timeouts screen is used to configure the various timeouts shown below for the selected TCP cluster. It can be accessed by selecting a cluster from the left navigational pane and selecting the **Configuration > Timeouts** tabs.



Client Timeout (seconds) 10
Server Timeout (seconds) 60
Connect Timeout (seconds) 1 31 60 10

Client Timeout	The time in seconds that Equalizer waits before closing an idle client connection. The default is the global value. (between 1 and 65535 seconds)

Server Timeout	The time in seconds that Equalizer waits before closing an idle server connection. The default is the global value. (between 1 and 65535 seconds)
Connect Timeout	The time in seconds that Equalizerwaits for a server to respond to a connection request. The default is the global value.

Click on the **Commit** button after making changes to the settings.

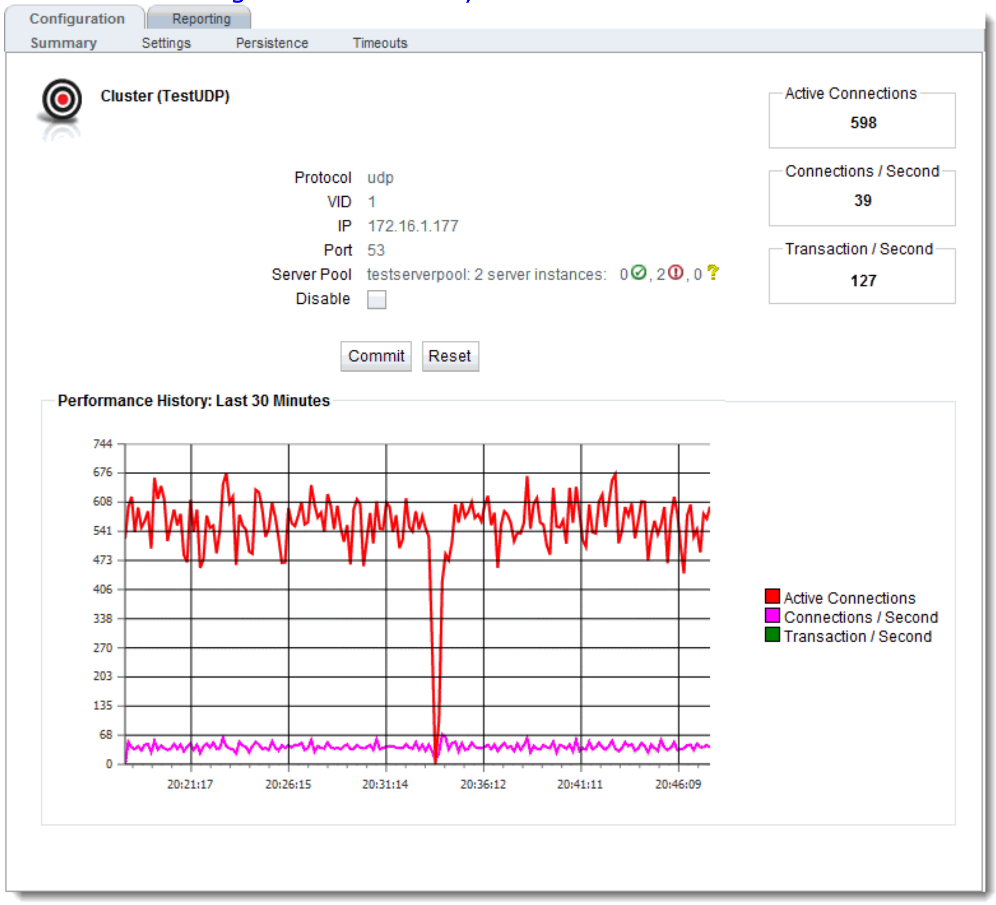
UDP Cluster Configuration Summary

The UDP **Cluster Configuration Summary** screen is displayed automatically when a UDP cluster is added to the system, or by selecting the cluster name from the Cluster branch on the left navigation pane. This screen displays a snapshot of the cluster and all of its associated objects (i.e., server pools, server instances and responders), the status of the objects, the Active Connections, Connections/Second and Transactions/Second.

A graphical plot is also displayed showing the traffic flow through the cluster from the past 30 minutes.

In addition you have the option to **Disable** the cluster by selecting the **Disable** checkbox.

Sample of UDP Cluster Configuration Summary Screen



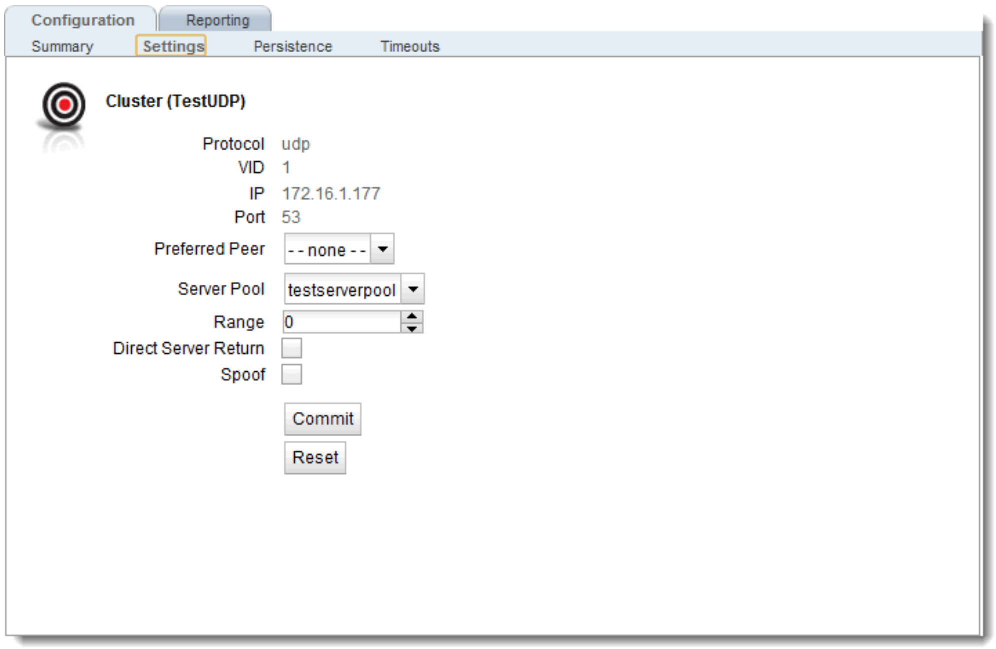
Cluster (TestUDP)

Protocol	udp
VID	1
IP	172.16.1.177
Port	53
Server Pool	testserverpool: 2 server instances: 0 ✓, 2 ⓘ, 0 ?
Disable	☐

Active Connections	598
Connections / Second	39
Transaction / Second	127

UDP Cluster Configuration Settings

The UDP Cluster Configuration Settings screen shown below is displayed automatically when the cluster is added to the system, or by selecting the cluster name from the left navigational pane on the GUI and selecting the **Configuration > Settings** tabs.



Cluster (TestUDP)

Protocol udp
VID 1
IP 172.16.1.177
Port 53
Preferred Peer -- none --
Server Pool testserverpool
Range 0
Direct Server Return
Spoof

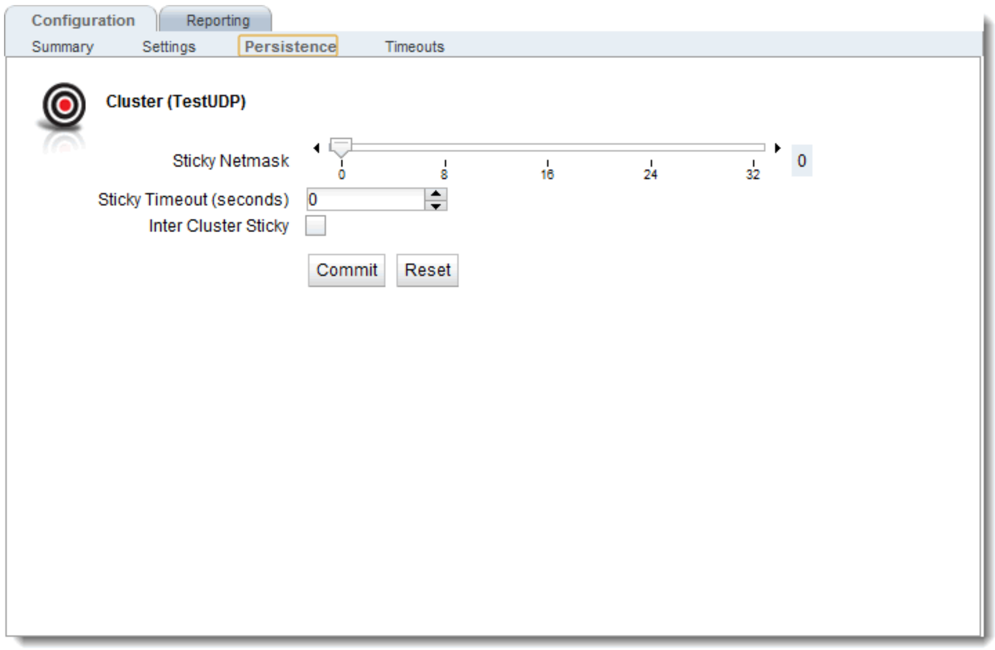
Protocol	The protocol used for the cluster.
VID	The VLAN ID number. This is an integer between 1 and 4095.
IP	Enter the **IP address**, which is the dotted decimal IP address of the cluster.
Port	For TCP protocol clusters the numeric port number on the Equalizer to be used for traffic between the clients and the cluster. For TCP clusters, the port defaults to 80. This port also becomes the default port for servers added to the cluster (though servers can use a different port number than the one used by the cluster).
Preferred Peer	Used with N+1 Failover Configuration. Refer to "Configuring N+1 Failover Between Two EQ/OS 10 Systems" on page 460.
Server Pool	The drop down list selects the **Server Pool** (grouping of server instances) to be associated with the TCP cluster.
Range	For L4 UDP and L4 TCP protocol clusters, a port **Range** can be defined by entering a value higher than the L4 port configured for the cluster. This range allows Equalizer users to create a single cluster to control the traffic for multiple, contiguous ports.
Direct Server Return -	When enabled, Equalizer forwards packets to the server in such a way that the server responds directly to the client, rather than through Equalizer. This option requires special configuration on the cluster; see "Configuring Direct Server Return" on page 313 before enabling this option. The **spoof** option must also be enabled when this option is enabled.
Spoof	When the **Spoof** option is enabled on a cluster, Equalizer uses the client's IP address as the source IP address in all packets sent to a server in that cluster.

	When **Spoof** is enabled, all server responses to client requests that came through the Equalizer cluster IP address must be routed by the server back to the client through Equalizer. In many cases, the easiest way to do this is to set the default gateway on the server instances in the server pool on a cluster to Equalizer's IP address on the server VLAN. If this is not possible, you can establish static routes on the server to send responses to specific client IP addresses to Equalizer's IP address on the VLAN. If you disable **Spoof**, the server receiving the request will see Equalizer's IP address as the client address because the TCP connection to the client is terminated when the request is routed. The server will therefore send its response back to Equalizer's IP address. When the **Spoof** flag is *disabled* on a Layer 4 cluster: If there is more than one VLAN defined, all server instances on a server pool *must* be located on the second defined VLAN in the configuration (the VLAN that appears after the **Default** VLAN in the GUI, in **ifconfig** output, and in the configuration file), so that source NAT will work correctly. This is because the source IP address used when **spoof** is disabled is the Equalizer IP address on that VLAN.

Click on the **Commit** button after making changes.

UDP Cluster Configuration Persistence

The UDP Cluster Configuration Persistence screen is used to configure Sticky Netmask values, Timeouts and assign the Inter Cluster sticky flag to the selected UDP cluster. It can be accessed by selecting a cluster from the left navigational pane and selecting the **Configuration > Persistence** tabs.



Sticky Netmask 0
Sticky Timeout (seconds) 0
Inter Cluster Sticky

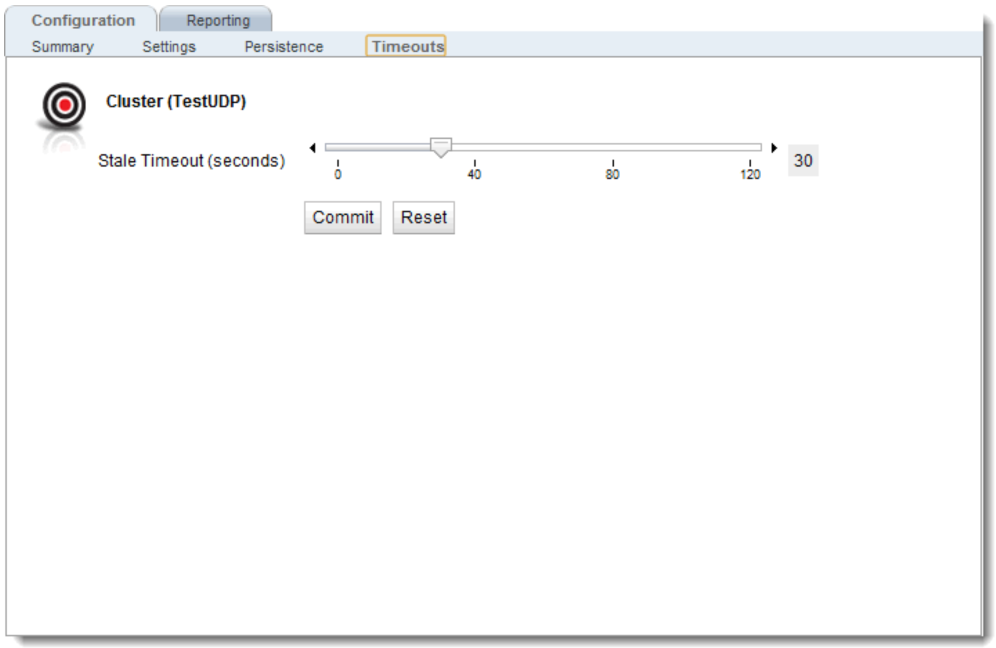
Sticky Netmask	Enables sticky network aggregation for a subnet. Sticky network aggregation is applicable for Layer 4 and Layer 7 clusters. Sticky network aggregation enables Equalizer to correctly handle sticky connections from ISPs that use multiple proxy servers to direct user connections. When you enable sticky network aggregation, all the connections coming from a particular network are directed to the same server. (Typically, all the servers in a proxy farm are on the same network.) The sticky netmask value indicates which portion of the address Equalizer should use to identify particular networks. Values are: **0-32** for IPV4 clusters (default=32) **0-128** for IPV6 clusters
Inter-Cluster Sticky	With the **inter-cluster sticky** option, you can configure Equalizer to direct requests from a client to the same server on any available port that has a current persistent connection *in any cluster*.Inter-Cluster Sticky is a Layer 4 option that allows you to extend Layer 4 persistence across multiple server ports.
Sticky Time Out -	Sticky Timeout is the number of seconds that Equalizer should "remember" connections from clients. Valid values are from 0 (which disables sticky connections) to 1073741823 seconds (or over 34 years). For more information, refer to "Enabling Sticky Connections" on page 303.

Click on the **Commit** button after making changes to the settings.

UDP Cluster Configuration Timeouts

The UDP Cluster Configuration Timeouts screen is used to configure the the **Stale Timeout** for the selected UDP cluster. It can be accessed by selecting a cluster from the left navigational pane and selecting the **Configuration > Timeouts** tabs.

The **Stale Timeout** is the length of time in seconds that a partially open or closed Layer 4 connection is maintained. If a client fails to complete the TCP connection termination handshake sequence or sends a SYN packet but does not respond to the server's SYN/ACK, Equalizer marks the connection as incomplete.



Click on the **Commit** button after making changes to the settings.

Modifying a Layer 7 HTTP or HTTPS Cluster

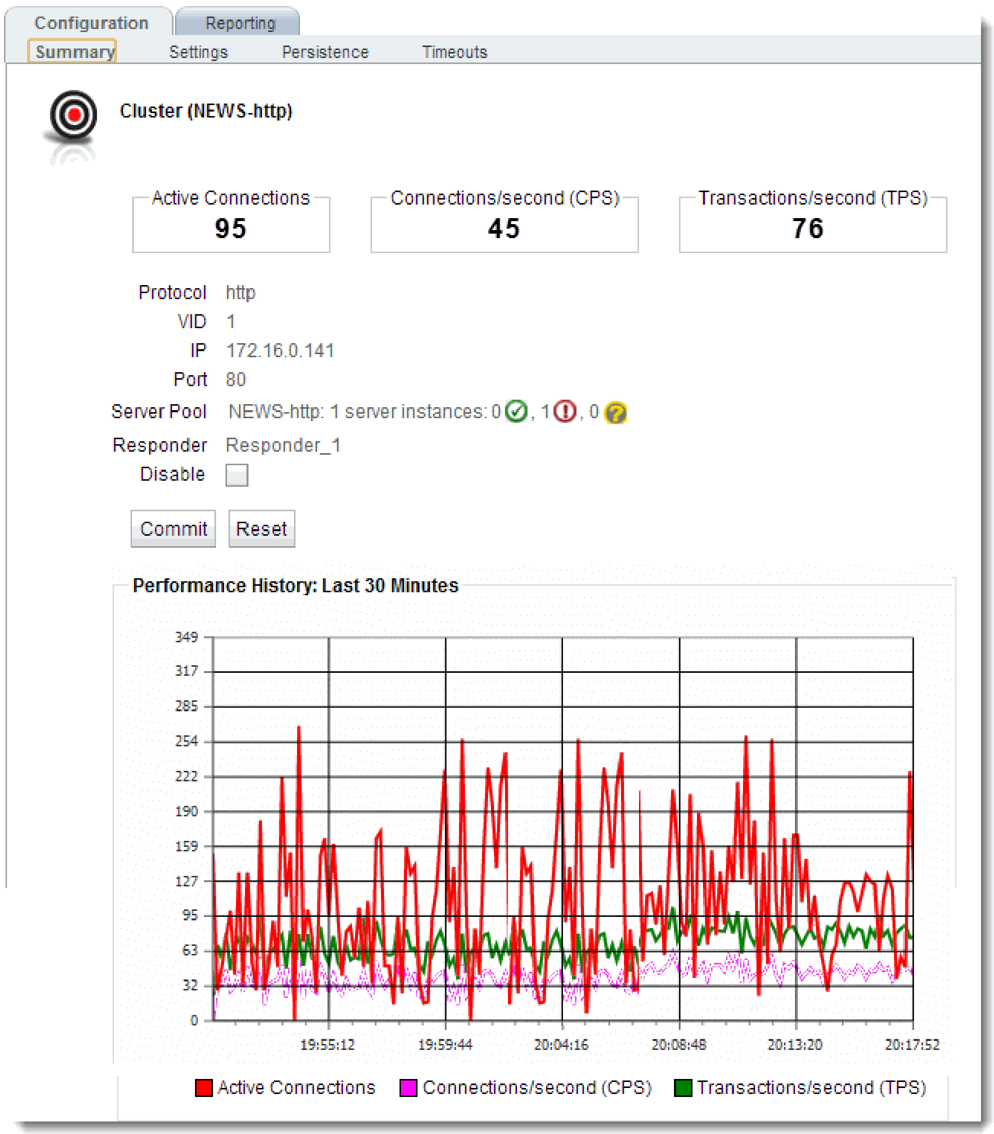
On the GUI, the **Configuration >Summary** for a layer 7 cluster is displayed automatically when a cluster is added to the system, or by selecting the cluster name from **Cluster** branch on the left navigation pane. HTTP and HTTPS clusters parameters are modified using the following tabs:

- **Configuration** including:

  Summary, **Settings**, **Persistence** and **Timeouts**

- Reporting including:

  Statistics and **Plotting**



Cluster (NEWS-http)

Active Connections	Connections/second (CPS)	Transactions/second (TPS)
95	45	76

Protocol	http
VID	1
IP	172.16.0.141
Port	80
Server Pool	NEWS-http: 1 server instances: 0 ✓, 1 ⓘ, 0 ?
Responder	Responder_1
Disable	☐

Layer 7 Cluster Configuration Summary

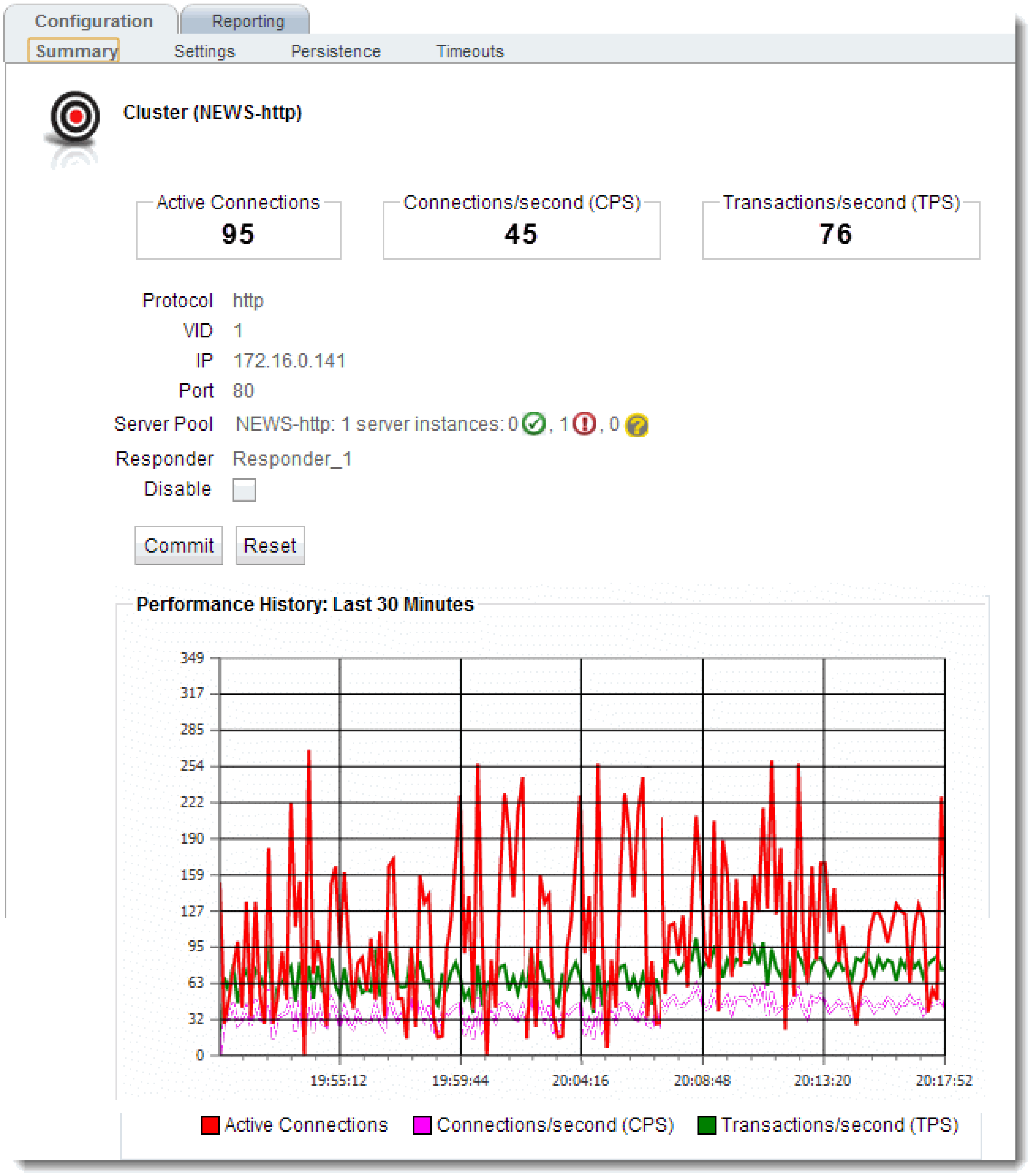
As described in "Modifying a Layer 7 HTTP or HTTPS Cluster" on page 282 the Layer 7 **Cluster Configuration Summary** screen is displayed automatically when a cluster is added to the system, or by selecting the cluster name from the Cluster branch on the left navigation pane. This screen displays a snapshot of the cluster and all of its associated objects (i.e., server pools, server instances and responders), the status of the objects, the Active Connections, Connections/Second and Transactions/Second.

A graphical plot is also displayed showing the traffic flow through the cluster from the past 30 minutes.

In addition you have the option to Disable the cluster by removing its IP address alias from the interface in addition to disabling cluster traffic.

The example below shows a sample of the **Cluster Summary Screen** for an HTTP cluster. The Summary Screens for the HTTPS and Layer 7 TCP clusters are similar.

Sample Layer 7 HTTP, HTTPS, and TCP Cluster Configuration Summary Screen



Cluster (NEWS-http)

Active Connections	Connections/second (CPS)	Transactions/second (TPS)
95	45	76

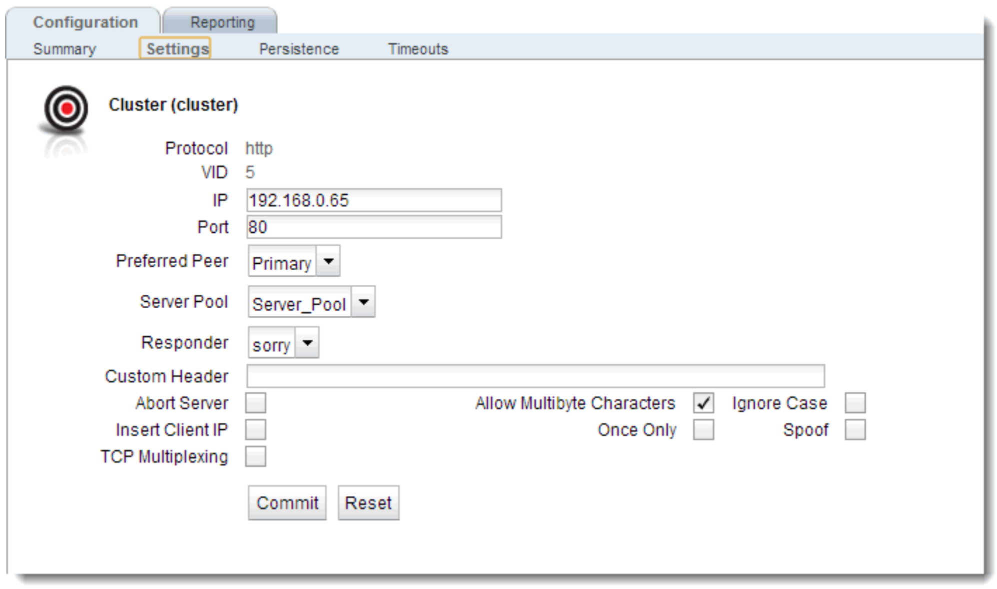
Protocol	http
VID	1
IP	172.16.0.141
Port	80
Server Pool	NEWS-http: 1 server instances: 0 ✓, 1 ⓘ, 0 ?
Responder	Responder_1
Disable	☐

Performance History: Last 30 Minutes

🟥 Active Connections 🟪 Connections/second (CPS) 🟩 Transactions/second (TPS)

Layer 7 HTTP and HTTPS Cluster Settings

The following are descriptions of the functionality and configuration parameters used with Layer 7 HTTP and HTTPS Clusters. The figure below shows a Layer 7 **Configuration>Settings** screen.



Cluster (cluster)

Protocol	http
VID	5
IP	192.168.0.65
Port	80
Preferred Peer	Primary
Server Pool	Server_Pool
Responder	sorry
Custom Header	
Abort Server	☐
Insert Client IP	☐
TCP Multiplexing	☐
Allow Multibyte Characters	✓
Once Only	☐
Ignore Case	☐
Spoof	☐

The fields on this screen are as follows:

Protocol	The protocol selected in the Add Cluster form will be displayed "grayed out".
VID	The VLAN ID number assigned to the VLAN on which the cluster resides. Refer to "Common Equalizer Networking Scenarios" on page 82 for details.
IP	Enter the IP address, which is the dotted decimal IP address of the cluster. The IP address of the cluster is the external address (for example, 172.16.0.201) with which clients connect to the cluster.
Port	For HTTP and HTTPS protocol clusters, enter the port: the numeric port number on the Equalizer to be used for traffic between the clients and the cluster. For HTTP clusters, the port is normally 80. For HTTPS clusters, the port is normally 443. This port also becomes the default port for servers added to the cluster (though servers can use a different port number than the one used by the cluster).
Preferred Peer	Used with Active-Active Failover. Refer to "Configuring Active/Active Failover Between Two EQ/OS 10 Systems" on page 456.
Server Pool	A drop down list used to select a Server Pool, or grouping of servers, to which the cluster will communicate with.
Responder	A Responder (See "Automatic Cluster Responders" on page 347) is a server-like object that can be associated with a Match Rule (See "Match Rules" on page 317). If an incoming request satisfies a Match Rule expression and all of the servers specified in the Match Rule are down, a Responder definition in the Match Rule (if present) tells Equalizer to send one of two automatic responses to the client.
Custom Header	A custom HTTP header that Equalizer inserts into all client requests before they are sent to the server. The format of the string is text:text. Also see

	"Specifying a Custom Header for HTTP/HTTPS Clusters" on page 308.
Compression Minimum Size (E650GX Only)	The minimum file size in bytes required for GZIP compression, if enabled. Equalizer uses GZIP to compress the payload (or content) of the server response before sending it back to the client. This is typically done for 2 reasons: faster client response and better user experience. In addition. less ISP bandwidth is used in sending smaller files back to clients. Files smaller than the minimum specified are not compressed. Default:1024 bytes.
Compression MIME Types (E650GX Only)	Specifies the mime-types that will be compressed when the Compress option is enabled for the cluster. The value of this parameter is a string (maximum length: 512 characters) with valid mime-type names separated by a colon (:). The default compress mime-types string specifies the following mime-types

```
text/* application/msword
application/postscript
application/rtf
application/x-csh
application/x-javascript
application/x-sh
application/x-shar
application/x-tar
application/x-tcl
application/xslt+xml
audio/midi audio/32kadpcm
audio/x-wav
image/bmp
image/tiff
image/x-rgb
```

Lists of officially supported mime-types can be found at:

http://www.iana.org/assignments/media-types/

Flags

Abort server	By default, when a client closes a connection, Equalizer waits for a response from the server before closing the server connection. If this flag is enabled, Equalizer will not wait for a response before closing the connection to the server; instead it sends a TCP RST (reset) to the server when the client closes the connection. This option will typically reduce the number of server connections in the TIME_WAIT state, as shown by the netstat console command.

Insert client IP	When this flag is enabled, Equalizer inserts an X-forwarded-for: header with the client's IP address into all client requests before they are sent to the server. This flag is disabled by default for HTTP clusters and enabled by default for HTTPS clusters.
TCP Multiplexing	This selection enables TCP multiplexing for a cluster. TCP multiplexing must also be enabled on at least one server instance in the server pool assigned to the cluster (or one of its match rules).
Allow Multibyte Characters	By default, support for extended characters (8-bit ASCII and multibyte UTF characters) in URIs is disabled. Equalizer returns a 400 Bad Request error when a request URI contains 8-bit or multibyte characters. To enable support for 8-bit and multibyte characters in URIs, click this checkbox. There are potential risks to enabling this option, because it allows Equalizer to pass requests that violate RFC2396; load-balanced servers may be running software that is incapable of handling such requests. Therefore, ensure that your server software is capable of handling URIs containing extended characters and will not serve as a potential weak point in your network before you enable extended characters.
Once only	Limits Equalizer to parsing headers (and executing match rules) for only the first request of any client making multiple requests across a single TCP connection. This option is off by default: meaning that Equalizer will parse the headers of every client request.
Ignore case	Applies to L7 clusters and is the global setting to ignore case in match expressions. You can override this value per cluster and per match rule. See "Match Rules" on page 317 .
Spoof	When the spoof option is enabled on a cluster, Equalizer uses the client's IP address as the source IP address in all packets sent to a server in that cluster. This option is enabled by default. When spoof is enabled, all server responses to client requests that came through the Equalizer cluster IP address must be routed by the server back to the client through Equalizer. In many cases, the easiest way to do this is to set the default gateway on the server with a server instance in a server pool to Equalizer's IP address on the server VLAN. If this is not possible, you can establish static routes on the server to send responses to specific client IP addresses to Equalizer's IP address on the VLAN. If you disable spoof, the server receiving the request will see Equalizer's IP address as the client address because the TCP connection to the client is terminated when the request is routed. The server will therefore send its response back to Equalizer's IP address. Disabling the spoof option enables Source Network Address Translation (SNAT).
Compression (E650GX Only)	When this option is enabled, Equalizer automatically detects requests to the cluster from compression-capable browser clients and performs GZIP compression on all cluster responses sent to that client. This disable - Disable this cluster. The cluster IP address will not accept requests when this flag is enabled.
Rewrite Redirects (HTTPS only-not shown above)	When enabled, forces Equalizer to pass responses from an HTTPS cluster's servers without rewriting them. In the typical Equalizer setup, you configure servers in an HTTPS cluster to listen and respond using HTTP; Equalizer communicates with the clients using SSL. If a server sends an HTTP redirect using the Location: header, this URL most likely will not include the https: protocol. Equalizer rewrites responses from the

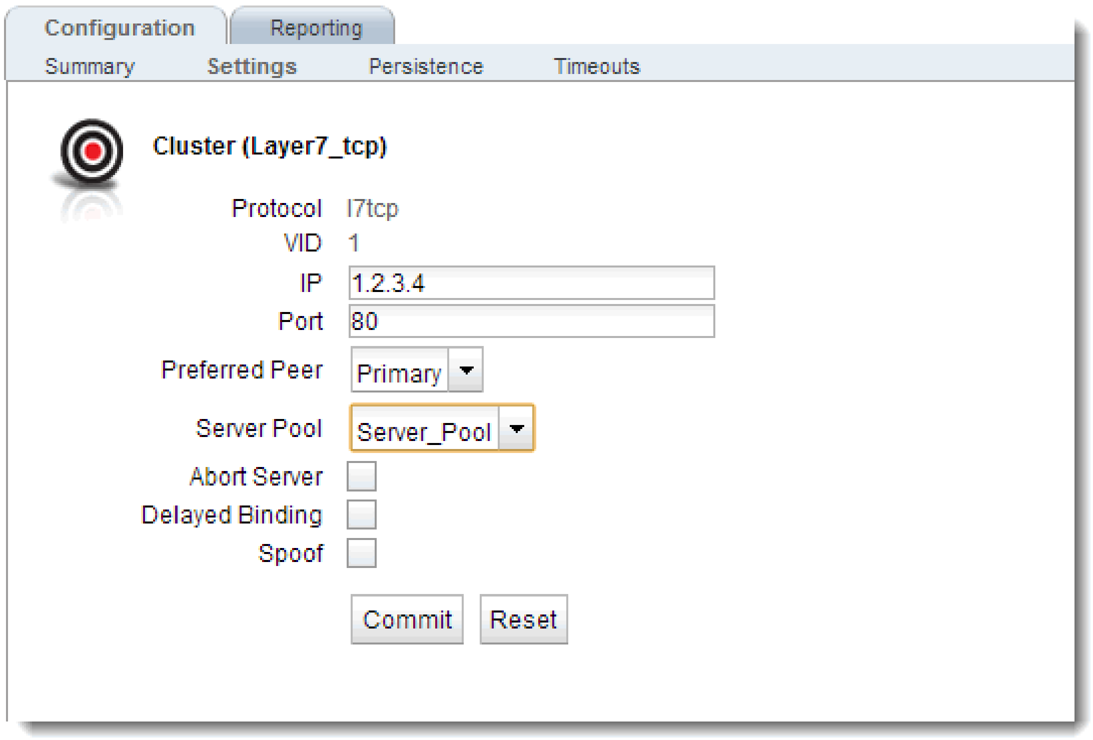
	server so that they are HTTPS. You can direct Equalizer to pass responses from the server without rewriting them by enabling this option.
Ignore Critical Extensions (HTTPS only- not shown above)	Control whether Equalizer will process "CRL Distribution Point" extensions in client certificates. This option only affects the processing of the "CRL Distribution Point" extension in client certificates: When **Ignore Critical Extensions** is disabled, a client certificate presented to Equalizer that includes any extension will be rejected by Equalizer. This is the behavior in previous releases. When **Ignore Critical Extensions** is enabled (the default), a client certificate presented to Equalizer that has a CRL Distribution Point extension will be processed and the CRL critical extension will be ignored. Note, however, that if other extensions are present in a client certificate they are not ignored and will cause the client certificate to be rejected by Equalizer.

Click on the **Commit** button after making changes to the settings.

Layer 7 TCP Cluster Settings

The Layer 7 TCP cluster is used to provide IPv6 addressing for generic Layer 4 protocols, and can support IPv4 and IPv6 addressing for clusters and servers. The functionality is very much like Layer 4 TCP clusters. This type of cluster should be used when IPv6 addressing is required for a TCP protocol other than HTTP or HTTPS. (The Layer 4 TCP and UDP clusters can use only IPv4 cluster addresses and can only be used with servers that have IPv4 addresses.) See the section "Cluster Types and How They're Used with Equalizer" on page 260 for a summary of cluster types.

The following are descriptions of the functionality and configuration parameters used with Layer 7 TCP Clusters. The figure below shows a Layer 7 TCP **Configuration > Settings** screen.



Cluster (Layer7_tcp)

Protocol	l7tcp
VID	1
IP	1.2.3.4
Port	80
Preferred Peer	Primary
Server Pool	Server_Pool
Abort Server	☐
Delayed Binding	☐
Spoof	☐

The fields on this screen are as follows:

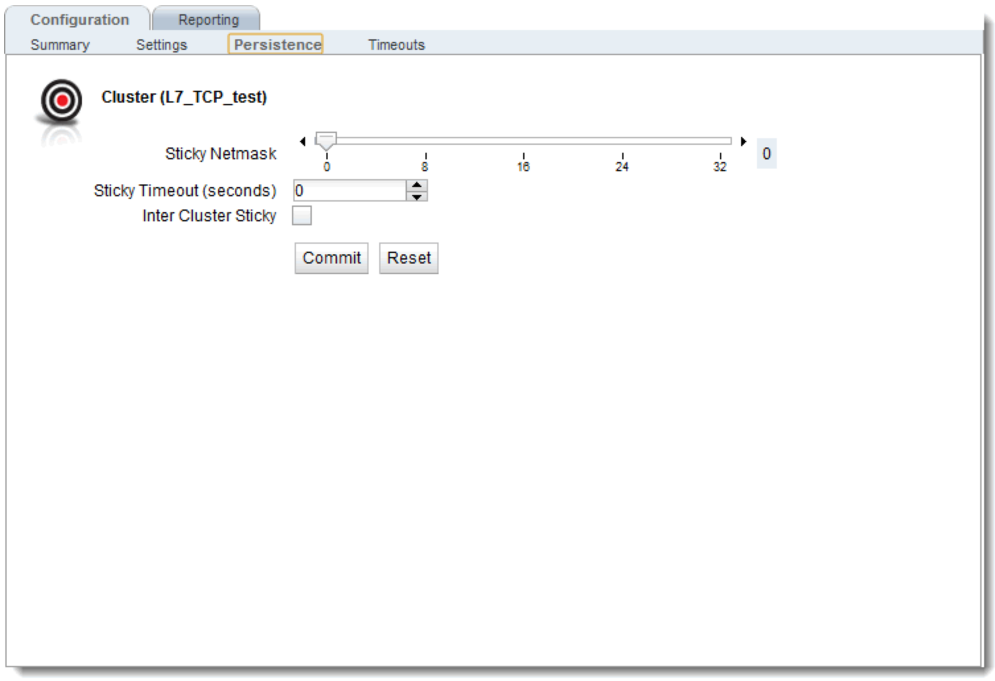
Protocol	The protocol selected in the Add Cluster form will be displayed “grayed out”.
VID	The VLAN ID number assigned to the VLAN on which the cluster resides. Refer to "Common Equalizer Networking Scenarios" on page 82 for details.
IP	Enter the IP address, which is the dotted decimal IP address of the cluster. The IP address of the cluster is the external address with which clients connect to the cluster.
Port	For TCP protocol clusters the numeric port number on the Equalizer to be used for traffic between the clients and the cluster. For TCP clusters, the port defaults to 80. This port also becomes the default port for servers added to the cluster (though servers can use a different port number than the one used by the cluster).
Preferred Peer	Used with Active-Active Failover. Refer to "Configuring Active/Active Failover Between Two EQ/OS 10 Systems" on page 456 for details.
Server Pool	A drop down list used to select a Server Pool, or grouping of servers, to which the cluster will communicate with.
Abort server	By default, when a client closes a connection, Equalizer waits for a response from the server before closing the server connection. If this flag is enabled, Equalizer will not wait for a response before closing the connection to the server; instead it sends a TCP RST (reset) to the server when the client closes the connection. This option will typically reduce the number of server connections in the TIME_WAIT state, as shown by the

	netstat console command.
Delayed Binding	When enabled, this option will require servers to send the first byte of information on newly established connections.
Spoof	When the spoof option is enabled on a cluster, Equalizer uses the client's IP address as the source IP address in all packets sent to a server in that cluster. This option is enabled by default. When spoof is enabled, all server responses to client requests that came through the Equalizer cluster IP address must be routed by the server back to the client through Equalizer. In many cases, the easiest way to do this is to set the default gateway on the server with a server instance in a server pool to Equalizer's IP address on the server VLAN. If this is not possible, you can establish static routes on the server to send responses to specific client IP addresses to Equalizer's IP address on the VLAN. If you disable spoof, the server receiving the request will see Equalizer's IP address as the client address because the TCP connection to the client is terminated when the request is routed. The server will therefore send its response back to Equalizer's IP address. Disabling the spoof option enables Source Network Address Translation (SNAT).

Click on the **Commit** button after making changes.

Layer 7 TCP Cluster Persistence

Layer 7 TCP cluster persistence is the same as Layer 4 TCP cluster persistence. Refer to "TCP Cluster Persistence" on page 275 for details.



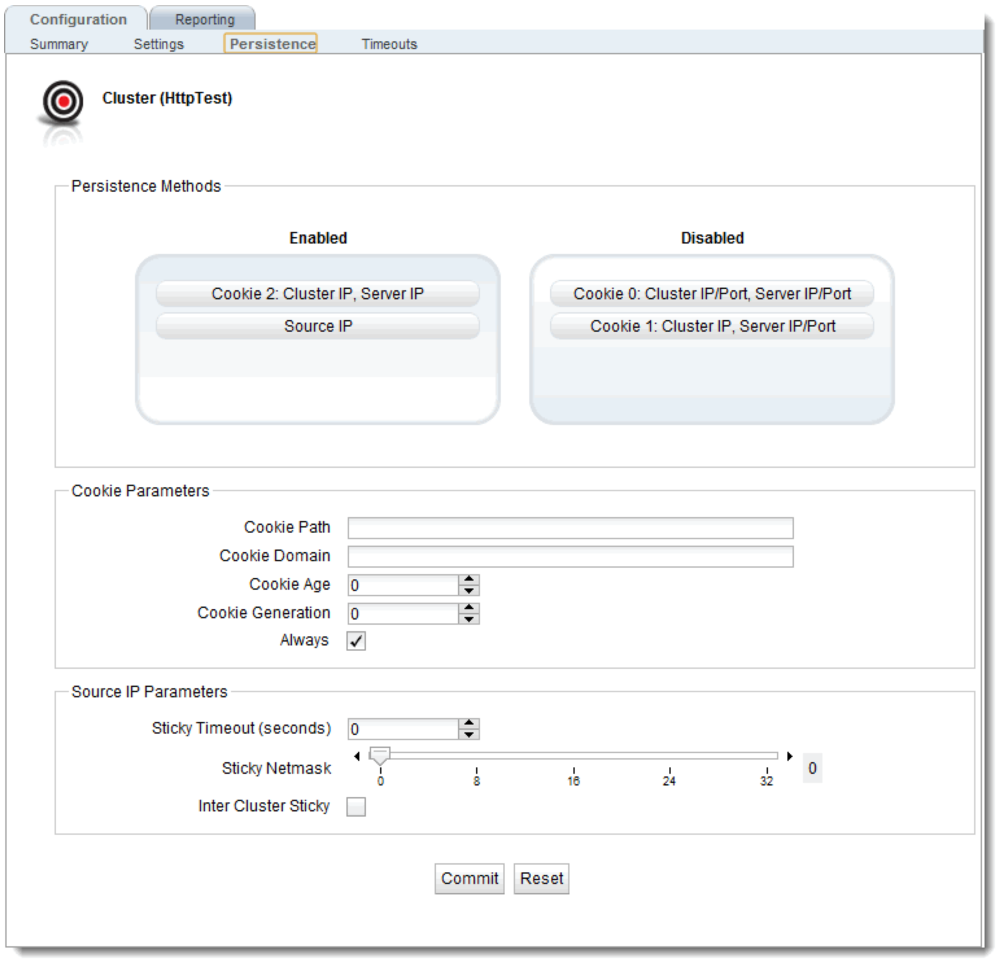
Sticky Netmask 0
Sticky Timeout (seconds) 0
Inter Cluster Sticky

Layer 7 HTTP and HTTPS Cluster Persistence

Equalizer can use cookies or a server's IP address to maintain a persistent session between a client and a particular server. A cookie is included with the server's response header on its way back to the client. This cookie uniquely identifies the server to which the client was just connected. Equalizer routes the first request from a client using load balancing criteria; subsequent client requests are routed to the same selected server for the entire session (while the cookie is valid -- see **Cookie Age**, above). In that way, a server's IP address can alternately be embedded into a response header that identifies the server.

EQ/OS 10 features "fallback persistence" where Equalizer provides a secondary persistence option where if, for example, a cookie response is not received, a secondary, or "fallback" option can be used. With these configurable options, if two persist methods are listed, (e.g., **Cookie 1:Cluster IP, Server IP /Port** and **Source IP**) In this example the order indicates the fallback order: if a **cookie** is found- the cookie will be used, otherwise the **Source IP** will be embedded in the response header back to the client.

Persistence options on an HTTP or HTTPS cluster are configured by selecting a cluster from the left navigational pane on the GUI and selecting **Cluster > Persistence** to display the screen shown below.



Persistence Methods

Enabled	Disabled
Cookie 2: Cluster IP, Server IP	Cookie 0: Cluster IP/Port, Server IP/Port
Source IP	Cookie 1: Cluster IP, Server IP/Port

Cookie Parameters

Cookie Path	
Cookie Domain	
Cookie Age	0
Cookie Generation	0
Always	✓

Source IP Parameters

Sticky Timeout (seconds)	0
Sticky Netmask	0
Inter Cluster Sticky	

There are three configuration panes on this screen. **Persistence Methods, Cookie Parameters** and **Source IP Parameters**.

Persistence Methods

With the **Persistence Methods** pane are an **Enabled** area and a **Not Used** area. One Persistence Type method and one Fallback Persistence Type only can be enabled. Enable and order persistence methods by dragging and dropping from between the **Not Used** area and the **Enable** area. Arrange the order between the primary persistence method and the “fallback” persistence method by dragging and dropping as well. As indicated previously, with “fallback persistence” Equalizer provides a secondary option where if, for example, a cookie response is not received, a secondary, or “fallback” option such as **Source IP** can be used.

The cookie scheme specifies the format of the cookie to be used for the cluster as an integer between 0 and 2 (default is 2).

Cookie 0:Cluster IP/Port, Server IP/Port	Constructs a cookie which will be named in such a way that so as long as the cluster maintains the same IP address, servers can be added to and removed from the cluster without invalidating all of the existing cookies. **This cookie stores the cluster IP and port, and the server IP and port.**
Cookie 1:Cluster IP, Server IP /Port	Constructs a cookie which will be valid across all clusters with the same IP address (not port specific). A requirement for this to be useful is that all clusters on that IP address share the same set of servers. **This cookie stores the Cluster IP, and Server IP and port.**
Cookie 2:Cluster IP, Server IP	Constructs a cookie which will be valid across all clusters with the same IP address (using any port), and the same server within those clusters (with the server using any port). A requirement for this to be useful is that all clusters on that IP address share the same set of servers. **This cookie encodes the Cluster IP and Server IP.**
Source IP	The Source IP address of the server will be embedded in the response header back to the client.

Cookie Parameters

The **Cookie Parameters** pane will expand if a cookie scheme is enabled.

Cookie age	The **Cookie age** sets the time, in seconds, over which the client browser maintains the cookie (“0” means the cookie never expires). After the specified number of seconds have elapsed, the browser deletes the cookie and any subsequent client requests will be handled by Equalizer’s load-balancing algorithms
Cookie path	If a **Cookie Path** is specified, Equalizer honors cookies in a client requests only when the path component of the request URI has the same prefix as that of the specified **Cookie Path**. For example, if the cookie path is /store/, Equalizer presents the cookie to the server only if the request URI includes a path such as /store/ mypage.html.
Cookie Domain -	If a cookie domain is specified, then Equalizer will honor cookies in client requests only if the server’s host name is within the specified domain. For example, if the cookie domain is coyotepoint.com, then Equalizer will only present the cookie to servers in the coyotepoint.com domain (for example, *www.coyotepoint.com* or my.coyotepoint.com). Wildcards are not supported in the cookie domain.
Cookie Generation -	A value added to cookies when the cookie scheme is 2. In order for cookies to be valid, the specified **Cookie Generation** must match the equivalent

	number embedded in the cookie. Conversely, if you need to invalidate old cookies, increment this number. **Always** - When this flag is disabled Equalizer will insert a cookie if a server was not selected based on a cookie received from the client. A cookie would only be inserted when a new client is seen or if cookie is received or if a cookie received cannot validate a server. If the **Always** flag is enabled, Equalizer includes a cookie in the response regardless of whether the server sent a cookie.

Source IP Parameters

The **Source IP** pane will expand if **Source IP** is moved to the Enabled pane.

Sticky Timeout	The number of seconds that Equalizer should "remember" connections from clients) Valid values are from 0 (which disables sticky connections) to 1073741823 seconds (or over 34 years).
Sticky Netmask	Enables sticky network aggregation for a subnet. Sticky network aggregation is applicable for Layer 4 and Layer 7 clusters. Sticky network aggregation enables Equalizer to correctly handle sticky connections from ISPs that use multiple proxy servers to direct user connections. When you enable sticky network aggregation, all the connections coming from a particular network are directed to the same server. (Typically, all the servers in a proxy farm are on the same network.) The sticky netmask value indicates which portion of the address Equalizer should use to identify particular networks. Values are: **0-32** for IPV4 clusters (default=32) **0-128** for IPV6 clusters
Inter cluster Sticky	With the inter-cluster sticky option, you can configure Equalizer to direct requests from a client to the same server on any available port that has a current persistent connection in any cluster. Inter-Cluster Sticky is a Layer 4 or Layer7 option that allows you to extend Layer 4 or Layer 7 persistence across multiple server ports.

Note - Inter-Cluster Sticky does not work for stickiness between a Layer 4 and a Layer 7 cluster only between a Layer 4/Layer 4 cluster or a Layer7/Layer 7 cluster.

Note - If you are using two Equalizer in a failover configuration, you must set the sticky network aggregation mask identically on both Equalizers.

Fallback Persistence Scenarios

The table below shows all of the possible persistence scenarios and the resulting load balancing server selections based on the persist types and fallback persist types that are "enabled".

Persist Type	Fallback Persist Type	Result
[none]	[none]	The server is selected on the load balancing Policy/Algorithm.
[none]	Source IP	invalid configuration
[none]	Cookie 0:Cluster IP/Port, Server IP/Port	invalid configuration
[none]	Cookie 1:Cluster IP, Server IP /Port	invalid configuration
[none]	Cookie 2:Cluster IP, Server IP	invalid configuration
Source IP	[none]	A server is selected on a sticky record (Source IP). If no records are found a server is selected and a new sticky record is created.
Source IP	Source IP	invalid configuration
Source IP	Cookie 0:Cluster IP/Port, Server IP/Port	A server is selected on a sticky record(Source IP). If no records are found a server is selected on the basis of the cookie and if the cookie is anything other than Cookie 0:Cluster IP/Port, Server IP/Port a server is selected using the Load balancing Policy/Algorithm.
Source IP	Cookie 1:Cluster IP, Server IP /Port	A server is selected on a sticky record(Source IP). If no records are found a server is selected on the basis of the cookie and if the cookie is anything other than Cookie 1:Cluster IP, Server IP /Port a server is selected using the Load balancing Policy/Algorithm.
Source IP	Cookie 2:Cluster IP, Server IP	A server is selected on a sticky record(Source IP). If no records are found a server is selected on the basis of the cookie and if the cookie is anything other than Cookie 2:Cluster IP, Server IP a server is selected using the Load balancing Policy/Algorithm.
Cookie 0:Cluster IP/Port, Server IP/Port	[none]	A server is selected based on the cookie If no cookie or a cookie other then Cookie 0:Cluster IP/Port, Server IP/Port is in the request the server is selected using the Load balancing Policy/Algorithm.
Cookie 0:Cluster IP/Port, Server IP/Port	Source IP	A server is selected based on the cookie. If no cookie or a cookie other then Cookie 0:Cluster IP/Port, Server IP/Port is in the request, a server is selected on the basis of the sticky record(Source IP). If no records are found a server is selected and a new sticky record is created.
Cookie 0:Cluster IP/Port, Server IP/Port	Cookie 0:Cluster IP/Port, Server IP/Port	invalid configuration
Cookie 0:Cluster IP/Port, Server IP/Port	Cookie 1:Cluster IP, Server IP /Port	A server is selected based on the cookie. If no cookie or a cookie other then coyote_cooke_0 or Cookie 1:Cluster IP, Server IP /Port is in the request the server is

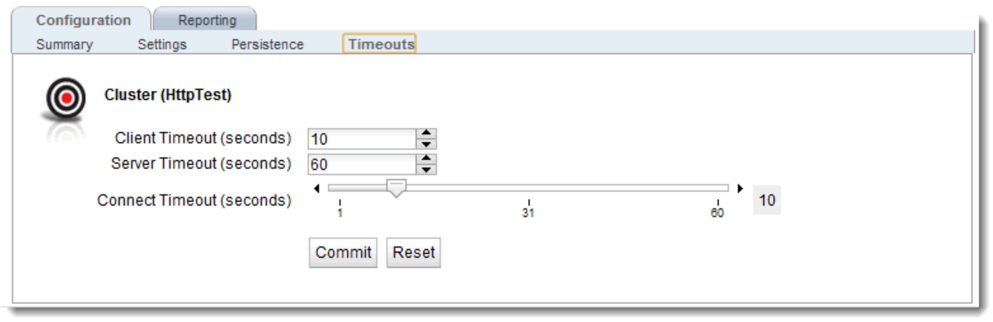
Persist Type	Fallback Persist Type	Result
		selected using the Load balancing Policy/Algorithm.
Cookie 0:Cluster IP/Port, Server IP/Port	Cookie 2:Cluster IP, Server IP	A server is selected based on the cookie. If no cookie or a cookie other then Cookie 0:Cluster IP/Port, Server IP/Port or Cookie 2:Cluster IP, Server IP is in the request the server is selected using the Load balancing Policy/Algorithm.
Cookie 1:Cluster IP, Server IP /Port	[[none]]	A server is selected based on the cookie. If no cookie is in the request the server is selected using the Load balancing Policy/Algorithm.
Cookie 1:Cluster IP, Server IP /Port	Source IP	A server is selected based on the cookie. If no cookie or a cookie other then Cookie 1:Cluster IP, Server IP /Port is in the request, a server is selected based on the sticky record(Source IP). If no records are found a server is selected and a new sticky record is created.
Cookie 1:Cluster IP, Server IP /Port	Cookie 0:Cluster IP/Port, Server IP/Port	A server is selected based on the cookie. If no cookie or a cookie other then Cookie 1:Cluster IP, Server IP /Port, Server IP/Port or Cookie 0:Cluster IP/Port, Server IP/Port is in the request a server is selected using the Load balancing Policy/Algorithm.
Cookie 1:Cluster IP, Server IP /Port	Cookie 1:Cluster IP, Server IP /Port	invalid configuration
Cookie 1:Cluster IP, Server IP /Port	Cookie 2:Cluster IP, Server IP	A server is selected based on the cookie. If no cookie or a cookie other then Cookie 1:Cluster IP, Server IP /Port or Cookie 2:Cluster IP, Server IP is in the request a server is selected using the Load balancing Policy/Algorithm.
Cookie 2:Cluster IP, Server IP	[none]	A server is selected based on the cookie. If no cookie is in the request a server is selected using the Load balancing Policy/Algorithm.
Cookie 2:Cluster IP, Server IP	Source IP	A server is selected based on the cookie. If no cookie or a cookie other then Cookie 2:Cluster IP, Server IP is in the request, a server is selected based on the on sticky record(Source IP). If no records are found a server is selected and a new sticky record is created.
Cookie 2:Cluster IP, Server IP	Cookie 0:Cluster IP/Port, Server IP/Port	A server is selected based on the cookie. If no cookie or a cookie other then Cookie 2:Cluster IP, Server IP or Cookie 0:Cluster IP/Port, Server IP/Port is in the request a server is selected using the Load balancing Policy/Algorithm.
Cookie 2:Cluster IP, Server IP	Cookie 1:Cluster IP, Server IP /Port	A server is selected based on the cookie. If no cookie or a cookie other then Cookie 2:Cluster IP, Server IP or Cookie 1:Cluster IP, Server IP /Port is in the request a server is selected using the Load balancing Policy/Algorithm.
Cookie 2:Cluster IP, Server IP	Cookie 2:Cluster IP, Server IP	invalid configuration

Layer 7 Cluster Reporting

Refer to "Cluster and Match Rule Reporting (CLI and GUI)" on page 404 for details.

Layer 7 Cluster Timeouts

The Layer 7 Cluster Timeouts screen is used to configure timeouts used in cluster connection with clients and servers. It can be accessed by clicking on the cluster on the left navigational pane and selecting the **Configuration> Timeouts** tabs.



Cluster (HttpTest)

Client Timeout (seconds) 10
Server Timeout (seconds) 60
Connect Timeout (seconds) 10

Client Timeout	The time in seconds that Equalizer waits before closing an idle client connection. The default is the global value. (between 1 and 65535 seconds)
Server Timeout	The time in seconds that Equalizer waits before closing an idle server connection. The default is the global value. (between 1 and 65535 seconds)
Connect Timeout	The time in seconds that Equalizer waits for a server to respond to a connection request. The default is the global value.

Click on the **Commit** button after making changes to the settings.

Layer 7 Security Certificate Screen (HTTPS Clusters only)

The Layer 7 **Security Certificate** screen shown below is displayed when an HTTPS cluster is selected from the **Cluster** branch on the left navigational pane.

Currently, the following certificate/key file formats are supported:

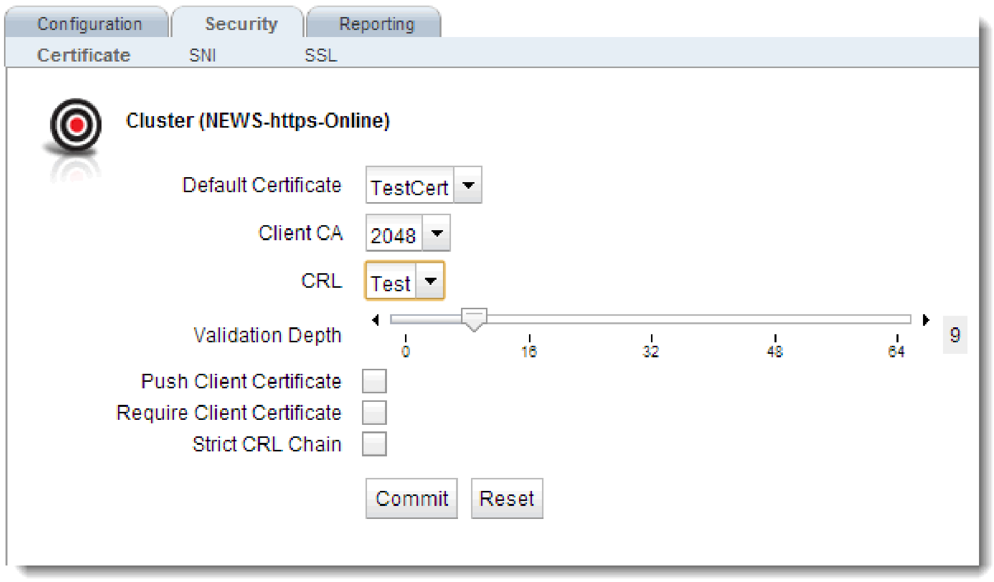
1. **PEM** - PEM format certificates/keys are ascii files that usually use a ".pem" extension with the file name. PEM stands for Privacy Enhanced Mail. A PEM-format certificate contains a Base64 encoded DER certificate, enclosed between *"-----BEGIN CERTIFICATE-----"* and *"-----END CERTIFICATE-----"* tokens. Keys encoded using the PEM format would have *"-----BEGIN PRIVATE KEY-----"* and *"-----END PRIVATE KEY-----"* tokens.

2. **PKCS #12** - PKCS #12 format files are binary files, usually with a ".p12'"extension with the file name.

3. **PFX** - PFX format files are also in PKCS #12 format, however, with additional Microsoft specifics. These files usually have a ".pfx" extension with the file name.

Currently, PEM-format certificates and keys must be uploaded separately in the CLI using the certfile and keyfile parameters in the certificate context or as shown below in the GUI.

PKCS #12 and PFX format files usually contain both the certificate and the associated key. You can upload this file once as either the certfile or the keyfile in the GUI. The GUI will separate the keyfile and the certfile behind the scenes and store them appropriately. You can also upload the same file as both the certfile and the keyfile.



Cluster (NEWS-https-Online)

Default Certificate: TestCert
Client CA: 2048
CRL: Test
Validation Depth: 9
Push Client Certificate: ☐
Require Client Certificate: ☐
Strict CRL Chain: ☐

Use the **Security > Certificate** tab to select a default SSL certificate that clients will use to validate a connection to an HTTPS cluster (a **cluster** certificate).

Default Certificate	Use the drop down list to select a default SSL certificate that clients will use to validate a connection to this HTTPS cluster.
Client CA	Use the drop down list to select the name of a client certificate authority (CA).This is an authority in a network that issues and manages security credentials and public keys for message encryption. It must be uploaded to Equalizer's certificated store. As part of a public key infrastructure, a CA checks with a registration authority to verify information provided by the requester of a digital certificate. If the registration authority verifies the requester's information, the CA can then issue a certificate. The certificate usually includes the owner's public key, the expiration date of the certificate, the owner's name, and other information about the public key owner.
CRL	Certificate Revocation Lists (**CRL**) can be used to verify that the certificates used by Equalizer are valid and have not been compromised. A **CRL** must have been uploaded to Equalizer and then associated with one or more clusters in the cluster specific context. Whenever a certificate is used to authenticate a connection to the cluster, the **CRL** is checked to make sure the certificate being used has not been revoked. Use the drop down list to select a **CRL**.
Validation Depth	The depth to which certificate checking is done on the client certificate

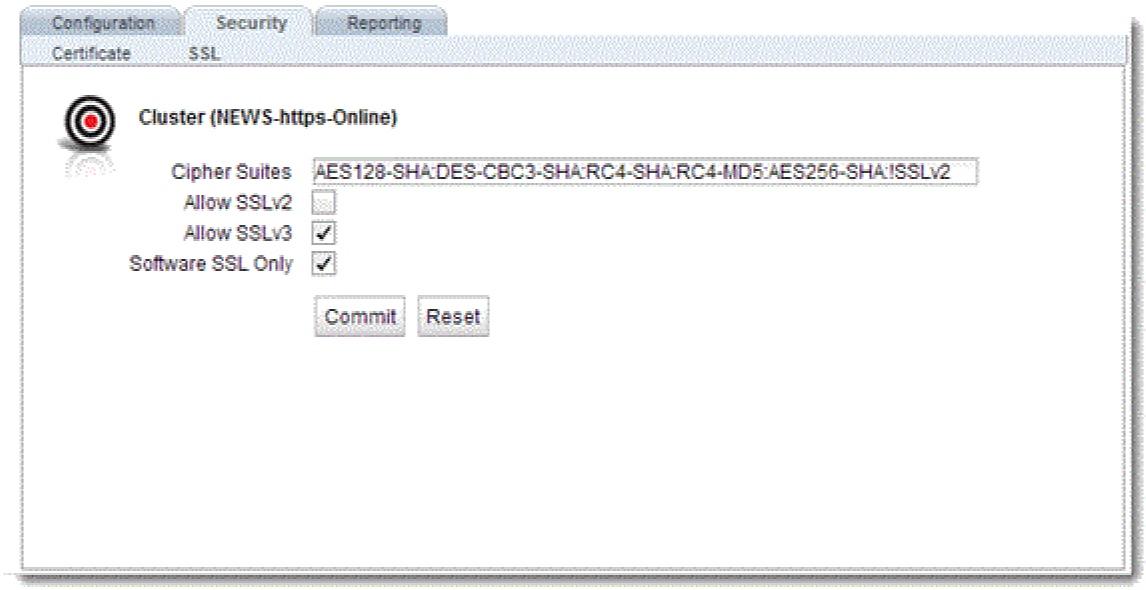
	chain. The default of 2 indicates that the client certificate (level 0) and two levels above it (levels 1 and 2) are checked; any certificates above level 2 in the chain are ignored. You should only need to increase this value if the Certificate Authority that issued your certificate provided you with more than 2 chained certificates in addition to your client certificate.

Flags

Push Client Certificate	Enabling this option sends the entire client certificate to the back-end server. This allows the server to confirm that the client connection is authenticated without having to do a complete SSL renegotiation.
Require Client Certificate	Enabling this option requires that clients present certificates.
Strict CRL Chain	Enabling this option checks the validity of all certificates in a certificate chain against the CRL associated with the cluster. If any of the certificates in the chain cannot be validated, return an error. If this option is disabled (the default), only the last certificate in the chain is checked for validity.

Layer 7 Security SSL Screen (HTTPS Clusters only)

The Layer 7 Security SSL screen shown below is displayed when an HTTPS cluster is selected from the **Cluster** branch on the left frame Configuration tree on the GUI.The **Security > SSL** tab allows you to configure various options that are specific to HTTPS connections.



Cluster (NEWS-https-Online)

Cipher Suites AES128-SHA:DES-CBC3-SHA:RC4-SHA:RC4-MD5:AES256-SHA:!SSLv2

Allow SSLv2 [ ]

Allow SSLv3 [✓]

Software SSL Only [✓]

Ciper Suites	Lists the supported cipher suites for incoming HTTPS requests. If a client request comes into Equalizer that does not use a cipher in this list, the connection is refused.
Allow SSLv2	Enables SSLv2 for client connections.

Allow SSLv3	Enables SSLv3 for client connections.
Software SSL Only (E450GX & E650GX only)	When disabled (default), an HTTPS cluster performs hardware SSL acceleration using the version of OpenSSL supported in previous releases. When enabled, an HTTPS cluster uses the updated version of OpenSSL (1.0.1e).

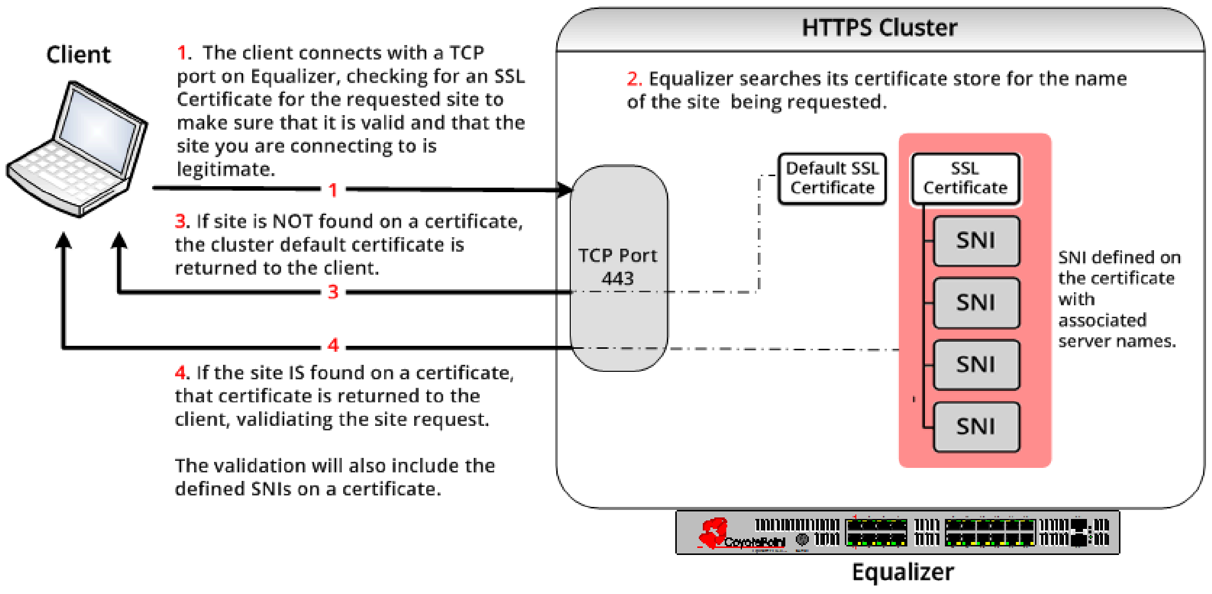
Click on **Commit** to save changes to the cluster configuration.

Server Name Indication

Server Name Indication (SNI) is an extension to the SSL and TLS protocols that indicates a server name or website that a client is attempting to connect with at the start of the handshake process. It allows a server to present multiple certificates on the same IP address and port number, thus allowing multiple secure (HTTPS) websites to be served off of the same IP address while allowing all of those sites to use the same certificate.

SNI objects are added to certificates that are in the certificate store on Equalizer and are configured on HTTPS clusters.After a client connects with a TCP port on Equalizer, Equalizer searches it's certificate store for the website name that was exchanged as part of the HTTPS packet header. If the website is NOT presented on a certificate, the cluster's default certificate will be returned to the client. If the website IS presented on a certificated, that certificate will be returned to the client. Using SNI, additional websites are associated with certificates allowing a certificate to be returned to a client for multiple website requests, thus minimizing the need to purchase costly wild card certificates.

The following illustration shows the connection and certificate process with Equalizer and an HTTPS cluster:


Client
1. The client connects with a TCP port on Equalizer, checking for an SSL Certificate for the requested site to make sure that it is valid and that the site you are connecting to is legitimate.
1
3. If site is NOT found on a certificate, the cluster default certificate is returned to the client.
3
4
4. If the site IS found on a certificate, that certificate is returned to the client, validiating the site request.
The validation will also include the defined SNIs on a certificate.
HTTPS Cluster
2. Equalizer searches its certificate store for the name of the site being requested.
TCP Port 443
Default SSL Certificate
SSL Certificate
SNI
SNI
SNI
SNI
SNI defined on the certificate with associated server names.
Equalizer

Note - An SNI sub object can be created for HTTPS clusters on Equalizer E450GX or E650GX only

Server Name Indication Using the GUI

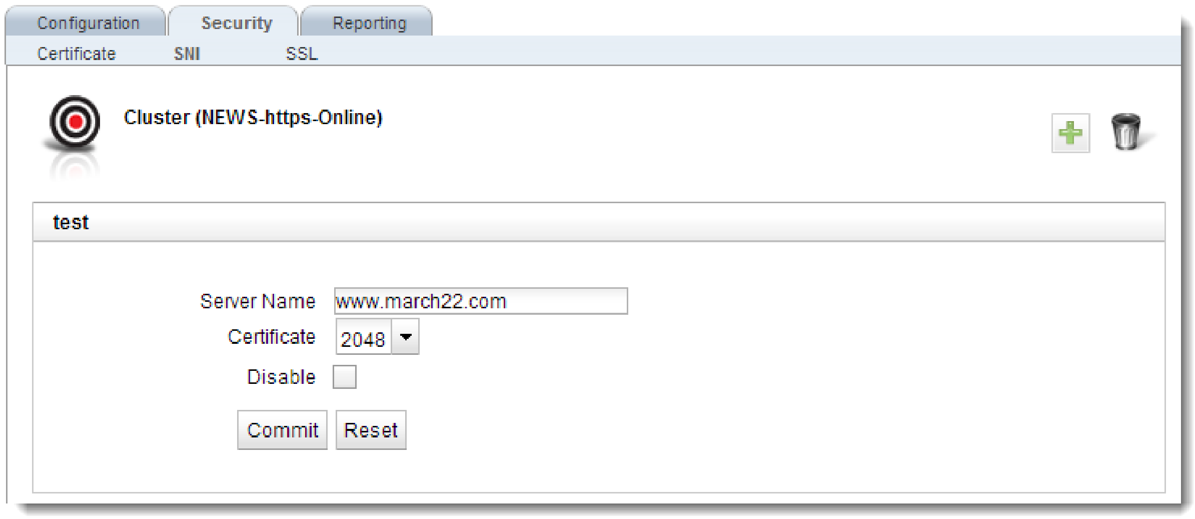
Proceed with the following to configured SNI certificates on an HTTPS cluster using the GUI:

1. Configure an HTTPS cluster on Equalizer. Use the GUI as described in "Adding and Deleting Clusters" on page 267

2. Add a default certificate to the cluster.as described in "Layer 7 Security Certificate Screen (HTTPS Clusters only)" on page 296 if one has not been added previously.

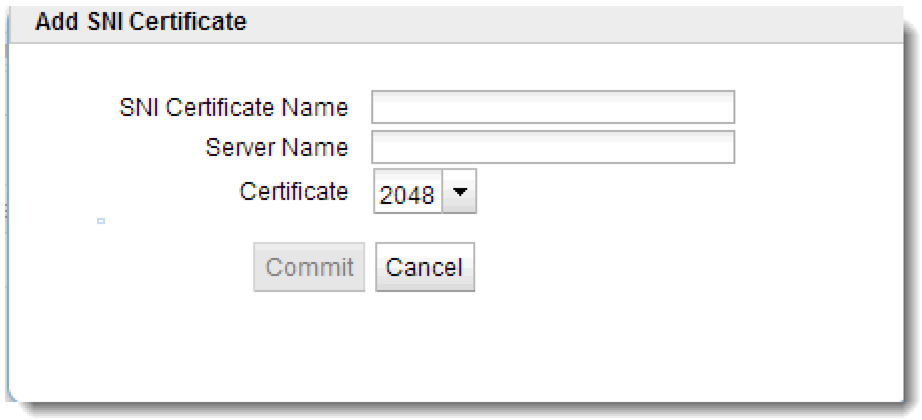
3. Upload additional certificates and their associated key files to Equalizer's file store as described in "Installing a Certificate" on page 201.

4. Select the HTTPS cluster from the left navigational pane if it is not already selected. Select the **Security > SNI** tab to display the SNI configuration screen as shown below. All previously configured SNI will be listed on accordion tabs. Selecting each accordion tab will display the following.



Server Name www.march22.com
Certificate 2048
Disable

5. To add an SNI click on ➕ to add a new SNI. The following will be displayed.



SNI Certificate Name
Server Name
Certificate 2048

6. Configure SNI parameters as follows:

SNI Certificate Name	The name of the SNI object. (up to 47 ASCII characters and can include period (.), dash (-), and underscore (_))
Server Name	The name of the website that you would like the SNI certificate to be

	associated with
Certificate	Use the drop down list to select the name of a certificate that you would like to associate the SNI with.

7. Click on **Commit** to save the SNI where it will be displayed on the accordion list on the **SNI** tab.

8. Add additional SNI objects to certificates as necessary.There is no maximum limit to the number of SNI objects that can be associated with each certificate. If you would like to remove an SNI, select the accordion tab on the SNI screen and click on the 🗑 button.

Server Name Indication Using the CLI

Proceed with the following to configured SNI certificates on an HTTPS cluster using the CLI:

1. Configure an HTTPS cluster on Equalizer. Use the CLI syntax described in "Cluster and Match Rule Commands" on page 146.

2. Add a default certificate to the cluster if one has not been added previously. Use the CLI syntax described in "Cluster and Match Rule Commands" on page 146.

3. Use the following CLI syntax to upload other certificates and the associated key files to Equalizer's file store.

```
eqcli > cert certname
eqcli cert-certname> certfile {edit|url}
```

   Do the same for the associated key files:

```
eqcli > cert certname
eqcli cert-certname> keyfile {edit|url}
```

4. Add an SNI object by entering the following in the HTTPS cluster context. The SNI name can be up to 47 ASCII characters and can include period (.), dash (-), and underscore (_).

```
eqcli cl-HTTPS*> sni testsni
eqcli cl-HTTPS*-sni-tes*>
```

5. Now associate certificates with the new SNI by entering the following in the SNI context:

```
eqcli cl-NEW* > sni testsni
eqcli cl-NEW*-sni-tes*> certificate snicertificate1
eqcli cl-NEW*-sni-tes*>
```

where:

`testsni` is the name of the SNI

`snicertificate1` is the name of the certificate being added to the SNI.

6. Display the contents of the new certificate by entering the following. Note that the SNI **`svname`** has not yet been entered.

```
eqcli cl-NEW*-sni-testsni> show
SNI Name : test
Certificate : snicertificate1
Flags :
SNI svname :
eqcli cl-NEW*-sni-test>
```

7. Add the name of the website that you would like the SNI certificate to be associated with by entering the following in the SNI context:

```
eqcli cl-NEW*-sni-testsni> sni_svname www.march22.com
eqcli cl-NEW*-sni-testsni> commit

eqcli: 12000287: Operation successful
```

8. Now verify the SNI to be sure that it is associated with a server name.

```
eqcli cl-NEW*-sni-testsni> show
SNI Name : test
Certificate : snicertificate1
Flags :
SNI svname : www.march22.com

eqcli cl-NEW*-sni-testsni>
```

9. Add additional SNI objects to certificates as necessary. There is no maximum limit to the number of SNI objects that can be associated with each certificate.

Additional Cluster Configuration

The Related Topics describe additional cluster configuration.

About Passive FTP Translation

In version 8.6 if your servers were on a network that the outside world could not reach, you were provided the capability of enabling a passive FTP translation option. This option caused Equalizer to rewrite outgoing FTP PASV control messages from the servers so they could contain the IP address of the virtual cluster rather than that of the server. This was a global option.

In building EQ OS 10 our experience indicated that the great majority of customers using FTP wanted this option turned ON. With that "passive FTP translation" is now always ON. It is set internally and there is no user interface control to turn it OFF. Our analysis leads us to believe that the only reason to turn it OFF would be in a high-bandwidth FTP server farm that supports "active FTP" only.

Contact customer support for instructions if you require this feature to be turned OFF.

Enabling Cookies for Persistent Connections

For Layer 7 HTTP and HTTPS clusters, you can enable the **persist** check box to use cookies to maintain a persistent session between a client and a particular server for the duration of the session.

When you use cookie-based persistence, Equalizer inserts a cookie into the server's response header on its way back to the client. This cookie uniquely identifies the server to which the client was connected and is included automatically in subsequent requests from the client to the same cluster. Equalizer can use the information in the cookie to route the requests to the same server. If the server is unavailable, Equalizer automatically selects a different server.

This option is enabled by default. Also see the descriptions of the **always**, **cookie age**, **cookie domain**, and **cookie path** cluster parameters under "Modifying a Layer 7 HTTP or HTTPS Cluster" on page 282.

Enabling Persistent Server Connections

Equalizer provides several methods by which connections between clients and servers can be made *persistent*; that is, it is possible to route a series of requests from a particular client to the same server, rather than have the Equalizer load balance each request in the series -- potentially sending each request to a different server.

- For Layer 4 clusters, persistent server connections are enabled using the Sticky Time cluster parameter and (optionally) the Inter-Cluster Sticky cluster flag.
- For Layer 7 clusters, persistent server connections are enabled using the **Persist** and **Always** cluster flags.

Enabling Sticky Connections

For Layer 4 TCP and UDP clusters, you can use IP-address based sticky connections to maintain persistent sessions.

The **sticky time** period is the length of time over which Equalizer ensures that it directs new connections from a particular client to the same server. The timer for the sticky time period begins to expire as soon as there are no active connections between the client and the cluster. If Equalizer establishes a new connection to the cluster, Equalizer resets the timer for the sticky time period.

Sticky connections are managed on Equalizer using *sticky records* that record the IP address, port and other information for the client-server connection. When you enable sticky connections, the memory and CPU overhead for a connection increase. This overhead increases as the sticky time period increases.

Consequently, you should use the shortest reasonable period for your application and avoid enabling sticky connections for applications unless they need it. For most clusters, a reasonable value for the sticky time period is 600 seconds (that is, 10 minutes). If your site is extremely busy, consider using a shorter sticky time period.

With the **inter-cluster sticky** option, you can configure Equalizer to direct requests from a client to the same server on any available port that has a current persistent connection *in any cluster*.

When Equalizer receives a client request for a Layer 4 cluster with inter-cluster sticky enabled and the client does not have a sticky record for the cluster, then Equalizer will check other clusters that have inter-cluster sticky enabled for a sticky record for the same client and server -- but on a different server port than the one originally used in the client request.

If such a sticky record is found and the server IP/port in the sticky record is configured as a server in the current cluster, then the sticky record is used to send the client request to that server IP/port. Otherwise, the client request is load balanced across the server pool in the cluster.

In order for the inter-cluster sticky option to work:

- The two clusters must have the same cluster IP address and different ports.
- At least one server in each of the two clusters must be configured with the same IP address and different ports.

Inter-cluster stickiness is provided for the case where you have similar services running on the same server IP on two or more ports. Using *port ranges* for a cluster achieves essentially the same effect, without using another cluster IP address (See "TCP Cluster Configuration Settings" on page 273). Using **inter-cluster sticky** is preferable in situations where you'd like the service available on multiple cluster IPs as well as multiple ports.

To enable sticky connections for a cluster, follow these steps:

1. Log into the GUI using a login that has add/del access for the cluster (See "Logging In" on page 192)
2. In the left frame, click the name of the Layer 4 TCP or UDP cluster to be configured. The cluster's parameters appear in the right frame.
3. Select the **Persistence** tab in the right frame.
4. In the **sticky time** field, specify the sticky time period in seconds greater than zero.
5. To direct all requests from a particular client to the same server even if the connection is to a different virtual cluster, check the **inter-cluster sticky** checkbox. You can turn on inter-cluster stickiness only if you have enabled sticky connections by specifying a **sticky time** greater than zero.
6. Click the **commit** button.

Enabling the Once Only and Persist Options

Since HTTP 1.0, web browsers and servers have been able to negotiate persistent connections over which multiple HTTP transactions could take place. This is useful when several TCP connections are required in order to satisfy a single client request.

For example, before HTTP 1.1, if a browser wished to retrieve the file *index.html* from the server www.coyotepoint.com, the browser would take the following actions:

1. Browser opens TCP connection to www.coyotepoint.com.
2. Browser sends request to server **"GET /index.html"**.
3. Server responds with the content of the page (HTML).
4. Server closes connection.
5. Browser determines that there are objects (images) in the HTML document that need to be retrieved, so the browser repeats Steps 1 to 4 for each of the objects.

There is a lot of overhead associated with opening and closing the TCP connections for each image. The way HTTP 1.0 optimizes this is to allow multiple objects (pages, images, etc) to be fetched and returned across one TCP socket connection. The client requests that the server keep the connection open by adding the request header **Connection: keep-alive** to the request. If the server agrees, the server will also include **Connection: keep-alive** in its response headers, and the client is able to send the next request over the persistent HTTP connection without the bother of opening additional connections.

For HTTP/1.1, persistent connections are the default.

For a Layer 7 cluster, Equalizer evaluates (and possibly changes) both the request and response headers that flow between the client and server (the request and response bodies are not examined). Match rules are applied to each client header, cookies may be inserted, and headers may be rewritten. When a client includes **keep-alive** in its headers, there is a fair amount of work required by the Equalizer to determine when the next set of request headers is ready to be parsed (evaluated), since there may be quite a lot of data going across the connection between sets of headers.

To reduce this workload, the **once only** flag instructs the Equalizer to evaluate (and potentially modify) only the *first* set of headers in a connection. So, in our example above, only the headers in the request for the *index.html* file are evaluated; the subsequent requests to obtain the images are not load balanced, but sent to the same server as the first request.

Enabling **once only** can be incompatible with persistence and Layer 7 HTTPS clusters (which rewrite HTTP to HTTPS links in server response headers), since in these cases we generally want to examine every request in a connection. However, in configurations where examining the headers in every transaction in a connection is not required, enabling **once only** can significantly improve performance.

Whether **once only** is enabled or not has a significant effect on how Equalizer routes requests, as summarized in the following table:

Requests in a single keep-alive connection	**once only enabled**	**once only disabled**
First Request		
persist enabled	If request contains a cookie and there is no match rule hit, send request to the server in the cookie. If request contains a cookie and there is a match rule	If request contains a cookie and there is no match rule hit, send request to the server in the cookie. If request contains a cookie and there is a match rule

Requests in a single keep-alive connection	**once only enabled**	**once only disabled**
	hit, send the request to the server in the cookie *only if it is in the list of servers selected in the match rule definition*. Otherwise, ignore the cookie. If there is no cookie, load balance the request and send to the server chosen.	hit, send the request to the server in the cookie *only if it is in the list of servers selected in the match rule definition*. Otherwise, ignore the cookie. If there is no cookie, load balance the request and send to the server chosen.
persist disabled	Load balance the request and send to the server chosen.	Load balance the request and send to the server chosen.
match rule hit	Send to the server chosen by the match rule.	Send to the server chosen by the match rule.
Subsequent Requests		
persist enabled	Send to same server as *first* request (any cookie in request is ignored).	If request contains a cookie, send request to the server in the cookie. If there is no cookie, load balance request and send to server chosen by policy.
persist disabled	Send to same server as *first* request.	Load balance the request and send to the server chosen.
match rule hit	Send to same server as *first* request.	Send to the server chosen by the match rule.

For example, let’s look at how Equalizer processes HTTPS requests. For an HTTPS cluster, Equalizer off loads SSL processing from the server pool in the cluster; that is, Equalizer does all the SSL related processing itself, and then forwards the request in HTTP to the server. When it does this, it inserts special headers into the request to indicate that the request was received by Equalizer in HTTPS and processed into HTTP (see “HTTPS Header Insertion” on page 139). If **once only** is set, these special headers are only inserted into the *first* request in a connection; the remainder of the requests in the connection are still processed, but no headers are inserted. Most servers that support SSL off loading require that every request contain the special headers -- therefore, in most cases like this you need to disable the **once only** flag for the cluster if you want to be able to parse for these headers in every request on the server end.

The **once only** flag is enabled by default when adding an L7 cluster. In general, it is more efficient to enable **once only**; but, in situations where load balancing decisions need to be made for every request or where any of the above effects are undesirable, **once only** should be disabled.

Note - Although it is permitted by the software, it is *not* recommended to define a Layer 7 cluster with **persist** and **once only** both turned off, and with no match rules. By defining a Layer 7 cluster in such a way, you are essentially disabling Layer 7 processing, while still incurring extra overhead for the Layer 7 cluster. If your application requires a cluster with no persistence, header processing, or match rules, then we recommend that you define a Layer 4 UDP or TCP cluster for the best performance.

Enabling Both the Once Only and Always Options

The **always** flag influences when Equalizer inserts cookies into server responses; it in turn is affected by the setting of the **once only** flag, as shown in the following table:

	once only enabled	once only disabled
always enabled	Equalizer always inserts a cookie into the *first* set of response headers on a connection *only*. The cookie is inserted regardless of whether the server included one in the response. Subsequent responses on the same connection are forwarded to the client *unchanged* by Equalizer.	Equalizer inserts its own cookie into *all* server responses on a connection. The cookie is inserted regardless of whether the server included one in the response.
always disabled	If the *first* server response on a connection already has a server cookie in it, Equalizer inserts its own cookie into the *first* set of response headers on the connection. If the response has no cookie in it, Equalizer does *not* insert one of its own. Subsequent responses on the same connection are forwarded to the client *unchanged* by Equalizer.	If the *first* server response on a connection already has a server cookie in it, Equalizer inserts its own cookie into the *first* set of response headers on the connection. Equalizer will insert a cookie into subsequent responses on the same connection if: they do not contain a valid cookie the **cookie generation** has changed the server in the cookie has the **quiesce** flag enabled

Note - the cluster parameters **cookie path**, **cookie age**, **cookie generation**, and **cookie domain** specify cookie content for the cluster. If any of these parameters are updated, this changes the information used in the cookies that Equalizer inserts into server responses.

Enabling Once Only and Compression

Enabling both the **once only** and **compress** options is not allowed by the GUI. These two options are not compatible, since setting them both would mean that only the first response in a connection would be compressed and not the remainder of the responses, which would likely cause client errors.

Enabling Once Only and No Header Rewrite for HTTPS

In a Layer 7 HTTPS cluster, clients connect to the cluster IP using HTTPS connections. Equalizer terminates the HTTPS connection and communicates with the server pool in the cluster using the HTTP protocol. By default, Equalizer examines server responses for `http://`URLs and rewrites them as `https://` URLs, so that these URLs work properly on the client. If, for example, a server sends an HTTP redirect using the `Location:` header, this URL most likely will include the `http://` protocol. Equalizer rewrites this response so that the URL uses `https://`.

For server connections that contain multiple server responses, the setting of the **once only** flag determines whether Location: headers in all server responses are rewritten. This is shown in the table below.

Note that the GUI does not permit you to enable **once only** and disable **no header rewrite** -- this option combination would rewrite the `Location:` header in only the first response in the connection, and not rewrite the headers in subsequent responses in the same connection. Doing so would produce errors on the client.

Of course, you can also direct Equalizer to pass responses from the server *without* rewriting URLs by enabling the **no header rewrite** flag on the cluster.

	once only enabled	**once only** disabled
no header rewrite disabled	Not supported.	The Location: headers of *every* response in a connection are rewritten.
no header rewrite enabled	No headers are rewritten.	No headers are rewritten.

Specifying a Custom Header for HTTP/HTTPS Clusters

Some applications require specific headers in incoming client requests, and Equalizer provides the custom header field in HTTP and HTTPS clusters to allow you to inject a custom header into the client request before it is sent to a server behind Equalizer.

An example is the Exchange 2003 version of Microsoft Outlook Web Access (OWA). OWA 2003 normally requires that all incoming client requests use the Secure Sockets Layer (SSL) protocol. This means that all client requests must have the `https://` protocol in the URI. If, however, OWA is running on a server in an Equalizer Layer 7 HTTPS cluster, then OWA will receive all requests with `http://` in the URI, since Equalizer performs SSL processing before passing the requests on to the server.

OWA 2003 allows for SSL off loading through the use of a special header, as explained in the following Microsoft technical article:

```
http://technet.microsoft.com/en-us/library/578a8973-dc2f-4fff-83c6-
39b1d771514c.aspx
```

Two things are necessary when running OWA 2003 behind Equalizer:

1. Configure OWA to watch HTTP traffic for requests containing a custom header that indicates that the request was originally an SSL request that was processed by SSL off loading hardware (i.e., Equalizer) before reaching OWA (see the above article for instructions)

2. Configure the Equalizer cluster to add the custom header to all requests before sending them on to the OWA server (this is explained below)

The following procedure shows you how to add a custom header to an existing HTTPS cluster definition, using the header required for an OWA 2003 server as an example.

3. Log into the GUI using a login that has add/del access for the cluster (See "Logging In" on page 192.)

4. In the left frame, click the name of the cluster to be configured.

5. In the right frame, select the **Cluster>>Configuration>>Required** tab.

6. Type the following in the **custom header** field:

```
Front-End-Https: on
```

7. Select **commit** to modify the cluster.

Performance Considerations for HTTPS Clusters

Layer 7 HTTPS clusters have several options that can have a significant impact on the performance and behavior of the cluster:

1. The injection of a **customheader** to provide transaction-specific information to the server. For example, to tell the server that Equalizer terminated the HTTPS connection and performed SSL processing on the incoming request (see the previous section, above).

2. The "munging", or translation, of HTTP redirects to HTTPS redirects (see the description of the **no header rewrite** flag under Modifying a Layer 7 Virtual Cluster).

3. The **once only** flag. This flag is present to speed up processing of HTTP requests by only looking at the first request, but since HTTPS has a lot of overhead associated with it anyway, turning this flag off does not reduce HTTPS performance. Furthermore, having this flag on for HTTPS clusters causes some applications to not function as needed.

In general, it is recommended to turn the **once only** flag off for HTTPS clusters. In order to inject custom headers and rewrite headers in every transaction in a connection, turning off **once only** is required.

HTTPS Performance and Xcel SSL Acceleration

The E650GX and E450GX include the Xcel SSL Accelerator Card. Equalizer models without Xcel (E250GX and E350GX) performs all SSL processing in software using the system CPU. Equalizers with Xcel perform all SSL processing using the dedicated processor on the Xcel card. This allows the system CPU to concentrate on non-SSL traffic. For most applications, Xcel will process several hundred HTTPS transactions per second with no noticeable degradation in performance either for the HTTPS cluster or for Equalizer as a whole.

In terms of bulk data throughput, the theoretical maximum throughput for Xcel/HTTPS is roughly 50% of that for the Equalizer in HTTP mode: Equalizer models with gigabit Ethernet can move HTTP traffic at wire speed (1Gbit/s) for large transfers, while Xcel can encrypt only approximately 400Mbit/s with 3DES/SHA1 or 600Mbit/s with RC4/MD5. This reflects the fact that Xcel is primarily a transaction accelerator, not a bulk data encryption device. It is noteworthy, however, that even when moving bulk data at 600Mbit/s, Xcel removes the entire load of HTTPS/SSL processing from the server pool in the cluster.

One final issue to be aware of is that Xcel supports only 3DES and RC4 encryption; it does not support AES. It also does not support SSL or TLS cipher suites that use ephemeral or anonymous Diffie-Hellman exchange (cipher suites whose names contain "EDH", "DHE", or "ADH").

The default configuration for HTTPS clusters created with Xcel enabled will not use the modes described above. If, however, one either modifies the cluster's cipher suite string to use them, it is possible that they may be negotiated with clients. This will not lead to incorrect operation of the system, but encryption for these cipher suites will occur in software instead of taking advantage of the improved performance provided by the Xcel hardware.

HTTPS Header Injection

When a connection is established by a client for an HTTPS cluster, Equalizer performs the SSL processing on the request (this is called SSL off loading), and adds some additional headers to the client's request before forwarding the request on to a server:

```
X-LoadBalancer: CoyotePoint Equalizer

X-Forwarded-For: (client's IP address)
```

If the client provides an SSL certificate, the following are also added:

```
X-SSL-Subject: (certificate's X509 subject)

X-SSL-Issuer: (certificate's X509 issuer)

X-SSL-notBefore: (certificate not valid before info)

X-SSL-notAfter: (certificate not valid after info)

X-SSL-serial: (certs serial number)

X-SSL-cipher: (cipher spec)
```

If these headers are present in a request received by a server, then the server knows that the request was originally an HTTPS request and was processed by Equalizer before being forwarded to the server.

These headers are inserted into every request if the **once only** flag is disabled; if **once only** is enabled, then only the first request in a connection will have these headers inserted.

Some application may require a special header in the request, and the following section describes how Equalizer can be configured to provide a custom HTTPS header for such applications.

Providing FTP Services on a Virtual Cluster

The FTP protocol dates from the 1970s, and was designed to be used in an environment where:

- the network topology is simple
- the FTP server and client communicate directly with one another
- the addresses used by the client and server for active FTP data connections can be negotiated over the FTP control connection
- the FTP server is able to make connections back to the FTP client
- These operational characteristics of FTP require special configuration for load balancers (as well as firewalls and NAT devices) that pass traffic between FTP servers and FTP clients:
- NAT devices and routers (including load balancers like Equalizer) on the client and server sides must be configured to monitor FTP transactions and provide appropriate address translation and packet rewriting.
- Firewalls on the client and server sides must be configured to let traffic on the ports used for FTP through the firewall.

Consult the documentation for the firewalls and NAT devices used at your site to determine how to set up those devices appropriately for FTP transfers. See the next section for how to configure an Equalizer cluster for responding to FTP requests from clients.

FTP Cluster Configuration

When configuring an FTP cluster on Equalizer, the following guidelines must be followed:

- The **protocol** for the cluster must be **Layer 4 TCP.**
- The **start port** parameter for the cluster must be set to port **21**. (Note that port 20 is also used, but you do not specify it when adding the cluster.)
- The **spoof** flag must be enabled for the cluster.

FTP data connections are automatically configured (internally) with a **sticky time** of one second. This is necessary to support the passive mode FTP data connection that most web browsers use. This means that there will be one sticky record kept for each FTP data connection. For an explanation of sticky records, see "Enabling Sticky Connections" on page 303"Enabling Sticky Connections" on page 303

- FTP clusters occupy two internal virtual cluster slots, even though only one appears in the interface. This permits Equalizer's NAT subsystem to rewrite server-originated FTP data connections as they are forwarded to the external network.
- You cannot enable the **direct server return** option on an FTP cluster.

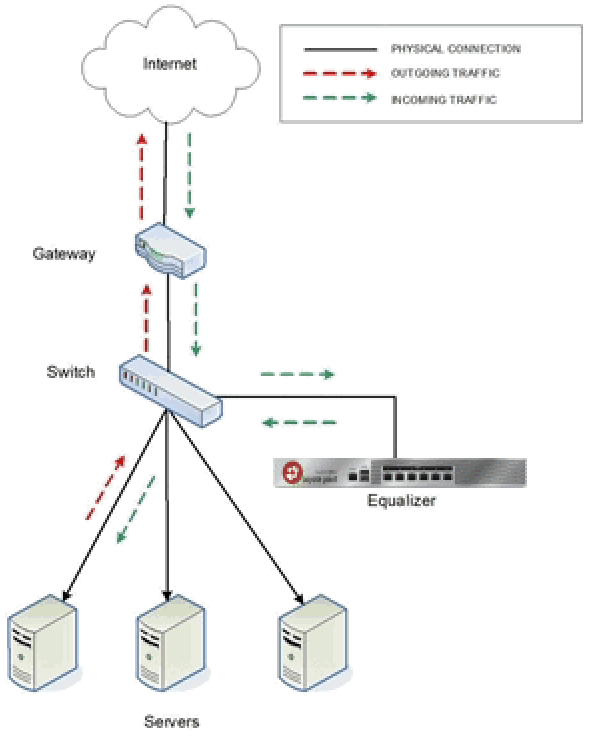
Configuring Direct Server Return (DSR)

In a typical load balancing scenario, server responses to client requests are routed through Equalizer on their way back to the client. Equalizer examines the headers of each response and may insert a cookie, before sending the server response on to the client.

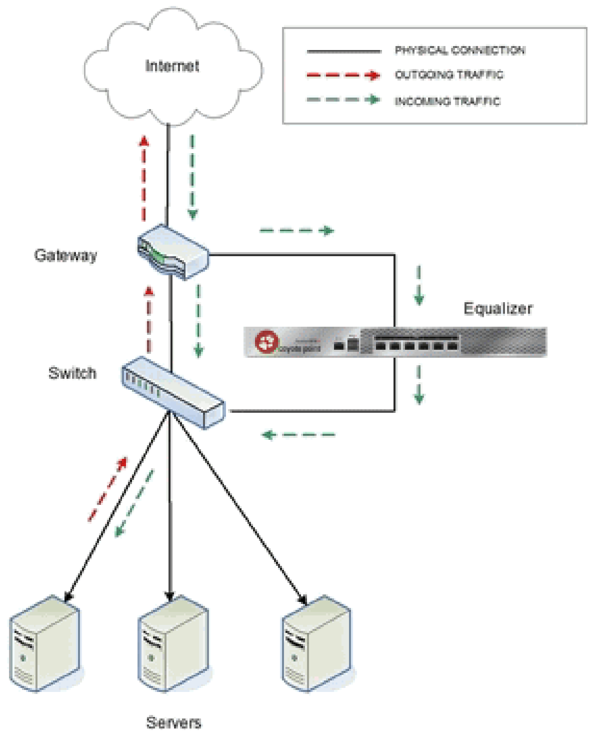
In a Direct Server Return (DSR) configuration, the server receiving a client request responds directly to the client IP, bypassing Equalizer. Because Equalizer only processes incoming requests, cluster performance is dramatically improved when using DSR in high bandwidth applications, especially those that deliver a significant amount of streaming content. In such applications, it is not necessary for Equalizer to receive and examine the server's responses: the client makes a request and the server simply streams a large amount of data to the client.

DSR is supported on Layer 4 TCP and UDP clusters only, and is not supported for FTP clusters (Layer 4 TCP clusters with a start port of 21). Port translation or port mapping is not supported in DSR configurations.

DSR configurations are usually configured in single network mode, where the cluster IP and the server IPs are all on the internal interface. An example single network mode DSR configuration is shown below:



DSR can also be used in dual network mode, although this is a less common configuration than single network mode. Cluster IPs are on the external interface, and server IPs are on the internal interface. An example of a dual network mode DSR configuration is shown below.



Note - In both configurations that the incoming client traffic is assumed to originate on the other side of the gateway device for the subnets on which Equalizer and the servers reside. The servers will usually have their default gateway set to something other than Equalizer so that they can respond directly to client requests.

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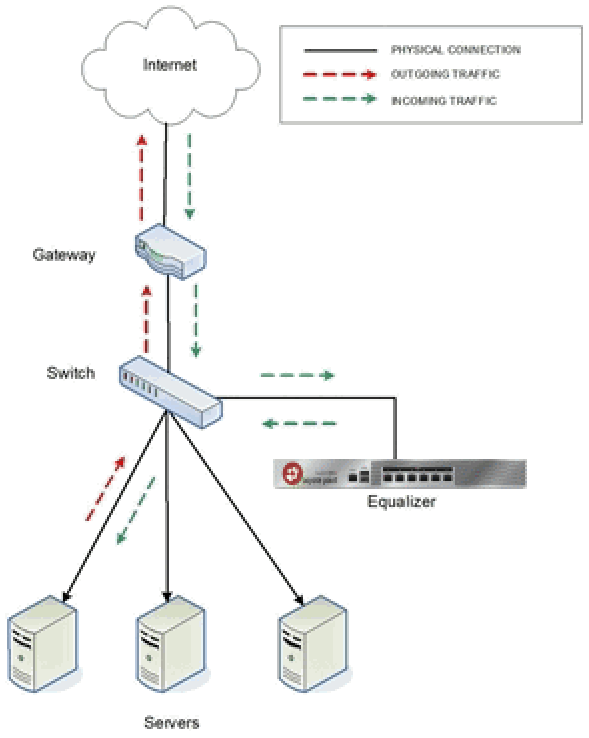

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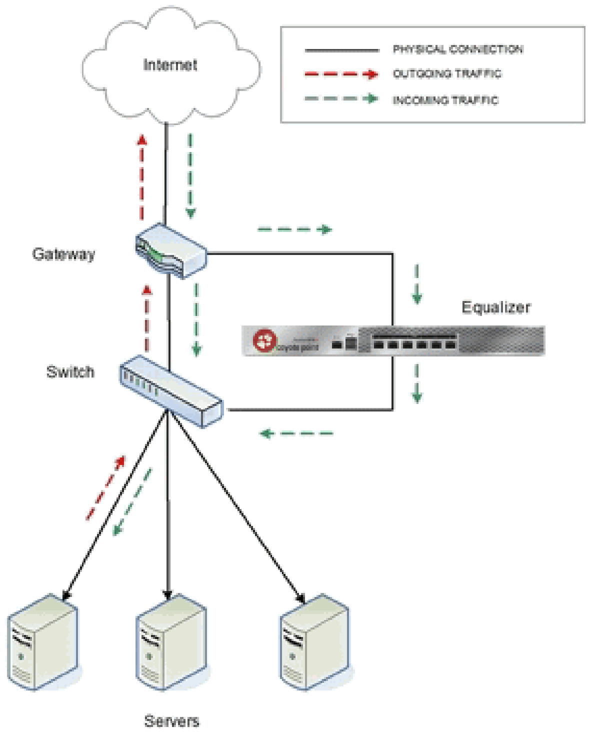


Note - In both configurations that the incoming client traffic is assumed to originate on the other side of the gateway device for the subnets on which Equalizer and the servers reside. The servers will usually have their default gateway set to something other than Equalizer so that they can respond directly to client requests.

The cluster parameters **Direct Server Return, Spoof**, and **Idle Timeout** are directly related to direct server return connections:

- **Direct Server Return -** this option enables Direct Server Return. All requests to this cluster IP will be forwarded to the server with the client IP as the source IP, and the cluster IP as the destination IP. The loopback interface of the server must be configured with the cluster IP to receive the requests. See "Configuring Servers for Direct Server Return" on page 183.

- **Spoof -** this option causes Equalizer to spoof the client IP address when Equalizer routes a request to a server in a virtual cluster; that is, the IP address of the *client* is sent to the server, not the IP address of the Equalizer. This flag must be enabled for DSR.

- **Idle Timeout -** The is the time in seconds before reclaiming idle Layer 4 connection records. Applies to Layer 4 TCP clusters only. For DSR the **Idle timeout** slider must be set to a non-zero value, or Equalizer will never reclaim connection records for connections terminated by the server. The cluster's **Idle Timeout** should be set to the longest period within your application that you would like Equalizer to wait for consecutive messages from the client (since the Equalizer does not see server packets on DSR connections). For example, if the longest expected server response time and the longest expected delay between client responses on active connections are both 60 seconds, then set the **Idle Timeout** slider to 120 seconds.

To create a new cluster or modify an existing one for DSR, do the following:

1. Log into the GUI using a login that has add/del access for the cluster (See "Logging In" on page 192.)

2. Do ***one*** of the following:

    a. Create a new Layer 4 TCP or UDP cluster: right-click **Equalizer** in the left navigational pane and select **Add Cluster.** After you enter and **commit** the basic information, you'll be taken to the server **Configuration** tab.

    b. Modify an existing Layer 4 TCP or UDP cluster: click on the cluster name in the left frame to display the cluster's **Configuration** tab in the right frame.

3. Enable the **Direct Server Return** and **Spoof** check boxes.

4. If the cluster is a Layer 4 TCP cluster and the **idle timeout** parameter is set to **0**, increase it as described in the table above. Skip this step for Layer 4 UDP clusters.

5. Click on **Commit** to save your changes to the cluster configuration.

6. If you need to add server instances to a server pool, add them by doing the following:

    a. Right-click the server pool name in the left navigational pane frame and select **Add Server Pool**.

    b. Fill in the remainder of the required information.

    c. Click on the **Commit** button to save your entries.

7. Perform the procedure in the following section on each server that you add to the cluster.

Testing Your Basic Configuration

Once you have installed and configured Equalizer and your servers, perform tests to verify that Equalizer is working properly.

To perform these tests, you need the following:

- A test machine on the internal network (the same physical network as the servers; one of the server machines can be used for this purpose).
- If you have a two-network configuration, a test machine on the external network.
- A client machine somewhere on the Internet, to simulate a “real-world” client. This machine should be set up so that the only way it can communicate with your servers or Equalizer is through your Internet router.

Then follow these steps:

1. PingEqualizer’s external address (if configured) from a host on the external network interface address.
2. Ping Equalizer’s internal address from a host on the internal network interface address.
3. If DNS is configured, ping a host on the Internet (e.g., `www.coyotepoint.com`) from Equalizerto ensure that DNS and the network gateway are functioning properly.
4. From the internal-network test machine, ping the physical IP address of each server. You should be able to successfully ping all of the servers from the test machine.
5. From the internal-network test machine, ping the server aliases on each of the servers. You should be able to successfully ping all of the servers from the test machine using their aliases.
6. From the internal test machine and each of the servers, ping the Equalizer address that you use as the default gateway on your servers. (If you use a two-network topology, this will be Equalizer’s internal address or failover alias.)
7. From the internal-network test machine, connect to the server aliases on service ports of running daemons (you may need to configure telnet or ssh services on Windows servers). You should be able to connect successfully to the server aliases.
8. If you use a two-network configuration: From the external-network test machine, ping a physical server IP address using `ping -R` to trace the route of the ping. The EqualizerIP address should appear in the list of interfaces that the ping packet traverses. You can also use the `traceroute` (UNIX) or `tracert` (Windows) tools to perform this test.
9. Log into the GUI on either the external (if configured) or internal interfaces, as described in "Logging In" on page 192.

Chapter 16

Match Rules

Sections in this chapter include:

Using Match Rules

The ability to make load balancing decisions based on the content of a client request is what separates Layer 7 processing from the processing options available at Layer 4. For Layer 7 HTTP and HTTPS clusters, Match Rules provide fine-grained control over load balancing decisions based on the content of the client request. If you need to be able to route requests to the servers in a cluster based on the content of the request, Match Rules are the answer.

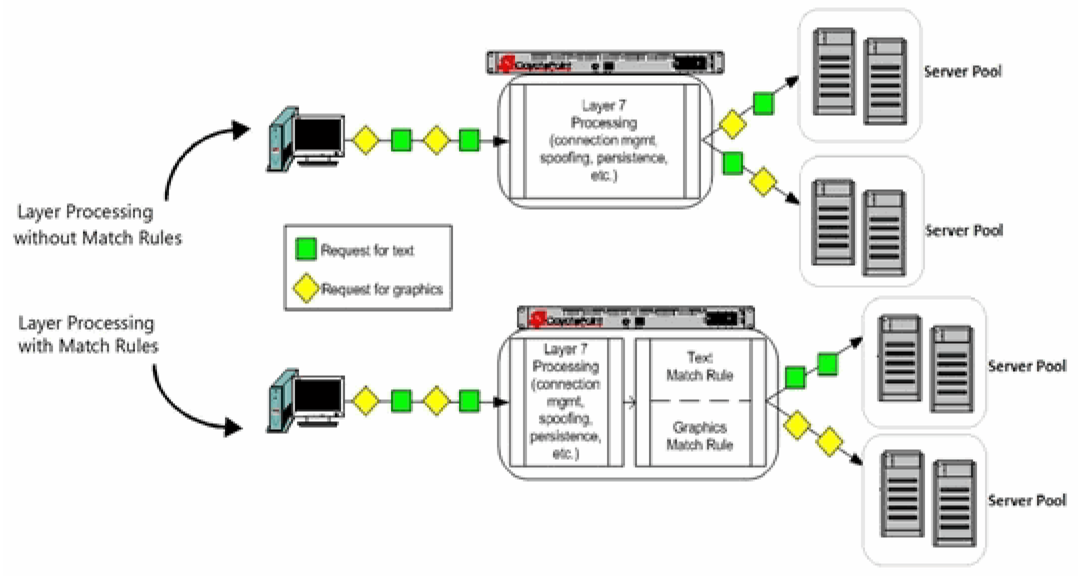
Layer 7 HTTP and HTTPS clusters can use logical constructs called “Match Rules” to control the processing of the incoming data stream from clients. Match rules extend the Layer 7 load balancing capabilities of HTTP and HTTPS clusters by allowing you to define a set of logical conditions which, when met by the contents of the request, trigger the load balancing behavior specified in the match rule.

Typically, a match rule selects the subset of servers that the load balancing algorithms will use for a particular request. By default, a request is load balanced over all the available non-spare servers in a cluster. Match rules allow you to select the group of servers, or server pools, that will be used to load balance the request.

For each virtual cluster, you can specify any number of match rules. For each match rule, you specify the subset of servers or server pools that can handle requests that meet the rule criteria.

A match rule provides custom processing of requests within connections. Equalizer provides common and protocol-specific match functions that enable dynamic matching based on a request’s contents. Protocol-specific match functions typically test for the presence of particular attributes in the current request.

For example, a Layer 7 HTTP virtual cluster can specify matching on specific pathname attributes to direct requests to subsets of servers or server pools so that all requests for images are sent to the image servers. The difference between load balancing with and without match rules in such a situation is illustrated in the following figure.


Layer Processing without Match Rules
Layer 7 Processing (connection mgmt, spoofing, persistence, etc.)
Server Pool
Server Pool
Request for text
Request for graphics
Layer Processing with Match Rules
Layer 7 Processing (connection mgmt, spoofing, persistence, etc.)
Text Match Rule
Graphics Match Rule
Server Pool
Server Pool

Most client requests are a mix of requests for text and graphics. Layer 7 processing without Match Rules balances requests across the specified server pool so that each server instance in the server pool will see a mix of text and graphics requests. This means that all text and graphics must be available on each server pool.

Some sites may want to have one system serve only requests for graphics, and one system serve only text requests.

By adding appropriate Match Rules, Equalizer can examine each request to determine if the content requested is Text or Graphics, and send the request to the appropriate server pool. In this example, the servers need only hold the content they are serving, text or graphics.

How Match Rules are Processed

A match *rule* is like an if-then statement: an expression is evaluated and if it evaluates to true the body of the match rule applies to the request.

A match *expression* is a combination of match functions with logical operators, and can be arbitrarily complex. This allows for matching requests that have, for example:

```
(attribute A) AND NOT (attribute B)
```

If a match expression evaluates to *true*, then the data in the request has selected the match rule, and the match body applies. The match *body* contains statements that affect the subsequent handling of the request.

Multiple match rules are checked in order. Once the data in the request selects a match rule -- that is, the match rule expression evaluates to true -- no further match rules are checked against the request.

Equalizer makes a load balancing decision as follows:

1. If the request headers contain a cookie that specifies a server pool for the match rule, Equalizer sends the request to the server in the cookie.

   Otherwise:

2. Equalizer sends the request to the server pool specified in the match rule that is selected by the load balancing policy in effect for the match rule.

This process applies even if all the servers selected for the match rule are unavailable. In this case, when the match rule expression matches the request and all the servers in the match rule server list are unavailable, no reply is sent to the client. Eventually, the client sees a connection timeout.

If the match expression evaluates to *false*, then each subsequent match rule in the list of match rules for the virtual cluster is processed until a match occurs. All virtual clusters have a Default Match rule, which always evaluates to *true* and which will use the entire set of servers for load balancing. The **Default Match** rule is always processed last.

Each virtual cluster can have any number of match rules, and each match rule can have arbitrarily complex match expressions. Keep in mind that Equalizer interprets match rules for every Layer 7 cluster connection, so it is a good idea to keep match rules as simple as possible.

Match Rule Order

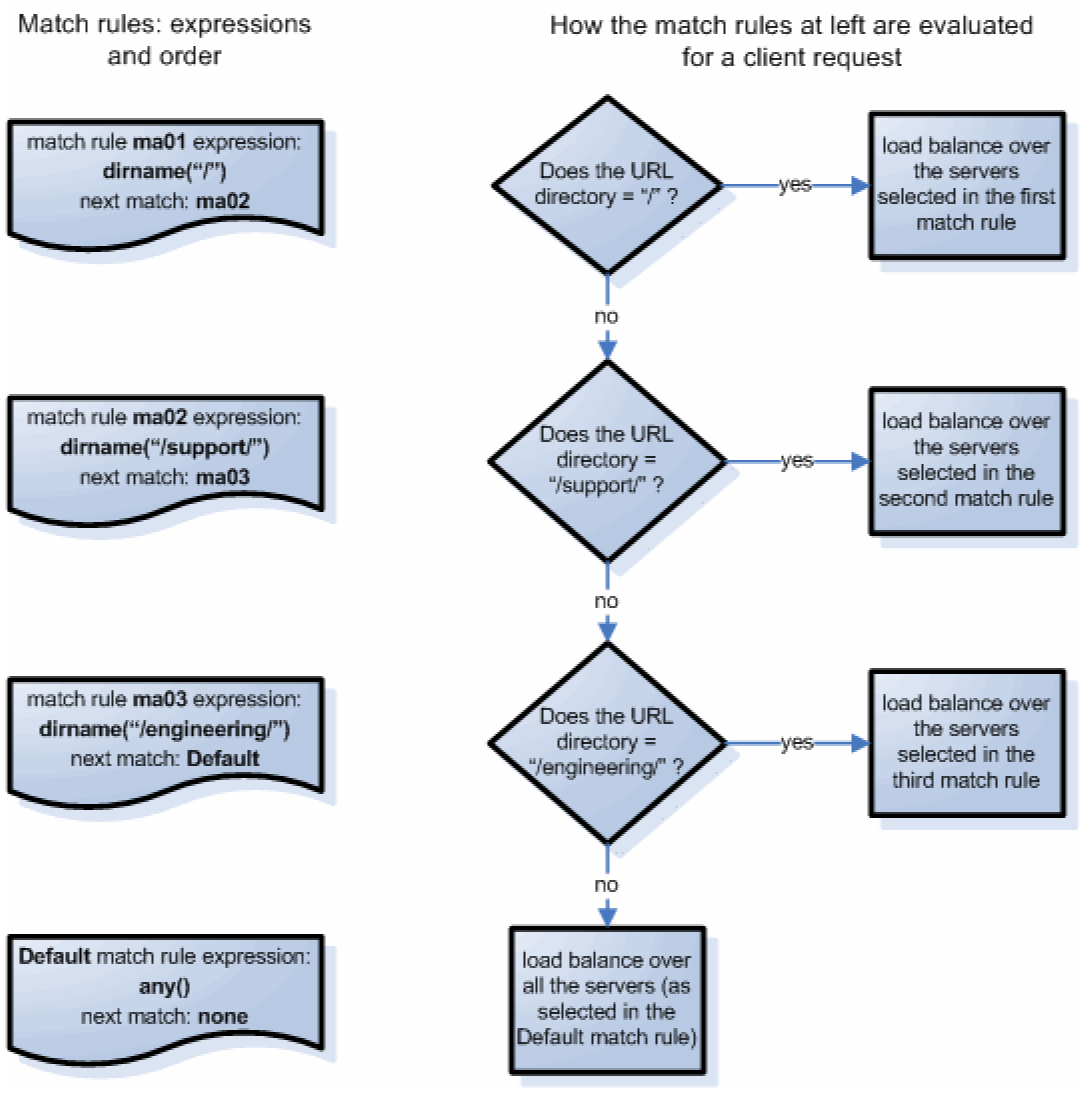
When you add more than one match rule to a cluster, the order in which the match rules are processed is important to system performance. Since processing a match rule requires system CPU and memory, the most efficient way of ordering match rules is from the most common case to the least common case. In this way, you ensure that the greatest number of client connections possible will process the first match rule and, if it matches the request, stop processing match rules for that request.

In other words, the goal is to load balance the highest possible number of requests according to the settings in the first match rule, which has the effect of reducing to a minimum the amount of match rule processing required for requests to that cluster.

This is best illustrated by an example. Let's say you want to construct a set of match rules that achieves these goals:

- Direct all requests whose URL contains one of two specific directories to specific server pools. Assume these two directories are.../support and.../engineering.
- Of the two directories above, we expect more requests to contain.../support.
- Load balance requests whose URL *does not* contain a directory across all servers.
- We want to process requests that *do not* contain a directory the fastest, since we expect that 75% of requests to this cluster will NOT contain a directory in the URL.

The set of match rules that achieves this, their order, and how the match rules are evaluated, is described in the following figure.


Match rules: expressions and order
How the match rules at left are evaluated for a client request
match rule ma01 expression: dirname("/") next match: ma02
match rule ma02 expression: dirname("/support/") next match: ma03
match rule ma03 expression: dirname("/engineering/") next match: Default
Default match rule expression: any() next match: none
Does the URL directory = "/" ?
Does the URL directory = "/support/" ?
Does the URL directory = "/engineering/" ?
yes
no
load balance over the servers selected in the first match rule
load balance over the servers selected in the second match rule
load balance over the servers selected in the third match rule
load balance over all the servers (as selected in the Default match rule)

At left in the figure above are the expressions for the three match rules, shown in the order in which they are configured in the cluster. At right, the decision tree describes how the match rules are evaluated for every client request that comes into this cluster.

As described previously, the first match rule (**ma01**) is meant to match any request that does not have a directory in it. Since this is our most common case, match rule evaluation will stop after the first match rule is evaluated for the majority of incoming requests.

The second and third rules, **ma02** and **ma03**, match for specific directory names. We match for the most common directory name first, then the less common directory name.

Finally, if all three of the match rule expressions for **ma01**, **ma02**, and **ma03** fail to match an incoming request, then that request is load balanced across the server pool in the cluster using the options set on the cluster (and mirrored in the Default match rule).

Match Rule Expressions and Bodies

Match functions and operators are used to construct the *expression* parameter found in a match rule. The *expression* parameter selects the requests to be processed using the parameters specified in the remainder of the match rule.

Match Rule Expressions

Match rules consists of a *match expression* and a *match body,* which identifies the operations to perform if the expression is satisfied by the request. Match syntax is as follows:

```
match name {expression} then {body}
```

Each match has a name, which is simply a label. The name must follow the same restrictions as those for cluster names and server pool names. All match names within a cluster must be unique.

Match expressions affect the subsequent processing of the request stream using URI, host, or other information. They are made up of match functions, most of which are protocol-specific, joined by logical operators, optionally preceded by the negation operator, with sets of beginning and end parentheses for grouping where required. This may sound complex, and it can be, but typical match expressions are simple; it is usually best from a performance perspective to keep them simple.

The most simple match expression is one made up solely of a single match function. The truth value (*true* or *false*) of this expression is then returned by the match function. For example, a match function common to all Layer 7 protocols is the **any**() function, which always returns *true*, independent of the contents of the request data. So, the most simple match expression is:

```
any()
```

which will always result in the match rule being selected.

Use the logical NOT operator to invert the sense of the truth value of the expression. So, you can use the NOT operator to logically invert a match expression, as follows:

```
!expression
```

giving rise to the next simplest example:

```
!any()
```

which always evaluates to *false* and always results in the match rule not being selected.

With the addition of the logical OR (||) and logical AND (&&) operators, you can specify complex expressions, selecting precise attributes from the request, as in this:

```
!happy() || (round() && happy())
```

Match expressions are read from left to right. Expressions contained within parentheses get evaluated before other parts of the expression. The previous expression would match anything that was not happy or that was round and happy.

Unlike the previous example, match functions correspond to certain attributes in a request header.

For example, a request URI for a web page might look like this:

```
\Get /somedir/somepage.html http/1.1
Accept: text/html, text/*, *.*
Accept-Encoding: gzip
Host: www.coyotepoint.com
User-Agent: Mozilla/4.7 [en] (Win98; U)
```

Various functions return true when their arguments match certain components of the request URI. Using the above request URI, for example, you could use several match functions:

- **pathname()** return*s true if its argument matches* /somedir/somepage.html
- **dirname()** retu*rns true if its argument matches* /somedir/
- **filename()** retu*rns true if its argument matches* somepage.html

Other functions can evaluate the contents of the Host header in the request URI above:

```
host (www.coyotepoint.com)
host_prefix (www)
host_suffix (coyotepoint.com).
```

Some function arguments can take the form of a regular expression[1]. Note that you cannot put regular expressions.

```
Matching regular expressions (using *_regex() functions) is many times more
processing-intensive than using other match functions. It is usually possible to
avoid using regular expressions by carefully crafting match expressions using
other functions. For example, the following regular expression match:
dirname_regex("(two|four|six|eight)")
Can be replaced by the more efficient:
dirname_substr("two") ||
dirname_substr("four") ||
dirname_substr("six") ||
dirname_substr("eight")
```

Match Bodies

Match *bodies* specify the actions to take if the match expression selects the request. This is specified in the form of statements that provide values to variables used by the load balancer to process the request. The most common (and most useful) match body selects the set of servers (server pool) over which to apply the load balancing.

The **servers** assignment statement takes a comma-separated list of server names, which specifies the set of servers to be used for load balancing all requests that match the expression in the match rule. The reserved server names all and none specify respectively the set of *all* servers in the virtual cluster and *none* of the servers in the virtual cluster. If you do not assign servers, none will be available for load balancing; as a result, the connection to the client will be dropped.

In general, you can override most cluster-specific variables in a match body. One useful example of overriding variables is as follows:

```
flags =!once_only;
```

which would load-balance across the specified server pool (which first must be defined in the virtual cluster) and also turn off the **once_only** flag for the duration of processing of that connection.

[1]Regular expressions are specified according to IEEE Std 1003.2 (“POSIX.2”).

Match Rule Functions

Match rule *functions* generally test for certain strings or settings in the headers and URI of a client request. In the table below, we first discuss match rule functions that examine information in the request other than the URI, and then we discuss the URI related functions.

The following table lists the non-URI functions supported by Equalizer match rules:

any()	This function always evaluates to *true* -- that is, this function matches any incoming request.
client_ip(string)	This function evaluates to *true* only if the IP address of the client machine making the connection matches the *string* argument. The *string* can be a simple IP address (e.g., “192.168.1.110”), or an IP address in Classless Inter-Domain Routing (CIDR) notation (e.g., “192.168.1.0/24”). This function can be useful in restricting match expressions to a particular client or group of clients, which can aid in debugging a new match rule when a cluster is in production. Only the specified clients match the rule, leaving other clients to be handled by other match rules
debug_message(string)	This function always evaluates to *true*. It writes the *string* argument to the Event Log for the cluster (**View > Event Log**). This function can be logically ANDed and ORed with other functions to write debug messages. *Use this function for testing and debugging only. Do not use it in production environments, since it has a negative impact on performance.*
ignore_case()	This function always evaluates to *true*, and is intended to be used to apply the **ignore_case** flag for comparisons when it is *not set* on the cluster. When this function is ANDed with other functions, it has the effect of forcing case to be ignored for any comparisons done by the match rule.
observe_case()	This function always evaluates to *true*, and is intended to be used to override the **ignore_case** flag for comparisons when it is *set* on a cluster. When this function is ANDed with other functions, it has the effect of forcing case to be honored for any comparisons done by the match rule.
http_09()	This function takes no arguments and evaluates to *true* if the HTTP protocol used by the request appears to be HTTP 0.9. This is done by inference: if an explicit protocol level is absent after the request URI, then the request is considered HTTP 0.9.
method(string)	This function evaluates to *true* if the *string* argument exactly matches the Request Method (e.g., GET, POST, etc.) specified in the request. Note that by default Equalizer forwards packets to servers without determining whether or not the method specified in the request is valid (i.e., is a method specified in Section 9 of RFC2616). One use of the **method()** function is to be able to override this default behavior and prevent invalid requests from being forwarded to a server.
ssl2()	HTTPS only. This function evaluates to *true* if the client negotiated the encrypted connection using SSL version 2.0.
ssl3()	HTTPS only. This function evaluates to *true* if the client negotiated the encrypted connection using SSL version 3.0.

tls1()	HTTPS only. This function evaluates to *true* if the client negotiated the encrypted connection using TLS version 1.0.

Non-URI header match functions

See Match Bodies, for the headers that can be specified in these functions.

header_prefix(header, string)	This function evaluates to *true* if the selected *header* is present and if the string-valued argument *string* is a prefix of the associated header text.
header_suffix(header, string)	This function evaluates to *true* if the selected *header* is present and if the argument *string* is a suffix of the header text.
header_substr(header, string)	This function evaluates to *true* if the selected *header* is present and if the string-valued argument *string* is a sub-string of the associated header text.
header_regex(header, string)	This function evaluates to *true* if the selected *header* is present and if the string-valued argument *string*, interpreted as a regular expression, matches the associated header text.

In addition to the functions in the preceding table, a set of functions is provided that allows you to process requests based on the various components of a request's destination URI.

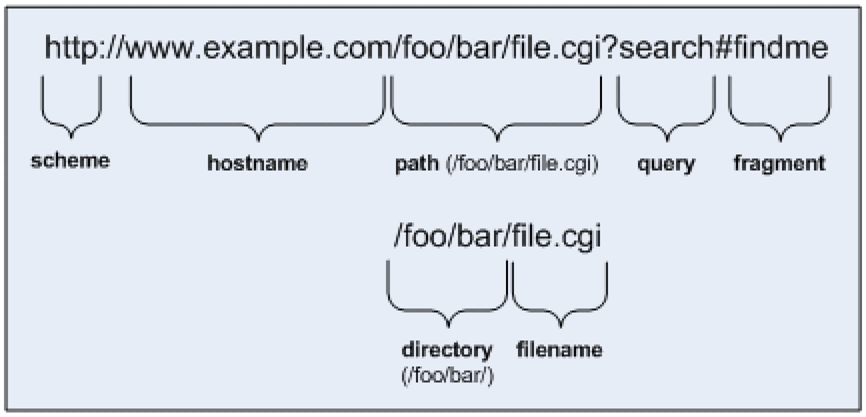
A URI has the following parts (as defined in RFC1808):

```
<scheme>://<hostname>/<path>;<params>?<query>#<fragment>
```

In addition, Equalizer further breaks up the <path> component of the URI into the following components:

```
<directory><filename>
```

The following figure illustrates how Equalizer breaks up a URI into the supported components:



Note that the following components of the URI do not have corresponding match functions:

- Match functions for the <scheme> component are not necessary, since a cluster must be configured to accept only one protocol: HTTP *or* HTTPS.

- Match functions for the optional <params> component are not provided. Use the **pathname*()** and **filename*()** functions to match characters at the end of the **path** and **filename** components.
- Match functions for the optional <fragment> component are not provided. The fragment portion of a URI is not transmitted by the browser to the server, but is instead retained by the client and applied after the reply from the server is received.

The following lists the URI matching functions that match text in the URI components shown.

URI Function	Description
host(string)	This function evaluates to *true* if the *string* argument exactly matches the hostname portion of the request. *In the case of HTTP 0.9, the host is a portion of the request URI. All other HTTP protocol versions require a Host header to specify the host, which would be compared to the string.*
host_prefix(string)	This function evaluates to *true* if the *string* argument is a prefix of the hostname portion of the URI path. The prefix of the hostname includes all text up to the first period; for eample, "www" in "www.example.com".
host_suffix(string)	This function evaluates to *true* if the *string* argument is a suffix of the hostname portion of the URI path. The suffix of the hostname includes all text after the first period in the hostname; for example, "example.com" in "www.example.com".
pathname(string)	This function evaluates to *true* if the *string* argument exactly matches the path component of the request URI.
pathname_prefix(string)	This function evaluates to *true* if the *string* argument is a prefix of the path component of the request URI.
pathname_suffix(string)	This function evaluates to *true* if the *string* argument is a suffix of the path component of the request URI.
pathname_substr(string)	This function evaluates to *true* if the *string* argument is a substring of the path component of the request URI.
pathname_regex(string)	This function evaluates to *true* if the *string* argument, interpreted as a regular expression, matches the path component of the request URI.
dirname(string)	This function evaluates to *true* if the *string* argument exactly matches the directory portion of the path component of the request URI. The path component is the entire directory path, including the trailing slash. For example, "/foo/bar/" is the directory portion of "/foo/bar/file.html".
dirname_prefix(string)	This function evaluates to *true* if the *string* argument is a prefix of the directory portion of the path component of the request URI. The leading slash must be included in the *string* (for example, "/fo" is a prefix of "/foo/bar/file.html").
dirname_suffix(string)	This function evaluates to *true* if the *string* argument is a suffix of the directory portion of the path component of the request URI. The trailing slash must be included in the *string* (for example, "ar/" is a suffix of the directory portion of "/foo/bar/file.html").
dirname_substr(string)	This function evaluates to *true* if the *string* argument is a substring of the directory portion of the path component of the request URI.

URI Function	Description
dirname_regex(string)	This function evaluates to *true* if the *string* argument, interpreted as a regular expression, matches the directory portion of the path component of the request URI.
filename(string)	This function evaluates to *true* if the *string* argument exactly matches the filename portion of the URI path. *This portion includes only the text after the last trailing path component separator (/), as that is considered part of the directory* (for example, "file.html" is the filename portion of "/foo/bar/file.html").
filename_prefix(string)	This function evaluates to *true* if the *string* argument is a prefix of the filename portion of the URI path.
filename_suffix(string)	This function evaluates to *true* if the *string* argument is a suffix of the filename portion of the URI path.
filename_substr(string)	This function evaluates to *true* if the *string* argument is a substring of the filename portion of the URI path.
filename_regex(string)	This function evaluates to *true* if the *string* argument, interpreted as a regular expression, matches the filename portion of the URI path.
query(string)	This function evaluates to *true* if the *string* argument exactly matches the (optional) query component of the request URI. The query, if present, appears in a URI following a question mark (?). The syntax of a query is application specific, but generally is a sequence of key/value pairs separated by an ampersand (&).
query_prefix(string)	This function evaluates to *true* if the *string* argument is a prefix of the query portion of the URI path.
query_suffix(string)	This function evaluates to *true* if the *string* argument is a suffix of the query portion of the URI path.
query_substr(string)	This function evaluates to *true* if the *string* argument is a substring of the query portion of the URI path.
query_regex(string)	This function evaluates to *true* if the *string* argument, interpreted as a regular expression, matches the query portion of the URI path.

Match Rule Operators

Match Rule Operators are as follows:

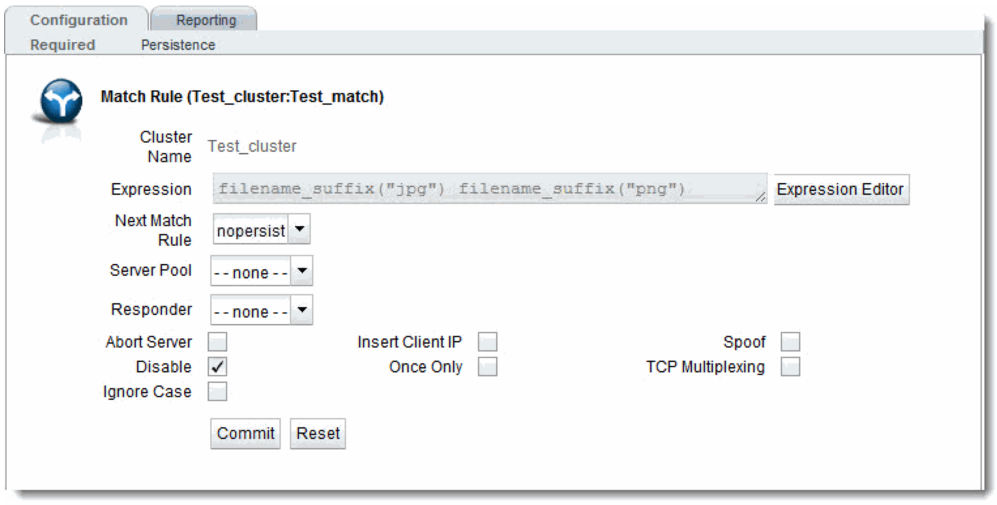
- **II -** logical OR operator
- **&& -** logical AND operator
- **! -** logical NOT operator
- **()** - used to group functions and operators

Match Rule Definitions

Match *rules* are defined in the file */var/eq/eq.conf* with the definition of the cluster to which the match rule applies. A match rule as it appears in *eq.conf* looks like the following example:

```
match ma01 {
client_ip("10.0.0.19")
} then {
flags =!spoof;
srvpool = sv_01;
}
```

In this example (the match rule is named “ma01”), the match function, **client_ip**, has an argument that matches all requests from IP address 10.0.0.19, which are all sent to server sv_01. Additionally, this rule disables the **spoof** flag (that is, when the connection is made to the server, the server sees a connection to the Equalizer, not to the client). This is displayed as follows:



Cluster Name: Test_cluster
Expression: filename_suffix("jpg") filename_suffix("png")
Next Match Rule: nopersist
Server Pool: -- none --
Responder: -- none --
Abort Server: ☐
Disable: ✓
Ignore Case: ☐
Insert Client IP: ☐
Once Only: ☐
Spoof: ☐
TCP Multiplexing: ☐

The **Expression** field shows the expression that is evaluated against the incoming request. If the expression evaluates to *true*, the **Server Pool** field specifies the "pool" of servers that will be used to satisfy the incoming request, as well as the options that will be set for the request.

Refer to "Server Pools and Server Instances" on page 229

Match Rule Expression Examples

A match rule *expression* must be specified in double quotes, so any quotes used in a function to delineate strings must be escaped with a backslash character (\), as in this example that matches all client requests with a source IP on the 10.10.10/24 network:

```
expression “client_ip(\“10.10.10/24\”)”
```

Functions can be negated using the “!” operator. To change the above example to match all client requests with a source IP *not* on the 10.10.10/24 network, use this expression:

```
    expression “!client_ip(\“10.10.10/24\”)”
```

Functions can be combined using the logical operators shown in the previous section. For example, to match a client request for any file with two different file suffixes, you could use an expression like this:

```
    expression “filename_suffix(\“jpg”) or filename_suffix(\“gif”)”
```

Functions and operators can be grouped using parentheses to create complex expressions. For example, to match a client request with a source IP on the 10.10.10/24 network and a URI whose filename suffix is *not* “jpg” or “gif”, use the following expression:

```
    expression “client_ip(\“10.10.10/24\”) and!(filename_suffix(\“jpg”) or
  filename_suffix(\“gif”))”
```

Match Rule Expression Notes

Observe the following when constructing match rule expressions:

Match Rule Behavior When Server Status is Not "Up"

When a match rule expression matches a client request, the request is load balanced using the server pools, parameters, and flags specified in the match rule. The server pools specified in the match rule may be in a number of “states” that affect the load balancing behavior: the servers within the sever pools may be up or down, and may have one or both of the **quiesce** and **hot spare** options enabled.

- **server up -** The request is routed to the selected server.
- **up/quiesce enabled -** The request is routed to the selected server.
- **up/hot spare enabled -** The request is routed to the selected server.
- **server down -** If no Responder is selected in the match rule, then the request is sent to the selected server and, eventually, the client times out. If a Responder is selected, the Equalizer sends the configured response to the client.

The reason match rules behave as shown above is because the purpose of a match rule is to send a request that matches an expression to a particular server that can (presumably) better satisfy the request. In some cases, sending the request to a particular server may be required behavior for a particular configuration.

With this in mind, it does not make sense to skip a match rule because the server (or servers) named in the rule are down, hot spared, or quiesced -- rather, since the server in the rule is presumably critical to satisfying the request, it makes sense to route the request to the (for example) down server, and have the client receive an appropriate error -- so that the request can be retried.

If we instead were to skip a match rule because, for example, the server selected by the match rule is down, the request would be evaluated by the next match rule -- or the default match rule. The request, therefore, could potentially be sent to a server in the cluster that does not have the requested content. This means that the client would receive a “not found” error, instead of an error indicating that the appropriate server is not currently available.

Considering Case in String Comparisons

String comparisons performed by match functions honor the setting of the **ignore case** cluster parameter: if it is set on the cluster (the default), then all match rule functions used for that cluster are case insensitive; that is, the case of strings is ignored. For example, the string “ab” will match occurrences of “ab”, “Ab”, “aB”, and “AB”. If **ignore case** is *not* set on the cluster, then all string comparisons are by default case sensitive (the string “ab” will match only “ab”).

To override the **ignore case** flag setting on the cluster for a match function or block of functions, you must logically AND the **observe_case()** or **ignore_case()** functions with the match function or block. For example, if **ignore case** is set on the cluster, you would use the following **expression** to force the **header_substr()** function to make case sensitive string comparisons:

```
(observe_case() and header_substr(\"host\", \"MySystem\"))
```

Regular Expressions

Some match functions have *prefix*, *suffix*, *substr*, or *regex* variants. The *regex* variants interpret an argument as a regular expression to match against requests. Regular expressions can be very costly to compute, so use the *prefix*, *suffix*, or *substr* variants of functions (or Boolean combinations of prefix and suffix testing), rather than the *regex* function variants, for best performance. For example, the following regular expression match:

```
dirname_regex(\"(two|four|six|eight)\")
```

Can be replaced by the more efficient:

```
dirname_substr(\"two\") OR

dirname_substr(\"four\") OR

dirname_substr(\"six\") OR

dirname_substr(\"eight\")
```

Note that Equalizer match rule expressions support POSIX regular expression syntax only.

Supported Headers

All of the **header_*** match functions take a **header** argument, which selects the header of interest. If this header is not present in the request, the match function evaluates to *false*. Otherwise, the text associated with the header is examined depending on the particular function.

Although HTTP permits a header to span multiple request lines, none of the functions matches text on more than one line. In addition, Equalizer will only parse the first instance of a header. If, for example, a request has multiple **cookie** headers, Equalizer will only match against the first **cookie** header in the request.

The list of supported headers for the **header** argument are as follows:

Accept	From	Referer
Accept-Charset	Host	TE
Accept-Encoding	If-Match	Trailer

Accept-Language	If-Modified-Since	Transfer-Encoding
Authorization	If-None-Match	Upgrade
Cache-Control	If-Range	User-Agent
Connection	If-Unmodified-Since	Via
Content-Length	Max-Forwards	Warning
Cookie	Pragma	X-Forwarded-For
Date	Proxy-Authorization	
Expect	Range	

HTTPS Protocol Matching

Equalizer permits the construction of virtual clusters running the HTTPS protocol. HTTPS is HTTP running over an encrypted transport, typically SSL version 2.0 or 3.0 or TLS version 1.0. All of the functions available for load balancing HTTP clusters are available for HTTPS clusters. In addition, there are some additional match functions [ssl2(), ssl3(), and tls1()], that match against the protocol specified in an HTTPS request.

Supported Characters in URIs

The characters permitted in a URI are defined in RFC2396. Equalizer supports all characters defined in the standard for all Match Functions that have a URI as an argument. Note in particular that the ASCII space character is not permitted in URIs -- it is required to be encoded by all conforming browsers as “%20” (see Section 2.4 of RFC2396).

Match Rules, the Once Only Flag, and Cookies

Since multiple client requests may be received on a single TCP/IP connection, Equalizer has a flag (**once only**) that specifies whether to check the headers in every request received on a connection, or to load balance based solely The **once only** flag is a cluster parameter on the **Networking** tab. When using Match Rules, it is usually desirable to turn off the **once only** flag for the cluster so that Equalizer matches against each individual request in a connection, not just the first one.

You can also enable or disable **once only** flag in the match rule **Configuration** screen (tab), to override the setting on the cluster for any request that matches that rule. For example, if **once only** is enabled on a cluster and disabled on a match rule, any request that matches that match rule’s expression will be load balanced as if **once only** were disabled on the cluster.

The following table shows how the setting of once only affects load balancing when a match rule hit occurs:

match rule hit on...	once only disabled	once only enabled
...the first request on a connection	If the request headers contain a cookie specifying a server in the match rule’s server list, send the request to the server in the cookie. Otherwise, send the request to the server in the match rule’s server list that is selected by the load balancing policy in effect for the match rule.	Same as at left.
...second and subsequent requests	Same as above.	If the request headers contain a cookie specifying a server in the match rule’s server

match rule hit on...	once only disabled	once only enabled
on the same connection		list, send the request to the server in the cookie. Otherwise, send the request to the server that was selected by the first request.

Note that Equalizer always honors a cookie that specifies a server in the match rule's server pool list, regardless of the setting of the **once only** flag: the request is sent to the server pool specified by the cookie. If, however, the cookie specifies a server pool that is not in the match rule's server list, the cookie is ignored.

Managing Match Rules

The EQ/OS 10 Administration Interface allows you to create and modify match rules, without requiring a detailed knowledge of the configuration language syntax used in the *eq.conf* file. The interface validates match rules before saving them so that all saved rules are syntactically correct. For this reason, we recommend you use the interface to create and edit match rules, rather than editing the configuration file.

The interface does *not*, however, test the behavior of match rules. Match rules must be tested against a flow of incoming requests in order to determine if the behavior of the rule is what you expect.

Before constructing a match rule, you should first understand the general concepts of match rules covered in "Match Rule Expressions and Bodies" on page 321.

In the Match Rule descriptions herein, instructions are provided for using the GUI first, followed by instructions for accomplishing the same task using the CLI. Refer to "Working in the CLI" on page 127 for details on using the CLI commands.

Displaying Match Rules

On the GUI, click on a cluster name in the navigation pane and then click on any of the Match Rules associated with any of the HTTP or HTTPS clusters to display the match rules defined for that cluster.

On `eqcli`, enter the following:

```
eqcli > cluster clname match
```

In the example below the Match Rules on the cluster "SP-fe_http" are displayed:

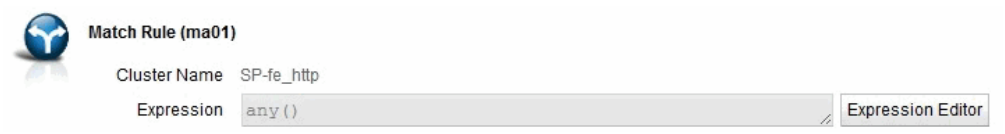
```
eqcli cl-SP-*> show match
Name Server Pool Responder Expression
nopersist serverool1 responder1 *
images *
test *
ma01 adp_tcp *
New_Match_Rule *
```

Default Match Rule

All Layer 7 clusters created via the Equalizer Administration Interface start with a single match rule (named **Default**) that matches all requests and selects all servers.

```
match Default {
any()
} then {
servers = all;
}
```

When displayed `any()` appears in the Expression field in the GUI as shown below.



Cluster Name SP-fe_http
Expression any()

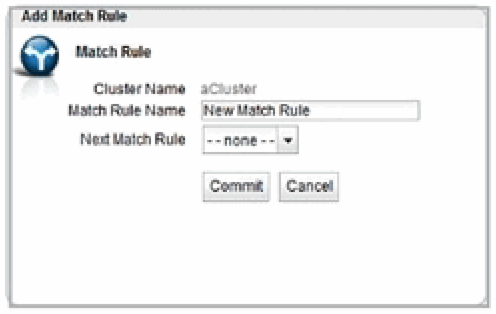
The default rule specifies that all server pools defined in the cluster should be used for load balancing the request, and that all flag settings for the request will be inherited from the cluster flag settings.

Creating a New Match Rule

Proceed with the following to add a match rule to a virtual cluster using the GUI:

1. Log into the GUI using a login that has add/del access for the cluster. See Logging in on page

2. In the navigation pane on the left, right-click the name of the Layer 7 cluster to which you want to add a match rule, and select **Add New Match Rule** to display the following:.



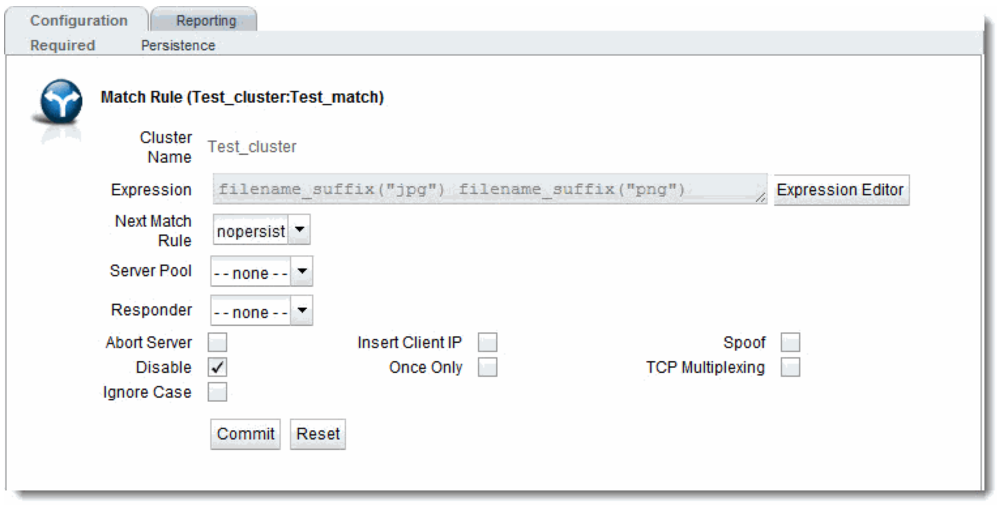
Cluster Name aCluster
Match Rule Name New Match Rule
Next Match Rule -- none --

3. Enter a name for the new rule in the **Match Rule Name** field. All match names within a cluster must be unique.

4. Make a selection for the **Next Match Rule** using the drop-down list. When you select **Next Match Rule,** the new match rule you are creating will be placed <u>before</u> the **Next Match Rule** and will be evaluated in that sequence in load balancing.

5. Click **Commit** when are finished. The **Configuration** screen (tab) will be displayed as shown below.

Note - If you do not enable a check box for at least one server pool, *Equalizer will drop the connection for any request that matches the rule*. You must also associate a server pool with the match rule on the **Configuration** screen (tab).



Match Rule (Test_cluster:Test_match)

Cluster Name: Test_cluster
Expression: filename_suffix("jpg") filename_suffix("png")
Next Match Rule: nopersist
Server Pool: -- none --
Responder: -- none --
Abort Server [ ]
Disable [✓]
Ignore Case [ ]
Insert Client IP [ ]
Once Only [ ]
Spoof [ ]
TCP Multiplexing [ ]

6. Use the Expression Editor to build your match expression. Refer to"Match Rule Expression Examples" on page 328 for details on using this feature.

7. Use the Server Pool drop down list to select a Server Pool to direct Layer 7 traffic if it complies with the match rule conditions specified. Refer to "Managing Server Pools" on page 230 for instructions on configuring Server Pools.

8. Configure the other parameters for the **Match Rule** as necessary. The following table describes each of the selections. Changing these parameters will override the cluster setting.

Expression	Refer to "Match Rule Expression Notes" on page 329.
Next Match Rule	The **Next Match Rule** field determines the order of processing. For example, if you were to configure a Match Rule 2 with a **Next Match Rule** parameter of Match Rule 1, it would be place *before* Match Rule 1 in the order of processing.
Server Pool	The **Server Pool** field determines the server pool to which a match rule applies its specified conditions and parameters.
Responder	The **Responder**field allows you to specify an automatic responder for client requests that match this rule when none of the servers selected in the rule are available. The responder must already be configured. For a description of responders as well as examples of using responders in match rules, see "Adding a Responder" on page 348.
Spoof	**Spoof**causes Equalizer to spoof the client IP address when Equalizer routes a request to a server in a virtual cluster; that is, the IP address of the *client* is sent to the server, not the IP address of the Equalizer. This option is on by default. If you disable this option, the server receiving the request will see the Equalizer's address as the client address because the TCP connection to the client is terminated when the request is routed. When spoof is enabled, the server pool in the cluster must use the Equalizer as the default gateway for routing.
Abort Server	By default, when a client closes a connection, Equalizer waits for a response from the server before closing the server connection. If this flag is enabled, Equalizer will not wait for a response before closing the connection to the server; instead it sends a TCP RST (reset) to the server when the client closes the

	connection.
Ignore Case	This function always evaluates to *true*, and is intended to be used to apply the **Ignore Case**flag for comparisons when it is *not set* on the cluster. When this function is ANDed with other functions, it has the effect of forcing case to be ignored for any comparisons done by the match rule.
Insert Client IP (HTTPS only)	When this flag is enabled, Equalizer inserts an **X-forwarded-for:**header with the client's IP address into all client requests before they are sent to the server. This flag is *disabled* by default for HTTP clusters and *enabled* by default for HTTPS clusters.
Once Only	Limits Equalizer to parsing headers (and executing match rules) for only the first request of any client making multiple requests across a single TCP connection. This option is off by default: meaning that Equalizer will parse the headers of every client request.
Disable	Enable this flag to disable this match rule without deleting it. This can be useful when testing new match rules.
TCP Multiplexing	Enables TCP multiplexing for a cluster. TCP multiplexing must also be enabled on at least one server instance in the server pool assigned to the cluster (or one of its match rules).

9. The ordering of match rules is important, as they are processed from first to last until one of them evaluates to *true*, at which time the match body is processed. The initial match expression of a new rule, any() is one that will always evaluate to *true*, meaning that this match rule will always be selected. It is good practice to be cautious when adding new match rules to ensure that all the traffic to a cluster does not get mishandled. Use the **Disable** flag to skip a match rule that is still being developed.

10. Click on the **Commit** button to Commit the parameter selections.

To add a match rule to a Layer 7 cluster using the CLI follow this general procedure:

1. Log into the CLI using a login that has add/del access for the cluster. (See "Starting the CLI" on page 128.)

2. At the eqcli prompt enter the cluster name followed by "match *maname*". In the example below a Match Rule **test** is added to the Layer 7 cluster **Sp-fe_http**.

```
Match Rule Name : test
Next Match Rule : ma01
Cluster Name : SP-fe_http
Server Pool :
Responder :
Cookie Path :
Cookie Domain :
Cookie Scheme : 0
Cookie Age : 0
Cookie Generation : 0
Flags : disable
Expression :
any()
```

3. Assign a Server Pool to the newly created Match Rule by entering:

```
eqcli cl-clname-ma-maname> srvpool spname
```

4. Add or remove **Responder**, **Cookie Path**, **Cookie Domain**, **Cookie Scheme**, **Cookie Age** and **Cookie Generation** and **Flags** using the procedures above.

5. Configure the Match Expressions using the following at the eqcli prompt. Descriptions of the Expressions are provided in "Match Rule Functions" on page 324.

```
eqcli cl-clname-ma-maname> expression string
```

Modifying a Match Rule

To edit a match rule using the GUI, follow these steps:

1. Log into the GUI using a login that has write access for the cluster (See "Logging In" on page 192).

2. In the navigation pane on the left click the name of the match rule to be changed.

3. Make the desired changes to the match rule, as shown in the procedure in the previous section, starting at Step 5.

To edit a match rule using eqcli follow these steps:

1. Log into eqcli using a login that has add/del access for the cluster (See "Starting the CLI" on page 128)

2. Make the desired changes using eqcli as shown in the procedures beginning with step 1.

Removing a Match Rule

To delete a match rule using the GUI, follow these steps:

1. Log into the GUI using a login that has add/del access for the cluster (See "Logging In" on page 192).

2. In the navigation pane on the left, right-click the name of the match rule to be deleted and select **Delete Match Rule**.

3. Click **delete** to confirm that you want to delete the match rule.

To delete a match rule using eqcli, follow these steps:

1. Log into eqcli using a login that has add/del access for the cluster (See "Starting the CLI" on page 128).

2. Enter the following at the eqcli prompt:

```
eqcli > cluster clname no match maname
```

Using Responders in Match Rules

Responders are used to send automated responses to clients when all the server pools in a match rule are down. See "Automatic Cluster Responders" on page 347 for a complete description of Responders as well as examples of using Responders in Match Rules.

Example Match Rules

The Related Topics navigate to examples of how to create a few of the most commonly used types of match rules.

Parsing the URI Using Match Rules

In this example, we want to direct requests to a pool of specific server pools based on the hostname used in the URI contained in the request. We want all requests for URIs that start with “support” to go to one server pool, and all other requests that do *not* match this rule to be load balanced across all server pools in the cluster.

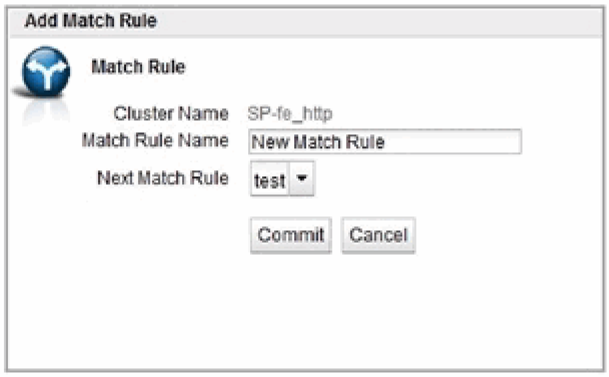
To do this, we will construct one match rule that parses the URI; if the URI contains the string **“support”**, it forwards the request to the server pool **sv_support**. For this example, we assume that a cluster with server pools has already been defined.

1. Log into the GUI using a login that has add/del access for the cluster.

2. In the left frame, right-click the name of the Layer 7 cluster to which you want to add the rule, and select **Add Match Rule**. The **Add Match Rule** dialog appears:

   a. Type a name into the **Match Rule Name** field. In this case **New Match Rule** was added.

   b. Select the **Next Match Rule** from the drop-down list to determine the placement of **New Match Rule** in the order of processing. In this case **test** was selected.



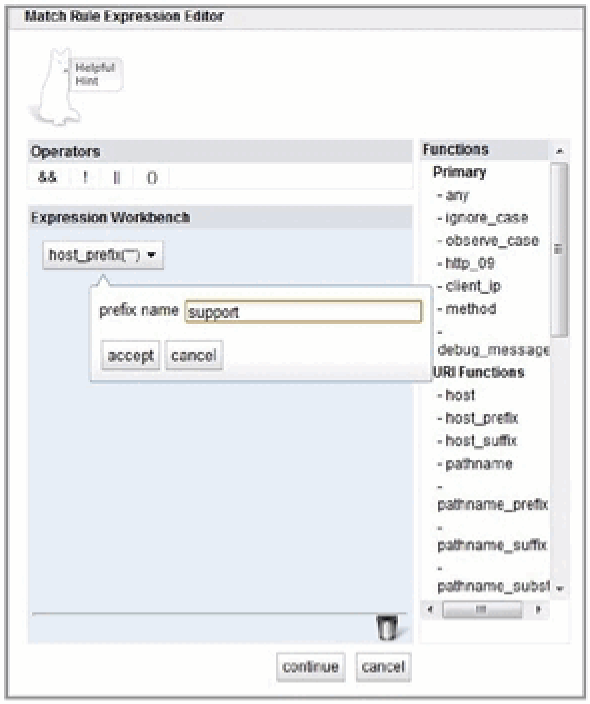
Cluster Name SP-fe_http
Match Rule Name New Match Rule
Next Match Rule test

   c. Click on **Commit**. If **test** was selected as the **Next Match Rule** it will appear beneath **Test** in the navigation pane on the left.

The match rule is created, added to the navigation pane on the left, and its **Configuration** tab is opened. Refer to "Using the Match Rule Expression Editor" on page 344 for further descriptions on using the Expression Editor.

3. Click on the **Expression Editor** button and drag and drop **host_prefix** from the drop-down box in the **Functions** pane into the **Expression Workbench** pane.

4. Type "**support**" into the **hostname prefix** text box as follows:



5. Click on **accept** after entering "**support**" and then click on the **continue** button at the bottom of the **Expression Editor** to save the expression.

Now, all requests for URIs that start with "**support**" should go to the **sv_support** server pool, and all other requests that do *not* match this rule to be load balanced across all server pools in the cluster.

Changing Persistence Settings Using Match Rules

By default, a client request that matches a match rule expression is load balanced using the same load balancing parameters and options that are currently set on the cluster. The following describes how to change load balancing parameters and flags in a match rule.

For example, persistent connections to server pools are enabled by the **Persist** cluster flag, which is enabled by default when you create a cluster. Let's assume that you only want to *disable* persistence for incoming requests that have a URI containing a hostname in the following format:

```
xxx.testdonotpersistexample.com
```

We'll use the **host_suffix()** match rule function to test for the above hostname format. For this example, we assume that a cluster with three server pools has already been defined. We will construct a match rule that will turn off **Persist** for any request that contains the host suffix "**testdonotpersistexample.com**"; this request will be balanced across all of the server pools in the cluster.

1. Log into the GUI using a login that has `add/del` access for the cluster.

2. In the navigation pane on the left, right-click the name of the Layer 7 cluster to which you want to add the rule, and select **Add Match Rule**. The **Add Match Rule** dialog appears:

   a. Type **nopersist** into the **match name** text box.

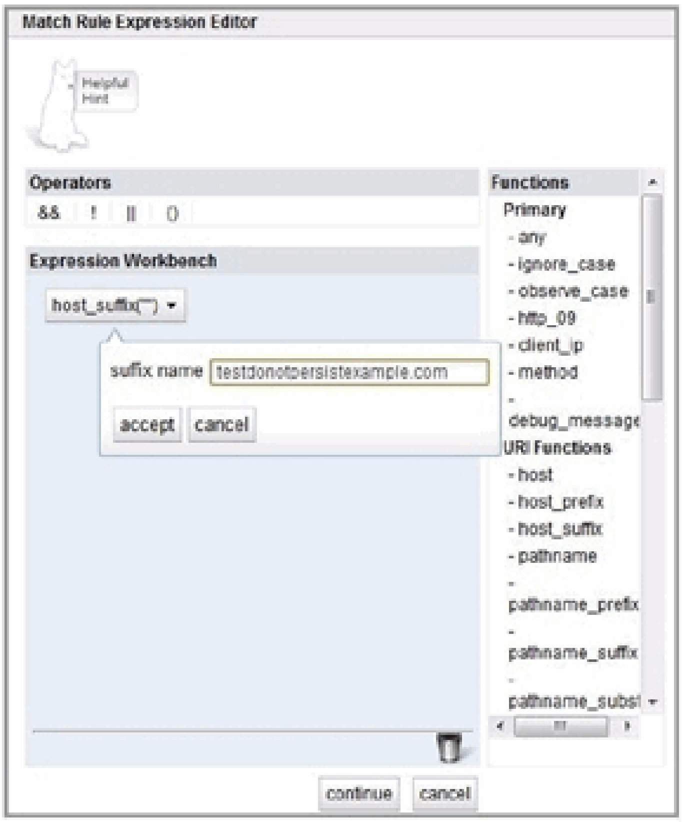
b. Select the server pool that this new rule will *precede* using the **Next Match Rule** drop-down list and click on **Commit**. The new rule will appear on the navigation tree in within the cluster from which is was created.

c. On the match rule **Configuration** screen (tab) select the **Server Pool** that will be used for load balancing with the **Persist** checkbox disabled.

3. Click on the **Expression Editor** button to display the Expression editor.

a. Leaving the **any()** expression in place, drag and drop the **host_suffix** from the **Functions** pane to the **Expression Workbox** *beside the* **any()** *expression.*

b. Type "**testdonotpersisteexample.com**" into the **hostname suffix()** function. The new expression should appear as follows.



suffix name: testdonotpersistexample.com

c. Click on **continue**.

4. Uncheck the **Persist** checkbox and **Disable** checkboxes on the **Configuration** tab.

5. Click on **Commit** to save your changes to the **nopersist** rule.

You have now *disabled* persistence for incoming requests that have a URI containing the hostname "testexample.com".

Using Persistence with Match Rules

When a match rule is configured you can specify that persistence methods for that match rule -- which supercede those the persistence method specified for a cluster. This is the persistence type to be used when the match rules conditions are met. For example, if you configured a match rule expression to redirect requests to Server A based on the criteria configured in an expression, you can also configure the persistence type to be used when that criteria is met.

To configure persistence with match rules select a configured match rule on the left navigational pane of the GUI. Select the **Persistence** tab to display the configuration screen. It is configured the same as the configuration of HTTP and HTTPS cluster persistence.

Changing the Spoof (SNAT) Setting Using Match Rules

By default, Equalizer uses the client IP address as the source address in the packets it forwards to server pools, and then translates the server IP in server responses to Equalizer’s cluster IP. This is commonly called a *Half-NAT* configuration, since Equalizer is *not* performing Network Address translation (or NAT) on client requests. Because the server pools behind Equalizer see the source IP of the client, the server pools need to be configured to route client requests back through Equalizer -- either by making Equalizer the default. This behavior is controlled by the **Spoof** option, which is enabled by default. Half-NAT configurations are only a problem when a client is on the same subnet as the servers behind Equalizer, since the servers will try to respond directly back to the client -- which will not recognize the server connection as a response to it’s original request and so refuse the connection.

This "local client" problem is solved by *disabling* the **Spoof** option. When **Spoof** is disabled, Equalizer translates the source IP address in the request to one of Equalizer’s IP addresses before sending it on to the server. This is called *Source Network Address Translation*, or *SNAT* -- and this configuration is often called *Full-NAT*, since Equalizer is translating the client IP in packets from clients, as well as the server IP in packets from servers. In this case, servers will send responses to Equalizer’s IP address, so no special routing or gateway is needed on the server.

So, clusters with clients on a different subnet than the server pools behind it can have the spoof option enabled, while clusters with only local clients should have spoof disabled.

But what do you do if you expect client requests to come to the cluster from the local server subnet as well as other subnets?

In network configurations where Equalizer needs to be able to forward server responses to clients on the server subnet as well as other subnets for the same virtual cluster IP, the **Spoof** option can be selectively enabled or disabled by creating a Layer 7 match rule that looks for specific client IP addresses in incoming requests. When an incoming request’s source IP matches the rule, **Spoof** will be set as appropriate for that connection. This is commonly called *Selective SNAT*.

On Equalizer, implementing Selective SNAT using a Match Rule is the recommended method to allow local access to Layer 7 clusters with **Spoof** enabled; other alternatives include:

- adding static routes on all your server pools to clients on the server’s local subnet
- creating two clusters -- one on the non-server subnet with **spoof** enabled, and one on the server subnet with spoof disabled

Selective SNAT using a match rule is more easily implemented and maintained than either of the above methods, but can be configured only for Layer 7 clusters. If you require Selective SNAT with a Layer 4 cluster, you’ll need to use one of the above methods.

Selective SNAT Example

The procedure below shows you how to create a match rule that selectively disables the cluster **Spoof** option based on the client IP address of an incoming connection. It is assumed that the cluster for which the match rule is created has **Spoof** *enabled* on the cluster **Configuration** screen (tab), and that the cluster works properly for clients on subnets other than the subnet to which the server pools in the cluster are connected.

1. Right-click the name of the cluster for which you want to implement selective SNAT, and select **Add Match Rule**.
2. On the **Add New Match Rule** form:
    a. Type in a **Match Name** or accept the default.
    b. Select the **Next Match Rule** from the drop down list to place the new match rule in the desired order on the cluster.
    c. Click on **Commit**.

The new match rule is created and its **Configuration** Screen (tab) is opened.

3. Leave **any()** in the **expression** field.
4. In the **Expression Editor**:
    a. Drag and drop the **client_ip** function from the **Functions** pane to the **Expression Workbench**.
    b. Specify a simple IP address (e.g., “192.168.0.240”), or an IP address in Classless Inter-Domain Routing (CIDR) notation (e.g., “192.168.0.0/24”) to specify an entire subnet in the **client_ip** function. Click on the **Continue** button when finished.

The **Expression** field should now contain the **client_ip** function with the **ip** argument you specified above.

5. Uncheck both the **Spoof** checkbox and the **Disable** checkbox on the **Configuration** Screen (tab).
6. Click on **Commit**.

Clients whose IP addresses are selected by the new match rule should now be able to connect successfully to the cluster IP. Right-click the name of the match rule in the left frame; the **Processed** counter in the popup menu should increase as clients are selected by the match rule. Select **Match Rule Plots** from the popup menu to display a history of the number of connections processed by the match rule.

Server Selection Based on Content Type Using Match Rules

In this example, assume a configuration that has dedicated one or more server pools to return only image files (*.gif*,*.jpg*, etc.), while the remainder of the server pools return all the other content for client requests.

We want to direct all requests for images to a particular server pool, and balance the remainder of requests across the other server pools in the cluster. The image server pool is connected to a common storage device that contains the images. The remaining server pools are all dedicated to serving particular content for different web sites. For this example, we assume that a cluster has already been defined.

We want to maintain persistent connections for the web site servers, assuming that some of the websites may need to maintain sessions for applications such as shopping carts, email, etc. Persistent connections are not necessary for the image servers, since they access the images from common storage and have no need to maintain client sessions, so there is no need to incur the performance impact of maintaining session information.

To do this, we'll create two match rules, as follows:

1. Log into the GUI using a login that has add/del access for the cluster.

2. In the navigation pane on the left, click the name of the Layer 7 cluster to which you want to add the rule. The cluster **Configuration** screen (tab) will appear on the right:

    a. Make sure that the **Once Only** checkbox is not checked; otherwise, uncheck it and click **Commit**.

    b. Make sure the **Persist** checkbox is not checked; otherwise, uncheck it and click **Commit**.

These steps are necessary because these flags, if enabled, cause only the first request in a connection to be evaluated. Since we want content to come from one server pool and images from another, we want the server pools that will have persistent connections to be chosen by the match rules.

3. Right-click the cluster name in the left frame and select **Add Match Rule**. The Add Match **Rule** form appears:

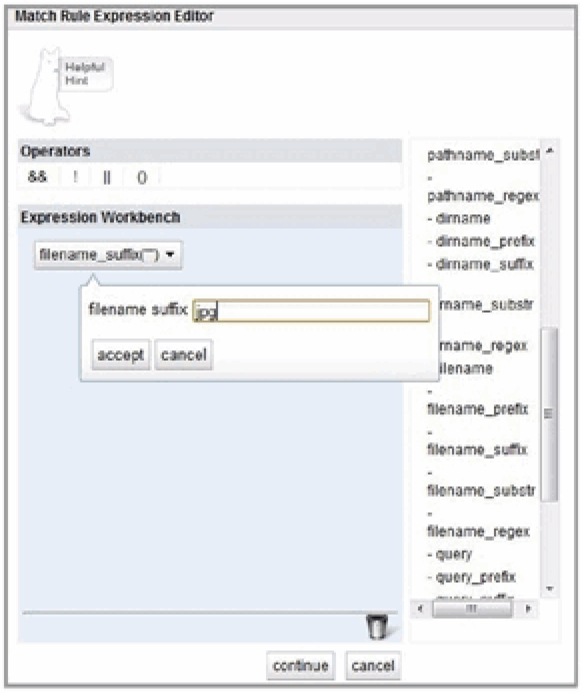
    a. Type **`images`** into the **Match Name** text box and use the **Next Match Rule** drop-down list to specify the match rule order for this match rule on the selected cluster. Click on **Commit**. In this match rule, we'll construct an expression that will match all the filename extensions of the images to be served. These requests will go to the image servers.

The match rule is created, added to the object tree, and its **Configuration** tab is opened:

4. Click on the **Expression Editor** button:

    a. Drag and drop the **filename_suffix** function from the from **Functions** pane to the **Expression Workbench**.

    b. Type "**jpg**" into the **filename suffix** text box.

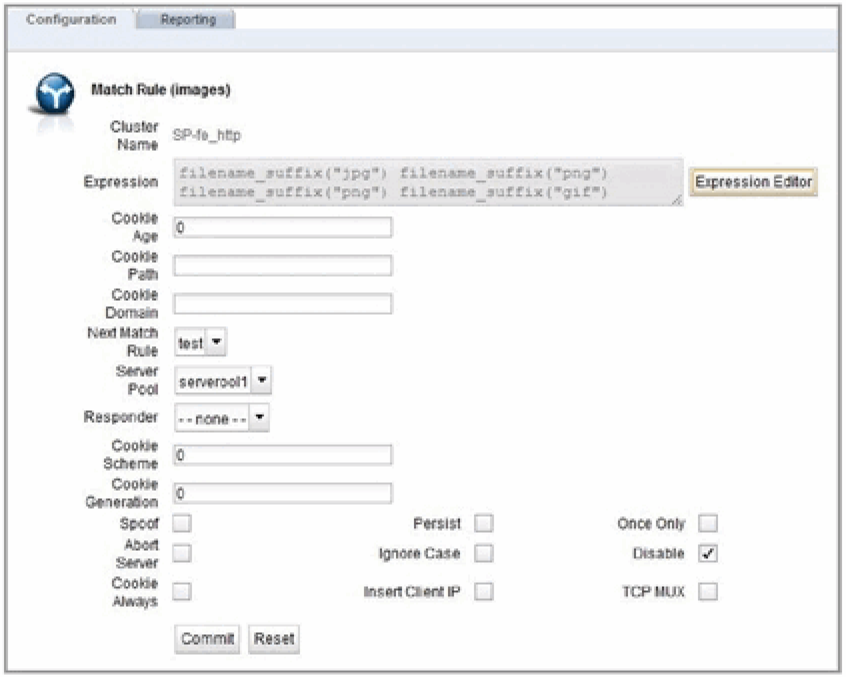


filename suffix: jpg

c. Select **continue**.

5. Repeat Step 4 for each of the other filename suffixes on our example servers -- **gif**, **bmp**, **tif** and **png**.

6. In our example, we want all the images to be served from **serverpool1**. On the **images Configuration** screen (tab), select **serverpool1** from the **Server Pool** drop-down list. When you are done, the match expression should look like this:



Cluster Name	SP-fe_http
Expression	filename_suffix("jpg") filename_suffix("png") filename_suffix("png") filename_suffix("gif")
Cookie Age	0
Cookie Path	
Cookie Domain	
Next Match Rule	test
Server Pool	serverool1
Responder	-- none --
Cookie Scheme	0
Cookie Generation	0

Spoof ☐ Persist ☐ Once Only ☐
Abort Server ☐ Ignore Case ☐ Disable ✓
Cookie Always ☐ Insert Client IP ☐ TCP MUX ☐

7. Click on **Commit**.

The **images** rule we created selects all the requests for image files; now we need a rule to determine which servers will receive all the other requests. The Default rule is not sufficient, and in fact we don’t want it to be reached, since it could send a request for content to one of the image servers. So, we’ll create another rule with the same match expression as the Default [**any()**], but a restricted list of servers. This effectively *replaces* the Default match rule with one of our own.

8. In the left frame, right-click the name of the cluster and select **Add Match Rule**. The **Add Match Rule** screen appears:

    a. Type “**content**” into the **match name** text box and use the **Next Match Rule** drop-down list to specify the match rule order for this match rule on the selected cluster. Click on **Commit**.

    b. On the **Configuration** screen (tab) use the drop-down list to select the server pool in which all other content is to be sent.

    c. Select **Commit**.

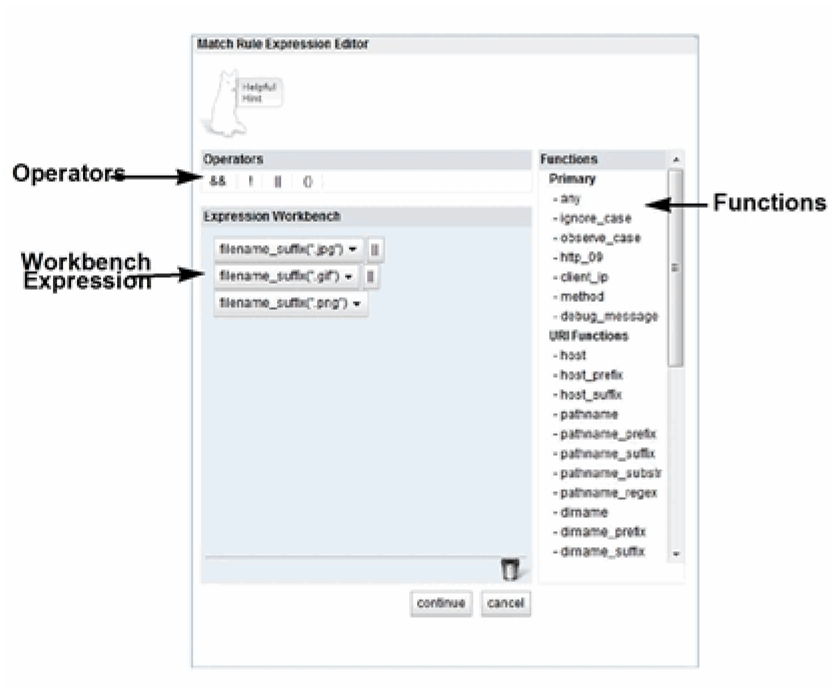
The match rule is created, added to the object tree, and its **Configuration** Screen (tab) is opened:

9. Check the **Persist** checkbox. (Remember that in our example we’re enabling **Persist** for the content servers, so that persistent sessions can be maintained by the applications that run on these servers.)

10. Select the **Commit** button to save your changes to the **Content** rule.

Using the Match Rule Expression Editor

The **Match Rule Expression Editor** shown below is a feature of the GUI that allows the user an easy method of building Match Expressions. As described in "Match Rule Expressions and Bodies" on page 321, Match Expressions are made up of match functions, most of which are protocol-specific, joined by logical operators, optionally preceded by the negation operator, with sets of beginning and end parentheses for grouping where Match Bodies required. The Expression editor allows the user to drag and drop functions and operators to build the desired expressions.



```
filename_suffix(".jpg")
||
filename_suffix(".gif")
||
filename_suffix(".png")
```

The **Match Rule Expression Editor** is separated into 3 panes.

- The **Operators** pane displays the available operators:

  “**$$**” is used for the logical AND operator.

  “**!**” is used for the logical NOT operator.

  “**II**” is used for the logical OR operator.

  “**()**” is used to group functions and operators

- The **Functions** (refer to "Match Rule Functions" on page 324) are displayed on the right pane displays a list of all of the available functions.

Note - On releases prior to version 10.0 of the GUI the functions all begin using the prefix “fu_*”. Although the “fu_” prefix is not used in version 10.0 and not shown in the **Functions** list on the **Expression Editor** the functions are the same and will operate correctly when used.

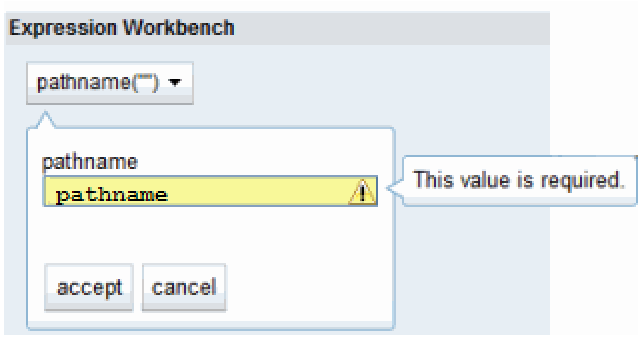
- The **Expression Workbench** is the work area used to build the expressions.

Operating within the Expression Editor

You can drag **Functions** and **Operators** into the **Expressions Workbench**. If you drag a new element onto the top of an existing element, the new element will be place before the existing element. If you drag the new element onto the bottom of en existing element, the new element will be placed after the existing element.

Elements can also be dragged moved within the **Expressions Workbench** or to the trash .

in many cases, **Functions** require a value such as shown below where the input of a path is required. Click on the **Function** to display the input field to enter the required details. Click on the **Accept** button to add the details to the **Function** or **Cancel** to discard the details.



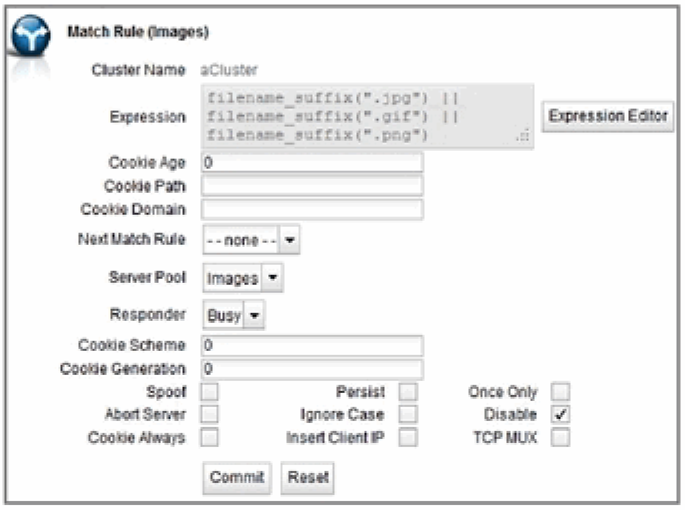
Clicking on the **continue** or **cancel** button will close the **Expression Editor**.

Clicking on the **Reset** button will remove all of your configured parameters and return to the default screen.

Clicking on the **Commit** button will assign all of your match rule configurations to the cluster.

The figure below shows an example of a completed Match Rule configuration. In this example a match rule is configured so that the incoming URL will be analyzed for the file extensions *.jpg*, *.gif* and *.png*. It this suffix is found, the incoming graphical files will be directed by Equalizer to a **Server Pool** called **Images**.

Note - If a new **Server Pool** is required in the match rule for redirection by Equalizer it must be configured prior to creating the match rule. Refer to "Managing Server Pools" on page 230 to configure a new **Server Pool** if a new one is required.



Match Rule (Images)

Cluster Name	aCluster
Expression	filename_suffix(".jpg") || filename_suffix(".gif") || filename_suffix(".png")
Cookie Age	0
Cookie Path	
Cookie Domain	
Next Match Rule	-- none --
Server Pool	Images
Responder	Busy
Cookie Scheme	0
Cookie Generation	0

Spoof	☐	Persist	☐	Once Only	☐
Abort Server	☐	Ignore Case	☐	Disable	✓
Cookie Always	☐	Insert Client IP	☐	TCP MUX	☐

Chapter 17

Automatic Cluster Responders

Note - Responders are not supported on E250GX model Equalizers

Sections within this chapter include:

Overview

A Responder is a server-like object that can be associated with a Match Rule. It provides you with the ability to cleanly load balance traffic where server pools associated with a cluster are not available to satisfy a client's request. The feature extends Cluster Match Rules to allow them to specify a target Responder which is used to provide a response to the client when the server pool in the match rule is not available. If an incoming request matches a Match Rule expression and the server pool specified in the Match Rule is down, a Responder definition in the Match Rule (if present) tells Equalizer to send one of two automatic responses to the client:

- **A customized HTML "sorry page"** that can, for example, ask the client to retry later or go to another URL.

- **A standard HTTP Redirect response** that specifies a return code and redirect URL. When the client receives this page, it is automatically redirected to the redirect URL. Redirect pages can be configured to use parts of the request URL in the HTTP Redirect response (using a regular expression).

Note - Responder definitions are not automatically transferred between Failover pairs or amongst Envoy sites. This means that Responders need to be created and maintained separately on each Equalizer in a Failover or Envoy configuration.

Managing Responders

To display a list of all currently defined Responders, click **Responders** on the navigation pane on the left. Select any of the **Responders** on the tree to display their configuration on the right pane.

- To add a Responder, you can either right click on the **Equalizer** icon at the top of the navigation pane on the left and select **Add Responder** or right click on **Responder** at the bottom of the navigation pane and select **Add Responder**.

- To edit a Responder's configuration, you can either click no the specific **Responder** name on the navigation pane on the left to display the configuration on the right.

- To delete a Responder, right click on the **Responder** name on the navigation pane on the left and select **Delete Responder** A Responder cannot be deleted if it is currently used in a match rule definition.

Adding a Responder

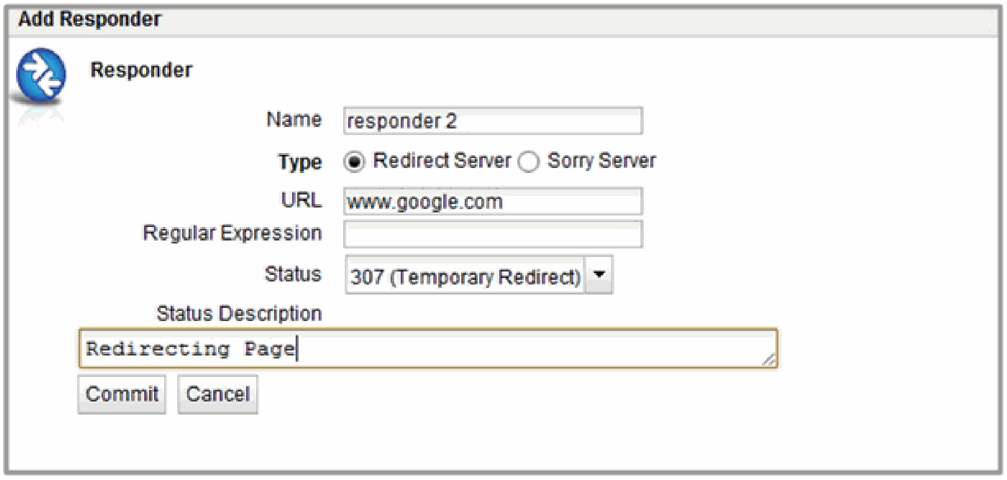
Responders are a "global" resource: once created, they can be individually assigned to one or more match rules in one or more clusters. Up to 8192 Responders can be created.

1. To create a Responder, you can either:

    - Right click on the **Equalizer** icon at the top of the navigation pane on the left and select **Add Responder**

    - Right click on **Responder** at the bottom of the navigation pane and select **Add Responder**.

The **Add New Responder** dialog appears. By default, the form for creating a **Redirect Responder** is displayed:



Name: responder 2
Type: [✓ Redirect Server] Sorry Server
URL: www.google.com
Regular Expression:
Status: 307 (Temporary Redirect)
Status Description: Redirecting Page

2. Type a **Name** for the Responder or leave the default name provided.

3. Do one of the following:

   - Create a custom HTML page by selecting **Sorry Server**. The dialog changes to a text entry box, into which you can type the HTML that Equalizer will return to clients. The text size limit is 4096 bytes.

   - Create a standard **Redirect** page by supplying the following information in the popup screen:

Status	The HTTP status code to return to the client. The default return code is **307 (Temporary Redirect).** Use the drop-down box to choose a different return code: **301 (Moved Permanently)** **302 (Found)** **303 (See Other)**

URL	The HTTP Redirect URL: the full URL of the page to which the client will be redirected, as in the following example:
	`http://www.coyotepoint.com/redirect/redirect.html`
	If a **Regular Expression** is used to split the client URL into string variables, any variables appearing in the URL are replaced with strings from the request URL. The following is an example of a Redirect URL with named variables:
	`http://$1.$2.net$3$4`
	See the see "Using Regular Expressions in Redirect Responders" on page 350.

Regular Expression	An optional POSIX-style regular expression that splits the incoming request URL into variables that can be used for string replacement in the HTTP Redirect **URL** (see above). See "Using Regular Expressions in Redirect Responders" on page 350.

When you are done, click on **Commit**.

4. In the screen that follows, you can optionally test your responder. Do one of the following:
   - For a **Sorry Server** responder, click the **test** button to see a preview of the page. Click the **close** button to close the preview.
   - For a **Redirect** responder, enter a **Test** URL (or use the default) and click the **test** button to see how the regular expression breaks the test URL into variables for re-use in the URL you supplied in the previous step.
   - Click the Next icon (**>**) at the top of the dialog to skip testing.
5. On the next screen, do one of the following:
   - Click the Back icon (**>**) at the top of the screen to review the responder configuration.
   - For a **Sorry Server**, click **commit** to add this responder or **cancel** to close the dialog without adding the responder.
   - For a **Redirect** responder, this screen displays the responder **Redirect URL** and the **Regular Expression** (if supplied).

     If you clicked the **test** button on the previous screen, the **Match Components** and **Resulting Redirect** produced by matching the **Test** URL against the **Regular Expression** are also displayed (any variables appearing in the **Redirect URL** are replaced with strings from the **Test** URL).

     Click **commit** to add the **Redirect** responder or **cancel** to close the dialog without adding the responder.

Modifying a Responder

1. To modify the configuration of an existing Responder, you can either:

- Click on the name of the Responder (under **Responders**) in the left frame.
- Click **Responders** in the left frame and then click on the **Edit** icon in the **Action** column of the table, on the same row as the name of the Responder you want to modify.

The Responder's **Configuration** tab appears.

2. Update the Responder configuration as desired; see "Adding a Responder" on page 348 for a description of all Responder parameters.
3. Click **commit** to save your changes.

Using Regular Expressions in Redirect Responders

In some cases, it may be desirable to examine the URL of an incoming request and re-use parts of it in the URL returned to the client by a Redirect Responder. This is the purpose of the **Regex** field: specify a custom regular expression that is used to:

- parse the URL of an incoming request
- break it down into separate strings (based on the positions of literal characters in the expression)
- assign each string to a named variable

These named variables can then be used in the URL field of the Redirect Responder. When the Responder replies to a client, it performs string substitution on the URL.

Because the purpose of using regular expressions to perform string substitution in Redirect URLs is to parse request URLs into strings, constructing an appropriate regular expression requires an exact knowledge of the format of the request URLs that will typically be coming in to the cluster IP.

Equalizer supports POSIX-style extended regular expressions.

See the examples that follow below to help you understand how regular expressions are constructed and interpreted by Responders.

Example 1 - HTTPS Redirect

The simplest form of HTTPS redirect involves simply referring the user to the top level of the https:// site, regardless of the path information that may have been included in the original request URL. For example, we could direct all requests for:

```
http://www.example.com/<path>
```

to:

```
https://www.example.com
```

But, this forces the client to re-specify the <path> after the redirect. It would be better to redirect to a URL that includes the path information:

```
https://www.example.com/<path>
```

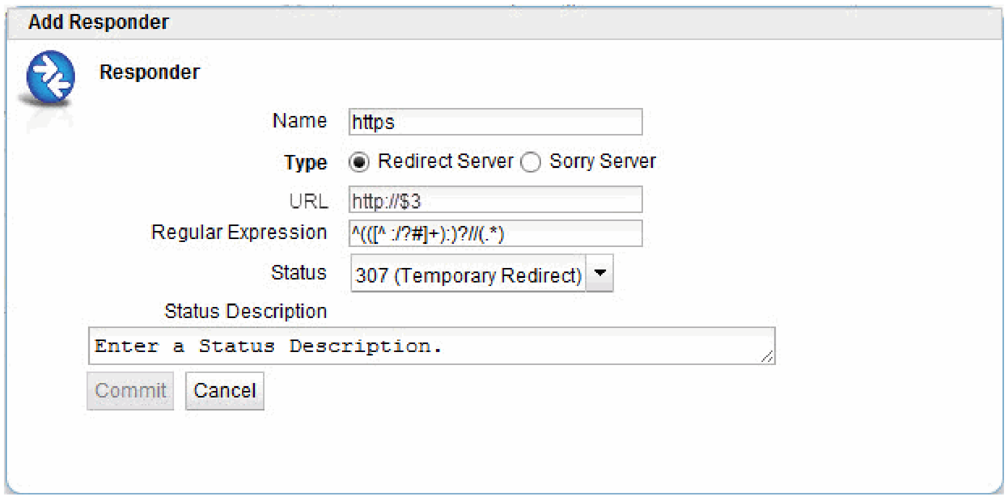
The following regular expression:

```
^(([^ :/?#]+):)?//(.*)
```

breaks a request URL into the following named variables:

```
$0 http://www.example.com/<path>
$1 http
$2 http:
$3 www.example.com/<path>
```

We can then use these variables in the URL field as shown in the following Responder **Configuration** screen (tab):



Name: https

Type: [✓ Redirect Server] Sorry Server

URL: http://$3

Regular Expression: ^(([^ :/?#]+):)?//(.*)

Status: 307 (Temporary Redirect)

Status Description: Enter a Status Description.

This Responder can be used in any cluster where a Redirect to an HTTPS cluster is desired.

Example 2 - Multi-Hostname Redirect

Let’s assume that we have a set of ".com" host names, all of which resolve to the same cluster IP, and we need a Responder that redirects requests to the same hostname prefixes with a ".net" suffix. We also want to include the rest of the URL exactly as specified by the client. For example, we want requests to URLs in these formats:

```
http://www.example.com/<path>
http://www.example2.com/<path>
http://www.example3.com/<path>
```

to be redirected to the following URLs:

```
http://www.example.net/<path>
http://www.example2.net/<path>
http://www.example3.net/<path>
```

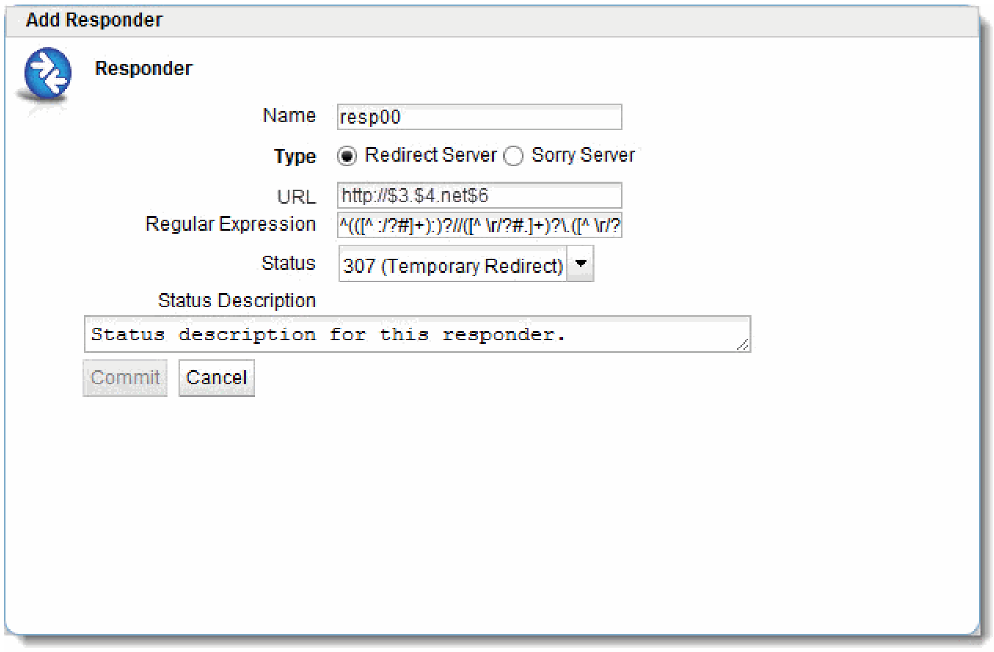
The following regular expression:

```
^(([^ :/?#]+):)?//([^ \r/?#.]+)?\.([^ \r/?#.]+)?\.([^ \r/?#]+)?(/[^ \r]+)?
```

breaks the request URL into the following named variables:

```
$0 http://www.example.com/<path>
$1 http:
$2 http
$3 www
$4 example
$5 com
$6 /<path>
```

We can then use these variables in the URL field as shown in the following Responder **Configuration** screen (tab):



Name	resp00
Type	[✓ Redirect Server] Sorry Server
URL	http://$3.$4.net$6
Regular Expression	^(([^ :/?#]+):)?//([^ \r/?#.]+)?\.([^ \r/?
Status	307 (Temporary Redirect)
Status Description	Status description for this responder.

It should be noted that this example will not work for requests with destination URLs specified with an IP address for a hostname (e.g.,"12.34.56.78" instead of "www.example.com"). Providing support for IP addresses in URLs as well as DNS host names would involve either: a more complex regular expression that matches both; or, an additional Responder with a regular expression that matches IP addresses, as well as two match rules to match the two types of host names (so that the appropriate Responder replies to the client).

Example 3 - Directory Redirect

The next example involves redirecting requests that include a particular directory to a different domain, omitting the directory from the redirect URL's path. Let's say we want all requests for:

```
http://www.example.com/images/<path>
```

to be redirected to:

```
http://images.example.com/<path>
```

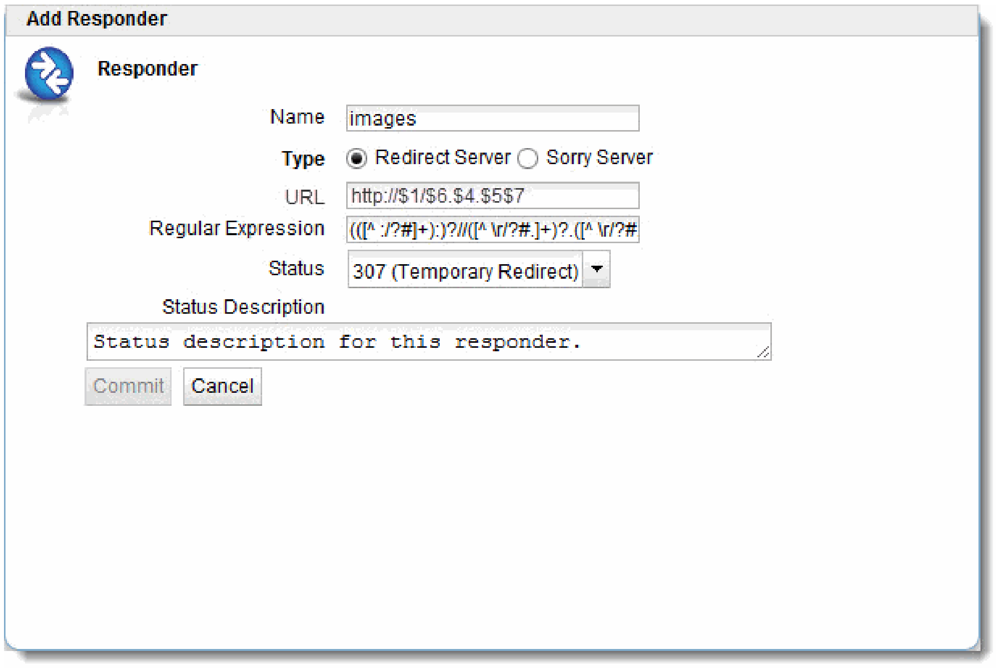
The following regular expression:

```
(([^ :/?#]+):)?//([^ \r/?#.]+)?.([^ \r/?#.]+)?.([^ \r/?#]+)?(/[^ \r]+)?(/[^ \r]+)
```

breaks the request URL into the following named variables:

```
$0 http://www.example.com/images/<path>
$1 http
$2 http:
$3 www
$4 example
$5 com
$6 /images
$7 /<path>
```

We can then use these variables in the URL field as shown in the following Responder **Configuration** screen (tab):


Add Responder

Responder

Name	images
Type	[✓ Redirect Server] Sorry Server
URL	http://$1/$6.$4.$5$7
Regular Expression	(([^ :/?#]+):)?//([^ \r/?#.]+)?.([^ \r/?#
Status	307 (Temporary Redirect)
Status Description	Status description for this responder.

This Responder can be used in a Match Rule in any cluster where a similar directory name based redirect is required.

Using Responders in Match Rules

Once a responder is created, it can be associated with a cluster using a match rule (See "Using Match Rules" on page 318). When adding a responder to a match Rule, the way the match rule is configured has a direct effect on the conditions under which the responder is used:

- **expression:** The default match rule **expression** [any()] matches all incoming requests. If you want the responder to be used only for specific requests, then create an appropriate match rule expression to match those requests; See "Using Match Rules" on page 318.

- **server selection:** By default, no servers are selected in a match rule. This means that any incoming request URL that matches the match rule expression will be handled by the responder specified in the match rule. If you want the responder to be used only if no servers (or particular servers) are available, select all (or some) of the **servers** listed in the match rule **Configuration** screen (tab).

Once a responder is created, it can then be selected in a match rule's **response** list. The following sections show some common match rule and Responder configurations.

Creating a Match Rule for a "Sorry Page"

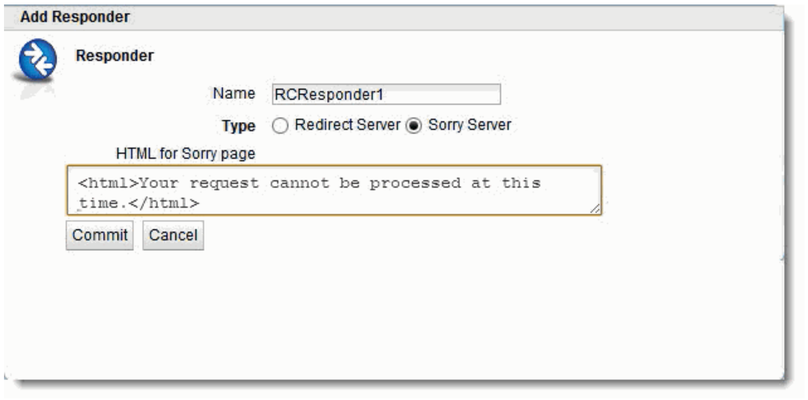
The most common use of a responder is to change the default match rule behavior when no server pools are available in a cluster. By default, every HTTP and HTTPS cluster is created with a **Default** match rule that does not specify a Responder -- thus, if all the server pools in the **Default** match rule are down, Equalizer drops the client connection to the cluster.

In order to change the default behavior and supply a "sorry page" or redirect for a cluster, you need to add a new match rule that:

- matches any incoming request
- selects the server pool specified
- has a **Sorry Server** Responder selected

For example, let's say you have two Responders defined and there is an existing cluster that you would like to redirect to http://www.example.com when no server pools in the cluster are available. To accomplish this, we need to create a new Responder and then add a match rule to the cluster:

1. Right-click on **Responders** in the left frame and select **Add New Responder** from the popup menu.
2. Type `Sorry_Example` into the **Name** field and select **Sorry Server**.
3. Type the HTML content for the page to display into the text box that appears, as shown in the following example.:



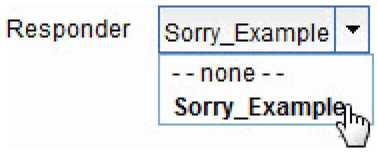
Name: RCResponder1
Type: ( ) Redirect Server [✓ Sorry Server]
HTML for Sorry page:

```
<html>Your request cannot be processed at this time.</html>
```

4. Click **Commit** to save the new Responder.
5. Right-click on the name of the cluster for which you want to display the sorry page in the left frame and select **Add Match Rule**.
6. Refer to "Creating a New Match Rule" on page 333 to configure the match rule. Leave the match rule **expression** set to the default [any()] -- the rule will match all incoming requests.

Note - The Responder will only be used if none of the server instances in the server pool is available.

7. Select **Sorry_Example** in the **response** drop-down list on the **Configuration** tab as shown below.



8. Click **Commit** to save the match rule.

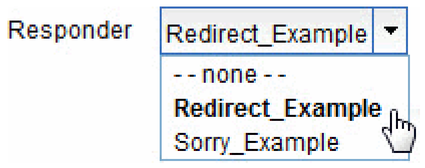
Creating a Match Rule to Redirect All Traffic for a Specific URL

Another common cluster configuration requirement is to be able to automatically redirect all traffic that uses a specific URL. To do this, you need to add a new match rule that:

- matches any incoming request
- has a **Redirect** Responder selected

For example, let's say that we want all traffic to a cluster that uses the URL `http://cluster/special/` to be redirected to `https://www.example.com/special/`. The following procedure shows you how to add the appropriate Responder and Match Rule:

1. Right-click on **Responders** in the left frame and select **Add New Responder** from the popup menu.
2. Type `Redirect_Example` into the **Name** field and select **Redirect**.
3. Type `https://www.example.com/special/` into the **URL** field.
4. Click **Commit** to save the new Responder.
5. Right-click on the name of the cluster for which you want to display the sorry page in the left frame and select **Add Match Rule** from the menu.
6. Refer to "Creating a New Match Rule" on page 333 to configure the match rule. Leave the match rule **expression** set to the default [any()] -- the rule will match all incoming requests. Do *not* select any server pools from the **Server Pool** drop down list. This means that if this match rule's expression selects a request, the Responder we select will respond to the selected request regardless of the status of the server pools in the cluster.
7. Click **Commit** to create the match rule.
8. Select **Redirect_Example** in the **Responder** drop-down list as shown below.



9. Click **commit** to save the match rule.

After completing the above procedure, all client requests to `http://cluster/special/` will be redirected to `https://www.example.com/special/`, even when all the server instances in a server pool are available.

More Responder Examples

More examples of using Responders and Match Rules can be found on the **Coyote Point Support Portal**, in the **Device Manuals** section.

http://support.coyotepoint.com

Responders and Hot Spares

Responders provide functionality that automates the very basic functions of a hot spare server, and off loads them onto Equalizer. If more functionality is desired, than a separate real server should be used as a hot spare for the cluster.

It should also be noted that resources Equalizer uses to service client requests via the Responder feature are resources potentially taken away from processing other client requests. In most cases, Responders might possibly have an effect on performance if all the servers in one or more clusters are down during periods of peak usage.

Chapter 18

Configuring Server Connections

Sections within this chapter include:

HTTP Multiplexing

HTTP multiplexing is the re-use of established server connections for multiple clients connections. The best way to understand this feature is to compare non-multiplexing behavior to multiplexing behavior. When HTTP multiplexing is disabled (the default on Equalizer), each client connection requires a new connection between Equalizer and a server.

What this means is that the servers behind Equalizer have to allocate a significant amount of resources to establishing and tearing down TCP connections -- resources that could otherwise be used by the applications running on the servers.

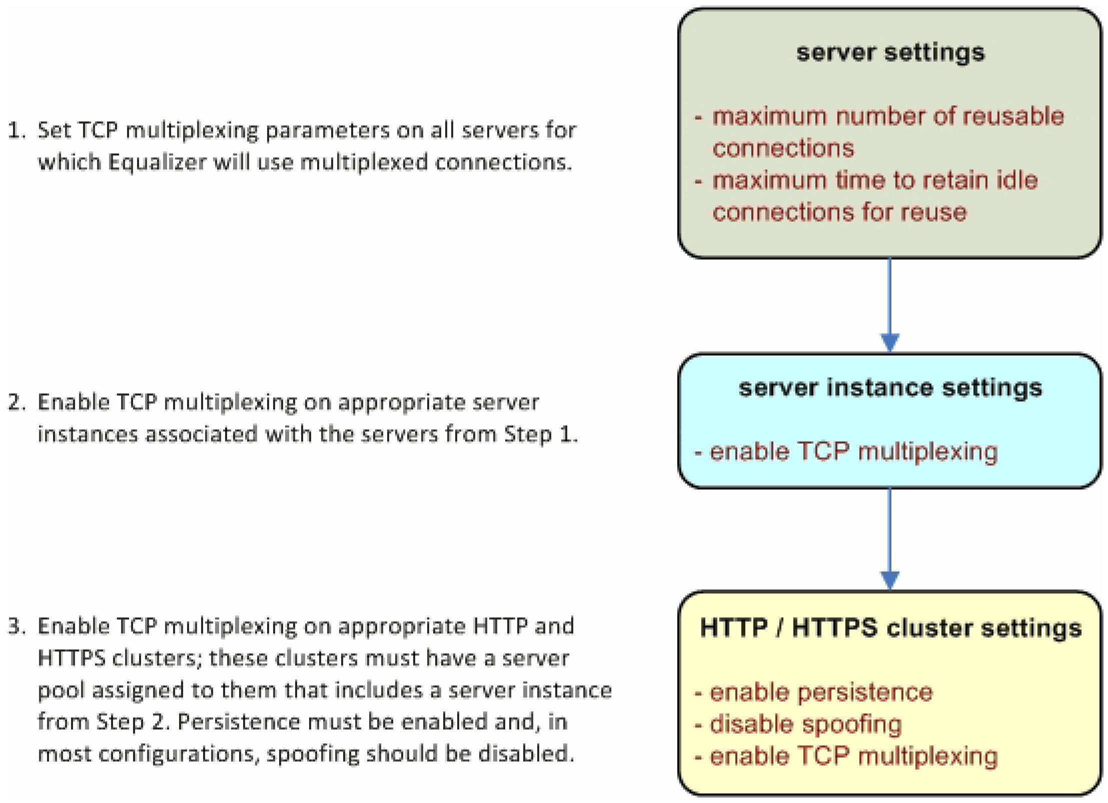
When HTTP multiplexing is enabled, an established server connection is left open for a period of time to see if any new client connections are load balanced to the same server. If so, this connection is used to forward the new client request to the server.

This allows Equalizer to service multiple client requests without all the overhead associated with establishing a new server connection for every request - and results in better performance on the client and server as well:

- the client does not have to wait for Equalizer to establish a server connection before sending the request to a server
- the server does not have to incur the overhead of establishing a new connection with Equalizer

Enabling HTTP Multiplexing

On Equalizer, TCP multiplexing can be enabled for HTTP and HTTPS clusters only and is disabled by default. The figure below describes the general process to follow when enabling TCP multiplexing for the first time.


1. Set TCP multiplexing parameters on all servers for which Equalizer will use multiplexed connections.
2. Enable TCP multiplexing on appropriate server instances associated with the servers from Step 1.
3. Enable TCP multiplexing on appropriate HTTP and HTTPS clusters; these clusters must have a server pool assigned to them that includes a server instance from Step 2. Persistence must be enabled and, in most configurations, spoofing should be disabled.
server settings
- maximum number of reusable connections
- maximum time to retain idle connections for reuse
server instance settings
- enable TCP multiplexing
HTTP / HTTPS cluster settings
- enable persistence
- disable spoofing
- enable TCP multiplexing

After TCP multiplexing is enabled as above, it can be selectively disabled on clusters and server instances without modifying the TCP multiplexing parameters set on the server.

Refer to "Modifying a Layer 7 HTTP or HTTPS Cluster" on page 282 or "Cluster and Match Rule Commands" on page 146 (on the CLI) for details.

Disabling "spoof" for HTTP Multiplexing

In the most common configurations, where many clients with unique IP addresses connect to the cluster, it makes sense to disable the **spoof** option when enabling TCP multiplexing, so that server connections can be re-used for any client request.

This is because the **spoof** option causes Equalizer to use the client IP address as the source address in all packets sent to servers (disabling Source Network Address Translation or SNAT). While this itself is not a problem, it means that server connections can only be re-used by client connections from the *same* client IP. This effectively disables much of the benefit of using TCP multiplexing. If the application running on the servers behind an Equalizer cluster requires the real client IP address in incoming requests (that is, **spoof** enabled), then in most configurations we recommend disabling TCP multiplexing.

In some cases, when it is known that most or all client connections will come from a relatively short list of IP addresses, **spoof** can be enabled with TCP multiplexing to improve performance. Examples include configurations where public client connections come from an HTTP or HTTPS proxy that uses a restricted set of IP address, or an internal corporate network that uses NAT.

Refer to "Modifying a Layer 7 HTTP or HTTPS Cluster" on page 282 or "Cluster and Match Rule Commands" on page 146 (on the CLI) for details.

Server Options for HTTP Multiplexing

Once a server sends a complete response to a client request, instead of closing the server connection, Equalizer keeps the connection open and places a record for the connection into a pool of connections available for re-use. The connection will be re-used by Equalizer when another client request is load balanced to the same server.

The reusable connection pool record for a server connection is only removed when either the server closes the connection, or the **Reused Connection Timeout** expires (see below).

The following server parameters for HTTP multiplexing control the size of the connection re-use pool.

- **Maximum Reused Connections (**An integer specifying the maximum number of reusable connection entries for this server allowed in the reusable server pool. The default is **0**, which means that there is no limit on the number of reusable connection pool entries.

  If you have HTTP multiplexing enabled and CPU or memory usage on Equalizer is significant, you can use this parameter to limit the size of the reusable connection pool -- which in turn limits the amount of memory and CPU resources used to manage HTTP multiplexing.

  You may also want to limit the number of reused connections to a server if the server is experiencing resource issues related to maintaining open connections with Equalizer.

- **Reused Connection Timeout (**The number of seconds after which a connection record for an idle connection in the reusable connection pool is removed, and the connection closed. The default value is **0** seconds, which means that records in the reusable connections pool never expire.

Outbound NAT

Outbound Network Address Translation, or *outbound NAT*, is designed to allow you the flexibility to configure the source IP address used in packets that Equalizer forwards for connections originating on servers.

For example, it might be required to allow connections from a server behind Equalizer to the Internet. If the server is routing these packets through Equalizer, we can select the IP address to use as the source IP address in the packets we forward for the server to the Internet.

We might want to use any of the following as the source IP:

- an Equalizer subnet IP address
- an Equalizer failover IP address
- a cluster IP address

Currently, there is a restriction that outbound NAT will work *only if the address you specify for outbound NAT is on a subnet that does not have any servers on it*. This will be fixed in an upcoming patch release.

Outbound NAT can be configured through the CLI or the GUI.

In releases of EQ/OS previous to Version 10, an outbound NAT address was specified on a per-server basis. In EQ/OS 10, outbound NAT addresses are configured on subnets -- the specified outbound NAT address is used for any server connection originating on that subnet.

Configuring Outbound NAT (CLI)

From the global context, enter the following command to specify an outbound NAT IP address for a subnet:

```
eqcli > vlan name subnet name outbound_nat IP_address
```

Configuring Outbound NAT (GUI)

1. Display the configuration tabs for the subnet on which you want to add an outbound NAT address, by following this click path in the left frame object tree:

   VLANs > *VLAN name* > *(expand subnets)* > *Subnet name*

2. In the right frame configuration tab, enter an existing IP address (one that is already defined on Equalizer, such as the subnet IP address) in the **Outbound NAT Address** text box.

3. Click **Commit**.

Direct Server Return (DSR)

In a typical load balancing scenario, server responses to client requests are routed through Equalizer on their way back to the client. Equalizer examines the headers of each response and may insert a cookie, before sending the server response on to the client.

In a Direct Server Return (DSR) configuration, the server receiving a client request responds directly to the client IP, bypassing Equalizer. Because Equalizer only processes incoming requests, cluster performance is dramatically improved when using DSR in high bandwidth applications, especially those that deliver a significant amount of streaming content. In such applications, it is not necessary for Equalizer to receive and examine the server’s responses: the client makes a request and the server simply streams a large amount of data to the client.

DSR is supported on Layer 4 TCP and UDP clusters only, and is not supported for FTP clusters (Layer 4 TCP clusters with a start port of 21).

DSR configurations are often configured on a single VLAN or subnet, where the cluster IP and the server IPs are all on the internal interface. Refer to "Configuring Direct Server Return" on page 313 for details.

DSR can also be used in multiple VLAN configurations, although this is less common. Cluster IP addresses are on one VLAN/subnet, while server IP addresses are on another VLAN/subnet.

In any DSR configuration, note that the incoming client traffic is assumed to originate on the other side of the gateway device for the subnets on which Equalizer and the servers reside. The servers will usually have their default gateway set to something other than Equalizer so that they can respond directly to client requests.

In DSR configurations where a client device resides on the same side of the gateway as the DSR servers, there is the possibility that the servers will receive the ARP (Address Resolution Protocol) request for the virtual cluster IP address. Since the cluster IP address is configured on the loopback interface of each server (See "Configuring Direct Server Return" on page 313), one or more may respond to the ARP request. The client, and possibly even the gateway, will then route requests for the cluster IP to servers directly without going through Equalizer. If this occurs, you need to reconfigure the servers so that they do not respond to ARP requests for the cluster IP addresses configured on the loopback interface. The procedure to follow to do this is specific to the operating system running on the servers, so please consult the documentation for your server operating system.

Configuring a Cluster for Direct Server Return

The cluster **dsr** and **spoof** flags must be enabled for direct server return connections. In addition, the cluster **idle timeout** parameter should be set as described in the table below:

- **dsr -** Enables Direct Server Return. All requests to this cluster IP will be forwarded to the server with the client IP as the source IP, and the cluster IP as the destination IP. The loopback interface of the server must be configured with the cluster IP to receive the requests.
- **spoof** - spoof causes Equalizer to spoof the client IP address when Equalizer routes a request to a server in a virtual cluster; that is, the IP address of the client is sent to the server, not the IP address of the Equalizer. This flag must be enabled for DSR.
- **idle timeout -** The time in seconds before reclaiming idle Layer 4 connection records. Applies to Layer 4 TCP clusters only. For DSR, **idle timeout** must be set to a non-zero value, or Equalizer will never reclaim connection records for connections terminated by the server. The cluster's **idle timeout** should be set to the longest period within your application that you would like Equalizer to wait for consecutive messages from the client (since the Equalizer does not see server packets on DSR connections). For example, if the longest expected server response time and the longest expected delay between client responses on active connections are both 60 seconds, then set the **idle timeout** to 120 seconds.

The general procedure for configuring DSR on a new or existing cluster is as follows:

1. Enable the **dsr** and **spoof** flags on the cluster.
2. If the cluster is a Layer 4 TCP cluster and the **idle timeout** parameter is set to **0**, increase it as described in the table above.
3. Perform the procedure on each server in the server pool associated with the cluster.

Configuring Servers for Direct Server Return

1. Server configuration for DSR involves these basic steps:
2. Add a *loopback* network interface on the server.
3. Configure the loopback interface with the IP address and port of the DSR cluster.
4. Edit the configuration of the application on the server to listen for connections on the cluster IP and port. (An HTTP server, for example, returns a Bad Hostname error to the client if there is an IP mismatch.)
5. Check the routing on your network to ensure that traffic is being routed as expected. For example, Equalizer is usually *not* going to be used as the default gateway on your servers, since we want the servers to

respond to clients directly. In most DSR configurations, the default gateway used on servers is the gateway most appropriate for reaching the client network. If routes are also needed through Equalizer, they should be configured through static routes on the servers.

See the Related Topics below for examples of configuring the loopback adapter and an HTTP server on Windows and Linux platforms for DSR.

Configuring Windows Server 2003 and IIS for DSR

The basic procedure below also applies to Windows XP and other versions of Windows.

1. Open **Start > Control Panel** and double-click **Network Connections**.
2. Select **View > Tiles**. If a **Microsoft Loopback Adapter** is already listed, proceed to the next step. Otherwise, to install the loopback interface as follows:
   a. Open **Start > Control Panel > Add Hardware**, and then click **Next**.
   b. Click **Yes, I have already connected the hardware**, and then click Next.
   c. At the bottom of the list, click **Add a new hardware device,** and then click **Next**.
   d. Click **Install the hardware that I manually select from a list,** and then click **Next**.
   e. Click **Network adapters**, and then click **Next**.
   f. In the **Manufacturer** box, click **Microsoft**.
   g. In the **Network Adapter** box, click **Microsoft Loopback Adapter**, and then click **Next**.
   h. Click **Finish**.
3. To configure the loopback interface for DSR:
   a. In **Network Connections**, right click on the **Microsoft Loopback Adapter** and select **Properties**.
   b. In the **General** tab, double-click on **Internet Protocol (TCP/IP)** in the scroll box.
   c. Select **Use the following IP address,** and enter the **IP address** and **Subnet mask** for the Layer 4 cluster, as configured on Equalizer. Click **OK**.
   d. Click **OK** to return to **Network Connections**.
4. To configure the IIS HTTP server for DSR:

Open **Start > Administrative Tools > Internet Information Service (IIS) Manager**.

   a. In the left frame, expand the **local computer** and then **Web Sites** to display a list of the web sites running on the server.
   b. Right-click on the web site you want to configure for DSR and select **Properties**.

c. On the **Web Site** tab, next to **IP address,** select the **Advanced** button.

d. Select the **Add...** button under the top list box.

e. Enter the **IP address** and the **TCP port** for the Layer 4 cluster, as configured on Equalizer. Click **OK**.

f. Click **OK** twice to return to the **Internet Information Service (IIS) Manager**.

You should now be able to send client requests to the cluster IP and port, and get responses directly from the IIS HTTP server running on Windows 2003. Remember that static routes on your servers may be necessary, depending on your network configuration.

Adjusting ARP Behavior on Linux Servers

Some operating systems, such as Linux, will reply to ARP requests for the cluster IP address configured on the loopback interface. On such systems, the ARP behavior needs to be adjusted so the system only replies to ARP requests for IP addresses on non-loopback interfaces. The method used to do this varies between operating systems. For example, to do this on a Linux box, you would adjust specific kernel parameter values as shown below, by editing the file `/etc/sysctl`:

```
net.ipv4.conf.all.arp_ignore = 1
net.ipv4.conf.all.arp_announce = 2
net.ipv4.conf.default.arp_ignore = 1
net.ipv4.conf.default.arp_announce = 2
net.ipv4.conf.eth0.arp_ignore = 1
net.ipv4.conf.eth0.arp_announce = 2
```

Configuring a Linux System running Apache for DSR

This is an example of how to configure a typical Linux system running Apache 2.0 for DSR:

1. Log into the Linux server as *root*, and enter the following command to configure a loopback interface:

```
# ifconfig lo:dsr inet cluster-ip netmask 255.255.255.255
```

Substitute the IP address of the DSR-enabled cluster on Equalizer for `cluster-ip` in the command above. Note that in most Linux distributions, you are configuring an alias for the loopback interface and should specify a netmask of 255.255.255.255 *instead of* the netmask used to configure the cluster on Equalizer.

2. Enter the following command to verify that the loopback alias was created:

```
# ifconfig lo:dsr
```

The output should look like this:

```
lo:dsr Link encap:Local Loopback
inet addr:cluster-ip Mask:255.255.255.255
UP LOOPBACK RUNNING MTU:16436 Metric:1
```

3. To configure an Apache 2.0 server for DSR, edit the server configuration file to add a Listen directive for the cluster IP (on many systems, the configuration file is found at **/usr/local/etc/apache/httpd.conf**). Look for the first line beginning with the Listen directive, and add another line that looks like this:

```
Listen cluster-ip
```

   Where cluster-ip is the DSR-enabled cluster IP. Save your changes to the file.

4. Reboot the Apache server:

```
# apachectl restart
```

You should now be able to send client requests to the cluster IP and port, and get responses directly from the Apache server running on Linux. Remember that static routes on your servers may be necessary, depending on your network configuration.

Configuring a Loopback Interface on Other Systems for DSR

The commands and interfaces used to configure a loopback interface vary slightly between operating systems, and sometimes between versions of the same operating system. Check the documentation for your server operating system for instructions on how to configure a loopback interface. For example, on some BSD systems, the command used in Step 1 in the previous section would be slightly different, as shown below:

```
# ifconfig lo0 cluster-ip netmask cluster-netmask alias
```

Notice that in this case, the netmask used matches the netmask used to configure the cluster on Equalizer, instead of 255.255.255.255 as in the Linux system example.

Weak and Strong Host Models and DSR

Network interfaces on non-routing systems use either the “weak host” or “strong host” models for packet transmission and reception (these models are defined in RFC1122). In the “strong host” model, a system that is not acting as a router cannot send or receive any packets on a given interface unless the destination/source IP in the packet is assigned to the interface. In the “weak host” model, this restriction does not apply.

In order for DSR to work, the “weak host” model must be enabled on the server’s loopback interface, as well as the interface on which requests are received from Equalizer.

Most Linux and Unix systems default to the “weak host” model on all network interfaces, so no additional configuration is usually necessary. For example, on FreeBSD and NetBSD, this behavior is controlled by the setting of `sysctl net.inet.ip.check_interface`, which by default is set to 0 (“weak host”).

Windows XP and Windows 2003 use the “weak host” model on all IPv4 interfaces and the “strong host” model on all IPv6 interfaces, and this is not configurable.

Windows Vista and Windows 2008 support “strong host” by default on all interfaces, but this is configurable for individual interfaces. Use the following command to list interface status:

```
netsh interface [ ipv4 | ipv6 ] show interface
```

The following three command are an example of changing the mode to “weak host” for the LAN and loopback interfaces:

```
netsh interface ipv4 set interface "Local Area Connection"
weakhostreceive=enabled
netsh interface ipv4 set interface "Loopback" weakhostreceive=enabled
netsh interface ipv4 set interface "Loopback" weakhostsend=enabled
```

The interface names used in quotes above must match the interface names that appear in the Windows **Network Connections** folder.

Chapter 19

Server Health Check Probes

Sections within this chapter include:

About Server Health Check Probes

This chapter describes:

- How Equalizer uses health check probes to ensure server availability.
- How you can configure probe parameters and options to tailor them for your specific configuration and applications.

On Equalizer, a "server" equates to an application running at an IP address and a port. Equalizer server health check probes ensure that load balancing decisions include only those applications that are currently available, and can be tailored to provide application-specific probes.

The types of probes Equalizer uses on a server depend upon the server's protocol setting (UDP or TCP), and are summarized below:

Layer	Protocol	Daemon	Port	Details
Layer 3	ICMP	l3pd	N/A	Echo request/reply
Layer 4	UDP/IP	udppd	53	DNS
			111	(RPC4) Portmap
			2049	(RPC4) NFS
Layer 4	TCP/IP	acvd	N/A	TCP (connect only)
Layer 7			N/A	ACV (Plaintext)
			N/A	ACV (SSL)
		hcd	1510 (default)	Simple Health Check
		vlbd	N/A	VLB Health Check

Layer 3 ICMP Probes

By default, Equalizer sends an Internet Control Message Protocol (ICMP) echo request (commonly called a "ping") to the IP address of every configured server object.

The delay between successive ping requests to the same server is determined internally, but can be as short as one second on a server that is not responding to ICMP requests. On a lightly loaded Equalizer it may be 5 seconds or longer.

If a server does not respond to an ICMP echo request, Equalizer continues to issue any other probes (TCP, ACV, server agent) configured for the cluster. This means, for example, that if TCP and ICMP probes are both configured (the default), then a server can fail any number of ICMP probes and will still be marked "UP" as long as it continues to respond to TCP probes.

If a server does not respond to an ICMP echo request and no other probes are configured, the server is marked "DOWN", and Equalizer continues to send ICMP requests to the server's IP address. If an ICMP echo response is subsequently received, the server is marked "UP".

Responding to ICMP echo requests is an option on most server platforms. If ICMP echo reply is disabled on one or more of the servers your configuration, then you may want to disable ICMP echo requests on Equalizer to reduce traffic between Equalizer and the servers, and rely solely on the other probing mechanisms.

Note - At least one ICMP probe of a server must have succeeded since the last Equalizer reboot, or failed ICMP probes for the server will be ignored. This is done to avoid marking down a server that is configured to ignore ICMP Echo Requests.

Enabling/Disabling Layer 3 ICMP Probes

Enable/Disable ICMP probes in the GUI

ICMP probes are enabled by default for all servers.

1. Click on a **Servers** on the left navigational pane and select a configured server.
2. In the right configuration pane, enable (or disable) the **Probe Layer 3** check box.
3. Click **Commit**.

Enable/Disable ICMP Probes in the CLI

ICMP probes are enabled by default for all servers.

1. To enable ICMP probes for a server in the CLI enter the following:

```
eqcli > server svname flags probe_l3
```

2. To disable ICMP probes for a server in the CLI:

```
eqcli > server svname flags !probe_l3
```

Configuring Layer 3 ICMP Probe Parameters

ICMP server probes are configured using the global parameters described in the table below. Each server is sent ICMP ECHO Request packets by Equalizer and is marked up or down depending upon whether the server responds or not.

The number of times a server is probed is determined by the ICMP Maximum Tries parameter. The ICMP Interval parameter is a timer. When the ICMP Interval timer starts, the first ICMP probe is sent. If the value of ICMP Maximum Tries is greater than 1, the next probe is sent a number of seconds later equal to:

```
(ICMP Interval) / (ICMP Maximum Tries)
```

For example, the default ICMP Interval is "15" and the default ICMP Maximum Tries is "3". So, by default, an ICMP probe is sent to each server every 5 seconds.

When the ICMP Interval timer expires, a server is marked "up" if a response to any probe sent during the ICMP Interval was received. A server is marked "down" by lack of a response to an ICMP probe only if no response is received and the server had been marked "up" at least once since the last Equalizer reboot. This is to prevent marking a server down when it has been configured to ignore ICMP ECHO Requests.

ICMP Probe Parameters

GUI Probe Parameter (CLI Probe Parameter)	**Description**
ICMP Probe Maximum Tries (icmp_maxtries)	The maximum number of times per **ICMP Probe Interval** that Equalizer will attempt to probe a server.
ICMP Probe Interval (icmp_interval)	A timer specifying the length of time (in seconds) during which a successful server probe must occur, or the server is marked "down". At least one ICMP probe of a server must have succeeded since the last Equalizer reboot, or failed ICMP probes for the server will be ignored and the server will be marked "UP."

Setting ICMP Probe Parameters in the GUI

1. Click on **Equalizer**in the left navigational pane. The **Global > Parameters** screen will be displayed on the right configuration pane.

2. Modify the ICMP probe parameter shown in *ICMP Probe Parameters* as necessary.

3. Click on **Commit**.

Setting ICMP Probe Parameters in the CLI

1. To set ICMP probe parameters in the CLI enter the following command in the global context.

```
eqcli > parameter_name value [...]
```

2. Enter a **`parameter_name`** and **`value`** which are described in *ICMP Probe Parameters* above.

L4 UDP Probes

L4 UDP probes are performed on UDP protocol servers only.

For specific Remote Procedure Call (RPC) services running on well-known ports - Network File System (NFS) and portmap - an RPC call is sent to the server. If no response is received the server is marked "DOWN".

For the Domain Name System (DNS), a DNS request is sent to the server. If no response is received the server is marked "DOWN”.

For all other UDP services, a UDP datagram is sent to the server probe port and if no response is received the server is marked "DOWN".

Enabling/Disabling L4 UDP Probes

UDP probes are enabled for a UDP server as soon as a server instance for the server is added to a server pool. Default settings for probe parameters are used unless specifically set on the server pool.

L4 TCP/IP Probes

L4 TCP probes (**acvd**) are performed on servers running TCP protocol only. Equalizer attempts to open a TCP connection with a server on its configured IP address and probe port. A TCP probe is successful if the connection is established.

Enabling/Disabling L4 TCP Probes

TCP probes are enabled for a TCP server as soon as a server instance for the server is added to a server pool. Default settings for probe parameters are used unless specifically set on the server pool.

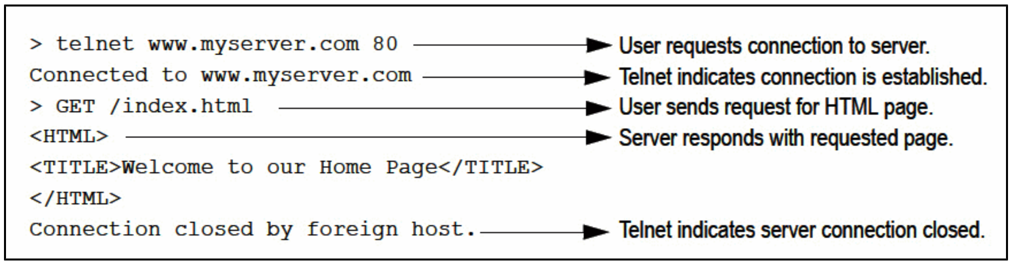
Active Content Verification (ACV) Probes

Active Content Verification serves two purposes: L4 probing and L7 probing. It is a mechanism for checking the validity of a server pool. When you enable ACV for a server pool, Equalizer requests data from each server pool in a cluster and verifies that the returned data contains a character string that indicates that the data is valid. You can use ACV with most network services that support a text-based request/response protocol, such as HTTP.

Note - You cannot use ACV with Layer 4 UDP clusters.

ACV checking requires that the server instance is configured with L4 probing (**probe_l4**) on. This is the default server instance configuration. To enable ACV, an ACV response string is configured for a server pool.The ACV probe is limited to 99 characters, and must use only the printable ASCII characters (decimal 32 to 126). Equalizer then searches for the ACV response string in the first 1024 characters of the server's response to high-level TCP probes. If the ACV response string is not found, the server is marked “DOWN”. An ACV query string can be specified if the service running on the server's probe port requires input in order to respond. If the TCP probe connection is not established ACV probing will fail as well.

ACV is best explained using a simple example. HTTP protocol enables you to establish a connection to a server, request a file, and read the result. The example below shows the connection process when a user requests a telnet connection to an HTTP server and requests an HTML page.


```
> telnet www.myserver.com 80
Connected to www.myserver.com
> GET /index.html
<HTML>
<TITLE>Welcome to our Home Page</TITLE>
</HTML>
Connection closed by foreign host.
```
User requests connection to server.
Telnet indicates connection is established.
User sends request for HTML page.
Server responds with requested page.
Telnet indicates server connection closed.

Equalizer can perform the same exchange automatically and verify the server pool's response by checking the returned data against an expected result.

Enabling/Disabling ACV Probes

Enable/Disable ACV Probes in the GUI

1. Click on a server pool name in the left navigational pane.
2. Enable ACV by typing a response string into the **ACV Response** edit box.
3. Disable ACV by clearing the contents of the **ACV Response** edit box or leaving it blank.
4. Click on **Commit**.

Enable/Disable ACV Probes in the CLI

1. To enable ACV probes for all TCP type servers in a server pool enter:

```
eqcli > srvpool spname acvr string
```

2. To disable ACV probes for all TCP type servers in a server pool enter:

```
eqcli > no srvpool spname acvr
```

Setting ACV Query and Response Strings

Specifying an *ACV Query* and an *ACV Response String* basically automates the exchange shown in "Active Content Verification (ACV) Probes" on page 373. Equalizer uses the probe string to request data from each server. To verify the server's content, Equalizer searches the returned data for the response string. For example, you can use "**`GET /index.html`**" as the *ACV Query* and you can set the *Response String* to some text, such as "Welcome" in the example in "Active Content Verification (ACV) Probes" on page 373, which appears on the home page.

Similarly, if you have a Web server with a PHP application that accesses a database, you can use ACV to ensure that all of the components in the application are working. You could set up a PHP page called **test.php** that accesses the database and returns a page containing **ALL OK** if there are no problems.

For most applications, only an ACV response string is needed - Equalizer connects to the probe port on the server instance and waits for a response.

Some applications may require input on the connection before a response is sent back to Equalizer. The ACV query string is used for this purpose - if it is non-empty, the ACV query string is sent after the server instance connection is established.

An ACV query or response string:

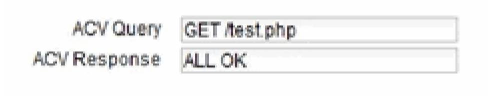
- Must be enclosed in single or double quotes if it contains a space character.
- Any single or double quotes included within the string must be preceded by the backslash character (\).

Note -In ACV Query strings character escapes such as “\n” for new-line, “\r” for carriage return and “\t” for Tab are supported. "\r" and "\n" must be manually inserted at the end of all HTTP and HTTPS ACV probes. The system does not do this manually at Layer 7.

For ACV Response strings Regular Expression matching is supported.

Setting the ACV Query and Response Strings in the GUI

Enter the following values on the **Server Pool > Configuration > LB Policy>** screen:



ACV Query: GET /test.php
ACV Response: ALL OK

If the page that is returned contains the correct response string (in the first 1024 characters, including headers) the server is marked “UP”; if **ALL OK** were not present, the server is marked “DOWN”.

The response string should be text that appears only in a valid response. This string is also case-sensitive. An example of a poorly chosen string would be **HTML**, since most web servers automatically generate error pages that contain valid HTML.

Setting the ACV Query and Response Strings in the CLI

The following commands are all examples of valid ACV string commands:

```
eqcli > srvpool srvpool_name acvr Up
eqcli > srvpool srvpool_name acvr "This is a response string with spaces."
eqcli > srvpool srvpool_name acvr "This is a response string with \"quotes\"."
```

Testing ACV Probes

You can test the ACV probe configuration in the CLI by entering the following:

```
eqcli > srvpool name test acv [server_name]
```

If the **server_name** is specified, only that server is probed. If **server_name** is omitted, all servers in the server pool are probed. Results are returned for each server by name.

Configuring UDP, TCP, and ACV Parameters

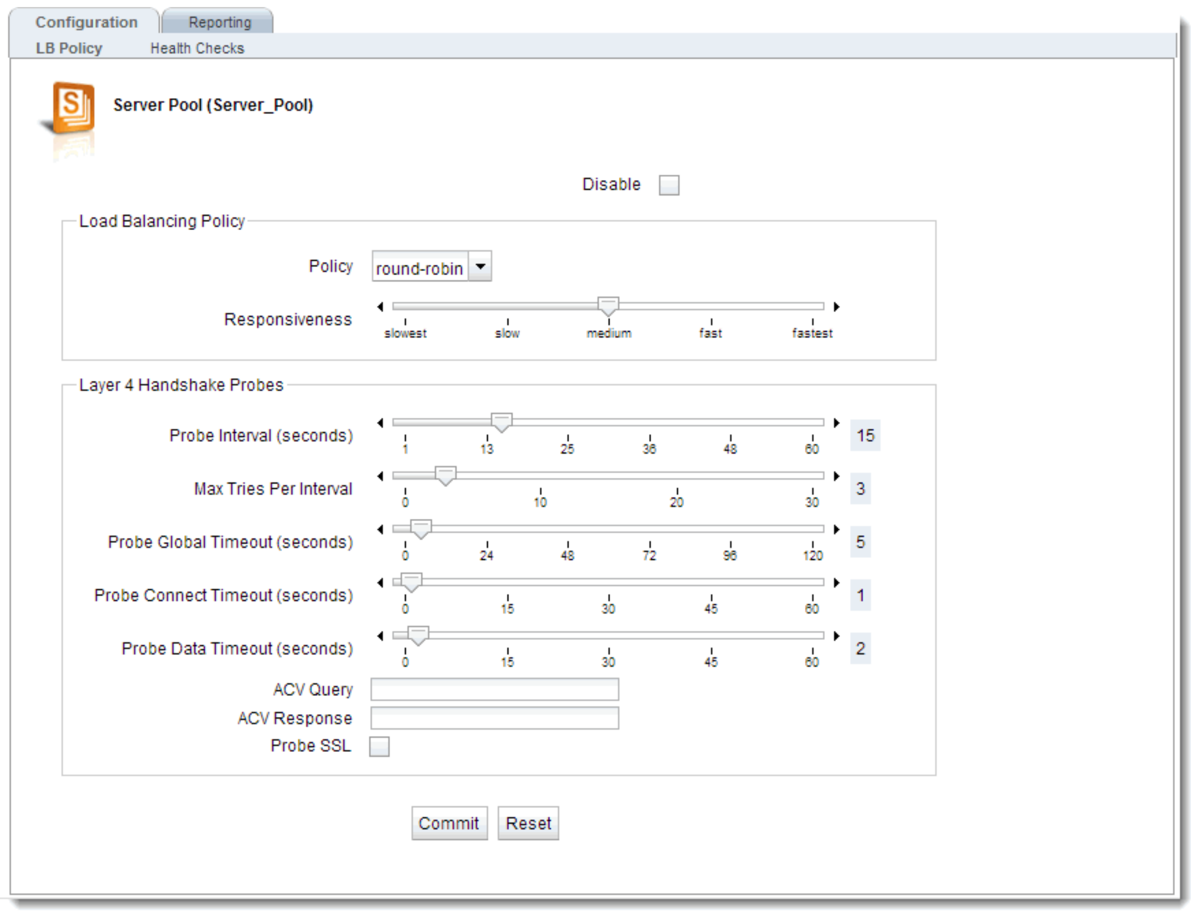
UDP, TCP, and ACV probe parameters are configured on all server pools and apply only to the server instances (and thus the servers) within a server pool:

UDP, TCP, and ACV Probe Parameters

GUI Probe Parameter (CLI Probe Parameter)	Description
Probe Interval (probe_interval)	A timer specifying the length of time (in seconds) during which a successful TCP or UDP server probe must occur, or the server is marked "down". If one or more successful probes have occurred before this timer expires, the server is marked "up" and the timer is reset. If no successful probes have occurred, the server is marked 'down" and the timer is reset. The **Probe Interval** acts as a hard limit on the **Probe Global Timeout** -- if a probe is in progress when the **Probe Interval** expires, then the probe is timed out.
Max Tries Per Interval (probe_maxties)	The maximum number of times per **Probe Interval** that Equalizer will attempt to probe a TCP or UDP server. For example, if **Max Tries Per Interval** is set to 3 (the default), Equalizer will send at most 3 probes to the server during any **Probe Interval** period.
Probe Global Timeout (probe_gto)	The maximum length of time (in seconds) to wait for a TCP or UDP probe to be sent and a connection established or a response is received. If the number of seconds specified exceeds the **Probe Interval** setting, then the **Probe Interval** is used as the **Probe Global Timeout**.
Probe Connect Timeout (probe_cto)	The maximum length of time (in seconds) to wait for a TCP server probe connection to be established.
Probe Data Timeout (probe_dto)	The maximum length of time (in seconds) to wait for the first byte of data to be transmitted over a TCP server probe connection.
ACV Query (acvq)	An optional string that is sent to the server to elicit the **ACV Response**. Some applications (notably Java) need to be queried before they return a response.
ACV Response (acvr)	A string that must match the ACV probe data received from a server in order for the server to be marked "up". POSIX style regular expressions are supported.

Setting UDP, TCP and ACV Probe Parameters in the GUI

1. Click on **Server Pools** on the left navigational pane and select a configured server pool. The **Server Pool > Configuration > LB Policy** screen will be displayed on the left configuration pane.



Server Pool (Server_Pool)

Disable	☐
Load Balancing Policy	
Policy	round-robin
Responsiveness	medium (slowest, slow, medium, fast, fastest)
Layer 4 Handshake Probes	
Probe Interval (seconds)	15
Max Tries Per Interval	3
Probe Global Timeout (seconds)	5
Probe Connect Timeout (seconds)	1
Probe Data Timeout (seconds)	2
ACV Query	
ACV Response	
Probe SSL	☐

2. Modify the appropriate probe parameter values, as described in *UDP, TCP, and ACV Probe Parameters* above.

3. Click on **Commit** to save the configuration or **Reset** to return all values to the default settings.

Setting TCP, UDP and ACV Probe Parameters in the CLI

1. To set TCP, UDP, and ACV probe parameters in the CLI, enter the following command in the global context.

```
eqcli > srvpool srvpool_name parameter_name  value [...]
```

2. Configure using the ***parameter_name*** and ***value*** described in *UDP, TCP, and ACV Probe Parameters* above.

Simple Health Check Probes

Simple health checks allow you to configure Equalizer to probe a specified target and retrieve a "load" value from the target which describes its current level of load.

A user-supplied "server agent" must be running at the target, which supplies a load value in response to a simple health check query from the Equalizer with a load value. This information is obtained by the server agent by any means available at the target server. The only requirement from Equalizer's perspective is that the server agent's response must be in the form of a single integer or floating point value. The server agent may either return the load value immediately upon accepting a connection on the configured port, or it may require a stimulus string before returning the value. After returning the value, the server agent closes the connection and waits for another connection.

Configuring Simple Health Check Probe Parameters

Simple Health check probe parameters are configured on server pools and then must be applied to the server instances (and thus the servers) within a server pool.

The following is a table of Simple Health Check Parameters.

Simple Health Check Parameters

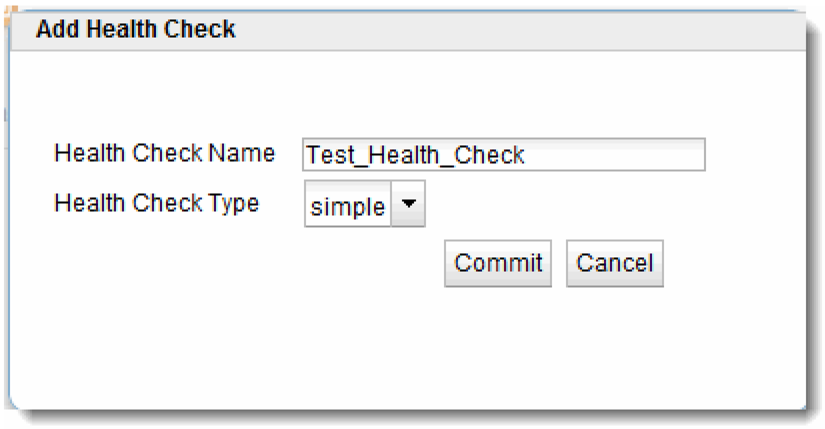
GUI Parameter (CLI Parameter)	Description
Health Check Relative Weight (weight)	Set the relative weight (default: **100**) of the health check load value returned by the application compared to other health check values returned by other health checks. The weight must be between 1 and 100.
Lightest Load Value (healthy)	A floating point value that is the 'healthiest' (or least busy) load value that can be returned by the health check server application. For example: if the application returns a value of -1 to indicate that it is very lightly loaded, then set **healthy** to -1. The default **healthy** value is **0.000000**.
Heaviest Load Value (loaded)	A floating point value that is the busiest (or most highly loaded) load value that can be returned by the health check server application for the health check. For example: if the application returns a value of 10 to indicate that it is very lightly loaded, then set **healthy** to 10. The default **loaded** value is **100.000000**.
Health Check Port (probe_port)	The port number for probing the health check server application. The default port is **1510**.
Probe Interval (probe_interval)	The number of seconds (default: **15**) Equalizer will wait for a health check attempt to succeed before marking a server down.
Max Tries Per Interval (probe_maxtries)	The maximum number of health check connection attempts per probe interval before marking a server down.
Probe Global Timeout (probe_gto)	The health check global timeout. The number of seconds (default: **5**) Equalizer waits for a connection to the health check server application to complete before marking the server down.

GUI Parameter (CLI Parameter)	Description
Probe Connect Timeout (probe_cto)	The health check connection timeout. The number of seconds (default: **1**) that Equalizer will wait for a connection attempt to the health check server application to succeed before marking the server down.
Probe Data Timeout (probe_dto)	The health check data timeout. Once a connection is established, this parameter indicates the number of seconds (default: **2**) Equalizer will wait for the first byte of the health check server application response before marking the server down.
Health Check Query (stimulus)	A string sent to the server agent after a connection is established. For example: a server health check application may require a string such as get load \r \n before it will send a load value. This parameter is optional.
[No GUI] (type)	Set the type for the health check probes. Required.
Require Response (require_response)(flag)	Mandates that the health check probe must receive a response or the server will be marked “Down”.

Setting Simple Health Check Parameters in the GUI

1. Click on **Server Pools** on the left navigational pane and select a configured server pool. The **Server Pool > Configuration > LB Policy** screen will be displayed on the left configuration pane.

2. Click on ✚ to add a new health check. The following will be displayed.

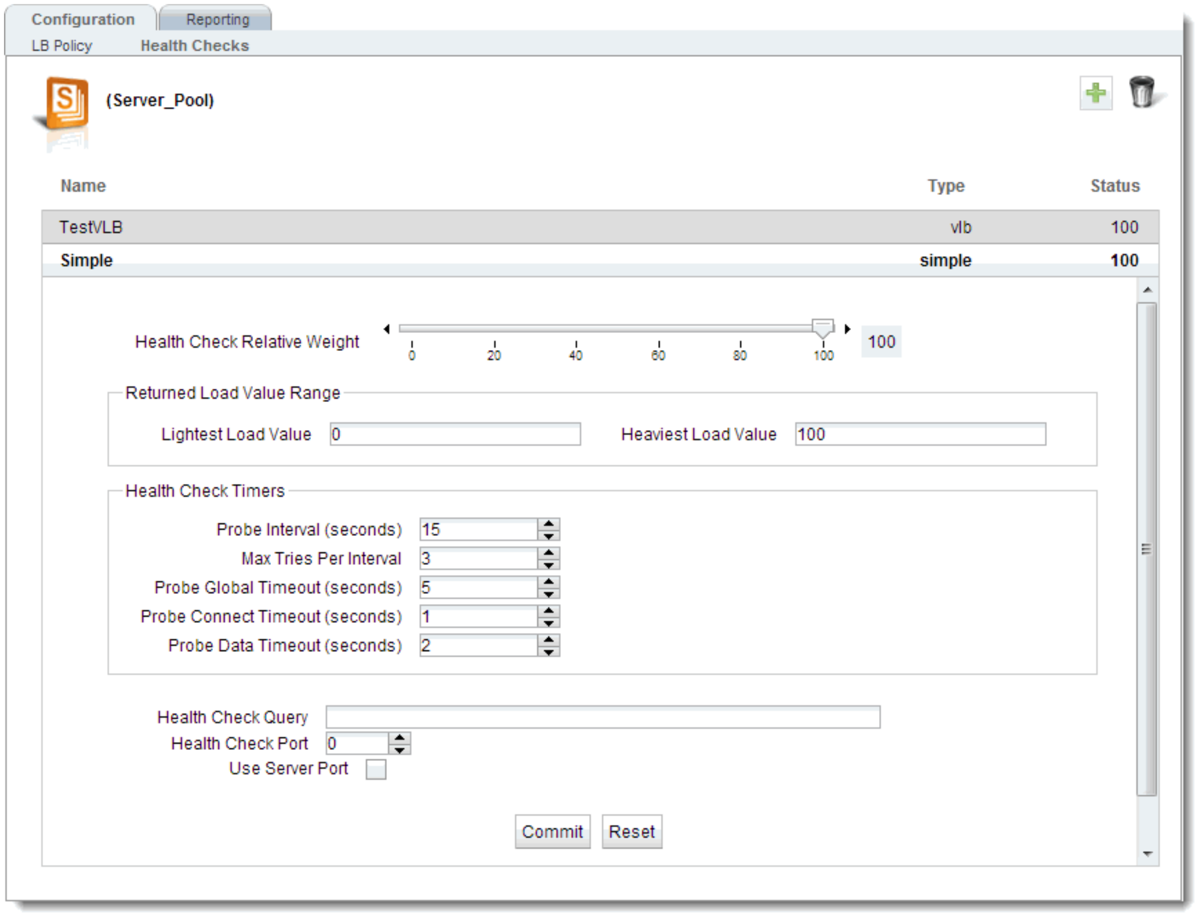

Add Health Check

Health Check Name: Test_Health_Check
Health Check Type: simple

3. Enter a name in the **Health Check Name** area and select **simple** from the **Health Check Type** drop down list.

4. Click on **Commit** to save the health check.

5. Click on the simple health check that will appear in the accordion list on the right pane when a server pool is selected from the right navigational pane. The following will be displayed:



Name	Type	Status
TestVLB	vlb	100
Simple	simple	100

Health Check Relative Weight: 100

Returned Load Value Range
Lightest Load Value: 0
Heaviest Load Value: 100

Health Check Timers
Probe Interval (seconds): 15
Max Tries Per Interval: 3
Probe Global Timeout (seconds): 5
Probe Connect Timeout (seconds): 1
Probe Data Timeout (seconds): 2

Health Check Query:
Health Check Port: 0
Use Server Port: ☐

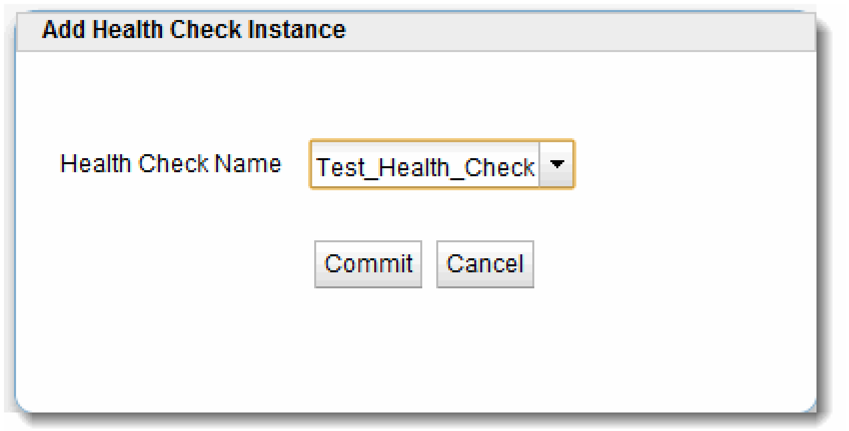
6. Enter Simple Health Check parameters using *Simple Health Check Parameters* above.

7. Click on **Commit** to save the configuration or **Reset** to return all values to the default settings.

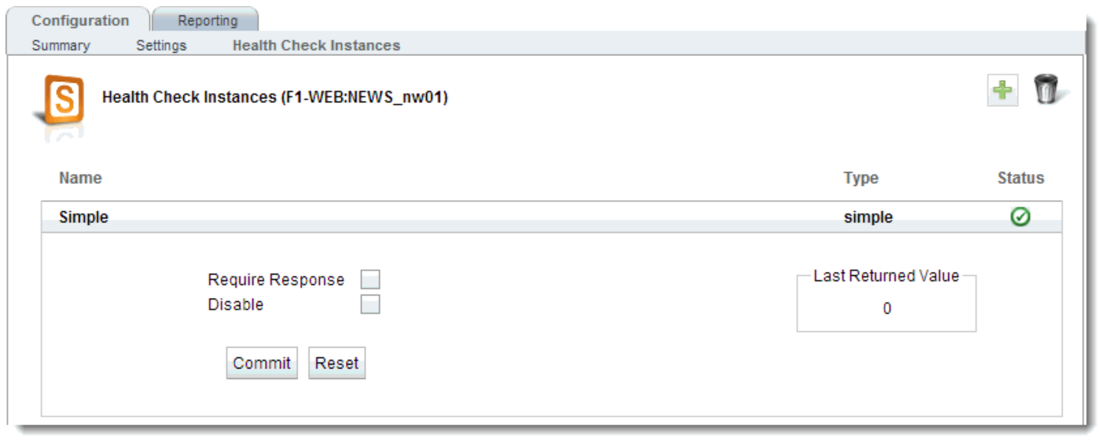
Add an instance of the health check (health check instance) to the server a server instance in the server pool. Health check instances are applied to server instances (and thus the servers) within a server pool to determine the health and to determine the "best" server to use.

8. Click on a server instance in the left navigational pane and then click on **Configuration > Health Check Instances** on the right pane.

9. Click on ➕ to add a health check instance to the server instance. The following will be displayed.



10. Select a **Health Check Name** from the drop down list and click on **Commit**. The following will be displayed.



11. Health check instances will be arranged in an expandable accordion list. The **Name**, **Type** and a **Status** indicator will appear on the accordion label. Click on the accordion label to expand the display. There are two options that may be enabled:

Require Response	Enabling the **Require Response** option (flag) mandates that the health check probe must receive a response or the server will be marked "Down".
Disable	Checking the **Disable** option will disable the health check for this server instance.

Setting Simple Health Check Parameters in the CLI

To demonstrated the configuration of Simple Health Check parameters the following examples are provided. In the examples we'll use a server pool named **MyPool** that has three server instances defined (**sv1**, **sv2**, and **sv3**). Let's also assume that there is no string required by the application running on the server to get the returned load value.

1. Add a health check definition named **HC1** to **MyPool**:

```
eqcli > srvpool MyPool health_check HC1 type simple
```

Note that type is the only required parameter.

2. Display the configuration of **HC1**:

```
eqcli > show srvpool MyPool health_check HC1
Health Check Name : HC1
Type : simple
Port : 1510
Stimulus :
Healthy : 0.000000
Loaded : 100.000000
Probe Interval : 15
Max tries per interval : 3
Global Timeout : 5
First state change timeout : 1
Second state change timeout : 2
Weight : 100
```

3. Configure the Simple Health Check with the parameters in the health check context where ***parameter_ name*** and ***values*** described in *Simple Health Check Parameters* above.

```
eqcli > srvpool MyPool health_check HC1 parameter_name value...
```

Add an instance of the health check (health check instance) to the server a server instance in the server pool. Health check instances are applied to server instances (and thus the servers) within a server pool to determine the health and to determine the "best" server to use.

4. Now add a health check instance for HC1 to each server instance (**si**) in the server pool.

```
eqcli > srvpool MyPool si sv1 hci HC1
eqcli > srvpool MyPool si sv2 hci HC1
eqcli > srvpool MyPool si sv3 hci HC1
```

Simple Health Checks and Load Balancing Policies

Simple health checks work with all load balancing policies, except for **round robin.Round robin** ignores any agent response for all server instances in a server pool. All other policies use the integer returned by the agent as one factor in determining the server to which a new request is sent.

Server Agents

A server agent is a custom written application that runs on a server and listens on a specific port (default: 1510). When a connection request is received on that port, the server agent returns an integer value between -1 and 100 that indicates the relative load on the server (-1 meaning the server should be considered unavailable, 0 meaning very lightly loaded, and 100 meaning heavily loaded). Server agents can be used with any cluster type, and have an effect on all load balancing policies except round robin, which ignores server agent return values.

By default, server agents are disabled on all new server pools. To enable server agents for a server pool, you need to write the agent, install and run it on each server pool in the cluster, and then enable server agents for the server pool on Equalizer.

Agent Probe Process

When Equalizer connects to the port on which the server agent is running, it uses the number returned by the agent in its load balancing calculations, with the server agent policy giving highest preference to the server agent’s return value over other factors.

The number returned by the agent to Equalizer is intended to indicate the current load on the server. The agent application that runs on the server can be written in any available scripting or programming language and can use any appropriate method to determine server load. By default, the result must be an integer between -1 and 100 returned on the server agent port.

When enabled, server agents should be running on all server instances in the server pool; however, by default, a server is not marked down when an agent value is not returned. Equalizer continues load balancing without the server agent return value unless the health check instance flag **Require Response** (`require_response`) flag is enabled; if it is, Equalizer must receive an agent response or the server is marked down.

Sample Server Agent

You can create custom Server Agents as shell scripts, or in Java, Perl, C, or other languages. The code snippet below is an example of a simple server agent example written in Perl. This code assumes that an integer response value is supplied on the command line and returns that value when a connection is made on port 1510 (configurable via the server instance **Probe Port** (`probe_port`) variable). This sample agent is intended for testing purposes only. In a real deployment, the server agent would determine the response value to return by polling system resources, or some other real-time method.

```
#!/usr/bin/perl -w
# serveragent.pl
#--------------------
#(c) Copyright 2013 Fortinet, Inc.

use strict;
use Socket;

# use port 1510 as default
my $port = 1510;
my $proto = getprotobyname('tcp');

# take the server agent response value from the command line
my $response = shift;

# response has to be a valid server agent response
$response==-1 or ($response > 0 and $response<101)
or die "Response must be between -1 and 100";

# create a socket and set the options, set up listen port
socket(SERVER, PF_INET, SOCK_STREAM, $proto) or die "socket: $!";
setsockopt(SERVER, SOL_SOCKET, SO_REUSEADDR, 1) or die "setsock: $!";
my $paddr = sockaddr_in($port, INADDR_ANY);
```

```
# bind to the port, then listen on it
bind(SERVER, $paddr) or die "bind: $!";
listen(SERVER, SOMAXCONN) or die "listen: $!";
print "Server agent started on port $port\n";

# accepting a connection
my $client_addr;
while ($client_addr = accept(CLIENT, SERVER)) {

# find out who connected
my ($client_port, $client_ip) = sockaddr_in($client_addr);
my $client_ipnum = inet_ntoa($client_ip);

# print who has connected -- this is for debugging only
print "Connection from: [$client_ipnum]\n";

# send the server agent response value
print CLIENT $response;

# close connection
close CLIENT;
}
```

Here is the output of the server program when it is started on the server:

```
$ ./serveragent.pl 50
Server agent started on port 1510
Connection from: [10.0.0.32]
```

Another “Connection” line prints each time the server agent is probed by Equalizer.

From Equalizer’s perspective, all that is returned by the server agent is the integer set on the command line. For example, if you use the example server agent above and set the response to “50”, here is what you will see if you use the **telnet**command to open the server agent IP and port:

```
$ telnet 10.0.0.120 1510
50
Connection to host lost.
```

VLB Health Check Probes

All Equalizers support basic load balancing of VMware servers through VMware vConsole integration. Equalizer uses VMware's management API to retrieve real-time virtual server performance information from a VMware vCenter console that manages virtual machines running on ESX Server (or from a single ESX Server directly). The additional server availability and resource utilization information obtained from VMware allows Equalizer to more efficiently direct the traffic flowing to VMware virtual machines.

By default VLB health using the information in the VLB Manager object and the UUID as specified by the server object. If the **`use_server_port`** is set, the server object's port is used. Otherwise the **`probe_port`** specified in the health check object is used.

Typically, VLB health check probes are configured in the following manner:

1. Provide VMware login information by creating "VLB Managers".
2. Associate Equalizer servers with virtual machines on VMware.
3. Create VLB health checks.
4. Configure parameters for each health check.
5. Add vlb health check instances to server instances in server pools.

Messages will appear in the Equalizer log (on the global **Logging > Event Log** tab) when Equalizer communicates with VMware, and when the state of a VM server changes. Otherwise, VLB works behind the scenes to provide accurate and detailed VM server status information that Equalizer uses to make well-informed load balancing decisions.

Enabling/Disabling VLB Health Check Probes

Enable/Disable VLB Health Check Probes in the GUI

VLB probes are enabled as soon as a health check instance is added to a server instance in a server pool. Default settings for probe parameters are used unless specifically set on the Health Check Configuration screen.

Health checks can be disabled by checking the disable option on the Add Health Check screen as shown on "Configuring VLB Health Check Probe Parameters" on page 386

Note - Health checks cannot be globally disabled and must be disabled for each health check.

Enable/Disable VLB Health Check Probes in the CLI

VLB probes are enabled as soon as a health check instance is added to a server instance in a server pool. Default settings for probe parameters are used unless specifically configured on `eqcli >`.

Health checks can be disabled by entering the following in each server instance context:

```
eqcli >srvpool sp-spname si siname no hci hci-name
```

where:

`sp-spname` is the name of the server pool

`si-siname` is the name of the server instance in the server pool

`hci-name` is the name of the health check instance

Note - Health checks cannot be globally disabled and must be disabled for each health check instance.

Configuring VLB Health Check Probe Parameters

The procedures in the Related Topics describe the process of configuring VLB manager, health checks and health check instances using both the GUI and the CLI.

VLB Health Check Probe Parameters

GUI Probe Parameter (CLI Probe Parameter)	Description
Health Check Relative Weight (weight)	Set the relative weight (default: **100**) of the health check load value returned by the application compared to other health check values returned by other health checks.
Probe Interval (probe_interval)	The number of seconds (default: **15**) Equalizer will wait for a health check attempt to succeed before marking a server down.
Max Tries per Interval (probe_maxtries)	The maximum number of health check connection attempts per probe interval before marking a server down.
Probe Global Timeout (probe_gto)	The health check global timeout. The number of seconds (default: **5**) Equalizer waits for a connection to the health check server application to complete before marking the server down.
Probe Connect Timeout (probe_cto)	The health check connection timeout. The number of seconds (default: **1**) that Equalizer will wait for a connection attempt to the health check server application to succeed before marking the server down.
Probe Data Timeout (probe_dto)	The health check data timeout. Once a connection is established, this parameter indicates the number of seconds (default: **2**) Equalizer will wait for the first byte of the health check server application response before marking the server down.

Configuring VLB Health Check in the GUI

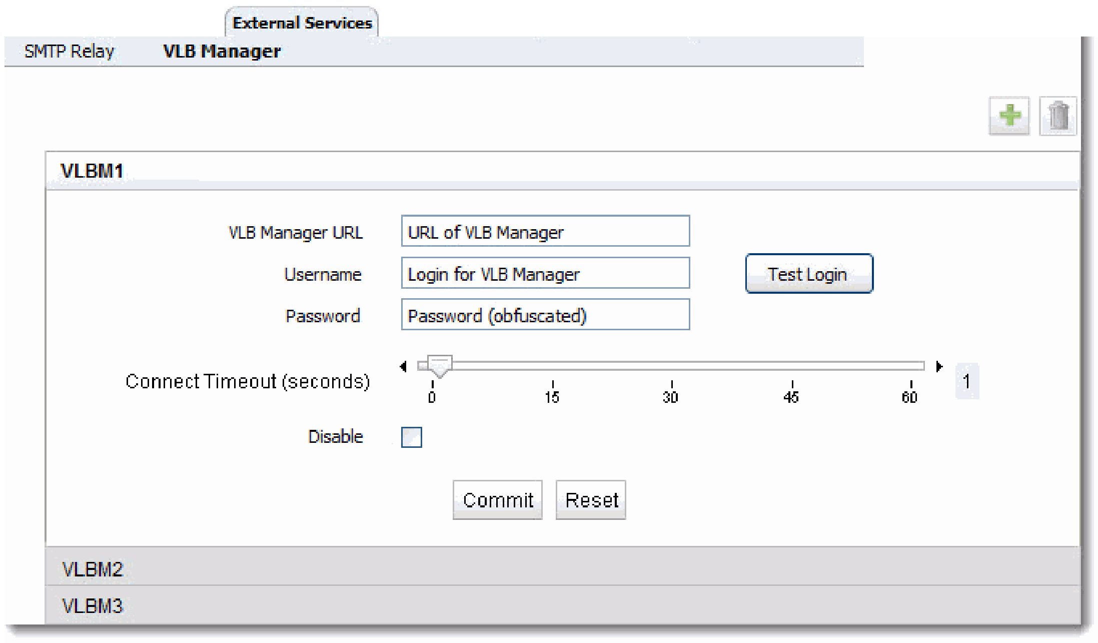
Proceed with the following to configure VLB health checks using the GUI:

1. Log in to the GUI as described in "Logging In" on page 192.

Configure VLB Managers

A VLB Manager is a saved configuration by which Equalizer communicates with VMware.

2. Configure VLB Managers by clicking on the **Host name** on the left navigational pane and selecting **External Services > VLB Manager.** the figure below will be displayed. The screen features accordion panes for the existing and the VLB managers that are labeled. Clicking on the delete icon will delete the health check whose accordion pane is currently open.Click on the "+" icon to add a new VLB Manager.



VLB Manager URL: URL of VLB Manager
Username: Login for VLB Manager
Password: Password (obfuscated)
Connect Timeout (seconds): 0 15 30 45 60 — 1
Disable: ☐

a. Enter a URL for the VLB Manager you would like to connect with in the **VLB Manager URL** field. Add **Username**/**Password** credentials for login as well.

b. The **Connect Timeout** slider is used to configure the allowable time to connect with VMware. By default this is 1.

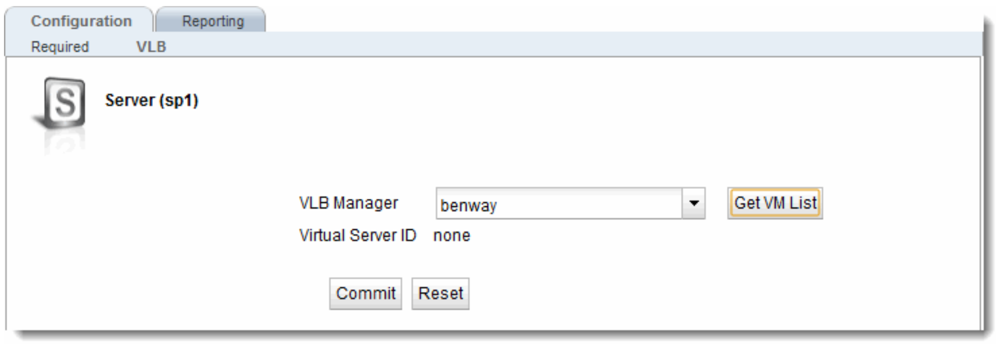
c. The **Disable** checkbox is used to disable the VLB Manager if necessary.

d. Clicking on the **Test Login** button will test your URL and credentials using the **Connect Timeout** settings that you configure. A pop up message will be displayed indicating success or failure.

e. Click on **Commit** to continue.

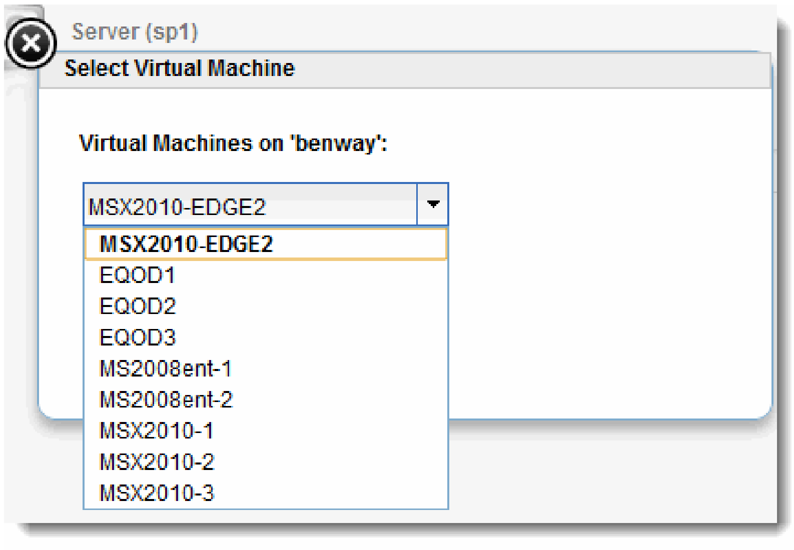
Associate an Equalizer server with a Virtual Machine on VMware

3. To associate an Equalizer server with a Virtual Machine on VMware, select the desired Equalizer Server on the left navigational pane and then select **Configuration > VLB** to display the figure below.



VLB Manager: benway
Virtual Server ID: none

The **VLB Manager** drop-down list lists all the VLB managers defined in the External Services context. [The default is **none**.] To associate an Equalizer server with a Virtual Machine on VMware, select a **VLB Manager** from the drop-down list above and click **Get VMList**. The figure below will be displayed.


Server (sp1)

Select Virtual Machine

Virtual Machines on 'benway':

The popup contains the list of the Virtual Machines (VMs) retrieved from the VLB Manager. The VM with the matching IP address (if found) is pre-chosen (highlighted) in the list. Click on **Select** to select the pre-highlighted VM, or choose another before clicking **Select**.

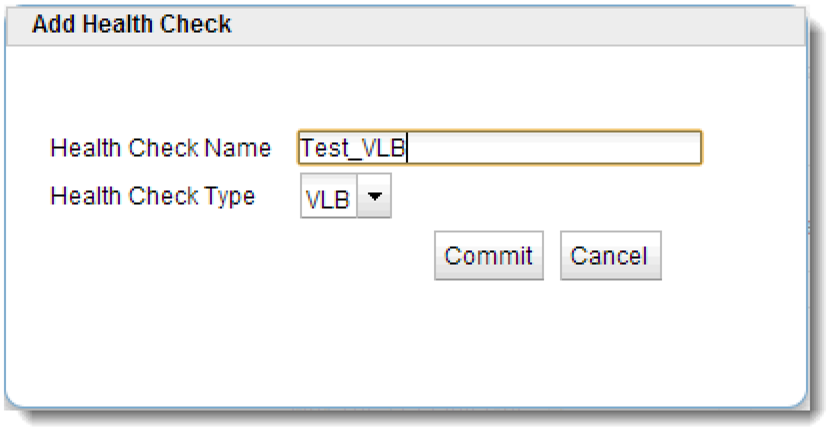
The tab is then redisplayed with the **Virtual Server ID** of the selected VM.

Click on **Commit** to save the setting.

Note - If getting the VM list from the VLB Manager fails, an Error popup is displayed with the message: "Failed to associate virtual server on VLB manager <name>." plus the detailed message returned from VMware.

Add health checks.

4. Click on a Server Pool in the left navigational pane and the select the **Health Checks** tab. Click on the "+" icon and the figure below will be displayed. Enter a name in the **Health Check Name** field and select **vlb** from the **Health Check Type** drop down list. Click on **Commit** to continue.


Add Health Check

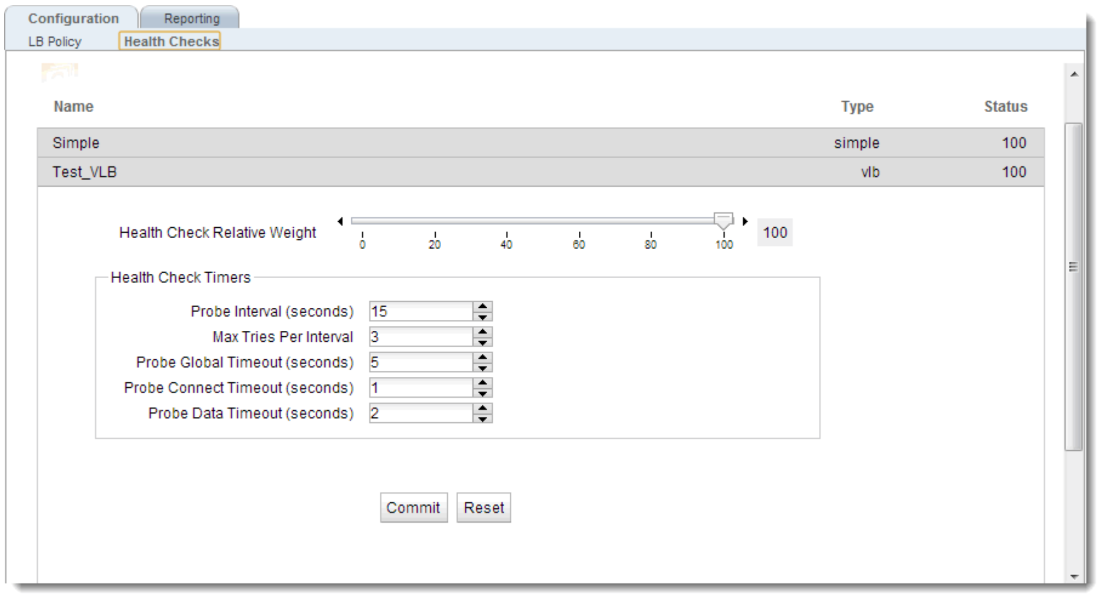
Health Check Name: Test_VLB

Health Check Type: VLB

Configure VLB Health Check Parameters

Note - Use the **custom** load balancing policy when you want to primarily rely on the load values specified by VLB health checks. Refer to "Equalizer's Load Balancing Policies" on page 230 for details.

5. The **Health Check** screen below will be displayed after adding a health check. The screen allows the configuration of all health checks and features accordion tabs, labeled with the health check name and type and the currently set health check relative weight. Clicking on the "+" icon will add a new health check. Clicking on the delete icon will delete the health check whose accordion pane is currently open.



Name	Type	Status
Simple	simple	100
Test_VLB	vlb	100

Health Check Relative Weight 100

Health Check Timers

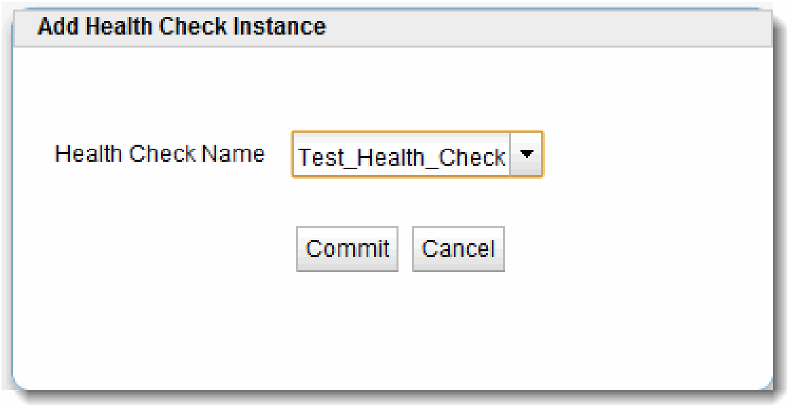
Probe Interval (seconds)	15
Max Tries Per Interval	3
Probe Global Timeout (seconds)	5
Probe Connect Timeout (seconds)	1
Probe Data Timeout (seconds)	2

6. Configure parameters as described in *VLB Health Check Probe Parameters* above.

7. Click on **Commit** to save the parameters.

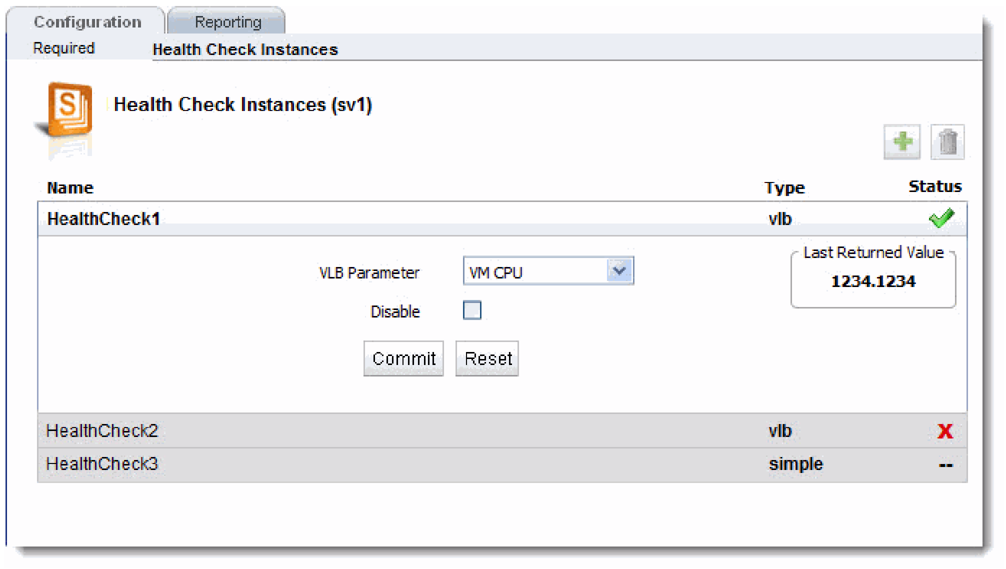
Add VLB health check instances to server instances on the server pool.

8. Click on a server instance (on a server pool branch) in the left navigational pane and then the **Health Check Instance** tab. Click on the "+" icon and the figure below will be displayed. Select a name from the **Health Check Name** drop down list. This is a list of the names of all health checks previously defined for the server pool. Click on **Commit**.



Health Check Name: Test_Health_Check

9. After selecting a **Health Check Name** the **Health Check Instances** screen shown below will be displayed.



The **Health Check Instances** screen features accordion panes for the existing and the new health check instances that are labeled with the health check instance. Clicking on the icon will display the figure above to add a new health check instance. Clicking on the icon will delete the health check whose accordion pane is currently open.

Use the drop down list to select a **VLB Parameter**. This can be either **VM CPU** or **VM RAM**. The default is **VM CPU**.**VM CPU** will display CPU performance values in **Last Returned Value** while **VM RAM** will display memory usage values.

The screen also features the last health check **Status**:

✓ indicates “Succeeded”.

✗ indicates “Failed”. Disabled (--) [means the **Disabled** check box is checked.

Checking the **Disable** checkbox will disable this health check instance for the server instance selected.

10. Click on **Commit** to save the health check instance.

Configuring VLB Health Check in the CLI

Proceed with the following to configure VLB health check parameters using the CLI:

Create a VLB Manager as an External Service

1. Log in to **eqcli** as described in "Starting the CLI" on page 128.
2. A VLB Manager is a saved configuration by which Equalizer communicates with VMware. Enter the following a the `eqcli` command prompt to create a VLB Manager as an External Service:

```
eqcli > ext_services vlb_manager <name>
```

where:

name is the name of the vlb manager

3. Enter the new VLB Manager, adding a URL, Username, Password, Connect Timeout parameters and flags. Enter:

```
eqcli xs vlb-nam* > URL value
eqcli xs vlb-nam* > username name
eqcli xs vlb-nam* > password name
eqcli xs vlb-nam* > flags disable[a]
```

a. The only flag used is **disable** which would disable the VLB Manager if necessary.

4. Enter the following to verify the new VLB Manager and parameters. In the example below, a VLB manager "esxi-01" is created.

```
eqcli > ext_services vlb_manager esxi-01
eqcli xs-vlb-esx*> show
VLB Manager Name : esxi-01
URL : https://192.168.213.196/sdk
Username : root
Timeout : 0
Flags :
```

Note - For security reasons, the Password value is not displayed.

Associate an Equalizer server with a Virtual Machine on VMware

5. Show the configured server by entering the server context and then entering:

```
eqcli > server servername show
```

where *server name* is the name of the server. An example with a server "centos216" is shown below.

```
This server is enabled.
Server Name : centos216
IP Address : 192.168.213.216
Port : 22
Protocol : tcp
VID : 1
Max Reuse Connections : 0
Reuse Connections Timeout : 0
VLB Manager :
UUID :
Flags : probe_l3
```

6. Enter the server context and set the `vlb_manager` value by entering the following. In this example the `vlb_manager` is “`esxi-01`” on a server “`centos216`”:

```
eqcli sv-cen*> vlb_manager esxi-01
eqcli sv-cen*> commit
eqcli: 12000287: Operation successful
```

Add Health Checks

7. The next step is to add a new health check to a specific server pool. Enter the following:

```
eqcli > srvpool srvpool name health_check health_check name type vlb
```

where:

`srvpool name` is the name of the server pool

`health_check name` is the name of the new health check

Set the VLB Health Check Parameters

8. Configure the VLB health check parameters by entering the following in the health check context:

```
eqcli > srvpool serverpool spname health_check healthcheck name parameter value
```

where:

`serverpool name` is the name of the server pool

`healthcheck name` is the name of the health check

`parameter value`is the parameter and value (see below)

Use the VLB health check parameters described in *VLB Health Check Probe Parameters* above to configure other parameters.

Set the VLB Manager and UUID for a Server

9. Show the configured VLB Managers. Enter:

```
eqcli >show ext_services vlb_manager
```

An example of a display is shown below:

```
eqcli > show ext_services vlb_manager
```

```
Name URL
esxi-01 https://192.168.213.196/sdk
eqcli > show server
Name Protocol IP Address Port Flags
mac-80 tcp 192.168.213.222 80 probe_l3
xp-80 tcp 192.168.213.211 80 probe_l3
bsd-80 tcp 192.168.213.212 80 probe_l3
bsdvm213 tcp 192.168.213.213 22 probe_l3
freebsd215 tcp 192.168.213.215 22 probe_l3
centos216 tcp 192.168.213.216 22 probe_l3
ubuntu217 tcp 192.168.213.217 22 probe_l3
bsdvm214 tcp 192.168.213.214 22 probe_l3
```

10. Enter the following to display the available virtual machines on a VLB Manager.

```
eqcli sv-name > vms
```

where *sv-name* is the name of the server. In the example below, the list of virtual machines that are configured on a vlb manager "esxi-01" are displayed.

```
The following virtual machines are configured on 'esxi-01':

Name IP Address UUID

bsdvm213 564d4e62-ce68-7fe6-0ac5-f1976625cedc
bsdvm214 564d1466-ce35-3ea8-c794-f37e9f8f1239
centos216 192.168.213.216 564d4447-ee96-1b6e-a993-76314f36eac6
freebsd215 564dfbd0-1a44-7c64-0437-19d6efe199e9
ubuntu217 192.168.213.217 564d36f6-0ffd-53cb-93e6-4607d46e755e
```

11. Set the **uuid** value by entering:

```
eqcli sv-name> uuid xxxxxxx-xxxx-xxxx-xxxx-xxxxxxxxxxxx
```

where ***sv-name*** is the name of the server and the **uuid** number corresponds with a server in step 10.

12. Show the server parameters to verify that the VLB Manger has been assigned by entering:

```
eqcli > show sv-name
```

where sv-name is the server name. An example of the display for a server "centos216" is shown below.

```
This server is enabled.

Server Name : centos216
IP Address : 192.168.213.216
Port : 22
Protocol : tcp
VID : 1
Max Reuse Connections : 0
Reuse Connections Timeout : 0
VLB Manager : esxi-01
UUID : 564d4447-ee96-1b6e-a993-76314f36eac6
Flags : probe_l3
```

Add a VLB Health Check Instance on a Server Instance in a Server Pool

You now will need to add health check instances to server instances in server pools.

13. Enter server instance context for the server instance on which you would like to add the health check:

```
eqcli > srvpool serverpoolname si serverinstancename hci health checkname vlb_
param parameter
```

where:

serverpoolnameis the name of the server pool.

serverinstancename is the name of the server instance in a server pool.

healthcheckname is the name of the health check instance that you are adding to the server instance.

By default the **vlb_param** is **vm_cpu**. The other option is **vm_ram**.

To change the **vlb_param** to **vm_ram** enter the following in the health check instance context:

```
eqcli > srvpool serverpoolname si server instance hci healthcheckinstancename
vlb_param vm_cpu
```

14. Health check instances must be added to each server instance in a server pool and cannot be added globally- for all server instances included in a server pool. Repeat step 13 for each health check instance that you would like to add.

Health Check Timeouts

Configure Health Check timeouts using either the CLI or the GUI.

Layer 3 Health Check Timeouts

By default, Equalizer sends an Internet Control Message Protocol (ICMP) echo request (commonly called a “ping”) to the IP address of every configured server object. The timeouts that control Layer 3 Health Check probes are located in the global CLI context and on the **EQUALIZER > Global** tab in the GUI:

Layer 3 Health Check Parameters (CLI Parameter)	Minimum	Default	Maximum	Units
ICMP Probe Maximum Tries (**icmp_maxtries**)	0	3	30	integer
ICMP Probe Interval (**icmp_interval**)	0	15.0	60.0	seconds

By default, ICMP health check probes are sent a maximum of 3 times every 15 seconds to every configured server that has Layer 3 probes enabled. Within a 15-second probe interval, the delay between successive ping requests to the same server is determined internally -- it can be as short as one second to a server that is not responding to ICMP requests and can be 5 seconds or longer when a server is responding to ICMP echo requests, depending on the amount of traffic that Equalizer is currently processing.

If a server responds to an ICMP Health Check, it is marked "Layer 3 UP". If a server does not respond to an ICMP echo request, it will be marked "Layer 3 DOWN" by Equalizer only if the server has responded to at least one ICMP echo request since Equalizer was last rebooted. This behavior accounts for the fact that many servers are configured by default to never respond to ICMP echo requests as a security precaution. In other words, if a server has never responded to a Layer 3 health check probe since the last reboot, it is never marked "Layer 3 Down".

Note - Responding to ICMP echo requests is an option on most server platforms. If ICMP echo reply is disabled on one or more of the servers in your configuration, then you may want to disable ICMP echo requests on Equalizer to reduce traffic between Equalizer and the servers, and rely solely on the other probing mechanisms.

Layer 4 TCP and ACV Health Check Timeouts

By default, Equalizer sends TCP Health Checks to every server instance object in every server pool. Equalizer and the server exchange a three-way TCP handshake to open a TCP connection. If Active Content Verification (ACV) is also configured, the ACV probe takes place after the TCP connection is established. Once the handshake is complete and ACV data is optionally exchanged, the probe connection is closed.

The controls to enable Layer 4 Health Checks are located on a server instance and on the server pool in which server instances reside:

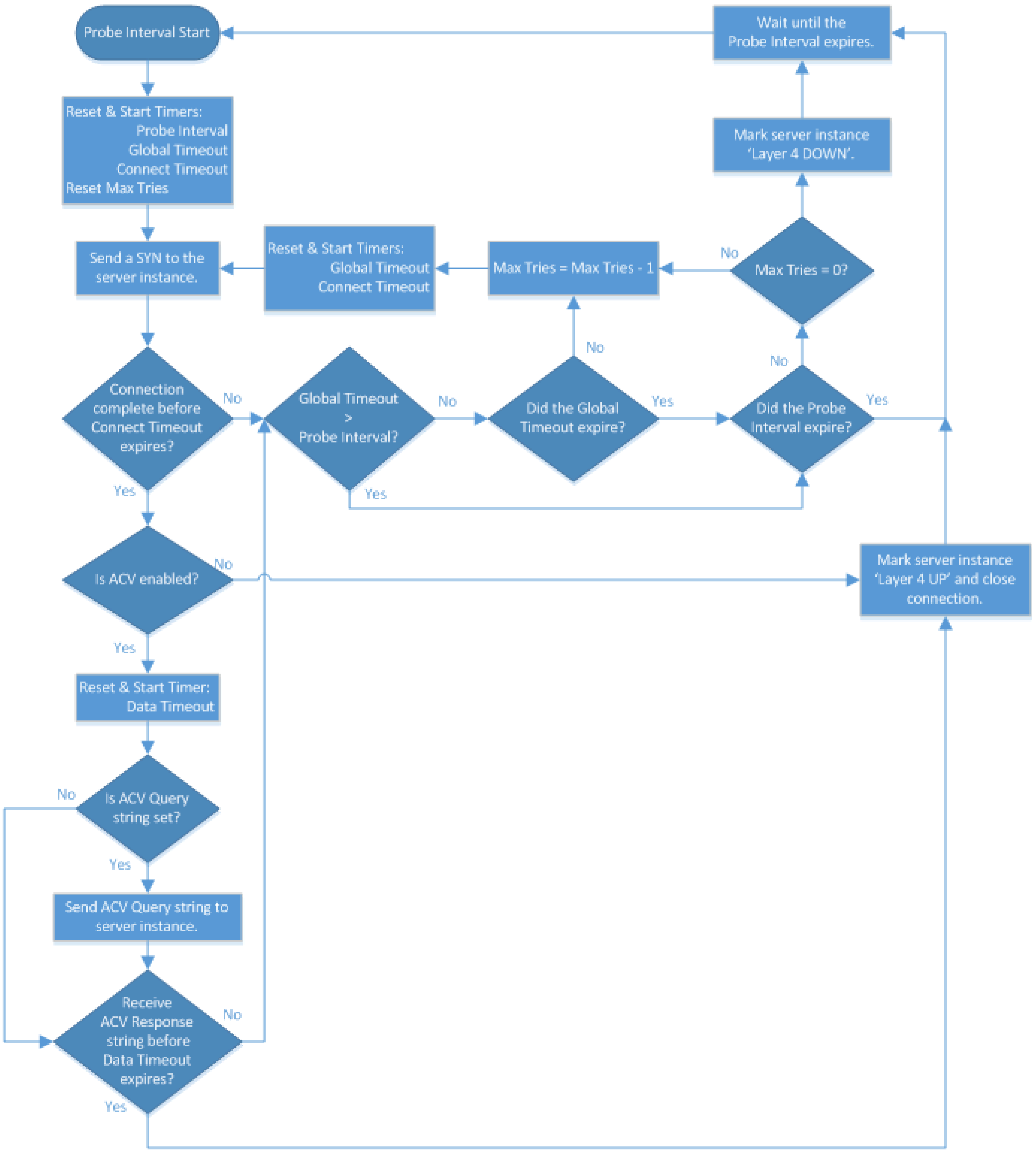
GUI Parameter (CLI Parameter)	Location	Description
Probe Layer 4 (**probe_l4**)	server instance	A flag on a server instance, enabled by default. If disabled, no TCP or ACV probes are sent to the server instance.
Probe Port (**probe_port**)	server instance	Optional. If this parameter is 0 (the default) probe using the port set on the server definition. If non-zero, use this parameter setting as the port number r TCP and ACV probes.
ACV Query (**acvq**)	server pool	Optional. A string sent to the server instance after the TCP handshake completes; the server instance is expected to respond with a string that contains the ACV Response in the first 1024 characters. If the ACV Response is not set, this parameter has no effect.
ACV Response (**acvr**)	server pool	Required to enable ACV probes. This is the string Equalizer

GUI Parameter (CLI Parameter)	Location	Description
		expects to receive in the first 1024 characters of the server instance response. If this string is not specified, ACV probes are disabled.
Probe SSL (**probe_ssl**)	server pool	A flag on a server pool, disabled by default. If enabled, the TCP and ACV probe exchange between Equalizer and the server instance will be performed over an encrypted SSL connection.

Once enabled, TCP and ACV probe behavior is determined by the timeouts located on the server pool configuration screen in the GUI (and in the **`srvpool`** context in the CLI.

GUI Parameter (CLI Parameter)	Minimum	Default	Maximum	Units
Max Tries Per Interval (**max_tries**)	0	3	30	integer
Probe Interval (**probe_interval**)	1	15	60	seconds
Probe Global Timeout (**probe_gto**)	0	5	120	seconds
Probe Connect Timeout (**probe_cto**)	0	1	60	seconds
Probe Data Timeout (**probe_dto**)	0	2	60	seconds

By default, Equalizer sends Layer 4 health check probes to a server instance at most 3 times (the Max Tries Per Interval setting), every 15 seconds (the Probe Interval). Exactly how many probes are sent in any given probe interval is determined by how long it takes each probe to complete and whether any of the timeouts listed above expire while Layer 4 health checks are being sent and received. Both TCP and ACV probes are subject to the same set of timeout values, as summarized in the following flowchart.


Probe Interval Start
Reset & Start Timers: Probe Interval Global Timeout Connect Timeout Reset Max Tries
Send a SYN to the server instance.
Reset & Start Timers: Global Timeout Connect Timeout
Max Tries = Max Tries - 1
Max Tries = 0?
Mark server instance 'Layer 4 DOWN'.
Wait until the Probe Interval expires.
Connection complete before Connect Timeout expires?
Global Timeout > Probe Interval?
Did the Global Timeout expire?
Did the Probe Interval expire?
Is ACV enabled?
Mark server instance 'Layer 4 UP' and close connection.
Reset & Start Timer: Data Timeout
Is ACV Query string set?
Send ACV Query string to server instance.
Receive ACV Response string before Data Timeout expires?
Yes
No

Simple and VLB Health Check Timeouts

Simple and VLB health checks each have their own timeouts, defined within the health check definition. They are named the same and behave the same as the timeouts for Layer 4 TCP and ACV health checks in the previous section, with the exception that the Probe Data Timeout (**probe_dto**) is the timeout for the server response for these health checks rather than ACV. This affects only the part of the flowchart that is outlined in the previous section.

Chapter 20

Logging

Sections within this chapter include:

Displaying Logs

Equalizer logs can be displayed in both the CLI and the GUI.

In the CLI, use the following command:

```
eqcli > show log name  lines number
```

Substitute **`sys`** for ***`name`*** to display the system log; use **`eq`** to display the Equalizer log. By default, the entire log is displayed. Use the **`lines`** keyword to specify the number of lines to display, starting with the most recent log message.

In the GUI, open the **Equalizer > Status** tab to display the graphical log browser. By default, the Equalizer log is displayed. Click **Syslog** in the left column of the log browser to display the Equalizer system log.

Remote System Logging

Remote system logging is enabled using commands in the global CLI context using the **syslog-server** and **syslog** commands, and in the GUI on the **<Host name> > Logging** tab.

Enabling Remote System Logging (GUI)

1. Open the **Equalizer > Monitoring** tab.
2. Type the IP address or name of the remote logging server into the **Syslog Server** text box. If one is already supplied, skip this step.
3. Turn on the **Syslog Enable** check box.
4. Click **Commit**.

Disabling Remote System Logging (GUI)

1. Open the **Equalizer > Monitoring** tab.
2. Do one or both of the following:
   a. Remove the contents of the **Syslog Server** text box.
   b. Turn off the **Syslog Enable** check box.
3. Click **Commit**.

Enabling Remote System Logging (CLI)

When setting up the system for the first time, remote logging is enabled by a single command:

```
eqcli > syslog-server IPaddr_or_name
```

Substitute the IP address or hostname of a working **syslog()** server for ***IPaddr_or_name***.

If the remote syslog server is later removed using the **no** form of the **syslog-server** command, use the syntax shown above to re-enable remote logging.

If remote logging is later disabled using the **syslog disable** command, use **syslog enable** to re-enable it.

Disabling Remote System Logging (CLI)

To disable remote logging without removing the IP address or name of the current remote logging server, enter:

```
eqcli > syslog disable
```

Alternatively, removing the IP address or name of the current remote logging server will also automatically disable remote logging:

```
eqcli > no syslog-server
```

Chapter 21

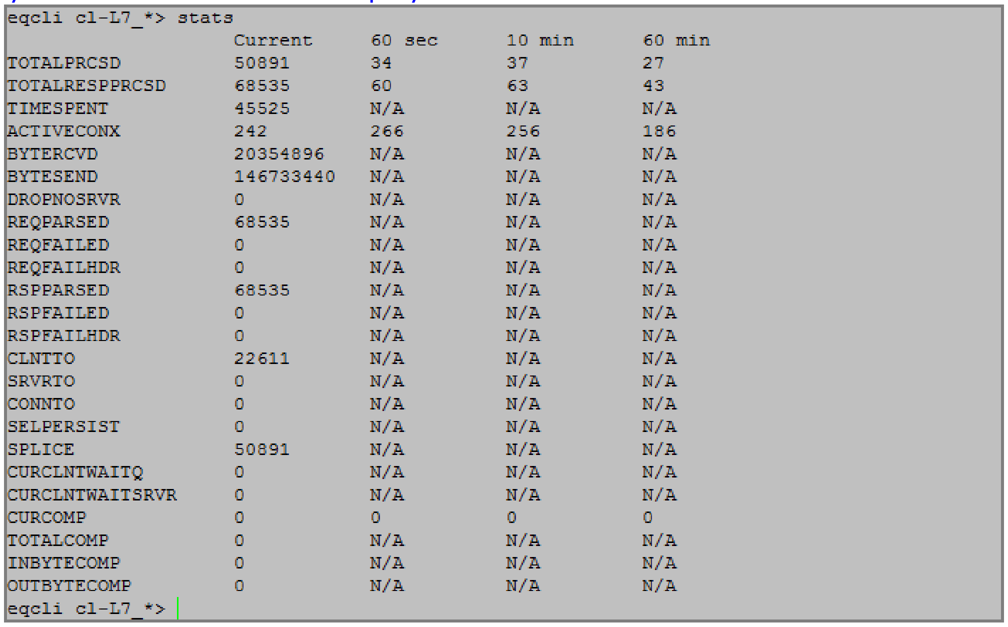
Reporting (Statistics and Plotting)

Sections within this chapter include:

Cluster and Match Rule Reporting

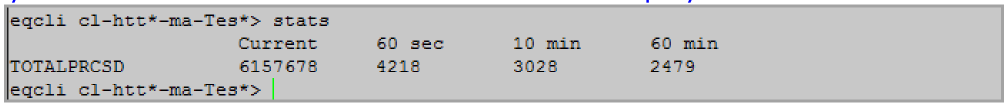
The CLI display of Statistics can be seen by entering the following within the cluster or match rule context:

Sample of Layer 7 Cluster Statistical Display



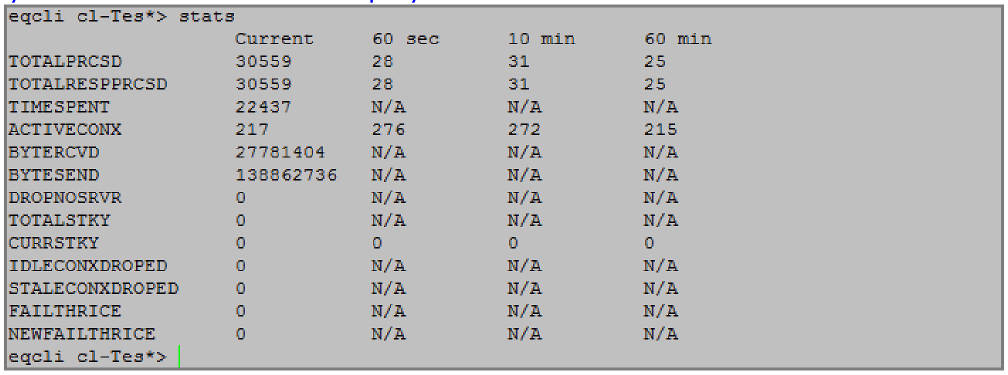
```
eqcli cl-L7_*> stats
                    Current     60 sec      10 min      60 min
TOTALPRCSD          50891       34          37          27
TOTALRESPPRCSD      68535       60          63          43
TIMESPENT           45525       N/A         N/A         N/A
ACTIVECONX          242         266         256         186
BYTERCVD            20354896    N/A         N/A         N/A
BYTESEND            146733440   N/A         N/A         N/A
DROPNOSRVR          0           N/A         N/A         N/A
REQPARSED           68535       N/A         N/A         N/A
REQFAILED           0           N/A         N/A         N/A
REQFAILHDR          0           N/A         N/A         N/A
RSPPARSED           68535       N/A         N/A         N/A
RSPFAILED           0           N/A         N/A         N/A
RSPFAILHDR          0           N/A         N/A         N/A
CLNTTO              22611       N/A         N/A         N/A
SRVRTO              0           N/A         N/A         N/A
CONNTO              0           N/A         N/A         N/A
SELPERSIST          0           N/A         N/A         N/A
SPLICE              50891       N/A         N/A         N/A
CURCLNTWAITQ        0           N/A         N/A         N/A
CURCLNTWAITSRVR     0           N/A         N/A         N/A
CURCOMP             0           0           0           0
TOTALCOMP           0           N/A         N/A         N/A
INBYTECOMP          0           N/A         N/A         N/A
OUTBYTECOMP         0           N/A         N/A         N/A
eqcli cl-L7_*>
```

Sample of Layer 7 HTTP and HTTPS Match Rule Statistical Display



```
eqcli cl-htt*-ma-Tes*> stats
                    Current     60 sec      10 min      60 min
TOTALPRCSD          6157678     4218        3028        2479
eqcli cl-htt*-ma-Tes*>
```

Sample of Layer 4 Cluster Statistical Display



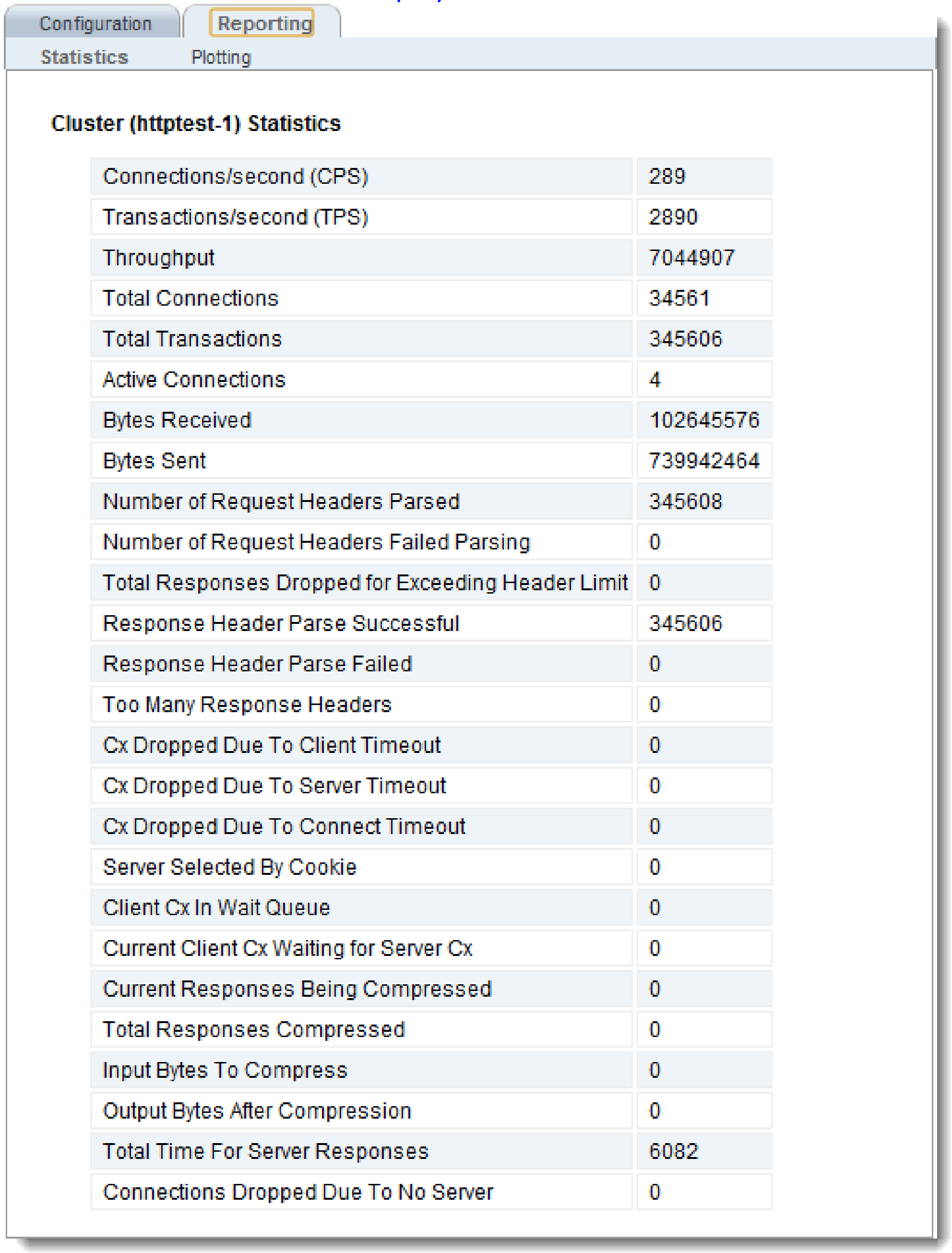
```
eqcli cl-Tes*> stats
                    Current     60 sec      10 min      60 min
TOTALPRCSD          30559       28          31          25
TOTALRESPPRCSD      30559       28          31          25
TIMESPENT           22437       N/A         N/A         N/A
ACTIVECONX          217         276         272         215
BYTERCVD            27781404    N/A         N/A         N/A
BYTESEND            138862736   N/A         N/A         N/A
DROPNOSRVR          0           N/A         N/A         N/A
TOTALSTKY           0           N/A         N/A         N/A
CURRSTKY            0           0           0           0
IDLECONXDROPED      0           N/A         N/A         N/A
STALECONXDROPED     0           N/A         N/A         N/A
FAILTHRICE          0           N/A         N/A         N/A
NEWFAILTHRICE       0           N/A         N/A         N/A
eqcli cl-Tes*>
```

To view the GUI display, select a cluster or responder Server on the left navigational pane and click on the **Reporting** tab to display statistics. The following is an example of the statistics displayed.

A Layer 4 statistical display is similar however it displays **Connections/second (CPS)**, **Throughput**, **Bytes Received**, **Bytes Sent**, **Total Sticky Records**, **Current Sticky Records**, and **Total Time for Server Responses**.

A Layer 7 Http and Https Match Rule statistical display is also similar however, it displays **Connections /second (CPS)** and **Total Connections**.

Sample Layer 7 Cluster GUI Statistical Displays



Cluster (httptest-1) Statistics

Connections/second (CPS)	289
Transactions/second (TPS)	2890
Throughput	7044907
Total Connections	34561
Total Transactions	345606
Active Connections	4
Bytes Received	102645576
Bytes Sent	739942464
Number of Request Headers Parsed	345608
Number of Request Headers Failed Parsing	0
Total Responses Dropped for Exceeding Header Limit	0
Response Header Parse Successful	345606
Response Header Parse Failed	0
Too Many Response Headers	0
Cx Dropped Due To Client Timeout	0
Cx Dropped Due To Server Timeout	0
Cx Dropped Due To Connect Timeout	0
Server Selected By Cookie	0
Client Cx In Wait Queue	0
Current Client Cx Waiting for Server Cx	0
Current Responses Being Compressed	0
Total Responses Compressed	0
Input Bytes To Compress	0
Output Bytes After Compression	0
Total Time For Server Responses	6082
Connections Dropped Due To No Server	0

The following are definitions for the statistical terms shown on both the CLI and GUI:

Layer 7 Cluster Statistic Definitions

CLI Term	GUI Term	Definition
TOTALPRCSD	Total Connections	Connections Processed.
TOTALRESPPRCSD	Total Transactions	The total responses processed.
TIMESPENT	Total Time For Server Responses	The total time spent on this object.

CLI Term	GUI Term	Definition
ACTIVECONX	Active Connections	Active Connections.
BYTERCVD	Bytes Received	Bytes received.
BYTESEND	Bytes Sent	Bytes transmitted.
REQPARSED	Number of Request Headers Parsed	This is the total number of times that an HTTP request header was parsed.
REQFAILED	Number of Request Headers	The number of request header failed
REQFAILHDR	Number of Request Headers Failed Parsing	The number of requests dropped for exceeding header limit.
RSPPARSED	Response Header Parse Successful	Total number of times HTTP response headers was parsed.
RSPFAILED	Response Header Parse failed	The number of response headers failed.
RSPFAILHDR	Too Many Response Headers	Too many response header.
CLNTTO	Cx dropped due to Client Timeout	Connections dropped due to client timeout.
SRVRTO	Cx Dropped due to Server Timeout	Connections dropped due to server timeout.
CONNTO	Cx Dropped Due to Connect Timeout	Connections dropped due to connect timeout
SELPERSIST	Server Selected By Cookie	The number of times the server was selected by a cookie.
SPLICE	Current Client Cx Waiting for Server Cx	Total client-server connections linked.
CURCLNTWAITQ	Client Cx in Wait Queue	The client connections in the queue.
CURCLNTWAITSRVR	Current Client Cx Waiting for Server Cx	The number of client connections waiting for server connections.
CURCOMP	Current Responses Being Compressed	The current responses being compressed.
TOTALCOMP	Total Responses Compressed	The total responses being compressed.
INBYTECOMP	Input Bytes to Compress	Input bytes to compress.
OUTBYTECOMP	Output Bytes after Compressions	Output byte after compression.

Layer 7 HTTP and HTTPS Match Rule Statistic Definitions

CLI Term	GUI Term	Definition
TOTALPRCSD	Connections/second (CSP)	Connections Processed.

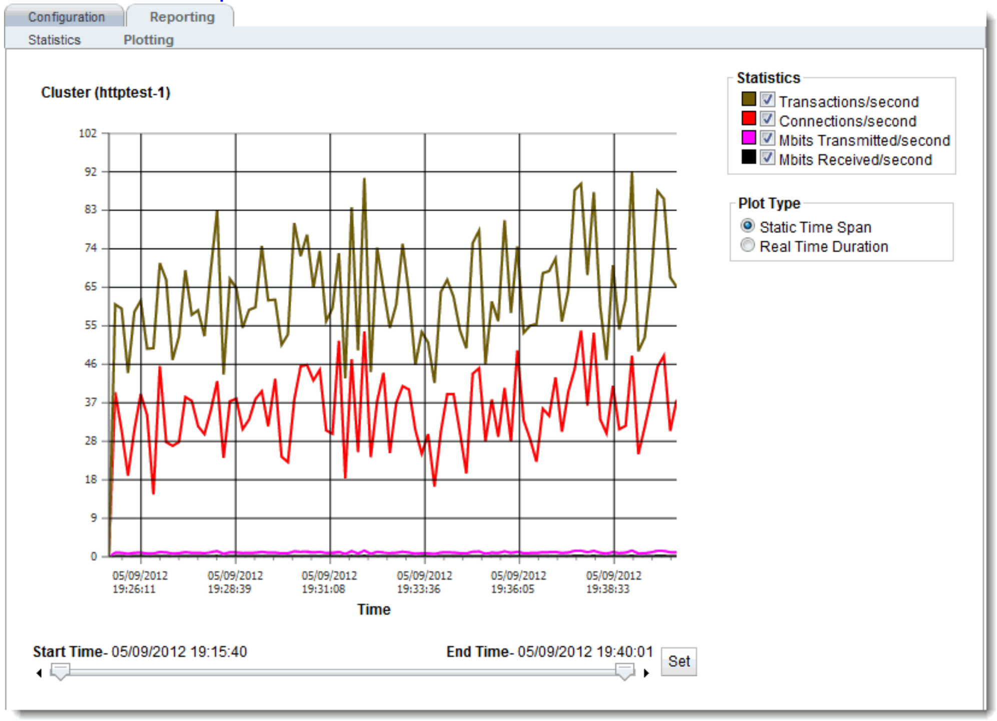
CLI Term	GUI Term	Definition
N/A	Transactions/second (TPS)	The total responses processed.
N/A	Throughput	Throughput
N/A	Total Connections	Total connections.
N/A	Total Transactions	Total transactions.
N/A	Active Connections	Active connections.
N/A	Bytes Received	Bytes received.
N/A	Bytes Sent	Bytes transmitted.
N/A	Total Time For Server Responses	Total time for server responses
N/A	Connections Dropped Due To No Server	Connections dropped due to no server

Layer 4 Cluster Statistic Definitions

CLI Term	GUI Term	Definition
BYTERCVD	Bytes Received	Bytes received.
BYTESEND	Bytes Sent	Bytes transmitted.
N/A	Connections/second (CPS)	Connections per second.
DROPNOSRVR	N/A	Connections dropped due to no server.
TOTALSTKY	Total Sticky Records	Total sticky connections.
N/A	Throughput	Throughput.
CURRSTKY	Current Sticky Records	The current sticky record.
N/A	Total Time For Server Responses	Total time for server responses.

The following is an example of a graphical plot that can be displayed on the GUI. Select a Cluster or Match Rule on the left navigational pane and click on the **Reporting** tab and then **Plotting**. The following will be displayed:

Sample Layer 7 Cluster Graphical Plot



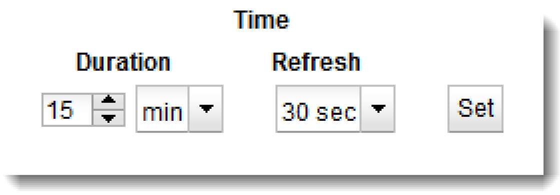
Statistics
- ✓ Transactions/second
- ✓ Connections/second
- ✓ Mbits Transmitted/second
- ✓ Mbits Received/second

Plot Type
- ● Static Time Span
- ○ Real Time Duration

Start Time- 05/09/2012 19:15:40
End Time- 05/09/2012 19:40:01

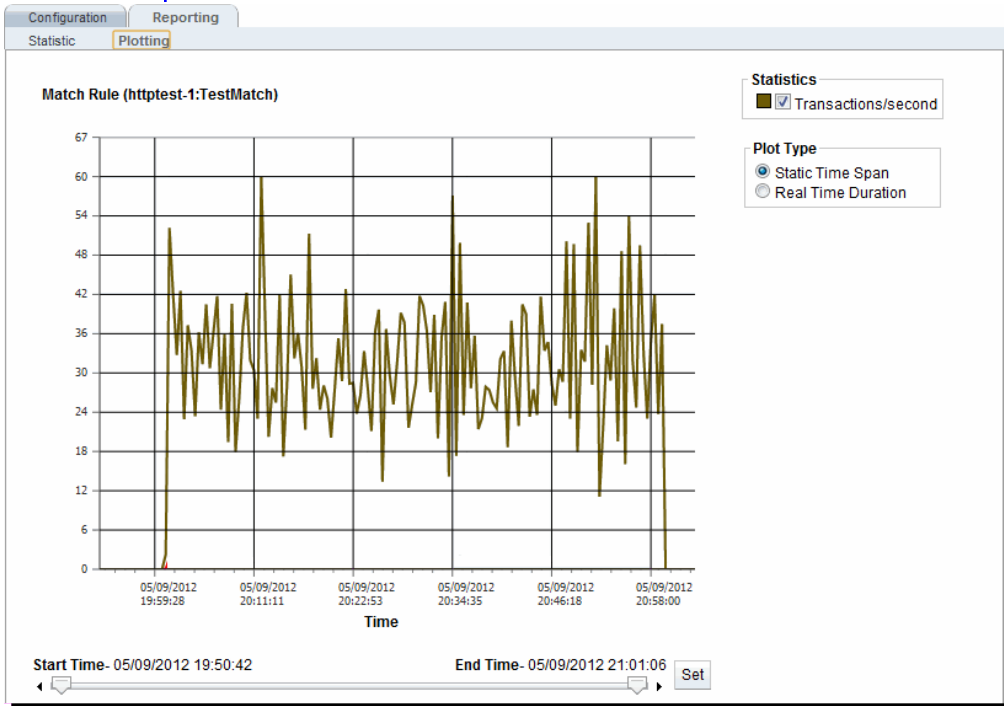
The specific types of statistics that are displayed are determined by the selections on the **Statistics** pane on the upper right corner of the GUI.Make selections based on the data that you require.

The **Plot Type** selection determines whether the display shown reflects a Static Time Span which is configured using the slider or whether a real time duration is display. If **Real Time Duration** is selected the slider controls will change to **Duration** and **Refresh** controls as shown below. In this case set the **Duration** of time in which you would like to review statistics and the **Refresh** rate desired.



Duration: 15 min
Refresh: 30 sec

Sample Match Rule Graphical Plot



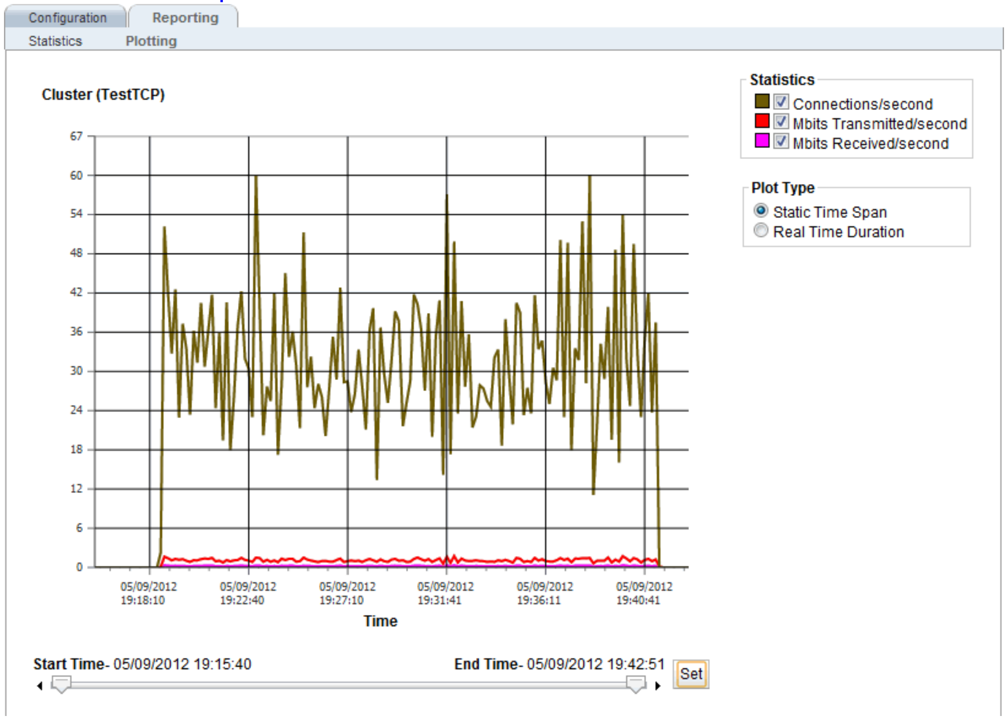
Statistics: ✓ Transactions/second

Plot Type: [● Static Time Span] Real Time Duration

Start Time- 05/09/2012 19:50:42

End Time- 05/09/2012 21:01:06

Sample Layer 4 Cluster Graphical Plot



Statistics: ✓ Connections/second; ✓ Mbits Transmitted/second; ✓ Mbits Received/second

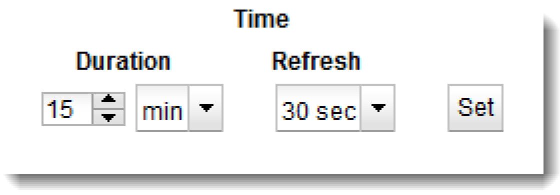
Plot Type: [● Static Time Span] Real Time Duration

Start Time- 05/09/2012 19:15:40

End Time- 05/09/2012 19:42:51

The specific types of statistics that are displayed are determined by the selections on the **Statistics** pane on the upper right corner of the GUI.Make selections based on the data that you require.

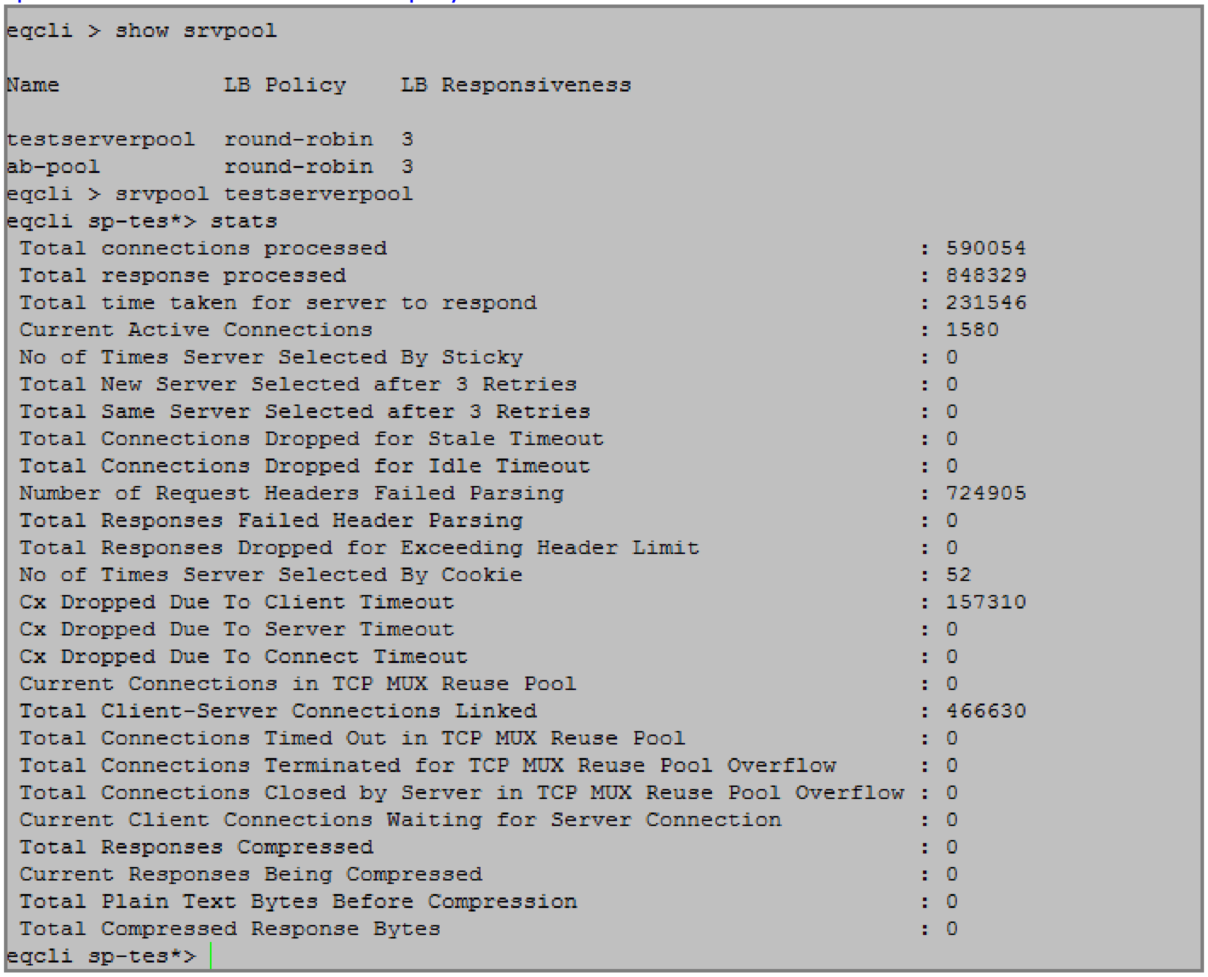
The **Plot Type** selection determines whether the display shown reflects a Static Time Span which is configured using the slider or whether a real time duration is display. If **Real Time Duration** is selected the slider controls will change to **Duration** and **Refresh** controls as shown below. In this case set the **Duration** of time in which you would like to review statistics and the **Refresh** rate desired.



Server Pool and Server Instance Reporting (CLI and GUI)

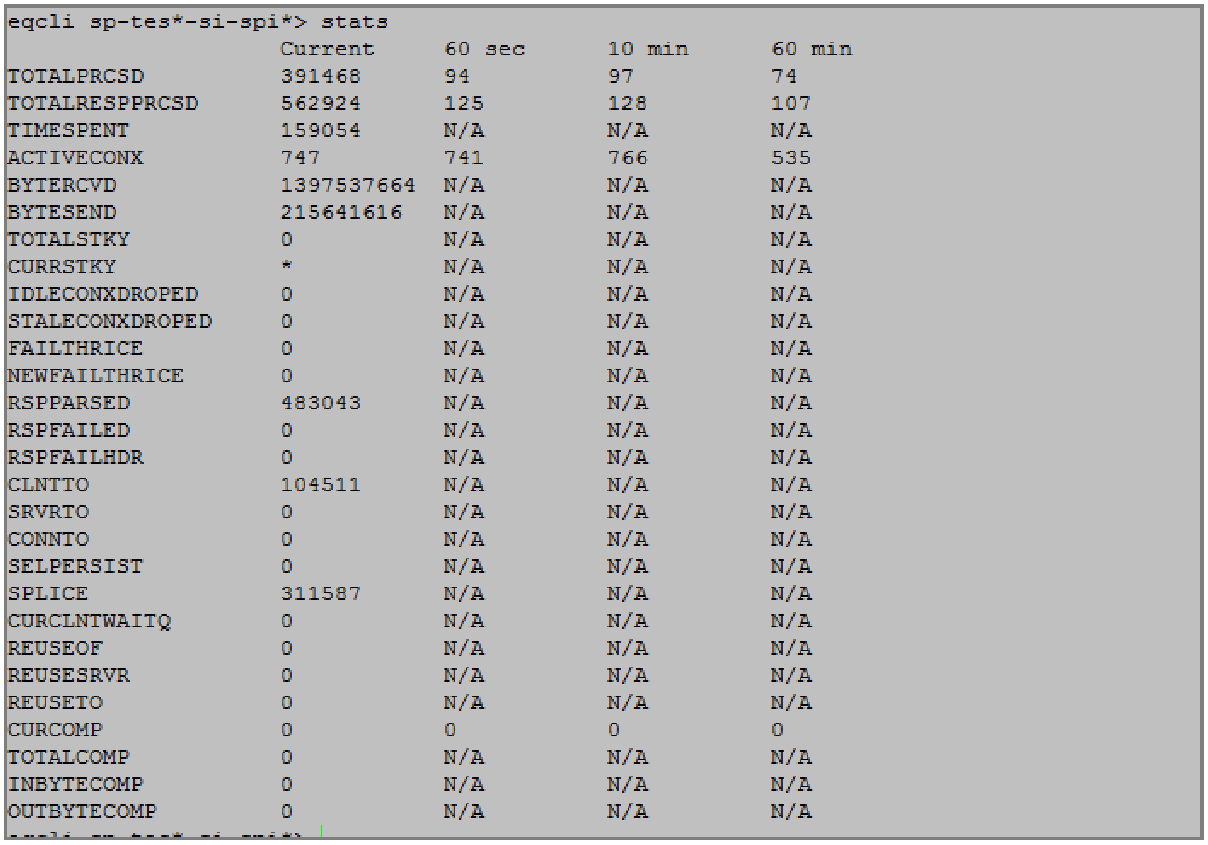
The CLI display of Statistics can be seen by entering the following within the server pool context:

Sample Server Pool Statistical Display



```
eqcli > show srvpool

Name             LB Policy    LB Responsiveness

testserverpool   round-robin  3
ab-pool          round-robin  3
eqcli > srvpool testserverpool
eqcli sp-tes*> stats
 Total connections processed                                    : 590054
 Total response processed                                       : 848329
 Total time taken for server to respond                         : 231546
 Current Active Connections                                     : 1580
 No of Times Server Selected By Sticky                          : 0
 Total New Server Selected after 3 Retries                      : 0
 Total Same Server Selected after 3 Retries                     : 0
 Total Connections Dropped for Stale Timeout                    : 0
 Total Connections Dropped for Idle Timeout                     : 0
 Number of Request Headers Failed Parsing                       : 724905
 Total Responses Failed Header Parsing                          : 0
 Total Responses Dropped for Exceeding Header Limit             : 0
 No of Times Server Selected By Cookie                          : 52
 Cx Dropped Due To Client Timeout                               : 157310
 Cx Dropped Due To Server Timeout                               : 0
 Cx Dropped Due To Connect Timeout                              : 0
 Current Connections in TCP MUX Reuse Pool                      : 0
 Total Client-Server Connections Linked                         : 466630
 Total Connections Timed Out in TCP MUX Reuse Pool              : 0
 Total Connections Terminated for TCP MUX Reuse Pool Overflow   : 0
 Total Connections Closed by Server in TCP MUX Reuse Pool Overflow : 0
 Current Client Connections Waiting for Server Connection       : 0
 Total Responses Compressed                                     : 0
 Current Responses Being Compressed                             : 0
 Total Plain Text Bytes Before Compression                      : 0
 Total Compressed Response Bytes                                : 0
eqcli sp-tes*>
```

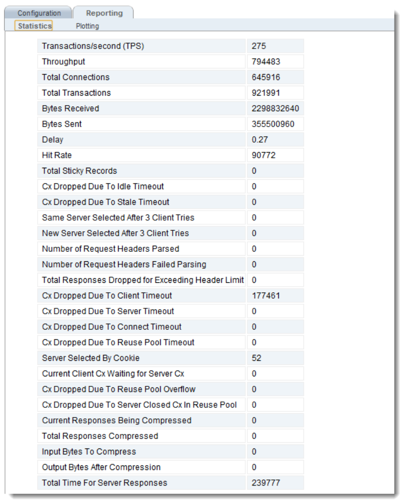
Sample Server Instance Statistical Display



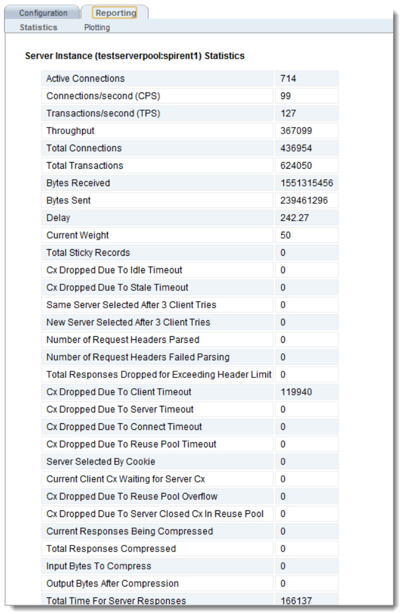
```
eqcli sp-tes*-si-spi*> stats
                    Current     60 sec      10 min      60 min
TOTALPRCSD          391468      94          97          74
TOTALRESPPRCSD      562924      125         128         107
TIMESPENT           159054      N/A         N/A         N/A
ACTIVECONX          747         741         766         535
BYTERCVD            1397537664  N/A         N/A         N/A
BYTESEND            215641616   N/A         N/A         N/A
TOTALSTKY           0           N/A         N/A         N/A
CURRSTKY            *           N/A         N/A         N/A
IDLECONXDROPED      0           N/A         N/A         N/A
STALECONXDROPED     0           N/A         N/A         N/A
FAILTHRICE          0           N/A         N/A         N/A
NEWFAILTHRICE       0           N/A         N/A         N/A
RSPPARSED           483043      N/A         N/A         N/A
RSPFAILED           0           N/A         N/A         N/A
RSPFAILHDR          0           N/A         N/A         N/A
CLNTTO              104511      N/A         N/A         N/A
SRVRTO              0           N/A         N/A         N/A
CONNTO              0           N/A         N/A         N/A
SELPERSIST          0           N/A         N/A         N/A
SPLICE              311587      N/A         N/A         N/A
CURCLNTWAITQ        0           N/A         N/A         N/A
REUSEOF             0           N/A         N/A         N/A
REUSESRVR           0           N/A         N/A         N/A
REUSETO             0           N/A         N/A         N/A
CURCOMP             0           0           0           0
TOTALCOMP           0           N/A         N/A         N/A
INBYTECOMP          0           N/A         N/A         N/A
OUTBYTECOMP         0           N/A         N/A         N/A
```

To view the GUI display, select a server pool or server instance on the left navigational pane and click on the **Reporting** tab to display statistics. The following will be displayed.

Sample Server Pool and Server Instance GUI Statisical Display



Transactions/second (TPS)	275
Throughput	794483
Total Connections	645916
Total Transactions	921991
Bytes Received	2298832640
Bytes Sent	355500960
Delay	0.27
Hit Rate	90772
Total Sticky Records	0
Cx Dropped Due To Idle Timeout	0
Cx Dropped Due To Stale Timeout	0
Same Server Selected After 3 Client Tries	0
New Server Selected After 3 Client Tries	0
Number of Request Headers Parsed	0
Number of Request Headers Failed Parsing	0
Total Responses Dropped for Exceeding Header Limit	0
Cx Dropped Due To Client Timeout	177461
Cx Dropped Due To Server Timeout	0
Cx Dropped Due To Connect Timeout	0
Cx Dropped Due To Reuse Pool Timeout	0
Server Selected By Cookie	52
Current Client Cx Waiting for Server Cx	0
Cx Dropped Due To Reuse Pool Overflow	0
Cx Dropped Due To Server Closed Cx In Reuse Pool	0
Current Responses Being Compressed	0
Total Responses Compressed	0
Input Bytes To Compress	0
Output Bytes After Compression	0
Total Time For Server Responses	239777



Server Instance (testserverpool:spirent1) Statistics

Active Connections	714
Connections/second (CPS)	99
Transactions/second (TPS)	127
Throughput	367099
Total Connections	436954
Total Transactions	624050
Bytes Received	1551315456
Bytes Sent	239461296
Delay	242.27
Current Weight	50
Total Sticky Records	0
Cx Dropped Due To Idle Timeout	0
Cx Dropped Due To Stale Timeout	0
Same Server Selected After 3 Client Tries	0
New Server Selected After 3 Client Tries	0
Number of Request Headers Parsed	0
Number of Request Headers Failed Parsing	0
Total Responses Dropped for Exceeding Header Limit	0
Cx Dropped Due To Client Timeout	119940
Cx Dropped Due To Server Timeout	0
Cx Dropped Due To Connect Timeout	0
Cx Dropped Due To Reuse Pool Timeout	0
Server Selected By Cookie	0
Current Client Cx Waiting for Server Cx	0
Cx Dropped Due To Reuse Pool Overflow	0
Cx Dropped Due To Server Closed Cx In Reuse Pool	0
Current Responses Being Compressed	0
Total Responses Compressed	0
Input Bytes To Compress	0
Output Bytes After Compression	0
Total Time For Server Responses	166137

The following are definitions for the statistical terms shown on both the CLI and GUI:

Server Pool Statistic Definitions

CLI Term	GUI Term	Definition
Total connections processed	Total Connections	Connections Processed.
Total response processed	Total Transactions	Responses Processed.
Total time taken for server to respond	Total Time For Server Responses	Total Time For Server Responses
Current Active Connections	Active Connections	Active Connections.
No of Times Server Selected By Sticky	Total Sticky Records	Total Sticky Records.
Total New Server Selected after 3 Retries	New Server Selected After 3 Client Tries	New Server Selected After 3 Client Tries.
Total Same Server Selected after 3 Retries	Same Server Selected After 3 Client Tries	Same Server Selected After 3 Client Tries.
Total Connections Dropped for Stale Timeout	Cx Dropped Due To Stale Timeout	Connections dropped due to stale timeout.
Total Connections Dropped for Idle Timeout	Cx Dropped Due To Idle Timeout	Total Connections Dropped for Idle Timeout.
Number of Request Headers Failed Parsing	Number of Request Headers Failed Parsing	Number of Request Headers Failed Parsing.
Total Responses Failed Header Parsing	Number of Request Headers Failed Parsing	Number of Request Headers Failed Parsing.
Total Responses Dropped for Exceeding Header Limit	Total Responses Dropped for Exceeding Header Limit	Total Responses Dropped for Exceeding Header Limit.
No of Times Server Selected By Cookie	Server Selected By Cookie	No of Times Server Selected By Cookie.
Cx Dropped Due To Client Timeout	Cx Dropped Due To Client Timeout	Connections dropped due to client timeout.
Cx Dropped Due To Server Timeout	Cx Dropped Due To Server Timeout	Connections dropped due to server timeout
Cx Dropped Due To Connect Timeout	Cx Dropped Due To Connect Timeout	Connections dropped due tto connect timeout.
Current Connections in TCP MUX Reuse Pool	Cx Dropped Due To Reuse Pool Timeout	Connections dropped due to reuse pool timeout.
Total Client-Server Connections Linked	Current Client Cx Waiting for Server Cx	Total client-server connections linked
Total Connections Timed Out in TCP MUX Reuse Pool	Cx Dropped Due To Reuse Pool Timeout	Total connections timed out in TCP MUX reuse pool.
Total Connections Terminated for	Cx Dropped Due To Reuse Pool	Total connections timed out in TCP MUX reuse pool.

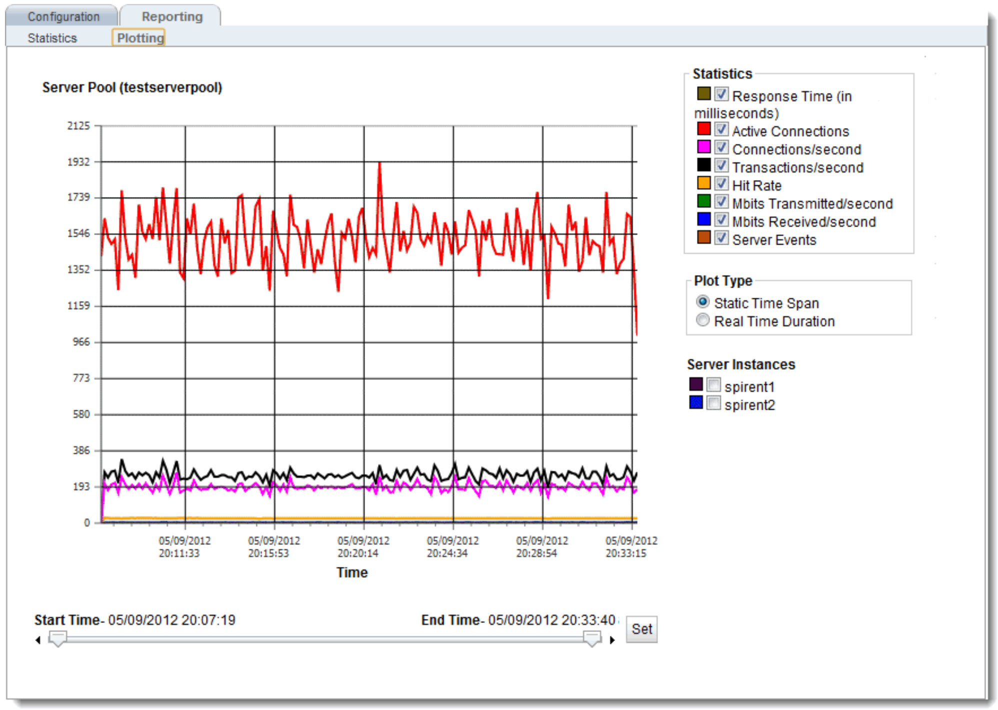
CLI Term	GUI Term	Definition
TCP MUX Reuse Pool Overflow	Overflow	
Total Connections Closed by Server in TCP MUX Reuse Pool Overflow	Cx Dropped Due To Server Closed Cx In Reuse Pool	Total connections closed by server in TCP MUX reuse pool overflow.
Current Client Connections Waiting for Server Connection	Current Client Cx Waiting for Server Cx	Current client connections waiting for server connection
Total Responses Compressed	Total Responses Compressed	Total responses compressed.
Current Responses Being Compressed	Current Responses Being Compressed	Current responses being compressed.
Total Plain Text Bytes Before Compression	Input Bytes To Compress	Total plain text bytes before compression
Total Compressed Response Bytes	Total Responses Compressed	Total responses compressed.

Server Instance Statistic Definitions

CLI Term	GUI Term	Definition
TOTALPRCSD	Total Connections	Connections Processed.
TOTALRESPPRCSD	Total Transactions	Responses Processed.
TIMESPENT	Total Time For Server Responses	Total time for server responses.
ACTIVECONX	Active Connections	Active Connections.
BYTERCVD	Bytes Received	Bytes received from peer.
BYTESEND	Bytes Sent	Bytes transmitted to peer.
TOTALSTKY	Total Sticky Records	Total sticky connections
CURRSTKY	Total Sticky Records	Current sticky record.
IDLECONXDROPED	Cx Dropped Due To Idle Timeout	Connections dropped for idle timeout.
STALECONXDROPED	Cx Dropped Due To Stale Timeout	Connections dropped for stale timeout.
FAILTHRICE	Same Server Selected After 3 Client Tries	Same server selected after 3 retries.
NEWFAILTHRICE	New Server Selected After 3 Client Tries	New server selected after 3 retries.
RSPPARSED	Number of Request Headers Parsed	Response headers parsed.
RSPFAILED	Number of Request Headers	Responses failed header parsing.

CLI Term	GUI Term	Definition
	Failed Parsing	
RSPFAILHDR	Total Responses Dropped for Exceeding Header Limit	Responses dropped for exceeding header limit.
CLNTTO	Cx Dropped Due To Client Timeout	Connections dropped due to client timeout.
SRVRTO	Cx Dropped Due To Server Timeout	Connections dropped due to server timeout
CONNTO	Cx Dropped Due To Connect Timeout	Connections dropped due to connect timeout.
SELPERSIST	Server Selected By Cookie	No of Times Server Selected By Cookie.
SPLICE	Total Connections	Total client-server connections linked.
CURCLNTWAITQ	Current Client Cx Waiting for Server Cx	Client connections waiting for server connection.
REUSEOF	Cx Dropped Due To Reuse Pool Overflow	Connection dropped due to reuse pool overflow
REUSESRVR	Cx Dropped Due To Server Closed Cx In Reuse Pool	Connection dropped due to server closed connection in reuse pool.
REUSETO	Cx Dropped Due To Reuse Pool Timeout	Total connections timed out in TCP MUX reuse pool.
CURCOMP	Current Responses Being Compressed	Current responses being compressed.
TOTALCOMP	Total Responses Compressed	Total responses compressed.
INBYTECOMP	Input Bytes To Compress	Total plain text bytes before compression.
OUTBYTECOMP	Output Bytes After Compression	Total compressed response bytes.

The following is a graphical plot that can be displayed on the GUI. Select a server pool or server instance on the left navigational pane and click on the **Reporting** tab and then **Plotting**. The following will be displayed

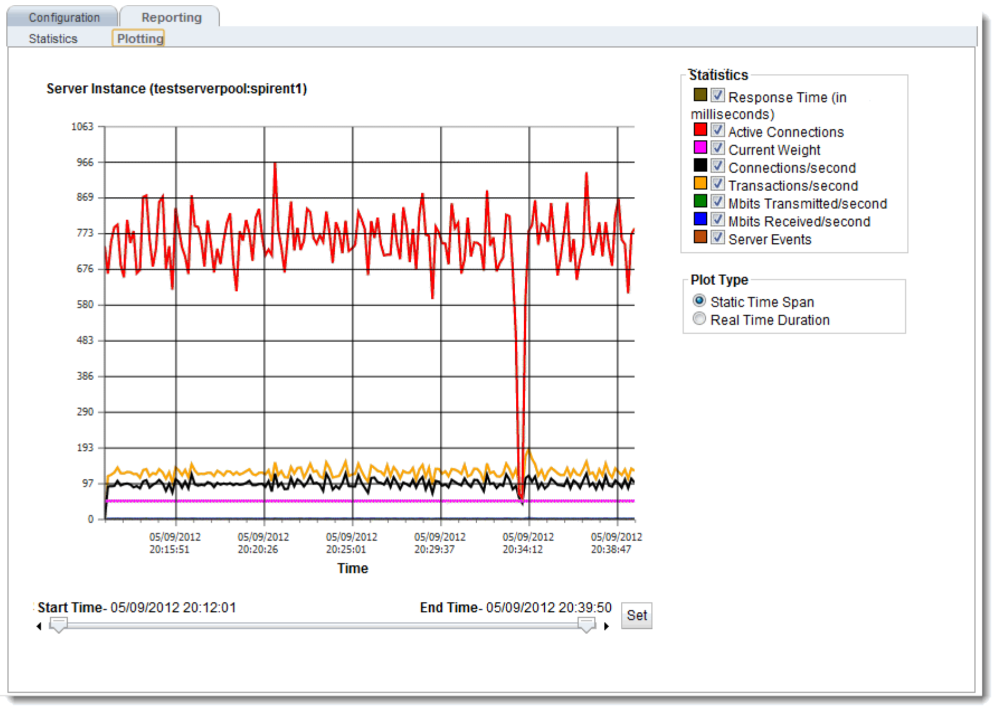


Statistics
- [✓] Response Time (in milliseconds)
- [✓] Active Connections
- [✓] Connections/second
- [✓] Transactions/second
- [✓] Hit Rate
- [✓] Mbits Transmitted/second
- [✓] Mbits Received/second
- [✓] Server Events

Plot Type
- [● Static Time Span]
- Real Time Duration

Server Instances
- [ ] spirent1
- [ ] spirent2

Start Time- 05/09/2012 20:07:19 **End Time**- 05/09/2012 20:33:40



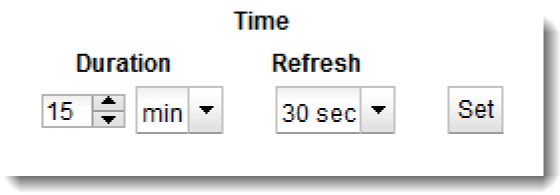
Statistics
- [✓] Response Time (in milliseconds)
- [✓] Active Connections
- [✓] Current Weight
- [✓] Connections/second
- [✓] Transactions/second
- [✓] Mbits Transmitted/second
- [✓] Mbits Received/second
- [✓] Server Events

Plot Type
- [● Static Time Span]
- Real Time Duration

Start Time- 05/09/2012 20:12:01 **End Time**- 05/09/2012 20:39:50

The specific types of statistics that are displayed are determined by the selections on the **Statistics** pane on the upper right corner of the GUI.Make selections based on the data that you require.

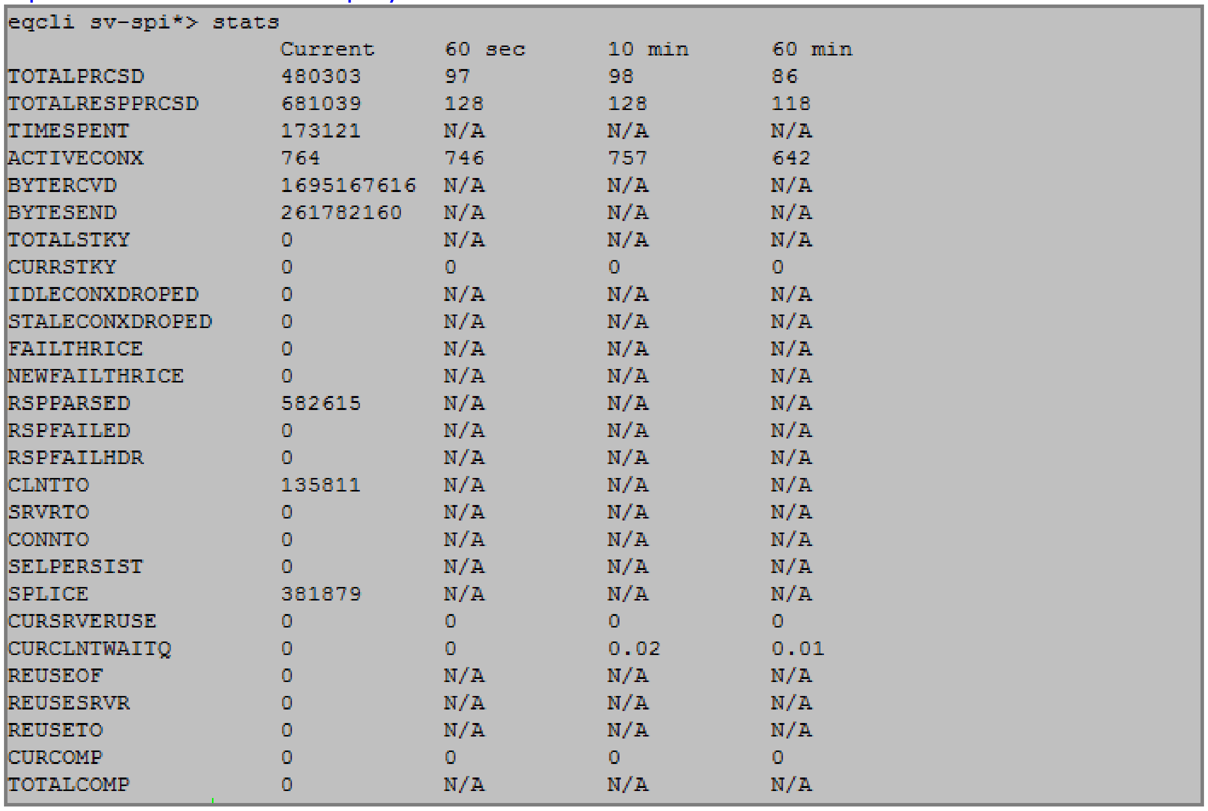
The **Plot Type** selection determines whether the display shown reflects a Static Time Span which is configured using the slider or whether a real time duration is display. If **Real Time Duration** is selected the slider controls will change to **Duration** and **Refresh** controls as shown below. In this case set the **Duration** of time in which you would like to review statistics and the **Refresh** rate desired.



Server Reporting (CLI and GUI)

The CLI display of Statistics can be seen by entering the following within the server context:

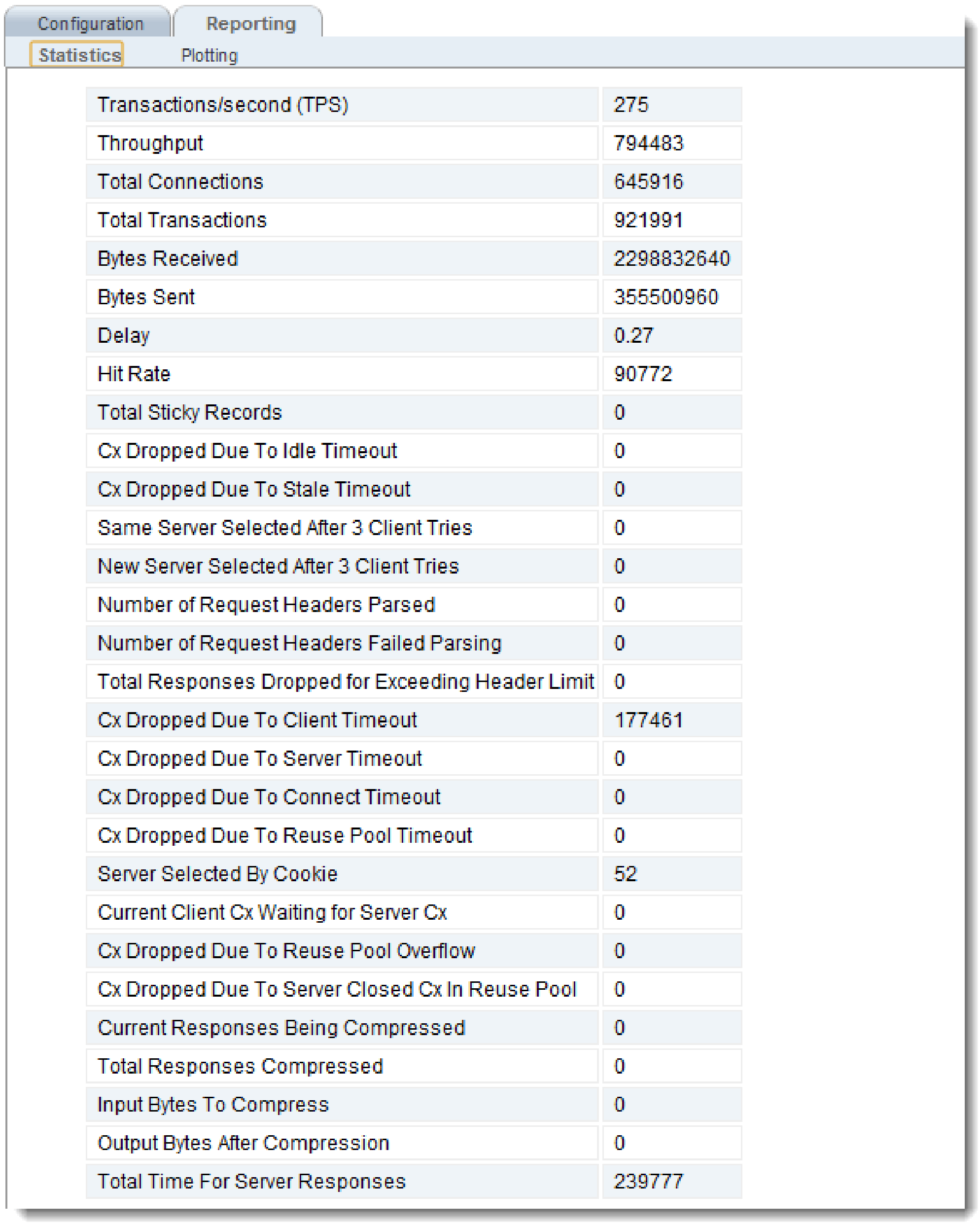
Sample Server Statistics Display



```
eqcli sv-spi*> stats
                    Current     60 sec      10 min      60 min
TOTALPRCSD          480303      97          98          86
TOTALRESPPRCSD      681039      128         128         118
TIMESPENT           173121      N/A         N/A         N/A
ACTIVECONX          764         746         757         642
BYTERCVD            1695167616  N/A         N/A         N/A
BYTESEND            261782160   N/A         N/A         N/A
TOTALSTKY           0           N/A         N/A         N/A
CURRSTKY            0           0           0           0
IDLECONXDROPED      0           N/A         N/A         N/A
STALECONXDROPED     0           N/A         N/A         N/A
FAILTHRICE          0           N/A         N/A         N/A
NEWFAILTHRICE       0           N/A         N/A         N/A
RSPPARSED           582615      N/A         N/A         N/A
RSPFAILED           0           N/A         N/A         N/A
RSPFAILHDR          0           N/A         N/A         N/A
CLNTTO              135811      N/A         N/A         N/A
SRVRTO              0           N/A         N/A         N/A
CONNTO              0           N/A         N/A         N/A
SELPERSIST          0           N/A         N/A         N/A
SPLICE              381879      N/A         N/A         N/A
CURSRVERUSE         0           0           0           0
CURCLNTWAITQ        0           0           0.02        0.01
REUSEOF             0           N/A         N/A         N/A
REUSESRVR           0           N/A         N/A         N/A
REUSETO             0           N/A         N/A         N/A
CURCOMP             0           0           0           0
TOTALCOMP           0           N/A         N/A         N/A
```

To view the GUI display, select a server on the left navigational pane and click on the **Reporting** tab to display statistics. The following will be displayed.

Sample Server Statistics GUI Display



Transactions/second (TPS)	275
Throughput	794483
Total Connections	645916
Total Transactions	921991
Bytes Received	2298832640
Bytes Sent	355500960
Delay	0.27
Hit Rate	90772
Total Sticky Records	0
Cx Dropped Due To Idle Timeout	0
Cx Dropped Due To Stale Timeout	0
Same Server Selected After 3 Client Tries	0
New Server Selected After 3 Client Tries	0
Number of Request Headers Parsed	0
Number of Request Headers Failed Parsing	0
Total Responses Dropped for Exceeding Header Limit	0
Cx Dropped Due To Client Timeout	177461
Cx Dropped Due To Server Timeout	0
Cx Dropped Due To Connect Timeout	0
Cx Dropped Due To Reuse Pool Timeout	0
Server Selected By Cookie	52
Current Client Cx Waiting for Server Cx	0
Cx Dropped Due To Reuse Pool Overflow	0
Cx Dropped Due To Server Closed Cx In Reuse Pool	0
Current Responses Being Compressed	0
Total Responses Compressed	0
Input Bytes To Compress	0
Output Bytes After Compression	0
Total Time For Server Responses	239777

The following are definitions for the statistical terms shown on both the CLI and GUI:

Server Statistic Definitions

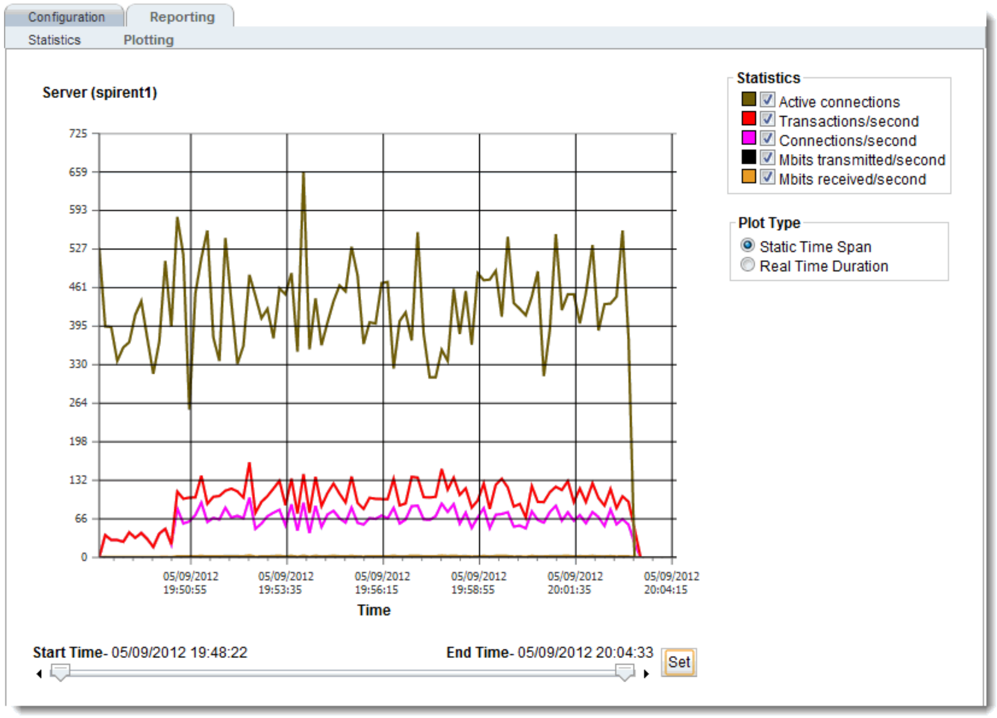
CLI Term	GUI Term	Definition
TOTALPRCSD	N/A	Connections processed.
TOTALRESPPRCSD	Total Transactions	Responses processed.
TIMESPENT	Total Time For Server Responses	The total time spent on this object.
ACTIVECONX	Active Connections	Active connections.

CLI Term	GUI Term	Definition
BYTERCVD	Bytes Received	Bytes received.
BYTESEND	Bytes Sent	Bytes transmitted.
TOTALSTKY	Total Sticky Records	Total sticky connections.
CURRSTKY	Current Sticky Records	Current sticky records.
IDLECONXDROPED	Cx Dropped Due To Idle Timeout	Connections dropped for idle timeout.
STALECONXDROPED	Cx Dropped Due To Stale Timeout	Connections dropped for stale timeout.
FAILTHRICE	Same Server Selected After 3 Client Tries	Same server selected after 3 retries.
NEWFAILTHRICE	New Server Selected After 3 Client Tries	New server selected after 3 retries.
RSPPARSED	Number of Request Headers Parsed	Response headers parsed.
RSPFAILED	Number of Request Headers Failed Parsing	Responses failed header parsing.
RSPFAILHDR	Total Responses Dropped for Exceeding Header Limit	Responses dropped for exceeding the header limit.
CLNTTO	Cx Dropped Due To Client Timeout	Connections dropped due to client timeout.
SRVRTO	Cx Dropped Due To Server Timeout	Connections dropped due to server timeout.
CONNTO	Cx Dropped Due To Connect Timeout	Connections dropped due to connect timeout.
SELPERSIST	Cx Dropped Due To Reuse Pool Timeout	The number of times the server was selected by a cookie.
SPLICE	Server Selected By Cookie	The total number of client-server connections linked.
CURSRVERUSE	Server Cx In Reuse Pool	The number of connections in the TCP MUX reuse pool.
CURCLNTWAITQ	Client Cx In Wait Queue	The number of client connections in the wait queue.
REUSEOF	Cx Dropped Due To Reuse Pool Overflow	The number of connections dropped due to reuse pool overflow.
REUSESRVR	Cx Dropped Due To Server Closed Cx In Reuse Pool	The number of connections dropped due to server closing a connection in the reuse pool.
REUSETO	Current Client Cx Waiting for Server Cx	Total connections timed out in TCP MUX reuse pool.
CURCOMP	Current Responses Being Compressed	Current responses being compressed.
TOTALCOMP	Total Responses Compressed	Total responses compressed.

CLI Term	GUI Term	Definition
N/A	Input Bytes To Compress	Input Bytes To Compress
N/A	Output Bytes After Compression	Output Bytes After Compression

The following is a graphical plot that can be displayed on the GUI. Select a server e on the left navigational pane and click on the **Reporting** tab and then **Plotting**. The following will be displayed:

Sample Server Plot

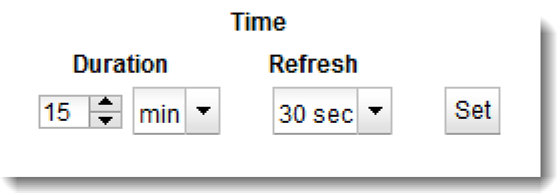


Start Time- 05/09/2012 19:48:22

End Time- 05/09/2012 20:04:33

The specific types of statistics that are displayed are determined by the selections on the **Statistics** pane on the upper right corner of the GUI.Make selections based on the data that you require.

The **Plot Type** selection determines whether the display shown reflects a Static Time Span which is configured using the slider or whether a real time duration is display. If **Real Time Duration** is selected the slider controls will change to **Duration** and **Refresh** controls as shown below. In this case set the **Duration** of time in which you would like to review statistics and the **Refresh** rate desired.



Duration: 15 min

Refresh: 30 sec

Responder Reporting (CLI and GUI)

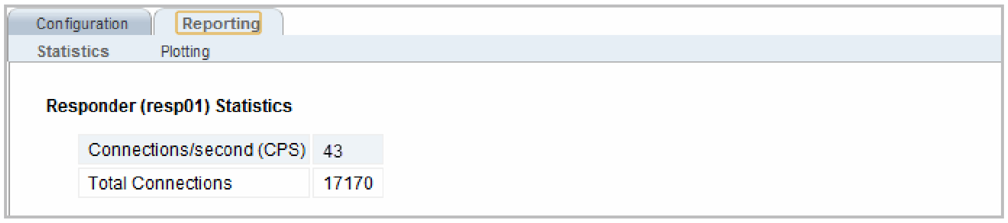
The CLI display of Statistics can be seen by entering the following within the responder context:

Sample Responder Statistics Display)

```
eqcli rsp-res*> stats

                   Current       60 sec        10 min        60 min
TOTALPRCSD         0             0             60            600

eqcli rsp-res*>
```

To view the GUI display, select a responder on the left navigational pane and click on the **Reporting** tab to display statistics. The following will be displayed.

Sample ResponderGUI Statistics Display



Responder (resp01) Statistics

Connections/second (CPS)	43
Total Connections	17170

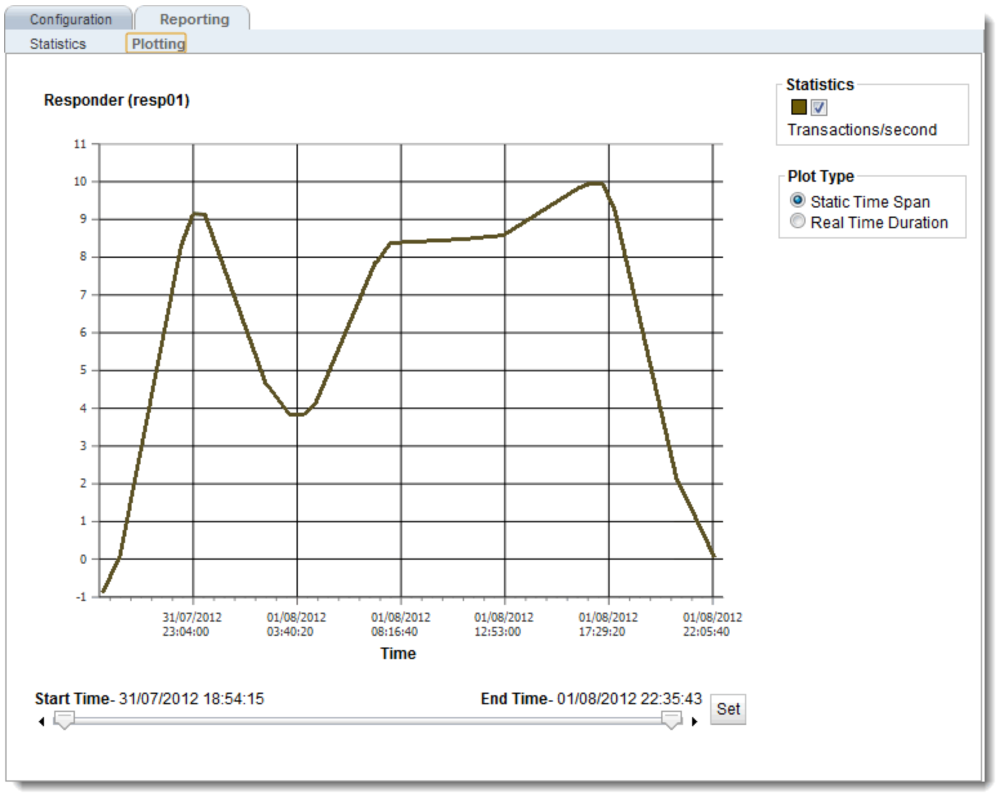
The following are definitions for the statistical terms shown on both the CLI and GUI:

Responder Statistics Definitions

CLI Term	GUI Term	Definition
N/A	Connections/second (CPS)	Connections/second
N/A	Transactions/second (TPS)	Transactions/second
N/A	Throughput	Throughput.
N/A	Total Connections	Total connections.
N/A	Active Connections	Active connections.
N/A	Bytes Received	Bytes received.
N/A	Bytes Sent	Bytes sent.
TOTALPRCSD	N/A	Connections Processed

The following is a graphical plot that can be displayed on the GUI. Select a Responder on the left navigational pane and click on the **Reporting** tab and then **Plotting**. The following will be displayed:

Sample Responder Plot



Statistics: ✓ Transactions/second

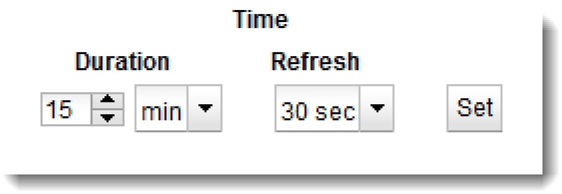
Plot Type: [● Static Time Span] Real Time Duration

Start Time- 31/07/2012 18:54:15

End Time- 01/08/2012 22:35:43

The specific types of statistics that are graphically displayed are determined by the selections on the **Statistics** pane on the upper right corner of the GUI.Make selections based on the data that you require. As you can see from the figure above, the Responder statistic displays only **Transactions/second**.

The **Plot Type** selection determines whether the display shown reflects a Static Time Span which is configured using the slider or whether a real time duration is display. If **Real Time Duration** is selected the slider controls will change to **Duration** and **Refresh** controls as shown below. In this case set the **Duration** of time in which you would like to review statistics and the **Refresh** rate desired.



Duration: 15 min

Refresh: 30 sec

Chapter 22

Failover

Sections within this chapter include:

Understanding Failover

In an Active/Passive failover configuration, two Equalizers are configured into active and passive roles, with the active Equalizer serving cluster traffic. A "failover" is said to occur when the active Equalizer stops processing client requests and the passive Equalizer starts processing cluster traffic.

When two Equalizers are configured into this failover configuration, they form a "failover pair". An Equalizer in a failover pair is called a "peer". At any given time, only one of the Equalizers in a failover pair is actually servicing requests sent to the cluster IP addresses defined in the configuration -- this unit is called the "active peer" or the "current primary" Equalizer in the pairing. The other Equalizer, called the “passive peer” or "current backup", does not process any client requests.

Both units continually send "heartbeat probes" or "failover probes" to one another. If the current primary does not respond to heartbeat probes, a failover occurs. In this scenario the current backup Equalizer assumes the primary role by assigning the cluster IP addresses to its network interfaces and begins processing cluster traffic.

In an Active/Active failover configuration, clusters are Active on *both* peers in the configuration. For the same failure situations that cause a peer to take over all the cluster and floating IP addresses in an Active/Passive failover configuration, Active/Active failover operates the same way - that is that a healthy peer will take over all of the cluster and failover IPs. This type of failover configuration is available when using two Equalizers using EQ/OS 10.

This section provides instructions for the configuration of Active/Passive failover between an EQ/OS 8.6 and EQ/OS 10 system and two EQ/OS 10 systems and Active/Active failover between two EQ/OS 10 systems.

How Equalizer Determines if it Should Assume the Primary Role

Equalizer expects to see a heartbeat from a failover peer (all failover peers in Active/Active Failover configuration [See "Configuring Active/Active Failover Between Two EQ/OS 10 Systems" on page 456]).within a "heartbeat interval" (time in seconds) on every subnet where a heartbeat flag is configured. When a "Failed Probe Count" value is reached - that is, when that number of heartbeat probe intervals has elapsed without receiving a heartbeat from a peer -the backup unit will attempt to assume primary role.

Equalizer will:

1. Check to see if any of the cluster or failover IP addresses defined in its configuration are already on the network -using ICMP requests/replies.

2. Perform checks on its locally defined networks and determine the number of subnets on which it has connectivity. It compares this information to the connectivity information in the last heartbeat received from the peer that reached the "Failed Probe Count" value.

    a. If the Global "Failed Probe Count" on the failover configuration = 0, then the "Failed Probe Count" configured on the subnet will be used to determine when failover occurs.

    b. If the Global "Failed Probe Count" is reached BEFORE the "Failed Probe Count" configured on the subnet, then failover will occur.

c. If the "Failed Probe Count" configured on the subnet is reached BEFORE the Global "Failed Probe Count" a failover will occur.

3. If Equalizer determines that no other systems own any of its cluster or failover IP addresses AND it has better connectivity than the peer, it becomes "Primary" otherwise, it will remain a "Backup".

Heartbeating MUST be established on an interface before failover can occur. If failover is configured between two peers, and the cable is removed from the primary peer, the backup will assume the role as the new primary. If the cable is removed from the "new" primary BEFORE heartbeating has been reestablished with the previous primary, this peer WILL NOT failover since heartbeating was never reestablished.

Releases Supported for Failover with EQ/OS 10

An Equalizer running EQ/OS 10 can be configured into failover with another Equalizer running either of these releases:

- EQ/OS 10
- EQ/OS 8.6 (latest release)

Note - Failover is *not* supported between EQ/OS 10 and any release prior to EQ/OS 8.6.0c.

Guidelines for Upgrading a Failover Pair from EQ/OS 8.6 to EQ/OS 10

The preferred method of upgrading the OS from EQ/OS 8.6 to EQ/OS 10 is:

1. Upgrade the preferred backup Equalizer to EQ/OS 10, while it is in backup failover mode. Refer to "Version 8.6 Upgrade Procedure" on page 58 for instructions.
2. Configure the EQ/OS 10 unit and the EQ/OS 8.6 unit into failover, with the EQ/OS 8.6 unit as the preferred primary. Run the two units in failover to validate that the units are communicating properly as observed on the EQ/OS 10 unit.
3. Test failover to EQ/OS 10 by rebooting the EQ/OS 8.6 system so that the EQ/OS 10 system becomes the current primary. Then, reboot the EQ/OS 10 unit to test failover to the EQ/OS 8.6 unit.
4. While the EQ/OS 8.6 system is the current backup, upgrade it to EQ/OS 10. Verify that the units are communicating properly. Reboot each unit to ensure that the other unit assumes the primary role.

Guidelines for Updating a Failover Pair with Both Units Using EQ/OS 10

The following guidelines should be adhered to when upgrading a failover pair between two EQ OS 10 systems.

1. Verify that your current failover configuration is operating properly and that there are no error messages in the Peer Summary Screen on the GUI ("Configuring Active/Passive Failover (GUI)" on page 451) or CLI ("Peer Commands" on page 164).

2. Upgrade the backup Equalizer first. ("Upgrading to the Latest Release" on page 65) The unit should be configured in failover prior to the upgrade.

3. After upgrading immediately check the logs in the CLI or "Events Log" on page 205 in the GUI and view the Equalizer's **Event Log** and **Syslog** for VLAN "mismatch" errors. Also check the GUI Peer Summary screen for failover related errors. If the Log or Syslog indicate a VLAN mismatch, configuration synchronization will be automatically disabled. As long as the 2 failover peers are heartbeating and a subnet configured with the command flag enabled works properly, they will exchange configuration files. It is possible that a VLAN mismatch will not allow them to synchronize properly.

    a. Check the VLANs and subnets on the Primary and Backup Equalizer to verify that they are configured identically.

    b. Check the messages in log for configuration file mismatch. If there is a configuration file mismatch, upgrade the primary equalizer.Until the primary equalizer is upgraded configuration changes will need to be made on both units for failover to work properly.

Failover Between EQ/OS 8.6 and EQ/OS 10

The procedures in this section show you how to configure failover using an Equalizer running EQ/OS 8.6 as the preferred primary and an Equalizer running EQ/OS 10 as the preferred backup.

EQ/OS Version 8.6 Failover Constraints

An Equalizer running EQ/OS 10 can be configured into failover with an Equalizer running EQ/OS 8.6, subject to these constraints:

- The failover configuration is limited to two (2) VLANs only; both Equalizers must be configured with at most two VLANs.

- Configuration synchronization is *not supported* (that is, the **dont transfer** option must be enabled on both units). The configurations on both devices must be updated manually to maintain equivalent configurations, meaning the following:

The VLAN configuration on the EQ/OS 10 Equalizer must match that of the Version 8.6 Equalizer. This includes the subnets and failover IP addresses set on each system. [Note that although EQ/OS 10 supports multiple subnets per VLAN, you can only configure one subnet per VLAN when enabling failover with an EQ/OS 8.6 system.]

Clusters and servers must be configured equivalently on both systems. This means that cluster and server IP addresses, ports, and parameters must be set to the same values on both systems. The difference is that on EQ/OS 8.6, servers are assigned directly to clusters, while on EQ/OS 10, servers are assigned to server pools and then to clusters. The important point is that the server pool used in a cluster on EQ/OS 10 must be configured with the same servers used in the equivalent cluster on the EQ/OS 8.6 system.

- On the EQ/OS 8.6 system, failover must be configured manually as shown in the procedure below (i.e., you cannot use the Failover Wizard).

Server Availability Constraint

For failover to initialize correctly, at least one server or gateway configured on a subnet defined on Equalizer must be responding to ARP (Address Resolution Protocol) requests. Otherwise, Equalizer will remain in the "initializing" failover state and will not assume the backup or primary role.

On EQ/OS 10, you can check server availability status in `eqcli` using this command:

```
eqcli > server server_name stats
```

On EQ/OS 8.6 and EQ/OS 10, server availability can be checked in the GUI by looking at the icons next to the server name in the left pane object tree. In Version 8.6, unavailable servers have an exclamation point (**!**) icon displayed over the server icon. In Version 10, unavailable servers have an exclamation point icon displayed to the right of the server icon.

Enable Failover of EQ/OS 8.6 to EQ/OS 10

Note - EQ/OS 8.6 uses the web-based GUI for all failover configuration.

On EQ/OS 10, you can set up failover using either the CLI or the GUI, but failover status information is currently only visible in the CLI **peer** context.

Perform the following to enable failover between one Equalizer running EQ/OS 10 and one running EQ/OS 8.6.

1. Configure the Equalizer running EQ/OS 8.6:
    a. Perform initial system configuration as outlined in the 8.6 *Installation and Administration Guide*.
    b. Create all required VLANs, clusters, servers, etc., required for your configuration.
    c. Ensure that the configuration is working properly. In particular, make sure that at least one server is active (that is, marked "up" in the GUI). Failover will not properly initialize if Equalizer cannot successfully probe at least one server.
2. Add the VLAN IP addresses. Once you verify that the EQ/OS 8.6 system is working properly in standalone mode, open the **Equalizer > Network > VLAN Configuration** tab and do the following for *each* VLAN in the table:
    a. Click the modify icon .
    b. Enter a **Failover IP** address and **Failover Netmask** for the VLAN.
    c. Enable the **Use IP for Failover Heartbeat** check box.
    d. Click **commit**.

3. Configure failover peers on the EQ/OS 8.6 system.

    a. Click **Mode: Standalone** at the top of the left frame to open the **Failover > Required** tab.

    b. Uncheck (turn off) the **Disable Failover** check box.

    c. In the **This Equalizer** section, check (turn on) the **Preferred Primary** check box.

    d. In the **Peer Equalizer** section, do the following:

    - Enter any name you like for **Equalizer Name** and any string of characters for **Signature**.

    - Enter **VLAN IP** addresses for each VLAN -- these are the IP addresses that you will assign later on the Equalizer running EQ/OS 10.

Note - The **Failover Parameters** section should display the **Failover IP** addresses you configured on the **VLAN Configuration** tab earlier.]

    e. Click **commit**.

    f. Open the **Failover > Synchronization** tab and do the following:

    - Check (turn on) the **dont transfer** check box.

    - Uncheck (turn off) the **Use SSL only** check box.

    - Click **commit**.

    g. Click **Help > About** and expand the system information box; the **failover mode** should now be **primary** (you may need to manually refresh the browser to see the change of state immediately).

    If the failover mode remains in the **initializing** state, make sure that at least one server is active (that is, marked "up" in the GUI). Failover in Version 8.6 will not properly initialize if Equalizer cannot successfully probe at least one server on the network.

4. Configure the EQ/OS 10 system as the preferred backup:

    a. Configure all required VLANS, servers, and server pools as described in "Network Configuration" on page 77, "Configuring Server Connections" on page 359, and "Server Pools and Server Instances" on page 229, using settings that are equivalent to the settings used on the EQ/OS 8.6 system. Note the following:

    - ***Do not configure any clusters at this time.*** We'll configure clusters *after* we configure the system into failover, so that we don't have both systems trying to assign the same cluster IP addresses.

- Be sure to use the same VLAN IP addresses on the EQ/OS 10 system that you specified in Step "Failover Between EQ/OS 8 and EQ/OS 10" on page 427"Failover Between EQ/OS 8 and EQ/OS 10" on page 427.

b. Assign a virtual IP address to the default subnet of each already configured VLAN, as in the examples below. ***The virt_addr values entered must match the Failover IP addresses and Failover Netmasks assigned on the EQ/OS 8.6 system in Step 2b.***

```
eqcli > vlan Mgmt subnet Default virt_addr 172.16.0.210
eqcli > vlan Servers subnet Default virt_addr 192.168.0.210
```

c. Enter this command to configure the peer object for the EQ/OS 8.6 system:

```
eqcli > peer eq_os8 signature os8-signature os8_intip os8_internal_addr
flags os8
```

You can copy the ***os8-signature*** from the EQ/OS 8.6 GUI by clicking the icon at the top of the left-frame tree to open up the **Failover > Required** tab. Copy the **Signature** value from the **This Equalizer** group at the top of the tab. If the EQ/OS 8.6 system is in dual network mode, replace ***os8_internal_addr*** with the VLAN IP of the Equalizer running EQ/OS 8.6 on the non-Default VLAN. If is in single network mode, then specify the VLAN IP of the only defined VLAN.

d. Add the **failover** flag to the EQ/OS 10 peer object:

```
eqcli > peer eq_00:00:00:00:00:00 flags failover
```

e. Display statistics for both peer objects using the **stats** command to confirm that failover has been negotiated between them, as in these examples:

Display the remote EQ/OS 8 peer statistics using this command:

```
eqcli > peer eq_os8 stats
```

```
12200442: Peer eq_os8: Failover Group Status
12200443: Member of Failover Group : Yes
12200444: Preferred Primary : Yes
12200445: Peer OS : EQ OS/8
12200446: State : Probing
12200447: Substate : Start
12200448: Takeover : Primary Mode
```

```
12200451: Last probe sent to this Peer : #2 at Fri Jan 7 22:03:40 2011
12200452: Last probe received from this Peer: #2 at Fri Jan 7 22:03:41 2011
12200453: Number of interfaces : 2
12200456: Interface : Mgmt
12200457: State : Probing
12200458: Substate : Start
12200459: Last probe sent on this if : #1 at Fri Jan 7 22:03:40 2011
12200460: Last probe received in this if: #1 at Fri Jan 7 22:03:41 2011
12200461: Number of strikes : 1
12200456: Interface : Mgmt
12200457: State : Probing
12200458: Substate : Start
12200459: Last probe sent on this if : #1 at Fri Jan 7 22:03:40 2011
12200460: Last probe received in this if: #1 at Fri Jan 7 22:03:41 2011
12200461: Number of strikes : 1
```

Look carefully at the output for any errors. If you see any, or if the State is anything other than Probing:

- Check the VLAN configurations on both systems to ensure they are exactly the same, and correct if not. If this is the source of the issue, failover will begin to work as soon as the VLAN configurations match.
- Check the logs on both units for errors.

List the local EQ/OS 10 peer statistics using the command:

```
eqcli > peer eq_00:30:48:d3:ee:b6 stats

12200442: Peer eq_00:30:48:d3:ee:b6: Failover Group Status
12200443: Member of Failover Group : Yes
12200444: Preferred Primary : No
12200445: Peer OS : EQ OS/10
12200446: State : Probing
12200447: Substate : Start
12200448: Takeover : Backup Mode
12200449: Last Peer probed : eq_os8
12200450: Last Peer probed from : eq_os8
12200453: Number of interfaces : 2
12200456: Interface : Mgmt
12200457: State : Probing
12200458: Substate : Start
12200461: Number of strikes : 0
12200456: Interface : Mgmt
12200457: State : Probing
12200458: Substate : Start
12200461: Number of strikes : 0
```

a. Create all clusters using settings equivalent to those in use on the EQ/OS 8.6 system, using the commands described in the 8.6 *Installation and Administration Guide*.

   b. Since the EQ/OS 10 Equalizer is in Backup Mode, it will not attempt to assume the cluster IP addresses until a failover occurs.

5. Set the **hb_interval** global parameter (**Heartbeat Interval** in the GUI) to the Probe Interval parameter on the EQ OS 8.6 system *times* the number of interfaces (VLANs) configured on the EQ OS 8.6 system. For example if the EQ OS 8.6 Probe Interval value is "5" and there are 2 VLANs configured, set the **hb_interval** global parameter to "10" on the EQ OS 10 system.

6. Reboot the EQ/OS 8.6 system to make the EQ/OS 10 system the primary unit: open the **Equalizer > Maintenance** tab and click the **reboot** button.

7. Once the EQ/OS 10 system detects that the EQ/OS 8.6 system is not responding to failover probes, the EQ/OS 10 peer configuration should indicate a change to **Primary Mode**. Use the command:

```
eqcli > peer eq_00:30:48:d3:ee:b6 stats

12200442: Peer eq_00:30:48:d3:ee:b6: Failover Group Status
12200443: Member of Failover Group : Yes
12200444: Preferred Primary : No
12200445: Peer OS : EQ OS/10
12200446: State : Probing
12200447: Substate : Start
12200448: Takeover : Primary Mode
12200449: Last Peer probed : eq_os8
12200450: Last Peer probed from : eq_os8
12200453: Number of interfaces : 2
12200456: Interface : Mgmt
12200457: State : Probing
12200458: Substate : Start
12200461: Number of strikes : 0
12200456: Interface : Mgmt
12200457: State : Probing
12200458: Substate : Start
12200461: Number of strikes : 0
```

The failover configuration is now complete, and the EQ/OS 10 system should have now assigned the cluster IP addresses to itself. The EQ/OS 8.6 GUI should display **initializing** for **failover mode** on the **Help > About** screen. Because of how failover in Version 8.6 works, the V8.6 unit will never transition to the **backup** failover state -- this is normal when an V8.6 Equalizer is configured in failover with a V10 Equalizer. It will remain in the **initializing** state until a failover occurs (while Equalizer is in **initializing** mode, it will not assume the cluster IP addresses).

The Equalizer running EQ/OS 10 will serve client requests and the Equalizer running EQ/OS 8.6 will remain in **initializing** mode. The two units will continuously exchange heartbeats with one another. Should the heartbeat exchange on any interface fail three times and on all other interfaces once, then the Equalizer running EQ/OS 8.6 will attempt to assume **primary** mode and assign the cluster IP addresses in the configuration to itself. Once the EQ/OS 10 system is available again, it will assume **backup** failover mode.

You can force the units to switch failover modes by rebooting the current **primary** Equalizer.

Note that the coyote icons at the top of the left frame of the EQ/OS GUI will not change to indicate when the EQ/OS 10 system is the primary unit -- that is, the EQ/OS 10 system will *always* have the sitting coyote icon next to it. For the Beta, this is normal and expected. Always use the **Help > About** screen or the Equalizer log (**Equalizer > Status > Event Log**) to check failover status on EQ/OS 8.6.

Failover Between Two EQ/OS 10 Systems

The procedures in this section show you how to configure failover using two Equalizers running EQ/OS 10.

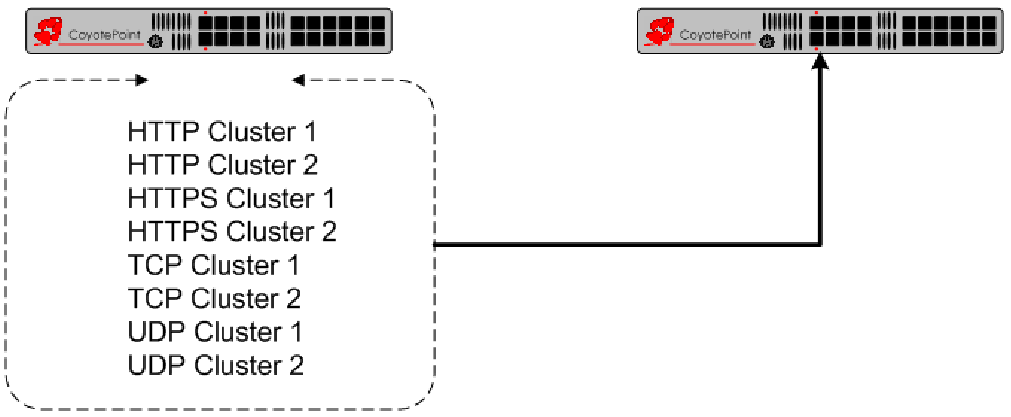
Types of Failover Configurations

Active/Passive Failover

When two Equalizers are configured into Active/Passive failover, they form a "failover pair". An Equalizer in a failover pair is called a "peer". At any given time, only one of the Equalizers in a failover pair is actually servicing requests sent to the cluster IP addresses defined in the configuration -- this unit is called the "active peer" or the "current primary" Equalizer in the failover pair. The other Equalizer, called the “passive peer” or "current backup", does not process any client requests.

Both units continually send "heartbeat probes" or "failover probes" to one another. If the current primary does not respond to heartbeat probes, a failover occurs. In this scenario the current backup Equalizer assumes the primary role by assigning the cluster IP addresses to its network interfaces and begins processing cluster traffic.

Refer to "Configuring Active/Passive Failover (CLI)" on page 443 or "Configuring Active/Passive Failover (GUI)" on page 451 for procedures on configuring Active/Passive failover.

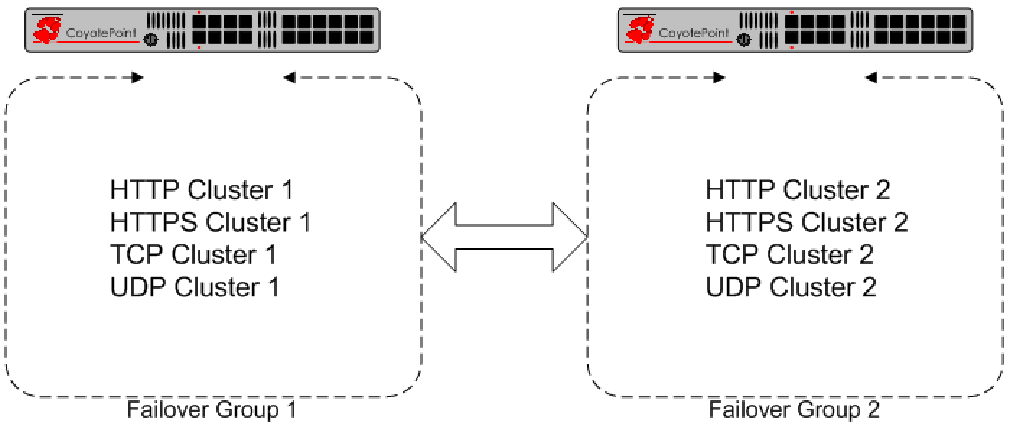


Active/Active Failover

Active/Active (A/A) failover is a feature of EQ/OS 10 that allows clusters to be Active on *both* peers that are in failover. For the same failure situations that cause a peer to take over all the cluster and floating IP addresses in an Active/Passive failover configuration, A/A operates the same way - that is that a healthy peer takes over all of the cluster and failover IPs. However, if and when the “sick” peer is healed, there is no automatic return migration of the clusters and the user needs to invoke a “rebalance” command to cause this to happen.

Active/Active failover can be configured between two EQ/OS 10 Systems only.

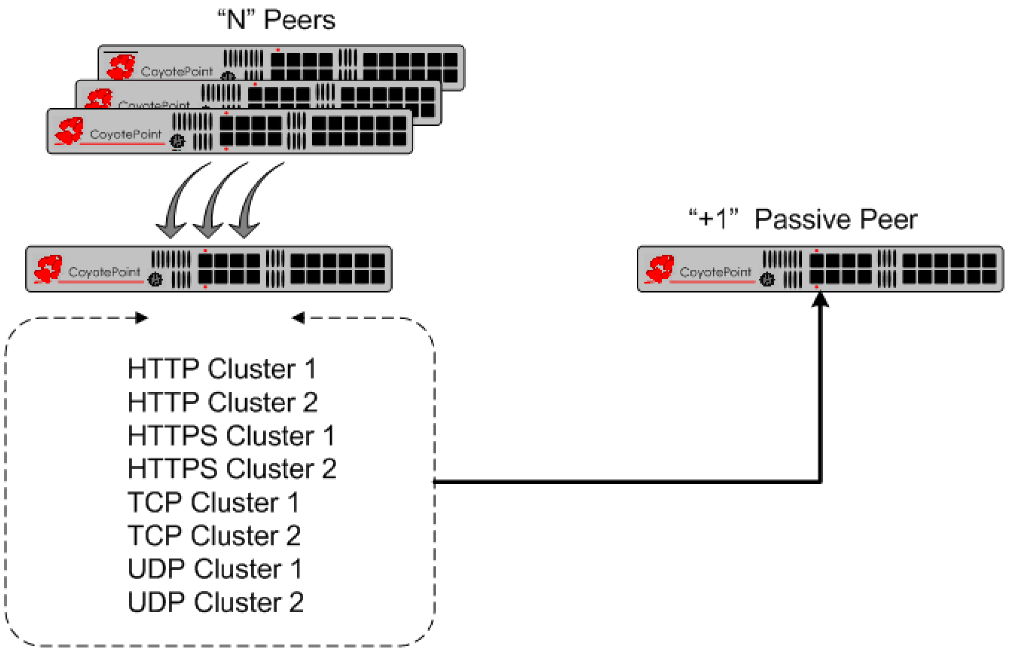
Refer to "Configuring Active/Passive Failover (CLI)" on page 443 or "Configuring Active/Passive Failover (GUI)" on page 451 for procedures on configuring Active/Active failover.



N+1 Failover

N+1 Failover is a feature of EQ/OS 10 where the failover configuration consists of multiple active peers ("N") plus 1 passive peer. In this type of failover configuration, the Equalizer clusters are instantiated on all "N" peers and organized into failover groups. If the passive, or backup peer's connectivity for a failover group's resources is judged to be "healthier" that the peer on which the group is running, then the group fails over to the passive peer, which becomes the Primary peer.

N+1 failover can be configured between two EQ/OS 10 Systems only.



Failover Modes

The Failover Mode is the current failover condition of an Equalizer peer or Failover Group when configured into Active/Passive, Active/Active, or N+1 failover configuration. It is shown both in the an eqcli display and on the GUI.

The following table lists the possible Failover Modes that can be displayed along with a description of each.

Failover Mode	Description
Standalone	No failover configured.
Not Initialized	A peer has not completed initialization. This is a temporary condition.
Primary	The Equalizer is the primary failover peer.
Backup	The Equalizer is the backup failover peer.
Not Used	This is always shown with the Unassigned F/O Group.It is specifically used with Active/Active or N+1 failover. This display is essentially a placeholder and indicates that there are no members to this failover group.

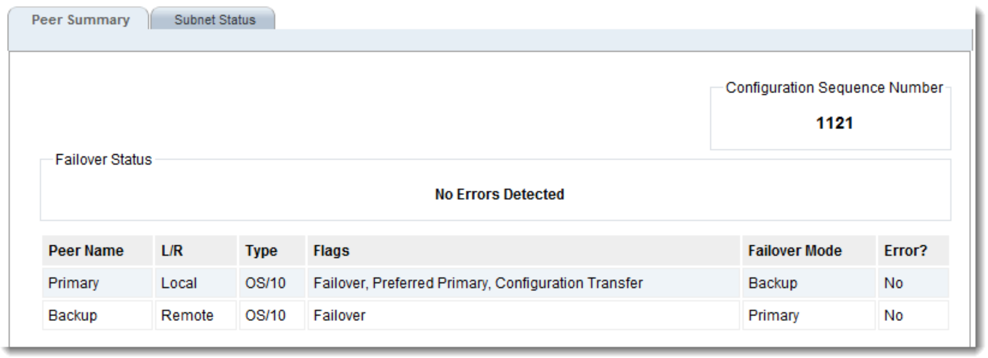
In the CLI, the failover mode is displayed in the **`F/O Mode`** column. To display the Failover Mode in the CLI, enter the following:

```
eqcli > show fogrp

F/O Group Name      F/O Group ID      F/O Mode      Primary Peer

Unassigned          0                 Not Used
fo_group1           1                 Primary       Eq-A
fo_group2           2                 Backup        Eq-B
```

If you are using Active/Active or N+1 failover, the following is an example of where the F/O Mode is displayed for the failover groups as follows:

```
eqcli > show fogrp

F/O Group Name      F/O Group ID      F/O Mode      Primary Peer

Unassigned          0                 Not Used
fo_group1           1                 Standalone
fo_group2           2                 Standalone
```

To display the **Failover Mode** in the **Failover Status** screen in the GUI, click on the **Peers** top level object on the left navigational pane. The following is an example of a **Failover Status** display:



Configuration Sequence Number

1121

Failover Status

No Errors Detected

Peer Name	L/R	Type	Flags	Failover Mode	Error?
Primary	Local	OS/10	Failover, Preferred Primary, Configuration Transfer	Backup	No
Backup	Remote	OS/10	Failover	Primary	No

EQ/OS Version 10 Failover Constraints

Before you begin configuring failover, you must do the following:

1. Ensure that the VLAN configuration on both EQ/OS 10 Equalizer is *exactly* the same. This includes all VLAN and subnet parameters *except* for the tagged and untagged ports assigned to a VLAN.

2. In some cases there may appear to be an issue where the Primary and Backup Equalizers are in a conflict over Primary. Any switch, such as one from Cisco or Dell, that comes with Spanning Tree Protocol enabled by default can cause a communication problem in a failover configuration. This problem occurs at boot up because the switch disables its ports for roughly 30 seconds to listen to BPDU (Bridge Protocol Data Unit) traffic. The 30 second pause causes both Equalizers to attempt to become the primary unit, and the default backup continually reboots. To repair this condition, either disable Spanning Tree Protocol or enable PortFast for the ports connected with the Equalizers. This enables the ports to act as normal hubs and accept all traffic immediately.

3. When configuring VLAN subnets, the following must be true:

   - the **heartbeat** flag must be enabled on *at least one* VLAN
   - the **command** flag must be enabled on *exactly one* VLAN
   - the **Failover IP** (**virt_addr** in the CLI) parameter must be set on all VLAN subnets that have the **heartbeat** or **command** flags enabled

4. Other important notes:

   - Run http on the failover IP address, not the VLAN IP address.
   - Only make changes when logging in over the failover IP address.
   - If you run GUI/SSH on the VLAN IP addresses on both peers, then do NOT go back and forth between peers making configuration changes, unless you verify that each change is transferred before you making a change on the “other” unit.

Configuration Synchronization Constraints

Whenever a configuration change is made on either EQ/OS 10 failover unit, the failover subsystem synchronizes the configuration by transferring the configuration file to the other unit over the VLAN subnet that has the **command** flag enabled.

If the command flag (Command Transfer in the GUI) is NOT set for any VLAN, the system will use the first VLAN in the configuration file for Configuration transfer.

The table below lists the Equalizer objects that ARE and ARE NOT synchronized between units in a failover configuration:

The following Equalizer objects ARE synchronized in a Failover configuration:	**The following Equalizer objects ARE NOT synchronized in a Failover configuration:**
Alerts Clusters	Interfaces (Switch Port Configuration)
Server Pools	Peers
SSL Certificates	VLANs
CRLs	Subnets
Servers	Tunnels
Responders	Users
GeoClusters	Licenses
GeoSite	
GeoSite Instances	
Global Parameters: Syslog server NTP server Name servers	
Health Checks	
Health Check Instances	
SMTP Relays	
VLB Managers	

Server / Gateway Availability Constraint

For failover to initialize correctly, at least one server or gateway configured on a subnet defined on Equalizer must be responding to ARP (Address Resolution Protocol) requests. Otherwise, Equalizer will remain in the "initializing" failover state and will not assume the backup or primary role.

You can check server availability status in eqcli using this command:

```
eqcli > server server_name stats
```

Server availability can also be checked in the GUI by looking at the icons next to the server name in the left pane object tree. Unavailable servers have an exclamation point icon displayed to the right of the server name.

Failover Probes and Failover Timeouts

When Equalizers are configured into a failover group, they continually probe (or heartbeat) each other so that a backup peer can assume the primary role, should the active primary unit become unreachable.

Heartbeat probes are performed over a long-lived TCP connection. Whenever Equalizer starts heartbeating a peer, it opens a heartbeat connection to the peer which remains open for as long as the two systems are operational and have network connectivity. All heartbeats between the two peers will occur over this long-lived connection.

Heartbeat probes are configured using the following parameters. The parameters are listed first by their label in the GUI, with the CLI parameter name in parentheses.

Once failover is configured, it is the system with the "greater" system ID that always starts the heartbeating process. For example, of one "sysid" is "003048BC2C8A" and the other is "003048D52AA2". The second "sysid" has a higher hex value and will start the heartbeating process.

Global and Subnet Failover Parameters:

These parameters are defined at both the global and subnet levels; the subnet value will override the global value.

- **Heartbeat Interval** (`hb_interval`)- The time in seconds (default:2) between sending and receiving heartbeat probes between Equalizer and a peer. Each peer expects to **receive** a heartbeat probe from other peers that have a failover IP address on a subnet within this interval.

- **Failed Probe Count** (`strike_count`) - The number of successive failed heartbeats that must occur before a peer is marked "down" (default:3). A heartbeat is considered to have failed whenever the **Heartbeat Interval** has elapsed and no probe has been received from a peer during that interval.

  Failover occurs if:

- The number of failed probes on any single subnet equals or exceeds the **Failed Probe Count** for that subnet.

  OR

- The number of subnets with a **Failed Probe Count** greater than 0 equals or exceeds the global **Failed Probe Count.**

Global Failover Parameters:

These parameters are defined at the global level only and cannot be overridden.

- **Retry Interval** (`retry_interval`) - Time in seconds (default:5) between checks for changes in Equalizer's configuration, for the purpose of determining whether a configuration transfer to the remote peer is required.

  The **Retry Interval** is also used when any failover operation other than heartbeating fails. For example, if the system is rebooted and a VLAN health check fails, we try again at this interval.

- **Connect Timeout** (`conn_timeout`) - Time in seconds (default:1) to wait for a TCP connection to be established between peers.

- **Receive Timeout** (`recv_timeout`) - Time in seconds (default:1) after a TCP connection is established, of how long a peer waits for the other peer's response.

Modifying Failover Timeouts in Production

When an failover pair is actively serving traffic, any changes to the global or subnet failover parameters could result in a failover if you do not perform them in the correct manner.

Note - These parameters are not currently synchronized.

To prevent a failover from occurring , proceed with the following to prevent an inadvertent failover:

1. Disable failover on both units by disabling the failover flag on the local peers on both units; first on the current primary unit and then the current backup. Refer to "Configuring Active/Passive Failover (CLI)" on page 443 or "Configuring Active/Passive Failover (GUI)" on page 451 for details.

2. Make the changes to failover timeouts required on both systems, in any order. Refer to "Parameters" on page 196 if necessary.

3. Re-enable failover by checking the failover flags on the on the primary Equalizer's local peer and then on the backup.

Peer, Interface, Subnet States and Substates

The following tables list the various valid states/substates for Peers, Interfaces, and Subnets.

Peer State	Peer Substate	Explanation
Send Join	Start	Communicating with remote Peer to join into a Failover configuration.
	Failed	Attempt to configure remote Peer into a failover configuration failed.
Configure	Success	The local and remote Peers have equivalent network configurations.
	Failed	The local and remote Peers do not have equivalent network configurations.
Initialize	Success	All interfaces have connectivity with the remote Peer.
	Partial	Some of the interfaces do not have connectivity with the remote Peer.
	Failed	None of the interfaces have connectivity with the remote Peer.
Configure heartbeating	Waiting	An attempt is being made to configure heartbeating on all heartbeating subnets.
	Failed	Heartbeating could not be configured on 1 or more heartbeating subnets on.
Heartbeating	Start	The local and remote Peers are heartbeating on all heartbeating subnets.
	Partial	The local and remote Peers are heartbeating on 1 or more heartbeating subnets.
	Suspended	The local and remote Peers are no longer heartbeating on any heartbeating subnets. The local Peer is attempting to re-establish heartbeating with the remote Peer.

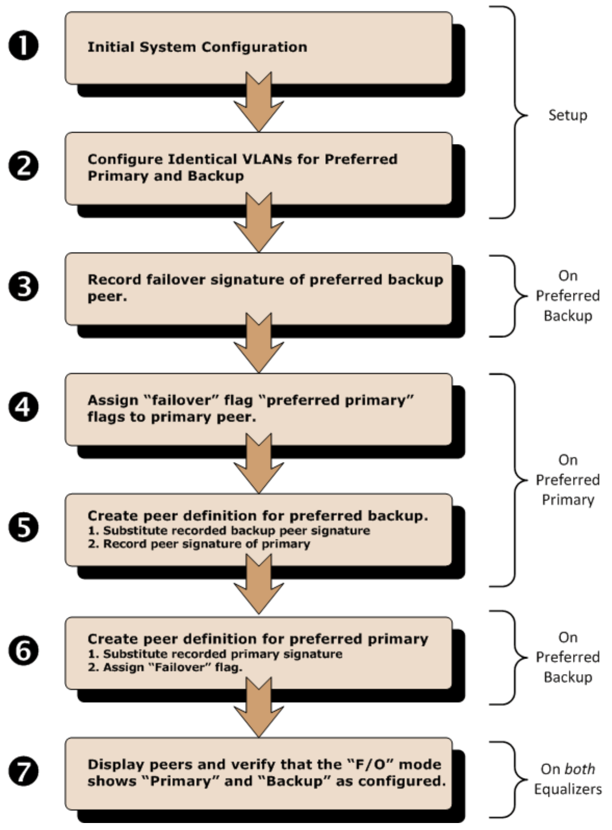
Configuring Active/Passive Failover Between Two EQ/OS 10 Systems

When two Equalizers are configured into Active/Passive failover, they form a "failover pair". An Equalizer in a failover pair is called a "peer". At any given time, only one of the Equalizers in a failover pair is actually servicing requests sent to the cluster IP addresses defined in the configuration -- this unit is called the "active peer" or the "current primary" Equalizer in the failover pair. The other Equalizer, called the “passive peer” or "current backup", does not process any client requests.

Both units continually send "heartbeat probes" or "failover probes" to one another. If the current primary does not respond to heartbeat probes, a failover occurs. In this scenario the current backup Equalizer assumes the primary role by assigning the cluster IP addresses to its network interfaces and begins processing cluster traffic.

Configuration of failover peer definitions and options on VLAN subnets can be performed through the CLI or the GUI.

The figure below shows the suggested sequence of steps for enabling both Active/Passive Failover and the preliminary steps for configuring Active/Active and N+1 Failover.


1
Initial System Configuration
2
Configure Identical VLANs for Preferred Primary and Backup
Setup
3
Record failover signature of preferred backup peer.
On Preferred Backup
4
Assign “failover” flag “preferred primary” flags to primary peer.
5
Create peer definition for preferred backup.
1. Substitute recorded backup peer signature
2. Record peer signature of primary
On Preferred Primary
6
Create peer definition for preferred primary
1. Substitute recorded primary signature
2. Assign “Failover” flag.
On Preferred Backup
7
Display peers and verify that the “F/O” mode shows “Primary” and “Backup” as configured.
On *both* Equalizers

Configuring VLAN (Subnet) Failover Settings (CLI)

1. Configure VLANs and Subnets as described in "Configuring Subnets" on page 103. It is important that both the VLANs are identical in both the preferred primary and the backup.

2. Access the CLI as described in "Starting the CLI" on page 128.

3. Configure the failover service parameters for the preferred primary equalizer:

   Enter:

```
eqcli > vlan vlname subnet sname flags flagname
```

   Where ***vlname*** is the name of the VLAN, ***sname*** is the name of the subnet and ***flagname*** is the name of the flag.

   The **Command** flag designates this subnet as the subnet over which the configuration file transfers (between preferred primary and preferred backup) can occur.

   The **Heartbeat** flag allows the failover peers to probe one another over the subnet. At least one subnet must have a **Heartbeat** flag enabled.

   The **def_src_addr** flag indicates that this subnet is to be used for the default equalizer source IP.

4. Enter:

```
eqcli > vlan vlname subnet sname flags flagnam
```

   Where ***vlname*** is the name of the VLAN, ***sname*** is the name of the subnet and ***flagname*** is the name of the flag. These flags enable the System Services for the Failover IP Address allow services that will be available:

   a. **fo_http** - when enabled the Equalizerwill listen for **http** connections on the Failover IP address on the subnet.

When configuring a Failover IP address on a subnet on Equalizer, make absolutely sure that no other system on the network is using that Failover IP address other than the Equalizers configured into failover.

If the IP address IS used by another system on the net, and a failover occurs, BOTH of the failover peers will transition to and remain in BACKUP mode! The way to fix the problem is to:

1. Remove the duplicate IP address from the offending system.
2. Reboot one of the peers.

The peers should transition to their proper failover modes.

This applies to both Active/Passive and Active/Active failover.

a. **fo_https**- when enabled the Equalizer will listen for **https** connections on the Failover IP address on the subnet.

b. **fo_ssh** - when enabled **ssh** login will be permitted on the Failover IP address on the subnet.

c. **fo_snmp** - when enabled **snmp** will accept connections on the Failover IP address on the subnet.

d. **fo_envoy** - when enabled this will allow Envoy to monitor this subnet for failover

e. **fo_envoy_agent** - when enabled this will allow an Envoy agent to monitor this subnet for failover

5. Enter:

```
eqcli > vlan vlname subnet sname stike_count integer
```

Where ***vlname*** is the name of the VLAN, ***sname*** is the name of the subnet and ***integer*** is thee strike count number, which is the strike count threshold for a subnet. When the number of strikes detected on this subnet exceeds this value, the subnet has failed. A value of 0 indicates this subnet will never be considered “failed”.

6. Enter:

```
eqcli > vlan vlname subnet sname probe_interval seconds
```

Where ***vlname*** is the name of the VLAN, ***sname*** is the name of the subnet and ***seconds*** is the Failed Probe Count or the number of failed peer probe attempts that must occur before marking a peer "down" (default: 3). The failed probes must all occur on the same VLAN subnet for the server to be marked "down".

7. Repeat the same procedure on the preferred backup.

Configuring VLAN (Subnet) Failover Settings (GUI)

1. Configure both Equalizers running EQ/OS 10:

   a. Perform initial system configuration as outlined in "Network Configuration" on page 77.

   b. Create all required VLANs, clusters, servers, etc., required for your configuration.

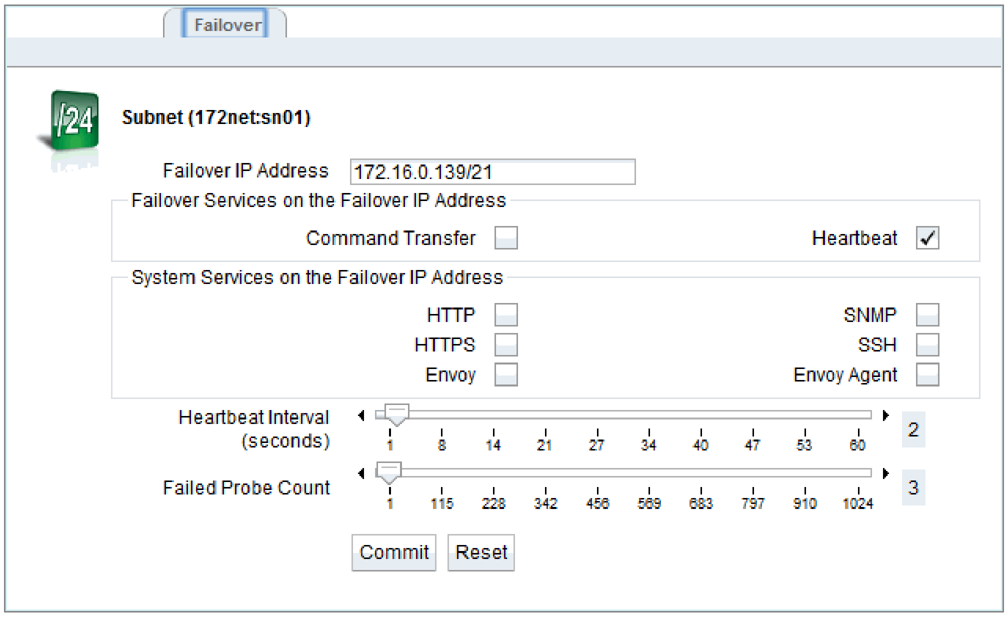
   c. Ensure that the configuration is working properly. In particular, make sure that at least one server is active (that is, marked "up" in the GUI). Failover will not properly initialize if Equalizer cannot successfully probe at least one server.

2. Configure VLANs and subnets on both units; they must be exactly the same as noted above under "EQ/OS Version 10 Failover Constraints" on page 435"EQ/OS Version 10 Failover Constraints" on page 435

3. Designate a preferred primary and preferred backup using "Configuring Active/Passive Failover (CLI)" on page 443 beginning with step 3.

4. Open the Equalizer Graphical User Interface (or GUI) and select the subnet of the VLAN to be used as the "Preferred Primary".

5. Click on the **Failover** tab to display the following. In the example shown below a subnet **sn01** for the VLAN **172net** is displayed.



Subnet (172net:sn01)

Failover IP Address 172.16.0.139/21

Failover Services on the Failover IP Address

Command Transfer ☐ Heartbeat ✓

System Services on the Failover IP Address

HTTP ☐ SNMP ☐
HTTPS ☐ SSH ☐
Envoy ☐ Envoy Agent ☐

Heartbeat Interval (seconds) 2

Failed Probe Count 3

6. Configure the failover parameters for the preferred primary equalizer; in this case **sn01** on the VLAN **172net**. Use the check boxes and sliders as necessary. You will not be able to change the **Failover IP Address**. The **Failover IP Address** is used primarily as a server gateway and to provide an IP address for system services such as the GUI, SSH, etc.

When configuring a Failover IP address on a subnet on Equalizer, make absolutely sure that no other system on the network is using that Failover IP address other than the Equalizers configured into failover.

If the IP address IS used by another system on the net, and a failover occurs, BOTH of the failover peers will transition to and remain in BACKUP mode! The way to fix the problem is to:

1. Remove the duplicate IP address from the offending system.
2. Reboot one of the peers.

The peers should transition to their proper failover modes.

This applies to both Active/Passive and Active/Active failover.

1. Check the appropriate check boxes in the **Use Subnet IP Address** pane as follows:

   a. Checking the **Command Transfer** checkbox will designate this subnet as the subnet over which the configuration file transfers (between preferred primary and preferred backup) can occur.

b. Checking the **Heartbeat** checkbox will allow the failover peers to probe one another over the subnet. At least one subnet must have a **Heartbeat** flag enabled.

Note - Command Transfer and **Heartbeat** use the subnet IP address, not the failover IP address.

8. Check the appropriate check boxes in the **Services on Failover IP Address** pane to select the allowable services that will be available:

    a. **HTTP** - when enabled the Equalizer will listen for **HTTP** connections on the Failover IP address on the subnet.

    b. **HTTPS**- when enabled the Equalizer will listen for **HTTPS** connections on the Failover IP address on the subnet.

    c. **SSH** - when enabled **SSH** login will be permitted on the Failover IP address on the subnet.

    d. **SNMP** - when enabled **SNMP** will accept connections on the Failover IP address on the subnet.

    e. **Envoy** -when enabled this will allow Envoy to monitor this subnet for failover

    f. **Envoy Agent** - when enabled this will allow an Envoy agent to monitor this subnet for failover

9. Adjust the **Heartbeat Interval** time in seconds (default: 2) between successful heartbeat checks of the peer.

10. Use the **Failed Probe Count** slider to adjust the number of failed peer probe attempts that must occur before marking a peer "down" (default: 3). The failed probes must all occur on the same VLAN subnet for the server to be marked "down". The global **Failed Probe Count** is not used until ALL heartbeating subnets have at least one strike. Once each subnet has a strike, we fail over when the number of failed heartbeats across all heartbeating subnets is equal to or greater than the global **Failed Probe Count**. If there are 0 strikes on at least one heartbeating network, then failover does not occur until the Failed Probe Count reaches the **Failed Probe Count** setting on a particular heartbeating subnet.

11. Click on **Commit** when you have finished.

12. Perform Steps 1 through 11 above on the preferred backup.

Configuring Active/Passive Failover (CLI)

Perform Steps 1 and 2 on *both*Equalizers

1. Perform initial system configuration on both units as outlined in "Networking Technologies" on page 78.

2. Configure VLANs and subnets on both units; they must be exactly the same as noted in "EQ/OS Version 10 Failover Constraints" on page 435.

    Ensure that the network configuration is working properly. In particular, make sure that at least one gateway on a subnet that has the heartbeat flag enabled is responding to a ping command:

```
eqcli > ping gateway_IP_address
```

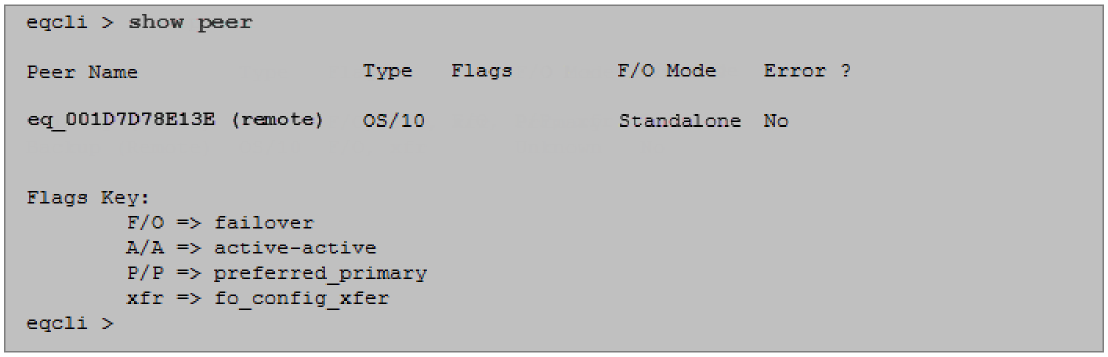
If no gateways are responding, then configure a server with an IP address on a subnet with **heartbeat** enabled. Make sure it is responding to a **ping** command:

```
eqcli > server name proto {tcp|udp} ip IP_address port port_number
eqcli > ping server_IP_address
```

Perform Step 3 on the *preferred backup*Equalizer to obtain the peer signature:

3. Obtain the failover signature of the preferred backup Equalizer.

   a. Log in to the CLI on the Equalizer you will use as the preferred backup and enter:



```
eqcli > show peer

Peer Name              Type   Flags      F/O Mode    Error ?

eq_001D7D78E13E (remote)   OS/10             Standalone  No


Flags Key:
        F/O => failover
        A/A => active-active
        P/P => preferred_primary
        xfr => fo_config_xfer
eqcli >
```

   b. Enter the **`show peer`** command again, however this time with the **`Name`** of the peer to display more details of the peer, including the signature.

```
eqcli > show peer name
```

Substitute the name of the peer displayed in the previous step for ***name***. The information for that peer definition is displayed, as in this example:

```
eqcli > show peer  eq_001D7D78E13E
Peer Name : eq_001D7D78E13E
Peer signature : 1RBC78142F9ADE9E8F29FF5373AE7DA6EB994075A9BAAC1001B4
Peer sysid : 00241DB2ABA0
Flags : failover
[remainder of output omitted...]
```

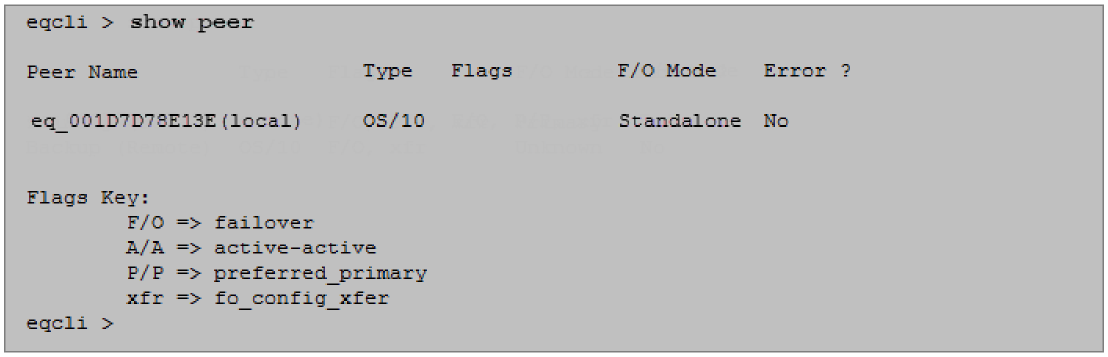
   c. Record the `Peer signature` displayed, or copy it using your terminal emulator's supported editing commands. You'll need it in the following steps.

Perform Steps 4 and 5 on the *preferred primary*Equalizer to add failover flags and to create a new peer definition for the backup.

You now need to configure the *preferred primary* Equalizer by adding failover flags and creating a peer on it for the backup that you created in steps 3 and 4. You will need the peer signature from the backup that you retained in step 4.

4. Log in to the Equalizer you will designate as the preferred primary and do the following:

   a. Display the peer name of the preferred primary by entering:



```
eqcli > show peer

Peer Name                  Type    Flags          F/O Mode    Error ?

 eq_001D7D78E13E(local)    OS/10                  Standalone  No


Flags Key:
        F/O => failover
        A/A => active-active
        P/P => preferred_primary
        xfr => fo_config_xfer
eqcli >
```

   b. Assign failover, peferred_primary flags to the preferred primary Equalizer by entering:

```
eqcli > peer name flags failover,preferred_primary,fo_config_xfer
```

   c. Verify that the flags are correct by entering the **show peer** command again to display the peer (preferred primary). The flags should display `F/O, P/P, xfr` beneath the Flags heading. The `fo_config_xfer` is used on the local peer and not on the remote peer. If it is enabled the primary peers on both systems will synchronized the configuration. When the flag is changed for the local peer, it should be reflected in the remote peer on the other system.

5. Now create a peer definition for the preferred backup on the primary Equalizer:

   a. Enter the following:

```
eqcli > peer name signature signature flags failover
```

   Substitute the signature of the preferred backup that you obtained in Step 4, above.

   b. Verify the new peer definition by entering:

```
eqcli > show peer
```

```
Peer Name                   Type       Flags            F/O Mode
eq_00241DB2ABA0 (Local)     OS/10 F/O, P/P, xfr Primary
eq_001D7D78E13E (Remote)    OS/10      F/O Backup

Flags Key:
          F/O => failover
          A/A => active-active
          P/P => preferred-primary
          xfr => fo_config_xfer
```

c. Now you will need the peer signature from the primary Equalizer. Enter the following:

```
eqcli > show peer name
```

Where **name** is the name of the peer for the primary Equalizer. The following will be displayed.

```
eqcli > show peer  eq_001D7D78E13E
Peer Name : eq_001D7D78E13E
Peer signature : 1RBC14245CBCC7552362679F0E2AD4C0B2CF0C6E6B84AC1000D2
Peer sysid : 001D7D78E13E
Flags : failover
[remainder of output omitted...]
```

Record the Peer signature displayed, or copy it using your terminal emulator's supported editing commands. You'll need it in the following steps.

Perform Step 6 on the *preferred backup* Equalizer to add failover flags and create a peer definition for the primary Equalizer.

6. Create a peer definition for the preferred primary, using the signature that you recorded in step 5:

   a. Display the peer name of the preferred backup by entering:

```
eqcli > show peer

Peer Name              Type     Flags    F/O Mode        Error
eq_00241DB2ABA(remote)  OS/10             Standalone      No

Flags Key:
          F/O => failover
          A/A => active-active
          P/P => preferred-primary
          xfr => fo_config_xfer
```

b. Add the failover flag to the backup by entering:

```
eqcli > peer name flags failover
```

Where the peer **name** is the same one that appears beneath the Peer Name heading.

c. Verify that the flag was assigned by entering:

```
eqcli > show peer
```

d. Now create a peer definition for the preferred primary by entering the following:Create the peer definition for the preferred primary:

```
eqcli > peer name signature signature flags failover,preferred_primary
```

Substitute the signature of the preferred backup that you obtained in Step 5 for *signature*.

e. Verify the peer definitions by entering the following that should show the new peer definition:

```
eqcli > show peer

Peer Name            Type Flags F/O Mode     Error
eq_00241DB2ABA0(Local)   OS/10    F/O, P/P, xfr Primary      No
eq_001D7D78E13E(Remote) OS/10    F/O            Backup       No

Flags Key:
          F/O => failover
          A/A => active-active
          P/P => preferred-primary
          xfr => fo_config_xfer
```

Note - Once the two peers are joined in a failover group (heartbeating and file sync are occurring), then they synchronize their remote peer definitions with the information obtained from the remote peer -The name and flags on the remote peer change. In addition, if you want to change the name of a peer, you MUST change the name of the local peer definition on that peer.

Perform Step 7 on *both* Equalizers.

7. Once both units start to communicate, displaying the peer definitions should indicate that the units have assumed the primary and backup failover roles.

   a. Confirm this on both units by entering:

```
eqcli > show peer

Peer Name                 Type          Flags        F/O Mode   Error
eq_00241DB2ABA0 (Local)    OS/10        F/O, P/P, xfr    Primary    No
eq_001D7D78E13E (Remote)   OS/10         F/O              Backup     No
```

Note that the F/O Mode column should appear as above when failover is working properly. The system on which you are logged in will always appear first in the list.

b. Enter the following command for each peer listed:

```
eqcli > peer name
```

On each unit, the local peer definition (for the unit on which you are logged in) should appear like this example:

```
eqcli > show peer eq_00241DB2ABA0
Peer Name : eq_00241DB2ABA0
Peer signature : 1RBC78142F9ADE9E8F29FF5373AE7DA6EB994075A9BAAC1001B4
Peer sysid : 00241DB2ABA0
Flags : failover, preferred_primary, fo_config_xfer
OS/8 Internal IP :
Number of Interfaces : 2
 Member of Failover Group : Yes
 Failover Enabled/Disabled : Enabled
 Local/Remote Peer : Local
 Preferred Primary : Yes
 Peer OS : EQ OS/10
 Peer State : Heartbeating:Start
 Failover State : FOSM Complete:Idle
 Failover Mode : Primary
 Last Peer heartbeated : eq_001D7D78E13E
 Last Peer heartbeated from : eq_001D7D78E13E
 Interface : in1
   State : Heartbeating
 Substate : Start
   Number of strikes : 0
   Subnet : Me2
    State : Heartbeating
    Substate : Start
     Number of strikes : 0
 Interface : in2
     State : Heartbeating
     Number of strikes : 0
   Subnet : Me3
     State : Heartbeating
     Substate : Start
     Number of strikes : 0
```

The remote peer definition includes detailed information about the success or failure of the health check probes being sent by the local Equalizer (the unit on which you are logged in) to the remote Equalizer (the other peer).

Look carefully at the output for any errors. If you see any, or if the State is anything other than Probing on any interface (subnet) on which **heartbeat** is enabled:

- Check the VLAN configurations on both systems to ensure they are exactly the same, and correct if not. If this is the source of the issue, failover will begin to work as soon as the VLAN configurations match.
- Check the logs on both units for errors.

The remote peer display should appear like this example:

```
eqcli > show peer eq_001D7D78E13E
Peer Name : eq_001D7D78E13E
Peer signature : 1RBC14245CBCC7552362679F0E2AD4C0B2CF0C6E6B84AC1000D2
Peer sysid : 001D7D78E13E
Flags : failover
OS/8 Internal IP :
Number of Interfaces : 2
 Member of Failover Group : Yes
 Failover Enabled/Disabled : Enabled
 Local/Remote Peer : Remote
 Preferred Primary : No
 Peer OS : EQ OS/10
 Peer State : Heartbeating:Start
 Failover State : FOSM Complete:Idle
 Failover Mode : Backup
 Last heartbeat sent : #322 at Wed Mar 14 12:07:10 2012
 Last heartbeat received : #194 at Wed Mar 14 12:07:10 2012
 Interface : in1a
  State : Heartbeating
  Substate : Start
  Last heartbeat sent : #161 at Wed Mar 14 12:07:10 2012
   Last heartbeat received : #97 at Wed Mar 14 12:07:10 2012
   Number of strikes : 0
  Subnet : Me1
    State : Heartbeating
    Substate : Start
   Last heartbeat sent : #161 at Wed Mar 14 12:07:10 2012
    Last heartbeat received : #97 at Wed Mar 14 12:07:10 2012
    Number of strikes : 0
 Interface : in2
   State : Heartbeating
   Substate : Start
  Last heartbeat sent : #161 at Wed Mar 14 12:07:10 2012
   Last heartbeat received : #97 at Wed Mar 14 12:07:10 2012
  Number of strikes : 0
   Subnet : sn1
   State : Heartbeating
    Substate : Start
```

```
        Last heartbeat sent : #161 at Wed Mar 14 12:07:10 2012
         Last heartbeat received : #97 at Wed Mar 14 12:07:10 2012
         Number of strikes : 0
```

The above display includes detailed information about the success or failure of the health check probes being sent by the remote Equalizer (the other peer) to the local Equalizer (the unit on which you are logged in).

Refer to "Peer Interface Subnet States and Substates" on page 438 for descriptions of the Peer states and substate conditions.

Configuring Active/Passive Failover (GUI)

Perform Steps 1 and 2 on *both* Equalizer.

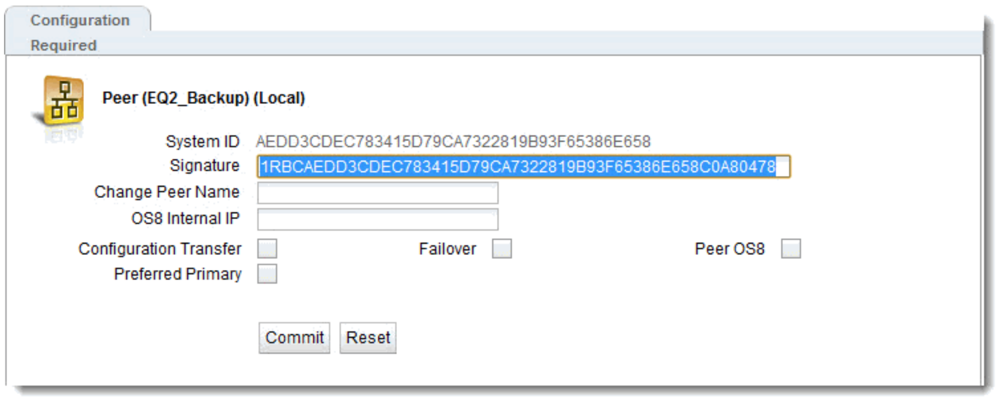
1. Perform initial system configuration on both units as outlined in "Networking Technologies" on page 78.

2. Configure VLANs and subnets on both units; they must be exactly the same as noted in "EQ/OS Version 10 Failover Constraints" on page 435.

Perform Step 3 on the *preferred backup* Equalizer to obtain the peer signature.

3. Log in to the GUI for the backup Equalizer using the procedures described in "Logging In" on page 192.

   a. Click on a peer to be used as the preferred backup on the left navigational pane. The following will be displayed:



Peer (EQ2_Backup) (Local)

System ID AEDD3CDEC783415D79CA7322819B93F65386E658
Signature 1RBCAEDD3CDEC783415D79CA7322819B93F65386E658C0A80478
Change Peer Name
OS8 Internal IP
Configuration Transfer ☐ Failover ☐ Peer OS8 ☐
Preferred Primary ☐

   b. Check the **Failover** flag.

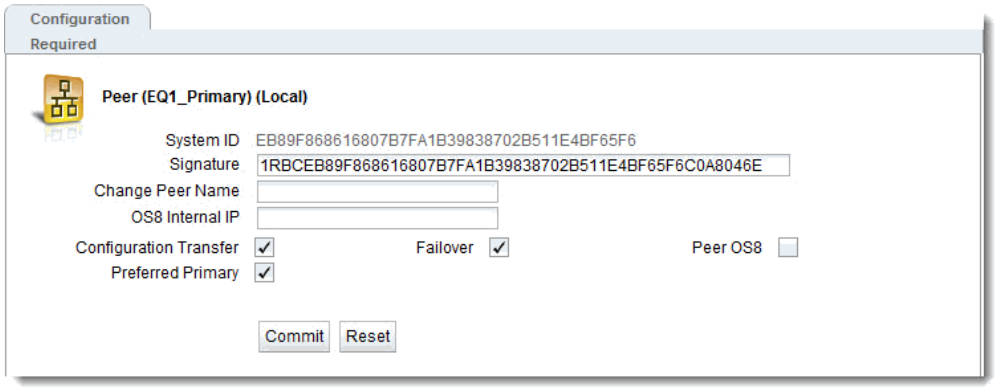
   c. Highlight and copy the failover **Signature**of the preferred backup Equalizer. Copy the signature to an electronic clipboard, notepad or whatever means available to save it.

Perform Steps 4 and 5 on the *preferred primary* Equalizer to add failover flags and to create a new peer definition for the backup.

You now need to configure the *preferred primary* Equalizer by adding failover flags and creating a peer on it for the backup that you configured in steps 3 and 4. You will need the peer signature from the backup that retained in step 4.

4. Log in to the GUI for the preferred primary Equalizer using the procedures described in "Logging In" on page 192.

   a. Configure the preferred primary peer and check the **Failover**and **preferred_primary**flags to the preferred primary Equalizer as shown below.



Peer (EQ1_Primary) (Local)

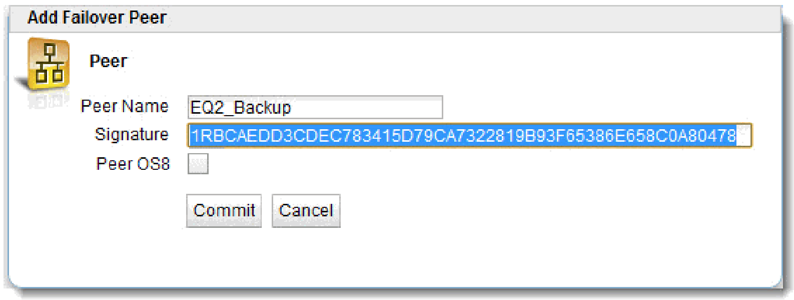
System ID	EB89F868616807B7FA1B39838702B511E4BF65F6				
Signature	1RBCEB89F868616807B7FA1B39838702B511E4BF65F6C0A8046E				
Change Peer Name					
OS8 Internal IP					
Configuration Transfer	✓	Failover	✓	Peer OS8	
Preferred Primary	✓				

b. Highlight and copy the failover **Signature**of the preferred primary Equalizer. Copy the signature to an electronic clipboard, notepad or whatever means available to save it.

c. Click on **Commit** to save the flag assignments.

5. Create a peer definition for the backup peer- *on the preferred primary* Equalizer.

   a. Right click on Peers on the left navigational pane and select **Add failover peer.** The failover peer entry form as shown below:

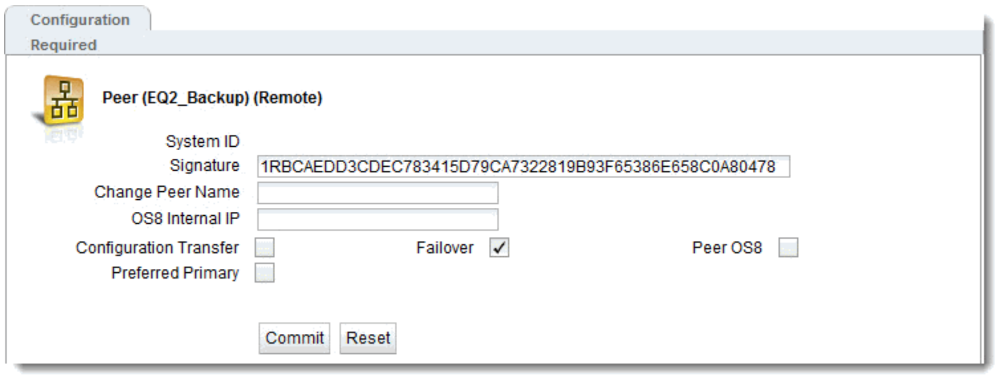


Peer

Peer Name	EQ2_Backup
Signature	1RBCAEDD3CDEC783415D79CA7322819B93F65386E658C0A80478
Peer OS8	

   b. Enter a **Peer Name** for the backup peer and type or paste in the signature of the preferred primary that you saved from step 3. Click on **Commit** to save the peer.

   c. You now need to assign a failover flag to the backup peer. Click on the backup peer (**EQ2_ Backup** in the example) to display the following.



Peer (EQ2_Backup) (Remote)

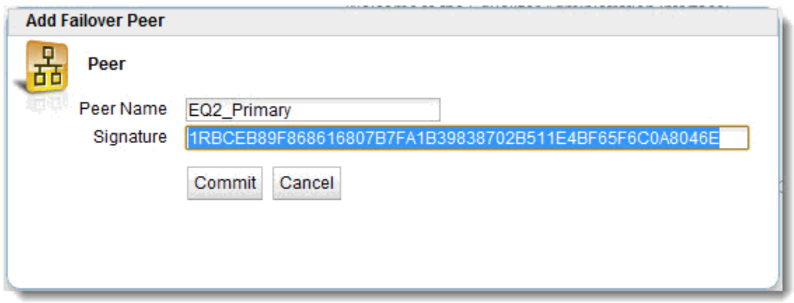
System ID					
Signature	1RBCAEDD3CDEC783415D79CA7322819B93F65386E658C0A80478				
Change Peer Name					
OS8 Internal IP					
Configuration Transfer		Failover	✓	Peer OS8	
Preferred Primary					

d. Enable the **Failover** flag and click on **Commit**. Both peers should appear on the left navigational pane on the **Peers** branch.

Perform Step 6 on the *preferred backup* Equalizer to add failover flags and create a peer definition for the primary Equalizer.

6. Log back in to the GUI for the backup Equalizer using the procedures described in "Logging In" on page 192. You will need to create a peer for the *preferred primary*, using the signature that you recorded from step 4b.

   a. Right click on Peers in the left navigational pane and select **Add failover peer** to display the peer entry form as shown below.



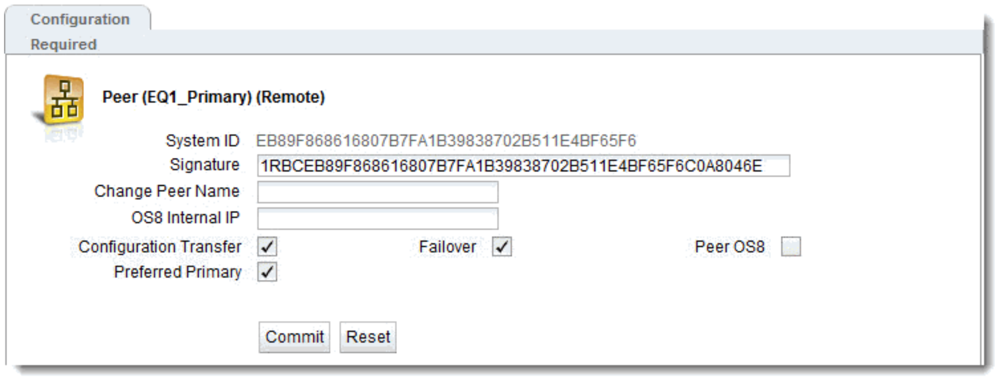
Add Failover Peer

Peer

Peer Name: EQ2_Primary

Signature: 1RBCEB89F868616807B7FA1B39838702B511E4BF65F6C0A8046E

   b. Type or paste the peer Signatureof the preferred primary Equalizer and click on **Commit**. The following will be displayed.



Configuration Required

Peer (EQ1_Primary) (Remote)

System ID: EB89F868616807B7FA1B39838702B511E4BF65F6

Signature: 1RBCEB89F868616807B7FA1B39838702B511E4BF65F6C0A8046E

Change Peer Name:

OS8 Internal IP:

Configuration Transfer ✓ Failover ✓ Peer OS8 ☐

Preferred Primary ✓

   c. Enable the Failover flag and click on **Commit**.

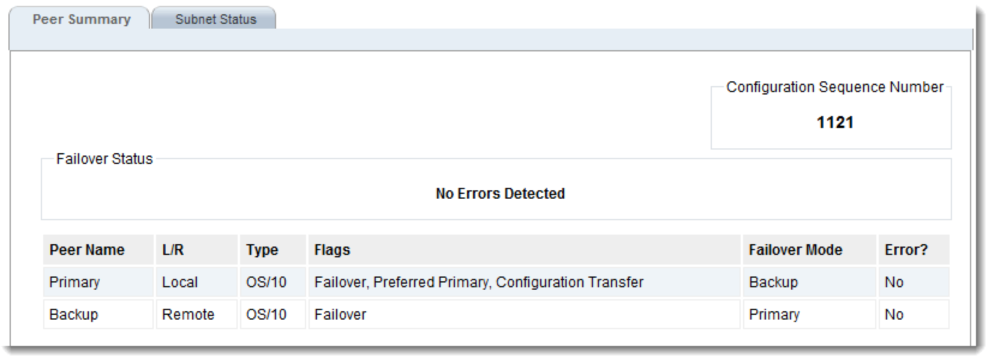
Note - Once the two peers are joined in a failover group (heartbeating and file sync are occurring), then they synchronize their remote peer definitions with the information obtained from the remote peer -The name and flags on the remote peer change. Once the two peers are joined in a failover group (heartbeating and file sync are occurring), then they synchronize their remote peer definitions with the information obtained from the remote peer -The name and flags on the remote peer change. In addition, if you want to change the name of a peer, you MUST change the name of the local peer definition on that peer.

Perform Steps 7 on *both* Equalizers.

You have now configured failover peers in both the preferred primary and backup Equalizers. To verify that you have correctly configured failover do the following.

7. Access the GUI for the preferred primary or backup Equalizer.

   a. Right click on **Peers**on the left navigational pane to display the Peers summary screen as shown below. Note that since the first screen shows the preferred primary Equalizer**Peer Summary**as it is categorized as Local and if a failover state exists it will become the backup.



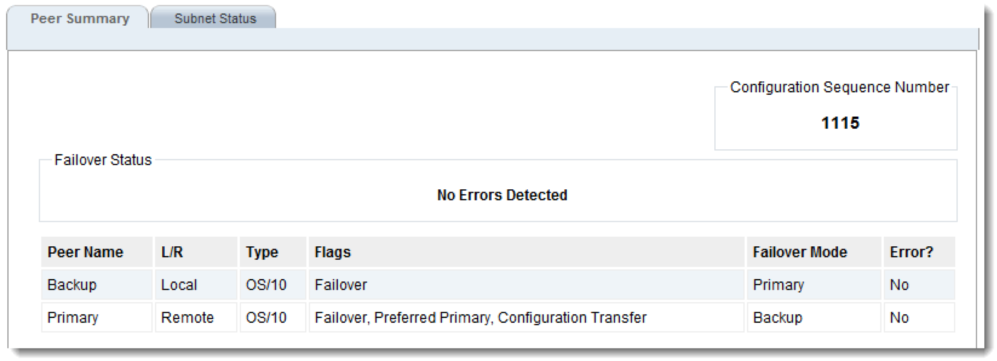
1121

Failover Status

No Errors Detected

Peer Name	L/R	Type	Flags	Failover Mode	Error?
Primary	Local	OS/10	Failover, Preferred Primary, Configuration Transfer	Backup	No
Backup	Remote	OS/10	Failover	Primary	No

The following shows the preferred backup **Equalizer Peer Summary** and shows the reversed condition in a failover state.



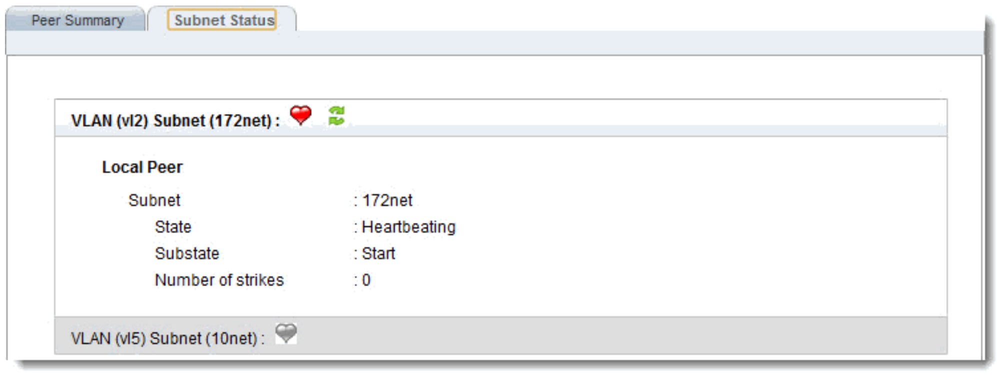
1115

Failover Status

No Errors Detected

Peer Name	L/R	Type	Flags	Failover Mode	Error?
Backup	Local	OS/10	Failover	Primary	No
Primary	Remote	OS/10	Failover, Preferred Primary, Configuration Transfer	Backup	No

   b. You can view the subnet stats of each by selecting the Subnet Status tab for each showing a **Heartbeating**condition. The first is the preferred primary Equalizer and the second is the backup.

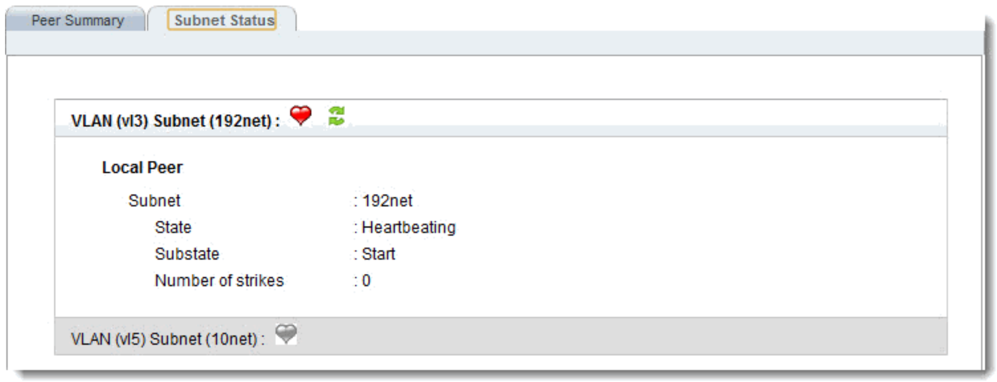


VLAN (vl2) Subnet (172net) :

Local Peer

Subnet	: 172net
State	: Heartbeating
Substate	: Start
Number of strikes	: 0

VLAN (vl5) Subnet (10net) :



VLAN (vl3) Subnet (192net) :

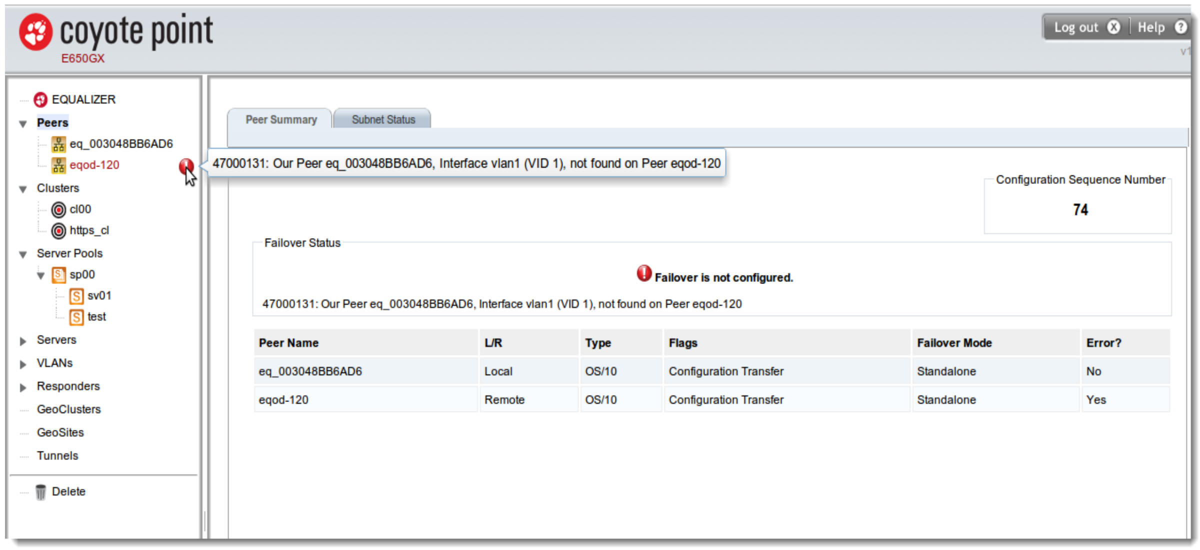
Local Peer

Subnet	: 192net
State	: Heartbeating
Substate	: Start
Number of strikes	: 0

VLAN (vl5) Subnet (10net) :

Peer Summary Display Showing Errors

If failover were NOT configured correctly or a problem existed with one of the peers, you would see a display similar to the following example. Note that a failure icon (❗) appears on the left navigational pane beside the peer with an error as well as on the right indicating that **Failover is not configured.** :



47000131: Our Peer eq_003048BB6AD6, Interface vlan1 (VID 1), not found on Peer eqod-120

Configuration Sequence Number

74

Failover Status

Failover is not configured.

47000131: Our Peer eq_003048BB6AD6, Interface vlan1 (VID 1), not found on Peer eqod-120

Peer Name	L/R	Type	Flags	Failover Mode	Error?
eq_003048BB6AD6	Local	OS/10	Configuration Transfer	Standalone	No
eqod-120	Remote	OS/10	Configuration Transfer	Standalone	Yes

Refer to "Peer Interface Subnet States and Substates" on page 438 for descriptions of the Peer states and substate conditions.

Configuring Active/Active Failover Between Two EQ/OS 10 Systems

Active/Active (A/A) failover allows clusters to be active on both Peers that are configured into failover. For the same failure situations that cause a Peer to take over all the cluster and floating IP addresses in an Active/Passive failover configuration, Active/Active failover operates the same way - that is that the healthy Peer will take over all of the cluster and failover IPs.

An Active/Active failover configuration consists of two peers. Equalizer's clusters are instantiated on both peers and organized into “Failover Groups”. If the one peer's connectivity for the failover group's resources is judged to be “healthier” than the peer on which the group is running, then the group “fails over” to the other peer.

It should be noted that if and when the "sick" Peer is healed, there is no automatic migration of the clusters back to it. You can, however, invoke a "rebalance" command to make this happen.

Failover Groups

Active/Active failover introduces the concept of "Failover Groups". A Failover Group consists of all the smallest set of resources that may be moved between Peers and can consist of one or more clusters, servers, and failover IPs.

Failover Groups are dynamically determined by the configuration and cannot be specified by the user.

In the simplest case, there is a maximum of 1 Failover group per subnet. However, based on the cluster/match rule/server pool/server configuration, a Failover Group may contain more than one subnet. Basically, the algorithm is that:

- a cluster subnet and, for *non-Spoof* match rules, all associated server subnets must all be in the same Failover Group. This means that all clusters and failover IPs on any of these subnets are in the same Failover Group.
- if *spoof* is set for all the cluster match rules, then the server subnets are not factored into the Failover group.

This means that as clusters and servers are added or deleted, the Failover group configuration may change.

Configuring Active/Active Failover (CLI)

1. Configure failover using the current procedures described in "Configuring Active/Passive Failover (CLI)" on page 443.
2. Activate the Active/Active failover mode by setting the active-active flag on the local Peers. This flag must be set on both Peers for A/A to be enabled. If the flag is set on only one, or no Peers, failover operates as in the current Active/Passive mode.

You will need to access both Equalizers so it may be easier to open two TTY sessions. Each one should access the local peers. Enter the following for each local peer:

```
eqcli > peer [name] flags active-active
```

Once you have added active-active flags to each local peer if the Equalizers are heartbeating you should see the A/A flags should be displayed when you enter show peer for each Equalizer as shown below. One Equalizer should be displayed as “Backup” while the other as “Primary”.

- If all Failover groups are instantiated on a Peer, the F/O column will display Primary.
- If none are instantiated, the F/O column will display Backup.
- If some Failover groups are instantiated on one Peer and some on the other, the F/O column will display Mixed.

Primary Equalizer

```
eqcli > show peer

Peer Name      Type      Flags      F/O Mode Error ?

Primary (Local) OS/10     F/O, A/A, P/P  Backup        No
Backup (Remote) OS/10     F/O, A/A      Primary       No

Flags Key:
        F/O => failover
        A/A => active-active
        P/P => preferred-primary
eqcli >
```

Backup Equalizer

```
eqcli > show peer

Peer Name     Type       Flags         F/O Mode      Error ?

Backup (Local) OS/10       F/O, A/A Primary       No
Primary (Remote) OS/10    F/O, A/A, P/P  Backup        No

Flags Key:
        F/O => failover
        A/A => active-active
        P/P => preferred-primary
eqcli >
```

3. As indicted previously Failover Groups are dynamically determined by the configuration and cannot be specified by the user. As clusters and servers are added or deleted, the Failover group configuration may change.

4. Set the preferred_peer flag on a cluster. The purpose of the preferred_peer parameter is to indicate the failover peer on which the cluster is "desired" to run, and it is the peer on which the cluster will be run if the user runs the rebalance command. This parameter is set on the Peer that your want the cluster to be associated with, in the non-failover case. If this parameter is not set, the cluster defaults to the Peer that has been set as the preferred primary.

Note - The preferrerred_peer flag for all cllusters that would be configured into the same Failover Group must be the same.

```
eqcli > cluster [name] flags preferred_peer
```

Show the cluster parameters by entering :

```
eqcli > show cluster cl-tcp

L4 Cluster Name : cl-tcp
Protocol : tcp
IP Address : 172.16.0.131
Port : 80
Port Range : 0
Preferred Peer : Primary
VID : 1
Server Pool : testserverpool
Sticky Timeout : 5
Sticky Netmask : 0
Idle Timeout : 5
Stale Timeout : 5
L4 Flags :
eqcli >
```

5. Display the dynamically created failover group by entering **show fogrp**. This command lists the Failover Groups that have been created, based on the configuration. For example:

```
eqcli > show fogrp

F/O Group Name           F/O Group ID    F/O Mode      Primary Peer
Unassigned                0               Not Used
fo_group1                1               Primary      Primary
fo_group2                 2               Backup
```

The `F/O Group Name` “Unassigned” is used:

- When active-active is NOT enabled on the local peer, all clusters are in the "Unassigned" F/O Group.
- If the system cannot determine a failover group in which to place a cluster, possibly because it was assigned a VLAN IP that does not reside on a defined subnet, it goes into Unassigned.

Display the elements of the failover group by entering show fogrp <name> - where ***<name>*** is one of the names in the list. For example:

```
eqcli > show fogrp fo_group1

F/O Group fo_group1:ID = 1
Preferred Peer = eq_001D7D78E13E
Subnet Members (num = 1):
God:Me
Cluster Members (num = 2):
cl01
cl02
No Server Members
```

Note - At least 2 subnets must be configured, along with their failover IP addresses.

6. When the "sick" Peer has been "healed", the clusters do not automatically migrate back. For this to occur you will need to invoke the rebalance command to make this happen. This command is at the global context level and causes the clusters to be "moved back" to their preferred peer. Enter:

```
eqcli > rebalance
```

Testing Active/Active Failover

1. With A/A disabled, verify that Active/Passive failover works the same as it currently does.
2. With A/A enabled:
    a. Configure more than 1 cluster, but all in the same Failover Group and verify that failover works the same as with an Active/Passive setup. Perform this with preferred_peer not set on the clusters, and then set and verify that the clusters are instantiated on the appropriate Peer and that they "failed over" as expected.

    b. Configure one or more clusters on each subnet, setting a different preferred_peer for each Failover Group. Verify that the clusters are instantiated on the appropriate Peer and that they "fail over" as expected.

    c. Using multiple failover groups, configure servers for the clusters, using both spoof and non-Spoof.

    - For non-spoof, configure servers on a different subnet than the cluster.
    - For spoof, configure servers on a different subnet than the cluster.

    d. Using multiple Failover Groups, change the configuration such that 2 Failover groups will be merged and verify that all work as expected. For example, suppose there are 2 F/O Groups:

    - F/O Group 1 -has subnet 172.16.0/24 with cluster cl01 (172.16.0.211), server sv01

(172.16.0.181) and floating IP 172.16.0.219.

- F/O Group 2 - has subnet 192.168.0/24 with cluster cl02 (192.168.0.211), server sv02 (192.168.0.181) and floating IP 192.168.0.219.

- If the clusters are using spoof and sv03 (192.168.0.182) is added to the server pool for cluster cl01, this will cause F/O Groups 1 and 2 to be merged into a single F/ O Group that includes cl01, cl02, sv01, sv02, sv03, and subnets 172.16.0/24 and 192.168.0/24.

e. Then, change the configuration such that the single F/O group is split into 2 F/O Groups.(e.g., by deleting sv03 from cl01, above.)

Verify that:

- All clusters can pass traffic.

- Failover occurs as expected if one Peer fails.

- The F/O Groups are rebalanced appropriately when the rebalance command is executed.

Configuring N+1 Failover Between EQ/OS 10 Systems

N+1 Failover is a feature of EQ/OS 10 where the failover configuration consists of multiple active peers ("N") plus 1 passive peer. In this type of failover configuration, the Equalizer clusters are instantiated on all "N" peers and organized into failover groups. If the passive, or backup peer's connectivity for a failover group's resources is judged to be "healthier" that the peer on which the group is running, then the group fails over to the passive peer, which becomes the Primary peer.

N+1 failover provides the ability to configure up to 4 Peers in a failover configuration. All peers will be "heartbeating" with each other and all synchronizing configuration. If a Peer "fails", for each failover group (F/O) group affected by the failure, one and only one of the other Peers will take over the F/O Group based on:

1. Which Peer in the F/O group has the best connectivity to servers, routers, etc. In case of a tie amongst one or more Peers, the Peer with the greatest System ID hex value or " sysid" will take over the F/O group. For example, if 2 peers have the same level of connectivity with servers, routers, etc, and one "sysid" is "003048BC2C8A" and the other is "003048D52AA2". The second "sysid" has a higher hex value and will take over the F/O group.

Note - All flavors of Microsoft© Windows include a hex calculator. A free, downloadable Hex Calculator widget for Mac OX is also available.

2. The user can subsequently adjust the load across the Peers by managing the preferred Peer for each F/O Group and executing the rebalance function.

Note - Currently, if a failover event occurs, all F/O Groups are moved when a failover event occurs, even if it only affects a subset of the F/O Groups. Failover occurs on a F/O Group basis. For example, if an interface goes down, only the affected F/O Group(s) will be moved.

Network Design for N+1 Failover

The design of the host network is critical to a successful failover configuration.

The essential concept of active-active failover is that resources that are required for a cluster to serve client requests are organized into "failover groups". For any cluster, the required resources include:

- the cluster object and all objects to which it points including server pools, server instances, servers, responders, certificates, etc.
- the subnet on which the cluster IP address resides
- the subnet (or subnets) on which all server IP addresses in the server pool reside

If you instead locate a cluster IP address on one subnet and the servers in the cluster’s server pool all reside on another subnet, then both those subnets would be considered part of the cluster’s failover group.

So, in order to allow each cluster to fail over separately to another Equalizer, the cluster IP address and all server IP addresses need to be located on Equalizer subnets that are distinct from the subnets on which other cluster and server IP addresses reside.

Once you configure cluster and server IPs and enable active-active failover, the clusters, servers, subnets, etc., are organized into "failover groups" that can be passed between all the peers at network connectivity issues occur.

How a Peer is Chosen for Failover in N+1 Configuration

A failover occurs when Equalizer detects that there is an issue with one of the subnets on which a cluster’s IP address or one of its server IP addresses resides. This typically means that Equalizer has lost connectivity on a subnet, and can happen for any number of reasons; for example, the failure of a downstream hub, router, or other networking device.

A failover event can be simulated by either removing a cable from Equalizer’s front panel or rebooting a peer.

In our example configuration, each VLAN subnet is connected to Equalizer through a separate port. When you remove a cable from Equalizer, it recognizes that it has lost connectivity on that subnet and attempts to fail over all the resources on that subnet (the "failover group") to another peer.

When Equalizer detects a network connectivity failure, it does the following:

1. It determines which failover groups are affected by the failure.
2. It examines the heartbeat information it has received from the other peers in the failover set, and determines which other peers can provide connectivity on the subnets that have failed.
3. If there is only one peer that can provide the required connectivity, the failover group is moved to that peer.
4. If there is more than one peer that can provide the required connectivity, Equalizer checks the ‘preferred peer’ setting on the cluster (or clusters) in the failover group (or groups), and if the preferred peer can provide connectivity, the failover groups are moved to that peer.

5. If the preferred peer is not one of the systems that can provide connectivity, or if a cluster has no preferred peer set, then Equalizer checks to see if the peer that has the ‘preferred primary’ flag set can provide the required connectivity. If it can, the failover groups are moved to that peer.

6. If the preferred primary is not one of the systems that can provide connectivity, the Equalizer checks the System ID of all the peers that can provide the required connectivity, and moves the failover groups to that peer.

7. If all the above fails to select a peer to which the failover groups can be moved, they remain instantiated on the current peer.

Note - In Step 6, above, the Equalizer System ID number is used to break "ties" if checking the preferred peer and preferred primary settings fail to identify a peer to which we can fail over, and there is more than one peer available that can provide the required connectivity. This is why the system with the highest System ID is used as the "+1" backup unit in all the sample configurations, so that we are guaranteed to move a failover group over to the dedicated backup unit when there is no preferred peer or preferred primary available that provides the connectivity required by the failover group.

Equalizer’s System ID is displayed in the CLI using the global context version command:

```
eqcli > version
Equalizer O/S Version      : 10.0.3a
Equalizer O/S Tag          : AA
System Type                : E450GX
System Revision            : 2
System Serial Number       : A08CA-16001
System ID                  : 0012345ABCDE
...
```

The System ID is a 12-digit hexadecimal number. You can use the hexadecimal setting on a calculator to determine which of your systems has the highest System ID.

Monitoring N+1 Failover

There are several CLI commands you can use to monitor failover status:

Displaying Failover Group Status

Failover groups are configured by Equalizer automatically according to your network topology and the subnets on which cluster and server IP addresses reside. You can modify the failover group configuration only by modifying your cluster IP addresses, server IP addresses, and subnet configuration.

To display the current list of failover groups, use the **show fogrp** global context command:

```
eqcli > show fogrp

F/O Group Name      F/O Group ID       F/O Mode      Primary Peer

Unassigned          0                  Not Used
fo_group1           1                  Primary       Eq-A
fo_group2           2                  Backup        Eq-B
```

The four columns contain the following details information:

`F/O Group Name`	These are determined by Equalizer, according to cluster IP addresses, server IP addresses, and the network configuration. 'Unassigned' is the failover group used when active-active failover is not yet enabled. Failover groups are not used in active-passive failover configurations.
`F/O Group ID`	An identifying number for the failover group. This is set by Equalizer and not direcetly modifiable.
`F/O Mode`	Indicates whether the system on which you executed the command is the current Primary for this failover group, or whether the system is a Backup for this failover group. If a system is the Primary for this group, it instantiates all the cluster IP addresses and failover IP addresses necessary for the failover group.
`Primary Peer`	Shows the peer name of the Equalizer that is currently Primary for this failover group.

Detailed failover group status can be obtained by supplying a group name to the **`show fogrp`** command:

```
eqcli > show fogrp fo_group1

F/O Group fo_group1:
  ID                     = 1
  Preferred Peer         = Eq-A
  Primary Peer           = Eq-A
  F/O Mode               = Primary
  Subnet Members (num = 1):
     vl2:172net
  Cluster Members (num = 1):
     clA
  Server Members (num = 1):
     sv2
```

In addition to the ID, peer, and mode information (see the previous table), this command displays exactly which subnets, clusters, and servers belong to this failover group. These are the objects that will become active on another peer when this failover group is moved as a result of a failover event.

This form of the command allows you to determine exactly how your clusters, servers, and subnets are organized by Equalizer into failover groups, and also which clusters are instantiated on which Equalizers at any given time.

Displaying Peer Status

The show peer command displays a summary of all the currently defined peers:

```
eqcli > show peer

Peer Name       Type      Flags                 F/O Mode    Error ?
Eq-A (Local)    OS/10     F/O, A/A, P/P, xfr    Mixed       No
Eq-B (Remote)   OS/10     F/O, A/A, xfr         Mixed       No
Eq-C (Remote)   OS/10     F/O, A/A, xfr         Backup      No

Flags Key:
        F/O => failover
        A/A => active-active
        P/P => preferred_primary
        xfr => fo_config_xfer
```

For "N+1" failover:
1. Each peer should have the A/A (active-active) flag enabled
2. The modes displayed will be different for active-active, as explained below.

As cables are removed, re-attached, and systems rebooted, the `F/O Mode` displayed for each peer will move through the following failover mode variations:

Primary	The peer has instantiated all cluster IP addresses, and all subnet failover IP addresses. Heartbeating is working properly.
Mixed	The peer has instantiated some of the cluster IP addresses in the configuration and is available as a Backup for others. It has also instantiated all subnet failover IP addresses for the subnets required by the instantiated clusters.
Backup	The peer has not instantiated any clusters and is available as a Backup. Heartbeating is working properly.
Isolated	The peer appears to be up but we cannot heartbeat it. This usually occurs when a peer is rebooted and has not yet fully assumed a failover mode, or when there is a connectivity issue on a heartbeating subnet.
Unknown	The peer status is unknown. No heartbeats from this system have been received. This usually occurs when first configuring failover, before all peers have started heartbeating one another, or when rebooting a peer.
Standalone	The peer is not participating in failover. It will instantiate all cluster IP addresses and all subnet failover IP addresses that exist in the configuration file.

For detailed output regarding hearbeat status between this peer and other peers in the failover set of Equalizers, specify the name of a remote peer:

```
eqcli > show peer
Eq-B Peer Name :
Eq-B Peer signature : 1RBCC92BAC9A56DD29D6847B1FDBE96E0CD467FB1DB1AC1001E6
Peer sysid : 003048BB6B12
Flags : failover, active-active, fo_config_xfer
OS/8 Internal IP :
Number of Interfaces : 2
  Member of Failover Group : Yes
  Failover Enabled/Disabled : Enabled
  Local/Remote Peer : Remote
  Preferred Primary : No
  Configuration Transfers :
  Enabled Peer OS : EQ OS/10
  Peer State :
  Heartbeating:Start
  Failover State :
  FOSM Complete:Idle
  Failover Mode : Mixed
  Last heartbeat sent : #89580 at Thu Aug 23 14:03:07 2012
  Last heartbeat received : #76476 at Thu Aug 23 14:03:05 2012
  Interface : vl2
    State : Heartbeating
    Substate : Start
    Last heartbeat sent : #44796 at Thu Aug 23 14:03:07 2012
    Last heartbeat received : #38239 at Thu Aug 23 14:03:07 2012
    Number of strikes : 0
    Subnet : 172net
      State : Heartbeating
      Substate : Start
      Last heartbeat sent : #44796 at Thu Aug 23 14:03:07 2012
      Last heartbeat received : #38239 at Thu Aug 23 14:03:07 2012
      Number of strikes : 0
      Interface : vl3
        State : Heartbeating
        Substate : Start
        Last heartbeat sent : #44784 at Thu Aug 23 14:03:07 2012
        Last heartbeat received : #38239 at Thu Aug 23 14:03:07 2012
        Number of strikes : 0
        Subnet : 192net
          State : Heartbeating
          Substate : Start
          Last heartbeat sent : #44784 at Thu Aug 23 14:03:07 2012
          Last heartbeat received : #38239 at Thu Aug 23 14:03:07 2012
          Number of strikes : 0
```

Displaying Cluster Status

Specify the name of a cluster to the show cluster command to see if the cluster is currently instantiated on the Equalizer to which you are logged in. The first couple of lines in the output indicate the cluster status, as in this example:

```
eqcli > show cluster clB
This cluster has a problem:
Cluster is not active on this Equalizer

L7 Cluster Name         : clB
Protocol                : http
IP Address              : 192.168.0.161
Port                    : 80
Preferred Peer          : Eq-B
VID                     : 3
...
```

The second line of output indicates that this cluster is not instantiated on this Equalizer; if this message does not appear, then the cluster should be instantiated on this Equalizer (assuming that there are no other issues, such as a cluster mis-configuration that is not related to failover).

Also shown in the output are the preferred peer and `VID` (VLAN ID) settings. Basic troubleshooting for failover includes verifying that all preferred peer and `VID` settings on clusters are correct.

Rebalancing

Rebalancing is usually done after a failover event occurs and all system have been returned to normal service. This instantiates each cluster (and its required objects, such as servers) on the peer set in the cluster's `preferred_peer` parameter. In the example configurations that follow, the clusters `clA` and `clB` will continue to run on Eq-A until you run this command on Eq-A:

```
eqcli > rebalance
```

This instantiates each cluster on the preferred peer set in its configuration. In this case, cluster clB will migrate from Eq-A to run on Eq-B (its preferred peer) instead. The clusters will continue to run on their preferred peers until a failover event occurs.

After rebalancing, the `F/O Mode` displayed for Eq-A and Eq-B should be `Mixed`. This indicates that it is acting as the primary system for some clusters and as backup for others.

Configuring N + 1 Failover with 3 Equalizers (CLI)

In this configuration, three Equalizers (Eq-A, Eq-B, and Eq-C) cooperate to provide high availability. They do not need to be the same models, and can include *Equalizer OnDemand*. They are configured with:

- 2 VLAN subnets
- 2 clusters -- 1 preferred on each of EQ-A and EQ-B, no clusters on Eq-C
- 2 failover groups

1. Do the following on all three Equalizers:

   a. Create all VLANs and subnets necessary for your configuration (see "Configuring VLANs" on page 100). For this example, we assume two VLANs: **vlan2** with two and **vlan3**) with one or two subnetsubnet each (**172net** and **192net**, respectively), and that these are cable-connected to Equalizer through separate front-panel ports. As with any failover configuration, the VLAN/subnet configuration on all peers must be exactly the same, except for object names and tagged/untagged port assignments.

   b. Set the Failover (or Virtual) IP address on each VLAN subnet, as in these examples:

   ```
   eqcli > vlan vlan2 subnet 172net virt_addr 172.16.0.169/21
   eqcli > vlan vlan3 subnet 192net virt_addr 192.168.0.169/21
   ```

c. Set the command and heartbeat flags on the subnets. One subnet must have the command flag enabled, both subnets need the heartbeat flag since we want to fail over when there is a connectivity issue on any subnet:

```
eqcli > vlan vlan2 subnet 172net flags command,heartbeat
eqcli > vlan vlan3 subnet 192net flags heartbeat
```

d. Change the system hostname so it is unique:

```
eqcli > hostname name
```

e. Set the timezone.

```
Enter: eqcli > timezone?
```

Locate your timezone in the displayed list and press "q" to quit out of the list. Then, type in your timezone number and press <`Enter`>, as in this example for the "America/New York" time zone:

```
eqcli > timezone 161
```

f. If Equalizer can reach the Internet, add a name server so that NTP will work and time will be the same across all Equalizers:

```
eqcli > name-server IP_address
```

Otherwise, set the time manually on all systems to the current time:

```
eqcli > date HHmmss
```

In the above command, **`HH`** is hours, mm is minutes, and **`ss`** is seconds. Seconds are optional.

g. Change the name of the local peer so it's easier to recognize, as in this example for Equalizer `Eq-A`:

```
eqcli > peer e<TAB> name Eq-A
```

Note that the <`TAB`> above means press the Tab key on your keyboard to auto-complete the local peer name. Since this unit currently has only one peer definition it fills it out with the local peer name.

2. After you complete Step 1 on *all three* Equalizers, do the following on Equalizer `Eq-A`:

   a. Create the clusters, servers, server pools, and server instances necessary for your configuration. For the purposes of this procedure, we created the following objects and non-default settings:

```
eqcli > server sv2 proto tcp ip 172.16.0.170 port 80
eqcli > srvpool sp01 policy adaptive
eqcli > srvpool sp01 si sv2 weight 100
eqcli > cluster clA proto http ip 172.16.0.160 port 80 srvpool
sp01

eqcli > server sv3 proto tcp ip 192.168.0.24 port 80
eqcli > srvpool sp01 policy adaptive
eqcli > srvpool sp02 si sv3 weight 100
eqcli > cluster clB proto http ip 192.168.0.161 port 80 srvpool
sp02
```

Note - In this procedure, we create all the clusters, servers, and server pools on the preferred primary Equalizer, assign a preferred peer to each cluster, and then rebalance to move the clusters to their preferred peer Equalizers. You could also create your clusters on the other peers. If you do, be sure to specify a preferred peer for each cluster when you create them if you want them to be instantiated on that peer; otherwise, they will be instantiated on the peer that has the preferred primary flag enabled

   b. Update the flags for peer `Eq-A`:

```
eqcli > peer Eq-A flags failover,fo_config_xfer,preferred_
primary,active-active
```

   c. Verify that Equalizer has created two failover groups:

```
eqcli > show fogrp

F/O Group Name     F/O Group ID      F/O Mode     Primary Peer

Unassigned         0                 Not Used
fo_group1          1                 Standalone
fo_group2          2                 Standalone
```

   d. Create the peer definitions for the remote peers `Eq-B` and `Eq-C`:

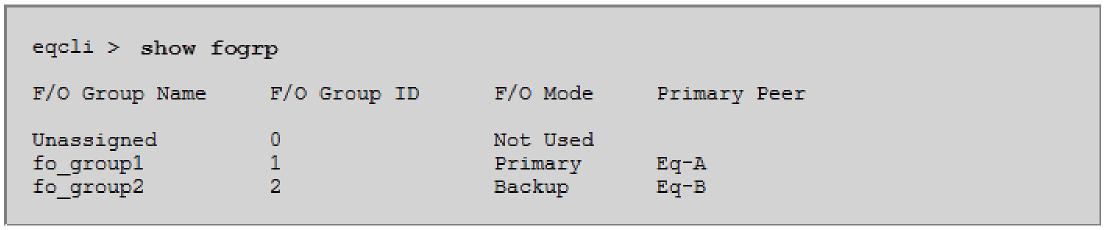
```
eqcli > peer Eq-B signature signature flags failover
eqcli > peer Eq-C signature signature flags failover
```

Note - The signature for each remote peer can be displayed by logging into the CLI on that peer and executing "show peer name", where ***name*** is Eq-B or Eq-C.

e. Set a preferred peer for each cluster:

```
eqcli > cluster clA preferred_peer Eq-A
eqcli > cluster clB preferred_peer Eq-B
```

f. Verify that the clusters have been configured into two failover groups:



```
eqcli >  show fogrp

F/O Group Name     F/O Group ID      F/O Mode     Primary Peer

Unassigned         0                 Not Used
fo_group1          1                 Primary      Eq-A
fo_group2          2                 Backup       Eq-B
```

3. Do the following on `Eq-B`:

   a. Update the flags for peer `Eq-B`:

```
eqcli > peer Eq-B flags failover,active-active
```

   b. Create the peer definitions for the remote peers `Eq-A` and `Eq-C`:

```
eqcli > peer Eq-A signature signature flags failover,fo_config_
xfer,preferred_primary
eqcli > peer Eq-C signature signature flags failover
```

Note - The signature for each remote peer can be displayed by logging into the CLI on that peer and executing "**`show peer name`**", where name is `Eq-A` or `Eq-C`.

4. Do the following on `Eq-C`:

   a. Update the flags for peer `Eq-C`:

```
eqcli > peer Eq-C flags failover,active-active
```

b. Create the peer definitions for the remote peers `Eq-A` and `Eq-B`:

```
eqcli > peer Eq-A signature signature flags failover,fo_config_
xfer,preferred_primary

eqcli > peer Eq-B signature signature flags failover
```

Note - The signature for each remote peer can be displayed by logging into the CLI on that peer and executing "**`show peer name`**", where name is `Eq-A` or `Eq-B`.

c. On `Eq-A`, the peer status should now look like this:

```
eqcli > show peer

Peer Name          Type      Flags               F/O Mode     Error ?
Eq-A (Local)       OS/10     F/O, A/A, P/P, xfr  Primary      No
Eq-B (Remote)      OS/10     F/O, A/A, xfr       Backup       No
Eq-C (Remote)      OS/10     F/O, A/A, xfr       Backup       No
```

d. On `Eq-B`, the peer status should now look like this:

```
eqcli >  show peer

Peer Name          Type      Flags                F/O Mode     Error ?
Eq-B (Local)       OS/10     F/O, A/A, xfr        Primary      No
Eq-A (Remote)      OS/10     F/O, A/A, P/P, xfr   Backup       No
Eq-C (Remote)      OS/10     F/O, A/A, xfr        Backup       No
```

e. On `Eq-C`, the peer status should now look like this:

```
eqcli > show peer

Peer Name          Type      Flags                F/O Mode     Error ?
Eq-C (Local)       OS/10     F/O, A/A, xfr        Backup       No
Eq-B (Remote)      OS/10     F/O, A/A, xfr        Backup       No
Eq-A (Remote)      OS/10     F/O, A/A, P/P, xfr   Primary      No
```

After the above procedure is completed, the object configuration should get synchronized over to Eq-B and Eq-C. All Equalizer objects will be visible in the CLI and GUI of all peers. The two clusters will continue to run on Eq-A until they are "rebalanced" (Refer to "Rebalancing" on page 466).

Configuring N + 1 Failover with 4 Equalizers (CLI)

In this configuration, four Equalizers (Eq-A, Eq-B, Eq-C, and Eq-D) cooperate to provide high availability. They do not need to be the same models, and can include *Equalizer OnDemand*. They are configured with:

- 3 VLAN subnets
- 3 clusters -- 1 preferred on each of EQ-A, Eq-B, and EQ-C; no clusters on Eq-D
- 3 failover groups

1. Do the following on all four Equalizers:

   a. Create all VLANs and subnets necessary for your configuration (see "Configuring VLANs" on page 100). For this example, we assume two VLANs (**vlan2** with two subnets and **vlan3** with one. These are cabled to Equalizer through separate front-panel ports. As with any failover configuration, the VLAN/subnet configuration on all peers must be exactly the same, except for object names and tagged/untagged port assignments.

   b. Set the Failover (or Virtual) IP address on each vlan subnet, as in these examples:

```
eqcli > vlan vlan2 subnet 172net-1 virt_addr 172.16.0.169/24
eqcli > vlan vlan2 subnet 172net-2 virt_addr 172.16.1.169/24
eqcli > vlan vlan3 subnet 192net virt_addr 192.168.0.169/21
```

   c. Set the command and heartbeat flags on the subnets. One subnet must have the command flag enabled, all subnets need the heartbeat flag since we want to fail over when there is a connectivity issue on any subnet:

```
eqcli > vlan vlan2 subnet 172net-1 flags command,heartbeat
eqcli > vlan vlan2 subnet 172net-2 flags heartbeat
eqcli > vlan vlan3 subnet 192net flags heartbeat
```

   d. Upgrade to the beta image:

```
eqcli > upgrade upgrade_url
```

   e. Change the system hostname so it is unique:

```
eqcli > hostname name
```

   f. Set the timezone. Enter:

```
eqcli > timezone?
```

Locate your timezone in the displayed list and press "q" to quit out of the list. Then, type in your timezone number and press <`Enter`>, as in this example for the "America/New York" time zone:

```
eqcli > timezone 161
```

g. If Equalizer can reach the Internet, add a name server so that NTP will work and time will be the same across all Equalizers:

```
eqcli > name-server IP_address
```

Otherwise, set the time manually on all systems to the current time:

```
eqcli > date HHmmss
```

In the above command, **`HH`** is hours, **`mm`** is minutes, and **`ss`** is seconds. Seconds are optional.

h. Change the name of the local peer so it's easier to recognize, as in this example for Equalizer `Eq-A`:

```
eqcli > peer e<TAB> name Eq-A
```

Note - Note that the `<TAB>` above means press the Tab key on your keyboard to auto-complete the local peer name. Since this unit currently has only one peer definition it fills it out with the local peer name.

2. After you complete Step 1 on all *three* Equalizers, do the following on Equalizer `Eq-A`:

a. Create the clusters, servers, server pools, and server instances necessary for your configuration. For the purposes of this procedure, we created the following objects and non-default settings:

```
eqcli > server sv2 proto tcp ip 172.16.0.170 port 80
eqcli > srvpool sp01 policy adaptive
eqcli > srvpool sp01 si sv2 weight 100
eqcli > cluster clA proto http ip 172.16.0.160 port 80 srvpool
sp01

eqcli > server sv3 proto tcp ip 172.16.1.170 port 80
eqcli > srvpool sp02 policy adaptive
eqcli > srvpool sp02 si sv3 weight 100
eqcli > cluster clB proto http ip 172.16.1.160 port 80 srvpool
```

```
sp02
eqcli > server sv4 proto tcp ip 192.168.0.24 port 80
eqcli > srvpool sp03 policy adaptive
eqcli > srvpool sp03 si sv4 weight 100
eqcli > cluster clC proto http ip 192.168.0.161 port 80 srvpool
sp03
```

Note - In this procedure, we create all the clusters, servers, and server pools on the preferred primary Equalizer, assign a preferred peer to each cluster, and then rebalance to move the clusters to their preferred peer Equalizers. You could also create your clusters on the other peers. If you do, be sure to specify a preferred peer for each cluster when you create them if you want them to be instantiated on that peer; otherwise, they will be instantiated on the peer that has the preferred primary flag enabled.

b. Update the flags for peer `Eq-A`:

```
eqcli > peer Eq-A flags failover,fo_config_xfer,preferred_
primary,active-active
```

c. Verify that Equalizer has created two failover groups:

```
eqcli > show fogrp

F/O Group Name     F/O Group ID     F/O Mode        Primary Peer

Unassigned         0                Not Used
fo_group1          1                Standalone
fo_group2          2                Standalone
fo_group3          3                Standalone
```

d. Create the peer definitions for the remote peers `Eq-B` and `Eq-C`:

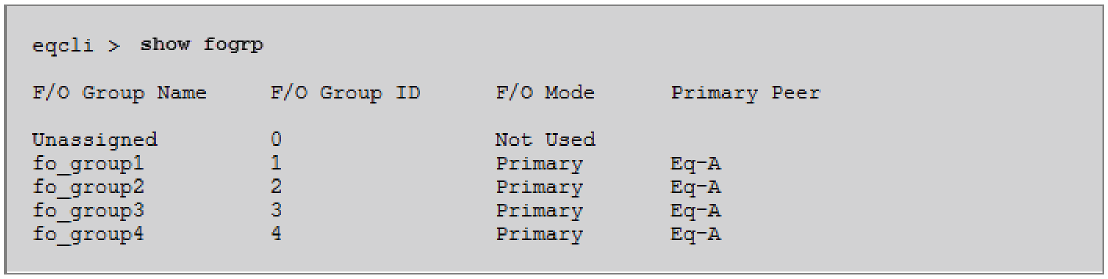
```
eqcli > peer Eq-B signature signature flags failover
eqcli > peer Eq-C signature signature flags failover
eqcli > peer Eq-D signature signature flags failover
```

Note - The signature for each remote peer can be displayed by logging into the CLI on that peer and executing "**`show peer name`**", where name is Eq-B, Eq-C, or Eq-D.

e. Set a preferred peer for each cluster:

```
eqcli > cluster clA preferred_peer Eq-A
eqcli > cluster clB preferred_peer Eq-B
eqcli > cluster clC preferred_peer Eq-C
```

f. Verify that the clusters have been configured into three failover groups:



```
eqcli > show fogrp

F/O Group Name     F/O Group ID     F/O Mode     Primary Peer

Unassigned         0                Not Used
fo_group1          1                Primary      Eq-A
fo_group2          2                Primary      Eq-A
fo_group3          3                Primary      Eq-A
fo_group4          4                Primary      Eq-A
```

3. Do the following on `Eq-B`:

   a. Update the flags for peer `Eq-B`:

```
eqcli > peer Eq-B flags failover,active-active
```

   b. Create the peer definitions for the remote peers `Eq-A`, `Eq-C`, and `Eq-D`:

```
eqcli > peer Eq-A signature signature flags failover,fo_config_
xfer,preferred_primary
 eqcli > peer Eq-C signature signature flags failover
eqcli > peer Eq-D signature signature flags failover
```

Note - The signature for each remote peer can be displayed by logging into the CLI on that peer and executing "`show peer name`", where name is Eq-A, Eq-C, and Eq-D.

4. Do the following on `Eq-C`:

   a. Update the flags for peer `Eq-C`:

```
eqcli > peer Eq-C flags failover,active-active
```

   b. Create the peer definitions for the remote peers E`q-A`, `Eq-B`, and `Eq-D`:

```
eqcli > peer Eq-A signature signature flags failover,fo_config_
xfer,preferred_primary
eqcli > peer Eq-B signature signature flags failover
eqcli > peer Eq-D signature signature flags failover
```

Note - The signature for each remote peer can be displayed by logging into the CLI on that peer and executing **`show peer`** ***`name`***, where ***`name`*** is Eq-A, Eq-B, or Eq-D.

5. Do the following on `Eq-D`:

    a. Update the flags for peer `Eq-D`:

    ```
    eqcli > peer Eq-D flags failover,active-active
    ```

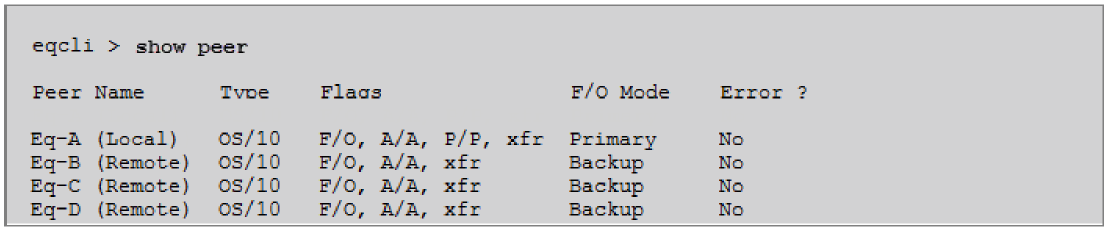
    b. Create the peer definitions for the remote peers `Eq-A`, `Eq-B`, and `Eq-C`:

    ```
    eqcli > peer Eq-A signature signature flags failover,fo_config_
    xfer,preferred_primary
    eqcli > peer Eq-B signature signature flags failover
    eqcli > peer Eq-C signature signature flags failover
    ```

Note - The signature for each remote peer can be displayed by logging into the CLI on that peer and executing "**`show peer name`**", where name is **`Eq-A`**, **`Eq-B`**, or **`Eq-C`**.

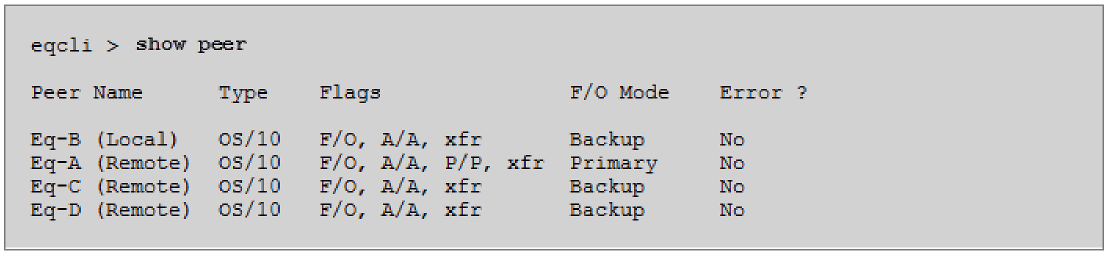
6. Check failover group status on each Equalizer:

    a. On `Eq-A`, the peer status should now look like this:



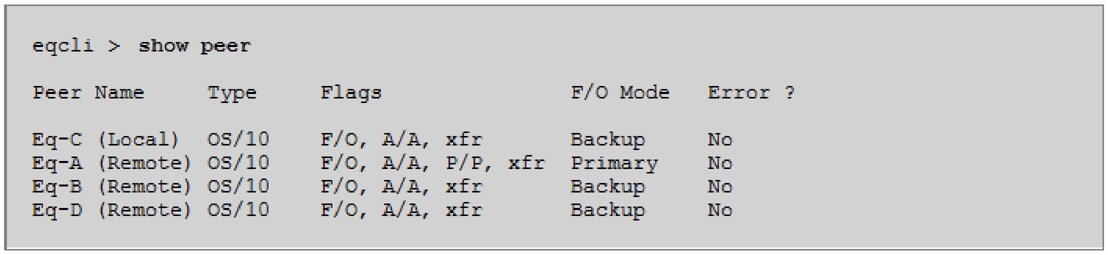
```
eqcli > show peer

Peer Name       Type    Flags               F/O Mode    Error ?

Eq-A (Local)    OS/10   F/O, A/A, P/P, xfr  Primary     No
Eq-B (Remote)   OS/10   F/O, A/A, xfr       Backup      No
Eq-C (Remote)   OS/10   F/O, A/A, xfr       Backup      No
Eq-D (Remote)   OS/10   F/O, A/A, xfr       Backup      No
```

    b. On `Eq-B`, the peer status should now look like this:



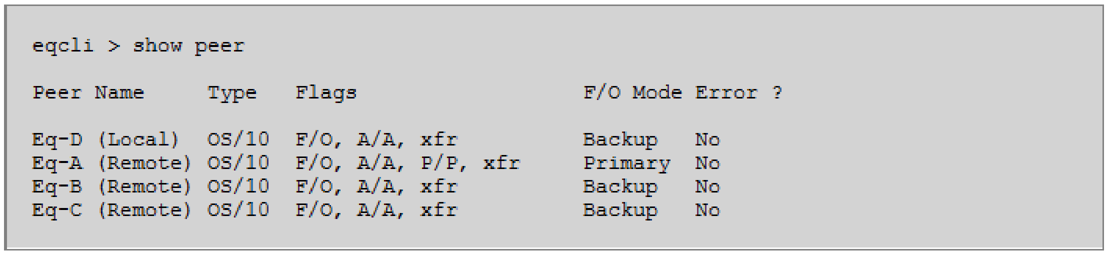
```
eqcli > show peer

Peer Name       Type    Flags               F/O Mode    Error ?

Eq-B (Local)    OS/10   F/O, A/A, xfr       Backup      No
Eq-A (Remote)   OS/10   F/O, A/A, P/P, xfr  Primary     No
Eq-C (Remote)   OS/10   F/O, A/A, xfr       Backup      No
Eq-D (Remote)   OS/10   F/O, A/A, xfr       Backup      No
```

    c. On `Eq-C`, the peer status should now look like this:



```
eqcli > show peer

Peer Name      Type     Flags              F/O Mode   Error ?

Eq-C (Local)   OS/10    F/O, A/A, xfr      Backup     No
Eq-A (Remote)  OS/10    F/O, A/A, P/P, xfr Primary    No
Eq-B (Remote)  OS/10    F/O, A/A, xfr      Backup     No
Eq-D (Remote)  OS/10    F/O, A/A, xfr      Backup     No
```

d. On `Eq-D`, the peer status should now look like this:



```
eqcli > show peer

Peer Name      Type   Flags                  F/O Mode Error ?

Eq-D (Local)   OS/10  F/O, A/A, xfr          Backup   No
Eq-A (Remote)  OS/10  F/O, A/A, P/P, xfr     Primary  No
Eq-B (Remote)  OS/10  F/O, A/A, xfr          Backup   No
Eq-C (Remote)  OS/10  F/O, A/A, xfr          Backup   No
```

If all peers sharing several failover groups are rebooted or powered on in a sequential fashion (first reboot `Eq-A`, then `Eq-B` etc.), the expected behavior is that one unit may become Primary for all failover groups, depending upon the sequence in which the systems become active on the network. If this occurs, running the "rebalance" command will re-distribute the failover groups to their preferred primary Equalizers.

After the above procedure is completed, the configuration on Eq-A should get copied over to Eq-B, Eq-C, and Eq-D. All Equalizer objects will be visible in the CLI and GUI of all peers. All clusters will continue to run on Eq-A until they are "rebalanced" or a failover occurs. (Refer to "Rebalancing" on page 466).

Configuring N + 0 Failover with 4 Equalizers (CLI)

In this configuration, four Equalizers (Eq-A, Eq-B, Eq-C, and Eq-D) cooperate to provide high availability. They do not need to be the same models, and can include Equalizer OnDemand. They are configured with:

- 4 VLAN subnets
- 4 clusters -- 1 preferred on each of Eq-A, Eq-B, Eq-C, and Eq-D
- 4 failover groups

1. Do the following on all four Equalizers:

   a. Create all VLANs and subnets necessary for your configuration (see "Configuring VLANs" on page 100). For this example, we assume two VLANs (**vlan2** with two subnets and **vlan3** with one. These are cabled to Equalizer through separate front-panel ports. As with any failover configuration, the VLAN/subnet configuration on all peers must be exactly the same, except for object names and tagged/untagged port assignments.

   b. Set the Failover (or Virtual) IP address on each vlan subnet, as in these examples:

```
eqcli > vlan vlan2 subnet 172net-1 virt_addr 172.16.0.169/24
eqcli > vlan vlan2 subnet 172net-2 virt_addr 172.16.1.169/24
eqcli > vlan vlan3 subnet 192net-1 virt_addr 192.168.0.169/24
eqcli > vlan vlan3 subnet 192net-2 virt_addr 192.168.1.169/24
```

   c. Set the command and heartbeat flags on the subnets. One subnet must have the command flag enabled, all subnets need the heartbeat flag since we want to fail over when there is a connectivity issue on any subnet:

```
eqcli > vlan vlan2 subnet 172net-1 flags command,heartbeat
eqcli > vlan vlan2 subnet 172net-2 flags heartbeat
eqcli > vlan vlan3 subnet 192net-1 flags heartbeat
eqcli > vlan vlan3 subnet 192net-2 flags heartbeat
```

   d. Upgrade to the beta image:

```
eqcli > upgrade upgrade_url
```

   e. Change the system hostname so it is unique:

```
eqcli > hostname name
```

f. Set the timezone. Enter:

```
eqcli > timezone?
```

Locate your timezone in the displayed list and press "q" to quit out of the list. Then, type in your timezone number and press <`Enter`>, as in this example for the "America/New York" time zone:

```
eqcli > timezone 161
```

g. If Equalizer can reach the Internet, add a name server so that NTP will work and time will be the same across all Equalizers:

```
eqcli > name-server IP_address
```

Otherwise, set the time manually on all systems to the current time:

```
eqcli > date HHmmss
```

In the above command, ***`HH`*** is hours, ***`mm`*** is minutes, and ***`ss`*** is seconds. Seconds are optional.

h. Change the name of the local peer so it's easier to recognize, as in this example for Equalizer `Eq-A`:

```
eqcli > peer <TAB> name Eq-A
```

Note - The <`TAB`> above means press the Tab key on your keyboard to auto-complete the local peer name. Since this unit currently has only one peer definition it fills it out with the local peer name.

2. After you complete Step 1 on all three Equalizers, do the following on Equalizer `Eq-A`:

   a. Create the clusters, servers, server pools, and server instances necessary for your configuration. For the purposes of this procedure, we created the following objects and non-default settings:

```
eqcli > server sv2 proto tcp ip 172.16.0.170 port 80
eqcli > srvpool sp01 policy adaptive
eqcli > srvpool sp01 si sv2 weight 100
eqcli > cluster clA proto http ip 172.16.0.161 port 80 srvpool
sp01

eqcli > server sv3 proto tcp ip 172.16.1.170 port 80
eqcli > srvpool sp02 policy adaptive
eqcli > srvpool sp02 si sv3 weight 100
eqcli > cluster clB proto http ip 172.16.1.161 port 80 srvpool
sp02

eqcli > server sv4 proto tcp ip 192.168.0.24 port 80
eqcli > srvpool sp03 policy adaptive
eqcli > srvpool sp03 si sv4 weight 100
eqcli > cluster clC proto http ip 192.168.0.161 port 80 srvpool
sp03
eqcli > server sv5 proto tcp ip 192.168.1.24 port 80
eqcli > srvpool sp04 policy adaptive
eqcli > srvpool sp04 si sv5 weight 100
eqcli > cluster clC proto http ip 192.168.1.161 port 80 srvpool
sp04
```

Note - In this procedure, we create all the clusters, servers, and server pools on the preferred primary Equalizer, assign a preferred peer to each cluster, and then rebalance to move the clusters to their preferred peer Equalizers.

You could also create your clusters on the other peers. If you do, be sure to specify a preferred peer for each cluster when you create them if you want them to be instantiated on that peer; otherwise, they will be instantiated on the peer that has the preferred primary flag enabled.

b. Update the flags for peer `Eq-A`:

```
eqcli > peer Eq-A flags failover,fo_config_xfer,preferred_
primary,active-active
```

c. Verify that Equalizer has created two failover groups:

```
eqcli >  show fogrp

F/O Group Name       F/O Group ID         F/O Mode       Primary Peer

Unassigned           0                    Not Used
fo_group1            1                    Standalone
fo_group2            2                    Standalone
fo_group3            3                    Standalone
```

d. Create the peer definitions for the remote peers `Eq-B` and `Eq-C`:

```
eqcli > peer Eq-B signature signature flags failover
eqcli > peer Eq-C signature signature flags failover
eqcli > peer Eq-D signature signature flags failover
```

Note - The signature for each remote peer can be displayed by logging into the CLI on that peer and executing **`show peer`** ***`name`***, where ***`name`*** is Eq-B, Eq-C, or Eq-D.

e. Set a preferred peer for each cluster:

```
eqcli > cluster clA preferred_peer Eq-A
eqcli > cluster clB preferred_peer Eq-B
eqcli > cluster clC preferred_peer Eq-C
eqcli > cluster clD preferred_peer Eq-D
```

f. Verify that the clusters have been configured into three failover groups:

```
eqcli >  show fogrp

F/O Group Name       F/O Group ID       F/O Mode       Primary Peer

Unassigned           0                  Not Used
fo_group1            1                  Primary        Eq-A
fo_group2            2                  Primary        Eq-A
fo_group3            3                  Primary        Eq-A
fo_group4            4                  Primary        Eq-A
```

3. Do the following on `Eq-B`:

a. Update the flags for peer Eq-B:

```
eqcli > peer Eq-B flags failover,active-active
```

b. Create the peer definitions for the remote peers `Eq-A`, `Eq-C`, and `Eq-D`:

```
eqcli > peer Eq-A signature signature flags failover,fo_config_
xfer,preferred_primary
eqcli > peer Eq-C signature signature flags failover
eqcli > peer Eq-D signature signature flags failover
```

Note - The signature for each remote peer can be displayed by logging into the CLI on that peer and executing "`show peer name`", where ***name*** is **Eq-A**, **Eq-C**, and **Eq-D**.

4. Do the following on `Eq-C`:

    a. Update the flags for peer `Eq-C`:

```
eqcli > peer Eq-C flags failover,active-active
```

    b. Create the peer definitions for the remote peers `Eq-A`, `Eq-B`, and `Eq-D`:

```
eqcli > peer Eq-A signature signature flags failover,fo_config_
xfer,preferred_primary
eqcli > peer Eq-B signature signature flags failover
eqcli > peer Eq-D signature signature flags failover
```

Note - The signature for each remote peer can be displayed by logging into the CLI on that peer and executing "`show peer name`", where ***name*** is **Eq-A**, **Eq-B**, or **Eq-D**.

5. Do the following on `Eq-D`:

    a. Update the flags for peer `Eq-D`:

```
eqcli > peer Eq-D flags failover,active-active
```

    b. Create the peer definitions for the remote peers `Eq-A`, `Eq-B`, and `Eq-C`:

```
eqcli > peer Eq-A signature signature flags failover,fo_config_
xfer,preferred_primary
eqcli > peer Eq-B signature signature flags failover
eqcli > peer Eq-C signature signature flags failover
```

Note - The signature for each remote peer can be displayed by logging into the CLI on that peer and executing "`show peer name`", where ***name*** is **Eq-A**, **Eq-B**, or **Eq-C**.

6. Check failover group status on each Equalizer:

    a. On `Eq-A`, the peer status should now look like this:

```
eqcli > show peer

Peer Name      Type    Flags              F/O Mode    Error ?

Eq-A (Local)   OS/10   F/O, A/A, P/P, xfr Primary     No
Eq-B (Remote)  OS/10   F/O, A/A, xfr      Backup      No
Eq-C (Remote)  OS/10   F/O, A/A, xfr      Backup      No
Eq-D (Remote)  OS/10   F/O, A/A, xfr      Backup      No
```

    b. On `Eq-B`, the peer status should now look like this:

```
eqcli > show peer

Peer Name      Type    Flags              F/O Mode    Error ?

Eq-B (Local)   OS/10   F/O, A/A, xfr      Backup      No
Eq-A (Remote)  OS/10   F/O, A/A, P/P, xfr Primary     No
Eq-C (Remote)  OS/10   F/O, A/A, xfr      Backup      No
Eq-D (Remote)  OS/10   F/O, A/A, xfr      Backup      No
```

    c. On `Eq-C`, the peer status should now look like this:

```
eqcli > show peer

Peer Name      Type     Flags              F/O Mode   Error ?

Eq-C (Local)   OS/10    F/O, A/A, xfr      Backup     No
Eq-A (Remote)  OS/10    F/O, A/A, P/P, xfr Primary    No
Eq-B (Remote)  OS/10    F/O, A/A, xfr      Backup     No
Eq-D (Remote)  OS/10    F/O, A/A, xfr      Backup     No
```

    d. On `Eq-D`, the peer status should now look like this:

```
eqcli > show peer

Peer Name      Type     Flags              F/O Mode  Error ?

Eq-D (Local)   OS/10    F/O, A/A, xfr      Backup    No
Eq-A (Remote)  OS/10    F/O, A/A, P/P, xfr Primary   No
Eq-B (Remote)  OS/10    F/O, A/A, xfr      Backup    No
Eq-C (Remote)  OS/10    F/O, A/A, xfr      Backup    No
```

After the above procedure is completed, the object configuration should get synchronized over to Eq-B, Eq-C, and Eq-D. All Equalizer objects will be visible in the CLI and GUI of all peers. All clusters will continue to run on Eq-A until they are "rebalanced" or a failover event occurs. (Refer to "Rebalancing" on page 466).

Chapter 23

Alerts

Sections within this chapter include:

Overview of Alerts

An alert is an administratively configured action that is executed whenever an event of a particular type occurs on a particular Equalizer object. For example: a user can be sent an email whenever a particular server is marked UP or DOWN by health check probes.

Currently, Equalizer supports email alerts when a server and server instance state change event occurs. The alert system will be expanded to include more object types and events in future releases.

Alert Object Names

Alert definitions require the name of an object to which the alert will apply. If you want to set an alert on a specific server, part of the alert definition includes the server name.

Currently, alerts for the following object types and second level objects are supported:

- **servers**
- **Server pools**
- **server instances**
- **peers**
- **interface**

The name specified must be the "fully qualified name" of the object within the Equalizer object hierarchy:

- For top-level objects use the name of the object.
- For objects that are contained within a top-level object (i.e. server instances, the alert object name must include: the name of the top-level object, a colon, and the name of the contained object. For example, to specify an alert for a server instance named **server1** within a server pool named **srvpool1**, use the object name **srvpool1:server1**.

Alert Types and Object Types

Currently, there are two alert types supported:

1. state_change
2. exception

Currently, alerts are supported for server instances (si), peers, and interfaces (ports).

The following is a listing with descriptions of currently supported alert types used with top level objects:

Alert Type	Object Type	When an alert is generated
state_change	Server instance	An alert is generated when a server instance in the server pool has been marked UP or DOWN by Layer 4 or ACV probes.

Alert Type	Object Type	When an alert is generated
exception	Peer	An alert is generated when Equalizer has received a heartbeat from a peer on a subnet on which it had previously lost contact.
exception	Peer	An alert is generated when failover is disabled because of a configuration mismatch.
exception	Peer	An alert is generated when a VLAN/subnet mismatch is detected and reports the error.
exception	Peer	An alert is generated when a previously reported VLAN/subnet mismatch is resolved.
state_change	Peer	An alert is generated when a failover group has transitioned from one mode to another. For example it may change from Primary to Backup.
state_change	Peer	An alert is generated when the local peer has transitioned from one mode to another. For example from Primary to Backup.
state_change	Peer	An alert is generated for state change for all failover peers and failover groups (aka "F/O Group" or "fogrp: in the CLI and GUI). This applies to both local and remote failover peers and groups. You can now define a state change alert on any local or remote peer definition or failover group, and if that peer or failover group changes state, the alert will fire on the system on which the alert is configured.
exception	Peer	An alert is generated when connectivity has been regained on a particular VLAN on which connectivity was previously lost.
exception	Peer	An alert is generated when connectivity has been regained on a particular VLAN on which connectivity was previously lost.
exception	Peer	An alert is generated when connectivity was lost on a particular VLAN port or ports.
exception	Peer	An alert is generated when connectivity has been regained on a particular VLAN port or ports on which connectivity was previously lost.
state_change	Server	An alert is generated when a server has been marked up or down by Layer 3 probes.
state_change	Interface	An alert is generated when a front panel port has been marked UP or DOWN, or when an internal motherboard port has been marked DOWN.

Alert Notification Types

Currently, the **email**, **syslog**, **snmp,** and **ui** notification types are supported. Multiple notification types can be specified for a single alert.

1. **email** - Sends an email to the specified recipients, using a specified SMTP relay mail server. When this notification type is used, an email address is also required. A subject line for the email is optional.

2. **syslog** - Sends an alert message to the system log.

3. **snmp** - SNMP traps enable an agent to notify a management station of significant events by way of unsolicited SNMP messages. Refer to "Setting Up SNMP Traps" on page 494 for additional information.

4. **ui** -The "ui" alert notification type is now supported for notifying users of an alert in the CLI.

Configuring Alerts

Alerts must currently be set up and managed using the CLI. Support for alerts in the GUI will be provided in a future release.

The use of "wild cards" in the name of an object that is configured for an alert is available. That is, for the "object" keyword when defining alerts in the CLI the last character of the name may be "*". In this case, all objects of that type whose name matches up to the "*" will be configured for the same alert.

For example, consider the following configured alert:

```
eqcli> user touch alert al_switch alert_type state_change notify_type
ui,syslog object_type interface object swport* subject"Testing switchd
alerts""
```

This configures this alert for all switch ports (which, on a 650GX Equalizer, is 22). A wildcard"*" could have been used.

There only restriction is that the "*" must either be the only character in the object name, or the last character of the object name., (i.e., "object *sv*" is not allowed.)

Enter the following in the CLI to show the alert configuration:

```
eqcli user-tou*> show alert al_switch

Alert Name                  : al_switch
Object Type                 : interface
Object                     : swport*
Alert Type                  : state_change
Notify Type                 : ui, syslog
From Email Address            :
Email Addresses               :
Subject : Testing switchd alerts

eqcli user-tou*>
```

Configuring an SMTP Relay in the CLI

Email alerts require an SMTP relay in order to send email to the recipient specified in the alert definition. To set up an SMTP relay, you need to know:

- The SMTP server's IP address or Fully Qualified Domain Name (FQDN). If an FQDN is used, DNS must also be configured.
- The port on which the SMTP server accepts incoming mail (usually port 25).

Currently, Equalizer supports one SMTP relay. The format of the global CLI command to create a new SMTP relay is:

```
eqcli > ext_services smtp_relay name server IP_or_FQDN port number
```

For example, if you have an SMTP relay server named **postmaster** that has an IP address of 10.0.0.111 and uses the standard SMTP port, you can enter this command:

```
eqcli > ext_services smtp_relay postmaster server 10.0.0.111 port 25
```

To display the SMTP relay definition, enter:

```
eqcli > show ext_services smtp_relay postmaster
```

To delete the SMTP relay definition, enter:

```
eqcli > no ext_services smtp_relay postmaster
```

To modify an existing SMTP relay definition, specify new values for the desired parameters. For example, this command changes the IP address for **postmaster**:

```
eqcli > ext_services smtp_relay postmaster server 172.16.0.123
```

Configuring Alerts in the CLI

Alerts are configured on a per-user basis. A user login name with the admin flag can specify alerts for any user on any object; users without the admin flag can only specify alerts for themselves on objects on which they have permission.

Refer to "Creating Alerts for SNMP Traps" on page 497 for descriptions on setting up alerts for SNMP traps.

Alert Parameters

name	A descriptive name for the alert.
object	The fully qualified name of the object to which the alert applies. Currently, must be a server, server instance, or a peer. See "Alert Types and Object Types" on page 484.
object_type	One of **server**, **si** (server instance), or **peer**.
alert_type	Currently, **state_change** is implemented.
notify_type	Currently supported are: **email** and **syslog**. You can specify multiple notification types by separating them on the command line with a comma (**,**) or vertical bar (**|**).
to	If the **email** notification type is specified, this is the list of email addresses to which the email will be sent. Multiple email addresses must be comma separated with no spaces.
subject	For the **email** notification type, this is the optional subject of the email. For the **syslog** notification type, this text is included in the system log message. The text must be enclosed in quotes.

Server Instance Alerts

Setting an alert on a server instance allows you to send email, log a message to the system log, or both, whenever a server instance is marked up or down by Layer 4 health check probes.

For example, the following sequence of commands creates an alert for the **touch** user that sends email whenever the server **testserver** in server pool named **realpool** is marked up or down by Layer 4 probes:

```
eqcli > user touch
eqcli user-tou*> alert testsrvrinst
eqcli user-tou*-alert-tes*> alert_type state_change
eqcli user-tou*-alert-tes*> notify_type email
eqcli user-tou*-alert-tes*> object realpool:testserver
eqcli user-tou*-alert-tes*> object_type si
eqcli user-tou*-alert-tes*> to user@example.com
eqcli user-tou*-alert-tes*> subject "Server instance status email from Eq450-
100."
eqcli user-tou*-alert-tes*> commit
```

Server Alerts

Setting an alert on a server allows you to send email, log a message to the system log, or both, whenever a server is marked up or down by Layer 3 health check probes.

For example, the following sequence of commands creates an alert for the **touch** user that sends email whenever the server **testserver** is marked up or down by Layer 3 probes:

```
eqcli > user touch
eqcli user-tou*> alert testsrvr
eqcli user-tou*-alert-tes*> alert_type state_change
eqcli user-tou*-alert-tes*> notify_type email
```

```
    eqcli user-tou*-alert-tes*> object testserver
    eqcli user-tou*-alert-tes*> object_type server
    eqcli user-tou*-alert-tes*> to user@example.com
    eqcli user-tou*-alert-tes*> subject "Server status email from Eq450-100."
    eqcli user-tou*-alert-tes*> commit
```

Peer Alerts

Setting an alert on a peer allows you to send email, log a message to the system log, or both, whenever a peer changes to Primary, Backup, or Standalone modes. Primary and Backup modes apply to Equalizer in a failover configuration. Standalone mode is the normal operational state for a single Equalizer not deployed in a failover pair when it is first booted.

On an Equalizer that is not deployed in a failover configuration, there is a single peer definition that refers to the local Equalizer. In a failover configuration, there are two peer definitions: one for the local Equalizer and one for the remote Equalizer in the failover pair.

For example, the following sequence of commands creates an alert for the **touch** user that sends email whenever the local Equalizer (peer Eq_AD1122CC99, which is not in failover) reboots and changes to Standalone mode:

```
    eqcli > user touch
    eqcli user-tou*> alert standmode
    eqcli user-tou*-alert-tes*> alert_type state_change
    eqcli user-tou*-alert-tes*> notify_type email
    eqcli user-tou*-alert-tes*> object Eq_AD1122CC99
    eqcli user-tou*-alert-tes*> object_type peer
    eqcli user-tou*-alert-tes*> to user@example.com
    eqcli user-tou*-alert-tes*> subject "Status email from Eq450-100."
    eqcli user-tou*-alert-tes*> commit
```

Alert Notifications

Notification alerts are displayed for ui type alerts only. They will notify you on the user interface (CLI) when a condition changes.You will be notified of any pending notifications when you log in as shown in the example below shows. In this example 2 pending alert notifications (highlighted) after log in.

```
Equalizer -- EQ/OS 10.0.4a-INTERNAL_DO_NOT_DISTRIBUTE

Username: touch
Password: *****
Login successful.

    EQ/OS 10.0.4c
     Copyright 2013 Fortinet, Inc.
     Welcome to Equalizer!

 12000004: You have 2 pending alert notifications.
eqcli >
```

You can configure notifications, via the user **alert_interval** parameter, a regular interval at which the presence of pending notifications will be checked. If there are any pending notifications, they are displayed as shown above if:

1. The number of pending notifications has changed, and
2. You have not entered data at the command prompt. In this case, the pending notifications will be displayed after clicking **ENTER**.

Displaying Notifications

Notification IDs are assigned a monotonically increasing number starting with 1, up to a maximum of 200. After 200, the notification ID wraps back to 1. After wrapping all previously uncleared notifications are overwritten as the ID is re-used.

To display *all* pending alert notifications enter:

```
eqcli > show notification
```

The notifications are listed in the order in which the alerts were generated (not configured).

```
eqcli > show notification

ID     Alert Type       Object Type       Object Name     Alert Name

1      state_change     interface          swport01    al_switch
2       state_change     interface    swport03    al_switch

eqcli >
```

To display the *first* notification enter:

```
eqcli > show notification first
```

The following is an example of the first alert above for the state change for **`swport01`**.

```
first
Notification ID : 1
Alert Type : state_change
Alert Subtype : Up
Alert Name : al_switch
Object Type : interface
Object Name : swport01
Message : 50000197: Port 1 has become ACTIVE

eqcli >
```

To show the first notification matching one or more filters enter:

```
eqcli > show notification first alert_type alerttype object_type objecttype object_name
objectname
```

If the **`object_name`** is specified, **`object_type`** must also be specified.

The following is an example showing the state change for **`swport01`** above.

```
eqcli > show notification first alert_type state_change object_type
interface object_name swport01

Notification ID : 1
Alert Type : state_change
Alert Subtype : Up
Alert Name : al_switch
Object Type : interface
Object Name : swport01
Message : 50000197: Port 1 has become ACTIVE
eqcli >
```

Setting the Interval

To set the interval at which alert notifications are displayed on the CLI enter the following:

```
eqcli> user-tou*> alert_interval integer
```

By default **`alert_interval`** is 1 minute. The maximum is 86400 (1 day).

Removing Notification Alerts

You can remove *all* notification alerts by entering:

```
eqcli > no notification all
```

Remove *individual* notifications using the ID number by entering:

```
eqcli > no notification id-number
```

Chapter 24

Using SNMP Traps

Sections within this chapter include:

Setting Up SNMP Traps

The Simple Network Management Protocol (SNMP) is an internet standard that allows a management station to monitor the status of a device over the network. SNMP organizes information about Equalizer and provides a standard way to help gather that information. Using SNMP requires:

- An SNMP agent running on the system to be monitored.
- A Management Information Base (MIB) database on the system to be monitored.
- An SNMP management station running on the same or another system.

An SNMP agent and MIB databases are provided on Equalizer Models E370LX, and E250GX and above, implemented for SNMPv1 and SNMPv2c.

A management station is not provided with Equalizer and must be obtained from a third party supplier. The management station is often used primarily to browse through the MIB tree, and so is sometimes called a MIB browser. One such management station that is available in a free personal edition is the *iReasoning MIB Browser*, available from www.ireasoning.com.

A MIB database is a hierarchical tree of variables whose values describe the state of the monitored device. A management station that wants to browse the MIB database on a device sends a request to the SNMP agent running on the device. The agent queries the MIB database for the variables requested by the management station, and then sends a reply to the management station.

SNMP traps are alerts that are tied into the Equalizer Alerts system. They enable an agent to notify a management station of significant events by way of unsolicited SNMP messages. First, they must be enabled using the CLI context and then created for each desired alerts. Presently, Equalizer supports the following SNMP traps:

- Server up/down events - Equalizer will triggers these traps when it detects either a server failure or a response from a failed server.
- Peer state change events - Equalizer will trigger these traps whenever a state change occurs to a peer or peer interface..
- Failover Group state change events - Equalizer triggers these traps whenever a state change occurs to a failover group.

Different OIDs (Object Identifier) are used for each item in the above list. The OID identifies a variable that can be read via SNMP. So, for example, server up and server down events are sent using different OIDs. The text message sent with the trap tells you exactly what the event was (server up or server down).

The SNMP Trap configuration process includes 4 steps:

I. Set up an SNMP Management Station

II. Enable SNMP

III. Enable SNMP Traps

IV. Creating alerts for the desired traps

Setting Up an SNMP Management Station

An SNMP management station is not provided with Equalizer. In order to use SNMP to manage Equalizer, a third-party management console must be installed and configured on a machine that can access Equalizer. Configuration procedures are specific to the management console used.

At a minimum, the SNMP management console needs to be configured to:

- Use Equalizer's IP address and port 161 for SNMP requests.
- Use the community string specified for Equalizer (Refer to "SNMP Commands" on page 176 or "SNMP" on page 198).
- Use the address and port specified in the above for SNMP traps (usually port 162 is used for this purpose, but this can be configured as shown in "Enabling SNMP Traps" on page 497).
- Use Equalizer MIB definitions; these need to be loaded into the management console, following the instructions for the console. The Equalizer MIB source files are located at:

  `http://<Equalizer-ip>/eqmanual/CPS-EQUALIZER-v10-MIB.my`

  `http://<Equalizer-ip>/eqmanual/CPS-REGISTRATIONS-v10-MIB.my`

  `http://<Equalizer-ip>/eqmanual/cpsSystemEqualizerv10TrapsB.my`

  In the above, **`<Equalizer-ip>`** is the IP address of the Equalizer. On the Equalizer, these are located in the directory `/usr/local/www/eqmanual.`

Enabling SNMP

Note - SNMP is enabled using the CLI.

By default, SNMP is a globally enabled service -- meaning that it will run on any subnet that is configured to offer the SNMP service. You must specifically enable SNMP on the subnet or subnets on which you want it to listen for SNMP MIB browser and management station connections.

SNMP can be enabled on *at most* one IPv4 subnet address/port and one IPv6 subnet address/port. SNMP runs on Equalizer's IP address on the configured subnet. Currently, SNMP runs on the default SNMP port (161) only.

To enable SNMP, you must enable it at the global level, and then enable it on any single IPv4 subnet, any single IPv6 subnet, or both. For this procedure, we assume the existence of a properly configured VLAN (172net) and its Default subnet.

1. In the global CLI context, confirm that SNMP is globally enabled:

```
eqcli > show
```

   You should see a line that looks like the following:

```
eqcli > show

Variable Value
recv_timeout       2
conn_timeout 1
hb_interval        2
retry_interval 5
strike_count 3
icmp_interval      15
icmp_maxtries 3
hostname           Equalizer
date               Thu Sep 13 11:49:09 UTC 2012
timezone           UTC
locale             en
global services     http, https, ssh, fo_snmp, snmp, envoy, envoy_agent
name-servers       None
ntp-server pool.ntp.org - Unavailable: name-server undefined
syslog-server       None
GUI logo           Coyote Point Systems Inc.
boot image         Equalizer Image B EQ/OS Version 10.0.2f (Build 19121)

eqcli >
```

In `global servicessnmp` means that SNMP is globally enabled for any Equalizer subnet IP address. “`fo_snmp`” means that SNMP is globally enabled for any subnet failover IP address. If either of these keywords has a preceding exclamation point (**!**), then SNMP is disabled for that class of IP addresses. You can enable and disable these flags using the services command, as shown in "Global Commands" on page 141.

2. Now, enable SNMP on the desired VLAN subnet, on either the subnet IP address or the subnet failover (aka “virtual”) IP address. In this example, we enable it on the subnet IP address:

```
eqcli > vlan 172net subnet Default services snmp
```

SNMP is now enabled and will respond to MIB browser requests received on the **172net:Default** subnet IP address (port 161).

Before accessing Equalizer via SNMP, download and install the Equalizer MIB files into your MIB browser, as explained in the following section.

Refer to "SNMP" on page 198 for details on setting SNMP parameters using the GUI.

Enabling SNMP Traps

SNMP traps must first be enabled using the CLI. An snmp trap address and port is required to enable the traps. Enter the following at the CLI prompt:

```
eqcli> snmp serverip ip serverport port
```

where: **`<ip>`** is the snmp trap server IP and ***`port`*** is the snmp trap server port.

The port is optional. If it is NOT entered, the default trap server port (162) will be used.

Multiple trap servers can be defined if desired. If they are, ALL traps are sent to ALL configured IPs. The **`show snmp`** command displays the configured trap servers.

A trap server IP can be deleted by entering:

```
eqcli > no snmp serverip
```

All trap server IPs may be deleted by entering:

```
eqcli > no snmp serverip
```

Creating Alerts for SNMP Traps

SNMP Traps are configured as alerts and are configured on a per-user basis. A user login name with the admin flag can specify alerts for any user on any object; users without the admin flag can only specify alerts for themselves on objects on which they have permission.

Creating SNMP Trap Server Alerts

Setting an SNMP Trap server alert enables the sending of snmp trap messages to snmp management stations whenever a server is marked up or down by a health check.

For example, the following sequence of commands creates an alert for the **touch** user that sends an snmp trap message whenever the server **testserver** is marked up or down by a health check:

```
eqcli > user touch
eqcli user-tou*> alert testsrvr
eqcli user-tou*-alert-tes*> alert_type state_change
eqcli user-tou*-alert-tes*> notify_type snmp
eqcli user-tou*-alert-tes*> object testserver
eqcli user-tou*-alert-tes*> object_type server
eqcli user-tou*-alert-tes*> commit
```

Creating SNMP Trap Peer Alerts

Setting an SNMP Trap alert enables the sending of snmp trap messages to the snmp management station whenever a peer state changes to Primary, Backup, or Standalone modes. Primary and Backup modes apply to Equalizer in a failover configuration. Standalone mode is the normal operational state for a single Equalizer not deployed in a failover pair when it is first booted.

For example, the following sequence of commands creates an snmp trap alert for the **touch** user that enables trap messages whenever the local Equalizer (peer Eq_AD1122CC99, which is not in failover) reboots and changes to Standalone mode:

```
eqcli > user touch
eqcli user-tou*> alert standalonemode
eqcli user-tou*-alert-tes*> alert_type state_change
eqcli user-tou*-alert-tes*> notify_type snmp
eqcli user-tou*-alert-tes*> object Eq_AD1122CC99
eqcli user-tou*-alert-tes*> object_type peer
eqcli user-tou*-alert-tes*> commit
```

Creating SNMP Trap Failover Group Alerts

Setting an SNMP Trap alert enables the sending of snmp trap messages to the snmp management station whenever a Failover Group changes to Primary, Backup, or Standalone modes.

For example, the following sequence of commands creates an snmp trap alert for the **touch** user that enables a trap message whenever a failover group (`fo_group1`) changes state. Note that the failover group object name must be entered as **`<peername>:<fogroupname>`**:

```
eqcli > user touch
eqcli user-tou*> alert fogroupstatechange
eqcli user-tou*-alert-tes*> alert_type state_change
eqcli user-tou*-alert-tes*> notify_type snmp
eqcli user-tou*-alert-tes*> object Eq_AD1122CC99:fo_group1
eqcli user-tou*-alert-tes*> object_type fogrp
eqcli user-tou*-alert-tes*> commit
```

Chapter 25

User and Group Management

Sections within this chapter include:

Best User and Group Management Practices

When adding additional users and groups to your configuration, follow these guidelines to establish object permissions that will be effective and easy to manage:

If you require multiple non-admin users in your configuration, it is preferable to first create all required objects (servers, server pools, clusters, etc.), and then create users with appropriate permissions to manage them.

In the easiest to manage scenario:

- There is one user with the "admin" flag set.
- The "admin" user creates all objects.
- The "admin" user assigns users "read", "write", and "delete" permissions on objects in the configuration (as necessary) so that those users can perform required tasks on those objects (see Table).
- A user can be given permission to perform certain administrative tasks by enabling the "read_global" and "write_global" flags for that user (See "User Flags" on page 182).
- No groups other than "Default" are used.

The next step up in complexity is to give a non-admin user the ability to create objects of a particular type.

An even more advanced mode allows users to create objects of a certain type and add them to a group other than "Default" as well. In this scenario, an "admin" user must update the users "permit" list to give the non-admin user access to any new objects the non-admin user creates.

In general, it is recommended that the "admin" flag and the "create" permission are enabled for as few users as possible. Otherwise, chaos may ensue. You have been warned!

Note - By default Equalizer comes with an admin user “touch”. User permissions can only be assigned by an administrator using the eqcli command line interface.

Object Permission Types

The following are the permissions available on Equalizer objects:

Permission Type	Descriptions
Read	The user can only view the object’s definition. **For global parameters:** the user can open all of the global parameter tabs displayed when you click on **Equalizer** in the left frame, but cannot use the **commit** button to make any changes. **For clusters:** cluster definitions for which the user has **read** permission are displayed in the left frame and all global tabs. The user can select clusters and view their definitions.

Permission Type	Descriptions
Write	In addition to **read** permission, the user can modify existing objects, but cannot add new objects or delete existing objects. **For global parameters:** the user can update all global parameters (including parameters that are not already assigned a value). The user cannot, however, add or delete global objects (for example: logins, clusters, and responders). **For clusters:** the user can modify the values assigned to all cluster parameters (including parameters that are not already assigned a value). The user cannot add or delete a cluster object (for example, a server or match rule.)
Create	In addition to **write** permission, the user can add new objects. **For global parameters:** the user can add and delete global objects (for example: logins, clusters, and responders). **For clusters:** the user can add a cluster object (for example, a server or match rule.)
Delete	In addition to **write** permission, the user can delete existing objects. **For global parameters:** the user can delete global objects (for example: logins, clusters, and responders). **For clusters:** the user can delete a cluster object (for example, a server or match rule.)

Required Task Permissions and Flags

The table below shows the permissions required for all object and administrative tasks in the CLI and the GUI.

Operation	Permissions Required	Flags Required	Notes
adding a certificate file	`write certificate_name`		
adding a CRL file	`write` *`crl`*		
adding a private key file	`write` *`certificate_name`*		
adding a certificate	`create certificate`		

adding a cluster	`create clusterwrite`
	`vlan_`*`name`*
	`read certificate_`*`name`*
	`read crl_`*`name`*		

adding a CRL	`create crl`		
adding a DNS server		`write_` `global`	

Operation	Permissions Required	Flags Required	Notes
adding a GeoCluster	`create geocluster`		
adding a GeoSite	`create geosite`		

adding a GeoSite instance	`write cluster_`*`name`*
	`read geosite_`*`name`*		

adding a GeoSite IP	`write geosite_`*`name`*		
adding a GeoSite resource	`write geosite_`*`name`*		

adding a match rule	`write cluster_`*`name`*
	`read srvpool_`*`name`*
	`read responder_`*`name`*		

adding an NTP server		`write_ global`	
adding a peer		`write_ global`	

adding a permit entry to a subnet	`write vlan_`*`name`*
	`read vlan_other`
			vlan_*name* is the name of the VLAN that contains the subnet being modified. vlan_ other is the name of the VLAN being added to the **permit** list.

adding a probe IP		`write_ global`	
adding a responder	`create responder`		
adding a server	`create server`		
adding a server instance	`write srvpoolread server_`*`name`*		
adding a server pool	`create srvpool`		
adding a subnet	`write vlan_`*`name`*		
adding a subnet route	`write vlan_`*`name`*		
adding a syslog server		`write_ global`	
adding a vlan	`create vlanwrite port_`*`name`*		
add/delete/modify group		`admin`	

Operation	Permissions Required	Flags Required	Notes
add/delete/modify group permit list		`admin`	
add/delete/modify user		`admin`	
add/delete/modify user permit list		`admin`	

deleting a certificate	`delete certificate_`*`name`*
	`write `*`cluster_name`*		

deleting a cluster	`delete `*`cluster_name`*		

deleting a crl	`delete crl_`*`name`*
	`write `*`cluster_name`*		

deleting a GeoCluster	`delete `*`geocluster_name`*		

deleting a GeoSite	`delete geosite_`*`name`*
	`write geo`*`cluster_name`*		

deleting a GeoSite instance	`write `*`geocluster_name`*		
deleting a GeoSite IP	`write `*`geosite_name`*		
deleting a GeoSite resource	`write `*`geosite_name`*		
deleting a match rule	`write `*`cluster_name`*		

deleting a responder	`delete responder_`*`name`*
	`write `*`cluster_name`*		

deleting a server	`delete server_`*`name`*
	`write `*`srvpool_name`*		

deleting a server instance	`write `*`srvpool_name`*		

deleting a server pool	`delete srvpool_`*`name`*
	`write `*`cluster_name`*		

deleting a subnet	`write `*`vlan_name`*		
deleting a subnet permit list entry	`write `*`vlan_name`*		
deleting a subnet route	`write `*`vlan_name`*		

deleting a VLAN	`delete `*`vlan_name`*
	`write `*`cluster_name`*		

Operation	Permissions Required	Flags Required	Notes
delete: peer DNS server NTP server syslog server		`write_global`	
displaying a certificate file	`read` *`certificate_name`*		
displaying a CRL file	`read` *`crl_name`*		
displaying a certificate	`read` *`certificate_name`*		
displaying a cluster	`read cluster_`*`name`*		
displaying a CRL	`read` *`crl_name`*		
displaying a file		`write_global`	
displaying a GeoCluster	`read geocluster_`*`name`*		
displaying a GeoSite	`read geosite_`*`name`*		
displaying a GeoSite instance	`read geocluster_`*`name`*		
displaying a GeoSite IP	`read geosite_`*`name`*		
displaying a GeoSite resource	`read geosite_`*`name`*		
displaying a global context parameter		`read_global`	
displaying a group	`read group_`*`name`*		
displaying a group permit list	`read group_`*`name`*		
displaying an interface		`read_global`	
displaying a interface status		`read_global`	
displaying logs		`read_global`	
displaying a match rule	`read cluster_`*`name`*		
displaying a number of entries in a permit list	`read vlan_`*`name`*		
displaying a number of peers		`read_global`	

Operation	Permissions Required	Flags Required	Notes
displaying a number of subnet routes	`read vlan_`*name*		
displaying a peer		`read_global`	
displaying peer status		`read_global`	
displaying a responder	`read responder_`*name*		
displaying a server	`read server_`*name*		
displaying a server instance	`read srvpool_`*name*		
displaying a server pool	`read srvpool_`*name*		
displaying a subnet	`read vlan_`*name*		
displaying a subnet permit list	`read vlan_`*name*		
displaying subnet routes	`read vlan_`*name*		
displaying a user	`read user_`*name*		
displaying a user permit list	`read user_`*name*		
displaying a VLAN	`read vlan_`*name*		
modifying a cluster	`write` *cluster_name*		
modifying global parameters		`write_global`	
modifying a interface		`write_global`	
modifying a match rule	`write` *cluster_name*		
modifying a peer		`write_global`	
modifying a port	`write` *port_name*		
modifying a responder	`write` *responder_name*		
modifying a server	`write` *server_name*		
modifying a server instance	`write` *srvpool_name*		
modifying a server pool	`write` *srvpool_name*		

Operation	Permissions Required	Flags Required	Notes
modifying a subnet	`write` *`vlan_name`*		
modifying a user password		admin (see note)	A user can only change their own password, unless that user has the **admin** flag set.

modifying a VLAN	`write` *`vlan_name`*
	`write` *`port_name`*		

MSG_GET_CONFIG		`admin`	
MSG_SET_CONFIG		`admin`	
running a global command		`write_global`	

Single and Multiple User Scenarios

The following scenarios describe access permissions to Equalizer and Equalizer objects by a single user and with multiple users.

Single User Scenario

In this, the simplest of scenarios:

- There is one user with the "admin" flag set.
- The "admin" user creates all objects.
- The "admin" user assigns users "read", "write", and "delete" permissions on objects in the configuration (as necessary) so that those users can perform required tasks on those objects (see Table).
- A user can be given permission to perform certain administrative tasks by enabling the "read_global" and "write_global" flags for that user (See "Required Task Permissions and Flags" on page 501).
- No groups other than "Default" are used.

Multiple-User Scenario

A multiple-user load balancing scenario is a “multi-tenant” setup where multiple users can access individual clusters on the same Equalizer. In this scenario the users are granted access privileges on their own Equalizer clusters, with it’s VLANs, Servers, Server Pools, etc.).

The permissions must be set up by a user with administrative privileges and they must be set up on the eqcli command line interface.

In the scenario described below, two users will be assigned permissions using the Operations and Permissions shown in "Object Permission Types" on page 500.

- User “Touch_1” will be able to read, write, create and delete all of the servers, server pools and associated VLAN and subnets used on an Equalizer.
- User “Touch_2” will be able to read, write, create and delete all of the servers, server pools and associated VLAN and subnets used on the same Equalizer.
- Neither of the users will have any access *at all* to the other user’s servers, server pools and associated VLAN and subnets.

Administrative Setup

The following needs to be configured by a user with administrative privileges on Equalizer.

Note - If you require multiple non-admin users in your configuration, it is preferable to first create all required objects (servers, server pools, clusters, etc.), and then create users with appropriate permissions to manage them

1. From the **eqlci** command line enter:

```
eqcli > user Touch_1
```

2. Enter and reenter a password of at least 6 characters to be used for logging in user “Touch_1”.

```
eqcli > user Touch_1
Enter desired user password:******
Retype desired user password:******
```

User “Touch_1” can now log in to Equalizer with these credentials.

3. Repeat steps 1 and 2, this time for a new user-”Touch_2”.
4. Set up permission for each new user with permissions for their individual clusters that were previously configured on Equalizer. Enter the following:

```
eqcli > user Touch_1 permit_object read,write cluster Cl1
eqcli > user Touch_2 permit_object read,write cluster Cl2
```

5. Add “global read” privileges for each user so that they can *view* all of Equalizers objects and object configurations within their designated clusters. Enter the following:

```
eqcli > user Touch_1 flags read_global
eqcli > user Touch_2 flags read_global
```

The new users and their log in credentials have now been created. User “Touch_1” now has “read” and “write” permissions for cluster “Cl1” and user “Touch_2” has “read” and “write” permissions for cluster “Cl2”. The next step is to add specific permissions on the Equalizer objects within each cluster for each user.

Object Permissions for Each User

Setup the object permissions for users “Touch_1” and “Touch_2”. Use "Required Task Permissions and Flags" on page 501"Required Task Permissions and Flags" on page 501as a guideline.

1. Create “read” and “write” permissions for user “Touch_1” on VLAN “vl1”.

```
eqcli > user Touch_1 permit_object read,write vlan vl1
```

2. Create “read” and “write” permissions for user “Touch_2” on VLAN “vl2”.

```
eqcli > user Touch_2 permit_object read,write vlan vl2
```

3. Create “read”, “write” and “delete” permissions for user “Touch_1” on “testserverpool1”.

```
eqcli > user Touch_1 permit_object read,write,delete srvpool testserverpool1
```

4. Create “read”, “write” and “delete” permissions for user “Touch_2” on “testserverpool2”.

```
eqcli > user Touch_1 permit_object read,write,delete srvpool testserverpool2
```

5. Create “read”, “write” and “delete” permissions for user “Touch_1” on servers “test1” and “test2”.

```
eqcli > user Touch_1 permit_object read,write,delete server test1
eqcli > user Touch_1 permit_object read,write,delete server test2
```

6. Create “read”, “write” and “delete” permissions for user “Touch_2” on servers “test3” and “test4”.

```
eqcli > user Touch_2 permit_object read,write,delete server test3
eqcli > user Touch_1 permit_object read,write,delete server test4
```

Permissions have now been configured for users “Touch_1” and “Touch_2”. Each has access to 1 cluster and access with permissions on VLANS, Servers and Server Pools within the cluster. To view the permissions enter the following:

```
eqcli > show user Touch_1
```

```
User Name : Touch_1
Duration : 3600
Flags :
Locale : en

Read Permissions :
servers : test2, test1
server pools : testserverpool1
responders :
VLANs : vl1
geoclusters :
geosites :
users :
certificates :
CRLs :
ports :
clusters : Cl1

Write Permissions :
servers : test2, test1
server pools : testserverpool1
responders :
VLANs : vl1
geoclusters :
geosites :
users :
certificates :
CRLs :
ports :
clusters : Cl1

Create Permissions :
servers :
server pools :
responders :
VLANs :
geoclusters :
geosites :
users :
certificates :
CRLs :
ports :
clusters :

Delete Permissions :
servers : test2, test1
server pools : testserverpool1
responders :
VLANs :
geoclusters :
geosites :
users :
certificates :
CRLs :
```

```
ports :
clusters :
```

```
eqcli > show user Touch_2

show user Touch_2
User Name : Touch_2
Duration : 3600
Flags :
Locale : en

Read Permissions :
servers : test3, test4
server pools : testserverpool2
responders :
VLANs : vl2
geoclusters :
geosites :
users :
certificates :
CRLs :
ports :
clusters : Cl2

Write Permissions :
servers : test3, test4
server pools : testserverpool2
responders :
VLANs : vl2
geoclusters :
geosites :
users :
certificates :
CRLs :
ports :
clusters : Cl2

Create Permissions :
servers :
server pools :
responders :
VLANs :
geoclusters :
geosites :
users :
certificates :
CRLs :
ports :
clusters :

Delete Permissions :
    servers : test3, test4
    server pools : testserverpool2
    responders :
    VLANs :
    geoclusters :
    geosites :
    users :
    certificates :
    CRLs :
    ports :
    clusters :
```

Chapter 26

Using Envoy

Sections within this chapter include:

Overview of Envoy® Geographic Load Balancing

Geographic load balancing increases availability by allowing regional server clusters to share workload transparently, maximizing overall resource utilization. The Envoy® Geographic load balancer is an optional software add-on for the Equalizer product line that supports load balancing requests across servers in different physical locations or on different networks.

An Envoy-enabled web site is a geographic server cluster, composed of regional clusters. Each regional cluster is composed of servers that provide a common service, supervised by an Equalizer running Envoy. For example, the web site www.coyotepoint.com might be supported by three regional clusters, located in California, New York City, and London. An Equalizer running Envoy software and web servers with similar content are deployed at each of these locations.

In non-Envoy Equalizer configurations, there is a one-to-one correspondence between a cluster and a website: when a client makes a request for a website (say, www.example.com), the client uses the Domain Name Service (DNS) to resolve the website name to an IP address. For a website that is load balanced by an Equalizer, the IP address returned is the IP address of an Equalizer cluster. After resolving the name, the client sends the request to the cluster IP. When Equalizer receives the client request, it load balances the request across the server pool in the cluster, based on the current load balancing policy and parameters.

In an Envoy conversation, you have two or more Equalizers located in separate locations. Each Equalizer and its set of clusters and servers forms a site (or Envoy site. With Envoy, the website name in the client request is resolved to a *GeoCluster IP*. A GeoCluster is analogous to a cluster, but one level above it: in other words, a GeoCluster actually points to two or more clusters that are defined on separate Equalizers.

In the same way that Equalizer balances requests for a cluster IP across the server pool in the cluster, Equalizer load balances a request for a GeoCluster IP across the clusters in the GeoCluster configuration. Once a site is chosen and the client request arrives at that site, the request is load balanced across the servers in the appropriate cluster. In this way, you can set up geographically distant Equalizer's to cooperatively load balance client requests.

Envoy on EQ/OS 10 can only interoperate with Envoy running on other units running EQ/OS 10, and does NOT interoperate with Envoy running on EQ/OS 8.6 (or earlier

Envoy Configuration Summary

Follow this general procedure when setting up Envoy for the first time:

1. Configure appropriate clusters (and servers) on all of the Equalizers to be included as Envoy sites in the GeoCluster.

2. Configure the GeoCluster on each Equalizer; the parameters used should be the same on all sites. This includes creating GeoSites and adding GeoSite Instances to the GeoCluster. (Refer to "Configuring GeoClusters" on page 518 and "Configuring GeoSites" on page 526 for details.)

3. Configure the authoritative DNS server for your website’s domain with DNS records for all Equalizers in the GeoCluster. The DNS server returns these records to clients in response to DNS requests to resolve the website (GeoCluster) name.

DNS Configuration

Every Web site is assigned a unique IP address. To access a website, a client needs to know what the site IP address is. Users don't usually enter an IP address into their Web browser, but rather enter a site's domain name instead. In order to access a requested website, a Web browser needs to be able to convert the site's domain name into the corresponding IP address. This is where DNS comes into play.

1. A client computer is configured with the address of a preferred DNS server.
2. A requested URL is forwarded to the DNS server, and the DNS server returns the IP address for the requested website.
3. The client is then able to access the requested site.

Local (Caching) DNS Server

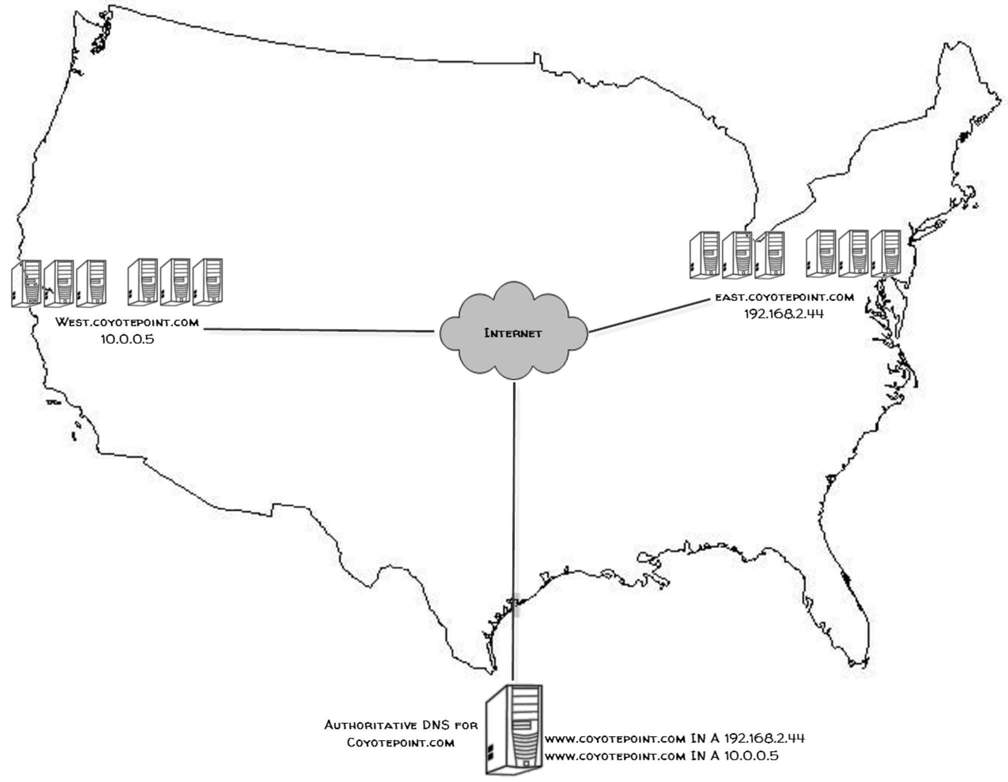
In a typical GSLB configuration a local, or caching DNS server resides in the client's LAN environment. When the client directs the browser to get to a URL (i.e., www.coyotepoint.com) the browser requests the local DNS to resolve the name (i.e. www.coyotepoint.com) to an IP address. Once local DNS server resolves the name to an ip address. It will first check a root name server, which returns a list of name servers for, say, the *.com* domain. The name servers for the domain name space return the IP addresses of an Authoritative DNS server for the domain name. Finally, the Authoritative DNS for the domain name returns the IP address of the web server, or in Envoy SAE, the FQDN of a GeoCluster. For each GeoCluster to be balanced, an Authoritative Name Server must be configured to return name server and alias records for Envoy SAE’s at every regional site

Configuring an Authoritative DNS Name Server for Envoy

You must configure an Authoritative DNS Name Server(s) for the domains that are to be geographically load balanced to delegate authority to the Envoy sites. You need to delegate each of the fully-qualified subdomains to be balanced. If your DNS server is run by an Internet Service Provider (ISP), then you need to ask the ISP to reconfigure the DNS server for Envoy. If you are running your own local DNS server, then you need to update the DNS server’s zone file for your Envoy configuration.

This is usually the last step performed when configuring Envoy. It is recommended to set up Envoy and test your Envoy configuration thoroughly before making changes on the authoritative name server.

For example, assume you must balance www.coyotepoint.com across a GeoCluster containing two Envoy sites, east.coyotepoint.com (at 192.168.2.44) and west.coyotepoint.com (at 10.0.0.5). In this case, you must configure the name servers that will handle the coyotepoint.com domain to delegate authority for www.coyotepoint.com to both east.coyotepoint.com and west.coyotepoint.com. When queried to resolve www.coyotepoint.com, coyotepoint.com’s name servers should return name server (NS) and alias (A) address or glue records for both Envoy sites.



An example of a DNS zone file for this configuration is shown below. In this example, the systems ns1 and ns2 are assumed to be the authoritative name servers (master and slave) for the coyotepoint.com domain.

```
$TTL 86400
coyotepoint.com. IN SOA ns1.coyotepoint.com.
hostmaster.coyotepoint.com. (
 0000000000
 00000
 0000
 000000
 00000 )
coyotepoint.com. IN NS ns1.coyotepoint.com.
coyotepoint.com. IN NS ns2.coyotepoint.com.
www.coyotepoint.com. IN NS east.coyotepoint.com.
www.coyotepoint.com. IN NS west.coyotepoint.com.
ns1 IN A ns1-IP-address
ns2 IN A ns2-IP-address
east IN A 192.168.2.44
west IN A 10.0.0.5
```

In the example above, we left the domain parameters as zeros, since these vary widely between DNS installations. Please see the documentation for the version of DNS that you are using for more information on the zone file content and format.

Envoy also supports AAAA (also called "quad-A" records) for IPv6 addresses.

To ensure that you have properly configured DNS for Envoy, you can use the **nslookup** command (supported on most OS platforms) to confirm that the DNS server is returning appropriate records, as in this example:

```
nslookup www.coyotepoint.com
Server: ns1.coyotepoint.com
Address: ns1-IP-address

Name: www.coyotepoint.com
Address: 192.168.2.44
```

Using Envoy with Firewalled Networks

Envoy sites communicate with each other using Coyote Point’s UDP-based Geographic Query Protocol (GQP). Similarly, Envoy sites communicate with clients using the DNS protocol. If you protect one or more of your Envoy sites with a network firewall, you must configure the firewall to permit the Envoy packets to pass through.

To use Envoy with firewalled networks, you need to configure the firewalls so that the following actions occur:

- Envoy sites communicate with each other on UDP ports 5300 and 5301. The firewall must allow traffic on these ports to pass between Equalizer sites.
- Envoy sites and clients can exchange packets on UDP port 53. The firewall must allow traffic on this port to flow freely between an Envoy site and any Internet clients so that clients trying to resolve host names via the Envoy DNS server can exchange packets with the Envoy sites.
- Envoy sites can send ICMP echo request packets out through the firewall and receive ICMP echo response packets from clients outside the firewall. When a client attempts a DNS resolution, Envoy sites send an ICMP echo request (ping) packet to the client and the client might respond with an ICMP echo response packet.

Using Envoy with NAT Devices

If an Envoy site is located behind a device (such as a firewall) that is performing Network Address Translation (NAT) on incoming IP addresses, then you must specify the public (non-translated) IP as the Site IP, and use the translated IP (the non-public IP) as the resource (cluster) IP in the Envoy configuration.

This is because Envoy must return the public cluster IP to a requesting client in order for the client to be able to contact that cluster -- since the request goes through the NAT device before it reaches Equalizer. The NAT device translates the public cluster IP in the request to the non-public cluster IP that is defined on Equalizer, and then forwards the packet to Equalizer.

The non-public cluster IP must still be specified as the resource IP for the site, as this is the IP that Envoy will use internally to probe the availability of the resource (cluster) on the site.

Configuring GeoClusters

This section shows you how to add or delete a GeoCluster and how to configure a GeoCluster's load-balancing options. Configuring a GeoCluster and its sites is analogous to configuring a virtual cluster and its servers.

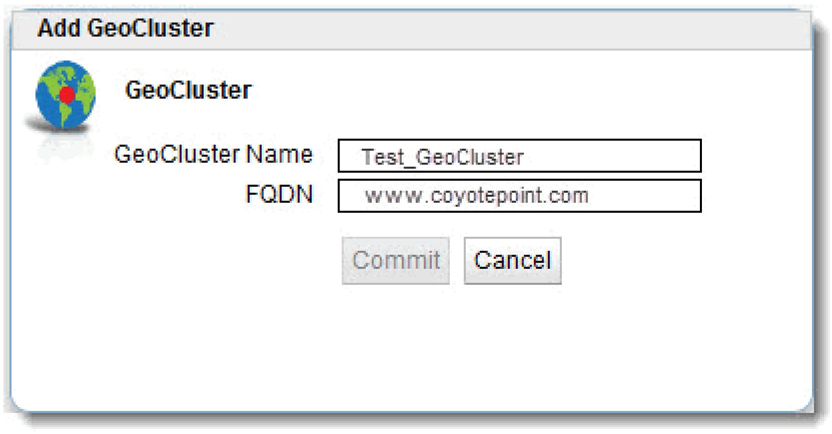
There are two parts to configuring GeoClusters. The first is to Add a GeoCluster and the second is to modify the GeoCluster parameters.

Adding a GeoCluster (GUI)

When Envoy is first enabled, there are no GeoClusters defined. To add a GeoCluster:

1. Log in to the GUI(See "Logging In" on page 192).

2. Right click on the **GeoClusters** in the left navigational pane and the **Add GeoCluster** form will be displayed.

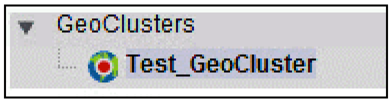


GeoCluster Name: Test_GeoCluster
FQDN: www.coyotepoint.com

3. Enter a **GeoCluster Name** in the space provided.

4. Enter a **FQDN** in the space provided. This is the Fully Qualified Domain Name of the GeoCluster (for example, `www.coyotepoint.com`). The FQDN must include all name components up to the top level (com, net, org, etc). Do not include the trailing period.

5. Click on **Commit** to add the GeoCluster. The new GeoCluster will appear on the left navigational pane as shown below.



Deleting a GeoCluster (GUI)

1. Log in to the GUI (See "Logging In" on page 192).

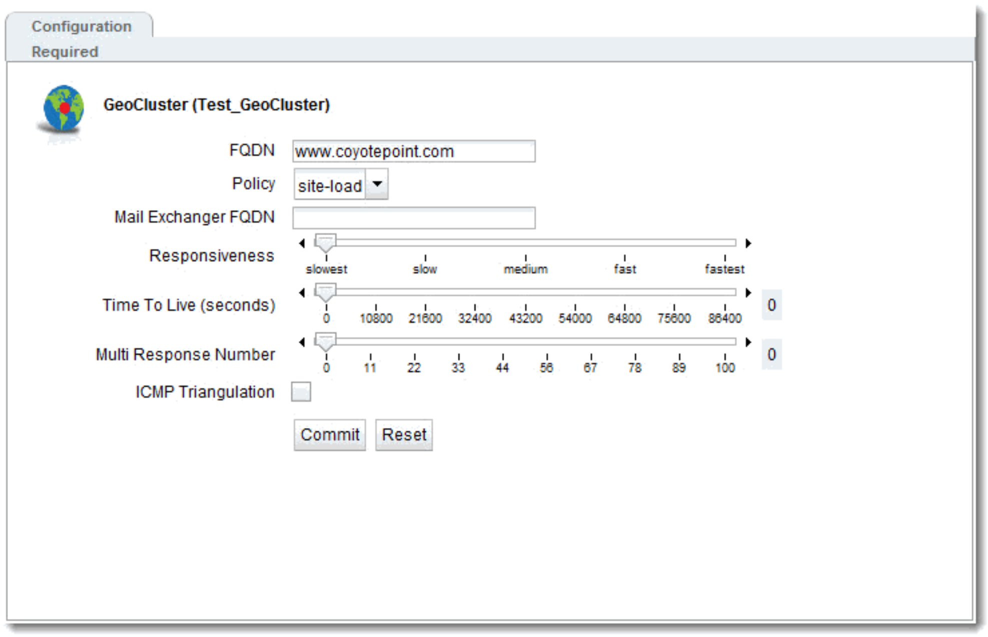
2. Right-click on the GeoCluster on the left navigational pane and select **Delete GeoCluster.**

Viewing and Modifying GeoCluster Parameters (GUI)

To view or modify a GeoCluster's load-balancing options, proceed with the following:

1. Log in to the GUI (See "Logging In" on page 192).

2. Click on the GeoCluster on the left navigation pane. The figure below will be displayed:



FQDN www.coyotepoint.com
Policy site-load
Mail Exchanger FQDN
Responsiveness
Time To Live (seconds) 0
Multi Response Number 0
ICMP Triangulation

3. View and Modify paramaters using the following guidelines:

FQDN	The **GeoCluster name** which is the fully-qualified domain name (FQDN) of the GeoCluster (for example, `www.coyotepoint.com`). The FQDN must include all name components up to the top level (com, net, org, etc). Do not include the trailing period
Policy	Three basic metrics are used by the policy to load balance requests among sites: the current load on the site, the initial weight setting of the site, and ICMP triangulation responses. The policy setting tells Envoy the realtive weight to assign to each metric when choosing a site: **round robin** causes Envoy to send requests to each available site, in turn, in the order they are listed in the configuration. This is equivalent to traditional ‘round-robin DNS’ load balancing. **round trip** weights the ICMP triangulation information received from each site more heavily than other criteria. **adaptive** give roughly equal weights to the site load and ICMP triangulation responses, and gives less weight to the initial weight for the site. This is the default setting. **site load** weights the current load at each site more heavily than other criteria. **site weight** weights the user-defined initial weight for each site more heavily

	than other criteria.
Mail Exchanger FQDN	The fully qualified domain name (e.g., "mail.example.com") to be returned if Equalizer receives a "mail exchanger" request for this GeoCluster. The mail exchanger is the host responsible for handling email sent to users in the domain. This field is not required.
Responsiveness	This value controls how aggressively Equalizeradjusts the site's dynamic weights. Equalizer provides five response settings: **slowest, slow, medium, fast**, and **fastest**. Faster settings enable Equalizer to adjust its load balancing criteria more frequently and permit a greater variance in the relative weights assigned to sites. Slower settings cause site measurements to be averaged over a longer period of time before Equalizer applies them to the cluster-wide load balancing; slower settings also tend to ignore spikes in cluster measurements caused by intermittent network glitches. Use the slider to make your selection. We recommend that you select the medium setting as a starting point.
Time To Live	The cache time-to-live, which is the length of time (in seconds) that the client's DNS server should cache the resolved IP address. Longer times will result in increased failover times in the event of a site failure, but are more efficient in terms of network Resources. Use the slider to make your selection. The default is 120 (that is, 2 minutes).
Multi Response Number	This is the maximum number of Resource records returned in a DNS response that will be allowed in this GeoCluster. The first address will be the actual selected GeoSite. Those that follow will be any site which is up in the list of GeoSites.
ICMP triangulation (option)	When a request for name resolution is received by Envoy from a client's local DNS, this option (if enabled) tells Envoy to request network latency information from all sites in order to make load balancing decisions based on the proximity of each site to the client's DNS server. To do this, all Envoy sites send an ICMP echo request ("ping") to the client's DNS server. The reply from the DNS server allows Equalizer to select a site using the length of time is takes for the DNS server's reply to reach the site. (Consequently, this method assumes that the client's DNS server is geographically close to the client -- which is usually the case.) If you do not want Envoy GeoSites to ping client DNS servers, disable this flag (this is the default setting). Please note that in order for ICMP triangulation data to be collected at each GeoSite: The client's DNS server must be configured to respond to ICMPv4 echo requests (ICMPv6 is not currently supported for Envoy triangulation). The client's DNS server must be allowed to respond through any firewalls between it and the Envoy GeoSites.

Note - For all policies, the current site load metric is ignored for the first 10 minutes that the site is up, so that the metric value is a meaningful measure of the site load before it is used.

Note - In Version 10, if ICMP triangulation is enabled and all GeoSites report that triangulation failed, then ICMP triangulation is ignored for GeoSite selection. That is, Envoy geographic load balancing will proceed as if ICMP triangulation were disabled. [In Version 8.6, if no GeoSites successfully completed ICMP triangulation then Envoy would send a NULL response.]

If only some GeoSites report failed triangulation, and there are others that did not fail and that are not down, then GeoSite selection will only include those sites that successfully completed ICMP triangualtion. [This is the same as the Version 8.6 behavior.]

Adding a GeoCluster (CLI)

To add a GeoCluster using eqcli as follows:

1. Log in to eqcli as described in "Starting the CLI" on page 128.
2. Enter the following at the CLI prompt:

```
eqcli > geocluster gcname req_cmds
```

Deleting a GeoCluster (CLI)

Delete a GeoCluster using eqcli as follows:

1. Log in to eqcli as described in "Starting the CLI" on page 128.
2. Enter the following at the CLI prompt:

```
eqcli > no geocluster gcname
```

Viewing and Modifying GeoCluster Parameters (CLI)

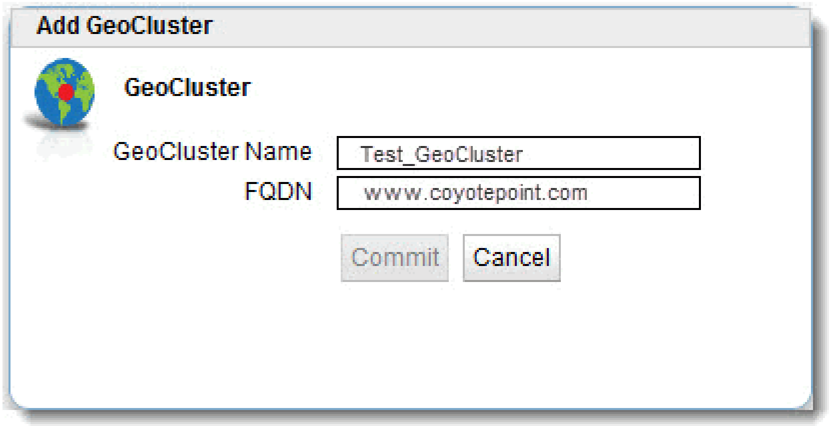
To add a GeoCluster using eqcli as follows:

1. Log in to eqcli as described in "Starting the CLI" on page 128.
2. Use the parameter descriptions above and the command line sequences described in "GeoCluster and GeoSite Instance Commands" on page 156 to view and modify GeoCluster parameters using eqcli.

Adding a GeoCluster (GUI)

When Envoy is first enabled, there are no GeoClusters defined. To add a GeoCluster:

1. Log in to the GUI(See "Logging In" on page 192).
2. Right click on the **GeoClusters** in the left navigational pane and the **Add GeoCluster** form will be displayed.

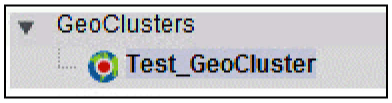


GeoCluster Name: Test_GeoCluster
FQDN: www.coyotepoint.com

3. Enter a **GeoCluster Name** in the space provided.

4. Enter a **FQDN** in the space provided. This is the Fully Qualified Domain Name of the GeoCluster (for example, `www.coyotepoint.com`). The FQDN must include all name components up to the top level (com, net, org, etc). Do not include the trailing period.

5. Click on **Commit** to add the GeoCluster. The new GeoCluster will appear on the left navigational pane as shown below.



Deleting a GeoCluster (GUI)

1. Log in to the GUI (See "Logging In" on page 192).

2. Right-click on the GeoCluster on the left navigational pane and select **Delete GeoCluster.**

Adding a GeoCluster (CLI)

To add a GeoCluster using eqcli as follows:

1. Log in to eqcli as described in "Starting the CLI" on page 128.

2. Enter the following at the CLI prompt:

```
eqcli > geocluster gcname req_cmds
```

Deleting a GeoCluster (CLI)

Delete a GeoCluster using eqcli as follows:

1. Log in to eqcli as described in "Starting the CLI" on page 128.
2. Enter the following at the CLI prompt:

```
eqcli > no geocluster gcname
```

Viewing and Modifying GeoCluster Parameters (CLI)

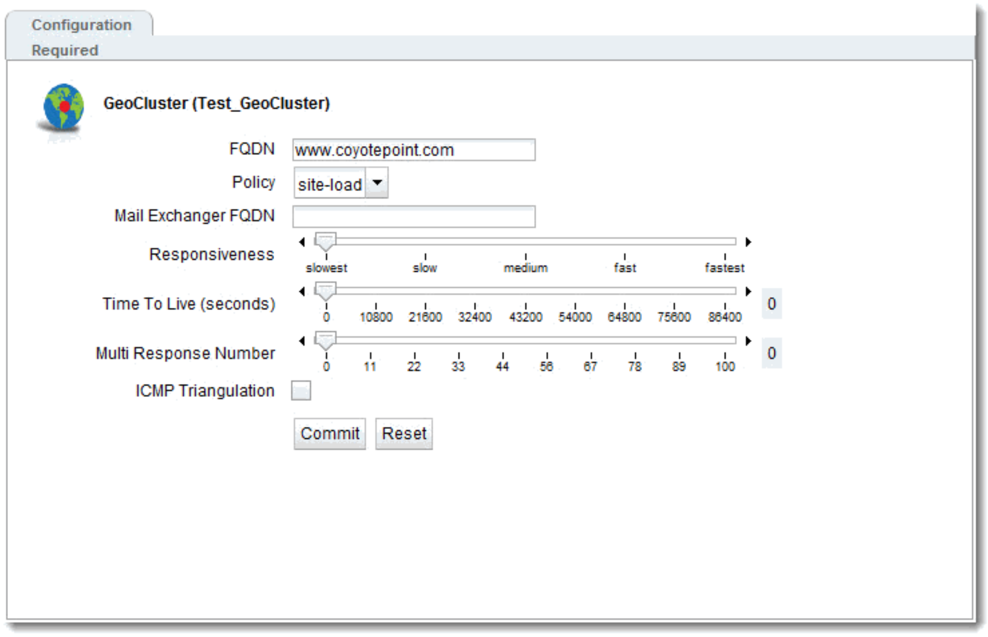
To add a GeoCluster using eqcli as follows:

1. Log in to eqcli as described in "Starting the CLI" on page 128.
2. Use the parameter descriptions above and the command line sequences described in "GeoCluster and GeoSite Instance Commands" on page 156 to view and modify GeoCluster parameters using eqcli.

Viewing and Modifying GeoCluster Parameters (GUI)

To view or modify a GeoCluster's load-balancing options, proceed with the following:

1. Log in to the GUI (See "Logging In" on page 192).
2. Click on the GeoCluster on the left navigation pane. The figure below will be displayed:



GeoCluster (Test_GeoCluster)

FQDN www.coyotepoint.com
Policy site-load
Mail Exchanger FQDN
Responsiveness
Time To Live (seconds) 0
Multi Response Number 0
ICMP Triangulation

3. View and Modify paramaters using the following:

FQDN	The **GeoCluster name**, which is the fully-qualified domain name (FQDN) of the

	GeoCluster (for example, `www.coyotepoint.com`). The FQDN must include all name components up to the top level (com, net, org, etc). Do not include the trailing period.
Policy	Three basic metrics are used by the policy to load balance requests among sites: the current load on the site, the initial weight setting of the site, and ICMP triangulation responses. The policy setting tells Envoy the realtive weight to assign to each metric when choosing a site: **round robin** causes Envoy to send requests to each available site, in turn, in the order they are listed in the configuration. This is equivalent to traditional ‘round-robin DNS’ load balancing. **round trip** weights the ICMP triangulation information received from each site more heavily than other criteria. **adaptive** give roughly equal weights to the site load and ICMP triangulation responses, and gives less weight to the initial weight for the site. This is the default setting. **site load** weights the current load at each site more heavily than other criteria. **site weight** weights the user-defined initial weight for each site more heavily than other criteria. **Note** - For all policies, the current site load metric is ignored for the first 10 minutes that the site is up, so that the metric value is a meaningful measure of the site load before it is used.
Mail Exchanger FQDN	The fully qualified domain name (e.g., "mail.example.com") to be returned if Equalizer receives a “mail exchanger” request for this GeoCluster. The mail exchanger is the host responsible for handling email sent to users in the domain. This field is not required.
Responsiveness	This value controls how aggressively Equalizer adjusts the site’s dynamic weights. Equalizer provides five response settings: **slowest, slow, medium, fast**, and **fastest**. Faster settings enable Equalizer to adjust its load balancing criteria more frequently and permit a greater variance in the relative weights assigned to sites. Slower settings cause site measurements to be averaged over a longer period of time before Equalizer applies them to the cluster-wide load balancing; slower settings also tend to ignore spikes in cluster measurements caused by intermittent network glitches. Use the slider to make your selection. We recommend that you select the medium setting as a starting point.
Time To Live	The cache time-to-live, which is the length of time (in seconds) that the client’s DNS server should cache the resolved IP address. Longer times will result in increased failover times in the event of a site failure, but are more efficient in terms of network Resources. Use the slider to make your selection. The default is 120 (that is, 2 minutes).
Multi Response Number	- this is the maximum number of Resource records returned in a DNS response that will be allowed in this GeoCluster. The first address will be the actual

	selected GeoSite. Those that follow will be any site which is up in the list of GeoSites.
ICMP triangulation (option)	When a request for name resolution is received by Envoy from a client's local DNS, this option (if enabled) tells Envoy to request network latency information from all sites in order to make load balancing decisions based on the proximity of each site to the client's DNS server. To do this, all Envoy sites send an ICMP echo request ("ping") to the client's DNS server. The reply from the DNS server allows Equalizer to select a site using the length of time is takes for the DNS server's reply to reach the site. (Consequently, this method assumes that the client's DNS server is geographically close to the client -- which is usually the case.) If you do not want Envoy GeoSites to ping client DNS servers, disable this flag (this is the default setting). Please note that in order for ICMP triangulation data to be collected at each GeoSite: The client's DNS server must be configured to respond to ICMPv4 echo requests (ICMPv6 is not currently supported for Envoy triangulation).The client's DNS server must be allowed to respond through any firewalls between it and the Envoy GeoSites.

Note - In Version 10, if ICMP triangulation is enabled and all GeoSites report that triangulation failed, then ICMP triangulation is ignored for GeoSite selection. That is, Envoy geographic load balancing will proceed as if ICMP triangulation were disabled. [In Version 8.6, if no GeoSites successfully completed ICMP triangulation then Envoy would send a NULL response.]

If only some GeoSites report failed triangulation, and there are others that did not fail and that are not down, then GeoSite selection will only include those sites that successfully completed ICMP triangualtion. [This is the same as the Version 8.6 behavior.]

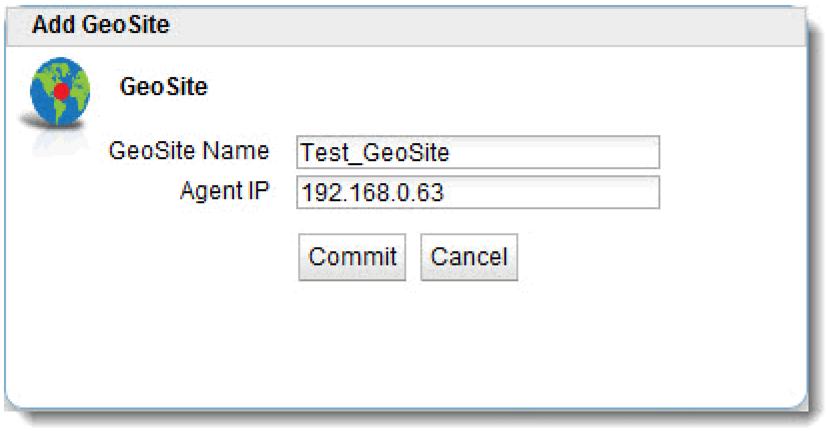
Configuring GeoSites

In EQ/OS 10, GeoSites are defined separately (like Servers) and then added to GeoClusters as GeoSite *Instances*. This section describes how to add, delete and configure GeoSites and includes descriptions of the parameters used by GeoSites.

Adding a GeoSite (GUI)

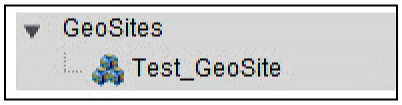
To add a GeoSite using the GUI proceed with the following:

1. Log in to the GUI(See "Logging In" on page 192).
2. Right-click on **GeoSites** on the left navigational pane and select **Add GeoSite**. The **Add GeoSite** form will be displayed.
3. Enter a **GeoSite Name** and an **Agent IP**. The **Agent IP** is the IP address of the GeoSite's Envoy Agent. This is the subnet IP address of Equalizer at this site on which the Envoy Agent is running. [On Version 10, you can enable the Envoy Agent on any subnet's VLAN IP address or Failover IP address.]



GeoSite Name: Test_GeoSite
Agent IP: 192.168.0.63

4. Click on **Commit** to add the GeoSite.The new GeoSite will appear on the left navigational pane as shown below.



Deleting a GeoSite (GUI)

To delete a GeoSite using the GUI proceed with the following:

1. Log in to the GUI (See "Logging In" on page 192).
2. Right-click on a GeoSite on the left navigational pane and select **Delete GeoSite**.

Adding a GeoSite (CLI)

Too add a GeoSite using eqcli as follows:

1. Log in to eqcli as described in "Starting the CLI" on page 128.
2. Enter the following at the CLI prompt:

```
eqcli > GeoSite gsnamereq_cmds
```

Deleting GeoSite (CLI)

Too delete a GeoSite using eqcli as follows:

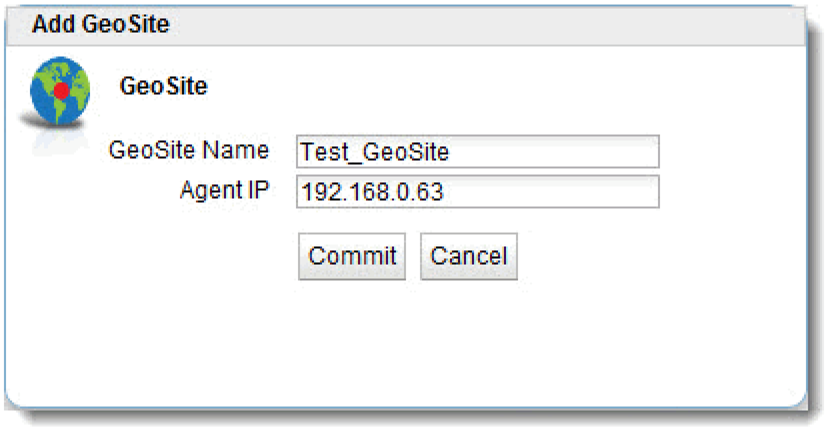
1. Log in to eqcli as described in "Starting the CLI" on page 128.
2. Enter the following at the CLI prompt:

```
    eqcli > no GeoSite gsname
```

Adding a GeoSite (GUI)

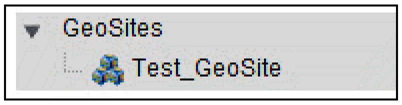
To add a GeoSite using the GUI proceed with the following:

1. Log in to the GUI(See "Logging In" on page 192).
2. Right-click on **GeoSites** on the left navigational pane and select **Add GeoSite**. The **Add GeoSite** form will be displayed.
3. Enter a **GeoSite Name** and an **Agent IP**. The **Agent IP** is the IP address of the GeoSite's Envoy Agent. This is the subnet IP address of Equalizer at this site on which the Envoy Agent is running. [On Version 10, you can enable the Envoy Agent on any subnet's VLAN IP address or Failover IP address.]



GeoSite Name: Test_GeoSite
Agent IP: 192.168.0.63

4. Click on **Commit** to add the GeoSite.The new GeoSite will appear on the left navigational pane as shown below.



Deleting a GeoSite (GUI)

To delete a GeoSite using the GUI proceed with the following:

1. Log in to the GUI (See "Logging In" on page 192).
2. Right-click on a GeoSite on the left navigational pane and select **Delete GeoSite**.

Adding a GeoSite (CLI)

Too add a GeoSite using eqcli as follows:

1. Log in to eqcli as described in "Starting the CLI" on page 128.
2. Enter the following at the CLI prompt:

```
eqcli > GeoSite gsnamereq_cmds
```

Deleting GeoSite (CLI)

Too delete a GeoSite using eqcli as follows:

1. Log in to eqcli as described in "Starting the CLI" on page 128.
2. Enter the following at the CLI prompt:

```
    eqcli > no GeoSite gsname
```

GeoSite Instance Parameters

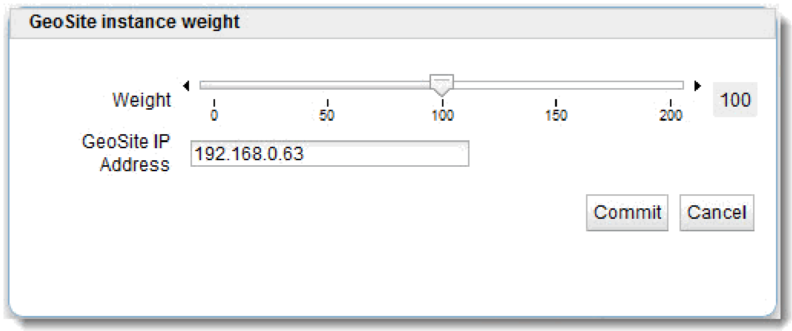
The following procedures describe the process of adding and configuring GeoSite Instance parameters.

Adding and Configuring a GeoSite Instance (GUI)

To add a GeoSite instance to a GeoCluster using the GUI proceed with the following:

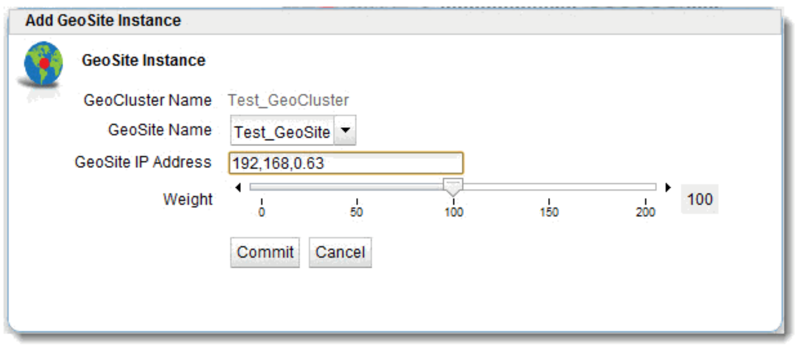
1. Log in to the GUI (See "Logging In" on page 192).
2. Refer to "Adding a GeoSite (GUI)" on page 527 or "Adding a GeoSite (CLI)" on page 528 to configure a GeoCluster.
3. Add a GeoSite instance to a GeoCluster using one of the following methods:

a. Using the GUI drag and drop functionality, click on a GeoSite on the left navigational pane and drag it to the desired GeoCluster on the tree. The **GeoSite instance weight** form will be displayed.



192.168.0.63

b. Right click on a GeoCluster on the left navigational pane and select Add GeoSite Instance. The Add GeoSite Instance form will be displayed. If this method is used, you will need to enter the **GeoSite IP Address** and select the desired GeoSite using the **GeoSite Name** drop down list.



GeoCluster Name: Test_GeoCluster
GeoSite Name: Test_GeoSite
GeoSite IP Address: 192.168.0.63

4. In both methods of creating GeoSite Instances the **GeoSite IP Address** is required. This is the IP address returned by DNS to a client when the GeoCluster is accessed. For example, when a client opens `www.coyotepoint.com`, the local DNS server returns an A record that contains the IP address for `www.coyotepoint.com`. This is usually the address of an Equalizer cluster and in this case is also used as the resource IP. However, the site's A record IP may be different from the cluster (resource) IP if the A record IP address is NAT'ed to an internal address (the actual cluster IP). In this case, you specify the A record IP as the site IP and the cluster IP as the resource IP.

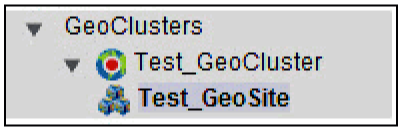
5. Using the slider on either form, adjust the **Weight**, which is an integer that represents the site's capacity. (This value is similar to a server's initial weight.) Valid values range between 10 and 200. Use the default of 100 if all sites are configured similarly; otherwise, adjust higher or lower for sites that have more or less capacity.

   Equalizer uses a site's initial weight as the starting point for determining what percentage of requests to route to that site. Equalizer assigns sites with a higher initial weight a higher percentage of the load. The relative values of site initial weights are more important than the actual values. For example, if two sites are in a GeoCluster and one has roughly twice the capacity of the other, setting the initial weights to 50 and 100 is equivalent to setting the initial weights to 100 and 200.

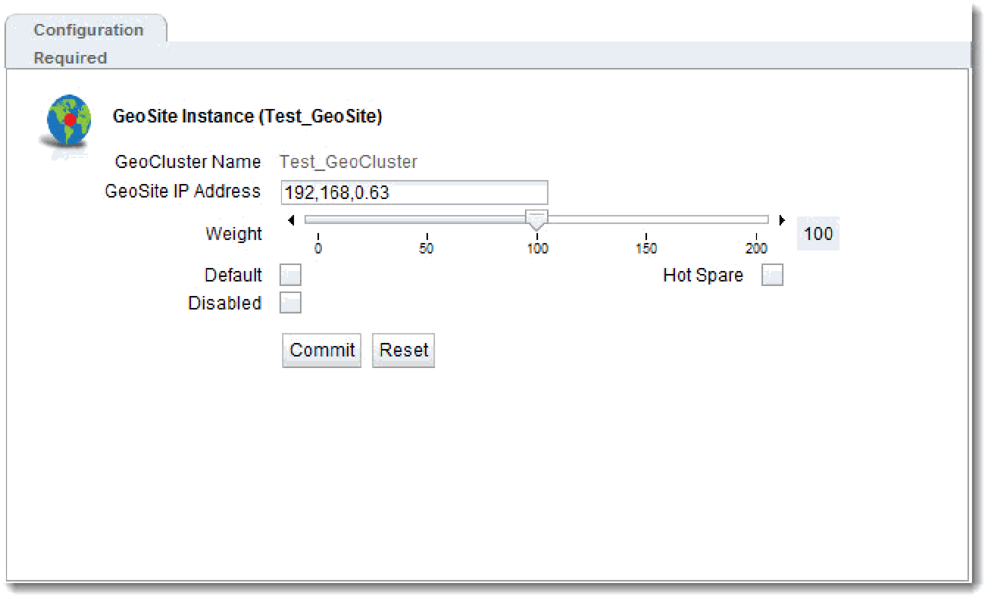
Dynamic site weights can vary from 50% to 150% of the assigned initial weights. To optimize GeoCluster performance, you might need to adjust the initial weights of the sites in the cluster based on their performance.

Site weights can range from 10 to 200. When you set up sites in a GeoCluster, you should set each site's initial weight value in proportion to its capacity for handling requests. It is not necessary for all of the initial weights in a cluster to add up to any particular number.

6. Click on **Commit** to add the GeoSite instance. The instance will appear beneath the GeoCluster on the left navigational pane as shown below.



7. Select additional options for the GeoSite instance by clicking the GeoSite instance from the left navigational pane to display the **Configuration Required** screen (tab).From this screen all configuration options can be modified.



GeoSite Instance (Test_GeoSite)

GeoCluster Name Test_GeoCluster
GeoSite IP Address 192.168.0.63
Weight 0 50 100 150 200 100
Default
Hot Spare
Disabled

- **Default -** Designates this site as the default site for the GeoCluster. Envoy load balances to the default site whenever it cannot choose a site based on the GQP probe information it gets from the sites. This can happen, for example, when GQP probe responses are not received from any site, when the resource (cluster) is down at all available sites, etc. If no default site is selected for a GeoCluster and all sites are down, then Envoy sends a null response to the client DNS.

- **Hot Spare -** When enabled, no traffic will be routed to the site unless there are no other sites available. Default value is disabled.

- **Disabled -** When turned on, no traffic will be routed to the site. Default value is off.

Deleting a GeoSite Instance (GUI)

To remove a GeoSite instance from a GeoCluster using the GUI proceed with the following:

1. Log in to the GUI (See "Logging In" on page 192).
2. Click on the GeoSite Instance on a GeoCluster branch on the left navigational pane and select **Delete GeoSite Instance**.

Adding and Configuring a GeoSite Instance (CLI)

To add and configure a GeoSite instance using eqcli proceed with the following:

1. Log in to eqcli as described in "Starting the CLI" on page 128.
2. Use the parameter descriptions above and the command line sequences described in "GeoSite Commands" on page 159 to view and modify GeoSite parameters using eqcli.

Deleting a GeoSite Instance (CLI)

To remove a GeoSite instance from a GeoCluster using eqcli proceed with the following:

1. Log in to eqcli as described in "Starting the CLI" on page 128.
2. Enter the following at the CLI prompt:

```
eqcli > no geocluster  gclname gsi gsimaname
```

where:

gclname is the name of the GeoCluster

gsi is the GeoSite instance

gsimaname is the name of the GeoSite instance.

Adding and Configuring a GeoSite Instance (CLI)

To add and configure a GeoSite instance using eqcli proceed with the following:

1. Log in to eqcli as described in "Starting the CLI" on page 128.
2. Use the parameter descriptions above and the command line sequences described in "GeoSite Commands" on page 159 to view and modify GeoSite parameters using eqcli.

Deleting a GeoSite Instance (CLI)

To remove a GeoSite instance from a GeoCluster using eqcli proceed with the following:

1. Log in to eqcli as described in "Starting the CLI" on page 128.
2. Enter the following at the CLI prompt:

```
eqcli > no geocluster  gclname gsi gsimaname
```

where:

gclname is the name of the GeoCluster

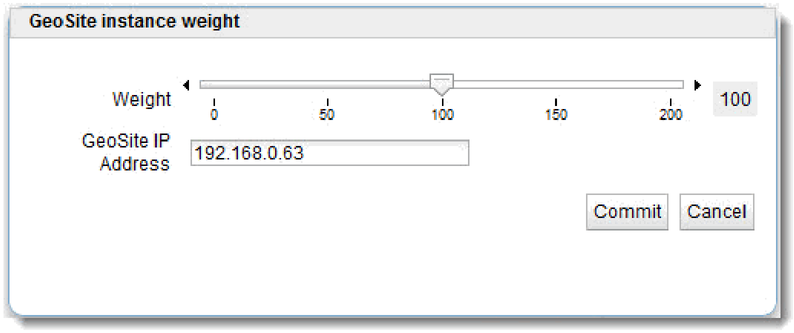
gsi is the GeoSite instance

gsimaname is the name of the GeoSite instance.

Adding and Configuring a GeoSite Instance (GUI)

To add a GeoSite instance to a GeoCluster using the GUI proceed with the following:

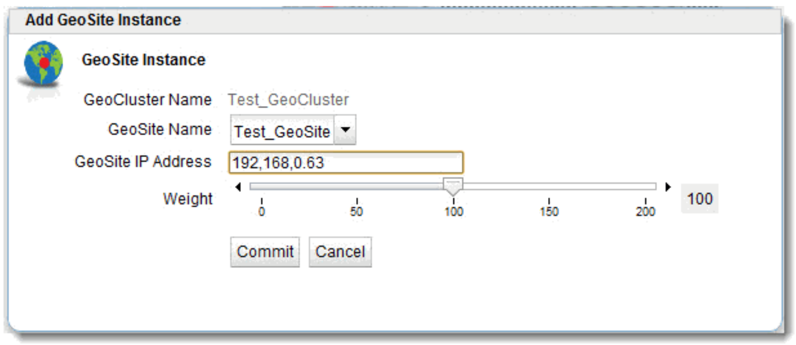
1. Log in to the GUI (See "Logging In" on page 192).
2. Refer to "Adding a GeoSite (GUI)" on page 527 or "Adding a GeoSite (CLI)" on page 528 to configure a GeoCluster.
3. Add a GeoSite instance to a GeoCluster using one of the following methods:
   a. Using the GUI drag and drop functionality, click on a GeoSite on the left navigational pane and drag it to the desired GeoCluster on the tree. The **GeoSite instance weight** form will be displayed.


GeoSite instance weight

Weight: 100

GeoSite IP Address: 192.168.0.63

   b. Right click on a GeoCluster on the left navigational pane and select Add GeoSite Instance. The Add GeoSite Instance form will be displayed. If this method is used, you will need to enter the **GeoSite IP Address** and select the desired GeoSite using the **GeoSite Name** drop down list.


Add GeoSite Instance

GeoSite Instance

GeoCluster Name: Test_GeoCluster

GeoSite Name: Test_GeoSite

GeoSite IP Address: 192.168.0.63

Weight: 100

4. In both methods of creating GeoSite Instances the **GeoSite IP Address** is required. This is the IP address returned by DNS to a client when the GeoCluster is accessed. For example, when a client opens `www.coyotepoint.com`, the local DNS server returns an A record that contains the IP address for `www.coyotepoint.com`. This is usually the address of an Equalizer cluster and in this case is also used as the resource IP. However, the site's A record IP may be different from the cluster (resource) IP if the A record IP address is NAT'ed to an internal address (the actual cluster IP). In this case, you specify the A record IP as the site IP and the cluster IP as the resource IP.

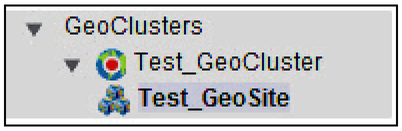
5. Using the slider on either form, adjust the **Weight**, which is an integer that represents the site's capacity. (This value is similar to a server's initial weight.) Valid values range between 10 and 200. Use the default of 100 if all sites are configured similarly; otherwise, adjust higher or lower for sites that have more or less capacity.

   Equalizer uses a site's initial weight as the starting point for determining what percentage of requests to route to that site. Equalizer assigns sites with a higher initial weight a higher percentage of the load. The relative values of site initial weights are more important than the actual values. For example, if two sites are in a GeoCluster and one has roughly twice the capacity of the other, setting the initial weights to 50 and 100 is equivalent to setting the initial weights to 100 and 200.

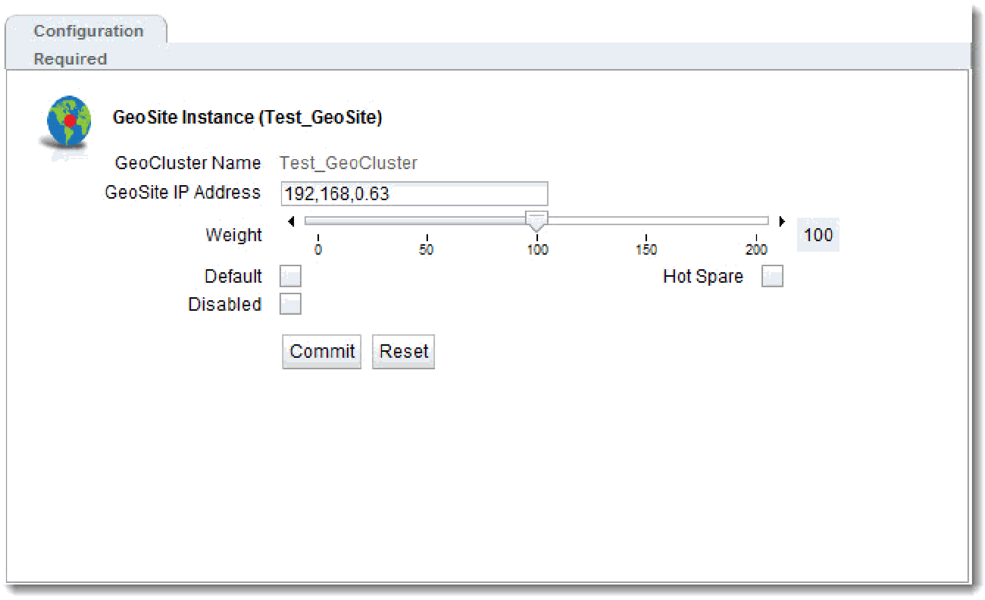
   Dynamic site weights can vary from 50% to 150% of the assigned initial weights. To optimize GeoCluster performance, you might need to adjust the initial weights of the sites in the cluster based on their performance.

   Site weights can range from 10 to 200. When you set up sites in a GeoCluster, you should set each site's initial weight value in proportion to its capacity for handling requests. It is not necessary for all of the initial weights in a cluster to add up to any particular number.

6. Click on **Commit** to add the GeoSite instance. The instance will appear beneath the GeoCluster on the left navigational pane as shown below.



7. Select additional options for the GeoSite instance by clicking the GeoSite instance from the left navigational pane to display the **Configuration Required** screen (tab).From this screen all configuration options can be modified.



GeoSite Instance (Test_GeoSite)

GeoCluster Name Test_GeoCluster
GeoSite IP Address 192,168,0.63
Weight 100
Default ☐
Hot Spare ☐
Disabled ☐

Default	Designates this site as the default site for the GeoCluster. Envoy load balances to the default site whenever it cannot choose a site based on the GQP probe information it gets from the sites. This can happen, for example, when GQP probe responses are not received from any site, when the resource (cluster) is down at all available sites, etc. If no default site is selected for a GeoCluster and all sites are down, then Envoy sends a null response to the client DNS.
Hot Spare	When enabled, no traffic will be routed to the site unless there are no other sites available. Default value is disabled.
Disabled	When turned on, no traffic will be routed to the site. Default value is off.

Deleting a GeoSite Instance (GUI)

To remove a GeoSite instance from a GeoCluster using the GUI proceed with the following:

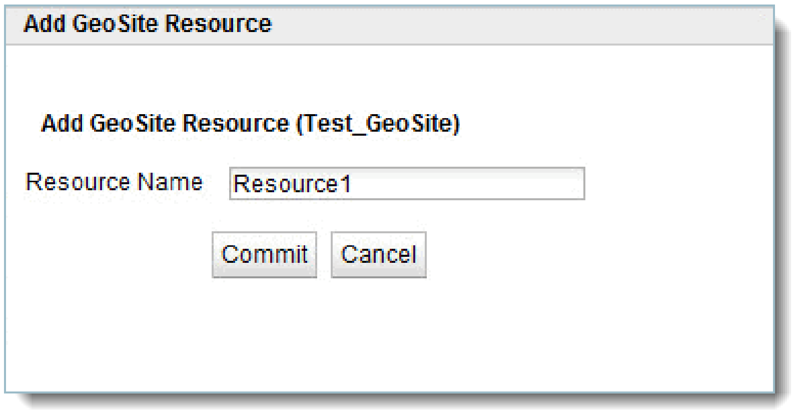
1. Log in to the GUI (See "Logging In" on page 192).
2. Click on the GeoSite Instance on a GeoCluster branch on the left navigational pane and select **Delete GeoSite Instance**.

GeoSite Resources and GeoSite Instance Resources

GeoSite Resources are named clusters defined within a GeoSite. They are assigned a name so that they can be configured into a GeoCluster. For example a GeoSite in New York may have a cluster “CLNY1” defined. Another GeoSite located in San Jose may have a cluster “CLSJ1” defined. In order to load balance between the New York and San Jose GeoSites the Resources of each will be defined as GeoSite Resource Instances in a GeoCluster.

Name a GeoSite Resource (GUI)

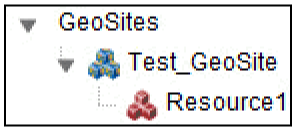
1. Log in to the GUI (See "Logging In" on page 192).
2. Select a GeoSite from the left navigational pane.
3. Right-click on the GeoSite and select **Add GeoSite Resource** and the following will be displayed.


Add GeoSite Resource

Add GeoSite Resource (Test_GeoSite)

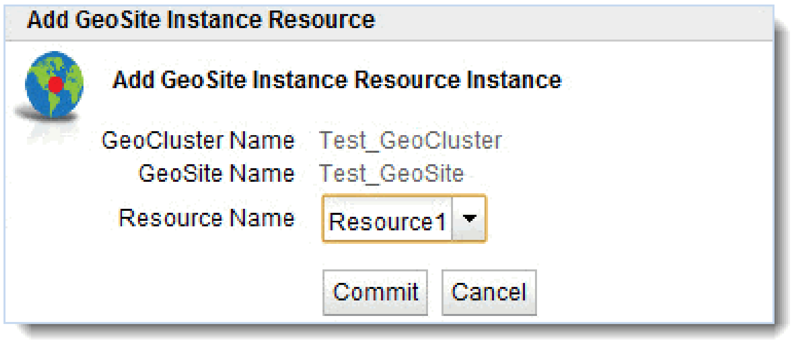
Resource Name: Resource1

4. Enter a name for the Resource and click on **Commit**. The GeoSite Resource will appear on the left navigation pane as shown below.



Add a GeoSite Resource Instance to a GeoCluster (GUI)

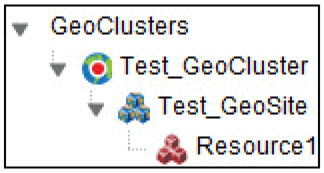
1. Log in to the GUI (See "Logging In" on page 192).
2. Right click the GeoSite Instance within a GeoCluster on the left navigation pane an select **Add GeoSite Instance Resource**. The following will be displayed:


Add GeoSite Instance Resource

Add GeoSite Instance Resource Instance

GeoCluster Name: Test_GeoCluster
GeoSite Name: Test_GeoSite
Resource Name: Resource1

3. Use the **Resource Name** drop down list to select one of the previously defined GeoSite Resources.
4. Click on Commit to add the Resource Instance. It will be displayed on the left navigation tree as shown below.



Name a GeoSite Resource (CLI)

1. Log in to eqcli as described in "Starting the CLI" on page 128.

2. Enter the GeoSite context and add the following at the CLI prompt:

```
eqcli > ga-gsname> resource clname
```

where:

clname is the cluster name at the GeoSite.

Add a GeoSite Resource Instance to a GeoCluster (CLI)

1. Log in to eqcli as described in "Starting the CLI" on page 128.

2. Enter the GeoCluster context and following at the CLI prompt:

```
eqcli > gcl-gclname> GeoSite gsname resource clname
```

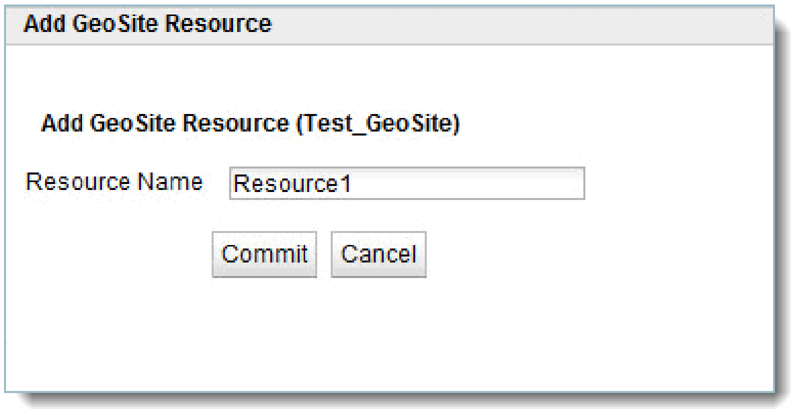
where:
`gcl` is the GeoCluster name
`gsname` is the GeoSite name.
`clname` is the name of the GeoSite Resource

Name a GeoSite Resource (GUI)

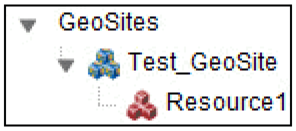
1. Log in to the GUI (See "Logging In" on page 192).

2. Select a GeoSite from the left navigational pane.

3. Right-click on the GeoSite and select **Add GeoSite Resource** and the following will be displayed.



4. Enter a name for the Resource and click on **Commit**. The GeoSite Resource will appear on the left navigation pane as shown below.



Name a GeoSite Resource (CLI)

1. Log in to eqcli as described in "Starting the CLI" on page 128.

2. Enter the GeoSite context and add the following at the CLI prompt:

```
eqcli > ga-gsname> resource clname
```

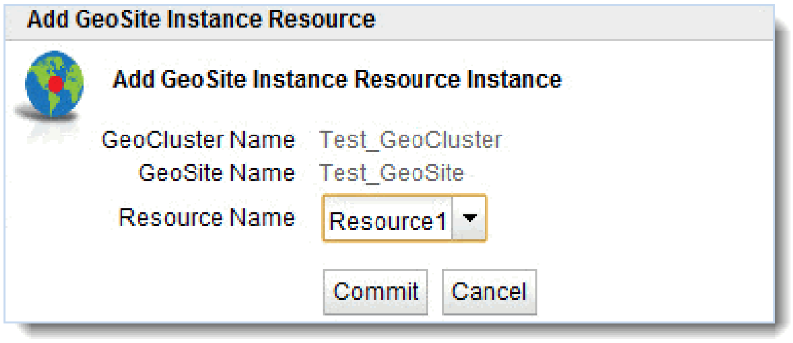
where:

clname	is the cluster name at the GeoSite.

Add a GeoSite Resource Instance to a GeoCluster (GUI)

1. Log in to the GUI (See "Logging In" on page 192).

2. Right click the GeoSite Instance within a GeoCluster on the left navigation pane an select **Add GeoSite Instance Resource**. The following will be displayed:

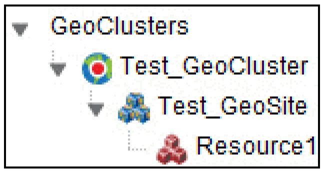

Add GeoSite Instance Resource

Add GeoSite Instance Resource Instance

GeoCluster Name Test_GeoCluster
GeoSite Name Test_GeoSite
Resource Name Resource1

3. Use the **Resource Name** drop down list to select one of the previously defined GeoSite Resources.

4. Click on Commit to add the Resource Instance. It will be displayed on the left navigation tree as shown below.



Add a GeoSite Resource Instance to a GeoCluster (CLI)

1. Log in to eqcli as described in "Starting the CLI" on page 128.

2. Enter the GeoCluster context and following at the CLI prompt:

```
eqcli > gcl-gclname> GeoSite gsname resource clname
```

where:

gcl	is the GeoCluster name
gsname	is the GeoSite name.
clname	is the name of the GeoSite Resource

Chapter 27

Backup and Restore

Sections within this chapter include:

Backup

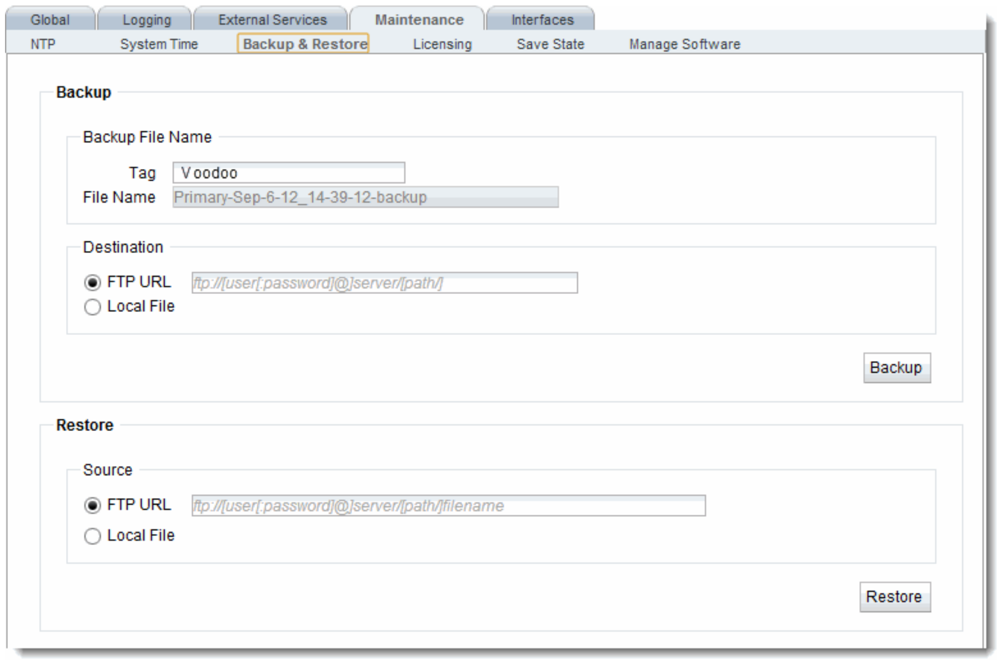
The Backup feature allows you to back up an Equalizer's user-configured objects and parameters to a file that can be uploaded and later restored to another Equalizer. Backup files may be uploaded to an FTP site or saved locally. Backup features are available through the GUI and through eqcli.

Note – eqcli backup of an archive to a local directory is not supported.

Backup (GUI)

Creating a backup file containing all user-configured objects and parameters through the GUI is as follows:

1. Log in to the GUI as described in "Logging In" on page 192.
2. Click on the **Maintenance** tab and then select **Backup and Restore.** The following will be displayed.



Tag: Voodoo
File Name: Primary-Sep-6-12_14-39-12-backup
Destination: (●) FTP URL ftp://[user[:password]@]server/[path/] ( ) Local File
Source: (●) FTP URL ftp://[user[:password]@]server/[path/]filename ( ) Local File

3. In the **Backup** pane enter a **File Name** which is built from the optionally specified **Tag**. In the example above, **voodoo** is used. The **Tag** is used in addition to the default file name, which is of the form:

```
<system_name>[-<tag>]-<date>_<time>-backup.tbz
```

As the **Tag** is typed, it is added to the **File Name** or, at least, when the focus leaves the **Tag**, the tag should be added to the **File Name** - which is read-only.

4. In the **Destination** section, select either **FTP URL** to upload to an FTP site or **Local File** to save the file locally.

    a. For **FTP URL**, you must type the full FTP URL path to the backup file -leaving off the file name. A terminating slash (/) is required. The italic text shown indicates the required URL format. Entry of an FTP URL will replace the italic text.

    b. If the **Local File** option is selected when you click on the **Backup** button a save location dialogue box will be displayed. Select a location to save the file and enter a file name. Click **Save** to save the file locally.

5. Click on the **Backup** button to create the backup file either save it to the specified local directory or transfers the file to the FTP server via the URL entered.

Backup (CLI)

The backup archive is created and then uploaded to a URL that specifies an FTP site that can be reached by Equalizer.

To create a backup and upload to a specific URL, enter the following:

```
eqcli > backup url URL name
```

where:

name is a string that will be used in the backup file name. The default name is of the form:

URL is the path to save the backup and must be in the form:

```
ftp://[user[:password]@]server[/path]
```

The backup file will be in the following format:

```
systemname-date_time-backup.tbz
```

When you restore , the ***name*** is required and must match the name of the backup archive to be downloaded.

Note - You will be prompted to enter a password if it is not supplied in the URL

Restore

The Restore feature allows you to restored a previous backup file containing user-configured objects and parameters to another Equalizer. Restored files may be uploaded to an Equalizer through FTP or from a locally saved backup file.

On boot, Equalizer looks for a unique local peer definition in the configuration file by comparing the System ID found in each peer definition to all available licenses:

If a unique local peer definition is found, the System ID found in the local peer definition is compared against the System ID being used by the running system. If they do not match (as in the case where a backup file from one Equalizer is being restored on another Equalizer), the configuration file is modified to reflect the System ID of the running system and the signature is re-generated. If they do match, the configuration is not modified.

If a unique local peer definition is not found, then all peer definitions are removed from the configuration file and a new local peer definition is generated. This behavior is the same behavior that occurs if Equalizer is booted and there are no peer definitions found in the configuration file (which happens, for example, when the system is reset to factory defaults).

Restore features are available through the GUI and through eqcli.

Restore Notes

1. eqcli restore of a backup archive from a local directory is not supported.

2. When restoring a backup archive created on an Equalizer other than the one you are restoring, all IP addresses (clusters, servers, failover IP addresses, VLAN IP addresses, etc.) will be instantiated as-is from the backup archive. Consequently, if the unit on which the backup archive was created is connected to the network, IP conflicts will arise. You must correct the IP address conflicts before configuring the restored unit into failover, or issues (such as core dumps) will occur.

3. If a backup was performed on a system with more interfaces than exist on the system on which it is being restored, full connectivity will not be restored if a VLAN specifies a port that does not exist on the system on which it is being restored. Connectivity can only be restored for vlans that specify ports that exist on the system on which they are being restored.

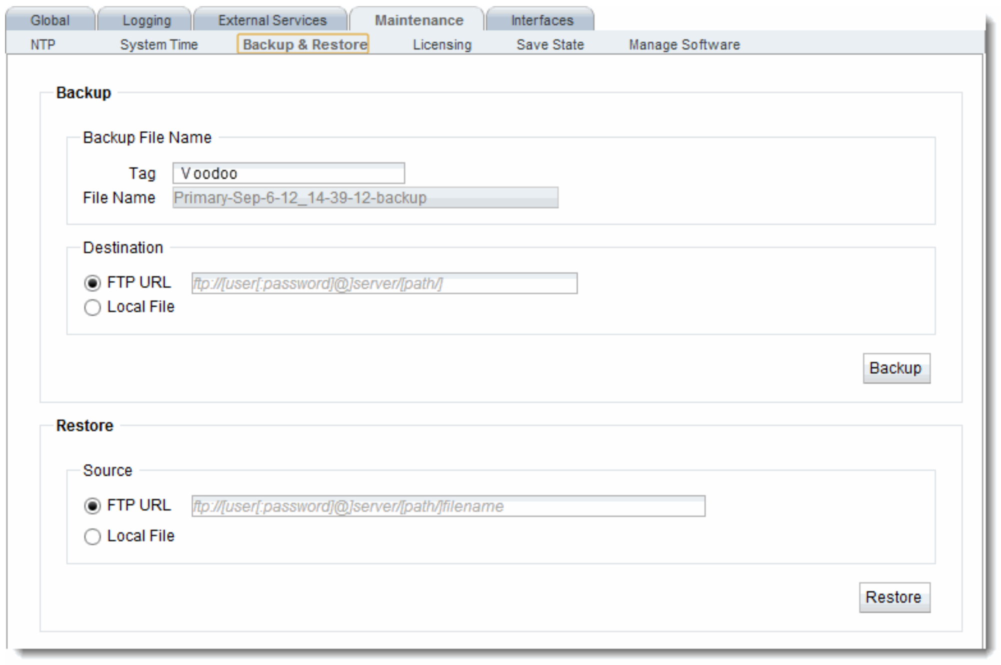
4. When a backup is restored on a system: -- Any valid licenses present on that system are preserved. The licenses in the backup file are discarded. If there are no valid licenses on that system, the licenses in the backup file are restored.

Restore (GUI)

Restore a backup file containing all user-configured objects and parameters through the GUI is as follows:

1. Log in to the GUI as described in "Logging In" on page 192.

2. Click on the **Maintenance** tab and then select **Backup and Restore.** The following will be displayed.



3. In the **Restore** section select either **FTP URL** or **Local File**.

   For **FTP URL** you must type in the full path name (including the file name) into the text box. The italic text shown indicates the required format. Entry of an FTP URL will replace the italic text. When the **Restore** button is clicked, the file is downloaded from the specified FTP site and a popup displays a summary of the configuration in the archive. A notification SSL Certificates for HTTPS cluster notification will be displayed. Click on **Continue** or **Cancel**. If **Continue** is selected the archive is restored and the system is rebooted.

   For **Local File** click on the **Restore** button to display a file selection dialogue to select a file from local storage. Once the file is selected, it is transferred to Equalizer and a popup displays a summary of the configuration in the archive. A notification SSL Certificates for HTTPS cluster notification will be displayed. Click on **Continue** or **Cancel**. If **Continue** is selected the archive is restored and the system is rebooted.

Restore (CLI)

The previously archived backup is uploaded from a URL that specifies an FTP site that can be reached by Equalizer.

To restore a previously backed up file from a specified URL (location) enter the following:

```
eqcli > restore url URL name
```

Where:

name must match the name of the backup archive to be downloaded.

URL is the path to the previously backed up file and must be of the form:

```
ftp://[user[:password]@]server[/path]
```

Note - You will be prompted to enter a password if it is not supplied in the URL

Chapter 28

How to Use Regular Expressions

Sections within this chapter include:

Regular Expression Terms

The terms in this section describe the components of regular expressions.

- A regular expression (RE) is one or more non-empty *branches*, separated by pipe symbols (|) . An expression matches anything that matches one of the *branches*.
- A branch consists of one or more concatenated *pieces*. A branch matches a match for the first *piece*, followed by a match for the second, and so on.
- A piece is an atom optionally followed by a single *, +, or ?, or by a *bound*.
    - An atom followed by an asterisk (*) matches a sequence of 0 or more matches of the atom.
    - An atom followed by a plus sign (+) matches a sequence of 1 or more matches of the atom.
    - An atom followed by a question mark (?) matches a sequence of 0 or 1 matches of the atom.
- A bound consists of an open brace ({) followed by an unsigned decimal integer, between 0 and 255 inclusive. You can follow the first unsigned decimal integer with a comma, or a comma and a second unsigned decimal integer. Close the *bound* with a close brace (}). If there are two integers, the value of the first may not exceed the value of the second.

Learning About Atoms

An atom followed by a bound that contains one integer i and no comma matches a sequence of exactly i matches of the atom. An atom followed by a bound that contains one integer i and a comma matches a sequence of i or more matches of the atom. An atom followed by a bound containing two integers i and j matches a sequence of i through j (inclusive) matches of the atom. An atom can consist of any of the following:

- A regular expression enclosed in parentheses, which matches a match for the regular expression.
- An empty set of parentheses, which matches the null string.
- A bracket expression.
- A period (.), which matches any single character.
- A carat (^), which matches the null string at the beginning of a line.
- A dollar sign ($), which matches the null string at the end of a line.
- A backslash (\) followed by one of the following characters: ^.[$()|*+?{\, which matches that character taken as an ordinary character.
- A backslash (\) followed by any other character, which matches that character taken as an ordinary character (as if the \ had not been present).

- A single character with no other significance, which simply matches that character. **Note that regular expressions are case-insensitive.**
- An open brace ({) followed by a character other than a digit is an ordinary character, not the beginning of a bound. It is illegal to end a real expression with a backslash (\).

Creating a Bracket Expression

A bracket expression is a list of characters enclosed in brackets ([...]). It normally matches any single character from the list. If the list begins with ^, it matches any single character not from the rest of the list. Two characters in a list that are separated by '-' indicates the full range of characters between those two (inclusive) in the collating sequence; for example, '[0-9]' in ASCII matches any decimal digit. It is illegal for two ranges to share an endpoint; for example, 'a-c-e'. Ranges are very collating-sequence-dependent, and portable programs should avoid relying on them.

- To include a literal ']' in the list, make it the first character (following an optional '^').
- To include a literal '-', make it the first or last character, or the second endpoint of a range.
- To use a literal '-' as the first endpoint of a range, enclose it in '[.' and '.]' to make it a collating element (see below).

With the exception of these and some combinations using '[' (see next paragraphs), all other special characters, including '\', lose their special significance within a bracket expression.

Within a bracket expression, a collating element (a character, a multi-character sequence that collates as if it were a single character, or a collating-sequence name for either) enclosed in '[.' and '.]' stands for the sequence of characters of that collating element. The sequence is a single element of the bracket expression's list. A bracket expression containing a multi-character collating element can thus match more than one character; e.g., if the collating sequence includes a 'ch' collating element, then the real expression '[[.ch.]]*c' matches the first five characters of 'chchcc'.

Within a bracket expression, a collating element enclosed in '[' and `]' is an equivalence class, representing the sequences of characters of all collating elements equivalent to that one, including itself. (If there are no other equivalent collating elements, the treatment is as if the enclosing delimiters were '[.' and '.]'.) For example, if 'x' and 'y' are the members of an equivalence class, then '[[x]]', '[[y]]', and '[xy]' are all synonymous. An equivalence class may not be an end-point of a range.

Within a bracket expression, the name of a character class enclosed in '[:' and ':]' stands for the list of all characters belonging to that class.

There are two special cases of bracket expressions: the bracket expressions '[[:<:]]' and '[[:>:]]' match the null string at the beginning and end of a word respectively. A word is defined as a sequence of word characters that is neither preceded nor followed by word characters. A word character is an alnum character (as defined by ctype(3)) or an underscore. This is an extension, compatible with but not specified by IEEE Std 1003.2 ("POSIX.2"), and should be used with caution in software intended to be portable to other systems.

Escape Sequences

The following escape character sequences match the indicated characters:

\	matches a single backslash (\)
\b	matches the beginning of a word (e.g.: `\bex` matches "`example`" but not "`text`")
\n, \r, \t, \v	match whitespace characters
\', \"	match single and double quotes

Matching in Regular Expressions

If a real expression could match more than one substring of a given string, the real expression matches the one starting earliest in the string. If the real expression could match more than one substring starting at that point, it matches the longest. Subexpressions also match the longest possible substrings, subject to the constraint that the whole match be as long as possible, with subexpressions starting earlier in the real expression taking priority over ones starting later. Note that higher-level subexpressions thus take priority over their lower-level component subexpressions.

Match lengths are measured in characters, not collating elements. A null string is considered longer than no match at all. For example, 'bb*' matches the three middle characters of 'abbbc', '(wee|week)(knights|nights)' matches all ten characters of 'weeknights', when '(.*).*' is matched against 'abc' the parenthesized subexpression matches all three characters, and when '(a*)*' is matched against 'bc' both the whole real expression and the parenthesized subexpression match the null string.

Using Regular Expressions in Match Rules

TBD

Using Regular Expressions in Responders

In some cases, it may be desirable to examine the URL of an incoming request and re-use parts of it in the URL returned to the client by a Redirect Responder. This is the purpose of the regex parameter: specify a custom regular expression that is used to:

- Parse the URL of an incoming request
- Break it down into separate strings (based on the positions of literal characters in the expression)
- Assign each string to a named variable

These named variables can then be used in the URL field of the Redirect Responder. When the Responder replies to a client, it performs string substitution on the URL. Because the purpose of using regular expressions to perform string substitution in Redirect URLs is to parse request URLs into strings, constructing an appropriate regular expression requires an exact knowledge of the format of the request URLs that will typically be coming in to the cluster IP.

Using Regular Expressions with ACV

TBD

Appendix A

Physical Dimensions

Sections within this chapter include:

Physical Dimensions

The following are the physical dimensions of the E370LX Equalizer as well as the GX series Equalizer.

Model	Weight	Height	Width	Depth
E370LX	15.4 lbs. (7kg)	1.75 in.	17 in.	12 in.
E250GX	7 lbs. (3.2kg)	1.75 in.	17.25 in.	10.5 in.
E350GXE450GX / E650GX	14 lbs. (6.4kg) 15 lbs. (6.8kg)	1.75 in.	17.25 in.	15.5 in.

Appendix B

Using the File Editor

Sections within this chapter include:

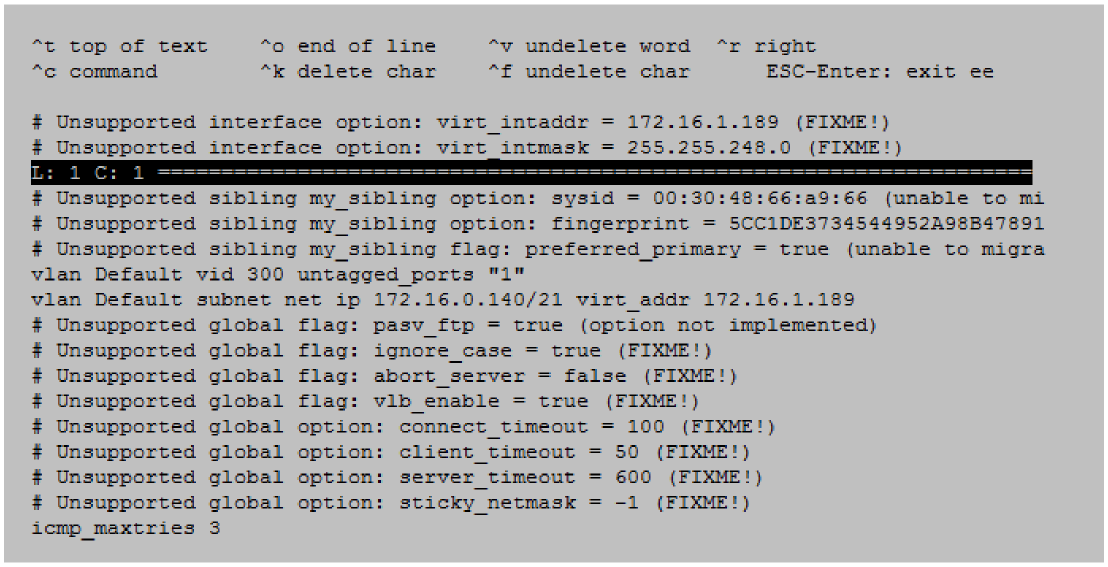
Editing Files

Files from the data store, for example, can be edited using the **`files edit`** command in the CLI using the "ee" editor . The most common example for using this feature is to edit CLI scripts which can then be executed using the **`run_script`** command, but there are other uses as well. You will be able to edit existing files, however you will not be able to create and save new files to the data store. (Use the files download command to place a new file into the datastore).

Examples of files that can be edited are **`responder html edit`**, **`certificate certfile/keyfile edit`**, **`files edit`**, and others. In the example below the files edit command is used. In the example below a configuration backup file script is opened for editing:

```
eqcli > files edit backup.script
```

When this command is executed, the "*ee*" editor will be displayed:



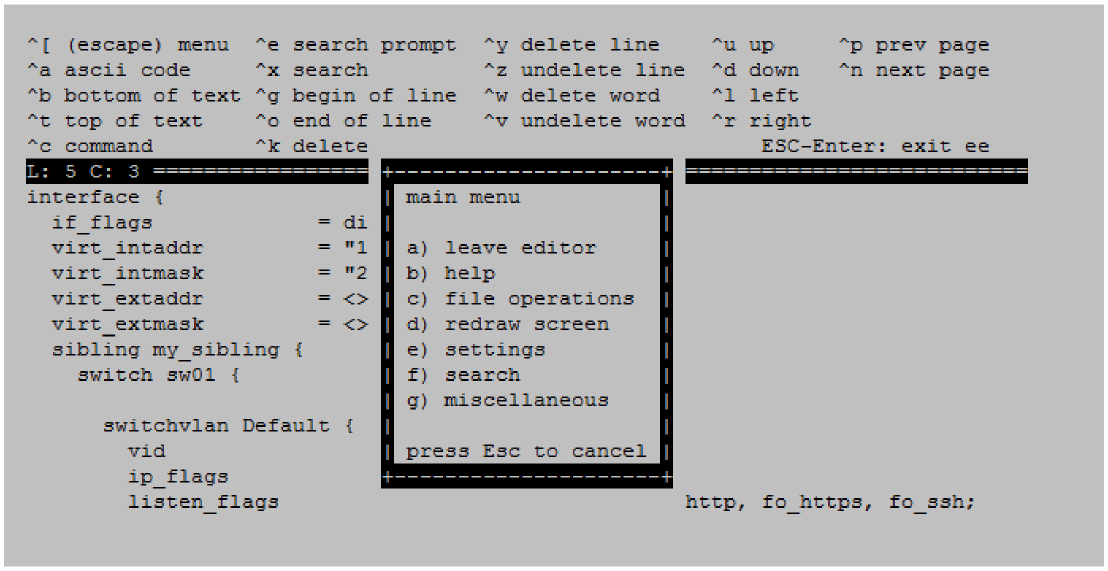
```
^t top of text    ^o end of line    ^v undelete word  ^r right
^c command        ^k delete char    ^f undelete char      ESC-Enter: exit ee

# Unsupported interface option: virt_intaddr = 172.16.1.189 (FIXME!)
# Unsupported interface option: virt_intmask = 255.255.248.0 (FIXME!)
L: 1 C: 1 ==============================================================
# Unsupported sibling my_sibling option: sysid = 00:30:48:66:a9:66 (unable to mi
# Unsupported sibling my_sibling option: fingerprint = 5CC1DE3734544952A98B47891
# Unsupported sibling my_sibling flag: preferred_primary = true (unable to migra
vlan Default vid 300 untagged_ports "1"
vlan Default subnet net ip 172.16.0.140/21 virt_addr 172.16.1.189
# Unsupported global flag: pasv_ftp = true (option not implemented)
# Unsupported global flag: ignore_case = true (FIXME!)
# Unsupported global flag: abort_server = false (FIXME!)
# Unsupported global flag: vlb_enable = true (FIXME!)
# Unsupported global option: connect_timeout = 100 (FIXME!)
# Unsupported global option: client_timeout = 50 (FIXME!)
# Unsupported global option: server_timeout = 600 (FIXME!)
# Unsupported global option: sticky_netmask = -1 (FIXME!)
icmp_maxtries 3
```

A list of commands is located at the top of the display.

The present location of your cursor is displayed in a highlighted block. For example **`L: 1 C: 1`** indicates that your cursor is on line 1, column 1 within the file contents. **`L:3 C;5`** indicates that your cursor is on line 3, column 5 within the file contents, etc.

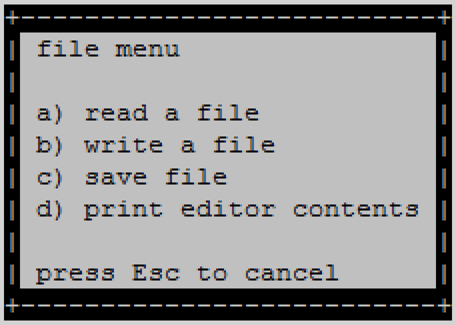
Use your keyboard's arrow keys (← ↑ ↓ →) to navigate to the text that requires editing.

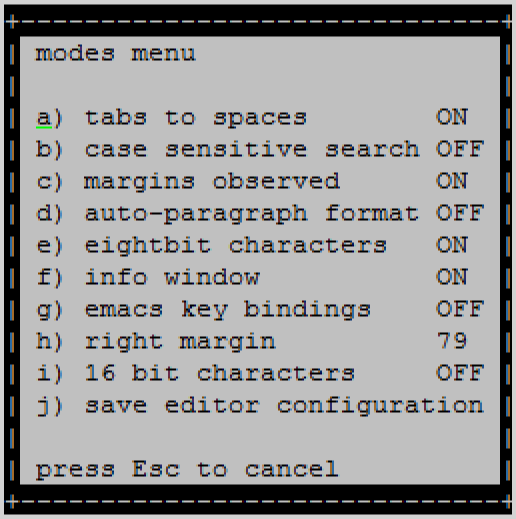
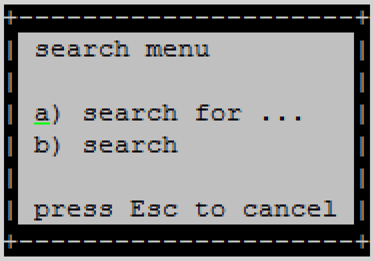
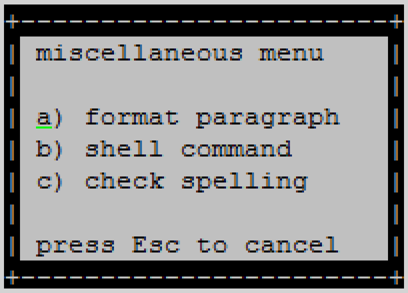
When you have finished editing enter **`ESC`** and a menu will be displayed as follows:



```
^[ (escape) menu  ^e search prompt  ^y delete line    ^u up      ^p prev page
^a ascii code     ^x search         ^z undelete line  ^d down    ^n next page
^b bottom of text ^g begin of line  ^w delete word    ^l left
^t top of text    ^o end of line    ^v undelete word  ^r right
^c command        ^k delete                                ESC-Enter: exit ee
L: 5 C: 3 ================= +--------------------+ ===========================
interface {                | main menu          |
  if_flags             = di|                    |
  virt_intaddr         = "1| a) leave editor    |
  virt_intmask         = "2| b) help            |
  virt_extaddr         = <>| c) file operations |
  virt_extmask         = <>| d) redraw screen   |
  sibling my_sibling {     | e) settings        |
    switch sw01 {          | f) search          |
                           | g) miscellaneous   |
      switchvlan Default { |                    |
        vid                | press Esc to cancel|
        ip_flags           +--------------------+
        listen_flags                            http, fo_https, fo_ssh;
```

Main and Submenu Commands

a) leave editor	Leaves the ee editor. You will be prompted to save changes before exiting.
b) help	Will display a complete list of Control Keys and Commands.
c) file operations	Will display a submenu of commands that includes:  `file menu` `a) read a file` `b) write a file` `c) save file` `d) print editor contents` `press Esc to cancel` **read a file**,**write afile**and**print editor contents** are all restricted and not available **save file** - will save the changes that you made to the file.
d) redraw screen	Will redraw the open screen.
e) settings	Will display the following **modes menu**

	
f) search	Will open a search submenu with 2 options:  **a) search for** - will prompt you to enter a search term(s) **b) search** - [not available]
g) miscellaneous	Will display the following **miscellaneous menu**: 

```
modes menu

a) tabs to spaces          ON
b) case sensitive search OFF
c) margins observed        ON
d) auto-paragraph format OFF
e) eightbit characters     ON
f) info window             ON
g) emacs key bindings     OFF
h) right margin            79
i) 16 bit characters      OFF
j) save editor configuration

press Esc to cancel
```

```
search menu

a) search for ...
b) search

press Esc to cancel
```

```
miscellaneous menu

a) format paragraph
b) shell command
c) check spelling

press Esc to cancel
```

Appendix C

Version 8.6 to 10.0 Configuration Converter

Sections within this chapter include:

EQ/OS 8.6 to EQ/OS 10 Configuration Conversion Process

EQ/OS 8.6 and EQ/OS 10 configuration files are not compatible. It is not possible to simply copy an older configuration to a new installation during the upgrade process, as is done when upgrading from a 8.6 to an 8.6 version, or from a 10 to a 10 version. The reason for this is that the two versions use different operating systems and cannot read each other's file systems.

The configuration migration will create a Version 10 configuration that is functionally equivalent to the Version 8.6 configuration in the supplied backup archive. Note that because of differences in the object model used by the two releases, there will not necessarily be a one-to-one correspondence between Version 8.6 objects and Version 10 objects as shown below. For example, since servers are defined within clusters in Version 8.6, some adjustments to a Version 8.6 configuration must be made because servers are global objects in Version 10 that must be placed in server pools before they are associated with clusters.

Configuration Conversion Notes

1. Only Equalizer GX hardware running EQ/OS 8.6.0h or greater can be upgraded to EQ/OS 10.
2. SSL Certificates are not converted. They will need to be to manually reinstalled after the migration to EQ/OS 10 is complete.

How configuration objects will be converted

The following shows Equalizer configuration objects that will or won't be converted during the migration:

Configuration Objects:	**Notes:**
Converted Configuration Objects	
Match Rules	Converted completely.
Local Peer Configuration	Only the local peer is converted. See "Failover" below.
Switch Ports	Converted completely.
VLANs	Automatically added as a VLAN with a single subnet on EQ/OS 10.
Responders	Converted completely if responder files are present in the backup. They will be automatically added.

Servers	Added as global server objects and server instances within server pools.
	The Server VID is now deprecated, and servers are automatically considered to be part of a particular subnet, based on their IP address. If using multi netting with servers, start with the converted configuration and then modify it by adding an additional subnet in a VLAN to achieve the multi-netting desired.
	Outbound NAT is configured differently now. (via networking as opposed to server configuration). You will need to manually verify and set up Outbound NAT after converting the configuration.
Clusters	Converted completely (with the exception of "Certificates" as described below).
	Send and receive socket options are not converted because they are deprecated. These are automatically managed in EQ/OS 10.
	Cluster VID is now deprecated. See the note about Server VID above.
VMware server configuration for VLB basic	Converted completely.
Email alerts	Converted completely. These are converted into email notification alerts.
Configuration Objects NOT Converted	
Envoy configuration	Not converted
Smart Control events	Not converted. The syntax & functionality are completely changing
Failover	Not completely converted. Only the "local" peer is converted. It is recommended that you reconfigure failover after the conversion.
Users	Not converted. Because the password is encoded, there is no way to add a user automatically -- manual intervention is needed to type the password. Also, the permissions model is different in EQ/OS 10, so there can be no direct conversion between them.
Certificates	Not converted. They are not present in the version 8.6 backup file. You will need to manually reinstall them.

Object Names Effected by Configuration Migration

In EQ/OS 8.6, each cluster is assigned its own servers. In EQ/OS 10, servers are global objects. When migrated, server names are contrived using the cluster name and server name to avoid having duplicates.

Note - It should be noted that EQ/OS 8.6 object names in excess of 47 characters will be truncated and appended with "`_XXX`". "`XXX`" is a number that starts with 000 and will increment. For example, two server instances may be appended with `_000` and `_001`.

The following are examples of the name changes. If the EQ/OS 8.6 configuration was:

cluster cl00 >> server sv00

The resulting cluster-server name in the configuration in EQ/OS 10 will be:

server cl00_sv00

EQ/OS 10 uses Server Pools that contain Server Instances. When migrating to EQ/OS 10 a Server Pool will be created using the cluster-server details described. A server instance (**si**) will be created for the new EQ/OS 10 server and assigned to a new cluster. For example:

A server pool (**srvpl**) is created with a new server instance (**si**):

> **srvpl cl00** >> **si cl00_sv00**

A new cluster is created with the new server pool attached:

> **cluster cl00** >> **srvpl cl00**

However, if there are duplicate servers shared between clusters in the EQ/OS 8.6 configuration, there will be a configuration where we use the name of the first cluster in which it appears, and there is a mismatch between the server name and the cluster name:

If the configuration in EQ/OS 8.6 was:

> **cluster cl00** >> **server sv00 (1.2.3.4 80**)
>
> **cluster cl01** >> **server sv01 (1.2.3.4 80)**

The resultant EQ/OS 10 configuration will be:

> **server cl00_sv00** (Note only one server)
>
> **srvpl cl00** >> **si cl00_sv00**
>
> **srvpl cl01** >> **si cl00_sv00** (Note the mismatch)
>
> **cluster cl00** >> **srvpl cl00**
>
> **cluster cl01** >> **srvpl cl01**

Migration Process

The following describes the process of converting an EQ/OS 8.6 configuration to EQ/OS 10. It is recommended that the migration be executed on a "clean" Equalizer, meaning, without configured objects. If there are configured objects on your system, it is advisable to review the names and IP configuration to verify that there are no conflicts with the migrating EQ/OS 8.6 configuration. If there are conflicts, they will be noted and displayed when the migration script is executed:

General Work flow

1. On Version 8.6, create a backup archive of the system. You will not be able to downgrade to Version 8.6 in the event that a downgrade becomes necessary in the future.
2. Upgrade your Version 8.6 system to Version 10.
3. Upload the backup file to Version 10.
4. Convert the backup file to a Version 10 configuration script.
5. Run the script.

Conversion using the CLI

1. Create a backup of the Version 8.6 system. Refer to the *Equalizer Administration Guide* for version 8.6 for instructions.

2. Upgrade your version 8.6 system to version 10. Refer to "Version 8.6 Upgrade Procedure" on page 58 for instructions.

3. Upload the EQ/OS 8 backup file onto the system:

   ```
   eqcli > files download [URL or Path to *.bkp file]
   ```

   For example:

   ```
   eqcli > files download ftp://10.0.0.10/os8backup.bkp
   ```

4. Convert the backup file into a EQ/OS 10 CLI script:

   ```
   eqcli> cfg_convert file [backup filename] outfile [output filename]
   ```

   For example:

   ```
   eqcli> cfg_convert file os8backup.bkp outfile os8cfg.script
   ```

   This will create a CLI script file, also in the version 10 data store. It will also create files for any “sorry” responders in the datastore. The script will be a list of eqcli commands to create converted configuration objects and comments describing parameters which could not be converted. For example:

```
cluster myclust proto "tcp" ip 10.0.0.10 port 1 range 4999 stickyto 3500
idleto 36000
# Unsupported user touch option: desc = touch (unable to migrate this
option, it must be hand converted)
```

Note - When viewing the translated file, look for lines that begin with "#" (comments). These are lines which could not be converted with the reason displayed. Make a note of these lines and determine whether the parameters described by them are important to them. If they are, they will need to be manually configured later. If not, they can be ignored.

5. Enter the following:

   ```
   eqcli> run_script [output filename]
   ```

   For example:

   ```
   eqcli> run_script os8cfg.script
   ```

   This will process the script, one line at a time, and stop if any errors are encountered. Here is an example of a successful run:

```
eqcli > run_script myscript
eqcli: 12020315: Processing line 1: server newserver ip 3.4.5.6 port 80
proto tcp
eqcli: 12000287: Operation successful
```

```
eqcli: 12020315: Processing line 2: server otherserver ip 3.4.5.6 port 81
proto tcp
eqcli: 12000287: Operation successful
eqcli: 12020318: All commands processed successfully.
eqcli >
```

6. If the script completes successfully you can continue using the system as normal. You may need to install certificates first .

7. If the script completed with an error you can modify the offending command, and restart the script from that line:

   ```
   eqcli> files edit [filename]
   eqcli> run_script [filename] [start line]
   ```

   For example:

   ```
   eqcli> files edit myscript
   eqcli> run_script myscript 5
   ```

Note - The default editor that is used when the "files edit" command is executed is "ee". If you are editing a long file, it may be helpful to jump to particular line number. In "ee", to do this, press **CTRL+C** to enter command mode, and then type the line number to jump to.

8. Once you have verified that the configuration was successfully converted, you can remove the EQ/OS 8 backup file and converted CLI script from the file store:

   ```
   eqcli> no files [filename]
   ```

   For example:

   ```
   eqcli> no files os8backup.bkp
   ```

Conversion using the GUI

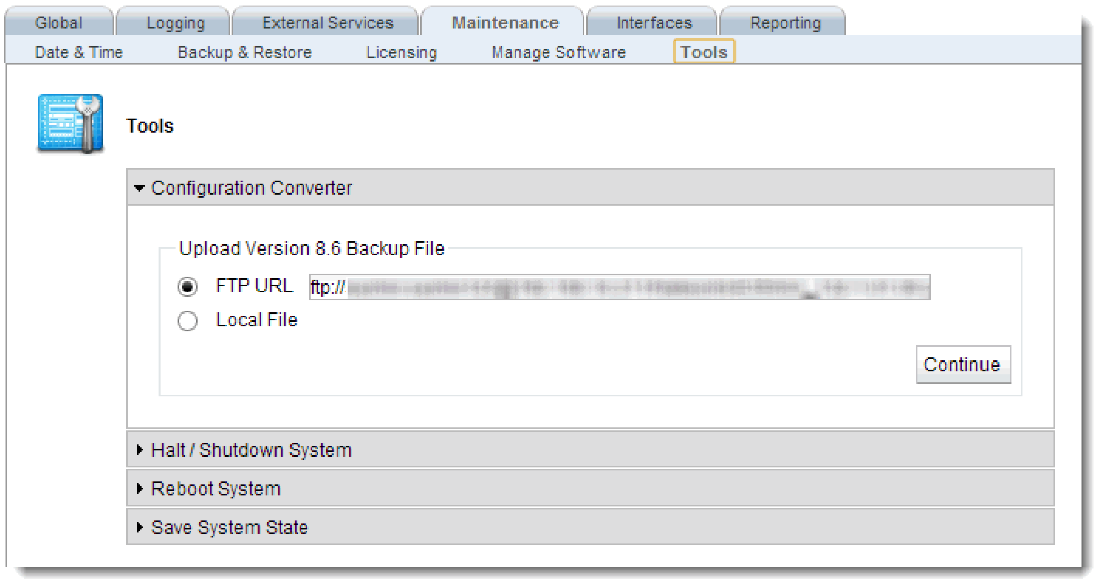
The GUI work flow would be simplified, particularly because there is no plan to implement file management in the GUI. This would all be done using a wizard screen with several steps:

1. Log in to the GUI as described in "Logging In" on page 192.

2. Click on **Equalizer** on the left navigational pane.

3. Click on the **Maintenance** tab and then **Tools** on the right to display the **Tools** accordion tabs.

4. Click on the **Configuration Converter** accordion tab and the following will be displayed.



The EQ/OS 8.6 backup file can be uploaded either from a URL or FTP server or from a local directory. Proceed with either step 5 or step 6 depending on the location of your backup file. After selecting a file from either method described in steps 5 and 6, proceed with step 7.:

5. To upload from a URL or FTP Server:

    a. Click on the **FTP URL** option and enter the FTP location or URL in the space provided.

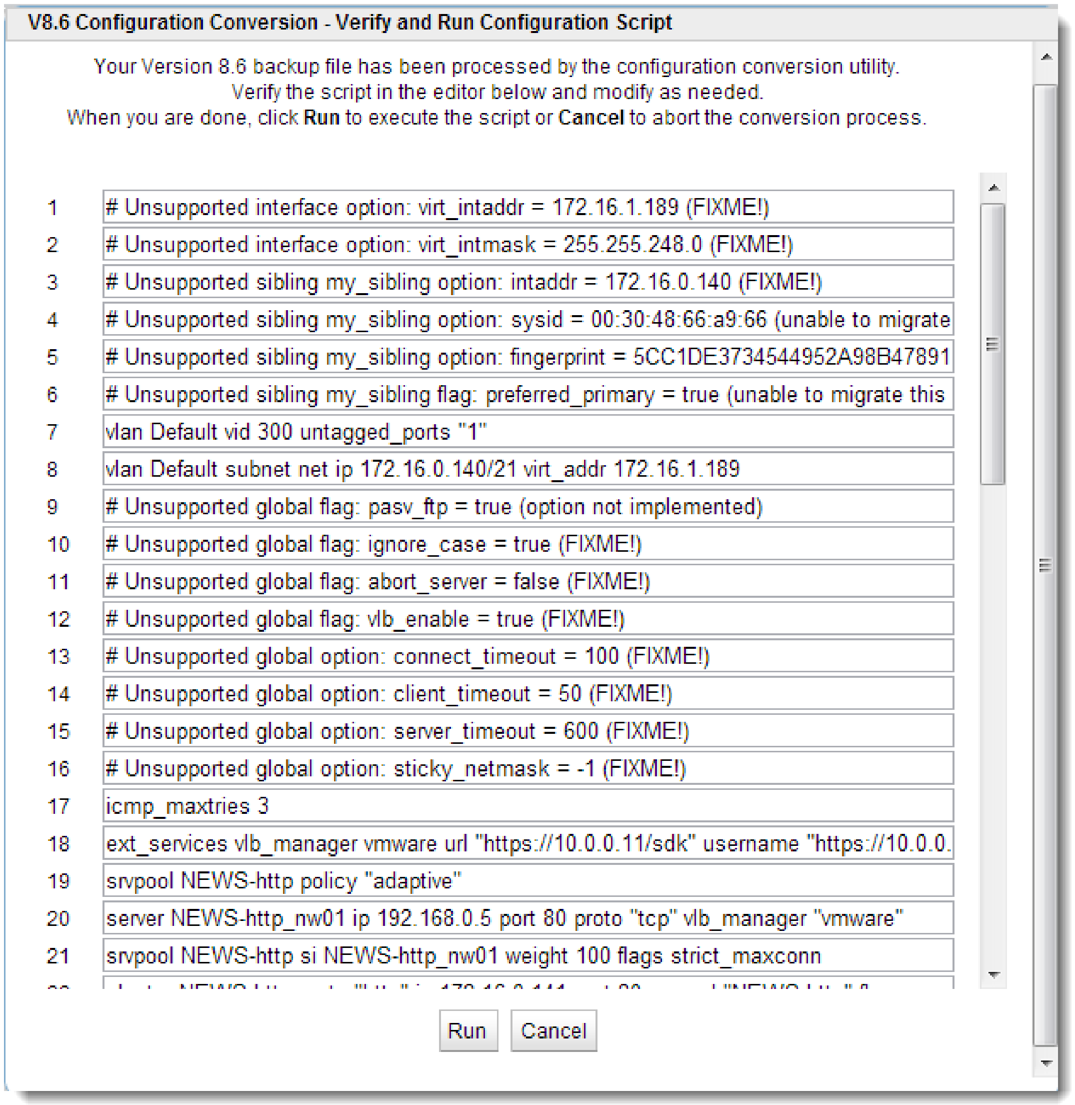
    b. Click on **Continue** to upload the file. A Please Wait message should appear while the file is downloaded from the FTP site. If connection with the FTP site fails, an error message will be displayed. If successful, a message will be displayed prompting you to continue. Press **Continue** again and the **Verify and Run Configuration Script** screen will be displayed.

6. To upload a locally stored file:

    a. Click on the **Local File** option and then **Continue** to located the file.

    b. After locating the file, select it and click on **Open** to begin the upload process.

7. The **Verify and Run Configuration Script** screen is a line numbered text editor. Here you can modify a script as needed before continuing with the conversion.



V8.6 Configuration Conversion - Verify and Run Configuration Script

Your Version 8.6 backup file has been processed by the configuration conversion utility.
Verify the script in the editor below and modify as needed.
When you are done, click **Run** to execute the script or **Cancel** to abort the conversion process.

```
# Unsupported interface option: virt_intaddr = 172.16.1.189 (FIXME!)
# Unsupported interface option: virt_intmask = 255.255.248.0 (FIXME!)
# Unsupported sibling my_sibling option: intaddr = 172.16.0.140 (FIXME!)
# Unsupported sibling my_sibling option: sysid = 00:30:48:66:a9:66 (unable to migrate
# Unsupported sibling my_sibling option: fingerprint = 5CC1DE3734544952A98B47891
# Unsupported sibling my_sibling flag: preferred_primary = true (unable to migrate this
vlan Default vid 300 untagged_ports "1"
vlan Default subnet net ip 172.16.0.140/21 virt_addr 172.16.1.189
# Unsupported global flag: pasv_ftp = true (option not implemented)
# Unsupported global flag: ignore_case = true (FIXME!)
# Unsupported global flag: abort_server = false (FIXME!)
# Unsupported global flag: vlb_enable = true (FIXME!)
# Unsupported global option: connect_timeout = 100 (FIXME!)
# Unsupported global option: client_timeout = 50 (FIXME!)
# Unsupported global option: server_timeout = 600 (FIXME!)
# Unsupported global option: sticky_netmask = -1 (FIXME!)
icmp_maxtries 3
ext_services vlb_manager vmware url "https://10.0.0.11/sdk" username "https://10.0.0.
srvpool NEWS-http policy "adaptive"
server NEWS-http_nw01 ip 192.168.0.5 port 80 proto "tcp" vlb_manager "vmware"
srvpool NEWS-http si NEWS-http_nw01 weight 100 flags strict_maxconn
```

8. After clicking on **Run** the script is executed on Equalizer. If no errors occur and the script runs to completion a **Configuration Complete** message will be displayed. If an error occurs the a **Correct Error and Continue** screen will be displayed which is the same as the **Verify and Run Script** screen except that it opens at the line at which the error occurred as indicated by the error message.

   a. If you click on **Cancel**, the editor screen will be closed and you will be prompted to **Save** your conversion script in the file store.Refer to "Editing Files" on page 556"EQ/OS 8.6 to EQ/OS 10 Configuration Conversion Process" on page 562 for instructions on accessing and editing files in the data store using the CLI. Click on **Discard** to discard the script.

   b. Click on **Continue** to execute the script on Equalizer starting at the line on which the error occurred. If no errors occur and the script runs to completion, a **Configuration Complete** message will be displayed. If an error occurs, the **Correct Error and Continue** screen will be displayed again and will open at the line at which the error occurred as indicated by the error message.

9. After the script has completed running the new objects should appear on the left navigational pane.

Appendix D

Equalizer OnDemand

Sections in this chapter include:

What is Equalizer OnDemand?

Equalizer OnDemand™ is a software-based virtual appliance that operates as an integral part of the virtual infrastructure model. Equalizer OnDemand is deployed as a single virtual server instance dedicated to load balancing and managing the application delivery needs of your business. The EQ/OS 10 platform on which Equalizer OnDemand is built drives the robust application traffic management capabilities of the Virtual Equalizer. Envoy OnDemand SAE is a software based virtual appliance that provides you with the ability to send website traffic to the 'best' geographic location amongst several independent data centers, based on application health, static weighting, server load or lowest latency to the client, to ensure the best application response.

Equalizer OnDemand instances can be deployed on a single server to maximize utilization of hardware infrastructure, and current server platforms can be used for load balancing and other application delivery needs without creating dependence on specific server hardware.

Equalizer OnDemand offers:

- Intelligent, layer 4-7 application-based load balancing that is the hallmark of Coyote Point products
- Flexible hybrid network support
- Optimization for VMware virtualized environments; real-time resource metrics are obtained from VMware
- Scalability and availability for today’s complex mission critical virtualized applications
- Predictable, reliable, and consistent application performance
- All the cost and energy saving benefits of virtualization technology

Equalizer OnDemand can also be combined with Equalizer hardware appliances to best meet your specific application delivery challenges.

Differences from Equalizer Hardware

All load balancing functionality found in EQ/OS 10 running on an Equalizer OnDemand hardware appliance is fully functional in Equalizer OnDemand. Some adjustments to functionality were necessary, however, in order to accommodate the VMware virtual machine environment.

1. Equalizer OnDemand is delivered with two Ethernet network interfaces configured -- one interface can be configured into a VLAN using port number **1**, the other using port number **2**. Port number 1 corresponds to the first interface added via VMware; port 2 to the second. The current release supports up to 16 network interfaces.

2. An interface port in the CLI or GUI can be assigned to one VLAN only, either:

    - a single untagged VLAN and , or
    - multiple tagged VLANs

    A port cannot be assigned to multiple untagged VLANs or to a mix of tagged and untagged VLANs.

3. Equalizer OnDemand is delivered with no serial console configured because this requires additional configuration by the user. A serial console can be added by editing the Virtual Machine settings. See your VMware product documentation for more information.

Adding Ports on VM Workstation

When adding an interface using VM Workstation (a.k.a. VM Player), you are not given the option to choose the type of network adapter added. as a result, you must edit the "vmx" file for the Virtual Machine manually and restart the Virtual Machine to see the new interface in the Equalizer OnDemand CLI and GUI.

1. Add an interface to the Equalizer OnDemand Virtual Machine using the standard VM Workstation GUI controls.

2. Power off the Virtual Machine.

3. Find and edit the "*.vmx*" file for the Virtual Machine. Assuming that you have an image shipped with 2 interfaces and you are adding a third, you will find lines like this towards the end of the "*.vmx*" file:

```
ethernet0.present = "TRUE"
ethernet0.virtualDev="e1000"
ethernet0.connectionType = "bridged"
ethernet0.wakeOnPcktRcv = "FALSE"
ethernet0.addressType = "generated"
ethernet0.linkStatePropagation.enable = "TRUE"
ethernet0.generatedAddress = "00:0c:29:bc:74:82"
ethernet0.pciSlotNumber = "32"
ethernet0.generatedAddressOffset = "0"
ethernet0.vnet = "vmnet2"
ethernet0.bsdName = "en0"
ethernet0.displayName = "Ethernet"
ethernet1.present = "TRUE"
ethernet1.virtualDev="e1000"
ethernet1.connectionType = "bridged"
ethernet1.wakeOnPcktRcv = "FALSE"
ethernet1.addressType = "generated"
ethernet1.linkStatePropagation.enable = "TRUE"
ethernet1.generatedAddress = "00:0c:29:bc:74:8c"
ethernet1.pciSlotNumber = "35"
ethernet1.generatedAddressOffset = "10"
ethernet1.vnet = "vmnet3"
ethernet1.bsdName = "en1"
ethernet1.displayName = "Ethernet2"
ethernet2.present = "TRUE"
ethernet2.wakeOnPcktRcv = "FALSE"
ethernet2.addressType = "generated"
ethernet2.generatedAddress = "00:0c:29:bc:74:96"
ethernet2.pciSlotNumber = "37"
ethernet2.generatedAddressOffset = "20"
```

4. Each interface has a set of properties that begin with "`ethernetN.`" where '*N*' is the interface number (this number indicates the order in which the interfaces were added to the VM). The first two interfaces have a

line (highlighted in green) that indicates the network interface device type. The text highlighted in yellow is what VMware added to the file for the third interface. Note that there is no `virtualDev` line in this set of properties that indicates the interface type. This line needs to be added for the interface to work on Equalizer OnDemand.

5. The text below shows what the "`ethernet2.`" set of properties should look like after editing:
6. Save your edits to the file.
7. Start the Equalizer OnDemand VM and log in to the CLI or GUI. You should now see 3 interfaces ports when you run the `show interface` command in the CLI and when you open the **Interfaces** tab in the GUI.

Installing and Upgrading Equalizer OnDemand

VMware Host Requirements

Equalizer OnDemand runs under any VMWare Hypervisors which support Version 7 virtual machines, including the following VMware releases:

- VMware ESX and ESXi 4.1 and above
- VMware Fusion 3.1.2 and above
- VMware Workstation 6 and above
- VMware Player 2.5.1 and above

A VM instance of Equalizer OnDemand requires the following minimum hardware resources:

- 1GB RAM
- 1GB free disk space
- 1 VMware supported 10/100/1000Gb Network Adapter (e1000 adapter type)
- Internet connectivity for license validation

The above requirements are *in addition to* the resources required to run VMware. See the VMware documentation for the VMware product you are using for installation requirements.

Installing Equalizer OnDemand Using OVF

VMware vSphere or vCenter Clients

VMware ESX and ESXi servers are managed using either the vSphere or vCenter management clients. If you are using either of these products, the OVF can be installed directly from the FTP site following the directions below.

1. Open the vSphere or vCenter client.
2. If your client has Internet access, do the following; otherwise goto the next step.
    a. Select **File > Deploy OVF Template**.
    b. Click **Deploy from URL**, and enter the FTP URL for the OVF image: Click **Next**. You can copy the hyperlink target available on the Equalizer OnDemand section of the support page at:

       http://www.coyotepoint.com/content/eqos-10-support-page

    c. The OVF details are displayed. Click **Next**.
    d. Type a name for the VM. Click **Next**.
    e. Associate the source network adapters in the OVF to networks defined on VMware. Click **Next**.
    f. A summary of the VM configuration is displayed. Click **Next**.
    g. The VMDK file for the OVF is now downloaded from the FTP site. When it is done, the Equalizer OnDemand VM should now appear in your inventory.
3. If you downloaded and deployed the OVF file in the previous step, skip this step. Otherwise, if your client does not have Internet access, do the following:
    a. Download the *.ovf files from the Equalizer OnDemand part of the site, into the same directory on your local system:

       http://www.coyotepoint.com/content/eqos-10-support-page

    b. Select **File > Deploy OVF Template**.
    c. Click **Deploy from file**, browse to the directory to which you downloaded the files in the *.ovf* and *.vmdk* files, and select the *.ovf* file. Click **Next**.
    d. The OVF details are displayed. Click **Next**.
    e. Type a name for the VM. Click **Next**.
    f. Associate the source network adapters in the OVF to networks defined on VMware. Click **Next**.
    g. A summary of the VM configuration is displayed. Click **Next**.

   h. The VMDK file for the OVF is now downloaded from the local directory. When it is done, the EqualizerOnDemand VM should now appear in your inventory.

4. The first time you start Equalizer OnDemand, login to the CLI on the VM console using the **touch** login (default password is **touch**). We recommend that you immediately change the default password for the **touch** login. Do this using the following CLI command:

```
eqcli > user touch password
```

Installing Equalizer OnDemand from a ZIP file

To install Equalizer OnDemand using the ZIP file distribution open the zip file that can be downloaded from:

http://www.coyotepoint.com/content/eqos-10-support-page

Follow the instructions for the VMware product you are using in the sections that follow.

VMware vSphere or vCenter Clients

VMware ESX and ESXi servers are managed using either the vSphere or vCenter management clients. For either of these products, the installation process is similar:

1. Copy the ZIP file onto the system running where vSphere or vCenter is installed. Unpack the ZIP file using utilities on that system.
2. Open the vSphere or vCenter client.
3. Select **Host > Configuration > Storage**.
4. Right-click on the DataStore on which you want to install Equalizer OnDemand and select **Browse**.
5. Select the **Upload** icon and then **Upload Folder**. Browse to the directory where you unpacked the ZIP file in Step 1, select the file **EqualizerOnDemand.vmx**, and click **Open**.
6. After completion, open the new OnDemand directory in the DataStore Browser.
7. Right click on file **EqualizerOnDemand.vmx** and select **Add to Inventory**.
8. Either accept the default VM name and resource pool or change them. Click **OK** to continue.
9. Once the virtual machine is loaded, Equalizer OnDemand should appear in the virtual machine list. Start (or play) the virtual machine by selecting the appropriate command from the menus or double-click on the virtual machine name.
10. Equalizer OnDemand will automatically boot and display the CLI login prompt. Login using the **touch** login (default password is **touch**).
11. We recommend that you immediately change the default password for the **touch** login. Do this using the following CLI command:

```
eqcli > user touch password
```

VMware Player and VMware Fusion

Besides running on dedicated hardware with the VMware ESX operating system, VMware can also run on Windows and MAC computers. VMware Workstation and VMware Player are Windows-based hypervisors, while VMware Fusion is the MAC version. After installing one of these products, follow these instructions to add the Equalizer OnDemand VM into either of these products.

1. Copy the ZIP file onto your Windows or MAC host. Unpack the ZIP file using utilities on your host system.

2. Open VM Player or Fusion and load the Equalizer OnDemand image:

   - On VM Player, select **File > Open a Virtual Machine**.

   - On VM Fusion, select **File > Open**.

   Browse to the location where you unpacked the ZIP file in Step 1, select the file Equalizer OnDemand**.vmx** and click **Open**.

3. Once the virtual machine is loaded, Equalizer OnDemand should appear in the virtual machine list. Start (or play) the virtual machine by selecting the appropriate command from the VMware menus or double-click on the virtual machine name.

4. Equalizer OnDemand will automatically boot and display the CLI login prompt. Login using the **touch** login (default password is **touch**).

5. We recommend that you immediately change the default password for the **touch** login. Do this using the following CLI command:

```
eqcli > user touch password
```

Licensing Equalizer OnDemand

When Equalizer OnDemandis first installed, it is unlicensed. In the unlicensed state, you can create objects but no clusterswill accept connections until a valid license is installed. You can license your system using the CLI or the GUI, either online or offline.

Note - Licensing Equalizer OnDemand requires the system Serial Number from the email receipt that was sent to you when you obtained Equalizer OnDemand.

1. Install Equalizer OnDemandon to your VMware host following the directions in the previous section.

2. Log in to the CLI or GUI using the **touch** login.

3. Display the **System ID** and copy it for use later in this procedure. Do *one* of the following:

- In the CLI, enter:

```
eqcli > version
```

- In the GUI, the **System ID** is shown on the **Welcome** screen that is displayed when you log in.

4. Register your copy of Equalizer OnDemand on the Coyote Point Registration site.

   a. Go to:

      http://www.coyotepoint.com

   b. Click **Support > Register Your Product** to open the registration form.

   c. Enter your System ID and your system Serial Number (see the **Note** above).

   d. Click continue.

   e. Follow the prompts to complete registration.

5. If you want to license your unit offline, go to the next step.

   To license your unit online over an Internet connection, follow these steps:

   a. Log into the CLI.

   b. Create a VLAN:

      To create an untagged (or port-based) VLAN, enter:

```
eqcli > vlan name vid VLAN_ID untagged_ports ports
```

      To create a tagged VLAN, enter:

```
eqcli > vlan name vid VLAN_ID tagged_ports ports
```

   c. Add a subnet through which you can reach the Internet:

```
eqcli > vlan name subnet name ip cidr_ip_addr default_route ip_addr flags
def_src_addr
```

      Note that the **ip** parameter must be entered as a CIDR format address (e.g.: 172.16.1.123/24). More information on configuring VLANs and subnets can be found in the section "Configuring VLANs" on page 100.

d. Confirm you can reach the default route gateway using the **ping** command:

```
eqcli > ping ip_addr
```

Use the default route IP address supplied for the subnet, above.

e. License the system:

```
eqcli > license get
```

Equalizer connects to the Coyote Point license server and automatically downloads a license. Your system is now licensed and you can skip the next step.

6. To license your system offline, do the following:

   a. Log into the CLI.

   b. Enter:

```
license genreq
```

   c. Copy the output of the above command into an email and send it to support@coyotepoint.com, requesting an offline license.

   d. Once you receive an email from Coyote Point Support containing your license, enter the following command:

```
license upload
```

   e. Copy the license information from the email sent by Coyote Point Support and paste it into the CLI.

   f. Press **<Enter>**.

Your unit is now licensed. Use the global **show license** command to confirm your license status.

Upgrading Equalizer OnDemand

Equalizer OnDemand can be upgraded to the latest release using the same methods in the CLI and GUI that are supported for hardware Equalizers. See the section "Upgrading to the Latest Release" on page 65 for instructions.

Glossary

6

6in4

6in4 is an Internet transition mechanism for migrating from Internet Protocol version 4 (IPv4) to IPv6.

A

Access Control Lists (ACLs)

Refers to rules that are applied to port numbers or network daemon names that are available on a host or other layer 3, each with a list of hosts and/or networks permitted to use the service

active connection count

Shows the number of connections currently active on the server.

active connections weight

The relative influence on the policy of the number of active connections currently open to a server

Active Content Verification (ACV)

These are Server Health Checks. ACV health checks basically have Equalizer attempting to open a TCP connection to a server and determing if the server accepts. When the server accepts, Equalizer sends a user-defined request to the server (for example GET a web page). If the server does not accept the request within the configured time, or is the server does not respond with the response the user configured, the server is marked "down" and no further traffic is sent to that server until it starts responding to health checks.

active-active

Equalizer clusters are instantiated on two peers and organized into failover groups. If the other peer's connectivity for the failover group's resources is judged to be "healthier" than the peer on wihich the group is running, then the group fails over to the other peer.

active-standby

All Equalizer clusters are instantiated on a primary system, and all will failover to a backup unit if the backup unit is judgged to be "healthier" than the primary system.

ActiveX

ActiveX is a Microsoft software component for Windows. It controls are small programs, sometimes called add-ons that are used on the Internet and can enhance the browsing experience by allowing animation or helping with tasks such as Microsoft security updates.

adaptive load balancing

Distributes the load according to the following performance indicators for each server.

Address Resolution Protocol

Address Resolution Protocol (ARP) is a protocol used by IPv4, to map IP network addresses to the hardware addresses used by a data link protocol. The protocol operates below the network layer as a part of the interface between the OSI network and OSI link layer.

address translation

The modification of external addresses to standardized network addresses and of standardized network addresses to external addresses.

administration address
The IP address assigned to Equalizer on any VLAN. Access to Equalizer can be configured for each VLAN.

administration interface
The browser-based interface for setting up and managing Equalizer.

affinity
Affinity is a technique that enables the load balancer to remember which balanced server was chosen for a certain client at its initial request. Subsequent requests are then directed to the same server again. If the affinity feature is disabled when a new TCP/IP connection is received from a client, load balancer chooses the correct server at that moment and forwards the packet to it. If a subsequent connection comes in from the same client, load balancer treats it as an unrelated connection, and again chooses the most appropriate server at that moment.

agent
An application that gathers or processes information for a larger application. See server agent.

agent weight
The relative influence on the policy of the return value of a server agent (if any) running on the servers in the cluster.

aggregation
See link aggregation and sticky network aggregation.

algorithm
Instructions, procedures, or formulas used to solve a problem.

alias
A nickname that replaces a long name or one that is difficult to remember or spell.

aliased IP address
A nickname for an IP address.

Application Delivery Controller (ADC)
An application delivery controller (ADC) is a network device that usually sits between the firewall/router and application servers. The ADC is in many cases described as the next generation load balancer.

application layer
Layer 7 of the Open Systems Interconnection (OSI) network model, where communication between endpoints is defined by the application.

atom
The smallest part of a regular expression in Equalizer. See branch, piece, and regular expression.

authoritative name server
A name server that maintains the master records for a particular domain. See name server.

B

back-end server
A physical server that is part of a virtual cluster on Equalizer.

backup Equalizer

The backup unit in a failover pair of Equalizers. The backup unit constantly monitors the health of the active (primary) unit, and replaces the primary unit in the event that the primary becomes unavailable. See hot backup and primary Equalizer.

bound

A character that represents the limit of part of a regular expression.

bracket expression

In a regular expression, a list of characters enclosed in brackets ([...]).

branch

In an Equalizer regular expression, a complete piece of a regular expression. You can concatenate and/or match branches. See atom, piece, and regular expression.

C

cache

An area in which information is temporarily stored.

client timeout

The time in seconds that Equalizer waits before closing an idle client connection.

cluster

A set of networked computer systems that work together as one system. See server cluster and virtual cluster.

cluster address

The IP address assigned to a particular cluster configured on Equalizer.

command transfer

In a failover configuration the subnet that is the subnet over which the configuration file transfers (between preferred primary and preferred backup) can occur.

Community String

Any SNMP management console needs to send the correct community string along with all SNMP requests. If the sent community string is not correct, Equalizer discards the request and will not respond.

computed load

A measure of the performance of a server relative to the overall performance of the cluster of which the server is a part.

connection

A connection is a Layer 4 transmission path established between two endpoints. Clients open connections to Equalizer cluster IPs, and Equalizer opens connections to the servers behind it. The notion of a connection is supplied by the underlying protocol. There are connection-oriented protocols, like TCP and connectionless protocols, such as UDP.

connection timeout (ms)

This is the failover timeout (in ms) for peer connections.

cookie

Data that a Web server stores on a client on behalf of a Web site. When a user returns to the Web site, the server reads the cookie data on the client, providing the Web site all the saved information about the user.

cookie header
One of Equalizer's supported headers, a cookie header is an HTTP data string previously sent by a server that is stored in Equalizer for future routing.

cookie persistence
In cookie-based persistence, Equalizer "stuffs" a cookie into the server's response header on its way back to the client. This cookie uniquely identifies the server to which the client was just connected. The client includes (sends) the cookie in subsequent requests to the Equalizer. Equalizer uses the information in the cookie to route the requests back to the same server.

cookie switching
Refers to three distinct ways to perform cookie switching: cookie-read, cookie-insert, and cookie-rewrite.

D

daemon
An application that runs in the background and performs one or more actions when events trigger those actions.

default gateway
A default gateway is on the same subnet as Equalizer, and is the gateway which Equalier relies on to route traffic.

delay weight
The relative influence on the policy of the current response time between Equalizer and the server.

Direct Server Return (DSR)
In a Direct Server Return (DSR) configuration, the server receiving a client request responds directly to the client IP, bypassing Equalizer. Because Equalizer only processes incoming requests, cluster performance is dramatically improved when using DSR in high bandwidth applications, especially those that deliver a significant amount of streaming content. In such applications, it is not necessary for Equalizer to receive and examine the server’s responses: the client makes a request and the server simply streams a large amount of data to the client.

DNS
Domain Name System or Domain Name Service; used to map domain names to Internet servers in order to link to IP addresses or map IP addresses to domain names. See IP address.

DNS TTL
The amount of time, in seconds, that a name server is allowed to cache the domain information. See DNS and TTL.

domain
The highest level in an IP address and the last part of the address in the URL. The domain identifies the category under which the Web site operates. For example, in www.coyotepoint.com, com is the domain, where com represents a commercial site. See domain name, IP address, and subdomain. See also DNS.

domain name
The owner of an IP address. The next highest level in an IP address and the next-to-last part of the address. For example, in www.coyotepoint.com, coyotepoint is the domain name. See domain, IP address, and subdomain. See also DNS.

dual stack networking
Dual-stack networking is a transition technology in which IPv4 and IPv6 coexist and operate in tandem and independently over shared or dedicated links. In a dual-stack network, IPv4 and IPv6 are fully deployed across

the network infrastructure so that configuration and routing protocols handle both IPv4 and IPv6 addressing.

dynamic weight

The weight that Equalizer assigns to a particular server during operation. See server weight, initial weight, and weight.

E

echo

An IP address-port pair that identifies the start or end of an address; a value that ends a process.

Enhanced NAT

NAT performed by a load balancer with protocol-specific knowledge in order to make certain protocols with with load balancing.

Envoy

Equalizer add-on software that supports geographic clustering and load balancing. See geographic cluster, geographic load balancing, and load balancing. See also intelligent load balancing.

eqcli

The Equalizer EQ/OS 10 Command Line Interface

EQOD

See "Equalizer OnDemand"

Equalizer Administration Interface

An Equalizer window with which you can monitor Equalizer’s operation; view statistics; add, modify, or clusters; add, modify, and delete servers; and shut down a server or Equalizer through a Javascript-enabled browser.

Equalizer Configuration Utility

An Equalizer feature that enables you to configure Equalizer, set parameters, and shut down and upgrade Equalizer.

Equalizer OnDemand

Equalizer OnDemand is a software-based virtual appliance that operates as an integral part of the virtual infrastructure model. It is deployed as a single virtual server instance dedicated to load balancing and managing the application delivery needs.

external address

The IP address assigned to Equalizer on the external network.

external interface

A network interface used to connect Equalizer to the external network. See interface, internal interface, and network interface.

external network

The subnet to which the client machines and possibly the Internet or an intranet are connected.

F

failover

The act of transferring operations from a failing component to a backup component without interrupting processing.

firewall
A set of security programs, which is located at a network gateway server and which protect the network from any user on an external network. See gateway.

FQDN
See Fully Qualified Domain Name (FQDN).

FTP
File Transfer Protocol; rules for transferring files from one computer to another.

FTP cluster
A virtual cluster providing service on the FTP control port (port 21). See cluster and virtual cluster.

Fully Qualified Domain Name (FQDN)
The complete, registered domain name of an Internet host, which is written relative to the root domain and unambiguously specifies a host's location in the DNS hierarchy. For example, east is a hostname and east.coyotepoint.com is its fully qualified domain name. See also domain name.

G

gateway
A network route that typically translates information between two different protocols.

geographic cluster
A collection of servers (such as Web sites) that provide a common service over different physical locations. See cluster.

geographic load balancing
Distributing requests as equally as possible across servers in different physical locations. See load balancing. See also intelligent load balancing.

geographic probe
A query sent to a site in a geographic cluster to gather information so Equalizer can determine the site that is best able to process a pending request. See geographic cluster.

H

header
One or more lines of data that identify the beginning of a block of information or a file.

hot backup
Configuring a second Equalizer as a backup unit that will take over in case of failure. Also known as a hot spare. See backup Equalizer. See also primary Equalizer. A server can also be used as a hot backup, or hot spare, within a cluster. If all the other servers in the cluster fail, the hot spare will begin processing requests for the cluster.

HTTP
HyperText Transfer Protocol; the protocol with which a computer or user access information on the World Wide Web.

HTTPS
HyperText Transfer Protocol (Secure). The SSL/TLS protocol is used in combination with the HTTP protocol to provide secure identification and data encryption.

hub

A device that joins all the components attached to a network.

I

ICMP

Internet Control Message Protocol. Used by operating systems of networked computers to send error messages indicating that a requested service is not available or that a host or router could not be reached.

ICMP echo request

The act of repeating a stream of characters (for example, echoing on the computer screen characters as a user types those characters). See ping. See also echo.

ICMP Probe Maximum Tries

Enables probing servers using ICMP echo (ping) probes. These probes are 5 seconds apart. If a server does not respond to an ICMP prebend it has attempted to probe the number of times specified, it is marked down only if there are no other probes (TCP, ACV, or server agent) active for the cluster.

ICMP Probes

These are Server Health Checks. ICMP health checks basically have Equalizer sending a "ping" to a server and "listening" if the server sends a response. If the server does not respond within the configured time, the server is marked "down" and no further traffic is sent to that server until it starts responding to health checks.

ICMP triangulation

Routing client requests to the closest site geographically based on triangulation, a method of calculating the location of a site using the known locations of two or more other sites.

initial weight

The weight that an administrator assigns to a particular server. During operation, Equalizer dynamically adjusts the server weights (that is, dynamic weight), so a server's weight at a particular time might be different from the initial weight originally set by the administrator. See dynamic weight, server weight, and weight.

intelligent load balancing

A request for load balancing using Equalizer-based algorithms that assess the configuration options set for cluster and servers, real-time server status information, and information in the request itself. See algorithm and load balancing. See also geographic load balancing.

interface

The place at which two or more systems connect and communicate with each other. See external interface, internal interface, and network interface.

internal address

The IP address assigned to Equalizer on the internal network.

internal network

The subnet to which the back-end server machines are connected.

Internet Control Message Protocol (ICMP)

The ISO/OSI Layer 3, Network, protocol that controls transport routes, message handling, and message transfers during IP packet processing. See ICMP triangulation and ISO/OSI model.

IP

Internet protocol; the TCP/IP protocol that controls breaking up data messages into packets, sending the packets, and reforming the packets into their original data messages. See Internet protocol stack, IP address, packet, and TCP/IP.

IP address

A 32-bit address assigned to a host using TCP/IP. IP addresses are written in dotted decimal format, for example, 192.22.33.1.

IPv4

Internet Protocol version 4 (IPv4) is the fourth revision in the development of the Internet Protocol (IP) and the first version of the protocol to be widely deployed. Together with IPv6, it is at the core of standards-based internetworking methods of the Internet.

IPv6

IPv6 (Internet Protocol version 6) is a version of the Internet Protocol (IP) intended to succeed IPv4, which is the protocol currently used to direct almost all Internet traffic.[1]

IPv6-IPv4 Translation

IPv6-IPv4 Translation is used when a portion of an internal network only supports IPv4 and/or a portion of applications can accept only IPv4 connections. The advantage of this is that IPv6 to IPv4 translations are provided for legacy IPv4 application services and provides additional time for completely migrating to IPv6 architecture.

ISO/IEC

International Organization for Standardization/International Electrotechnical Commission; international standards organizations.

ISO/OSI model

International Organization for Standardization/Open Systems Interconnection model, a standard that consists of seven layers that control how computers communicate with other computers over a network. Layer 1, Physical, which sets the rules for physical connections via hardware, is the lowest layer. Layer 2, Data-link, uses Layer 1 and its own rules to control coding, addressing, and transmitting information. Layer 3, Network, uses the prior two layers rules as well as its own rules to control transport routes, message handling, and message transfers. Layer 4, Transport, uses its rules and those of the previous layers to control accuracy of message delivery and service. Layer 5, Session, uses its rules and those of the previous layers to establish, maintain, and coordinate communication. Layer 6, Presentation, uses its rules and those of the previous layers to control text formatting and appearance as well as conversion of code. Layer 7, Application, uses its rules and those of the other layers to control transmission of information from one application to another. Layer 7 is the highest layer. See Layer 4, Layer 7, and transport layer.

L

L4

See Layer 4.

L4 Load Balancing

Layer 4 load balancing is the most basic form of load balancing. It is only aware of IP information present in UDP or TCP headers, that is IP addresses and TCP/UDP port numbers. You can load balance a great many applications using this capability, which functions as follows: A packet arrives at Equalizer with a specific destination IP address and port number. We look in the list of configured clusters to find one that matches. Attached to that cluster areservers.The "best server" is chosen and the packet/request is then sent to that server using NAT.

L4 TCP and UDP

IP protocols. They are well described at http://en.wikipedia.org/wiki/Transmission_Control_Protocol and http://en.wikipedia.org/wiki/User_Datagram_Protocol respectively. TCP is a way in which computers connected to a network can communicate reliably. TCP protects against data loss, corruption and reordering at the cost of some performance. TCP is the underlying protocol for HTTP, email and many common Internet applications. UDP is a more performant protocol which does not protect data from all the issues described above. It is however more useful for time-sensitive data so it is commonly used for audio, video and... DNS

L7

See Layer 7.

L7 Load Balancing

Layer 7 refers to the "application layer". That is, data embedded within the part of the data packet which is not TCP or IP header information. For example, in HTTP protocol, you can find information such as a requested URL or the data type in the L7 information. Equalizer can search for this information in the packets exchanged between clients and servers and make decisions about how to handle the traffic such as with Match Rules, Cookie Persistence, or Responders. Note that to this date Equalizer supports L7 load balancing for HTTP and HTTPS protocols.

LAN

See Local Area Network.

latency

The time over which a signal travels over a network, from the starting point to the endpoint. See ping. See also CMP echo request and echo.

Layer 4 (L4)

The transport layer; Layer 4 uses its rules and those of the previous three layers to control accuracy of message delivery and service.which controls accuracy of message delivery and service. See ISO/OSI model and Layer 7.

Layer 7 (L7)

The application layer; Layer 7 uses its rules and those of the other layers to control transmission of information from one application to another. Layer 7 is the highest layer in the ISO/OSI model. See ISO/OSI model and Layer 4.

least cxns (least connections)load balancing

Dispatches the highest percentage of requests to the server with the least number of active connections. In the same way as Fastest Response, Equalizer tries to avoid overloading the server so it checks the server’s response time and server agent value. Least Connections optimizes the balance of connections to servers in the cluster.

load

A job that can be processed or transported once. See load balancing. See also geographic load balancing and intelligent load balancing.

load balancing

Moving a load from a highly-used resource to a resource that is used less often so that operations are efficient. Equalizer balances loads over a wide physical area or by using algorithms that assess options and real-time information. See geographic load balancing and intelligent load balancing.

Local Area Network (LAN)

Local Area Network

M

Match Rules

Match Rules are a feature associated with Layer 7 load balancing. This is often called "content switching" by other vendors. Using match rules you can configure Equalizer to handle application (HTTP) requests in specific ways depending on the data present in the request. For example, you can tell Equalizer to send any image requests to one of three dedicated image servers while all other requests go to an application server. You can specify that if a page is requested which is company-internal only and the client is not on the local network to drop the request (or hand out a denied response).

Multi-gateway
A dedicated 0/0 gateway for every IP network defined on Equalizer

Multi-netting
Adding multiple layer 3 IP networks, to a single layer 2 environment (vlan, interface)

MX exchanger
Mail exchanger; a fully qualified domain name to be returned if a server receives a mail exchanger request.

N

N+1
Equalizer clusters are instantiated on all "N" peers and organized into failover groups. If the passive, or backup peer's connectivity for a failover group's resources is judged to be "healthier" that the peer on which the group is running, then the group fails over to the passive peer, which becomes the Primary peer.

name server
A server that stores information about the domain name space.

NAT
Network Address Translation; an Internet standard that defines the process of converting IP addresses on a local-area network to Internet IP addresses. See NAT subsystem.

NAT subsystem
The Equalizer subsystem responsible for transferring connections to and from the back-end servers.

netmask
Address mask; a bit mask used to select bits from an Internet address for subnet addressing. The mask is 32 bits long and selects the network portion of the Internet address and one or more bits of the local portion.

Network Address Translation (NAT)
See NAT.

network interface
The place at which two or more networks connect and communicate with each other. See interface. See external interface, interface, and internal interface.

network route
See gateway.

O

OSI network
A network that uses the International Organization for Standardization/Open Systems Interconnection model. See ISO/OSI model, Layer 4, Layer 7, and transport layer.

outbound NAT
If a client or server is using Equalizer as a gateway device, their source IP will translated to an Equalizer IP on the egress interface of Equalizer used to reach the destination network

P

packet
A group of data that is transmitted as a single entity.

passive FTP connection
An Equalizer option that rewrites outgoing FTP PASV control messages from the servers so that they contain the IP address of the virtual cluster rather than that of the server. See FTP and PASV.

PASV
Passive mode FTP; a mode with which you can establish FTP connections for clients that are behind firewalls. See firewall, FTP, and passive FTP connections.

pattern match
A pattern of ASCII or hexadecimal data that filters data.

payload
The set of data to be transmitted. A payload contains user information, user overhead information, and other information that a user requests. A payload does not include system overhead information. Also known as the mission bit stream.

persistence
The act of storing or retaining data for use at a later time, especially data that shows the state of the network before processing resumes. See cookie and IP-address-based persistence.

Persistence
Often, when a client (web browser) connects to an application, there is some "shared state" between the client and server which cannot be used with any other server. Using the following example: You point your web browser at www.website.com and log in. The server notes that you are logged in and allows you to use the application. Now,for example, there were two servers and a load balancer, and that the load balancer just alternated handing any requests it recieved between the two servers... You've been connected to server "A" where you log in. You then send a different request (run a report) and the load balancer sends your request to server "B". Since you are not logged into server "B" so you get an error and are asked to log in again. This is because you have NO PERSISTENCE. Your connection does not get connected to the same server each time. What you need is some way for the load balancer to recognize your browser and always send your requests to server "A". We do this in two ways. #1 is called "IP persistence" or "sticky persistence". The load balancer remembers your IP address the first time you connect to a server and records which server you were connected to. The next time you connect, Equalizer looks up your IP address in an internal table and notes that you belong on server "A", so that is where you are sent. Sticky Persistence is available with both L4 and L7 load balancing. An alternate persistence scheme is available under L7 only. It is called "cookie persistence" and it uses information stored at the client (a cookie http://en.wikipedia.org/wiki/HTTP_cookie) to recall which server it should be connected to. The advantage of keeping the persistence information on the client is that no memory is used on the Eq. This way millions of clients can have poersistence for an indefinate period of time. With sticky persistence the number of persistent clients is limited by the memory available to store the sticky table.

physical server
A machine located on the internal network that provides services on specific IP addresses and ports. See server and virtual web server. See also authoritative name server, back-end server, name server, and proxy server.

piece
An atom followed by a single *, +, or ?, or by a bound. See atom, branch, and regular expression.

ping
A program used to test reachability of destinations by sending them an ICMP echo request and waiting for a reply. See echo and probe. See also CMP echo request

port
The abstraction used by Internet transport protocols to distinguish among multiple simultaneous connections to a single destination host.

port grouping
Refers to the configuration of a load balancers with a list of application ports that must be treated as one group.

port number
The number used to identify a service contact port, such as HTTP port 80.

Port-Address Translation (PAT)
PAT is inherent in load balancers and refers to tranlsating the port number in TCP/UDP packets.

primary Equalizer
The primary unit that handles requests. If the primary Equalizer fails, the backup unit replaces it. See also backup Equalizer and hot backup.

probe
An action that obtains status information about a computer, network, or device. See geographic probe and ping.

probing interval
The target interval between TCP probes of a cluster that has been marked failing in the load balancing daemon’s internal tables. If the server does not respond to strikeout threshold (see below) additional TCP probes after it is marked failing, then the server is marked down. These additional probes are at least probe interval seconds apart. This value is solely a target; the monitoring process adjusts itself based on a number of factors, including system load. The default value is 20 seconds.

protocol
A set of rules that govern adherence to a set of standards. See protocol stack.

protocol stack
A layer of protocols that process network actions cooperatively and in tandem. See protocol.

proxy server
A utility, which is part of a firewall, that helps the regular tasks of managing data transmittal from a network to the Internet and from the Internet to the network. See also firewall.

Q

quiesce
Quiesce is a server option that, when enabled, tells Equalizer not to send the server any new traffic, while existing connections are allowed to complete. Eventually, the server should not be serving any traffic. Sometimes called ‘server draining’.

R

RADIUS
Remote Authentication Dial-In User Service; a protocol that authorizes and authenticates a user trying to link to a network or the Internet.

receive timeout
This is the failover timeout (in ms) for receiving peer data.

redirection

The process of receiving input from or sending output to a different resource than usual.

regular expression (RE)

One or more non-empty branches, separated by pipe symbols (|). An expression matches anything that matches one of the branches. See atom, branch and piece.

request packet

A packet that contains information that requests a response. See packet and response packet.

reserved network

A network consisting of “phony” IP addresses, which are not registered and cannot be made visible outside of the internal network.

resolution

The process of interpreting all the messages between an IP address and a domain name address.

Responder

This is an L7 advanced feature. A user can configure Equalizer to send a response directly to the client under specified circumstances. Without involving a server. Responders come in two flavors. "Sorry"

response load balancing

Dispatches the highest percentage of requests to the server with the shortest response time. Equalizer does this carefully: if Equalizer sends too many requests to a server, the result can be an overloaded server with slower response time. The fastest response policy optimizes the cluster-wide response time. The fastest response policy also checks the number of active connections and server agent values (if configured); but both of these have less of an influence than they do under the adaptive load balancing policy. For example, if a server’s active connection count and server agent values are high, Equalizer might not dispatch new requests to that server even if that server’s response time is the fastest in the cluster.

response packet

A packet that contains information that responds to a request. See packet and request packet.

retry interval (ms)

This is the time (in ms) between failed failover peer probes.

round robin

The default load balancing policy which distributes requests equally among all servers in a virtual cluster, without regard to initial weights or adaptive load balancing criteria. The first request received is routed to the first server in the list, the second request to the second server, and so on. When the last server is reached, the cycle starts again with the first server.

round-robin load balancing

Diistributes requests equally among all the servers in the cluster. Equalizer dispatches the first incoming request to the first server, the second to the second server, and so on. When Equalizer reaches the last server, it repeats the cycle. If a server in the cluster is down, Equalizer does not send requests to that server. This is the default method.

router

A network device that facilitates the transmission (that is, routing) of messages.

routing table

A database, which is static or dynamic, that contains a set of route addresses and routing information familiar to the router. A human being enters and updates the information in a static routing table; routers operate and constantly update a dynamic routing table.

RST

Refers to the TCP protocol’s reset command, which instructs a device to end a connection.

S

Secure Sockets Layer (SSL)

A protocol that enables secure communication between two hosts, using data encryption and authentication.

server

A computer or application that controls access to a network and its associated devices and applications. A server communicates with one or more clients as well as other servers. See authoritative name server, back-end server, name server, physical server, proxy server, and virtual web server.

server address

The IP address of a server on the internal interface. Multiple IP addresses can be aliased to a single physical server. See server.

server agent

An agent that provides Equalizer with real-time performance statistics for a specified server. See server.

server agent load balancing

Dispatches the highest percentage of requests to the server with the lowest server agent value. In a similar way to Fastest Response, Equalizer tries to avoid overloading the server by checking the number of connections and response time. This method only works if server agents are running on all servers in the cluster.

server agent value

The value returned by the server agent daemon (if any) running on the server.

Server Agents

These are somtimes called Smple Health Checks. Simple health checks resemble ICMP, TCP and ACV server health checks, but they have a slightly different purpose. Rather than determining if a server is either "up" or "down", they send a request to a server and the server is expected to reply with a number between -1 and 100 to say exactly how alive it is. In order to give Equalizer a proper answer to the health check query, the server needs to run a Server Agent.

server cluster

A group of servers that are components in a network and joined through hardware or software. See cluster. See also FTP cluster, geographic cluster, and virtual cluster. See server.

server draining

The process of allowing existing connections to a server to complete while not allowing any new connections, so that the server is eventually not serveing any traffic. Usually done in preparation for shutting down, rebooting, or upgrading a server. On Equalizer, server draining is enabled using the quiesce server option.

server endpoint

An IP address-port pair that identifies a physical or virtual server on the internal network to which Equalizer can route connection requests. See server.

server response time

The length of time for the server to begin sending reply packets after Equalizer sends a request.

server weight

A value that indicates the relative proportion of connection requests that a particular server will receive. See dynamic weight, server, initial weight, and weight.

session

A logical connection between a server and a client that may span a series of individual client requests and server responses (i.e., transactions). Depending on the application, a session may also span multiple client-server connections as well as transactions. Session data is typically maintained using cookies inserted into client requests and server responses, by Equalizer, servers, or both. Session data may also be maintained on clients and servers. Equalizer uses cookies at Layer 7 and a sticky timer at Layer 4 to provide server persistence; the cookie lifetime or sticky time to set on Equalizer is determined by the application, and should usually match the corresponding cookie or session timeouts set on the real servers in a cluster.

SFP and SFP+

SFP+ is the new version which supports 10Gb throughput. Stands for "Small Factor Pluggable transceiver". A port with which a number of different network cables to be used, including regular 'copper' cables, or 'fiber' (optical) cables.Fiber-optic uses a glass cable to send light signals, and copper users a metal (copper) cable to send electrical signals.

site

An Envoy site is part of an Envoy geocluster. It points to an existing virtual cluster on an Equalizer running Envoy.

source IP-based persistence

When a TCP SYN packet is received, a load balancer looks for hte source IP address in its session table. If an entry is not found, it treats the user as "new" and selects a server based on the load balancing algorithm. to forward the packet. The load balancer also makes an entry in the session table. If an entry for this source IP address is found in the session table, the load balancer forwards the packet to the same server that received the previous connection for this source IP address regardless of the load balancing algorithm.

Source NAT

This inbound address translation feature allows Equalizer to substitute one of it's own IP addresses for the requesting clients IP address.

Source Routing

Source routing allows a sender of a packet to partially or completely specify the route the packet takes through the network. In contrast, in non-source routing protocols, routers in the network determine the path based on the packet's destination.

spoofing

Using the client’s IP address for the source IP address in client requests. This fools (or spoofs) the server into regarding the client as the source of the request. For spoofing to work, the default gateway for the server must be set to Equalizer’s internal IP address.

SSL

See Secure Sockets Layer (SSL).

stack

An area of reserved memory in which applications place status data and other data. See protocol stack.

stale connection

A partially open or closed connection.

state

Status; the current condition of a network, computer, or peripherals.

stateless

A condition in which a server processes each request from a site independently and cannot store information about prior requests from that site. Each request stands on its own. See also DNS and RADIUS.

sticky connection

A Layer 4 connection in which a particular client remains connected to same server to handle subsequent requests within a set period of time. Sticky connections are managed on Equalizer using sticky records, which record the server-client connection details; sticky records expire according to the configured sticky timer setting.

sticky network aggregation

Basically, this is server affinity determined by a network mask at Layer 4. If the following conditions are all true: an incoming request to a Layer 4 cluster has a source IP that matches the sticky network mask set for the cluster the destination port on the server is not responding the same server IP with another port is defined in another cluster Then Equalizer will attempt to forward the request to the same server on the other port.

sticky timer

A countdown timer used to manage sticky connections to a Layer 4 cluster. When this timer expires (i.e., there is no activity between the server and client for the duration of the timer setting), Equalizer removes the sticky record for the connection.

strike count

This is the maximum number of failed failover peer probes. The global strike count is not used until ALL heartbeating subnets have at least one strike. Once each subnet has a strike, we fail over when the number of failed heartbeats across all heartbeating subnets is equal to or greater than the global strike count

subdomain

A section, which is formally named, that is under a domain name; analogous to the relationship between a subfolder and folder. For example, in www.coyotepoint.com, www is the subdomain. See domain, domain name, and IP address. See also DNS.

subnet

Part of a network that has the same address as the network plus a unique subnet mask.

switch

A Layer 2 device that connects network segments into one broadcast domain.

SYN/ACK

Synchronize and acknowledge; a message that synchronizes a sequence of data information and acknowledges the reception of that information.

syslog

A system log file, in which information, warning, and error messages are stored in a file, sent to a system, or printed.

System Contact

Contact is the name of the person responsible for this unit.

System Descriptions

The user-assigned description of the Equalizer.

System Location

Location describes Equalizer’s physical location.

System Name

The name assigned to the system. By default it is Equalizer.

T

TCP
Transmission Control Protocol; the rules for the conversion of data messages into packets. TCP providesSee ISO/OSI model, Layer 4, packet, transport layer.

TCP Probes
These are Server Health Checks. TCP health checks basically have Equalizer attempting to open a TCP connection to a server and determining if the server accepts. If the server does not accept within the configured time, the server is marked "down" and no further traffic is sent to that server until it starts responding to health checks.

TCP/IP
Transmission Control Protocol/Internet Protocol; the rules for transmitting data over networks and the Internet.

Telnet
Part of TCP/IP, a protocol that enables a user to log onto a remote computer connected to the Internet. See TCP/IP.

traceroute
A utility that shows the route over which a packet travels to reach its destination.

transaction
A transaction is a Layer 7 interaction between a client and a server over a network protocol that defines the format of the interaction. An HTTP transaction, for example, is a single client request and associated server response. HTTP is thus a transaction-oriented protocol. This is in contrast to Layer 4 TCP, which is a connection-oriented protocol and does not provide the notion of a transaction to applications running over it.

Transmission Control Protocol (TCP)
See TCP.

Transmission Control Protocol/Internet Protocol (TCP/IP)
See TCP/IP.

transport layer
See Layer 4. See also ISO/OSI model.

TTL
Time-to-live, the length of time, in seconds, that a client’s DNS server should cache a resolved IP address.

U

User Datagram Protocol (UDP)
Within TCP/IP, a protocol that is similar to Layer 4 (the transport layer). UDP converts data into packets to be sent from one server to another but does not verify the validity of the data. See ISO/OSI, TCP/IP, and transport layer.

V

virtual cluster
An endpoint that acts as the network-visible port for a set of hidden back-end servers. See cluster, endpoint, FTP cluster, geographic cluster, and server cluster.

virtual server address

An IP address that is aliased to a physical server that has its own, separate IP address. See virtual web server.

virtual web server

Software that imitates HTTP server hardware. A virtual web server has its own domain name and IP address. See domain name, HTTP, IP address, server, and virtual server address. See also authoritative name server, back-end server, name server, physical server, and proxy server.

VLAN

See Virtual Local Area Network.

VM CPU

For servers that are associated with VMware Virtual Machines, the relative influence on the policy of the VM CPU usage status returned by VMware. Displayed only if VLB Advanced is licensed and VLB is enabled for this cluster

VM RAM

For servers that are associated with VMware Virtual Machines, the relative influence on the policy of the VM RAM usage status returned by VMware. Displayed only if VLB Advanced is licensed and VLB is enabled for this cluster.

W

WAP

See Wireless Application Protocol.

weight

The relative proportion of a single item in a population of similar items. See dynamic weight, server weight, and initial weight.

Wireless Application Protocol (WAP)

A set of rules that govern access to the Internet through wireless devices such as cellular telephones, pagers, and two-way communication devices.