VYATTA, INC. | Vyatta System

High Availability

REFERENCE GUIDE

WAN Load Balancing
VRRP
Clustering
Stateful NAT and Firewall Failover
RAID 1
Configuration Synchronization

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Quick Reference to Commands

Use this section to help you quickly locate a command.

Quick List of Examples

Use this list to help you locate examples you'd like to try or look at.

Preface

This document describes the various deployment, installation, and upgrade options for Vyatta software.

This preface provides information about using this guide. The following topics are presented:

Intended Audience

This guide is intended for experienced system and network administrators. Depending on the functionality to be used, readers should have specific knowledge in the following areas:

- Networking and data communications
- TCP/IP protocols
- General router configuration
- Routing protocols
- Network administration
- Network security
- IP services

Organization of This Guide

This guide has the following aid to help you find the information you are looking for:

- Quick Reference to Commands

  Use this list to help you quickly locate commands.

- Quick List of Examples

  Use this list to help you locate examples you'd like to try or look at.

This guide has the following chapters:

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Document Conventions

This guide uses the following advisory paragraphs, as follows.

WARNING *Warnings alert you to situations that may pose a threat to personal safety.*

CAUTION *Cautions alert you to situations that might cause harm to your system or damage to equipment, or that may affect service.*

NOTE *Notes provide information you might need to avoid problems or configuration errors.*

This document uses the following typographic conventions.

`Monospace`	Examples, command-line output, and representations of configuration nodes.
`bold Monospace`	Your input: something you type at a command line.
bold	Commands, keywords, and file names, when mentioned inline. Objects in the user interface, such as tabs, buttons, screens, and panes.
italics	An argument or variable where you supply a value.
<key>	A key on your keyboard, such as <Enter>. Combinations of keys are joined by plus signs (“+”), as in <Ctrl>+c.
[key1 | key2]	Enumerated options for completing a syntax. An example is [enable | disable].
num1–numN	A inclusive range of numbers. An example is 1–65535, which means 1 through 65535, inclusive.

arg1..argN	A range of enumerated values. An example is eth0..eth3, which means eth0, eth1, eth2, or eth3.
arg[*arg*...] *arg*[,*arg*...]	A value that can optionally represent a list of elements (a space-separated list and a comma-separated list, respectively).

Vyatta Publications

Full product documentation is provided in the Vyatta technical library. To see what documentation is available for your release, see the *Guide to Vyatta Documentation*. This guide is posted with every release of Vyatta software and provides a great starting point for finding the information you need.

Additional information is available on www.vyatta.com and www.vyatta.org.

Chapter 1: WAN Load Balancing

This chapter describes how to use the wide area network (WAN) load balancing feature of the Vyatta System.

This chapter presents the following topics:

WAN Load Balancing Configuration

This section describes how to configure WAN load balancing on the Vyatta System.

This section presents the following topics:

WAN Load Balancing Overview

This section presents the following topics:

What Load Balancing Is

The Vyatta system supports automatic load balancing for outbound traffic across two or more outbound interfaces. In addition to balancing traffic loads across interfaces, this feature also provides for path redundancy should a path fail, as traffic will be balanced across the remaining healthy paths. When the failed path recovers it will be added to the list of healthy paths so that the load balancing system can use it again. The system determines path health through periodic health checking to a remote target or targets.

Load balancing is supported for outbound traffic only. Load balancing is not performed on packets sourced from the system itself unless it is explicitly confgured to do so (using e load-balancing wan enable-local-traffic command).

For load balancing to occur, at least two paths need to be available in the routing table, and these paths must egress through the interfaces being load balanced. The WAN load balancing process automatically installs the default routes you configure

for each path, and balances traffic according to path health and the weights you apply to each interface. You can see which paths are installed in the routing table using the **show ip route** command.

Balancing Algorithm

Outbound packets are load balanced using a weighted random distribution load balancing algorithm. If no weights are assigned, each interface has an equal chance of being picked, which, on average, results in each interface receiving approximately the same number of packets. If an interface has a higher weight, it will tend to be picked more often; for example, if interface A has a weight of 2 and interface B has a weight of 1, interface A will tend to be picked 67% of the time.

Load Balancing Rules

The kind of traffic to be balanced, the set of interfaces, and the relative weight for each interface is specified in a load balancing rule. A load balancing rule contains a set of match criteria and a set of interfaces with weights attached. Outgoing packets are matched against the criteria specified in the rule. If the packet is a match for the rule, the load balancing algorithm determines to which interface in the specified set the packet is sent.

Rules are executed in numeric order until a successful match is achieved. If a match is achieved, the packet is sent to one of the interfaces specified by the rule, unless none of the interfaces is active. In this case, the next rule is executed until a matching rule has at least one active interface. If no rules are matched, then the main system routing table is used.

Once configured, rule numbers cannot be changed. For this reason, it is good practice to configure rules at intervals (for example, rule 5, rule 10, rule 15, and so on) in case a rule must be inserted later on.

Flow-Based vs. Packet-Based Balancing

In general, traffic is load balanced on a per-flow basis, not on a per-packet basis. Any connection-oriented traffic remains appropriately associated with the interface assigned for load balancing. Flows are tracked by means of an entry in the connection tracking table. Flows are identified by a tuple consisting of source address, destination address, and port.

If source-based routing is enabled, traffic is load balanced on a per-packet basis and the source address is considered when choosing the egress interface. Also, if the connection tracking table is flushed, previously established flows are balanced on a per-packet basis until a new connection is established on the flow.

Health Checking

A load balanced WAN interface is considered an active member of the interface pool so long as it passes health checks. The health of the interface is monitored by having it send an ICMP Echo Request ("ping") message at intervals to some remote destination. Successful receipt of the ICMP Echo Reply message from the destination shows that the interface can both transmit to the Internet and receive packets from the Internet. If the interface fails the health check, it is removed from the pool of active interfaces.

NOTE *A time-to-live (ttl) test is also available which sends a udp packet with a ttl limit to the target.*

For each interface to be load balanced, the interface health criteria must be configured, including the number of missed health checks that cause an interface to be declared unhealthy and the successes required to declare its health restored. Configuring more than one target for health check tests means that one does not have to rely on a single target which might be non-responsive for reasons other than path failure. Multi-targets will be tested until a test is successful or the list of tests is exhausted.

Health check configuration consists of the following:

- The remote destination to be tested for accessibility. Use load-balancing wan interface-health <if-name> test <test-no> target <address> command.
- The nexthop on the path to the target destination. Use load-balancing wan interface-health <if-name> nexthop <ipv4> command
- The type of test to perform (either **ping** or **ttl**). Use load-balancing wan interface-health <if-name> test <test-no> type <type> command
- The maximum response time to the ping message that can be considered a success. Use load-balancing wan interface-health <if-name> test <test-no> resp-time <seconds> command. Or the ttl limit for **ttl** tests. Use load-balancing wan interface-health <if-name> test <test-no> ttl-limit <limit> command
- The number of health check failures that can occur before the interface is considered unavailable. Use load-balancing wan interface-health <if-name> failure-count <num> command.
- The number of successful health checks that must occur before the interface can be added back into the pool of active interfaces. Use load-balancing wan interface-health <if-name> success-count <num> command.

Implicit NAT

One potential issue with multiple external interfaces is that return traffic can enter through a different interface than it was sent. This is referred to as asymmetric routing and, in general, it is undesirable for a number of reasons—including a potential load imbalance on incoming traffic and difficulties troubleshooting. In order to prevent asymmetric routing, the WAN load balancer, by default, replaces the

source address of all IP packets egressing through an interface with the address of that interface (that is, it performs masquerade NAT on egressing packets) so that reply traffic will return through the same interface that it was sent on. If this default behavior is not what you intend, you can disable it using the load-balancing wan disable-source-nat command.

Failover

Normally, all balanced interfaces are utilized to balance traffic. However, the Vyatta system supports a failover mode for WAN load balancing (using load-balancing wan rule <rule> failover command). When in failover mode, one interface is selected by the system as the primary and the remaining interfaces are designated secondary or spare.

The primary interface is selected based on its configured weight and the reachability of the target. If connectivity through the primary interface is interrupted, the next secondary interface is selected from the set of secondary interfaces.

In addition to weight-based primary interface selection, the primary interface can be selected based on rule order. Because traffic is directed out through the first healthy interface specified in a matching rule, rules can be ordered based on egress interface preference. For example, if eth0 is to be used as the primary interface unless it becomes unhealthy, in which case eth1 is to be used, then eth0 would be included in the first rule and eth1 in the following rule.

When a link fails over and a new primary interface is selected, existing sessions do not automatically fail over to the new path. The end user experiences a session timeout. To avoid this delay if there is a link-state change and session failure, the session table can be flushed using load-balancing wan flush-connections command.

Excluding Traffic from WAN Load Balancing

There are cases where it is not desirable to load balance all traffic sourced from a specified interface. For example, in a scenario where two local LANs each have upstream traffic is to be load balanced, traffic from one LAN to the other will also be routed upstream, which is not the desired behavior. To avoid this, the intra-LAN traffic can be excluded from being load balanced. Traffic exclusion is configured using load-balancing wan rule <rule> exclude command.

Rate Limiting

WAN load balancing rate limiting sets a rate limit at which a rule will be active. For example, you may want to configure the system to send all packets out one interface up to a given limit, but to send all packets in excess of that limit out a second interface. This scenario requires two rules:

- The first rule, with a rate limit specified, sends packets out interface 1.

- The second rule, with no limits specified, sends packets out interface 2.

Rate limiting is configured using load-balancing wan rule <rule> limit command.

Script Execution on Interface State Changes

To provide flexibility in what actions can be taken on an interface state change, the Vyatta system provides a "hook" feature is provided. This feature allows a script to be run when an interface state changes from active to failed or from failed to active.

Script execution on interface state changes is configured using load-balancing wan hook <script-name> command.

Considerations for DHCP/Static Route Default Gateway Environments

In environments where WAN load balancing is set up to balance traffic over DHCP client interfaces and static default gateway routes also exist, WAN load balancing will not work properly unless the next-hop distance for the static default routes is changed from 1 to 2. The reason for this is that, by default, static default routes have a distance of 1, while those set by DHCP have a distance of 2—a lower priority. Their higher priority causes the static default gateway routes to be selected in every case. Setting them to same priority as the DHCP client interfaces allows them to be evaluated equally, providing multiple default routes.

Steps for Configuring WAN Load Balancing

There are three steps for setting up WAN load balancing:

1. Define a target (or targets) for each interface being load balanced that is (are) accessible to the interface. The target is used by the load balancing service to determine the health of the interface.
2. Configure a next-hop address for each target, for each interface to be load balanced. The load balancing service uses this address to access the target.
3. Configure one static host route entry for each target to provide routing for accessing the target through the desired interface.

Configuration Examples

This section presents the following topics:

- Failover Using Rule Order—Priority Traffic
- Excluding Traffic from Load Balancing

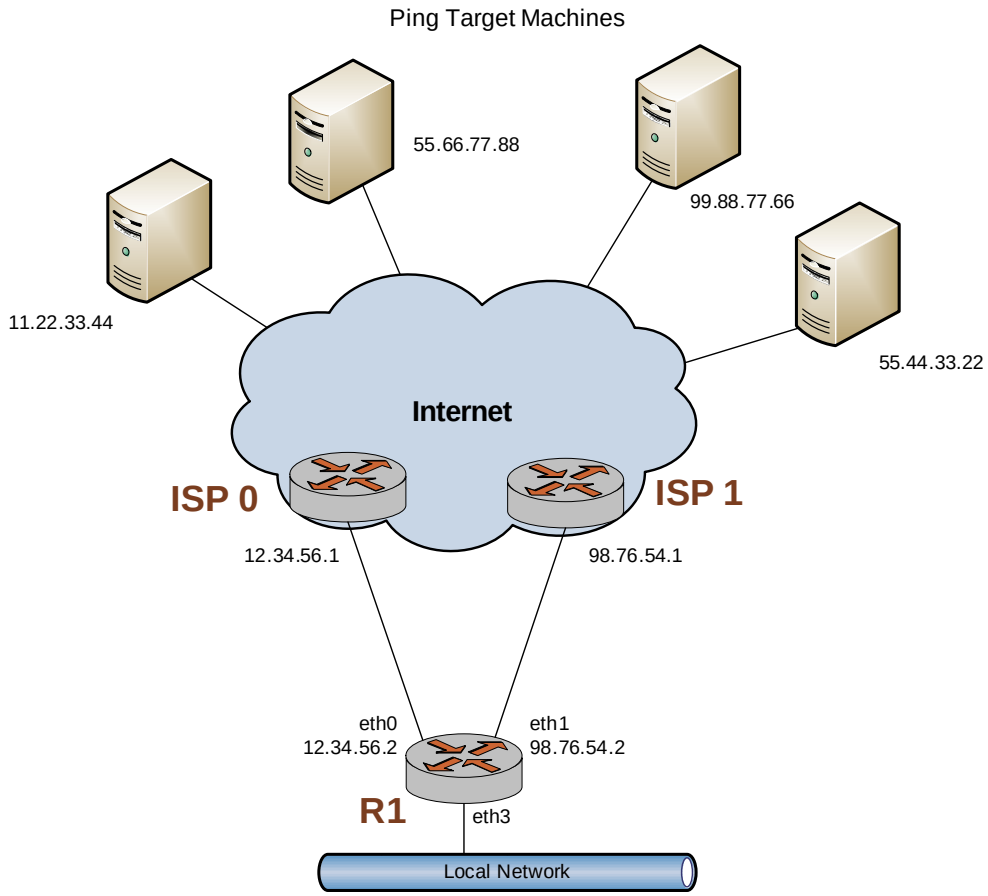
Basic WAN Load Balancing

In this example, a sample configuration is presented for a basic WAN load balancing scenario. In this configuration:

- All traffic incoming through interface eth3 is balanced between interfaces eth0 and eth1 on R1.
- The outgoing interfaces eth0 and eth1 are tested for interface health by pinging remote ping targets via these interfaces. The remote targets in this example are: 11.22.33.44, 55.66.77.88, 99.88.77.66, and 55.44.33.22.
- Outgoing packets are assigned the primary source address of the assigned interface.
- Interface eth1 is to be removed from the active pool after four consecutive ping failures and interface eth0 after five consecutive failures.

When you are finished, R1 will be configured as shown in Figure 1-1.

Figure 1-1 WAN load balancing



This section includes the following examples:

- Example 1-1 Creating static routes to ping targets
- Example 1-2 Creating load balancing configuration

Example 1-1 creates static routes directed towards the two ISPs that the load will be balanced between: 12.34.56.1 and 98.76.54.1. To create these static routes, perform the following steps in configuration mode:

Example 1-1 Creating static routes to ping targets

Step	Command
Create a static route to a ping target for testing the health of eth0.	`vyatta@R1# set protocols static route 11.22.33.44/32 next-hop 12.34.56.1`
Create a static route to a second ping target for testing the health of eth0.	`vyatta@R1# set protocols static route 55.66.77.88/32 next-hop 12.34.56.1`

Example 1-1 Creating static routes to ping targets

Create a static route to a ping target for testing the health of eth1.	`vyatta@R1# set protocols static route 99.88.77.66/32 next-hop 98.76.54.1`
Create a static route to a second ping target for testing the health of eth1.	`vyatta@R1# set protocols static route 55.44.33.22/32 next-hop 98.76.54.1`
Commit the configuration.	`vyatta@R1# commit`

Display the configuration	`vyatta@R1# show protocols static`
	` route 11.22.33.44/32 {`
	`  next-hop 12.34.56.1 {`
	`  }`
	` }`
	` route 55.66.77.88/32 {`
	`  next-hop 12.34.56.1 {`
	`  }`
	` }`
	` route 99.88.77.66/32 {`
	`  next-hop 98.76.54.1 {`
	`  }`
	` }`
	` route 55.44.33.22/32 {`
	`  next-hop 98.76.54.1 {`
	`  }`
	` }`

Example 1-2 sets up a basic WAN load balancing configuration on R1. To create the load balancing configuration, perform the following steps in configuration mode:

Example 1-2 Creating load balancing configuration

Step	Command
Set the failure count for eth0.	`vyatta@R1# set load-balancing wan interface-health eth0 failure-count 5`
Set the next hop for eth0.	`vyatta@R1# set load-balancing wan interface-health eth0 nexthop 12.34.56.1`
Set the test type for eth0.	`vyatta@R1# set load-balancing wan interface-health eth0 test 10 type ping`
Set a ping target for eth0.	`vyatta@R1# set load-balancing wan interface-health eth0 test 10 target 11.22.33.44`

Example 1-2 Creating load balancing configuration

Set a second test and type for eth0.	`vyatta@R1# set load-balancing wan interface-health eth0 test 20 type ping`
Set a second ping target for eth0.	`vyatta@R1# set load-balancing wan interface-health eth0 test 20 target 55.66.77.88`
Set the failure count for eth1.	`vyatta@R1# set load-balancing wan interface-health eth1 failure-count 4`
Set the nexthop for eth1.	`vyatta@R1# set load-balancing wan interface-health eth1 nexthop 98.76.54.1`
Set the test type for eth1.	`vyatta@R1# set load-balancing wan interface-health eth1 test 10 type ping`
Set a ping target for eth1.	`vyatta@R1# set load-balancing wan interface-health eth1 test 10 target 99.88.77.66`
Set a second test and type for eth1.	`vyatta@R1# set load-balancing wan interface-health eth1 test 20 type ping`
Set a second ping target for eth1.	`vyatta@R1# set load-balancing wan interface-health eth1 test 20 target 55.44.33.22`
Define eth3 as the inbound interface.	`vyatta@R1# set load-balancing wan rule 10 inbound-interface eth3`
Define eth0 as one of the interfaces to be load balanced.	`vyatta@R1# set load-balancing wan rule 10 interface eth0`
Define eth1 as another interface to be load balanced.	`vyatta@R1# set load-balancing wan rule 10 interface eth1`
Commit the configuration.	`vyatta@R1# commit`

Example 1-2 Creating load balancing configuration

Display the configuration

```
vyatta@R1# show load-balancing
wan {
    interface-health eth0 {
        failure-count 5
        nexthop 12.34.56.1
        test 10 {
            target 11.22.33.44
            type ping
        }
        test 20 {
            target 55.66.77.88
            type ping
        }
    }
    interface-health eth1 {
        failure-count 4
        nexthop 98.76.54.1
        test 10 {
            target 99.88.77.66
            type ping
        }
        test 20 {
            target 55.44.33.22
            type ping
        }
    }
    rule 10 {
        inbound-interface eth3
        interface eth0 {
        }
        interface eth1 {
        }
    }
}
```

Failover Using Interface Weights

In the previous example, the system was configured to balance the traffic load between eth0 and eth1. In the example in this section, instead of balancing the traffic, eth0 is configured as the primary interface and eth1 as a backup interface to be used if eth0 fails. The only change is to Rule 10.

In this example:

- All traffic incoming through interface eth3 is sent out interface eth0.

- If eth0 fails, all traffic incoming through interface eth3 will be sent out eth1.

Example 1-3 sets up a failover configuration rule on R1. To modify the previous example to create the failover configuration using interface weights, perform the following steps in configuration mode:

Example 1-3 Creating failover configuration using interface weights

Step	Command
Remove the existing Rule 10 from the previous example.	`vyatta@R1# delete load-balancing wan rule 10`
Enable failover mode.	`vyatta@R1# set load-balancing wan rule 10 failover`
Define eth3 as the inbound interface.	`vyatta@R1# set load-balancing wan rule 10 inbound-interface eth3`
Define eth0 as the primary interface as it will have the largest weight value.	`vyatta@R1# set load-balancing wan rule 10 interface eth0 weight 10`
Define eth1 as the secondary interface as it will have the smallest weight value.	`vyatta@R1# set load-balancing wan rule 10 interface eth1 weight 1`
Commit the configuration.	`vyatta@R1# commit`

Example 1-3 Creating failover configuration using interface weights

Display the configuration

```
vyatta@R1# show load-balancing
wan {
    interface-health eth0 {
        failure-count 5
        nexthop 12.34.56.1
        test 10 {
            target 11.22.33.44
            type ping
        }
        test 20 {
            target 55.66.77.88
            type ping
        }
    }
    interface-health eth1 {
        failure-count 4
        nexthop 98.76.54.1
        test 10 {
            target 99.88.77.66
            type ping
        }
        test 20 {
            target 55.44.33.22
            type ping
        }
    }
    rule 10 {
        failover
        inbound-interface eth3
        interface eth0 {
            weight 10
        }
        interface eth1 {
            weight 1
        }
    }
}
```

Failover Using Rule Order

In the previous example, the system was configured to send all incoming traffic from eth3 out eth0 unless the health check on eth0 failed. If the health check on eth0 failed all incoming traffic from eth3 would be sent out eth1. This was accomplished using the **failover** command and assigning different weights to the two outbound

interfaces. In the example in this section, failover is accomplished based on rule order. Again, all traffic from eth3 is sent out eth0 unless its health check fails, at which point the traffic is sent out eth1.

This behavior is accomplished using two rules. One rule directs all trffic from eth3 to eth0 and the other directs all traffic from eth3 to eth1. When eth0 is healthy, all traffic from eth3 matches the first rule and is sent out eth0. If eth0 fails, the first rule is bypassed due to path health and the second rule takes effect, directing all traffic from eth3 to eth1. Once eth0 becomes healthy, traffic again matches the first rule and is sent out eth0.

Example 1-4 sets up failover configuration rules on R1. To modify the previous example to create the failover configuration using rule order, perform the following steps in configuration mode:

Example 1-4 Creating failover configuration using rule order

Step	Command
Remove the existing Rule 10 from the previous example.	`vyatta@R1# delete load-balancing wan rule 10`
Define eth3 as the inbound interface for this rule.	`vyatta@R1# set load-balancing wan rule 10 inbound-interface eth3`
Define eth0 as the primary egress interface.	`vyatta@R1# set load-balancing wan rule 10 interface eth0`
Define eth3 as the inbound interface for this rule.	`vyatta@R1# set load-balancing wan rule 20 inbound-interface eth3`
Define eth1 as the secondary egress interface.	`vyatta@R1# set load-balancing wan rule 20 interface eth1`
Commit the configuration.	`vyatta@R1# commit`

Example 1-4 Creating failover configuration using rule order

Display the configuration

```
vyatta@R1# show load-balancing
wan {
    interface-health eth0 {
        failure-count 5
        nexthop 12.34.56.1
        test 10 {
            target 11.22.33.44
            type ping
        }
        test 20 {
            target 55.66.77.88
            type ping
        }
    }
    interface-health eth1 {
        failure-count 4
        nexthop 98.76.54.1
        test 10 {
            target 99.88.77.66
            type ping
        }
        test 20 {
            target 55.44.33.22
            type ping
        }
    }
    rule 10 {
        inbound-interface eth3
        interface eth0 {
        }
    }
    rule 20 {
        inbound-interface eth3
        interface eth1 {
        }
    }
}
```

Failover Using Rule Order—Priority Traffic

One of the advantages of using rule order for failover configuration is the additional flexibility it provides. For example, in situations where the backup link is a lower-speed link than the primary and is only able to pass priority traffic, a rule order configuration is required.

In the previous example, the system was configured to send all incoming traffic from eth3 out eth0 unless the health check on eth0 failed. If the health check on eth0 failed all incoming traffic from eth3 was to be sent out eth1. This was accomplished using rule order. In the example in this section, we assume that the backup link has a lower speed and is unable to accomodate all traffic, so we select only high-priority traffic (in this case VoIP traffic) to send out the backup link if eth0 fails the health check.

Example 1-5 sets up failover configuration rules on R1. To modify the previous example to create the failover configuration using rule order where only a subset of traffic is sent out the secondary interface when the primary interface fails a health check, perform the following steps in configuration mode:

Example 1-5 Creating failover configuration using rule order and a lower-speed backup link

Step	Command
Remove the existing Rule 20 from the previous example.	`vyatta@R1# delete load-balancing wan rule 20`
Define eth3 as the inbound interface for this rule.	`vyatta@R1# set load-balancing wan rule 20 inbound-interface eth3`
Define eth1 as the secondary egress interface.	`vyatta@R1# set load-balancing wan rule 20 interface eth1`
Identify the traffic to match by port (VoIP traffic is on the sip port) ...	`vyatta@R1# set load-balancing wan rule 20 destination port sip`
... and protocol.	`vyatta@R1# set load-balancing wan rule 20 protocol tcp`
Allow traffic that falls through the load-balancing rules to try to exit via eth0 as the health check failure may be due to issues with the health check target rather than the local link.	`vyatta@R1# set protocols static route 0.0.0.0/0 next-hop 12.34.56.1`
Commit the configuration.	`vyatta@R1# commit`

Example 1-5 Creating failover configuration using rule order and a lower-speed backup link

Display the load-balancing configuration

```
vyatta@R1# show load-balancing
wan {
    interface-health eth0 {
        failure-count 5
        nexthop 12.34.56.1
        test 10 {
            target 11.22.33.44
            type ping
        }
        test 20 {
            target 55.66.77.88
            type ping
        }
    }
    interface-health eth1 {
        failure-count 4
        nexthop 98.76.54.1
        test 10 {
            target 99.88.77.66
            type ping
        }
        test 20 {
            target 55.44.33.22
            type ping
        }
    }
    rule 10 {
        inbound-interface eth3
        interface eth0 {
        }
    }
    rule 20 {
        destination {
            port sip
        }
        inbound-interface eth3
        interface eth1 {
        }
        protocol tcp
    }
}
```

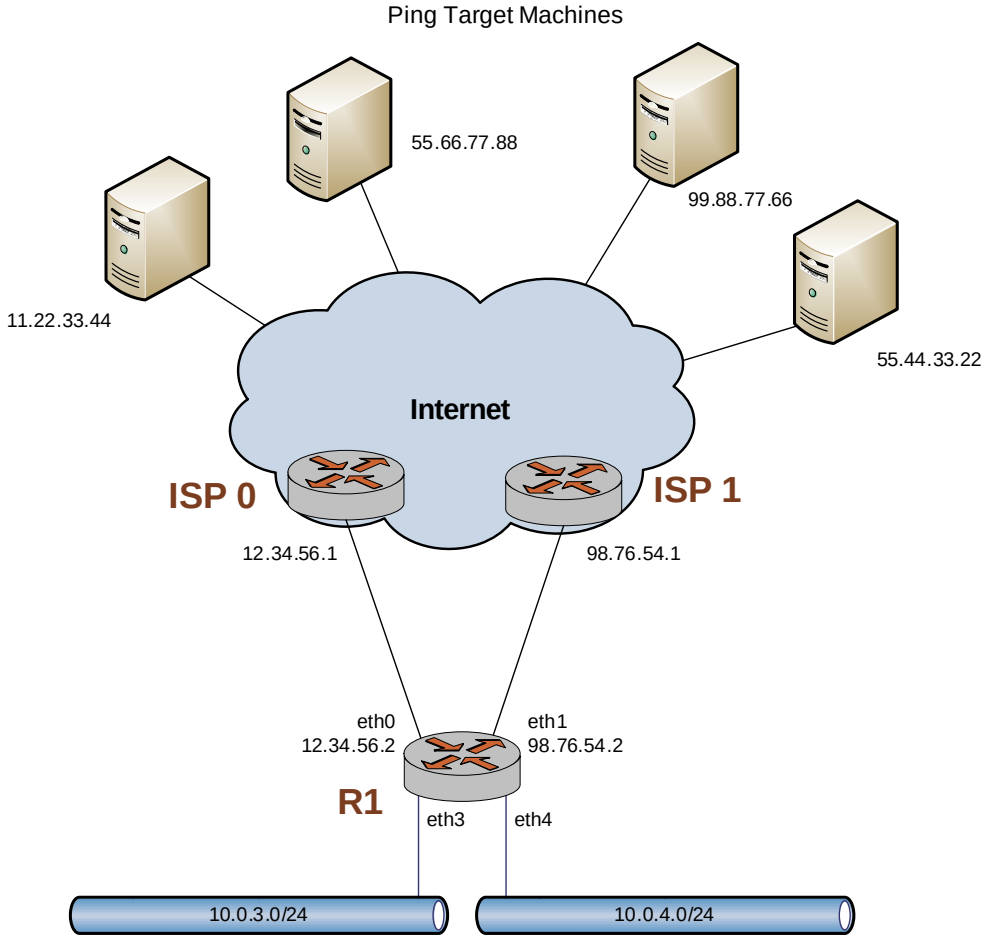
Display the static route configuration.

```
vyatta@R1# show protocols static
 route 0.0.0.0/0 next-hop 12.34.56.1
```

Excluding Traffic from Load Balancing

This example uses an almost identical configuration to the first example . The only difference is that there are two local LANs rather than one; see Figure 1-2.

Figure 1-2 WAN load balancing with two local networks



On first thought, it might appear that simply adding another rule to account for traffic from the second source would suffice. For example, a rule such as rule 20 in Example 1-6 might be added to load balance traffic from eth4:

Example 1-6 Adding a rule for a second traffic source

Step	Command

Display the configuration	vyatta@R1# show load-balancing wan rule 20
	inbound-interface eth4
	interface eth0 {
	}
	interface eth1 {
	}

However, this configuration does not account for intra-LAN traffic, and traffic that is meant to be routed between LANs will also be sent out either eth0 or eth1. To prevent this misdirection, an additional rule is required to exclude intra-LAN traffic from being load balanced.

In Example 1-7, rule 5 is added to exclude all traffic that is destined to either of the LANs. Note, in this example, that **eth+** is used to refer to all Ethernet interfaces.

Note also that this rule also excludes any locally-sourced packets destined for 10.0.0.0/8. This is required when using services like web caching with WAN load balancing.

Example 1-7 Adding a rule to exclude traffic destined for the LANs

Step	Command

Display the configuration	vyatta@R1# show load-balancing wan rule 5
	destination {
	address 10.0.0.0/8
	}
	exclude
	inbound-interface eth+

When complete, the configuration is as shown in Example 1-8.

Example 1-8 Complete WAN load balancing configuration

```
vyatta@R1# show load-balancing
wan {
    interface-health eth0 {
        failure-count 5
        nexthop 12.34.56.1
        test 10 {
```

```
            target 11.22.33.44
            type ping
        }
        test 20 {
            target 55.66.77.88
            type ping
        }
    }
    interface-health eth1 {
        failure-count 4
        nexthop 98.76.54.1
        test 10 {
            target 99.88.77.66
            type ping
        }
        test 20 {
            target 55.44.33.22
            type ping
        }
    }
    rule 5 {
        destination {
            address 10.0.0.0/8
        }
        exclude
        inbound-interface eth+
    }
    rule 10 {
        inbound-interface eth3
        interface eth0 {
        }
        interface eth1 {
        }
    }
    rule 20 {
        inbound-interface eth4
        interface eth0 {
        }
        interface eth1 {
        }
    }
}
```

WAN Load Balancing Commands

This section presents the following commands.

Configuration Commands	
Processing Directives	
load-balancing wan	Enables WAN load balancing on the system.
load-balancing wan disable-source-nat	Disables source NAT for balanced traffic.
load-balancing wan enable-local-traffic	Enables WAN load balancing for locally sourced traffic.
load-balancing wan flush-connections	Directs the system to flush the connection tracking table when a connection changes state.
load-balancing wan hook <script-name>	Specifies a script to be run on interface status changes.
Interface Health	
load-balancing wan interface-health <if-name>	Sets the characteristics for health checking for a load-balanced interface.
load-balancing wan interface-health <if-name> failure-count <num>	Sets the number of failed ping tests that can occur before an interface is considered unavailable.
load-balancing wan interface-health <if-name> nexthop <ipv4>	Sets the next-hop address for interface health checks.
load-balancing wan interface-health <if-name> success-count <num>	Sets the number of successful ping tests required for an interface to be considered healthy.
load-balancing wan interface-health <if-name> test <test-no>	Defines an interface health test.
load-balancing wan interface-health <if-name> test <test-no> resp-time <seconds>	Sets the time to wait for a response before declaring a ping test failed.
load-balancing wan interface-health <if-name> test <test-no> target <address>	Specifies the address of the health check target.
load-balancing wan interface-health <if-name> test <test-no> test-script <script-name>	Specifies the name of a user-defined script to use to test interface health.
load-balancing wan interface-health <if-name> test <test-no> ttl-limit <limit>	Specifies the hop count limit for a UDP TTL test.

load-balancing wan interface-health <if-name> test <test-no> type <type>	Specifies the interface health check test type.
Load Balancing Rules	
load-balancing wan rule <rule>	Defines a WAN load balancing rule.
load-balancing wan rule <rule> description <desc>	Records a description for a WAN load balancing rule.
load-balancing wan rule <rule> destination	Specifies a destination as a match criterion for a WAN load balancing rule.
load-balancing wan rule <rule> enable-source-based-routing	Enables source-based routing for a WAN load balancing rule.
load-balancing wan rule <rule> exclude	Excludes traffic matching a WAN load balancing rule from being load balanced.
load-balancing wan rule <rule> failover	Puts the load balancing process into failover mode, where one load balancing interface as active and the remaining links are spare.
load-balancing wan rule <rule> inbound-interface <if-name>	Specifies the interface that traffic to be load-balanced will come from.
load-balancing wan rule <rule> interface <if-name>	Adds an interface to the set of interfaces to be load-balanced in a WAN load balancing rule.
load-balancing wan rule <rule> limit	Specifies the traffic rate limiting parameters for a WAN load balancing rule.
load-balancing wan rule <rule> protocol <protocol>	Specifies an IP protocol as a match criterion for a WAN load balancing rule.
load-balancing wan rule <rule> source	Specifies a source as a match criterion for a WAN load balancing rule.
Operational Commands	
restart wan-load-balance	Restarts the WAN load balancing process.
show wan-load-balance	Displays information about WAN load-balanced interfaces.
show wan-load-balance connection	Displays connection data generated by load balanced traffic.
show wan-load-balance status	Displays information about the status of WAN load balancing.

restart wan-load-balance

Restarts the WAN load balancing process.

Syntax

restart wan-load-balance

Command Mode

Operational mode.

Parameters

None.

Default

None.

Usage Guidelines

Use this command to restart the WAN load balancing process.

load-balancing wan

Enables WAN load balancing on the system.

Syntax

set load-balancing wan

delete load-balancing wan

show load-balancing wan

Command Mode

Configuration mode.

Configuration Statement

```
load-balancing {
   wan
}
```

Parameters

None.

Default

None.

Usage Guidelines

Use this command to enable wide area networking (WAN) load balancing on the system.

Use the **set** form of this command to create the configuration node for WAN load balancing.

Use the **delete** form of this command to remove the WAN load balancing configuration and disable WAN load balancing on the system.

Use the **show** form of this command to display the configuration node.

load-balancing wan disable-source-nat

Disables source NAT for balanced traffic.

Syntax

set load-balancing wan disable-source-nat

delete load-balancing wan disable-source-nat

show load-balancing wan

Command Mode

Configuration mode.

Configuration Statement

```
load-balancing {
   wan {
      disable-source-nat
   }
}
```

Parameters

None.

Default

Source NAT rules are automatically generated when the source address is changed.

Usage Guidelines

Use this command to disable the automatic generation of source network address translation (source NAT or SNAT) rules for load balanced traffic.

Normally, the WAN load balanced interface replaces the source IP address of outbound traffic with its own IP address to ensure that reply traffic arrives back on the egressing interface. To do this, the WAN load balancing process automatically generates SNAT rules. These SNAT rules are specific to WAN load balancing; they rewrite the source address only for balanced traffic (that is, traffic matching the WAN load balancing rule).

In some scenarios—for example, cases where you are connecting private networks and do not require NAT, or cases where you want to employ other SNAT rules instead of relying on the rules generated by the WAN load balancing process. When the load-balancing wan disable-source-nat command is issued, WAN load balancing SNAT is not performed on balanced traffic.

Use the **set** form of this command to disable SNAT on balanced traffic.

Use the **delete** form of this command to restore the default behavior for SNAT.

Use the **show** form of this command to display WAN load balancing configuration.

load-balancing wan enable-local-traffic

Enables WAN load balancing for locally sourced traffic.

Syntax

set load-balancing wan enable-local-traffic

delete load-balancing wan enable-local-traffic

show load-balancing wan

Command Mode

Configuration mode.

Configuration Statement

```
load-balancing {
   wan {
      enable-local-traffic
   }
}
```

Parameters

None.

Default

Traffic that originates on the Vyatta system does not participate in WAN load balancing.

Usage Guidelines

Use this command to enable WAN load balancing for traffic that originates on the Vyatta system itself.

Normally, only traffic that passes through the Vyatta system can be WAN load balanced. Setting this parameter allows both through traffic and traffic that originates from the Vyatta system to be WAN load balanced.

Use the **set** form of this command to enable WAN load balancing for locally sourced traffic.

Use the **delete** form of this command to restore the default behavior for locally sourced traffic.

Use the **show** form of this command to display WAN load balancing configuration.

load-balancing wan flush-connections

Directs the system to flush the connection tracking table when a connection changes state.

Syntax

set load-balancing wan flush-connections

delete load-balancing wan flush-connections

show load-balancing wan

Command Mode

Configuration mode.

Configuration Statement

```
load-balancing {
    wan {
        flush-connections
    }
}
```

Parameters

None.

Default

The connection tracking table is not flushed when connections change state.

Usage Guidelines

Use this command to direct the system to flush the connection tracking table when any connection changes state. The complete connection tracking table is flushed.

The connection tracking table can accumulate stale entries—for example, when a DHCP advertisement causes a change of address for a balanced interface or where a balanced link fails. Enabling connection tracking directs the system to flush the table when a connection changes state in this way.

Note that enabling this option causes the entire connection tracking table to be flushed when any connection changes state. This removes entries for other flows than the changed flow, including entries for established and active flows. Subsequently, the system does not create a new entry in the connection tracking table until a new

connection is established on the flow (where a flow is a tuple consisting of source address, destination address, IP address, and port). Until then, previously established flows are balanced on a per-packet, rather than a per-flow, basis.

NOTE *This feature should not be used together with stateful failover, since stateful failover uses the same connection tracking mechanism to maintain and synchronize state with the standby components.*

Use the **set** form of this command to enable connection tracking table flushing.

Use the **delete** form of this command to restore the default behavior for the connection tracking table.

Use the **show** form of this command to display WAN load balancing configuration.

load-balancing wan hook <script-name>

Specifies a script to be run on interface status changes.

Syntax

set load-balancing wan hook *script-name*

delete load-balancing wan hook

show load-balancing wan hook

Command Mode

Configuration mode.

Configuration Statement

```
load-balancing {
    wan {
        hook script-name
    }
}
```

Parameters

script-name	The name of the script to be executed on an interface state change.

Default

None.

Usage Guidelines

Use this command to specify the name of a script that will be run on a per-interface state-change basis. There are two environment variables available to the script:

- WLB_INTERFACE_NAME=[interfacename]—specifies the interface to monitor for state change.
- WLB_INTERFACE_STATE=[ACTIVE|FAILED]—specifies the interface state.

Script files are assumed to be in /config/scripts unless an absolute path is specified.

NOTE *This is a blocking call, so if the script does not return, the WAN load balancing process waits forever, rendering the system unresponsive.*

Use the **set** form of this command to specify the name of the script to be run when an interface changes state.

Use the **delete** form of this command to remove the specified script name.

Use the **show** form of this command to display the script name configured.

load-balancing wan interface-health <if-name>

Sets the characteristics for health checking for a load-balanced interface.

Syntax

set load-balancing wan interface-health *if-name*

delete load-balancing wan interface-health *if-name*

show load-balancing wan interface-health *if-name*

Command Mode

Configuration mode.

Configuration Statement

```
load-balancing {
    wan {
        interface-health if-name
    }
}
```

Parameters

if-name	Mandatory. Multi-node. The name of a physical or logical interface. This is the load-balanced interface whose health is to be monitored. You can define health checks for all load-balanced interfaces by creating multiple **interface-health** configuration nodes.

Default

None.

Usage Guidelines

Use this command set the health-checking characteristics on a load-balanced outbound interface.

Use the **set** form of this command to enable health checking on an interface.

Use the **delete** form of this command to remove health checking on an interface.

Use the **show** form of this command to display health checking configuration.

load-balancing wan interface-health <if-name> failure-count <num>

Sets the number of failed ping tests that can occur before an interface is considered unavailable.

Syntax

set load-balancing wan interface-health *if-name* **failure-count** *num*

delete load-balancing wan interface-health *if-name* **failure-count**

show load-balancing wan interface-health *if-name* **failure-count**

Command Mode

Configuration mode.

Configuration Statement

```
load-balancing {
    wan {
        interface-health if-name {
            failure-count num
        }
    }
}
```

Parameters

if-name	Mandatory. The name of a physical or logical interface.
num	The number of consecutive ICMP Echo Request (ping) messages sent without receiving a response before the interface is considered unavailable. The range is 1 to 10. The default is 1.

Default

If an interface fails to respond to one ICMP Echo Request (ping) message, it is considered unavailable.

Usage Guidelines

Use this command to set the failure count for interface health checks. The failure count is the number of consecutive failed pings required to remove an interface from the pool of active load balanced interfaces.

Use the **set** form of this command to specify the failure count.

Use the **delete** form of this command to restore the default failure count.

Use the **show** form of this command to display failure count configuration.

load-balancing wan interface-health <if-name> nexthop <ipv4>

Sets the next-hop address for interface health checks.

Syntax

set load-balancing wan interface-health *if-name* **nexthop** *ipv4*

delete load-balancing wan interface-health *if-name* **nexthop**

show load-balancing wan interface-health *if-name* **nexthop**

Command Mode

Configuration mode.

Configuration Statement

```
load-balancing {
    wan {
        interface-health if-name {
            nexthop ipv4
        }
    }
}
```

Parameters

if-name	Mandatory. The name of a physical or logical interface.
ipv4	The IPv4 address of the next hop for interface health checks, or the keyword **dhcp**, which directs the system to obtain the IP address from the DHCP server.

Default

None.

Usage Guidelines

Use this command to set the IPv4 address of the next hop for interface health checks.

If the next-hop address is specified using the **dhcp** keyword, the next-hop IP address is obtained from the DHCP advertisement. In this case, the applicable source NAT rule and the routing table are automatically updated when the new DHCP assignment is made.

Use the **set** form of this command to specify the IPv4 address of the next hop.

Use the **delete** form of this command to remove the IPv4 address of the next hop.

Use the **show** form of this command to display the next hop configuration.

load-balancing wan interface-health <if-name> success-count <num>

Sets the number of successful ping tests required for an interface to be considered healthy.

Syntax

set load-balancing wan interface-health *if-name* **success-count** *num*

delete load-balancing wan interface-health *if-name* **success-count**

show load-balancing wan interface-health *if-name* **success-count**

Command Mode

Configuration mode.

Configuration Statement

```
load-balancing {
    wan {
        interface-health if-name {
            success-count num
        }
    }
}
```

Parameters

if-name	Mandatory. The name of a physical or logical interface.
num	The number of consecutive responses received for ICMP Echo Request (ping) messages sent for the interface to be considered healthy. The range is 1 to 10. The default is 1.

Default

If an interface completes one successful ping test, it is added back to the pool of active load-balanced interfaces.

Usage Guidelines

Use this command to set the number of consecutive successful pings required to add an interface back into the pool of active load-balanced interfaces.

Use the **set** form of this command to specify the success count.

Use the **delete** form of this command to restore the default success count.

Use the **show** form of this command to display success count configuration.

load-balancing wan interface-health <if-name> test <test-no>

Defines an interface health test.

Syntax

set load-balancing wan interface-health *if-name* **test** *test-no*

delete load-balancing wan interface-health *if-name* **test**

show load-balancing wan interface-health *if-name* **test**

Command Mode

Configuration mode.

Configuration Statement

```
load-balancing {
    wan {
        interface-health if-name {
            test test-no {
            }
        }
    }
}
```

Parameters

if-name	The name of a physical or logical interface.
test-no	The test identifier.

Default

None.

Usage Guidelines

Use this command to define an interface health test. Multiple health test targets provide more than one target for a single interface. Rather than relying on a single target which might be non-responsive for reasons other than path failure, this allows

multiple endpoints to be tested. Multi-targets will test until either the list of tests for that interface are exhausted or until the first successful response is received. Interface health tests are run every 5 seconds.

Use the **set** form of this command to specify the test configuration node.

Use the **delete** form of this command to remove the test.

Use the **show** form of this command to display test configuration.

load-balancing wan interface-health <if-name> test <test-no> resp-time <seconds>

Sets the time to wait for a response before declaring a ping test failed.

Syntax

set load-balancing wan interface-health *if-name* **test** *test-no* **resp-time** *seconds*

delete load-balancing wan interface-health *if-name* **test** *test-no* **resp-time**

show load-balancing wan interface-health *if-name* **test** *test-no* **resp-time**

Command Mode

Configuration mode.

Configuration Statement

```
load-balancing {
    wan {
        interface-health if-name {
            test test-no {
                resp-time seconds
            }
        }
    }
}
```

Parameters

if-name	The name of a physical or logical interface.
test-no	The test identifier.
seconds	The number of seconds to wait for a ping response before declaring the ping to have failed. The range is 1 to 30. The default is 5.

Default

If an ICMP Echo Reply message is not received within 5 seconds, the ping test is considered to have failed.

Usage Guidelines

Use this command to configure the number of seconds to wait for a ping response before considering the health check to have failed. Pings are sent to test interface health when **type** is set to **ping**.

Use the **set** form of this command to set the maximum response time.

Use the **delete** form of this command to restore the default response time.

Use the **show** form of this command to display response time configuration.

load-balancing wan interface-health <if-name> test <test-no> target <address>

Specifies the address of the health check target.

Syntax

set load-balancing wan interface-health *if-name* **test** *test-no* **target** *address*

delete load-balancing wan interface-health *if-name* **test** *test-no* **target**

show load-balancing wan interface-health *if-name* **test** *test-no* **target**

Command Mode

Configuration mode.

Configuration Statement

```
load-balancing {
    wan {
        interface-health if-name {
            test test-no {
                target address
            }
        }
    }
}
```

Parameters

if-name	The name of a physical or logical interface.
test-no	The test identifier.
address	The IPv4 address or hostname of an interface health check target.

Default

None.

Usage Guidelines

Use this command to configure the destination for interface health checks. The target is used when the test **type** is set to either **ping** or **ttl**.

Use the **set** form of this command to set the destination for interface health checks.

Use the **delete** form of this command to remove the destination for interface health checks.

Use the **show** form of this command to display target configuration.

load-balancing wan interface-health <if-name> test <test-no> test-script <script-name>

Specifies the name of a user-defined script to use to test interface health.

Syntax

set load-balancing wan interface-health *if-name* **test** *test-no* **test-script** *script-name*

delete load-balancing wan interface-health *if-name* **test** *test-no* **test-script**

show load-balancing wan interface-health *if-name* **test** *test-no* **test-script**

Command Mode

Configuration mode.

Configuration Statement

```
load-balancing {
    wan {
        interface-health if-name {
            test test-no {
                test-script script-name
            }
        }
    }
}
```

Parameters

if-name	The name of a physical or logical interface.
test-no	The test identifier.
script-name	The name of a script to be used to test interface health.

Default

None.

Usage Guidelines

Use this command to specify the name of a script to be used to test interface health (for example, /config/scripts/http_test.pl).

A user defined script can be used in situations where the other health test types are insufficient to test the ability to reach a specific destination. For example, the ability to ping a remote webserver will indicate the the server is operational but it will not indicate the state of the webserver application. A script that opens an HTTP connection to the webserver and returns 0 only if it recieves a 200 (OK) message from the server provides a more accurate determinateion of health.

Another possible use would be to have the script intentionally failover to a specific interface depending on the time of day.

For the script to be used, the test **type** must be set to **user-defined**. When run, the script must return 0 to indicate a successful test and non-zero to indicate a failed test.

User defined scripts are assumed to be located in /config/scripts unless an absolute path is specified.

Use the **set** form of this command to specify the name and absolute location of a script to be used to test interface health.

Use the **delete** form of this command to remove the test script specification.

Use the **show** form of this command to display the test script configuration.

load-balancing wan interface-health <if-name> test <test-no> ttl-limit <limit>

Specifies the hop count limit for a UDP TTL test.

Syntax

set load-balancing wan interface-health *if-name* **test** *test-no* **ttl-limit** *limit*

delete load-balancing wan interface-health *if-name* **test** *test-no* **ttl-limit**

show load-balancing wan interface-health *if-name* **test** *test-no* **ttl-limit**

Command Mode

Configuration mode.

Configuration Statement

```
load-balancing {
    wan {
        interface-health if-name {
            test test-no {
                ttl-limit limit
            }
        }
    }
}
```

Parameters

if-name	The name of a physical or logical interface.
test-no	The test identifier.
limit	The hop count limit used when the test **type** is **ttl**. The default value is 1.

Default

The limit is one hop.

Usage Guidelines

Use this command to configure the hop count limit for use with UDP TTL health check tests.

With these tests, the target is sent a UDP packet with a time-to-live (TTL) limit to the target. For the test to be successful the TTL limit must be shorter than the path length to the target as the test requires an ICMP time expired message to be returned for a successful test.

Use the **set** form of this command to specify the hop count limit for use with UDP TTL health check tests.

Use the **delete** form of this command to remove the hop count limit.

Use the **show** form of this command to display ttl-limit configuration.

load-balancing wan interface-health <if-name> test <test-no> type <type>

Specifies the interface health check test type.

Syntax

set load-balancing wan interface-health *if-name* **test** *test-no* **type** [**ping | ttl | user-defined**]

delete load-balancing wan interface-health *if-name* **test** *test-no* **type**

show load-balancing wan interface-health *if-name* **test** *test-no* **type**

Command Mode

Configuration mode.

Configuration Statement

```
load-balancing {
    wan {
        interface-health if-name {
            test test-no {
                type type
            }
        }
    }
}
```

Parameters

if-name	The name of a physical or logical interface.
test-no	The test identifier.
type	The type of test to perform. Supported values are: **ping**: Runs a ping test to test interface health. **ttl**: Runs a time-to-live (TTL) test to test interface health. **user-defined**: Runs a user defined script to test interface health.

Default

None.

Usage Guidelines

Use this command to specify the type of health check test to be performed.

Use the **set** form of this command to specify the type of health check test to be performed.

Use the **delete** form of this command to remove the type configuration.

Use the **show** form of this command to display type configuration.

load-balancing wan rule <rule>

Defines a WAN load balancing rule.

Syntax

set load-balancing wan rule *rule*

delete load-balancing wan rule *rule*

show load-balancing wan rule *rule*

Command Mode

Configuration mode.

Configuration Statement

```
load-balancing {
   wan {
      rule rule {
      }
   }
}
```

Parameters

rule	Mandatory. Multi-node. A unique number identifying the rule. The range is 1 to 4294967295. You can define multiple load balancing rules by creating multiple **rule** configuration nodes.

Default

None.

Usage Guidelines

Use this command to define a WAN load balancing rule.

Once configured, rule numbers cannot be changed. For this reason, it is good practice to configure rules at intervals (for example, Rule 5, Rule 10, Rule 15, and so on) in case a rule must be inserted later on.

Use the **set** form of this command to create the load balancing rule. Note that you cannot use **set** to change the number of an existing rule. To change a rule's number, delete the rule and re-create it.

Use the **delete** form of this command to remove a load balancing rule.

Use the **show** form of this command to display load balancing rule configuration.

load-balancing wan rule <rule> description <desc>

Records a description for a WAN load balancing rule.

Syntax

set load-balancing wan rule *rule* **description** *desc*

delete load-balancing wan rule *rule* **description**

show load-balancing wan rule *rule* **description**

Command Mode

Configuration mode.

Configuration Statement

```
load-balancing {
    wan {
        rule rule {
            description desc
        }
    }
}
```

Parameters

rule	Mandatory. The number of the rule being configured.
desc	A description for the WAN load balancing rule.

Default

None.

Usage Guidelines

Use this command to provide a description for the WAN load balancing rule.

Use the **set** form of this command to specify a description for the WAN load balancing rule.

Use the **delete** form of this command to remove a description for the WAN load balancing rule.

Use the **show** form of this command to display the WAN load balancing rule description.

load-balancing wan rule <rule> destination

Specifies a destination as a match criterion for a WAN load balancing rule.

Syntax

set load-balancing wan rule *rule* **destination** {**address** *address* | **port** *port*}

delete load-balancing wan rule *rule* **destination** [**address** | **port**]

show load-balancing wan rule *rule* **destination**

Command Mode

Configuration mode.

Configuration Statement

```
load-balancing {
    wan {
        rule rule {
            destination {
                address address
                port port
            }
        }
    }
}
```

Parameters

rule	Mandatory. The number of the rule being configured.

address	The destination address to match. Supported formats are as follows: *ip-address*: An IPv4 address. *ip-address/prefix*: A network address, where 0.0.0.0/0 matches any network. *ip-address–ip-address*: A range of contiguous IP addresses; for example, 192.168.1.1–192.168.1.150. **!***ip-address*: Matches all IP addresses except the one specified. **!***ip-address/prefix*: Matches all network addresses except the one specified. **!***ip-address–ip-address*: Matches all IP addresses except those in the specified range. Exactly one of **address** or **port** must be specified.
port	Applicable only when the protocol is TCP or UDP. The destination port to match. Supported formats are as follows: *port-name*: Matches the name of an IP service; for example, **http**. You can specify any service name in the file **/etc/services**. *port-num*: Matches a port number. The range is 1 to 65535. start–end: Matches the specified range of ports; for example, 1001–1005. You can use a combination of these formats in a comma-separated list. You can also negate the entire list by prepending it with an exclamation mark (“!”); for example,**!22,telnet,http,123,1001-1005**. Exactly one of **address** or **port** must be specified.

Default

If not set, or if the **destination** configuration node is created with no attributes, the packet matches any destination.

Usage Guidelines

Use this command to define a match criterion based on destination address for a load balancing rule.

You can match packets based on a destination represented by an IP address or port.

Use the **set** form of this command to specify a destination to be matched.

Use the **delete** form of this command to remove destination configuration.

Use the **show** form of this command to display destination configuration.

load-balancing wan rule <rule> enable-source-based-routing

Enables source-based routing for a WAN load balancing rule.

Syntax

set load-balancing wan rule *rule* **enable-source-based-routing**

delete load-balancing wan rule *rule* **enable-source-based-routing**

show load-balancing wan rule *rule*

Command Mode

Configuration mode.

Configuration Statement

```
load-balancing {
    wan {
        rule rule {
            enable-source-based-routing
        }
    }
}
```

Parameters

rule	Mandatory. The number of the rule being configured.

Default

None.

Usage Guidelines

Use this command to enable source-based routing (also called policy-based routing) during load balancing.

Normally, the Vyatta system balances traffic flows based on a tuple consisting ot source address, destination address, and port. The first packet of the flow initiates the connection and subsequent packets matching the flow tuple are directed to the same interface. Flow-based load balancing helps prevent problems associated with

out-of-order packets; for example, in cases where one link in the set is much faster or slower than others in the set. (Out-of-order packets can affect performance because of the processing required to reassemble the flow.)

For some scenarios—for example, scenarios where out-of-order packets are not a concern—flow-based balancing is not required; packet-based balancing (that is, simple statistically random distribution) is sufficient. Disabling flow-based balancing can afford efficiencies in forwarding packets; in addition, a better balance of packets can be achieved.

Use the **set** form of this command to enable source-based routing.

Use the **delete** form of this command to disable source-based routing.

Use the **show** form of this command to display WAN load balancing configuration.

load-balancing wan rule <rule> exclude

Excludes traffic matching a WAN load balancing rule from being load balanced.

Syntax

set load-balancing wan rule *rule* **exclude**

delete load-balancing wan rule *rule* **exclude**

show load-balancing wan rule *rule*

Command Mode

Configuration mode.

Configuration Statement

```
load-balancing {
   wan {
      rule rule {
         exclude
      }
   }
}
```

Parameters

None.

Default

Traffic matching the characteristics specified in this rule is load balanced.

Usage Guidelines

Use this command to define an exclusion rule excluding traffic from being load balanced.

Traffic matching the characteristics specified in the load balancing rule is not load balanced, but is routed normally.

Use the **set** form of this command to exclude traffic matching this rule from being load balanced.

Use the **delete** form of this command to restore default load balancing behavior.

Use the **show** form of this command to display WAN load balancing rule configuration.

load-balancing wan rule <rule> failover

Puts the load balancing process into failover mode, where one load balancing interface as active and the remaining links are spare.

Syntax

set load-balancing wan rule *rule* **failover**

delete load-balancing wan rule *rule* **failover**

show load-balancing wan rule *rule*

Command Mode

Configuration mode.

Configuration Statement

```
load-balancing {
    wan {
        rule rule {
            failover
        }
    }
}
```

Parameters

None.

Default

All configured load balancing links are used to balance traffic.

Usage Guidelines

Use this command to direct the system to put the load balancing process into failover mode. In failover mode, one load balancing link is selected by the system as the active link; the remaining load balancing links are reserved as standby or spare links to be used in case the connection to the active link is interrupted.

The active link is selected by the system based on its configured weight and the reachability of the target from the interface. Only the active link is used to forward traffic. If the active link becomes inoperable, the interface with the next highest combination of weight and reachability becomes the active link.

Use the **set** form of this command to enable failover mode.

Use the **delete** form of this command to restore default load balancing behavior.

Use the **show** form of this command to display WAN load balancing rule configuration.

load-balancing wan rule <rule> inbound-interface <if-name>

Specifies the interface that traffic to be load-balanced will come from.

Syntax

set load-balancing wan rule *rule* **inbound-interface** *if-name*

delete load-balancing wan rule *rule* **inbound-interface** *if-name*

show load-balancing wan rule *rule* **inbound-interface**

Command Mode

Configuration mode.

Configuration Statement

```
load-balancing {
    wan {
        rule rule {
            inbound-interface if-name
        }
    }
}
```

Parameters

rule	Mandatory. The number of the rule being configured.
if-name	Mandatory. The interface that traffic to be load-balanced will come from.

Default

None.

Usage Guidelines

Use this command to specify the interface that traffic to be load-balanced will come from.

Use the **set** form of this command to specify the interface that traffic to be load-balanced will come from.

Use the **delete** form of this command to remove the inbound interface from the load balancing rule.

Use the **show** form of this command to display inbound interface configuration in a load balancing rule.

load-balancing wan rule <rule> interface <if-name>

Adds an interface to the set of interfaces to be load-balanced in a WAN load balancing rule.

Syntax

set load-balancing wan rule *rule* **interface** *if-name* [**weight** *num*]

delete load-balancing wan rule *rule* **interface** *if-name* [**weight**]

show load-balancing wan rule *rule* **interface** *if-name* [**weight**]

Command Mode

Configuration mode.

Configuration Statement

```
load-balancing {
    wan {
        rule rule {
            interface if-name {
                weight num
            }
        }
    }
}
```

Parameters

rule	Mandatory. The number of the rule being configured.
if-name	Mandatory. The name of a physical or logical interface.
weight	The weight to be associated with the interface, where weight represents the relative distribution of packets to this interface.The range is 1 to 255. The default is 1.

Default

Each interface is assigned a weight of 1.

Usage Guidelines

Use this command to add an interface to the set of interfaces to be load-balanced in a WAN load balancing rule. When a load balancing rule is matched, the outgoing packet is sent out through one of the interfaces specified in this set, as determined by the load balancing algorithm.

Use the **set** form of this command to add an interface to the load balancing rule or to modify an interface's load balancing weight.

Use the **delete** form of this command to remove the interface from the load balancing rule or to restore the default weight of an interface.

Use the **show** form of this command to display interface configuration in a load balancing rule.

load-balancing wan rule <rule> limit

Specifies the traffic rate limiting parameters for a WAN load balancing rule.

Syntax

set load-balancing wan rule *rule* **limit** {**burst** *burst* | **period** [**second** | **minute** | **hour**] | **rate** *rate* | **threshold** [**above** | **below**]}

delete load-balancing wan rule *rule* **limit** [**burst** | **period** | **rate** | **threshold**]

show load-balancing wan rule *rule* **limit** [**burst** | **period** | **rate** | **threshold**]

Command Mode

Configuration mode.

Configuration Statement

```
load-balancing {
    wan {
        rule rule {
            limit {
                burst burst
                period [second|minute|hour]
                rate rate
                threshold [above|below]
            }
    }
}
```

Parameters

rule	The number of the rule being configured.
burst	The number of packets over the limit that are allowed within the specified **period**. The default value is 5.
period	The time window for rate calculation. Supported values are as follows: **second**: One second **minute**: One minure **hour**: One hour The default value is **second**.

rate	The number of packets used for the rate limit. The default value is 5.
threshold	The threshold behavior for limit. Supported values are as follows: **above**: The rule applies to packets above the limit **below**: The rule applies to packets below the limit The default value is **below**.

Default

No limits are applied.

Usage Guidelines

Use this command to set the rate limit at which the rule will be active. It can be interpreted as "Apply this rule to traffic below (or above) this rate. Allow bursts of x packets per time period above (or below) this rate as well."

Use the **set** form of this command to specify the traffic rate limiting parameters for a WAN load balancing rule.

Use the **delete** form of this command to remove the traffic rate limiting parameters for a WAN load balancing rule.

Use the **show** form of this command to display the traffic rate limiting parameters for a WAN load balancing rule.

load-balancing wan rule <rule> protocol <protocol>

Specifies an IP protocol as a match criterion for a WAN load balancing rule.

Syntax

set load-balancing wan rule *rule* **protocol** *protocol*

delete load-balancing wan rule *rule* **protocol** *protocol*

show load-balancing wan rule *rule* **protocol** *protocol*

Command Mode

Configuration mode.

Configuration Statement

```
load-balancing {
    wan {
        rule rule {
            protocol protocol
        }
    }
}
```

Parameters

rule	Mandatory. The number of the rule being configured.
protocol	The protocol(s) on which to perform load balancing. Any protocol literals or numbers listed in **/etc/protocols** can be used. The keyword **all** is also supported. Prefixing the protocol name with the exclamation mark character (“**!**”) matches every protocol except the specified protocol. For example, **!tcp** matches all protocols except TCP.

Default

All protocols are matched.

Usage Guidelines

Use this command to specify the protocol(s) on which to define a match.

Note that you should take care in using more than one “exclusion” rule (that is, a rule using the negation operation (“!”) in combination. Locad balancing rules are evaluated sequentially, and a sequence of exclusion rules could result in unexpected behavior.

Use the **set** form of this command to specify a protocol to be matched.

Use the **delete** form of this command to restore the default protocol match value.

Use the **show** form of this command to display protocol match configuration.

load-balancing wan rule <rule> source

Specifies a source as a match criterion for a WAN load balancing rule.

Syntax

set load-balancing wan rule *rule* **source** {**address** *address* | **port** *port*}

delete load-balancing wan rule *rule* **source** {**address** | **port**}

show load-balancing wan rule *rule* **source**

Command Mode

Configuration mode.

Configuration Statement

```
load-balancing {
    wan {
        rule rule {
            source {
                address address
                port port
            }
        }
    }
}
```

Parameters

rule	Mandatory. The number of the rule being configured.

address	The destination address to match. Supported formats are as follows: *ip-address*: An IPv4 address. *ip-address/prefix*: A network address, where 0.0.0.0/0 matches any network. *ip-address–ip-address*: A range of contiguous IP addresses; for example, 192.168.1.1–192.168.1.150. **!***ip-address*: Matches all IP addresses except the one specified. **!***ip-address/prefix*: Matches all network addresses except the one specified. **!***ip-address–ip-address:* Matches all IP addresses except those in the specified range. Exactly one of **address** or **port** must be specified.
port	Applicable only when the protocol is TCP or UDP. The destination port to match. Supported formats are as follows: *port-name*: Matches the name of an IP service; for example, **http**. You can specify any service name in the file **/etc/services**. *port-num*: Matches a port number. The range is 1 to 65535. start–end: Matches the specified range of ports; for example, 1001–1005. You can use a combination of these formats in a comma-separated list. You can also negate the entire list by prepending it with an exclamation mark (“**!**”); for example,**!22,telnet,http,123,1001-1005**. Exactly one of **address** or **port** must be specified.

Default

If not set, or if the **source** configuration node is created with no attributes, the packet matches any source.

Usage Guidelines

Use this command to define a match criterion based on source address for a load balancing rule.

You can match packets based on a source represented by an IP address or port.

Use the **set** form of this command to specify a source to be matched.

Use the **delete** form of this command to remove source configuration.

Use the **show** form of this command to display source configuration.

show wan-load-balance

Displays information about WAN load-balanced interfaces.

Syntax

show wan-load-balance

Command Mode

Operational mode.

Parameters

None.

Default

None.

Usage Guidelines

Use this command to see information about WAN load-balanced interfaces.

The command displays information for each balanced interface and reports on the current status, including the last time the interface changed state from active to failed or failed to active.

The command also shows the test type and the target for the test (in order of configured test number). The character at the beginning of the line represents the state of the test, as follow:

+ The last test was successful.
- The last test failed.
* No test has been performed.

Examples

Example 1-9 shows WAN load balancing information where eth0 and eth1 are balanced interfaces.

Example 1-9 Displaying load balanced interface information

```
vyatta@vyatta>show wan-load-balance
Interface:  eth0
```

```
    Status:  active
    Last Status Change:  Fri May 15 13:38:39 2009
    -Test:  Ping  Target:  192.168.0.120
    +Test:  ttl   Target:  192.168.0.1
      Last Interface Success:  0s
      Last Interface Failure:  35s
      # Interface Failure(s):  10

  Interface:  eth1
    Status:  active
    Last Status Change:  Fri May 15 13:38:39 2009
    +Test:  Ping  Target:  192.168.0.1
    *Test:  Ping  Target:  192.168.0.120
      Last Interface Success:  10s
      Last Interface Failure:  0s
      # Interface Failure(s):  0
```

show wan-load-balance connection

Displays connection data generated by load balanced traffic.

Syntax

show wan-load-balance connection

Command Mode

Operational mode.

Parameters

None.

Default

None.

Usage Guidelines

Use this command to see connection information generated by load balanced traffic.

Examples

Example 1-10 shows WAN load balancing connection information.

Example 1-10 Displaying load balancing connection information

```
vyatta@vyatta>show wan-load-balance connection
Type     State     Src                  Dst                  Packets    Bytes
tcp      estab     172.16.117.1:123     172.16.117.2:123       1          11
icmp               172.16.117.1         172.16.117.2           1          11
```

show wan-load-balance status

Displays information about the status of WAN load balancing.

Syntax

show wan-load-balance status [with-dns]

Command Mode

Operational mode.

Parameters

with-dns	Perform DNS resolution.

Default

None.

Usage Guidelines

Use this command to see information about status of WAN load balancing.

Examples

Example 1-11 shows WAN load balancing information where eth0 and eth1 are balanced interfaces.

Example 1-11 Displaying load balancing status

```
vyatta@vyatta>show wan-load-balance status
Chain PREROUTING (policy ACCEPT 1415 packets, 96338 bytes)
 pkts bytes target prot opt in  out source   destination
 0    0     ISP_1  tcp  --  any any anywhere anywhere multiport dports 223
              state NEW statistic mode random probability 0.500000
 0    0     ISP_2  tcp  --  any any anywhere anywhere multiport dports 223
```

Chapter 2: VRRP

This chapter explains how to use Virtual Router Redundancy Protocol (VRRP) on the Vyatta System.

This chapter presents the following topics:

VRRP Configuration

This section describes how to configure the Virtual Router Redundancy Protocol on the Vyatta System.

This section presents the following topics:

VRRP Overview

This section presents the following topics:

Virtual Router Redundancy Protocol (VRRP) is a protocol for allowing a cluster of routers to act as one virtual router. VRRP, as specified by RFC 2338 and RFC 3678, was designed to provide router failover services in the event of an interface failure.

On the Vyatta System, VRRP can be run on either a standard Ethernet interface, or it can be run on the vif of an Ethernet interface (that is, a VLAN interface).

VRRP Groups

A VRRP group consists of a cluster of interfaces and/or virtual interfaces providing redundancy for a primary, or "master," interface in the group. Each interface in the group is typically on a separate router. Redundancy is managed by the VRRP process on each system.

The VRRP group has a unique numeric identifier and can be assigned up to 20 virtual IP addresses (called the virtual IP or VIP). A VIP is linked with the MAC address of the master router. If the master router fails, a new master is elected and the new master notifies the network of its MAC address by issuing a gratuitous ARP. The VIP assumes the MAC address of the physical interface of the master router.

All interfaces in the group must be assigned the same VRRP group identifier and virtual address; otherwise they cannot provide redundancy for one another. Interfaces being mapped to the virtual address must be on the same subnet as the virtual address, but should not have the same address as the virtual address. Multiple VRRP groups are supported on an interface.

The Virtual IP Address

Routers in a VRRP cluster share the VIP. This provides alternate paths through the network for hosts without explicitly configuring them, and creates redundancy that eliminates any individual router as a single point of failure in the network. This is particularly important for statically configured default routers, the failure of which could otherwise be a catastrophic event on a network.

In VRRP, the IP addresses of interfaces on different real routers are mapped onto a "virtual router". The virtual router is an abstract object, managed by the VRRP process, that is defined by its virtual router ID (the group identifier of the set of routers forming the virtual router) plus the VIP presented to the network. Hosts on the network are configured to direct packets to the VIP, rather than to the IP addresses of the real interfaces.

The master router forwards packets for local hosts and responds to ARP requests, ICMP pings, and IP datagrams directed to the VIP. Backup routers remain idle, even if healthy. ARP requests, pings, and datagrams made to the real IP addresses of interfaces are responded to by the interface in the normal way.

Election of the Master Router

VRRP dynamically elects the router that is to be the master. In most cases, the master router is simply the router with the interface that has the highest configured priority. If two interfaces have identical priorities, the router with the one having the highest IP address is elected master.

If the master interface fails, the interface with the next highest priority is elected master and assumes the virtual address of the group. The new master notifies the network of its MAC address by sending out a gratuitous ARP message.

The priority of the master interface is typically set to 255. The backup interface can be left with the default priority; however, if more than one interface is acting as backup, they should be configured with different priorities.

VRRP Advertisements and Failover

To signal that it is still in service, the master interface or vif sends MAC-level multicast "heartbeat" packets called advertisements to the backup routers on the LAN segment, using the IP address 224.0.0.18, which is the IPv4 multicast address assigned to VRRP. These advertisements confirm the health of the master to backup routers and contain other VRRP information, such as the master's priority.

If the heartbeat stops for a configured period (the "dead interval"), the VRRP process considers the master out of service and triggers failover by electing the backup interface with the highest priority to become the new master router. The new master assumes the virtual address and notifies the network of its MAC address by issuing a gratuitous ARP message.

Preemption

If preemption is enabled, a backup router with a higher priority than the current master will "preempt" the master, and become the master itself. The backup router preempts the master by beginning to send out its own VRRP advertisements. The master router examines these, and discovers that the backup router has a higher priority than itself. The master then stops sending out advertisements, while the backup continues to send, thus making itself the new master.

Preemption is useful in situation where a lower-performance backup router becomes master when a higher-performance router fails. In this case, a new higher-performance router can be brought online, and it will automatically preempt the lower-performance backup.

VRRP Authentication

If a password is set for VRRP authentication, the authentication type must also be defined. If the password is set and authentication type is not defined, the system generates an error when you try to commit the configuration.

Similarly, you cannot delete the VRRP password without also deleting the VRRP authentication type. If you do, the system generates an error when you try to commit the configuration.

If you delete both the VRRP authentication password and authentication type, VRRP authentication is disabled.

VRRP Sync Groups

Interfaces in a VRRP synchronization group ("sync group") are synchronized such that, if one of the interfaces in the group fails over to backup, all interfaces in the group fail over to backup.

For example, in many cases, if one interface on a master router fails, the whole router should fail over to a backup router. By assigning all the interfaces on the master to a sync group, the failure of one interface will trigger a failover of all the interfaces in the sync group to the backups configured for each interface in the sync group.

VRRP Configuration Examples

This section presents the following topics:

Basic VRRP Configuration

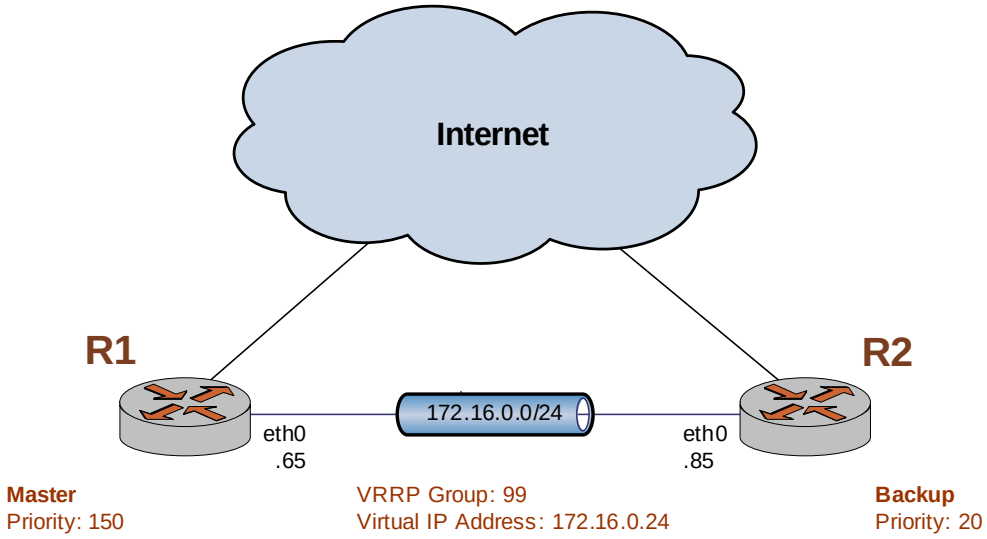
This sequence sets up a basic VRRP configuration between two Vyatta systems.

Remember that in VRRP:

- The system configured with the highest priority will initially be elected the master router. If more than one system has the highest priority, then the first active system will be elected the master router.
- Enabling preemption will allow a higher-priority neighbor to preempt the current master and become master itself.

In this section, a sample configuration is presented for VRRP. When you have finished, the system will be configured as shown in Figure 2-1.

Figure 2-1 VRRP



This section includes the following configuration examples:

- Example 2-1 Configuring the master system for VRRP

- Example 2-2 Configuring the backup system for VRRP

Configuring the Master System

Example 2-1 enables VRRP on eth0 of the master system (R1) and assigns it to VRRP group 99. The virtual address is 172.16.0.24/24. Preemption is enabled, and R1 is assigned a priority of 150.

To configure the first system for VRRP, perform the following steps in configuration mode:

Example 2-1 Configuring the master system for VRRP

Step	Command
Create the VRRP configuration node for eth0 on R1. This enables VRRP on that interface. Assign the VRRP group.	`vyatta@R1# set interfaces ethernet eth0 vrrp vrrp-group 99`
Specify the virtual address of the VRRP group.	`vyatta@R1# set interfaces ethernet eth0 vrrp vrrp-group 99 virtual-address 172.16.0.24/24`
Enable preemption.	`vyatta@R1# set interfaces ethernet eth0 vrrp vrrp-group 99 preempt true`
Set the priority of this system to 150.	`vyatta@R1# set interfaces ethernet eth0 vrrp vrrp-group 99 priority 150`
Commit the configuration.	`vyatta@R1# commit`

Display the configuration.	`vyatta@R1# show interfaces ethernet eth0 vrrp`
	`vrrp-group 99 {`
	`  preempt true`
	`  priority 150`
	`  virtual-address 172.16.0.24/24`
	`}`

Configuring the Backup System

Example 2-2 enables VRRP on eth0 of the backup system (R2), and assigns it to VRRP group 99. The virtual address is the same as that for R1: 172.16.0.24/24. Preemption is enabled, and R2 is assigned a priority of 20. This is lower than the priority of R1, so R1 will be the master and R2 will be the backup under ordinary circumstances.

To configure the backup system for VRRP, perform the following steps in configuration mode:

Example 2-2 Configuring the backup system for VRRP

Step	Command
Create the VRRP configuration node for eth0 of R2. This enables VRRP on that interface. Assign the VRRP group.	`vyatta@R2# set interfaces ethernet eth0 vrrp vrrp-group 99`
Specify the virtual address of the VRRP group.	`vyatta@R2# set interfaces ethernet eth0 vrrp vrrp-group 99 virtual-address 172.16.0.24/24`
Enable preemption.	`vyatta@R2# set interfaces ethernet eth0 vrrp vrrp-group 99 preempt true`
Set the priority of this system to 20. This is a lower priority than that set for R1, so R1 will become the master.	`vyatta@R2# set interfaces ethernet eth0 vrrp vrrp-group 99 priority 20`
Commit the configuration.	`vyatta@R2# commit`

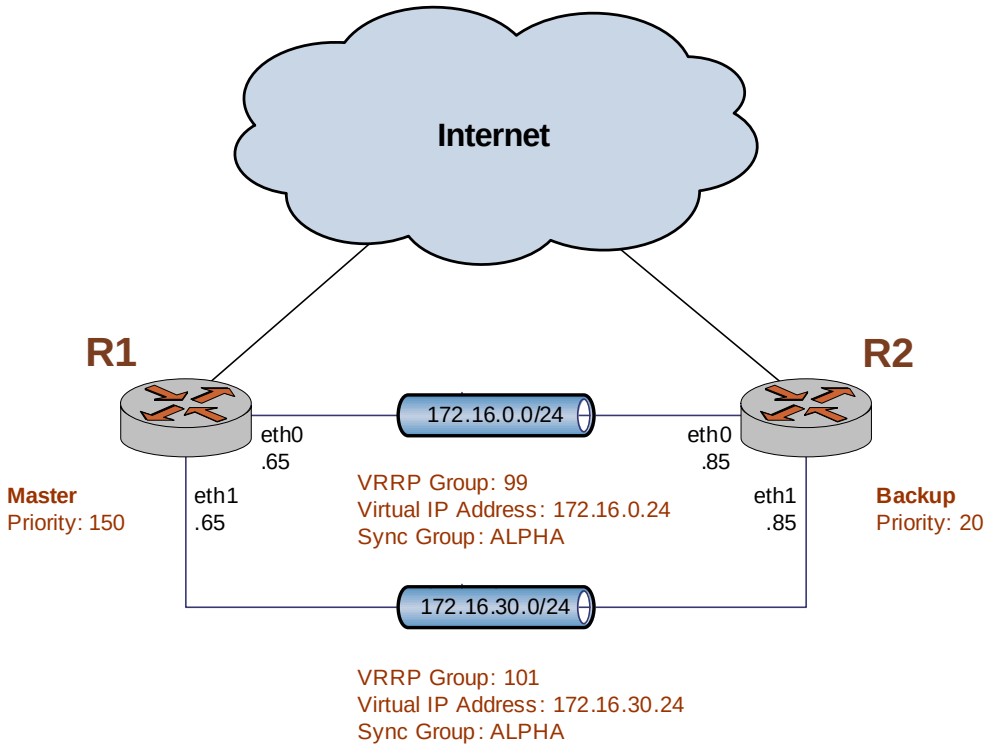
Display the configuration.	`vyatta@R1# show interfaces ethernet eth0 vrrp`
	`vrrp-group 99 {`
	`  preempt true`
	`  priority 20`
	`  virtual-address 172.16.0.24/24`
	`}`

VRRP Configuration with a Sync Group

This example builds on the previous example by adding an interface to each system, specifying a VRRP group and virtual IP address for these interfaces, and then including all interfaces in a sync group so that if one of the interfaces on the master fails, all interfaces on the master pass control to interfaces on the backup system.

When you have finished, the system will be configured as shown in Figure 2-2.

Figure 2-2 VRRP with a sync group



This section includes the following configuration examples:

- Example 2-3 Configuring the master system for VRRP with a sync group
- Example 2-4 Configuring the backup system for VRRP with a sync group

CONFIGURING THE MASTER SYSTEM

To configure the master system for VRRP with a sync group , perform the following steps in configuration mode:

Example 2-3 Configuring the master system for VRRP with a sync group

Step	Command
Add the sync group configuration to the existing configuration for VRRP group 99 on eth0.	`vyatta@R1# set interfaces ethernet eth0 vrrp vrrp-group 99 sync-group ALPHA`

Example 2-3 Configuring the master system for VRRP with a sync group

Display the VRRP configuration on eth0.	`vyatta@R1# show interfaces ethernet eth0 vrrp`
	`vrrp-group 99 {`
	`preempt true`
	`priority 150`
	`sync-group ALPHA`
	`virtual-address 172.16.0.24/24`
	`}`

Create the VRRP configuration node for eth1 on R1. This enables VRRP on that interface. Assign the VRRP group.	`vyatta@R1# set interfaces ethernet eth1 vrrp vrrp-group 101`
Specify the virtual address of the VRRP group.	`vyatta@R1# set interfaces ethernet eth1 vrrp vrrp-group 101 virtual-address 172.16.30.24/24`
Enable preemption.	`vyatta@R1# set interfaces ethernet eth1 vrrp vrrp-group 101 preempt true`
Set the priority of this system to 150.	`vyatta@R1# set interfaces ethernet eth1 vrrp vrrp-group 101 priority 150`
Add the VRRP group on eth1 to the sync group.	`vyatta@R1# set interfaces ethernet eth1 vrrp vrrp-group 101 sync-group ALPHA`
Commit the configuration.	`vyatta@R1# commit`

Display the configuration.	`vyatta@R1# show interfaces ethernet eth1 vrrp`
	`vrrp-group 101 {`
	`preempt true`
	`priority 150`
	`sync-group ALPHA`
	`virtual-address 172.16.30.24/24`
	`}`

Configuring the Backup System

To configure the backup system for VRRP with a sync group, perform the following steps in configuration mode:

Example 2-4 Configuring the backup system for VRRP with a sync group

Step	Command
Add the sync group configuration to the existing configuration for VRRP group 99 on eth0.	`vyatta@R2# set interfaces ethernet eth0 vrrp vrrp-group 99 sync-group ALPHA`

Example 2-4 Configuring the backup system for VRRP with a sync group

Display the VRRP configuration on eth0.	`vyatta@R2# show interfaces ethernet eth0 vrrp`
	`vrrp-group 99 {`
	`  preempt true`
	`  priority 20`
	`  sync-group ALPHA`
	`  virtual-address 172.16.0.24/24`
	`}`

Create the VRRP configuration node for eth1 on R2. This enables VRRP on that interface. Assign the VRRP group.	`vyatta@R2# set interfaces ethernet eth1 vrrp vrrp-group 101`
Specify the virtual address of the VRRP group.	`vyatta@R2# set interfaces ethernet eth1 vrrp vrrp-group 101 virtual-address 172.16.30.24/24`
Enable preemption.	`vyatta@R2# set interfaces ethernet eth1 vrrp vrrp-group 101 preempt true`
Set the priority of this system to 20.	`vyatta@R2# set interfaces ethernet eth1 vrrp vrrp-group 101 priority 20`
Add the VRRP group on eth1 to the sync group.	`vyatta@R2# set interfaces ethernet eth1 vrrp vrrp-group 101 sync-group ALPHA`
Commit the configuration.	`vyatta@R2# commit`

Display the configuration.	`vyatta@R2# show interfaces ethernet eth1 vrrp`
	`vrrp-group 101 {`
	`  preempt true`
	`  priority 20`
	`  sync-group ALPHA`
	`  virtual-address 172.16.30.24/24`
	`}`

VRRP Commands

This section presents the following commands.

Configuration Commands	
interfaces <interface> vrrp vrrp-group <group-id>	Assigns an Ethernet interface to a VRRP group.
interfaces <interface> vrrp vrrp-group <group-id> advertise-interval <interval>	Sets the advertisement interval for a VRRP group on an interface.
interfaces <interface> vrrp vrrp-group <group-id> authentication password <pwd>	Sets the VRRP authentication password for a VRRP group on an interface.
interfaces <interface> vrrp vrrp-group <group-id> authentication type <type>	Specifies the VRRP authentication type for a VRRP group on an interface.
interfaces <interface> vrrp vrrp-group <group-id> description <desc>	Specifies a description for a VRRP group on an interface.
interfaces <interface> vrrp vrrp-group <group-id> disable	Disables a VRRP group.
interfaces <interface> vrrp vrrp-group <group-id> hello-source-address <addr>	Specifies the source address for VRRP hello packets.
interfaces <interface> vrrp vrrp-group <group-id> preempt <preempt>	Enables or disables preemption for a VRRP group on an interface.
interfaces <interface> vrrp vrrp-group <group-id> preempt-delay <delay>	Sets the preemption delay for a VRRP group on an interface.
interfaces <interface> vrrp vrrp-group <group-id> priority <priority>	Sets the priority of an interface within a VRRP group.
interfaces <interface> vrrp vrrp-group <group-id> run-transition-scripts	Specify a script to run on VRRP state transition.
interfaces <interface> vrrp vrrp-group <group-id> sync-group <group>	Assigns an interface to a VRRP sync group.
interfaces <interface> vrrp vrrp-group <group-id> virtual-address <addr>	Sets the virtual IP address or network address for a VRRP group on an interface.
Operational Commands	
clear vrrp master interface <interface> group <group-id>	Forces a VRRP state transition to the backup state.
restart vrrp	Restarts the VRRP process.
show vrrp	Displays information about VRRP groups.

clear vrrp master interface <interface> group <group-id>

Forces a VRRP state transition to the backup state.

Syntax

clear vrrp master interface *interface* **group** *group-id*

Command Mode

Operational mode.

Parameters

interface	The interface to force to backup. The type of interface. For detailed keywords and arguments that can be specified as interface types, see the table in the Usage Guidelines below.
group-id	The group within the interface to force to the backup state.

Default

None.

Usage Guidelines

Use this command to force the current master to transition to the backup state.

The following table shows the syntax and parameters for supported interface types.

Interface Type	Syntax	Parameters
Bonding	bonding *bondx*	*bondx* The identifier for the bonding interface. Supported values are **bond0** through **bond99**.
Bonding Vif	bonding *bondx* vif *vlan-id*	*bondx* The identifier for the bonding interface. Supported values are **bond0** through **bond99**. *vlan-id* The VLAN ID for the vif. The range is 0 to 4094.
Ethernet	ethernet *ethx*	*ethx* The name of an Ethernet interface. The range is **eth0** through **eth23**, depending on the physical interfaces available on your system.

Interface Type	Syntax	Parameters
Ethernet Vif	ethernet *ethx* vif *vlan-id*	*ethx* The name of an Ethernet interface. The range is **eth0** through **eth23**, depending on the physical interfaces available on your system. *vlan-id* The VLAN ID for the vif. The range is 0 to 4094.

Examples

Example 2-5 shows sample output for the **clear vrrp master interface <interface> group <group-id>** command. Notice that prior to the command running the "State" is "master" and afterwards it is "backup". Also notice the change in "Master router".

Example 2-5 Forcing the VRRP master into the backup state

```
vyatta@vyatta:~$ show vrrp interface eth1
Physical interface: eth1.4001, Address 172.16.40.160
  Interface state: up, Group 200, State: master
  Priority: 201, Advertisement interval: 1, Authentication type: none
  Preempt: false, VIP count: 2, VIP: 172.16.40.100
                                     172.16.40.101
  Master router: 172.16.40.160
  Last transition: 51s

vyatta@vyatta:~$ clear vrrp master interface eth1.4001 group 200
Forcing eth1.4001-200 to BACKUP...
vyatta@vyatta:~$ show vrrp interface eth1
Physical interface: eth1.4001, Address 172.16.40.160
  Interface state: up, Group 200, State: backup
  Priority: 201, Advertisement interval: 1, Authentication type: none
  Preempt: false, VIP count: 2, VIP: 172.16.40.100
                                     172.16.40.101
  Master router: 172.16.40.128 [00:0C:29:11:B2:75], Master Priority: 200
  Last transition: 3s

vyatta@vyatta:~$
```

restart vrrp

Restarts the VRRP process.

Syntax

restart vrrp process

Command Mode

Operational mode.

Parameters

None.

Default

None.

Usage Guidelines

Use this command to restart the VRRP process.

interfaces <interface> vrrp vrrp-group <group-id>

Assigns an Ethernet interface to a VRRP group.

Syntax

set interfaces *interface* **vrrp vrrp-group** *group-id*

delete interfaces *interface* **vrrp vrrp-group** *group-id*

show interfaces *interface* **vrrp vrrp-group** *group-id*

Command Mode

Configuration mode.

Configuration Statement

```
interfaces interface {
    vrrp {
        vrrp-group group-id {
        }
    }
}
```

Parameters

interface	Mandatory. The type of interface. For detailed keywords and arguments that can be specified as interface types, see the table in the Usage Guidelines below.
group-id	Mandatory. Multi-node. An integer uniquely identifying a VRRP group. The range is 1 to 255. The default is 1. You can assign an interface to multiple VRRP groups by creating multiple **vrrp-group** configuration nodes within the **interfaces *interface*** configuration node.

Default

The default is 1.

Usage Guidelines

Use this command to assign a virtual interface to a VRRP group on an interface.

A VRRP group consists of a cluster of interfaces and/or vifs providing redundancy for the primary, or "master," interface in the group. Redundancy is managed by the VRRP process on the system.

The VRRP group has a unique numeric identifier and is assigned a single virtual IP address (sometimes called a virtual IP or VIP). The virtual address is linked with the MAC address of the master router. If the master router fails, a new master is elected and the new master notifies the network of its MAC address by issuing a gratuitous ARP.

All interfaces in the group must be assigned the same VRRP group identifier and virtual address; otherwise they cannot provide redundancy for one another. Interfaces being mapped to the virtual address must be on the same subnet as the virtual address, but should not have the same address as the virtual address.

An interface or virtual interface can belong to more than one VRRP group.

The following table shows the syntax and parameters for supported interface types.

Interface Type	Syntax	Parameters
Bonding	bonding *bondx*	*bondx* The identifier for the bonding interface. Supported values are **bond0** through **bond99**.
Bonding Vif	bonding *bondx* vif *vlan-id*	*bondx* The identifier for the bonding interface. Supported values are **bond0** through **bond99**. *vlan-id* The VLAN ID for the vif. The range is 0 to 4094.
Ethernet	ethernet *ethx*	*ethx* The name of an Ethernet interface. The range is **eth0** through **eth23**, depending on the physical interfaces available on your system.
Ethernet Vif	ethernet *ethx* vif *vlan-id*	*ethx* The name of an Ethernet interface. The range is **eth0** through **eth23**, depending on the physical interfaces available on your system. *vlan-id* The VLAN ID for the vif. The range is 0 to 4094.

Use the **set** form of the command to assign an interface to a VRRP group.

Use the **delete** form of the command to remove an interface from a VRRP group.

Use the **show** form of the command to view VRRP group configuration settings for an interface.

interfaces <interface> vrrp vrrp-group <group-id> advertise-interval <interval>

Sets the advertisement interval for a VRRP group on an interface.

Syntax

set interfaces *interface* **vrrp vrrp-group** *group-id* **advertise-interval** *interval*

delete interfaces *interface* **vrrp vrrp-group** *group-id* **advertise-interval**

show interfaces *interface* **vrrp vrrp-group** *group-id* **advertise-interval**

Command Mode

Configuration mode.

Configuration Statement

```
interfaces interface {
    vrrp {
        vrrp-group group-id {
            advertise-interval interval
        }
    }

}
```

Parameters

interface	Mandatory. The type of interface. For detailed keywords and arguments that can be specified as interface types, see the table in the Usage Guidelines below.
group-id	Mandatory. The VRRP group being configured. The range is 1 to 255.
interval	Optional. The interval in seconds between VRRP advertisement packets. All interfaces in this VRRP group must use the same advertisement interval. The range is 1 to 255. The default is 1.

Default

The master router sends VRRP advertisements 1-second intervals.

Usage Guidelines

Use this command to set the interval between VRRP advertisements.

To signal that it is still in service, the master interface or vif sends MAC-level multicast "heartbeat" packets called advertisements to the LAN segment, using the IP address 224.0.0.18, , which is the IPv4 multicast address assigned to VRRP. These advertisements confirm the health of the master to backup routers and contain other VRRP information, such as the master's priority.

If the master fails to send advertisements for some number of intervals, the master is declared out of service, and the VRRP process triggers failover to the backup interface. In this case, the backup interface with the highest priority is elected as the new master. The new master assumes the virtual address and notifies the network of its MAC address by issuing a gratuitous ARP message.

The following table shows the syntax and parameters for supported interface types.

Interface Type	Syntax	Parameters
Bonding	bonding *bondx*	*bondx* The identifier for the bonding interface. Supported values are **bond0** through **bond99**.
Bonding Vif	bonding *bondx* vif *vlan-id*	*bondx* The identifier for the bonding interface. Supported values are **bond0** through **bond99**. *vlan-id* The VLAN ID for the vif. The range is 0 to 4094.
Ethernet	ethernet *ethx*	*ethx* The name of an Ethernet interface. The range is **eth0** through **eth23**, depending on the physical interfaces available on your system.
Ethernet Vif	ethernet *ethx* vif *vlan-id*	*ethx* The name of an Ethernet interface. The range is **eth0** through **eth23**, depending on the physical interfaces available on your system. *vlan-id* The VLAN ID for the vif. The range is 0 to 4094.

Use the **set** form of the command to set the VRRP advertise interval for a VRRP group on an interface.

Use the **delete** form of the command to restore the default value for VRRP advertise interval for a VRRP group on an interface.

Use the **show** form of the command to view VRRP advertise interval configuration.

interfaces <interface> vrrp vrrp-group <group-id> authentication password <pwd>

Sets the VRRP authentication password for a VRRP group on an interface.

Syntax

set interfaces *interface* **vrrp vrrp-group** *group-id* **authentication password** *pwd*

delete interfaces *interface* **vrrp vrrp-group** *group-id* **authentication password**

show interfaces *interface* **vrrp vrrp-group** *group-id* **authentication password**

Command Mode

Configuration mode.

Configuration Statement

```
interfaces interface {
    vrrp {
        vrrp-group group-id {
            authentication {
                password pwd
            }
        }
    }
}
```

Parameters

interface	Mandatory. The type of interface. For detailed keywords and arguments that can be specified as interface types, see the table in the Usage Guidelines below.
group-id	Mandatory. The VRRP group being configured. The range is 1 to 255.
pwd	Mandatory. The password the interface will use to authenticate itself as a member of the VRRP group.

Default

Interfaces are not required to authenticate themselves to the VRRP group.

Usage Guidelines

Use this command to set a password for VRRP authentication on an interface.

If a password is set for VRRP authentication, the authentication type (AH or plaintext-password) must also be defined. If the password is set and authentication type is not defined, the system will generate an error when you try to commit the configuration.

The following table shows the syntax and parameters for supported interface types.

Interface Type	Syntax	Parameters
Bonding	bonding *bondx*	*bondx* The identifier for the bonding interface. Supported values are **bond0** through **bond99**.
Bonding Vif	bonding *bondx* vif *vlan-id*	*bondx* The identifier for the bonding interface. Supported values are **bond0** through **bond99**. *vlan-id* The VLAN ID for the vif. The range is 0 to 4094.
Ethernet	ethernet *ethx*	*ethx* The name of an Ethernet interface. The range is **eth0** through **eth23**, depending on the physical interfaces available on your system.
Ethernet Vif	ethernet *ethx* vif *vlan-id*	*ethx* The name of an Ethernet interface. The range is **eth0** through **eth23**, depending on the physical interfaces available on your system. *vlan-id* The VLAN ID for the vif. The range is 0 to 4094.

Use the **set** form of the command to specify a VRRP authentication password for a VRRP group on an interface.

Use the **delete** form of the command to delete the VRRP authentication password.

- You cannot delete the VRRP password without also deleting the VRRP authentication type. If you do, the system will generate an error when you try to commit the configuration.
- If you delete both the VRRP authentication password and authentication type, VRRP authentication is disabled on the interface.

Use the **show** form of the command to view the VRRP authentication password for a VRRP group on an interface.

interfaces <interface> vrrp vrrp-group <group-id> authentication type <type>

Specifies the VRRP authentication type for a VRRP group on an interface.

Syntax

set interfaces *interface* **vrrp vrrp-group** *group-id* **authentication type** *type*

delete interfaces *interface* **vrrp vrrp-group** *group-id* **authentication type**

show interfaces *interface* **vrrp vrrp-group** *group-id* **authentication type**

Command Mode

Configuration mode.

Configuration Statement

```
interfaces interface {
    vrrp {
        vrrp-group group-id {
            authentication {
                type type
            }
        }
    }
}
```

Parameters

interface	Mandatory. The type of interface. For detailed keywords and arguments that can be specified as interface types, see the table in the Usage Guidelines below.
group-id	Mandatory. The VRRP group being configured. The range is 1 to 255.
type	The type of authentication to be used. Supported values are as follows: **ah**: The IP Authentication Header (AH) protocol is used. **plaintext-password**: Plain-text password authentication is used.

Default

Interfaces are not required to authenticate themselves to the VRRP group.

Usage Guidelines

Use this command to set the authentication type for VRRP authentication on an interface.

If the authentication type is set for VRRP authentication, a password must also be specified. If the authentication type is defined and a password is not set, the system will generate an error when you try to commit the configuration.

The following table shows the syntax and parameters for supported interface types.

Interface Type	Syntax	Parameters
Bonding	bonding *bondx*	*bondx* The identifier for the bonding interface. Supported values are **bond0** through **bond99**.
Bonding Vif	bonding *bondx* vif *vlan-id*	*bondx* The identifier for the bonding interface. Supported values are **bond0** through **bond99**. *vlan-id* The VLAN ID for the vif. The range is 0 to 4094.
Ethernet	ethernet *ethx*	*ethx* The name of an Ethernet interface. The range is **eth0** through **eth23**, depending on the physical interfaces available on your system.
Ethernet Vif	ethernet *ethx* vif *vlan-id*	*ethx* The name of an Ethernet interface. The range is **eth0** through **eth23**, depending on the physical interfaces available on your system. *vlan-id* The VLAN ID for the vif. The range is 0 to 4094.

Use the **set** form of the command to specify the VRRP authentication type for a VRRP group on an interface.

Use the **delete** form of the command to delete the authentication type.

- You cannot delete the VRRP authentication type without also deleting the VRRP password. If you do, the system will generate an error when you try to commit the configuration.
- If you delete both the VRRP authentication password and authentication type, VRRP authentication is disabled on the interface.

Use the **show** form of the command to view the VRRP authentication password for a VRRP group on an interface.

interfaces <interface> vrrp vrrp-group <group-id> description <desc>

Specifies a description for a VRRP group on an interface.

Syntax

set interfaces *interface* **vrrp vrrp-group** *group-id* **description** *desc*

delete interfaces *interface* **vrrp vrrp-group** *group-id* **description**

show interfaces *interface* **vrrp vrrp-group** *group-id* **description**

Command Mode

Configuration mode.

Configuration Statement

```
interfaces interface {
    vrrp {
        vrrp-group group-id {
            description desc
        }
    }
}
```

Parameters

interface	Mandatory. The type of interface. For detailed keywords and arguments that can be specified as interface types, see the table in the Usage Guidelines below.
group-id	Mandatory. The VRRP group being configured. The range is 1 to 255.
desc	A description for the VRRP group on a vif.

Default

Preemption is enabled.

Usage Guidelines

Use this command to provide a description for the VRRP group.

The following table shows the syntax and parameters for supported interface types.

Interface Type	Syntax	Parameters
Bonding	bonding *bondx*	*bondx* The identifier for the bonding interface. Supported values are **bond0** through **bond99**.
Bonding Vif	bonding *bondx* vif *vlan-id*	*bondx* The identifier for the bonding interface. Supported values are **bond0** through **bond99**. *vlan-id* The VLAN ID for the vif. The range is 0 to 4094.
Ethernet	ethernet *ethx*	*ethx* The name of an Ethernet interface. The range is **eth0** through **eth23**, depending on the physical interfaces available on your system.
Ethernet Vif	ethernet *ethx* vif *vlan-id*	*ethx* The name of an Ethernet interface. The range is **eth0** through **eth23**, depending on the physical interfaces available on your system. *vlan-id* The VLAN ID for the vif. The range is 0 to 4094.

Use the **set** form of the command to provide a description for the VRRP.

Use the **delete** form of the command to provide a description for the VRRP.

Use the **show** form of the command to view VRRP configuration.

interfaces <interface> vrrp vrrp-group <group-id> disable

Disables a VRRP group.

Syntax

set interfaces *interface* **vrrp vrrp-group** *group-id* **disable**

delete interfaces *interface* **vrrp vrrp-group** *group-id* **disable**

show interfaces *interface* **vrrp vrrp-group** *group-id*

Command Mode

Configuration mode.

Configuration Statement

```
interfaces interface {
    vrrp {
        vrrp-group group-id {
            disable
        }
    }
}
```

Parameters

interface	Mandatory. The type of interface. For detailed keywords and arguments that can be specified as interface types, see the table in the Usage Guidelines below.
group-id	Mandatory. The VRRP group being configured. The range is 1 to 255.

Default

The VRRP group is enabled.

Usage Guidelines

Use this command to disable a VRRP group on an Ethernet interface without deleting VRRP configuration for the group. Later, you can reenable the VRRP group by deleting this option.

The following table shows the syntax and parameters for supported interface types.

Interface Type	Syntax	Parameters
Bonding	bonding *bondx*	*bondx* The identifier for the bonding interface. Supported values are **bond0** through **bond99**.
Bonding Vif	bonding *bondx* vif *vlan-id*	*bondx* The identifier for the bonding interface. Supported values are **bond0** through **bond99**. *vlan-id* The VLAN ID for the vif. The range is 0 to 4094.
Ethernet	ethernet *ethx*	*ethx* The name of an Ethernet interface. The range is **eth0** through **eth23**, depending on the physical interfaces available on your system.
Ethernet Vif	ethernet *ethx* vif *vlan-id*	*ethx* The name of an Ethernet interface. The range is **eth0** through **eth23**, depending on the physical interfaces available on your system. *vlan-id* The VLAN ID for the vif. The range is 0 to 4094.

Use the **set** form of the command to disable a VRRP group.

Use the **delete** form of the command to reenable a VRRP group.

Use the **show** form of the command to view VRRP group configuration.

interfaces <interface> vrrp vrrp-group <group-id> hello-source-address <addr>

Specifies the source address for VRRP hello packets.

Syntax

set interfaces *interface* **vrrp vrrp-group** *group-id* **hello-source-address** *addr*

delete interfaces *interface* **vrrp vrrp-group** *group-id* **hello-source-address** *addr*

show interfaces *interface* **vrrp vrrp-group** *group-id* **hello-source-address**

Command Mode

Configuration mode.

Configuration Statement

```
interfaces interface {
    vrrp {
        vrrp-group group-id {
            hello-source-address addr
        }
    }
}
```

Parameters

interface	Mandatory. The type of interface. For detailed keywords and arguments that can be specified as interface types, see the table in the Usage Guidelines below.
group-id	Mandatory. The VRRP group being configured. The range is 1 to 255.
addr	Mandatory. The IP address to use as the VRRP source address when sending VRRP hello packets. The format is *ipv4-addr*. The address must already be defined on an interface.

Default

The IP address of the interface is used as the source for VRRP hello packets.

Usage Guidelines

Use this command to specify the source address for VRRP hello packets. This is typically used when an address other than the default address for the interface is required. Note that the address must be defined on an interface already

The following table shows the syntax and parameters for supported interface types.

Interface Type	Syntax	Parameters
Bonding	bonding *bondx*	*bondx* The identifier for the bonding interface. Supported values are **bond0** through **bond99**.
Bonding Vif	bonding *bondx* vif *vlan-id*	*bondx* The identifier for the bonding interface. Supported values are **bond0** through **bond99**. *vlan-id* The VLAN ID for the vif. The range is 0 to 4094.
Ethernet	ethernet *ethx*	*ethx* The name of an Ethernet interface. The range is **eth0** through **eth23**, depending on the physical interfaces available on your system.
Ethernet Vif	ethernet *ethx* vif *vlan-id*	*ethx* The name of an Ethernet interface. The range is **eth0** through **eth23**, depending on the physical interfaces available on your system. *vlan-id* The VLAN ID for the vif. The range is 0 to 4094.

Use the **set** form of the command to specify the source address for VRRP hello packets.

Use the **delete** form of the command to restore the default source address.

Use the **show** form of the command to view the configuration.

interfaces <interface> vrrp vrrp-group <group-id> preempt <preempt>

Enables or disables preemption for a VRRP group on an interface.

Syntax

set interfaces *interface* **vrrp vrrp-group** *group-id* **preempt** *preempt*

delete interfaces *interface* **vrrp vrrp-group** *group-id* **preempt**

show interfaces *interface* **vif vrrp vrrp-group** *group-id* **preempt**

Command Mode

Configuration mode.

Configuration Statement

```
interfaces interface {
    vrrp {
        vrrp-group group-id {
            preempt preempt
        }
    }
}
```

Parameters

interface	Mandatory. The type of interface. For detailed keywords and arguments that can be specified as interface types, see the table in the Usage Guidelines below.
group-id	Mandatory. The VRRP group being configured. The range is 1 to 255.

preempt	Optional. Allows a higher-priority VRRP backup router to assert itself as master over a lower-priority master router. Supported values are as follows: **true**: Allow the master router to be preempted by a backup router with higher priority. **false**: Do not allow the master router to be preempted by a backup router with higher priority. The default is **true**; that is, the master router can be preempted by a backup router with higher priority.

Default

Preemption is enabled.

Usage Guidelines

Use this command to enable or disable preemption on an interface.

If preemption is enabled, a backup router with a higher priority than the current master will "preempt" the master, and become the master itself.

A backup router preempts the master by beginning to send out its own VRRP advertisements. The master router examines these, and discovers that the backup router has a higher priority than itself. The master then stops sending out advertisements, while the backup continues to send, thus making itself the new master.

Preemption is useful in situation where a lower-performance backup router becomes master when a higher-performance router fails. In this case, a new higher-performance router can be brought online, and it will automatically preempt the lower-performance backup.

The following table shows the syntax and parameters for supported interface types.

Interface Type	Syntax	Parameters
Bonding	bonding *bondx*	*bondx* The identifier for the bonding interface. Supported values are **bond0** through **bond99**.
Bonding Vif	bonding *bondx* vif *vlan-id*	*bondx* The identifier for the bonding interface. Supported values are **bond0** through **bond99**. *vlan-id* The VLAN ID for the vif. The range is 0 to 4094.
Ethernet	ethernet *ethx*	*ethx* The name of an Ethernet interface. The range is **eth0** through **eth23**, depending on the physical interfaces available on your system.

Interface Type	Syntax	Parameters
Ethernet Vif	ethernet *ethx* vif *vlan-id*	*ethx* The name of an Ethernet interface. The range is **eth0** through **eth23**, depending on the physical interfaces available on your system. *vlan-id* The VLAN ID for the vif. The range is 0 to 4094.

Use the **set** form of the command to enable or disable VRRP preemption on an interface.

Use the **delete** form of the command to restore the default value for VRRP preemption on an interface.

Use the **show** form of the command to view VRRP preemption configuration on an interface.

interfaces <interface> vrrp vrrp-group <group-id> preempt-delay <delay>

Sets the preemption delay for a VRRP group on an interface.

Syntax

set interfaces *interface* **vrrp vrrp-group** *group-id* **preempt-delay** *delay*

delete interfaces *interface* **vrrp vrrp-group** *group-id* **preempt-delay**

show interfaces *interface* **vif vrrp vrrp-group** *group-id* **preempt-delay**

Command Mode

Configuration mode.

Configuration Statement

```
interfaces interface {
    vrrp {
        vrrp-group group-id {
            preempt-delay delay
        }
    }
}
```

Parameters

interface	Mandatory. The type of interface. For detailed keywords and arguments that can be specified as interface types, see the table in the Usage Guidelines below.
group-id	Mandatory. The VRRP group being configured. The range is 1 to 255.
delay	The amount of time to postpone preemption, in seconds. The range is 0 to 3600 (1 hour), where 0 means no delay. The default is 0.

Default

A router preempting another router does not wait.

Usage Guidelines

Use this command to set the preemption delay on an interface. The preemption delay is the amount of time a router must wait before preempting a lower-priority VRRP router and becoming the master.

The following table shows the syntax and parameters for supported interface types.

Interface Type	Syntax	Parameters
Bonding	bonding *bondx*	*bondx* The identifier for the bonding interface. Supported values are **bond0** through **bond99**.
Bonding Vif	bonding *bondx* vif *vlan-id*	*bondx* The identifier for the bonding interface. Supported values are **bond0** through **bond99**. *vlan-id* The VLAN ID for the vif. The range is 0 to 4094.
Ethernet	ethernet *ethx*	*ethx* The name of an Ethernet interface. The range is **eth0** through **eth23**, depending on the physical interfaces available on your system.
Ethernet Vif	ethernet *ethx* vif *vlan-id*	*ethx* The name of an Ethernet interface. The range is **eth0** through **eth23**, depending on the physical interfaces available on your system. *vlan-id* The VLAN ID for the vif. The range is 0 to 4094.

Use the **set** form of the command to set the preemption delay.

Use the **delete** form of the command to restore the default value preemption delay

Use the **show** form of the command to view preemption delay configuration on an interface.

interfaces <interface> vrrp vrrp-group <group-id> priority <priority>

Sets the priority of an interface within a VRRP group.

Syntax

set interfaces *interface* **vrrp vrrp-group** *group-id* **priority** *priority*

delete interfaces *interface* **vrrp vrrp-group** *group-id* **priority**

show interfaces *interface* **vrrp vrrp-group** *group-id* **priority**

Command Mode

Configuration mode.

Configuration Statement

```
interfaces interface {
    vrrp {
        vrrp-group group-id {
            priority priority
        }
    }
}
```

Parameters

interface	Mandatory. The type of interface. For detailed keywords and arguments that can be specified as interface types, see the table in the Usage Guidelines below.
group-id	Mandatory. The VRRP group being configured. The range is 1 to 255.
priority	Mandatory. The priority with which this interface should be considered for election as master within the VRRP group. The higher the configured number, the higher the priority. The range for a VRRP backup router is from 1 to 254. The VRRP master router must have the highest priority, and typically has a priority of 255. The default is 1.

Default

The default is 1.

Usage Guidelines

Use this command to set the VRRP priority of a real interface. This determines the likelihood of its being elected the master router in a cluster of VRRP routers.

The master interface in the VRRP group is elected master based on its priority, where the higher the configured number, the higher the priority. If the master interface fails, the interface with the next highest priority is elected master and assumes the virtual address of the group. The new master notifies the network of its MAC address by sending out a gratuitous ARP message.

The priority of the master interface is typically set to 255. The backup interface can be left with the default priority; however, if more than one interface is acting as backup, they should be configured with different priorities.

The following table shows the syntax and parameters for supported interface types.

Interface Type	Syntax	Parameters
Bonding	bonding *bondx*	*bondx* The identifier for the bonding interface. Supported values are **bond0** through **bond99**.
Bonding Vif	bonding *bondx* vif *vlan-id*	*bondx* The identifier for the bonding interface. Supported values are **bond0** through **bond99**. *vlan-id* The VLAN ID for the vif. The range is 0 to 4094.
Ethernet	ethernet *ethx*	*ethx* The name of an Ethernet interface. The range is **eth0** through **eth23**, depending on the physical interfaces available on your system.
Ethernet Vif	ethernet *ethx* vif *vlan-id*	*ethx* The name of an Ethernet interface. The range is **eth0** through **eth23**, depending on the physical interfaces available on your system. *vlan-id* The VLAN ID for the vif. The range is 0 to 4094.

Use the **set** form of the command to specify the VRRP group priority for the interface.

Use the **delete** form of the command to remove the VRRP group priority from the interface.

Use the **show** form of the command to view the VRRP group priority for the interface.

interfaces <interface> vrrp vrrp-group <group-id> run-transition-scripts

Specify a script to run on VRRP state transition.

Syntax

set interfaces *interface* **vrrp vrrp-group** *group-id* **run-transition-scripts** [**backup** | **fault** | **master**] *script*

delete interfaces *interface* **vrrp vrrp-group** *group-id* **run-transition-scripts** [**backup** | **fault** | **master**]

show interfaces *interface* **vrrp vrrp-group** *group-id* **run-transition-scripts** [**backup** | **fault** | **master**]

Command Mode

Configuration mode.

Configuration Statement

```
interfaces interface {
    vrrp {
        vrrp-group group-id {
            run-transition-scripts {
                backup script
                fault script
                master script
            }
        }
    }
}
```

Parameters

interface	Mandatory. The type of interface. For detailed keywords and arguments that can be specified as interface types, see the table in the Usage Guidelines below.
group-id	Mandatory. The VRRP group being configured. The range is 1 to 255.

backup *script*	The name of the executable script to run during VRRP state transition to the backup state.
fault *script*	The name of the executable script to run during VRRP state transition to the fault state.
master *script*	The name of the executable script to run during VRRP state transition to the master state.

Default

None.

Usage Guidelines

Use this command to specify a script to run when the VRRP group on the specified interface changes state. The state is either backup, fault, or master. Script files are assumed to be in /config/scripts unless an absolute path is specified.

The following table shows the syntax and parameters for supported interface types.

Interface Type	Syntax	Parameters
Bonding	bonding *bondx*	*bondx* The identifier for the bonding interface. Supported values are **bond0** through **bond99**.
Bonding Vif	bonding *bondx* vif *vlan-id*	*bondx* The identifier for the bonding interface. Supported values are **bond0** through **bond99**. *vlan-id* The VLAN ID for the vif. The range is 0 to 4094.
Ethernet	ethernet *ethx*	*ethx* The name of an Ethernet interface. The range is **eth0** through **eth23**, depending on the physical interfaces available on your system.
Ethernet Vif	ethernet *ethx* vif *vlan-id*	*ethx* The name of an Ethernet interface. The range is **eth0** through **eth23**, depending on the physical interfaces available on your system. *vlan-id* The VLAN ID for the vif. The range is 0 to 4094.

Use the **set** form of the command to specify a script to run when the VRRP group on the specified interface changes state.

Use the **delete** form of the command to stop the script from being run when the specifed state transition occurs.

Use the **show** form of the command to view the configuration.

interfaces <interface> vrrp vrrp-group <group-id> sync-group <group>

Assigns an interface to a VRRP sync group.

Syntax

set interfaces *interface* **vrrp vrrp-group** *group-id* **sync-group** *group*

delete interfaces *interface* **vrrp vrrp-group** *group-id* **sync-group**

show interfaces *interface* **vrrp vrrp-group** *group-id* **sync-group**

Command Mode

Configuration mode.

Configuration Statement

```
interfaces interface {
    vrrp {
        vrrp-group group-id {
            sync-group group
        }
    }
}
```

Parameters

interface	Mandatory. The type of interface. For detailed keywords and arguments that can be specified as interface types, see the table in the Usage Guidelines below.
group-id	Mandatory. The VRRP group being configured. The range is 1 to 255.
group	A text string defining the name of a sync group.

Default

None.

Usage Guidelines

Use this command to define a VRRP sync group for an interface on a router.

Interfaces in a sync group are synchronized such that, if one of the interfaces in the group fails over to backup, all interfaces in the group fail over to backup.

For example, in many cases, if one interface on a master router fails, the whole router should fail over to a backup router. By assigning all the interfaces on the master to a sync group, the failure of one interface will trigger a failover of all the interfaces in the sync group to the backup configured for the interface.

The following table shows the syntax and parameters for supported interface types.

Interface Type	Syntax	Parameters
Bonding	bonding *bondx*	*bondx* The identifier for the bonding interface. Supported values are **bond0** through **bond99**.
Bonding Vif	bonding *bondx* vif *vlan-id*	*bondx* The identifier for the bonding interface. Supported values are **bond0** through **bond99**. *vlan-id* The VLAN ID for the vif. The range is 0 to 4094.
Ethernet	ethernet *ethx*	*ethx* The name of an Ethernet interface. The range is **eth0** through **eth23**, depending on the physical interfaces available on your system.
Ethernet Vif	ethernet *ethx* vif *vlan-id*	*ethx* The name of an Ethernet interface. The range is **eth0** through **eth23**, depending on the physical interfaces available on your system. *vlan-id* The VLAN ID for the vif. The range is 0 to 4094.

Use the **set** form of the command to assign an interface to a sync group.

Use the **delete** form of the command to remove an interface from a sync group.

Use the **show** form of the command to view sync group configuration for an interface.

interfaces <interface> vrrp vrrp-group <group-id> virtual-address <addr>

Sets the virtual IP address or network address for a VRRP group on an interface.

Syntax

set interfaces *interface* **vrrp vrrp-group** *group-id* **virtual-address** *addr*

delete interfaces *interface* **vrrp vrrp-group** *group-id* **virtual-address**

show interfaces *interface* **vrrp vrrp-group** *group-id* **virtual-address**

Command Mode

Configuration mode.

Configuration Statement

```
interfaces interface {
    vrrp {
        vrrp-group group-id {
            virtual-address addr
    }
}
```

Parameters

interface	Mandatory. The type of interface. For detailed keywords and arguments that can be specified as interface types, see the table in the Usage Guidelines below.
group-id	Mandatory. The VRRP group being configured. The range is 1 to 255.
addr	Mandatory. The virtual IP address or network address of the VRRP group. The format is either *ipv4-addr* or *ipv4-addr/prefix*.

Default

None.

Usage Guidelines

Use this command to set the virtual IP address or network address for a VRRP group. Every VRRP group must have a virtual address, and all interfaces and vifs in the VRRP group must be configured with the same virtual address.

The virtual address is "shared" by the VRRP group and is dynamically assigned to the master interface in the group. The master links the virtual address to its own MAC address in the network by issuing a gratuitous ARP to the LAN segment. If the master fails, the group elects a new master, to whom the virtual address is then assigned. The new master notifies the network of the changed MAC address by issuing another gratuitous ARP.

In general, a real interface or vif should not be configured with the virtual address of the VRRP group. In practice, if a real interface is configured with the virtual address, the interface is said to "own" the virtual address. The VRRP standard (RFC 2338) prescribes that a router owning the virtual address should be assigned a priority of 255, which automatically elects the router owning the VIP as master. If you do assign a virtual address to a real interface, set the priority of the interface to 255.

The following table shows the syntax and parameters for supported interface types.

Interface Type	Syntax	Parameters
Bonding	bonding *bondx*	*bondx* The identifier for the bonding interface. Supported values are **bond0** through **bond99**.
Bonding Vif	bonding *bondx* vif *vlan-id*	*bondx* The identifier for the bonding interface. Supported values are **bond0** through **bond99**. *vlan-id* The VLAN ID for the vif. The range is 0 to 4094.
Ethernet	ethernet *ethx*	*ethx* The name of an Ethernet interface. The range is **eth0** through **eth23**, depending on the physical interfaces available on your system.
Ethernet Vif	ethernet *ethx* vif *vlan-id*	*ethx* The name of an Ethernet interface. The range is **eth0** through **eth23**, depending on the physical interfaces available on your system. *vlan-id* The VLAN ID for the vif. The range is 0 to 4094.

Use the **set** form of the command to specify the virtual address of a VRRP group for an interface.

Use the **delete** form of the command to remove the virtual address from the interface. However, note that the virtual address is mandatory in VRRP configuration.

Use the **show** form of the command to view the virtual address configured for a VRRP group on an interface.

show vrrp

Displays information about VRRP groups.

Syntax

show vrrp [**interface** *eth0..eth23* [**group** *group-name*] | **summary**]

Command Mode

Operational mode.

Parameters

eth0..eth23	Shows VRRP information for the specified interface.
group-name	Shows VRRP information for the specified interface and group.
summary	Shows a summary of VRRP information.

Default

Displays information about all groups on all interfaces.

Usage Guidelines

Use this command to see information about VRRP groups, including current VRRP elections and statistics.

Examples

Example 2-6 shows output for **show vrrp summary** command.

Example 2-6 Showing VRRP summary information

```
vyatta@R1> show vrrp summary
VRRP    Addr                    Interface       VRRP
Interface       Group   Type    Address         State           State
---------       -----   ----    -------         -----           -----
eth1.10         110     int     192.168.10.128  down            fault
                        vip     192.168.10.100
```

```
eth1            10      int     192.168.74.128  down            fault
                        vip     192.168.74.100
eth2.20         220     int     172.16.20.128   up              master
                        vip     172.16.20.100
```

Chapter 3: Clustering

This chapter explains clustering for high availability on the Vyatta system.

This chapter presents the following topics:

Clustering Configuration

This section presents the following topics:

Clustering Overview

This section presents the following topics:

On the Vyatta system, clustering can be used as a failover mechanism to provide high availability (HA) for mission-critical services. The cluster monitors the nodes providing designated services (for example, an IPsec VPN tunnel) at a designated address. If the system detects that the node has failed, or that the link to the node has failed, the system migrates both the services and the IP addresses to a backup node.

Failover is currently supported between two nodes: a primary node and a secondary node.

Components of a Cluster

There are three types of nodes in a cluster:

- **The primary cluster node.** This is the "active" router in the cluster; it is the router initially providing the service. For example, in a scenario with redundant VPN tunnels, this is the router initially operating as the local endpoint of the VPN tunnel.
- **A secondary cluster node.** This is the "backup" router in the cluster. It is the router to which the cluster fails over if the primary cluster node fails. Currently, only one secondary node is supported.
- **Monitor nodes.** The primary and secondary nodes monitor their own network connectivity by "pinging" devices upstream/downstream on the network. These devices are called "monitor nodes."

Monitor nodes themselves do not actively participate in the clustering; the only requirement for a monitor node is that it must respond to ICMP Echo Request messages (ping). Communication between monitor nodes and the cluster devices uses the IP addresses applied to the physical interfaces of the cluster devices. This is distinct from the cluster IP addresses, but must be on the same subnet.

A cluster provides failover for two types of resources:

- **Cluster IP addresses.** These are IP addresses that are "shared" between the redundant nodes. Initially, these IP addresses are assigned to the primary node. If the primary node fails over, the system migrates the cluster IP addresses to the secondary node.

  Note that, in the cluster model, cluster IP addresses are considered "services." When the system fails over, the IP address "services" are "started up" on the secondary node along with other services.

  In addition to cluster IP addresses, the interfaces used for clustering must be configured with a separate IP address on the same subnet for communicating with monitor nodes.

- **Services.** The set of things to be made redundant. Together with the cluster IP addresses, the currently supported service is ipsec, which provides redundancy for IPsec VPN tunnels.

These cluster nodes and resources are specified as a *resource group*. Currently, only one resource group is supported.

Failure Detection in a Cluster

A cluster can respond to two kinds of failure:

- **Node failure.** The primary and the secondary cluster nodes exchange regular heartbeat messages through their network interfaces. If a cluster node does not receive a heartbeat message from its peer within a certain interval, it considers the peer to be dead. If the secondary node determines that the primary peer is dead, the secondary node triggers the failover process and takes over the cluster resources.

- **Connectivity failure.** The primary and secondary nodes monitor their own network connectivity by "pinging" the specified monitor nodes. Failover is triggered when connectivity is lost. For example, if the primary node can no longer reach one of the monitor nodes, it considers itself down and triggers the failover process so that the secondary node can take over the cluster resources.

Clustering Heartbeat Mechanism

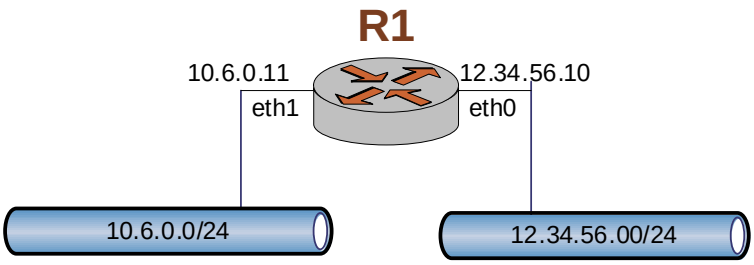
As soon as configuration is committed on a cluster node, the node begins sending heartbeat messages. By default the heartbeat mechanism waits for 120 seconds for the other cluster node to start up.

- If heartbeat messages are received from the other node within this interval, the services listed in the cluster resource group are started on the primary node, and the secondary node becomes an active standby.
- If heartbeat messages are not received from the cluster peer node within this interval, the node with the functioning heartbeat "acquires" the services specified in the resource group configuration and assumes control.

IP Addressing in Clusters

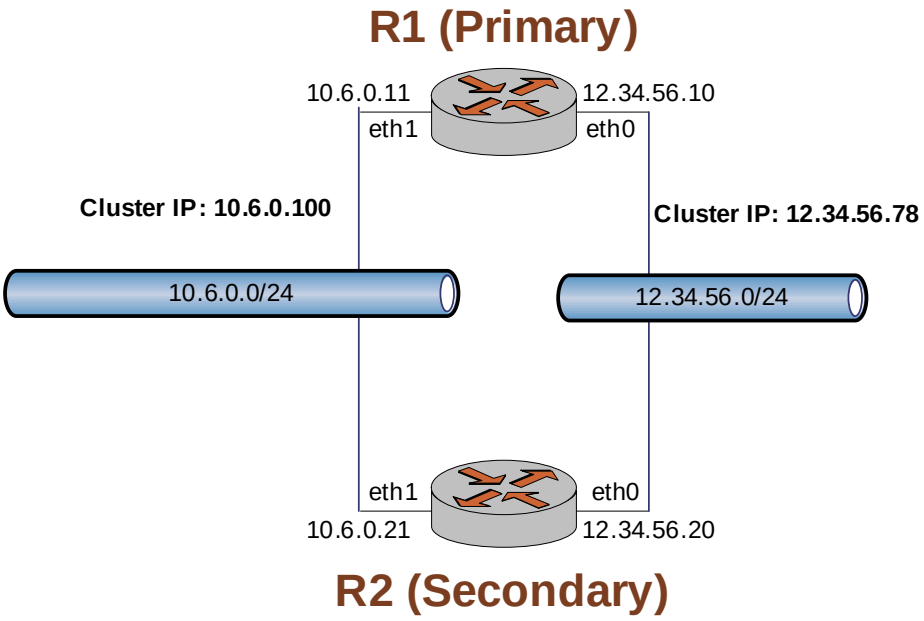
In a non-redundant scenario, IP addresses are assigned to network interfaces or vifs, as shown in Figure 3-1.

Figure 3-1 Explicitly configured IP addresses



In a cluster, cluster IP addresses are "shared" between the two cluster nodes, as shown in Figure 3-2. These are distinct from IP addresses configured for the physical Ethernet interfaces. They must be different from the IP addresses configured for the interface, but must reside within the same subnet.

Figure 3-2 Clustered IP addresses



Initially, the primary node "owns" the cluster IP addresses. When the heartbeat mechanism starts the services on the primary cluster node, it creates alias interfaces for the cluster IP addresses. For example, on router R1 the heartbeat mechanism would create an alias interface eth0:0 with IP address 12.34.56.78 and an alias interface eth1:0 with IP address 10.6.0.100.

If router R1 fails, the heartbeat mechanism creates the same alias interfaces on the secondary cluster node R2.

NOTE *Cluster IP addresses are started and stopped automatically and dynamically by the system. This means that those addresses must not be explicitly configured for any interfaces on the cluster nodes.*

Revertive and Non-Revertive Failover

Failover can be revertive or non-revertive. If revertive failover (also called "auto-failback") is configured, the system will fail back from the secondary node to the primary if the primary recovers. If non-revertive failover is configured, the secondary node will remain active even if the primary node recovers.

By default, auto-failback is disabled (that is, failover is non-revertive).

Clustering Configuration Examples

This section presents the following topics:

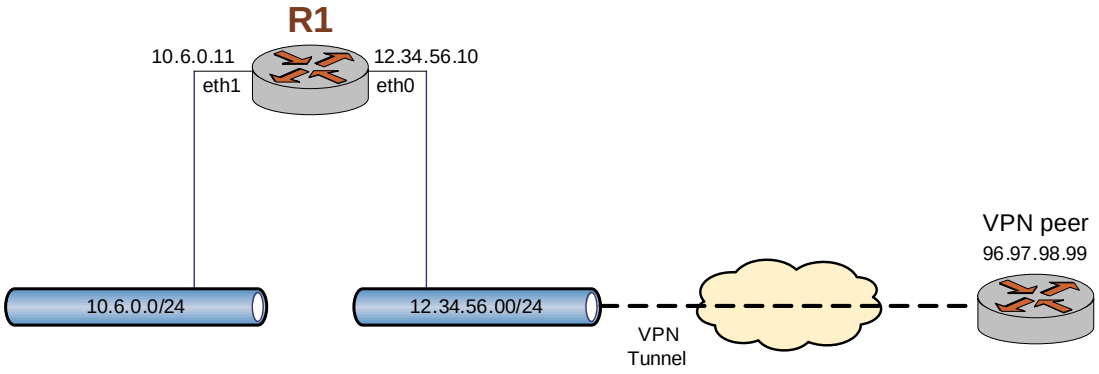
- Defining a Site-to-Site VPN Configuration
- Defining the Cluster on Router R1
- Defining the Cluster on Router R2

This section describes a scenario where failover is required for IPsec VPN tunnels between a local site and a remote VPN peer.

NOTE *The Site-to-site VPN configuration should be set up prior to setting up the cluster configuration.*

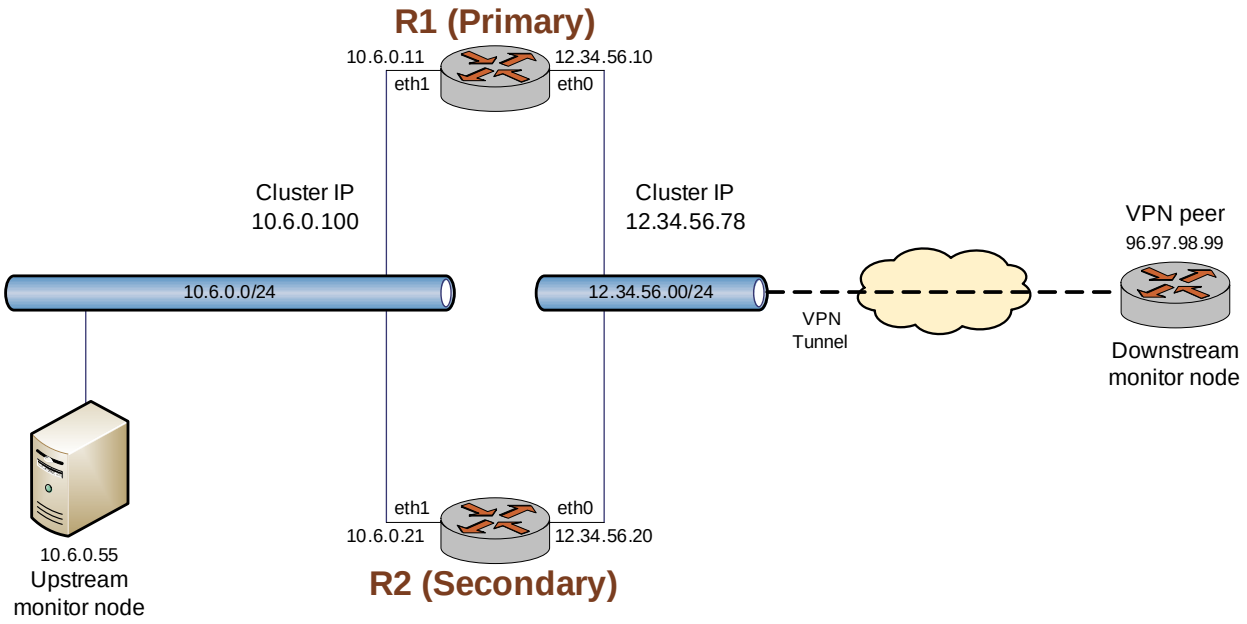
In the non-redundant setup, the VPN tunnel is terminated at the near end by router R1 on interface 12.34.56.10 and at the far end by the remote VPN peer on interface 96.97.98.99, as shown in Figure 3-3.

Figure 3-3 Non-redundant VPN tunnel



To provide redundancy for router R1, we would define the cluster shown Figure 3-4.

Figure 3-4 HA cluster for VPN tunnel failover



In this scenario:

- Routers R1 and R2 are the cluster nodes: R1 is the primary node and R2 is the secondary node.
- The cluster IP addresses are 10.6.0.100 and 12.34.56.78. As in all clusters, these cluster IP addresses are each considered a "service." The IPsec process managing the VPN tunnels on the router is the third "service" in the cluster.
- The host at 10.6.0.55, which is a reliable host in the upstream network, is the upstream monitor node. This host will be used by the cluster nodes to test upstream connectivity.
- The remote VPN peer is the downstream monitor node. This peer will be used by the cluster to test downstream connectivity.

This deployment allows detection of both node failure and network connectivity failure.

Under normal operational conditions, all three services (the two cluster IP addresses and the IPsec process) run on the primary node, R1. The VPN tunnel is established and maintained between the cluster IP address 12.34.56.78 and the VPN peer on IP address 96.97.98.99. If the primary node fails, or connectivity is lost between the primary node and either of the monitor nodes, the system detects the failure and migrates the two cluster IP addresses and the IPsec process to R2, minimizing service disruption. After failover, router R2 "owns" the cluster IP addresses and establishes and maintains the VPN tunnel with the peer 96.97.98.99.

Defining a Site-to-Site VPN Configuration

When a VPN tunnel is created within a high availability cluster the cluster IP address is used as the local IP address for the peer. This is in contrast to a non-clustered tunnel, where the IP address configured for the physical interface is used as the local IP address for the tunnel.

Note that, in addition to the cluster IP, an IP address must be configured independently for the physical Ethernet interface, so that the cluster node can ping the monitor nodes. (This configuration is not shown in this example.)

Example 3-1 sets up a VPN endpoint for router R1.

To configure the VPN endpoint on R1, perform the following steps in configuration mode:

Example 3-1 Defining a VPN on router R1

Step	Command
Enable VPN on eth0 on R1.	`vyatta@R1# set vpn ipsec ipsec-interfaces interface eth0`
Create the configuration node for proposal 1 of IKE group VYATTA.	`vyatta@R1# set vpn ipsec ike-group VYATTA proposal 1`
Set the encryption cipher for proposal 1.	`vyatta@R1# set vpn ipsec ike-group VYATTA proposal 1 encryption 3des`
Set the hash algorithm for proposal 1.	`vyatta@R1# set vpn ipsec ike-group VYATTA proposal 1 hash sha1`
Set the lifetime for the whole IKE group.	`vyatta@R1# set vpn ipsec ike-group VYATTA lifetime 28800`
Set IKE keep-alive message interval.	`vyatta@R1# set vpn ipsec ike-group VYATTA dead-peer-detection interval 30`
Non-response timeout before **action** will be taken.	`vyatta@R1# set vpn ipsec ike-group VYATTA dead-peer-detection timeout 90`
Action to take on timeout.	`vyatta@R1# set vpn ipsec ike-group VYATTA dead-peer-detection action clear`
Create the configuration node for proposal 1 of ESP group VYATTA.	`vyatta@R1# set vpn ipsec esp-group VYATTA proposal 1`
Set the encryption cipher for proposal 1.	`vyatta@R1# set vpn ipsec esp-group VYATTA proposal 1 encryption 3des`
Set the hash algorithm for proposal 1.	`vyatta@R1# set vpn ipsec esp-group VYATTA proposal 1 hash sha1`

Example 3-1 Defining a VPN on router R1

Set IPsec connection mode to tunnel.	vyatta@R1# **set vpn ipsec esp-group VYATTA mode tunnel**
Set the lifetime for the whole ESP group.	vyatta@R1# **set vpn ipsec esp-group VYATTA lifetime 3600**
Enable Perfect Forward Secrecy.	vyatta@R1# **set vpn ipsec esp-group VYATTA pfs enable**
Disable compression.	vyatta@R1# **set vpn ipsec esp-group VYATTA compression disable**
Create the site-to-site node for R1 and set the authentication mode.	vyatta@R1# **set vpn ipsec site-to-site peer 96.97.98.99 authentication mode pre-shared-secret**
Navigate to the node for the peer for easier editing.	vyatta@R1# **edit vpn ipsec site-to-site peer 96.97.98.99** [edit vpn/ipsec/site-to-site/peer/96.97.98.99]
Provide the string that will be used to generate encryption keys.	vyatta@R1# **set authentication pre-shared-secret vyatta** [edit vpn/ipsec/site-to-site/peer/96.97.98.99]
Specify the IKE group.	vyatta@R1# **set ike-group VYATTA** [edit vpn/ipsec/site-to-site/peer/96.97.98.99]
Identify the IP address on this router to be used for this connection. ***NOTE*** *The local IP address specified is the Cluster IP.*	vyatta@R1# **set local-ip 12.34.56.78** [edit vpn/ipsec/site-to-site/peer/96.97.98.99]
Create a tunnel configuration, and provide the local subnet for this tunnel.	vyatta@R1# **set tunnel 1 local-subnet 10.6.0.0/24** [edit vpn/ipsec/site-to-site/peer/96.97.98.99]
Provide the remote subnet for the tunnel.	vyatta@R1# **set tunnel 1 remote-subnet 10.5.0.0/24** [edit vpn/ipsec/site-to-site/peer/96.97.98.99]
Do not allow connection to the private network.	vyatta@R1# **set tunnel 1 allow-nat-networks disable** [edit vpn/ipsec/site-to-site/peer/96.97.98.99]
Do not allow connections to public networks.	vyatta@R1# **set tunnel 1 allow-public-networks disable** [edit vpn/ipsec/site-to-site/peer/96.97.98.99]
Specify the ESP group for this tunnel.	vyatta@R1# **set tunnel 1 esp-group VYATTA** [edit vpn/ipsec/site-to-site/peer/96.97.98.99]
Return to the top of the configuration tree.	vyatta@R1# **top**
Commit the configuration.	vyatta@R1# commit

Example 3-1 Defining a VPN on router R1

View the configuration.

```
vyatta@R1# show -all vpn
   ipsec {
        ipsec-interfaces {
            interface eth0
        }
        ike-group VYATTA {
            proposal 1 {
                encryption 3des
                hash sha1
            }
            lifetime 28800
            dead-peer-detection {
                interval 30
                timeout 90
                action clear
            }
        }
        esp-group VYATTA {
            proposal 1 {
                encryption 3des
                hash sha1
            }
            mode tunnel
            lifetime 3600
            pfs enable
            compression disable
        }
```

```
   site-to-site {
            peer 96.97.98.99 {
                authentication {
                    mode pre-shared-secret
                    pre-shared-secret "vyatta"
                }
                ike-group VYATTA
                local-ip 12.34.56.78
                tunnel 1 {
                    local-subnet 10.6.0.0/24
                    remote-subnet 10.5.0.0/24
                    allow-nat-networks disable
                    allow-public-networks disable
                    esp-group VYATTA
                }
            }
        }
```

Example 3-2 sets up a VPN endpoint for router R2.

To configure the VPN endpoint on R2, perform the following steps in configuration mode:

Example 3-2 Defining a VPN on router R2

Step	Command
Enable VPN on eth0 on R2.	vyatta@R2# **set vpn ipsec ipsec-interfaces interface eth0**
Create the configuration node for proposal 1 of IKE group VYATTA.	vyatta@R2# **set vpn ipsec ike-group VYATTA proposal 1**
Set the encryption cipher for proposal 1.	vyatta@R2# **set vpn ipsec ike-group VYATTA proposal 1 encryption 3des**
Set the hash algorithm for proposal 1.	vyatta@R2# **set vpn ipsec ike-group VYATTA proposal 1 hash sha1**
Set the lifetime for the whole IKE group.	vyatta@R2# **set vpn ipsec ike-group VYATTA lifetime 28800**
Set IKE keep-alive message interval.	vyatta@R2# **set vpn ipsec ike-group VYATTA dead-peer-detection interval 30**
Non-response timeout before **action** will be taken.	vyatta@R2# **set vpn ipsec ike-group VYATTA dead-peer-detection timeout 90**
Action to take on timeout.	vyatta@R2# **set vpn ipsec ike-group VYATTA dead-peer-detection action clear**
Create the configuration node for proposal 1 of ESP group VYATTA.	vyatta@R2# **set vpn ipsec esp-group VYATTA proposal 1**
Set the encryption cipher for proposal 1.	vyatta@R2# **set vpn ipsec esp-group VYATTA proposal 1 encryption 3des**
Set the hash algorithm for proposal 1.	vyatta@R2# **set vpn ipsec esp-group VYATTA proposal 1 hash sha1**
Set IPsec connection mode to tunnel.	vyatta@R2# **set vpn ipsec esp-group VYATTA mode tunnel**
Set the lifetime for the whole ESP group.	vyatta@R2# **set vpn ipsec esp-group VYATTA lifetime 3600**
Enable Perfect Forward Secrecy.	vyatta@R2# **set vpn ipsec esp-group VYATTA pfs enable**
Disable compression.	vyatta@R2# **set vpn ipsec esp-group VYATTA compression disable**

Example 3-2 Defining a VPN on router R2

Create the site-to-site node for R2 and set the authentication mode.	vyatta@R2# **set vpn ipsec site-to-site peer 96.97.98.99 authentication mode pre-shared-secret**
Navigate to the node for the peer for easier editing.	vyatta@R2# **edit vpn ipsec site-to-site peer 96.97.98.99** [edit vpn/ipsec/site-to-site/peer/96.97.98.99]
Provide the string that will be used to generate encryption keys.	vyatta@R2# **set authentication pre-shared-secret vyatta** [edit vpn/ipsec/site-to-site/peer/96.97.98.99]
Specify the IKE group.	vyatta@R2# **set ike-group VYATTA** [edit vpn/ipsec/site-to-site/peer/96.97.98.99]
Identify the IP address on this router to be used for this connection. ***NOTE*** *The local IP address specified is the Cluster IP.*	vyatta@R2# **set local-ip 12.34.56.78** [edit vpn/ipsec/site-to-site/peer/96.97.98.99]
Create a tunnel configuration, and provide the local subnet for this tunnel.	vyatta@R2# **set tunnel 1 local-subnet 10.6.0.0/24** [edit vpn/ipsec/site-to-site/peer/96.97.98.99]
Provide the remote subnet for the tunnel.	vyatta@R2# **set tunnel 1 remote-subnet 10.5.0.0/24** [edit vpn/ipsec/site-to-site/peer/96.97.98.99]
Do not allow connection to the private network.	vyatta@R2# **set tunnel 1 allow-nat-networks disable** [edit vpn/ipsec/site-to-site/peer/96.97.98.99]
Do not allow connections to public networks.	vyatta@R2# **set tunnel 1 allow-public-networks disable** [edit vpn/ipsec/site-to-site/peer/96.97.98.99]
Specify the ESP group for this tunnel.	vyatta@R2# **set tunnel 1 esp-group VYATTA** [edit vpn/ipsec/site-to-site/peer/96.97.98.99]
Return to the top of the configuration tree.	vyatta@R2# **top**
Commit the configuration.	vyatta@R2# commit

Example 3-2 Defining a VPN on router R2

View the configuration.

```
vyatta@R2# show -all vpn
   ipsec {
        ipsec-interfaces {
            interface eth0
        }
        ike-group VYATTA {
            proposal 1 {
                encryption 3des
                hash sha1
            }
            lifetime 28800
            dead-peer-detection {
                interval 30
                timeout 90
                action clear
            }
        }
        esp-group VYATTA {
            proposal 1 {
                encryption 3des
                hash sha1
            }
            mode tunnel
            lifetime 3600
            pfs enable
            compression disable
        }
```

```
   site-to-site {
            peer 96.97.98.99 {
                authentication {
                    mode pre-shared-secret
                    pre-shared-secret "vyatta"
                }
                ike-group VYATTA
                local-ip 12.34.56.78
                tunnel 1 {
                    local-subnet 10.6.0.0/24
                    remote-subnet 10.5.0.0/24
                    allow-nat-networks disable
                    allow-public-networks disable
                    esp-group VYATTA
                }
            }
        }
```

Example 3-3 sets up a VPN endpoint on the VPN router VPNPeer.

To configure the VPN on VPNPeer, perform the following steps in configuration mode:

Example 3-3 Defining a VPN on router VPNPeer

Step	Command
Enable VPN on eth1 on VPNPeer.	vyatta@VPNPeer# **set vpn ipsec ipsec-interfaces interface eth1**
Create the configuration node for proposal 1 of IKE group VYATTA.	vyatta@VPNPeer# **set vpn ipsec ike-group VYATTA proposal 1**
Set the encryption cipher for proposal 1.	vyatta@VPNPeer# **set vpn ipsec ike-group VYATTA proposal 1 encryption 3des**
Set the hash algorithm for proposal 1.	vyatta@VPNPeer# **set vpn ipsec ike-group VYATTA proposal 1**
Set the lifetime for the whole IKE group.	vyatta@VPNPeer# **set vpn ipsec ike-group VYATTA lifetime 28800**
Set IKE keep-alive message interval.	vyatta@VPNPeer# **set vpn ipsec ike-group VYATTA dead-peer-detection interval 30**
Non-response timeout before **action** will be taken.	vyatta@VPNPeer# **set vpn ipsec ike-group VYATTA dead-peer-detection timeout 90**
Action to take on timeout.	vyatta@VPNPeer# **set vpn ipsec ike-group VYATTA dead-peer-detection action clear**
Create the configuration node for proposal 1 of ESP group VYATTA.	vyatta@VPNPeer# **set vpn ipsec esp-group VYATTA proposal 1**
Set the encryption cipher for proposal 1.	vyatta@VPNPeer# **set vpn ipsec esp-group VYATTA proposal 1 encryption 3des**
Set the hash algorithm for proposal 1.	vyatta@VPNPeer# **set vpn ipsec esp-group VYATTA proposal 1 hash sha1**
Set IPsec connection mode to tunnel.	vyatta@VPNPeer# **set vpn ipsec esp-group VYATTA mode tunnel**
Set the lifetime for the whole ESP group.	vyatta@VPNPeer# **set vpn ipsec esp-group VYATTA lifetime 3600**
Enable Perfect Forward Secrecy.	vyatta@VPNPeer# **set vpn ipsec esp-group VYATTA pfs enable**
Disable compression.	vyatta@VPNPeer# **set vpn ipsec esp-group VYATTA compression disable**

Example 3-3 Defining a VPN on router VPNPeer

Create the site-to-site node for VPNPeer and set the authentication mode. ***NOTE*** *The peer IP address specified is the Cluster IP.*	vyatta@VPNPeer# **set vpn ipsec site-to-site peer 12.34.56.78 authentication mode pre-shared-secret**
Navigate to the node for the peer for easier editing.	vyatta@VPNPeer# **edit vpn ipsec site-to-site peer 12.34.56.78** [edit vpn/ipsec/site-to-site/peer/12.34.56.78]
Provide the string that will be used to generate encryption keys.	vyatta@VPNPeer# **set authentication pre-shared-secret vyatta** [edit vpn/ipsec/site-to-site/peer/12.34.56.78]
Specify the IKE group.	vyatta@VPNPeer# **set ike-group VYATTA** [edit vpn/ipsec/site-to-site/peer/12.34.56.78]
Identify the IP address on this router to be used for this connection.	vyatta@VPNPeer# **set local-ip 96.97.98.99** [edit vpn/ipsec/site-to-site/peer/12.34.56.78]
Create a tunnel configuration, and provide the local subnet for this tunnel.	vyatta@VPNPeer# **set tunnel 1 local-subnet 10.5.0.0/24** [edit vpn/ipsec/site-to-site/peer/12.34.56.78]
Provide the remote subnet for the tunnel.	vyatta@VPNPeer# **set tunnel 1 remote-subnet 10.6.0.0/24** [edit vpn/ipsec/site-to-site/peer/12.34.56.78]
Do not allow connection to the private network.	vyatta@VPNPeer# **set tunnel 1 allow-nat-networks disable** [edit vpn/ipsec/site-to-site/peer/12.34.56.78]
Do not allow connections to public networks.	vyatta@VPNPeer# **set tunnel 1 allow-public-networks disable** [edit vpn/ipsec/site-to-site/peer/12.34.56.78]
Specify the ESP group for this tunnel.	vyatta@VPNPeer# **set tunnel 1 esp-group VYATTA** [edit vpn/ipsec/site-to-site/peer/12.34.56.78]
Return to the top of the configuration tree.	vyatta@VPNPeer# **top**
Commit the configuration.	vyatta@VPNPeer# commit

Example 3-3 Defining a VPN on router VPNPeer

View the configuration.

```
vyatta@VPNPeer# show -all vpn
   ipsec {
        ipsec-interfaces {
            interface eth1
        }
        ike-group VYATTA {
            proposal 1 {
                encryption 3des
                hash sha1
            }
            lifetime 28800
            dead-peer-detection {
                interval 30
                timeout 90
                action clear
            }
        }
        esp-group VYATTA {
            proposal 1 {
                encryption 3des
                hash sha1
            }
            mode tunnel
            lifetime 3600
            pfs enable
            compression disable
        }
```

Example 3-3 Defining a VPN on router VPNPeer

```
site-to-site {
        peer 12.34.56.78 {
            authentication {
                mode pre-shared-secret
                pre-shared-secret "vyatta"
            }
            ike-group VYATTA
            local-ip 96.97.98.99
            tunnel 1 {
                local-subnet 10.5.0.0/24
                remote-subnet 10.6.0.0/24
                allow-nat-networks disable
                allow-public-networks disable
                esp-group VYATTA
            }
        }
    }
}
```

Defining the Cluster on Router R1

Example 3-4 sets up clustering on router R1. In this example:

- Interfaces eth0 and eth1 on R1 are used to exchange heartbeat messages between R1 and R2.
- The pre-shared key for heartbeat authentication is "!secret!"
- The heartbeat interval is 2 seconds (2000 milliseconds).
- The longest allowable interval between heartbeat messages is 10 seconds (10,000 milliseconds). After that period, the peer cluster node is considered dead.
- R1 is the primary node. ("R1" is the configured host name for the router. It is the name that would be returned when the **show host name** command is issued on R1.)
- R2 is the secondary node. ("R2" is the configured host name for the router. It is the name that would be returned when the **show host name** command is issued on R2.)
- The VPN peer at 96.97.98.99 is a monitor node.
- The reliable host at 10.6.0.55 is a monitor node.
- 10.6.0.100 is a cluster IP address, and therefore a cluster service.
- 12.34.56.78 is a cluster IP address, and therefore a cluster service.

- The IPsec process **ipsec** is the cluster service.
- Failover is to be non-revertive. This is the default, and need not be explicitly configured.

This example assumes that IP addresses have already been configured for the Ethernet interfaces eth0 and eth1 on both R1 and R2. This example focuses on cluster-specific configurations.

To configure this cluster on R1, perform the following steps in configuration mode:

Example 3-4 Defining a cluster on router R1

Step	Command
Specify the interfaces to use for heartbeat messages	`vyatta@R1# set cluster interface eth0` `vyatta@R1# set cluster interface eth1`
Provide the pre-shared key for heartbeat authentication.	`vyatta@R1# set cluster pre-shared-secret !secret!`
Set the interval between heartbeats.	`vyatta@R1# set cluster keepalive-interval 2000`
Set the length of the interval after which the cluster peer is considered dead.	`vyatta@R1# set cluster dead-interval 10000`
Create the resource group.	`vyatta@R1# set cluster group cluster1`
Specify the primary node in the cluster.	`vyatta@R1# set cluster group cluster1 primary R1`
Specify the secondary node in the cluster.	`vyatta@R1# set cluster group cluster1 secondary R2`
Specify the downstream monitor node.	`vyatta@R1# set cluster group cluster1 monitor 96.97.98.99`
Specify the upstream monitor node.	`vyatta@R1# set cluster group cluster1 monitor 10.6.0.55`
List both cluster IP addresses as services to fail over in the event of failure. Note that the interface used is also specified.	`vyatta@R1# set cluster group cluster1 service 10.6.0.100/24/eth1` `vyatta@R1# set cluster group cluster1 service 12.34.56.78/24/eth0`
List the **ipsec** process as a service to fail over in the event of failure.	`vyatta@R1# set cluster group cluster1 service ipsec`
Commit the configuration.	`vyatta@R1# commit`

Example 3-4 Defining a cluster on router R1

View the configuration.	vyatta@R1# show cluster
	  dead-interval 10000
	  group cluster1 {
	  primary R1
	  secondary R2
	  monitor 96.97.98.99
	  monitor 10.6.0.55
	  service 10.6.0.100/24/eth1
	  service 12.34.56.78/24/eth0
	  service ipsec
	  }
	  interface eth0
	  interface eth1
	  keepalive-interval 2000
	  pre-shared-secret "!secret!"
	vyatta@R1#

Defining the Cluster on Router R2

Example 3-5 sets up clustering on router R2. Note that the commands in this example are identical to those used to configure R1.

To configure this cluster on R2, perform the following steps in configuration mode:

Example 3-5 Defining a cluster on router R2

Step	Command
Specify the interfaces to use for heartbeat messages	vyatta@R2# **set cluster interface eth0** vyatta@R2# **set cluster interface eth1**
Provide the pre-shared key for heartbeat authentication.	vyatta@R2# **set cluster pre-shared-secret !secret!**
Set the interval between heartbeats.	vyatta@R2# **set cluster keepalive-interval 2000**
Set the length of the interval after which the cluster peer is considered dead.	vyatta@R2# **set cluster dead-interval 10000**
Create the resource group.	vyatta@R2# **set cluster group cluster1**
Specify the primary node in the cluster.	vyatta@R2# **set cluster group cluster1 primary R1**

Example 3-5 Defining a cluster on router R2

Specify the secondary node in the cluster.	`vyatta@R2# set cluster group cluster1 secondary R2`
Specify the downstream monitor node.	`vyatta@R2# set cluster group cluster1 monitor 96.97.98.99`
Specify the upstream monitor node.	`vyatta@R2# set cluster group cluster1 monitor 10.6.0.55`
List both cluster IP addresses as services to fail over in the event of failure. Note that the interface used is also specified.	`vyatta@R2# set cluster group cluster1 service 10.6.0.100/24/eth1` `vyatta@R2# set cluster group cluster1 service 12.34.56.78/24/eth0`
List the **ipsec** process as a service to fail over in the event of failure.	`vyatta@R2# set cluster group cluster1 service ipsec`
Commit the configuration.	`vyatta@R2# commit`

View the configuration.	`vyatta@R2# show cluster`
	`  dead-interval 10000`
	`  group cluster1 {`
	`  primary R1`
	`  secondary R2`
	`  monitor 96.97.98.99`
	`  monitor 10.6.0.55`
	`  service 10.6.0.100/24/eth1`
	`  service 12.34.56.78/24/eth0`
	`  service ipsec`
	`  }`
	`  interface eth0`
	`  interface eth1`
	`  keepalive-interval 2000`
	`  pre-shared-secret: "!secret!"`
	`vyatta@R2#`

Clustering Commands

This section presents the following commands.

Configuration Commands	
Clusters	
cluster	Enables clustering for high availability.
cluster dead-interval <interval>	Defines the time after which a cluster peer is considered dead.
cluster interface <interface>	Defines a interface over which heartbeat messages will be sent.
cluster keepalive-interval <interval>	Defines the time interval between heartbeat messages.
cluster mcast-group <ipv4>	Defines the multicast group for sending and receiving heartbeat messages.
cluster monitor-dead-interval <interval>	Defines the time after which a monitor node is considered dead.
cluster pre-shared-secret <secret>	Defines the shared key for heartbeat authentication.
Cluster Groups	
cluster group <group>	Defines a cluster resource group.
cluster group <group> auto-failback <mode>	Specifies whether or not the system should revert back to the primary node should the primary node become available again.
cluster group <group> monitor <ipv4>	Defines a monitor node for a cluster resource group.
cluster group <group> primary <hostname>	Specifies the host name configured for the primary node in the cluster.
cluster group <group> secondary <hostname>	Specifies the host name configured for the secondary node in the cluster.
cluster group <group> service <service>	Specifies the services that will be started on the primary and secondary nodes.
Operational Commands	
show cluster status	Displays current clustering status.

cluster

Enables clustering for high availability.

Syntax

set cluster

delete cluster

show cluster

Command Mode

Configuration mode.

Configuration Statement

```
cluster {
}
```

Parameters

None.

Default

None.

Usage Guidelines

Use this command to specify a cluster configuration.

Use the **set** form of this command to create the cluster configuration.

Use the **delete** form of this command to remove the cluster configuration.

Use the **show** form of this command to view the cluster configuration.

cluster dead-interval <interval>

Defines the time after which a cluster peer is considered dead.

Syntax

set cluster dead-interval *interval*

delete cluster dead-interval

show cluster dead-interval

Command Mode

Configuration mode.

Configuration Statement

```
cluster {
   dead-interval interval
}
```

Parameters

interval	The time, in milliseconds, after which if a heartbeat message is not received from the cluster peer node, the peer is considered dead. This triggers the failover procedure and all services are moved to the secondary node.The default is 20000 (20 seconds).

Default

A peer is considered dead after not sending a heartbeat after 20 seconds.

Usage Guidelines

Use this command to specify the dead interval in a cluster configuration.

Use the **set** form of this command to specify the dead interval in a cluster configuration.

Use the **delete** form of this command to return the dead interval setting to its default.

Use the **show** form of this command to view the dead interval configuration.

cluster group <group>

Defines a cluster resource group.

Syntax

set cluster group *group*

delete cluster group *group*

show cluster group *group*

Command Mode

Configuration mode.

Configuration Statement

```
cluster {
    group group {
    }
}
```

Parameters

group	The name of the cluster group.

Default

None.

Usage Guidelines

Use this command to define the resources and clustering behavior associated with a cluster group. Currently only one group is supported.

Use the **set** form of this command to create the cluster resource group configuration.

Use the **delete** form of this command to remove the cluster resource group configuration.

Use the **show** form of this command to view the cluster resource group configuration.

cluster group <group> auto-failback <mode>

Specifies whether or not the system should revert back to the primary node should the primary node become available again.

Syntax

set cluster group *group* **auto-failback** *mode*

delete cluster group *group* **auto-failback**

show cluster group *group* **auto-failback**

Command Mode

Configuration mode.

Configuration Statement

```
cluster {
    group group {
        auto-failback mode
    }
}
```

Parameters

group	The name of the cluster group.
mode	Specifies whether the system should revert back to the primary node, should it become available again. Supported values are as follows: **true:** Failover is revertive. Migrate back to the primary node if it recovers. **false:** Failover is non-revertive. Do not migrate back to the primary node even if it recovers.

Default

The default is **false**.

Usage Guidelines

Use this command to specify the auto failback mode in a cluster resource group configuration.

Use the **set** form of this command to create the auto failback mode in a cluster resource group configuration.

Use the **delete** form of this command to remove the auto failback mode in a cluster resource group configuration.

Use the **show** form of this command to view the auto failback mode in a cluster resource group configuration.

cluster group <group> monitor <ipv4>

Defines a monitor node for a cluster resource group.

Syntax

set cluster group *group* **monitor** *ipv4*

delete cluster group *group* **monitor** *ipv4*

show cluster group *group* **monitor**

Command Mode

Configuration mode.

Configuration Statement

```
cluster {
    group group {
        monitor ipv4
    }
}
```

Parameters

group	The name of the cluster group.
ipv4	Multi-node. The IP address of a monitor node. Monitor nodes are used within the cluster to confirm network connectivity. Note that communication between monitor nodes and the cluster devices takes place using the IP addresses configured for the physical interfaces in the cluster, not the cluster IP addresses. You can define more than one monitor node by creating multiple **monitor** configuration nodes.

Default

None.

Usage Guidelines

Use this command to specify the IP address of a monitor node in a cluster resource group configuration.

Use the **set** form of this command to create the IP address of a monitor node in a cluster resource group configuration.

Use the **delete** form of this command to remove the IP address of a monitor node in a cluster resource group configuration.

Use the **show** form of this command to view the IP address of a monitor node in a cluster resource group configuration.

cluster group <group> primary <hostname>

Specifies the host name configured for the primary node in the cluster.

Syntax

set cluster group *group* **primary** *hostname*

delete cluster group *group* **primary**

show cluster group *group* **primary**

Command Mode

Configuration mode.

Configuration Statement

```
cluster {
    group group {
        primary hostname
    }
}
```

Parameters

group	The name of the cluster group.
hostname	Mandatory. The host name configured for the primary node in the cluster. Enter the host name exactly as configured for the device. You can view this by issuing the **show host name** command on the primary (active) node.

Default

None.

Usage Guidelines

Use this command to specify the host name of for the primary node in a cluster resource group configuration.

Use the **set** form of this command to create the host name of for the primary node in a cluster resource group configuration.

Use the **delete** form of this command to remove the host name of for the primary node in a cluster resource group configuration.

Use the **show** form of this command to view the host name of for the primary node in a cluster resource group configuration.

cluster group <group> secondary <hostname>

Specifies the host name configured for the secondary node in the cluster.

Syntax

set cluster group *group* **secondary** *hostname*

delete cluster group *group* **secondary**

show cluster group *group* **secondary**

Command Mode

Configuration mode.

Configuration Statement

```
cluster {
    group group {
        secondary hostname
    }
}
```

Parameters

group	The name of the cluster group.
hostname	Mandatory. The host name configured for the secondary node in the cluster. Enter the host name exactly as configured for the device. You can view this by issuing the **show host name** command on the secondary (backup) node. Currently, only one secondary node is supported.

Default

None.

Usage Guidelines

Use this command to specify the host name of for the secondary node in a cluster resource group configuration.

Use the **set** form of this command to create the host name of for the secondary node in a cluster resource group configuration.

Use the **delete** form of this command to remove the host name of for the secondary node in a cluster resource group configuration.

Use the **show** form of this command to view the host name of for the secondary node in a cluster resource group configuration.

cluster group <group> service <service>

Specifies the services that will be started on the primary and secondary nodes.

Syntax

set cluster group *group* **service** *service*

delete cluster group *group* **service** *service*

show cluster group *group* **service**

Command Mode

Configuration mode.

Configuration Statement

```
cluster {
    group group {
        service service
    }
}
```

Parameters

group	The name of the cluster group.
service	Mandatory. Multi-node. The services that will be started on the primary node initially and will be restarted on the secondary node when failover occurs. The following formats are supported: *ip-address/prefix* [*if-name* [*broadcast-address*]], where ip-address/prefix is the network address of the cluster, *if-name* is the interface to which the address is to be added, and *broadcast-address* is the broadcast address for the cluster. If the *if-name* is not specified then eth0 is assumed. *service*, where service is a script in **/etc/init.d**. *script*::*args*, where script is a script in **/etc/ha.d/resource.d** and args are the arguments for the script. You can define more than one service node by creating multiple **service** configuration nodes. At least one service must be specified.

Default

None.

Usage Guidelines

Use this command to specify the services that will be started on the primary and secondary nodes in a cluster resource group configuration.

A service can be:

- An IP address/network prefix specification. IP addresses supplied as a service are used as cluster IP addresses.

  The cluster IP address is distinct from the IP address configured for the physical interface. Cluster IP addresses are applied to the cluster interfaces by the clustering mechanism. You do not explicitly apply the cluster IP address to the interface.

- A script as defined in the file **/etc/init.d**, in the form *script-name*.
- A script as defined in the file **/etc/ha.d/resource.d**, with arguments, in the form *script-name*::*args*.
- A cluster IP address/prefix length with two optional parameters: the interface to which this address will be added (defaulting to eth0) and the broadcast address.

Use the **set** form of this command to specify the services that will be started on the primary and secondary nodes in a cluster resource group configuration.

Use the **delete** form of this command to remove the services that will be started on the primary and secondary nodes in a cluster resource group configuration.

Use the **show** form of this command to view the services that will be started on the primary and secondary nodes in a cluster resource group configuration.

cluster interface <interface>

Defines a interface over which heartbeat messages will be sent.

Syntax

set cluster interface *interface*

delete cluster interface *interface*

show cluster interface

Command Mode

Configuration mode.

Configuration Statement

```
cluster {
   interface interface
}
```

Parameters

interface	Mandatory. Multi-node. The name of the interface over which heartbeat messages will be sent to the peer cluster node. You can assign more than one interface to the cluster by creating multiple **interface** configuration nodes.

Default

None.

Usage Guidelines

Use this command to specify the interface over which heartbeat messages will be sent in a cluster configuration.

Use the **set** form of this command to specify the interface over which heartbeat messages will be sent in a cluster configuration.

Use the **delete** form of this command to remove the interface over which heartbeat messages will be sent in a cluster configuration.

Use the **show** form of this command to view the interface over which heartbeat messages will be sent in a cluster configuration.

cluster keepalive-interval <interval>

Defines the time interval between heartbeat messages.

Syntax

set cluster keepalive-interval *interval*

delete cluster keepalive-interval

show cluster keepalive-interval

Command Mode

Configuration mode.

Configuration Statement

```
cluster {
   keepalive-interval interval
}
```

Parameters

interval	The time interval between heartbeat messages, in milliseconds. The default is 5000 (5 seconds).

Default

The default is 5000.

Usage Guidelines

Use this command to specify the keepalive interval in a cluster configuration.

Use the **set** form of this command to create the keepalive interval in a cluster configuration.

Use the **delete** form of this command to remove the keepalive interval in a cluster configuration.

Use the **show** form of this command to view the keepalive interval in a cluster configuration.

cluster mcast-group <ipv4>

Defines the multicast group for sending and receiving heartbeat messages.

Syntax

set cluster mcast-group *ipv4*

delete cluster mcast-group

show cluster mcast-group

Command Mode

Configuration mode.

Configuration Statement

```
cluster {
   mcast-group ipv4
}
```

Parameters

ipv4	The IP address of the multicast group used for sending and receiving heartbeat messages.

Default

The default is **239.251.252.253**.

Usage Guidelines

Use this command to specify the multicast group for sending and receiving heartbeat messages. Typically it will only be changed if the default group conflicts with your network setup.

Use the **set** form of this command to create the multicast group for sending and receiving heartbeat messages.

Use the **delete** form of this command to remove the multicast group for sending and receiving heartbeat messages.

Use the **show** form of this command to view the multicast group for sending and receiving heartbeat messages

cluster monitor-dead-interval <interval>

Defines the time after which a monitor node is considered dead.

Syntax

set cluster monitor-dead-interval *interval*

delete cluster monitor-dead-interval

show cluster monitor-dead-interval

Command Mode

Configuration mode.

Configuration Statement

```
cluster {
   monitor-dead-interval interval
}
```

Parameters

interval	The time, in milliseconds, after which if a ping response is not received from the monitor node, the monitor node is considered dead. This triggers the failover procedure and all services are moved to the secondary node. The default is 20000 (20 seconds).

Default

A monitor node is considered dead after not replying to a ping for 20 seconds.

Usage Guidelines

Use this command to specify the time after which a monitor node is considered dead..

Use the **set** form of this command to specify the monitor dead interval.

Use the **delete** form of this command to return the monitor dead interval to its default setting.

Use the **show** form of this command to view the monitor dead interval configuration.

cluster pre-shared-secret <secret>

Defines the shared key for heartbeat authentication.

Syntax

set cluster pre-shared-secret *secret*

delete cluster pre-shared-secret

show cluster pre-shared-secret

Command Mode

Configuration mode.

Configuration Statement

```
cluster {
   pre-shared-secret secret
}
```

Parameters

secret	Mandatory. A shared key for heartbeat authentication.

Default

None.

Usage Guidelines

Use this command to specify the shared key for heartbeat authentication.

Use the **set** form of this command to specify the shared key for heartbeat authentication.

Use the **delete** form of this command to remove the shared key for heartbeat authentication.

Use the **show** form of this command to view the shared key for heartbeat authentication.

show cluster status

Displays current clustering status.

Syntax

show cluster status

Command Mode

Operational mode.

Parameters

None.

Usage Guidelines

Use this command to view the operational status of a cluster.

Examples

Example 3-6 and Example 3-7 show output for **show cluster status** on the primary node and secondary nodes, respectively, in the case where the primary node is operational and active, and owns the cluster resources.

Example 3-6 "show cluster status": Primary node active (primary output)

```
vyatta@R1> show cluster status
=== Status report on primary node R1 ===

  Primary R1 (this node): Active

  Secondary R2: Active (standby)

  Monitor 10.6.0.55: Reachable
  Monitor 10.1.0.1: Reachable

  Resources [10.6.0.100 10.1.0.170 ipsec]:
    Active on primary R1 (this node)
```

Example 3-7 “show cluster status”: Primary node output (secondary output)

```
vyatta@R2> show cluster status
=== Status report on secondary node R2 ===

  Primary R1: Active

  Secondary R2 (this node): Active (standby)

  Monitor 10.6.0.55: Reachable
  Monitor 10.1.0.1: Reachable

  Resources [10.6.0.100 10.1.0.170 ipsec]:
    Active on primary R1
```

Example 3-8 and Example 3-9 show output for **show cluster status** on the primary node and secondary nodes, respectively, in the case where interface eth1 R1 has failed and is unable to reach the upstream monitor mode (10.6.0.55). Therefore, the failover mechanism has migrated the cluster resources to the secondary node, R2.

Example 3-8 “show cluster status”: Failed link on primary (primary output)

```
vyatta@R1> show cluster status
=== Status report on primary node R1 ===

  Primary R1 (this node): Down (at least 1 monitor not reachable)

  Secondary R2: Active

  Monitor 10.6.0.55: Unreachable
  Monitor 10.1.0.1: Reachable

  Resources [10.6.0.100 10.1.0.170 ipsec]:
    Active on secondary R2
```

Example 3-9 “show cluster status”: Failed link on primary (secondary output)

```
vyatta@R2> show cluster status
=== Status report on secondary node R2 ===

  Primary R1: Down (at least 1 monitor node not reachable)
```

```
  Secondary R2 (this node): Active

  Monitor 10.6.0.55: Reachable
  Monitor 10.1.0.1: Reachable

  Resources [10.6.0.100 10.1.0.170 ipsec]:
    Active on secondary R2 (this node)
```

Example 3-10 shows output for **show cluster status** on the secondary node R2 in the case where the primary node R1 has failed altogether and the failover mechanism has migrated the resources to R2.

Example 3-10 "show cluster status": Failed primary node (secondary output)

```
vyatta@R2> show cluster status
=== Status report on secondary node R2 ===

  Primary R1: Down

  Secondary R2(this node): Active

  Monitor 10.6.0.55: Reachable
  Monitor 10.1.0.1: Reachable

  Resources [10.6.0.100 10.1.0.170 ipsec]:
    Active on secondary R2 (this node)
```

Chapter 4: Stateful NAT and Firewall Failover

This chapter describes the stateful NAT and firewall failover feature on the Vyatta System.

This chapter presents the following topics:

Stateful Failover Configuration

This section describes how to configure stateful failover on the Vyatta System.

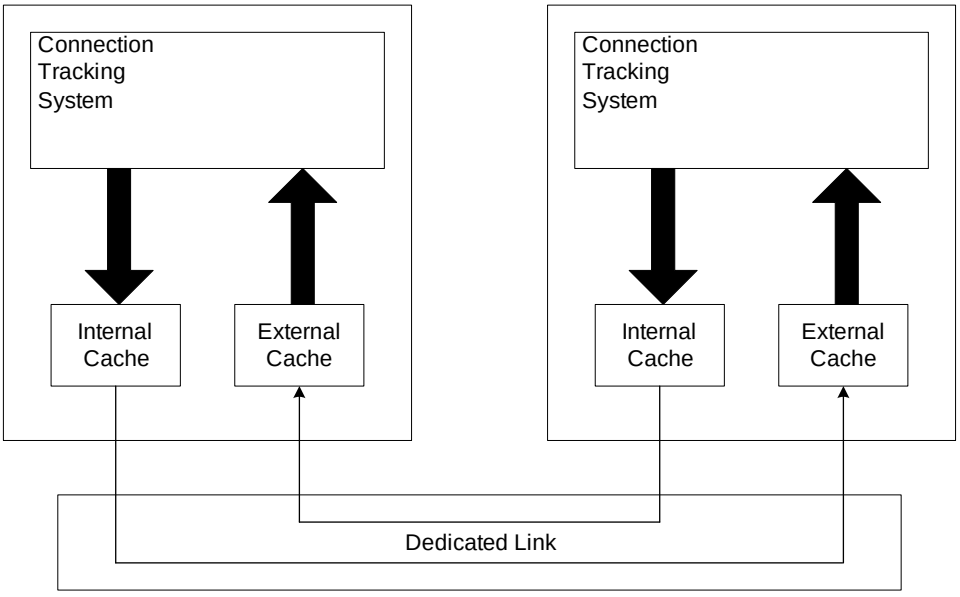
This section presents the following topics:

Stateful Failover Overview

In high-availability mechanisms such as VRRP and clustering, traffic can be successfully forwarded over a backup system if the primary system fails; however, existing connections are not replicated and the session information is lost. Stateful failover provides a mechanism for replicating information about active connections onto the standby system and keeping connection information synchronized. When the system fails over, all connection state information is available to the standby system and connectivity can be maintained.

The following diagram shows the architecture of the stateful failover system.

Figure 4-1 Stateful failover architecture



The Connection Tracking System is maintained by the system kernel. Updates to the Connection Tracking System are filtered by the **accept-protocol** and **ignore-address** configuration commands and then propogated to the Internal Cache. Changes to the Internal Cache are forwarded to the External Cache of failover peer as they occur. The connection entries in the External Cache of the failover peer can be injected into its Connection Tracking System in the event of a failure of the primary system.

Either VRRP or clustering can be used as the failover mechanism, but not both. In either case, a dedicated link between the two systems for connection synchronization is recommended.

The Vyatta system tracks state for individual IP flows only. The Vyatta system does not replicate state information for features such as IPsec, FTP, SIP, H.323, and so on, that require additional security and/or session-based information.

Consequently, stateful failover is supported only for NAT and IPv4 firewall. Stateful failover is not supported for IPv6.

In general, stateful failover is not supported together with WAN load balancing or web proxy features. Specifically, since stateful firewall uses the same mechanisms to track connections as the WAN load balancing feature does, the Vyatta system must not be configured to flushWAN load balancing connections.

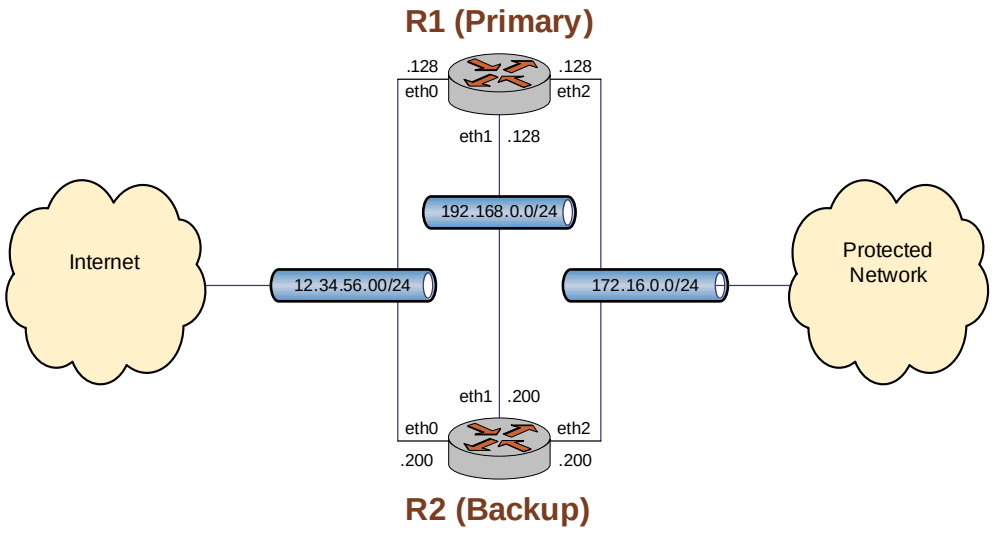
Stateful Failover Configuration Examples

This section presents the following topics:

- Before You Begin
- Stateful Failover Using Clustering
- Stateful Failover Using VRRP
- NAT Considerations for Stateful Failover

In this section, stateful failover examples are presented using clustering and VRRP as failover mechanisms. Both examples use the diagram shown in Figure 4-2. In this scenario, R1 is the primary system and R2 is the backup system.

Figure 4-2 Stateful failover



Before You Begin

The stateful failover examples in the sections that follow assume that both systems R1 and R2 have common firewall configurations. These are shown in Example 4-1:

Example 4-1 Example firewall configuration for stateful failover

```
vyatta@R1# show firewall
   name internet_to_protected {
       default_action drop
       description “Internet to Protected”
       rule 10 {
           action accept
           state {
               established enable
           }
       }
       rule 20 {
           action accept
           destination {
               address 172.16.0.33
               port 80
           }
           protocol tcp
           state {
               new enable
           }
       }
   }
   name protected_to_internet {
       default_action accept
       description “Protected to Internet”
       rule 10 {
           action drop
           state {
               invalid enable
           }
       }
   }
```

The examples also assume that R1 has its Ethernet interfaces configured as shown in Example 4-2 and that R2 has its Ethernet interfaces configured as shown in Example 4-3.

Example 4-2 Ethernet configuration on R1 for stateful failover

```
vyatta@R1# show interfaces ethernet
   eth0 {
       address 12.34.56.128/24
       firewall {
           in {
               name internet_to_protected
           }
       }
   }
   eth1 {
       address 192.168.0.128/24
   }
   eth2 {
       address 172.16.0.128/24
       firewall {
           in {
               name protected_to_internet
           }
       }
   }
```

Example 4-3 Ethernet configuration on R2 for stateful failover

```
vyatta@R2# show interfaces ethernet
   eth0 {
       address 12.34.56.200/24
       firewall {
           in {
               name internet_to_protected
           }
       }
   }
   eth1 {
       address 192.168.0.200/24
   }
   eth2 {
       address 172.16.0.200/24
       firewall {
           in {
               name protected_to_internet
           }
       }
```

```
}
```

Stateful Failover Using Clustering

The stateful failover example using Clustering as a failover mechanism assumes that R1 and R2 are configured for Clustering as shown in Example 4-4.

For more information about configuring clustering, see Chapter 3: Clustering.

Example 4-4 Clustering configuration for stateful failover

```
vyatta@R1# show cluster
   dead-inteval 2000
   group TEST {
       auto-fallback true
       monitor 172.16.0.131
       monitor 12.34.56.133
       primary R1
       secondary R2
       service 12.34.56.100/24/eth0
       service 172.16.0.100/24/eth2
   }
   interface eth1
   keepalive-interval 500
   monitor-dead-interval 2000
   pre-shared-secret testing
```

Test that the system is configured and operating as you expect by taking the following steps:

- Confirm that R1 is the primary system and R2 is the secondary system by issuing show cluster status command.
- Bring the system back to the point where R1 is the primary and R2 is the secondary, then begin to retrieve a large file from a host in the protected network by means of a host on the Internet. While the file transfer is taking place, either shut down R1 or disconnect it.—the file transfer should stall, even though R2 takes over as primary. The reason for this is that the failover is not yet stateful: R2 is not aware of the existing connection on R1 so it blocks these connections, in accordance with the firewall rules. Stateful failover prevents this from occuring.
- Use the command **show log | match conntrack-tools** to observe the log messages pertaining to the stateful failover. There should be none at this point.

Configure stateful failover on R1 by performing the steps shown in Example 4-5 in configuration mode. When you are finished, repeat the same configuration for R2.

Example 4-5 Configuring R1 for stateful failover (repeat for R2)

Step	Command
Create the connection tracking synchronization service and define clustering as the failover mechanism using cluster group "TEST".	`vyatta@R1# set service conntrack-sync failover-mechanism cluster group TEST`
Set the interface for passing connection synchronization messages.	`vyatta@R1# set service conntrack-sync interface eth1`
Commit the configuration.	`vyatta@R1# commit`

Display the configuration	`vyatta@R1# show service conntrack-sync`
	`  failover-mechanism cluster {`
	`  group TEST`
	`  }`
	`  interface eth1`

Once stateful failover is configured, repeat the file transfer test performed previously. Interrupt the file transfer by taking R1 out of service. R2 should take over as primary, but this time the file transfer should succeed, since at takeover, R2 is aware of the connections existing on R1. Again, use the command **show log | match conntrack-tools** to observe the log messages pertaining to the stateful failover.

Stateful Failover Using VRRP

The stateful failover example using VRRP as a failover mechanism assumes that R1 is configured for VRRP as shown in Example 4-6 and R2 is configured for VRRP as shown in .

For more information about configuring VRRP, see Chapter 2: VRRP.

Example 4-6 VRRP configuration for stateful failover (R1)

```
vyatta@R1# show ethernet eth0 vrrp
  vrrp-group 1 {
      advertise-interval 1
      priority 200
      sync-group TESTING
      virtual-address 12.34.56.100
```

```
    }
vyatta@R1# show ethernet eth2 vrrp
    vrrp-group 2 {
        advertise-interval 1
        priority 200
        sync-group TESTING
        virtual-address 172.16.0.100
    }
```

Example 4-7 VRRP configuration for stateful failover (R2)

```
vyatta@R2# show ethernet eth0 vrrp
    vrrp-group 1 {
        advertise-interval 1
        priority 100
        sync-group TESTING
        virtual-address 12.34.56.100
    }
vyatta@R2# show ethernet eth2 vrrp
    vrrp-group 2 {
        advertise-interval 1
        priority 100
        sync-group TESTING
        virtual-address 172.16.0.100
    }
```

Test that the system is configured and operating as you expect by taking the following steps:

- Confirm that R1 is the master router and R2 is the backup by issuing show vrrp command.
- Bring the system back to the point where R1 is the master and R2 is the backup, then begin to retrieve a large file from a host in the protected network by means of a host on the Internet. While the file transfer is taking place, either shut down R1 or disconnect it.—the file transfer should stall, even though R2 takes over as primary. The reason for this is that the failover is not yet stateful: R2 is not aware of the existing connection on R1 so it blocks these connections, in accordance with the firewall rules. Stateful failover prevents this from occuring.
- Use the command **show log | match conntrack-tools** to observe the log messages pertaining to the stateful failover. There should be none at this point.

Configure stateful failover on R1 by performing the steps shown in Example 4-8 in configuration mode. When you are finished, repeat the same configuration for R2.

Example 4-8 Configuring R1 for stateful failover (repeat for R2)

Step	Command
Create the connection tracking synchronization service and define VRRP as the failover mechanism using VRRP sync group “TESTING”.	`vyatta@R1# set service conntrack-sync failover-mechanism vrrp sync-group TESTING`
Set the interface for passing connection synchronization messages.	`vyatta@R1# set service conntrack-sync interface eth1`
Commit the configuration.	`vyatta@R1# commit`

Display the configuration	`vyatta@R1# show service conntrack-sync`
	`  failover-mechanism vrrp {`
	`  sync-group TESTING`
	`  }`
	`  interface eth1`

Once stateful failover is configured, repeat the file transfer test performed previously. Interrupt the file transfer by taking R1 out of service. R2 should take over as master, but this time the file transfer should succeed, since at takeover, R2 is aware of the connections existing on R1. Again, use the command **show log | match conntrack-tools** to observe the log messages pertaining to the stateful failover.

NAT Considerations for Stateful Failover

The configuration examples presented in this chapter have not yet taken NAT into consideration. In general, NAT is needed on systems where one interface faces the Internet and the other faces a private (RFC 1918) network. When configuring NAT rules on systems in a failover setup, it is important to remember that those rules must be based on the virtual IP being shared by the failover peer.

Example 4-9 shows two NAT rules that could be configured on R1 and R2 in the previous examples. The first rule is a Source NAT rule that uses the Virtual IP address on the Internet-facing interface to SNAT all traffic initiated from the protected network. The second rule is a Destination NAT rule that uses the Virtual IP address on the Internet-facing interface to DNAT all HTTP traffic to an internal server. These NAT rules should be configured on R1 and the configuration repeated for R2.

Example 4-9 NAT rule configuration for stateful failover

```
vyatta@R1# show service nat
```

```
    rule 10 {
        description “SNAT all traffic to Internet from protected network”
        outbound-interface eth0
        outside-address {
            address 12.34.56.100
        }
        source {
            address 172.16.0.0/24
        }
        type source
    }
    rule 20 {
        description “DNAT http traffic to a server on the protected network
from the Internet”
        destination {
            address 12.34.56.100
            port 80
        }
        inbound-interface eth0
        inside-address {
            address 176.16.0.33
        }
        protocol tcp
        type destination
    }
```

Stateful Failover Commands

This section presents the following commands.

Configuration Commands	
service conntrack-sync accept-protocol <protocol>	Sets the protocol types that will be tracked in the internal cache.
service conntrack-sync event-listen-queue-size <mbytes>	Sets the event buffer size.
service conntrack-sync failover-mechanism cluster group <group-name>	Sets the cluster group to perform failover synchronization actions for.
service conntrack-sync failover-mechanism vrrp sync-group <group-name>	Sets the vrrp sync group to perform failover synchronization actions for.
service conntrack-sync ignore-address	Ignores connection tracking events for the specified address.
service conntrack-sync interface <interface>	Sets the interface used for connection synchronization messages.
service conntrack-sync mcast-group <ipv4>	Sets the multicast address used as the destination in connection synchronization messages.
service conntrack-sync sync-queue-size <mbytes>	Sets the connection synchronization queue size.
Operational Commands	
clear conntrack-sync external-cache	Flushes the external cache and resynchronizes with replica systems.
clear conntrack-sync internal-cache	Flushes the internal cache and resynchronizes internally and with replica systems.
restart conntrack-sync	Restarts the connection tracking synchronization service.
show conntrack-sync external-cache	Displays foreign connection entries.
show conntrack-sync internal-cache	Displays local connection entries.
show conntrack-sync statistics	Displays connection tracking synchronization statistics.
show conntrack-sync status	Displays connection tracking synchronization status.

clear conntrack-sync external-cache

Flushes the external cache and resynchronizes with replica systems.

Syntax

clear conntrack-sync external-cache

Command Mode

Operational mode.

Parameters

None.

Default

None.

Usage Guidelines

Use this command to flush the external cache and request resynchronization with replica systems to refill the external cache.

clear conntrack-sync internal-cache

Flushes the internal cache and resynchronizes internally and with replica systems.

Syntax

clear conntrack-sync internal-cache

Command Mode

Operational mode.

Parameters

None.

Default

None.

Usage Guidelines

Use this command to flush the internal cache, resynchronize with the internal connection tracking table, and send an update of the internal cache to replica systems.

restart conntrack-sync

Restarts the connection tracking synchronization service.

Syntax

restart conntrack-sync

Command Mode

Operational mode.

Parameters

None.

Default

None.

Usage Guidelines

Use this command to restart the connection tracking synchronization service. Once restarted the service will re-populate the internal cache. In addition it will request a resynchronization with the failover peer and send a replica of its internal cache to the peer to update its external cache.

service conntrack-sync accept-protocol <protocol>

Sets the protocol types that will be tracked in the internal cache.

Syntax

set service conntrack-sync accept-protocol *protocol*

delete service conntrack-sync accept-protocol

show service conntrack-sync accept-protocol

Command Mode

Configuration mode.

Configuration Statement

```
service {
    conntrack-sync {
        accept-protocol protocol
    }
}
```

Parameters

protocol	The protocol type to be tracked. Supported values are: **tcp**, **udp**, **sctp**, and **icmp**. Multiple entries can be specified using commas as separators (e.g., tcp,udp,sctp)

Default

Connections with all protocol types are tracked in the internal cache.

Usage Guidelines

Use this command to specify that only connections with certain protocol type be tracked in the internal cache.

Use the **set** form of the command to specify the protocol types to track in the internal cache.

Use the **delete** form of the command to return the configuration to its default behavior.

Use the **show** form of the command to view the protocol types to track in the internal cache.

service conntrack-sync event-listen-queue-size <mbytes>

Sets the event buffer size.

Syntax

set service conntrack-sync event-listen-queue-size *mbytes*

delete service conntrack-sync event-listen-queue-size

show service conntrack-sync event-listen-queue-size

Command Mode

Configuration mode.

Configuration Statement

```
service {
    conntrack-sync {
        event-listen-queue-size mbytes
    }
}
```

Parameters

mbytes	The size of the event buffer. The default is 8 MB.

Default

The event buffer size is 8 MB.

Usage Guidelines

Use this command to specify the event buffer size used for listening to connection tracking events from the kernel. If messages in the log file indicate that the "maximum netlink socket buffer size has been reached", then the event buffer size should be increased.

Use the **set** form of the command to specify the event buffer size.

Use the **delete** form of the command to return the event buffer size to its default value.

Use the **show** form of the command to view the event buffer size.

service conntrack-sync failover-mechanism cluster group <group-name>

Sets the cluster group to perform failover synchronization actions for.

Syntax

set service conntrack-sync failover-mechanism cluster group *group-name*

delete service conntrack-sync failover-mechanism cluster group

show service conntrack-sync failover-mechanism cluster group

Command Mode

Configuration mode.

Configuration Statement

```
service {
    conntrack-sync {
        failover-mechanism {
            cluster {
                group group-name
            }
        }
    }
}
```

Parameters

group-name	The name of the cluster group to perform failover synchronization actions for.

Default

None.

Usage Guidelines

Use this command to specify the name of the cluster group to perform failover synchronization actions for.

NOTE *Only one of clustering or VRRP can be used as the failover mechanism.*

Use the **set** form of the command to specify the name of the cluster group to perform failover synchronization actions for.

Use the **delete** form of the command to remove the cluster group name.

Use the **show** form of the command to view the cluster group name.

service conntrack-sync failover-mechanism vrrp sync-group <group-name>

Sets the vrrp sync group to perform failover synchronization actions for.

Syntax

set service conntrack-sync failover-mechanism vrrp sync-group *group-name*

delete service conntrack-sync failover-mechanism vrrp sync-group

show service conntrack-sync failover-mechanism vrrp sync-group

Command Mode

Configuration mode.

Configuration Statement

```
service {
    conntrack-sync {
        failover-mechanism {
            vrrp {
                sync-group group-name
            }
        }
    }
}
```

Parameters

group-name	The name of the vrrp sync group to perform failover synchronization actions for.

Default

None.

Usage Guidelines

Use this command to specify the name of the vrrp sync group to perform failover synchronization actions for.

NOTE *Only one of clustering or VRRP can be used as the failover mechanism.*

Use the **set** form of the command to specify the name of the vrrp sync group to perform failover synchronization actions for.

Use the **delete** form of the command to remove the vrrp sync group name.

Use the **show** form of the command to view the vrrp sync group name.

service conntrack-sync ignore-address

Ignores connection tracking events for the specified address.

Syntax

set service conntrack-sync ignore-address ipv4 {*ipv4* | *ipv4net*}

delete service conntrack-sync ignore-address ipv4 {*ipv4* | *ipv4net*}

show service conntrack-sync ignore-address ipv4

Command Mode

Configuration mode.

Configuration Statement

```
service {
    conntrack-sync {
        ignore-address ipv4 [ipv4|ipv4net]
    }
}
```

Parameters

ipv4	Multinode. An ipv4 address to ignore connection tracking events for.
ipv4net	Multinode. An ipv4 network address to ignore connection tracking events for.

Default

None.

Usage Guidelines

Use this command to specify an address or network address to ignore connection tracking events for. The connection tracking events can have the address as a source or destination. This command is useful to help reduce the size of the internal cache that is forwarded to the failover peer. Typically, one can ignore connection tracking

entries for the loopback address (127.0.0.1), IP addresses that exist on the system itself (as we are generally interested in through traffic), and connections involving multicast address space (for example, 224.0.0.0/24).

You can ignore multiple addresses or subnets by creating multiple **ignore-address** configuration nodes.

Use the **set** form of the command to specify an address or network address to ignore connection tracking events for.

Use the **delete** form of the command to remove an address or network address from the configuration.

Use the **show** form of the command to view an address or network address to ignore connection tracking events for.

service conntrack-sync interface <interface>

Sets the interface used for connection synchronization messages.

Syntax

set service conntrack-sync interface *interface*

delete service conntrack-sync interface

show service conntrack-sync interface

Command Mode

Configuration mode.

Configuration Statement

```
service {
    conntrack-sync {
        interface interface
    }
}
```

Parameters

interface	Mandatory. The interface used for connection synchronization messages. This interface is directly connected to a similar interface on the failover peer.

Default

None.

Usage Guidelines

Use this command to specify the interface to be used pass connection synchronization messages between failover peers. Ideally this should be a dedicated link between the failover peers.

Use the **set** form of the command to specify the connection synchronization interface.

Use the **delete** form of the command to remove the connection synchronization interface from the configuration.

Use the **show** form of the command to view the connection synchronization interface configuration.

service conntrack-sync mcast-group <ipv4>

Sets the multicast address used as the destination in connection synchronization messages.

Syntax

set service conntrack-sync mcast-group *ipv4*

delete service conntrack-sync mcast-group

show service conntrack-sync mcast-group

Command Mode

Configuration mode.

Configuration Statement

```
service {
    conntrack-sync {
        mcast-group ipv4
    }
}
```

Parameters

ipv4	The multicast address used as the destination in connection synchronization messages.

Default

The multicast destination address is 255.0.0.50.

Usage Guidelines

Use this command to specify the multicast address used as a destination in connection synchronization messages. This address does not have to be added to any of your existing interfaces.

Use the **set** form of the command to specify the multicast address used as a destination in connection synchronization messages.

Use the **delete** form of the command to return the multicast address to its default value.

Use the **show** form of the command to view the multicast address.

service conntrack-sync sync-queue-size <mbytes>

Sets the connection synchronization queue size.

Syntax

set service conntrack-sync sync-queue-size *mbytes*

delete service conntrack-sync sync-queue-size

show service conntrack-sync sync-queue-size

Command Mode

Configuration mode.

Configuration Statement

```
service {
    conntrack-sync {
        sync-queue-size mbytes
    }
}
```

Parameters

mbytes	The size of the connection synchronization queue, in MB. The default is 1 MB.

Default

The connection synchronization queue size is 1 MB.

Usage Guidelines

Use this command to specify the connection synchronization queue size used for transmitting and receiving connection state information. If the show conntrack-sync statistics command shows "Lost msgs", the connection synchronization queue size should be increased.

Use the **set** form of the command to specify the the connection synchronization queue size.

Use the **delete** form of the command to return the connection synchronization queue size to its default value.

Use the **show** form of the command to view the connection synchronization queue size.

show conntrack-sync external-cache

Displays foreign connection entries.

Syntax

show conntrack-sync external-cache

Command Mode

Operational mode.

Parameters

None.

Default

None.

Usage Guidelines

Use this command to see foreign connection entries received from replica systems.

Examples

Example 4-10 shows output for **show conntrack-sync external-cache** command. These are connections tracked in the internal cache of the remote system.

Example 4-10 Showing connection tracking entries in the external cache

```
vyatta@R1> show conntrack-sync external-cache
Source                          Destination                     Protocol
|192.168.74.1|:138              |192.168.74.255|:138            udp [17]
|192.168.74.1|:1140             |192.168.74.128|:22             tcp [6]
|192.168.74.1|:1145             |192.168.74.200|:22             tcp [6]
|172.16.117.133|:55964          |10.1.0.23|:80                  tcp [6]
|10.3.0.182|:1151               |10.3.0.15|:22                 tcp [6]
```

show conntrack-sync internal-cache

Displays local connection entries.

Syntax

show conntrack-sync internal-cache

Command Mode

Operational mode.

Parameters

None.

Default

None.

Usage Guidelines

Use this command to see local connection entries that are being tracked in the internal cache.

Examples

Example 4-11 shows output for **show conntrack-sync internal-cache** command. These are connections tracked in the internal cache of the local system.

Example 4-11 Showing connection tracking entries in the internal cache

```
vyatta@R1> show conntrack-sync internal-cache
Source                      Destination                 Protocol
|192.168.74.1|:1140        |192.168.74.128|:22         tcp [6]
|192.168.74.1|:1145        |192.168.74.200|:22         tcp [6]
|10.3.0.182|:1151          |10.3.0.15|:22             tcp [6]
|172.16.117.128|           |224.0.0.18|                unknown [112]
```

show conntrack-sync statistics

Displays connection tracking synchronization statistics.

Syntax

show conntrack-sync statistics

Command Mode

Operational mode.

Parameters

None.

Default

None.

Usage Guidelines

Use this command to see statistics regarding connection tracking synchronization.

Examples

Example 4-12 shows output for **show conntrack-sync statistics** command.

The output is devided into five sections:

1. statistics for internal cache
2. statistics for external cache
3. traffic processed by destroyed connections reported in the internal cache section
4. statistics for multicast traffic which is used for exchanging connection synchronization messages
5. statistics for message tracking which is used for reliable delivery of messages over UDP

Example 4-12 Showing connection tracking synchronization statistics

```
vyatta@R1> show conntrack-sync statistics
cache internal:
current active connections:                3
connections created:                    3477    failed:           0
```

```
connections updated:                    12    failed:           0
connections destroyed:                3474    failed:           0

cache external:
current active connections:              4
connections created:                    11    failed:           0
connections updated:                     8    failed:           0
connections destroyed:                   7    failed:           0

traffic processed:
           135219375 Bytes                   163080 Pckts

multicast traffic (active device=eth1):
              333248 Bytes sent              327592 Bytes recv
                8515 Pckts sent                8137 Pckts recv
                   0 Error send                   0 Error recv

message tracking:
                   0 Malformed msgs                   0 Lost msgs
```

show conntrack-sync status

Displays connection tracking synchronization status.

Syntax

show conntrack-sync status

Command Mode

Operational mode.

Parameters

None.

Default

None.

Usage Guidelines

Use this command to see the status of connection tracking synchronization.

Examples

Example 4-13 shows output for **show conntrack-sync status** command.

Example 4-13 Showing connection tracking synchronization status

```
vyatta@R1> show conntrack-sync status

uptime                : 1 h 33 min
sync-interface        : eth1
failover-mechanism    : cluster [group test]
last state transition : PRIMARY at Fri Jul 9 23:15:26 GMT 2010
```

Chapter 5: RAID 1

This chapter describes how to set up hard drives in a Redundant Array of Independent Disks (RAID) 1 deployment using the Vyatta system.

This chapter presents the following topics:

RAID 1 Configuration

This section describes how to set up RAID 1 on the Vyatta System. This section presents the following topics:

RAID 1 Overview

This section presents the following topics:

RAID Implementations

A Redundant Array of Independent Disks (RAID) uses two or more hard disk drives to improve disk speed, store more data, and/or provide fault tolerance. There are several storage schemes possible in a RAID array, each offering a different combination of storage, reliability, and/or performance.

The Vyatta system supports a “RAID 1” deployment. RAID 1 allows two or more disks to mirror one another to provide system fault tolerance. In a RAID 1 solution, every sector of one disk is duplicated onto every sector of all disks in the array. Provided even one disk in the RAID 1 set is operational, the system continues to run, even through disk replacement (provided that the hardware supports in-service replacement of drives).

RAID 1 can be implemented using special hardware or it can be implemented in software. The Vyatta system supports software RAID 1 on two disks.

The Vyatta implementation of RAID 1 allows the following:

- Detection and reporting of disk failure
- The ability to maintain system operation with one failed disk
- The ability to boot the system with one failed disk
- The ability to replace a failed disk and initiate re-mirroring
- The ability to monitor the status of remirroring

On a Vyatta system, RAID 1 is configured during the installation process. Likewise, breaking a RAID 1 set into two component (non–RAID 1) disks also requires reinstallation of the Vyatta software. If two disks of dissimilar size are used together in a RAID 1 set, the system sizes the partitions based on the size of the smaller disk, and there will be unused space on the larger disk.

All RAID-1 configuration information is located on the hard disk, not in the Vyatta configuration file. For this reason, there are no configuration mode commands associated with this feature.

RAID-1 Set States

A RAID 1 set has several “states” associated with it which reflect the health of the array. Some of these states are completely independent (that is, their value has no bearing on other states), while others interact. States are reported in the “State” line in the output of the show raid command. Table 5-1 shows the relevant state variables.

Table 5-1 RAID 1 state variables

State Variable	Description
Active	There is outstanding write I/O. If the system crashes while in the Active state, it is considered an unclean shutdown and the system enters a Resyncing state after the system reboots. Active and Clean states are mutually exclusive, and both are independent of the other states.
Clean	All write I/O has been completed. Active and Clean states are mutually exclusive, and both are independent of the other states.
Degraded	The RAID 1 set is missing one or more members. Since the Vyatta system supports only two-disk RAID 1, this means that the RAID 1 set is operating with only one member.
Recovering	A new member has been added to a RAID 1 set, and the system is in the process of copying the data from another member to the new member. The new member will not be usable until the rebuild is completed. The Recovering state can only occur if the RAID 1 set is in the Degraded state.
Resyncing	The system is recovering from an unclean shutdown by copying all of the data from one member to the others. The objective of recovery is simply to make the two members identical, not to recover I/O that was lost at the time of the unclean shutdown. Since, after an unclean shutdown, the system has no way of knowing which of the members is more accurate, it therefore arbitrarily chooses one to be the source of the resync. Since both members hold valid data, this state is not considered “unhealthy”; the data on both disks is valid. The Resyncing state never occurs at the same time as Degraded or Recovering.

Table 5-1 RAID 1 state variables

State Variable	Description
Synchronized	The RAID 1 set is not Degraded, Recovering, or Resyncing.

The RAID 1 set is considered “Synchronized” if it is not Degraded, Recovering, or Resyncing—that is, both disks are present and healthy, and the only state value displayed is either Clean or Active. This is shown in Example 5-1.

Example 5-1 RAID 1 Synchronized state

```
State:    clean
Number    Major  Minor  RaidDevice    State
0         8      2      0             active sync   /dev/sda2
1         8      18     1             active sync   /dev/sdb2
```

In Example 5-2, one disk has been removed, and the RAID set is running on only one member. The disk display section of the command output clearly shows that only one member of the RAID 1 set is present.

Example 5-2 RAID 1 Degraded state

```
State:    clean, degraded
Number    Major  Minor  RaidDevice    State
0         0      0      0             removed       /dev/sda2
1         8      18     1             active sync   /dev/sdb2
```

In Example 5-3, a second disk has been added and is in the process of rebuilding. The disk display shows which member is being rebuilt. Note that the member is considered “spare” until the rebuild is completed.

Example 5-3 RAID 1 Recovering state

```
State:    clean, degraded, recovering
Rebuild status: 3% complete

Number    Major  Minor  RaidDevice    State
2         8      18     0             spare rebuilding/dev/sda2
1         8      18     1             active sync   /dev/sdb2
```

In Example 5-4, the RAID 1 set is recovering from an unclean shutdown. As in the Recovering state, the status of the rebuild is displayed; unlike the Recovering state, both drives are considered healthy.

Example 5-4 RAID 1 Resyncing state

```
State:    active, resyncing
Rebuild status: 3% complete

Number    Major  Minor  RaidDevice    State
2         8      2      0             active sync   /dev/sda2
1         8      18     1             active sync   /dev/sdb2
```

Booting

The Vyatta system uses the **grub-2** boot package. The **install-system** utility installs the a small first-stage boot program from the **grub** package into the Master Boot Record (MBR), which occupies the first sector of both disk drives. It also installs a small second-stage **grub** boot program onto both disks at a location between the MBR and the first partition. The Vyatta software will reinstall this boot code when a new member is added to a RAID 1 set.

Neither of these sections are covered by the RAID 1 set, but by installing the identical boot code onto both drives, the system can boot from either drive.

- The purpose of the first-stage boot program is to load the second-stage boot program.
- The purpose of the second-stage boot program is to load the kernel and initial RAMdisk files residing on the root file system, which is located on the RAID 1 set.

The first-stage boot program is unaware of the RAID subsystem; it can only operate correctly if it can locate the second-stage boot program on the same disk drive. The second-stage boot program, on the other hand, is aware of the RAID subsystem; it can operate correctly provide one of the two disk partitions comprising the RAID 1 set is available.

When a new member is added to a RAID 1 group, the new member must be "rebuilt": the contents of the good member is copied to the new member. The **grub** boot sections can only be installed *after* the rebuild is complete. When you issue the add raid <RAID-1-device> member <disk-partition> command to add a new member, the system starts the rebuild.

After rebuilding is complete, the system automatically writes the two **grub** sections on the new disk drive. This means you must wait for the rebuild to complete before rebooting the system; otherwise the new disk will not be bootable.

The system will write the boot sections only when the root file system is located on the RAID 1 group; It will not do so when the system is running on LiveCD.

Installation Implications

The Vyatta systems installation utility provides several options for installing to a RAID 1 set. You can:

- Use the **install-system** to create the RAID 1 set
- Use the underlying Linux commands to create a RAID 1 set before running the **install-system** command
- Use a previously-created RAID 1 set.

However the RAID 1 set is created, you must be aware of the states of the RAID 1 set, and observe the following rules:

It is SAFE to install when:

- The RAID 1 set is in Synchronized state. This is the normal case.
- A RAID 1 set is in Resyncing state. Sometimes, the RAID 1 set will go into Resyncing state when **install-system** creates it. It is also safe to reboot after running **install-system** if the system is in Resyncing state as the system will restart the resyncing after rebooting.
- The RAID 1 set state Degraded BUT NOT Recovering. However, in this case, be aware that the RAID 1 set is missing a member.

It is NOT SAFE to install when:

- The RAID 1 set state en a RAID 1 set is Degraded AND Recovering. This is because the system is in the process of adding a new member to the RAID 1 set, and the grub boot program will not be set up properly on the new member. Instead, the user should wait for the rebuild to complete before starting **install-system**.

It is NOT SAFE to add a new member to the RAID 1 set:

- AFTER running the **install-system** utility BUT BEFORE rebooting. This is because the **grub** boot program will not be set up properly on the new drive. Instead, you should reboot the system, let the system come up on the RAID 1 set, and only then add the new member. Once the system is running on the RAID 1 set, it will ensure that **grub** is properly set up whenever a new drive is added.

BIOS Issues

The first stage of booting takes place when the BIOS reads the master boot record from one of the disks and executes the small boot program it contains. This process is completely outside of the control of the software RAID feature, and different platforms behave differently.

The software RAID feature will set up both of the disks that are members of the RAID 1 set to be bootable. Most BIOS implementations provide control over boot order, allowing the user to select one or the other disk to be tried first. Some, but not all, BIOS implementations automatically fail over to the second disk if the first disk in the boot order is missing or failing in some way.

When a replacement disk drive is added, you may need to navigate the BIOS configuration menu in order to boot the system from the remaining good disk instead of the new disk drive. This procedure is necessarily platform-dependent.

RAID 1 Operational Examples

This section presents the following topics:

Setting Up a Non–RAID 1 System

When the Vyatta system is installed, it automatically detects the presence of two disks not currently part of a RAID array. In these cases, the Vyatta installation utility automatically offers you the option of configuring RAID 1 mirroring for the drives, with the following prompt.

```
Would you like to configure RAID 1 mirroring on them?
```

- If you do not want to configure RAID 1 mirroring, enter “No” at the prompt and continue with installation in the normal way.

Non–RAID 1 to RAID 1

If you reinstall a non-RAID Vyatta system on a system with two identical disks that are not currently part of a RAID 1 set, the Vyatta installation utility automatically offers you the option of configuring RAID 1 mirroring for the drives, with the following prompt.

```
Would you like to configure RAID 1 mirroring on them?
```

1. To create a new RAID 1 array, enter “Yes” at the prompt. If the system detects a filesystem on the partitions being used for RAID 1 it will prompt you to indicate whether you want to continue creating the RAID 1 array.

   ```
   Continue creating array?
   ```

2. To overwrite the old filesystem, enter “Yes”.
3. The system informs you that all data on both drives will be erased. You are prompted to confirm that you want to continue

```
Are you sure you want to do this?
```

4. Enter “Yes” at the prompt. The system prompts you to indicate whether you want to save the old configuration data. This represents the current Vyatta configuration.

```
Would you like me to save the data on it before I delete it?
```

5. Enter “Yes” at the prompt to retain the current Vyatta configuration once installation is complete. Enter “No” to delete the current Vyatta configuration.
6. Continue with installation in the normal way.

RAID 1 to Non–RAID 1

If you reinstall Vyatta software on a system with a RAID 1 set already configured, the installation utility will detect the array and will display the following prompt:

```
Would you like to use this one?
```

1. To break apart the current RAID 1 set, enter “No” at the prompt. The installation utility detects that there are two identical disks and offers you the option of configuring RAID 1 mirroring on them, displaying the following prompt:

```
Would you like to configure RAID 1 mirroring on them?
```

2. To decline to set up a new RAID 1 configuration on the disks, enter “No” at the prompt. The system prompts you to indicate which partition you would like the system installed on.

```
Which partition should I install the root on? [sda1]:
```

3. Enter the partition where you would like the system installed. The system then prompts you to indicate whether you want to save the old configuration data. This represents the current Vyatta configuration.

```
Would you like me to save the data on it before I delete it?
```

4. Enter “Yes” at the prompt to retain the current Vyatta configuration once installation is complete. Enter “No” to delete the current Vyatta configuration.
5. Continue with installation in the normal way.

RAID 1 to RAID 1

If you reinstall the Vyatta software on a system with a RAID 1 set already configured, the installation utility will detect the array and will display the following prompt:

```
Would you like to use this one?
```

1. To continue to use the existing RAID 1 array, enter "Yes" at the prompt. The system prompts you to indicate whether you want to save the old configuration data. This represents the current Vyatta configuration.

   ```
   Would you like me to save the data on it before I delete it?
   ```

2. Enter "Yes" at the prompt to retain the current Vyatta configuration once installation is complete. Enter "No" to delete all current Vyatta configuration.
3. Continue with installation in the normal way.

RAID 1 to new RAID 1

You can also recreate the RAID 1 array on disk drives already configured for RAID-1.The installation utility will detect the array and will display the following prompt:

```
Would you like to use this one?
```

1. To stop using the existing RAID 1 array, enter "No" at the prompt. The system detects the two disks and prompts you to indicate whether you want to configure RAID 1 mirroring in them.

   ```
   Would you like to configure RAID 1 mirroring on them?
   ```

2. To create a new RAID 1 array, enter "Yes" at the prompt. If the system detects a file system on the partitions being used for RAID 1 it will prompt you to indicate whether you want to continue creating the RAID 1 array.

   ```
   Continue creating array?
   ```

3. To overwrite the old filesystem, enter "Yes".
4. Continue with installation in the normal way.

Detecting and Replacing a Failed RAID 1 Disk

The Vyatta system automatically detects a disk failure within a RAID 1 set and reports it to the system console. You can verify the failure by issuing the **show raid** command.

To replace a bad disk within a RAID 1 set, perform the following steps:

1. Remove the failed disk from the RAID 1 set by issuing the following command:

   remove raid *RAID-1-device* **member** *disk-partition*

   where *RAID-1-device* is the name of the RAID 1 device (for example, **md0**) and *disk-partition* is the name of the failed disk partition (for example, s**db2**).
2. Physically remove the failed disk from the system. If the drives are not hot-swappable, then you must shut down the system before removing the disk.
3. Replace the failed drive with a drive of the same size or larger.
4. Format the new disk for RAID 1 by issuing the following command:

```
format disk-device1 like disk-device2
```

where *disk-device1* is the replacement disk (for example, **sdb**) and *disk-device2* is the existing healthy disk (for example, **sda**).

5 Add the replacement disk to the RAID 1 set by issuing the following command:

```
add RAID-1-device member disk-partition
```

where *RAID-1-device* is the name of the RAID 1 device (for example, **md0**) and *disk-partition* is the name of the replacement disk partition (for example, **sdb2**).

RAID 1 Commands

This section presents the following commands.

Configuration Commands	
None	
Operational Commands	
add raid <RAID-1-device> member <disk-partition>	Adds a disk partition to the specified RAID 1 set.
format <disk-device1> like <disk-device2>	Formats the first disk device to be just like the second.
remove raid <RAID-1-device> member <disk-partition>	Removes a member of the specified RAID 1 device.
show disk <disk-device> format	Displays the formatting of the specified disk.
show raid <RAID-1-device>	Displays the status of the specified RAID 1 device.

add raid <RAID-1-device> member <disk-partition>

Adds a disk partition to the specified RAID 1 set.

Syntax

add raid *RAID-1-device* **member** *disk-partition*

Command Mode

Operational mode.

Parameters

RAID-1-device	The name of the RAID 1 device. This name will have a form similar to **md0**; it represents the device name for the RAID 1 set of the same name residing in **/dev/**.
disk-partition	The disk partition to be made a RAID 1 member. The device name will have a form similar to **sda1**; it represents the block device of the same name residing in **/dev/**.

Default

None.

Usage Guidelines

Use this command to add a member disk partition to the RAID 1 set. Adding a disk partition to a RAID 1 set initiates mirror synchronization, where all data on the existing member partition is copied to the new partition.

Before adding a brand new drive to a RAID 1 set, the drive must be formatted using format <disk-device1> like <disk-device2> command.

format <disk-device1> like <disk-device2>

Formats the first disk device to be just like the second.

Syntax

format *disk-device1* **like** *disk-device2*

Command Mode

Operational mode.

Parameters

disk-device1	The disk to format. The device name will have a form similar to **sda**; it represents the block device of the same name residing in **/dev/**.
disk-device2	The disk whose partitioning you wish to emulate. The device name will have a form similar to **sdb**; it represents the block device of the same name residing in **/dev/**.

Default

None.

Usage Guidelines

Use this command to format a disk to be partitioned exactly like a second disk.

The disk to be formatted must be inactive; that is, it must not have any partitions mounted and it must not already be part of an active RAID 1 set. In formatting, no data is copied to the formatted device, but any existing data on the formatted device is lost.

This command is typically used to prepare a disk to be added to a preexisting RAID 1 set (of which *disk-device2* is already a member). To add the disk to the RAID 1 set. use add raid <RAID-1-device> member <disk-partition> command.

remove raid <RAID-1-device> member <disk-partition>

Removes a member of the specified RAID 1 device.

Syntax

remove raid *RAID-1-device* **member** *disk-partition*

Command Mode

Operational mode.

Parameters

RAID 1_device	The name of the RAID 1 device. This name will have a form similar to **md0**; it represents the device name for the RAID 1 set of the same name residing in **/dev/**.
disk_partition	The RAID 1 member disk partition. The device name will have a form similar to **sda1**; it represents the block device of the same name residing in **/dev/**.

Default

None.

Usage Guidelines

Use this command to remove a member disk partition from a RAID 1 set.

The command will not allow the last member disk to be removed from the RAID 1 set. To remove the last disk from the set, you must reinstall the Vyatta software and decline the offer to continue using the RAID 1 set. For this procedure, see "RAID 1 to Non–RAID 1" on page 208.

show disk <disk-device> format

Displays the formatting of the specified disk.

Syntax

show disk *disk-device* **format**

Command Mode

Operational mode.

Parameters

disk-device	The disk device name. The device name will have a form similar to **sda**; it represents the block device of the same name residing in **/dev/**.

Default

None.

Usage Guidelines

Use this command to display the formatting of a hard disk.

The information shown includes the partitions on the disk, their size, the start and end sectors, and the system ID.

Examples

Example 5-5 shows output for **show disk** *sda* **format**.

Example 5-5 show disk sda format": Displaying information about a member of a RAID 1 set.

```
vyatta@vyatta:~$ show disk sda format

Disk /dev/sda: 1073 MB, 1073741824 bytes
85 heads, 9 sectors/track, 2741 cylinders
Units = cylinders of 765 * 512 = 391680 bytes
Disk identifier: 0x000b7179
```

```
   Device Boot      Start         End      Blocks   Id  System
/dev/sda1               6        2737     1044922+  fd  Linux raid autodetect
vyatta@vyatta:~$
```

show raid <RAID-1-device>

Displays the status of the specified RAID 1 device.

Syntax

show raid *RAID 1_device*

Command Mode

Operational mode.

Parameters

RAID-1-device	The name of the RAID 1 device. This name will have a form similar to **md0**; it represents the device name for the RAID 1 set of the same name residing in **/dev/**.

Default

None.

Usage Guidelines

Use this command to display the status of a RAID 1 device.

A RAID 1 device is created during system installation. It consists of two identical partitions on two physical disks which mirror one another to provide fault tolerance. These are the members of the RAID 1 set.

The information shown includes the devices that are members of the RAID 1 set, whether any of the members are offline, whether the RAID 1 set is currently undergoing mirror resynchronization, and, if so, the percentage of synchronization that is complete.

Examples

Example 5-6 shows output for **show raid** *md0* as sdb1 is being added to the RAID 1 set and is in the process of being resynchronized.

Example 5-6 "show raid md0": Displaying information about a RAID 1 set with two members - one being resynchronized.

```
vyatta@vyatta:~$ show raid md0
```

```
/dev/md0:
        Version : 00.90
  Creation Time : Wed Oct 29 09:19:09 2008
     Raid Level : raid1
     Array Size : 1044800 (1020.48 MiB 1069.88 MB)
  Used Dev Size : 1044800 (1020.48 MiB 1069.88 MB)
   Raid Devices : 2
  Total Devices : 2
Preferred Minor : 0
    Persistence : Superblock is persistent

    Update Time : Wed Oct 29 19:34:23 2008
          State : active, degraded, recovering
 Active Devices : 1
Working Devices : 2
 Failed Devices : 0
  Spare Devices : 1

 Rebuild Status : 17% complete

           UUID : 981abd77:9f8c8dd8:fdbf4de4:3436c70f
         Events : 0.103

    Number   Major   Minor   RaidDevice State
       0       8        1        0      active sync   /dev/sda1
       2       8       17        1      spare rebuilding   /dev/sdb1
vyatta@vyatta:~$
```

Example 5-7shows output for **show raid** *md0*.

Example 5-7 “show raid md0”: Displaying information about a RAID 1 set with two synchronized members.

```
vyatta@vyatta:~$ show raid md0
/dev/md0:
        Version : 00.90
  Creation Time : Wed Oct 29 09:19:09 2008
     Raid Level : raid1
     Array Size : 1044800 (1020.48 MiB 1069.88 MB)
  Used Dev Size : 1044800 (1020.48 MiB 1069.88 MB)
   Raid Devices : 2
  Total Devices : 2
Preferred Minor : 0
    Persistence : Superblock is persistent

    Update Time : Wed Oct 29 18:05:26 2008
```

```
          State : clean
 Active Devices : 2
Working Devices : 2
 Failed Devices : 0
  Spare Devices : 0

           UUID : 981abd77:9f8c8dd8:fdbf4de4:3436c70f
         Events : 0.6

    Number   Major   Minor   RaidDevice State
       0       8        1        0      active sync   /dev/sda1
       1       8       17        1      active sync   /dev/sdb1
vyatta@vyatta:~$
```

Chapter 6: Configuration Synchronization

This chapter explains how to set up the Vyatta system to synchronize portions of the configuration.

This feature is available only in the Vyatta Subscription Edition.

This chapter presents the following topics:

Configuration Synchronization Configuration

This section describes the configuration synchronization feature and provides examples on setting it up and using it. This section presents the following topics:

Configuration Synchronization Overview

Many high-availability deployments involve the use of hot standby systems. In these scenarios, one priority is reducing configuration differences between the master and standby systems. The ability to synchronize defined portions of configuration minimizes configuration differences at failover while posing the least-possible burden on the master system.

By default, all configuration is excluded from synchronization and you must explicitly include a configuration node in order for it to be synchronized. Only a single standby system is currently supported.

Every time the master system starts up or a **commit**, **load**, or **merge** is executed on the master system the standby system will be synchronously updated and its configuration will be saved. The system will try to make all parameter values on the standby system within the **sync-map** identical to the master. Partial commits, in the event of a commit failure, will synchronize only the sections that were successfully committed on the master.

NOTE *Be sure to save the configuration on the master and be mindful that this operation does not trigger the standby system to save its configuration.*

NOTE *Both the master and standby systems must be running Vyatta SE software, must be properly configured for entitlement, and must be able to access the Vyatta entitlement server.*

Master and Standby Systems

Configuration synchronization allows you to designate a master Vyatta system that can synchronize defined portions of the configuration with a remote standby system. The master system dispatches locally-generated configuration commands (**set**, **delete**, **commit**, and so on) to the remote standby system; the commands are dispatched from the master when the configuration change is commited.

The master system uses the Vyatta system's REST API to propagate commands to the remote systems; for this reason, the remote system must have HTTPs enabled in order to participate.

When setting up the master and standby systems on the network, keep in mind that the Vyatta system does not prevent you from setting up mis-synchronization scenarios that can result in network problems. Take care to avoid scenarios that will cause network problems. For example:

- Configuration information that is unique to a system should not be synchronized between systems because synchronizing this information can cause problems on the network. Examples of configuration that should be excluded from synchronization include interface, IP addresses, and VRRP priorities.
- Avoid setting up two masters to synchronize one another.
- Avoid setting up two masters to both synchronize the same configuration on a third system.

Note that some configuration items are not allowed to be synchronized, because synchronizing them would damage your system configuration. The two items that cannot be synchronized are the **system config-sync** configuration node itself and the **service https** configuration node. Disallowed configuration items do not appear in the configuration tree when excluded items are listed.

Also note that only one **sync-map** can be defined for the standby system.

Finally, avoid direct modification of the configuration on the standby system in areas contained in the **sync-map as this may result in conflicts and commit failures during the sync process.**

Out-of-Sync Systems

The master system logs a warning if configuration elements become out-of-sync, but does not attempt to correct configuration. You can view the warnings in the log file or by issuing the **show config-sync status** opearational command.

If configuration does become out-of-sync, you can reset the configuration on the standby system by issuing the **update config-sync** operational command. When this command has successfully completed, the systems will be synchronized again.

If the systems become out of sync due to a configuration conflict, the conflict must be addressed prior to issuing the **update config-sync** command.

The **update config-sync** command is also useful if the secondary is booted with an out of sync configuration. Issuing this command on the master will syncchronize the configurations without having to commit a configuration change on the master.

To set up configuration synchronization on the Vyatta system, you use the following workflow:

1. Identify the master system.
2. Identify the remote standby system.
3. Identify the portion of the configuration tree to be synchronized (“include”).

Configuration Synchronization Examples

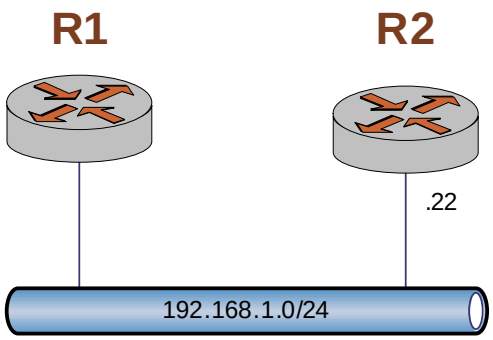
This section shows examples of configuring configuration synchronization on the Vyatta System.

This section presents the following topics:

Basic Configuration Synchronization

This section sets up configuration synchronization using the scenario shown in Figure 6-1.

Figure 6-1 Configuration synchronization



In this example:

- The master system is R1.
- The standby system is R2. The remote system is to be accessed using the default username and password **vyatta**.
- Firewall configuration is to be synchronized.

To configure R1 for configuration synchronization in this way, perform the following steps in configuration mode:

Example 6-1 Configuring R1 for Configuration Synchronization

Step	Command
Create the configuration synchronization service and a synchronization map (TEST) with a rule (1) within the synchronization map. Specify the “firewall” node as a node to take action on.	`vyatta@R1# set system config-sync sync-map TEST rule 1 location firewall`
Specify the synchronization action action to take on the “firewall” configuration node during configuration synchronization. The “firewall” node is to be included in configuration synchronization.	`vyatta@R1# set system config-sync sync-map TEST rule 1 action include`
Define the remote system to synchronize with and set the username (vyatta) used for connecting to the remote system.	`vyatta@R1# set system config-sync remote-router 192.168.1.22 username vyatta`
Set the password (vyatta) used for connecting to the remote system.	`vyatta@R1# set system config-sync remote-router 192.168.1.22 password vyatta`
Set TEST as the synchronization map to be used for configuration synchronization with the remote system.	`vyatta@R1# set system config-sync remote-router 192.168.1.22 sync-map TEST`
Commit the configuration.	`vyatta@R1# commit`

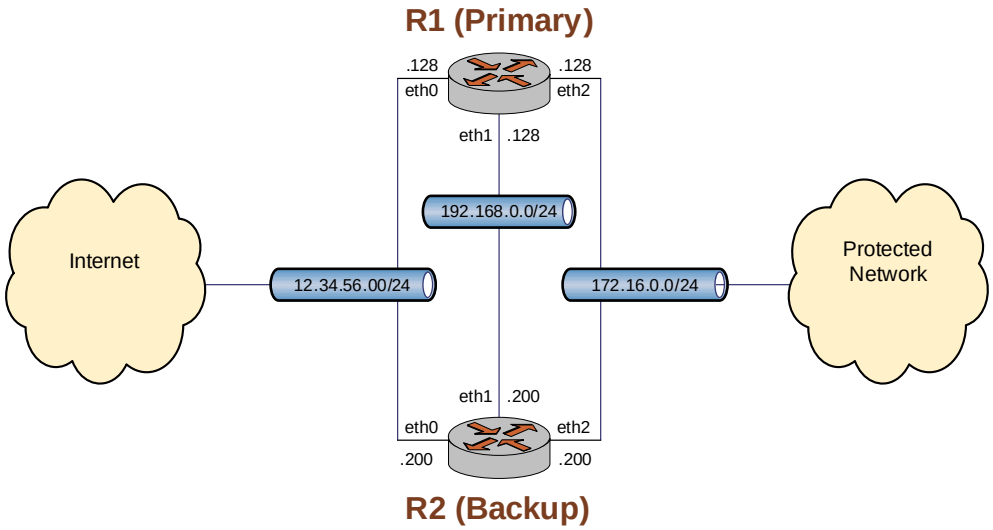
Display the configuration.	`vyatta@R1# show system config-sync`
	`  remote-router 192.168.1.22 {`
	`  password vyatta`
	`  sync-map TEST`
	`  username vyatta`
	`  }`
	`  sync-map TEST {`
	`  rule 1 {`
	`  action include`
	`  location firewall`
	`  }`
	`  }`

Configuration Synchronization in a High Availability Scenario

The example in this section shows the integration of Configuration Synchronization in a Clustering scenario. For further information on Clustering see Chapter 3: Clustering.

This section sets up configuration synchronization using the scenario shown in Figure 6-2.

Figure 6-2 Configuration Synchronization and Clustering



In this example, R1 and R2 are set up in a clustering configuration. R1 is also set up as a master for configuration synchronization and will synchronize firewall, NAT, and clustering configurations with R2.

The configuration for R1 is shown in Example 6-2:

Example 6-2 Configuration for R1

```
vyatta@R1# show
cluster {
     dead-inteval 2000
     group MAIN {
        auto-fallback true
        monitor 172.16.0.131
        monitor 12.34.56.133
        primary R1
        secondary R2
        service 12.34.56.100/24/eth0
        service 172.16.0.100/24/eth2
```

```
    }
    interface eth1
    keepalive-interval 500
    monitor-dead-interval 2000
    pre-shared-secret testing
}
firewall {
    name internet_to_protected {
        default_action drop
        description “Internet to Protected”
        rule 10 {
            action accept
            state {
                established enable
                related enable
            }
        }
    }
    name protected_to_internet {
        default_action accept
        description “Protected to Internet”
        rule 10 {
            action drop
            state {
                invalid enable
            }
        }
    }
}
interfaces {
    eth0 {
        address 12.34.56.128/24
        firewall {
            in {
                name internet_to_protected
            }
        }
    }
    eth1 {
        address 192.168.0.128/24
    }
    eth2 {
        address 172.16.0.128/24
        firewall {
            in {
                name protected_to_internet
            }
        }
```

```
        }
        loopback lo {
        }
    }
    service {
        https
        nat {
            rule 10 {
                description “Masquerade all trffice to Internet from protected
network.”
                outbound-interface eth0
                type masquerade
            }
        }
    }
    system {
        config-sync {
            remote-router 192.168.0.200 {
                password vyatta
                sync-map FW-NAT-CLUS
                username vyatta
            }
            sync-map FW-NAT-CLUS {
                rule 10 {
                    action include
                    location firewall
                }
                rule 20 {
                    action include
                    location “interfaces ethernet eth0 firewall”
                }
                rule 30 {
                    action include
                    location “interfaces ethernet eth2 firewall”
                }
                rule 40 {
                    action include
                    location “service nat”
                }
                rule 50 {
                    action include
                    location cluster
                }
            }
        }
        host-name R1
        login {
            user vyatta {
```

```
            authentication {
               encrypted-password $1$4XHPj9eT$G3ww9B/pYDLSXC8YVvazP0
            }
            level admin
         }
      }
      name-server 172.16.0.80
      ntp-server 0.vyatta.pool.ntp.org
      package {
         auto-sync 1
         repository supported {
            components main
            distribution stable
            password ""
            url http://packages.vyatta.com/vyatta-supported
            username ""
         }
      }
      syslog {
         global {
            facility all {
               level notice
            }
            facility protocols {
               level debug
            }
         }
      }
      time-zone GMT
   }
```

The configuration for R2 is shown in Example 6-3:

Example 6-3 Configuration for R2

```
vyatta@R2# show
cluster {
     dead-inteval 2000
     group MAIN {
        auto-fallback true
        monitor 172.16.0.131
        monitor 12.34.56.133
        primary R1
        secondary R2
        service 12.34.56.100/24/eth0
        service 172.16.0.100/24/eth2
```

```
    }
    interface eth1
    keepalive-interval 500
    monitor-dead-interval 2000
    pre-shared-secret testing
}
firewall {
    name internet_to_protected {
        default_action drop
        description “Internet to Protected”
        rule 10 {
            action accept
            state {
                established enable
                related enable
            }
        }
    }
    name protected_to_internet {
        default_action accept
        description “Protected to Internet”
        rule 10 {
            action drop
            state {
                invalid enable
            }
        }
    }
}
interfaces {
    eth0 {
        address 12.34.56.200/24
        firewall {
            in {
                name internet_to_protected
            }
        }
    }
    eth1 {
        address 192.168.0.200/24
    }
    eth2 {
        address 172.16.0.200/24
        firewall {
            in {
                name protected_to_internet
            }
        }
```

```
        }
        loopback lo {
        }
    }
    service {
        https
        nat {
            rule 10 {
                description “Masquerade all trffice to Internet from protected
network.”
                outbound-interface eth0
                type masquerade
            }
        }
    }
    system {
        host-name R2
        login {
            user vyatta {
                authentication {
                    encrypted-password $1$4XHPj9eT$G3ww9B/pYDLSXC8YVvazP0
                }
                level admin
            }
        }
        name-server 172.16.0.80
        ntp-server 0.vyatta.pool.ntp.org
        package {
            auto-sync 1
            repository supported {
                components main
                distribution stable
                password ""
                url http://packages.vyatta.com/vyatta-supported
                username ""
            }
        }
        syslog {
            global {
                facility all {
                    level notice
                }
                facility protocols {
                    level debug
                }
            }
        }
        time-zone GMT
```

```
}
```

Configuration Synchronization Commands

This section presents the following commands.

Configuration Commands	
system config-sync remote-router <addr>	Specifies the address of the standby system.
system config-sync remote-router <addr> password <password>	Specifies the password to be used to access the standby system.
system config-sync remote-router <addr> sync-map <sync-map-name>	Specifies the name of the synchronization map used to define the standby system configuration.
system config-sync remote-router <addr> username <username>	Specifies the username to be used to access the standby system.
system config-sync sync-map <sync-map-name>	Specifies the portions of the configuration to be synchronized with the standby system.
system config-sync sync-map <sync-map-name> rule <rule-num>	Specifies a synchronization map rule.
system config-sync sync-map <sync-map-name> rule <rule-num> action <action>	Specifies an action for this rule.
system config-sync sync-map <sync-map-name> rule <rule-num> location <config-path>	Specifies a configuration node to be acted on by this rule.
Operational Commands	
show config-sync difference	Displays configuration differences between master and standby systems.
show config-sync status	Provides details of the last commit to the standby system.
update config-sync	Synchronizes configuration on the standby system.

system config-sync remote-router <addr>

Specifies the address of the standby system.

Syntax

set system config-sync remote-router *addr*

delete system config-sync remote-router *addr*

show system config-sync remote-router *addr*

Availability

Vyatta Subscription Edition

Command Mode

Configuration mode.

Configuration Statement

```
system {
    config-sync {
        remote-router addr {}
    }
}
```

Parameters

addr	Multi-node. The IPv4 address of the standby system.

Default

None.

Usage Guidelines

Use this command to specify the address of the system whose configuration is to be automatically synchronized with a subset of that defined on the master system by the **sync-map**.

Use the **set** form of the command to specify the address of the standby system.

Use the **delete** form of the command to remove the address of the standby system.

Use the **show** form of the command to view the configuration syncronization configuration of the standby system.

system config-sync remote-router <addr> password <password>

Specifies the password to be used to access the standby system.

Syntax

set system config-sync remote-router *addr* **password** *password*

delete system config-sync remote-router *addr* **password**

show system config-sync remote-router *addr* **password**

Availability

Vyatta Subscription Edition

Command Mode

Configuration mode.

Configuration Statement

```
system {
    config-sync {
        remote-router addr {
            password password
        }
    }
}
```

Parameters

addr	Multi-node. The IPv4 address of the standby system.
password	The password used (in conjunction with a username) to access the standby system.

Default

None.

Usage Guidelines

Use this command to specify the password to use to access the standby system for automated configuration synchronization.

Use the **set** form of the command to specify the password.

Use the **delete** form of the command to remove the password.

Use the **show** form of the command to view the password

system config-sync remote-router <addr> sync-map <sync-map-name>

Specifies the name of the synchronization map used to define the standby system configuration.

Syntax

set system config-sync remote-router *addr* **sync-map** *sync-map-name*

delete system config-sync remote-router *addr* **sync-map**

show system config-sync remote-router *addr* **sync-map**

Availability

Vyatta Subscription Edition

Command Mode

Configuration mode.

Configuration Statement

```
system {
    config-sync {
        remote-router addr {
            sync-map sync-map-name
        }
    }
}
```

Parameters

addr	Multi-node. The IPv4 address of the standby system.
sync-map-name	The name of a synchronization map.

Default

None.

Usage Guidelines

Use this command to specify the name of the synchronization map used to define the subset of the local configuration to be synchronized with the standby system. Only one **sync-map** can be defined per **remote-router.**

Use the **set** form of the command to specify the synchronization map name.

Use the **delete** form of the command to remove the synchronization map name.

Use the **show** form of the command to view the synchronization map name.

system config-sync remote-router <addr> username <username>

Specifies the username to be used to access the standby system.

Syntax

set system config-sync remote-router *addr* **username** *username*

delete system config-sync remote-router *addr* **username**

show system config-sync remote-router *addr* **username**

Availability

Vyatta Subscription Edition

Command Mode

Configuration mode.

Configuration Statement

```
system {
    config-sync {
        remote-router addr {
            username username
        }
    }
}
```

Parameters

addr	Multi-node. The IPv4 address of the standby system.
username	The username used (in conjunction with a password) to access the standby system.

Default

None.

Usage Guidelines

Use this command to specify the username to use to access the standby system for automated configuration synchronization. The user must have admin rights on the standby system or else synchronization will fail. Synchronization will also fail if an invalid username/password combination is specified.

Use the **set** form of the command to specify the username.

Use the **delete** form of the command to remove the username.

Use the **show** form of the command to view the username

system config-sync sync-map <sync-map-name>

Specifies the portions of the configuration to be synchronized with the standby system.

Syntax

set system config-sync sync-map *sync-map-name*

delete system config-sync sync-map *sync-map-name*

show system config-sync sync-map *sync-map-name*

Availability

Vyatta Subscription Edition

Command Mode

Configuration mode.

Configuration Statement

```
system {
    config-sync {
        sync-map sync-map-name {}
    }
}
```

Parameters

sync-map-name	Multi-node. The name of the synchronization map.

Default

None.

Usage Guidelines

Use this command to specify a synchronization map which defines the portions of the configuration to be synchronized with the standby system. Multiple configuration nodes can be specified to identify multiple synchronization maps. Only one **sync-map** can be assigned to the standby system at one time.

Use the **set** form of the command to specify the synchronization map name.

Use the **delete** form of the command to remove the synchronization map.

Use the **show** form of the command to view the synchronization map configuration.

system config-sync sync-map <sync-map-name> rule <rule-num>

Specifies a synchronization map rule.

Syntax

set system config-sync sync-map *sync-map-name* **rule** *rule-num*

delete system config-sync sync-map *sync-map-name* **rule** *rule-num*

show system config-sync sync-map *sync-map-name* **rule** *rule-num*

Command Mode

Configuration mode.

Availability

Vyatta Subscription Edition

Configuration Statement

```
system {
    config-sync {
        sync-map sync-map-name {
            rule rule-num {}
        }
    }
}
```

Parameters

sync-map-name	Multi-node. The name of the synchronization map.
rule-num	Multi-node. A numeric identifier for the rule. The range is 1-1024.

Default

None.

Usage Guidelines

Use this command to specify a synchronization map rule which defines the portions of the configuration to be synchronized with the standby system. Multiple configuration nodes can be specified to identify multiple synchronization map rules. The rule number specifies the order of evaluation with respect to other rules. The first match of a configuration element will stop further comparisons.

Use the **set** form of the command to specify the synchronization map rule.

Use the **delete** form of the command to remove the synchronization map rule.

Use the **show** form of the command to view the synchronization map rule configuration.

system config-sync sync-map <sync-map-name> rule <rule-num> action <action>

Specifies an action for this rule.

Syntax

set system config-sync sync-map *sync-map-name* **rule** *rule-num* **action** *action*

delete system config-sync sync-map *sync-map-name* **rule** *rule-num* **action**

show system config-sync sync-map *sync-map-name* **rule** *rule-num* **action**

Command Mode

Configuration mode.

Availability

Vyatta Subscription Edition

Configuration Statement

```
system {
    config-sync {
        sync-map sync-map-name {
            rule rule-num {
                action action
            }
        }
    }
}
```

Parameters

sync-map-name	Multi-node. The name of the synchronization map.
rule-num	Multi-node. A numeric identifier for the rule. The range is 1-1024.
action **include**	Include the configuration node specified by the **location** parameter in the configuration synchronization.

action **exclude**	Exclude the configuration node specified by the **location** parameter from the configuration synchronization.

Default

None.

Usage Guidelines

Use this command to specify the action for this rule.

Use the **set** form of the command to specify the action for this rule.

Use the **delete** form of the command to remove the action configuration.

Use the **show** form of the command to view the action configuration.

system config-sync sync-map <sync-map-name> rule <rule-num> location <config-path>

Specifies a configuration node to be acted on by this rule.

Syntax

set system config-sync sync-map *sync-map-name* **rule** *rule-num* **location** *config-path*

delete system config-sync sync-map *sync-map-name* **rule** *rule-num* **location**

show system config-sync sync-map *sync-map-name* **rule** *rule-num* **location**

Availability

Vyatta Subscription Edition

Command Mode

Configuration mode.

Configuration Statement

```
system {
    config-sync {
        sync-map sync-map-name {
            rule rule-num {
                location config-path
            }
        }
    }
}
```

Parameters

sync-map-name	Multi-node. The name of the synchronization map.
rule-num	Multi-node. A numeric identifier for the rule. The range is 1-1024.
config-path	The path to the configuration node. If the configuration node being specified contains more than one string they should be separated by spaces and the entire string enclosed in double quotes (e.g. “system login user dave”).

Default

None.

Usage Guidelines

Use this command to specify the configuration node to be acted on by this rule.

Use the **set** form of the command to specify the configuration node to be acted on by this rule.

Use the **delete** form of the command to remove the location configuration.

Use the **show** form of the command to view the location configuration.

show config-sync difference

Displays configuration differences between master and standby systems.

Syntax

show config-sync difference [*addr* [**detail**]]

Availability

Vyatta Subscription Edition

Command Mode

Operational mode.

Parameters

addr	The IP address of the standby system.
detail	Provide detailed information.

Default

None.

Usage Guidelines

Use this command to compare the configuration identified in the **sync-map** on the standby system with that of the master to find any differences.

Examples

Example 6-4 shows output for **show config-sync difference** command.

Example 6-4 Showing configuration synchronization differences

```
vyatta@R1> show config-sync difference

192.168.0.200 configuration is in sync
```

Example 6-5 shows output for **show config-sync difference <addr> detail** command.

Example 6-5 Showing detailed configuration synchronization differences

```
vyatta@R1> show config-sync difference 192.168.74.200 detail

Configuration only on master (compared to 192.168.74.200):
  zone-policy zone lan default-action drop
  zone-policy zone lan from public firewall name public_to_lan
  zone-policy zone lan interface eth0
  zone-policy zone public default-action drop
  zone-policy zone public from lan firewall name lan_to_public
  zone-policy zone public interface eth3

192.168.74.200 configuration is out of sync
```

show config-sync status

Provides details of the last commit to the standby system.

Syntax

show config-sync status [*addr* [**detail**]]

Availability

Vyatta Subscription Edition

Command Mode

Operational mode.

Parameters

addr	The IP address of the standby system.
detail	Provide detailed information.

Default

None.

Usage Guidelines

Use this command to display the commit status of the standby system. The status includes any errors and where they occurred in the synchronization process, the reason for the errors, and the software version on the local and remote systems.

Examples

Example 6-6 shows output for **show config-sync status** command.

Example 6-6 Showing configuration synchronization status

```
vyatta@R1> show config-sync status
remote-router:  192.168.0.200
  version:              999.larkspurse.08101304
  sync-map:             MAP1
```

```
  last sync:            good
  last sync time:       Thu Aug 12 18:18:14 2010
  in-sync?:             yes
  access-status:        connected
```

Example 6-7 shows output for **show config-sync status <addr> detail** command.

Example 6-7 Showing detailed configuration synchronization status

```
vyatta@R1> show config-sync status 192.168.0.200 detail
remote-router:  192.168.0.200
  version:              999.larkspurse.08101304
  sync-map:             MAP1
  last sync:            good
  last sync time:       Thu Aug 12 18:18:14 2010
  in-sync?:             yes
  access-status:        connected

remote configuration:
   cluster {
     dead-inteval 2000
     group MAIN {
        auto-fallback true
        monitor 172.16.0.131
        monitor 12.34.56.133
        primary R1
        secondary R2
        service 12.34.56.100/24/eth0
        service 172.16.0.100/24/eth2
     }
     interface eth1
     keepalive-interval 500
     monitor-dead-interval 2000
     pre-shared-secret testing
  }
  firewall {
     name internet_to_protected {
        default_action drop
:
```

update config-sync

Synchronizes configuration on the standby system.

Syntax

update config-sync [*addr*]

Availability

Vyatta Subscription Edition

Command Mode

Operational mode.

Parameters

addr	The IP address of the standby system.

Default

None.

Usage Guidelines

Use this command to synchronize the configuration of the standby system with the master based on the configuration nodes specified in the **sync-map**.

Glossary of Acronyms

ACL	access control list
ADSL	Asymmetric Digital Subscriber Line
AMI	Amazon Machine Image
API	Application Programming Interface
AS	autonomous system
ARP	Address Resolution Protocol
AWS	Amazon Web Services
BGP	Border Gateway Protocol
BIOS	Basic Input Output System
BPDU	Bridge Protocol Data Unit
CA	certificate authority
CCMP	AES in counter mode with CBC-MAC
CHAP	Challenge Handshake Authentication Protocol
CLI	command-line interface
DDNS	dynamic DNS
DHCP	Dynamic Host Configuration Protocol
DHCPv6	Dynamic Host Configuration Protocol version 6

DLCI	data-link connection identifier
DMI	desktop management interface
DMZ	demilitarized zone
DN	distinguished name
DNS	Domain Name System
DSCP	Differentiated Services Code Point
DSL	Digital Subscriber Line
eBGP	external BGP
EBS	Amazon Elastic Block Storage
EC2	Amazon Elastic Compute Cloud
EGP	Exterior Gateway Protocol
ECMP	equal-cost multipath
ESP	Encapsulating Security Payload
FIB	Forwarding Information Base
FTP	File Transfer Protocol
GRE	Generic Routing Encapsulation
HDLC	High-Level Data Link Control
I/O	Input/Ouput
ICMP	Internet Control Message Protocol
IDS	Intrusion Detection System
IEEE	Institute of Electrical and Electronics Engineers
IGP	Interior Gateway Protocol
IPS	Intrusion Protection System
IKE	Internet Key Exchange
IP	Internet Protocol
IPOA	IP over ATM

IPsec	IP security
IPv4	IP Version 4
IPv6	IP Version 6
ISP	Internet Service Provider
KVM	Kernel-Based Virtual Machine
L2TP	Layer 2 Tunneling Protocol
LACP	Link Aggregation Control Protocol
LAN	local area network
LDAP	Lightweight Directory Access Protocol
LLDP	Link Layer Discovery Protocol
MAC	medium access control
MIB	Management Information Base
MLPPP	multilink PPP
MRRU	maximum received reconstructed unit
MTU	maximum transmission unit
NAT	Network Address Translation
ND	Neighbor Discovery
NIC	network interface card
NTP	Network Time Protocol
OSPF	Open Shortest Path First
OSPFv2	OSPF Version 2
OSPFv3	OSPF Version 3
P2P	peer-to-peer
PAM	Pluggable Authentication Module
PAP	Password Authentication Protocol
PAT	Port Address Translation

PCI	peripheral component interconnect
PKI	Public Key Infrastructure
PPP	Point-to-Point Protocol
PPPoA	PPP over ATM
PPPoE	PPP over Ethernet
PPTP	Point-to-Point Tunneling Protocol
PVC	permanent virtual circuit
QoS	quality of service
RADIUS	Remote Authentication Dial-In User Service
RHEL	Red Hat Enterprise Linux
RIB	Routing Information Base
RIP	Routing Information Protocol
RIPng	RIP next generation
Rx	receive
S3	Amazon Simple Storage Service
SLAAC	Stateless Address Auto-Configuration
SNMP	Simple Network Management Protocol
SMTP	Simple Mail Transfer Protocol
SONET	Synchronous Optical Network
SSH	Secure Shell
SSID	Service Set Identifier
STP	Spanning Tree Protocol
TACACS+	Terminal Access Controller Access Control System Plus
TCP	Transmission Control Protocol
TKIP	Temporal Key Integrity Protocol
ToS	Type of Service

Tx	transmit
UDP	User Datagram Protocol
vif	virtual interface
VLAN	virtual LAN
VPC	Amazon virtual private cloud
VPN	Virtual Private Network
VRRP	Virtual Router Redundancy Protocol
WAN	wide area network
WAP	wireless access point
WPA	Wired Protected Access