vodafone

Vodafone MachineLink

VRRP Configuration Guide

Doc No CG01202

Document History

This guide covers the following products:

- Vodafone MachineLink 4G Lite NWL-221
- Vodafone MachineLink 4G Lite NWL-222
- Vodafone MachineLink 4G Lite NWL-224

Ver.	Document Description	Date
v. 1.0	Initial document release.	November 2019

Table i - Document revision history

Note – Before performing the instructions in this guide, please ensure that you have the latest firmware version installed on your router.

Visit http://vodafone.netcommwireless.com to download the latest firmware.

Note – The functions described in this document require that the router is assigned with a publicly routable IP address.

Please ensure that your mobile carrier has provided you with a publicly routable IP address before performing the instructions in this document.

Copyright

Copyright© 2019 NetComm Wireless Limited. All rights reserved.

Copyright© 2019 Vodafone Group Plc. All rights reserved.

The information contained herein is proprietary to NetComm Wireless and Vodafone. No part of this document may be translated, transcribed, reproduced, in any form, or by any means without prior written consent of NetComm Wireless and Vodafone.

Trademarks and registered trademarks are the property of NetComm Wireless Limited or Vodafone Group or their respective owners. Specifications are subject to change without notice. Images shown may vary slightly from the actual product.

Note – This document is subject to change without notice.

Contents

Notation

The following symbols are used in this user guide:

Note – The following note provides useful information.

Important – The following note requires attention.

Warning – The following note provides a warning.

Introduction

What is VRRP?

VRRP (Virtual Router Redundancy Protocol) is a non-proprietary redundancy protocol designed to increase the availability of the default gateway servicing hosts on the same subnet.

The Virtual Router Redundancy Protocol is a standards-based alternative to Cisco's proprietary Hot Standby Router Protocol (HSRP) concept defined in IETF standard RFC 3768. The two technologies are similar in concept, but are not compatible. The advantage of using VRRP is that you gain a higher availability for the default path without requiring configuration of dynamic routing or router discovery protocols on every end host.

VRRP routers, viewed as a "redundancy group", share the responsibility for forwarding packets as if they "owned" the IP address corresponding to the default gateway configured on the hosts. At any time, one of the VRRP routers acts as the master, and other VRRP routers act as backups. If the master router fails, a backup router becomes the new master. In this way, router redundancy is always provided, allowing traffic on the LAN to be routed without relying on a single router.

The physical router that is currently forwarding data on behalf of the virtual router is called the master router. There is always a master for the shared IP address. If the master goes down, the remaining VRRP routers elect a new master VRRP router. The new master forwards packets on behalf of the owner by taking over the virtual MAC address used by the owner.

Master routers have a priority of 255 and backup router(s) can have priority between 1-254.

A virtual router must use 00-00-5E-00-01-XX as its (MAC) address. The last byte of the address (XX) is the Virtual Router Identifier (VRID), which is different for each virtual router in the network. This address is used by only one physical router at a time, and is the only way that other physical routers can identify the master router within a virtual router.

VRRP terminology

Virtual Router

A single router image created through the operation of one or more routers running VRRP.

VRRP Instance

A program, implementing VRRP, running on a router. A single VRRP instance can provide VRRP capability for more than one virtual router.

Virtual Router ID (VRID)

Virtual Router ID, also called VRID, this is a numerical identification of a particular virtual router.

VRIDs must be unique on a given network segment.

Virtual Router IP

An IP address associated with a VRID that other hosts can use to obtain network service from. The VRIP is managed by the VRRP instances belonging to a VRID.

Virtual MAC address

For media that use MAC addressing (such as Ethernet), VRRP instances use predefined MAC addresses for all VRRP actions instead of the real adapter MAC addresses. This isolates the operation of the virtual router from the real router providing the routing function. The VMAC is derived from the VRID.

Master

The one VRRP instance that performs the routing function for the virtual router at a given time. Only one master is active at a time for a given VRID. Also refers to the state of the VRRP FSM when the VRRP instance is operating as master (that is, “master state”).

Backup

VRRP instances for a VRID that are active but not in the master state. Any number of backups can exist for a VRID. Backups are ready to take on the role of master if the current master fails. Also refers to the state of the VRRP FSM when the VRRP instance is operating as backup (that is, “backup state”).

Priority

Different VRRP instances are assigned a priority value in order to determine which router will take on the role of master if the current master fails. *Priority is a number from 1 to 254 (0 and 255 are reserved).* Larger numbers have higher priority.

Owner

If the virtual IP address is the same as any of the IP addresses configured on an interface of a router, that router is the owner of the virtual IP address. The priority of the VRRP instance when it is the VIP owner is 255, the highest (and reserved) value.

Router VRRP configuration

Open a web browser and navigate to the LAN IP address of the MachineLink router. The default is http://192.168.1.1.

1 Login to the router with the following credentials:

Username: `root`

Password:

Note – Original factory password is printed on the device's label on the underside of the router casing. After the initial login you will be prompted to define your personal secure password. Thereafter you must use that password to log in.

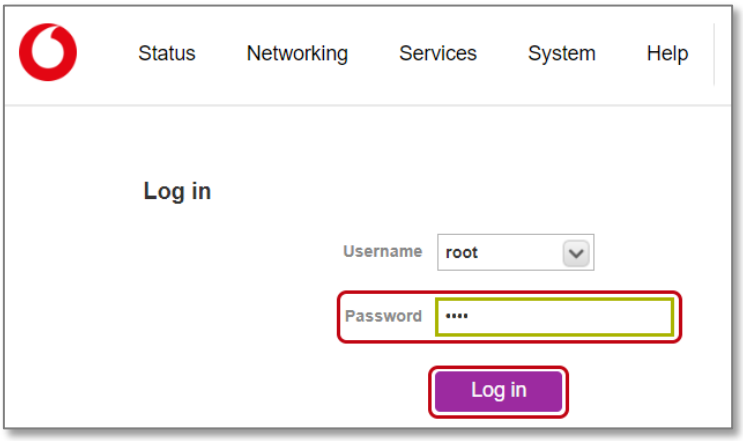


Figure 1: Login page

2 From the menu bar along the top of the screen, click on **Networking** then open the **Routing** menu on the left and select **Redundancy (VRRP)** from its drop-down menu.

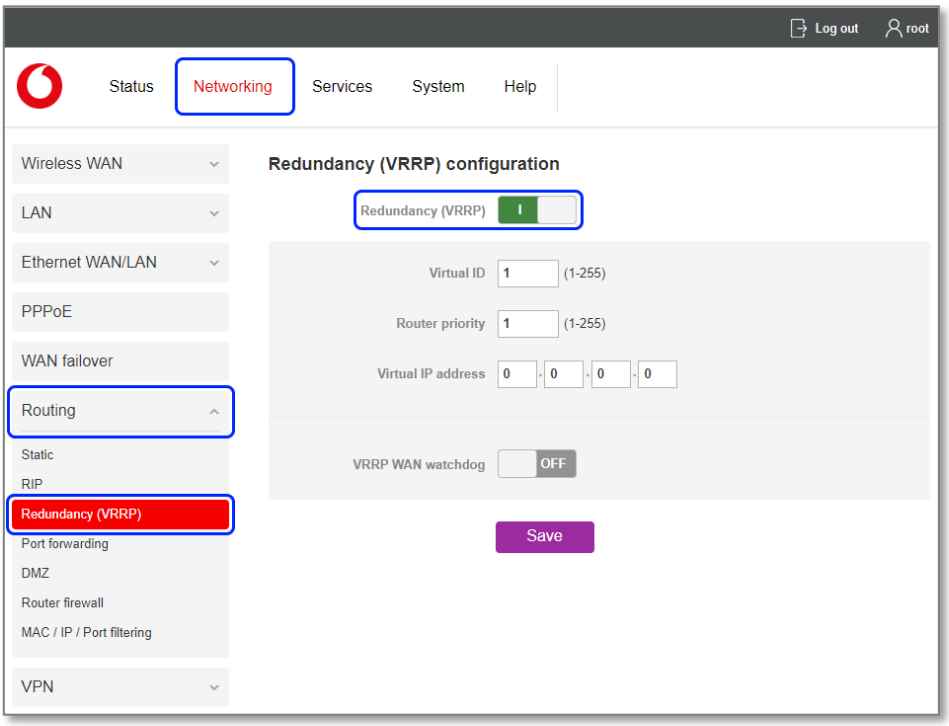


Figure 2 – Vodafone MachineLink router VRRP configuration page

3 Enable the **Redundancy (VRRP)** checkbox and the following fields will be displayed:

Item	Definition
Redundancy (VRRP)	Enables or disables the VRRP function.
Virtual ID	This is the VRRP ID which is different for each virtual router on the network.
Router Priority	The priority determining which router will take on the role of the master. A higher value has a higher priority.
Virtual IP address	This is the virtual IP address that both virtual routers share.

Table 1 –VRRP configuration items

Note – Configuring VRRP changes the MAC address of the Ethernet port and therefore if you want to resume with the web configuration you must use the new IP address (VRRP IP) or on a command prompt type: `arp –d <ip address> (i.e arp –d 192.168.1.50)` to clear the arp cache.(old MAC address).

VRRP in action – How it operates on the Ethernet

Configuration diagram

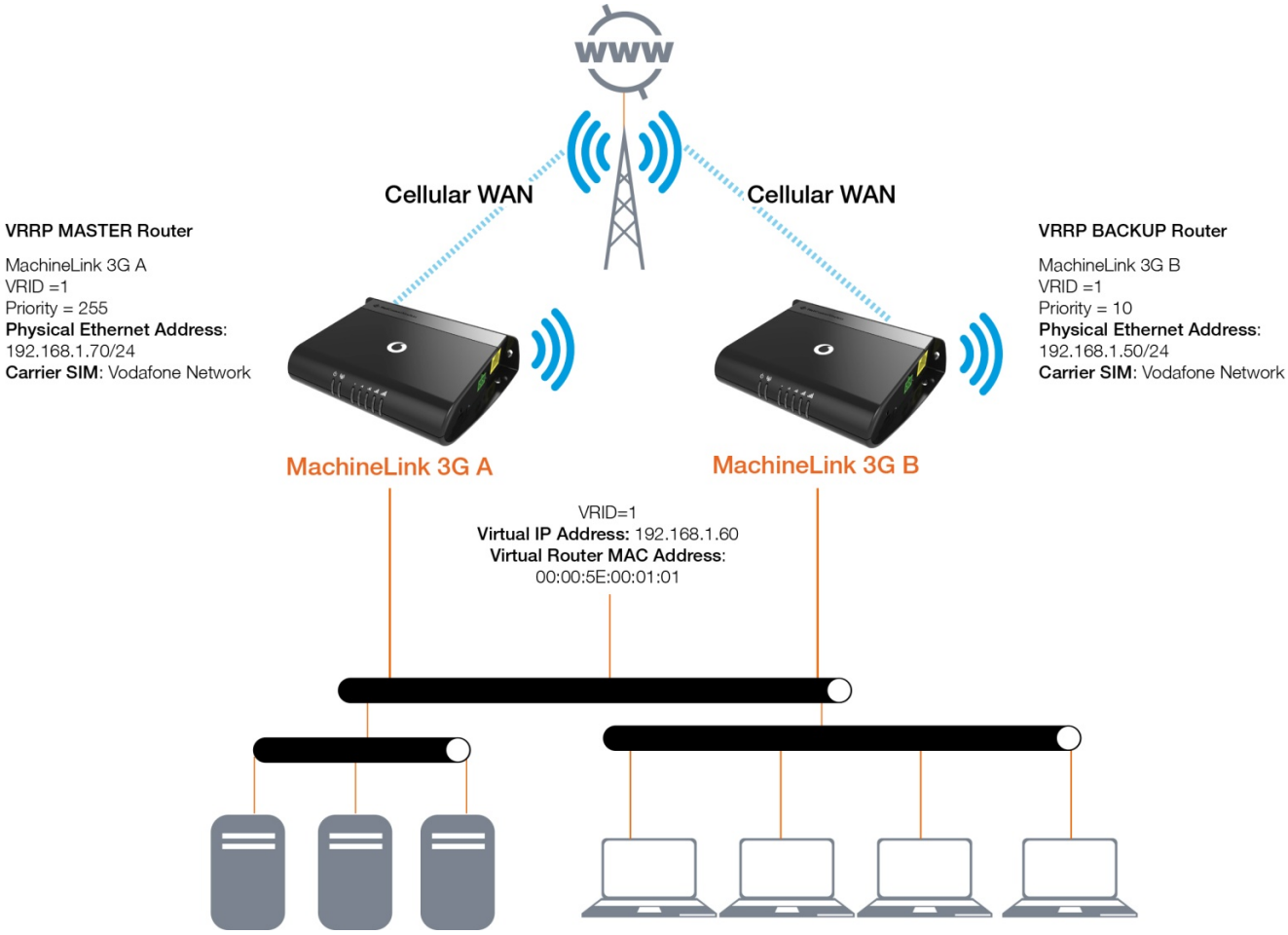


Figure 3 – VRRP in action - How it operates on Ethernet

Referring to the logical network diagram, in our example, we have configured MachineLink 'A"s priority to be 255 and MachineLink 'B"s priority to be 10. If we did not set the priority on the routers, MachineLink 'A' would have become the master because the IP address of its Ethernet interface is higher than that of MachineLink 'B'.

Tips

- It is a good idea for your priority values to be at extremes, as it helps the protocol make "clean state" transitions.
- When planning your VRRP configuration, we recommended that you decide in advance which instance will be your preferred master with highest priority. Configuring the preferred master's startup state allows it to transition straight to master when it is started, rather than waiting for advertisements from other instances.

MachineLink router 'A' configuration

LAN configuration

1 Establish a mobile broadband connection. See the Vodafone MachineLink User Guide for detailed instructions.

2 Open the **Networking** menu from the taskbar at top of the screen, then open the **LAN** menu from the menu on the left and click **LAN** from the drop-down menu.

3 Configure the LAN IP address using the fields on the **LAN configuration** page:

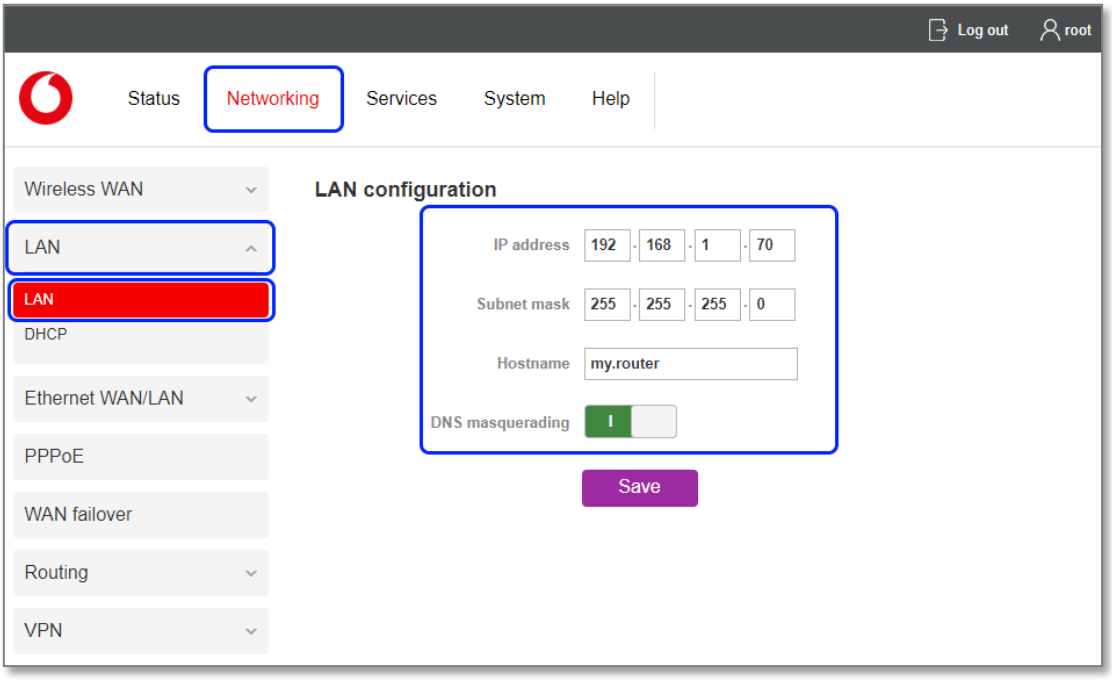


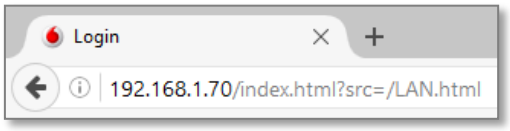
Figure 4 – MachineLink 'A' LAN IP address configuration

Item	Description	Value
IP address	Change the last octet of the IP address from "1" to "70".	**192.168.1.70**
Subnet mask	Retain the default Subnet mask.	**255.255.255.0**
Hostname	Retain the default Hostname of my.router.	**my.router**
DNS masquerading	Turn DNS masquerading ON so that the DHCP server embedded in the MachineLink hands out its own IP address (e.g. 192.168.1.70) as the DNS server address to LAN clients.	**ON**

Table 5 – MachineLink 'A' LAN IP Address configuration settings details

4 Click **Save**.

5 The router will close and reopen in the new IP address:



6 As the IP address has changed, you will be prompted to log in to the new address.

DHCP configuration

1 Open the **Networking** menu from the taskbar at top of the screen, then open the **LAN** menu from the menu on the left and click **DHCP** from the drop-down menu.

2 Configure the DHCP using the fields in the **DHCP configuration** section of the page:

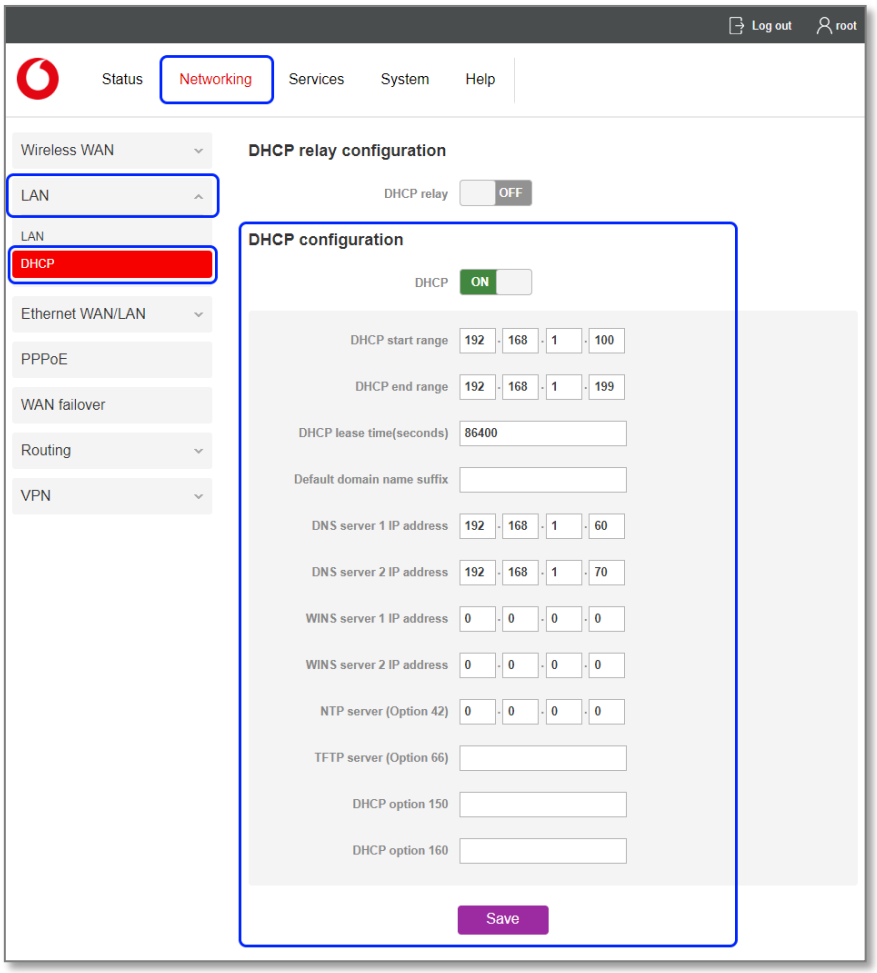


Figure 6 – MachineLink 'A' DHCP server configuration settings

Item	Description	Value
DHCP toggle switch	Toggle "ON" to display all DHCP configuration options.	**ON**
DHCP start range	Sets the first IP address of the DHCP range.	**192.168.1.120**
DHCP end range	Sets the last IP address of the DHCP range.	**192.168.1.200**
DHCP lease time (seconds)	The length of time in seconds that DHCP allocated IP addresses are valid.	**86400 seconds (24 hours)**
Default domain name suffix	Specifies the default domain name suffix for the DHCP clients.	Can be left blank
DNS server 1 IP address	Specifies the primary DNS (Domain Name System) server's IP address.	**192.168.1.60**
DNS server 2 IP address	Specifies the secondary DNS (Domain Name System) server's IP address.	**192.168.1.70**
WINS server 1 IP address	Specifies the primary WINS (Windows Internet Name Service) server IP address.	**0.0.0.0**
WINS server 2 IP address	Specifies the secondary WINS (Windows Internet Name Service) server IP address.	**0.0.0.0**
NTP server (option 42)	The IP address of the NTP (Network Time Protocol) server.	Leave blank
TFTP server (option 66)	The TFTP (Trivial File Transfer Protocol) server.	Leave blank
DHCP option 150	Used to configure Cisco IP phones.	Leave blank
DHCP option 160	Used to configure Polycom IP phones.	Leave blank

Table 7 – MachineLink 'A' DCHP server configuration settings details

3 Click **Save**.

Redundancy (VRRP) configuration

1 Open the **Networking** menu from the taskbar at top of the screen, then open the **Routing** menu from the menu on the left and select **Redundancy (VRRP)** from the drop-down menu.

2 Click the **Redundancy (VRRP)** toggle key **ON** to display the VRRP configuration fields.

3 Configure the VRRP settings:

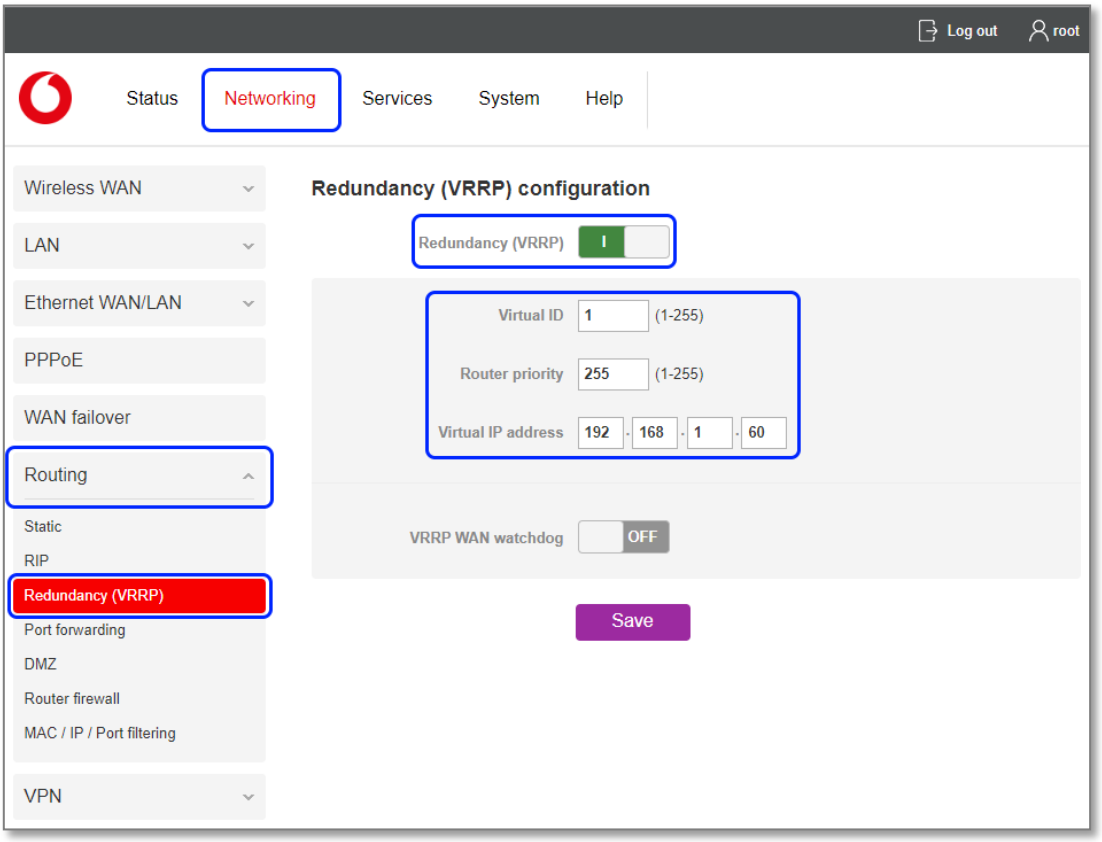


Figure 8 – MachineLink 'A' Redundancy (VRRP) configuration settings

Item	Description	Value
Redundancy (VRRP) toggle switch	Toggle "ON" to display all VRRP configuration options	**I**
Virtual ID	Enter an ID between 1 and 255. This is the VRRP ID which is different for each virtual router on the network.	**1**
Router priority	Value range is 1 thru 255. A higher value is a higher priority. As MachineLink 'A' will be the primary router, therefore it is set to the highest: priority: 255	**255**
Virtual IP address	This is the virtual IP address that both virtual routers share.	**192.168.1.60**

Table 9 – MachineLink 'A' Redundancy (VRRP) configuration settings details

4 Click **Save** and reboot the router.

Confirm MAC address of MachineLink router 'A'

When it has finished starting up, check the **LAN** settings on the **Status** page.

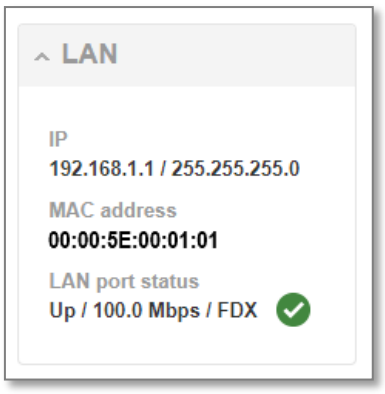


Figure 10 – MachineLink A's VRRP LAN address

The MAC address of MachineLink A changes to the VRRP virtual MAC address **00:00:5E:00:01:01** where the last octet '**01**' is the Virtual Device ID.

MachineLink router 'B' configuration

LAN configuration

1 Establish a mobile broadband connection. See the Vodafone MachineLink User Guide for detailed instructions.

2 Open the **Networking** menu from the taskbar at top of the screen, then open the **LAN** menu from the menu on the left and click **LAN** from the drop-down menu.

3 Configure the LAN IP address using the fields on the **LAN configuration** page:

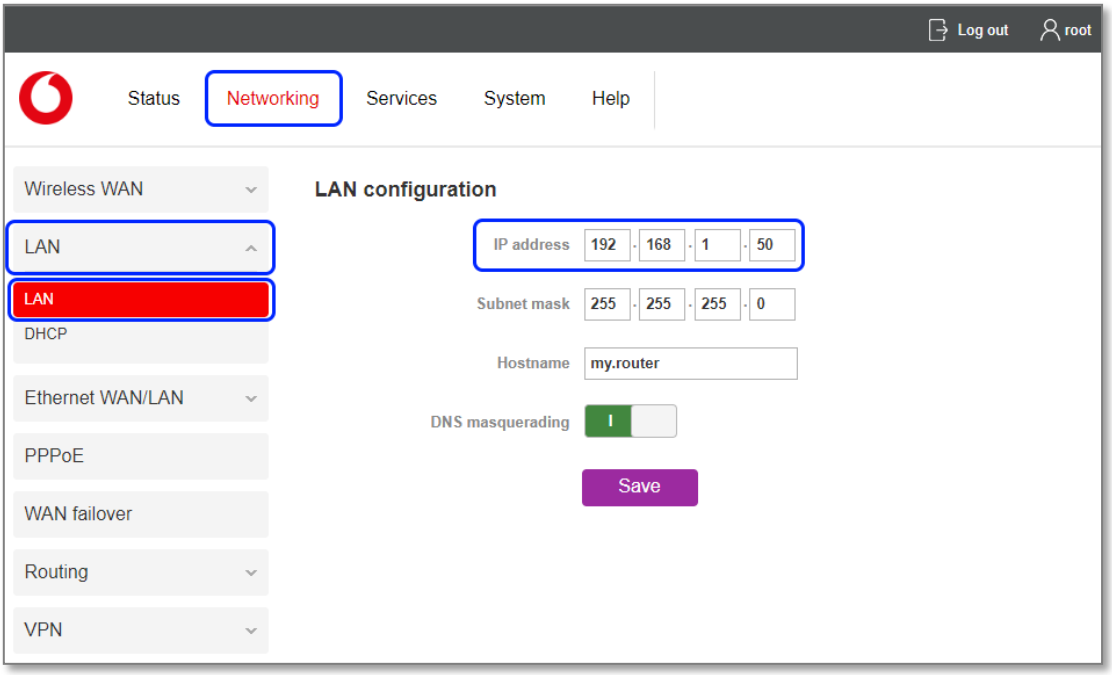


Figure 11 – MachineLink 'B' LAN IP Address Configuration

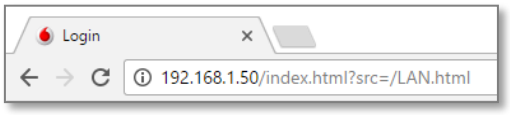
4 Use the same settings as for the LAN 'A' IP Address configuration with the following exceptions:

Item	Description	Value
IP address	Change the last octet of the IP address from "1" to "50"	192.168.1.**50**
Subnet mask		Same as in 'A'
Hostname		Same as in 'A'
DNS masquerading		Same as in 'A'

Table 12 – MachineLink 'B' LAN IP Address configuration settings details

5 Click **Save**.

6 The router close and will reopen in the new IP address:



7 As the IP address has changed, you will be prompted to log in to the new address.

DHCP configuration

1 Open the **Networking** menu from the taskbar at top of the screen, then open the **LAN** menu from the menu on the left and click **DHCP** from the drop-down menu.

2 Configure the DHCP using the fields in the **DHCP configuration** section of the page:

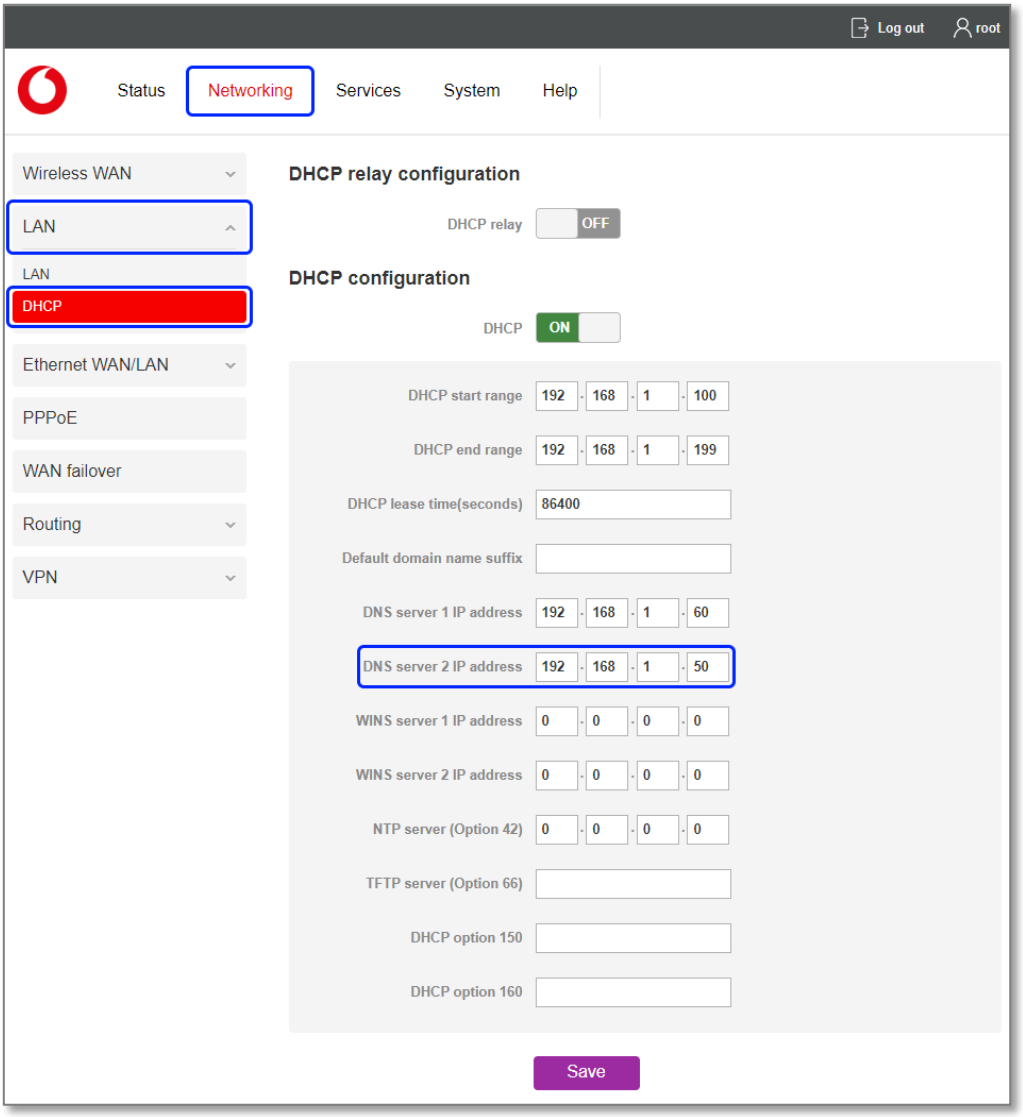


Figure 13 – MachineLink 'B' DHCP server configuration settings

3 Use the same settings as for the DHCP server 'A' configuration with the following exceptions:

Item	Description	Value
DHCP toggle switch	Toggle "ON" to display all DHCP config options	**ON**

Item	Description	Value
DHCP start range	Sets the first IP address of the DHCP range	Same as in 'A'
DHCP end range	Sets the last IP address of the DHCP range	Same as in 'A'
DHCP lease time (seconds)	The length of time in seconds that DHCP allocated IP addresses are valid.	Same as in 'A'
Default domain name suffix	Specifies the default domain name suffix for the DHCP clients.	Leave Blank
DNS server 1 IP address	Specifies the primary DNS (Domain Name System) server's IP address.	Same as in 'A'
DNS server 2 IP address	Specifies the secondary DNS (Domain Name System) server's IP address.	**192.168.1.50**
WINS server 1 IP address	Specifies the primary WINS (Windows Internet Name Service) server IP address.	Same as in 'A'
WINS server 2 IP address	Specifies the secondary WINS (Windows Internet Name Service) server IP address.	Same as in 'A'
NTP server (option 42)	The IP address of the NTP (Network Time Protocol) server.	Leave blank
TFTP server (option 66)	The TFTP (Trivial File Transfer Protocol) server.	Leave blank
DHCP option 150	Used to configure Cisco IP phones.	Leave blank
DHCP option 160	Used to configure Polycom IP phones.	Leave blank

Table 14 – MachineLink 'B' DCHP server configuration settings details

4 Click **Save**.

Redundancy (VRRP) configuration

1 Open the **Networking** menu from the taskbar at top of the screen, then open the **Routing** menu from the menu on the left and select **Redundancy (VRRP)** from the drop-down menu.

2 Click the **Redundancy (VRRP)** toggle key ON to display the VRRP configuration fields.

3 Configure the VRRP settings:

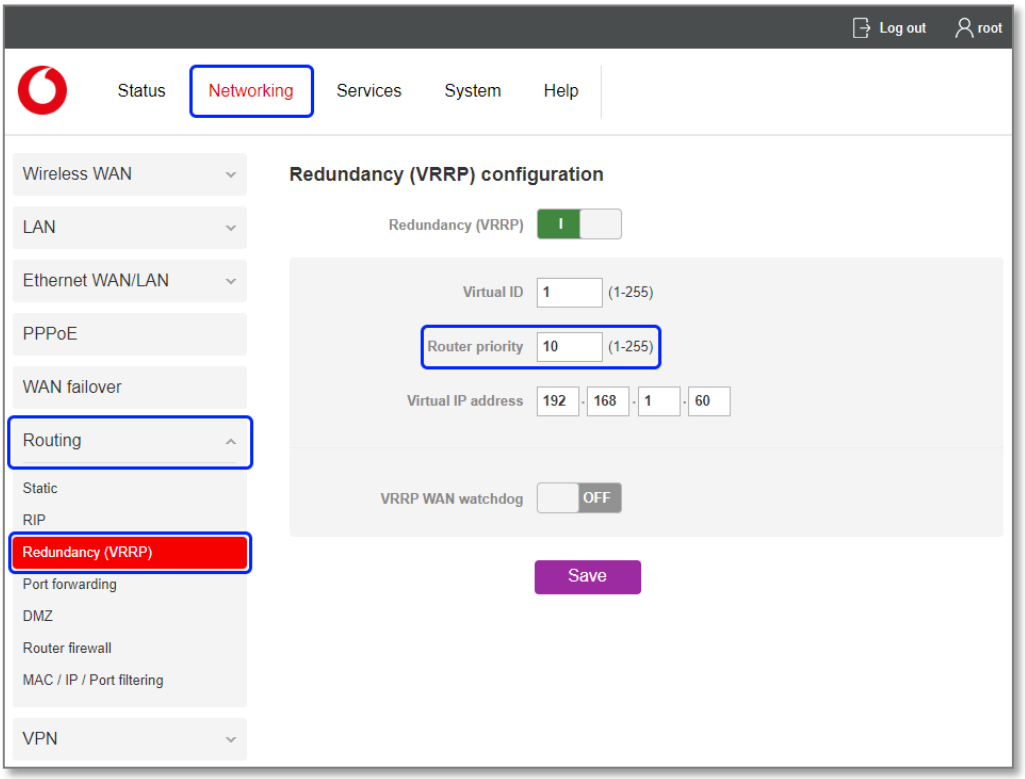


Figure 15 – MachineLink 'B' VRRP configuration settings

4 Use the same settings as for the VRRP 'A' configuration with the following exception:

Figure 16 – MachineLink 'B' Redundancy (VRRP) configuration settings

Item	Description	Value
Redundancy (VRRP) toggle switch	Toggle "ON" to display all VRRP configuration options	**I**
Virtual ID		Same as 'A'
Router priority	Value range is 1 thru 255. A higher value is a higher priority. MachineLink 'B' will be the secondary router, therefore set the router priority at a very low level: 10	**10**
Virtual IP address		Same as 'A'

Table 17 – MachineLink 'B' Redundancy (VRRP) configuration settings details

5 Click **Save** and reboot the router.

Confirm MAC address of MachineLink router 'B'

When it has finished starting up, check the LAN settings on the **Status** page.

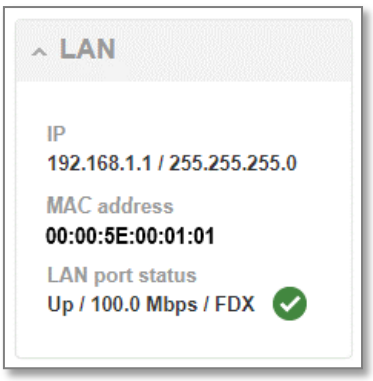


Figure 18 – MachineLink 'B"s VRRP LAN address

The MAC address of MachineLink "B" changes to the VRRP virtual MAC address 00:00:5E:00:01:01 where the last octet '01' is the Virtual Device ID.

VRRP in Action

VRRP experience from 'Test PC 1'

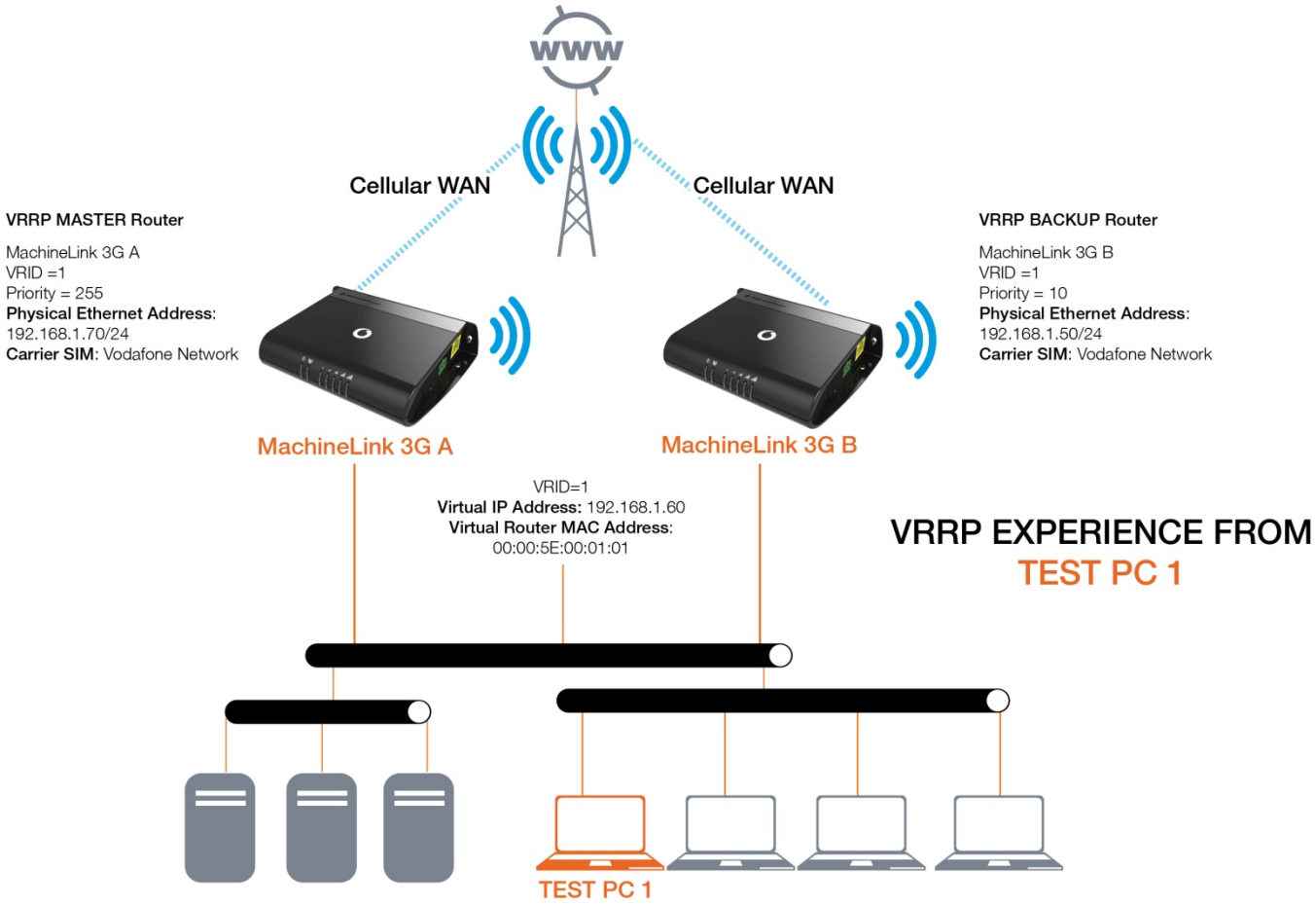


Figure 19 - VRRP concept generic logical network diagram

Test PC 1

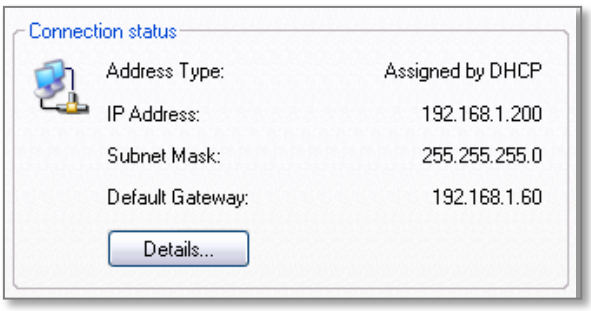


Figure 20 – VRRP connection status details

```
C:\Documents and Settings\carmenl>ipconfig

Windows IP Configuration

Ethernet adapter Local Area Connection:

        Connection-specific DNS Suffix  . :
        IP Address. . . . . . . . . . . . : 192.168.1.200
        Subnet Mask . . . . . . . . . . . : 255.255.255.0
        Default Gateway . . . . . . . . . : 192.168.1.60

C:\Documents and Settings\carmenl>arp -a

Interface: 192.168.1.200 --- 0x2
  Internet Address      Physical Address      Type
  192.168.1.50          00-00-5e-00-01-01     dynamic
  192.168.1.60          00-00-5e-00-01-01     dynamic
  192.168.1.70          00-00-5e-00-01-01     dynamic
```

Figure 21 – Test PC 1 configuration

When both Cellular Routers are up, the master VRRP router, MachineLink 'A' is used as the default internet gateway.

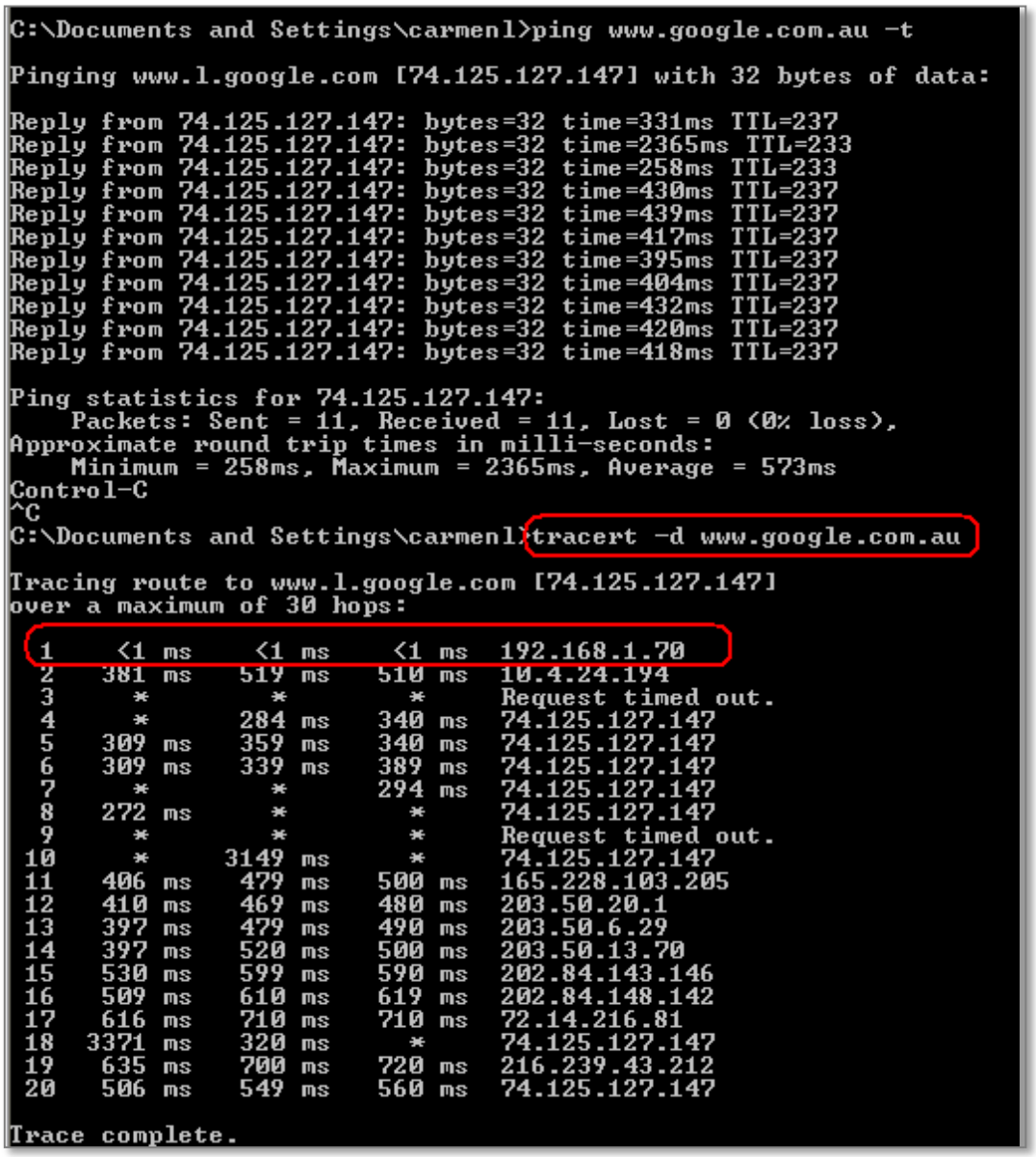


Figure 22 – MachineLink 'A' as default internet gateway

When master router MachineLink 'A' is down, the backup router MachineLink 'B' becomes the gateway to the internet.

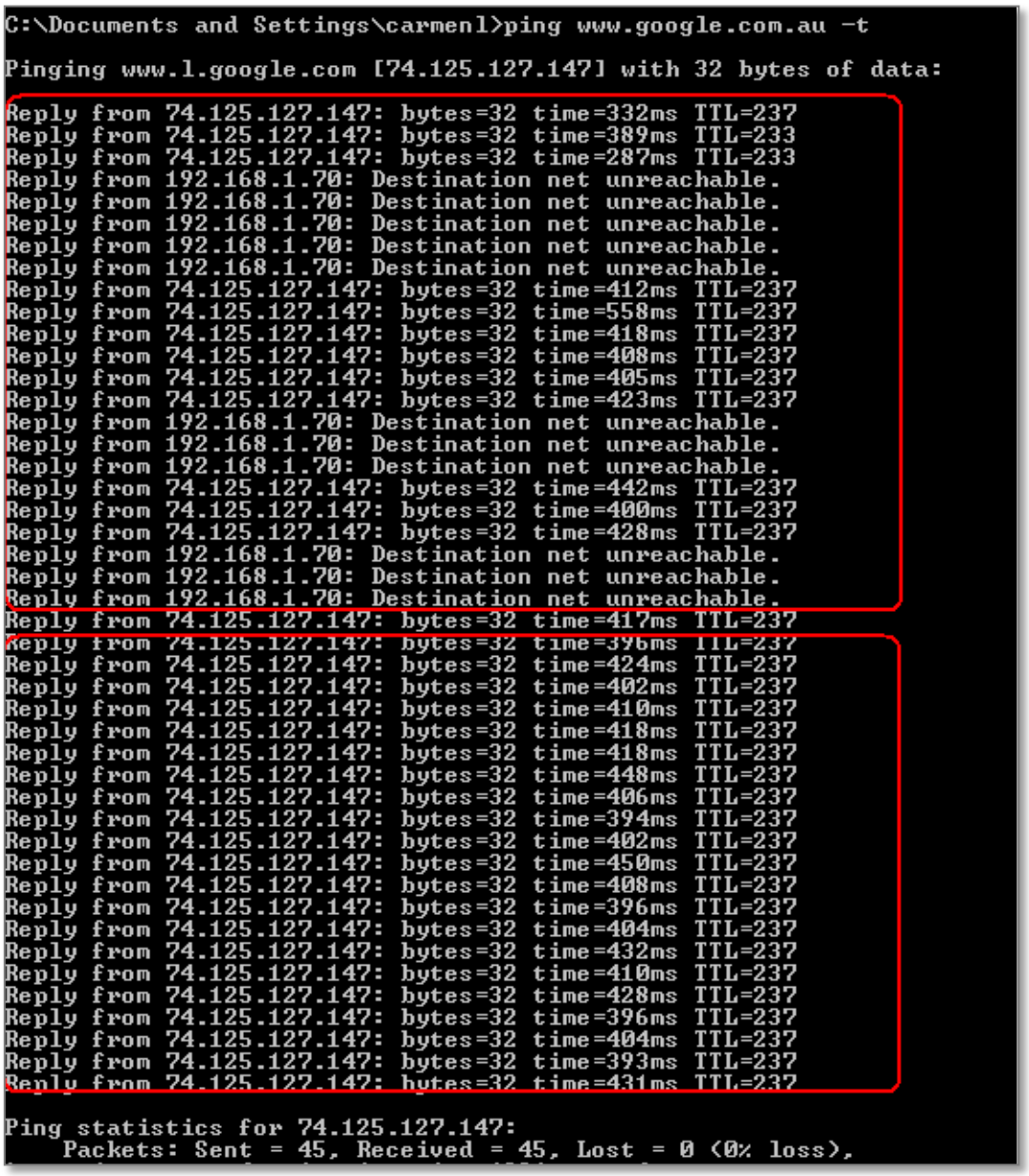


Figure 23 – MachineLink 'B' becomes the internet gateway

```
C:\Documents and Settings\carmenl>tracert -d www.google.com.au

Tracing route to www.l.google.com [74.125.127.104]
over a maximum of 30 hops:

  1    <1 ms    <1 ms    <1 ms  192.168.1.50
  2     *        *        *     Request timed out.
  3     *        *        *     Request timed out.
  4   144 ms    89 ms    89 ms  74.125.127.104
  5   138 ms   107 ms   110 ms  74.125.127.104
  6    79 ms   109 ms   109 ms  74.125.127.104
  7     *      135 ms   118 ms  74.125.127.104
  8     *        *      136 ms  74.125.127.104
  9    83 ms     *        *     74.125.127.104
 10   153 ms     *        *     74.125.127.104
 11   153 ms     *        *     74.125.127.104
 12   163 ms     *        *     74.125.127.104
 13     *        *        *     Request timed out.
 14     *        *        *     Request timed out.
 15     *        *        *     Request timed out.
 16     *        *        *     Request timed out.
 17   282 ms     *        *     74.125.127.104
 18     *        *        *     Request timed out.
 19     *      333 ms     *     74.125.127.104
 20   332 ms   290 ms   289 ms  74.125.127.104

Trace complete.

C:\Documents and Settings\carmenl>ping www.google.com.au -t

Pinging www.l.google.com [74.125.127.104] with 32 bytes of data:

Reply from 74.125.127.104: bytes=32 time=442ms TTL=237
Reply from 74.125.127.104: bytes=32 time=420ms TTL=237
Reply from 74.125.127.104: bytes=32 time=439ms TTL=237
Reply from 74.125.127.104: bytes=32 time=417ms TTL=237
Reply from 74.125.127.104: bytes=32 time=407ms TTL=237
Reply from 74.125.127.104: bytes=32 time=415ms TTL=237

Ping statistics for 74.125.127.104:
    Packets: Sent = 6, Received = 6, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 407ms, Maximum = 442ms, Average = 423ms
Control-C
^C
C:\Documents and Settings\carmenl>arp -a

Interface: 192.168.1.200 --- 0x2
  Internet Address      Physical Address      Type
  192.168.1.50          00-00-5e-00-01-01     dynamic
  192.168.1.60          00-00-5e-00-01-01     dynamic
```

Figure 24 – MachineLink 'B' as internet gateway

When master router MachineLink 'A''s (192.168.1.70) 3G connection is back online, master router MachineLink 'A' becomes the internet gateway.

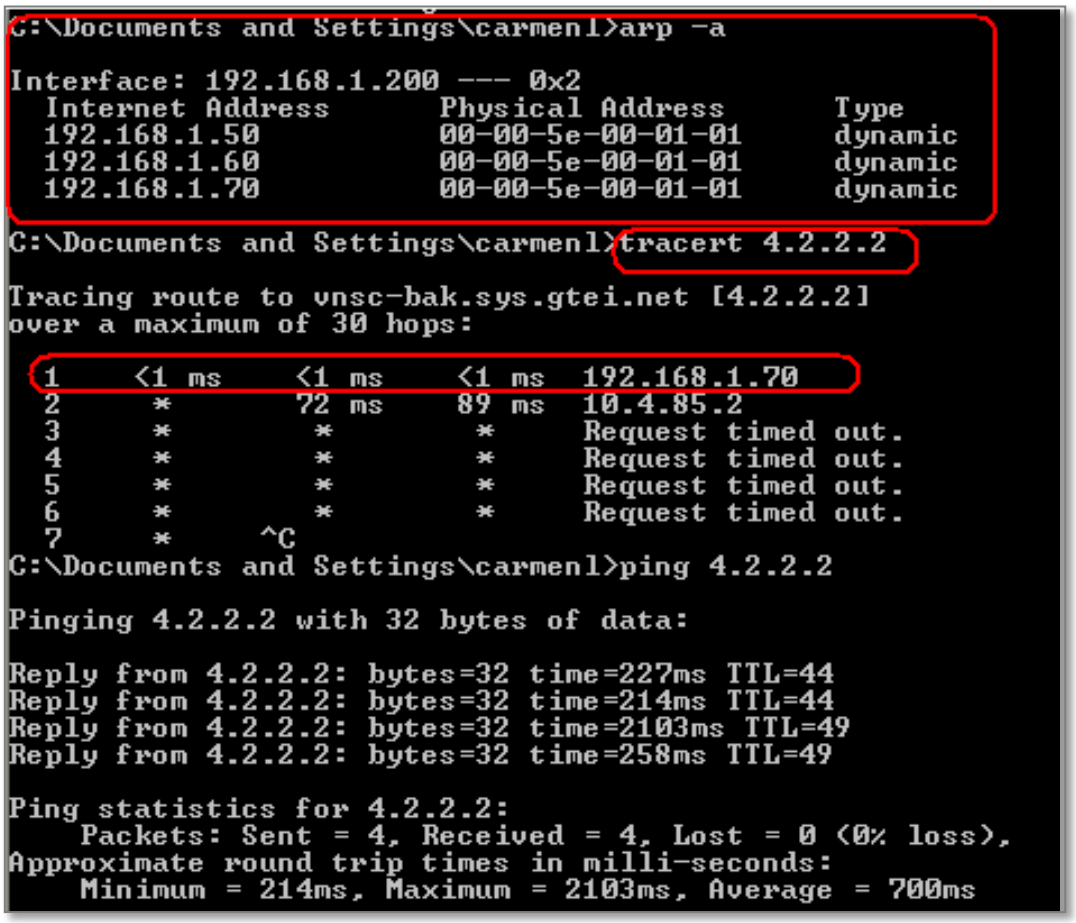


Figure 25 – MachineLink 'A' as internet gateway after connection is restored

Using the VRRP WAN watchdog

By default, VRRP WAN watchdog is disabled. When it is disabled, VRRP monitors the status of the master and slave by the physical link. When enabled, the VRRP WAN watchdog feature monitors the status of the connection by both the physical link and controlled ping packets. Refer to the Ping monitor section for more information on how to configure the watchdog.

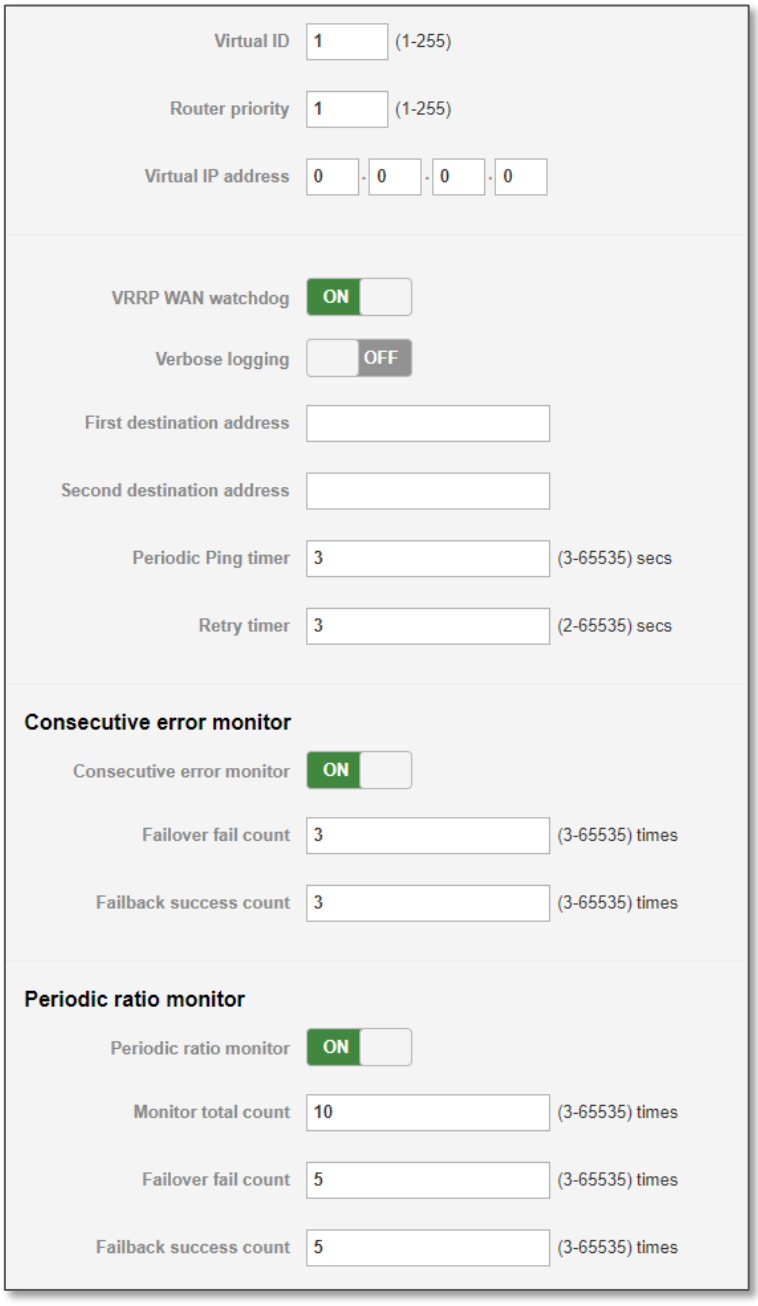


Figure 26 - VRRP WAN watchdog configuration

Ping monitor

When Monitoring method is set to **Ping**, controlled ping packets can be used to determine the status of the link. These are small packets of data that the router sends to a remote address and if the connection is up, a reply is received. They are sent indefinitely at regular intervals that you specify. At each interval, 3 pings are sent to the first destination address and 3 pings are sent to the second destination address configured for each WAN interface to test the availability of the interface. The pings sent at each interval are from here on referred to as an "instance" of pings.

Ping timers

The **Periodic ping timer** setting sets a regular interval at which an instance of pings is sent to test the availability of an interface.

The **Retry timer** setting is activated only when all pings in an instance sent at the **Periodic ping timer** interval fail and is used to set a different, usually shorter, interval to speed up the router's response to an interface failure.

Methods of evaluating ping responses

For simplicity, we recommend using only one of the two methods of evaluating the ping responses. The available methods are:

- **Consecutive errors** - using this method, the router will determine the availability of an interface based on a set number of consecutive ping instance responses.
- **Periodic ratio monitor** - using this method, the router will determine the availability of an interface based on a set ratio of ping instance successes or failures to the number of attempts.

It should be noted that the **Periodic ratio monitor** evaluates an interface over a series of ping instances (defined by the **Total monitor count**) and when the series has completed, the success and fail counts are reset. For example, with the default **Total monitor count** value set to 10 and **Failover fail count** set to 5, the router sends 10 ping instances and if 4 of those instances fail and the first instance of the next series of 10 fails, the router will not fail over because the 5 failed instances occurred across a different series.

Failing over to a lower priority interface

Each WAN interface is independently monitored according to its own distinct settings, following the processes outlined below.

a. At a regular interval stipulated by the **Periodic ping timer** setting, the router sends 3 ping requests via the interface to both the first and second destination addresses simultaneously. If it receives a reply to any of those pings on the interface, it is considered to be up and the router continues pinging on the interface at the **Periodic ping timer** interval.

b. If the router does not receive a response to all six pings on the interface by the start of the next **Periodic ping timer** interval, it registers this failure as a Fail count and continues to send pings to both destination addresses at the **Retry timer** interval (typically set at a shorter interval than the **Periodic ping timer** since there may be a problem). If a response is received to any of those pings, the router returns to sending pings according to the **Periodic ping timer** setting.

c. However, if after another period defined by the **Retry timer** setting the router again does not receive a response to any of the pings, it registers another Fail count.

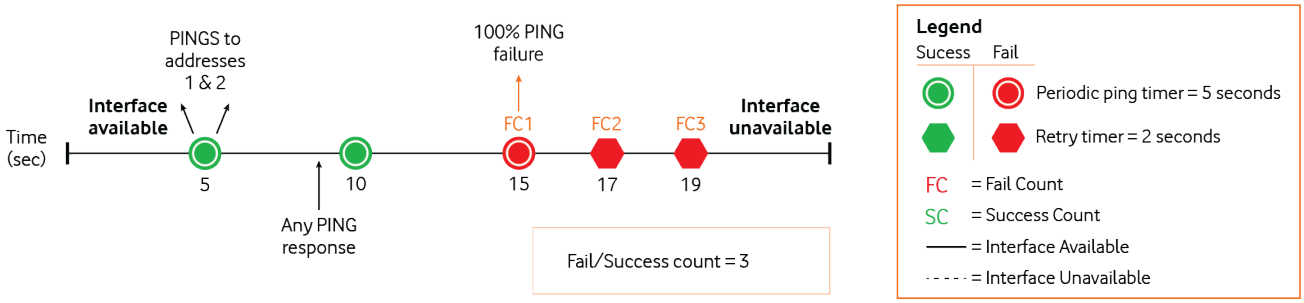
d The router repeats the retry process until one of the following conditions is met:

i it receives a ping response and returns to testing the interface according to the **Periodic ping timer**;

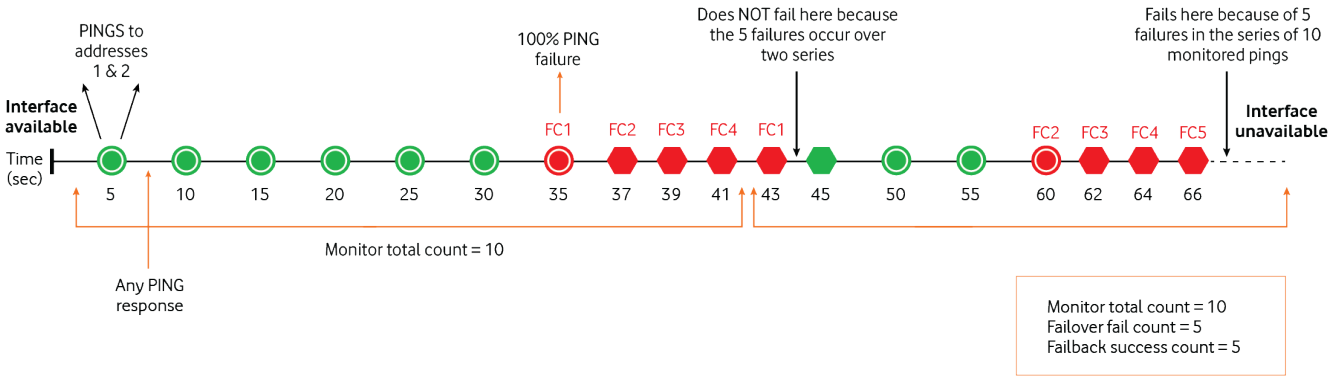
ii the number configured in the **Failover fail count** field (under **Consecutive error monitor**) is reached, in which case the interface is marked as unavailable and the router automatically reroutes packets according to the configured priorities of the remaining interfaces;

iii the number of **Failover fail count** pings (under **Periodic ratio monitor**) is reached within a particular series of the **Monitor total count,** in which case the interface is marked as unavailable and the router automatically reroutes packets according to the configured priorities of the remaining interfaces.

Consecutive error monitor failover example



Periodic ratio monitor failover example

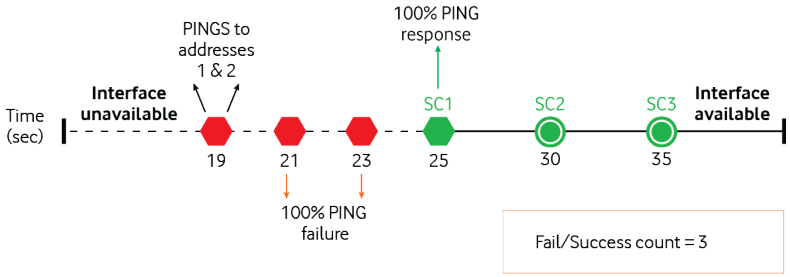


Failing back to a higher priority interface

The process for returning an unavailable interface to an available state is similar to the above process. When an interface is marked unavailable by the ping monitor, the router continues to retry pings to the two destination addresses via that interface according to the **Periodic ping timer** setting until one of the following conditions is met:

- it receives a 100% successful response to the six pings for a number of consecutive periods that equal the configured **Failback success count** setting
- the number of **Failback success count** pings (under **Periodic ratio monitor**) is reached within a particular series of the **Monitor total count,** in which case the router continues pinging at the **Periodic ping timer** interval and marks the interface as available. The router automatically reroutes packets according to the configured priorities of the available interfaces.

Consecutive error monitor failback example



Periodic ratio monitor failback example