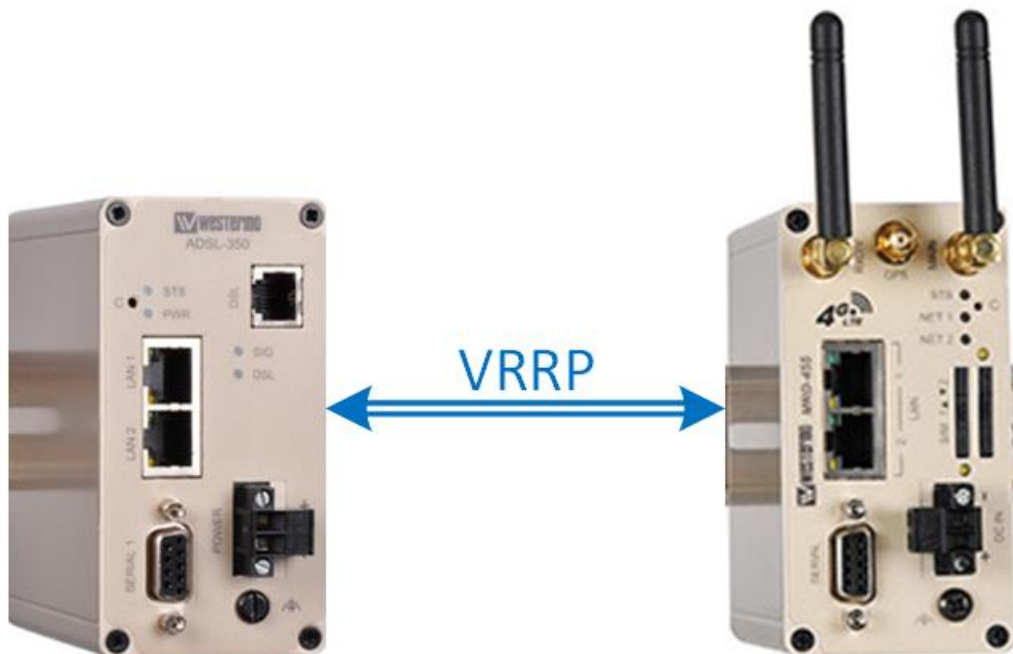


APPLICATION NOTE AN-004-WUK

VRRP with VPN FAILOVER

How to share a default gateway using a ADSL-350 Broadband Router and a MRD-455 4G router - including VPN failover



INTRODUCTION

What is VRRP?

The Virtual Router Redundancy Protocol (VRRP) eliminates the single point of failure by allowing 2 or more gateway routers to share a single virtual IP address and virtual MAC address. This virtual IP address is used by IP devices on the local area Ethernet network as their default gateway.

The benefit of VRRP is that the routers running VRRP act as one virtual router. Failover from one router to the other is transparent and requires no additional configuration to devices on the LAN. As far as these are concerned, the default gateway never changes even if the primary gateway goes offline.

VRRP dynamically assigns responsibility for the virtual gateway IP address to one of the physical routers on a LAN according to a priority value that is set. The VRRP router that controls the default gateway IP address is called the **Master** and takes charge of forwarding packets received from devices on the LAN. When the Master becomes unavailable, (or also in this case if the DSL link becomes offline), a backup gateway router, known as the **Slave**, is promoted to Master and controls the forwarding of IP packets from the LAN.

New Features

The Westermo **ADSL-350** and **MRD-455** routers allow us to go a step further. The ADSL-350 can now be set to demote itself to Slave if the DSL link goes down, promoting the MRD-455 to Master. And the MRD-455 can now keep the 4G link up, but hold off from bringing up the VPN until it is the VRRP Master, avoiding routing errors where the VPN concentrator doesn't know which VPN to use.

Firmware Versions

Applies to Firmware versions;
ADSL-350 v1.6.4.0 onwards.
MRD-455 v1.7.4.0 onwards.

Assumptions

This application note applies to the ADSL-350 DSL router MRD-455 4G router. It assumes both routers are starting from a factory default configuration.

NB: This application note does not go into detail about setting up VPN tunnels. Please refer to specific application notes available from Westermo with regards to setting up VPN tunnels if required.

Corrections

Requests for corrections or amendments to this application note are welcome and should be addressed technical@westermo.co.uk

Requests for new application notes can be sent to the same address.

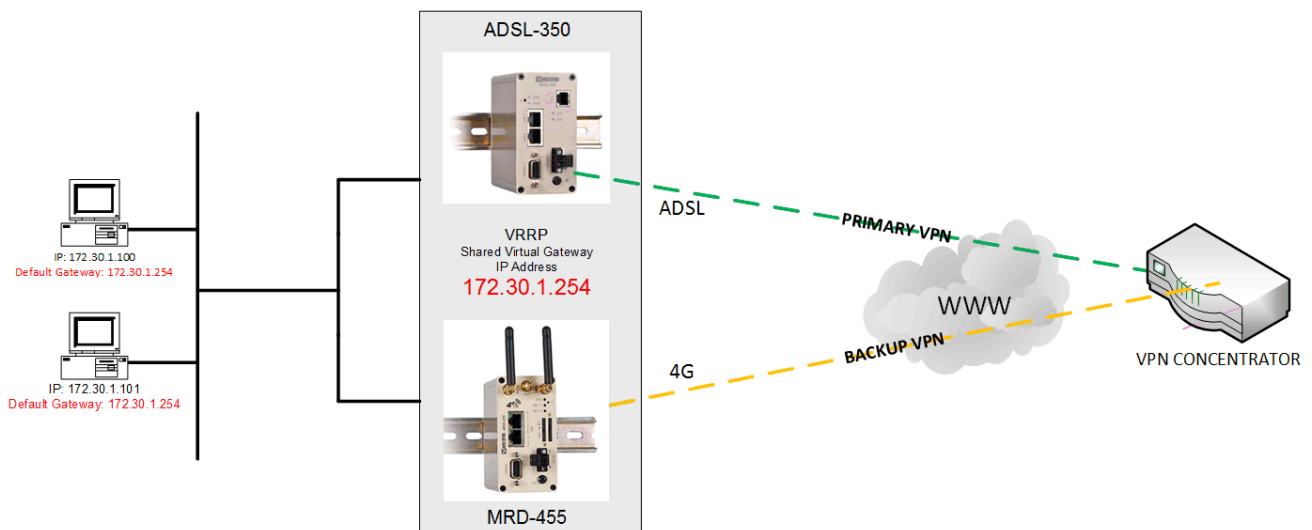
Overview

The following pages show how to implement VRRP between an ADSL-350 designated as the **Master** and an MRD-455 4G router designated as the **Slave**. Together these become one virtual router sharing the same LAN IP address.

This VRRP Virtual LAN address is used as the Default Gateway for devices on the LAN.

This application note also shows how to set up link monitoring on the DSL line, so should the link go down, the MRD-455 and its 4G link will be promoted to Master.

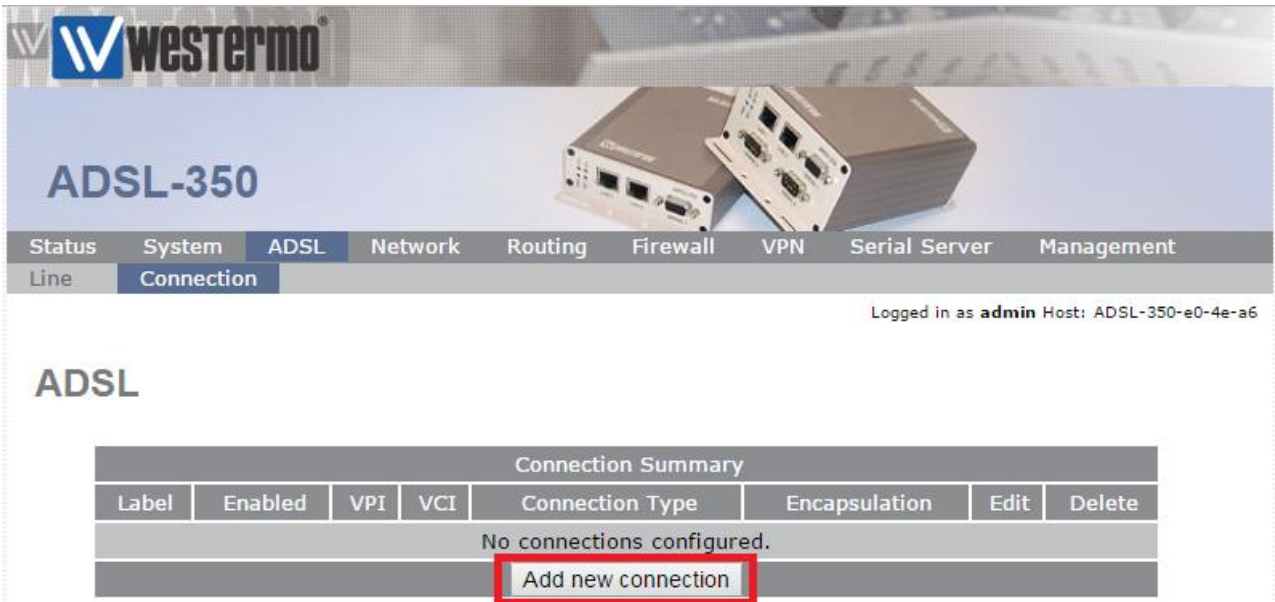
Both routers have a VPN to a central VPN Concentrator, but the MRD-455 will prevent its VPN from establishing unless it is promoted to VRRP Master.



ADSL Broadband Configuration

NB: If you have working ADSL and 4G links already, skip to chapter 4.0

Browse to ADSL → Connection



Click Add New Connection.

General & ATM Settings



Default settings a standard UK BT ADSL line

Connection Settings

The screenshot shows the Westermo ADSL-350 web interface. The top navigation bar includes: Status, System, ADSL (selected), Network, Routing, Firewall, VPN, Serial Server, and Management. Below this is a sub-navigation bar: Line, Connection (selected). The page title is "ADSL-350". A status bar at the top right indicates "Logged in as admin Host: ADSL-350-e0-4e-a6". The main content area is titled "ADSL" and contains a "Connection Settings" form. The form has the following fields: "Connection Type" set to "PPPoA", "Encapsulation" set to "VC Mux", and "Timeout for connection establishment (sec)" with "Enable:" checked and "120" entered. There are "Back" and "Next" buttons at the bottom of the form.

Default settings a standard UK BT ADSL line

PPP Settings

The screenshot shows the Westermo ADSL-350 web interface for PPP Settings. The top navigation bar is the same as in the previous screenshot. The sub-navigation bar is: Line, Connection (selected). The page title is "ADSL-350". The status bar at the top right indicates "Logged in as admin Host: ADSL-350-e0-4e-a6". The main content area is titled "ADSL" and contains a "PPP Settings" form. The form has the following fields: "User" with the value "your_broadband_username" (highlighted with a red box), "Password" with "Set New:" checked and "your_broadband_password" (highlighted with a red box), "Service" (empty), "Authentication" set to "Auto", "Automatically obtain DNS" checked, "Debug to system log" unchecked, and "MTU" set to "1492". There are "Back" and "Submit" buttons at the bottom of the form.

MRD-455 4G CONNECTION

Browse to Wireless → Packet Mode

The screenshot shows the MRD-455 web interface. The top navigation bar includes: Status, System, **Wireless**, Network, Routing, Firewall, VPN, Serial Server, and Management. Under the **Wireless** menu, there are options for Network, **Packet Mode**, Connection Management, Circuit Switched Mode, and SMS. The user is logged in as 'admin' on host 'MRD-455-e0-be-3b'. The main heading is 'Packet Mode'. Below it is a 'Connection Configuration' form with fields for 'Connection Mode' (set to 'Disabled'), 'SIM 1 profile (active)', and 'SIM 2 profile'. There are 'Reset' and 'Update' buttons. Below the form is a table with columns: Index, APN, Auth, User, Password, Edit, and Delete. The table contains the text 'No profiles configured.' and a red-bordered button labeled 'Add new profile'.

Click Add New Profile

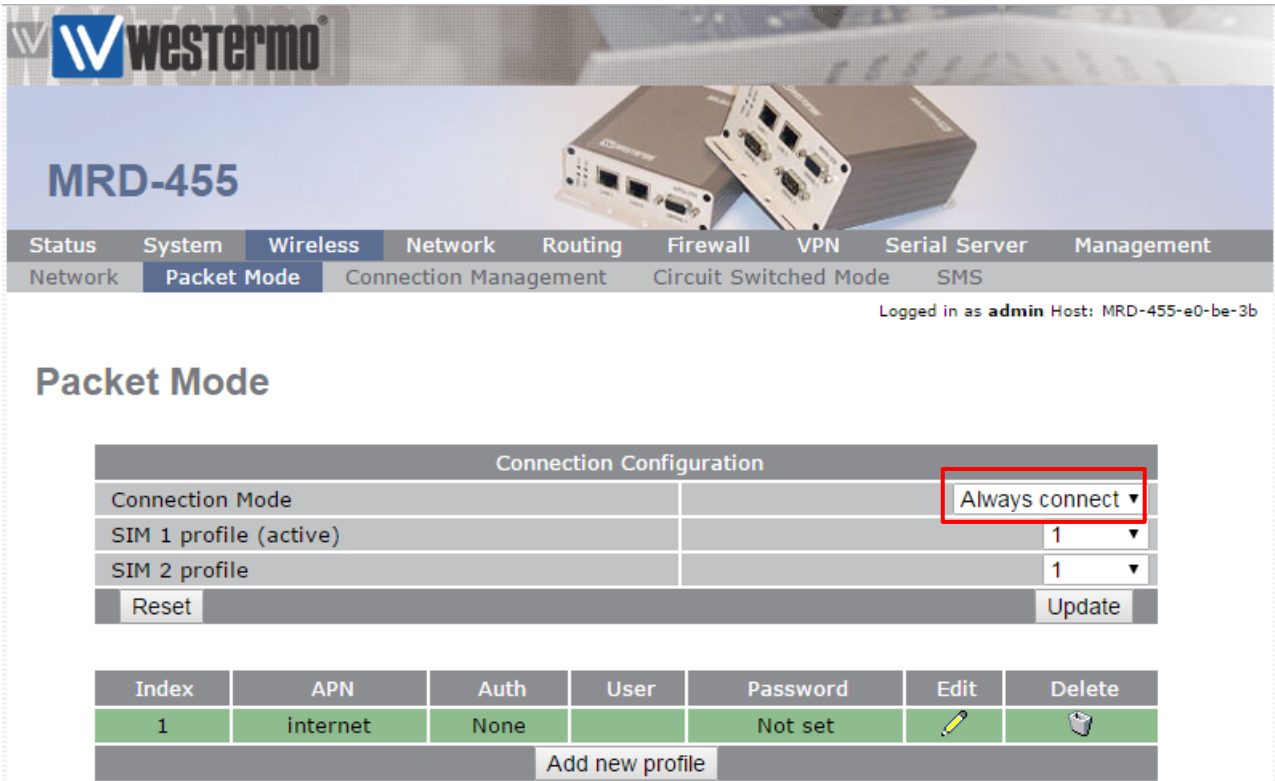
Profile

The screenshot shows the MRD-455 web interface for editing a profile. The navigation bar is the same as in the previous screenshot. The main heading is 'Packet Mode'. Below it is a form titled 'Editing profile 1'. The 'APN' field is highlighted with a red box and contains the text 'internet'. Other fields include 'Authentication' (set to 'None'), 'Username', and 'Password' (set to 'Not set'). There are 'Cancel' and 'Update' buttons.

Enter the correct APN (Access Point Name) for your SIM card.
You may need to contact your SIM network provider.

MRD-455 4G CONNECTION


Connection Configuration



The screenshot shows the MRD-455 web interface. At the top, there is a navigation menu with tabs: Status, System, **Wireless**, Network, Routing, Firewall, VPN, Serial Server, and Management. Under the 'Wireless' tab, there are sub-tabs: Network, **Packet Mode**, Connection Management, Circuit Switched Mode, and SMS. The user is logged in as 'admin' on host 'MRD-455-e0-be-3b'. The main heading is 'Packet Mode'. Below it is a 'Connection Configuration' form with the following fields:

Connection Configuration	
Connection Mode	Always connect ▼
SIM 1 profile (active)	1 ▼
SIM 2 profile	1 ▼
Reset	Update

Below the form is a table of profiles:

Index	APN	Auth	User	Password	Edit	Delete
1	internet	None		Not set		

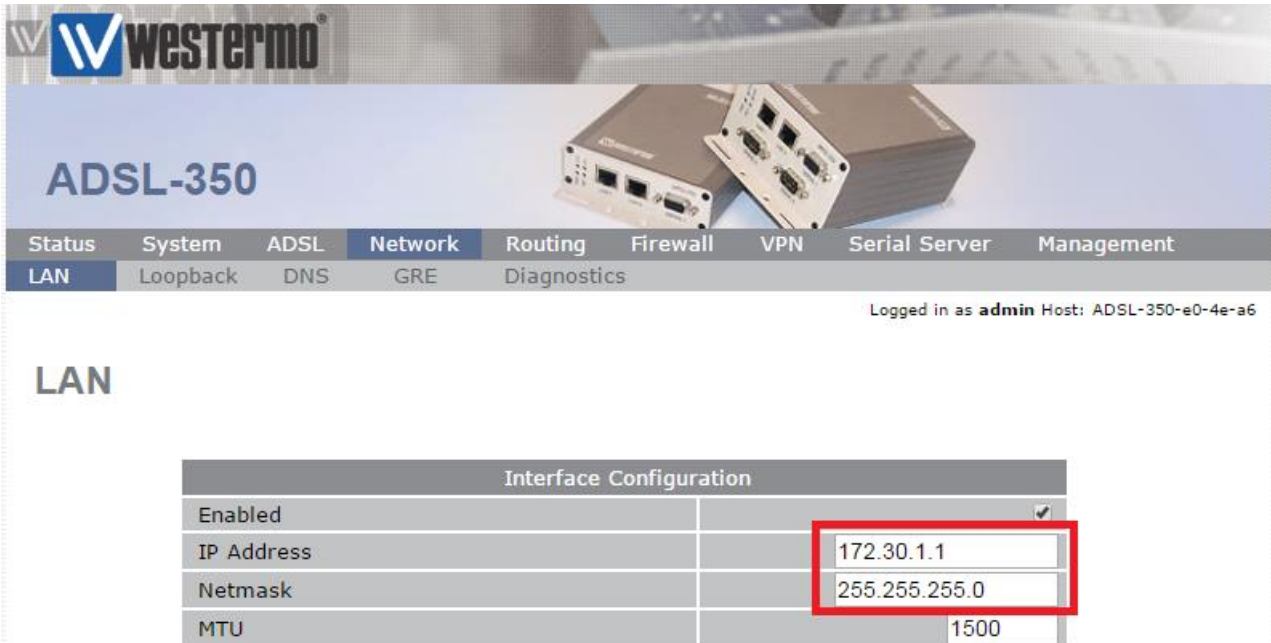
At the bottom of the table is an 'Add new profile' button.

Set the **Connection Mode** to **Always Connect**.

MANAGEMENT LAN IP ADDRESSES

It's important to give the router a unique management IP address on the LAN subnet, as well as the VRRP IP address to enable permanent admin access.

ADSL-350: Browse to Network → LAN

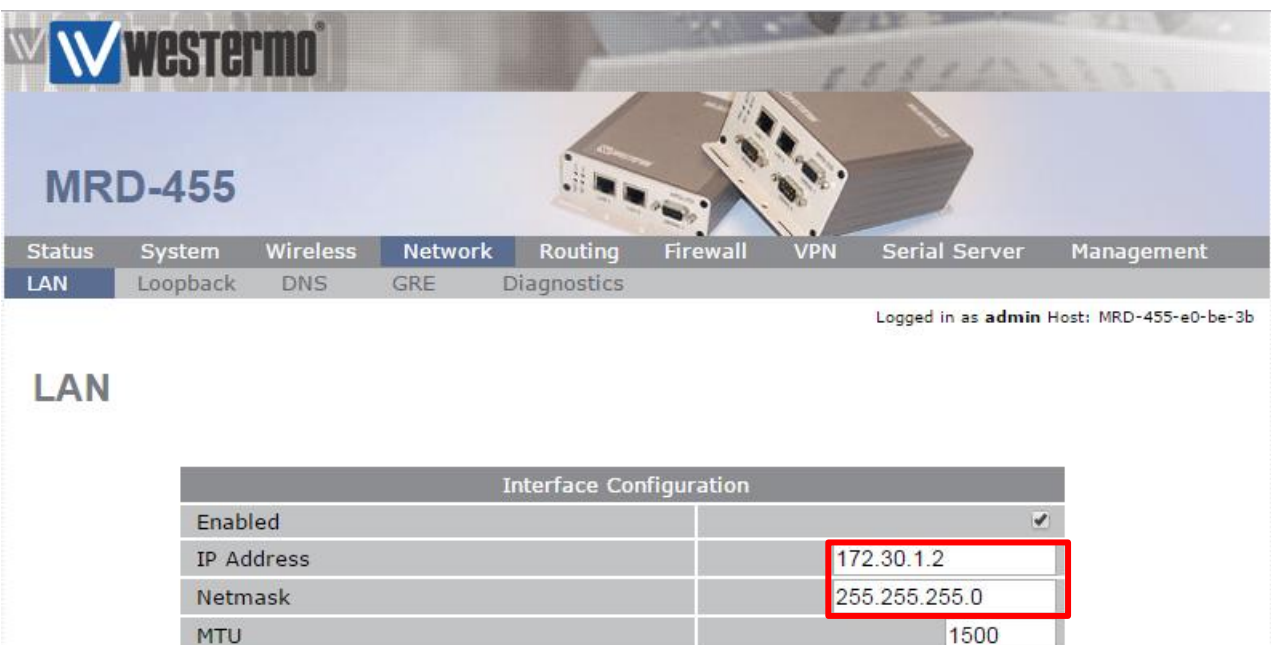


The screenshot shows the ADSL-350 web interface. The 'Network' tab is selected, and the 'LAN' sub-tab is active. The 'Interface Configuration' table is shown with the following values:

Interface Configuration	
Enabled	<input checked="" type="checkbox"/>
IP Address	172.30.1.1
Netmask	255.255.255.0
MTU	1500

IP Address: 172.30.1.1 **Netmask:** 255.255.255.0

MRD-455: Browse to Network → LAN



The screenshot shows the MRD-455 web interface. The 'Network' tab is selected, and the 'LAN' sub-tab is active. The 'Interface Configuration' table is shown with the following values:

Interface Configuration	
Enabled	<input checked="" type="checkbox"/>
IP Address	172.30.1.2
Netmask	255.255.255.0
MTU	1500

IP Address: 172.30.1.2 **Netmask:** 255.255.255.0

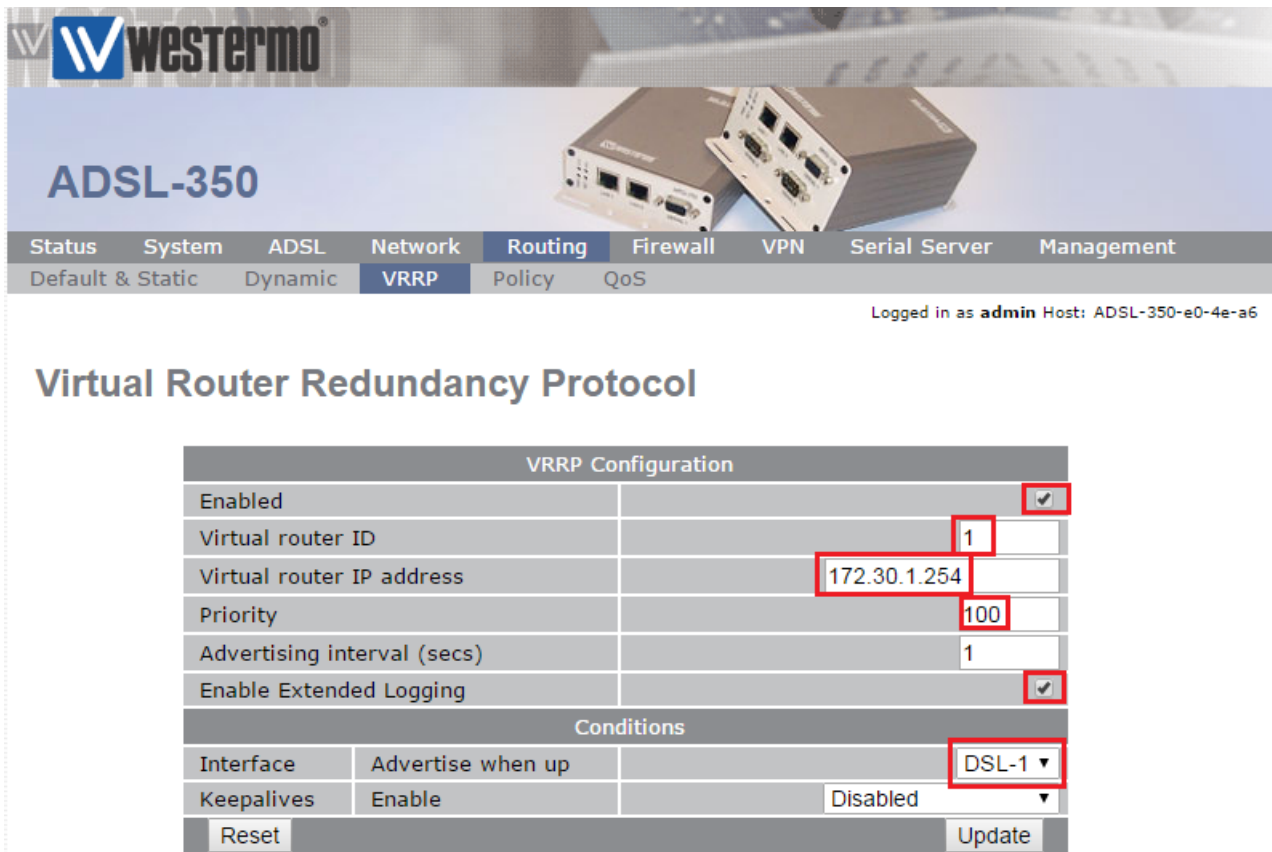
VIRTUAL ROUTER REDUNDANCY PROTOCOL (VRRP) SETTINGS

Next set up the VRRP virtual IP address on both routers. For the purpose of this application note, the two routers will share the VRRP IP address 172.30.1.254 subnet mask 255.255.255.0. This will be the Default Gateway IP address for devices on the LAN.

The **ADSL-350** will be the **VRRP Master**. The **MRD-455** will be the **VRRP Slave**.

ADSL-350 VRRP Master

Browse to Routing → VRRP



ADSL-350

Status System ADSL Network Routing Firewall VPN Serial Server Management

Default & Static Dynamic VRRP Policy QoS

Logged in as **admin** Host: ADSL-350-e0-4e-a6

Virtual Router Redundancy Protocol

VRRP Configuration	
Enabled	<input checked="" type="checkbox"/>
Virtual router ID	1
Virtual router IP address	172.30.1.254
Priority	100
Advertising interval (secs)	1
Enable Extended Logging	<input checked="" type="checkbox"/>
Conditions	
Interface	Advertise when up
Keepalives	Enabled
Reset	Update

Enabled: ✓

Virtual Router ID: 1

The ID must be identical on both routers. This identifies which routers should be sending and receiving the VRRP status messages.

Virtual Router IP address: 172.30.1.254

The VRRP IP address is the virtual address to be shared and should be identical on both routers.

Priority: 100

Can be a number between 1 and 255. The router with the highest priority is the default VRRP Master

Enable Extended Login: ✓

Conditions: Interface – Advertise when up: DSL-1

Sets the condition to only send VRRP advertisements then the DSL link is up.

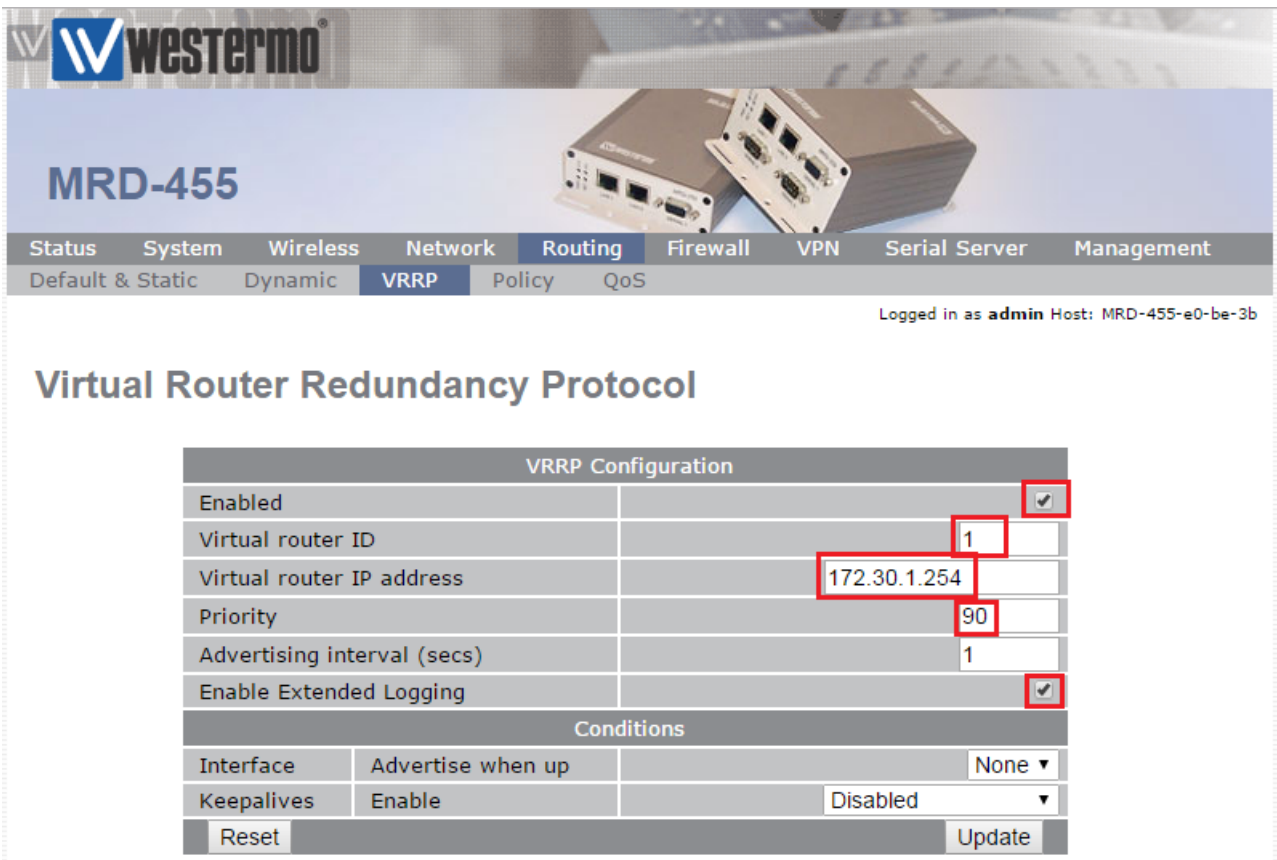
VIRTUAL ROUTER REDUNDANCY PROTOCOL (VRRP) SETTINGS

Next set up the VRRP virtual IP address on both routers. For the purpose of this application note, the two routers will share the VRRP IP address 172.30.1.254 subnet mask 255.255.255.0. This will be the Default Gateway IP address for devices on the LAN.

The **ADSL-350** will be the **VRRP Master**. The **MRD-455** will be the **VRRP Slave**.

MRD-455 VRRP Slave

Browse to Routing → VRRP



Enabled: ✓

Virtual Router ID: 1

The ID must be identical on both routers. This identifies which routers should be sending and receiving the VRRP status messages.

Virtual Router IP address: 172.30.1.254

The VRRP IP address is the virtual address to be shared and should be identical on both routers.

Priority: 90

Can be a number between 1 and 255. The router with the lowest priority is the default VRRP Slave

Enable Extended Login: ✓

MRD-455: ENABLE VPN ONLY WHEN VRRP MASTER

Next configure the MRD-455 to only establish the preconfigured VPN tunnel when it is the VRRP Master.

The combination of only allowing the ADSL-350 to be VRRP Master when the ADSL link is up - and only allowing the MRD-455 to establish a VPN when it is VRRP Master, prevents a situation where VPN traffic is sent to the wrong Gateway and VPN traffic from the VPN Concentrator going down the wrong VPN Tunnel.

NB: This application note does not go into detail about setting up VPN tunnels. Please contact Westermo Technical Support (technical@westermo.co.uk) for application notes specific to setting up VPN tunnels if required.

Browse to VPN → IPsec

The screenshot shows the MRD-455 web interface. At the top, there is a navigation menu with tabs for Status, System, Wireless, Network, Routing, Firewall, VPN, Serial Server, and Management. The 'VPN' tab is selected, and a sub-menu shows 'IPsec' selected. Below the navigation, it says 'Logged in as admin Host: MRD-455-e0-be-3b'. The main content area is titled 'IPsec VPN' and contains two sections: 'General IPsec Configuration' and 'Tunnels'. In the 'General IPsec Configuration' section, the 'Enabled' checkbox is checked and highlighted with a red box. In the 'Tunnels' section, there is a table with columns: Group, Tunnel, Enable, Remote Host, Remote ID, Edit, and Del. The 'Enable' dropdown menu for the 'primary' tunnel is set to 'Enable On VRRP' and is highlighted with a red box. Below the table are buttons for 'Add backup tunnel' and 'Add new tunnel group'.

General IPsec Configuration						
Enabled		<input checked="" type="checkbox"/>				
NAT traversal enabled & keepalive period (secs)	<input checked="" type="checkbox"/>	45				
Overwrite IPsec MTU	<input type="checkbox"/>					
Enable extended logging	<input type="checkbox"/>					
Reset		Update				

Tunnels						
Group	Tunnel	Enable	Remote Host	Remote ID	Edit	Del
VRRP-Slave	primary	Enable On VRRP	80.45.19.205	@wonderwall		
		Add backup tunnel				
Add new tunnel group						

Enabled: ✓

Tunnels – Enable: Enable on VRRP

TESTING – NORMAL CIRCUMSTANCES

ADSL-350

Under normal circumstances the ADSL-350 will be the VRRP Master. The ADSL link will be up and the VPN will be active over that link.

ADSL-350

Logged in as **admin** Host: ADSL-350-e0-4e-a6

10:54:35 28/10/2015

System	
Power On Self Test	Passed
Temperature (°C)	now: 30.00, min: 28.25, max: 30.00
Uptime	00:02:52

ADSL	
Line Status	No Fault
Connection Status	No Fault

Network	
LAN	No Fault
Loopback	No Fault

Services	
DHCP Server	Disabled
VPN	No Fault
Serial Server	Disabled
VRRP	Master

ADSL-350

Logged in as **admin** Host: ADSL-350-e0-4e-a6

LAN

Description	LAN
Status	Up
IP Address	172.30.1.1
Netmask	255.255.255.0
Packets Received	8,670
Bytes Received	2.53 MB
Packets Transmitted	8,838
Bytes Transmitted	3.43 MB

VRRP	
Status	Master
Conditions	
Bound Interface (LAN)	No Fault
DSL-1	No Fault

ADSL-350

Logged in as **admin** Host: ADSL-350-e0-4e-a6

VPN

IPsec Connection Status						
Label	Tunnel	Status	Uptime	Time Since Rekey	Local IP	Connection Management
						Status Restarts
VRRPmaster prime		Connected	00:18:03	00:18:03	172.30.1.1	Disabled

[Detailed IPsec status](#)

TESTING – NORMAL CIRCUMSTANCES

MRD-455

Under normal circumstances the MRD-455 will be the VRRP Slave. The 4G link will be up but the VPN will be disabled.

MRD-455

Logged in as **admin** Host: MRD-455-e0-be-3b

Alarms 13:16:07 11/10/2016

System	
Power On Self Test	Passed
Temperature (°C)	now: 33.25, min: 30.50, max: 33.75
Uptime	03:24:27
Wireless	
Network Status	No Fault
Connection Status	No Fault
Network	
LAN	No Fault
Loopback	No Fault
Services	
DHCP Server	No Fault
VPN	Disabled
Serial Server	Disabled
VRRP	Slave

MRD-455

Logged in as **admin** Host: MRD-455-e0-be-3b

LAN

Description	LAN
Status	Up
IP Address	172.30.1.2
Netmask	255.255.255.0
Packets Received	18,635
Bytes Received	3.26 MB
Packets Transmitted	28,757
Bytes Transmitted	4.05 MB

DHCP Server Leases			
IP Address	MAC Address	Hostname	Expires
No active leases			

VRRP	
Status	Slave
Conditions	
Bound Interface (LAN)	No Fault

MRD-455

Logged in as **admin** Host: MRD-455-e0-be-3b

VPN

VPN Connection Status	No VPNs enabled
-----------------------	-----------------

TESTING – WITH FAILOVER

ADSL-350

To test the Failover, disconnect the ADSL line from the ADSL-350. You should now see that the ADSL-350 reports a fault for the connection status, VPN and VRRP.

ADSL-350

Status	System	ADSL	Network	Routing	Firewall	VPN	Serial Server	Management
Alarms	ADSL	LAN	VPN	GRE	Serial Server	System Log		

Logged in as **admin** Host: ADSL-350-e0-4e-a6

Alarms

11:31:49 28/10/2015

System	
Power On Self Test	Passed
Temperature (°C)	now: 44.50, min: 28.25, max: 44.50
Uptime	00:40:07
ADSL	
Line Status	No Fault
Connection Status	Fault
Network	
LAN	No Fault
Loopback	No Fault
Services	
DHCP Server	Disabled
VPN	Fault
Serial Server	Disabled
VRRP	Fault

ADSL-350

Status	System	ADSL	Network	Routing	Firewall	VPN	Serial Server	Management
Alarms	ADSL	LAN	VPN	GRE	Serial Server	System Log		

Logged in as **admin** Host: ADSL-350-e0-4e-a6

LAN

Description	LAN
Status	Up
IP Address	172.30.1.1
Netmask	255.255.255.0
Packets Received	10,169
Bytes Received	2.69 MB
Packets Transmitted	9,728
Bytes Transmitted	3.91 MB

VRRP	
Status	Fault
Conditions	
Bound Interface (LAN)	No Fault
DSL-1	Fault

ADSL-350

Status	System	ADSL	Network	Routing	Firewall	VPN	Serial Server	Management
Alarms	ADSL	LAN	VPN	GRE	Serial Server	System Log		

Logged in as **admin** Host: ADSL-350-e0-4e-a6

VPN

IPsec Connection Status						
Label	Tunnel	Status	Uptime	Time Since Rekey	Local IP	Connection Management
		Status	Restarts			
VRRPmaster	primary	Not connected			0.0.0.0	Disabled

TESTING – WITH FAILOVER

MRD-455

After the DSL link has been disconnected, (or the ADSL-350 has been taken offline), the MRD-455 will promote itself to VRRP Master and take ownership of the virtual IP address 172.30.1.254. The VPN is also allowed to establish over the 4G connection.

MRD-455

Status System Wireless Network Routing Firewall VPN Serial Server Management
Alarms Wireless LAN VPN GRE Serial Server System Log

Logged in as **admin** Host: MRD-455-e0-be-3b

Alarms

13:01:31 11/10/2016

System	
Power On Self Test	Passed
Temperature (°C)	now: 33.25, min: 30.50, max: 33.75
Uptime	03:09:52
Wireless	
Network Status	No Fault
Connection Status	No Fault
Network	
LAN	No Fault
Loopback	No Fault
Services	
DHCP Server	No Fault
VPN	No Fault
Serial Server	Disabled
VRRP	Master

MRD-455

Status System Wireless Network Routing Firewall VPN Serial Server Management
Alarms Wireless LAN VPN GRE Serial Server System Log

Logged in as **admin** Host: MRD-455-e0-be-3b

LAN

Description	LAN
Status	Up
IP Address	172.30.1.2
Netmask	255.255.255.0
Packets Received	18,301
Bytes Received	3.23 MB
Packets Transmitted	28,288
Bytes Transmitted	3.92 MB

DHCP Server Leases			
IP Address	MAC Address	Hostname	Expires
No active leases			

VRRP	
Status	Master
Conditions	No Fault
Bound Interface (LAN)	No Fault

MRD-455

Status System Wireless Network Routing Firewall VPN Serial Server Management
Alarms Wireless LAN VPN GRE Serial Server System Log

Logged in as **admin** Host: MRD-455-e0-be-3b

VPN

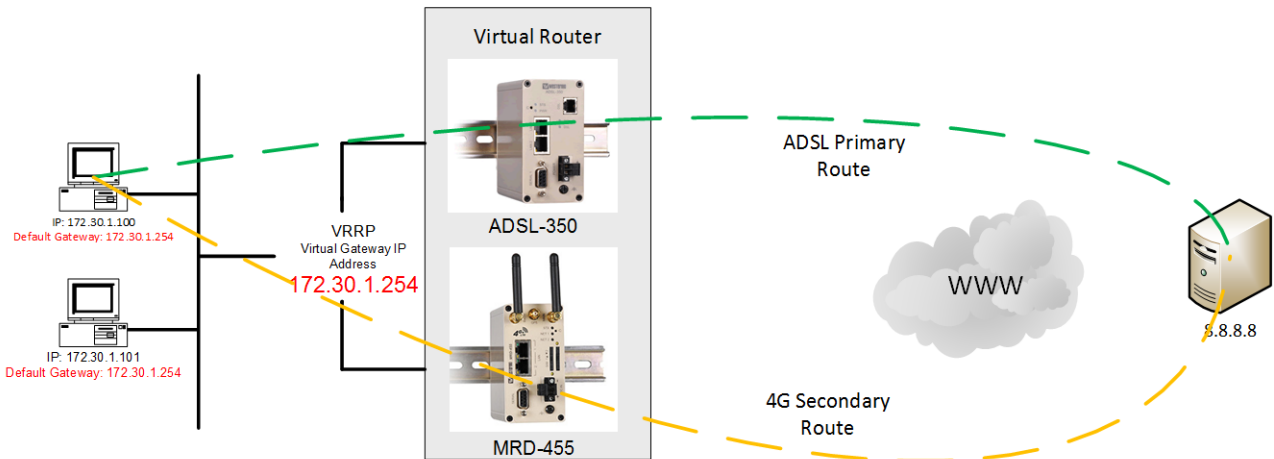
IPsec Connection Status						
Label	Tunnel	Status	Uptime	Time Since Rekey	Local IP	Connection Management
						Status Restarts
VRRP-Slave	primary	connected	00:11:51	00:11:51	172.30.1.2	Disabled

[Detailed IPsec status](#)

TESTING – WITH FAILOVER

TEST PINGS TO AN IP ADDRESS ON THE INTERNET.

To test connectivity from your PC behind the VRRP routers, assign it an IP address on the same LAN and configure the VRRP IP address to be the Default Gateway and DNS Server.

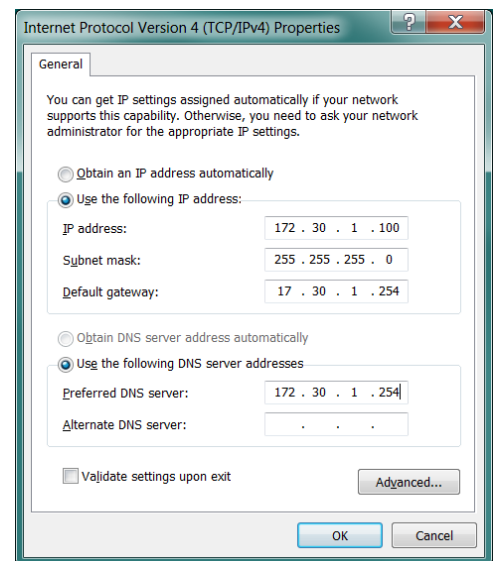


NB: Example IP address to ping is 8.8.8.8 which is a public DNS server for public use.

```
C:\Windows\System32>ping 8.8.8.8 -t
```

Pinging 8.8.8.8 with 32 bytes of data:

```
Reply from 8.8.8.8: bytes=32 time=40ms TTL=53
Reply from 8.8.8.8: bytes=32 time=40ms TTL=53
Reply from 8.8.8.8: bytes=32 time=40ms TTL=53
Reply from 8.8.8.8: bytes=32 time=39ms TTL=53
Reply from 8.8.8.8: bytes=32 time=40ms TTL=53
Reply from 8.8.8.8: bytes=32 time=39ms TTL=53
Reply from 8.8.8.8: bytes=32 time=40ms TTL=53
Reply from 8.8.8.8: bytes=32 time=39ms TTL=53
Reply from 8.8.8.8: bytes=32 time=41ms TTL=53
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Reply from 8.8.8.8: bytes=32 time=668ms TTL=51
Reply from 8.8.8.8: bytes=32 time=597ms TTL=51
Reply from 8.8.8.8: bytes=32 time=2699ms TTL=51
Reply from 8.8.8.8: bytes=32 time=754ms TTL=51
Reply from 8.8.8.8: bytes=32 time=1921ms TTL=51
Reply from 8.8.8.8: bytes=32 time=338ms TTL=51
Reply from 8.8.8.8: bytes=32 time=259ms TTL=51
```



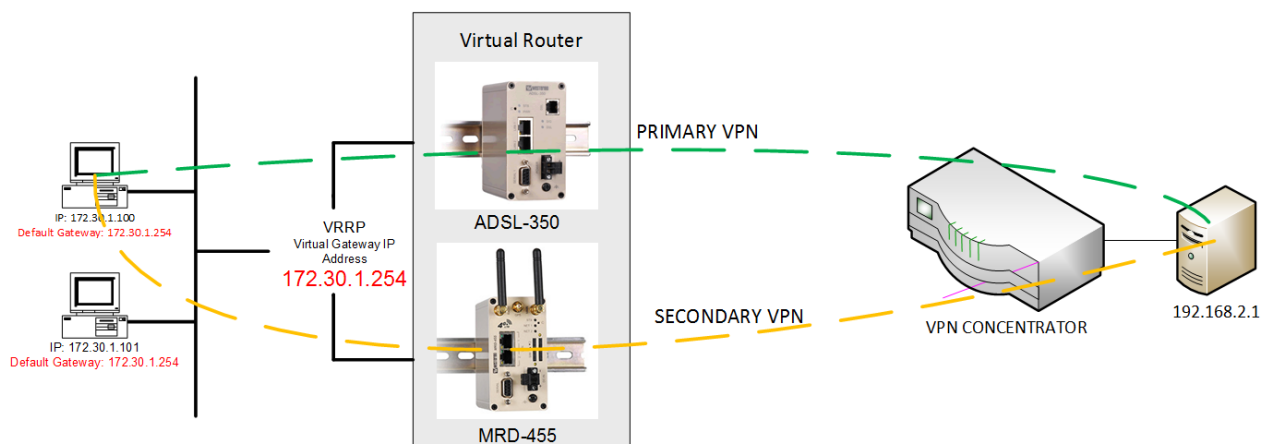
The transition where the DSL line is disconnected to where the MRD-455 becomes the VRRP Master can be clearly seen. Although there is some brief downtime of a few seconds, the traffic from the PC has automatically been rerouted via the MRD-455 from the ADSL-350 without having to re-configure the PC.

TESTING – WITH FAILOVER

TEST PINGS TO AN IP ADDRESS DOWN THE VPN TUNNEL.

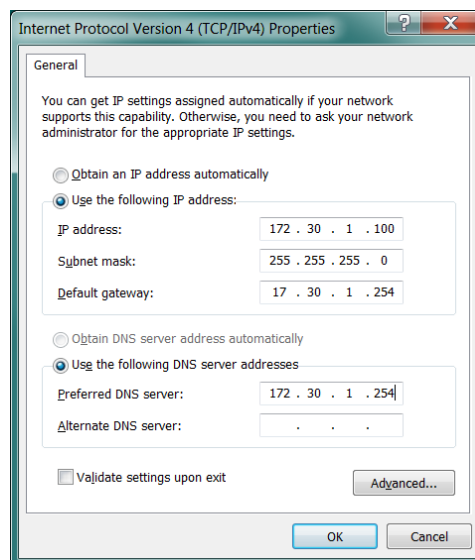
To test connectivity from your PC behind the VRRP routers, assign it an IP address on the same LAN and configure the VRRP IP address to be the Default Gateway and DNS Server.

This time ping an IP address at the LAN side of the VPN Concentrator.



```
C:\Windows\System32>ping 192.168.2.1 -t
```

```
Pinging 192.168.2.1 with 32 bytes of data:
Reply from 192.168.2.1: bytes=32 time=64ms TTL=249
Reply from 192.168.2.1: bytes=32 time=64ms TTL=249
Reply from 192.168.2.1: bytes=32 time=65ms TTL=249
Reply from 192.168.2.1: bytes=32 time=64ms TTL=249
Reply from 192.168.2.1: bytes=32 time=64ms TTL=249
Reply from 192.168.2.1: bytes=32 time=65ms TTL=249
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Reply from 192.168.2.1: bytes=32 time=1324ms TTL=249
Reply from 192.168.2.1: bytes=32 time=3496ms TTL=249
Reply from 192.168.2.1: bytes=32 time=2421ms TTL=249
Reply from 192.168.2.1: bytes=32 time=1115ms TTL=249
Reply from 192.168.2.1: bytes=32 time=621ms TTL=249
Reply from 192.168.2.1: bytes=32 time=1146ms TTL=249
```



The transition where the DSL line is disconnected to where the MRD-455 becomes the VRRP Master and establishes the VPN can be clearly seen. Although there is some brief downtime of a few seconds, the traffic from the PC has automatically been rerouted via the MRD-455 from the ADSL-350 without having to re-configure the PC.

Revision history for version 2.0

Revision	Rev by	Revision note	Date
00	JM	Supersedes AN-0195-ENG Rev. 1.0 Rev 2.0 includes standby VPN on the VRRP Slave. The VPN on the VRRP Slave MRD-455/355 can be prohibited unless it is promoted to VRRP Master. Applies to 3G and 4G MRD-xxx routers only from firmware version 1.7.4.0.onwards.	19/10/2016
01			
02			
03			
04			
05			
06			
07			



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