Virtual Router Redundancy Protocol (VRRP) Configuration Whitepaper
Table of Contents

What is VRRP? .............................................................................................................................................................................. 3
VRRP Terminology ........................................................................................................................................................................ 3
  Virtual Router .................................................................................................................................................................................. 3
  VRRP Instance ............................................................................................................................................................................... 3
  Virtual Router ID ........................................................................................................................................................................... 3
  Virtual Router IP ........................................................................................................................................................................... 3
  Virtual MAC address ..................................................................................................................................................................... 3
  Master .................................................................................................................................................................................................... 3
  Backup .......................................................................................................................................................................................... 3
  Priority .................................................................................................................................................................................................... 4
  Owner .................................................................................................................................................................................................... 4

Router VRRP Configuration Page ................................................................................................................................................. 4

VRRP in Action – How it operates on Ethernet ............................................................................................................................. 5
  Device Configuration ....................................................................................................................................................................... 5
  NTC-6908_A Configuration .......................................................................................................................................................... 6
  NTC-6908_B Configuration .......................................................................................................................................................... 9

VRRP in Action – Test VRRP for 3G Mobile Broadband Failover Internet Connection on Ethernet ........................................ 12
  VRRP Experience from 'Test PC 1' ..................................................................................................................................................... 12
  Test PC 1 ..................................................................................................................................................................................................... 12

Note: Before performing the instructions in this guide, please ensure that you have the latest firmware version on your router. Visit http://www.netcommwireless.com/products/m2m-wireless to find your device and download the latest firmware.
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
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, as a way of determining 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 Page

![Image of NetComm M2M Router VRRP configuration page]

**Table 2 - VRRP configuration items**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>VRRP Enable</td>
<td>Enables or disables the VRRP function.</td>
</tr>
<tr>
<td>Virtual Device ID</td>
<td>This is the VRRP ID which is different for each virtual router on the network.</td>
</tr>
<tr>
<td>Router Priority</td>
<td>The priority determining which router will take on the role of the master. A higher value has a higher priority.</td>
</tr>
<tr>
<td>Virtual IP Address</td>
<td>This is the virtual IP address that both virtual routers share.</td>
</tr>
</tbody>
</table>

**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 Ethernet

Device Configuration

Referring to the logical network diagram, in our example, we have configured NTC-6908_A’s priority to be 255 and NTC-6908_B’s priority to be 10. If we did not set the priority on the routers, NTC-6908_A would have become the master because the IP address of its Ethernet interface is higher than that of NTC-6908_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.
NTC-6908_A Configuration

1. Configure the 3G Mobile Broadband settings

![Figure 3 - NTC-6908_A Mobile Broadband Configuration](image)

2. Configure the LAN IP address

![Figure 4 - NTC-6908_A LAN IP Address Configuration](image)
3. Configure the LAN DHCP Server

![DHCP Configuration](image1)

**Figure 5 - NTC-6908_A LAN DHCP Server Configuration Settings**

4. Configure the VRRP settings

![VRRP Configuration](image2)

**Figure 6 - NTC-6908_A VRRP Configuration Settings**
5. Click **Save** and reboot the router. When it has finished starting up, click the **Status** link and then click the **LAN** link to see the LAN settings. The MAC address of NTC-6908_A changes to the VRRP virtual MAC address 00:00:5E:00:01:01 where the last octet ‘01’ is the Virtual Device ID.

![Figure 7 - NTC-6908_A Status page](image-url)
NTC-6908_B Configuration

1. Configure the 3G Mobile Broadband settings

![Mobile Broadband Configuration](image1)

- Profile Name: Profile1
- APN Name: telstra.internet
- Mobile Broadband Connection: Enable

![Mobile Broadband Configuration Details](image2)

- Profile Name: Profile1
- Enabling: Yes
- APN: telstra.internet

2. Configure the LAN IP address

![LAN IP Address Configuration](image3)

- IP Address: 192.168.1.50
- Subnet Mask: 255.255.255.0
- Hostname: my.router

![LAN IP Address Configuration Details](image4)
3. Configure the LAN DHCP Server

**Figure 10 - NTC-6908_B LAN DHCP Server Configuration Settings**

4. Configure VRRP settings

**Figure 11 - NTC-6908_B VRRP Configuration Settings**
Click **Save** and reboot the router. When it has finished starting up, click the **Status** link and then click the **LAN** link to see the LAN settings. The MAC address of NTC-6908_B changes to the VRRP virtual MAC address 00:00:5E:00:01:01 where the last octet ‘01’ is the Virtual Device ID.

![Figure 12 - NTC-6908_B Status page](image)
VRRP in Action – Test VRRP for 3G Mobile Broadband Failover Internet Connection on Ethernet

VRRP Experience from ‘Test PC 1’

Test PC 1

Figure 13 - VRRP concept generic logical network diagram

Figure 14 - Test PC 1 configuration
When both Cellular Routers are up, the master VRRP router, NTC-6908_A is used as the default internet gateway.

![Figure 15 - NTC-6908_A as default internet gateway](image)

When Master Router NTC-6908_A is down, the backup router, Router NTC-6908_B becomes the gateway to the internet.

![Ping statistics for 74.125.127.147](image)

![Traceroute](image)
When Master Router NTC-6908_A's (192.168.1.70) 3G connection is back online, Master Router NTC-6908_A becomes the internet gateway.

---

<table>
<thead>
<tr>
<th>Interface</th>
<th>192.168.1.200</th>
<th>192.168.1.128</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internet Address</td>
<td>Physical Address</td>
<td>Type</td>
</tr>
<tr>
<td>00-00-5e-00-01-01</td>
<td>192.168.1.50</td>
<td>dynamic</td>
</tr>
<tr>
<td>00-00-5e-00-01-01</td>
<td>192.168.1.60</td>
<td>dynamic</td>
</tr>
<tr>
<td>00-00-5e-00-01-01</td>
<td>192.168.1.70</td>
<td>dynamic</td>
</tr>
</tbody>
</table>

---

Tracing route to www.google.com over a maximum of 30 hops:

```
1  1  1  1  192.168.1.50
2  *   *   * Request timed out.
3  *   *   * Request timed out.
4  144 ms 89 ms 89 ms 192.168.1.128
5  138 ms 109 ms 110 ms 192.168.1.128
6  79 ms 109 ms 199 ms 192.168.1.128
7  <   <   <   192.168.1.128
8  <   <   <   192.168.1.128
9  <   <   <   192.168.1.128
10  87 ms 87 ms 87 ms 192.168.1.128
11  153 ms 153 ms 153 ms 192.168.1.128
12  161 ms 161 ms 161 ms 192.168.1.128
13  *   *   * Request timed out.
14  *   *   * Request timed out.
15  *   *   * Request timed out.
16  *   *   * Request timed out.
17  292 ms 292 ms 292 ms 192.168.1.128
18  *   *   * Request timed out.
19  *   *   * Request timed out.
20  333 ms 290 ms 289 ms 192.168.1.128
```

---

Tracing route to www.google.com (74.125.127.104) over a maximum of 30 hops:

```
1  1  1  1  192.168.1.50
2  *   *   * Request timed out.
3  *   *   * Request timed out.
4  144 ms 89 ms 89 ms 192.168.1.128
5  138 ms 109 ms 110 ms 192.168.1.128
6  79 ms 109 ms 199 ms 192.168.1.128
7  <   <   <   192.168.1.128
8  <   <   <   192.168.1.128
9  <   <   <   192.168.1.128
10  87 ms 87 ms 87 ms 192.168.1.128
11  153 ms 153 ms 153 ms 192.168.1.128
12  161 ms 161 ms 161 ms 192.168.1.128
13  *   *   * Request timed out.
14  *   *   * Request timed out.
15  *   *   * Request timed out.
16  *   *   * Request timed out.
17  292 ms 292 ms 292 ms 192.168.1.128
18  *   *   * Request timed out.
19  *   *   * Request timed out.
20  333 ms 290 ms 289 ms 192.168.1.128
```

---

When Master Router NTC-6908_A's (192.168.1.70) 3G connection is back online, Master Router NTC-6908_A becomes the internet gateway.

---

Figure 16 - NTC-6908_B as internet gateway

Figure 17 - NTC-6908_A as internet gateway after connection is restored