

Virtual Router Redundancy Protocol (VRRP) Configuration Whitepaper

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DOCUMENT VERSION	DATE
- Initial document release	January 2013

Table 1 - Document Revision History



Note: Before performing the instructions in this guide, please ensure that you have the latest firmware version on your router. Visit <u>http://www.netcommwireless.com/products/m2m-wireless</u> 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

VRRP Configuration	
VRRP Enable	● Enable ○ Disable
Virtual Device ID	1 (1-255)
Router Priority	1 (1-255)
Virtual IP Address	0.0.0
	Save

Figure 1 - NetComm M2M Router VRRP configuration page

ITEM	DEFINITION
VRRP Enable	Enables or disables the VRRP function.
Virtual Device 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 2 - 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 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.



- 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

Status Internet Settings	Vireless Settings Services System							
Internet Settings > Mobile Broadband > Connection								
Mobile Broadband Profile Settings	Mobile Broadband Profile Settings							
Profile Name	Profile1 💌 🗌 Automatically configure my mobile broadband							
APN Name	telstra.internet							
Mobile Broadband Connection	● Enable ○ Disable							
Username								
Password								
Authentication Type	⊙ CHAP O PAP							
Reconnect Delay	30 (30-65535) secs							
Reconnect Retries	0 (1-65535, 0=Unlimited)							
Metric	20 (1-65535)							
MTU	1400 (1-1500)							
NAT Masquerading	• Enable O Disable							
Profile Name	Enabled APN User							
Profile1	Yes telstra.internet							
Profile2	No							
Profile3	No							
Profile4	No							
Profile5	No							
Profile6	No							

Save

Figure 3 - NTC-6908_A Mobile Broadband Configuration

2. Configure the LAN IP address

Status	► Internet Settings	▶ Wireless Settings	Services	▶ System	
Internet Settings > I	LAN > IP Setup				
LAN Configuration					
IP Address		192 . 168 . 1	. 70		
Subnet Mask		255 . 255 . 2	55 . 0		
Hostname		my.router			
DNS Masquerade					
DNS Masquerade		⊙Enable ○Disable	е		
			Save		

Figure 4 - NTC-6908_A LAN IP Address Configuration



3. Configure the LAN DHCP Server

Status 🕨 Inte	ernet Settings 🔹 🕨 Wirele	ess Settings 🔹 🕨 Serv	ices	▶ System	
Internet Settings > LAN > DF	ICP				
DHCP Configuration					
DHCP		⊙Enable ○Dis	able		
DHCP Start Range		192 . 168	. 1 . 120		
DHCP End Range		192 . 168	. 1 . 200		
DHCP Lease Time		86400 (sec	onds)		
Default Domain Name Suffi	x				
DNS Server 1 IP Address		192 . 168	. 1 . 60		
DNS Server 2 IP Address		192 . 168	. 1 . 70		
WINS Server 1 IP Address		0.0	. 0 . 0		
WINS Server 2 IP Address		0.0	. 0 . 0		
NTP Server (Option 42)		0.0	. 0 . 0		
TFTP Server (Option 66)					
Option 150					
Option 160					
DHCP Relay Configuration					
DHCP Relay		OEnable ODis	able		
DHCP Server Address		0.0	.0.0		
Address Reservation List					
Computer Name	MAC Address	IP Address			Add
DHCP Client List					
Computer Name	MAC Address	IP Address	E	xpire Time	
computer1	00:40:f4:ce:fa:1e	192.168.1.92	2 W	/ednesday, 30 January 2013 11:01:22AM	Clone
		Sav	e		

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

4. Configure the VRRP settings

Status	Internet Settings	▶ Wireless Settings	Services	► System	
Internet Settings > R	outing > VRRP				
VRRP Configuration					
VRRP Enable		Enable	ODisable		
Virtual Device ID		1 (1	1-255)		
Router Priority		255 (1	1-255)		
Virtual IP Address		192 .	168 . 1	. 60	
			Save]	

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.

Status		Login								
All Status	PPPoE	PPTP	IPsec	Call-Forwarding						
📈 Syste	em Informat	ion								
System U	p Time		00:02:3	0						
Router Ver	rsion		Hardwa	are: 1.0 Software: V1.10.12.1						
Phone Mo	dule		Model:	MC8704 Hardware: 1.0 Firmware: T3_0_	_0_28AP					
MAC Addr	ess		00:00:5	E:00:01:01						
📕 LAN										
IP			192.168	8.1.70 / 255.255.255.0						
MAC Addr	ess		00:00:5	E:00:01:01						
📕 Ethe	// Ethernet Port Status									
LAN: 🖌			Up / 10	0.0 Mbps / FDX						
📈 Mob	ile Broadba	nd (MBB)		Show data usage						
Profile Na	ime	Inter	face	Status	APN IP Address					
Profile1		wwa	n0	Up	telstra.internet 10.102.46.36					
📕 Coni	nection Stat	us	_							
Connectio	on Up Time		00:01:2	21						
Provider			Telstra	Telstra						
Coverage			HSPA+	HSPA+						
IMEI			357597	357597040214003						
Frequency	y		WCDM/	WCDMA850						
Signal Str	enath (dBm)			_						
-			-67 dBr	n (High)						

Figure 7 - NTC-6908_A Status page



NTC-6908_B Configuration

1. Configure the 3G Mobile Broadband settings

Status Internet Settings	Wireless Settings Services System							
Internet Settings > Mobile Broadband > Connection								
Mobile Broadband Profile Settings	Mobile Broadband Profile Settings							
Profile Name	Profile1 Automatically configure my mobile broadband							
APN Name	telstra.internet							
Mobile Broadband Connection	• Enable O Disable							
Username								
Password								
Authentication Type	● CHAP O PAP							
Reconnect Delay	30 (30-65535) secs							
Reconnect Retries	0 (1-65535, 0=Unlimited)							
Metric	20 (1-65535)							
MTU	1400 (1-1500)							
NAT Masquerading	• Enable O Disable							
Profile Name	Enabled APN User							
Profile1	Yes telstra.internet							
Profile2	No							
Profile3	No							
Profile4	No							
Profile5	No							
Profile6	No							

Save

Figure 8 - NTC-6908_B Mobile Broadband Configuration

2. Configure the LAN IP address

Status Internet Settings I Wireless Settings I Services I System

Internet Settings > LAN > IP Setup

LAN Configuration	
IP Address	192 . 168 . 1 . 50
Subnet Mask	255 . 255 . 255 . 0
Hostname	my.router
DNS Masquerade	
DNS Masquerade	⊙ Enable ○ Disable
	Save

Figure 9 - NTC-6908_B LAN IP Address Configuration



3. Configure the LAN DHCP Server

Status 🕨 Int	ernet Settings 💦 🕨 V	Vireless Settings	Services	•	System	
Internet Settings > LAN > DI	НСР					
DHCP Configuration						
DHCP		Enat	ble ODisable			
DHCP Start Range		192	. 168 . 1	. 120		
DHCP End Range		192	. 168 . 1	. 200		
DHCP Lease Time		86400	(seconds)			
Default Domain Name Suff	ix					
DNS Server 1 IP Address		192	. 168 . 1	. 60		
DNS Server 2 IP Address		192	. 168 . 1	. 50		
WINS Server 1 IP Address		0	. 0 . 0	. 0		
WINS Server 2 IP Address		0	. 0 . 0	. 0		
NTP Server (Option 42)		0	. 0 . 0	. 0		
TFTP Server (Option 66)						
Option 150						
Option 160						
DHCP Relay Configuration						
DHCP Relay		OEnat	ble 💿 Disable			
DHCP Server Address		0	.0.0	. 0		
Address Reservation List						
Computer Name	MAC Address	IP Ac	ddress			Add
DHCP Client List						
Computer Name	MAC Addres	s IF	Address	Expi	ire Time	
			Save			

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

4. Configure VRRP settings

Status	Internet Settings	Wireless Settings	Services	▶ System	
Internet Settings >	Routing > VRRP				
VRRP Configurati	on				
VRRP Enable		 Enable 	ODisable		
Virtual Device ID		1 (1	-255)		
Router Priority		10 (1	-255)		
Virtual IP Address		192 .	168 . 1 .	60	
			Save		

Figure 11 - NTC-6908_B 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_B changes to the VRRP virtual MAC address 00:00:5E:00:01:01 where the last octet '01' is the Virtual Device ID.

Status	Login										
All Status PPPoE	PPTP	IPsec	Call-Forwarding								
📕 System Informa	tion										
System Up Time		00:01:17									
Router Version		Hardware:	1.0 Software: V1.10.12.1								
Phone Module		Model: MC	8704 Hardware: 1.0 Firmware: T3_0_0_2BAP								
MAC Address		00:00:5E:0	0:01:01								
📕 LAN											
IP		192.168.1.50 / 255.255.255.0									
MAC Address		00:00:5E:00:01:01									
Ethernet Port S	tatus										
LAN: 🖌		Up / 100.0	Mbps / FDX								
Mobile Broadba	and (MBB)	Sh	iow data usage								
Profile Name	Interf	ace	Status	APN	IP Address						
Profile 1	wwan	D Up telstra.internet 10.102.46.39									
Connection Sta	itus										
Connection Up Time		00:00:32									
Provider		Telstra									
Coverage		HSPA+									
IMEI		357597040	0214002								
Frequency		WCDMA85	0								
Signal Strength (dBm)	-67 dBm (H	High)								
SIM Status		SIM OK									

Figure 12 - NTC-6908_B Status page



VRRP in Action – Test VRRP for 3G Mobile Broadband Failover Internet Connection on Ethernet

VRRP Experience from 'Test PC 1'



Figure 13 - VRRP concept generic logical network diagram

Test PC 1

Connect	ion status								
2	Address Type:			Assign	ed by	DHCF	,		
24	IP Address:			19	92.168	3.1.200	1		
	Subnet Mask:			25	5.255	5.255.0)		
	Default Gatewa	y:		1	92.16	68.1.60)		
	Details]							
C:\Documents and Windows IP Confi Ethernet adapter	l Settings\ .guration • Local Are	carme a Con	nl>ip necti	on:	ig				
Connecti IP Addre Subnet M Default	on-specifi ss lask Gateway.	.c DNS	Suff	i× • •		192 255 192	.168 .255 .168	.1.2 .255 .1.6	00 -0 0
C:\Documents and	l Settings\	carme	n1>ar	∙р –а					
Interface: 192.1 Internet Addre 192.168.1.50 192.168.1.60 192.168.1.60 192.168.1.70	.68.1.200 - ss Pl 00 00 00	0x ysica -00-5 -00-5 -00-5	2 1 Add e-00- e-00- e-00-	ress 01–0 01–0 01–0	1 1 1	T d d	ype ynam ynam ynam	ic ic ic	

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.

C:/D	ocumei	nts	and Se	ettin	gs∖ca	arme	nl≻ping www.google.com.au -t
Ping	ing w	w.1	.goog]	le.co	m [74	4.12	5.127.147] with 32 bytes of data:
Repl Repl Repl Repl Repl Repl Repl Repl	y froi y froi y froi y froi y froi y froi y froi y froi y froi	n 74 n 74 n 74 n 74 n 74 n 74 n 74 n 74	.125.1 .125.1 .125.1 .125.1 .125.1 .125.1 .125.1 .125.1 .125.1 .125.1	127.1 127.1 127.1 127.1 127.1 127.1 127.1 127.1 127.1 127.1	47:] 47:] 47:] 47:] 47:] 47:] 47:] 47:] 47:] 47:]	byte byte byte byte byte byte byte byte	<pre>s=32 time=331ms TTL=237 s=32 time=2365ms TTL=233 s=32 time=258ms TTL=233 s=32 time=430ms TTL=237 s=32 time=439ms TTL=237 s=32 time=417ms TTL=237 s=32 time=494ms TTL=237 s=32 time=494ms TTL=237 s=32 time=420ms TTL=237 s=32 time=418ms TTL=237</pre>
Ping Appro Cont: ^C C:\Do Trac:	stat: Packet oximat Minimu rol-C ocumen ing ru	isti ts: te r um = nts nute	cs for Sent = ound f 258ms and Se	r 74. = 11, trip s, Ma ettin	125.1 Rece times ximur gs\ca	127. eive s in m = arme	147: d = 11, Lost = 0 (0% loss), milli-seconds: 2365ms, Average = 573ms nl%tracert -d www.google.com.au
			CO WY	WW - I -	goog.	TC • C	UN 174.143.147.147J
over	a ma:	kimu	mof	30 ho	9009. ps:	16.6	UN L/4.125.12/.14/J
over	a ma: <1	kimu ms	m of 3	30 ho ms	9009. ps: <1	ms	192.168.1.70
over	a ma: <1 381	kimu ms ms	m of 3 <1 519	30 ho ms ms	9009. ps∶ <1 510	ms ms	192.168.1.70 10.4.24.194
over 1 2 3	a max <1 381 *	kimu ms ms	m of 3 <1 519 *	ms ms	9009. ps: <1 510 *	ms ms	192.168.1.70 10.4.24.194 Request timed out.
over 1 2 3 4	a max <1 381 *	kimu ms ms	m of 3 <1 519 284	ms ms ms ms	9009. ps: <1 510 * 340	ms ms ms	192.168.1.70 10.4.24.194 Request timed out. 74.125.127.147
over 1 2 3 4 5	a max <1 381 * 309	kimu ms ms ms	m of 3 <1 519 284 359	ms ms ms ms ms	9889. ps: 510 340 340	ms ms ms ms	192.168.1.70 10.4.24.194 Request timed out. 74.125.127.147 74.125.127.147
over 1 2 3 4 5 6	a max <1 381 * 309 309	kimu MS MS MS	m of 3 519 284 359 339	ms ms ms ms ms ms ms	9009. ps: 510 340 340 389	ms ms ms ms ms ms	192.168.1.70 194.24.194 Request timed out. 74.125.127.147 74.125.127.147 74.125.127.147
over 1 3 4 5 6 7	a max <pre></pre>	ximu ms ms ms ms	m of 3 <1 519 284 359 339 *	ms ms ms ms ms ms ms	9009 ps: <pre></pre>	ms ms ms ms ms ms ms	192.168.1.70 18.4.24.194 Request timed out. 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147
over 1 2 3 4 5 6 7 8	a max <pre></pre>	kimu ms ms ms ms ms	m of 3 <1 519 284 359 339 * * *	ms ms ms ms ms ms ms	9009 ps: 510 510 340 340 389 294 *	MS MS MS MS MS MS	192.168.1.70 194.124.194 Request timed out. 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147
over 1 2 3 4 5 6 7 8 9	a max <1 381 * 309 309 309 * 272 *	ms ms ms ms ms	co w m of 3 519 284 359 339 * *	ms ms ms ms ms ms ms	9009 ps: <pre></pre>	ns MS MS MS MS MS MS	192.168.1.70 19.4.24.194 Request timed out. 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 Request timed out.
over 1 2 3 4 5 6 7 8 9 10	a max <1 381 * 309 309 309 * 272 * *	ms ms ms ms ms	m of (1) 519 284 359 339 ** * 3149	ms ms ms ms ms ms ms ms	\$009 ps: 510 510 340 340 389 294 * *	MS MS MS MS MS MS MS	192.168.1.70 18.4.24.194 Request timed out. 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 Request timed out. 74.125.127.147
over 1 2 3 4 5 6 7 8 9 10 11	a max <1 381 * 309 309 272 * 406	ms ms ms ms ms ms	m of 3 519 284 359 339 * * 3149 479	ms ms ms ms ms ms ms	9009 ps: 510 340 340 389 294 * 500	ms ms ms ms ms ms ms	192.168.1.70 194.125.127.147 Request timed out. 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 Request timed out. 74.125.127.147 165.228.183.205
over 1 3 4 5 6 7 8 9 10 11 12	a ma (1 381 309 309 272 * 406 410	ms ms ms ms ms ms ms	m of <1 519 284 339 339 * 3149 469	ms ms ms ms ms ms ms ms	9009 ps: (1 510 340 340 340 389 294 * 500 480	ms ms ms ms ms ms ms	192.168.1.70 192.168.1.70 18.4.24.194 Request timed out. 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 165.228.183.205 203.56.28.183.205
over 12345678910111213	a max <1 381 309 309 272 * 406 410 39 <u>7</u>	ms ms ms ms ms ms ms ms	<pre></pre>	ms ms ms ms ms ms ms ms ms	9009 ps: 510 510 340 340 340 340 340 340 340 34	ms ms ms ms ms ms ms ms	192.168.1.70 194.125.127.147 Request timed out. 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 Request timed out. 74.125.127.147 165.228.103.205 203.50.20.1 203.50.6.29
over 1234567899 1011213 11213	a max <pre></pre>	ms ms ms ms ms ms ms ms ms	<pre></pre>	ms ms ms ms ms ms ms ms ms ms	9009 ps: 510 510 340 340 340 340 340 340 340 34	ms ms ms ms ms ms ms ms ms ms	192.168.1.70 19.4.125.127.147 Hequest timed out. 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 165.228.103.205 203.50.20.1 203.50.6.29 203.50.13.70
over 123456789 101121314 15	a max <pre></pre>	ms ms ms ms ms ms ms ms ms ms	cov of (1 519 284 359 339 ** * 3149 479 469 479 520 59 <u>9</u>	80 ho ms ms ms ms ms ms ms ms ms ms	9009 ps: <pre></pre>	ns ns ns ns ns ns ns ns ns ns ns	192.168.1.70 194.125.127.147 194.24.194 Request timed out. 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 Request timed out. 74.125.127.147 165.228.103.205 203.50.20.1 203.50.6.29 203.50.6.29 203.50.13.70 202.84.143.146
0Ver 12345678901112341516	a max 381 381 309 309 272 * 406 410 397 397 509	ms ms ms ms ms ms ms ms ms ms ms ms	c of (519 519 284 359 339 * 3149 479 479 520 520 520 519	80 ho ms ms ms ms ms ms ms ms ms ms ms ms ms	9009 ps: <pre></pre>	ms ms ms ms ms ms ms ms ms ms ms ms	192.168.1.70 192.168.1.70 194.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 Request timed out. 74.125.127.147 165.228.103.205 203.50.20.1 203.50.6.29 203.50.13.70 202.84.143.146 202.84.148.142
over 1234567899111234567 111234567899111234567	a max 381 381 309 309 272 * 406 416 416 397 397 530 516	kimu MS MS MS MS MS MS MS MS MS MS MS	m of	80 ho ns ns ns ns ns ns ns ns ns ns ns ns ns	905: ps: <pre> </pre> <pre> <pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre></pre>	ms ms ms ms ms ms ms ms ms ms ms ms ms m	192.168.1.70 192.168.1.70 18.4.24.194 Request timed out. 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 Request timed out. 74.125.127.147 165.228.103.205 203.50.20.1 203.50.6.29 203.50.6.29 203.50.6.29 203.50.13.70 202.84.143.146 202.84.148.142 72.14.216.81
0 0 1 1 2 3 4 5 6 7 8 9 0 1 1 2 3 4 5 6 7 8 9 0 1 1 2 3 4 5 6 7 8 9 0 1 1 2 3 4 5 6 7 8 9 0 1 1 2 3 4 5 6 7 8 9 0 1 1 1 2 3 4 5 5 7 8 9 1 1 1 2 1 1 2 3 4 5 1 2 3 4 5 1 2 1 1 2 1 1 2 3 4 5 1 2 1 1 2 3 4 5 1 2 3 1 1 2 3 1 1 2 3 4 5 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 1 2 3 1 2 3 1 1 2 3 1 1 1 2 3 1 1 1 1	a max <pre></pre>	kimu ms ms ms ms ms ms ms ms ms ms ms ms ms	<pre></pre>	No ho ms ms ms sssssssssssssssssssssssssssss	9009 ps: <pre></pre>	MS MS MS MS MS MS MS MS MS MS MS MS MS M	192.168.1.70 194.125.127.147 Request timed out. 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 Request timed out. 74.125.127.147 165.228.103.205 203.50.20.1 203.50.6.29 203.50.6.29 203.50.6.29 203.50.13.70 202.84.143.146 202.84.148.142 72.14.216.81 74.125.127.147
over 12345678901123456789 11123456789	a max <pre></pre>	kimu ms ms ms ms ms ms ms ms ms ms ms ms ms	C of (51% 284 339 339 479 479 479 479 520 590 710 3200 700	30 ho ms sss ms sss ms sss ms sss ms ms ms ms ms ms ms ms ms ms ms ms	905: ps: 510 510 3400 3403 3403 3403 3403 3894 5000 5900 5900 5900 5900 5900 5900 5900 5900 510 510 510 510 510 510 510 5	ms ms ms ms ms ms ms ms ms ms ms ms ms m	192.168.1.70 192.168.1.70 18.4.24.194 Request timed out. 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 165.228.103.205 203.50.20.1 203.50.20.1 203.50.20.1 203.50.3.70 202.84.143.146 202.84.143.146 202.84.143.142 72.14.216.81 74.125.127.147 216.239.43.212
0 1 2 3 4 5 6 7 8 9 0 1 1 2 3 4 5 6 7 8 9 0 1 1 2 3 4 5 6 7 8 9 0 1 1 2 3 4 5 6 7 8 9 0 1 1 2 3 4 5 6 7 8 9 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	a max 3 wa 3 wa 4 066 4 106 4 106 4 106 4 106 4 107 3 9 7 5 397 5 307 5 307	ns ns ns ns ns ns ns ns ns ns ns ns ns n	C of (of (519 519 284 339 339 479 469 479 469 479 599 610 720 320 709 599 610 720 320 709		905: ps: <11 510 × 510 340 340 340 340 389 29 × × *0 500 5010 7200 7200 7200	ns ms ms ms ms ms ms ms ms ms ms ms ms ms	192.168.1.70 194.125.127.147 Request timed out. 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 74.125.127.147 Request timed out. 74.125.127.147 165.228.103.205 203.50.6.29 203.50.6.29 203.50.6.29 203.50.6.29 203.50.13.70 202.84.143.146 202.84.148.142 72.14.216.81 74.125.127.147 216.239.43.212 74.125.127.147

Figure 15 - NTC-6908_A as default internet gateway

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

ungi	ng ww	w.1.go	ogle.com	[74.125.1	27.147] with	32 J	oytes	of dat	ta
leply	from	74.12	5.127.14	7: bytes≕	32 time	=332ms	TTL	=237		
leply	from	74.12	5.127.14	7: bytes≕	32 time:	=389ms	TTL=	=233		
leply	from	74.12	5.127.14	7: bytes=3	32 time:	=287ms	TTL=	=233		
leply	from	192.1	68.1.70:	Destinat:	ion net	unread	hab]	le.		
leply	from	192.1	68.1.70:	Destinat:	ion net	unread	habl	le.		
leply	from	192.1	68.1.70:	Destinat:	ion net	unread	habl	le.		
Reply	from	192.1	68.1.70:	Destinat:	ion net	unread	hab	le.		
Reply	from	192.1	68.1.70:	_Destinat:	ion net	unread	hab	le.		
Reply	from	74.12	5.127.14	7: bytes≕	32 time	= 41 2ms	TTL=	=237		
Reply	from	74.12	5.127.14	7: bytes≕	32 time	=558ms	TTL=	=237		
Reply	from	74.12	5.127.14	7: bytes=	32 time	= 41 8ms	TTL=	=237		
leply	from	74.12	5.127.14	7: bytes=	32 time	=408ms	<u>TTL</u> =	=237		
leply	from	74.12	5.127.14	7: bytes=	32 time	=405ms	TTL:	=237		
leply	from	74.12	5.127.14	7 bytes=	32 time	=423ms	TTL	=237		
leply	from	192.1	68.1.70:	Destinat:	ion net	unread	hab	Le.		
leply	from	192.1	68.1.70:	Destinat:	ion net	unread	hab	Le.		
teply	from	192,1	68.1.70	Destinat	Lon net	unread	hab	Le.		
tepiy	from	24.12	5.127.14	7 bytes=	2 time	=442ms	IIL:	-237		
(ep1y	trom	74.12	5.127.14	7 bytes=	32 time	=400ms	IIL:	237		
epiy	from	74.12	5.127.14	bytes=	32 time	=428ms	116	237		
epty	from	192.1	68.1.70	Destinat:	Lon net	unread	hab.	Le.		
epty	from	192.1	68.1.70:	Destinat:	lon net	unread	nab.	Le.		
sep14	from	172.1	68.1.70	Destinat	Lon net	unread	nap.	Le.		
sepiy	from	74.12	5.127.14	i/: bytes=:	32 time	=41 /ms	111	-237		
sepiy	from	74.12	5.147.14	l7: bytes=	2 time	=376MS		-237		
ve p r y	from	74.14	5.147.14 5 199 1 <i>4</i>	9. butco-	DZ LIME	-42405		-237		
ve p r y	from	74.14	5.147.14 5 199 1 <i>4</i>	9. hutoo-	DZ LIME	-40205	11L- TTT-	-237		
epty Dowle	from	74.14	5.147.14 5 199 1 <i>4</i>	7. bytes-	DZ LIME	-419ms	11L- TTT-	-437		
epty only	from	54 19	5 197 14	7. butco-2	2 time	-419mo		-237		
	from	54 19	5 197 14	7. butes=	22 time	-449mg		-237		
	from	74 19	5 197 14	7. butes=	20 time	=406ms		-237		
lenlu	from	74 12	5 127 14	7: hutes=	2 time	=394me	ŤŤĹ	-237		
lonlu	from	74 19	5 197 14	7. butes=	22 time	=402ms		-237		
lenlu	from	74 12	5 127 14	7: hutes=	2 time	=450ms	ŤŤĹ	=237		
lenlu	from	74 12	5 127 14	7: hutes=	12 time	=408ms	ŤŤĹ	237		
lenlu	from	74 12	5 127 14	7: hutes=	2 time	=396ms	ŤŤĹ	-237		
lenlu	from	74 12	5 127 14	7: hutes=	2 time	=404ms	ŤŤĹ	=237		
lenlu	from	74 12	5 127 14	7: hutes=	12 time	=432ms	ŤŤĹ	=237		
lenlu	from	74 12	5 127 14	7: hutes=	12 time	=41Øms	ŤŤĹ	237		
lenlu	from	74.12	5.127.14	7: hutes=	12 time	=428ms	ŤŤĹ	237		
lenlu	from	74.12	5.127.14	7: hutes=	12 time	=396ms	TTL	237		
leplu	from	74.12	5.127.14	7: butes=	12 time	=404ms	ŤŤ Ľ	237		
	from	74.12	5.127.14	7: hutes=	12 time	=393ms	TTL	237		
Renlú								the second se		



C:\Do	cumer	nts	and Se	etti	ngs∖ca	arme	nlptracert -d www.google.com.au
Traci over	ng ro a max	oute kimu	to wu m of 3	w.1 30 h	.goog	le.c	om [74.125.127.104]
G	<1	ms	<1	ms	<1	ms	192.168.1.50
2	×		×		×		Request timed out.
3	*		*		*		Request timed out.
14	144	ms	89	ms	. 89	ms	74.125.127.104
5	138	ms	107	ms	110	ms	74.125.127.104
1 2	- 79	ms	107	ms	109	ms	74.125.127.104
6	*		132	ms	176	ms	74.123.127.104 77 195 197 107
l ö	ดวิ	me	*		130	115	74.123.127.104
าด์	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.
17	*		333	ms	*		74.125.127.104
20	332	ms	270	ms	289	ms	74.125.127.104
Trace	comj	plet	e.				
C:\Do	cumer	its	and Se	etti	ngs\ca	arme	nl>ping www.google.com.au -t
Pingi	ng wu	w.1	.goog]	Le.c	om [74	4.12	5.127.104] with 32 bytes of data:
Reply	fro	n 74	.125.1	127.	104:]	byte	s=32 time=442ms TTL=237
Reply	fro	n <u>74</u>	.125.1	127.	104:]	byte	s=32 time=420ms TTL=237
Reply	fro	n 74	.125.1	127.	104:	byte	s=32 time=439ms TTL=237
Керту	fro	n 74	-125-1	L27.	104:	byte	s=32 time=417ms IIL=237
Reply	tro	n 74	.125.1	L27.	104:	byte	S=32 time=407ms llL=237
керту керту	fro	n 74± 	.125.1		104: 1	оусе	S=32 time=415ms IIL=237
LIUG	stat	isti	CS 101	* 74 - C	.125.	127.	104:
0,000	acket		sent ·	- 0,	time	ivea	- 6, LOST - 0 (0% 1088), milli-pepende:
мррго	inim	.c r	407mg	Υ.ΤΠ Μ	L LINC:	» =	$442mc \Delta \mu = 423mc$
Contr	01-C		10116	ا ر «	αλτηπη	-	112115, HVEPage - 125115
^C	OI U						
C:\Do	cumer	nts	and Se	etti	ngs\ca	arme	nl>arp -a
Inter	face	19	2 168	1 2	QQ	- Øv	2
Int	ernet	: Āá	dress		Phu	sica	1 Address Type
192	.168	1.5	0		00-1	00-5	e-00-01-01 dynamic
192	.168	.1.6	Ø		00-	00-Š	e-00-01-01 dynamic

Figure 16 - NTC-6908_B as internet gateway

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.

G:\Docu	iments and	Setting	(s∖carme	n1≻arp –a	a	
Interfa	ice: 192.1	68.1.200) 0x	2 1 Oddnoor		Tuno
100 4	net Huure Zo 4 Fo	55	rnysica	- 00 04 (5 71-1	iype
172.1	.68.1.50		00-00-5	6-00-01-0	91 34	qynamic
172.1	68.1.60		00-00-5	6-00-01-0	91 34	qynamic
192.1	.68.1.70		00-00-5	е-00-01-0	91	dynamic
C:∖Docu	iments and	Setting	ſs∖carme	nl>trace	rt 4.2 .	.2.2
Twacino	woute to	unse-ha	ak sus a	tei net	[4 2 2	21
over a	maximum o	f 30 hor)S:	001.000		
G	<1 ms	<1 ms	<1 ms	192.168	.1.70	
2	×	72 ms	89 ms	10.4.85	.2	
3	×	×	×	Request	timed	out.
4	×	×	×	Request	timed	out.
5	×	×	×	Request	timed	out.
ň	×	×	×	Request	timed	out.
2	* ^0			noquoov	o ino a	040.
C:\Docu	ments and	Setting	∫s\carme	nl>ping 4	4.2.2.2	2
.	4 0 0 0			c 1 / -		
Pinging	4.2.2.2	with 32	bytes o	f data:		
Renlv f	rom 4.2.2	.2: bute	es=32 ti	me=227ms	TTL=44	1
Renlu f	rom 4.2.2	2: hute	s=32 ti	me = 214ms	TTL=44	ī
Renlu f	vom 4 2 2	2: hute	s=32 ti	me=2103m	TTL=4	Îq
Reply f	wom 4 2 2	2: bute	s = 32 + 1	$m_{e} = 258m_{e}$	TTI.=49)
vebrà i	1.2.2	.z. byce	3-32 CI	MC - 200M3	110-17	1
Ping st	atistics	for 4.2.	2.2:			
Pac	kets: Sen	t = 4. F	Received	= 4. Los	st = Ø	(0% loss).
Approxi	mate roun	d trip t	imes in	milli-se	econds	
Min	imum = 21	4ms Max	cimum =	2103ms - 0	luerage	e = 700ms

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