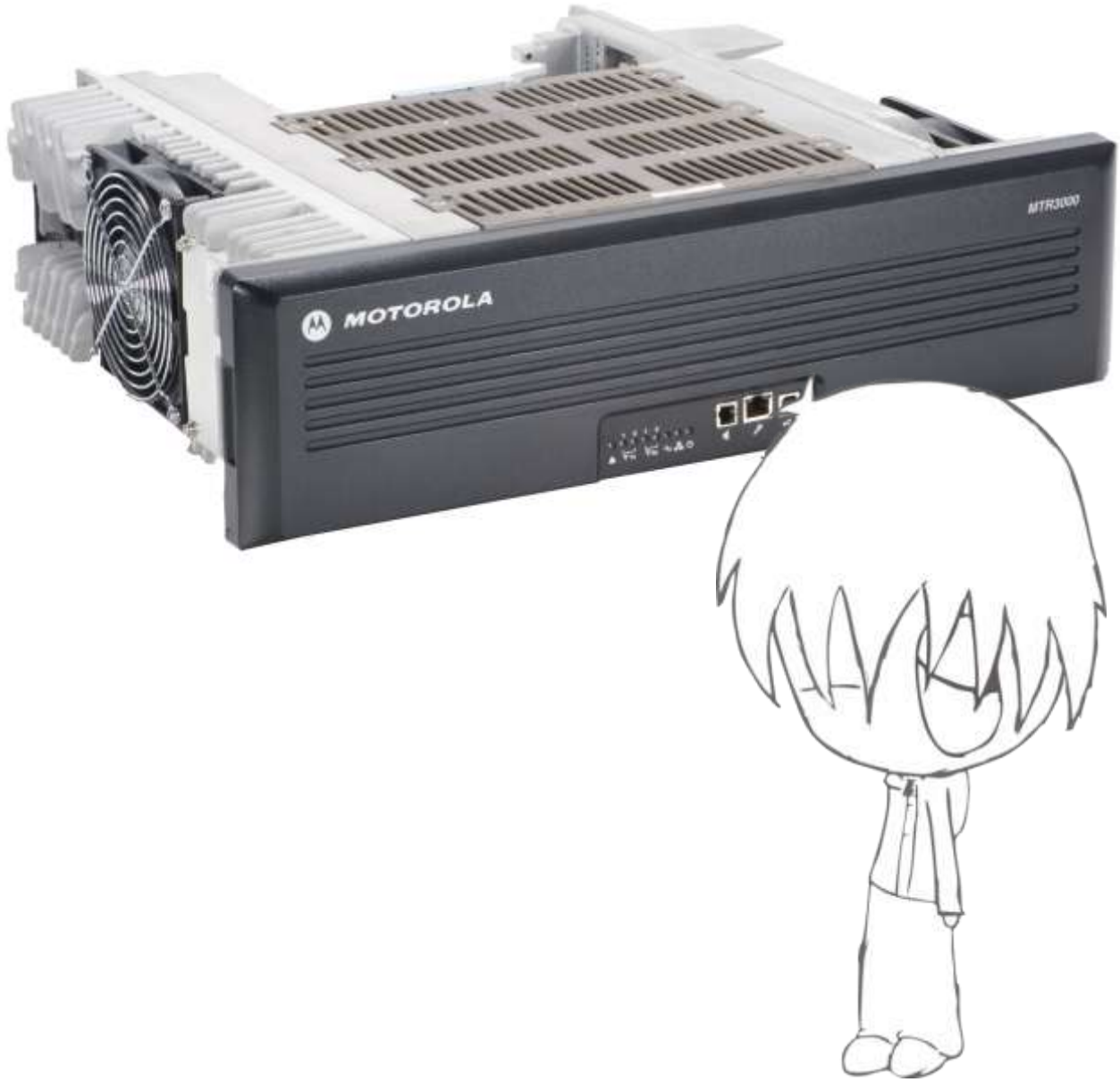
MOTORBO IP Site Connect

For Dummies



PH17/11/2011

Content

Introduction

This document is an attempt to remove all the waffle and try to give you the basic understanding to set up a basic MOTOTRBO™ IP Site Connect system. The system may however still need some tweaking regarding RSSI levels, delays and beacon lengths once operating. For more in-depth information, refer to Motorola's IP-Site-System-Integration document and System Planner. The purpose of this document is however, to get the basic system running first.

IP Network Requirements

The IP backbone network can be a dedicated network or an internet connection provided by an Internet Service Provider (ISP). ISPs provide a range of technologies such as dial-up; DSL (typically ADSL); Cable Modem; broadband wireless access; ISDN; Frame Relay; Satellite etc. The connection cannot use a dial-up connection (due to small bandwidth) or Satellite (due to large delay).

The ideal end-to-end system delay must be less than 254 milliseconds.

Sufficient bandwidth must be made available by the IP Network and the packet loss; latency and jitter must be within the limits. Calculate the minimum system bandwidth required using the below guide and if using a device like ADSL you will need a guaranteed quality of service connection from your ISP (Table 1).

The master repeater requires a static IP address. Peer repeaters can use a dynamic IP address. A defined UDP port must be opened on all devices across the IP network which is responsible for routing (e.g. ADSL modems; routers etc.) or firewall protection. The router and/or firewall's user manual will give further guidance on this.

If the Master repeater is connected to the IP Site Connect network via a router or (ADSL modem), the internet service provider or network administrator has to allocate a static IP address to the WAN port of that router/modem. A static IP address on the internet is expensive and one way to solve this is to use VPN to connect the sites – some routers have VPN built-in.

When a Peer device registers with the Master repeater, the return IP Address and UDP Port of that Peer device is supplied as part of the link establishment process. This IP Address and UDP Port must then be made available by the IP Network to all other IP Site connect devices on the IP Site Connect System.

The IP Network must not use a Proxy server which redirects a user to a login page before connecting to the internet.

We have found that using fixed (static) IP addresses is easier than using dynamic addresses (DHCP) due to the reduced complexity of configuration.

Always design the system so that there is a minimum of one unmanaged Ethernet (LAN) port to connect the repeater to the broadband, ADSL or other connectivity devices, this allows for easy connection of a laptop to service the equipment (such as setting up the connected devices IP's and pinging the devices), and will safeguard unnecessary plugging in and out of patch cables and the outside chance of forgetting to reconnect or worse still damage the patch cable and or connectors.

Please note that if connected via an ISP or using a VPN, then a managed router is mandatory.

Bandwidth Calculations

The following examples show the bandwidth calculation and values for a standard IP connection with no VPN.

BW_{VC} = 15 kbps = Bandwidth required to support Wide Area Voice or Data (per slot)

BW_{LM} = 6 kbps = Bandwidth required to support Link Management

BW_{IR} = 3 kbps = Bandwidth required to support Master Messaging

BW_{RD} = 55 kbps = Bandwidth required to support RDAC[1] commands

Example 1: Master & 4 Peer Repeaters with both slots linked with no RDAC[1]

Number of Wide Area Channel Peers[2] for Slot 1	4	BW_{VC}	15kbps	60kbps
Number of Wide Area Channel Peers[2] for Slot 2	4	BW_{VC}	15kbps	60kbps
Total Number of IP Site Connect Peers[2]	4	BW_{LM}	6kbps	24kbps
If Master, Total Number of IP Site Connect Peers[2]	4	BW_{IR}	3kbps	12kbps
RDAC[1] Traffic	0	BW_{RD}	55kbps	0kbps
Required Minimum & Guaranteed Uplink/Downlink Bandwidth				156kbps

Example 2: Master & 4 Peer Repeaters with both slots linked on two sites, slot 2 linked on three sites and with RDAC[1]

Number of Wide Area Channel Peers[2] for Slot 1	2	BW_{VC}	15kbps	30kbps
Number of Wide Area Channel Peers[2] for Slot 2	3	BW_{VC}	15kbps	45kbps
Total Number of IP Site Connect Peers[2]	5	BW_{LM}	6kbps	30kbps
If Master, Total Number of IP Site Connect Peers[2]	5	BW_{IR}	3kbps	15kbps
RDAC[1] Traffic	1	BW_{RD}	55kbps	55kbps
Required Minimum & Guaranteed Uplink/Downlink Bandwidth				175kbps

Using VPN adds some overhead (i.e. extra bandwidth needed) to maintain the connection and to support encryption.

BW_{VC} = 23 kbps = Bandwidth required to support Wide Area Voice or Data (per slot)

BW_{LM} = 5 kbps = Bandwidth required to support Link Management

BW_{IR} = 4 kbps = Bandwidth required to support Master Messaging

BW_{RD} = 64 kbps = Bandwidth required to support RDAC[1] commands

Example 3: Master & 4 Peer Repeaters with all time slots activated for interconnect with no RDAC[1]

Number of Wide Area Channel Peers[2] for Slot 1	4	BW_{VC}	23kbps	92kbps
Number of Wide Area Channel Peers[2] for Slot 2	4	BW_{VC}	23kbps	92kbps
Total Number of IP Site Connect Peers[2]	4	BW_{LM}	5kbps	20kbps
If Master, Total Number of IP Site Connect Peers[2]	4	BW_{IR}	4kbps	16kbps
RDAC[1] Traffic	0	BW_{RD}	64kbps	0kbps
Required Minimum & Guaranteed Uplink/Downlink Bandwidth				220kbps

Example 4: Master & 4 Peer Repeaters with selected time slots activated 2 * 1 WAC[3] & 3 * 2 WAC[3] for interconnect with RDAC[1] (Figure 1)

Number of Wide Area Channel Peers[2] for Slot 1	2	BW_{VC}	23kbps	46kbps
Number of Wide Area Channel Peers[2] for Slot 2	3	BW_{VC}	23kbps	69kbps
Total Number of IP Site Connect Peers[2]	5	BW_{LM}	5kbps	25kbps
If Master, Total Number of IP Site Connect Peers[2]	5	BW_{IR}	4kbps	20kbps
RDAC[1] Traffic	1	BW_{RD}	64kbps	64kbps
Required Minimum & Guaranteed Uplink/Downlink Bandwidth				224kbps

1 *RDAC is an optional MOTOTRBO Repeater Diagnostics and Control application*

2 *Peer does not include self.*

3 *WAC is Wide Area Coverage*

4 *LC is local; no link slots selected*

Note: The above tables with automated calculation in Excel, are included on the ARD CPS disk, and are available for downloaded from the ARD download site.

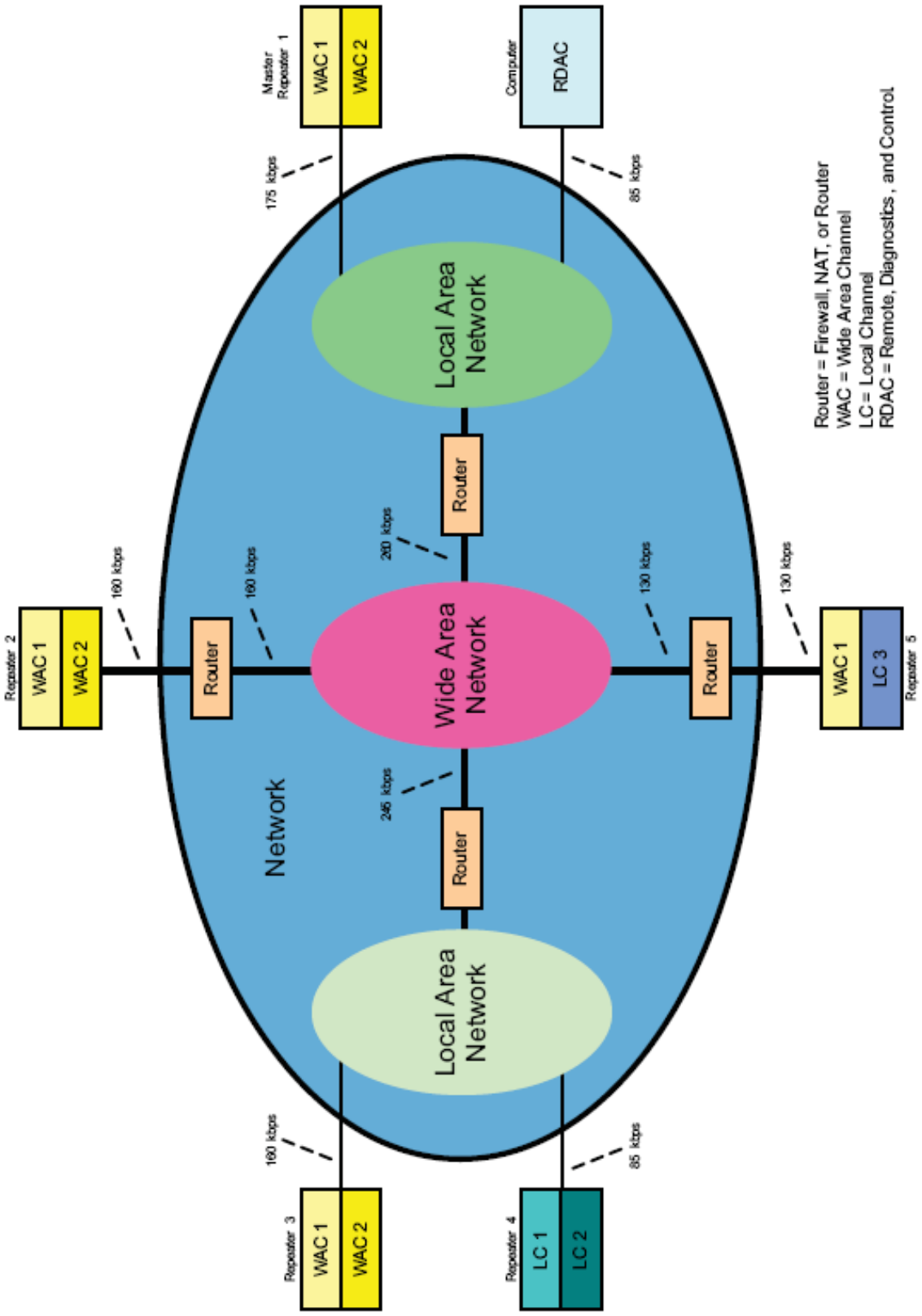

Master Repeater 1
WAC 1
WAC 2
Computer
RDAC
175 kbps
85 kbps
Local Area Network
Router
200 kbps
160 kbps
160 kbps
Repeater 2
WAC 1
WAC 2
Router
Wide Area Network
130 kbps
130 kbps
Router
WAC 1
LC 3
Repeater 5
Network
245 kbps
Router
Local Area Network
160 kbps
85 kbps
Repeater 3
WAC 1
WAC 2
Repeater 4
LC 1
LC 2
Router = Firewall, NAT, or Router
WAC = Wide Area Channel
LC = Local Channel
RDAC = Remote, Diagnostics , and Control

Figure 1

Wireless Broadband and MOTOTRBO

It is possible to provide IP connectivity between sites using a Motorola Point to Point Wireless Broadband link. The below drawing and screenshots show a three site IP Site Connected system using such a broadband connection (the Motorola PTP300). Connectivity between the two devices is buffered by a simple Ethernet Unmanaged Switch.

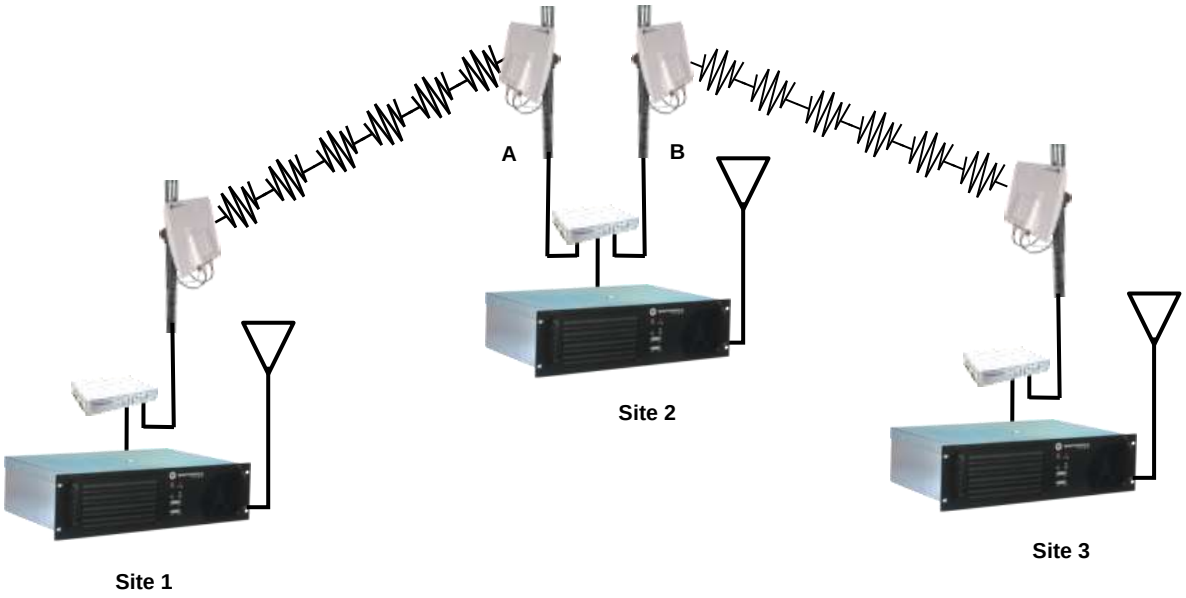


Figure 2

	Radio			Both		
Device	**ID**	**Radio IP**	**Master IP**	**Ethernet IP**	**Gateway IP**	**DHCP**
Master	**1**	**192.168.10.1**	**0.0.0.0**	**196.168.4.101**	**192.168.4.254**	✖
PTP300		**N/A**	**N/A**	**196.168.4.200**	**192.168.4.254**	✖
Peer 1	**2**	**192.168.10.1**	**196.168.4.101**	**196.168.4.11**	**192.168.4.254**	✖
PTP300 A		**N/A**	**N/A**	**196.168.4.201**	**192.168.4.254**	✖
PTP300 B		**N/A**	**N/A**	**196.168.4.202**	**192.168.4.254**	✖
Peer 2	**3**	**192.168.10.1**	**196.168.4.101**	**196.168.4.12**	**192.168.4.254**	✖
PTP300		**N/A**	**N/A**	**196.168.4.203**	**192.168.4.254**	✖

Radio UDP Port = 50000

NOTE: The IP addresses in the DR3000 and the PTP300 example starting with 196 are routable (public); you should consider changing these to something starting with 10 or 192. The same goes for the other diagrams.

The below screenshots show the PTP300 configuration settings

Site 1 PTP300 configuration settings

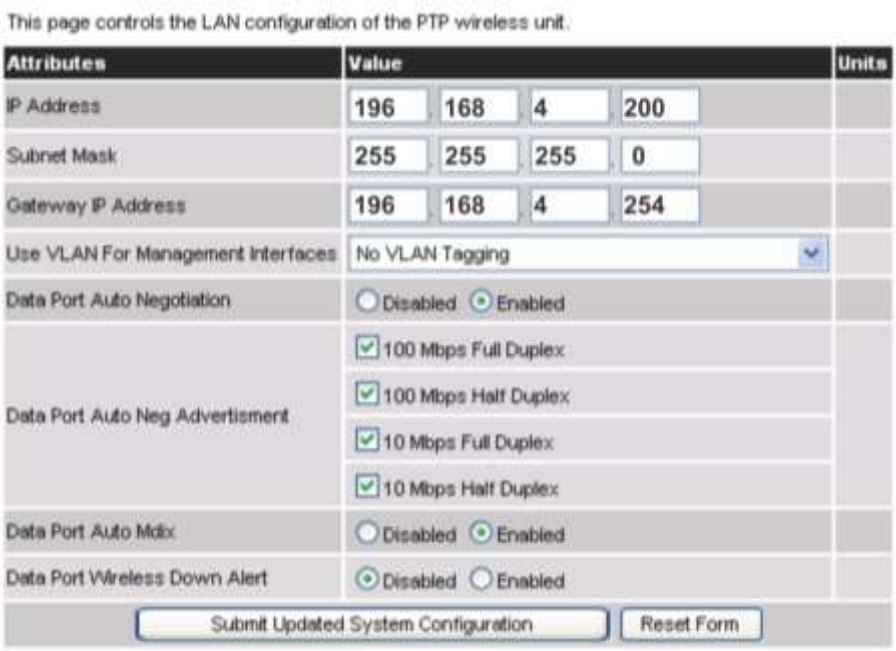


Figure 3

Site 2 PTP300 configuration settings

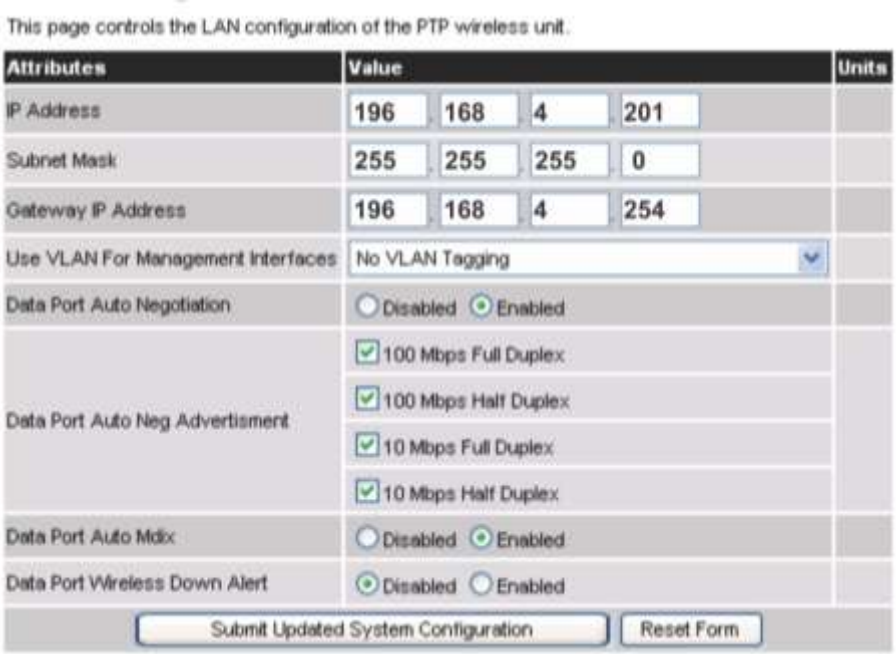


Figure 4

Site 2B PTP300 configuration settings

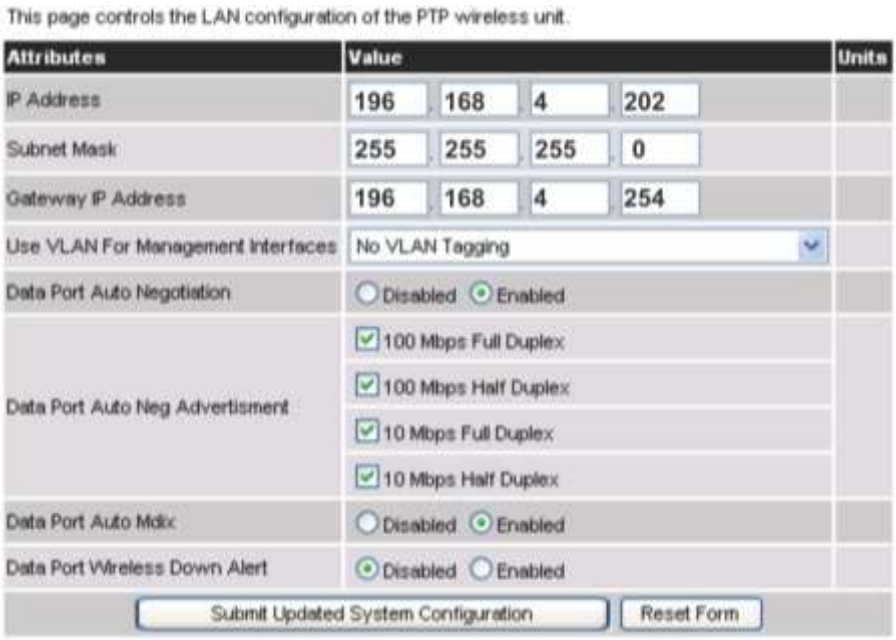


Figure 5

Site 3 PTP300 configuration settings

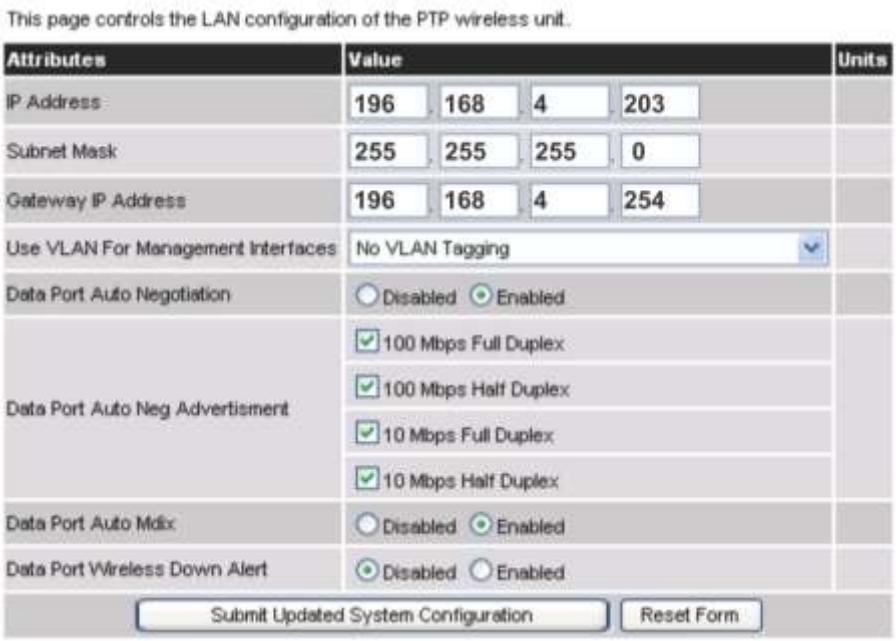


Figure 6

Master repeater CPS settings

Figure 7

Figure 8

Peer 1 repeater CPS settings

Figure 9

Figure 10

Peer 2 CPS settings

Figure 11

Figure 12

MOTOTRBO and ADSL (no VPN)

Another way of providing IP Site Connect service across sites, which (in some cases) may not have microwave (wireless broadband) connectivity, is to use ADSL. In order for such a system to work, the WAN port of the router/modem at the Master site must have a static IP address. This static IP address is allocated by the internet service provider for which there is an additional (large) monthly fee.

Since the majority of bandwidth usage will be outbound, the ISP has to configure the service for high upload rate - in most cases it is the other way around. Most ADSL connections are designed for users to browse the web and download emails thus the majority of the bandwidth will be consumed by downloading videos (Youtube) and pictures.

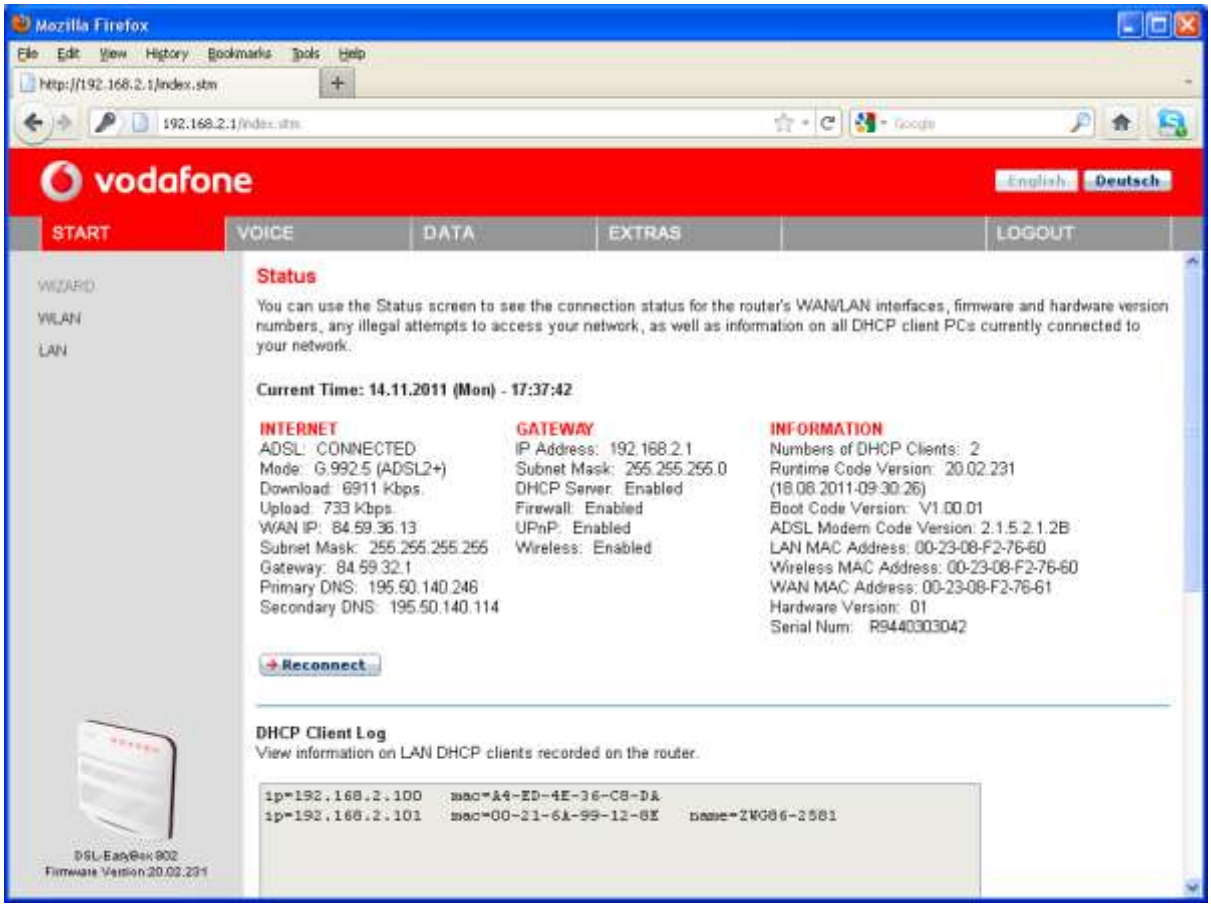


Figure 13

The above Router has been configured to provide 6,9MBps downstream and only 733kbps upstream. In a MOTOTRBO network, consisting of three repeaters, the upstream will be around 80kbps and the downstream around 16kbps.

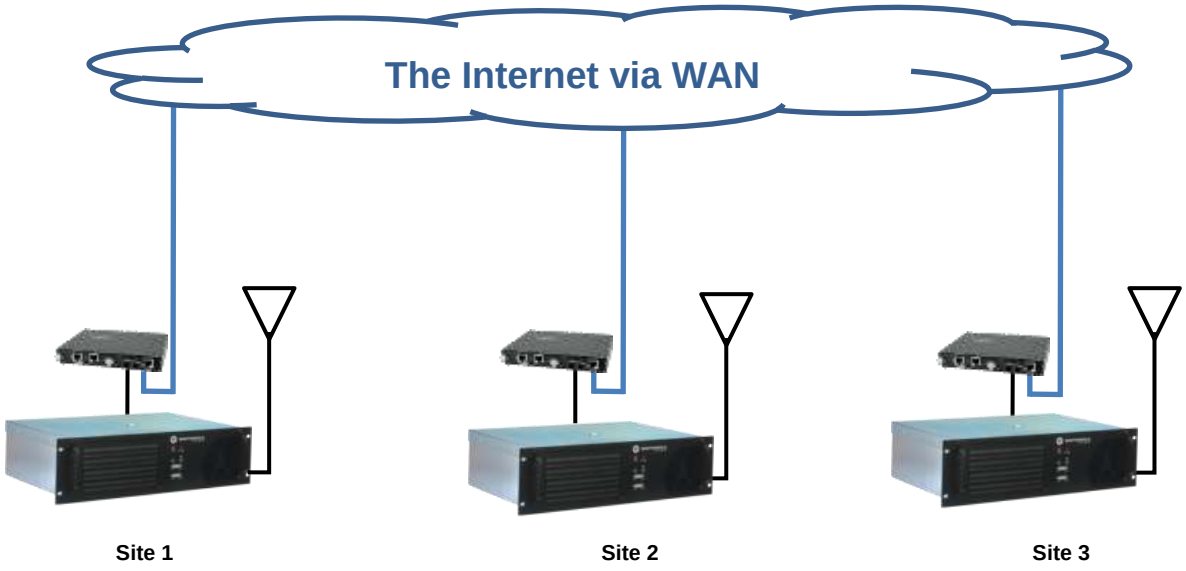


Figure 14

	Radio			Both			Router
Device	**ID**	**Radio IP**	**Master IP**	**LAN IP**	**Gateway IP**	**DHCP**	**WAN IP**
Master	**1**	**192.168.10.1**	**0.0.0.0**	**196.168.2.110**	**192.168.2.1**	✘	**N/A**
ADSL Master Router		**N/A**	**N/A**	**196.168.2.1**	**84.59.32.1**[1]	✘	**84.59.32.13**[1]
Peer 1	**2**	**192.168.10.1**	**84.59.32.13**[1]	**Assigned**[3]	**Assigned**[3]	✓	**N/A**
ADSL Router		**N/A**	**N/A**	**196.168.2.1**	**Assigned**[2]	✓	**Assigned**[2]
Peer 2	**3**	**192.168.10.1**	**84.59.32.13**[1]	**Assigned**[3]	**Assigned**[3]	✓	**N/A**
ADSL Router		**N/A**	**N/A**	**196.168.2.1**	**Assigned**[2]	✓	**Assigned**[2]

Radio UDP Port = 50000

[1] **Assigned by ISP (Fixed)**

[2] **Assigned by ISP (DHCP)**

[3] **Assigned by Local Router (DHCP)**

In the above diagram, the repeaters are connected to the internet via ADSL modems. A typical ADSL modem (router) is a sophisticated device that connects to the Internet Service Provider using ADSL and provides connectivity for several computers via Ethernet and WiFi. The ADSL router then transfers IP data between the computers and the internet. The computers connected to the router can connect to the internet via the router. On top of that, the router provides some degree of protection to the computers against attackers.

In the MOTOTRBO radio network, the repeaters would connect to the internet (WAN) in the same way a computer would despite being a fairly simple device.

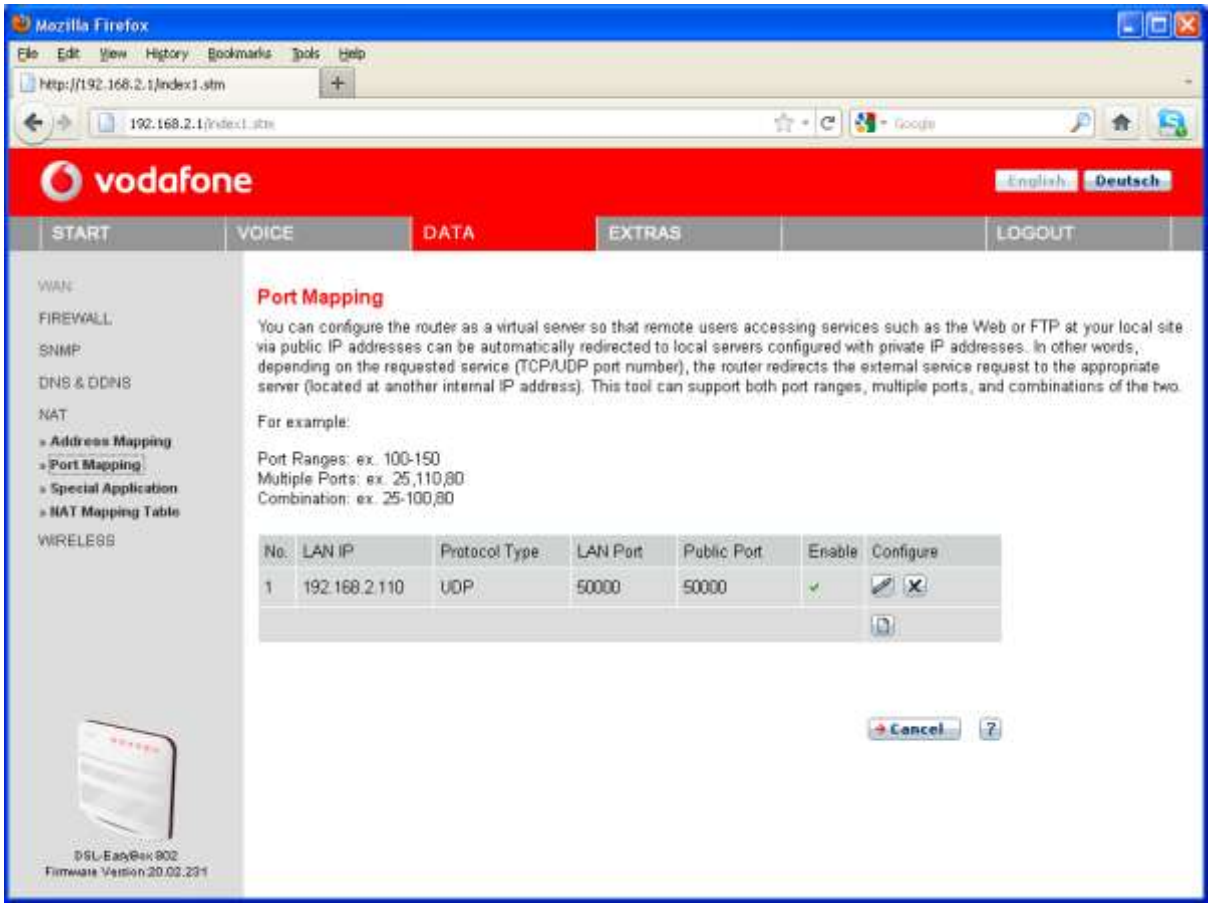


Figure 15

The above screenshot shows how the UDP port would be mapped in the ADSL Router. The above setting says that any UDP port 50000 traffic that arrives on the WAN, must be forwarded to IP address 192.168.2.110 (i.e. the Master DR3000).

MOTOTRBO and ADSL (with VPN)

One way of providing IP Site Connect service across sites which may not have microwave connectivity, is to use ADSL. To overcome the requirement for a static WAN IP address at the Master site, is to use VPN (Virtual Private Networking). VPN offers an additional benefit in that IP packets transferred across the internet are encrypted thus providing the customer additional communications security.

As the name suggests, VPN creates a virtual private network on the internet. This makes all the sites seem as if they are on the same network. Most importantly, the VPN also eliminates the need for a static IP WAN address at the Master site. The Master repeater will still need to be configured with a static IP address on the LAN but this is fairly simple.

The VPN however will create additional consumption as the various routers in the network maintain the connection.

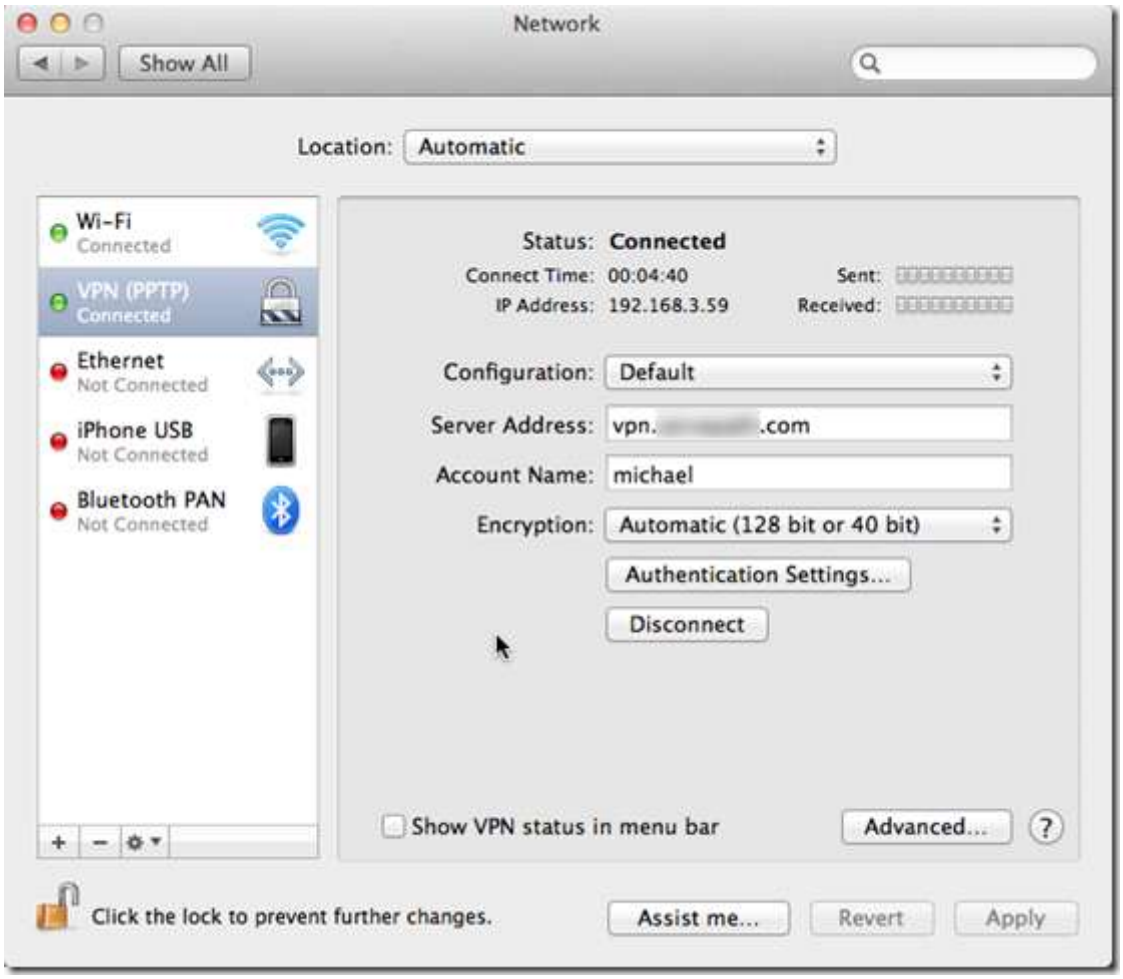


Figure 16

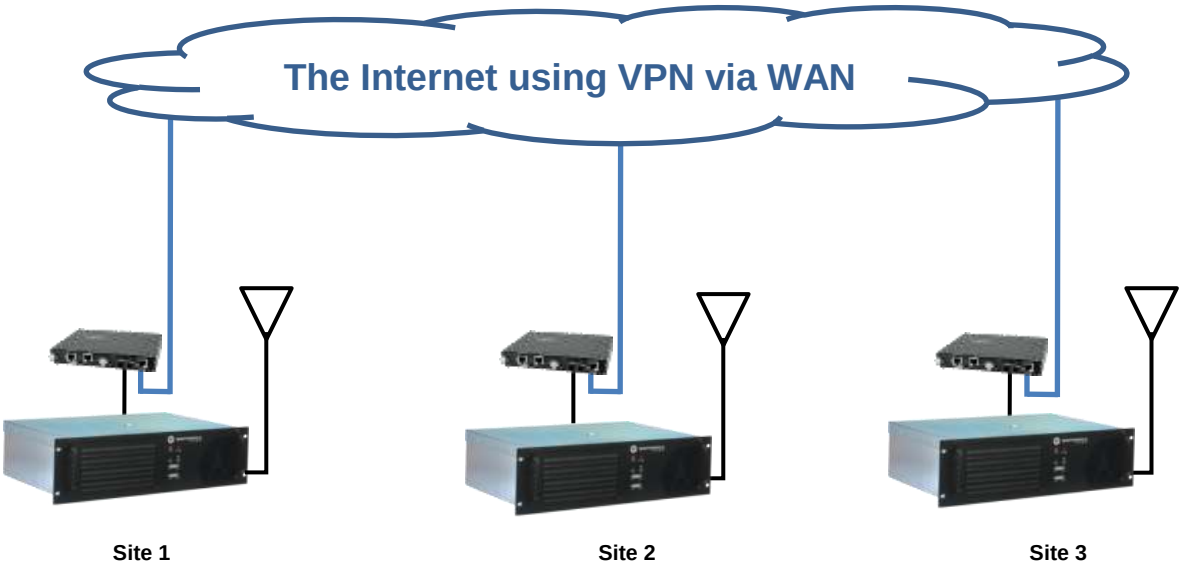


Figure 17

	Radio			Both			Router
Device	**ID**	**Radio IP**	**Master IP**	**LAN IP**	**Gateway IP**	**DHCP**	**WAN IP**
Master	1	192.168.10.1	0.0.0.0	196.168.2.110	192.168.2.1	✗	N/A
ADSL Master Router		N/A	N/A	196.168.2.1	Assigned[1]	✓	Assigned[1]
Peer 1	2	192.168.10.1	196.168.2.110	Assigned[1]	Assigned[1]	✓	N/A
ADSL Router		N/A	N/A	196.168.2.1	Assigned[1]	✓	Assigned[1]
Peer 2	3	192.168.10.1	196.168.2.110	Assigned[1]	Assigned[1]	✓	N/A
ADSL Router		N/A	N/A	196.168.2.1	Assigned[1]	✓	Assigned[1]

Radio UDP Port = 50000

[1] **Assigned by ISP (DHCP)**

[2] **Assigned by Local Router (DHCP)**

Further reading

- MOTOTRBO System Planner
- MOTOTRBO IP Site Connect Integration Guide
- TCP/IP For Dummies ISBN: 978-0-470-45060-4 http://bit.ly/tYzb12
- Networking For Dummies ISBN: 978-0-470-53405-2 http://bit.ly/tEeJnn
- Bandwidth link calculation for MotoTrbo: on http://download.ard.co.za & on CPS DVD

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