ZYXEL
Your Networking Ally

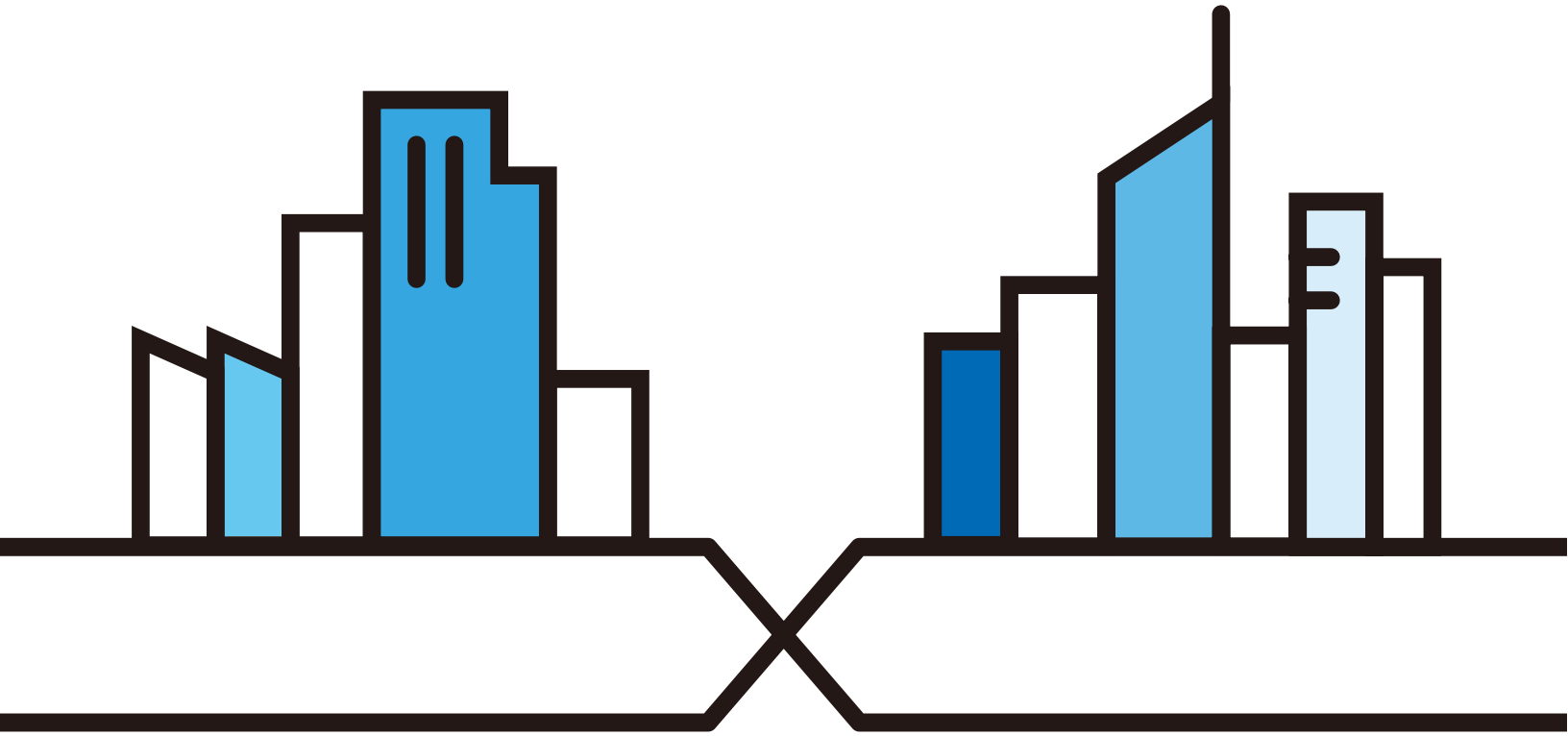
User's Guide

XMG3563-B10A

Dual-Band Wireless AC/N VDSL2 Combo WAN Gigabit IAD

Default Login Details	
LAN IP Address	http://192.168.200.1
Login	admin
Password	Administrator Password (on device label)

Version 1.10 Edition 1, 10/2017



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IMPORTANT!

READ CAREFULLY BEFORE USE.

KEEP THIS GUIDE FOR FUTURE REFERENCE.

This is a User's Guide for a system managing a series of products. Not all products support all features. Menushots and graphics in this book may differ slightly from what you see due to differences in release versions or your computer operating system. Every effort has been made to ensure that the information in this manual is accurate.

Related Documentation

- Quick Start Guide

  The Quick Start Guide shows how to connect the managed device.

- More Information

  Go to **support.zyxel.com** to find other information on the XMG.

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Document Conventions

Warnings and Notes

These are how warnings and notes are shown in this guide.

Warnings tell you about things that could harm you or your device.

Note: Notes tell you other important information (for example, other things you may need to configure or helpful tips) or recommendations.

Syntax Conventions

- The XMG3563-B10A may be referred to as the "XMG" in this guide.
- Product labels, screen names, field labels and field choices are all in **bold** font.
- A right angle bracket (>) within a screen name denotes a mouse click. For example, **Network Setting > Wireless > General** means you first click **Network Setting** in the navigation panel, then **Wireless** and finally the **General** tab to get to that screen.

Icons Used in Figures

Figures in this user guide may use the following generic icons. The XMG icon is not an exact representation of your device.

XMG3563-B10A	Generic Router	Wireless Router / Access Point
Switch	Firewall	USB Storage Device
Server	Printer	Setup Box

PART I
User's Guide

CHAPTER 1
Introducing the XMG

1.1 Overview

The XMG is an ADSL/VDSL2 bonding and high-performance wireless gateway that provides ultra-speed VDSL Internet access for triple-play services and optimized HD IPTV services at home or office. This model offers a Gigabit Ethernet (GbE) WAN with an interface using Small Form Factor Pluggable (SFP), Ethernet or DSL port. The XMG offers 2.4G and 5G Wi-Fi networks that operate simultaneously, providing a simple and unified network management. The XMG has one USB port for sharing files via a USB storage device. The XMG is also backward compatible with ADSL, ADSL2 and ADSL2+.

Only use firmware for your XMG's specific model. Refer to the label on the bottom of your XMG.

1.1.1 Internet Access

Computers can connect to the XMG's LAN ports (or wirelessly).

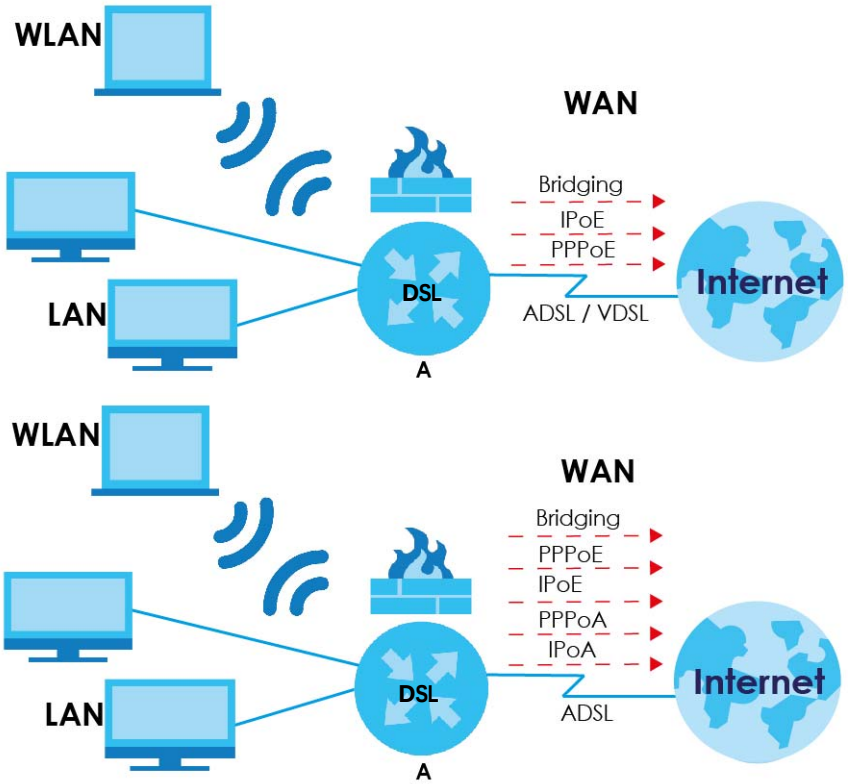
You can also configure IP filtering on the XMG for secure Internet access. When the IP filter is on, all incoming traffic from the Internet to your network is blocked by default unless it is initiated from your network. This means that probes from the outside to your network are not allowed, but you can safely browse the Internet and download files.

1.1.1.1 DSL

Your XMG provides shared Internet access by connecting the DSL port to the **DSL** or **MODEM** jack on a splitter or your telephone jack. You can have multiple WAN services over one ADSL or VDSL. The XMG cannot work in ADSL and VDSL mode at the same time.

Note: The ADSL and VDSL lines share the same WAN (layer-2) interfaces that you configure in the XMG. Refer to Section 6.2 on page 68 for the **Network Setting > Broadband** screen.

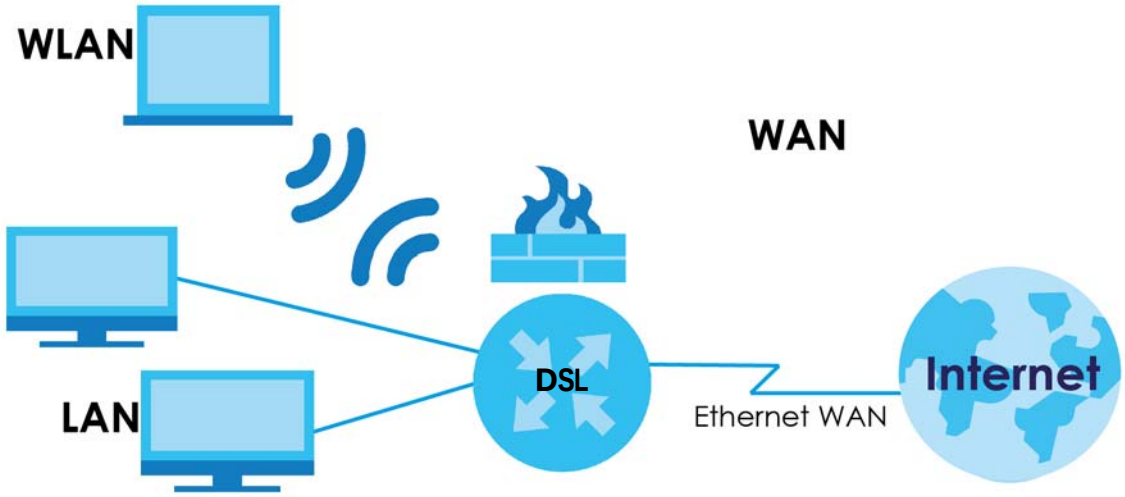
Figure 1 XMG's Internet Access Application



1.1.1.2 Ethernet WAN

If you prefer not to use a DSL line and you have another broadband modem or router (such as ADSL) available, you can convert LAN port number four as a WAN port using the **Network Setting > Broadband > Ethernet WAN** screen and then connect the LAN port to the broadband modem or router. This way, you can access the Internet via an Ethernet connection and still use the QoS, Firewall and parental control functions on the XMG.

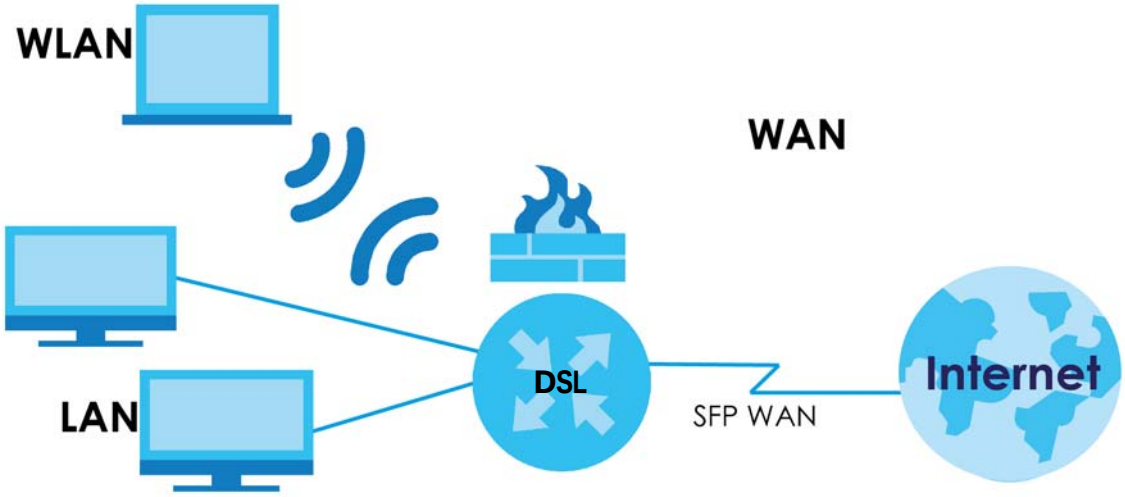
Figure 2 XMG's Internet Access Application: Ethernet WAN



1.1.1.3 SFP

If you prefer not to use the Ethernet or DSL line, your XMG also provides shared Internet access by connecting the Small Form-Factor Pluggable (SFP) transceiver. SFP is also known as Fiber Optics interface. The Gigabit Ethernet (GbE) WAN with SFP is a dual-personality design (GbE + Fiber) which enables increased bandwidth and extended coverage. The XMG supports multiple VLANs over the SFP WAN interface for triple play. To connect the SFP port use a Fiber Optic Module, also known as a mini-GBIC transceiver, to a Switch or Router.

Figure 3 XMG's Internet Access Application: SFP WAN



Note: You can only have Internet access through one of the ports (DSL, Ethernet or SFP) at a time. Your XMG has WAN priority, and if you connect all ports simultaneously to a successful internet access, only one WAN port interface will be active. The XMG will prioritize SFP, then Ethernet, and last DSL.

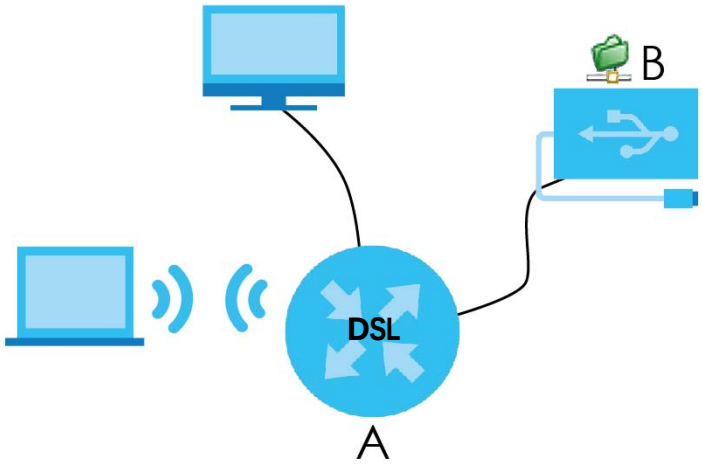
1.1.2 XMG's USB Support

The USB port of the XMG is used for file-sharing and media server.

File Sharing

Use the built-in USB 2.0 port to share files on a USB memory stick or a USB hard drive (**B**). You can connect one USB hard drive to the XMG at a time. Use FTP to access the files on the USB device.

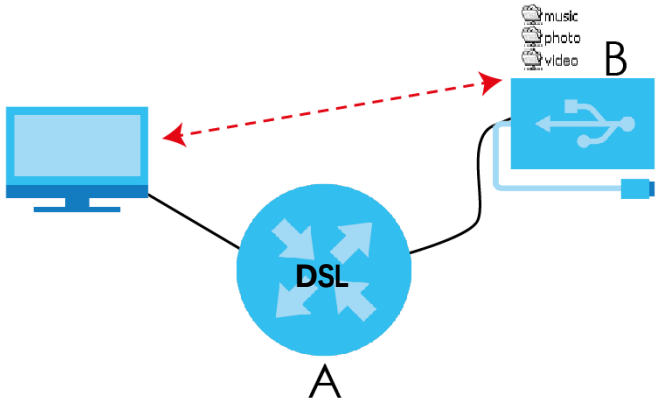
Figure 4 USB File Sharing Application



Media Server

You can also use the XMG as a media server. This lets anyone on your network play video, music, and photos from a USB device (**B**) connected to the XMG's USB port (without having to copy them to another computer).

Figure 5 USB Media Server Application



1.2 Ways to Manage the XMG

Use any of the following methods to manage the XMG.

- Web Configurator. This is recommended for everyday management of the XMG using a (supported) web browser.

1.3 Good Habits for Managing the XMG

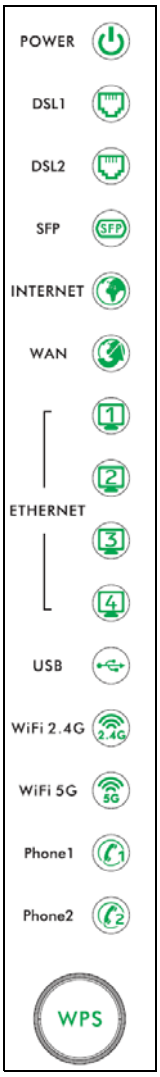
Do the following things regularly to make the XMG more secure and to manage the XMG more effectively.

- Change the password. Use a password that's not easy to guess and that consists of different types of characters, such as numbers and letters.
- Write down the password and put it in a safe place.
- Back up the configuration (and make sure you know how to restore it). Restoring an earlier working configuration may be useful if the device becomes unstable or even crashes. If you forget your password, you will have to reset the XMG to its factory default settings. If you backed up an earlier configuration file, you would not have to totally re-configure the XMG. You could simply restore your last configuration.

1.4 LEDs (Lights)

The following graphic displays the labels of the LEDs.

Figure 6 LEDs on the XMG



None of the LEDs are on if the XMG is not receiving power.

Table 1 LED Descriptions

LED	COLOR	STATUS	DESCRIPTION
Power	Green	On	The XMG is receiving power and ready for use.
		Blinking	The XMG is self-testing.
	Red	On	The XMG detected an error while self-testing, or there is a device malfunction.
		Blinking	The XMG is upgrading its firmware.
		Off	The XMG is not receiving power.
DSL1 DSL2	Green	On	The ADSL/VDSL line is up.
		Blinking (Rate 2Hz)	The XMG detects a ADSL/VDSL carrier signal.
		Blinking (Rate 4Hz)	The XMG is initializing an ADSL/VDSL line.
		Off	The DSL line is down.
SFP	Green	On	The XMG has a successful connection on the WAN.
		Blinking	The XMG is sending or receiving data to/from the WAN.
		Off	The XMG does not detect a SFP connection to the WAN.
Internet	Green	On	The XMG has an IP connection but no traffic. Your device has a WAN IP address (either static or assigned by a DHCP server), PPP negotiation was successfully completed (if used) and the DSL connection is up.
		Blinking	The XMG is sending or receiving IP traffic.
	Red	On	The XMG attempted to make an IP connection but failed. Possible causes are no response from a DHCP server, no PPPoE response, PPPoE authentication failed.
		Off	There is no Internet connection or the gateway is in bridged mode.
WAN	Green	On	The XMG has a successful 10/100/1000 Mbps Ethernet connection on the WAN.
		Blinking	The XMG is sending or receiving data to/from the WAN at 10/100/1000 Mbps.
		Off	There is no Ethernet connection on the WAN.
Ethernet 1~4	Green	On	The XMG has a successful 1000 Mbps Ethernet connection with a device on the Local Area Network (LAN).
		Blinking	The XMG is sending or receiving data to/from the LAN at 1000 Mbps.
		Off	The XMG does not have an Ethernet connection with the LAN.
USB	Green	On	The XMG recognizes a USB connection through the USB slot.
		Blinking	The XMG is sending/receiving data to /from the USB device connected to it.
		Off	The XMG does not detect a USB connection through the USB slot.

Table 1 LED Descriptions (continued)

LED	COLOR	STATUS	DESCRIPTION
2.4G WiFi 2.4G	Green	On	The 2.4 GHz wireless network is activated.
		Blinking	The XMG is communicating with 2.4 GHz wireless clients.
	Amber	On	The XMG is setting up a WPS connection with a 2.4GHz wireless client using the WPS Method 3. To learn more about each WPS method see Section 7.5 on page 93 .
		Blinking	The XMG is setting up a WPS connection with a 2.4 GHz wireless client using the WPS Methods 1 or 2. To learn more about each WPS method see Section 7.5 on page 93 .
		Off	The 2.4 GHz wireless network is not activated.
5G WiFi 5G	Green	On	The 5 GHz wireless network is activated.
		Blinking	The XMG is communicating with 5 GHz wireless clients.
	Amber	On	The XMG is setting up a WPS connection with a 5 GHz wireless client using the WPS Method 3. To learn more about each WPS method see Section 7.5 on page 93 .
		Blinking	The XMG is setting up a WPS connection with a 5 GHz wireless client using the WPS Methods 1 or 2. To learn more about each WPS method see Section 7.5 on page 93 .
		Off	The 5 GHz wireless network is not activated.
Phone 1~2	Green	On	A SIP account is registered for the phone port.
		Blinking	A telephone connected to the phone port has its receiver off of the hook or there is an incoming call.
	Amber	On	A SIP account is registered for the phone port and there is a voice message in the corresponding SIP account.
		Blinking	A telephone connected to the phone port has its receiver off of the hook and there is a voice message in the corresponding SIP account.
		Off	The phone port does not have a SIP account registered.
WPS WPS	Amber	On	The 2.4 Ghz or 5 GHz wireless network and WPS are enabled.
		Off	Both 2.4 Ghz and 5 GHz wireless network and WPS are disabled.

1.5 The RESET Button

If you forget your password or cannot access the Web Configurator, you will need to use the **RESET** button at the back of the device to reload the factory-default configuration file. This means that you will lose all configurations that you had previously and the password will be reset to "1234".

1 Make sure the **POWER** LED is on (not blinking).

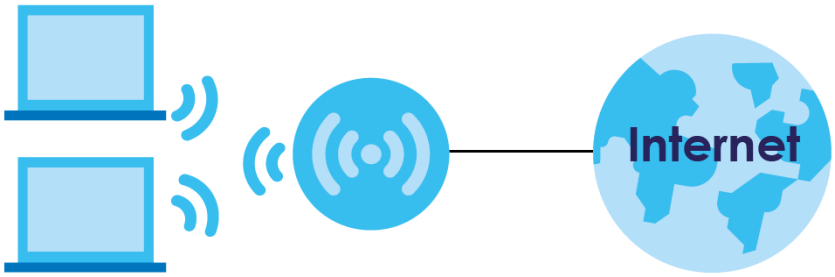
2 To set the device back to the factory default settings, press the **RESET** button for five seconds or until the **POWER** LED begins to blink and then release it. When the **POWER** LED begins to blink, the defaults have been restored and the device restarts.

1.6 Wireless Access

The XMG is a wireless Access Point (AP) for wireless clients, such as notebook computers or PDAs and iPads. It allows them to connect to the Internet without having to rely on inconvenient Ethernet cables.

You can configure your wireless network in either the built-in Web Configurator, or using the WPS button.

Figure 7 Wireless Access Example



1.6.1 Using the WPS Button

Once the **WiFi** LED turns green, the wireless network is active. If the wireless network is turned off, see Section 7.2 on page 86 for how to enable the wireless network on the XMG.

You can also use the **WPS** button to quickly set up a secure wireless connection between the XMG and a WPS-compatible client by adding one device at a time.

To activate WPS:

1. Make sure the **POWER** LED is on and not blinking.
2. Press the **WPS** button for five seconds and release it.
3. Press the WPS button on another WPS-enabled device within range of the XMG. The **WiFi** LED flashes orange while the XMG sets up a WPS connection with the other wireless device.
4. Once the connection is successfully made, the **WPS** LED shines green.

   The **WPS** LED turns off when the wireless network is off.

1.7 Wall Mounting

You may need screw anchors if mounting on a concrete or brick wall.

Table 2 Wall Mounting Information

Distance between holes	90 mm
M4 Screws	Two
Screw anchors (optional)	Two

5. Select a position free of obstructions on a wall strong enough to hold the weight of the device.

6 Mark two holes on the wall at the appropriate distance apart for the screws.

Be careful to avoid damaging pipes or cables located inside the wall when drilling holes for the screws.

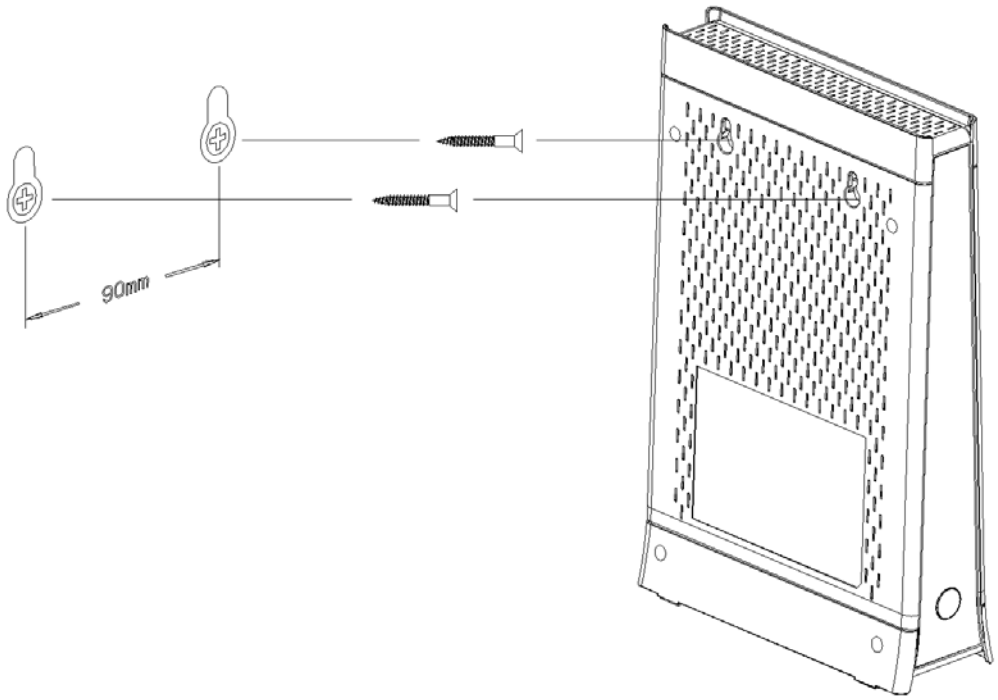
7 If using screw anchors, drill two holes for the screw anchors into the wall. Push the anchors into the full depth of the holes, then insert the screws into the anchors. Do not insert the screws all the way in - leave a small gap of about 0.5 cm.

If not using screw anchors, use a screwdriver to insert the screws into the wall. Do not insert the screws all the way in - leave a gap of about 0.5 cm.

8 Make sure the screws are fastened well enough to hold the weight of the XMG with the connection cables.

9 Align the holes on the back of the XMG with the screws on the wall. Hang the XMG on the screws.

Figure 8 Wall Mounting Example



CHAPTER 2
The Web Configurator

2.1 Overview

The web configurator is an HTML-based management interface that allows easy XMG setup and management via Internet browser. Use Internet Explorer 8.0 and later versions or Mozilla Firefox 3 and later versions or Safari 2.0 and later versions.* The recommended screen resolution is 1024 by 768 pixels.

In order to use the web configurator you need to allow:

- Web browser pop-up windows from your XMG. Web pop-up blocking is enabled by default in Windows XP SP (Service Pack) 2.
- JavaScript (enabled by default).
- Java permissions (enabled by default).

2.1.1 Accessing the Web Configurator

1 Make sure your XMG hardware is properly connected (refer to the Quick Start Guide).

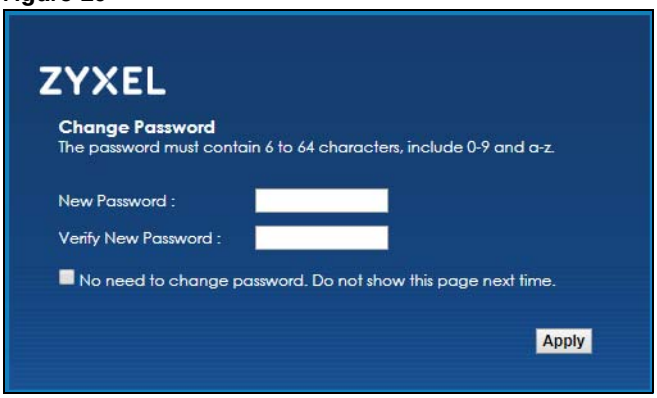
2 Launch your web browser. If the XMG does not automatically re-direct you to the login screen, go to http://192.168.200.1.

3 A password screen displays. To access the administrative web configurator and manage the XMG, type the default username **admin** and password is the **Administrator Password** (located on device label) and click **Login**. If you have changed the password, enter your password and click **Login**.

Figure 9

4 The following screen displays if you have not yet changed your password. Enter a new password, retype it to confirm and click **Apply**.

Figure 10



5 The **Quick Start Wizard** screen appears. You can configure basic Internet access, and wireless settings. See Chapter 3 on page 33 for more information.

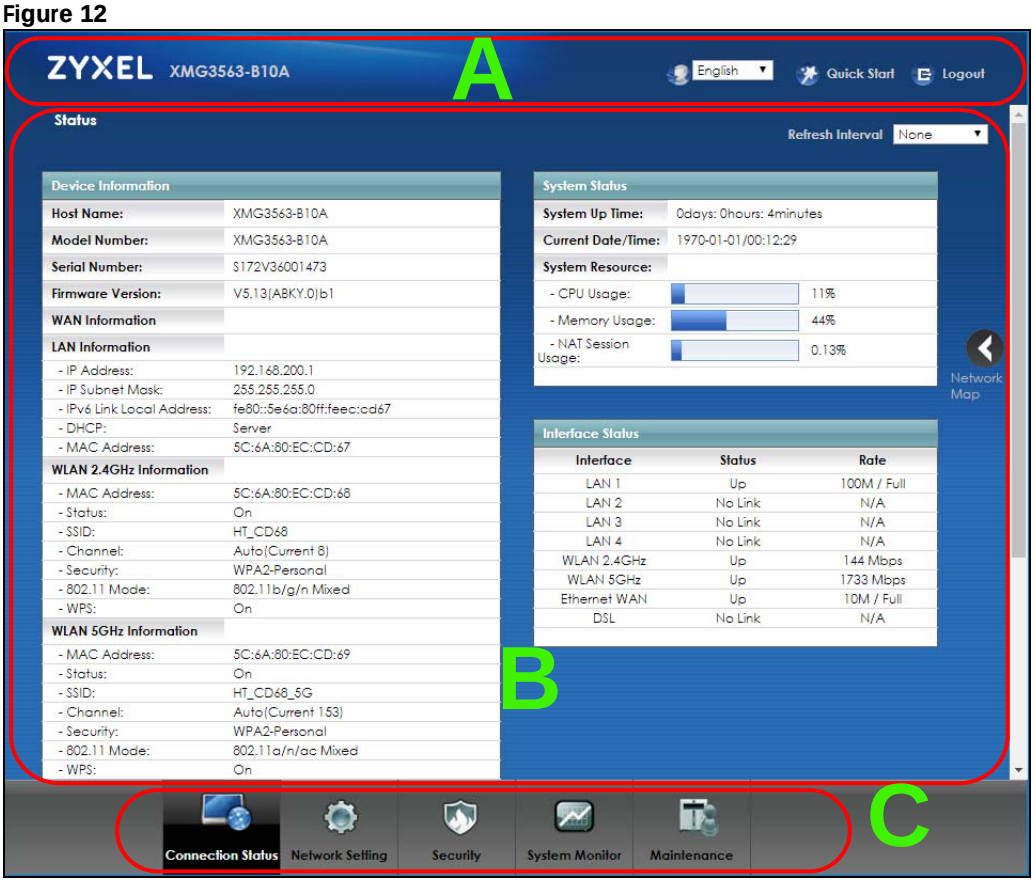
6 After you finished or closed the **Quick Start Wizard** screen, the **Network Map** page appears.

Figure 11

7 Click **Status** to display the **Status** screen, where you can view the XMG's interface and system information.

2.2 Web Configurator Layout

Figure 12

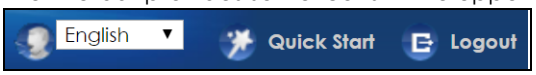


As illustrated above, the main screen is divided into these parts:

- **A** - title bar
- **B** - main window
- **C** - navigation panel

2.2.1 Title Bar

The title bar provides some icons in the upper right corner.



The icons provide the following functions.

Table 3 Web Configurator Icons in the Title Bar

ICON	DESCRIPTION
	Language: Select the language you prefer.

Table 3 Web Configurator Icons in the Title Bar

ICON	DESCRIPTION
Quick Start	**Quick Start**: Click this icon to open screens where you can configure the XMG's time zone Internet access, and wireless settings.
Logout	**Logout**: Click this icon to log out of the web configurator.

2.2.2 Navigation Panel

Use the menu items on the navigation panel to open screens to configure XMG features. The following tables describe each menu item.

Table 4 Navigation Panel Summary

LINK	TAB	FUNCTION
Connection Status		This screen shows the network status of the XMG and computers/devices connected to it.
Network Setting		
Broadband	Broadband	Use this screen to view and configure ISP parameters, WAN IP address assignment, and other advanced properties. You can also add new WAN connections.
	Advanced	Use this screen to enable or disable PTM over ADSL, Annex M/Annex J, and DSL PhyR functions.
	Ethernet WAN	Use this screen to enable the fourth Ethernet LAN port to be an Ethernet WAN port.
Wireless	General	Use this screen to configure the wireless LAN settings and WLAN authentication/security settings.
	Guest/More AP	Use this screen to configure multiple BSSs on the XMG.
	MAC Authentication	Use this screen to block or allow wireless traffic from wireless devices of certain SSIDs and MAC addresses to the XMG.
	WPS	Use this screen to configure and view your WPS (Wi-Fi Protected Setup) settings.
	WMM	Use this screen to enable or disable Wi-Fi MultiMedia (WMM).
	Others	Use this screen to configure advanced wireless settings.
	Channel Status	Use this screen to scan wireless LAN channel noises and view the results.
Home Networking	LAN Setup	Use this screen to configure LAN TCP/IP settings, and other advanced properties.
	Static DHCP	Use this screen to assign specific IP addresses to individual MAC addresses.
	UPnP	Use this screen to turn UPnP and UPnP NAT-T on or off.
	Additional Subnet	Use this screen to configure IP alias and public static IP.
	STB Vendor ID	Use this screen to configure the Vendor IDs of the connected Set Top Box (STB) devices, which have the XMG automatically create static DHCP entries for the STB devices when they request IP addresses.
	Wake on LAN	Use this screen to remotely turn on a device on the local network.
	TFTP Server Name	Configure a TFTP server name which is sent to clients using DHCP option 66.

Table 4 Navigation Panel Summary (continued)

LINK	TAB	FUNCTION
Routing	Static Route	Use this screen to view and set up static routes on the XMG.
	DNS Route	Use this screen to forward DNS queries for certain domain names through a specific WAN interface to its DNS server(s).
	Policy Route	Use this screen to configure policy routing on the XMG.
	RIP	Use this screen to configure Routing Information Protocol to exchange routing information with other routers.
QoS	General	Use this screen to enable QoS and traffic prioritizing. You can also configure the QoS rules and actions.
	Queue Setup	Use this screen to configure QoS queues.
	Classification Setup	Use this screen to define a classifier.
	Shaper Setup	Use this screen to limit outgoing traffic rate on the selected interface.
	Policer Setup	Use this screen to configure QoS policers.
NAT	Port Forwarding	Use this screen to make your local servers visible to the outside world.
	Applications	Use this screen to configure servers behind the XMG.
	Port Triggering	Use this screen to change your XMG's port triggering settings.
	DMZ	Use this screen to configure a default server which receives packets from ports that are not specified in the **Port Forwarding** screen.
	ALG	Use this screen to enable or disable SIP ALG.
	Address Mapping	Use this screen to change your XMG's address mapping settings.
	Sessions	Use this screen to configure the maximum number of NAT sessions each client host is allowed to have through the XMG.
DNS	DNS Entry	Use this screen to view and configure DNS routes.
	Dynamic DNS	Use this screen to allow a static hostname alias for a dynamic IP address.
IGMP/MLD	IGMP/MLD	Use this screen to view the status of all IGMP settings on the XMG.
Vlan Group	Vlan Group	Use this screen to group and tag VLAN IDs to outgoing traffic from the specified interface.
Interface Grouping	Interface Grouping	Use this screen to map a port to a PVC or bridge group.
USB Service	File Sharing	Use this screen to enable file sharing via the XMG.
	Media Server	Use this screen to use the XMG as a media server.
Security		
Firewall	General	Use this screen to configure the security level of your firewall.
	Protocol	Use this screen to add Internet services and configure firewall rules.
	Access Control	Use this screen to enable specific traffic directions for network services.
	DoS	Use this screen to activate protection against Denial of Service (DoS) attacks.
MAC Filter	MAC Filter	Use this screen to block or allow traffic from devices of certain MAC addresses to the XMG.
Parental Control	Parental Control	Use this screen to block web sites with the specific URL.
Scheduler Rules	Scheduler Rules	Use this screen to configure the days and times when a configured restriction (such as parental control) is enforced.

Table 4 Navigation Panel Summary (continued)

LINK	TAB	FUNCTION
Certificates	Local Certificates	Use this screen to view a summary list of certificates and manage certificates and certification requests.
	Trusted CA	Use this screen to view and manage the list of the trusted CAs.
VoIP		
SIP	SIP Account	Use this screen to set up information about your SIP account and configure audio settings such as volume levels for the phones connected to the XMG.
	SIP Service Provider	Use this screen to configure the SIP server information, QoS for VoIP calls, the numbers for certain phone functions, and dialing plan.
Phone	Phone Device	Use this screen to view detailed information of the phone devices.
	Region	Use this screen to select your location and a call service mode.
Call Rule	Speed Dial	Use this screen to configure speed dial for SIP phone numbers that you call often.
Call History	Call History	Use this screen to view all the information of previous calls.
	Call Summary	Use this screen to view a summary of all the previous calls made and received.
System Monitor		
Log	System Log	Use this screen to view the status of events that occurred to the XMG. You can export or e-mail the logs.
	Security Log	Use this screen to view all security related events. You can select level and category of the security events in their proper drop-down list window. Levels include: • Emergency • Alert • Critical • Error • Warning • Notice • Informational • Debugging Categories include: • Account • Attack • Firewall • MAC Filter
Traffic Status	WAN	Use this screen to view the status of all network traffic going through the WAN port of the XMG.
	LAN	Use this screen to view the status of all network traffic going through the LAN ports of the XMG.
	NAT	Use this screen to view NAT statistics for connected hosts.
VoIP Status	VoIP Status	Use this screen to view the VoIP registration, current call status and phone numbers.
ARP table	ARP table	Use this screen to view the ARP table. It displays the IP and MAC address of each DHCP connection.
Routing Table	Routing Table	Use this screen to view the routing table on the XMG.
Multicast Status	IGMP Status	Use this screen to view the status of all IGMP settings on the XMG.
	MLD Status	Use this screen to view the status of all MLD settings on the XMG.

Table 4 Navigation Panel Summary (continued)

LINK	TAB	FUNCTION
xDSL Statistics	xDSL Statistics	Use this screen to view the XMG's xDSL traffic statistics.
Maintenance		
System	System	Use this screen to set Device name and Domain name.
User Account	User Account	Use this screen to change user password on the XMG.
Remote Management	MGMT Services	Use this screen to enable specific traffic directions for network services.
	Trust Domain	Use this screen to view a list of public IP addresses which are allowed to access the XMG through the services configured in the **Maintenance** > **Remote Management** screen.
TR-069 Client	TR-069 Client	Use this screen to configure the XMG to be managed by an Auto Configuration Server (ACS).
SNMP	SNMP	Use this screen to configure SNMP (Simple Network Management Protocol) settings.
Time	Time	Use this screen to change your XMG's time and date.
E-mail Notification	E-mail Notification	Use this screen to configure up to two mail servers and sender addresses on the XMG.
Log Setting	Log Setting	Use this screen to change your XMG's log settings.
Firmware Upgrade	Firmware Upgrade	Use this screen to upload firmware to your XMG.
Backup/Restore	Backup/Restore	Use this screen to backup and restore your XMG's configuration (settings) or reset the factory default settings.
Reboot	Reboot	Use this screen to reboot the XMG without turning the power off.
Diagnostic	Ping&Traceroute &Nslookup	Use this screen to identify problems with the DSL connection. You can use Ping, TraceRoute, or Nslookup to help you identify problems.
	802.1ag	Use this screen to configure CFM (Connectivity Fault Management) MD (maintenance domain) and MA (maintenance association), perform connectivity tests and view test reports.
	OAM Ping	Use this screen to view information to help you identify problems with the DSL connection.

CHAPTER 3
Quick Start

3.1 Overview

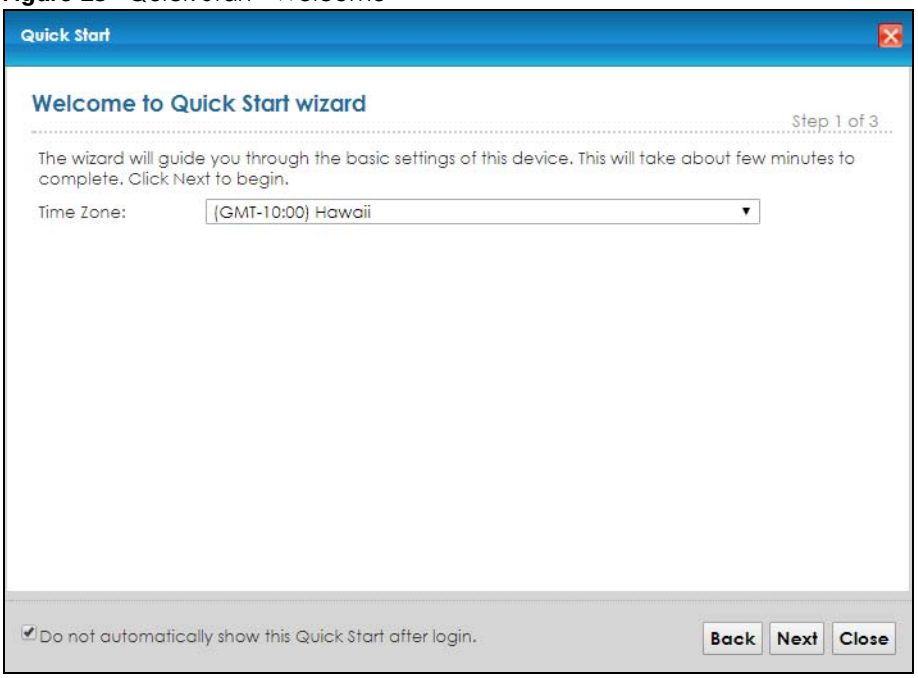
Use the Quick Start screens to configure the XMG's time zone, basic Internet access, and wireless settings.

Note: See the technical reference chapters (starting on Chapter 4 on page 36) for background information on the features in this chapter.

3.2 Quick Start Setup

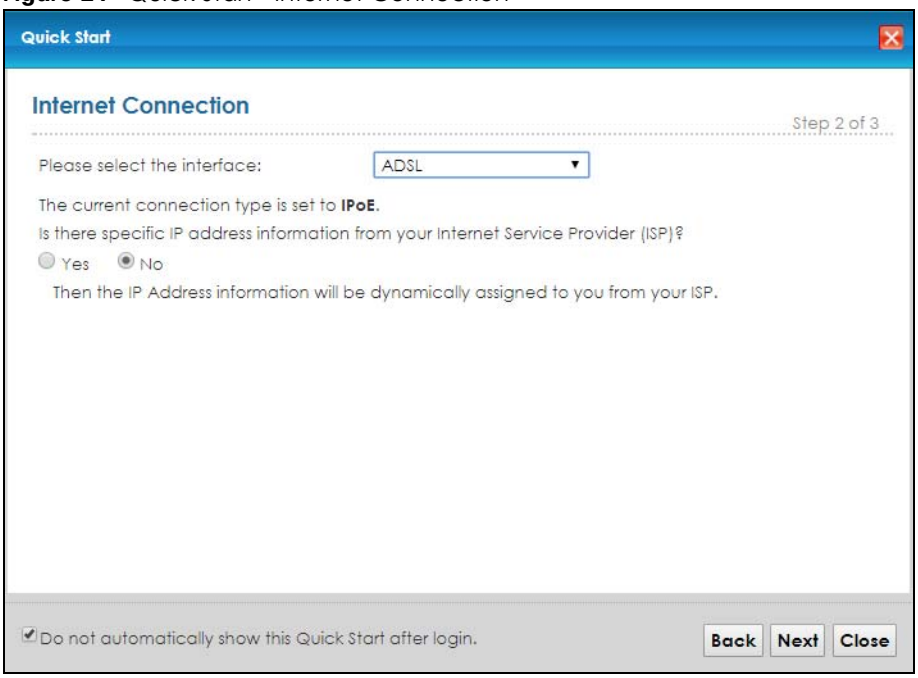
1 The Quick Start Wizard appears automatically after login. Or you can click the **Quick Start** icon in the top right corner of the web configurator to open the quick start screens. Select the time zone of your location. Click **Next**.

Figure 13 Quick Start - Welcome



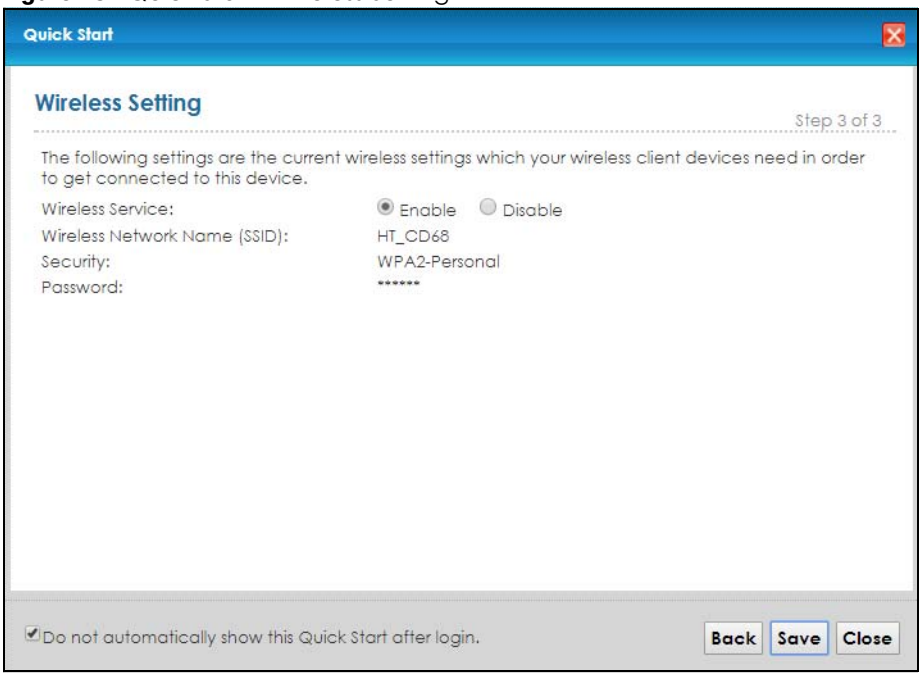
2 Enter your Internet connection information in this screen. The screen and fields to enter may vary depending on your current connection type. Click **Next**.

Figure 14 Quick Start - Internet Connection



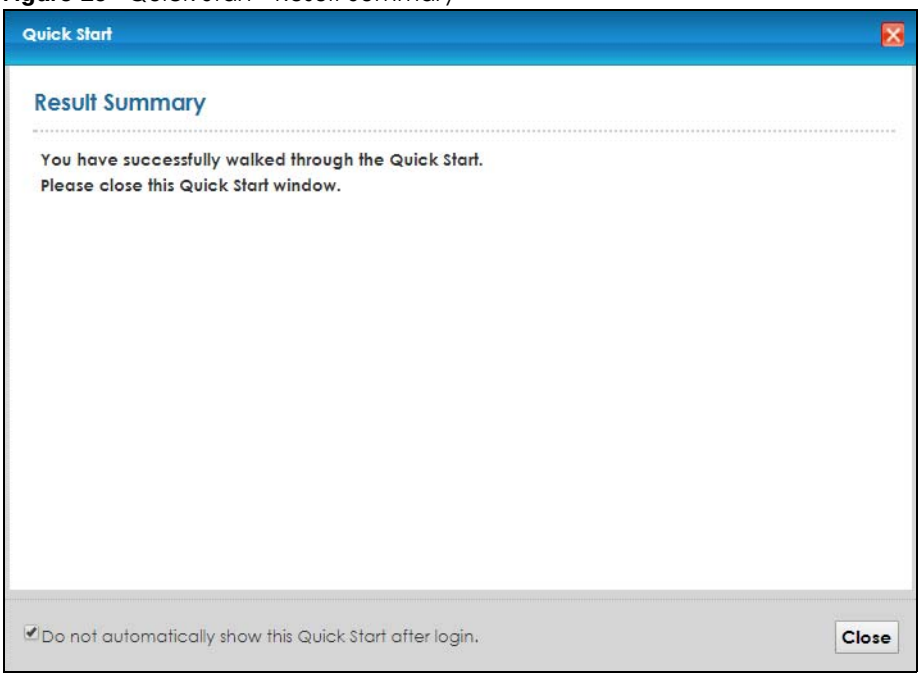
3 Turn the wireless LAN on or off. If you keep it on, record the security settings so you can configure your wireless clients to connect to the XMG. Click **Save**.

Figure 15 Quick Start - Wireless Setting



4 Your XMG saves your settings and attempts to connect to the Internet. Click **Close** to complete the setup.

Figure 16 Quick Start - Result Summary



CHAPTER 4
Tutorials

4.1 Overview

This chapter shows you how to use the XMG's various features.

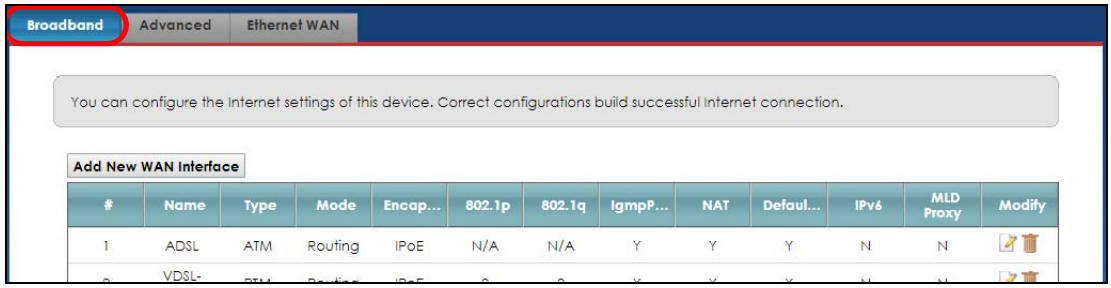
- Setting Up an ADSL PPPoE Connection, see page 36
- Setting Up a Secure Wireless Network, see page 39
- Setting Up Multiple Wireless Groups, see page 45
- Configuring Static Route for Routing to Another Network, see page 48
- Configuring QoS Queue and Class Setup, see page 50
- Access the XMG Using DDNS, see page 54
- Configuring the MAC Address Filter, see page 55
- Access Your Shared Files From a Computer, see page 56

4.2 Setting Up an ADSL PPPoE Connection

This tutorial shows you how to set up an ADSL Internet connection using the Web Configurator.

If you connect to the Internet through an ADSL connection, use the information from your Internet Service Provider (ISP) to configure the XMG. Be sure to contact your service provider for any information you need to configure the **Broadband** screens.

1 Click **Network Setting > Broadband** to open the following screen. Click **Add New WAN Interface**.



2 In this example, the DSL connection has the following information.

General	
Name	MyDSLConnection
Type	ADSL over ATM
Connection Mode	Routing

Encapsulation	PPPoE
IPv6/IPv4 Mode	IPv4
ATM PVC Configuration	
VPI/VCI	36/48
Encapsulation Mode	LLC/SNAP-Bridging
Service Category	UBR Without PCR
Account Information	
PPP User Name	1234@DSL-Ex.com
PPP Password	ABCDEF!
PPPoE Service Name	MyDSL
Static IP Address	192.168.1.32
Others	Authentication Method: AUTO PPPoE Passthrough: Disabled NAT: Enabled IGMP Multicast Proxy: Enabled Apply as Default Gateway: Enabled VLAN: Disabled

3 Select the **Active** check box. Enter the **General** and **ATM PVC Configuration** settings as provided above.

Set the **Type** to **ADSL over ATM**.

Choose the **Encapsulation** specified by your DSL service provider. For this example, the service provider requires a username and password to establish Internet connection. Therefore, select **PPPoE** as the WAN encapsulation type.

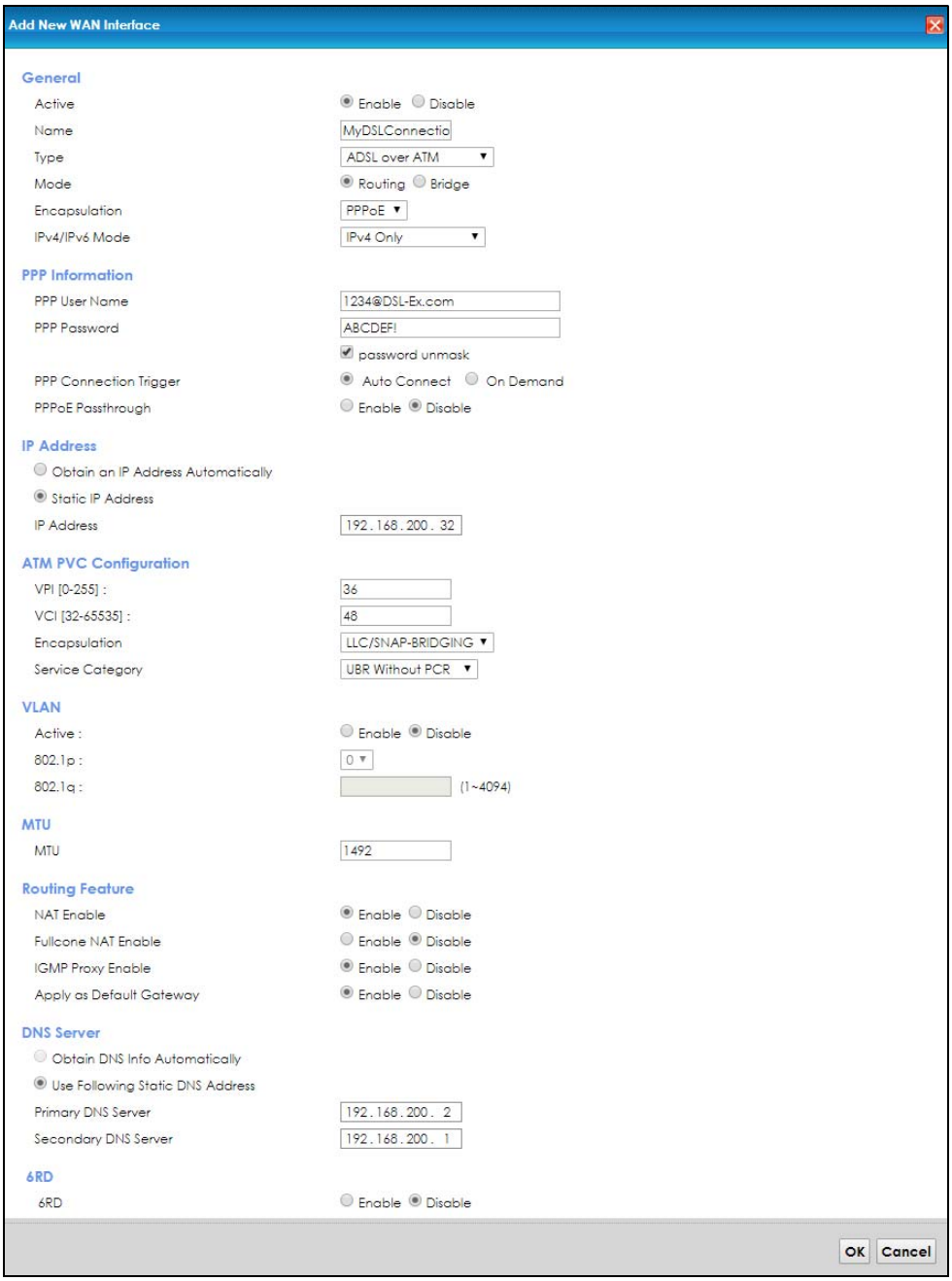
Set the **IPv6/IPv4 Mode** to **IPv4 Only**.

4 Enter the account information provided to you by your DSL service provider.

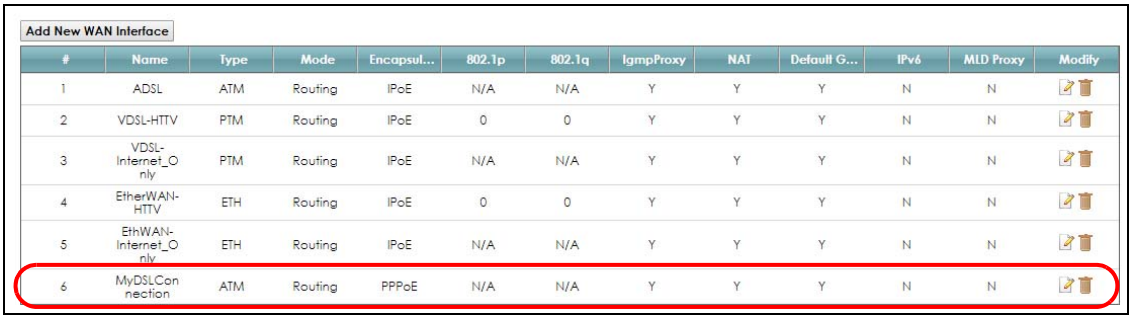
5 Configure this rule as your default Internet connection by selecting the **Apply as Default Gateway** check box. Then select DNS as **Static** and enter the DNS server addresses provided to you, such as **192.168.5.2** (DNS server1)/**192.168.5.1** (DNS server2).

6 Leave the rest of the fields to the default settings.

7 Click **Apply** to save your settings.



8 You should see a summary of your new DSL connection setup in the **Broadband** screen as follows.



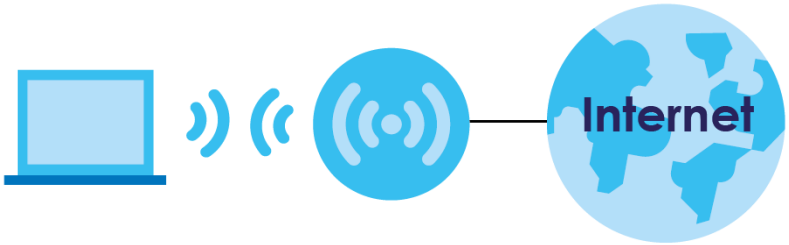
Add New WAN Interface

#	Name	Type	Mode	Encapsul...	802.1p	802.1q	IgmpProxy	NAT	Default G...	IPv6	MLD Proxy	Modify
1	ADSL	ATM	Routing	IPoE	N/A	N/A	Y	Y	Y	N	N	
2	VDSL-HTTV	PTM	Routing	IPoE	0	0	Y	Y	Y	N	N	
3	VDSL-Internet_Only	PTM	Routing	IPoE	N/A	N/A	Y	Y	Y	N	N	
4	EtherWAN-HTTV	ETH	Routing	IPoE	0	0	Y	Y	Y	N	N	
5	EthWAN-Internet_Only	ETH	Routing	IPoE	N/A	N/A	Y	Y	Y	N	N	
6	MyDSLConnection	ATM	Routing	PPPoE	N/A	N/A	Y	Y	Y	N	N	

Try to connect to a website to see if you have correctly set up your Internet connection. Be sure to contact your service provider for any information you need to configure the WAN screens.

4.3 Setting Up a Secure Wireless Network

Thomas wants to set up a wireless network so that he can use his notebook to access the Internet. In this wireless network, the XMG serves as an access point (AP), and the notebook is the wireless client. The wireless client can access the Internet through the AP.



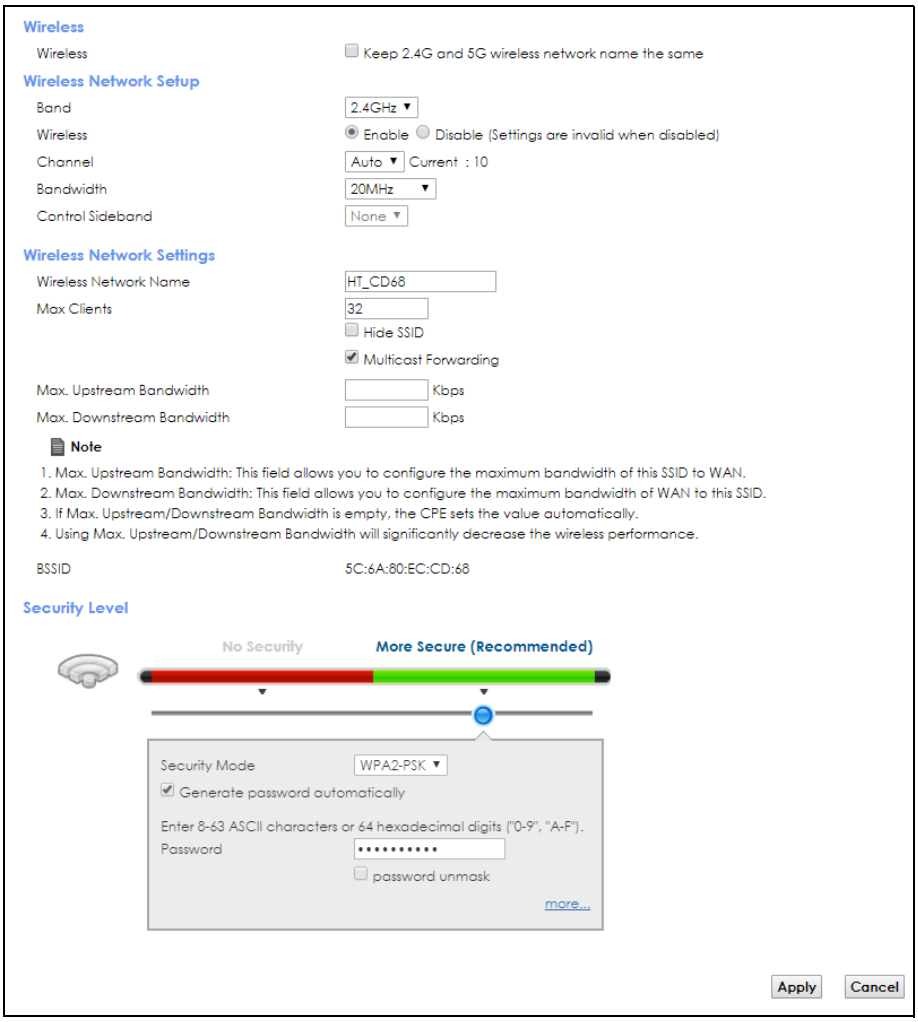
Thomas has to configure the wireless network settings on the XMG. Then he can set up a wireless network using WPS (Section 4.3.2 on page 40) or manual configuration (Section 4.3.3 on page 44).

4.3.1 Configuring the Wireless Network Settings

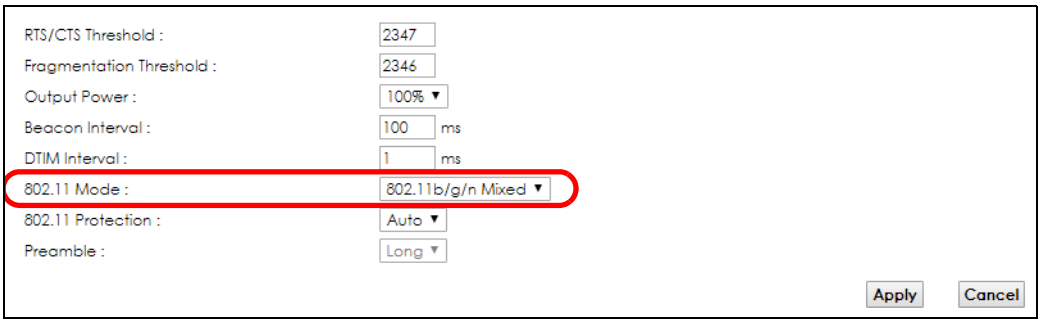
This example uses the following parameters to set up a wireless network.

SSID	Example
Security Mode	WPA2-PSK
Pre-Shared Key	DoNotStealMyWirelessNetwork
802.11 Mode	802.11b/g/n Mixed

1 Click **Network Setting** > **Wireless** to open the **General** screen. Select **More Secure** as the security level and **WPA2-PSK** as the security mode. Configure the screen using the provided parameters (see page 39). Click **Apply**.



2 Go to the **Wireless > Others** screen and select **802.11b/g/n Mixed** in the **802.11 Mode** field. Click **Apply**.



Thomas can now use the WPS feature to establish a wireless connection between his notebook and the XMG (see Section 4.3.2 on page 40). He can also use the notebook's wireless client to search for the XMG (see Section 4.3.3 on page 44).

4.3.2 Using WPS

This section shows you how to set up a wireless network using WPS. It uses the XMG as the AP and Zyxel NWD210N as the wireless client which connects to the notebook.

Note: The wireless client must be a WPS-aware device (for example, a WPS USB adapter or PCMCIA card).

There are two WPS methods to set up the wireless client settings:

- **Push Button Configuration (PBC)** - simply press a button. This is the easier of the two methods.
- **PIN Configuration** - configure a Personal Identification Number (PIN) on the XMG. A wireless client must also use the same PIN in order to download the wireless network settings from the XMG.

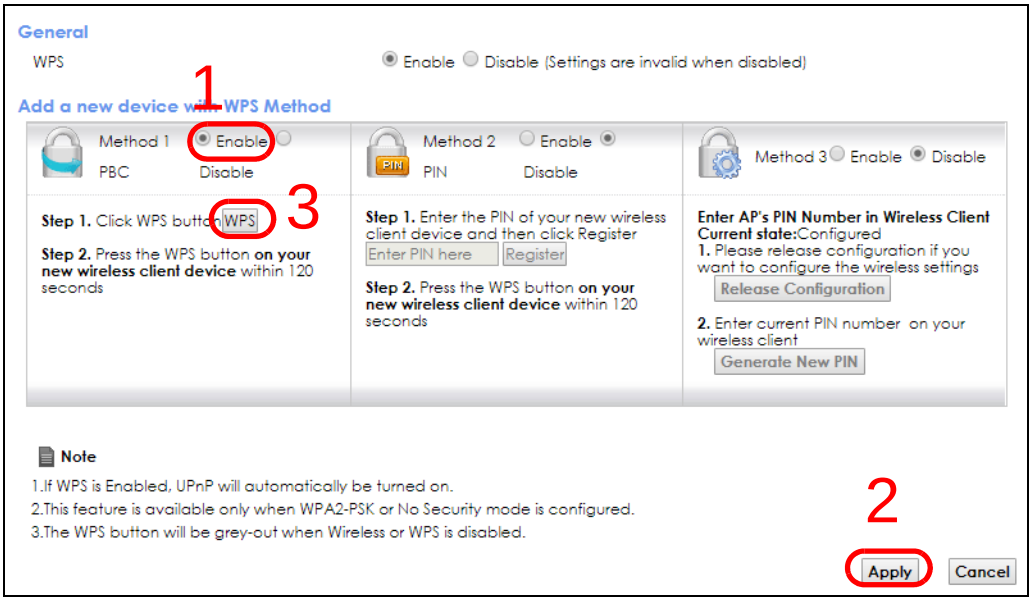
Push Button Configuration (PBC)

1 Make sure that your XMG is turned on and your notebook is within the cover range of the wireless signal.

2 Make sure that you have installed the wireless client driver and utility in your notebook.

3 In the wireless client utility, go to the WPS setting page. Enable WPS and press the WPS button for more than five seconds (**Start** or **WPS** button).

4 Push and hold the **WPS** button located on the XMG's front panel for more than 5 seconds. Alternatively, you may log into XMG's web configurator and go to the **Network Setting > Wireless > WPS** screen. Enable the WPS function for method 1 and click **Apply**. Then click the **WPS** button.



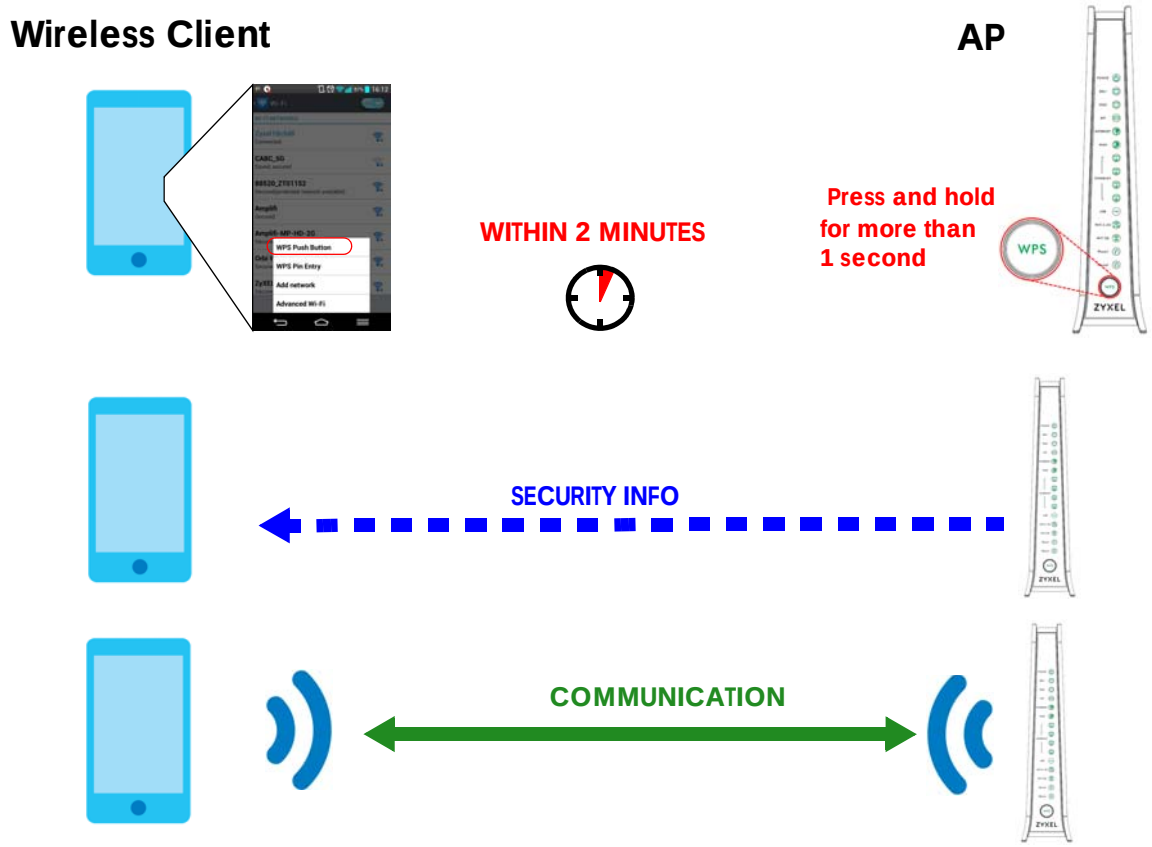
Note: Your XMG has a WPS button located on its front panel as well as a WPS button in its configuration utility. Both buttons have exactly the same function: you can use one or the other.

Note: It doesn't matter which button is pressed first. You must press the second button within two minutes of pressing the first one.

The XMG sends the proper configuration settings to the wireless client. This may take up to two minutes. The wireless client is then able to communicate with the XMG securely.

The following figure shows you an example of how to set up a wireless network and its security by pressing a button on both XMG and wireless client (the Android 4.4.2 phone in this example).

Figure 17 Example WPS Process: PBC Method

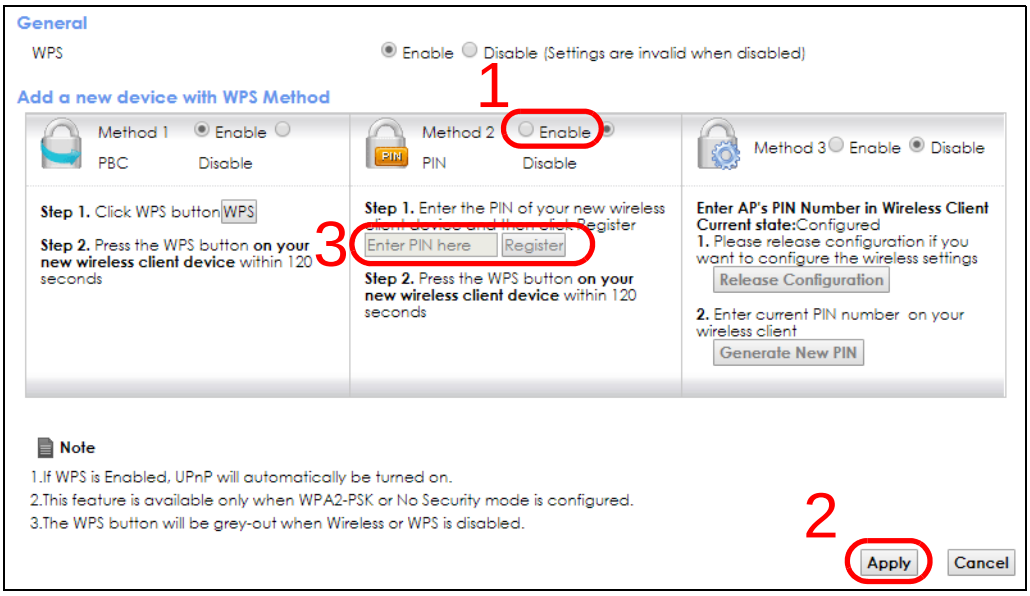


PIN Configuration

When you use the PIN configuration method, you need to use both the XMG's web configurator and the wireless client's utility.

1 Launch your wireless client's configuration utility. Go to the WPS settings and select the PIN method to get a PIN number.

2 Log into XMG's web configurator and go to the **Network Setting > Wireless > WPS** screen. Enable the WPS function and click **Apply**.

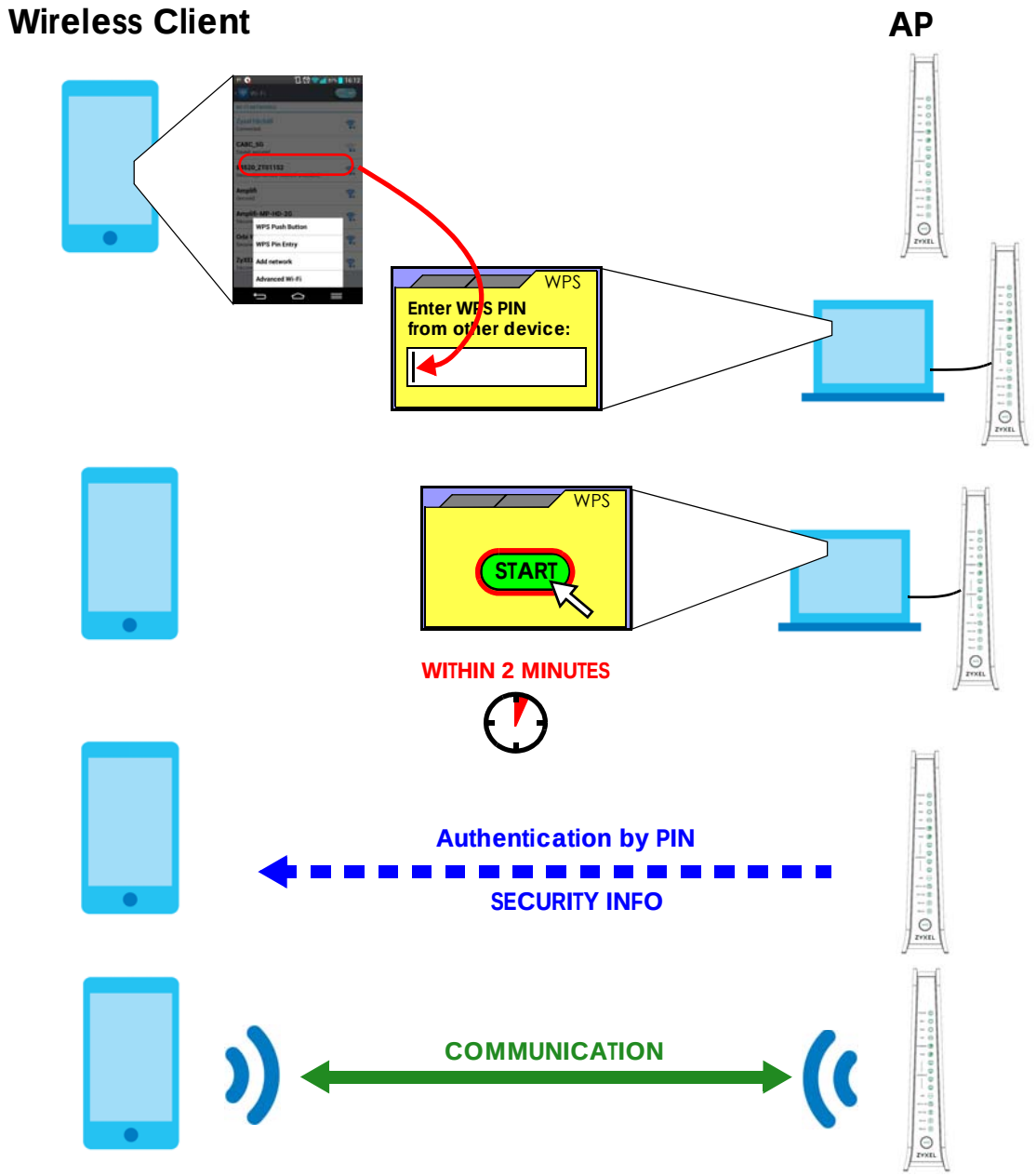


3 Enter the PIN number of the wireless client and click the **Register** button. Activate WPS function on the wireless client utility screen within two minutes.

The XMG authenticates the wireless client and sends the proper configuration settings to the wireless client. This may take up to two minutes. The wireless client is then able to communicate with the XMG securely.

The following figure shows you how to set up a wireless network and its security on a XMG and a wireless client (android 4.4.2 smartphone) by using PIN method.

Figure 18 Example WPS Process: PIN Method



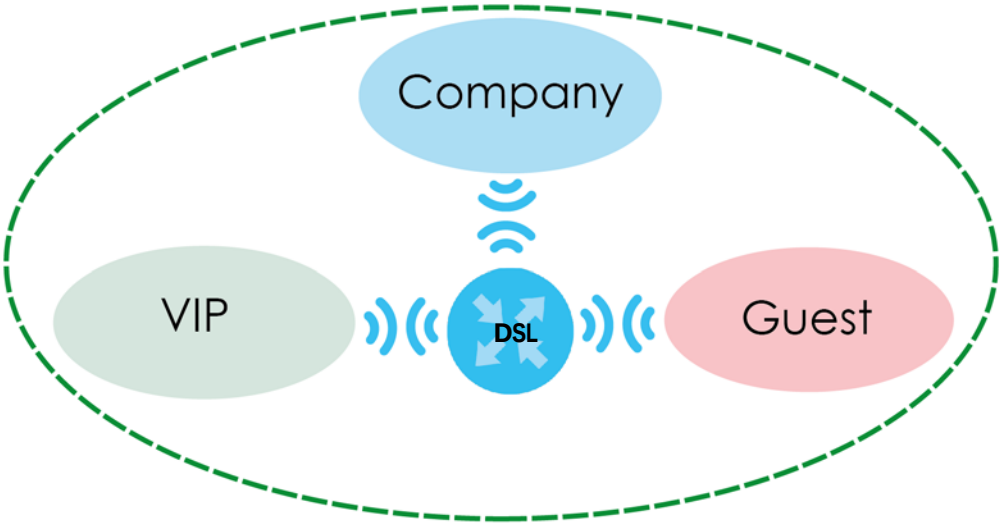
4.3.3 Without WPS

Use the wireless adapter's utility installed on the notebook to search for the "Example" SSID. Then enter the "DoNotStealMyWirelessNetwork" pre-shared key to establish an wireless Internet connection.

Note: The XMG supports IEEE 802.11b and IEEE 802.11g wireless clients. Make sure that your notebook or computer's wireless adapter supports one of these standards.

4.4 Setting Up Multiple Wireless Groups

Company A wants to create different wireless network groups for different types of users as shown in the following figure. Each group has its own SSID and security mode.

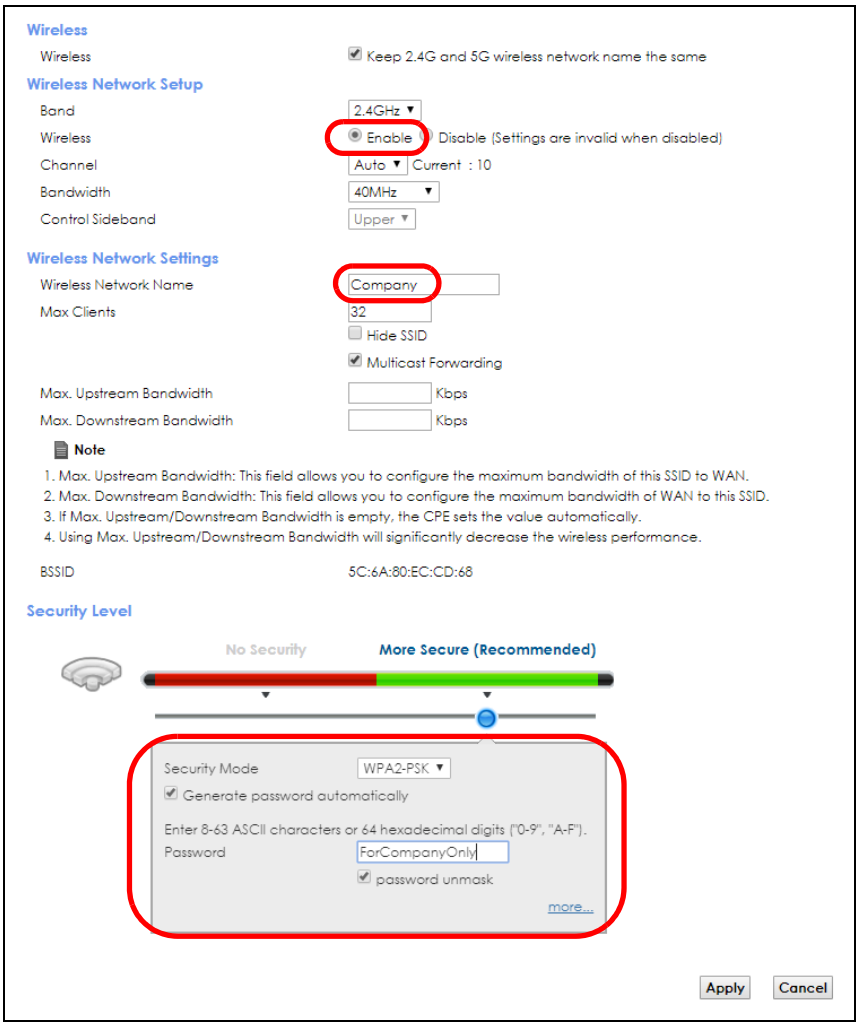


- Employees in Company A will use a general **Company** wireless network group.
- Higher management level and important visitors will use the **VIP** group.
- Visiting guests will use the **Guest** group, which has a different SSID and password.

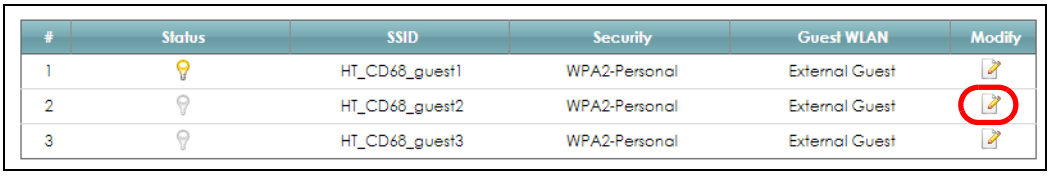
Company A will use the following parameters to set up the wireless network groups.

	COMPANY	VIP	GUEST
SSID	Company	VIP	Guest
Security Level	More Secure	More Secure	More Secure
Security Mode	WPA2-PSK	WPA2-PSK	WPA2-PSK
Pre-Shared Key	ForCompanyOnly	123456789	guest123

1 Click **Network Setting > Wireless** to open the **General** screen. Use this screen to set up the company's general wireless network group. Configure the screen using the provided parameters and click **Apply**.

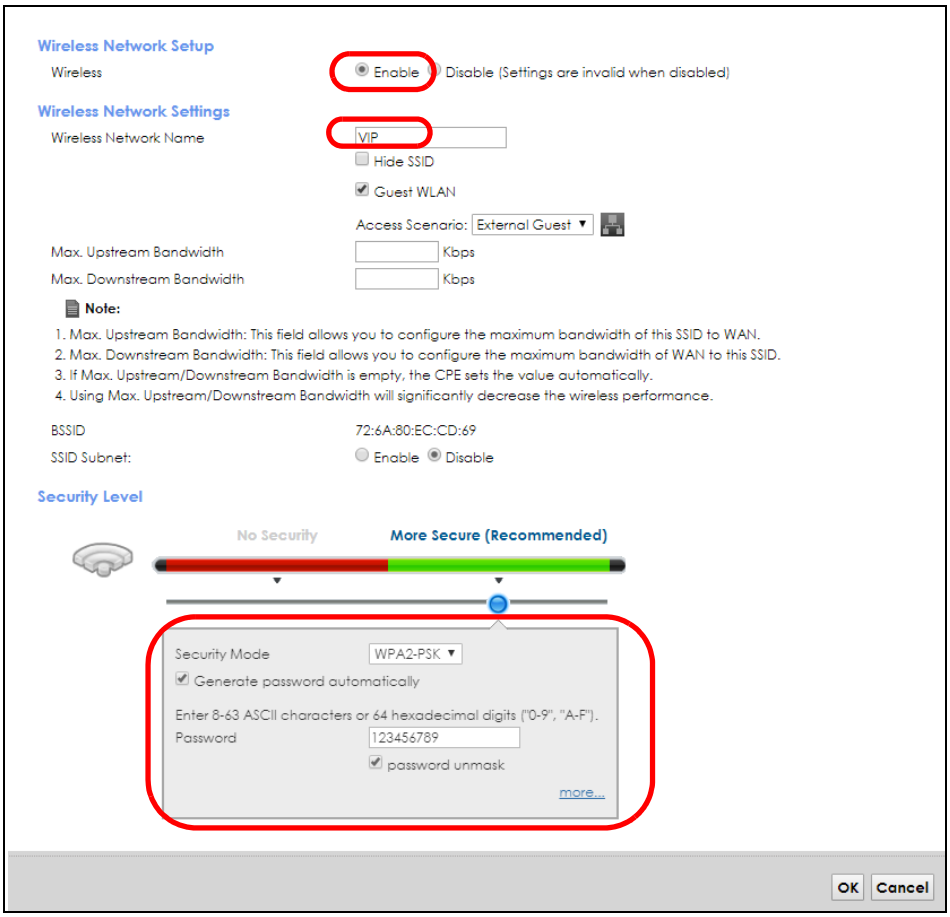


2 Click **Network Setting > Wireless > Guest/More AP** to open the following screen. Click the **Edit** icon to configure the second wireless network group.

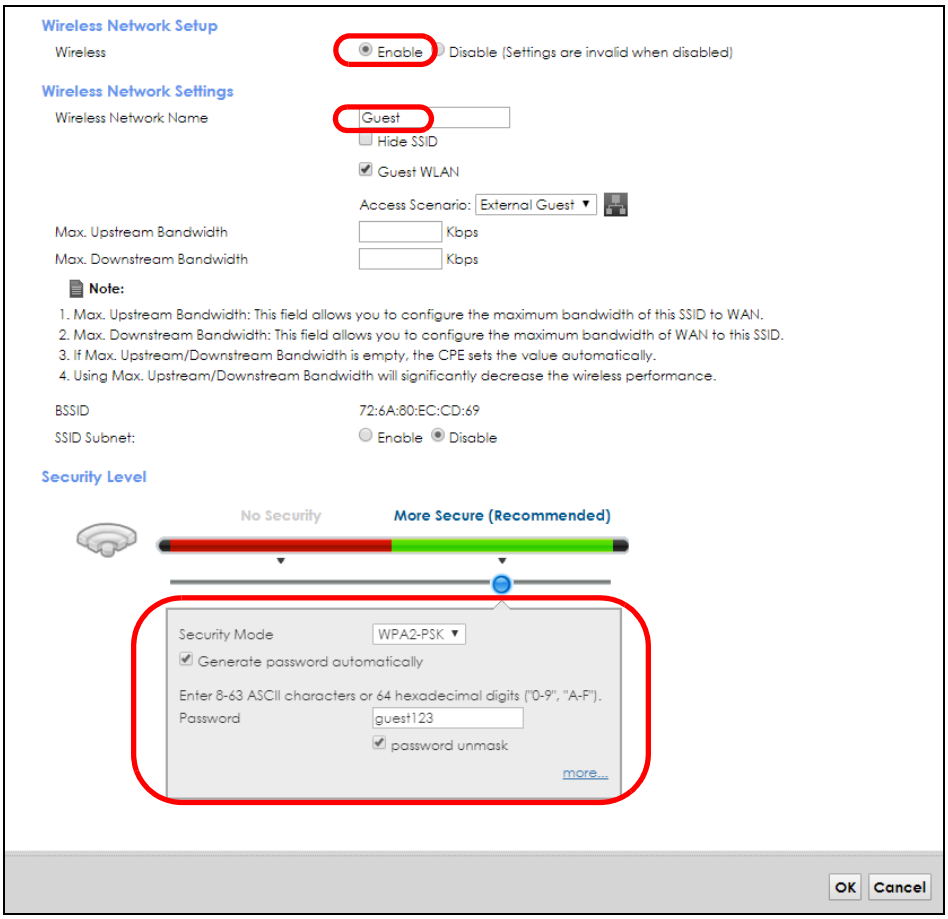


#	Status	SSID	Security	Guest WLAN	Modify
1		HT_CD68_guest1	WPA2-Personal	External Guest	
2		HT_CD68_guest2	WPA2-Personal	External Guest	
3		HT_CD68_guest3	WPA2-Personal	External Guest	

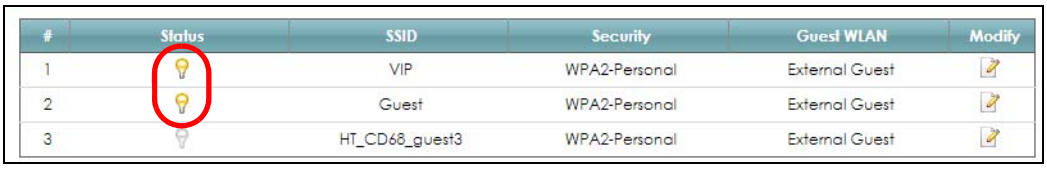
3 Configure the screen using the provided parameters and click **OK**.



4 In the **Guest/More AP** screen, click the **Edit** icon to configure the third wireless network group.Configure the screen using the provided parameters and click **Apply**.



5 Check the status of **VIP** and **Guest** in the **Guest/More AP** screen. The yellow bulbs signify that the SSIDs are active and ready for wireless access.

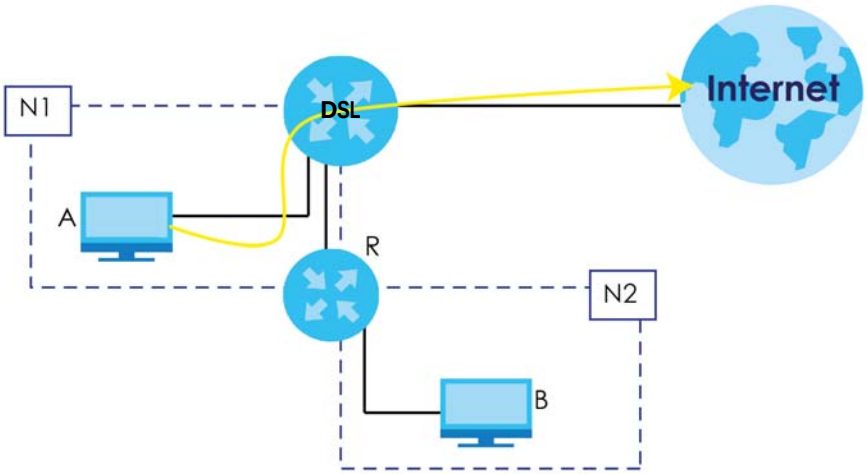


#	Status	SSID	Security	Guest WLAN	Modify
1		VIP	WPA2-Personal	External Guest	
2		Guest	WPA2-Personal	External Guest	
3		HT_CD68_guest3	WPA2-Personal	External Guest	

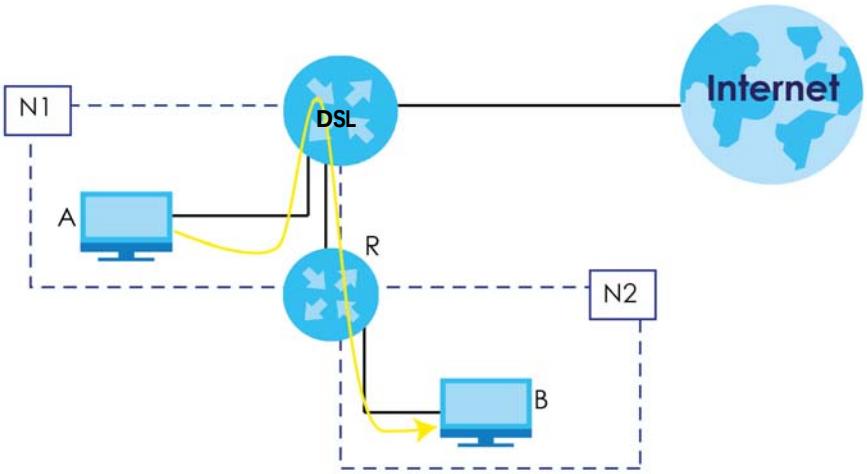
4.5 Configuring Static Route for Routing to Another Network

In order to extend your Intranet and control traffic flowing directions, you may connect a router to the XMG's LAN. The router may be used to separate two department networks. This tutorial shows how to configure a static routing rule for two network routings.

In the following figure, router **R** is connected to the XMG's LAN. **R** connects to two networks, **N1** (192.168.1.x/24) and **N2** (192.168.10.x/24). If you want to send traffic from computer **A** (in **N1** network) to computer **B** (in **N2** network), the traffic is sent to the XMG's WAN default gateway by default. In this case, **B** will never receive the traffic.



You need to specify a static routing rule on the XMG to specify **R** as the router in charge of forwarding traffic to **N2**. In this case, the XMG routes traffic from **A** to **R** and then **R** routes the traffic to **B**.



This tutorial uses the following example IP settings:

Table 5 IP Settings in this Tutorial

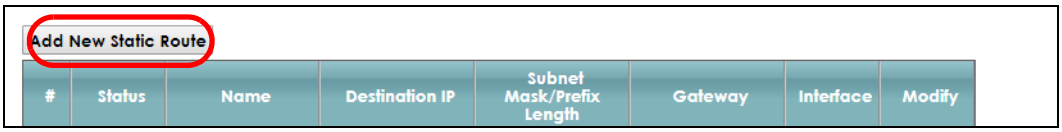
DEVICE / COMPUTER	IP ADDRESS
The XMG's WAN	172.16.1.1
The XMG's LAN	192.168.200.1
IP Type	IPv4
Use Interface	VDSL/ppp1.1
A	192.168.1.34
R's N1	192.168.1.253
R's N2	192.168.10.2
B	192.168.10.33

To configure a static route to route traffic from **N1** to **N2**:

1 Log into the XMG's Web Configurator in advanced mode.

2 Click **Network Setting** > **Routing**.

3 Click **Add new Static Route** in the **Static Route** screen.



4 Configure the **Static Route Setup** screen using the following settings:

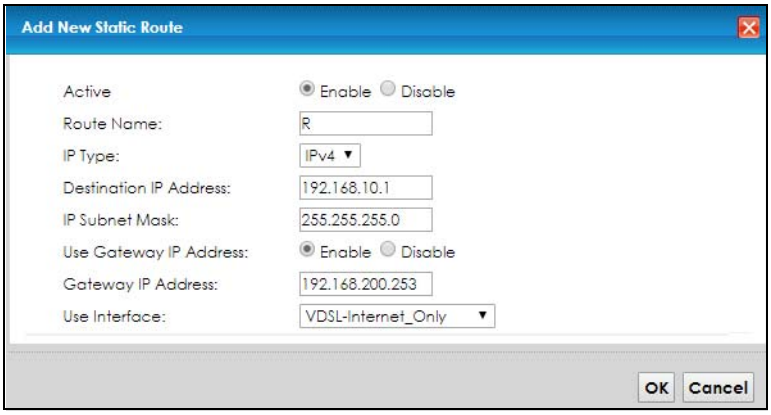
4a Select the **Active** check box. Enter the **Route Name** as **R**.

4b Set **IP Type** to **IPv4**.

4c Type **192.168.10.0** and subnet mask **255.255.255.0** for the destination, **N2**.

4d Select **Enable** in the **Use Gateway IP Address field**. Type **192.168.1.253** (**R**'s N1 address) in the **Gateway IP Address** field.

4e Select **VDSL/ppp1.1** as the **Use Interface**.



4a Click **OK**.

Now **B** should be able to receive traffic from **A**. You may need to additionally configure **B**'s firewall settings to allow specific traffic to pass through.

4.6 Configuring QoS Queue and Class Setup

This section contains tutorials on how you can configure the QoS screen.

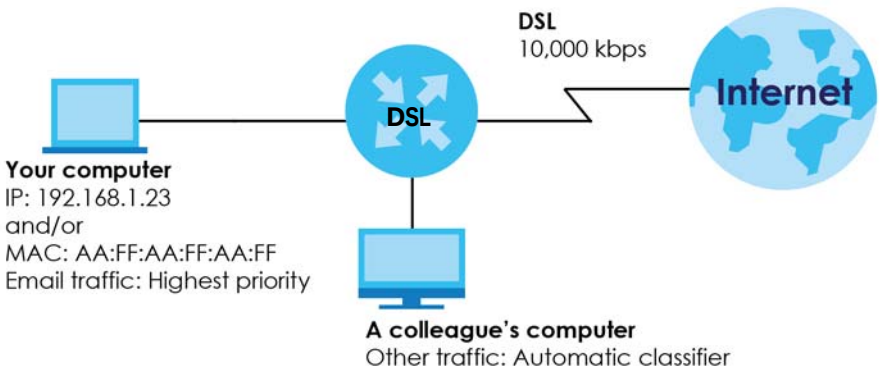
Let's say you are a team leader of a small sales branch office. You want to prioritize e-mail traffic because your task includes sending urgent updates to clients at least twice every hour. You also upload data files (such as logs and e-mail archives) to the FTP server throughout the day. Your colleagues use the Internet for research, as well as chat applications for communicating with other branch offices.

In the following figure, your Internet connection has an upstream transmission bandwidth of 10,000 kbps. For this example, you want to configure QoS so that e-mail traffic gets the highest priority with at least 5,000 kbps. You can do the following:

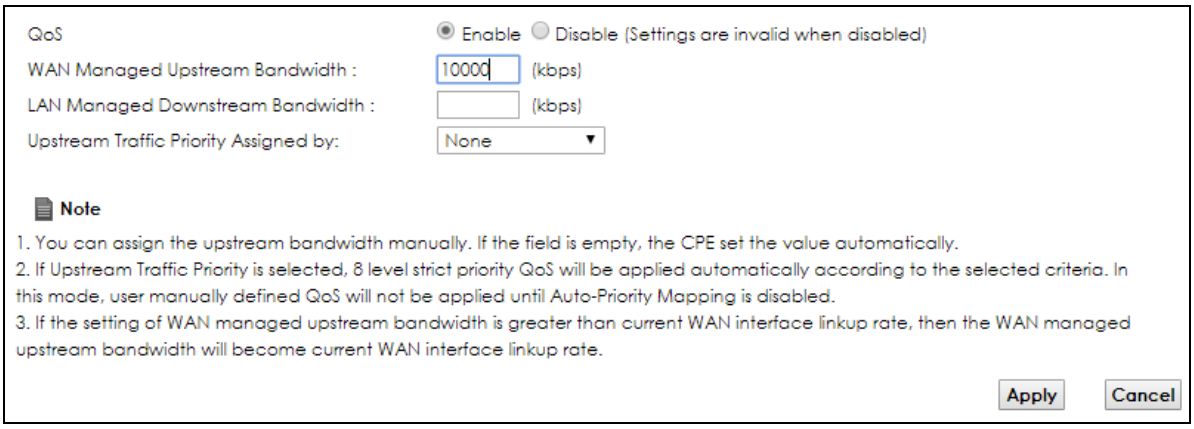
- Configure a queue to assign the highest priority queue (1) to e-mail traffic going to the WAN interface, so that e-mail traffic would not get delayed when there is network congestion.
- Note the IP address (192.168.1.23 for example) and/or MAC address (AA:FF:AA:FF:AA:FF for example) of your computer and map it to queue 7.

Note: QoS is applied to traffic flowing out of the XMG.

Traffic that does not match this class is assigned a priority queue based on the internal QoS mapping table on the XMG.

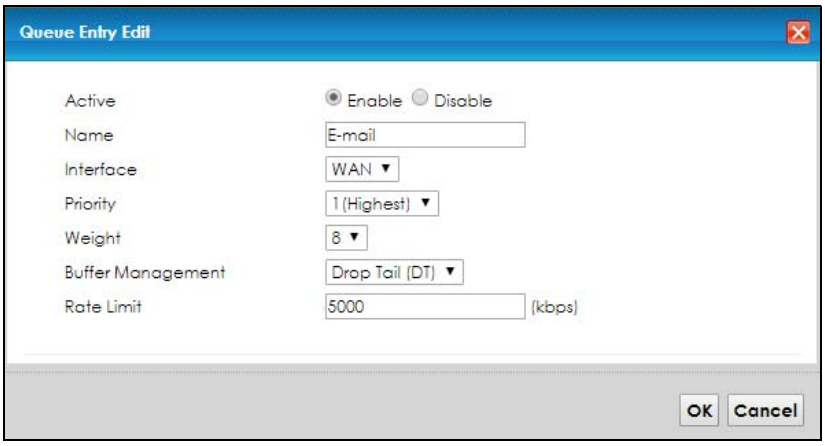


1 Click **Network Setting > QoS > General** and select **Enable**. Set your **WAN Managed Upstream Bandwidth** to 10,000 kbps (or leave this blank to have the XMG automatically determine this figure). Click **Apply**.

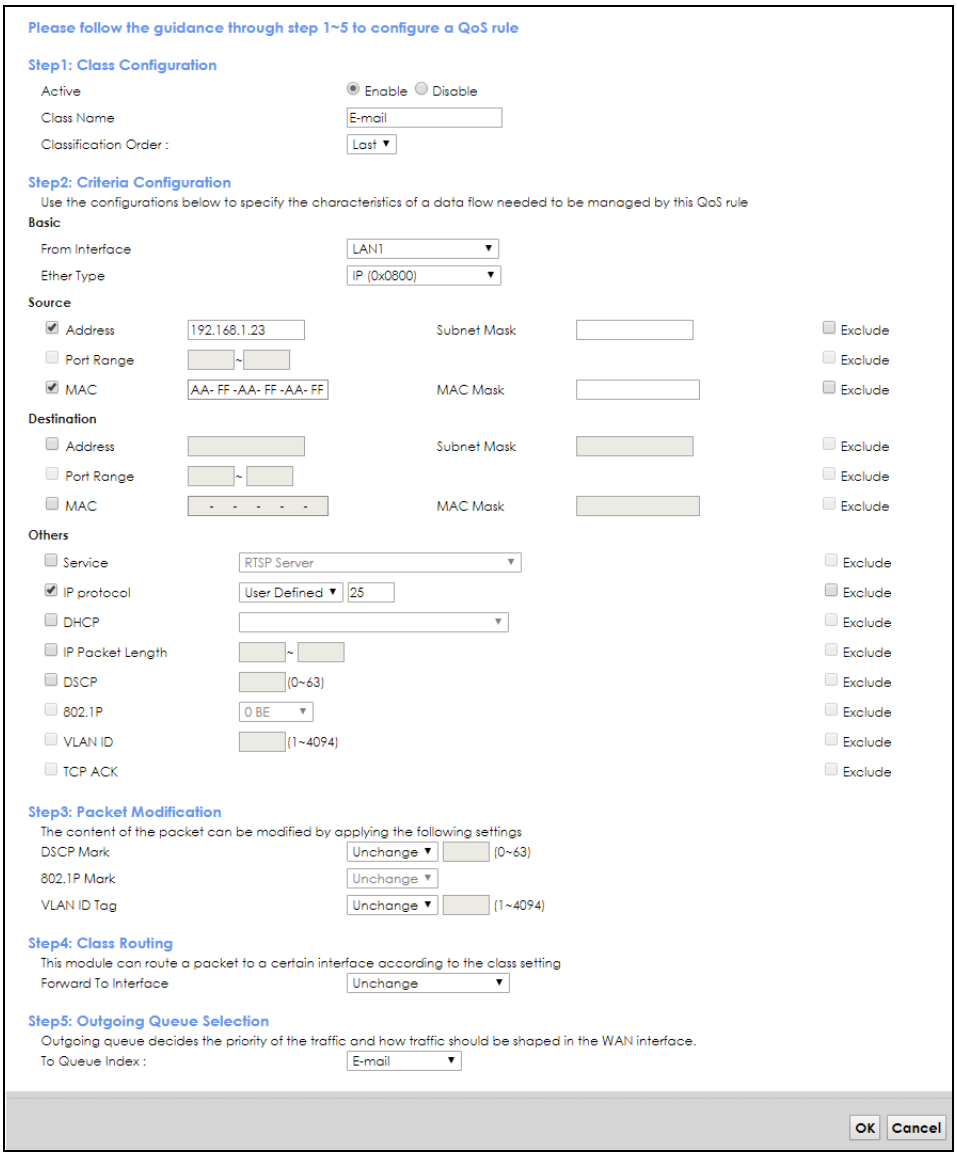


2 Click **Queue Setup** > **Add new Queue** to create a new queue. In the screen that opens, check **Active** and enter or select the following values:

- **Name**: E-mail
- **Interface**: **WAN**
- **Priority**: 1 (High)
- **Weight**: 8
- **Rate Limit**: 5,000 (kbps)



3 Click **Classification Setup** > **Add new Classification** to create a new class. Check **Active** and follow the settings as shown in the screen below.



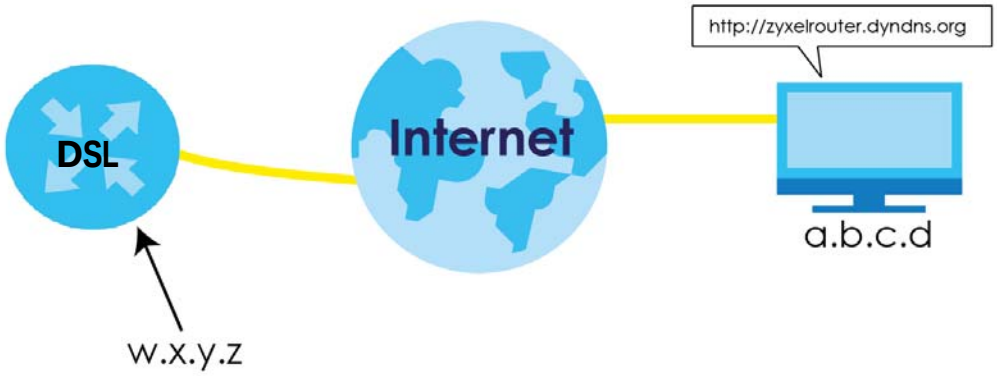
Class Name	Give a class name to this traffic, such as **E-mail** in this example.
From Interface	This is the interface from which the traffic will be coming from. Select **LAN1** for this example.
Ether Type	Select **IP** to identify the traffic source by its IP address or MAC address.
IP Address	Type the IP address of your computer - **192.168.1.23**. Type the **IP Subnet Mask** if you know it.
MAC Address	Type the MAC address of your computer - **AA:FF:AA:FF:AA:FF**. Type the **MAC Mask** if you know it.
To Queue Index	Link this to an item in the **Network Setting > QoS > Queue Setup** screen, which is the **E-mail** queue created in this example.

This maps e-mail traffic coming from port 25 to the highest priority, which you have created in the previous screen (see the **IP Protocol** field). This also maps your computer's IP address and MAC address to the **E-mail** queue (see the **Source** fields).

4 Verify that the queue setup works by checking **Network Setting > QoS > Monitor**. This shows the bandwidth allotted to e-mail traffic compared to other network traffic.

4.7 Access the XMG Using DDNS

If you connect your XMG to the Internet and it uses a dynamic WAN IP address, it is inconvenient for you to manage the device from the Internet. The XMG's WAN IP address changes dynamically. Dynamic DNS (DDNS) allows you to access the XMG using a domain name.



To use this feature, you have to apply for DDNS service at www.dyndns.org.

This tutorial covers:

- Registering a DDNS Account on www.dyndns.org
- Configuring DDNS on Your XMG
- Testing the DDNS Setting

Note: If you have a private WAN IP address, then you cannot use DDNS.

4.7.1 Registering a DDNS Account on www.dyndns.org

1. Open a browser and type **http://www.dyndns.org**.
2. Apply for a user account. This tutorial uses **UserName1** and **12345** as the username and password.
3. Log into www.dyndns.org using your account.
4. Add a new DDNS host name. This tutorial uses the following settings as an example.
   - Hostname: **zyxelrouter.dyndns.org**
   - Service Type: **Host with IP address**
   - IP Address: Enter the WAN IP address that your XMG is currently using. You can find the IP address on the XMG's Web Configurator **Status** page.

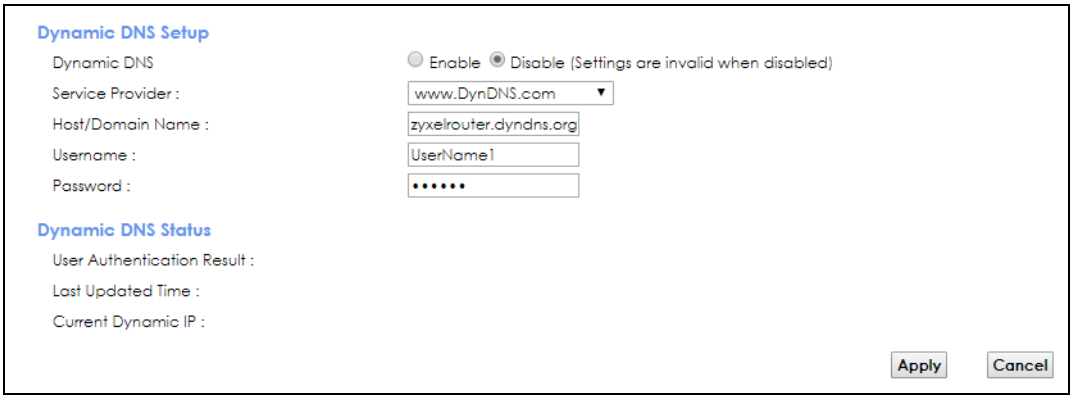
Then you will need to configure the same account and host name on the XMG later.

4.7.2 Configuring DDNS on Your XMG

Configure the following settings in the **Network Setting > DNS > Dynamic DNS** screen.

- Select **Enable Dynamic DNS**.

- Select **www.DynDNS.com** as the service provider.
- Type **zyxelrouter.dyndns.org** in the **Host Name** field.
- Enter the user name (**UserName1**) and password (**12345**).



Click **Apply**.

4.7.3 Testing the DDNS Setting

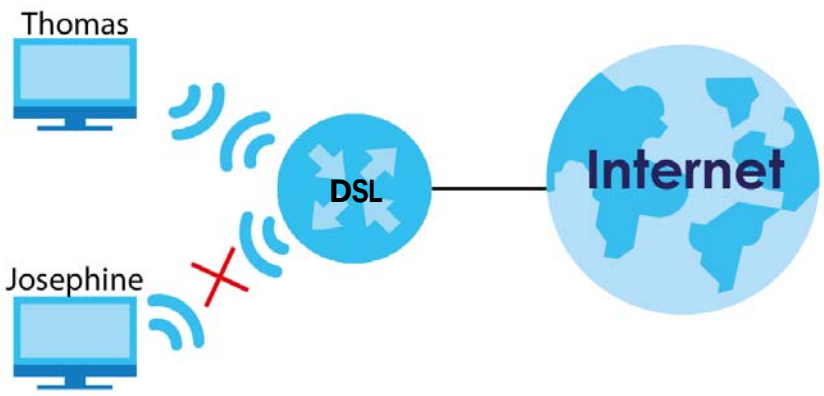
Now you should be able to access the XMG from the Internet. To test this:

1. Open a web browser on the computer (using the IP address **a.b.c.d**) that is connected to the Internet.
2. Type **http://zyxelrouter.dyndns.org** and press [Enter].
3. The XMG's login page should appear. You can then log into the XMG and manage it.

4.8 Configuring the MAC Address Filter

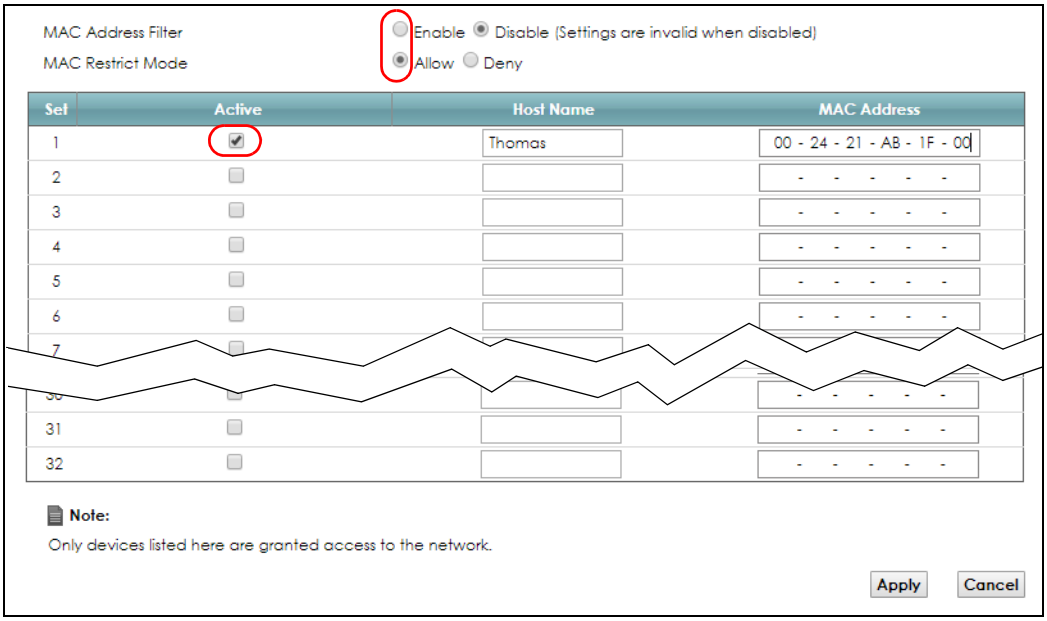
Thomas noticed that his daughter Josephine spends too much time surfing the web and downloading media files. He decided to prevent Josephine from accessing the Internet so that she can concentrate on preparing for her final exams.

Josephine's computer connects wirelessly to the Internet through the XMG. Thomas decides to use the **Security > MAC Filter** screen to grant wireless network access to his computer but not to Josephine's computer.



1 Click **Security** > **MAC Filter** to open the **MAC Filter** screen. Select the **Enable** check box to activate MAC filter function.

2 Select **Active**. Then enter the host name and MAC address of Thomas' computer in this screen. Click **Apply**.



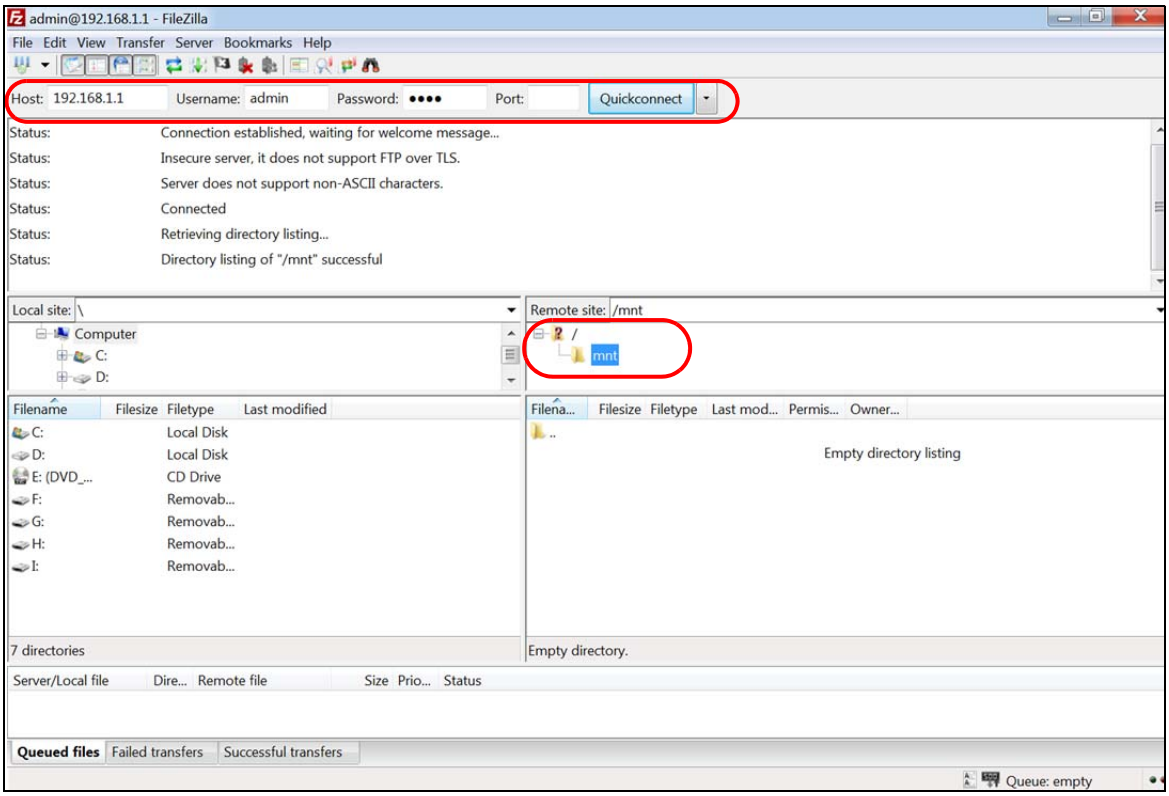
Thomas can also grant access to the computers of other members of his family and friends. However, Josephine and others not listed in this screen will no longer be able to access the Internet through the XMG.

4.9 Access Your Shared Files From a Computer

Here is how to use an FTP program to access a file storage device connected to the XMG's USB port.

Note: This example uses the FileZilla FTP program to browse your shared files.

1 In FileZilla enter the IP address of the XMG (the default is 192.168.200.1), your account's user name and password and port 21 and click **Quickconnect**. A screen asking for password authentication appears.



2 Once you log in the USB device displays in the **mnt** folder.

Part II
Technical Reference

CHAPTER 5
Network Map and Status Screens

5.1 Overview

After you log into the Web Configurator, the **Network Map** screen appears. This shows the network connection status of the XMG and clients connected to it.

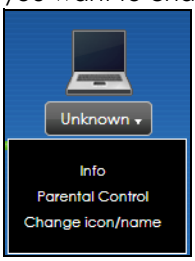
You can use the **Status** screen to look at the current status of the XMG, system resources, and interfaces (LAN, WAN, and WLAN).

5.2 The Network Map Screen

Use this screen to view the network connection status of the device and its clients. A warning message appears if there is a connection problem.

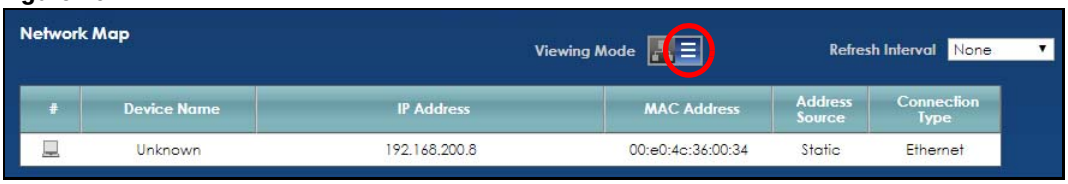
Figure 19 Network Map

If you want to view information about a client, click the client's name and **Info**. Click the IP address if you want to change it. If you want to change the name or icon of the client, click **Change name/icon**.



If you prefer to view the status in a list, click **List View** in the **Viewing mode** selection box. You can configure how often you want the XMG to update this screen in **Refresh interval**.

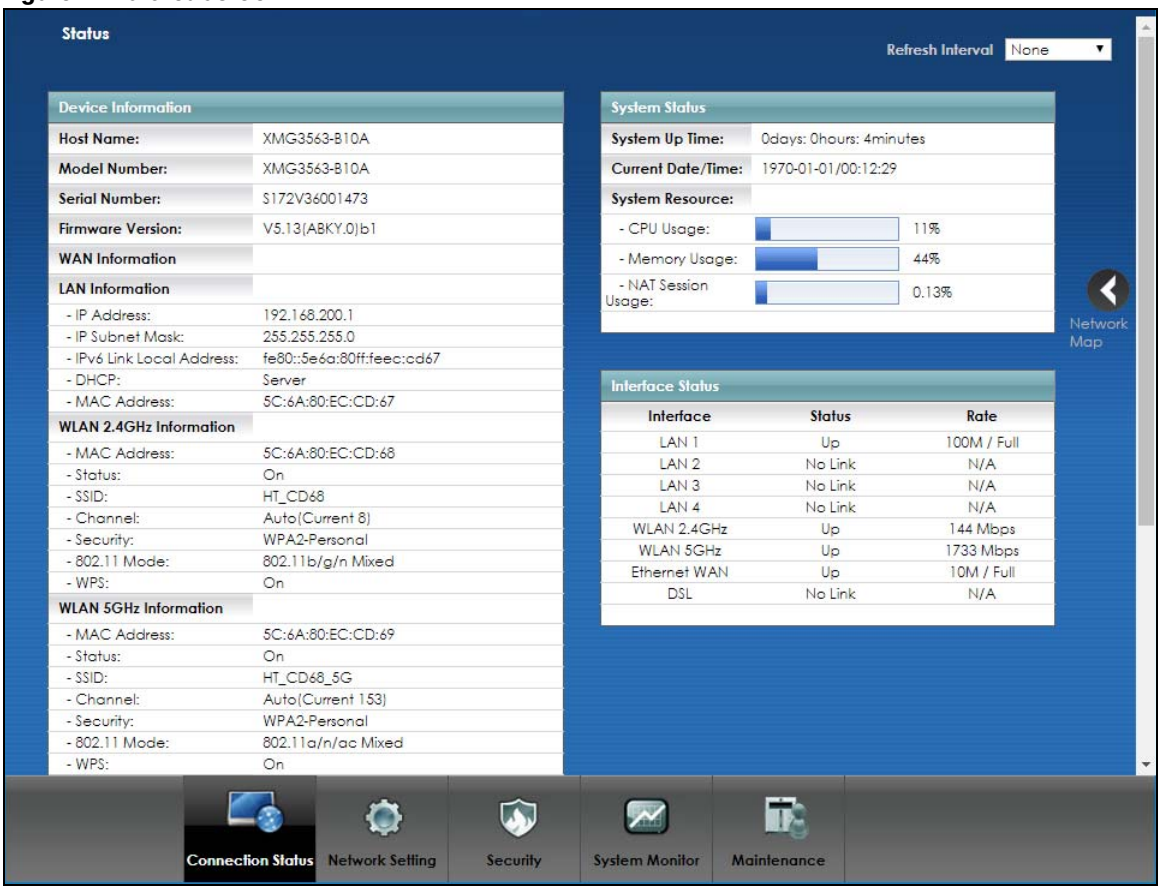
Figure 20



5.3 The Status Screen

Use this screen to view the status of the XMG. Click **Status** to open this screen.

Figure 21 Status Screen



Each field is described in the following table.

Table 6 Status Screen

LABEL	DESCRIPTION
Refresh Interval	Select how often you want the XMG to update this screen.
Device Information	
Host Name	This field displays the XMG system name. It is used for identification.
Model Number	This shows the model number of your XMG.
Serial Number	This field displays the serial number of the XMG.
Firmware Version	This is the current version of the firmware inside the XMG.
WAN Information (These fields display when you have a WAN connection.)	
Encapsulation	This field displays the current encapsulation method.
IP Address	This field displays the current IP address of the XMG in the WAN.
IP Subnet Mask	This field displays the current subnet mask in the WAN.
MAC Address	This shows the WAN Ethernet adapter MAC (Media Access Control) Address of your XMG.

Table 6 Status Screen (continued)

LABEL	DESCRIPTION
Primary DNS server	This field displays the first DNS server address assigned by the ISP.
Secondary DNS server	This field displays the second DNS server address assigned by the ISP.
DHCP	This field displays whether the WAN interface is using a DHCP IP address or a static IP address. Choices are: **Client** - The WAN interface can obtain an IP address from a DHCP server. **None** - The WAN interface is using a static IP address.
LAN Information	
IP Address	This is the current IP address of the XMG in the LAN.
IP Subnet Mask	This is the current subnet mask in the LAN.
IPv6 Link Local Address	This field displays the current link-local address of the XMG for the LAN interface.
DHCP	This field displays what DHCP services the XMG is providing to the LAN. The possible values are: **Server** - The XMG is a DHCP server in the LAN. It assigns IP addresses to other computers in the LAN. **Relay** - The XMG acts as a surrogate DHCP server and relays DHCP requests and responses between the remote server and the clients. **Disable** - The XMG is not providing any DHCP services to the LAN.
MAC Address	This shows the LAN Ethernet adapter MAC (Media Access Control) Address of your XMG.
WLAN 2.4GHz/5GHz Information	
MAC Address	This shows the wireless adapter MAC (Media Access Control) Address of the wireless interface.
Status	This displays whether the WLAN is activated.
SSID	This is the descriptive name used to identify the XMG in a wireless LAN.
Channel	This is the channel number used by the wireless interface now.
Security	This displays the type of security mode the wireless interface is using in the wireless LAN.
802.11 Mode	This displays the type of 802.11 mode the wireless interface is using in the wireless LAN.
WPS	This displays whether WPS is activated on the wireless interface.
Security	
Firewall	This displays the firewall's current security level.
System Status	
System Up Time	This field displays how long the XMG has been running since it last started up. The XMG starts up when you plug it in, when you restart it (**Maintenance > Reboot**), or when you reset it.
Current Date/ Time	This field displays the current date and time in the XMG. You can change this in **Maintenance> Time Setting**.
System Resource	
CPU Usage	This field displays what percentage of the XMG's processing ability is currently used. When this percentage is close to 100%, the XMG is running at full load, and the throughput is not going to improve anymore. If you want some applications to have more throughput, you should turn off other applications (for example, using QoS; see Chapter 10 on page 133).
Memory Usage	This field displays what percentage of the XMG's memory is currently used. Usually, this percentage should not increase much. If memory usage does get close to 100%, the XMG is probably becoming unstable, and you should restart the device. See Section 39.2 on page 274, or turn off the device (unplug the power) for a few seconds.

Table 6 Status Screen (continued)

LABEL	DESCRIPTION
NAT Session Usage	This field displays what percentage of the XMG supported NAT sessions are currently being used. This field also displays the number of active NAT sessions and the maximum number of NAT sessions the XMG can support.
Interface Status	
Interface	This column displays each interface the XMG has.
Status	This field indicates the interface's use status. For the LAN and Ethernet WAN interfaces, this field displays **Up** when using the interface and **NoLink** when not using the interface. For a WLAN interface, this field displays the enabled (**Up**) or disabled (**Disable**) state of the interface. For the DSL interface, this field displays **Down** (line down), **Up** (line up or connected), **Drop** (dropping a call) if you're using PPPoE encapsulation, and **NoLink** when not using the interface.
Rate	For the Ethernet WAN and LAN interfaces, this displays the port speed and duplex setting. For the DSL interface, it displays the downstream and upstream transmission rate. For the WLAN interface, it displays the maximum transmission rate or **N/A** with WLAN disabled.

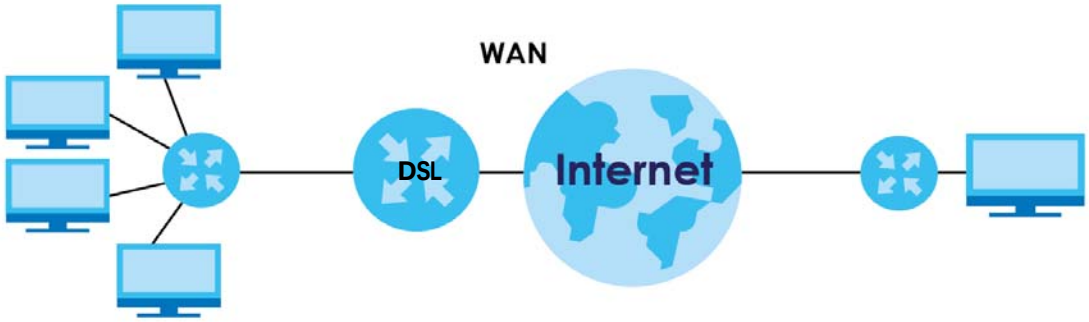
CHAPTER 6
Broadband

6.1 Overview

This chapter discusses the XMG's **Broadband** screens. Use these screens to configure your XMG for Internet access.

A WAN (Wide Area Network) connection is an outside connection to another network or the Internet. It connects your private networks, such as a LAN (Local Area Network) and other networks, so that a computer in one location can communicate with computers in other locations.

Figure 22 LAN and WAN



6.1.1 What You Can Do in this Chapter

- Use the **Broadband** screen to view, remove or add a WAN interface. You can also configure the WAN settings on the XMG for Internet access (Section 6.2 on page 68).
- Use the **Advanced** screen to enable or disable PTM over ADSL, Annex M/Annex J, and DSL PhyR functions (Section 6.3 on page 75).
- Use the **Ethernet WAN** screen to enable the fourth Ethernet LAN port to be an Ethernet WAN port (Section 6.4 on page 79).

Table 7 WAN Setup Overview

LAYER-2 INTERFACE		INTERNET CONNECTION		
CONNECTION	**DSL LINK TYPE**	**MODE**	**ENCAPSULATION**	**CONNECTION SETTINGS**
ADSL/VDSL over PTM	N/A	Routing	PPPoE	PPP information, IPv4/IPv6 IP address, routing feature, DNS server, VLAN, and MTU
			IPoE	IPv4/IPv6 IP address, routing feature, DNS server, VLAN, and MTU
		Bridge	N/A	VLAN

Table 7 WAN Setup Overview

LAYER-2 INTERFACE		INTERNET CONNECTION		
CONNECTION	**DSL LINK TYPE**	**MODE**	**ENCAPSULATION**	**CONNECTION SETTINGS**
ADSL over ATM	EoA	Routing	PPPoE/PPPoA	ATM PVC configuration, PPP information, IPv4/IPv6 IP address, routing feature, DNS server, VLAN, and MTU
			IPoE/IPoA	ATM PVC configuration, IPv4/IPv6 IP address, routing feature, DNS server, VLAN, and MTU
		Bridge	N/A	ATM PVC configuration
Ethernet	N/A	Routing	PPPoE	PPP user name and password, WAN IPv4/IPv6 IP address, routing feature, DNS server, VLAN, and MTU
			IPoE	WAN IPv4/IPv6 IP address, NAT, DNS server and routing feature
		Bridge	N/A	VLAN

6.1.2 What You Need to Know

The following terms and concepts may help as you read this chapter.

WAN IP Address

The WAN IP address is an IP address for the XMG, which makes it accessible from an outside network. It is used by the XMG to communicate with other devices in other networks. It can be static (fixed) or dynamically assigned by the ISP each time the XMG tries to access the Internet.

If your ISP assigns you a static WAN IP address, they should also assign you the subnet mask and DNS server IP address(es).

ATM

Asynchronous Transfer Mode (ATM) is a WAN networking technology that provides high-speed data transfer. ATM uses fixed-size packets of information called cells. With ATM, a high QoS (Quality of Service) can be guaranteed. ATM uses a connection-oriented model and establishes a virtual circuit (VC) between Finding Out More

PTM

Packet Transfer Mode (PTM) is packet-oriented and supported by the VDSL2 standard. In PTM, packets are encapsulated directly in the High-level Data Link Control (HDLC) frames. It is designed to provide a low-overhead, transparent way of transporting packets over DSL links, as an alternative to ATM.

IPv6 Introduction

IPv6 (Internet Protocol version 6), is designed to enhance IP address size and features. The increase in IPv6 address size to 128 bits (from the 32-bit IPv4 address) allows up to 3.4 x 10^{38} IP addresses. The XMG can use IPv4/IPv6 dual stack to connect to IPv4 and IPv6 networks, and supports IPv6 rapid deployment (6RD).

IPv6 Addressing

The 128-bit IPv6 address is written as eight 16-bit hexadecimal blocks separated by colons (:). This is an example IPv6 address `2001:0db8:1a2b:0015:0000:0000:1a2f:0000`.

IPv6 addresses can be abbreviated in two ways:

- Leading zeros in a block can be omitted. So `2001:0db8:1a2b:0015:0000:0000:1a2f:0000` can be written as `2001:db8:1a2b:15:0:0:1a2f:0`.
- Any number of consecutive blocks of zeros can be replaced by a double colon. A double colon can only appear once in an IPv6 address. So `2001:0db8:0000:0000:1a2f:0000:0000:0015` can be written as `2001:0db8::1a2f:0000:0000:0015`, `2001:0db8:0000:0000:1a2f::0015`, `2001:db8::1a2f:0:0:15` or `2001:db8:0:0:1a2f::15`.

IPv6 Prefix and Prefix Length

Similar to an IPv4 subnet mask, IPv6 uses an address prefix to represent the network address. An IPv6 prefix length specifies how many most significant bits (start from the left) in the address compose the network address. The prefix length is written as "/x" where x is a number. For example,

```
2001:db8:1a2b:15::1a2f:0/32
```

means that the first 32 bits (`2001:db8`) is the subnet prefix.

IPv6 Subnet Masking

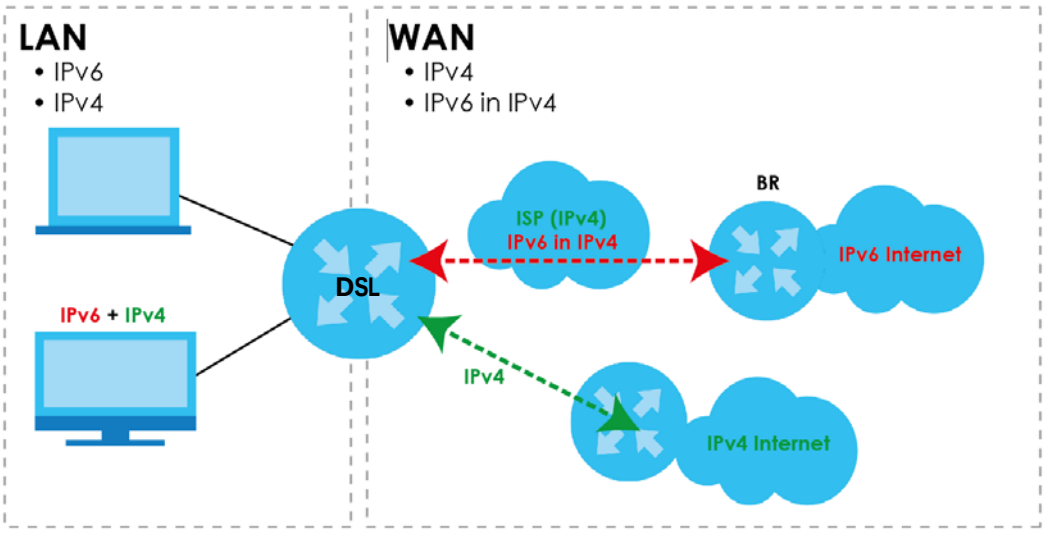
Both an IPv6 address and IPv6 subnet mask compose of 128-bit binary digits, which are divided into eight 16-bit blocks and written in hexadecimal notation. Hexadecimal uses four bits for each character (1 ~ 10, A ~ F). Each block's 16 bits are then represented by four hexadecimal characters. For example, FFFF:FFFF:FFFF:FFFF:FC00:0000:0000:0000.

IPv6 Rapid Deployment

Use IPv6 Rapid Deployment (6rd) when the local network uses IPv6 and the ISP has an IPv4 network. When the XMG has an IPv4 WAN address and you set **IPv4/IPv6 Mode** to **IPv4 Only**, you can enable 6rd to encapsulate IPv6 packets in IPv4 packets to cross the ISP's IPv4 network.

The XMG generates a global IPv6 prefix from its IPv4 WAN address and tunnels IPv6 traffic to the ISP's Border Relay router (BR in the figure) to connect to the native IPv6 Internet. The local network can also use IPv4 services. The XMG uses it's configured IPv4 WAN IP to route IPv4 traffic to the IPv4 Internet.

Figure 23 IPv6 Rapid Deployment

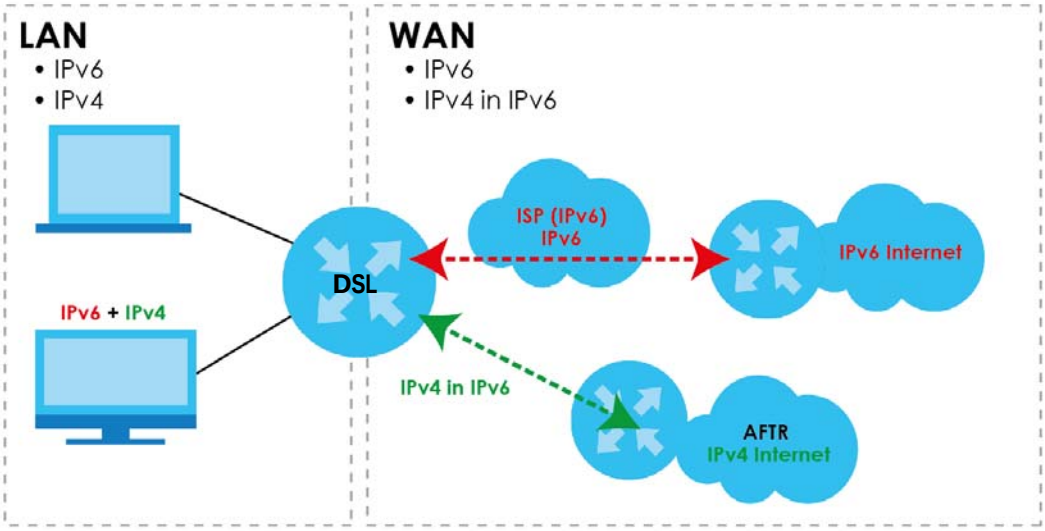


Dual Stack Lite

Use Dual Stack Lite when local network computers use IPv4 and the ISP has an IPv6 network. When the XMG has an IPv6 WAN address and you set **IPv4/IPv6 Mode** to **IPv6 Only**, you can enable Dual Stack Lite to use IPv4 computers and services.

The XMG tunnels IPv4 packets inside IPv6 encapsulation packets to the ISP's Address Family Transition Router (AFTR in the graphic) to connect to the IPv4 Internet. The local network can also use IPv6 services. The XMG uses it's configured IPv6 WAN IP to route IPv6 traffic to the IPv6 Internet.

Figure 24 Dual Stack Lite



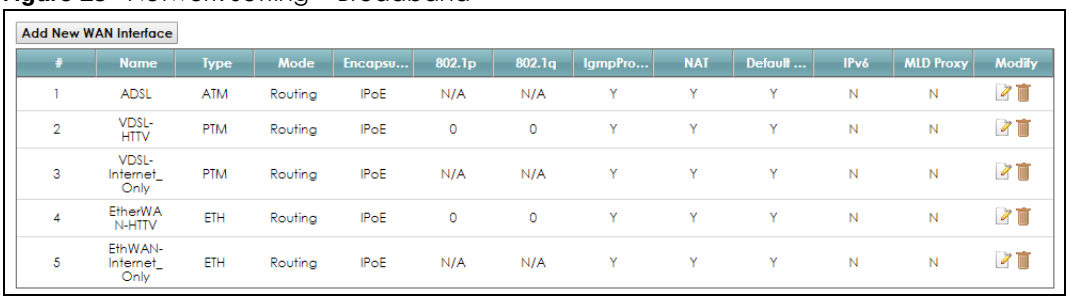
6.1.3 Before You Begin

You need to know your Internet access settings such as encapsulation and WAN IP address. Get this information from your ISP.

6.2 The Broadband Screen

Use this screen to change your XMG's Internet access settings. Click **Network Setting** > **Broadband** from the menu. The summary table shows you the configured WAN services (connections) on the XMG.

Figure 25 Network Setting > Broadband



Add New WAN Interface

#	Name	Type	Mode	Encapsu...	802.1p	802.1q	IgmpPro...	NAT	Default ...	IPv6	MLD Proxy	Modify
1	ADSL	ATM	Routing	IPoE	N/A	N/A	Y	Y	Y	N	N	
2	VDSL-HTTV	PTM	Routing	IPoE	0	0	Y	Y	Y	N	N	
3	VDSL-Internet_Only	PTM	Routing	IPoE	N/A	N/A	Y	Y	Y	N	N	
4	EtherWAN-HTTV	ETH	Routing	IPoE	0	0	Y	Y	Y	N	N	
5	EthWAN-Internet_Only	ETH	Routing	IPoE	N/A	N/A	Y	Y	Y	N	N	

The following table describes the labels in this screen.

Table 8 Network Setting > Broadband

LABEL	DESCRIPTION
Add New WAN Interface	Click this button to create a new connection.
#	This is the index number of the entry.
Name	This is the service name of the connection.
Type	This shows whether it is an ATM, Ethernet or a PTM connection.
Mode	This shows whether the connection is in routing or bridge mode.
Encapsulation	This is the method of encapsulation used by this connection.
802.1p	This indicates the 802.1p priority level assigned to traffic sent through this connection. This displays **N/A** when there is no priority level assigned.
802.1q	This indicates the VLAN ID number assigned to traffic sent through this connection. This displays **N/A** when there is no VLAN ID number assigned.
IGMP Proxy	This shows whether the XMG act as an IGMP proxy on this connection.
NAT	This shows whether NAT is activated or not for this connection.
Default Gateway	This shows whether the XMG use the WAN interface of this connection as the system default gateway.
IPv6	This shows whether IPv6 is activated or not for this connection. IPv6 is not available when the connection uses the bridging service.
MLD Proxy	This shows whether Multicast Listener Discovery (MLD) is activated or not for this connection. MLD is not available when the connection uses the bridging service.
Modify	Click the **Edit** icon to configure the WAN connection. Click the **Delete** icon to remove the WAN connection.

6.2.1 Add/Edit Internet Connection

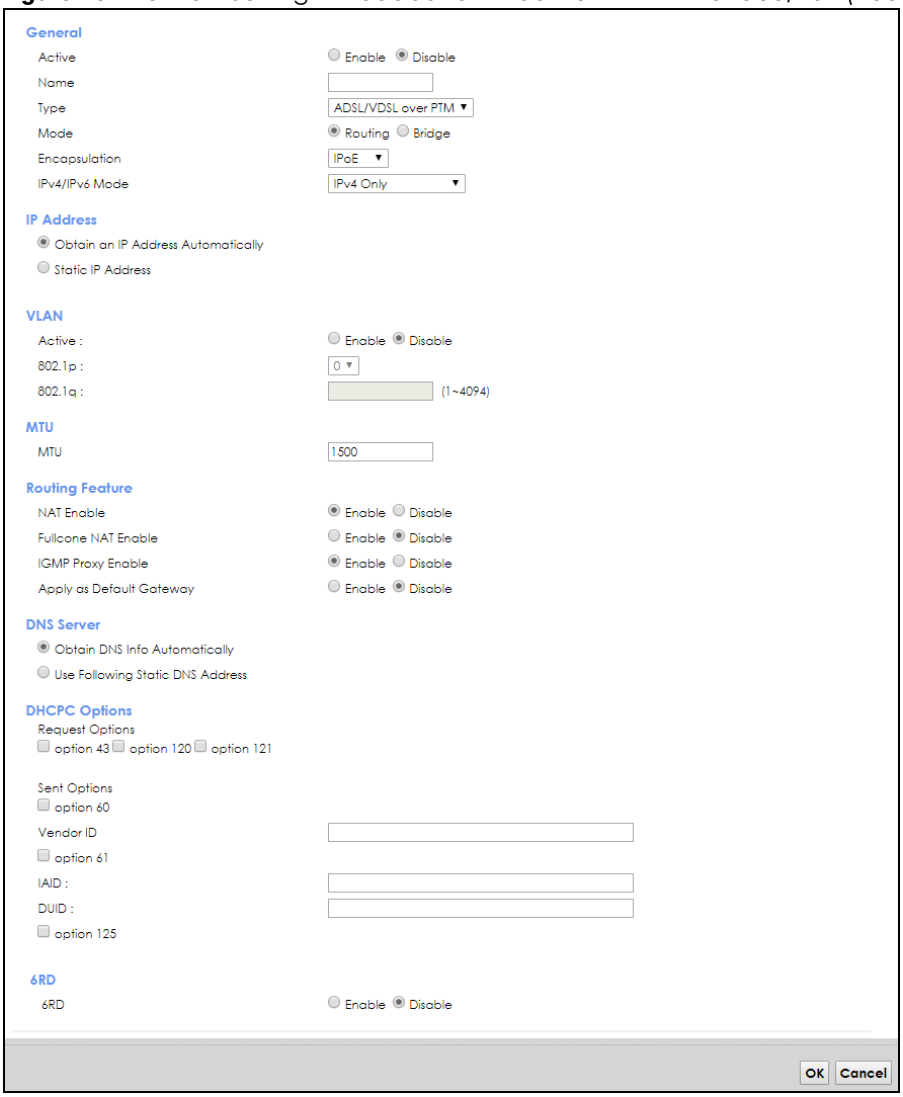
Click **Add New WAN Interface** in the **Broadband** screen or the **Edit** icon next to an existing WAN interface to configure a WAN connection. The screen varies depending on the interface type, mode, encapsulation, and IPv6/IPv4 mode you select.

6.2.1.1 Routing Mode

Use **Routing** mode if your ISP give you one IP address only and you want multiple computers to share an Internet account.

The following example screen displays when you select the **ADSL/VDSL over ATM** connection type, **Routing** mode, and **IPoE** encapsulation. The screen varies when you select other interface type, encapsulation, and IPv4/IPv6 mode.

Figure 26 Network Setting > Broadband > Add New WAN Interface/Edit (Routing Mode)



The following table describes the labels in this screen.

Table 9 Network Setting > Broadband > Add New WAN Interface/Edit (Routing Mode)

LABEL	DESCRIPTION
General	
Active	Select this to enable the WAN interface.
Name	Specify a descriptive name for this connection.
Type	Select whether it is an ADSL/VDSL over PTM, ADSL over ATM connection or Ethernet.

Table 9 Network Setting > Broadband > Add New WAN Interface/Edit (Routing Mode) (continued)

LABEL	DESCRIPTION
Mode	Select **Routing** if your ISP give you one IP address only and you want multiple computers to share an Internet account.
Encapsulation	Select the method of encapsulation used by your ISP from the drop-down list box. This option is available only when you select **Routing** in the **Mode** field. The choices depend on the connection type you selected. If your connection type is **ADSL/VDSL over PTM**, the choices are **PPPoE** and **IPoE**. If your connection type is **ADSL over ATM**, the choices are **PPPoE**, **PPPoA**, **IPoE** and **IPoA**. If your connection type is **Ethernet**, the choices are **PPPoE** and **IPoE**.
IPv4/IPv6 Mode	Select **IPv4 Only** if you want the XMG to run IPv4 only. Select **IPv4 IPv6 DualStack** to allow the XMG to run IPv4 and IPv6 at the same time. Select **IPv6 Only** if you want the XMG to run IPv6 only.
ATM PVC Configuration (These fields appear when the **Type** is set to **ADSL over ATM**.)	
VPI	The valid range for the VPI is 0 to 255. Enter the VPI assigned to you.
VCI	The valid range for the VCI is 32 to 65535 (0 to 31 is reserved for local management of ATM traffic). Enter the VCI assigned to you.
Encapsulation Mode	Select the method of multiplexing used by your ISP from the drop-down list box. Choices are: • **LLC/SNAP-BRIDGING:** In LCC encapsulation, bridged PDUs are encapsulated by identifying the type of the bridged media in the SNAP header. This is available only when you select **IPoE** or **PPPoE** in the **Select DSL Link Type** field. • **VC/MUX:** In VC multiplexing, each protocol is carried on a single ATM virtual circuit (VC). To transport multiple protocols, the XMG needs separate VCs. There is a binding between a VC and the type of the network protocol carried on the VC. This reduces payload overhead since there is no need to carry protocol information in each Protocol Data Unit (PDU) payload. • **LLC/ENCAPSULATION:** More than one protocol can be carried over the same VC. This is available only when you select **PPPoA** in the **Encapsulation** field. • **LLC/SNAP-ROUTING:** In LCC encapsulation, an IEEE 802.2 Logical Link Control (LLC) header is prefixed to each routed PDU to identify the PDUs. The LCC header can be followed by an IEEE 802.1a SubNetwork Attachment Point (SNAP) header. This is available only when you select **IPoA** in the **Encapsulation** field.
Service Category	Select **UBR Without PCR** or **UBR With PCR** for applications that are non-time sensitive, such as e-mail. Select **CBR** (Continuous Bit Rate) to specify fixed (always-on) bandwidth for voice or data traffic. Select **Non Realtime VBR** (non real-time Variable Bit Rate) for connections that do not require closely controlled delay and delay variation. Select **Realtime VBR** (real-time Variable Bit Rate) for applications with bursty connections that require closely controlled delay and delay variation.
IP Address (This is available only when you select **IPv4 Only** or **IPv4 IPv6 DualStack** in the **IPv4/IPv6 Mode** field.)	
Obtain an IP Address Automatically	A static IP address is a fixed IP that your ISP gives you. A dynamic IP address is not fixed; the ISP assigns you a different one each time you connect to the Internet. Select this if you have a dynamic IP address.
DHCP option 60/ Vendor ID	This field displays when editing an existing WAN interface. Type the class vendor ID you want the XMG to add in the DHCP Discovery packets that go to the DHCP server.
DHCP option 61 IAD	This field displays when editing an existing WAN interface. Type the Identity Association Identifier (IAD) you want the XMG to add in the DHCP Discovery packets that go to the DHCP server.
DHCP option 61 DUID	This field displays when editing an existing WAN interface. Type the DHCP Unique Identifier (DUID) you want the XMG to add in the DHCP Discovery packets that go to the DHCP server.
DHCP option 43 Enable	This field displays when editing an existing WAN interface. Type the vendor specific information you want the XMG to add in the DHCP Offer packets. The information is used, for example, for configuring an ACS's (Auto Configuration Server) URL.

Table 9 Network Setting > Broadband > Add New WAN Interface/Edit (Routing Mode) (continued)

LABEL	DESCRIPTION
Static IP Address	Select this option If the ISP assigned a fixed IP address
IP Address	Enter the static IP address provided by your ISP.
Subnet Mask	Enter the subnet mask provided by your ISP.
Gateway IP Address	Enter the gateway IP address provided by your ISP.
VLAN (These fields appear when the **Type** is set to **ADSL/VDSL over PTM**.)	
Active	Select this to enable VLAN on this WAN interface.
802.1p	IEEE 802.1p defines up to 8 separate traffic types by inserting a tag into a MAC-layer frame that contains bits to define class of service. Select the IEEE 802.1p priority level (from 0 to 7) to add to traffic through this connection. The greater the number, the higher the priority level.
802.1q	Type the VLAN ID number (from 1 to 4094) for traffic through this connection.
MTU	Enter the MTU (Maximum Transfer Unit) size for this traffic.
Routing Feature (This is available only when you select **IPv4 Only** or **IPv4 IPv6 DualStack** in the **IPv4/IPv6 Mode** field.)	
NAT Enable	Select this option to activate NAT on this connection.
Fullcone NAT Enable	Select this option to enable full cone NAT on this connection. This field is available only when you activate NAT. In full cone NAT, the XMG maps all outgoing packets from an internal IP address and port to a single IP address and port on the external network. The XMG also maps packets coming to that external IP address and port to the internal IP address and port.
IGMP Proxy Enable	Internet Group Multicast Protocol (IGMP) is a network-layer protocol used to establish membership in a Multicast group - it is not used to carry user data. Select this option to have the XMG act as an IGMP proxy on this connection. This allows the XMG to get subscribing information and maintain a joined member list for each multicast group. It can reduce multicast traffic significantly.
Apply as Default Gateway	Select this option to have the XMG use the WAN interface of this connection as the system default gateway.
DNS Server (This is available only when you select **IPv4 Only** or **IPv4 IPv6 DualStack** in the **IPv4/IPv6 Mode** field.)	
	Select **Obtain DNS Info Automically** if you want the XMG to use the DNS server addresses assigned by your ISP. Select **Use Following Static DNS Address** if you want the XMG to use the DNS server addresses you configure manually.
Primary DNS Server	Enter the first DNS server address assigned by the ISP.
Secondary DNS Server	Enter the second DNS server address assigned by the ISP.
Tunnel The DS-Lite (Dual Stack Lite) fields display when you set the **IPv4/IPv6 Mode** field to **IPv6 Only**. Enable Dual Stack Lite to let local computers use IPv4 through an ISP's IPv6 network. See Dual Stack Lite on page 67 for more information.	
Enable DS-Lite	This is available only when you select **IPv6 Only** in the **IPv4/IPv6 Mode** field. Select **Enable** to let local computers use IPv4 through an ISP's IPv6 network.
DS-Lite Relay Server IP	Specify the transition router's IPv6 address.
6RD The 6RD (IPv6 rapid deployment) fields display when you set the **IPv6/IPv4 Mode** field to **IPv4 Only**. See IPv6 Rapid Deployment on page 66 for more information.	

Table 9 Network Setting > Broadband > Add New WAN Interface/Edit (Routing Mode) (continued)

LABEL	DESCRIPTION
6RD	Select **Enable** to tunnel IPv6 traffic from the local network through the ISP's IPv4 network.
	Select **Manually Configured** if you have the IPv4 address of the relay server. Otherwise, select **Automatically configured by DHCPC** to have the XMG detect it automatically through DHCP. The **Automatically configured by DHCPC** option is configurable only when you set the method of encapsulation to **IPoE**.
Service Provider IPv6 Prefix	Enter an IPv6 prefix for tunneling IPv6 traffic to the ISP's border relay router and connecting to the native IPv6 Internet.
IPv4 Mask Length	Enter the subnet mask number (1~32) for the IPv4 network.
Border Relay IPv4 Address	When you select **Manually Configured**, specify the relay server's IPv4 address in this field.
DHCPC Options (This is available only when you select **IPv4 Only** or **IPv4 IPv6 DualStack** in the **IPv4/IPv6 Mode** field.)	
Request Options	Select **Option 43** to have the XMG automatically add vendor specific information in the DHCP packets to request the vendor specific options from the DHCP server. Select **Option 121** to have the XMG push static routes to clients.
Sent Options	
option 60	Select this and enter the device identity you want the XMG to add in the DHCP discovery packets that go to the DHCP server.
Vendor ID	Enter the Vendor Class Identifier, such as the type of the hardware or firmware.
option 61	Select this and enter any string that identifies the device.
IAID	Enter the Identity Association Identifier (IAID) of the device, for example, the WAN connection index number.
DUID	Enter the hardware type, a time value and the MAC address of the device.
option 125	Select this to have the XMG automatically generate and add vendor specific parameters in the DHCP discovery packets that go to the DHCP server.
IPv6 Address (This is available only when you select **IPv4 IPv6 DualStack** or **IPv6 Only** in the **IPv4/IPv6 Mode** field.)	
Obtain an IPv6 Address Automatically	Select **Obtain an IPv6 Address Automatically** if you want to have the XMG use the IPv6 prefix from the connected router's Router Advertisement (RA) to generate an IPv6 address.
Static IPv6 Address	Select **Static IPv6 Address** if you have a fixed IPv6 address assigned by your ISP. When you select this, the following fields appear.
IPv6 Address	Enter an IPv6 IP address that your ISP gave to you for this WAN interface.
Prefix Length	Enter the address prefix length to specify how many most significant bits in an IPv6 address compose the network address.
IPv6 Default Gateway	Enter the IP address of the next-hop gateway. The gateway is a router or switch on the same segment as your XMG's interface(s). The gateway helps forward packets to their destinations.
IPv6 Routing Feature (This is available only when you select **IPv4 IPv6 DualStack** or **IPv6 Only** in the **IPv4/IPv6 Mode** field. You can enable IPv6 routing features in the following section.)	
MLD Proxy Enable	Select this checkbox to have the XMG act as an MLD proxy on this connection. This allows the XMG to get subscription information and maintain a joined member list for each multicast group. It can reduce multicast traffic significantly.
Apply as Default Gateway	Select this option to have the XMG use the WAN interface of this connection as the system default gateway.
IPv6 DNS Server This is available only when you select **IPv4 IPv6 DualStack** or **IPv6 Only** in the **IPv4/IPv6 Mode** field. Configure the IPv6 DNS server in the following section.	

Table 9 Network Setting > Broadband > Add New WAN Interface/Edit (Routing Mode) (continued)

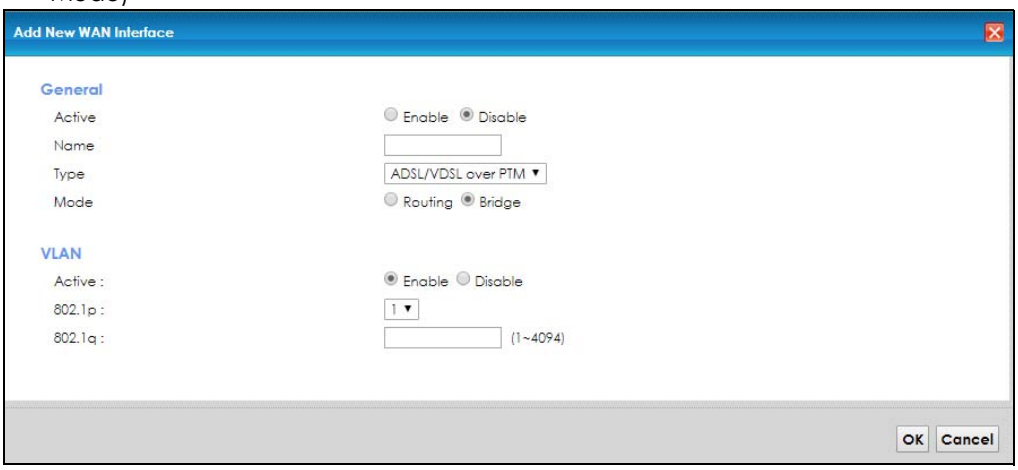
LABEL	DESCRIPTION
Obtain IPv6 DNS Info Automatically	Select **Obtain IPv6 DNS Info Automatically** to have the XMG get the IPv6 DNS server addresses from the ISP automatically.
Use Following Static IPv6 DNS Address	Select **Use Following Static IPv6 DNS Address** to have the XMG use the IPv6 DNS server addresses you configure manually.
Primary DNS Server	Enter the first IPv6 DNS server address assigned by the ISP.
Secondary DNS Server	Enter the second IPv6 DNS server address assigned by the ISP.
Apply	Click **Apply** to save your changes back to the XMG.
Cancel	Click **Cancel** to exit this screen without saving.

6.2.1.2 Bridge Mode

Click the **Add new WAN Interface** in the **Network Setting > Broadband** screen or the **Edit** icon next to the connection you want to configure. Select **Bridge** as the encapsulation mode. The screen varies depending on the interface type you select.

If you select **ADSL/VDSL over PTM** or **Ethernet** as the interface type, the following screen appears.

Figure 27 Network Setting > Broadband > Add New WAN Interface/Edit (ADSL/VDSL over PTM -Bridge Mode)



The following table describes the fields in this screen.

Table 10 Network Setting > Broadband > Add New WAN Interface/Edit (ADSL/VDSL over PTM -Bridge or Ethernet Mode)

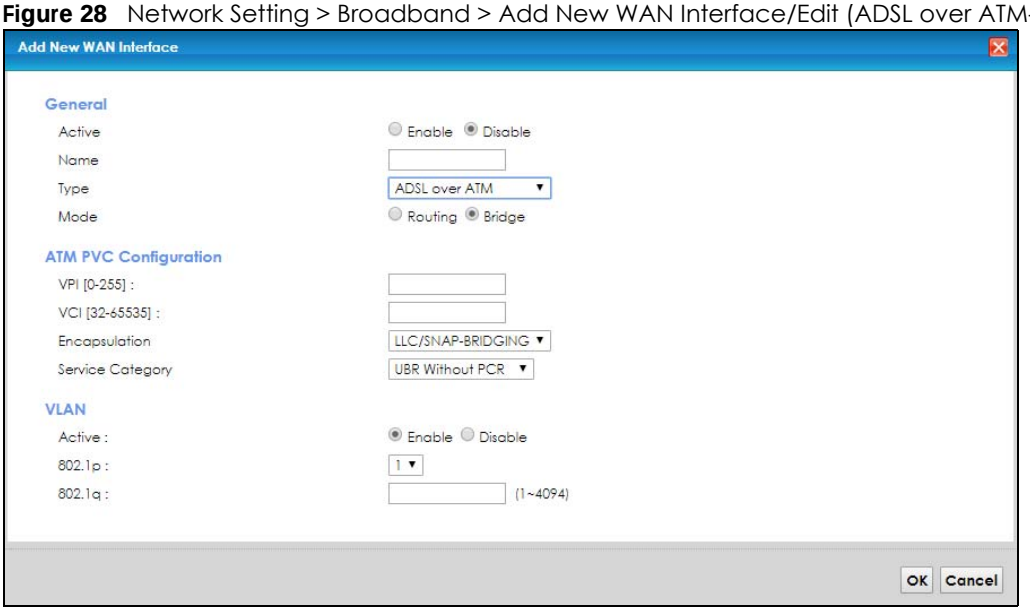
LABEL	DESCRIPTION
General	
Active	Select this to enable the WAN interface.
Name	Enter a service name of the connection.
Type	Select **ADSL/VDSL over PTM** as the interface that you want to configure. The XMG uses the VDSL technology for data transmission over the DSL port.

Table 10 Network Setting > Broadband > Add New WAN Interface/Edit (ADSL/VDSL over PTM -Bridge or Ethernet Mode) (continued)

LABEL	DESCRIPTION
Mode	Select **Bridge** when your ISP provides you more than one IP address and you want the connected computers to get individual IP address from ISP's DHCP server directly. If you select **Bridge**, you cannot use routing functions, such as QoS, Firewall, DHCP server and NAT on traffic from the selected LAN port(s).
VLAN	This section is available only when you select **ADSL/VDSL over PTM** in the **Type** field.
Active	Select **Enable** to enable VLAN on this WAN interface.
802.1p	IEEE 802.1p defines up to 8 separate traffic types by inserting a tag into a MAC-layer frame that contains bits to define class of service. Select the IEEE 802.1p priority level (from 0 to 7) to add to traffic through this connection. The greater the number, the higher the priority level.
802.1q	Type the VLAN ID number (from 0 to 4094) for traffic through this connection.
OK	Click **OK** to save your changes.
Cancel	Click **Cancel** to exit this screen without saving.

If you select **ADSL over ATM** as the interface type, the following screen appears.

Figure 28 Network Setting > Broadband > Add New WAN Interface/Edit (ADSL over ATM-Bridge Mode)



The following table describes the fields in this screen.

Table 11 Network Setting > Broadband > Add New WAN Interface/Edit (ADSL over ATM-Bridge Mode)

LABEL	DESCRIPTION
General	
Name	Enter a service name of the connection.
Type	Select **ADSL over ATM** as the interface that you want to configure. The XMG uses the ADSL technology for data transmission over the DSL port.
Mode	Select **Bridge** when your ISP provides you more than one IP address and you want the connected computers to get individual IP address from ISP's DHCP server directly. If you select **Bridge**, you cannot use routing functions, such as QoS, Firewall, DHCP server and NAT on traffic from the selected LAN port(s).
ATM PVC Configuration (These fields appear when the **Type** is set to **ADSL over ATM**.)	

Table 11 Network Setting > Broadband > Add New WAN Interface/Edit (ADSL over ATM-Bridge Mode)

LABEL	DESCRIPTION
VPI	The valid range for the VPI is 0 to 255. Enter the VPI assigned to you.
VCI	The valid range for the VCI is 32 to 65535 (0 to 31 is reserved for local management of ATM traffic). Enter the VCI assigned to you.
Encapsulation	Select the method of multiplexing used by your ISP from the drop-down list box. Choices are: • **LLC/SNAP-BRIDGING:** In LCC encapsulation, bridged PDUs are encapsulated by identifying the type of the bridged media in the SNAP header. This is available only when you select **IPoE** or **PPPoE** in the **Encapsulation** field. • **VC/MUX:** In VC multiplexing, each protocol is carried on a single ATM virtual circuit (VC). To transport multiple protocols, the XMG needs separate VCs. There is a binding between a VC and the type of the network protocol carried on the VC. This reduces payload overhead since there is no need to carry protocol information in each Protocol Data Unit (PDU) payload.
Service Category	Select **UBR Without PCR** for applications that are non-time sensitive, such as e-mail. Select **CBR** (Continuous Bit Rate) to specify fixed (always-on) bandwidth for voice or data traffic. Select **Non Realtime VBR** (non real-time Variable Bit Rate) for connections that do not require closely controlled delay and delay variation. Select **Realtime VBR** (real-time Variable Bit Rate) for applications with bursty connections that require closely controlled delay and delay variation.
VLAN	This section is available only when you select **ADSL/VDSL over PTM** in the **Type** field.
Active	Select **Enable** to enable VLAN on this WAN interface.
802.1p	IEEE 802.1p defines up to 8 separate traffic types by inserting a tag into a MAC-layer frame that contains bits to define class of service. Select the IEEE 802.1p priority level (from 0 to 7) to add to traffic through this connection. The greater the number, the higher the priority level.
802.1q	Type the VLAN ID number (from 0 to 4094) for traffic through this connection.
OK	Click **OK** to save your changes.
Cancel	Click **Cancel** to exit this screen without saving.

6.3 The Advanced Screen

Use the **Advanced** screen to enable or disable ADSL over PTM, Annex M, DSL PhyR functions. The XMG supports the PhyR retransmission scheme. PhyR is a retransmission scheme designed to provide protection against noise on the DSL line. It improves voice, video and data transmission resilience by utilizing a retransmission buffer.

ITU-T G.993.2 standard defines a wide range of settings for various parameters, some of which are encompassed in profiles as shown in the next table.

Table 12 VDSL Profiles

PROFILE	BANDWIDTH (MHZ)	NUMBER OF DOWNSTREAM CARRIERS	CARRIER BANDWIDTH (KHZ)	POWER (DBM)	MAX. DOWNSTREAM THROUGHPUT (MBIT/S)
8a	8.832	2048	4.3125	17.5	50
8b	8.832	2048	4.3125	20.5	50
8c	8.5	1972	4.3125	11.5	50
8d	8.832	2048	4.3125	14.5	50

Table 12 VDSL Profiles (continued)

PROFILE	BANDWIDTH (MHZ)	NUMBER OF DOWNSTREAM CARRIERS	CARRIER BANDWIDTH (KHZ)	POWER (DBM)	MAX. DOWNSTREAM THROUGHPUT (MBIT/S)
12a	12	2783	4.3125	14.5	68
12b	12	2783	4.3125	14.5	68
17a	17.664	4096	4.3125	14.5	100
30a	30	3479	8.625	14.5	200

6.3.1 DSL Bonding

If the DSLAM of your ISP supports DSL bonding, you can connect the two DSL ports on the XMG to two separate telephone jacks and enable the bonding feature in the **Advanced** screen.

DSL signals have distance limitations. VDSL2 (profile 17a) supports greater speed but offer shorter distances (within 3000 ft). The farther away the subscribers are from the DSLAM, the slower the speed. VDSL (profile 12a) provides longer distance range (over 3000 ft) but at lower speeds. DSL bonding allows subscribers to use data streams spread over two DSL lines in order to (almost) double the speed at longer distances. You may choose to use DSL bonding if the DSLAM supports it and there are two DSL lines to the DSLAM.

The total available bandwidth for the subscriber then becomes the sum of the bandwidth available for each of the subscriber's line connections. The data rate depends on the DSL type, its standard/profile, and the standard/profile that the DSLAM supports. The table below shows the transmission data rate for single DSL line and DSL bonding.

Table 13 Comparison Table for Single DSL line and DSL Bonding

ITEM	VDSL2	VDSL BONDING	ADSL2+	ADSL(2+) BONDING
PROFILE/ STANDARD	G993.2 Profile 17a	G993.2 Profile 12a	G.992.5	G.992.5
MAX. DOWNSTREAM/ UPSTREAM	100/60 Mbps	50/25 x 2 = 100/50 Mbps	25/1 Mbps	25/1 x 2 = 50/2 Mbps
DISTANCE	within 3000 ft	over 3000 ft	over 5000 ft	5000 to 7000 ft

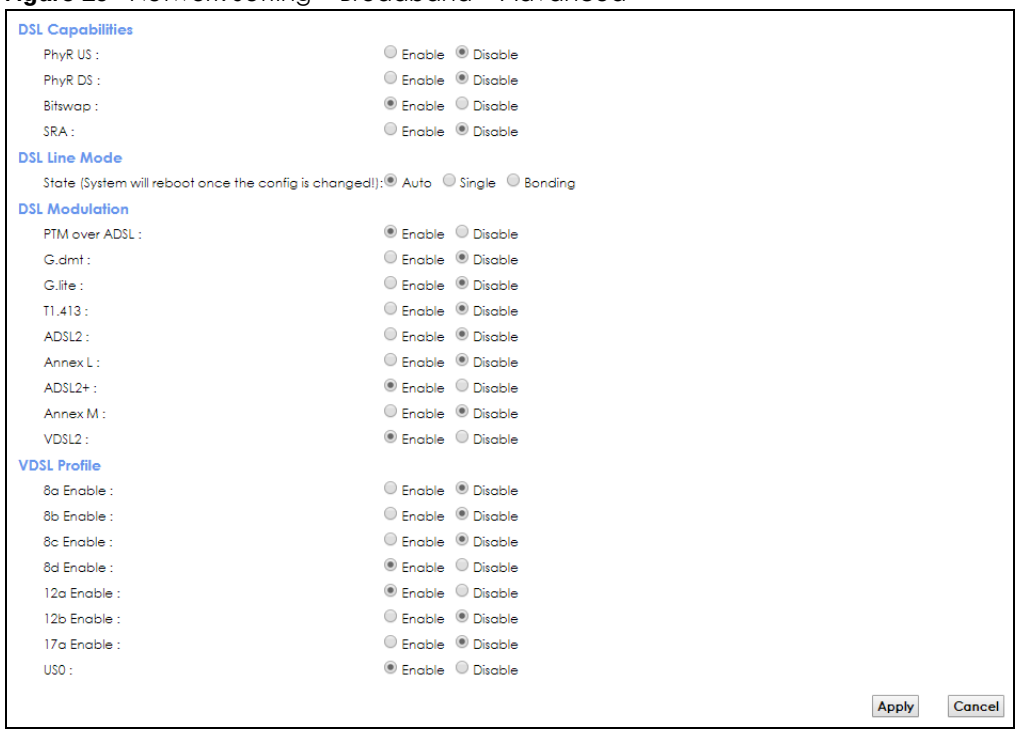
For a single VDSL2 line, the profile is 17a, which provides a maximum data rate of 100/60 Mbps (downstream/upstream). A VDSL2 17a bonding profile can reach 200Mbps/100Mbps. If VDSL bonding is used, the supported profile is 12a, which provides a maximum data rate of 50/25 Mbps for each VDSL line. The ideal total data rate for the bonded connection is 100/50 Mbps.

For a single ADSL line, the standard with the highest data rate supported is ADSL2+, which provides 25/1 Mbps data rate. When ADSL bonding is used, the data rate doubles to 50/2 Mbps.

In addition, DSL bonding supports ADSL bonding fallback. If a VDSL connection cannot be established, the XMG tries to use ADSL. If the VDSL connection is re-established, the XMG automatically switches back to VDSL. You must enable DSL bonding in order to use ADSL fallback.

Click **Network Setting** > **Broadband** > **Advanced** to display the following screen.

Figure 29 Network Setting > Broadband > Advanced



The following table describes the labels in this screen.

Table 14 Network Setting > Broadband > Advanced

LABEL	DESCRIPTION
PhyR US	Enable or disable **PhyR US** (upstream) for upstream transmission to the WAN. PhyR US should be enabled if data being transmitted upstream is sensitive to noise. However, enabling PhyR US can decrease the US line rate. Enabling or disabling PhyR will require the CPE to retrain. For PhyR to function, the DSLAM must also support PhyR and have it enabled.
PhyR DS	Enable or disable **PhyR DS** (downstream) for downstream transmission from the WAN. PhyR DS should be enabled if data being transmitted downstream is sensitive to noise. However, enabling PhyR DS can decrease the DS line rate. Enabling or disabling PhyR will require the CPE to retrain. For PhyR to function, the DSLAM must also support PhyR and have it enabled.
Bitswap	Select **Enable** to allow the XMG to adapt to line changes when you are using G.dmt. Bit-swapping is a way of keeping the line more stable by constantly monitoring and redistributing bits between channels.
SRA	Enable or disable Seamless Rate Adaption (SRA). Select **Enable** to have the XMG automatically adjust the connection's data rate according to line conditions without interrupting service.
DSL Line Mode	
State (System will reboot once the config is changed!)	Select **Auto** for the XMG to change DSL line modes automatically. Select **Single** to have a single DSL line transmission. Select **Bonding** to allow subscribers to use data streams spread over two DSL lines in order to (almost) double the speed at longer distances.
DSL Modulation	
PTM over ADSL:	Select **Enable** to use PTM over ADSL. Since PTM has less overhead than ATM, some ISPs use this for better performance.

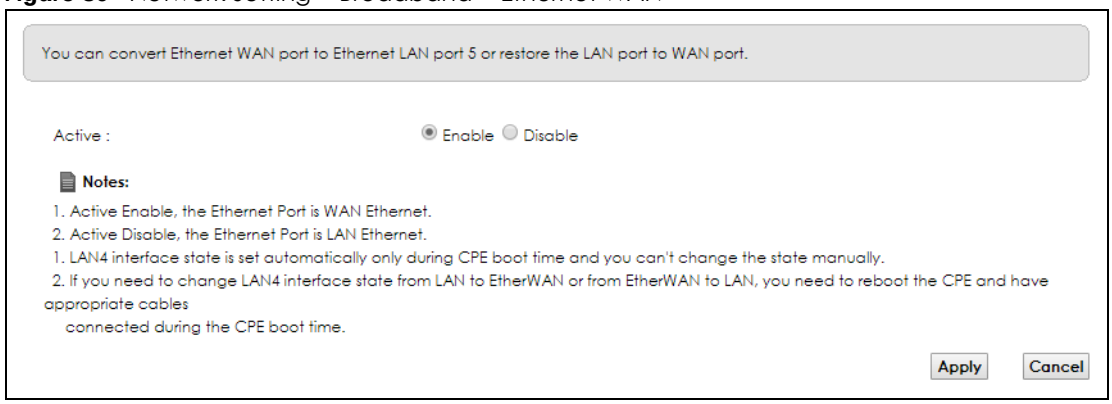
Table 14 Network Setting > Broadband > Advanced (continued)

LABEL	DESCRIPTION
G.dmt:	ITU G.992.1 (better known as G.dmt) is an ITU standard for ADSL using discrete multitone modulation. G.dmt full-rate ADSL expands the usable bandwidth of existing copper telephone lines, delivering high-speed data communications at rates up to 8 Mbit/s downstream and 1.3 Mbit/s upstream.
G.lite :	ITU G.992.2 (better known as G.lite) is an ITU standard for ADSL using discrete multitone modulation. G.lite does not strictly require the use of DSL filters, but like all variants of ADSL generally functions better with splitters.
T1.413 :	ANSI T1.413 is a technical standard that defines the requirements for the single asymmetric digital subscriber line (ADSL) for the interface between the telecommunications network and the customer installation in terms of their interaction and electrical characteristics.
ADSL2 :	It optionally extends the capability of basic ADSL in data rates to 12 Mbit/s downstream and, depending on Annex version, up to 3.5 Mbit/s upstream (with a mandatory capability of ADSL2 transceivers of 8 Mbit/s downstream and 800 kbit/s upstream).
AnnexL :	Annex L is an optional specification in the ITU-T ADSL2 recommendation G.992.3 titled Specific requirements for a Reach Extended ADSL2 (READSL2) system operating in the frequency band above POTS, therefore it is often referred to as Reach Extended ADSL2 or READSL2.The main difference between this specification and commonly deployed Annex A is the maximum distance that can be used. The power of the lower frequencies used for transmitting data is boosted up to increase the reach of this signal up to 7 kilometers (23,000 ft).
ADSL2+ :	ADSL2+ extends the capability of basic ADSL by doubling the number of downstream channels. The data rates can be as high as 24 Mbit/s downstream and up to 1.4 Mbit/s upstream depending on the distance from the DSLAM to the customer's premises.
AnnexM :	Annex M is an optional specification in ITU-T recommendations G.992.3 (ADSL2) and G.992.5 (ADSL2+), also referred to as ADSL2 M and ADSL2+ M. This specification extends the capability of commonly deployed Annex A by more than doubling the number of upstream bits. The data rates can be as high as 12 or 24 Mbit/s downstream and 3 Mbit/s upstream depending on the distance from the DSLAM to the customer's premises.
VDSL2	VDSL is a specification that supports wide deployment of voice, video, data and HDTV. The data can be as high as on ADSL2+. It has a long reach performance, and unlike VDSL systems it is not limited to short local loops.
VDSL Profile	VDSL2 profiles differ in the width of the frequency band used to transmit the broadband signal. Profiles that use a wider frequency band can deliver higher maximum speeds.
8a, 8b, 8c, 8d, 12a, 12b, 17a, 30a, US0	The G.993.2 VDSL standard defines a wide range of profiles that can be used in different VDSL deployment settings, such as in a central office, a street cabinet or a building. The XMG must comply with at least one profile specified in G.993.2. but compliance with more than one profile is allowed.
Apply	Click **Apply** to save your changes back to the XMG.
Cancel	Click **Cancel** to return to the previous configuration.

6.4 The Ethernet WAN Screen

You can enable the fourth Ethernet LAN port to be an Ethernet WAN port in the **Ethernet WAN** screen. Click **Network Setting** > **Broadband** > **Ethernet WAN** to display the following screen.

Figure 30 Network Setting > Broadband > Ethernet WAN



The following table describes the labels in this screen.

Table 15 Network Setting > Broadband > Ethernet WAN

LABEL	DESCRIPTION
Active	Select **Enable** to convert the fourth Ethernet LAN port to the Ethernet WAN port. Otherwise, select **Disable**.
Apply	Click **Apply** to save your changes back to the XMG.
Cancel	Click **Cancel** to return to the previous configuration.

6.5 Technical Reference

The following section contains additional technical information about the XMG features described in this chapter.

Encapsulation

Be sure to use the encapsulation method required by your ISP. The XMG can work in bridge mode or routing mode. When the XMG is in routing mode, it supports the following methods.

IP over Ethernet

IP over Ethernet (IPoE) is an alternative to PPPoE. IP packets are being delivered across an Ethernet network, without using PPP encapsulation. They are routed between the Ethernet interface and the WAN interface and then formatted so that they can be understood in a bridged environment. For instance, it encapsulates routed Ethernet frames into bridged Ethernet cells.

PPP over ATM (PPPoA)

PPPoA stands for Point to Point Protocol over ATM Adaptation Layer 5 (AAL5). A PPPoA connection functions like a dial-up Internet connection. The XMG encapsulates the PPP session based on RFC1483 and sends it through an ATM PVC (Permanent Virtual Circuit) to the Internet Service Provider's (ISP) DSLAM (digital access multiplexer). Please refer to RFC 2364 for more information on PPPoA. Refer to RFC 1661 for more information on PPP.

PPP over Ethernet (PPPoE)

Point-to-Point Protocol over Ethernet (PPPoE) provides access control and billing functionality in a manner similar to dial-up services using PPP. PPPoE is an IETF standard (RFC 2516) specifying how a personal computer (PC) interacts with a broadband modem (DSL, cable, wireless, etc.) connection.

For the service provider, PPPoE offers an access and authentication method that works with existing access control systems (for example RADIUS).

One of the benefits of PPPoE is the ability to let you access one of multiple network services, a function known as dynamic service selection. This enables the service provider to easily create and offer new IP services for individuals.

Operationally, PPPoE saves significant effort for both you and the ISP or carrier, as it requires no specific configuration of the broadband modem at the customer site.

By implementing PPPoE directly on the XMG (rather than individual computers), the computers on the LAN do not need PPPoE software installed, since the XMG does that part of the task. Furthermore, with NAT, all of the LANs' computers will have access.

RFC 1483

RFC 1483 describes two methods for Multiprotocol Encapsulation over ATM Adaptation Layer 5 (AAL5). The first method allows multiplexing of multiple protocols over a single ATM virtual circuit (LLC-based multiplexing) and the second method assumes that each protocol is carried over a separate ATM virtual circuit (VC-based multiplexing). Please refer to RFC 1483 for more detailed information.

Multiplexing

There are two conventions to identify what protocols the virtual circuit (VC) is carrying. Be sure to use the multiplexing method required by your ISP.

VC-based Multiplexing

In this case, by prior mutual agreement, each protocol is assigned to a specific virtual circuit; for example, VC1 carries IP, etc. VC-based multiplexing may be dominant in environments where dynamic creation of large numbers of ATM VCs is fast and economical.

LLC-based Multiplexing

In this case one VC carries multiple protocols with protocol identifying information being contained in each packet header. Despite the extra bandwidth and processing overhead, this method may be advantageous if it is not practical to have a separate VC for each carried protocol, for example, if charging heavily depends on the number of simultaneous VCs.

Traffic Shaping

Traffic Shaping is an agreement between the carrier and the subscriber to regulate the average rate and fluctuations of data transmission over an ATM network. This agreement helps eliminate congestion, which is important for transmission of real time data such as audio and video connections.

Peak Cell Rate (PCR) is the maximum rate at which the sender can send cells. This parameter may be lower (but not higher) than the maximum line speed. 1 ATM cell is 53 bytes (424 bits), so a maximum speed of 832Kbps gives a maximum PCR of 1962 cells/sec. This rate is not guaranteed because it is dependent on the line speed.

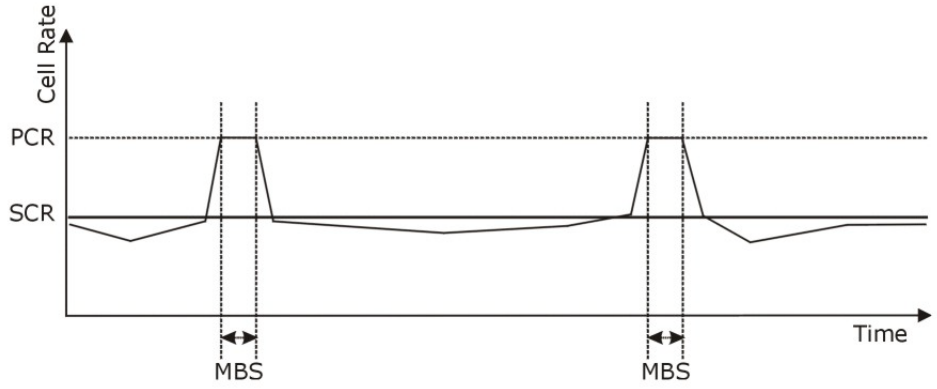
Sustained Cell Rate (SCR) is the mean cell rate of each bursty traffic source. It specifies the maximum average rate at which cells can be sent over the virtual connection. SCR may not be greater than the PCR.

Maximum Burst Size (MBS) is the maximum number of cells that can be sent at the PCR. After MBS is reached, cell rates fall below SCR until cell rate averages to the SCR again. At this time, more cells (up to the MBS) can be sent at the PCR again.

If the PCR, SCR or MBS is set to the default of "0", the system will assign a maximum value that correlates to your upstream line rate.

The following figure illustrates the relationship between PCR, SCR and MBS.

Figure 31 Example of Traffic Shaping



ATM Traffic Classes

These are the basic ATM traffic classes defined by the ATM Forum Traffic Management 4.0 Specification.

Constant Bit Rate (CBR)

Constant Bit Rate (CBR) provides fixed bandwidth that is always available even if no data is being sent. CBR traffic is generally time-sensitive (doesn't tolerate delay). CBR is used for connections that continuously require a specific amount of bandwidth. A PCR is specified and if traffic exceeds this rate, cells may be dropped. Examples of connections that need CBR would be high-resolution video and voice.

Variable Bit Rate (VBR)

The Variable Bit Rate (VBR) ATM traffic class is used with bursty connections. Connections that use the Variable Bit Rate (VBR) traffic class can be grouped into real time (VBR-RT) or non-real time (VBR-nRT) connections.

The VBR-RT (real-time Variable Bit Rate) type is used with bursty connections that require closely controlled delay and delay variation. It also provides a fixed amount of bandwidth (a PCR is specified) but is only available when data is being sent. An example of an VBR-RT connection would be video conferencing. Video conferencing requires real-time data transfers and the bandwidth requirement varies in proportion to the video image's changing dynamics.

The VBR-nRT (non real-time Variable Bit Rate) type is used with bursty connections that do not require closely controlled delay and delay variation. It is commonly used for "bursty" traffic typical on LANs. PCR and MBS define the burst levels, SCR defines the minimum level. An example of an VBR-nRT connection would be non-time sensitive data file transfers.

Unspecified Bit Rate (UBR)

The Unspecified Bit Rate (UBR) ATM traffic class is for bursty data transfers. However, UBR doesn't guarantee any bandwidth and only delivers traffic when the network has spare bandwidth. An example application is background file transfer.

IP Address Assignment

A static IP is a fixed IP that your ISP gives you. A dynamic IP is not fixed; the ISP assigns you a different one each time. The Single User Account feature can be enabled or disabled if you have either a dynamic or static IP. However the encapsulation method assigned influences your choices for IP address and default gateway.

Introduction to VLANs

A Virtual Local Area Network (VLAN) allows a physical network to be partitioned into multiple logical networks. Devices on a logical network belong to one group. A device can belong to more than one group. With VLAN, a device cannot directly talk to or hear from devices that are not in the same group(s); the traffic must first go through a router.

In Multi-Tenant Unit (MTU) applications, VLAN is vital in providing isolation and security among the subscribers. When properly configured, VLAN prevents one subscriber from accessing the network resources of another on the same LAN, thus a user will not see the printers and hard disks of another user in the same building.

VLAN also increases network performance by limiting broadcasts to a smaller and more manageable logical broadcast domain. In traditional switched environments, all broadcast packets go to each and every individual port. With VLAN, all broadcasts are confined to a specific broadcast domain.

Introduction to IEEE 802.1Q Tagged VLAN

A tagged VLAN uses an explicit tag (VLAN ID) in the MAC header to identify the VLAN membership of a frame across bridges - they are not confined to the switch on which they were created. The VLANs can be created statically by hand or dynamically through GVRP. The VLAN ID associates a frame with a specific VLAN and provides the information that switches need to process the frame across the network. A tagged frame is four bytes longer than an untagged frame and contains two bytes of TPID (Tag Protocol Identifier), residing within the type/length field of the Ethernet frame) and two bytes of TCI (Tag Control Information), starts after the source address field of the Ethernet frame).

The CFI (Canonical Format Indicator) is a single-bit flag, always set to zero for Ethernet switches. If a frame received at an Ethernet port has a CFI set to 1, then that frame should not be forwarded as it is to an untagged port. The remaining twelve bits define the VLAN ID, giving a possible maximum number of 4,096 VLANs. Note that user priority and VLAN ID are independent of each other. A frame with VID (VLAN Identifier) of null (0) is called a priority frame, meaning that only the priority level is significant and the default VID of the ingress port is given as the VID of the frame. Of the 4096 possible VIDs, a VID of 0 is used to identify priority frames and value 4095 (FFF) is reserved, so the maximum possible VLAN configurations are 4,094.

TPID	User Priority	CFI	VLAN ID
2 Bytes	3 Bits	1 Bit	12 Bits

Multicast

IP packets are transmitted in either one of two ways - Unicast (1 sender - 1 recipient) or Broadcast (1 sender - everybody on the network). Multicast delivers IP packets to a group of hosts on the network - not everybody and not just 1.

Internet Group Multicast Protocol (IGMP) is a network-layer protocol used to establish membership in a Multicast group - it is not used to carry user data. IGMP version 2 (RFC 2236) is an improvement over version 1 (RFC 1112) but IGMP version 1 is still in wide use. If you would like to read more detailed information about interoperability between IGMP version 2 and version 1, please see sections 4 and 5 of RFC 2236. The class D IP address is used to identify host groups and can be in the range 224.0.0.0 to 239.255.255.255. The address 224.0.0.0 is not assigned to any group and is used by IP multicast computers. The address 224.0.0.1 is used for query messages and is assigned to the permanent group of all IP hosts (including gateways). All hosts must join the 224.0.0.1 group in order to participate in IGMP. The address 224.0.0.2 is assigned to the multicast routers group.

At start up, the XMG queries all directly connected networks to gather group membership. After that, the XMG periodically updates this information.

DNS Server Address Assignment

Use Domain Name System (DNS) to map a domain name to its corresponding IP address and vice versa, for instance, the IP address of www.zyxel.com is 204.217.0.2. The DNS server is extremely important because without it, you must know the IP address of a computer before you can access it.

The XMG can get the DNS server addresses in the following ways.

1. The ISP tells you the DNS server addresses, usually in the form of an information sheet, when you sign up. If your ISP gives you DNS server addresses, manually enter them in the DNS server fields.
2. If your ISP dynamically assigns the DNS server IP addresses (along with the XMG's WAN IP address), set the DNS server fields to get the DNS server address from the ISP.

IPv6 Addressing

The 128-bit IPv6 address is written as eight 16-bit hexadecimal blocks separated by colons (:). This is an example IPv6 address `2001:0db8:1a2b:0015:0000:0000:1a2f:0000`.

IPv6 addresses can be abbreviated in two ways:

- Leading zeros in a block can be omitted. So `2001:0db8:1a2b:0015:0000:0000:1a2f:0000` can be written as `2001:db8:1a2b:15:0:0:1a2f:0`.
- Any number of consecutive blocks of zeros can be replaced by a double colon. A double colon can only appear once in an IPv6 address. So `2001:0db8:0000:0000:1a2f:0000:0000:0015` can be written as `2001:0db8::1a2f:0000:0000:0015`, `2001:0db8:0000:0000:1a2f::0015`, `2001:db8::1a2f:0:0:15` or `2001:db8:0:0:1a2f::15`.

IPv6 Prefix and Prefix Length

Similar to an IPv4 subnet mask, IPv6 uses an address prefix to represent the network address. An IPv6 prefix length specifies how many most significant bits (start from the left) in the address compose the network address. The prefix length is written as "/x" where x is a number. For example,

```
2001:db8:1a2b:15::1a2f:0/32
```

means that the first 32 bits (`2001:db8`) is the subnet prefix.

CHAPTER 7
Wireless

7.1 Overview

This chapter describes the XMG's **Network Setting > Wireless** screens. Use these screens to set up your XMG's wireless connection.

7.1.1 What You Can Do in this Chapter

This section describes the XMG's **Wireless** screens. Use these screens to set up your XMG's wireless connection.

- Use the **General** screen to enable the Wireless LAN, enter the SSID and select the wireless security mode (Section 7.2 on page 86).
- Use the **Guest/More AP** screen to set up multiple wireless networks on your XMG (Section 7.3 on page 89).
- Use the **MAC Authentication** screen to allow or deny wireless clients based on their MAC addresses from connecting to the XMG (Section 7.4 on page 92).
- Use the **WPS** screen to enable or disable WPS, view or generate a security PIN (Personal Identification Number) (Section 7.5 on page 93).
- Use the **WMM** screen to enable Wi-Fi MultiMedia (WMM) to ensure quality of service in wireless networks for multimedia applications (Section 7.6 on page 95).
- Use the **Others** screen to configure wireless advanced features, such as the RTS/CTS Threshold (Section 7.7 on page 96).
- Use the **Channel Status** screen to scan wireless LAN channel noises and view the results (Section 7.8 on page 97).

7.1.2 What You Need to Know

Wireless Basics

"Wireless" is essentially radio communication. In the same way that walkie-talkie radios send and receive information over the airwowaves, wireless networking devices exchange information with one another. A wireless networking device is just like a radio that lets your computer exchange information with radios attached to other computers. Like walkie-talkies, most wireless networking devices operate at radio frequency bands that are open to the public and do not require a license to use. However, wireless networking is different from that of most traditional radio communications in that there a number of wireless networking standards available with different methods of data encryption.

Finding Out More

See Section 7.9 on page 98 for advanced technical information on wireless networks.

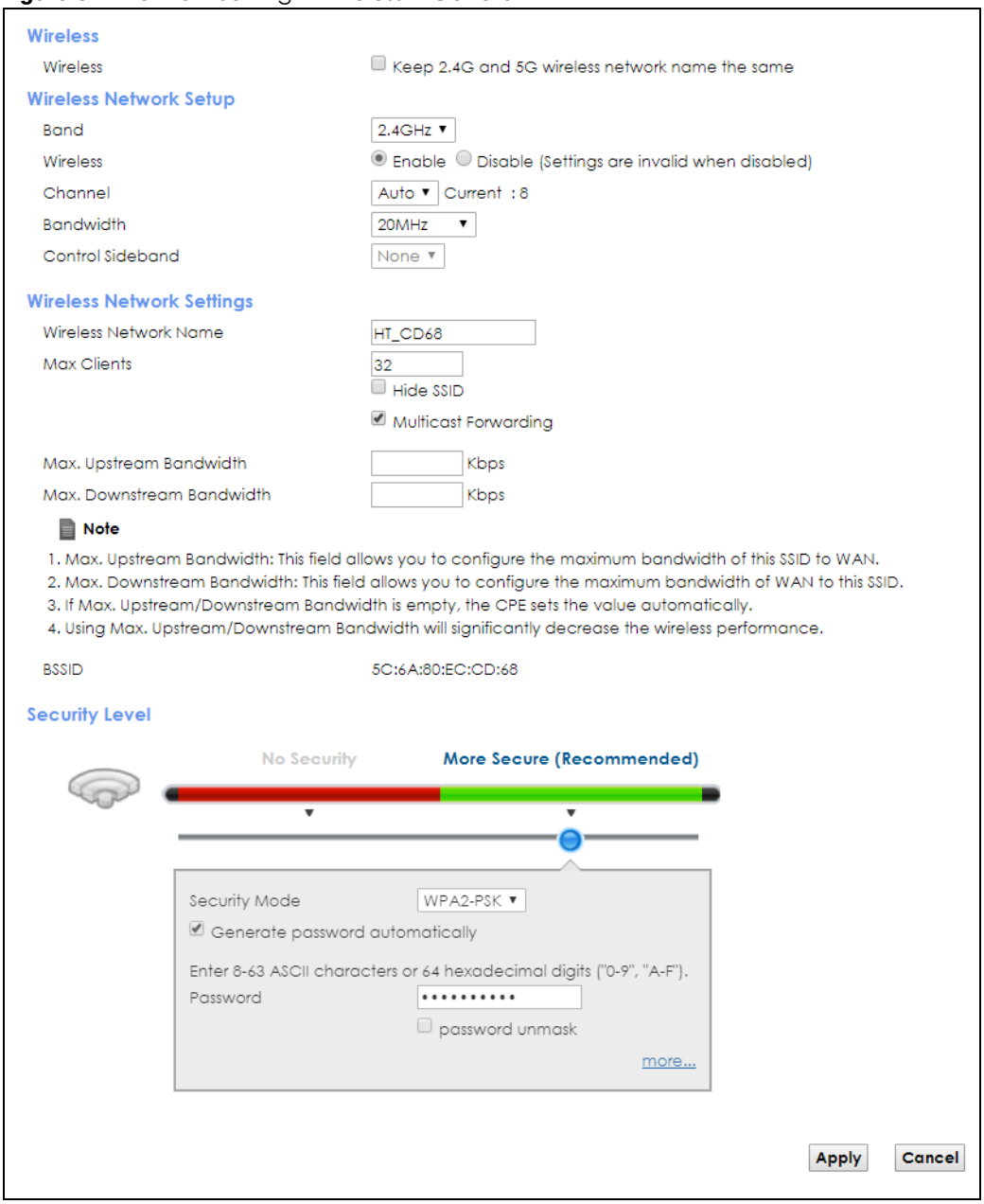
7.2 The General Screen

Use this screen to enable the Wireless LAN, enter the SSID and select the wireless security mode.

Note: If you are configuring the XMG from a computer connected to the wireless LAN and you change the XMG's SSID, channel or security settings, you will lose your wireless connection when you press **Apply** to confirm. You must then change the wireless settings of your computer to match the XMG's new settings.

Click **Network Setting** > **Wireless** to open the **General** screen.

Figure 32 Network Setting > Wireless > General



The following table describes the general wireless LAN labels in this screen.

Table 16 Network Setting > Wireless > General

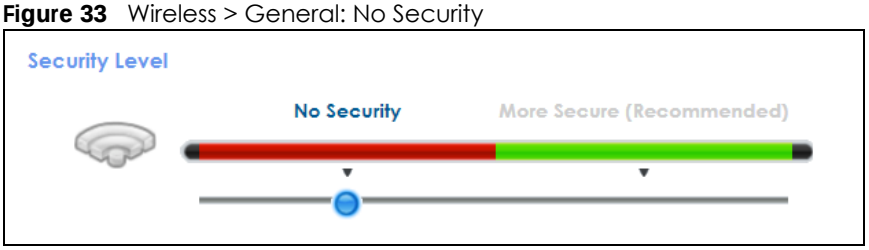
LABEL	DESCRIPTION
Wireless	Select this check box so both 2.4GHz and 5GHz wireless networks use the same name you input in the **Wireless Network Name** field.
Wireless Network Setup	
Band	This shows the wireless band which this radio profile is using. **2.4GHz** is the frequency used by IEEE 802.11b/g/n wireless clients while **5GHz** is used by IEEE 802.11a/ac wireless clients.
Wireless	You can **Enable** or **Disable** the wireless LAN in this field.
Channel	Use **Auto** to have the XMG automatically determine a channel to use.
Bandwidth	Select whether the XMG uses a wireless channel width of **20MHz**, **40MHz** or **80MHz**. A standard 20MHz channel offers transfer speeds of up to 150Mbps whereas a 40MHz channel uses two standard channels and offers speeds of up to 300 Mbps. 40MHz (channel bonding or dual channel) bonds two adjacent radio channels to increase throughput. The wireless clients must also support 40 MHz. It is often better to use the 20 MHz setting in a location where the environment hinders the wireless signal. An 80MHz channel groups adjacent 40MHz channels into pairs to increase bandwidth even higher. Select **20MHz** if you want to lessen radio interference with other wireless devices in your neighborhood or the wireless clients do not support channel bonding.
Control Sideband	This is available for some regions when you select a specific channel and set the Bandwidth field to **40MHz**. Set whether the control channel (set in the **Channel** field) should be in the **Lower** or **Upper** range of channel bands.
Wireless Network Settings	
Wireless Network Name (SSID)	The SSID (Service Set IDentity) identifies the service set with which a wireless device is associated. Wireless devices associating to the access point (AP) must have the same SSID. Enter a descriptive name (up to 32 English keyboard characters) for the wireless LAN.
Max Clients	Specify the maximum number of clients that can connect to this network at the same time.
Hide SSID	Select this check box to hide the SSID in the outgoing beacon frame so a station cannot obtain the SSID through scanning using a site survey tool.
Multicast Forwarding	Select this check box to allow the XMG to convert wireless multicast traffic into wireless unicast traffic.
Max. Upstream Bandwidth	Specify the maximum rate for upstream wireless traffic to the WAN from this WLAN in kilobits per second (Kbps).
Max. Downstream Bandwidth	Specify the maximum rate for downstream wireless traffic to this WLAN from the WAN in kilobits per second (Kbps).
BSSID	This shows the MAC address of the wireless interface on the XMG when wireless LAN is enabled.
Security Level	Select **More Secure (WPA(2)-PSK)** to add security on this wireless network. The wireless clients which want to associate to this network must have same wireless security settings as the XMG. When you select to use a security, additional options appears in this screen. Or you can select **No Security** to allow any client to associate this network without any data encryption or authentication. See the following sections for more details about this field.
Apply	Click **Apply** to save your changes.
Cancel	Click **Cancel** to restore your previously saved settings.

7.2.1 No Security

Select **No Security** to allow wireless stations to communicate with the access points without any data encryption or authentication.

Note: If you do not enable any wireless security on your XMG, your network is accessible to any wireless networking device that is within range.

Figure 33 Wireless > General: No Security



The following table describes the labels in this screen.

Table 17 Wireless > General: No Security

LABEL	DESCRIPTION
Security Level	Choose **No Security** to allow all wireless connections without data encryption or authentication.

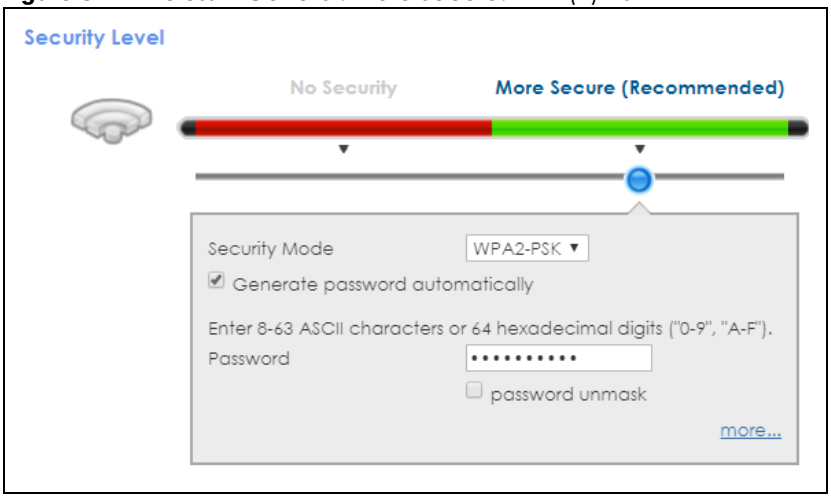
7.2.2 More Secure (WPA(2)-PSK)

The WPA-PSK security mode provides both improved data encryption and user authentication over WEP. Using a Pre-Shared Key (PSK), both the XMG and the connecting client share a common password in order to validate the connection. This type of encryption, while robust, is not as strong as WPA, WPA2 or even WPA2-PSK. The WPA2-PSK security mode is a newer, more robust version of the WPA encryption standard. It offers slightly better security, although the use of PSK makes it less robust than it could be.

Note: **WPA-PSK** is not available if you enable WPS before you configure them.

Click **Network Setting** > **Wireless** to display the **General** screen. Select **More Secure** as the security level. Then select **WPA-PSK** or **WPA2-PSK** from the **Security Mode** list.

Figure 34 Wireless > General: More Secure: WPA(2)-PSK



The following table describes the labels in this screen.

Table 18 Wireless > General: More Secure: WPA(2)-PSK

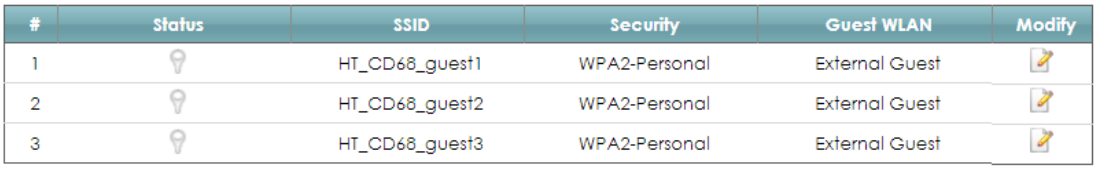
LABEL	DESCRIPTION
Security Level	Select **More Secure** to enable WPA(2)-PSK data encryption.
Security Mode	Select **WPA-PSK** or **WPA2-PSK** from the drop-down list box.
Generate password automatically	Select this option to have the XMG automatically generate a password. The password field will not be configurable when you select this option.
Password	The encryption mechanisms used for WPA(2) and WPA(2)-PSK are the same. The only difference between the two is that WPA(2)-PSK uses a simple common password, instead of user-specific credentials. If you did not select **Generate password automatically**, you can manually type a pre-shared key from 8 to 64 case-sensitive keyboard characters. Select **password unmask** to display the entered password in plain text. Clear it to hide the password to avoid shoulder surfing.
more.../hide	Click **more...** to show more fields in this section. Click **hide** to hide them.
Encryption	Select the encryption type (**TKIP**, **AES** or **TKIP+AES**) for data encryption. Select **TKIP** if your wireless clients can all use TKIP. Select **AES** if your wireless clients can all use AES. Select **TKIP+AES** to allow the wireless clients to use either TKIP or AES.
Group Key Update Timer	The **Group Key Update Timer** is the rate at which the RADIUS server sends a new group key out to all clients.

7.3 The Guest/More AP Screen

This screen allows you to enable and configure multiple Basic Service Sets (BSSs) on the XMG.

Click **Network Setting > Wireless** > **Guest/More AP**. The following screen displays.

Figure 35 Network Setting > Wireless > Guest/More AP



#	Status	SSID	Security	Guest WLAN	Modify
1		HT_CD68_guest1	WPA2-Personal	External Guest	
2		HT_CD68_guest2	WPA2-Personal	External Guest	
3		HT_CD68_guest3	WPA2-Personal	External Guest	

The following table describes the labels in this screen.

Table 19 Network Setting > Wireless > Guest/More AP

LABEL	DESCRIPTION
#	This is the index number of the entry.
Status	This field indicates whether this SSID is active. A yellow bulb signifies that this SSID is active. A gray bulb signifies that this SSID is not active.
SSID	An SSID profile is the set of parameters relating to one of the XMG's BSSs. The SSID (Service Set IDentifier) identifies the Service Set with which a wireless device is associated. This field displays the name of the wireless profile on the network. When a wireless client scans for an AP to associate with, this is the name that is broadcast and seen in the wireless client utility.

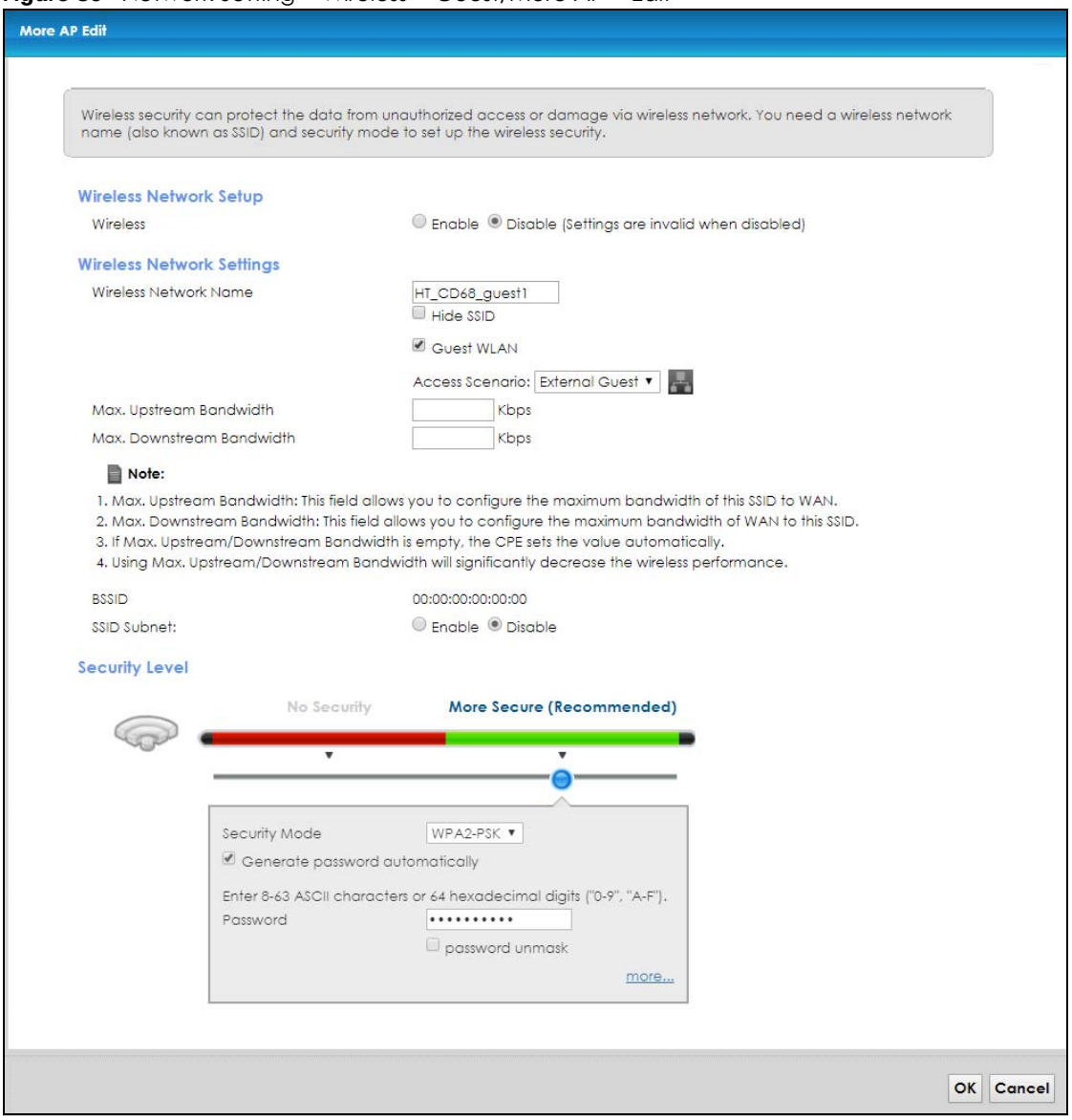
Table 19 Network Setting > Wireless > Guest/More AP (continued)

LABEL	DESCRIPTION
Security	This field indicates the security mode of the SSID profile.
Guest WLAN	This displays if the guest WLAN function has been enabled for this WLAN. If **Home Guest** displays, clients connecting to the same SSID can communicate with each other directly. If **External Guest** displays, clients are blocked from connecting to each other directly. **N/A** displays if guest WLAN is disabled.
Modify	Click the **Edit** icon to configure the SSID profile.

7.3.1 Edit Guest/More AP

Use this screen to edit an SSID profile. Click the **Edit** icon next to an SSID in the **Guest/More AP** screen. The following screen displays.

Figure 36 Network Setting > Wireless > Guest/More AP > Edit



The following table describes the fields in this screen.

Table 20 Network Setting > Wireless > Guest/More AP > Edit

LABEL	DESCRIPTION
Wireless Network Setup	
Wireless	You can **Enable** or **Disable** the wireless LAN in this field.
Wireless Network Settings	
Wireless Network Name (SSID)	The SSID (Service Set IDentity) identifies the service set with which a wireless device is associated. Wireless devices associating to the access point (AP) must have the same SSID. Enter a descriptive name (up to 32 English keyboard characters) for the wireless LAN.
Hide SSID	Select this check box to hide the SSID in the outgoing beacon frame so a station cannot obtain the SSID through scanning using a site survey tool.
Guest WLAN	Select this to create Guest WLANs for home and external clients. Select the WLAN type in the **Access Scenario** field.

Table 20 Network Setting > Wireless > Guest/More AP > Edit (continued)

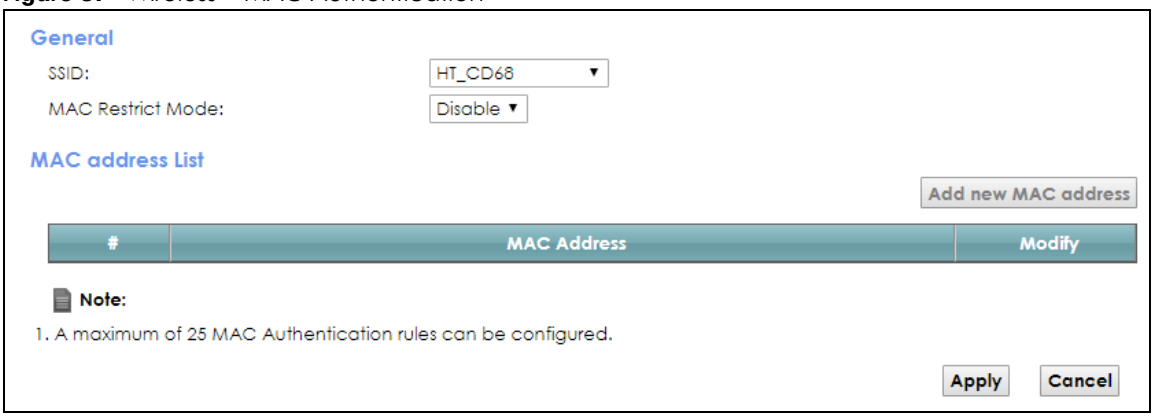
LABEL	DESCRIPTION
Access Scenario	If you select **Home Guest**, clients connecting to the same SSID can communicate with each other directly. If you select **External Guest**, clients are blocked from connecting to each other directly.
Max. Upstream Bandwidth	Specify the maximum rate for upstream wireless traffic to the WAN from this WLAN in kilobits per second (Kbps).
Max. Downstream Bandwidth	Specify the maximum rate for downstream wireless traffic to this WLAN from the WAN in kilobits per second (Kbps).
BSSID	This shows the MAC address of the wireless interface on the XMG when wireless LAN is enabled.
SSID Subnet	Select **Enable** if you want the wireless network interface to assign DHCP IP addresses to the associated wireless clients.
DHCP Start Address	Specify the first of the contiguous addresses in the DHCP IP address pool. The XMG assigns IP addresses from this DHCP pool to wireless clients connecting to the SSID.
DHCP End Address	Specify the last of the contiguous addresses in the DHCP IP address pool.
SSID Subnet Mask	Specify the subnet mask of the XMG for the SSID subnet.
LAN IP Address	Specify the IP address of the XMG for the SSID subnet..
Security Level	
Security Mode	Select **More Secure (WPA(2)-PSK)** to add security on this wireless network. The wireless clients which want to associate to this network must have same wireless security settings as the XMG. After you select to use a security, additional options appears in this screen. Or you can select **No Security** to allow any client to associate this network without any data encryption or authentication. See Section 7.2.1 on page 88 for more details about this field.
Apply	Click **Apply** to save your changes.
Cancel	Click **Cancel** to exit this screen without saving.

7.4 MAC Authentication

This screen allows you to configure the Zyxel Device to give exclusive access to specific devices **(Allow)** or exclude specific devices from accessing the Zyxel Device **(Deny)**. Every Ethernet device has a unique MAC (Media Access Control) address. The MAC address is assigned at the factory and consists of six pairs of hexadecimal characters, for example, 00:A0:C5:00:00:02. You need to know the MAC addresses of the devices to configure this screen.

Use this screen to view your XMG's MAC filter settings and add new MAC filter rules. Click **Network Setting > Wireless > MAC Authentication**. The screen appears as shown.

Figure 37 Wireless > MAC Authentication



The following table describes the labels in this screen.

Table 21 Wireless > MAC Authentication

LABEL	DESCRIPTION
SSID	Select the SSID for which you want to configure MAC filter settings.
MAC Restrict Mode	Define the filter action for the list of MAC addresses in the **MAC Address** table. Select **Disable** to turn off MAC filtering. Select **Deny** to block access to the XMG. MAC addresses not listed will be allowed to access the XMG. Select **Allow** to permit access to the XMG. MAC addresses not listed will be denied access to the XMG.
MAC address List	
Add new MAC address	Click this if you want to add a new MAC address entry to the MAC filter list below. Enter the MAC addresses of the wireless devices that are allowed or denied access to the XMG in these address fields. Enter the MAC addresses in a valid MAC address format, that is, six hexadecimal character pairs, for example, 12:34:56:78:9a:bc.
#	This is the index number of the entry.
MAC Address	This is the MAC addresses of the wireless devices that are allowed or denied access to the XMG.
Modify	Click the **Edit** icon and type the MAC address of the peer device in a valid MAC address format (six hexadecimal character pairs, for example 12:34:56:78:9a:bc). Click the **Delete** icon to delete the entry.
Apply	Click **Apply** to save your changes.
Cancel	Click **Cancel** to exit this screen without saving.

7.5 The WPS Screen

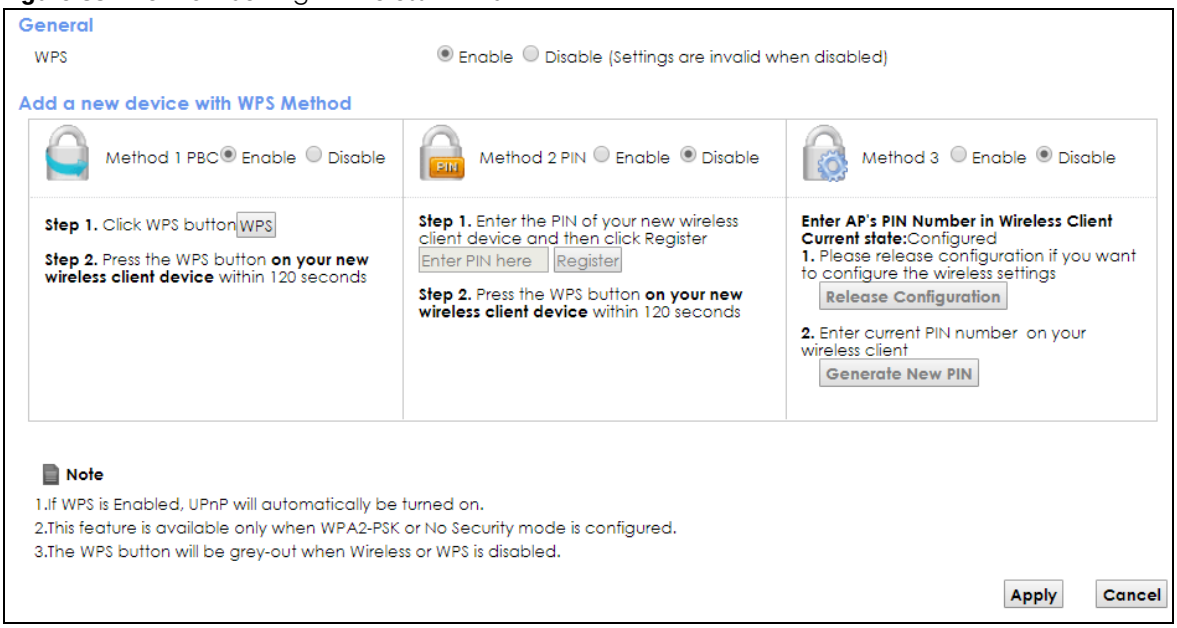
Use this screen to configure WiFi Protected Setup (WPS) on your XMG.

WPS allows you to quickly set up a wireless network with strong security, without having to configure security settings manually. Set up each WPS connection between two devices. Both devices must support WPS. See Section 7.9.8.3 on page 106 for more information about WPS.

Note: The XMG applies the security settings of the **SSID1** profile (see Section 7.2 on page 86). If you want to use the WPS feature, make sure you have set the security mode of **SSID1** to **WPA2-PSK** or **No Security**.

Click **Network Setting > Wireless > WPS**. The following screen displays. Select **Enable** and click **Apply** to activate the WPS function. Then you can configure the WPS settings in this screen.

Figure 38 Network Setting > Wireless > WPS



The following table describes the labels in this screen.

Table 22 Network Setting > Wireless > WPS

LABEL	DESCRIPTION
General	
WPS	Select Enable to activate WPS on this XMG.
Add a new device with WPS Method	
Method 1	Use this section to set up a WPS wireless network using Push Button Configuration (PBC). Select **Enable** and click **Apply** to activate WPS method 1 on the XMG.
WPS	Click this button to add another WPS-enabled wireless device (within wireless range of the XMG) to your wireless network. This button may either be a physical button on the outside of device, or a menu button similar to the **WPS** button on this screen. Note: You must press the other wireless device's WPS button within two minutes of pressing this button.
Method 2	Use this section to set up a WPS wireless network by entering the PIN of the client into the XMG. Select **Enable** and click **Apply** to activate WPS method 2 on the XMG.

Table 22 Network Setting > Wireless > WPS (continued)

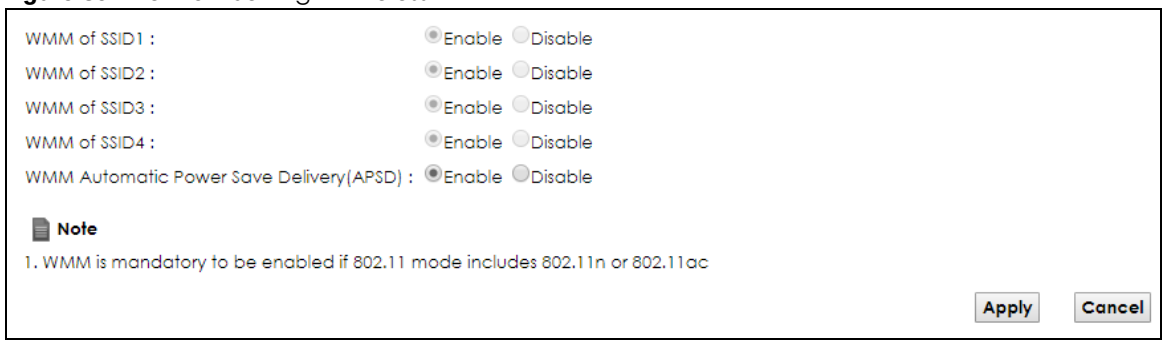
LABEL	DESCRIPTION
Register	Enter the PIN of the device that you are setting up a WPS connection with and click **Register** to authenticate and add the wireless device to your wireless network. You can find the PIN either on the outside of the device, or by checking the device's settings. Note: You must also activate WPS on that device within two minutes to have it present its PIN to the XMG.
Method 3	Use this section to set up a WPS wireless network by entering the PIN of the XMG into the client. Select **Enable** and click **Apply** to activate WPS method 3 on the XMG.
Release Configuration	The default WPS status is configured. Click this button to remove all configured wireless and wireless security settings for WPS connections on the XMG.
Generate New PIN Number	If this method has been enabled, the PIN (Personal Identification Number) of the XMG is shown here. Enter this PIN in the configuration utility of the device you want to connect to using WPS. The PIN is not necessary when you use WPS push-button method. Click the **Generate New PIN** button to have the XMG create a new PIN.
Apply	Click **Apply** to save your changes.
Cancel	Click **Cancel** to restore your previously saved settings.

7.6 The WMM Screen

Use this screen to enable Wi-Fi MultiMedia (WMM) and WMM Power Save in wireless networks for multimedia applications.

Click **Network Setting > Wireless > WMM**. The following screen displays.

Figure 39 Network Setting > Wireless > WMM



The following table describes the labels in this screen.

Table 23 Network Setting > Wireless > WMM

LABEL	DESCRIPTION
2.4GHz WMM Setup / 5GHz WMM Setup	
WMM of SSID1~4	Select **On** to have the XMG automatically give the wireless network (SSIDx) a priority level according to the ToS value in the IP header of packets it sends. WMM QoS (Wifi MultiMedia Quality of Service) gives high priority to voice and video, which makes them run more smoothly.

Table 23 Network Setting > Wireless > WMM (continued)

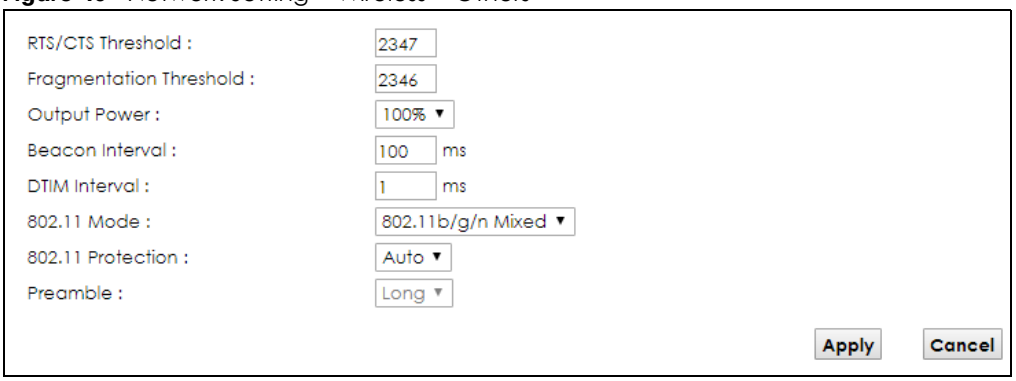
LABEL	DESCRIPTION
WMM Automatic Power Save Delivery(APSD)	Select this option to extend the battery life of your mobile devices (especially useful for small devices that are running multimedia applications). The XMG goes to sleep mode to save power when it is not transmitting data. The AP buffers the packets sent to the XMG until the XMG "wakes up". The XMG wakes up periodically to check for incoming data. Note: This works only if the wireless device to which the XMG is connected also supports this feature.
Apply	Click **Apply** to save your changes.
Cancel	Click **Cancel** to restore your previously saved settings.

7.7 The Others Screen

Use this screen to configure advanced wireless settings. Click **Network Setting > Wireless > Others**. The screen appears as shown.

See Section 7.9.2 on page 100 for detailed definitions of the terms listed in this screen.

Figure 40 Network Setting > Wireless > Others



The following table describes the labels in this screen.

Table 24 Network Setting > Wireless > Others

LABEL	DESCRIPTION
RTS/CTS Threshold	Data with its frame size larger than this value will perform the RTS (Request To Send)/CTS (Clear To Send) handshake. Enter a value between 0 and 2347.
Fragmentation Threshold	This is the maximum data fragment size that can be sent. Enter a value between 256 and 2346.
Output Power	Set the output power of the XMG. If there is a high density of APs in an area, decrease the output power to reduce interference with other APs. Select one of the following: **20%**, **40%**, **60%**, **80%** or **100%**.
Beacon Interval	When a wirelessly networked device sends a beacon, it includes with it a beacon interval. This specifies the time period before the device sends the beacon again. The interval tells receiving devices on the network how long they can wait in low power mode before waking up to handle the beacon. This value can be set from 50ms to 1000ms. A high value helps save current consumption of the access point.

Table 24 Network Setting > Wireless > Others (continued)

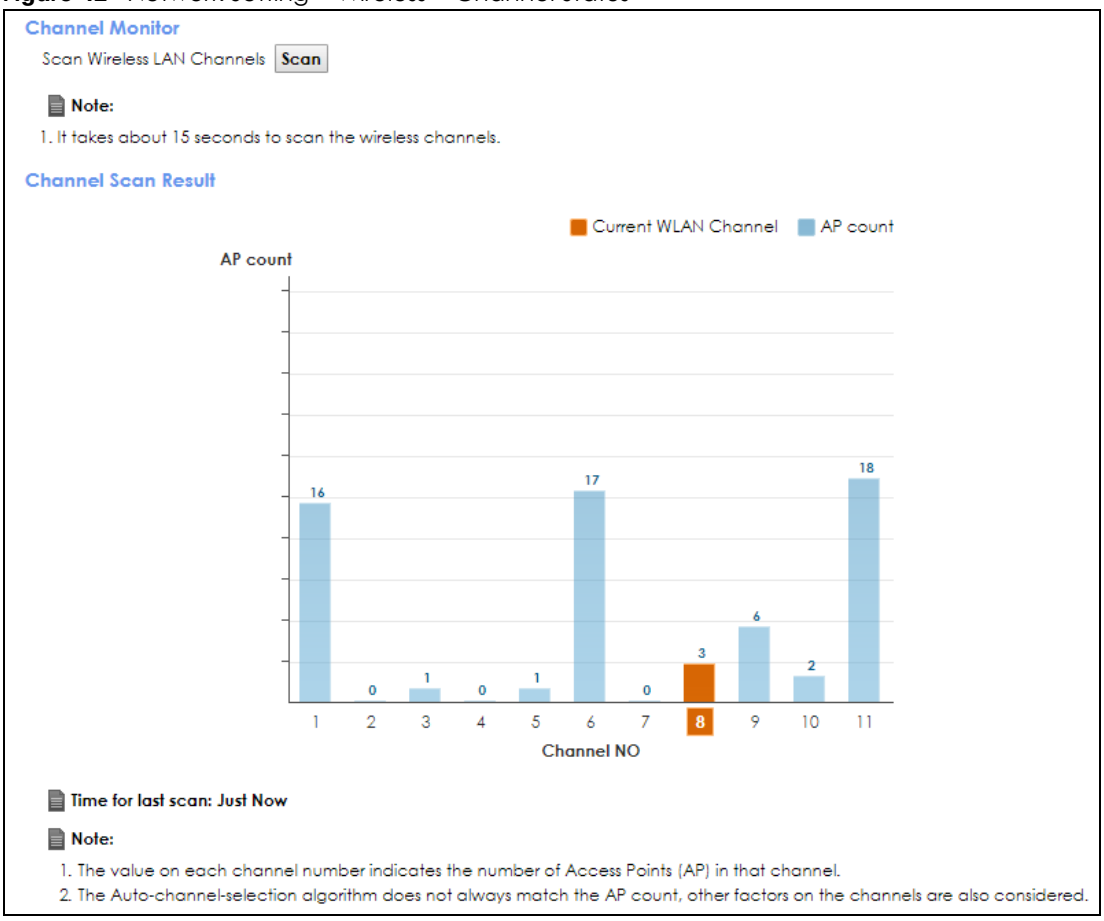
LABEL	DESCRIPTION
DTIM Interval	Delivery Traffic Indication Message (DTIM) is the time period after which broadcast and multicast packets are transmitted to mobile clients in the Power Saving mode. A high DTIM value can cause clients to lose connectivity with the network. This value can be set from 1 to 255.
802.11 Mode	Select **802.11b Only** to allow only IEEE 802.11b compliant WLAN devices to associate with the XMG. Select **802.11g Only** to allow only IEEE 802.11g compliant WLAN devices to associate with the XMG. Select **802.11n Only** to allow only IEEE 802.11n compliant WLAN devices to associate with the XMG. Select **802.11b/g Mixed** to allow either IEEE 802.11b or IEEE 802.11g compliant WLAN devices to associate with the XMG. The transmission rate of your XMG might be reduced. Select **802.11b/g/n Mixed** to allow IEEE 802.11b, IEEE 802.11g or IEEE802.11n compliant WLAN devices to associate with the XMG. The transmission rate of your XMG might be reduced.
802.11 Protection	Enabling this feature can help prevent collisions in mixed-mode networks (networks with both IEEE 802.11b and IEEE 802.11g traffic). Select **Auto** to have the wireless devices transmit data after a RTS/CTS handshake. This helps improve IEEE 802.11g performance. Select **Off** to disable 802.11 protection. The transmission rate of your XMG might be reduced in a mixed-mode network. This field displays **Off** and is not configurable when you set **802.11 Mode** to **802.11b Only**.
Preamble	Select a preamble type from the drop-down list box. Choices are **Long** or **Short**. See Section 7.9.7 on page 103 for more information. This field is configurable only when you set 802.11 Mode to **802.11b**.
Apply	Click **Apply** to save your changes.
Cancel	Click **Cancel** to restore your previously saved settings.

7.8 The Channel Status Screen

Use the **Channel Status** screen to scan wireless LAN channel noises and view the results. Click **Network Setting > Wireless > Channel Status**. The screen appears as shown. Click **Scan** to scan the wireless LAN channels. You can view the results in the **Channel Scan Result** section.

Note: The **Scan** button only works when the XMG uses 20MHz for the wireless channel width. You can go to the **Network Setting > Wireless > General** screen, click the **more** link, and then change the channel width setting in the **Bandwidth** field.

Figure 41 Network Setting > Wireless > Channel Status



7.9 Technical Reference

This section discusses wireless LANs in depth. For more information, see Appendix B on page 295.

7.9.1 Wireless Network Overview

Wireless networks consist of wireless clients, access points and bridges.

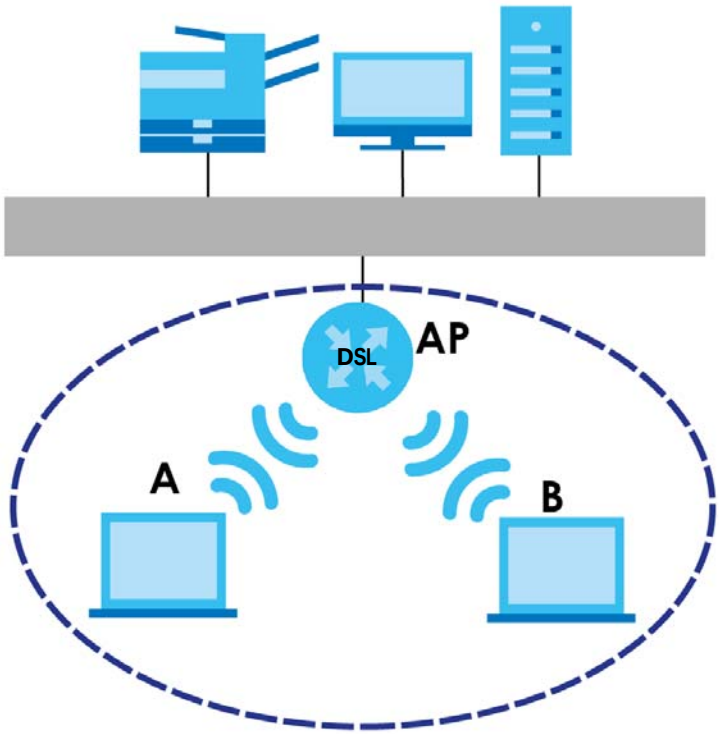
- A wireless client is a radio connected to a user's computer.
- An access point is a radio with a wired connection to a network, which can connect with numerous wireless clients and let them access the network.
- A bridge is a radio that relays communications between access points and wireless clients, extending a network's range.

Traditionally, a wireless network operates in one of two ways.

- An "infrastructure" type of network has one or more access points and one or more wireless clients. The wireless clients connect to the access points.
- An "ad-hoc" type of network is one in which there is no access point. Wireless clients connect to one another in order to exchange information.

The following figure provides an example of a wireless network.

Figure 42 Example of a Wireless Network



The wireless network is the part in the blue circle. In this wireless network, devices **A** and **B** use the access point (**AP**) to interact with the other devices (such as the printer) or with the Internet. Your XMG is the AP.

Every wireless network must follow these basic guidelines.

- Every device in the same wireless network must use the same SSID.

  The SSID is the name of the wireless network. It stands for Service Set IDentifier.
- If two wireless networks overlap, they should use a different channel.

  Like radio stations or television channels, each wireless network uses a specific channel, or frequency, to send and receive information.
- Every device in the same wireless network must use security compatible with the AP.

  Security stops unauthorized devices from using the wireless network. It can also protect the information that is sent in the wireless network.

Radio Channels

In the radio spectrum, there are certain frequency bands allocated for unlicensed, civilian use. For the purposes of wireless networking, these bands are divided into numerous channels. This allows a variety of networks to exist in the same place without interfering with one another. When you create a network, you must select a channel to use.

Since the available unlicensed spectrum varies from one country to another, the number of available channels also varies.

7.9.2 Additional Wireless Terms

The following table describes some wireless network terms and acronyms used in the XMG's Web Configurator.

Table 25 Additional Wireless Terms

TERM	DESCRIPTION
RTS/CTS Threshold	In a wireless network which covers a large area, wireless devices are sometimes not aware of each other's presence. This may cause them to send information to the AP at the same time and result in information colliding and not getting through. By setting this value lower than the default value, the wireless devices must sometimes get permission to send information to the XMG. The lower the value, the more often the devices must get permission. If this value is greater than the fragmentation threshold value (see below), then wireless devices never have to get permission to send information to the XMG.
Preamble	A preamble affects the timing in your wireless network. There are two preamble modes: long and short. If a device uses a different preamble mode than the XMG does, it cannot communicate with the XMG.
Authentication	The process of verifying whether a wireless device is allowed to use the wireless network.
Fragmentation Threshold	A small fragmentation threshold is recommended for busy networks, while a larger threshold provides faster performance if the network is not very busy.

7.9.3 Wireless Security Overview

By their nature, radio communications are simple to intercept. For wireless data networks, this means that anyone within range of a wireless network without security can not only read the data passing over the airwaves, but also join the network. Once an unauthorized person has access to the network, he or she can steal information or introduce malware (malicious software) intended to compromise the network. For these reasons, a variety of security systems have been developed to ensure that only authorized people can use a wireless data network, or understand the data carried on it.

These security standards do two things. First, they authenticate. This means that only people presenting the right credentials (often a username and password, or a "key" phrase) can access the network. Second, they encrypt. This means that the information sent over the air is encoded. Only people with the code key can understand the information, and only people who have been authenticated are given the code key.

These security standards vary in effectiveness. Some can be broken, such as the old Wired Equivalent Protocol (WEP). Other security standards are secure in themselves but can be broken if a user does not use them properly. For example, the WPA-PSK security standard is very secure if you use a long key which is difficult for an attacker's software to guess - for example, a twenty-letter long string of apparently random numbers and letters - but it is not very secure if you use a short key which is very easy to guess - for example, a three-letter word from the dictionary.

Because of the damage that can be done by a malicious attacker, it's not just people who have sensitive information on their network who should use security. Everybody who uses any wireless network should ensure that effective security is in place.

A good way to come up with effective security keys, passwords and so on is to use obscure information that you personally will easily remember, and to enter it in a way that appears random and does not include real words. For example, if your mother owns a 1970 Dodge Challenger and her favorite movie is

Vanishing Point (which you know was made in 1971) you could use "70dodchal71vanpoi" as your security key.

The following sections introduce different types of wireless security you can set up in the wireless network.

7.9.3.1 SSID

Normally, the XMG acts like a beacon and regularly broadcasts the SSID in the area. You can hide the SSID instead, in which case the XMG does not broadcast the SSID. In addition, you should change the default SSID to something that is difficult to guess.

This type of security is fairly weak, however, because there are ways for unauthorized wireless devices to get the SSID. In addition, unauthorized wireless devices can still see the information that is sent in the wireless network.

7.9.3.2 MAC Address Filter

Every device that can use a wireless network has a unique identification number, called a MAC address.[1] A MAC address is usually written using twelve hexadecimal characters[2]; for example, 00A0C5000002 or 00:A0:C5:00:00:02. To get the MAC address for each device in the wireless network, see the device's User's Guide or other documentation.

You can use the MAC address filter to tell the XMG which devices are allowed or not allowed to use the wireless network. If a device is allowed to use the wireless network, it still has to have the correct information (SSID, channel, and security). If a device is not allowed to use the wireless network, it does not matter if it has the correct information.

This type of security does not protect the information that is sent in the wireless network. Furthermore, there are ways for unauthorized wireless devices to get the MAC address of an authorized device. Then, they can use that MAC address to use the wireless network.

7.9.3.3 User Authentication

Authentication is the process of verifying whether a wireless device is allowed to use the wireless network. You can make every user log in to the wireless network before using it. However, every device in the wireless network has to support IEEE 802.1x to do this.

For wireless networks, you can store the user names and passwords for each user in a RADIUS server. This is a server used in businesses more than in homes. If you do not have a RADIUS server, you cannot set up user names and passwords for your users.

Unauthorized wireless devices can still see the information that is sent in the wireless network, even if they cannot use the wireless network. Furthermore, there are ways for unauthorized wireless users to get a valid user name and password. Then, they can use that user name and password to use the wireless network.

1. Some wireless devices, such as scanners, can detect wireless networks but cannot use wireless networks. These kinds of wireless devices might not have MAC addresses.
2. Hexadecimal characters are 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, and F.

7.9.3.4 Encryption

Wireless networks can use encryption to protect the information that is sent in the wireless network. Encryption is like a secret code. If you do not know the secret code, you cannot understand the message.

The types of encryption you can choose depend on the type of authentication. (See Section 7.9.3.3 on page 101 for information about this.)

Table 26 Types of Encryption for Each Type of Authentication

	NO AUTHENTICATION	RADIUS SERVER
Weakest	No Security	WPA
↕	WPA-PSK	
Strongest	WPA2-PSK	WPA2

For example, if the wireless network has a RADIUS server, you can choose **WPA** or **WPA2**. If users do not log in to the wireless network, you can choose no encryption, **WPA-PSK** or **WPA2-PSK**.

Note: It is recommended that wireless networks use **WPA-PSK**, **WPA**, or stronger encryption. The other types of encryption are better than none at all, but it is still possible for unauthorized wireless devices to figure out the original information pretty quickly.

When you select **WPA2** or **WPA2-PSK** in your XMG, you can also select an option (**WPA compatible**) to support WPA as well. In this case, if some of the devices support WPA and some support WPA2, you should set up **WPA2-PSK** or **WPA2** (depending on the type of wireless network login) and select the **WPA compatible** option in the XMG.

Many types of encryption use a key to protect the information in the wireless network. The longer the key, the stronger the encryption. Every device in the wireless network must have the same key.

7.9.4 Signal Problems

Because wireless networks are radio networks, their signals are subject to limitations of distance, interference and absorption.

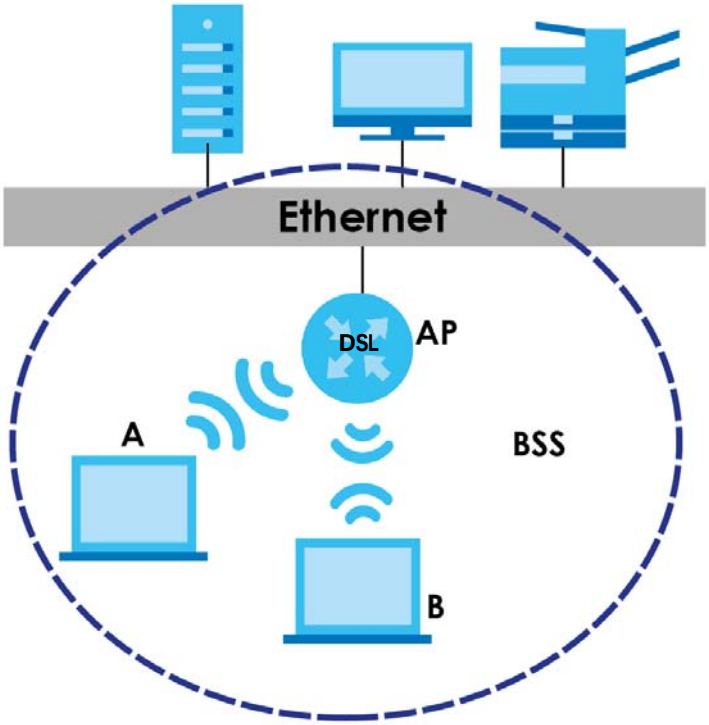
Problems with distance occur when the two radios are too far apart. Problems with interference occur when other radio waves interrupt the data signal. Interference may come from other radio transmissions, such as military or air traffic control communications, or from machines that are coincidental emitters such as electric motors or microwaves. Problems with absorption occur when physical objects (such as thick walls) are between the two radios, muffling the signal.

7.9.5 BSS

A Basic Service Set (BSS) exists when all communications between wireless stations or between a wireless station and a wired network client go through one access point (AP).

Intra-BSS traffic is traffic between wireless stations in the BSS. When Intra-BSS traffic blocking is disabled, wireless station A and B can access the wired network and communicate with each other. When Intra-BSS traffic blocking is enabled, wireless station A and B can still access the wired network but cannot communicate with each other.

Figure 43 Basic Service set



7.9.6 MBSSID

Traditionally, you need to use different APs to configure different Basic Service Sets (BSSs). As well as the cost of buying extra APs, there is also the possibility of channel interference. The XMG's MBSSID (Multiple Basic Service Set IDentifier) function allows you to use one access point to provide several BSSs simultaneously. You can then assign varying QoS priorities and/or security modes to different SSIDs.

Wireless devices can use different BSSIDs to associate with the same AP.

7.9.6.1 Notes on Multiple BSSs

- A maximum of eight BSSs are allowed on one AP simultaneously.
- You must use different keys for different BSSs. If two wireless devices have different BSSIDs (they are in different BSSs), but have the same keys, they may hear each other's communications (but not communicate with each other).
- MBSSID should not replace but rather be used in conjunction with 802.1x security.

7.9.7 Preamble Type

Preamble is used to signal that data is coming to the receiver. Short and long refer to the length of the synchronization field in a packet.

Short preamble increases performance as less time sending preamble means more time for sending data. All IEEE 802.11 compliant wireless adapters support long preamble, but not all support short preamble.

Use long preamble if you are unsure what preamble mode other wireless devices on the network support, and to provide more reliable communications in busy wireless networks.

Use short preamble if you are sure all wireless devices on the network support it, and to provide more efficient communications.

Use the dynamic setting to automatically use short preamble when all wireless devices on the network support it, otherwise the XMG uses long preamble.

Note: The wireless devices MUST use the same preamble mode in order to communicate.

7.9.8 WiFi Protected Setup (WPS)

Your XMG supports WiFi Protected Setup (WPS), which is an easy way to set up a secure wireless network. WPS is an industry standard specification, defined by the WiFi Alliance.

WPS allows you to quickly set up a wireless network with strong security, without having to configure security settings manually. Each WPS connection works between two devices. Both devices must support WPS (check each device's documentation to make sure).

Depending on the devices you have, you can either press a button (on the device itself, or in its configuration utility) or enter a PIN (a unique Personal Identification Number that allows one device to authenticate the other) in each of the two devices. When WPS is activated on a device, it has two minutes to find another device that also has WPS activated. Then, the two devices connect and set up a secure network by themselves.

7.9.8.1 Push Button Configuration

WPS Push Button Configuration (PBC) is initiated by pressing a button on each WPS-enabled device, and allowing them to connect automatically. You do not need to enter any information.

Not every WPS-enabled device has a physical WPS button. Some may have a WPS PBC button in their configuration utilities instead of or in addition to the physical button.

Take the following steps to set up WPS using the button.

1. Ensure that the two devices you want to set up are within wireless range of one another.
2. Look for a WPS button on each device. If the device does not have one, log into its configuration utility and locate the button (see the device's User's Guide for how to do this - for the XMG, see Section 7.6 on page 95).
3. Press the button on one of the devices (it doesn't matter which). For the XMG you must press the WPS button for more than five seconds.
4. Within two minutes, press the button on the other device. The registrar sends the network name (SSID) and security key through an secure connection to the enrollee.

   If you need to make sure that WPS worked, check the list of associated wireless clients in the AP's configuration utility. If you see the wireless client in the list, WPS was successful.

7.9.8.2 PIN Configuration

Each WPS-enabled device has its own PIN (Personal Identification Number). This may either be static (it cannot be changed) or dynamic (in some devices you can generate a new PIN by clicking on a button in the configuration interface).

Use the PIN method instead of the push-button configuration (PBC) method if you want to ensure that the connection is established between the devices you specify, not just the first two devices to activate WPS in range of each other. However, you need to log into the configuration interfaces of both devices to use the PIN method.

When you use the PIN method, you must enter the PIN from one device (usually the wireless client) into the second device (usually the Access Point or wireless router). Then, when WPS is activated on the first device, it presents its PIN to the second device. If the PIN matches, one device sends the network and security information to the other, allowing it to join the network.

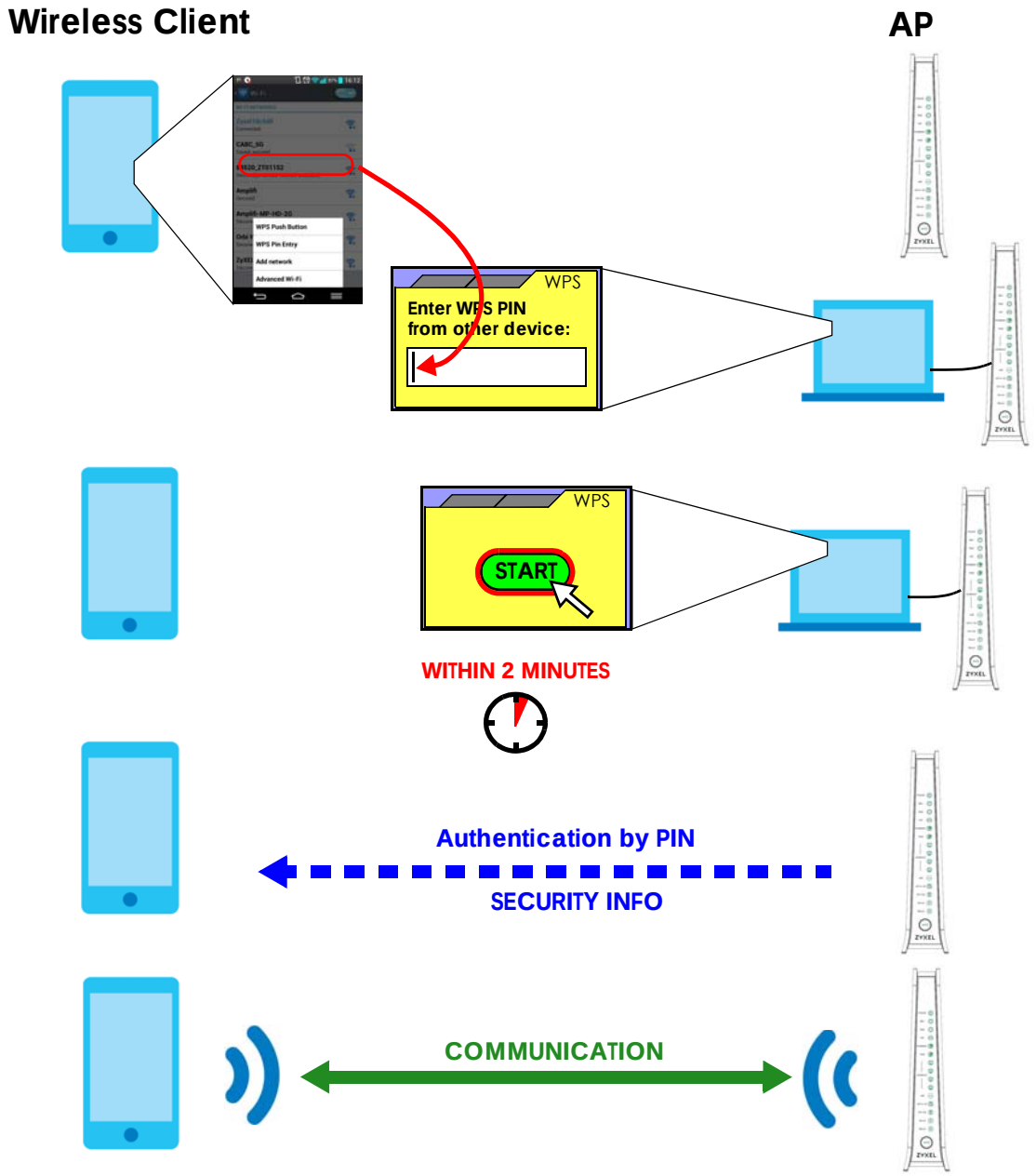
Take the following steps to set up a WPS connection between an access point or wireless router (referred to here as the AP) and a client device using the PIN method.

1. Ensure WPS is enabled on both devices.
2. Access the WPS section of the AP's configuration interface. See the device's User's Guide for how to do this.
3. Look for the client's WPS PIN; it will be displayed either on the device, or in the WPS section of the client's configuration interface (see the device's User's Guide for how to find the WPS PIN - for the XMG, see Section 7.5 on page 93).
4. Enter the client's PIN in the AP's configuration interface.
5. If the client device's configuration interface has an area for entering another device's PIN, you can either enter the client's PIN in the AP, or enter the AP's PIN in the client - it does not matter which.
6. Start WPS on both devices within two minutes.
7. Use the configuration utility to activate WPS, not the push-button on the device itself.
8. On a computer connected to the wireless client, try to connect to the Internet. If you can connect, WPS was successful.

   If you cannot connect, check the list of associated wireless clients in the AP's configuration utility. If you see the wireless client in the list, WPS was successful.

The following figure shows you how to set up a wireless network and its security on a XMG and a wireless client (android 4.4.2 smartphone) by using PIN method.

Figure 44 Example WPS Process: PIN Method

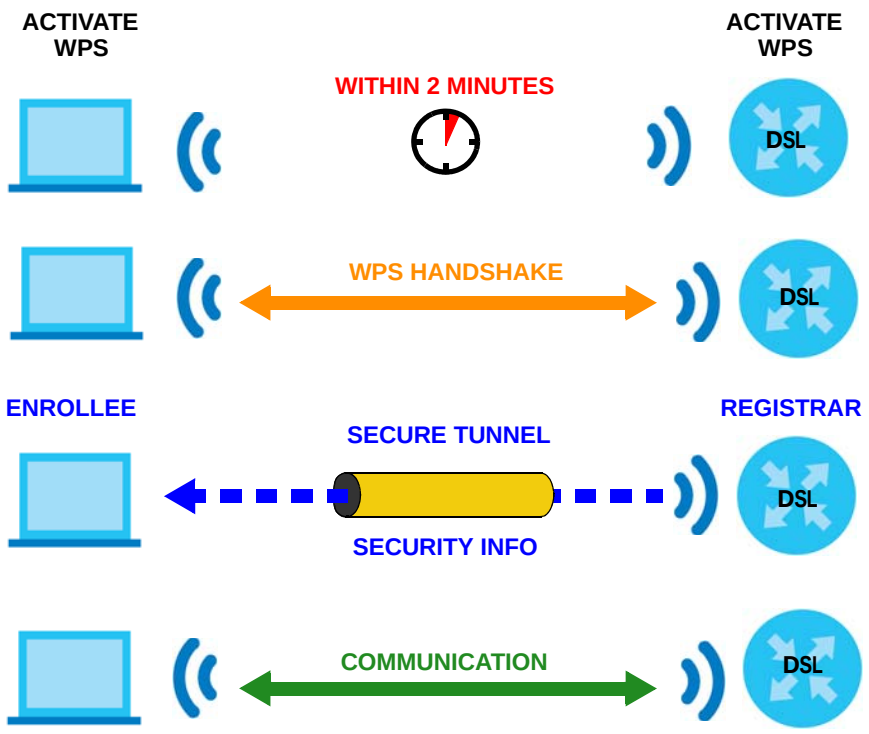


7.9.8.3 How WPS Works

When two WPS-enabled devices connect, each device must assume a specific role. One device acts as the registrar (the device that supplies network and security settings) and the other device acts as the enrollee (the device that receives network and security settings. The registrar creates a secure EAP (Extensible Authentication Protocol) tunnel and sends the network name (SSID) and the WPA-PSK or WPA2-PSK pre-shared key to the enrollee. Whether WPA-PSK or WPA2-PSK is used depends on the standards supported by the devices. If the registrar is already part of a network, it sends the existing information. If not, it generates the SSID and WPA(2)-PSK randomly.

The following figure shows a WPS-enabled client (installed in a notebook computer) connecting to a WPS-enabled access point.

Figure 45 How WPS works



The roles of registrar and enrollee last only as long as the WPS setup process is active (two minutes). The next time you use WPS, a different device can be the registrar if necessary.

The WPS connection process is like a handshake; only two devices participate in each WPS transaction. If you want to add more devices you should repeat the process with one of the existing networked devices and the new device.

Note that the access point (AP) is not always the registrar, and the wireless client is not always the enrollee. All WPS-certified APs can be a registrar, and so can some WPS-enabled wireless clients.

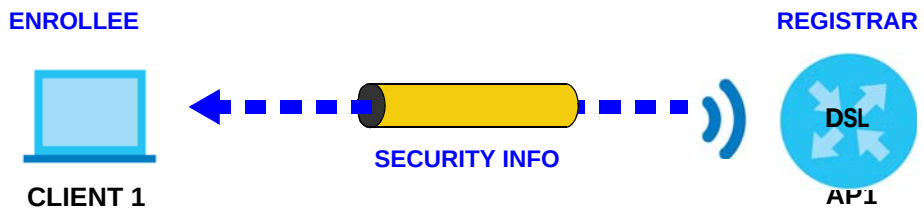
By default, a WPS devices is "unconfigured". This means that it is not part of an existing network and can act as either enrollee or registrar (if it supports both functions). If the registrar is unconfigured, the security settings it transmits to the enrollee are randomly-generated. Once a WPS-enabled device has connected to another device using WPS, it becomes "configured". A configured wireless client can still act as enrollee or registrar in subsequent WPS connections, but a configured access point can no longer act as enrollee. It will be the registrar in all subsequent WPS connections in which it is involved. If you want a configured AP to act as an enrollee, you must reset it to its factory defaults.

7.9.8.4 Example WPS Network Setup

This section shows how security settings are distributed in an example WPS setup.

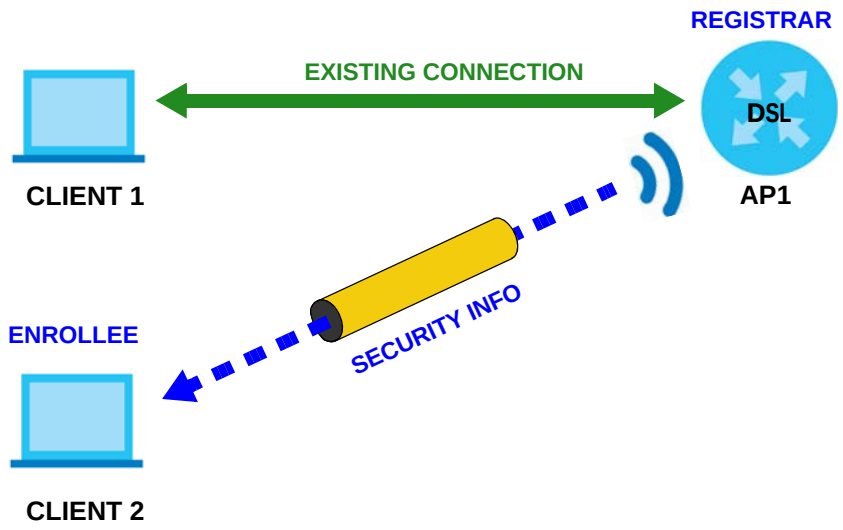
The following figure shows an example network. In step **1**, both **AP1** and **Client 1** are unconfigured. When WPS is activated on both, they perform the handshake. In this example, **AP1** is the registrar, and **Client 1** is the enrollee. The registrar randomly generates the security information to set up the network, since it is unconfigured and has no existing information.

Figure 46 WPS: Example Network Step 1



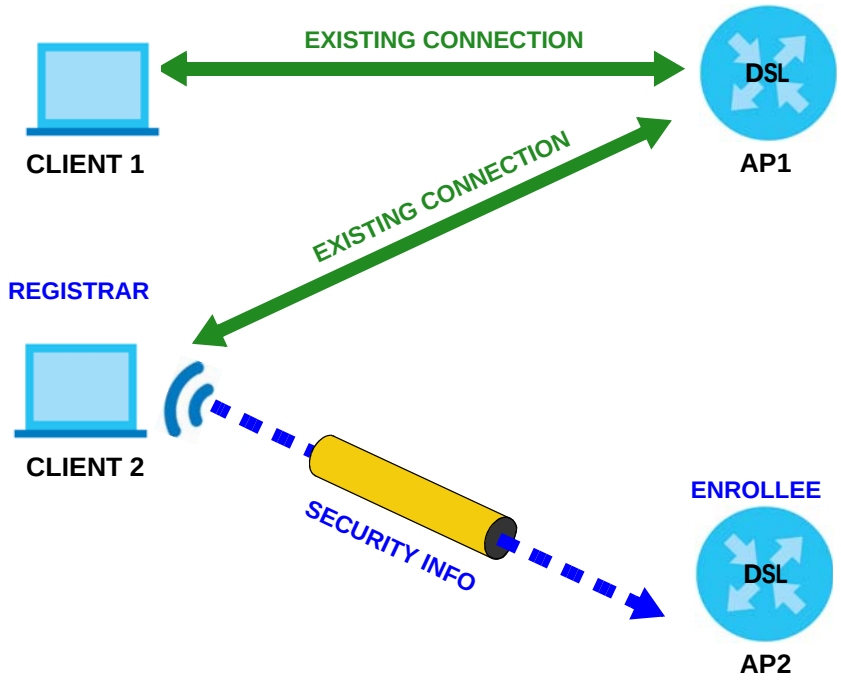
In step **2**, you add another wireless client to the network. You know that **Client 1** supports registrar mode, but it is better to use **AP1** for the WPS handshake with the new client since you must connect to the access point anyway in order to use the network. In this case, **AP1** must be the registrar, since it is configured (it already has security information for the network). **AP1** supplies the existing security information to **Client 2**.

Figure 47 WPS: Example Network Step 2



In step 3, you add another access point (**AP2**) to your network. **AP2** is out of range of **AP1**, so you cannot use **AP1** for the WPS handshake with the new access point. However, you know that **Client 2** supports the registrar function, so you use it to perform the WPS handshake instead.

Figure 48 WPS: Example Network Step 3



7.9.8.5 Limitations of WPS

WPS has some limitations of which you should be aware.

- WPS works in Infrastructure networks only (where an AP and a wireless client communicate). It does not work in Ad-Hoc networks (where there is no AP).
- When you use WPS, it works between two devices only. You cannot enroll multiple devices simultaneously, you must enroll one after the other.

  For instance, if you have two enrollees and one registrar you must set up the first enrollee (by pressing the WPS button on the registrar and the first enrollee, for example), then check that it successfully enrolled, then set up the second device in the same way.
- WPS works only with other WPS-enabled devices. However, you can still add non-WPS devices to a network you already set up using WPS.

  WPS works by automatically issuing a randomly-generated WPA-PSK or WPA2-PSK pre-shared key from the registrar device to the enrollee devices. Whether the network uses WPA-PSK or WPA2-PSK depends on the device. You can check the configuration interface of the registrar device to discover the key the network is using (if the device supports this feature). Then, you can enter the key into the non-WPS device and join the network as normal (the non-WPS device must also support WPA-PSK or WPA2-PSK).
- When you use the PBC method, there is a short period (from the moment you press the button on one device to the moment you press the button on the other device) when any WPS-enabled device could join the network. This is because the registrar has no way of identifying the "correct" enrollee, and cannot differentiate between your enrollee and a rogue device. This is a possible way for a hacker to gain access to a network.

  You can easily check to see if this has happened. WPS works between only two devices simultaneously, so if another device has enrolled your device will be unable to enroll, and will not have access to the network. If this happens, open the access point's configuration interface and look at the list of associated clients (usually displayed by MAC address). It does not matter if the access

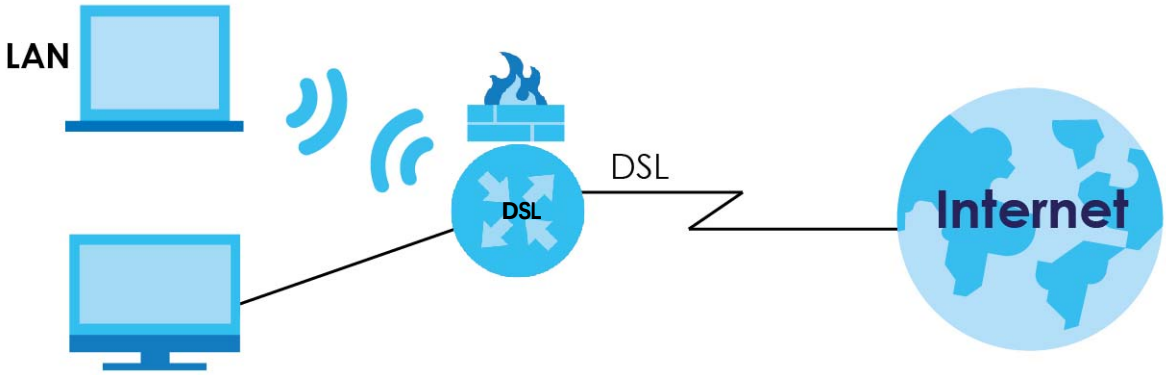
point is the WPS registrar, the enrollee, or was not involved in the WPS handshake; a rogue device must still associate with the access point to gain access to the network. Check the MAC addresses of your wireless clients (usually printed on a label on the bottom of the device). If there is an unknown MAC address you can remove it or reset the AP.

CHAPTER 8
Home Networking

8.1 Overview

A Local Area Network (LAN) is a shared communication system to which many networking devices are connected. It is usually located in one immediate area such as a building or floor of a building.

Use the LAN screens to help you configure a LAN DHCP server and manage IP addresses.



8.1.1 What You Can Do in this Chapter

- Use the **LAN Setup** screen to set the LAN IP address, subnet mask, and DHCP settings of your XMG (Section 8.2 on page 113).
- Use the **Static DHCP** screen to assign IP addresses on the LAN to specific individual computers based on their MAC Addresses (Section 8.3 on page 117).
- Use the **UPnP** screen to enable UPnP and UPnP NAT traversal on the XMG (Section 8.4 on page 118).
- Use the **Additional Subnet** screen to configure IP alias and public static IP (Section 8.5 on page 121).
- Use the **STB Vendor ID** screen to configure the Vendor IDs of the connected Set Top Box (STB) devices, which have the XMG automatically create static DHCP entries for the STB devices when they request IP addresses (Section 8.6 on page 122).
- Use the **Wake on LAN** screen to remotely turn on a device on the network. (Section 8.7 on page 122).
- Use the **TFTP Server Name** screen to set a TFTP server address which is passed to the clients using DHCP option 66. (Section 8.8 on page 123).

8.1.2 What You Need To Know

8.1.2.1 About LAN

IP Address

IP addresses identify individual devices on a network. Every networking device (including computers, servers, routers, printers, etc.) needs an IP address to communicate across the network. These networking devices are also known as hosts.

Subnet Mask

Subnet masks determine the maximum number of possible hosts on a network. You can also use subnet masks to divide one network into multiple sub-networks.

DHCP

A DHCP (Dynamic Host Configuration Protocol) server can assign your XMG an IP address, subnet mask, DNS and other routing information when it's turned on.

DNS

DNS (Domain Name System) is for mapping a domain name to its corresponding IP address and vice versa. The DNS server is extremely important because without it, you must know the IP address of a networking device before you can access it.

RADVD (Router Advertisement Daemon)

When an IPv6 host sends a Router Solicitation (RS) request to discover the available routers, RADVD with Router Advertisement (RA) messages in response to the request. It specifies the minimum and maximum intervals of RA broadcasts. RA messages containing the address prefix. IPv6 hosts can be generated with the IPv6 prefix an IPv6 address.

8.1.2.2 About UPnP

Identifying UPnP Devices

UPnP hardware is identified as an icon in the Network Connections folder (Windows XP). Each UPnP compatible device installed on your network will appear as a separate icon. Selecting the icon of a UPnP device will allow you to access the information and properties of that device.

NAT Traversal

UPnP NAT traversal automates the process of allowing an application to operate through NAT. UPnP network devices can automatically configure network addressing, announce their presence in the network to other UPnP devices and enable exchange of simple product and service descriptions. NAT traversal allows the following:

- Dynamic port mapping
- Learning public IP addresses

- Assigning lease times to mappings

Windows Messenger is an example of an application that supports NAT traversal and UPnP.

See the for more information on NAT.

Cautions with UPnP

The automated nature of NAT traversal applications in establishing their own services and opening firewall ports may present network security issues. Network information and configuration may also be obtained and modified by users in some network environments.

When a UPnP device joins a network, it announces its presence with a multicast message. For security reasons, the XMG allows multicast messages on the LAN only.

All UPnP-enabled devices may communicate freely with each other without additional configuration. Disable UPnP if this is not your intention.

UPnP and Zyxel

Zyxel has achieved UPnP certification from the Universal Plug and Play Forum UPnP™ Implementers Corp. (UIC). Zyxel's UPnP implementation supports Internet Gateway Device (IGD) 1.0.

See Section 8.4.1 on page 119 for examples of installing and using UPnP.

Finding Out More

See Section 8.9 on page 124 for technical background information on LANs.

8.1.3 Before You Begin

Find out the MAC addresses of your network devices if you intend to add them to the DHCP Client List screen.

8.2 The LAN Setup Screen

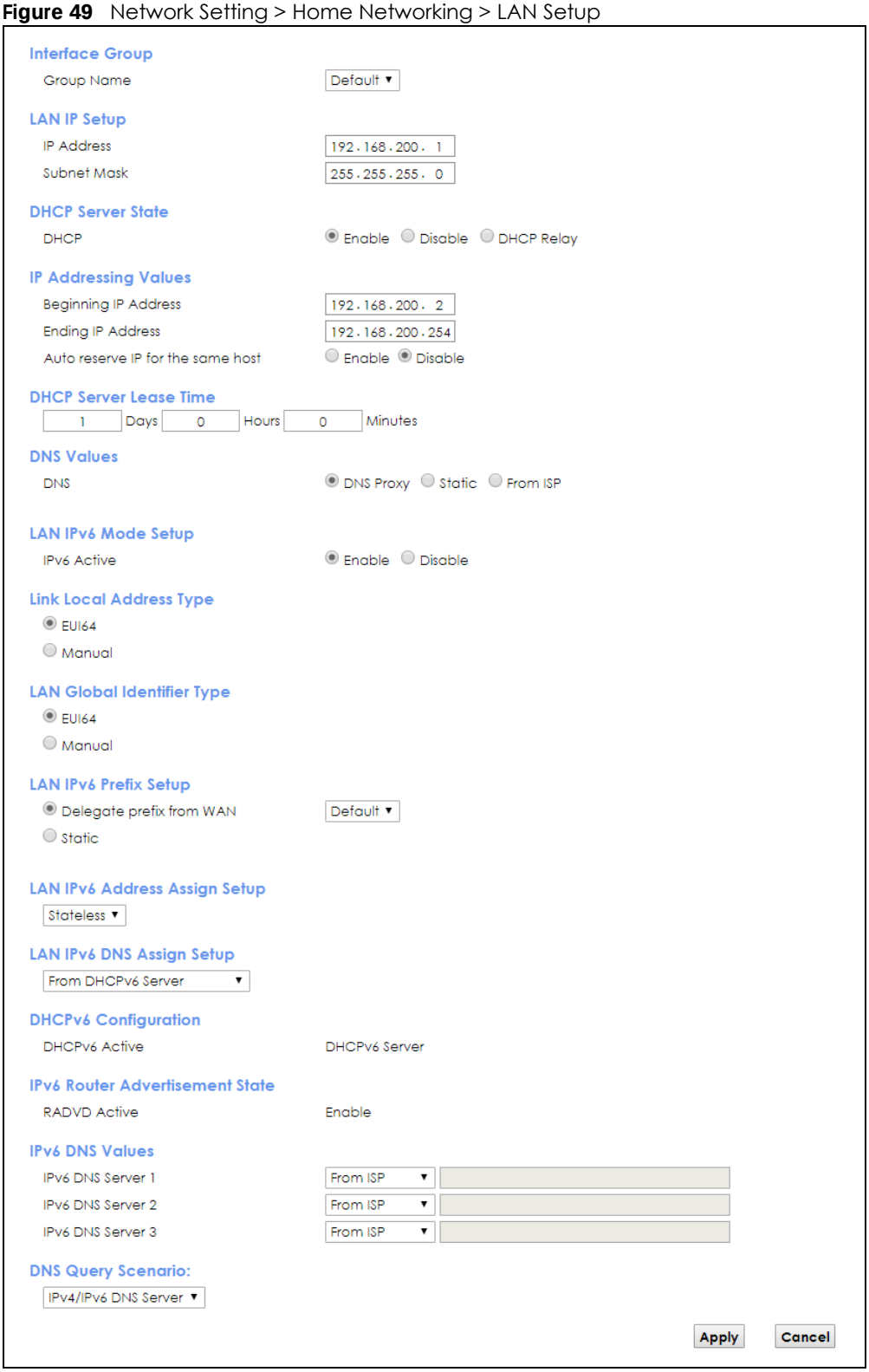
Use this screen to set the Local Area Network IP address and subnet mask of your XMG. Click **Network Setting > Home Networking** to open the **LAN Setup** screen.

Follow these steps to configure your LAN settings.

1. Enter an IP address into the **IP Address** field. The IP address must be in dotted decimal notation. This will become the IP address of your XMG.
2. Enter the IP subnet mask into the **Subnet Mask** field. Unless instructed otherwise it is best to leave this alone, the configurator will automatically compute a subnet mask based upon the IP address you entered.

3 Click **Apply** to save your settings.

Figure 49 Network Setting > Home Networking > LAN Setup



The following table describes the fields in this screen.

Table 27 Network Setting > Home Networking > LAN Setup

LABEL	DESCRIPTION
Interface Group	
Group Name	Select the interface group name for which you want to configure LAN settings. See Chapter 15 on page 175 for how to create a new interface group.
LAN IP Setup	
IP Address	Enter the LAN IPv4 address you want to assign to your XMG in dotted decimal notation, for example, 192.168.200.1 (factory default).
Subnet Mask	Type the subnet mask of your network in dotted decimal notation, for example 255.255.255.0 (factory default). Your XMG automatically computes the subnet mask based on the IP Address you enter, so do not change this field unless you are instructed to do so.
DHCP Server State	
DHCP	Select **Enable** to have the XMG act as a DHCP server or DHCP relay agent. Select **Disable** to stop the DHCP server on the XMG. Select **DHCP Relay** to have the XMG forward DHCP request to the DHCP server.
DHCP Relay Server Address	This field is only available when you select **DHCP Relay** in the **DHCP** field.
IP Address	Enter the IPv4 address of the actual remote DHCP server in this field.
IP Addressing Values	This field is only available when you select **Enable** in the **DHCP** field.
Beginning IP Address	This field specifies the first of the contiguous addresses in the IP address pool.
Ending IP Address	This field specifies the last of the contiguous addresses in the IP address pool.
Auto reserve IP for the same host	Select **Enable** to have the XMG record DHCP IP addresses with the MAC addresses the IP addresses are assigned to. The XMG assigns the same IP address to the same MAC address when the host requests an IP address again through DHCP.
DHCP Server Lease Time	This is the period of time DHCP-assigned addresses is used. DHCP automatically assigns IP addresses to clients when they log in. DHCP centralizes IP address management on central computers that run the DHCP server program. DHCP leases addresses, for a period of time, which means that past addresses are "recycled" and made available for future reassignment to other systems. This field is only available when you select **Enable** in the **DHCP** field.
Days/Hours/ Minutes	Enter the lease time of the DHCP server.
DNS Values	This field is only available when you select **Enable** in the **DHCP** field.
DNS	Select **From ISP** if your ISP dynamically assigns DNS server information. Select **DNS Proxy** if you have the DNS proxy service. The XMG redirects clients' DNS queries to a DNS server for resolving domain names. Select **Static** if you have the IP address of a DNS server.
DNS Server 1/2	This field is only available when you select **Static** in the **DNS** field. Enter the first and second DNS (Domain Name System) server IP addresses the XMG passes to the DHCP clients.
LAN IPv6 Mode Setup	
IPv6 Active	Select **Enable** to activate the IPv6 mode and configure IPv6 settings on the XMG.
Link Local Address Type	
EUI64	Select this to have the XMG generate an interface ID for the LAN interface's link-local address using the EUI-64 format.

Table 27 Network Setting > Home Networking > LAN Setup (continued)

LABEL	DESCRIPTION
Manual	Select this to manually enter an interface ID for the LAN interface's link-local address.
LAN Global Identifier Type	
EUI64	Select this to have the XMG generate an interface ID using the EUI-64 format for its global address .
Manual	Select this to manually enter an interface ID for the LAN interface's global IPv6 address.
LAN IPv6 Prefix Setup	
Delegate prefix from WAN	Select this option to automatically obtain an IPv6 network prefix from the service provider or an uplink router.
Static	Select this option to configure a fixed IPv6 address for the XMG's LAN IPv6 address.
MLD Snooping	Multicast Listener Discovery (MLD) allows an IPv6 switch or router to discover the presence of MLD hosts who wish to receive multicast packets and the IP addresses of multicast groups the hosts want to join on its network.
Active	Select **Enable** to activate MLD Snooping on the XMG. This allows the XMG to check MLD packets passing through it and learn the multicast group membership. It helps reduce multicast traffic.
MLD Mode	Select **Standard Mode** to allow the XMG to forward MLD packets only to ports that want to receive it. Select **MLD Mode** to allow the XMG to block MLD packets for a specific multicast group.
LAN IPv6 Address Assign Setup	Select how you want to obtain an IPv6 address: • **Stateless**: The XMG uses IPv6 stateless autoconfiguration. RADVD (Router Advertisement Daemon) is enabled to have the XMG send IPv6 prefix information in router advertisements periodically and in response to router solicitations. DHCPv6 server is disabled. • **Stateful**: The XMG uses IPv6 stateful autoconfiguration. The DHCPv6 server is enabled to have the XMG act as a DHCPv6 server and pass IPv6 addresses to DHCPv6 clients. • **Stateless and Stateful**: The XMG uses both IPv6 stateless and stateful autoconfiguration. The LAN IPv6 clients can obtain IPv6 addresses either through router advertisements or through DHCPv6.
LAN IPv6 DNS Assign Setup	Select how the XMG provide DNS server and domain name information to the clients: • **From Router Advertisement**: The XMG provides DNS information through router advertisements. • **From DHCPv6 Server**: The XMG provides DNS information through DHCPv6. • **From RA & DHCPv6 Server**: The XMG provides DNS information through both router advertisements and DHCPv6.
DHCPv6 Configuration	
DHCPv6 Active	This shows the status of the DHCPv6. **DHCPv6 Server** displays if you configured the XMG to act as a DHCPv6 server which assigns IPv6 addresses and/or DNS information to clients.
IPv6 Router Advertisement State	
RADVD Active	This shows whether RADVD is enabled or not.
IPv6 DNS Values	
IPv6 DNS Server 1-3	Select **From ISP** if your ISP dynamically assigns IPv6 DNS server information. Select **User-Defined** if you have the IPv6 address of a DNS server. Enter the DNS server IPv6 addresses the XMG passes to the DHCP clients. Select **None** if you do not want to configure IPv6 DNS servers.

Table 27 Network Setting > Home Networking > LAN Setup (continued)

LABEL	DESCRIPTION
DNS Query Scenario	Select how the XMG handles clients' DNS information requests. • **IPv4/IPv6 DNS Server**: The XMG forwards the requests to both the IPv4 and IPv6 DNS servers and sends clients the first DNS information it receives. • **IPv6 DNS Server Only**: The XMG forwards the requests to the IPv6 DNS server and sends clients the DNS information it receives. • **IPv4 DNS Server Only**: The XMG forwards the requests to the IPv4 DNS server and sends clients the DNS information it receives. • **IPv6 DNS Server First**: The XMG forwards the requests to the IPv6 DNS server first and then the IPv4 DNS server. Then it sends clients the first DNS information it receives. • **IPv4 DNS Server First**: The XMG forwards the requests to the IPv4 DNS server first and then the IPv6 DNS server. Then it sends clients the first DNS information it receives.
Apply	Click **Apply** to save your changes.
Cancel	Click **Cancel** to restore your previously saved settings.

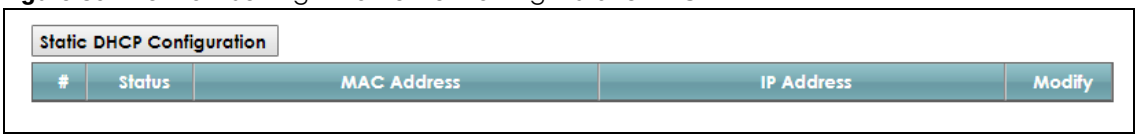
8.3 The Static DHCP Screen

This table allows you to assign IP addresses on the LAN to specific individual computers based on their MAC Addresses.

Every Ethernet device has a unique MAC (Media Access Control) address. The MAC address is assigned at the factory and consists of six pairs of hexadecimal characters, for example, 00:A0:C5:00:00:02.

Use this screen to change your XMG's static DHCP settings. Click **Network Setting > Home Networking > Static DHCP** to open the following screen.

Figure 50 Network Setting > Home Networking > Static DHCP



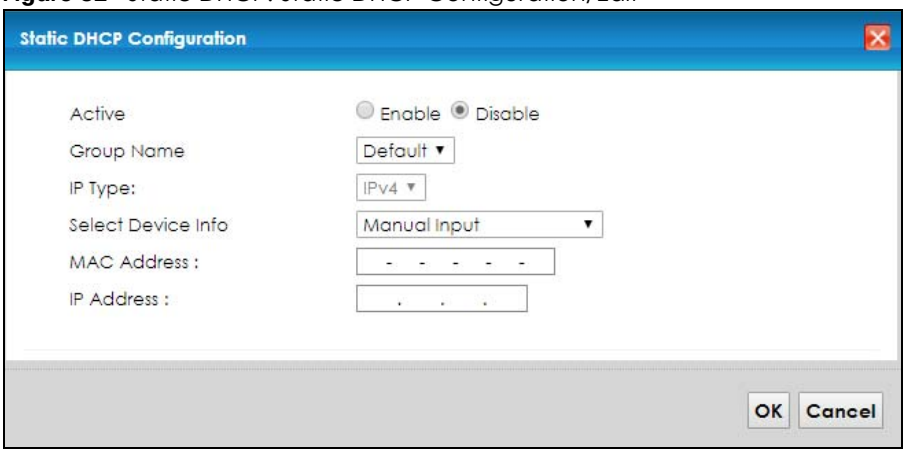
The following table describes the labels in this screen.

Table 28 Network Setting > Home Networking > Static DHCP

LABEL	DESCRIPTION
Static DHCP Configuration	Click this to add a new static DHCP entry.
#	This is the index number of the entry.
Status	This field displays whether the client is connected to the XMG.
MAC Address	The MAC (Media Access Control) or Ethernet address on a LAN (Local Area Network) is unique to your computer (six pairs of hexadecimal notation). A network interface card such as an Ethernet adapter has a hardwired address that is assigned at the factory. This address follows an industry standard that ensures no other adapter has a similar address.
IP Address	This field displays the IP address relative to the # field listed above.
Modify	Click the **Edit** icon to have the IP address field editable and change it. Click the **Delete** icon to delete a static DHCP entry. A window displays asking you to confirm that you want to delete the selected entry.

If you click **Static DHCP Configuration** in the **Static DHCP** screen or the Edit icon next to a static DHCP entry, the following screen displays.

Figure 51 Static DHCP: Static DHCP Configuration/Edit



The following table describes the labels in this screen.

Table 29 Static DHCP: Static DHCP Configuration/Edit

LABEL	DESCRIPTION
Active	Select **Enable** to activate the connection between the client and the XMG.
Group Name	Select the interface group name for which you want to configure static DHCP settings. See Chapter 15 on page 175 for how to create a new interface group.
IP Type	This field displays **IPv4** for the type of the DHCP IP address. At the time of writing, it is not allowed to select other type.
Select Device Info	Select a device or computer from the drop-down list or select **Manual Input** to manually enter a device's MAC address and IP address in the following fields.
MAC Address	If you select **Manual Input**, enter the MAC address of a computer on your LAN.
IP Address	If you select **Manual Input**, enter the IP address that you want to assign to the computer on your LAN with the MAC address that you will also specify.
OK	Click **OK** to save your changes.
Cancel	Click **Cancel** to exit this screen without saving.

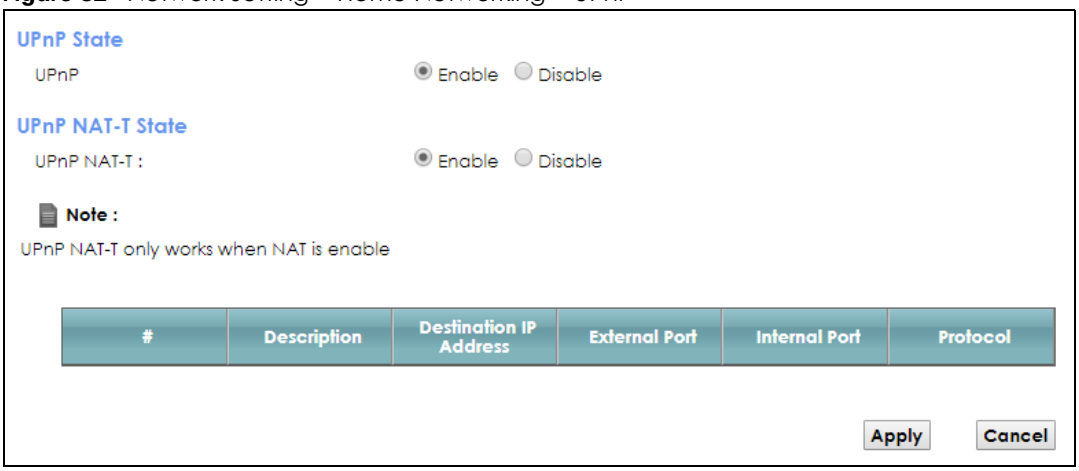
8.4 The UPnP Screen

Universal Plug and Play (UPnP) is a distributed, open networking standard that uses TCP/IP for simple peer-to-peer network connectivity between devices. A UPnP device can dynamically join a network, obtain an IP address, convey its capabilities and learn about other devices on the network. In turn, a device can leave a network smoothly and automatically when it is no longer in use.

See page 112 for more information on UPnP.

Use the following screen to configure the UPnP settings on your XMG. Click **Network Setting > Home Networking > UPnP** to display the screen shown next.

Figure 52 Network Setting > Home Networking > UPnP



The following table describes the labels in this screen.

Table 30 Network Setting > Home Networking > UPnP

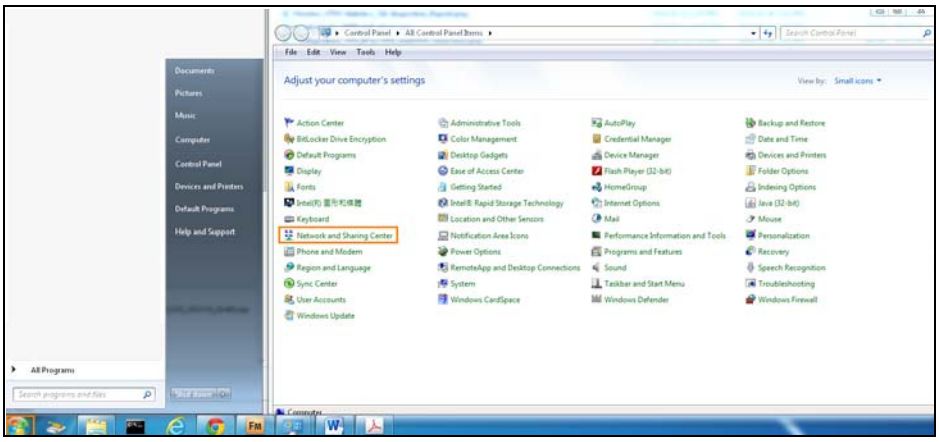
LABEL	DESCRIPTION
UPnP State	
UPnP	Select **Enable** to activate UPnP. Be aware that anyone could use a UPnP application to open the web configurator's login screen without entering the XMG's IP address (although you must still enter the password to access the web configurator).
UPnP NAT-T State	
UPnP NAT-T	Select **Enable** to allow UPnP-enabled applications to automatically configure the XMG so that they can communicate through the XMG by using NAT traversal. UPnP applications automatically reserve a NAT forwarding port in order to communicate with another UPnP enabled device; this eliminates the need to manually configure port forwarding for the UPnP enabled application. The table below displays the NAT port forwarding rules added automatically by UPnP NAT-T.
#	This is the index number of the UPnP NAT-T connection.
Description	This is the description of the UPnP NAT-T connection.
Destination IP Address	This is the IP address of the other connected UPnP-enabled device.
External Port	This is the external port number that identifies the service.
Internal Port	This is the internal port number that identifies the service.
Protocol	This is the transport layer protocol used for the service.
Apply	Click **Apply** to save your changes.
Cancel	Click **Cancel** to exit this screen without saving.

8.4.1 Turning On UPnP in Windows 7 Example

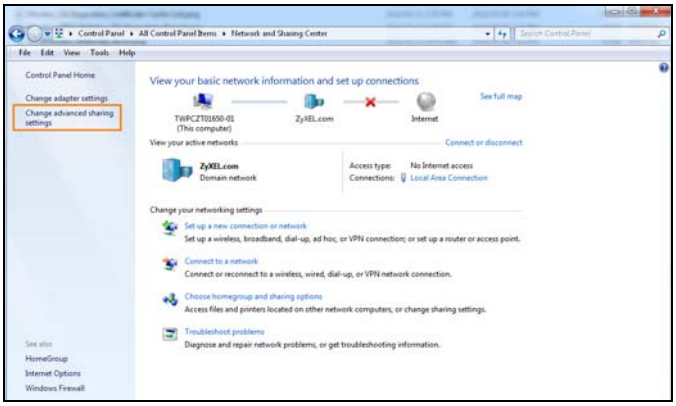
This section shows you how to use the UPnP feature in Windows 7. UPnP server is installed in Windows 7. Activate UPnP on the XMG.

Make sure the computer is connected to a LAN port of the XMG. Turn on your computer and the XMG.

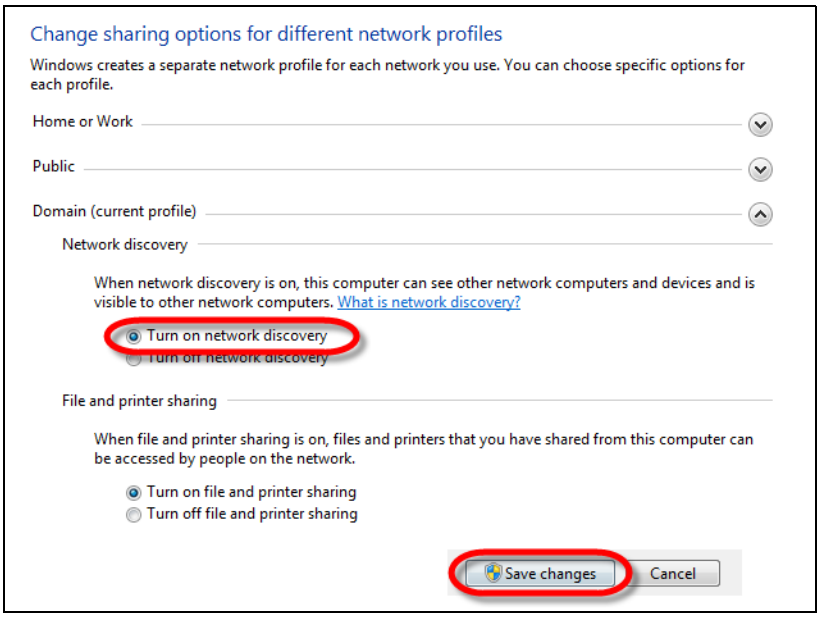
1 Click the start icon, **Control Panel** and then the **Network and Sharing Center.**



2 Click **Change Advanced Sharing Settings**.



3 Select **Turn on network discovery** and click **Save Changes**. Network discovery allows your computer to find other computers and devices on the network and other computers on the network to find your computer. This makes it easier to share files and printers.



8.5 The Additional Subnet Screen

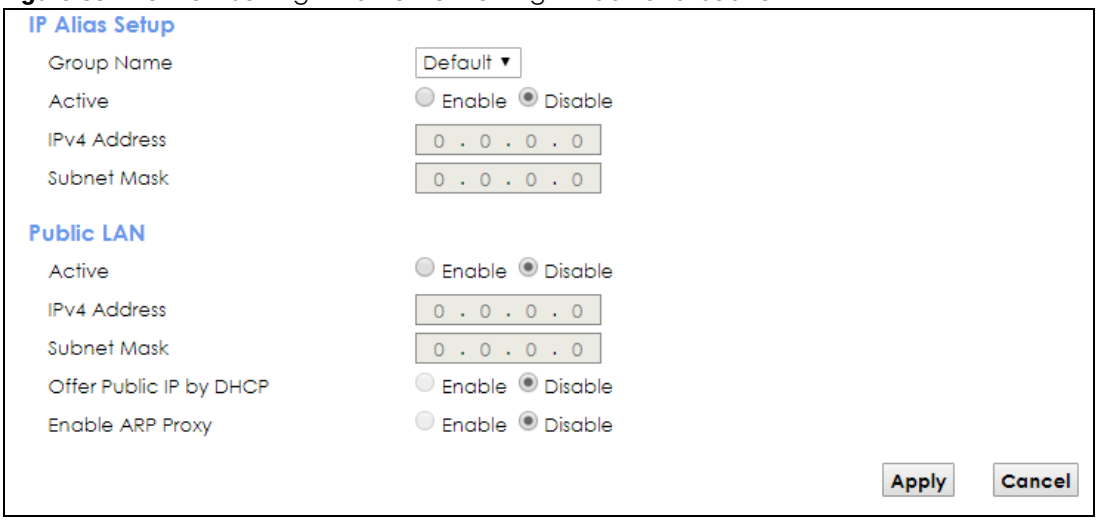
Use the **Additional Subnet** screen to configure IP alias and public static IP.

IP alias allows you to partition a physical network into different logical networks over the same Ethernet interface. The XMG supports multiple logical LAN interfaces via its physical Ethernet interface with the XMG itself as the gateway for the LAN network. When you use IP alias, you can also configure firewall rules to control access to the LAN's logical network (subnet).

If your ISP provides the Public LAN service, the XMG may use an LAN IP address that can be accessed from the WAN.

Click **Network Setting > Home Networking > Additional Subnet** to display the screen shown next.

Figure 53 Network Setting > Home Networking > Additional Subnet



The following table describes the labels in this screen.

Table 31 Network Setting > Home Networking > Additional Subnet

LABEL	DESCRIPTION
IP Alias Setup	
Group Name	Select the interface group name for which you want to configure the IP alias settings. See Chapter 15 on page 175 for how to create a new interface group.
Active	Select **Enable** to configure a LAN network for the XMG.
IPv4 Address	Enter the IP address of your XMG in dotted decimal notation.
Subnet Mask	Enter the subnet mask of your network in dotted decimal notation, for example 255.255.255.0 (factory default).
Public LAN	
Active	Select **Enable** to enable the Public LAN feature. Your ISP must support Public LAN and Static IP.
IPv4 Address	Enter the public IP address provided by your ISP.
Subnet Mask	Enter the public IPv4 subnet mask provided by your ISP.
Offer Public IP by DHCP	Select **Enable** to enable the XMG to provide public IP addresses by DHCP server.
Enable ARP Proxy	Select **Enable** to enable the ARP (Address Resolution Protocol) proxy.

Table 31 Network Setting > Home Networking > Additional Subnet (continued)

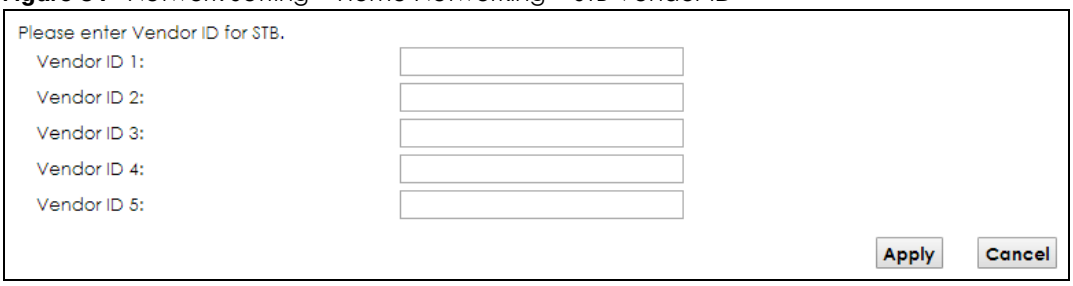
LABEL	DESCRIPTION
Apply	Click **Apply** to save your changes.
Cancel	Click **Cancel** to exit this screen without saving.

8.6 The STB Vendor ID Screen

Set Top Box (STB) devices with dynamic IP addresses sometimes don't renew their IP addresses before the lease time expires. This could lead to IP address conflicts if the STB continues to use an IP address that gets assigned to another device. Use this screen to configure the Vendor IDs of connected STBs, which have the XMG automatically created static DHCP entries for them when they request IP addresses.

Click **Network Setting** > **Home Networking** > **STB Vendor ID** to open this screen.

Figure 54 Network Setting > Home Networking > STB Vendor ID



The following table describes the labels in this screen.

Table 32 Network Setting > Home Networking > STB Vendor ID

LABEL	DESCRIPTION
Vendor ID 1~5	These are STB's Vendor Class Identifiers (DHCP option 60). A Vendor Class Identifier is usually used to inform the DHCP server a DHCP client's vendor and functionality.
Apply	Click **Apply** to save your changes.
Cancel	Click **Cancel** to exit this screen without saving.

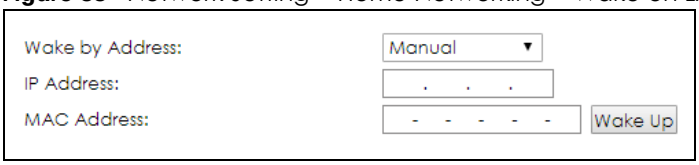
8.7 The Wake on LAN Screen

Use this screen to turn on a device on the LAN network. To use this feature, the remote device must also support Wake On LAN.

You need to know the MAC address of the LAN device. It may be on a label on the device or in its documentation.

Click **Network Setting** > **Home Networking** > **Wake on LAN** to open this screen.

Figure 55 Network Setting > Home Networking > Wake on LAN



The following table describes the labels in this screen.

Table 33 Network Setting > Home Networking > Wake on LAN

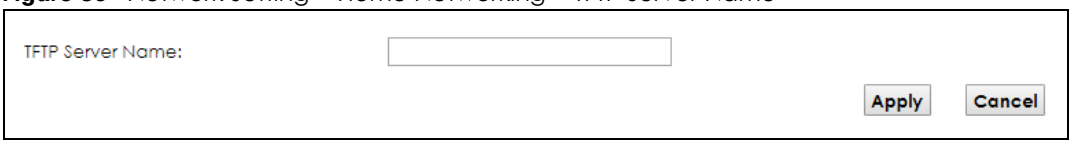
LABEL	DESCRIPTION
Wake by Address	Select **Manual** and enter the IP address or MAC address of the device to turn it on remotely. The drop-down list also lists the IP addresses that can be found in the XMG's ARP table. Select an IP address and it will then automatically update the IP address and MAC address in the following fields.
IP Address	Enter the IPv4 IP address of the device to turn it on.
MAC Address	Enter the MAC address of the device to turn it on. A MAC address consists of six hexadecimal character pairs.
Wake up	Click this to send a wake up packet to wake up the specified device.

8.8 The TFTP Server Name Screen

Use the **TFTP Server Name** screen to set the TFTP server address which is passed to the clients using DHCP option 66. The DHCP clients in the XMG local network, such as STB devices that support the TFTP booting mechanism, can then use the TFTP server address or domain name for initial system settings download. RFC 2132 defines the option 66 open standard. DHCP option 66 carries the IP address or the domain name of a single TFTP server.

Click **Network Setting** > **Home Networking** > **TFTP Server Name** to open this screen.

Figure 56 Network Setting > Home Networking > TFTP Server Name



The following table describes the labels in this screen.

Table 34 Network Setting > Home Networking > TFTP Server Name

LABEL	DESCRIPTION
TFTP Server Name	Enter the IP address or the domain name of a single TFTP server.
Apply	Click **Apply** to save your changes.
Cancel	Click **Cancel** to exit this screen without saving.

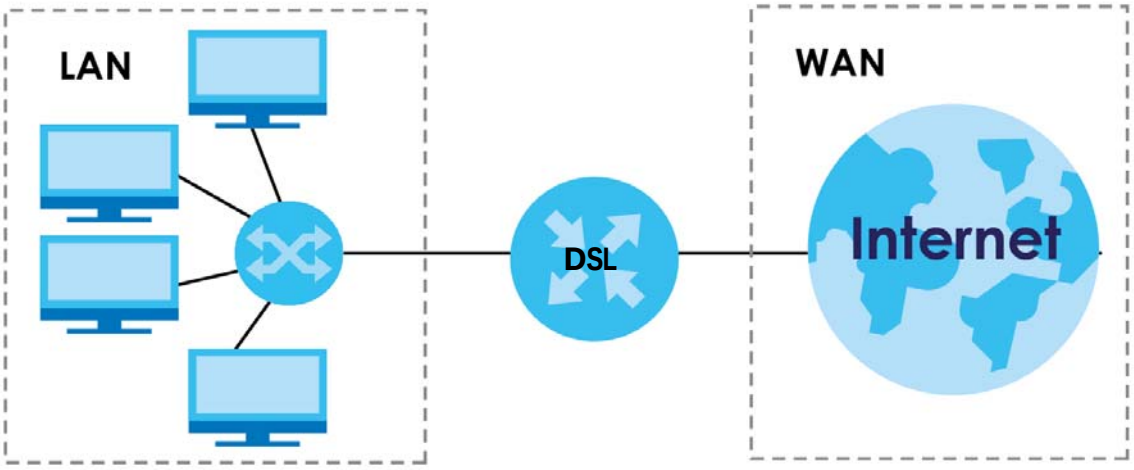
8.9 Technical Reference

This section provides some technical background information about the topics covered in this chapter.

8.9.1 LANs, WANs and the XMG

The actual physical connection determines whether the XMG ports are LAN or WAN ports. There are two separate IP networks, one inside the LAN network and the other outside the WAN network as shown next.

Figure 57 LAN and WAN IP Addresses



8.9.2 DHCP Setup

DHCP (Dynamic Host Configuration Protocol, RFC 2131 and RFC 2132) allows individual clients to obtain TCP/IP configuration at start-up from a server. You can configure the XMG as a DHCP server or disable it. When configured as a server, the XMG provides the TCP/IP configuration for the clients. If you turn DHCP service off, you must have another DHCP server on your LAN, or else the computer must be manually configured.

IP Pool Setup

The XMG is pre-configured with a pool of IP addresses for the DHCP clients (DHCP Pool). See the product specifications in the appendices. Do not assign static IP addresses from the DHCP pool to your LAN computers.

8.9.3 DNS Server Addresses

DNS (Domain Name System) maps a domain name to its corresponding IP address and vice versa. The DNS server is extremely important because without it, you must know the IP address of a computer before you can access it. The DNS server addresses you enter when you set up DHCP are passed to the client machines along with the assigned IP address and subnet mask.

There are two ways that an ISP disseminates the DNS server addresses.

- The ISP tells you the DNS server addresses, usually in the form of an information sheet, when you sign up. If your ISP gives you DNS server addresses, enter them in the **DNS Server** fields in the **DHCP Setup** screen.
- Some ISPs choose to disseminate the DNS server addresses using the DNS server extensions of IPCP (IP Control Protocol) after the connection is up. If your ISP did not give you explicit DNS servers, chances are the DNS servers are conveyed through IPCP negotiation. The XMG supports the IPCP DNS server extensions through the DNS proxy feature.

  Please note that DNS proxy works only when the ISP uses the IPCP DNS server extensions. It does not mean you can leave the DNS servers out of the DHCP setup under all circumstances. If your ISP gives you explicit DNS servers, make sure that you enter their IP addresses in the **DHCP Setup** screen.

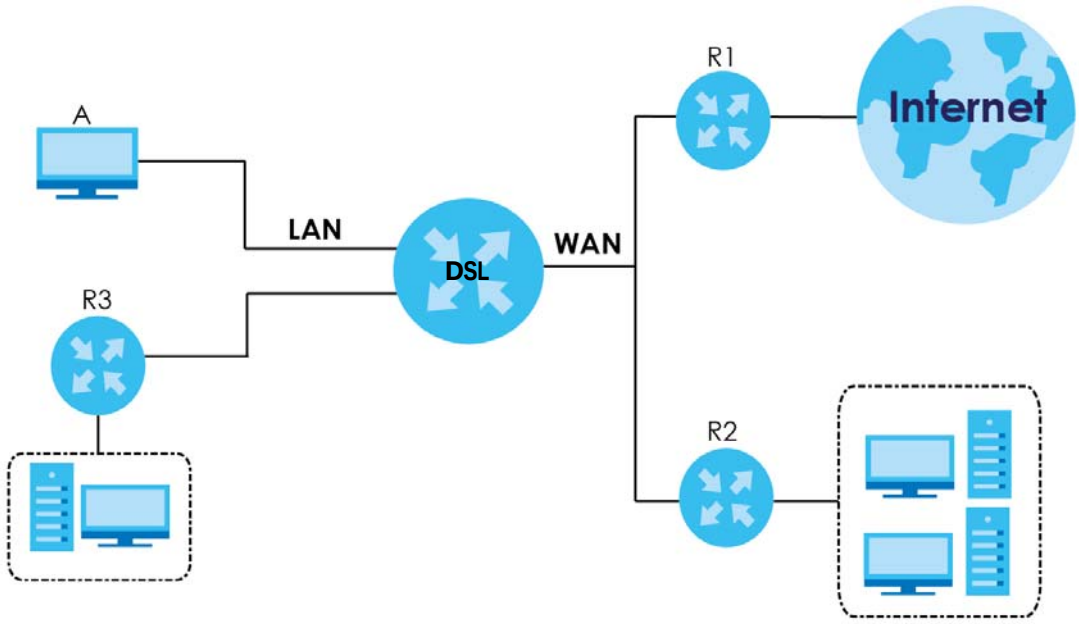
CHAPTER 9
Routing

9.1 Overview

The XMG usually uses the default gateway to route outbound traffic from computers on the LAN to the Internet. To have the XMG send data to devices not reachable through the default gateway, use static routes.

For example, the next figure shows a computer (**A**) connected to the XMG's LAN interface. The XMG routes most traffic from **A** to the Internet through the XMG's default gateway (**R1**). You create one static route to connect to services offered by your ISP behind router **R2**. You create another static route to communicate with a separate network behind a router **R3** connected to the LAN.

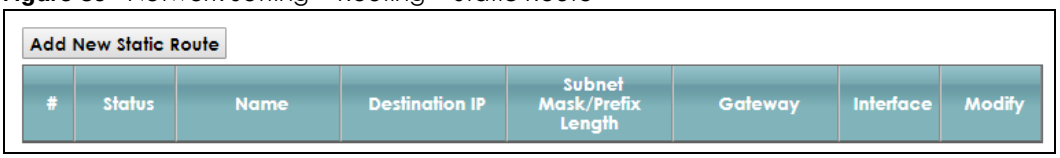
Figure 58 Example of Routing Topology



9.2 The Routing Screen

Use this screen to view and configure the static route rules on the XMG. Click **Network Setting > Routing > Static Route** to open the following screen.

Figure 59 Network Setting > Routing > Static Route



The following table describes the labels in this screen.

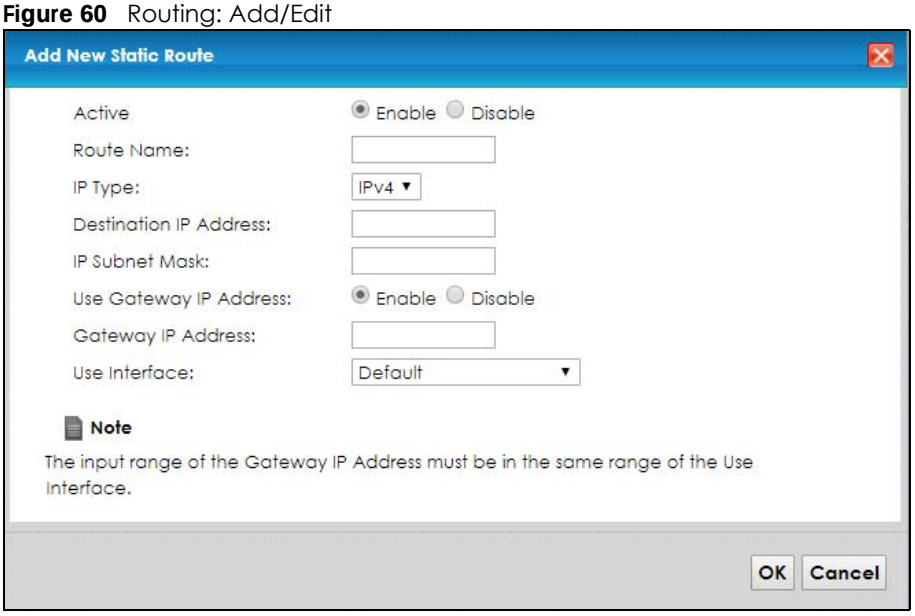
Table 35 Network Setting > Routing > Static Route

LABEL	DESCRIPTION
Add new static route	Click this to configure a new static route.
#	This is the index number of the entry.
Status	This field displays whether the static route is active or not. A yellow bulb signifies that this route is active. A gray bulb signifies that this route is not active.
Name	This is the name that describes or identifies this route.
Destination IP	This parameter specifies the IP network address of the final destination. Routing is always based on network number.
Subnet Mask	This parameter specifies the IP network subnet mask of the final destination.
Gateway	This is the IP address of the gateway. The gateway is a router or switch on the same network segment as the device's LAN or WAN port. The gateway helps forward packets to their destinations.
Interface	This is the WAN interface used for this static route.
Modify	Click the **Edit** icon to edit the static route on the XMG. Click the **Delete** icon to remove a static route from the XMG. A window displays asking you to confirm that you want to delete the route.

9.2.1 Add/Edit Static Route

Use this screen to add or edit a static route. Click **Add new static route** in the **Routing** screen or the **Edit** icon next to the static route you want to edit. The screen shown next appears.

Figure 60 Routing: Add/Edit



The following table describes the labels in this screen.

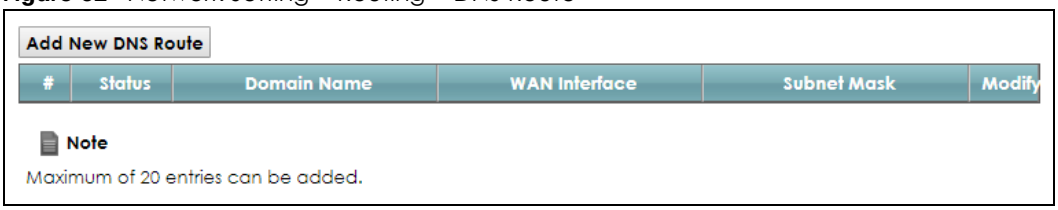
Table 36 Routing: Add/Edit

LABEL	DESCRIPTION
Active	This field allows you to activate/deactivate this static route. Select **Enable** to activate the static route. Select **Disable** to deactivate this static route without having to delete the entry.
Route Name	Enter a descriptive name for the static route.
IP Type	Select whether your IP type is **IPv4** or **IPv6**.
Destination IP Address	Enter the IPv4 or IPv6 network address of the final destination.
IP Subnet Mask	If you are using IPv4 and need to specify a route to a single host, use a subnet mask of 255.255.255.255 in the subnet mask field to force the network number to be identical to the host ID. Enter the IP subnet mask here.
Use Gateway IP Address	The gateway is a router or switch on the same network segment as the device's LAN or WAN port. The gateway helps forward packets to their destinations. If you want to use the gateway IP address, select **Enable**.
Gateway IP Address	Enter the IP address of the gateway.
Use Interface	Select the WAN interface you want to use for this static route.
OK	Click **OK** to save your changes.
Cancel	Click **Cancel** to exit this screen without saving.

9.3 The DNS Route Screen

Use this screen to view and configure DNS routes on the XMG. Click **Network Setting > Routing > DNS Route** to open the following screen.

Figure 61 Network Setting > Routing > DNS Route



The following table describes the labels in this screen.

Table 37 Network Setting > Routing > DNS Route

LABEL	DESCRIPTION
Add New DNS Route	Click this to add a new DNS route.
#	This is the index number of a DNS route.
Status	This field displays whether the DNS route is active or not. A yellow bulb signifies that this DNS route is active. A gray bulb signifies that this DNS route is not active.
Domain Name	This is the host name or domain name of the DNS route entry.
WAN Interface	This is the WAN connection through which the XMG forwards DNS requests for this domain name.

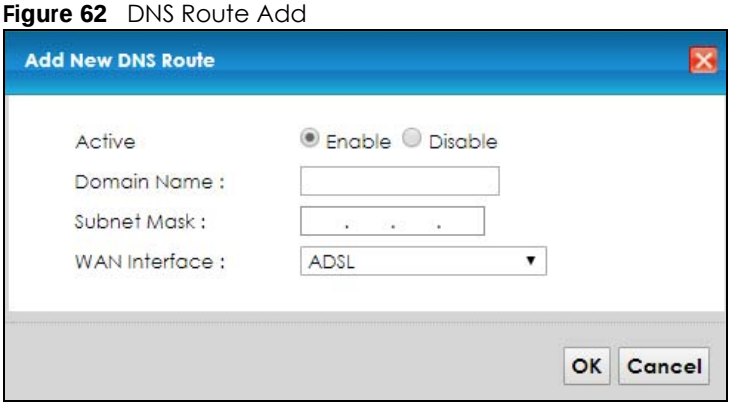
Table 37 Network Setting > Routing > DNS Route (continued)

LABEL	DESCRIPTION
Subnet Mask	This is the subnet mask of the DNS route entry.
Modify	Click the **Edit** icon to modify the DNS route. Click the **Delete** icon to delete the DNS route.

9.3.1 The DNS Route Add Screen

You can manually add the XMG's DNS route entry. Click **Add New DNS Route** in the **Network Setting > Routing > DNS Route** screen. The screen shown next appears.

Figure 62 DNS Route Add



The following table describes the labels in this screen.

Table 38 DNS Route Add

LABEL	DESCRIPTION
Active	Select to enable or disable this DNS route.
Domain Name	Enter the domain name of the DNS route entry.
Subnet Mask	Enter the subnet mask of the DNS route entry.
WAN Interface	Select the WAN connection through which the XMG forwards DNS requests for this domain name.
OK	Click this to save your changes.
Cancel	Click this to exit this screen without saving any changes.

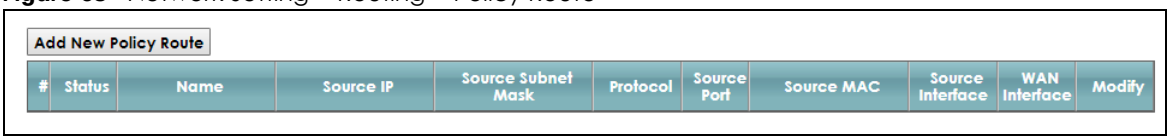
9.4 The Policy Route Screen

Traditionally, routing is based on the destination address only and the XMG takes the shortest path to forward a packet. Policy route allows the XMG to override the default routing behavior and alter the packet forwarding based on the policy defined by the network administrator. Policy-based routing is applied to outgoing packets, prior to the normal routing.

You can use source-based policy forwarding to direct traffic from different users through different connections or distribute traffic among multiple paths for load sharing.

The **Policy Route** screen let you view and configure routing policies on the XMG. Click **Network Setting > Routing > Policy Route** to open the following screen.

Figure 63 Network Setting > Routing > Policy Route



The following table describes the labels in this screen.

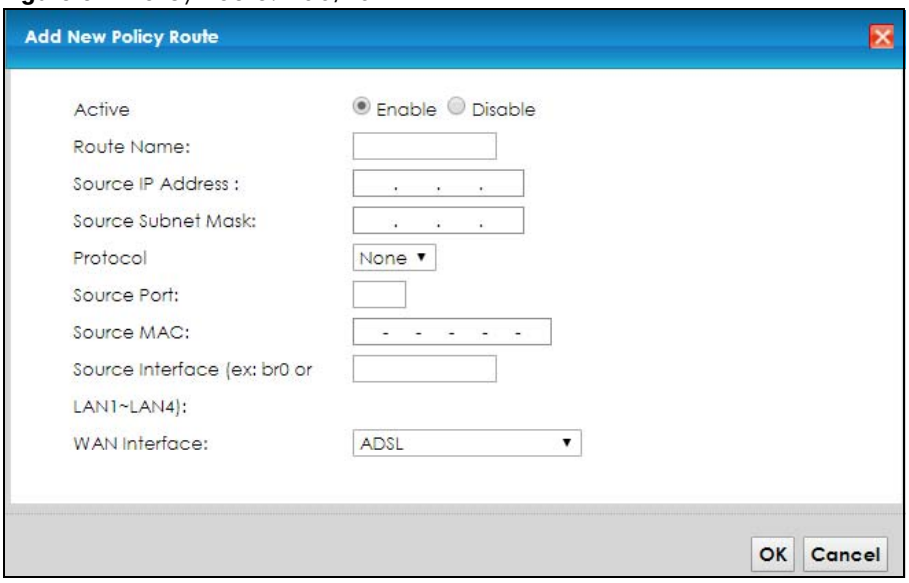
Table 39 Network Setting > Routing >Policy Route

LABEL	DESCRIPTION
Add New Policy Route	Click this to create a new policy forwarding rule.
#	This is the index number of the entry.
Status	This field displays whether the DNS route is active or not. A yellow bulb signifies that this DNS route is active. A gray bulb signifies that this DNS route is not active.
Name	This is the name of the rule.
Source IP	This is the source IP address.
Source Subnet Mask	his is the source subnet mask address.
Protocol	This is the transport layer protocol.
Source Port	This is the source port number.
Source MAC	This is the source MAC address.
Source Interface	This is the interface from which the matched traffic is sent.
WAN Interface	This is the WAN interface through which the traffic is routed.
Modify	Click the **Edit** icon to edit this policy. Click the **Delete** icon to remove a policy from the XMG. A window displays asking you to confirm that you want to delete the policy.

9.4.1 Add/Edit Policy Route

Click **Add New Policy Route** in the **Policy Route** screen or click the **Edit** icon next to a policy. Use this screen to configure the required information for a policy route.

Figure 64 Policy Route: Add/Edit



The following table describes the labels in this screen.

Table 40 Policy Route: Add/Edit

LABEL	DESCRIPTION
Active	Select to enable or disable this policy route.
Route Name	Enter a descriptive name of up to 8 printable English keyboard characters, not including spaces.
Source IP Address	Enter the source IP address.
Source Subnet Mask	Enter the source subnet mask address.
Protocol	Select the transport layer protocol (**TCP** or **UDP**).
Source Port	Enter the source port number.
Source MAC	Enter the source MAC address.
Source Interface	Type the name of the interface from which the matched traffic is sent.
WAN Interface	Select a WAN interface through which the traffic is sent. You must have the WAN interface(s) already configured in the **Broadband** screens.
OK	Click **OK** to save your changes.
Cancel	Click **Cancel** to exit this screen without saving.

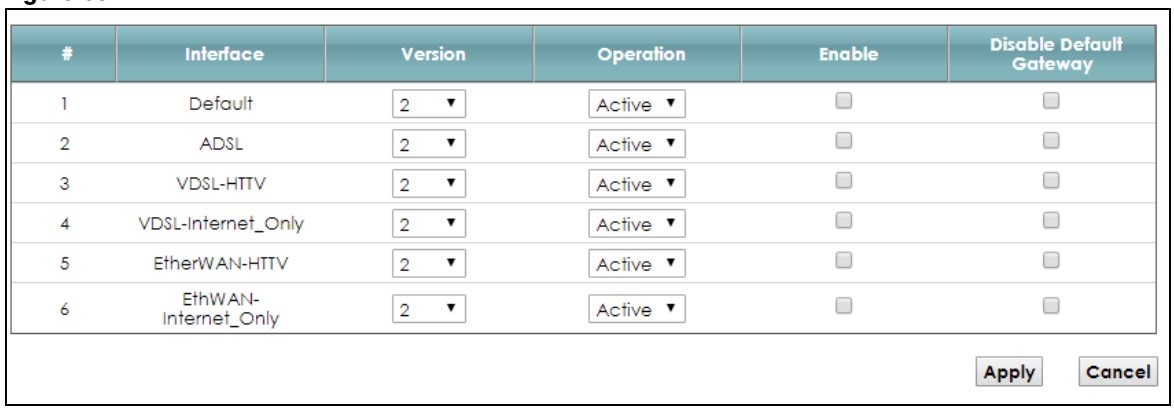
9.5 RIP

Routing Information Protocol (RIP, RFC 1058 and RFC 1389) allows a device to exchange routing information with other routers.

9.5.1 The RIP Screen

Click **Network Setting > Routing > RIP** to open the **RIP** screen.

Figure 65 RIP



#	Interface	Version	Operation	Enable	Disable Default Gateway
1	Default	2	Active		
2	ADSL	2	Active		
3	VDSL-HTTV	2	Active		
4	VDSL-Internet_Only	2	Active		
5	EtherWAN-HTTV	2	Active		
6	EthWAN-Internet_Only	2	Active		

Apply Cancel

The following table describes the labels in this screen.

Table 41 RIP

LABEL	DESCRIPTION
#	This is the index of the interface in which the RIP setting is used.
Interface	This is the name of the interface in which the RIP setting is used.
Version	The RIP version controls the format and the broadcasting method of the RIP packets that the XMG sends (it recognizes both formats when receiving). RIP version **1** is universally supported but RIP version **2** carries more information. RIP version **1** is probably adequate for most networks, unless you have an unusual network topology.
Operation	Select **Passive** to have the XMG update the routing table based on the RIP packets received from neighbors but not advertise its route information to other routers in this interface. Select **Active** to have the XMG advertise its route information and also listen for routing updates from neighboring routers.
Enable	Select the check box to activate the settings.
Disable Default Gateway	Select the check box to set the XMG to not send the route information to the default gateway.
Apply	Click **Apply** to save your changes back to the XMG.
Cancel	Click **Cancel** to restore your previously saved settings.

CHAPTER 10
Quality of Service (QoS)

10.1 Overview

Quality of Service (QoS) refers to both a network's ability to deliver data with minimum delay, and the networking methods used to control the use of bandwidth. Without QoS, all traffic data is equally likely to be dropped when the network is congested. This can cause a reduction in network performance and make the network inadequate for time-critical application such as video-on-demand.

Configure QoS on the XMG to group and prioritize application traffic and fine-tune network performance. Setting up QoS involves these steps:

1. Configure classifiers to sort traffic into different flows.
2. Assign priority and define actions to be performed for a classified traffic flow.

The XMG assigns each packet a priority and then queues the packet accordingly. Packets assigned a high priority are processed more quickly than those with low priority if there is congestion, allowing time-sensitive applications to flow more smoothly. Time-sensitive applications include both those that require a low level of latency (delay) and a low level of jitter (variations in delay) such as Voice over IP (VoIP) or Internet gaming, and those for which jitter alone is a problem such as Internet radio or streaming video.

This chapter contains information about configuring QoS and editing classifiers.

10.1.1 What You Can Do in this Chapter

- Use the **General** screen to enable or disable QoS and set the upstream bandwidth (Section 10.3 on page 135).
- Use the **Queue Setup** screen to configure QoS queue assignment (Section 10.4 on page 136).
- Use the **Classification Setup** screen to add, edit or delete QoS classifiers (Section 10.5 on page 138).
- Use the **Shaper Setup** screen to limit outgoing traffic transmission rate on the selected interface (Section 10.6 on page 143).
- Use the **Policer Setup** screen to control incoming traffic transmission rate and bursts (Section 10.7 on page 144).

10.2 What You Need to Know

The following terms and concepts may help as you read through this chapter.

QoS versus Cos

QoS is used to prioritize source-to-destination traffic flows. All packets in the same flow are given the same priority. CoS (class of service) is a way of managing traffic in a network by grouping similar types of traffic together and treating each type as a class. You can use CoS to give different priorities to different packet types.

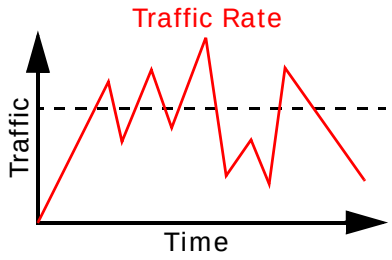
CoS technologies include IEEE 802.1p layer 2 tagging and DiffServ (Differentiated Services or DS). IEEE 802.1p tagging makes use of three bits in the packet header, while DiffServ is a new protocol and defines a new DS field, which replaces the eight-bit ToS (Type of Service) field in the IP header.

Tagging and Marking

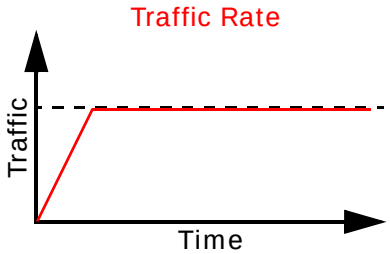
In a QoS class, you can configure whether to add or change the DSCP (DiffServ Code Point) value, IEEE 802.1p priority level and VLAN ID number in a matched packet. When the packet passes through a compatible network, the networking device, such as a backbone switch, can provide specific treatment or service based on the tag or marker.

Traffic Shaping

Bursty traffic may cause network congestion. Traffic shaping regulates packets to be transmitted with a pre-configured data transmission rate using buffers (or queues). Your XMG uses the Token Bucket algorithm to allow a certain amount of large bursts while keeping a limit at the average rate.



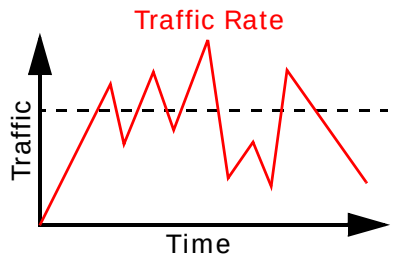
(Before Traffic Shaping)



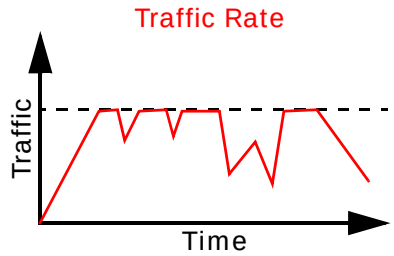
(After Traffic Shaping)

Traffic Policing

Traffic policing is the limiting of the input or output transmission rate of a class of traffic on the basis of user-defined criteria. Traffic policing methods measure traffic flows against user-defined criteria and identify it as either conforming, exceeding or violating the criteria.



(Before Traffic Policing)



(After Traffic Policing)

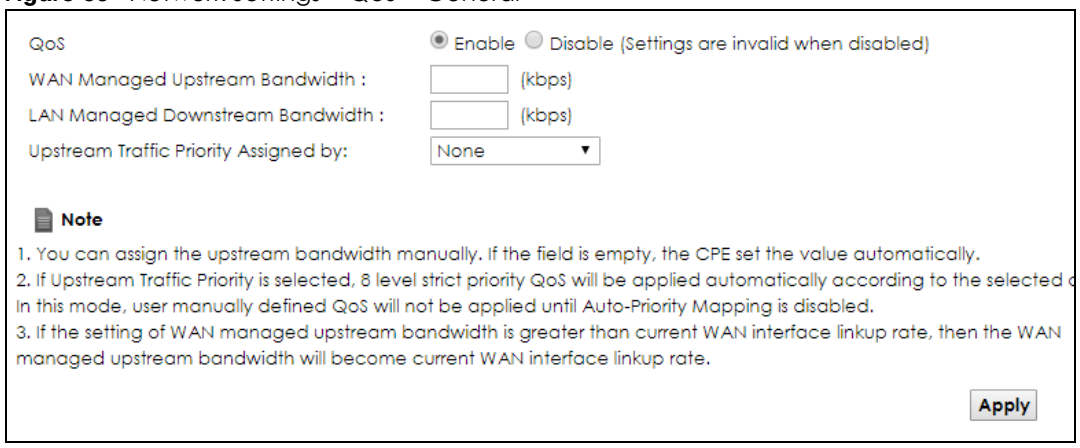
The XMG supports three incoming traffic metering algorithms: Token Bucket Filter (TBF), Single Rate Two Color Maker (srTCM), and Two Rate Two Color Marker (trTCM). You can specify actions which are performed on the colored packets. See Section 10.8 on page 146 for more information on each metering algorithm.

10.3 The Quality of Service General Screen

Click **Network Setting > QoS > General** to open the screen as shown next.

Use this screen to enable or disable QoS and set the upstream bandwidth. See Section 10.1 on page 133 for more information.

Figure 66 Network Settings > QoS > General



The following table describes the labels in this screen.

Table 42 Network Setting > QoS > General

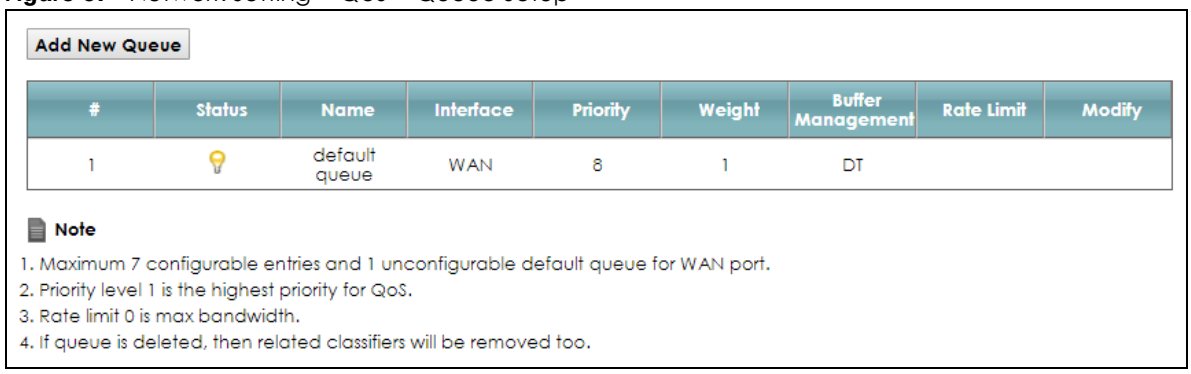
LABEL	DESCRIPTION
QoS	Select the **Enable** check box to turn on QoS to improve your network performance.
WAN Managed Upstream Bandwidth	Enter the amount of upstream bandwidth for the WAN interfaces that you want to allocate using QoS. The recommendation is to set this speed to match the interfaces' actual transmission speed. For example, set the WAN interfaces' speed to 100000 kbps if your Internet connection has an upstream transmission speed of 100 Mbps. You can set this number higher than the interfaces' actual transmission speed. The XMG uses up to 95% of the DSL port's actual upstream transmission speed even if you set this number higher than the DSL port's actual transmission speed. You can also set this number lower than the interfaces' actual transmission speed. This will cause the XMG to not use some of the interfaces' available bandwidth. If you leave this field blank, the XMG automatically sets this number to be 95% of the WAN interfaces' actual upstream transmission speed.
LAN Managed Downstream Bandwidth	Enter the amount of downstream bandwidth for the LAN interfaces (including WLAN) that you want to allocate using QoS. The recommendation is to set this speed to match the WAN interfaces' actual transmission speed. For example, set the LAN managed downstream bandwidth to 100000 kbps if you use a 100 Mbps wired Ethernet WAN connection. You can also set this number lower than the WAN interfaces' actual transmission speed. This will cause the XMG to not use some of the interfaces' available bandwidth. If you leave this field blank, the XMG automatically sets this to the LAN interfaces' maximum supported connection speed.
Upstream Traffic Priority Assigned by	Select how the XMG assigns priorities to various upstream traffic flows. • **None:** Disables auto priority mapping and has the XMG put packets into the queues according to your classification rules. Traffic which does not match any of the classification rules is mapped into the default queue with the lowest priority. • **Ethernet Priority:** Automatically assign priority based on the IEEE 802.1p priority level. • **IP Precedence:** Automatically assign priority based on the first three bits of the TOS field in the IP header. • **Packet Length:** Automatically assign priority based on the packet size. Smaller packets get higher priority since control, signaling, VoIP, internet gaming, or other real-time packets are usually small while larger packets are usually best effort data packets like file transfers.
Apply	Click **Apply** to save your changes.
Cancel	Click **Cancel** to restore your previously saved settings.

10.4 The Queue Setup Screen

Click **Network Setting > QoS > Queue Setup** to open the screen as shown next.

Use this screen to configure QoS queue assignment.

Figure 67 Network Setting > QoS > Queue Setup



The following table describes the labels in this screen.

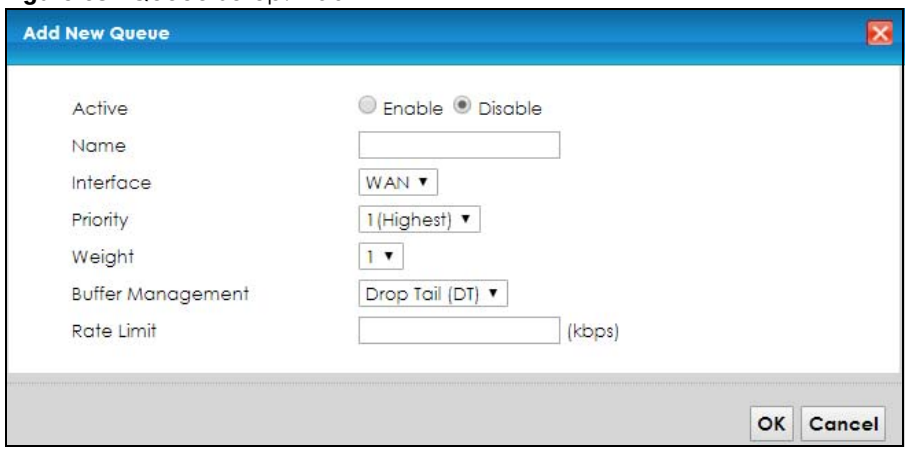
Table 43 Network Setting > QoS > Queue Setup

LABEL	DESCRIPTION
Add New Queue	Click this button to create a new queue entry.
#	This is the index number of the entry.
Status	This field displays whether the queue is active or not. A yellow bulb signifies that this queue is active. A gray bulb signifies that this queue is not active.
Name	This shows the descriptive name of this queue.
Interface	This shows the name of the XMG's interface through which traffic in this queue passes.
Priority	This shows the priority of this queue.
Weight	This shows the weight of this queue.
Buffer Management	This shows the queue management algorithm used for this queue. Queue management algorithms determine how the XMG should handle packets when it receives too many (network congestion).
Rate Limit	This shows the maximum transmission rate allowed for traffic on this queue.
Modify	Click the **Edit** icon to edit the queue. Click the **Delete** icon to delete an existing queue. Note that subsequent rules move up by one when you take this action.

10.4.1 Adding a QoS Queue

Click **Add New Queue** or the edit icon in the **Queue Setup** screen to configure a queue.

Figure 68 Queue Setup: Add



The following table describes the labels in this screen.

Table 44 Queue Setup: Add

LABEL	DESCRIPTION
Active	Select to enable or disable this queue.
Name	Enter the descriptive name of this queue.
Interface	Select the interface to which this queue is applied. This field is read-only if you are editing the queue.
Priority	Select the priority level (from 1 to 7) of this queue. The smaller the number, the higher the priority level. Traffic assigned to higher priority queues gets through faster while traffic in lower priority queues is dropped if the network is congested.
Weight	Select the weight (from 1 to 8) of this queue. If two queues have the same priority level, the XMG divides the bandwidth across the queues according to their weights. Queues with larger weights get more bandwidth than queues with smaller weights.
Buffer Management	This field displays **Drop Tail (DT)**. **Drop Tail (DT)** is a simple queue management algorithm that allows the XMG buffer to accept as many packets as it can until it is full. Once the buffer is full, new packets that arrive are dropped until there is space in the buffer again (packets are transmitted out of it).
Rate Limit	Specify the maximum transmission rate (in Kbps) allowed for traffic on this queue.
OK	Click **OK** to save your changes.
Cancel	Click **Cancel** to exit this screen without saving.

10.5 The Classification Setup Screen

Use this screen to add, edit or delete QoS classifiers. A classifier groups traffic into data flows according to specific criteria such as the source address, destination address, source port number, destination port number or incoming interface. For example, you can configure a classifier to select traffic from the same protocol port (such as Telnet) to form a flow.

You can give different priorities to traffic that the XMG forwards out through the WAN interface. Give high priority to voice and video to make them run more smoothly. Similarly, give low priority to many large file downloads so that they do not reduce the quality of other applications.

Click **Network Setting > QoS > Classification Setup** to open the following screen.

Figure 69 Network Setting > QoS > Classification Setup

Add New Classification

Order	Status	Class Name	Classification Criteria	DSCP Mark	802.1P Mark	VLAN ID Tag	To Queue	Modify
1		IPTV-0	From Intf: LAN Ether Type: IP Dest IP: 72.253.24.1 / 26	48	6(VO)	Add VID: 0	default queue	
2		IPTV-1	From Intf: LAN Ether Type: IP Dest IP: 72.253.27.1 / 26	34	4(CL)	Add VID: 0	default queue	
3		IPTV-3	From Intf: LAN Ether Type: IP Dest IP: 72.253.24.64 / 27	18	3(EE)	Add VID: 0	default queue	
4		IPTV-4	From Intf: LAN Ether Type: IP Dest IP: 72.253.25.1 / 24	34	4(CL)	Add VID: 0	default queue	
5		IPTV-5	From Intf: LAN Ether Type: IP Dest IP: 72.253.22.96 / 27	48	6(VO)	Add VID: 0	default queue	
6		IPTV-6	From Intf: LAN Ether Type: IP Dest IP: 72.253.24.128 / 26	34	4(CL)	Add VID: 0	default queue	
7		IPTV-7	From Intf: LAN Ether Type: IP Dest IP: 72.253.26.1 / 24	10	2(SPARE)	Add VID: 0	default queue	
8		IPTV-8	From Intf: LAN Ether Type: IP Dest IP: 72.253.24.192 / 26	10	2(SPARE)	Add VID: 0	default queue	
9		IPTV-9	From Intf: LAN Ether Type: IP Dest IP: 72.253.27.194 / 32	18	2(SPARE)	Add VID: 0	default queue	

The following table describes the labels in this screen.

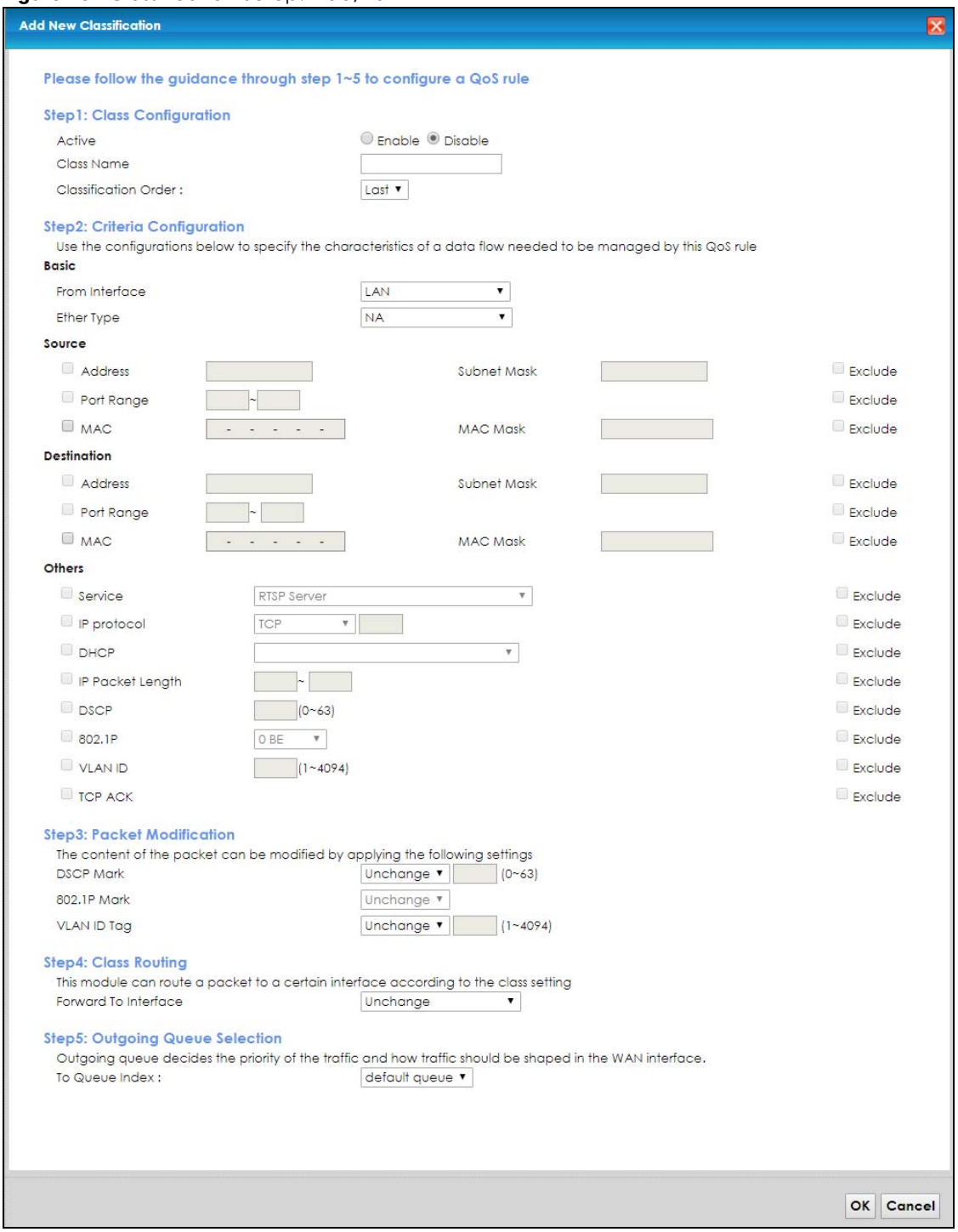
Table 45 Network Setting > QoS > Classification Setup

LABEL	DESCRIPTION
Add New Classification	Click this to create a new classifier.
Order	This is the index number of the entry. The classifiers are applied in order of their numbering.
Status	This field displays whether the classifier is active or not. A yellow bulb signifies that this classifier is active. A gray bulb signifies that this classifier is not active.
Class Name	This is the name of the classifier.
Classification Criteria	This shows criteria specified in this classifier, for example the interface from which traffic of this class should come and the source MAC address of traffic that matches this classifier.
DSCP Mark	This is the DSCP number added to traffic of this classifier.
802.1P Mark	This is the IEEE 802.1p priority level assigned to traffic of this classifier.
VLAN ID Tag	This is the VLAN ID number assigned to traffic of this classifier.
To Queue	This is the name of the queue in which traffic of this classifier is put.
Modify	Click the **Edit** icon to edit the classifier. Click the **Delete** icon to delete an existing classifier. Note that subsequent rules move up by one when you take this action.

10.5.1 Add/Edit QoS Class

Click **Add New Classification** in the **Classification Setup** screen or the **Edit** icon next to a classifier to open the following screen.

Figure 70 Classification Setup: Add/Edit



The following table describes the labels in this screen.

Table 46 Classification Setup: Add/Edit

LABEL	DESCRIPTION
Step1: Class Configuration	
Active	Select to enable or disable this classifier.
Class Name	Enter a descriptive name of up to 15 printable English keyboard characters, not including spaces.
Classification Order	Select an existing number for where you want to put this classifier to move the classifier to the number you selected after clicking **Apply**. Select **Last** to put this rule in the back of the classifier list.
Step2: Criteria Configuration	
From Interface	If you want to classify the traffic by an ingress interface, select an interface from the **From Interface** drop-down list box.
Ether Type	Select a predefined application to configure a class for the matched traffic. If you select **IP**, you also need to configure source or destination MAC address, IP address, DHCP options, DSCP value or the protocol type. If you select **802.1Q**, you can configure an 802.1p priority level.
Source	
Address	Select the check box and enter the source IP address in dotted decimal notation. A blank source IP address means any source IP address.
Subnet Mask	Enter the source subnet mask.
Port Range	If you select **TCP** or **UDP** in the **IP Protocol** field, select the check box and enter the port number(s) of the source.
MAC	Select the check box and enter the source MAC address of the packet.
MAC Mask	Type the mask for the specified MAC address to determine which bits a packet's MAC address should match. Enter "f" for each bit of the specified source MAC address that the traffic's MAC address should match. Enter "0" for the bit(s) of the matched traffic's MAC address, which can be of any hexadecimal character(s). For example, if you set the MAC address to 00:13:49:00:00:00 and the mask to ff:ff:ff:00:00:00, a packet with a MAC address of 00:13:49:12:34:56 matches this criteria.
Exclude	Select this option to exclude the packets that match the specified criteria from this classifier.
Destination	
Address	Select the check box and enter the destination IP address in dotted decimal notation. A blank source IP address means any source IP address.
Subnet Mask	Enter the destination subnet mask.
Port Range	If you select **TCP** or **UDP** in the **IP Protocol** field, select the check box and enter the port number(s) of the destination.
MAC	Select the check box and enter the destination MAC address of the packet.
MAC Mask	Type the mask for the specified MAC address to determine which bits a packet's MAC address should match. Enter "f" for each bit of the specified destination MAC address that the traffic's MAC address should match. Enter "0" for the bit(s) of the matched traffic's MAC address, which can be of any hexadecimal character(s). For example, if you set the MAC address to 00:13:49:00:00:00 and the mask to ff:ff:ff:00:00:00, a packet with a MAC address of 00:13:49:12:34:56 matches this criteria.
Exclude	Select this option to exclude the packets that match the specified criteria from this classifier.
Others	

Table 46 Classification Setup: Add/Edit (continued)

LABEL	DESCRIPTION
Service	This field is available only when you select **IP** in the **Ether Type** field. This field simplifies classifier configuration by allowing you to select a predefined application. When you select a predefined application, you do not configure the rest of the filter fields.
IP Protocol	This field is available only when you select **IP** in the **Ether Type** field. Select this option and select the protocol (service type) from **TCP**, **UDP**, **ICMP** or **IGMP**. If you select **User defined**, enter the protocol (service type) number.
DHCP	This field is available only when you select **IP** in the **Ether Type** field. Select this option and select a DHCP option. If you select **Vendor Class ID (DHCP Option 60)**, enter the Vendor Class Identifier (Option 60) of the matched traffic, such as the type of the hardware or firmware. If you select **Client ID (DHCP Option 61)**, enter the Identity Association IDentifier (IAD Option 61) of the matched traffic, such as the MAC address of the device. If you select **User Class ID (DHCP Option 77)**, enter a string that identifies the user's category or application type in the matched DHCP packets. If you select **Vendor Specific Info (DHCP Option 125)**, enter the vendor specific information of the matched traffic, such as the product class, model name, and serial number of the device.
IP Packet Length	This field is available only when you select **IP** in the **Ether Type** field. Select this option and enter the minimum and maximum packet length (from 46 to 1500) in the fields provided.
DSCP	This field is available only when you select **IP** in the **Ether Type** field. Select this option and specify a DSCP (DiffServ Code Point) number between 0 and 63 in the field provided.
802.1P	This field is available only when you select **802.1Q** in the **Ether Type** field. Select this option and select a priority level (between 0 and 7) from the drop-down list box. "0" is the lowest priority level and "7" is the highest.
VLAN ID	This field is available only when you select **802.1Q** in the **Ether Type** field. Select this option and specify a VLAN ID number.
TCP ACK	This field is available only when you select **IP** in the **Ether Type** field. If you select this option, the matched TCP packets must contain the ACK (Acknowledge) flag.
Exclude	Select this option to exclude the packets that match the specified criteria from this classifier.
Step3: Packet Modification	
DSCP Mark	This field is available only when you select **IP** in the **Ether Type** field. If you select **Remark**, enter a DSCP value with which the XMG replaces the DSCP field in the packets. If you select **Unchange**, the XMG keep the DSCP field in the packets.
802.1P Mark	Select a priority level with which the XMG replaces the IEEE 802.1p priority field in the packets. If you select **Unchange**, the XMG keep the 802.1p priority field in the packets.
VLAN ID Tag	If you select **Remark**, enter a VLAN ID number with which the XMG replaces the VLAN ID of the frames. If you select **Remove**, the XMG deletes the VLAN ID of the frames before forwarding them out. If you select **Add**, the XMG treat all matched traffic untagged and add a second VLAN ID. If you select **Unchange**, the XMG keep the VLAN ID in the packets.

Table 46 Classification Setup: Add/Edit (continued)

LABEL	DESCRIPTION
Step4: Class Routing	
Forward to Interface	Select a WAN interface through which traffic of this class will be forwarded out. If you select **Unchange**, the XMG forward traffic of this class according to the default routing table.
Step5: Outgoing Queue Selection	
To Queue Index	Select a queue that applies to this class. You should have configured a queue in the **Queue Setup** screen already.
OK	Click **OK** to save your changes.
Cancel	Click **Cancel** to exit this screen without saving.

10.6 The QoS Shaper Setup Screen

This screen shows that you can use the token bucket algorithm to allow a certain amount of large bursts while keeping a limit for processing outgoing traffic at the average rate. Click **Network Setting > QoS > Shaper Setup**. The screen appears as shown.

Figure 71 Network Setting > QoS > Shaper Setup

The following table describes the labels in this screen.

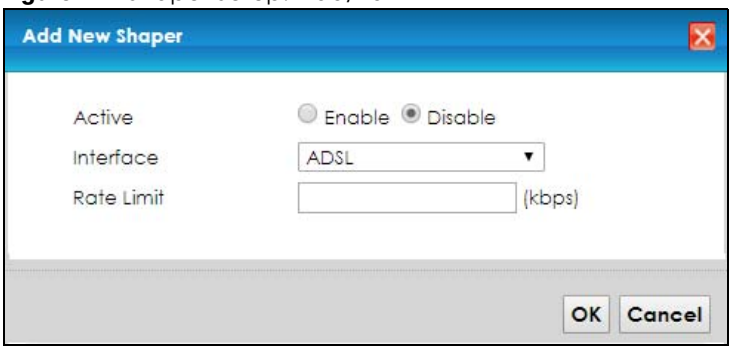
Table 47 Network Setting > QoS > Shaper Setup

LABEL	DESCRIPTION
Add New Shaper	Click this to create a new entry.
#	This is the index number of the entry.
Status	This field displays whether the shaper is active or not. A yellow bulb signifies that this policer is active. A gray bulb signifies that this shaper is not active.
Outgoing Interface	This shows the name of the XMG's interface through which traffic in this shaper applies.
Rate Limit (kbps)	This shows the average rate limit of traffic bursts for this shaper.
Modify	Click the **Edit** icon to edit the shaper. Click the **Delete** icon to delete an existing shaper. Note that subsequent rules move up by one when you take this action.

10.6.1 Add/Edit a QoS Shaper

Click **Add New Shaper** in the **Shaper Setup** screen or the **Edit** icon next to a shaper to show the following screen.

Figure 72 Shaper Setup: Add/Edit



The following table describes the labels in this screen.

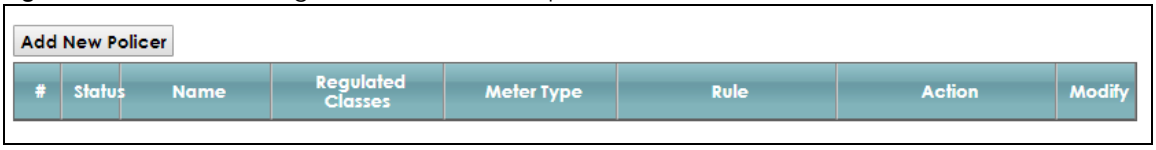
Table 48 Shaper Setup: Add/Edit

LABEL	DESCRIPTION
Active	Select to enable or disable this shaper.
Interface	Select the XMG's interface through which traffic in this shaper applies
Rate Limit	Enter the average rate limit of traffic bursts for this shaper.
OK	Click **OK** to save your changes.
Cancel	Click **Cancel** to exit this screen without saving.

10.7 The QoS Policer Setup Screen

Use this screen to view QoS policers that allow you to limit the transmission rate of incoming traffic and apply actions, such as drop, pass, or modify the DSCP value for matched traffic. Click **Network Setting > QoS > Policer Setup**. The screen appears as shown.

Figure 73 Network Setting > QoS > Policer Setup



The following table describes the labels in this screen.

Table 49 Network Setting > QoS > Policer Setup

LABEL	DESCRIPTION
Add new Policer	Click this to create a new entry.
#	This is the index number of the entry.
Status	This field displays whether the policer is active or not. A yellow bulb signifies that this policer is active. A gray bulb signifies that this policer is not active.
Name	This field displays the descriptive name of this policer.

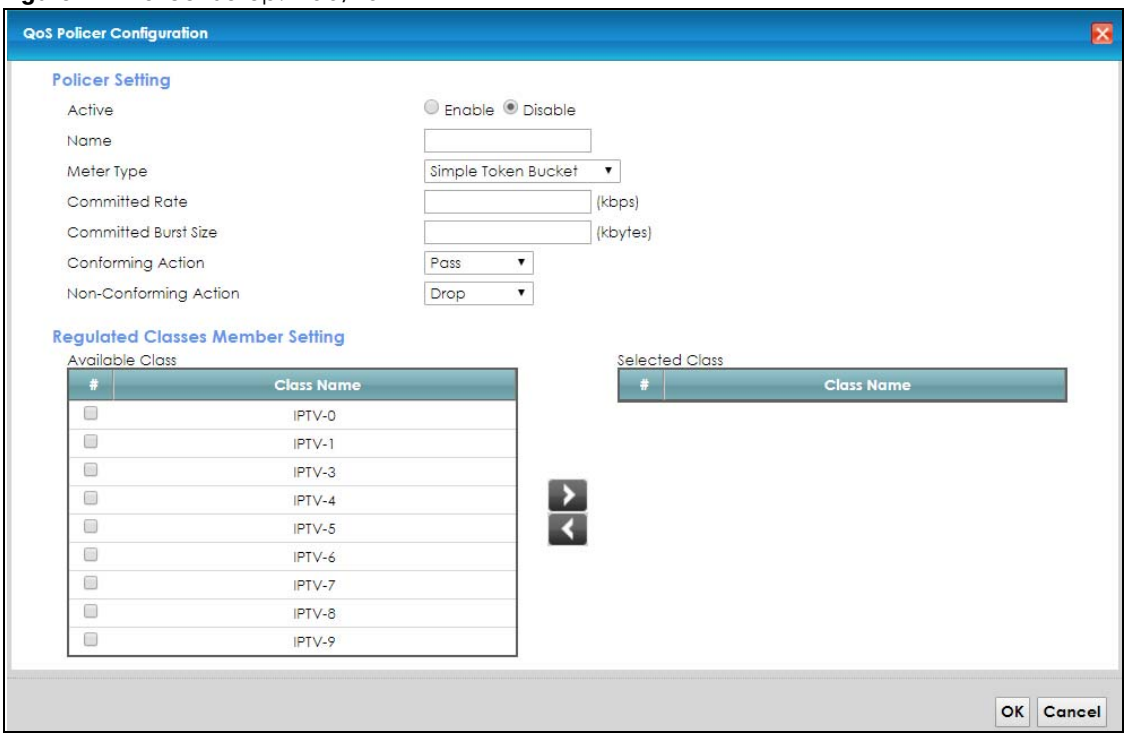
Table 49 Network Setting > QoS > Policer Setup (continued)

LABEL	DESCRIPTION
Regulated Classes	This field displays the name of a QoS classifier
Meter Type	This field displays the type of QoS metering algorithm used in this policer.
Rule	These are the rates and burst sizes against which the policer checks the traffic of the member QoS classes.
Action	This shows the how the policer has the XMG treat different types of traffic belonging to the policer's member QoS classes.
Modify	Click the **Edit** icon to edit the policer. Click the **Delete** icon to delete an existing policer. Note that subsequent rules move up by one when you take this action.

10.7.1 Add/Edit a QoS Policer

Click **Add New Policer** in the **Policer Setup** screen or the **Edit** icon next to a policer to show the following screen.

Figure 74 Policer Setup: Add/Edit



The following table describes the labels in this screen.

Table 50 Policer Setup: Add/Edit

LABEL	DESCRIPTION
Active	Select to enable or disable this policer.
Name	Enter the descriptive name of this policer.

Table 50 Policer Setup: Add/Edit

LABEL	DESCRIPTION
Meter Type	This shows the traffic metering algorithm used in this policer. The **Simple Token Bucket** algorithm uses tokens in a bucket to control when traffic can be transmitted. Each token represents one byte. The algorithm allows bursts of up to *b* bytes which is also the bucket size. The **Single Rate Three Color Marker** (srTCM) is based on the token bucket filter and identifies packets by comparing them to the Committed Information Rate (CIR), the Committed Burst Size (CBS) and the Excess Burst Size (EBS). The **Two Rate Three Color Marker** (trTCM) is based on the token bucket filter and identifies packets by comparing them to the Committed Information Rate (CIR) and the Peak Information Rate (PIR).
Committed Rate	Specify the committed rate. When the incoming traffic rate of the member QoS classes is less than the committed rate, the device applies the conforming action to the traffic.
Committed Burst Size	Specify the committed burst size for packet bursts. This must be equal to or less than the peak burst size (two rate three color) or excess burst size (single rate three color) if it is also configured. This is the maximum size of the (first) token bucket in a traffic metering algorithm.
Conforming Action	Specify what the XMG does for packets within the committed rate and burst size (green-marked packets). • **Pass:** Send the packets without modification. • **DSCP Mark:** Change the DSCP mark value of the packets. Enter the DSCP mark value to use.
Non-Conforming Action	Specify what the XMG does for packets that exceed the excess burst size or peak rate and burst size (red-marked packets). • **Drop:** Discard the packets. • **DSCP Mark:** Change the DSCP mark value of the packets. Enter the DSCP mark value to use. The packets may be dropped if there is congestion on the network.
Available Class Selected Class	Select a QoS classifier to apply this QoS policer to traffic that matches the QoS classifier. Highlight a QoS classifier in the **Available Class** box and use the **>** button to move it to the **Selected Class** box. To remove a QoS classifier from the **Selected Class** box, select it and use the **<** button.
OK	Click **OK** to save your changes.
Cancel	Click **Cancel** to exit this screen without saving.

10.8 Technical Reference

The following section contains additional technical information about the XMG features described in this chapter.

IEEE 802.1Q Tag

The IEEE 802.1Q standard defines an explicit VLAN tag in the MAC header to identify the VLAN membership of a frame across bridges. A VLAN tag includes the 12-bit VLAN ID and 3-bit user priority. The VLAN ID associates a frame with a specific VLAN and provides the information that devices need to process the frame across the network.

IEEE 802.1p specifies the user priority field and defines up to eight separate traffic types. The following table describes the traffic types defined in the IEEE 802.1d standard (which incorporates the 802.1p).

Table 51 IEEE 802.1p Priority Level and Traffic Type

PRIORITY LEVEL	TRAFFIC TYPE
Level 7	Typically used for network control traffic such as router configuration messages.
Level 6	Typically used for voice traffic that is especially sensitive to jitter (jitter is the variations in delay).
Level 5	Typically used for video that consumes high bandwidth and is sensitive to jitter.
Level 4	Typically used for controlled load, latency-sensitive traffic such as SNA (Systems Network Architecture) transactions.
Level 3	Typically used for "excellent effort" or better than best effort and would include important business traffic that can tolerate some delay.
Level 2	This is for "spare bandwidth".
Level 1	This is typically used for non-critical "background" traffic such as bulk transfers that are allowed but that should not affect other applications and users.
Level 0	Typically used for best-effort traffic.

DiffServ

QoS is used to prioritize source-to-destination traffic flows. All packets in the flow are given the same priority. You can use CoS (class of service) to give different priorities to different packet types.

DiffServ (Differentiated Services) is a class of service (CoS) model that marks packets so that they receive specific per-hop treatment at DiffServ-compliant network devices along the route based on the application types and traffic flow. Packets are marked with DiffServ Code Points (DSCPs) indicating the level of service desired. This allows the intermediary DiffServ-compliant network devices to handle the packets differently depending on the code points without the need to negotiate paths or remember state information for every flow. In addition, applications do not have to request a particular service or give advanced notice of where the traffic is going.

DSCP and Per-Hop Behavior

DiffServ defines a new Differentiated Services (DS) field to replace the Type of Service (TOS) field in the IP header. The DS field contains a 2-bit unused field and a 6-bit DSCP field which can define up to 64 service levels. The following figure illustrates the DS field.

DSCP is backward compatible with the three precedence bits in the ToS octet so that non-DiffServ compliant, ToS-enabled network device will not conflict with the DSCP mapping.

DSCP (6 bits)	Unused (2 bits)

The DSCP value determines the forwarding behavior, the PHB (Per-Hop Behavior), that each packet gets across the DiffServ network. Based on the marking rule, different kinds of traffic can be marked for different kinds of forwarding. Resources can then be allocated according to the DSCP values and the configured policies.

IP Precedence

Similar to IEEE 802.1p prioritization at layer-2, you can use IP precedence to prioritize packets in a layer-3 network. IP precedence uses three bits of the eight-bit ToS (Type of Service) field in the IP header. There are eight classes of services (ranging from zero to seven) in IP precedence. Zero is the lowest priority level and seven is the highest.

Automatic Priority Queue Assignment

If you enable QoS on the XMG, the XMG can automatically base on the IEEE 802.1p priority level, IP precedence and/or packet length to assign priority to traffic which does not match a class.

The following table shows you the internal layer-2 and layer-3 QoS mapping on the XMG. On the XMG, traffic assigned to higher priority queues gets through faster while traffic in lower index queues is dropped if the network is congested.

Table 52 Internal Layer2 and Layer3 QoS Mapping

PRIORITY QUEUE	LAYER 2	LAYER 3		
	IEEE 802.1P USER PRIORITY (ETHERNET PRIORITY)	TOS (IP PRECEDENCE)	DSCP	IP PACKET LENGTH (BYTE)
0	1	0	000000	
1	2			
2	0	0	000000	>1100
3	3	1	001110 001100 001010 001000	250~1100
4	4	2	010110 010100 010010 010000	
5	5	3	011110 011100 011010 011000	<250
6	6	4	100110 100100 100010 100000	
		5	101110 101000	
7	7	6	110000	
		7	111000	

Token Bucket

The token bucket algorithm uses tokens in a bucket to control when traffic can be transmitted. The bucket stores tokens, each of which represents one byte. The algorithm allows bursts of up to *b* bytes which is also the bucket size, so the bucket can hold up to *b* tokens. Tokens are generated and added into the bucket at a constant rate. The following shows how tokens work with packets:

- A packet can be transmitted if the number of tokens in the bucket is equal to or greater than the size of the packet (in bytes).
- After a packet is transmitted, a number of tokens corresponding to the packet size is removed from the bucket.
- If there are no tokens in the bucket, the XMG stops transmitting until enough tokens are generated.
- If not enough tokens are available, the XMG treats the packet in either one of the following ways:

  In traffic shaping:

  - Holds it in the queue until enough tokens are available in the bucket.

  In traffic policing:

  - Drops it.
  - Transmits it but adds a DSCP mark. The XMG may drop these marked packets if the network is overloaded.

Configure the bucket size to be equal to or less than the amount of the bandwidth that the interface can support. It does not help if you set it to a bucket size over the interface's capability. The smaller the bucket size, the lower the data transmission rate and that may cause outgoing packets to be dropped. A larger transmission rate requires a big bucket size. For example, use a bucket size of 10 kbytes to get the transmission rate up to 10 Mbps.

Single Rate Three Color Marker

The Single Rate Three Color Marker (srTCM, defined in RFC 2697) is a type of traffic policing that identifies packets by comparing them to one user-defined rate, the Committed Information Rate (CIR), and two burst sizes: the Committed Burst Size (CBS) and Excess Burst Size (EBS).

The srTCM evaluates incoming packets and marks them with one of three colors which refer to packet loss priority levels. High packet loss priority level is referred to as red, medium is referred to as yellow and low is referred to as green.

The srTCM is based on the token bucket filter and has two token buckets (CBS and EBS). Tokens are generated and added into the bucket at a constant rate, called Committed Information Rate (CIR). When the first bucket (CBS) is full, new tokens overflow into the second bucket (EBS).

All packets are evaluated against the CBS. If a packet does not exceed the CBS it is marked green. Otherwise it is evaluated against the EBS. If it is below the EBS then it is marked yellow. If it exceeds the EBS then it is marked red.

The following shows how tokens work with incoming packets in srTCM:

- A packet arrives. The packet is marked green and can be transmitted if the number of tokens in the CBS bucket is equal to or greater than the size of the packet (in bytes).
- After a packet is transmitted, a number of tokens corresponding to the packet size is removed from the CBS bucket.

- If there are not enough tokens in the CBS bucket, the XMG checks the EBS bucket. The packet is marked yellow if there are sufficient tokens in the EBS bucket. Otherwise, the packet is marked red. No tokens are removed if the packet is dropped.

Two Rate Three Color Marker

The Two Rate Three Color Marker (trTCM, defined in RFC 2698) is a type of traffic policing that identifies packets by comparing them to two user-defined rates: the Committed Information Rate (CIR) and the Peak Information Rate (PIR). The CIR specifies the average rate at which packets are admitted to the network. The PIR is greater than or equal to the CIR. CIR and PIR values are based on the guaranteed and maximum bandwidth respectively as negotiated between a service provider and client.

The trTCM evaluates incoming packets and marks them with one of three colors which refer to packet loss priority levels. High packet loss priority level is referred to as red, medium is referred to as yellow and low is referred to as green.

The trTCM is based on the token bucket filter and has two token buckets (Committed Burst Size (CBS) and Peak Burst Size (PBS)). Tokens are generated and added into the two buckets at the CIR and PIR respectively.

All packets are evaluated against the PIR. If a packet exceeds the PIR it is marked red. Otherwise it is evaluated against the CIR. If it exceeds the CIR then it is marked yellow. Finally, if it is below the CIR then it is marked green.

The following shows how tokens work with incoming packets in trTCM:

- A packet arrives. If the number of tokens in the PBS bucket is less than the size of the packet (in bytes), the packet is marked red and may be dropped regardless of the CBS bucket. No tokens are removed if the packet is dropped.
- If the PBS bucket has enough tokens, the XMG checks the CBS bucket. The packet is marked green and can be transmitted if the number of tokens in the CBS bucket is equal to or greater than the size of the packet (in bytes). Otherwise, the packet is marked yellow.

CHAPTER 11
Network Address Translation (NAT)

11.1 Overview

This chapter discusses how to configure NAT on the XMG. NAT (Network Address Translation - NAT, RFC 1631) is the translation of the IP address of a host in a packet, for example, the source address of an outgoing packet, used within one network to a different IP address known within another network.

11.1.1 What You Can Do in this Chapter

- Use the **Port Forwarding** screen to configure forward incoming service requests to the server(s) on your local network (Section 11.2 on page 152).
- Use the **Applications** screen to forward incoming service requests to the server(s) on your local network (Section 11.3 on page 155).
- Use the **Port Triggering** screen to add and configure the XMG's trigger port settings (Section 11.4 on page 156).
- Use the **DMZ** screen to configure a default server (Section 11.5 on page 159).
- Use the **ALG** screen to enable and disable the NAT and SIP (VoIP) ALG in the XMG (Section 11.6 on page 160).
- Use the **Address Mapping** screen to configure the XMG's address mapping settings (Section 11.7 on page 160).
- Use the **Sessions** screen to configure the XMG's maximum number of NAT sessions (Section 11.8 on page 162).

11.1.2 What You Need To Know

Inside/Outside

Inside/outside denotes where a host is located relative to the XMG, for example, the computers of your subscribers are the inside hosts, while the web servers on the Internet are the outside hosts.

Global/Local

Global/local denotes the IP address of a host in a packet as the packet traverses a router, for example, the local address refers to the IP address of a host when the packet is in the local network, while the global address refers to the IP address of the host when the same packet is traveling in the WAN side.

NAT

In the simplest form, NAT changes the source IP address in a packet received from a subscriber (the inside local address) to another (the inside global address) before forwarding the packet to the WAN side. When the response comes back, NAT translates the destination address (the inside global address) back to the inside local address before forwarding it to the original inside host.

Port Forwarding

A port forwarding set is a list of inside (behind NAT on the LAN) servers, for example, web or FTP, that you can make visible to the outside world even though NAT makes your whole inside network appear as a single computer to the outside world.

Finding Out More

See Section 11.9 on page 163 for advanced technical information on NAT.

11.2 The Port Forwarding Screen

Use the **Port Forwarding** screen to forward incoming service requests to the server(s) on your local network.

You may enter a single port number or a range of port numbers to be forwarded, and the local IP address of the desired server. The port number identifies a service; for example, web service is on port 80 and FTP on port 21. In some cases, such as for unknown services or where one server can support more than one service (for example both FTP and web service), it might be better to specify a range of port numbers. You can allocate a server IP address that corresponds to a port or a range of ports.

The most often used port numbers and services are shown in Appendix C on page 308. Please refer to RFC 1700 for further information about port numbers.

Note: Many residential broadband ISP accounts do not allow you to run any server processes (such as a Web or FTP server) from your location. Your ISP may periodically check for servers and may suspend your account if it discovers any active services at your location. If you are unsure, refer to your ISP.

Configuring Servers Behind Port Forwarding (Example)

Let's say you want to assign ports 21-25 to one FTP, Telnet and SMTP server (**A** in the example), port 80 to another (**B** in the example) and assign a default server IP address of 192.168.1.35 to a third (**C** in the example). You assign the LAN IP addresses and the ISP assigns the WAN IP address. The NAT network appears as a single host on the Internet.