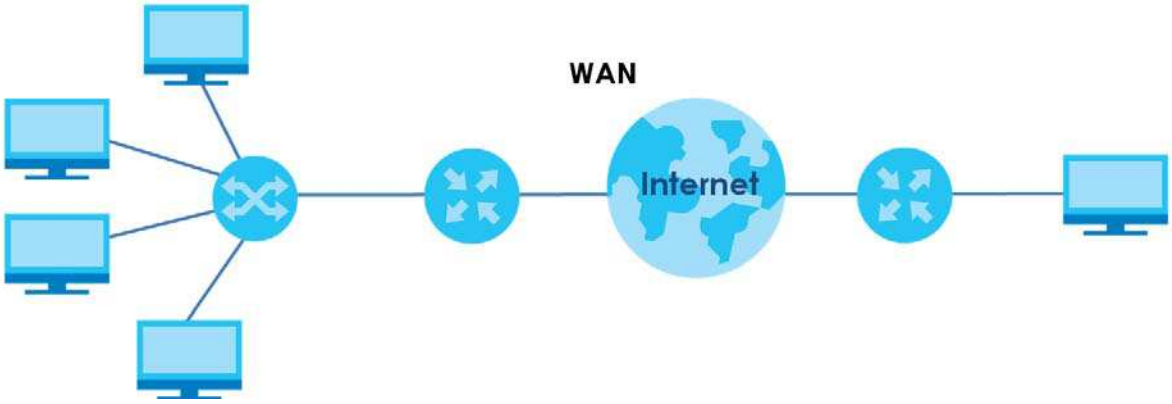
CHAPTER 6
Broadband

6.1 Overview

This chapter discusses the Zyxel Device's **Broadband** screens. Use these screens to configure your Zyxel Device 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 41 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 Zyxel Device for Internet access (Section 6.2 on page 74).

Table 14 WAN Setup Overview

LAYER-2 INTERFACE	INTERNET CONNECTION		
CONNECTION	**MODE**	**ENCAPSULATION**	**CONNECTION SETTINGS**
Ethernet	Routing	PPPoE	PPP user name and password, WAN IPv4/IPv6 IP address, routing feature, DNS server, VLAN, QoS, 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 Zyxel Device, which makes it accessible from an outside network. It is used by the Zyxel Device to communicate with other devices in other networks. It can be static (fixed) or dynamically assigned by the ISP each time the Zyxel Device 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).

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 Zyxel Device 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

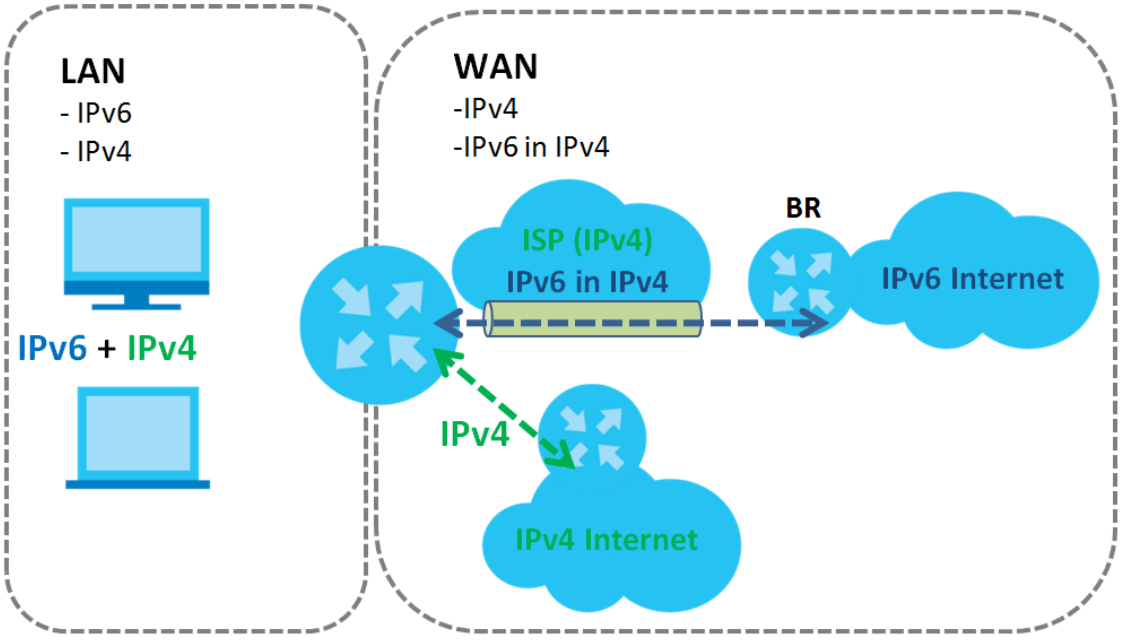
Both an IPv6 address and IPv6 subnet mask compose of 128-bit binary digits, which are divided into eight 16-bit blocks and written in hexadecimal notation. Hexadecimal uses four bits for each character (1 ~ 10, A ~ F). Each block's 16 bits are then represented by four hexadecimal characters. For example, 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 Zyxel Device has an IPv4 WAN address and you set **IPv6/IPv4 Mode** to **IPv4 Only**, you can enable 6rd to encapsulate IPv6 packets in IPv4 packets to cross the ISP's IPv4 network.

The Zyxel Device 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 Zyxel Device uses its configured IPv4 WAN IP to route IPv4 traffic to the IPv4 Internet.

Figure 42 IPv6 Rapid Deployment

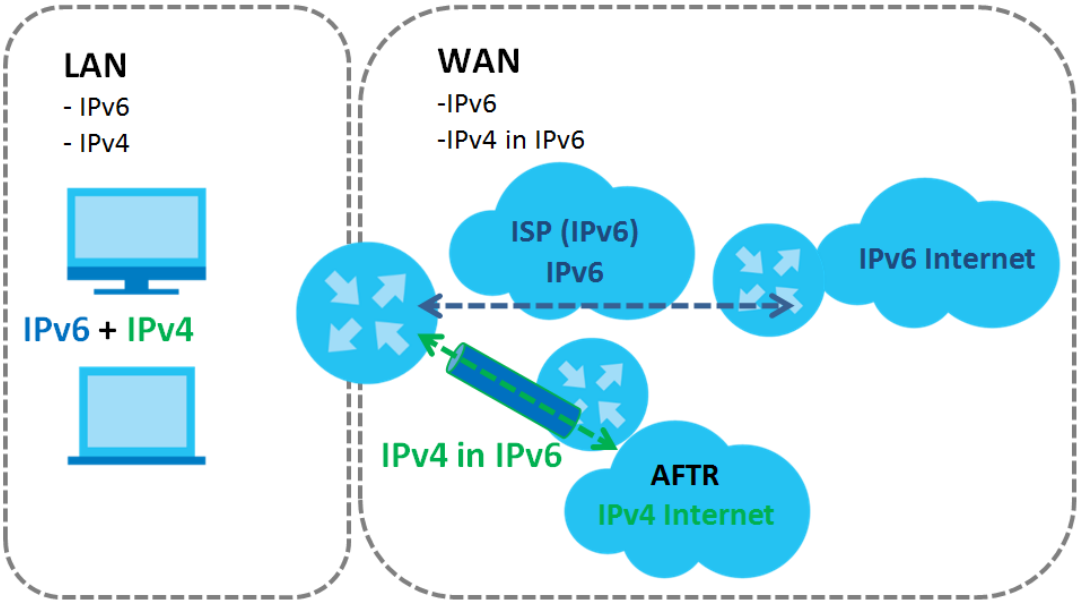


Dual Stack Lite

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

The Zyxel Device 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 Zyxel Device uses it's configured IPv6 WAN IP to route IPv6 traffic to the IPv6 Internet.

Figure 43 Dual Stack Lite



6.1.3 Before You Begin

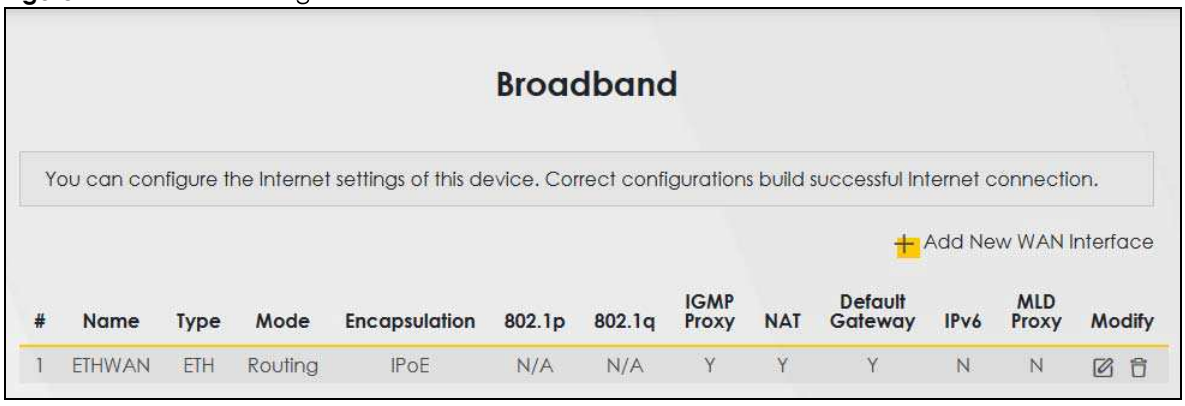
You need to know your Internet access settings such as encapsulation and WAN IP address. Get this information from your ISP.

6.2 Broadband Settings

Use this screen to change your Zyxel Device's Internet access settings. The summary table shows you the configured WAN services (connections) on the Zyxel Device. Use information provided by your ISP to configure WAN settings.

Click **Network Setting** > **Broadband** to access this screen.

Figure 44 Network Setting > Broadband



The following table describes the labels in this screen.

Table 15 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 it is an Ethernet 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 Zyxel Device 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 Zyxel Device 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

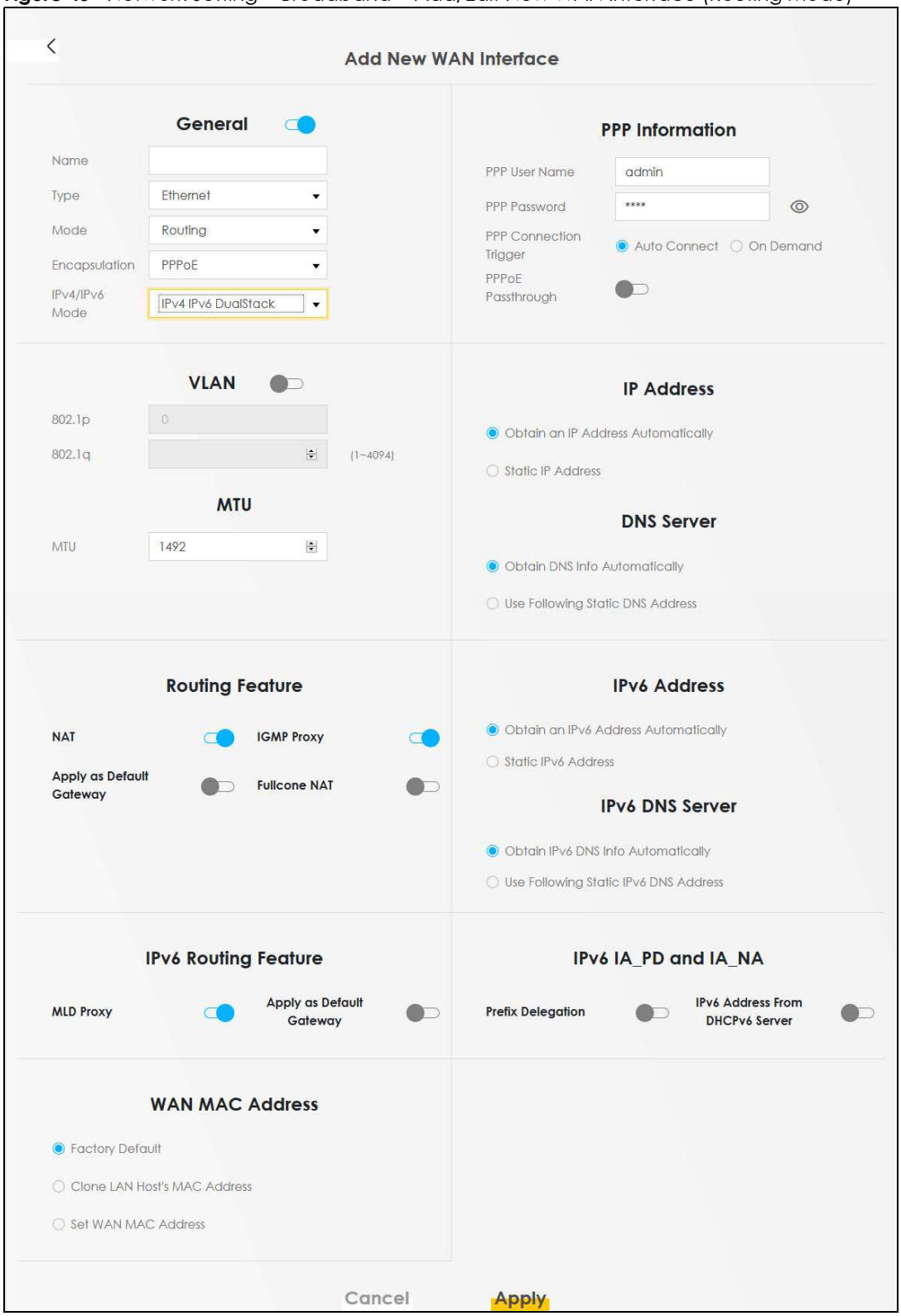
Click **Add New WAN Interface** in the **Broadband** screen or the Edit icon next to an existing WAN interface to open the following screen. Use this screen to configure a WAN connection. The screen varies depending on the mode, encapsulation, and IPv6/IPv4 mode you select.

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 **Routing** mode and **PPPoE** encapsulation. The screen varies when you select other encapsulation and IPv6/IPv4 mode.

Figure 45 Network Setting > Broadband > Add/Edit New WAN Interface (Routing Mode)



The following table describes the labels in this screen.

Table 16 Network Setting > Broadband > Add/Edit New WAN Interface (Routing Mode)

LABEL	DESCRIPTION
General	Click this switch to enable or disable the interface. When the switch goes to the right, the function is enabled. Otherwise, it is not.
Name	Specify a descriptive name for this connection.
Type	This field shows an Ethernet connection.
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 are **PPPoE** and **IPoE**.
IPv4/IPv6 Mode	Select **IPv4 Only** if you want the Zyxel Device to run IPv4 only. Select **IPv4 IPv6 DualStack** to allow the Zyxel Device to run IPv4 and IPv6 at the same time. Select **IPv6 Only** if you want the Zyxel Device to run IPv6 only.
PPP Information (This is available only when you select **Routing** in the **Mode** field.)	
PPP User Name	Enter the user name exactly as your ISP assigned. If assigned a name in the form user@domain where domain identifies a service name, then enter both components exactly as given.
PPP Password	Enter the password associated with the user name above. Select **password unmask** to show your entered password in plain text.
PPP Connection Trigger	Select when to have the Zyxel Device establish the PPP connection. **Auto Connect** - select this to not let the connection time out. **On Demand** - select this to automatically bring up the connection when the Zyxel Device receives packets destined for the Internet.
Idle Timeout	This value specifies the time in minutes that elapses before the router automatically disconnects from the PPPoE server. This field is not available if you select **Auto Connect** in the **PPP Connection Trigger** field.
PPPoE Passthrough	This field is available when you select **PPPoE** encapsulation. In addition to the Zyxel Device's built-in PPPoE client, you can enable PPPoE pass through to allow up to ten hosts on the LAN to use PPPoE client software on their computers to connect to the ISP via the Zyxel Device. Each host can have a separate account and a public WAN IP address. PPPoE pass through is an alternative to NAT for application where NAT is not appropriate. Disable PPPoE pass through if you do not need to allow hosts on the LAN to use PPPoE client software on their computers to connect to the ISP.
VLAN	Click this switch to enable or disable VLAN on this WAN interface. When the switch goes to the right, the function is enabled. Otherwise, it is not.
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	
MTU	Enter the MTU (Maximum Transfer Unit) size for traffic through this connection.
IP Address (This is available only when you select **IPv4 Only** or **IPv4 IPv6 DualStack** in the **IPv4/IPv6 Mode** field.)	

Table 16 Network Setting > Broadband > Add/Edit New WAN Interface (Routing Mode)

LABEL	DESCRIPTION
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.
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. This is available only when you set the **Encapsulation** to **IPoE**.
Gateway IP Address	Enter the gateway IP address provided by your ISP. This is available only when you set the **Encapsulation** to **IPoE**.
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 Zyxel Device to use the DNS server addresses assigned by your ISP. Select **Use Following Static DNS Address** if you want the Zyxel Device 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.
Routing Feature (This is available only when you select **IPv4 Only** or **IPv4 IPv6 DualStack** in the **IPv4/IPv6 Mode** field.)	
NAT	Click this switch to activate or deactivate NAT on this connection. When the switch goes to the right, the function is enabled. Otherwise, it is not.
IGMP Proxy	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. Click this switch to have the Zyxel Device act as an IGMP proxy on this connection. When the switch goes to the right, the function is enabled. Otherwise, it is not. This allows the Zyxel Device to get subscribing information and maintain a joined member list for each multicast group. It can reduce multicast traffic significantly.
Apply as Default Gateway	Click this switch to have the Zyxel Device use the WAN interface of this connection as the system default gateway. When the switch goes to the right, the function is enabled. Otherwise, it is not.
Fullcone NAT Enable	Click this switch to enable or disable full cone NAT on this connection. When the switch goes to the right, the function is enabled. Otherwise, it is not. This field is available only when you activate **NAT**. In full cone NAT, the Zyxel Device maps all outgoing packets from an internal IP address and port to a single IP address and port on the external network. The Zyxel Device also maps packets coming to that external IP address and port to the internal IP address and port.
DHCPC Options (This is available only when you set the **Encapsulation** to **IPoE** and select **IPv4 Only** or **IPv4 IPv6 DualStack** in the **IPv4/IPv6 Mode** field.)	
Request Options	Select **Option 43** to have the Zyxel Device 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 Zyxel Device push static routes to clients.
Sent Options	
option 60	Select this and enter the device identity you want the Zyxel Device 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.

Table 16 Network Setting > Broadband > Add/Edit New WAN Interface (Routing Mode)

LABEL	DESCRIPTION
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 Zyxel Device 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 Zyxel Device 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 Zyxel Device's interface(s). The gateway helps forward packets to their destinations.
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.)	
Obtain IPv6 DNS Info Automatically	Select **Obtain IPv6 DNS Info Automatically** to have the Zyxel Device 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 Zyxel Device 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.
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 check box to have the Zyxel Device act as an MLD proxy on this connection. This allows the Zyxel Device 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 Zyxel Device use the WAN interface of this connection as the system default gateway.
DS-Lite	This is available only when you select **IPv6 Only** in the **IPv4/IPv6 Mode** field. Enable Dual Stack Lite to let local computers use IPv4 through an ISP's IPv6 network. See Dual Stack Lite on page 73 for more information. Click this switch to let local computers use IPv4 through an ISP's IPv6 network. When the switch goes to the right  , the function is enabled. Otherwise, it is not.
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 72 for more information. Click this switch to tunnel IPv6 traffic from the local network through the ISP's IPv4 network. When the switch goes to the right  , the function is enabled. Otherwise, it is not.

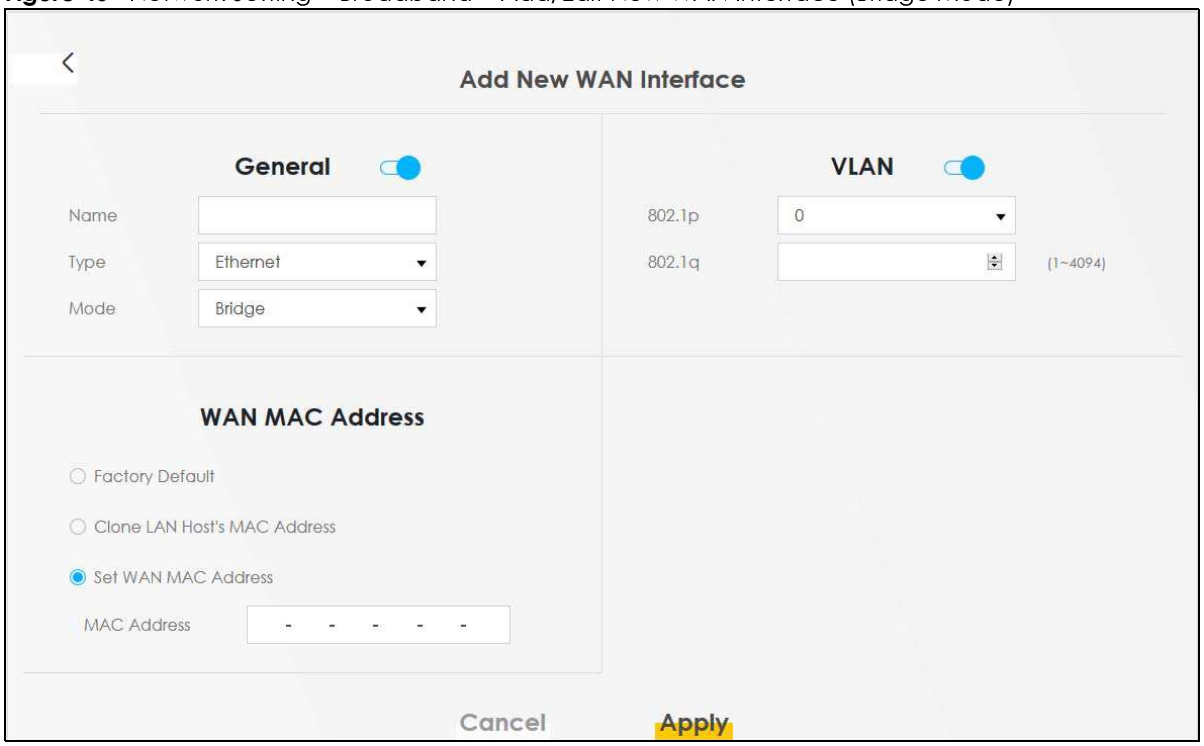
Table 16 Network Setting > Broadband > Add/Edit New WAN Interface (Routing Mode)

LABEL	DESCRIPTION
	Select **Manually Configured** if you have the IPv4 address of the relay server. Otherwise, select **Automatically configured by DHCPC** to have the Zyxel Device 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.
IPv6 IA_PD and IA_NA (This is available only when you select **IPv4 IPv6 DualStack** or **IPv6 Only** in the **IPv4/IPv6 Mode** field.)	
Prefix Delegation	Click this switch to use DHCP PD (Prefix Delegation) which enables the Zyxel Device to pass the IPv6 prefix information to its LAN hosts. The hosts can then use the prefix to generate their IPv6 addresses. When the switch goes to the right, the function is enabled. Otherwise, it is not.
IPv6 Address From DHCPv6 Server	Click this switch to obtain an IPv6 address from a DHCPv6 server. The IP address assigned by a DHCPv6 server has priority over the IP address automatically generated by the Zyxel Device using the IPv6 prefix from a Router Advertisement (RA). When the switch goes to the right, the function is enabled. Otherwise, it is not.
WAN MAC Address (You can set the WAN MAC address in the following section.)	
Factory Default	Select **Factory Default** to use the factory assigned default MAC address.
Clone LAN Host's MAC Address	Select this option to clone the MAC address of the computer (displaying in the screen) from which you are configuring the Zyxel Device. It is advisable to clone the MAC address from a computer on your LAN even if your ISP does not presently require MAC address authentication.
IP Address	Enter the IP address of the computer on the LAN whose MAC address you are cloning.
Set WAN MAC Address	Select this option to enter the MAC address you want to use.
MAC Address	Enter the MAC address you want to use.
Cancel	Click **Cancel** to exit this screen without saving any changes.
Apply	Click **Apply** to save your changes.

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. The following example screen displays when you select **Bridge** mode.

Figure 46 Network Setting > Broadband > Add/Edit New WAN Interface (Bridge Mode)



The following table describes the fields in this screen.

Table 17 Network Setting > Broadband > Add/Edit New WAN Interface (Bridge Mode)

LABEL	DESCRIPTION
General	Click this switch to enable or disable the interface. When the switch goes to the right, the function is enabled. Otherwise, it is not.
Name	Enter a service name of the connection.
Type	This field shows an Ethernet connection.
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	Click this switch to enable or disable VLAN on this WAN interface. When the switch goes to the right, the function is enabled. Otherwise, it is not.
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.
WAN MAC Address (You can set the WAN MAC address in the following section.)	
Factory Default	Select **Factory Default** to use the factory assigned default MAC address.
Clone LAN Host's MAC Address	Select this option to clone the MAC address of the computer (displaying in the screen) from which you are configuring the Zyxel Device. It is advisable to clone the MAC address from a computer on your LAN even if your ISP does not presently require MAC address authentication.
IP Address	Enter the IP address of the computer on the LAN whose MAC address you are cloning.

Table 17 Network Setting > Broadband > Add/Edit New WAN Interface (Bridge Mode) (continued)

LABEL	DESCRIPTION
Set WAN MAC Address	Select this option to enter the MAC address you want to use.
MAC Address	Enter the MAC address you want to use.
Cancel	Click **Cancel** to exit this screen without saving any changes.
Apply	Click **Apply** to save your changes.

6.3 Technical Reference

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

Encapsulation

Be sure to use the encapsulation method required by your ISP. The Zyxel Device can work in bridge mode or routing mode. When the Zyxel Device 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 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, and so on) 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 Zyxel Device (rather than individual computers), the computers on the LAN do not need PPPoE software installed, since the Zyxel Device does that part of the task. Furthermore, with NAT, all of the LANs' computers will have access.

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 Zyxel Device queries all directly connected networks to gather group membership. After that, the Zyxel Device 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 Zyxel Device 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 Zyxel Device'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 Wireless Overview

This chapter describes the Zyxel Device's **Network Setting > Wireless** screens. Use these screens to set up your Zyxel Device's WiFi connection and security settings.

7.1.1 What You Can Do in this Chapter

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

- Use the **General** screen to enable WiFi, 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 Zyxel Device (Section 7.3 on page 91).
- Use the **MAC Authentication** screen to allow or deny wireless clients based on their MAC addresses from connecting to the Zyxel Device (Section 7.4 on page 95).
- Use the **WPS** screen to enable or disable WPS, view or generate a security PIN (Personal Identification Number) (Section 7.5 on page 97).
- Use the **WMM** screen to enable WiFi MultiMedia (WMM) to ensure quality of service in wireless networks for multimedia applications (Section 7.6 on page 99).
- Use the **Others** screen to configure wireless advanced features, such as the RTS/CTS Threshold (Section 7.7 on page 100).
- Use the **Channel Status** screen to scan WiFi channel noises and view the results (Section 7.8 on page 103).
- Use the **EasyMesh** screen to enable or disable wireless roaming between the Zyxel Device and a wireless AP extender device (Section 7.9 on page 103).

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 airwaves, 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 are a number of wireless networking standards available with different methods of data encryption.

WiFi6 / IEEE 802.11ax

WiFi6 is backwards compatible with IEEE 802.11a/b/g/n/ac and is most suitable in areas with a high concentration of users. WiFi6 devices support Target Wakeup Time (TWT) allowing them to automatically power down when they are inactive. Depending on the link rate, it can support the 2.4 / 5 GHz wireless band as well as allow up 128 simultaneous connections.

Finding Out More

See Section 7.9 on page 103 for advanced technical information on wireless networks.

7.2 Wireless General Settings

Use this screen to enable WiFi, enter the SSID and select the wireless security mode. These are basic elements for starting a wireless service. It's recommended that you select **More Secure** to enable **WPA2-PSK** data encryption.

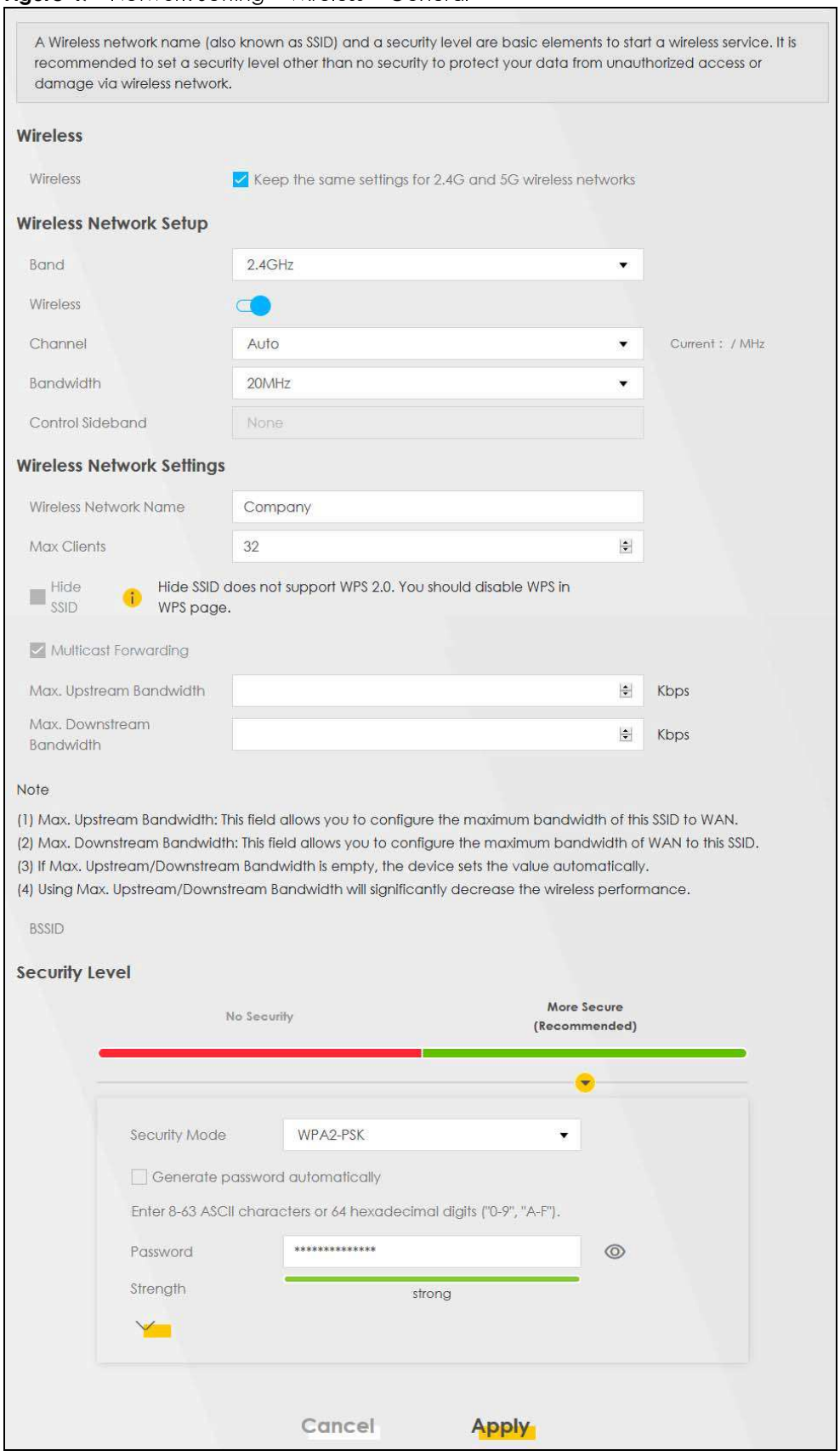
Note: If you are configuring the Zyxel Device from a computer connected to WiFi and you change the Zyxel Device's SSID, channel or security settings, you will lose your wireless connection when you press **Apply** to confirm. You must then change the wireless settings of your computer to match the Zyxel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

Note: If upstream/downstream bandwidth is empty, the Zyxel Device sets the value automatically.

Note: Setting a maximum upstream/downstream bandwidth will significantly decrease wireless performance.

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

Figure 47 Network Setting > Wireless > General



The following table describes the general WiFi labels in this screen.

Table 18 Network Setting > Wireless > General

LABEL	DESCRIPTION
Wireless	
Wireless	Select **Keep the same settings for 2.4G and 5G wireless networks** and the 2.4 GHz and 5 GHz wireless networks will use the same SSID and wireless security settings.
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/ax wireless clients while **5GHz** is used by IEEE 802.11a/n/ac/ax wireless clients.
Wireless	Click this switch to enable or disable WiFi in this field. When the switch turns blue  , the function is enabled. Otherwise, it is not.
Channel	Select a channel from the drop-down list box. The options vary depending on the frequency band and the country you are in. Use **Auto** to have the Zyxel Device automatically determine a channel to use.
Bandwidth	Select whether the Zyxel Device uses a wireless channel width of **20MHz**, **40MHz, 20/40MHz** or **20/40/80MHz**. Note: **20/40/80MHz** is only available if you select the **5GHz Band**. A standard 20 MHz channel offers transfer speeds of up to 150 Mbps whereas a 40 MHz channel uses two standard channels and offers speeds of up to 300 Mbps. 40 MHz (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 80 MHz channel groups adjacent 40 MHz 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** or **20/40MHz**. 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	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 WiFi.
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. This check box is grayed out if the WPS function is enabled in the **Network Setting** > **Wireless** > **WPS** screen.
Multicast Forwarding	Select this check box to allow the Zyxel Device to convert wireless multicast traffic into wireless unicast traffic.
Max. Upstream Bandwidth	Max. Upstream Bandwidth allows you to specify the maximum rate for upstream wireless traffic to the WAN from this wireless LAN in kilobits per second (Kbps).
Max. Downstream Bandwidth	Max. Upstream Bandwidth allows you to specify the maximum rate for downstream wireless traffic to this wireless LAN from the WAN in kilobits per second (Kbps).
BSSID	This shows the MAC address of the wireless interface on the Zyxel Device when WiFi is enabled.
Security Level	

Table 18 Network Setting > Wireless > General (continued)

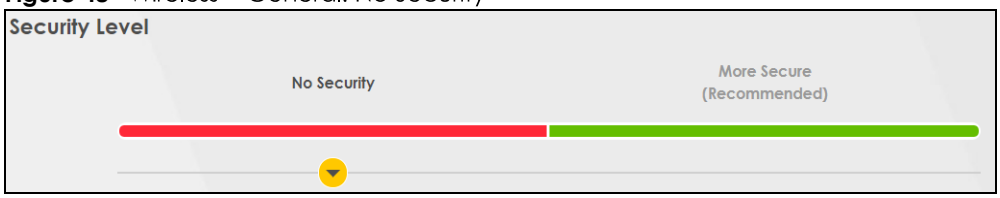
LABEL	DESCRIPTION
Security Mode	Select **More Secure (Recommended)** to add security on this wireless network. The wireless clients which want to associate to this network must have same wireless security settings as the Zyxel Device. When you select to use a security, additional options appears in this 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.
Cancel	Click **Cancel** to restore your previously saved settings.
Apply	Click **Apply** to save your changes.

7.2.1 No Security

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

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

Figure 48 Wireless > General: No Security



The following table describes the labels in this screen.

Table 19 Wireless > General: No Security

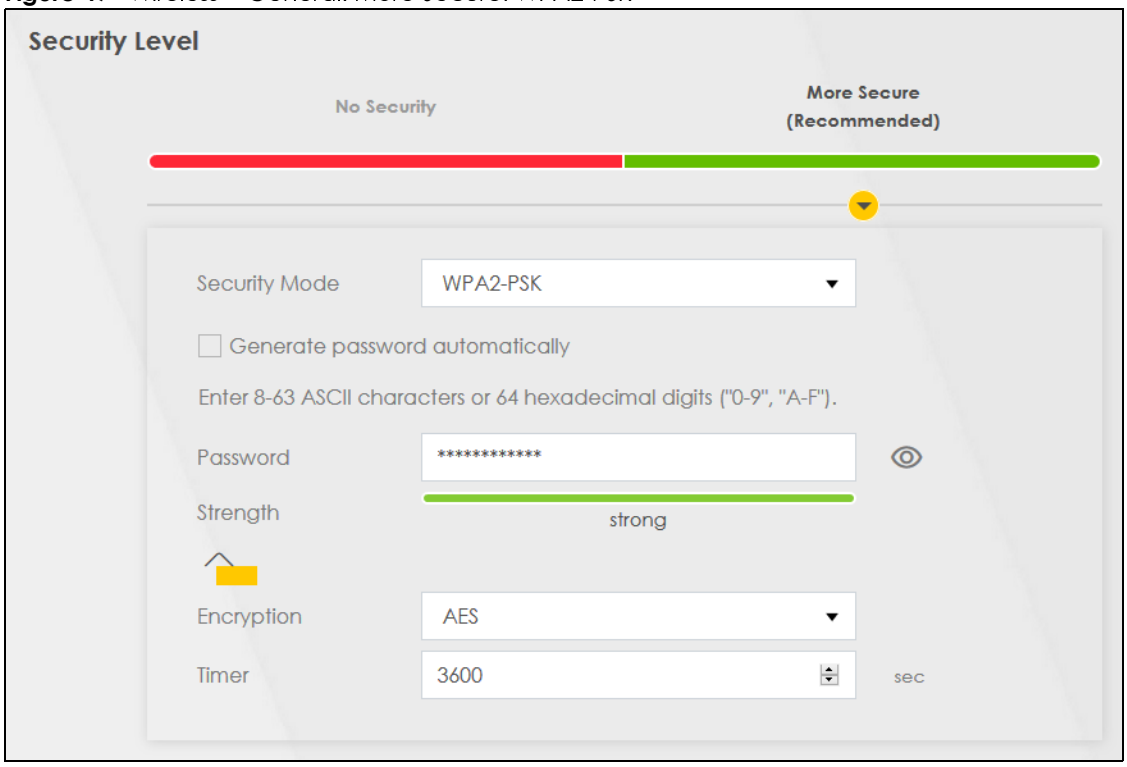
LABEL	DESCRIPTION
Security Level	Choose **No Security** to allow all wireless connections without data encryption or authentication.

7.2.2 More Secure (Recommended)

The WPA-PSK security mode provides both improved data encryption and user authentication over WEP. Using a Pre-Shared Key (PSK), both the Zyxel Device 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.

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

Figure 49 Wireless > General: More Secure: WPA2-PSK



The following table describes the labels in this screen.

Table 20 Wireless > General: More Secure: WPA2-PSK

LABEL	DESCRIPTION
Security Level	Select **More Secure** to enable WPA2-PSK or WPA2-EAP data encryption.
Security Mode	Select **WPA2-PSK** or **WPA2-EAP** from the drop-down list box.
Generate password automatically	Select this option to have the Zyxel Device automatically generate a password. The password field will not be configurable when you select this option.
Password	Select **Generate password automatically** or enter a **Password**. The password has two uses. 1. Manual. Manually enter the same password on the Zyxel Device and the client. Enter 8-63 ASCII characters or exactly 64 hexadecimal ('0-9', 'a-f') characters. 2. WPS. When using WPS, the Zyxel Device sends this password to the client. Click the Eye icon to show or hide the password of your wireless network. When the Eye icon is slashed, you'll see the password in plain text. Otherwise, it is hidden.
Authentication Server (This option is available only when you select **WPA2-EAP** in the **Security Mode** field.)	
IP Address	Enter the IP address of the external authentication server in dotted decimal notation.
Port Number	Enter the port number of the external authentication server. The default port number is 1812. You need not change this value unless your network administrator instructs you to do so with additional information.
Shared Secret	Enter a password (up to 31 alphanumeric characters) as the key to be shared between the external authentication server and the Zyxel Device. The key must be the same on the external authentication server and the Zyxel Device. The key is not sent over the network.

Table 20 Wireless > General: More Secure: WPA2-PSK (continued)

LABEL	DESCRIPTION
	Click this to show more fields in this section. Click again to hide them.
Encryption	This field shows the **AES** type of data encryption.
WPA2 Pre-authentication	This option is available only when you select **WPA2-EAP** in the **Security Mode** field. When the switch goes to the right , the function is enabled. Otherwise, it is not. Pre-authentication enables fast roaming by allowing the wireless client (already connecting to an AP) to perform IEEE 802.1x authentication with another AP before connecting to it. Click this switch to turn on pre-authentication in WAP2.
Network Re-auth Interval	This option is available only when you select **WPA2-EAP** in the **Security Mode** field. Specify how often wireless clients have to resend usernames and passwords in order to stay connected. Enter a time interval between 10 and 2147483647 seconds. Note: If wireless client authentication is done using a RADIUS server, the re-authentication timer on the RADIUS server has priority.
Timer	The **Timer** is the rate at which the RADIUS server sends a new group key out to all clients.

7.3 Guest/More AP

This screen allows you to configure a guest wireless network that allows access to the Internet only through the Zyxel Device. You can also configure additional wireless networks, each with different security settings, in this screen.

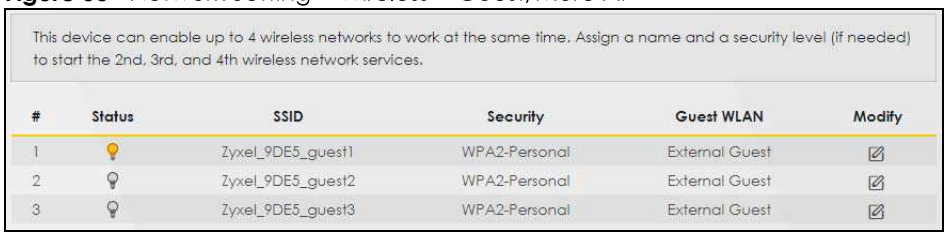
Click **Network Setting > Wireless** > **Guest/More AP**. The following screen displays.

The following table introduces the supported wireless networks.

Table 21 Supported Wireless Networks

WIRELESS NETWORKS	WHERE TO CONFIGURE
Main/1	Network Setting > Wireless > General screen
Guest/3	Network Setting > Wireless > Guest/More AP screen

Figure 50 Network Setting > Wireless > Guest/More AP



The following table describes the labels in this screen.

Table 22 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, while a gray bulb signifies that this SSID is not active.

Table 22 Network Setting > Wireless > Guest/More AP (continued)

LABEL	DESCRIPTION
SSID	An SSID profile is the set of parameters relating to one of the Zyxel Device'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.
Security	This field indicates the security mode of the SSID profile.
Guest WLAN	This displays if the guest WiFi function has been enabled for this wireless LAN. If **Home Guest** displays, clients can connect to each other directly. If **External Guest** displays, clients are blocked from connecting to each other directly. **N/A** displays if guest wireless LAN is disabled.
Modify	Click the **Edit** icon to configure the SSID profile.

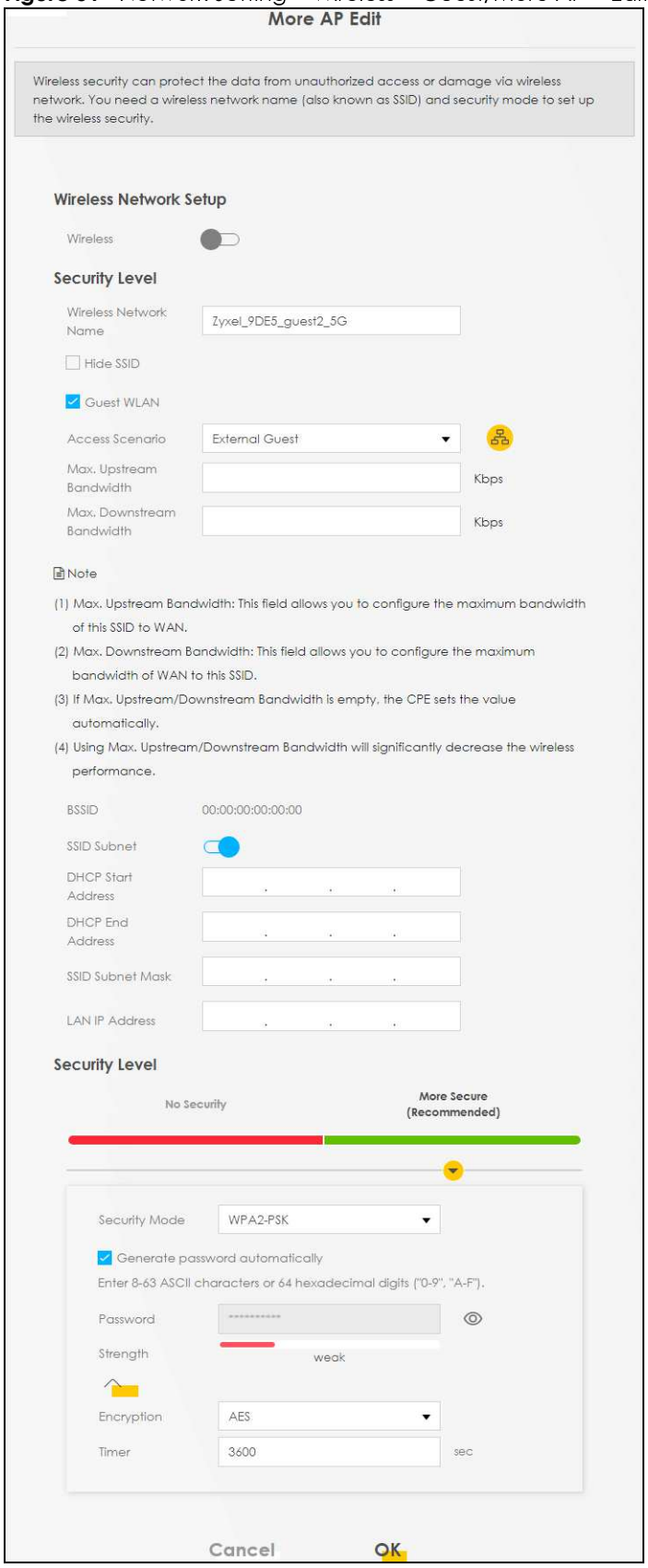
7.3.1 Edit Guest/More AP Settings

Use this screen to create Guest and additional wireless networks with different security settings.

Note: If upstream/downstream bandwidth is empty, the Zyxel Device sets the value automatically. Setting a maximum upstream/downstream bandwidth will significantly decrease wireless performance.

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

Figure 51 Network Setting > Wireless > Guest/More AP > Edit



The following table describes the fields in this screen.

Table 23 Network Setting > Wireless > Guest/More AP > Edit

LABEL	DESCRIPTION
Wireless Network Setup	
Wireless	Click this switch to enable or disable WiFi in this field. When the switch turns blue, the function is enabled; otherwise, it is not.
Security Level	
Wireless Network Name	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 WiFi.
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 WiFis for home and external clients. Select the WiFi type in the **Access Scenario** field.
Access Scenario	If you select **Home Guest**, clients can connect to 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 wireless LAN in kilobits per second (Kbps).
Max. Downstream Bandwidth	Specify the maximum rate for downstream wireless traffic to this wireless LAN from the WAN in kilobits per second (Kbps).
BSSID	This shows the MAC address of the wireless interface on the Zyxel Device when WiFi is enabled.
SSID Subnet	Click on this switch to **Enable** this function if you want the wireless network interface to assign DHCP IP addresses to the associated wireless clients. This option cannot be used if the WPS function is enabled in the **Network Setting** > **Wireless** > **WPS** screen or if the **Keep the same settings for 2.4G and 5G wireless networks** check box is selected in **Network Setting** > **Wireless** > **General**.
DHCP Start Address	Specify the first of the contiguous addresses in the DHCP IP address pool. The Zyxel Device 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 Zyxel Device for the SSID subnet.
LAN IP Address	Specify the IP address of the Zyxel Device for the SSID subnet.
Security Level	Select **More Secure (Recommended)** to add security on this wireless network. The wireless clients which want to associate to this network must have the same wireless security settings as the Zyxel Device. 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 89 for more details about this field.
Security Mode	Select **WPA2-PSK** or **WPA2-EAP** from the drop-down list box.
Generate password automatically	Select this option to have the Zyxel Device automatically generate a password. The password field will not be configurable when you select this option.