Click **Network > Wireless LAN > WDS**. The following screen displays.

Figure 101 Network > Wireless LAN > WDS

The following table describes the labels in this screen.

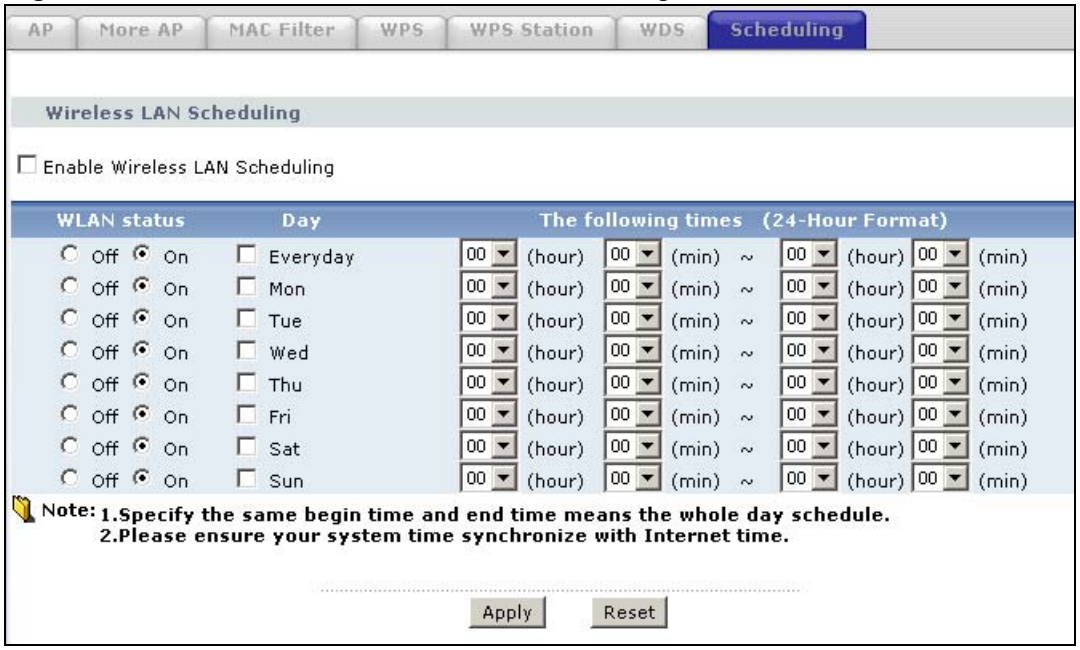
Table 37 Network > Wireless LAN > WDS

LABEL	DESCRIPTION
Enable WDS Security	Select this option and the type of the key used to encrypt data between APs. All the wireless APs (including the ZyXEL Device) must use the same pre-shared key for data transmission. If you de-select this option, the data sent between APs is not encrypted. Anyone can read it.
TKIP	Select this to use TKIP (Temporal Key Integrity Protocol) encryption.
AES	Select this to use AES (Advanced Encryption Standard) encryption.
#	This is the index number of the individual WDS link.
Active	Select this to activate the link between the ZyXEL Device and the peer device to which this entry refers. When you do not select the check box this link is down.
Remote Bridge MAC Address	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).
PSK	Enter a Pre-Shared Key (PSK) from 8 to 63 case-sensitive ASCII characters (including spaces and symbols).
Apply	Click **Apply** to save your changes back to the ZyXEL Device.
Cancel	Click **Cancel** to reload the previous configuration for this screen.

8.8 Scheduling Screen

Click **Network > Wireless LAN > Scheduling** to open the **Wireless LAN Scheduling** screen. Use this screen to configure when the ZyXEL Device enables or disables the wireless LAN.

Figure 102 Network > Wireless LAN > Scheduling



The following table describes the labels in this screen.

Table 38 Network > Wireless LAN > Scheduling

LABEL	DESCRIPTION
Enable Wireless LAN Scheduling	Select this to activate wireless LAN scheduling on your ZyXEL Device.
WLAN status	Select **On** or **Off** to enable or disable the wireless LAN.
Day	Select the day(s) you want to turn the wireless LAN on or off.
The following times	Specify the time period during which to apply the schedule. For example, if you decide to turn off the wireless LAN everyday, but you set an exception from 12:00 to 1:30. Then the wireless LAN is only available from 12:00 to 1:30 everyday.
Apply	Click this to save your changes.
Reset	Click this to restore your previously saved settings.

8.9 Wireless LAN Technical Reference

This section discusses wireless LANs in depth. For more information, see the appendix.

8.9.1 Additional Wireless Terms

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

Table 39 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 ZyXEL Device. 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 ZyXEL Device.
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 ZyXEL Device does, it cannot communicate with the ZyXEL Device.
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.

8.9.2 Wireless Security Overview

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

8.9.2.1 SSID

Normally, the ZyXEL Device acts like a beacon and regularly broadcasts the SSID in the area. You can hide the SSID instead, in which case the ZyXEL Device 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.

8.9.2.2 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 ZyXEL Device 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.

8.9.2.3 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 they can use 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.

8.9.2.4 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 8.9.2.3 on page 154 for information about this.)

Table 40 Types of Encryption for Each Type of Authentication

	NO AUTHENTICATION	RADIUS SERVER
Weakest	No Security	
↕	Static WEP	
	WPA-PSK	WPA
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, **Static WEP**, **WPA-PSK**, or **WPA2-PSK**.

Usually, you should set up the strongest encryption that every device in the wireless network supports. For example, suppose you have a wireless network with the ZyXEL Device and you do not have a RADIUS server. Therefore, there is no authentication. Suppose the wireless network has two devices. Device A only supports WEP, and device B supports WEP and WPA. Therefore, you should set up **Static WEP** in the wireless network.

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 ZyXEL Device, 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 ZyXEL Device.

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.

8.9.3 MBSSID

Traditionally, you needed to use different APs to configure different Basic Service Sets (BSSs). As well as the cost of buying extra APs, there was also the possibility of channel interference. The ZyXEL Device'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.

8.9.3.1 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.

8.9.4 Wireless Distribution System (WDS)

The ZyXEL Device can act as a wireless network bridge and establish WDS (Wireless Distribution System) links with other APs. You need to know the MAC addresses of the APs you want to link to. Once the security settings of peer sides match one another, the connection between devices is made.

At the time of writing, WDS security is compatible with other ZyXEL access points only. Refer to your other access point's documentation for details.

The following example illustrates how WDS link works between APs. Notebook computer **A** is a wireless client connecting to access point **AP 1**. **AP 1** has no wired Internet connection, but can establish a WDS link with access point **AP 2**, which does. When **AP 1** has a WDS link with **AP 2**, the notebook computer can access the Internet through **AP 2**.

Figure 103 WDS Link Example

8.9.5 WiFi Protected Setup

Your ZyXEL Device 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.

8.9.5.1 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 ZyXEL Device, see Section 8.6 on page 149).
3. Press the button on one of the devices (it doesn't matter which). For the ZyXEL Device you must press the WPS button for more than three 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.

8.9.5.2 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 ZyXEL Device, see Section 8.5 on page 148).
4. Enter the client's PIN in the AP's configuration interface.

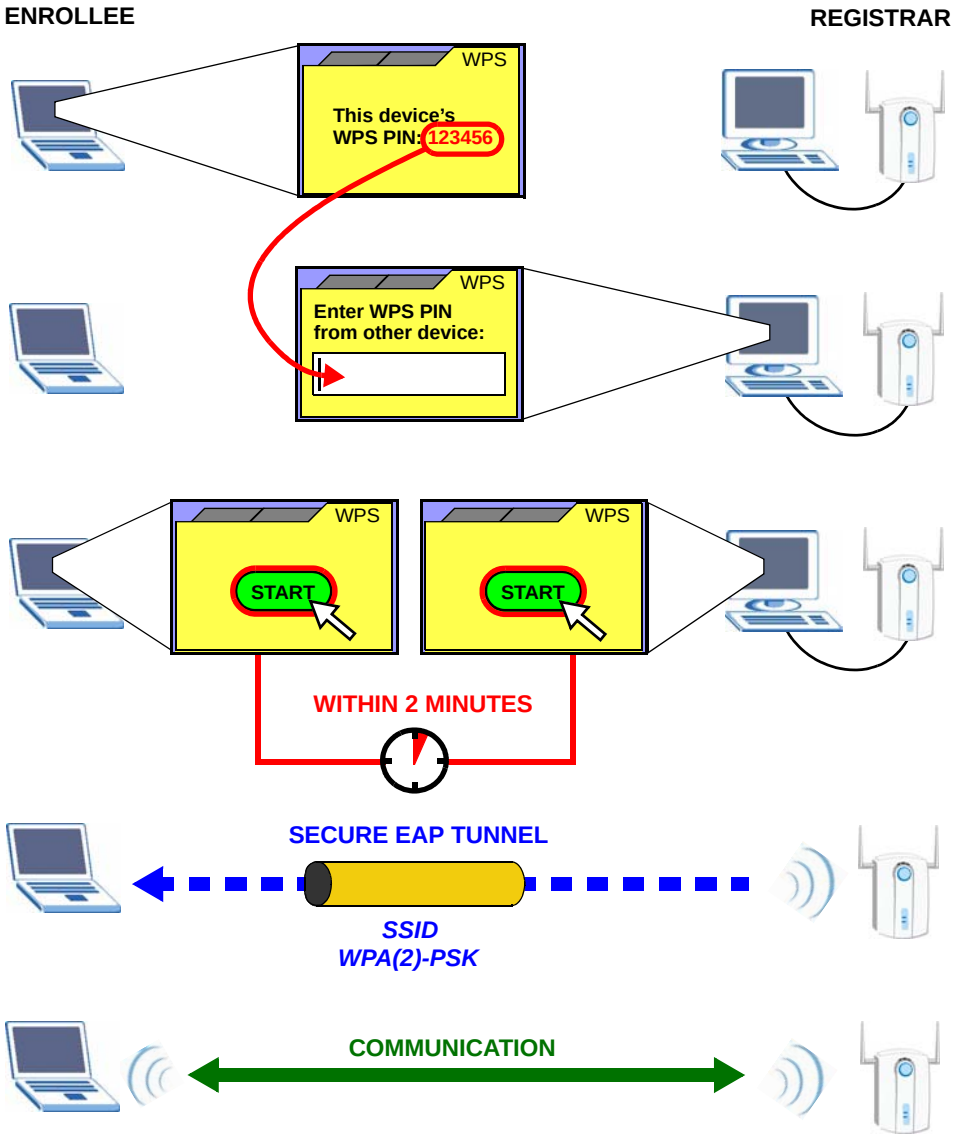
   Note: If the client device's configuration interface has an area for entering another device's PIN, you can either enter the client's PIN in the AP, or enter the AP's PIN in the client - it does not matter which.
5. Start WPS on both devices within two minutes.

   Note: Use the configuration utility to activate WPS, not the push-button on the device itself.
6. 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 a WPS-enabled wireless client (installed in a notebook computer) connecting to the WPS-enabled AP via the PIN method.

Figure 104 Example WPS Process: PIN Method

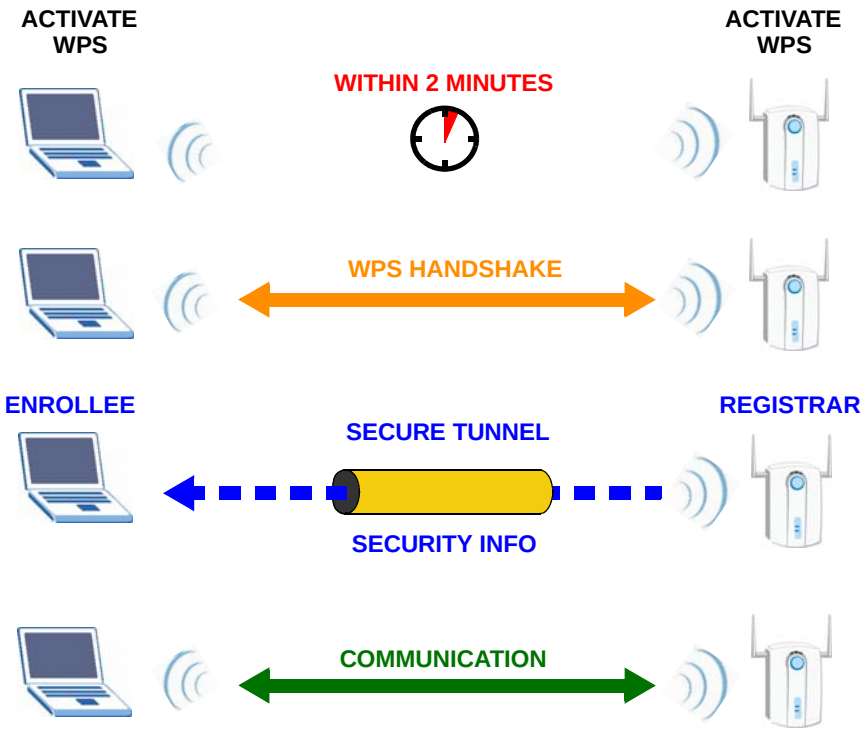


8.9.5.3 How WPS Works

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 105 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.

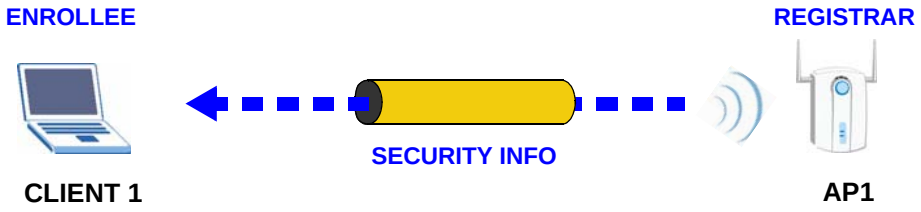
By default, a WPS devices is “unconfigured”. This means that it is not part of an existing network and can act as either enrollee or registrar (if it supports both functions). If the registrar is unconfigured, the security settings it transmits to the enrollee are randomly-generated. Once a WPS-enabled 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.

8.9.5.4 Example WPS Network Setup

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

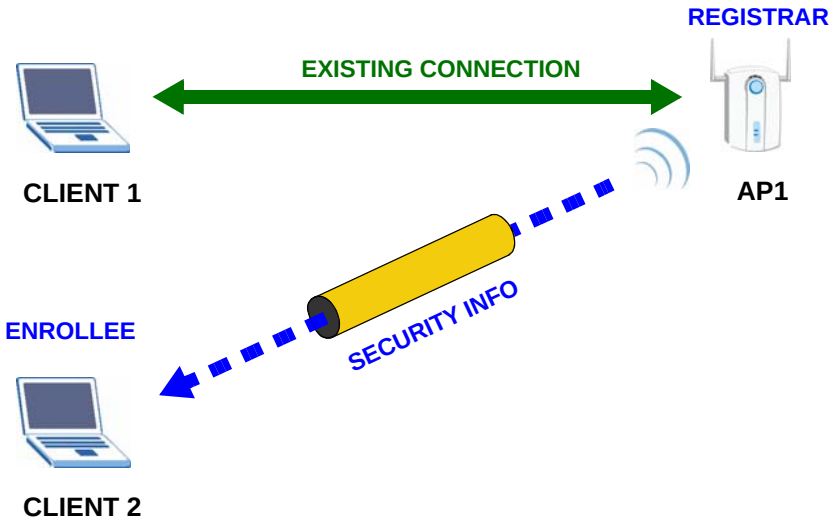
The following figure shows an example network. In step **1**, both **AP1** and **Client 1** are unconfigured. When WPS is activated on both, they perform the handshake. In this example, **AP1** is the registrar, and **Client 1** is the enrollee. The registrar randomly generates the security information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

Figure 106 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**.

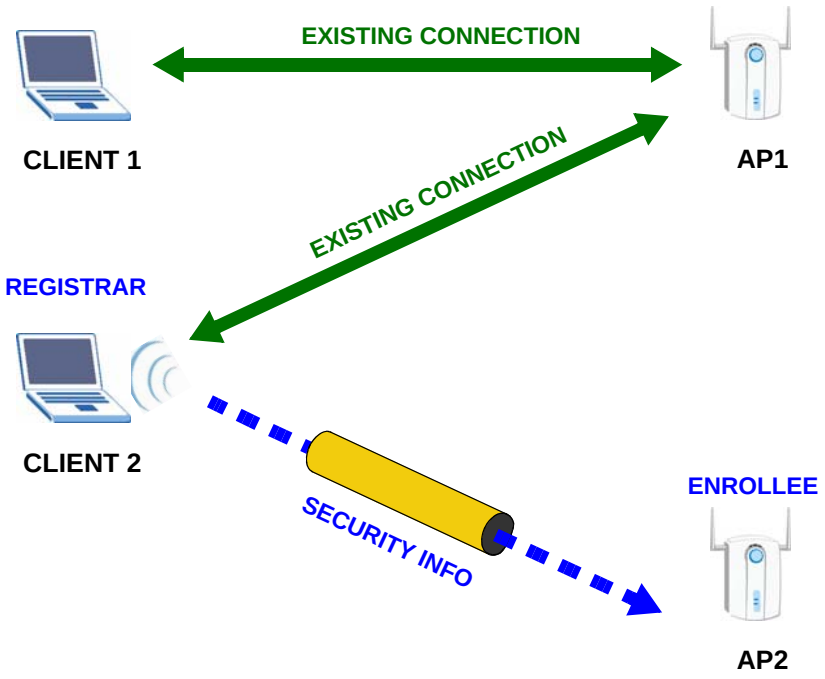
Figure 107 WPS: Example Network Step 2



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 108 WPS: Example Network Step 3



8.9.5.5 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.

9

Network Address Translation (NAT)

9.1 Overview

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.

9.1.1 What You Can Do in the NAT Screens

- Use the **NAT General Setup** screen (Section 9.2 on page 166) to configure the NAT setup settings.
- Use the **Port Forwarding** screen (Section 9.3 on page 168) to configure forward incoming service requests to the server(s) on your local network.
- Use the **Address Mapping** screen (Section 9.4 on page 172) to change your ZyXEL Device's address mapping settings.
- Use the **SIP ALG** screen (Section 9.4.2 on page 174) to enable and disable the SIP (VoIP) ALG in the ZyXEL Device.

9.1.2 What You Need To Know About NAT

Inside/Outside and Global/Local

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

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.

SUA (Single User Account) Versus NAT

SUA (Single User Account) is a ZyNOS implementation of a subset of NAT that supports two types of mapping, **Many-to-One** and **Server**. The ZyXEL Device also supports **Full Feature** NAT to map multiple global IP addresses to multiple private LAN IP addresses of clients or servers using mapping types as outlined in Table 48 on page 179.

- Choose **SUA Only** if you have just one public WAN IP address for your ZyXEL Device.
- Choose **Full Feature** if you have multiple public WAN IP addresses for your ZyXEL Device.

Finding Out More

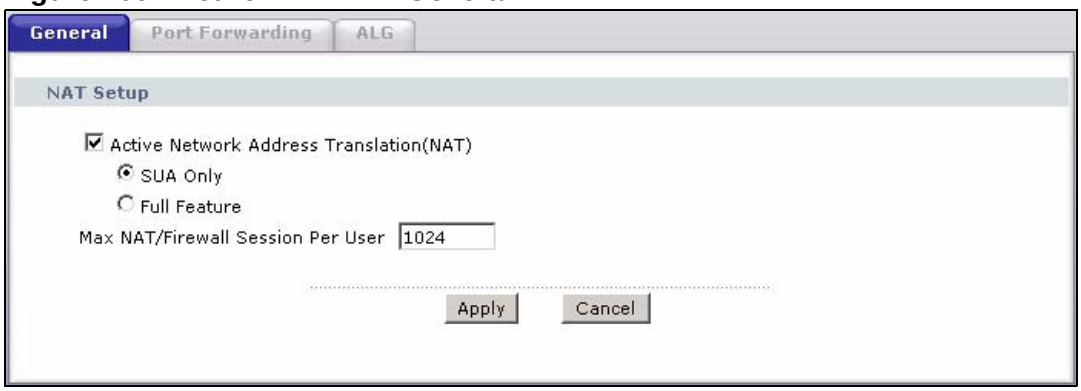
See Section 9.5 on page 175 for advanced technical information on NAT.

9.2 NAT General Setup

Note: You must create a firewall rule in addition to setting up SUA/NAT, to allow traffic from the WAN to be forwarded through the ZyXEL Device.

Click **Network > NAT** to open the following screen.

Figure 109 Network > NAT > General



The following table describes the labels in this screen.

Table 41 Network > NAT > General

LABEL	DESCRIPTION
Active Network Address Translation (NAT)	Select this check box to enable NAT.
SUA Only	Select this radio button if you have just one public WAN IP address for your ZyXEL Device.
Full Feature	Select this radio button if you have multiple public WAN IP addresses for your ZyXEL Device.
Max NAT/ Firewall Session Per User	When computers use peer to peer applications, such as file sharing applications, they need to establish NAT sessions. If you do not limit the number of NAT sessions a single client can establish, this can result in all of the available NAT sessions being used. In this case, no additional NAT sessions can be established, and users may not be able to access the Internet. Each NAT session establishes a corresponding firewall session. Use this field to limit the number of NAT/Firewall sessions client computers can establish through the ZyXEL Device. If your network has a small number of clients using peer to peer applications, you can raise this number to ensure that their performance is not degraded by the number of NAT sessions they can establish. If your network has a large number of users using peer to peer applications, you can lower this number to ensure no single client is exhausting all of the available NAT sessions.
Apply	Click **Apply** to save your changes back to the ZyXEL Device.
Cancel	Click **Cancel** to reload the previous configuration for this screen.

9.3 Port Forwarding

Note: This screen is available only when you select **SUA only** in the **NAT > General** 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 E on page 557. 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.

Default Server IP Address

In addition to the servers for specified services, NAT supports a default server IP address. A default server receives packets from ports that are not specified in this screen.

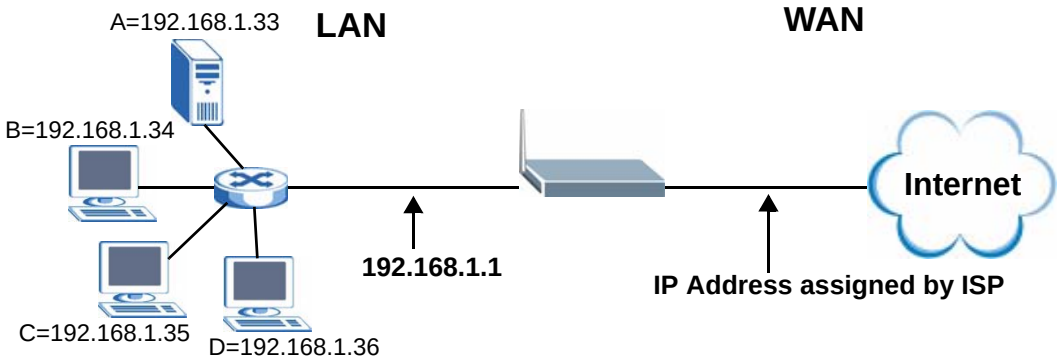
Note: If you do not assign a **Default Server** IP address, the ZyXEL Device discards all packets received for ports that are not specified here or in the remote management setup.

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.

Figure 110 Multiple Servers Behind NAT Example

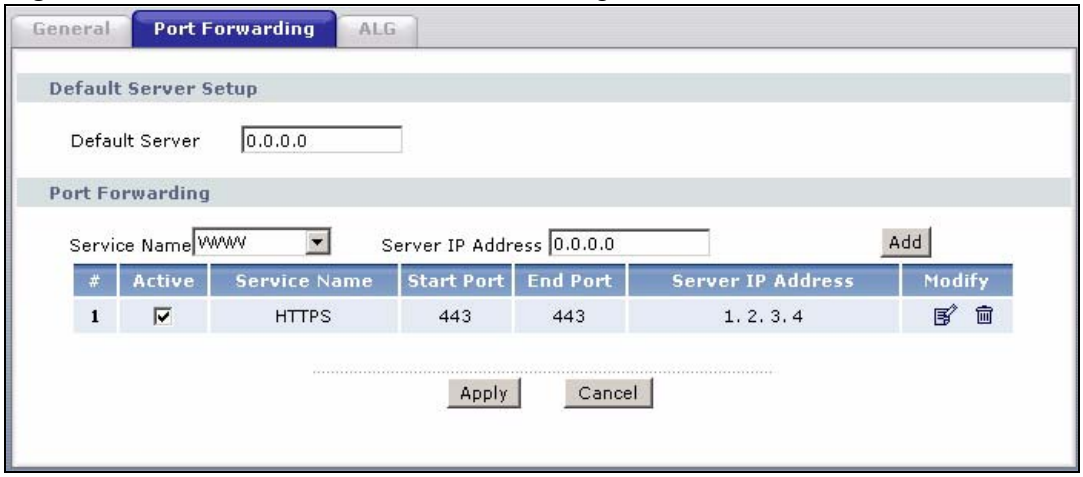


9.3.1 Configuring the Port Forwarding Screen

Click **Network > NAT > Port Forwarding** to open the following screen.

See Appendix E on page 557 for port numbers commonly used for particular services.

Figure 111 Network > NAT > Port Forwarding



The following table describes the fields in this screen.

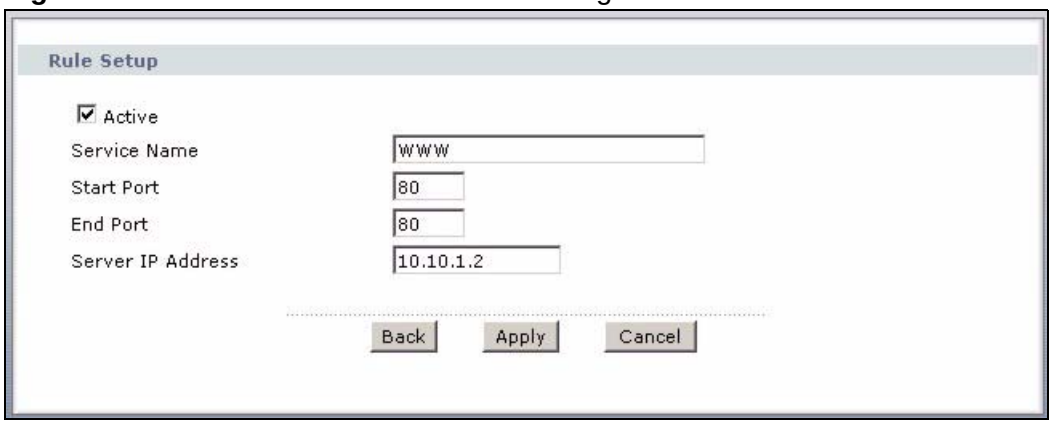
Table 42 Network > NAT > Port Forwarding

LABEL	DESCRIPTION
Default Server Setup	
Default Server	In addition to the servers for specified services, NAT supports a default server. A default server receives packets from ports that are not specified in this screen. If you do not assign a **Default Server** IP address, the ZyXEL Device discards all packets received for ports that are not specified here or in the remote management setup.
Port Forwarding	
Service Name	Select a service from the drop-down list box.
Server IP Address	Enter the IP address of the server for the specified service.
Add	Click this button to add a rule to the table below.
#	This is the rule index number (read-only).
Active	This field indicates whether the rule is active or not. Clear the check box to disable the rule. Select the check box to enable it.
Service Name	This is a service's name.
Start Port	This is the first port number that identifies a service.
End Port	This is the last port number that identifies a service.
Server IP Address	This is the server's IP address.
Modify	Click the edit icon to go to the screen where you can edit the port forwarding rule. Click the delete icon to delete an existing port forwarding rule. Note that subsequent address mapping rules move up by one when you take this action.
Apply	Click **Apply** to save your changes back to the ZyXEL Device.
Cancel	Click **Cancel** to return to the previous configuration.

9.3.2 Port Forwarding Rule Edit

Use this screen to add or edit a port forwarding rule. Select **User define** in the **Service Name** field of the **Port Forwarding** screen or click an existing rule's edit icon in the **Port Forwarding** screen to display the screen shown next.

Figure 112 Network > NAT > Port Forwarding > Edit



The following table describes the fields in this screen.

Table 43 Network > NAT > Port Forwarding > Edit

LABEL	DESCRIPTION
Active	Click this check box to enable the rule.
Service Name	Enter a name to identify this port-forwarding rule.
Start Port	Enter a port number in this field. To forward only one port, enter the port number again in the **End Port** field. To forward a series of ports, enter the start port number here and the end port number in the **End Port** field.
End Port	Enter a port number in this field. To forward only one port, enter the port number again in the **Start Port** field above and then enter it again in this field. To forward a series of ports, enter the last port number in a series that begins with the port number in the **Start Port** field above.
Server IP Address	Enter the inside IP address of the server here.
Back	Click **Back** to return to the previous screen.
Apply	Click **Apply** to save your changes back to the ZyXEL Device.
Cancel	Click **Cancel** to begin configuring this screen afresh.

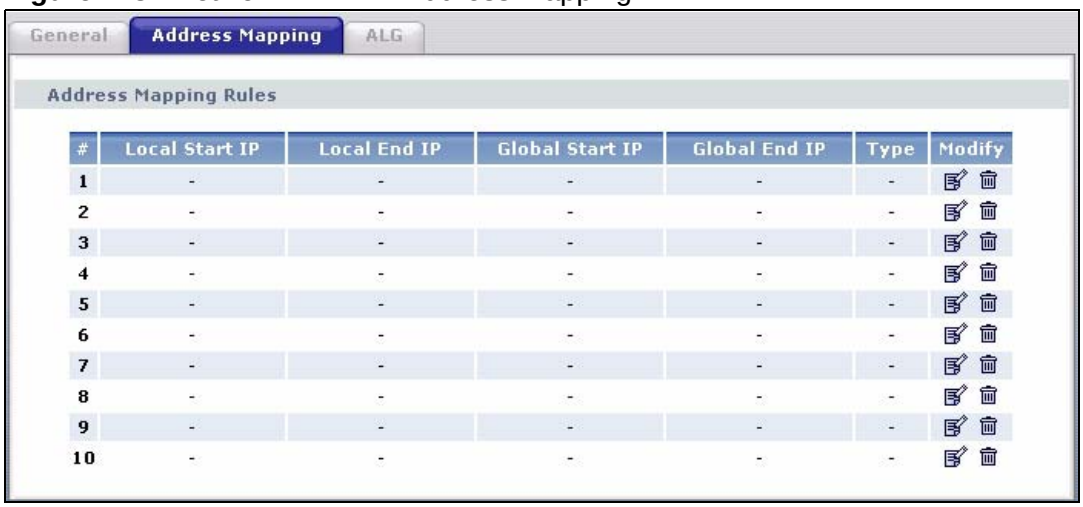
9.4 Address Mapping

Note: The **Address Mapping** screen is available only when you select **Full Feature** in the **NAT > General** screen.

Ordering your rules is important because the ZyXEL Device applies the rules in the order that you specify. When a rule matches the current packet, the ZyXEL Device takes the corresponding action and the remaining rules are ignored. If there are any empty rules before your new configured rule, your configured rule will be pushed up by that number of empty rules. For example, if you have already configured rules 1 to 6 in your current set and now you configure rule number 9. In the set summary screen, the new rule will be rule 7, not 9. Now if you delete rule 4, rules 5 to 7 will be pushed up by 1 rule, so old rules 5, 6 and 7 become new rules 4, 5 and 6.

To change your ZyXEL Device's address mapping settings, click **Network > NAT > Address Mapping** to open the following screen.

Figure 113 Network > NAT > Address Mapping



The following table describes the fields in this screen.

Table 44 Network > NAT > Address Mapping

LABEL	DESCRIPTION
#	This is the rule index number.
Local Start IP	This is the starting Inside Local IP Address (ILA). Local IP addresses are **N/A** for **Server** port mapping.
Local End IP	This is the end Inside Local IP Address (ILA). If the rule is for all local IP addresses, then this field displays 0.0.0.0 as the **Local Start IP** address and 255.255.255.255 as the **Local End IP** address. This field is **N/A** for **One-to-one** and **Server** mapping types.
Global Start IP	This is the starting Inside Global IP Address (IGA). Enter 0.0.0.0 here if you have a dynamic IP address from your ISP. You can only do this for **Many-to-One** and **Server** mapping types.

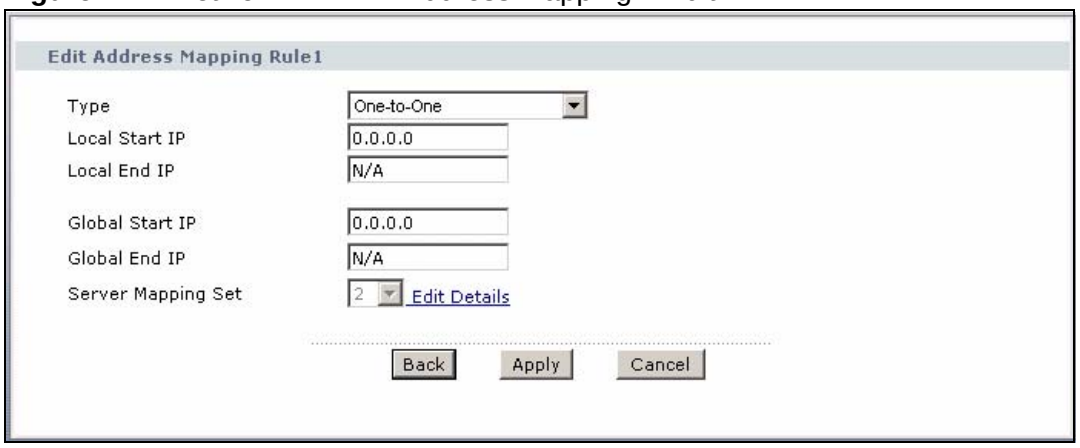
Table 44 Network > NAT > Address Mapping (continued)

LABEL	DESCRIPTION
Global End IP	This is the ending Inside Global IP Address (IGA). This field is **N/A** for **One-to-one**, **Many-to-One** and **Server** mapping types.
Type	**1-1**: One-to-one mode maps one local IP address to one global IP address. Note that port numbers do not change for the One-to-one NAT mapping type. **M-1**: Many-to-One mode maps multiple local IP addresses to one global IP address. This is equivalent to SUA (i.e., PAT, port address translation), ZyXEL's Single User Account feature that previous ZyXEL routers supported only. **M-M Ov** (Overload): Many-to-Many Overload mode maps multiple local IP addresses to shared global IP addresses. **MM No** (No Overload): Many-to-Many No Overload mode maps each local IP address to unique global IP addresses. **Server**: This type allows you to specify inside servers of different services behind the NAT to be accessible to the outside world.
Modify	Click the edit icon to go to the screen where you can edit the address mapping rule. Click the delete icon to delete an existing address mapping rule. Note that subsequent address mapping rules move up by one when you take this action.

9.4.1 Address Mapping Rule Edit

To edit an address mapping rule, click the rule's edit icon in the **Address Mapping** screen to display the screen shown next.

Figure 114 Network > NAT > Address Mapping > Edit



The following table describes the fields in this screen.

Table 45 Network > NAT > Address Mapping > Edit

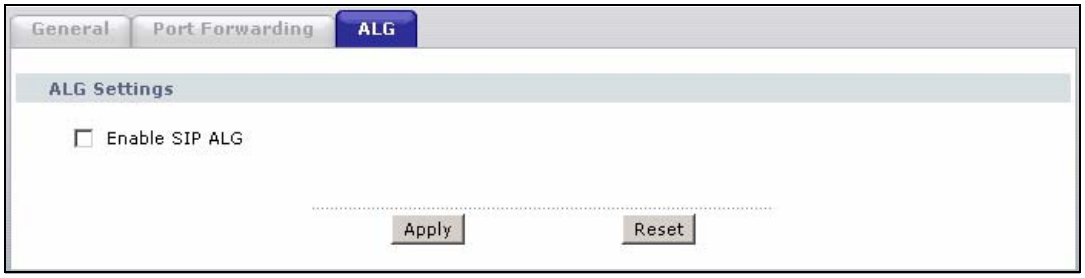
LABEL	DESCRIPTION
Type	Choose the port mapping type from one of the following. **One-to-One**: One-to-One mode maps one local IP address to one global IP address. Note that port numbers do not change for One-to-one NAT mapping type. **Many-to-One**: Many-to-One mode maps multiple local IP addresses to one global IP address. This is equivalent to SUA (i.e., PAT, port address translation), ZyXEL's Single User Account feature that previous ZyXEL routers supported only. **Many-to-Many Overload**: Many-to-Many Overload mode maps multiple local IP addresses to shared global IP addresses. **Many-to-Many No Overload**: Many-to-Many No Overload mode maps each local IP address to unique global IP addresses. **Server**: This type allows you to specify inside servers of different services behind the NAT to be accessible to the outside world.
Local Start IP	This is the starting local IP address (ILA). Local IP addresses are **N/A** for **Server** port mapping.
Local End IP	This is the end local IP address (ILA). If your rule is for all local IP addresses, then enter 0.0.0.0 as the **Local Start IP** address and 255.255.255.255 as the **Local End IP** address. This field is **N/A** for **One-to-One** and **Server** mapping types.
Global Start IP	This is the starting global IP address (IGA). Enter 0.0.0.0 here if you have a dynamic IP address from your ISP.
Global End IP	This is the ending global IP address (IGA). This field is **N/A** for **One-to-One**, **Many-to-One** and **Server** mapping types.
Server Mapping Set	Only available when **Type** is set to **Server**. Select a number from the drop-down menu to choose a port forwarding set.
Edit Details	Click this link to go to the **Port Forwarding** screen to edit a port forwarding set that you have selected in the **Server Mapping Set** field.
Back	Click **Back** to return to the previous screen.
Apply	Click **Apply** to save your changes to the ZyXEL Device.
Cancel	Click **Cancel** to begin configuring this screen afresh.

9.4.2 SIP ALG

A SIP Application Layer Gateway (ALG) allows SIP calls to pass through NAT by examining and translating IP addresses embedded in the data stream. When the ZyXEL Device registers with the SIP register server, the SIP ALG translates the ZyXEL Device's private IP address inside the SIP data stream to a public IP address. You do not need to use STUN or an outbound proxy if your ZyXEL Device is behind a SIP ALG.

Use this screen to enable and disable the SIP (VoIP) ALG in the ZyXEL Device. To access this screen, click **Network > NAT > ALG**.

Figure 115 Network > NAT > ALG



Each field is described in the following table.

Table 46 Network > NAT > ALG

LABEL	DESCRIPTION
Enable SIP ALG	Select this to make sure SIP (VoIP) works correctly with port-forwarding and address-mapping rules.
Apply	Click this to save your changes and to apply them to the ZyXEL Device.
Reset	Click this to return to previously saved configuration.

9.5 NAT Technical Reference

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

9.5.1 NAT Definitions

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

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.

Note that inside/outside refers to the location of a host, while global/local refers to the IP address of a host used in a packet. Thus, an inside local address (ILA) is the IP address of an inside host in a packet when the packet is still in the local network, while an inside global address (IGA) is the IP address of the same inside

host when the packet is on the WAN side. The following table summarizes this information.

Table 47 NAT Definitions

ITEM	DESCRIPTION
Inside	This refers to the host on the LAN.
Outside	This refers to the host on the WAN.
Local	This refers to the packet address (source or destination) as the packet travels on the LAN.
Global	This refers to the packet address (source or destination) as the packet travels on the WAN.

NAT never changes the IP address (either local or global) of an outside host.

9.5.2 What NAT Does

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. Note that the IP address (either local or global) of an outside host is never changed.

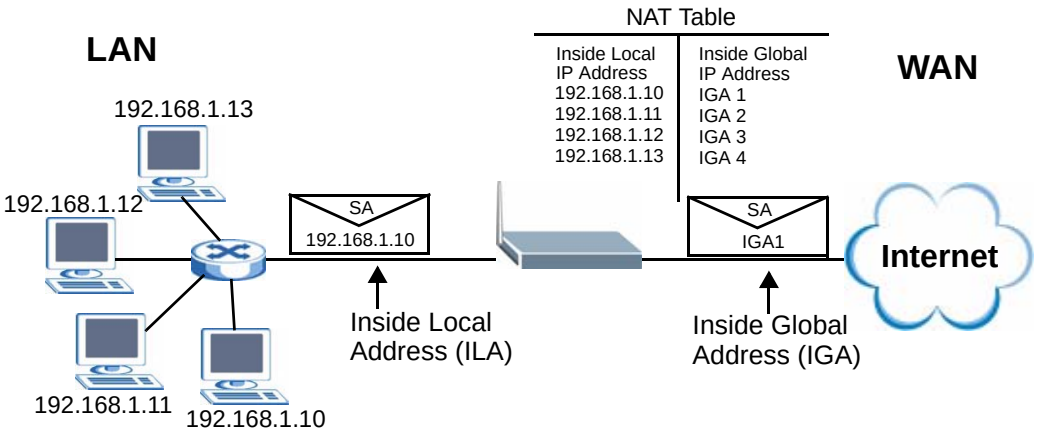
The global IP addresses for the inside hosts can be either static or dynamically assigned by the ISP. In addition, you can designate servers, for example, a web server and a telnet server, on your local network and make them accessible to the outside world. If you do not define any servers (for Many-to-One and Many-to-Many Overload mapping – see Table 48 on page 179), NAT offers the additional benefit of firewall protection. With no servers defined, your ZyXEL Device filters out all incoming inquiries, thus preventing intruders from probing your network. For more information on IP address translation, refer to *RFC 1631*, *The IP Network Address Translator (NAT)*.

9.5.3 How NAT Works

Each packet has two addresses – a source address and a destination address. For outgoing packets, the ILA (Inside Local Address) is the source address on the LAN, and the IGA (Inside Global Address) is the source address on the WAN. For incoming packets, the ILA is the destination address on the LAN, and the IGA is the destination address on the WAN. NAT maps private (local) IP addresses to globally unique ones required for communication with hosts on other networks. It replaces the original IP source address (and TCP or UDP source port numbers for Many-to-One and Many-to-Many Overload NAT mapping) in each packet and then forwards it to the Internet. The ZyXEL Device keeps track of the original addresses

and port numbers so incoming reply packets can have their original values restored. The following figure illustrates this.

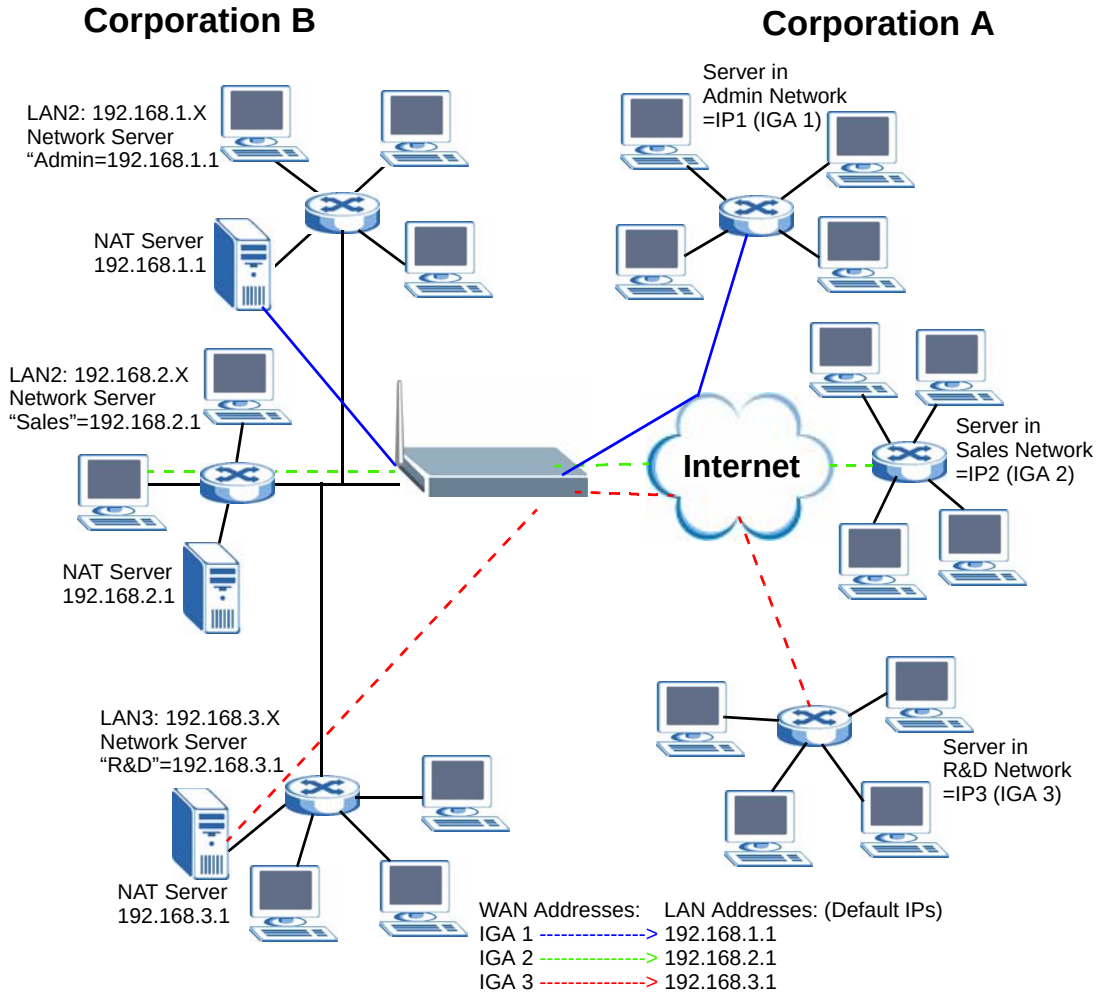
Figure 116 How NAT Works



9.5.4 NAT Application

The following figure illustrates a possible NAT application, where three inside LANs (logical LANs using IP alias) behind the ZyXEL Device can communicate with three distinct WAN networks.

Figure 117 NAT Application With IP Alias



9.5.5 NAT Mapping Types

NAT supports five types of IP/port mapping. They are:

- **One to One**: In One-to-One mode, the ZyXEL Device maps one local IP address to one global IP address.
- **Many to One**: In Many-to-One mode, the ZyXEL Device maps multiple local IP addresses to one global IP address. This is equivalent to SUA (for instance, PAT, port address translation), ZyXEL's Single User Account feature that previous ZyXEL routers supported (the **SUA Only** option in today's routers).

- **Many to Many Overload**: In Many-to-Many Overload mode, the ZyXEL Device maps the multiple local IP addresses to shared global IP addresses.
- **Many-to-Many No Overload**: In Many-to-Many No Overload mode, the ZyXEL Device maps each local IP address to a unique global IP address.
- **Server**: This type allows you to specify inside servers of different services behind the NAT to be accessible to the outside world.

Port numbers do NOT change for **One-to-One** and **Many-to-Many No Overload** NAT mapping types.

The following table summarizes these types.

Table 48 NAT Mapping Types

TYPE	IP MAPPING
One-to-One	ILA1←→ IGA1
Many-to-One (SUA/PAT)	ILA1←→ IGA1 ILA2←→ IGA1 ...
Many-to-Many Overload	ILA1←→ IGA1 ILA2←→ IGA2 ILA3←→ IGA1 ILA4←→ IGA2 ...
Many-to-Many No Overload	ILA1←→ IGA1 ILA2←→ IGA2 ILA3←→ IGA3 ...
Server	Server 1 IP←→ IGA1 Server 2 IP←→ IGA1 Server 3 IP←→ IGA1

10 Voice

10.1 Overview

Use this chapter to:

- Connect an analog phone to the ZyXEL Device.
- Make phone calls over the Internet, as well as the regular phone network.
- Configure settings such as speed dial and distinctive ringing.
- Configure network settings to optimize the voice quality of your phone calls.

10.1.1 What You Can Do in the VoIP Screens

These screens allow you to configure your ZyXEL Device to make phone calls over the Internet and your regular phone line, and to set up the phones you connect to the ZyXEL Device.

- Use the **SIP Settings** screen (Section 10.2 on page 183) to set up information about your SIP account.
- Use the **SIP QoS** screen (Section 10.4 on page 189) to configure Quality of Service for VoIP calls. QoS can give VoIP traffic higher priority on the network so it gets dealt with more quickly.
- Use the **Analog Phone** screen (Section 10.5 on page 190) to control which SIP accounts the phones connected to the ZyXEL Device use.
- Use the **Advanced Analog Phone Setup** screen (Section 10.6 on page 190) to configure audio settings such as volume levels for the phones connected to the ZyXEL Device.
- Use the **EXT. Table** screen (Section 10.7 on page 193) to configure extension numbers for the phones connected to the ZyXEL Device so they can be separately identified for intercom use.
- Use the **Common Phone Settings** screen (Section 10.8 on page 194) to turn immediate dialing on or off.
- Use the **Region** screen (Section 10.9 on page 195) to change settings that depend on the country you are in.
- Use the **Speed Dial** screen (Section 10.10 on page 196) to set up shortcuts for dialing frequently-used (VoIP) phone numbers.

- Use the **Incoming Call Policy** screen (Section 10.11 on page 199) to configure how the ZyXEL Device deals with incoming calls.
- Use the **SIP Prefix** screen (Section 10.12 on page 201) to set up numbers you dial on your phone that specify which SIP account you want to use.

You don't necessarily need to use all these screens to set up your account. In fact, if your service provider did not supply information on a particular field in a screen, it is usually best to leave it at its default setting.

10.1.2 What You Need to Know About VoIP

VoIP

VoIP stands for Voice over IP. IP is the Internet Protocol, which is the message-carrying standard the Internet runs on. So, Voice over IP is the sending of voice signals (speech) over the Internet (or another network that uses the Internet Protocol).

SIP

SIP stands for Session Initiation Protocol. SIP is a signalling standard that lets one network device (like a computer or the ZyXEL Device) send messages to another. In VoIP, these messages are about phone calls over the network. For example, when you dial a number on your ZyXEL Device, it sends a SIP message over the network asking the other device (the number you dialed) to take part in the call.

SIP Accounts

A SIP account is a type of VoIP account. It is an arrangement with a service provider that lets you make phone calls over the Internet. When you set the ZyXEL Device to use your SIP account to make calls, the ZyXEL Device is able to send all the information about the phone call to your service provider on the Internet.

Strictly speaking, you don't need a SIP account. It is possible for one SIP device (like the ZyXEL Device) to call another without involving a SIP service provider. However, the networking difficulties involved in doing this make it tremendously impractical under normal circumstances. Your SIP account provider removes these difficulties by taking care of the call routing and setup - figuring out how to get your call to the right place in a way that you and the other person can talk to one another.

How to Find Out More

See Chapter 4 on page 59 for a tutorial showing how to set up these screens in an example scenario.

See Section 10.13 on page 202 for advanced technical information on SIP.

10.1.3 Before You Begin

- Before you can use these screens, you need to have a VoIP account already set up. If you don't have one yet, you can sign up with a VoIP service provider over the Internet.
- You should have the information your VoIP service provider gave you ready, before you start to configure the ZyXEL Device.

10.2 The SIP Settings Screen

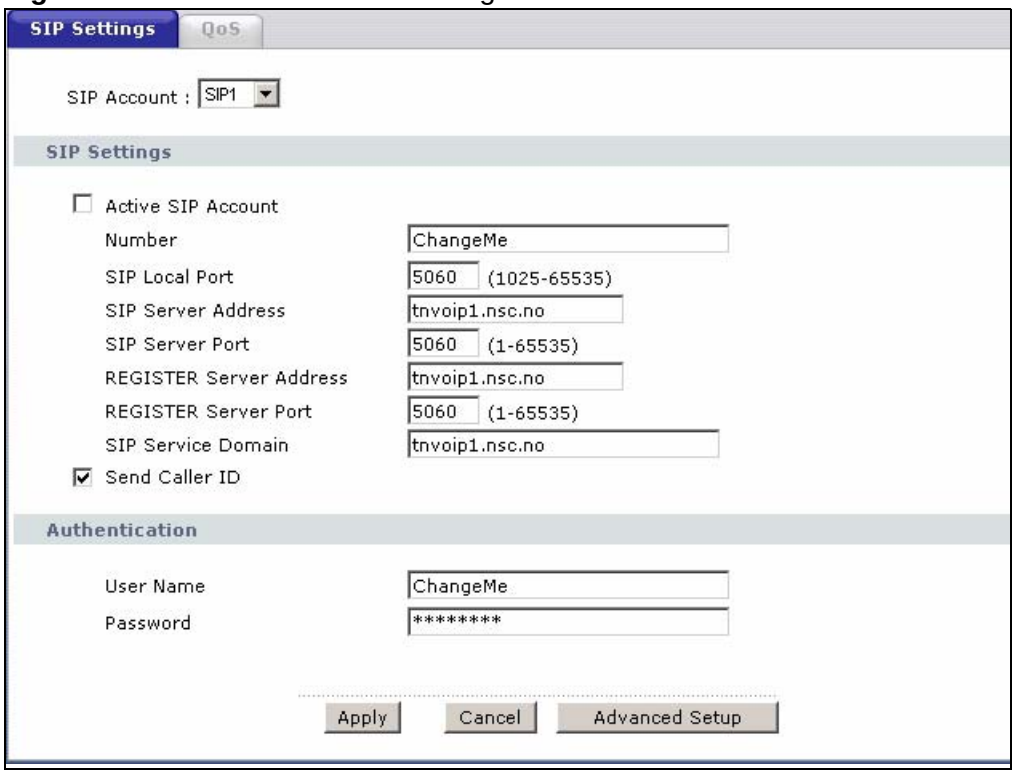
The ZyXEL Device uses a SIP account to make outgoing VoIP calls and check if an incoming call's destination number matches your SIP account's SIP number. In order to make or receive a VoIP call, you need to enable and configure a SIP account, and map it to a phone port. The SIP account contains information that allows your ZyXEL Device to connect to your VoIP service provider.

If you want to make only peer-to-peer VoIP calls, there is no VoIP service provider involved, so the SIP account information does not have to match a real VoIP service provider's SIP account. You can make up the SIP numbers. However, you should still activate a SIP account and configure its number and map it to a phone port, so that the person you call knows what SIP number you are using and the ZyXEL Device knows to which phone port it should forward an incoming VoIP call. You must use speed dial to make peer-to-peer VoIP calls.

See Section 10.5 on page 190 for how to map a SIP account to a phone port.

Use this screen to maintain basic information about each SIP account. You can also enable and disable each SIP account. To access this screen, click **VoIP > SIP > SIP Settings**.

Figure 118 VoIP > SIP > SIP Settings



Each field is described in the following table.

Table 49 VoIP > SIP > SIP Settings

LABEL	DESCRIPTION
SIP Account	Select the SIP account you want to see in this screen. If you change this field, the screen automatically refreshes.
SIP Settings	
Active SIP Account	Select this if you want the ZyXEL Device to use this account. Clear it if you do not want the ZyXEL Device to use this account.
Number	Enter your SIP number. In the full SIP URI, this is the part before the @ symbol. You can use up to 127 printable ASCII characters.
SIP Local Port	Enter the ZyXEL Device's listening port number, if your VoIP service provider gave you one. Otherwise, keep the default value.
SIP Server Address	Enter the IP address or domain name of the SIP server provided by your VoIP service provider. You can use up to 95 printable ASCII characters. It does not matter whether the SIP server is a proxy, redirect or register server.
SIP Server Port	Enter the SIP server's listening port number, if your VoIP service provider gave you one. Otherwise, keep the default value.

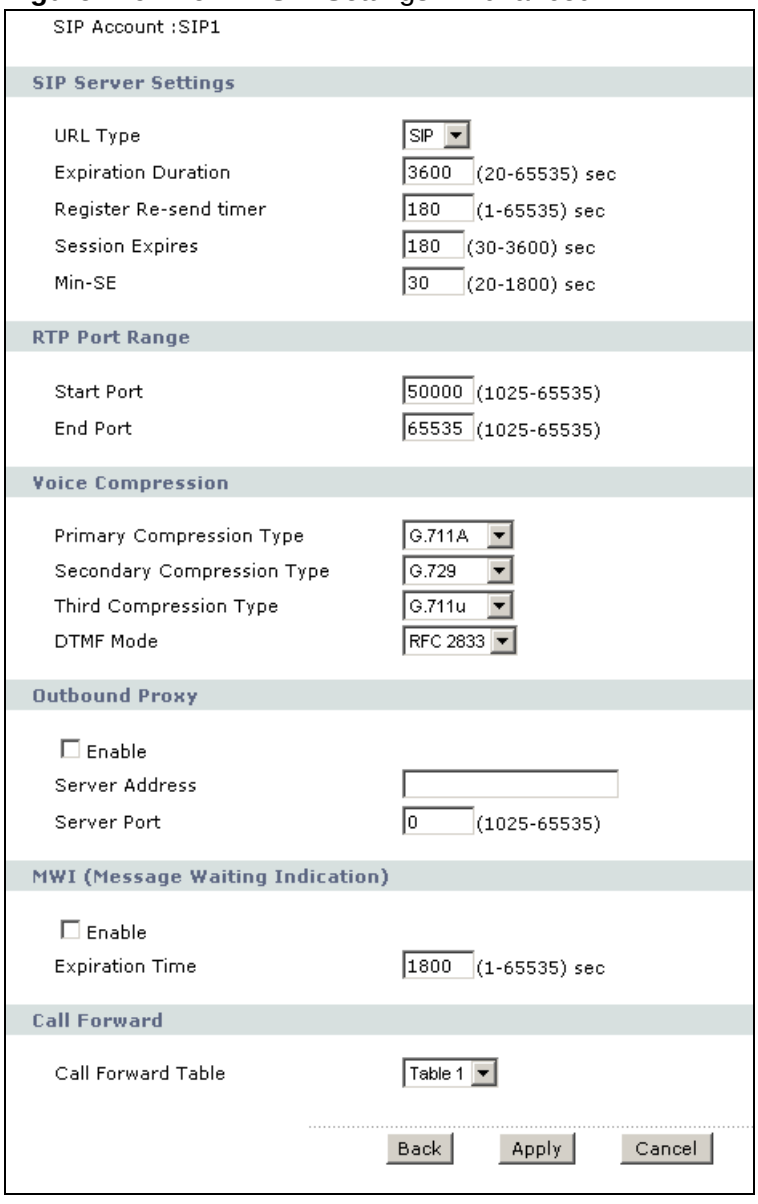
Table 49 VoIP > SIP > SIP Settings

LABEL	DESCRIPTION
REGISTER Server Address	Enter the IP address or domain name of the SIP register server, if your VoIP service provider gave you one. Otherwise, enter the same address you entered in the **SIP Server Address** field. You can use up to 95 printable ASCII characters.
REGISTER Server Port	Enter the SIP register server's listening port number, if your VoIP service provider gave you one. Otherwise, enter the same port number you entered in the **SIP Server Port** field.
SIP Service Domain	Enter the SIP service domain name. In the full SIP URI, this is the part after the @ symbol. You can use up to 127 printable ASCII Extended set characters.
Send Caller ID	Select this if you want to send identification when you make VoIP phone calls. Clear this if you do not want to send identification.
Authentication	
User Name	Enter the user name for registering this SIP account, exactly as it was given to you. You can use up to 95 printable ASCII characters.
Password	Enter the user name for registering this SIP account, exactly as it was given to you. You can use up to 95 printable ASCII Extended set characters.
Apply	Click this to save your changes and to apply them to the ZyXEL Device.
Cancel	Click this to set every field in this screen to its last-saved value.
Advanced Setup	Click this to edit the advanced settings for this SIP account. The **Advanced SIP Setup** screen appears.

10.3 The Advanced SIP Setup Screen

Click **VoIP > SIP > SIP Settings** to open the **SIP Settings** screen. Select a SIP account and click **Advanced Setup** to open the **Advanced SIP Setup** screen. Use this screen to maintain advanced settings for each SIP account.

Figure 119 VoIP > SIP Settings > Advanced



Each field is described in the following table.

Table 50 VoIP > SIP Settings > Advanced

LABEL	DESCRIPTION
SIP Account	This field displays the SIP account you see in this screen.
SIP Server Settings	
URL Type	Select whether or not to include the SIP service domain name when the ZyXEL Device sends the SIP number. **SIP** - include the SIP service domain name. **TEL** - do not include the SIP service domain name.
Expiration Duration	Enter the number of seconds your SIP account is registered with the SIP register server before it is deleted. The ZyXEL Device automatically tries to re-register your SIP account when one-half of this time has passed. (The SIP register server might have a different expiration.)
Register Re-send timer	Enter the number of seconds the ZyXEL Device waits before it tries again to register the SIP account, if the first try failed or if there is no response.
Session Expires	Enter the number of seconds the ZyXEL Device lets a SIP session remain idle (without traffic) before it automatically disconnects the session.
Min-SE	Enter the minimum number of seconds the ZyXEL Device lets a SIP session remain idle (without traffic) before it automatically disconnects the session. When two SIP devices start a SIP session, they must agree on an expiration time for idle sessions. This field is the shortest expiration time that the ZyXEL Device accepts.
RTP Port Range	
Start Port End Port	Enter the listening port number(s) for RTP traffic, if your VoIP service provider gave you this information. Otherwise, keep the default values. To enter one port number, enter the port number in the **Start Port** and **End Port** fields. To enter a range of ports, • enter the port number at the beginning of the range in the **Start Port** field. • enter the port number at the end of the range in the **End Port** field.
Voice Compression	Select the type of voice coder/decoder (codec) that you want the ZyXEL Device to use. G.711 provides higher voice quality but requires more bandwidth (64 kbps). • **G.711A** is typically used in Europe. • **G.711u** is typically used in North America and Japan. **G.726** operates at **16**, **24**, **32** or **40** kbps. By contrast, **G.729** only requires 8 kbps. The ZyXEL Device must use the same codec as the peer. When two SIP devices start a SIP session, they must agree on a codec.

Table 50 VoIP > SIP Settings > Advanced

LABEL	DESCRIPTION
Primary Compression Type	Select the ZyXEL Device's first choice for voice coder/decoder.
Secondary Compression Type	Select the ZyXEL Device's second choice for voice coder/decoder. Select **None** if you only want the ZyXEL Device to accept the first choice.
Third Compression Type	Select the ZyXEL Device's third choice for voice coder/decoder. Select **None** if you only want the ZyXEL Device to accept the first or second choice.
DTMF Mode	Control how the ZyXEL Device handles the tones that your telephone makes when you push its buttons. You should use the same mode your VoIP service provider uses. **RFC 2833** - send the DTMF tones in RTP packets. **PCM** - send the DTMF tones in the voice data stream. This method works best when you are using a codec that does not use compression (like G.711). Codecs that use compression (like G.729 and G.726) can distort the tones. **SIP INFO** - send the DTMF tones in SIP messages.
Outbound Proxy	
Enable	Select this if your VoIP service provider has a SIP outbound server to handle voice calls. This allows the ZyXEL Device to work with any type of NAT router and eliminates the need for STUN or a SIP ALG. Turn off any SIP ALG on a NAT router in front of the ZyXEL Device to keep it from re-translating the IP address (since this is already handled by the outbound proxy server).
Server Address	Enter the IP address or domain name of the SIP outbound proxy server.
Server Port	Enter the SIP outbound proxy server's listening port, if your VoIP service provider gave you one. Otherwise, keep the default value.
MWI (Message Waiting Indication)	
Enable	Select this if you want to hear a waiting (beeping) dial tone on your phone when you have at least one voice message. Your VoIP service provider must support this feature.
Expiration Time	Keep the default value for this field, unless your VoIP service provider tells you to change it. Enter the number of seconds the SIP server should provide the message waiting service each time the ZyXEL Device subscribes to the service. Before this time passes, the ZyXEL Device automatically subscribes again.
Call Forward	
Call Forward Table	Select which call forwarding table you want the ZyXEL Device to use for incoming calls. You set up these tables in **VoIP** > **Phone Book** > **Incoming Call Policy**.
Back	Click this to return to the **SIP Settings** screen without saving your changes.

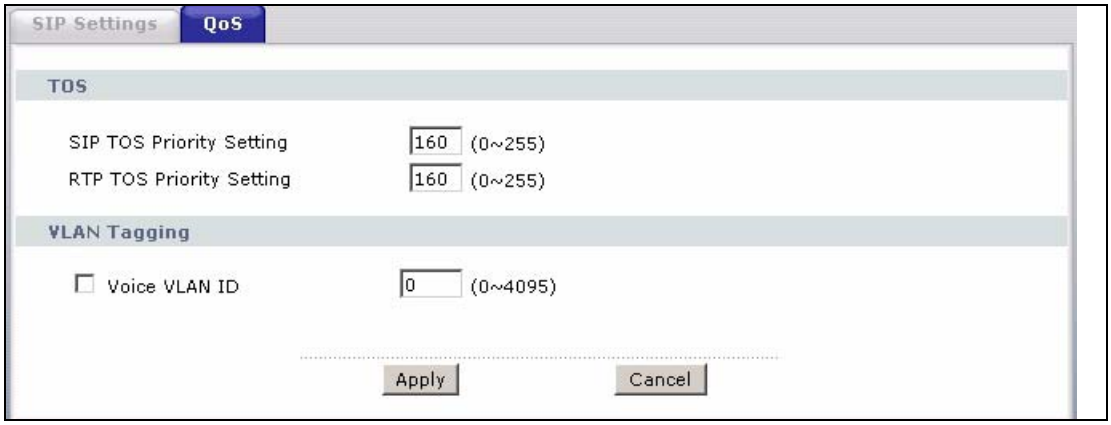
Table 50 VoIP > SIP Settings > Advanced

LABEL	DESCRIPTION
Apply	Click this to save your changes and to apply them to the ZyXEL Device.
Cancel	Click this to set every field in this screen to its last-saved value.

10.4 The SIP QoS Screen

Use this screen to maintain ToS and VLAN settings for the ZyXEL Device. To access this screen, click **VoIP > SIP > QoS**.

Figure 120 VoIP > SIP > QoS



Each field is described in the following table.

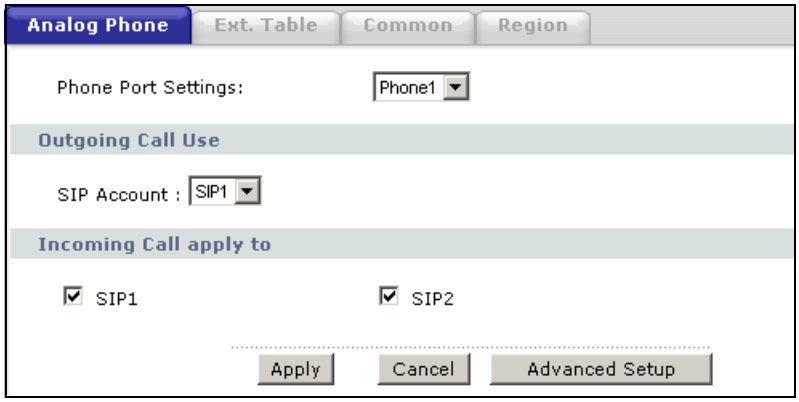
Table 51 VoIP > SIP > QoS

LABEL	DESCRIPTION
SIP TOS Priority Setting	Enter the priority for SIP voice transmissions. The ZyXEL Device creates Type of Service priority tags with this priority to voice traffic that it transmits.
RTP TOS Priority Setting	Enter the priority for RTP voice transmissions. The ZyXEL Device creates Type of Service priority tags with this priority to RTP traffic that it transmits.
Voice VLAN ID	Select this if the ZyXEL Device has to be a member of a VLAN to communicate with the SIP server. Ask your network administrator, if you are not sure. Enter the VLAN ID provided by your network administrator in the field on the right. Your LAN and gateway must be configured to use VLAN tags. Otherwise, clear this field.
Apply	Click this to save your changes and to apply them to the ZyXEL Device.
Cancel	Click this to set every field in this screen to its last-saved value.

10.5 The Analog Phone Screen

Use this screen to control which SIP accounts and PSTN line each phone uses. To access this screen, click **VoIP > Phone > Analog Phone**.

Figure 121 VoIP > Phone > Analog Phone



Each field is described in the following table.

Table 52 VoIP > Phone > Analog Phone

LABEL	DESCRIPTION
Phone Port Settings	This is the phone port in the ZyXEL Device.
SIP Account	Select the SIP account you want to use when making outgoing calls with the analog phone connected to this phone port.
Incoming Call apply to	Select a SIP account if you want to receive phone calls for the selected SIP account on this phone port. If you select more than one SIP account for incoming calls, there is no way to distinguish between them when you receive phone calls. If you do not select a source for incoming calls, you cannot receive any calls on this phone port.
Apply	Click this to save your changes and to apply them to the ZyXEL Device.
Cancel	Click this to set every field in this screen to its last-saved value.
Advanced Setup	Click this to edit the advanced settings for this phone port. The **Advanced Analog Phone Setup** screen appears.

10.6 The Advanced Analog Phone Setup Screen

Use this screen to configure the volume, echo cancellation and VAD (Voice Activity Detection) settings for each individual phone port on the ZyXEL Device. You can also select which SIP account to use for making outgoing calls.

Voice Activity Detection/Silence Suppression

Voice Activity Detection (VAD) detects whether or not speech is present. This lets the ZyXEL Device reduce the bandwidth that a call uses by not transmitting “silent packets” when you are not speaking.

Comfort Noise Generation

When using VAD, the ZyXEL Device generates comfort noise when the other party is not speaking. The comfort noise lets you know that the line is still connected as total silence could easily be mistaken for a lost connection.

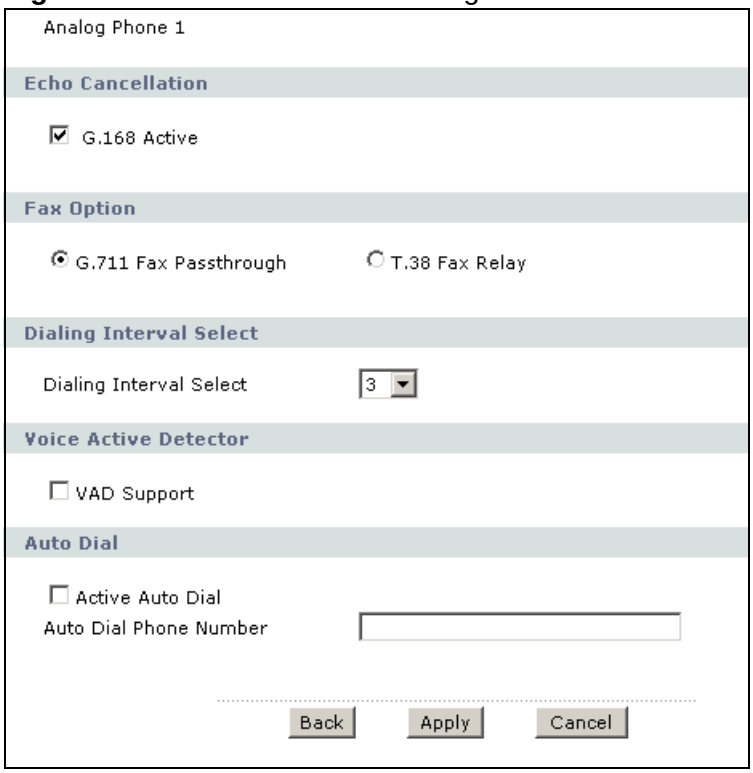
Echo Cancellation

G.168 is an ITU-T standard for eliminating the echo caused by the sound of your voice reverberating in the telephone receiver while you talk.

10.6.1 Configuring the Advanced Analog Phone Screen

To access this screen, click **Advanced Setup** in **VoIP > Phone > Analog Phone**.

Figure 122 VoIP > Phone > Analog Phone > Advanced



Each field is described in the following table.

Table 53 VoIP > Phone > Analog Phone > Advanced

LABEL	DESCRIPTION
Analog Phone	This field displays the analog phone port you see in this screen.
Echo Cancellation	
Active G.168	Select this if you want to eliminate the echo caused by the sound of your voice reverberating in the telephone receiver while you talk.
Fax Option	This field controls how the ZyXEL Device handles fax messages.
G.711 Fax Passthrough	Select this if the ZyXEL Device should use G.711 to send fax messages. The peer devices must also use G.711.
T.38 Fax Relay	Select this if the ZyXEL Device should send fax messages as UDP or TCP/IP packets through IP networks. This provides better quality, but it may have inter-operability problems. The peer devices must also use T.38.
Dialing Interval Selection	
Dialing Interval Selection	Enter the number of seconds the ZyXEL Device should wait after you stop dialing numbers before it makes the phone call. The value depends on how quickly you dial phone numbers. If you select **Active Immediate Dial** in **VoIP > Phone > Common**, you can press the pound key (#) to tell the ZyXEL Device to make the phone call immediately, regardless of this setting.
Voice Active Detector	
VAD Support	Select this if the ZyXEL Device should stop transmitting when you are not speaking. This reduces the bandwidth the ZyXEL Device uses.
Auto Dial	
Active Auto Dial	Select this if you want the ZyXEL Device to automatically dial the phone number you enter in the **Auto Dial Phone Number** field as soon as you take the phone off the hook.
Auto Dial Phone Number	If you select **Active Auto Dial**, enter the phone number you want the ZyXEL Device to automatically dial in this field.
Back	Click this to return to the **Analog Phone** screen without saving your changes.
Apply	Click this to save your changes.
Cancel	Click this to set every field in this screen to its last-saved value.

10.7 The Phone Settings Ext. Table Screen

Each phone connected to the ZyXEL Device has an extension number so that it can be separately identified for intercom use. The default settings of extension numbers are shown in the following table.

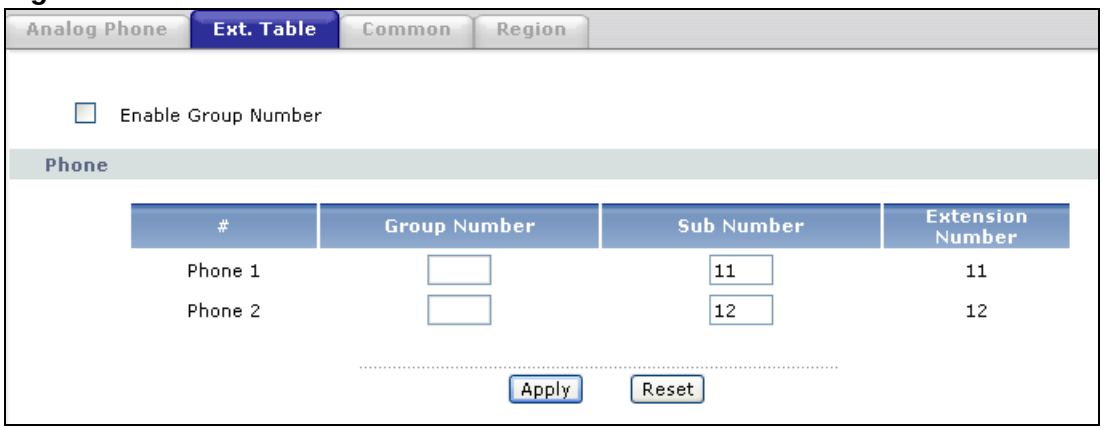
Table 54 Default Ext. Numbers

PHONE	DEFAULT EXT. NUMBER
Analog Phone 1	11
Analog Phone 2	12

An extension number is composed of a group number and a sub number. If group number is not enabled, the extension number is simply the sub number. You can assign a group number to several phones and use this number to call the group of phones. When you dial a group number, all of the phones with the same group number ring. The phone that picks up first gets the line, and the other phones stop ringing.

Click **VoIP > Phone > Ext. Table** to access this screen.

Figure 123 VoIP > Phone > Ext. Table



Each field is described in the following table.

Table 55 VoIP > Phone > Ext. Table

LABEL	DESCRIPTION
Enable Group Number	Select this if you want to enable group number for the DECT and analog phones connected to the ZyXEL Device.
Phone	Use these fields to assign extension numbers to the phones connected to the ZyXEL Device.
#	This is an index number of the phone to be assigned an extension number.

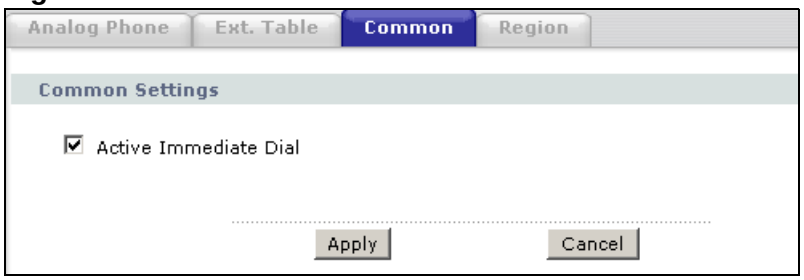
Table 55 VoIP > Phone > Ext. Table

LABEL	DESCRIPTION
Group Number	Enter a group number for this phone. The maximum length of a group number is one digit. This is only available when the check box of **Enable Group Number** is selected. For example, you can assign Phone 1 and Phone 2 a group number “5” and leave the sub numbers at default (“11” and “12”). When you dial “5”, both Phone 1 and Phone 2 ring. If Phone 1 picks up the line first, it gets the line and Phone 2 stops ringing.
Sub Number	Enter a sub number for this phone. The maximum length of a sub number is two digits. When the check box of **Enable Group Number** is not selected, the extension number is simply the sub number.
Extension Number	This read-only field displays the extension number which is a combination of “Group Number” and “Sub Number“. When you change group number or sub number, the extension number automatically refreshes. Use extension number to make calls between phones connected to the ZyXEL Device.
Apply	Click this to save your changes and to apply them to the ZyXEL Device.
Cancel	Click this to set every field in this screen to its last-saved value.

10.8 The Common Phone Settings Screen

Use this screen to activate and deactivate immediate dialing. To access this screen, click **VoIP > Phone > Common**.

Figure 124 VoIP > Phone > Common



Each field is described in the following table.

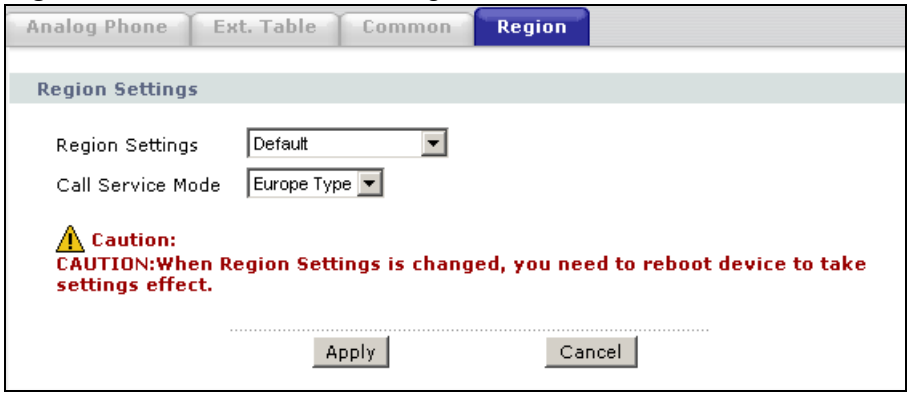
Table 56 VoIP > Phone > Common

LABEL	DESCRIPTION
Immediate Dial	
Active Immediate Dial	Select this if you want to use the pound key (#) to tell the ZyXEL Device to make the phone call immediately, instead of waiting the number of seconds you selected in the **Dialing Interval Selection** in **VoIP > Phone > Analog Phone > Advanced Setup**. If you select this, dial the phone number, and then press the pound key. The ZyXEL Device makes the call immediately, instead of waiting. You can still wait, if you want.
Apply	Click this to save your changes and to apply them to the ZyXEL Device.
Cancel	Click this to set every field in this screen to its last-saved value.

10.9 The Phone Region Screen

Use this screen to maintain settings that depend on which region of the world the ZyXEL Device is in. To access this screen, click **VoIP > Phone > Region**.

Figure 125 VoIP > Phone > Region



Each field is described in the following table.

Table 57 VoIP > Phone > Region

LABEL	DESCRIPTION
Region Settings	Select the place in which the ZyXEL Device is located.
Call Service Mode	Select the mode for supplementary phone services (call hold, call waiting, call transfer and three-way conference calls) that your VoIP service provider supports. **Europe Type** - use supplementary phone services in European mode **USA Type** - use supplementary phone services American mode You might have to subscribe to these services to use them. Contact your VoIP service provider.
Apply	Click this to save your changes and to apply them to the ZyXEL Device.
Cancel	Click this to set every field in this screen to its last-saved value.

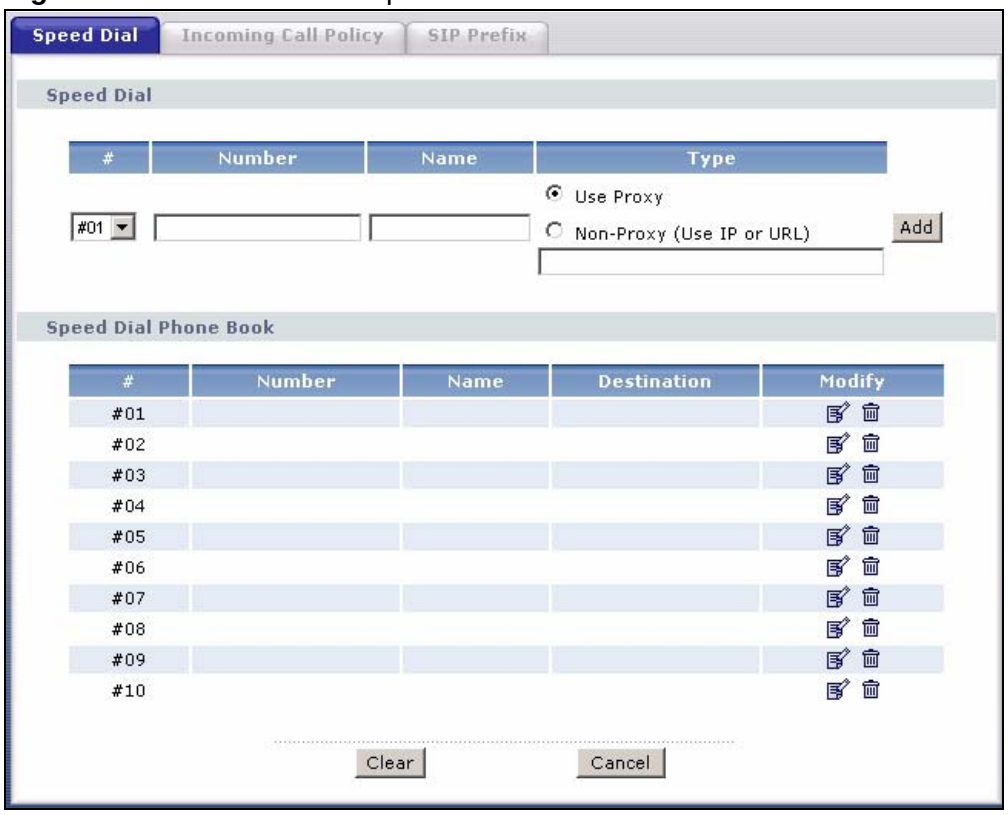
10.10 The Speed Dial Screen

Use this screen to add, edit, or remove speed-dial numbers for outgoing calls. Speed dial provides shortcuts for dialing frequently-used (VoIP) phone numbers. You also have to create speed-dial entries if you want to make peer-to-peer calls or call SIP numbers that contain letters. Once you have configured a speed dial rule, you can use a shortcut (the speed dial number, #01 for example) on your phone's keypad to call the phone number.

In peer-to-peer calls, you call another VoIP device directly without going through a VoIP service provider's SIP server. Select **Non-Proxy (Use IP or URL)** in the **Type** column and enter the callee's IP address or domain name. The ZyXEL Device

sends SIP INVITE requests to the peer VoIP device when you use the speed dial entry.

Figure 126 Phone Book > Speed Dial



Each field is described in the following table.

Table 58 Phone Book > Speed Dial

LABEL	DESCRIPTION
Speed Dial	Use this section to create or edit speed-dial entries.
#	Select the speed-dial number you want to use for this phone number.
Number	Enter the SIP number you want the ZyXEL Device to call when you dial the speed-dial number.
Name	Enter a name to identify the party you call when you dial the speed-dial number. You can use up to 127 printable ASCII characters.
Type	Select **Use Proxy** if you want to use one of your SIP accounts to call this phone number. Select **Non-Proxy (Use IP or URL)** if you want to use a different SIP server or if you want to make a peer-to-peer call. In this case, enter the IP address or domain name of the SIP server or the other party in the field below.
Add	Click this to use the information in the **Speed Dial** section to update the **Speed Dial Phone Book** section.
Speed Dial Phone Book	Use this section to look at all the speed-dial entries and to erase them.

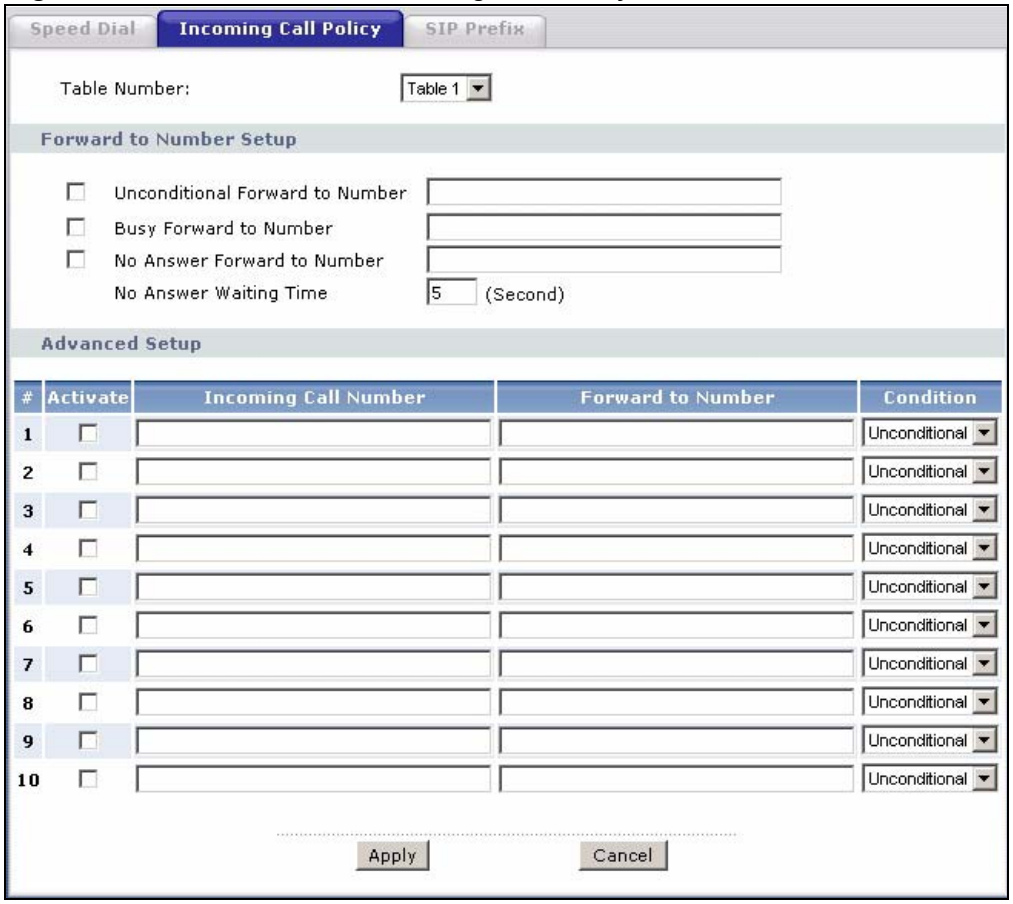
Table 58 Phone Book > Speed Dial

LABEL	DESCRIPTION
#	This field displays the speed-dial number you should dial to use this entry.
Number	This field displays the SIP number the ZyXEL Device calls when you dial the speed-dial number.
Name	This field displays the name of the party you call when you dial the speed-dial number.
Destination	This field is blank, if the speed-dial entry uses one of your SIP accounts. Otherwise, this field shows the IP address or domain name of the SIP server or other party. (This field corresponds with the **Type** field in the **Speed Dial** section.)
Modify	Use this field to edit or erase the speed-dial entry. Click the **Edit** icon to copy the information for this speed-dial entry into the **Speed Dial** section, where you can change it. Click the **Remove** icon to erase this speed-dial entry.
Clear	Click this to erase all the speed-dial entries.
Cancel	Click this to set every field in this screen to its last-saved value.

10.11 Incoming Call Policy Screen

Use this screen to maintain rules for handling incoming calls. You can block, redirect, or accept them. To access this screen, click **VoIP > Phone Book > Incoming Call Policy**.

Figure 127 Phone Book > Incoming Call Policy



You can create two sets of call-forwarding rules. Each one is stored in a call-forwarding table. Each field is described in the following table.

Table 59 Phone Book > Incoming Call Policy

LABEL	DESCRIPTION
Table Number	Select the call-forwarding table you want to see in this screen. If you change this field, the screen automatically refreshes.
Forward to Number Setup	The ZyXEL Device checks these rules, in the order in which they appear, after it checks the rules in the **Advanced Setup** section.
Unconditional Forward to Number	Select this if you want the ZyXEL Device to forward all incoming calls to the specified phone number, regardless of other rules in the **Forward to Number Setup** section. Specify the phone number in the field on the right.

Table 59 Phone Book > Incoming Call Policy

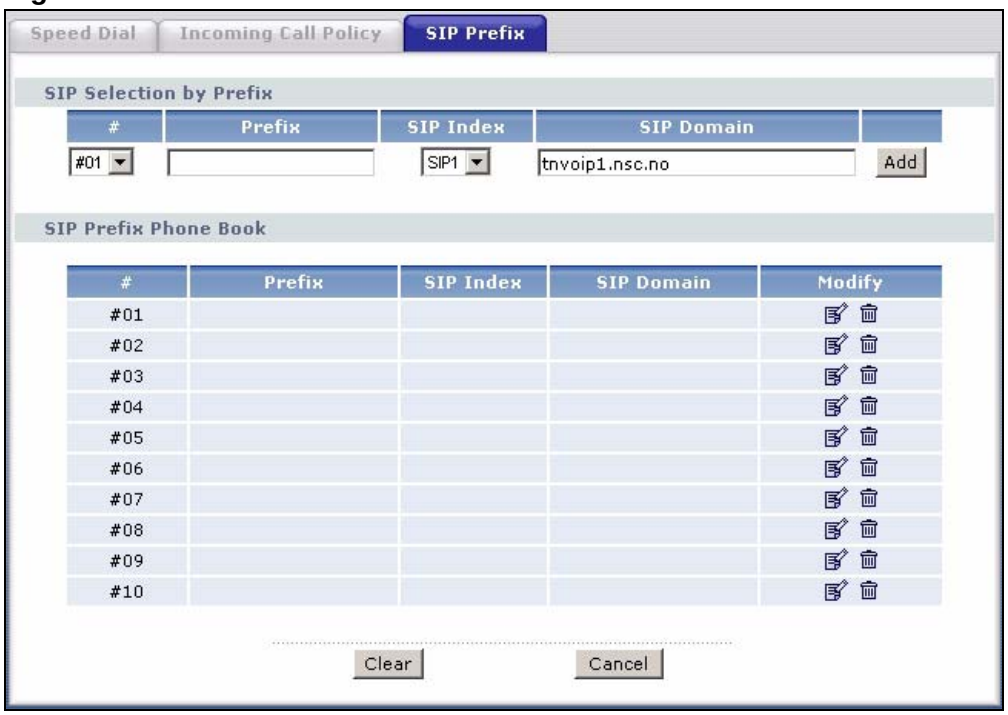
LABEL	DESCRIPTION
Busy Forward to Number	Select this if you want the ZyXEL Device to forward incoming calls to the specified phone number if the phone port is busy. Specify the phone number in the field on the right. If you have call waiting, the incoming call is forwarded to the specified phone number if you reject or ignore the second incoming call.
No Answer Forward to Number	Select this if you want the ZyXEL Device to forward incoming calls to the specified phone number if the call is unanswered. (See **No Answer Waiting Time**.) Specify the phone number in the field on the right.
No Answer Waiting Time	This field is used by the **No Answer Forward to Number** feature and **No Answer** conditions below. Enter the number of seconds the ZyXEL Device should wait for you to answer an incoming call before it considers the call is unanswered.
Advanced Setup	The ZyXEL Device checks these rules after it checks the rules in the **Forward to Number Setup** section.
#	This field is a sequential value, and it is not associated with a specific rule. The sequence is important, however. The ZyXEL Device checks each rule in order, and it only follows the first one that applies.
Activate	Select this to enable this rule. Clear this to disable this rule.
Incoming Call Number	Enter the phone number to which this rule applies.
Forward to Number	Enter the phone number to which you want to forward incoming calls from the **Incoming Call Number**. You may leave this field blank, depending on the **Condition**.
Condition	Select the situations in which you want to forward incoming calls from the **Incoming Call Number**, or select an alternative action. **Unconditional** - The ZyXEL Device immediately forwards any calls from the **Incoming Call Number** to the **Forward to Number**. **Busy -** The ZyXEL Device forwards any calls from the **Incoming Call Number** to the **Forward to Number** when your SIP account already has a call connected. **No Answer -** The ZyXEL Device forwards any calls from the **Incoming Call Number** to the **Forward to Number** when the call is unanswered. (See **No Answer Waiting Time**.) **Block -** The ZyXEL Device rejects calls from the **Incoming Call Number**. **Accept -** The ZyXEL Device allows calls from the **Incoming Call Number**. You might create a rule with this condition if you do not want incoming calls from someone to be forwarded by rules in the **Forward to Number** section.
Apply	Click this to save your changes and to apply them to the ZyXEL Device.
Cancel	Click this to set every field in this screen to its last-saved value.

10.12 SIP Prefix Screen

The SIP prefix screen allows you to set up numbers you dial on your phone to specify which SIP account you want to use for a call. If you dial only the phone number (no prefix number) the ZyXEL Device uses default SIP settings to make the call.

Click **VoIP > Phone Book > SIP Prefix**. The following screen displays.

Figure 128 Phone Book > SIP Prefix



Each field is described in the following table.

Table 60 Phone Book > SIP Prefix

LABEL	DESCRIPTION
SIP Selection by Prefix	
#	Select the index number of the rule you want to edit.
Prefix	Enter the prefix number (1 ~ 8 digits). This is the number you dial before you dial the phone number.
SIP Index	Select the SIP account you want to use to make outgoing calls when you dial the number in the **Prefix** field.
SIP Domain	This field displays the SIP service domain name you entered when configuring this SIP account.
Add	Click this to use the information in the **SIP Selection by Prefix** section to update the **SIP Prefix Phone Book** section.

Table 60 Phone Book > SIP Prefix

LABEL	DESCRIPTION
SIP Prefix Phone Book	This section displays all SIP prefix numbers currently configured on the ZyXEL Device.
#	This is a read-only index number.
Prefix	This field displays the SIP prefix number you dial (before you dial the phone number) in order to use the SIP account specified in the **SIP Index** field.
SIP Index	This field displays the SIP account used to make outgoing calls when you dial the number in the **Prefix** field.
SIP Domain	This field displays the SIP domain of the corresponding SIP account.
Modify	Use this field to edit or erase the SIP prefix entry. Click the **Edit** icon to copy the information for this SIP prefix entry into the **SIP Prefix** section, where you can change it. Click the **Remove** icon to erase this SIP prefix entry.
Clear	Click this to erase all the SIP prefix entries.
Cancel	Click this to set every field in this screen to its last-saved value.

10.13 SIP Technical Reference

This section contains background material relevant to the **VoIP** > **SIP** screens.

10.13.1 VoIP

VoIP is the sending of voice signals over Internet Protocol. This allows you to make phone calls and send faxes over the Internet at a fraction of the cost of using the traditional circuit-switched telephone network. You can also use servers to run telephone service applications like PBX services and voice mail. Internet Telephony Service Provider (ITSP) companies provide VoIP service.

Circuit-switched telephone networks require 64 kilobits per second (Kbps) in each direction to handle a telephone call. VoIP can use advanced voice coding techniques with compression to reduce the required bandwidth.

10.13.2 SIP

The Session Initiation Protocol (SIP) is an application-layer control (signaling) protocol that handles the setting up, altering and tearing down of voice and multimedia sessions over the Internet.

SIP signaling is separate from the media for which it handles sessions. The media that is exchanged during the session can use a different path from that of the

signaling. SIP handles telephone calls and can interface with traditional circuit-switched telephone networks.

SIP Identities

A SIP account uses an identity (sometimes referred to as a SIP address). A complete SIP identity is called a SIP URI (Uniform Resource Identifier). A SIP account's URI identifies the SIP account in a way similar to the way an e-mail address identifies an e-mail account. The format of a SIP identity is SIP-Number@SIP-Service-Domain.

SIP Number

The SIP number is the part of the SIP URI that comes before the “@” symbol. A SIP number can use letters like in an e-mail address (johndoe@your-ITSP.com for example) or numbers like a telephone number (1122334455@VoIP-provider.com for example).

SIP Service Domain

The SIP service domain of the VoIP service provider is the domain name in a SIP URI. For example, if the SIP address is 1122334455@VoIP-provider.com, then “VoIP-provider.com” is the SIP service domain.

SIP Registration

Each ZyXEL Device is an individual SIP User Agent (UA). To provide voice service, it has a public IP address for SIP and RTP protocols to communicate with other servers.

A SIP user agent has to register with the SIP registrar and must provide information about the users it represents, as well as its current IP address (for the routing of incoming SIP requests). After successful registration, the SIP server knows that the users (identified by their dedicated SIP URIs) are represented by the UA, and knows the IP address to which the SIP requests and responses should be sent.

Registration is initiated by the User Agent Client (UAC) running in the VoIP gateway (the ZyXEL Device). The gateway must be configured with information letting it know where to send the REGISTER message, as well as the relevant user and authorization data.

A SIP registration has a limited lifespan. The User Agent Client must renew its registration within this lifespan. If it does not do so, the registration data will be deleted from the SIP registrar's database and the connection broken.

The ZyXEL Device attempts to register all enabled subscriber ports when it is switched on. When you enable a subscriber port that was previously disabled, the ZyXEL Device attempts to register the port immediately.

Authorization Requirements

SIP registrations (and subsequent SIP requests) require a username and password for authorization. These credentials are validated via a challenge / response system using the HTTP digest mechanism (as detailed in RFC3261, "SIP: Session Initiation Protocol").

SIP Servers

SIP is a client-server protocol. A SIP client is an application program or device that sends SIP requests. A SIP server responds to the SIP requests.

When you use SIP to make a VoIP call, it originates at a client and terminates at a server. A SIP client could be a computer or a SIP phone. One device can act as both a SIP client and a SIP server.

SIP User Agent

A SIP user agent can make and receive VoIP telephone calls. This means that SIP can be used for peer-to-peer communications even though it is a client-server protocol. In the following figure, either **A** or **B** can act as a SIP user agent client to initiate a call. **A** and **B** can also both act as a SIP user agent to receive the call.

Figure 129 SIP User Agent

SIP Proxy Server

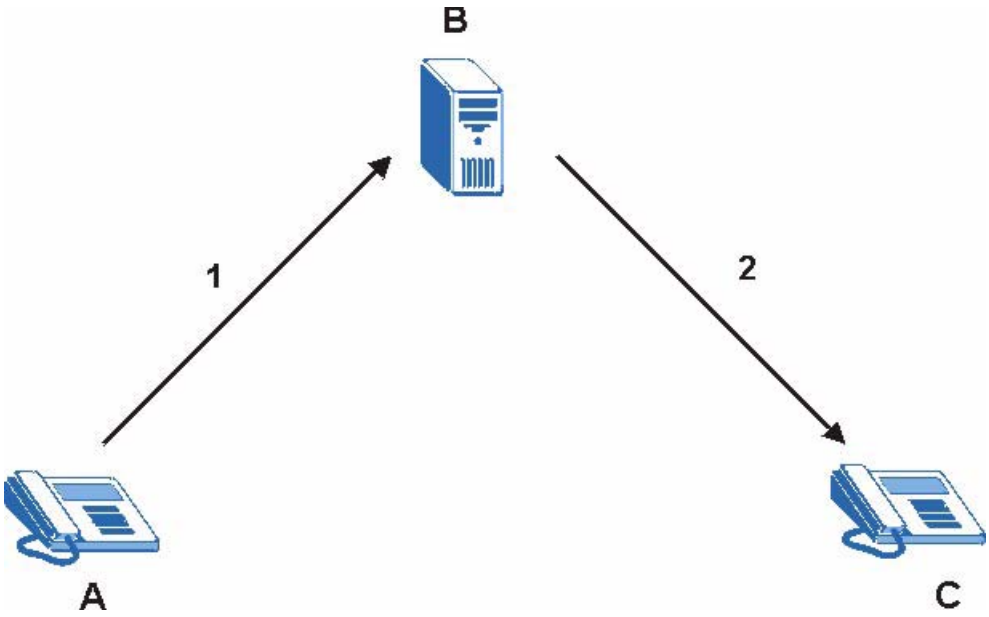
A SIP proxy server receives requests from clients and forwards them to another server.

In the following example, you want to use client device **A** to call someone who is using client device C.

1 The client device (**A** in the figure) sends a call invitation to the SIP proxy server (**B**).

2 The SIP proxy server forwards the call invitation to **C**.

Figure 130 SIP Proxy Server



SIP Redirect Server

A SIP redirect server accepts SIP requests, translates the destination address to an IP address and sends the translated IP address back to the device that sent the request. Then the client device that originally sent the request can send requests to the IP address that it received back from the redirect server. Redirect servers do not initiate SIP requests.

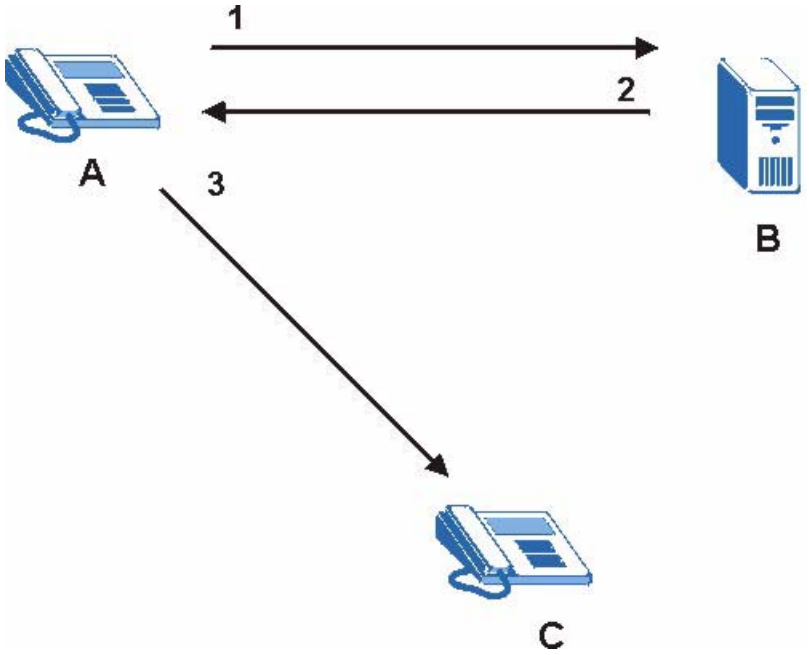
In the following example, you want to use client device **A** to call someone who is using client device **C**.

1 Client device **A** sends a call invitation for **C** to the SIP redirect server (**B**).

2 The SIP redirect server sends the invitation back to **A** with **C**'s IP address (or domain name).

3 Client device **A** then sends the call invitation to client device **C**.

Figure 131 SIP Redirect Server



SIP Register Server

A SIP register server maintains a database of SIP identity-to-IP address (or domain name) mapping. The register server checks your user name and password when you register.

RTP

When you make a VoIP call using SIP, the RTP (Real time Transport Protocol) is used to handle voice data transfer. See RFC 1889 for details on RTP.

Pulse Code Modulation

Pulse Code Modulation (PCM) measures analog signal amplitudes at regular time intervals and converts them into bits.

SIP Call Progression

The following figure displays the basic steps in the setup and tear down of a SIP call. A calls B.

Table 61 SIP Call Progression

A		B
1. INVITE	→	
	←	2. Ringing

Table 61 SIP Call Progression (continued)

A		B
	←	3. OK
4. ACK	→	
	5.Dialogue (voice traffic)	
6. BYE	→	
	←	7. OK

1 **A** sends a SIP INVITE request to **B**. This message is an invitation for **B** to participate in a SIP telephone call.

2 **B** sends a response indicating that the telephone is ringing.

3 **B** sends an OK response after the call is answered.

4 **A** then sends an ACK message to acknowledge that **B** has answered the call.

5 Now **A** and **B** exchange voice media (talk).

6 After talking, **A** hangs up and sends a BYE request.

7 **B** replies with an OK response confirming receipt of the BYE request and the call is terminated.

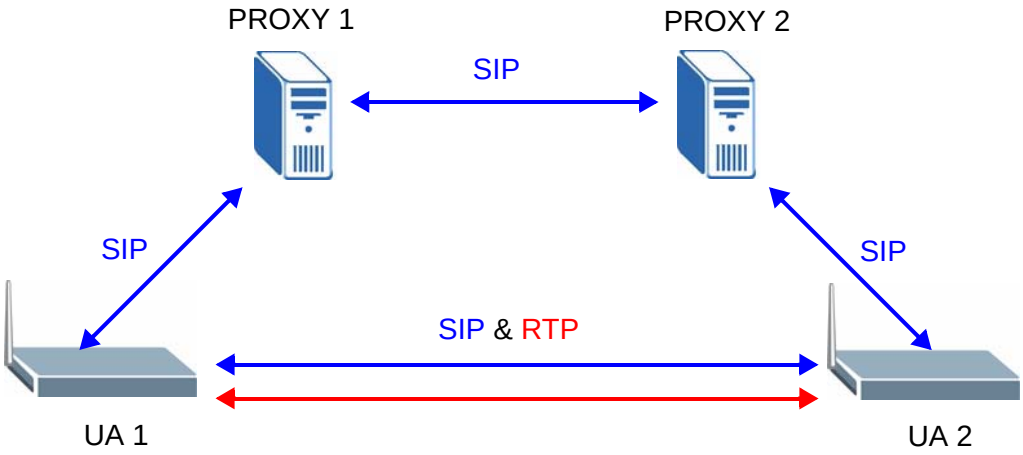
SIP Call Progression Through Proxy Servers

Usually, the SIP UAC sets up a phone call by sending a request to the SIP proxy server. Then, the proxy server looks up the destination to which the call should be forwarded (according to the URI requested by the SIP UAC). The request may be forwarded to more than one proxy server before arriving at its destination.

The response to the request goes to all the proxy servers through which the request passed, in reverse sequence. Once the session is set up, session traffic is sent between the UAs directly, bypassing all the proxy servers in between.

The following figure shows the SIP and session traffic flow between the user agents (**UA 1** and **UA 2**) and the proxy servers (this example shows two proxy servers, **PROXY 1** and **PROXY 2**).

Figure 132 SIP Call Through Proxy Servers



The following table shows the SIP call progression.

Table 62 SIP Call Progression

UA 1		PROXY 1		PROXY 2		UA 2
Invite	→					
		Invite	→			
		100 Trying	←	Invite	→	
				100 Trying	←	
						180 Ringing
				180 Ringing	←	
		180 Ringing	←			
						200 OK
				200 OK	←	
		200 OK	←			
ACK	→					
RTP	↔					RTP
						BYE
200 OK	→					

1 **User Agent 1** sends a SIP INVITE request to **Proxy 1**. This message is an invitation to **User Agent 2** to participate in a SIP telephone call. **Proxy 1** sends a response indicating that it is trying to complete the request.

2 **Proxy 1** sends a SIP INVITE request to **Proxy 2**. **Proxy 2** sends a response indicating that it is trying to complete the request.

3 **Proxy 2** sends a SIP INVITE request to **User Agent 2**.

4 **User Agent 2** sends a response back to **Proxy 2** indicating that the phone is ringing. The response is relayed back to **User Agent 1** via **Proxy 1**.

5 **User Agent 2** sends an OK response to **Proxy 2** after the call is answered. This is also relayed back to **User Agent 1** via **Proxy 1**.

6 **User Agent 1** and **User Agent 2** exchange RTP packets containing voice data directly, without involving the proxies.

7 When **User Agent 2** hangs up, he sends a BYE request.

8 **User Agent 1** replies with an OK response confirming receipt of the BYE request, and the call is terminated.

Voice Coding

A codec (coder/decoder) codes analog voice signals into digital signals and decodes the digital signals back into analog voice signals. The ZyXEL Device supports the following codecs.

- G.711 is a Pulse Code Modulation (PCM) waveform codec. PCM measures analog signal amplitudes at regular time intervals and converts them into digital samples. G.711 provides very good sound quality but requires 64 kbps of bandwidth.
- G.726 is an Adaptive Differential PCM (ADPCM) waveform codec that uses a lower bitrate than standard PCM conversion. ADPCM converts analog audio into digital signals based on the difference between each audio sample and a prediction based on previous samples. The more similar the audio sample is to the prediction, the less space needed to describe it. G.726 operates at 16, 24, 32 or 40 kbps.
- G.729 is an Analysis-by-Synthesis (AbS) hybrid waveform codec that uses a filter based on information about how the human vocal tract produces sounds. G.729 provides good sound quality and reduces the required bandwidth to 8 kbps.

PSTN Call Setup Signaling

Dual-Tone MultiFrequency (DTMF) signaling uses pairs of frequencies (one lower frequency and one higher frequency) to set up calls. It is also known as Touch Tone®. Each of the keys on a DTMF telephone corresponds to a different pair of frequencies.

Pulse dialing sends a series of clicks to the local phone office in order to dial numbers.[3]

MWI (Message Waiting Indication)

Enable Message Waiting Indication (MWI) enables your phone to give you a message–waiting (beeping) dial tone when you have a voice message(s). Your VoIP service provider must have a messaging system that sends message waiting status SIP packets as defined in RFC 3842.

Custom Tones (IVR)

IVR (Interactive Voice Response) is a feature that allows you to use your telephone to interact with the ZyXEL Device. The ZyXEL Device allows you to record custom tones for the **Caller Ringing Tone** and **On Hold Tone** functions. The same recordings apply to both the caller ringing and on hold tones.

Table 63 Custom Tones Details

LABEL	DESCRIPTION
Total Time for All Tones	128 seconds for all custom tones combined
Time per Individual Tone	20 seconds
Total Number of Tones Recordable	8 You can record up to 8 different custom tones but the total time must be 128 seconds or less.

Recording Custom Tones

Use the following steps if you would like to create new tones or change your tones:

1. Pick up the phone and press "*****" on your phone's keypad and wait for the message that says you are in the configuration menu.
2. Press a number from 1101~1108 on your phone followed by the "#" key.
3. Play your desired music or voice recording into the receiver's mouthpiece. Press the "#" key.
4. You can continue to add, listen to, or delete tones, or you can hang up the receiver when you are done.

Listening to Custom Tones

Do the following to listen to a custom tone:

3. The ZyXEL Device does not support pulse dialing at the time of writing.

1 Pick up the phone and press "****" on your phone's keypad and wait for the message that says you are in the configuration menu.

2 Press a number from 1201~1208 followed by the "#" key to listen to the tone.

3 You can continue to add, listen to, or delete tones, or you can hang up the receiver when you are done.

Deleting Custom Tones

Do the following to delete a custom tone:

1 Pick up the phone and press "****" on your phone's keypad and wait for the message that says you are in the configuration menu.

2 Press a number from 1301~1308 followed by the "#" key to delete the tone of your choice. Press 14 followed by the "#" key if you wish to clear all your custom tones.

You can continue to add, listen to, or delete tones, or you can hang up the receiver when you are done.

10.13.3 Quality of Service (QoS)

Quality of Service (QoS) refers to both a network's ability to deliver data with minimum delay, and the networking methods used to provide bandwidth for real-time multimedia applications.

Type of Service (ToS)

Network traffic can be classified by setting the ToS (Type of Service) values at the data source (for example, at the ZyXEL Device) so a server can decide the best method of delivery, that is the least cost, fastest route and so on.

DiffServ

DiffServ 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 (DSCP) 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.[4]

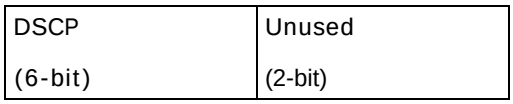
4. The ZyXEL Device does not support DiffServ at the time of writing.

DSCP and Per-Hop Behavior

DiffServ defines a new DS (Differentiated Services) 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.

Figure 133 DiffServ: Differentiated Service Field



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 priorities of forwarding. Resources can then be allocated according to the DSCP values and the configured policies.

VLAN Tagging

Virtual Local Area Network (VLAN) allows a physical network to be partitioned into multiple logical networks. Only stations within the same group can communicate with each other.

Your ZyXEL Device can add IEEE 802.1Q VLAN ID tags to voice frames that it sends to the network. This allows the ZyXEL Device to communicate with a SIP server that is a member of the same VLAN group. Some ISPs use the VLAN tag to identify voice traffic and give it priority over other traffic.

10.13.4 Phone Services Overview

Supplementary services such as call hold, call waiting, and call transfer. are generally available from your VoIP service provider. The ZyXEL Device supports the following services:

- Call Hold
- Call Waiting
- Making a Second Call
- Call Transfer
- Call Forwarding (see Section 10.11 on page 199)

- Three-Way Conference
- Internal Calls
- Call Park and Pickup
- Do not Disturb

Note: To take full advantage of the supplementary phone services available through the ZyXEL Device's phone ports, you may need to subscribe to the services from your VoIP service provider.

The Flash Key

Flashing means to press the hook for a short period of time (a few hundred milliseconds) before releasing it. On newer telephones, there should be a "flash" key (button) that generates the signal electronically. If the flash key is not available, you can tap (press and immediately release) the hook by hand to achieve the same effect. However, using the flash key is preferred since the timing is much more precise. With manual tapping, if the duration is too long, it may be interpreted as hanging up by the ZyXEL Device.

You can invoke all the supplementary services by using the flash key.

Europe Type Supplementary Phone Services

This section describes how to use supplementary phone services with the **Europe Type Call Service Mode**. Commands for supplementary services are listed in the table below.

After pressing the flash key, if you do not issue the sub-command before the default sub-command timeout (2 seconds) expires or issue an invalid sub-command, the current operation will be aborted.

Table 64 European Flash Key Commands

COMMAND	SUB-COMMAND	DESCRIPTION
Flash		Put a current call on hold to place a second call. Switch back to the call (if there is no second call).
Flash	0	Drop the call presently on hold or reject an incoming call which is waiting for answer.
Flash	1	Disconnect the current phone connection and answer the incoming call or resume with caller presently on hold.
Flash	2	1. Switch back and forth between two calls. 2. Put a current call on hold to answer an incoming call. 3. Separate the current three-way conference call into two individual calls (one is on-line, the other is on hold).

Table 64 European Flash Key Commands

COMMAND	SUB-COMMAND	DESCRIPTION
Flash	3	Create three-way conference connection.
Flash	*98#	Transfer the call to another phone.

European Call Hold

Call hold allows you to put a call (**A**) on hold by pressing the flash key.

If you have another call, press the flash key and then “2” to switch back and forth between caller **A** and **B** by putting either one on hold.

Press the flash key and then “0” to disconnect the call presently on hold and keep the current call on line.

Press the flash key and then “1” to disconnect the current call and resume the call on hold.

If you hang up the phone but a caller is still on hold, there will be a remind ring.

European Call Waiting

This allows you to place a call on hold while you answer another incoming call on the same telephone (directory) number.

If there is a second call to a telephone number, you will hear a call waiting tone. Take one of the following actions.

- Reject the second call.

  Press the flash key and then press “0”.
- Disconnect the first call and answer the second call.

  Either press the flash key and press “1”, or just hang up the phone and then answer the phone after it rings.
- Put the first call on hold and answer the second call.

  Press the flash key and then “2”.

European Call Transfer

Do the following to transfer an incoming call (that you have answered) to another phone.

1. Press the flash key to put the caller on hold.
2. When you hear the dial tone, dial “*98#” followed by the number to which you want to transfer the call. to operate the Intercom.

3 After you hear the ring signal or the second party answers it, hang up the phone.

European Three-Way Conference

Use the following steps to make three-way conference calls.

1 When you are on the phone talking to someone, press the flash key to put the caller on hold and get a dial tone.

2 Dial a phone number directly to make another call.

3 When the second call is answered, press the flash key and press “3” to create a three-way conversation.

4 Hang up the phone to drop the connection.

5 If you want to separate the activated three-way conference into two individual connections (one is on-line, the other is on hold), press the flash key and press “2”.

USA Type Supplementary Services

This section describes how to use supplementary phone services with the **USA Type Call Service Mode**. Commands for supplementary services are listed in the table below.

After pressing the flash key, if you do not issue the sub-command before the default sub-command timeout (2 seconds) expires or issue an invalid sub-command, the current operation will be aborted.

Table 65 USA Flash Key Commands

COMMAND	SUB-COMMAND	DESCRIPTION
Flash		Put a current call on hold to place a second call. After the second call is successful, press the flash key again to have a three-way conference call. Put a current call on hold to answer an incoming call.
Flash	*98#	Transfer the call to another phone.

USA Call Hold

Call hold allows you to put a call (**A**) on hold by pressing the flash key.

If you have another call, press the flash key to switch back and forth between caller **A** and **B** by putting either one on hold.

If you hang up the phone but a caller is still on hold, there will be a remind ring.

USA Call Waiting

This allows you to place a call on hold while you answer another incoming call on the same telephone (directory) number.

If there is a second call to your telephone number, you will hear a call waiting tone.

Press the flash key to put the first call on hold and answer the second call.

USA Call Transfer

Do the following to transfer an incoming call (that you have answered) to another phone.

1. Press the flash key to put the caller on hold.
2. When you hear the dial tone, dial "*98#" followed by the number to which you want to transfer the call. to operate the Intercom.
3. After you hear the ring signal or the second party answers it, hang up the phone.

USA Three-Way Conference

Use the following steps to make three-way conference calls.

1. When you are on the phone talking to someone (party A), press the flash key to put the caller on hold and get a dial tone.
2. Dial a phone number directly to make another call (to party B).
3. When party B answers the second call, press the flash key to create a three-way conversation.
4. Hang up the phone to drop the connection.
5. If you want to separate the activated three-way conference into two individual connections (with party A on-line and party B on hold), press the flash key.
6. If you want to go back to the three-way conversation, press the flash key again.
7. If you want to separate the activated three-way conference into two individual connections again, press the flash key. This time the party B is on-line and party A is on hold.

11

Phone Usage

11.1 Overview

This chapter describes how to use a phone connected to your ZyXEL Device for basic tasks.

Note: Not all service providers support all features.

11.2 Dialing a Telephone Number

The **PHONE** LED turns green when your SIP account is registered. Dial a SIP number like “12345” on your phone’s keypad.

Use speed dial entries (see Section 10.10 on page 196) for peer-to-peer calls or SIP numbers that use letters. Dial the speed dial entry on your telephone’s keypad.

Use your VoIP service provider’s dialing plan to call regular telephone numbers.

11.3 Using Speed Dial to Dial a Telephone Number

After configuring the speed dial entry and adding it to the phonebook, press the speed dial entry’s key combination on your phone’s keypad.

11.4 Using Call Park and Pickup

Do the following to put a call on hold on one phone and continue it on another (connected to the ZyXEL Device). This feature may not be supported by all service providers.

1 During the call, press “*97#” and then any number (up to 8 digits long). You need to remember this number in order to pick up the call on another phone. Hang up the receiver.

2 Pick up another phone’s receiver. Press “#97#” followed by the same number you entered before to continue the call.

11.5 Checking the ZyXEL Device’s IP Address

Do the following to listen to the ZyXEL Device’s current IP address.

1 Pick up your phone’s receiver.

2 Press “*****” on your phone’s keypad and wait for the message that says you are in the configuration menu.

3 Press “5” followed by the # key.

4 Listen to the IP address and make a note of it.

5 Hang up the receiver.

11.6 Auto Provisioning and Auto Firmware Upgrade

If your service provider uses an auto-provisioning server to set up your device, you must first enter the HTTP pincode (supplied by your service provider). This authenticates your ZyXEL Device with the auto provisioning server, allowing you to use the service.

- On a phone connected to the device, enter “*99**”, your SIP number, “*”, the HTTP pincode you were given, then “#”.
- For example, if your SIP number is 0123456 and the HTTP pincode you were given is 9876, you would enter “*99**0123456*9876#”.

During auto-provisioning, the ZyXEL Device checks to see if there is a newer firmware version (if your service provider activates this feature). If newer firmware is available, the ZyXEL Device plays a recording when you pick up your phone’s handset.

- Press “*99#” to upgrade the ZyXEL Device’s firmware.
- Press “#99#” to not upgrade the ZyXEL Device’s firmware.

11.7 Phone Services Overview

Supplementary services such as call hold, call waiting, and call transfer. are generally available from your VoIP service provider. The ZyXEL Device supports the following services:

- Call Hold
- Call Waiting
- Making a Second Call
- Call Transfer
- Call Forwarding (see Section 10.11 on page 199)
- Three-Way Conference
- Internal Calls
- Call Park and Pickup
- Do not Disturb

Note: To take full advantage of the supplementary phone services available through the ZyXEL Device's phone port, you may need to subscribe to the services from your VoIP service provider.

11.7.1 The Flash Key

Flashing means to press the hook for a short period of time (a few hundred milliseconds) before releasing it. On newer telephones, there should be a "flash" key (button) that generates the signal electronically. If the flash key is not available, you can tap (press and immediately release) the hook by hand to achieve the same effect. However, using the flash key is preferred since the timing is much more precise. With manual tapping, if the duration is too long, it may be interpreted as hanging up by the ZyXEL Device.

You can invoke all the supplementary services by using the flash key.

11.7.2 Europe Type Supplementary Phone Services

This section describes how to use supplementary phone services with the **Europe Type Call Service Mode**. Commands for supplementary services are listed in the table below.

After pressing the flash key, if you do not issue the sub-command before the default sub-command timeout (2 seconds) expires or issue an invalid sub-command, the current operation will be aborted.

Table 66 European Flash Key Commands

COMMAND	SUB-COMMAND	DESCRIPTION
Flash		Put a current call on hold to place a second call. Switch back to the call (if there is no second call).
Flash	0	Drop the call presently on hold or reject an incoming call which is waiting for answer.
Flash	1	Disconnect the current phone connection and answer the incoming call or resume with caller presently on hold.
Flash	2	1. Switch back and forth between two calls. 2. Put a current call on hold to answer an incoming call. 3. Separate the current three-way conference call into two individual calls (one is on-line, the other is on hold).
Flash	3	Create three-way conference connection.
Flash	*98#	Transfer the call to another phone.

11.7.2.1 European Call Hold

Call hold allows you to put a call (**A**) on hold by pressing the flash key.

If you have another call, press the flash key and then “2” to switch back and forth between caller **A** and **B** by putting either one on hold.

Press the flash key and then “0” to disconnect the call presently on hold and keep the current call on line.

Press the flash key and then “1” to disconnect the current call and resume the call on hold.

If you hang up the phone but a caller is still on hold, there will be a remind ring.

11.7.2.2 European Call Waiting

This allows you to place a call on hold while you answer another incoming call on the same telephone (directory) number.

If there is a second call to a telephone number, you will hear a call waiting tone. Take one of the following actions.

- Reject the second call.

  Press the flash key and then press “0”.

- Disconnect the first call and answer the second call.

  Either press the flash key and press “1”, or just hang up the phone and then answer the phone after it rings.

- Put the first call on hold and answer the second call.

  Press the flash key and then “2”.

11.7.2.3 European Call Transfer

Do the following to transfer an incoming call (that you have answered) to another phone.

1. Press the flash key to put the caller on hold.
2. When you hear the dial tone, dial “*98#” followed by the number to which you want to transfer the call. to operate the Intercom.
3. After you hear the ring signal or the second party answers it, hang up the phone.

11.7.2.4 European Three-Way Conference

Use the following steps to make three-way conference calls.

1. When you are on the phone talking to someone, press the flash key to put the caller on hold and get a dial tone.
2. Dial a phone number directly to make another call.
3. When the second call is answered, press the flash key and press “3” to create a three-way conversation.
4. Hang up the phone to drop the connection.
5. If you want to separate the activated three-way conference into two individual connections (one is on-line, the other is on hold), press the flash key and press “2”.

11.7.3 USA Type Supplementary Services

This section describes how to use supplementary phone services with the **USA Type Call Service Mode**. Commands for supplementary services are listed in the table below.

After pressing the flash key, if you do not issue the sub-command before the default sub-command timeout (2 seconds) expires or issue an invalid sub-command, the current operation will be aborted.

Table 67 USA Flash Key Commands

COMMAND	SUB-COMMAND	DESCRIPTION
Flash		Put a current call on hold to place a second call. After the second call is successful, press the flash key again to have a three-way conference call. Put a current call on hold to answer an incoming call.
Flash	*98#	Transfer the call to another phone.

11.7.3.1 USA Call Hold

Call hold allows you to put a call (**A**) on hold by pressing the flash key.

If you have another call, press the flash key to switch back and forth between caller **A** and **B** by putting either one on hold.

If you hang up the phone but a caller is still on hold, there will be a remind ring.

11.7.3.2 USA Call Waiting

This allows you to place a call on hold while you answer another incoming call on the same telephone (directory) number.

If there is a second call to your telephone number, you will hear a call waiting tone.

Press the flash key to put the first call on hold and answer the second call.

11.7.3.3 USA Call Transfer

Do the following to transfer an incoming call (that you have answered) to another phone.

1. Press the flash key to put the caller on hold.
2. When you hear the dial tone, dial "*98#" followed by the number to which you want to transfer the call. to operate the Intercom.
3. After you hear the ring signal or the second party answers it, hang up the phone.

11.7.3.4 USA Three-Way Conference

Use the following steps to make three-way conference calls.

1 When you are on the phone talking to someone (party A), press the flash key to put the caller on hold and get a dial tone.

2 Dial a phone number directly to make another call (to party B).

3 When party B answers the second call, press the flash key to create a three-way conversation.

4 Hang up the phone to drop the connection.

5 If you want to separate the activated three-way conference into two individual connections (with party A on-line and party B on hold), press the flash key.

6 If you want to go back to the three-way conversation, press the flash key again.

7 If you want to separate the activated three-way conference into two individual connections again, press the flash key. This time the party B is on-line and party A is on hold.

11.8 Phone Functions Summary

The following table shows the key combinations you can enter on your phone's keypad to use certain features.

Table 68 Phone Functions Summary

ACTION	FUNCTION	DESCRIPTION
*99**	HTTP pincode	Use this if your service provider gave you a personal identification number to enter in order to start using the service. See Section 11.6 on page 218.
*99#	Enable firmware update	Use these to upload or not upload new firmware to the ZyXEL Device, if requested by your service provider. See Section 11.6 on page 218.
#99#	Disable firmware update	
*98#	Call transfer	Transfer a call to another phone. See Section 11.7.2 on page 219 (Europe type) and Section 11.7.3 on page 221 (USA type).
*97#	Call park	Use these to place a call on hold on one phone and then continue it on another (if supported by your service provider). See Chapter 30 on page 471.
#97#	Call pickup	
*66#	Call return	Place a call to the last person who called you. See Chapter 30 on page 471.
*95#	Enable Do Not Disturb	Use these to set your phone not to ring when someone calls you, or to turn this function off. Chapter 30 on page 471
#95#	Disable Do Not Disturb	
*41#	Enable call waiting	Use these to allow you to put a call on hold while answering another, or to turn this function off. See Section 11.7.2 on page 219 (Europe type) and Section 11.7.3 on page 221 (USA type).
#41#	Disable call waiting	

Table 68 Phone Functions Summary

ACTION	FUNCTION	DESCRIPTION
*21#	Enable call forward	Use these to allow you to use the call forwarding tables you set in the ZyXEL Device, or to turn this function off. See Section 10.11 on page 199.
#21#	Disable call forward	
22	Uncondition forward	Forward all incoming calls. See Section 10.11 on page 199.
23	No answer forward	Forward incoming calls if you do not answer. See Section 10.11 on page 199.
24	Busy forward	Forward calls if you are already making a call. See Section 10.11 on page 199.
*70	One shot Call Waiting Disable	Activate or deactivate call waiting on the next call only. See Section 11.7.2 on page 219 (Europe type) and Section 11.7.3 on page 221 (USA type)
*85	One shot Call Waiting Enable	

12 Firewall

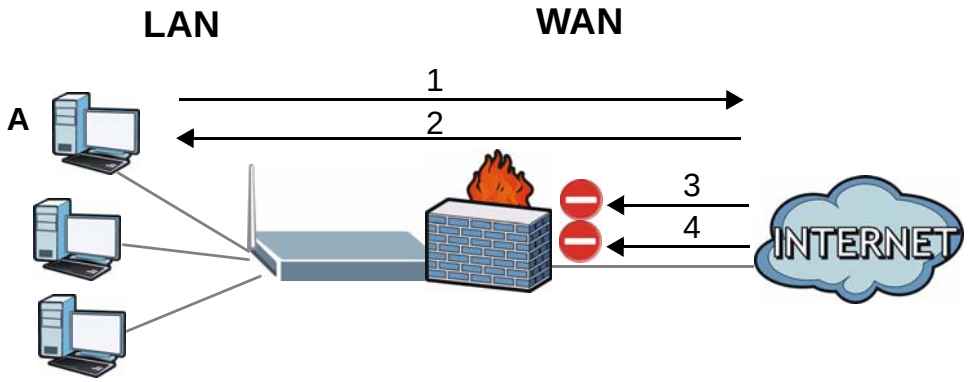
12.1 Overview

Use the ZyXEL Device firewall screens to enable and configure the firewall that protects your ZyXEL Device and network from attacks by hackers on the Internet and control access to it. By default the firewall:

- allows traffic that originates from your LAN computers to go to all other networks.
- blocks traffic that originates on other networks from going to the LAN.

The following figure illustrates the default firewall action. User **A** can initiate an IM (Instant Messaging) session from the LAN to the WAN (1). Return traffic for this session is also allowed (2). However other traffic initiated from the WAN is blocked (3 and 4).

Figure 134 Default Firewall Action



12.1.1 What You Can Do in the Firewall Screens

- Use the **General** screen (Section 12.2 on page 230) to enable firewall and/or triangle route on the ZyXEL Device, and set the default action that the firewall takes on packets that do not match any of the firewall rules.
- Use the **Rules** screen (Section 12.3 on page 232) to view the configured firewall rules and add, edit or remove a firewall rule.

- Use the **Threshold** screen (Section 12.4 on page 237) to set the thresholds that the ZyXEL Device uses to determine when to start dropping sessions that do not become fully established (half-open sessions).

12.1.2 What You Need to Know About Firewall

DoS

Denials of Service (DoS) attacks are aimed at devices and networks with a connection to the Internet. Their goal is not to steal information, but to disable a device or network so users no longer have access to network resources. The ZyXEL Device is pre-configured to automatically detect and thwart all known DoS attacks.

Anti-Probing

If an outside user attempts to probe an unsupported port on your ZyXEL Device, an ICMP response packet is automatically returned. This allows the outside user to know the ZyXEL Device exists. The ZyXEL Device supports anti-probing, which prevents the ICMP response packet from being sent. This keeps outsiders from discovering your ZyXEL Device when unsupported ports are probed.

ICMP

Internet Control Message Protocol (ICMP) is a message control and error-reporting protocol between a host server and a gateway to the Internet. ICMP uses Internet Protocol (IP) datagrams, but the messages are processed by the TCP/IP software and directly apparent to the application user.

DoS Thresholds

For DoS attacks, the ZyXEL Device uses thresholds to determine when to drop sessions that do not become fully established. These thresholds apply globally to all sessions. You can use the default threshold values, or you can change them to values more suitable to your security requirements.

Finding Out More

- See Section 12.1.3 on page 226 for an example of setting up a firewall.
- See Section 12.5 on page 241 for advanced technical information on firewall.

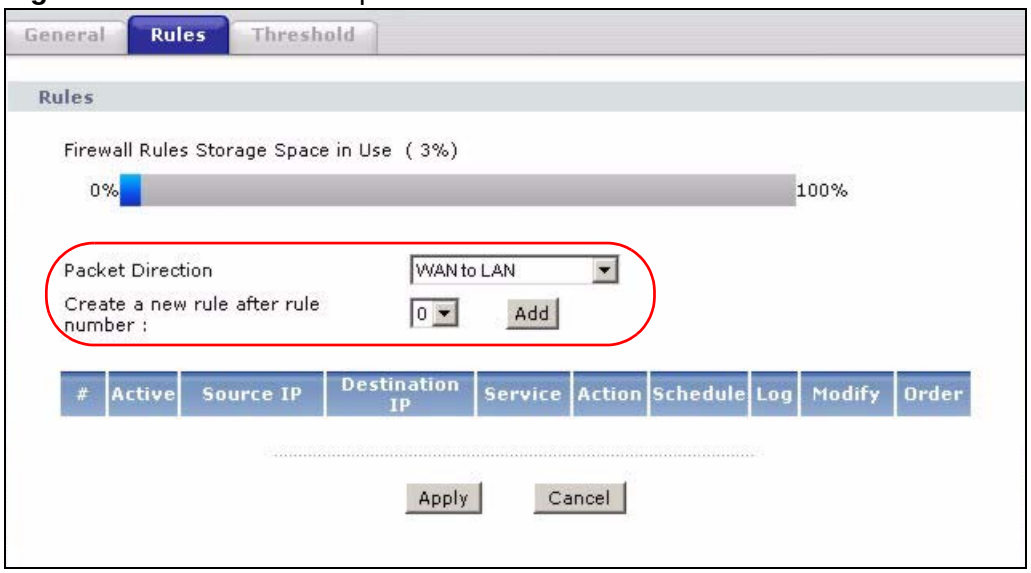
12.1.3 Firewall Rule Setup Example

The following Internet firewall rule example allows a hypothetical “MyService” connection from the Internet.

1 Click **Security > Firewall** > **Rules**.

2 Select **WAN to LAN** in the **Packet Direction** field.

Figure 135 Firewall Example: Rules



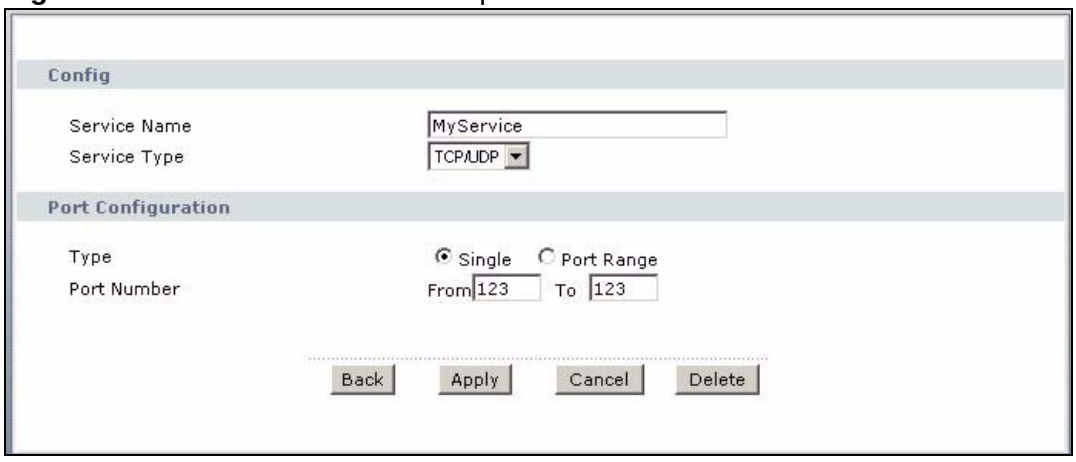
3 In the **Rules** screen, select the index number after that you want to add the rule. For example, if you select “6”, your new rule becomes number 7 and the previous rule 7 (if there is one) becomes rule 8.

4 Click **Add** to display the firewall rule configuration screen.

5 In the **Edit Rule** screen, click the **Edit Customized Services** link to open the **Customized Service** screen.

6 Click an index number to display the **Customized Services Config** screen and configure the screen as follows and click **Apply**.

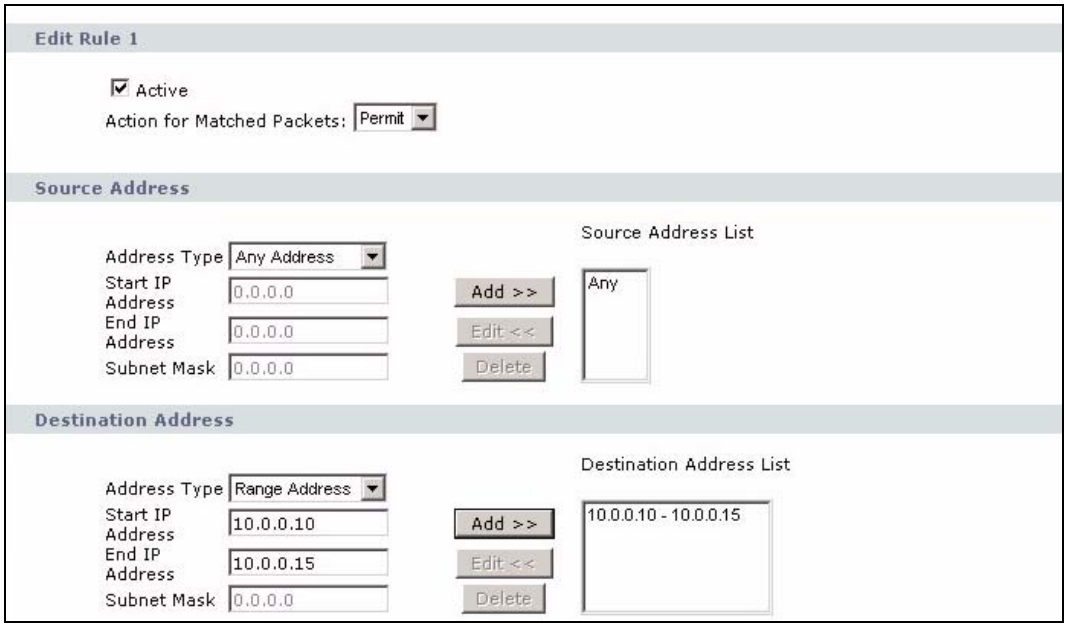
Figure 136 Edit Custom Port Example



7 Select **Any** in the **Destination Address List** box and then click **Delete**.

8 Configure the destination address screen as follows and click **Add**.

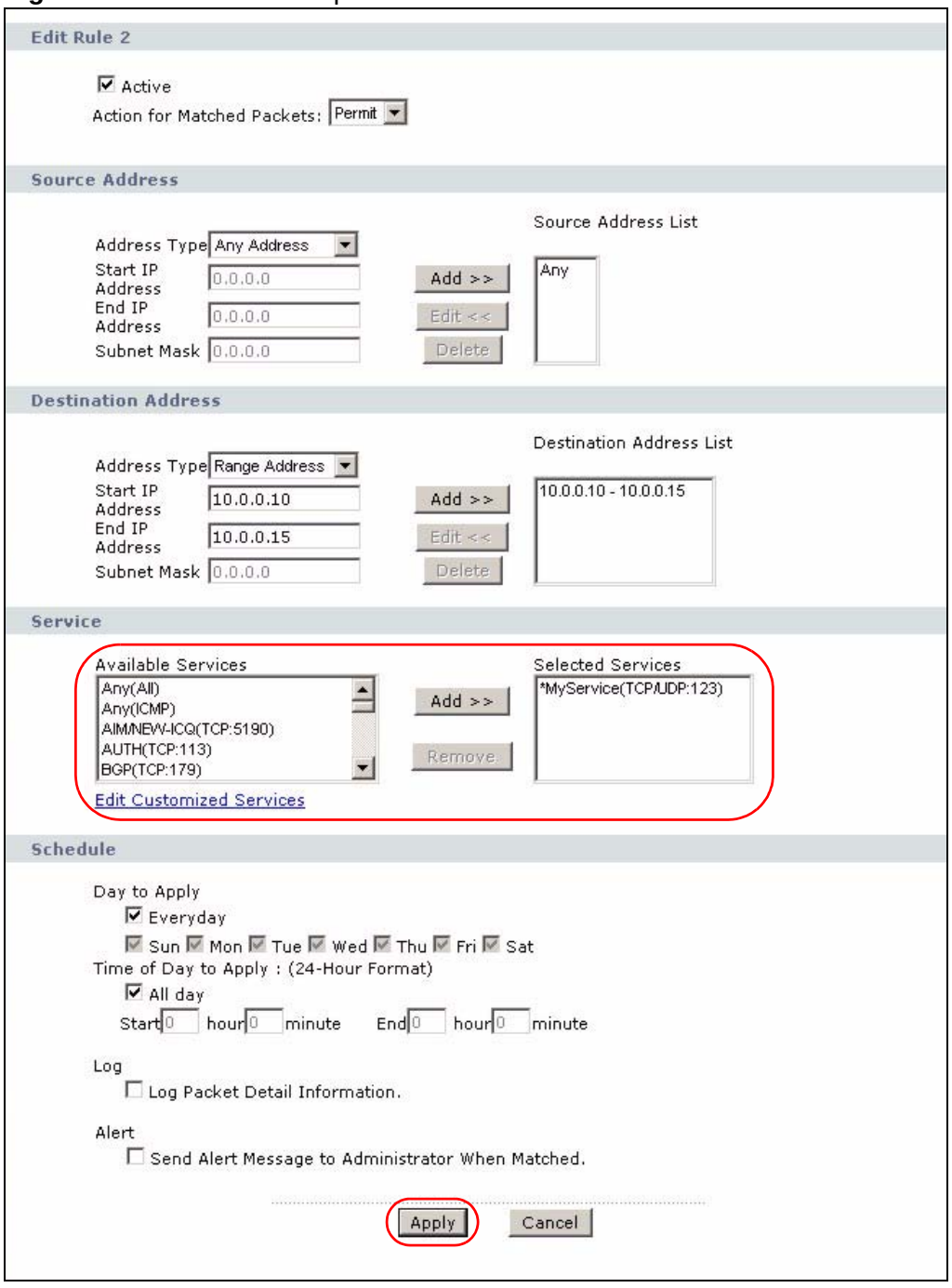
Figure 137 Firewall Example: Edit Rule: Destination Address



9 Use the **Add >>** and **Remove** buttons between **Available Services** and **Selected Services** list boxes to configure it as follows. Click **Apply** when you are done.

Note: Custom services show up with an "*" before their names in the **Services** list box and the **Rules** list box.

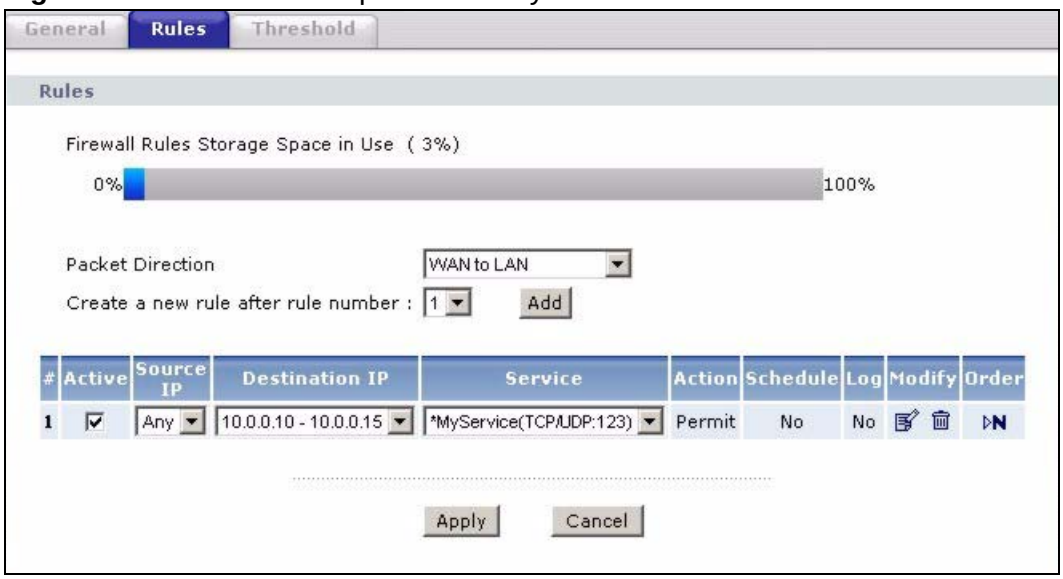
Figure 138 Firewall Example: Edit Rule: Select Customized Services



On completing the configuration procedure for this Internet firewall rule, the **Rules** screen should look like the following.

Rule 1 allows a “MyService” connection from the WAN to IP addresses 10.0.0.10 through 10.0.0.15 on the LAN.

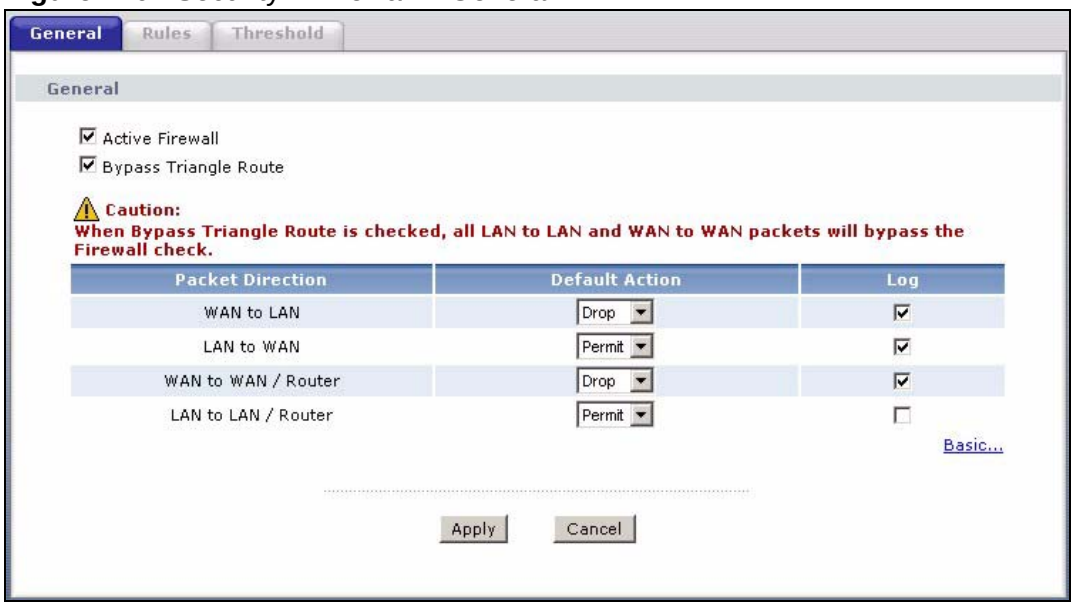
Figure 139 Firewall Example: Rules: MyService



12.2 The Firewall General Screen

Use this screen to configure the firewall settings. Click **Security > Firewall** to display the following screen.

Figure 140 Security > Firewall > General



The following table describes the labels in this screen.

Table 69 Security > Firewall > General

LABEL	DESCRIPTION
Active Firewall	Select this check box to activate the firewall. The ZyXEL Device performs access control and protects against Denial of Service (DoS) attacks when the firewall is activated.
Bypass Triangle Route	If an alternate gateway on the LAN has an IP address in the same subnet as the ZyXEL Device's LAN IP address, return traffic may not go through the ZyXEL Device. This is called an asymmetrical or "triangle" route. This causes the ZyXEL Device to reset the connection, as the connection has not been acknowledged. Select this check box to have the ZyXEL Device permit the use of asymmetrical route topology on the network (not reset the connection). Note: Allowing asymmetrical routes may let traffic from the WAN go directly to the LAN without passing through the ZyXEL Device. A better solution is to use IP alias to put the ZyXEL Device and the backup gateway on separate subnets. See Section 12.5.4.1 on page 243 for an example.
Packet Direction	This is the direction of travel of packets (**LAN to LAN / Router**, **LAN to WAN**, **WAN to WAN / Router**, **WAN to LAN)**. Firewall rules are grouped based on the direction of travel of packets to which they apply. For example, **LAN to LAN / Router** means packets traveling from a computer/subnet on the LAN to either another computer/subnet on the LAN interface of the ZyXEL Device or the ZyXEL Device itself.
Default Action	Use the drop-down list boxes to select the default action that the firewall is to take on packets that are traveling in the selected direction and do not match any of the firewall rules. Select **Drop** to silently discard the packets without sending a TCP reset packet or an ICMP destination-unreachable message to the sender. Select **Reject** to deny the packets and send a TCP reset packet (for a TCP packet) or an ICMP destination-unreachable message (for a UDP packet) to the sender. Select **Permit** to allow the passage of the packets.
Log	Select the check box to create a log (when the above action is taken) for packets that are traveling in the selected direction and do not match any of your customized rules.
Expand...	Click this to display more information.
Basic...	Click this to display less information.
Apply	Click this to save your changes.
Cancel	Click this to restore your previously saved settings.

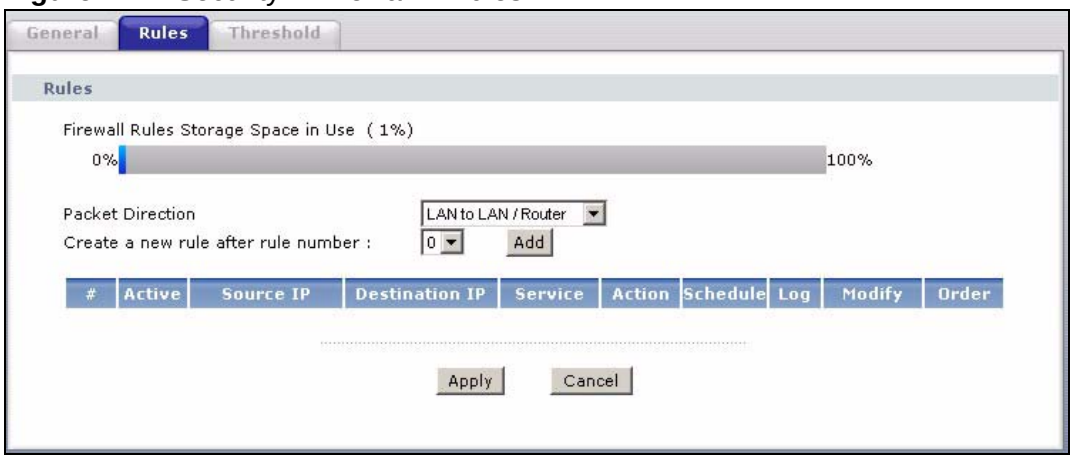
12.3 The Firewall Rule Screen

Note: The ordering of your rules is very important as rules are applied in turn.

Refer to Section 12.5 on page 241 for more information.

Click **Security > Firewall > Rules** to bring up the following screen. This screen displays a list of the configured firewall rules. Note the order in which the rules are listed.

Figure 141 Security > Firewall > Rules



The following table describes the labels in this screen.

Table 70 Security > Firewall > Rules

LABEL	DESCRIPTION
Firewall Rules Storage Space in Use	This read-only bar shows how much of the ZyXEL Device's memory for recording firewall rules it is currently using. When you are using 80% or less of the storage space, the bar is green. When the amount of space used is over 80%, the bar is red.
Packet Direction	Use the drop-down list box to select a direction of travel of packets for which you want to configure firewall rules.
Create a new rule after rule number	Select an index number and click **Add** to add a new firewall rule after the selected index number. For example, if you select “6”, your new rule becomes number 7 and the previous rule 7 (if there is one) becomes rule 8.
	The following read-only fields summarize the rules you have created that apply to traffic traveling in the selected packet direction. The firewall rules that you configure (summarized below) take priority over the general firewall action settings in the **General** screen.
#	This is your firewall rule number. The ordering of your rules is important as rules are applied in turn.
Active	This field displays whether a firewall is turned on or not. Select the check box to enable the rule. Clear the check box to disable the rule.

Table 70 Security > Firewall > Rules (continued)

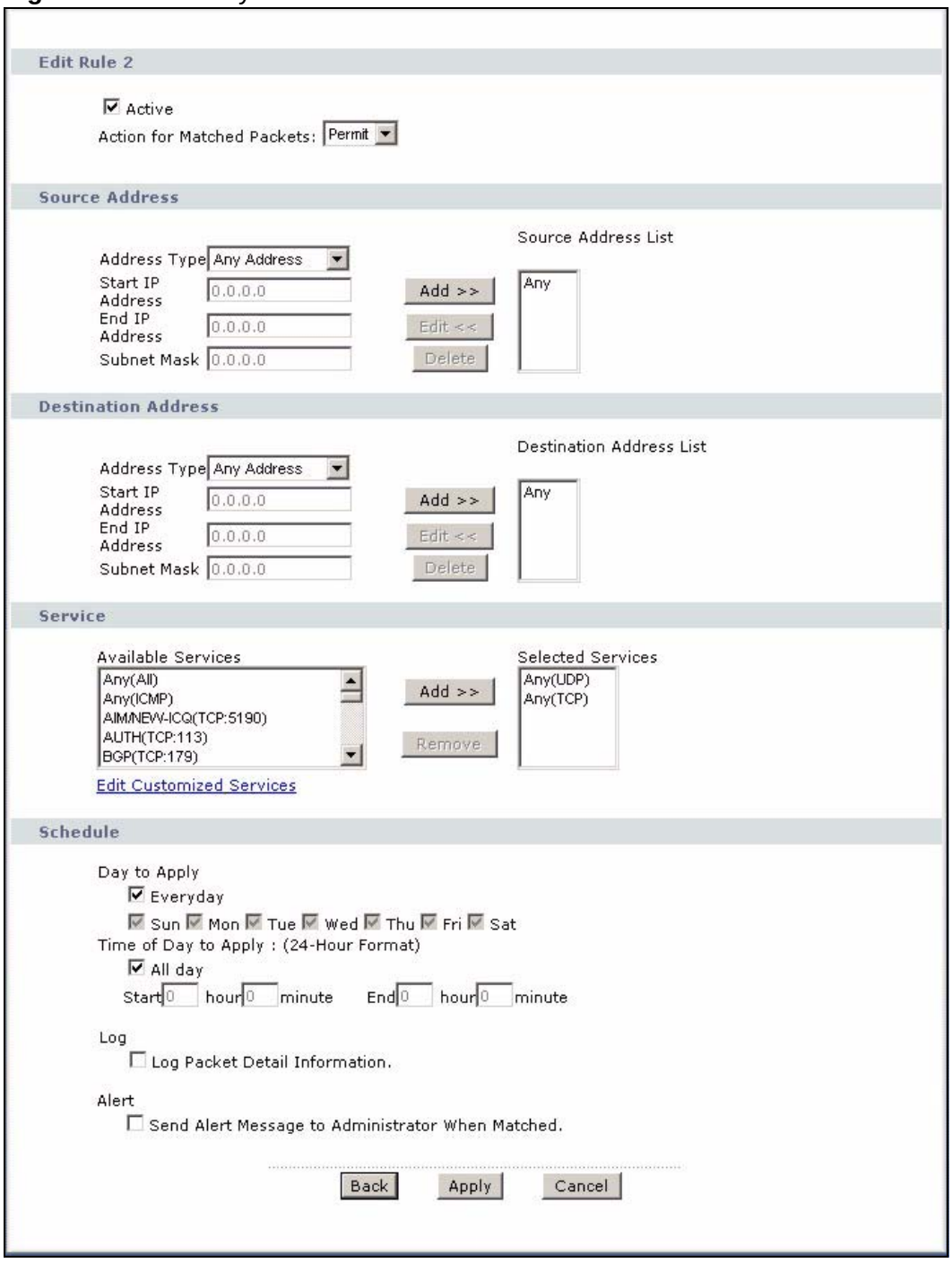
LABEL	DESCRIPTION
Source IP	This drop-down list box displays the source addresses or ranges of addresses to which this firewall rule applies. Please note that a blank source or destination address is equivalent to **Any**.
Destination IP	This drop-down list box displays the destination addresses or ranges of addresses to which this firewall rule applies. Please note that a blank source or destination address is equivalent to **Any**.
Service	This drop-down list box displays the services to which this firewall rule applies. See Appendix E on page 557 for more information.
Action	This field displays whether the firewall silently discards packets (**Drop**), discards packets and sends a TCP reset packet or an ICMP destination-unreachable message to the sender (**Reject**) or allows the passage of packets (**Permit**).
Schedule	This field tells you whether a schedule is specified (**Yes**) or not (**No**).
Log	This field shows you whether a log is created when packets match this rule (**Yes**) or not (**No**).
Modify	Click the Edit icon to go to the screen where you can edit the rule. Click the Remove icon to delete an existing firewall rule. A window displays asking you to confirm that you want to delete the firewall rule. Note that subsequent firewall rules move up by one when you take this action.
Order	Click the Move icon to display the **Move the rule to** field. Type a number in the **Move the rule to** field and click the **Move** button to move the rule to the number that you typed. The ordering of your rules is important as they are applied in order of their numbering.
Apply	Click this to save your changes.
Cancel	Click this to restore your previously saved settings.

12.3.1 Configuring Firewall Rules

Refer to Section 12.1.2 on page 226 for more information.

Use this screen to configure firewall rules. In the **Rules** screen, select an index number and click **Add** or click a rule's **Edit** icon to display this screen and refer to the following table for information on the labels.

Figure 142 Security > Firewall > Rules > Edit



The following table describes the labels in this screen.

Table 71 Security > Firewall > Rules: Edit

LABEL	DESCRIPTION
Edit Rule	
Active	Select this option to enable this firewall rule.
Action for Matched Packet	Use the drop-down list box to select whether to discard (**Drop**), deny and send an ICMP destination-unreachable message to the sender of (**Reject**) or allow the passage of (**Permit**) packets that match this rule.
Source/Destination Address	
Address Type	Do you want your rule to apply to packets with a particular (single) IP, a range of IP addresses (for instance, 192.168.1.10 to 192.169.1.50), a subnet or any IP address? Select an option from the drop-down list box that includes: **Single Address**, **Range Address**, **Subnet Address** and **Any Address**.
Start IP Address	Enter the single IP address or the starting IP address in a range here.
End IP Address	Enter the ending IP address in a range here.
Subnet Mask	Enter the subnet mask here, if applicable.
Add >>	Click **Add >>** to add a new address to the **Source** or **Destination Address** box. You can add multiple addresses, ranges of addresses, and/or subnets.
Edit <<	To edit an existing source or destination address, select it from the box and click **Edit <<**.
Delete	Highlight an existing source or destination address from the **Source** or **Destination Address** box above and click **Delete** to remove it.
Services	
Available/ Selected Services	Please see Appendix E on page 557 for more information on services available. Highlight a service from the **Available Services** box on the left, then click **Add >>** to add it to the **Selected Services** box on the right. To remove a service, highlight it in the **Selected Services** box on the right, then click **Remove**.
Edit Customized Service	Click the **Edit Customized Services** link to bring up the screen that you use to configure a new custom service that is not in the predefined list of services.
Schedule	
Day to Apply	Select everyday or the day(s) of the week to apply the rule.
Time of Day to Apply (24-Hour Format)	Select **All Day** or enter the start and end times in the hour-minute format to apply the rule.
Log	
Log Packet Detail Information	This field determines if a log for packets that match the rule is created or not. Go to the **Log Settings** page and select the **Access Control** logs category to have the ZyXEL Device record these logs.
Alert	

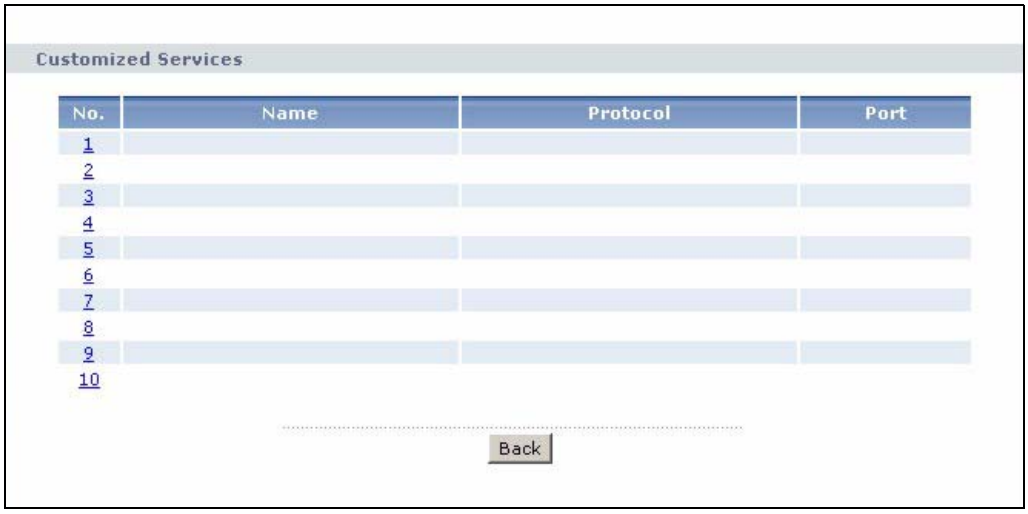
Table 71 Security > Firewall > Rules: Edit (continued)

LABEL	DESCRIPTION
Send Alert Message to Administrator When Matched	Select the check box to have the ZyXEL Device generate an alert when the rule is matched.
Back	Click this to return to the previous screen without saving.
Apply	Click this to save your changes.
Cancel	Click this to restore your previously saved settings.

12.3.2 Customized Services

Configure customized services and port numbers not predefined by the ZyXEL Device. For a comprehensive list of port numbers and services, visit the IANA (Internet Assigned Number Authority) website. See Appendix E on page 557 for some examples. Click the **Edit Customized Services** link while editing a firewall rule to configure a custom service port. This displays the following screen.

Figure 143 Security > Firewall > Rules: Edit: Edit Customized Services



The following table describes the labels in this screen.

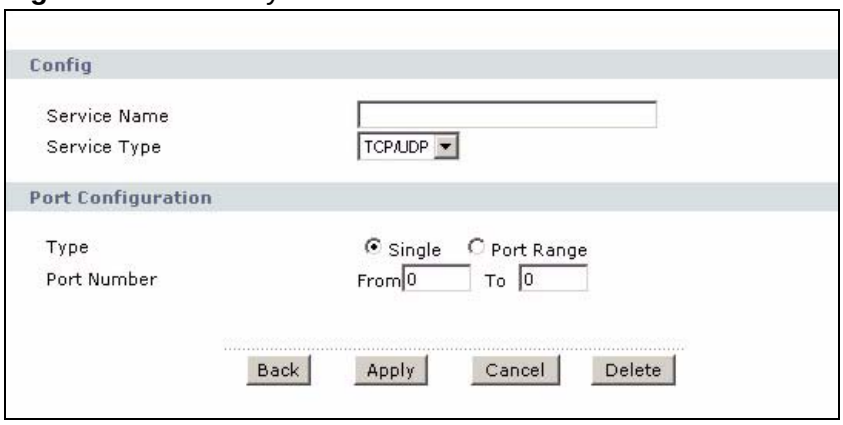
Table 72 Security > Firewall > Rules: Edit: Edit Customized Services

LABEL	DESCRIPTION
No.	This is the number of your customized port. Click a rule's number of a service to go to the **Firewall Customized Services Config** screen to configure or edit a customized service.
Name	This is the name of your customized service.
Protocol	This shows the IP protocol (**TCP**, **UDP** or **TCP/UDP**) that defines your customized service.
Port	This is the port number or range that defines your customized service.
Back	Click this to return to the **Firewall Edit Rule** screen.

12.3.3 Configuring a Customized Service

Use this screen to add a customized rule or edit an existing rule. Click a rule number in the **Firewall Customized Services** screen to display the following screen.

Figure 144 Security > Firewall > Rules: Edit: Edit Customized Services: Config



The following table describes the labels in this screen.

Table 73 Security > Firewall > Rules: Edit: Edit Customized Services: Config

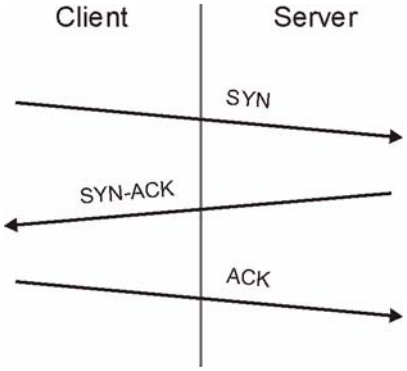
LABEL	DESCRIPTION
Config	
Service Name	Type a unique name for your custom port.
Service Type	Choose the IP port (**TCP**, **UDP** or **TCP/UDP**) that defines your customized port from the drop down list box.
Port Configuration	
Type	Click **Single** to specify one port only or **Range** to specify a span of ports that define your customized service.
Port Number	Type a single port number or the range of port numbers that define your customized service.
Back	Click this to return to the previous screen without saving.
Apply	Click this to save your changes.
Cancel	Click this to restore your previously saved settings.
Delete	Click this to delete the current rule.

12.4 The Firewall Threshold Screen

For DoS attacks, the ZyXEL Device uses thresholds to determine when to start dropping sessions that do not become fully established (half-open sessions). These thresholds apply globally to all sessions.

For TCP, half-open means that the session has not reached the established state-the TCP three-way handshake has not yet been completed. Under normal circumstances, the application that initiates a session sends a SYN (synchronize) packet to the receiving server. The receiver sends back an ACK (acknowledgment) packet and its own SYN, and then the initiator responds with an ACK (acknowledgment). After this handshake, a connection is established.

Figure 145 Three-Way Handshake



For UDP, half-open means that the firewall has detected no return traffic. An unusually high number (or arrival rate) of half-open sessions could indicate a DOS attack.

12.4.1 Threshold Values

If everything is working properly, you probably do not need to change the threshold settings as the default threshold values should work for most small offices. Tune these parameters when you believe the ZyXEL Device has been receiving DoS attacks that are not recorded in the logs or the logs show that the ZyXEL Device is classifying normal traffic as DoS attacks. Factors influencing choices for threshold values are:

1 The maximum number of opened sessions.

2 The minimum capacity of server backlog in your LAN network.

3 The CPU power of servers in your LAN network.

4 Network bandwidth.

5 Type of traffic for certain servers.

Reduce the threshold values if your network is slower than average for any of these factors (especially if you have servers that are slow or handle many tasks and are often busy).

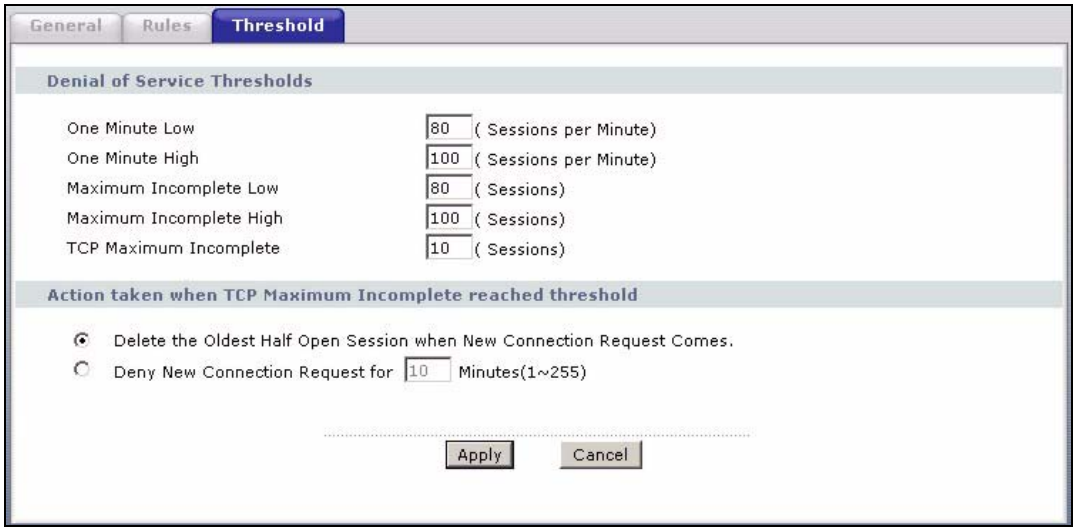
- If you often use P2P applications such as file sharing with eMule or eDonkey, it's recommended that you increase the threshold values since lots of sessions will be established during a small period of time and the ZyXEL Device may classify them as DoS attacks.

12.4.2 Configuring Firewall Thresholds

The ZyXEL Device also sends alerts whenever **TCP Maximum Incomplete** is exceeded. The global values specified for the threshold and timeout apply to all TCP connections.

Click **Firewall** > **Threshold** to bring up the next screen.

Figure 146 Security > Firewall > Threshold



The following table describes the labels in this screen.

Table 74 Security > Firewall > Threshold

LABEL	DESCRIPTION
Denial of Service Thresholds	The ZyXEL Device measures both the total number of existing half-open sessions and the rate of session establishment attempts. Both TCP and UDP half-open sessions are counted in the total number and rate measurements. Measurements are made once a minute.
One Minute Low	This is the rate of new half-open sessions per minute that causes the firewall to stop deleting half-open sessions. The ZyXEL Device continues to delete half-open sessions as necessary, until the rate of new connection attempts drops below this number.

Table 74 Security > Firewall > Threshold (continued)

LABEL	DESCRIPTION
One Minute High	This is the rate of new half-open sessions per minute that causes the firewall to start deleting half-open sessions. When the rate of new connection attempts rises above this number, the ZyXEL Device deletes half-open sessions as required to accommodate new connection attempts. For example, if you set the one minute high to 100, the ZyXEL Device starts deleting half-open sessions when more than 100 session establishment attempts have been detected in the last minute. It stops deleting half-open sessions when the number of session establishment attempts detected in a minute goes below the number set as the one minute low.
Maximum Incomplete Low	This is the number of existing half-open sessions that causes the firewall to stop deleting half-open sessions. The ZyXEL Device continues to delete half-open requests as necessary, until the number of existing half-open sessions drops below this number.
Maximum Incomplete High	This is the number of existing half-open sessions that causes the firewall to start deleting half-open sessions. When the number of existing half-open sessions rises above this number, the ZyXEL Device deletes half-open sessions as required to accommodate new connection requests. Do not set **Maximum Incomplete High** to lower than the current **Maximum Incomplete Low** number. For example, if you set the maximum incomplete high to 100, the ZyXEL Device starts deleting half-open sessions when the number of existing half-open sessions rises above 100. It stops deleting half-open sessions when the number of existing half-open sessions drops below the number set as the maximum incomplete low.
TCP Maximum Incomplete	An unusually high number of half-open sessions with the same destination host address could indicate that a DoS attack is being launched against the host. Specify the number of existing half-open TCP sessions with the same destination host IP address that causes the firewall to start dropping half-open sessions to that same destination host IP address. Enter a number between 1 and 256. As a general rule, you should choose a smaller number for a smaller network, a slower system or limited bandwidth. The ZyXEL Device sends alerts whenever the **TCP Maximum Incomplete** is exceeded.
Action taken when TCP Maximum Incomplete reached threshold	Select the action that ZyXEL Device should take when the TCP maximum incomplete threshold is reached. You can have the ZyXEL Device either: Delete the oldest half open session when a new connection request comes. or Deny new connection requests for the number of minutes that you specify (between 1 and 255).
Apply	Click this to save your changes.
Cancel	Click this to restore your previously saved settings.

12.5 Firewall Technical Reference

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

12.5.1 Firewall Rules Overview

Your customized rules take precedence and override the ZyXEL Device's default settings. The ZyXEL Device checks the source IP address, destination IP address and IP protocol type of network traffic against the firewall rules (in the order you list them). When the traffic matches a rule, the ZyXEL Device takes the action specified in the rule.

Firewall rules are grouped based on the direction of travel of packets to which they apply:

- LAN to LAN/ Router
- LAN to WAN
- WAN to LAN
- WAN to WAN/ Router

Note: The LAN includes both the LAN port and the WLAN.

By default, the ZyXEL Device's stateful packet inspection allows packets traveling in the following directions:

- LAN to LAN/ Router

  These rules specify which computers on the LAN can manage the ZyXEL Device (remote management) and communicate between networks or subnets connected to the LAN interface (IP alias).

Note: You can also configure the remote management settings to allow only a specific computer to manage the ZyXEL Device.

- LAN to WAN

  These rules specify which computers on the LAN can access which computers or services on the WAN.

By default, the ZyXEL Device's stateful packet inspection drops packets traveling in the following directions:

- WAN to LAN

  These rules specify which computers on the WAN can access which computers or services on the LAN.

Note: You also need to configure NAT port forwarding (or full featured NAT address mapping rules) to allow computers on the WAN to access devices on the LAN.

- WAN to WAN/ Router

  By default the ZyXEL Device stops computers on the WAN from managing the ZyXEL Device or using the ZyXEL Device as a gateway to communicate with other computers on the WAN. You could configure one of these rules to allow a WAN computer to manage the ZyXEL Device.

Note: You also need to configure the remote management settings to allow a WAN computer to manage the ZyXEL Device.

You may define additional rules and sets or modify existing ones but please exercise extreme caution in doing so.

For example, you may create rules to:

- Block certain types of traffic, such as IRC (Internet Relay Chat), from the LAN to the Internet.
- Allow certain types of traffic, such as Lotus Notes database synchronization, from specific hosts on the Internet to specific hosts on the LAN.
- Allow everyone except your competitors to access a web server.
- Restrict use of certain protocols, such as Telnet, to authorized users on the LAN.

These custom rules work by comparing the source IP address, destination IP address and IP protocol type of network traffic to rules set by the administrator. Your customized rules take precedence and override the ZyXEL Device's default rules.

12.5.2 Guidelines For Enhancing Security With Your Firewall

1. Change the default password via web configurator.
2. Think about access control before you connect to the network in any way.
3. Limit who can access your router.
4. Don't enable any local service (such as telnet or FTP) that you don't use. Any enabled service could present a potential security risk. A determined hacker might be able to find creative ways to misuse the enabled services to access the firewall or the network.
5. For local services that are enabled, protect against misuse. Protect by configuring the services to communicate only with specific peers, and protect by configuring rules to block packets for the services at specific interfaces.
6. Protect against IP spoofing by making sure the firewall is active.
7. Keep the firewall in a secured (locked) room.

12.5.3 Security Considerations

Note: Incorrectly configuring the firewall may block valid access or introduce security risks to the ZyXEL Device and your protected network. Use caution when creating or deleting firewall rules and test your rules after you configure them.

Consider these security ramifications before creating a rule:

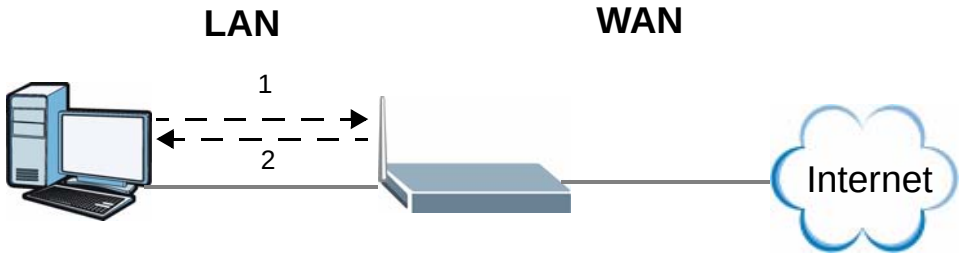
1. Does this rule stop LAN users from accessing critical resources on the Internet? For example, if IRC is blocked, are there users that require this service?
2. Is it possible to modify the rule to be more specific? For example, if IRC is blocked for all users, will a rule that blocks just certain users be more effective?
3. Does a rule that allows Internet users access to resources on the LAN create a security vulnerability? For example, if FTP ports (TCP 20, 21) are allowed from the Internet to the LAN, Internet users may be able to connect to computers with running FTP servers.
4. Does this rule conflict with any existing rules?

Once these questions have been answered, adding rules is simply a matter of entering the information into the correct fields in the web configurator screens.

12.5.4 Triangle Route

When the firewall is on, your ZyXEL Device acts as a secure gateway between your LAN and the Internet. In an ideal network topology, all incoming and outgoing network traffic passes through the ZyXEL Device to protect your LAN against attacks.

Figure 147 Ideal Firewall Setup



12.5.4.1 The “Triangle Route” Problem

A traffic route is a path for sending or receiving data packets between two Ethernet devices. You may have more than one connection to the Internet (through one or more ISPs). If an alternate gateway is on the LAN (and its IP address is in the same subnet as the ZyXEL Device’s LAN IP address), the “triangle

route" (also called asymmetrical route) problem may occur. The steps below describe the "triangle route" problem.

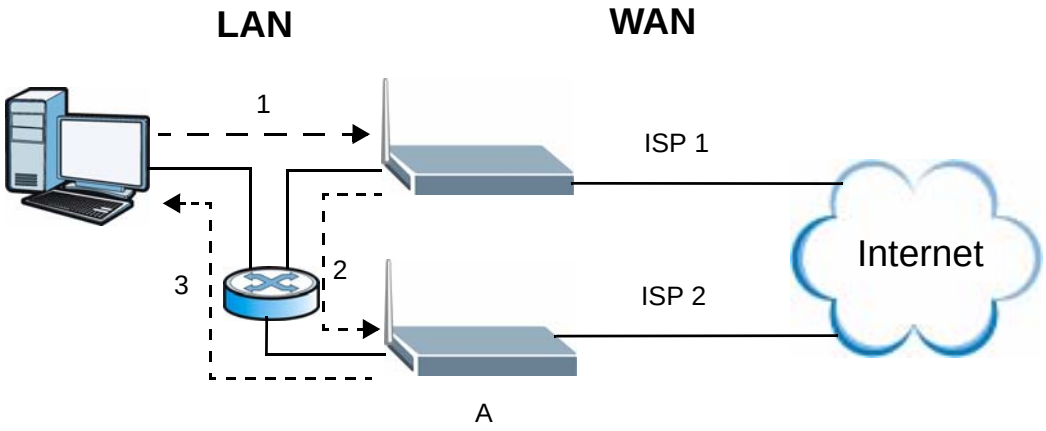
1 A computer on the LAN initiates a connection by sending out a SYN packet to a receiving server on the WAN.

2 The ZyXEL Device reroutes the SYN packet through Gateway **A** on the LAN to the WAN.

3 The reply from the WAN goes directly to the computer on the LAN without going through the ZyXEL Device.

As a result, the ZyXEL Device resets the connection, as the connection has not been acknowledged.

Figure 148 "Triangle Route" Problem



12.5.4.2 Solving the "Triangle Route" Problem

If you have the ZyXEL Device allow triangle route sessions, traffic from the WAN can go directly to a LAN computer without passing through the ZyXEL Device and its firewall protection.

Another solution is to use IP alias. IP alias allows you to partition your network into logical sections over the same Ethernet interface. Your ZyXEL Device supports up to three logical LAN interfaces with the ZyXEL Device being the gateway for each logical network.

It's like having multiple LAN networks that actually use the same physical cables and ports. By putting your LAN and Gateway **A** in different subnets, all returning network traffic must pass through the ZyXEL Device to your LAN. The following steps describe such a scenario.

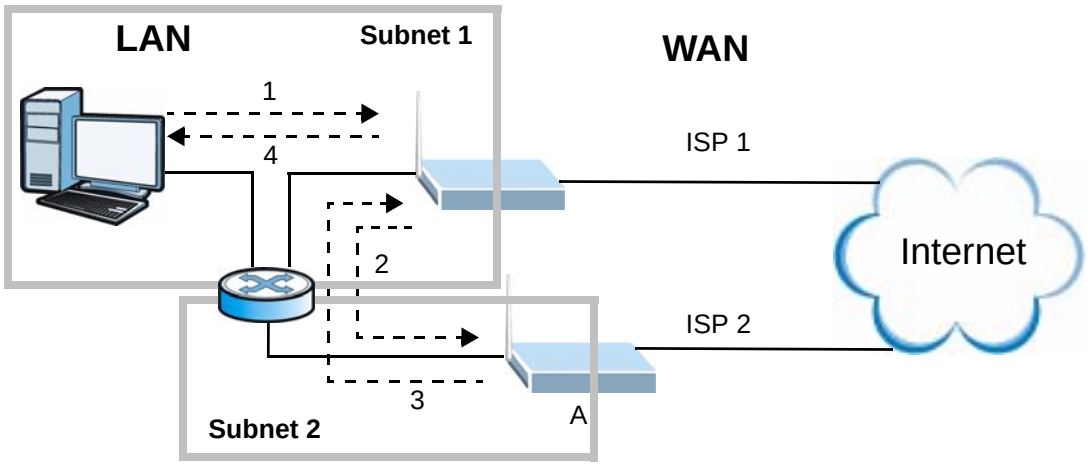
1 A computer on the LAN initiates a connection by sending a SYN packet to a receiving server on the WAN.

2 The ZyXEL Device reroutes the packet to Gateway A, which is in Subnet 2.

3 The reply from the WAN goes to the ZyXEL Device.

4 The ZyXEL Device then sends it to the computer on the LAN in Subnet 1.

Figure 149 IP Alias



13

Content Filtering

13.1 Overview

Internet content filtering allows you to block web sites based on keywords in the URL.

13.1.1 What You Can Do in the Content Filter Screens

- Use the **Keyword** screen (Section 13.2 on page 250) to block web sites based on a keyword in the URL.
- Use the **Schedule** screen (Section 13.3 on page 251) to specify the days and times keyword blocking is active.
- Use the **Trusted** screen (Section 13.4 on page 252) to exclude computers and other devices on your LAN from the keyword blocking filter.

13.1.2 What You Need to Know About Content Filtering

URL

The URL (Uniform Resource Locator) identifies and helps locates resources on a network. On the Internet the URL is the web address that you type in the address bar of your Internet browser, for example “http://www.zyxel.com”.

Finding Out More

See Section 13.1.4 on page 248 for an example of setting up content filtering.

13.1.3 Before You Begin

To use the **Trusted** screen, you need the IP addresses of devices on your network. See the **LAN** section (Section 13.4 on page 252) for more information.

13.1.4 Content Filtering Example

The following shows the steps required for a parent (Bob) to set up content filtering on a home network in order to limit his children's access to certain web sites. In the following example, all URLs containing the word 'bad' are blocked.

1 Click **Security > Content Filter** to display the following screen.

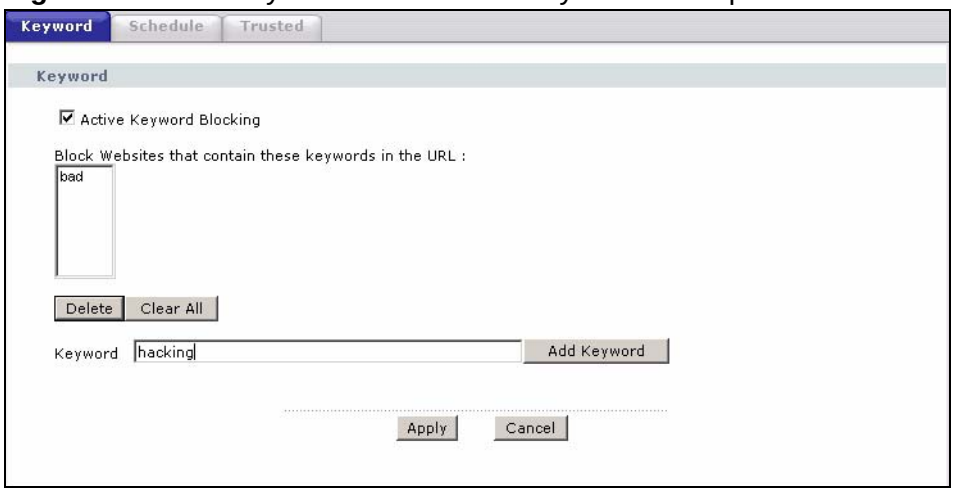
2 Select **Active Keyword Blocking**.

3 In the **Keyword** field type keywords to identify websites to be blocked.

4 Click **Add Keyword** for each keyword to be entered.

5 Click **Apply**.

Figure 150 Security > Content Filter > Keyword: Example



Bob's son arrives home from school at four, while his parents arrive later, at about 7pm. So keyword blocking is enabled for these times on weekdays and not on the weekend when the parents are at home.

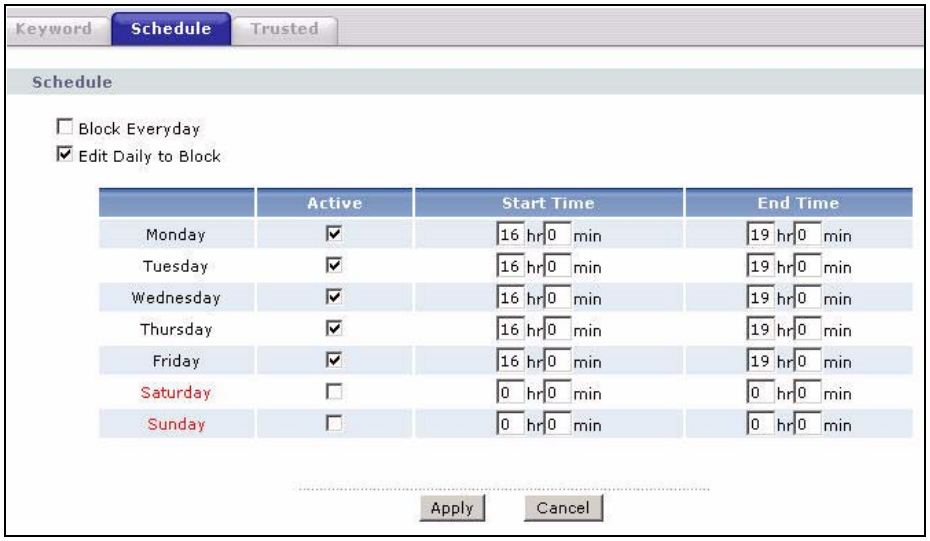
1 Click **Security > Content Filter > Schedule** to display the following screen.

2 Click **Edit Daily to Block** and select all weekdays.

3 Under **Start Time** and **End Time**, type the times for blocking to begin and end (4pm ~ 7pm in this example).

4 Click **Apply**.

Figure 151 Security > Content Filter > Schedule: Example



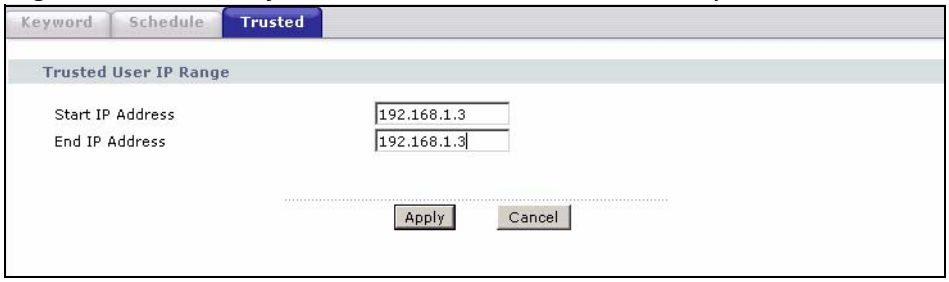
The children can access the family computer in the living room, while only the parents use another computer in the study room. So keyword blocking is only needed on the family computer and the study computer can be excluded from keyword blocking. Bob's home network is on the domain "192.168.1.xxx". Bob gave his home computer a static IP address of 192.168.1.2 and the study computer a static IP address of 192.168.1.3. To exclude the study computer from keyword blocking he follows these steps.

1 Click **Security > Content Filter** > **Trusted** to display the following screen.

2 In the **Start IP Address** and **End IP Address** fields, type 192.168.1.3.

3 Click **Apply**.

Figure 152 Security > Content Filter > Trusted: Example



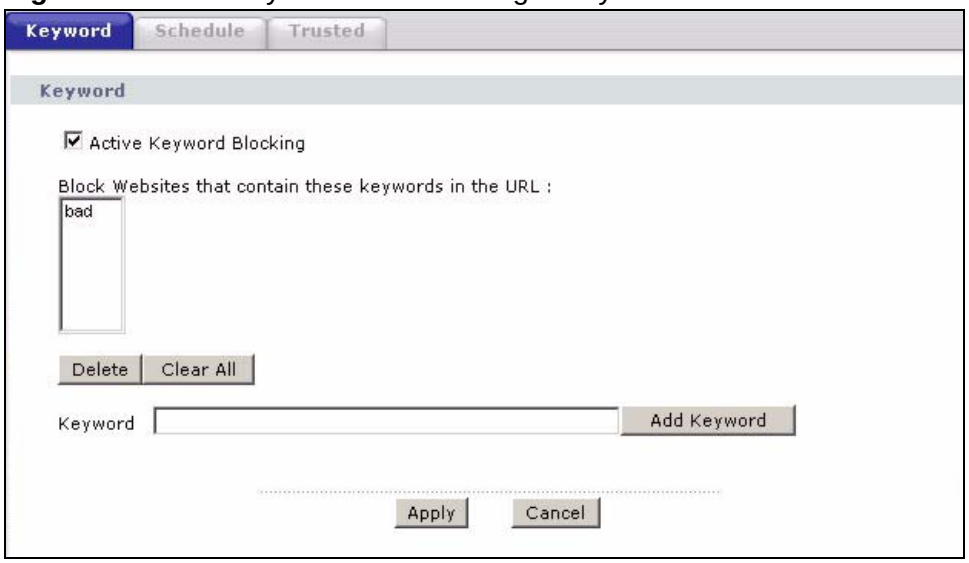
That finishes setting up keyword blocking on the home computer.

13.2 The Keyword Screen

Use this screen to block sites containing certain keywords in the URL. For example, if you enable the keyword "bad", the ZyXEL Device blocks all sites containing this keyword including the URL http://www.website.com/bad.html.

To have your ZyXEL Device block websites containing keywords in their URLs, click **Security > Content Filter**. The screen appears as shown.

Figure 153 Security > Content Filtering > Keyword



The following table describes the labels in this screen.

Table 75 Security > Content Filtering > Keyword

LABEL	DESCRIPTION
Active Keyword Blocking	Select this check box to enable this feature.
Block Websites that contain these keywords in the URL:	This box contains the list of all the keywords that you have configured the ZyXEL Device to block.
Delete	Highlight a keyword in the box and click this to remove it.
Clear All	Click this to remove all of the keywords from the list.
Keyword	Type a keyword in this field. You may use any character (up to 127 characters). Wildcards are not allowed.
Add Keyword	Click this after you have typed a keyword. Repeat this procedure to add other keywords. Up to 64 keywords are allowed. When you try to access a web page containing a keyword, you will get a message telling you that the content filter is blocking this request.

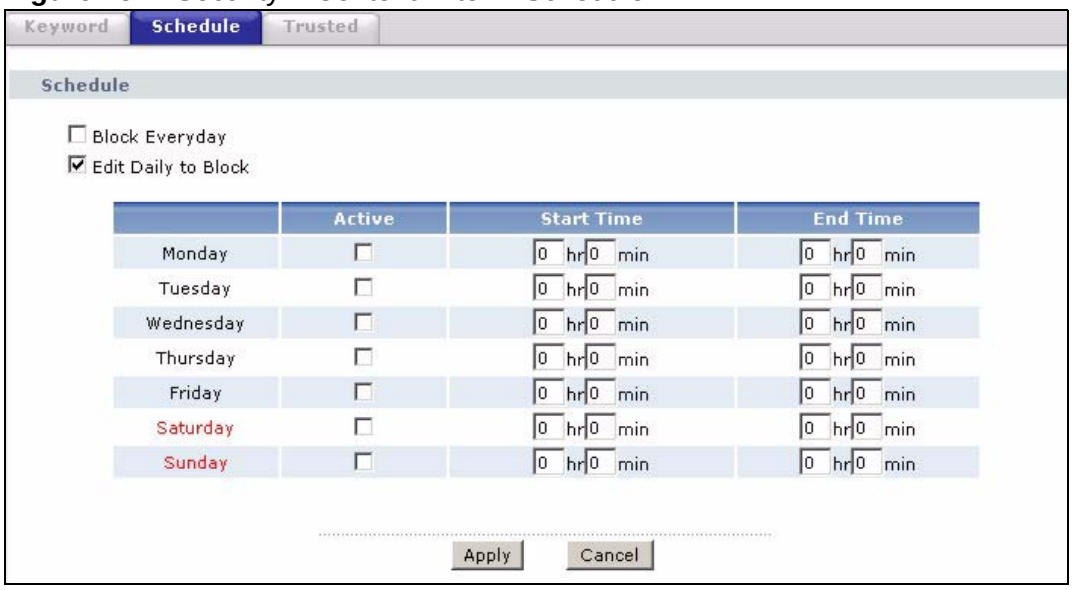
Table 75 Security > Content Filtering > Keyword (continued)

LABEL	DESCRIPTION
Apply	Click this to save your changes.
Cancel	Click this to restore your previously saved settings.

13.3 The Schedule Screen

Use this screen to set the days and times for the ZyXEL Device to perform content filtering. Click **Security > Content Filter** > **Schedule**. The screen appears as shown.

Figure 154 Security > Content Filter > Schedule



The following table describes the labels in this screen.

Table 76 Security > Content Filter: Schedule

LABEL	DESCRIPTION
Schedule	Select **Block Everyday** to make the content filtering active everyday. Otherwise, select **Edit Daily to Block** and configure which days of the week (or everyday) and which time of the day you want the content filtering to be active.
Active	Select the check box to have the content filtering to be active on the selected day.
Start TIme	Enter the time when you want the content filtering to take effect in hour-minute format.
End Time	Enter the time when you want the content filtering to stop in hour-minute format.

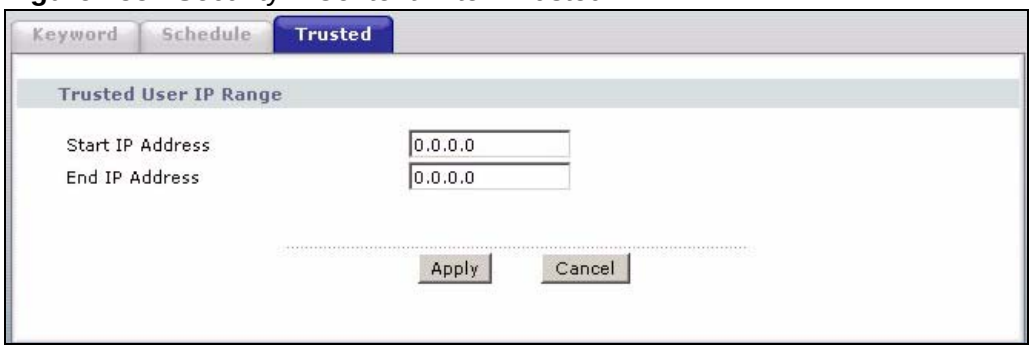
Table 76 Security > Content Filter: Schedule (continued)

LABEL	DESCRIPTION
Apply	Click this to save your changes.
Cancel	Click this to restore your previously saved settings.

13.4 The Trusted Screen

Use this screen to exclude a range of users on the LAN from content filtering on your ZyXEL Device. Click **Security > Content Filter** > **Trusted**. The screen appears as shown.

Figure 155 Security > Content Filter: Trusted



The following table describes the labels in this screen.

Table 77 Security > Content Filter: Trusted

LABEL	DESCRIPTION
Start IP Address	Type the IP address of a computer (or the beginning IP address of a specific range of computers) on the LAN that you want to exclude from content filtering.
End IP Address	Type the ending IP address of a specific range of users on your LAN that you want to exclude from content filtering. Leave this field blank if you want to exclude an individual computer.
Apply	Click this to save your changes.
Cancel	Click this to restore your previously saved settings.

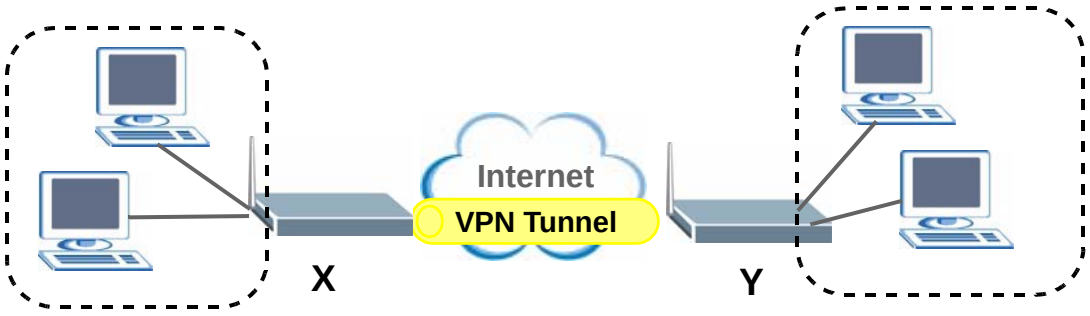
14 VPN

14.1 Overview

A virtual private network (VPN) provides secure communications between sites without the expense of leased site-to-site lines. A secure VPN is a combination of tunneling, encryption, authentication, access control and auditing. It is used to transport traffic over the Internet or any insecure network that uses TCP/IP for communication.

Internet Protocol Security (IPSec) is a standards-based VPN that offers flexible solutions for secure data communications across a public network like the Internet. IPSec is built around a number of standardized cryptographic techniques to provide confidentiality, data integrity and authentication at the IP layer. The following figure is an example of an IPSec VPN tunnel.

Figure 156 VPN: Example



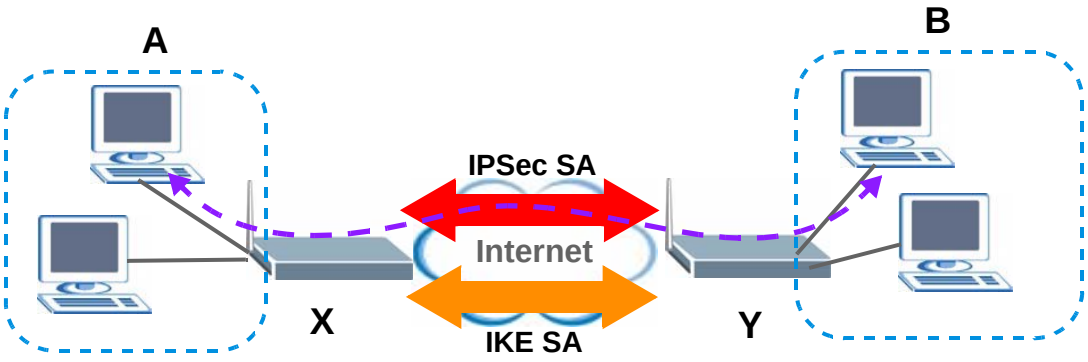
14.1.1 What You Can Do in the VPN Screens

- Use the **Setup** screen (Section 14.2 on page 256) to view the configured VPN policies and add, edit or remove a VPN policy.
- Use the **Monitor** screen (Section 14.7 on page 271) to display and manage the current active VPN connections.
- Use the **VPN Global Setting** screen (Section 14.8 on page 273) to allow NetBIOS packets passing through the VPN connection.

14.1.2 What You Need to Know About IPSec VPN

A VPN tunnel is usually established in two phases. Each phase establishes a security association (SA), a contract indicating what security parameters the ZyXEL Device and the remote IPSec router will use. The first phase establishes an Internet Key Exchange (IKE) SA between the ZyXEL Device and remote IPSec router. The second phase uses the IKE SA to securely establish an IPSec SA through which the ZyXEL Device and remote IPSec router can send data between computers on the local network and remote network. The following figure illustrates this.

Figure 157 VPN: IKE SA and IPSec SA



In this example, a computer in network **A** is exchanging data with a computer in network **B**. Inside networks **A** and **B**, the data is transmitted the same way data is normally transmitted in the networks. Between routers **X** and **Y**, the data is protected by tunneling, encryption, authentication, and other security features of the IPSec SA. The IPSec SA is established securely using the IKE SA that routers **X** and **Y** established first.

My IP Address

My IP Address is the WAN IP address of the ZyXEL Device. The ZyXEL Device has to rebuild the VPN tunnel if **My IP Address** changes after setup.

The following applies if this field is configured as **0.0.0.0**:

- The ZyXEL Device uses the current ZyXEL Device WAN IP address (static or dynamic) to set up the VPN tunnel.

Secure Gateway Address

Secure Gateway Address is the WAN IP address or domain name of the remote IPSec router (secure gateway).

If the remote secure gateway has a static WAN IP address, enter it in the **Secure Gateway Address** field. You may alternatively enter the remote secure gateway's domain name (if it has one) in the **Secure Gateway Address** field.

You can also enter a remote secure gateway's domain name in the **Secure Gateway Address** field if the remote secure gateway has a dynamic WAN IP address and is using DDNS. The ZyXEL Device has to rebuild the VPN tunnel each time the remote secure gateway's WAN IP address changes (there may be a delay until the DDNS servers are updated with the remote gateway's new WAN IP address).

Dynamic Secure Gateway Address

If the remote secure gateway has a dynamic WAN IP address and does not use DDNS, enter 0.0.0.0 as the secure gateway's address. In this case only the remote secure gateway can initiate SAs. This may be useful for telecommuters initiating a VPN tunnel to the company network (see Section 14.9.12 on page 282 for configuration examples).

The Secure Gateway IP Address may be configured as **0.0.0.0** only when using **IKE** key management and not **Manual** key management.

Finding Out More

See Section 14.9 on page 273 for advanced technical information on IPSec VPN.

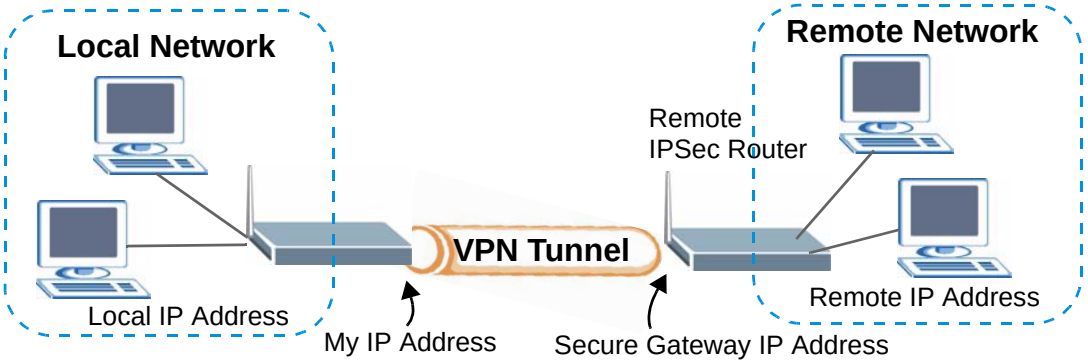
14.1.3 Before You Begin

If a VPN tunnel uses Telnet, FTP, WWW, then you should configure remote management (**Remote MGMT**) to allow access for that service.

14.2 VPN Setup Screen

The following figure helps explain the main fields in the web configurator.

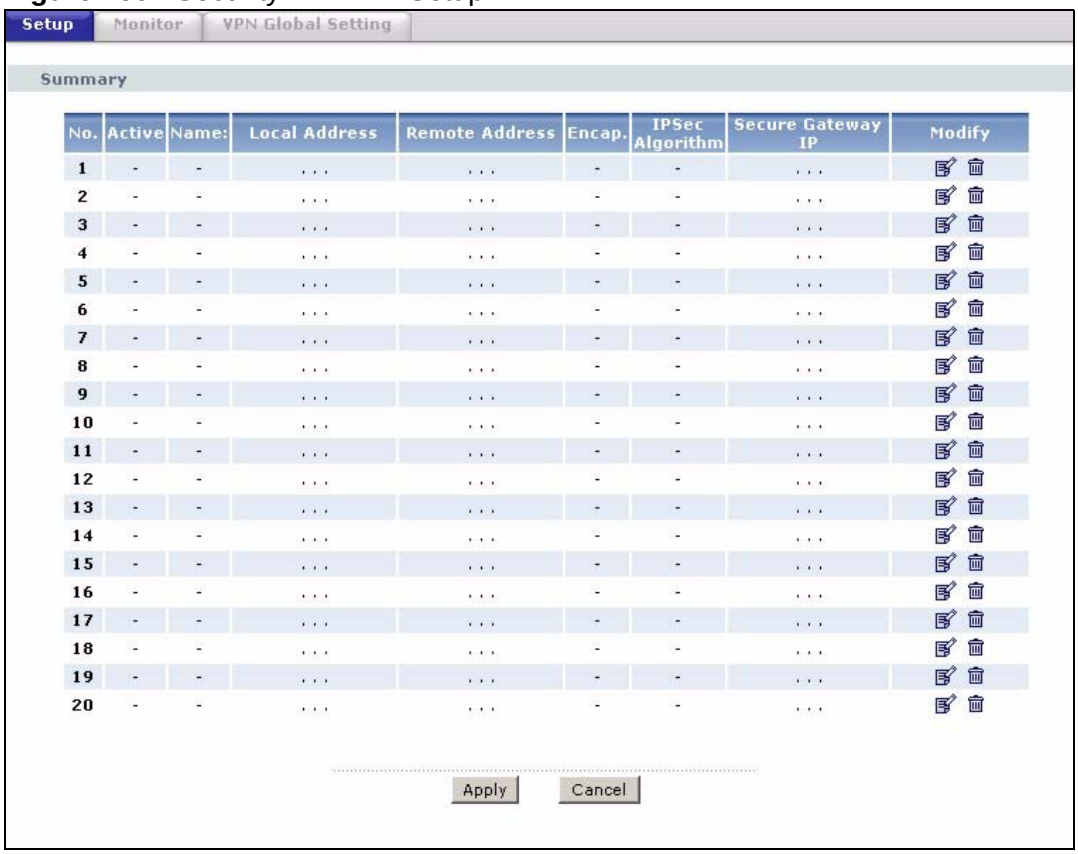
Figure 158 IPSec Summary Fields



Local and remote IP addresses must be static.

Click **Security** > **VPN** to open the **VPN Setup** screen. This is a menu of your IPSec rules (tunnels). The IPSec summary menu is read-only. Edit a VPN by selecting an index number and then configuring its associated submenus.

Figure 159 Security > VPN > Setup



The following table describes the fields in this screen.

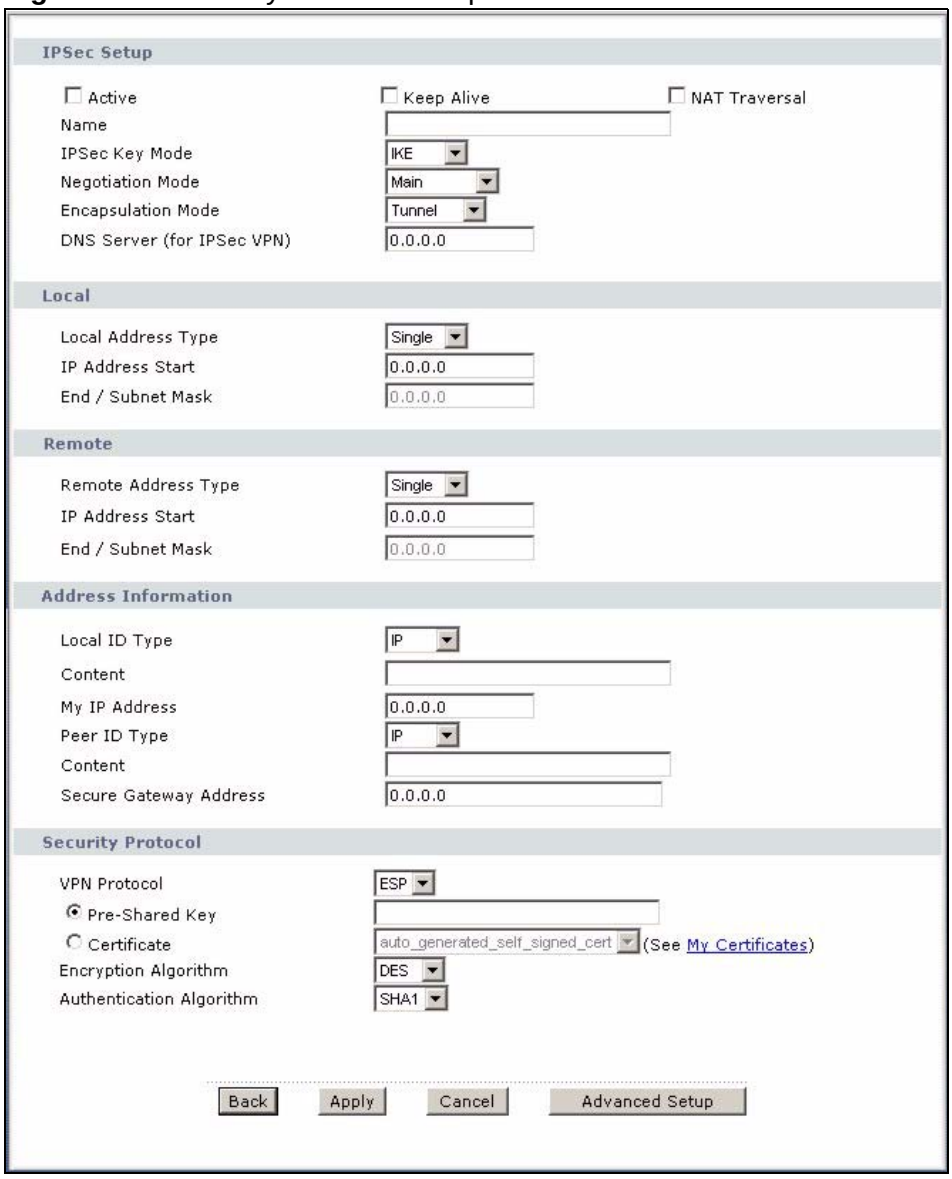
Table 78 Security > VPN > Setup

LABEL	DESCRIPTION
No.	This is the VPN policy index number. Click a number to edit VPN policies.
Active	This field displays whether the VPN policy is active or not. A **Yes** signifies that this VPN policy is active. **No** signifies that this VPN policy is not active.
Name	This field displays the identification name for this VPN policy.
Local Address	This is the IP address(es) of computer(s) on your local network behind your ZyXEL Device. The same (static) IP address is displayed twice when the **Local Address Type** field in the **VPN Setup - Edit** screen is configured to **Single**. The beginning and ending (static) IP addresses, in a range of computers are displayed when the **Local Address Type** field in the **VPN Setup - Edit** screen is configured to **Range**. A (static) IP address and a subnet mask are displayed when the **Local Address Type** field in the **VPN Setup - Edit** screen is configured to **Subnet**.
Remote Address	This is the IP address(es) of computer(s) on the remote network behind the remote IPSec router. This field displays **N/A** when the **Secure Gateway Address** field displays **0.0.0.0**. In this case only the remote IPSec router can initiate the VPN. The same (static) IP address is displayed twice when the **Remote Address Type** field in the **VPN Setup - Edit** screen is configured to **Single**. The beginning and ending (static) IP addresses, in a range of computers are displayed when the **Remote Address Type** field in the **VPN Setup - Edit** screen is configured to **Range**. A (static) IP address and a subnet mask are displayed when the **Remote Address Type** field in the **VPN Setup - Edit** screen is configured to **Subnet**.
Encap.	This field displays **Tunnel** or **Transport** mode (**Tunnel** is the default selection).
IPSec Algorithm	This field displays the security protocols used for an SA. Both **AH** and **ESP** increase ZyXEL Device processing requirements and communications latency (delay).
Secure Gateway IP	This is the static WAN IP address or URL of the remote IPSec router. This field displays **0.0.0.0** when you configure the **Secure Gateway Address** field in the **VPN-IKE** screen to **0.0.0.0.**
Modify	Click the **Edit** icon to go to the screen where you can edit the VPN configuration. Click the **Remove** icon to remove an existing VPN configuration.
Apply	Click this to save your changes and apply them to the ZyXEL Device.
Cancel	Click this return your settings to their last saved values.

14.3 The VPN Edit Screen

Click an **Edit** icon in the **VPN Setup** screen to edit VPN policies.

Figure 160 Security > VPN > Setup > Edit



The following table describes the fields in this screen.

Table 79 Security > VPN > Setup > Edit

LABEL	DESCRIPTION
IPSec Setup	
Active	Select this check box to activate this VPN policy. This option determines whether a VPN rule is applied before a packet leaves the firewall.

Table 79 Security > VPN > Setup > Edit

LABEL	DESCRIPTION
Keep Alive	Select either **Yes** or **No** from the drop-down list box. Select **Yes** to have the ZyXEL Device automatically reinitiate the SA after the SA lifetime times out, even if there is no traffic. The remote IPSec router must also have keep alive enabled in order for this feature to work.
NAT Traversal	This function is available if the **VPN Protocol** is **ESP**. Select this check box if you want to set up a VPN tunnel when there are NAT routers between the ZyXEL Device and remote IPSec router. The remote IPSec router must also enable NAT traversal, and the NAT routers have to forward UDP port 500 packets to the remote IPSec router behind the NAT router.
Name	Type up to 32 characters to identify this VPN policy. You may use any character, including spaces, but the ZyXEL Device drops trailing spaces.
IPSec Key Mode	Select **IKE** or **Manual** from the drop-down list box. **IKE** provides more protection so it is generally recommended. **Manual** is a useful option for troubleshooting if you have problems using **IKE** key management.
Negotiation Mode	Select **Main** or **Aggressive** from the drop-down list box. Multiple SAs connecting through a secure gateway must have the same negotiation mode.
Encapsulation Mode	Select **Tunnel** mode or **Transport** mode from the drop-down list box.
DNS Server (for IPSec VPN)	If there is a private DNS server that services the VPN, type its IP address here. The ZyXEL Device assigns this additional DNS server to the ZyXEL Device's DHCP clients that have IP addresses in this IPSec rule's range of local addresses. A DNS server allows clients on the VPN to find other computers and servers on the VPN by their (private) domain names.
Local	Specify the IP addresses of the devices behind the ZyXEL Device that can use the VPN tunnel. The local IP addresses must correspond to the remote IPSec router's configured remote IP addresses. Two active SAs cannot have the local and remote IP address(es) both the same. Two active SAs can have the same local or remote IP address, but not both. You can configure multiple SAs between the same local and remote IP addresses, as long as only one is active at any time.
Local Address Type	Use the drop-down menu to choose **Single**, **Range**, or **Subnet**. Select **Single** for a single IP address. Select **Range** for a specific range of IP addresses. Select **Subnet** to specify IP addresses on a network by their subnet mask.
IP Address Start	When the **Local Address Type** field is configured to **Single**, enter a (static) IP address on the LAN behind your ZyXEL Device. When the **Local Address Type** field is configured to **Range**, enter the beginning (static) IP address, in a range of computers on your LAN behind your ZyXEL Device. When the **Local Address Type** field is configured to **Subnet**, this is a (static) IP address on the LAN behind your ZyXEL Device.

Table 79 Security > VPN > Setup > Edit

LABEL	DESCRIPTION
End / Subnet Mask	When the **Local Address Type** field is configured to **Single**, this field is N/A. When the **Local Address Type** field is configured to **Range**, enter the end (static) IP address, in a range of computers on the LAN behind your ZyXEL Device. When the **Local Address Type** field is configured to **Subnet**, this is a subnet mask on the LAN behind your ZyXEL Device.
Remote	Specify the IP addresses of the devices behind the remote IPSec router that can use the VPN tunnel. The remote IP addresses must correspond to the remote IPSec router's configured local IP addresses. Two active SAs cannot have the local and remote IP address(es) both the same. Two active SAs can have the same local or remote IP address, but not both. You can configure multiple SAs between the same local and remote IP addresses, as long as only one is active at any time.
Remote Address Type	Use the drop-down menu to choose **Single**, **Range**, or **Subnet**. Select **Single** with a single IP address. Select **Range** for a specific range of IP addresses. Select **Subnet** to specify IP addresses on a network by their subnet mask.
IP Address Start	When the **Remote Address Type** field is configured to **Single**, enter a (static) IP address on the network behind the remote IPSec router. When the **Remote Address Type** field is configured to **Range**, enter the beginning (static) IP address, in a range of computers on the network behind the remote IPSec router. When the **Remote Address Type** field is configured to **Subnet**, enter a (static) IP address on the network behind the remote IPSec router.
End / Subnet Mask	When the **Remote Address Type** field is configured to **Single**, this field is N/A. When the **Remote Address Type** field is configured to **Range**, enter the end (static) IP address, in a range of computers on the network behind the remote IPSec router. When the **Remote Address Type** field is configured to **Subnet**, enter a subnet mask on the network behind the remote IPSec router.
Address Information	
Local ID Type	Select **IP** to identify this ZyXEL Device by its IP address. Select **DNS** to identify this ZyXEL Device by a domain name. Select **E-mail** to identify this ZyXEL Device by an e-mail address.

Table 79 Security > VPN > Setup > Edit

LABEL	DESCRIPTION
Content	When you select **IP** in the **Local ID Type** field, type the IP address of your computer in the local **Content** field. The ZyXEL Device automatically uses the IP address in the **My IP Address** field (refer to the **My IP Address** field description) if you configure the local **Content** field to **0.0.0.0** or leave it blank. It is recommended that you type an IP address other than **0.0.0.0** in the local **Content** field or use the **DNS** or **E-mail** ID type in the following situations. When there is a NAT router between the two IPSec routers. When you want the remote IPSec router to be able to distinguish between VPN connection requests that come in from IPSec routers with dynamic WAN IP addresses. When you select **DNS** or **E-mail** in the **Local ID Type** field, type a domain name or e-mail address by which to identify this ZyXEL Device in the local **Content** field. Use up to 31 ASCII characters including spaces, although trailing spaces are truncated. The domain name or e-mail address is for identification purposes only and can be any string.
My IP Address	Enter the WAN IP address of your ZyXEL Device. The VPN tunnel has to be rebuilt if this IP address changes. The following applies if this field is configured as **0.0.0.0**: The ZyXEL Device uses the current ZyXEL Device WAN IP address (static or dynamic) to set up the VPN tunnel.
Peer ID Type	Select **IP** to identify the remote IPSec router by its IP address. Select **DNS** to identify the remote IPSec router by a domain name. Select **E-mail** to identify the remote IPSec router by an e-mail address.
Content	The configuration of the peer content depends on the peer ID type. For **IP**, type the IP address of the computer with which you will make the VPN connection. If you configure this field to **0.0.0.0** or leave it blank, the ZyXEL Device will use the address in the **Secure Gateway Address** field (refer to the **Secure Gateway Address** field description). For **DNS** or **E-mail**, type a domain name or e-mail address by which to identify the remote IPSec router. Use up to 31 ASCII characters including spaces, although trailing spaces are truncated. The domain name or e-mail address is for identification purposes only and can be any string. It is recommended that you type an IP address other than **0.0.0.0** or use the **DNS** or **E-mail** ID type in the following situations: When there is a NAT router between the two IPSec routers. When you want the ZyXEL Device to distinguish between VPN connection requests that come in from remote IPSec routers with dynamic WAN IP addresses.

Table 79 Security > VPN > Setup > Edit

LABEL	DESCRIPTION
Secure Gateway Address	Type the WAN IP address or the URL (up to 31 characters) of the IPSec router with which you're making the VPN connection. Set this field to **0.0.0.0** if the remote IPSec router has a dynamic WAN IP address (the **IPSec Key Mode** field must be set to **IKE**). In order to have more than one active rule with the **Secure Gateway Address** field set to **0.0.0.0**, the ranges of the local IP addresses cannot overlap between rules. If you configure an active rule with **0.0.0.0** in the **Secure Gateway Address** field and the LAN's full IP address range as the local IP address, then you cannot configure any other active rules with the **Secure Gateway Address** field set to **0.0.0.0**.
Security Protocol	
VPN Protocol	Select **ESP** if you want to use ESP (Encapsulation Security Payload). The ESP protocol (RFC 2406) provides encryption as well as some of the services offered by **AH**. If you select **ESP** here, you must select options from the **Encryption Algorithm** and **Authentication Algorithm** fields (described below).
Pre-Shared Key	Click the button to use a pre-shared key for authentication, and type in your pre-shared key. A pre-shared key identifies a communicating party during a phase 1 IKE negotiation. It is called "pre-shared" because you have to share it with another party before you can communicate with them over a secure connection. Type from 8 to 31 case-sensitive ASCII characters or from 16 to 62 hexadecimal ("0-9", "A-F") characters. You must precede a hexadecimal key with a "0x" (zero x), which is not counted as part of the 16 to 62 character range for the key. For example, in "0x0123456789ABCDEF", "0x" denotes that the key is hexadecimal and "0123456789ABCDEF" is the key itself. Both ends of the VPN tunnel must use the same pre-shared key. You will receive a "PYLD_MALFORMED" (payload malformed) packet if the same pre-shared key is not used on both ends.
Certificate	Click the button to use a certificate for authentication. Select the certificate you want to use from the list. You can create, import and configure certificates in the **Security > Certificates** screens, or click the **My Certificates** link.
My Certificates	Click this to go to the **Security > Certificates > My Certificates** screen. If you do not click **Apply** first, your VPN settings will not be saved.

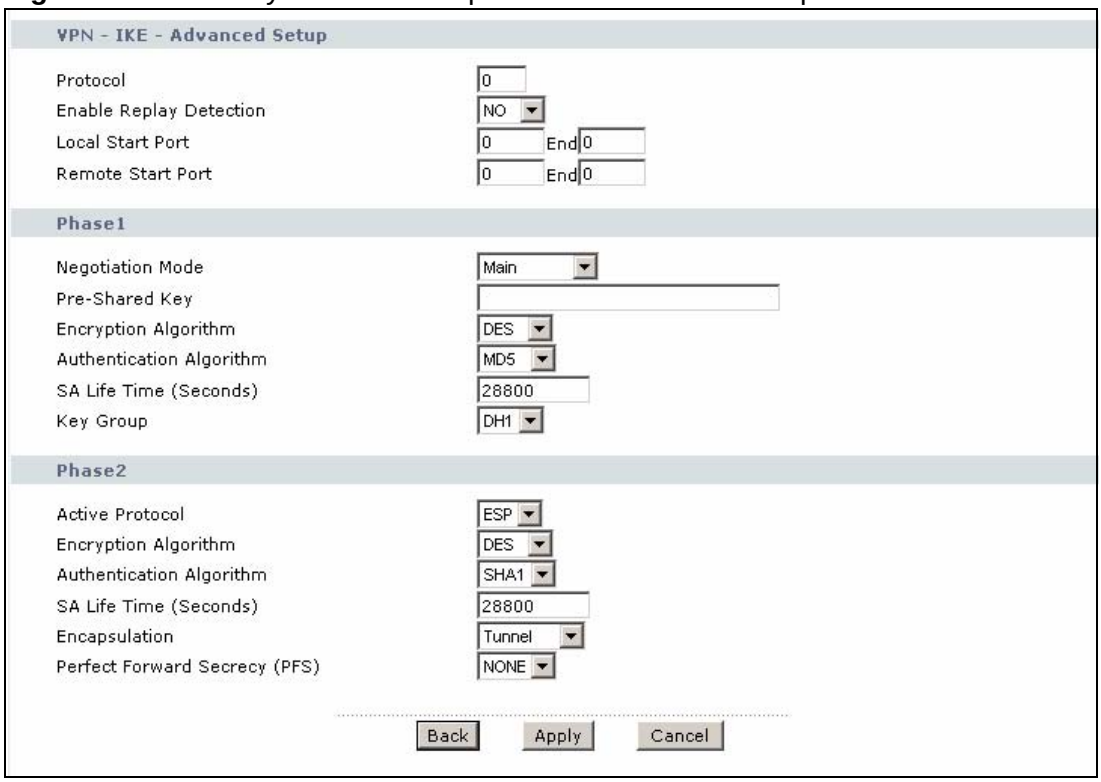
Table 79 Security > VPN > Setup > Edit

LABEL	DESCRIPTION
Encryption Algorithm	Select **DES**, **3DES**, **AES** or **NULL** from the drop-down list box. When you use one of these encryption algorithms for data communications, both the sending device and the receiving device must use the same secret key, which can be used to encrypt and decrypt the message or to generate and verify a message authentication code. The DES encryption algorithm uses a 56-bit key. Triple DES (**3DES**) is a variation on **DES** that uses a 168-bit key. As a result, **3DES** is more secure than **DES**. It also requires more processing power, resulting in increased latency and decreased throughput. This implementation of **AES** uses a 128-bit key. **AES** is faster than **3DES**. Select **NULL** to set up a tunnel without encryption. When you select **NULL**, you do not enter an encryption key.
Authentication Algorithm	Select **SHA1** or **MD5** from the drop-down list box. **MD5** (Message Digest 5) and **SHA1** (Secure Hash Algorithm) are hash algorithms used to authenticate packet data. The **SHA1** algorithm is generally considered stronger than **MD5**, but is slower. Select **MD5** for minimal security and **SHA-1** for maximum security.
Back	Click **Back** to return to the previous screen.
Apply	Click **Apply** to save your changes back to the ZyXEL Device.
Cancel	Click **Cancel** to begin configuring this screen afresh.
Advanced Setup	Click **Advanced Setup** to configure more detailed settings of your IKE key management.

14.4 Configuring Advanced IKE Settings

Click **Advanced Setup** in the **VPN Setup-Edit** screen to open this screen.

Figure 161 Security > VPN > Setup > Edit > Advanced Setup



The following table describes the fields in this screen.

Table 80 Security > VPN > Setup > Edit > Advanced Setup

LABEL	DESCRIPTION
VPN - IKE - Advanced Setup	
Protocol	Enter 1 for ICMP, 6 for TCP, 17 for UDP, and so on. 0 is the default and signifies any protocol.
Enable Replay Detection	As a VPN setup is processing intensive, the system is vulnerable to Denial of Service (DoS) attacks The IPSec receiver can detect and reject old or duplicate packets to protect against replay attacks. Select **YES** from the drop-down menu to enable replay detection, or select **NO** to disable it.
Local Start Port	0 is the default and signifies any port. Type a port number from 0 to 65535. Some of the most common IP ports are: 21, FTP; 53, DNS; 23, Telnet; 80, HTTP; 25, SMTP; 110, POP3.
End	Enter a port number in this field to define a port range. This port number must be greater than that specified in the previous field. If **Local Start Port** is left at 0, **End** will also remain at 0.

Table 80 Security > VPN > Setup > Edit > Advanced Setup (continued)

LABEL	DESCRIPTION
Remote Start Port	0 is the default and signifies any port. Type a port number from 0 to 65535. Some of the most common IP ports are: 21, FTP; 53, DNS; 23, Telnet; 80, HTTP; 25, SMTP; 110, POP3.
End	Enter a port number in this field to define a port range. This port number must be greater than that specified in the previous field. If **Remote Start Port** is left at 0, **End** will also remain at 0.
Phase 1	
Negotiation Mode	Select **Main** or **Aggressive** from the drop-down list box. Multiple SAs connecting through a secure gateway must have the same negotiation mode.
Pre-Shared Key	Type your pre-shared key in this field. A pre-shared key identifies a communicating party during a phase 1 IKE negotiation. It is called "pre-shared" because you have to share it with another party before you can communicate with them over a secure connection. Type from 8 to 31 case-sensitive ASCII characters or from 16 to 62 hexadecimal ("0-9", "A-F") characters. You must precede a hexadecimal key with a "0x" (zero x), which is not counted as part of the 16 to 62-character range for the key. For example, in "0x0123456789ABCDEF", "0x" denotes that the key is hexadecimal and "0123456789ABCDEF" is the key itself. Both ends of the VPN tunnel must use the same pre-shared key. You will receive a "PYLD_MALFORMED" (payload malformed) packet if the same pre-shared key is not used on both ends.
Encryption Algorithm	Select **DES**, **3DES** or **AES** from the drop-down list box. When you use one of these encryption algorithms for data communications, both the sending device and the receiving device must use the same secret key, which can be used to encrypt and decrypt the message or to generate and verify a message authentication code. The DES encryption algorithm uses a 56-bit key. Triple DES (**3DES**) is a variation on **DES** that uses a 168-bit key. As a result, **3DES** is more secure than **DES**. It also requires more processing power, resulting in increased latency and decreased throughput. This implementation of AES uses a 128-bit key. **AES** is faster than **3DES**.
Authentication Algorithm	Select **SHA1** or **MD5** from the drop-down list box. **MD5** (Message Digest 5) and **SHA1** (Secure Hash Algorithm) are hash algorithms used to authenticate packet data. The **SHA1** algorithm is generally considered stronger than **MD5**, but is slower. Select **MD5** for minimal security and **SHA-1** for maximum security.
SA Life Time (Seconds)	Define the length of time before an IPSec SA automatically renegotiates in this field. It may range from 60 to 3,000,000 seconds (almost 35 days). A short SA Life Time increases security by forcing the two VPN gateways to update the encryption and authentication keys. However, every time the VPN tunnel renegotiates, all users accessing remote resources are temporarily disconnected.
Key Group	You must choose a key group for phase 1 IKE setup. **DH1** (default) refers to Diffie-Hellman Group 1 a 768 bit random number. **DH2** refers to Diffie-Hellman Group 2 a 1024 bit (1Kb) random number.

Table 80 Security > VPN > Setup > Edit > Advanced Setup (continued)

LABEL	DESCRIPTION
Phase 2	
Active Protocol	Use the drop-down list box to choose from **ESP** or **AH**.
Encryption Algorithm	This field is available when you select **ESP** in the **Active Protocol** field. Select **DES**, **3DES**, **AES** or **NULL** from the drop-down list box. When you use one of these encryption algorithms for data communications, both the sending device and the receiving device must use the same secret key, which can be used to encrypt and decrypt the message or to generate and verify a message authentication code. The DES encryption algorithm uses a 56-bit key. Triple DES (**3DES**) is a variation on DES that uses a 168-bit key. As a result, **3DES** is more secure than **DES**. It also requires more processing power, resulting in increased latency and decreased throughput. This implementation of AES uses a 128-bit key. **AES** is faster than **3DES**. Select **NULL** to set up a tunnel without encryption. When you select **NULL**, you do not enter an encryption key.
Authentication Algorithm	Select **SHA1** or **MD5** from the drop-down list box. MD5 (Message Digest 5) and SHA1 (Secure Hash Algorithm) are hash algorithms used to authenticate packet data. The SHA1 algorithm is generally considered stronger than MD5, but is slower. Select **MD5** for minimal security and **SHA-1** for maximum security.
SA Life Time (Seconds)	Define the length of time before an IKE SA automatically renegotiates in this field. It may range from 60 to 3,000,000 seconds (almost 35 days). A short SA Life Time increases security by forcing the two VPN gateways to update the encryption and authentication keys. However, every time the VPN tunnel renegotiates, all users accessing remote resources are temporarily disconnected.
Encapsulation	Select **Tunnel** mode or **Transport** mode from the drop-down list box.
Perfect Forward Secrecy (PFS)	Perfect Forward Secrecy (PFS) is disabled (**NONE**) by default in phase 2 IPSec SA setup. This allows faster IPSec setup, but is not so secure. Choose **DH1** or **DH2** from the drop-down list box to enable PFS. **DH1** refers to Diffie-Hellman Group 1 a 768 bit random number. **DH2** refers to Diffie-Hellman Group 2 a 1024 bit (1Kb) random number (more secure, yet slower).
Back	Click **Back** to return to the previous screen.
Apply	Click **Apply** to save your changes back to the ZyXEL Device and return to the **VPN-IKE** screen.
Cancel	Click **Cancel** to return to the **VPN-IKE** screen without saving your changes.

14.5 Manual Key Setup

Manual key management is useful if you have problems with **IKE** key management.

14.5.1 Security Parameter Index (SPI)

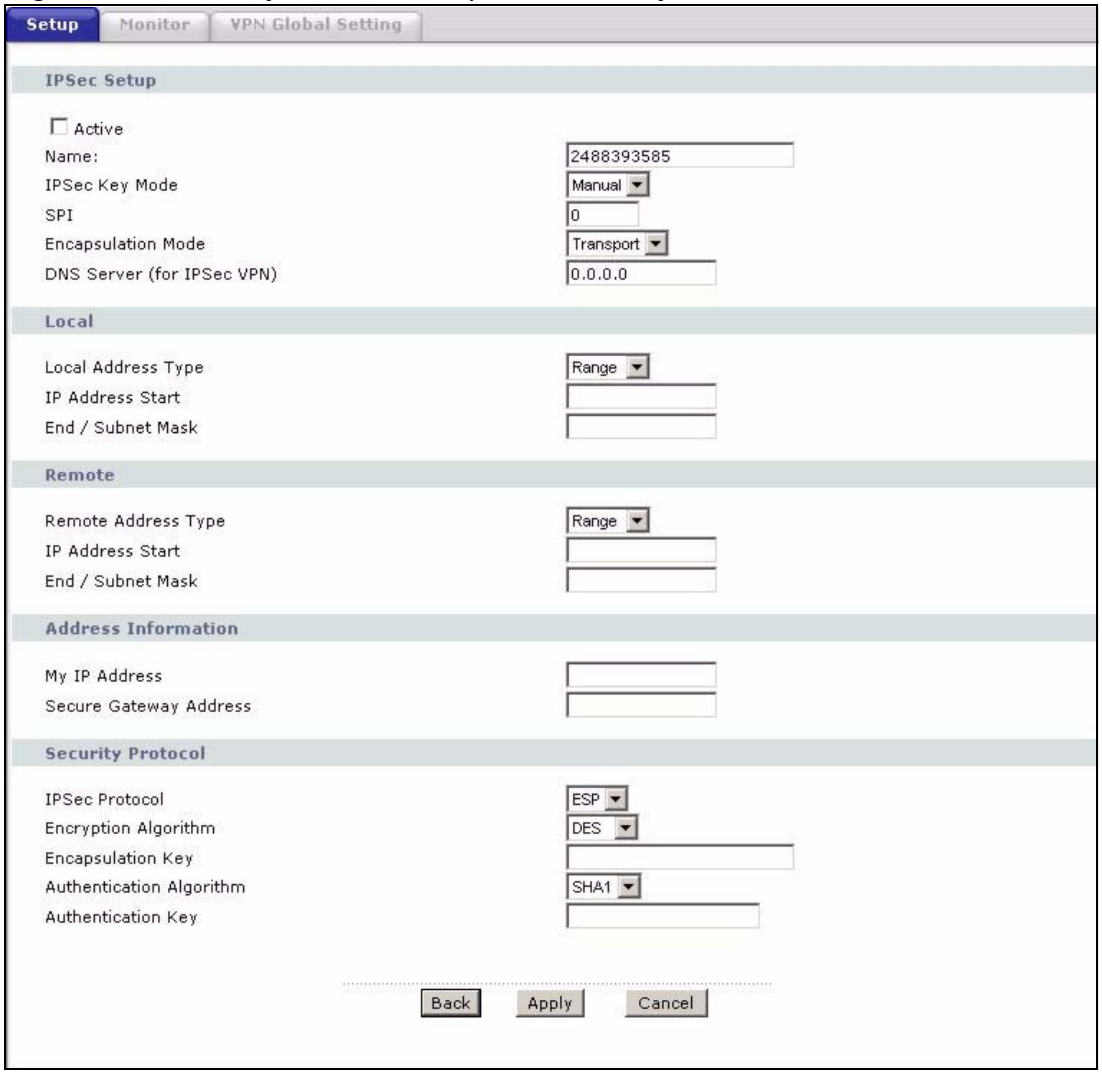
An SPI is used to distinguish different SAs terminating at the same destination and using the same IPSec protocol. This data allows for the multiplexing of SAs to a single gateway. The **SPI** (Security Parameter Index) along with a destination IP address uniquely identify a particular Security Association (SA). The **SPI** is transmitted from the remote VPN gateway to the local VPN gateway. The local VPN gateway then uses the network, encryption and key values that the administrator associated with the SPI to establish the tunnel.

Current ZyXEL implementation assumes identical outgoing and incoming SPIs.

14.6 Configuring Manual Key

You only configure VPN manual key when you select **Manual** in the **IPSec Key Mode** field on the **VPN Setup-Edit** screen. This is the **VPN Setup - Manual Key** screen as shown next.

Figure 162 Security > VPN > Setup > Manual Key



The following table describes the fields in this screen.

Table 81 Security > VPN > Setup > Manual Key

LABEL	DESCRIPTION
IPSec Setup	
Active	Select this check box to activate this VPN policy.
Name	Type up to 32 characters to identify this VPN policy. You may use any character, including spaces, but the ZyXEL Device drops trailing spaces.

Table 81 Security > VPN > Setup > Manual Key (continued)

LABEL	DESCRIPTION
IPSec Key Mode	Select **IKE** or **Manual** from the drop-down list box. **Manual** is a useful option for troubleshooting if you have problems using **IKE** key management.
SPI	Type a number (base 10) from 1 to 999999 for the Security Parameter Index.
Encapsulation Mode	Select **Tunnel** mode or **Transport** mode from the drop-down list box.
DNS Server (for IPSec VPN)	If there is a private DNS server that services the VPN, type its IP address here. The ZyXEL Device assigns this additional DNS server to the ZyXEL Device 's DHCP clients that have IP addresses in this IPSec rule's range of local addresses. A DNS server allows clients on the VPN to find other computers and servers on the VPN by their (private) domain names.
Local	Local IP addresses must be static and correspond to the remote IPSec router's configured remote IP addresses. Two active SAs cannot have the local and remote IP address(es) both the same. Two active SAs can have the same local or remote IP address, but not both. You can configure multiple SAs between the same local and remote IP addresses, as long as only one is active at any time.
Local Address Type	Use the drop-down menu to choose **Single**, **Range**, or **Subnet**. Select **Single** for a single IP address. Select **Range** for a specific range of IP addresses. Select **Subnet** to specify IP addresses on a network by their subnet mask.
IP Address Start	When the **Local Address Type** field is configured to **Single**, enter a (static) IP address on the LAN behind your ZyXEL Device. When the **Local Address Type** field is configured to **Range**, enter the beginning (static) IP address, in a range of computers on your LAN behind your ZyXEL Device. When the **Local Address Type** field is configured to **Subnet**, this is a (static) IP address on the LAN behind your ZyXEL Device.
End / Subnet Mask	When the **Local Address Type** field is configured to **Single**, this field is N/A. When the **Local Address Type** field is configured to **Range**, enter the end (static) IP address, in a range of computers on the LAN behind your ZyXEL Device. When the **Local Address Type** field is configured to **Subnet**, this is a subnet mask on the LAN behind your ZyXEL Device.
Remote	Remote IP addresses must be static and correspond to the remote IPSec router's configured local IP addresses. Two active SAs cannot have the local and remote IP address(es) both the same. Two active SAs can have the same local or remote IP address, but not both. You can configure multiple SAs between the same local and remote IP addresses, as long as only one is active at any time.
Remote Address Type	Use the drop-down menu to choose **Single**, **Range**, or **Subnet**. Select **Single** with a single IP address. Select **Range** for a specific range of IP addresses. Select **Subnet** to specify IP addresses on a network by their subnet mask.

Table 81 Security > VPN > Setup > Manual Key (continued)

LABEL	DESCRIPTION
IP Address Start	When the **Remote Address Type** field is configured to Single, enter a (static) IP address on the network behind the remote IPSec router. When the **Remote Address Type** field is configured to **Range**, enter the beginning (static) IP address, in a range of computers on the network behind the remote IPSec router. When the **Remote Address Type** field is configured to **Subnet**, enter a (static) IP address on the network behind the remote IPSec router.
End / Subnet Mask	When the **Remote Address Type** field is configured to **Single**, this field is N/A. When the **Remote Address Type** field is configured to **Range**, enter the end (static) IP address, in a range of computers on the network behind the remote IPSec router. When the **Remote Address Type** field is configured to **Subnet**, enter a subnet mask on the network behind the remote IPSec router.
Address Information	
My IP Address	Enter the WAN IP address of your ZyXEL Device. The VPN tunnel has to be rebuilt if this IP address changes. The following applies if this field is configured as **0.0.0.0**: The ZyXEL Device uses the current ZyXEL Device WAN IP address (static or dynamic) to set up the VPN tunnel.
Secure Gateway Address	Type the WAN IP address or the URL (up to 31 characters) of the IPSec router with which you're making the VPN connection.
Security Protocol	
IPSec Protocol	Select **ESP** if you want to use ESP (Encapsulation Security Payload). The ESP protocol (RFC 2406) provides encryption as well as some of the services offered by **AH**. If you select ESP here, you must select options from the **Encryption Algorithm** and **Authentication Algorithm** fields (described next).
Encryption Algorithm	Select **DES**, **3DES** or **NULL** from the drop-down list box. When **DES** is used for data communications, both sender and receiver must know the same secret key, which can be used to encrypt and decrypt the message or to generate and verify a message authentication code. The **DES** encryption algorithm uses a 56-bit key. Triple DES (**3DES**) is a variation on **DES** that uses a 168-bit key. As a result, **3DES** is more secure than **DES**. It also requires more processing power, resulting in increased latency and decreased throughput. Select **NULL** to set up a tunnel without encryption. When you select **NULL**, you do not enter an encryption key.
Encapsulation Key (only with ESP)	With **DES**, type a unique key 8 characters long. With **3DES**, type a unique key 24 characters long. Any characters may be used, including spaces, but trailing spaces are truncated.
Authentication Algorithm	Select **SHA1** or **MD5** from the drop-down list box. **MD5** (Message Digest 5) and **SHA1** (Secure Hash Algorithm) are hash algorithms used to authenticate packet data. The **SHA1** algorithm is generally considered stronger than **MD5**, but is slower. Select **MD5** for minimal security and **SHA-1** for maximum security.

Table 81 Security > VPN > Setup > Manual Key (continued)

LABEL	DESCRIPTION
Authentication Key	Type a unique authentication key to be used by IPSec if applicable. Enter 16 characters for **MD5** authentication or 20 characters for **SHA-1** authentication. Any characters may be used, including spaces, but trailing spaces are truncated.
Back	Click **Back** to return to the previous screen.
Apply	Click **Apply** to save your changes back to the ZyXEL Device.
Cancel	Click **Cancel** to begin configuring this screen afresh.

14.7 Viewing SA Monitor

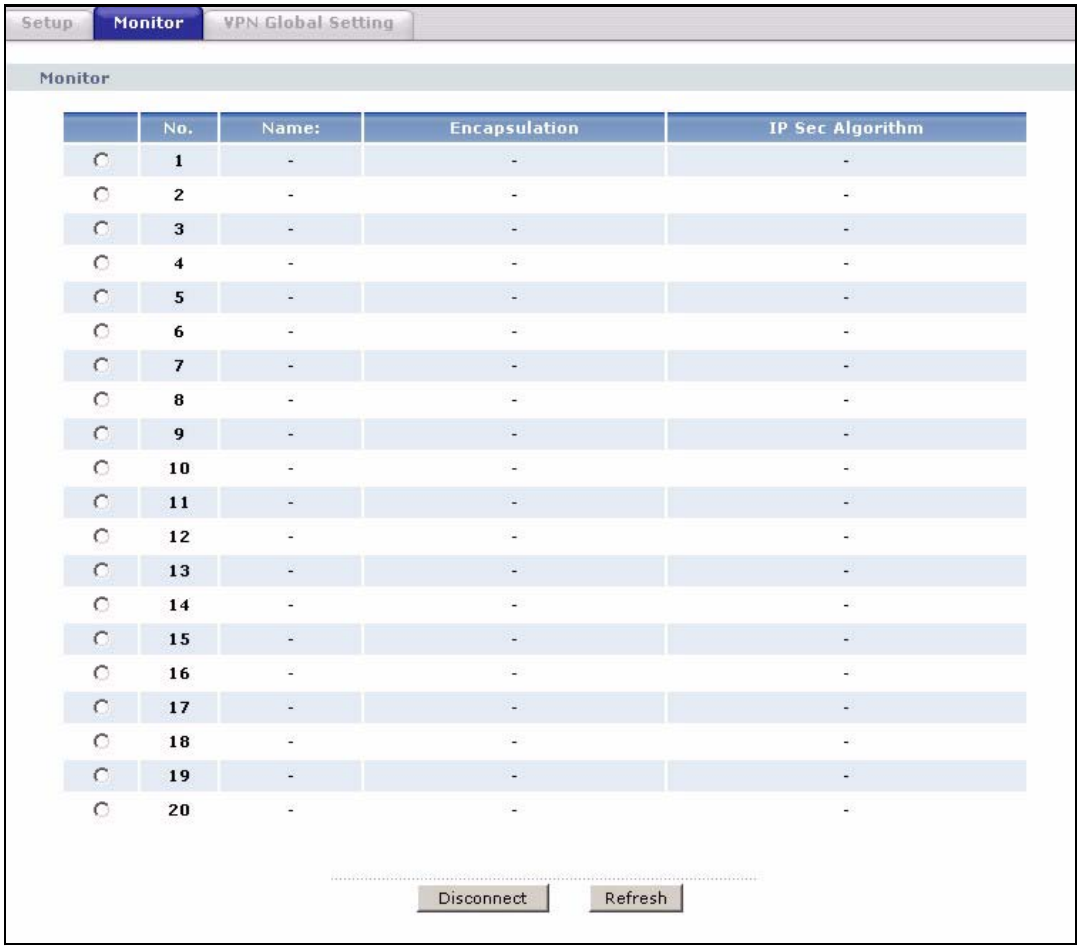
Click **Security** > **VPN** > **Monitor** to open the screen as shown. Use this screen to display and manage active VPN connections.

A Security Association (SA) is the group of security settings related to a specific VPN tunnel. This screen displays active VPN connections. Use **Refresh** to display active VPN connections. This screen is read-only. The following table describes the fields in this tab.

When there is outbound traffic but no inbound traffic, the SA times out automatically after two minutes. A tunnel with no outbound or inbound traffic is "idle" and does not timeout until the SA lifetime period expires. See Section

14.9.7 on page 279on keep alive to have the ZyXEL Device renegotiate an IPSec SA when the SA lifetime expires, even if there is no traffic.

Figure 163 Security > VPN > Monitor



The following table describes the fields in this screen.

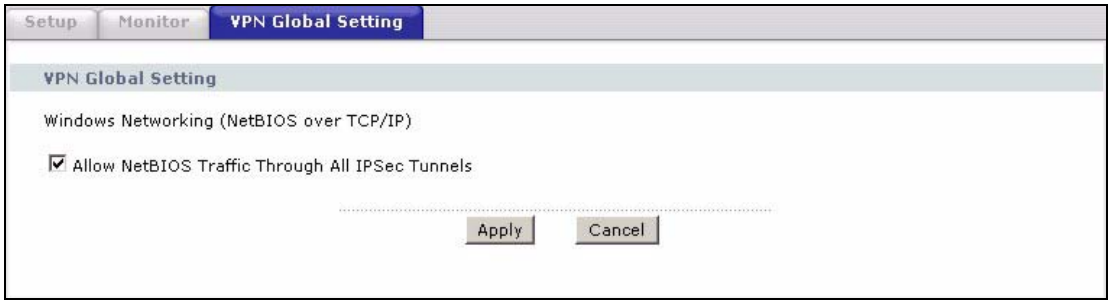
Table 82 Security > VPN > Monitor

LABEL	DESCRIPTION
No	This is the security association index number.
Name	This field displays the identification name for this VPN policy.
Encapsulation	This field displays **Tunnel** or **Transport** mode.
IPSec Algorithm	This field displays the security protocol, encryption algorithm, and authentication algorithm used in each VPN tunnel.
Disconnect	Select one of the security associations, and then click **Disconnect** to stop that security association.
Refresh	Click **Refresh** to display the current active VPN connection(s).

14.8 Configuring VPN Global Setting

To change your ZyXEL Device's global settings, click **VPN** > **VPN Global Setting**. The screen appears as shown.

Figure 164 Security > VPN > Global Setting



The following table describes the fields in this screen.

Table 83 Security > VPN > Global Setting

LABEL	DESCRIPTION
Windows Networking (NetBIOS over TCP/IP)	NetBIOS (Network Basic Input/Output System) are TCP or UDP packets that enable a computer to find other computers. It may sometimes be necessary to allow NetBIOS packets to pass through VPN tunnels in order to allow local computers to find computers on the remote network and vice versa.
Allow NetBIOS Traffic Through All IPSec Tunnels	Select this check box to send NetBIOS packets through the VPN connection.
Apply	Click **Apply** to save your changes back to the ZyXEL Device.
Cancel	Click **Cancel** to begin configuring this screen afresh.

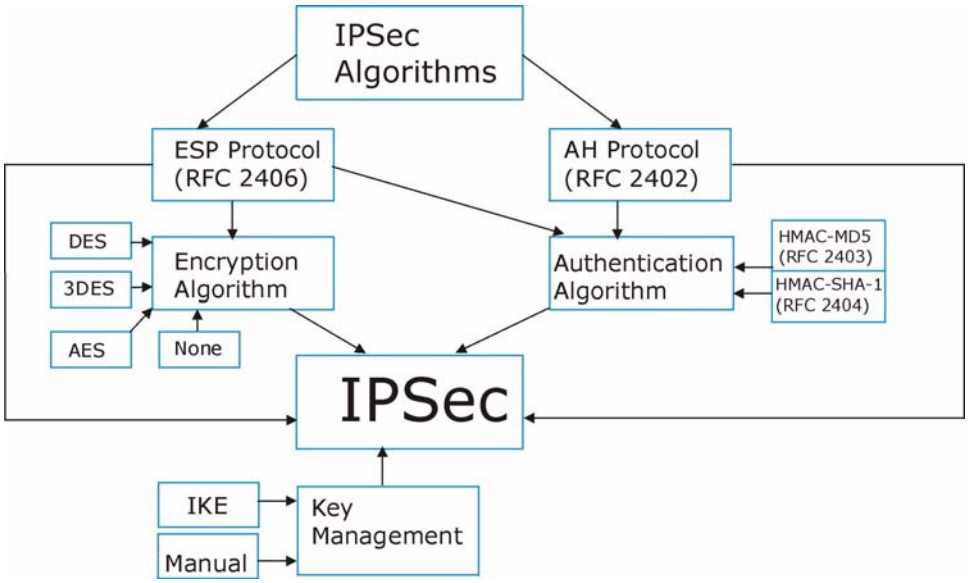
14.9 IPSec VPN Technical Reference

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

14.9.1 IPSec Architecture

The overall IPSec architecture is shown as follows.

Figure 165 IPSec Architecture



IPSec Algorithms

The **ESP** (Encapsulating Security Payload) Protocol (RFC 2406) and **AH** (Authentication Header) protocol (RFC 2402) describe the packet formats and the default standards for packet structure (including implementation algorithms).

The Encryption Algorithm describes the use of encryption techniques such as DES (Data Encryption Standard) and Triple DES algorithms.

The Authentication Algorithms, HMAC-MD5 (RFC 2403) and HMAC-SHA-1 (RFC 2404, provide an authentication mechanism for the **AH** and **ESP** protocols.

Key Management

Key management allows you to determine whether to use IKE (ISAKMP) or manual key configuration in order to set up a VPN.

14.9.2 IPSec and NAT

Read this section if you are running IPSec on a host computer behind the ZyXEL Device.

NAT is incompatible with the **AH** protocol in both **Transport** and **Tunnel** mode. An IPSec VPN using the **AH** protocol digitally signs the outbound packet, both data

payload and headers, with a hash value appended to the packet. When using **AH** protocol, packet contents (the data payload) are not encrypted.

A NAT device in between the IPSec endpoints will rewrite either the source or destination address with one of its own choosing. The VPN device at the receiving end will verify the integrity of the incoming packet by computing its own hash value, and complain that the hash value appended to the received packet doesn't match. The VPN device at the receiving end doesn't know about the NAT in the middle, so it assumes that the data has been maliciously altered.

IPSec using **ESP** in **Tunnel** mode encapsulates the entire original packet (including headers) in a new IP packet. The new IP packet's source address is the outbound address of the sending VPN gateway, and its destination address is the inbound address of the VPN device at the receiving end. When using **ESP** protocol with authentication, the packet contents (in this case, the entire original packet) are encrypted. The encrypted contents, but not the new headers, are signed with a hash value appended to the packet.

Tunnel mode **ESP** with authentication is compatible with NAT because integrity checks are performed over the combination of the "original header plus original payload," which is unchanged by a NAT device.

Transport mode **ESP** with authentication is not compatible with NAT.

Table 84 VPN and NAT

SECURITY PROTOCOL	MODE	NAT
AH	Transport	N
AH	Tunnel	N
ESP	Transport	N
ESP	Tunnel	Y

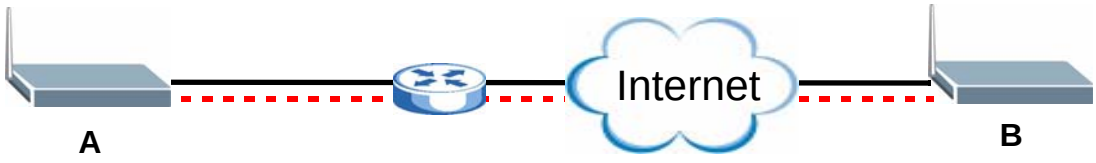
14.9.3 VPN, NAT, and NAT Traversal

NAT is incompatible with the AH protocol in both transport and tunnel mode. An IPSec VPN using the AH protocol digitally signs the outbound packet, both data payload and headers, with a hash value appended to the packet, but a NAT device between the IPSec endpoints rewrites the source or destination address. As a result, the VPN device at the receiving end finds a mismatch between the hash value and the data and assumes that the data has been maliciously altered.

NAT is not normally compatible with ESP in transport mode either, but the ZyXEL Device's **NAT Traversal** feature provides a way to handle this. NAT traversal

allows you to set up an IKE SA when there are NAT routers between the two IPSec routers.

Figure 166 NAT Router Between IPSec Routers



Normally you cannot set up an IKE SA with a NAT router between the two IPSec routers because the NAT router changes the header of the IPSec packet. NAT traversal solves the problem by adding a UDP port 500 header to the IPSec packet. The NAT router forwards the IPSec packet with the UDP port 500 header unchanged. In Figure 166 on page 276, when IPSec router **A** tries to establish an IKE SA, IPSec router **B** checks the UDP port 500 header, and IPSec routers **A** and **B** build the IKE SA.

For NAT traversal to work, you must:

- Use ESP security protocol (in either transport or tunnel mode).
- Use IKE keying mode.
- Enable NAT traversal on both IPSec endpoints.
- Set the NAT router to forward UDP port 500 to IPSec router **A**.

Finally, NAT is compatible with ESP in tunnel mode because integrity checks are performed over the combination of the "original header plus original payload," which is unchanged by a NAT device. The compatibility of AH and ESP with NAT in tunnel and transport modes is summarized in the following table.

Table 85 VPN and NAT

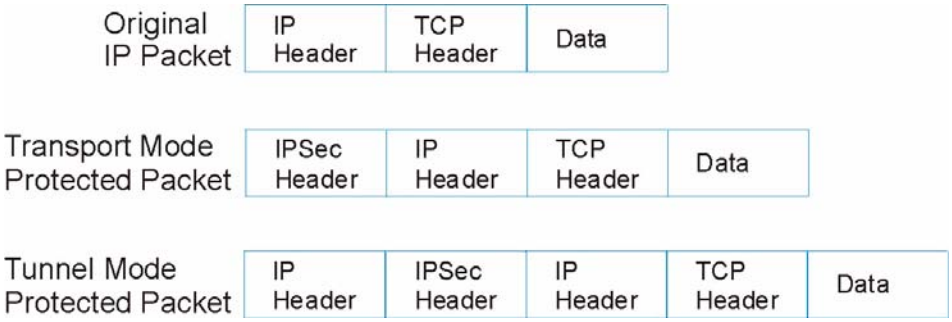
SECURITY PROTOCOL	MODE	NAT
AH	Transport	N
AH	Tunnel	N
ESP	Transport	Y*
ESP	Tunnel	Y

Y* - This is supported in the ZyXEL Device if you enable NAT traversal.

14.9.4 Encapsulation

The two modes of operation for IPSec VPNs are **Transport** mode and **Tunnel** mode.

Figure 167 Transport and Tunnel Mode IPSec Encapsulation



Transport Mode

Transport mode is used to protect upper layer protocols and only affects the data in the IP packet. In **Transport** mode, the IP packet contains the security protocol (**AH** or **ESP**) located after the original IP header and options, but before any upper layer protocols contained in the packet (such as TCP and UDP).

With **ESP,** protection is applied only to the upper layer protocols contained in the packet. The IP header information and options are not used in the authentication process. Therefore, the originating IP address cannot be verified for integrity against the data.

With the use of **AH** as the security protocol, protection is extended forward into the IP header to verify the integrity of the entire packet by use of portions of the original IP header in the hashing process.

Tunnel Mode

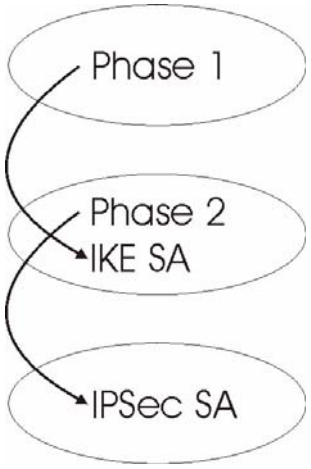
Tunnel mode encapsulates the entire IP packet to transmit it securely. A **Tunnel** mode is required for gateway services to provide access to internal systems. **Tunnel** mode is fundamentally an IP tunnel with authentication and encryption. This is the most common mode of operation. **Tunnel** mode is required for gateway to gateway and host to gateway communications. **Tunnel** mode communications have two sets of IP headers:

- **Outside header**: The outside IP header contains the destination IP address of the VPN gateway.
- **Inside header**: The inside IP header contains the destination IP address of the final system behind the VPN gateway. The security protocol appears after the outer IP header and before the inside IP header.

14.9.5 IKE Phases

There are two phases to every IKE (Internet Key Exchange) negotiation – phase 1 (Authentication) and phase 2 (Key Exchange). A phase 1 exchange establishes an IKE SA and the second one uses that SA to negotiate SAs for IPSec.

Figure 168 Two Phases to Set Up the IPSec SA



In phase 1 you must:

- Choose a negotiation mode.
- Authenticate the connection by entering a pre-shared key.
- Choose an encryption algorithm.
- Choose an authentication algorithm.
- Choose a Diffie-Hellman public-key cryptography key group (**DH1** or **DH2**).
- Set the IKE SA lifetime. This field allows you to determine how long an IKE SA should stay up before it times out. An IKE SA times out when the IKE SA lifetime period expires. If an IKE SA times out when an IPSec SA is already established, the IPSec SA stays connected.

In phase 2 you must:

- Choose which protocol to use (**ESP** or **AH**) for the IKE key exchange.
- Choose an encryption algorithm.
- Choose an authentication algorithm
- Choose whether to enable Perfect Forward Secrecy (PFS) using Diffie-Hellman public-key cryptography – see Appendix D on page 533. Select **None** (the default) to disable PFS.
- Choose **Tunnel** mode or **Transport** mode.

- Set the IPSec SA lifetime. This field allows you to determine how long the IPSec SA should stay up before it times out. The ZyXEL Device automatically renegotiates the IPSec SA if there is traffic when the IPSec SA lifetime period expires. The ZyXEL Device also automatically renegotiates the IPSec SA if both IPSec routers have keep alive enabled, even if there is no traffic. If an IPSec SA times out, then the IPSec router must renegotiate the SA the next time someone attempts to send traffic.

14.9.6 Negotiation Mode

The phase 1 **Negotiation Mode** you select determines how the Security Association (SA) will be established for each connection through IKE negotiations.

- **Main Mode** ensures the highest level of security when the communicating parties are negotiating authentication (phase 1). It uses 6 messages in three round trips: SA negotiation, Diffie-Hellman exchange and an exchange of nonces (a nonce is a random number). This mode features identity protection (your identity is not revealed in the negotiation).
- **Aggressive Mode** is quicker than **Main Mode** because it eliminates several steps when the communicating parties are negotiating authentication (phase 1). However the trade-off is that faster speed limits its negotiating power and it also does not provide identity protection. It is useful in remote access situations where the address of the initiator is not know by the responder and both parties want to use pre-shared key authentication.

14.9.7 Keep Alive

When you initiate an IPSec tunnel with keep alive enabled, the ZyXEL Device automatically renegotiates the tunnel when the IPSec SA lifetime period expires (see Section 14.9.5 on page 278 for more on the IPSec SA lifetime). In effect, the IPSec tunnel becomes an “always on” connection after you initiate it. Both IPSec routers must have a ZyXEL Device-compatible keep alive feature enabled in order for this feature to work.

If the ZyXEL Device has its maximum number of simultaneous IPSec tunnels connected to it and they all have keep alive enabled, then no other tunnels can take a turn connecting to the ZyXEL Device because the ZyXEL Device never drops the tunnels that are already connected.

When there is outbound traffic with no inbound traffic, the ZyXEL Device automatically drops the tunnel after two minutes.

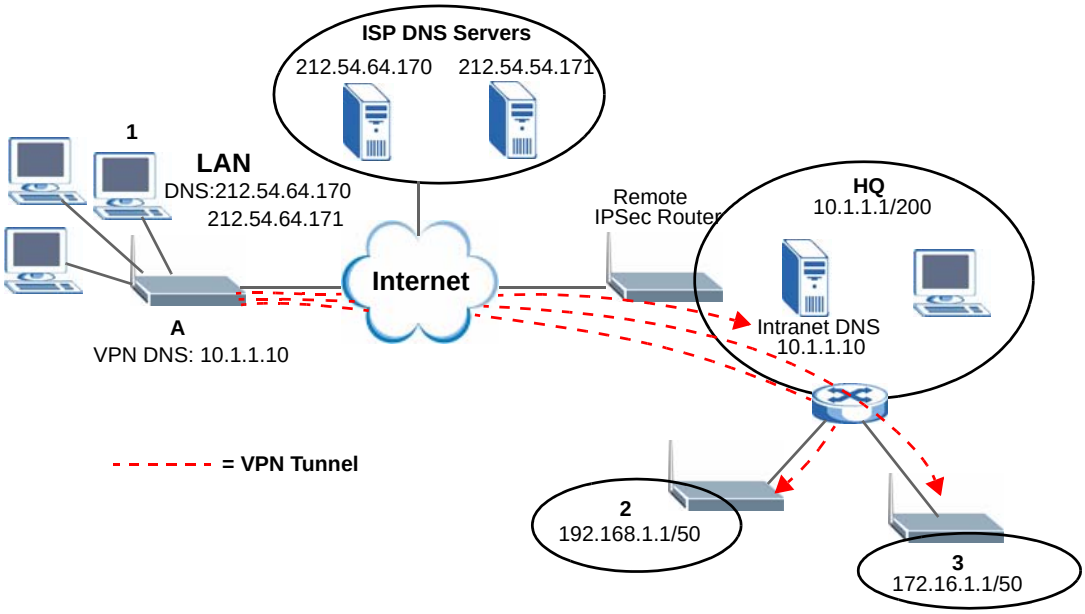
14.9.8 Remote DNS Server

In cases where you want to use domain names to access Intranet servers on a remote network that has a DNS server, you must identify that DNS server. You

cannot use DNS servers on the LAN or from the ISP since these DNS servers cannot resolve domain names to private IP addresses on the remote network

The following figure depicts an example where three VPN tunnels are created from ZyXEL Device A; one to branch office 2, one to branch office 3 and another to headquarters. In order to access computers that use private domain names on the headquarters (HQ) network, the ZyXEL Device at branch office 1 uses the Intranet DNS server in headquarters. The DNS server feature for VPN does not work with Windows 2000 or Windows XP.

Figure 169 VPN Host using Intranet DNS Server Example



If you do not specify an Intranet DNS server on the remote network, then the VPN host must use IP addresses to access the computers on the remote network.

14.9.9 ID Type and Content

With aggressive negotiation mode (seeSection 14.9.6 on page 279), the ZyXEL Device identifies incoming SAs by ID type and content since this identifying information is not encrypted. This enables the ZyXEL Device to distinguish between multiple rules for SAs that connect from remote IPSec routers that have dynamic WAN IP addresses. Telecommuters can use separate passwords to simultaneously connect to the ZyXEL Device from IPSec routers with dynamic IP addresses (seeSection 14.9.12 on page 282 for a telecommuter configuration example).

Regardless of the ID type and content configuration, the ZyXEL Device does not allow you to save multiple active rules with overlapping local and remote IP addresses.

With main mode (seeSection 14.9.6 on page 279), the ID type and content are encrypted to provide identity protection. In this case the ZyXEL Device can only distinguish between up to 12 different incoming SAs that connect from remote IPSec routers that have dynamic WAN IP addresses. The ZyXEL Device can distinguish up to 12 incoming SAs because you can select between three encryption algorithms (DES, 3DES and AES), two authentication algorithms (MD5 and SHA1) and two key groups (DH1 and DH2) when you configure a VPN rule (seeSection 14.4 on page 264). The ID type and content act as an extra level of identification for incoming SAs.

The type of ID can be a domain name, an IP address or an e-mail address. The content is the IP address, domain name, or e-mail address.

Table 86 Local ID Type and Content Fields

LOCAL ID TYPE=	CONTENT=
IP	Type the IP address of your computer or leave the field blank to have the ZyXEL Device automatically use its own IP address.
DNS	Type a domain name (up to 31 characters) by which to identify this ZyXEL Device.
E-mail	Type an e-mail address (up to 31 characters) by which to identify this ZyXEL Device.
	The domain name or e-mail address that you use in the **Content** field is used for identification purposes only and does not need to be a real domain name or e-mail address.

Table 87 Peer ID Type and Content Fields

PEER ID TYPE=	CONTENT=
IP	Type the IP address of the computer with which you will make the VPN connection or leave the field blank to have the ZyXEL Device automatically use the address in the **Secure Gateway Address** field.
DNS	Type a domain name (up to 31 characters) by which to identify the remote IPSec router.
E-mail	Type an e-mail address (up to 31 characters) by which to identify the remote IPSec router.
	The domain name or e-mail address that you use in the **Content** field is used for identification purposes only and does not need to be a real domain name or e-mail address. The domain name also does not have to match the remote router's IP address or what you configure in the **Secure Gateway Address** field below.

14.9.9.1 ID Type and Content Examples

Two IPSec routers must have matching ID type and content configuration in order to set up a VPN tunnel.

The two ZyXEL Devices in this example can complete negotiation and establish a VPN tunnel.

Table 88 Matching ID Type and Content Configuration Example

ZYXEL DEVICE A	ZYXEL DEVICE B
Local ID type: E-mail	Local ID type: IP
Local ID content: tom@yourcompany.com	Local ID content: 1.1.1.2
Peer ID type: IP	Peer ID type: E-mail
Peer ID content: 1.1.1.2	Peer ID content: tom@yourcompany.com

The two ZyXEL Devices in this example cannot complete their negotiation because ZyXEL Device B's **Local ID type** is **IP**, but ZyXEL Device A's **Peer ID type** is set to **E-mail**. An "ID mismatched" message displays in the IPSEC LOG.

Table 89 Mismatching ID Type and Content Configuration Example

ZYXEL DEVICE A	ZYXEL DEVICE B
Local ID type: IP	Local ID type: IP
Local ID content: 1.1.1.10	Local ID content: 1.1.1.10
Peer ID type: E-mail	Peer ID type: IP
Peer ID content: aa@yahoo.com	Peer ID content: N/A

14.9.10 Pre-Shared Key

A pre-shared key identifies a communicating party during a phase 1 IKE negotiation (see Section 14.9.5 on page 278 for more on IKE phases). It is called "pre-shared" because you have to share it with another party before you can communicate with them over a secure connection.

14.9.11 Diffie-Hellman (DH) Key Groups

Diffie-Hellman (DH) is a public-key cryptography protocol that allows two parties to establish a shared secret over an unsecured communications channel. Diffie-Hellman is used within IKE SA setup to establish session keys. 768-bit (Group 1 - **DH1**) and 1024-bit (Group 2 – **DH2**) Diffie-Hellman groups are supported. Upon completion of the Diffie-Hellman exchange, the two peers have a shared secret, but the IKE SA is not authenticated. For authentication, use pre-shared keys.

14.9.12 Telecommuter VPN/IPSec Examples

The following examples show how multiple telecommuters can make VPN connections to a single ZyXEL Device at headquarters. The telecommuters use IPSec routers with dynamic WAN IP addresses. The ZyXEL Device at headquarters has a static public IP address.

14.9.12.1 Telecommuters Sharing One VPN Rule Example

See the following figure and table for an example configuration that allows multiple telecommuters (**A**, **B** and **C** in the figure) to use one VPN rule to simultaneously access a ZyXEL Device at headquarters (**HQ** in the figure). The telecommuters do not have domain names mapped to the WAN IP addresses of their IPSec routers. The telecommuters must all use the same IPSec parameters but the local IP addresses (or ranges of addresses) should not overlap.

Figure 170 Telecommuters Sharing One VPN Rule Example

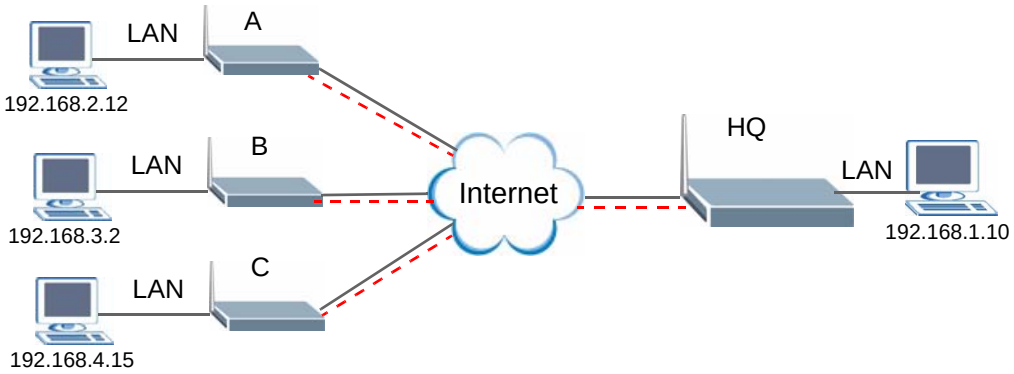


Table 90 Telecommuters Sharing One VPN Rule Example

FIELDS	TELECOMMUTERS	HEADQUARTERS
My IP Address:	0.0.0.0 (dynamic IP address assigned by the ISP)	Public static IP address
Secure Gateway IP Address:	Public static IP address	0.0.0.0 With this IP address only the telecommuter can initiate the IPSec tunnel.
Local IP Address:	Telecommuter A: 192.168.2.12 Telecommuter B: 192.168.3.2 Telecommuter C: 192.168.4.15	192.168.1.10
Remote IP Address:	192.168.1.10	0.0.0.0 (N/A)

14.9.12.2 Telecommuters Using Unique VPN Rules Example

In this example the telecommuters (**A**, **B** and **C** in the figure) use IPSec routers with domain names that are mapped to their dynamic WAN IP addresses (use Dynamic DNS to do this).

With aggressive negotiation mode (see Section 14.9.6 on page 279), the ZyXEL Device can use the ID types and contents to distinguish between VPN rules. Telecommuters can each use a separate VPN rule to simultaneously access a ZyXEL Device at headquarters. They can use different IPSec parameters. The local IP addresses (or ranges of addresses) of the rules configured on the ZyXEL Device

at headquarters can overlap. The local IP addresses of the rules configured on the telecommuters' IPSec routers should not overlap.

See the following table and figure for an example where three telecommuters each use a different VPN rule for a VPN connection with a ZyXEL Device located at headquarters. The ZyXEL Device at headquarters (**HQ** in the figure) identifies each incoming SA by its ID type and content and uses the appropriate VPN rule to establish the VPN connection.

The ZyXEL Device at headquarters can also initiate VPN connections to the telecommuters since it can find the telecommuters by resolving their domain names.

Figure 171 Telecommuters Using Unique VPN Rules Example

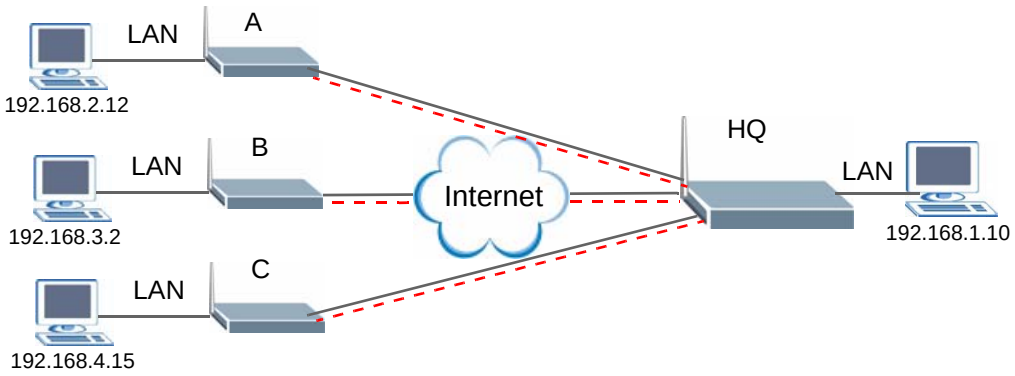


Table 91 Telecommuters Using Unique VPN Rules Example

TELECOMMUTERS	HEADQUARTERS
All Telecommuter Rules:	All Headquarters Rules:
My IP Address 0.0.0.0	My IP Address: bigcompanyhq.com
Secure Gateway Address: bigcompanyhq.com	Local IP Address: 192.168.1.10
Remote IP Address: 192.168.1.10	Local ID Type: E-mail
Peer ID Type: E-mail	Local ID Content: bob@bigcompanyhq.com
Peer ID Content: bob@bigcompanyhq.com	
Telecommuter A (telecommutera.dydns.org)	Headquarters ZyXEL Device Rule 1:
Local ID Type: IP	Peer ID Type: IP
Local ID Content: 192.168.2.12	Peer ID Content: 192.168.2.12
Local IP Address: 192.168.2.12	Secure Gateway Address: telecommuter1.com
	Remote Address 192.168.2.12

Table 91 Telecommuters Using Unique VPN Rules Example (continued)

TELECOMMUTERS	HEADQUARTERS
Telecommuter B (telecommuterb.dydns.org)	Headquarters ZyXEL Device Rule 2:
Local ID Type: DNS	Peer ID Type: DNS
Local ID Content: telecommuterb.com	Peer ID Content: telecommuterb.com
Local IP Address: 192.168.3.2	Secure Gateway Address: telecommuterb.com
	Remote Address 192.168.3.2
Telecommuter C (telecommuterc.dydns.org)	Headquarters ZyXEL Device Rule 3:
Local ID Type: E-mail	Peer ID Type: E-mail
Local ID Content: myVPN@myplace.com	Peer ID Content: myVPN@myplace.com
Local IP Address: 192.168.4.15	Secure Gateway Address: telecommuterc.com
	Remote Address 192.168.4.15

15

Certificates

15.1 Overview

The ZyXEL Device can use certificates (also called digital IDs) to authenticate users. Certificates are based on public-private key pairs. A certificate contains the certificate owner's identity and public key. Certificates provide a way to exchange public keys for use in authentication.

15.1.1 What You Can Do in the Certificate Screens

- Use the **My Certificate** screens (see Section 15.2 on page 291) to generate and export self-signed certificates or certification requests and import the ZyXEL Device's CA-signed certificates.
- Use the **Trusted CA** screens (see Section 15.5 on page 300) to save the certificates of trusted CAs to the ZyXEL Device. You can also export the certificates to a computer.
- Use the **Trusted Remote Hosts** screens (see Section 15.8 on page 306) to import self-signed certificates from trusted remote hosts.

15.1.2 What You Need to Know About Certificates

Certification Authorities

A Certification Authority (CA) issues certificates and guarantees the identity of each certificate owner. There are commercial certification authorities like CyberTrust or VeriSign and government certification authorities. You can use the ZyXEL Device to generate certification requests that contain identifying information and public keys and then send the certification requests to a certification authority.

Public and Private Keys

When using public-key cryptology for authentication, each host has two keys. One key is public and can be made openly available; the other key is private and must be kept secure. Public-key encryption in general works as follows.

1. Tim wants to send a private message to Jenny. Tim generates a public-private key pair. What is encrypted with one key can only be decrypted using the other.
2. Tim keeps the private key and makes the public key openly available.
3. Tim uses his private key to encrypt the message and sends it to Jenny.
4. Jenny receives the message and uses Tim's public key to decrypt it.
5. Additionally, Jenny uses her own private key to encrypt a message and Tim uses Jenny's public key to decrypt the message.

The ZyXEL Device uses certificates based on public-key cryptology to authenticate users attempting to establish a connection. The method used to secure the data that you send through an established connection depends on the type of connection. For example, a VPN tunnel might use the triple DES encryption algorithm.

The certification authority uses its private key to sign certificates. Anyone can then use the certification authority's public key to verify the certificates.

Certification Path

A certification path is the hierarchy of certification authority certificates that validate a certificate. The ZyXEL Device does not trust a certificate if any certificate on its path has expired or been revoked.

Certificate Directory Servers

Certification authorities maintain directory servers with databases of valid and revoked certificates. A directory of certificates that have been revoked before the scheduled expiration is called a CRL (Certificate Revocation List). The ZyXEL Device can check a peer's certificate against a directory server's list of revoked certificates. The framework of servers, software, procedures and policies that handles keys is called PKI (public-key infrastructure).

Advantages of Certificates

Certificates offer the following benefits.

- The ZyXEL Device only has to store the certificates of the certification authorities that you decide to trust, no matter how many devices you need to authenticate.
- Key distribution is simple and very secure since you can freely distribute public keys and you never need to transmit private keys.

Self-signed Certificates

You can have the ZyXEL Device act as a certification authority and sign its own certificates.

15.1.3 Verifying a Certificate

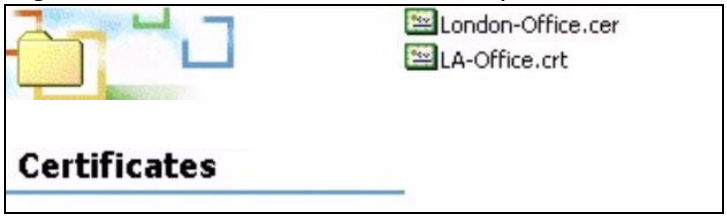
Before you import a trusted CA or trusted remote host certificate into the ZyXEL Device, you should verify that you have the actual certificate. This is especially true of trusted CA certificates since the ZyXEL Device also trusts any valid certificate signed by any of the imported trusted CA certificates.

You can use a certificate's fingerprint to verify it. A certificate's fingerprint is a message digest calculated using the MD5 or SHA1 algorithms. The following procedure describes how to check a certificate's fingerprint to verify that you have the actual certificate.

1 Browse to where you have the certificate saved on your computer.

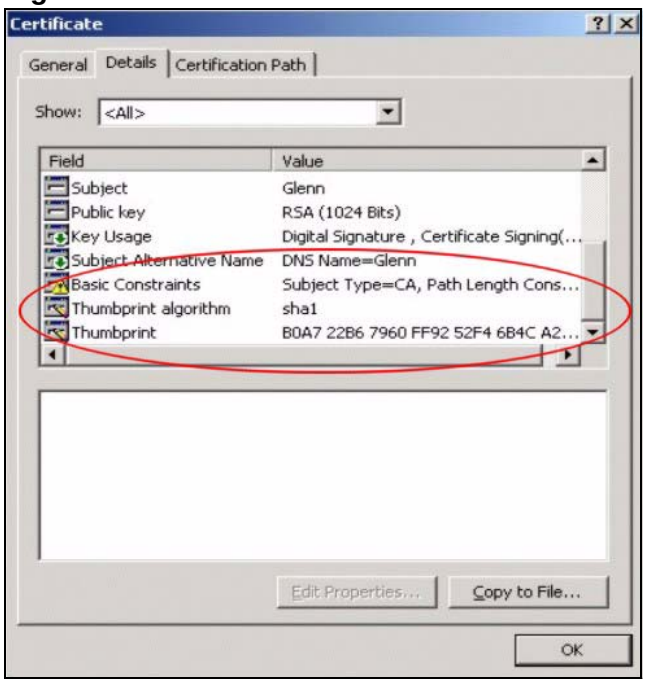
2 Make sure that the certificate has a ".cer" or ".crt" file name extension.

Figure 172 Certificates on Your Computer



3 Double-click the certificate's icon to open the **Certificate** window. Click the **Details** tab and scroll down to the **Thumbprint Algorithm** and **Thumbprint** fields.

Figure 173 Certificate Details

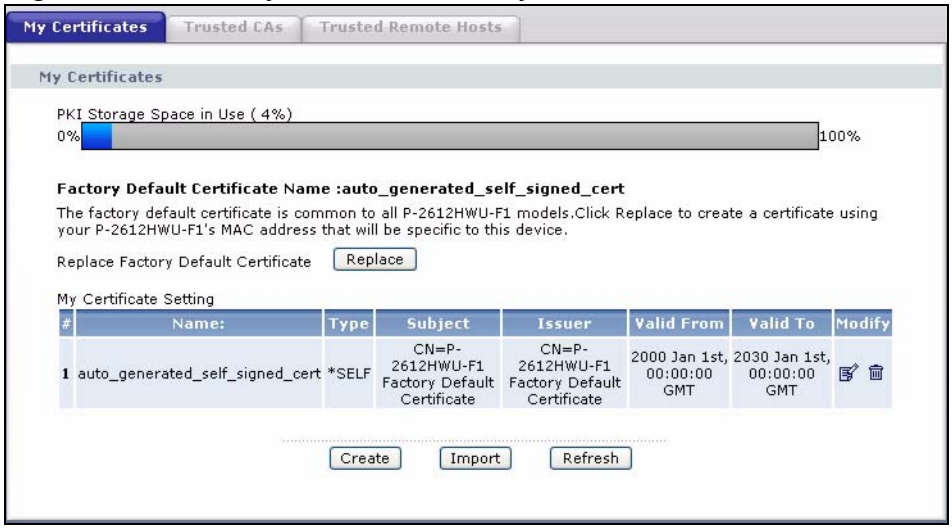


4 Use a secure method to verify that the certificate owner has the same information in the **Thumbprint Algorithm** and **Thumbprint** fields. The secure method may very based on your situation. Possible examples would be over the telephone or through an HTTPS connection.

15.2 My Certificates

Click **Security > Certificates > My Certificates** to open the **My Certificates** screen. This is the ZyXEL Device's summary list of certificates and certification requests. Certificates display in black and certification requests display in gray.

Figure 174 Security > Certificates > My Certificates



The following table describes the labels in this screen.

Table 92 Security > Certificates > My Certificates

LABEL	DESCRIPTION
PKI Storage Space in Use	This bar displays the percentage of the ZyXEL Device's PKI storage space that is currently in use. The bar turns from green to red when the maximum is being approached. When the bar is red, you should consider deleting expired or unnecessary certificates before adding more certificates.
Replace	This button displays when the ZyXEL Device has the factory default certificate. The factory default certificate is common to all devices of this model. ZyXEL recommends that you use this button to replace the factory default certificate with one that uses your ZyXEL Device's MAC address.
#	This field displays the certificate index number. The certificates are listed in alphabetical order.
Name	This field displays the name used to identify this certificate. It is recommended that you give each certificate a unique name.

Table 92 Security > Certificates > My Certificates (continued)

LABEL	DESCRIPTION
Type	This field displays what kind of certificate this is. **REQ** represents a certification request and is not yet a valid certificate. Send a certification request to a certification authority, which then issues a certificate. Use the **My Certificate Import** screen to import the certificate and replace the request. **SELF** represents a self-signed certificate. ***SELF** represents the default self-signed certificate, which the ZyXEL Device uses to sign imported trusted remote host certificates. **CERT** represents a certificate issued by a certification authority.
Subject	This field displays identifying information about the certificate's owner, such as CN (Common Name), OU (Organizational Unit or department), O (Organization or company) and C (Country). It is recommended that each certificate have unique subject information.
Issuer	This field displays identifying information about the certificate's issuing certification authority, such as a common name, organizational unit or department, organization or company and country. With self-signed certificates, this is the same information as in the **Subject** field.
Valid From	This field displays the date that the certificate becomes applicable. The text displays in red and includes a Not Yet Valid! message if the certificate has not yet become applicable.
Valid To	This field displays the date that the certificate expires. The text displays in red and includes an Expiring! or Expired! message if the certificate is about to expire or has already expired.
Modify	Click the Edit icon to open a screen with an in-depth list of information about the certificate. Click the Remove icon to remove the certificate. A window displays asking you to confirm that you want to delete the certificate. You cannot delete a certificate that one or more features is configured to use. Do the following to delete a certificate that shows ***SELF** in the **Type** field. 1. Make sure that no other features, such as HTTPS, VPN, SSH are configured to use the ***SELF** certificate. 2. Click the Edit icon next to another self-signed certificate (see the description on the **Create** button if you need to create a self-signed certificate). 3. Select the **Default self-signed certificate which signs the imported remote host certificates** check box. 4. Click **Apply** to save the changes and return to the **My Certificates** screen. 5. The certificate that originally showed ***SELF** displays **SELF** and you can delete it now. Note that subsequent certificates move up by one when you take this action

Table 92 Security > Certificates > My Certificates (continued)

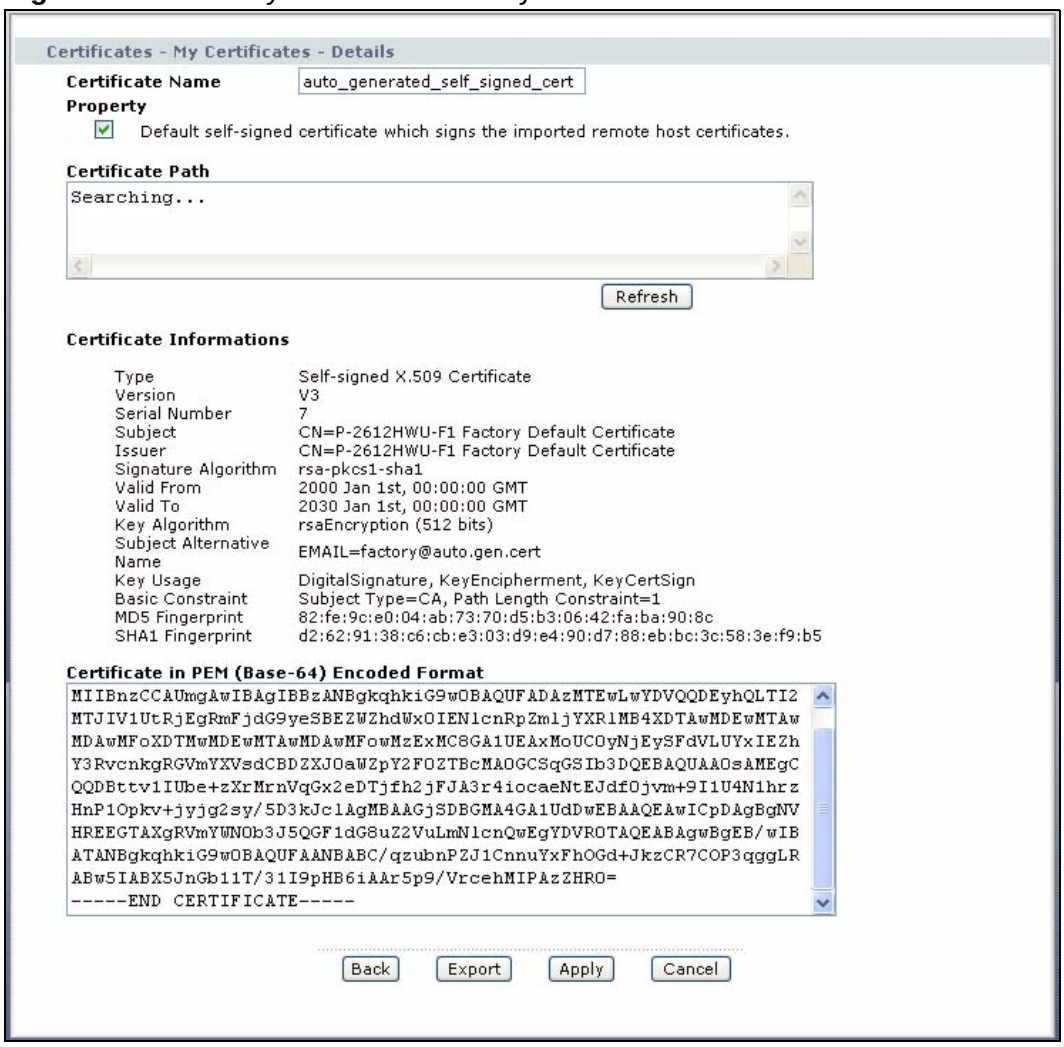
LABEL	DESCRIPTION
Create	Click **Create** to go to the screen where you can have the ZyXEL Device generate a certificate or a certification request.
Import	Click **Import** to open a screen where you can save the certificate that you have enrolled from a certification authority from your computer to the ZyXEL Device.
Refresh	Click **Refresh** to display the current validity status of the certificates.

15.3 My Certificate Details

Click **Security** > **Certificates** > **My Certificates** to open the **My Certificates** screen (see Figure 174 on page 291). Click the edit icon to open the **My Certificate Details** screen. Use this screen to view in-depth certificate information and change the certificate's name.

If it is a self-signed certificate, you can also set the ZyXEL Device to use the certificate to sign the imported trusted remote host certificates.

Figure 175 Security > Certificates > My Certificates > Details



The following table describes the labels in this screen.

Table 93 Security > Certificates > My Certificates > Details

LABEL	DESCRIPTION
Certificate Name	This field displays the identifying name of this certificate. If you want to change the name, type up to 31 characters to identify this certificate. You may use any character (not including spaces).
Property Default self-signed certificate which signs the imported remote host certificates.	Select this check box to have the ZyXEL Device use this certificate to sign the trusted remote host certificates that you import to the ZyXEL Device. This check box is only available with self-signed certificates. If this check box is already selected, you cannot clear it in this screen, you must select this check box in another self-signed certificate's details screen. This automatically clears the check box in the details screen of the certificate that was previously set to sign the imported trusted remote host certificates.

Table 93 Security > Certificates > My Certificates > Details (continued)

LABEL	DESCRIPTION
Certification Path	Click the **Refresh** button to have this read-only text box display the hierarchy of certification authorities that validate the certificate (and the certificate itself). If the issuing certification authority is one that you have imported as a trusted certification authority, it may be the only certification authority in the list (along with the certificate itself). If the certificate is a self-signed certificate, the certificate itself is the only one in the list. The ZyXEL Device does not trust the certificate and displays "Not trusted" in this field if any certificate on the path has expired or been revoked.
Refresh	Click **Refresh** to display the certification path.
Certificate Information	These read-only fields display detailed information about the certificate.
Type	This field displays general information about the certificate. CA-signed means that a Certification Authority signed the certificate. Self-signed means that the certificate's owner signed the certificate (not a certification authority). "X.509" means that this certificate was created and signed according to the ITU-T X.509 recommendation that defines the formats for public-key certificates.
Version	This field displays the X.509 version number.
Serial Number	This field displays the certificate's identification number given by the certification authority or generated by the ZyXEL Device.
Subject	This field displays information that identifies the owner of the certificate, such as Common Name (CN), Organizational Unit (OU), Organization (O) and Country (C).
Issuer	This field displays identifying information about the certificate's issuing certification authority, such as Common Name, Organizational Unit, Organization and Country. With self-signed certificates, this is the same as the **Subject Name** field.
Signature Algorithm	This field displays the type of algorithm that was used to sign the certificate. The ZyXEL Device uses rsa-pkcs1-sha1 (RSA public-private key encryption algorithm and the SHA1 hash algorithm). Some certification authorities may use rsa-pkcs1-md5 (RSA public-private key encryption algorithm and the MD5 hash algorithm).
Valid From	This field displays the date that the certificate becomes applicable. The text displays in red and includes a Not Yet Valid! message if the certificate has not yet become applicable.
Valid To	This field displays the date that the certificate expires. The text displays in red and includes an Expiring! or Expired! message if the certificate is about to expire or has already expired.
Key Algorithm	This field displays the type of algorithm that was used to generate the certificate's key pair (the ZyXEL Device uses RSA encryption) and the length of the key set in bits (1024 bits for example).
Subject Alternative Name	This field displays the certificate owner's IP address (IP), domain name (DNS) or e-mail address (EMAIL).

Table 93 Security > Certificates > My Certificates > Details (continued)

LABEL	DESCRIPTION
Key Usage	This field displays for what functions the certificate's key can be used. For example, "DigitalSignature" means that the key can be used to sign certificates and "KeyEncipherment" means that the key can be used to encrypt text.
Basic Constraint	This field displays general information about the certificate. For example, Subject Type=CA means that this is a certification authority's certificate and "Path Length Constraint=1" means that there can only be one certification authority in the certificate's path.
MD5 Fingerprint	This is the certificate's message digest that the ZyXEL Device calculated using the MD5 algorithm.
SHA1 Fingerprint	This is the certificate's message digest that the ZyXEL Device calculated using the SHA1 algorithm.
Certificate in PEM (Base-64) Encoded Format	This read-only text box displays the certificate or certification request in Privacy Enhanced Mail (PEM) format. PEM uses 64 ASCII characters to convert the binary certificate into a printable form. You can copy and paste a certification request into a certification authority's web page, an e-mail that you send to the certification authority or a text editor and save the file on a management computer for later manual enrollment. You can copy and paste a certificate into an e-mail to send to friends or colleagues or you can copy and paste a certificate into a text editor and save the file on a management computer for later distribution (via floppy disk for example).
Back	Click **Back** to return to the previous screen.
Export	Click this button and then **Save** in the **File Download** screen. The **Save As** screen opens, browse to the location that you want to use and click **Save**.
Apply	Click **Apply** to save your changes back to the ZyXEL Device. You can only change the name, except in the case of a self-signed certificate, which you can also set to be the default self-signed certificate that signs the imported trusted remote host certificates.
Cancel	Click **Cancel** to quit and return to the **My Certificates** screen.

You can only import a certificate that matches a corresponding certification request that was generated by the ZyXEL Device (the certification request contains the private key). The certificate you import replaces the corresponding request in the **My Certificates** screen.

One exception is that you can import a PKCS#12 format certificate without a corresponding certification request since the certificate includes the private key.

Note: Remove any spaces from the certificate's filename before you import it.

Certificate File Formats

The certification authority certificate that you want to import has to be in one of these file formats:

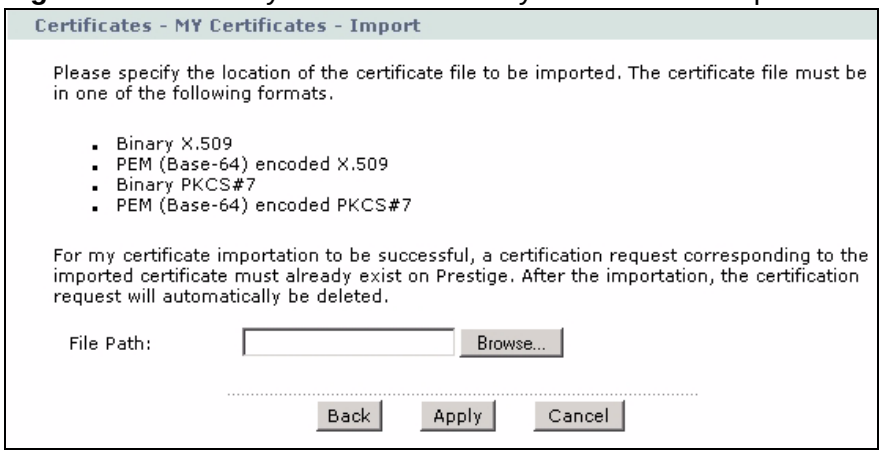
- Binary X.509: This is an ITU-T recommendation that defines the formats for X.509 certificates.
- PEM (Base-64) encoded X.509: This Privacy Enhanced Mail format uses 64 ASCII characters to convert a binary X.509 certificate into a printable form.
- Binary PKCS#7: This is a standard that defines the general syntax for data (including digital signatures) that may be encrypted. The ZyXEL Device currently allows the importation of a PKS#7 file that contains a single certificate.
- PEM (Base-64) encoded PKCS#7: This Privacy Enhanced Mail (PEM) format uses 64 ASCII characters to convert a binary PKCS#7 certificate into a printable form.
- Binary PKCS#12: This is a format for transferring public key and private key certificates. The private key in a PKCS #12 file is within a password-encrypted envelope. The file's password is not connected to your certificate's public or private passwords. Exporting a PKCS #12 file creates this and you must provide it to decrypt the contents when you import the file into the ZyXEL Device.

Note: Be careful not to convert a binary file to text during the transfer process. It is easy for this to occur since many programs use text files by default.

15.3.1 Using the My Certificate Import Screen

Click **Security > Certificates > My Certificates** and then **Import** to open the **My Certificate Import** screen. Follow the instructions in this screen to save an existing certificate to the ZyXEL Device.

Figure 176 Security > Certificates > My Certificates > Import



The following table describes the labels in this screen.

Table 94 Security > Certificates > My Certificates > Import

LABEL	DESCRIPTION
File Path	Type in the location of the file you want to upload in this field or click **Browse** to find it.
Browse	Click **Browse** to find the certificate file you want to upload.

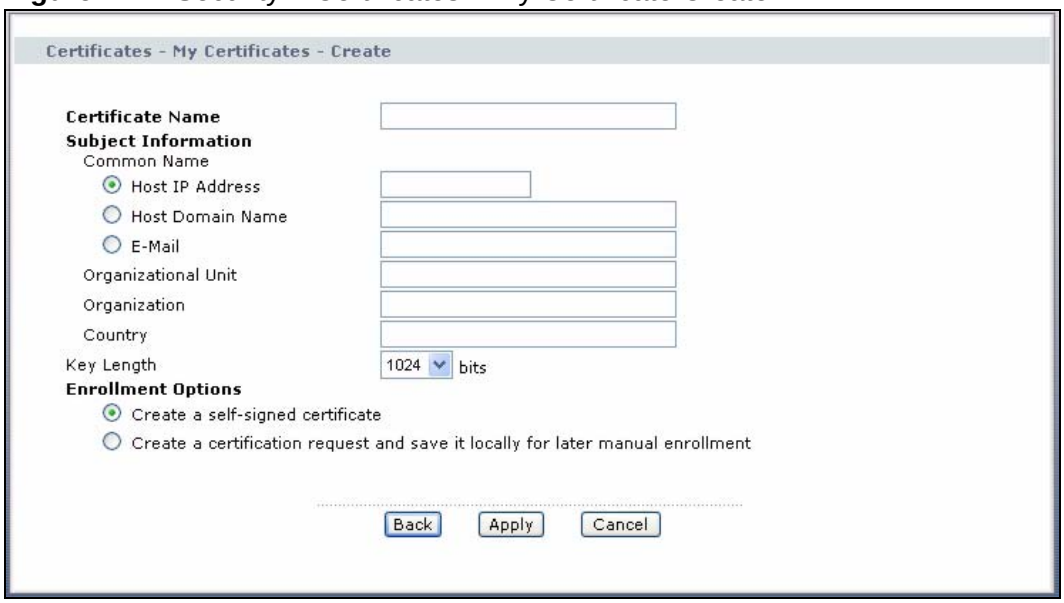
Table 94 Security > Certificates > My Certificates > Import

LABEL	DESCRIPTION
Back	Click **Back** to return to the previous screen.
Apply	Click **Apply** to save the certificate on the ZyXEL Device.
Cancel	Click **Cancel** to clear your settings.

15.4 My Certificate Create

Click **Security** > **Certificates** > **My Certificates** > **Create** to open the **My Certificate Create** screen. Use this screen to have the ZyXEL Device create a self-signed certificate, enroll a certificate with a certification authority or generate a certification request.

Figure 177 Security > Certificates > My Certificate Create



The following table describes the labels in this screen.

Table 95 Security > Certificates > My Certificates > Create

LABEL	DESCRIPTION
Certificate Name	Type up to 31 ASCII characters (not including spaces) to identify this certificate.
Subject Information	Use these fields to record information that identifies the owner of the certificate. You do not have to fill in every field, although the **Common Name** is mandatory. The certification authority may add fields (such as a serial number) to the subject information when it issues a certificate. It is recommended that each certificate have unique subject information.

Table 95 Security > Certificates > My Certificates > Create (continued)

LABEL	DESCRIPTION
Common Name	Select a radio button to identify the certificate's owner by IP address, domain name or e-mail address. Type the IP address (in dotted decimal notation), domain name or e-mail address in the field provided. The domain name or e-mail address can be up to 31 ASCII characters. The domain name or e-mail address is for identification purposes only and can be any string.
Organizational Unit	Type up to 127 characters to identify the organizational unit or department to which the certificate owner belongs. You may use any character, including spaces, but the ZyXEL Device drops trailing spaces.
Organization	Type up to 127 characters to identify the company or group to which the certificate owner belongs. You may use any character, including spaces, but the ZyXEL Device drops trailing spaces.
Country	Type up to 127 characters to identify the nation where the certificate owner is located. You may use any character, including spaces, but the ZyXEL Device drops trailing spaces.
Key Length	Select a number from the drop-down list box to determine how many bits the key should use (512 to 2048). The longer the key, the more secure it is. A longer key also uses more PKI storage space.
Enrollment Options	These radio buttons deal with how and when the certificate is to be generated.
Create a self-signed certificate	Select **Create a self-signed certificate** to have the ZyXEL Device generate the certificate and act as the Certification Authority (CA) itself. This way you do not need to apply to a certification authority for certificates.
Create a certification request and save it locally for later manual enrollment	Select **Create a certification request and save it locally for later manual enrollment** to have the ZyXEL Device generate and store a request for a certificate. Use the **My Certificate Details** screen to view the certification request and copy it to send to the certification authority. Copy the certification request from the **My Certificate Details** screen (see Section 15.3 on page 293) and then send it to the certification authority.
Back	Click **Back** to return to the previous screen.
Apply	Click **Apply** to begin certificate or certification request generation.
Cancel	Click **Cancel** to quit and return to the **My Certificates** screen.

After you click **Apply** in the **My Certificate Create** screen, you see a screen that tells you the ZyXEL Device is generating the self-signed certificate or certification request.

After the ZyXEL Device successfully enrolls a certificate or generates a certification request or a self-signed certificate, you see a screen with a **Return** button that takes you back to the **My Certificates** screen.

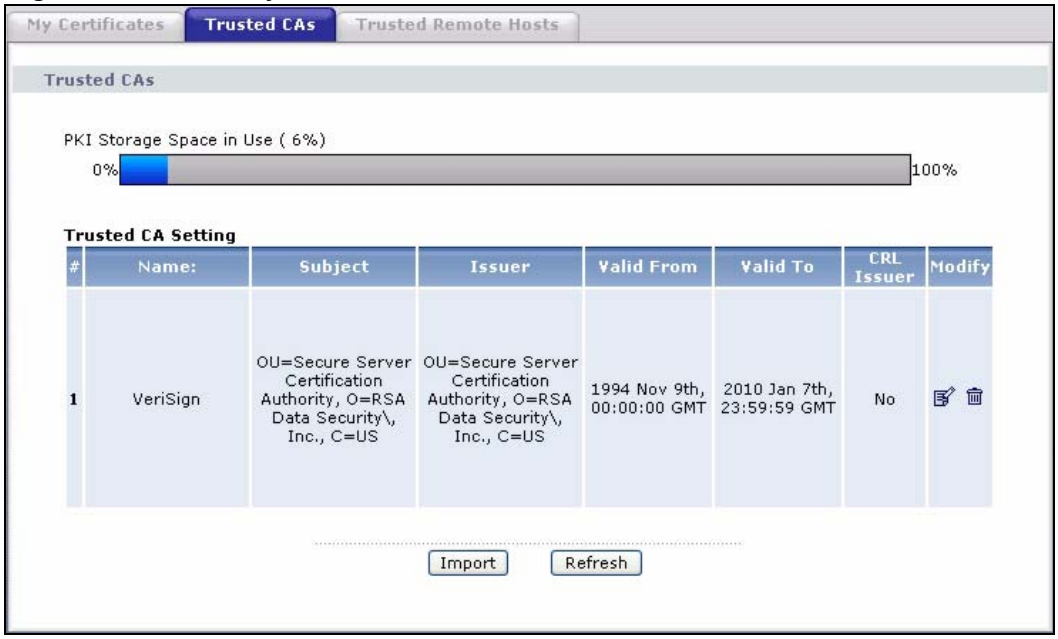
If you configured the **My Certificate Create** screen to have the ZyXEL Device enroll a certificate and the certificate enrollment is not successful, you see a screen with a **Return** button that takes you back to the **My Certificate Create**

screen. Click **Return** and check your information in the **My Certificate Create** screen. Make sure that the certification authority information is correct and that your Internet connection is working properly if you want the ZyXEL Device to enroll a certificate online.

15.5 Trusted CAs

Click **Security > Certificates > Trusted CAs** to open the **Trusted CAs** screen. This screen displays a summary list of certificates of the certification authorities that you have set the ZyXEL Device to accept as trusted. The ZyXEL Device accepts any valid certificate signed by a certification authority on this list as being trustworthy; thus you do not need to import any certificate that is signed by one of these certification authorities.

Figure 178 Security > Certificates > Trusted CAs



The following table describes the labels in this screen.

Table 96 Security > Certificates > Trusted CAs

LABEL	DESCRIPTION
PKI Storage Space in Use	This bar displays the percentage of the ZyXEL Device's PKI storage space that is currently in use. The bar turns from blue to red when the maximum is being approached. When the bar is red, you should consider deleting expired or unnecessary certificates before adding more certificates.
#	This field displays the certificate index number. The certificates are listed in alphabetical order.
Name	This field displays the name used to identify this certificate.