The following table describes the labels in this screen.

Table 89 Access Control: Add/Edit

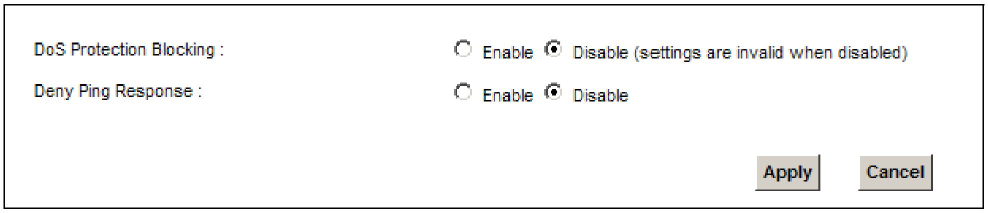
LABEL	DESCRIPTION
Filter Name	Enter a descriptive name of up to 16 alphanumeric characters, not including spaces, underscores, and dashes. You must enter the filter name to add an ACL rule. This field is read-only if you are editing the ACL rule.
Order	Select the order of the ACL rule.
Select Source Device	Select the source device to which the ACL rule applies. If you select **Specific IP Address**, enter the source IP address in the field below.
Source IP Address	Enter the source IP address.
Select Destination Device	Select the destination device to which the ACL rule applies. If you select **Specific IP Address**, enter the destiniation IP address in the field below.
Destination IP Address	Enter the destination IP address.
IP Type	Select whether your IP type is **IPv4** or **IPv6**.
Select Protocol	Select the transport layer protocol that defines your customized port from the drop-down list box. The specific protocol rule sets you add in the **Security > Firewall > Service > Add** screen display in this list. If you want to configure a customized protocol, select **Specific Service**.
Protocol	This field is displayed only when you select **Specific Protocol** in **Select Protocol**. Choose the IP port (**TCP/UDP**, **TCP**, **UDP**, **ICMP**, or **ICMPv6**) that defines your customized port from the drop-down list box.
Custom Source Port	This field is displayed only when you select **Specific Protocol** in **Select Protocol**. Enter a single port number or the range of port numbers of the source.
Custom Destination Port	This field is displayed only when you select **Specific Protocol** in **Select Protocol**. Enter a single port number or the range of port numbers of the destination.
Policy	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 (**ACCEPT**) packets that match this rule.
Direction	Use the drop-down list box to select the direction of traffic to which this rule applies.
Enable Rate Limit	Select this check box to set a limit on the upstream/downstream transmission rate for the specified protocol. Specify how many packets per minute or second the transmission rate is.
Scheduler Rules	Select a schedule rule for this ACL rule form the drop-down list box. You can configure a new schedule rule by click **Add New Rule**. This will bring you to the **Security > Scheduler Rules** screen.
Apply	Click **Apply** to save your changes.
Cancel	Click **Cancel** to exit this screen without saving.

15.5 The DoS Screen

DoS (Denial of Service) attacks can flood your Internet connection with invalid packets and connection requests, using so much bandwidth and so many resources that Internet access becomes unavailable.

Use the **DoS** screen to activate protection against DoS attacks. Click **Security > Firewall > DoS** to display the following screen.

Figure 121 Security > Firewall > DoS



DoS Protection Blocking : ○ Enable ● Disable (settings are invalid when disabled)

Deny Ping Response : ○ Enable ● Disable

The following table describes the labels in this screen.

Table 90 Security > Firewall > DoS

LABEL	DESCRIPTION
DoS Protection Blocking	Select **Enable** to enable protection against DoS attacks.
Deny Ping Response	Select Enable to block ping request packets.
Apply	Click **Apply** to save your changes.
Cancel	Click **Cancel** to exit this screen without saving.

16

MAC Filter

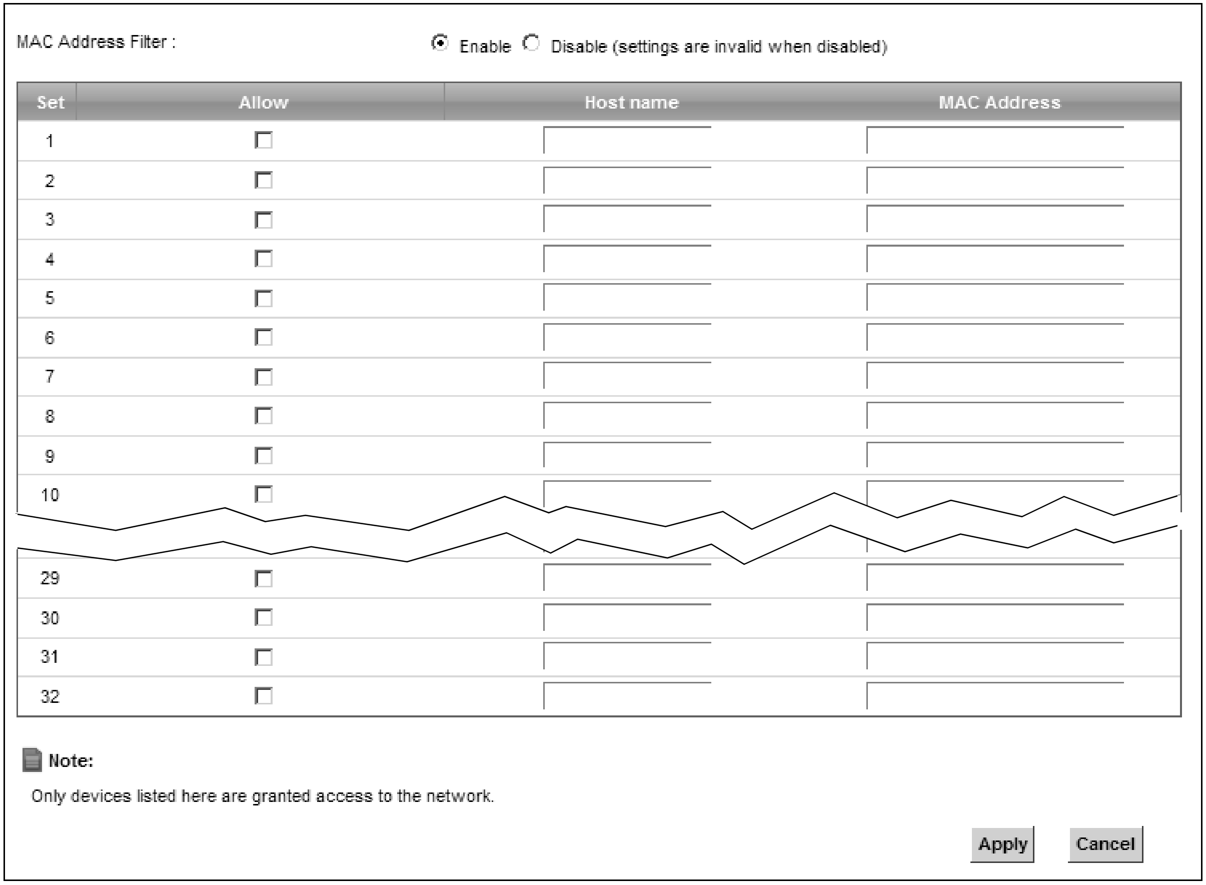
16.1 Overview

You can configure the Device to permit access to clients based on their MAC addresses in the **MAC Filter** screen. This applies to wired and wireless connections. Every Ethernet device has a unique MAC (Media Access Control) address. The MAC address is assigned at the factory and consists of six pairs of hexadecimal characters, for example, 00:A0:C5:00:00:02. You need to know the MAC addresses of the devices to configure this screen.

16.2 The MAC Filter Screen

Use this screen to allow wireless and LAN clients access to the Device. Click **Security** > **MAC Filter**. The screen appears as shown.

Figure 122 Security > MAC Filter



MAC Address Filter : ● Enable ○ Disable (settings are invalid when disabled)

Set	Allow	Host name	MAC Address
1	□		
2	□		
3	□		
4	□		
5	□		
6	□		
7	□		
8	□		
9	□		
10	□		
29	□		
30	□		
31	□		
32	□		

Note:

Only devices listed here are granted access to the network.

The following table describes the labels in this screen.

Table 91 Security > MAC Filter

LABEL	DESCRIPTION
MAC Address Filter	Select **Enable** to activate the MAC filter function.
Set	This is the index number of the MAC address.
Allow	Select **Allow** to permit access to the Device. MAC addresses not listed will be denied access to the Device. If you clear this, the MAC Address field for this set clears.
Host name	Enter the host name of the wireless or LAN clients that are allowed access to the Device.
MAC Address	Enter the MAC addresses of the wireless or LAN clients that are allowed access to the Device in these address fields. Enter the MAC addresses in a valid MAC address format, that is, six hexadecimal character pairs, for example, 12:34:56:78:9a:bc.
Apply	Click **Apply** to save your changes.
Cancel	Click **Cancel** to restore your previously saved settings.

17

Parental Control

17.1 Overview

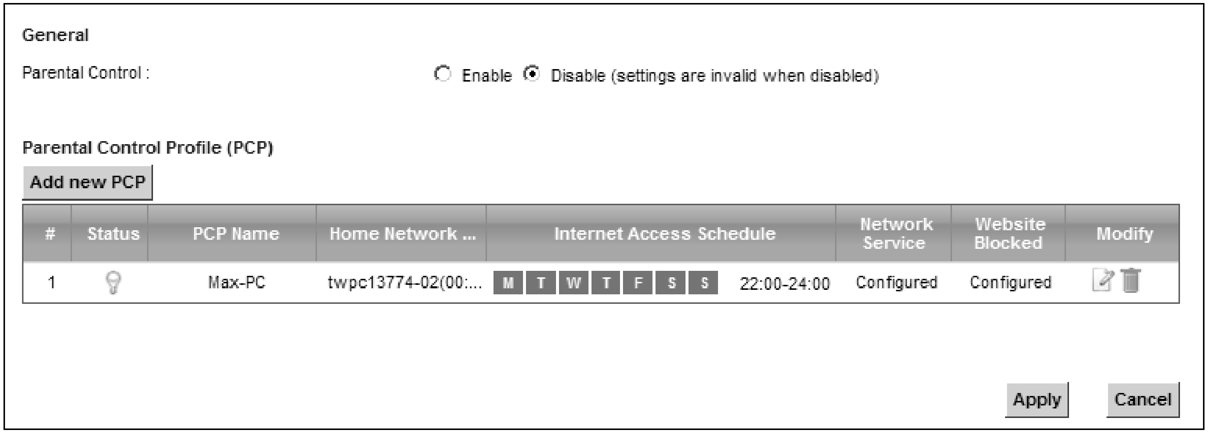
Parental control allows you to block web sites with the specific URL. You can also define time periods and days during which the Device performs parental control on a specific user.

17.2 The Parental Control Screen

Use this screen to enable parental control, view the parental control rules and schedules.

Click **Security** > **Parental Control** to open the following screen.

Figure 123 Security > Parental Control



General

Parental Control : ○ Enable ● Disable (settings are invalid when disabled)

Parental Control Profile (PCP)

#	Status	PCP Name	Home Network ...	Internet Access Schedule	Network Service	Website Blocked	Modify
1	💡	Max-PC	twpc13774-02(00:...	M T W T F S S 22:00-24:00	Configured	Configured	✎ 🗑

The following table describes the fields in this screen.

Table 92 Security > Parental Control

LABEL	DESCRIPTION
Parental Control	Select **Enable** to activate parental control.
Add new PCP	Click this if you want to configure a new parental control rule.
#	This shows the index number of the rule.
Status	This indicates whether the rule is active or not. A yellow bulb signifies that this rule is active. A gray bulb signifies that this rule is not active.
PCP Name	This shows the name of the rule.
Home Network User (MAC)	This shows the MAC address of the LAN user’s computer to which this rule applies.

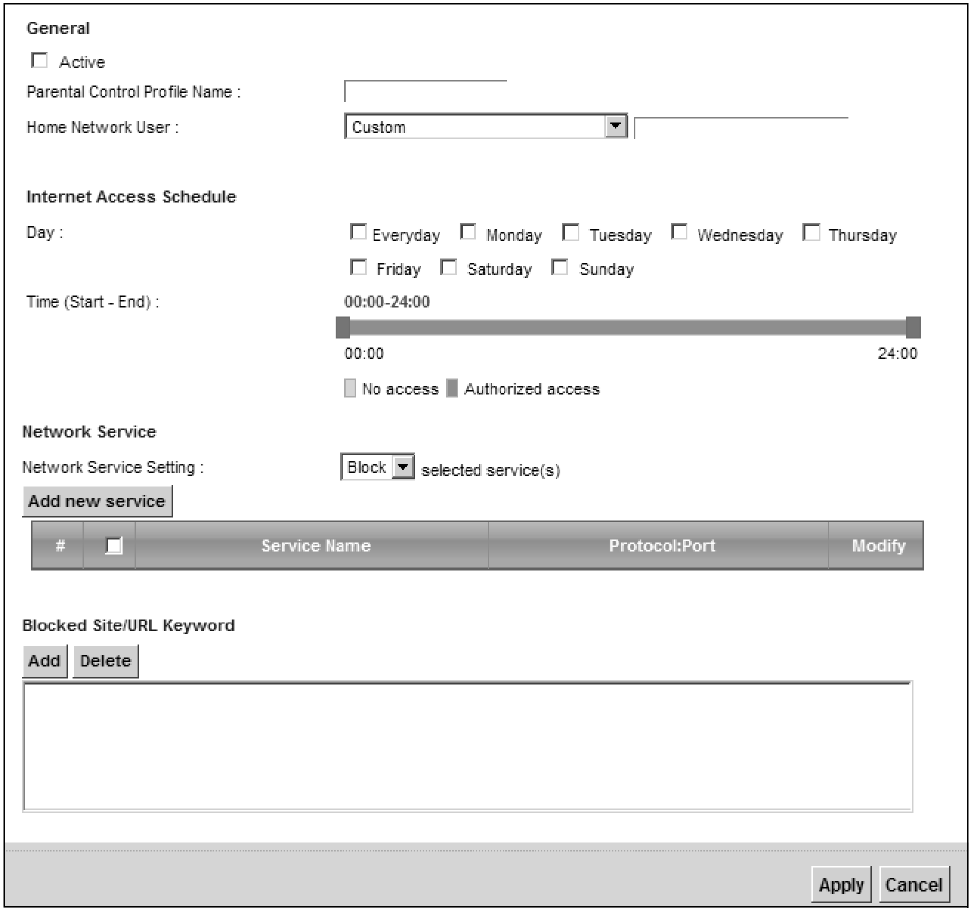
Table 92 Security > Parental Control (continued)

LABEL	DESCRIPTION
Internet Access Schedule	This shows the day(s) and time on which parental control is enabled.
Network Service	This shows whether the network service is configured. If not, **None** will be shown.
Website Block	This shows whether the website block is configured. If not, **None** will be shown.
Modify	Click the **Edit** icon to go to the screen where you can edit the rule. Click the **Delete** icon to delete an existing rule.
Apply	Click **Apply** to save your changes.
Cancel	Click **Cancel** to restore your previously saved settings.

17.2.1 Add/Edit a Parental Control Rule

Click **Add new PCP** in the **Parental Control** screen to add a new rule or click the **Edit** icon next to an existing rule to edit it. Use this screen to configure a restricted access schedule and/or URL filtering settings to block the users on your network from accessing certain web sites.

Figure 124 Parental Control Rule: Add/Edit



General

□ Active

Parental Control Profile Name :

Home Network User : Custom

Internet Access Schedule

Day : □ Everyday □ Monday □ Tuesday □ Wednesday □ Thursday □ Friday □ Saturday □ Sunday

Time (Start - End) : 00:00-24:00

Network Service

Network Service Setting : Block selected service(s)

#	□	Service Name	Protocol:Port	Modify

Blocked Site/URL Keyword

The following table describes the fields in this screen.

Table 93 Parental Control Rule: Add/Edit

LABEL	DESCRIPTION
General	
Active	Select the checkbox to activate this parental control rule.
Parental Control Profile Name	Enter a descriptive name for the rule.
Home Network User	Select the LAN user that you want to apply this rule to from the drop-down list box. If you select **Custom**, enter the LAN user's MAC address. If you select **All**, the rule applies to all LAN users.
Internet Access Schedule	
Day	Select check boxes for the days that you want the Device to perform parental control.
Time	Drag the time bar to define the time that the LAN user is allowed access.
Network Service	
Network Service Setting	If you select **Block**, the Device prohibits the users from viewing the Web sites with the URLs listed below. If you select **Allow**, the Device blocks access to all URLs except ones listed below.
Add new service	Click this to show a screen in which you can add a new service rule. You can configure the **Service Name**, **Protocol**, and **Name** of the new rule.
#	This shows the index number of the rule. Select the checkbox next to the rule to activate it.
Service Name	This shows the name of the rule.
Protocol:Port	This shows the protocol and the port of the rule.
Modify	Click the **Edit** icon to go to the screen where you can edit the rule. Click the **Delete** icon to delete an existing rule.
Blocked Site/ URL Keyword	Click **Add** to show a screen to enter the URL of web site or URL keyword to which the Device blocks access. Click **Delete** to remove it.
Apply	Click this button to save your settings back to the Device.
Cancel	Click **Cancel** to restore your previously saved settings.

Scheduler Rule

18.1 Overview

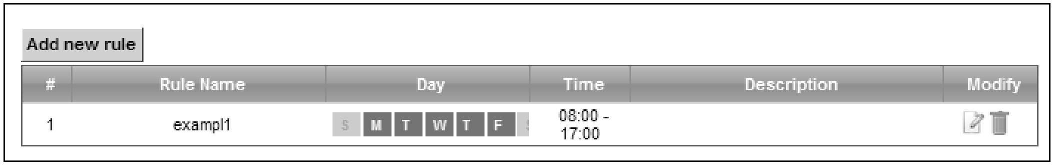
You can define time periods and days during which the Device performs scheduled rules of certain features (such as Firewall Access Control) in the **Scheduler Rule** screen.

18.2 The Scheduler Rule Screen

Use this screen to view, add, or edit time schedule rules.

Click **Security > Scheduler Rule** to open the following screen.

Figure 125 Security > Scheduler Rule



Add new rule

#	Rule Name	Day	Time	Description	Modify
1	exampl1	S M T W T F S	08:00 - 17:00		

The following table describes the fields in this screen.

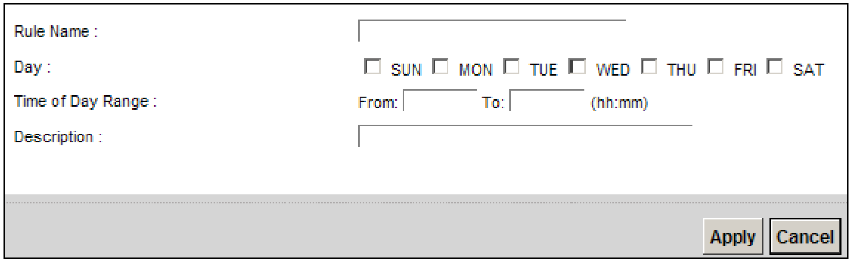
Table 94 Security > Scheduler Rule

LABEL	DESCRIPTION
Add new rule	Click this to create a new rule.
#	This is the index number of the entry.
Rule Name	This shows the name of the rule.
Day	This shows the day(s) on which this rule is enabled.
Time	This shows the period of time on which this rule is enabled.
Description	This shows the description of this rule.
Modify	Click the **Edit** icon to edit the schedule. Click the **Delete** icon to delete a scheduler rule. Note: You cannot delete a scheduler rule once it is applied to a certain feature.

18.2.1 Add/Edit a Schedule

Click the **Add** button in the **Scheduler Rule** screen or click the **Edit** icon next to a schedule rule to open the following screen. Use this screen to configure a restricted access schedule.

Figure 126 Scheduler Rule: Add/Edit



Rule Name :	
Day :	□ SUN □ MON □ TUE □ WED □ THU □ FRI □ SAT
Time of Day Range :	From: To: (hh:mm)
Description :	

The following table describes the fields in this screen.

Table 95 Scheduler Rule: Add/Edit

LABEL	DESCRIPTION
Rule Name	Enter a name (up to 31 printable English keyboard characters, not including spaces) for this schedule.
Day	Select check boxes for the days that you want the Device to perform this scheduler rule.
Time if Day Range	Enter the time period of each day, in 24-hour format, during which the rule will be enforced.
Description	Enter a description for this scheduler rule.
Apply	Click **Apply** to save your changes.
Cancel	Click **Cancel** to exit this screen without saving.

19

Certificates

19.1 Overview

The 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.

19.1.1 What You Can Do in this Chapter

- The **Local Certificates** screen lets you generate certification requests and import the Device's CA-signed certificates (Section 19.4 on page 214).
- The **Trusted CA** screen lets you save the certificates of trusted CAs to the Device (Section 19.4 on page 214).

19.2 What You Need to Know

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

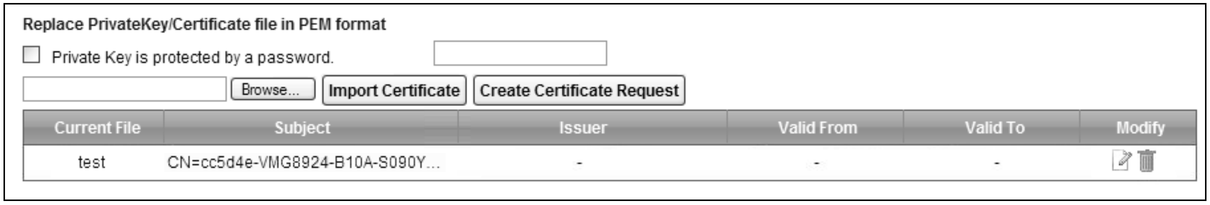
Certification Authority

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. The certification authority uses its private key to sign certificates. Anyone can then use the certification authority's public key to verify the certificates. You can use the Device to generate certification requests that contain identifying information and public keys and then send the certification requests to a certification authority.

19.3 The Local Certificates Screen

Click **Security > Certificates** to open the **Local Certificates** screen. This is the Device's summary list of certificates and certification requests.

Figure 127 Security > Certificates > Local Certificates



Replace PrivateKey/Certificate file in PEM format

□ Private Key is protected by a password.

Current File	Subject	Issuer	Valid From	Valid To	Modify
test	CN=cc5d4e-VMG8924-B10A-S090Y...	-	-	-	

The following table describes the labels in this screen.

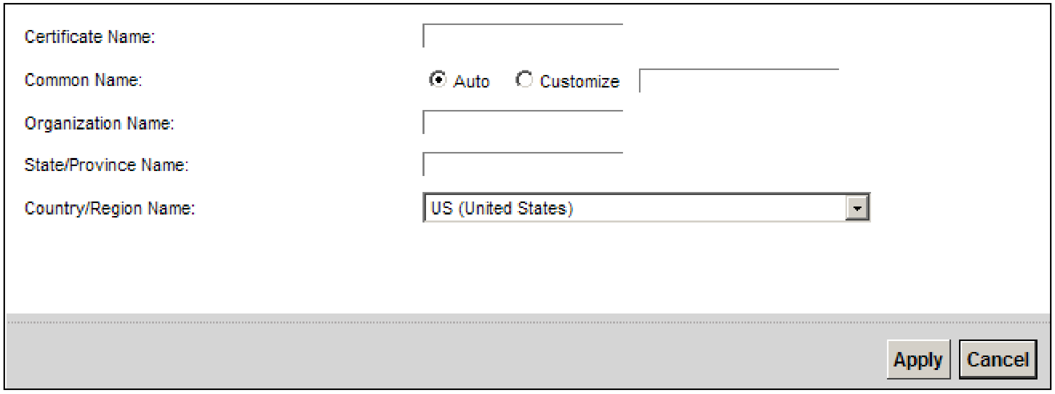
Table 96 Security > Certificates > Local Certificates

LABEL	DESCRIPTION
Private Key is protected by a password	Select the checkbox and enter the private key into the text box to store it on the Device. The private key should not exceed 63 ASCII characters (not including spaces).
Browse...	Click this to find the certificate file you want to upload.
Import Certificate	Click this button to save the certificate that you have enrolled from a certification authority from your computer to the Device.
Create Certificate Request	Click this button to go to the screen where you can have the Device generate a certification request.
Current File	This field displays the name used to identify this certificate. It is recommended that you give each certificate a unique name.
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.
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 **View** icon to open a screen with an in-depth list of information about the certificate (or certification request). For a certification request, click **Load Signed** to import the signed certificate. Click the **Remove** icon to delete the certificate (or certification request). You cannot delete a certificate that one or more features is configured to use.

19.3.1 Create Certificate Request

Click **Security** > **Certificates** > **Local Certificates** and then **Create Certificate Request** to open the following screen. Use this screen to have the Device generate a certification request.

Figure 128 Create Certificate Request



Certificate Name:	
Common Name:	● Auto ○ Customize
Organization Name:	
State/Province Name:	
Country/Region Name:	US (United States)

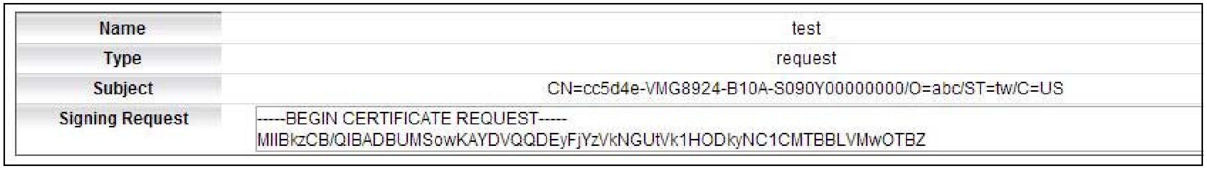
The following table describes the labels in this screen.

Table 97 Create Certificate Request

LABEL	DESCRIPTION
Certificate Name	Type up to 63 ASCII characters (not including spaces) to identify this certificate.
Common Name	Select **Auto** to have the Device configure this field automatically. Or select **Customize** to enter it manually. 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 63 ASCII characters. The domain name or e-mail address is for identification purposes only and can be any string.
Organization Name	Type up to 63 characters to identify the company or group to which the certificate owner belongs. You may use any character, including spaces, but the Device drops trailing spaces.
State/Province Name	Type up to 32 characters to identify the state or province where the certificate owner is located. You may use any character, including spaces, but the Device drops trailing spaces.
Country/Region Name	Select a country to identify the nation where the certificate owner is located.
Apply	Click **Apply** to save your changes.
Cancel	Click **Cancel** to exit this screen without saving.

After you click **Apply**, the following screen displays to notify you that you need to get the certificate request signed by a Certificate Authority. If you already have, click **Load_Signed** to import the signed certificate into the Device. Otherwise click **Back** to return to the **Local Certificates** screen.

Figure 129 Certificate Request Created



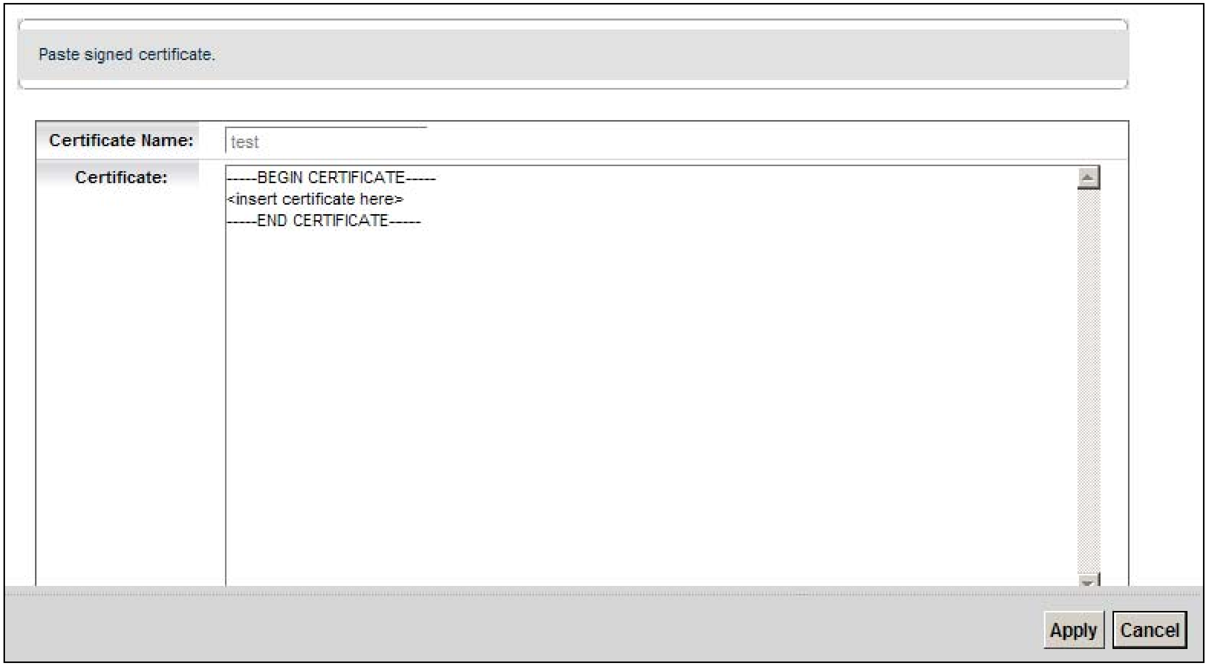
Name	test
Type	request
Subject	CN=cc5d4e-VMG8924-B10A-S090Y00000000/O=abc/ST=tw/C=US
Signing Request	-----BEGIN CERTIFICATE REQUEST----- MIIBkzCB/QIBADBUMSowKAYDVQQDEyFjYzVkNGUtVk1HODkyNC1CMTBBLVMwOTBZ

19.3.2 Load Signed Certificate

After you create a certificate request and have it signed by a Certificate Authority, in the **Local Certificates** screen click the certificate request's **Load Signed** icon to import the signed certificate into the Device.

Note: You must remove any spaces from the certificate’s filename before you can import it.

Figure 130 Load Signed Certificate



Paste signed certificate.

Certificate Name: test

Certificate:

```
-----BEGIN CERTIFICATE-----
<insert certificate here>
-----END CERTIFICATE-----
```

The following table describes the labels in this screen.

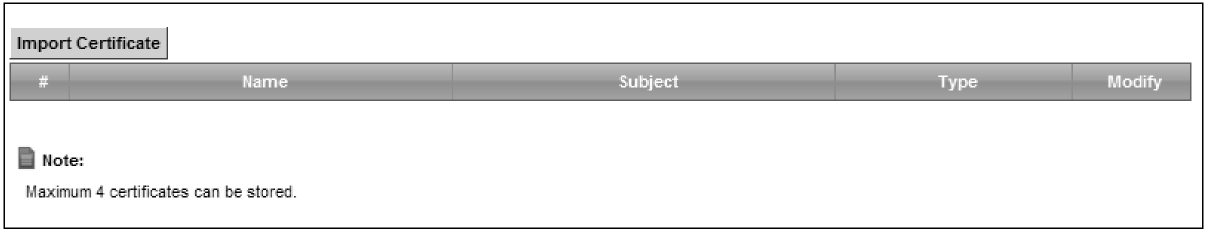
Table 98 Load Signed Certificate

LABEL	DESCRIPTION
Certificate Name	This is the name of the signed certificate.
Certificate	Copy and paste the signed certificate into the text box to store it on the Device.
Apply	Click **Apply** to save your changes.
Cancel	Click **Cancel** to exit this screen without saving.

19.4 The Trusted CA Screen

Click **Security > Certificates > Trusted CA** to open the following screen. This screen displays a summary list of certificates of the certification authorities that you have set the Device to accept as trusted. The 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 131 Security > Certificates > Trusted CA



Note:

Maximum 4 certificates can be stored.

The following table describes the fields in this screen.

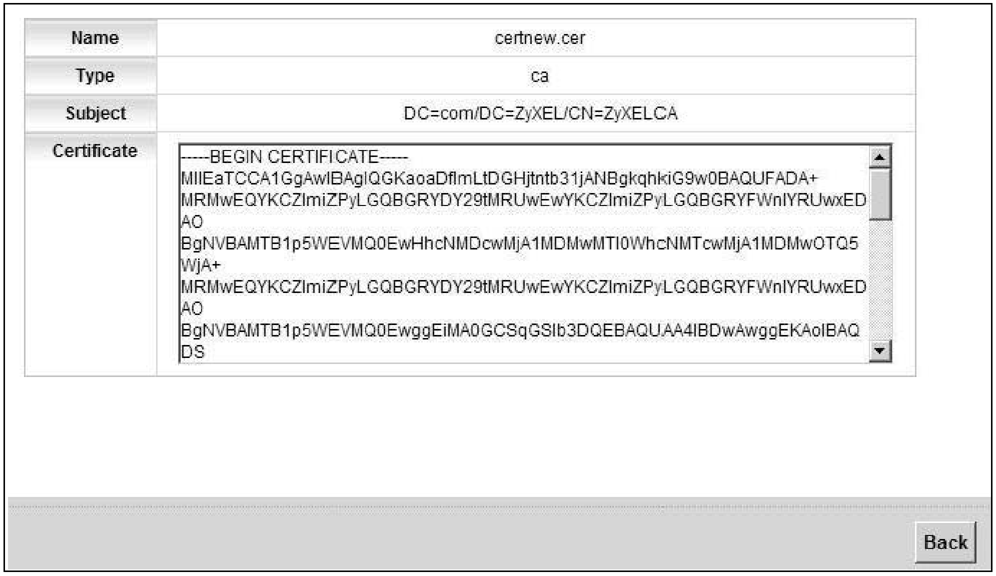
Table 99 Security > Certificates > Trusted CA

LABEL	DESCRIPTION
Import Certificate	Click this button to open a screen where you can save the certificate of a certification authority that you trust to the Device.
#	This is the index number of the entry.
Name	This field displays the name used to identify this certificate.
Subject	This field displays information that identifies the owner of the certificate, such as Common Name (CN), OU (Organizational Unit or department), Organization (O), State (ST) and Country (C). It is recommended that each certificate have unique subject information.
Type	This field displays general information about the certificate. **ca** means that a Certification Authority signed the certificate.
Modify	Click the **View** icon to open a screen with an in-depth list of information about the certificate (or certification request). Click the **Remove** button to delete the certificate (or certification request). You cannot delete a certificate that one or more features is configured to use.

19.4.1 View Trusted CA Certificate

Click the **View** icon in the **Trusted CA** screen to open the following screen. Use this screen to view in-depth information about the certification authority's certificate.

Figure 132 Trusted CA: View



Name	certnew.cer
Type	ca
Subject	DC=com/DC=ZyXEL/CN=ZyXELCA
Certificate	

```
-----BEGIN CERTIFICATE-----
MIIEaTCCA1GgAwIBAgIQGKaoaDflmLtDGHjtntb31jANBgkqhkiG9w0BAQUFADA+
MRMwEQYKCZImiZPyLGQBGRYDY29tMRUwEwYKCZImiZPyLGQBGRYFWnlYRUwxED
AO
BgNVBAMTB1p5WEVMQ0EwHhcNMDcwMjA1MDMwMTI0WhcNMTcwMjA1MDMwOTQ5
WjA+
MRMwEQYKCZImiZPyLGQBGRYDY29tMRUwEwYKCZImiZPyLGQBGRYFWnlYRUwxED
AO
BgNVBAMTB1p5WEVMQ0EwggEiMA0GCSqGSIb3DQEBAQUAA4IBDwAwggEKAoIBAQ
DS
```

The following table describes the fields in this screen.

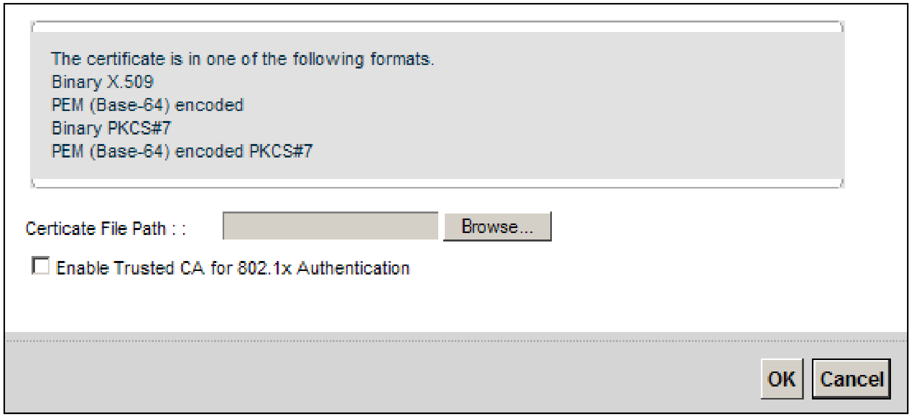
Table 100 Trusted CA: View

LABEL	DESCRIPTION
Name	This field displays the identifying name of this certificate.
Type	This field displays general information about the certificate. **ca** means that a Certification Authority signed the certificate.
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).
Certificate	This read-only text box displays the certificate in Privacy Enhanced Mail (PEM) format. PEM uses base 64 to convert the binary certificate into a printable form. You can copy and paste the certificate into an e-mail to send to friends or colleagues or you can copy and paste the 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.

19.4.2 Import Trusted CA Certificate

Click the **Import Certificate** button in the **Trusted CA** screen to open the following screen. The Device trusts any valid certificate signed by any of the imported trusted CA certificates.

Figure 133 Trusted CA: Import Certificate



The certificate is in one of the following formats.
Binary X.509
PEM (Base-64) encoded
Binary PKCS#7
PEM (Base-64) encoded PKCS#7

Certicate File Path : :

□ Enable Trusted CA for 802.1x Authentication

The following table describes the fields in this screen.

Table 101 Trusted CA: Import Certificate

LABEL	DESCRIPTION
Certificate File Path	Type in the location of the certificate you want to upload in this field or click **Browse ...** to find it.
Enable Trusted CA for 802.1x Authentication	If you select this checkbox, the trusted CA will be used for 802.1x authentication. The selected trusted CA will be displayed in the **Network Setting** > **Broadband** > **802.1x: Edit** screen.
Certificate	Copy and paste the certificate into the text box to store it on the Device.
OK	Click **OK** to save your changes.
Cancel	Click **Cancel** to exit this screen without saving.

20

VPN

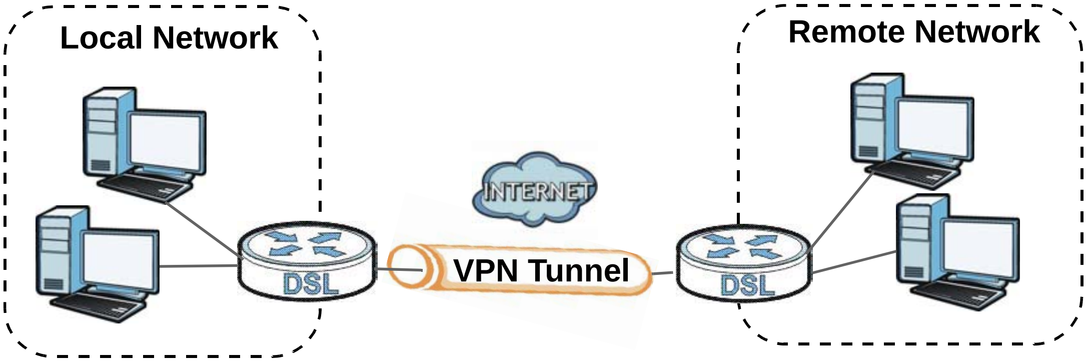
20.1 Overview

A virtual private network (VPN) provides secure communications over the the Internet. Internet Protocol Security (IPSec) is a standards-based VPN that provides confidentiality, data integrity, and authentication. This chapter shows you how to configure the Device's VPN settings.

20.2 The IPSec VPN General Screen

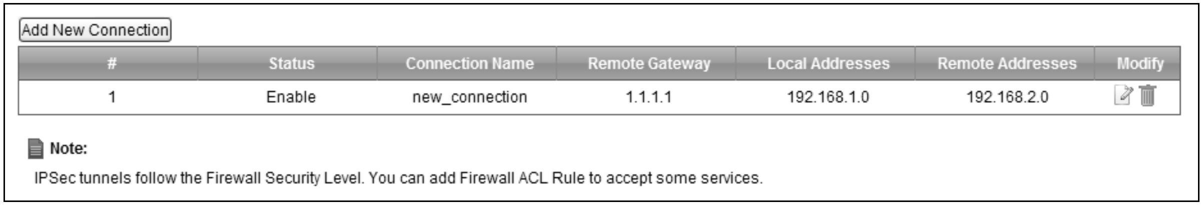
Use this screen to view and manage your VPN tunnel policies. The following figure helps explain the main fields in the web configurator.

Figure 134 IPSec Fields Summary



Click **Security > IPSec VPN** to open this screen as shown next.

Figure 135 Security > IPSec VPN



#	Status	Connection Name	Remote Gateway	Local Addresses	Remote Addresses	Modify
1	Enable	new_connection	1.1.1.1	192.168.1.0	192.168.2.0	

Note:

IPSec tunnels follow the Firewall Security Level. You can add Firewall ACL Rule to accept some services.

This screen contains the following fields:

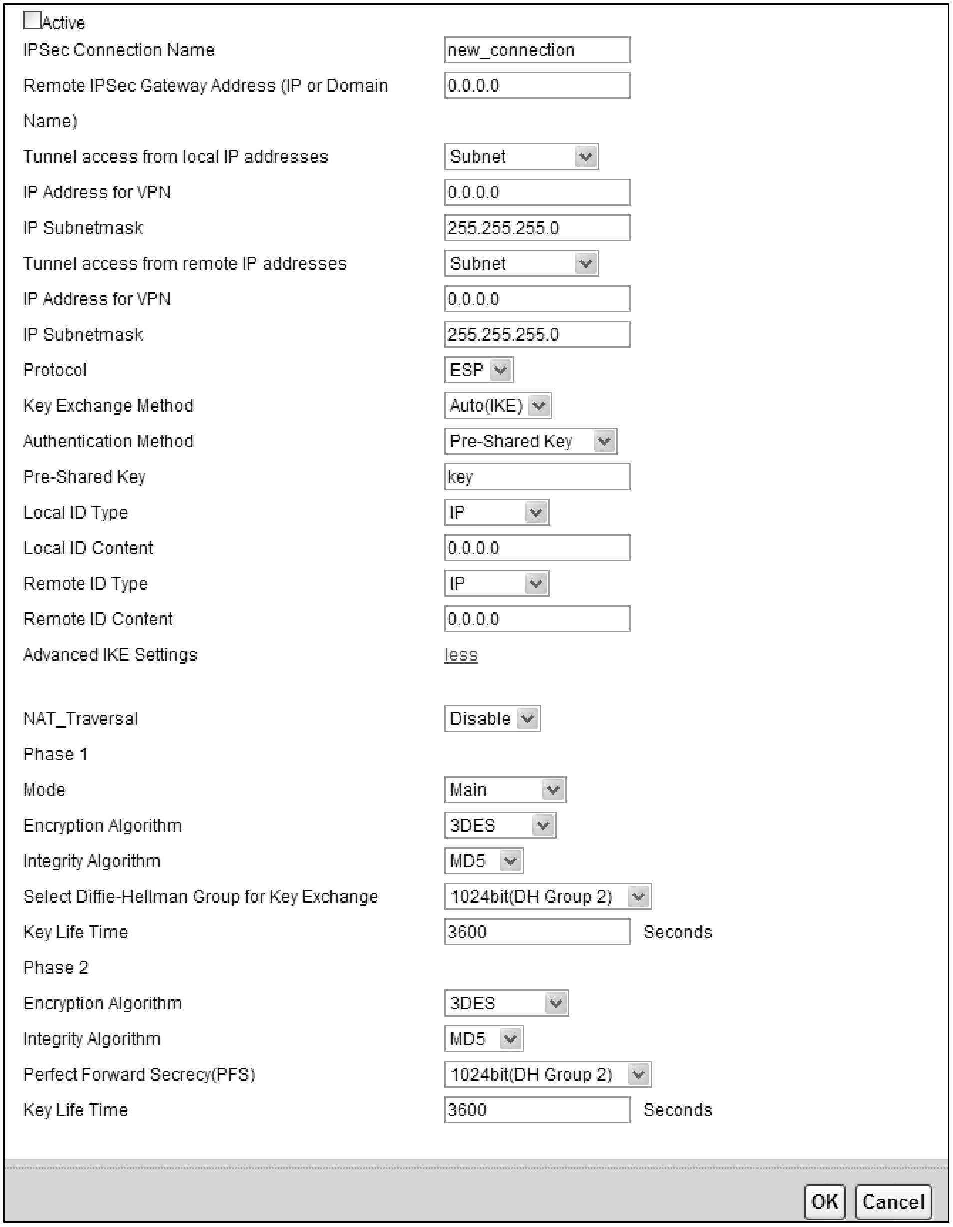
Table 102 Security > IPSec VPN

LABEL	DESCRIPTION
Add New Connection	Click this button to add an item to the list.
#	This displays the index number of an entry.
Status	This displays whether the VPN policy is enabled (**Enable**) or not (**Disable**).
Connection Name	The name of the VPN policy.
Remote Gateway	This is the IP address of the remote IPSec router in the IKE SA.
Local Addresses	This displays the IP address(es) on the LAN behind your Device.
Remote Addresses	This displays the IP address(es) on the LAN behind the remote IPSec's router.
Delete	Click the **Edit** icon to modify the VPN policy. Click the **Delete** icon to delete the VPN policy.

20.3 The IPSec VPN Add/Edit Screen

Use these settings to add or edit VPN policies. Click the **Add New Connection** button in the **Security > VPN** screen to open this screen as shown next.

Figure 136 Security > IPSec VPN: Add/Edit



□ Active

IPSec Connection Name	new_connection
Remote IPSec Gateway Address (IP or Domain Name)	0.0.0.0
Tunnel access from local IP addresses	Subnet
IP Address for VPN	0.0.0.0
IP Subnetmask	255.255.255.0
Tunnel access from remote IP addresses	Subnet
IP Address for VPN	0.0.0.0
IP Subnetmask	255.255.255.0
Protocol	ESP
Key Exchange Method	Auto(IKE)
Authentication Method	Pre-Shared Key
Pre-Shared Key	key
Local ID Type	IP
Local ID Content	0.0.0.0
Remote ID Type	IP
Remote ID Content	0.0.0.0
Advanced IKE Settings	less
NAT_Traversal	Disable
Phase 1	
Mode	Main
Encryption Algorithm	3DES
Integrity Algorithm	MD5
Select Diffie-Hellman Group for Key Exchange	1024bit(DH Group 2)
Key Life Time	3600 Seconds
Phase 2	
Encryption Algorithm	3DES
Integrity Algorithm	MD5
Perfect Forward Secrecy(PFS)	1024bit(DH Group 2)
Key Life Time	3600 Seconds

This screen contains the following fields:

Table 103 Security > IPSec VPN: Add/Edit

LABEL	DESCRIPTION
Active	Select this to activate this VPN policy.
IPSec Connection Name	Enter the name of the VPN policy.
Remote IPSec Gateway Address	Enter the IP address of the remote IPSec router in the IKE SA.
Tunnel access from local IP addresses	Select **Single Address** to have only one local LAN IP address use the VPN tunnel. Select **Subnet** to specify local LAN IP addresses by their subnet mask.

Table 103 Security > IPSec VPN: Add/Edit

LABEL	DESCRIPTION
IP Address for VPN	If **Single Address** is selected, enter a (static) IP address on the LAN behind your Device. If **Subnet** is selected, specify IP addresses on a network by their subnet mask by entering a (static) IP address on the LAN behind your Device. Then enter the subnet mask to identify the network address.
IP Subnetmask	If **Subnet** is selected, enter the subnet mask to identify the network address.
Tunnel access from remote IP addresses	Select **Single Address** to have only one remote LAN IP address use the VPN tunnel. Select **Subnet** to specify remote LAN IP addresses by their subnet mask.
IP Address for VPN	If **Single Address** is selected, enter a (static) IP address on the LAN behind the remote IPSec's router. If **Subnet** is selected, specify IP addresses on a network by their subnet mask by entering a (static) IP address on the LAN behind the remote IPSec's router. Then enter the subnet mask to identify the network address.
IP Subnetmask	If **Subnet** is selected, enter the subnet mask to identify the network address.
Protocol	Select which protocol you want to use in the IPSec SA. Choices are: **AH** (RFC 2402) - provides integrity, authentication, sequence integrity (replay resistance), and non-repudiation but not encryption. If you select **AH**, you must select an **Integraty Algorithm**. **ESP** (RFC 2406) - provides encryption and the same services offered by **AH**, but its authentication is weaker. If you select **ESP**, you must select an **Encryption Agorithm** and **Integraty Algorithm**. Both **AH** and **ESP** increase processing requirements and latency (delay). The Device and remote IPSec router must use the same active protocol.
Key Exchange Method	Select the key exchange method: **Auto(IKE)** - Select this to use automatic IKE key management VPN connection policy. **Manual** - Select this option to configure a VPN connection policy that uses a manual key instead of IKE key management. This may be useful if you have problems with IKE key management. Note: Only use manual key as a temporary solution, because it is not as secure as a regular IPSec SA.
Authentication Method	Select **Pre-Shared Key** 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. Select **Certificate (X.509)** to use a certificate for authentication.
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. 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.
Local ID Type	Select **IP** to identify the Device by its IP address. Select **E-mail** to identify this Device by an e-mail address. Select **DNS** to identify this Device by a domain name. Select **ASN1DN** (Abstract Syntax Notation one - Distinguished Name) to this Device by the subject field in a certificate. This is used only with certificate-based authentication.

Table 103 Security > IPSec VPN: Add/Edit

LABEL	DESCRIPTION
Local ID Content	When you select IP in the **Local ID Type** field, type the IP address of your computer in this field. If you configure this field to 0.0.0.0 or leave it blank, the Device automatically uses the **Pre-Shared Key** (refer to the **Pre-Shared Key** field description). It is recommended that you type an IP address other than 0.0.0.0 in this field or use the **DNS** or **E-mail** 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 Device in this 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.
Remote ID Type	Select **IP** to identify the remote IPSec router by its IP address. Select **E-mail** to identify the remote IPSec router by an e-mail address. Select **DNS** to identify the remote IPSec router by a domain name. Select **ASN1DN** to identify the remote IPSec router by the subject field in a certificate. This is used only with certificate-based authentication.
Remote ID Content	The configuration of the remote content depends on the remote 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 Device will use the address in the **Remote IPSec Gateway Address** field (refer to the **Remote IPSec 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 Device to distinguish between VPN connection requests that come in from remote IPSec routers with dynamic WAN IP addresses.
Advanced IKE Settings	Click **more** to display advanced settings. Click **less** to display basic settings only.
NAT_Traversal	Select **Enable** if you want to set up a VPN tunnel when there are NAT routers between the 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. Otherwise, select **Disable**.
Phase 1	
Mode	Select the negotiation mode to use to negotiate the IKE SA. Choices are: **Main** - this encrypts the Device's and remote IPSec router's identities but takes more time to establish the IKE SA. **Aggressive** - this is faster but does not encrypt the identities. The Device and the remote IPSec router must use the same negotiation mode.

Table 103 Security > IPSec VPN: Add/Edit

LABEL	DESCRIPTION
Encryption Algorithm	Select which key size and encryption algorithm to use in the IKE SA. Choices are: **DES** - a 56-bit key with the DES encryption algorithm **3DES** - a 168-bit key with the DES encryption algorithm **AES** - **128** - a 128-bit key with the AES encryption algorithm **AES** - **196** - a 196-bit key with the AES encryption algorithm **AES** - **256** - a 256-bit key with the AES encryption algorithm The Device and the remote IPSec router must use the same key size and encryption algorithm. Longer keys require more processing power, resulting in increased latency and decreased throughput.
Integrity Algorithm	Select which hash algorithm to use to authenticate packet data. Choices are **MD5**, **SHA1**. **SHA** is generally considered stronger than **MD5**, but it is also slower.
Select Diffie-Hellman Group for Key Exchange	Select which Diffie-Hellman key group you want to use for encryption keys. Choices for number of bits in the random number are: 768, 1024, 1536, 2048, 3072, 4096. The longer the key, the more secure the encryption, but also the longer it takes to encrypt and decrypt information. Both routers must use the same DH key group.
Key Life Time	Define the length of time before an IPSec SA automatically renegotiates in this field. 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.
Phase 2	
Encryption Algorithm	Select which key size and encryption algorithm to use in the IKE SA. Choices are: **DES** - a 56-bit key with the DES encryption algorithm **3DES** - a 168-bit key with the DES encryption algorithm **AES** - **128** - a 128-bit key with the AES encryption algorithm **AES** - **192** - a 196-bit key with the AES encryption algorithm **AES** - **256** - a 256-bit key with the AES encryption algorithm Select **ESP_NULL** to set up a tunnel without encryption. When you select **ESP_NULL**, you do not enter an encryption key. The Device and the remote IPSec router must use the same key size and encryption algorithm. Longer keys require more processing power, resulting in increased latency and decreased throughput.
Integrity Algorithm	Select which hash algorithm to use to authenticate packet data. Choices are **MD5** and **SHA1**. **SHA** is generally considered stronger than **MD5**, but it is also slower.

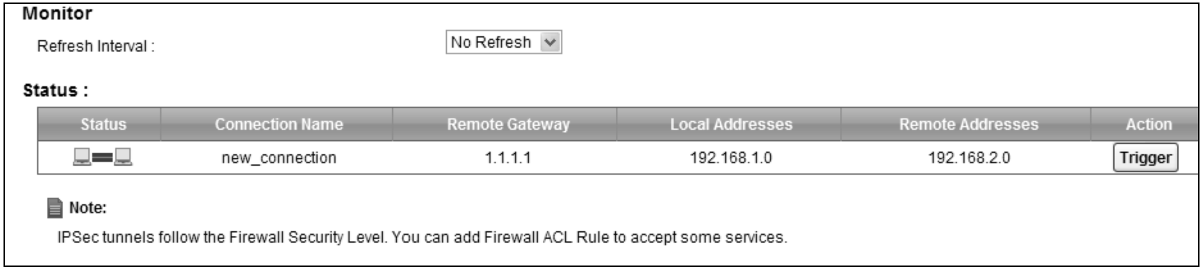
Table 103 Security > IPSec VPN: Add/Edit

LABEL	DESCRIPTION
Perfect Forward Secrecy (PFS)	Select whether or not you want to enable Perfect Forward Secrecy (PFS) PFS changes the root key that is used to generate encryption keys for each IPSec SA. The longer the key, the more secure the encryption, but also the longer it takes to encrypt and decrypt information. Both routers must use the same DH key group. Choices are: **None** - do not use any random number. **768bit(DH Group1)** - use a 768-bit random number **1024bit(DH Group2)** - use a 1024-bit random number **1536bit(DH Group5)** - use a 1536-bit random number **2048bit(DH Group14)** - use a 2048-bit random number **3072bit(DH Group15)** - use a 3072-bit random number **4096bit(DH Group16)** - use a 4096-bit random number
Key Life Time	Define the length of time before an IPSec SA automatically renegotiates in this field. 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.
The following fields are available if you select Manual in the Key Exchange Method field.	
Encryption Algorithm	Select which key size and encryption algorithm to use in the IKE SA. Choices are: **DES** - a 56-bit key with the DES encryption algorithm **3DES** - a 168-bit key with the DES encryption algorithm **EPS_NULL** - no encryption key or algorithm
Encryption Key	This field is applicable when you select an Encryption Algorithm. Enter the encryption key, which depends on the encryption algorithm. **DES** - type a unique key 16 hexadecimal characters long **3DES** - type a unique key 48 hexadecimal characters long
Authentication Algorithm	Select which hash algorithm to use to authenticate packet data. Choices are MD5, SHA1. SHA is generally considered stronger than MD5, but it is also slower.
Authentication Key	Enter the authentication key, which depends on the authentication algorithm. **MD5** - type a unique key 32 hexadecimal characters long **SHA1** - type a unique key 40 hexadecimal characters long
SPI	Type a unique SPI (Security Parameter Index) in hexadecimal characters. The SPI is used to identify the Device during authentication. The Device and remote IPSec router must use the same SPI.
OK	Click **OK** to save your changes.
Cancel	Click **Cancel** to restore your previously saved settings.

20.4 The IPSec VPN Monitor Screen

Use this screen to check your VPN tunnel's current status. You can also manually trigger a VPN tunnel to the remote network. Click **Security > IPSec VPN > Monitor** to open this screen as shown next.

Figure 137 Security > IPSec VPN > Monitor



Monitor

Refresh Interval : No Refresh

Status :

Status	Connection Name	Remote Gateway	Local Addresses	Remote Addresses	Action
	new_connection	1.1.1.1	192.168.1.0	192.168.2.0	Trigger

Note:

IPSec tunnels follow the Firewall Security Level. You can add Firewall ACL Rule to accept some services.

This screen contains the following fields:

Table 104 Security > IPSec VPN > Monitor

LABEL	DESCRIPTION
Refresh Interval	Select how often you want the Device to update this screen. Select **No Refresh** to have the Device stop updating the screen.
Status	This displays a green line between two hosts if the VPN tunnel has been established successfully. Otherwise, it displays a red line in between.
Connection Name	This displays the name of the VPN policy.
Remote Gateway	This is the IP address of the remote IPSec router in the IKE SA.
Local Addresses	This displays the IP address(es) on the LAN behind your Device.
Remote Addresses	This displays the IP address(es) on the LAN behind the remote IPSec router.
Action	Click **Trigger** to establish a VPN connection with the remote network.

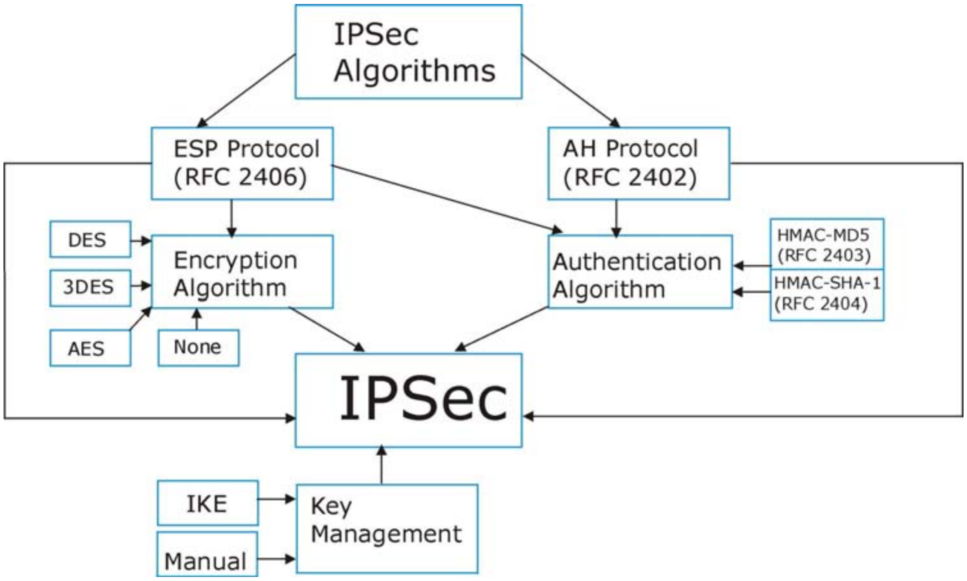
20.5 Technical Reference

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

20.5.1 IPSec Architecture

The overall IPSec architecture is shown as follows.

Figure 138 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.

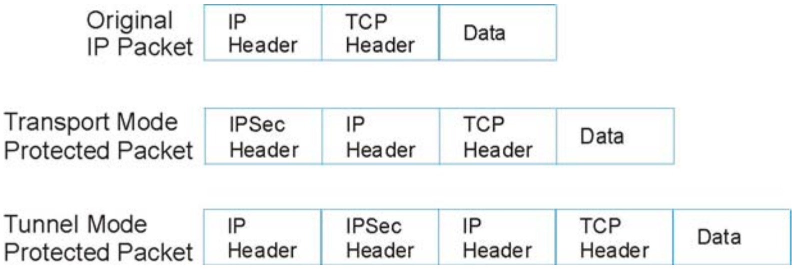
Key Management

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

20.5.2 Encapsulation

The two modes of operation for IPSec VPNs are **Transport** mode and **Tunnel** mode. At the time of writing, the Device supports **Tunnel** mode only.

Figure 139 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

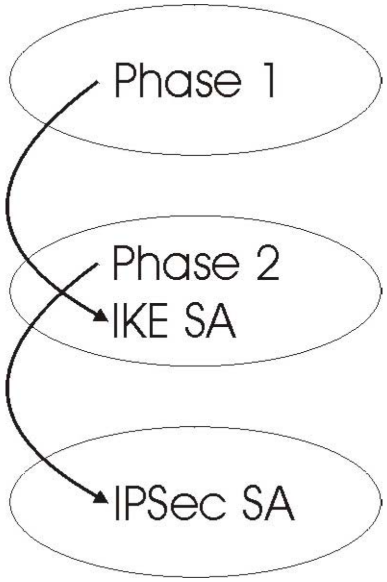
Tunnel mode encapsulates the entire IP packet to transmit it securely. A **Tunnel** mode is required for gateway services to provide access to internal systems. **Tunnel** mode is fundamentally an IP tunnel with authentication and encryption. This is the most common mode of operation. **Tunnel** mode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

20.5.3 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 140 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.
- 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 an encryption algorithm.
- Choose an authentication algorithm
- Choose a Diffie-Hellman public-key cryptography key group.
- Set the IPSec SA lifetime. This field allows you to determine how long the IPSec SA should stay up before it times out. The Device automatically renegotiates the IPSec SA if there is traffic when the IPSec SA lifetime period expires. If an IPSec SA times out, then the IPSec router must renegotiate the SA the next time someone attempts to send traffic.

20.5.4 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.

20.5.5 IPSec and NAT

Read this section if you are running IPSec on a host computer behind the 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 105 VPN and NAT

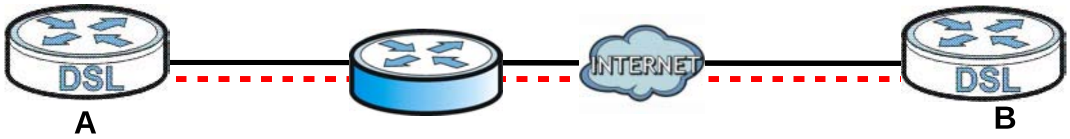
SECURITY PROTOCOL	MODE	NAT
AH	Transport	N
AH	Tunnel	N
ESP	Transport	N
ESP	Tunnel	Y

20.5.6 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 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 141 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 the above figure, 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 106 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 Device if you enable NAT traversal.

20.5.7 ID Type and Content

With aggressive negotiation mode (see Section 20.5.4 on page 229), the Device identifies incoming SAs by ID type and content since this identifying information is not encrypted. This enables the Device to distinguish between multiple rules for SAs that connect from remote IPSec routers that have dynamic WAN IP addresses.

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

With main mode (see Section 20.5.4 on page 229), the ID type and content are encrypted to provide identity protection. In this case the Device can only distinguish between up to 12 different incoming SAs that connect from remote IPSec routers that have dynamic WAN IP addresses. The Device can distinguish up to 48 incoming SAs because you can select between three encryption algorithms (DES, 3DES and AES), two authentication algorithms (MD5 and SHA1) and eight key groups when you configure a VPN rule (see Section 20.2 on page 219). 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 107 Local ID Type and Content Fields

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

20.5.7.1 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 Devices in this example can complete negotiation and establish a VPN tunnel.

Table 108 Matching ID Type and Content Configuration Example

Device A	Device B
Local ID type: E-mail	Local ID type: IP
Local ID content: tom@yourcompany.com	Local ID content: 1.1.1.2
Remote ID type: IP	Remote ID type: E-mail
Remote ID content: 1.1.1.2	Remote ID content: tom@yourcompany.com

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

Table 109 Mismatching ID Type and Content Configuration Example

DEVICE A	DEVICE B
Local ID type: IP	Local ID type: IP
Local ID content: 1.1.1.10	Local ID content: 1.1.1.2
Remote ID type: E-mail	Remote ID type: IP
Remote ID content: aa@yahoo.com	Remote ID content: 1.1.1.0

20.5.8 Pre-Shared Key

A pre-shared key identifies a communicating party during a phase 1 IKE negotiation (see Section 20.5.3 on page 228 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.

20.5.9 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. 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.

21

Voice

21.1 Overview

Use this chapter to:

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

21.1.1 What You Can Do in this Chapter

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

- Use the **SIP Account** screen (Section 21.3 on page 234) to set up information about your SIP account, control which SIP accounts the phones connected to the Device use and configure audio settings such as volume levels for the phones connected to the Device.
- Use the **SIP Service Provider** screen (Section 21.4 on page 239) to configure the SIP server information, QoS for VoIP calls, the numbers for certain phone functions, and dialing plan.
- Use the **PhoneRegion** screen (Section 21.5 on page 247) to change settings that depend on the country you are in.
- Use the **Call Rule** screen (Section 21.6 on page 247) to set up shortcuts for dialing frequently-used (VoIP) phone numbers.
- Use the **Call History Summary** screen (Section 21.7 on page 248) to view the summary list of received, dialed and missed calls.
- Use the **Call History Outgoing** screen (Section 21.8 on page 249) to view detailed information for each outgoing call you made.
- Use the **Call History Incoming** screen (Section 21.9 on page 249) to view detailed information for each incoming call from someone calling you.

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.

21.1.2 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 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 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 Device to use your SIP account to make calls, the 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 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 37 for a tutorial showing how to set up these screens in an example scenario.

See Section 21.10 on page 250 for advanced technical information on SIP.

21.2 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 Device.

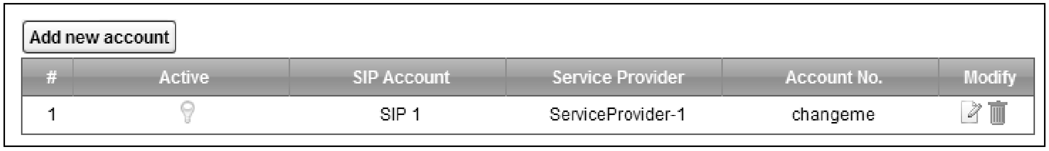
21.3 The SIP Account Screen

The 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 Device to connect to your VoIP service provider.

See Section 21.3.1 on page 235 for how to map a SIP account to a phone port.

Use this screen to view SIP account information. You can also enable and disable each SIP account. To access this screen, click **VoIP > SIP > SIP Account**.

Figure 142 VoIP > SIP > SIP Account



#	Active	SIP Account	Service Provider	Account No.	Modify
1	○	SIP 1	ServiceProvider-1	changeme	

Each field is described in the following table.

Table 110 VoIP > SIP > SIP Account

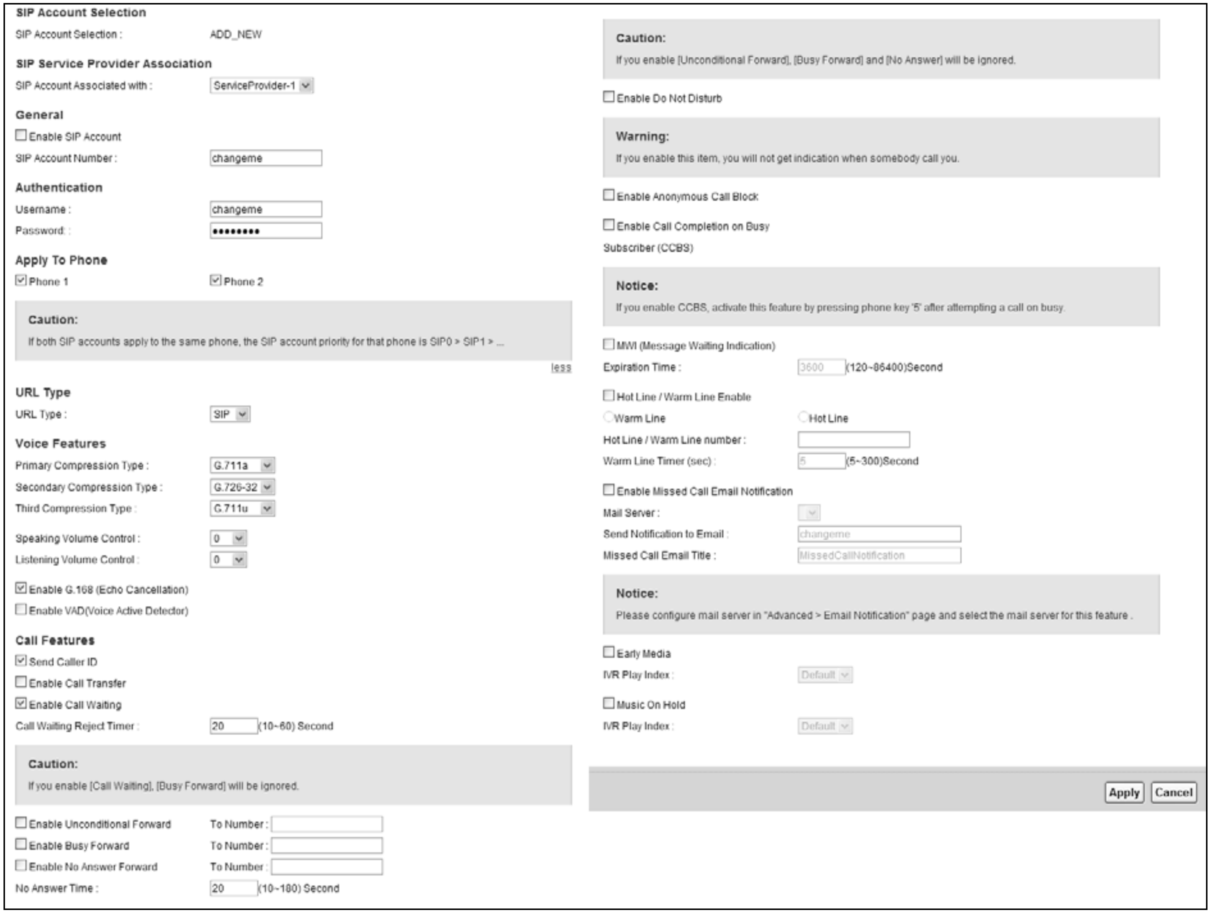
LABEL	DESCRIPTION
Add new account	Click this to configure a SIP account.
#	This is the index number of the entry.
Active	This shows whether the SIP account is activated or not. A yellow bulb signifies that this SIP account is activated. A gray bulb signifies that this SIP account is not activated.
SIP Account	This shows the name of the SIP account.
Service Provider	This shows the name of the SIP service provider.
Account No.	This shows the SIP number.
Modify	Click the **Edit** icon to configure the SIP account. Click the **Delete** icon to delete this SIP account from the Device.

21.3.1 The SIP Account Add/Edit Screen

Use this screen to configure a SIP account and map it to a phone port. To access this screen, click the **Add new account** button or click the **Edit** icon of an entry in the **VoIP > SIP > SIP Account** screen.

Note: Click **more** to see all the fields in the screen. You don't necessarily need to use all these fields to set up your account. Click **less** to see and configure only the fields needed for this feature.

Figure 143 VoIP > SIP > SIP Account > Add new accoun/Edit



SIP Account Selection

SIP Account Selection : ADD_NEW

SIP Service Provider Association

SIP Account Associated with : ServiceProvider-1

General

□ Enable SIP Account

SIP Account Number : changeme

Authentication

Username : changeme

Password : ●●●●●●●●●

Apply To Phone

☑ Phone 1 ☑ Phone 2

Caution:

If both SIP accounts apply to the same phone, the SIP account priority for that phone is SIP0 > SIP1 > ...

URL Type

URL Type : SIP

Voice Features

Primary Compression Type : G.711a

Secondary Compression Type : G.726-32

Third Compression Type : G.711u

Speaking Volume Control : 0

Listening Volume Control : 0

☑ Enable G.168 (Echo Cancellation)

□ Enable VAD(Voice Active Detector)

Call Features

☑ Send Caller ID

□ Enable Call Transfer

☑ Enable Call Waiting

Call Waiting Reject Timer : 20 (10~60) Second

Caution:

If you enable [Call Waiting], [Busy Forward] will be ignored.

□ Enable Unconditional Forward To Number :

□ Enable Busy Forward To Number :

□ Enable No Answer Forward To Number :

No Answer Time : 20 (10~180) Second

Caution:

If you enable [Unconditional Forward], [Busy Forward] and [No Answer] will be ignored.

□ Enable Do Not Disturb

Warning:

If you enable this item, you will not get indication when somebody call you.

□ Enable Anonymous Call Block

□ Enable Call Completion on Busy Subscriber (CCBS)

Notice:

If you enable CCBS, activate this feature by pressing phone key '5' after attempting a call on busy.

□ MWI (Message Waiting Indication)

Expiration Time : 3600 (120~86400)Second

□ Hot Line / Warm Line Enable

○ Warm Line ○ Hot Line

Hot Line / Warm Line number :

Warm Line Timer (sec) : 5 (5~300)Second

□ Enable Missed Call Email Notification

Mail Server :

Send Notification to Email : changeme

Missed Call Email Title : MissedCallNotification

Notice:

Please configure mail server in "Advanced > Email Notification" page and select the mail server for this feature .

□ Early Media

IVR Play Index : Default

□ Music On Hold

IVR Play Index : Default

Each field is described in the following table.

Table 111 VoIP > SIP > SIP Account > Add new accoun/Edit

LABEL	DESCRIPTION
SIP Account Selection	This field displays **ADD_NEW** if you are creating a new SIP account or the SIP account you are modifying.
SIP Service Provider Association	Select the SIP service provider profile to use for the SIP account you are configuring in this screen. This field is read-only when you are modifying a SIP account.
General	
Enable SIP Account	Select this if you want the Device to use this account. Clear it if you do not want the Device to use this account.
SIP 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.
Authentication	
Username	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.

Table 111 VoIP > SIP > SIP Account > Add new accoun/Edit (continued)

LABEL	DESCRIPTION
Apply To Phone	Select a phone port on which you want to make or receive phone calls for this SIP account. If you map a phone port to more than one SIP account, there is no way to distinguish between the SIP accounts when you receive phone calls. The Device uses the most recently registered SIP account first when you make an outgoing call. If a phone port is not mapped to a SIP account, you cannot receive or make any calls on the phone connected to this phone port.
more/less	Click **more** to display and edit more information for the SIP account. Click **less** to display and configure the basic SIP account settings.
URI Type	Select whether or not to include the SIP service domain name when the Device sends the SIP number. **SIP** - include the SIP service domain name. **TEL** - do not include the SIP service domain name.
Voice Features	
Primary Compression Type Secondary Compression Type Third Compression Type	Select the type of voice coder/decoder (codec) that you want the Device to use. G.711 provides high voice quality but requires more bandwidth (64 kbps). G.711 is the default codec used by phone companies and digital handsets. • **G.711a** is typically used in Europe. • **G.711u** is typically used in North America and Japan. **G.726-24** operates at **24** kbps. **G.726-32** operates at **32** kbps. **G.722** is a 7 KHz wideband voice codec that operates at 48, 56 and 64 kbps. By using a sample rate of 16 kHz, G.722 can provide higher fidelity and better audio quality than narrowband codecs like G.711, in which the voice signal is sampled at 8 KHz. The Device must use the same codec as the peer. When two SIP devices start a SIP session, they must agree on a codec. Select the Device's first choice for voice coder/decoder. Select the Device's second choice for voice coder/decoder. Select **None** if you only want the Device to accept the first choice. Select the Device's third choice for voice coder/decoder. Select **None** if you only want the Device to accept the first or second choice.
Speaking Volume Control	Select the loudness that the Device uses for speech that it sends to the peer device. **-12** is the quietest, and **12** is the loudest.
Listening Volume Control	Select the loudness that the Device uses for speech that it receives from the peer device. **-12** is the quietest, and **12** is the loudest.
Enable G.168 (Echo Cancellation)	Select this if you want to eliminate the echo caused by the sound of your voice reverberating in the telephone receiver while you talk.
Enable VAD (Voice Active Detector)	Select this if the Device should stop transmitting when you are not speaking. This reduces the bandwidth the Device uses.
Call Features	

Table 111 VoIP > SIP > SIP Account > Add new accoun/Edit (continued)

LABEL	DESCRIPTION
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.
Enable Call Transfer	Select this to enable call transfer on the Device. This allows you to transfer an incoming call (that you have answered) to another phone.
Enable Call Waiting	Select this to enable call waiting on the Device. This allows you to place a call on hold while you answer another incoming call on the same telephone number.
Call Waiting Reject Timer	Specify a time of seconds that the Device waits before rejecting the second call if you do not answer it.
Enable Unconditional Forward	Select this if you want the Device to forward all incoming calls to the specified phone number. Specify the phone number in the **To Number** field on the right.
Enable Busy Forward	Select this if you want the Device to forward incoming calls to the specified phone number if the phone port is busy. Specify the phone number in the **To Number** 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.
Enable No Answer Forward	Select this if you want the Device to forward incoming calls to the specified phone number if the call is unanswered. (See **No Answer Time**.) Specify the phone number in the **To Number** field on the right.
No Answer Time	This field is used by the **Active No Answer Forward** feature. Enter the number of seconds the Device should wait for you to answer an incoming call before it considers the call is unanswered.
Enable Do Not Disturb	Select this to set your phone to not ring when someone calls you.
Enable Anonymous Call Block	Select this if you do not want the phone to ring when someone tries to call you with caller ID deactivated.
Enable Call Completion on Busy Subscriber (CCBS)	When you make a phone call but hear a busy tone, Call Completion on Busy Subscriber (CCBS) allows you to enable auto-callback by pressing 5 and hanging up the phone. The Device then tries to call that phone number every minute since after you hang up the phone. When the called party becomes available within the CCBS timeout period (60 minutes by default), both phones ring. • If the called party's phone rings because of CCBS but no one answers the phone after 180 seconds, you will hear a busy tone. You can enable CCBS on the called number again. • If you manually call the number on which you have enabled CCBS before the CCBS timeout period expires, the Device disables CCBS on the called number. • If you call a second number before the first called number's CCBS timeout period expires, the Device stops calling the first number until you finish the second call. Select this option to activate CCBS on the Device.
MWI (Message Waiting Indication)	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 Device subscribes to the service. Before this time passes, the Device automatically subscribes again.
Hot Line / Warm Line Enable	Select this to enable the hot line or warm line feature on the Device.

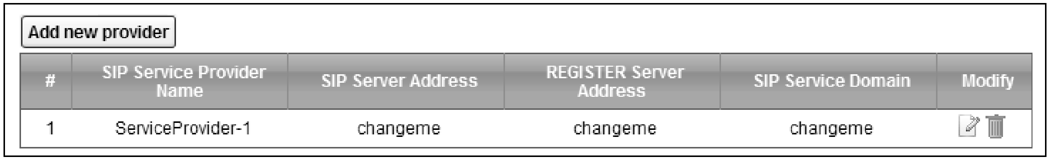
Table 111 VoIP > SIP > SIP Account > Add new accoun/Edit (continued)

LABEL	DESCRIPTION
Warm Line	Select this to have the Device dial the specified warm line number after you pick up the telephone and do not press any keys on the keypad for a period of time.
Hot Line	Select this to have the Device dial the specified hot line number immediately when you pick up the telephone.
Hot Line / Warm Line number	Enter the number of the hot line or warm line that you want the Device to dial.
Warm Line Timer	Enter a number of seconds that the Device waits before dialing the warm line number if you pick up the telephone and do not press any keys on the keypad.
Enable Missed Call Email Notification	Select this option to have the Device e-mail you a notification when there is a missed call.
Mail Server	Select a mail server for the e-mail address specified below. If you select **None** here, e-mail notifications will not be sent via e-mail. You must have configured a mail server already in the **Email Notification** screen.
Send Notification to Email	Notifications are sent to the e-mail address specified in this field. If this field is left blank, notifications will not be sent via e-mail.
Missed Call Email Title	Type a title that you want to be in the subject line of the e-mail notifications that the Device sends.
Early Media	Select this option if you want people to hear a customized recording when they call you.
IVR Play Index	Select the tone you want people to hear when they call you. This field is configurable only when you select **Early Media**. See Section 21.10 on page 250 for information on how to record these tones.
Music On Hold	Select this option to play a customized recording when you put people on hold.
IVR Play Index	Select the tone to play when you put someone on hold. This field is configurable only when you select **Music On Hold**. See Section 21.10 on page 250 for information on how to record these tones.
Apply	Click this to save your changes and to apply them to the Device.
Cancel	Click this to set every field in this screen to its last-saved value.

21.4 The SIP Service Provider Screen

Use this screen to view the SIP service provider information on the Device. Click **VoIP > SIP > SIP Service Provider** to open the following screen.

Figure 144 VoIP > SIP > SIP Service Provider



#	SIP Service Provider Name	SIP Server Address	REGISTER Server Address	SIP Service Domain	Modify
1	ServiceProvider-1	changeme	changeme	changeme	

Each field is described in the following table.

Table 112 VoIP > SIP > SIP Service Provider

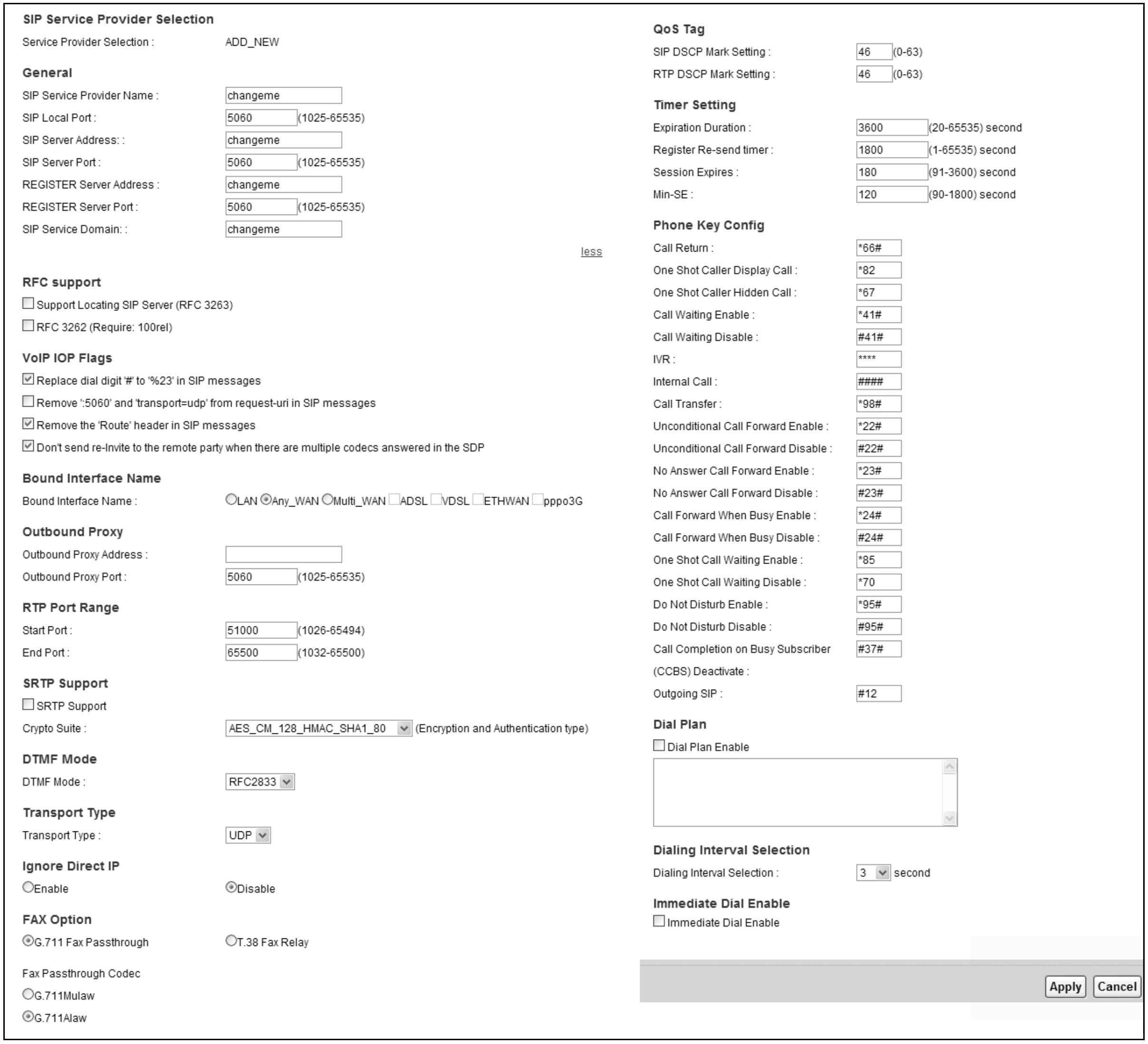
LABEL	DESCRIPTION
Add new provider	
#	This is the index number of the entry.
SIP Service Provider Name	This shows the name of the SIP service provider.
SIP Server Address	This shows the IP address or domain name of the SIP server.
REGISTER Server Address	This shows the IP address or domain name of the SIP register server.
SIP Service Domain	This shows the SIP service domain name.
Modify	Click the **Edit** icon to configure the SIP service provider. Click the **Delete** icon to delete this SIP service provider from the Device.

21.4.1 The SIP Service Provider Add/Edit Screen

Use this screen to configure a SIP service provider on the Device. Click the **Add new provider** button or an **Edit** icon in the **VoIP > SIP > SIP Service Provider** to open the following screen.

Note: Click **more** to see all the fields in the screen. You don’t necessarily need to use all these fields to set up your account. Click **less** to see and configure only the fields needed for this feature.

Figure 145 VoIP > SIP > SIP Service Provider > Add new provider/Edit



SIP Service Provider Selection

Service Provider Selection : ADD_NEW

General

SIP Service Provider Name : changeme
SIP Local Port : 5060 (1025-65535)
SIP Server Address: : changeme
SIP Server Port : 5060 (1025-65535)
REGISTER Server Address : changeme
REGISTER Server Port : 5060 (1025-65535)
SIP Service Domain: : changeme

RFC support

□ Support Locating SIP Server (RFC 3263)
□ RFC 3262 (Require: 100rel)

VoIP IOP Flags

☑ Replace dial digit '#' to '%23' in SIP messages
□ Remove ':5060' and 'transport=udp' from request-uri in SIP messages
☑ Remove the 'Route' header in SIP messages
☑ Don't send re-Invite to the remote party when there are multiple codecs answered in the SDP

Bound Interface Name

Bound Interface Name : ○LAN ●Any_WAN ○Multi_WAN □ADSL □VDSL □ETHWAN □pppo3G

Outbound Proxy

Outbound Proxy Address :
Outbound Proxy Port : 5060 (1025-65535)

RTP Port Range

Start Port : 51000 (1026-65494)
End Port : 65500 (1032-65500)

SRTP Support

□ SRTP Support
Crypto Suite : AES_CM_128_HMAC_SHA1_80 (Encryption and Authentication type)

DTMF Mode

DTMF Mode : RFC2833

Transport Type

Transport Type : UDP

Ignore Direct IP

○Enable ●Disable

FAX Option

●G.711 Fax Passthrough ○T.38 Fax Relay

Fax Passthrough Codec
○G.711Mulaw
●G.711Alaw

QoS Tag

SIP DSCP Mark Setting : 46 (0-63)
RTP DSCP Mark Setting : 46 (0-63)

Timer Setting

Expiration Duration : 3600 (20-65535) second
Register Re-send timer : 1800 (1-65535) second
Session Expires : 180 (91-3600) second
Min-SE : 120 (90-1800) second

Phone Key Config

Call Return : *66#
One Shot Caller Display Call : *82
One Shot Caller Hidden Call : *67
Call Waiting Enable : *41#
Call Waiting Disable : #41#
IVR : ****
Internal Call : ####
Call Transfer : *98#
Unconditional Call Forward Enable : *22#
Unconditional Call Forward Disable : #22#
No Answer Call Forward Enable : *23#
No Answer Call Forward Disable : #23#
Call Forward When Busy Enable : *24#
Call Forward When Busy Disable : #24#
One Shot Call Waiting Enable : *85
One Shot Call Waiting Disable : *70
Do Not Disturb Enable : *95#
Do Not Disturb Disable : #95#
Call Completion on Busy Subscriber (CCBS) Deactivate : #37#
Outgoing SIP : #12

Dial Plan

□ Dial Plan Enable

Dialing Interval Selection

Dialing Interval Selection : 3 second

Immediate Dial Enable

□ Immediate Dial Enable

Each field is described in the following table.

Table 113 VoIP > SIP > SIP Service Provider > Add new provider/Edit

LABEL	DESCRIPTION
SIP Service Provider Selection	
Service Provider Selection	Select the SIP service provider profile you want to use for the SIP account you configure in this screen. If you change this field, the screen automatically refreshes.
General	
SIP Service Provider Name	Enter the name of your SIP service provider.
SIP Local Port	Enter the Device’s listening port number, if your VoIP service provider gave you one. Otherwise, keep the default value.

Table 113 VoIP > SIP > SIP Service Provider > Add new provider/Edit (continued)

LABEL	DESCRIPTION
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.
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.
RFC Support	
Support Locating SIP Server (RFC3263)	Select this option to have the Device use DNS procedures to resolve the SIP domain and find the SIP server's IP address, port number and supported transport protocol(s). The Device first uses DNS Name Authority Pointer (NAPTR) records to determine the transport protocols supported by the SIP server. It then performs DNS Service (SRV) query to determine the port number for the protocol. The Device resolves the SIP server's IP address by a standard DNS address record lookup. The **SIP Server Port** and **REGISTER Server Port** fields in the **General** section above are grayed out and not applicable and the **Transport Type** can also be set to **AUTO** if you select this option.
RFC 3262(Require: 100rel)	PRACK (RFC 3262) defines a mechanism to provide reliable transmission of SIP provisional response messages, which convey information on the processing progress of the request. This uses the option tag 100rel and the Provisional Response ACKnowledgement (PRACK) method. Select this to have the the peer device require the option tag 100rel to send provisional responses reliably.
VoIP IOP Flags	Select the VoIP inter-operability settings you want to activate.
Replace dial digit '#' to '%23' in SIP messages	Replace a dial digit "#" with "%23" in the INVITE messages.
Remove ':5060' and 'transport=udp' from request-uri in SIP messages	Remove ":5060" and "transport=udp" from the "Request-URI" string in the REGISTER and INVITE packets.
Remove the 'Route' header in SIP messages	Remove the 'Route' header in SIP packets.
Don't send re-Invite to the remote party when there are multiple codecs answered in the SDP	Do not send a re-Invite packet to the remote party when the remote party answers that it can support multiple codecs.
Bound Interface Name	

Table 113 VoIP > SIP > SIP Service Provider > Add new provider/Edit (continued)

LABEL	DESCRIPTION
Bound Interface Name	If you select **LAN** or **Any_WAN**, the Device automatically activates the VoIP service when any LAN or WAN connection is up. If you select **Multi_WAN**, you also need to select two or more pre-configured WAN interfaces. The VoIP service is activated only when one of the selected WAN connections is up.
Outbound Proxy	
Outbound Proxy Address	Enter the IP address or domain name of the SIP outbound proxy server if your VoIP service provider has a SIP outbound server to handle voice calls. This allows the 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 Device to keep it from re-translating the IP address (since this is already handled by the outbound proxy server).
Outbound Proxy Port	Enter the SIP outbound proxy server’s listening port, if your VoIP service provider gave you one. Otherwise, keep the default value.
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.
SRTP Support	
SRTP Support	When you make a VoIP call using SIP, the Real-time Transport Protocol (RTP) is used to handle voice data transfer. The Secure Real-time Transport Protocol (SRTP) is a security profile of RTP. It is designed to provide encryption and authentication for the RTP data in both unicast and multicast applications. The Device supports encryption using AES with a 128-bit key. To protect data integrity, SRTP uses a Hash-based Message Authentication Code (HMAC) calculation with Secure Hash Algorithm (SHA)-1 to authenticate data. HMAC SHA-1 produces a 80 or 32-bit authentication tag that is appended to the packet. Both the caller and callee should use the same algorithms to establish an SRTP session.
Crypto Suite	Select the encryption and authentication algorithm set used by the Device to set up an SRTP media session with the peer device. Select **AES_CM_128_HMAC_SHA1_80** or **AES_CM_128_HMAC_SHA1_32** to enable both data encryption and authentication for voice data. Select **AES_CM_128_NULL** to use 128-bit data encryption but disable data authentication. Select **NULL_CIPHER_HMAC_SHA1_80** to disable encryption but require authentication using the default 80-bit tag.
DTMF Mode	
DTMF Mode	Control how the Device handles the tones that your telephone makes when you push its buttons. You should use the same mode your VoIP service provider uses. **RFC2833** - 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.
Transport Type	
Transport Type	Select the transport layer protocol **UDP** or **TCP** (usually UDP) used for SIP.

Table 113 VoIP > SIP > SIP Service Provider > Add new provider/Edit (continued)

LABEL	DESCRIPTION
Ignore Direct IP	Select **Enable** to have the connected CPE devices accept SIP requests only from the SIP proxy/register server specified above. SIP requests sent from other IP addresses will be ignored.
FAX Option	This field controls how the Device handles fax messages.
G711 Fax Passthrough	Select this if the Device should use G.711 to send fax messages. You have to also select which operating codec (**G.711Mulaw** or **G.711Alaw**) to use for encoding/decoding FAX data. The peer devices must use the same settings.
T38 Fax Relay	Select this if the 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.
QoS Tag	
SIP DSCP Mark Setting	Enter the DSCP (DiffServ Code Point) number for SIP message transmissions. The Device creates Class of Service (CoS) priority tags with this number to SIP traffic that it transmits.
RTP DSCP Mark Setting	Enter the DSCP (DiffServ Code Point) number for RTP voice transmissions. The Device creates Class of Service (CoS) priority tags with this number to RTP traffic that it transmits.
Timer Setting	
Expiration Duration	Enter the number of seconds your SIP account is registered with the SIP register server before it is deleted. The 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 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 Device lets a SIP session remain idle (without traffic) before it automatically disconnects the session.
Min-SE	Enter the minimum number of seconds the 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 Device accepts.
Phone Key Config	Enter the key combinations for certain functions of the SIP phone.
Call Return	Enter the key combinations that you can enter to place a call to the last number that called you.
One Shot Caller Display Call	Enter the key combinations that you can enter to activate caller ID for the next call only.
One Shot Caller Hidden Call	Enter the key combinations that you can enter to deactivate caller ID for the next call only.
Call Waiting Enable	Enter the key combinations that you can enter to turn on the call waiting function.
Call Waiting Disable	Enter the key combinations that you can enter to turn off the call waiting function.
IVR	Enter the key combinations that you can enter to record custom caller ringing tones (the sound a caller hears before you pick up the phone) and on hold tones (the sound someone hears when you put their call on hold). IVR stands for Interactive Voice Response.
Internal Call	Enter the key combinations that you can enter to call the phone(s) connected to the Device.
Call Transfer	Enter the key combinations that you can enter to transfer a call to another phone.
Unconditional Call Forward Enable	Enter the key combinations that you can enter to forward all incoming calls to the phone number you specified in the **SIP > SIP Account** screen.
Unconditional Call Forward Disable	Enter the key combinations that you can enter to turn the unconditional call forward function off.

Table 113 VoIP > SIP > SIP Service Provider > Add new provider/Edit (continued)

LABEL	DESCRIPTION
No Answer Call Forward Enable	Enter the key combinations that you can enter to forward incoming calls to the phone number you specified in the **SIP > SIP Account** screen if the calls are unanswered.
No Answer Call Forward Disable	Enter the key combinations that you can enter to turn the no answer call forward function off.
Call Forward When Busy Enable	Enter the key combinations that you can enter to forward incoming calls to the phone number you specified in the **SIP > SIP Account** screen if the phone port is busy.
Call Forward When Busy Disable	Enter the key combinations that you can enter to turn the busy forward function off.
One Shot Call Waiting Enable	Enter the key combinations that you can enter to activate call waiting on the next calls.
One Shot Call Waiting Disable	Enter the key combinations that you can enter to deactivate call waiting on the next call only.
Do Not Disturb Enable	Enter the key combinations that you can enter to set your phone not to ring when someone calls you.
Do Not Disturb Disable	Enter the key combinations that you can enter to turn this function off.
Call Completion on Busy Subscriber (CCBS) Deactivate	Enter the key combinations that you can enter to disable CCBS on a call.
Outgoing SIP	Enter the key combinations that you can enter to select the SIP account that you use to make outgoing calls. If you enter #12(by default)<SIP account index number>#<the phone number you want to call>, #1201#12345678 for example, the Device uses the first SIP account to call 12345678.
Dial Plan	
Dial Plan Enable	Select this to activate the dial plan rules you specify in the text box provided. See Section 21.4.2 on page 246 for how to set up a rule.
Dialing Interval Selection	
Dialing Interval Selection	Enter the number of seconds the 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 **Immediate Dial Enable**, you can press the pound key (#) to tell the Device to make the phone call immediately, regardless of this setting.
Immediate Dial Enable	
Immediate Dial Enable	Select this if you want to use the pound key (#) to tell the Device to make the phone call immediately, instead of waiting the number of seconds you selected in the **Dialing Interval Selection** field. If you select this, dial the phone number, and then press the pound key. The Device makes the call immediately, instead of waiting. You can still wait, if you want.
Apply	Click **Apply** to save your changes.
Cancel	Click **Cancel** to restore your previously saved settings.

21.4.2 Dial Plan Rules

A dial plan defines the dialing patterns, such as the length and range of the digits for a telephone number. It also includes country codes, access codes, area codes, local numbers, long distance numbers or international call prefixes. For example, the dial plan ([2-9]xxxxxx) does not allow a local number which begins with 1 or 0.

Without a dial plan, users have to manually enter the whole callee's number and wait for the specified dialing interval to time out or press a terminator key (usually the pound key on the phone keypad) before the Device makes the call.

The Device initializes a call when the dialed number matches any one of the rules in the dial plan. Dial plan rules follow these conventions:

- The collection of rules is in parentheses ().
- Rules are separated by the | (bar) symbol.
- "x" stands for a wildcard and can be any digit from 0 to 9.
- A subset of keys is in a square bracket []. Ranges are allowed.

  For example, [359] means a number matching this rule can be 3, 5 or 9. [26-8*] means a number matching this rule can be 2, 6, 7, 8 or *.
- The dot "." appended to a digit allows the digit to be ignored or repeated multiple times. Any digit (0~9, *, #) after the dot will be ignored.

  For example, (01.) means a number matching this rule can be 0, 01, 0111, 01111, and so on.
- <dialed-number:translated-number> indicates the number after the colon replaces the number before the colon in an angle bracket <>. For example,

  (<:1212> xxxxxxx) means the Device automatically prefixes the translated-number "1212" to the number you dialed before making the call. This can be used for local calls in the US.

  (<9:> xxx xxxxxxx) means the Device automatically removes the specified prefix "9" from the number you dialed before making the call. This is always used for making outside calls from an office.

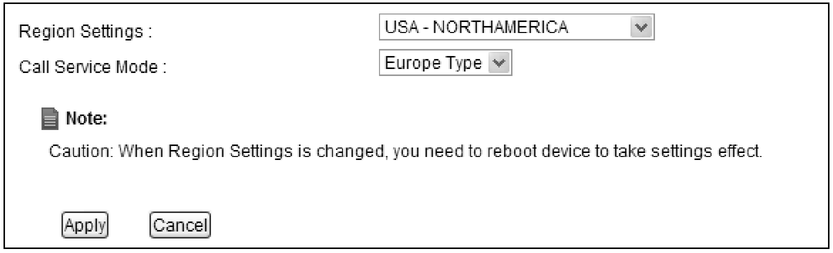
  (xx<123:456>xxxx) means the Device automatically translates "123" to "456" in the number you dialed before making the call.
- Calls with a number followed by the exclamation mark "!" will be dropped.
- Calls with a number followed by the termination character "@" will be made immediately. Any digit (0~9, *, #) after the @ character will be ignored.

In this example dial plan (0 | [49]11 | 1 [2-9]xx xxxxxxx | 1 947 xxxxxxx !), you can dial "0" to call the local operator, call 411 or 911, or make a long distance call with an area code starting from 2 to 9 in the US. The calls with the area code 947 will be dropped.

21.5 The Phone Screen

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

Figure 146 VoIP > Phone



Region Settings : USA - NORTHAMERICA

Call Service Mode : Europe Type

Note:

Caution: When Region Settings is changed, you need to reboot device to take settings effect.

Each field is described in the following table.

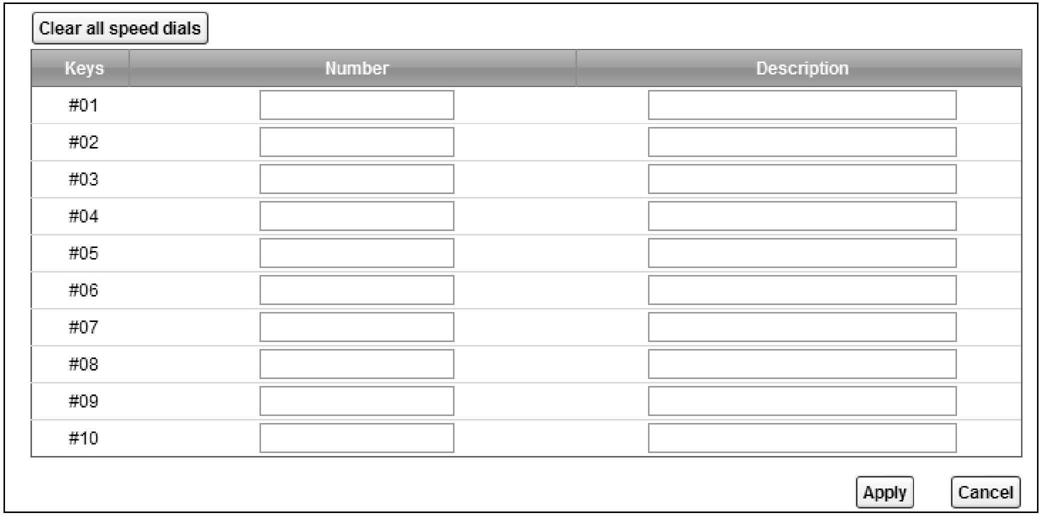
Table 114 VoIP > Phone

LABEL	DESCRIPTION
Region Settings	Select the place in which the 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 Device.
Cancel	Click this to set every field in this screen to its last-saved value.

21.6 The Call Rule 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 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.

Figure 147 VoIP > Call Rule



Clear all speed dials

Keys	Number	Description
#01		
#02		
#03		
#04		
#05		
#06		
#07		
#08		
#09		
#10		

Apply Cancel

Each field is described in the following table.

Table 115 VoIP > Call Rule

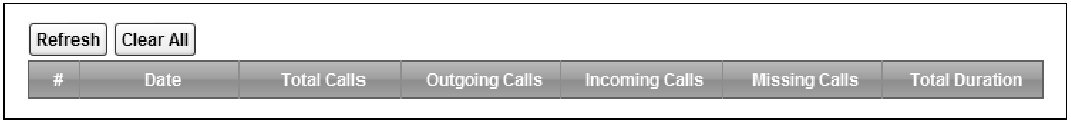
LABEL	DESCRIPTION
Clear all speed dials	Click this to erase all the speed-dial entries on this screen.
Keys	This field displays the speed-dial number you should dial to use this entry.
Number	Enter the SIP number you want the Device to call when you dial the speed-dial number.
Description	Enter a name to identify the party you call when you dial the speed-dial number. You can use up to 127 printable ASCII characters.
Apply	Click this to save your changes and to apply them to the Device.
Cancel	Click this to set every field in this screen to its last-saved value.

21.7 The Call History Summary Screen

The Device logs calls from or to your SIP numbers. This screen allows you to view the summary of received, dialed and missed calls.

Click **VoIP > Call History > Call History Summary**. The following screen displays.

Figure 148 VoIP > Call History > Call History Summary



Refresh Clear All

#	Date	Total Calls	Outgoing Calls	Incoming Calls	Missing Calls	Total Duration

Each field is described in the following table.

Table 116 VoIP > Call History > Call History Summary

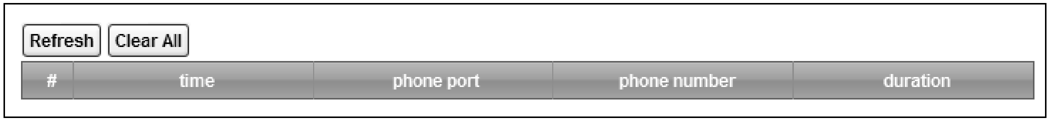
LABEL	DESCRIPTION
Refresh	Click this button to renew the call history list.
Clear All	Click this button to remove all entries from the call history list.
#	This is a read-only index number.
Date	This is the date when the calls were made.
Total Calls	This displays the total number of calls from or to your SIP numbers that day.
Outgoing Calls	This displays how many calls originated from you that day.
Incoming Calls	This displays how many calls you received that day.
Missing Calls	This displays how many incoming calls were not answered that day.
Total Duration	This displays how long all calls lasted that day.

21.8 The Call History Outgoing Calls Screen

Use this screen to see detailed information for each outgoing call you made.

Click **VoIP > Call History > Call History Outgoing**. The following screen displays.

Figure 149 VoIP > Call History > Call History Outgoing



Each field is described in the following table.

Table 117 VoIP > Call History > Call History Outgoing

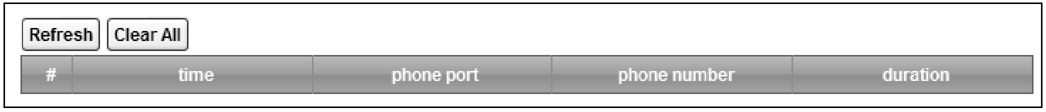
LABEL	DESCRIPTION
Refresh	Click this button to renew the dialed call list.
Clear All	Click this button to remove all entries from the dialed call list.
#	This is a read-only index number.
time	This is the date and time when the call was made.
phone port	This is the phone port on which you made the call.
phone number	This is the SIP number you called.
duration	This displays how long the call lasted.

21.9 The Call History Incoming Calls Screen

Use this screen to see detailed information for each incoming call from someone calling you.

Click **VoIP > Call History > Call History Incoming Calls**. The following screen displays.

Figure 150 VoIP > Call History > Call History Incoming Calls



#	time	phone port	phone number	duration

Each field is described in the following table.

Table 118 VoIP > Call History > Call History Incoming

LABEL	DESCRIPTION
Refresh	Click this button to renew the received call list.
Clear All	Click this button to remove all entries from the received call list.
#	This is a read-only index number.
time	This is the date and time when the call was made.
phone port	This is the phone port on which you received the call. **Missed** means the call was unanswered.
phone number	This is the SIP number that called you.
duration	This displays how long the call lasted.

21.10 Technical Reference

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

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.

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 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 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 Device attempts to register all enabled subscriber ports when it is switched on. When you enable a subscriber port that was previously disabled, the 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 RFC 3261, "SIP: Session Initiation Protocol").

SIP Servers

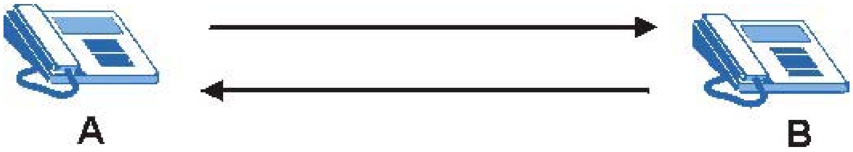
SIP is a client-server protocol. A SIP client is an application program or device that sends SIP requests. A SIP server responds to the SIP requests.

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 151 SIP User Agent



SIP Proxy Server

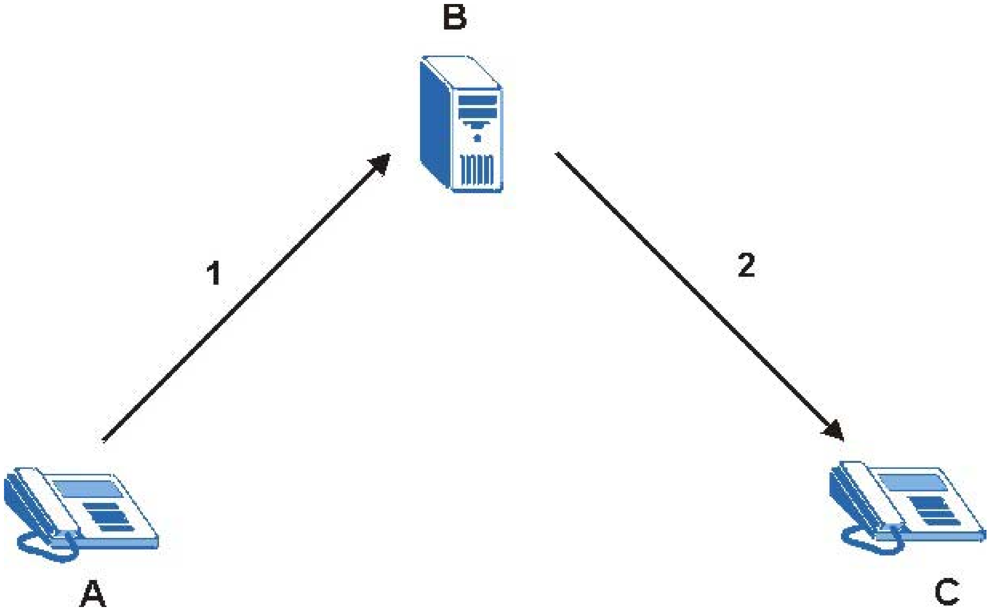
A SIP proxy server receives requests from clients and forwards them to another server.

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 152 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.

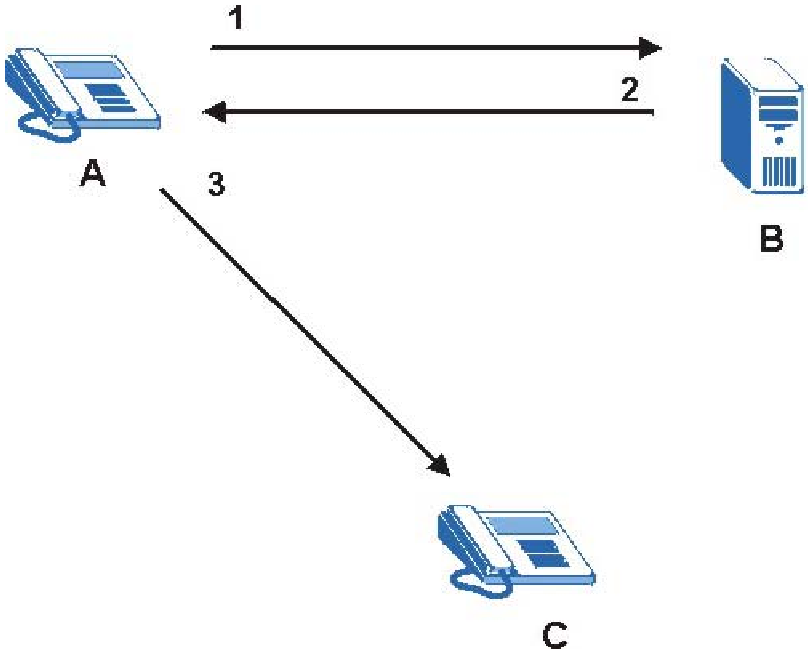
In the following example, you want to use client device **A** to call someone who is using client device **C**.

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 153 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 119 SIP Call Progression

A		B
1. INVITE	→	
	←	2. Ringing
	←	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.

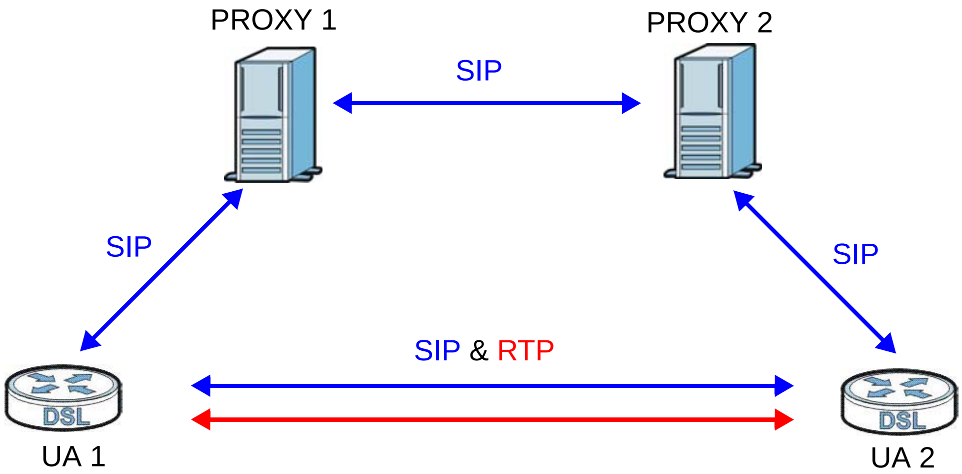
SIP Call Progression Through Proxy Servers

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 154 SIP Call Through Proxy Servers



The following table shows the SIP call progression.

Table 120 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 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.

Voice Activity Detection/Silence Suppression

Voice Activity Detection (VAD) detects whether or not speech is present. This lets the 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 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.

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 Device. The Device allows you to record custom tones for the **Early Media** and **Music On Hold** functions. The same recordings apply to both the caller ringing and on hold tones.

Table 121 Custom Tones Details

LABEL	DESCRIPTION
Total Time for All Tones	900 seconds for all custom tones combined
Maximum Time per Individual Tone	180 seconds
Total Number of Tones Recordable	5 You can record up to 5 different custom tones but the total time must be 900 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 1101~1105 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:

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.

21.10.1 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 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.[3]

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 155 DiffServ: Differentiated Service Field

DSCP	Unused
(6-bit)	(2-bit)

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.

21.10.2 Phone Services Overview

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

[3] The Device does not support DiffServ at the time of writing.

- Call Return
- Call Hold
- Call Waiting
- Making a Second Call
- Call Transfer
- Call Forwarding
- Three-Way Conference
- Internal Calls
- Call Park and Pickup
- Do not Disturb
- IVR
- Call Completion
- CCBS
- Outgoing SIP

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

21.10.2.1 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 Device.

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

21.10.2.2 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 122 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.

Table 122 European Flash Key Commands

COMMAND	SUB-COMMAND	DESCRIPTION
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.

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.

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”.

21.10.2.3 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 123 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.

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.

21.10.2.4 Phone Functions Summary

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

Table 124 Phone Functions Summary

ACTION	FUNCTION	DESCRIPTION
*98#	Call transfer	Transfer a call to another phone. See Section 21.10.2.2 on page 259 (Europe type) and Section 21.10.2.3 on page 261 (USA type).
*66#	Call return	Place a call to the last person who called you.
*95#	Enable Do Not Disturb	Use these to set your phone not to ring when someone calls you, or to turn this function off.
#95#	Disable Do Not Disturb	
*41#	Enable Call Waiting	Use these to allow you to put a call on hold when you are answering another, or to turn this function off.
#41#	Disable Call Waiting	
****	IVR	Use these to set up Interactive Voice Response (IVR). IVR allows you to record custom caller ringing tones (the sound a caller hears before you pick up the phone) and on hold tones (the sound someone hears when you put their call on hold).
####	Internal Call	Call the phone(s) connected to the Device.

Table 124 Phone Functions Summary

ACTION	FUNCTION	DESCRIPTION
*82	One Shot Caller Display Call	Activate or deactivate caller ID for the next call only.
*67	One Shot Caller Hidden Call	

CHAPTER 22

Log

22.1 Overview

The web configurator allows you to choose which categories of events and/or alerts to have the Device log and then display the logs or have the Device send them to an administrator (as e-mail) or to a syslog server.

22.1.1 What You Can Do in this Chapter

- Use the **System Log** screen to see the system logs (Section 22.2 on page 266).
- Use the **Security Log** screen to see the security-related logs for the categories that you select (Section 22.3 on page 267).

22.1.2 What You Need To Know

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

Alerts and Logs

An alert is a type of log that warrants more serious attention. They include system errors, attacks (access control) and attempted access to blocked web sites. Some categories such as **System Errors** consist of both logs and alerts. You may differentiate them by their color in the **View Log** screen. Alerts display in red and logs display in black.

Syslog Overview

The syslog protocol allows devices to send event notification messages across an IP network to syslog servers that collect the event messages. A syslog-enabled device can generate a syslog message and send it to a syslog server.

Syslog is defined in RFC 3164. The RFC defines the packet format, content and system log related information of syslog messages. Each syslog message has a facility and severity level. The syslog facility identifies a file in the syslog server. Refer to the documentation of your syslog program for details. The following table describes the syslog severity levels.

Table 125 Syslog Severity Levels

CODE	SEVERITY
0	Emergency: The system is unusable.
1	Alert: Action must be taken immediately.
2	Critical: The system condition is critical.
3	Error: There is an error condition on the system.
4	Warning: There is a warning condition on the system.

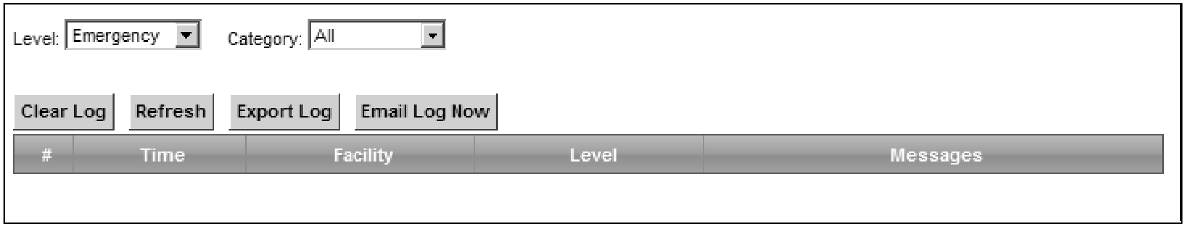
Table 125 Syslog Severity Levels

CODE	SEVERITY
5	Notice: There is a normal but significant condition on the system.
6	Informational: The syslog contains an informational message.
7	Debug: The message is intended for debug-level purposes.

22.2 The System Log Screen

Use the **System Log** screen to see the system logs. Click **System Monitor > Log** to open the **System Log** screen.

Figure 156 System Monitor > Log > System Log



The following table describes the fields in this screen.

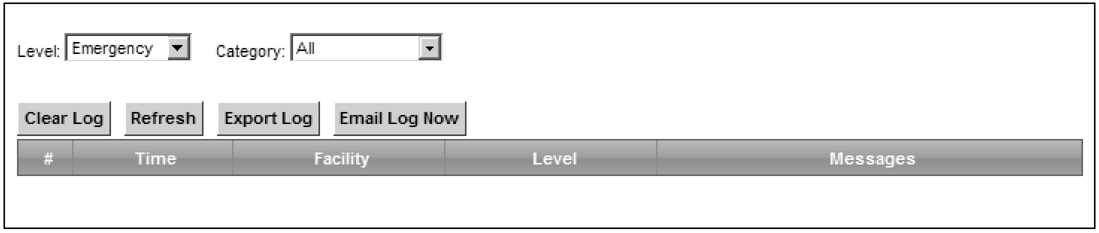
Table 126 System Monitor > Log > System Log

LABEL	DESCRIPTION
Level	Select a severity level from the drop-down list box. This filters search results according to the severity level you have selected. When you select a severity, the Device searches through all logs of that severity or higher.
Category	Select the type of logs to display.
Clear Log	Click this to delete all the logs.
Refresh	Click this to renew the log screen.
Export Log	Click this to export the selected log(s).
Email Log Now	Click this to send the log file(s) to the E-mail address you specify in the **Maintenance > Logs Setting** screen.
System Log	
#	This field is a sequential value and is not associated with a specific entry.
Time	This field displays the time the log was recorded.
Facility	The log facility allows you to send logs to different files in the syslog server. Refer to the documentation of your syslog program for more details.
Level	This field displays the severity level of the logs that the device is to send to this syslog server.
Messages	This field states the reason for the log.

22.3 The Security Log Screen

Use the **Security Log** screen to see the security-related logs for the categories that you select. Click **System Monitor > Log > Security Log** to open the following screen.

Figure 157 System Monitor > Log > Security Log



Level: Emergency Category: All

The following table describes the fields in this screen.

Table 127 System Monitor > Log > Security Log

LABEL	DESCRIPTION
Level	Select a severity level from the drop-down list box. This filters search results according to the severity level you have selected. When you select a severity, the Device searches through all logs of that severity or higher.
Category	Select the type of logs to display.
Clear Log	Click this to delete all the logs.
Refresh	Click this to renew the log screen.
Export Log	Click this to export the selected log(s).
Email Log Now	Click this to send the log file(s) to the E-mail address you specify in the **Maintenance > Logs Setting** screen.
#	This field is a sequential value and is not associated with a specific entry.
Time	This field displays the time the log was recorded.
Facility	The log facility allows you to send logs to different files in the syslog server. Refer to the documentation of your syslog program for more details.
Level	This field displays the severity level of the logs that the device is to send to this syslog server.
Messages	This field states the reason for the log.

23

Traffic Status

23.1 Overview

Use the **Traffic Status** screens to look at network traffic status and statistics of the WAN, LAN interfaces and NAT.

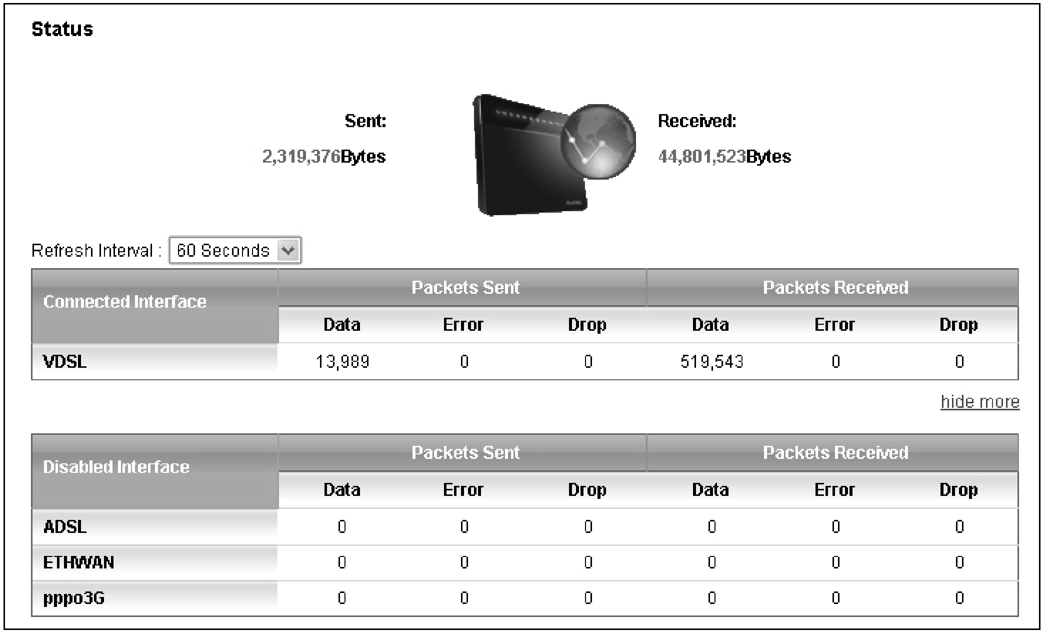
23.1.1 What You Can Do in this Chapter

- Use the **WAN** screen to view the WAN traffic statistics (Section 23.2 on page 269).
- Use the **LAN** screen to view the LAN traffic statistics (Section 23.3 on page 271).
- Use the **NAT** screen to view the NAT status of the Device's client(s) (Section 23.4 on page 272)

23.2 The WAN Status Screen

Click **System Monitor > Traffic Status** to open the **WAN** screen. The figure in this screen shows the number of bytes received and sent on the Device.

Figure 158 System Monitor > Traffic Status > WAN



Status

Sent: 2,319,376Bytes

Received: 44,801,523Bytes

Refresh Interval : 60 Seconds

Connected Interface	Packets Sent			Packets Received		
	Data	Error	Drop	Data	Error	Drop
VDSL	13,989	0	0	519,543	0	0

hide more

Disabled Interface	Packets Sent			Packets Received		
	Data	Error	Drop	Data	Error	Drop
ADSL	0	0	0	0	0	0
ETHWAN	0	0	0	0	0	0
pppo3G	0	0	0	0	0	0

The following table describes the fields in this screen.

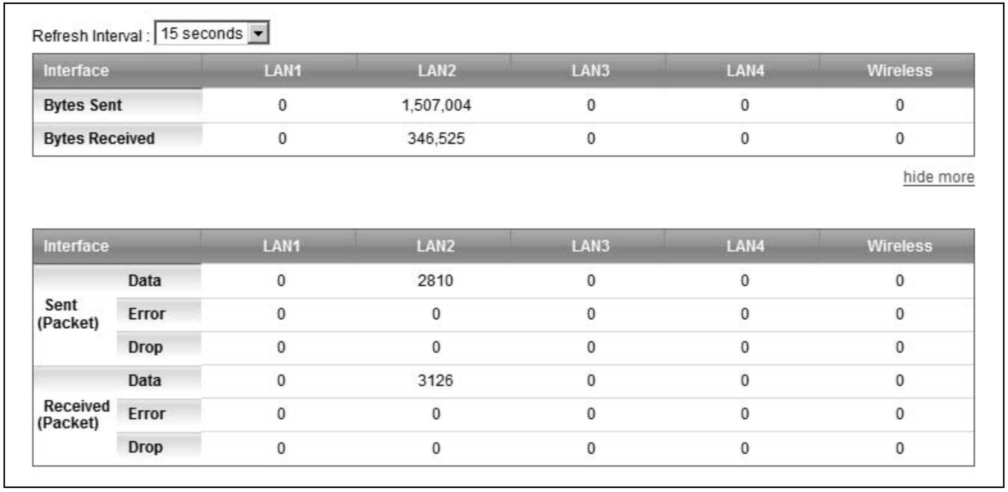
Table 128 System Monitor > Traffic Status > WAN

LABEL	DESCRIPTION
Connected Interface	This shows the name of the WAN interface that is currently connected.
Packets Sent	
Data	This indicates the number of transmitted packets on this interface.
Error	This indicates the number of frames with errors transmitted on this interface.
Drop	This indicates the number of outgoing packets dropped on this interface.
Packets Received	
Data	This indicates the number of received packets on this interface.
Error	This indicates the number of frames with errors received on this interface.
Drop	This indicates the number of received packets dropped on this interface.
more...hide more	Click **more...** to show more information. Click **hide more** to hide them.
Disabled Interface	This shows the name of the WAN interface that is currently disconnected.
Packets Sent	
Data	This indicates the number of transmitted packets on this interface.
Error	This indicates the number of frames with errors transmitted on this interface.
Drop	This indicates the number of outgoing packets dropped on this interface.
Packets Received	
Data	This indicates the number of received packets on this interface.
Error	This indicates the number of frames with errors received on this interface.
Drop	This indicates the number of received packets dropped on this interface.

23.3 The LAN Status Screen

Click **System Monitor > Traffic Status > LAN** to open the following screen. The figure in this screen shows the interface that is currently connected on the Device.

Figure 159 System Monitor > Traffic Status > LAN



Refresh Interval : 15 seconds

Interface	LAN1	LAN2	LAN3	LAN4	Wireless
Bytes Sent	0	1,507,004	0	0	0
Bytes Received	0	346,525	0	0	0

hide more

Interface		LAN1	LAN2	LAN3	LAN4	Wireless
Sent (Packet)	Data	0	2810	0	0	0
	Error	0	0	0	0	0
	Drop	0	0	0	0	0
Received (Packet)	Data	0	3126	0	0	0
	Error	0	0	0	0	0
	Drop	0	0	0	0	0

The following table describes the fields in this screen.

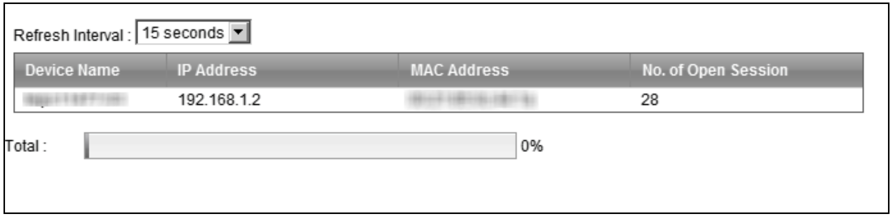
Table 129 System Monitor > Traffic Status > LAN

LABEL	DESCRIPTION
Refresh Interval	Select how often you want the Device to update this screen.
Interface	This shows the LAN or WLAN interface.
Bytes Sent	This indicates the number of bytes transmitted on this interface.
Bytes Received	This indicates the number of bytes received on this interface.
more...hide more	Click **more...** to show more information. Click **hide more** to hide them.
Interface	This shows the LAN or WLAN interface.
Sent (Packets)	
Data	This indicates the number of transmitted packets on this interface.
Error	This indicates the number of frames with errors transmitted on this interface.
Drop	This indicates the number of outgoing packets dropped on this interface.
Received (Packets)	
Data	This indicates the number of received packets on this interface.
Error	This indicates the number of frames with errors received on this interface.
Drop	This indicates the number of received packets dropped on this interface.

23.4 The NAT Status Screen

Click **System Monitor > Traffic Status > NAT** to open the following screen. The figure in this screen shows the NAT session statistics for hosts currently connected on the Device.

Figure 160 System Monitor > Traffic Status > NAT



Refresh Interval : 15 seconds

Device Name	IP Address	MAC Address	No. of Open Session
[redacted]	192.168.1.2	[redacted]	28

Total : 0%

The following table describes the fields in this screen.

Table 130 System Monitor > Traffic Status > NAT

LABEL	DESCRIPTION
Refresh Interval	Select how often you want the Device to update this screen.
Device Name	This displays the name of the connected host.
IP Address	This displays the IP address of the connected host.
MAC Address	This displays the MAC address of the connected host.
No. of Open Session	This displays the number of NAT sessions currently opened for the connected host.
Total	This displays what percentage of NAT sessions the Device can support is currently being used by all connected hosts.

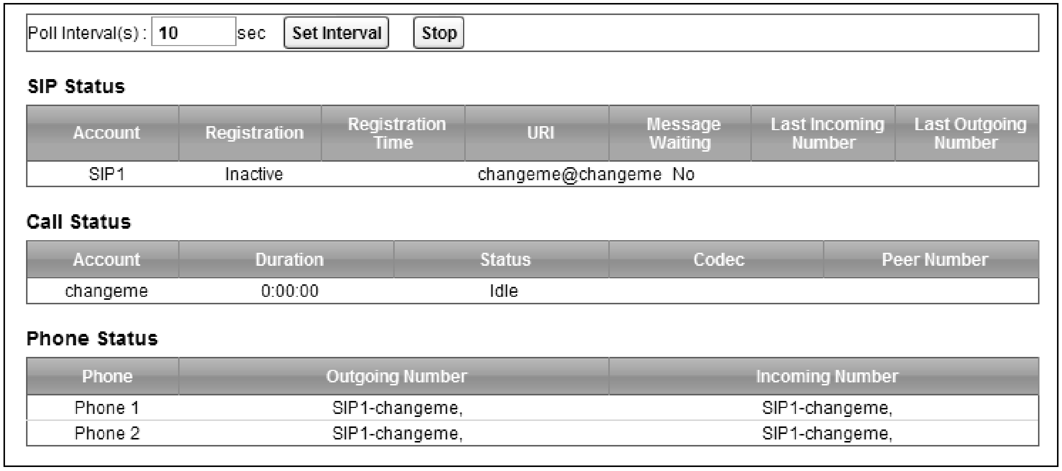
24

VoIP Status

24.1 The VoIP Status Screen

Click **System Monitor > VoIP Status** to open the following screen. You can view the VoIP registration, current call status and phone numbers in this screen.

Figure 161 System Monitor > VoIP Status



Poll Interval(s) : 10 sec

SIP Status

Account	Registration	Registration Time	URI	Message Waiting	Last Incoming Number	Last Outgoing Number
SIP1	Inactive		changeme@changeme	No		

Call Status

Account	Duration	Status	Codec	Peer Number
changeme	0:00:00	Idle		

Phone Status

Phone	Outgoing Number	Incoming Number
Phone 1	SIP1-changeme,	SIP1-changeme,
Phone 2	SIP1-changeme,	SIP1-changeme,

The following table describes the fields in this screen.

Table 131 System Monitor > VoIP Status

LABEL	DESCRIPTION
Poll Interval(s)	Enter the number of seconds the Device needs to wait before updating this screen and then click **Set Interval**. Click **Stop** to have the Device stop updating this screen.
SIP Status	
Account	This column displays each SIP account in the Device.
Registration	This field displays the current registration status of the SIP account. You can change this in the **Status** screen. **Registered** - The SIP account is registered with a SIP server. **Not Registered** - The last time the Device tried to register the SIP account with the SIP server, the attempt failed. The Device automatically tries to register the SIP account when you turn on the Device or when you activate it. **Inactive** - The SIP account is not active. You can activate it in **VoIP > SIP > SIP Account**.
Registration Time	This field displays the last time the Device successfully registered the SIP account. The field is blank if the Device has never successfully registered this account.
URI	This field displays the account number and service domain of the SIP account. You can change these in the **VoIP > SIP** screens.

Table 131 System Monitor > VoIP Status (continued)

LABEL	DESCRIPTION
Message Waiting	This field indicates whether or not there are any messages waiting for the SIP account.
Last Incoming Number	This field displays the last number that called the SIP account. The field is blank if no number has ever dialed the SIP account.
Last Outgoing Number	This field displays the last number the SIP account called. The field is blank if the SIP account has never dialed a number.
Call Status	
Account	This column displays each SIP account in the Device.
Duration	This field displays how long the current call has lasted.
Status	This field displays the current state of the phone call. **Idle** - There are no current VoIP calls, incoming calls or outgoing calls being made. **Dial** - The callee’s phone is ringing. **Ring** - The phone is ringing for an incoming VoIP call. **Process** - There is a VoIP call in progress. **DISC** - The callee’s line is busy, the callee hung up or your phone was left off the hook.
Codec	This field displays what voice codec is being used for a current VoIP call through a phone port.
Peer Number	This field displays the SIP number of the party that is currently engaged in a VoIP call through a phone port.
Phone Status	
Phone	This field displays the name of a phone port on the Device.
Outgoing Number	This field displays the SIP number that you use to make calls on this phone port.
Incoming Number	This field displays the SIP number that you use to receive calls on this phone port.

25

ARP Table

25.1 Overview

Address Resolution Protocol (ARP) is a protocol for mapping an Internet Protocol address (IP address) to a physical machine address, also known as a Media Access Control or MAC address, on the local area network.

An IP (version 4) address is 32 bits long. In an Ethernet LAN, MAC addresses are 48 bits long. The ARP Table maintains an association between each MAC address and its corresponding IP address.

25.1.1 How ARP Works

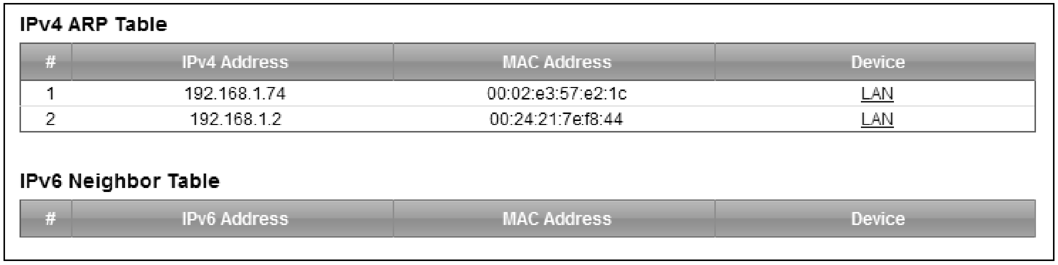
When an incoming packet destined for a host device on a local area network arrives at the device, the device's ARP program looks in the ARP Table and, if it finds the address, sends it to the device.

If no entry is found for the IP address, ARP broadcasts the request to all the devices on the LAN. The device fills in its own MAC and IP address in the sender address fields, and puts the known IP address of the target in the target IP address field. In addition, the device puts all ones in the target MAC field (FF.FF.FF.FF.FF.FF is the Ethernet broadcast address). The replying device (which is either the IP address of the device being sought or the router that knows the way) replaces the broadcast address with the target's MAC address, swaps the sender and target pairs, and unicasts the answer directly back to the requesting machine. ARP updates the ARP Table for future reference and then sends the packet to the MAC address that replied.

25.2 ARP Table Screen

Use the ARP table to view IP-to-MAC address mapping(s). To open this screen, click **System Monitor** > **ARP Table**.

Figure 162 System Monitor > ARP Table



IPv4 ARP Table

#	IPv4 Address	MAC Address	Device
1	192.168.1.74	00:02:e3:57:e2:1c	LAN
2	192.168.1.2	00:24:21:7e:f8:44	LAN

IPv6 Neighbor Table

#	IPv6 Address	MAC Address	Device

The following table describes the labels in this screen.

Table 132 System Monitor > ARP Table

LABEL	DESCRIPTION
#	This is the ARP table entry number.
IPv4/IPv6 Address	This is the learned IPv4 or IPv6 IP address of a device connected to a port.
MAC Address	This is the MAC address of the device with the listed IP address.
Device	This is the type of interface used by the device. You can click on the device type to go to its configuration screen.

26

Routing Table

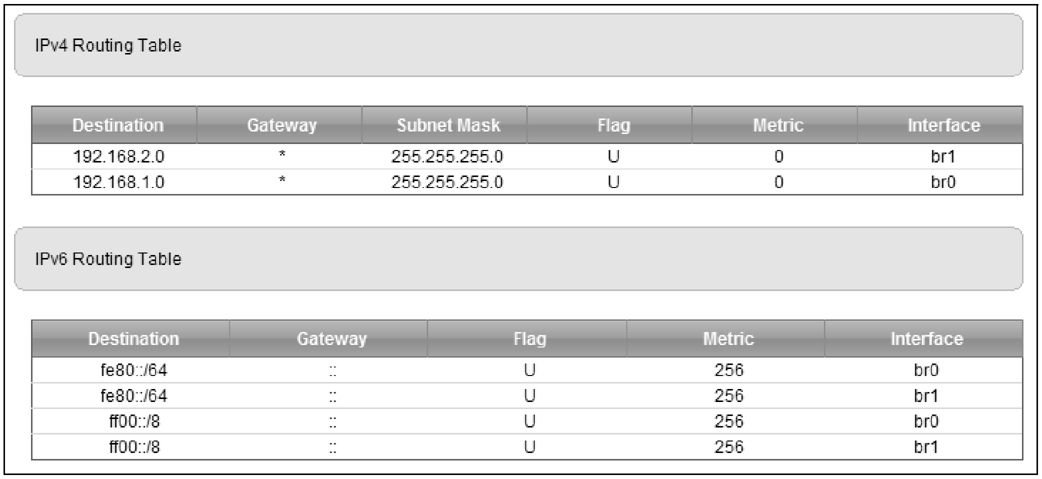
26.1 Overview

Routing is based on the destination address only and the Device takes the shortest path to forward a packet.

26.2 The Routing Table Screen

Click **System Monitor** > **Routing Table** to open the following screen.

Figure 163 System Monitor > Routing Table



IPv4 Routing Table

Destination	Gateway	Subnet Mask	Flag	Metric	Interface
192.168.2.0	*	255.255.255.0	U	0	br1
192.168.1.0	*	255.255.255.0	U	0	br0

IPv6 Routing Table

Destination	Gateway	Flag	Metric	Interface
fe80::/64	::	U	256	br0
fe80::/64	::	U	256	br1
ff00::/8	::	U	256	br0
ff00::/8	::	U	256	br1

The following table describes the labels in this screen.

Table 133 System Monitor > Routing Table

LABEL	DESCRIPTION
IPv4/IPv6 Routing Table	
Destination	This indicates the destination IPv4 address or IPv6 address and prefix of this route.
Gateway	This indicates the IPv4 address or IPv6 address of the gateway that helps forward this route's traffic.
Subnet Mask	This indicates the destination subnet mask of the IPv4 route.

Table 133 System Monitor > Routing Table (continued)

LABEL	DESCRIPTION
Flag	This indicates the route status. **U-Up:** The route is up. **!-Reject:** The route is blocked and will force a route lookup to fail. **G-Gateway:** The route uses a gateway to forward traffic. **H-Host:** The target of the route is a host. **R-Reinstate:** The route is reinstated for dynamic routing. **D-Dynamic (redirect):** The route is dynamically installed by a routing daemon or redirect. **M-Modified (redirect):** The route is modified from a routing daemon or redirect.
Metric	The metric represents the "cost of transmission". A router determines the best route for transmission by choosing a path with the lowest "cost". The smaller the number, the lower the "cost".
Service	This indicates the name of the service used to forward the route.
Interface	This indicates the name of the interface through which the route is forwarded. **brx** indicates a LAN interface where x can be 0~3 to represent LAN1 to LAN4 respectively. **ptm0** indicates a WAN interface using IPoE or in bridge mode. **ppp0** indicates a WAN interface using PPPoE.

27

IGMP/MLD Status

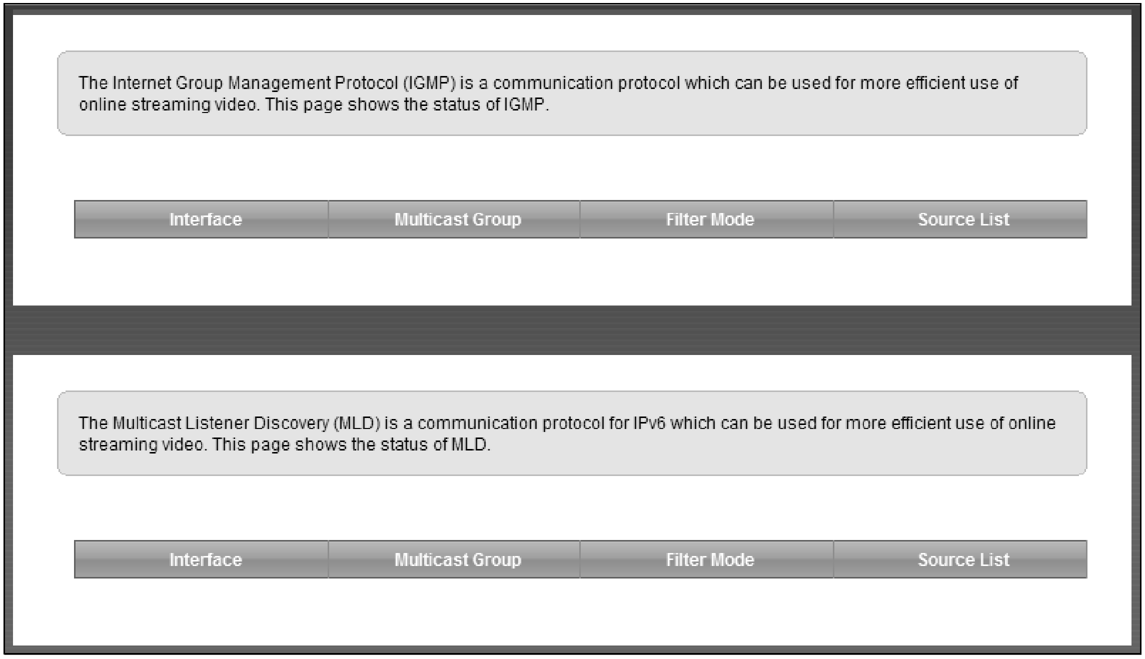
27.1 Overview

Use the **IGMP Status** screens to look at IGMP/MLD group status and traffic statistics.

27.2 The IGMP/MLD Group Status Screen

Use this screen to look at the current list of multicast groups the Device has joined and which ports have joined it. To open this screen, click **System Monitor > IGMP/MLD Group Status**.

Figure 164 System Monitor > IGMP/MLD Group Status



The Internet Group Management Protocol (IGMP) is a communication protocol which can be used for more efficient use of online streaming video. This page shows the status of IGMP.

Interface	Multicast Group	Filter Mode	Source List

The Multicast Listener Discovery (MLD) is a communication protocol for IPv6 which can be used for more efficient use of online streaming video. This page shows the status of MLD.

Interface	Multicast Group	Filter Mode	Source List

The following table describes the labels in this screen.

Table 134 System Monitor > IGMP/MLD Group Status

LABEL	DESCRIPTION
Interface	This field displays the name of an interface on the Device that belongs to an IGMP or MLD multicast group.
Multicast Group	This field displays the name of the IGMP or MLD multicast group to which the interface belongs.

Table 134 System Monitor > IGMP/MLD Group Status (continued)

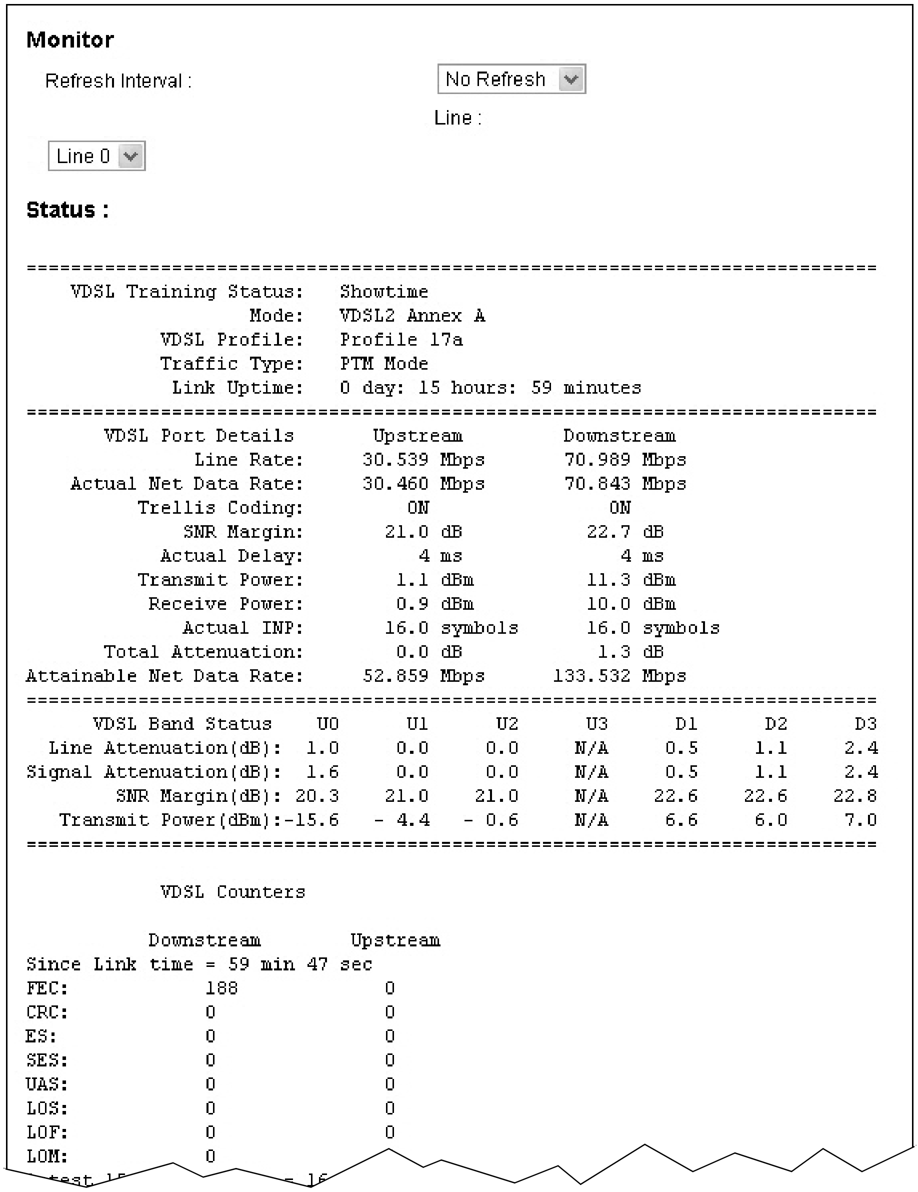
LABEL	DESCRIPTION
Filter Mode	**INCLUDE** means that only the IP addresses in the **Source List** get to receive the multicast group’s traffic. **EXCLUDE** means that the IP addresses in the **Source List** are not allowed to receive the multicast group’s traffic but other IP addresses can.
Source List	This is the list of IP addresses that are allowed or not allowed to receive the multicast group’s traffic depending on the filter mode.

xDSL Statistics

28.1 The xDSL Statistics Screen

Use this screen to view detailed DSL statistics. Click **System Monitor > xDSL Statistics** to open the following screen.

Figure 165 System Monitor > xDSL Statistics



Monitor

Refresh Interval : No Refresh

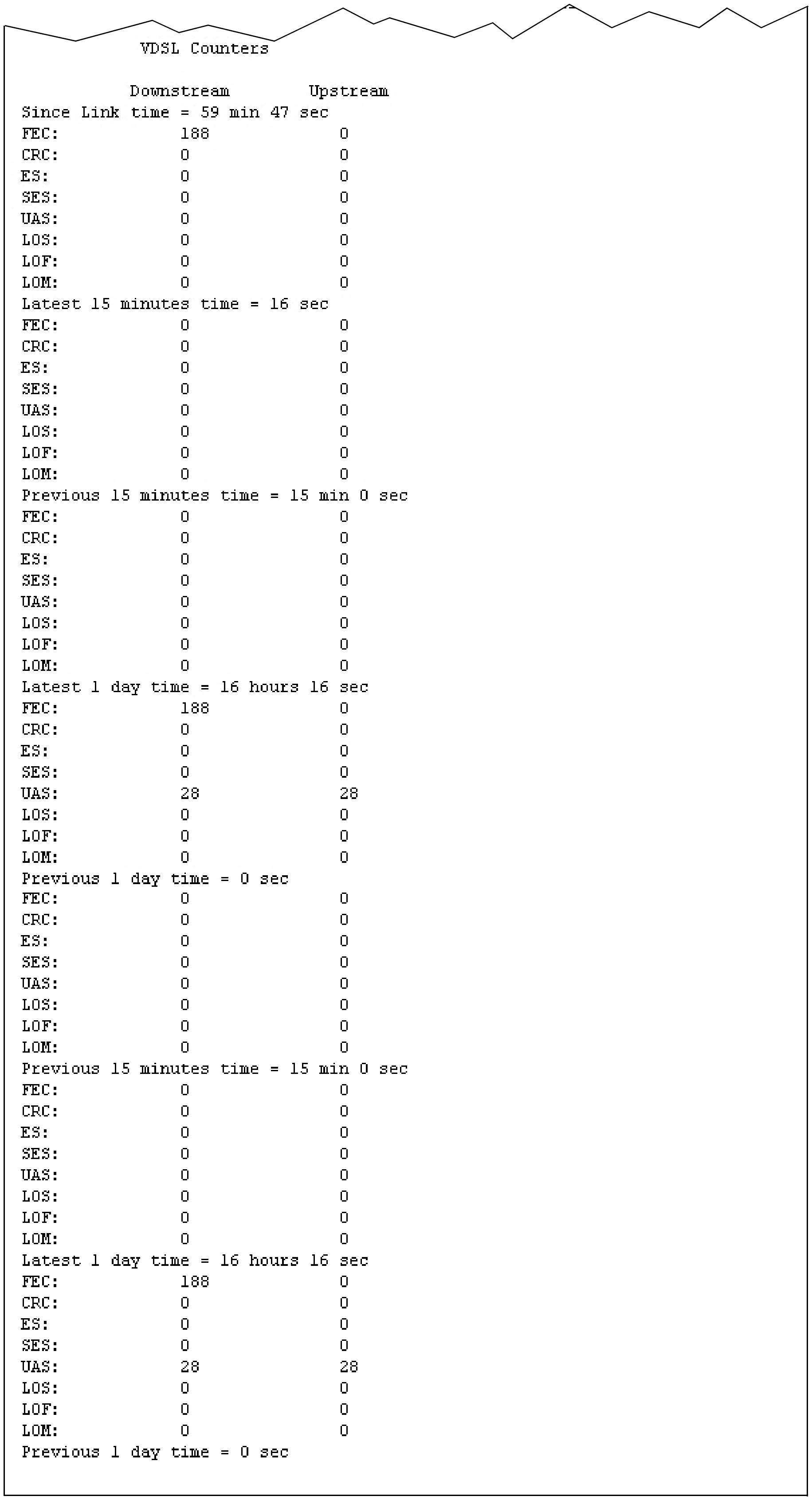
Line : Line 0

Status :

```
============================================================================
    VDSL Training Status:   Showtime
                    Mode:   VDSL2 Annex A
            VDSL Profile:   Profile 17a
            Traffic Type:   PTM Mode
             Link Uptime:   0 day: 15 hours: 59 minutes
============================================================================
       VDSL Port Details       Upstream         Downstream
               Line Rate:     30.539 Mbps       70.989 Mbps
    Actual Net Data Rate:     30.460 Mbps       70.843 Mbps
          Trellis Coding:         ON                ON
              SNR Margin:       21.0 dB           22.7 dB
            Actual Delay:          4 ms              4 ms
          Transmit Power:        1.1 dBm          11.3 dBm
           Receive Power:        0.9 dBm          10.0 dBm
              Actual INP:       16.0 symbols      16.0 symbols
       Total Attenuation:        0.0 dB            1.3 dB
Attainable Net Data Rate:     52.859 Mbps      133.532 Mbps
============================================================================
      VDSL Band Status    U0      U1      U2      U3      D1      D2      D3
  Line Attenuation(dB):  1.0     0.0     0.0     N/A     0.5     1.1     2.4
Signal Attenuation(dB):  1.6     0.0     0.0     N/A     0.5     1.1     2.4
        SNR Margin(dB): 20.3    21.0    21.0     N/A    22.6    22.6    22.8
   Transmit Power(dBm):-15.6   - 4.4   - 0.6     N/A     6.6     6.0     7.0
============================================================================


            VDSL Counters

           Downstream        Upstream
Since Link time = 59 min 47 sec
FEC:            188             0
CRC:            0               0
ES:             0               0
SES:            0               0
UAS:            0               0
LOS:            0               0
LOF:            0               0
LOM:            0
    test 15            = 16
```



```
             VDSL Counters

            Downstream        Upstream
Since Link time = 59 min 47 sec
FEC:            188             0
CRC:            0               0
ES:             0               0
SES:            0               0
UAS:            0               0
LOS:            0               0
LOF:            0               0
LOM:            0               0
Latest 15 minutes time = 16 sec
FEC:            0               0
CRC:            0               0
ES:             0               0
SES:            0               0
UAS:            0               0
LOS:            0               0
LOF:            0               0
LOM:            0               0
Previous 15 minutes time = 15 min 0 sec
FEC:            0               0
CRC:            0               0
ES:             0               0
SES:            0               0
UAS:            0               0
LOS:            0               0
LOF:            0               0
LOM:            0               0
Latest 1 day time = 16 hours 16 sec
FEC:            188             0
CRC:            0               0
ES:             0               0
SES:            0               0
UAS:            28              28
LOS:            0               0
LOF:            0               0
LOM:            0               0
Previous 1 day time = 0 sec
FEC:            0               0
CRC:            0               0
ES:             0               0
SES:            0               0
UAS:            0               0
LOS:            0               0
LOF:            0               0
LOM:            0               0
Previous 15 minutes time = 15 min 0 sec
FEC:            0               0
CRC:            0               0
ES:             0               0
SES:            0               0
UAS:            0               0
LOS:            0               0
LOF:            0               0
LOM:            0               0
Latest 1 day time = 16 hours 16 sec
FEC:            188             0
CRC:            0               0
ES:             0               0
SES:            0               0
UAS:            28              28
LOS:            0               0
LOF:            0               0
LOM:            0               0
Previous 1 day time = 0 sec
```

The following table describes the labels in this screen.

Table 135 Status > xDSL Statistics

LABEL	DESCRIPTION
Refresh Interval	Select the time interval for refreshing statistics.
Line	Select which DSL line's statistics you want to display.
xDSL Training Status	This displays the current state of setting up the DSL connection.
Mode	This displays the ITU standard used for this connection.
Traffic Type	This displays the type of traffic the DSL port is sending and receiving. **Inactive** displays if the DSL port is not currently sending or receiving traffic.
Link Uptime	This displays how long the port has been running (or connected) since the last time it was started.
xDSL Port Details	
Upstream	These are the statistics for the traffic direction going out from the port to the service provider.
Downstream	These are the statistics for the traffic direction coming into the port from the service provider.
Line Rate	These are the data transfer rates at which the port is sending and receiving data.
Actual Net Data Rate	These are the rates at which the port is sending and receiving the payload data without transport layer protocol headers and traffic.
Trellis Coding	This displays whether or not the port is using Trellis coding for traffic it is sending and receiving. Trellis coding helps to reduce the noise in ADSL transmissions. Trellis may reduce throughput but it makes the connection more stable.
SNR Margin	This is the upstream and downstream Signal-to-Noise Ratio margin (in dB). A DMT sub-carrier's SNR is the ratio between the received signal power and the received noise power. The signal-to-noise ratio margin is the maximum that the received noise power could increase with the system still being able to meet its transmission targets.
Actual Delay	This is the upstream and downstream interleave delay. It is the wait (in milliseconds) that determines the size of a single block of data to be interleaved (assembled) and then transmitted. Interleave delay is used when transmission error correction (Reed- Solomon) is necessary due to a less than ideal telephone line. The bigger the delay, the bigger the data block size, allowing better error correction to be performed.
Transmit Power	This is the upstream and downstream far end actual aggregate transmit power (in dBm). Upstream is how much power the port is using to transmit to the service provider. Downstream is how much port the service provider is using to transmit to the port.
Receive Power	Upstream is how much power the service provider is receiving from the port. Downstream is how much power the port is receiving from the service provider.
Actual INP	Sudden spikes in the line's level of external noise (impulse noise) can cause errors and result in lost packets. This could especially impact the quality of multimedia traffic such as voice or video. Impulse noise protection (INP) provides a buffer to allow for correction of errors caused by error correction to deal with this. The number of DMT (Discrete Multi-Tone) symbols shows the level of impulse noise protection for the upstream and downstream traffic. A higher symbol value provides higher error correction capability, but it causes overhead and higher delay which may increase error rates in received multimedia data.
Total Attenuation	This is the upstream and downstream line attenuation, measured in decibels (dB). This attenuation is the difference between the power transmitted at the near-end and the power received at the far-end. Attenuation is affected by the channel characteristics (wire gauge, quality, condition and length of the physical line).
Attainable Net Data Rate	These are the highest theoretically possible transfer rates at which the port could send and receive payload data without transport layer protocol headers and traffic.
xDSL Counters	

Table 135 Status > xDSL Statistics (continued)

LABEL	DESCRIPTION
Downstream	These are the statistics for the traffic direction coming into the port from the service provider.
Upstream	These are the statistics for the traffic direction going out from the port to the service provider.
FEC	This is the number of Far End Corrected blocks.
CRC	This is the number of Cyclic Redundancy Checks.
ES	This is the number of Errored Seconds meaning the number of seconds containing at least one errored block or at least one defect.
SES	This is the number of Severely Errored Seconds meaning the number of seconds containing 30% or more errored blocks or at least one defect. This is a subset of ES.
UAS	This is the number of UnAvailable Seconds.
LOS	This is the number of Loss Of Signal seconds.
LOF	This is the number of Loss Of Frame seconds.
LOM	This is the number of Loss of Margin seconds.

29

3G Statistics

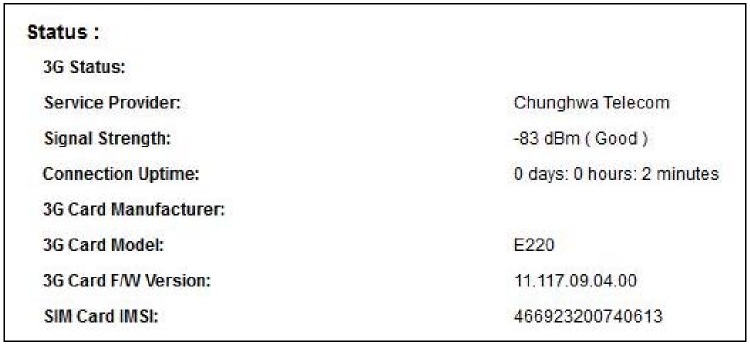
29.1 Overview

Use the **3G Statistics** screens to look at 3G Internet connection status.

29.2 The 3G Statistics Screen

To open this screen, click **System Monitor > 3G Statistics**. The 3G status is available on this screen only when you insert a compatible 3G dongle in a USB port on the Device.

Figure 166 System Monitor > 3G Statistics



Status :

3G Status:

Service Provider: Chunghwa Telecom

Signal Strength: -83 dBm (Good)

Connection Uptime: 0 days: 0 hours: 2 minutes

3G Card Manufacturer:

3G Card Model: E220

3G Card F/W Version: 11.117.09.04.00

SIM Card IMSI: 466923200740613

The following table describes the labels in this screen.

Table 136 System Monitor > 3G Statistics

LABEL	DESCRIPTION
Refresh Interval	Select how often you want the Device to update this screen. Select **No Refresh** to stop refreshing.
3G Status	This field displays the status of the 3G Internet connection. This field can display: **GSM** - Global System for Mobile Communications, 2G **GPRS** - General Packet Radio Service, 2.5G **EDGE** - Enhanced Data rates for GSM Evolution, 2.75G **WCDMA** - Wideband Code Division Multiple Access, 3G **HSDPA** - High-Speed Downlink Packet Access, 3.5G **HSUPA** - High-Speed Uplink Packet Access, 3.75G **HSPA** - HSDPA+HSUPA, 3.75G
Service Provider	This field displays the name of the service provider.

Table 136 System Monitor > 3G Statistics (continued)

LABEL	DESCRIPTION
Signal Strength	This field displays the strength of the signal in dBm.
Connection Uptime	This field displays the time the connection has been up.
3G Card Manufacturer	This field displays the manufacturer of the 3G card.
3G Card Model	This field displays the model name of the 3G card.
3G Card F/W Version	This field displays the firmware version of the 3G card.
SIM Card IMSI	The International Mobile Subscriber Identity or IMSI is a unique identification number associated with all cellular networks. This number is provisioned in the SIM card.

30

User Account

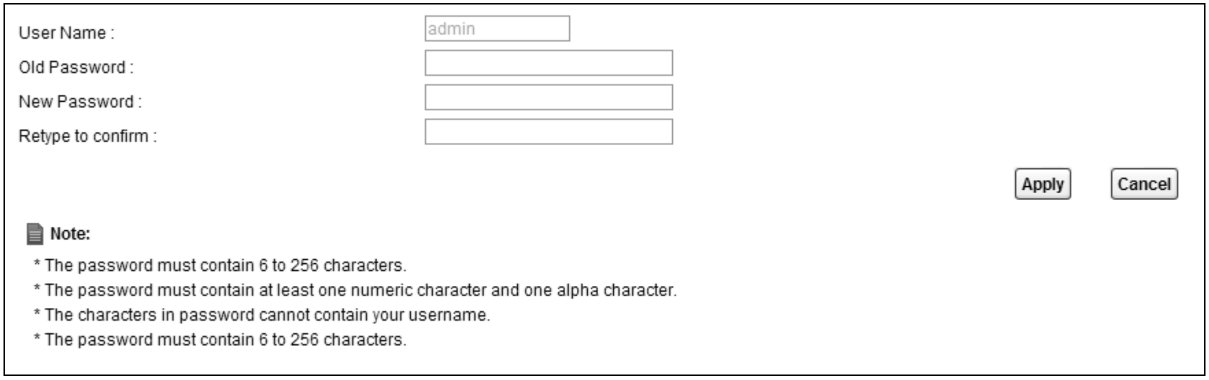
30.1 Overview

In the **Users Account** screen, you can change the password of the “admin” user account that you used to log in the Device.

30.2 The User Account Screen

Click **Maintenance > User Account** to open the following screen.

Figure 167 Maintenance > User Account



User Name :	admin
Old Password :	
New Password :	
Retype to confirm :	

Note:

* The password must contain 6 to 256 characters.
* The password must contain at least one numeric character and one alpha character.
* The characters in password cannot contain your username.
* The password must contain 6 to 256 characters.

The following table describes the labels in this screen.

Table 137 Maintenance > User Account

LABEL	DESCRIPTION
User Name	This field displays the name of the account that you used to log in the system.
Old Password	Type the default password or the existing password you use to access the system in this field.
New Password	Type your new system password (6 to 256 characters). At least one numeric character and one letter are required. After you change the password, use the new password to access the Device.
Retype to confirm	Type the new password again for confirmation.
Apply	Click **Apply** to save your changes.
Cancel	Click **Cancel** to restore your previously saved settings.

Remote Management

31.1 Overview

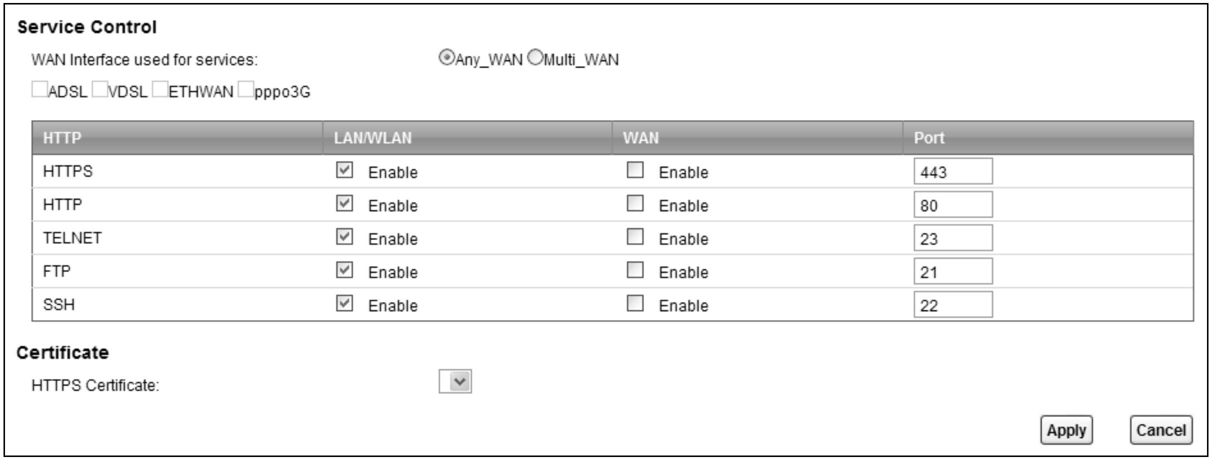
Remote management controls through which interface(s), which services can access the Device.

Note: The Device is managed using the Web Configurator.

31.2 The Remote MGMT Screen

Use this screen to configure through which interface(s), which services can access the Device. You can also specify the port numbers the services must use to connect to the Device. Click **Maintenance > Remote MGMT** to open the following screen.

Figure 168 Maintenance > Remote MGMT



Service Control

WAN Interface used for services: ● Any_WAN ○ Multi_WAN

□ ADSL □ VDSL □ ETHWAN □ pppo3G

HTTP	LAN/WLAN	WAN	Port
HTTPS	☑ Enable	□ Enable	443
HTTP	☑ Enable	□ Enable	80
TELNET	☑ Enable	□ Enable	23
FTP	☑ Enable	□ Enable	21
SSH	☑ Enable	□ Enable	22

Certificate

HTTPS Certificate:

The following table describes the fields in this screen.

Table 138 Maintenance > Remote MGMT

LABEL	DESCRIPTION
WAN Interface used for services	Select **Any WAN** to have the Device automatically activate the remote management service when any WAN connection is up. Select **Multi WAN** and then select one or more WAN connections to have the Device activate the remote management service when the selected WAN connections are up.
HTTP	This is the service you may use to access the Device.
LAN/WLAN	Select the **Enable** check box for the corresponding services that you want to allow access to the Device from the LAN/WLAN.
WAN	Select the **Enable** check box for the corresponding services that you want to allow access to the Device from the WAN.

Table 138 Maintenance > Remote MGMT (continued)

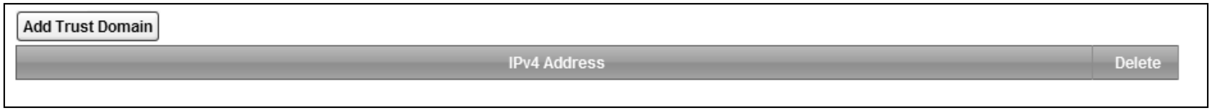
LABEL	DESCRIPTION
Port	You may change the server port number for a service if needed, however you must use the same port number in order to use that service for remote management.
Certificate	
HTTPS Certificate	Select a certificate the HTTPS server (the Device) uses to authenticate itself to the HTTPS client. You must have certificates already configured in the **Certificates** screen.
Apply	Click **Apply** to save your changes back to the Device.
Cancel	Click **Cancel** to restore your previously saved settings.

31.3 The Trust Domain Screen

Use this screen to view a list of public IP addresses which are allowed to access the Device through the services configured in the **Maintenance > Remote MGMT** screen. Click **Maintenance > Remote MGMT > Turst Domain** to open the following screen.

Note: If this list is empty, all public IP addresses can access the Device from the WAN through the specified services.

Figure 169 Maintenance > Remote MGMT > Trust Domain



The following table describes the fields in this screen.

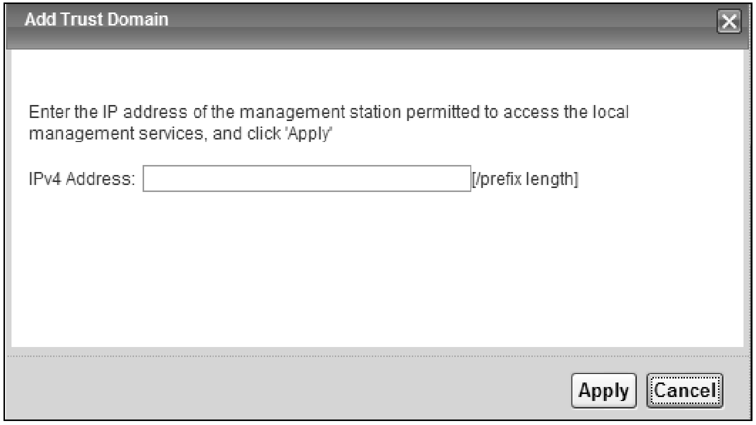
Table 139 Maintenance > Remote MGMT > Trust Domain

LABEL	DESCRIPTION
Add Trust Domain	Click this to add a trusted host IP address.
IPv4 Address	This field shows a trusted host IP address.
Delete	Click the **Delete** icon to remove the trust IP address.

31.4 The Add Trust Domain Screen

Use this screen to configure a public IP address which is allowed to access the Device. Click the **Add Trust Domain** button in the **Maintenance > Remote MGMT > Turst Domain** screen to open the following screen.

Figure 170 Maintenance > Remote MGMT > Trust Domain > Add Trust Domain



Add Trust Domain

Enter the IP address of the management station permitted to access the local management services, and click 'Apply'

IPv4 Address: [/prefix length]

The following table describes the fields in this screen.

Table 140 Maintenance > Remote MGMT > Trust Domain > Add Trust Domain

LABEL	DESCRIPTION
IPv4 Address	Enter a public IPv4 IP address which is allowed to access the service on the Device from the WAN.
Apply	Click **Apply** to save your changes back to the Device.
Cancel	Click **Cancel** to restore your previously saved settings.

32

TR-069 Client

32.1 Overview

This chapter explains how to configure the Device's TR-069 auto-configuration settings.

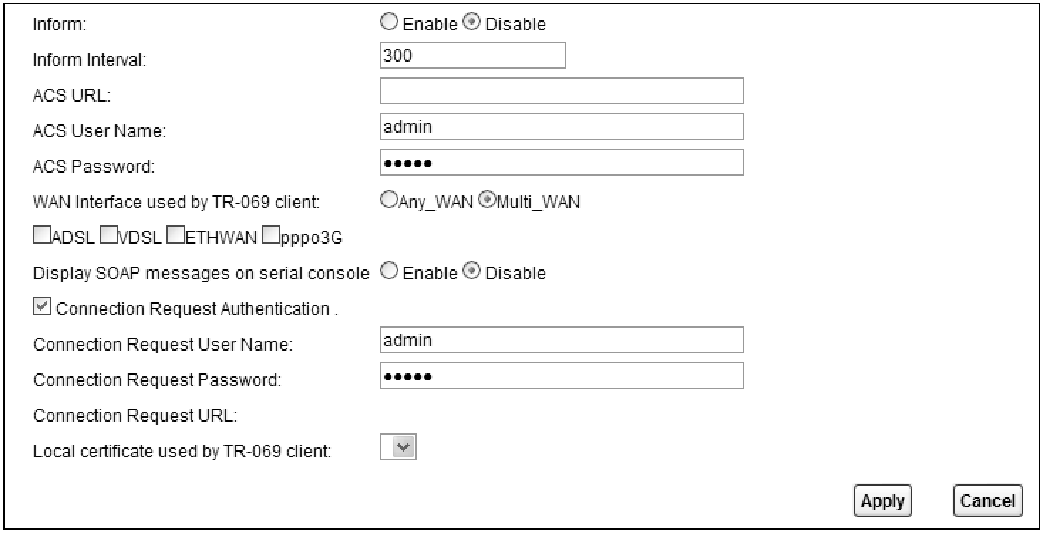
32.2 The TR-069 Client Screen

TR-069 defines how Customer Premise Equipment (CPE), for example your Device, can be managed over the WAN by an Auto Configuration Server (ACS). TR-069 is based on sending Remote Procedure Calls (RPCs) between an ACS and a client device. RPCs are sent in Extensible Markup Language (XML) format over HTTP or HTTPS.

An administrator can use an ACS to remotely set up the Device, modify settings, perform firmware upgrades as well as monitor and diagnose the Device. You have to enable the device to be managed by the ACS and specify the ACS IP address or domain name and username and password.

Click **Maintenance > TR-069 Client** to open the following screen. Use this screen to configure your Device to be managed by an ACS.

Figure 171 Maintenance > TR-069 Client



Inform:	○ Enable ● Disable
Inform Interval:	300
ACS URL:	
ACS User Name:	admin
ACS Password:	•••••
WAN Interface used by TR-069 client:	○ Any_WAN ● Multi_WAN
□ ADSL □ VDSL □ ETHWAN □ pppo3G	
Display SOAP messages on serial console	○ Enable ● Disable
☑ Connection Request Authentication .	
Connection Request User Name:	admin
Connection Request Password:	•••••
Connection Request URL:	
Local certificate used by TR-069 client:	

The following table describes the fields in this screen.

Table 141 Maintenance > TR-069 Client

LABEL	DESCRIPTION
Inform	Select **Enable** for the Device to send periodic inform via TR-069 on the WAN. Otherwise, select **Disable**.
Inform Interval	Enter the time interval (in seconds) at which the Device sends information to the auto-configuration server.
ACS URL	Enter the URL or IP address of the auto-configuration server.
ACS User Name	Enter the TR-069 user name for authentication with the auto-configuration server.
ACS Password	Enter the TR-069 password for authentication with the auto-configuration server.
WAN Interface used by TR-069 client	Select a WAN interface through which the TR-069 traffic passes. If you select **Any_WAN**, the Device automatically passes the TR-069 traffic when any WAN connection is up. If you select **Multi_WAN**, you also need to select two or more pre-configured WAN interfaces. The Device automatically passes the TR-069 traffic when one of the selected WAN connections is up.
Display SOAP messages on serial console	Select **Enable** to show the SOAP messages on the console.
Connection Request Authentication	Select this option to enable authentication when there is a connection request from the ACS.
Connection Request User Name	Enter the connection request user name. When the ACS makes a connection request to the Device, this user name is used to authenticate the ACS.
Connection Request Password	Enter the connection request password. When the ACS makes a connection request to the Device, this password is used to authenticate the ACS.
Connection Request URL	This shows the connection request URL. The ACS can use this URL to make a connection request to the Device.
Local certificate used by TR-069 client	You can choose a local certificate used by TR-069 client. The local certificate should be imported in the **Security** > **Certificates** > **Local Certificates** screen.
Apply	Click **Apply** to save your changes.
Cancel	Click **Cancel** to exit this screen without saving.

33

TR-064

33.1 Overview

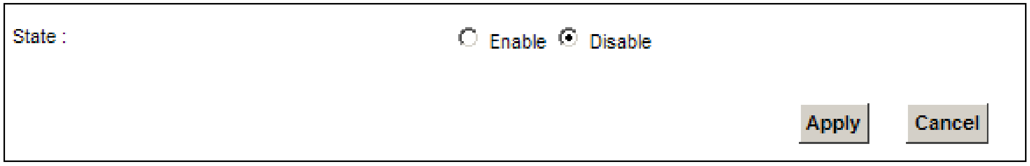
This chapter explains how to configure the Device's TR-064 auto-configuration settings.

33.2 The TR-064 Screen

TR-064 is a LAN-Side DSL CPE Configuration protocol defined by the DSL Forum. TR-064 is built on top of UPnP. It allows the users to use a TR-064 compliant CPE management application on their computers from the LAN to discover the CPE and configure user-specific parameters, such as the username and password.

Click **Maintenance > TR-064** to open the following screen.

Figure 172 Maintenance > TR-064



State : ○ Enable ● Disable

The following table describes the fields in this screen.

Table 142 Maintenance > TR-064

LABEL	DESCRIPTION
State	Select **Enable** to activate management via TR-064 on the LAN.
Apply	Click **Apply** to save your changes.
Cancel	Click **Cancel** to exit this screen without saving.

34

SNMP

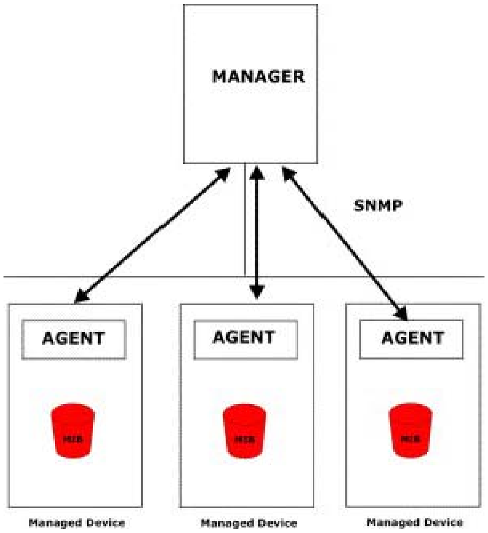
34.1 Overview

This chapter explains how to configure the SNMP settings on the Device.

34.2 The SNMP Screen

Simple Network Management Protocol is a protocol used for exchanging management information between network devices. Your Device supports SNMP agent functionality, which allows a manager station to manage and monitor the Device through the network. The Device supports SNMP version one (SNMPv1) and version two (SNMPv2c). The next figure illustrates an SNMP management operation.

Figure 173 SNMP Management Model



An SNMP managed network consists of two main types of component: agents and a manager.

An agent is a management software module that resides in a managed device (the Device). An agent translates the local management information from the managed device into a form compatible with SNMP. The manager is the console through which network administrators perform network management functions. It executes applications that control and monitor managed devices.

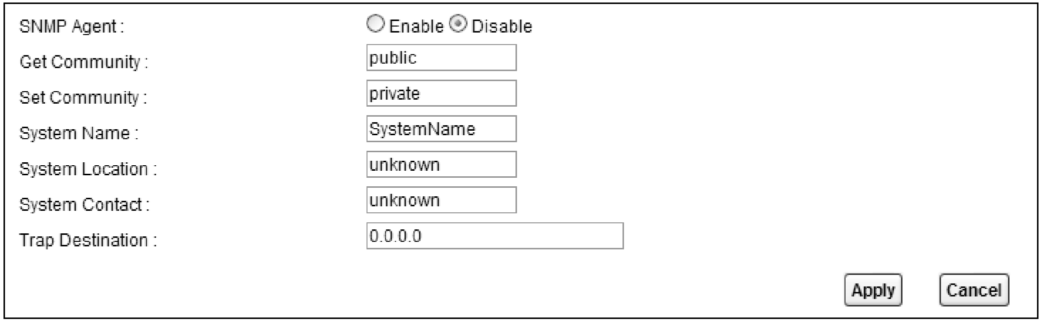
The managed devices contain object variables/managed objects that define each piece of information to be collected about a device. Examples of variables include such as number of packets received, node port status etc. A Management Information Base (MIB) is a collection of managed objects. SNMP allows a manager and agents to communicate for the purpose of accessing these objects.

SNMP itself is a simple request/response protocol based on the manager/agent model. The manager issues a request and the agent returns responses using the following protocol operations:

- Get - Allows the manager to retrieve an object variable from the agent.
- GetNext - Allows the manager to retrieve the next object variable from a table or list within an agent. In SNMPv1, when a manager wants to retrieve all elements of a table from an agent, it initiates a Get operation, followed by a series of GetNext operations.
- Set - Allows the manager to set values for object variables within an agent.
- Trap - Used by the agent to inform the manager of some events.

Click **Maintenance > SNMP** to open the following screen. Use this screen to configure the Device SNMP settings.

Figure 174 Maintenance > SNMP



SNMP Agent : ○ Enable ● Disable

Get Community : public

Set Community : private

System Name : SystemName

System Location : unknown

System Contact : unknown

Trap Destination : 0.0.0.0

The following table describes the fields in this screen.

Table 143 Maintenance > SNMP

LABEL	DESCRIPTION
SNMP Agent	Select **Enable** to let the Device act as an SNMP agent, which allows a manager station to manage and monitor the Device through the network. Select **Disable** to turn this feature off.
Get Community	Enter the **Get Community**, which is the password for the incoming Get and GetNext requests from the management station.
Set Community	Enter the **Set community**, which is the password for incoming Set requests from the management station.
System Name	Enter the SNMP system name.
System Location	Enter the SNMP system location.
System Contact	Enter the SNMP system contact.
Trap Destination	Type the IP address of the station to send your SNMP traps to.
Apply	Click this to save your changes back to the Device.
Cancel	Click this to restore your previously saved settings.

35

Time Settings

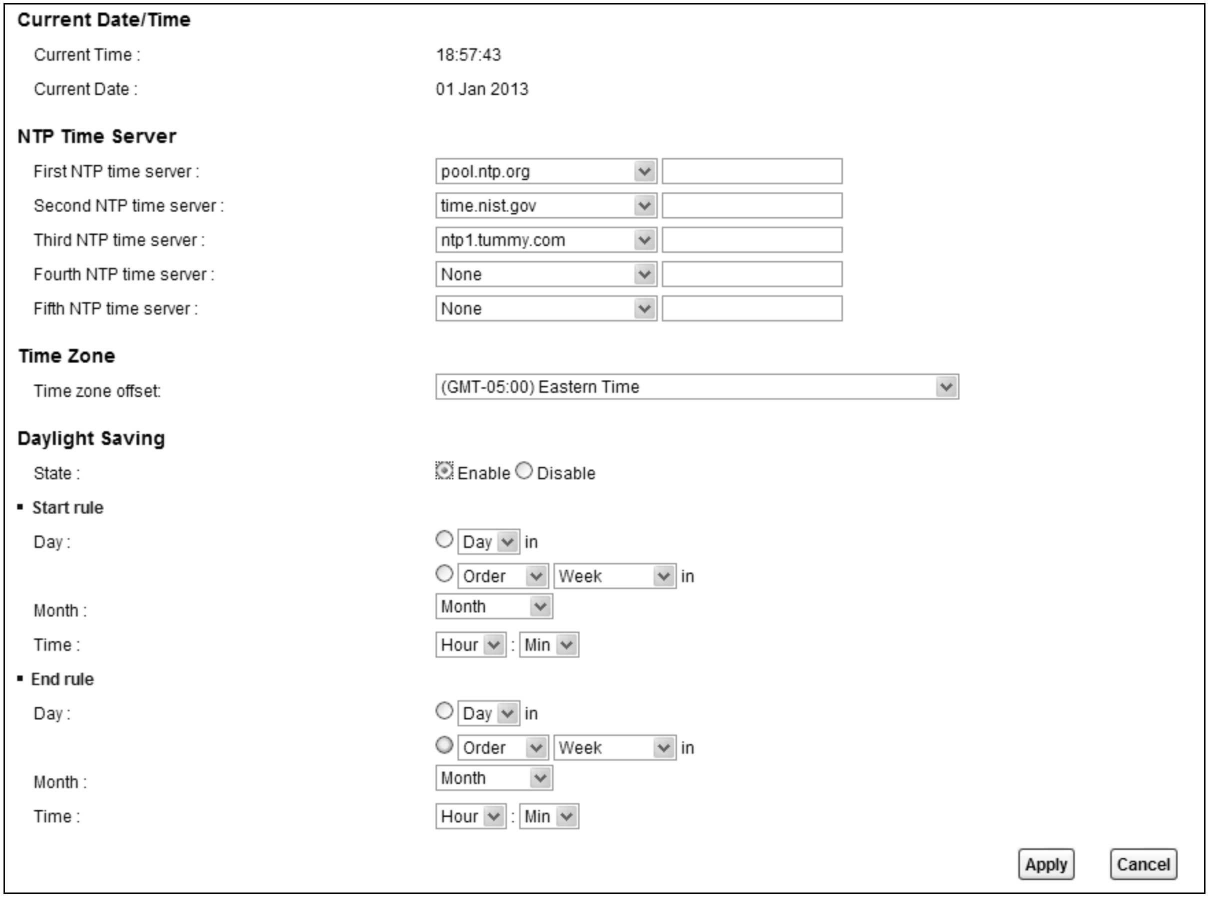
35.1 Overview

This chapter shows you how to configure system related settings, such as system time, password, name, the domain name and the inactivity timeout interval.

35.2 The Time Screen

To change your Device's time and date, click **Maintenance > Time**. The screen appears as shown. Use this screen to configure the Device's time based on your local time zone.

Figure 175 Maintenance > Time



Current Date/Time

Current Time :	18:57:43
Current Date :	01 Jan 2013

NTP Time Server

First NTP time server :	pool.ntp.org
Second NTP time server :	time.nist.gov
Third NTP time server :	ntp1.tummy.com
Fourth NTP time server :	None
Fifth NTP time server :	None

Time Zone

Time zone offset:	(GMT-05:00) Eastern Time

Daylight Saving

State :	● Enable ○ Disable
▪ Start rule	
Day :	○ Day in
	○ Order Week in
Month :	Month
Time :	Hour : Min
▪ End rule	
Day :	○ Day in
	○ Order Week in
Month :	Month
Time :	Hour : Min

The following table describes the fields in this screen.

Table 144 Maintenance > Time

LABEL	DESCRIPTION
Current Date/Time	
Current Time	This field displays the time of your Device. Each time you reload this page, the Device synchronizes the time with the time server.
Current Date	This field displays the date of your Device. Each time you reload this page, the Device synchronizes the date with the time server.
NTP Time Server	
First ~ Fifth NTP time server	Select an NTP time server from the drop-down list box. Otherwise, select **Other** and enter the IP address or URL (up to 29 extended ASCII characters in length) of your time server. Select **None** if you don't want to configure the time server. Check with your ISP/network administrator if you are unsure of this information.
Time Zone	
Time zone offset	Choose the time zone of your location. This will set the time difference between your time zone and Greenwich Mean Time (GMT).
Daylight Saving	Daylight Saving Time is a period from late spring to early fall when many countries set their clocks ahead of normal local time by one hour to give more daytime light in the evening.
State	Select **Enable** if you use Daylight Saving Time.
Start rule:	Configure the day and time when Daylight Saving Time starts if you enabled Daylight Saving. You can select a specific date in a particular month or a specific day of a specific week in a particular month. The **Time** field uses the 24 hour format. Here are a couple of examples: Daylight Saving Time starts in most parts of the United States on the second Sunday of March. Each time zone in the United States starts using Daylight Saving Time at 2 A.M. local time. So in the United States, set the day to **Second**, **Sunday**, the month to **March** and the time to **2** in the **Hour** field. Daylight Saving Time starts in the European Union on the last Sunday of March. All of the time zones in the European Union start using Daylight Saving Time at the same moment (1 A.M. GMT or UTC). So in the European Union you would set the day to **Last**, **Sunday** and the month to **March**. The time you select in the **o'clock** field depends on your time zone. In Germany for instance, you would select **2** in the **Hour** field because Germany's time zone is one hour ahead of GMT or UTC (GMT+1).
End rule	Configure the day and time when Daylight Saving Time ends if you enabled Daylight Saving. You can select a specific date in a particular month or a specific day of a specific week in a particular month. The **Time** field uses the 24 hour format. Here are a couple of examples: Daylight Saving Time ends in the United States on the first Sunday of November. Each time zone in the United States stops using Daylight Saving Time at 2 A.M. local time. So in the United States you would set the day to **First**, **Sunday**, the month to **November** and the time to **2** in the **Hour** field. Daylight Saving Time ends in the European Union on the last Sunday of October. All of the time zones in the European Union stop using Daylight Saving Time at the same moment (1 A.M. GMT or UTC). So in the European Union you would set the day to **Last**, **Sunday**, and the month to **October**. The time you select in the **o'clock** field depends on your time zone. In Germany for instance, you would select **2** in the **Hour** field because Germany's time zone is one hour ahead of GMT or UTC (GMT+1).

Table 144 Maintenance > Time (continued)

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

36

E-mail Notification

36.1 Overview

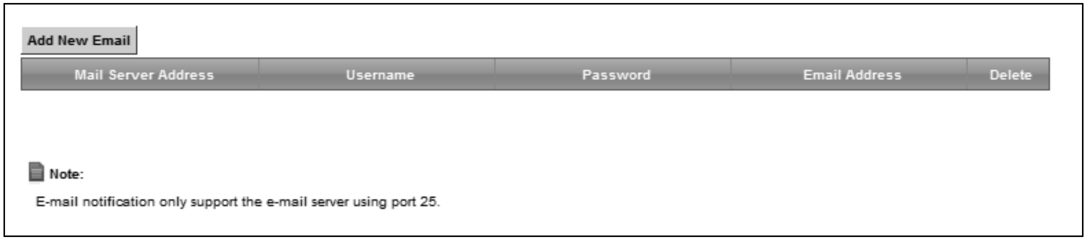
A mail server is an application or a computer that runs such an application to receive, forward and deliver e-mail messages.

To have the Device send reports, logs or notifications via e-mail, you must specify an e-mail server and the e-mail addresses of the sender and receiver.

36.2 The Email Notification Screen

Click **Maintenance > Email Notification** to open the **Email Notification** screen. Use this screen to view, remove and add mail server information on the Device.

Figure 176 Maintenance > Email Notification



Mail Server Address	Username	Password	Email Address	Delete

Note:

E-mail notification only support the e-mail server using port 25.

The following table describes the labels in this screen.

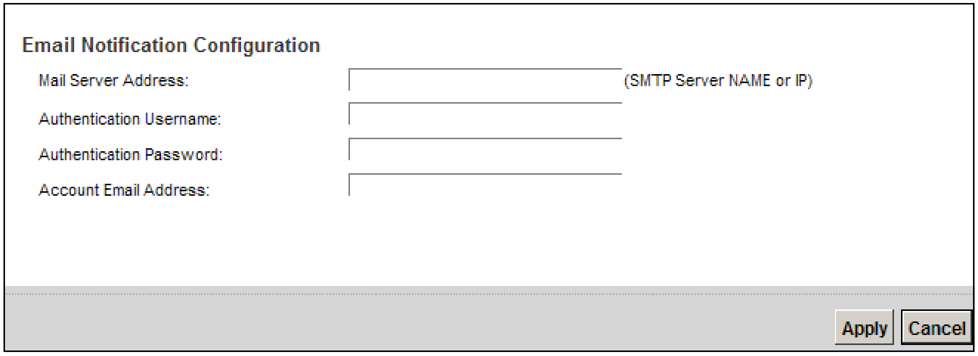
Table 145 Maintenance > Email Notification

LABEL	DESCRIPTION
Add New Email	Click this button to create a new entry.
Mail Server Address	This field displays the server name or the IP address of the mail server.
Username	This field displays the user name of the sender's mail account.
Password	This field displays the password of the sender's mail account.
Email Address	This field displays the e-mail address that you want to be in the from/sender line of the e-mail that the Device sends.
Delete	Click this button to delete the selected entry(ies).

36.2.1 Email Notification Edit

Click the **Add** button in the **Email Notification** screen. Use this screen to configure the required information for sending e-mail via a mail server.

Figure 177 Email Notification > Add



Email Notification Configuration

Mail Server Address: (SMTP Server NAME or IP)

Authentication Username:

Authentication Password:

Account Email Address:

The following table describes the labels in this screen.

Table 146 Email Notification > Add

LABEL	DESCRIPTION
Mail Server Address	Enter the server name or the IP address of the mail server for the e-mail address specified in the **Account Email Address** field. If this field is left blank, reports, logs or notifications will not be sent via e-mail.
Authentication Username	Enter the user name (up to 32 characters). This is usually the user name of a mail account you specified in the **Account Email Address** field.
Authentication Password	Enter the password associated with the user name above.
Account Email Address	Enter the e-mail address that you want to be in the from/sender line of the e-mail notification that the Device sends. If you activate SSL/TLS authentication, the e-mail address must be able to be authenticated by the mail server as well.
Apply	Click this button to save your changes and return to the previous screen.
Cancel	Click this button to begin configuring this screen afresh.

37

Logs Setting

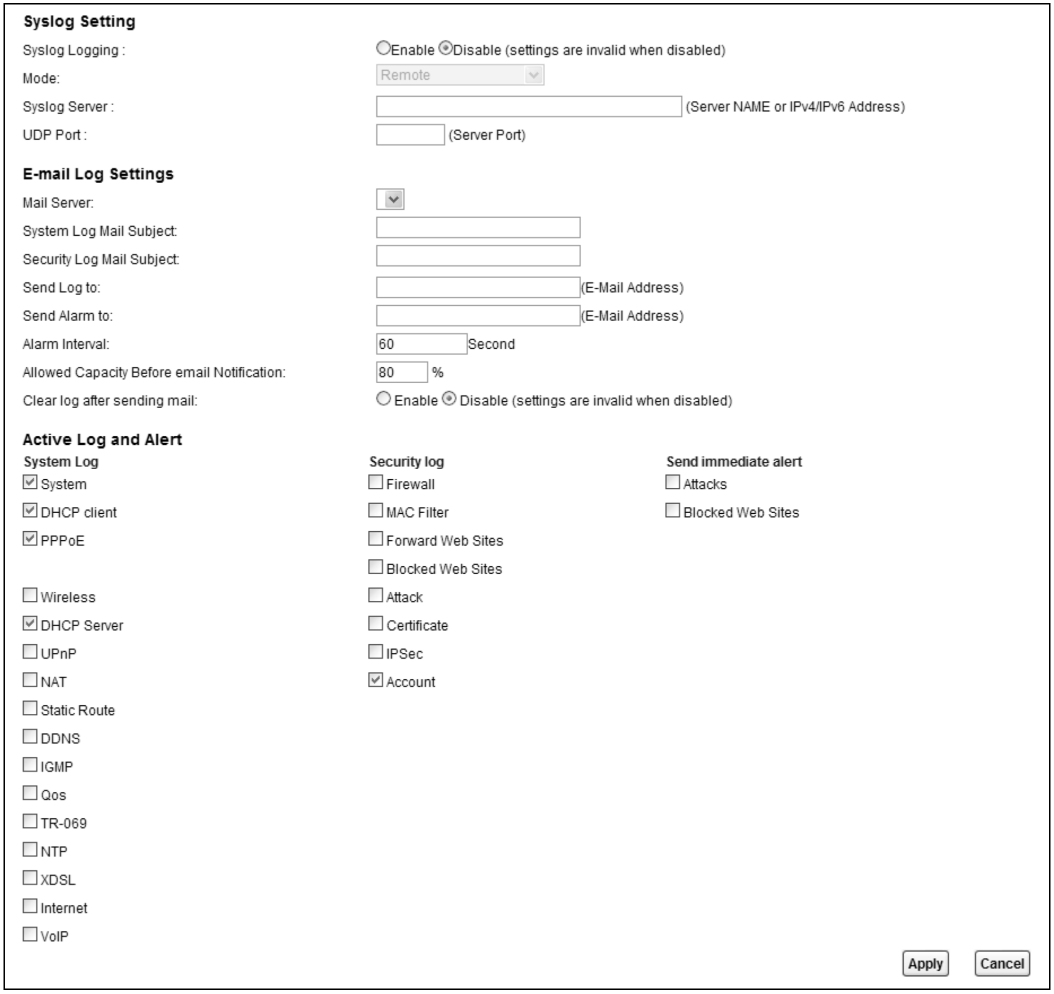
37.1 Overview

You can configure where the Device sends logs and which logs and/or immediate alerts the Device records in the **Logs Setting** screen.

37.2 The Log Settings Screen

To change your Device's log settings, click **Maintenance > Logs Setting**. The screen appears as shown.

Figure 178 Maintenance > Logs Setting



Syslog Setting

Syslog Logging :	○Enable ●Disable (settings are invalid when disabled)
Mode:	Remote
Syslog Server :	(Server NAME or IPv4/IPv6 Address)
UDP Port :	(Server Port)

E-mail Log Settings

Mail Server:	
System Log Mail Subject:	
Security Log Mail Subject:	
Send Log to:	(E-Mail Address)
Send Alarm to:	(E-Mail Address)
Alarm Interval:	60 Second
Allowed Capacity Before email Notification:	80 %
Clear log after sending mail:	○ Enable ● Disable (settings are invalid when disabled)

Active Log and Alert

System Log
- ☑ System
- ☑ DHCP client
- ☑ PPPoE
- □ Wireless
- ☑ DHCP Server
- □ UPnP
- □ NAT
- □ Static Route
- □ DDNS
- □ IGMP
- □ Qos
- □ TR-069
- □ NTP
- □ XDSL
- □ Internet
- □ VoIP

Security log
- □ Firewall
- □ MAC Filter
- □ Forward Web Sites
- □ Blocked Web Sites
- □ Attack
- □ Certificate
- □ IPSec
- ☑ Account

Send immediate alert
- □ Attacks
- □ Blocked Web Sites

The following table describes the fields in this screen.

Table 147 Maintenance > Logs Setting

LABEL	DESCRIPTION
Syslog Setting	
Syslog Logging	The Device sends a log to an external syslog server. Select **Enable** to enable syslog logging.
Mode	Select the syslog destination from the drop-down list box. If you select **Remote**, the log(s) will be sent to a remote syslog server. If you select **Local File**, the log(s) will be saved in a local file. If you want to send the log(s) to a remote syslog server and save it in a local file, select **Local File and Remote**.
Syslog Server	Enter the server name or IP address of the syslog server that will log the selected categories of logs.
UDP Port	Enter the port number used by the syslog server.
E-mail Log Settings	
Mail Server	Enter the server name or the IP address of the mail server for the e-mail addresses specified below. If this field is left blank, logs and alert messages will not be sent via E-mail.
System Log Mail Subject	Type a title that you want to be in the subject line of the system log e-mail message that the Device sends.
Security Log Mail Subject	Type a title that you want to be in the subject line of the security log e-mail message that the Device sends.
Send Log to	The Device sends logs to the e-mail address specified in this field. If this field is left blank, the Device does not send logs via E-mail.
Send Alarm to	Alerts are real-time notifications that are sent as soon as an event, such as a DoS attack, system error, or forbidden web access attempt occurs. Enter the E-mail address where the alert messages will be sent. Alerts include system errors, attacks and attempted access to blocked web sites. If this field is left blank, alert messages will not be sent via E-mail.
Alarm Interval	Specify how often the alarm should be updated.
Allowed Capacity Before Email	Set what percent of the Device's log storage space can be filled before the Device sends a log e-mail.
Clear log after sending mail	Select this to delete all the logs after the Device sends an E-mail of the logs.
Active Log and Alert	
System Log	Select the categories of system logs that you want to record.
Security Log	Select the categories of security logs that you want to record.
Send immediate alert	Select log categories for which you want the Device to send E-mail alerts immediately.
Apply	Click **Apply** to save your changes.
Cancel	Click **Cancel** to restore your previously saved settings.

37.2.1 Example E-mail Log

An "End of Log" message displays for each mail in which a complete log has been sent. The following is an example of a log sent by e-mail.

- You may edit the subject title.
- The date format here is Day-Month-Year.
- The date format here is Month-Day-Year. The time format is Hour-Minute-Second.

- "End of Log" message shows that a complete log has been sent.

Figure 179 E-mail Log Example

```
Subject:
        Firewall Alert From
   Date:
        Fri, 07 Apr 2000 10:05:42
   From:
        user@zyxel.com
     To:
        user@zyxel.com
  1|Apr  7 00 |From:192.168.1.1     To:192.168.1.255   |default policy  |forward
   | 09:54:03 |UDP     src port:00520 dest port:00520  |<1,00>          |
  2|Apr  7 00 |From:192.168.1.131   To:192.168.1.255   |default policy  |forward
   | 09:54:17 |UDP     src port:00520 dest port:00520  |<1,00>          |
  3|Apr  7 00 |From:192.168.1.6     To:10.10.10.10 |match           |forward
   | 09:54:19 |UDP     src port:03516 dest port:00053  |<1,01>          |
……………………………..{snip}…………………………………..
……………………………..{snip}…………………………………..
126|Apr  7 00 |From:192.168.1.1     To:192.168.1.255   |match           |forward
   | 10:05:00 |UDP     src port:00520 dest port:00520  |<1,02>          |
127|Apr  7 00 |From:192.168.1.131   To:192.168.1.255   |match           |forward
   | 10:05:17 |UDP     src port:00520 dest port:00520  |<1,02>          |
128|Apr  7 00 |From:192.168.1.1     To:192.168.1.255   |match           |forward
   | 10:05:30 |UDP     src port:00520 dest port:00520  |<1,02>          |

End of Firewall Log
```

38

Firmware Upgrade

38.1 Overview

This chapter explains how to upload new firmware to your Device. You can download new firmware releases from your nearest ZyXEL FTP site (or www.zyxel.com) to use to upgrade your device's performance.

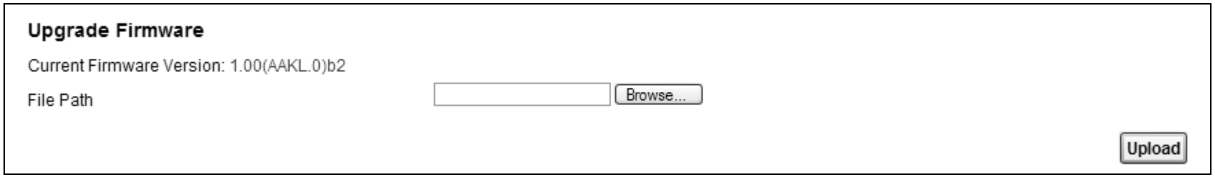
Only use firmware for your device's specific model. Refer to the label on the bottom of your Device.

38.2 The Firmware Screen

Click **Maintenance > Firmware Upgrade** to open the following screen. The upload process uses HTTP (Hypertext Transfer Protocol) and may take up to two minutes. After a successful upload, the system will reboot.

Do NOT turn off the Device while firmware upload is in progress!

Figure 180 Maintenance > Firmware Upgrade



Upgrade Firmware

Current Firmware Version: 1.00(AAKL.0)b2

File Path

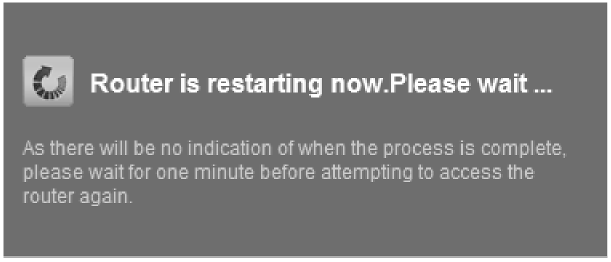
The following table describes the labels in this screen.

Table 148 Maintenance > Firmware Upgrade

LABEL	DESCRIPTION
Current Firmware Version	This is the present Firmware version and the date created.
File Path	Type in the location of the file you want to upload in this field or click **Browse ...** to find it.
Browse...	Click this to find the .bin file you want to upload. Remember that you must decompress compressed (.zip) files before you can upload them.
Upload	Click this to begin the upload process. This process may take up to two minutes.

After you see the firmware updating screen, wait two minutes before logging into the Device again.

Figure 181 Firmware Uploading

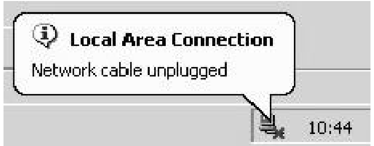


Router is restarting now.Please wait ...

As there will be no indication of when the process is complete, please wait for one minute before attempting to access the router again.

The Device automatically restarts in this time causing a temporary network disconnect. In some operating systems, you may see the following icon on your desktop.

Figure 182 Network Temporarily Disconnected



Local Area Connection
Network cable unplugged

After two minutes, log in again and check your new firmware version in the **Status** screen.

If the upload was not successful, the following screen will appear. Click **OK** to go back to the **Firmware Upgrade** screen.

Figure 183 Error Message

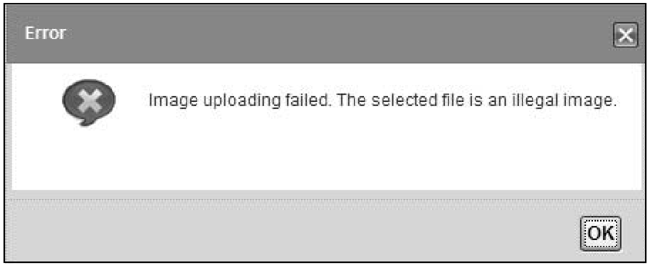


Image uploading failed. The selected file is an illegal image.

Configuration

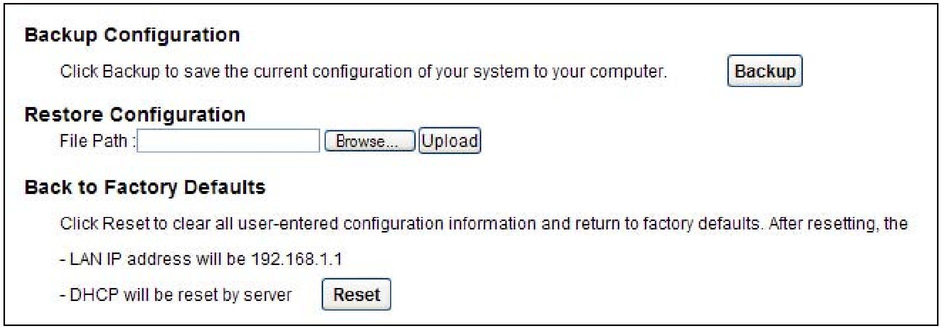
39.1 Overview

The **Configuration** screen allows you to backup and restore device configurations. You can also reset your device settings back to the factory default.

39.2 The Configuration Screen

Click **Maintenance > Configuration**. Information related to factory defaults, backup configuration, and restoring configuration appears in this screen, as shown next.

Figure 184 Maintenance > Configuration



Backup Configuration

Click Backup to save the current configuration of your system to your computer.

Restore Configuration

File Path :

Back to Factory Defaults

Click Reset to clear all user-entered configuration information and return to factory defaults. After resetting, the

- LAN IP address will be 192.168.1.1

- DHCP will be reset by server

Backup Configuration

Backup Configuration allows you to back up (save) the Device’s current configuration to a file on your computer. Once your Device is configured and functioning properly, it is highly recommended that you back up your configuration file before making configuration changes. The backup configuration file will be useful in case you need to return to your previous settings.

Click **Backup** to save the Device’s current configuration to your computer.

Restore Configuration

Restore Configuration allows you to upload a new or previously saved configuration file from your computer to your Device.

Table 149 Restore Configuration

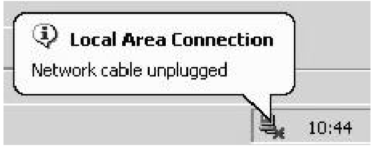
LABEL	DESCRIPTION
File Path	Type in the location of the file you want to upload in this field or click **Browse ...** to find it.
Browse...	Click this to find the file you want to upload. Remember that you must decompress compressed (.ZIP) files before you can upload them.
Upload	Click this to begin the upload process.

Do not turn off the Device while configuration file upload is in progress.

After the Device configuration has been restored successfully, the login screen appears. Login again to restart the Device.

The Device automatically restarts in this time causing a temporary network disconnect. In some operating systems, you may see the following icon on your desktop.

Figure 185 Network Temporarily Disconnected

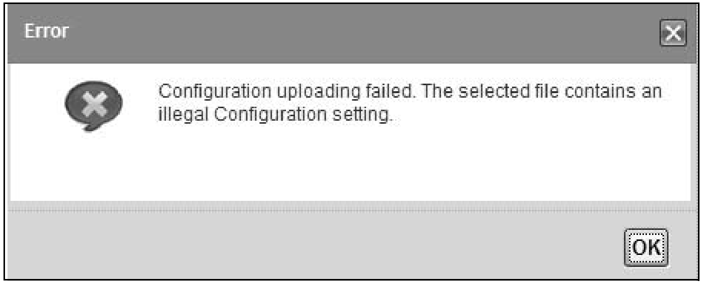


Local Area Connection
Network cable unplugged

If you uploaded the default configuration file you may need to change the IP address of your computer to be in the same subnet as that of the default device IP address (192.168.1.1). See Appendix A on page 327 for details on how to set up your computer's IP address.

If the upload was not successful, the following screen will appear. Click **OK** to go back to the **Configuration** screen.

Figure 186 Configuration Upload Error



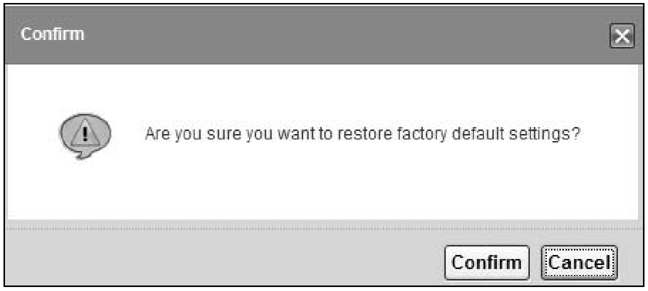
Error

Configuration uploading failed. The selected file contains an illegal Configuration setting.

Reset to Factory Defaults

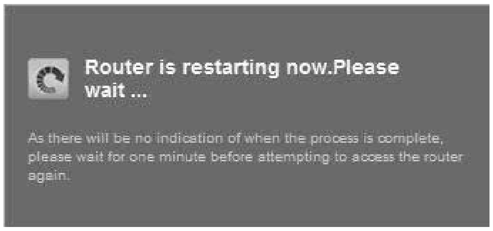
Click the **Reset** button to clear all user-entered configuration information and return the Device to its factory defaults. The following warning screen appears.

Figure 187 Reset Warning Message



Are you sure you want to restore factory default settings?

Figure 188 Reset In Process Message



Router is restarting now.Please wait ...

As there will be no indication of when the process is complete, please wait for one minute before attempting to access the router again.

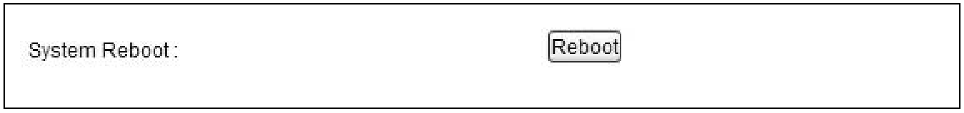
You can also press the **RESET** button on the rear panel to reset the factory defaults of your Device. Refer to Section 1.6 on page 22 for more information on the **RESET** button.

39.3 The Reboot Screen

System restart allows you to reboot the Device remotely without turning the power off. You may need to do this if the Device hangs, for example.

Click **Maintenance > Reboot**. Click **Reboot** to have the Device reboot. This does not affect the Device's configuration.

Figure 189 Maintenance > Reboot



40

Diagnostic

40.1 Overview

The **Diagnostic** screens display information to help you identify problems with the Device.

The route between a CO VDSL switch and one of its CPE may go through switches owned by independent organizations. A connectivity fault point generally takes time to discover and impacts subscriber's network access. In order to eliminate the management and maintenance efforts, IEEE 802.1ag is a Connectivity Fault Management (CFM) specification which allows network administrators to identify and manage connection faults. Through discovery and verification of the path, CFM can detect, analyze and isolate connectivity faults in bridged LANs.

40.1.1 What You Can Do in this Chapter

- The **Ping & TraceRoute & NsLookup** screen lets you ping an IP address or trace the route packets take to a host (Section 40.3 on page 316).
- The **802.1ag** screen lets you perform CFM actions (Section 40.5 on page 318).
- The **OAM Ping** screen lets you send an ATM OAM (Operation, Administration and Maintenance) packet to verify the connectivity of a specific PVC. (Section 40.5 on page 318).

40.2 What You Need to Know

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

How CFM Works

A Maintenance Association (MA) defines a VLAN and associated Maintenance End Point (MEP) ports on the device under a Maintenance Domain (MD) level. An MEP port has the ability to send Connectivity Check Messages (CCMs) and get other MEP ports information from neighbor devices' CCMs within an MA.

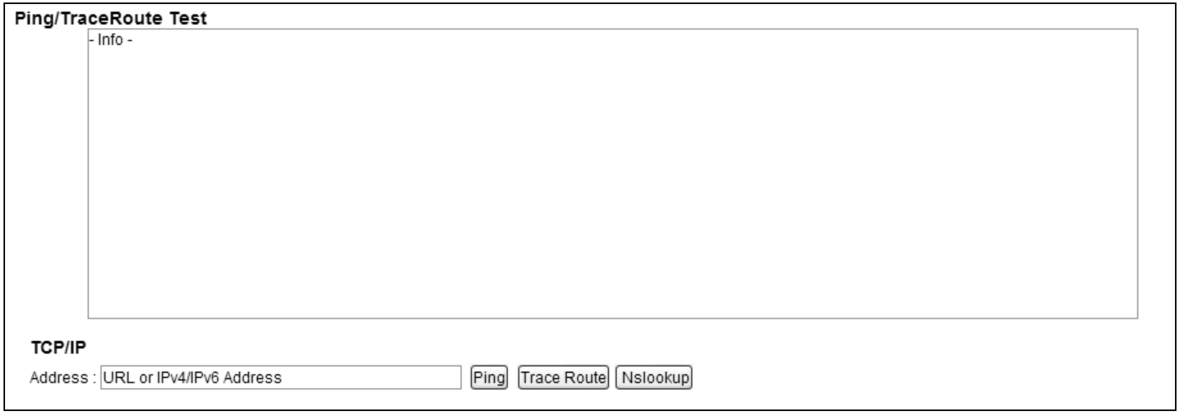
CFM provides two tests to discover connectivity faults.

- Loopback test - checks if the MEP port receives its Loop Back Response (LBR) from its target after it sends the Loop Back Message (LBM). If no response is received, there might be a connectivity fault between them.
- Link trace test - provides additional connectivity fault analysis to get more information on where the fault is. If an MEP port does not respond to the source MEP, this may indicate a fault. Administrators can take further action to check and resume services from the fault according to the line connectivity status report.

40.3 Ping & TraceRoute & NsLookup

Use this screen to ping, traceroute, or nslookup an IP address. Click **Maintenance > Diagnostic > Ping&TraceRoute&NsLookup** to open the screen shown next.

Figure 190 Maintenance > Diagnostic > Ping &TraceRoute&NsLookup



The following table describes the fields in this screen.

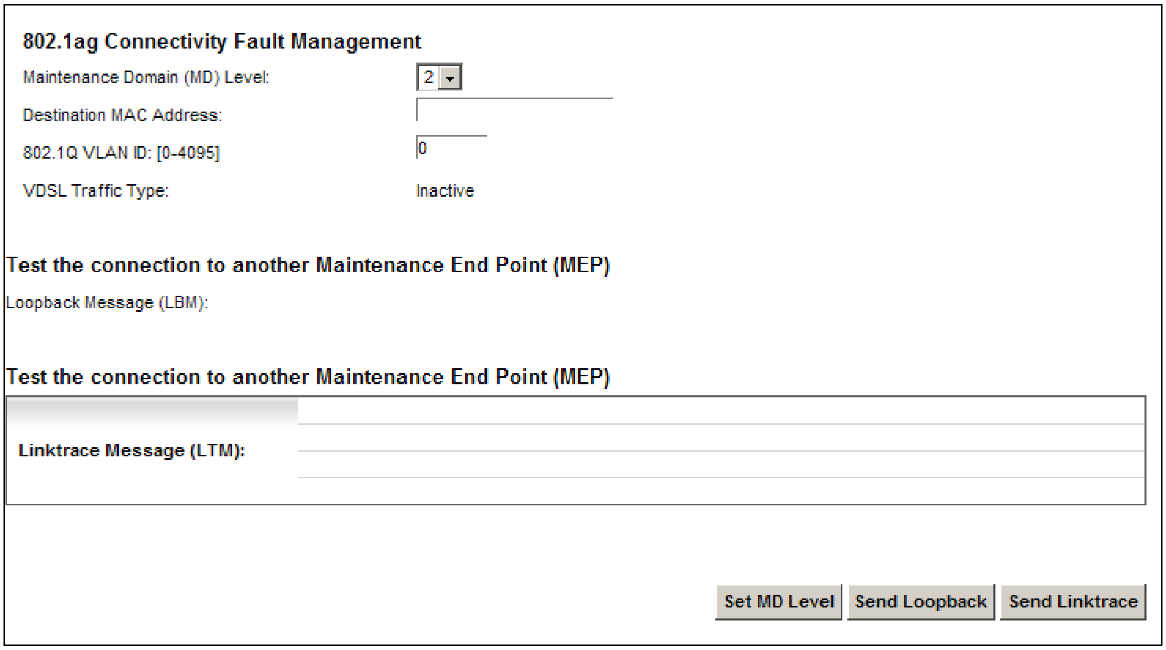
Table 150 Maintenance > Diagnostic > Ping & TraceRoute & NsLookup

LABEL	DESCRIPTION
URL or IP Address	Type the IP address of a computer that you want to perform ping, traceroute, or nslookup in order to test a connection.
Ping	Click this to ping the IP address that you entered.
TraceRoute	Click this button to perform the traceroute function. This determines the path a packet takes to the specified computer.
Nslookup	Click this button to perform a DNS lookup on the IP address of a computer you enter.

40.4 802.1ag

Click **Maintenance > Diagnostic** > **8.2.1ag** to open the following screen. Use this screen to perform CFM actions.

Figure 191 Maintenance > Diagnostic > 802.1ag



802.1ag Connectivity Fault Management

Maintenance Domain (MD) Level: 2

Destination MAC Address:

802.1Q VLAN ID: [0-4095] 0

VDSL Traffic Type: Inactive

Test the connection to another Maintenance End Point (MEP)

Loopback Message (LBM):

Test the connection to another Maintenance End Point (MEP)

Linktrace Message (LTM):

The following table describes the fields in this screen.

Table 151 Maintenance > Diagnostic > 802.1ag

LABEL	DESCRIPTION
802.1ag Connectivity Fault Management	
Maintenance Domain (MD) Level	Select a level (0-7) under which you want to create an MA.
Destination MAC Address	Enter the target device's MAC address to which the Device performs a CFM loopback test.
802.1Q VLAN ID	Type a VLAN ID (0-4095) for this MA.
VDSL Traffic Type	This shows whether the VDSL traffic is activated.
Loopback Message (LBM)	This shows how many Loop Back Messages (LBMs) are sent and if there is any inorder or outorder Loop Back Response (LBR) received from a remote MEP.
Linktrace Message (LTM)	This shows the destination MAC address in the Link Trace Response (LTR).
Set MD Level	Click this button to configure the MD (Maintenance Domain) level.
Send Loopback	Click this button to have the selected MEP send the LBM (Loop Back Message) to a specified remote end point.
Send Linktrace	Click this button to have the selected MEP send the LTMs (Link Trace Messages) to a specified remote end point.

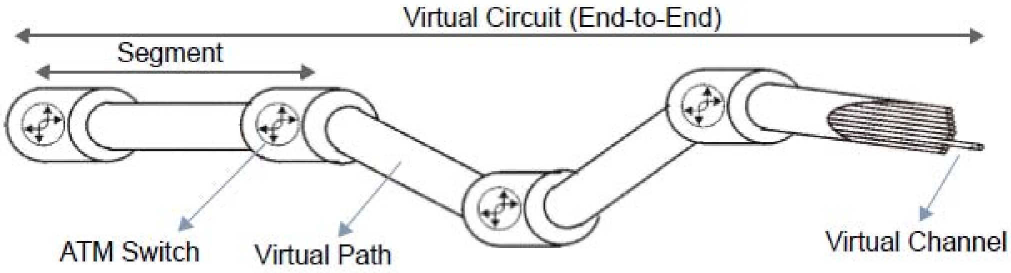
40.5 OAM Ping

Click **Maintenance > Diagnostic > OAM Ping** to open the screen shown next. Use this screen to perform an OAM (Operation, Administration and Maintenance) F4 or F5 loopback test on a PVC. The Device sends an OAM F4 or F5 packet to the DSLAM or ATM switch and then returns it to the Device. The test result then displays in the text box.

ATM sets up virtual circuits over which end systems communicate. The terminology for virtual circuits is as follows:

• Virtual Channel (VC)	Logical connections between ATM devices
• Virtual Path (VP)	A bundle of virtual channels
• Virtual Circuits	A series of virtual paths between circuit end points

Figure 192 Virtual Circuit Topology



Think of a virtual path as a cable that contains a bundle of wires. The cable connects two points and wires within the cable provide individual circuits between the two points. In an ATM cell header, a VPI (Virtual Path Identifier) identifies a link formed by a virtual path; a VCI (Virtual Channel Identifier) identifies a channel within a virtual path. A series of virtual paths make up a virtual circuit.

F4 cells operate at the virtual path (VP) level, while F5 cells operate at the virtual channel (VC) level. F4 cells use the same VPI as the user data cells on VP connections, but use different predefined VCI values. F5 cells use the same VPI and VCI as the user data cells on the VC connections, and are distinguished from data cells by a predefinded Payload Type Identifier (PTI) in the cell header. Both F4 flows and F5 flows are bidirectional and have two types.

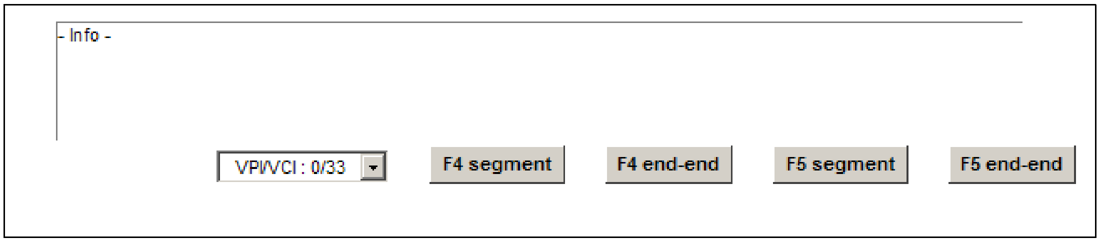
- segment F4 flows (VCI=3)
- end-to-end F4 flows (VCI=4)
- segment F5 flows (PTI=100)
- end-to-end F5 flows (PTI=101)

OAM F4 or F5 tests are used to check virtual path or virtual channel availability between two DSL devices. Segment flows are terminated at the connecting point which terminates a VP or VC segment. End-to-end flows are terminated at the end point of a VP or VC connection, where an ATM link is terminated. Segment loopback tests allow you to verify integrity of a PVC to the nearest neighboring ATM device. End-to-end loopback tests allow you to verify integrity of an end-to-end PVC.

Note: The DSLAM to which the Device is connected must also support ATM F4 and/or F5 to use this test.

Note: This screen is available only when you configure an ATM layer-2 interface.

Figure 193 Maintenance > Diagnostic > OAM Ping



The following table describes the fields in this screen.

Table 152 Maintenance > Diagnostic > OAM Ping

LABEL	DESCRIPTION
	Select a PVC on which you want to perform the loopback test.
F4 segment	Press this to perform an OAM F4 segment loopback test.
F4 end-end	Press this to perform an OAM F4 end-to-end loopback test.
F5 segment	Press this to perform an OAM F5 segment loopback test.
F5 end-end	Press this to perform an OAM F5 end-to-end loopback test.

41

Troubleshooting

This chapter offers some suggestions to solve problems you might encounter. The potential problems are divided into the following categories.

- Power, Hardware Connections, and LEDs
- Device Access and Login
- Internet Access
- Wireless Internet Access
- USB Device Connection
- UPnP

41.1 Power, Hardware Connections, and LEDs

The Device does not turn on. None of the LEDs turn on.

1. Make sure the Device is turned on.
2. Make sure you are using the power adaptor or cord included with the Device.
3. Make sure the power adaptor or cord is connected to the Device and plugged in to an appropriate power source. Make sure the power source is turned on.
4. Turn the Device off and on.
5. If the problem continues, contact the vendor.

One of the LEDs does not behave as expected.

1. Make sure you understand the normal behavior of the LED. See Section 1.5 on page 20.
2. Check the hardware connections.
3. Inspect your cables for damage. Contact the vendor to replace any damaged cables.
4. Turn the Device off and on.

5 If the problem continues, contact the vendor.

41.2 Device Access and Login

I forgot the IP address for the Device.

1 The default LAN IP address is 192.168.1.1.

2 If you changed the IP address and have forgotten it, you might get the IP address of the Device by looking up the IP address of the default gateway for your computer. To do this in most Windows computers, click **Start > Run**, enter **cmd**, and then enter **ipconfig**. The IP address of the **Default Gateway** might be the IP address of the Device (it depends on the network), so enter this IP address in your Internet browser.

3 If this does not work, you have to reset the device to its factory defaults. See Section 1.6 on page 22.

I forgot the password.

1 The default admin password is **1234**.

2 If this does not work, you have to reset the device to its factory defaults. See Section 1.6 on page 22.

I cannot see or access the **Login** screen in the web configurator.

1 Make sure you are using the correct IP address.

- The default IP address is 192.168.1.1.
- If you changed the IP address (Section 7.2 on page 107), use the new IP address.
- If you changed the IP address and have forgotten it, see the troubleshooting suggestions for I forgot the IP address for the Device.

2 Check the hardware connections, and make sure the LEDs are behaving as expected. See Section 1.5 on page 20.

3 Make sure your Internet browser does not block pop-up windows and has JavaScripts and Java enabled. See Appendix C on page 357.

4 If it is possible to log in from another interface, check the service control settings for HTTP and HTTPS (**Maintenance > Remote MGMT**).

5 Reset the device to its factory defaults, and try to access the Device with the default IP address. See Section 1.6 on page 22.

6 If the problem continues, contact the network administrator or vendor, or try one of the advanced suggestions.

Advanced Suggestions

- Make sure you have logged out of any earlier management sessions using the same user account even if they were through a different interface or using a different browser.
- Try to access the Device using another service, such as Telnet. If you can access the Device, check the remote management settings and firewall rules to find out why the Device does not respond to HTTP.

I can see the **Login** screen, but I cannot log in to the Device.

1 Make sure you have entered the password correctly. The default admin password is **1234**. The field is case-sensitive, so make sure [Caps Lock] is not on.

2 You cannot log in to the web configurator while someone is using Telnet to access the Device. Log out of the Device in the other session, or ask the person who is logged in to log out.

3 Turn the Device off and on.

4 If this does not work, you have to reset the device to its factory defaults. See Section 41.1 on page 321.

I cannot Telnet to the Device.

See the troubleshooting suggestions for I cannot see or access the Login screen in the web configurator. Ignore the suggestions about your browser.

I cannot use FTP to upload / download the configuration file. / I cannot use FTP to upload new firmware.

See the troubleshooting suggestions for I cannot see or access the Login screen in the web configurator. Ignore the suggestions about your browser.

41.3 Internet Access

I cannot access the Internet.

1 Check the hardware connections, and make sure the LEDs are behaving as expected. See the **Quick Start Guide** and Section 1.5 on page 20.

2 Make sure you entered your ISP account information correctly in the **Network Setting > Broadband** screen. These fields are case-sensitive, so make sure [Caps Lock] is not on.

3 If you are trying to access the Internet wirelessly, make sure that you enabled the wireless LAN in the Device and your wireless client and that the wireless settings in the wireless client are the same as the settings in the Device.

4 Disconnect all the cables from your device and reconnect them.

5 If the problem continues, contact your ISP.

I cannot access the Internet through a DSL connection.

1 Make sure you have the **DSL WAN** port connected to a telephone jack (or the DSL or modem jack on a splitter if you have one).

2 Make sure you configured a proper DSL WAN interface (**Network Setting > Broadband** screen) with the Internet account information provided by your ISP and that it is enabled.

3 Check that the LAN interface you are connected to is in the same interface group as the DSL connection (**Network Setting > Interface Group**).

4 If you set up a WAN connection using bridging service, make sure you turn off the DHCP feature in the **LAN** screen to have the clients get WAN IP addresses directly from your ISP's DHCP server.

I cannot connect to the Internet using a second DSL connection.

ADSL and VDSL connections cannot work at the same time. You can only use one type of DSL connection, either ADSL or VDSL connection at one time.

I cannot access the Internet anymore. I had access to the Internet (with the Device), but my Internet connection is not available anymore.

1 Your session with the Device may have expired. Try logging into the Device again.

2 Check the hardware connections, and make sure the LEDs are behaving as expected. See the **Quick Start Guide** and Section 1.5 on page 20.

3 Turn the Device off and on.

4 If the problem continues, contact your ISP.

41.4 Wireless Internet Access

What factors may cause intermittent or unstabled wireless connection? How can I solve this problem?

The following factors may cause interference:

- Obstacles: walls, ceilings, furniture, and so on.
- Building Materials: metal doors, aluminum studs.
- Electrical devices: microwaves, monitors, electric motors, cordless phones, and other wireless devices.

To optimize the speed and quality of your wireless connection, you can:

- Move your wireless device closer to the AP if the signal strength is low.
- Reduce wireless interference that may be caused by other wireless networks or surrounding wireless electronics such as cordless phones.
- Place the AP where there are minimum obstacles (such as walls and ceilings) between the AP and the wireless client.
- Reduce the number of wireless clients connecting to the same AP simultaneously, or add additional APs if necessary.
- Try closing some programs that use the Internet, especially peer-to-peer applications. If the wireless client is sending or receiving a lot of information, it may have too many programs open that use the Internet.

What is a Server Set ID (SSID)?

An SSID is a name that uniquely identifies a wireless network. The AP and all the clients within a wireless network must use the same SSID.

41.5 USB Device Connection

The Device fails to detect my USB device.

1. Disconnect the USB device.
2. Reboot the Device.
3. If you are connecting a USB hard drive that comes with an external power supply, make sure it is connected to an appropriate power source that is on.
4. Re-connect your USB device to the Device.

41.6 UPnP

When using UPnP and the Device reboots, my computer cannot detect UPnP and refresh **My Network Places > Local Network**.

1. Disconnect the Ethernet cable from the Device's LAN port or from your computer.
2. Re-connect the Ethernet cable.

The **Local Area Connection** icon for UPnP disappears in the screen.

Restart your computer.

I cannot open special applications such as white board, file transfer and video when I use the MSN messenger.

1. Wait more than three minutes.
2. Restart the applications.

A

Setting up Your Computer's IP Address

All computers must have a 10M or 100M Ethernet adapter card and TCP/IP installed.

Windows 95/98/Me/NT/2000/XP/Vista, Macintosh OS 7 and later operating systems and all versions of UNIX/LINUX include the software components you need to install and use TCP/IP on your computer. Windows 3.1 requires the purchase of a third-party TCP/IP application package.

TCP/IP should already be installed on computers using Windows NT/2000/XP, Macintosh OS 7 and later operating systems.

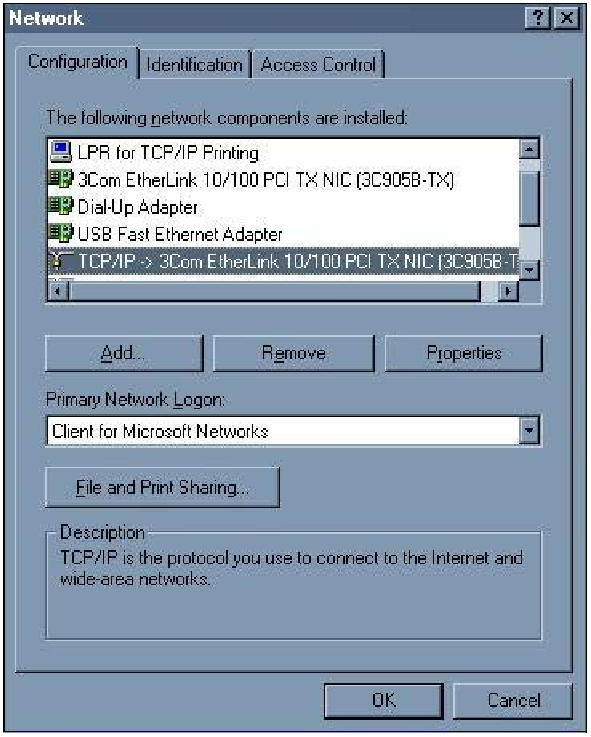
After the appropriate TCP/IP components are installed, configure the TCP/IP settings in order to "communicate" with your network.

If you manually assign IP information instead of using dynamic assignment, make sure that your computers have IP addresses that place them in the same subnet as the Device's LAN port.

Windows 95/98/Me

Click **Start**, **Settings**, **Control Panel** and double-click the **Network** icon to open the **Network** window.

Figure 194 WIndows 95/98/Me: Network: Configuration



The following network components are installed:

- LPR for TCP/IP Printing
- 3Com EtherLink 10/100 PCI TX NIC (3C905B-TX)
- Dial-Up Adapter
- USB Fast Ethernet Adapter
- TCP/IP -> 3Com EtherLink 10/100 PCI TX NIC (3C905B-T

Primary Network Logon: Client for Microsoft Networks

Description
TCP/IP is the protocol you use to connect to the Internet and wide-area networks.

Installing Components

The **Network** window **Configuration** tab displays a list of installed components. You need a network adapter, the TCP/IP protocol and Client for Microsoft Networks.

If you need the adapter:

1. In the **Network** window, click **Add**.
2. Select **Adapter** and then click **Add**.
3. Select the manufacturer and model of your network adapter and then click **OK**.

If you need TCP/IP:

1. In the **Network** window, click **Add**.
2. Select **Protocol** and then click **Add**.
3. Select **Microsoft** from the list of **manufacturers**.
4. Select **TCP/IP** from the list of network protocols and then click **OK**.

If you need Client for Microsoft Networks:

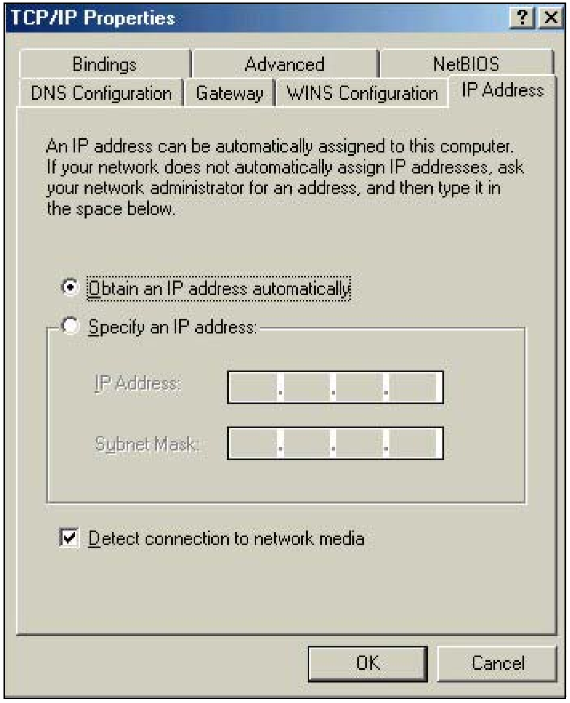
1. Click **Add**.
2. Select **Client** and then click **Add**.
3. Select **Microsoft** from the list of manufacturers.
4. Select **Client for Microsoft Networks** from the list of network clients and then click **OK**.
5. Restart your computer so the changes you made take effect.

Configuring

1. In the **Network** window **Configuration** tab, select your network adapter's TCP/IP entry and click **Properties**
2. Click the **IP Address** tab.
   - If your IP address is dynamic, select **Obtain an IP address automatically**.

- If you have a static IP address, select **Specify an IP address** and type your information into the **IP Address** and **Subnet Mask** fields.

Figure 195 Windows 95/98/Me: TCP/IP Properties: IP Address



An IP address can be automatically assigned to this computer. If your network does not automatically assign IP addresses, ask your network administrator for an address, and then type it in the space below.

● Obtain an IP address automatically

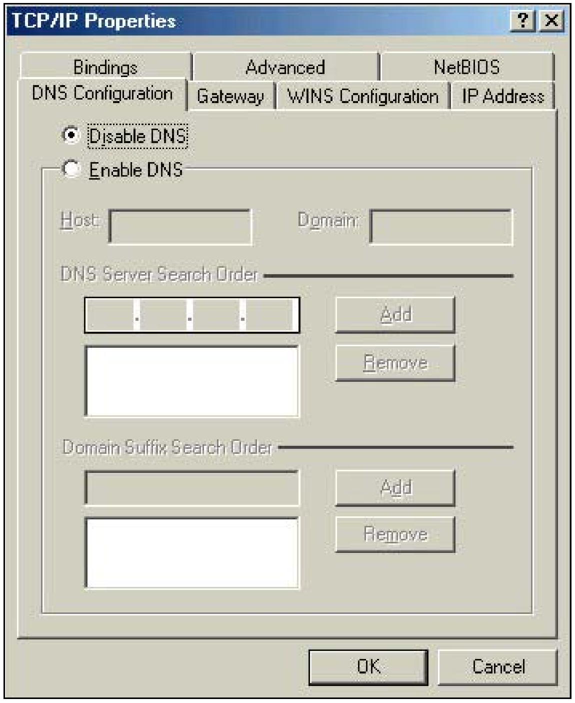
○ Specify an IP address:

☑ Detect connection to network media

3 Click the **DNS** Configuration tab.

- If you do not know your DNS information, select **Disable DNS**.
- If you know your DNS information, select **Enable DNS** and type the information in the fields below (you may not need to fill them all in).

Figure 196 Windows 95/98/Me: TCP/IP Properties: DNS Configuration



● Disable DNS

○ Enable DNS

4 Click the **Gateway** tab.

- If you do not know your gateway's IP address, remove previously installed gateways.
- If you have a gateway IP address, type it in the **New gateway field** and click **Add**.

5 Click **OK** to save and close the **TCP/IP Properties** window.

6 Click **OK** to close the **Network** window. Insert the Windows CD if prompted.

7 Turn on your Device and restart your computer when prompted.

Verifying Settings

1 Click **Start** and then **Run**.

2 In the **Run** window, type "winipcfg" and then click **OK** to open the **IP Configuration** window.

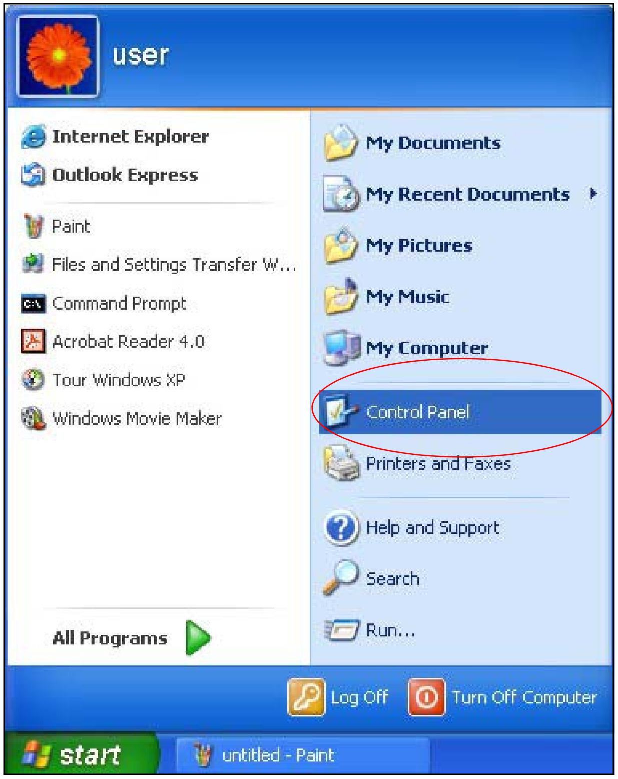
3 Select your network adapter. You should see your computer's IP address, subnet mask and default gateway.

Windows 2000/NT/XP

The following example figures use the default Windows XP GUI theme.

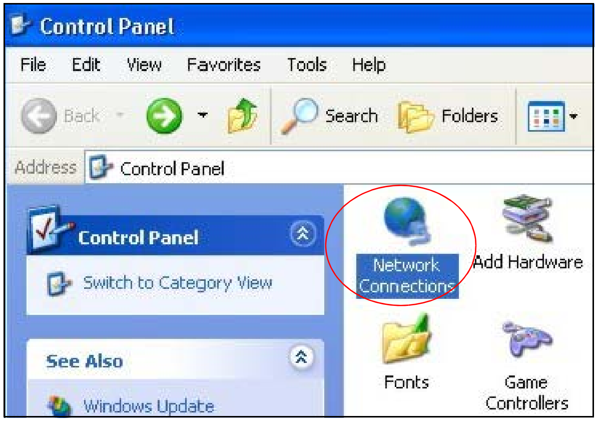
1 Click **start** (**Start** in Windows 2000/NT), **Settings**, **Control Panel**.

Figure 197 Windows XP: Start Menu



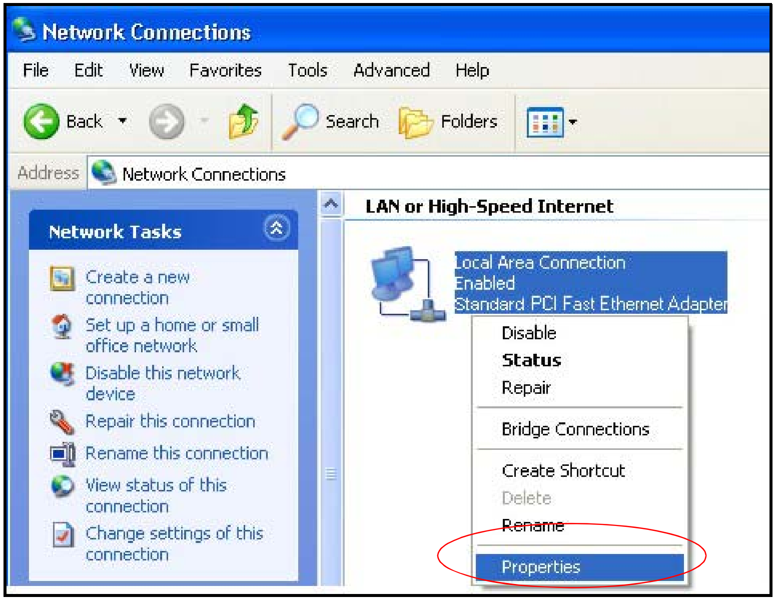
2 In the **Control Panel**, double-click **Network Connections** (**Network and Dial-up Connections** in Windows 2000/NT).

Figure 198 Windows XP: Control Panel



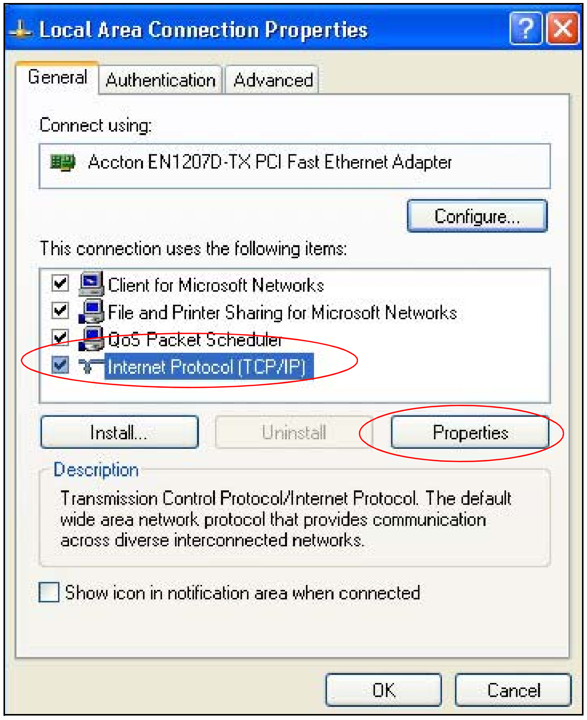
3 Right-click **Local Area Connection** and then click **Properties**.

Figure 199 Windows XP: Control Panel: Network Connections: Properties


Network Connections
File Edit View Favorites Tools Advanced Help
Back Search Folders
Address Network Connections
Network Tasks
Create a new connection
Set up a home or small office network
Disable this network device
Repair this connection
Rename this connection
View status of this connection
Change settings of this connection
LAN or High-Speed Internet
Local Area Connection
Enabled
Standard PCI Fast Ethernet Adapter
Disable
Status
Repair
Bridge Connections
Create Shortcut
Delete
Rename
Properties

4 Select **Internet Protocol (TCP/IP)** (under the **General** tab in Win XP) and then click **Properties**.

Figure 200 Windows XP: Local Area Connection Properties



Connect using:

Accton EN1207D-TX PCI Fast Ethernet Adapter

This connection uses the following items:

- ☑ Client for Microsoft Networks
- ☑ File and Printer Sharing for Microsoft Networks
- ☑ QoS Packet Scheduler
- ☑ Internet Protocol (TCP/IP)

Description

Transmission Control Protocol/Internet Protocol. The default wide area network protocol that provides communication across diverse interconnected networks.

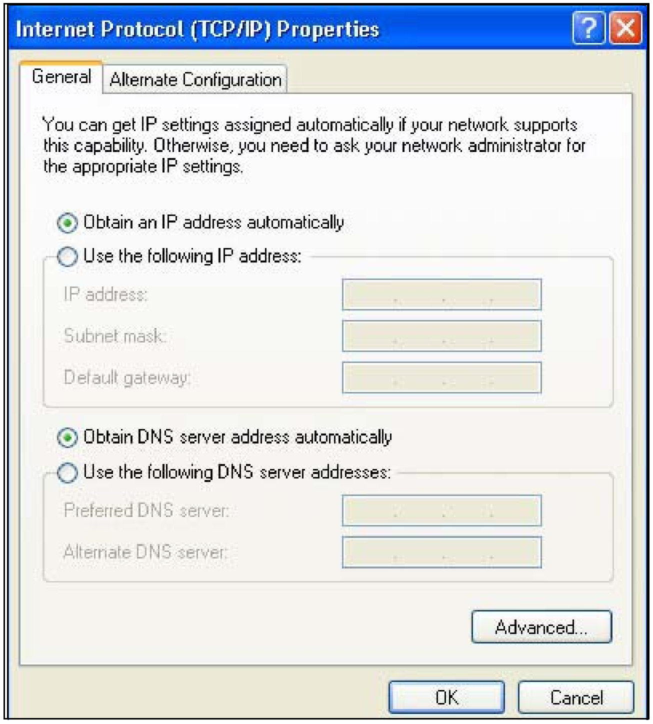
□ Show icon in notification area when connected

5 The **Internet Protocol TCP/IP Properties** window opens (the **General tab** in Windows XP).

- If you have a dynamic IP address click **Obtain an IP address automatically**.
- If you have a static IP address click **Use the following IP Address** and fill in the **IP address**, **Subnet mask**, and **Default gateway** fields.

- Click **Advanced**.

Figure 201 Windows XP: Internet Protocol (TCP/IP) Properties


Internet Protocol (TCP/IP) Properties
General
Alternate Configuration
You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.
● Obtain an IP address automatically
○ Use the following IP address:
IP address:
Subnet mask:
Default gateway:
● Obtain DNS server address automatically
○ Use the following DNS server addresses:
Preferred DNS server:
Alternate DNS server:
Advanced...
OK
Cancel

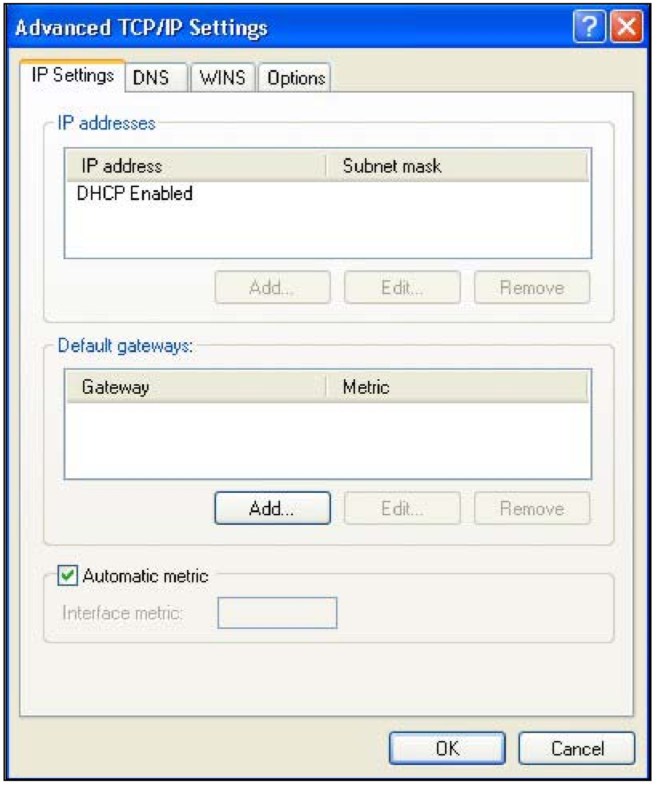
6 If you do not know your gateway's IP address, remove any previously installed gateways in the **IP Settings** tab and click **OK**.

Do one or more of the following if you want to configure additional IP addresses:

- In the **IP Settings** tab, in IP addresses, click **Add**.
- In **TCP/IP Address**, type an IP address in **IP address** and a subnet mask in **Subnet mask**, and then click **Add**.
- Repeat the above two steps for each IP address you want to add.
- Configure additional default gateways in the **IP Settings** tab by clicking **Add** in **Default gateways**.
- In **TCP/IP Gateway Address**, type the IP address of the default gateway in **Gateway**. To manually configure a default metric (the number of transmission hops), clear the **Automatic metric** check box and type a metric in **Metric**.
- Click **Add**.
- Repeat the previous three steps for each default gateway you want to add.

- Click **OK** when finished.

Figure 202 Windows XP: Advanced TCP/IP Properties

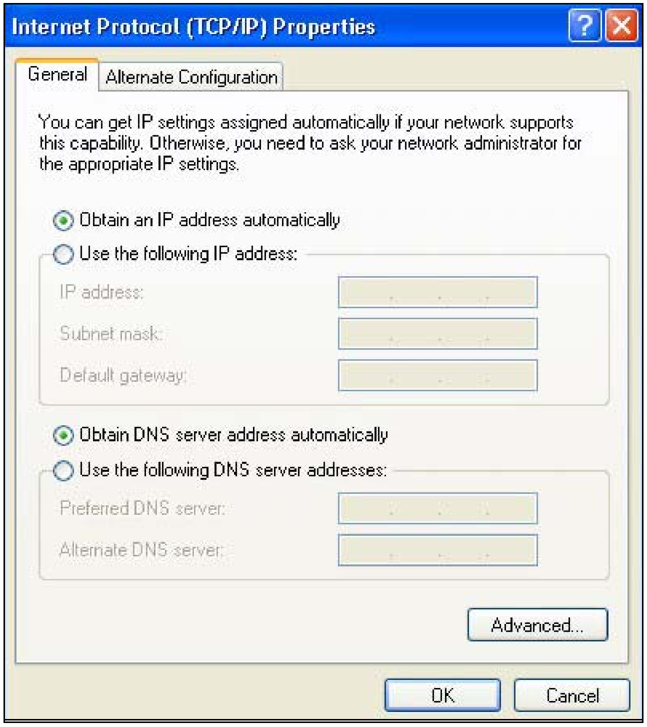


7 In the **Internet Protocol TCP/IP Properties** window (the **General** tab in Windows XP):

- Click **Obtain DNS server address automatically** if you do not know your DNS server IP address(es).
- If you know your DNS server IP address(es), click **Use the following DNS server addresses**, and type them in the **Preferred DNS server** and **Alternate DNS server** fields.

If you have previously configured DNS servers, click **Advanced** and then the **DNS** tab to order them.

Figure 203 Windows XP: Internet Protocol (TCP/IP) Properties



Internet Protocol (TCP/IP) Properties

You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

● Obtain an IP address automatically

○ Use the following IP address:

IP address:

Subnet mask:

Default gateway:

● Obtain DNS server address automatically

○ Use the following DNS server addresses:

Preferred DNS server:

Alternate DNS server:

8 Click **OK** to close the **Internet Protocol (TCP/IP) Properties** window.

9 Click **Close** (**OK** in Windows 2000/NT) to close the **Local Area Connection Properties** window.

10 Close the **Network Connections** window (**Network and Dial-up Connections** in Windows 2000/NT).

11 Turn on your Device and restart your computer (if prompted).

Verifying Settings

1 Click **Start**, **All Programs**, **Accessories** and then **Command Prompt**.

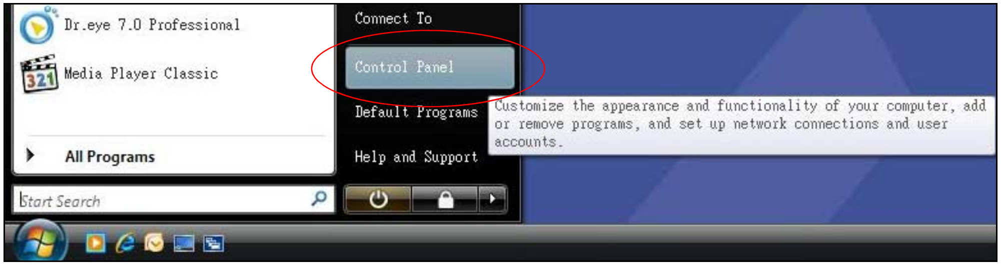
2 In the **Command Prompt** window, type "ipconfig" and then press [ENTER]. You can also open **Network Connections**, right-click a network connection, click **Status** and then click the **Support** tab.

Windows Vista

This section shows screens from Windows Vista Enterprise Version 6.0.

1 Click the **Start** icon, **Control Panel**.

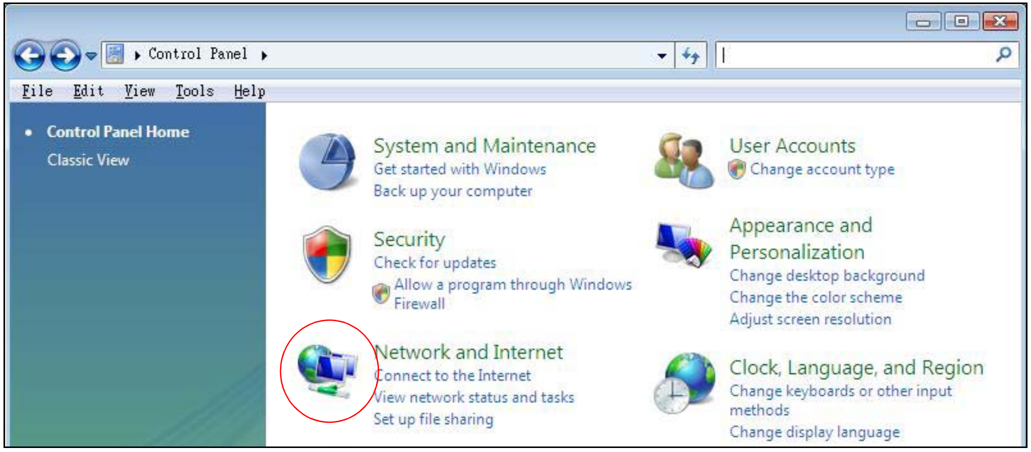
Figure 204 Windows Vista: Start Menu



Customize the appearance and functionality of your computer, add or remove programs, and set up network connections and user accounts.

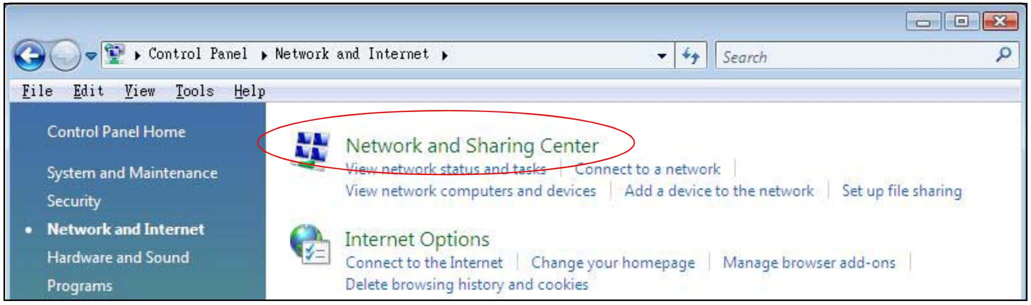
2 In the **Control Panel**, double-click **Network and Internet**.

Figure 205 Windows Vista: Control Panel



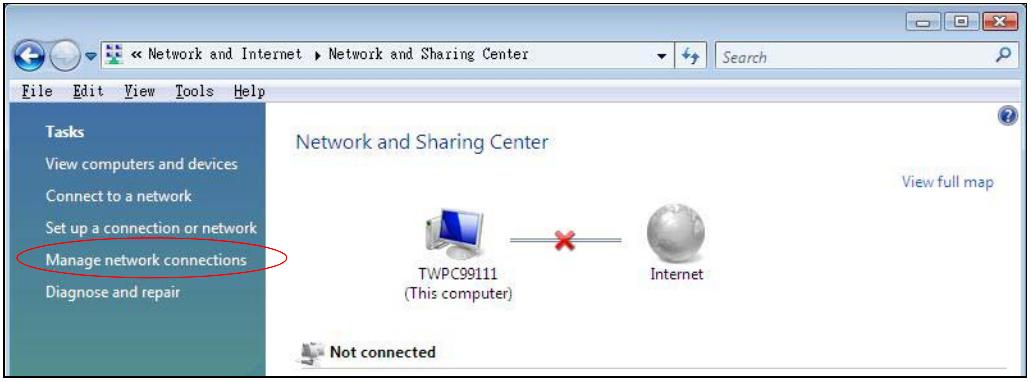
3 Click **Network and Sharing Center**.

Figure 206 Windows Vista: Network And Internet



4 Click **Manage network connections**.

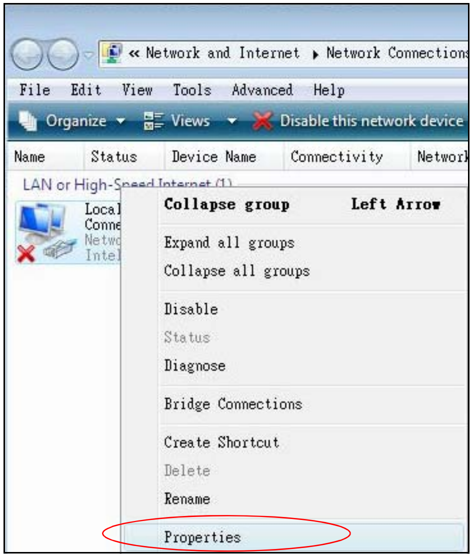
Figure 207 Windows Vista: Network and Sharing Center


« Network and Internet ▸ Network and Sharing Center
Search
File Edit View Tools Help
Tasks
View computers and devices
Connect to a network
Set up a connection or network
Manage network connections
Diagnose and repair
Network and Sharing Center
View full map
TWPC99111
(This computer)
Internet
Not connected

5 Right-click **Local Area Connection** and then click **Properties**.

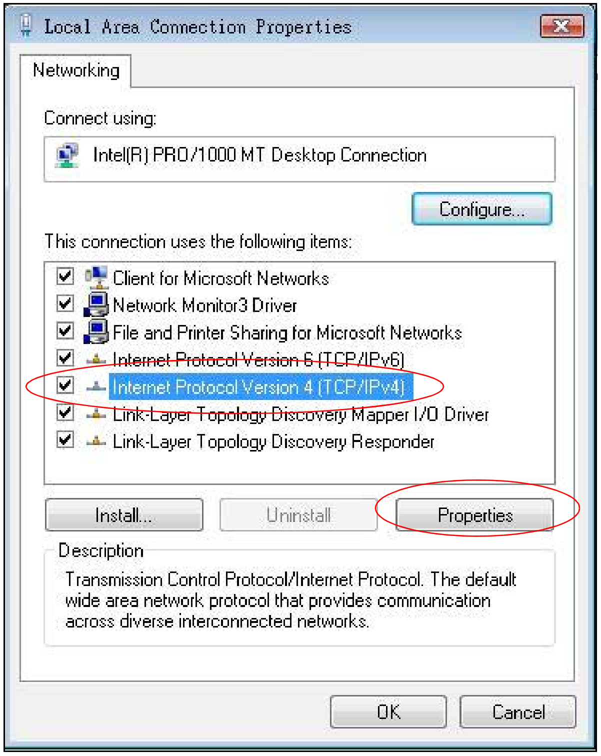
Note: During this procedure, click **Continue** whenever Windows displays a screen saying that it needs your permission to continue.

Figure 208 Windows Vista: Network and Sharing Center


« Network and Internet ▸ Network Connections
File Edit View Tools Advanced Help
Organize Views Disable this network device
Name Status Device Name Connectivity Network
LAN or High-Speed Internet (1)
Local Conne Netwo Intel
Collapse group Left Arrow
Expand all groups
Collapse all groups
Disable
Status
Diagnose
Bridge Connections
Create Shortcut
Delete
Rename
Properties

6 Select **Internet Protocol Version 4 (TCP/IPv4)** and click **Properties**.

Figure 209 Windows Vista: Local Area Connection Properties



Local Area Connection Properties
Networking
Connect using:
Intel(R) PRO/1000 MT Desktop Connection
Configure...
This connection uses the following items:
☑ Client for Microsoft Networks
☑ Network Monitor3 Driver
☑ File and Printer Sharing for Microsoft Networks
☑ Internet Protocol Version 6 (TCP/IPv6)
☑ Internet Protocol Version 4 (TCP/IPv4)
☑ Link-Layer Topology Discovery Mapper I/O Driver
☑ Link-Layer Topology Discovery Responder
Install...
Uninstall
Properties
Description
OK
Cancel

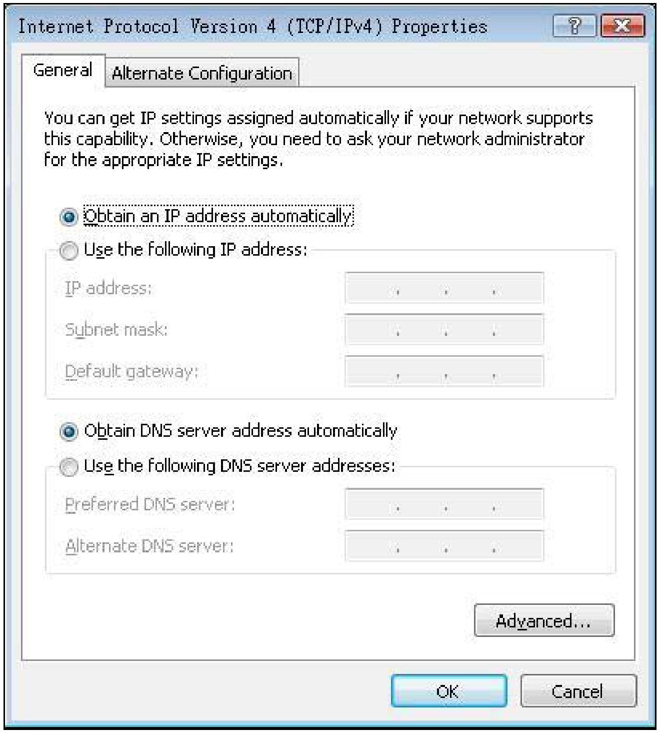
Transmission Control Protocol/Internet Protocol. The default wide area network protocol that provides communication across diverse interconnected networks.

7 The **Internet Protocol Version 4 (TCP/IPv4) Properties** window opens (the **General tab**).

- If you have a dynamic IP address click **Obtain an IP address automatically**.
- If you have a static IP address click **Use the following IP address** and fill in the **IP address**, **Subnet mask**, and **Default gateway** fields.

- Click **Advanced**.

Figure 210 Windows Vista: Internet Protocol Version 4 (TCP/IPv4) Properties



Internet Protocol Version 4 (TCP/IPv4) Properties

General | Alternate Configuration

You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

● Obtain an IP address automatically

○ Use the following IP address:

IP address: . . .

Subnet mask: . . .

Default gateway: . . .

● Obtain DNS server address automatically

○ Use the following DNS server addresses:

Preferred DNS server: . . .

Alternate DNS server: . . .

Advanced...

OK | Cancel

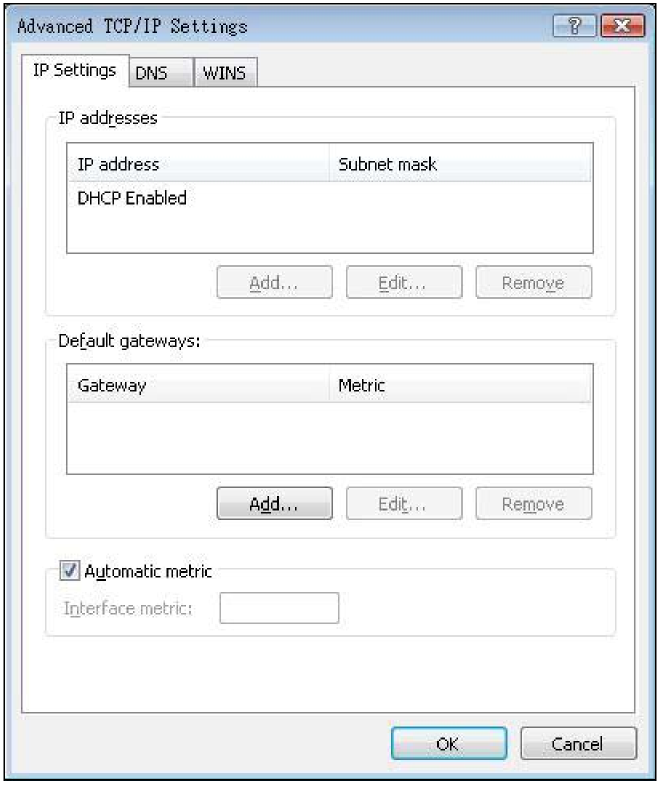
8 If you do not know your gateway's IP address, remove any previously installed gateways in the **IP Settings** tab and click **OK**.

Do one or more of the following if you want to configure additional IP addresses:

- In the **IP Settings** tab, in IP addresses, click **Add**.
- In **TCP/IP Address**, type an IP address in **IP address** and a subnet mask in **Subnet mask**, and then click **Add**.
- Repeat the above two steps for each IP address you want to add.
- Configure additional default gateways in the **IP Settings** tab by clicking **Add** in **Default gateways**.
- In **TCP/IP Gateway Address**, type the IP address of the default gateway in **Gateway**. To manually configure a default metric (the number of transmission hops), clear the **Automatic metric** check box and type a metric in **Metric**.
- Click **Add**.
- Repeat the previous three steps for each default gateway you want to add.

- Click **OK** when finished.

Figure 211 Windows Vista: Advanced TCP/IP Properties



IP address	Subnet mask
DHCP Enabled	

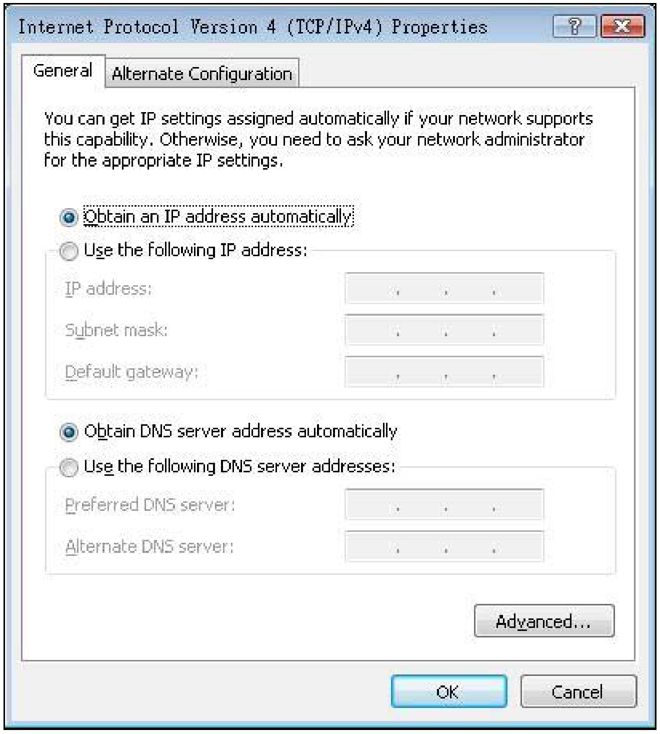
☑ Automatic metric

9 In the **Internet Protocol Version 4 (TCP/IPv4) Properties** window, (the **General tab**):

- Click **Obtain DNS server address automatically** if you do not know your DNS server IP address(es).
- If you know your DNS server IP address(es), click **Use the following DNS server addresses**, and type them in the **Preferred DNS server** and **Alternate DNS server** fields.

If you have previously configured DNS servers, click **Advanced** and then the **DNS** tab to order them.

Figure 212 Windows Vista: Internet Protocol Version 4 (TCP/IPv4) Properties



You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

● Obtain an IP address automatically

○ Use the following IP address:

IP address: . . .

Subnet mask: . . .

Default gateway: . . .

● Obtain DNS server address automatically

○ Use the following DNS server addresses:

Preferred DNS server: . . .

Alternate DNS server: . . .

10 Click **OK** to close the **Internet Protocol Version 4 (TCP/IPv4) Properties** window.

11 Click **Close** to close the **Local Area Connection Properties** window.

12 Close the **Network Connections** window.

13 Turn on your Device and restart your computer (if prompted).

Verifying Settings

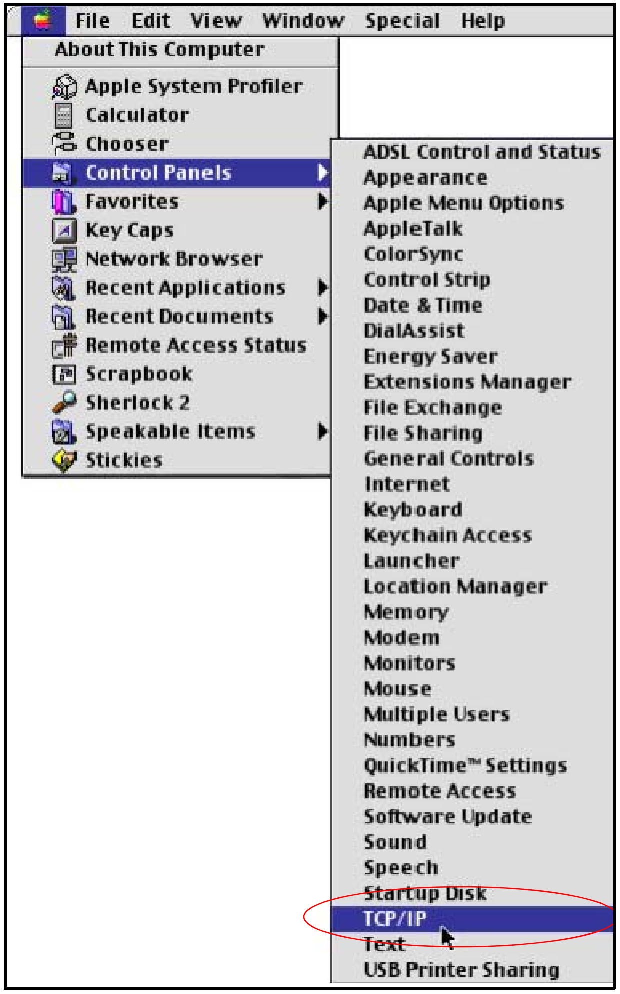
1 Click **Start**, **All Programs**, **Accessories** and then **Command Prompt**.

2 In the **Command Prompt** window, type "ipconfig" and then press [ENTER]. You can also open **Network Connections**, right-click a network connection, click **Status** and then click the **Support** tab.

Macintosh OS 8/9

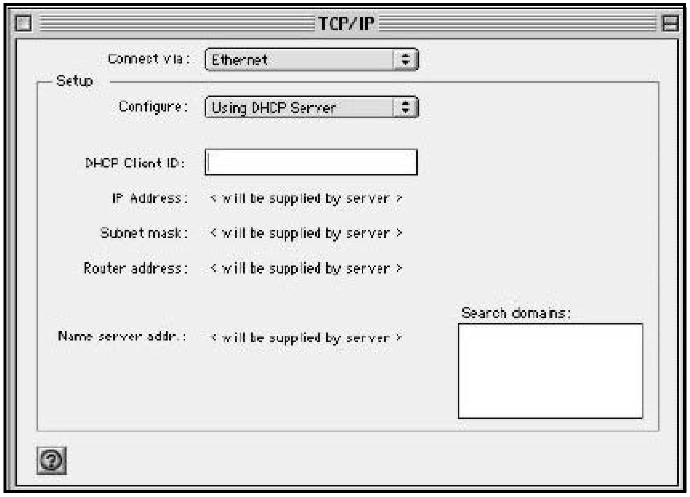
1 Click the **Apple** menu, **Control Panel** and double-click **TCP/IP** to open the **TCP/IP Control Panel**.

Figure 213 Macintosh OS 8/9: Apple Menu



2 Select **Ethernet built-in** from the **Connect via** list.

Figure 214 Macintosh OS 8/9: TCP/IP



TCP/IP

Connect via: Ethernet

Setup

Configure: Using DHCP Server

DHCP Client ID:

IP Address: < will be supplied by server >

Subnet mask: < will be supplied by server >

Router address: < will be supplied by server >

Name server addr.: < will be supplied by server >

Search domains:

3 For dynamically assigned settings, select **Using DHCP Server** from the **Configure:** list.

4 For statically assigned settings, do the following:

- From the **Configure** box, select **Manually**.
- Type your IP address in the **IP Address** box.
- Type your subnet mask in the **Subnet mask** box.
- Type the IP address of your Device in the **Router address** box.

5 Close the **TCP/IP Control Panel**.

6 Click **Save** if prompted, to save changes to your configuration.

7 Turn on your Device and restart your computer (if prompted).

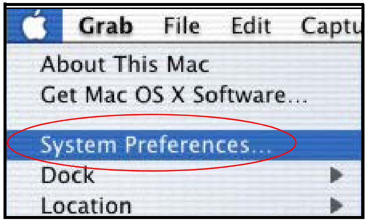
Verifying Settings

Check your TCP/IP properties in the **TCP/IP Control Panel** window.

Macintosh OS X

1 Click the **Apple** menu, and click **System Preferences** to open the **System Preferences** window.

Figure 215 Macintosh OS X: Apple Menu



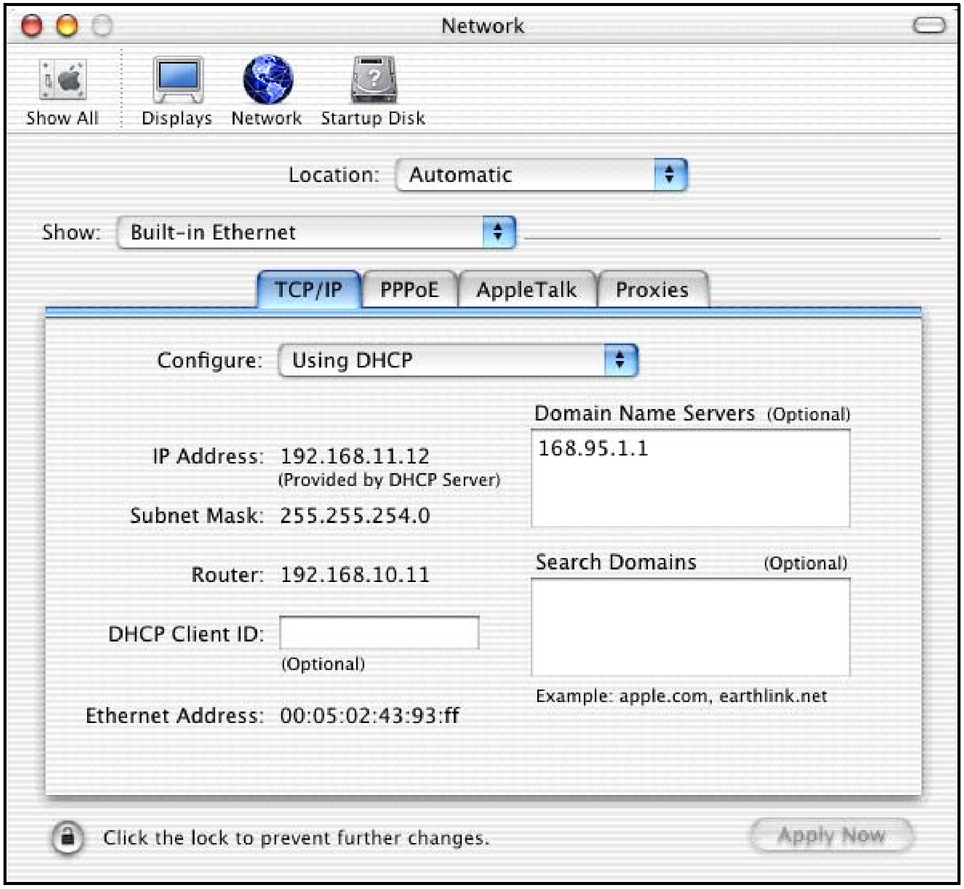
2 Click **Network** in the icon bar.

- Select **Automatic** from the **Location** list.

- Select **Built-in Ethernet** from the **Show** list.
- Click the **TCP/IP** tab.

3 For dynamically assigned settings, select **Using DHCP** from the **Configure** list.

Figure 216 Macintosh OS X: Network



Location: Automatic

Show: Built-in Ethernet

Configure: Using DHCP

Domain Name Servers (Optional)
168.95.1.1

IP Address: 192.168.11.12
(Provided by DHCP Server)

Subnet Mask: 255.255.254.0

Router: 192.168.10.11

Search Domains (Optional)

DHCP Client ID:
(Optional)

Example: apple.com, earthlink.net

Ethernet Address: 00:05:02:43:93:ff

4 For statically assigned settings, do the following:

- From the **Configure** box, select **Manually**.
- Type your IP address in the **IP Address** box.
- Type your subnet mask in the **Subnet mask** box.
- Type the IP address of your Device in the **Router address** box.

5 Click **Apply Now** and close the window.

6 Turn on your Device and restart your computer (if prompted).

Verifying Settings

Check your TCP/IP properties in the **Network** window.

Linux

This section shows you how to configure your computer's TCP/IP settings in Red Hat Linux 9.0. Procedure, screens and file location may vary depending on your Linux distribution and release version.

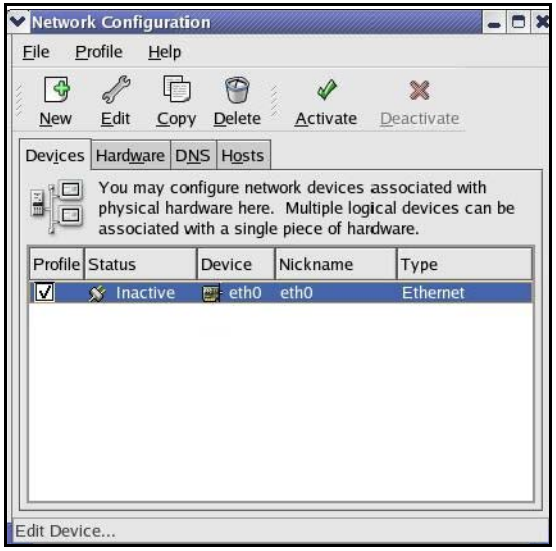
Note: Make sure you are logged in as the root administrator.

Using the K Desktop Environment (KDE)

Follow the steps below to configure your computer IP address using the KDE.

1 Click the Red Hat button (located on the bottom left corner), select **System Setting** and click **Network**.

Figure 217 Red Hat 9.0: KDE: Network Configuration: Devices

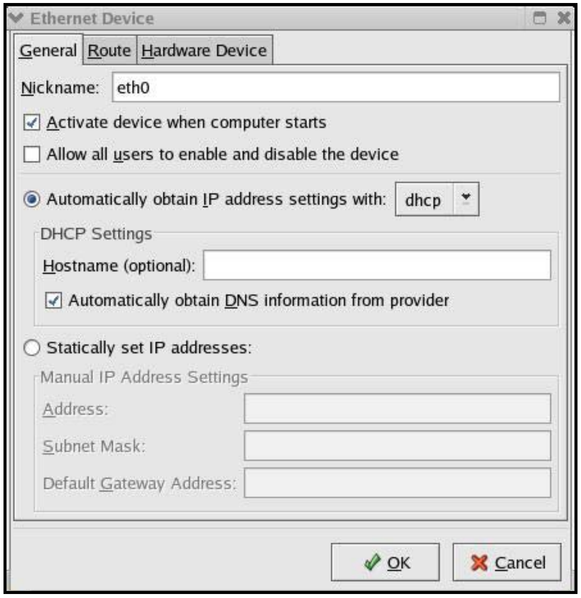


You may configure network devices associated with physical hardware here. Multiple logical devices can be associated with a single piece of hardware.

Profile	Status	Device	Nickname	Type
☑	Inactive	eth0	eth0	Ethernet

2 Double-click on the profile of the network card you wish to configure. The **Ethernet Device General** screen displays as shown.

Figure 218 Red Hat 9.0: KDE: Ethernet Device: General



Nickname: eth0

☑ Activate device when computer starts

□ Allow all users to enable and disable the device

● Automatically obtain IP address settings with: dhcp

DHCP Settings

Hostname (optional):

☑ Automatically obtain DNS information from provider

○ Statically set IP addresses:

Manual IP Address Settings

Address:

Subnet Mask:

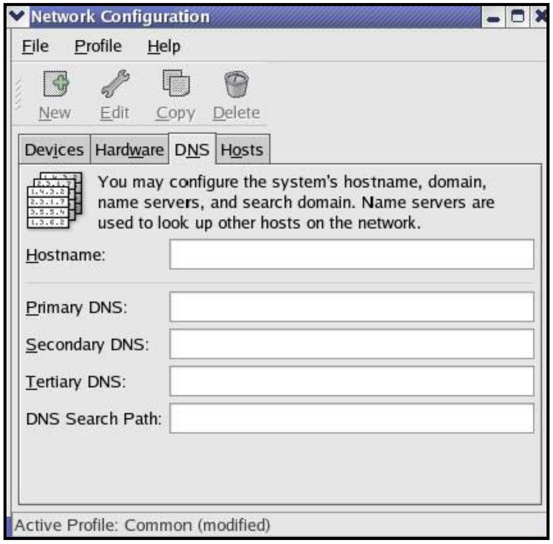
Default Gateway Address:

- If you have a dynamic IP address, click **Automatically obtain IP address settings with** and select **dhcp** from the drop down list.
- If you have a static IP address, click **Statically set IP Addresses** and fill in the **Address**, **Subnet mask**, and **Default Gateway Address** fields.

3 Click **OK** to save the changes and close the **Ethernet Device General** screen.

4 If you know your DNS server IP address(es), click the **DNS** tab in the **Network Configuration** screen. Enter the DNS server information in the fields provided.

Figure 219 Red Hat 9.0: KDE: Network Configuration: DNS



You may configure the system's hostname, domain, name servers, and search domain. Name servers are used to look up other hosts on the network.

Hostname:

Primary DNS:

Secondary DNS:

Tertiary DNS:

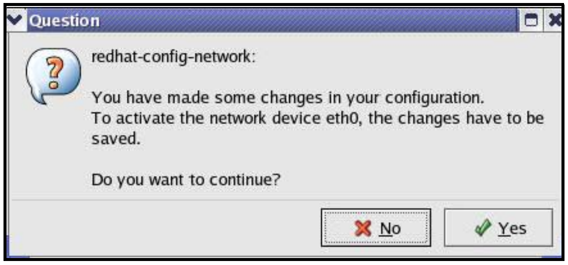
DNS Search Path:

Active Profile: Common (modified)

5 Click the **Devices** tab.

6 Click the **Activate** button to apply the changes. The following screen displays. Click **Yes to save the changes in all screens.**

Figure 220 Red Hat 9.0: KDE: Network Configuration: Activate



redhat-config-network:

You have made some changes in your configuration.
To activate the network device eth0, the changes have to be saved.

Do you want to continue?

7 After the network card restart process is complete, make sure the **Status** is **Active** in the **Network Configuration** screen.

Using Configuration Files

Follow the steps below to edit the network configuration files and set your computer IP address.

1 Assuming that you have only one network card on the computer, locate the `ifconfig-eth0` configuration file (where `eth0` is the name of the Ethernet card). Open the configuration file with any plain text editor.

- If you have a dynamic IP address, enter **dhcp** in the `BOOTPROTO=` field. The following figure shows an example.

Figure 221 Red Hat 9.0: Dynamic IP Address Setting in ifconfig-eth0

```
DEVICE=eth0
ONBOOT=yes
BOOTPROTO=dhcp
USERCTL=no
PEERDNS=yes
TYPE=Ethernet
```

- If you have a static IP address, enter **static** in the `BOOTPROTO=` field. Type `IPADDR=` followed by the IP address (in dotted decimal notation) and type `NETMASK=` followed by the subnet mask. The following example shows an example where the static IP address is 192.168.1.10 and the subnet mask is 255.255.255.0.

Figure 222 Red Hat 9.0: Static IP Address Setting in ifconfig-eth0

```
DEVICE=eth0
ONBOOT=yes
BOOTPROTO=static
IPADDR=192.168.1.10
NETMASK=255.255.255.0
USERCTL=no
PEERDNS=yes
TYPE=Ethernet
```

2 If you know your DNS server IP address(es), enter the DNS server information in the `resolv.conf` file in the `/etc` directory. The following figure shows an example where two DNS server IP addresses are specified.

Figure 223 Red Hat 9.0: DNS Settings in resolv.conf

```
nameserver 172.23.5.1
nameserver 172.23.5.2
```

3 After you edit and save the configuration files, you must restart the network card. Enter `./network restart` in the `/etc/rc.d/init.d` directory. The following figure shows an example.

Figure 224 Red Hat 9.0: Restart Ethernet Card

```
[root@localhost init.d]# network restart

Shutting down interface eth0:                [OK]
Shutting down loopback interface:            [OK]
Setting network parameters:                  [OK]
Bringing up loopback interface:              [OK]
Bringing up interface eth0:                  [OK]
```

Verifying Settings

Enter `ifconfig` in a terminal screen to check your TCP/IP properties.

Figure 225 Red Hat 9.0: Checking TCP/IP Properties

```
[root@localhost]# ifconfig
eth0      Link encap:Ethernet  HWaddr 00:50:BA:72:5B:44
          inet addr:172.23.19.129  Bcast:172.23.19.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:717 errors:0 dropped:0 overruns:0 frame:0
          TX packets:13 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:100
          RX bytes:730412 (713.2 Kb)  TX bytes:1570 (1.5 Kb)
          Interrupt:10 Base address:0x1000
[root@localhost]#
```

B

IP Addresses and Subnetting

This appendix introduces IP addresses and subnet masks.

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

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

Introduction to IP Addresses

One part of the IP address is the network number, and the other part is the host ID. In the same way that houses on a street share a common street name, the hosts on a network share a common network number. Similarly, as each house has its own house number, each host on the network has its own unique identifying number - the host ID. Routers use the network number to send packets to the correct network, while the host ID determines to which host on the network the packets are delivered.

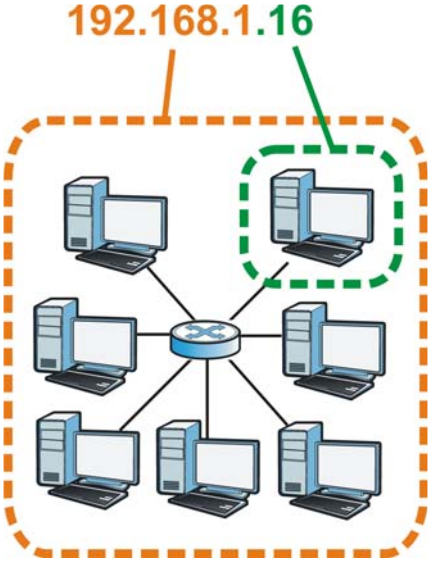
Structure

An IP address is made up of four parts, written in dotted decimal notation (for example, 192.168.1.1). Each of these four parts is known as an octet. An octet is an eight-digit binary number (for example 11000000, which is 192 in decimal notation).

Therefore, each octet has a possible range of 00000000 to 11111111 in binary, or 0 to 255 in decimal.

The following figure shows an example IP address in which the first three octets (192.168.1) are the network number, and the fourth octet (16) is the host ID.

Figure 226 Network Number and Host ID



How much of the IP address is the network number and how much is the host ID varies according to the subnet mask.

Subnet Masks

A subnet mask is used to determine which bits are part of the network number, and which bits are part of the host ID (using a logical AND operation). The term “subnet” is short for “sub-network”.

A subnet mask has 32 bits. If a bit in the subnet mask is a “1” then the corresponding bit in the IP address is part of the network number. If a bit in the subnet mask is “0” then the corresponding bit in the IP address is part of the host ID.

The following example shows a subnet mask identifying the network number (in bold text) and host ID of an IP address (192.168.1.2 in decimal).

Table 153 Subnet Masks

	1ST OCTET: **(192)**	**2ND OCTET:** **(168)**	**3RD OCTET:** **(1)**	**4TH OCTET** **(2)**
IP Address (Binary)	11000000	10101000	00000001	00000010
Subnet Mask (Binary)	**11111111**	**11111111**	**11111111**	00000000
Network Number	**11000000**	**10101000**	**00000001**	
Host ID				00000010

By convention, subnet masks always consist of a continuous sequence of ones beginning from the leftmost bit of the mask, followed by a continuous sequence of zeros, for a total number of 32 bits.

Subnet masks can be referred to by the size of the network number part (the bits with a "1" value). For example, an "8-bit mask" means that the first 8 bits of the mask are ones and the remaining 24 bits are zeroes.

Subnet masks are expressed in dotted decimal notation just like IP addresses. The following examples show the binary and decimal notation for 8-bit, 16-bit, 24-bit and 29-bit subnet masks.

Table 154 Subnet Masks

	BINARY				DECIMAL
	1ST OCTET	2ND OCTET	3RD OCTET	4TH OCTET	
8-bit mask	11111111	00000000	00000000	00000000	255.0.0.0
16-bit mask	11111111	11111111	00000000	00000000	255.255.0.0
24-bit mask	11111111	11111111	11111111	00000000	255.255.255.0
29-bit mask	11111111	11111111	11111111	11111000	255.255.255.248

Network Size

The size of the network number determines the maximum number of possible hosts you can have on your network. The larger the number of network number bits, the smaller the number of remaining host ID bits.

An IP address with host IDs of all zeros is the IP address of the network (192.168.1.0 with a 24-bit subnet mask, for example). An IP address with host IDs of all ones is the broadcast address for that network (192.168.1.255 with a 24-bit subnet mask, for example).

As these two IP addresses cannot be used for individual hosts, calculate the maximum number of possible hosts in a network as follows:

Table 155 Maximum Host Numbers

SUBNET MASK		HOST ID SIZE		MAXIMUM NUMBER OF HOSTS
8 bits	255.0.0.0	24 bits	$2^{24} – 2$	16777214
16 bits	255.255.0.0	16 bits	$2^{16} – 2$	65534
24 bits	255.255.255.0	8 bits	$2^{8} – 2$	254
29 bits	255.255.255.248	3 bits	$2^{3} – 2$	6

Notation

Since the mask is always a continuous number of ones beginning from the left, followed by a continuous number of zeros for the remainder of the 32 bit mask, you can simply specify the number of ones instead of writing the value of each octet. This is usually specified by writing a "/" followed by the number of bits in the mask after the address.

For example, 192.1.1.0 /25 is equivalent to saying 192.1.1.0 with subnet mask 255.255.255.128.

The following table shows some possible subnet masks using both notations.

Table 156 Alternative Subnet Mask Notation

SUBNET MASK	ALTERNATIVE NOTATION	LAST OCTET (BINARY)	LAST OCTET (DECIMAL)
255.255.255.0	/24	0000 0000	0
255.255.255.128	/25	1000 0000	128
255.255.255.192	/26	1100 0000	192
255.255.255.224	/27	1110 0000	224
255.255.255.240	/28	1111 0000	240
255.255.255.248	/29	1111 1000	248
255.255.255.252	/30	1111 1100	252

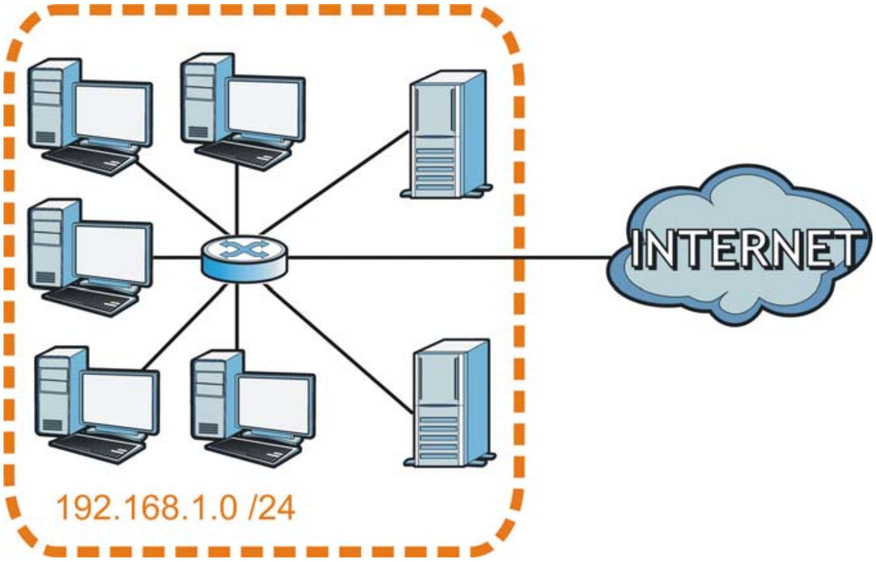
Subnetting

You can use subnetting to divide one network into multiple sub-networks. In the following example a network administrator creates two sub-networks to isolate a group of servers from the rest of the company network for security reasons.

In this example, the company network address is 192.168.1.0. The first three octets of the address (192.168.1) are the network number, and the remaining octet is the host ID, allowing a maximum of 2^8 – 2 or 254 possible hosts.

The following figure shows the company network before subnetting.

Figure 227 Subnetting Example: Before Subnetting

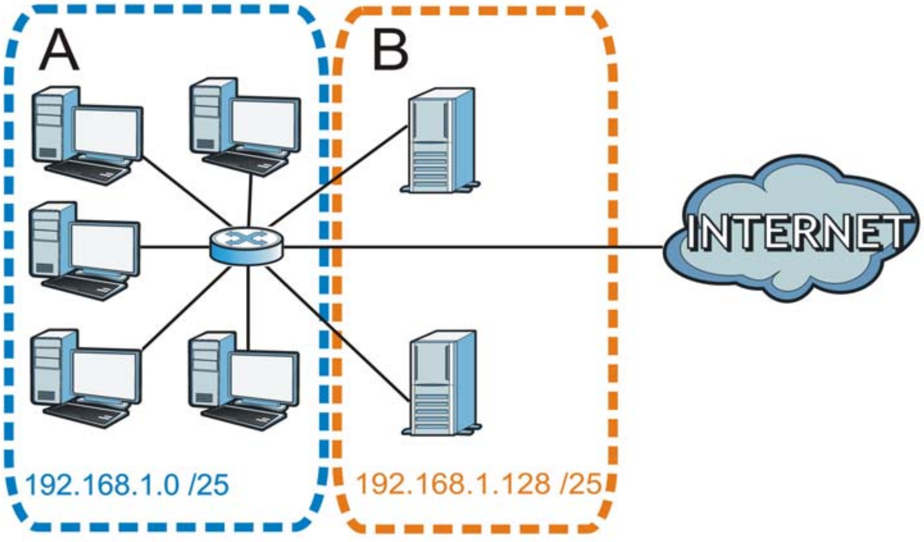


You can “borrow” one of the host ID bits to divide the network 192.168.1.0 into two separate sub-networks. The subnet mask is now 25 bits (255.255.255.128 or /25).

The “borrowed” host ID bit can have a value of either 0 or 1, allowing two subnets; 192.168.1.0 /25 and 192.168.1.128 /25.

The following figure shows the company network after subnetting. There are now two sub-networks, **A** and **B**.

Figure 228 Subnetting Example: After Subnetting



In a 25-bit subnet the host ID has 7 bits, so each sub-network has a maximum of 2^7 – 2 or 126 possible hosts (a host ID of all zeroes is the subnet's address itself, all ones is the subnet's broadcast address).

192.168.1.0 with mask 255.255.255.128 is subnet **A** itself, and 192.168.1.127 with mask 255.255.255.128 is its broadcast address. Therefore, the lowest IP address that can be assigned to an actual host for subnet **A** is 192.168.1.1 and the highest is 192.168.1.126.

Similarly, the host ID range for subnet **B** is 192.168.1.129 to 192.168.1.254.

Example: Four Subnets

The previous example illustrated using a 25-bit subnet mask to divide a 24-bit address into two subnets. Similarly, to divide a 24-bit address into four subnets, you need to "borrow" two host ID bits to give four possible combinations (00, 01, 10 and 11). The subnet mask is 26 bits (11111111.11111111.11111111.**11**000000) or 255.255.255.192.

Each subnet contains 6 host ID bits, giving 2^6 - 2 or 62 hosts for each subnet (a host ID of all zeroes is the subnet itself, all ones is the subnet's broadcast address).

Table 157 Subnet 1

IP/SUBNET MASK	NETWORK NUMBER	LAST OCTET BIT VALUE
IP Address (Decimal)	192.168.1.	0
IP Address (Binary)	11000000.10101000.00000001.	**00**000000
Subnet Mask (Binary)	11111111.11111111.11111111.	**11**000000

Table 157 Subnet 1 (continued)

IP/SUBNET MASK	NETWORK NUMBER	LAST OCTET BIT VALUE
Subnet Address: 192.168.1.0	Lowest Host ID: 192.168.1.1	
Broadcast Address: 192.168.1.63	Highest Host ID: 192.168.1.62	

Table 158 Subnet 2

IP/SUBNET MASK	NETWORK NUMBER	LAST OCTET BIT VALUE
IP Address	192.168.1.	64
IP Address (Binary)	11000000.10101000.00000001.	**01**000000
Subnet Mask (Binary)	11111111.11111111.11111111.	**11**000000
Subnet Address: 192.168.1.64	Lowest Host ID: 192.168.1.65	
Broadcast Address: 192.168.1.127	Highest Host ID: 192.168.1.126	

Table 159 Subnet 3

IP/SUBNET MASK	NETWORK NUMBER	LAST OCTET BIT VALUE
IP Address	192.168.1.	128
IP Address (Binary)	11000000.10101000.00000001.	**10**000000
Subnet Mask (Binary)	11111111.11111111.11111111.	**11**000000
Subnet Address: 192.168.1.128	Lowest Host ID: 192.168.1.129	
Broadcast Address: 192.168.1.191	Highest Host ID: 192.168.1.190	

Table 160 Subnet 4

IP/SUBNET MASK	NETWORK NUMBER	LAST OCTET BIT VALUE
IP Address	192.168.1.	192
IP Address (Binary)	11000000.10101000.00000001.	**11**000000
Subnet Mask (Binary)	11111111.11111111.11111111.	**11**000000
Subnet Address: 192.168.1.192	Lowest Host ID: 192.168.1.193	
Broadcast Address: 192.168.1.255	Highest Host ID: 192.168.1.254	

Example: Eight Subnets

Similarly, use a 27-bit mask to create eight subnets (000, 001, 010, 011, 100, 101, 110 and 111).

The following table shows IP address last octet values for each subnet.

Table 161 Eight Subnets

SUBNET	SUBNET ADDRESS	FIRST ADDRESS	LAST ADDRESS	BROADCAST ADDRESS
1	0	1	30	31
2	32	33	62	63

Table 161 Eight Subnets (continued)

SUBNET	SUBNET ADDRESS	FIRST ADDRESS	LAST ADDRESS	BROADCAST ADDRESS
3	64	65	94	95
4	96	97	126	127
5	128	129	158	159
6	160	161	190	191
7	192	193	222	223
8	224	225	254	255

Subnet Planning

The following table is a summary for subnet planning on a network with a 24-bit network number.

Table 162 24-bit Network Number Subnet Planning

NO. “BORROWED” HOST BITS	SUBNET MASK	NO. SUBNETS	NO. HOSTS PER SUBNET
1	255.255.255.128 (/25)	2	126
2	255.255.255.192 (/26)	4	62
3	255.255.255.224 (/27)	8	30
4	255.255.255.240 (/28)	16	14
5	255.255.255.248 (/29)	32	6
6	255.255.255.252 (/30)	64	2
7	255.255.255.254 (/31)	128	1

The following table is a summary for subnet planning on a network with a 16-bit network number.

Table 163 16-bit Network Number Subnet Planning

NO. “BORROWED” HOST BITS	SUBNET MASK	NO. SUBNETS	NO. HOSTS PER SUBNET
1	255.255.128.0 (/17)	2	32766
2	255.255.192.0 (/18)	4	16382
3	255.255.224.0 (/19)	8	8190
4	255.255.240.0 (/20)	16	4094
5	255.255.248.0 (/21)	32	2046
6	255.255.252.0 (/22)	64	1022
7	255.255.254.0 (/23)	128	510
8	255.255.255.0 (/24)	256	254
9	255.255.255.128 (/25)	512	126
10	255.255.255.192 (/26)	1024	62
11	255.255.255.224 (/27)	2048	30
12	255.255.255.240 (/28)	4096	14
13	255.255.255.248 (/29)	8192	6
14	255.255.255.252 (/30)	16384	2
15	255.255.255.254 (/31)	32768	1

Configuring IP Addresses

Where you obtain your network number depends on your particular situation. If the ISP or your network administrator assigns you a block of registered IP addresses, follow their instructions in selecting the IP addresses and the subnet mask.

If the ISP did not explicitly give you an IP network number, then most likely you have a single user account and the ISP will assign you a dynamic IP address when the connection is established. If this is the case, it is recommended that you select a network number from 192.168.0.0 to 192.168.255.0. The Internet Assigned Number Authority (IANA) reserved this block of addresses specifically for private use; please do not use any other number unless you are told otherwise. You must also enable Network Address Translation (NAT) on the Device.

Once you have decided on the network number, pick an IP address for your Device that is easy to remember (for instance, 192.168.1.1) but make sure that no other device on your network is using that IP address.

The subnet mask specifies the network number portion of an IP address. Your Device will compute the subnet mask automatically based on the IP address that you entered. You don't need to change the subnet mask computed by the Device unless you are instructed to do otherwise.

Private IP Addresses

Every machine on the Internet must have a unique address. If your networks are isolated from the Internet (running only between two branch offices, for example) you can assign any IP addresses to the hosts without problems. However, the Internet Assigned Numbers Authority (IANA) has reserved the following three blocks of IP addresses specifically for private networks:

- 10.0.0.0 — 10.255.255.255
- 172.16.0.0 — 172.31.255.255
- 192.168.0.0 — 192.168.255.255

You can obtain your IP address from the IANA, from an ISP, or it can be assigned from a private network. If you belong to a small organization and your Internet access is through an ISP, the ISP can provide you with the Internet addresses for your local networks. On the other hand, if you are part of a much larger organization, you should consult your network administrator for the appropriate IP addresses.

Regardless of your particular situation, do not create an arbitrary IP address; always follow the guidelines above. For more information on address assignment, please refer to RFC 1597, *Address Allocation for Private Internets* and RFC 1466, *Guidelines for Management of IP Address Space.*

Pop-up Windows, JavaScripts and Java Permissions

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

- Web browser pop-up windows from your device.
- JavaScripts (enabled by default).
- Java permissions (enabled by default).

Note: Internet Explorer 6 screens are used here. Screens for other Internet Explorer versions may vary.

Internet Explorer Pop-up Blockers

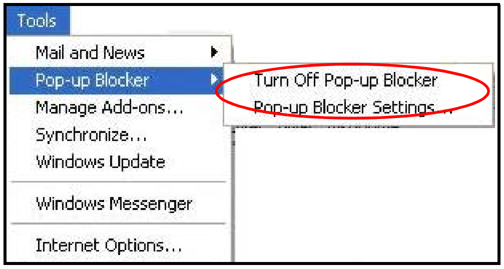
You may have to disable pop-up blocking to log into your device.

Either disable pop-up blocking (enabled by default in Windows XP SP (Service Pack) 2) or allow pop-up blocking and create an exception for your device's IP address.

Disable Pop-up Blockers

1 In Internet Explorer, select **Tools**, **Pop-up Blocker** and then select **Turn Off Pop-up Blocker**.

Figure 229 Pop-up Blocker

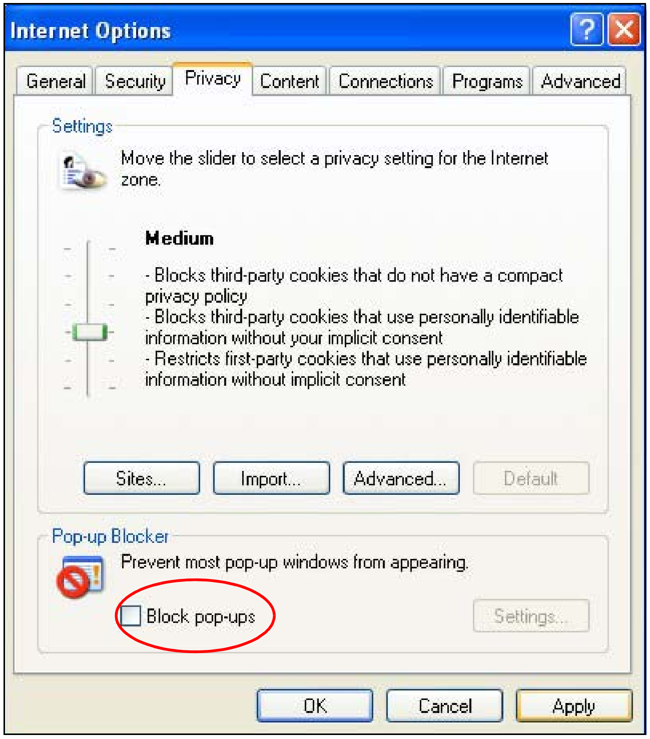


You can also check if pop-up blocking is disabled in the **Pop-up Blocker** section in the **Privacy** tab.

1 In Internet Explorer, select **Tools**, **Internet Options**, **Privacy**.

2 Clear the **Block pop-ups** check box in the **Pop-up Blocker** section of the screen. This disables any web pop-up blockers you may have enabled.

Figure 230 Internet Options: Privacy



Move the slider to select a privacy setting for the Internet zone.

Medium

- Blocks third-party cookies that do not have a compact privacy policy
- Blocks third-party cookies that use personally identifiable information without your implicit consent
- Restricts first-party cookies that use personally identifiable information without implicit consent

Prevent most pop-up windows from appearing.

☐ Block pop-ups

3 Click **Apply** to save this setting.

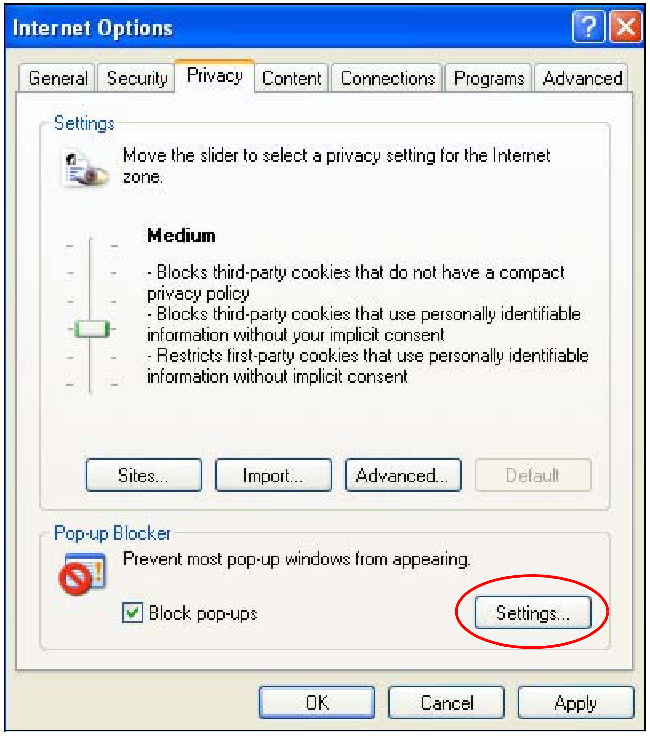
Enable Pop-up Blockers with Exceptions

Alternatively, if you only want to allow pop-up windows from your device, see the following steps.

1 In Internet Explorer, select **Tools**, **Internet Options** and then the **Privacy** tab.

2 Select **Settings...**to open the **Pop-up Blocker Settings** screen.

Figure 231 Internet Options: Privacy



Move the slider to select a privacy setting for the Internet zone.

Medium

- Blocks third-party cookies that do not have a compact privacy policy
- Blocks third-party cookies that use personally identifiable information without your implicit consent
- Restricts first-party cookies that use personally identifiable information without implicit consent

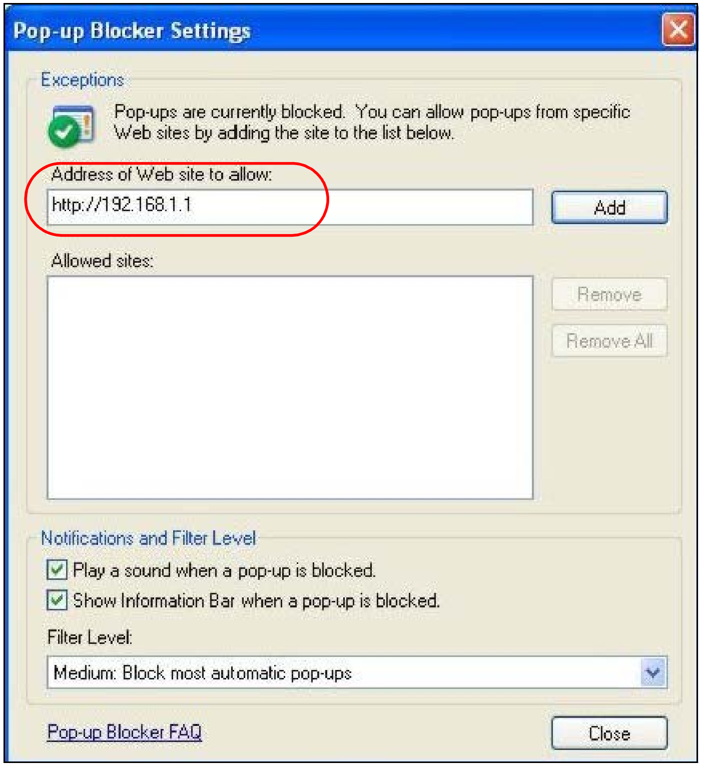
Prevent most pop-up windows from appearing.

☑ Block pop-ups

3 Type the IP address of your device (the web page that you do not want to have blocked) with the prefix "http://". For example, http://192.168.167.1.

4 Click **Add** to move the IP address to the list of **Allowed sites**.

Figure 232 Pop-up Blocker Settings



Pop-ups are currently blocked. You can allow pop-ups from specific Web sites by adding the site to the list below.

Address of Web site to allow: http://192.168.1.1

☑ Play a sound when a pop-up is blocked.

☑ Show Information Bar when a pop-up is blocked.

Filter Level: Medium: Block most automatic pop-ups

5 Click **Close** to return to the **Privacy** screen.

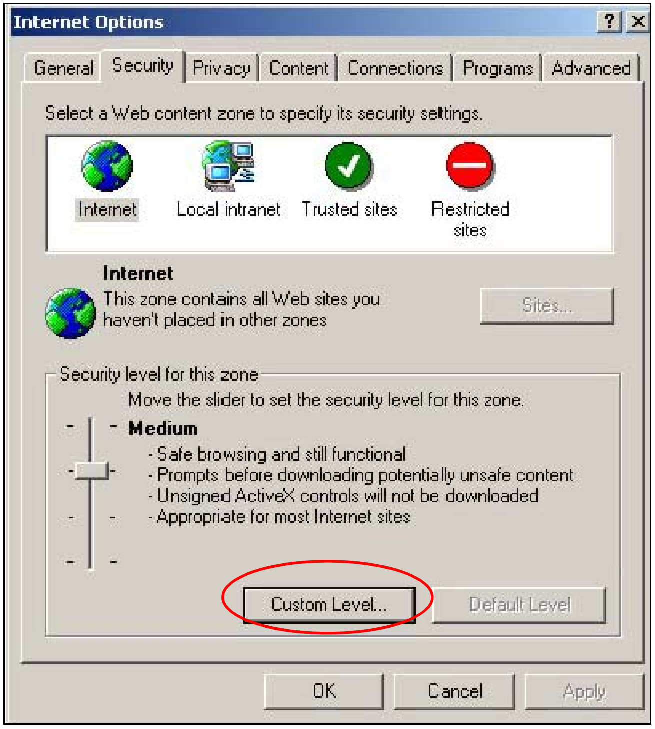
6 Click **Apply** to save this setting.

JavaScripts

If pages of the web configurator do not display properly in Internet Explorer, check that JavaScripts are allowed.

1 In Internet Explorer, click **Tools**, **Internet Options** and then the **Security** tab.

Figure 233 Internet Options: Security



Internet Options

General | Security | Privacy | Content | Connections | Programs | Advanced

Select a Web content zone to specify its security settings.

Internet · Local intranet · Trusted sites · Restricted sites

Internet
This zone contains all Web sites you haven't placed in other zones

Security level for this zone

Move the slider to set the security level for this zone.

Medium
- Safe browsing and still functional
- Prompts before downloading potentially unsafe content
- Unsigned ActiveX controls will not be downloaded
- Appropriate for most Internet sites

2 Click the **Custom Level...** button.

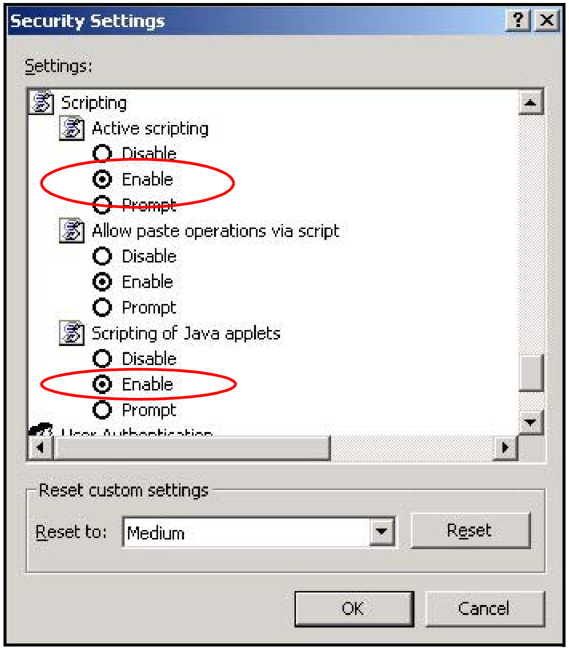
3 Scroll down to **Scripting**.

4 Under **Active scripting** make sure that **Enable** is selected (the default).

5 Under **Scripting of Java applets** make sure that **Enable** is selected (the default).

6 Click **OK** to close the window.

Figure 234 Security Settings - Java Scripting



Scripting

Active scripting
○ Disable
● Enable
○ Prompt

Allow paste operations via script
○ Disable
● Enable
○ Prompt

Scripting of Java applets
○ Disable
● Enable
○ Prompt

User Authentication

Reset to: Medium

Java Permissions

1 From Internet Explorer, click **Tools**, **Internet Options** and then the **Security** tab.

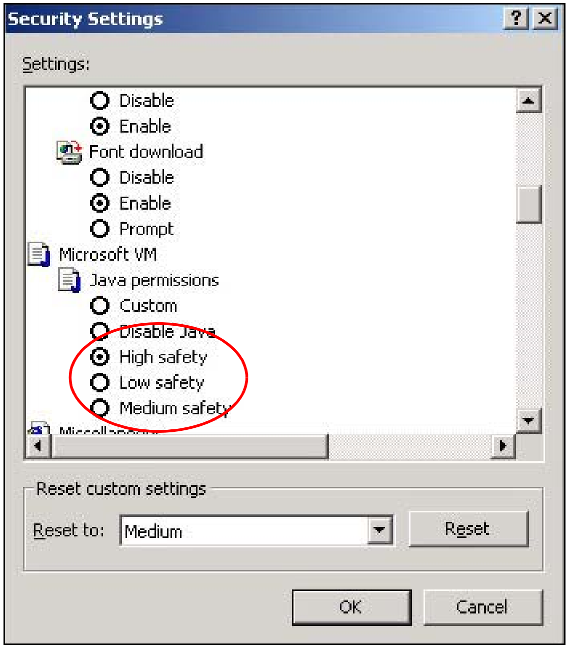
2 Click the **Custom Level...** button.

3 Scroll down to **Microsoft VM**.

4 Under **Java permissions** make sure that a safety level is selected.

5 Click **OK** to close the window.

Figure 235 Security Settings - Java



Security Settings

Settings:

- ○ Disable
- ● Enable
- Font download
  - ○ Disable
  - ● Enable
  - ○ Prompt
- Microsoft VM
  - Java permissions
    - ○ Custom
    - ○ Disable Java
    - ● High safety
    - ○ Low safety
    - ○ Medium safety

Reset custom settings

Reset to: Medium

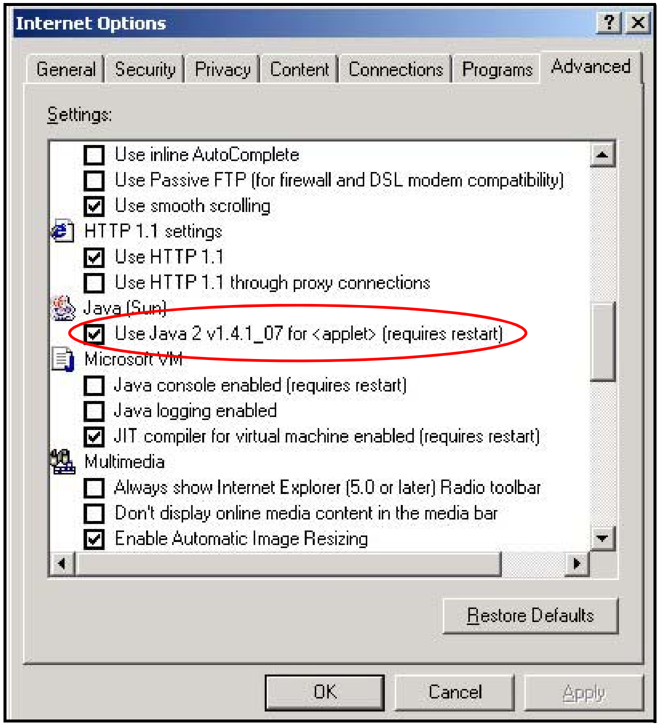
JAVA (Sun)

1 From Internet Explorer, click **Tools**, **Internet Options** and then the **Advanced** tab.

2 Make sure that **Use Java 2 for <applet>** under **Java (Sun)** is selected.

3 Click **OK** to close the window.

Figure 236 Java (Sun)



- ☐ Use inline AutoComplete
- ☐ Use Passive FTP (for firewall and DSL modem compatibility)
- ☑ Use smooth scrolling

HTTP 1.1 settings

- ☑ Use HTTP 1.1
- ☐ Use HTTP 1.1 through proxy connections

Java (Sun)

- ☑ Use Java 2 v1.4.1_07 for <applet> (requires restart)

Microsoft VM

- ☐ Java console enabled (requires restart)
- ☐ Java logging enabled
- ☑ JIT compiler for virtual machine enabled (requires restart)

Multimedia

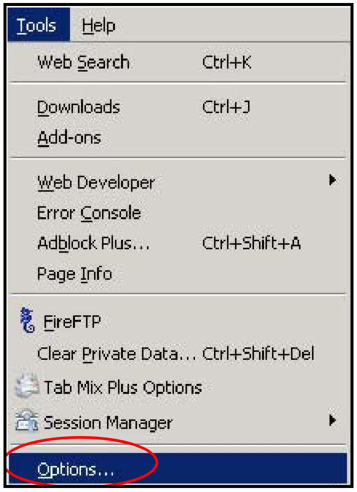
- ☐ Always show Internet Explorer (5.0 or later) Radio toolbar
- ☐ Don't display online media content in the media bar
- ☑ Enable Automatic Image Resizing

Mozilla Firefox

Mozilla Firefox 2.0 screens are used here. Screens for other versions may vary.

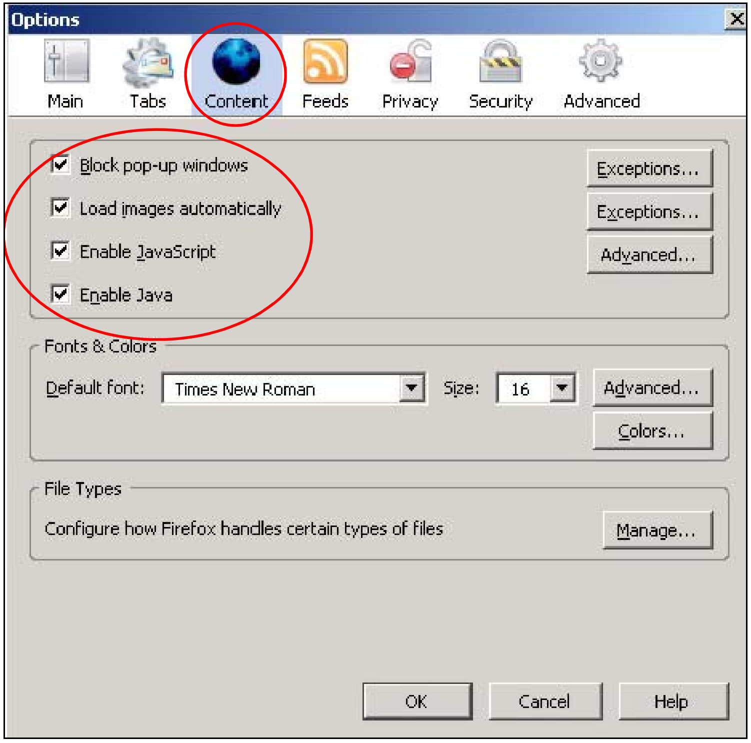
You can enable Java, Javascripts and pop-ups in one screen. Click **Tools,** then click **Options** in the screen that appears.

Figure 237 Mozilla Firefox: Tools > Options



Click **Content**.to show the screen below. Select the check boxes as shown in the following screen.

Figure 238 Mozilla Firefox Content Security



Options

☑ Block pop-up windows

☑ Load images automatically

☑ Enable JavaScript

☑ Enable Java

Fonts & Colors

Default font: Times New Roman Size: 16

File Types

Configure how Firefox handles certain types of files

Wireless LANs

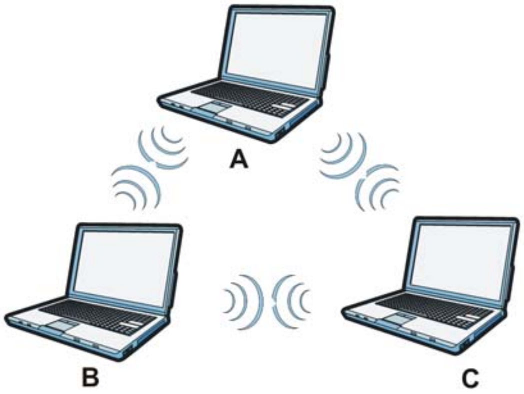
Wireless LAN Topologies

This section discusses ad-hoc and infrastructure wireless LAN topologies.

Ad-hoc Wireless LAN Configuration

The simplest WLAN configuration is an independent (Ad-hoc) WLAN that connects a set of computers with wireless adapters (A, B, C). Any time two or more wireless adapters are within range of each other, they can set up an independent network, which is commonly referred to as an ad-hoc network or Independent Basic Service Set (IBSS). The following diagram shows an example of notebook computers using wireless adapters to form an ad-hoc wireless LAN.

Figure 239 Peer-to-Peer Communication in an Ad-hoc Network

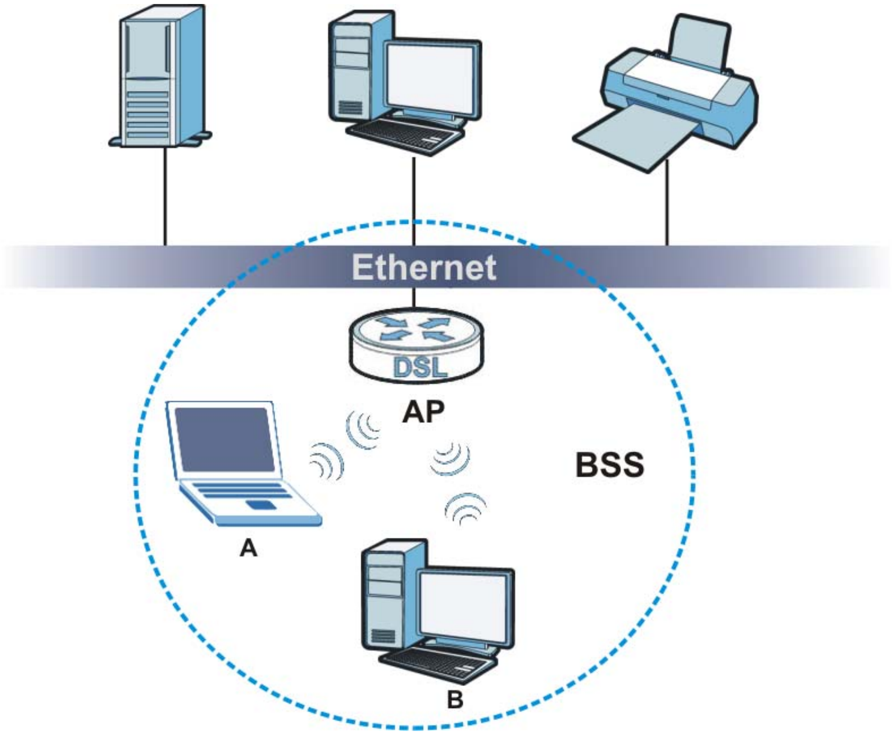


BSS

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

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

Figure 240 Basic Service Set



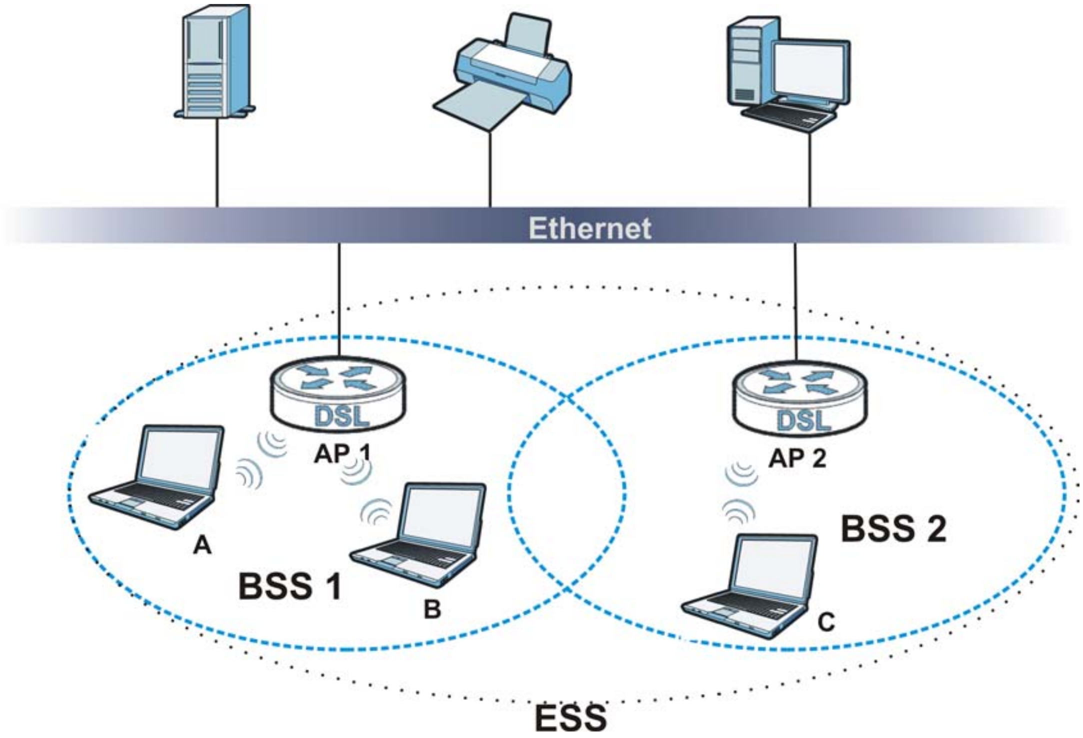
ESS

An Extended Service Set (ESS) consists of a series of overlapping BSSs, each containing an access point, with each access point connected together by a wired network. This wired connection between APs is called a Distribution System (DS).

This type of wireless LAN topology is called an Infrastructure WLAN. The Access Points not only provide communication with the wired network but also mediate wireless network traffic in the immediate neighborhood.

An ESSID (ESS IDentification) uniquely identifies each ESS. All access points and their associated wireless clients within the same ESS must have the same ESSID in order to communicate.

Figure 241 Infrastructure WLAN



Channel

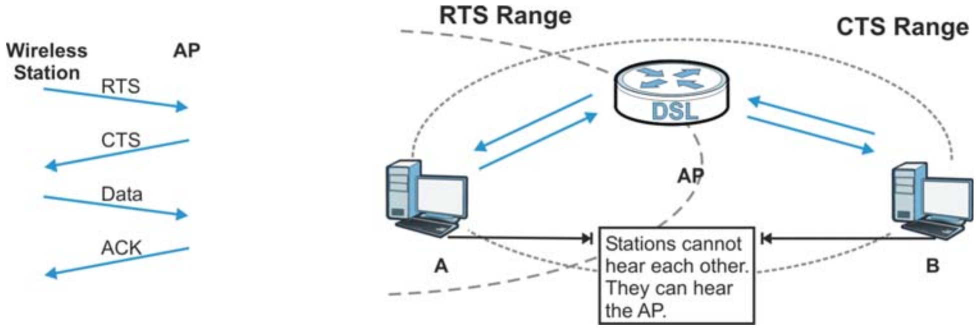
A channel is the radio frequency(ies) used by wireless devices to transmit and receive data. Channels available depend on your geographical area. You may have a choice of channels (for your region) so you should use a channel different from an adjacent AP (access point) to reduce interference. Interference occurs when radio signals from different access points overlap causing interference and degrading performance.

Adjacent channels partially overlap however. To avoid interference due to overlap, your AP should be on a channel at least five channels away from a channel that an adjacent AP is using. For example, if your region has 11 channels and an adjacent AP is using channel 1, then you need to select a channel between 6 or 11.

RTS/CTS

A hidden node occurs when two stations are within range of the same access point, but are not within range of each other. The following figure illustrates a hidden node. Both stations (STA) are within range of the access point (AP) or wireless gateway, but out-of-range of each other, so they cannot "hear" each other, that is they do not know if the channel is currently being used. Therefore, they are considered hidden from each other.

Figure 242 RTS/CTS



When station **A** sends data to the AP, it might not know that the station **B** is already using the channel. If these two stations send data at the same time, collisions may occur when both sets of data arrive at the AP at the same time, resulting in a loss of messages for both stations.

RTS/CTS is designed to prevent collisions due to hidden nodes. An **RTS/CTS** defines the biggest size data frame you can send before an RTS (Request To Send)/CTS (Clear to Send) handshake is invoked.

When a data frame exceeds the **RTS/CTS** value you set (between 0 to 2432 bytes), the station that wants to transmit this frame must first send an RTS (Request To Send) message to the AP for permission to send it. The AP then responds with a CTS (Clear to Send) message to all other stations within its range to notify them to defer their transmission. It also reserves and confirms with the requesting station the time frame for the requested transmission.

Stations can send frames smaller than the specified **RTS/CTS** directly to the AP without the RTS (Request To Send)/CTS (Clear to Send) handshake.

You should only configure **RTS/CTS** if the possibility of hidden nodes exists on your network and the "cost" of resending large frames is more than the extra network overhead involved in the RTS (Request To Send)/CTS (Clear to Send) handshake.

If the **RTS/CTS** value is greater than the **Fragmentation Threshold** value (see next), then the RTS (Request To Send)/CTS (Clear to Send) handshake will never occur as data frames will be fragmented before they reach **RTS/CTS** size.

Note: Enabling the RTS Threshold causes redundant network overhead that could negatively affect the throughput performance instead of providing a remedy.

Fragmentation Threshold

A **Fragmentation Threshold** is the maximum data fragment size (between 256 and 2432 bytes) that can be sent in the wireless network before the AP will fragment the packet into smaller data frames.

A large **Fragmentation Threshold** is recommended for networks not prone to interference while you should set a smaller threshold for busy networks or networks that are prone to interference.

If the **Fragmentation Threshold** value is smaller than the **RTS/CTS** value (see previously) you set then the RTS (Request To Send)/CTS (Clear to Send) handshake will never occur as data frames will be fragmented before they reach **RTS/CTS** size.

IEEE 802.11g Wireless LAN

IEEE 802.11g is fully compatible with the IEEE 802.11b standard. This means an IEEE 802.11b adapter can interface directly with an IEEE 802.11g access point (and vice versa) at 11 Mbps or lower depending on range. IEEE 802.11g has several intermediate rate steps between the maximum and minimum data rates. The IEEE 802.11g data rate and modulation are as follows:

Table 164 IEEE 802.11g

DATA RATE (MBPS)	MODULATION
1	DBPSK (Differential Binary Phase Shift Keyed)
2	DQPSK (Differential Quadrature Phase Shift Keying)
5.5 / 11	CCK (Complementary Code Keying)
6/9/12/18/24/36/48/54	OFDM (Orthogonal Frequency Division Multiplexing)

Wireless Security Overview

Wireless security is vital to your network to protect wireless communication between wireless clients, access points and the wired network.

Wireless security methods available on the Device are data encryption, wireless client authentication, restricting access by device MAC address and hiding the Device identity.

The following figure shows the relative effectiveness of these wireless security methods available on your Device.

Table 165 Wireless Security Levels

SECURITY LEVEL	SECURITY TYPE
Least Secure	Unique SSID (Default)
	Unique SSID with Hide SSID Enabled
	MAC Address Filtering
	WEP Encryption
	IEEE802.1x EAP with RADIUS Server Authentication
	Wi-Fi Protected Access (WPA)
Most Secure	WPA2

Note: You must enable the same wireless security settings on the Device and on all wireless clients that you want to associate with it.

IEEE 802.1x

In June 2001, the IEEE 802.1x standard was designed to extend the features of IEEE 802.11 to support extended authentication as well as providing additional accounting and control features. It is supported by Windows XP and a number of network devices. Some advantages of IEEE 802.1x are:

- User based identification that allows for roaming.
- Support for RADIUS (Remote Authentication Dial In User Service, RFC 2138, 2139) for centralized user profile and accounting management on a network RADIUS server.
- Support for EAP (Extensible Authentication Protocol, RFC 2486) that allows additional authentication methods to be deployed with no changes to the access point or the wireless clients.

RADIUS

RADIUS is based on a client-server model that supports authentication, authorization and accounting. The access point is the client and the server is the RADIUS server. The RADIUS server handles the following tasks:

- Authentication

  Determines the identity of the users.
- Authorization

  Determines the network services available to authenticated users once they are connected to the network.
- Accounting

  Keeps track of the client’s network activity.

RADIUS is a simple package exchange in which your AP acts as a message relay between the wireless client and the network RADIUS server.

Types of RADIUS Messages

The following types of RADIUS messages are exchanged between the access point and the RADIUS server for user authentication:

- Access-Request

  Sent by an access point requesting authentication.
- Access-Reject

  Sent by a RADIUS server rejecting access.
- Access-Accept

  Sent by a RADIUS server allowing access.
- Access-Challenge

  Sent by a RADIUS server requesting more information in order to allow access. The access point sends a proper response from the user and then sends another Access-Request message.

The following types of RADIUS messages are exchanged between the access point and the RADIUS server for user accounting:

- Accounting-Request

  Sent by the access point requesting accounting.
- Accounting-Response

  Sent by the RADIUS server to indicate that it has started or stopped accounting.

In order to ensure network security, the access point and the RADIUS server use a shared secret key, which is a password, they both know. The key is not sent over the network. In addition to the shared key, password information exchanged is also encrypted to protect the network from unauthorized access.

Types of EAP Authentication

This section discusses some popular authentication types: EAP-MD5, EAP-TLS, EAP-TTLS, PEAP and LEAP. Your wireless LAN device may not support all authentication types.

EAP (Extensible Authentication Protocol) is an authentication protocol that runs on top of the IEEE 802.1x transport mechanism in order to support multiple types of user authentication. By using EAP to interact with an EAP-compatible RADIUS server, an access point helps a wireless station and a RADIUS server perform authentication.

The type of authentication you use depends on the RADIUS server and an intermediary AP(s) that supports IEEE 802.1x.

For EAP-TLS authentication type, you must first have a wired connection to the network and obtain the certificate(s) from a certificate authority (CA). A certificate (also called digital IDs) can be used to authenticate users and a CA issues certificates and guarantees the identity of each certificate owner.

EAP-MD5 (Message-Digest Algorithm 5)

MD5 authentication is the simplest one-way authentication method. The authentication server sends a challenge to the wireless client. The wireless client ‘proves’ that it knows the password by encrypting the password with the challenge and sends back the information. Password is not sent in plain text.

However, MD5 authentication has some weaknesses. Since the authentication server needs to get the plaintext passwords, the passwords must be stored. Thus someone other than the authentication server may access the password file. In addition, it is possible to impersonate an authentication server as MD5 authentication method does not perform mutual authentication. Finally, MD5 authentication method does not support data encryption with dynamic session key. You must configure WEP encryption keys for data encryption.

EAP-TLS (Transport Layer Security)

With EAP-TLS, digital certifications are needed by both the server and the wireless clients for mutual authentication. The server presents a certificate to the client. After validating the identity of the server, the client sends a different certificate to the server. The exchange of certificates is done in the open before a secured tunnel is created. This makes user identity vulnerable to passive attacks. A digital certificate is an electronic ID card that authenticates the sender’s identity. However, to implement EAP-TLS, you need a Certificate Authority (CA) to handle certificates, which imposes a management overhead.

EAP-TTLS (Tunneled Transport Layer Service)

EAP-TTLS is an extension of the EAP-TLS authentication that uses certificates for only the server-side authentications to establish a secure connection. Client authentication is then done by sending username and password through the secure connection, thus client identity is protected. For client authentication, EAP-TTLS supports EAP methods and legacy authentication methods such as PAP, CHAP, MS-CHAP and MS-CHAP v2.

PEAP (Protected EAP)

Like EAP-TTLS, server-side certificate authentication is used to establish a secure connection, then use simple username and password methods through the secured connection to authenticate the clients, thus hiding client identity. However, PEAP only supports EAP methods, such as EAP-MD5, EAP-MSCHAPv2 and EAP-GTC (EAP-Generic Token Card), for client authentication. EAP-GTC is implemented only by Cisco.

LEAP

LEAP (Lightweight Extensible Authentication Protocol) is a Cisco implementation of IEEE 802.1x.

Dynamic WEP Key Exchange

The AP maps a unique key that is generated with the RADIUS server. This key expires when the wireless connection times out, disconnects or reauthentication times out. A new WEP key is generated each time reauthentication is performed.

If this feature is enabled, it is not necessary to configure a default encryption key in the wireless security configuration screen. You may still configure and store keys, but they will not be used while dynamic WEP is enabled.

Note: EAP-MD5 cannot be used with Dynamic WEP Key Exchange

For added security, certificate-based authentications (EAP-TLS, EAP-TTLS and PEAP) use dynamic keys for data encryption. They are often deployed in corporate environments, but for public deployment, a simple user name and password pair is more practical. The following table is a comparison of the features of authentication types.

Table 166 Comparison of EAP Authentication Types

	EAP-MD5	EAP-TLS	EAP-TTLS	PEAP	LEAP
Mutual Authentication	No	Yes	Yes	Yes	Yes
Certificate – Client	No	Yes	Optional	Optional	No
Certificate – Server	No	Yes	Yes	Yes	No
Dynamic Key Exchange	No	Yes	Yes	Yes	Yes
Credential Integrity	None	Strong	Strong	Strong	Moderate
Deployment Difficulty	Easy	Hard	Moderate	Moderate	Moderate
Client Identity Protection	No	No	Yes	Yes	No

WPA and WPA2

Wi-Fi Protected Access (WPA) is a subset of the IEEE 802.11i standard. WPA2 (IEEE 802.11i) is a wireless security standard that defines stronger encryption, authentication and key management than WPA.

Key differences between WPA or WPA2 and WEP are improved data encryption and user authentication.

If both an AP and the wireless clients support WPA2 and you have an external RADIUS server, use WPA2 for stronger data encryption. If you don't have an external RADIUS server, you should use WPA2-PSK (WPA2-Pre-Shared Key) that only requires a single (identical) password entered into each access point, wireless gateway and wireless client. As long as the passwords match, a wireless client will be granted access to a WLAN.

If the AP or the wireless clients do not support WPA2, just use WPA or WPA-PSK depending on whether you have an external RADIUS server or not.

Select WEP only when the AP and/or wireless clients do not support WPA or WPA2. WEP is less secure than WPA or WPA2.

Encryption

WPA improves data encryption by using Temporal Key Integrity Protocol (TKIP), Message Integrity Check (MIC) and IEEE 802.1x. WPA2 also uses TKIP when required for compatibility reasons, but offers stronger encryption than TKIP with Advanced Encryption Standard (AES) in the Counter mode with Cipher block chaining Message authentication code Protocol (CCMP).

TKIP uses 128-bit keys that are dynamically generated and distributed by the authentication server. AES (Advanced Encryption Standard) is a block cipher that uses a 256-bit mathematical algorithm called Rijndael. They both include a per-packet key mixing function, a Message Integrity Check (MIC) named Michael, an extended initialization vector (IV) with sequencing rules, and a re-keying mechanism.

WPA and WPA2 regularly change and rotate the encryption keys so that the same encryption key is never used twice. .

The RADIUS server distributes a Pairwise Master Key (PMK) key to the AP that then sets up a key hierarchy and management system, using the PMK to dynamically generate unique data encryption keys to encrypt every data packet that is wirelessly communicated between the AP and the wireless clients. This all happens in the background automatically.

The Message Integrity Check (MIC) is designed to prevent an attacker from capturing data packets, altering them and resending them. The MIC provides a strong mathematical function in which the receiver and the transmitter each compute and then compare the MIC. If they do not match, it is assumed that the data has been tampered with and the packet is dropped.

By generating unique data encryption keys for every data packet and by creating an integrity checking mechanism (MIC), with TKIP and AES it is more difficult to decrypt data on a Wi-Fi network than WEP and difficult for an intruder to break into the network.

The encryption mechanisms used for WPA(2) and WPA(2)-PSK are the same. The only difference between the two is that WPA(2)-PSK uses a simple common password, instead of user-specific credentials. The common-password approach makes WPA(2)-PSK susceptible to brute-force password-guessing attacks but it’s still an improvement over WEP as it employs a consistent, single, alphanumeric password to derive a PMK which is used to generate unique temporal encryption keys. This prevent all wireless devices sharing the same encryption keys. (a weakness of WEP)

User Authentication

WPA and WPA2 apply IEEE 802.1x and Extensible Authentication Protocol (EAP) to authenticate wireless clients using an external RADIUS database. WPA2 reduces the number of key exchange messages from six to four (CCMP 4-way handshake) and shortens the time required to connect to a network. Other WPA2 authentication features that are different from WPA include key caching and pre-authentication. These two features are optional and may not be supported in all wireless devices.

Key caching allows a wireless client to store the PMK it derived through a successful authentication with an AP. The wireless client uses the PMK when it tries to connect to the same AP and does not need to go with the authentication process again.

Pre-authentication enables fast roaming by allowing the wireless client (already connecting to an AP) to perform IEEE 802.1x authentication with another AP before connecting to it.

Wireless Client WPA Supplicants

A wireless client supplicant is the software that runs on an operating system instructing the wireless client how to use WPA. At the time of writing, the most widely available supplicant is the WPA patch for Windows XP, Funk Software's Odyssey client.

The Windows XP patch is a free download that adds WPA capability to Windows XP's built-in "Zero Configuration" wireless client. However, you must run Windows XP to use it.

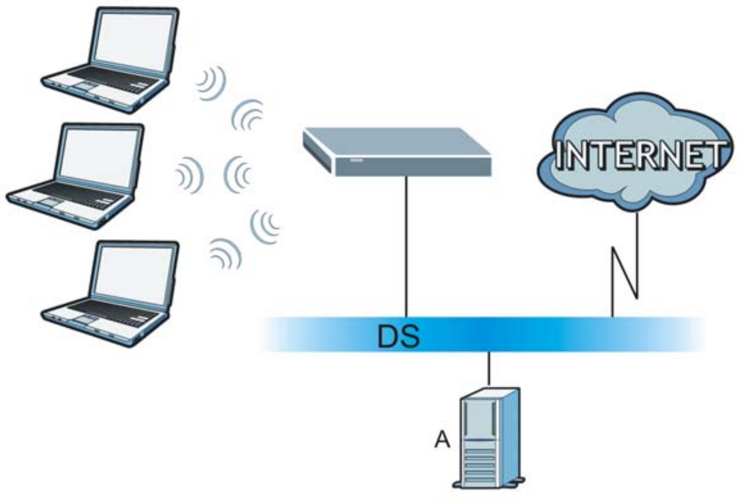
WPA(2) with RADIUS Application Example

To set up WPA(2), you need the IP address of the RADIUS server, its port number (default is 1812), and the RADIUS shared secret. A WPA(2) application example with an external RADIUS server looks as follows. "A" is the RADIUS server. "DS" is the distribution system.

1. The AP passes the wireless client's authentication request to the RADIUS server.
2. The RADIUS server then checks the user's identification against its database and grants or denies network access accordingly.
3. A 256-bit Pairwise Master Key (PMK) is derived from the authentication process by the RADIUS server and the client.

4 The RADIUS server distributes the PMK to the AP. The AP then sets up a key hierarchy and management system, using the PMK to dynamically generate unique data encryption keys. The keys are used to encrypt every data packet that is wirelessly communicated between the AP and the wireless clients.

Figure 243 WPA(2) with RADIUS Application Example



WPA(2)-PSK Application Example

A WPA(2)-PSK application looks as follows.

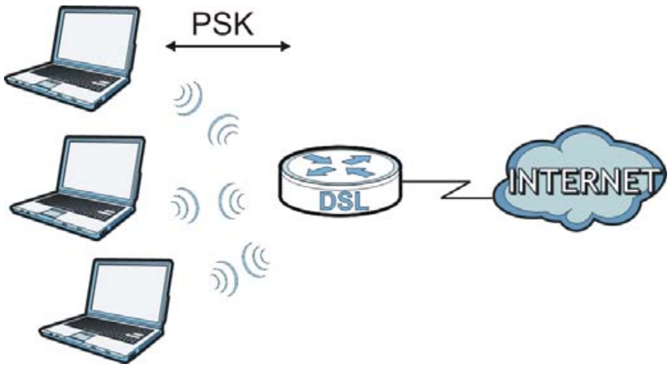
1 First enter identical passwords into the AP and all wireless clients. The Pre-Shared Key (PSK) must consist of between 8 and 63 ASCII characters or 64 hexadecimal characters (including spaces and symbols).

2 The AP checks each wireless client's password and allows it to join the network only if the password matches.

3 The AP and wireless clients generate a common PMK (Pairwise Master Key). The key itself is not sent over the network, but is derived from the PSK and the SSID.

4 The AP and wireless clients use the TKIP or AES encryption process, the PMK and information exchanged in a handshake to create temporal encryption keys. They use these keys to encrypt data exchanged between them.

Figure 244 WPA(2)-PSK Authentication



Security Parameters Summary

Refer to this table to see what other security parameters you should configure for each authentication method or key management protocol type. MAC address filters are not dependent on how you configure these security features.

Table 167 Wireless Security Relational Matrix

AUTHENTICATION METHOD/ KEY MANAGEMENT PROTOCOL	ENCRYPTION METHOD	ENTER MANUAL KEY	IEEE 802.1X
Open	None	No	Disable
			Enable without Dynamic WEP Key
Open	WEP	No	Enable with Dynamic WEP Key
		Yes	Enable without Dynamic WEP Key
		Yes	Disable
Shared	WEP	No	Enable with Dynamic WEP Key
		Yes	Enable without Dynamic WEP Key
		Yes	Disable
WPA	TKIP/AES	No	Enable
WPA-PSK	TKIP/AES	Yes	Disable
WPA2	TKIP/AES	No	Enable
WPA2-PSK	TKIP/AES	Yes	Disable

Antenna Overview

An antenna couples RF signals onto air. A transmitter within a wireless device sends an RF signal to the antenna, which propagates the signal through the air. The antenna also operates in reverse by capturing RF signals from the air.

Positioning the antennas properly increases the range and coverage area of a wireless LAN.

Antenna Characteristics

Frequency

An antenna in the frequency of 2.4GHz (IEEE 802.11b and IEEE 802.11g) or 5GHz (IEEE 802.11a) is needed to communicate efficiently in a wireless LAN

Radiation Pattern

A radiation pattern is a diagram that allows you to visualize the shape of the antenna's coverage area.

Antenna Gain

Antenna gain, measured in dB (decibel), is the increase in coverage within the RF beam width. Higher antenna gain improves the range of the signal for better communications.

For an indoor site, each 1 dB increase in antenna gain results in a range increase of approximately

2.5%. For an unobstructed outdoor site, each 1dB increase in gain results in a range increase of approximately 5%. Actual results may vary depending on the network environment.

Antenna gain is sometimes specified in dBi, which is how much the antenna increases the signal power compared to using an isotropic antenna. An isotropic antenna is a theoretical perfect antenna that sends out radio signals equally well in all directions. dBi represents the true gain that the antenna provides.

Types of Antennas for WLAN

There are two types of antennas used for wireless LAN applications.

- Omni-directional antennas send the RF signal out in all directions on a horizontal plane. The coverage area is torus-shaped (like a donut) which makes these antennas ideal for a room environment. With a wide coverage area, it is possible to make circular overlapping coverage areas with multiple access points.
- Directional antennas concentrate the RF signal in a beam, like a flashlight does with the light from its bulb. The angle of the beam determines the width of the coverage pattern. Angles typically range from 20 degrees (very directional) to 120 degrees (less directional). Directional antennas are ideal for hallways and outdoor point-to-point applications.

Positioning Antennas

In general, antennas should be mounted as high as practically possible and free of obstructions. In point-to–point application, position both antennas at the same height and in a direct line of sight to each other to attain the best performance.

For omni-directional antennas mounted on a table, desk, and so on, point the antenna up. For omni-directional antennas mounted on a wall or ceiling, point the antenna down. For a single AP application, place omni-directional antennas as close to the center of the coverage area as possible.

For directional antennas, point the antenna in the direction of the desired coverage area.

E

IPv6

Overview

IPv6 (Internet Protocol version 6), is designed to enhance IP address size and features. The increase in IPv6 address size to 128 bits (from the 32-bit IPv4 address) allows up to 3.4 x 10^{38} IP addresses.

IPv6 Addressing

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

IPv6 addresses can be abbreviated in two ways:

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

Prefix and Prefix Length

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

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

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

Link-local Address

A link-local address uniquely identifies a device on the local network (the LAN). It is similar to a “private IP address” in IPv4. You can have the same link-local address on multiple interfaces on a device. A link-local unicast address has a predefined prefix of fe80::/10. The link-local unicast address format is as follows.

Table 168 Link-local Unicast Address Format

1111 1110 10	0	Interface ID
10 bits	54 bits	64 bits

Global Address

A global address uniquely identifies a device on the Internet. It is similar to a “public IP address” in IPv4. A global unicast address starts with a 2 or 3.

Unspecified Address

An unspecified address (0:0:0:0:0:0:0:0 or ::) is used as the source address when a device does not have its own address. It is similar to “0.0.0.0” in IPv4.

Loopback Address

A loopback address (0:0:0:0:0:0:0:1 or ::1) allows a host to send packets to itself. It is similar to “127.0.0.1” in IPv4.

Multicast Address

In IPv6, multicast addresses provide the same functionality as IPv4 broadcast addresses. Broadcasting is not supported in IPv6. A multicast address allows a host to send packets to all hosts in a multicast group.

Multicast scope allows you to determine the size of the multicast group. A multicast address has a predefined prefix of ff00::/8. The following table describes some of the predefined multicast addresses.

Table 169 Predefined Multicast Address

MULTICAST ADDRESS	DESCRIPTION
FF01:0:0:0:0:0:0:1	All hosts on a local node.
FF01:0:0:0:0:0:0:2	All routers on a local node.
FF02:0:0:0:0:0:0:1	All hosts on a local connected link.
FF02:0:0:0:0:0:0:2	All routers on a local connected link.
FF05:0:0:0:0:0:0:2	All routers on a local site.
FF05:0:0:0:0:0:1:3	All DHCP severs on a local site.

The following table describes the multicast addresses which are reserved and can not be assigned to a multicast group.

Table 170 Reserved Multicast Address

MULTICAST ADDRESS
FF00:0:0:0:0:0:0:0
FF01:0:0:0:0:0:0:0
FF02:0:0:0:0:0:0:0
FF03:0:0:0:0:0:0:0
FF04:0:0:0:0:0:0:0
FF05:0:0:0:0:0:0:0
FF06:0:0:0:0:0:0:0
FF07:0:0:0:0:0:0:0

Table 170 Reserved Multicast Address (continued)

MULTICAST ADDRESS
FF08:0:0:0:0:0:0:0
FF09:0:0:0:0:0:0:0
FF0A:0:0:0:0:0:0:0
FF0B:0:0:0:0:0:0:0
FF0C:0:0:0:0:0:0:0
FF0D:0:0:0:0:0:0:0
FF0E:0:0:0:0:0:0:0
FF0F:0:0:0:0:0:0:0

Subnet Masking

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

Interface ID

In IPv6, an interface ID is a 64-bit identifier. It identifies a physical interface (for example, an Ethernet port) or a virtual interface (for example, the management IP address for a VLAN). One interface should have a unique interface ID.

EUI-64

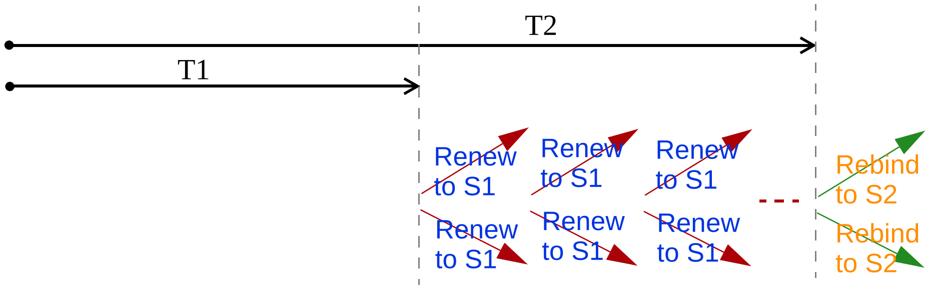
The EUI-64 (Extended Unique Identifier) defined by the IEEE (Institute of Electrical and Electronics Engineers) is an interface ID format designed to adapt with IPv6. It is derived from the 48-bit (6-byte) Ethernet MAC address as shown next. EUI-64 inserts the hex digits fffe between the third and fourth bytes of the MAC address and complements the seventh bit of the first byte of the MAC address. See the following example.

MAC	00 : 13 : 49 : 12 : 34 : 56
EUI-64	02 : 13 : 49 : FF : FE : 12 : 34 : 56

Identity Association

An Identity Association (IA) is a collection of addresses assigned to a DHCP client, through which the server and client can manage a set of related IP addresses. Each IA must be associated with exactly one interface. The DHCP client uses the IA assigned to an interface to obtain configuration from a DHCP server for that interface. Each IA consists of a unique IAID and associated IP information.

The IA type is the type of address in the IA. Each IA holds one type of address. IA_NA means an identity association for non-temporary addresses and IA_TA is an identity association for temporary addresses. An IA_NA option contains the T1 and T2 fields, but an IA_TA option does not. The DHCPv6 server uses T1 and T2 to control the time at which the client contacts with the server to extend the lifetimes on any addresses in the IA_NA before the lifetimes expire. After T1, the client sends the server (**S1**) (from which the addresses in the IA_NA were obtained) a Renew message. If the time T2 is reached and the server does not respond, the client sends a Rebind message to any available server (**S2**). For an IA_TA, the client may send a Renew or Rebind message at the client's discretion.



DHCP Relay Agent

A DHCP relay agent is on the same network as the DHCP clients and helps forward messages between the DHCP server and clients. When a client cannot use its link-local address and a well-known multicast address to locate a DHCP server on its network, it then needs a DHCP relay agent to send a message to a DHCP server that is not attached to the same network.

The DHCP relay agent can add the remote identification (remote-ID) option and the interface-ID option to the Relay-Forward DHCPv6 messages. The remote-ID option carries a user-defined string, such as the system name. The interface-ID option provides slot number, port information and the VLAN ID to the DHCPv6 server. The remote-ID option (if any) is stripped from the Relay-Reply messages before the relay agent sends the packets to the clients. The DHCP server copies the interface-ID option from the Relay-Forward message into the Relay-Reply message and sends it to the relay agent. The interface-ID should not change even after the relay agent restarts.

Prefix Delegation

Prefix delegation enables an IPv6 router to use the IPv6 prefix (network address) received from the ISP (or a connected uplink router) for its LAN. The Device uses the received IPv6 prefix (for example, 2001:db2::/48) to generate its LAN IP address. Through sending Router Advertisements (RAs) regularly by multicast, the Device passes the IPv6 prefix information to its LAN hosts. The hosts then can use the prefix to generate their IPv6 addresses.

ICMPv6

Internet Control Message Protocol for IPv6 (ICMPv6 or ICMP for IPv6) is defined in RFC 4443. ICMPv6 has a preceding Next Header value of 58, which is different from the value used to identify ICMP for IPv4. ICMPv6 is an integral part of IPv6. IPv6 nodes use ICMPv6 to report errors encountered in packet processing and perform other diagnostic functions, such as "ping".

Neighbor Discovery Protocol (NDP)

The Neighbor Discovery Protocol (NDP) is a protocol used to discover other IPv6 devices and track neighbor’s reachability in a network. An IPv6 device uses the following ICMPv6 messages types:

- Neighbor solicitation: A request from a host to determine a neighbor’s link-layer address (MAC address) and detect if the neighbor is still reachable. A neighbor being “reachable” means it responds to a neighbor solicitation message (from the host) with a neighbor advertisement message.

- Neighbor advertisement: A response from a node to announce its link-layer address.
- Router solicitation: A request from a host to locate a router that can act as the default router and forward packets.
- Router advertisement: A response to a router solicitation or a periodical multicast advertisement from a router to advertise its presence and other parameters.

IPv6 Cache

An IPv6 host is required to have a neighbor cache, destination cache, prefix list and default router list. The Device maintains and updates its IPv6 caches constantly using the information from response messages. In IPv6, the Device configures a link-local address automatically, and then sends a neighbor solicitation message to check if the address is unique. If there is an address to be resolved or verified, the Device also sends out a neighbor solicitation message. When the Device receives a neighbor advertisement in response, it stores the neighbor's link-layer address in the neighbor cache. When the Device uses a router solicitation message to query for a router and receives a router advertisement message, it adds the router's information to the neighbor cache, prefix list and destination cache. The Device creates an entry in the default router list cache if the router can be used as a default router.

When the Device needs to send a packet, it first consults the destination cache to determine the next hop. If there is no matching entry in the destination cache, the Device uses the prefix list to determine whether the destination address is on-link and can be reached directly without passing through a router. If the address is unlink, the address is considered as the next hop. Otherwise, the Device determines the next-hop from the default router list or routing table. Once the next hop IP address is known, the Device looks into the neighbor cache to get the link-layer address and sends the packet when the neighbor is reachable. If the Device cannot find an entry in the neighbor cache or the state for the neighbor is not reachable, it starts the address resolution process. This helps reduce the number of IPv6 solicitation and advertisement messages.

Multicast Listener Discovery

The Multicast Listener Discovery (MLD) protocol (defined in RFC 2710) is derived from IPv4's Internet Group Management Protocol version 2 (IGMPv2). MLD uses ICMPv6 message types, rather than IGMP message types. MLDv1 is equivalent to IGMPv2 and MLDv2 is equivalent to IGMPv3.

MLD allows an IPv6 switch or router to discover the presence of MLD listeners who wish to receive multicast packets and the IP addresses of multicast groups the hosts want to join on its network.

MLD snooping and MLD proxy are analogous to IGMP snooping and IGMP proxy in IPv4.

MLD filtering controls which multicast groups a port can join.

MLD Messages

A multicast router or switch periodically sends general queries to MLD hosts to update the multicast forwarding table. When an MLD host wants to join a multicast group, it sends an MLD Report message for that address.

An MLD Done message is equivalent to an IGMP Leave message. When an MLD host wants to leave a multicast group, it can send a Done message to the router or switch. The router or switch then sends a group-specific query to the port on which the Done message is received to determine if other devices connected to this port should remain in the group.

Example - Enabling IPv6 on Windows XP/2003/Vista

By default, Windows XP and Windows 2003 support IPv6. This example shows you how to use the `ipv6 install` command on Windows XP/2003 to enable IPv6. This also displays how to use the `ipconfig` command to see auto-generated IP addresses.

```
C:\>ipv6 install
Installing...
Succeeded.

C:\>ipconfig

Windows IP Configuration


Ethernet adapter Local Area Connection:

        Connection-specific DNS Suffix  . :
        IP Address. . . . . . . . . . . . : 10.1.1.46
        Subnet Mask . . . . . . . . . . . : 255.255.255.0
        IP Address. . . . . . . . . . . . : fe80::2d0:59ff:feb8:103c%4
        Default Gateway . . . . . . . . . : 10.1.1.254
```

IPv6 is installed and enabled by default in Windows Vista. Use the `ipconfig` command to check your automatic configured IPv6 address as well. You should see at least one IPv6 address available for the interface on your computer.

Example - Enabling DHCPv6 on Windows XP

Windows XP does not support DHCPv6. If your network uses DHCPv6 for IP address assignment, you have to additionally install a DHCPv6 client software on your Windows XP. (Note: If you use static IP addresses or Router Advertisement for IPv6 address assignment in your network, ignore this section.)

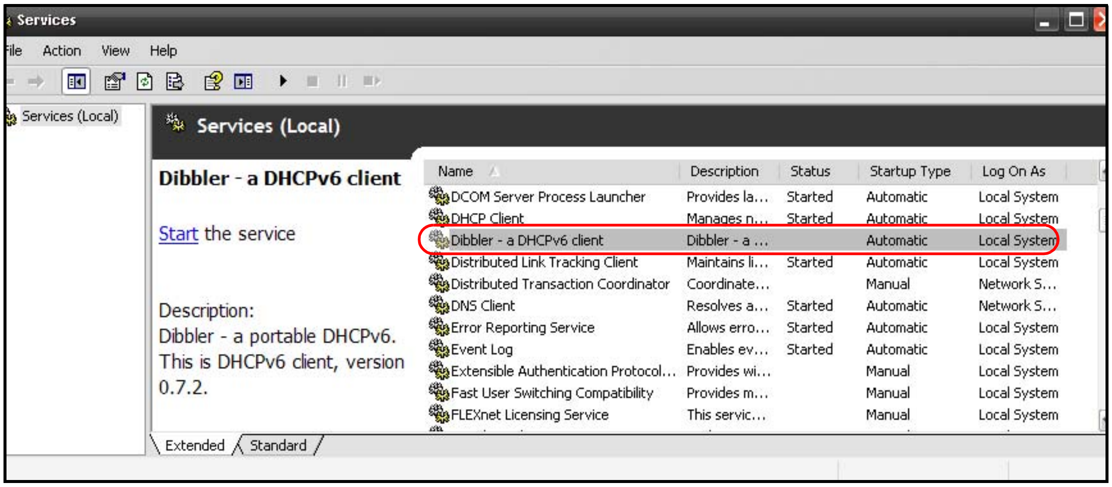
This example uses Dibbler as the DHCPv6 client. To enable DHCPv6 client on your computer:

1 Install Dibbler and select the DHCPv6 client option on your computer.

2 After the installation is complete, select **Start** > **All Programs** > **Dibbler-DHCPv6** > **Client Install as service**.

3 Select **Start** > **Control Panel** > **Administrative Tools** > **Services**.

4 Double click **Dibbler - a DHCPv6 client**.



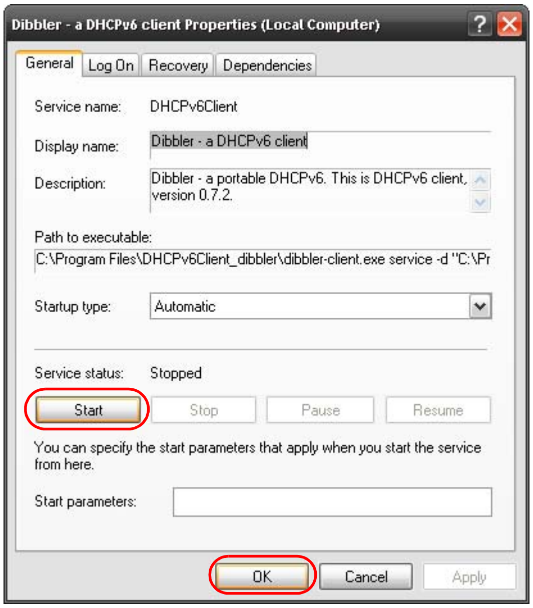
Dibbler - a DHCPv6 client

Start the service

Description:
Dibbler - a portable DHCPv6. This is DHCPv6 client, version 0.7.2.

Name	Description	Status	Startup Type	Log On As
DCOM Server Process Launcher	Provides la...	Started	Automatic	Local System
DHCP Client	Manages n...	Started	Automatic	Local System
Dibbler - a DHCPv6 client	Dibbler - a ...		Automatic	Local System
Distributed Link Tracking Client	Maintains li...	Started	Automatic	Local System
Distributed Transaction Coordinator	Coordinate...		Manual	Network S...
DNS Client	Resolves a...	Started	Automatic	Network S...
Error Reporting Service	Allows erro...	Started	Automatic	Local System
Event Log	Enables ev...	Started	Automatic	Local System
Extensible Authentication Protocol...	Provides wi...		Manual	Local System
Fast User Switching Compatibility	Provides m...		Manual	Local System
FLEXnet Licensing Service	This servic...		Manual	Local System

5 Click **Start** and then **OK**.



Service name: DHCPv6Client

Display name: Dibbler - a DHCPv6 client

Description: Dibbler - a portable DHCPv6. This is DHCPv6 client, version 0.7.2.

Path to executable:
C:\Program Files\DHCPv6Client_dibbler\dibbler-client.exe service -d "C:\Pr

Startup type: Automatic

Service status: Stopped

You can specify the start parameters that apply when you start the service from here.

Start parameters:

6 Now your computer can obtain an IPv6 address from a DHCPv6 server.

Example - Enabling IPv6 on Windows 7

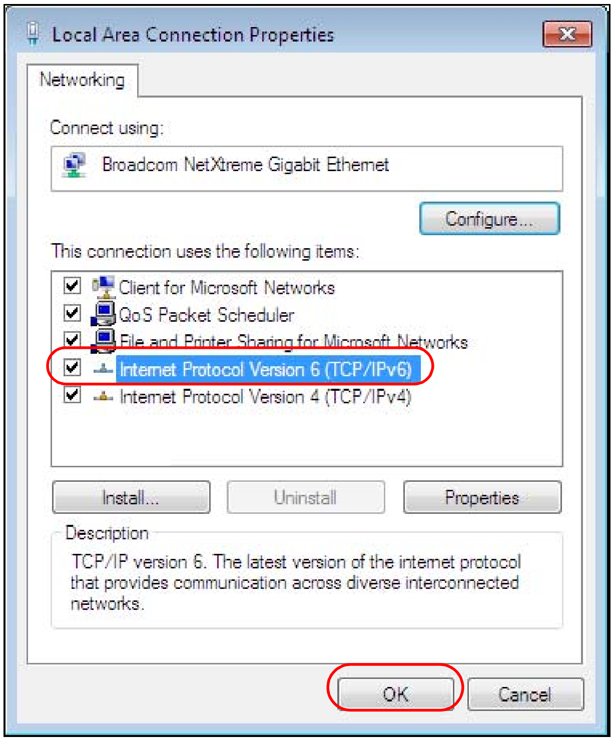
Windows 7 supports IPv6 by default. DHCPv6 is also enabled when you enable IPv6 on a Windows 7 computer.

To enable IPv6 in Windows 7:

1 Select **Control Panel** > **Network and Sharing Center** > **Local Area Connection**.

2 Select the **Internet Protocol Version 6 (TCP/IPv6)** checkbox to enable it.

3 Click **OK** to save the change.



Connect using:

Broadcom NetXtreme Gigabit Ethernet

This connection uses the following items:

☑ Client for Microsoft Networks
☑ QoS Packet Scheduler
☑ File and Printer Sharing for Microsoft Networks
☑ Internet Protocol Version 6 (TCP/IPv6)
☑ Internet Protocol Version 4 (TCP/IPv4)

Description

TCP/IP version 6. The latest version of the internet protocol that provides communication across diverse interconnected networks.

4 Click **Close** to exit the **Local Area Connection Status** screen.

5 Select **Start** > **All Programs** > **Accessories** > **Command Prompt**.

6 Use the `ipconfig` command to check your dynamic IPv6 address. This example shows a global address (2001:b021:2d::1000) obtained from a DHCP server.

```
C:\>ipconfig

Windows IP Configuration


Ethernet adapter Local Area Connection:

   Connection-specific DNS Suffix  . :
   IPv6 Address. . . . . . . . . . . : 2001:b021:2d::1000
   Link-local IPv6 Address . . . . . : fe80::25d8:dcab:c80a:5189%11
   IPv4 Address. . . . . . . . . . . : 172.16.100.61
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Default Gateway . . . . . . . . . : fe80::213:49ff:feaa:7125%11
                                       172.16.100.254
```

Services

The following table lists some commonly-used services and their associated protocols and port numbers.

- **Name**: This is a short, descriptive name for the service. You can use this one or create a different one, if you like.
- **Protocol**: This is the type of IP protocol used by the service. If this is **TCP/UDP**, then the service uses the same port number with TCP and UDP. If this is **USER-DEFINED**, the **Port(s**) is the IP protocol number, not the port number.
- **Port(s)**: This value depends on the **Protocol**.
    - If the **Protocol** is **TCP**, **UDP**, or **TCP/UDP**, this is the IP port number.
    - If the **Protocol** is **USER**, this is the IP protocol number.
- **Description**: This is a brief explanation of the applications that use this service or the situations in which this service is used.

Table 171 Examples of Services

NAME	PROTOCOL	PORT(S)	DESCRIPTION
AH (IPSEC_TUNNEL)	User-Defined	51	The IPSEC AH (Authentication Header) tunneling protocol uses this service.
AIM	TCP	5190	AOL's Internet Messenger service.
AUTH	TCP	113	Authentication protocol used by some servers.
BGP	TCP	179	Border Gateway Protocol.
BOOTP_CLIENT	UDP	68	DHCP Client.
BOOTP_SERVER	UDP	67	DHCP Server.
CU-SEEME	TCP/UDP TCP/UDP	7648 24032	A popular videoconferencing solution from White Pines Software.
DNS	TCP/UDP	53	Domain Name Server, a service that matches web names (for instance www.zyxel.com) to IP numbers.
ESP (IPSEC_TUNNEL)	User-Defined	50	The IPSEC ESP (Encapsulation Security Protocol) tunneling protocol uses this service.
FINGER	TCP	79	Finger is a UNIX or Internet related command that can be used to find out if a user is logged on.
FTP	TCP TCP	20 21	File Transfer Protocol, a program to enable fast transfer of files, including large files that may not be possible by e-mail.
H.323	TCP	1720	NetMeeting uses this protocol.
HTTP	TCP	80	Hyper Text Transfer Protocol - a client/server protocol for the world wide web.
HTTPS	TCP	443	HTTPS is a secured http session often used in e-commerce.
ICMP	User-Defined	1	Internet Control Message Protocol is often used for diagnostic purposes.
ICQ	UDP	4000	This is a popular Internet chat program.
IGMP (MULTICAST)	User-Defined	2	Internet Group Multicast Protocol is used when sending packets to a specific group of hosts.
IKE	UDP	500	The Internet Key Exchange algorithm is used for key distribution and management.
IMAP4	TCP	143	The Internet Message Access Protocol is used for e-mail.
IMAP4S	TCP	993	This is a more secure version of IMAP4 that runs over SSL.
IRC	TCP/UDP	6667	This is another popular Internet chat program.
MSN Messenger	TCP	1863	Microsoft Networks' messenger service uses this protocol.
NetBIOS	TCP/UDP TCP/UDP TCP/UDP TCP/UDP	137 138 139 445	The Network Basic Input/Output System is used for communication between computers in a LAN.

Table 171 Examples of Services (continued)

NAME	PROTOCOL	PORT(S)	DESCRIPTION
NEW-ICQ	TCP	5190	An Internet chat program.
NEWS	TCP	144	A protocol for news groups.
NFS	UDP	2049	Network File System - NFS is a client/server distributed file service that provides transparent file sharing for network environments.
NNTP	TCP	119	Network News Transport Protocol is the delivery mechanism for the USENET newsgroup service.
PING	User-Defined	1	Packet INternet Groper is a protocol that sends out ICMP echo requests to test whether or not a remote host is reachable.
POP3	TCP	110	Post Office Protocol version 3 lets a client computer get e-mail from a POP3 server through a temporary connection (TCP/IP or other).
POP3S	TCP	995	This is a more secure version of POP3 that runs over SSL.
PPTP	TCP	1723	Point-to-Point Tunneling Protocol enables secure transfer of data over public networks. This is the control channel.
PPTP_TUNNEL (GRE)	User-Defined	47	PPTP (Point-to-Point Tunneling Protocol) enables secure transfer of data over public networks. This is the data channel.
RCMD	TCP	512	Remote Command Service.
REAL_AUDIO	TCP	7070	A streaming audio service that enables real time sound over the web.
REXEC	TCP	514	Remote Execution Daemon.
RLOGIN	TCP	513	Remote Login.
ROADRUNNER	TCP/UDP	1026	This is an ISP that provides services mainly for cable modems.
RTELNET	TCP	107	Remote Telnet.
RTSP	TCP/UDP	554	The Real Time Streaming (media control) Protocol (RTSP) is a remote control for multimedia on the Internet.
SFTP	TCP	115	The Simple File Transfer Protocol is an old way of transferring files between computers.
SMTP	TCP	25	Simple Mail Transfer Protocol is the message-exchange standard for the Internet. SMTP enables you to move messages from one e-mail server to another.
SMTPS	TCP	465	This is a more secure version of SMTP that runs over SSL.
SNMP	TCP/UDP	161	Simple Network Management Program.
SNMP-TRAPS	TCP/UDP	162	Traps for use with the SNMP (RFC:1215).

Table 171 Examples of Services (continued)

NAME	PROTOCOL	PORT(S)	DESCRIPTION
SQL-NET	TCP	1521	Structured Query Language is an interface to access data on many different types of database systems, including mainframes, midrange systems, UNIX systems and network servers.
SSDP	UDP	1900	The Simple Service Discovery Protocol supports Universal Plug-and-Play (UPnP).
SSH	TCP/UDP	22	Secure Shell Remote Login Program.
STRM WORKS	UDP	1558	Stream Works Protocol.
SYSLOG	UDP	514	Syslog allows you to send system logs to a UNIX server.
TACACS	UDP	49	Login Host Protocol used for (Terminal Access Controller Access Control System).
TELNET	TCP	23	Telnet is the login and terminal emulation protocol common on the Internet and in UNIX environments. It operates over TCP/IP networks. Its primary function is to allow users to log into remote host systems.
VDOLIVE	TCP UDP	7000 user-defined	A videoconferencing solution. The UDP port number is specified in the application.

Legal Information

Copyright

Disclaimer

ZyXEL does not assume any liability arising out of the application or use of any products, or software described herein. Neither does it convey any license under its patent rights nor the patent rights of others. ZyXEL further reserves the right to make changes in any products described herein without notice. This publication is subject to change without notice.

Certifications

Federal Communications Commission (FCC) Interference Statement

The device complies with Part 15 of FCC rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference.

(2) This device must accept any interference received, including interference that may cause undesired operations.

This device has been tested and found to comply with the limits for a Class B digital device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This device generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this device does cause harmful interference to radio/television reception, which can be determined by turning the device off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.

- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Radiation Exposure Statement

- This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter.
- For operation within 5.15 ~ 5.25GHz frequency range, it is restricted to indoor environment.
- IEEE 802.11b, 802.11g or 802.11n (20MHz) operation of this product in the U.S.A. is firmware-limited to channel 1 through 11. IEEE 802.11n (40MHz) operation of this product in the U.S.A. is firmware-limited to channel 3 through 9.
- This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body.

Notices

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

The device complies with the essential requirements of the R&TTE Directive 1995/5/EC.

Radiation Exposure Statement

This equipment complies with EU radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body.

National Communications Commission (NCC)

Article 12

Without permission, any company, firm or user shall not alter the frequency, increase the power, or change the characteristics and functions of the original design of the certified lower power frequency electric machinery.

Article 14

The application of low power frequency electric machineries shall not affect the navigation safety nor interfere a legal communication, if an interference is found, the service will be suspended until improvement is made and the interference no longer exists.

Industry Canada (IC)

CAN ICES-3 (B)/NMB-3(B)

This device complies with RSS-210 of the Industry Canada Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and

(2) this device must accept any interference received, including interference that may cause undesired operation.

Ce dispositif est conforme à la norme CNR-192 d'Industrie Canada applicable aux appareils radio exempts de licence. Son fonctionnement est sujet aux deux conditions suivantes:

(1) le dispositif ne doit pas produire de brouillage préjudiciable, et

(2) ce dispositif doit accepter tout brouillage reçu, y compris un brouillage susceptible de provoquer un fonctionnement indésirable.

IMPORTANT NOTE:

Radiation Exposure Statement:

This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body.

Déclaration d'exposition aux radiations:

Cet équipement est conforme aux limites d'exposition aux rayonnements IC établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20cm de distance entre la source de rayonnement et votre corps.

ZyXEL Limited Warranty

ZyXEL warrants to the original end user (purchaser) that this product is free from any defects in materials or workmanship for a period of up to two years from the date of purchase. During the warranty period, and upon proof of purchase, should the product have indications of failure due to faulty workmanship and/or materials, ZyXEL will, at its discretion, repair or replace the defective products or components without charge for either parts or labor, and to whatever extent it shall deem necessary to restore the product or components to proper operating condition. Any replacement will consist of a new or re-manufactured functionally equivalent product of equal or higher value, and will be solely at the discretion of ZyXEL. This warranty shall not apply if the product has been modified, misused, tampered with, damaged by an act of God, or subjected to abnormal working conditions.

Note

Repair or replacement, as provided under this warranty, is the exclusive remedy of the purchaser. This warranty is in lieu of all other warranties, express or implied, including any implied warranty of merchantability or fitness for a particular use or purpose. ZyXEL shall in no event be held liable for indirect or consequential damages of any kind to the purchaser.

To obtain the services of this warranty, contact ZyXEL's Service Center for your Return Material Authorization number (RMA). Products must be returned Postage Prepaid. It is recommended that the unit be insured when shipped. Any returned products without proof of purchase or those with an out-dated warranty will be repaired or replaced (at the discretion of ZyXEL) and the customer will be billed for parts and labor. All repaired or replaced products will be shipped by ZyXEL to the corresponding return address, Postage Paid. This warranty gives you specific legal rights, and you may also have other rights that vary from country to country.

Registration

Register your product online to receive e-mail notices of firmware upgrades and information at www.zyxel.com for global products, or at www.us.zyxel.com for North American products.

Safety Warnings

- Do NOT use this product near water, for example, in a wet basement or near a swimming pool.
- Do NOT expose your device to dampness, dust or corrosive liquids.
- Do NOT store things on the device.
- Do NOT install, use, or service this device during a thunderstorm. There is a remote risk of electric shock from lightning.
- Connect ONLY suitable accessories to the device.
- Do NOT open the device or unit. Opening or removing covers can expose you to dangerous high voltage points or other risks. ONLY qualified service personnel should service or disassemble this device. Please contact your vendor for further information.
- Make sure to connect the cables to the correct ports.
- Place connecting cables carefully so that no one will step on them or stumble over them.
- Always disconnect all cables from this device before servicing or disassembling.
- Use ONLY an appropriate power adaptor or cord for your device.
- Connect the power adaptor or cord to the right supply voltage (for example, 110V AC in North America or 230V AC in Europe).
- Do NOT allow anything to rest on the power adaptor or cord and do NOT place the product where anyone can walk on the power adaptor or cord.
- Do NOT use the device if the power adaptor or cord is damaged as it might cause electrocution.
- If the power adaptor or cord is damaged, remove it from the device and the power source.
- Do NOT attempt to repair the power adaptor or cord. Contact your local vendor to order a new one.
- Do not use the device outside, and make sure all the connections are indoors. There is a remote risk of electric shock from lightning.
- Do NOT obstruct the device ventilation slots, as insufficient airflow may harm your device.
- Use only No. 26 AWG (American Wire Gauge) or larger telecommunication line cord.
- Antenna Warning! This device meets ETSI and FCC certification requirements when using the included antenna(s). Only use the included antenna(s).

Your product is marked with this symbol, which is known as the WEEE mark. WEEE stands for Waste Electronics and Electrical Equipment. It means that used electrical and electronic products should not be mixed with general waste. Used electrical and electronic equipment should be treated separately.

Index