NWD-170N

Draft 802.11n Wireless CardBus Card

User's Guide

Version 1.00
Edition 1
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ZyXEL

Copyright

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Certifications

Federal Communications Commission (FCC) Interference Statement

The device complies with Part 15 of FCC rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference.
- 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:

1. Reorient or relocate the receiving antenna.
2. Increase the separation between the equipment and the receiver.
3. Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
4. Consult the dealer or an experienced radio/TV technician for help.

FCC Radiation Exposure Statement

- This device has been tested to the FCC exposure requirements (Specific Absorption Rate).
- This device complies with the requirements of Health Canada Safety Code 6 for Canada.
- Testing was performed on laptop computers with antennas at 0mm spacing. The maximum SAR value is: 0.26 W/kg. The device must not be collocated with any other antennas or transmitters.
- This equipment has been SAR-evaluated for use in laptops (notebooks) with side slot configuration.

- The device complies with FCC RF radiation exposure limits set forth for an uncontrolled environment, under 47 CFR 2.1093 paragraph (d)(2). End users must follow the specific operating instructions for satisfying RF exposure compliance. To maintain compliance with FCC RF exposure compliance requirements, please follow operation instruction as documented in this manual.
- This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.
- IEEE 802.11b or 802.11g operation of this product in the U.S.A. is firmware-limited to channels 1 through 11.

Industry Canada Statement

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 interference.

and

2 This device must accept any interference, including interference that may cause undesired operation of the device.

Important Note: IC Radiation Exposure Statement

This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment. End users must follow the specific operating instructions for satisfying RF exposure compliance. To maintain compliance with IC RF exposure compliance requirements, please follow operation instruction as documented in this manual.

注意！

依據 低功率電波輻射性電機管理辦法

第十二條 經型式認證合格之低功率射頻電機，非經許可，公司、商號或使用者均不得擅自變更頻率、加大功率或變更原設計之特性及功能。

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SAR: 標示： SAR 標準值 1.6W/kg; 送測產品實測值爲 : 0.26 W/kg。

Notices

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device has been designed for the WLAN 2.4 GHz network throughout the EC region and Switzerland, with restrictions in France.

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

Viewing Certifications

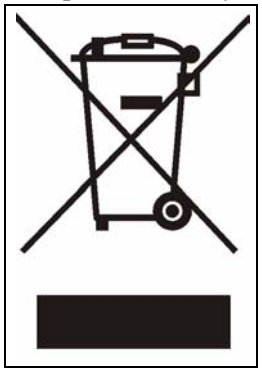
1. Go to http://www.zyxel.com.
2. Select your product on the ZyXEL home page to go to that product's page.
3. Select the certification you wish to view from this page.

Safety Warnings

For your safety, be sure to read and follow all warning notices and instructions.

- 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.
- ONLY qualified service personnel should service or disassemble this device.
- Do not use the device outside, and make sure all the connections are indoors. There is a remote risk of electric shock from lightning.
- Antenna Warning! This device meets ETSI and FCC certification requirements when using the included antenna(s). Only use the included antenna(s).

This product is recyclable. Dispose of it properly.



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.

Customer Support

Please have the following information ready when you contact customer support.

- Product model and serial number.
- Warranty Information.
- Date that you received your device.
- Brief description of the problem and the steps you took to solve it.

METHOD / LOCATION	SUPPORT E-MAIL / SALES E-MAIL	TELEPHONE / FAX	WEB SITE / FTP SITE	REGULAR MAIL
CORPORATE HEADQUARTERS (WORLDWIDE)	support@zyxel.com.tw sales@zyxel.com.tw	+886-3-578-3942 +886-3-578-2439	www.zyxel.com www.europe.zyxel.com ftp.zyxel.com ftp.europe.zyxel.com	ZyXEL Communications Corp. 6 Innovation Road II Science Park Hsinchu 300 Taiwan
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+" is the (prefix) number you enter to make an international telephone call.

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Preface

Congratulations on your purchase of the NWD-170N Draft 802.11n Wireless CardBus Card. Your NWD-170N plugs into a PCMCIA slot on your computer and allows you to access wireless networks.

Your NWD-170N is easy to install and configure.

About This User's Guide

This manual is designed to guide you through the configuration of your NWD-170N for its various applications.

Related Documentation

- Supporting Disk

  Refer to the included CD for support documents.

- Quick Start Guide

  The Quick Start Guide is designed to help you get up and running right away. They contain hardware installation/connection information.

- ZyXEL Web Site

  Please go to http://www.zyxel.com for product news, firmware, updated documents, and other support materials.

User Guide Feedback

Help us help you. E-mail all User's Guide-related comments, questions or suggestions for improvement to techwriters@zyxel.com.tw or send regular mail to The Technical Writing Team, ZyXEL Communications Corp., 6 Innovation Road II, Science-Based Industrial Park, Hsinchu, 300, Taiwan. Thank you.

Syntax Conventions

- "Enter" means for you to type one or more characters. "Select" or "Choose" means for you to use one predefined choice.
- Mouse action sequences are denoted using a right angle bracket (>). For example, "In Windows, click **Start** > **Settings** > **Control Panel**" means first click the **Start** button, then point your mouse pointer to **Settings** and then click **Control Panel**.
- "e.g.," is a shorthand for "for instance", and "i.e.," means "that is" or "in other words".
- The NWD-170N Draft 802.11n Wireless CardBus Card may be referred to as the NWD-170N in this user's guide.

Graphics Icons Key

Wireless Access Point 	Computer 	Notebook Computer 
Server 	Modem or Router 	Wireless Signal 
Internet Cloud 		

CHAPTER 1
Getting Started

This chapter introduces the NWD-170N and prepares you to use the ZyXEL utility. The ZyXEL utility is a tool that helps you configure your NWD-170N.

1.1 About Your NWD-170N

The NWD-170N is an IEEE 802.11n draft compliant wireless LAN adapter, using MIMO (Multiple-In, Multiple-Out) antenna technology to deliver high-speed wireless networking. It can also connect to IEEE 802.11b/g wireless networks.

See the appendix for detailed product specifications.

Figure 1 The NWD-170N

The following table describes the NWD-170N.

Table 1 External View

LABEL	DESCRIPTION
1	PCMCIA connector
2	PWR LED (light)
3	LINK LED (light)

The following table describes the operation of the **PWR** and **LINK** LEDs on the device.

Table 2 NWD-170N LEDs

STATE	DESCRIPTION
The **PWR** LED is off	The NWD-170N is not receiving power.
The **PWR** LED is blinking	The NWD-170N is receiving power.
The **PWR** and **LINK** LEDs are blinking alternately.	The NWD-170N is not connected to a wireless network.
The **PWR** and **LINK** LEDs are blinking simultaneously and regularly.	The NWD-170N is connected to a wireless network.
The **PWR** and **LINK** LEDs are blinking simultaneously and irregularly.	The NWD-170N is connected to a wireless network and is sending or receiving data.

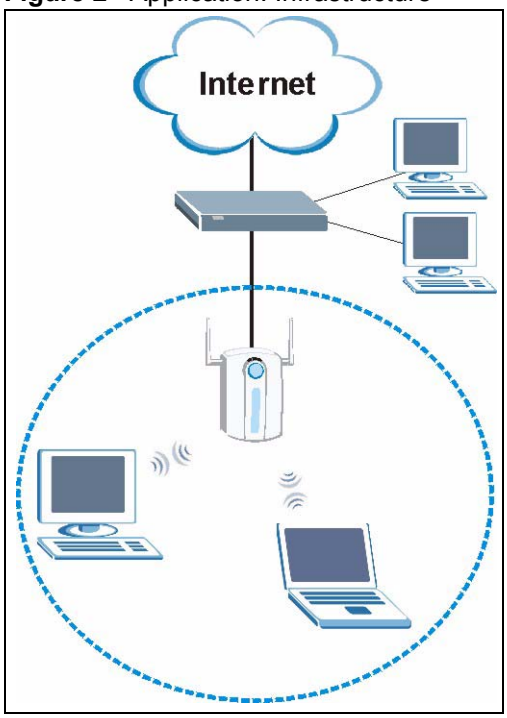
1.2 Application Overview

This section describes some network applications for the NWD-170N. You can either set the network type to **Infrastructure** and connect to an AP or use **Ad-Hoc** mode and connect to a peer computer (another wireless device in Ad-Hoc mode).

1.2.0.1 Infrastructure

To connect to a network via an access point (AP), set the NWD-170N network type to **Infrastructure**. Through the AP, you can access the Internet or the wired network behind the AP.

Figure 2 Application: Infrastructure

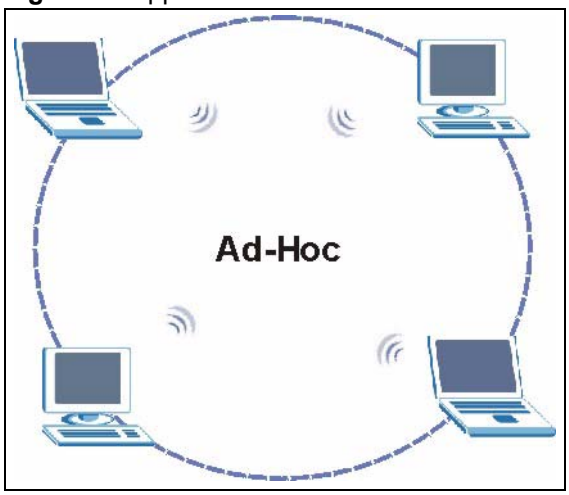


1.2.0.2 Ad-Hoc

To set up a small independent wireless workgroup without an AP, use **Ad-Hoc**.

Ad-Hoc does not require an AP or a wired network. Two or more wireless clients communicate directly with each other.

Figure 3 Application: Ad-Hoc



1.3 NWD-170N Hardware and Utility Installation

Follow the instructions in the Quick Start Guide to install the ZyXEL utility and make hardware connections.

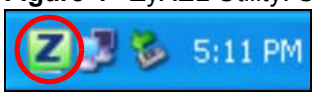
1.3.1 ZyXEL Utility Icon

After you install and start the ZyXEL utility, an icon for the ZyXEL utility appears in the system tray.

Note: The ZyXEL utility system tray icon displays only when the NWD-170N is installed properly.

When you use the ZyXEL utility, it automatically disables Wireless Zero Configuration (WZC).

Figure 4 ZyXEL Utility: System Tray Icon



The color of the ZyXEL utility system tray icon indicates the status of the NWD-170N. Refer to the following table for details.

Table 3 ZyXEL Utility: System Tray Icon

COLOR	DESCRIPTION
Red	The NWD-170N is not connected to a wireless network.
Green	The NWD-170N is connected to a wireless network.

1.4 Configuration Methods

To configure your NWD-170N, use one of the following applications:

- Wireless Zero Configuration (WZC) (the Windows XP wireless configuration tool)
- ZyXEL Utility

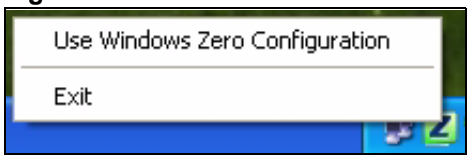
Note: Do NOT use WZC at the same time you use the ZyXEL utility.

1.4.1 Enabling WZC

Note: When you use the ZyXEL utility, it automatically disables WZC.

If you want to use WZC to configure the NWD-170N, you need to disable the ZyXEL utility by right-clicking the utility icon ( ) in the system tray and selecting **Use Windows Zero Configuration**.

Figure 5 Enable WZC



Refer to the appendices for information on how to use WZC to manage the NWD-170N.

To reactivate the ZyXEL utility, double-click the ( ) icon on your desktop or click **Start**, **(All) Programs**, **ZyXEL NWD-170N Wireless Adapter Utility**, **ZyXEL NWD-170N Wireless Adapter Software**.

1.4.2 Accessing the ZyXEL Utility

Double-click on the ZyXEL wireless LAN utility icon in the system tray to open the ZyXEL utility.

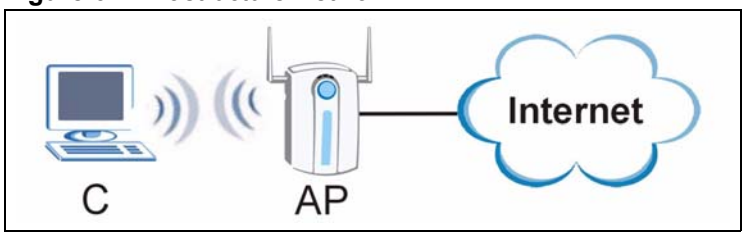
The ZyXEL utility screens are similar in all Microsoft Windows versions. Screens for Windows XP are shown in this User's Guide.

Note: Click the icon (located in the top right corner) to display the online help window.

CHAPTER 2
Tutorial

The following sections show you how to join a wireless network using the ZyXEL utility, as in the following diagrams. The wireless client is labeled **C** and the access point is labeled **AP**.

Figure 6 Infrastructure Network



There are three ways to connect the wireless client (the NWD-170N) to a network.

- Configure nothing and leave the wireless client to automatically scan for and connect to any available network that has no wireless security configured.
- Manually connect to a network (see Section 2.1 on page 25).
- Configure a profile to have the wireless client automatically connect to a specific network or peer computer (see Section 2.2 on page 27).

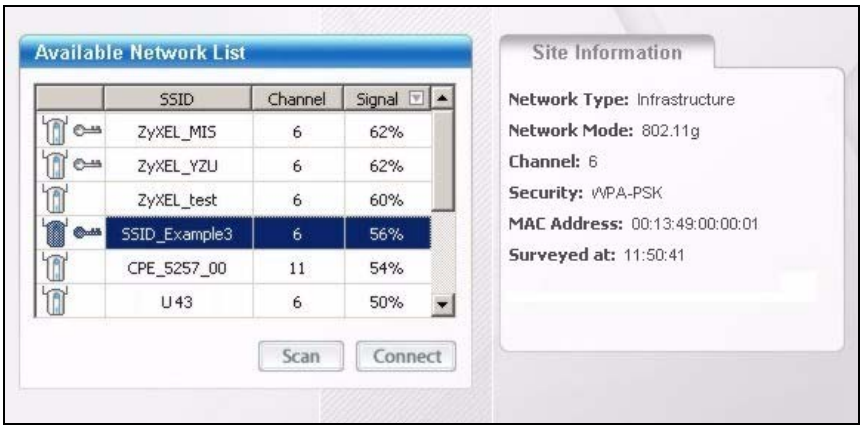
2.1 Connecting to a Wireless LAN

This example illustrates how to manually connect your wireless client to an access point (AP) configured for WPA-PSK security and connected to the Internet. Before you connect to the access point, you must know its Service Set IDentity (SSID) and WPA-PSK pre-shared key. In this example, the AP's SSID is "SSID_Example3" and its pre-shared key is "ThisismyWPA-PSKpre-sharedkey".

After you install the ZyXEL utility and then insert the wireless client, follow the steps below to connect to a network using the **Site Survey** screen.

1 Open the ZyXEL utility and click the **Site Survey** tab to open the screen shown next.

Figure 7 ZyXEL Utility: Site Survey



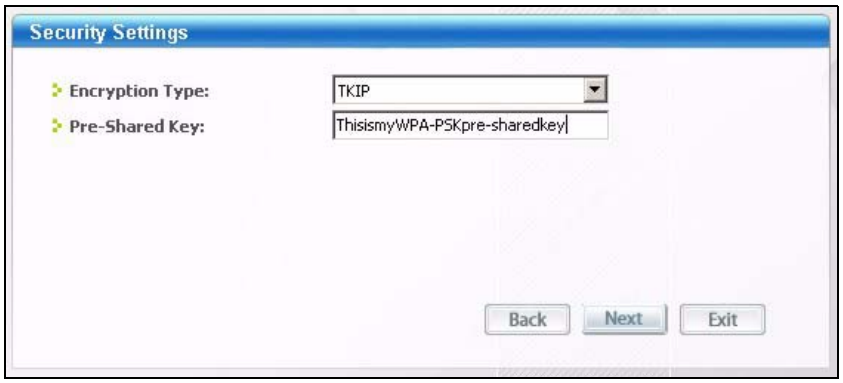
2 The wireless client automatically searches for available wireless networks. Click **Scan** if you want to search again. If no entry displays in the **Available Network List**, that means there is no wireless network available within range. Make sure the AP or peer computer is turned on, or move the wireless client closer to the AP or peer computer. See Table 4.3 on page 37 for detailed field descriptions.

3 To connect to an AP or peer computer, either click an entry in the list and then click **Connect** or double-click an entry (**SSID_Example3** in this example).

4 When you try to connect to an AP with security configured, a window will pop up prompting you to specify the security settings. Enter the pre-shared key and leave the encryption type at the default setting.

Use the **Next** button to move on to the next screen. You can use the **Back** button at any time to return to the previous screen, or the **Exit** button to return to the **Site Survey** screen.

Figure 8 ZyXEL Utility: Security Settings

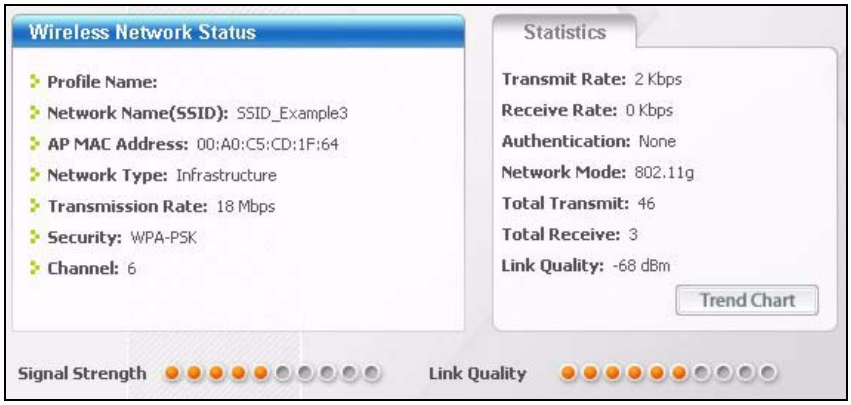


5 The **Confirm Save** window appears. Check your settings and click **Save** to continue.

Figure 9 ZyXEL Utility: Confirm Save

6 The ZyXEL utility returns to the **Link Info** screen while it connects to the wireless network using your settings. When the wireless link is established, the ZyXEL utility icon in the system tray turns green and the **Link Info** screen displays details of the active connection. Check the network information in the **Link Info** screen to verify that you have successfully connected to the selected network. If the wireless client is not connected to a network, the fields in this screen remain blank. See Table 4.2 on page 35 for detailed field descriptions.

Figure 10 ZyXEL Utility: Link Info



7 Open your Internet browser and enter http://www.zyxel.com or the URL of any other web site in the address bar. If you are able to access the web site, your wireless connection is successfully configured. If you cannot access the web site, check the Troubleshooting section of this User's Guide or contact your network administrator if necessary.

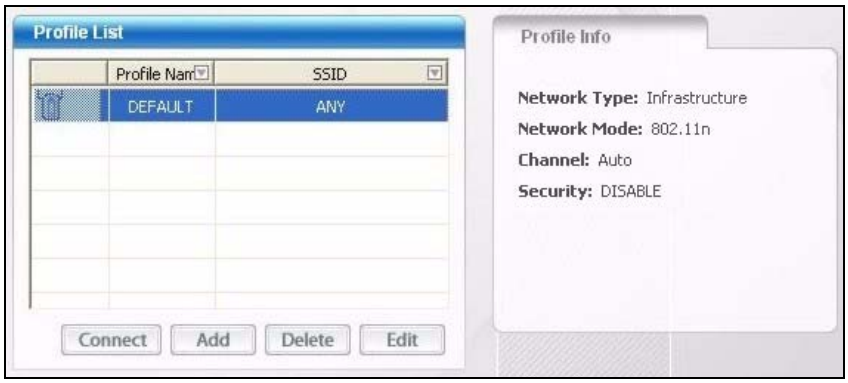
2.2 Creating and Using a Profile

A profile lets you automatically connect to the same wireless network every time you use the ZyXEL utility. You can also configure different profiles for different networks, for example if you connect a notebook computer to wireless networks at home and at work.

This example illustrates how to set up a profile and connect the wireless client to an access point configured for WPA-PSK security. In this example, the AP's SSID is "SSID_Example3" and its pre-shared key is "ThisismyWPA-PSKpre-sharedkey". You have chosen the profile name "PN_Example3".

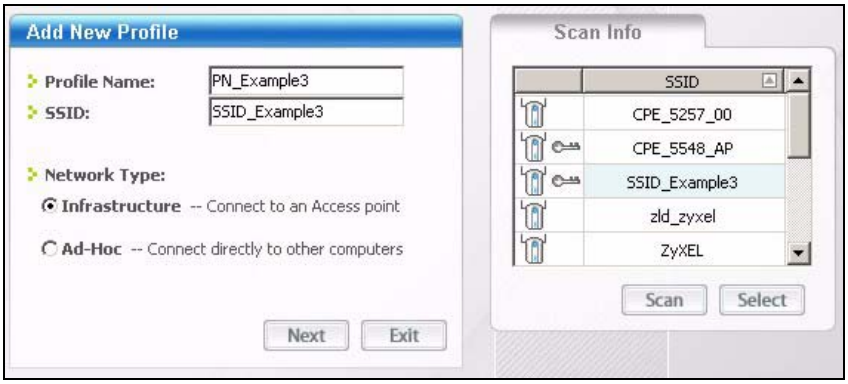
1 Open the ZyXEL utility and click the **Profile** tab to open the screen as shown. Click **Add** to configure a new profile.

Figure 11 ZyXEL Utility: Profile



2 The **Add New Profile** screen appears. The wireless client automatically searches for available wireless networks, which are displayed in the **Scan Info** box. You can also configure your profile for a wireless network that is not in the list.

Figure 12 ZyXEL Utility: Add New Profile



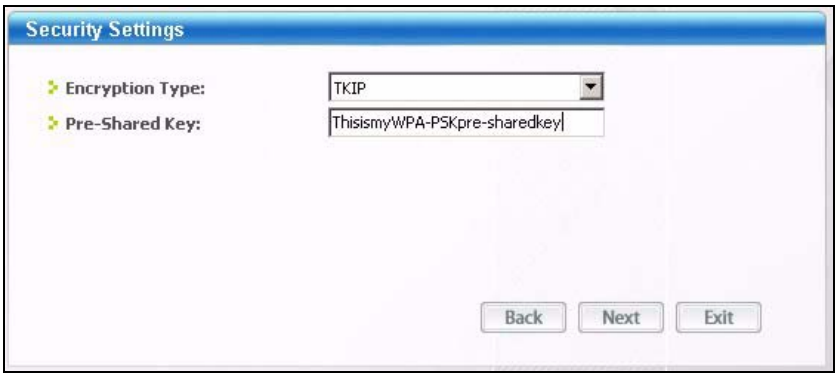
3 Give the profile a descriptive name (of up to 32 printable ASCII characters). Select **Infrastructure** and either manually enter or select the AP's SSID in the **Scan Info** table and click **Select**.

4 Choose the same encryption method as the AP to which you want to connect (In this example, WPA-PSK).

Figure 13 ZyXEL Utility: Profile Security

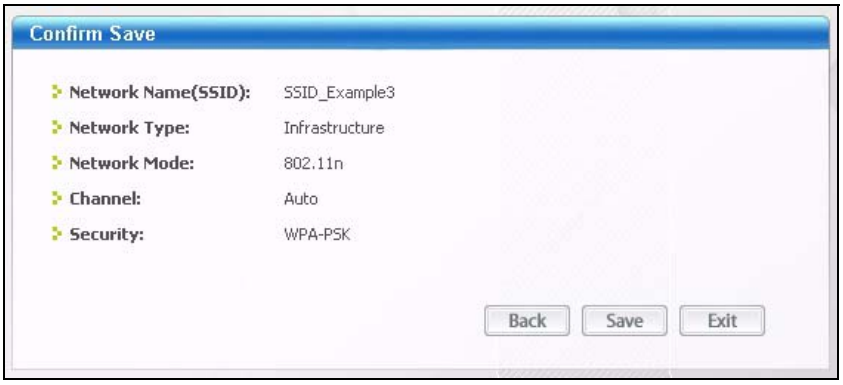
5 This screen varies depending on the encryption method you selected in the previous screen. In this example, enter the pre-shared key and leave the encryption type at the default setting.

Figure 14 ZyXEL Utility: Profile Encryption



6 Verify the profile settings in the ready-only screen. Click **Save** to save and go to the next screen.

Figure 15 ZyXEL Utility: Profile Confirm Save



7 Click **Activate Now** to use the new profile immediately. Otherwise, click the **Activate Later** button to go back to the **Profile List** screen.

If you clicked **Activate Later** you can select the profile from the list in the **Profile** screen and click **Connect** to activate it.

Note: Only one profile can be activated and used at any given time.

Figure 16 ZyXEL Utility: Profile Activate

8 When you activate the new profile, the ZyXEL utility goes to the **Link Info** screen while it connects to the AP using your settings. When the wireless link is established, the ZyXEL utility icon in the system tray turns green and the **Link Info** screen displays details of the active connection.

9 Make sure the selected AP in the active profile is on and connected to the Internet. Open your Internet browser, enter http://www.zyxel.com or the URL of any other web site in the address bar and press ENTER. If you are able to access the web site, your new profile is successfully configured.

10 If you cannot access the Internet, go back to the **Profile** screen. Select the profile you are using and click **Edit**. Check the details you entered previously. Also, refer to the Troubleshooting section of this User's Guide or contact your network administrator if necessary.

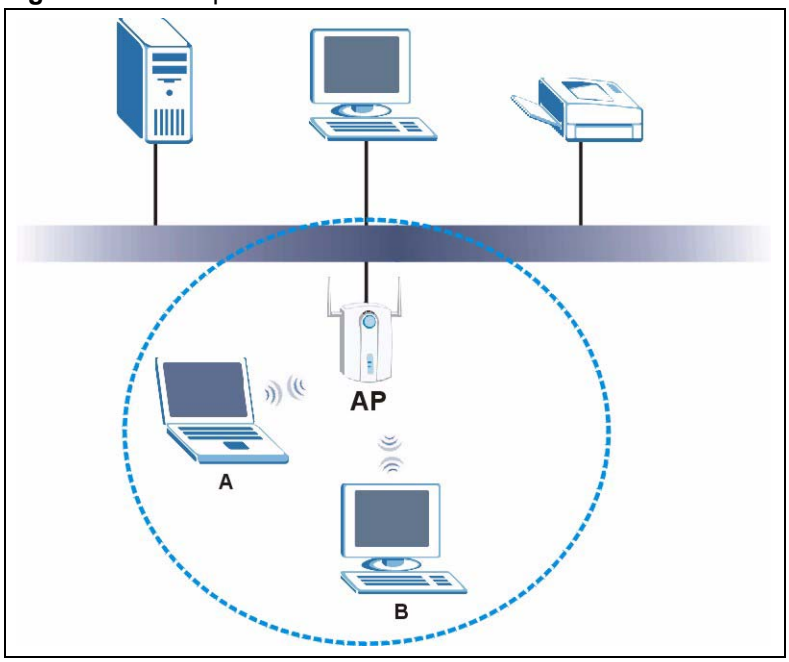
CHAPTER 3
Wireless LAN Network

This chapter provides background information on wireless LAN networks.

3.1 Wireless LAN Overview

The following figure provides an example of a wireless network with an AP. See Figure 3 on page 21 for an Ad Hoc network example.

Figure 17 Example of a Wireless Network



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

Every wireless network must follow these basic guidelines.

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

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

  Like radio stations or television channels, each wireless network uses a specific channel, or frequency, to send and receive information.

- Every device in the same wireless network must use security compatible with the AP or peer computer.

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

3.2 Wireless LAN Security

Wireless LAN security is vital to your network to protect wireless communications.

If you do not enable any wireless security on your NWD-170N, the NWD-170N's wireless communications are accessible to any wireless networking device that is in the coverage area.

Note: You can use only WEP encryption if you set the NWD-170N to Ad-hoc mode.

See the appendices for more detailed information about wireless security.

3.2.1 User Authentication and Encryption

You can make every user log in to the wireless network before they can use it. This is called user authentication. However, every wireless client in the wireless network has to support IEEE 802.1x to do this.

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

3.2.1.1 WEP

3.2.1.1.1 Data Encryption

WEP (Wired Equivalent Privacy) encryption scrambles all data packets transmitted between the NWD-170N and the AP or other wireless stations to keep network communications private. Both the wireless stations and the access points must use the same WEP key for data encryption and decryption.

There are two ways to create WEP keys in your NWD-170N.

- Automatic WEP key generation based on a "password phrase" called a passphrase. The passphrase is case sensitive. You must use the same passphrase for all WLAN adapters with this feature in the same WLAN.

  For WLAN adapters without the passphrase feature, you can still take advantage of this feature by writing down the four automatically generated WEP keys from the **Security Settings** screen of the ZyXEL utility and entering them manually as the WEP keys in the other WLAN adapter(s).
- Enter the WEP keys manually.

Your NWD-170N allows you to configure up to four 64-bit, 128-bit or 152-bit WEP keys. Only one key is used as the default key at any one time.

3.2.1.1.2 Authentication Type

The IEEE 802.11b/g standard describes a simple authentication method between the wireless stations and AP. Three authentication types are defined: **Auto**, **Open** and **Shared**.

- Open mode is implemented for ease-of-use and when security is not an issue. The wireless station and the AP or peer computer do not share a secret key. Thus the wireless stations can associate with any AP or peer computer and listen to any transmitted data that is not encrypted.
- Shared mode involves a shared secret key to authenticate the wireless station to the AP or peer computer. This requires you to enable the wireless LAN security and use same settings on both the wireless station and the AP or peer computer.
- Auto authentication mode allows the NWD-170N to switch between the open system and shared key modes automatically. Use the auto mode if you do not know the authentication mode of the other wireless stations.

3.2.1.2 IEEE 802.1x

The IEEE 802.1x standard outlines enhanced security methods for both the authentication of wireless stations and encryption key management. Authentication can be done using an external RADIUS server.

3.2.1.2.1 EAP Authentication

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. The NWD-170N supports EAP-TLS, EAP-TTLS and EAP-PEAP. Refer to Appendix C on page 71 for descriptions.

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). Certificates (also called digital IDs) can be used to authenticate users and a CA issues certificates and guarantees the identity of each certificate owner.

3.2.1.3 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(2) and WEP are improved data encryption and user authentication.

Both WPA and WPA2 improve data encryption by using Temporal Key Integrity Protocol (TKIP), Message Integrity Check (MIC) and IEEE 802.1x. WPA and WPA2 use Advanced Encryption Standard (AES) in the Counter mode with Cipher block chaining Message authentication code Protocol (CCMP) to offer stronger encryption than TKIP.

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.

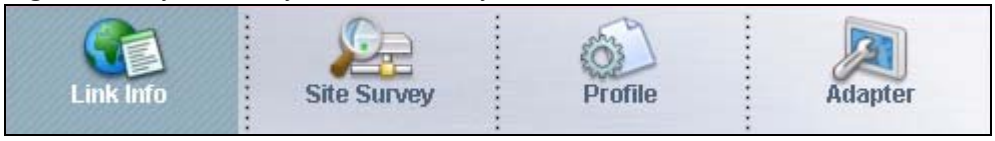
CHAPTER 4
Wireless Configuration

This chapter shows you how to configure your NWD-170N.

4.1 ZyXEL Utility Screen Summary

This section describes the ZyXEL utility screens.

Figure 18 ZyXEL Utility Menu Summary



The following table describes the menus.

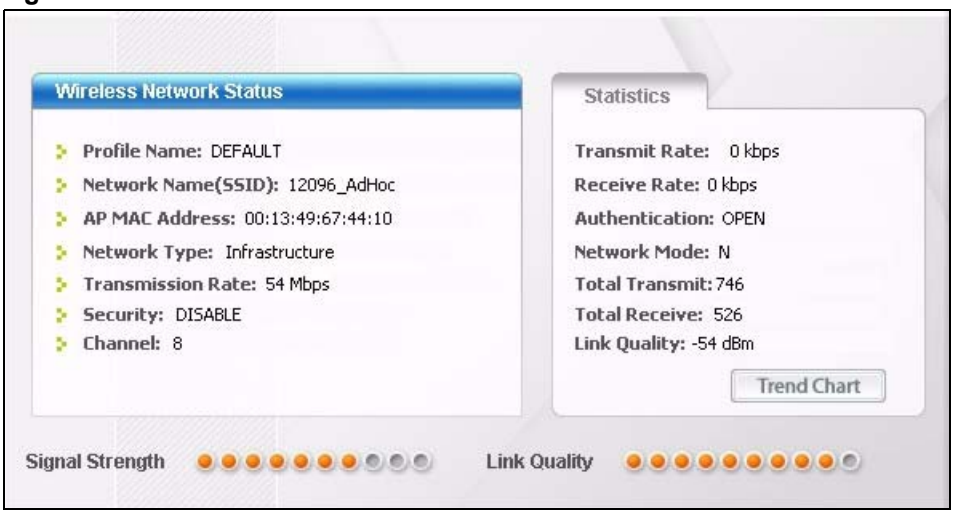
Table 4 ZyXEL Utility Menu Summary

TAB	DESCRIPTION
Link Info	Use this screen to see your current connection status, configuration and data rate statistics.
Site Survey	Use this screen to • scan for a wireless network • configure wireless security (if activated on the selected network). • connect to a wireless network.
Profile	Use this screen to add, delete, edit or activate a profile with a set of wireless and security settings.
Adapter	Use this screen to configure preamble type and enable power saving.

4.2 The Link Info Screen

When the ZyXEL utility starts, the **Link Info** screen displays, showing the current configuration and connection status of your NWD-170N.

Figure 19 Link Info



The following table describes the labels in this screen.

Table 5 Link Info

LABEL	DESCRIPTION
Wireless Network Status	
Profile Name	This is the name of the profile you are currently using.
Network Name (SSID)	The SSID identifies the wireless network to which a wireless station is associated. This field displays the name of the wireless device to which the NWD-170N is associated.
AP MAC Address	This field displays the MAC address of the AP or peer computer to which the NWD-170N is associated.
Network Type	This field displays the network type (**Infrastructure** or **Ad-Hoc**) of the wireless network.
Transmission Rate	This field displays the current transmission rate of the NWD-170N in megabits per second (Mbps).
Security	This field displays whether data encryption is activated (**WEP** (WEP or 802.1x), **TKIP** (WPA/WPA-PSK/WPA2/WPA2-PSK), **AES** (WPA/WPA-PSK/WPA2/WPA2-PSK)) or inactive (**DISABLE**).
Channel	This field displays the radio channel the NWD-170N is currently using.
Statistics	
Transmit Rate	This field displays the current data transmission rate in kilobits per second (Kbps).
Receive Rate	This field displays the current data receiving rate in kilobits per second (Kbps).
Authentication	This field displays the authentication method of the NWD-170N.
Network Mode	This field displays the wireless standard (**802.11b**, **802.11g** or **802.11n**) of the AP or peer computer.
Total Transmit	This field displays the total number of data frames transmitted.
Total Receive	This field displays the total number of data frames received.
Link Quality	This field displays the signal strength of the NWD-170N.

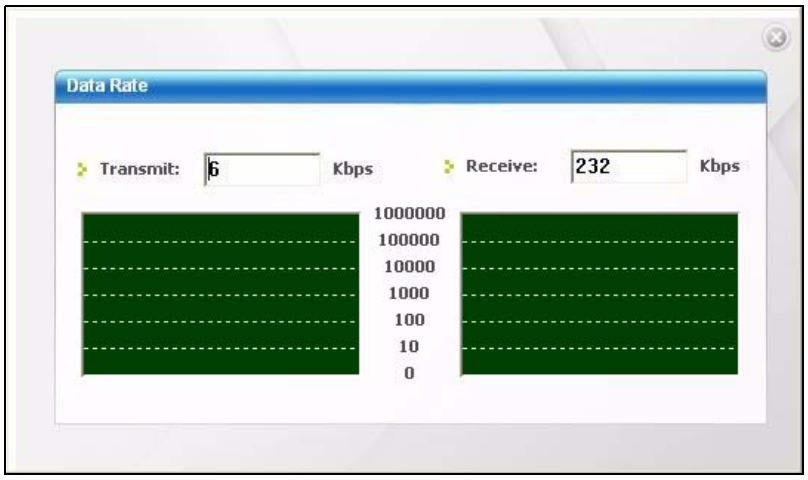
Table 5 Link Info (continued)

LABEL	DESCRIPTION
Trend Chart	Click this button to display the real-time statistics of the data rate in kilobits per second (Kbps).
Signal Strength	The status bar shows the strength of the signal. The signal strength mainly depends on the antenna output power and the distance between your NWD-170N and the AP or peer computer.
Link Quality	The status bar shows the quality of wireless connection. This refers to the percentage of packets transmitted successfully. If there are too many wireless stations in a wireless network, collisions may occur which could result in a loss of messages even though you have high signal strength.

4.2.1 Trend Chart

Click **Trend Chart** in the **Link Info** screen to display a screen as shown below. Use this screen to view real-time data traffic statistics.

Figure 20 Link Info: Trend Chart



The following table describes the labels in this screen.

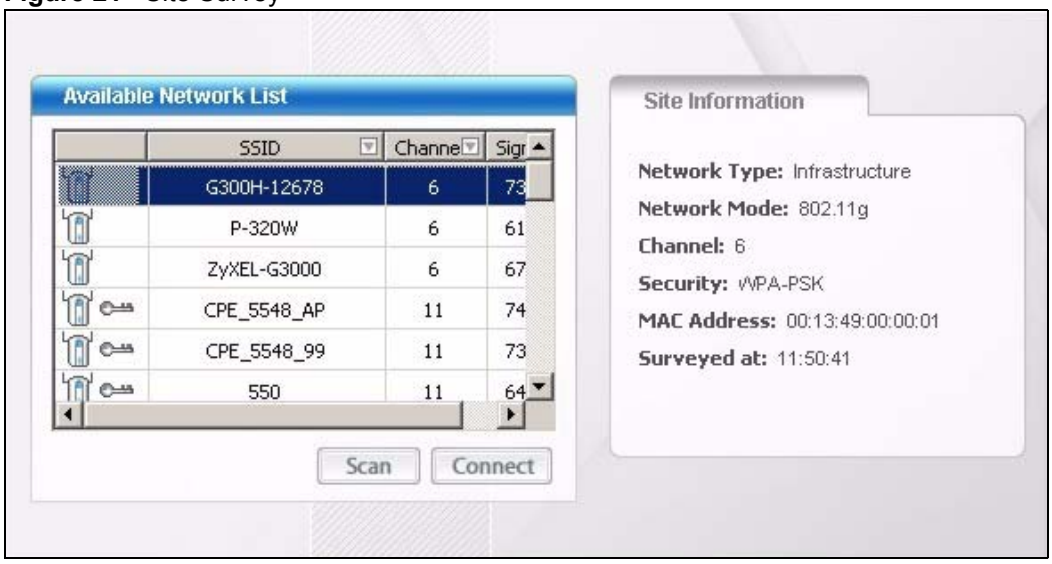
Table 6 Link Info: Trend Chart

LABEL	DESCRIPTION
Transmit	This field displays the current data transmission rate in kilobits per second (Kbps).
Receive	This field displays the current data receiving rate in kilobits per second (Kbps).

4.3 The Site Survey Screen

Use the **Site Survey** screen to scan for and connect to a wireless network automatically.

Figure 21 Site Survey



The following table describes the labels in this screen.

Table 7 Site Survey

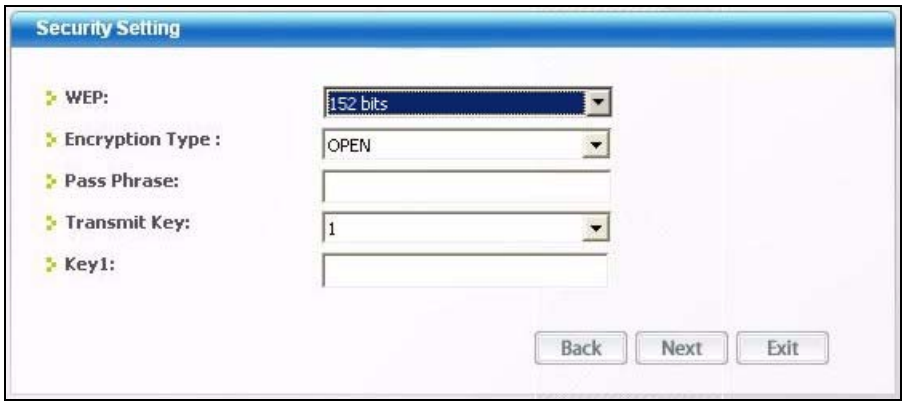
LABEL	DESCRIPTION
Available Network List	Click a column heading to sort the entries.
, , or	denotes that the wireless device is in infrastructure mode and the wireless security is activated. denotes that the wireless device is in infrastructure mode but the wireless security is deactivated. denotes that the wireless device is in Ad-Hoc mode and the wireless security is activated. denotes that the wireless device is in Ad-Hoc mode but the wireless security is deactivated.
SSID	This field displays the SSID (Service Set IDentifier) of each wireless device.
Channel	This field displays the channel number used by each wireless device.
Signal	This field displays the signal strength of each wireless device.
Scan	Click **Scan** to search for available wireless devices within transmission range.
Connect	Click **Connect** to associate to the selected wireless device.
Site Information	Click an entry in the **Available Network List** table to display the information of the selected wireless device.
Network Type	This field displays the network type (**Infrastructure** or **Ad Hoc**) of the wireless device.
Network Mode	This field displays the wireless standard (**802.11b**, **802.11g** or **802.11n**) used by the selected wireless device.
Channel	This field displays the channel number used by each wireless device.
Security	This field shows whether data encryption is activated (**WEP**, **WPA**, **WPA-PSK**, **WPA2**, **WPA2-PSK** or **802.1x**) or inactive (**DISABLE**).
MAC address	This field displays the MAC address of the wireless device.
Surveyed at	This field displays the time when the wireless device was scanned.

4.3.1 Security Settings

When you configure the NWD-170N to connect to a network with wireless security activated and the security settings are disabled on the NWD-170N, the screen varies according to the encryption method used by the selected network.

4.3.1.1 WEP Encryption

Figure 22 Security Setting: WEP



The following table describes the labels in this screen.

Table 8 Security Setting: WEP

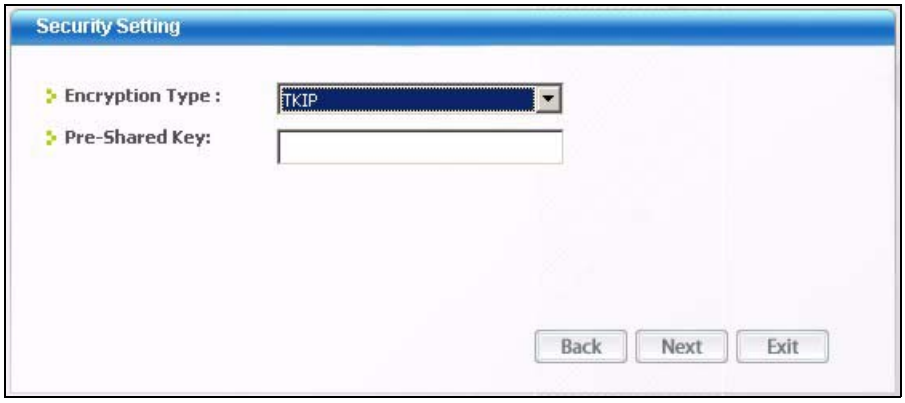
LABEL	DESCRIPTION
Security Settings	
WEP	Select **64 Bits**, **128 Bits** or **152 Bits** to activate WEP encryption and then fill in the related fields.
Encryption Type	Select an authentication method. Choices are **Open**, **Shared** and **Auto Switch**. Refer to Section 3.2.1.1.2 on page 33 for more information.
Pass Phrase	Enter a passphrase of up to 63 case-sensitive printable characters. As you enter the passphrase, the NWD-170N automatically generates four different WEP keys and displays it in the key field below. Refer to Section 3.2.1.1.1 on page 32 for more information.
Transmit Key	Select a default WEP key to use for data encryption. The key displays in the field below.

Table 8 Security Setting: WEP (continued)

LABEL	DESCRIPTION
Key x (where x is a number between 1 and 4)	Select this option if you want to manually enter the WEP keys. Enter the WEP key in the field provided. If you select **64 Bits** in the **WEP** field. Enter either 10 hexadecimal digits in the range of "A-F", "a-f" and "0-9" (for example, 11AA22BB33) for HEX key type. or Enter 5 ASCII characters (case sensitive) ranging from "a-z", "A-Z" and "0-9" (for example, MyKey) for ASCII key type. If you select **128 Bits** in the **WEP** field, Enter either 26 hexadecimal digits in the range of "A-F", "a-f" and "0-9" (for example, 00112233445566778899AABBCC) for HEX key type or Enter 13 ASCII characters (case sensitive) ranging from "a-z", "A-Z" and "0-9" (for example, MyKey12345678) for ASCII key type. If you select **152 Bits** in the **WEP** field, Enter either 32 hexadecimal digits in the range of "A-F", "a-f" and "0-9" (for example, 00112233445566778899AABBCCDDEEFF) for HEX key type or Enter 16 ASCII characters (case sensitive) ranging from "a-z", "A-Z" and "0-9" (for example, MyKey12345678901) for ASCII key type. **Note:** The values for the WEP keys must be set up exactly the same on all wireless devices in the same wireless LAN. ASCII WEP keys are case sensitive.
Back	Click **Back** to go to the **Site Survey** screen to select and connect to another network.
Next	Click **Next** to confirm your selections and advance to the **Confirm Save** screen. Refer to Section 4.3.2 on page 43.
Exit	Click **Exit** to return to the **Site Survey** screen without saving.

4.3.1.2 WPA-PSK/WPA2-PSK

Figure 23 Security Setting: WPA-PSK/WPA2-PSK



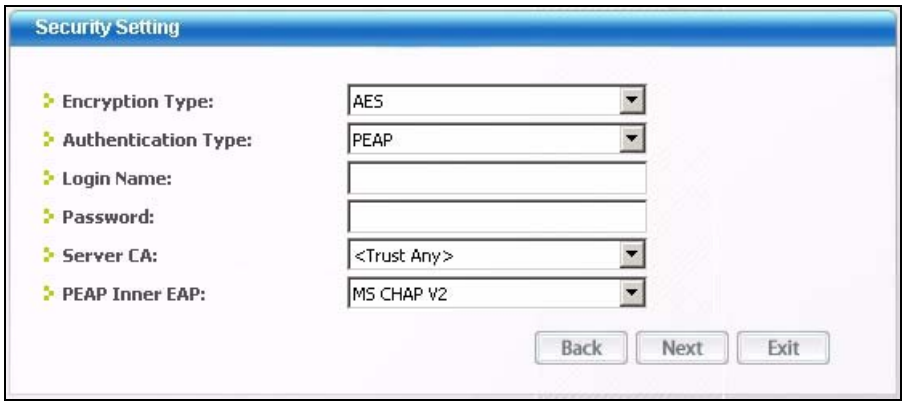
The following table describes the labels in this screen.

Table 9 Security Setting: WPA-PSK/WPA2-PSK

LABEL	DESCRIPTION
Encryption Type	The encryption mechanisms used for WPA/WPA2 and WPA-PSK/WPA2-PSK are the same. The only difference between the two is that WPA-PSK/WPA2-PSK uses a simple common password, instead of user-specific credentials. Select the encryption type (**TKIP** or **AES**) for data encryption. Refer to Section 3.2.1.3 on page 33 for more information.
Pre-Shared Key	Type a pre-shared key (same as the AP or peer device) of between 8 and 63 case-sensitive ASCII characters (including spaces and symbols) or 64 hexadecimal characters.
Back	Click **Back** to go to the **Site Survey** screen to select and connect to another network.
Next	Click **Next** to confirm your selections and advance to the **Confirm Save** screen. Refer to Section 4.3.2 on page 43.
Exit	Click **Exit** to return to the **Site Survey** screen without saving.

4.3.1.3 WPA/WPA2

Figure 24 Security Settings: WPA/WPA2



The following table describes the labels in this screen.

Table 10 Security Setting: WPA/WPA2

LABEL	DESCRIPTION
Encryption Type	The encryption mechanisms used for WPA/WPA2 and WPA-PSK/WPA2-PSK are the same. The only difference between the two is that WPA-PSK/WPA2-PSK uses a simple common password, instead of user-specific credentials. Select the encryption type (**TKIP** or **AES**) for data encryption. Refer to Section 3.2.1.3 on page 33 for more information.
Authentication Type	The type of authentication you use depends on the RADIUS server or AP. Select an authentication method from the drop down list. Options are **TLS**, **TTLS** and **PEAP**.
Login Name	Enter a user name. This is the user name that you or an administrator set up on a RADIUS server.

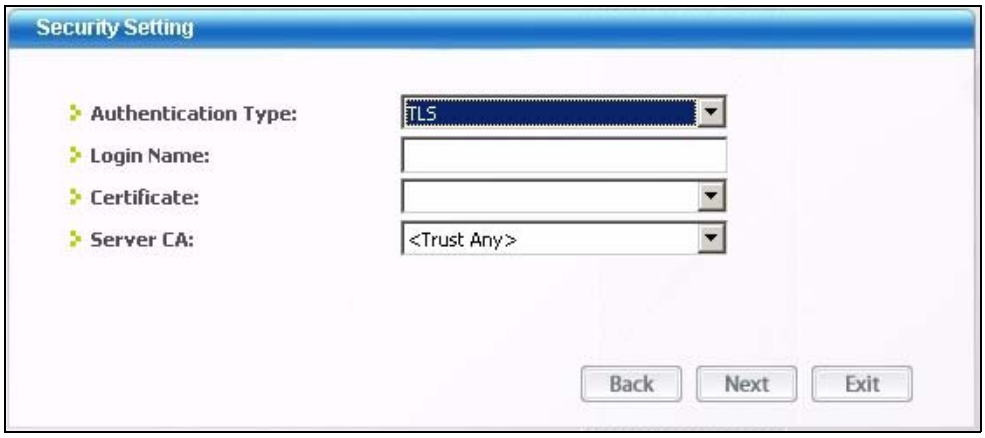
Table 10 Security Setting: WPA/WPA2

LABEL	DESCRIPTION
Password	This field is not available when you select **TLS** in the **Authentication Type** field. Enter the password associated with the user name above.
Certificate	This field is only available when you select **TLS** in the **Authentication Type** field. Click **Browse** to select a certificate. **Note:** You must first have a wired connection to a network and obtain the certificate(s) from a certificate authority (CA). Consult your network administrator for more information.
Server CA	Select a certificate authority (CA) that you trust and accept any certificates signed by the CA. Otherwise, select **Trust Any** to accept certificates from any CA.
PEAP Inner EAP	This field is only available when you select **PEAP** in the **Authentication Type** field. The PEAP method used by the RADIUS server or AP for client authentication is **MS CHAP v2**.
Back	Click **Back** to go to the **Site Survey** screen to select and connect to another network.
Next	Click **Next** to confirm your selections and advance to the **Confirm Save** screen. Refer to Section 4.3.2 on page 43.
Exit	Click **Exit** to return to the **Site Survey** screen without saving.

4.3.1.4 IEEE 802.1x

Configure IEEE 802.1x security with various authentication methods in this screen.

Figure 25 Security Setting: 802.1x



The following table describes the labels in this screen.

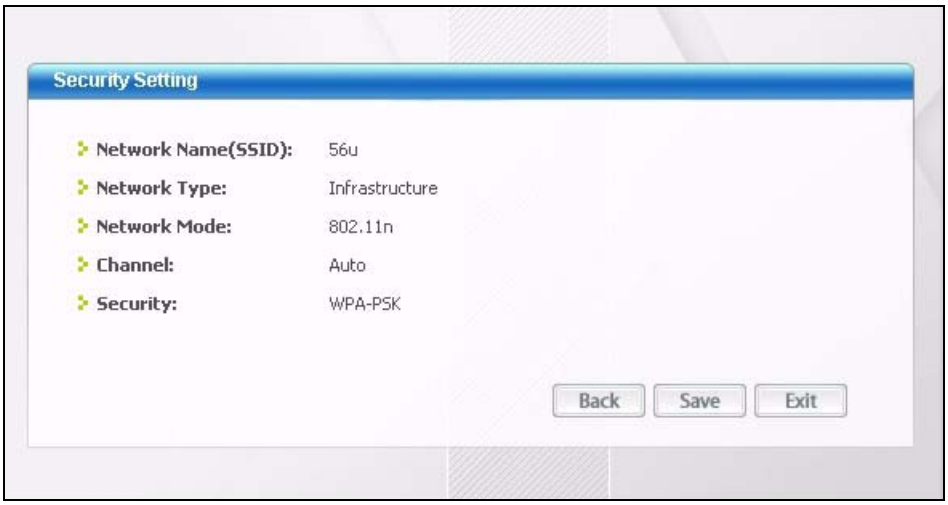
Table 11 Security Settings: IEEE 802.1x

LABEL	DESCRIPTION
Authentication Type	The type of authentication you use depends on the RADIUS server or AP. Select an authentication method from the drop down list. Options are **TLS**, **TTLS** and **PEAP**.
Login Name	Enter a user name. This is the user name that you or an administrator set up on a RADIUS server.
Password	This field is not available when you select **TLS** in the **Authentication Type** field. Enter the password associated with the user name above.
Certificate	This field is only available when you select **TLS** in the **Authentication Type** field. Click **Browse** to select a certificate. **Note:** You must first have a wired connection to a network and obtain the certificate(s) from a certificate authority (CA). Consult your network administrator for more information.
Server CA	Select a certificate authority (CA) that you trust and accept any certificates signed by the CA. Otherwise, select **Trust Any** to accept certificates from any CA.
PEAP Inner EAP	This field is only available when you select **PEAP** in the **Authentication Type** field. The PEAP method used by the RADIUS server or AP for client authentication is **MS CHAP v2**.
Back	Click **Back** to go to the **Site Survey** screen to select and connect to another network.
Next	Click **Next** to confirm your selections and advance to the **Confirm Save** screen. Refer to Section 4.3.2 on page 43.
Exit	Click **Exit** to return to the **Site Survey** screen without saving.

4.3.2 Confirm Save Screen

Use this screen to confirm and save the security settings.

Figure 26 Confirm Save Screen



The following table describes the labels in this screen.

Table 12 Confirm Save Screen

LABEL	DESCRIPTION
Security Setting	
Network Name (SSID)	This field displays the SSID previously entered.
Network Type	This field displays the network type (**Infrastructure** or **Ad-Hoc**) of the wireless device.
Network Mode	This field displays the wireless standard (**802.11b**, **802.11g** or **802.11n**) used by the selected wireless device.
Channel	This field displays the channel number used by the profile.
Security	This field shows whether data encryption is activated (**WEP**, **WPA**, **WPA-PSK**, **WPA2**, **WPA2-PSK**, **802.1x**) or inactive (**DISABLE**).
Back	Click **Back** to return to the previous screen.
Save	Click **Save** to save the changes back to the NWD-170N and display the **Link Info** screen.
Exit	Click **Exit** to discard changes and return to the **Site Survey** screen.

4.4 The Profile Screen

A profile is a set of wireless parameters that you need to connect to a wireless network. With a profile activated, each time you start the NWD-170N, it automatically scans for the specific SSID and joins that network with the pre-defined wireless security settings. If the specified network is not available, the NWD-170N cannot connect to a network.

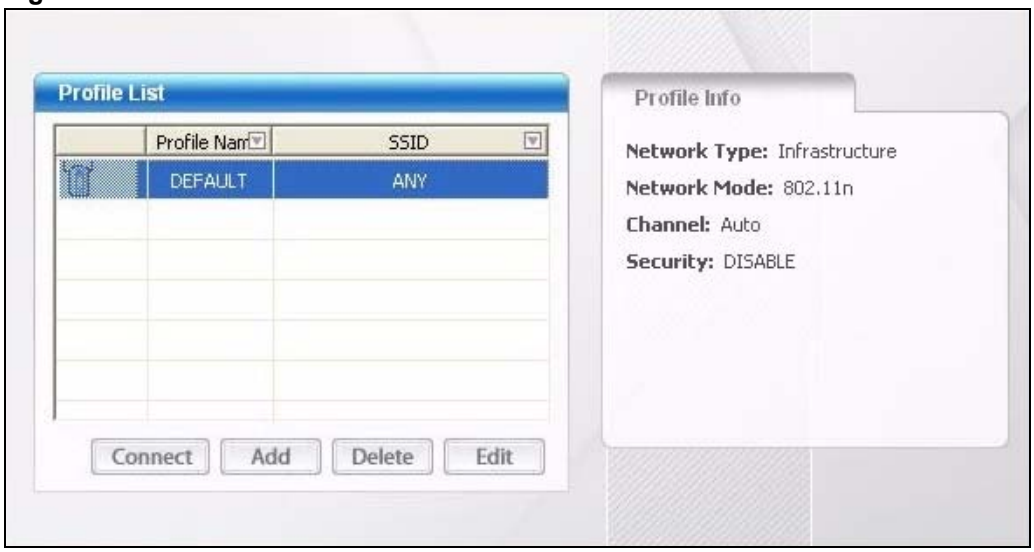
If you do not configure and activate a profile, each time you start the NWD-170N, the NWD-170N uses the default profile to connect to any available network that has no security enabled.

The default profile is a profile that allows you to connect to any SSID that has no security enabled.

Click the **Profile** tab in the ZyXEL utility program to display the **Profile** screen as shown next.

The profile function allows you to save the wireless network settings in this screen, or use one of the pre-configured network profiles.

Figure 27 Profile



The following table describes the labels in this screen.

Table 13 Profile

LABEL	DESCRIPTION
Profile List	Click a column heading to sort the entries.
, , or	denotes that the wireless device is in infrastructure mode and the wireless security is activated. denotes that the wireless device is in infrastructure mode but the wireless security is deactivated. denotes that the wireless device is in Ad-Hoc mode and the wireless security is activated. denotes that the wireless device is in Ad-Hoc mode but the wireless security is deactivated.
Profile Name	This is the name of the pre-configured profile.
SSID	This is the SSID of the wireless network to which the selected profile associate.
Connect	To use and activate a previously saved network profile, select a pre-configured profile name in the table and click **Connect**.
Add	To add a new profile into the table, click **Add**.
Delete	To delete an existing wireless network configuration, select a profile in the table and click **Delete**.
Edit	To edit an existing wireless network configuration, select a profile in the table and click **Edit**.

Table 13 Profile (continued)

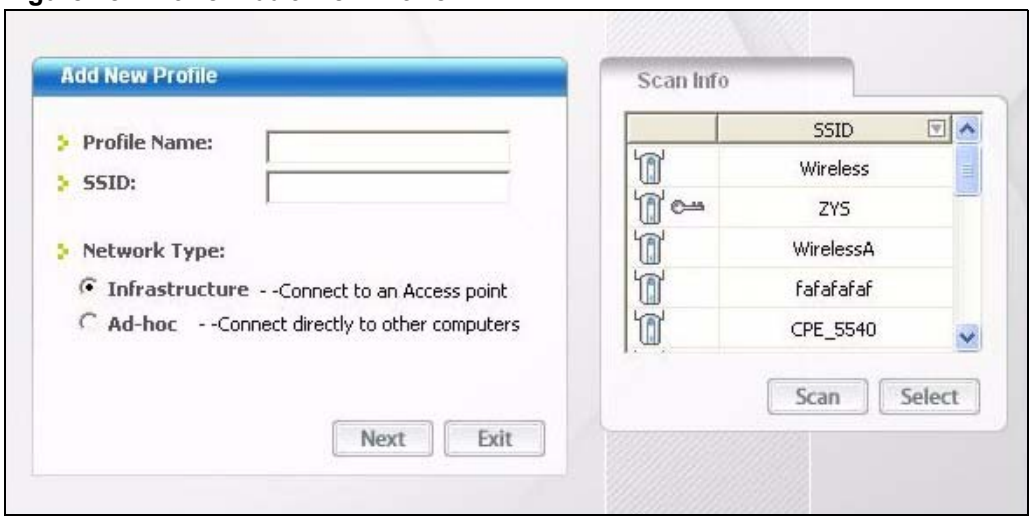
LABEL	DESCRIPTION
Profile Info	The following fields display detailed information of the selected profile in the **Profile List** table.
Network Type	This field displays the network type (**Infrastructure** or **Ad-Hoc**) of the profile.
Network Mode	This field displays the wireless standard (**802.11b**, **802.11g** or **802.11n**) used by the selected wireless device.
Channel	This field displays the channel number used by the profile.
Security	This field shows whether data encryption is activated (**WEP**, **WPA**, **WPA-PSK**, **WPA2**, **WPA2-PSK** or **802.1x**) or inactive (**DISABLE**).
Transfer Rate	This field displays the transmission speed of the selected profile in megabits per second (Mbps).

4.4.1 Adding a New Profile

Follow the steps below to add a new profile.

1 Click **Add** in the **Profile** screen. An **Add New Profile** screen displays as shown next. Click **Next** to continue.

Figure 28 Profile: Add a New Profile



The following table describes the labels in this screen.

Table 14 Profile: Add a New Profile

LABEL	DESCRIPTION
Add New Profile	
Profile Name	Enter a descriptive name in this field.
SSID	Select an available wireless device in the **Scan Info** table and click **Select**, or enter the SSID of the wireless device to which you want to associate in this field manually. Otherwise, enter **Any** to have the NWD-170N associate to any AP or roam between any infrastructure wireless networks.

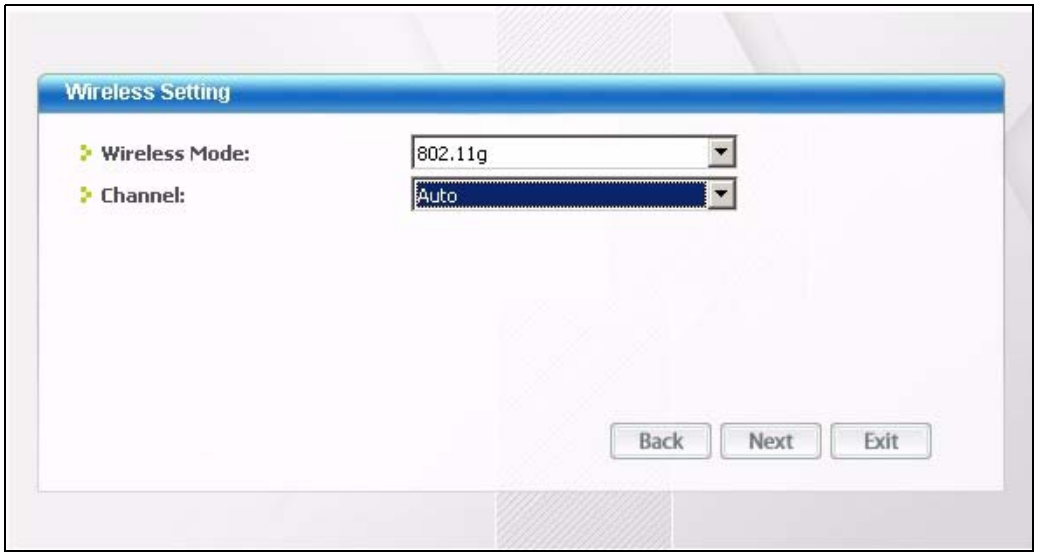
Table 14 Profile: Add a New Profile (continued)

LABEL	DESCRIPTION
Network Type	Select **Infrastructure** to associate to an AP. Select **Ad-Hoc** to associate to a peer computer.
Next	Click **Next** to go to the next screen.
Exit	Click **Exit** to go back to the previous screen without saving.
Scan Info	This table displays the information of the available wireless networks within the transmission range.
, , or	denotes that the wireless device is in infrastructure mode and the wireless security is activated. denotes that the wireless device is in infrastructure mode but the wireless security is deactivated. denotes that the wireless device is in Ad-Hoc mode and the wireless security is activated. denotes that the wireless device is in Ad-Hoc mode but the wireless security is deactivated.
SSID	This field displays the SSID (Service Set IDentifier) of each AP or peer device.
Scan	Click **Scan** to search for available wireless devices within transmission range.
Select	Select an available wireless device in the table and click **Select** to add it to this profile. Whenever you activate this profile, the NWD-170N associates to the selected wireless network only.

2 If you select the **Infrastructure** network type in the previous screen, skip to step 3. If you select the **Ad-Hoc** network type in the previous screen, a screen displays as follows. Select a channel number and click **Next** to continue.

Note: To associate to an ad-hoc network, you must use the same channel as the peer computer.

Figure 29 Profile: Wireless Settings



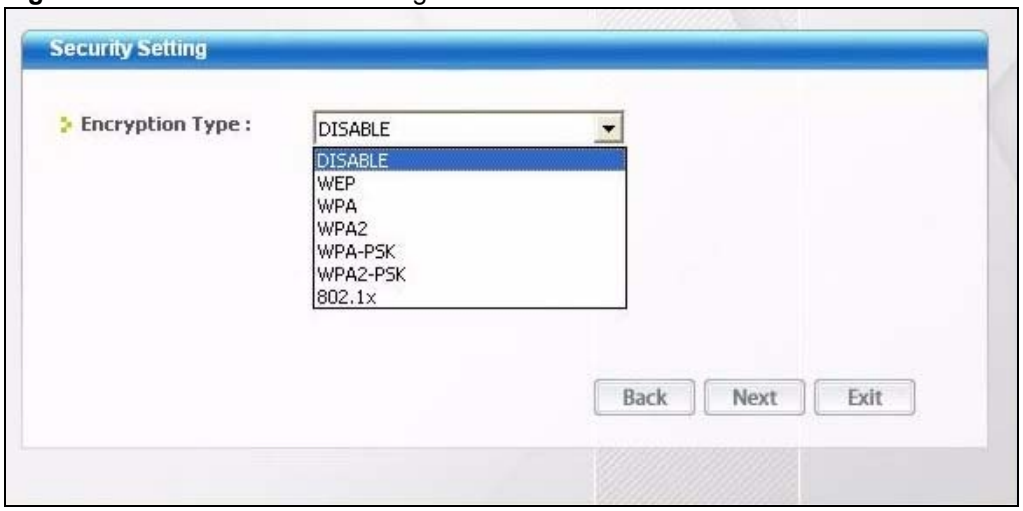
The following table describes the labels in this screen.

Table 15 Profile: Wireless Settings

LABEL	DESCRIPTION
Wireless Settings	
Wireless Mode	This is the wireless standard the NWD-170N uses. In Ad-Hoc mode, you can use only 802.11g.
Channel	Select a channel number from the drop-down list box. To associate to an ad-hoc network, you must use the same channel as the peer computer.

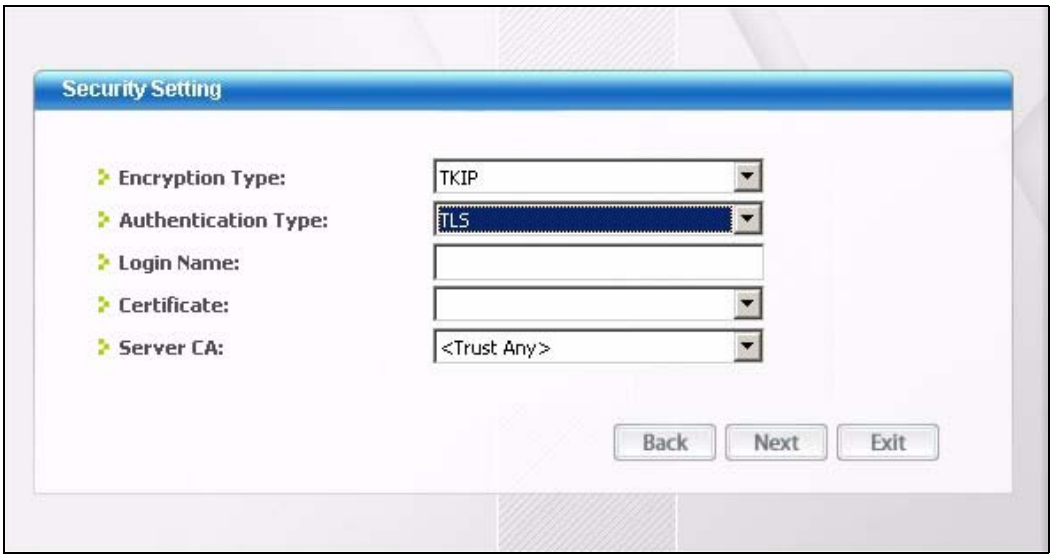
3 If you selected **Infrastructure** network type in the first screen, select **WEP**, **WPA**, **WPA2**, **WPA-PSK**, **WPA2-PSK** or **802.1x** from the drop-down list box to enable data encryption. If you selected **Ad-Hoc** network type in the first screen, you can use only **WEP** encryption method. Otherwise, select **DISABLE** to allow the NWD-170N to communicate with the access points or other peer wireless computers without any data encryption, and skip to step 5.

Figure 30 Profile: Wireless Settings



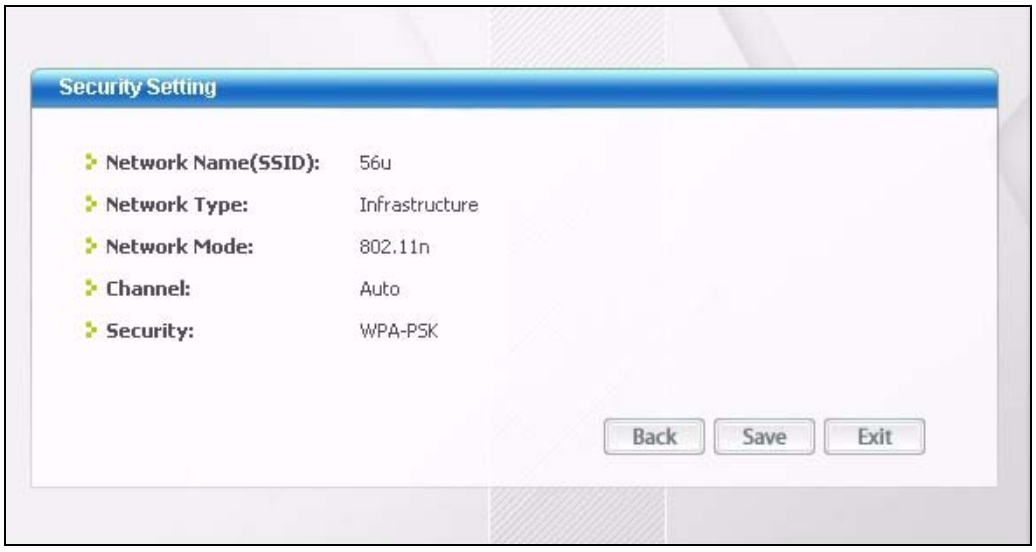
4 The screen varies depending on the encryption method you select in the previous screen. The settings must be exactly the same on the APs or other peer wireless computers as they are on the NWD-170N. Refer to Section 4.3.1 on page 39 for detailed information on wireless security configuration.

Figure 31 Profile: Security Settings



5 This read-only screen shows a summary of the new profile settings. Verify that the settings are correct. Click **Save** to save and go to the next screen. Click **Back** to return to the previous screen. Otherwise, click **Exit** to go back to the **Profile** screen without saving.

Figure 32 Profile: Confirm New Settings



6 To use this network profile, click the **Activate Now** button. Otherwise, click the **Activate Later** button. You can activate only one profile at a time.

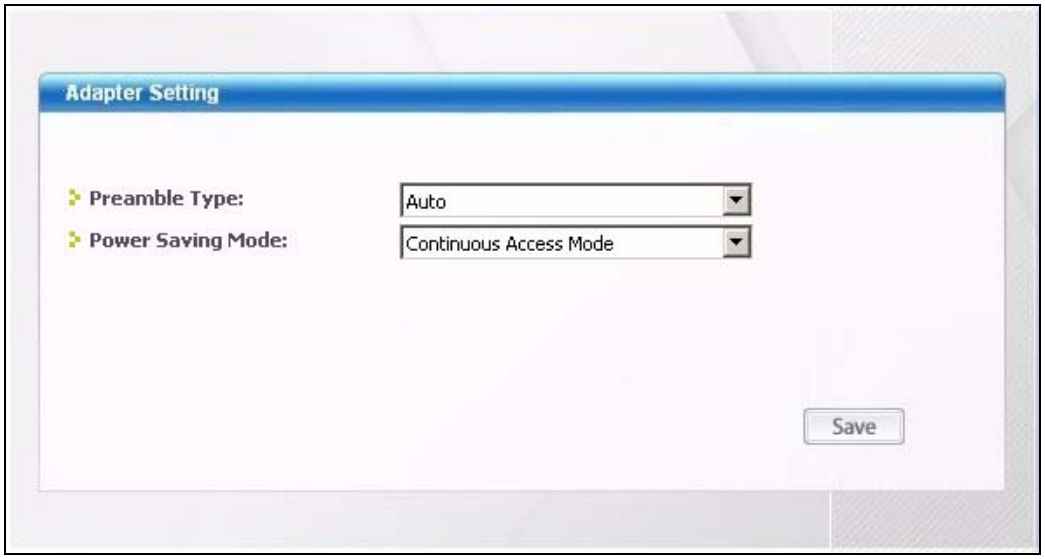
Note: Once you activate a profile, the ZyXEL utility will use that profile the next time it is started.

Figure 33 Profile: Activate the Profile

4.5 The Adapter Screen

To set the other advanced features on the NWD-170N, click the **Adapter** tab.

Figure 34 Adapter



The following table describes the labels in this screen.

Table 16 Adapter

LABEL	DESCRIPTION
Adapter Setting	
Preamble Type	Preamble is used to signal that data is coming to the receiver. Select the preamble type that the AP uses. **Short** preamble increases performance as less time sending preamble means more time for sending data. All IEEE 802.11b/g compliant wireless adapters support **Long** preamble, but not all support short preamble. Select **Auto** to have the NWD-170N automatically use short preamble when the access point supports it; otherwise the NWD-170N uses long preamble. **Note:** The NWD-170N and the access point MUST use the same preamble mode in order to communicate.

Table 16 Adapter (continued)

LABEL	DESCRIPTION
Power Saving Mode	Select **Maximum Power Save** or **Fast Power Save** to save power (especially for notebook computers). This forces the NWD-170N to go to sleep mode when it is not transmitting data. When you select **Continuous Access Mode**, the NWD-170N will never go to sleep mode.
Save	Click **Save** to save the changes to the NWD-170N and return to the **Link Info** screen.

CHAPTER 5
Maintenance

This chapter describes how to uninstall or upgrade the ZyXEL utility.

5.1 The About Screen

The **About** screen displays driver and utility version numbers of the NWD-170N. To display the screen as shown below, click the about ( ) button.

Figure 35 About

The following table describes the read-only fields in this screen.

Table 17 About

LABEL	DESCRIPTION
Driver Version	This field displays the version number of the NWD-170N driver.
Utility Version	This field displays the version number of the ZyXEL utility.

5.2 Uninstalling the ZyXEL Utility

Follow the steps below to remove (or uninstall) the ZyXEL utility from your computer.

Note: Before you uninstall the ZyXEL utility, take note of your current wireless configurations.

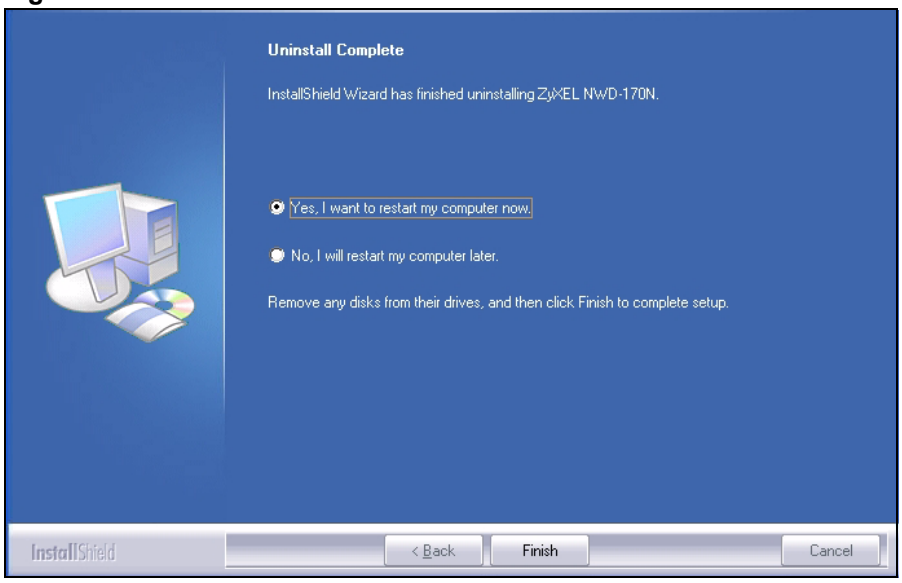
1 Click **Start**, **(All) Programs**, **ZyXEL NWD-170N Utility**, **Uninstall ZyXEL NWD-170N Wireless CardBus Card Utility**.

2 When prompted, click **OK** or **Yes** to remove the driver and the utility software.

Figure 36 Uninstall: Confirm

3 Click **Finish** to complete uninstalling the software and restart the computer when prompted.

Figure 37 Uninstall: Finish



5.3 Upgrading the ZyXEL Utility

Note: Before you uninstall the ZyXEL utility, take note of your current wireless configurations.

To perform the upgrade, follow the steps below.

1 Download the latest version of the utility from the ZyXEL web site and save the file on your computer.

2 Follow the steps in Section 5.2 on page 53 to remove the current ZyXEL utility from your computer.

3 Restart your computer when prompted.

4 Disconnect the NWD-170N from your computer.

5 Double-click on the setup program for the new utility to start the ZyXEL utility installation.

6 Insert the NWD-170N and check the version numbers in the **About** screen to make sure the new utility is installed properly.

CHAPTER 6
Troubleshooting

This chapter covers potential problems and the possible remedies. After each problem description, some instructions are provided to help you to diagnose and to solve the problem.

6.1 Problems Starting the ZyXEL Utility

Table 18 Troubleshooting Starting ZyXEL Utility

PROBLEM	CORRECTIVE ACTION
Cannot start the ZyXEL Wireless LAN utility	Make sure the NWD-170N is properly inserted and the LEDs are on. Refer to the Quick Start Guide for the LED descriptions. Use the **Device Manager** to check for possible hardware conflicts. Click **Start**, **Settings**, **Control Panel**, **System**, **Hardware** and **Device Manager**. Verify the status of the NWD-170N under **Network Adapter**. (Steps may vary depending on the version of Windows). Install the NWD-170N in another computer. If the error persists, you may have a hardware problem. In this case, you should contact your local vendor.
The ZyXEL utility icon does not display.	If you have installed the Funk Odyssey Client software on the computer, uninstall (remove) both the Funk Odyssey Client software and ZyXEL utility, and then install the ZyXEL utility again after restarting the computer.

6.2 Problems with the Link Quality

Table 19 Troubleshooting Link Quality

PROBLEM	CORRECTIVE ACTION
The link quality and/or signal strength is poor.	Search and connect to another AP with a better link quality using the **Site Survey** screen. Move your computer closer to the AP or the peer computer(s) within the transmission range. There may be too much radio interference (for example microwave or another AP using the same channel) around your wireless network. Lower the output power of each AP. Make sure there are not too many wireless stations connected to a wireless network.

6.3 Problems Communicating With Other Computers

Table 20 Troubleshooting Communication Problems

PROBLEM	CORRECTIVE ACTION
The computer with the NWD-170N installed cannot communicate with the other computer(s).	In Infrastructure Mode • Make sure that the AP and the associated computers are turned on and working properly. • Make sure the NWD-170N computer and the associated AP use the same SSID. • Change the AP and the associated wireless clients to use another radio channel if interference is high. • Make sure that the computer and the AP share the same security option and key. Verify the settings in the **Profile Security Setting** screen. • If you are using WPA(2) or WPA(2)-PSK security, try changing your encryption type from TKIP to AES or vice versa. In Ad-Hoc (IBSS) Mode • Verify that the peer computer(s) is turned on. • Make sure the NWD-170N computer and the peer computer(s) are using the same SSID and channel. • Make sure that the computer and the peer computer(s) share the same security settings. • Change the wireless clients to use another radio channel if interference is high.

APPENDIX A
Product Specifications

Table 21 Product Specifications

PHYSICAL AND ENVIRONMENTAL	
Product Name	NWD-170N Draft 802.11n Wireless CardBus Card
Interface	Cardbus 32-bit
Standards	IEEE 802.11b IEEE 802.11g IEEE 802.11n (draft)
Network Architecture	Infrastructure
Operating Temperature	0 ~ 50 degrees Centigrade
Storage Temperature	-30 ~ 60 degrees Centigrade
Operating Humidity	20 ~ 95% (non-condensing)
Storage Humidity	20 ~ 95% (non-condensing)
Power	TX power consumption: < 690 mA RX power consumption: < 600 mA
Voltage	3.3 V
Weight	40 g
Dimension	(W) 115 mm × (D) 53 mm × (H) 6 mm
RADIO SPECIFICATIONS	
Media Access Protocol	IEEE 802.11
Frequency	Industrial Scientific Medical Band 2.4 ~ 2.4835 GHz (IEEE 802.11b/g)
Operating Channels	North American and Taiwan: 11 Europe: 13
Data Rate	IEEE 802.11b: 11Mbps with automatic fallback to 5.5, 2, 1 Mbps IEEE 802.11g: 54Mbps with automatic fallback to 48, 36, 24, 18, 12, 9, 6 Mbps IEEE 802.11n (draft): up to 300 Mbps
Modulation	IEEE 802.11b: CCK (11 and 5.5 Mbps), DQPSK (2 Mbps) and DBPSK (1 Mbps) IEEE 802.11g: OFDM with BPSK, QPSK and 16/64-QAM sub-Carrier modulations
Average Output Power	Tolerance: +/- 1.5 dBm IEEE 802.11b: 18 dBm at 11 Mbps IEEE 802.11g: 15 dBm at 54 Mbps IEEE 802.11n (draft): 14 dBm at HT20 & HT40

Table 21 Product Specifications (continued)

RX Sensitivity	Tolerance: +/- 1 dBm IEEE 802.11b: -84 dBm at 11 Mbps IEEE 802.11g: -72 dBm at 54 Mbps IEEE 802.11n (draft): -70 dBm at HT40
SOFTWARE SPECIFICATIONS	
Device Drivers	Windows 2000, Windows XP
Security	64/128/152-bit WEP WPA/WPA-PSK/WPA2/WPA2-PSK IEEE 802.1x
Roaming	IEEE 802.11b/g/n (draft) compliant

APPENDIX B
Management with Wireless Zero Configuration

This appendix shows you how to manage your NWD-170N using the Windows XP wireless zero configuration tool.

Be sure you have the Windows XP service pack 2 installed on your computer. Otherwise, you should at least have the Windows XP service pack 1 already on your computer and download the support patch for WPA from the Microsoft web site.

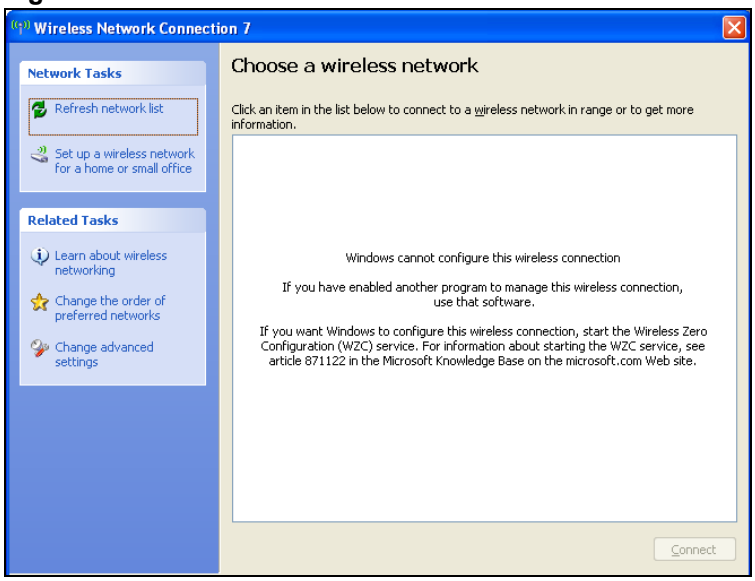
Windows XP SP2 screen shots are shown unless otherwise specified. Click the help icon ( ) in most screens, move the cursor to the item that you want the information about and click to view the help.

Activating Wireless Zero Configuration

Make sure the **Use Windows to configure my wireless network settings** check box is selected in the **Wireless Network Connection Properties** screen. Refer to Appendix C on page 71.

If you see the following screen, refer to article 871122 on the Microsoft web site for information on starting WZC.

Figure 38 Windows XP SP2: WZC Not Available



Connecting to a Wireless Network

1 Double-click the network icon for wireless connections in the system tray to open the Wireless Network Connection Status screen.

Figure 39 Windows XP SP2: System Tray Icon

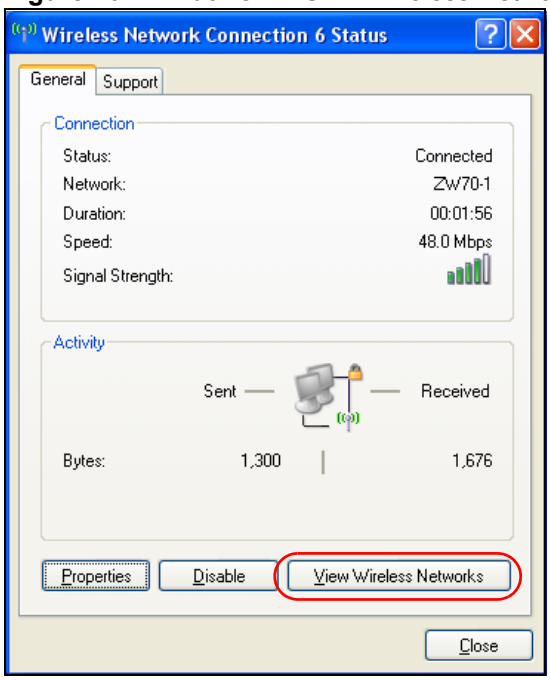
The type of the wireless network icon in Windows XP SP2 indicates the status of the NWD-170N. Refer to the following table for details.

Table 22 Windows XP SP2: System Tray Icon

ICON	DESCRIPTION
	The NWD-170N is connected to a wireless network.
	The NWD-170N is in the process of connecting to a wireless network.
	The connection to a wireless network is limited because the network did not assign a network address to the computer.
	The NWD-170N is not connected to a wireless network.

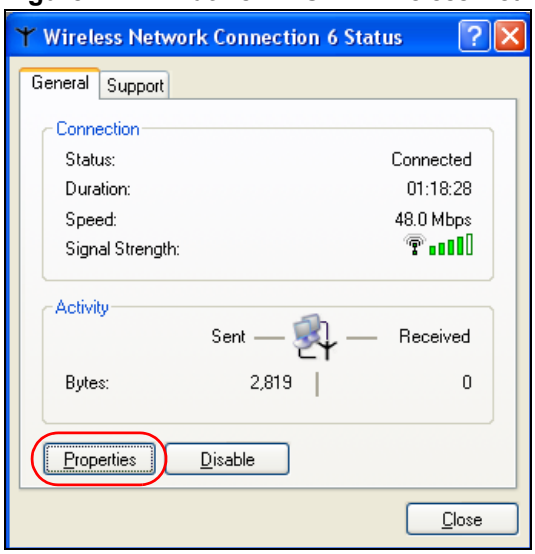
2 Windows XP SP2: In the **Wireless Network Connection Status** screen, click **View Wireless Networks** to open the **Wireless Network Connection** screen.

Figure 40 Windows XP SP2: Wireless Network Connection Status



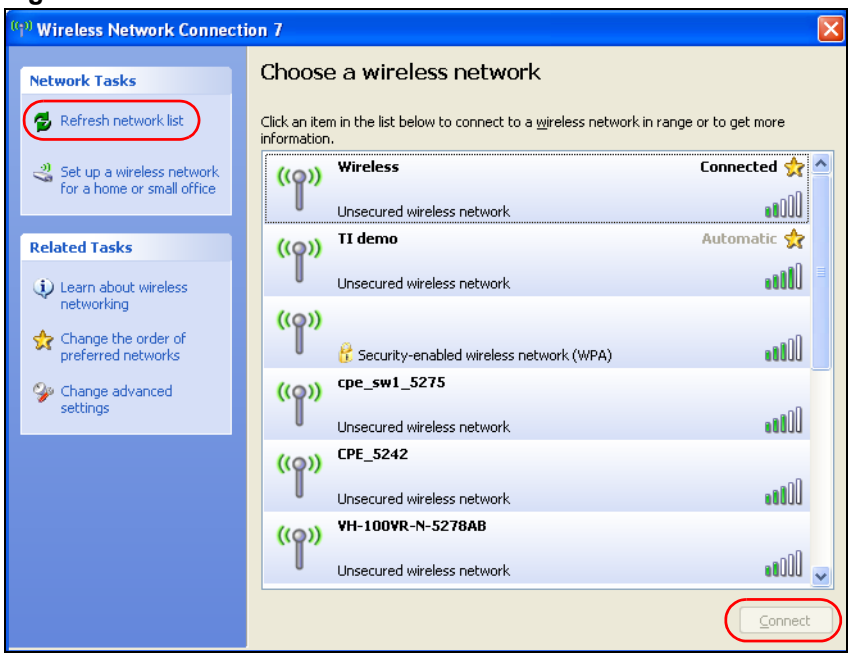
Windows XP SP1: In the **Wireless Network Connection Status** screen, click **Properties** and the **Wireless Networks** tab to open the **Wireless Network Connection Properties** screen.

Figure 41 Windows XP SP1: Wireless Network Connection Status



3 Windows XP SP2: Click **Refresh network list** to reload and search for available wireless devices within transmission range. Select a wireless network in the list and click **Connect** to join the selected wireless network.

Figure 42 Windows XP SP2: Wireless Network Connection



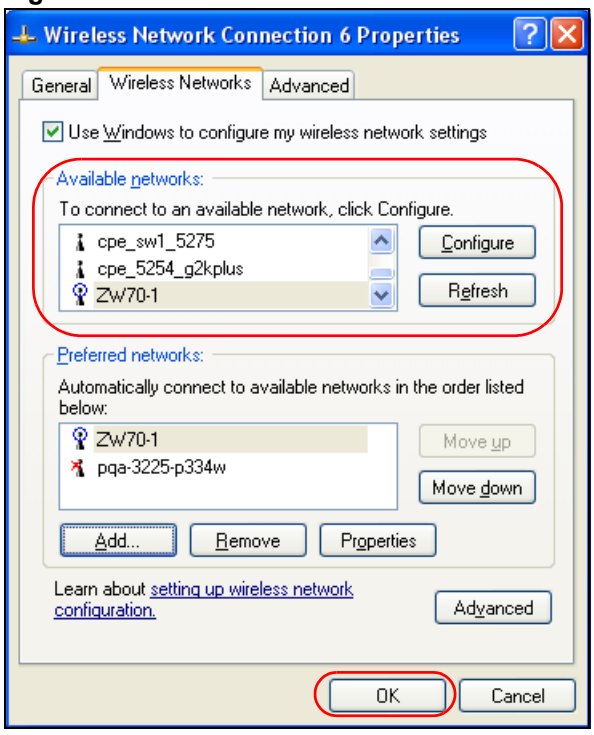
The following table describes the icons in the wireless network list.

Table 23 Windows XP SP2: Wireless Network Connection

ICON	DESCRIPTION
	This denotes that wireless security is activated for the wireless network.
	This denotes that this wireless network is your preferred network. Ordering your preferred networks is important because the NWD-170N tries to associate to the preferred network first in the order that you specify. Refer to the section on ordering the preferred networks for detailed information.
	This denotes the signal strength of the wireless network. Move your cursor to the icon to see details on the signal strength.

Windows XP SP1: Click **Refresh** to reload and search for available wireless devices within transmission range. Select a wireless network in the **Available networks** list, click **Configure** and set the related fields to the same security settings as the associated AP to add the selected network into the **Preferred** networks table. Click **OK** to join the selected wireless network. Refer to the section on security settings (discussed later) for more information.

Figure 43 Windows XP SP1: Wireless Network Connection Properties



4 4.Windows XP SP2: If the wireless security is activated for the selected wireless network, the **Wireless Network Connection** screen displays. You must set the related fields in the **Wireless Network Connection** screen to the same security settings as the associated AP and click **Connect**. Refer to the section about security settings for more information. Otherwise click **Cancel** and connect to another wireless network without data encryption.

If there is no security activated for the selected wireless network, a warning screen appears. Click **Connect Anyway** if wireless security is not your concern.

Figure 44 Windows XP SP2: Wireless Network Connection: WEP or WPA-PSK

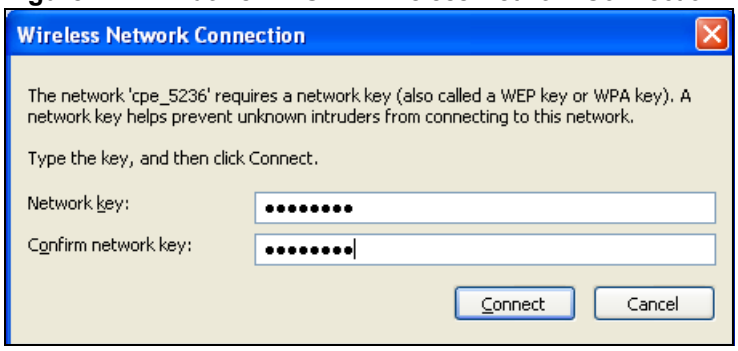


Figure 45 Windows XP SP2: Wireless Network Connection: No Security

5 Verify that you have successfully connected to the selected network and check the connection status in the wireless network list or the connection icon in the **Preferred networks** or **Available networks** list.

The following table describes the connection icons.

Table 24 Windows XP: Wireless Networks

ICON	DESCRIPTION
	This denotes the wireless network is an available wireless network.
	This denotes the NWD-170N is associated to the wireless network.
	This denotes the wireless network is not available.

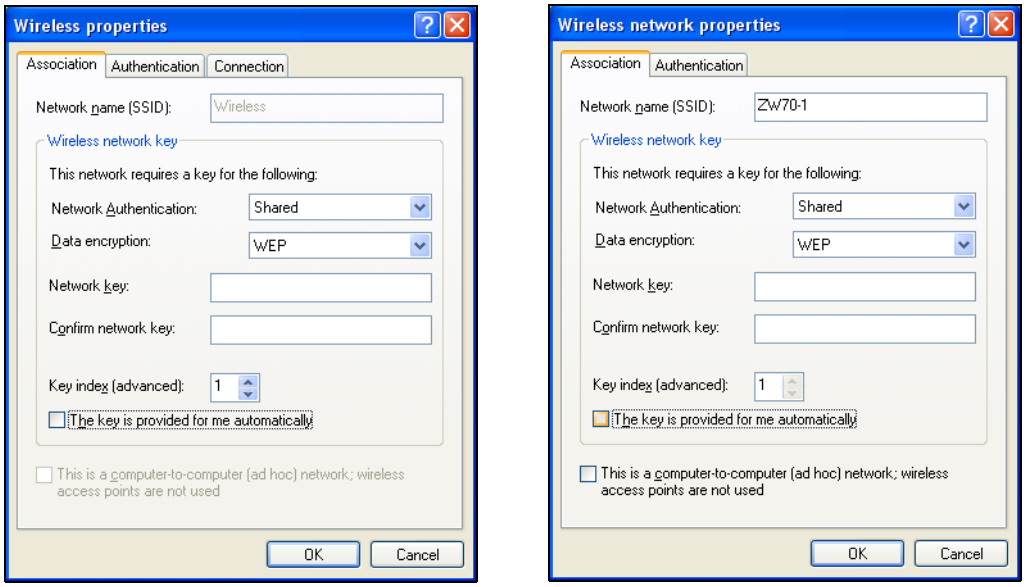
Security Settings

When you configure the NWD-170N to connect to a secure network but the security settings are not yet enabled on the NWD-170N, you will see different screens according to the authentication and encryption methods used by the selected network.

Association

Select a network in the Preferred networks list and click Properties to view or configure security.

Figure 46 Windows XP: Wireless (network) properties: Association



The following table describes the labels in this screen.

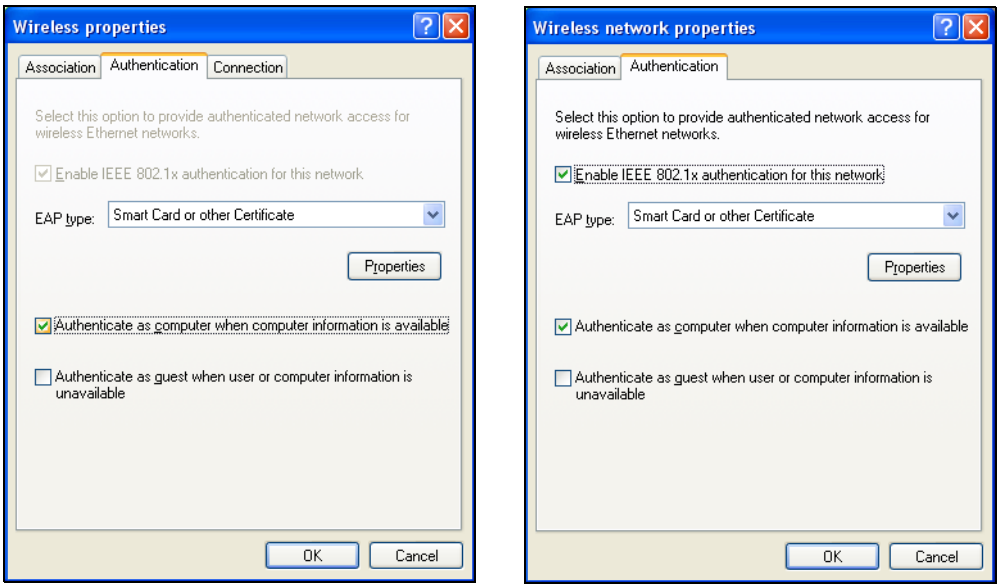
Table 25 Windows XP: Wireless (network) properties: Association

LABEL	DESCRIPTION
Network name (SSID)	This field displays the SSID (Service Set IDentifier) of each wireless network.
Network Authentication	This field automatically shows the authentication method (**Share**, **Open**, **WPA** or **WPA-PSK**) used by the selected network.
Data Encryption	This field automatically shows the encryption type (**TKIP**, **WEP** or **Disable**) used by the selected network.
Network Key	Enter the pre-shared key or WEP key. The values for the keys must be set up exactly the same on all wireless devices in the same wireless LAN.
Confirm network key	Enter the key again for confirmation.
Key index (advanced)	Select a default WEP key to use for data encryption. This field is available only when the network use **WEP** encryption method and the **The key is provided for me automatically** check box is not selected.
The key is provided for me automatically	If this check box is selected, the wireless AP assigns the NWD-170N a key.
This is a computer-to-computer (ad hoc) network; wireless access points are not used	If this check box is selected, you are connecting to another computer directly.
OK	Click **OK** to save your changes.
Cancel	Click **Cancel** to leave this screen without saving any changes you may have made.

Authentication

Click the **Authentication** tab in the **Wireless (network) properties** screen to display the screen shown next. The fields on this screen are grayed out when the network is in Ad-Hoc mode or data encryption is disabled.

Figure 47 Windows XP: Wireless (network) properties: Authentication



The following table describes the labels in this screen.

Table 26 Windows XP: Wireless (network) properties: Authentication

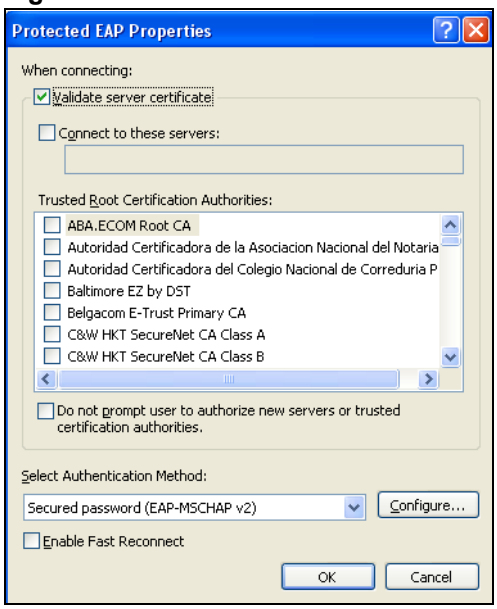
LABEL	DESCRIPTION
Enable IEEE 802.1x authentication for this network	This field displays whether the IEEE 802.1x authentication is active. If the network authentication is set to **Open** in the previous screen, you can choose to disable or enable this feature.
EAP Type	Select the type of EAP authentication. Options are **Protected EAP (PEAP)** and **Smart Card or other Certificate**.
Properties	Click this button to open the properties screen and configure certificates. The screen varies depending on what you select in the **EAP type** field.
Authenticate as computer when computer information is available	Select this check box to have the computer send its information to the network for authentication when a user is not logged on.
Authenticate as guest when user or computer information is unavailable	Select this check box to have the computer access to the network as a guest when a user is not logged on or computer information is not available.
OK	Click **OK** to save your changes.
Cancel	Click **Cancel** to leave this screen without saving any changes you may have made.

Authentication Properties

Select an EAP authentication type in the **Wireless (network) properties: Authentication** screen and click the **Properties** button to display the following screen.

Protected EAP Properties

Figure 48 Windows XP: Protected EAP Properties



The following table describes the labels in this screen.

Table 27 Windows XP: Protected EAP Properties

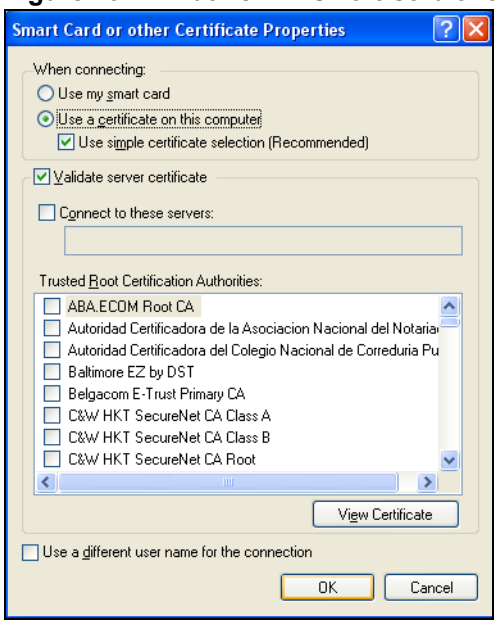
LABEL	DESCRIPTION
Validate server certificate	Select the check box to verify the certificate of the authentication server.
Connect to these servers	Select the check box and specify a domain in the field below to have your computer connect to a server which resides only within this domain.
Trusted Root Certification Authorities:	Select a trusted certification authority from the list below. **Note:** You must first have a wired connection to a network and obtain the certificate(s) from a certificate authority (CA). Consult your network administrator for more information.
Do not prompt user to authorize new server or trusted certification authorities.	Select this check box to verify a new authentication server or trusted CA without prompting. This field is available only if you installed the Windows XP server pack 2.
Select Authentication Method:	Select an authentication method from the drop-down list box and click **Configure** to do settings.

Table 27 Windows XP: Protected EAP Properties

LABEL	DESCRIPTION
Enable Fast Reconnect	Select the check box to automatically reconnect to the network (without re-authentication) if the wireless connection goes down.
OK	Click **OK** to save your changes.
Cancel	Click **Cancel** to leave this screen without saving any changes you may have made.

Smart Card or other Certificate Properties

Figure 49 Windows XP: Smart Card or other Certificate Properties



The following table describes the labels in this screen.

Table 28 Windows XP: Smart Card or other Certificate Properties

LABEL	DESCRIPTION
Use my smart card	Select this check box to use the smart card for authentication.
Use a certificate on this computer	Select this check box to use a certificate on your computer for authentication.
Validate server certificate	Select the check box to check the certificate of the authentication server.
Connect to these servers	Select the check box and specify a domain in the field below to have your computer connect to a server which resides only within this domain.
Trusted Root Certification Authorities:	Select a trusted certification authority from the list below. **Note:** You must first have a wired connection to a network and obtain the certificate(s) from a certificate authority (CA). Consult your network administrator for more information.
View Certificate	Click this button if you want to verify the selected certificate.

Table 28 Windows XP: Smart Card or other Certificate Properties

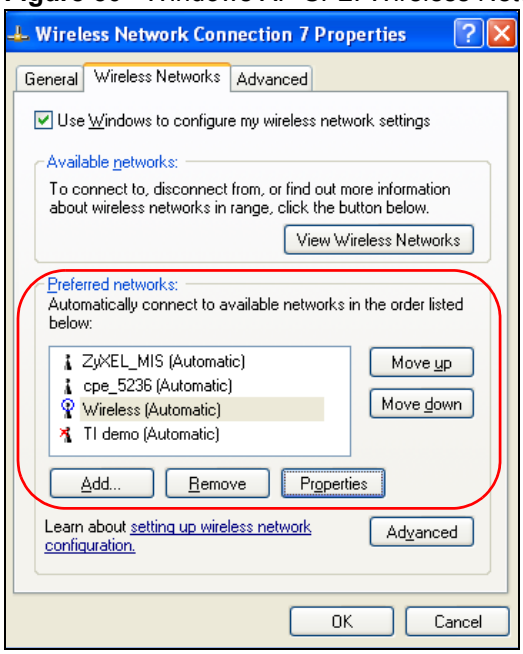
LABEL	DESCRIPTION
Use a different user name for the connection:	Select the check box to use a different user name when the user name in the smart card or certificate is not the same as the user name in the domain that you are logged on to.
OK	Click **OK** to save your changes.
Cancel	Click **Cancel** to leave this screen without saving any changes you may have made.

Ordering the Preferred Networks

Follow the steps below to manage your preferred networks.

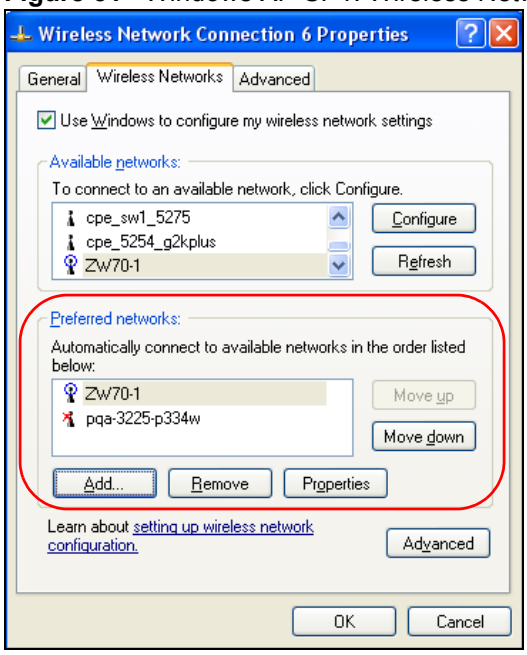
1 Windows XP SP2: Click **Change the order of preferred networks** in the **Wireless Network Connection** screen (see Figure 42 on page 61). The screen displays as shown.

Figure 50 Windows XP SP2: Wireless Networks: Preferred Networks



Windows XP SP1: In the **Wireless Network Connection Status** screen, click **Properties** and the **Wireless Networks** tab to open the screen as shown.

Figure 51 Windows XP SP1: Wireless Networks: Preferred Networks



2 Whenever the NWD-170N tries to connect to a new network, the new network is added in the **Preferred networks** table automatically. Select a network and click **Move up** or **Move down** to change it's order, click **Remove** to delete it or click **Properties** to view the security, authentication or connection information of the selected network. Click **Add** to add a preferred network into the list manually.

APPENDIX C
Wireless Security

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 station. The wireless station '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 stations 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 screen. You may still configure and store keys here, 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 29 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(2) 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

Both WPA and WPA2 improve data encryption by using Temporal Key Integrity Protocol (TKIP), Message Integrity Check (MIC) and IEEE 802.1x. WPA and WPA2 use Advanced Encryption Standard (AES) in the Counter mode with Cipher block chaining Message authentication code Protocol (CCMP) to offer stronger encryption than TKIP.

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 stations. 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 stations 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.

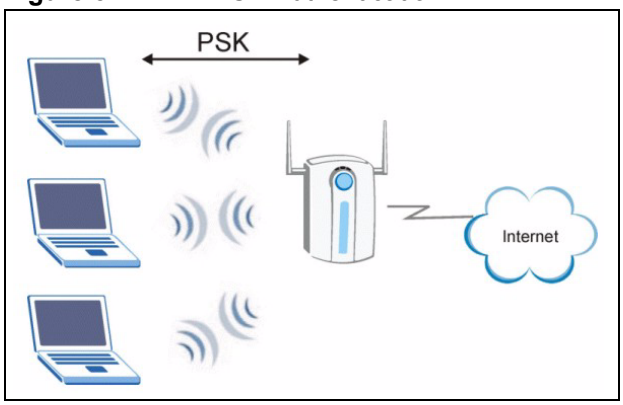
Pre-authentication enables fast roaming by allowing the wireless client (already connecting to an AP) to perform IEEE 802.1x authentication with another AP before connecting to it.

WPA(2)-PSK Application Example

A WPA(2)s-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 client's password and (only) allows it to join the network if it matches its password.
3. The AP and wireless clients use the pre-shared key to generate a common PMK.
4. The AP and wireless clients use the TKIP or AES encryption process to encrypt data exchanged between them.

Figure 52 WPA-PSK Authentication

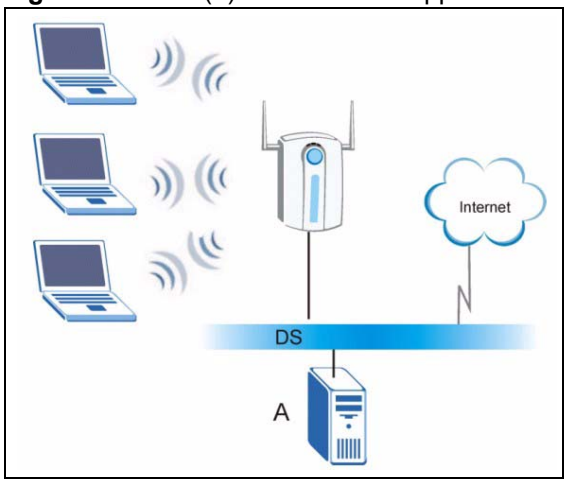


WPA(2) with RADIUS Application Example

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. 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 pair-wise key to dynamically generate unique data encryption keys to encrypt every data packet that is wirelessly communicated between the AP and the wireless clients.

Figure 53 WPA(2) with RADIUS Application Example



Security Parameters Summary

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

Table 30 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

APPENDIX D
Setting up Your Computer's IP Address

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

Windows 98/Me/2000/XP 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.

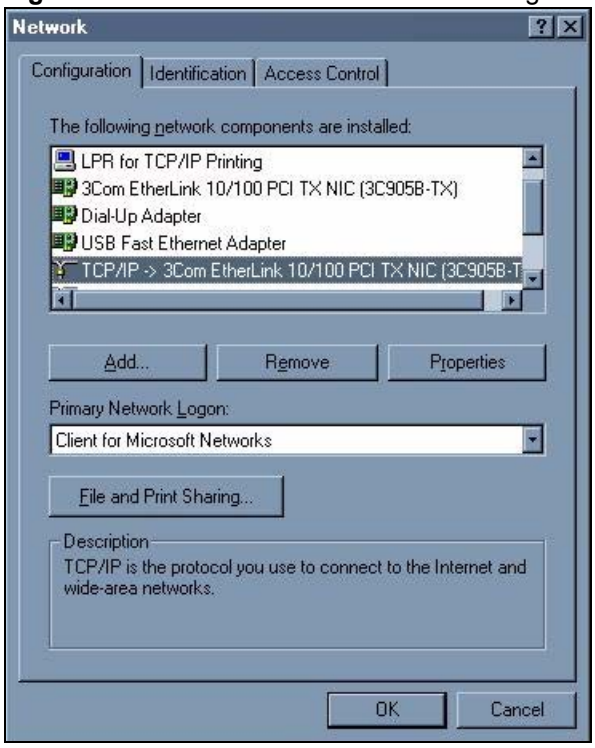
TCP/IP should already be installed on computers using Windows 2000 and XP.

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

Windows 98/Me

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

Figure 54 WIndows 98/Me: Network: Configuration



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.

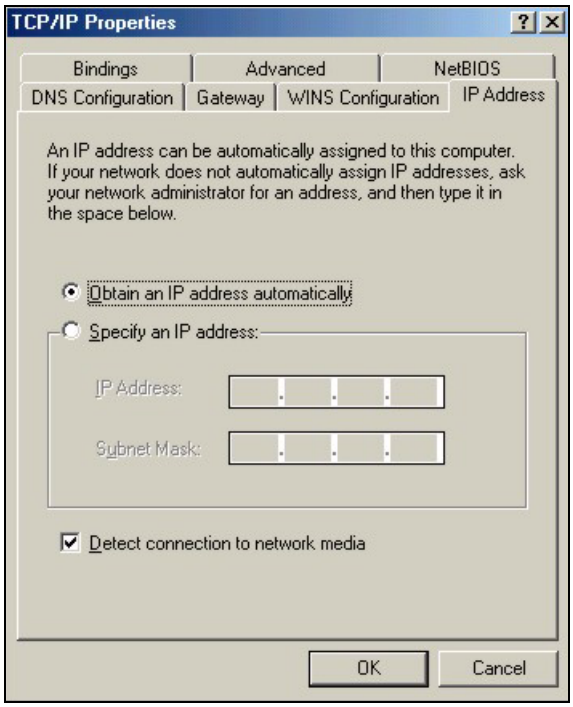
Configuring

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.

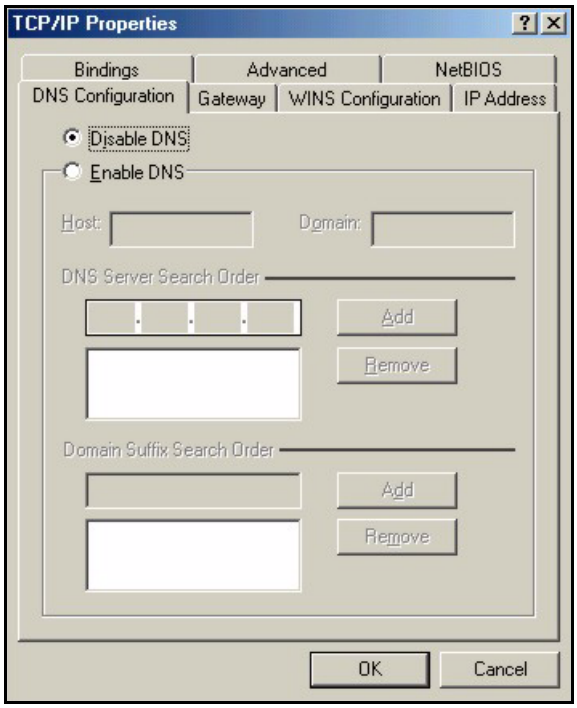
Figure 55 Windows 98/Me: TCP/IP Properties: IP Address



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 56 Windows 98/Me: TCP/IP Properties: DNS Configuration



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 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/XP

1 For Windows XP, click **start**, **Control Panel**. In Windows 2000, click **Start**, **Settings**, **Control Panel**.

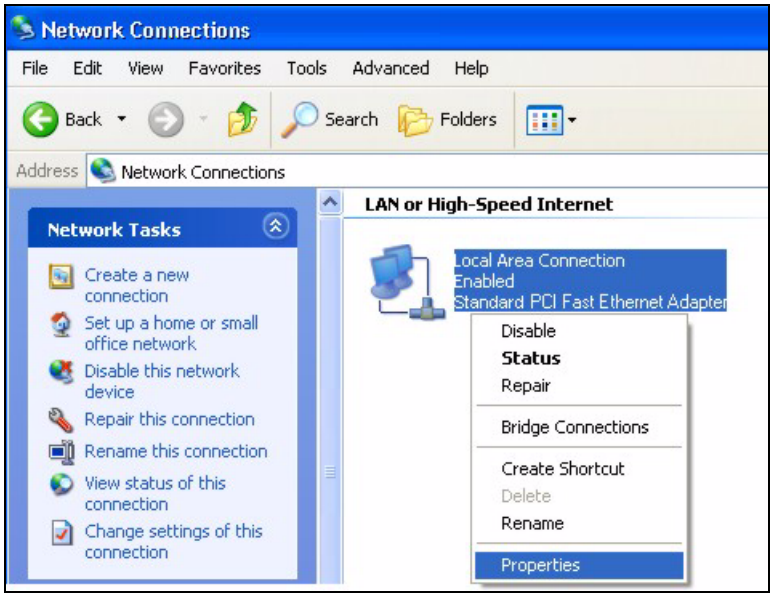
Figure 57 Windows XP: Start Menu

2 For Windows XP, click **Network Connections**. For Windows 2000, click **Network and Dial-up Connections**.

Figure 58 Windows XP: Control Panel

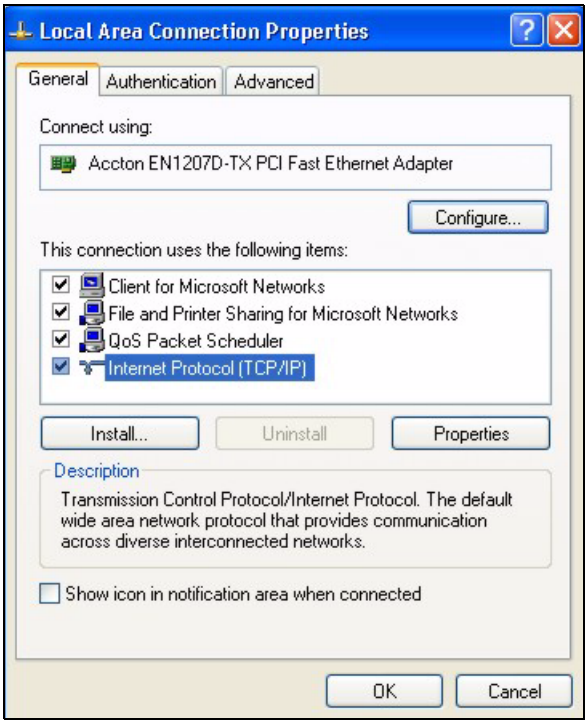
3 Right-click **Local Area Connection** and then click **Properties**.

Figure 59 Windows XP: Control Panel: Network Connections: Properties



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

Figure 60 Windows XP: Local Area Connection Properties

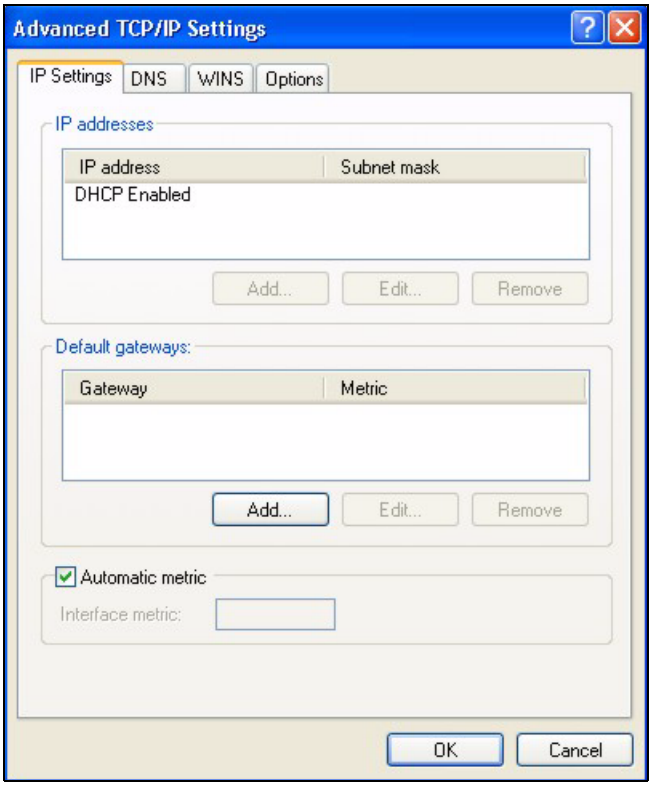


5 The **Internet Protocol TCP/IP Properties** window opens (the **General** tab in Windows XP).

- 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 61 Windows XP: Advanced TCP/IP Settings



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:

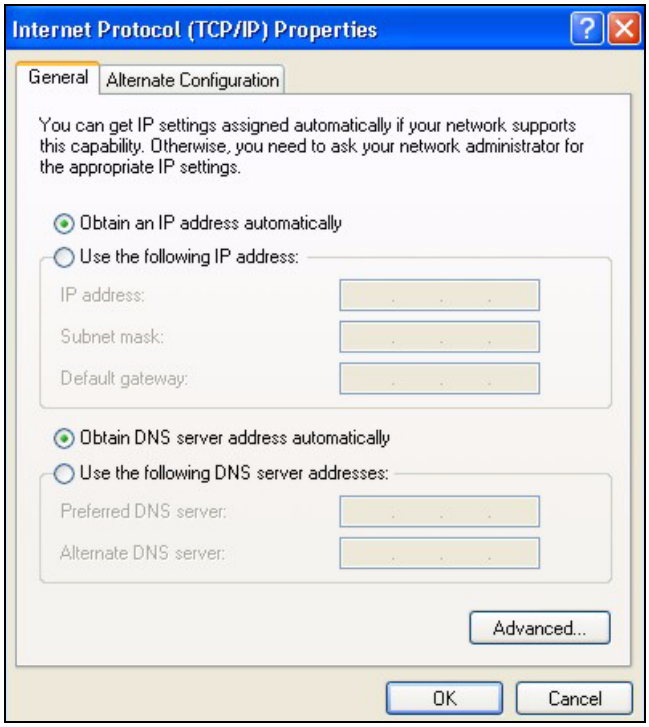
- In the **IP Settings** tab, in **IP addresses**, click **Add**.
- In **TCP/IP Address**, type an IP address in **IP address** and a subnet mask in **Subnet mask**, and then click **Add**.
- Repeat the above two steps for each IP address you want to add.
- Configure additional default gateways in the **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.

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 62 Windows XP: Internet Protocol (TCP/IP) Properties



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

9 Click **OK** to close the **Local Area Connection Properties** window.

10 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.

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