

ZyXEL G-162

802.11g Wireless CardBus Card

User's Guide

Version 1.0

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The Industry Canada label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective operation and safety requirements. The Industry Canada does not guarantee that the equipment will operate to a user's satisfaction.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. In some cases, the company's inside wiring associated with a single line individual service may be extended by means of a certified connector assembly. The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

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Caution

Users should not attempt to make such connections themselves, but should contact the appropriate electrical inspection authority, or electrician, as appropriate.

Note

This digital apparatus does not exceed the Class B limits for radio noise emissions from digital apparatus set out in the radio interference regulations of Industry.

Federal Communications Commission (FCC) Interference Statement¹

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 equipment 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 commercial environment. This equipment 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.

If this equipment does cause harmful interference to radio/television reception, which can be determined by turning the equipment 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.

Notice 1

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

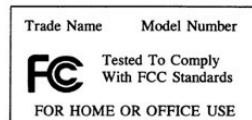
This product has been designed for the WLAN 2.4 GHz network throughout the EC region and Switzerland, with restrictions in France.

Caution

1. This Transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Certifications

Refer to the product page at www.zyxel.com.



¹ Refer to the *Quick Start Guide* for model specific FCC statement(s) and the procedure to view the product's certification(s).

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When contacting your Customer Support Representative, please have the following information ready:

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

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² “+” is the (prefix) number you enter to make an international telephone call.

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FINLAND	support@zyxel.fi	+358-9-4780-8411	www.zyxel.fi	ZyXEL Communications Oy Malminkaari 10 00700 Helsinki Finland

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Preface

Congratulations on the purchase of your new ZyXEL G-162!

About This User's Guide

This manual provides information about the ZyXEL Wireless LAN Utility.

Syntax Conventions

- “Type” or “Enter” means for you to type one or more characters. “Select” or “Choose” means for you to use one of the predefined choices.
- Mouse action sequences are denoted using a comma. For example, “click the Apple icon, **Control Panels** and then **Modem**” means first click the Apple icon, then point your mouse pointer to **Control Panels** and then click **Modem**.
- Window and command choices are in **Bold Times New Roman** font. Predefined field choices are in **Bold Arial** font.
- The ZyXEL G-162 802.11g Wireless CardBus Card is referred to as the ZyXEL G-162 in this guide.
- The ZyXEL Wireless LAN Utility may be referred to as the ZyXEL WLAN Utility or, simply, as the ZyXEL Utility in this guide.










Related Documentation

- Support Disk
Refer to the included CD for support documents and device drivers.
- Quick Start Guide
Our Quick Start Guide is designed to help you get your ZyXEL G-162 up and running right away. It contains a detailed easy-to-follow connection diagram and information on installing your ZyXEL G-162.
- ZyXEL Glossary and Web Site
Please refer to www.zyxel.com for an online glossary of networking terms and additional support documentation.

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.

Graphics Icons Key

 Wireless Access Point	 Computer	 Notebook computer
 Server	 Modem	 Wireless Signal
 Telephone	 Switch	 Router

Chapter 1

Getting Started

This chapter introduces the ZyXEL G-162 and prepares you to use the ZyXEL Utility.

1.1 About Your ZyXEL G-162

The ZyXEL G-162 is an IEEE 802.11g compliant wireless LAN adapter. With the ZyXEL G-162, you can enjoy the wireless mobility within the coverage area.

The following lists the main features of your ZyXEL G-162.

- Your ZyXEL G-162 can communicate with other IEEE 802.11b/g compliant wireless devices.
- Automatic rate selection.
- Data transmission rates up to 54 Mbps.
- Proprietary transmission rates of **22Mbps** and **125 Mbps**
- Offers 64-bit, 128-bit and 256-bit WEP (Wired Equivalent Privacy) data encryption for network security.
- Supports IEEE802.1x and WPA (Wi-Fi Protected Access).
- Low CPU utilization allowing more computer system resources for other programs.
- A built-in antenna.
- Driver support for Windows XP/2000/Me/98 SE.

1.2 ZyXEL G-162 Hardware and Utility Installation

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

1.3 Ways to Configure the ZyXEL G-162

To configure your ZyXEL G-162, use one of the following applications:

In Windows XP:

- ZyXEL Utility
- Zero Configuration
- Funk Odyssey Client

In Windows 98 SE/Me/2000

- ZyXEL Utility
- Funk Odyssey Client

DO NOT use the Windows XP configuration tool or the Funk Odyssey Client and the ZyXEL Utility at the same time.

It is recommended you use the ZyXEL Utility to configure your ZyXEL G-162.

The bundled Funk Odyssey Client only works for your ZyXEL G-162. Do NOT use the Funk Odyssey Client to configure non-ZyXEL WLAN adapters.

Refer to the *User's Guide* of your Funk Odyssey Client for details on how to uninstall (or remove) it.

1.4 Disable Windows XP Wireless LAN Configuration Tool

Windows XP includes a configuration tool for wireless devices.

Follow the steps below to disable the configuration tool in Windows XP after you install the ZyXEL Utility. The screen varies depending on the version of Windows XP service pack.

- Step 1.** Double-click the network icon for wireless connections in the system tray. If the icon is not present, proceed to *Step 2*. Otherwise skip to *Step 5*.



Figure 1-1 Windows XP: System Tray Icon

- Step 2.** If the icon for the wireless network connection is not in the system tray, click **Start, Control Panel** and double-click **Network Connections**.

- Step 3.** Double-click on the icon for wireless network connection to display a status window as shown next.

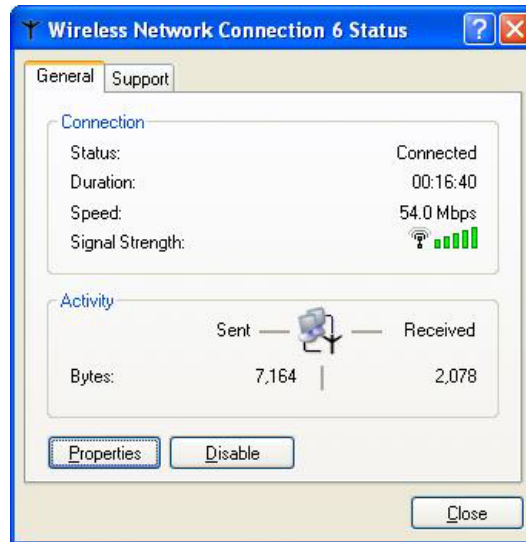


Figure 1-2 Windows XP: Wireless Network Connection Status

- Step 4.** Click **Properties** and click the **Wireless Networks** tab. Then skip to *Step 6*.

Step 5. When a **Wireless Network Connection** window displays, click **Advanced...**

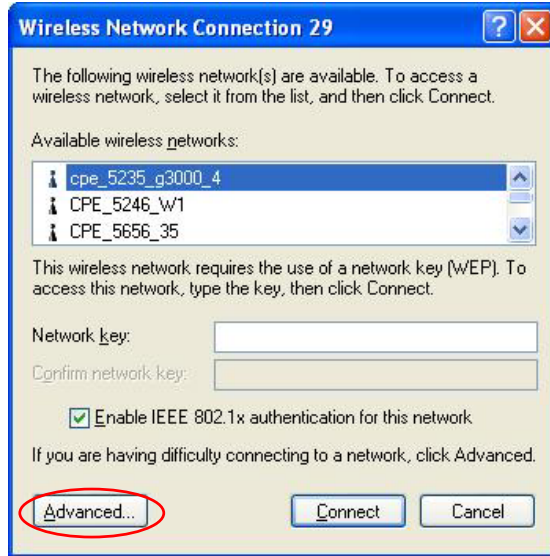


Figure 1-3 Windows XP: Connect to Wireless Network

- Step 6.** In the **Wireless Network Connection Properties** window, make sure the **Use Windows to configure my wireless network settings** check box is *not* selected. Click **OK**.

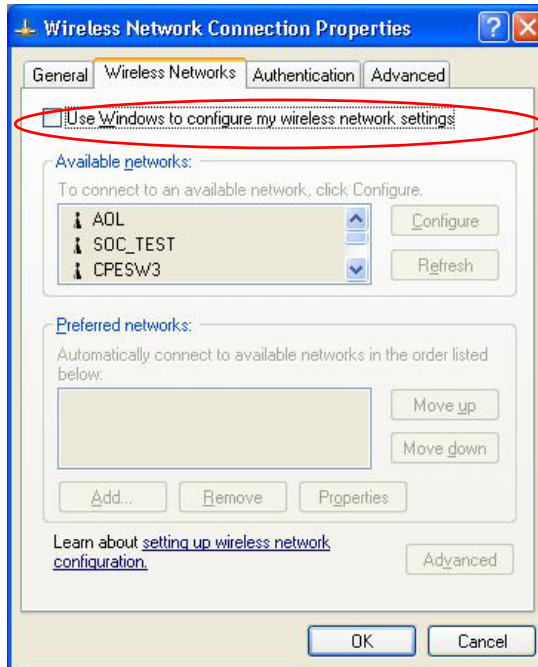


Figure 1-4 Windows XP: Wireless Network Connection Properties

1.5 Accessing the ZyXEL Utility

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

When the ZyXEL Utility system tray icon displays, the ZyXEL G-162 is installed properly.



Figure 1-5 ZyXEL Utility: System Tray Icon

The color of the ZyXEL Utility system tray icon indicates the status of the ZyXEL G-162. Refer to the following table for details.

Table 1-1 ZyXEL Utility: System Tray Icon

COLOR	DESCRIPTION
Red	The ZyXEL G-162 is not connected to a wireless network or is searching for an available wireless network.
Green	The ZyXEL G-162 is connected to a wireless network.

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 2000 are shown.

Click the  icon (located in the top right corner) to display the on-line help window.

Chapter 2

Wireless LAN Network

This chapter provides background information on wireless LAN network.

2.1 Overview

This section describes the wireless LAN network terms and applications.

2.1.1 SSID

The SSID (Service Set Identity) is a unique name shared among all wireless devices in a wireless network. Wireless devices must have the same SSID to communicate with each other.

2.1.2 Channel

A radio frequency used by a wireless device is called a channel.

2.1.3 Transmission Rate (Transfer Rate)

The ZyXEL G-162 provides various transmission (data) rate options for you to select. Options include **Fully Auto**, **1 Mbps**, **2 Mbps**, **5.5 Mbps**, **11 Mbps**, **6 Mbps**, **9 Mbps**, **12 Mbps**, **18 Mbps**, **22 Mbps**, **24 Mbps**, **36 Mbps**, **48 Mbps**, **54 Mbps** and **125 Mbps**. In most networking scenarios, the factory default **Fully Auto** setting proves the most efficient. This setting allows your ZyXEL G-162 to operate at the maximum transmission (data) rate. When the communication quality drops below a certain level, the ZyXEL G-162 automatically switches to a lower transmission (data) rate. Transmission at lower data speeds is usually more reliable. However, when the communication quality improves again, the ZyXEL G-162 gradually increases the transmission (data) rate again until it reaches the highest available transmission rate.

You can select any of the above options. If you wish to balance speed versus reliability, select **54 Mbps** in a networking environment where you are certain that all wireless devices can communicate at the highest transmission (data) rate. **1 Mbps** or **2 Mbps** are used often in networking environments where the range of the wireless connection is more important than speed.

Your ZyXEL G-162 (in infrastructure mode) can transmit at the proprietary transmission rates of 22Mbps or 125 Mbps if you are connecting to the ZyXEL G-560.³

2.1.4 Wireless Network Application

Wireless LAN works in either of the two modes: ad-hoc and infrastructure.

To connect to a wired network within a coverage area using Access Points (APs), set the ZyXEL G-162 operation mode to **Infrastructure (BSS)**. An AP acts as a bridge between the wireless stations and the wired network. In case you do not wish to connect to a wired network, but prefer to set up a small independent wireless workgroup without an AP, use the **Ad-hoc (IBSS)** (Independent Basic Service Set) mode.

Ad-Hoc (IBSS)

Ad-hoc mode does not require an AP or a wired network. Two or more wireless stations communicate directly to each other. An ad-hoc network may sometimes be referred to as an Independent Basic Service Set (IBSS).

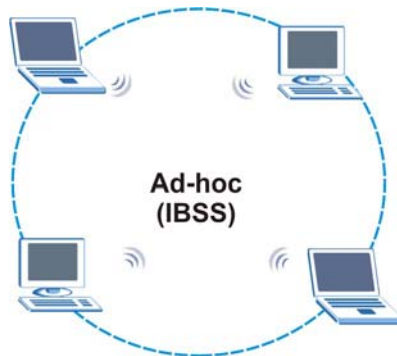


Figure 2-1 IBSS Example

To set up an ad-hoc network, configure all wireless stations in ad-hoc network type and use the same SSID and channel.

Infrastructure (BSS)

When a number of wireless stations are connected using a single AP, you have a Basic Service Set (BSS).

³ At the time of writing, the proprietary transmission rate is only available for ZyXEL G-162, G-360 and G-560.

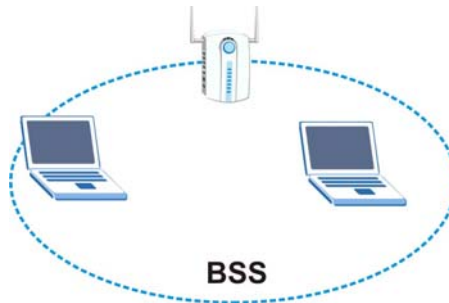


Figure 2-2 BSS Example

A series of overlapping BSS and a network medium, such as an Ethernet forms an Extended Service Set (ESS) or infrastructure network. All communication is done through the AP, which relays data packets to other wireless stations or devices connected to the wired network. Wireless stations can then access resource, such as the printer, on the wired network.

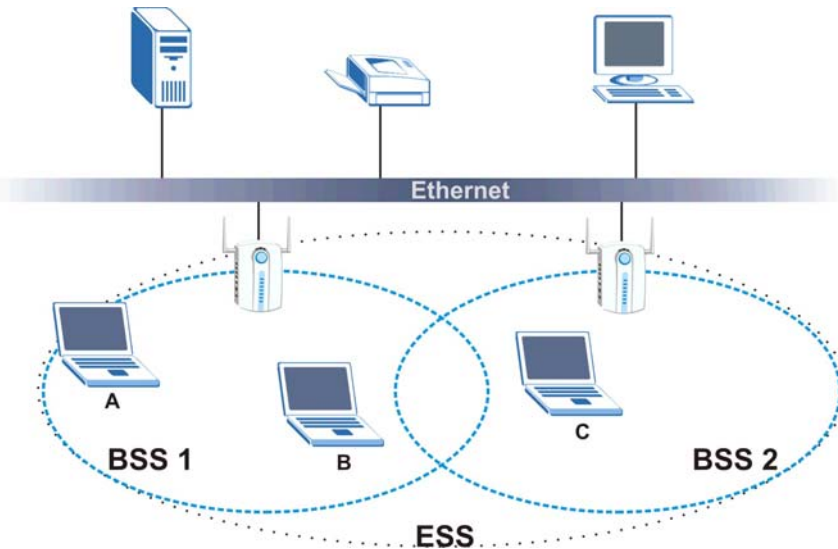


Figure 2-3 Infrastructure Network Example

2.1.5 Roaming

In an infrastructure network, wireless stations are able to switch from one BSS to another as they move between the coverage areas. During this period, the wireless stations maintain uninterrupted connection to the network. This is roaming. As the wireless station moves from place to place, it is responsible for choosing the most appropriate AP depending on the signal strength, network utilization or other factors.

The following figure depicts a roaming example. When wireless station **B** moves to position **X**, the ZyXEL G-162 in wireless station **B** automatically switches the channel to the one used by access point **2** in order to stay connected to the network.

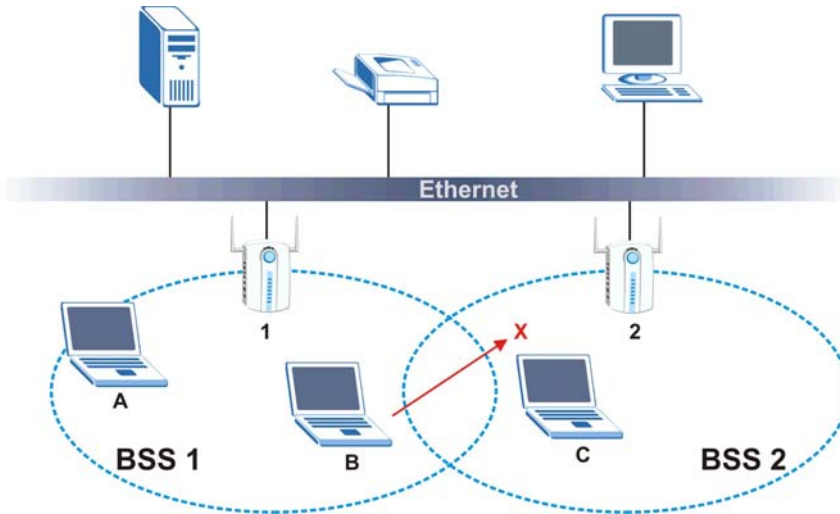


Figure 2-4 Roaming Example

2.2 Wireless LAN Security

Wireless LAN security is vital to your network to protect wireless communication between wireless stations and the wired network.

The figure below shows the possible wireless security levels on your ZyXEL G-162. EAP (Extensible Authentication Protocol) is used for authentication and utilizes dynamic WEP key exchange. It requires interaction with a RADIUS (Remote Authentication Dial-In User Service) server either on the WAN or your LAN to provide authentication service for wireless stations.

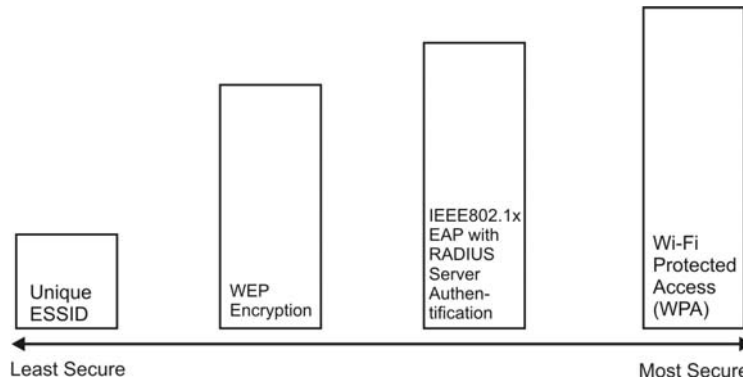


Figure 2-5 Wireless LAN Security Levels

Configure the wireless LAN security using the **Profile Security Settings** screen. If you do not enable any wireless security on your ZyXEL G-162, the ZyXEL G-162's wireless communications are accessible to any wireless networking device that is in the coverage area.

2.2.1 Data Encryption with WEP

WEP (Wired Equivalent Privacy) encryption scrambles all data packets transmitted between the ZyXEL G-162 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 ZyXEL G-162.

- 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 ZyXEL G-162 allows you to configure up to four 64-bit, 128-bit or 256-bit WEP keys and only one key is used as the default key at any one time.

2.2.2 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.

EAP Authentication

EAP (Extensible Authentication Protocol) is an authentication protocol that runs on top of the IEEE802.1x 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 IEEE802.1x. The ZyXEL G-162 supports EAP-TLS, EAP-TTLS and EAP-PEAP. Refer to the *Types of EAP Authentication* appendix 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). 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.

2.2.3 WPA

Wi-Fi Protected Access (WPA) is a subset of the IEEE 802.11i security specification draft. Key differences between WPA and WEP are user authentication and improved data encryption.

User Authentication

WPA applies IEEE 802.1x and Extensible Authentication Protocol (EAP) to authenticate wireless clients using an external RADIUS database.

Therefore, if you don't have an external RADIUS server, you should use WPA-PSK (WPA -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 client will be granted access to a WLAN.

Encryption

WPA improves data encryption by using Temporal Key Integrity Protocol (TKIP), Message Integrity Check (MIC) and IEEE 802.1x.

Temporal Key Integrity Protocol (TKIP) uses 128-bit keys that are dynamically generated and distributed by the authentication server. It includes 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.

TKIP regularly changes and rotates 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 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. 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), TKIP makes it much more difficult to decode data on a Wi-Fi network than WEP, making it difficult for an intruder to break into the network.

The encryption mechanisms used for WPA and WPA-PSK are the same. The only difference between the two is that WPA-PSK uses a simple common password, instead of user-specific credentials. The common-password approach makes WPA-PSK susceptible to brute-force password-guessing attacks but it's still an improvement over WEP as it employs an easier-to-use, consistent, single, alphanumeric password.

2.2.4 WPA-PSK Application Example

A WPA-PSK application looks as follows.

- Step 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 (including spaces and symbols).
- Step 2.** The AP checks each client's password and (only) allows it to join the network if it matches its password.
- Step 3.** The AP derives and distributes keys to the wireless clients.
- Step 4.** The AP and wireless clients use the TKIP encryption process to encrypt data exchanged between them.

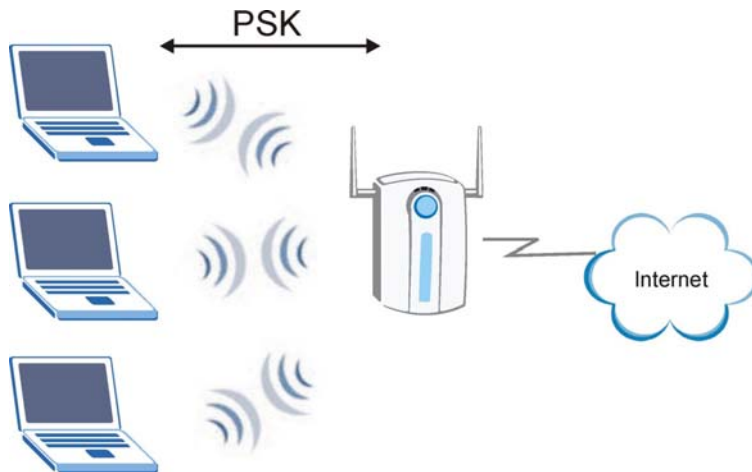


Figure 2-6 WPA-PSK Authentication

2.2.5 WPA 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 application example with an external RADIUS server looks as follows. "A" is the RADIUS server. "DS" is the distribution system.

- Step 1.** The AP passes the wireless client's authentication request to the RADIUS server.
- Step 2.** The RADIUS server then checks the user's identification against its database and grants or denies network access accordingly.

- Step 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.

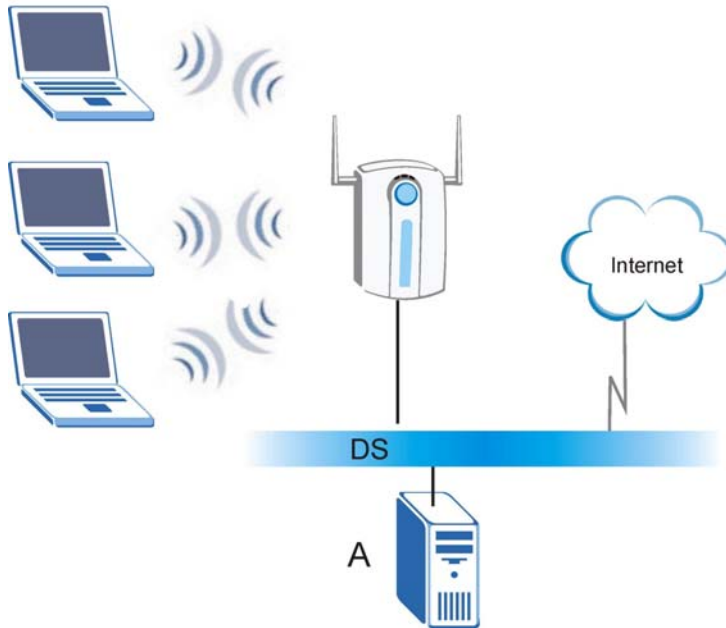


Figure 2-7 WPA with RADIUS Application Example

2.3 Fragmentation Threshold

A **Fragmentation Threshold** is the maximum data fragment size (between 256 and 2432 bytes) that can be sent in the wireless network before the ZyXEL G-162 will fragment the packet into smaller data frames.

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

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

2.4 RTS/CTS Threshold

A hidden node occurs when two stations are within range of the same access point, but are not within range of each other. The following figure illustrates a hidden node. Both stations are within range of the access

point (AP) or wireless gateway, but out-of-range of each other, so they cannot “hear” each other, that is they do not know if the channel is currently being used. Therefore, they are considered hidden from each other.

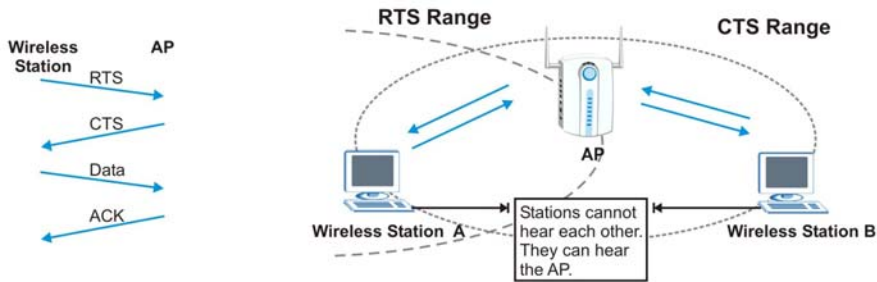


Figure 2-8 RTS Threshold

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

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

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

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

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

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

Enabling the RTS Threshold causes redundant network overhead that could negatively affect the throughput performance.

2.5 Authentication Type

The IEEE 802.11b standard describes a simple authentication method between the wireless stations and AP. Two authentication modes are defined: **Open** and **Share**.

Open authentication mode is implemented for ease-of-use and when security is not an issue. The wireless station and the AP do *not* share a secret key. Thus the wireless stations can associate with any AP and listen to any data transmitted plaintext.

Share authentication mode involves a shared secret key to authenticate the wireless station to the AP. This requires you to enable the wireless LAN security and use same settings on both the wireless station and the AP.

Chapter 3

Using the ZyXEL Utility

This chapter shows you how to configure the ZyXEL G-162 using the ZyXEL Utility.

3.1 The Link Info Screen

When the ZyXEL Utility starts, the **Link Info** screen displays, showing the current configuration and connection status of your ZyXEL G-162.

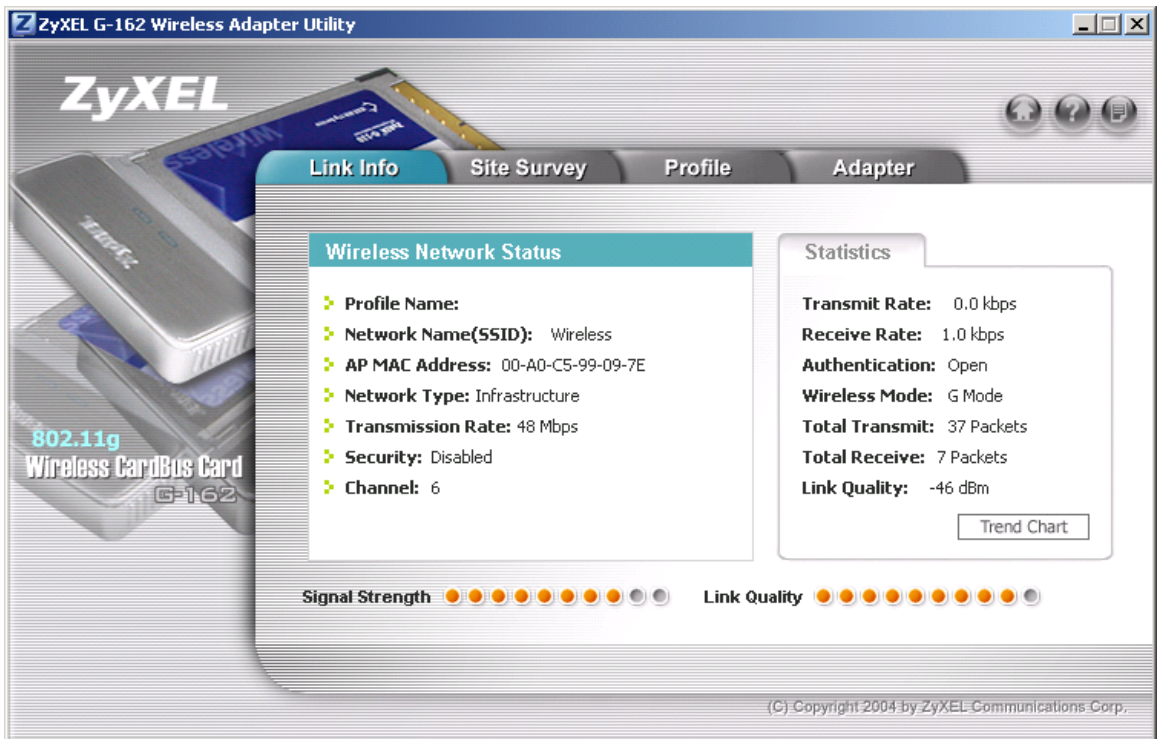


Figure 3-1 Link Info

The following table describes the labels in this screen.

Table 3-1 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 Service Set to which a wireless station is associated. This field displays the name of the wireless device to which the ZyXEL G-162 is associated.
AP MAC Address	This field displays the MAC address of the wireless device to which the ZyXEL G-162 is associated.
Network Type	This field displays the network type (Infrastructure(BSS) or Ad Hoc) of the wireless network.
Transmission Rate	This field displays the current transmission rate of the ZyXEL G-162 in megabits per second (Mbps).
Security	This field displays whether WEP data encryption is activated (WEP , WPA-PSK , WPA-RADIUS or WPA) or inactive (Disabled).
Channel	This field displays the radio channel the ZyXEL G-162 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 ZyXEL G-162.
Wireless Mode	This field indicates the wireless standard (802.11b or 802.11g) of the wireless device. This field displays G Mode , B Mode or Mixed Mode .
Total Transmit	This field displays the total number of data frames transmitted.
Total Receive	This field displays the total number of data frames received.
Signal Strength	This field displays the signal strength of the ZyXEL G-162.
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.
Link Quality	The status bar shows the quality of the signal.

3.1.1 Trend Chart

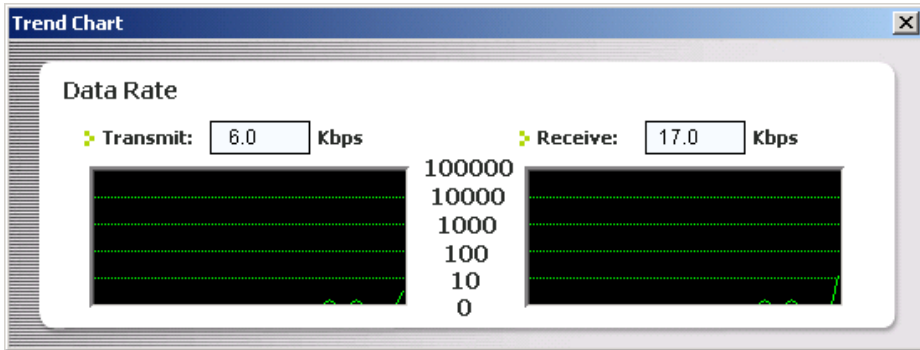


Figure 3-2 Link Info: Trend Chart

The following table describes the labels in this screen.

Table 3-2 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).

3.2 The Site Survey Screen

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

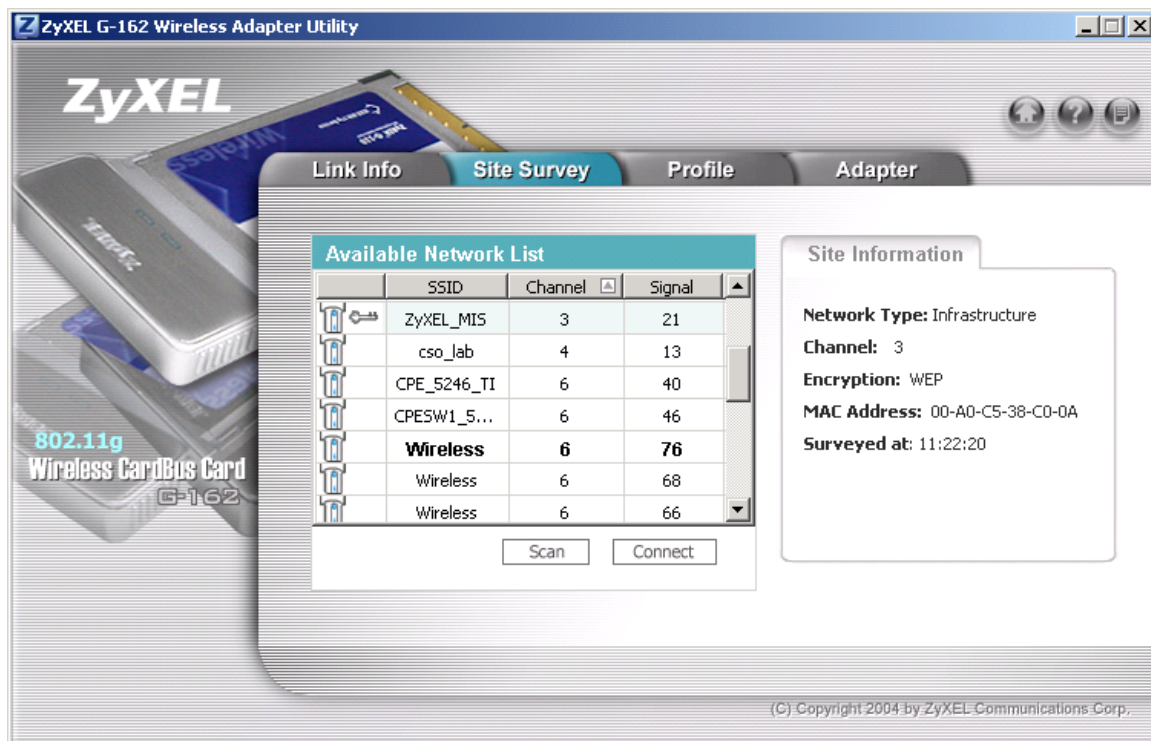










Figure 3-3 Site Survey

The following table describes the labels in this screen.

Table 3-3 Site Survey

LABEL	DESCRIPTION
Available Network List	The device information in bold indicates the wireless network to which the ZyXEL G-162 is associated. Click a column heading to sort the entries. A triangle indicates ascending or descending sort order.

Table 3-3 Site Survey

LABEL	DESCRIPTION
 ,   or 	<p> denotes that the wireless device is in infrastructure mode and the wireless security is activated.</p> <p> denotes that the wireless device is in infrastructure mode but the wireless security is deactivated.</p> <p> denotes that the wireless device is in Ad-Hoc mode and the wireless security is activated.</p> <p> denotes that the wireless device is in Ad-Hoc mode but the wireless security is deactivated.</p>
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 Info 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.
Channel	This field displays the channel number used by each wireless device.
Encryption	This field shows whether WEP data encryption is activated (WEP , WPA-PSK , WPA-RADIUS or WPA) or inactive (Disabled).
MAC address	This field displays the MAC address of the wireless device.
Surveyed at	This field displays the time when the wireless device is scanned.

3.2.1 Connecting to a Network

Follow the steps below to connect to a network using the **Site Survey** screen.

- Step 1.** Click **Scan** to search for all available wireless networks within range.
- Step 2.** To join a network, either click an entry in the table to select a wireless network and then click **Connect** or double-click an entry.
- Step 3.** If the wireless security is activated for the selected wireless network, the **Security Settings** screen displays. You must set the related fields in the **Security Settings** screen to the same

security settings as the associated AP. Refer to *Section 3.2.2* for more information. Otherwise click the close (X) button and connect to another wireless network without data encryption.

- Step 4.** Verify that you have successfully connected to the selected network and check the network information in the **Link Info** screen.

3.2.2 Security Settings

When you configure the ZyXEL G-162 to connect to a network with wireless security activated and the security settings are disabled on the ZyXEL G-162, the screen varies according to the encryption method used by the selected network.

WEP Encryption

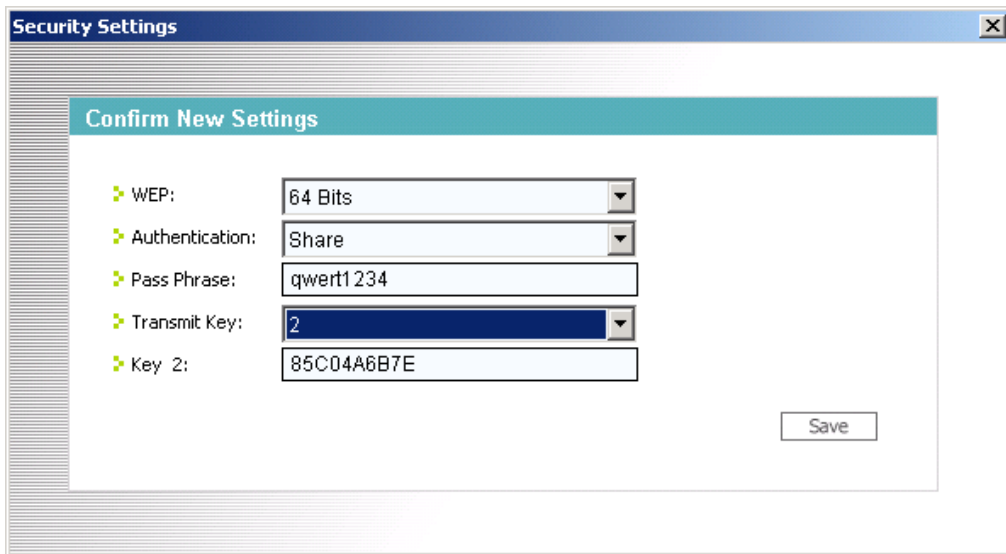



Figure 3-4 Site Survey: Security Settings: WEP

The following table describes the labels in this screen.

Table 3-4 Site Survey: Security Settings: WEP

LABEL	DESCRIPTION
WEP	Select 64 Bits , 128 Bits or 256 Bits to activate WEP encryption and then fill in the related fields.
Authentication	Select an authentication method. Choices are Share and Open . Refer to <i>Section 2.5</i> for more information.

Table 3-4 Site Survey: Security Settings: WEP

LABEL	DESCRIPTION
Pass Phrase	As you enter the passphrase, the ZyXEL G-162 automatically generates four different WEP keys and displays it in the key field below. Refer to <i>Section 2.2.1</i> for more information.
Transmit Key	Select a default WEP key to use for data encryption. The key displays in the field below.
Key x (where x is a number between 1 and 4)	<p>If you want to manually set the WEP keys, enter the WEP key in the field provided.</p> <p>If you select 64 Bits in the WEP field.</p> <ul style="list-style-type: none"> ◆ Enter either 10 hexadecimal digits in the range of “A-F”, “a-f” and “0-9” (for example, 11AA22BB33) for HEX key type <p>or</p> <ul style="list-style-type: none"> ◆ Enter 5 ASCII characters (case sensitive) ranging from “a-z”, “A-Z” and “0-9” (for example, MyKey) for ASCII key type. <p>If you select 128 Bits in the WEP field,</p> <ul style="list-style-type: none"> ◆ Enter either 26 hexadecimal digits in the range of “A-F”, “a-f” and “0-9” (for example, 00112233445566778899AABBCC) for HEX key type <p>or</p> <ul style="list-style-type: none"> ◆ Enter 13 ASCII characters (case sensitive) ranging from “a-z”, “A-Z” and “0-9” (for example, MyKey12345678) for ASCII key type. <p>If you select 256 Bits in the WEP field,</p> <ul style="list-style-type: none"> ◆ Enter either 58 hexadecimal digits in the range of “A-F”, “a-f” and “0-9” (for example, 0000111122223333444455556666777788889999AAAABBBBCCCC000011) for HEX key type <p>or</p> <ul style="list-style-type: none"> ◆ Enter 29 ASCII characters (case sensitive) ranging from “a-z”, “A-Z” and “0-9” (for example, MyKey111122223333444455556678) for ASCII key type. <div style="border: 1px solid black; padding: 5px; text-align: center; margin-top: 10px;"> <p>The values for the WEP keys must be set up exactly the same on all wireless devices in the same wireless LAN.</p> <p>ASCII WEP keys are case sensitive.</p> </div>
Save	Click Save to save the changes back to ZyXEL G-162 and display the Link Info screen. Otherwise, click the close () button to discard changes and go back to the Site Survey screen.

WPA-PSK

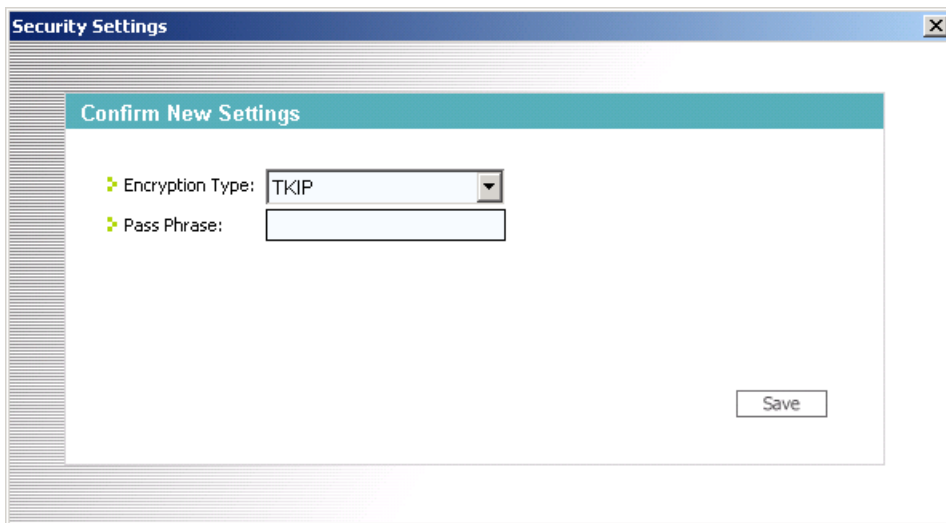


Figure 3-5 Site Survey: Security Settings: WPA-PSK

The following table describes the labels in this screen.

Table 3-5 Site Survey: Security Settings: WPA-PSK

FIELD	DESCRIPTION
Encryption Type	WPA uses Temporal Key Integrity Protocol (TKIP) to improve data encryption.
Pass Phrase	The encryption mechanisms used for WPA and WPA-PSK are the same. The only difference between the two is that WPA-PSK uses a simple common password, instead of user-specific credentials. Type a passphrase from 8 to 63 case-sensitive ASCII characters (including spaces and symbols).
Save	Click Save to save the changes back to ZyXEL G-162 and display the Link Info screen. Otherwise, click the close (✖) button to discard changes and go back to the Site Survey screen.

WPA

The screenshot shows a window titled "Security Settings" with a sub-header "Confirm New Settings". The configuration is as follows:

- Authentication Type: EAP-TTLS (selected in a dropdown menu)
- Login Name: [Empty text box]
- Password: [Empty text box]
- Validate server certificate
- TLS Protocol: MS CHAP (selected in a dropdown menu)
- Save button


Figure 3-6 Site Survey: Security Settings: WPA

The following table describes the labels not previously discussed

Table 3-6 Site Survey: Security Settings: WPA

FIELD	DESCRIPTION
Authentication Type	Select an authentication method from the drop down list. Options are EAP-TLS , EAP-TTLS and EAP-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 EAP-TLS in the Authentication Type field. Enter the password associated with the user name above.

Table 3-6 Site Survey: Security Settings: WPA

FIELD	DESCRIPTION
Certificate	<p>This field is only available when you select EAP-TLS in the Authentication Type field.</p> <p>Specify the location and name of a certificate in the Certificate field or click Browse to locate it.</p> <div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>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.</p> </div>
Browse	<p>This field is only available when you select EAP-TLS in the Authentication Type field.</p> <p>Click this button to display the Select Certificate screen, select a certificate and click OK.</p>
Validate Server Certificate	<p>Select the check box to check the certificate of the authentication server.</p>
TTLS Protocol	<p>This field is only available when you select EAP-TTLS in the Authentication Type field.</p> <p>Use the drop-down list box to select a TTLS protocol. Options are PAP, CHAP, MS CHAP, MS CHAP v2 and EAP.</p>
PEAP Inner EAP	<p>This field is only available when you select EAP-PEAP in the Authentication Type field.</p> <p>Use the drop-down list box to select a PEAP protocol. Options are EAP-GTC and MS CHAP v2.</p>
Save	<p>Click Save to save the changes back to ZyXEL G-162 and display the Link Info screen. Otherwise, click the close () button to discard changes and go back to the Site Survey screen.</p>

802.1x

The following section describes how to configure IEEE802.1x security with various authentication methods.


Figure 3-7 Site Survey: Security Settings: 802.1x

The following table describes the labels not previously discussed

Table 3-7 Site Survey: Security Settings: 802.1x

FIELD	DESCRIPTION
Authentication Type	Select an authentication method from the drop down list. Options are EAP-TLS , EAP-TTLS and EAP-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 EAP-TLS in the Authentication Type field. Enter the password associated with the user name above.
Certificate	This field is only available when you select EAP-TLS in the Authentication Type field. Specify the location and name of a certificate in the Certificate field or click Browse to locate it. <div style="border: 1px solid black; padding: 5px; background-color: #e0e0e0;"> <p>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.</p> </div>

Table 3-7 Site Survey: Security Settings: 802.1x

FIELD	DESCRIPTION
Browse	This field is only available when you select EAP-TLS in the Authentication Type field. Click this button to display the Select Certificate screen, select a certificate and click OK .
Validate Server Certificate	Select the check box to check the certificate of the authentication server.
TTLS Protocol	This field is only available when you select EAP-TTLS in the Authentication Type field. Use the drop-down list box to select a TTLS protocol. Options are PAP , CHAP , MS CHAP , MS CHAP v2 and EAP .
PEAP Inner EAP	This field is only available when you select EAP-PEAP in the Authentication Type field. Use the drop-down list box to select a PEAP protocol. Options are EAP-GTC and MS CHAP v2 .
Save	Click Save to save the changes back to ZyXEL G-162 and display the Link Info screen. Otherwise, click the close () button to discard changes and go back to the Site Survey screen.

3.3 The Profile Screen

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.

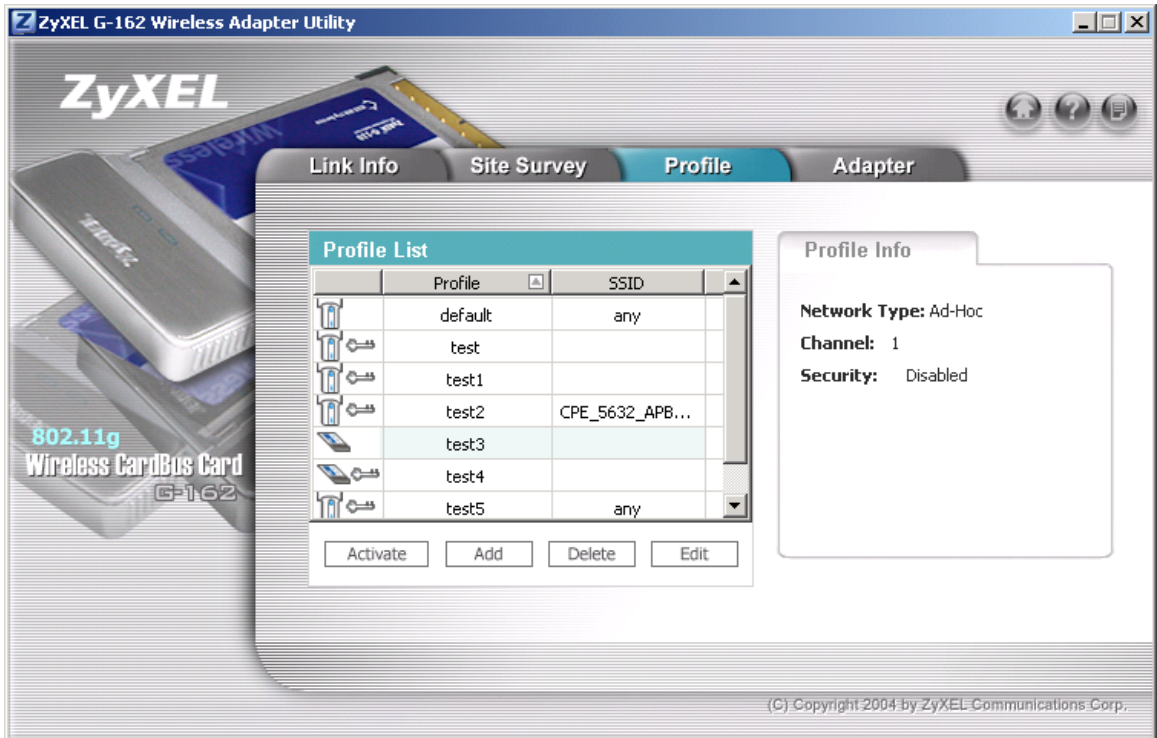


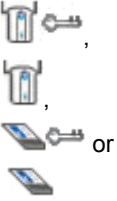





Figure 3-8 Profile

The following table describes the labels in this screen.

Table 3-8 Profile

LABEL	DESCRIPTION
Profile List	Click a column heading to sort the entries. A triangle indicates ascending or descending sort order.

Table 3-8 Profile

LABEL	DESCRIPTION
 or 	<p> denotes that the wireless device is in infrastructure mode and the wireless security is activated.</p> <p> denotes that the wireless device is in infrastructure mode but the wireless security is deactivated.</p> <p> denotes that the wireless device is in Ad-Hoc mode and the wireless security is activated.</p> <p> denotes that the wireless device is in Ad-Hoc mode but the wireless security is deactivated.</p>
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 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 .
Profile Info The following fields display detail 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.
Channel	This field displays the channel number used by the profile.
Security	This field shows whether WEP data encryption is activated (WEP , WPA-PSK , WPA-RADIUS or WPA) or inactive (Disabled).

3.3.1 Adding a New Profile

Follow the steps below to add a new profile.

Step 1. Click **Add** in the **Profile** screen to display the screen as shown next. Click **Next** to continue.

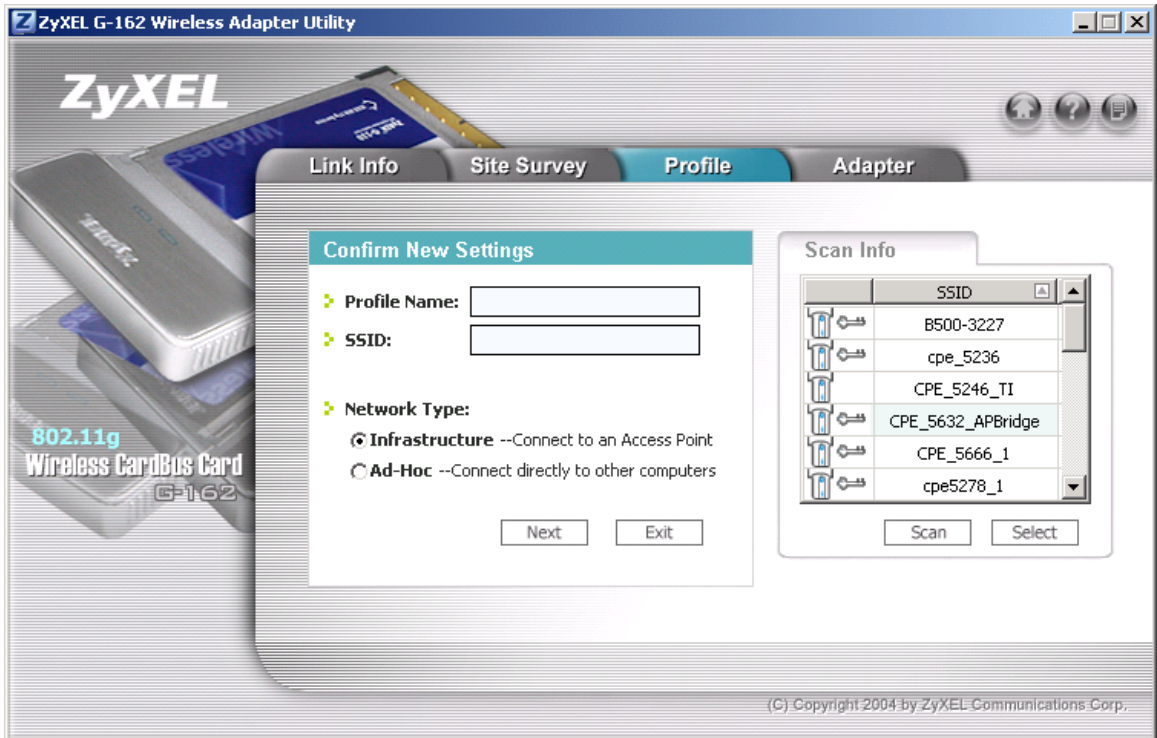


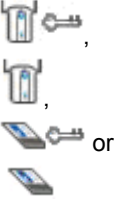




Figure 3-9 Profile: Add New Profile

The following table describes the labels in this screen.

Table 3-9 Profile: Add New Profile

LABEL	DESCRIPTION
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 (Service Set IDentifier) of the AP or the peer ad-hoc computer to which you want to associate in this field. To associate to an ad-hoc network, you must enter the same SSID as the peer ad-hoc computer. Otherwise, leave this field blank or enter any to have the ZyXEL G-162 associate to or roam between any infrastructure wireless networks.
Network Type	Select the Infrastructure radio button to associate to an AP. Select the Ad-Hoc radio button to associate to a peer computer.

Table 3-9 Profile: Add New Profile

LABEL	DESCRIPTION
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.	
	<p> denotes that the wireless device is in infrastructure mode and the wireless security is activated.</p> <p> denotes that the wireless device is in infrastructure mode but the wireless security is deactivated.</p> <p> denotes that the wireless device is in Ad-Hoc mode and the wireless security is activated.</p> <p> denotes that the wireless device is in Ad-Hoc mode but the wireless security is deactivated.</p>
SSID	This field displays the SSID (Service Set Identifier) of each wireless 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 ZyXEL G-162 associates to the selected wireless network only.

Step 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.

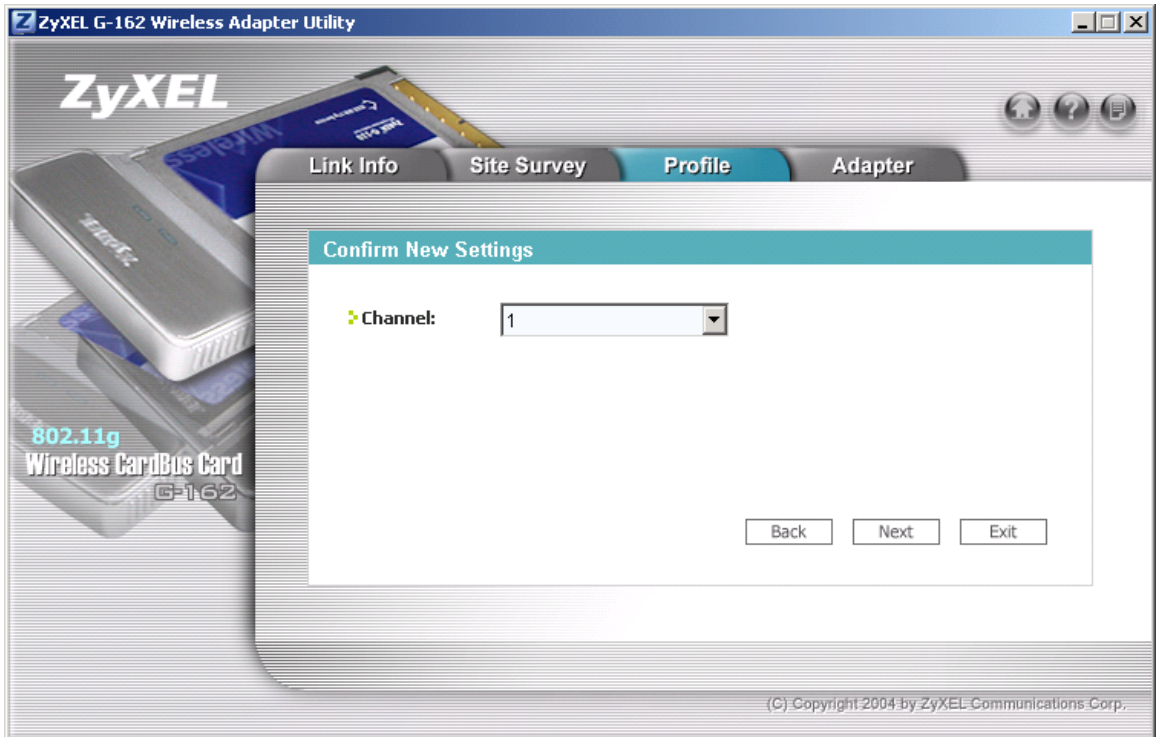


Figure 3-10 Profile: Select a Channel

The following table describes the labels in this screen.

Table 3-10 Profile: Select a Channel

LABEL	DESCRIPTION
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.

Step 3. If you select **Infrastructure** network type in the first screen, select **WEP**, **WPA-PSK**, **WPA** or **802.1x** from the drop-down list box to enable data encryption. If you select **Ad-Hoc** network type in the first screen, you can only use WEP encryption method. Otherwise, select **Disabled** to allow the ZyXEL G-162 to communicate with the access points or other peer wireless computers without any data encryption and skip to *Step 5*.

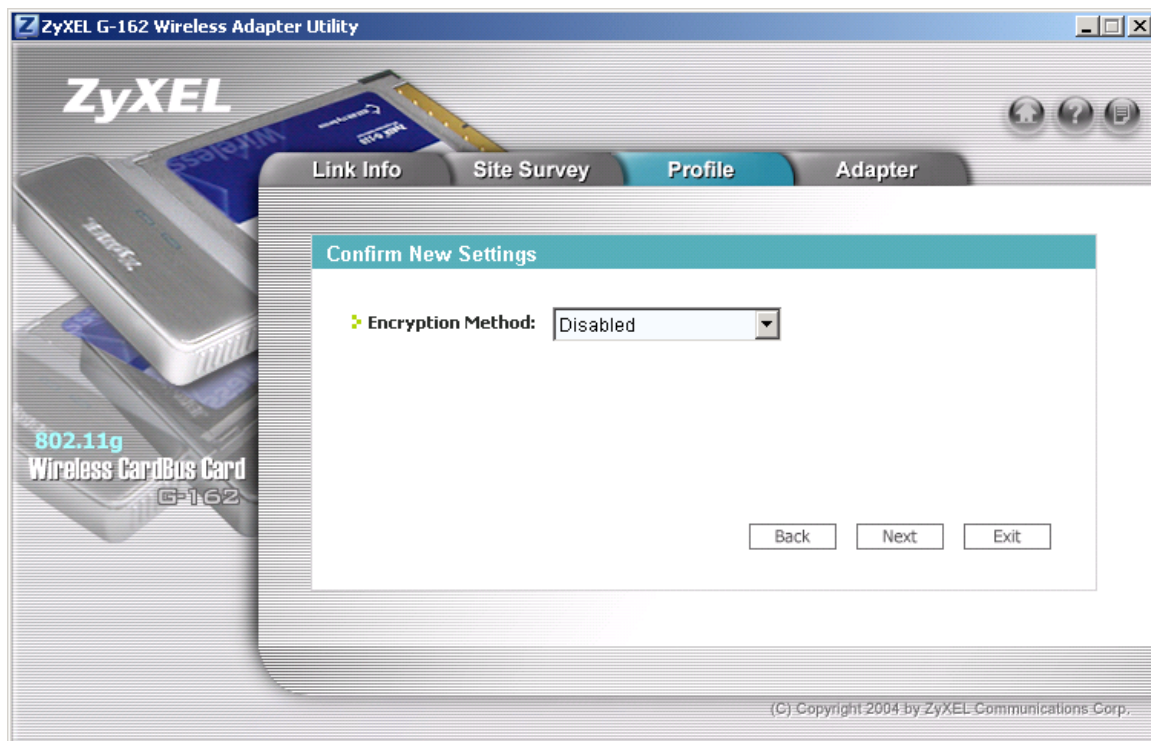


Figure 3-11 Profile: Wireless Settings

- Step 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 ZyXEL G-162. Refer to *Section 3.2.2* for detailed information on wireless security configuration.

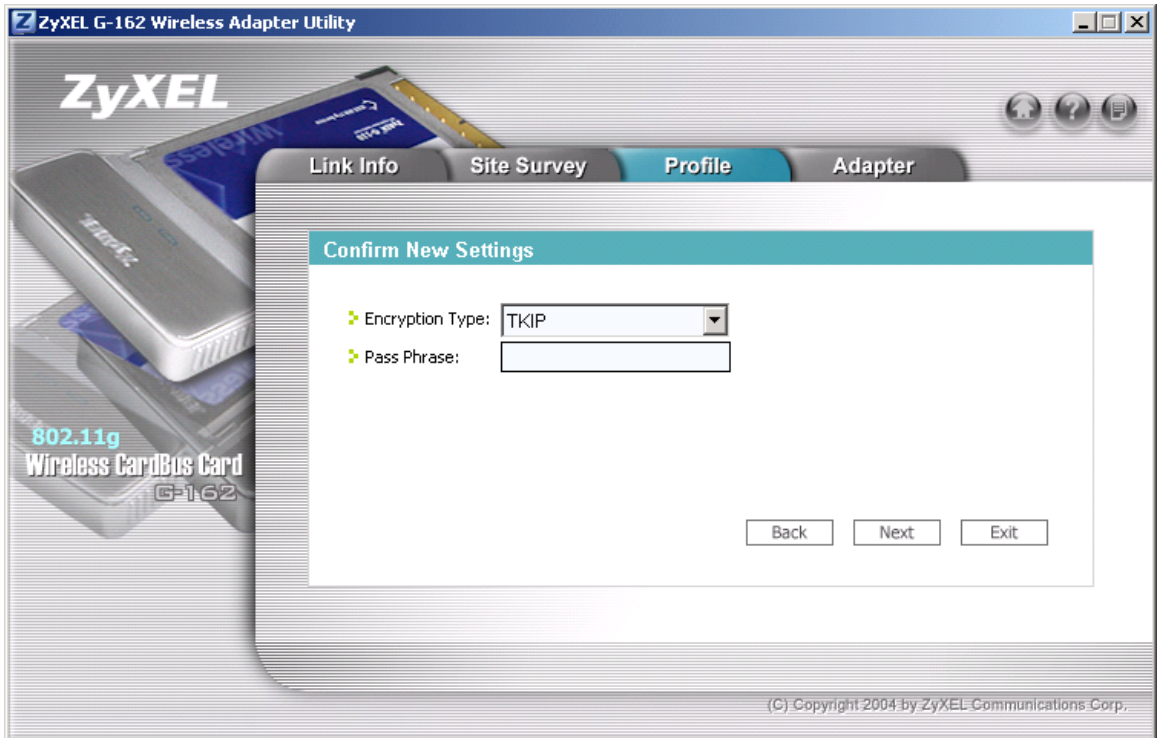


Figure 3-12 Profile: Security Settings

- Step 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.

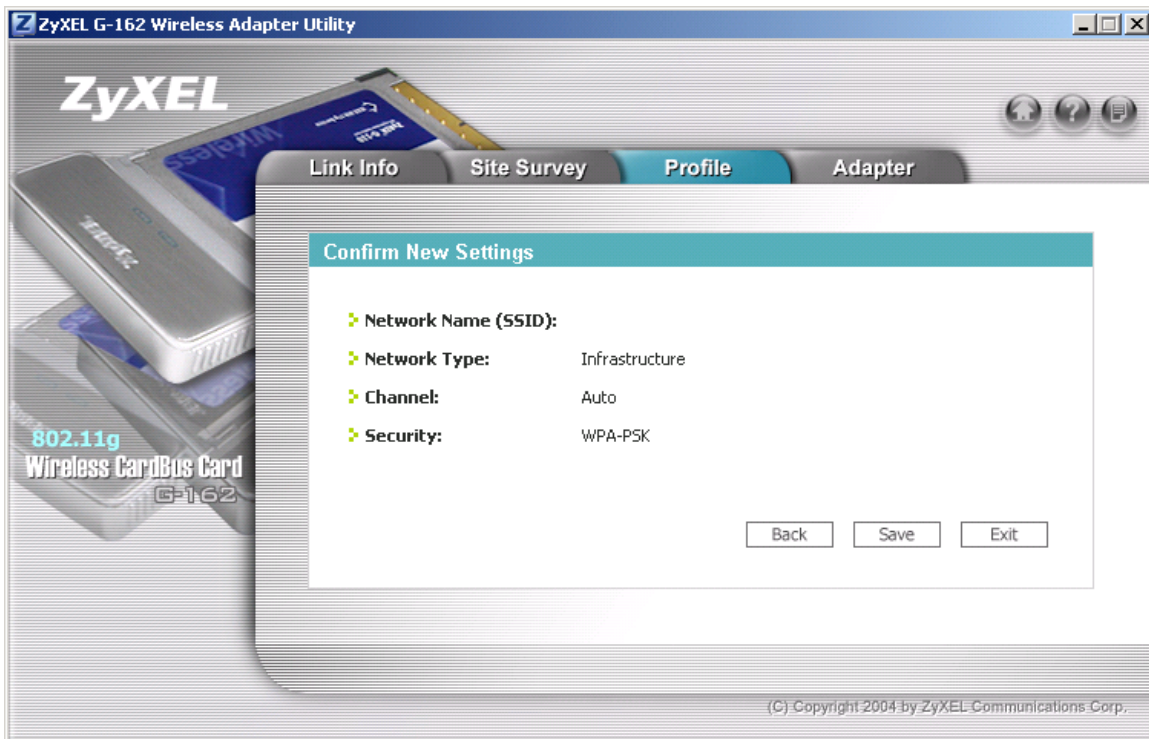


Figure 3-13 Profile: Confirm New Settings

Step 6. To use this network profile, click the **Activate Now** button. Otherwise, click the **Activate Later** button.

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

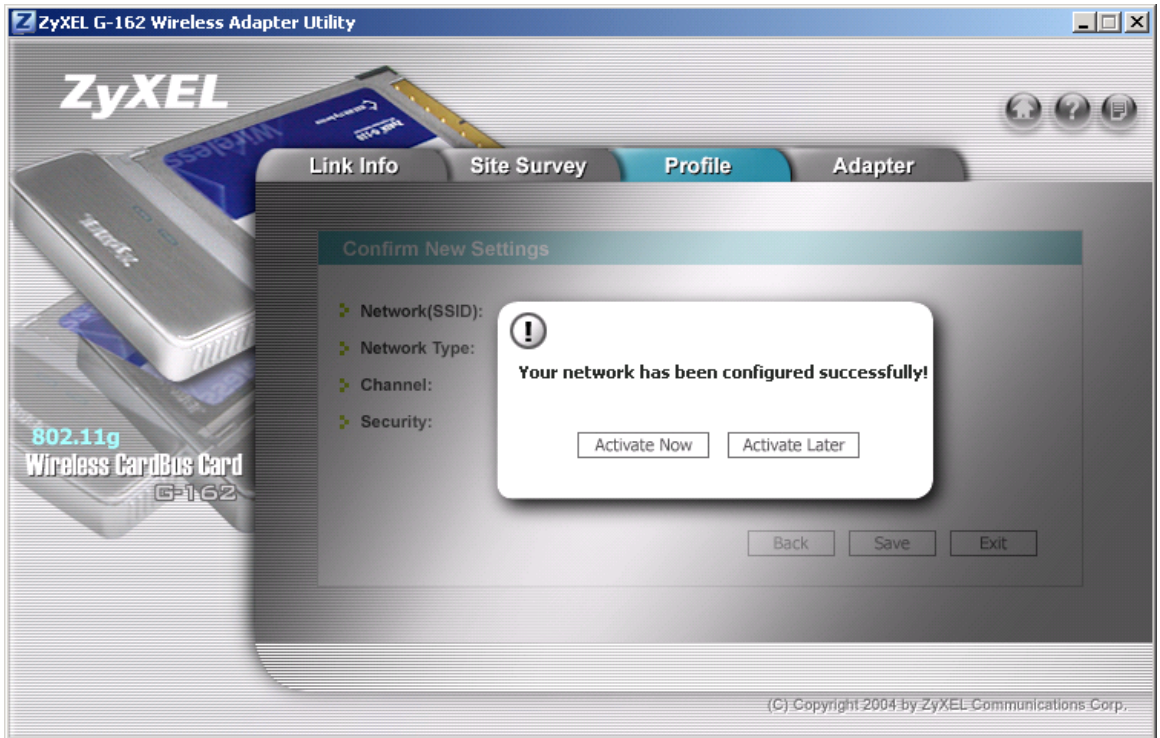


Figure 3-14 Profile: Activate the Profile

3.4 The Adapter Screen

To set advanced features on the ZyXEL G-162, click the **Adapter** tab.

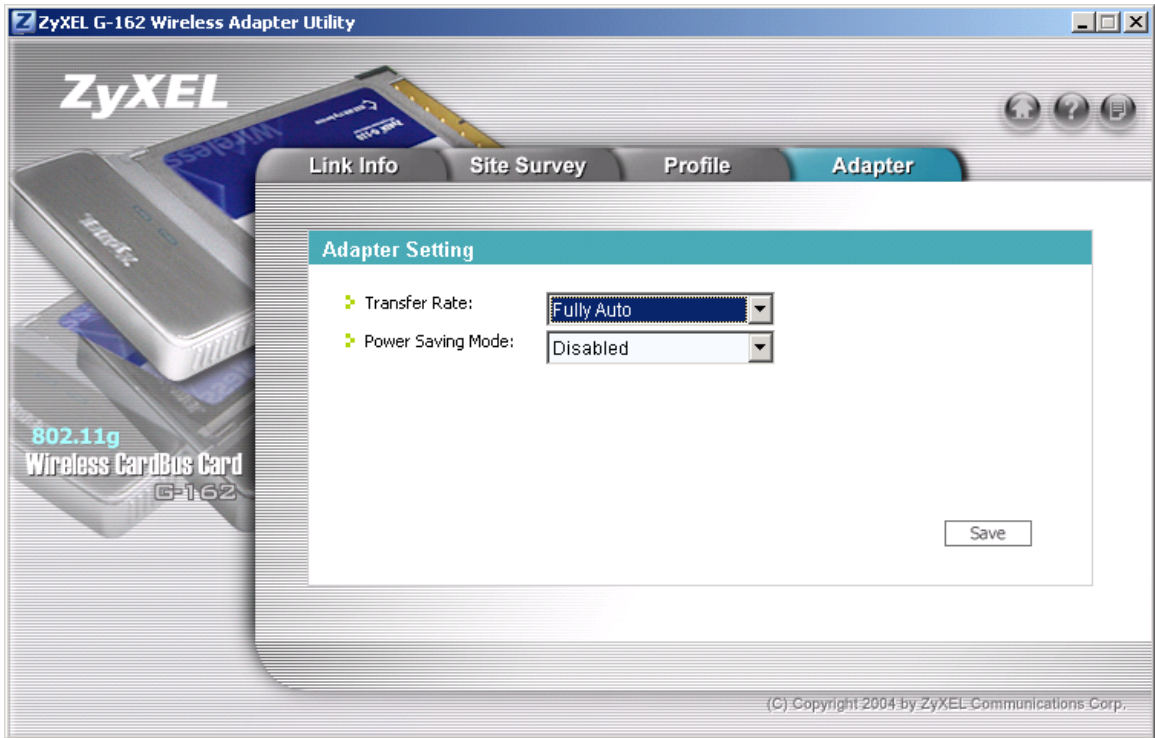


Figure 3-15 Adapter

The following table describes the labels in this screen.

Table 3-11 Adapter

LABEL	DESCRIPTION
Adapter	
Transfer Rate	<p>Select a transmission speed from the drop-down list box. Choose from Fully Auto (default), 1 Mbps, 2 Mbps, 5.5 Mbps, 11 Mbps, 6 Mbps, 9 Mbps, 12 Mbps, 18 Mbps, 22 Mbps, 24 Mbps, 36 Mbps, 48 Mbps, 54 Mbps and 125 Mbps.</p> <p>Your ZyXEL G-162 (in infrastructure mode) can transmit at the proprietary transmission rates of 22Mbps or 125 Mbps if you are connecting to the ZyXEL G-560.⁴</p>

⁴ At the time of writing, the proprietary transmission rate is only available for ZyXEL G-162, G-360 and G-560.

Table 3-11 Adapter

LABEL	DESCRIPTION
Power Saving Mode	Select Enabled to save power (especially for notebook computers). This forces the ZyXEL G-162 to go to sleep mode when it is not transmitting data. When you select Disabled , the ZyXEL G-162 will never go to sleep mode.
Save	Click Save to save the changes back to ZyXEL G-162.

Chapter 4

Maintenance

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

4.1 The About Screen


The **About** screen displays related version numbers of the ZyXEL G-162. To display the screen as shown next, click the about () button.



Figure 4-1 About

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

Table 4-1 About

LABEL	DESCRIPTION
Driver Version	This field displays the version number of the ZyXEL driver.
Utility Version	This field displays the version number of the ZyXEL Utility.

4.2 Uninstalling the ZyXEL Utility

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

Step 1. Click **Start, Programs, ZyXEL G-162 Wireless Adapter, Uninstall**.

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

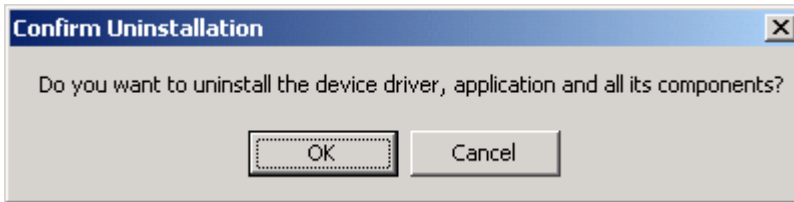


Figure 4-2 Confirm Uninstall

Step 3. Click **Finish** to complete uninstalling the software. Restart your computer if prompted.

4.3 Upgrading the ZyXEL Utility

Before you uninstall the ZyXEL Utility, take note of the current network configuration.

To perform the upgrade, follow the steps below.

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

Step 2. Follow the steps in *Section 4.2* to remove the current ZyXEL Utility from your computer.

Step 3. Restart your computer when prompted.

Step 4. After restarting, refer to the procedure in the *Quick Start Guide* to install the new utility.

Step 5. Check the version numbers in the **About** screen to make sure the new utility is installed properly.

Chapter 5

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.

5.1 Problems Starting the ZyXEL Utility Program

Table 5-1 Troubleshooting Starting ZyXEL Utility Program

PROBLEM	CORRECTIVE ACTION
Cannot start the ZyXEL Wireless LAN Utility	Make sure the ZyXEL G-162 is properly inserted and the LED(s) is on. Refer to the <i>Quick Start Guide</i> 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 ZyXEL G-162 under Network Adapter . (Steps may vary depending on the version of Windows).
	Install the ZyXEL G-162 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 install 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. If you use the Windows XP configuration tool and the ZyXEL Utility to configure the ZyXEL G-162 at the same time, the ZyXEL Utility icon does not display. You need to disable the Windows XP configuration tool (refer to Section 1.4 for more information).

5.2 Problem with the Link Status

Table 5-2 Troubleshooting Link Quality

PROBLEM	CORRECTIVE ACTION
The link quality and/or signal strength is poor all the time.	<p>Search and connect to another AP with a better link quality using the Site Survey screen.</p> <p>Move your computer closer to the AP or the peer computer(s) within the transmission range.</p> <p>There may be too much radio interference (for example microwave or another AP using the same channel) around your wireless network. Relocate or reduce the radio interference.</p>

5.3 Problems Communicating With Other Computers

Table 5-3 Troubleshooting Communication Problems

PROBLEM	CORRECTIVE ACTION
The ZyXEL G-162 computer cannot communicate with the other computer.	Make sure you are connected to the network.
A. Infrastructure	<p>Make sure that the AP and the associated computers are turned on and working properly.</p> <p>Make sure the ZyXEL G-162 computer and the associated AP use the same SSID.</p> <p>Change the AP and the associated wireless clients to use another radio channel if interference is high.</p> <p>Make sure that the computer and the AP share the same security option and key. Verify the settings in the Profile Security Settings screen.</p>
B. Ad-Hoc (IBSS)	<p>Verify that the peer computer(s) is turned on.</p> <p>Make sure the ZyXEL G-162 computer and the peer computer(s) are using the same SS ID and channel.</p> <p>Make sure that the computer and the peer computer(s) share the same security option and key.</p> <p>Change the wireless clients to use another radio channel if interference is high.</p>

Appendix A

Product Specifications

PHYSICAL SPECIFICATIONS	
Product Name	ZyXEL G-162 802.11g Wireless CardBus Card
Type	3.3V 32-bit Cardbus card
Standards	IEEE 802.11b IEEE 802.11g
Network Architectures	Infrastructure Ad-Hoc
Operating Frequencies	2.412-2.483GHz
Operating Channels	IEEE 802.11b: 11 Channels (North America) IEEE 802.11g: 11 Channels (North America) IEEE 802.11b: 13 Channels (Europe) IEEE 802.11g: 13 Channels (Europe)
Data Rate	IEEE 802.11b: 22, 11, 5.5, 2, 1Mbps IEEE 802.11g: 125, 54, 48, 36, 24, 18, 12, 9, 6 Mbps
Modulation	IEEE 802.11g: Orthogonal Frequency Division Multiplexing (64QAM, 16QAM, QPSK and BPSK) IEEE 802.11b: PBCC, Direct Sequence Spread Spectrum (CCK, DQPSK, DBPSK).
Security	64/128/256-bit WEP, WPA, WPA-PSK, 802.1x
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 Consumption	IEEE 802.11g: TX: 600mA RX: 450mA (max.) IEEE 802.11b: TX: 600mA RX: 450mA (max.)
Voltage	3.3V±5%
Weight	< 50g

Dimension	(W) 115mm × (D) 54.5mm × (H) 9.3 mm
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RADIO SPECIFICATIONS	
Media Access Protocol	IEEE 802.11
Frequency	2.4 ~ 2.483GHz (Industrial Scientific Medical Band)
Channels	1~11 Channels (USA, Canada) 1~13 Channels (Europe)
Data Rate	802.11g (OFDM): 6, 9, 12, 18, 24, 36, 48, 54, 125 Mbps 802.11b: 1, 2, 5.5, 11, 22 Mbps
Modulation	802.11g: OFDM with BPSK, QPSK and 16/64-QAM sub-carrier modulations 802.11b: PBCC, DSSS (DBPSK, DQPSK, CCK)
Output Power	17 dBm (typical) at 11Mbps DBPSK, DQPSK, CCK 14 dBm (typical) at 54Mbps OFDM
RX Sensitivity	802.11g (OFDM): 54 Mbps: < -68 dBm (typ.) < -69 dBm (max.) 802.11b (PBCC): 22 Mbps: < -83 dBm (typ.) < -88 dBm (max.)

SOFTWARE SPECIFICATIONS	
Device Drivers	Microsoft Windows 98(SE), Windows 2000, Windows XP, Windows ME
Roaming	802.11b/g compliant
WEP	Supports 64-bit, 128-bit and 256-bit encryption

ENVIRONMENTAL SPECIFICATIONS	
Temperature	Operating: 0° ~ 50° C Storage: -30° ~ 60° C
Relative Humidity	20% to 95% (non-condensing)

Appendix B

Types of EAP Authentication

This appendix discusses the five popular EAP authentication types: **EAP-MD5**, **EAP-TLS**, **EAP-TTLS**, **PEAP** and **LEAP**. The type of authentication you use depends on the RADIUS server. Consult your network administrator for more information.

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 IEEE802.1x.

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 five authentication types.

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

Appendix C

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