

ZyXEL MAX-100 Series

WiMAX PCMCIA Card

User's Guide

Version 1.00

Edition 1

03/2007

The logo for ZyXEL, featuring the word "ZyXEL" in a bold, blue, sans-serif font. The "Zy" is in a slightly larger font size than "XEL".

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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).
- Testing was performed on laptop computers with antennas at 0mm spacing. The maximum SAR value is: 0.850W/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.
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注意！

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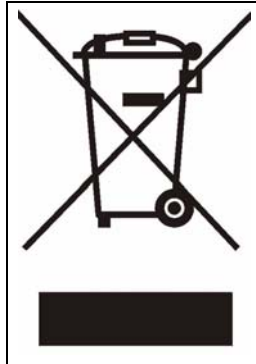
- 1 Go to <http://www.zyxel.com>.
- 2 Select your product from the drop-down list box on the ZyXEL home page to go to that product's page.
- 3 Select the certification you wish to view from this page.

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.
- Do NOT open the device or unit. Opening or removing covers can expose you to dangerous high voltage points or other risks. ONLY qualified service personnel should service or disassemble this device. Please contact your vendor for further information.
- 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	SUPPORT E-MAIL	TELEPHONE	WEB SITE	REGULAR MAIL
LOCATION	SALES E-MAIL	FAX	FTP SITE	
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	sales@zyxel.com.tw	+886-3-578-2439	ftp.zyxel.com ftp.europe.zyxel.com	
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KAZAKHSTAN	http://zyxel.kz/support	+7-3272-590-698	www.zyxel.kz	ZyXEL Kazakhstan 43, Dostyk ave., Office 414 Dostyk Business Centre 050010, Almaty Republic of Kazakhstan
	sales@zyxel.kz	+7-3272-590-689		
NORTH AMERICA	support@zyxel.com	1-800-255-4101 +1-714-632-0882	www.us.zyxel.com	ZyXEL Communications Inc. 1130 N. Miller St. Anaheim CA 92806-2001 U.S.A.
	sales@zyxel.com	+1-714-632-0858	ftp.us.zyxel.com	

LOCATION	METHOD	SUPPORT E-MAIL	TELEPHONE	WEB SITE	REGULAR MAIL
		SALES E-MAIL	FAX	FTP SITE	
NORWAY		support@zyxel.no	+47-22-80-61-80	www.zyxel.no	ZyXEL Communications A/S Nils Hansens vei 13 0667 Oslo Norway
		sales@zyxel.no	+47-22-80-61-81		
POLAND		info@pl.zyxel.com	+48 (22) 333 8250	www.pl.zyxel.com	ZyXEL Communications ul. Okrzei 1A 03-715 Warszawa Poland
			+48 (22) 333 8251		
RUSSIA		http://zyxel.ru/support	+7-095-542-89-29	www.zyxel.ru	ZyXEL Russia Ostrovityanova 37a Str. Moscow, 117279 Russia
		sales@zyxel.ru	+7-095-542-89-25		
SPAIN		support@zyxel.es	+34-902-195-420	www.zyxel.es	ZyXEL Communications Arte, 21 5ª planta 28033 Madrid Spain
		sales@zyxel.es	+34-913-005-345		
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		sales@zyxel.co.uk	+44-1344 303034	ftp.zyxel.co.uk	

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

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Preface

Congratulations on your purchase of the ZyXEL MAX-100 Series WiMAX PCMCIA Card. Your ZyXEL Device plugs into a PCMCIA port on your notebook computer and allows you to access WiMAX wireless networks.

Your ZyXEL Device is easy to install and configure.

About This User's Guide

This manual is designed to guide you through the configuration of your ZyXEL Device 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. It contains 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 ZyXEL MAX-100 Series WiMAX PCMCIA Card may be referred to as “the ZyXEL Device” or “the device” in this user's guide.

Graphics Icons Key

Computer 	Notebook Computer 	Wireless Base Station 
Wireless Signal 	Internet Cloud 	Server 
Router 		

CHAPTER 1

Getting Started

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

1.1 About Your ZyXEL Device

The ZyXEL Device is an IEEE 802.16e compliant WiMAX wireless card for your notebook computer. See the appendix for detailed product specifications.

At the time of writing this User's Guide covers the following models:

Table 1 Models Covered

MAX-100
MAX-110
MAX-130

This User's Guide uses screens and example settings from the MAX-100 model.

1.2 Application Overview

In a wireless metropolitan area network (MAN), the ZyXEL Device connects to a base station (BS) for Internet access.

The following diagram shows a notebook computer equipped with the ZyXEL Device connecting to the Internet through a base station BS1.

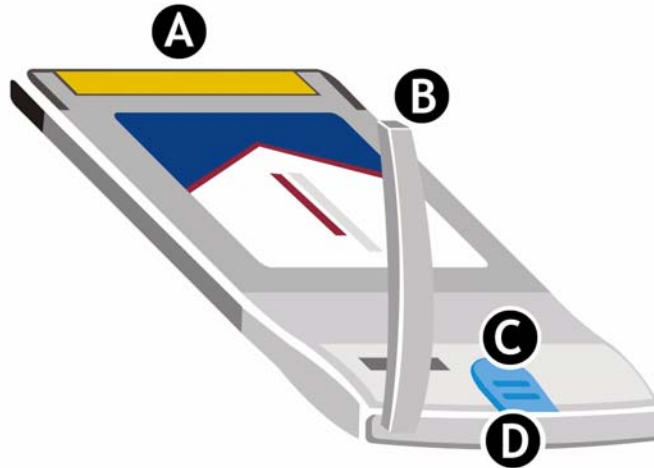
Figure 1 Mobile Station and Base Station



1.3 ZyXEL Device Hardware

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

Figure 2 The ZyXEL Device



The following table describes the ZyXEL Device.

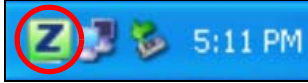
Table 2 The ZyXEL Device

Label	Description		
A	PCMCIA connector.		
B	2dBi rotating antenna		
C	PWR LED	ON	The ZyXEL Device is properly connected and receiving power.
		OFF	The ZyXEL Device is not receiving power.
D	LINK LED	ON	The ZyXEL Device has a connection with a base station.
		BLINKING	The ZyXEL Device is connecting with a base station.
		OFF	The ZyXEL Device does not have a connection with a base station.

1.4 The ZyXEL Utility

After you install the ZyXEL utility and insert the ZyXEL Device, an icon appears in the system tray.

Note: The ZyXEL utility system tray icon displays only when the ZyXEL Device is inserted properly.

Figure 3 ZyXEL Utility: System Tray Icon

The color of the ZyXEL utility system tray icon indicates whether the ZyXEL Device is connected to a wireless network. Refer to the following table for details.

Table 3 ZyXEL Utility: System Tray Icon

COLOR	DESCRIPTION
Orange	The ZyXEL Device is not connected to a wireless network, or is starting up.
Green	The ZyXEL Device is connected to a wireless network.
Blue	The ZyXEL Device is connected to a wireless network, but is in power saving mode or changing its connection from one base station to another. See Section 3.3 on page 29 for information on WiMAX states.

1.4.1 Accessing the ZyXEL Utility

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

The ZyXEL utility screens are similar in all Microsoft Windows versions.

CHAPTER 2

Tutorial

The following example shows you how to configure settings to join a wireless network and access the Internet using the ZyXEL utility.

2.1 Connecting to the Internet

There are three parts to this example, as follows:

- 1 Set up your user name and password (in the **Profile** screen).
- 2 Set up search frequencies (in the **Site Survey** screen).
- 3 Confirm the connection (in the **Link Info** screen).

To access the Internet, you need information from your Internet Service Provider (ISP) about your account and the network. In this example, your ISP has given you the following information about your account:

Table 4 Tutorial: Example Account Information

User name	User1234
Password	xyz9876
Anonymous Identity	anonymous@zyxel.com
Available Frequencies	2.5, 2.525, 2.6 and 2.625 gigahertz (GHz)
Downlink Frequency Step	25 megahertz (MHz)

See [Section 3.4 on page 31](#) for more information on radio frequencies.

2.1.1 Set Up Your User Name and Password

After you install the ZyXEL utility and then insert the ZyXEL Device (see the Quick Start Guide for details) follow the steps below to set up your user name and password.

- 1 Start the ZyXEL utility and click the **Profile** tab to open the screen shown next.

Figure 4 Tutorial: Profile Screen

Profile

User :

Password : ☐ Don't save user and password

Anonymous Identity :

PKM : PKMv2

Authentication : TTLS

TTLS Inner EAP : CHAP

Save

- 2 In the **User** field, enter your user name (“User1234”) and in the **Password** field, enter your password (“xyz9876”). Select the **Don't save user and password** box if you don't want anyone who uses the ZyXEL Device on this computer to be able to access the Internet using your account details. Enter your **Anonymous Identity** (“anonymous@zyxel.com”) and leave the other fields at their default values. Click the **Save** button.

2.1.2 Set Up Search Frequencies

- 1 Click the **Site Survey** tab to open the screen shown next. The **Site Survey** screen allows you to specify a set of frequencies to search for a connection to a base station. The **Manual** site survey screen displays.

Figure 5 Tutorial: Site Survey Screen (Manual)

Site Information

DL Frequency [1] : kHz

DL Frequency [2] : kHz

DL Frequency [3] : kHz

DL Frequency [4] : kHz

DL Frequency [5] : kHz

DL Frequency [6] : kHz

DL Frequency [7] : kHz

DL Frequency [8] : kHz

DL Frequency [9] : kHz

Express Save

- 2 You have chosen to use the **Manual** site survey screen because you need to enter four different frequencies. See [Section 3.5 on page 32](#) for more information on when to use the **Manual** or the **Express** site survey screen.
 - In the **DL Frequency [1]** field, enter **2500000** (2500000 kilohertz (kHz) is equal to 2.5 gigahertz).
 - In the **DL Frequency [2]** field, enter **2525000**.
 - In the **DL Frequency [3]** field, enter **2600000**.

- In the **DL Frequency [4]** field, enter **2625000**.

Leave the rest of the **DL Frequency** fields at zero.

Figure 6 Tutorial: Completing the Manual Site Survey Screen

Site Information		
DL Frequency [1]:	2500000	kHz
DL Frequency [2]:	2525000	kHz
DL Frequency [3]:	2600000	kHz
DL Frequency [4]:	2625000	kHz
DL Frequency [5]:	0	kHz
DL Frequency [6]:	0	kHz
DL Frequency [7]:	0	kHz
DL Frequency [8]:	0	kHz
DL Frequency [9]:	0	kHz

Express Save

- 3 Click **Save**. The ZyXEL Device stores your settings.
- 4 When the ZyXEL Device searches for available frequencies, it scans all frequencies from **DL Frequency [1]** to **DL Frequency [4]**.

2.1.3 Confirm the Connection

- 1 Click the **Link Info** tab. The screen appears as shown next. If the ZyXEL Device has successfully connected to a base station the indicators at the bottom of the screen show the strength and quality of the connection.

Figure 7 Tutorial: Link Info Screen

WiMAX Network Status	
Operator ID :	0:0:0
BSID :	00:00:00:00:00:01
Cell ID :	5
Frequency :	2500000
MAC address :	00:13:49:00:00:03
WiMAX State :	Connection state
Bandwidth :	8.75 MHz

Statistics	
CINR mean :	24.00 dB
CINR deviation :	16.81 dB
RSSI :	-46.99 dBm
UL Data Rate :	0 pkt/sec
DL Data Rate :	0 pkt/sec
PER :	28.4005 %
Tx Power :	-2 dBm

Signal Strength Link Quality

- 2 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.

CHAPTER 3

Wireless Configuration

This chapter discusses WiMAX and introduces each screen in the ZyXEL utility. See the Quick Start Guide for hardware and utility installation procedures.

3.1 WiMAX Overview

WiMAX (Worldwide Interoperability for Microwave Access) is the IEEE 802.16 wireless networking standard, which provides high-bandwidth, wide-range wireless service across wireless Metropolitan Area Networks (MANs). ZyXEL is a member of the WiMAX Forum, the industry group dedicated to promoting and certifying interoperability of wireless broadband products.

In a wireless MAN, a wireless-equipped computer is known either as a mobile station (MS) or a subscriber station (SS). Mobile stations use the IEEE 802.16e standard and are able to maintain connectivity while switching their connection from one base station to another base station (handover) while subscriber stations use other standards that do not have this capability (IEEE 802.16-2004, for example). The following figure shows an MS-equipped notebook computer **MS1** moving from base station **BS1**'s coverage area and connecting to **BS2**.

Figure 8 WiMax: Mobile Station



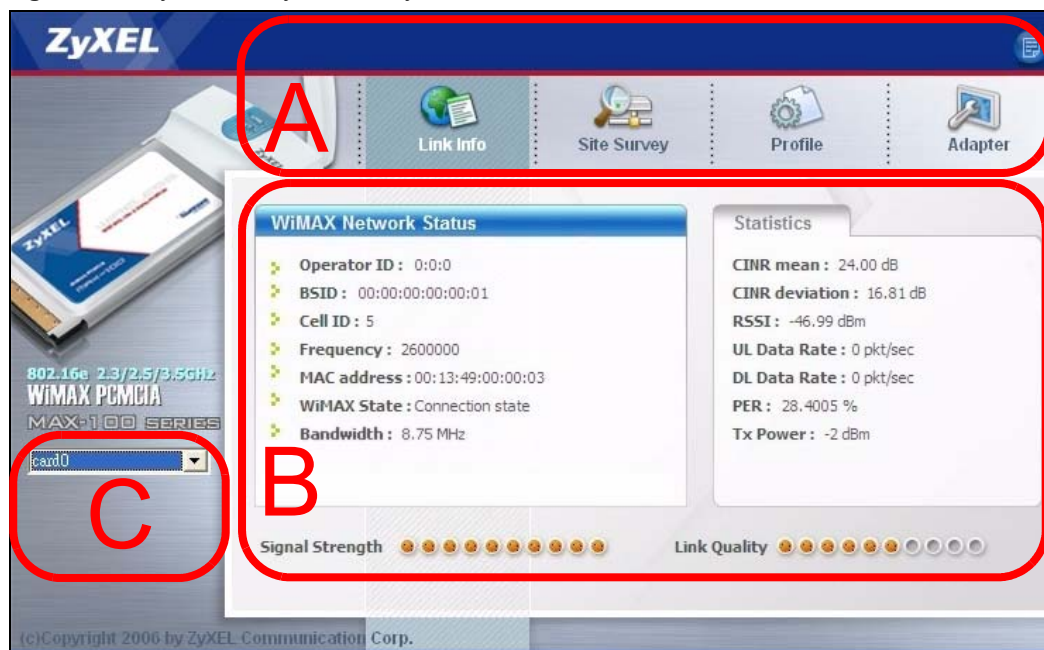
WiMAX technology uses radio signals (around 2 to 10 GHz) to connect subscriber stations and mobile stations to local base stations. Numerous subscriber stations and mobile stations connect to the network through a single base station (BS), as in the following figure.

Figure 9 WiMAX: Multiple Mobile Stations

A base station's coverage area can extend over many hundreds of meters, even under poor conditions. A base station provides network access to subscriber stations and mobile stations, and communicates with other base stations.

3.2 ZyXEL Utility Summary

This section describes the ZyXEL utility.

Figure 10 ZyXEL Utility Summary

The following table describes the labels in this screen.

Table 5 ZyXEL Utility Summary

LABEL	DESCRIPTION
A	Use these buttons to display the different screens in the utility.
Link Info	Use this screen to see your current connection status, configuration, and data rate statistics.
Site Survey	Use these screens to configure wireless connection settings.
Profile	Use this screen to configure wireless security and Internet access settings.
Adapter	Use this screen to see your ZyXEL Device's firmware version number, and to upload new firmware.
About ()	Click this button to see your ZyXEL Device's driver and utility version number.
B	Each utility screen displays here. When you first open the utility, the Link Info screen displays.
C	If you have more than one ZyXEL Device connected to your computer, use this list to see details and configure settings of each ZyXEL Device currently connected. The ZyXEL Device you first insert is Card0 , the second ZyXEL Device you install is Card1 , etc.

3.3 The Link Info Screen

Use this screen to see your current connection status, configuration, and data rate statistics.

When the ZyXEL utility starts, the Link Info screen displays, showing the current configuration and connection status of your ZyXEL Device. If the fields in this screen are blank, the ZyXEL Device is not connected to a base station.

Figure 11 The Link Info Screen



The following table describes the labels in this screen.

Table 6 The Link Info Screen

LABEL	DESCRIPTION
WiMAX Network Status	These fields provide information about the ZyXEL Device's current network connection status.
Operator ID	Every WiMAX service provider has a unique Operator ID number, which is broadcast by each base station it owns. You can only connect to the Internet through base stations belonging to your service provider's network.
BSID (Base Station Identity)	This field displays the identification number of the wireless base station to which the ZyXEL Device is connected. Every base station transmits a unique BSID, which identifies it across the network.
Cell ID	A base station's coverage area can be divided into multiple cells. This field shows the identification number of the cell in which the ZyXEL Device is connected. The Cell ID is transmitted by the base station.
Frequency	This field displays the radio frequency of the current wireless connection.
MAC address	This field displays the Media Access Control (MAC) address of the ZyXEL Device. Every network device has a unique MAC address which identifies it across the network.
WiMAX State	This field displays the status of the ZyXEL Device's current connection. • NA: the ZyXEL Device is starting up. • Fail: The ZyXEL Device is unable to connect to a base station. • Initial Synchronization: the ZyXEL Device is attempting to locate a base station. • Initial DCD (Downlink Channel Descriptor): the ZyXEL Device has located a base station and is receiving information about a possible downlink connection. • Initial UCD (Uplink Channel Descriptor): the ZyXEL Device is receiving information from the base station about a possible uplink connection. • Initial Ranging and Calibration: the ZyXEL Device and the base station are transmitting and receiving information about the distance between them. Ranging allows the ZyXEL Device to use a lower transmission power level when communicating with a nearby base station, and a higher transmission power level when communicating with a distant base station. • Initial Negotiation: the ZyXEL Device and the base station are exchanging information about their capabilities. • Initial PKM (Privacy Key Management): the ZyXEL Device and the base station are exchanging security information. • Initial Registration: the ZyXEL Device is registering with a RADIUS server. • Running: the ZyXEL Device has successfully registered with the base station. Traffic can now flow between the ZyXEL Device and the base station. • Sleep: the ZyXEL Device is in power saving mode, but periodically checks whether a base station has traffic waiting. • Idle: the ZyXEL Device is in power saving mode, but can connect when a base station alerts it that there is traffic waiting. • Handover: the ZyXEL Device is moving from one coverage area to another, and is connecting to the new base station.
Bandwidth	This field shows the size of the bandwidth step the ZyXEL Device uses to connect to a base station in megahertz (MHz).
Statistics	These fields provide information on the ZyXEL Device's wireless signal status.

Table 6 The Link Info Screen (continued)

LABEL	DESCRIPTION
CINR mean	This field shows the average Carrier to Interference plus Noise Ratio (CINR) of the current connection. This value is an indication of overall radio signal quality. A higher value indicates a higher signal quality, and a lower value indicates a lower signal quality.
CINR deviation	This field shows the amount of change in the CINR level. This value is an indication of radio signal stability. A lower number indicates a more stable signal, and a higher number indicates a less stable signal.
RSSI	This field shows the Received Signal Strength Indication (RSSI). This value is a measurement of overall radio signal strength. A higher RSSI level indicates a stronger signal, and a lower RSSI level indicates a weaker signal.
UL Data Rate	This field shows the number of data packets uploaded from the ZyXEL Device to the base station each second.
DL Data Rate	This field shows the number of data packets downloaded to the ZyXEL Device from the base station each second.
PER	This field shows the Packet Error Rate (PER). The PER is the percentage of data packets transmitted across the network but not successfully received.
Tx Power	This field shows the output transmission (Tx) level of the ZyXEL Device.
Signal Strength	This bar shows the current Received Signal Strength Indication (RSSI). Signal strength depends mainly on the antenna output power and the distance between your ZyXEL Device and the base station.
Link Quality	This bar shows the quality of the 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.

3.4 Frequency Settings

In a WiMAX network, a mobile or subscriber station must use a radio frequency supported by the base station to communicate. When the ZyXEL Device looks for a connection to a base station, it searches a range of frequencies.

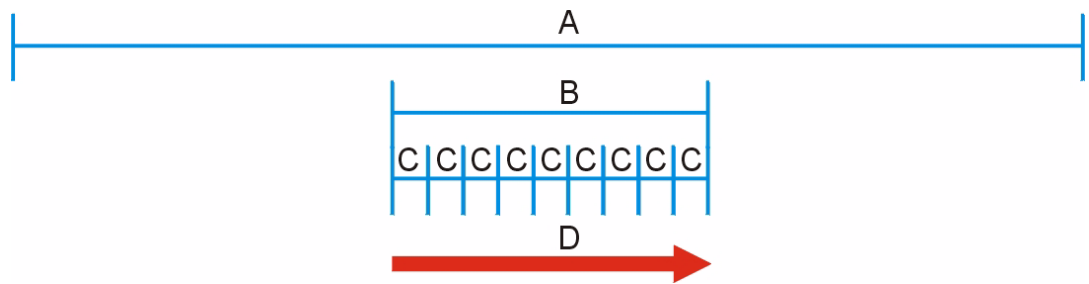
Radio frequency is measured in hertz (Hz), kilohertz (kHz), megahertz (MHz) and gigahertz (GHz).

Table 7 Radio Frequency Conversion

1 kHz = 1000 Hz
1 MHz = 1000 kHz (1000000 Hz)
1 GHz = 1000 MHz (1000000 kHz)

3.4.1 Frequency Ranges

The following figure shows the ZyXEL Device searching a range of frequencies to find a connection to a base station.

Figure 12 Frequency Ranges

In this figure, **A** is the WiMAX frequency range. “WiMAX frequency range” refers to the entire range of frequencies the ZyXEL Device is capable of using to transmit and receive (see the Product Specifications appendix for details).

In the figure, **B** shows the operator frequency range. This is the range of frequencies within the WiMAX frequency range supported by your operator (service provider).

The operator range is subdivided into bandwidth steps. In the figure, each **C** is a bandwidth step.

The arrow **D** shows the ZyXEL Device searching for a connection.

Have the ZyXEL Device search only certain frequencies by configuring the downlink frequencies. Your operator can give you information on the supported frequencies.

The downlink frequencies are points of the frequency range your ZyXEL Device searches for an available connection. Use the site survey screen to set these bands. You can set the downlink frequencies anywhere within the WiMAX frequency range. In this example, the downlink frequencies have been set to search all of the operator range for a connection.

3.5 The Site Survey Screen

Click the **Site Survey** tab. Use these screens to configure wireless connection settings.

When you want to have the ZyXEL Device search for a connection to a base station, you have the following options.

- Use the **Manual** site survey screen to type in settings yourself. Do this if you want to configure the ZyXEL Device to scan frequencies that are not in a range (for example, 2.55 GHz, 2.525 GHz, 2.65GHz and 2.675 GHz). See [Section 2.1 on page 23](#) for an example of using the **Manual** screen.

or

- Use the **Express** site survey screen to set the ZyXEL Device to scan a specified range of frequencies automatically. Do this if your service provider has given you details of an available frequency range in your region (for example, 2.55 ~ 2.6 GHz with a bandwidth step of 25MHz). See [Section 3.5.2.1 on page 35](#) for an example of using the **Express** screen.

3.5.1 Site Survey: Manual

Use this screen to define radio frequencies to be searched for available wireless connections.

- The ZyXEL Device searches the **DL Frequency** settings in ascending numerical order, from [1] to [9].
- If you enter a 0 in a **DL Frequency** field, the ZyXEL Device immediately moves on to the next **DL Frequency** field.
- When the ZyXEL Device connects to a base station, the values in this screen are automatically set to the base station's frequency. The next time the ZyXEL Device searches for a connection, it searches only this frequency. If you want the ZyXEL Device to search other frequencies, enter them in the **DL Frequency** fields.

The following table describes some examples of **DL Frequency** settings.

Table 8 DL Frequency Example Settings

	EXAMPLE 1	EXAMPLE 2
DL Frequency [1]:	2500000	2500000
DL Frequency [2]:	2550000	2550000
DL Frequency [3]:	0	2600000
DL Frequency [4]:	0	0
DL Frequency [5]:	0	0
	The ZyXEL Device searches at 2500000 kHz, and then searches at 2550000 kHz if it has not found a connection.	The ZyXEL Device searches at 2500000 kHz and then at 2550000 kHz if it has not found an available connection. If it still does not find an available connection, it searches at 2600000 kHz.

Figure 13 The Site Survey Screen (manual)

Site Information

DL Frequency [1]: 0 kHz

DL Frequency [2]: 0 kHz

DL Frequency [3]: 0 kHz

DL Frequency [4]: 0 kHz

DL Frequency [5]: 0 kHz

DL Frequency [6]: 0 kHz

DL Frequency [7]: 0 kHz

DL Frequency [8]: 0 kHz

DL Frequency [9]: 0 kHz

Express Save

The following table describes the labels in this screen.

Table 9 The Site Survey Screen (Manual)

LABEL	DESCRIPTION
Site Information	
DL Frequency [1-9]	These fields show the downlink frequency settings in kilohertz (kHz). Enter values in these fields to have the ZyXEL Device scan these frequencies for available channels in ascending numerical order. Contact your service provider for details of supported frequencies.
Express	Click this button to go to the Express site survey screen.
Save	Click this button to save your wireless settings.

3.5.2 Site Survey: Express

Click **Site Survey > Express**. Use this screen to set the ZyXEL Device to automatically search a range of frequencies for an available connection to a base station.

Figure 14 The Site Survey Screen (Express)

Site Information

DL Frequency Start : 0000000 kHz

DL Frequency Stop : 0000000 kHz

DL Frequency Step : 25000

Manual Finish

The following table describes the labels in this screen.

Table 10 The Site Survey Screen (Express)

LABEL	DESCRIPTION
DL Frequency Start	Use this field to set the low end of the frequency range (in kilohertz).
DL Frequency Stop	Use this field to set the high end of the frequency range (in kilohertz).
DL Frequency Step	Use this field to set the step size between DL Frequency values (in kilohertz). The step size is the difference between two adjacent DL Frequency values. The Site Survey (Express) screen automatically creates a maximum of nine frequency bands. Therefore, make sure that the DL Frequency Step setting is no less than one-ninth of the difference between the DL Frequency start and DL Frequency stop values.
Manual	Click this button to return to the Manual site survey screen. Your settings in the Express screen will not be saved.
Finish	Click this button to return to the Manual screen. Your settings will be displayed in the DL frequency [1-9] fields. You still need to save your settings.

3.5.2.1 Using the Site Survey Screen (Express): Example

In this example, your Internet service provider has given you a range of supported frequencies, as follows.

Table 11 Example Supported Frequencies (GHz)

Start	2.525
Stop	2.6

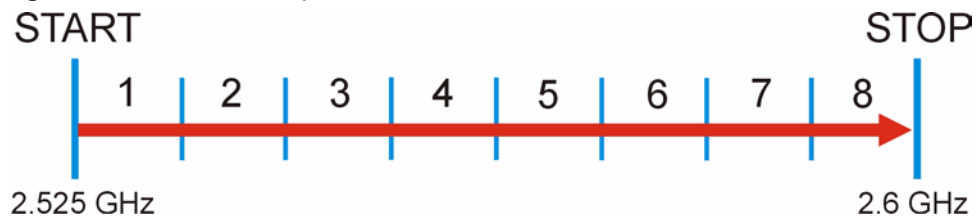
You have chosen to use the **Express** site survey screen, as you have a single frequency range to search for a connection.

- 1 You need to enter the frequency settings your ISP gave you. 1GHz is equal to 1000000 kilohertz (kHz), so enter “2525000” in the **DL Frequency Start** field and enter “2600000” in the **DL frequency Stop** field.

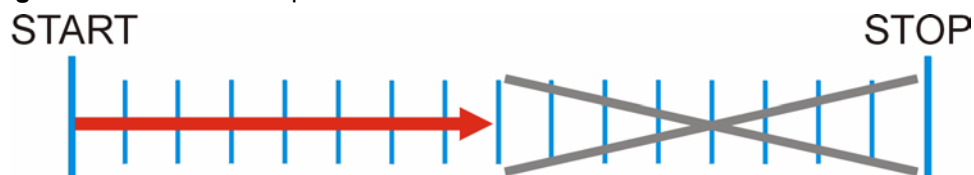
Table 12 Example Frequency Settings

Start	2.525 GHz	=	2525000 kHz
Stop	2.6 GHz	=	2600000 kHz

The ZyXEL Device splits this range of frequencies into (at most) eight bands between **DL Frequency Start** and **DL Frequency Stop** (this gives nine search points). The gap between these points is controlled by the **DL Frequency Step** value. The ZyXEL Device searches each of the points (the blue lines in the following figure) for a connection as shown.

Figure 15 Search Example 1

The ZyXEL Device uses only the first nine points between **DL Frequency Start** and **DL Frequency Stop**, so if the **DL Frequency Step** is too small the rest of the range is not searched, as in the following figure. The arrow shows the ZyXEL Device searching the first nine points, and the cross shows the points that are not searched.

Figure 16 Search Example 2

- 2 Your ISP gave you 25 MHZ as the downlink frequency step, so leave the **DL Frequency Step** field at its default (25 MHZ = 25000 kHz).

Figure 17 Frequency Values

Figure 17 shows the 'Site Information' configuration window. The 'DL Frequency Start' field is set to 2525000 kHz, the 'DL Frequency Stop' field is set to 2600000 kHz, and the 'DL Frequency Step' field is set to 25000 kHz. These fields are highlighted with a red circle. The 'Manual' and 'Finish' buttons are visible at the bottom.

- 3 Click **Finish** to return to the **Manual** screen. The **DL Frequency** fields have been automatically filled in.

Figure 18 Automatic Completion

Site Information		
DL Frequency [1]	2525000	kHz
DL Frequency [2]	2550000	kHz
DL Frequency [3]	2575000	kHz
DL Frequency [4]	2600000	kHz
DL Frequency [5]	2600000	kHz
DL Frequency [6]	2600000	kHz
DL Frequency [7]	2600000	kHz
DL Frequency [8]	2600000	kHz
DL Frequency [9]	2600000	kHz

Express Save

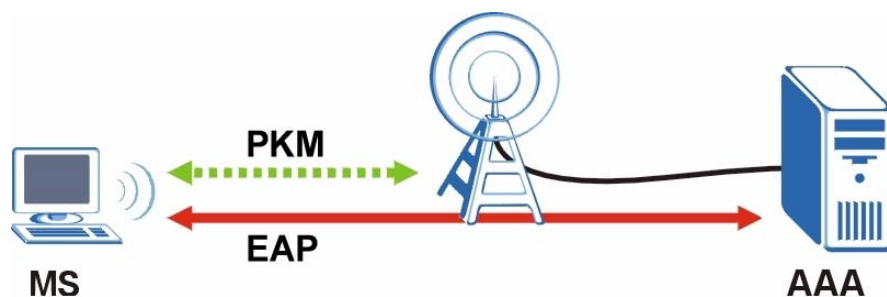
- 4 Click **Save** to save your settings to the ZyXEL Device. The ZyXEL Device scans for a connection in the order on the screen. When it finds one, the fields in this screen are automatically set to use that frequency.

3.6 Authentication

When authenticating a user, the base station uses a third-party RADIUS or Diameter server known as an AAA (Authentication, Authorization and Accounting) server to authenticate the mobile or subscriber stations.

WiMAX uses PKM (Privacy Key Management) for authentication between the mobile or subscriber station and the base station, and supports EAP (Extensible Authentication Protocol) between the mobile or subscriber station, the base station, and the AAA server.

The following figure shows a base station using an AAA server to authenticate mobile station MS, allowing it to access the Internet.

Figure 19 Authentication

In this figure, the dashed arrow shows the PKM secured connection between the mobile station and the base station, and the solid arrow shows the EAP secured connection between the mobile station, the base station and the AAA server. See the WiMAX security appendix for more details.

3.7 The Profile Screen

Click the **Profile** tab. Use this screen to configure wireless security and Internet access settings.

A profile is a set of wireless parameters that you need to connect to a wireless network. Use the settings given to you by your Internet service provider.

If you do not configure the profile, each time you start the ZyXEL Device it uses the default user name and password to try to connect to any available network.

Figure 20 The Profile Screen

The following table describes the labels in this screen.

Table 13 The Profile Screen

LABEL	DESCRIPTION
User	Enter the user name associated with your Internet access account.
Password	Enter the password associated with your Internet access account.
Don't save user and password	Select this box if you want to enter your user name and password every time you use the ZyXEL Device on this computer. If you do not select this box, anyone using the ZyXEL Device on this computer can use your Internet account to access the Internet.
Anonymous Identity	Enter the anonymous identity provided by your Internet Service Provider. Anonymous identity (also known as outer identity) is used with EAP-TTLS encryption. The anonymous identity is used to route your authentication request to the correct authentication server, and does not reveal your real user name. Your real user name and password are encrypted in the TLS tunnel, and only the anonymous identity can be seen. Leave this field blank if your ISP did not give you an anonymous identity to use.
PKM	This field displays the Privacy Key Management version number. See the WiMAX security appendix for more information.
Authentication	This field displays the user authentication method.

Table 13 The Profile Screen (continued)

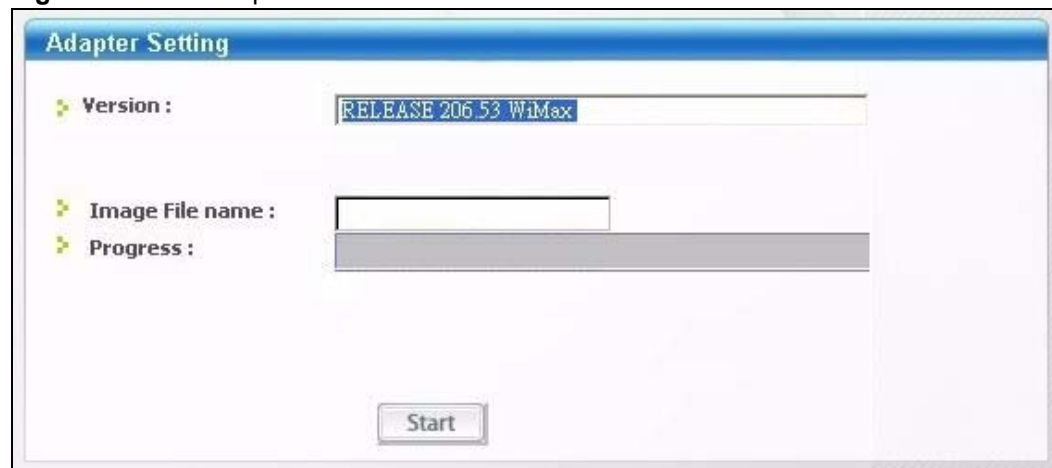
LABEL	DESCRIPTION
TTLS Inner EAP	Select the type of inner authentication to be used from the drop-down list box. Check with your service provider if you are unsure of the correct setting for your account. The ZyXEL Device supports the following inner authentication types: • CHAP (Challenge Handshake Authentication Protocol) • EAP (Extensible Authentication Protocol) • MSCHAP (Microsoft CHAP) • MSCHAP2 (Microsoft CHAP version2) • PAP (Password Authentication Protocol)
Save	Click this button to save your profile settings.

3.8 The Adapter Screen

Click the **Adapter** tab. Use this screen to see your ZyXEL Device's firmware version number, and to upload new firmware.

The firmware determines the device's available features and functionality. You can download new firmware releases from your nearest ZyXEL FTP site (or www.zyxel.com) to use to upgrade your device's performance.

Note: Only use firmware for your device's specific model. Refer to the label on your ZyXEL Device.

Figure 21 The Adapter Screen

The following table describes the labels in this screen.

Table 14 The Adapter Screen

LABEL	DESCRIPTION
Version	This is the version number of the firmware the ZyXEL Device is currently using.
Image File Name	This shows the file name of the firmware you are uploading.
Progress	This shows the amount of the firmware file that has been uploaded. Note: Do not turn off or remove the ZyXEL Device while firmware upload is in progress!
Start	Click this to select a firmware file and upload it to the ZyXEL Device.

3.8.1 Uploading Firmware

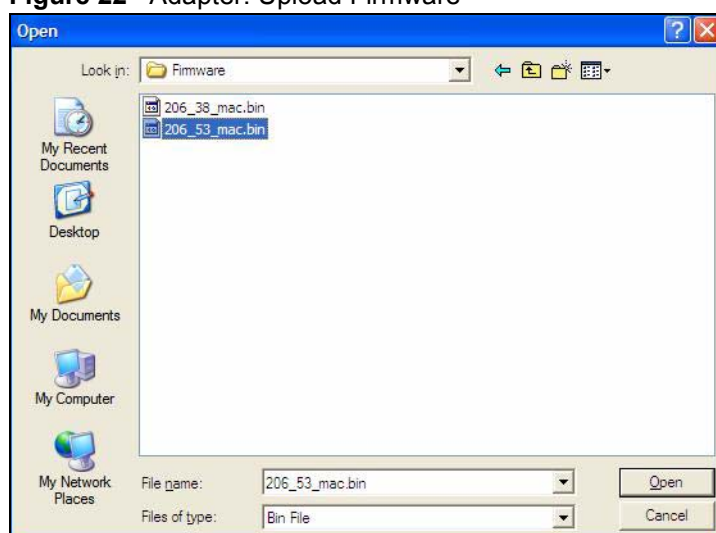
Take the following steps to upload new firmware to the ZyXEL Device.

- 1 Save the new firmware in the ZyXEL Device's directory on your computer. The default directory is C:\Program Files\ZyXEL\MAX-100 Series\.

If the firmware is in a compressed (.zip) file, you need to decompress (unzip) it. The ZyXEL Device firmware is a binary (.bin) file.

- 2 Open the ZyXEL Device utility and click the **Adapter** tab. Click **Start** when you are ready to upload. A window similar to the following appears.

Figure 22 Adapter: Upload Firmware



- 3 Locate the firmware file and click **Open**.
- 4 The firmware's filename appears in the **Image File Name** field. The progress bar displays how much of the file has uploaded. This may take several minutes.

Note: Do NOT unplug your ZyXEL Device or turn off the computer while firmware upload is in progress! This may PERMANENTLY DAMAGE your device!

- 5** When the upload is finished, restart your ZyXEL Device (unplug it then plug it back in). Open the utility and click the **Adapter** tab. Check that the **Version** field displays the filename of the new firmware.

CHAPTER 4

Maintenance

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

4.1 The About Screen

The **About** screen displays the driver and utility version numbers of the ZyXEL Device. To display the screen as shown below, click the About () button.

Figure 23 About



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

Table 15 About

LABEL	DESCRIPTION
Driver version	This field displays the version number of the ZyXEL Device driver. The driver is a piece of software your computer needs to communicate with the ZyXEL Device.
Utility version	This field displays the version number of the ZyXEL utility. The ZyXEL utility is software you use to configure your ZyXEL Device.

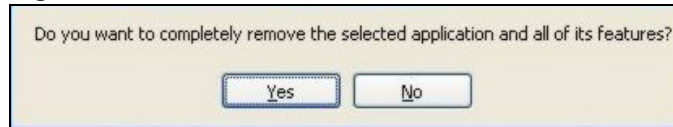
4.2 Uninstalling the ZyXEL Utility

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

Note: Before you uninstall the ZyXEL utility, make a copy of your current wireless configurations.

- 1 Click **Start**, (**All**) **Programs**, **ZyXEL ZyXEL Device Utility**, **Uninstall ZyXEL ZyXEL Device Utility**.
- 2 When prompted, click **OK** or **Yes** to remove the driver and the utility software.

Figure 24 Uninstall: Confirm



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

Figure 25 Uninstall: Finish



4.3 Upgrading the ZyXEL Utility

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.

Note: Before you uninstall the ZyXEL utility, make a copy of your current wireless configurations.

- 2 Follow the steps in [Section 4.2 on page 43](#) to remove the current ZyXEL utility from your computer. Restart your computer when prompted.
- 3 Disconnect the ZyXEL Device from your computer.
- 4 Double-click on the setup program for the new utility to start the ZyXEL utility installation.

- 5 Insert the ZyXEL Device and 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

Table 16 Troubleshooting Starting the ZyXEL Utility

PROBLEM	CORRECTIVE ACTION
Cannot start the ZyXEL utility	Make sure the ZyXEL Device is properly inserted and the PWR LED is on. 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 Device under Network Adapter. (Steps may vary depending on the version of Windows). Install the ZyXEL utility and the ZyXEL Device in another computer and attempt to start the utility. 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.	Restart your computer and insert the ZyXEL Device. If the icon still does not display, uninstall (remove) and re-install the ZyXEL utility.

5.2 Problems Connecting to the Internet

Table 17 Troubleshooting Internet Connection

PROBLEM	CORRECTIVE ACTION
I cannot access the Internet.	Check your connection. Open the ZyXEL utility and check the Link Info screen. If the ZyXEL Device cannot detect a signal, you are not connected to a base station. Use the following steps to make sure you are using the correct settings. Check your security settings. Open the Profile screen in the ZyXEL utility and make sure that you are using the correct security settings for your Internet account. Check your frequency settings. The ZyXEL Device may have been set to search the wrong frequencies for a wireless connection. Open the Site Survey screen in the ZyXEL utility and ensure that the values are correct. If you are unsure of the correct values, contact your service provider. Check your IP settings. You may be using IP address settings incompatible with your Internet account. If you are unsure of the correct settings, contact your service provider. See Appendix C on page 55 for information on how to set up your IP address.

5.3 Problems with the Link Quality

Table 18 Troubleshooting Link Quality

PROBLEM	CORRECTIVE ACTION
Internet access is slow or intermittent.	The quality of the ZyXEL Device's wireless connection to the base station may be poor. Use the Link Info screen in the ZyXEL utility to see information about your wireless connection. Poor signal reception may be improved by changing the position of the antenna, or moving the ZyXEL Device away from thick walls and other obstructions or to a higher floor in your building. There may be radio interference caused by nearby electrical devices such as microwave ovens and radio transmitters. Move the ZyXEL Device away or switch the other devices off. Weather conditions may also affect signal quality.

APPENDIX A

Product Specifications

Table 19 Product Specifications

PHYSICAL AND ENVIRONMENTAL	
Product Name	ZyXEL MAX-100 Series WiMAX PCMCIA Card
Interface	3.3V 16-bit PCMCIA card
Standards	IEEE 802.16e-2005
Antenna	1 X 2dBi omni dipole antenna
Operating Temperature	0 ~ 45 degrees C
Storage Temperature	-25 ~ 55 degrees C
Operating Humidity	10% ~ 90% (non-condensing)
Storage Humidity	10% ~ 95%
Power	Maximum 2W
Dimensions	58 x 125 x 10mm
RADIO SPECIFICATIONS	
Media Access Protocol	IEEE 802.16e
WiMAX Frequency Range	MAX-100: 2.5 ~ 2.7 GHz MAX-110: 3.4 ~ 3.6 GHz MAX-130: 2.3 ~ 2.4 GHz
Data Rate	Downlink: Maximum 5Mbps Uplink: Maximum 2Mbps
Modulation	QPSK (upload and download) 16-QAM (upload and download) 64-QAM (download only)
Output Power	23dBm (+/- 1dB)
Duplex mode	Time Division Duplex (TDD)
SOFTWARE SPECIFICATIONS	
Device Drivers	Windows 2000 (Service Pack 4 or later) Windows XP (Service Pack 2 or later)
Security	PKMv2 EAP CCMP, 128-bit AES
System Requirements	Pentium II 300 MHz or above PCMCIA port Minimum 20 MB available hard disk space Minimum 32 MB RAM CD-ROM drive

APPENDIX B

WiMAX Security

Wireless security is vital to protect your wireless communications. Without it, information transmitted over the wireless network would be accessible to any networking device within range.

User Authentication and Data Encryption

The WiMAX (IEEE 802.16) standard employs user authentication and encryption to ensure secured communication at all times.

User authentication is the process of confirming a user's identity and level of authorization. Data encryption is the process of encoding information so that it cannot be read by anyone who does not know the code.

WiMAX uses PKMv2 (Privacy Key Management version 2) for authentication, and CCMP (Counter Mode with Cipher Block Chaining Message Authentication Protocol) for data encryption.

WiMAX also supports EAP (Extensible Authentication Protocol, RFC 2486) which allows additional authentication methods to be deployed with no changes to the base station or the mobile or subscriber stations.

PKMv2

PKMv2 is a procedure that allows authentication of a mobile or subscriber station and negotiation of a public key to encrypt traffic between the MS/SS and the base station. PKMv2 uses standard EAP methods such as Transport Layer Security (EAP-TLS) or Tunneled TLS (EAP-TTLS) for secure communication.

In cryptography, a 'key' is a piece of information, typically a string of random numbers and letters, that can be used to 'lock' (encrypt) or 'unlock' (decrypt) a message. Public key encryption uses key pairs, which consist of a public (freely available) key and a private (secret) key. The public key is used for encryption and the private key is used for decryption. You can decrypt a message only if you have the private key. Public key certificates (or 'digital IDs') allow users to verify each other's identity.

CCMP

All traffic in a WiMAX network is encrypted using CCMP (Counter Mode with Cipher Block Chaining Message Authentication Protocol). CCMP is based on the 128-bit Advanced Encryption Standard (AES) algorithm.

‘Counter mode’ refers to the encryption of each block of plain text with an arbitrary number, known as the counter. This number changes each time a block of plain text is encrypted. Counter mode avoids the security weakness of repeated identical blocks of encrypted text that makes encrypted data vulnerable to pattern-spotting.

‘Cipher Block Chaining Message Authentication’ (also known as CBC-MAC) ensures message integrity by encrypting each block of plain text in such a way that its encryption is dependent on the block before it. This series of ‘chained’ blocks creates a message authentication code (MAC or CMAC) that ensures the encrypted data has not been tampered with.

Security Association

The set of information about user authentication and data encryption between two computers is known as a security association (SA). In a WiMAX network, the process of security association has three stages.

- Authorization request and reply

The MS/SS presents its public certificate to the base station. The base station verifies the certificate and sends an authentication key (AK) to the MS/SS.

- Key request and reply

The MS/SS requests a transport encryption key (TEK) which the base station generates and encrypts using the authentication key.

- Encrypted traffic

The MS/SS decrypts the TEK (using the authentication key). Both stations can now securely encrypt and decrypt the data flow.

RADIUS

RADIUS is based on a client-server model that supports authentication, authorization and accounting (AAA). The base station is the client and the server is the RADIUS server. The RADIUS server handles the following tasks:

- Authentication

Determines the identity of the users.

- Authorization

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

- Accounting

Keeps track of the client's network activity.

RADIUS is a simple package exchange in which your base station acts as a message relay between the MS/SS and the network RADIUS server.

Types of RADIUS Messages

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

- **Access-Request**
Sent by a base station requesting authentication.
- **Access-Reject**
Sent by a RADIUS server rejecting access.
- **Access-Accept**
Sent by a RADIUS server allowing access.
- **Access-Challenge**
Sent by a RADIUS server requesting more information in order to allow access. The base station sends a proper response from the user and then sends another Access-Request message.

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

- **Accounting-Request**
Sent by the base station requesting accounting.
- **Accounting-Response**
Sent by the RADIUS server to indicate that it has started or stopped accounting.

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

Diameter

Diameter (RFC 3588) is a type of AAA server that provides several improvements over RADIUS in efficiency, security, and support for roaming.

EAP Authentication Types

The type of authentication you use depends on the AAA server.

EAP-TLS (Transport Layer Security)

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

EAP-TTLS (Tunneled Transport Layer Service)

EAP-TTLS is an extension of the EAP-TLS authentication that uses certificates for only the server-side authentications to establish a secure connection. Client authentication is then done by sending user name 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. See [Section 3.7 on page 38](#) for details.

APPENDIX C

Setting up Your Computer's IP Address

All computers must have TCP/IP installed. Windows 2000 and Windows XP usually include TCP/IP.

Configure the TCP/IP settings in order to communicate with your network.

Windows 2000/XP

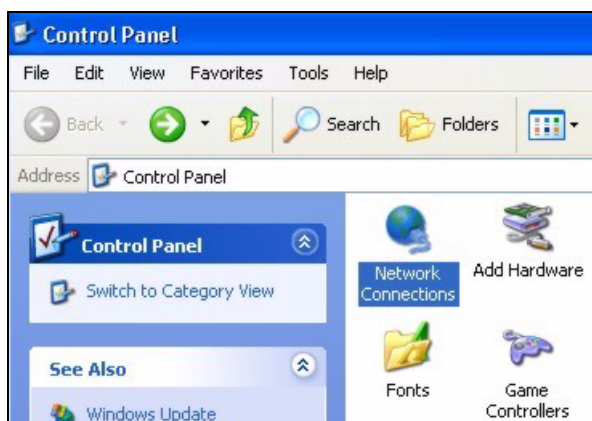
- 1 Click **start** (**Start** in Windows 2000), **Control Panel**.

Figure 26 Windows XP: Start Menu



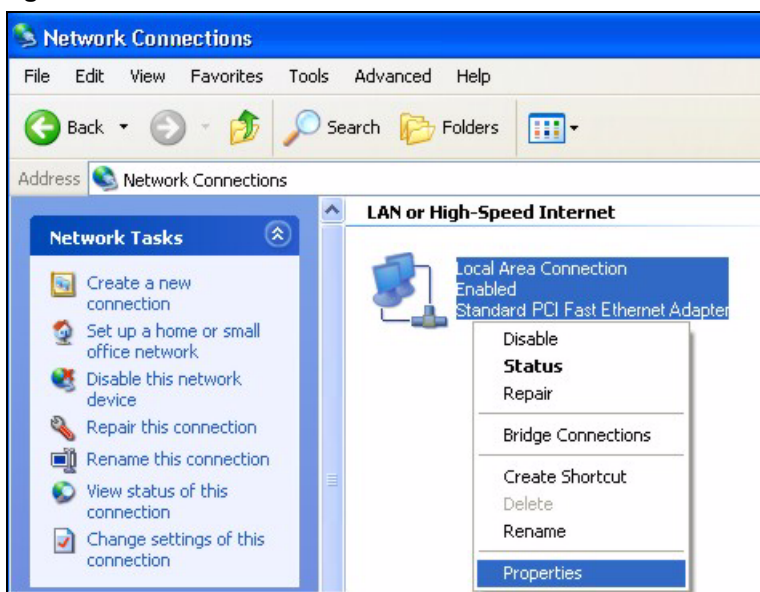
- 2 Click **Network Connections** (**Network and Dial-up Connections** in Windows 2000).

Figure 27 Windows XP: Control Panel

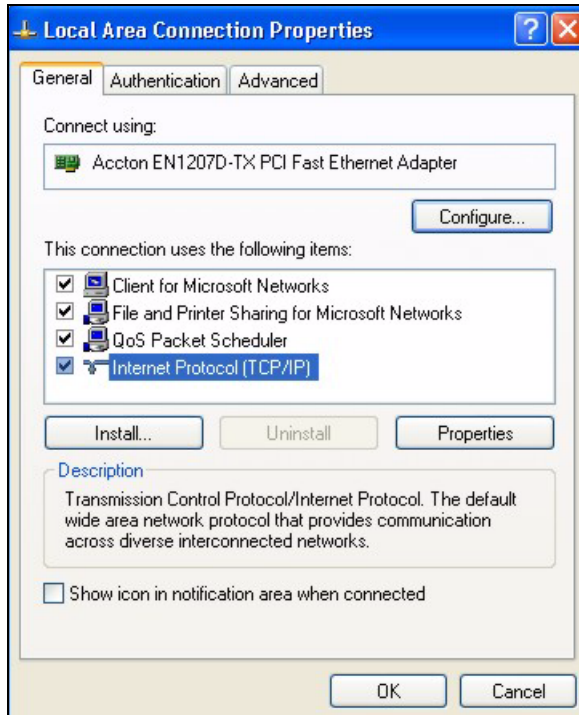


3 Right-click **Local Area Connection** and then click **Properties**.

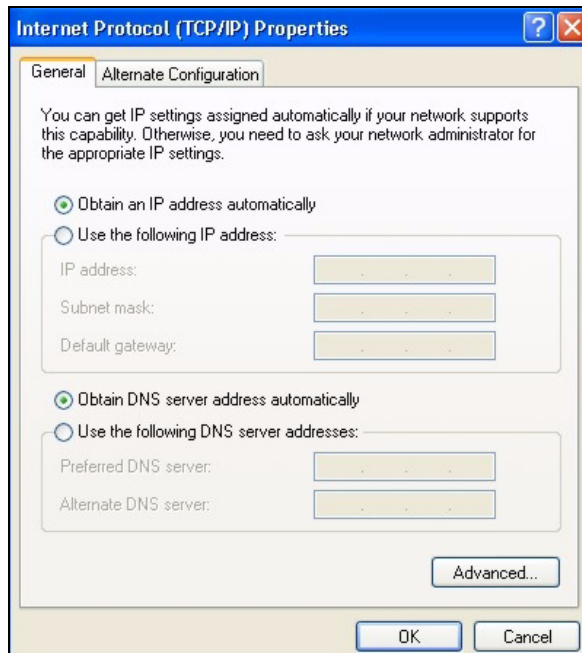
Figure 28 Windows XP: Control Panel: Network Connections: Properties



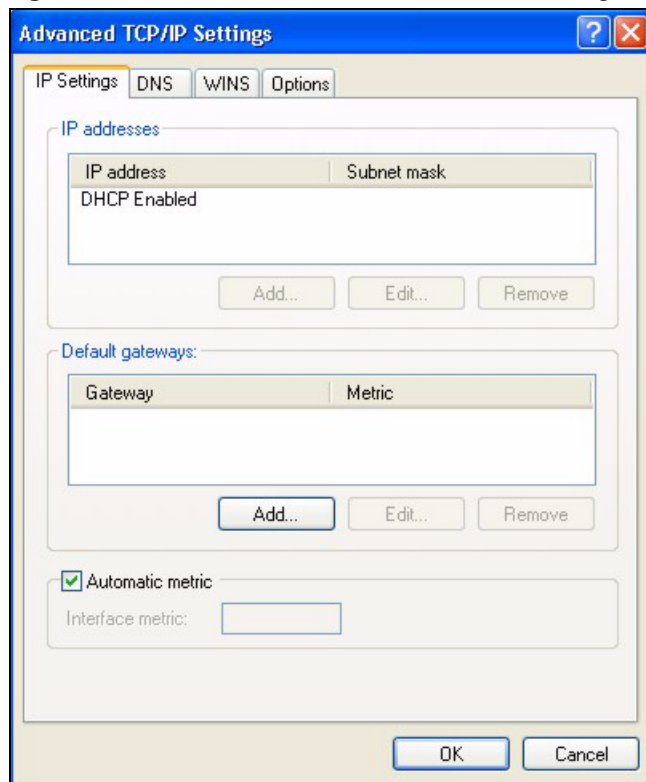
4 Select **Internet Protocol (TCP/IP)** (under the **General** tab in Win XP) and click **Properties**.

Figure 29 Windows XP: Local Area Connection Properties

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

Figure 30 Windows XP: Internet Protocol TCP/IP Properties

- 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 31 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**.

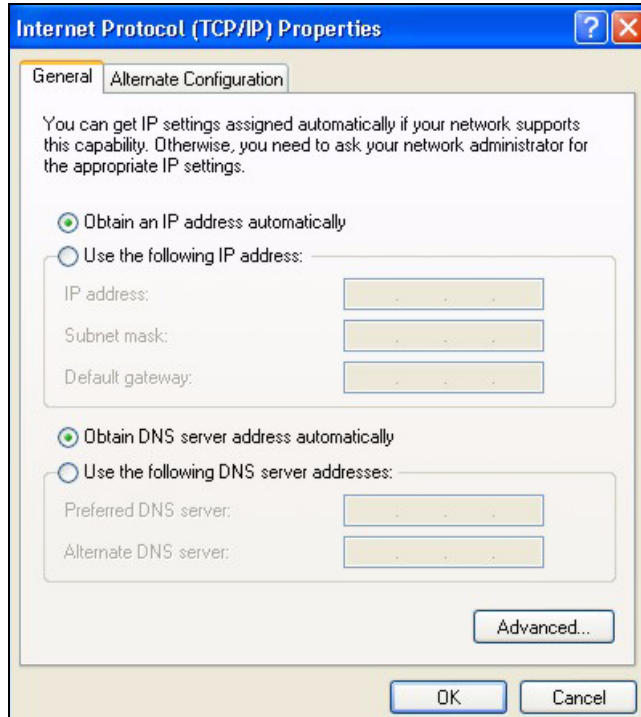
Do one or more of the following if you want to configure additional IP addresses:

- 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 32 Windows XP: Internet Protocol (TCP/IP) Properties



- 8** Click **OK** to close the **Internet Protocol (TCP/IP) Properties** window.
- 9** Click **Close** (**OK** in Windows 2000) to close the **Local Area Connection Properties** window.
- 10** Close the **Network Connections** window (**Network and Dial-up Connections** in Windows 2000).
- 11** 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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