

6 WiMAX Settings

EAP Mode – Selects if only a specific user is to be authenticated (user-only), the subscriber device itself (device-only), or both a user and the device (user-device). Select the option instructed by the WiMAX service operator.

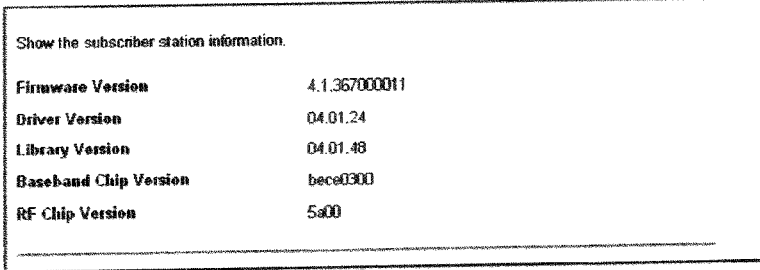
User Name – The user name required for EAP-TTLS authentication.
(Default: pseudo@realm)

Password – The user password required for EAP-TTLS authentication.
(Default: hello)

MAC Address@domain – An identity that is used to authenticate the WiMAX subscriber device itself. It consists of the MAC address of the RG230 specified in the format xx:xx:xx:xx:xx:xx @ the domain URL of the service provider. For example; 1f:20:30:10:4d:50@service-telecom.

Subscriber Station Information

The SSInfo page displays information about the software versions on the RG230 unit.



Show the subscriber station information.

Firmware Version	4.1.367000011
Driver Version	04.01.24
Library Version	04.01.48
Baseband Chip Version	bece0300
RF Chip Version	5a00

Figure 6-5 Subscriber Station Information

Firmware Version – The version of software code running on the unit.

Driver Version – The version of the WiMAX chip driver software.

Library Version – The version of WiMAX library software.

Baseband Chip Version – The version of the WiMAX baseband chip.

RF Chip Version – The version of the WiMAX radio chip.

Chapter 7: VoIP Settings

Voice over Internet Protocol (VoIP) technology is a way of using the Internet to make phone calls. Phone calls can be transmitted over the Internet by encoding a voice call into data packets at one end and then decoding it back into voice calls at the other end. This encoding and decoding is from an analog signal (your voice) into a digital signal (data packets) and then back into an analog signal.

The RG230 uses Session Initiation Protocol (SIP) as the control mechanism that sets up, initiates, and terminates calls between a caller and a called party. The SIP messaging makes use of "Proxy," "Redirect," and "Registration" servers to process call requests and find the location of called parties across the Internet. When SIP has set up a call between two parties, the actual voice communication is a direct peer-to-peer connection using the standard Real-Time Protocol (RTP), which streams the encoded voice data across the network.

You can make VoIP calls by connecting a regular phone to one of the RG230's RJ-11 Phone ports. You can also make VoIP calls from your computer using a VoIP application with a simple microphone and computer speakers. Using either method, VoIP provides an experience identical to normal telephoning.

Before using the VoIP Phone ports on the RG230, you must have an account with a SIP service provider and configure the required parameters through the web interface. The RG230 allows the two RJ-11 Phone ports to be configured separately with different settings.

The VoIP configuration pages include the following options.

Menu	Description	Page
SIP Account	Sets up basic SIP account details for Phone 1 and Phone 2	7-2
SIP Setting	Configures SIP connection parameters	7-3
Dial Plan	Sets control strings for dialed phone numbers	7-4
Call Feature	Configures call forwarding options	7-6
Codecs	Select coder/decoders (codecs) to use for phone traffic	7-8
Call Block Setting	Set incoming and outgoing numbers to block	7-9
Phone Setting	Sets phone timeout parameters	7-10

7 VoIP Settings

SIP Account

From the VoIP SIP Account page, you can configure the basic SIP service parameters for Phone 1 and Phone 2.

You can setup SIP parameter here.

Enable Proxy Outbound

Always Proxy Outbound

Expire Time secs (>60)

You can setup phone 1 SIP parameter here.

User Name	<input type="text" value="2222"/>
Auth. User Name	<input type="text" value="proxyuser"/>
Auth. Password	<input type="password" value="*****"/>
Display Name	<input type="text" value="voip2"/>
SIP registrar	<input type="text" value="192.168.7.117"/>
SIP registrar port number	<input type="text" value="5060"/>
Proxy Address	<input type="text" value="192.168.7.117"/>
Proxy Port	<input type="text" value="5060"/>

Figure 7-1 SIP Account Settings

Enable Proxy Outbound – Enables the use of proxy servers in the local network to forward SIP requests. (Default: Disabled)

Always Proxy Outbound – Forces all SIP requests to be forwarded through local proxy servers. (Default: Disabled)

Expire Time – The time the RG230 waits for a response from a proxy server before a VoIP call fails. (Range: 61-65535 seconds; Default: 3600 seconds)

User Name – The SIP account user name.

Auth. User Name – An alphanumeric string that uniquely identifies the user to the SIP server.

Auth. Password – An alphanumeric string that uniquely identifies the SIP user's permission rights.

Display Name – The name that is displayed to the other party during a call.

SIP Register – The IP address of the SIP registrar server. A registrar is a server that accepts SIP register requests and places the information it receives in those requests into the location service for the domain it handles.

SIP Register Port Number – The TCP port number used by the VoIP service provider's register server. (Range: 0-65535; Default: 5060)

Proxy Address – Address of the VoIP service provider SIP proxy server.

Proxy Port – The TCP port number used by the VoIP service provider's SIP proxy server. (Range: 0-65535; Default: 5060)

SIP Setting

From the VoIP SIP Setting page you can configure SIP parameter details.

You can setup SIP parameter here.

RTP Packetization Time	<input type="text" value="20"/> ms	
RTP Port Base	<input type="text" value="49000"/>	
RTP Port Limit	<input type="text" value="49050"/>	

Stun Server	<input type="text" value="0.0.0.0"/> <input type="text" value="3478"/>	
	ex:0.0.0.0:3478 (0.0.0.0 means not available)	
DTMF	<input type="text" value="2833 RELAY"/>	
Invite Timeout	<input type="text" value="12"/> secs	

	Phone 1	Phone 2
T.38 Option	<input type="text" value="Voice and T.38 Fax Relay"/>	<input type="text" value="Voice and T.38 Fax Relay"/>

Figure 7-2 SIP Setting

RTP Packetization Time – Specifies a maximum amount of time for transmission of a RTP data packet. (Options: 10, 20, 30 ms; Default: 20 ms)

RTP Port Base/Limit – The Real-time Transport Protocol (RTP) and Real-time Control Protocol (RTCP) do not use specified port numbers. You can specify a port range that the RTP and RTCP traffic can use. Enter the port Base and Limit to define the range. (Range: 1024-65535)

Stun Server – STUN (Simple Traversal of UDP through NAT (Network Address Translation)) is a protocol that assists devices behind a NAT firewall or router with

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packet routing. The problem of NAT firewalls can also be solved using a proxy server to control SIP traffic. Specify the IP address and TCP port used by the STUN server. (Default: 0.0.0.0:3478, "0.0.0.0" means not available; Port Range: 0-65535)

DTMF – Enables the sending of dual-tone multi-frequency (touch tone) phone signals over the VoIP connection. There are several methods to choose from:

- **No DTMF:** The DTMF signals are not sent over the VoIP connection.
- **In-band Mode:** The DTMF signals are sent over the RTP voice stream. In the case when low-bandwidth codecs are used, the DTMF signals may be distorted.
- **2833 Relay:** Uses the RFC 2833 method to relay the DTMF signals over the RTP voice stream without any distortion. (This is the default.)
- **Both In-band and 2833:** Uses the best method depending on the codecs selected.

Invite Timeout – The time that the unit waits for a response to a SIP Invite message before a call fails. If network connections are slow and many SIP calls fail, you may need to increase this timeout value. (Range: 1-300 seconds; Default: 12 seconds)

T.38 Option – Selects the method to use when sending fax messages over the VoIP network from a fax machine connected to one of the RJ-11 Phone ports on the RG230. (Default: Voice and T.38 Fax Relay)

- **T.38 Fax Relay:** The SIP protocol sets up the VoIP call, then the T.38 Fax Relay protocol sends the fax data over the network.
- **Voice and T.38 Fax Relay:** Enables voice calls and faxes to be sent from the Phone port connection. When a fax tone signal is detected on the port, the T.38 Fax Relay standard is used instead of the voice codec.
- **Voice and Fax Pass Through:** Enables voice calls and faxes to be sent from the Phone port connection. For this option, fax signals are sent over the VoIP network using the voice codec, just as if it were a voice call.

Dial Plan

A dial-plan string can be specified to control phone numbers dialed out through the RG230. A dial plan describes the number and pattern of digits that a user dials to reach a particular telephone number. Access codes, area codes, specialized codes, and combinations of the number of digits dialed can all be part of a dial plan. This enables a user to predefine dialling sequences that are permitted. It can help transfer, check, limit phone numbers, and handle prefixes to certain numbers.

The dial-plan string consists of a single digit rule. A typical example of a dial-plan string is: [0123]xxxxx.t

Three standard dial plans are defined; Call Transfer Key, New Call Key, and 3-way Conference. Up to 10 other dial plans can be defined by the user.

Dialplan : <symbol>[]*

Symbol : (x|<digit><digit list>{|start_digit-end_digit})*

x : Any digit (0-9)

<digit> : 0-9

[digit list] : A list of digits, of which any one must be found in the dialed digits, eg. [2345]

{start_digit-end_digit} : A range of allowed digits may be given; start_digit must be <= end_digit, eg. [2-5], {<digit1><digit2><digit3><digit4><digit5>} is also possible.

. : 0 or more occurrences of the previous <symbol>

Hence, the valid dialplan patterns are <digit> . x . {<digit list>} . etc.

t : Timeout Indicator (can occur at end of digitmap &/or end of dialed digits)

Allowed characters in dialplan are 0-9 and x, {, |, ., - and *

SNo	Action	Plan
1	Call Transfer Key	*#
2	New Call Key	*
3	3-way Conference	*3
4	Dial Plan 1	xt
5	Dial Plan 2	
6	Dial Plan 3	
7	Dial Plan 4	

Figure 7-3 Dial Plan Settings

The function of elements allowed in a dial plan are described in the table below:

Element	Example	Description
x	xxxx	Represents a digit of any value (0 to 9) that can be dialed on a phone. This example has a rule with four digits of any number.
.	xx.	Indicates zero or more occurrences of the previous symbol. The example acts like a wildcard, meaning any dialed phone number of two or more digits is allowed.
0-9	01xx	Indicates dialed digits that must be matched. This example only allows four-digit numbers starting "01."
[]	[125-8]	Limits a dialed digit to specified values or a range of values. The example specifies that only digits 1, 2, 5, 6, 7, and 8 are permitted.
t	xx.t	The timeout indicator that can placed after dialed digits or at the end of the dial-plan string.

When a user dials a series of digits, the dial-plan rule is tested for a possible match. If a match is made, the dialed sequence is transmitted. If no match is made, the dialed number is blocked and the user will hear an error tone.

A dial-plan string cannot include spaces between elements. Dialed sequences that are longer than specified in a dial-plan rule are truncated after the number of specified digits. For example, if the dial-plan rule is "011x" and "0115678" is dialed, only the digit sequence "0115" is transmitted.

Call Feature

The RG230 allows you to configure several call features, such as call waiting and call-forwarding. Other call features can be implemented by pressing specific phone buttons or entering dial patterns.

The table below describes the various call features available.

Note: Some call features may be dependent on support at the SIP server. Check with the SIP service provider.

Table 7-1. VoIP Call Features		
Call Feature	Description	Activation
Call Hold	Places an active call on hold for an unlimited period of time.	Press the "Flash," "Flash Hook," or "Hold" button on the phone.
Call Waiting	If during a call there is another incoming call, an alert tone is heard.	This feature must first be enabled using the web interface. You can place the active call on hold and switch to the incoming call. You can switch between the two calls by placing the active call on hold.
Call Switching	Calls two numbers, then switches between them.	Dial the first number, then place it on hold. Dial the key sequence "*" and wait until you hear the dial tone, then dial the second number. Placing the active call on hold switches to the other call. If the active call is hung up, the phone rings again to activate the other call.
Call Transfer	Transfers any received call to another number you specify.	First place the received call on hold, then dial the transfer key sequence "##". When you hear a dial tone, enter the transfer phone number, then hang up.
Call Forward	Forwards an incoming call to another number.	This feature can be configured using the web interface. You can specify forwarding numbers for all calls, when busy, or for no answer.
3-Way Conference	Calls two numbers, then allows all to talk together.	Dial the first number, then place it on hold. Dial the key sequence "*" and wait until you hear the dial tone, then dial the second number. When the second call is active, dial "*"3" to establish the three-way conference.

Call Waiting	<input type="radio"/> Enable <input checked="" type="radio"/> Disable	
Call Waiting Timeout	30 secs	
	Phone 1	Phone 2
Always Forward Phone Number	12345	54321
On Busy Forward Phone Number		
No Answer Forward Phone Number		
Call Forward No Answer Timeout	10	10

Figure 7-4 Call Features

Call Waiting – Enables a call waiting alert. If during a call there is another incoming call, an alert tone is heard. You can place the active call on hold (press the “Flash,” “Flash Hook,” or “Hold” button on the phone) and switch to the incoming call. (Default: Disabled)

Call Waiting Timeout – The time a second incoming call waits before a “no answer” message is sent. (Range: 1-300 seconds; Default: 30 seconds)

Always Forward Phone Number – Another phone number to which all incoming calls are forwarded.

On Busy Forward Phone Number – Another phone number to which incoming calls are forwarded when the phone is busy.

No Answer Forward Phone Number – Another phone number to which incoming calls are forwarded when there is no answer.

Call Forward No Answer Timeout – The time a call waits for an answer before being forwarded to the No Answer Forward Phone Number. (Range: 1-300 seconds; Default: 10 seconds)

7 VoIP Settings

Codecs

A codec (coder/decoder) is the way a voice analog signal is converted into a digital bitstream to send over the network, and how it is converted back into an analog signal at the receiving end. Codecs differ in the type of data compression that is used to save network bandwidth and in the time delay caused in the signal. This results in different voice quality experienced by the user.

The voice codecs in common use today have been standardized by the International Telecommunication Union Telecommunication Standardization Sector (ITU-T) and are identified by a standard number, such as G.711 or G.726. The same codec must be supported at each end of a VoIP call to be able to encode and decode the signal. Since devices in other networks may want to use different codecs, the RG230 provides support for several common standards.

Codec	Enabled	Priority Codec List
PCMA(G711-aLaw)	<input checked="" type="checkbox"/>	G729ab
PCMU(G711-uLaw)	<input checked="" type="checkbox"/>	PCMU(G711-uLaw)
G723	<input checked="" type="checkbox"/>	PCMA(G711-aLaw)
G729ab	<input checked="" type="checkbox"/>	G726-32
G726-16	<input checked="" type="checkbox"/>	G726-16
G726-24	<input checked="" type="checkbox"/>	G726-24
G726-32	<input checked="" type="checkbox"/>	G726-40
G726-40	<input checked="" type="checkbox"/>	G723
	Check All	
		<input type="button" value="UP"/> <input type="button" value="DOWN"/>

Figure 7-5 Codecs

Codec – Lists the codecs supported by the RG230. You can enable specific codecs to use, or enable all. Alternatively, you may want to disable certain codecs, such as high-bandwidth codecs, to preserve network bandwidth.

- **PCMA (G711.aLaw):** The ITU-T G.711 with A-law standard codec that uses Pulse Code Modulation (PCM) to produce a 64 Kbps high-quality voice data stream. This standard is used in Europe and most other countries around the world.
- **PCMU (G711.uLaw):** The ITU-T G.711 with mu-law standard codec that uses Pulse Code Modulation (PCM) to produce a 64 Kbps high-quality voice data stream. This standard is used in North America and Japan.
- **G723:** The ITU-T G.723 standard codec that uses Adaptive Differential Pulse Code Modulation (ADPCM) to produce data streams of 24 and 40 Kbps. This standard has now been superseded by G.726.
- **G729ab:** The ITU-T G.729ab standard codec that uses Conjugate Structure Algebraic-Code Excited Linear Prediction (CS-ACELP) with silence suppression to

produce a low-bandwidth data stream of 8 Kbps. Note that DTMF and fax tones do not transport reliably with this codec, it is better to use G.711 for these signals.

- **G726-16/24/32/40:** The ITU-T G.726 standard codecs that use Adaptive Differential Pulse Code Modulation (ADPCM) to produce good-quality, low-bandwidth data streams of either 16, 24, 32, or 40 Kbps.

Priority Codec List – The RG230 automatically negotiates the codec to use for each called party. You can specify a priority for the codecs that you prefer to use. For example, you may want to use a low-bandwidth codec such as G729ab instead of a high-bandwidth G711 codec. Select a codec in the list, then use the UP and DOWN buttons to set the priority. The RG230 attempts to use the codec highest in the list before trying the next lower one.

Call Block Setting

The RG230 can block certain incoming and outgoing phone numbers from making calls through the unit. You can specify up to 15 incoming and 15 outgoing numbers to block.

Phone			<input checked="" type="radio"/> 1	<input type="radio"/> 2
SNo.	Outgoing	Incoming		
1	123456	123456		
2	112233	112233		
3				
4				
5				
6				
7				
8				
9				
10				
11				

Figure 7-6 Call Block Setting

Phone – Selects either VoIP port PHONE1 or PHONE2.

Outgoing – Blocks outgoing calls from the listed numbers. (Valid characters 0-9)

Incoming – Blocks incoming calls from the listed numbers. (Valid characters 0-9)

7 VoIP Settings

Phone Setting

The RG230 allows the timings for certain events on the VoIP phone ports to be precisely configured. For example, you can specify how long a phone will ring and how long a dial tone is heard on a phone.

The RG230 also enables the line delay to be specified for each phone so that the caller's voice echo is cancelled.

Answer Timeout	60	secs
Release Timeout	4	secs
Dial Tone Timeout	16	secs
Inter Digit Timeout	2	secs
Attended Transfer Timeout	32	secs

	Phone 1	Phone 2
Line Echo Cancellation	<input checked="" type="radio"/> Enable <input type="radio"/> Disable	<input checked="" type="radio"/> Enable <input type="radio"/> Disable

Figure 7-7 Phone Setting

Answer Timeout – The time after which a no answer message is sent to the caller. (Range: 1-300 seconds; Default: 60 seconds)

Release Timeout – The time after which a call is terminated when a phone is hung up. (Range: 1-300 seconds; Default: 4 seconds)

Dial Tone Timeout – The length of time a dial tone is heard on a connected phone. (Range: 1-300 seconds; Default: 16 seconds)

Inter Digit Timeout – The maximum time delay allowed between each dialed digit. When the time is exceeded, a call is made using the dialed digits. (Range: 1-300 seconds; Default: 2 seconds)

Attended Transfer Timeout – The time after which a held call that is being transferred is terminated. (Range: 5-300 seconds; Default: 32 seconds)

Note: You can hold a call by pressing the "Flash," "Flash Hook," or "Hold" button on the phone, then dial a transfer number.

Line Echo Cancellation – Enables a time delay for voice echo cancellation. A voice echo can be created on some two-wire phone loops, which becomes increasingly louder and annoying when there is a long delay. If voice echo is a problem during a call, you can enable this parameter to try and reduce or remove it. (Default: Enabled)

Appendix A: Troubleshooting

Diagnosing LED Indicators

Symptom	Action
Power LED is Off	<ul style="list-style-type: none">• AC power adapter may be disconnected. Check connections between the unit, the AC power adapter, and the wall outlet.
Power LED is Red	<ul style="list-style-type: none">• The unit has detected a system error. Reboot the unit to try and clear the condition.• If the condition does not clear, contact your local dealer for assistance.
WiMAX LED is Off	<ul style="list-style-type: none">• Check with the WiMAX service provider for service coverage information.
WiMAX Signal LEDs are Off	<ul style="list-style-type: none">• Move the location of the unit.• Check with the WiMAX service provider for service coverage information.
WiMAX Signal LEDs are blinking simultaneously	<ul style="list-style-type: none">• The receive signal strength is too high. Move the unit to another location where the LEDs display a normal signal level.
LAN link LED is Off	<ul style="list-style-type: none">• Verify that the unit and attached device are powered on.• Be sure the cable is plugged into both the unit and corresponding device.• Verify that the proper cable type is used and its length does not exceed specified limits.• Check the cable connections for possible defects. Replace the defective cable if necessary.

Cannot Connect to the Internet

If you cannot access the Internet from the PC, check the following:

- If you cannot access the Internet, be sure your Windows system is correctly configured for TCP/IP. The IP settings should be set to "obtain an IP address automatically."
- The WAN Type settings for the service provider may not be configured correctly. Use the web interface to check that the WAN settings match those provided by the service provider.
- You may be out of the service area of the WiMAX network. Check with the WiMAX service provider for service coverage information.
- If you cannot resolve the problem, check the System Status page of the web interface and contact your WiMAX service provider.

Cannot Access Web Management

If the management interface cannot be accessed using a web browser:

- Be sure the management station is correctly configured for TCP/IP. The IP settings should be set to "obtain an IP address automatically."
- Try a Ping command from the management station to the unit's IP address to verify that the entire network path between the two devices is functioning correctly.
- Check that the management station has a valid network connection and that the Ethernet port that you are using has not been disabled.
- Check the network cabling between the management station and the unit. If the problem is not resolved, try using a different port or a different cable.

Forgot or Lost the Password

Set the unit to its default configuration by pressing the reset button on the back panel for 5 seconds or more. Then use the default password "admin" to access the management interface.

Resetting the Unit

If all other recovery measures fail and the unit is still not functioning properly, take either of these steps:

- Reset the unit using the web interface, or through a power reset.
- Reset the unit to its factory default configuration by pressing the reset button on the back panel for 5 seconds or more. Then use the default password "admin" to access the management interface.

Appendix B: Specifications

Physical Specifications

Ports

4 LAN ports, 10/100BASE-TX with auto-negotiation, RJ-45 connector
(Optional) 2 FXS ports (PHONE1, PHONE2), RJ-11 connector

Network interface

RJ-45 connector, auto MDI/X:

10BASE-T: RJ-45 (100-ohm, UTP cable; Category 3 or better)

100BASE-TX: RJ-45 (100-ohm, UTP cable; Category 5 or better)

LED Indicators

System: Power, WiMAX signal strength

Ports: Link/Activity

AC Power Adapter

Input: 100-240 VAC, 50-60 Hz, 0.5 A

Output: 19 VDC, 3.4 A

Unit Power Supply

DC Input: 9~19 VDC, 2 A maximum

Power Consumption: 11 W maximum

Physical Size

169 x 184 x 80 mm (6.65 x 7.24 x 3.15 in)

Weight

1.2 kg (2.65 lbs)

Temperature

Operating: -5 to 45 °C (23 to 113 °F)

Storage: -40 to 75 °C (-40 to 167 °F)

Humidity

5% to 95% (non-condensing)

B Specifications

WiMAX Specifications

Antennas

Omnidirectional:

Included dual dipole antennas

Transmit: Single antenna

Receive: Two antennas using Maximal-Ratio Combining (MRC)

Gain: 4 dBi at 2.5 GHz

Impedance: 50 Ohm

Operating Frequency

FCC-2.5: 2496-2690 MHz

Taiwan NCC: 2500-2690 MHz

Support for Full Scan and Partial Scan

Bandwidth Allocation

5, 7, 8.75, or 10 MHz depending on model (software configurable)

2.5 GHz Model: 5 and 10 MHz

Modulation Scheme

Scaleable OFDMA employing Time-Division Duplex (TDD) mechanism

PRBS subcarrier randomization

Contains pilot, preamble, and ranging modulation

Modulation and Coding Types

Down Link: QPSK, 16 QAM, 64 QAM

Up Link: QPSK, 16 QAM

Maximum Throughput

Up link: 5 Mbps maximum

Down link: 20 Mbps maximum

Receive Sensitivity

-94 dBm maximum

VoIP Specifications

Voice Signaling Protocol

SIP v2 (RFC 3261)

Voice Codec

G.711 (a-law and u-law)

G.726

G.729ab

G.723

Voice Quality

VAD (Voice Activity Detection)
CNG (Comfortable Noise Generation)
Echo cancellation (G.165/G.168)
Adaptive jitter buffer, up to 200 milliseconds
DTMF tone detection and generation

Call Features

Call transfer
Call waiting/hold/retrieve
3-way conference call
Call blocking
T.38 fax relay
Dial plan (E.164 dialing plan)
Call forwarding: No Answer/Busy/All

REN (Ring Equivalent Number)

3 REN total in system

Compliances

Emissions

CFR 47 Part 15 Class B
EN 55022 class B
EN 301 489-1/-17

Immunity

EN 61000-4-2/3/4/5/8/11

WIMAX Radio Signal Certification

US: 2.5 GHz - CFR 47 Part 27M

Safety

US/C TUV, TUV/SUD Safety Mark
TUV/SUD CB Report & LVD

Standards

IEEE 802.16e-2005 WAVE 1 and WAVE 2
IEEE 802.3-2005 10BASE-T and 100BASE-TX
UPnP

Appendix C: Cables and Pinouts

Twisted-Pair Cable Assignments

For 10/100BASE-TX connections, a twisted-pair cable must have two pairs of wires. Each wire pair is identified by two different colors. For example, one wire might be green and the other, green with white stripes. Also, an RJ-45 connector must be attached to both ends of the cable.

Caution: Each wire pair must be attached to the RJ-45 connectors in a specific orientation. (See "Straight-Through Wiring" on page C-2 and "Crossover Wiring" on page C-2 for an explanation.)

Caution: DO NOT plug a phone jack connector into the RJ-45 port. Use only twisted-pair cables with RJ-45 connectors that conform with FCC standards.

The following figure illustrates how the pins on the RJ-45 connector are numbered. Be sure to hold the connectors in the same orientation when attaching the wires to the pins.

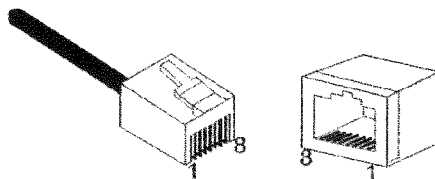


Figure C-1 RJ-45 Connector

10/100BASE-TX Pin Assignments

Use unshielded twisted-pair (UTP) or shielded twisted-pair (STP) cable for RJ-45 connections: 100-ohm Category 3 or better cable for 10 Mbps connections, or 100-ohm Category 5 or better cable for 100 Mbps connections. Also be sure that the length of any twisted-pair connection does not exceed 100 meters (328 feet).

The RJ-45 ports on the unit supports automatic MDI/MDI-X operation, so you can use straight-through or crossover cables for all network connections to PCs, switches, or hubs. In straight-through cable, pins 1, 2, 3, and 6, at one end of the cable, are connected straight through to pins 1, 2, 3, and 6 at the other end of the cable.

C Cables and Pinouts

Pin	MDI-X Signal Name	MDI Signal Name
1	Receive Data plus (RD+)	Transmit Data plus (TD+)
2	Receive Data minus (RD-)	Transmit Data minus (TD-)
3	Transmit Data plus (TD+)	Receive Data plus (RD+)
6	Transmit Data minus (TD-)	Receive Data minus (RD-)
4,5,7,8	Not used	Not used

Note: The "+" and "-" signs represent the polarity of the wires that make up each wire pair.

Straight-Through Wiring

If the twisted-pair cable is to join two ports and only one of the ports has an internal crossover (MDI-X), the two pairs of wires must be straight-through.

EIA/TIA 568B RJ-45 Wiring Standard
10/100BASE-TX Straight-through Cable

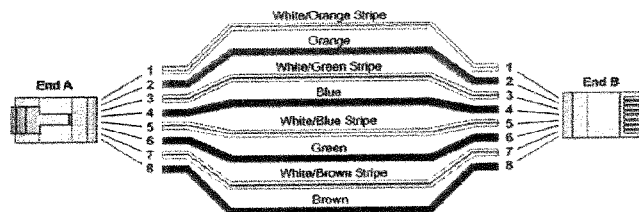


Figure C-2 Straight-Through Wiring

Crossover Wiring

If the twisted-pair cable is to join two ports and either both ports are labeled with an "X" (MDI-X) or neither port is labeled with an "X" (MDI), a crossover must be implemented in the wiring.

EIA/TIA 568B RJ-45 Wiring Standard
10/100BASE-TX Crossover Cable

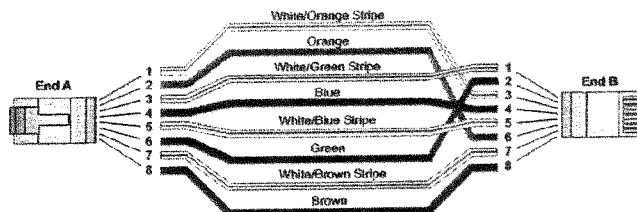


Figure C-3 Crossover Wiring

RJ-11 Ports

Standard telephone RJ-11 connectors and cabling can be found in several common wiring patterns. These six-pin connectors can accommodate up to three wire pairs (three telephone lines), but usually only one or two pairs of conductor pins and wires are implemented.

The RJ-11 ports on this device contain only one wire pair on the inner pins (3 and 4).

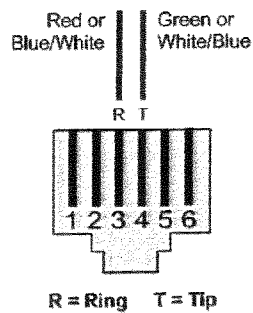


Figure C-4 RJ-11 Port Pinout

Pin	Signal Name	Wire Color
1	Not used	
2	Not used	
3	Line 1 Ring	Red or Blue/White
4	Line 1 Tip	Green or White/Blue
5	Not used	
6	Not used	

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Glossary

10BASE-T

IEEE 802.3-2005 specification for 10 Mbps Ethernet over two pairs of Category 3 or better UTP cable.

100BASE-TX

IEEE 802.3-2005 specification for 100 Mbps Fast Ethernet over two pairs of Category 5 or better UTP cable.

Authentication

The process to verify the identity of a client requesting network access.

Auto-Negotiation

Signalling method allowing each node to select its optimum operational mode (speed and duplex mode) based on the capabilities of the node to which it is connected.

Base Station

A WIMAX service provider's equipment that is installed at a fixed location to provide network connectivity for subscriber stations within a defined service area.

Carrier-to-Interference-Plus-Noise Ratio (CINR)

A measurement of the channel quality in a WiMAX link. Subscriber stations measure the received CINR and send the information back to the base station. The base station can then adjust modulation and coding for the link to optimize throughput.

Center Frequency

The radio frequency at the center of a WiMAX channel. WiMAX channels can be of different widths (the channel bandwidth) and the transmitted radio signal is spread across the full width of the channel.

Channel Bandwidth

The range of frequencies occupied by a WiMAX radio signal. The amount of information that can be transmitted in a radio signal is related to the channel

Glossary

bandwidth, which is measured in Megahertz (MHz). WiMAX supports a range of channel bandwidths that can be defined by the service operator depending on performance requirements, operating preferences, and regulatory constraints.

CPE (Customer-Premises Equipment)

Terminal equipment provided by a service provider that is located at a subscriber's premises and supports a communication channel between a customer and the service provider.

Domain Name System (DNS)

A system used for translating host names for network nodes into IP addresses.

Dynamic Host Configuration Protocol (DHCP)

Provides a framework for passing configuration information to hosts on a TCP/IP network. DHCP is based on the Bootstrap Protocol (BOOTP), adding the capability of automatic allocation of reusable network addresses and additional configuration options.

Encryption

Data passing between a base station and subscribers uses encryption to protect from interception and eavesdropping.

Ethernet

A popular local area data communications network, which accepts transmission from computers and terminals.

Extensible Authentication Protocol (EAP)

An authentication protocol used to authenticate subscribers. EAP is used with TLS or TTLS authentication to provide "mutual authentication" between a subscriber and a WiMAX network.

Hypertext Transfer Protocol (HTTP)

HTTP is a standard used to transmit and receive all data over the World Wide Web.

IEEE 802.16e

The WiMAX standard that provides mobile broadband wireless access using Scalable Orthogonal Frequency Division Multiple Access (SOFDMA).

IEEE 802.1X

Port Authentication controls access to the switch ports by requiring users to first enter a user ID and password for authentication.

Internet Service Provider

A company that offers an access service that connects customers to the Internet.

IP Address

The Internet Protocol (IP) address is a numerical identification assigned to a device that communicates in a network using the Internet Protocol.

LED

Light emitting diode, used for indicating a device or network condition.

Local Area Network (LAN)

A group of interconnected computer and support devices.

MAC Address

The physical layer address used to uniquely identify network nodes.

MS-CHAPV2

Microsoft's version 2 of the Challenge-Handshake Authentication Protocol. Introduced by Microsoft with Windows 2000, MS-CHAPV2 (defined in RFC 2759) provides mutual authentication between peers using user names and passwords.

Orthogonal Frequency Division Multiplexing (OFDM)

The air interface defined for IEEE 802.11g Wi-Fi. OFDM allows multiple users to transmit in an allocated band by dividing the bandwidth into many narrow bandwidth carriers.

RADIUS

Remote Authentication Dial-in User Service. A logon authentication protocol that uses software running on a central server to control access to a network.

RJ-45 Connector

A connector for twisted-pair wiring.

Receive Signal Strength Indicator (RSSI)

A measurement of the strength of a received wireless signal. The higher the RSSI value, the stronger the received signal from the antenna.

Roaming

The process where a WiMAX subscriber can move onto another operator's network while maintaining a continuous connection.

Scalable Orthogonal Frequency Division Multiple Access (SOFDMA)

The air interface defined for mobile WiMAX. SOFDMA is a multiple access method that allows simultaneous transmissions to and from several users, employing a subchannel structure that scales with bandwidth.

Service Provider

See Internet Service Provider.

Service Set Identifier (SSID)

A name that is sent in packets over a Wi-Fi network, which functions as a password for clients connecting to the network. The SSID differentiates one Wi-Fi network from another.

Simple Network Time Protocol (SNTP)

SNTP allows a device to set its internal clock based on periodic updates from a Network Time Protocol (NTP) server. Updates can be requested from a specific NTP server, or can be received via broadcasts sent by NTP servers.

Subscriber Identity Module (SIM)

A standard for a small removable integrated circuit card that securely stores information used to identify a mobile wireless subscriber.

Subscriber Station

A general term for a customer's WiMAX terminal equipment that provides connectivity with a base station.

Transmission Control Protocol/Internet Protocol (TCP/IP)

Protocol suite that includes TCP as the primary transport protocol, and IP as the network layer protocol.

Transport Layer Security (TLS)

An standard defined in RFC 5216, EAP-TLS is an authentication protocol that provides strong security through the use of client-side certificates.

Tunneled Transport Layer Security (TTLS)

EAP-TTLS is a protocol extension of EAP-TLS. The authentication server is authenticated to the client using its Certification Authority certificate, this establishes a secure "tunnel" through which the client is then authenticated.

URL (Uniform Resource Locator)

An easy-to-read character string that is used to represent a resource available on the Internet. For example, "http://www.url-example.com/."

UTP

Unshielded twisted-pair cable.

Wired Equivalent Privacy (WEP)

WEP is the Wi-Fi security based on the use of RC4 encryption keys. Wi-Fi devices without a valid WEP key are excluded from the network.

WPA Pre-shared Key (PSK)

PSK security can be used for small Wi-Fi networks that may not have the resources to configure and maintain a RADIUS server. WPA provides a simple operating mode that uses just a pre-shared password for network access.

WiMAX

The IEEE 802.16 standard for Worldwide Interoperability for Microwave Access. The IEEE 802.16-2004 standard, known as "fixed WiMAX," supports only point-to-point links and has no support for mobility. The IEEE 802.16e-2005 standard, known as "mobile WiMAX," is an amendment to IEEE 802.16-2004 and supports mobility. Note that mobile WiMAX standard is not backward compatible with the fixed WiMAX standard.

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