APPLICATION NOTE

STL link / Outside location reporting to a private WiMAX network







# **AEQ PHOENIX AUDIOCODECS. APPLICATION NOTE 3**

# STL link / Outside location reporting to a private WiMAX network

WiMAX stands for *Worldwide Interoperability for Microwave Access*. It is a standard for data transmission based on protocol IEEE 802.16.que using radio waves in the frequency bands 2.400-2.4835 GHz, 5.15-5.35 GHz, 5.47-5.725 GHz, 5.725-5.875 GHz. The last three are license-free in most countries.

A WiMAX system is composed of a base station and an indefinite number of CPE (user stations). All of them have at least one IP interface in order to be connected to other IP equipment, Local Area Networks (LAN) or Wide Area Networks (WAN), the largest one being Internet. Base stations have the ability to distribute the binary rates to particular CPE and distribute the rest of available bandwidth to the rest of CPE.

This application note describes how to use WiMAX systems for bidirectional audio transport between a radio station and a transmitting center (STL application), or between a remote location outdoors (a place where a reporting is being sent) and a radio studio.

A Broadcast company can deploy a private WiMAX system for its own usage, for example, by placing a base station with an omnidirectional-coverage set of antennas, or alternatively focused to the area of interest, AND deploying CPE (user stations) both in the transmission centers and the mobile units. The bit rate to be reserved to each CPE, for each program sent or originated in that location, can be determined as follows:

- Linear stereo audio: 4 Mb/s
- Compressed audio: G722, AEQ LD2 or MPEG 2 / 4: between 128 kb/s for mono material, and 512 kb/s stereo program audio.

Once the needs of the company are covered, The rest of available bandwidth can be used to remote control pieces of equipment, be resold to other users, by connecting the base station to Internet and becoming a kind of ISP (internet service provider).

# 1. ESTABLISHING A STUDIO TO TRANSMITTER LINK (STL) USING A COUPLE OF PHOENIX STUDIO AUDIOCODECS

STL links (between a radio studio and the transmission center) is one of the scenarios where professional Audiocodecs such as the AEQ PHOENIX family can provide competitive advantages, both in the technical and economical areas.

# 1.1. REQUIRED HARDWARE

- Two AEQ Phoenix Studio professional audiocodecs.
- WIMAX base station with its corresponding antenna.



- WiMAX User Station (also called CPE) and its antenna.
- Required interconnecting cabling.



Schematic setup of a STL using AEQ Phoenix Studio

# **1.2. INSTALLATION**

• Install the WiMAX base station at one of the intended communication ends. This place will typically be the radio studio, as the cost of this unit is higher than the CPE's and the security conditions are usually better in this place that at the top of a mountain where the transmitter is usually situated.

The installation of each base station is usually performed using the pole mounting hardware supplied with the unit.







Detail of the base station and mounting hardware

• Proceed to connect and align the WiMAX base station to the remote location. It is recommended that both places have direct line-of-sight. Under these conditions, a range up to tenths of kilometers can be achieved.



Detail of a WiMAX base station an associated antenna on a tripod

- Repeat the above described assembly for the WiMAX User Station.
- Connect two AEQ Phoenix Studio audiocodecs, one to each WiMAX station at each end. WiMAX equipment is usually fed by means of Power Over Ethernet (POE) units, where an external unit combines power and data, sending both of them over the same RJ45-ended cable.



Detail of a POE unit





- Connect the power cable to the POE unit of the WiMAX station.
- Connect an Ethernet cable between the AEQ Phoenix (preferably choose ETH1 port) and the POE unit. RECOMMENDATION: use a small Ethernet switch that will allow us to connect other equipment such as PCs in order to provide remote configuration to the units of the presented setup, for example.
- Connect an Ethernet cable between the output of the POE unit and the back port of the WiMAX base station.
- Repeat the same procedure at the other end of the WiMAX link.
- Connect the analog/digital audio inputs and outputs at the back of the AEQQ Phoenix Studio. RECOMMENDATION: as a starting point, use channel CH1.
- Connect the mains supply cable to the back of the AEQ Phoenix units.
- Turn all the equipment on.

# **1.3. CONFIGURATION**

WiMAX units usually come from factory with a default IP address, i.e. 172.31.70.1 for the base station and 172.31.70.29 for the User Station. These IP addresses can be modified from the control interface embedded in each WiMAX station.

🧕 🙆 🖨 Configurati	on - Mozilla Firefox			ৰ× 🖾 12:13 😣 asier 🖰								
DEMO - ARBA556 Managem	📉 🗋 Configuration 🛛 🗱 📑											
🔶 🧼 📽 🛄 http://192.1	68.70.29/frameset.html		😭 🔻 🕑 🚼 🕶 Google	🐟 👁 🤉								
🛅 Most Visited 👻 📄 Getting St	arted 📓 Latest Headlines 👻											
₩ TRANZEO		ettings										
Home Information Page Wimax Setup Wireless Network Setup	To apply TCP/IP resetting, click "Apply" button. To get back to "Information Page", click "Back to Information Page" button. Secondary Management Connection Support must be set to "No Secondary Management" for router options to be available.											
		speed 100 duplex full	Speed & Duplex									
Status <u>Wireless</u>	IP Mode	() Static	DHCP Client									
Service Flows System		192.168.70.29	Wireless IP Address									
Statistics ARP Table		255.255.255.0	Wireless Net Mask									
System Log		192.168.70.1	Route Gateway									
Administrative Settings Administrative Settings Firmware Copyright 0 2007-3007 Transes Wireless Technologies, Inc.		Apply Back to Info	rmation Page									

Detail of a CPE configuration screen

 Configure the AEQ Phoenix Studio with IP addresses that are compatible with the ones corresponding to the WiMAX equipment, from the internal menu MENU → SYSTEM → SETTINGS → ETHERNET → NET1.





ETHERNET1 CONFIG	and the second se
UN: 172.31.11.68 MASK: 255.255.0.0	
GWAY: 0.0.0.0	

Detail of the configuration of IP address of AEQ Phoenix Studio

 If a small Ethernet switch has been connected between the AEQ Phoenix and the WiMAX POE units, in order to grant access to an external PC for control and monitoring, this PC must be setup with a valid IP address / mask as well, within the same network range. Now it is possible to access the WiMAX control interface using a standard web browser (usually MS Internet Explorer) simply by typing the IP of the corresponding station in the URL bar.

NOTE: once the WiMAX link is correctly set up as a transparent IP connection between both ends, it is possible to control and/or manage all the units in the setup from any of the ends of the link.

 Use the control interface of the WiMAX base station to verify that the signal levels are correct (around -26dBm typically, this can vary as a function of the link distance), and that no packets are lost.

In this step, it is recommended that small adjustments to the antenna(s) orientation are made in order to optimize the alignment and get the highest possible signal strength. Usually, the CPE antenna is uni-directional and its orientation is critical, so it is recommended that this is the end of the link where most alignment effort is invested, whereas base-station antennas are usually omni-directional or multi-directional.

DEMO-ARBA556 Managem ★     Image: Configuration        Image: Configuration <th colspan="8">🔕 🛛 😣 🗇 DEMO - ARBA556 Management Web - Albentia Systems S.A Mozilla Firefox</th> <th></th> <th></th> <th></th> <th></th> <th></th> <th>12:44</th> <th>🔉 asier 😃</th>	🔕 🛛 😣 🗇 DEMO - ARBA556 Management Web - Albentia Systems S.A Mozilla Firefox													12:44	🔉 asier 😃	
Y 1922168:703 https://192.168.70.1/     Y C Y C Y Coogle     Q        Y C Y C Y Coogle	DEMO - ARBA556 Manag	gem 🗱 🗋 Con	ifiguration	î.	×	+										ΞΨ.
Most Visited * Cetting started @Latest Headlines *         Logged as: wmax       Profile: Wimax User         Equipment: ARBA556 Name: DEMO       Type: BS - CPE :         Version: 3.3.8384       Location: Sevilla Status: Running Status: Admins Setup         System Tools       Admin Setup         Mng Setup       CPE Stats         Basic View       Detailed View         Users       CPE         Option Files       System Log         Device Features       WiMAX         Radio Setup       Option Adrive 00:31:08 2       6:4Bm         User Statas       Bisconnect selected CPEs       Disconnect all CPEs         Disconnect selected CPEs       Disconnect all CPEs       Download CSV         Updating       Refresh Timeout: 1s       c)         Provisioning       AAA Setup       AAA Setup	🔶 🤿 😵 [] 192.16	8.70.1 https://19	2.168.70.1	1/						🚖 🛪 🥙 🚼 🛪 Google 🛛 🔍 🚇 🕫						
Logged as: wmax       Profile: Wimax User         Equipment: ARBA556 Name: DEMO       Type: BS - CPE c)         Version: 3.3.8384       Location: Sevilla Status: Running Status: Running Status: Running Status: Rystem Tools         Admin Setup       Ming Setup         Config Files       Basic View         Users       CPE Stats         System Log       Device Features         WiMAX       Radio Setup         Cell Setup       BWSched Setup         User Stats       Disconnect all CPEs         Device Reatures       Disconnect all CPEs         WiMAX       Refresh Timeout: 1s         Porvisioning       AAA Setup	🛅 Most Visited 👻 📄 Gett	ing Started 🔂 La	atest Head	dlines 🕶												
Status & Alarms         Systems         Status & Alarms         System Tools         Admin Setup         Mng Setup         Config Files         System Rog         Device Features         WIMAX         Radio Setup         Cell Setup         BW/Sched Setup         User Statis         BW/Sched Setup         User Statis         BW Statis         BAA Setup	II F										Logged	as: wma	ax Profile	e: Wimax U	lser	
Systems     Version: 3.3.8384     Location: Sevilla Status: Running Status       Status & Alarms       System Tools       Admin Setup       Ming Setup       Config Files       System Log       Device Features       WIMAX       Radio Setup       Gell Setup       BW/Sched Setup       User Stats       BW/Sched Setup       User Stats       BW Stats       Spectrum       User Stats       Spectrum       User Stats       BW Stats       Spectrum       User Status       Spectrum       User Stats       BW Stats       AAA Setup	albenli	ia								Equipment	: ARBA556	Name:	DEMO	Type: B	S - CPE	: Set
Status & Alarms         System Tools         Admin Setup         Config Files         System Log         Device Features         WiMAX         Radio Setup         Cell Setup         BW/Sched Setup         User Status         User Status         User Status         Device Features         WiMAX         Radio Setup         Cell Setup         BW/Sched Setup         User Status         Spectrum         User Status         Secture         Disconnect all CPEs         Disconnect all CPEs         Disconnect all CPEs         Disconnect all CPEs         Device Features         Wy Status         Gell Setup         BW/Status         BW Status         Sepectrum         User Status         BW Status         Sepectrum         User Status         AAA Setup	Syste	ems								Version: 2.2.9394 Leastion: Souille Otation Duration Stan						Stop
Status & Alarms         System Tools         Admin Setup         Ming Setup         Config Files         System Log         Device Features         WIMAX         Radio Setup         Cell Setup         Disconnect selected CPEs         Disconnect all CPEs         Disconnect all CPEs         User Status         User Status         BW/Status         Secturn         User Status         BW Status         Secturn         User Status         BW Status         Secturn         User Status         AAA Setup	0									veraion. o.	0.0004	Locane	n. Gevine	a Status.	nunning	Stop
System Tools       Admin Setup         Ming Setup       Basic View         Config Files       System Log         Device Features       CINR         WIMAX       Radio Setup         Cell       Status         User S       640AM-34         Device Features       00:13:4F:00:1D:49         Active       00:31:06       2         640AM-34       640AM-34       2068         Bisconnect selected CPEs       Disconnect all CPEs       Download CSV         User Stats       BW Stats       Updating       Refresh Timeout:       1s         Provisioning       AAA Setup       AAA Setup       Image: State	Status & Alarms	CPE Sta	ts													
Admin Setup         Mng Setup         Config Files         System Log         Device Features         WIMAX         Radio Setup         Cell Setup         BW/Sched Setup         User Status         User Status         User Status         Device Features         Pictorisonnect selected CPEs         Disconnect all CPEs         Disconnect selected CPEs         Disconnect all CPEs         Disconnect selected CPEs         Disconnect selected CPEs         Disconnect all CPEs         Disconnect selected CPEs         Refresh Timeout:         15         Disconnect selected CPEs         <	System Tools															
Mng Setup Config Files       Users         System Log Device Features       CPE       Status       Uptime       Flows       SS Tx Pow       Uptimk       Downlink       UL BW       DL BW       Dist         WIMAX       Radio Setup Cell Setup       00:13:4F:00:1D:49       Adlve       00:31:08       2       6dBm       -67.0dBm       25dB       640AM-3/4       28dB       -61dBm       1.8Mbps       1.8Mbps       0.5H         BW/Sched Setup       User Statis       BW Statis       BW Statis       BW Statis       Spectrum       User Statis       Spectrum       Valear Statis       Spectrum       <	Admin Setup	Basic View	Detailed	d View												
Config Files       Status       Uptime       Flows       SS Tx Pow       Uptimk       Downlink       UL BW       DL BW       DIst         Dovice Features       00:13:4F:00:10:49       Active       00:31:08       2       6dBm       -67.0dBm       25dB       6dQAM-3/4       28dB       -61dBm       1.8Mbps       0.5H         WiMAX       Radio Setup       00:13:4F:00:10:49       Active       00:31:08       2       6dBm       -67.0dBm       25dB       6dQAM-3/4       28dB       -61dBm       1.8Mbps       0.5H         BW/Sched Setup       Disconnect all CPEs       Download CSV	Mng Setup	Heare														
System Log       Openink       Oownink       Oownink       Out BW       Disc         Device Features       00:13:4F:00:1D:49       Active       00:31:08       2       6dBm       67:04Bm       Mod.       CINR       RSSI       UL BW       DL BW       Disc         WIMAX       Radio Setup       Disconnect selected CPEs       Disconnect all CPEs       Download CSV       57:04Bm       640AM-3/4       29dB       61dBm       1.8Mbps       0.5H         BW/Sched Setup       User Stats       BW Stats       User Stats       User Stats       Forward Status       Secture       V	Config Files	USEIS		1			1								1	
Device Features     Nosi     Citient     Mod.     Citient     Nosi       WiMAX     00:13:4F:00:1D:49     Active     0:10:40 <t< td=""><td>System Log</td><td>CPE</td><td></td><td>Status</td><td>Uptime</td><td>Flows</td><td>SS Tx Pow</td><td>Uplink</td><td></td><td></td><td>Downlink</td><td></td><td></td><td>UL BW</td><td>DL BW</td><td>Dist</td></t<>	System Log	CPE		Status	Uptime	Flows	SS Tx Pow	Uplink			Downlink			UL BW	DL BW	Dist
WIMAX         Image: Control - 10 - 10 - 10 - 10 - 10 - 10 - 10 - 1	Device Features					ļ,		RSSI	CINR	Mod.	Mod.	CINR	RSSI			
Radio Setup Cell Setup       Disconnect selected CPEs       Disconnect all CPEs       Download CSV         BW/Sched Setup       User Stats       User Stats       Spectrum       <	WIMAX	00:13:4F:00 Test Voz	0:1D:49	Active	00:31:08	2	6dBm	-67.0dBm	25dB	64QAM-3/4	64QAM-3/4	29dB	-61dBm	1.8Mbps	1.8Mbps	0.5Km
Cell Setup BW/Sched Setup User Stats User Net Status Spectrum User Summary Provisioning AAA Setup	Radio Setup	Disconne	ect select	ted CPF	s r	isconn	ect all CPEs	Do	wnloa	dCSV						
BW/Sched Setup User Stats BW Stats User Net Status Spectrum User Summary Provisioning AAA Setup	Cell Setup	Disconne	ee seree			Jiscorin			Wintou	U COV						
User Stats BW Stats User Net Status Spectrum User Summary Provisioning AAA Setup	BW/Sched Setup	Updating											Refresh T	imeout:	1s	: Set
BW Stats User Net Status Spectrum User Summary Provisioning AAA Setup	User Stats	_t														
User Net Status Spectrum User Summary Provisioning AAA Setup	BW Stats															
Spectrum User Summary Provisioning AAA Setup	User Net Status															
User Summary Provisioning AAA Setup	Spectrum															
AAA Setup	User Summary															
AAA Setup	Provisioning															
	AAA Setup							$\square$								
Local AA	Local AA															
CA Certs	CA Certs															

#### WiMAX connection status screen

 At this point, the WiMAX connection has been established. We recommend that the BRIDGE operating mode is selected to warrantee that we end up with a totally transparent IP bidirectional link.



 The available bandwidth can vary as a function of the WiMAX modulation implemented, from a theoretical maximum of 35Mbps down to 32Kbps (very rare in these high-capacity links). The modulation is selected automatically and transparently to the user between both WiMAX stations as a function of the visibility conditions and the distance of the link.

												SICI (		
70.1 https://192.168	370.1/	T				<u> </u>	C R Cor	ale			a 🐽	- 6		
ig Started SLatest	Headlines <del>•</del>						1.00 (	9.4						
					1		Logged as: wm	ax Prof	ile: Wimax	User				
a					Equ	Equipment: ARBA556 Name: DEMO Type: BS - CPE + Set								
ms					Ver	sion: 3.3.838	4 Locatio	on: Sevi	lla Status	: Runn	ing St	top		
BW Stats														
Basic Cell Stats	Basic Service Stat	s Detailed	Cell Stats	Detailed S	ervice Stat	ts								
												_		
Tx (DL) Data S	Service Stats							Sum	mary					
User	Ser	rvice	CS Queu	ed Droppir	g Tx Rate	Usage		Summ	nary Do	wnlink	Uplin	k		
00:13:4F:00:1D:49	- Test Voz - weth0 Do	wnlink - DATA	[7] 3.0pkt	no	2.0Mbps	97	.0%	Servic	es 1		1			
	an a later a							Bits	2.0	Mbps	1.9Mt	bps		
Rx (UL) Data S	Service Stats		_					Pkts	53	6.1pkt	524.0	pkt		
User			Service	F	Rx Rate	Usage								
00:13:4F:00:1D:49	- Test Voz - weth0		Uplink -DATA	[?] 1	.9Mbps	91.	6% 🔓	Ethe	rnet Sta	its				
								Dev	Tx	L	Rx			
								eth0	1.8Mbp	s	1.7Mbps			
										-		_		
										(a)	- 11	<b>C</b> 1		
								Refresh	Timeout:	15	<u></u>	Set		
	Z0.1 https://192.166 g Started Latest BW Stats Basic Cell Stats Tx (DL) Data S User 00:13:4F:00:1D:49 Rx (UL) Data S User 00:13:4F:00:1D:49	201 https://192.168.70.1/ g Started Latest Headlines + BW Stats Basic Cell Stats Basic Service Stats User Se 00:13:4F:00:1D:49 - Test Voz - weth0 Dc Rx (UL) Data Service Stats User 00:13:4F:00:1D:49 - Test Voz - weth0	ZO3 https://192.168.70.1/         g Started Latest Headlines *         O         BW Stats         Basic Cell Stats         Basic Cell Stats         User         00:13:4F.00:1D:49 - Test Voz - weth0         Downlaw F.00:1D:49 - Test Voz - weth0	201 https://192.168.70.1/ gStarted Latest Headlines * BW Stats Basic Cell Stats Basic Service Stats Detailed Cell Stats Tx (DL) Data Service Stats User CS Queu 00:13:4F:00:1D:49 - Test Voz - weth0 Downlink - DATA [7] 3.0pkt Rx (UL) Data Service Stats User Service 00:13:4F:00:1D:49 - Test Voz - weth0 Uplink - DATA	Z031 https://192.168.70.1/g         g Started         Basic Cell Stats         Basic Cell Stats         User         Service         Ver         00:13:4F:00:1D:49 - Test Voz - weth0         Uplink - DATA [7]	ZQ3_https://192.168.70.1/         g Started       Latest Headlines *         Q       Eq         Main       Eq         Main       Basic Service Stats         Detailed Cell Stats       Detailed Service Stats         User       Service       CS Queued         00:13:4F:00:1D:49 - Test Voz - weth0       Domlink - DATA [7]       3.0pkt         Ver       Service       Rx Rate         00:13:4F:00:1D:49 - Test Voz - weth0       Uplink -DATA [7]       1.9Mbps	Inttps://192.168.70.1/       Image: Content of the second se	ZQ3 https://192.168.70.1/       Image: Constraint of the cons	Z01 https://192.168.70.1/       G C S ⊂ Coogle         g Started       Logged as: wmax       Prof         G       Equipment: ARBA556 Name: DEMO       Version: 3.3.8384       Location: Sevi         BW Stats       Basic Cell Stats       Basic Service Stats       Location: Sevi         User       Service       CS Queued Dropping Tx Rate       Usage       Summ         00:13:4F:00:1D:49 - Test Voz - weth0       Downlink - DATA [?]       3.9Mth ro       2.0Mbps       97.0%       Bits         User       Service       Rx Rate       Usage       Usage       Wert       Bits         00:13:4F:00:1D:49 - Test Voz - weth0       Uplink -DATA [?]       1.9Mbps       91.6%       Ethel         eth0       Refresh       Ethel       Detailed       Refresh       Refresh	Zoal https://192.168.70.1/       Image: Second Secon	ZQ3 https://192.168.70.1/	Zoal https://192.168.70.1/       Image: Pice Second		

#### WiMAX connection status screen detail

# 1.4. OPERATION

As the WiMAX connection is configured as a private LAN, with no Internet access, there is no way to access the AEQ external SIP server, but there are another two operating modes in the Phoenix Studio codecs: RTP POINT TO POINT and DIRECT SIP.

neti SIHIUS	
LOCAL MEDIA PORT: 1024 DEST MEDIA PORT: 1024 DEST MEDIA PORT: 1024 RTP INTERFACE: FTH1(Main)	STATUS OK

Detail of the IP mode selection of Phoenix Studio

In order to establish a SIP DIRECT connection, the first step is to select this mode at the corresponding option of the internal menu: MENU → SYSTEM → INTERFACES → NET1 → MODE and, after that, press the CALL key at the front of the equipment. Type the URI (alphanumeric identifier) of the remote equipment (format: <name>@<IP>) to connect to. Before pressing CALL key again, you can select the list of audio-coding algorithms inside LINK PROFILE submenu, from 64Kbps mono MP2 to >2Mbps 24bit/sample, 48KHz Stereo linear PCM audio.



- The acoustic RING signal will be received at the other end. AUTOANSWER can be configured, or conversely, the call can be manually accepted or rejected. NOTE: don't forget to activate the ON AIR key.
- Verify that audio is being provided to the audiocodecs and that it is being received at the other end using the vu-meters at the front of the units.



Detail of a correctly established connection

- In order to establish a RTP POINT TO POINT connection, the first step is to select this mode at the corresponding internal menu: MENU → SYSTEM → INTERFACES → NET1 → MODE and, after that, press the CALL key associated to Ch1 at the front of the unit and type the remote equipment IP in. You can select the audio coding algorithm among a list of modes covering from 64Kbps MP2 mono to >2Mbps 24bit/sample, 48KHz Stereo linear PCM audio.
  - You have to repeat the same procedure (using exactly the same coding algorithm) at the other end of the connection. Unlike when in DIRECT SIP, in RTP the link will be established only where calls are sent from both ends.
  - Verify that audio is being provided to the audiocodecs and that it is being received at the other end using the vu-meters at the front of the units.

# 2. LINK BETWEEN A REMOTE OUTDOORS LOCATION TO A CENTRAL STUDIO USING PHOENIX MOBILE & STUDIO

A connection between a remote outdoor location using AEQ Phoenix Mobile units to a central production studio using a WiMAX radio link using Phoenix Studio is another one of the scenarios where professional audiocodecs such as the AEQ PHOENIX family can provide competitive advantages, both in the technical and economical areas.

# 2.1. REQUIRED HARDWARE

- AEQ Phoenix Studio professional stationary audiocodec.
- AEQ Phoenix Mobile professional portable audiocodec.
- WiMAX base station with its corresponding antenna.



- WiMAX user station (also called CPE) and its corresponding antenna.
- Required interconnection cabling.



Schematic setup for a transmission from remote location over WiMAX using AEQ

# 2.2. ASSEMBLY

 Install the WiMAX base station at one of the intended communication ends. This place will typically be the radio studio, as the cost of this unit is higher than the CPE's and the security conditions are usually better in this place that in exterior locations. Also, this is more convenient if the broadcaster wants to resell internet access service and become an ISP (internet service provider) using the spare bandwidth.

The installation of each base station is usually performed using the pole mounting hardware supplied with the unit.







Detail of the base station and mounting hardware

• Proceed to connect and align the WiMAX base station to the remote location. It is recommended that both places have direct line-of-sight. Under these conditions, a range up to tenths of kilometers can be achieved.



Detail of a WiMAX base station an associated antenna on a tripod

- Repeat the above described assembly for the WiMAX User Station.
- Connect two AEQ Phoenix Studio audiocodecs, one to each WiMAX station at each end. WiMAX equipment is usually fed by means of Power Over Ethernet (POE) units, where an external unit combines power and data, sending both of them over the same RJ45-ended cable.



Detail of a POE unit





- Connect the power cable to the POE unit of the WiMAX base station.
- Connect an Ethernet cable between the AEQ Phoenix (preferably choose ETH1 port) and the POE unit. RECOMMENDATION: use a small Ethernet switch that will allow us to connect other equipment such as PCs in order to provide remote configuration to the units of the presented setup, for example.
- Connect an Ethernet cable between the output of the POE unit and the back port of the WiMAX base station.
- Repeat the same procedure at the remote end of the WiMAX link, using the AEQ Phoenix Mobile, that has only one Ethernet port.



Detail of the Phoenix Mobile Ethernet connector

- Connect the analog/digital audio inputs and outputs at the back of the AEQ Phoenix Studio. RECOMMENDATION: as a starting point, use channel CH1.
- Connect the analog inputs/outputs to the AEQ Phoenix Mobile. RECOMMENDATION: for this test, start with MIC1 and HP1 connectors.
- Connect the mains supply cable to the back of the AEQ Phoenix units.
- Turn all the equipment on.

# 2.3. CONFIGURATION

WiMAX units usually come from factory with a default IP address, i.e. 172.31.70.1 for the base station and 172.31.70.29 for the User Station. These IP addresses can be modified from the control interface embedded in each WiMAX station.





O O Configurati	on - Mozilla Firefox			🍽 🗢 🖘 🖂 12:13 🔕 asier 😃					
← → ♥ 🖺 http://192.1	68.70.29/frameset.html	☆ ▾ Ơ 🚼 ▾ Google 🔍 🚇 ▾ 🏫							
📷 Most Visited 👻 🔛 Getting St	arted 🔝 Latest Headlines 👻								
TRANZEO		TCP/IP S	ettings						
<u>Home</u> Information Page Wimax Setup <u>Wireless</u>	To get back Secondary Management Connectior ම Bridge Ethernet 1	click "Apply" button. 'Back to Information Page" button. Secondary Management" for router o uter mode NAT mode	ptions to be available.						
Network Setup TCP/NP VLAN		speed 100 duplex full	Auto-negotiation Speed & Duplex						
Status <u>Wireless</u>	IP Mode	• Static	DHCP Client						
Service Flows System		192.168.70.29	Wireless IP Address						
Statistics ARP Table		255.255.255.0	Wireless Net Mask						
Administration		192.168.70.1	Route Gateway						
Administrative Settings Firmware Copyright © 2007-2009 Tranzeo Wireless Technologies, Inc.		Apply Back to Info	rmation Page						

Detail of a CPE configuration screen

 Configure the AEQ Phoenix Studio with IP addresses that are compatible with the ones corresponding to the WiMAX equipment, from the internal menu MENU → SYSTEM → SETTINGS → ETHERNET → NET1.

ETHERNET1 CONFIG	
IP: 172.31.11.68 MASK: 255.255.0.0 GWAY: 0.0.0.0	

Detail of the configuration of IP address of AEQ Phoenix Studio

 Configure la unidad AEQ Phoenix Mobile con una dirección IP compatible con Configure the AEQ Phoenix Mobile unit with another IP address within the same network as the WiMAX units, from the internal menu MENU → COMMUNICATIONS → ETHERNET.







Detail of AEQ Phoenix Mobile IP configuration

 If a small Ethernet switch has been connected between the AEQ Phoenix and the WiMAX POE units, in order to grant access to an external PC for control and monitoring, this PC must be setup with a valid IP address / mask as well, within the same network range. Now it is possible to access the WiMAX control interface using a standard web browser (usually MS Internet Explorer) simply by typing the IP of the corresponding station in the URL bar.

NOTE: once the WiMAX link is correctly set up as a transparent IP connection between both ends, it is possible to control and/or manage all the units in the setup from any of the ends of the link.

 Use the control interface of the WiMAX base station to verify that the signal levels are correct (around -26dBm typically, this can vary as a function of the link distance), and that no packets are lost.

In this step, it is recommended that small adjustments to the antenna(s) orientation are made in order to optimize the alignment and get the highest possible signal strength. In case of low signal level, try to mount the remote location antenna on a tripod in the highest accessible location, or on the mobile unit mast.



WiMAX connection status screen

- At this point, the WiMAX connection has been established. We recommend that the BRIDGE operating mode is selected to warrantee that we end up with a totally transparent IP bidirectional link.
- The available bandwidth can vary as a function of the WiMAX modulation implemented, from a theoretical maximum of 35Mbps down to 32Kbps (very rare in these high-capacity links). The modulation is selected automatically and transparently to the user between both WiMAX stations as a function of the visibility conditions and the distance of the link.

	O - ARBA556 Manager	nent Web - Alber	ntia Sys	stems S.A	Mozilla Fi	refox							≪ 🖂 1	2:43 🛞 a	asier (
🖕 🔿 😵 🚺 192.1	68.70.1 https://192.16	8.70.1/							<b>☆</b> ₹ C	Sa + Goo	gle			۹ 💷	- 6
🖥 Most Visited 👻 🔡 Get	tting Started 🔂 Latest	: Headlines 🔻													
11 1							1		Log	ged as: wm	ax Prof	ile: W	imax User		
albenl	ia						Equ	ipmen	t: ARBA5	56 Name:	: DEMO Type: BS - CPE + Set				
Sys	tems						Ver	sion: 3	.3.8384	Locatio	on: Sevi	lla St	atus: Rur	n <mark>ning</mark> S	top
Status & Alarms	BW Stats														
System Tools		1													
Admin Setup	Basic Cell Stats	Basic Service	Stats	Detailed Co	ell Stats	Detailed S	ervice Stat	IS							
Mng Setup	Tr (DL) Data (	Comulao Stato									Cum				
Config Files	TX (DL) Data Service Stats										Summary		.ry		_
System Log	User Service		e	CS Queued Dropping		g Tx Rate	Usage		Summary		Downlin	k Uplin	ık		
Device Features	00:13:4F:00:1D:49 - Test Voz - weth0 Downlink - DAT		link - DATA [?]	A [?] 3.0pkt no 2.0Mbps			97.0%		Services		1	1			
WIMAX	Rx (UL) Data	Service Stats									Bits		2.0Mbps	1.9M	ibps
Radio Setup	User			Sei	Service Rx Rat		x Rate	Usage		PRIS		536. Ipki	524.0	ркі	
Cell Setup	00:13:4F:00:1D:49	- Test Voz - weth0	8	Up	link -DATA	[?] 1	.9Mbps		91.6%	Ethernet Stats					
BW/Sched Setup											Dev	Ty		By	
User Stats											oth0	1.0	Mbpc	1.7Mbpc	
BW Stats											cuio	1.0	MDP3	1.7 Mope	,
User Net Status															
Spectrum											Refresh	Timeo	out: 1s	(\$	Set
User Summary															
Provisioning															
AAA Setup															
Local AA															
CA Certs															

WiMAX connection status screen detail





# 2.4. OPERATION

As the WiMAX connection is configured as a private LAN, with no Internet access, there is no way to access the AEQ external SIP server, but there are another two operating modes in the Phoenix Studio codecs: RTP POINT TO POINT and DIRECT SIP.

Net1 STATUS	
LOCAL MEDIA POINt to Point LOCAL MEDIA PORT: 1024 DEST MEDIA PORT: 1024 RTP INTERFACE: ETH1(Main)	STATUS OK

Detail of the IP mode selection in Phoenix Studio

- In order to establish a SIP DIRECT connection, the first step is to select this mode at the corresponding option of the internal menu: MENU → SYSTEM → INTERFACES → NET1 → MODE and, after that, press the CALL key at the front of the equipment. Type the URI (alphanumeric identifier) of the remote equipment (format: <name>@<IP>) to connect to. Before pressing CALL key again, you can select the list of audio-coding algorithms inside LINK PROFILE submenu, from 64Kbps mono MP2 to >2Mbps 24bit/sample, 48KHz Stereo linear PCM audio.
  - The acoustic RING signal will be received at the other end. AUTOANSWER can be configured, or conversely, the call can be manually accepted or rejected. NOTE: don't forget to activate the ON AIR key.
  - Verify that audio is being provided to the audiocodecs and that it is being received at the other end using the vu-meters at the front of the units.



Detail of a correctly established connection

 In order to establish a SIP DIRECT connection from AEQ Phoenix Mobile, verify that the option PROXY=OFF in the Communications → SIP menu. Press the CHN key on the control surface of the unit, and type the alphanumeric identifier (URI) of the remote equipment (format: <name>@<IP>). Before pressing the green CALL key, a LINK PROFILE specifying the audio coding algorithms to use can be selected, from 64Kbps G711 to 128Kbps AAC.



- The acoustic RING signal will be received at the other end. AUTOANSWER can be configured, or conversely, the call can be manually accepted or rejected. NOTE: don't forget to activate the ON AIR key.
- Verify that audio is coming into the audiocodecs and that the remote unit is receiving and showing audio in the vu-meters displayed in the main screen.



Detail of the Phoenix Mobile control surface and on-screen vu-meters



APPLICATION NOTE: R+D DEPARTMENT, AEQ

MADRID (SPAIN)

AEQ, S.A. Calle Margarita Sala 24 Parque Científico Leganés Tecnológico 28919, Leganés (Madrid)

aeqsales@aeq.es www.aeq.eu