# APPLICATION NOTE

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


AEQ

# 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).

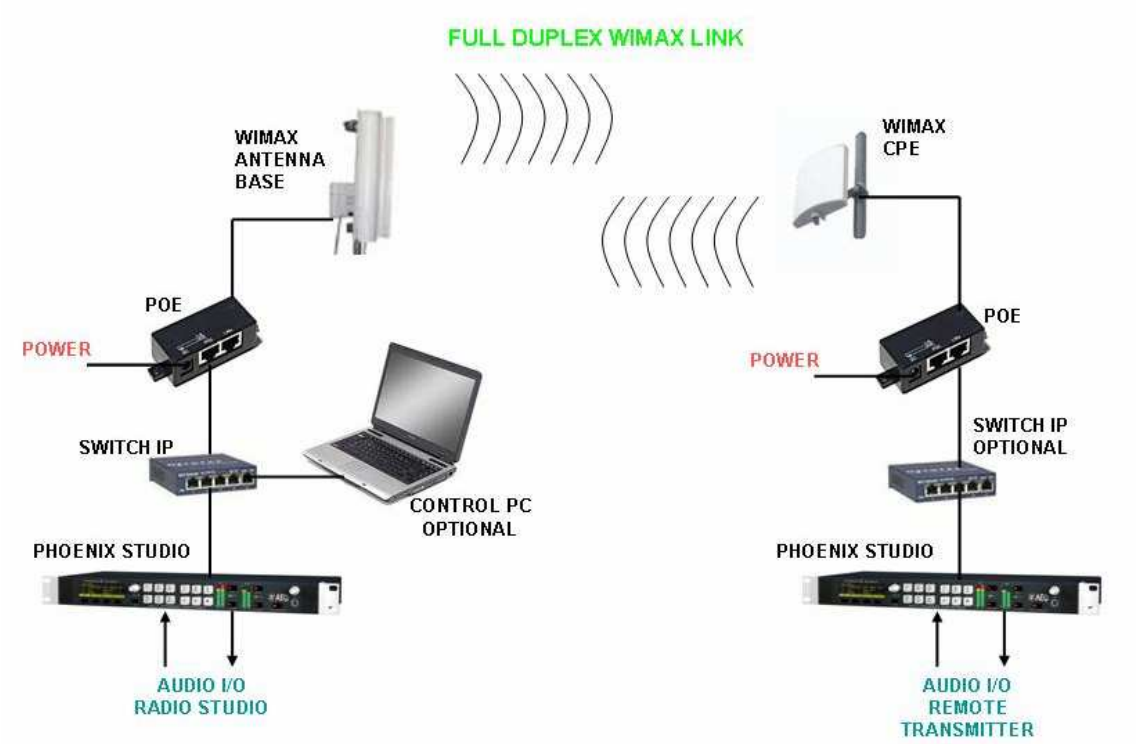
### 1. ESTABLISHING A STUDIO TO TRANSMITTER LINK (STL) USING A COUPLE OF PHOENIX STUDIO AUDIOCODECS

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

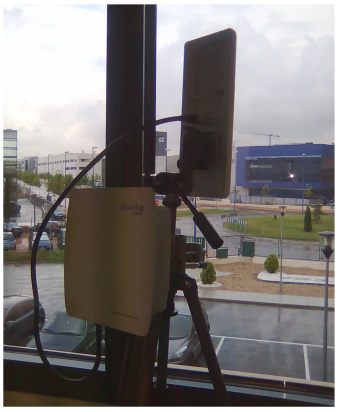
## 1.2. INSTALLATION

- 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

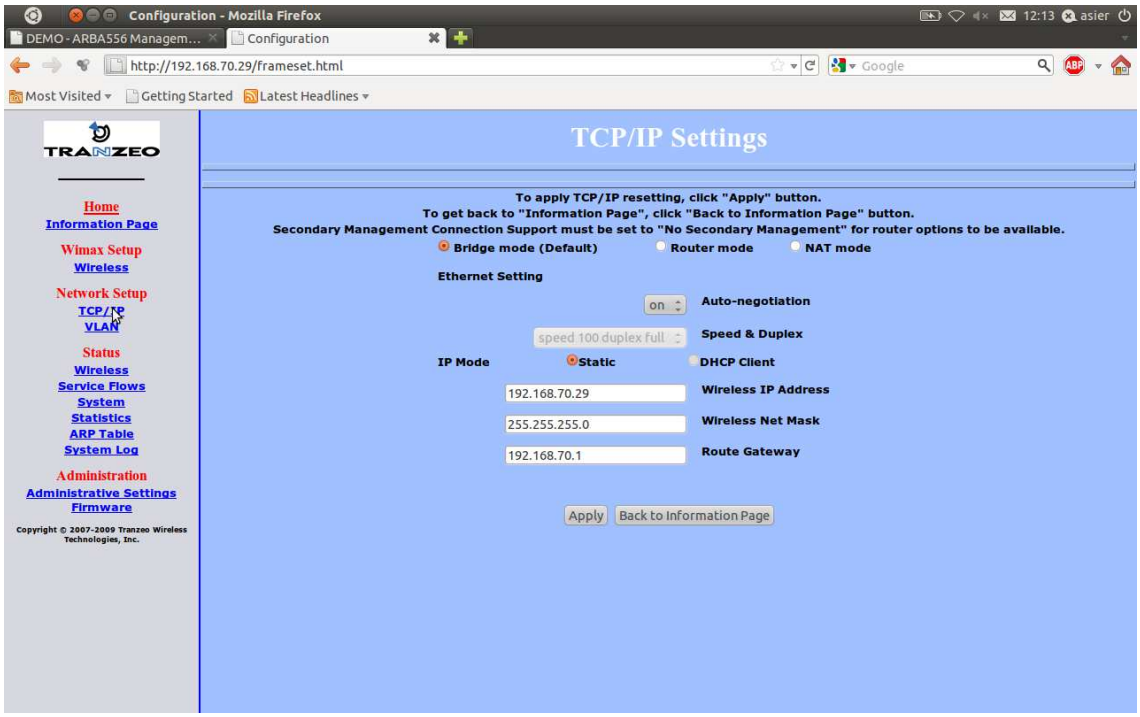


TEL: (34) 91 686 13 00 - FAX: (34) 91 686 44 92 - E-mail: aeqsales@aeq.es - Web: www.aeq.eu

- 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.




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.

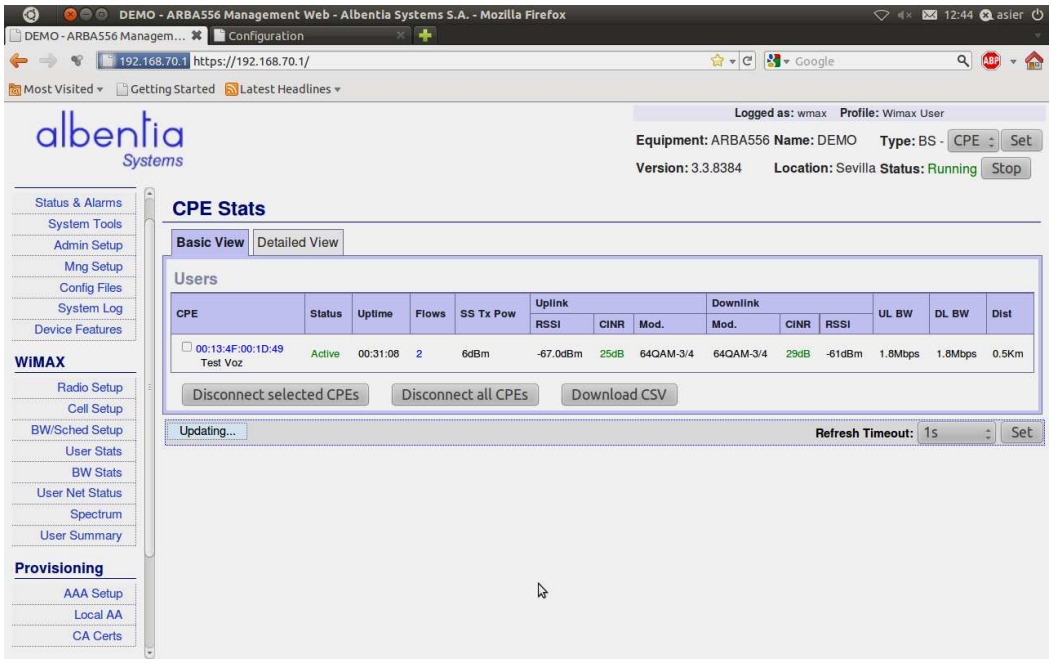

Detail of the configuration of IP address of AEQ Phoenix Studio

- 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.

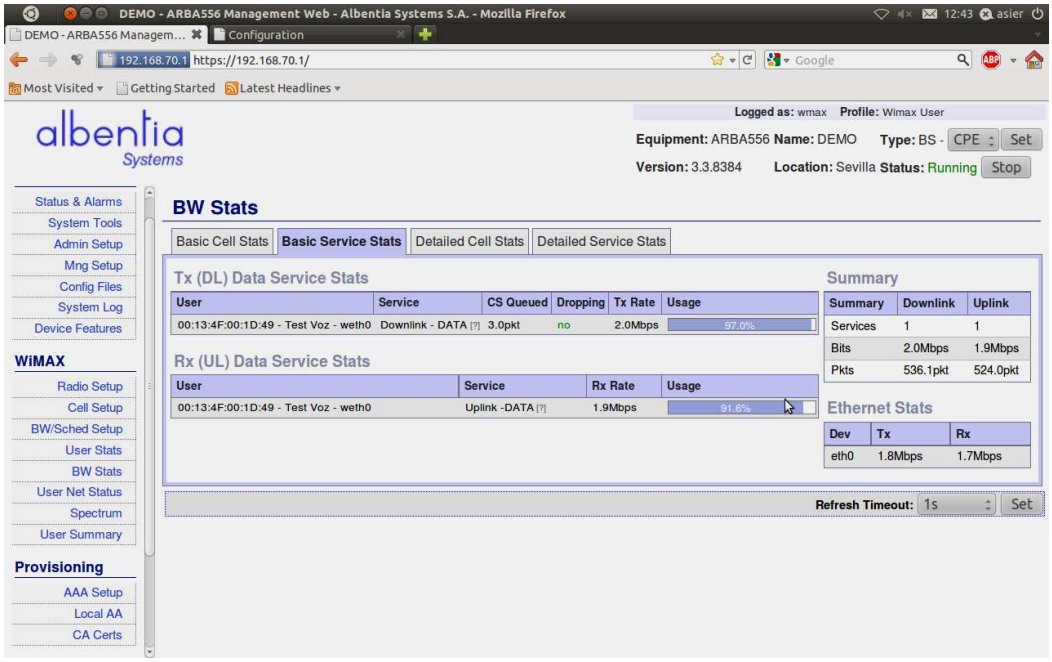
  In this step, it is recommended that small adjustments to the antenna(s) orientation are made in order to optimize the alignment and get the highest possible signal strength. Usually, the CPE antenna is uni-directional and its orientation is critical, so it is recommended that this is the end of the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




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.




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.


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.

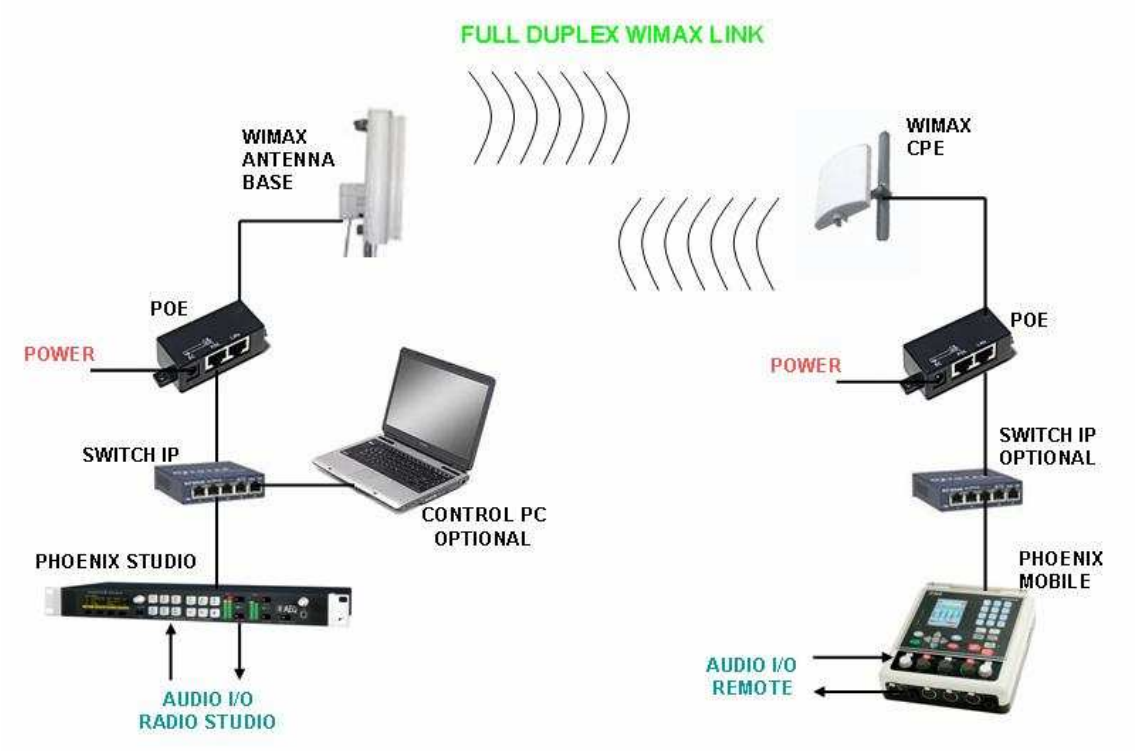
## 2. LINK BETWEEN A REMOTE OUTDOORS LOCATION TO A CENTRAL STUDIO USING PHOENIX MOBILE & STUDIO

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

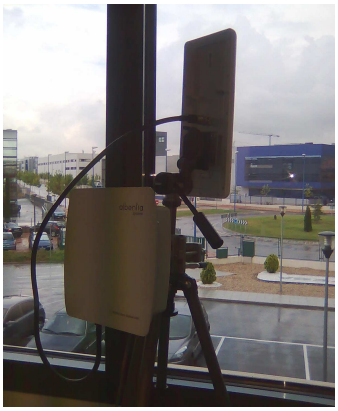
## 2.2. ASSEMBLY

- 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

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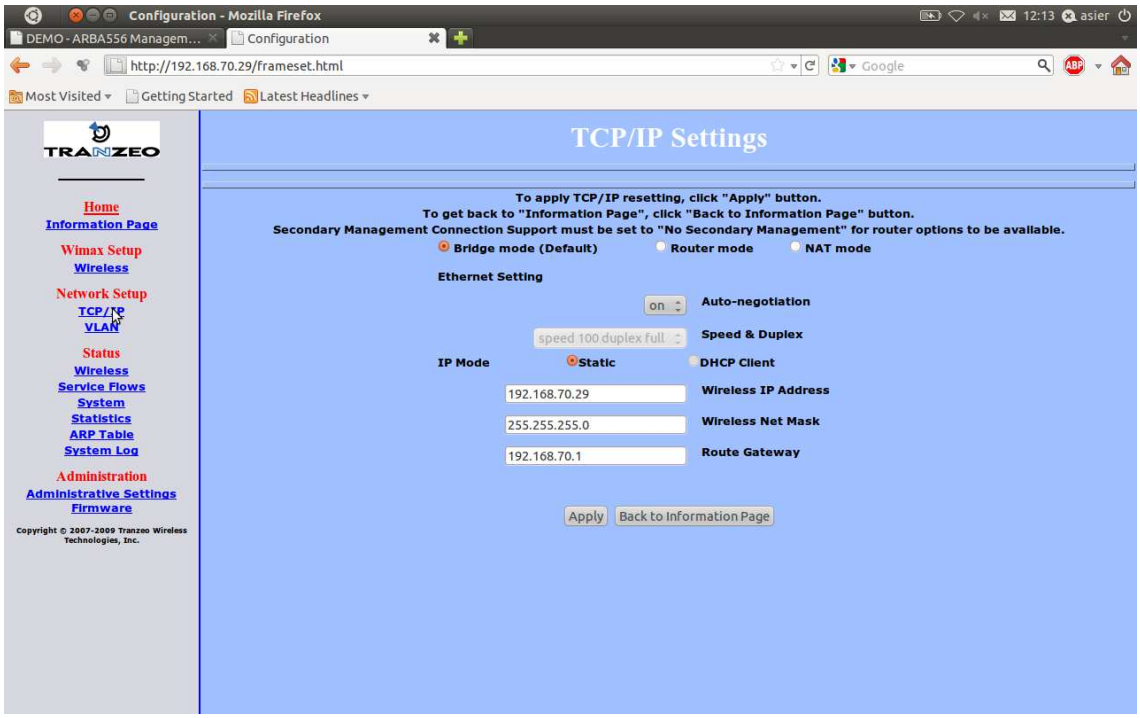
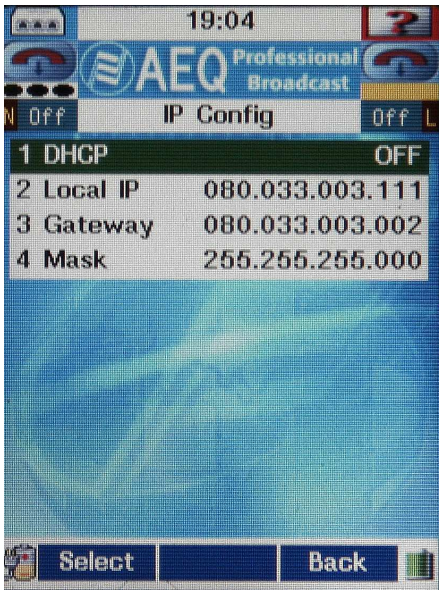



Detail of a CPE configuration screen

- 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.


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

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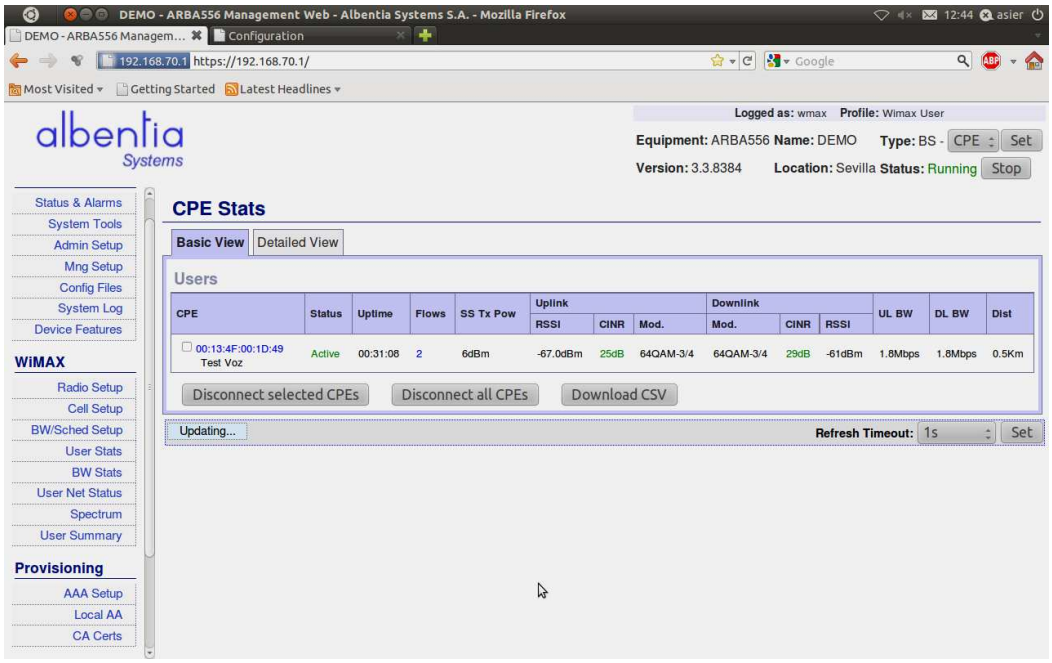
  In this step, it is recommended that small adjustments to the antenna(s) orientation are made in order to optimize the alignment and get the highest possible signal strength. In case of low signal level, try to mount the remote location antenna on a tripod in the highest accessible location, or on the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

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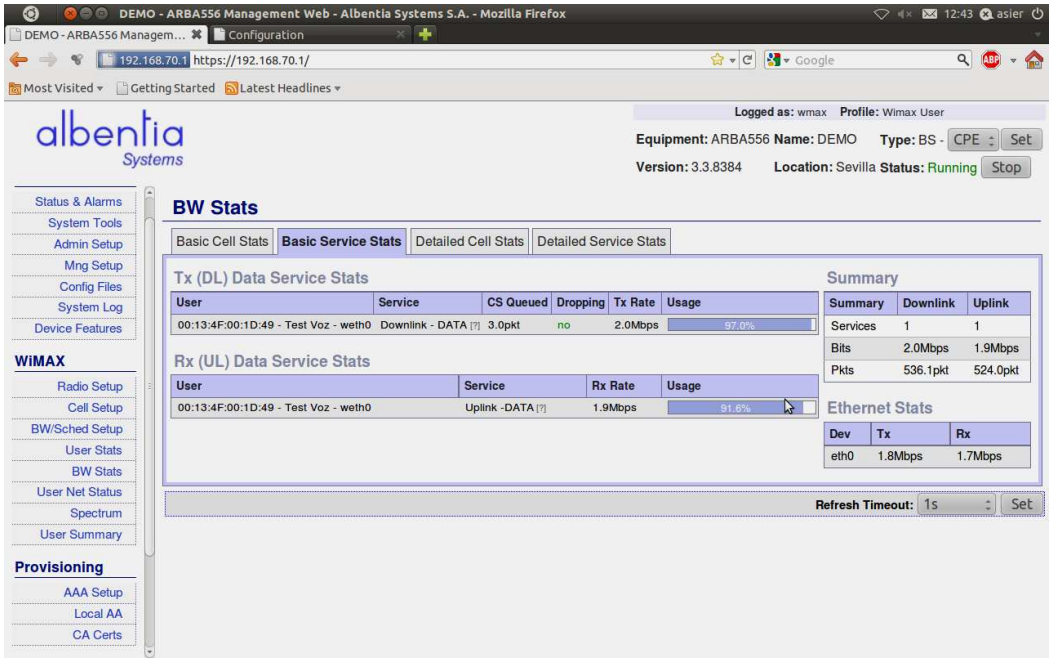


WiMAX connection status screen detail

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Detail of the IP mode selection in Phoenix Studio

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    - 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:**
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