APPLICATION NOTE

3G/4G wireless transmission system using AEQ Talent or Alio audiocodecs

AEQ

NA7 – 3G/4G WIRELESS TRANSMISSION SYSTEM USING AEQ TALENT OR AEQ ALIO AUDIOCODECS

APPLICATION NOTE

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1. Introduction

This Application Note intends to serve as a guide to those customers who need to build a system to send high-quality chronicles to the studio from any place, whenever a wired Internet connection is not available, and portability is a must.

TALENT is an ultra-portable IP audiocodec with professional-grade microphone input and a flexible headphone amplifier. It can be controlled remotely via Internet or locally by means of a Bluetooth-connected App installed on a mobile device.

Its light weight, small size and low power consumption make it ideal for portable applications. It features very efficient audio compression algorithms such as OPUS, allowing for the transmission of many program hours using only a reduced amount of data from your plan.

By connecting an external battery and a simple wireless modem-router, we can achieve a perfect solution easily and at a low cost, as this Application Note will demonstrate. Also, advice is provided to select the required products.

2. Power supply

TALENT can be powered in many ways. Besides, it has a low, predictable power consumption of around 5.5W, which is mostly independent on its operating state, making it ideal for portable applications.

It is possible to feed it via the incorporated micro-USB connector at 5V (current consumption = 1.1A approx.), or using the DC connector, with a voltage between 5 and 15V (current consumption is inversely proportional to input voltage, so it will draw around 0.5A at 12V).

The most effective, economical and readily available solution consists on using a so-called “Power Bank” or portable battery with USB outputs. There are many models in the market with very respectable capacity and a size equivalent to that of a typical mobile phone (maybe thicker), which look like this:

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Battery requirements

The first requirement for the battery is the availability of at least two USB (type A) 5V output connectors, so a USB-A to micro-USB cable can be used to power TALENT, while still having a free output to power the modem-router. It also needs a dedicated charge port (which usually has a different connector, such as micro-USB or USB-C).

Also, according to our experience and tests, USB ports must be able to provide 3 amperes, not because TALENT requires that (a standard 2.1A port is more than enough), but because 3G/4G routers may draw current peaks sometimes.

If it provides more than two ports, that's of course not a problem, and they can be useful to keep our phone charged, for instance, but of course the total power consumption needs to be considered in order to estimate the battery's life.

A very useful functionality found in some Power Banks is the presence of a numeric remaining battery display ("83%", for instance), as opposed to 3 or 4 LED indicators that provide quite inaccurate readings.

Range calculation

The total available operating time depends on the battery's capacity.

If TALENT power consumption is taken into account only, the range will be around 10 hours with a 20.000 mAh battery, or 15h with a 30.000 mAh one, allowing for some reasonable headroom to avoid discharging the battery completely, which could reduce its operating life.

If a modem-router is also connected (the tested model draws 2.5W average), the autonomy with an active call is estimated to be around 7h with a 20.000 mAh battery, or 10-11h with a 30.000 mAh one.

Connections

Using a Power Bank such as the ones described above, the only power connection to power TALENT would be a USB-A to micro-USB cable, connected to the audiocodec's rear USB port:

Have in mind that the power button works in inverse mode when powering from this port (a pressed-in POWER SWITCH will turn off the device)

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How to get the battery

Due to air transportation restrictions applying to large batteries, AEQ cannot provide this kind of product to many of our customers, so we recommended that you obtain it locally.

Many available compatible products can be found on the large online platforms or consumer electronics stores. A larger than 20000mAh battery with 2 or more 3A USB ports and numeric display like this can be obtaining at a very reduced price today.

This Application Note was written in March 2022. Of course, availability and pricing may vary along time.

2. IP Connectivity

TALENT relies on an Ethernet port to establish an IP connection to the remote studio end through Internet. An external, low cost router can be connected there. Some of them are compatible with 3G/4G networks, but of course they will eventually be substituted by more evolved routers for 5G or other networks to be deployed in the future.

Router requirements

The first and most important requirement applying to the router is that it must provide an RJ45 Ethernet port to connect to TALENT.

It would also be desirable that it can be powered from 5V, usually through a USB port (i.e. micro-USB). This way, we can use the same Power Bank to feed TALENT and the router, without the need for a more specific model providing higher output voltage (12V, etc.) or DC voltage boosters.

The router should preferably include a slot for the SIM card, so no external USB modems are required, providing a cleaner, more compact and cost-effective solution.

You need to make sure that the selected router is compatible with the RF bands used in the country or region it is going to be used in. This is usually not a problem, especially if you acquire it locally.

Most routers incorporate an internal DHCP server, so we can forget about TALENT's IP configuration. By default, it obtains IP configuration automatically in a transparent manner.

IMPORTANT NOTICE: turn the audio-codec ON always after the router has booted, so it can properly obtain its IP configuration by means of the DHCP protocol.

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Many routers also offer a WiFi network which is useful not only for sharing the Internet connection with other devices, but also to provide management (configuration, etc., as we will see later on).

Some mobile routers include its own battery, but isn't usually cost-effective to pay for that extra when we can power it using the same Power Bank which we already purchased to power TALENT.

Data plan consumption calculations

When a data plan is used, it is important to know whether the monthly limit established by the service provider is high enough to be able to broadcast the number of hours we need during that month. TALENT can help with this, and a whole lot, as it implements very efficient audio encoding algorithms that use very little data, so even a low-end small data plan can provide many hours of transmission.

Usually, the data limit is calculated as the maximum between the upstream and downstream data. In this case, both bitrates are quite symmetrical, anyway.

As a typical case, using a 128kbps OPUS algorithm (providing stereo CD-quality with 20Hz-20kHz bandwidth and ow delay) using only a 2GB/month data plan, up to almost 24h of audio can be transmitted every month. This time can be doubled if using a 64kbps algorithm, when in OPUS still provides excellent quality.

Of course, data is used only when a connection is established (even if there is no audio level). Remote control traffic, if used, exchanges very small amounts of data, so its contribution can be neglected in practice.

How to get a router. Recommendations

There are many router manufacturers, and at AEQ we have tested compatibility with several of the ones which fulfill the requirements explained above.

Due to its low cost and good enough features, we recommend this ***Outdoor LTE 4G Router*** from KuWfi, which is conveniently distributed by large online e-commerce platforms.

This router, with a very low price-tag, provides an Ethernet port, two removable independent antennas (one used for mobile data and the other for WiFi) and external 12V power supply (including AC/DC adaptor), but it can also be powered from a micro-USB port at 5V.

It includes a SIM card slot in micro SIM format.

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There is also this other model offered by the same manufacturer.

Configuration example with the recommended router

In this section, we will explain how to provide Internet connectivity to TALENT using the mentioned KuWfi mobile router, starting from the default factory configuration (which we can revert to at any time by holding the RESET button pressed with a sharp object for 5 seconds)

Once that we are sure that the router is in its default factory configuration, these are the steps to follow:

1) Choose a valid SIM card associated to a suitable data plan for the country it is going to be used in. It is recommended that the SIM card is inserted in a mobile phone first, in order to deactivate its SIM PIN lock feature.
   This is usually done under the SECURITY → SIM Lock option, or by means of the SECURITY → Additional Settings → Credentials and cyphering → SIM Lock menu. The current PIN will need to be typed first, for security reasons.

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2) Next, insert the SIM card into the router (remember that it accepts micro SIM format only, so if it is a Nano-SIM, an adapter will be required)

3) Connect the router's Ethernet port to TALENT's Ethernet port using a normal (not crossover) RJ45 cable.

4) Power the router using its AC/DC adapter or the battery (never connect both cables at the same time). **This router can draw current peaks higher than 2A when fed at 5V, so that's why using 3A USB ports is recommended.**

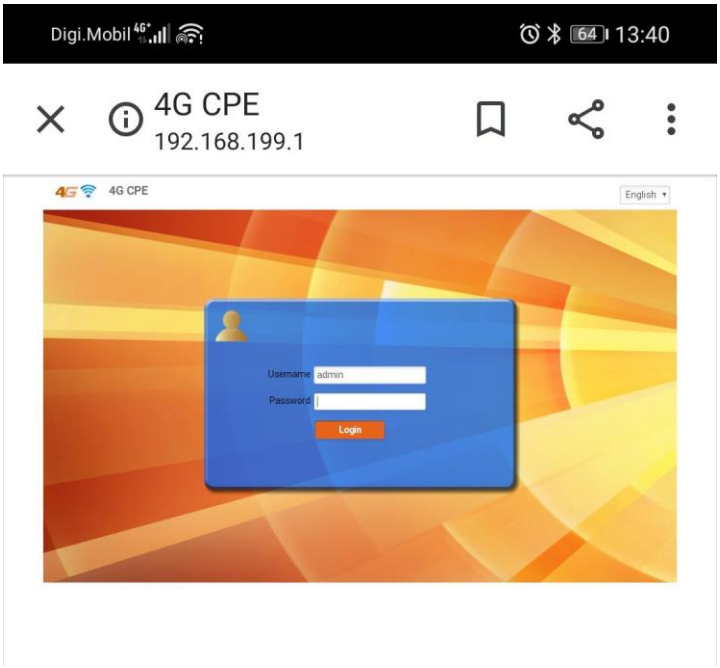
5) After approx. 1 minute, search for the new WiFi network provided by the router in our mobile phone, and connect to it. These are the default WiFI SSID and password:

WiFi ID: 4G-CPE_*XXXX*

Password: 1234567890

Alternatively, you can connect a Laptop with an Ethernet cable, making sure that it is configured to "Obtain IP automatically". After some seconds, the PC will obtain its IP configuration and we can continue.

6) After a while, open a Web Browser in the mobile device or PC and type the following address: **192.168.199.1** (default from factory), and we will access the management Web server. But before, some credentials will be requested:



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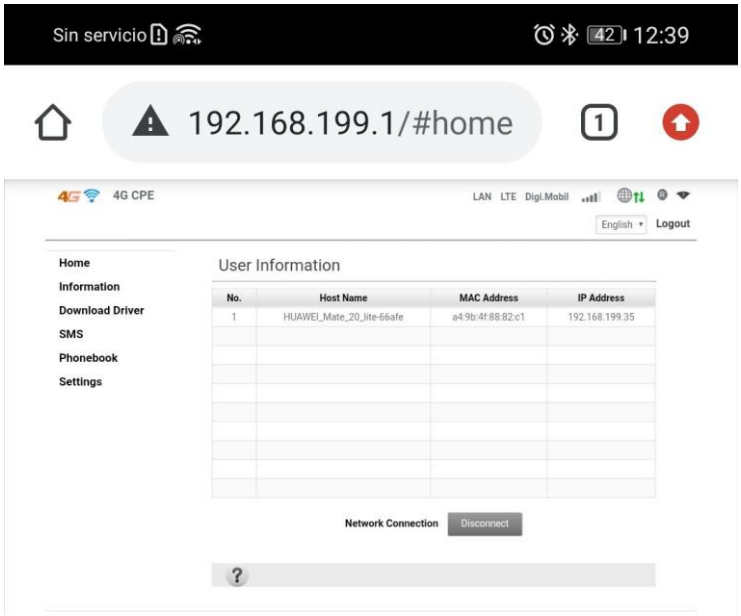
Default user and password are as follows:

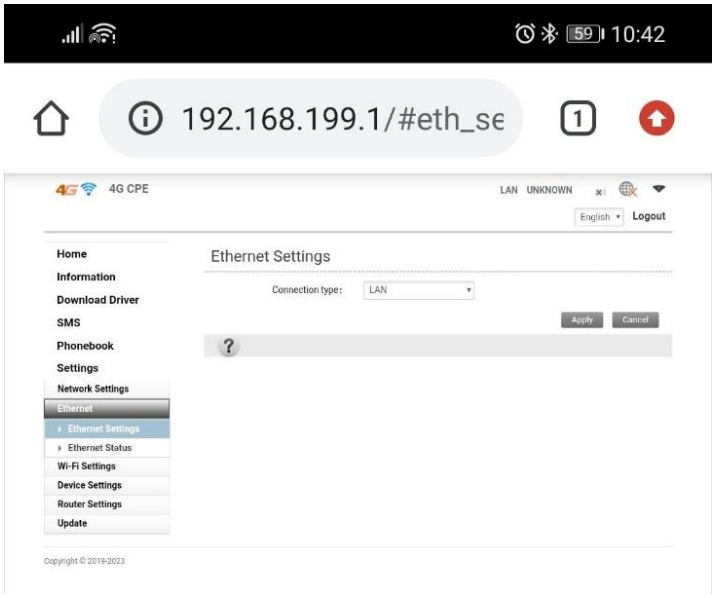
User: admin

Password: admin

7) Once we have gained access to the router's management Web, if the SIM card is correctly inserted, a menu like this will be presented:



8) The first time, go to ***SETTINGS → Ethernet Settings*** menu and, in the ***Connection Type*** drop-down menu, please select "LAN" and then click on ***Apply***:



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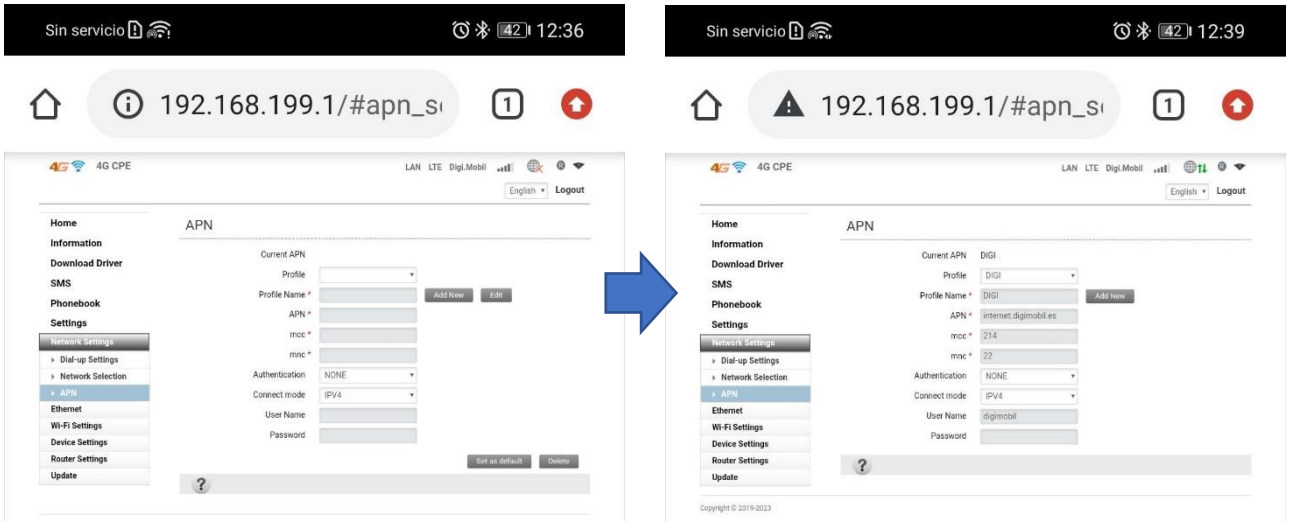
9) Next, configure the Internet connection settings corresponding to the selected service provider. Go to ***Settings → APN*** and fill the fields in with the provided data:



In order to do that, click on the ***Add New*** button and give the connection a name in the Profile Name field (i.e., "DIGI"). Then, fill the APN and User Name fields in with the credentials provided by the service provider. Usually, these two values are enough and the rest of parameters can be left as default. In order to test the connection, ***Apply*** and click on ***Set as Default***.

10) Check the router side lights. Several signal level bar LEDs should illuminate, and also the last "globe" symbol, indicating Internet connectivity.

11) Once the router is configured, connect its WAN/LAN port to the TALENT Ethernet port if it wasn't already, and with the router already ON, power the TALENT ON from the Power Bank using a USB-A to micro-USB cable. Finally, turn it on using the POWER SWITCH (set to its outer position).

12) Connect to TALENT using TALENT Pilot App (see TALENT's User Manual) and check its IP configuration. Make sure that, as you scroll down, the DHCP setting is set to the right (ON). If you need to change it, the unit will ask for confirmation and reboot.

13) Once TALENT has obtained its IP configuration automatically, the yellow network indicator at TALENT will be steadily illuminated, meaning that it is ready to establish connections if the router's INTERNET LED is ON and there is enough RF signal.

14) Do an RTP test using AEQ Test unit, by dialing **178.239.208.179:5008**. If all is ok, the CONNECTED green sign will steadily illuminate and music should be received in the selected quality. In order to call any other remote codec, use its public IP

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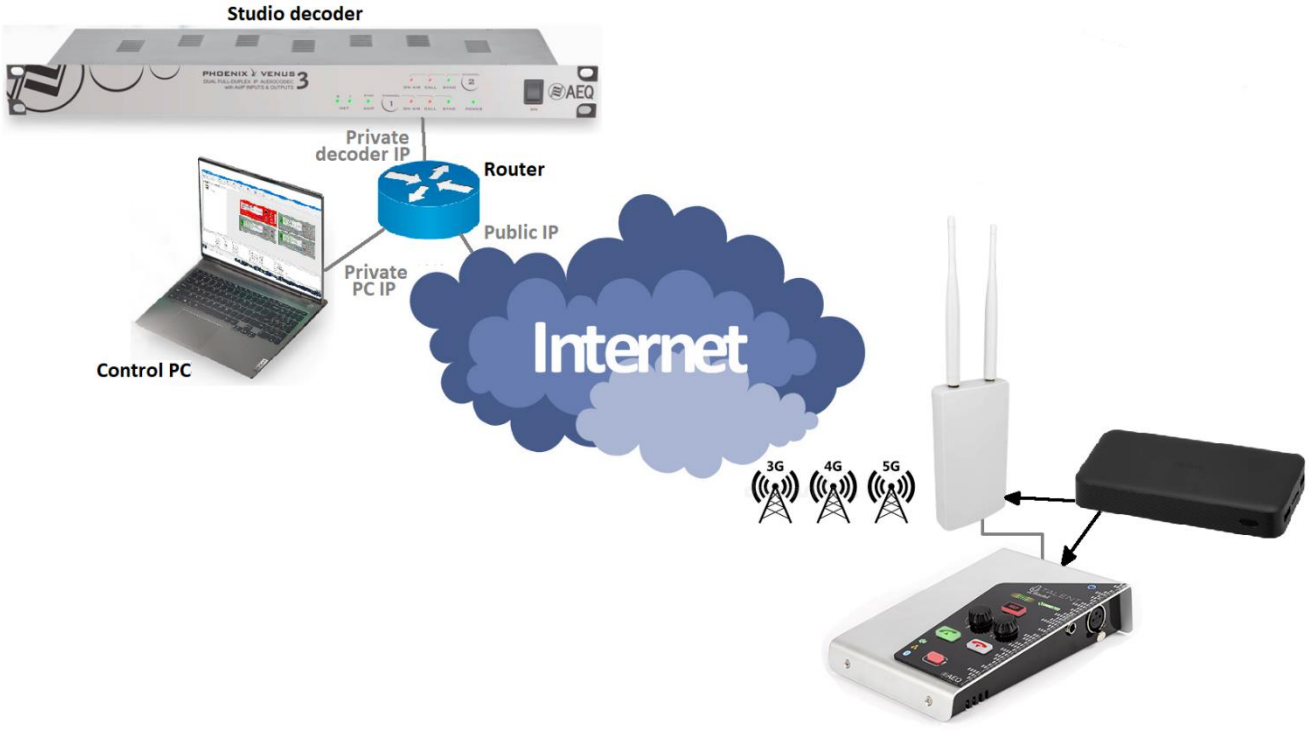
address:port and remember that the selected ports (5004 to 5008 UDP, for instance) need to be open to the receiving codec's private IP address by the IT staff.

15) Next, and if required, you can change to SIP mode. The yellow network indicator at the front should remain steady after changing to SIP mode, meaning that registration in the server (**sip.aeq.es** by default) has been successfully completed. At this moment, you can call to any other codec registered in the same server, for example **phoenixMaster**, (case sensitive), our 24/7 test unit for SIP.

3. Remote Control

This could be a typical diagram for the connection of a mobile TALENT to a studio audiocodec:



In order to make the functionality of our mobile unit complete, we can prepare the system so that TALENT can be controlled from the studio, in case that we need assistance or some detail that is not accessible from TALENT Pilot needs to be configured.

In order to do that, we first need to know the studio's public IP address, and ask the IT staff to forward port 4422 (both TCP and UDP) to the private IP address of the PC where we have installed ControlPhoenix in the studio. Note that this only needs to be done once and it will allow us to control any other AEQ codecs deployed outside.

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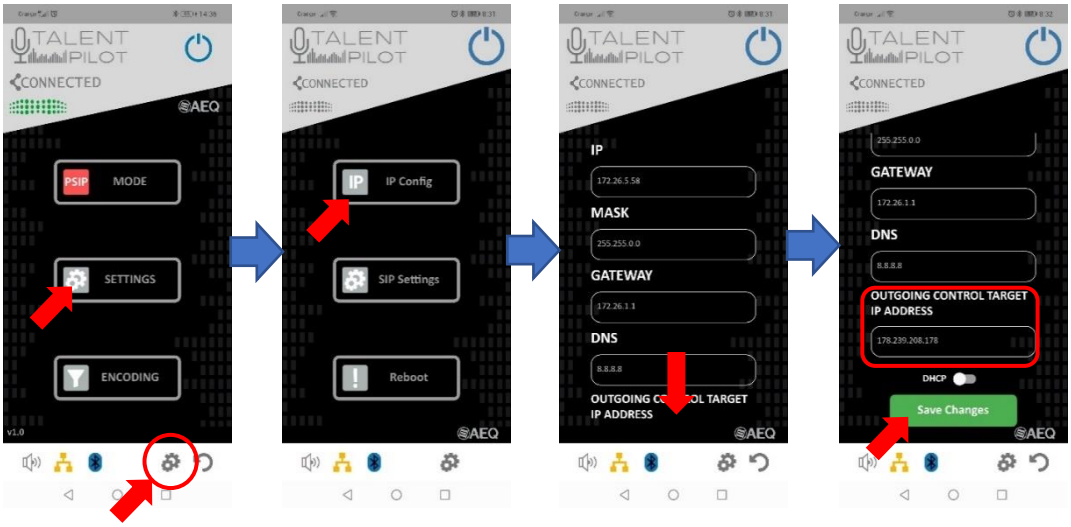
Next, open TALENT Pilot App and go to ⚙ → **Settings** → **IP Config**. Scroll down to the bottom and carefully fill in the **OUTGOING CONTROL TARGET IP ADDRESS** field using the studio's public IP, and then tough **Save Changes**.



From then on, any time you turn TALENT on and it is connected to Internet in any way, it will automatically show up in ControlPhoenix in that PC to be fully remotely controlled from the studio.

For example, the studio operator will be able to make calls, load a new call-book into the codec, adjust audio routings and levels, and even selectively forbid certain actions to be executed at the front-panel and App.

4. Other considerations

In order to optimize the connection quality, it is important to evaluate the performance of the network we are using. In order to do that, there are several tools that allow us to know the evolution of the number of lost packets and network jitter, helping us taking measures to solve that deficiencies.

In order to do that, we can use the graphical statistics that ControlPhoenix currently offers (2.2.1.50 or later version, codec CPU Firmware v9.60 or later), and adjust the receiving buffer sizes accordingly in both ends to be able to absorb the existing jitter.

Raising the buffer size in a codec is always related to an increase in reception delay, so it needs to be optimized to avoid making it unnecessarily large. Using the adaptive buffer with a defined minimum and maximum size is a good option. The start values can be something around 200ms (min) / 1000ms (max) (adaptive buffer), or 400ms (fixed buffer), at both ends.

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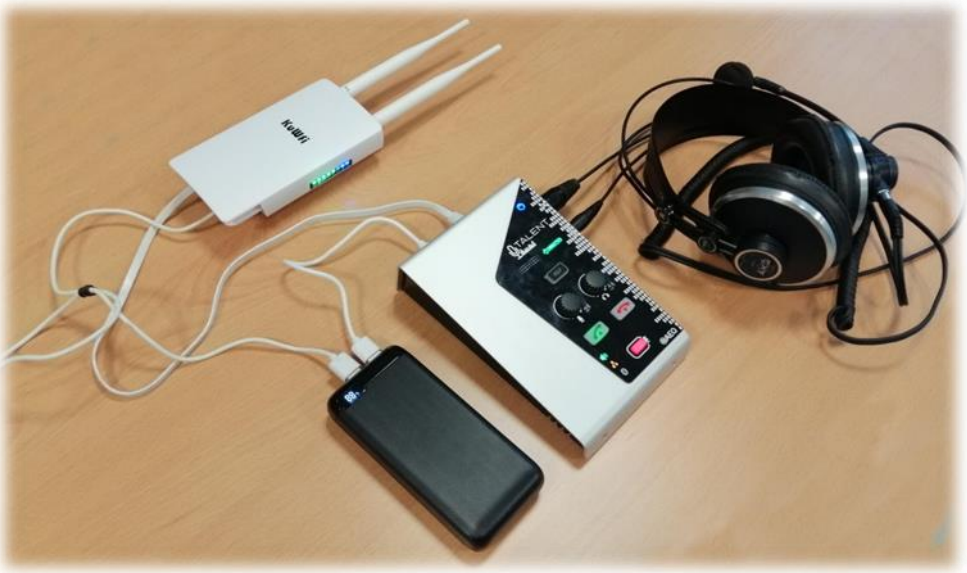

This is how all the necessary connections look like.

All the necessary devices easily fit into a small bag or handbag where we can store everything, and it can be used while moving, with the bag hung and simply taking the headphones out and plugging the antennas. The whole set weighs less than 2kg, including bag and micro-headphones.

Next, at the left, the equipment inside a simple 28 x 21 x 12 cm bag and, at the right, a professional assembly into a ventilated case, courtesy of OM Solutions integrator (Miami, USA).

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5. Using Phoenix ALIO

It is also possible to build a similar system using Phoenix ALIO, more suitable to those scenarios where the transmission of more than one microphone or to two different destinations is demanded (assuming that the used ALIO has double-channel license).

System connections are equivalent; the only difference is that to power Phoenix ALIO, 12 to 15V are required. For this reason, in order to be able to continue using a Power Bank, we will use a suitable USB 5V to 12V boost converter, with compatible output connector.

This converter must be able to provide a sustained current of 1 ampere (there are more economical models which can only put out around 0.6-0.7A, too low for this application). This current consumption at 12V translates to around 2.5 A at 5V, so using a Power Bank with 3A ports is mandatory.

NOTE: this particular converter can provide 9 or 12V, but it should be adjusted to always provide 12V.

This converter can be purchased in Amazon or Aliexpress, for instance.

The max. duration of a 20.000 mAh Power Bank powering ALIO is more than 4h including the recommended modem-router.

As for the configuration, just in the same way as we explained for TALENT, you must go to **MENU → ETHERNET →** Activate **DHCP** and turn the unit on after the router.

The codec is ready to make a call when the IP or SIP keys are illuminated steadily (depending on the current operating mode, RTP or SIP, respectively). If the router has enough RF signal and the Internet (globe) signal is also ON, we will be able to make calls normally.

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