

APPLICATION NOTE

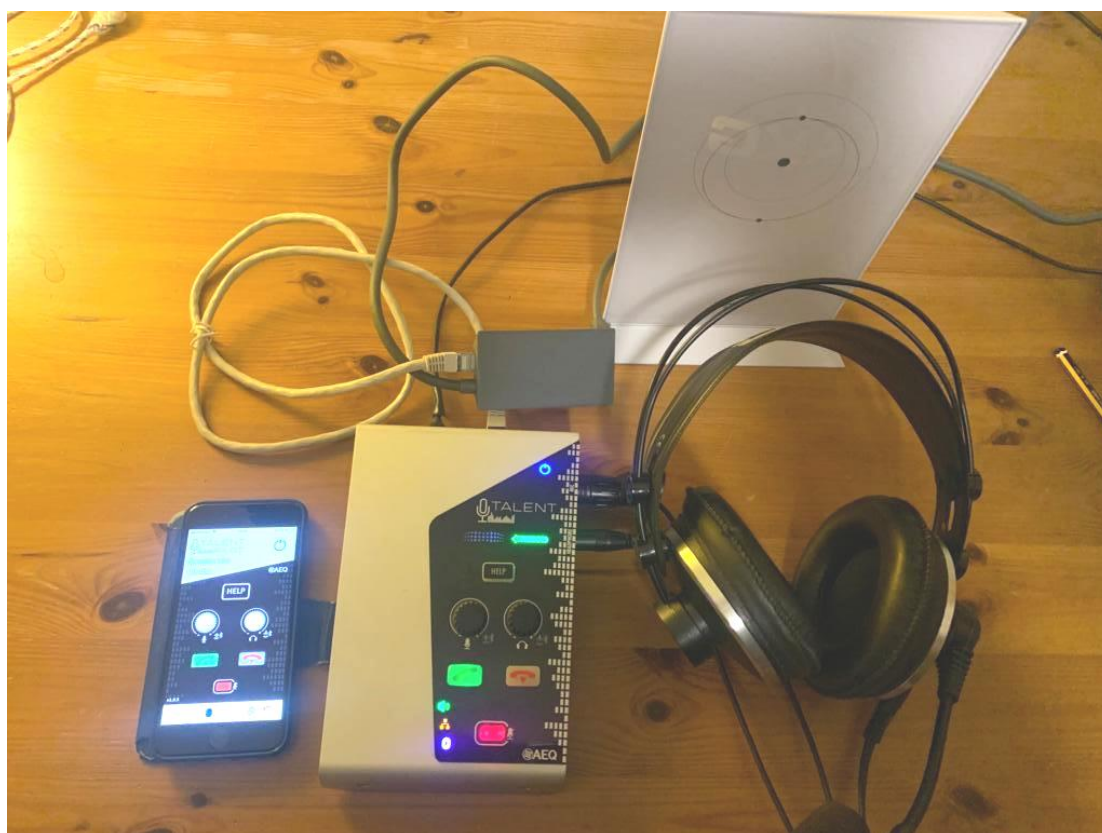
Using the AEQ
portable audiocoders
with Starlink Satellite
System



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1. Introduction

This Application Note is intended to serve as a guide for those customers who need to rely on a system to send bulletins, reports, events or even bi-directional contributions between a venue and a studio with great audio quality from anywhere, where GSM, 3G, 4G etc. coverage is not available or when proper service of these networks is not guaranteed due to possible saturation. Now, this is possible using the new generation Starlink satellite connection system.

TALENT is an ultra-portable IP audiocodec with professional microphone input and an output for any kind of headphone. It can be remotely controlled through the Internet or by means of an App installed on a mobile phone using Bluetooth connectivity.



ALIO is a portable IP audiocodec with integrated mixer for 4 microphones plus stereo line input/output. It features two communications channels and can be locally operated or remotely controlled through the Internet.



Both of them are ideal for portable applications. The incorporation of very efficient and high-quality compression algorithms, such as OPUS, allows for the transmission of the program signal with the same quality as if the journalist would be talking from the studio. Even when OPUS provide excellent delay and audio quality, thanks to the wide bandwidth provided by Starlink, transmission is also possible using uncompressed linear PCM, for seamless audio quality.

Introduction to Starlink

The new Starlink satellite IP communications system (developed by SpaceX company, owned by Elon Musk), is a qualitative leap forward over conventional satellite systems such as Inmarsat, etc. which, for a very high cost (both for the equipment and operation, as traffic is billed in a per-volume or per-time basis) can provide several hundreds of kbits/second (in the best conditions, when optimum visibility is available to the -only-satellite). Further, the delay is so high that it makes bi-directional conversation very uncomfortable.

The new Starlink system provides stable connections at tens of Mbps at a cost which is comparable to that of terrestrial fiber lines, and with only a small investment, in most parts of the world. The covered geographical areas are constantly growing. At the time when this note was written, the whole Europa continent, North-America, most areas in South-America, Australia and Japan are covered. It will be soon available in Africa, some regions in Mid-West and India.

Current coverage can always be checked at <https://www.starlink.com/map>

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This system is based on a constellation of thousands of low-orbit (around 550km) satellites, what allows for a very low delay (typically around 25ms) and consistent signal, as there may be more than 1 satellite at reach at a given time. The antenna has low cost and automatically orientates in order to provide easy installation. It consists on a motorized flat surface of around 30x50cm installed on a stand, and can reach up to 60cm height in some positions. Its weight is low, around 4kg.



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Billing is done in fixed periods and not based on data amount. It is a so-called flat-rate. The cost is very competitive, making it even suitable to provide internet coverage in country homes, caravans, etc.

The included router offers a WiFi hotspot, although an optional Ethernet adaptor is also available as an option. We strongly recommend getting it in order to provide wired connectivity to the audiocoders, voiding the need for additional converters or accessories.

The system is powered from mains, so in a portable installation, a small DC/AC inverter will be required.

The antenna is connected to the router and is powered by the same (included) wire, which is 22,85 meters long.

Services and tariffs

(NOTE: Tariffs are variable, it's always better to check the currently applicable ones)

Several service types are offered: <https://www.starlink.com/>

At the time this Application Note was written, in April 2023, these were the conditions offered in Spain:

There are individual and corporate services to choose from. Individuals enjoy considerably lower rates, while quality of service is more than enough for high-quality audio transmissions; but for this kind of service, invoices will be unavoidably issued to a physical person, and they cannot be billed to a Company.

Stationary Individual <https://www.starlink.com/>

Prices in Spain: Equipment 300 € (or a 15€/ month rental). Service: 70 €/month

Itinerant Individual <https://www.starlink.com/roam>

Prices in Spain: Equipment 300 € (or a 15€/ month rental). Continental Service: 100 €/month. Global service: 230 €/month. The service (and billing) may be suspended when it is not needed during some months, for instance.

There is a kit to operate on the roof of a moving vehicle, but at the time this Application Note was written, its price was still not available in the Spanish website.

Corporate: <https://www.starlink.com/business>

A higher-reliability service is guaranteed, what's not apparently required for the use we are describing here.

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218 €/month with a monthly traffic limit of 1 TB. Additional costs will apply for larger traffic volumes. There is an initial payment of 2850 € for the equipment set, which is a bit different to the one provided for Individual services.

2. Installation

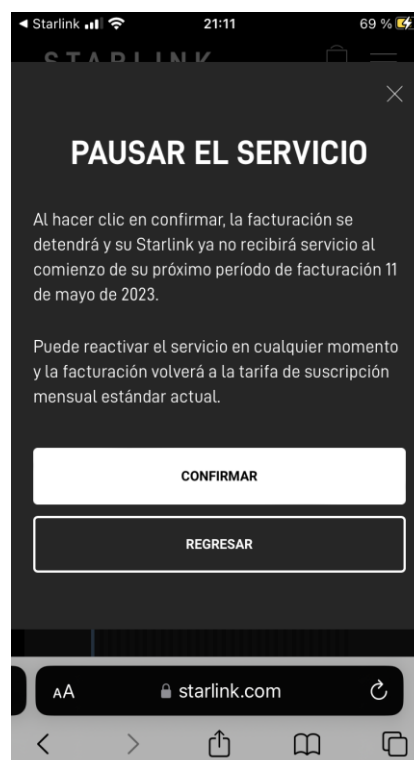
As expected, the first step is to hire the service in the starlink.com Website, where the system can also be ordered, once the most suitable fare has been chosen.

We have selected the Itinerant Individual Continental service for our tests, using a stationary antenna and adding the optional Ethernet adapter to simplify connection to the audiocodecs.

This itinerant service has two advantages for outdoors transmissions:

First, it can be used in different places.

Second, the contract billing can be paused during the seasons when it is not used.

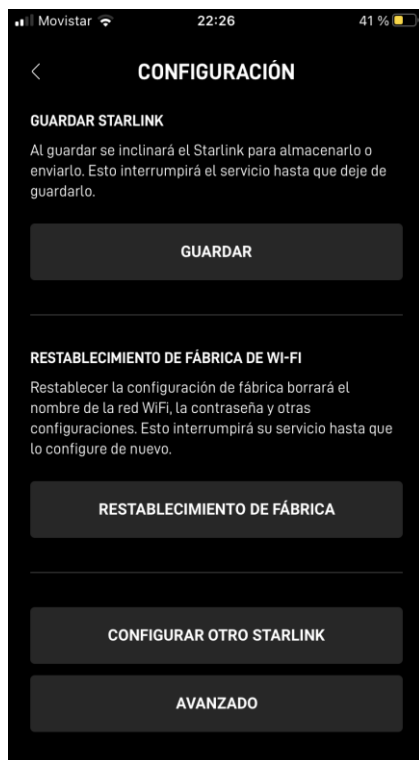


Un-packing and re-packing

When an itinerant use is going to be made, it is important to re-pack the system as it came from factory, without forgetting the previous step (folding the antenna to its vertical position on the mast), carefully rolling up the cable to place it on the packaging's lower compartment. Please observe the following images which describe the unpacking and re-packing processes:

First, using the App, find the STOW option and use it, so the antenna gets vertical. Then, release the mast by pressing on its tab. Place the antenna cable on the bottom, which has a central protrusion used to roll it up. Place the power supply cable on the deepest part and then, carefully wind the cable around the protrusion without twisting it, place above the router with its front pointing upwards, the antenna with its flat panel downwards (its cable end won't be disconnected), and finally the cross-looking stand on top.

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To finish, place the upper plastic packaging molding on top, fitting the mast and stand.

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Assembly



Once the kit is received, the only thing to be done is to assembly the antenna on its base (no tools are required) and place it in a location enjoying wide sky visibility in all directions.

Next, connect the antenna cable to the WiFi router, with the Ethernet adaptor in between to provide wired connectivity to our audiocoders. The router may be in an inner location, as the provided wire is quite long, although the whole kit is designed to withstand outdoors usage.

Feed the router by connecting the AC cord. A small white indicator at the bottom of the router (where all the cables are connected) will light up.

Assembly in partially covered places

Starlink needs to see most of the sky open above it. There is a quick coverage test available in the App which is performed by placing the mobile phone, with its camera open, looking to the sky and, in a few minutes, it will say if there is enough sky view in a particular place. Operation in the north hemisphere tends to require more opening to the North, while operation in the South hemisphere needs to have a clearer view to the South.

It may happen that the system seems to work without having full sky clearance, and then it loses coverage after a while. The definitive coverage test lasts 6 hours, the time that a satellite needs to pass by so the antenna roams to the next one as a result of their continuous movement around Earth.

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When the transmission of an event needs to be covered, you must react quickly. That's why we encourage users to carry a long power cord and a 50m or longer Ethernet wire (max. 90 meters) and, if the quick coverage tests doesn't report much clearance, place the antenna on a nearby roof or terrace which has open sky above and around it. The Starlink router needs to be configured up there through the WiFi it generates, but once it is working, nothing else needs to be done.

TALENT or ALIO audiocoders are connected by wire, but it may be still useful to provide WiFi to auxiliary devices such as a PC, Smartphones, etc. If the Starlink router is too far away, a standard domestic router can be installed on the other end of the Ethernet cable, providing a WiFi access point plus some more wired RJ45 ports.

Starting up and initial checks

Next step consists on downloading the free "Starlink" App for Android or iOS in our smartphone or Tablet, and follow the steps it will provide:

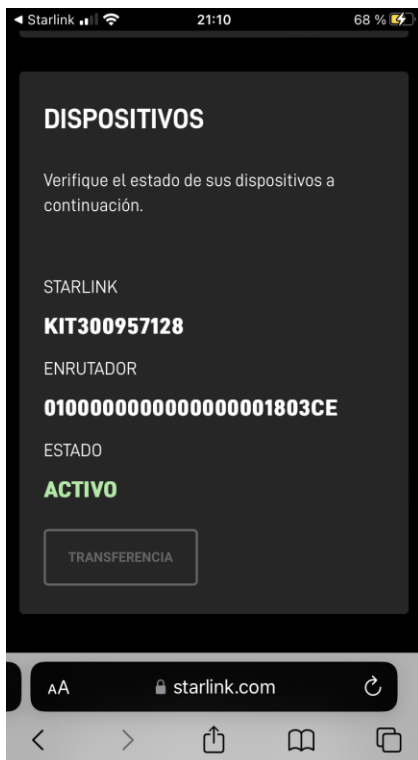
First, activate our smartphone's WiFi, then find and connect to the Starlink SSID network.

If this is the first installation, at some point a new SSID and password will be requested to change the name of the WiFi network created by the router to a different one. Enter a valid name (SSID) and a suitable password. Then look for this new network in the phone and switch the WiFi connection to it.

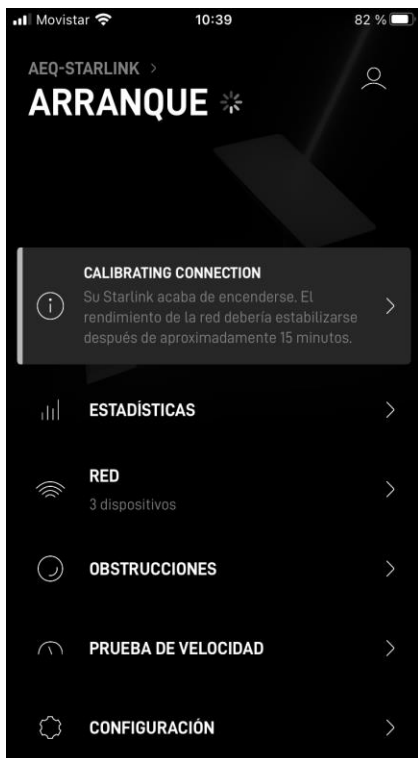
The application will always guide the user in the startup process. If the system is to be used by several people, have in mind that they must know the two passwords generated during the contract process and the first startup: the one for the Starlink account and that of the WiFi generated by the router. The App cannot be used without the second one, so it won't be even possible to correctly open or close the system.

The following screens are self-explanatory:

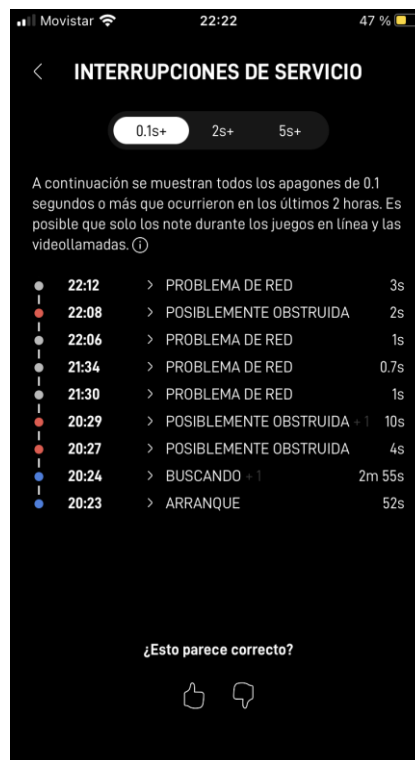
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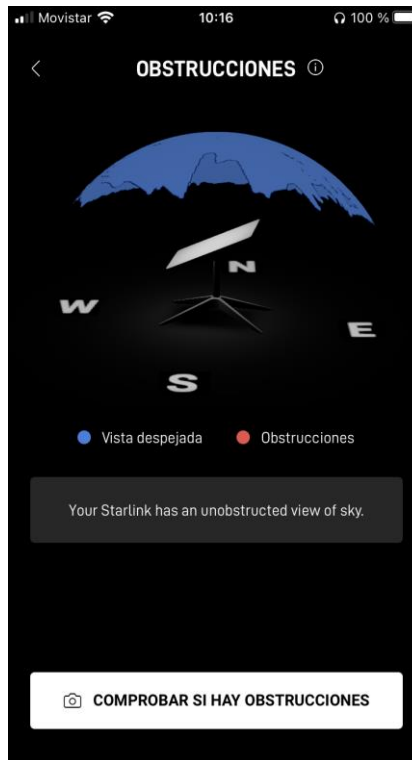
Starlink needs around 15 minutes to explore the sky, orient and adjust itself. During that time, operation may be erratic and show cuts, failures and errors. We don't recommend to try and start the audiocodex service during this time; wait until you have checked that everything is ok with the App.



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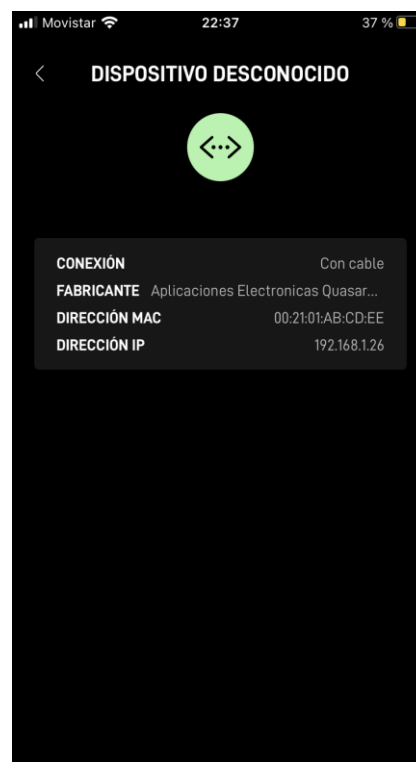


Coverage needs up to 6 hours to be fully checked, as the system needs to test every position with respect to the satellites during their continuous movement.



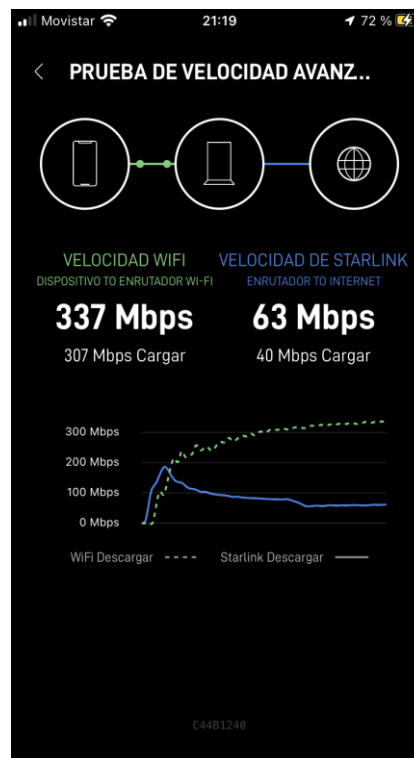
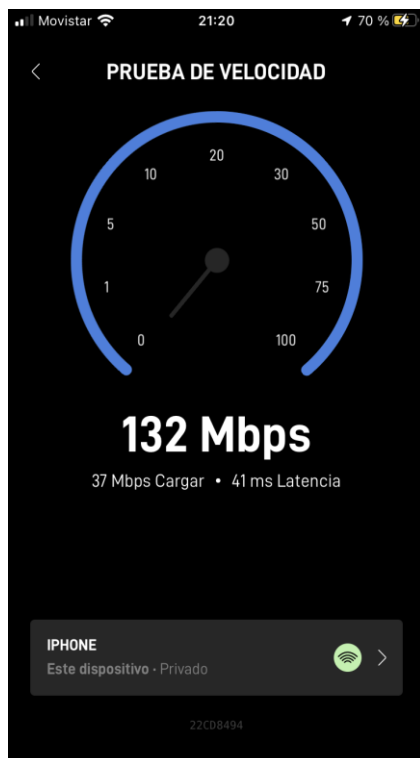
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In this case, an unknown device named “Aplicaciones Electrónicas Quasar SA (AEQ)” corresponds to our TALENT audiocodec. Detailed data can be seen here:

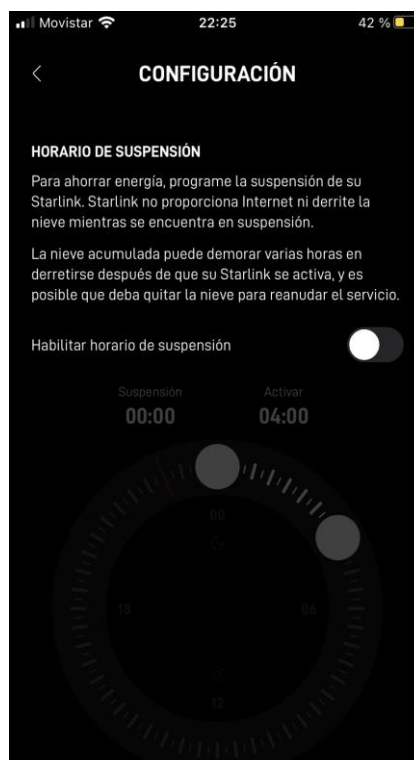
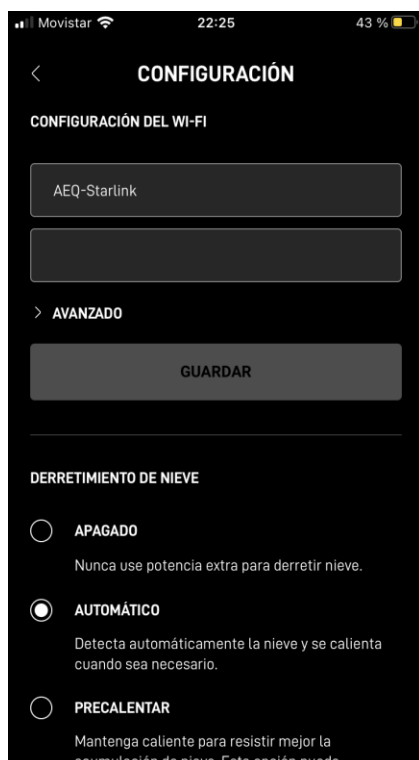


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WiFi and obtained satellite connection speeds can be checked for WiFi-connected devices.



There are other less relevant configuration options available in the App:



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Connecting the audiocodecs

The chosen audiocodec (for instance, Talent or Alio) needs to be connected to the Starlink Ethernet adaptor by means of an Ethernet cable plugged into their RJ45 port.

It must be configured to automatically obtain IP configuration (DHCP ON). In the case of ALIO, this can be selected from the front panel in MENU → ETHERNET → DHCP (on). (This requires the unit to reboot). In the case of Talent, this can be configured using the Talent PILOT App -freely downloadable for Android or iOS- , which needs Bluetooth activation to connect to the codec. (please check AEQ Talent User's Manual in order to obtain more details)



AEQ Talent PILOT App icon. It can be downloaded at no cost from Play Store or Apple Store.

Power supply

In order to feed the audiocodec, as AC mains will be required anyway to power the Starlink system, the most reasonable option is to use the supplied AC adaptor. If AC is not available at a regular socket, a power inverter will be required.

If this is the case, as may happen in portable applications, we always recommend selecting a pure-sinewave model.

Also, an independent power-bank may be used to power the codec (the only required connection for TALENT would be a USB-A to micro-USB wire connected to the rear USB port), as TALENT can operate from 5V.

In the case of ALIO, a 12VDC supply is required, so a proper Power Bank offering this voltage (1.5A minimum) must be used, or, alternatively you can connect a 5V to 12V booster to an available 3A USB port in a regular power bank (see AN6 for more details).

However, there are complete good quality solutions with integrated high-capacity battery and sine-wave inverter for Starlink, also providing USB and 12V outputs to power Talent or Alio for a long time:

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This is just an example:



<https://www.bluettipower.eu/products/bluetti-eb55-power-station>

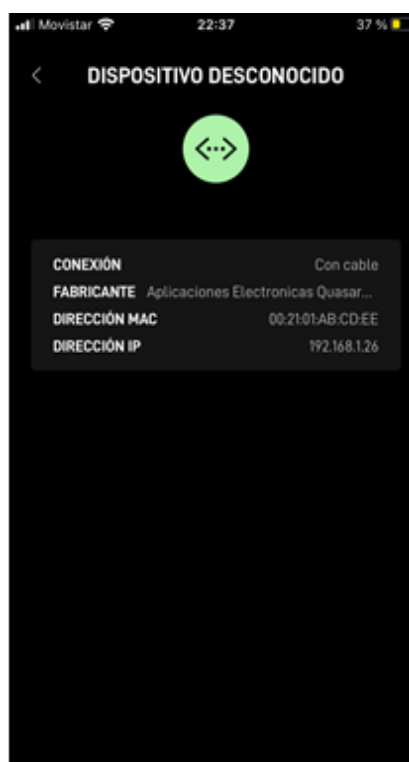
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3. Connectivity

Once Starlink coverage is available (we can check on the phone App, that we can use as a connection monitor), the status should indicate “ON LINE”.

We can perform a speed test to check that we have at least several tens of Mb/s. (Anyway, by no means we will require more than 1Mbps or so for a high-quality connection between two codecs).

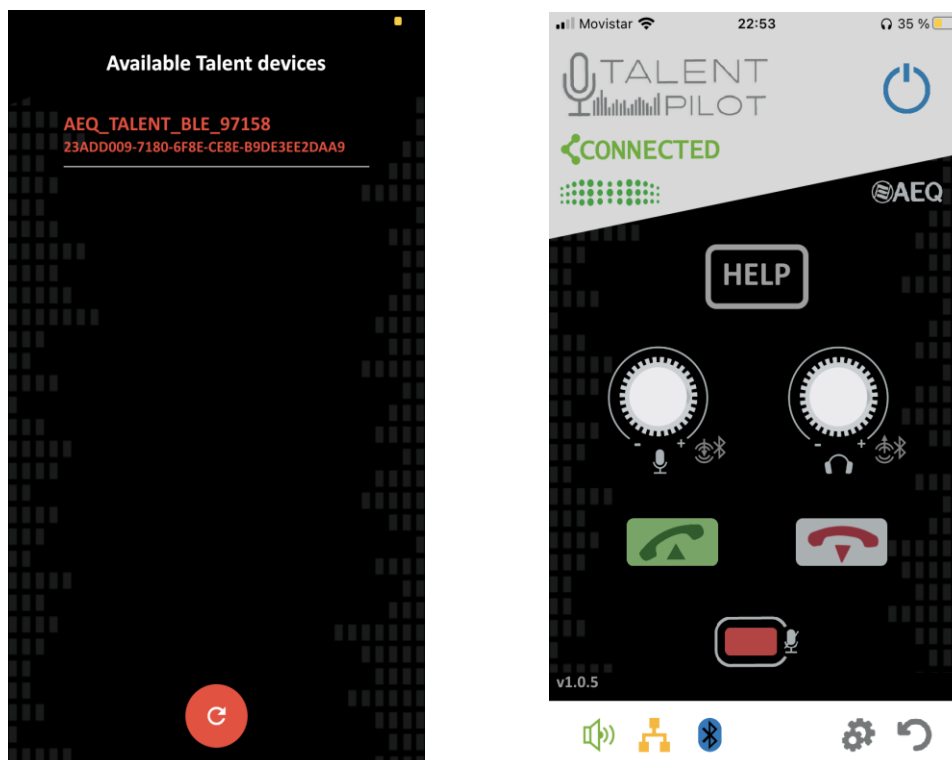
Two devices must appear in the NETWORK section of the App: one is the phone itself while the other one will be displayed as “unknown device”, “Aplicaciones Electrónicas Quasar (AEQ)”, with a green icon indicating that Ethernet connection is available. The assigned IP and device’s MAC addresses can be checked by touching that icon. Note that, in the example below, we also had another Phone and a PC connected to the Starlink router via WiFi:



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Making a call

In order to check the connection, a first call can be made to AEQ test codec. The correct procedure to make a call varies as a function of the selected codec model. With Talent, this can be done using Talent PILOT control App:



The leftmost screen shows how Talent devices within the phone's BT range are detected. When we touch one of the names, a control link will be established and the device's main screen will appear (right picture)

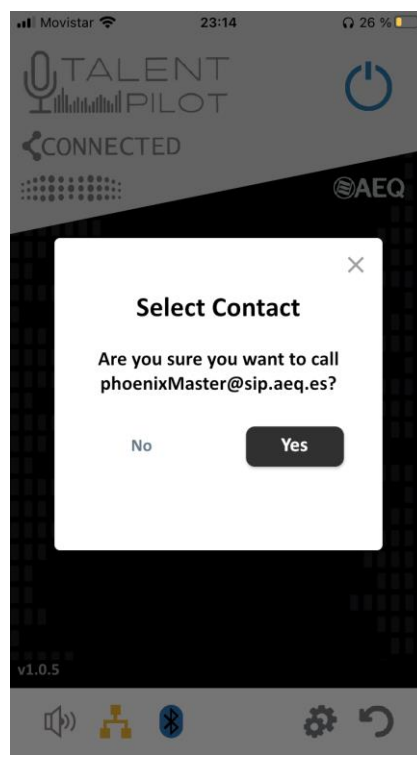
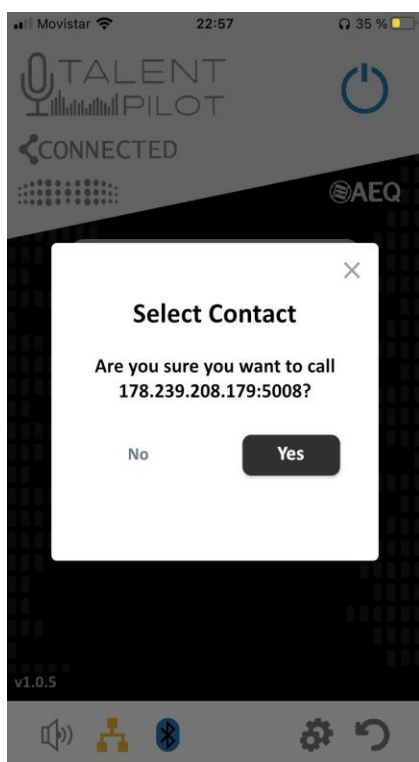
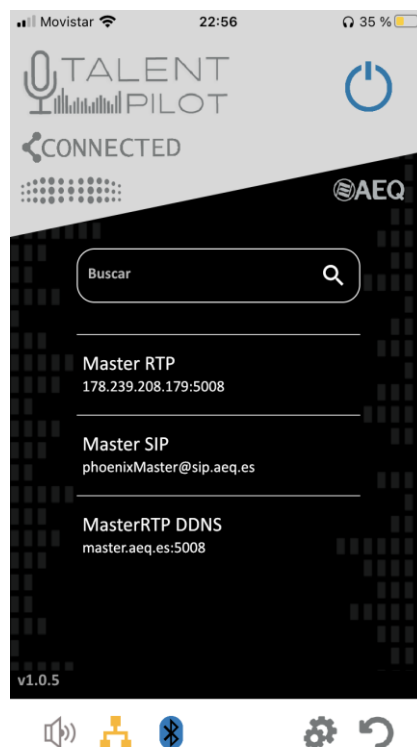
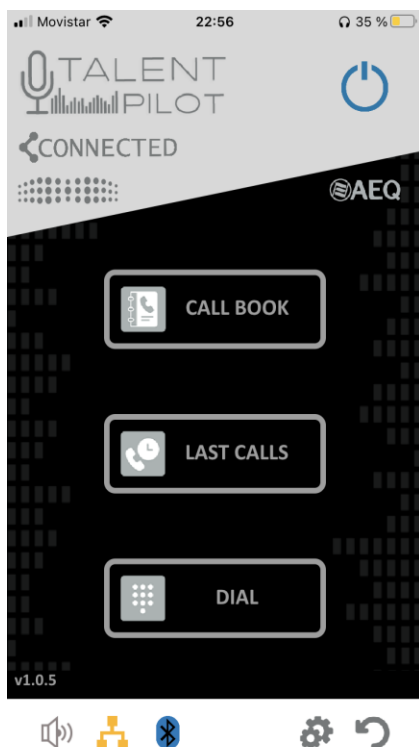
A call can be sent in two ways:

- In RTP mode (make sure that SmartRTP option is active), the user must call this IP and port: **178.239.208.179:5008**
- In SIP mode, it is first required to register our codec in AEQ's free **sip.aeq.es** server using the credentials (user and password) supplied and configured from factory in all AEQ audiocoders. Once registration is complete, call the following URI: **phoenixMaster**.

In general, in order to send a call, just touch the green button and you will be able to select how to choose the destination: from the CALL BOOK, a list of LAST CALLS, or directly dialing

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the required destination's IP and port (RTP) / URI (SIP) (DIAL). When an option is selected or dialed, confirmation will be requested to actually send the call.



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In the case of ALIO, however, we can use the front panel's menus and keys.

In any case, we recommend to read the relevant codec's User Manual.

If the call has been correctly established, we should receive some music compressed with the coding algorithm we have selected from the calling end.

Once connectivity has been checked and its quality and stability are assessed, we can make a call to our remote studio codec but, first, the required mode must be selected. If we know its public IP and port, we can directly work in RTP mode, by activating the SmartRTP option in both ends, dialing the destination's IP: port using our preferred audio encoding algorithm.

Alternatively, we can also register on a common SIP server (for example, the already mentioned free AEQ sip.aeq.es, server, where all codecs sold by AEQ are registered by default). Once both ends are registered, we can make calls between them exactly in the same way we have described above.

Remotely controlling the audiocodec

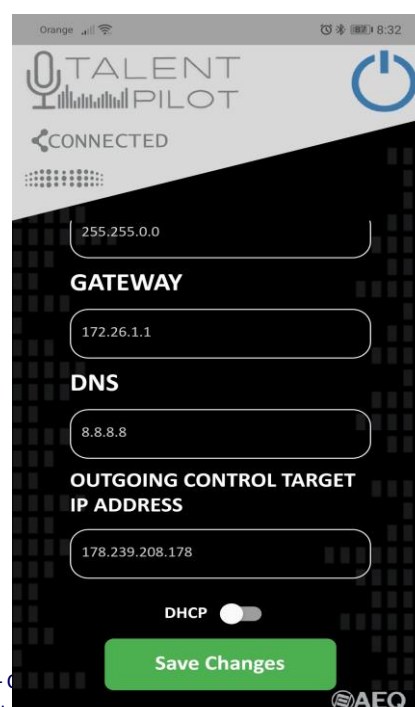
In order to LOCALLY control the audiocodec, we have several options:

- AEQ TALENT: apart from the limited set of physical controls it has, by means of Talent PILOT App, we can access via Bluetooth to most of the device's configuration options, select mode (SIP / RTP), audio encoding algorithm or profile and even make calls (dialing or using a pre-loaded call book or the list of last calls).
- AEQ ALIO: Control can be performed locally at a similar level using the device front panel controls and menus.

In both cases, we can alternatively connect a PC with controlPhoenix to the same network (we can use Starlink's WiFi or an external Ethernet Switch for that if we prefer a wired connection).

But it is also possible to remotely control the satellite-end codec from the studio through the Internet, by activating the Outgoing Connection mode:

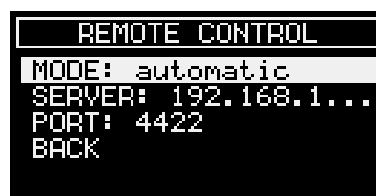
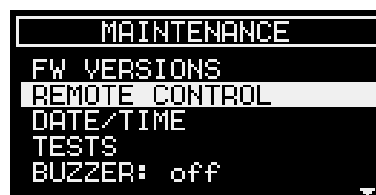
- AEQ TALENT: Using Talent PILOT App, go to the IP configuration menu and scroll down to its bottom area. We need to fill-in the



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studio's public IP in the "Outgoing Control Target IP Address" field. Just carefully type a valid IP address (and confirm with the Save Changes button) and this mode will be activated.

AEQ ALIO: Press the MENU key and use the encoder to access MENU → MAINTENANCE → REMOTE CONTROL, where we can activate this mode (explicitly, by selecting MODE: automatic), and specify the studio public IP address (SERVER). Remember to keep the default PORT:4422 setting unaltered.



In the studio side, you just need to open the 4422 port (UDP + TCP) once to the IP address corresponding to the computer where controlPhoenix is installed, and once any AEQ codec outside has Internet connectivity, it will just pop-up in the control screen just as if it was a local codec.

All AEQ codecs that will be used outside at some moment should have this same Outgoing Connection setting activated in order to be controlled from the same PC when required.

NOTE: due to some Starlink router limitations, it won't be possible to remotely see vu-meter or connections statistics for the remotely connected codecs using Outgoing Connection, nor accessing their Web management server.

Encoding Algorithms

AEQ usually recommends the OPUS family of audiocoders due to their low delay and great audio quality while still using a reduced data bandwidth.

In this case, however, the extraordinary speed offered by the Starlink system makes us think that, if no other massive data connections will be used simultaneously (such as radio or tv monitoring, navigation, etc.), PCM linear uncompressed audio can be tested thus reducing delay and creating a truly transparent audio connection. (In this case, we recommend selecting the PCM 16 1536kbps 48kHz stereo mode).



4. Conclusions

Starlink offers an additional connectivity solution to outdoors broadcastings, which is very convenient even when we have terrestrial 3G or 4G coverage, as saturation in these networks -which is common in events with a lot of public- can be a problem.

Also, for transmission in remote locations, its low equipment and operation costs greatly outperform Inmarsat in regions where Starlink coverage is already available, even when the system is comparatively a bit bulkier (4,2 Kg, 60x30x30 cm).

Have in mind that the large system's capacity and the low bitrate required by AEQ audiocoders allow for enough margin to enjoy additional services such as Internet browsing, voice or video-conferencing, audio streaming or file downloads without expected audio cuts or quality degradations.

The Itinerant Individual service we have used for our tests provided the desired results: quality and reliability. The possibility of temporarily suspending the service (and billing) in monthly periods is also very attractive for an evaluation kit.

Due to Starlink policy, if Company billing is required, you must necessarily hire the corporate service, even if its additional performance improvements are apparently not required in our case.

The Itinerant antenna for moving vehicles, installable on the roof of a car, for example, is also more economical and easier to install and use than Inmarsat alternative (or other satellite services).

For all these reasons, we strongly encourage all AEQ codec users to test and explore the possibilities of this system as a function of their broadcasting requirements.