



# **IRIS for Android User Guide**

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## Revision Sheet

Release No.	Date	Revision Description
Rev. 0	11/01/2020	Pre-Release
Rev. 0.1	11/07/2020	Pre-Release, updated Section 3 to include Chat Screen
Rev. 0.2	7/12/2021	Updated to reflect new features nearing final release



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## A. OVERVIEW

### 1.1 Purpose

Iris is capable of sending and receiving short text messages and GPS information over short, point to point handheld radio links. Received GPS data is automatically displayed in OsmAnd (an offline map application).

Data is sent to and from the radio using an android phone's audio jack. Handheld UHF/VHF FM radios designed for voice conversations transmit digital data as audio tones. The achievable data rate over aradio voice channel is low but is still useful for transmitting short messages. Figure 1 below shows all the hardware needed for two users to communicate using Iris. See Section B for a more detailed hardware list.

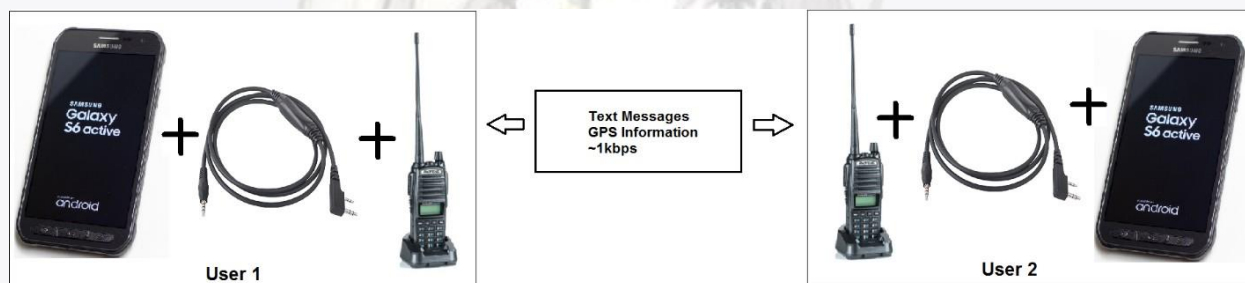
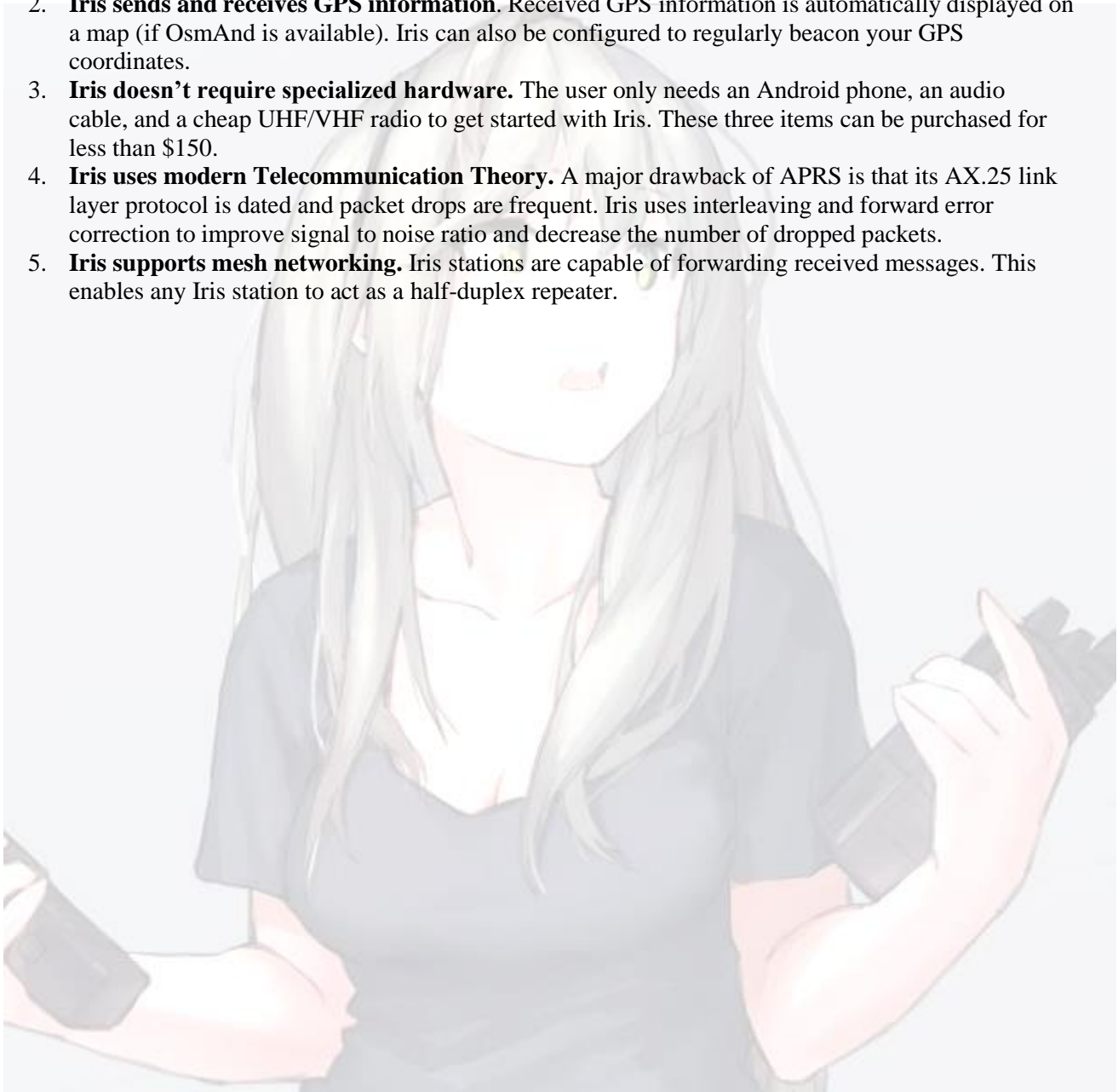


Figure 1

## 1.2 Why Iris?

There are plenty of other HAM radio protocols that also use sound cards to achieve data over voice such as Fldigi, APRS, or IL2P. These are all good protocols but Iris is unique in that it achieves all of the following objectives:

1. **Iris is simple to use.** Once the user has the radio and app configured, it will not require the user's full attention to operate. The goal of Iris is to be "fire and forget"
2. **Iris sends and receives GPS information.** Received GPS information is automatically displayed on a map (if OsmAnd is available). Iris can also be configured to regularly beacon your GPS coordinates.
3. **Iris doesn't require specialized hardware.** The user only needs an Android phone, an audio cable, and a cheap UHF/VHF radio to get started with Iris. These three items can be purchased for less than \$150.
4. **Iris uses modern Telecommunication Theory.** A major drawback of APRS is that its AX.25 link layer protocol is dated and packet drops are frequent. Iris uses interleaving and forward error correction to improve signal to noise ratio and decrease the number of dropped packets.
5. **Iris supports mesh networking.** Iris stations are capable of forwarding received messages. This enables any Iris station to act as a half-duplex repeater.



## B. SOFTWARE INSTALLATION AND HARDWARE CONFIGURATION

### 2.1 Required Hardware

In general only three pieces of hardware are needed: an Android phone, a VHF/UHF FM radio, and a compatible audio cable to connect the radio and phone.

Most testing and development were done using LGG6's and Samsung Galaxy S6's with various different versions of Android OS. If your android phone is newer than a Samsung Galaxy S6, then Iris will likely work on your phone. Keep in mind that if the phone you are using does not have a working GPS receiver, GPS beaconing will not work.

Iris was developed using Baofeng UV-82hp radios and APRS-K2 audio cables:

- <https://baofengtech.com/uv-82hp>
- <https://baofengtech.com/aprs-k2-trrs-cable>

In theory, Iris should work with any radio and cable that can be connected to a smart phone.

### 2.2 Required Software

The Iris installer will is named something like “iris-0.97-armeabi-v7a-debug.apk”. When installing Iris it will ask for permission to access your location, record audio, and read/write to memory. Iris requires all of these permissions to function properly. **After installing Iris and granting the required permissions, it may need to be restarted after installation for the changes to take effect.**

You will need to install the free version of *OsmAnd* if you want to see GPS contacts on a map. Do NOT install OsmAnd+ (the paid version). It won't work with Iris since from the point of Android OS, OsmAnd and OsmAnd+ are seen as two different applications.

Another application that is not required but is recommended is *GPS Status & Toolbox*. This free application can be used to verify that the GPS receiver is working on your phone.

### 2.3 Configuring the Radio

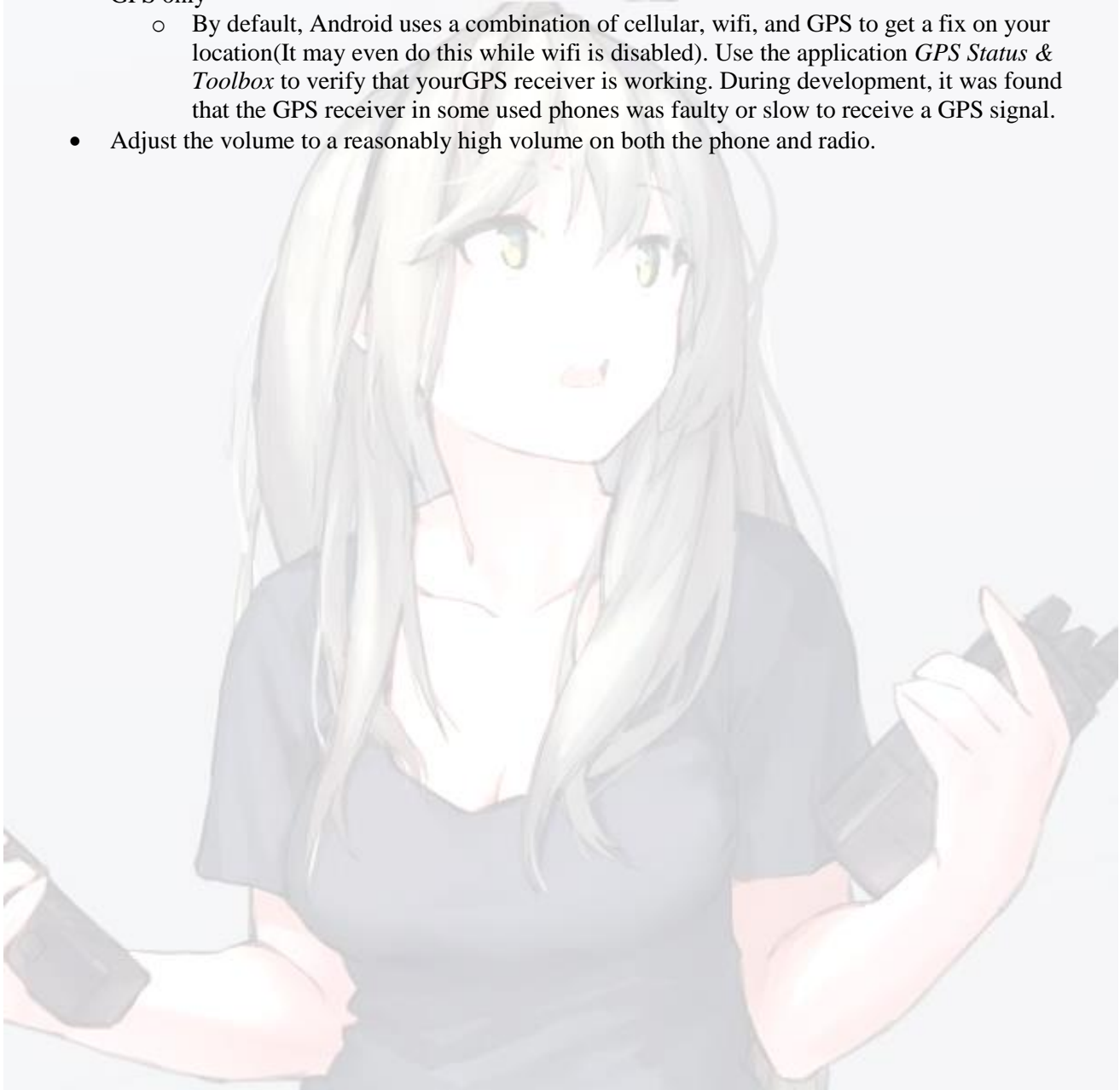
In general your radio needs the following settings:

- The Squelch needs to be on a lower setting but not off.
  - On the Baofeng UV-82hp: **SQL=1**
- VOX needs to be enabled. This enables your radio to transmit without having to push the PTT button.
  - On the Baofeng UV-82hp: **VOX=1**
- If you don't have a HAM radio license, set the transmit power to its lowest setting.
  - On the Baofeng UV-82hp: **TXP=LOW**
- If you don't have a HAM radio license, select an FRS Frequency to use. FRS frequencies are in the range **462 to 467MHz**.
- If you do have a HAM radio license and want to use higher power on different frequencies, you are strongly advised to conform to your local band plan and use frequencies that are dedicated to experimental protocols. Also make sure your FCC issued call sign is entered into Iris before transmitting.

## 2.4 Configuring the Android Phone

In order for Iris to perform optimally, you will need to change a few of the settings on your phone.

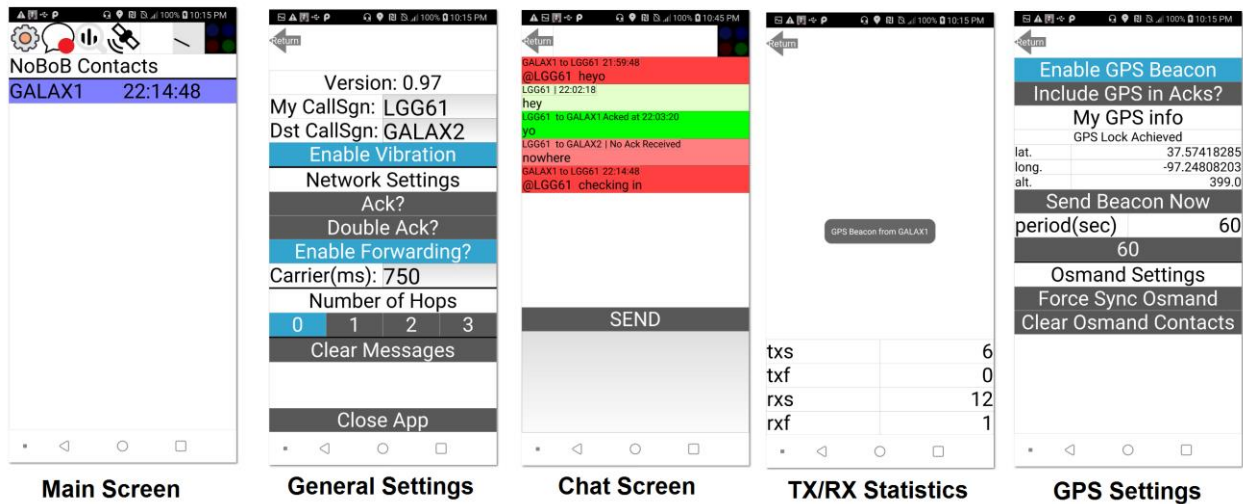
- Set your phone to vibrate
  - If you don't do this, and you receive a notification from another application, it will play a sound which will be sent to the radio and will interfere with other users.
- Find your location settings (Settings > Connections > Location) and set the locating method to use GPS only
  - By default, Android uses a combination of cellular, wifi, and GPS to get a fix on your location (It may even do this while wifi is disabled). Use the application *GPS Status & Toolbox* to verify that your GPS receiver is working. During development, it was found that the GPS receiver in some used phones was faulty or slow to receive a GPS signal.
- Adjust the volume to a reasonably high volume on both the phone and radio.





## C. UI OVERVIEW

Iris's UI is meant to be simple and minimalistic. The four screens in the app are shown in the Figure below.



### 3.1 Main Screen

When you receive a GPS or Text Message, the source call sign and time of reception will be displayed here.

A Status Indicator located on the top right. The Status Indicator will change colors to indicate state changes of the Iris Transceiver. The following colors are used:

- **Black:** No messages are presently being Transmitted or Received
- **Red:** A message is currently being transmitted
- **Blue:** A message is currently being received, but has not yet been decoded.
- **Green:** A message has been successfully received

### 3.2 Chat Screen

The Chat Screen is where you can send Text Messages and view received messages. Messages are color coded depending on whether they were sent directly to you or are requesting an acknowledgement

### 3.3 General Settings

General Settings contains the following settings.

- **My Callsign:** A 6 character, alphanumeric callsign. Messages sent by you will contain this callsign.
- **Dst Callsign:** A 6 character, alphanumeric callsign. Text Messages sent by you will contain this callsign. Whenever someone with this call sign receives one of your messages, it will be indicated that the message was addressed to them.
- **Enable Vibration:** Enable/Disable Vibration when messages are received
- **Ack? :** Request one acknowledgment from the destination callsign when sending text messages.
- **Double Ack?** Request two acknowledgements from the destination callsign when sending text messages
- **Enable Forwarding:** Automatically forward multi-hop messages that have one or more hop to go
- **Carrier(ms):** The length, in milliseconds, of the carrier signal to be appended to the front of



messages while transmitting.

- **Number of Hops:** Set to a value greater than zero to have your messages automatically forwarded by other Iris stations on air one or more times. This setting is critical when using digital repeaters.
- **Clear Messages:** Clear all received text messages from storage.
- **Close App:** Close Iris

### 3.4 TX/RX Statistics

This screen displays four counters keeping track of the number of successful/failed messages that were transmitted/received since the last application restart.

- **txs:** successful transmits
- **txf:** failed transmits
- **rxs:** successful receives
- **rxs:** failed receives

### 3.5 GPS Settings

This screen allows you to enable your GPS beacon and view received GPS Messages.

- **Enable GPS Beacon:** Enable your GPS beacon. When the beacon is enabled, your GPS coordinates will be transmitted at the rate specified on this screen.
- **Include GPS in Acks?:** Add your GPS information to acknowledgments so that other stations can query for your location
- **Send Beacon Now:** Press to manually send a GPS Beacon
- **Period(sec):** Adjust the period of your GPS beacon when its enabled
- **Force Sync Osmand:** Send all received GPS information to Osmand
- **Clear Osmand Contacts:** Clear all received GPS information from storage

## D. TESTING AND TROUBLESHOOTING

### 4.1 Testing Iris

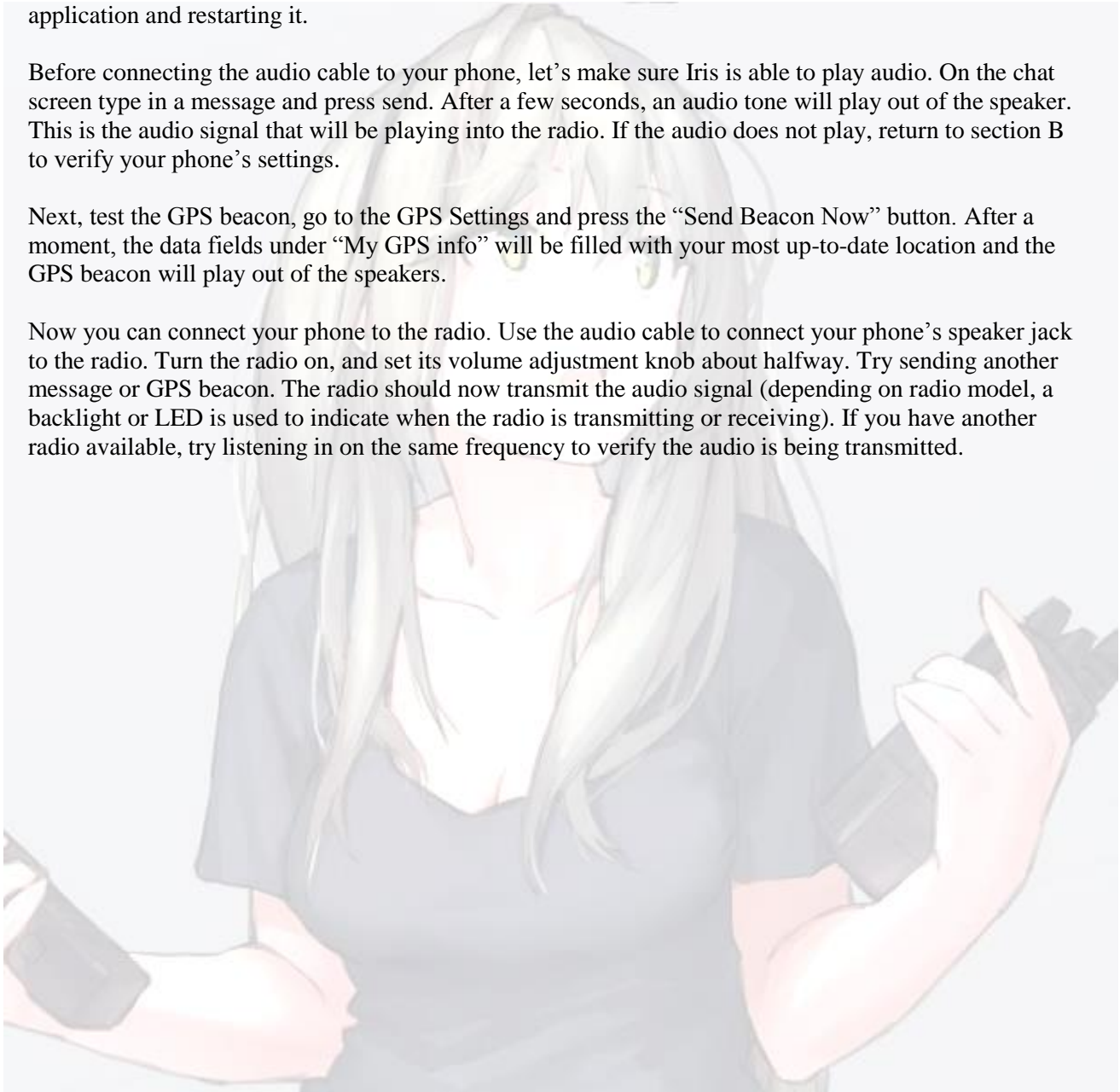
After installing and configuring the application, you should test it to make sure everything is in working order.

After a brief splash screen, the Application UI should display. If you get a black screen, try closing the application and restarting it.

Before connecting the audio cable to your phone, let's make sure Iris is able to play audio. On the chat screen type in a message and press send. After a few seconds, an audio tone will play out of the speaker. This is the audio signal that will be playing into the radio. If the audio does not play, return to section B to verify your phone's settings.

Next, test the GPS beacon, go to the GPS Settings and press the "Send Beacon Now" button. After a moment, the data fields under "My GPS info" will be filled with your most up-to-date location and the GPS beacon will play out of the speakers.

Now you can connect your phone to the radio. Use the audio cable to connect your phone's speaker jack to the radio. Turn the radio on, and set its volume adjustment knob about halfway. Try sending another message or GPS beacon. The radio should now transmit the audio signal (depending on radio model, a backlight or LED is used to indicate when the radio is transmitting or receiving). If you have another radio available, try listening in on the same frequency to verify the audio is being transmitted.



## 4.2 Receiving a Signal

To successfully receive a signal from the radio, it is critical to have the volume correct. If the radio's volume is too low, Iris will have trouble detecting the signal. If the volume is too high, the audio will be distorted and Iris will have difficulty decoding it.

It is recommended to first disconnect the radio from the audio cable and listen to incoming signals through the radio's speaker. After some experience, you will gain a sense of whether or not a signal is clean or distorted.

After listening to a signal and adjusting the volume as needed, plug the audio cable into the radio to see if the volume is correct for Iris. For the following scenarios, take the recommended action to adjust your radio volume.

<p><b>Scenario 1:</b> The radio indicates it is receiving a transmission but the status indicator in Iris does not turn blue.</p> <ul style="list-style-type: none"> <li>Action: The audio is too quiet for Iris. Increase the radio volume slightly and wait for another transmission.</li> </ul>
<p><b>Scenario 2:</b> The radio indicates it is receiving a transmission and the Iris status indicator briefly turns blue, but it never turns green.</p> <ul style="list-style-type: none"> <li>Action: The audio from the radio is too loud and distorted. Decrease the radio volume slightly and wait for another transmission.</li> </ul>
<p><b>Scenario 3:</b> The radio indicates it is receiving a transmission and the Iris status indicator turns blue, and then turns green.</p> <ul style="list-style-type: none"> <li>Congratulations! You have successfully received a transmission, check for new text messages or GPS messages in Iris. If you received a GPS message, go to OsmAnd to see if a Favorites Marker was placed to indicate the call sign, location, and time of the contact.</li> </ul>
<p><b>Scenario 4:</b> I have gone through Scenario 1 several times now and the status indicator never turns blue, it always stays black.</p> <ul style="list-style-type: none"> <li>Action: Your phone's audio settings may not be properly configured, or Iris is unable to record audio. Refer to Section B.</li> </ul>
<p><b>Scenario 5:</b> I have gone through Scenario 2 several times now and the status indicator briefly turns blue, but never turns green.</p> <ul style="list-style-type: none"> <li>Action: Iris is failing to decode the signal. This means the audio from the radio is distorted or something is amiss with the application. Try listening to the audio from the radio to determine if the signal is distorted and restart Iris.</li> </ul>

## E. Repeaters and Mesh Networking

Iris performs best at range when a stationary repeater is setup central to the area of operations. An example Iris network involving a repeater is shown in the figure below. In this scenario two mobile stations (GALAX1 and LGG6) are able to communicate via a repeater located at a high elevation point. (As an aside don't think your repeater has to be on a mountain to perform well, in our experience 20 feet above the ground has led to appreciable gains in effective range). In order to work best, each Iris station should have use the following settings.

### RPEAT1

- Disable Vibration
- Enable Forwarding
- Enable GPS Beacon (240 seconds)
- Include GPS in Acks
- Number of Hops: 0

### GALAX1 and LGG6

- Enable Vibration
- Enable Forwarding
- Enable GPS Beacon (60 seconds)
- Enable Acks
- Number of Hops: 1

In this configuration, the repeater station will send out an occasional GPS beacon and forward any multi-hop message it receives, while the mobile stations will beacon more often so that their positions are continually updated. Additionally, it is critical that their hops settings are set to 1 so that a message sent by one mobile station will work its way to the other via the repeater.

