Satellite Communications With Serenity

Lesson 1: Setting up a listening station on Raspberry Pi

In this lesson you will learn to use the Raspberry Pi computer to:

- Set up a basic satellite listening station.
- Use software to tune in a local radio station as a model of how to acquire radio transmissions from orbiting satellites.

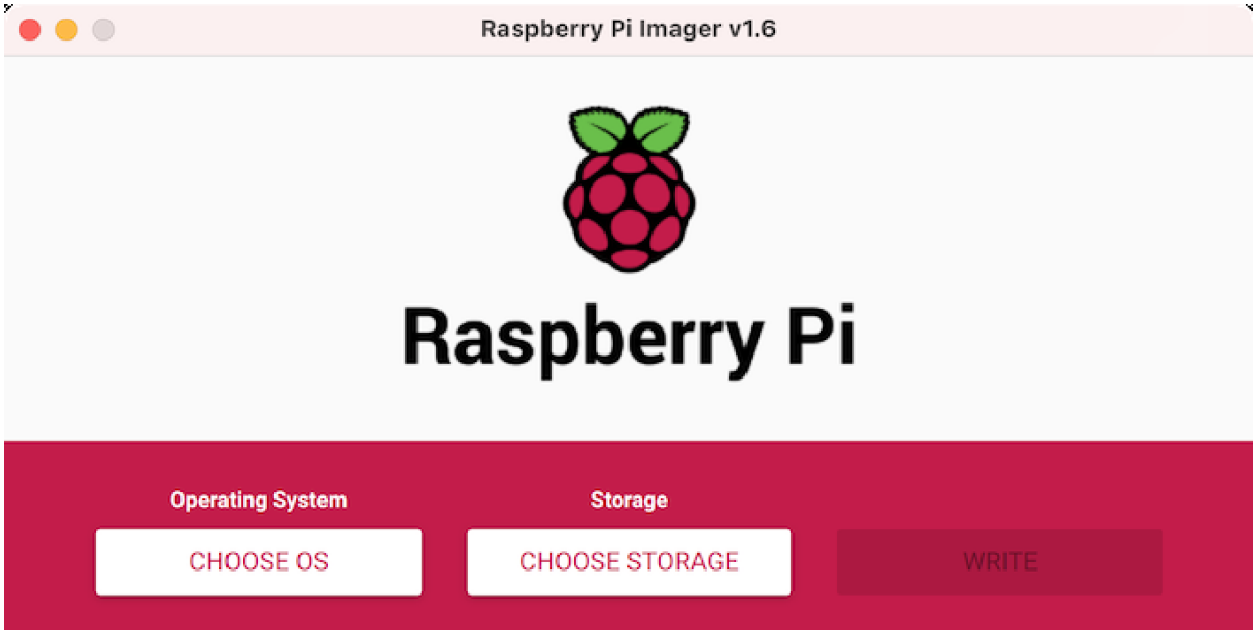
What you need

- Computer with Internet Access
- Raspberry Pi Radio System:
    - Raspberry Pi 3 or 4 single board computer (RPi)
    - Power supply for the RPi
    - 8 Gb Micro SD Card
    - Micro SD Card adapter
    - Software Defined Radio dongle with Antenna
        - NESDR
        - RTL-SDR
    - HDMI cable/Adapter (Depends on type of RPi you use)
    - Monitor/TV (capable of supplying sound through an HDMI connection)
    - Keyboard
    - Mouse
    - A pair of powered speakers to listen to the signal (optional)
- Software for Raspberry Pi system:
    - Raspberry Pi Imager
    - RadioPi Operating System Image

Assembly

Step One – Write the software to the SD card

- Download and install the Raspberry Pi Imager software to your computer.
- Download the RadioPi Image saving it to the Downloads folder on your computer.
- Start the RPi Imager. You should see a screen similar to this:



- Select "Choose OS"
- In that menu choose "Use Custom"
- Using the popup finder window, locate and select the RadioPi image in your Downloads folder
- Insert the 8Gb microSD card into an adapter and connect it to your computer using either a USB or SD Card interface.
- Click on 'Choose Storage' and select the card.
- Click on the 'Write' command. After a few minutes, you will have a card ready for use. Do not remove the card until the process is complete.

Step Two – Setup the RPi

- Insert the microSD card into the RPi
- Connect the keyboard, mouse, and HDMI cables to the RPi
- Connect the other end of the HDMI to the monitor/TV
- Plug the Software Defined Radio dongle into an open USB port on the RPi
- Attach the antenna to the Software Defined Radio dongle
- Connect the monitor/TV to power and turn it on
- Plug the power cord into the RPi and then into a power outlet
- The RPi should have a green blinking light
- After a few moments, you should be at the desktop for the RadioPi Operating System

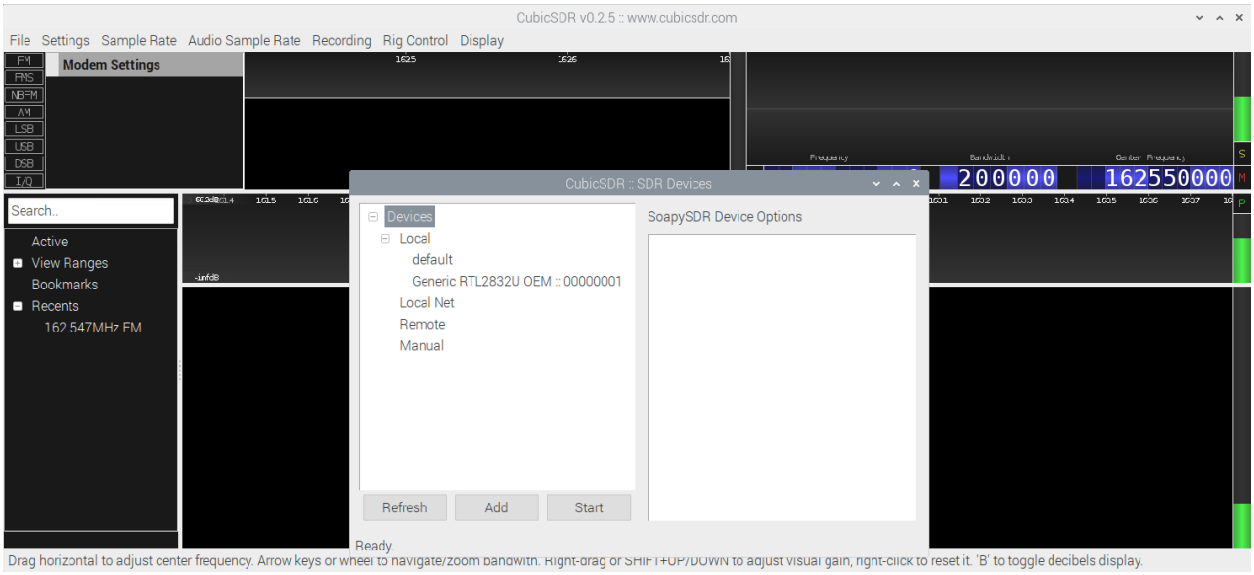
Step Three – Testing the System

The software we are going to use is CubicSDR. It is preloaded onto the RPi. This software gives you a visual look at the data you are receiving.

When you first start the software, it will ask you to set the port the SDR is on.

Select: Generic RTL2832U OEM :: 00000001then click the START button located toward the bottom of the screen.

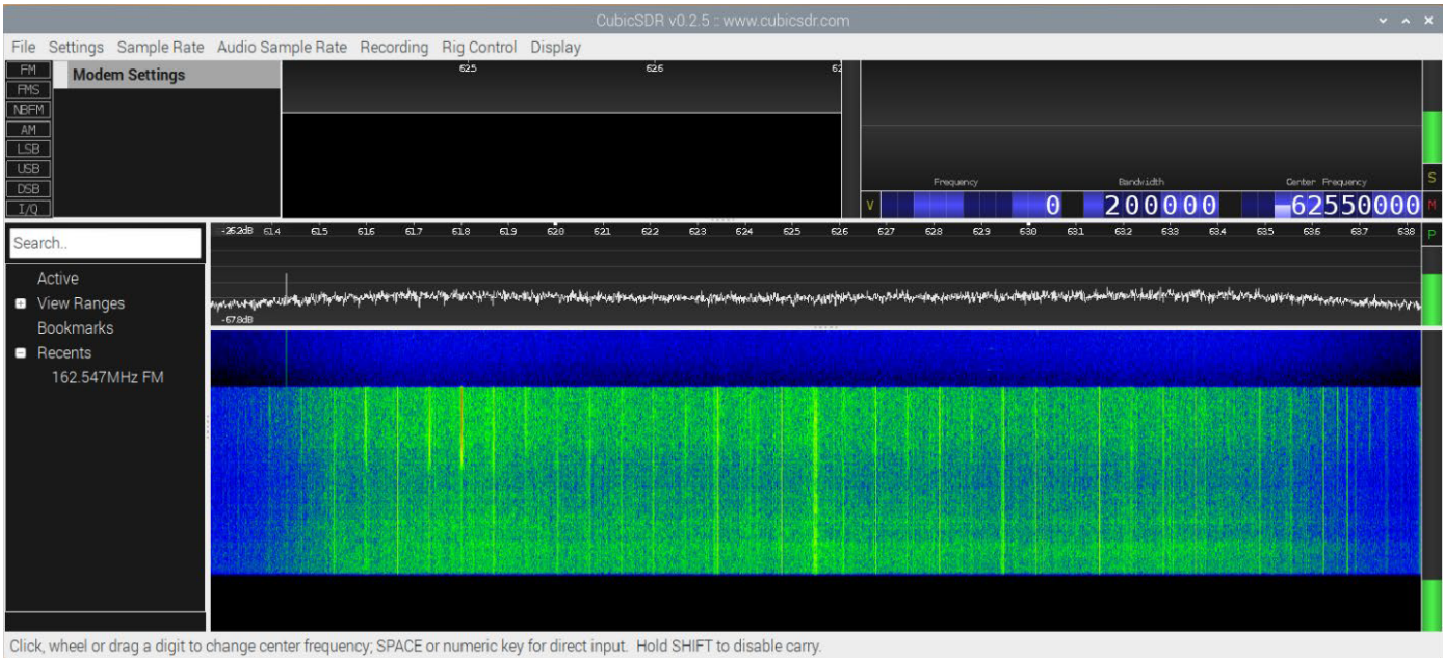
It should look something like the image below:



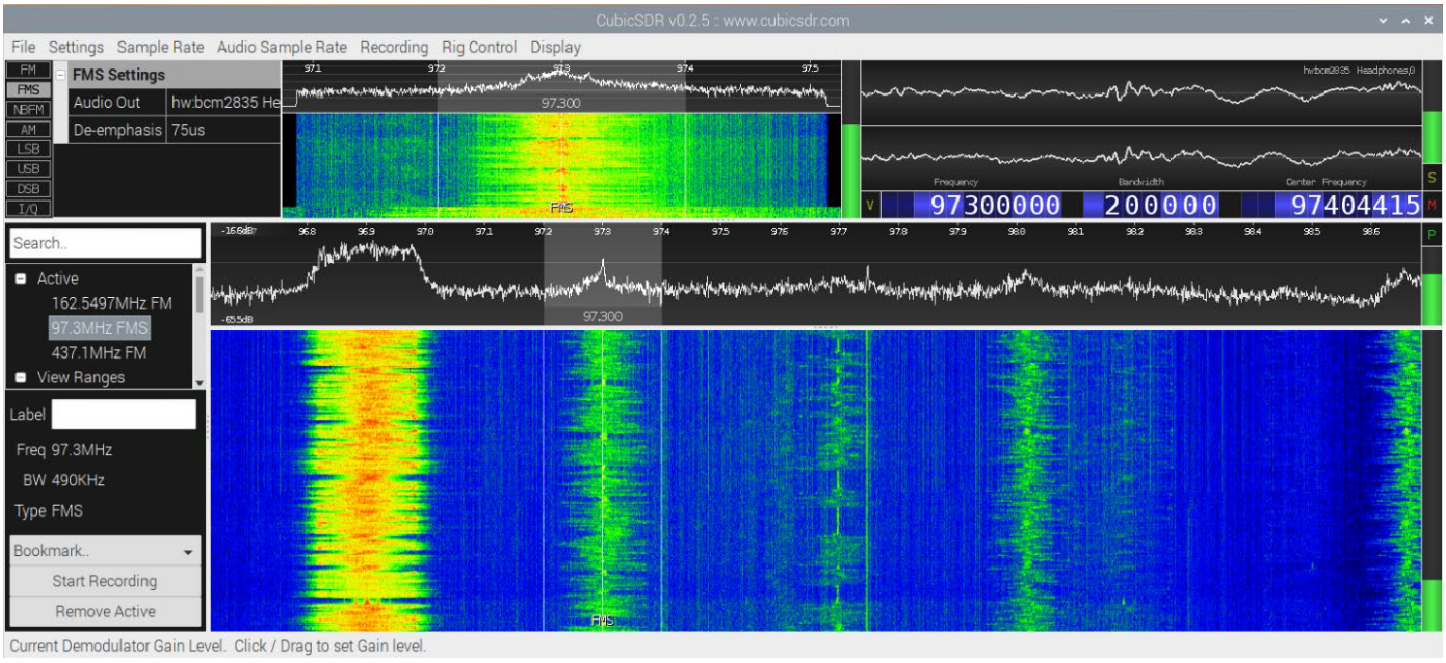
We are going to test the radio by looking for an FM radio station. You can select one that you like to listen to in your area. The radio station should have a frequency that they are on, for example 97.3. This translates to 97.300.00MHz, a specific radio frequency we can listen to.

When the software starts, you will see three important areas:

- **Bandwidth**
- **Frequency**
- **Waterfall**



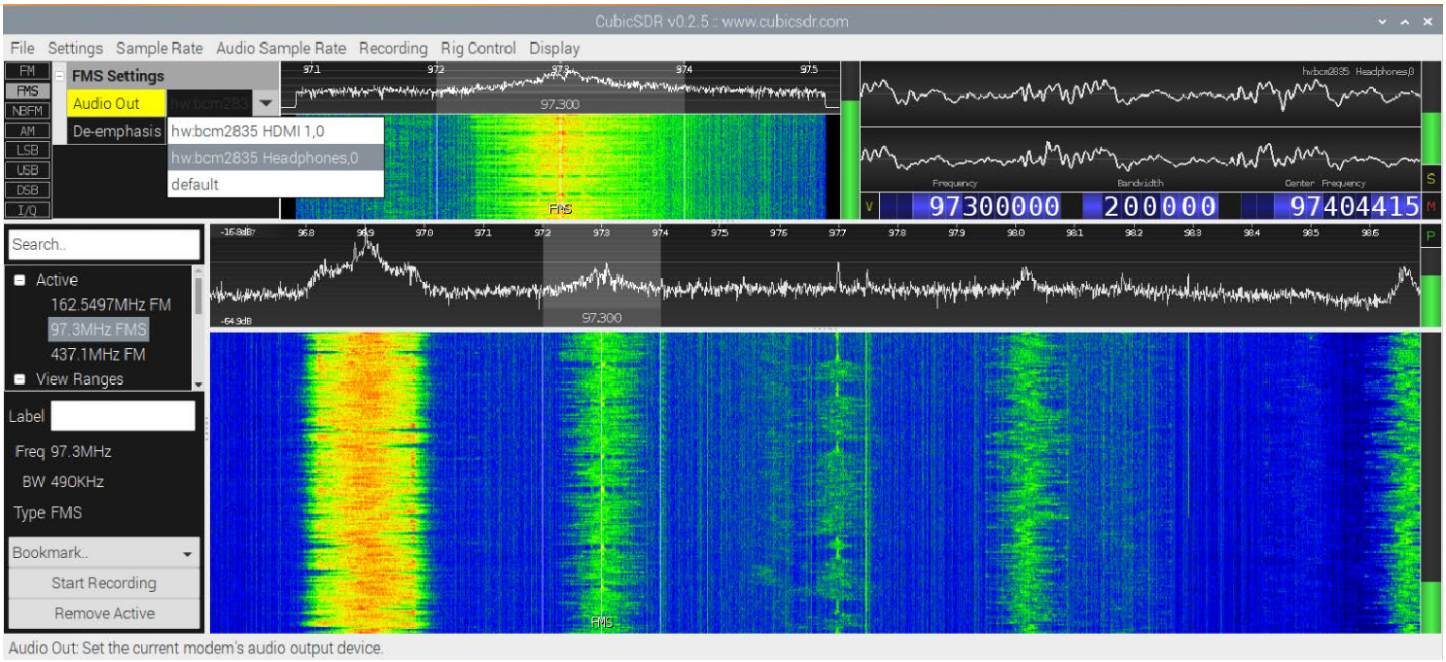
The frequency is on the upper right hand side. You can set this to a local radio station. In this example, we have set it to 97.300.000 with a bandwidth of 200.000. This relates to 97.3 on the radio dial. If you want to listen to 100.7, then you would set the numbers to 100.700.000. Once you set the frequency, the waterfall (center bottom) and the bandwidth view (upper left) should show you a bright orange and red stream of data.



Adjusting the frequency
Adjust the frequency numbers by clicking on the digits. If you click on the top portion of the number, it will go up. Likewise, you lower the number by clicking on the bottom. You may need to set the bandwidth as well. Keep it to 200.000Hz or whatever is just outside the bright yellow areas of the waterfall.

You may need to set a parameter called de-emphasis. This is located on the upper left, just below the audio. Set this to 75us to clean up the sound.

Listen to the audio using the speakers
To listen to the audio stream, you must set the correct audio device. In the upper left select Audio. You will see a dropdown with different items. Select HDMI 1 or HDMI 2.



Congratulations, you now have a working system! Enjoy listening to your radio stations.