Homework 1

In the lab we learned how to use GNU Radio to capture signals with the HackRF and display them with GUI sinks. For the homework assignment you will use this knowledge to create a spectrum analyser using the HackRF.

Spectrum analyser construction:
- The spectrum analyser should show the waterfall plot (GUI Waterfall Sink) of the current section of the radio spectrum being viewed. The frequencies in view should be displayed on the Frequency axis (x-axis). **[0.25 pts]**
- A frequency plot (GUI Frequency Sink) should also be added to the spectrum analyser. As with the waterfall plot, the current frequencies being viewed should be displayed on the x-axis. **[0.25 pts]**
- The HackRF should be used as the input source for capturing frequencies. **[0.25 pts]**
- As the HackRF has a range of 1 MHz to 6 GHz, there should be a sliding bar which allows the user to scroll this frequency range (GUI Range). **[0.5 pts]**
- At times however, a user may want to inspect a particular section of the radio spectrum without having to scroll. Therefore, predefined ranges should be an option as well. 4 predefined radio frequency allocations (your choice) should be added using a GUI chooser. The center frequency can be any point in that frequency range. **[0.5 pts]**
  Example ranges:
  - FM Radio: 88MHz to 108MHz (example center frequency: 98MHz, 90MHz, 104MHz)
  - WiFi: ~2400MHz to ~2485MHz, ~5180MHz to ~5320MHz, ~5500MHz to ~5835MHz
  - ISM: 433MHz, 868 MHz, 2400MHz
  - GPS: 1575MHz, 1227MHz
  - Mobile Networks: 790MHz to 821MHz, 925MHz to 960MHz, 1805MHz to 1880….
- A GUI range (or some other GUI tool – there are more options in GNU Radio 3.10) should also be used to allow a user to switch between scrolling and the predefined radio frequencies **[0.25 pts]**

***Additional adjustments to graph***:
- In the options block
  - Add a title to the GNU script e.g. Spectrum Analyser/Analyzer
  - Add your name in the Author section
  - Set the id parameter e.g. spectrum_analyser. (*Remember - no spaces allowed)*
  - Optional: add a description to the file
- A sampling rate of 2M, 5M or 10M can be used. This depends on the limitations of your computer. Use whichever sampling rate works with your computer. Please note, however, that the sampling rate **does not** have to change as the frequency changes, only one constant sampling rate is fine.

Hints:
- The frequency specified *(Ch0: Frequency)* in the HackRF block will be the center frequency of your graph. With a sampling rate of 5M and a center frequency of 2.4G (2400 MHz), the frequency range that will be seen is 2.3975G to 2.4025G (2397.5 MHz to 2402.5 MHz). Therefore to observe 6 GHz maximum or 1MHz minimum, remember to choose your maximum range value based on your sampling rate.
- The center frequency for GUI sinks, as well as the frequency for input sources, can be set with one line if statements in Python e.g. a if something is True else b

- The GUI Hint field (https://wiki.gnuradio.org/index.php/GUI_Hint) can be used to position components on the graph if needed (if you position one component then you'll need to position all of them).

Sample output:
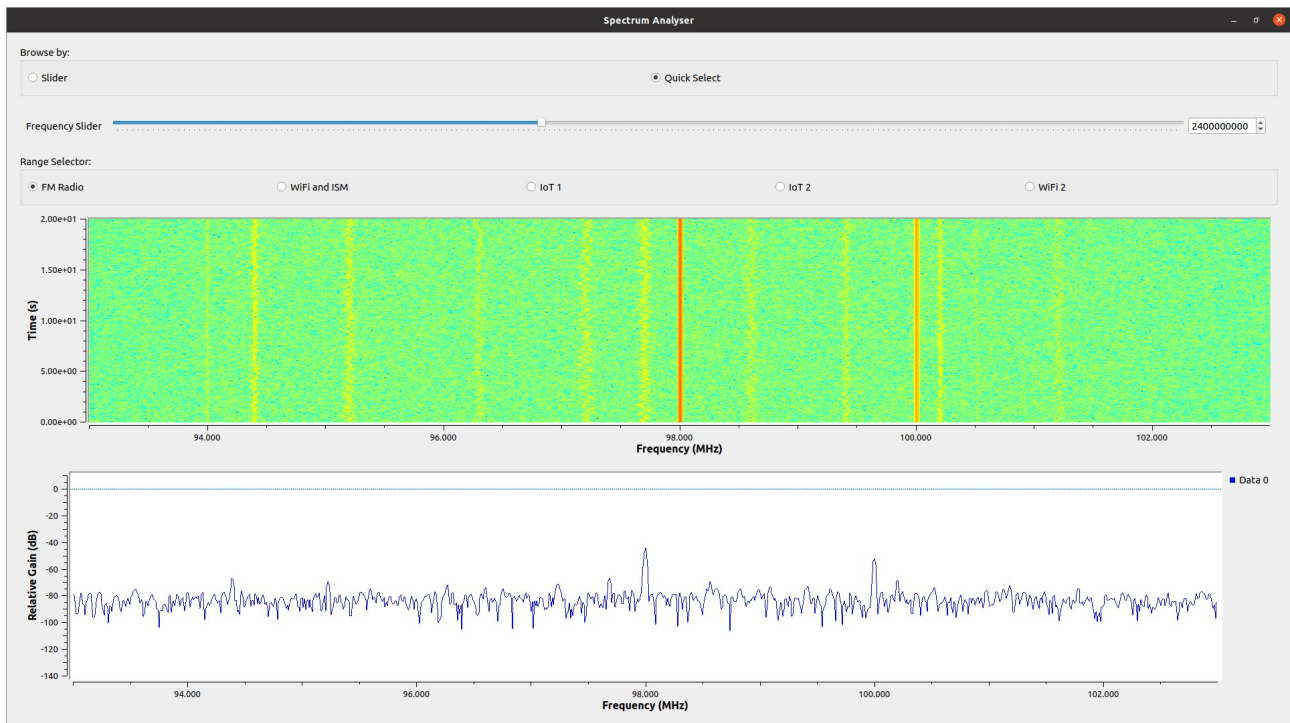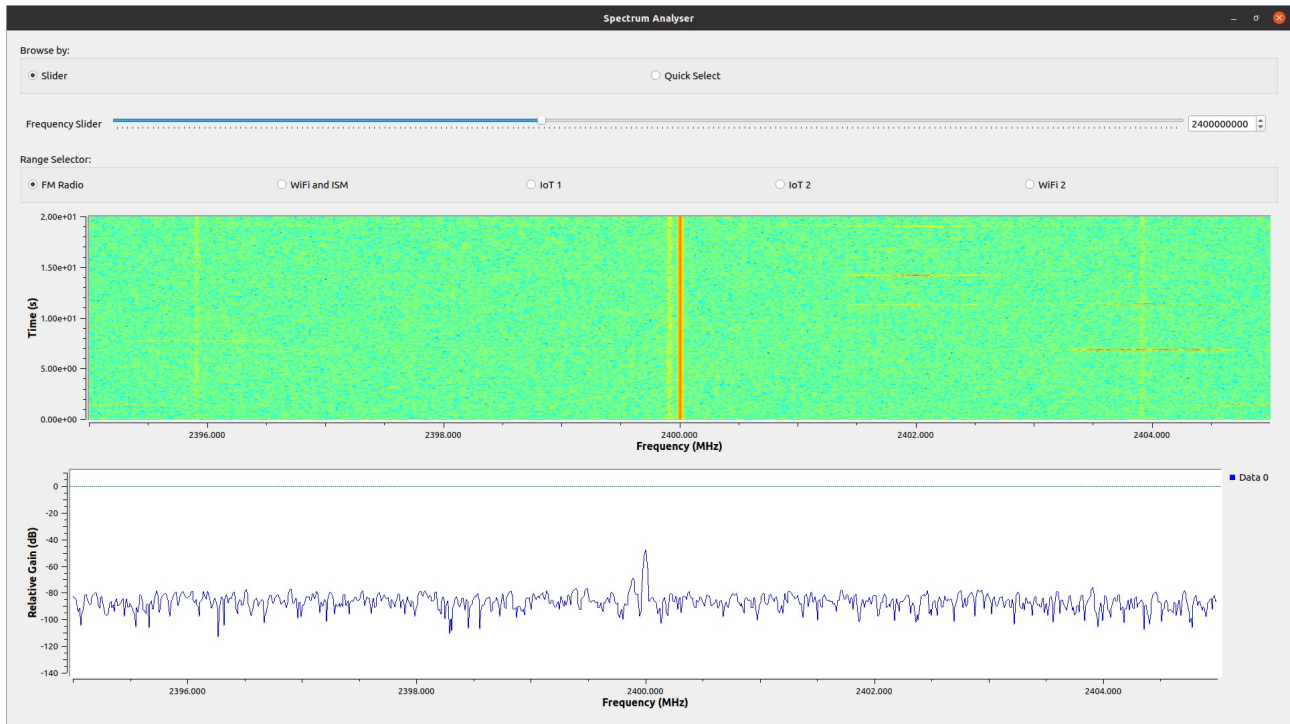
Block Diagram of program in Action
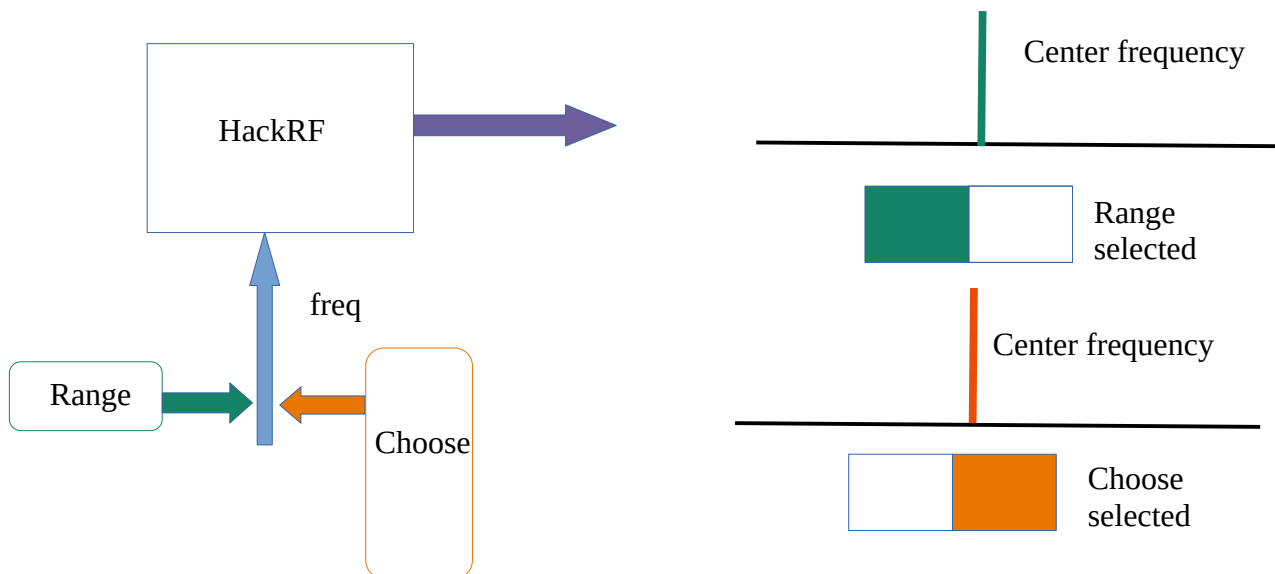
The hackrf receives one value for its center frequency. The value comes from the GUI Chooser or the GUI Range. Which value is sent to the HackRF depends on the value selected in the GUI Chooser labelled Browse by in the image before. If "Slider" (or a similar name) is selected then the value should come from the GUI Range (labelled Frequency Slider in the images above) and if "Quick Select" is chosen then the value should come from the GUI Chooser. The Chooser should not work if Range is selected and vice versa.

Due Date: Check Moodle for date
Late Submission Deadline: Check Moodle for date (usually 1 week after due date)
Submission Files: .grc file and .py especially if modified.
Location: Moodle Homework 1 link