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Computer Engineer
UCSB
Gorman Scholar

Enhancing Spectral Usage Through Full Duplex Communication

Electrical and Computer Engineering
Advisor : Jim Buckwalter
Mentor: Hussam AlShammary

Today’s average phone data speed is 26.1 Mbps, what will the average data speed be in the year 2020 ? **A: 52.1Mbps** **B: 62.1Mbps** **A: 42.1Mbps**

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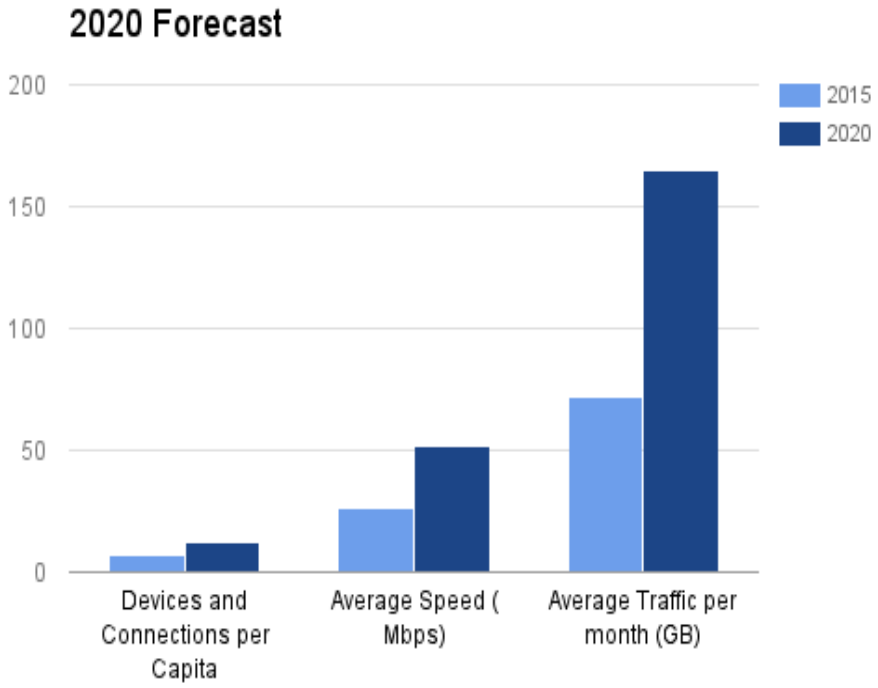

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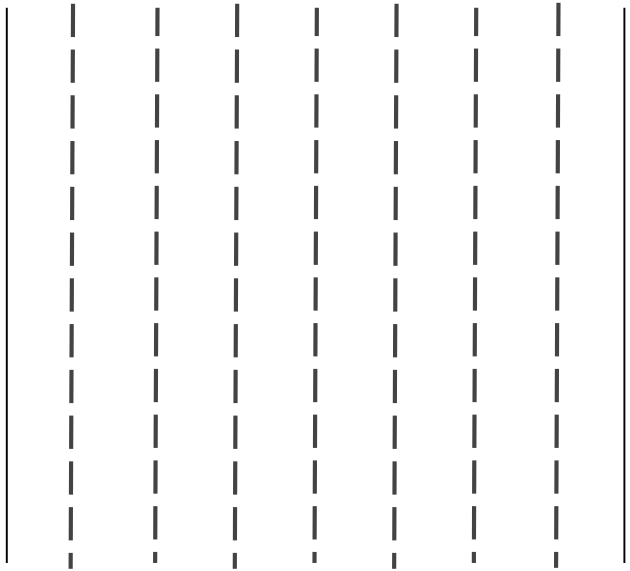

Radio Spectrum

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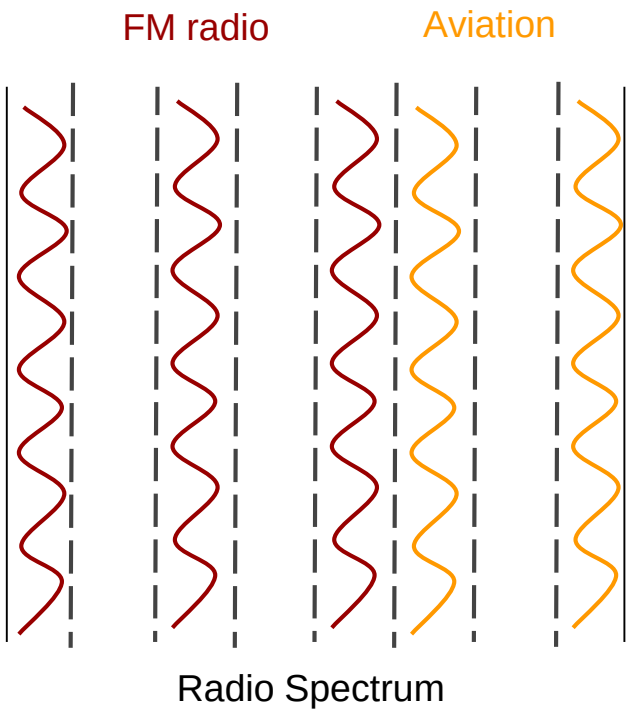

- FCC allocates bands to services.
- Many services leave frequencies unused.

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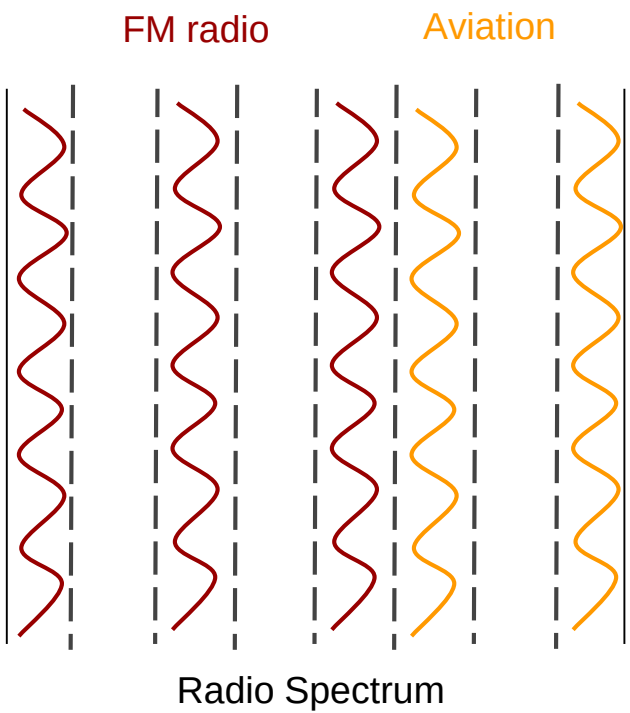


- FCC allocates bands to services.
- Many services leave frequencies unused.

- Need to understand how spectrum works now.
- Spectrum will be prioritized.

Analysing the Radio Spectrum

What frequencies are being used?

Analysing the Radio Spectrum

What frequencies are being used?

What services own these frequencies?

Analysing the Radio Spectrum

What frequencies are being used?

What services own these frequencies?

How they use it?

Analysing the Radio Spectrum

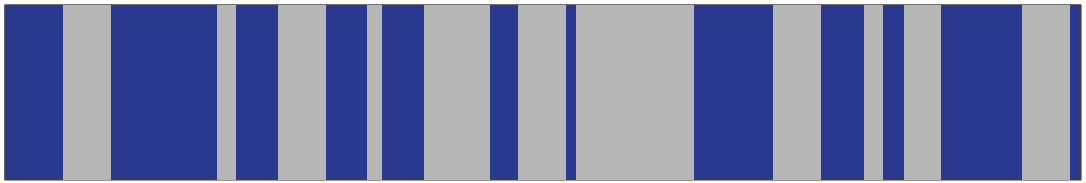
What frequencies are being used?

What services own these frequencies?

How they use it?

Used
Unused

Hypothetical Radio Spectrum (now)



Analysing the Radio Spectrum

What frequencies are being used?

What services own these frequencies?

How they use it?

Hypothetical Radio Spectrum (future)

Frequent Users

Less Frequent Users

Night Users

Day Users

Free Spectrum

Acquiring Signals from a Software Defined Radio

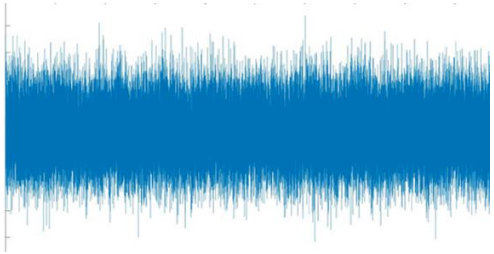
SDR

Acquiring Signals from a Software Defined Radio

SDR

Matlab
LabView

Amplitude



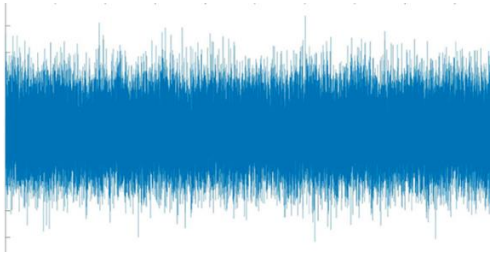
Time

Acquiring Signals from a Software Defined Radio

SDR

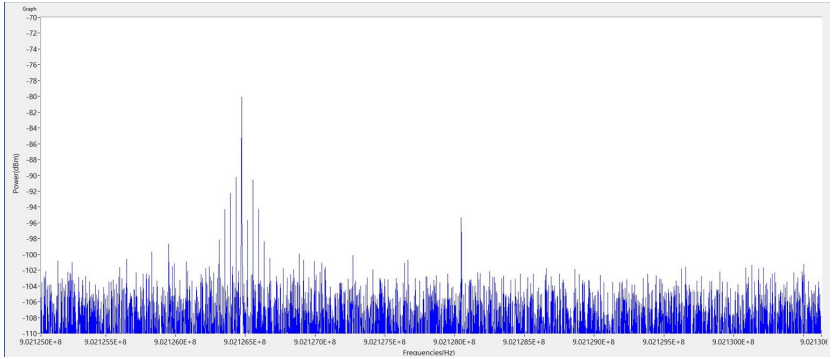
Matlab
LabView

Amplitude



Time

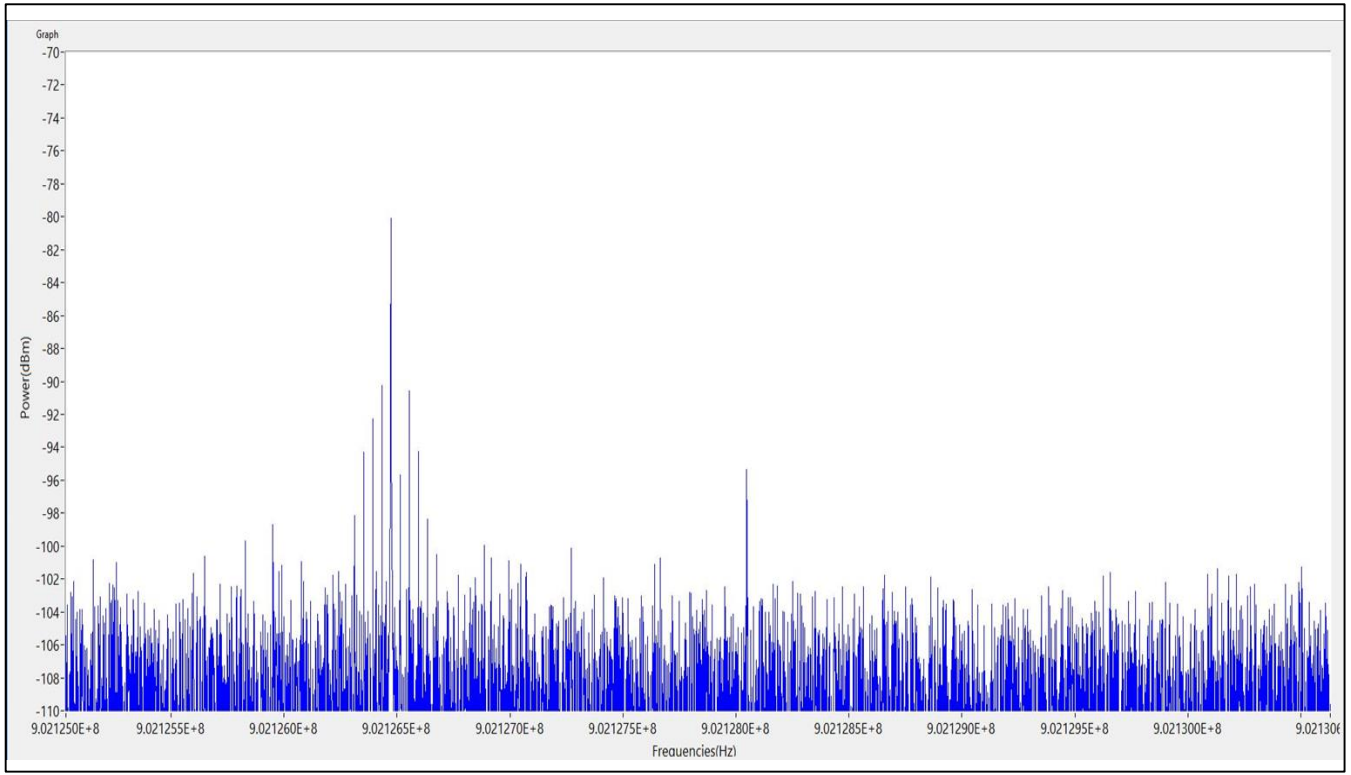
Fast Fourier
Function (FFT)



Power

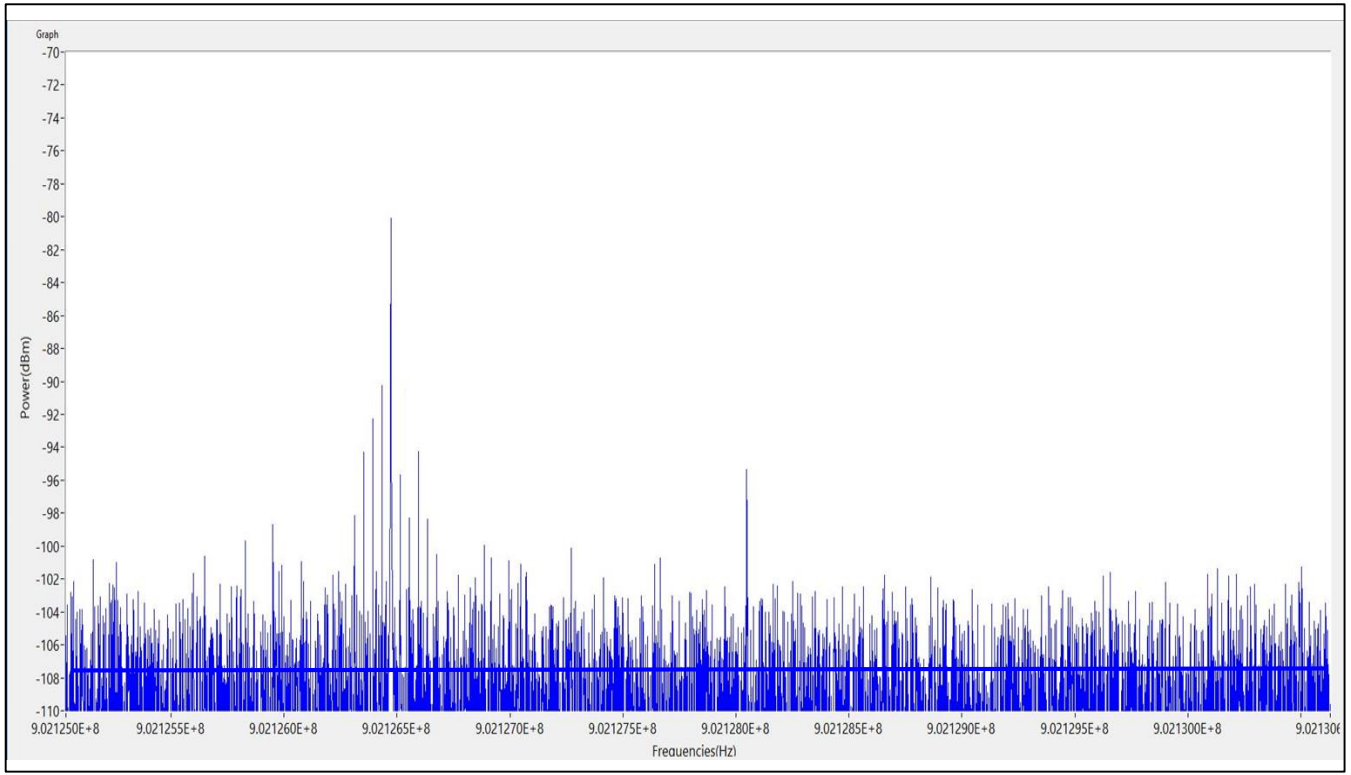
Frequency

Detecting the Power of Signals



Identifies the frequencies being used.

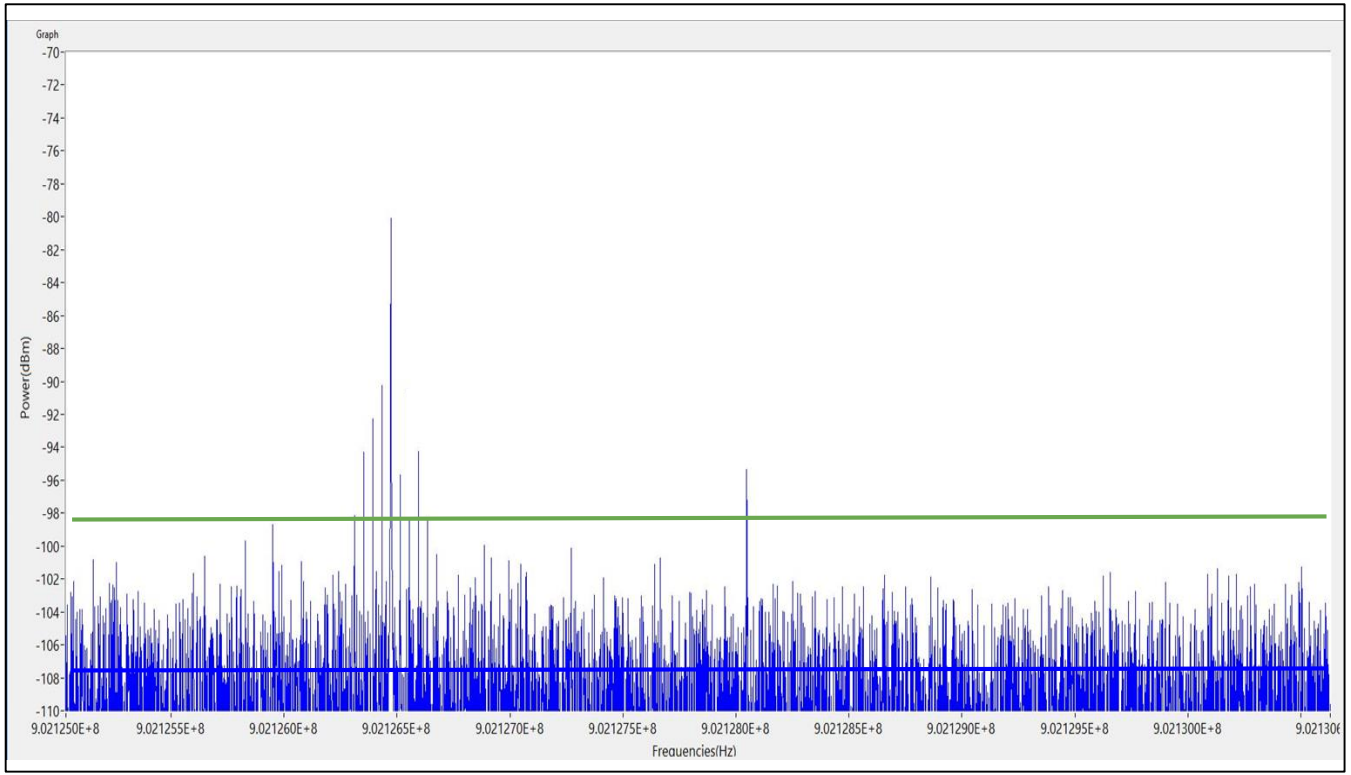
Detecting the Power of Signals



Identifies the frequencies being used.

Noise floor.

Detecting the Power of Signals



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Noise floor.

Threshold = 10 dBm above noise floor.

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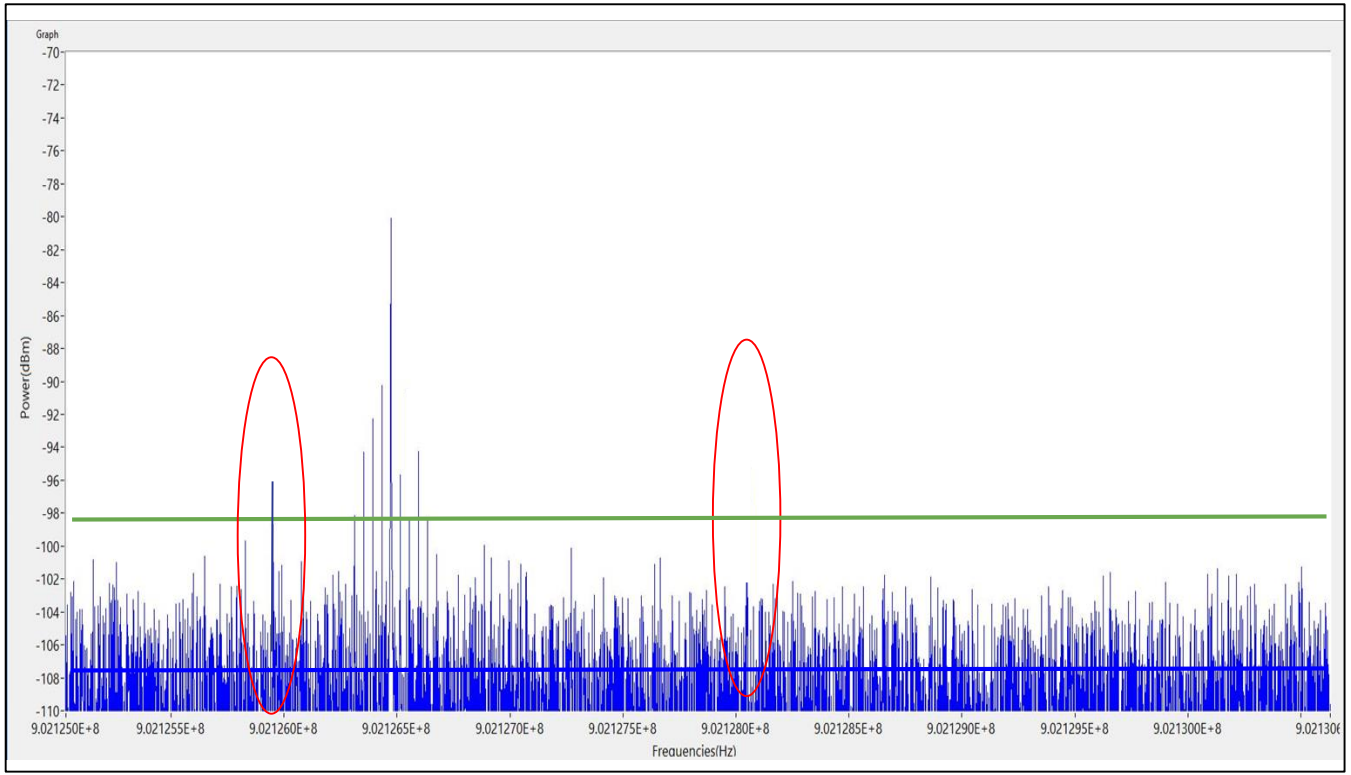

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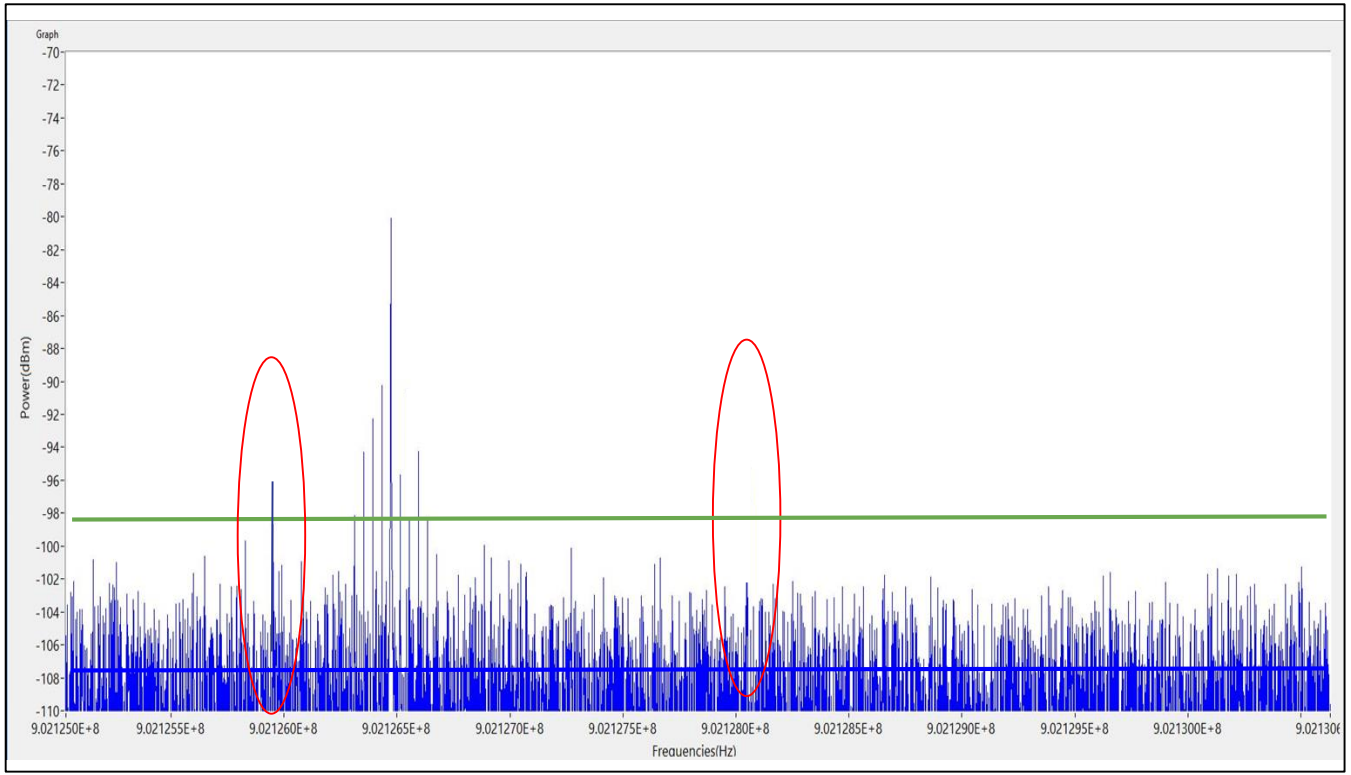
Signals will fluctuate due to noise.

Detecting the Power of Signals



Identifies the frequencies being used.

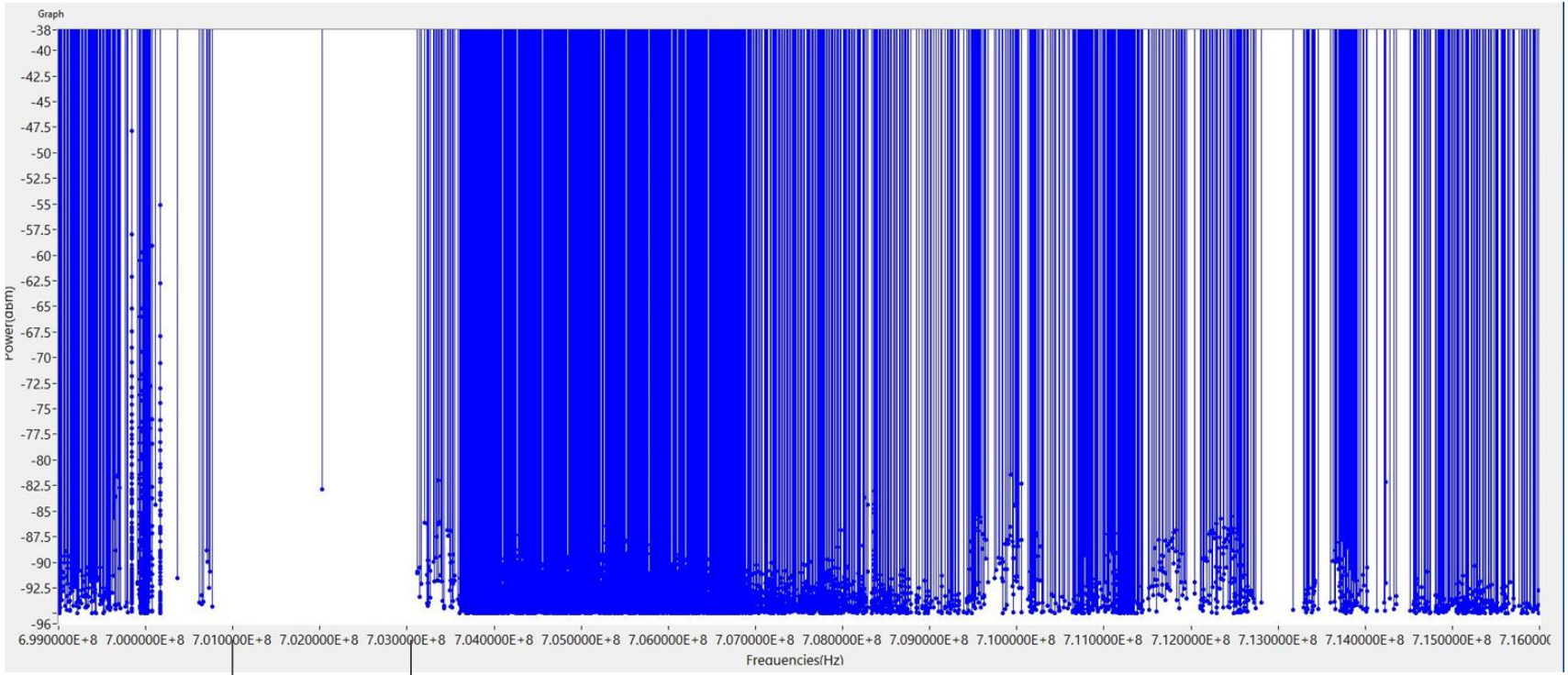
Noise floor.

Threshold = 10 dBm above noise floor.

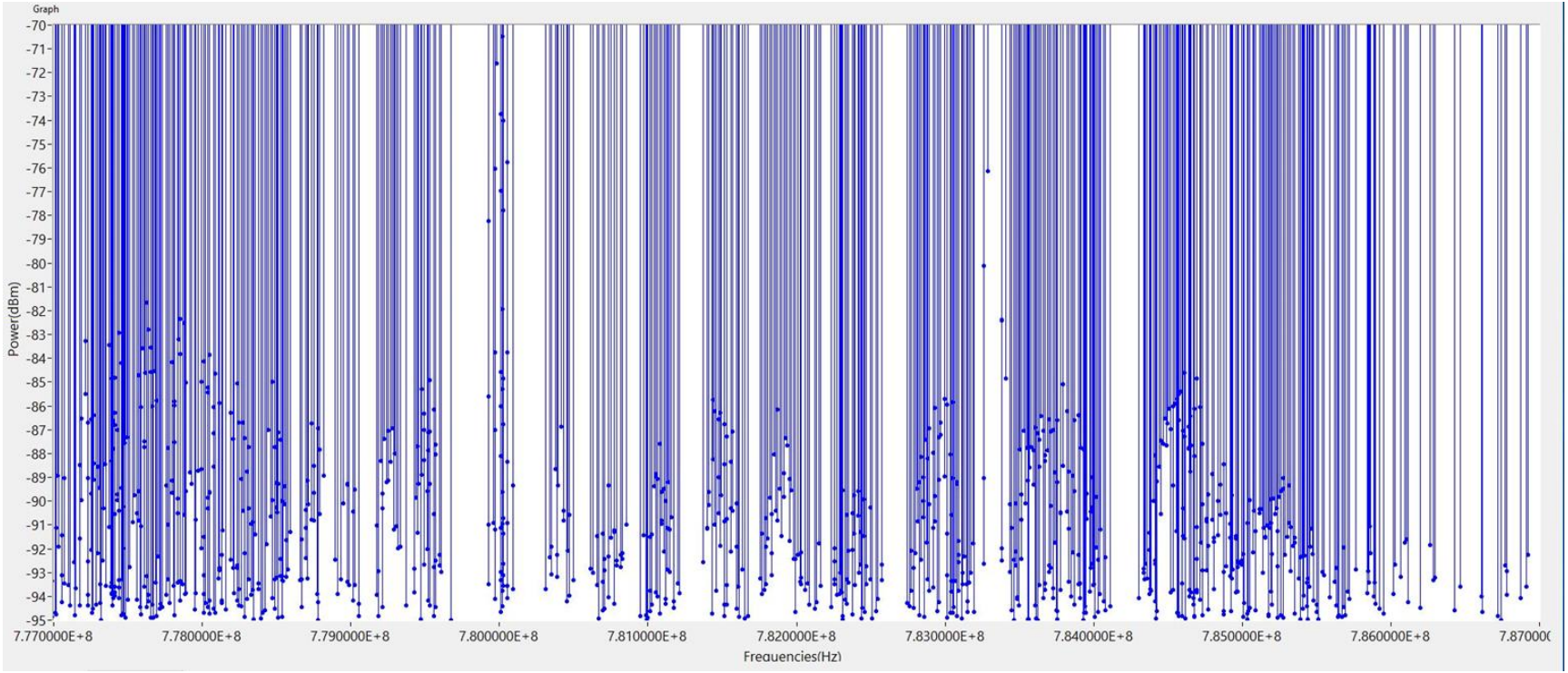
Signals will fluctuate due to noise.

Increase samples to reduce error.

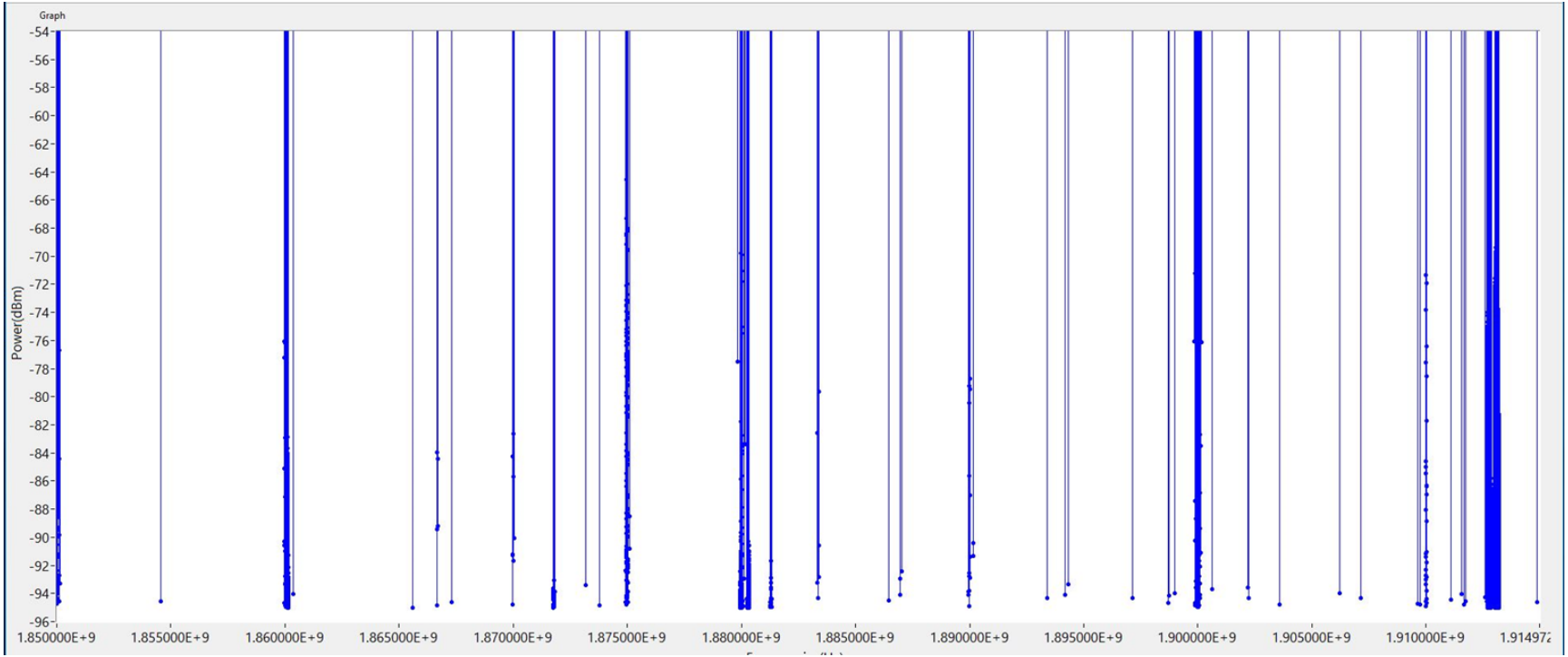
T-Mobile (699 MHz - 716 MHz) and AT&T (704 MHz - 716 MHz)



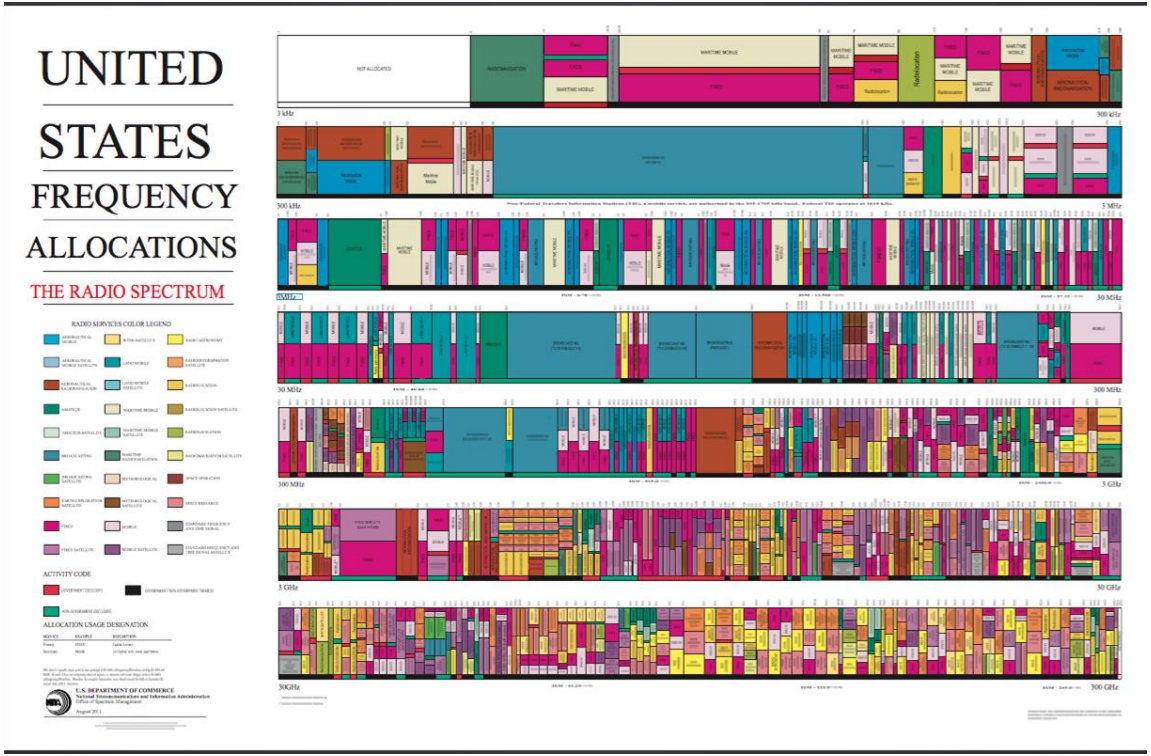
Verizon Preferred Band (777 MHz - 787 MHz)



Sprint Preferred Band (1850 MHz - 1915 MHz)



Small Portion of Radio Spectrum



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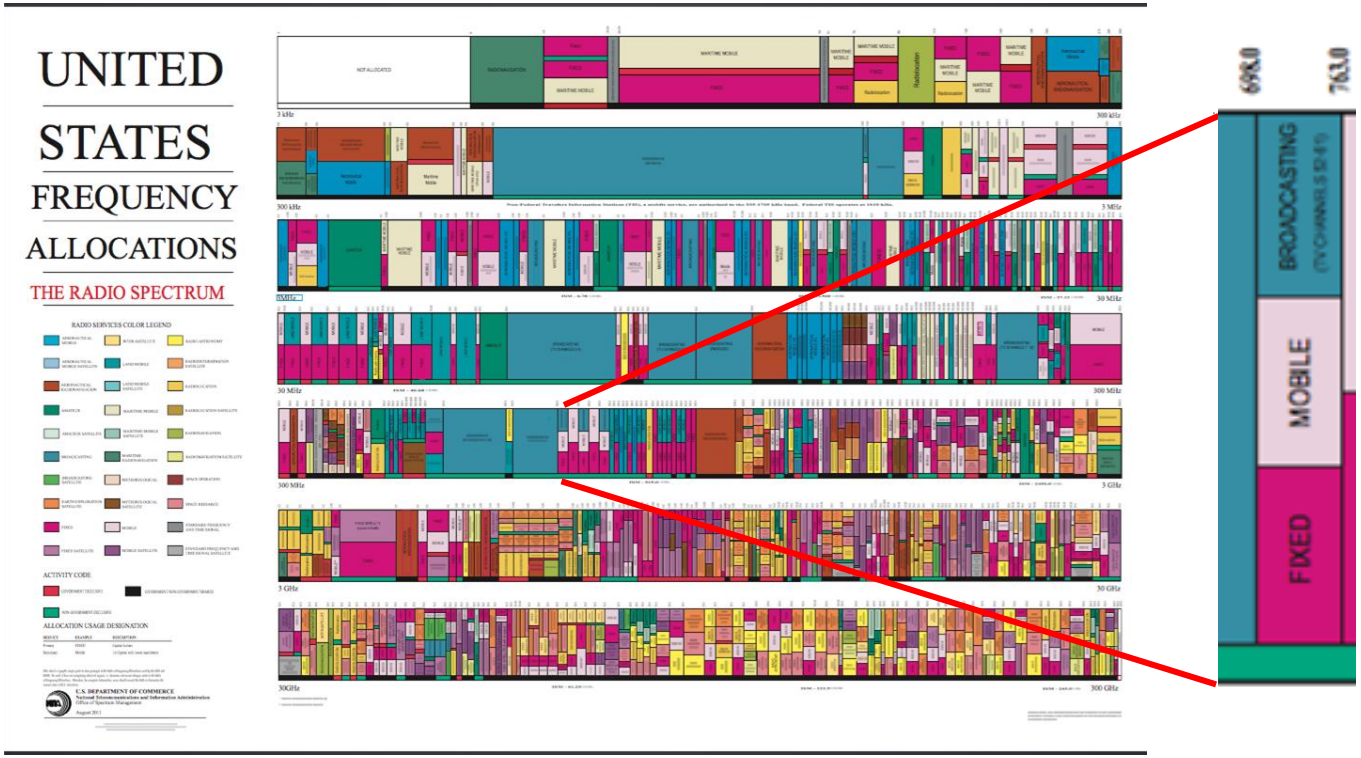

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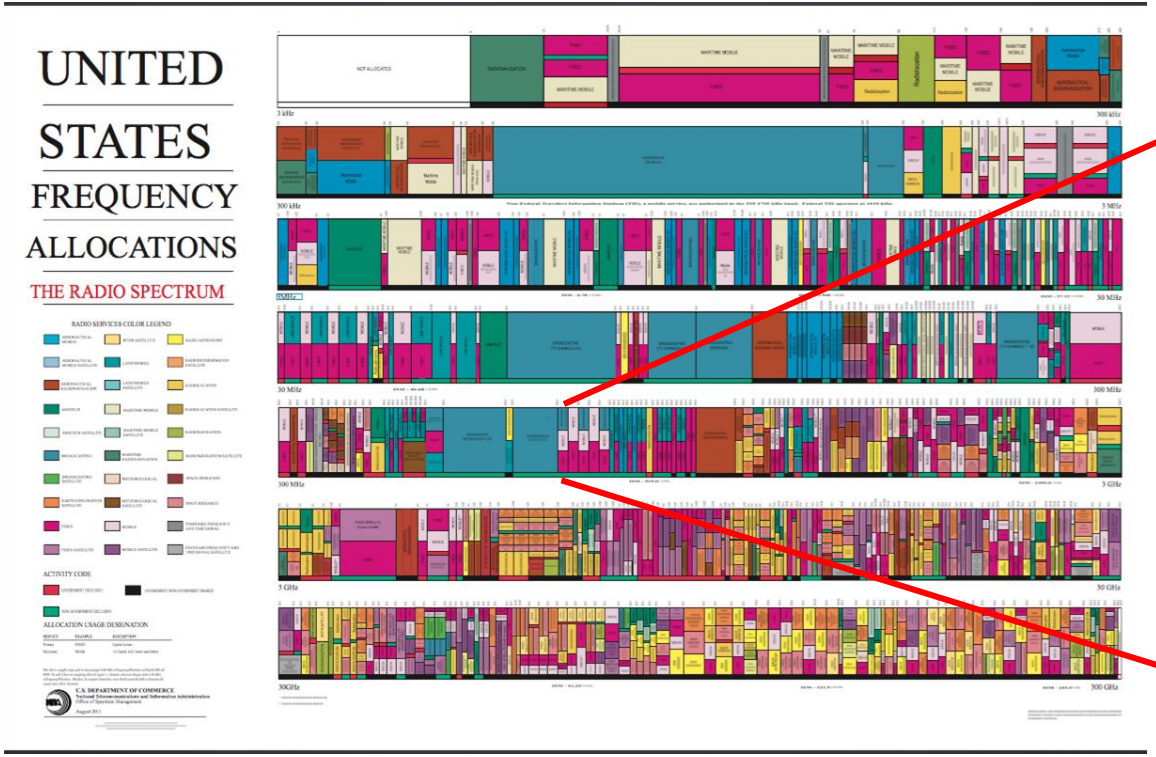

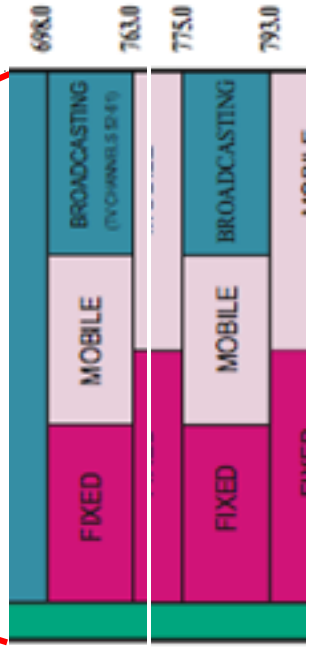

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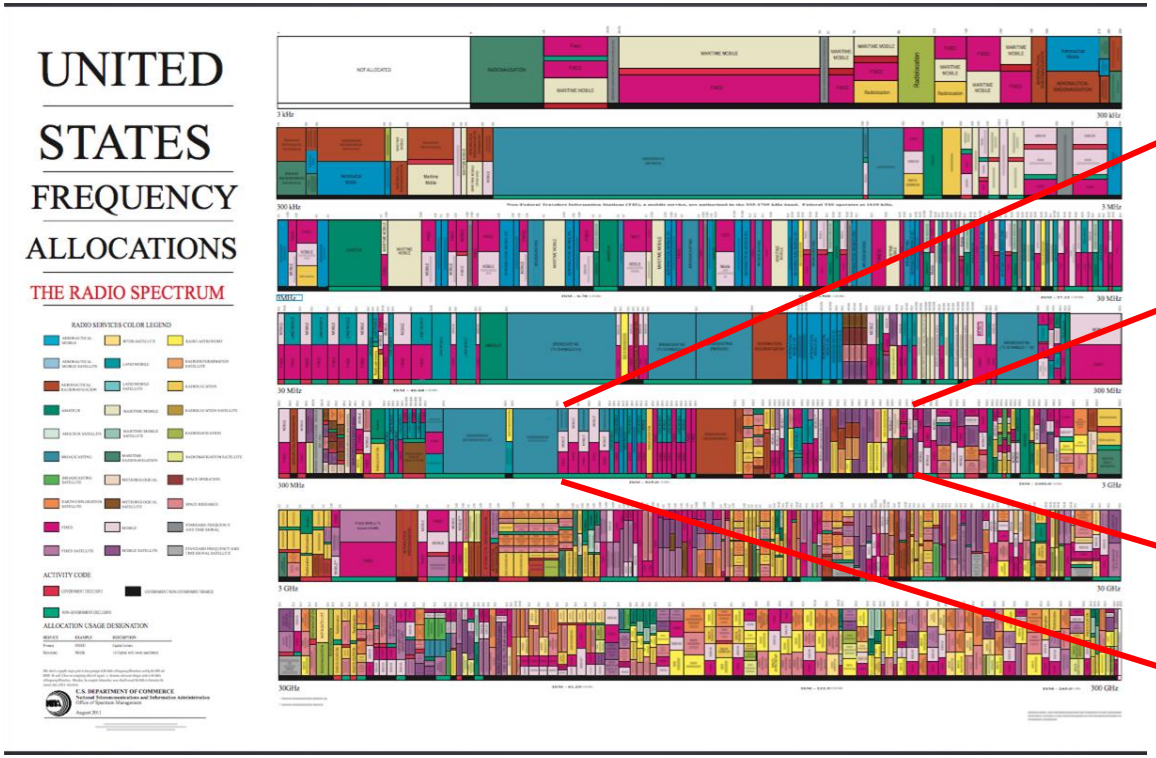
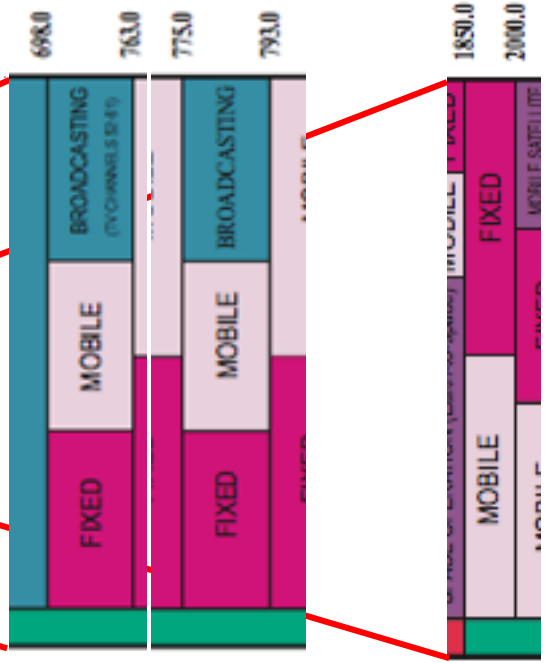




699 MHz - 716 MHz

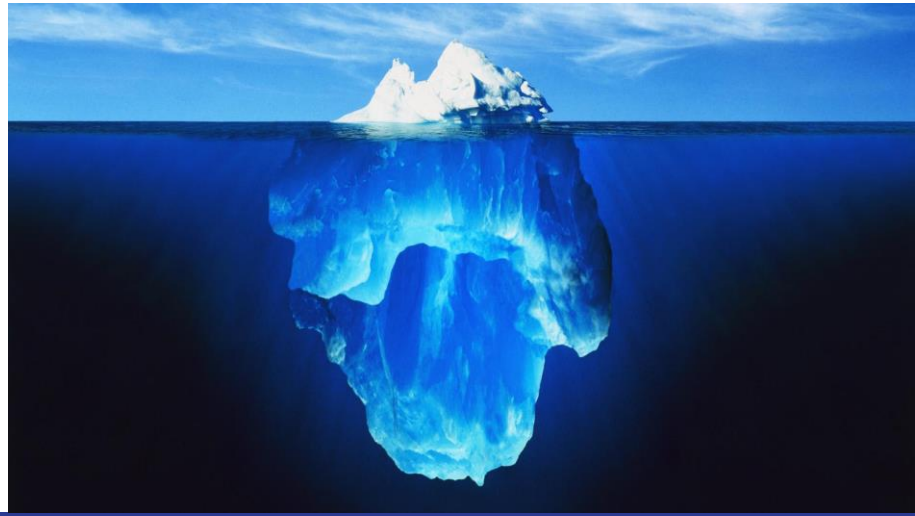
777 MHz - 787 MHz

1850 MHz - 1915 MHz

The Tip of the Iceberg

Future work should:

- Look to analyze a larger range of frequencies
- Increase the efficiency of looking for used frequencies



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James Buckwalter
Hussam AlShammary