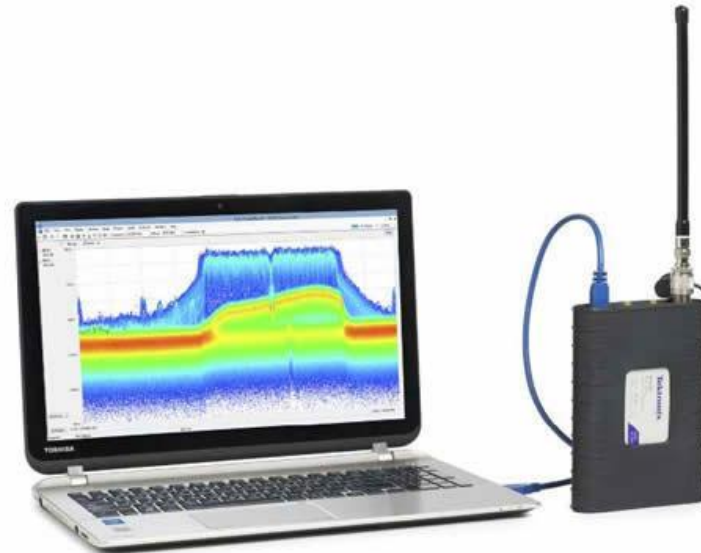# Team GNU – It's Not Radio

Walker Frank, Quyen Nguyen, Max Oakes, Nick Wagner, Quentin Ward
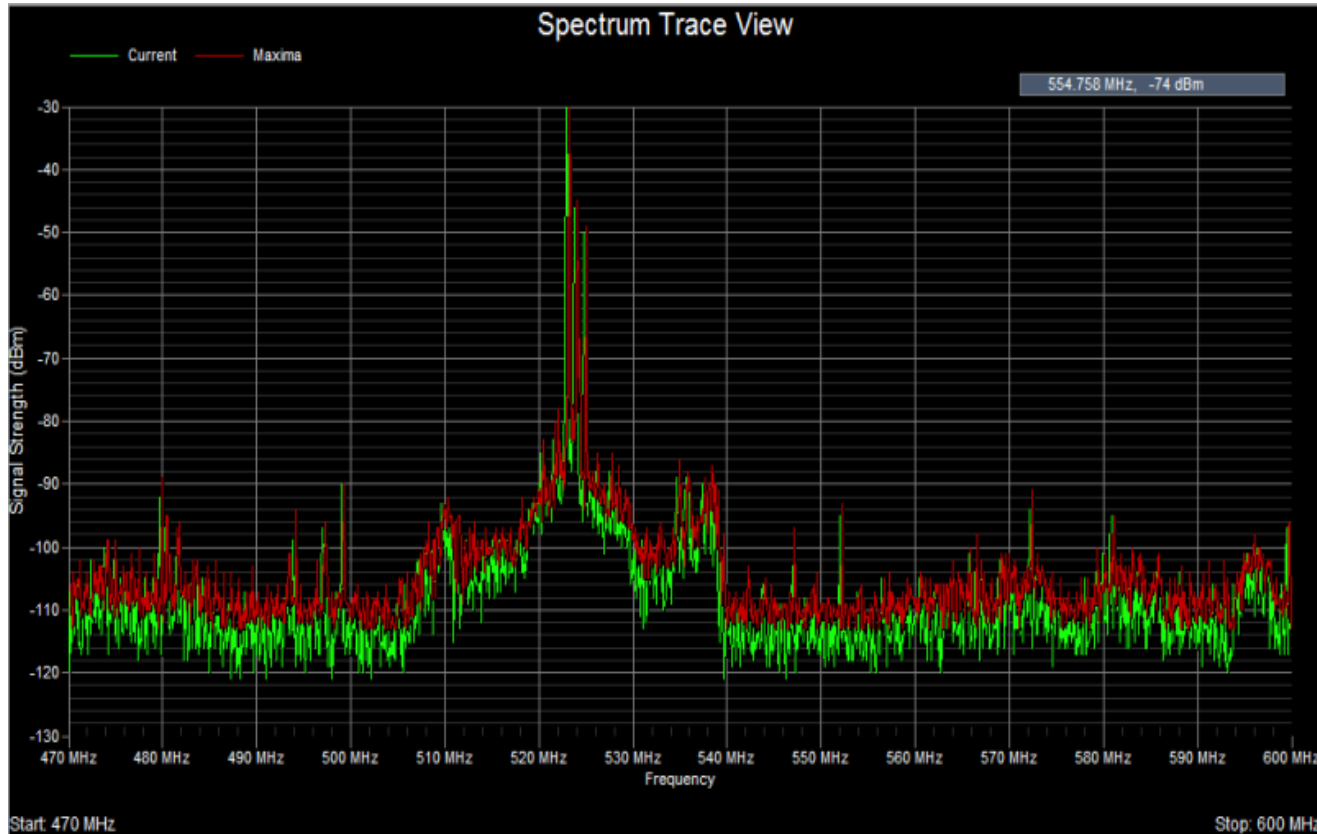
# Project Overview

- The Tektronix RSA series are Real-time Spectrum Analyzers(RSA) that can be over 15 times cheaper than a conventional RSA and can weigh less than 2 lbs.
- Our project seeks to connect these RSAs to GNURadio, an open source coding library.

# What is an RSA?



- A real-time spectrum analyzer (RSA) measures the magnitude of an input signal versus frequency within the full frequency range of the instrument.

- The primary use is to measure the power of the spectrum of known and unknown signals.

# What our Project Does

- The RSA traditionally used to output the collected data into a Tektronix provided program, SignalVu.
  ◦ SignalVu only allows the user to observe the waveform.
- The goal of our project was to create a "block" of code for GNU Radio that allows the data to be read from the RSA.
- Using GNU Radio enables the user to perform signal processing and implement a software defined radio, allowing limitless possibilities.

Our GNURadio Block

# What is GNURadio?



- GNURadio is used to implement software defined radios (SDR).
  - A software defined radio is radio system where the components are implemented in software rather than hardware

- It can be used with external RF hardware, like the RSA306, to create SDRs or without hardware to create simulations.

- GNURadio Companion (GRC)
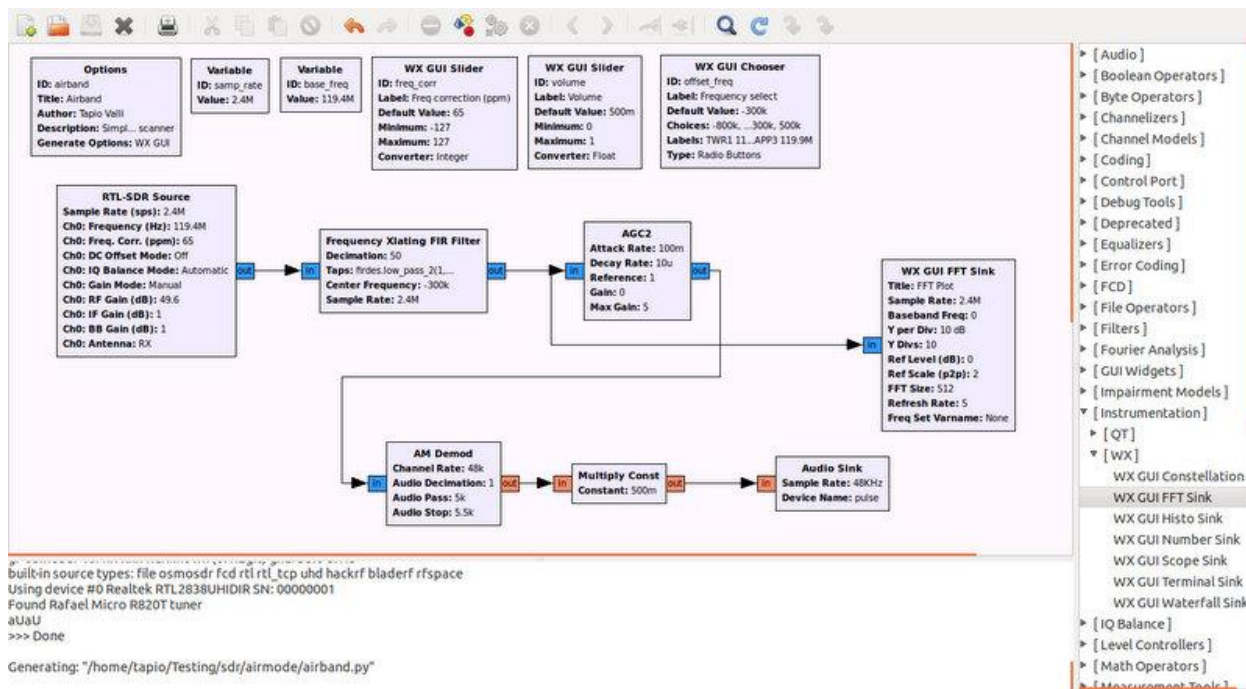
# Why GNURadio?

▸ GNURadio is a free, powerful resource in the RF and Communication Engineering Field

▸ One software defined radio can be used for a variety of applications, opening the door to limitless applications.
  ◦ Filters
  ◦ Demodulators
  ◦ Decoders
  ◦ And more!

# Design Process

▶ Tektronix provided a document with essential and desired capabilities:

- ◦ IQ Block capability
- ◦ IQ Stream capability
- ◦ IF Stream capability

# What is IQ Data?
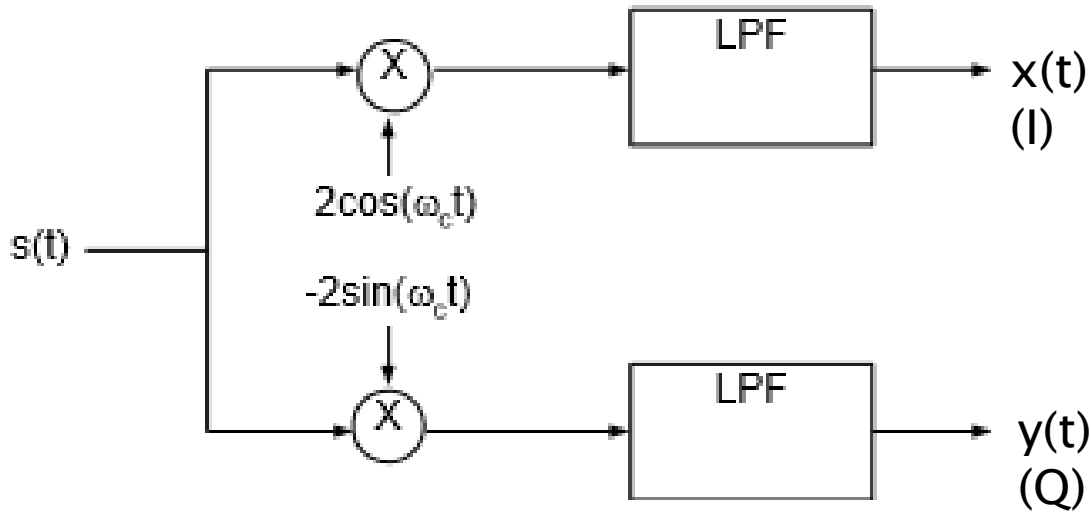


- I – Inphase component
- Q – Quadrature component

- When you combine I and Q components, you get the *complex envelope:*
  ◦ S(t) = x(t) + j*y(t)

- This allows for demodulation and extracting the intended information from the carrier signal

# High-level diagram of the custom GNU radio block for the RSA
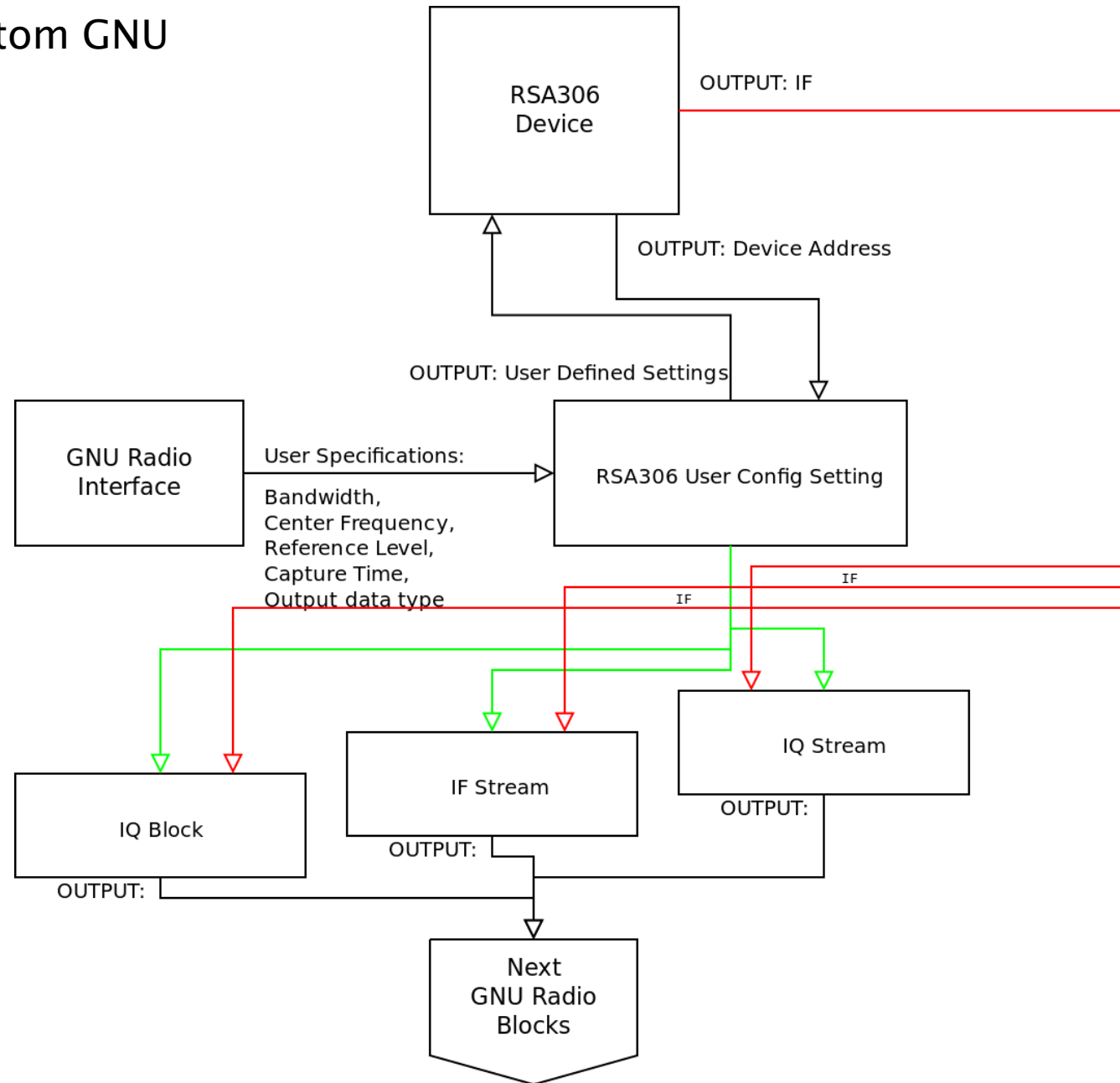
# Results/Conclusions

▶ We successfully completed the following requirements:
  ◦ GNURadio style compliance
  ◦ Deployment for Ubuntu 15
  ◦ Successful implementation of IQ block and IQ stream capabilities

▶ Unable to implement IF streaming capabilities:
  ◦ Tektronix needed to update the RSA's API to allow us to include IF streaming however, the API is still in development.

# Demonstrations

- Key Fob
- Wi-Fi Signal
- FM Radio

# Potential Uses for Our Project

- Corporate Research
  - Wireless technology research and simulation
    - GPS (Garmin, Magellan, Motorola, etc.)
    - Wi-Fi (Internet service providers)
    - RFID (credit card companies)
    - Cell phone signals (cell phone companies)
- Military Research and Development
- Future University of Portland Senior Design Projects
  - Next year's senior design project on triangulating position
- Amateur Hobbyist Activities

# Acknowledgements

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# Citations

"What Is GNU Radio and Why Do I Want It?." *WhatIsGR – GNU Radio*. GNU Radio, n.d. Web. 06 Mar. 2017.

"USB Spectrum Analyzer." Tektronix, n.d. Web. 08 Mar. 2017.

# Questions?