

Geo-Location of RF Emitters

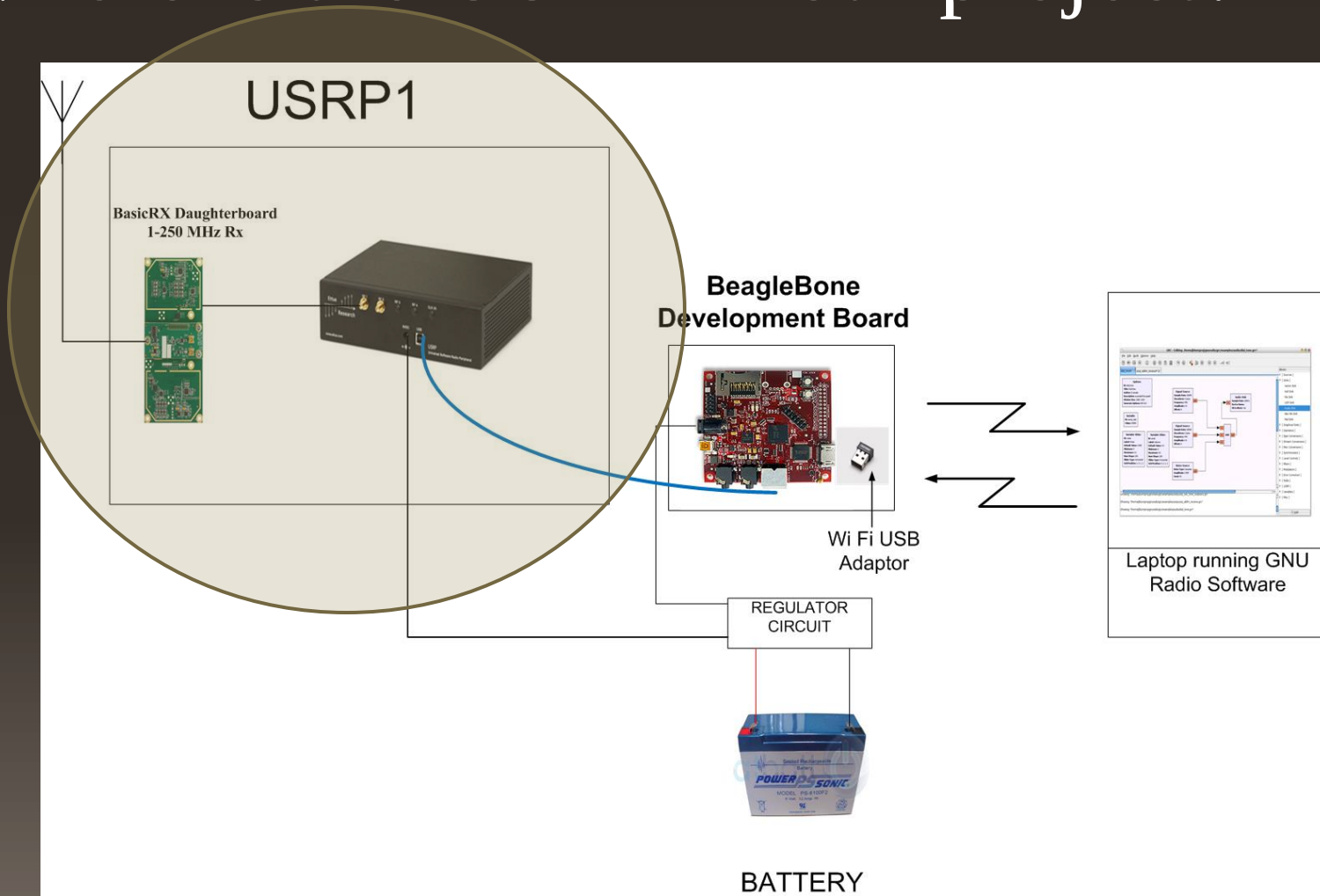
George Godby | Ken Wilkins | Viktor Simovski
Justin Mascotto | Matthew Roach

USRP: UNIVERSAL SOFTWARE RADIO PERIPHERAL



- Manufactured by Ettus Research
- Relatively new technology (past ten years)

Where is the USRP in our project?



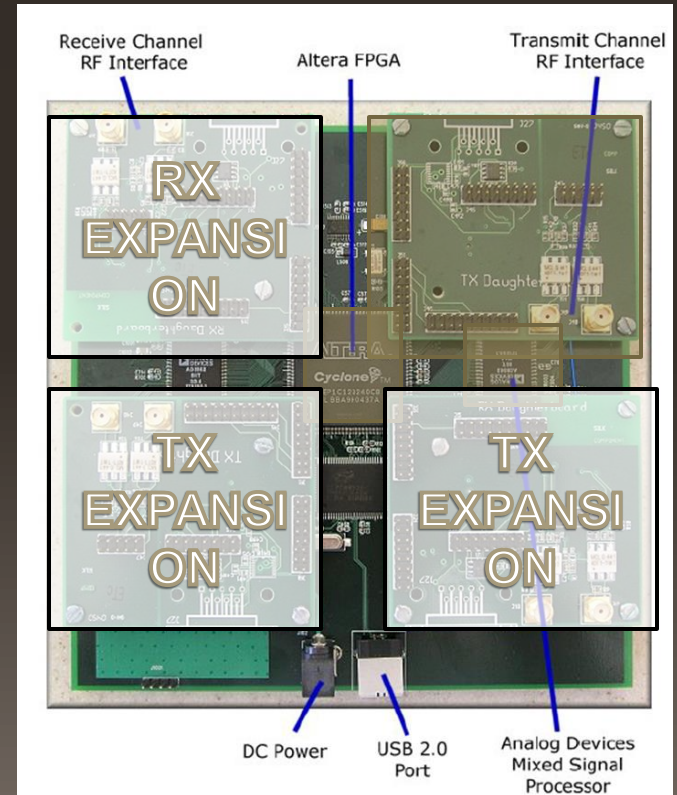
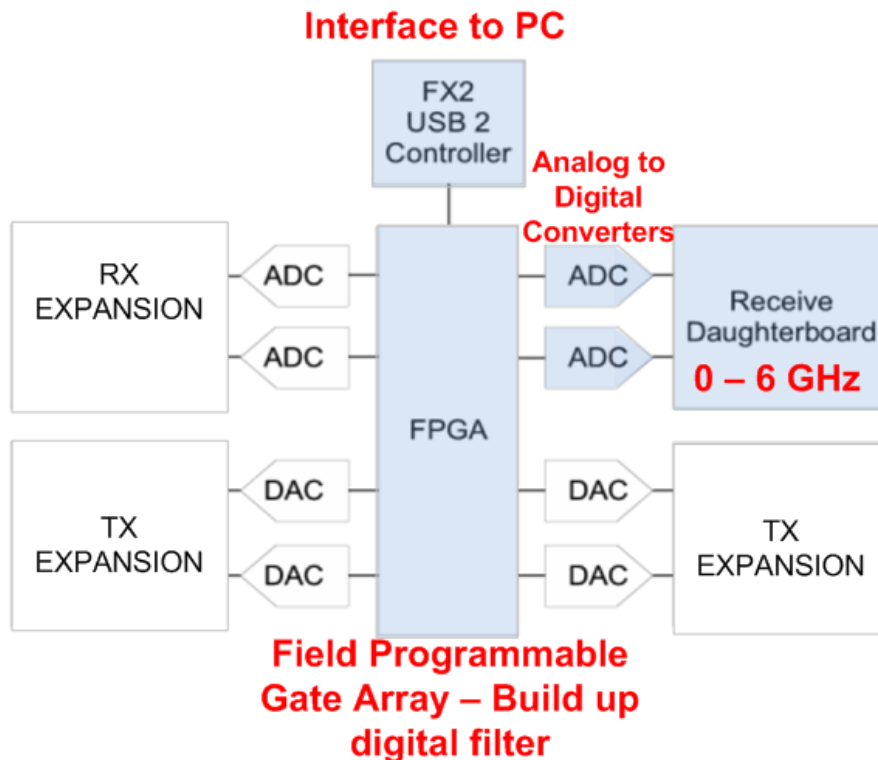
USRP:

What is a Software Radio?

- A radio interface that contains a minimum amount of RF components
- Relies as much as possible on software for signal processing
- Works in conjunction with GNU Radio software to configure radio parameters
- Controlled by a PC or laptop

A CLOSER LOOK AT THE COMPONENTS

(Core components highlighted in blue)



How will we use the USRP in our project?

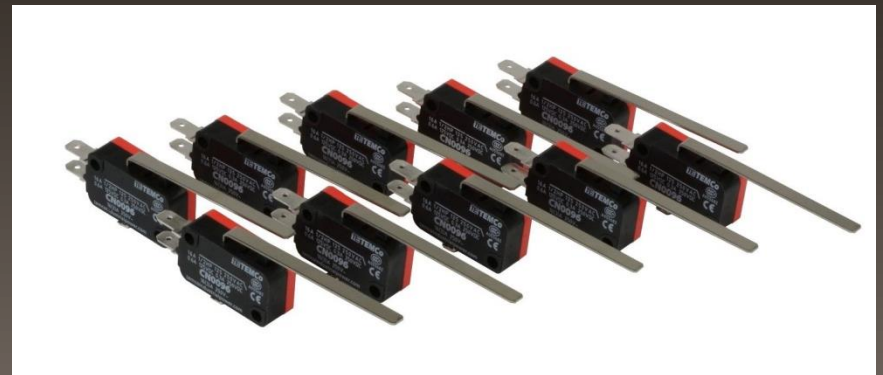
- The USRP will allow us to receive any signal in to 0 to 250 MHz range.
The receive frequency can be dynamically from the control PC
- Information about the signal is converted to a digital format for processing by GNU software
- Most importantly the USRP will log Radio Signal Strength (RSS) as a function of time as the antenna is swept through an area
- The RSS information packet will be concatenated with GPS information and sent to the GNU Software for further analysis.
- The Processing algorithms will help to “*paint an RF picture*” of the area, showing where a particular RF signal is peaking and thus aid in the location of RF emitter source

Antenna

- USRP1 is not capable of two simultaneous transmits or receives.
- With only one receiver, previous Antenna design no longer accommodates goal
- Goals: Received Signal Strength & Angle of Arrival
- Strategy:
 - Gather signal levels from different angles and choose the measurement with the greatest level and thus give us an idea of the AOA (angle of arrival)

Antenna

- Solution:
 - Motorized Rotating Antenna
 - 120 Mile Reception Range
 - 47-860 MHz
 - Rotating Speed: 4-6 Rounds per minute
 - 12 Seconds per 360 degree rotation
- Antenna Position:
 - Antenna won't give direction of signal
 - Use of micro switch positioned below rotating head and combinational logic will give us position of antenna



Interfacing

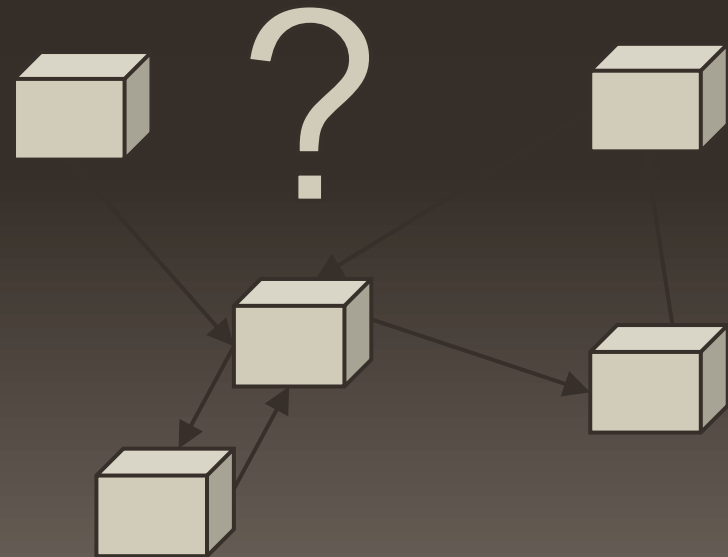
Hardware

- USRP1 Complex
- BeagleBone
- WiFi module
- GPS module
- Laptop Hub

Software

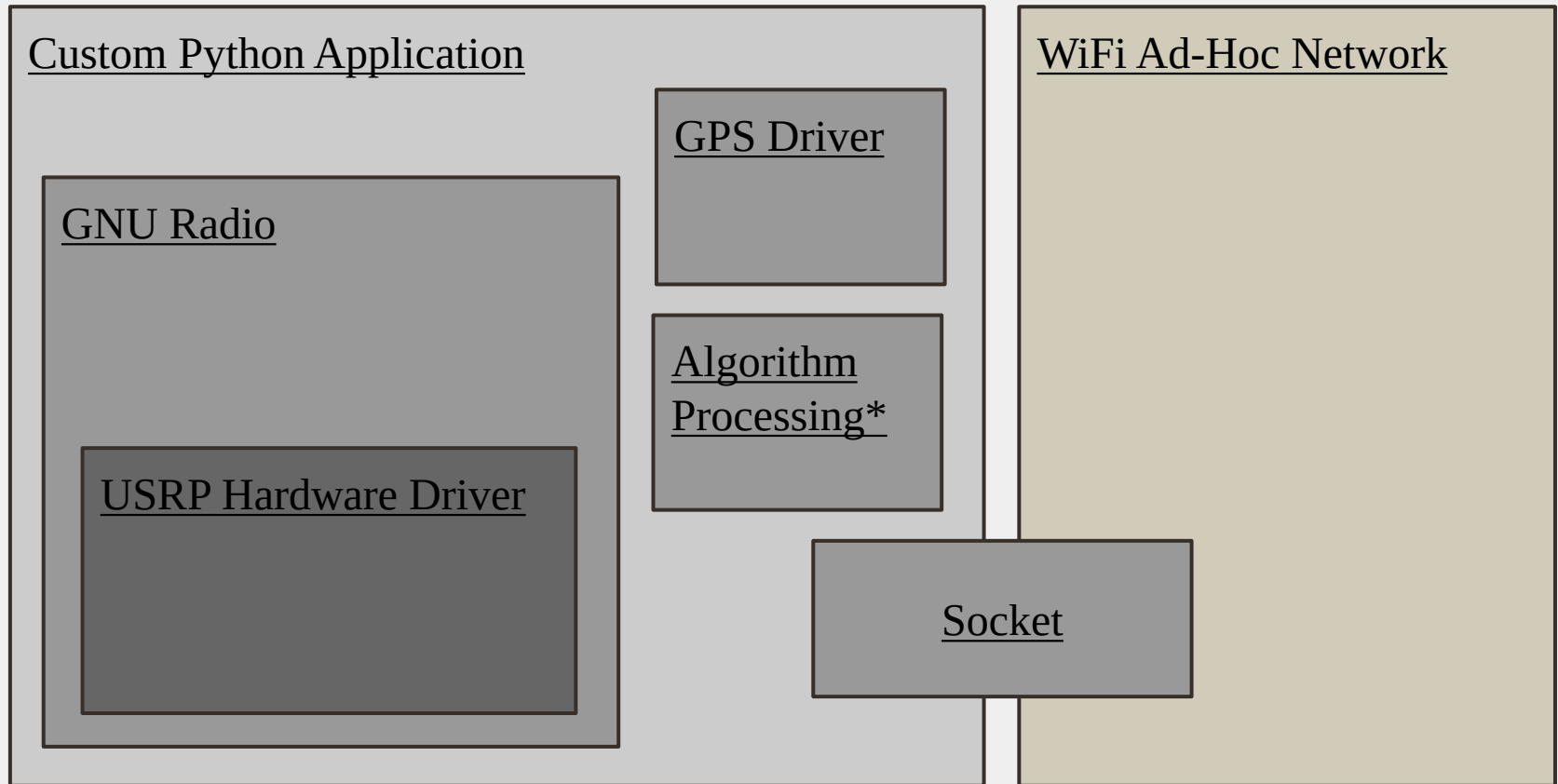
- USRP Hardware Driver
- GPS Driver
- GNU Radio
- Custom Python Application
- Linux OS

With so many components, a major task is to interface them all into a user friendly client-server application.



Software Hierarchy

Linux OS



GNU Radio

- Free & open source software
 - Lots of documentation and avenues for support
- Powerful digital signal processing library
 - Filters
 - Sinks
 - Sources
 - UI
- Source library includes USRP Hardware Driver “block”
 - Out-of-the-box compatibility with USRP devices.
- GUI Companion
 - Provides graphical interface for creating signal processing flows.
- Written in Python* and can be easily included into larger application.
 - Algorithm means
 - Sensor-sensor communication
 - Expandable

Possible Issues

- Proof of Concept
 - One sensor, but possibility of others
- Antenna
 - Position
- Accuracy
- Mobility
 - Our design is only as good as its usability
 - Sensor needs to be semi-compact and movable
- Data Movement

Questions?