# *Software Defined Radio Server*

"A Radio Server for VHF+ Contesting
And Weak Signal Work"

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## *Initial Plans*

- Need Band Data
- Switch Transverters

- 6700 is Great Radio (#1 on Sherwood Engineering List)
- No way to change uW bands
- Of HF bands for that matter

## *Put an Embedded Device to work*

- Select Device
- Use Rapid Development Tools
  - Python
- Get on the air
- End of Story ?

## *Python in Action*

## *Elegance and Simplicity*

- Integrated Development Environment
- Built In – Off the Shelf
  - Beagle Bone Black
  - Immediate Bone Script
  - Python
  - Ethernet or USB

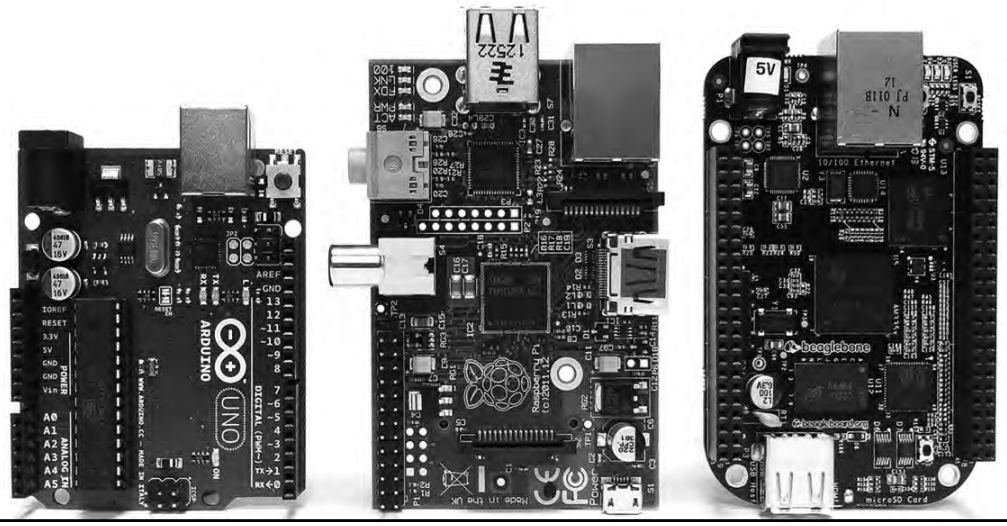


## *Talk Today*

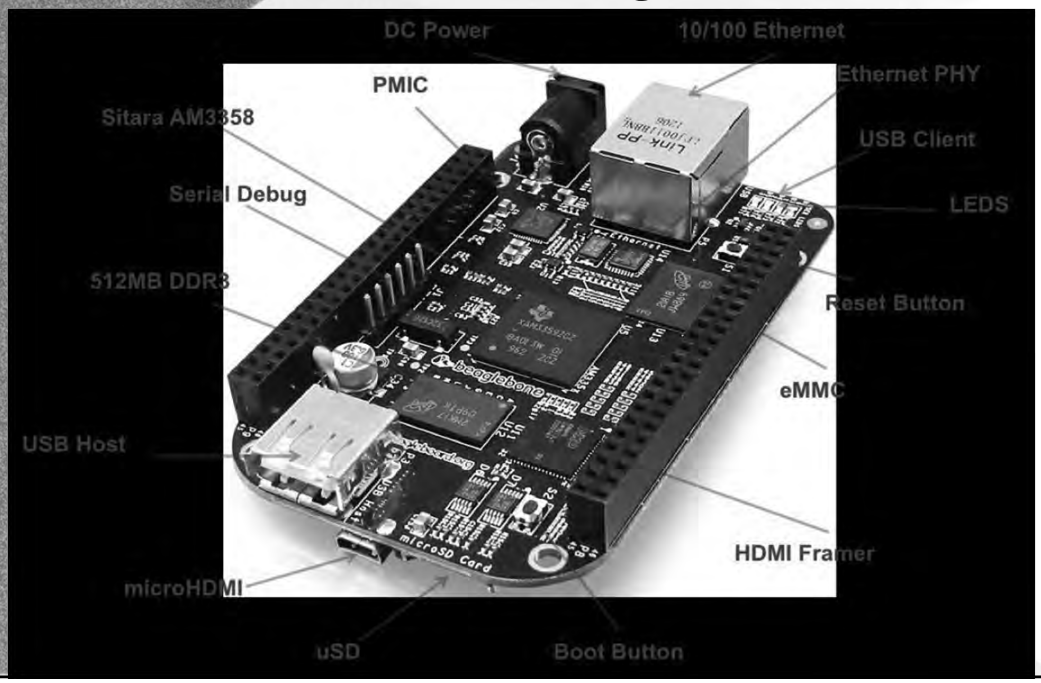
- Take you through the Process
- See what I learned along the way
- Much more that can happen
  - Transverter Control
  - Remote Control of 6K radios
  - Tasks around the Shack
- All Via Ethernet

## *Device Choices*

- Arduino – Rasberry PI – Beagle Bone



## *Beagle Bone Black*



# *GPIO pins*

## 65 possible digital I/Os

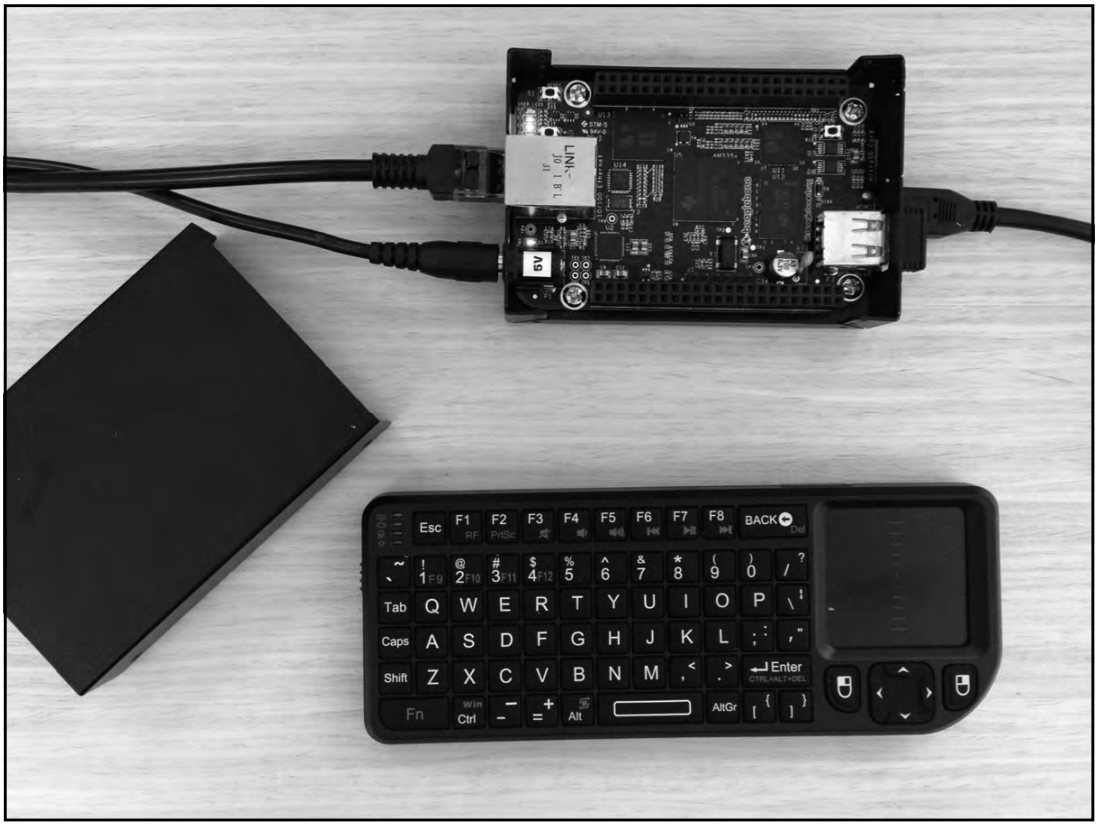
P9

| DGND | 1 | 2 | DGND |
|---|---|---|---|
| VDD_3V3 | 3 | 4 | VDD_3V3 |
| VDD_5V | 5 | 6 | VDD_5V |
| SYS_5V | 7 | 8 | SYS_5V |
| PWR_BUT | 9 | 10 | SYS_RESETN |
| GPIO_30 | 11 | 12 | GPIO_60 |
| GPIO_31 | 13 | 14 | GPIO_40 |
| GPIO_48 | 15 | 16 | GPIO_51 |
| GPIO_4 | 17 | 18 | GPIO_5 |
| I2C2_SCL | 19 | 20 | I2C2_SDA |
| GPIO_3 | 21 | 22 | GPIO_2 |
| GPIO_49 | 23 | 24 | GPIO_15 |
| GPIO_117 | 25 | 26 | GPIO_14 |
| GPIO_125 | 27 | 28 | GPIO_123 |
| GPIO_121 | 29 | 30 | GPIO_122 |
| GPIO_120 | 31 | 32 | VDD_ADC |
| AIN4 | 33 | 34 | GNDA_ADC |
| AIN6 | 35 | 36 | AIN5 |
| AIN2 | 37 | 38 | AIN3 |
| AIN0 | 39 | 40 | AIN1 |
| GPIO_20 | 41 | 42 | GPIO_7 |
| DGND | 43 | 44 | DGND |
| DGND | 45 | 46 | DGND |

P8

| DGND | 1 | 2 | DGND |
|---|---|---|---|
| GPIO_38 | 3 | 4 | GPIO_39 |
| GPIO_34 | 5 | 6 | GPIO_35 |
| GPIO_66 | 7 | 8 | GPIO_67 |
| GPIO_69 | 9 | 10 | GPIO_68 |
| GPIO_45 | 11 | 12 | GPIO_44 |
| GPIO_23 | 13 | 14 | GPIO_26 |
| GPIO_47 | 15 | 16 | GPIO_46 |
| GPIO_27 | 17 | 18 | GPIO_65 |
| GPIO_22 | 19 | 20 | GPIO_63 |
| GPIO_62 | 21 | 22 | GPIO_37 |
| GPIO_36 | 23 | 24 | GPIO_33 |
| GPIO_32 | 25 | 26 | GPIO_61 |
| GPIO_86 | 27 | 28 | GPIO_88 |
| GPIO_87 | 29 | 30 | GPIO_89 |
| GPIO_10 | 31 | 32 | GPIO_11 |
| GPIO_9 | 33 | 34 | GPIO_81 |
| GPIO_8 | 35 | 36 | GPIO_80 |
| GPIO_78 | 37 | 38 | GPIO_79 |
| GPIO_76 | 39 | 40 | GPIO_77 |
| GPIO_74 | 41 | 42 | GPIO_75 |
| GPIO_72 | 43 | 44 | GPIO_73 |
| GPIO_70 | 45 | 46 | GPIO_71 |

In GPIO mode, each digital I/O can produce interrupts.



## *Apache Web Server*

- Port 80
- PHP
- Available to any Device

Apache HTTP SERVER

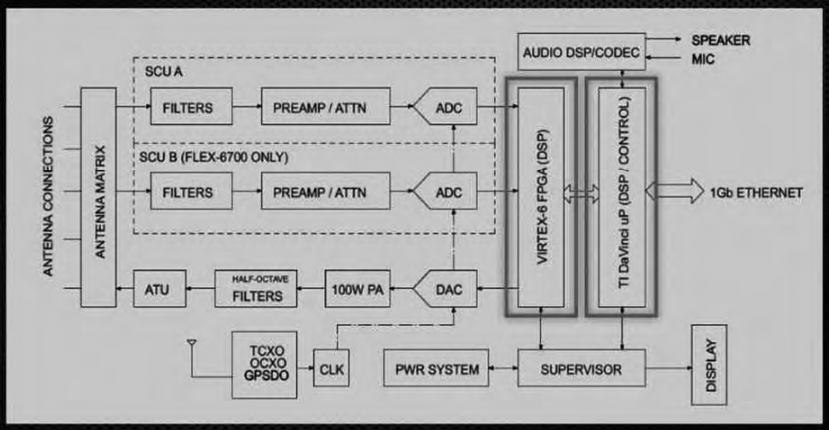
Linux Apache MySQL PHP

## *The Radio Server*

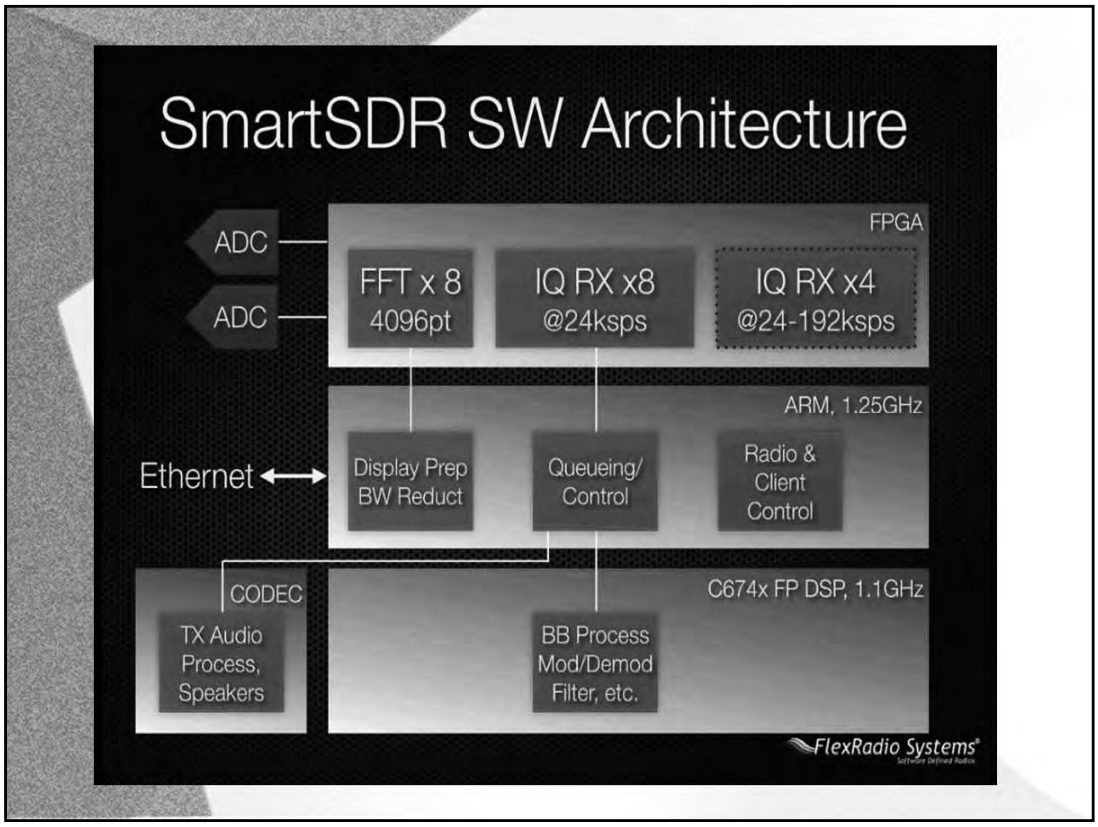
# FLEX-6000 Signature Series Family

| | Pan /RX | Max BW | DAXIQ | SCU | ATU | GPSDO | Mic | Freq |
|---|---|---|---|---|---|---|---|---|
| FLEX-6300 | 2 | 7 MHz | 2 up to 96kHz | 1 | Opt | – | Unbal | 160–6m |
| FLEX-6500 | 4 | 14 MHz | 4 up to 192kHz | 1 | YES | Opt | Unbal + Bal | 160–4m |
| FLEX-6700 | 8 | 14 MHz | 4 up to 192kHz | 2 | YES | Opt | Unbal + Bal | 160–2m |
| FLEX-6700R | 8 | 14 MHz | 4 up to 192kHz | 2 | N/A | Opt | N/A | 160–2m |

# FLEX-6000 HW System Architecture




FlexRadio Systems


SmartSDR SW Architecture
ADC
ADC
FPGA
FFT x 8
4096pt
IQ RX x8
@24ksps
IQ RX x4
@24-192ksps
ARM, 1.25GHz
Ethernet
Display Prep
BW Reduct
Queueing/
Control
Radio &
Client
Control
CODEC
TX Audio
Process,
Speakers
C674x FP DSP, 1.1GHz
BB Process
Mod/Demod
Filter, etc.
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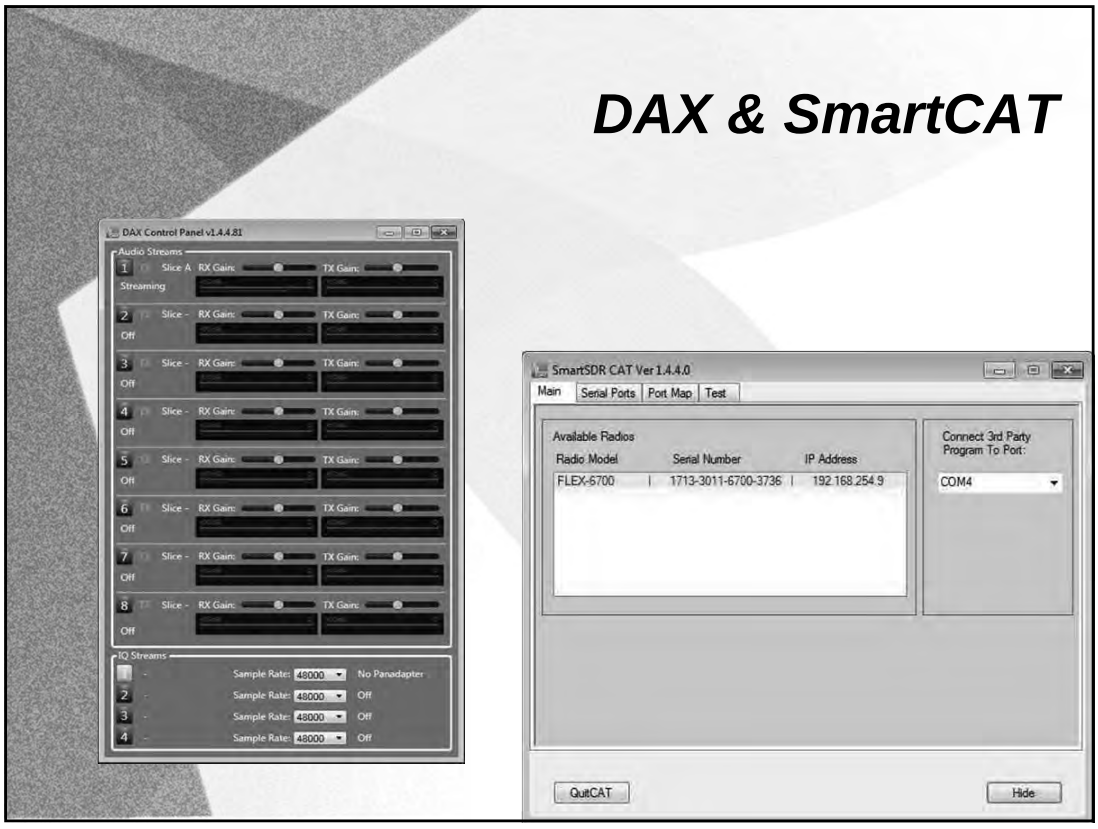
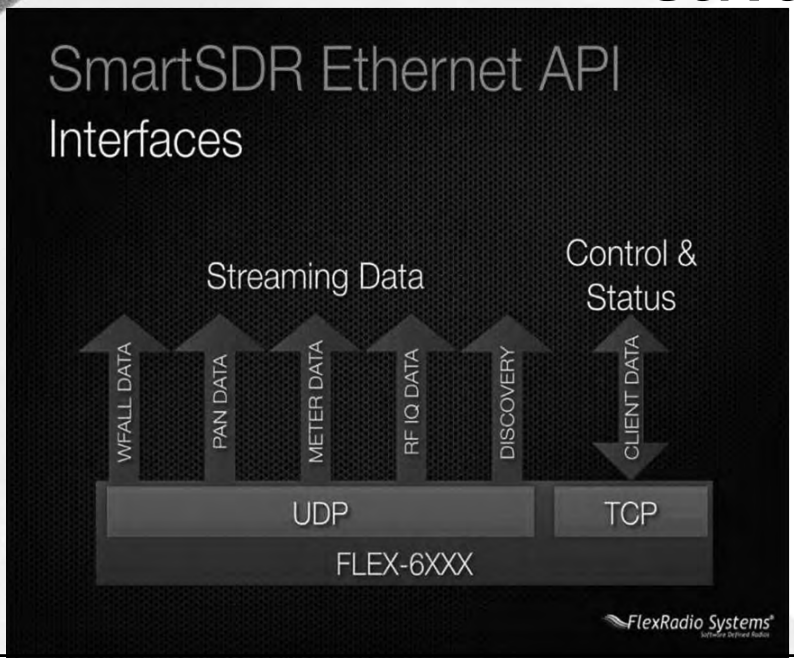
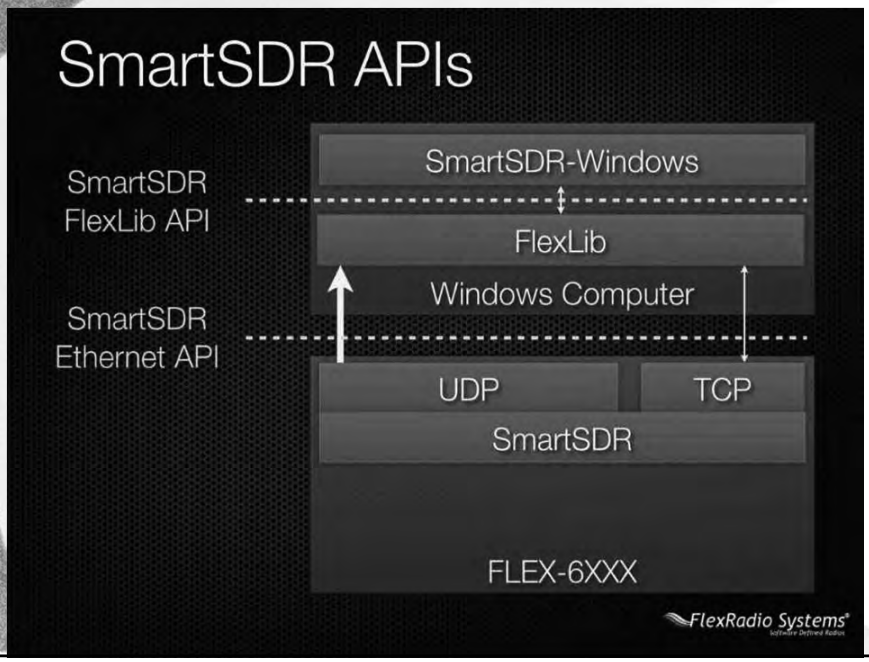

DAX & SmartCAT
DAX Control Panel v1.4.4.81
Audio Streams
Slice A
RX Gain:
TX Gain:
Streaming
Off
IQ Streams
Sample Rate: 48000
No Panadapter
SmartSDR CAT Ver 1.4.4.0
Main
Serial Ports
Port Map
Test
Available Radios
Radio Model
Serial Number
IP Address
FLEX-6700
1713-3011-6700-3736
192.168.254.9
Connect 3rd Party
Program To Port:
COM4
QuitCAT
Hide

## *Talking to the Radio Server*



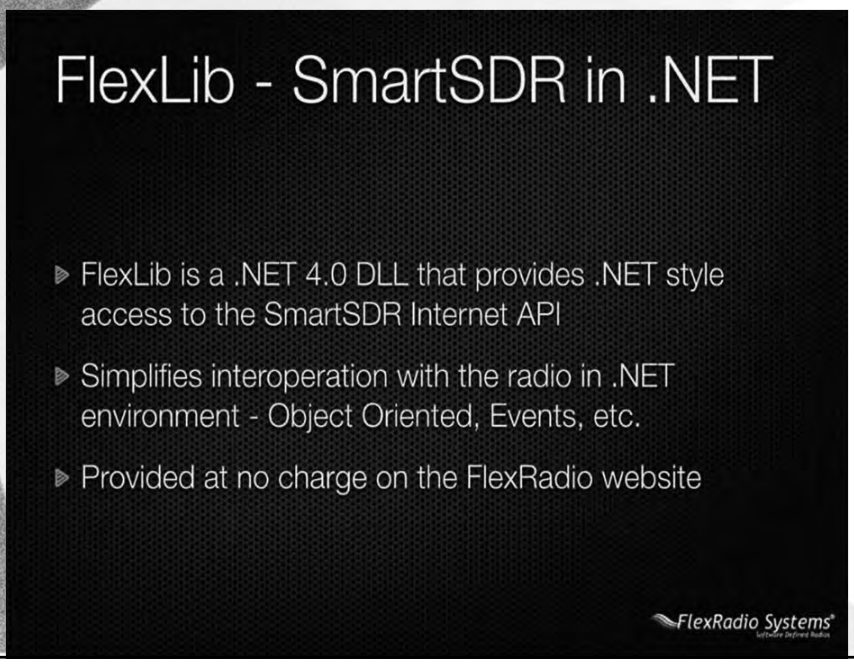

## *SmartSDR and the use of FlexLib*



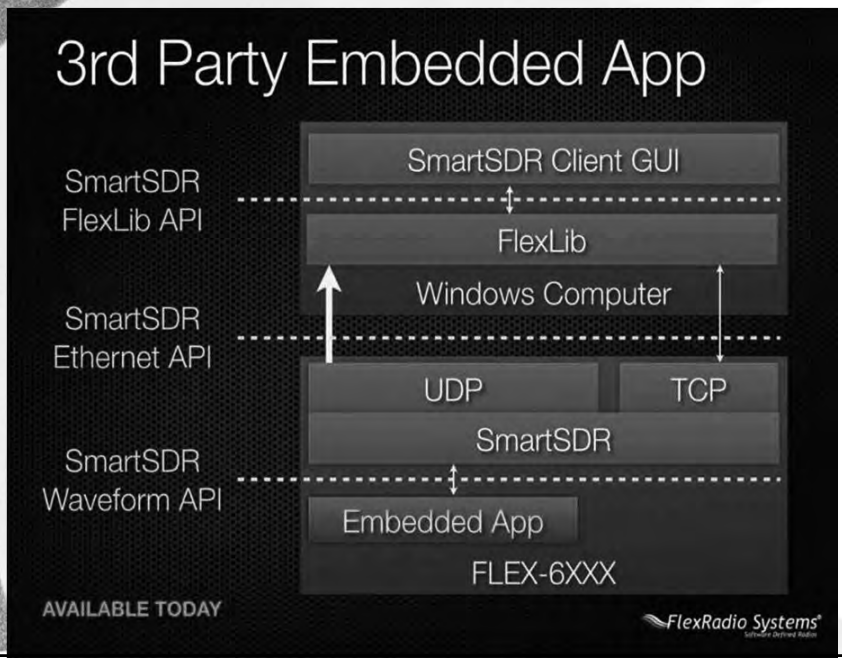
## *Flex Uses the API*

- SmartSDR Windows client rests on FlexLib which rests on the internet API
- CAT and DAX also use FlexLib
- You can do anything done in SmartSDR
- Unprecedented control over a Radio Server

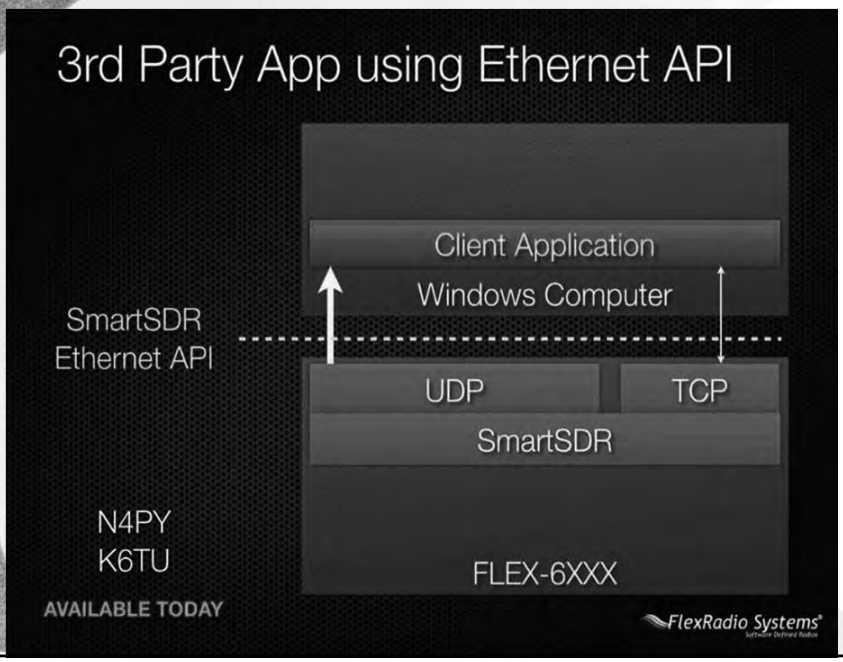
## *FlexLib*



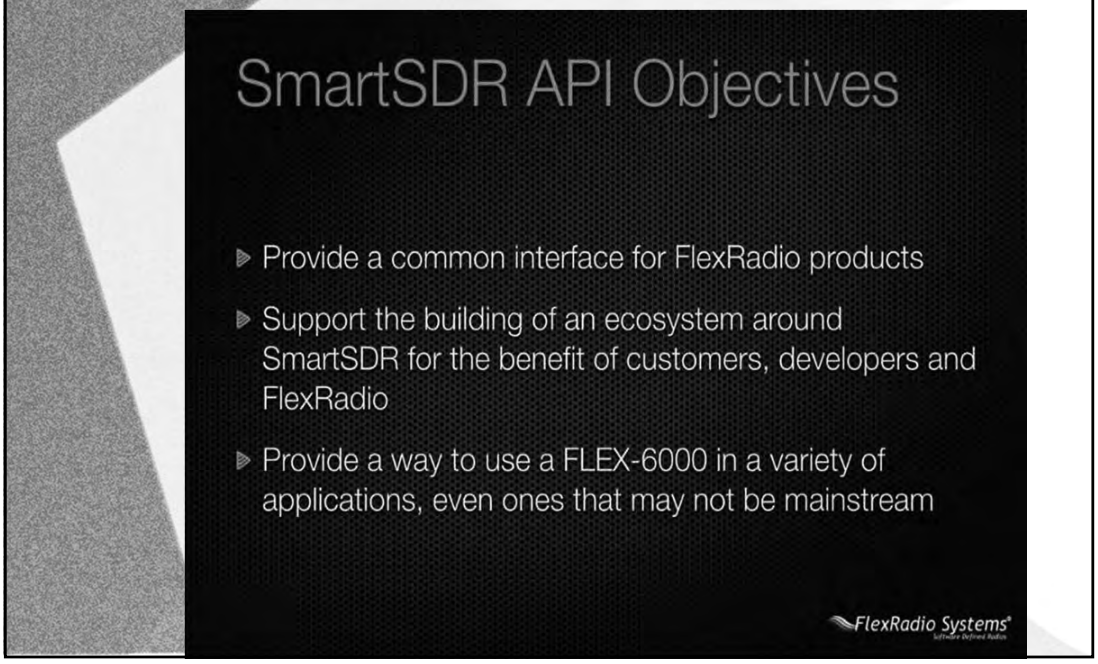
## *Installing App in Radio*



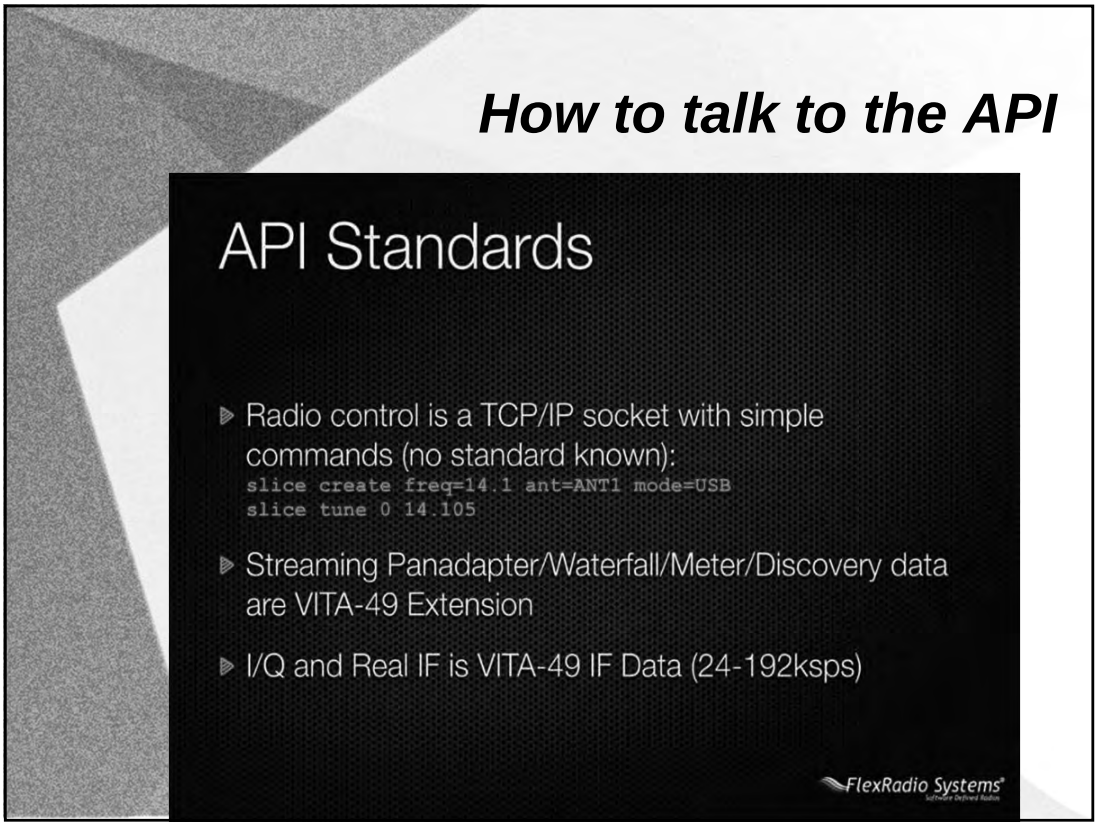

## *What I am doing*



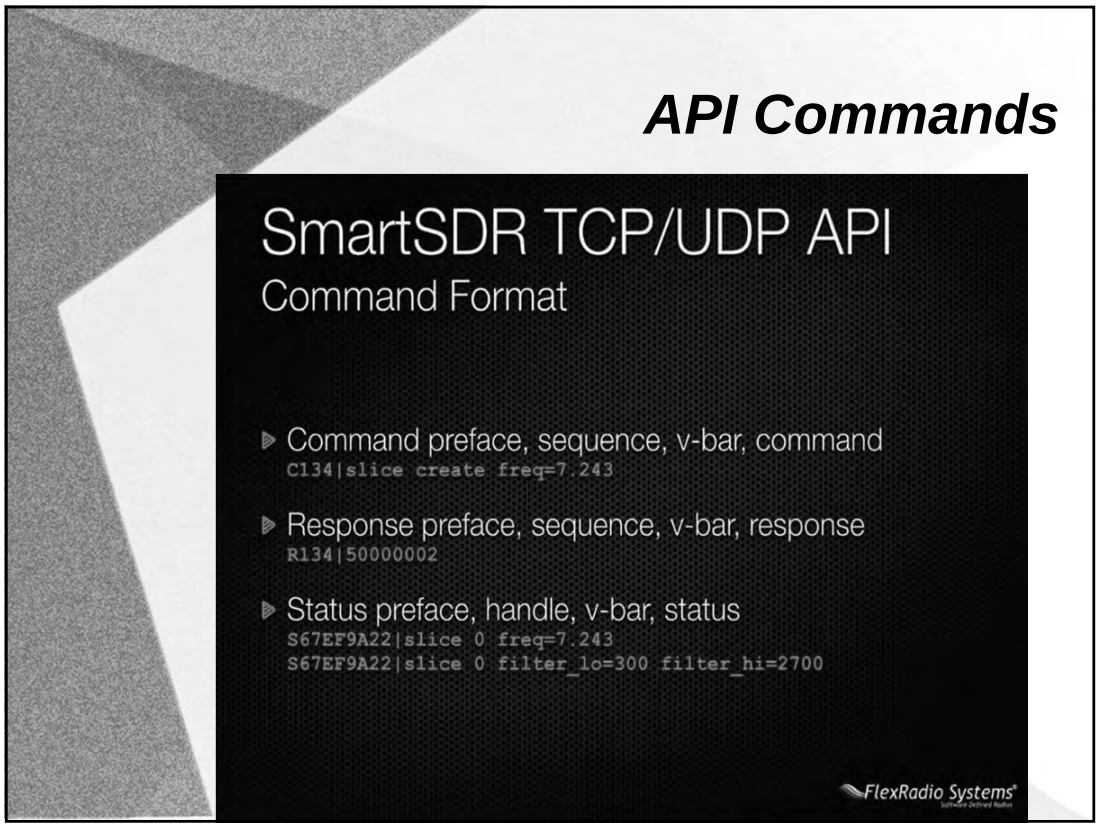
## API Objectives



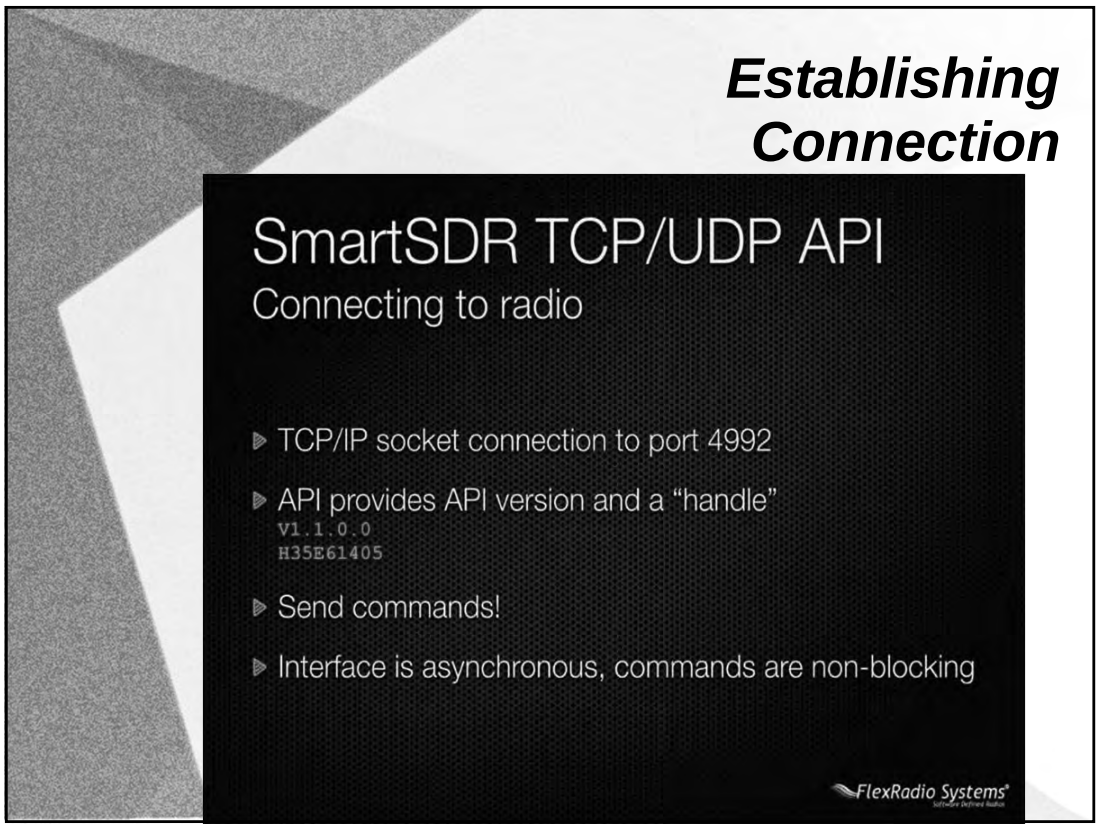

## How to talk to the API



## API Commands




## Establishing Connection



## *Slice Exchange*

### Slice Receivers, example

- Create a slice receiver

```
slice create [freq=<MHz>] [ant=<antenna>] [mode=<mode>]
C34|slice create freq=14.236 mode=FDV
R34|0
```

- Tune a slice receiver

```
slice tune 0 [freq=<MHz>] [ant=<antenna>] [mode=<mode>]
C45|slice 0 freq=14.236
```

- Change slice receiver settings

```
slice set <slice> [<feature>=<value>]
C71|slice set 0 diversity=1 tx=0 record=1
R71|0
```

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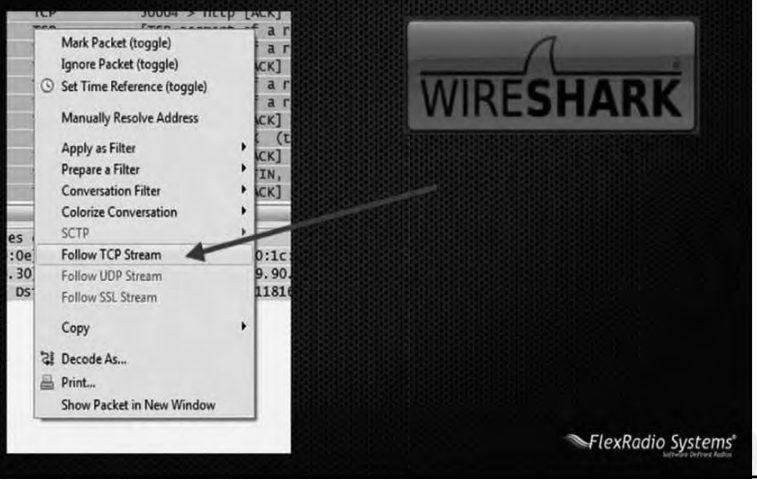
## *Learning the Protocol*

### Sniffing TCP/IP API

Using Wireshark

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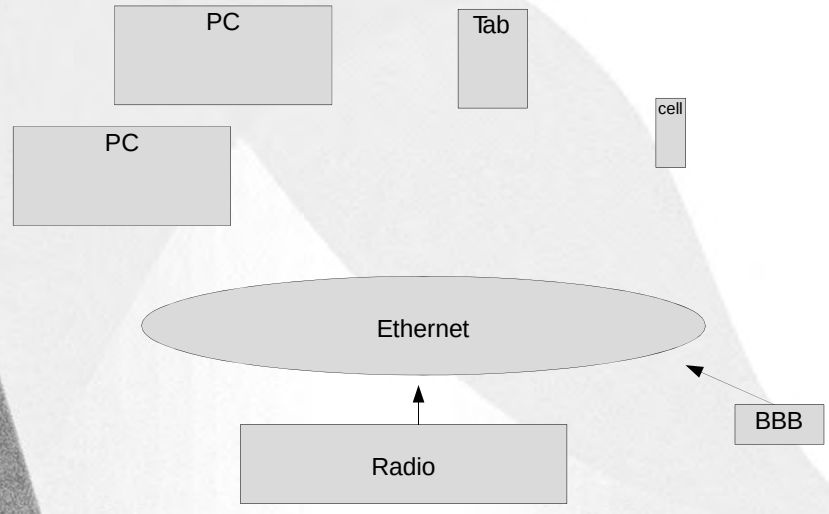
## My Port 80 Plan



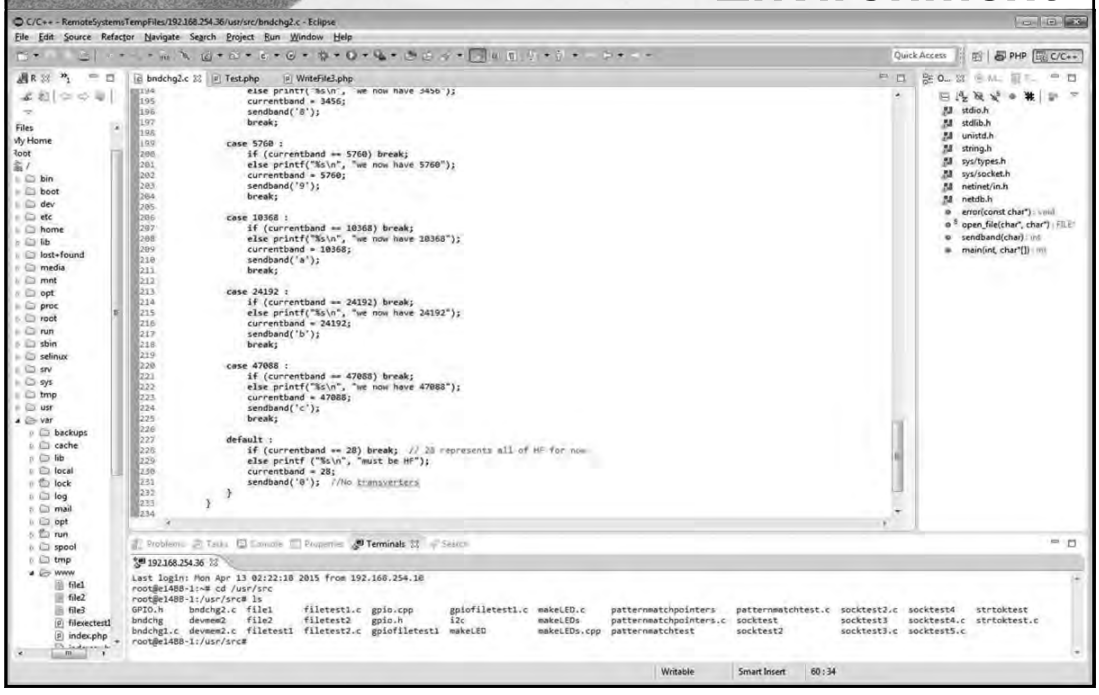

## Technology: Languages

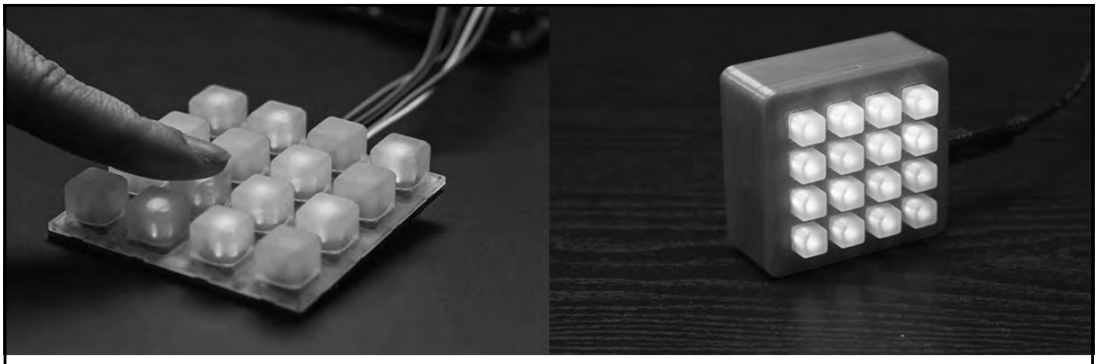
- HTML Hyper Text Markup Language
- AJAX Asynchronous JavaScript and XML
- DOM The Document Object Model is a platform and language-neutral interface that will allow programs and scripts to dynamically access and update the content, structure and style of documents
- Apache / PHP is a server-side scripting language designed for web development but also used as a general-purpose programming language

## *Technology: Languages*

- C Programming Language for the server
- JavaScript is a dynamic computer programming language. It is most commonly used as part of Web browsers, whose implementations allow client-side scripts to interact with the user, control the browser, communicate asynchronously, and alter the document content that is displayed
- JSON JavaScript Object Notation
- Python for early proof of concept

## *Eclipse Development Environment*





- Instantaneous Re-Configuration
- Liaison to Run
- Split Audio
- No Loss of Focus
- Complete Control of Radio
- LED Feedback

## Future Tasks

- Monitor Temperatures
- Control Power Supplies
- Turn Antennas / Switch Antennas
- Multiple Locations with Distributed Computing
- Beacon Monitoring:  Propagation Notification
- Performance of Beacons: Real Time Status
- Dayton Demonstration