



# U.S. ARMY COMBAT CAPABILITIES DEVELOPMENT COMMAND – ARMAMENTS CENTER

Software Defined Radio For Medium Caliber Munitions  
64<sup>th</sup> Annual NDIA Fuze Conference

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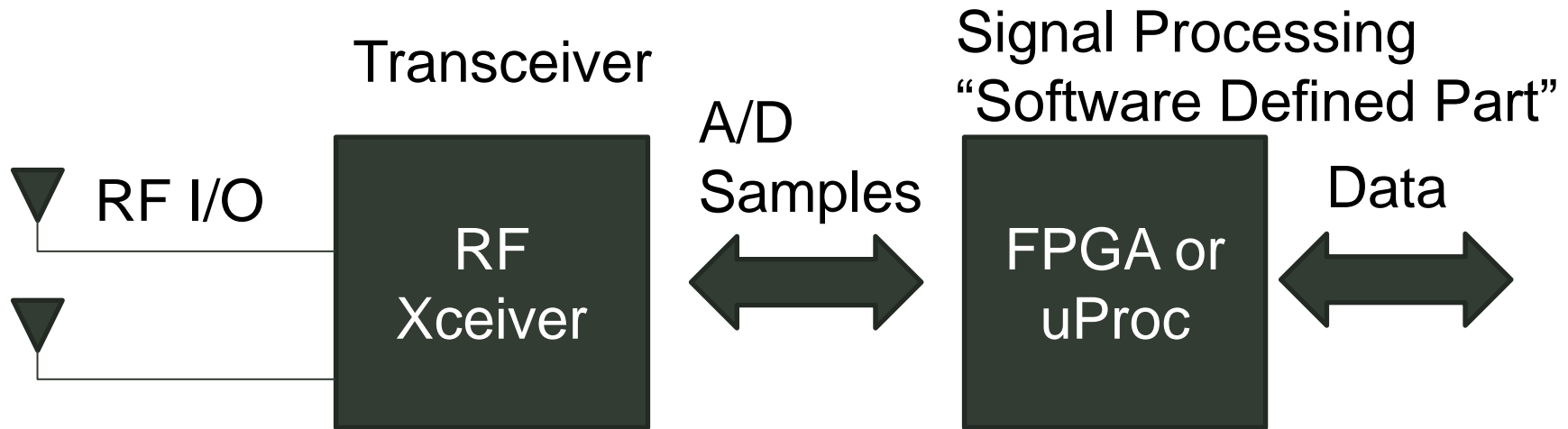
DEVCOM-Armaments Center, Fuze Division



## WHAT IS A SDR



“Software-defined radio (SDR) is a **radio communication system where components that have been traditionally implemented in hardware (e.g. mixers, filters, amplifiers, modulators/demodulators, detectors, etc.)** are instead implemented by means of software on a personal computer or embedded system”





## WHY A SOFTWARE DEFINE RADIO



- **Software Defined Radio**
  - Arbitrary Waveform
  - Arbitrary Bandwidths
  - Arbitrary Data Packets
  
- **Allows for Host Nation operation**
  - Programmable Waveforms
  - Adjustable Frequencies
  - Adjustable Bandwidths
  
- **Demonstrate Prototype with EVM hardware**
  - Goal to eventually fit in 30 mm or 40 mm sized munition





## ISSUES IN DEVELOPING RF DATA LINK



- **Performance Requirements**
  - Information Requirements
  - Data Latency < xx milliseconds
- **Munition Radio Pairing in Real Environment**
  - Operate with Arbitrary Channel Assignment
- **Spectrum Supportable Regulatory Approval to Operate**
  - Frequency Assignments : Manual (SPXXI) Authority to use a specific frequency under specified operating conditions, location (like a “LICENSE” to operate something).
  - Host Nation Approval: Manual (HNC Process & HNSWD) Authority to operate equipment/emitter on a specific frequency within a Host nations sovereign borders (PERMIT & LICENSE in another country).



## USES OF SDR

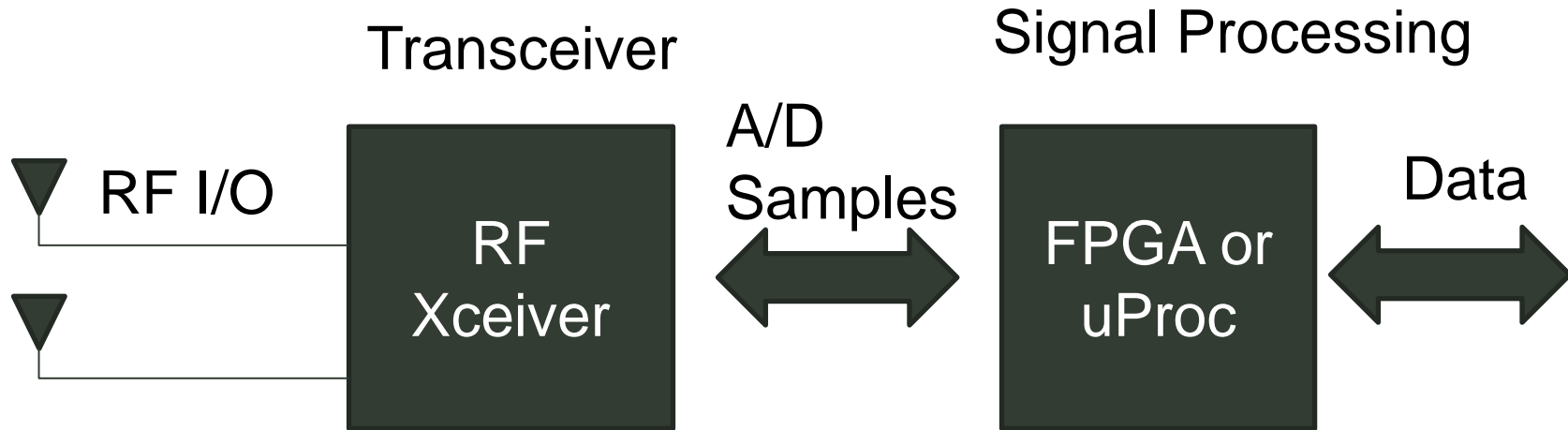


- **In Munitions**

- Experimental system development before FCC approval
- Allow for custom telemetry beyond COTS chips
- Receive Communication from Base Station

- **Ground Station**

- Experimental system development before stage FCC approval
- Allow for custom telemetry beyond COTS chips
- Direct access to Data for post processing

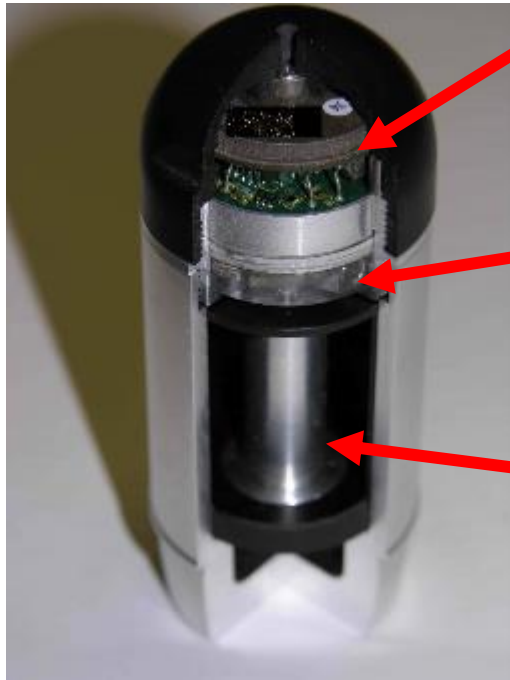




# Traditional Round vs. SDR System

## Off board Sensor allows for Advanced Detection Algorithms

### Conventional

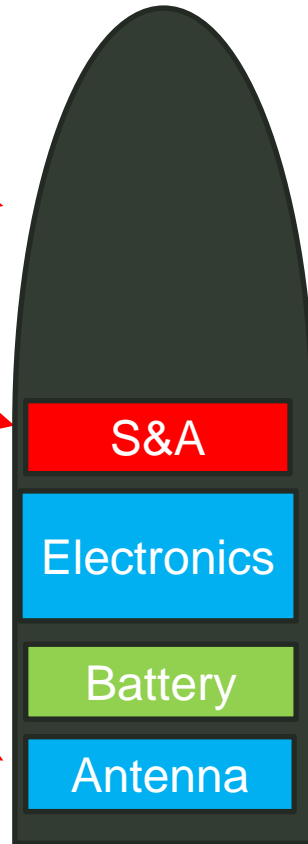


Electronics Warhead

S&A S&A

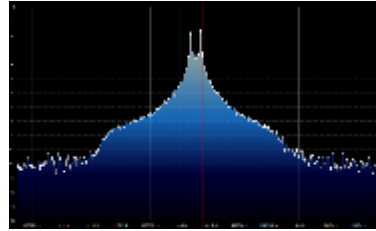
SDR  
Electronics  
Antenna

Base Station



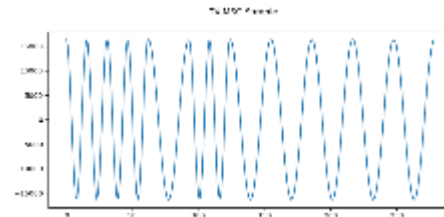


# LABORATORY DEMONSTRATION OVERVIEW



Channel

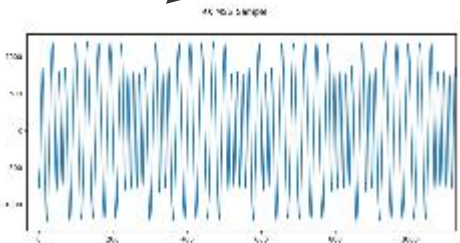
SDR



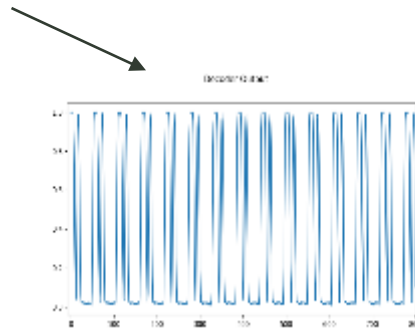
Transmit



Ground Station



Demodulate



Data



# SDR VERSUS COTS SUMMARY

5 = BEST, 1 = WORST



Description	(ASIC COTS CHIP)	Software Defined Radio
Channel Scan Time	1	5
Power Consumption	5	1
Wakeup Time	5	3
Component Size	5	1
Power	5	1
Host Nations Support	1	5
DoD Waveforms	1	5

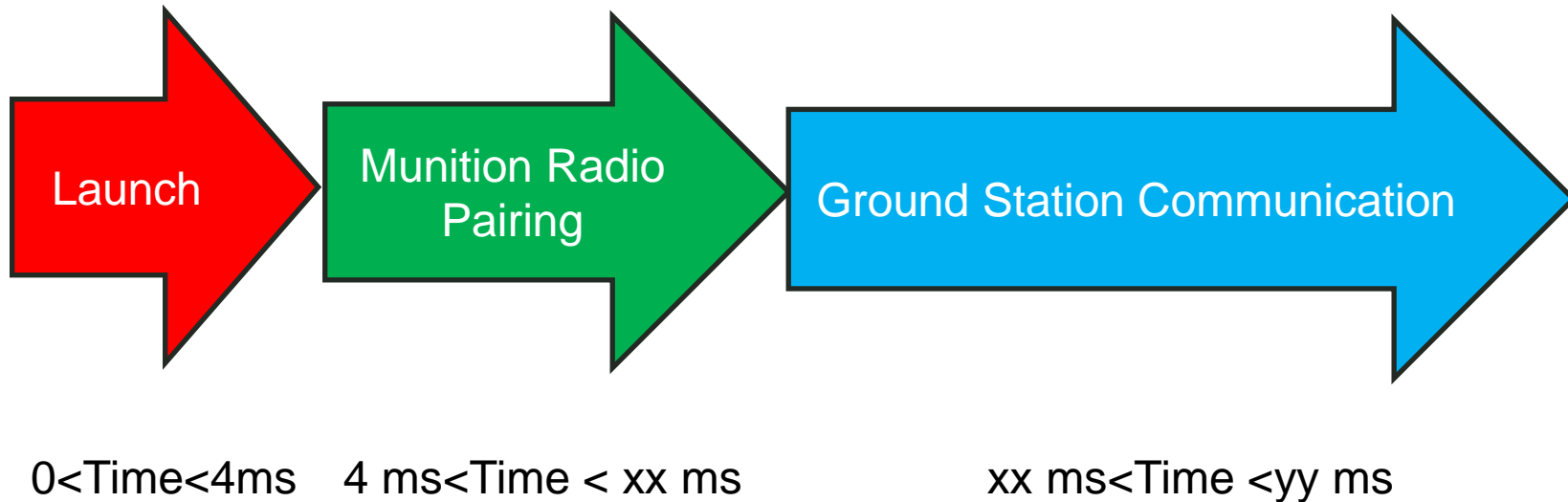




# FUTURE WORK JFTF SHF COMMUNICATION LINK



- *Use SDR to Investigate Communication Waveforms*
- *Demonstrate with Hardware in the Loop*
- **Develop Munition Pairing Algorithm**





## OTHER RESOURCES



- **GNU Radio**
  - GNU Radio is a free open-source software development toolkit that provides signal processing blocks to investigate software radios.
- **Mathworks**
  - Complete End to End development of Radio Link into Embedded Hardware
  - Simulink, Communication Tool Box, Hardware Description Language Coder
- **Analog Devices**
  - Free Book “Software-Defined Radio for Engineers, 2018 | Education | Analog Devices”



## SUMMARY



- **ASIC Chips are smaller and lower power than SDR**
- **SDR allows for more flexibility for DoD applications**
- **SDR's are becoming more prevalent. Free software tools are available for evaluation.**
- **SDR allows for development and demonstration of DoD systems without having to build custom ASIC's**