



# DESIGN OF MODULAR SDR ARCHITECTURE FOR RESOURCE CONSTRAINED MANET

## Session 6C on “Networks” at SDR’10

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# DISCLAIMER

- The research work on Software Defined Radio is supported by the U.S. Army Research Office under Cooperative Agreement No. W911NF-04-2-0054. The views and conclusions contained in this document are those of the author and should not be interpreted as representing the official policies, either expressed or implied, of the Army Research Office or the U. S. Government.



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# OVERVIEW

- NETWORK ARCHITECTURE OBJECTIVES
- TACTICAL REQUIREMENTS
- SDR TO INCREASE NETWORK ARCHITECTURE CYCLE



## NETWORK ARCHITECTURE OBJECTIVES

- Design and implementation of technology based network and systems and end user applications to support tactical operations.
- Develop technology requirements and specification of components based on satisfying tactical requirements Design a reliable secure and robust Network centric architecture that meets all technology requirements.
- Design SDR that can be flexibly used for supporting tactical operations with high degree of QoS assurance for multi-service applications under all channel and terrain conditions.



# TACTICAL REQUIREMENTS

- Security and Trust
- Power and Resource Efficiency
- Efficient Management Function and MIB
- Quality of Service Assurance for Multi-Service Applications
- Flexible and Dynamically Configurable Algorithms for Different Tactical Environment with Different RF
- IP Based Information Transport Allow Interfacing Fixed Networks



# SDR TO INCREASE NETWORK ARCHITECTURE LIFE CYCLE

- Flexibility of Configuring a Set of Programmable Elements and the Functions are Configured such that they can be Dynamically Used for Different Tactical Operations and Environments.
- Allows Incorporation of Existing and Evolving Algorithms to Coexist in Radios.
  - Facilitates Interoperability with Existing Conventional Radios in Each Tactical Environment.
- Modularity of Components within each OSI Layer which Allows Dynamical Changes of Functions with Cross-Layer Management Control.
- Unique Ability to Handle Channel Impairments Flexibly in Each Architecture, and Maintain Efficiency and Performance.
- Thus, Increases Life Cycle of the Network Centric Architecture.



# DESIGN OF SDR

- Design Challenges:
  - Power Efficiency
  - Resource Efficiency
  - For Tactical Environment
    - Multi-band and
    - Multimode Radio in a
    - Multi-role



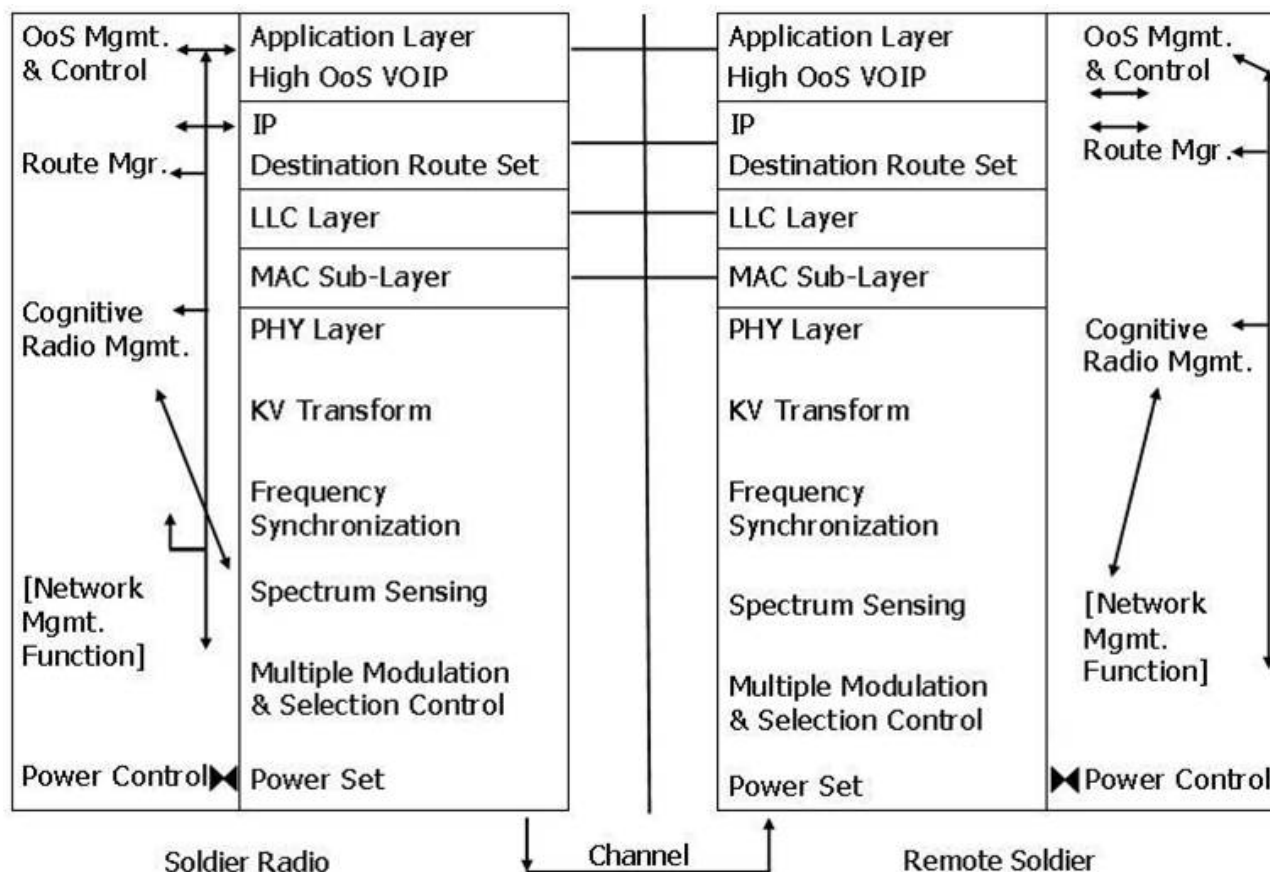
# Components

- PMD
  - Dynamically Changeable Modulations and
  - Demodulations
  - Cognitive Radio Spectrum Sensing
  - Transmit Power Setting Functions
- PS
  - Frequency Synchronization
  - Mod-Demod Control
  - KV Transform Coding with Real time Channel
  - Condition Assessment

**Standard Applicable MAC and Higher Layer Functions**



# PROPOSED SDR ARCHITECTURE





## SPECIFIC IMPLEMENTED FUNCTIONS

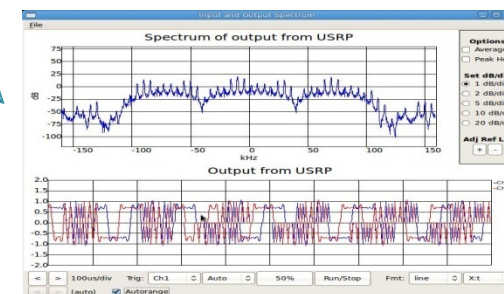
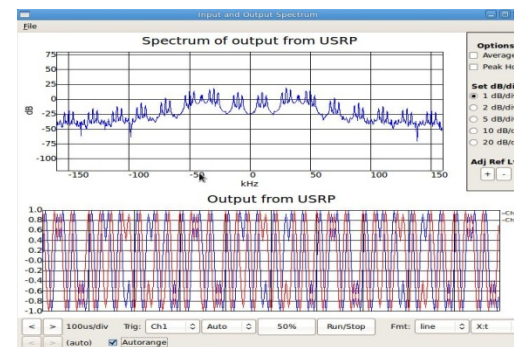
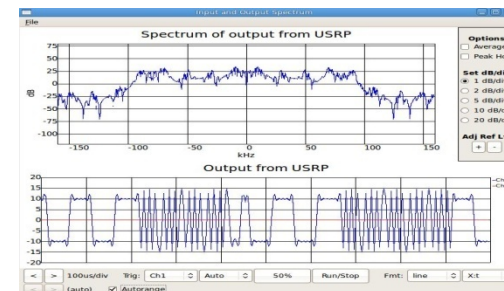
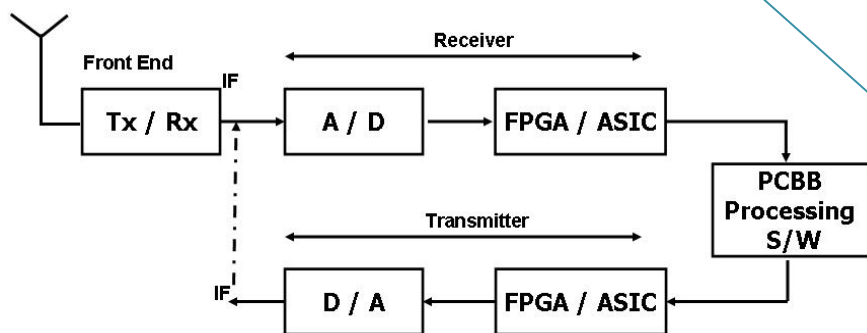
- Modulators

**GMSK**

**DBPSK**

**DQPSK**

- Hardware Components

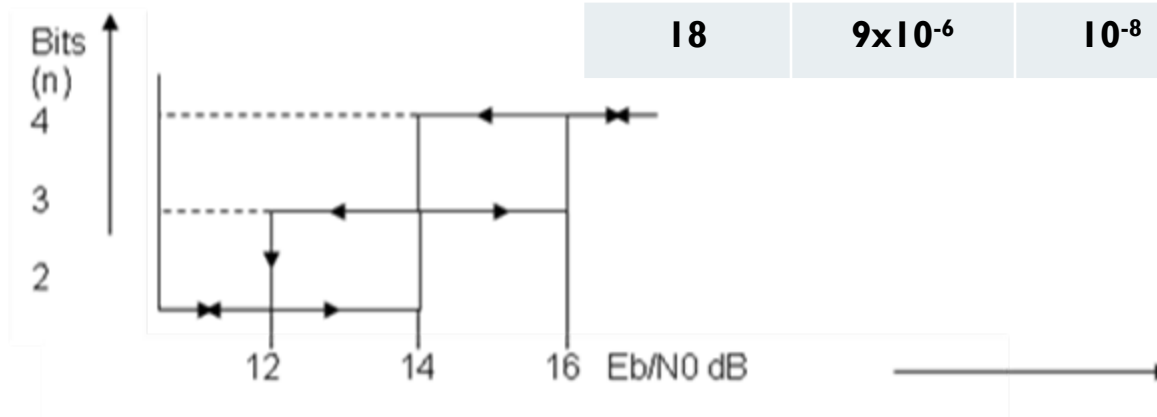




## SPECIFIC IMPLEMENTED FUNCTIONS - MULTI-PATH IMPAIRMENT HANDLING USING KV TRANSFORM

**Target BER set =  $2(10^{-3})$**   
**Vary  $E_b/N_0$  for each data ensemble**

| $E_b/N_0$ dB | Value of n - Bits/discrete sample      |                                      |                    |             |
|--------------|--|--------------------------------------|--------------------|-------------|
| 9.8          | 4                                      | 3                                    | 2                  | 1           |
| 10           | .05                                    | .03                                  | .0098              | .001        |
| 12           | .01                                    | .009                                 | <b>.002</b>        | $10^{-4}$   |
| 14           | $5 \times 10^{-3}$                     | <b><math>2 \times 10^{-3}</math></b> | $2 \times 10^{-4}$ | $10^{-8}$   |
| 16           | <b><math>9.8 \times 10^{-4}</math></b> | $5 \times 10^{-4}$                   | $9 \times 10^{-6}$ | $< 10^{-8}$ |
| 18           | $9 \times 10^{-6}$                     | $10^{-8}$                            | $< 10^{-8}$        | $< 10^{-8}$ |



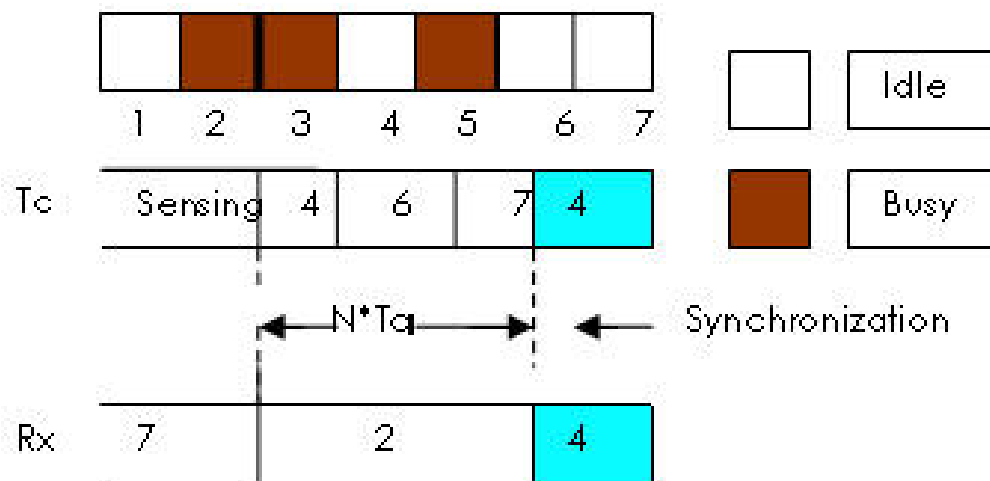


# SPECIFIC IMPLEMENTED FUNCTIONS - COGNITIVE RADIO FUNCTION

## Spectrum Sensing

TOTAL NUMBER OF CHANNELS = 7

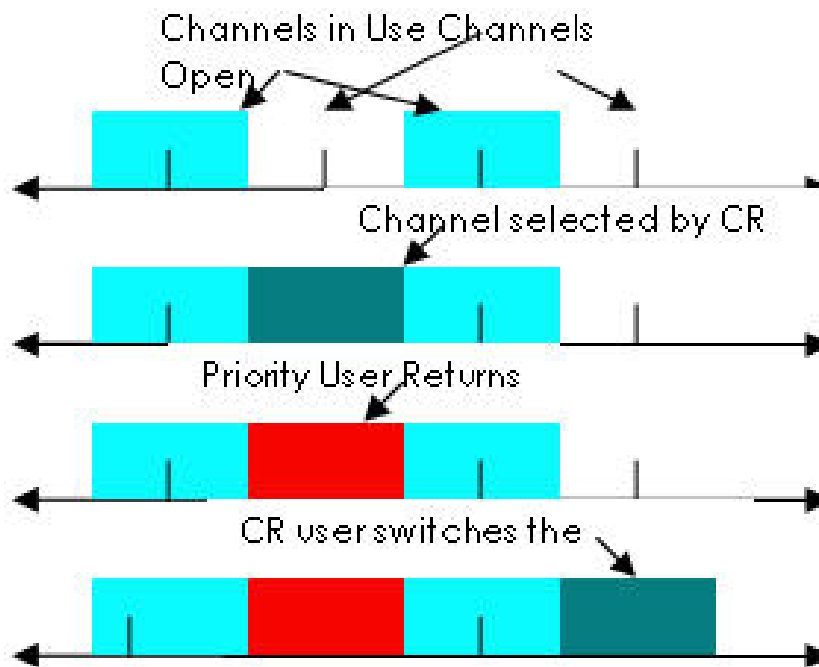
LISTENING CHANNELS OF RECEIVER: 2, 4, 6, 7





# SPECIFIC IMPLEMENTED FUNCTIONS - COGNITIVE RADIO FUNCTION

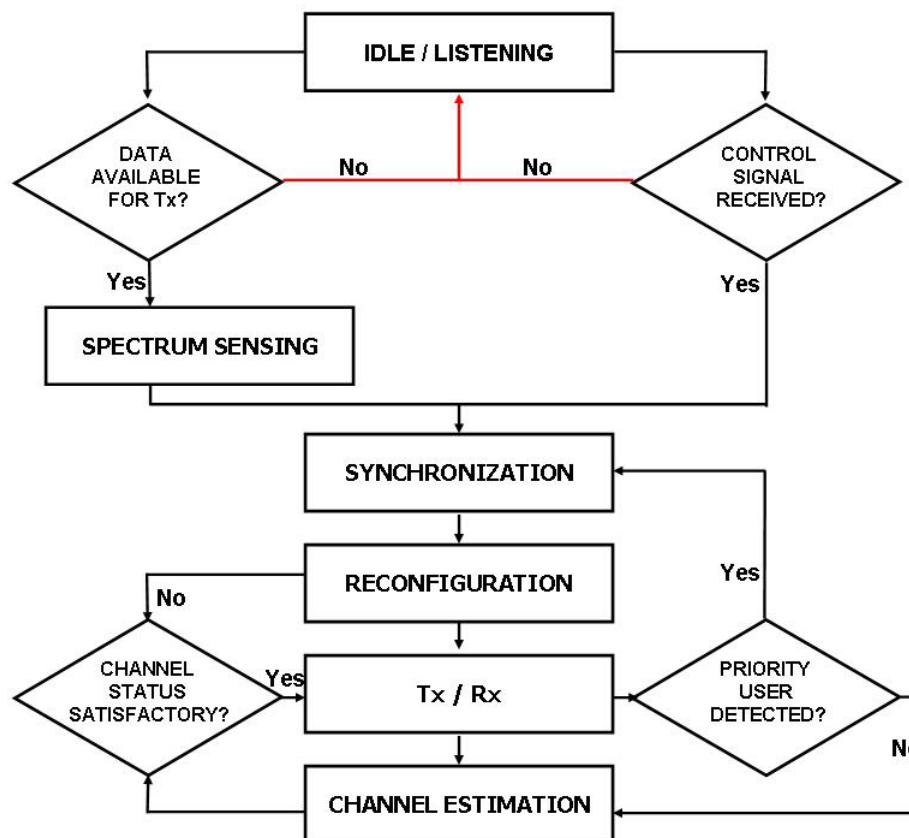
## Dynamic Switching





# SPECIFIC IMPLEMENTED FUNCTIONS - COGNITIVE RADIO FUNCTION

## CR Flow Diagram





# SUMMARY

- Presented Initial Implementation of SDR using GNU Platform Implemented:
- Multiple Modulators with a Representative Samples that can be Changed with an External User Port (for protected secure waveform)
- KV Transform Coding for Real time Channel Condition to maintain Target Error Rate with a Dynamically Changeable Data Rate of Transport to Handle Multi-path Impairment
- (Allows constant delay response time at all times)
- Cognitive Radio Function for Efficient Spectrum Sensing and Switching
- **Intended to use this Implementation for Integrated Sensor – Radio Design.**



# PEACE