



# 700 MHz Broadband for Mission Critical Public Safety Data – A Technical Discussion

CITIG 2012

<http://www.pscr.gov>

Public Safety Communications Research Program  
Department of Commerce – Boulder Labs

# Public Safety Communications Research Program

Located at the  
Department of Commerce  
Boulder Labs in Colorado

The PSCR Program is a joint  
effort between:

NIST's  
Office of Law  
Enforcement Standards  
(OLES)  
and  
NTIA's  
Institute for  
Telecommunication  
Sciences  
(ITS)



# PSCR Funding Sources



**Homeland  
Security**

**Department of Homeland  
Security**

**Office for Interoperability  
and Compatibility**

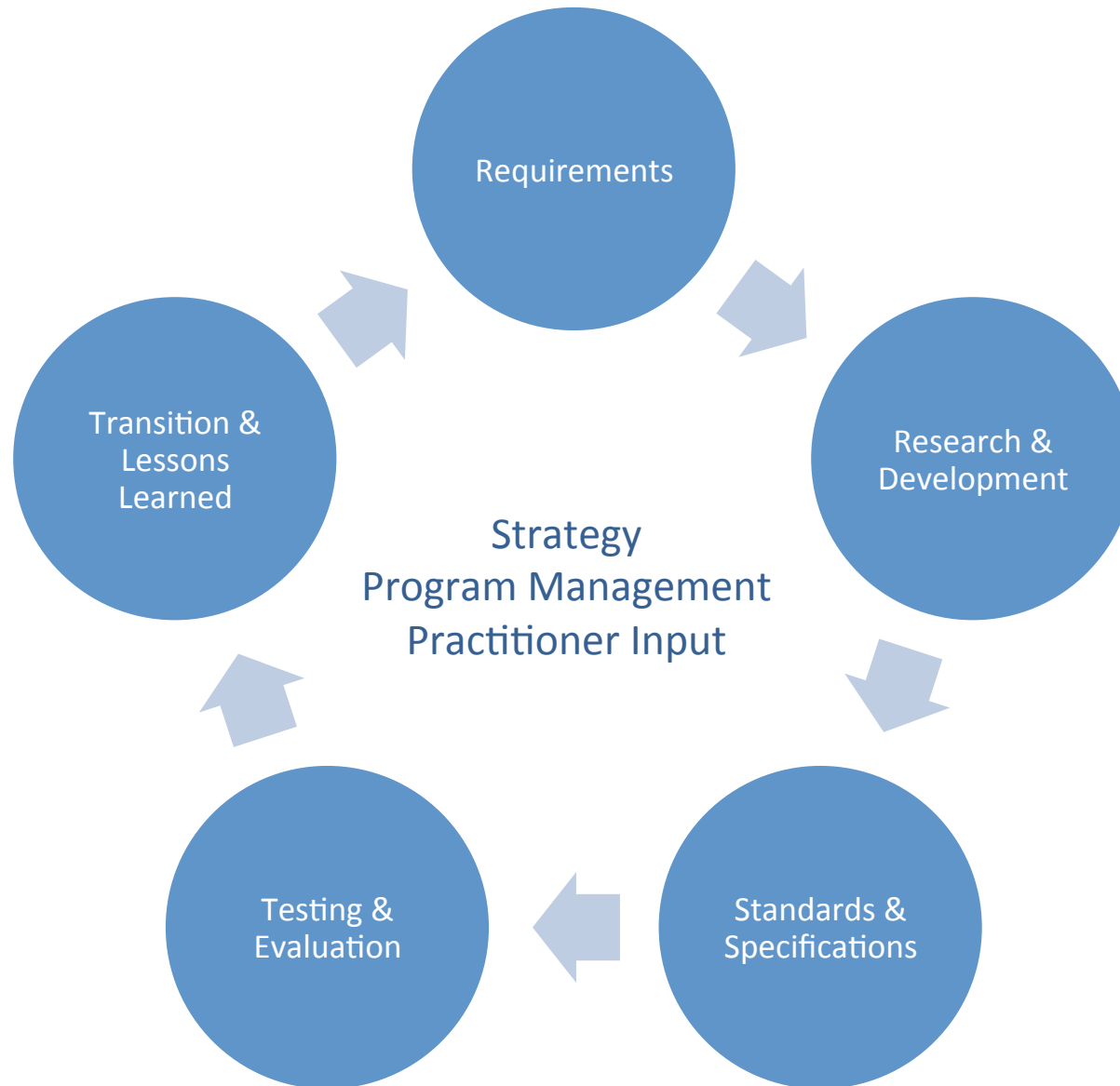
**Office of Emergency  
Communications**



# PSCR Portfolio

LMR Standards and Technologies	Broadband Standards and Technologies	Emerging Standards and Technologies
P25 Standards and CAP	Demonstration Network	Bridging LMR & LTE
P25 Test Tools and Simulation	Requirements and Standards	Video Quality
Public Safety VoIP	Mission Critical Voice	
Audio Quality	Modeling and Simulation	
RF Propagation Studies		

# PSCR Approach & Capabilities



# DISCLAIMER

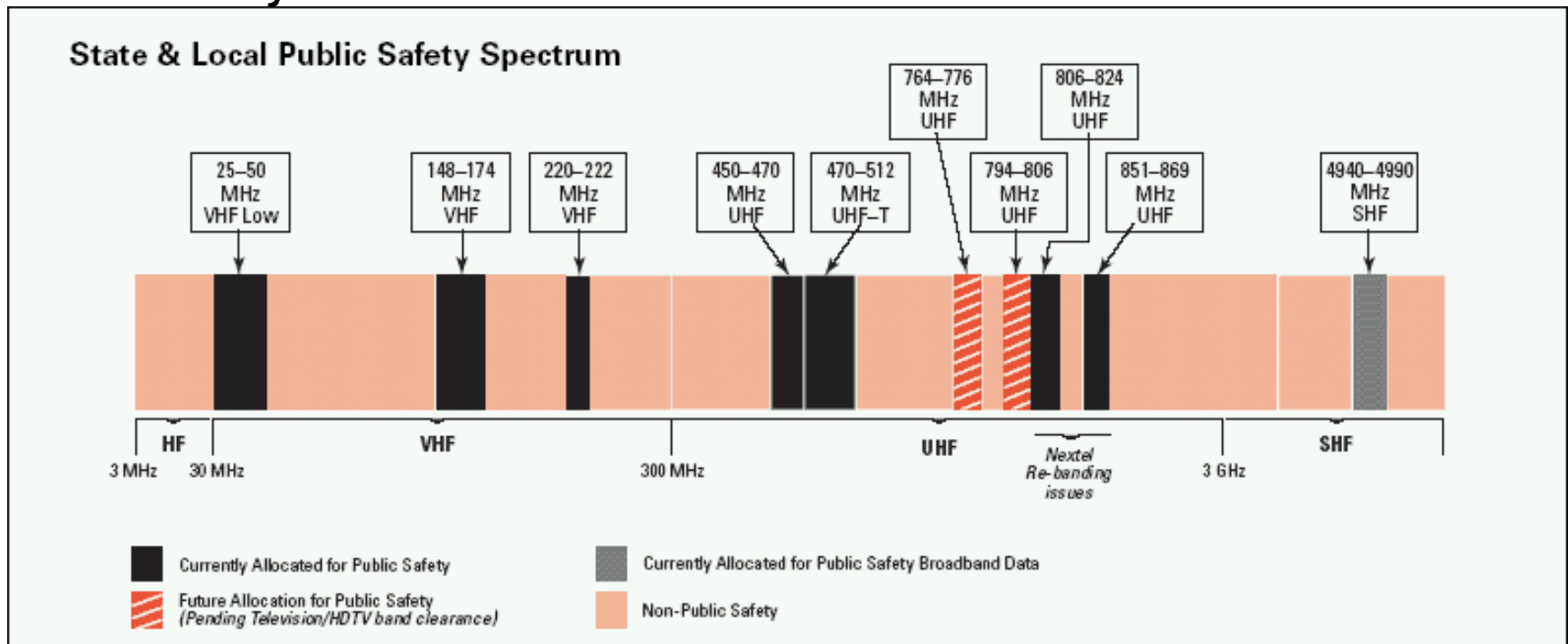
The full description of the procedures used in the following PSCR presentations require the identification of certain agencies, localities, commercial products and their suppliers. The inclusion of such information should in no way be construed as indicating that such agencies, products or suppliers are endorsed by PSCR, or are recommended by PSCR, or that they are necessarily the best materials, instruments, software or suppliers for the purposes described.

# Public Safety Communications Interoperability



# Fragmented PS Radio Frequency Spectrum

- Limited and fragmented radio spectrum
  - Inadequate and scattered spectrum allocations
  - Over 10 separate bands are used for public safety narrowband communications





# US Public Safety Broadband Background

- As early as 2004, public safety began developing requirements for a dedicated broadband network
- In July 2007, the Federal Communications Commission (FCC) designated the lower half of the 700 MHz Public Safety Band (763-768/793-798 MHz) for broadband communications. This spectrum had been cleared by the Digital Television and Public Safety Act of 2005
- In early 2009, Congress directed the FCC to develop a National Broadband Plan, including recommendations for a dedicated public safety broadband network
- Later in 2009, public safety chose Long Term Evolution (LTE) as the primary technology for the broadband network

## **Middle Class Tax Relief and Job Creation Act of 2012**

Title VI – Public Safety Communications  
and Electromagnetic Spectrum Auctions

Created the First Responder Network  
Authority – aka “FirstNet”

**Signed into Public Law 112-96  
on February 22, 2012**

# US Public Safety Broadband in 2012

- In February, Congress passed the Middle Class Tax Relief and Jobs Creation Act of 2012, which re-allocates the D Block (700 MHz spectrum adjacent to the existing public safety block) to public safety and allocates \$7 Billion of incentive auction proceeds to the build out of a nationwide, interoperable public safety broadband network
- The Act created the First Responders Network Authority (FirstNet), the body charged with developing and managing the network
  - The FirstNet Board of Directors was announced in August 2012, and the FirstNet Board held their first meeting in September
  - In October, the NTIA (on behalf of FirstNet) issued a Notice Of Inquiry to “seek public comment on the conceptual network architecture presentation made at the FirstNet Board of Directors’ meeting held on September 25, 2012, as well as to invite input on other network design and business plan considerations.”

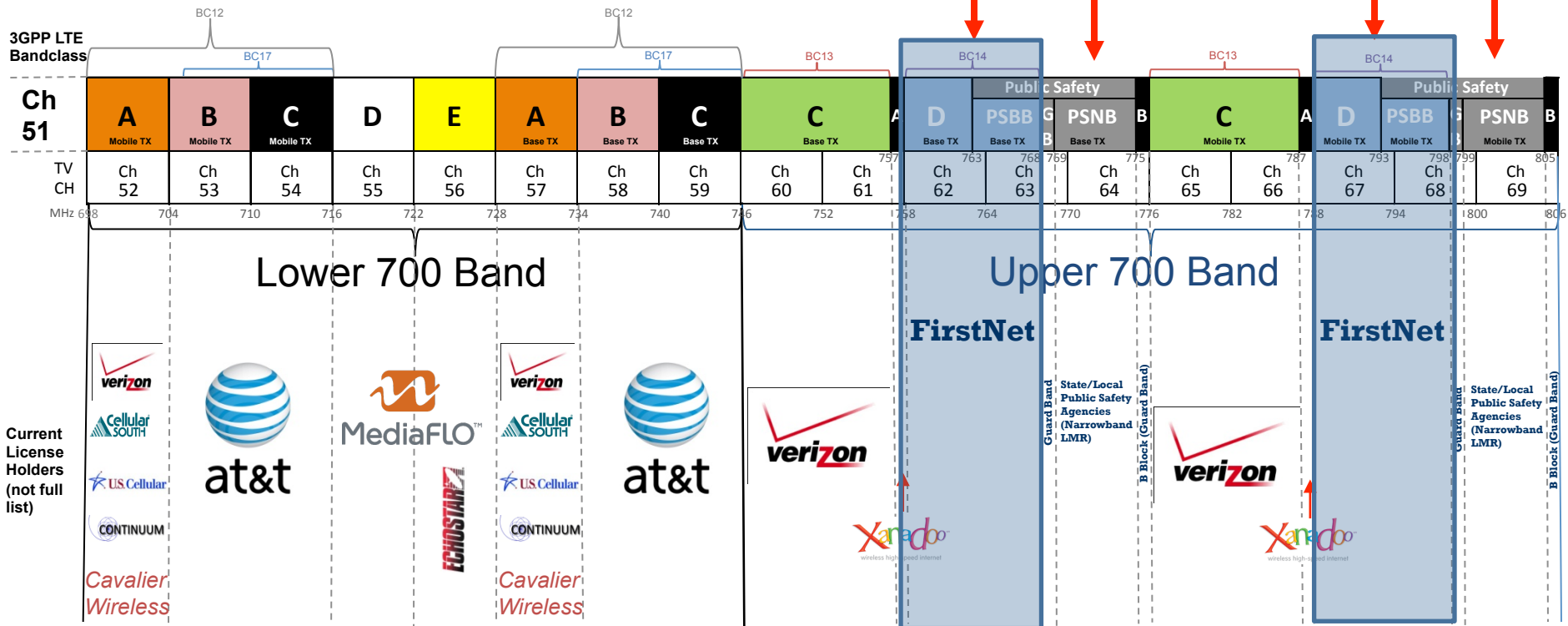
# 700 MHz Spectrum after Public Law 112-96

FirstNet License: 

Base TX	Mobile TX	Bandwidth
758-768	788-798	10x10 MHz

**FirstNet PS Broadband**

**PS Narrowband**



# PSCR Current Efforts

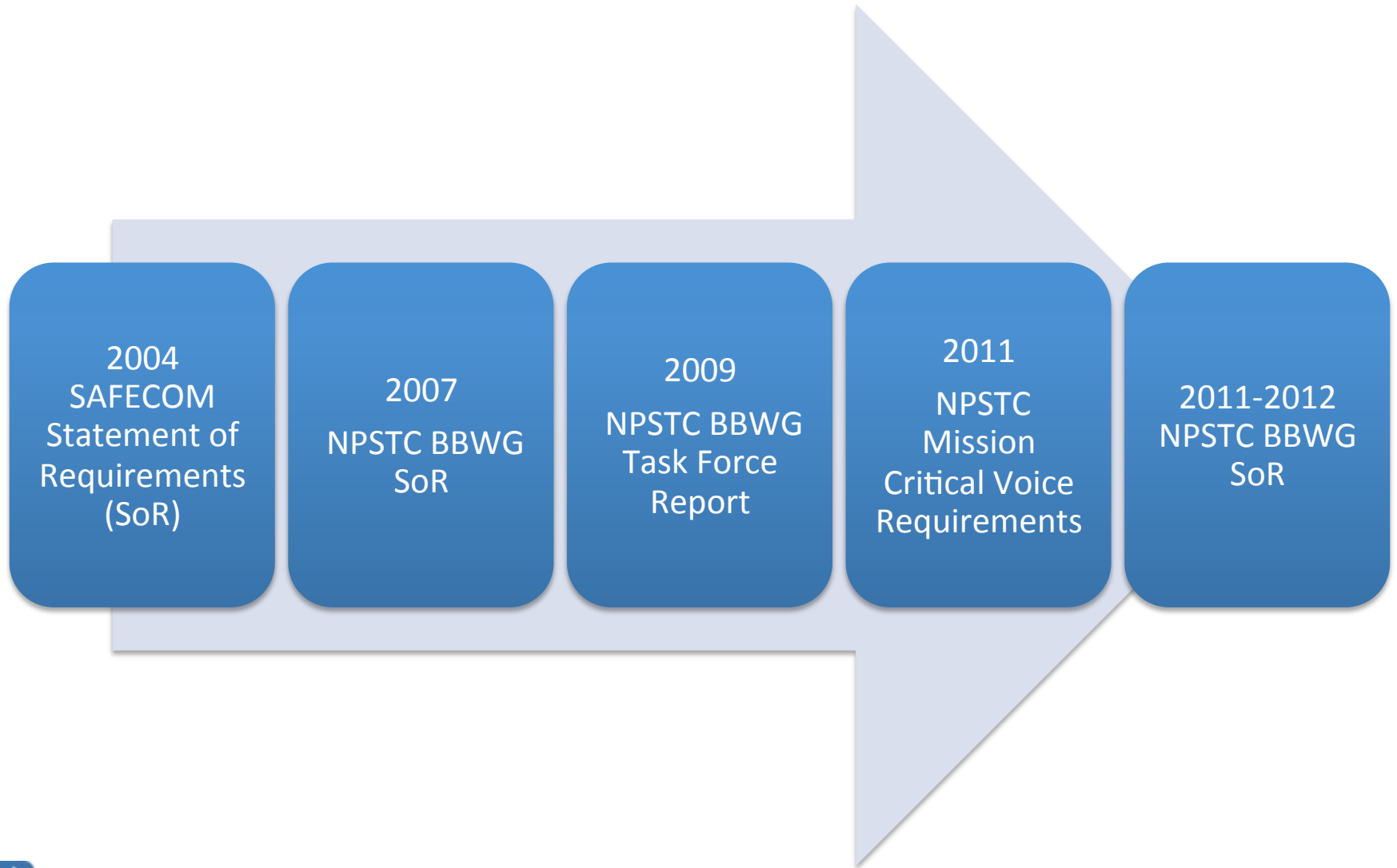
Requirements

Standards

700 MHz Public Safety Broadband  
Demonstration Network

Modeling & Simulation

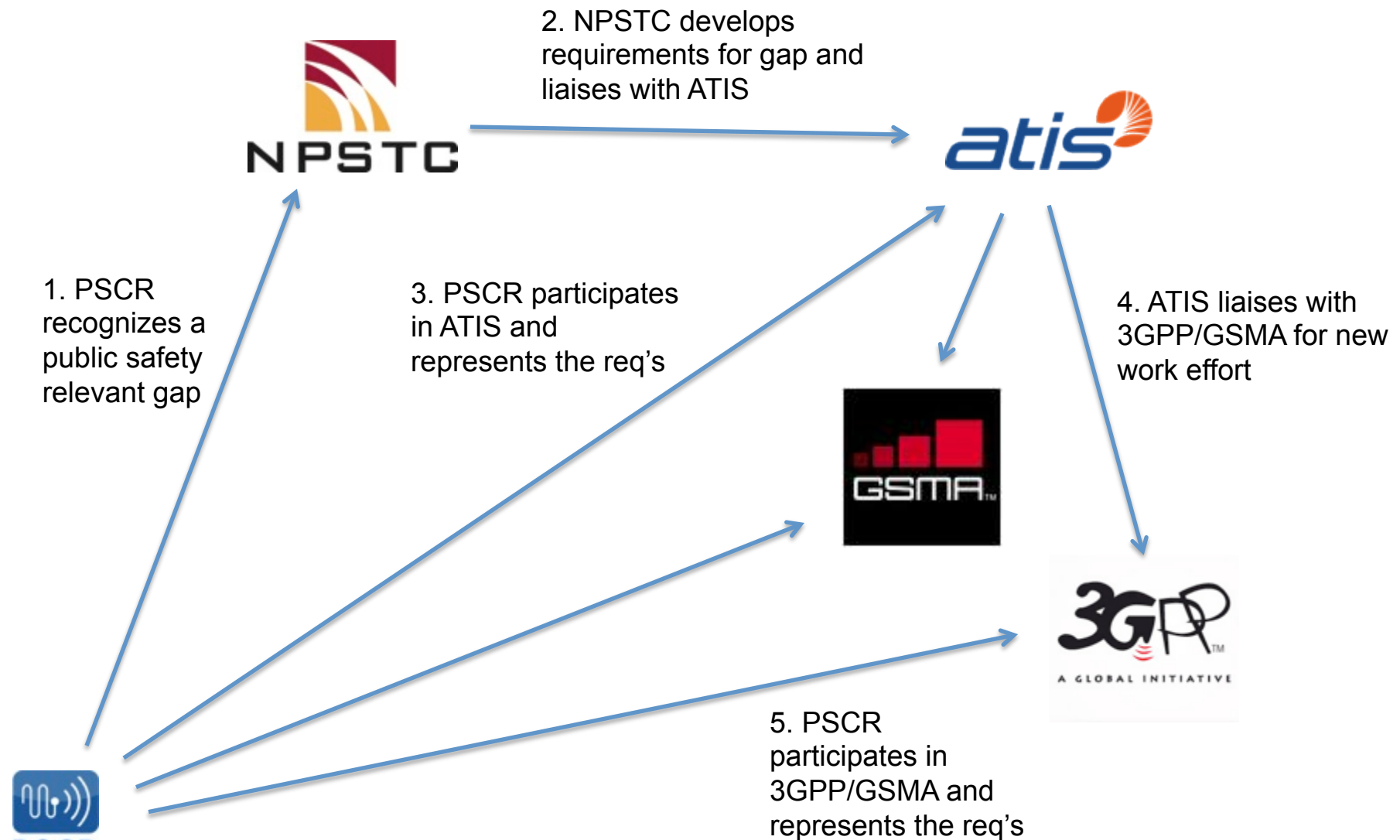
# Requirements



# Requirements: Current Efforts

- 2004 SAFECOM Statement of Requirements
  - Who, what, why, when operational understanding
- 2007 National Public Safety Telecommunications Council (NPSTC) Broadband Working Group (BBWG) Statement of Requirements
- 2009 NPSTC BBWG Task Force Report
  - Public safety selects LTE
  - LMR model for procurement and operation
- 2011 Mission Critical Voice Requirements
  - BBWG seeks to define features/functions that make up mission critical voice
- 2011-2012 NPSTC BBWG Task Group Efforts
  - Priority/quality of service
  - Local control
- 2012 NPSTC BBWG Statement of Requirements
  - Currently developing “Launch Requirements” for FirstNet

# Broadband Standards: Current Efforts





# Standards Continued: 3GPP Structure

## Technical Specifications Group (TSG) Structure

**TSG GERAN**  
GSM EDGE Radio  
Access Network

GERAN WG1  
Radio Aspects

GERAN WG2  
Protocol Aspects

GERAN WG3  
Terminal Testing

**TSG RAN**  
Radio Access  
Network

RAN WG1  
RL 1 Spec

RAN WG2  
RL 2 Spec  
RL 3 RR Spec

RAN WG3  
Lub, lur, lu specs  
UTRAN O&M Reqs

RAN WG4  
Radio Perf  
Protocol Aspects

RAN WG5  
Mobile Terminal  
Conformance Testing

**TSG SA**  
Service &  
Systems Aspects

SA WG1  
Services

SA WG2  
Architecture

SA WG3  
Security

SA WG4  
Codec

SA WG5  
Telecom Mgt

**TSG CT**  
Core Network &  
Terminals

CT WG1  
MM/CC/SM (lu)

CT WG3  
Interworking w/ Ext networks

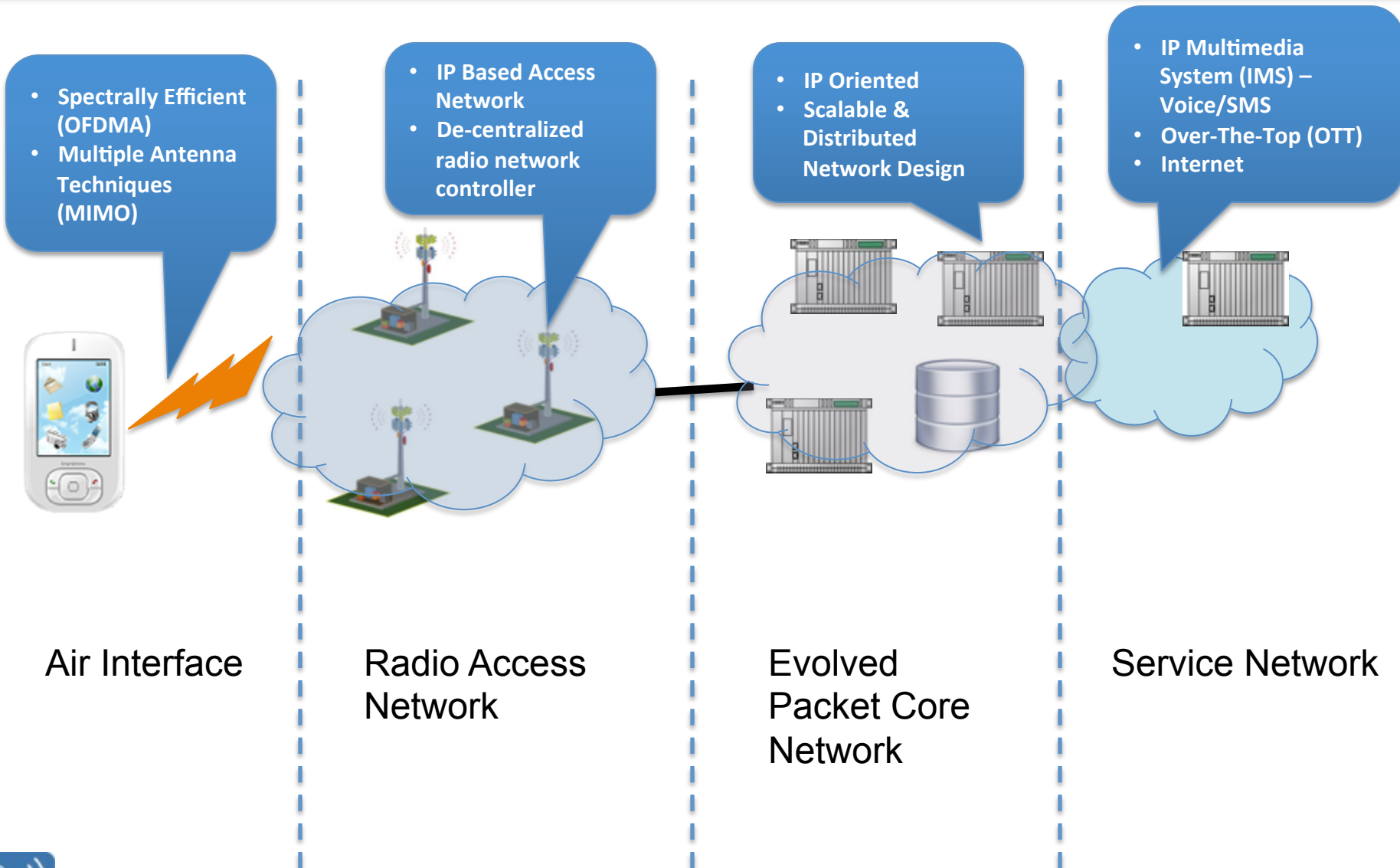
CT WG4  
MAP/GTP/BCH/SS

CT WG6  
Smart Card App Aspects

# Broadband Standards: Current Efforts

- Current Focus
  - 3GPP
    - Proximity Services/ProSe (Talk-around)
    - Group Efficiency (Group communications)
  - ATIS
    - PLMN ID (Public Land Mobile Network Identifier)
    - PTT over LTE (Push-to-talk over LTE)
  - GSMA
    - VoLTE (Voice over LTE)
- Lessons Learned
  - Public safety LTE is a global market; PSCR's global partnerships have been successful

# LTE Network Architecture



# PSCR Demo Network: Current Efforts

- Obtain, procure, and generate interest from broadband vendors to develop a 700 MHz broadband equipment ecosystem - including Band Class 14 (D Block & Public Safety Block), Long Term Evolution (LTE)
- Demonstrate broadband air-interface and core network capabilities
- Interoperability with existing cellular, broadband and LMR technology
- Validation of key public safety functionalities and requirements
- Modeling & Simulation of various potential public safety LTE deployments
- R&D **nationwide interoperability** through a unified approach to network design and implementation
  - Testing (conformance, performance and evaluation)
  - Multi-site/vendor Over-The-Air network – allows consistent testing between vendors
  - Develop guidelines/industry requirements for network architecture
  - Advanced feature testing

# Demonstration Network CRADA Partners



# PSCR Boulder Sites

- PSCR Demonstration network cellsites:

Cellsites On Wheels (COW)



Green Mountain



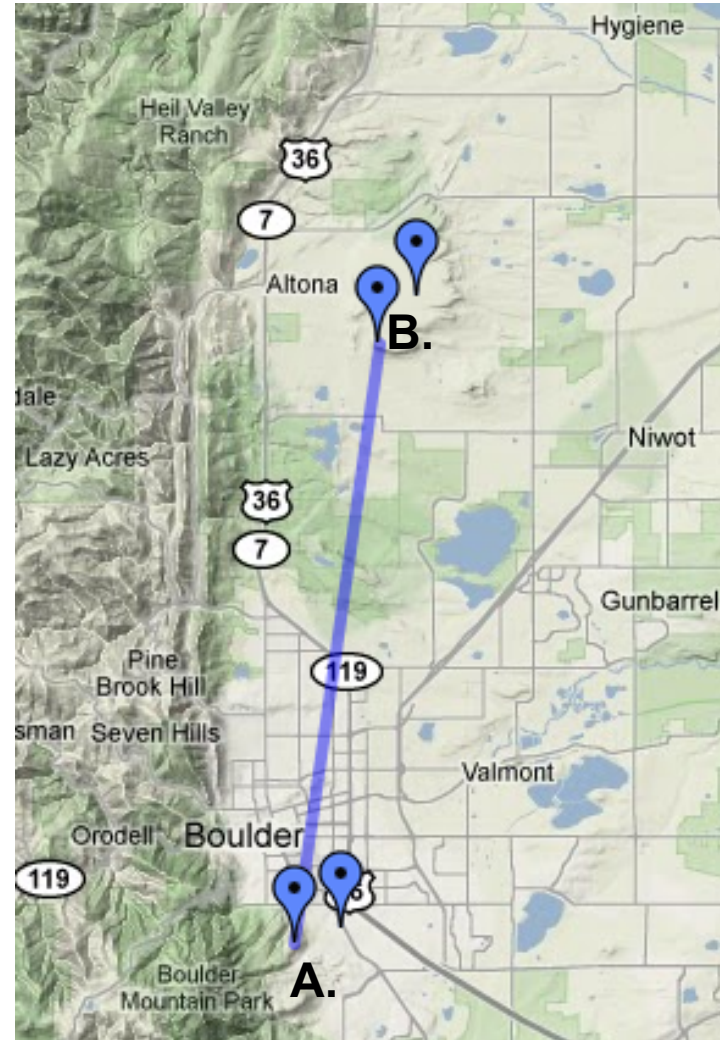
Table Mountain Mesa



# PSCR Boulder Sites

Site locations for the Boulder Demo Network:

- A. Green Mountain
  - Dept. of Commerce Labs
- B. Table Mountain Mesa (9 miles NE of DOC Labs)
  - Radio Quiet Zone
  - Managed by NTIA/ITS
- C. Cell on Wheels (COW)
  - Currently at GunBarrel



# Green Mountain Base Station





# Table Mountain Mesa



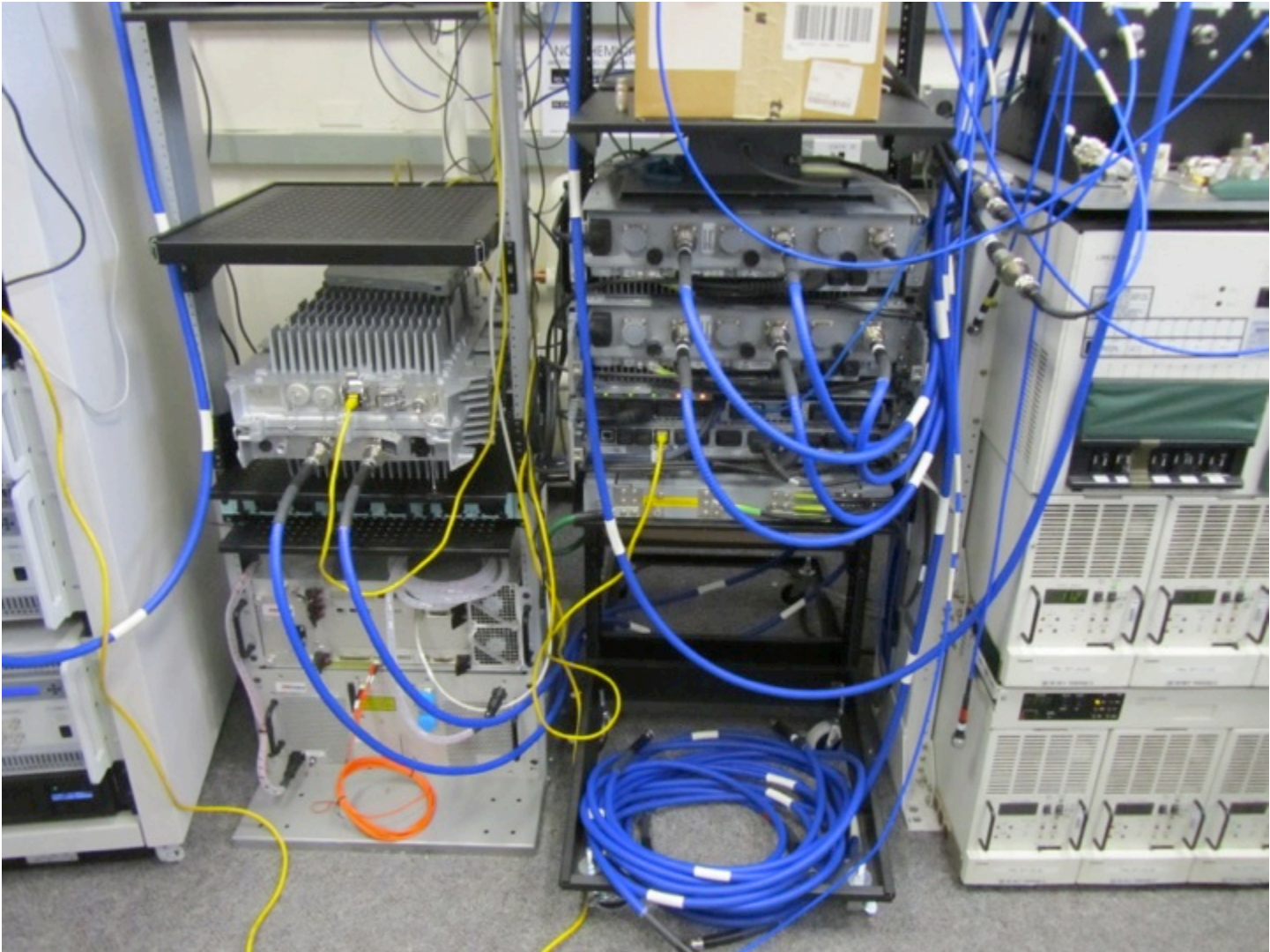
# Table Mountain Mesa (inside)



# Cellsite Base Stations



# Cellsite Base Stations



# Cellsite on Wheels (COW)



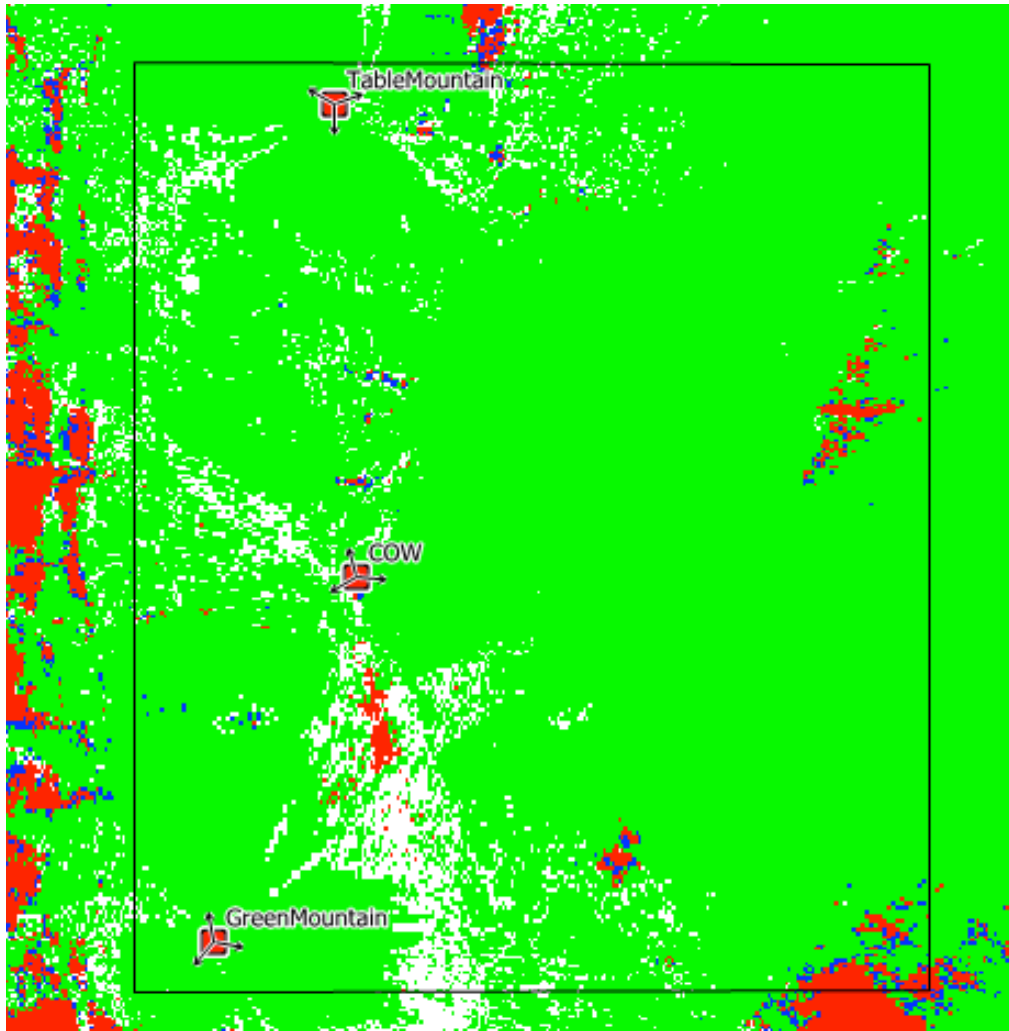
# GunBarrel Co-Located Cellsite



# Network Modeling: Current Efforts

- Evaluate the performance of Long Term Evolution (LTE) networks and their capacity to support Public Safety requirements
  - Optimize different scenarios for the demonstration network
  - Estimate the resources required to build a nationwide public safety broadband network
  - Define performance metrics to facilitate the comparisons of network scenarios and deployments
  - Obtain area, population, and user coverage
  - Determine maximum supported capacity

# Example: 700 MHz Demonstration Network



RSRP Coverage	96.0%
SINR Coverage	91.6%

Red square	Uplink Fail, Downlink Fail
Blue square	Uplink Fail, Downlink OK
White square	Uplink OK, Downlink Fail
Green square	Uplink OK, Downlink OK





Thank You!

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