



PSCR

Network Architecture

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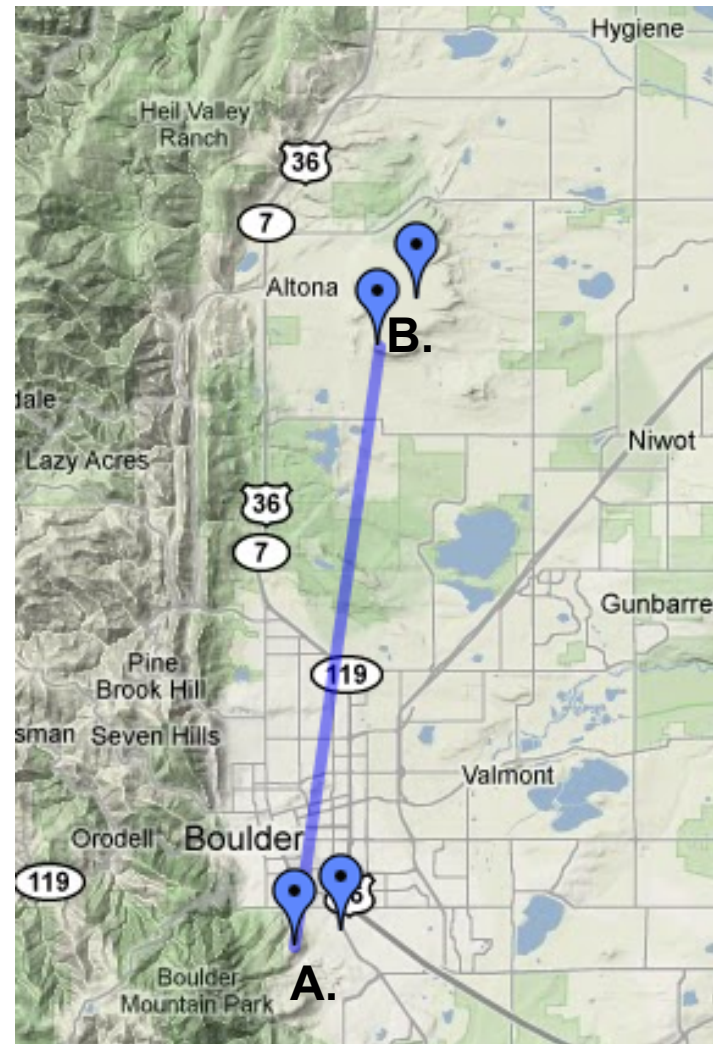
Boulder Site Locations

Two locations for the Boulder Demo Network:

A. Green Mountain Mesa
(immediately west of DOC Labs)

B. Table Mountain
(9 miles NE of DOC Labs)

- Radio Quiet Zone
- Managed by ITS



Boulder Site

- **The initial laboratory and demonstration network will utilize the PSCR facilities located in Boulder, CO.**
 - PSCR Boulder labs will be used for evaluation of signalling, RF and EPC hosting
 - Vendor eNodeB equipment will be co-located
 - All facilities are Federal property and are secure locations
 - VPN connections for external vendor access can be provided



Backhaul

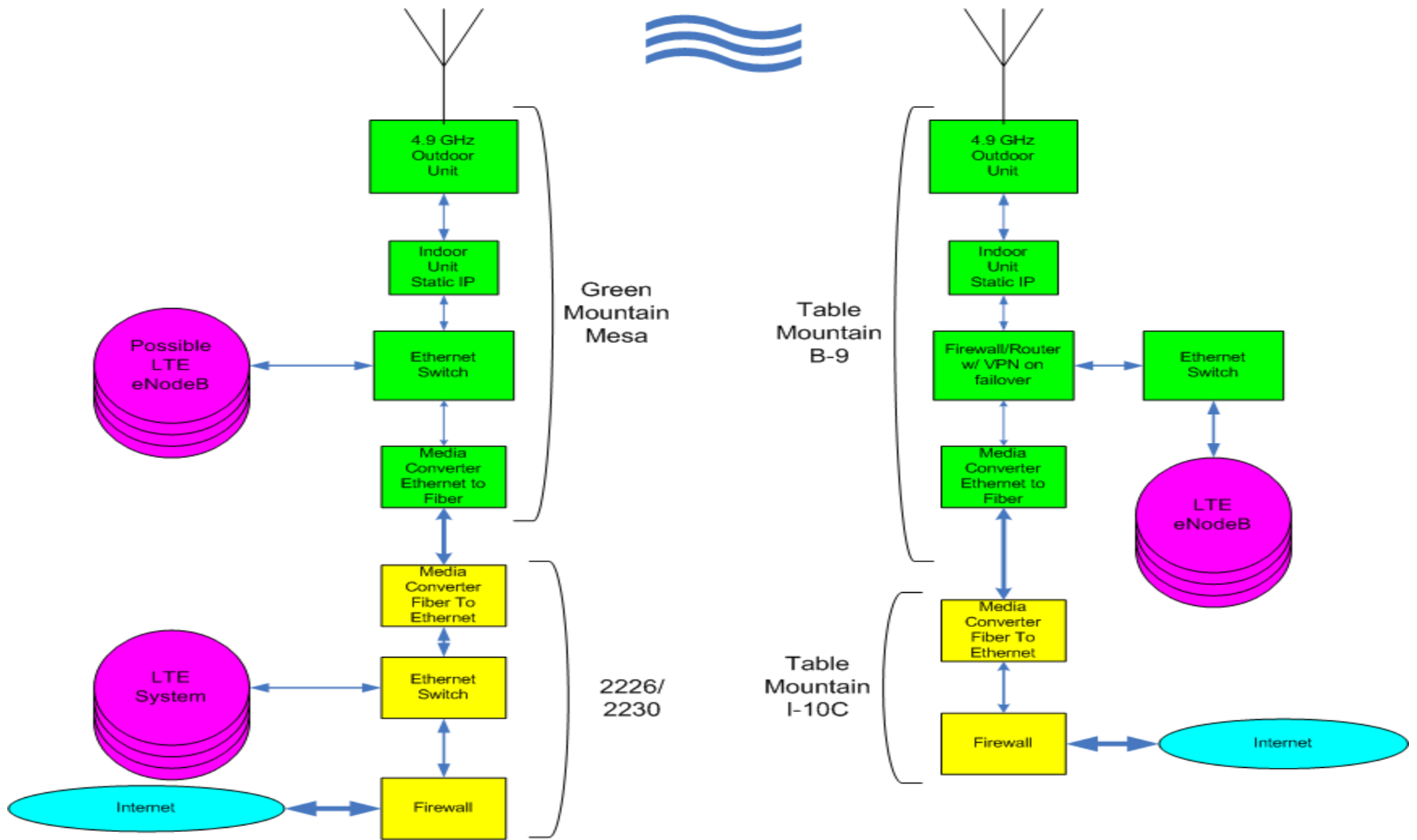
A. Green Mountain Mesa:

- Fiber connection to PSCR labs for connection to EPC/Internet

B. Table Mountain:

- Utilizing Public Safety 4.9GHz Point-to-Point Backhaul for link from/to Table Mountain and Green Mountain Mesa
- Experimental STA for 4940-4990 MHz currently in progress

Backhaul



PSCR 4.9 GHz LTE Back-haul

Spectrum

- Utilizing Experimental STA – 5x5 MHz Allocation for the Boulder Demo Network
 - Target submission this quarter
- State of Colorado coordination for PSBB Allocation due to Statewide Narrowband LMR occupancy
- Backup plan to utilize 5x5 D Block for Boulder Network if LMR not cleared in time
 - Need to understand issues related to this.

Facilities Requirements

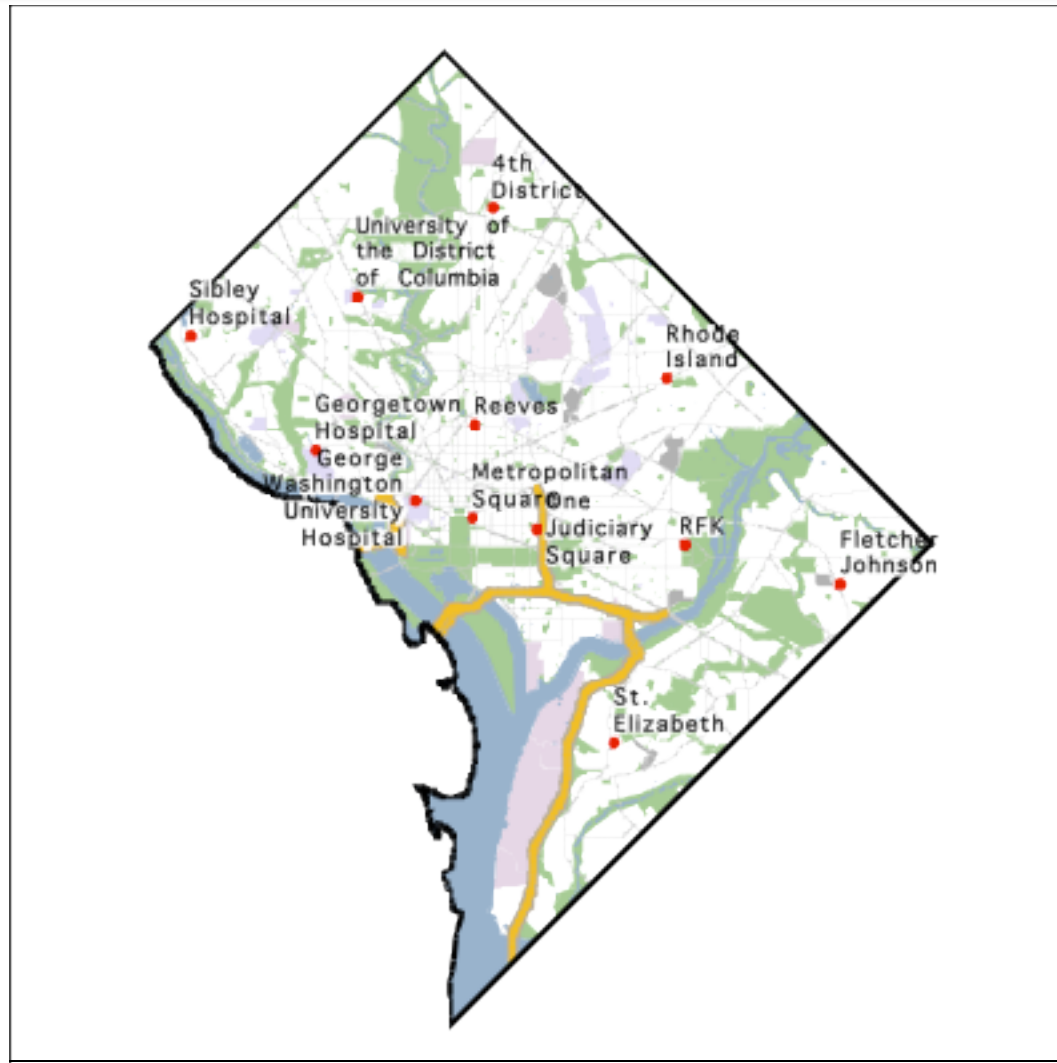
- Equipment Power Requirements
 - +24vDC/-48vDC/120vAC?
- HVAC Requirements
- Site Access Requirements
 - Remote Access assumed
 - Footprint/Cabinet requirements
- Antennas / Cabling

District of Columbia eNodeB Sites

Remote Test Network Topology

- DC eNodeB sites
 - 12 outdoor 3-sector sites
 - 3 tower sites
 - 9 building sites
 - All with indoor radio rooms
 - Environmentally controlled (except RFK)
 - Co-sited with LMR systems (except RFK, Met. Sq)
 - AC power
- Backhaul and Remote Test Network Topology
- DC Test Environment Issues

Washington DC eNodeB Sites



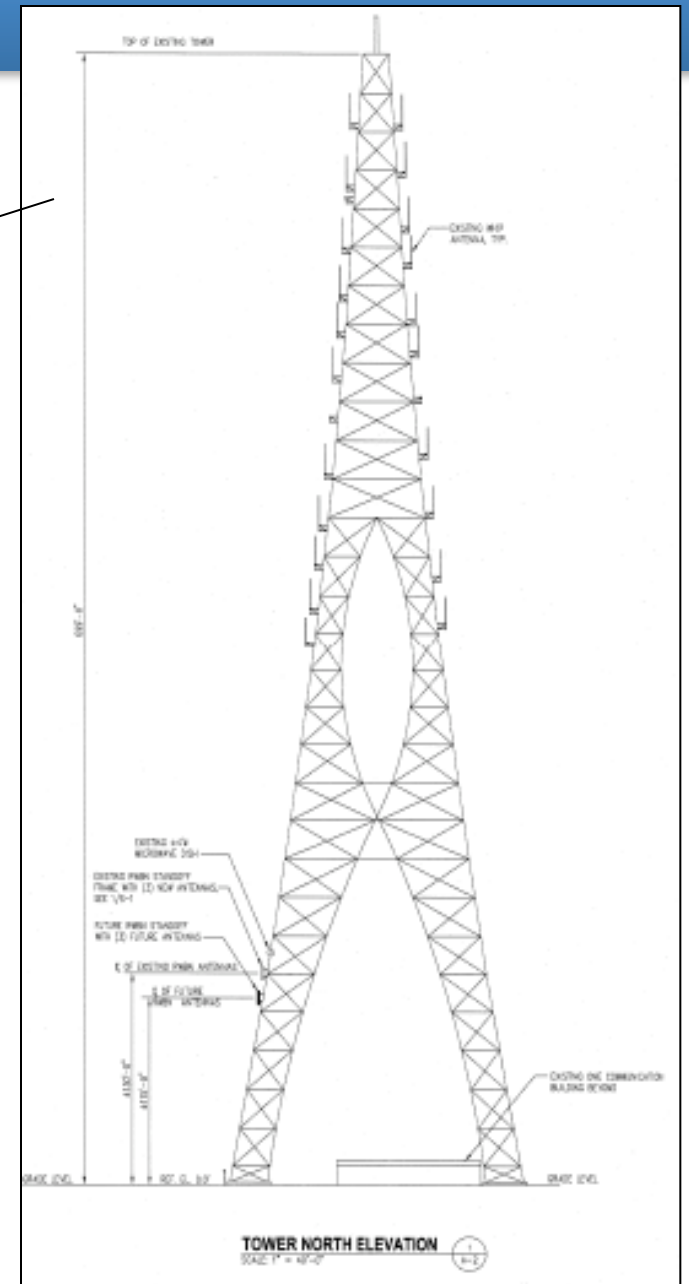
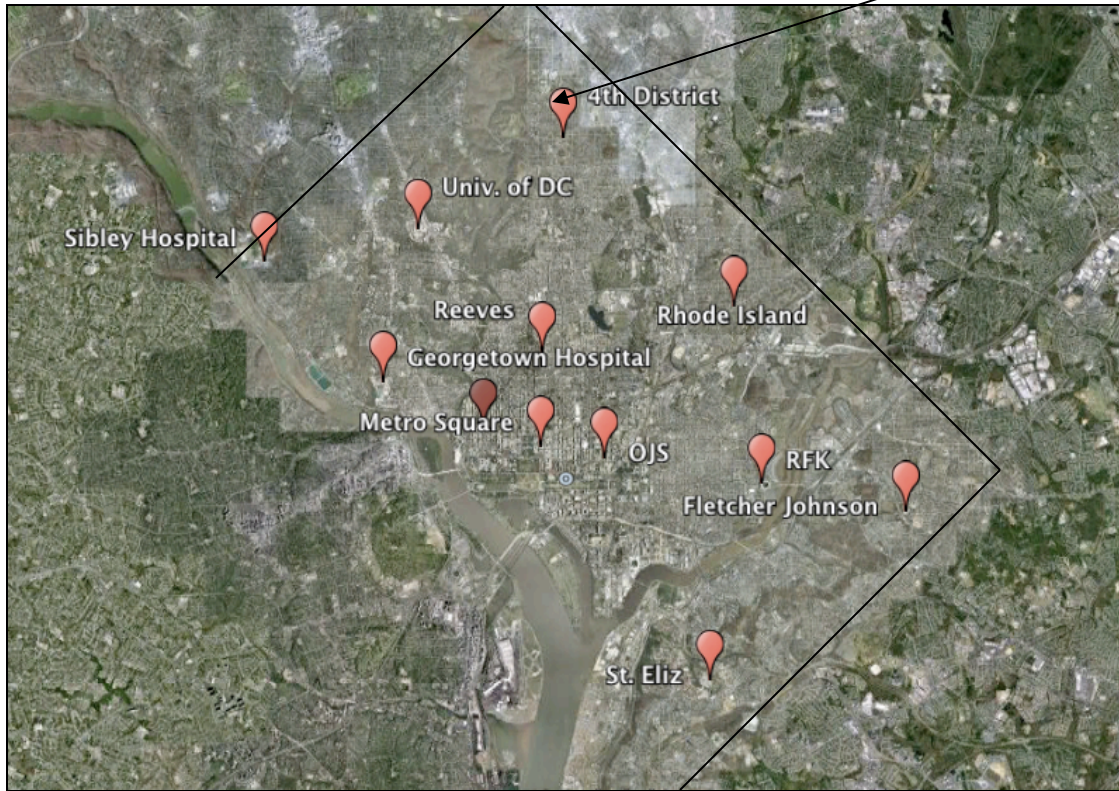
Antenna Cable Systems

3-Sectors at Each Site

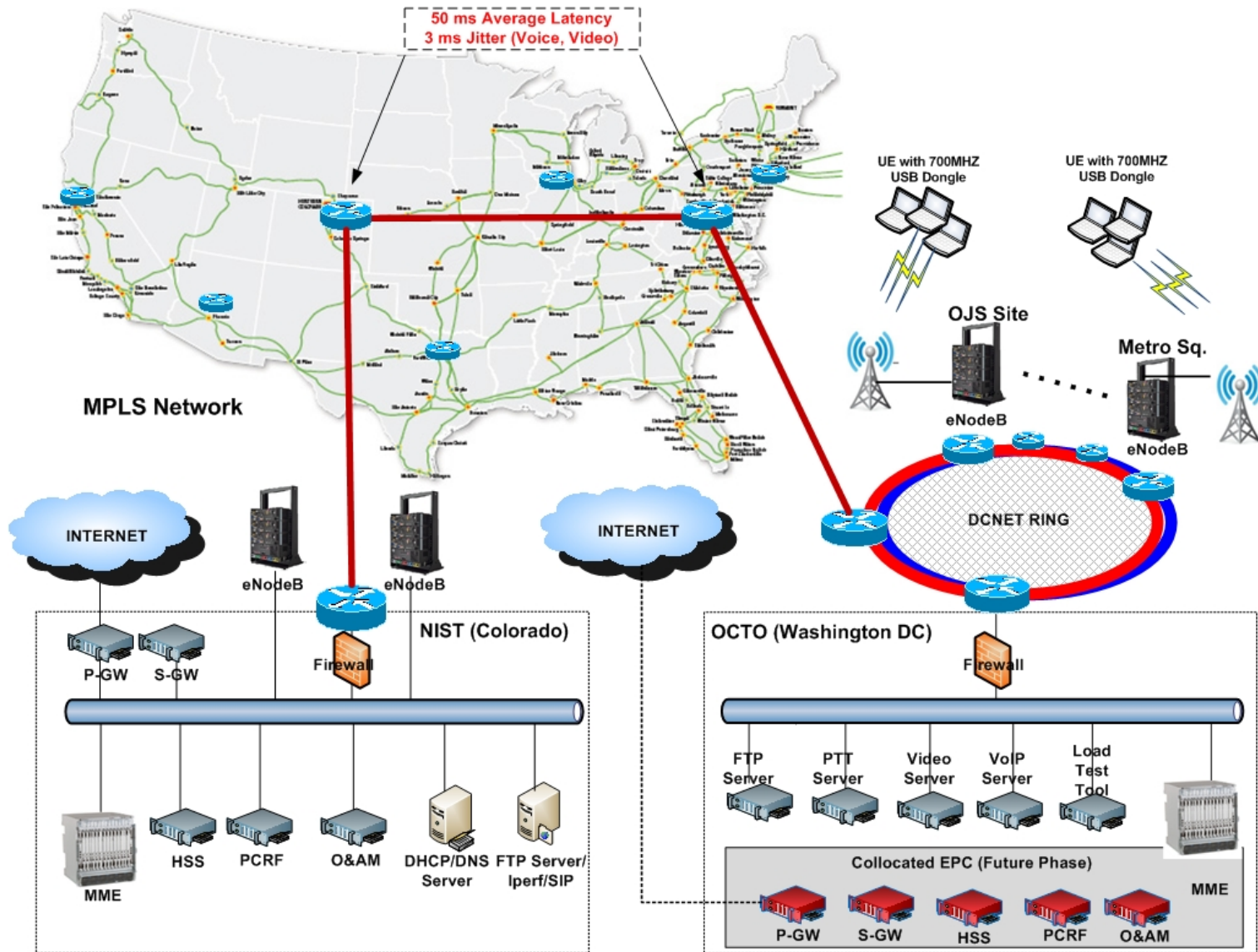
- Sites with six antennas (2 x 3-sector)
 - Metro Square
 - Georgetown
 - Reeves
 - Rhode Island
 - Sibley Hospital
 - Univ. DC
 - 4th District
 - Fletcher
- Sites with 3 antennas (1 x 3-sector)
 - One Judiciary Square
 - St. Elizabeth
 - RFK Stadium
 - George Washington Univ.



4th District



Remote Test Facility Topology



DC Test Environment Issues

- Special Temporary Authority (STA) & Experimental License
 - STA was granted to DC from the FCC to operate in 700 MHz
 - STA renewal expected, specific to PS (763-768 MHz, 793-798 MHz)
 - Application for Experimental License filed (758-768, 788-798 MHz)
- Interference and Noise Mitigation
 - RF tools are needed to measure, monitor and clear spectrum
 - Ongoing test and measurement is needed
 - Interference is highly specific to “events” and “location”
 - Previous tests show interference vulnerability (wireless microphones)
 - Mobile (eNB) test van could enable more comprehensive location and event testing
 - Improved test regimes needed for over-the-air (over)load testing and interference control

Interference Issues - Wireless Microphones

- V-COMM measurements March 26-28, 2009
- 48 test points; 22 of 65 in-use microphones in public safety band
- Conditions found are typical of test results in other markets

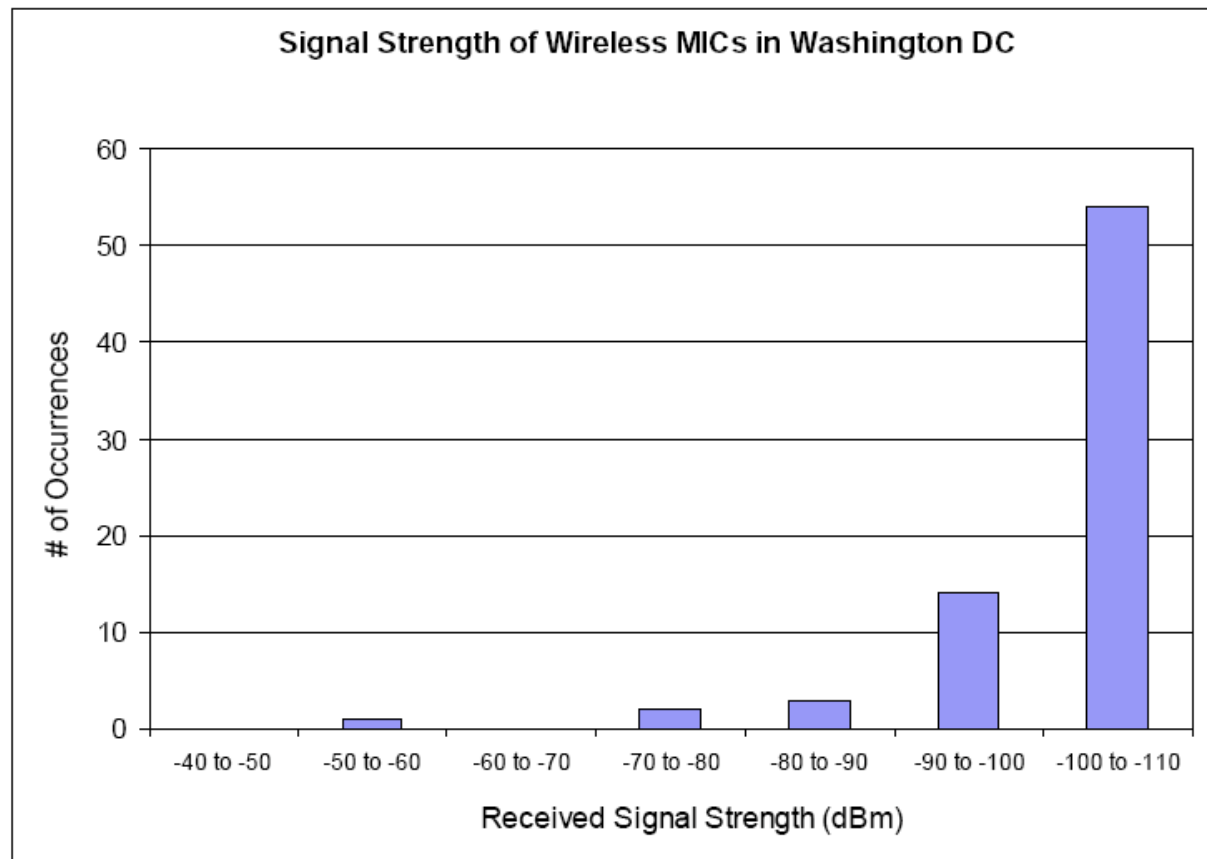
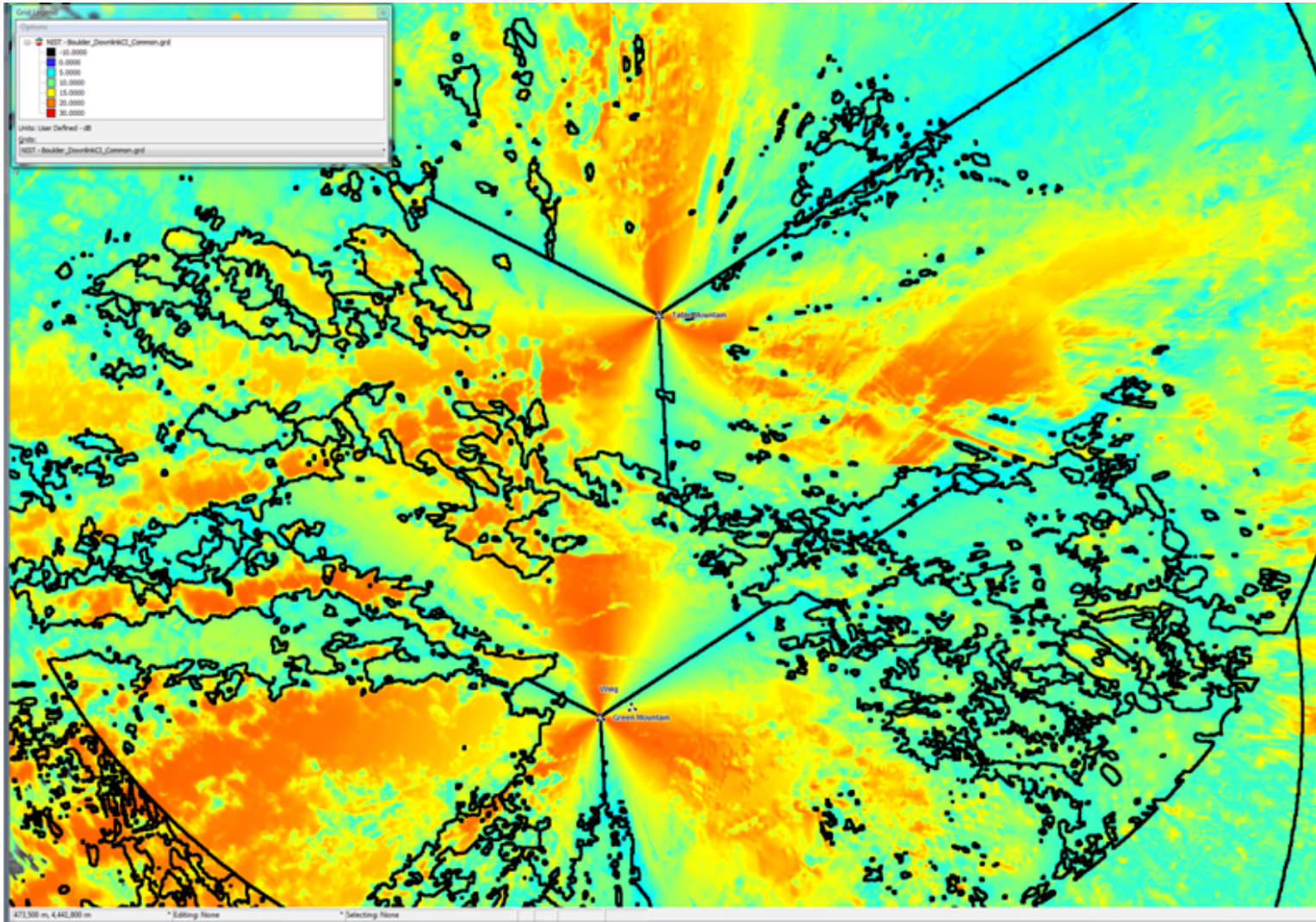


Figure 1 - Washington DC Wireless Microphone Signal Strength tabulation

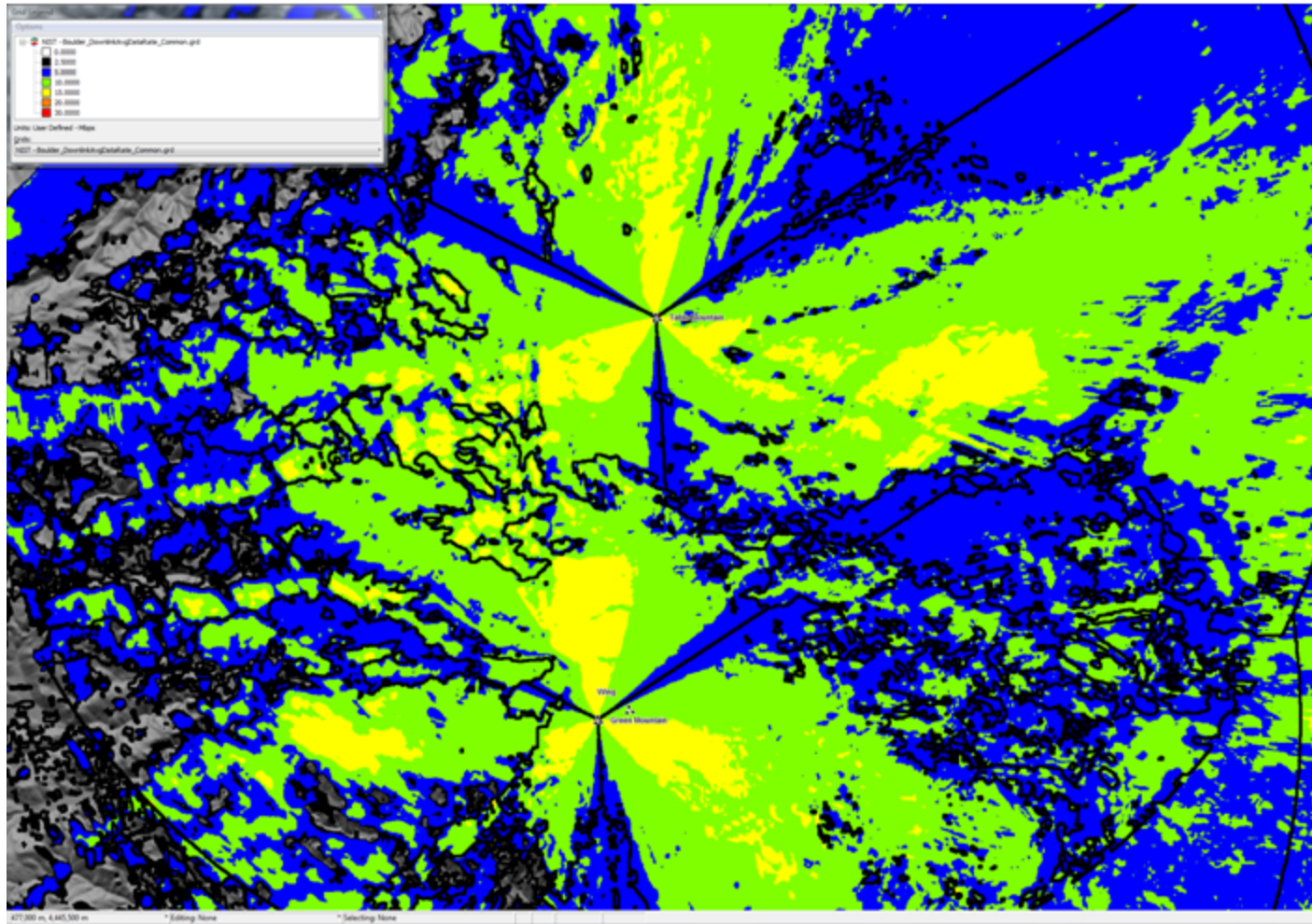
Network Modeling

- Creating generic LTE Link Budget(s) for Boulder and OCTO networks that can be used and referenced by all vendors
 - Predicted coverage using both capacity and coverage type parameters
 - Physical Cell ID
 - N=1 design initially but will also design FFR system N=3
 - Evaluate eMBMS and/or MBSFN
 - Simulate traffic loading and predict signal quality, coverage and throughput
 - Utilizing Mentum Planet for network modeling
 - Project team evaluating multiple tools
 - eNodeB specific parameters will need to be evaluated with each participating vendor

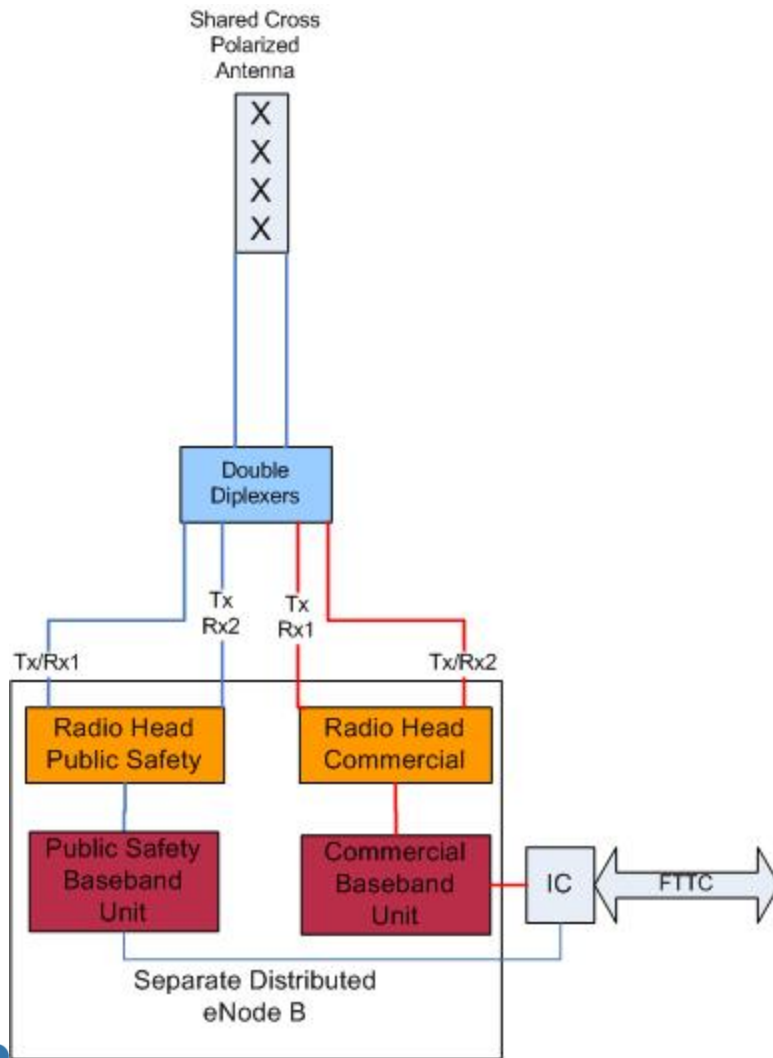
Coverage Predictions



Data Predictions DL



Managed or Leveraged Network

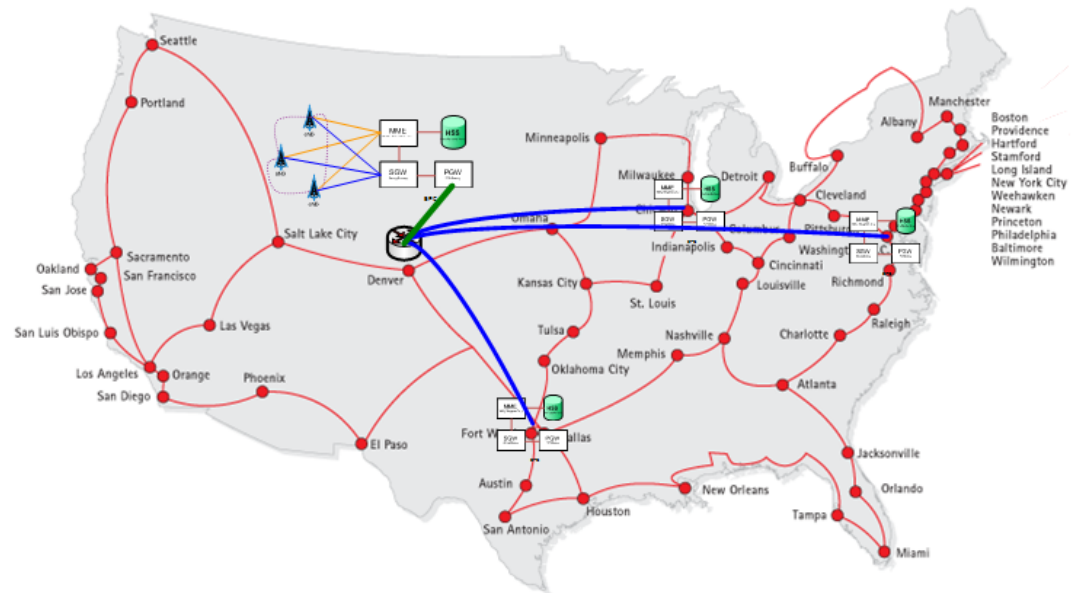


- Managed service utilizing public safety dedicated 700Mhz eNode B
 - Procure/lease eNode B's from commercial service provider
 - Use public safety spectrum (BC 14)
 - Commercial service provider maintains public safety eNode B's
 - Shared backhaul – Logically partitioned
 - Shared EPC and IP/MPLS backbone – logically partitioned
 - Public Safety-specific policies
 - Utilize existing provisioning and service delivery systems
 - Service Level Agreement
 - Band 14 added to commercial devices
 - Offered as a managed service

Simulating Managed Network

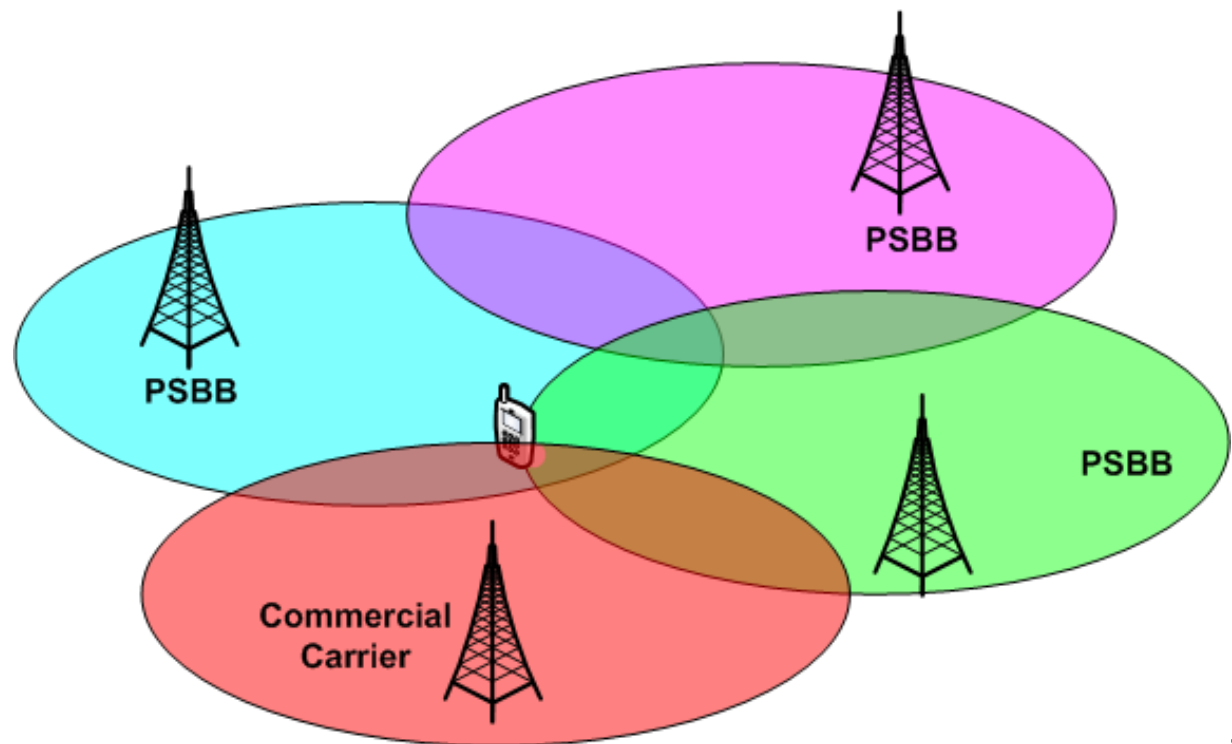
- EPC vendors may need to host systems off-site from Boulder – essentially simulating ‘managed’ network
 - S1 sizing, cost & latency implications
 - Pending multi-mode/band Ue may be able to do inter-RAT HO testing
 - Multi EPC setup possible
 - Multiple PGW, MME or APN scenarios

Potential creation of Interoperability Testing (IOT) between multiple vendors in Phase 1



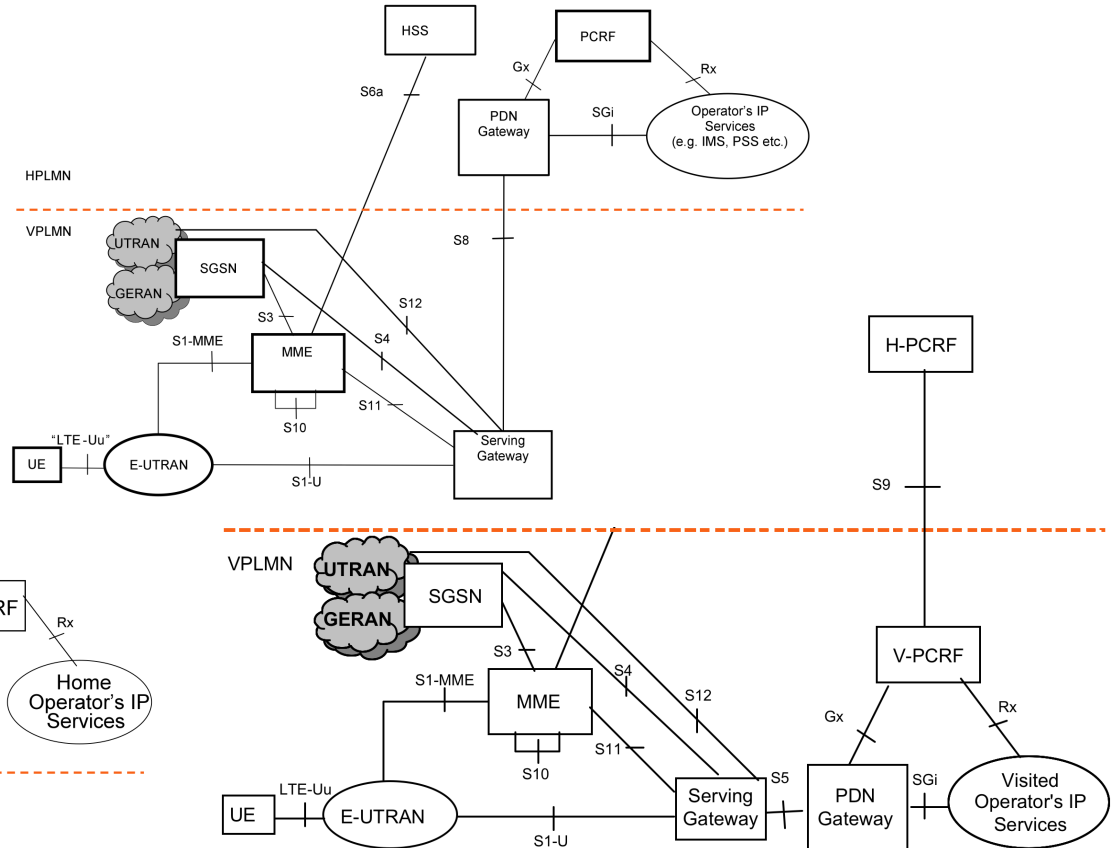
Handover, Roaming & Interference

- Multiple Roaming Scenarios need to be evaluated and their potential problems
 - Intra-RAT – handover to another PLMN or public safety BC 14 network
 - Intra-RAT different band – handover to another commercial LTE network
 - Inter-RAT – handover to a commercial carrier cellular data network
- Evaluate ping-pong effect between PSBB and commercial carrier
- Cell-edge interference on N=1 systems



Handover Scenarios

- Demo Network needs to be flexible enough to support multiple handover schemes
 - Multiple PLMN boundaries
 - Home & visited routed traffic



- Potential integration into commercial carrier for inter-RAT testing

Questions?