Powerful Connections
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Philadelphia, PA

Public Safety Broadband Demonstration Network

Public Safety Communications Research Program

PSCR

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Agenda

- PSCR Introductions & Overview
- Testing Updates
- CRADA Updates
- Study Item updates
- Next meeting

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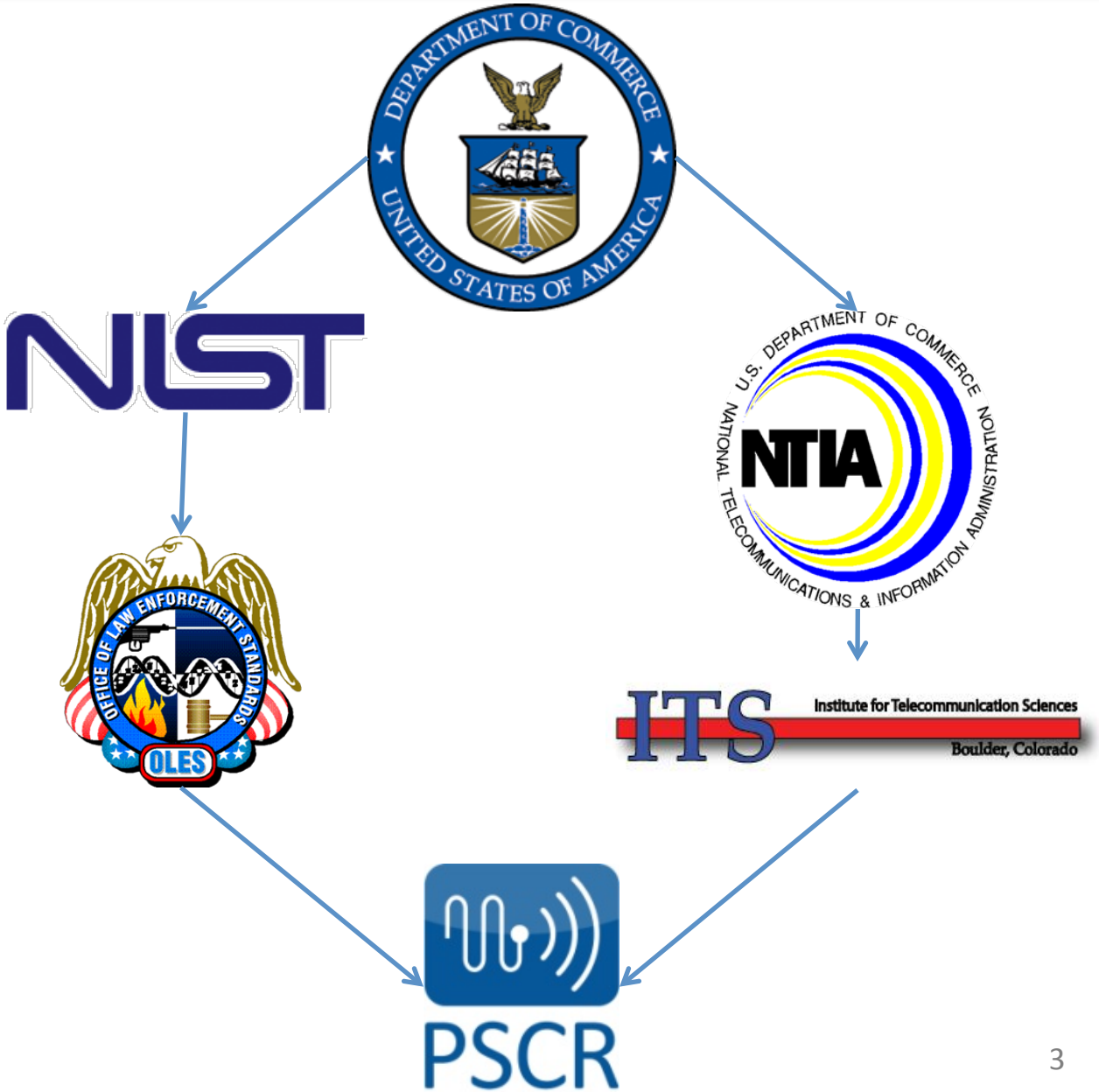
Public Safety Communications Research Program

Located at the Department of Commerce Boulder Labs in Colorado

The PSCR Program is a joint effort between:

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



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PSCR Sponsors

Department of Homeland Security

Department of Justice

Office for Interoperability and Compatibility

Office of Community Oriented Policing Services

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PSCR Vision & Mission

VISION

The response community nationwide can exchange voice and data seamlessly to effectively respond to any incident or emergency.

MISSION

To fulfill this vision, PSCR will act as an objective technical advisor and laboratory to public safety to accelerate the adoption and implementation of only the most critical public safety communication standards and technologies.

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PSCR Portfolio

LMR Standards and Technologies	Broadband Standards and Technologies	Interoperability Device Standards and Technologies	Emerging Standards and Technologies	Cross-cutting or Supporting Activities
Project 25 Compliance Assessment Program (P25CAP)	**700MHz PSBB Demonstration Network**	Multi-Band Radio	P25 Security	Program Management & Outreach
P25 Standards Development	Public Safety VoIP	Interim Interoperability Device Testing	Technical Services Projects	Statement of Requirements (SOR)
ISSI Test Tools	NPSTC Broadband working group (BBWG)		Video Quality in Public Safety (VQiPS)	Public Safety Architecture Framework
Audio Quality	Modeling and Simulation			RF Propagation Studies

Detailed information on all the above PSCR projects can be found at:

http://www.pscr.gov

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Why a BB Demo Network for Public Safety?

- Public Safety licensed to use 700MHz spectrum and chose Long Term Evolution (LTE) as their broadband technology.
- There was no government or independent laboratory facilities in the United States to test and demonstrate the Public Safety specific LTE implementation requirements
  - PSCR created this network to provide manufacturers a site for early deployment of their systems, an opportunity to evaluate them in a multi-vendor environment, and create integration opportunities for commercial service providers.

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Spectrum

- Licensing: Experimental Special Temporary Authorizations (STAs)
  - 5x5 MHz Public Safety allocation for the Boulder Demo Network
    - Base TX/Mobile RX: 763-768 MHz
    - Base RX/Mobile TX: 793-798 MHz
  - 4940-4990 MHz Public Safety allocation for backhaul
- Ongoing State of Colorado DTRS coordination with Statewide 700MHz Narrowband LMR system

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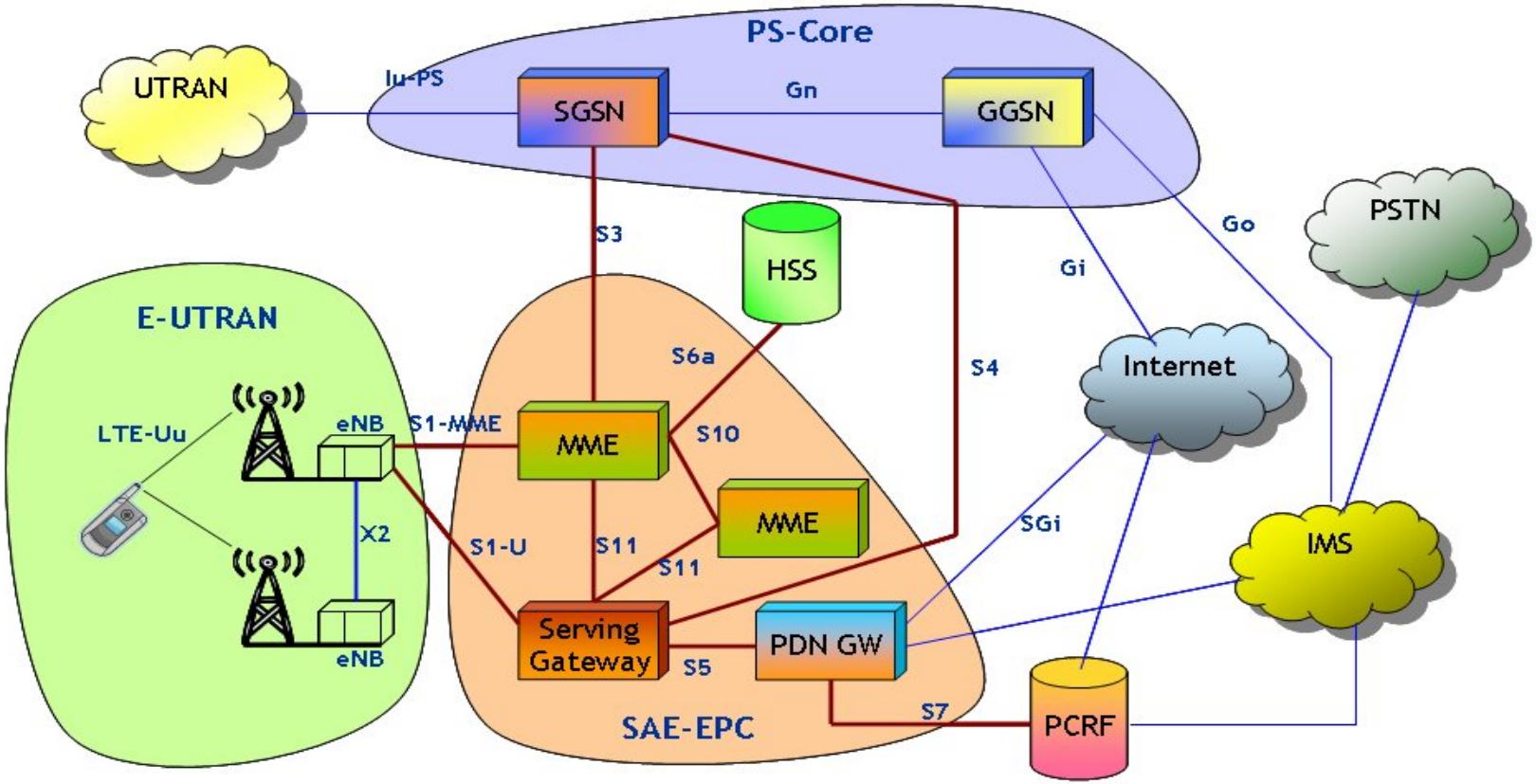
Long Term Evolution



eXplanoTech
Explaining Technology

(c) eXplanoTech Training Solutions

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PSCR Boulder Sites

- The demonstration network utilizes the PSCR facilities located in Boulder, Colorado:
  - PSCR Boulder labs used for evaluation of signalling, RF and EPC hosting
  - Vendor eNodeB equipment co-located
  - Sites are Federal property and are secure locations
  - VPN connections for external vendor access provided

DOC Boulder Labs

Table Mountain Mesa

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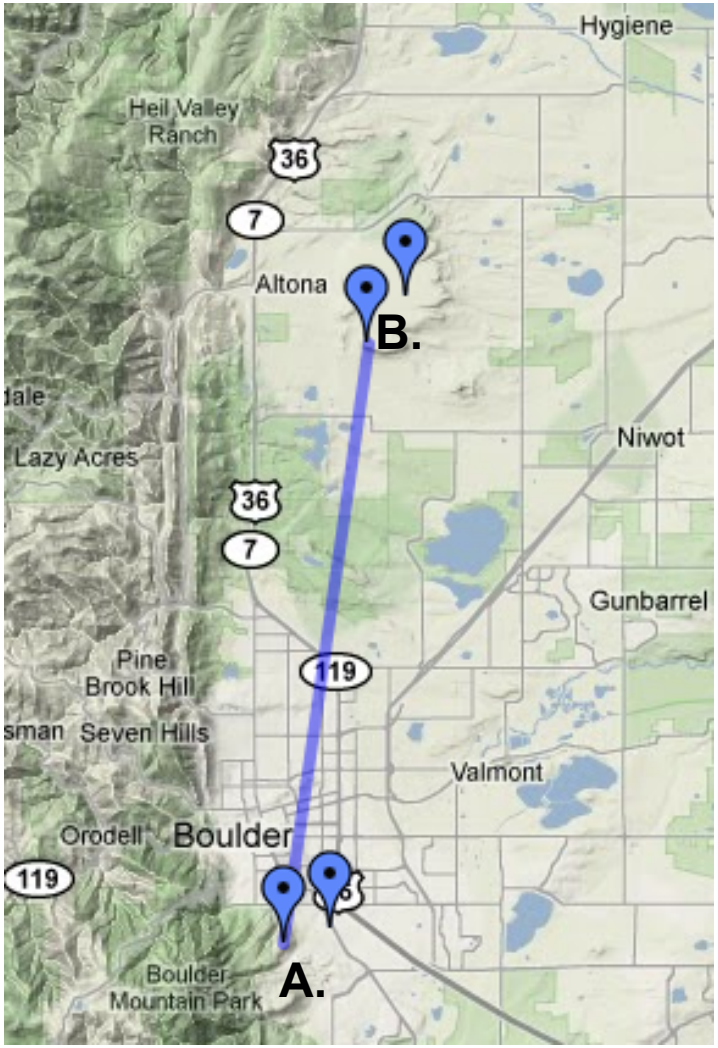
PSCR Boulder Sites

Site locations for the Boulder Demo Network:

A. Green Mountain Mesa
   (on DoC Labs campus)

B. Table Mountain
   (9 miles NE of DOC Labs)
   - Radio Quiet Zone
   - Managed by NTIA/ITS



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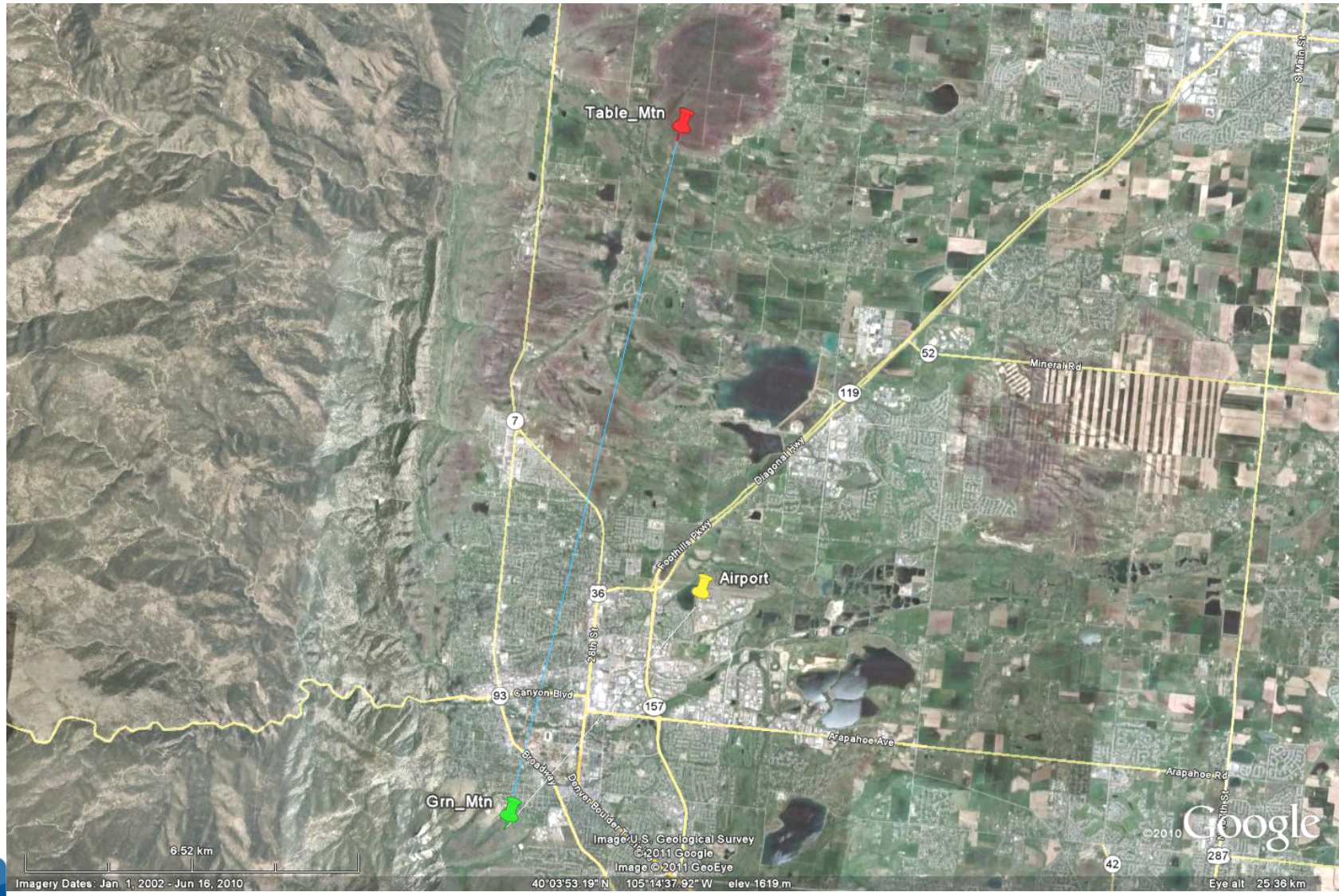
Network eNB Locations



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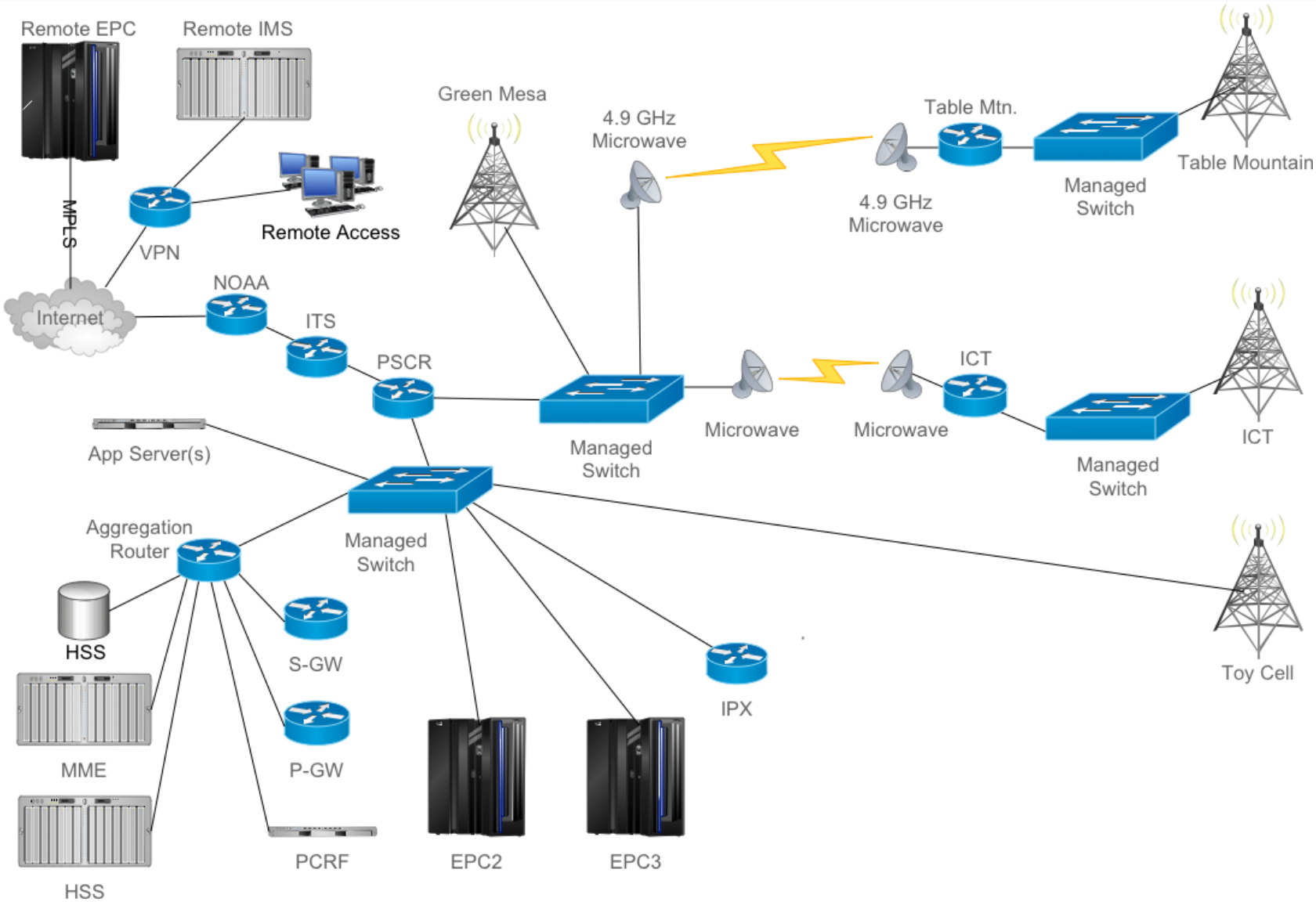
PSCR Test Network



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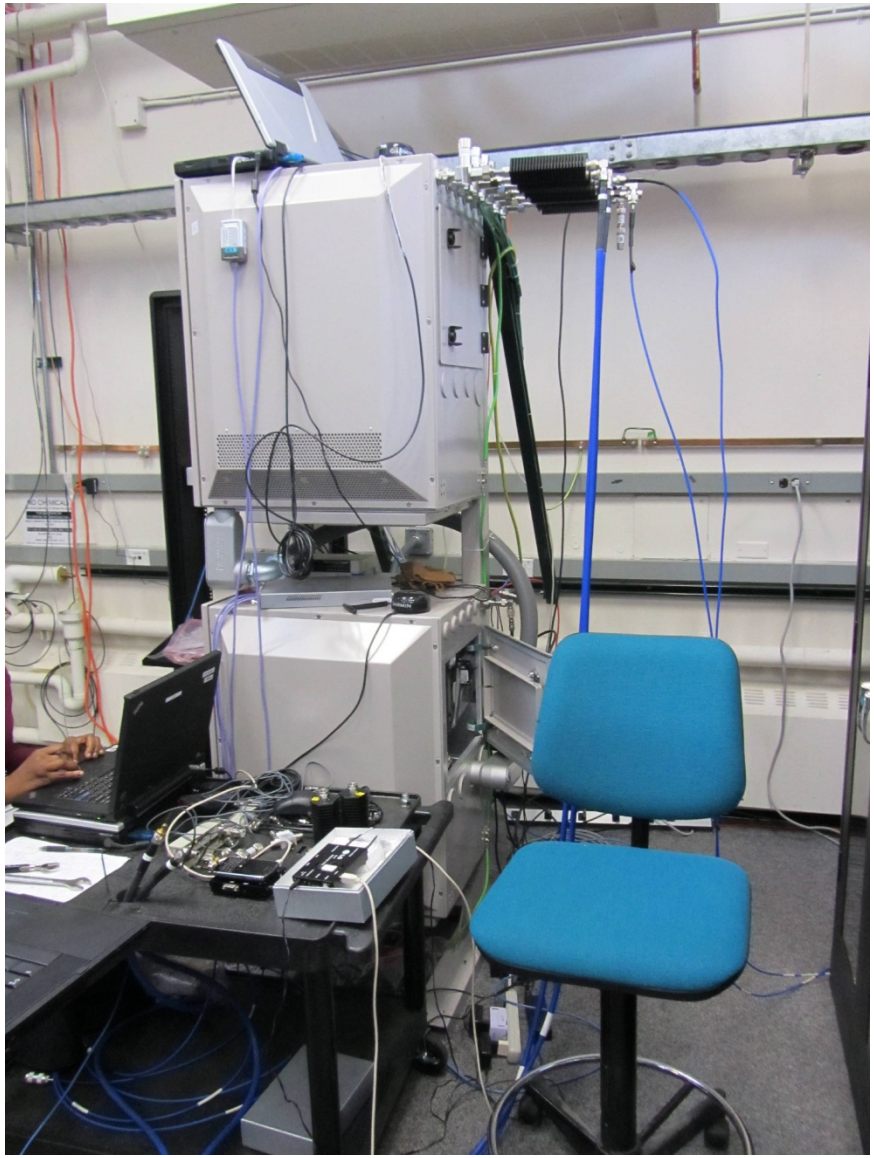
eNodeB



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Another eNodeB

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eNodeB Antennas

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Evolved Packet Core

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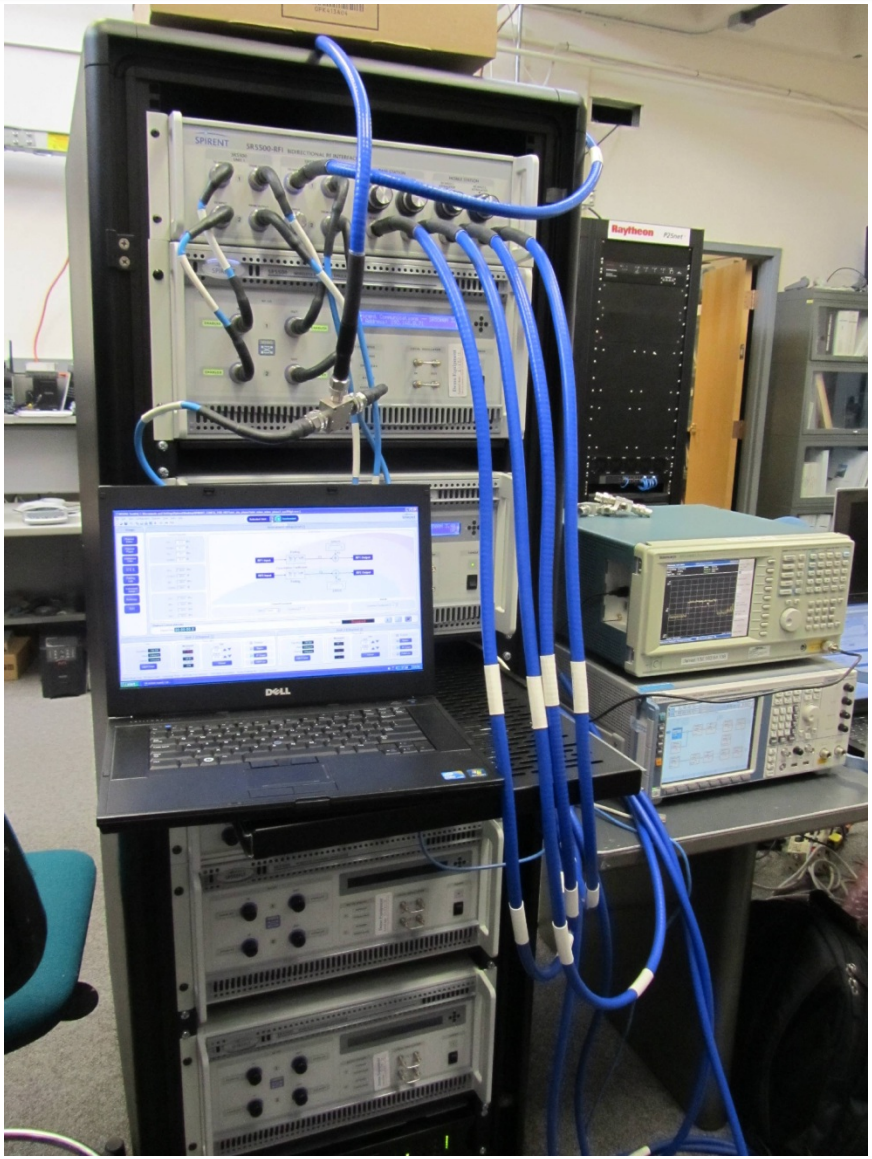
Channel Emulator



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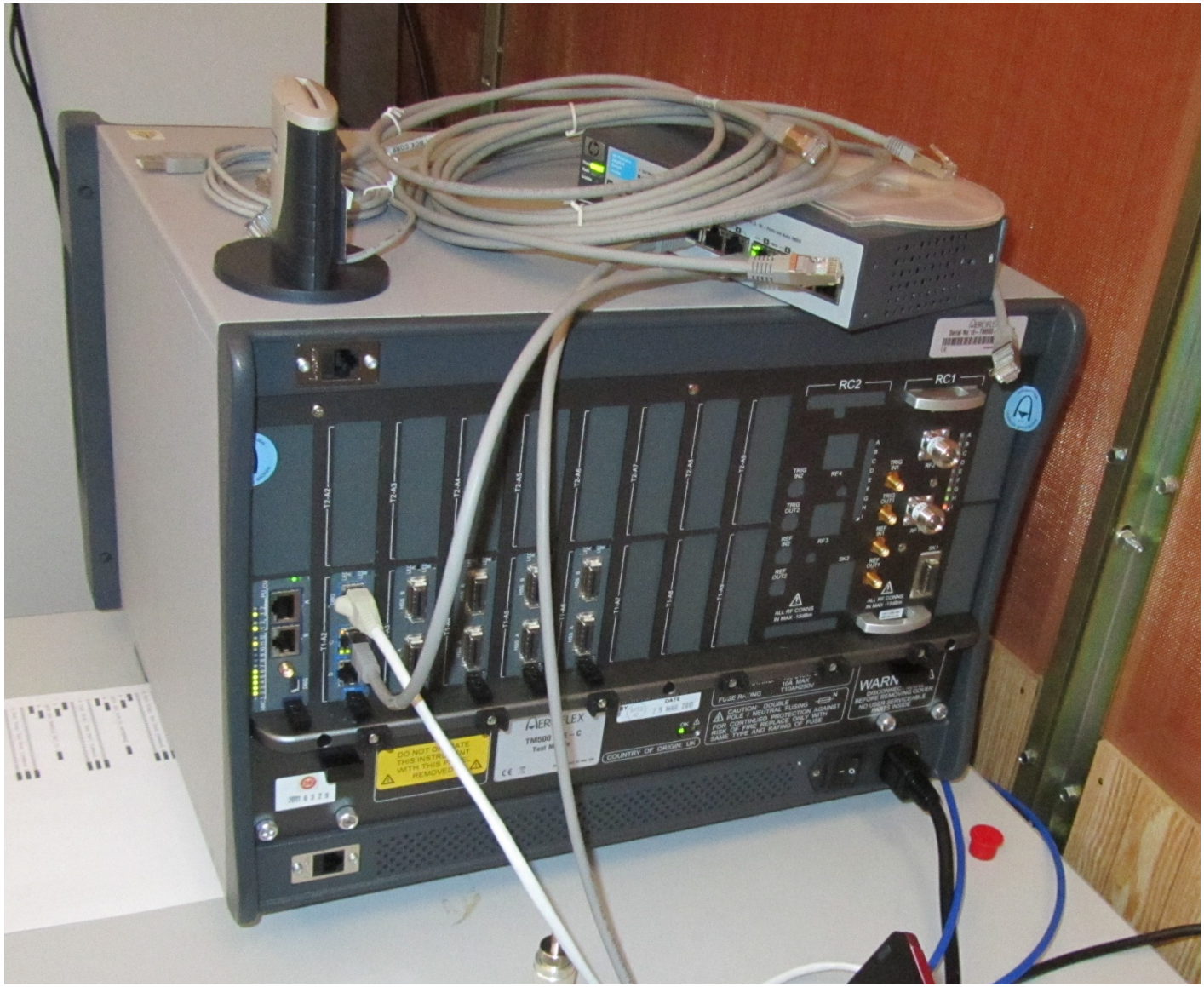
User Equipment Emulator



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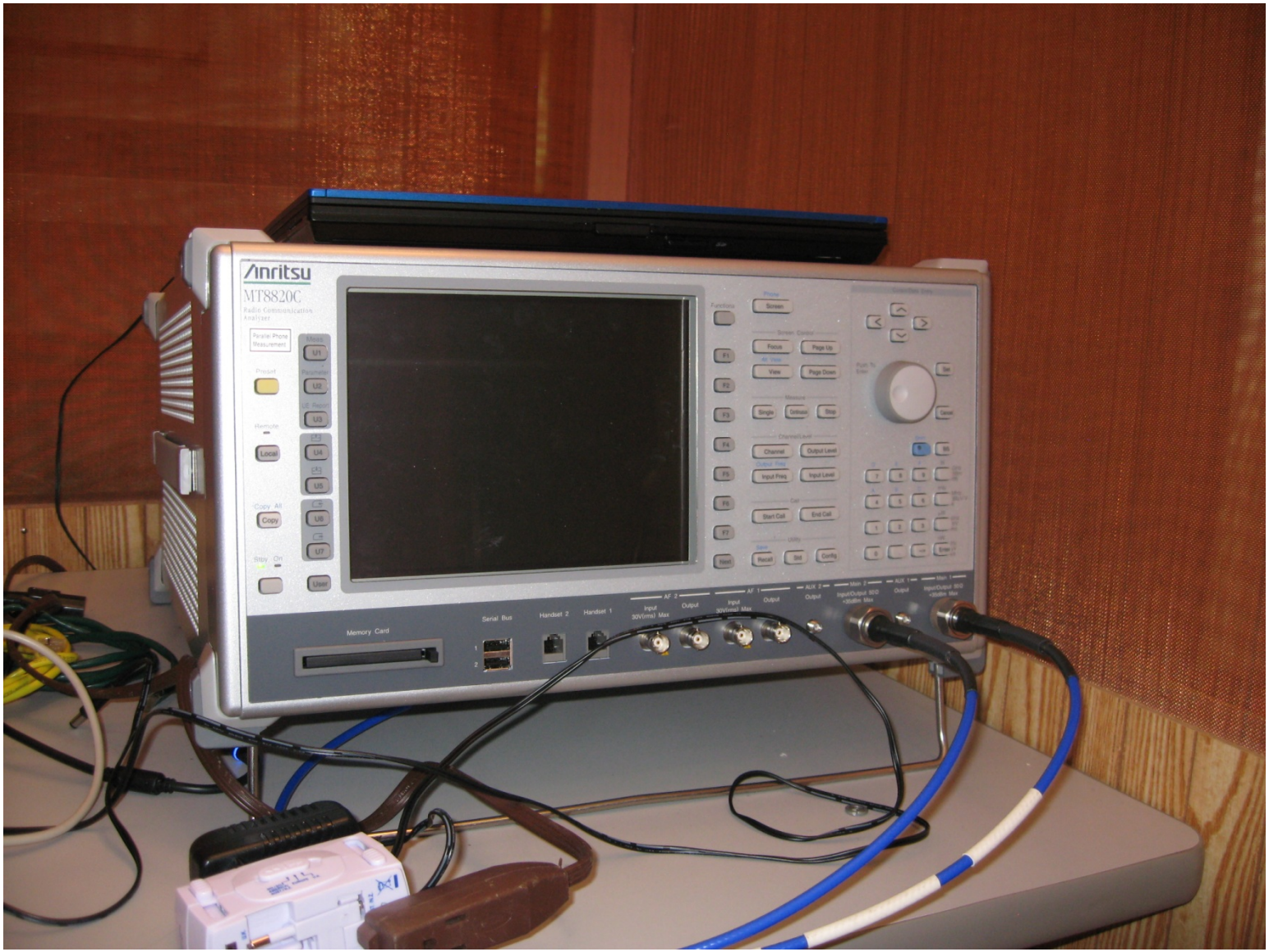
UE Test Equipment



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Cell On Wheels

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Project & Testing

Updates

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Genesis of PSCR Demo Network

- **Spring 2010 PSCR kicks off 700 MHz LTE Demonstration Network**
  - The only government or independent lab facility located in the United States to test and demonstrate public safety 700 MHz broadband networks and applications, the Demonstration Network provides:
    - A vendor-neutral place for manufacturers and carriers to deploy their systems to test them in a multi-vendor environment. This provides integration opportunities.
    - A place for public safety to see how these systems will function, specific to their unique needs. Interested agencies can visit the network and get hands-on experience with these systems, as well as run public safety specific test cases that relate directly to their operational environments.
    - A place where early builders can ensure that the systems they might procure will in fact work in the eventual nationwide network, assisting agencies in their procurement process.

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Public Safety Broadband Requirements

- PSCR has been involved for several years working with public safety on their requirements for Broadband
  - 700 MHz Broadband Questionnaire
  - Public Safety 700MHz Broadband Statement of Requirements (SoR)
- Led the Technology Working Group of the 700MHz NPSTC Broadband Task Force (BBTF)
  - Overwhelming support from public safety, press, PSST, emergency responder organizations and vendors
- All documents available on http://www.pscr.gov/projects/broadband/700mhz/700mhz.php

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PSCR Demo Network Project Plan

- Generate interest from broadband vendors to develop a 700 MHz broadband equipment ecosystem
  - **Band Class 14 (D Block & Public Safety Block), Long Term Evolution (LTE)**
  - **Stimulate early development for public safety systems (e.g. Waiver Orders)**
  - **Support the commercial standards and testing process with public safety requirements e.g.**
  - **Publish test results (non-attributable) to inform stakeholders**

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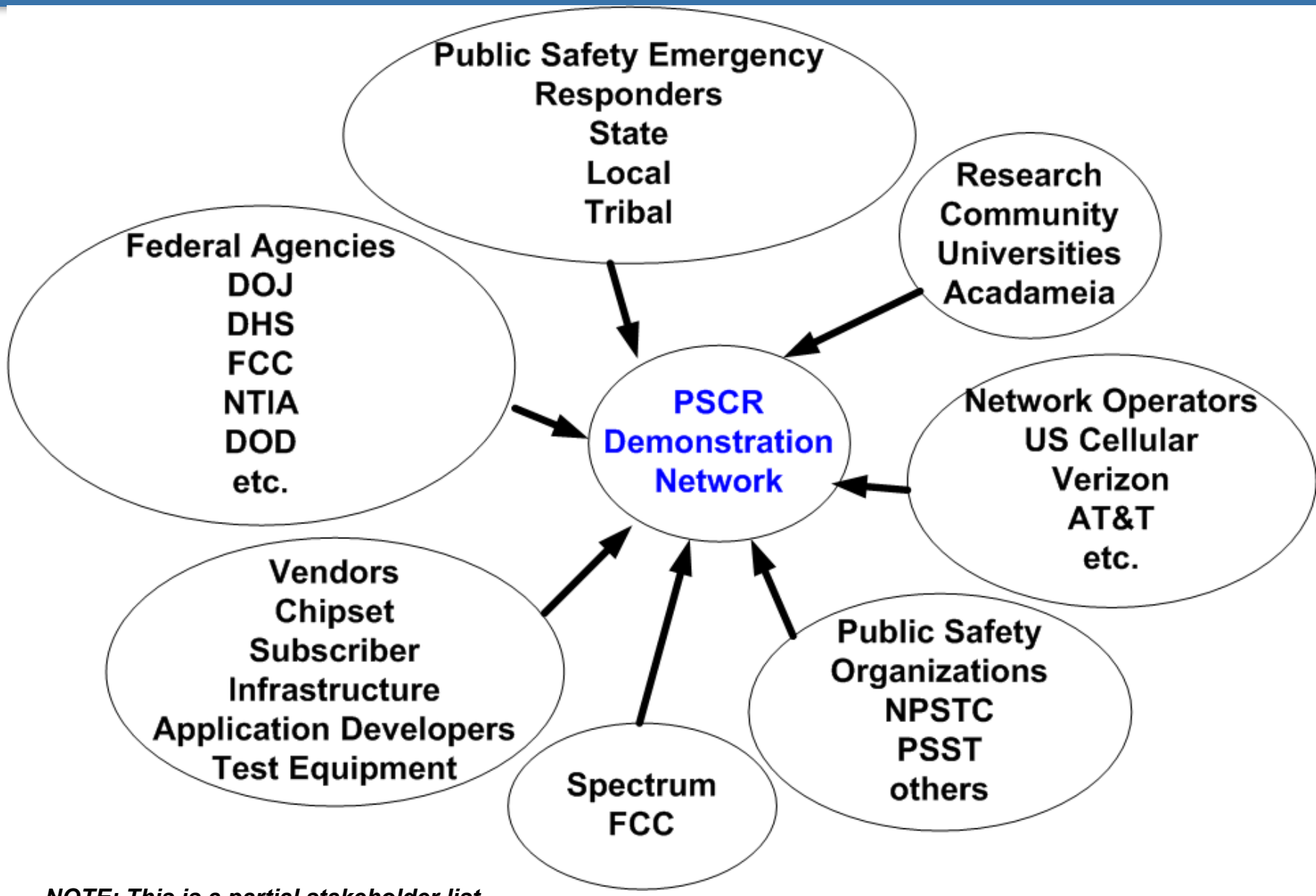
Demo Project Stakeholders



NOTE: This is a partial stakeholder list

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Project Process

- Demonstration Network has three major stages for stakeholder participation:
  1. Stage 1—Network and Test Planning
     - Stakeholders will be involved in creating a common test plan for all vendors and creating a common network deployment and coverage scheme.
  2. Stage 2—Deployment (3 sub-phases)
     1. Equipment is scheduled for delivery to site locations.
     2. Coverage, network planning, site preparation is completed.
     3. Systems are installed and commissioned.
  3. Stage 3—Testing and Demonstrations
     - Test plan execution takes place. This is staggered into three main phases with sub-phases as equipment and features become available. Network is available to perform system level testing and demonstrations on.

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Project Status – Stage 1

- Stage 1 is nearing completion
  - Phase 1 and 2.1 stable and released
  - Test planning for Phase 2.2 and Phase 3 out for review
    - Phase 2.2 target publish date by end of August 2011
    - Phase 3 target publish date by end of September 2011
  - UE related tests removed from Phase 1 test plan
    - UE test plan standalone from system & infrastructure testing
  - All test documents available on www.pscr.gov

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Project Status – Stage 2

- Infrastructure deployment
  - Alcatel Lucent EPC & eNodeB completed
  - Motorola Solutions Inc./Ericsson EPC & eNodeB
    - Phase 1 test configuration complete
    - Phase 2 & 3 test configuration in progress (late Q3)
  - Harris/Nokia Siemens EPC & eNodeB
    - Phase 1 test configuration complete
    - Phase 2 & 3 test configuration in progress (Sept)
  - Cisco EPC installation beginning in two weeks, integration in early September
  - IPWireless TBD

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Project Status – Stage 2 cont.

- UE & UICC deployment
  - LG deployed
  - Motorola Solutions Inc. deployed
  - IPWireless deployed
  - Gemalto deployed
  - Others TBD
- Test Equipment
  - Aeroflex, Agilent, Rohde & Schwarz, Anritsu, Sanjole

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Stage 3 - Testing Updates (1)

- The PSCR program has established a test plan with three major phases of testing and evaluation.
  - Phase 1: Basic Functionality Testing
    - Phase 1: Basic Functionality Tests
    - Basic functionality testing will determine if the LTE equipment submitted for use in the PSCR demonstration project has been configured correctly to achieve a minimal level of functionality. Tests will include:
      - Physical layer tests to ensure that the submitted equipment will not interfere with other existing 700 MHz LMR, PSCR demonstration systems
      - Messaging/protocol tests
      - Public safety application tests
      - Basic performance tests

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Stage 3 - Testing Updates (2)

- Phase 2.1: System and Node Level Testing
  - Predominately simulated propagation
    - Physical Layer Tests: Examine several characteristics of the eNB that will indicate how this equipment will operate in PS scenarios.
      - Provides indication of sensitivity level and robustness for the RF section of the eNB.
    - Throughput Performance Tests
      - Tests examine throughput in bidirectional, downlink and uplink configurations.
      - Test configurations examine both TCP and UDP throughput.
    - Messaging/Protocol Tests: The test in this phase examines the messaging behavior of the LTE system in the event that an additional radio bearer is requested.

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Stage 3 - Testing Updates (3)

- Phase 2.2: System and Node Level Testing
  - Stress Tests: These tests will examine the loading and potential capacity of the target cell.
    - Multi-user, loaded network stress testing
  - Performance Tests: There are three tests, two of which are designed to examine user plane latency.
  - Messaging/Protocol Tests: These tests cover the areas of security, interoperability, and failure modes.
    - The Security tests focus on intrinsic security modes in LTE as opposed to Over the Top (OTT) methods that may be used at higher levels in the protocol stack.
  - Network O&M - Alarm/Fault Reporting
  - "Status Info Homepage" evaluate a standardized mechanism to quickly inform the user of system information.

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Stage 3 - Testing Updates (4)

- Phase 3: Advanced Feature, Conformance, Interoperability, and Roaming Testing
  - Network architecture type testing, including evaluation of various PLMN, eNUM and IP implementations
  - Interoperability testing that includes testing the EPC and inter-connecting multiple EPCs
    - Basic RAN IOT – UE and eNB based both
  - Handover testing and evaluation (pending UE availability)
    - LTE-to-LTE (public safety-to-public safety)
    - LTE-to-LTE (PS to commercial)
    - LTE-to-3G
  - Stress, performance, messaging/protocol, application tests all included. Several based off of VZW Open Test Procedures
- New webpage created just for testing updates:
  http://www.pscr.gov/projects/broadband/700mhz_demo_net/testing/about_testing.php

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Testing Status

- Phase 1 tests published & available on www.pscr.gov
  - Test plan stable at v1.12
  - Completed Phase 1 testing with Alcatel-Lucent
  - Started testing with MSI and NSN
- Phase 2.1 testing complete with Alcatel-Lucent (in review now)
- Phase 2.2 scheduled to start late August (ALU)
- Phase 3 TBD start date
- Once we have multiple vendors that have executed all tests we will publish data (non-attributable)

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UE Testing

- UE testing covers several key aspects
  - RF Conformance & Performance tests based on several key documents
    - 3GPP 36.521-1 v8.4.0 (Dec 2009)
    - PTCRB RFT #76
  - Radio Resource Management (RRM) Conformance Testing
    - 3GPP 36.521-3 v8.4.0 (Dec 2009)
  - Scenario Based Tests
    - Based upon Verizon Wireless Device Requirements LTE 3GPP Band 13 Network Access Issued May 2010 v4.0
  - Field Performance Tests
    - Verizon Wireless Device Requirements LTE 3GPP Band 13
    - GSMA DG.11 Device Field and Lab Test Guidelines, Version 8.0, 11 June 2010, Annex C

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UE Testing (2)

- Using Conformance test equipment – R&S 8980S w/Contest 2.20
- PSCR looking to move most UE testing to PTCRB certified labs
- Working with PTCRB on PVG submittal for Band 14 validation
  - CRADAs signed with 7Layers & AT4 Wireless + 1 in progress
  - One lab has already tested on one UE chipset but did not meet 2 chipset criteria
- No UE vendors have final designs ready for full conformance yet
  - Could have testing done by end of 2011 if UEs

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Infrastructure Conformance

- PSCR submitted a new work item in March 2011 to the Multi-Service Forum entitled: MSF LTE EPC Certification Program
  - Initially accepted but slow response for sponsorship due to "certification" aspect
  - Initially tested S1-MME
    - Would eventually evaluate :
      - S1-U (eNB to S-GW)
      - S-11 (MME to S-GW)
      - S6a (MME to HSS)
      - S5 (S-GW to P-GW)
      - Gx (P-GW to PCRF)
      - Rx (PCRF to P-CSCF)

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Infrastructure Conformance (2)

- PSCR will re-submit a modified work item next week at the August 2011 MSF that removes certification aspect
- PSCR still investigating other organizations such as GSMA and ATIS to perform infrastructure IOT for public safety on an on-going basis

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Study Item Groups

Updates

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Study Item Groups

- PSCR has defined nine initial, specific Study Items for the Broadband Demonstration Network. These Study Items are areas of technical need identified within the PSCR Demonstration Network project that require input from our stakeholders.
- PSCR will directly be leading six of these groups.
- The other three Study Items will be handled outside of PSCR e.g. NPSTC – we are working with these organizations to ensure a smooth transition and will provide updates on how to specifically get involved in these three other Study Items.
- To join the groups goto www.pscr.gov and sign up for the groups and for sharepoint/web portal access

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Study Item Groups (2)

- The following Study Items will be led by the PSCR Project Team:
  - UE Testing
  - Network Identifiers
  - Network Performance
  - Infrastructure Testing - RAN & EPC
  - Roaming & Clearing
  - UICC
- The remaining Study Items will eventually be folded back in to the PSCR Study Items
  - Network Security
  - QoS
  - Application Testing
- *Each Study Item has a scope of work document associated with it.*

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CRADA

Updates

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CRADA

- CRADA – Cooperative Research And Development Agreement
  - CRADAs are partnering tools allowing federal laboratories to work with US industries, academia and other organizations on cooperative R&D projects. CRADAs provide flexibility in structuring project contributions, intellectual property rights, and in protecting proprietary information and CRADA research results.
  - 33 of 45 submissions executed
    - Project Phased Approach relates to phased CRADA execution
    - Judgment of NIST on whether or not to execute CRADA based on project needs

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Executed CRADAs

COMMSCOPE ANDREW
INMOTION TECHNOLOGY
IXIA
ROHDE&SCHWARZ
IPWireless
verizon wireless
TALLEY
Alcatel·Lucent
HARRIS
Anritsu Discover What's Possible™
at&t
Sprint
MOTOROLA SOLUTIONS
U.S. Cellular
Powerwave technologies
7 layers
AIRCOM INTERNATIONAL
Wavesat
CASSIDIAN AN EADS COMPANY
CISCO
LG
JDSU
CAVIUM NETWORKS
EDX WIRELESS
ERICSSON
ISCO INTERNATIONAL
AEROFLEX
Nokia Siemens Networks
TWISTEDPAIR Rethink Critical Communications
AT4 WIRELESS
Agilent Technologies
PSCR
T-Mobile
NORTHROP GRUMMAN
Syniverse

Executed CRADAs

- Alcatel Lucent
- Andrew Commscope
- Anritsu
- IP Wireless
- ISCO
- LG
- US Cellular
- Wavesat
- Cisco
- Ixia
- Ericsson
- Aeroflex
- T-Mobile
- Agilent
- Harris
- EDX
- Syniverse
- Powerwave
- Talley
- In Motion Tech
- Northrop Grumman Systems Corporation
- Cassidian
- Nokia Siemens Networks
- Motorola Solutions Inc.
- Rohde & Schwarz
- Verizon Wireless (VZW) Cellco
- Sprint Nextel
- AT&T Services
- 7 Layers Inc.
- AIRCOM
- JDS Uniphase Corp
- AT4 Wireless
- Twisted Pair Solutions

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CRADA Submissions

- If you want to submit your information to execute a CRADA please provide the following to 700MHz@its.bldrdoc.gov

1. Official Company **name and address**
2. Company point of contact **name, address, phone, email** (this is the person that will sign the CRADA)
3. Company Principal Investigator **name, address, phone, email** (this is our primary POC for the project)
4. Names of other members of the Company's project team (active members of the project)
5. What the company will be contributing to the research-- such as specific infrastructure equipment, subscriber equipment, test equipment, antenna's, software testing, hardware testing or any other collaboration.

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Face-to-Face

- Semi-Annual PSCR Face-to-Face meetings held in April 2010 & December 2010
- Tentatively scheduling for late July or early November 2011 in Boulder, CO - **but remains TBD based on testing**
- **Considering hosting virtual web conference**
  - Send email to 700MHz@its.bldrdoc.gov to get added to distribution list or if interested in presenting
  - Will update via email distribution list and www.pscr.gov website

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Thank you!

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For Additional Information:
http://www.pscr.gov

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