Public Safety Communications Today and Vision for the Future

Motorola, Inc

September 9, 2009

Topics

- Public Safety Environment & How We Got Here
- Project 25 (P25)
- Interoperability in Action
- Broadband Data and LTE Technology
- Mission Critical Voice/Broadband Voice Comparison
- Vision for Future of Public Safety Communications
- Summary

Complex Market & Spectrum Environment

- 138 – 174 MHz State/Local & Federal Segments
- 380 – 400 MHz Defense
- 406 – 420 MHz Federal
- 450 – 470 MHz State/Local segments
- 470 – 512 MHz State/Local 11 markets only
- 800 MHz State/Local
- 700 MHz State/Local
- 4.9 GHz State/Local

Federal Use by MOU

- Mix of P25 digital and analog technologies, 25 kHz & 12.5 kHz channels, large and small systems, basic and advanced capabilities.

Operability: Coverage, Capacity, Reliability & Control
Interoperability: Communicate with whom needed, as authorized

P25 Is Designed to Meet the Operational Environment

US Public Safety Environment:	P25
One standard, applicable to VHF, UHF, 700, 800 MHz	Yes
Migrate while re-using existing spectrum with growth to new compatible bands	Yes
Subscriber equipment must support digital and 25/12.5 kHz analog operation	Yes
Applicable to Conventional and Trunking architectures	Yes
Digital coverage equal to or better than analog system	Yes
Same or better coverage from existing analog sites	Yes
Applicable to voting receiver and simulcast subsystems	Yes
Allow customized implementations, such as cross-band repeaters, site steering, etc.	Yes
Evolve to incorporate new requirements, e.g., add Phase 2 for 6.25 kHz equivalent efficiency	Yes

P25 provides standard to address operability, interoperability and enable multi-vendor competition

Project 25 Standards

- **P25 Phase I**
  - *Standard developed for Public Safety environment.*
  - *One FDMA voice path in 12.5 kHz.*
  - *Enables Operability and Interoperability.*
  - *Well established and "public safety tested" in market.*
  - *Competitive equipment market place.*

- **P25 Phase 2**
  - *Under development*
  - *Focus is 6.25e equivalent efficiency*
  - *Two-slot TDMA in 12.5 kHz*
    - Two voice paths in 12.5 kHz
    - Interoperable with Phase 1 FDMA
    - Standard documents completion anticipated mid 2010 for trunking
  - *Additional work underway also to address conventional LMR.*
  - *Complementary Project 25 system-level interfaces.*
    - Inter RF Sub-System Interface (ISSI)
    - Console Interface (CSSI)
    - Fixed Station interface (FSSI)

Project 25 Phase 1 Global Competitive Market

- 14 Subscriber vendors
- 12 Repeater/base station vendors
- 5 Test equipment suppliers
- 10 Network providers
- 12 System integrators

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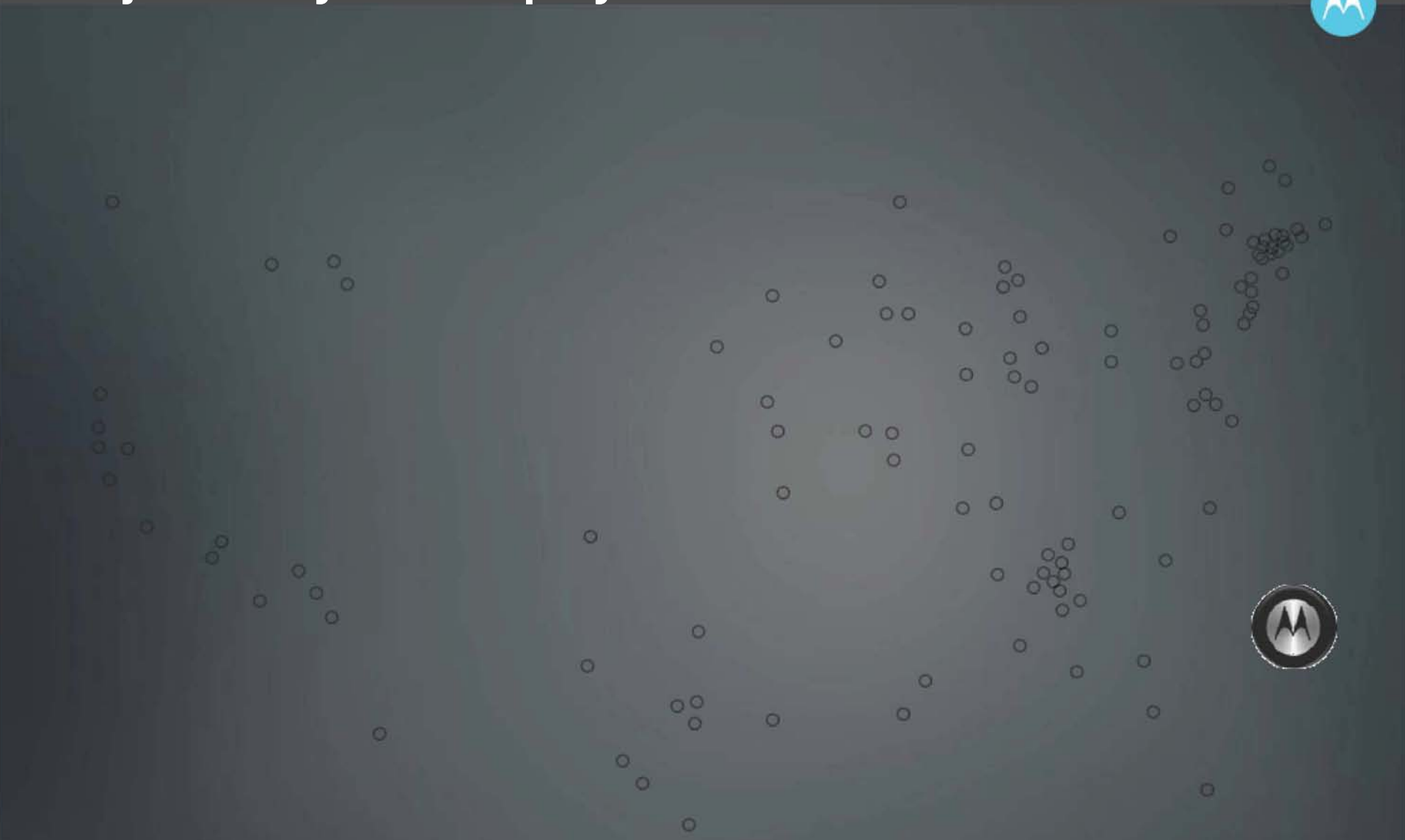
Project 25 System Deployments



**All information represented is to the best of Motorola's knowledge.*

- P25 Statewide System
- Planning to Move to P25 Statewide System
- Currently Operating Non-P25 Statewide System
- Currently Operating Non-P25 Statewide System – Plans to Migrate to P25
- Currently Implementing Non-P25 Statewide System
- No P25 Statewide Plans

7- 127 Total US P25 State and Regional Systems - 33 Total US P25 DOD Systems Not shown: 500+ P25 Smaller Local Systems

Interoperability at Work

August 1, 2007

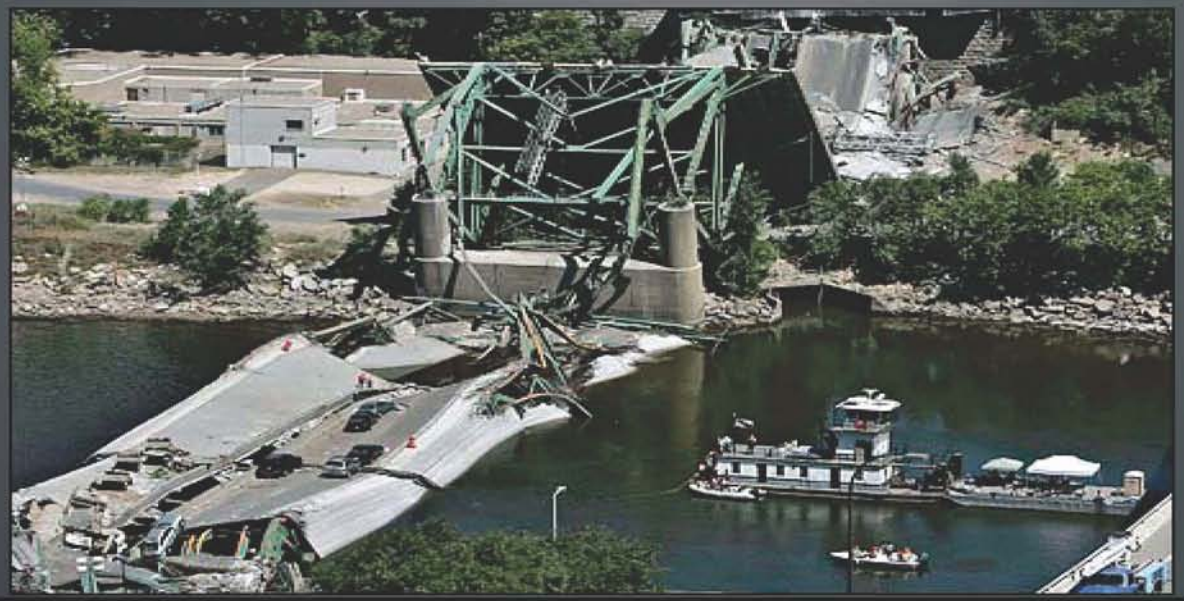
Minneapolis Bridge Collapse

- Project 25 System Worked as Designed
  - State of Minnesota
  - City of Minneapolis
  - Hennepin County
- Multiple User Agencies had Interoperable Communications
- Local Commercial Networks were Blocked

State of Minnesota – State and Local Interoperability

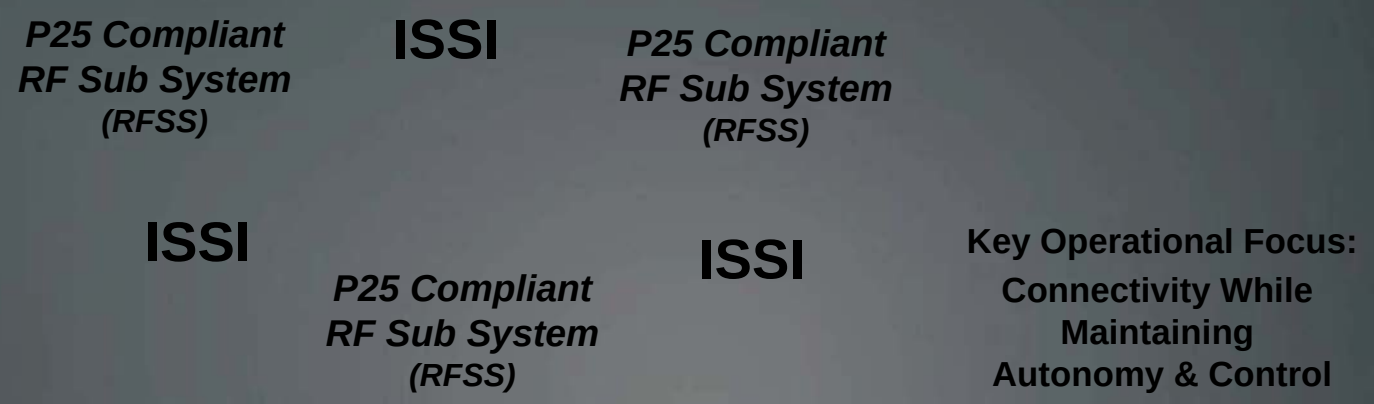
- Mission Critical Systems
  - Design for worst-case, not just for day-to-day use

- Example – Minneapolis Bridge Collapse
  - 63,508 PTTs for a total of 321,573 seconds airtime – normal usage
  - 114,97 PTTs for a total of 641,423 seconds airtime – after incident
    - Only 0.06% of all calls were delayed over 10 seconds (67 total)
      - Only 2 of these were interoperability/critical incident talkgroups (0.00002%)



P25 ISSI Defined and Benefits

Trunked P25 Inter-RF Sub-System Interface (P25 ISSI)



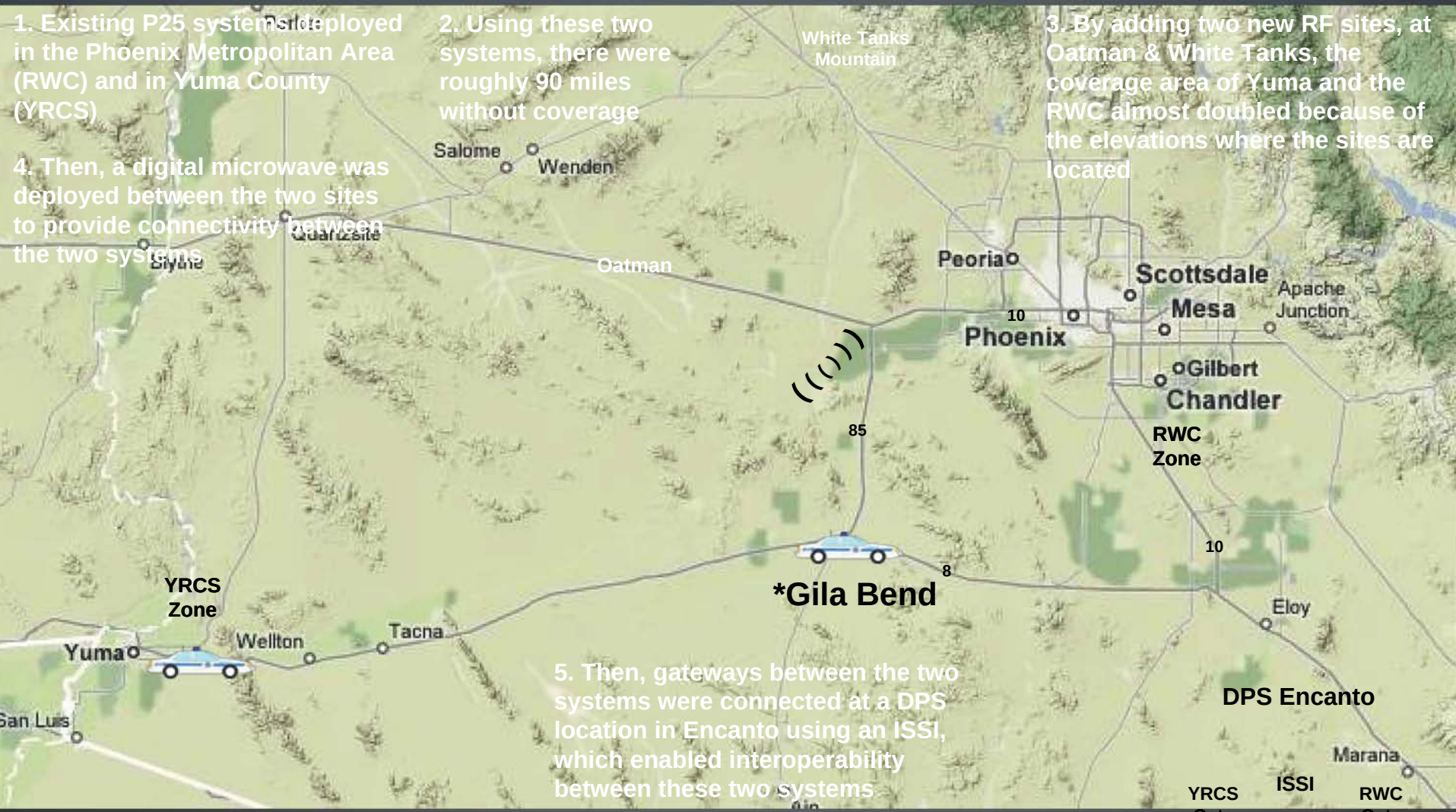
- ISSI is a standards based interface that enables two or more P25 networks to be connected at the network layer.

- User Benefits:
  - Establishes long term interoperability options with neighboring networks, regardless of how they evolve and change.
  - Delivers connectivity and network sharing while maintaining autonomy & control .
  - Provides connectivity between P25 systems of mixed vintages.
  - Supports mixed vendor configurations.
  - Provides network Coverage extension, sharing of RF site infrastructures.
  - Enables partnership of users to share network resources during time of need or everyday.

Phoenix & Yuma P25 Networks

- **RWC – Phoenix Regional Wireless Cooperative**
- **YRCS – Yuma Regional Communication System**

ISSI AT Work



6. Now, a public safety responder will be able to stay connected as he or she travels from Yuma to Phoenix.

7. When the user's signal from the Yuma system beings to decline, the user will roam into the RWC

Pieces of the Interoperability Puzzle

You need all the pieces for mission critical interoperability

Motorola 700 MHz BB Recommendations

1. Reallocate the D Block to PSST for public safety use
2. Enable deployment by host agencies (deploy own system) and third parties (to serve PS agencies)
3. Establish national framework for interoperability for PSST to administer via sub-licensing/leasing
4. Permit host agency option to prioritize and serve Federal, S&L public service, & Critical Infrastructure when capacity is available
5. Allow agencies on the systems to provide own devices and supplemental applications
6. Set provisions for optional ancillary satellite use
7. Prioritize the UASI* areas for Congressional funding
8. Support funding for PSST to complete narrowband relocation and administer the national framework

* Urban Area Security Initiative

* Urban Area Security Initiative

Mobile Multimedia Requires Broadband LTE Networks

Tier 1 (1- 4 kb/s*)

- **Messaging**
  - **Dispatch**
  - **Text messaging**
- **Query Databases**
  - **Driver's License**
  - **License Plates**
  - **Warrants**
- **AVL (Limited update intervals)**
- **Sensor Reading**
- **OTAR**

Text Based

Tier 2 (20kb/s*)

- **Mobile AFIS**
- **Mug Shots**
- **Text-based reports**
- **Intranet/Internet Access (Limited)**
- **Automatic Vehicle Location**

Simple Web

Tier 3 (500Kb/s*)

- **Fast Intranet and Internet Access**
- **Mobile Office Apps**
- **High Res. Image and Large File Transfers**
- **Multiple sessions of Low Res. Video (not evidentiary quality)**

Limited Video

Tier 4 (>1Mb/s*)

- **High Res. Video (evidentiary qual.)**
- **Rich Web Multimedia**
- **Real-time 3D Graphics**
- **In-vehicle Video Upload for Archiving**
- **Incidents with High User Density**

Rich Multimedia

Supported by Narrowband LMR networks

Requires Broadband LTE with QoS

*** Effective application & IP layer data rates at cell edge (after overheads removed)***

Next Generation Public Safety Revolves Around Multimedia

Command center dispatchers & first responders connect to video and rich multimedia content wherever they are, and however they need it, in order to be more effective in their mission

Enhanced Situational Awareness

Improved Protection of People & Resources

Expanded Evidentiary Capabilities

Dispatchers

- Multimedia capable CAD
- Access to fixed and mobile video camera feeds
- Multimedia content sourced by 911 callers
- Ability to wirelessly transfer relevant multimedia content to responders

Responders -Vehicular

- Mobile computers with in-vehicle cameras & DVRs
- Wireless access to fixed cameras for surveillance
- Multimedia CAD clients, mobile office apps and high speed wireless web access
- Sufficient wireless bandwidth to serve as on-scene incident command posts

Responders -Handheld

- Portable access to all content and applications while out of vehicle
- Mobile VoIP telephony extending wirelessly from their agency's PBx
- Advanced portable location services with rich graphics content

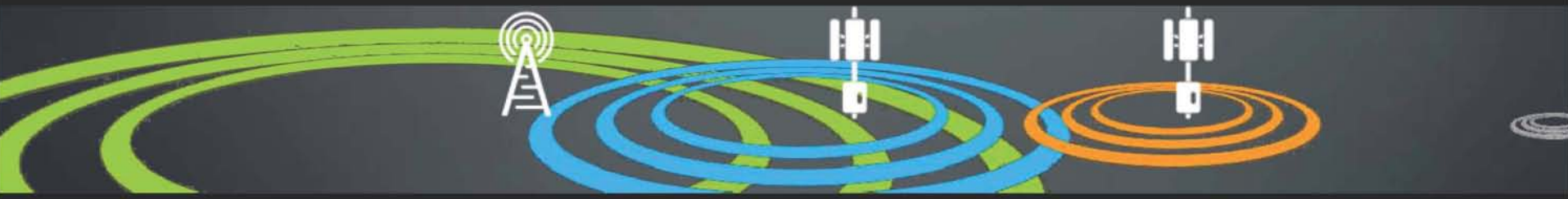
Requirements for a Mission Critical LTE Network

- **High Coverage Guarantees**
  - 95-97% geographic coverage across entire jurisdictional area
- **High Reliability/Availability**
  - Core network sites and cell sites must be hardened, including emergency power and redundant backhaul (24 hrs battery + Generator)
  - Redundant core sites and overlapping coverage from cell sites in the event of complete site destruction or failure
  - Subscriber devices able to communicate direct mode for data to other subscriber devices if entire infrastructure is down (*unresolved issue for all cellular technologies, including LTE)
- **Service Capacity Designed for Emergency Incidents**
  - When sufficient spectrum available, often double the peak busy hour traffic load

Coverage

Broadband networks will overlay & interoperate with narrowband networks to balance coverage, capacity, and cost for data services

	LMR voice		*LTE Broadband*
	700 MHz		**700 MHz**
	Lower data rate but serving the broadest coverage area		High bandwidth within a moderate coverage zone
Sub//Rural Site Coverage	**100 – 700 sq mi**	**~5X sites**	**20 – 100 sq mi**
Urban Site Coverage	**10 - 40 sq mi**		**1 - 8 sq mi**



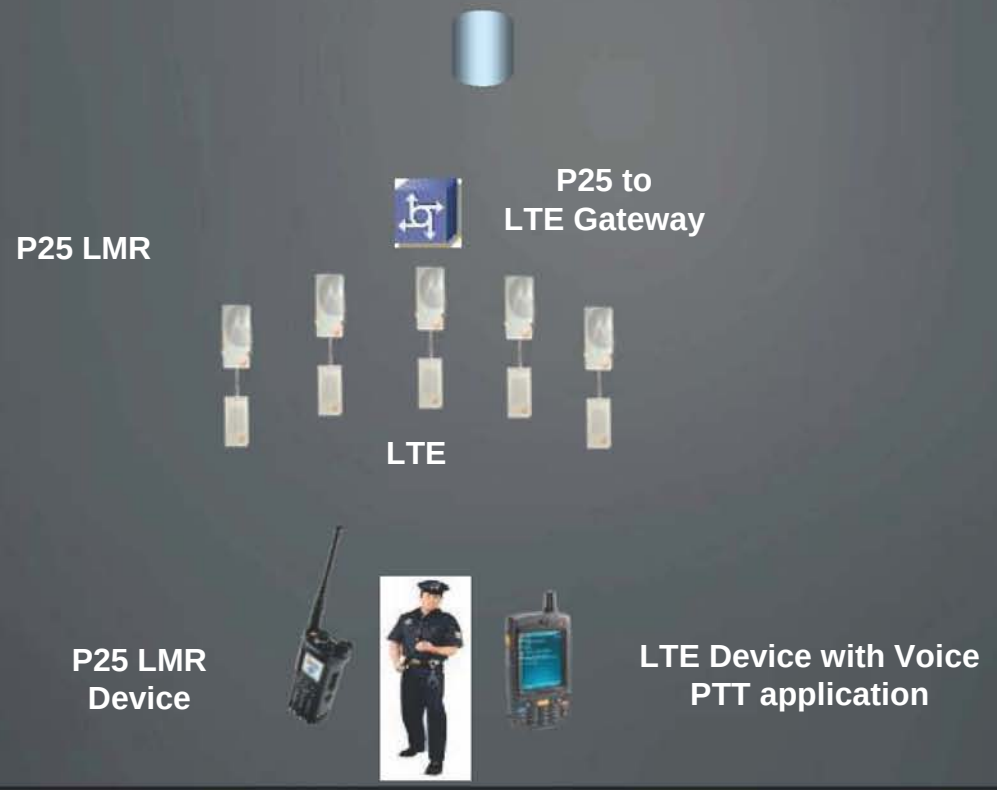
Requirements for Public Safety-grade PTT Service

- Deliver voice access in under 1.3 seconds from button press
- Provide reliable audio simultaneously to possibly 100's of responders in each talkgroup.
- Support for multiple talkgroups densely located at a common incident scene
- Provide Direct Mode for mobile/portable units to communicate directly if local infrastructure is down or users are in uncovered geography (*unsolved issue for all cellular technologies, including LTE)

Access time for current P25 Trunked systems is approx. 1.1 to 1.3 seconds and for current P25 conventional systems is approx. 0.25-0.65 seconds.

Coexistence of P25 & LTE

- The primary added-value of 700 MHz broadband systems is capacity for data and video.
- P25 and LTE networks can coexist and provide benefits to Public Safety
  - Leverage investment in voice systems
  - Add high speed data and video capabilities
  - Provide P25 and Broadband connections
  - Further enable Operability and Interoperability



Sharing of Regional LTE Networks

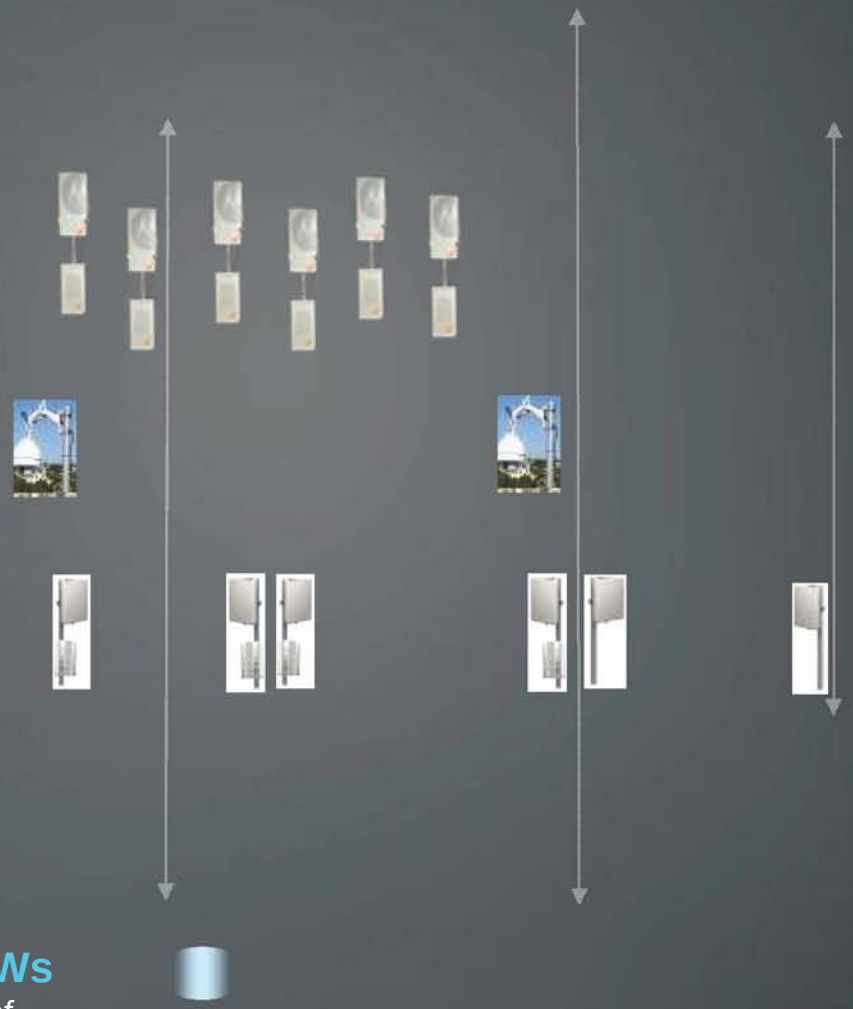
- Many Public Safety agencies want the control that private networks offer
- For 700MHz BB, there must be network sharing and options for partnerships with 3rd parties
- Need to ensure users have the right to deploy applications they need, beyond those identified for interoperability, and interoperable devices that match their respective environment
  - Ensures all agencies can deploy the applications and devices they need
  - Promotes ecosystems for partnerships and innovative services
  - Federal agencies as users would also welcome ability to securely control user subscriptions, authentication and payload encryption keys, user location information, etc.

Future U.S. Public Safety Communications – An Overlay of Interoperable Networks

- Networks optimized for the specific services they provide and their economical support for urban or rural deployments of those services

Urban

Rural



P25 Land Mobile Radio

optimized for PS PTT voice and basic data with economical 95+% geo-coverage. VHF, UHF, 700, 800 MHz

700MHz LTE Mobile Broadband

Shared networks optimized for mobile collaboration of video and data content and supplementary voice capacity but mostly economical in urban /suburban areas

Fixed Video on 4.9GHz

Broadly deployed 24x7 high resolution cameras to maintain situational awareness; Hotspots

4.9GHz Wireless Backhaul (PMP/PTP)

Optimized PMP and PTP networks for backhauling each overlaying network's base sites and cameras to fiber backbones

Fiber Backbones

Optimized to carry gigabytes of multimedia traffic to Command & Control Centers and media storage/archiving locations.

Integrated Command Centers/ Interop GWs

Integrated view of services and individual agency control of users, security , policy, applications, content and devices

Summary

- Narrowband systems/P25 Networks will continue to provide value to Public Safety Users.
- LTE Broadband networks will add much needed data and video capabilities as well as some non-mission critical voice applications.
- FCC rules should enable flexibility in deployment scenarios for LTE: Both direct PS regional deployments and the option for public/private partnerships
- To ensure operational value of 700 LTE networks, users need the flexibility to select and deploy applications and interoperable devices that match their operational needs.
- LTE and current voice systems can connect to leverage the value of each for Public Safety operability & interoperability.