

APCO Technology Forum

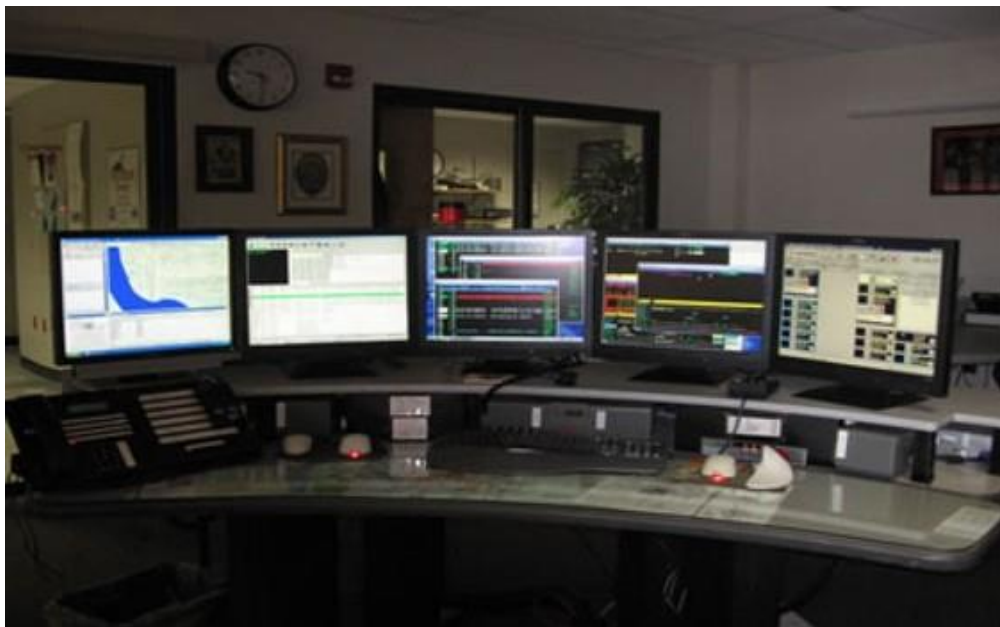
PUBLIC SAFETY BROADBAND (LTE201)

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Disclaimer

- Andrew M. Seybold serves as a Senior Public Safety Communications Advisor to FirstNet (A Contractor)
- Andrew Seybold is representing himself and NOT FirstNet in this presentation
- The views expressed in this presentation are his own and not based on any inside information obtained from FirstNet
- None of his comments are to be construed as FirstNet policy
- Andrew Seybold is a consultant, writer, and educator in the field of wireless communications
- Clients include Public Safety Agencies as well as Commercial Wireless Operators in addition to FirstNet



Public Safety Communications

CURRENT STATUS



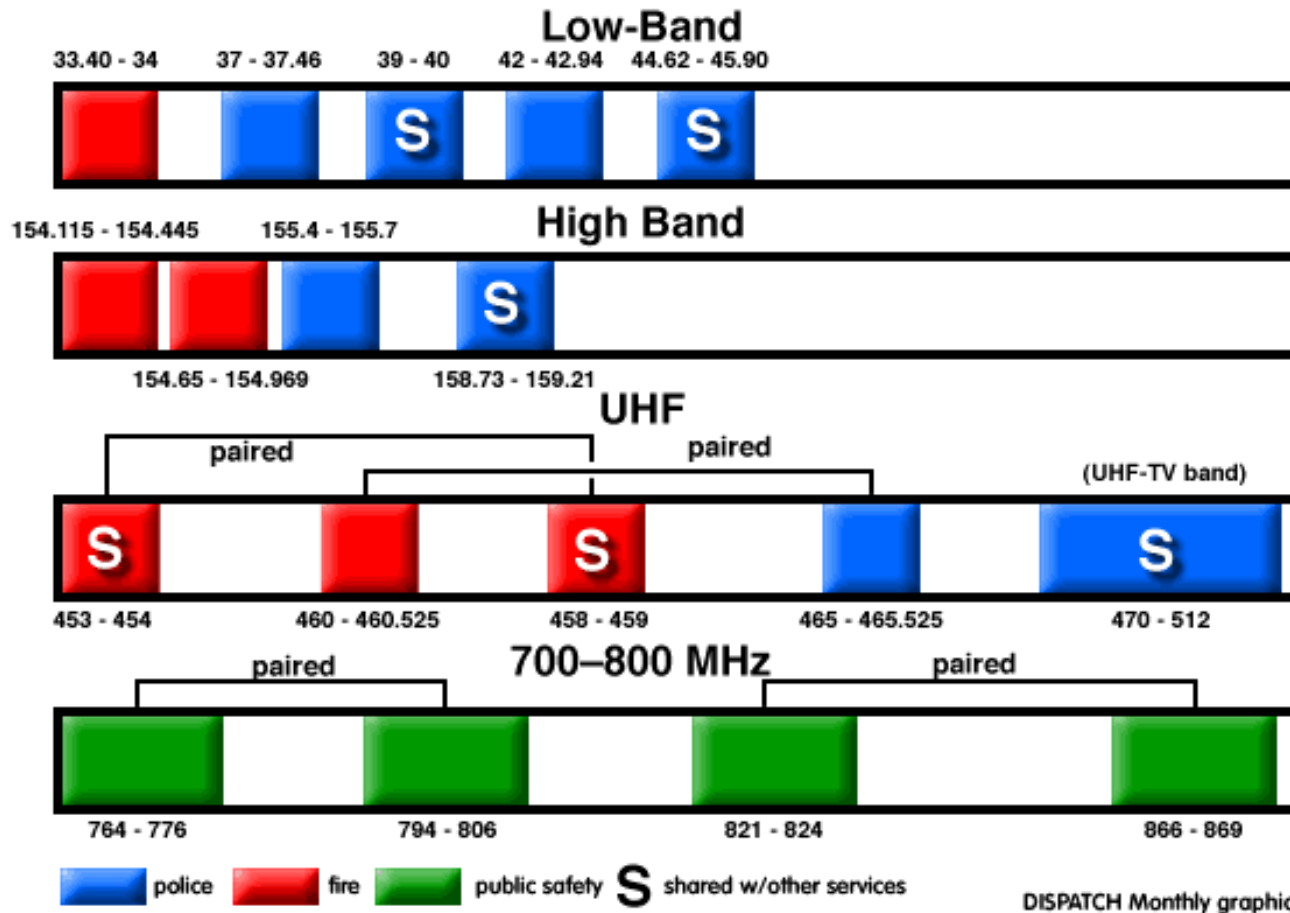
Public Safety Today

- Lack of true interoperability between agencies for voice
- Many departments employ two radios per vehicle in order to talk to other agencies (\$10K per vehicle average cost)
- Multi-band portables are available but very expensive
- Additional radio channels hard to come by
 - » New FCC rules limit output power based on height above average terrain
- FCC's narrowband requirement took effect Jan 1, 2013
- Congress mandated that T-Band (470-512 MHz) be returned to FCC by 2021

Public Safety Interoperability Issues

- FCC provided new spectrum to Public Safety over time
 - » Started with 30-50 MHz Added 150-174 MHz
 - » Then 450-470 MHz Next 800 MHz
 - » Then came 470-512 (T-Band) in 11 metro areas
 - » In some areas, 220 MHz Last was 700 MHz
- Result: No one band has enough channels for all services
 - » Interoperability nightmare
 - » 9/11 and Katrina: Responding units could not talk to each other
 - » Per vehicle cost for radios \$5K to \$10K!
 - » Some Public Safety moving from Analog FM to P-25 digital voice systems—still a lot of analog FM in use

Current Public Safety Spectrum





Adds Video/Data/GPS

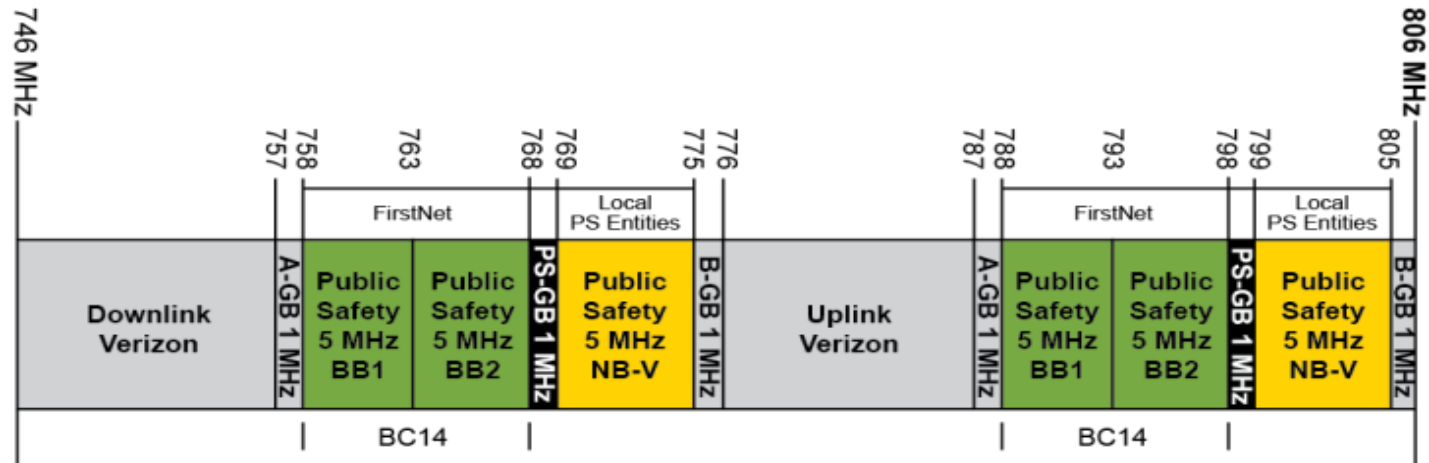
PUBLIC SAFETY MOVES INTO THE FUTURE

Public Safety Broadband, What It Is

- Starts with new, **Nationwide** Public Safety radio license for 20 MHz of 700-MHz spectrum
- Will be fully interoperable on nationwide basis
- Network will provide Public Safety with mission-critical
 - » High-speed data/Video Services/GPS more
 - » Will provide same types of services citizens have with smartphones but on hardened, mission-critical network CONTROLLED by Public Safety, NOT commercial network operators
- Will be based on commercial 4G technology (LTE)
- Will bring Public Safety into 21st century
- **Will be MOST secure wireless network ever built!**

Public Safety 700-MHz Spectrum

Public Safety Spectrum Allocation in the 700 MHz Band



Public Safety 700 MHz Allocations

Total Allocation	34 MHz	
Broadband Portion (10 x 10)	20 MHz	
Narrowband Portion (6 x 6)	12 MHz	
Guardband Portion (1 x 1)	2 MHz	

Legend

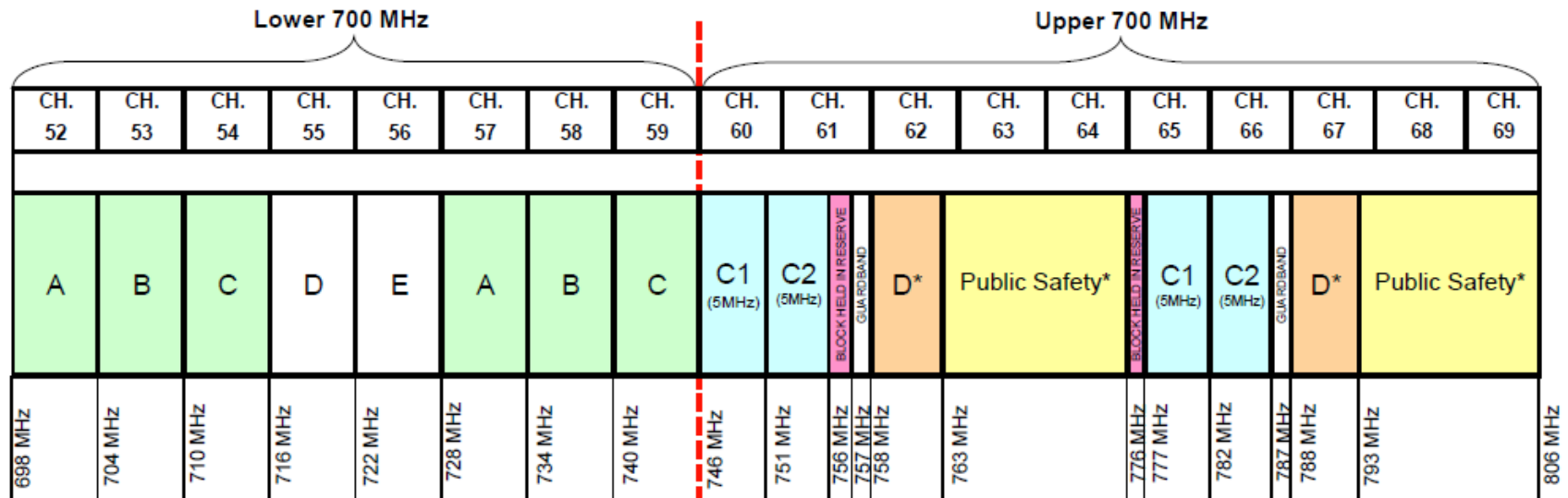
FirstNet = First Responder Network Authority
 PS Entities = Public Safety Narrowband Licensees

BB = Broadband
 NB-V = Narrowband Voice (e.g., P25 systems)
 PS-GB = Public Safety Guardband

 FCC allocated spectrum to public safety for broadband data services

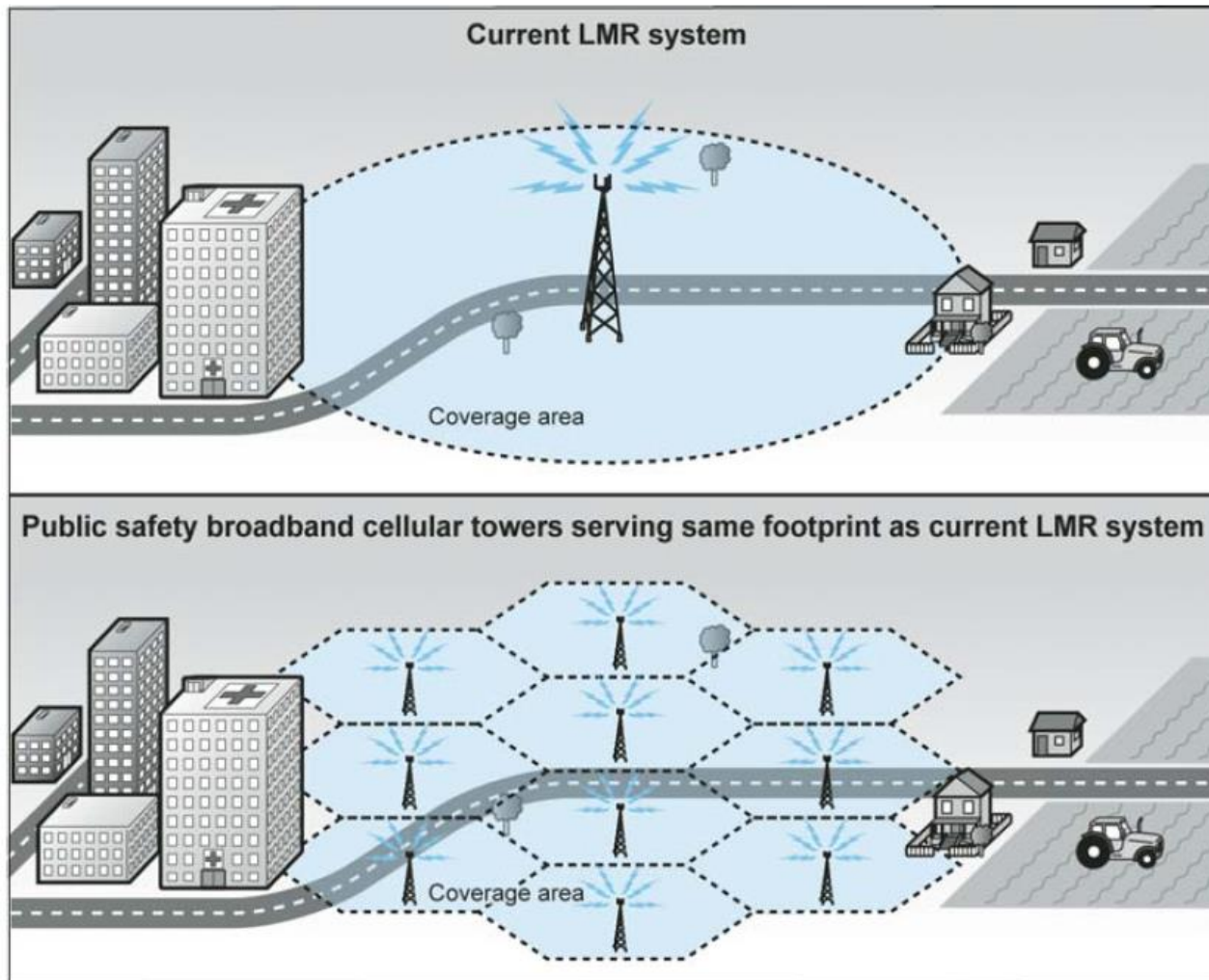
 Commercial Mobile Carriers

The Entire 700-MHz Broadband Spectrum



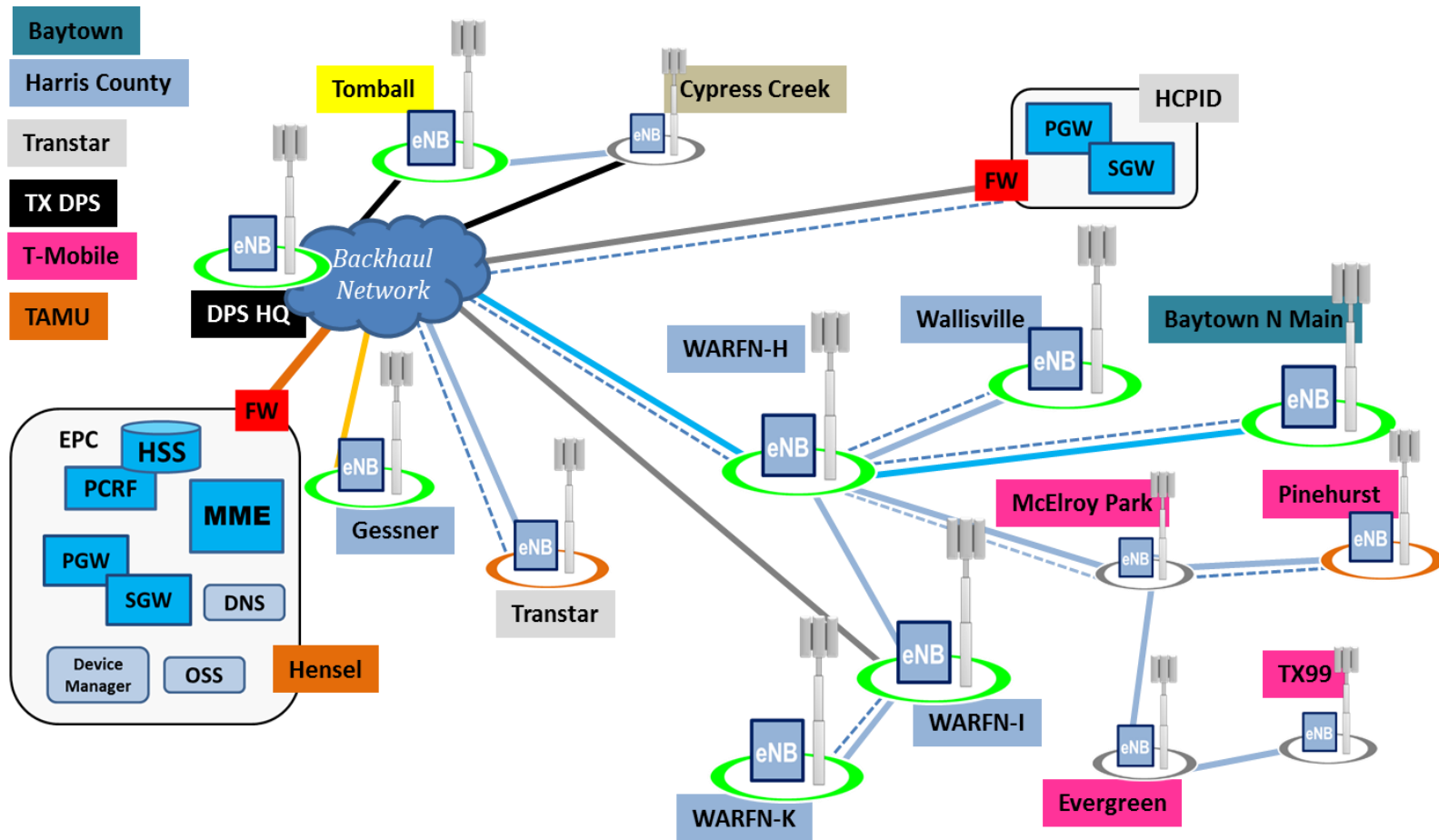
Lower 700 MHz: AT&T and small operators
Upper 700 MHz: Verizon and Public Safety

LMR and LTE System Differences



Source: GAO.

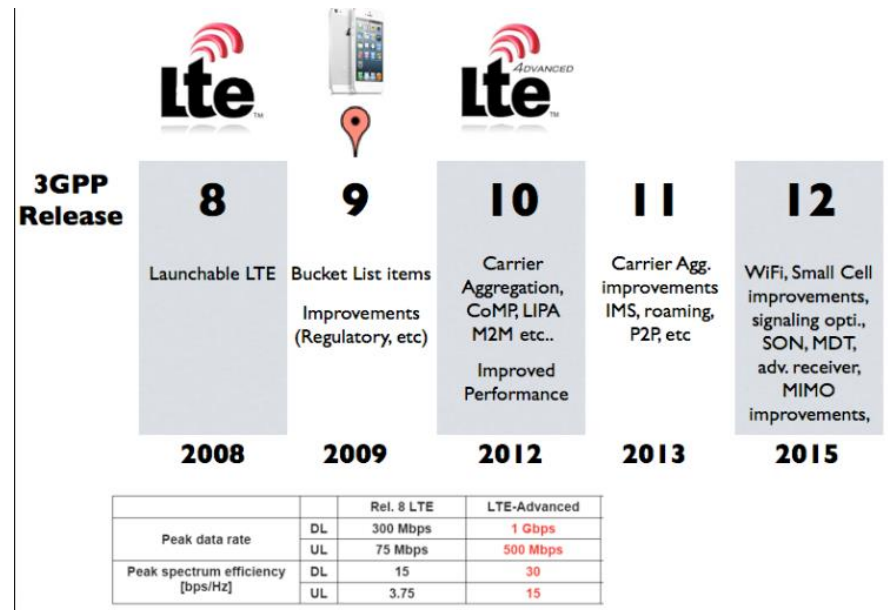
Harris County Texas Demo System



LTE: Long Term Evolution

4G Wireless Technology

WHAT LTE IS



What LTE Is

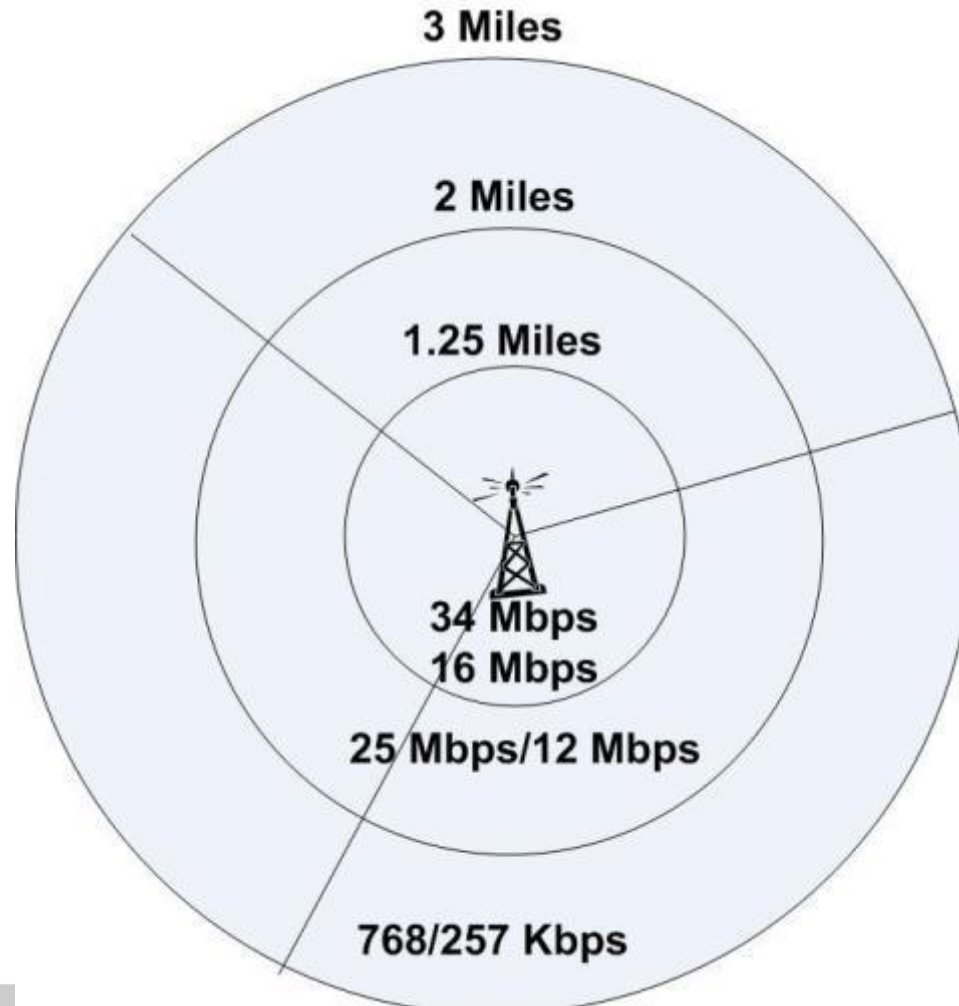
- LTE stands for Long Term Evolution
 - Standard developed by 3GPP organization
 - Networks and vendors tired of 1G, 2G, 2.5G, 3G names; LTE is really 4G technology
 - Unlike 1G, 2G, 3G that were designed for voice first with data added, LTE was designed for broadband data services first and foremost
 - Voice, using Voice over LTE (VoLTE) will be an add-on (at some point)
 - All-IP network
 - used by commercial networks

Typical LTE Cell Site at 700 MHz

Data speeds down to device/up from device

Capacity in each sector shared by all users in the sector

These are typical numbers, may vary from system to system



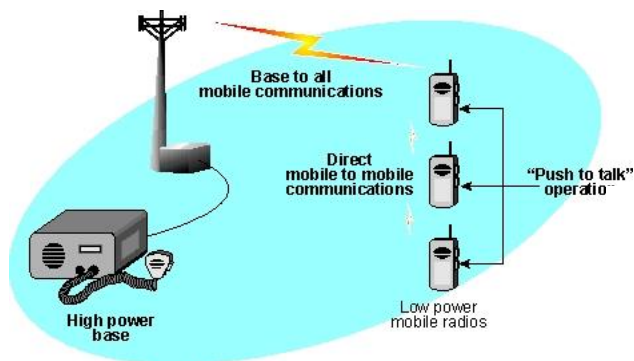
Shared Bandwidth/Capacity

- Bandwidth will not be an issue for
 - normal dispatch, patrol, location, and other services spread out over a city or county
- Where it becomes an issue
 - When a large incident occurs in a confined area
 - LTE coverage from only one or two cell sectors
- In this case, real-time network management will be required
 - Priority traffic settings, which videos are important
 - Change video resolution/frame rate
- Public Safety WILL have pre-emptive priority

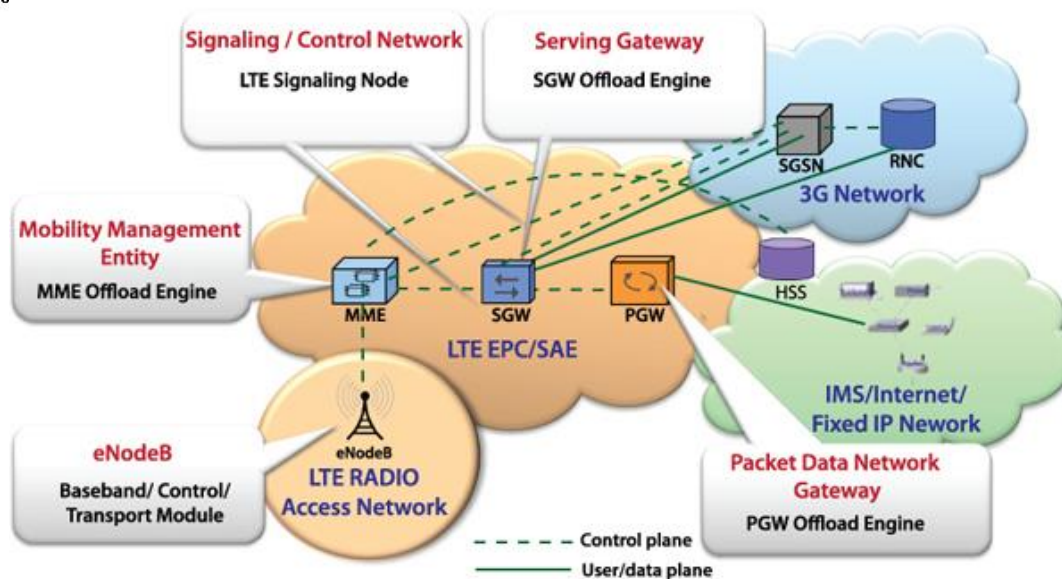
It is Important therefore...

- For all Public Safety Agencies in an area to start:
 - Working together with Unified Incident command
 - Identify who will be managing bandwidth at an incident
 - This spectrum will be shared by all agencies responding and MUST be allocated on a priority basis
 - Priorities can shift from Law, to Fire to EMS during an incident
 - More use of Unified command structure is essential

LMR Networks



LTE Public Safety Network



The Differences

BROADBAND VERSUS LMR SYSTEM DESIGN

LTE Broadband System Design

– LMR Systems Base

- High-level sites
- High-power transmit
- Transmit as needed
- Coverage 20-40 miles
- Omni antenna

– LMR Mobile/HT

- High power (5-100W)
- External antennas
- Talk-around simplex

– LTE Broadband Cell

- Low-level sites
- Low-power transmit
- Transmits 24/7
- Coverage 1-3 miles
- Sectorized antennas

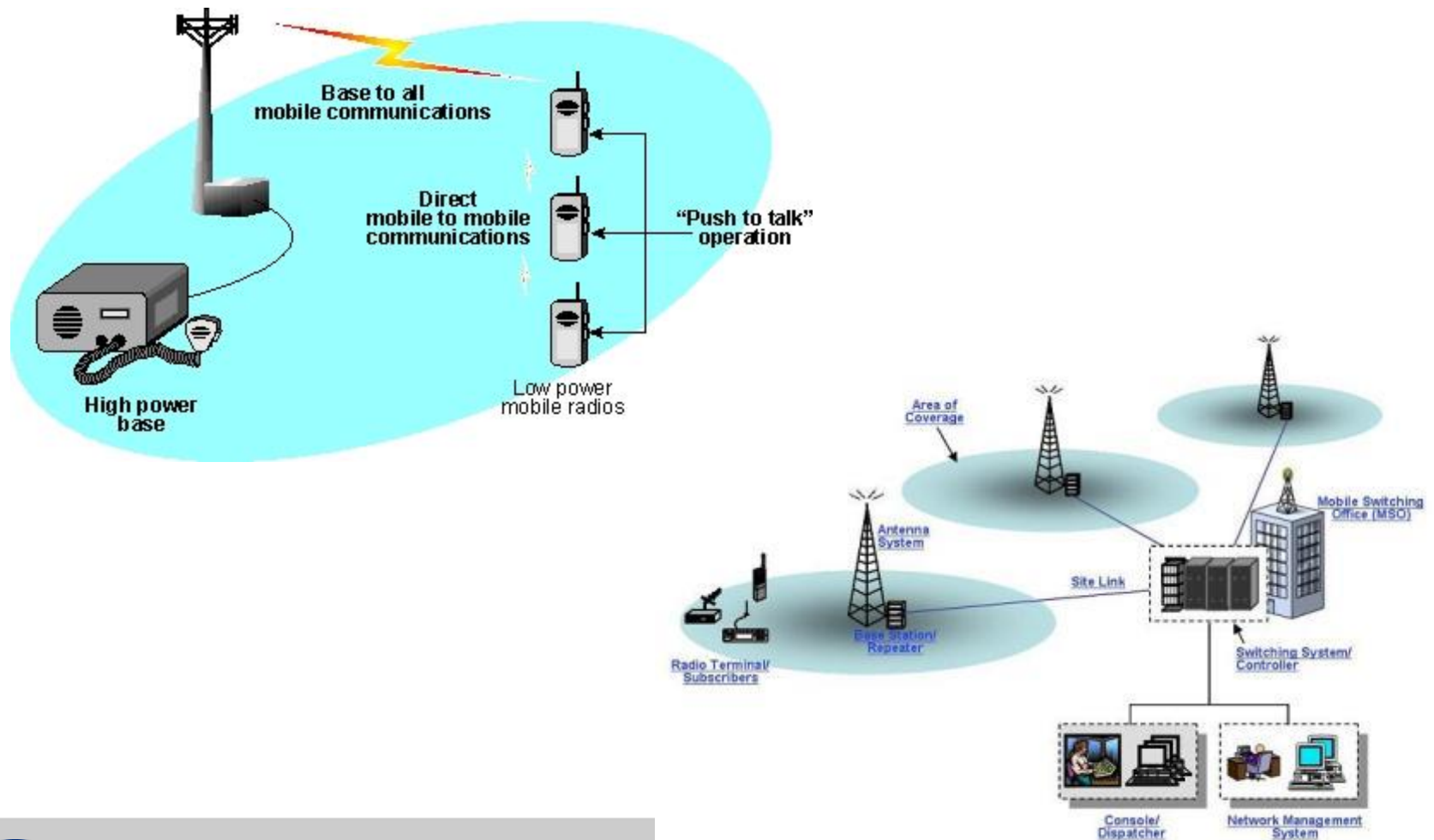
– LTE Devices

- Low power (250 MW)
- Built-in antennas
- MUST use cell site

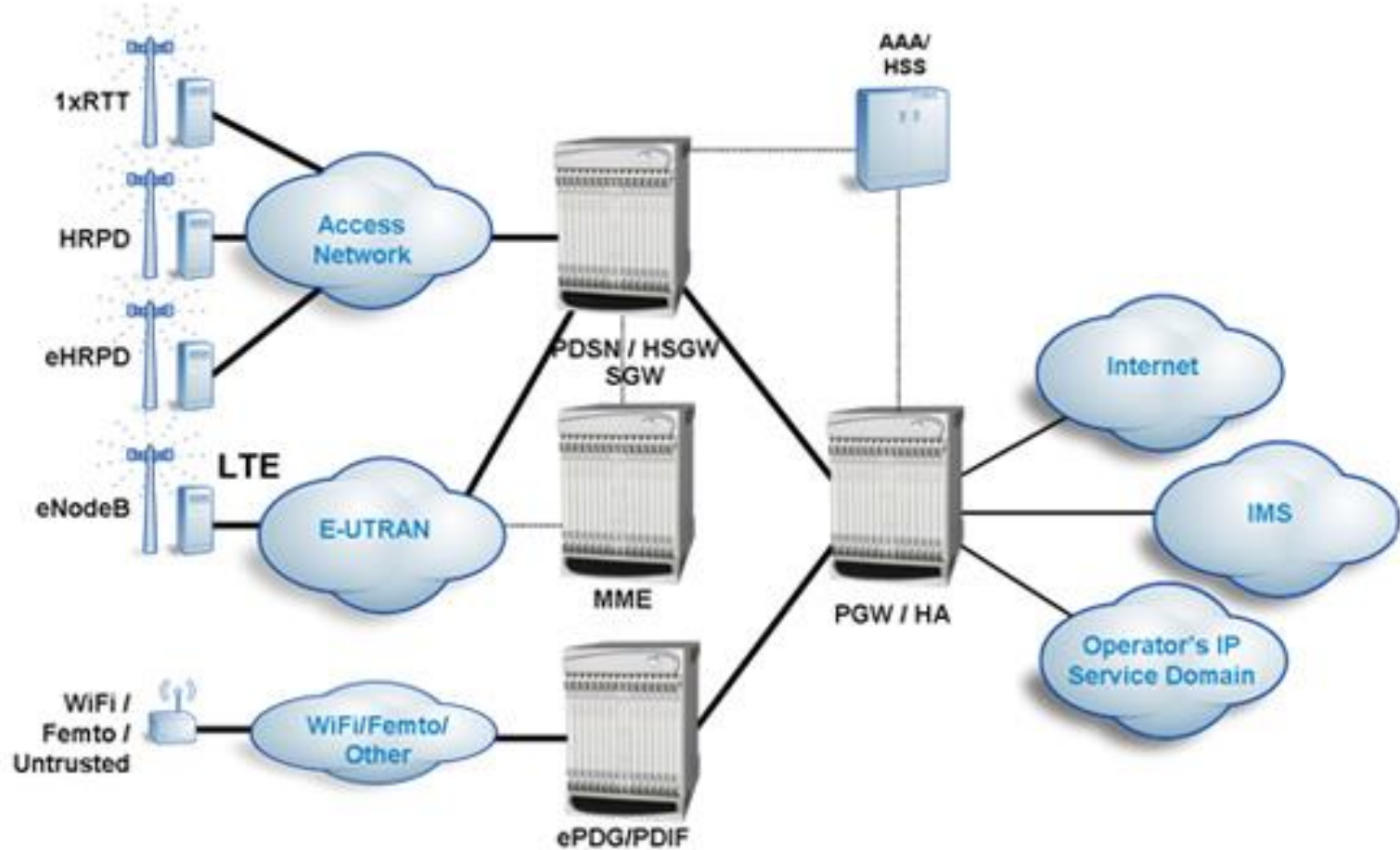
Other Differences

- LMR
 - Wireline/control station/microwave
 - Low capacity requirements
 - Dumb networks
 - Trunked are semi-smart
 - Set and forget
 - External spkr/mic
 - Channel change by user
- LTE Broadband
 - Fiber/microwave
 - High capacity
 - 50+ Mbps per site
 - Smart cell sites
 - Requires network core
 - Modify parameters to handle data demand on real-time basis
 - Channel change by network

Typical LMR System Diagram



Typical LTE Broadband Systems



LMR

PTT

LTE

Base Radio
Simplex
Talk Around

eNodeB
RAN
IMS

LMR AND LTE TERMINOLOGY

LMR and LTE: Different Languages

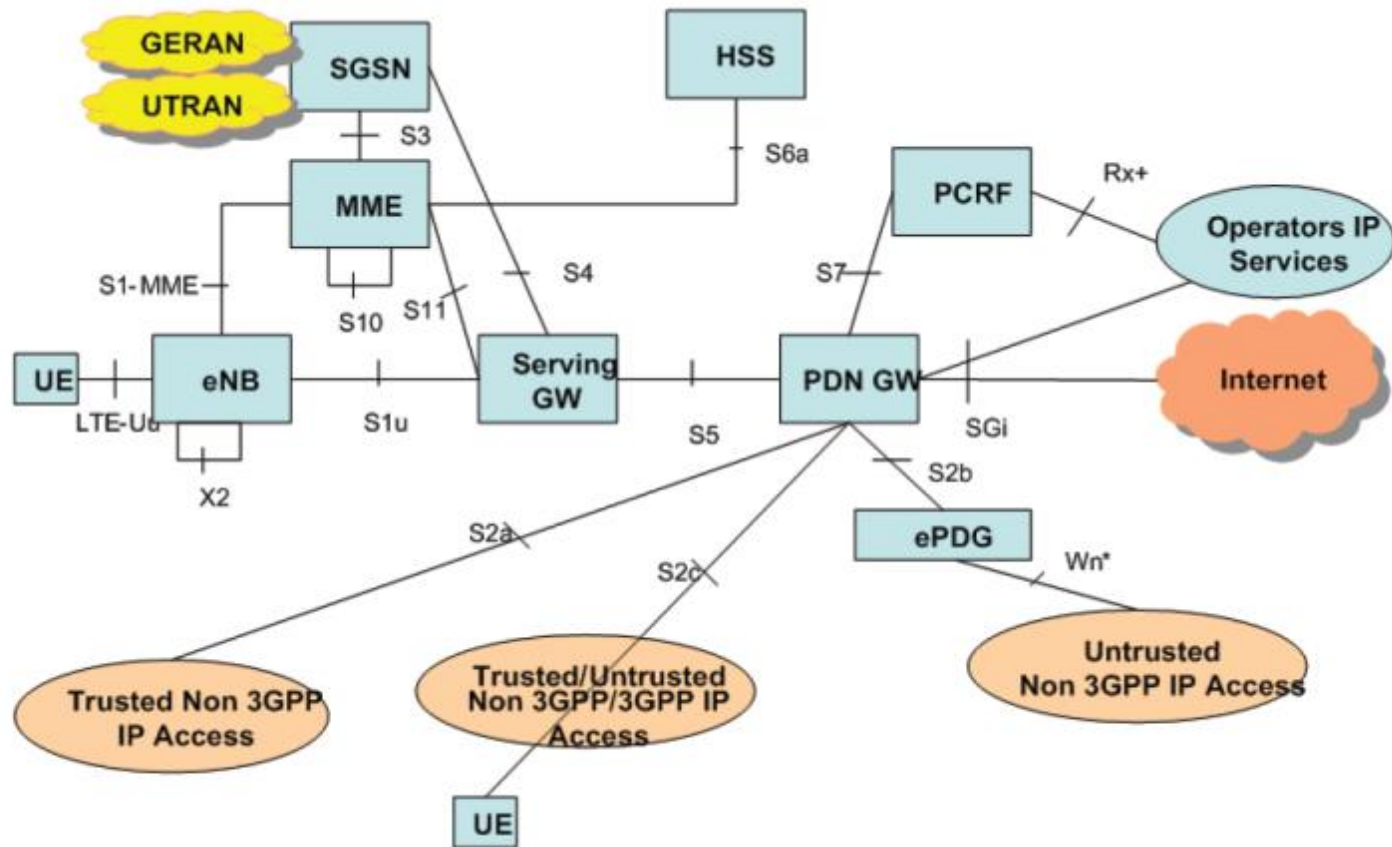
LMR Speak

- Base station/repeater
- Tower/radio location
- Mobile/HT
- Omni-directional antenna
- Output power in Watts
 - 5 Watts = 37 dBm
- Connection to dispatch
- Simulcast
- Narrowband Voice

LTE Speak

- eNodeB
- RAN (Radio Access Network)
- User device
- Sectorized antennas
- Output power in dBm
 - 250 MW= 23.98 dBm
- Network backhaul
- Multi-cast (future)
- Broadband data

LTE Architecture: A Complex Network



LTE Systems Basics

- LTE:
 - is a complex broadband cellular architecture
 - has many built-in system and user controls
 - Some can be static, others designed to be changed dynamically

system design differs from LMR system design in many ways

- More, lower-level cell sites: Lower-powered user equipment :Optimized for data and video today

More Points of Failure for Broadband

- LTE networks built as cellular networks—without connectivity to back-end system, cell site won't be usable
- Points of failure due to storm, fire, other events including
 - Antenna damage at site, Damage to site
 - AC power loss, No generator and running out of battery back-up, Generator runs out of fuel
 - Fiber or microwave backhaul is disabled

When Will the Network Arrive?

- Harris County Texas up and running
- BTOP Grant recipients will be next to build
 - These builds should be considered beta areas for the network
 - Used to prove out capabilities, capacity, operation of the network
 - These portions of the network will be proving grounds for FirstNet network, devices, applications, and security

Timeframe Moving Forward

- Lots of planning remains
- States all have their planning grants
- FirstNet has sent out large number of RFIs
 - Many are all ready being reviewed and compiled
- NPSTC and APCO working on what is 'Public Safety Grade'
 - Will serve as guideline for network build-out and hardening requirements
 - Includes site hardening for both LTE and LMR sites
- Best Guess: Network build-out will start in 2014
- Will take multiple years to complete nationwide

While Waiting for FirstNet

WHAT CAN YOU DO?

Prepare, Test, and Learn

- Making use of the Broadband network will require
 - Agencies working together closer than ever before
 - At incidents involving law, fire, EMS
 - Bandwidth demands for all three
 - Priority traffic for all three
 - Some will also require capacity for ongoing field use
 - Network will have to be carefully managed

Working Together

- Better use of Unified Command structure
 - Who needs bandwidth when
 - May not be enough for all, must be on “need to have” basis
- Pre-planning cross-agencies a must
- Start now to work closer together
 - Practice incidents, tabletops
 - Real incidents, how much data/video is needed

Pre-Planning Is Essential

- Bringing video from the scene into a PSAP
 - Implications for dispatchers
 - How video priorities will be set, by whom
 - What is acceptable video resolution
 - From incident to IC/PSAP
 - From PSAP to IC and others at incident
 - There are companies working on video resolutions/compression/switching systems
 - Different types of incidents will require different types of video resolution

During an Incident

- Who determines what video is needed
 - Initial response
 - After incident command has been established
 - After incident is under control
- How much capacity do EMS teams need
 - From scene for vital signs/ultrasound
 - For video triage
- Who else needs access

There Will Be a Learning Curve

- Not only in what network will do
- How each city/county will allocate network resources during incidents
- This will be a nationwide network BUT controlled locally
- Local control means managing the network
- Across ALL first responder services

Commercial Networks for Broadband

- Commercial 3G and 4G caveat
 - Commercial MAY offer some form of priority access, but not pre-emptive priority access
 - One reason Congress agreed Public Safety needs its own network
 - During times of major incidents, commercial networks may be overcrowded; Public Safety may not have access
 - If device cannot communicate with signaling channel, network will have no idea you are attempting to access it

Commercial Networks for Broadband (2)

- For this reason and others
 - Do NOT consider commercial networks as mission-critical networks
 - Understand their shortcomings as well as their advantages
- However
 - Making use of commercial networks before, during, and after NPSBN is deployed makes sense.

Hands-on with LTE

MAKING USE OF COMMERCIAL NETWORKS

Start Now with Commercial Networks

- Four commercial networks are deploying LTE
 - AT&T Wireless
 - Fall-back to HSPA and HSPA+ (3G)
 - Verizon Wireless
 - Fall-back to CDMA EV-DO Rev A
 - Sprint/Nextel
 - Fall-back to CDMA EV-DO Rev A
 - T-Mobile
 - Fall back to HSPA+
- Networks continue to roll out more LTE coverage
 - Only AT&T, Verizon have deployed 700-MHz LTE

Getting Started

- If you have not already deployed commercial broadband
 - Take it slow: You don't have to equip all first responders at first
 - Make sure police, fire, EMS all have subscribers to experiment with interoperability between departments
 - Choose devices that meet your needs
 - Vehicular modems for laptop-equipped vehicles
 - Tablets for Chiefs, Command Staff, Investigators, Incident Command
 - Smartphones
 - Work with network operators/vendors for security of the network
 - Virtual Private Network (VPN) connections, secure applications
 - Locked devices in the field

FirstNet May Start at Street Level

- Vehicular modems are best place to start
 - If you already use laptops, new LTE modems can be easy deployed
 - If you already use low/speed text-based applications, today's LTE modems will let you move into more robust data and video world
 - You can purchase modems “FirstNet”-ready

Choosing a Commercial Network

- Caveat
 - During Incidents, commercial networks may become overloaded and not available
- Determine which network provides best coverage in your area
 - Which has best overall coverage to handheld devices
 - Ask for drive test information from each

Choose One or More Networks

- It is possible to contract with more than one network operator
 - There is no LTE roaming between major networks today, but some devices will enable a session to remain up when switching
 - One contract for each network *OR* primary contract with one and a bucket of data from a second network
 - Play them against each other

LTE Commercial Contracts

- The more users you sign up, the less the cost per user (normally)
 - Work cross-agency in your area to achieve maximum number of units and best pricing
- Commercial networks want your business
 - Now and after FirstNet is live for routine traffic
 - Will work with you and your organization to have you up and running over broadband

What You Can Do over LTE

- Send and receive videos
- Send and receive pictures
- Faster, more complete license plate checks
- Building plans to first-in responding units
- More advanced EMS diagnostics
- Much more

What Applications Are Available

- APCO Application Community (APPCOMM)
 - Various applications including FBI Child ID, EMS, utilities, local police, fire and EMS applications, learning tools, resource books, many more
- Smith Micro, Motorola Solutions, many more
- Many in development

Applications

- GPS and voice-enabled navigation apps
 - Real-time route traffic updates
- Location of needed incident resources
 - Location of all responders regardless of agency
 - Other resources such as fire hydrants
- NCIC access (must be secure)
- Online report preparation and submittal
- Missing persons pictures
- Fingerprints from the field

CAD to the Field

- Many CAD companies have, or are developing CAD extensions for sending call data to responding units
- Many existing text-based apps being upgraded to take advantage of broadband
- Harris County Texas has number of applications up and running
- More to come soon!

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Once You Are Connected

- Try the network, both data and video
- Send and receive information not only with your own department but to other first responders in your jurisdiction as well
 - Get used to sharing incident information among law, fire, and EMS
- Unified Incident Command will be more important than ever after FirstNet is in operation
 - Practice network sharing during incidents

Learning about Broadband Now

- Makes sense
- Will reduce training time on FirstNet
- Will teach how to share data
- Will jumpstart advantages of data and video capabilities
- First responders will learn to work closer together
- Remember: Commercial networks are *NOT* mission-critical and can become congested
- During major incidents, commercial networks may not be available for use



BROADBAND DEVICES

Broadband Devices

- Start out with mobile-only modems
- Next, tablets for command, control, reporting
- Others will evolve over time
 - Separate LTE and LMR handheld devices
 - Combined LTE and LMR devices
- SOMEDAY perhaps a single LTE device for voice, data, and video

LTE Band 14

HANDHELD DEVICES

First Responders and Smartphones

- Today's smartphones are not one-handed devices
 - Require two hands to operate
 - Most use touchscreen
 - Not a problem when first responder is patrolling or sitting in a vehicle *BUT* it is a problem when on an incident
 - Today's smartphones not designed for harsh environments
 - Touchscreens not conducive to use when wearing gloves
- Hardened devices are coming but most vendors do not understand one-handed requirements of Public Safety
 - If used in the field, will augment but *not* replace existing LMR radios for the next few years at least

Law Enforcement and Other Responders

- Will **Public Safety REALLY** use both hands on a device?



Will they use two hands during even a routine traffic stop ?

Getting Ready to

MOVE FORWARD WITH LTE

Commercial Networks

- Commercial 3G, 4G networks have good coverage today
 - AT&T, Verizon use 700-MHz band for LTE so coverage and building penetration will be similar
 - Sprint, T-Mobile deploying LTE on higher spectrum
 - Coverage will be good but different from 700-MHz coverage
- Commercial operators want your business
 - Make them earn it with pricing and compatibility guarantees
 - How much will it cost per user per month?
 - Remember, you will have to pay for both commercial and FirstNet service, don't get into long-term commercial contracts that cannot be changed

Once You Choose Your Network

- Stage the equipment
- Check it out before installation
- Pre-load applications from your network
 - *DO NOT* install more than a few applications to start
 - Choose the ones that will be most used and of benefit in the field
 - Train those who will be using the applications
 - Start slow, get feedback from the field—insist on it!
 - Seed your field users
 - Give some units to those who adapt to technology quickly
 - Give some to those who resist using new technology
 - Make sure you can manage the devices over the air

Questions that Need Answers

- Adding broadband capabilities to augment existing LMR voice services will require a learning curve
 - What can it be used for?
 - How much video can be used over the network?
 - How do we manage video streams?
 - What types of applications can it support?
 - How do we secure our applications?
 - How is capacity and bandwidth managed across all of the agencies?

Questions that Need Answers (2)

- Ideal to use now to shorten learning curve for FirstNet
- What types of devices should be given to which types of first responders?
- How secure are the devices? How do we make them more secure?
- How secure is the network? How do we make it more secure?

Recapping

CONCLUSION

Recommendations

- Get together with all first responder organizations in your jurisdiction
 - Make a group purchase/lease agreement
 - Pool data between all agencies
 - Make sure devices are interoperable between agencies
 - When dealing with vendors
 - Make sure to purchase FirstNet upgradable devices
 - Get a guarantee that the vendor will replace/upgrade devices
 - Go slow...remember that LTE is about data and video
 - FirstNet is a network to *AUGMENT* voice not replace it!

Recommendations (2)

- Experiment with coverage for mobile and handheld devices
 - Coverage will be different
 - Check in-building coverage
 - If Wi-Fi roaming is available make sure it has same security levels
- Experiment with applications and video
 - Check your applications; make sure what you have on commercial network will be nearly the same on the Public Safety network

One Final Reminder

- Using commercial LTE will help prepare for FirstNet!
- *BUT* understand the differences between commercial networks and what is coming on FirstNet
- On commercial networks you will have
 - No priority access
 - Slower data speeds (good for learning)
 - Differing capacity issues depending upon how many commercial users are sharing same cell sector
- MOST OF ALL
- ***DURING MAJOR INCIDENTS YOU MAY HAVE NO ACCESS!***

VOICE OVER LTE: WHEN, WHAT, AND HOW MUCH?

Voice over LTE

- AT&T, Verizon, Sprint
 - All offer push-to-talk over their networks
 - Each network has its own PTT service
 - They are *NOT* compatible or interoperable with each other
 - All work well for *NON*-mission-critical communications
- Can be interconnected to LMR systems using IP bridges
- Voice over LTE for dial-up calls will happen soon

Voice over LTE (2)

- PTT over LTE is *NOT* mission-critical in nature today
- There is *NO* LTE PTT standard for either commercial or FirstNet broadband
- Public Safety needs LMR for voice, use broadband *ONLY* for data and video services
- PTT over LTE may become available at some point
- Harris County using PTT over LTE but it too is a proprietary technology from its vendor, could provide some interesting test results
- PTT over LTE will reduce network capacity for data and video services

Moving into the 21st Century

PUBLIC SAFETY BROADBAND CHANGES EVERYTHING!

Public Safety Broadband

- Nationwide
- Interoperable
- Adds data, streaming audio, video to Public Safety in the field
- Enables operations center, incident commander to see in real time
- Dispatch will include video from nearest camera

LTE Benefits

- LTE Public Safety broadband
 - Mission-critical data and video services to Public Safety communications
 - Nationwide, fully interoperable data/video network
 - Lower-cost devices because they are based on commercial technology
 - Public Safety will have full control of Public Safety LTE network
 - Won't have to share network with commercial customers
- Network will be secure, hardened, mission-critical in nature

Q & A



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