



Current state of 700 MHz Broadband for Public Safety

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- Market Evolution
 - What is LTE BB and a Short history
 - Legislative and Regulatory Effects
 - 700 MHz Broadband Regulatory & Funding Framework

- What a 700 MHz Broadband Solution for Public Safety Can Look Like

- Summary

What is LTE?



- Long Term Evolution is an international 3GPP standard, the next generation of data centric broadband technology to be used by public carriers worldwide
- LTE is considered either a 3.5G (generation) or a 4G a so-called technology; it supersedes 3G technologies
- Broadband = data speeds > 1 million bits/second
- LTE is expected to deliver data speeds of 50 Megabits on the uplink, and 100 Mbps on DL in a 20 MHz channel on wireless, delivering cable and DSL speeds for mobile devices
- LTE channel access:
 - Downlink: OFDMA (orthogonal frequency division multiple access)
 - Uplink: SC-FDMA (single carrier) (also called SC-DFT), which allows lower peak-average power ratios and hence eliminates linear RF amplifiers in subscriber devices, improving battery life
- OFDMA = Multiple carriers spaced closely together providing frequency and time diversity: 15 kHz spacing, a resource block = 180 kHz x 1 msec



What is LTE?



- Modulation on UL is up to 64 QAM; channel coding is dynamically selected based on RF channel quality
- LTE will run on RF channels of 1.25 to 20 MHz bandwidth
- FDD (frequency division duplex), TDD, and $\frac{1}{2}$ duplex FDD can be used
- MIMO (multiple input, multiple output) is used to provide path diversity to improve multipath RF performance
- Quality of Service (QoS) enhanced with 2 error correction loops:
 - Fast Hybrid Automatic Request for Retransmission (HARQ) catches most errors
 - Slower ARQ for remaining errors
- Performance as compared to 802.16 WiMAX:
 - DL: 60% better on average in spectrum efficiency and throughput, 100% better on cell edge
 - UL: 100% better at both average and cell edge



700MHz Broadband History



- Digital TV Transition Legislation 2006
 - Allocated 24MHz of Spectrum to PS
- July 2007, the Federal Communications Commission (FCC) revised the 700 MHz band plan
 - Consolidated existing NB allocations to upper half of 700 MHz Public Safety block (769-775/799-805 MHz)
 - Designated the lower half of 700 MHz Public Safety Band (763-768/793-798 MHz) for BB communications
 - Created 1MHz guard band (768-769/798-799 MHz) between the public safety BB and NB segments



700 MHz Broadband History



- Current 700 MHz Band Plan Created (July 2007) by FCC
 - 10 MHz of spectrum for Public Safety Broadband
 - 10 MHz of spectrum for D-Block
 - Pairing of D-Block and Public Safety Block for auction (no guardband)
 - PSST established as licensee (PSBL) for the Public Safety Broadband Spectrum

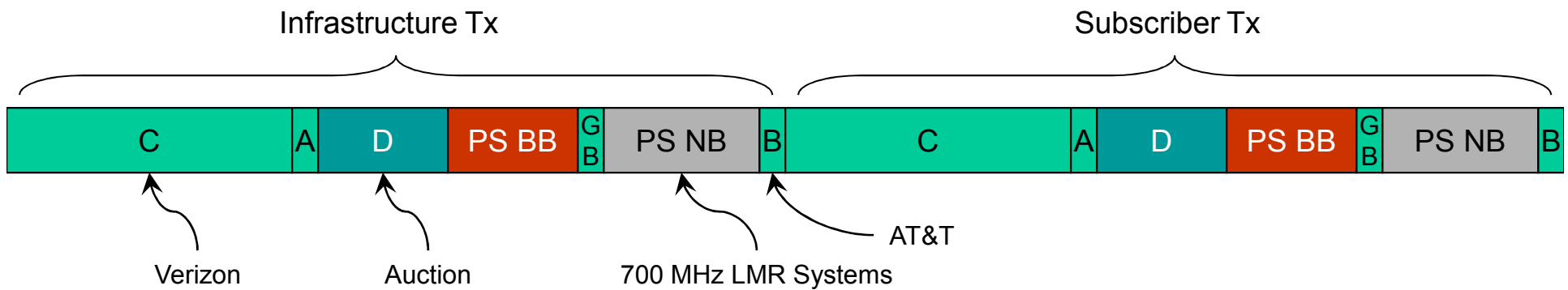
- Commercial Spectrum Auctions (March 2008)
 - D block + PS Block auction was not successful

- DTV Transition Complete (June 2009)
 - 700 MHz Spectrum available nationwide for narrowband and broadband Public Safety systems
 - **FCC R&O still in effect linking D +PS Block**

- FCC National Broadband Plan (March 2010)
 - FCC will separate D-Block from Public Safety Broadband Block
 - D-Block will be auctioned
 - Public Safety block will be made available for construction of a nationwide interoperable broadband network
 - PS can roam onto commercial carrier systems for peak bandwidth usage



Upper 700 MHz Band Plan



- FCCs National Broadband Plan
- Auction “D” Block
 - Public Safety builds nation-wide network in PS BB block
 - Established ERIC within the FCC to develop interoperability requirements for regional 700 MHz PS networks
 - FCC encourages “Leveraged Network Model”
 - Use of Carriers for Sites/Backhaul/Core
 - Advocate for ~\$10B of grant funds for public safety broadband



700 MHz Broadband Significant Recent Events



- On May 11, 2010, the FCC adopted an Order granting conditional waiver authority to various state and local governments to use 700 MHz spectrum to deploy public safety broadband systems on a local or regional basis
- NTIA reopened the CCI (BTOP) application filing window to those entities that meet the eligibility criteria in the Second NOFA and that have received authority from the FCC
- NTIA accepted applications from June 1, 2010 to July 1, 2010 for infrastructure projects from the affected parties (21)
- NTIA limited eligibility under this Notice to this group of entities to help ensure that all BTOP grant funds can be obligated by the statutory deadline of September 30, 2010 (~ \$4B to be awarded)



- Waiver Conditions
 - Sub-license spectrum from PSST
 - Fee structure subsequently established based upon 21 waiver recipient participation
 - Must deploy 3GPP Release 8
 - Vendors supplying solutions must participate in NIST demonstration network
 - Submit Interoperability Showing documentation by July 19
 - Quarterly reports
 - System must comply with ultimate ERIC requirements

- BTOP Grants
 - NTIA opened Round 3 (June-July) for waiver recipients, 7 granted to public safety entities

Waiver Applicants



- Many FCC waiver applicants
- 21 Waivers granted
- 7 were awarded BTOP grants in 2 rounds, \$384M total:
 - LA RICS \$155M
 - State of Mississippi \$70M
 - San Francisco Bay RICS \$51M
 - State of New Jersey \$40M
 - State of New Mexico \$39M
 - Charlotte NC \$17M
 - Adams Co Colorado \$12M
- Some non awardees still expected to proceed on building early systems



Emerging 700 MHz Broadband Regulatory & Funding Framework



FCC

Emergency Response & Interoperability Center (ERIC)

- Oversight of Network Design & Operations
- Comprised of:
 - Public Safety Advisory Board (State & Local)
 - Federal Agencies (NIST, DOJ, DHS, NTIA)

NIST

(Dept. of Commerce)

- Development of standards
- Oversight of Testing

DHS

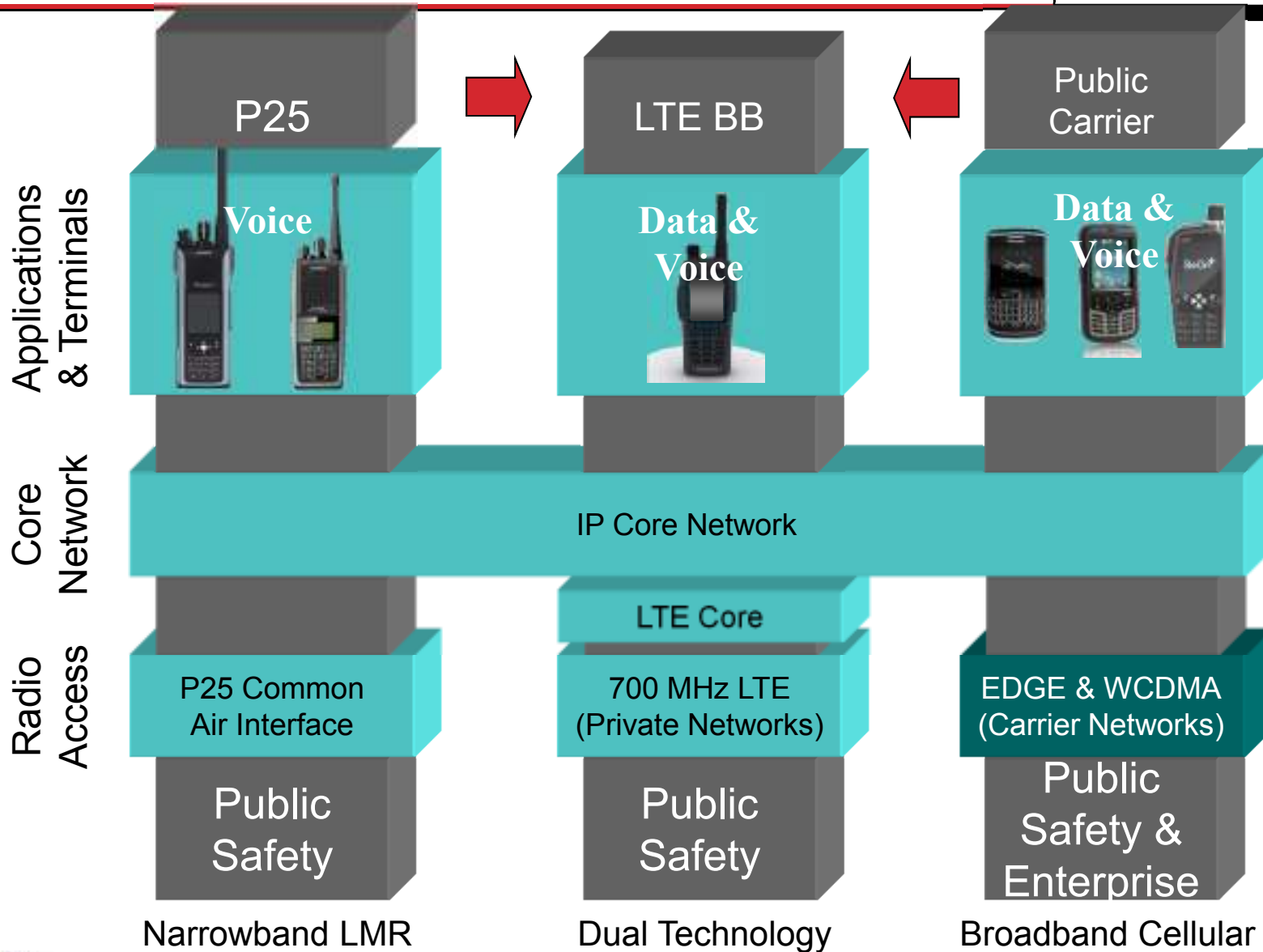
- Administration of Grants
- Technical Assistance
- FCC recommends grant appropriation of \$16B over 10 years

- New Federal oversight
 - FCC reaching beyond traditional role of establishing spectrum policy – to include oversight responsibilities for technology selection, deployment and operations
 - Mandated NIST Standards – will marginalize role of TIA/APCO
 - Funding will be tied to strict compliance to standards
- \$5.6B Capital Expense + \$1.3B annual Operating Expense cost model
- Significant paradigm shift for the Public Safety Market – Will initially be focused on broadband data then gradually encompass PTT Voice as well



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Private vs. Public Networks: Solutions for Public Safety



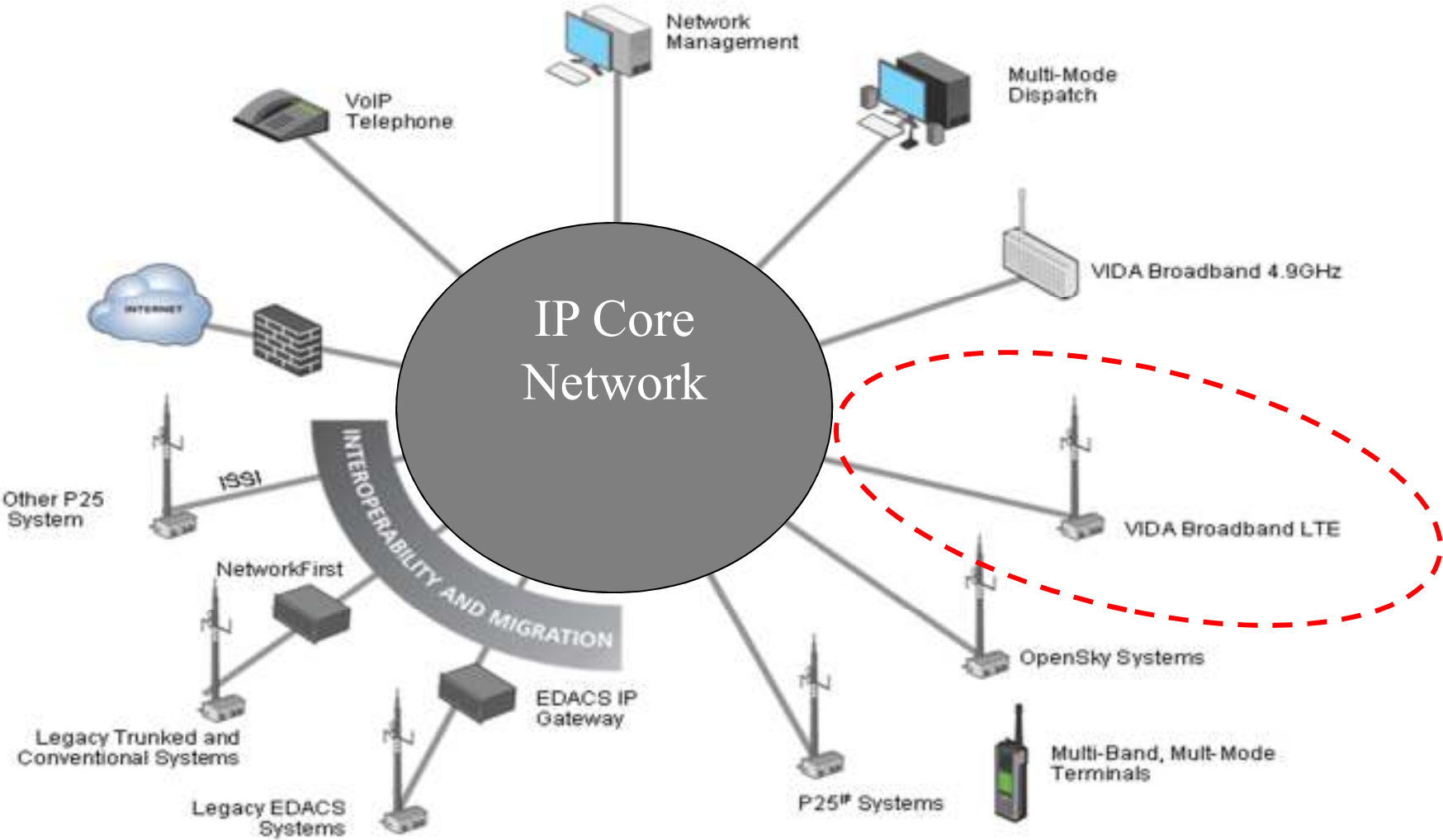
Public Safety Broadband Solutions



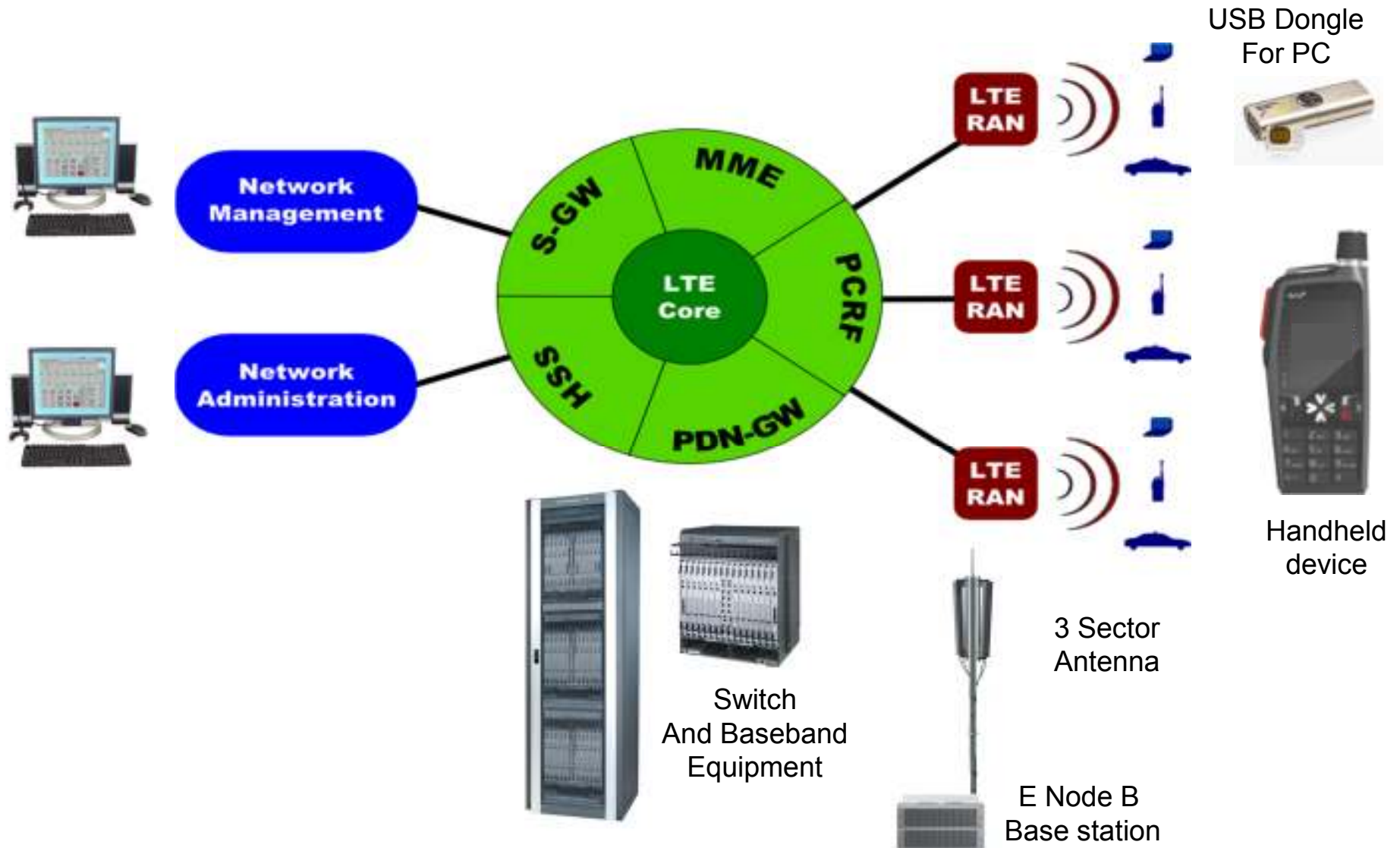
- Must use 3GPP Release 8
- Should allow for 10 MHz (5 + 5) for Public Safety Block, or 20 MHz (10 + 10) if the D Block is given to PS.
- Must meet the requirements of the FCC (Federal Communication Commission) National Broadband Plan
- Should enable public safety agencies to seamlessly integrate their existing narrowband LMR systems into the emerging nationwide, interoperable public safety wireless broadband network
- Should meet the emerging FCC cyber security and critical infrastructure survivability requirements
- Should support the evolving technical framework for the FCC's Emergency Response Interoperability Center (ERIC).



Integrating Broadband LTE to LMR



LTE Solution Elements



700MHz LTE RAN Performance



Channel Bandwidths	1.4, 3, 5, 10 MHz	Either a 5x5 or 10x10 is viable – depending on FCC spectrum decision
Data Rates (5 MHz Channels)	≈ 600kbps to 18 Mbps	
Latency	≈ 50 ms initial packet connection ≈ 20 ms afterwards	LTE is low latency – Will support VoIP
Capacity	> 200 users per 5 MHz cell	Peak requirement will be several hundred users per cell
Typical Cell Size	0.6 – 3 miles Urban 2 – 8 miles Rural	Expect a nominal implementation with cell area of 2- 5 sq miles



How is LTE different from LMR?



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- Coverage is designed based on data rates at the edge, or midpoint; not like a voice LMR system designed for DAQ 3.4.
 - Multi sector base antennas increase number of users
 - MIMO techniques improve reliability with path diversity
 - At 700 MHz, an LTE BB system will require more sites than a narrowband LMR voice system at 700 MHz
 - N = 1 means the network is single frequency, so high profile sites are problematic; systems will use many small sites with sectorized and in some cases down tilt antennas
 - Voice not envisioned until Release 10, but voice important to many public safety agencies
 - Public Safety wants a Radio – Radio direct mode like they have in LMR
 - What does this mean for data, or IP voice?



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- 700 Broadband for Public Safety has come from being just an idea ~4 years ago to several vendors offering equipment and beginning testing
- LTE is a very robust technology delivering very fast data speeds for wireless
- There will be a learning curve with LTE – it's a new technology, different from traditional voice LMR systems
- Expect to see pilot systems deployed in 2011 and 2012



Thank You!

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