



Coverage and Capacity Modeling for LTE Systems including FirstNet



**IWCE 2019 – Session TH11
FirstNet & Public Safety Broadband Track**

**Assessing the Promised Coverage of FirstNet's Public Safety
LTE Network: Getting What You Pay For**



Agenda

- **FirstNet Overview**
 - Basics
 - Coverage
 - Capacity
- **Considerations when Modeling LTE (such as FirstNet)**
- **Other considerations**



FirstNet Overview





The Basics

- **Uses Long-Term Evolution (LTE) Technology**
 - Four major carriers use LTE in the United States for broadband data (Sprint, T-Mobile, Verizon, AT&T)
- **FirstNet uses Band 14 in the 700 MHz band**
 - AT&T is the FirstNet private partner (other bands provided via AT&T)
- **700 MHz frequencies have unique propagation characteristics**
 - Generally speaking, better penetration in-buildings, and worse penetration through forest canopies than lower LMR frequency bands (VHF / UHF)



FirstNet Coverage

- **Originally-provided coverage maps (upon launch of AT&T partnership) showed outdoor coverage at -110 dBm, however there was ambiguity about what loss values were used**
- **AT&T is building out its own LTE network (which FN users have priority access to), and Band 14 where capacity is needed**
- **FirstNet / AT&T has a goal of providing coverage to 95% of the U.S. population**



FirstNet Capacity

- **All FirstNet users within a given area share the same spectrum, whether that's Band 14 or other AT&T LTE spectrum bands**
- **Per FirstNet, as of October 2018:**
 - **3,600 US agencies have subscribed**
 - **Approximately 250,000 subscribers/connections**
- **AT&T claims Band 14 buildout is “one-third” completed**



Modeling Coverage and Capacity





Software Requirements

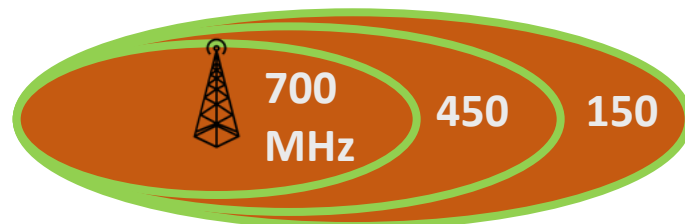
- **Basic coverage software can model signal strength (RSSI), maybe Bit Error Rate (BER)**
 - Sufficient for voice LMR systems, not for LTE
- **More comprehensive package needed for LTE**
 - Needs to consider LTE-specific factors (RSRP, RSRQ, throughput)
 - Needs all propagation software basics:
 - Terrain, clutter, buildings (project-dependent)



LTE Software Developers



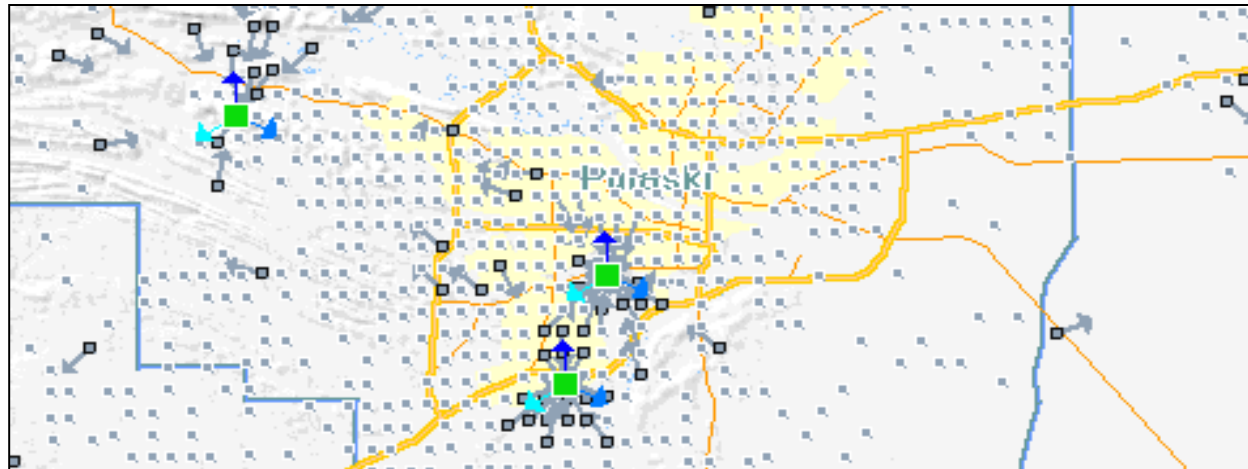
- When comparing current LMR system layouts vs. potential LTE layouts, additional sites may be needed based on frequency



- Interference concerns may prevent high-elevation sites (i.e. mountaintops) from being used

Capacity and Loading Considerations

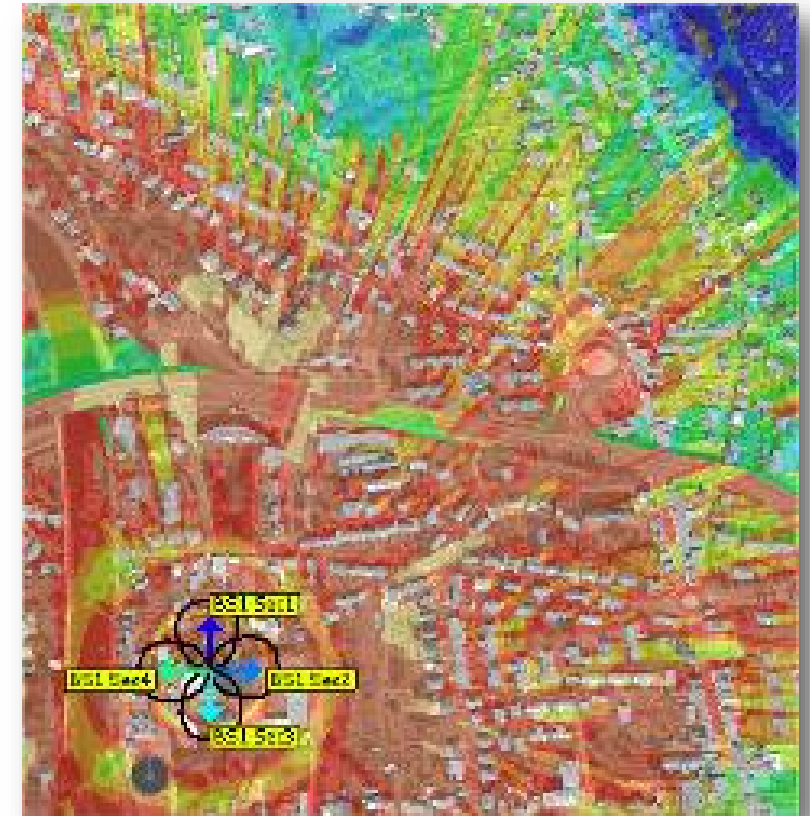
- In addition to more sites based on frequency or lower-elevation, more sites are likely needed in populated areas due to bandwidth demand
- Application demands and projected device counts create congestion and drive capacity requirements





In-Building Considerations

- **Public-safety Distributed Antenna Systems (DAS)**
- **Bi-directional Amplifiers (BDAs)**
- **Compliance with building coverage codes (NFPA, IFC)**
- **Basements and elevators**
- **Private LTE systems**



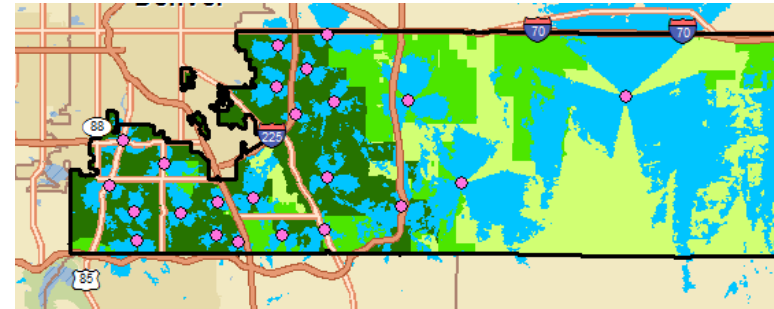


Other Considerations

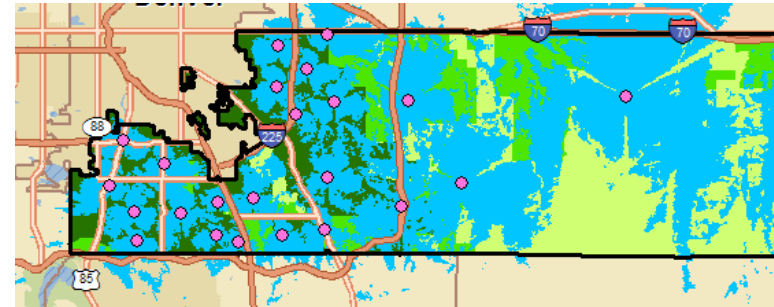


Operational Needs

- What type of User Equipment (UE) will your agency need from FirstNet?
 - PC cards, smartphones, tablets, etc. – different equipment may have different performance on the network
- What types of applications will be used?
 - Streaming video, voice chat, video chat, metering, etc. all have different bandwidth, throughput, and latency requirements



768 kbps DL /
256 kbps UL



256 kbps DL /
128 kbps UL



Filling the Gaps

- **FirstNet deployables**
 - **Cells/Sites on Wheels**
 - **Designed to improve coverage/capacity when needed**
- **External networks**
 - **Wi-fi**
 - **3G / 5G (future) offloading**
 - **Indoor systems**



Thank you...

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