Wisconsin Public Safety Broadband Project

Regional Kickoff Meetings

July 2016

Agenda

- FirstNet 101
  - Mission
  - Resources
  - Consultation Process
  - Timeline
- LTE Technical Overview
  - Brief Technology Overview
  - Equipment Options and Current Public Safety Networks
- About WiPSB
  - Our Mission
  - Our Team
  - Our Project
  - What's Next?

FirstNet 101

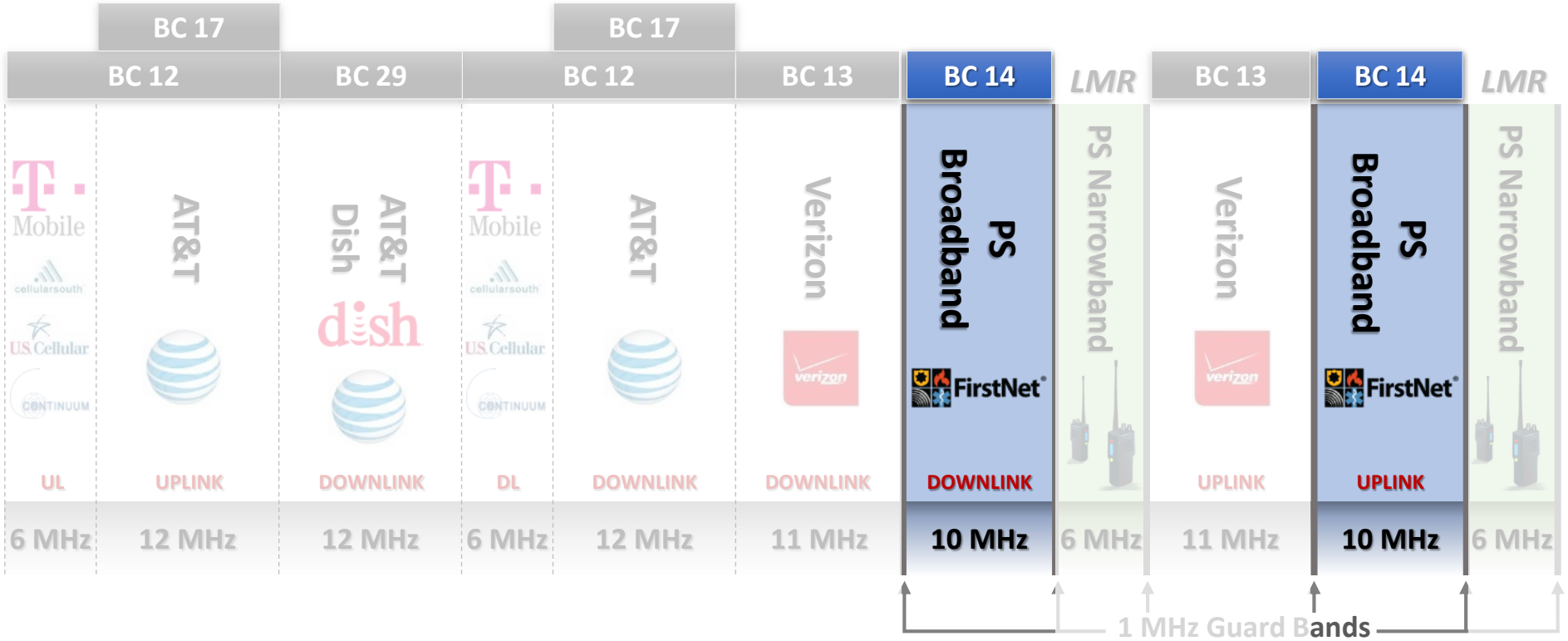
FirstNet Mission

FirstNet’s mission is to build a nationwide cellular broadband network for public safety

FirstNet Resources

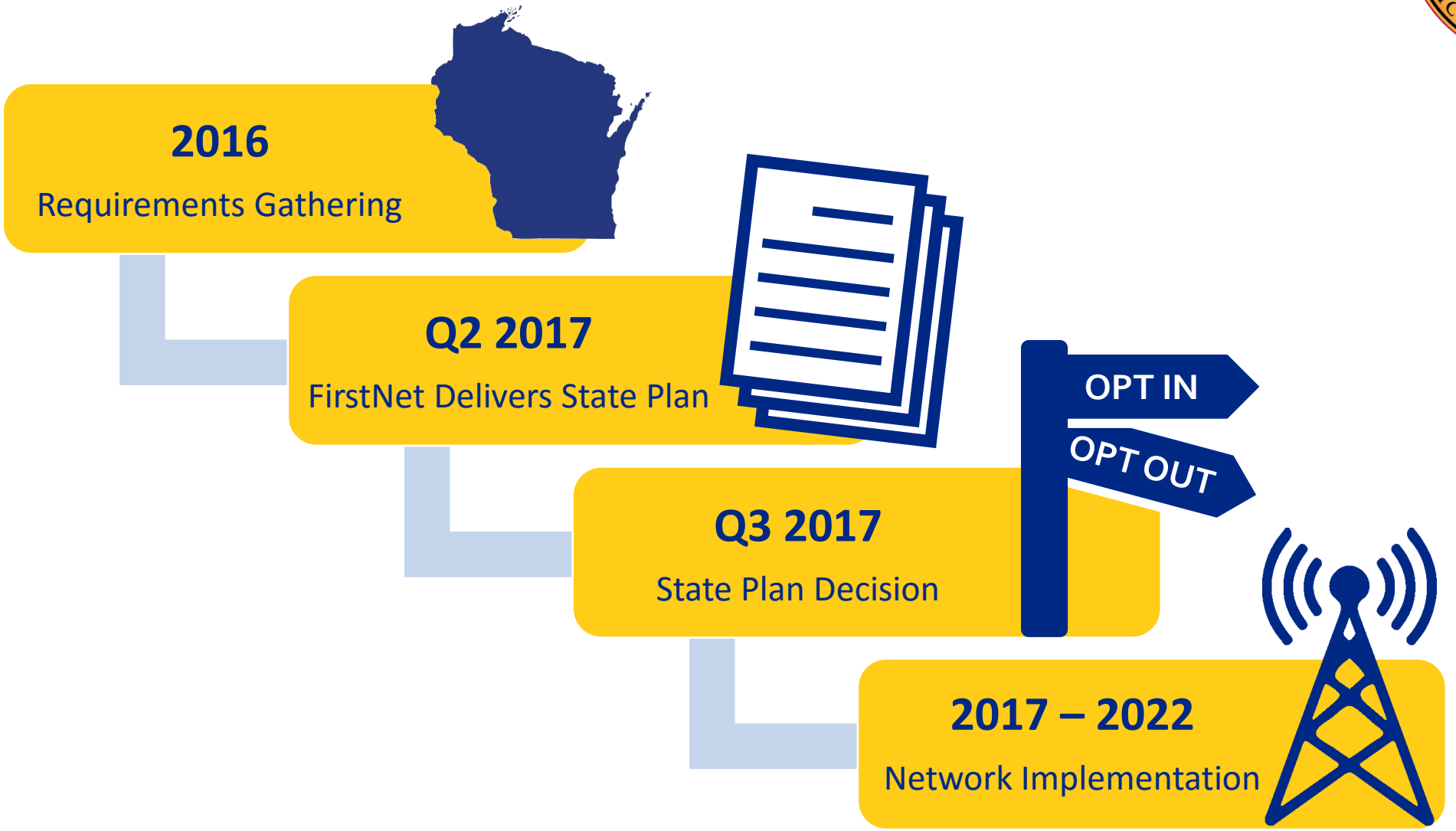
- Congress allocated **$7 billion** in 2012
  - These funds alone will not be sufficient to construct and operate a nationwide network
  - Operate like a carrier; collect revenue for service
  - CEO; board; corporate structure
- Like any other carrier, FirstNet will need to earn your business and charge for service
- You are not forced to adopt

FirstNet Resources

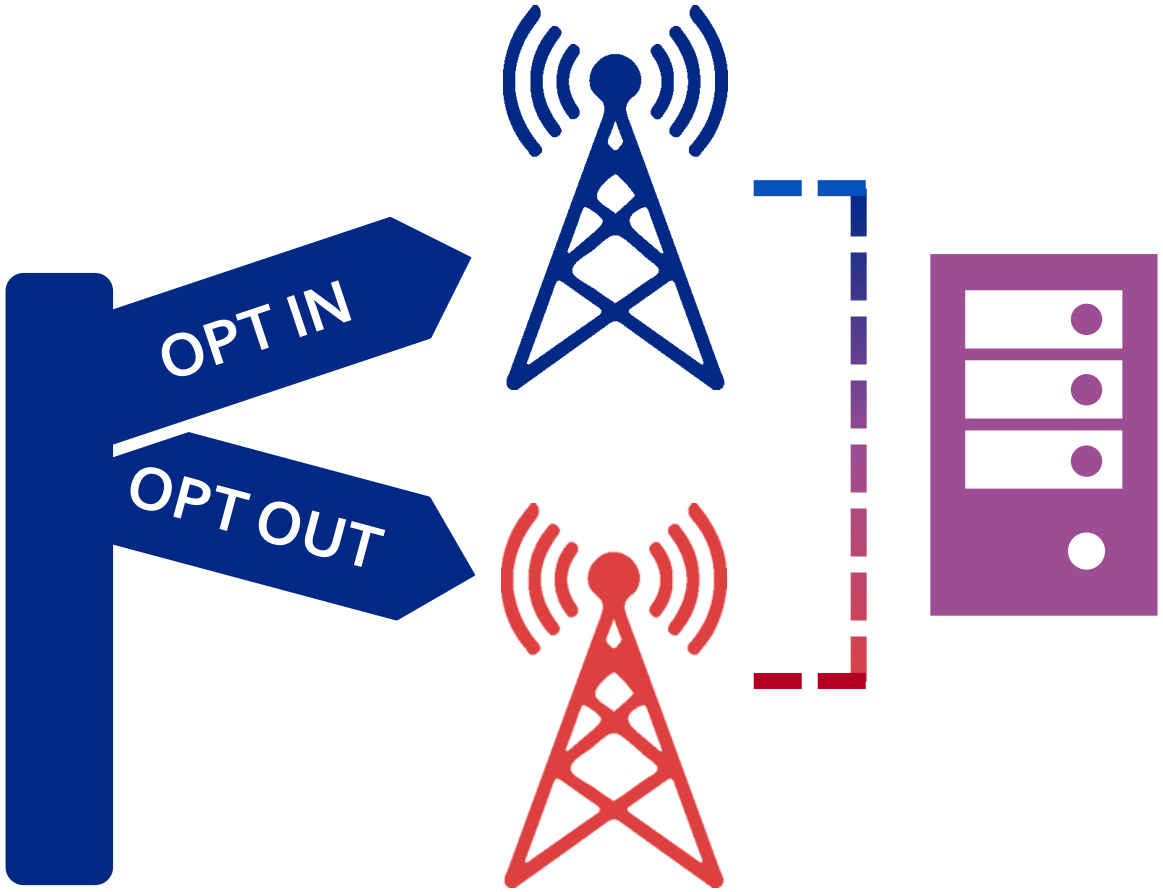


FirstNet will offer frequencies that are dedicated exclusively to public safety use, and shared with the commercial carrier when not required for public safety use.

Consultation Process

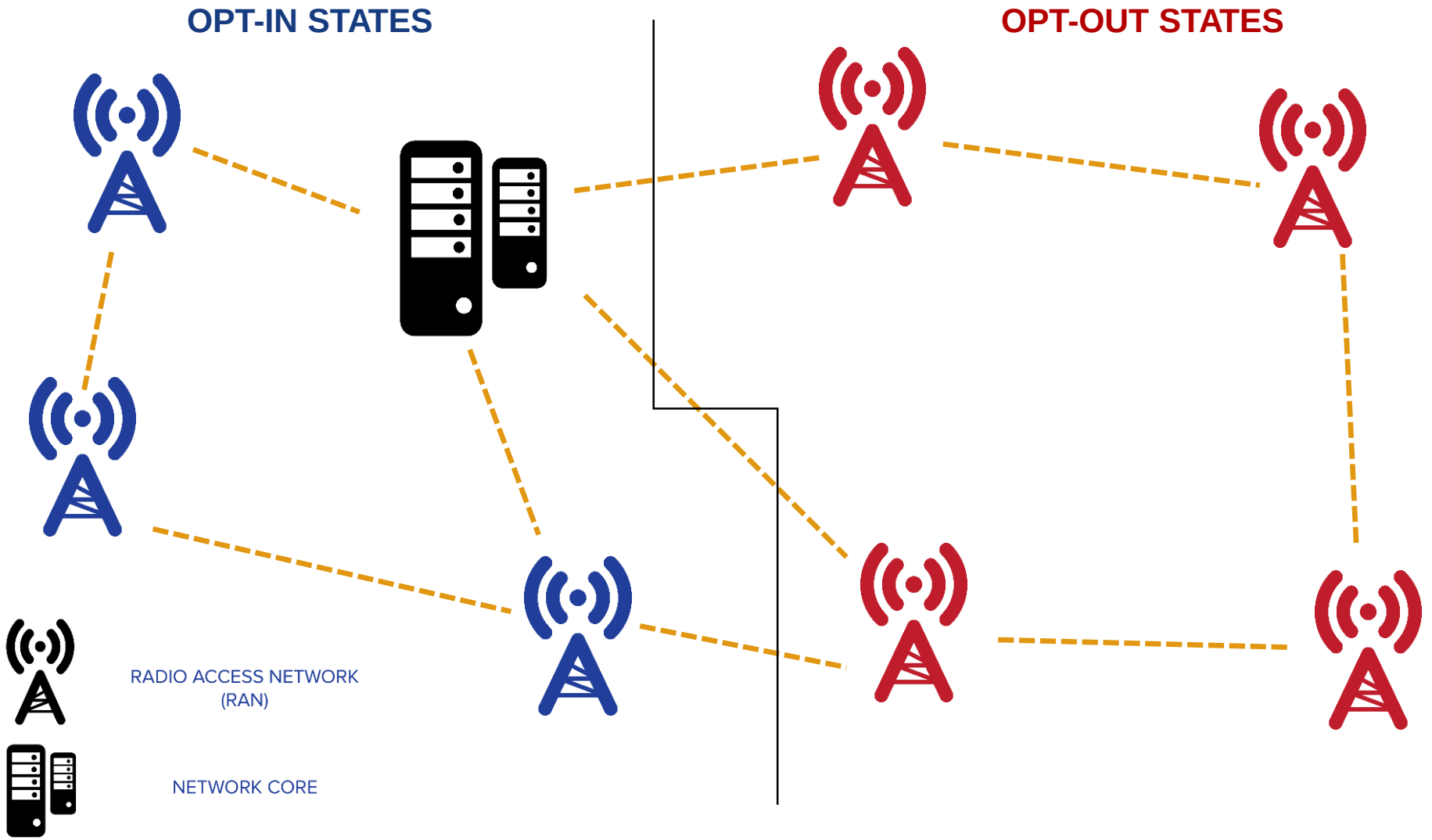


Opt In and Opt Out

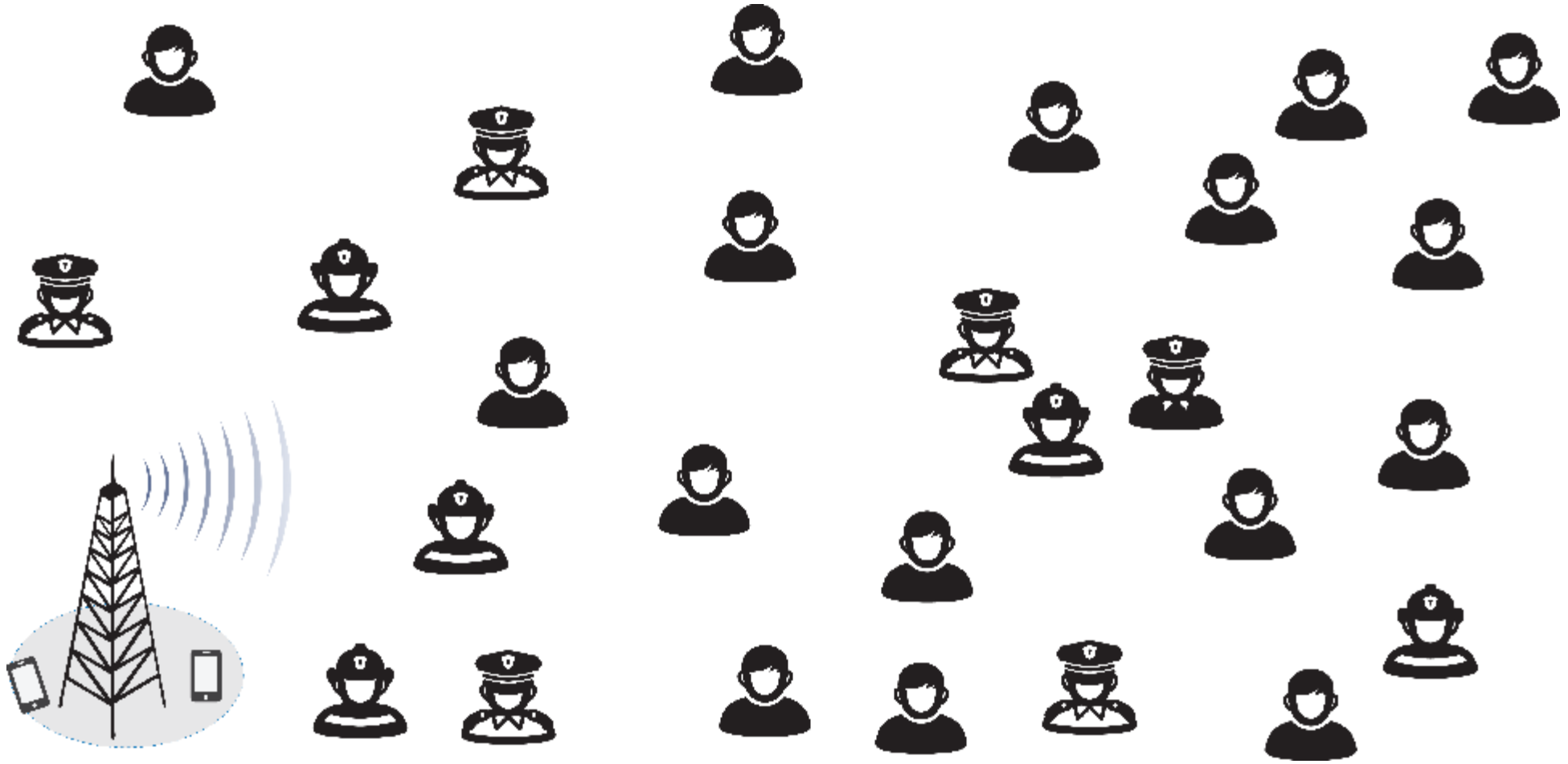


- The FirstNet core will be connected to the radio access network (RAN) in each state regardless of whether FirstNet or the State builds the RAN
- This means all states will have access to the same interoperable data network
- To end-users; opt-in/opt-out is the same: you get the same network

Opt In and Opt Out

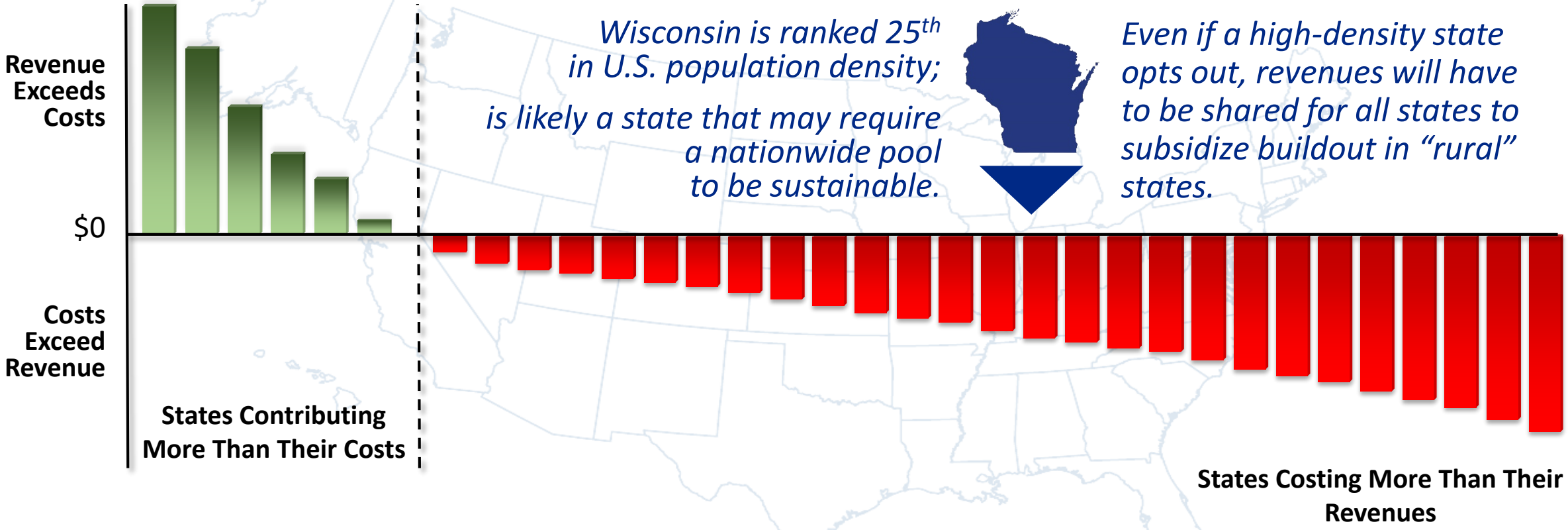


Shared Commercial Network vs. FirstNet



Shared Commercial Network vs. FirstNet

Revenue and Architecture

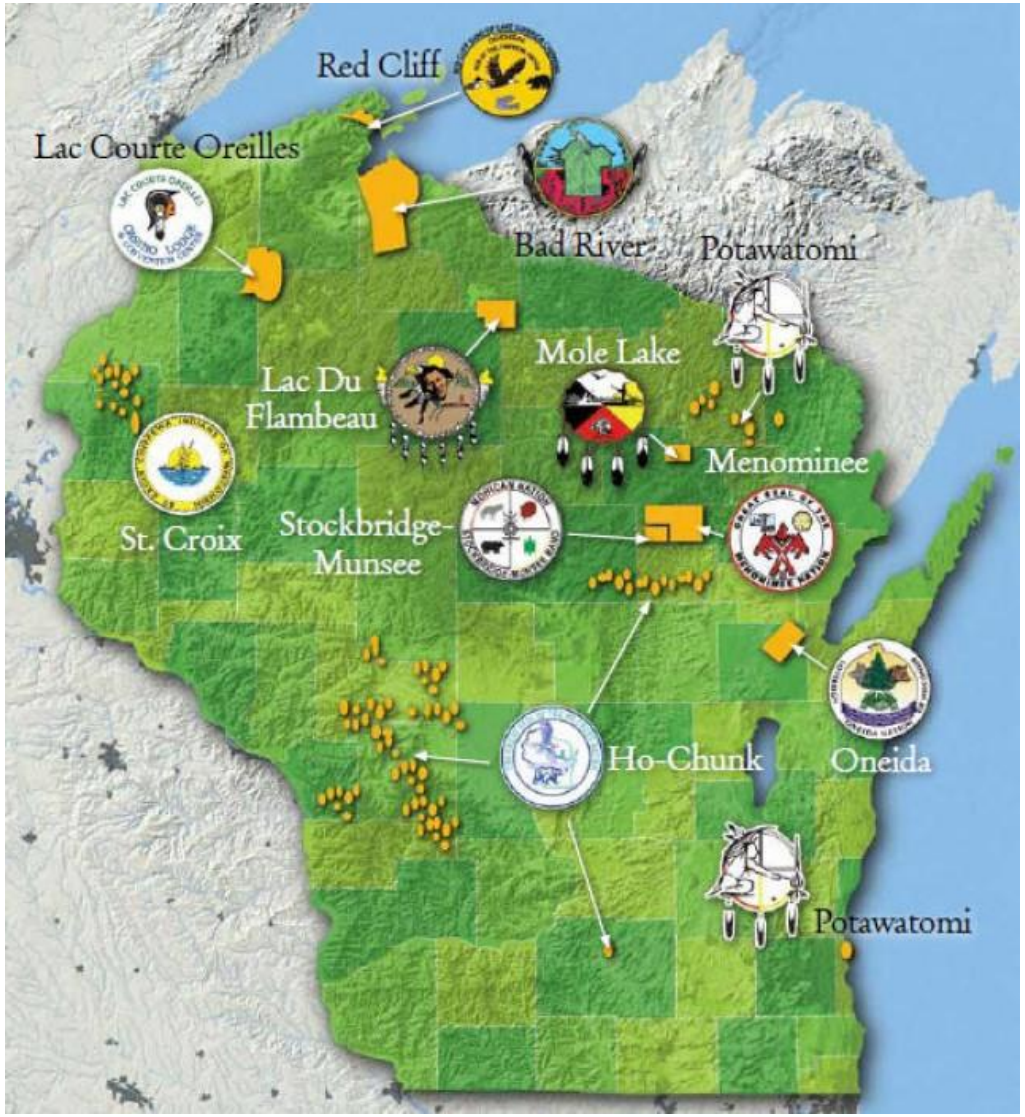


Wisconsin is ranked 25th in U.S. population density;

is likely a state that may require a nationwide pool to be sustainable.

Even if a high-density state opts out, revenues will have to be shared for all states to subsidize buildout in "rural" states.

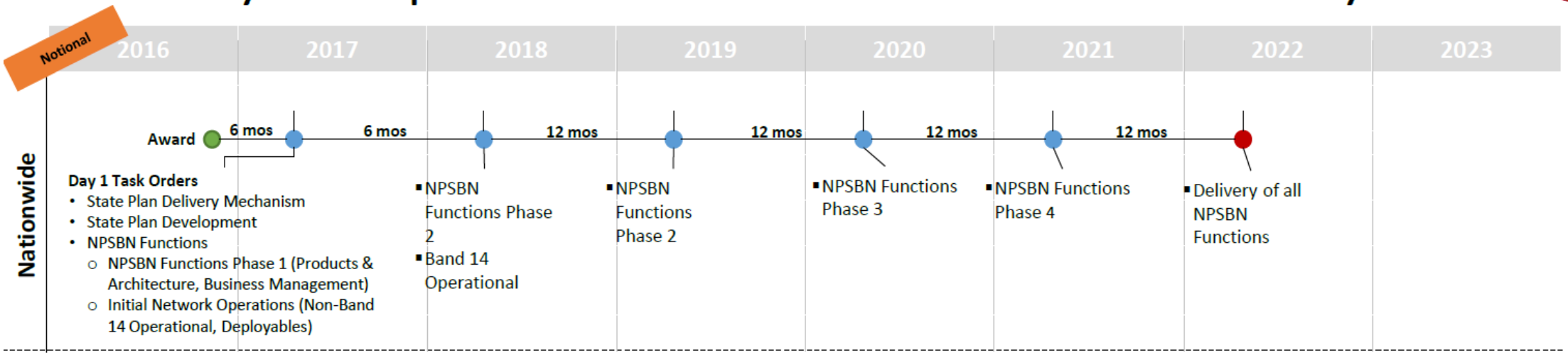
Consultation with Tribal Nations



- FirstNet is required in federal law to consult with states *and* tribes
- The law does *not* directly address how tribes are involved in the decision process for network rollout
- FirstNet does some direct consultation with the tribes
- Additionally our *state* program will gather tribal requirements so we can include tribal needs in the statewide decision process

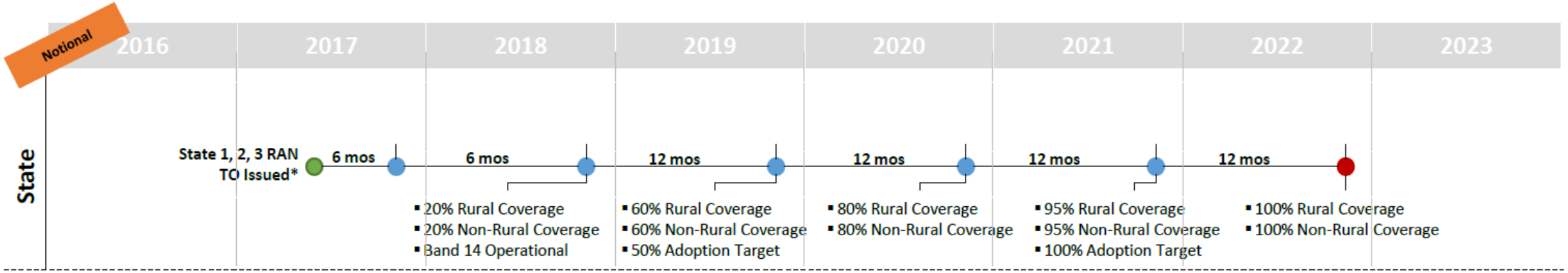
FirstNet Timeline

Payments to partner initiate at award for nationwide milestone delivery.



Source: FirstNet

Payments to FirstNet initiate with partner's access to spectrum as state RAN is deployed.



EG: Flooding in NW WI

What was the response like?

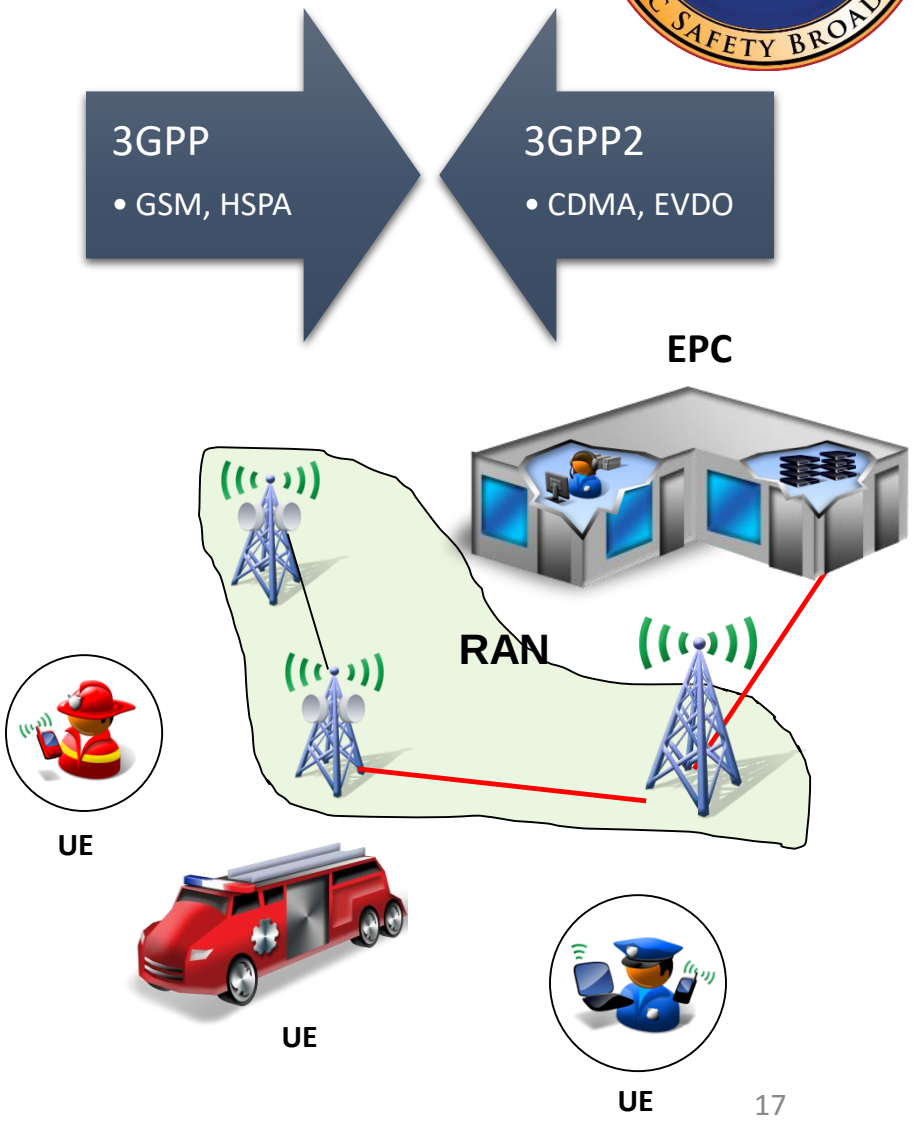
Were cellular network services available?

Were deployable services available?

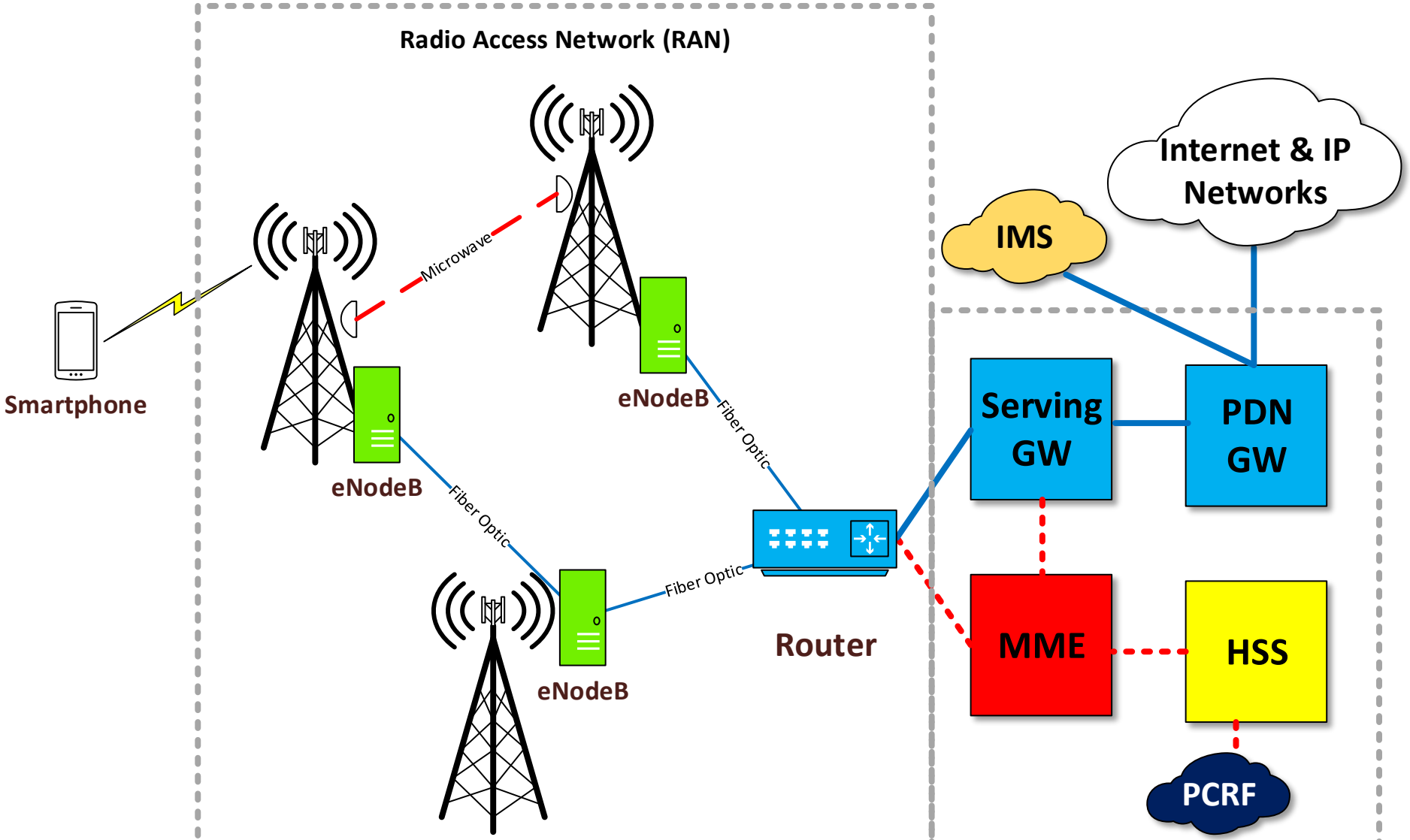
LTE Technical Overview

LTE Overview

- LTE = Long Term Evolution
- 3GPP (Third Generation Partnership Project) standard to achieve broadband data 4G speeds and features
- Evolution and convergence of current technologies: GSM/GPRS, WCDMA/HSPA , CDMA/EVDO
- Globally adopted by dozens of major commercial carriers
- Centralized portion of the network is called Evolved Packet Core (EPC)
- Radio Access Network (RAN) provides wireless coverage to User Equipment (UE)
  - E-UTRAN (Evolved Universal Terrestrial Radio Access Network) is the LTE RAN
- LTE is considered a 4G technology by the International Telecommunications Union (ITU)

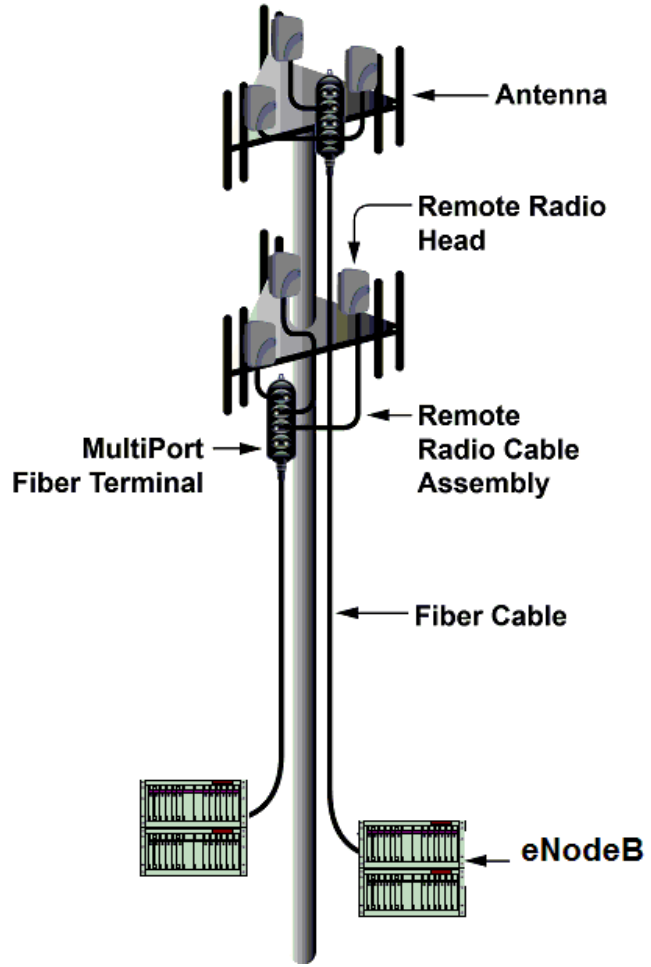


LTE Overview

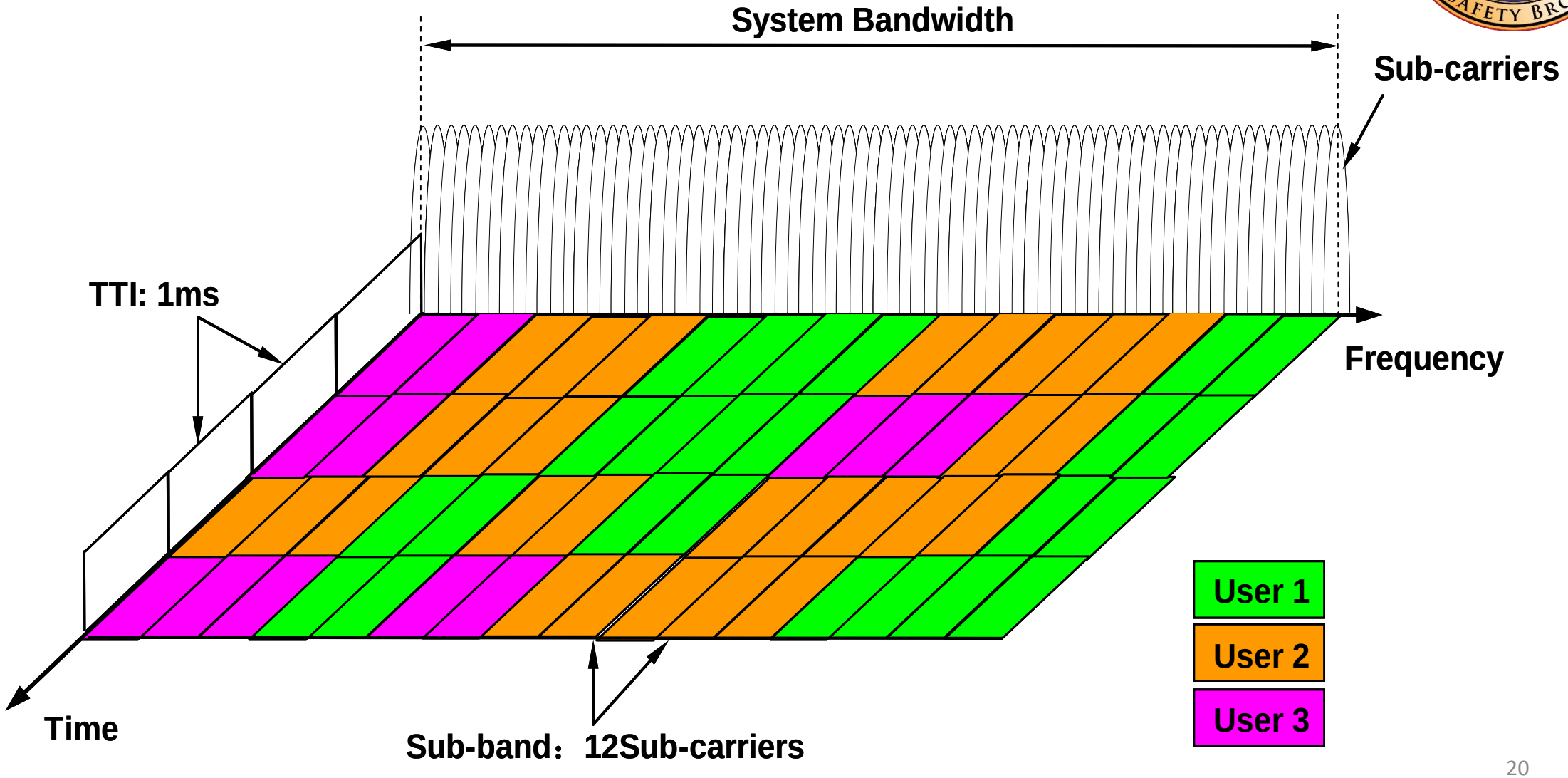


Radio Access Network

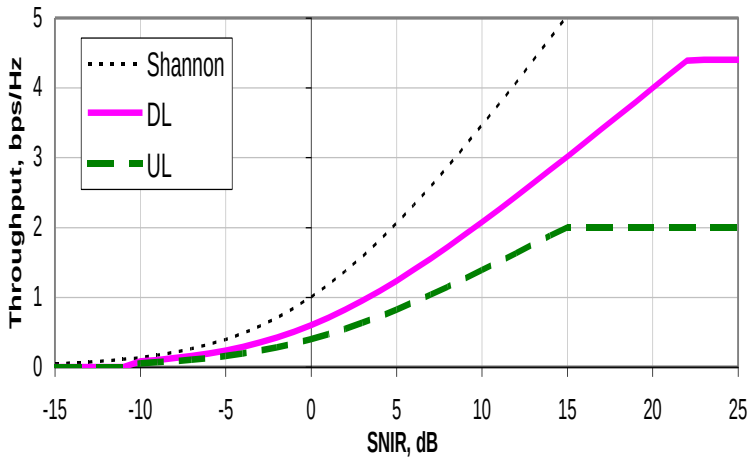
- Radio Access Network (RAN) connects the User Equipment wirelessly
- A site is called a “NodeB”
- Most likely site configuration
  - 3 sector configuration
  - 65 degrees antennas
  - 14 to 18 dBi antennas (up to 8ft long)
- Transmit powers
  - eNodeB: 10 to 20 Watt (3GPP doesn’t specify eNodeB transmit power)
  - User Equipment (UE): transmit power does not exceed 200 mW (23 dBm)
- Line loss can be reduced by placing radios near the antennas instead of the at the bottom of the site

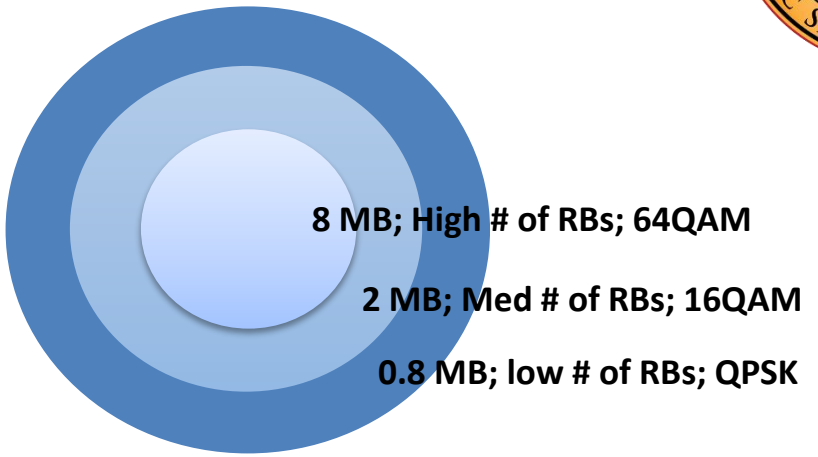


LTE Air Interface Basics



Modulation and Coding Schemes





- LTE changes the modulation and coding scheme (MCS) based on the channel quality
  - The better the signal quality, the higher the throughput
- Only the modulation and coding scheme with the best throughput is selected.
  - QPSK: 2 bits/symbol
  - 16 QAM 4 bits/symbol
  - 64 QAM (Optional Uplink) 6 bits/symbol

Modulation and Coding Schemes

LTE switches to a different technology as you get further from the site instead of just dropping your session

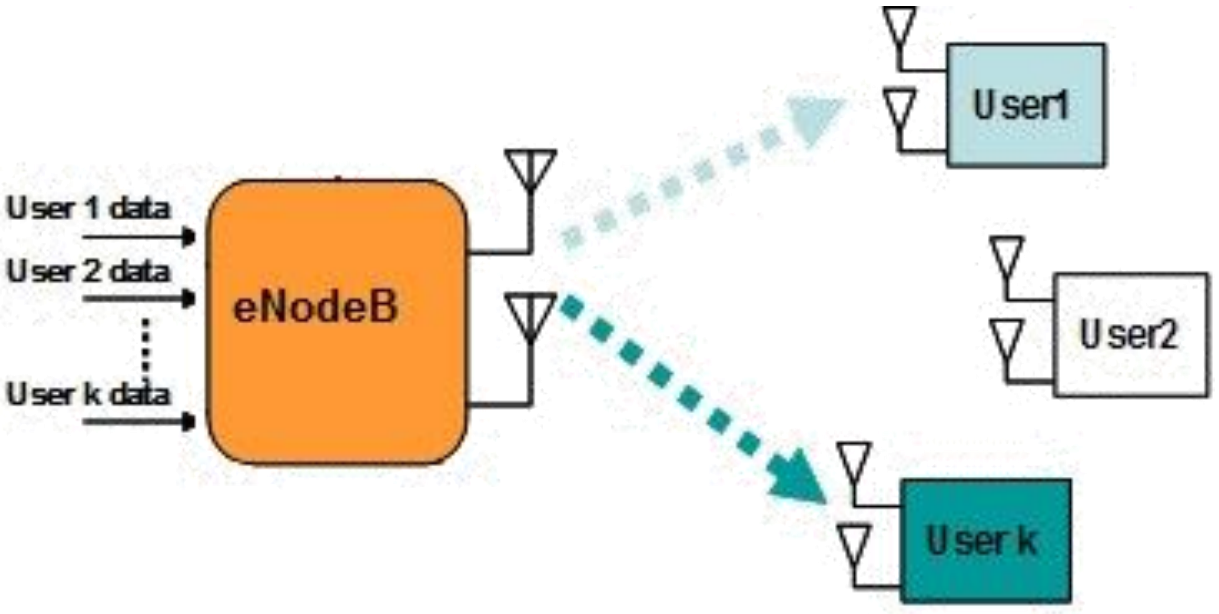
8 MB; High # of RBs; 64QAM

2 MB; Med # of RBs; 16QAM

0.8 MB; low # of RBs; QPSK

LTE Air Interface Basics

MIMO: Multiple Input/Multiple Output
In English: multiple antennas



- Provides significant performance gains
- MIMO isn't a new idea; wifi and other devices have used MIMO for many years

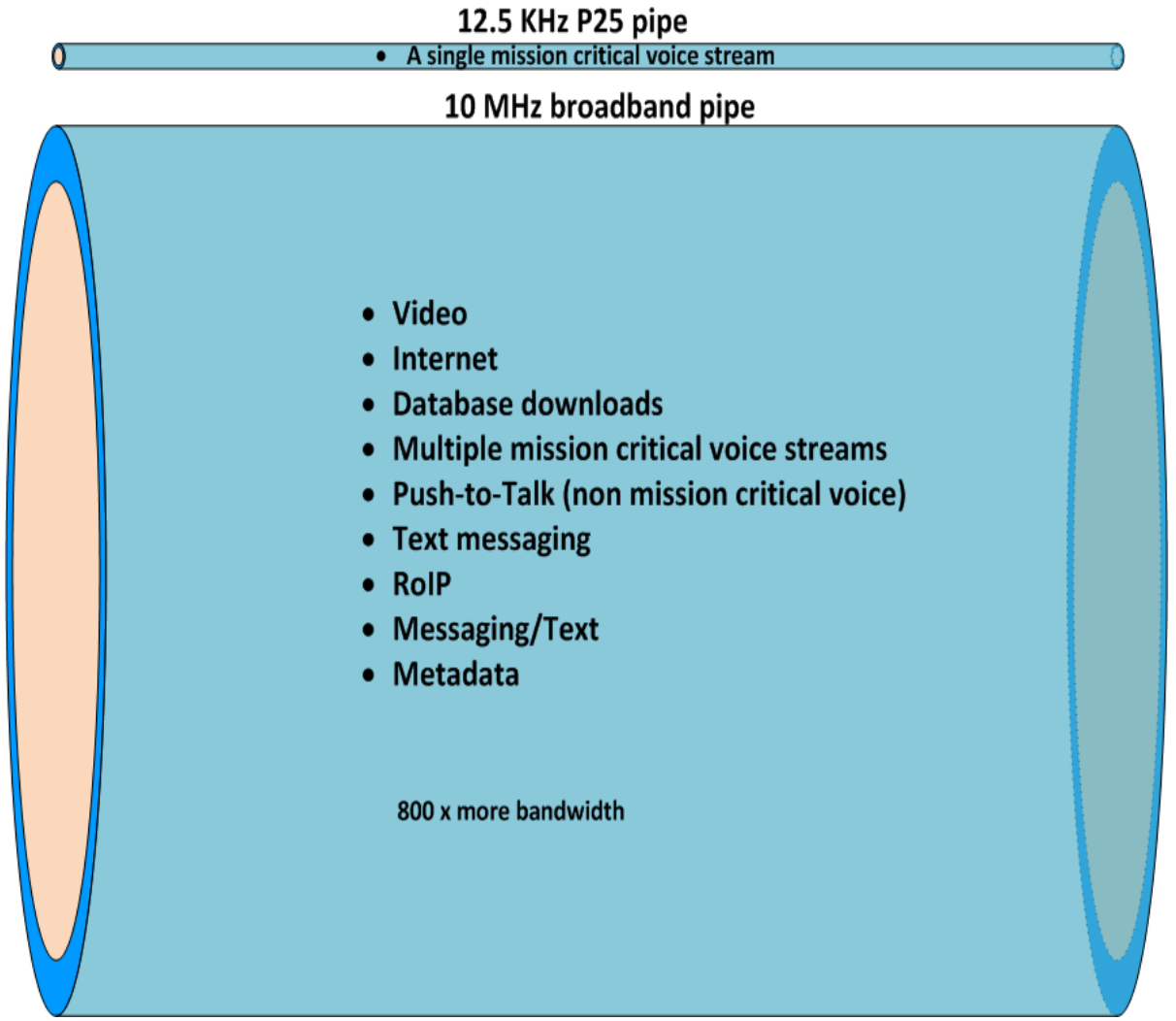
Comparing LTE & Radio Throughput

High Data Throughput

- Comparable with Wi-Fi data throughput speeds

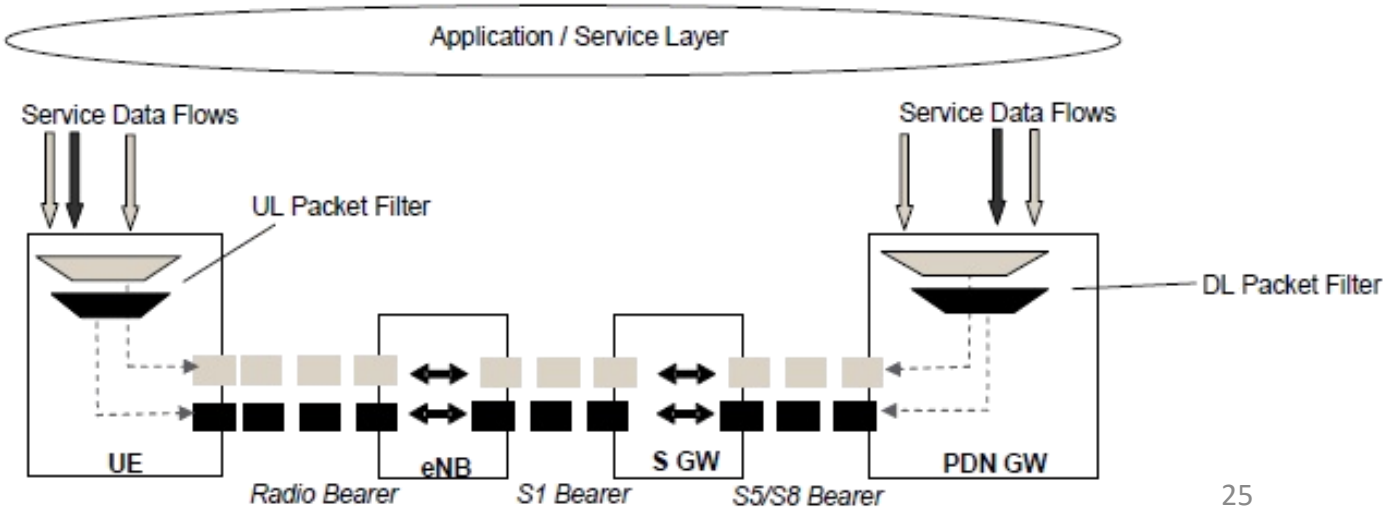
Supports multiple data services simultaneously

- Unlike radio, which is dedicated to providing mission critical voice over a single frequency channel, LTE can support multiple data streams (bearers) at the same time and even on the same device



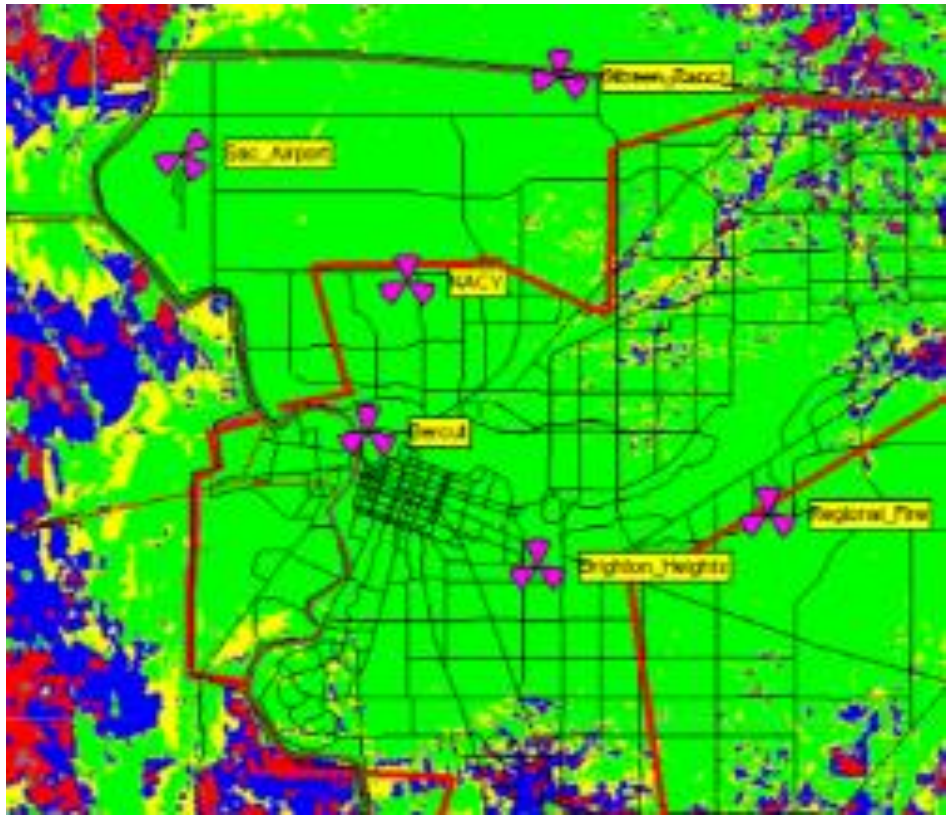
Quality Of Service (QoS)

- Quality of Service (QoS) facilitates higher LTE communications reliability and performance
  - Facilitates priority access of users and applications
- A **bearer** aggregates Internet Protocol (IP) comm flows related to one or more services
  - Each bearer is assigned a QoS Class Identifier (QCI) that decides how the data is treated.
  - The QCI value is then mapped to:
    - Guaranteed bit rate
    - Packet delay budget
    - Packet Error Loss Rate allowed
    - Priority

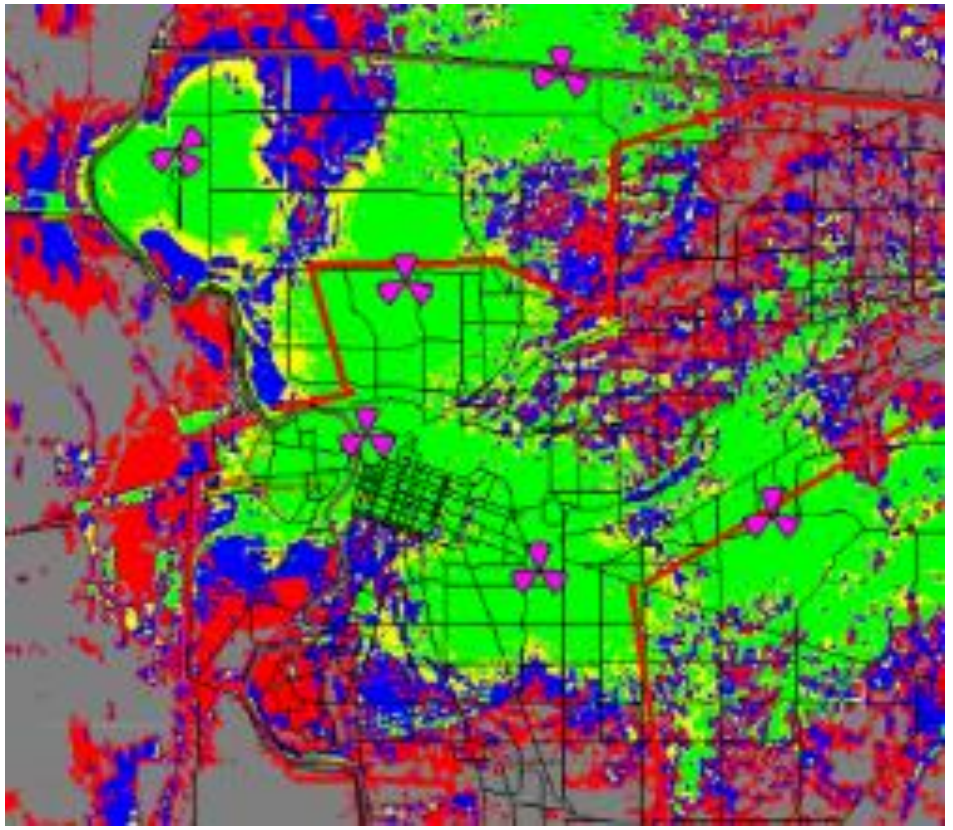


MIMO

P25 Coverage



LTE w/ same sites



Put simply, LTE needs more sites than radio.

HOWEVER, CAPEX and OPEX tend to be less expensive.

Equipment—JerseyNet Deployables

Fully Functional Deployable

Core and eNodeB in a Box

Noack mount eNodeB

Equipment—LA-RICS

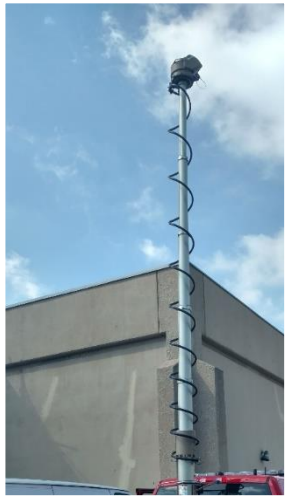
Rooftop Antenna Mount

Van with 60 ft mast

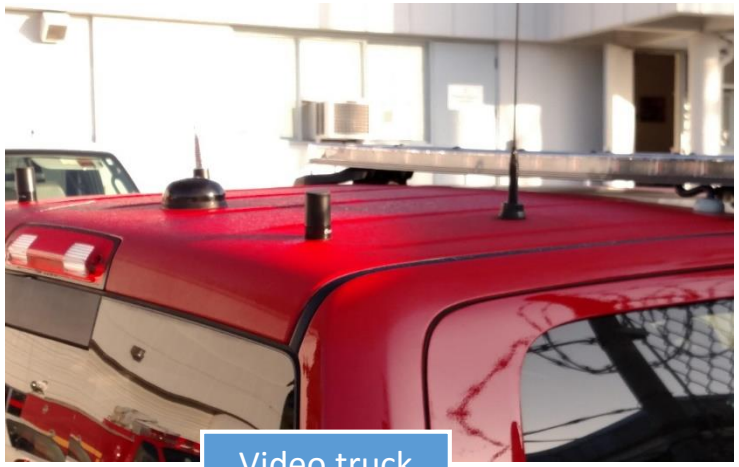
Mast, Antenna, MW Dish

Cell-on-Wheels (COW)

Antenna Mounting



Hi-fi, hi-def multivideo format video camera



Video truck

Antenna mounting

eNodeB Options

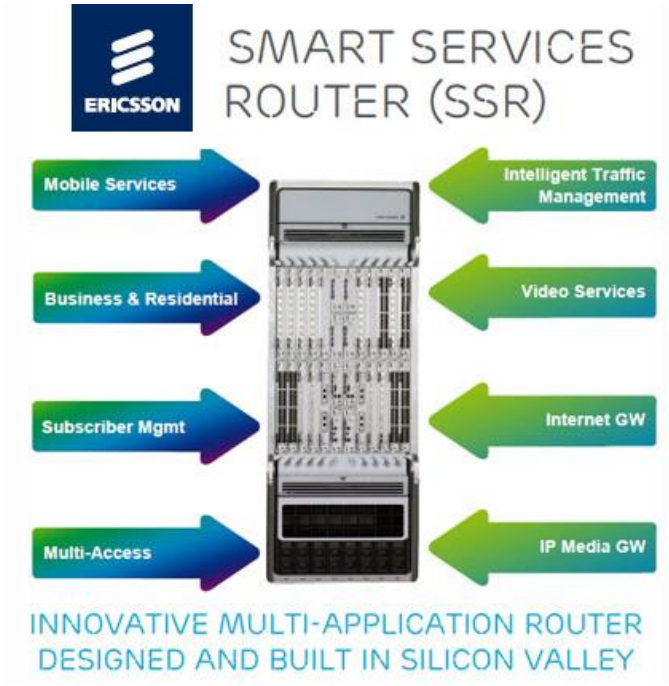
In-door eNB Lineup

Out-door eNB Lineup

Rack Mount deployable eNodeB

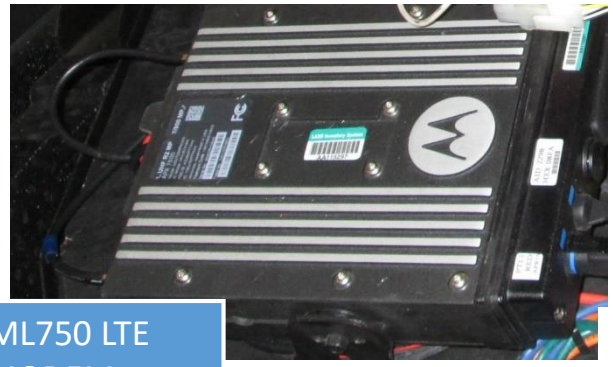
Self Contained eNB

EPC (Evolved Packet Core) Equipment



BandClass 14 Devices

BandClass 14 Devices



Motorola VML750 LTE
VEHICLE MODEM

Sierra Wireless oMG
Mobile Gateway

TeleCommunication Systems Inc. Lynx
Rugged Vehicle Router

Harris MBC200 Router

About WiPSB

Our Mission

Vision

To achieve and advance seamless statewide public safety interoperable communications through support and participation of Federal, State, tribal, local, public and private organizations.

Mission

To promote and achieve interoperable communications through development and implementation of standards and best practices, conducting ongoing training and exercising, supporting existing technology, exploring and adopting new technologies, pursuing and securing adequate funding, while integrating all disciplines and jurisdictions.

Our Team

WiPSB's priority is to ensure that FirstNet produces a network that meets the needs and expectations of Wisconsin's public safety community.

Our Team

Televate is a nationwide public safety telecommunications and information technology consulting firm based in northern Virginia.

We have many years of experience building and operating LTE and land mobile radio networks and in providing planning, governance, and IT consulting support for public safety organizations in the United States and Canada.

We have been retained by the Wisconsin DoJ to provide technical consulting services for this project and to support the FirstNet Consultation Process.

Our Team

The Interoperability Group

Law, policy and governance for technology interoperability

The Interoperability Group (IOG) is a Legal and consulting practice with emphasis on interoperability projects, esp. legal and governance issues.

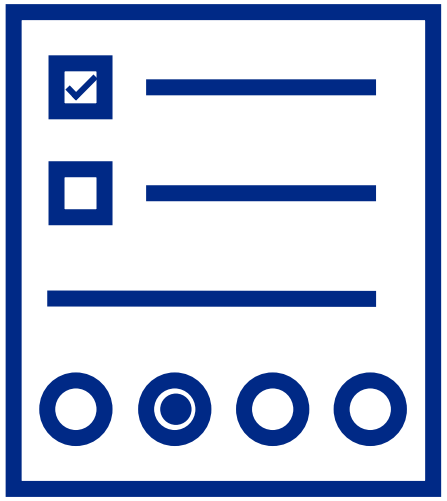
IOG has partnered with Televate to provide governance and legal consulting to DOJ for this project.

Task: Outreach

Regularly updated outreach materials:

- Inform stakeholders of project status
- Provide information about current and planned activities
- Prepare stakeholders to participate in the project

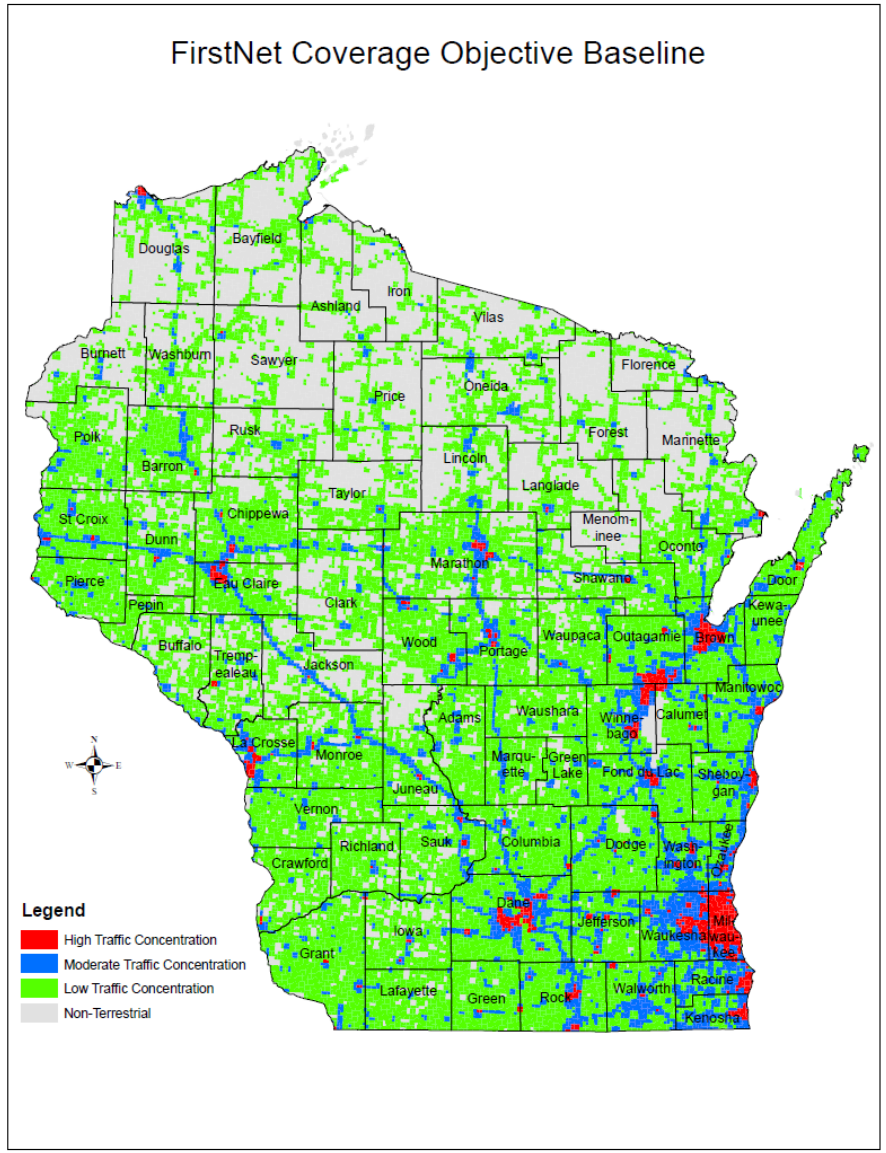
Task: Data Gathering and Requirements

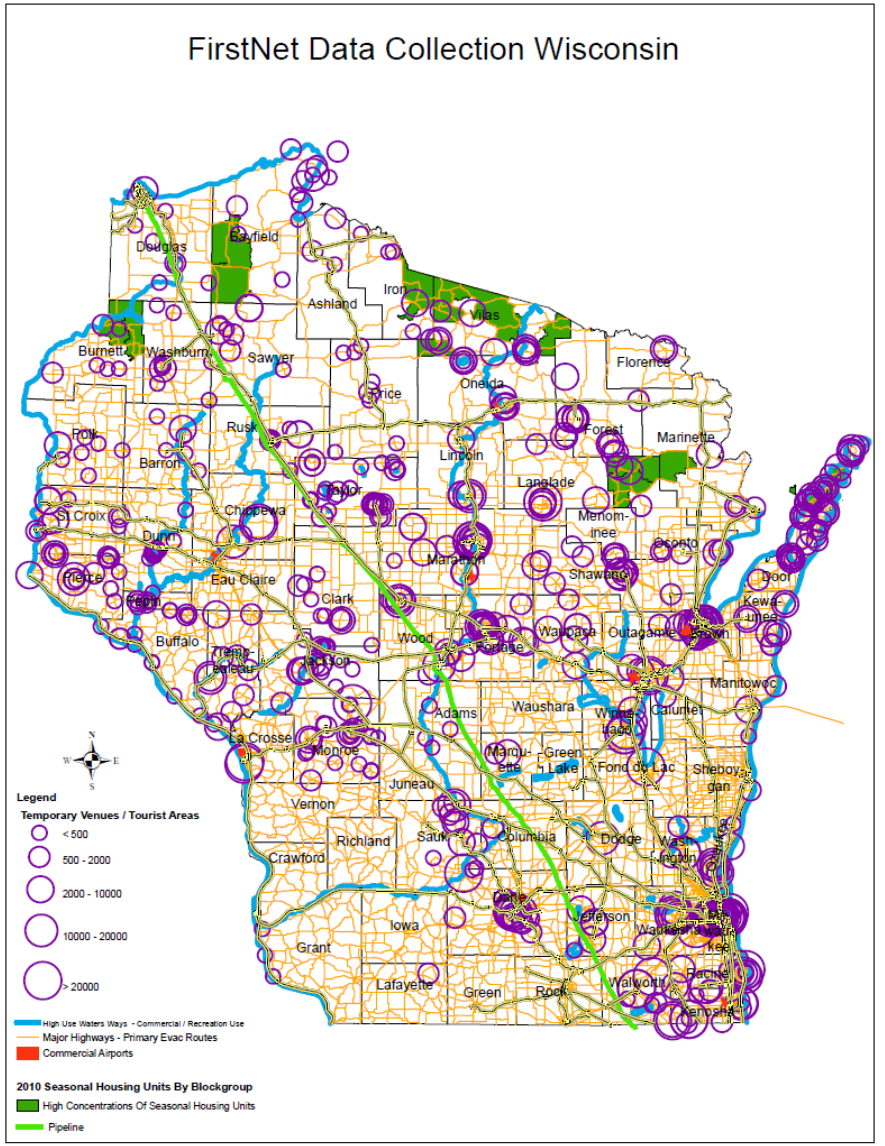


Web-based surveys:

- Provide a projection of NPSBN users throughout the state
- Identify device and network requirements
- Identify barriers to adoption

Previous Data Collection





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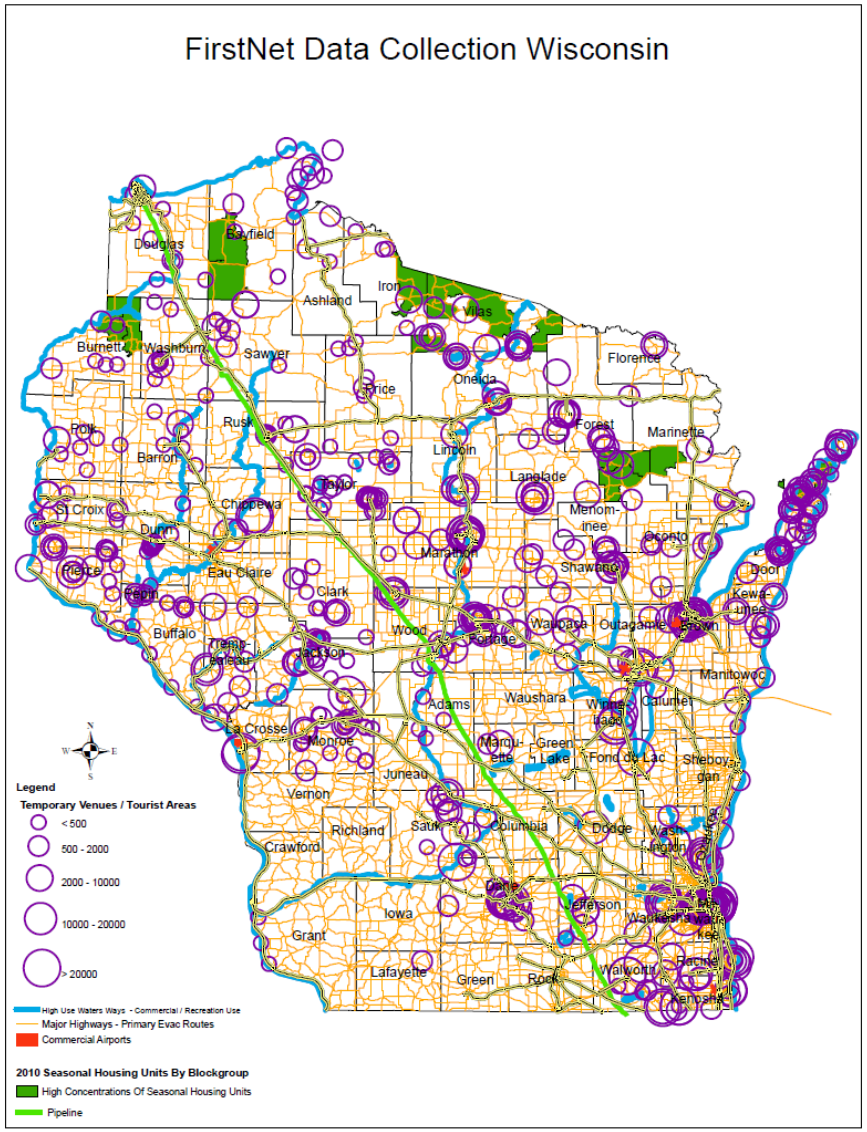
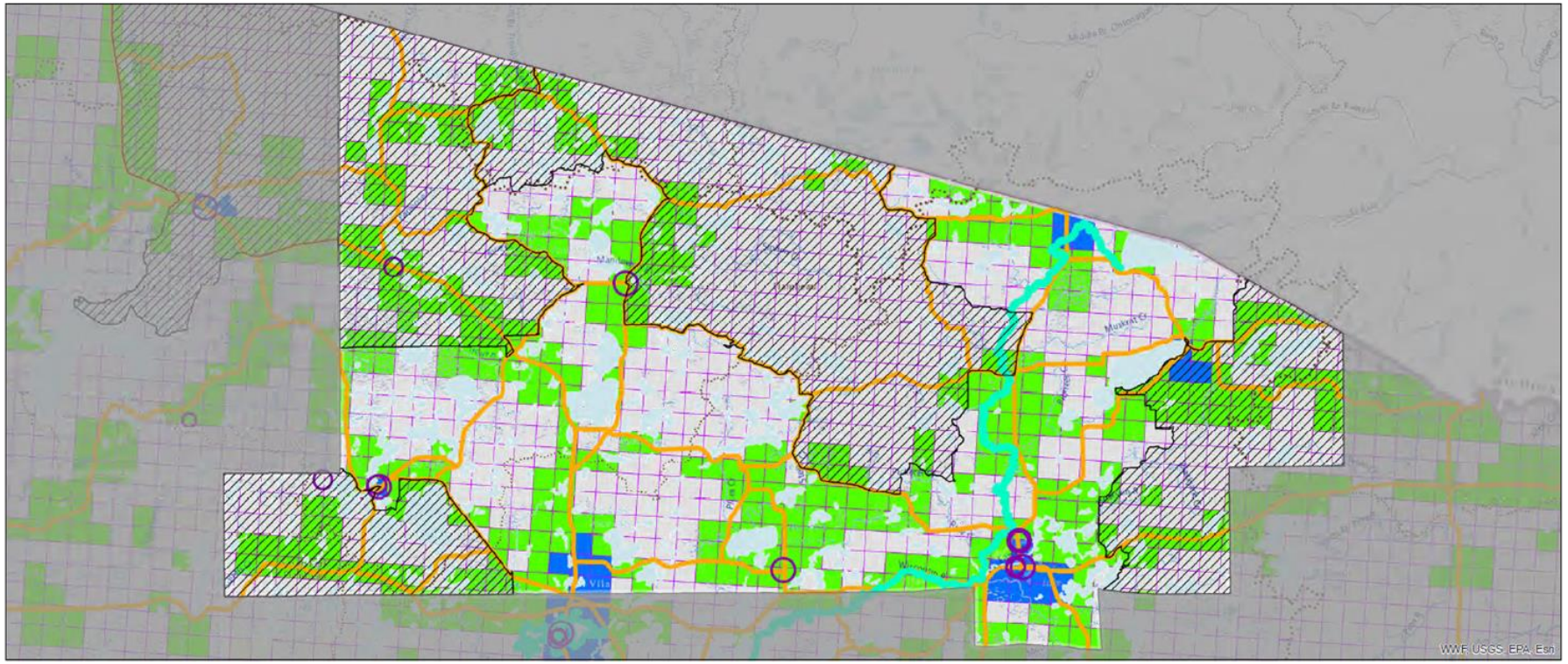


- 433 MDST survey responses
- Temporary Venues/Tourist Areas
- Waterways
- Major Highways – Primary Evacuation Routes
- Commercial Airports
- High Concentrations of Seasonal Housing Units

Previous Data Collection

Vilas County - FirstNet Coverage Objective Baseline With Overlays



Legend

- 1mi x 1mi GRID Overlay Wisconsin
- High Traffic Concentration
- Moderate Traffic Concentration
- Low Traffic Concentration
- Non-Terrestrial

Temporary Venues / Tourist Areas

- < 500
- 500 - 2000
- 2000 - 10000
- 10000 - 20000
- > 20000

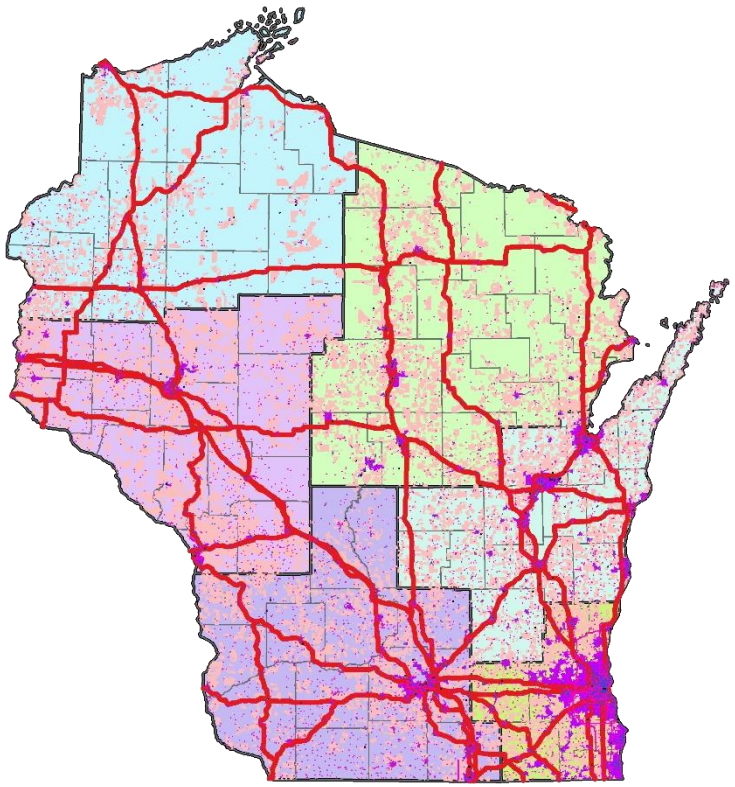
- High Use Waters Ways - Commercial / Recreation Use
- Major Highways - Primary Evac Routes
- Commercial Airports

2010 Seasonal Housing Units By Blockgroup

- High Concentrations Of Seasonal Housing Units

Date: 9/18/2015

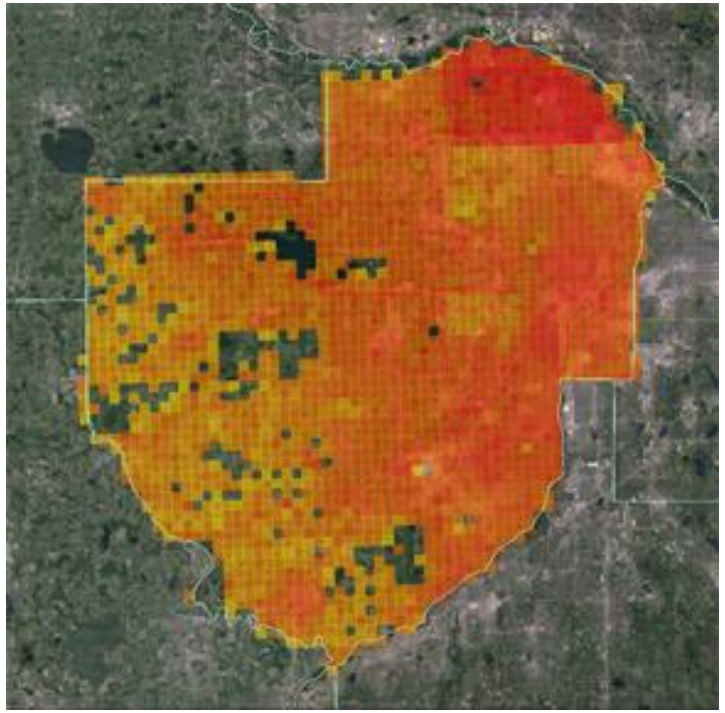
Task: Data Gathering and Requirements



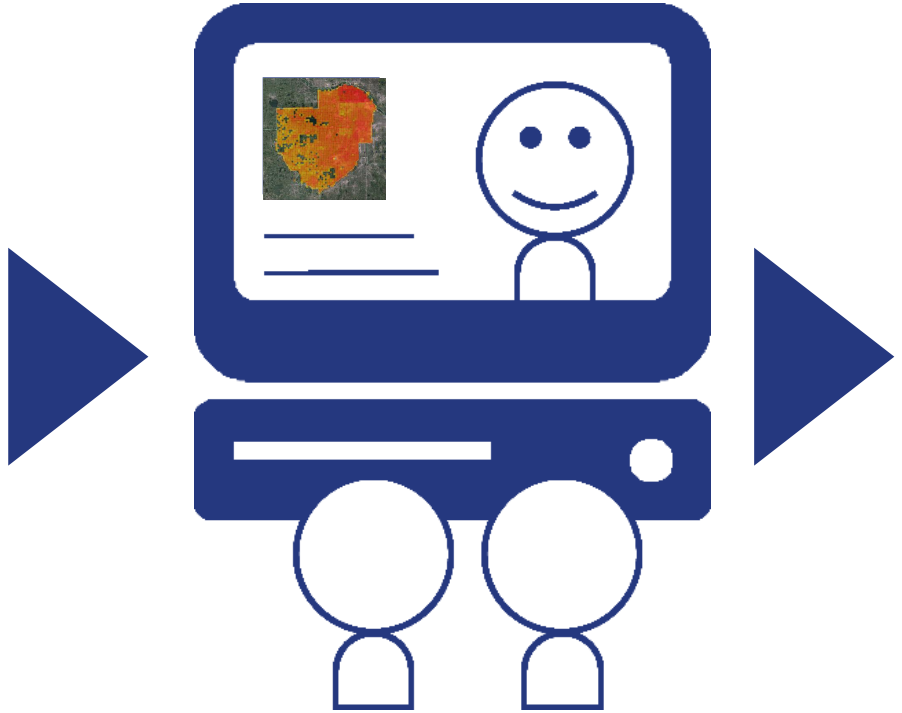
Interactive Coverage Reviews:

- Provide counties and major cities to express their unique coverage needs
- Capture critical and extended service areas
- Identify data that will be leveraged for the statewide phased coverage objectives map and roll-out plan

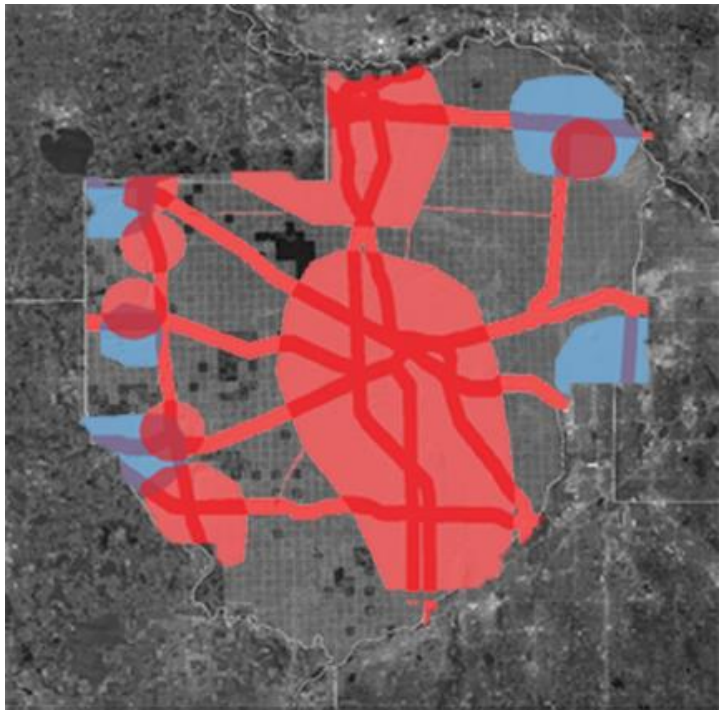
Task: Data Gathering and Requirements



Collect CAD and render heatmaps

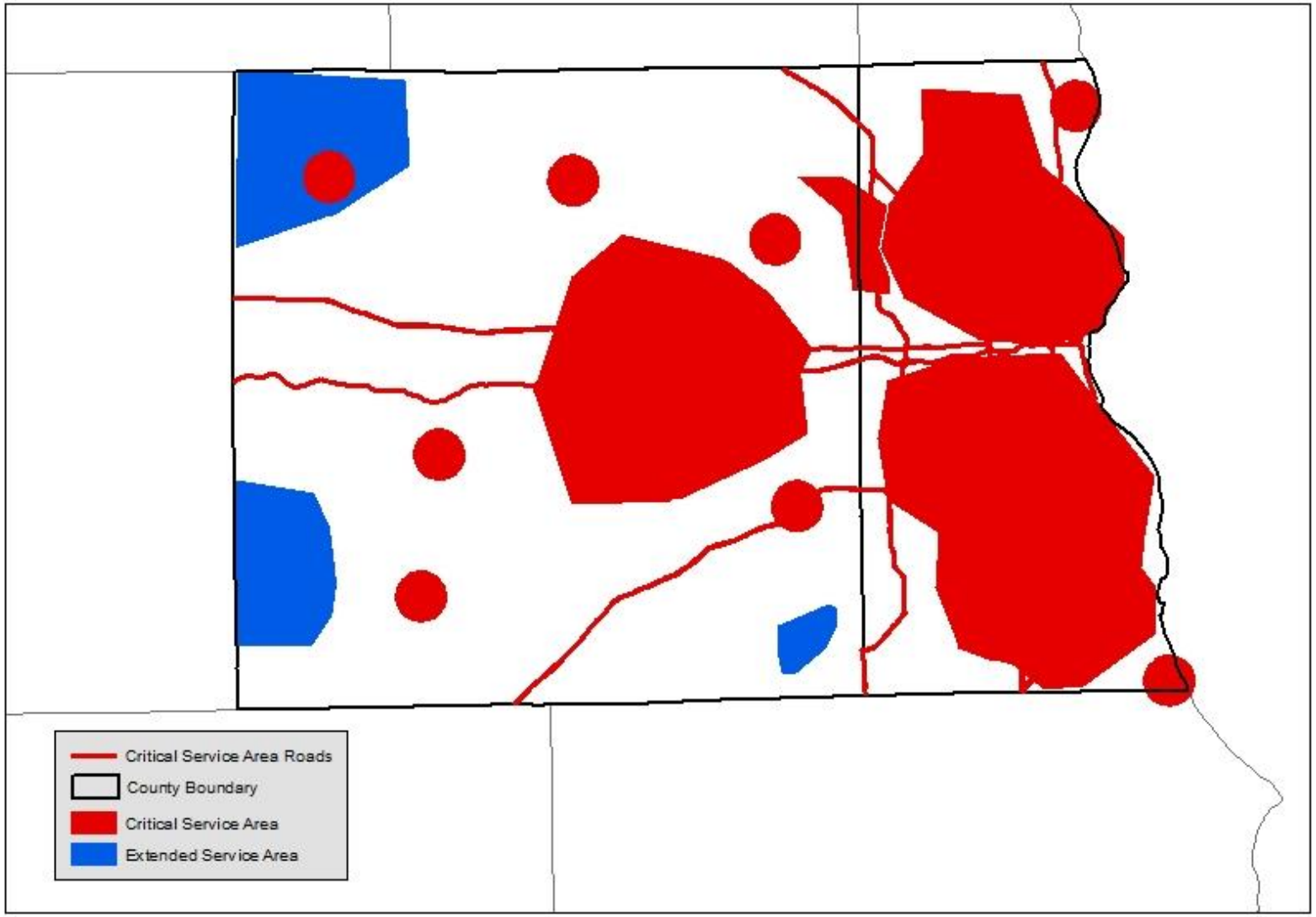


Perform coverage review



Final coverage requirements

Task: Data Gathering and Requirements



Task: Governance

Existing Bodies

- Identify and evaluate existing relevant governance bodies in Wisconsin
- With State guidance, identify and interview (up to 16) key knowledgeable individuals
- Focus on the effectiveness of two-way information flow to and from the governance body, at all levels of government
- Ascertain structure, membership, and authority of current governance bodies; research charters, bylaws, rules, ordinances, statutes, etc.

What's Next?

- Stakeholder identification
- User surveys
- CAD data collection
- Coverage reviews

Thank you!