PSCR 2020:

THE DIGITAL EXPERIENCE

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Broadband Wireless Access Technologies for Deployable Systems: Where are they?

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Certain commercial entities, equipment, or materials may be identified in this document in order to describe an experimental procedure or concept adequately.

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*** Please note, unless mentioned in reference to a NIST Publication, all information and data presented is preliminary/in-progress and subject to change**

HIGHLY MOBILE DEPLOYED NETWORKS

Deployable Systems Research

PSCR

Public Safety Communications Research

Resilient Systems Projects: To develop, evaluate, and evangelize tools and techniques for architecting efficient, resilient networks and applications for public safety.

Sponsored by

Science & Technology Directorate
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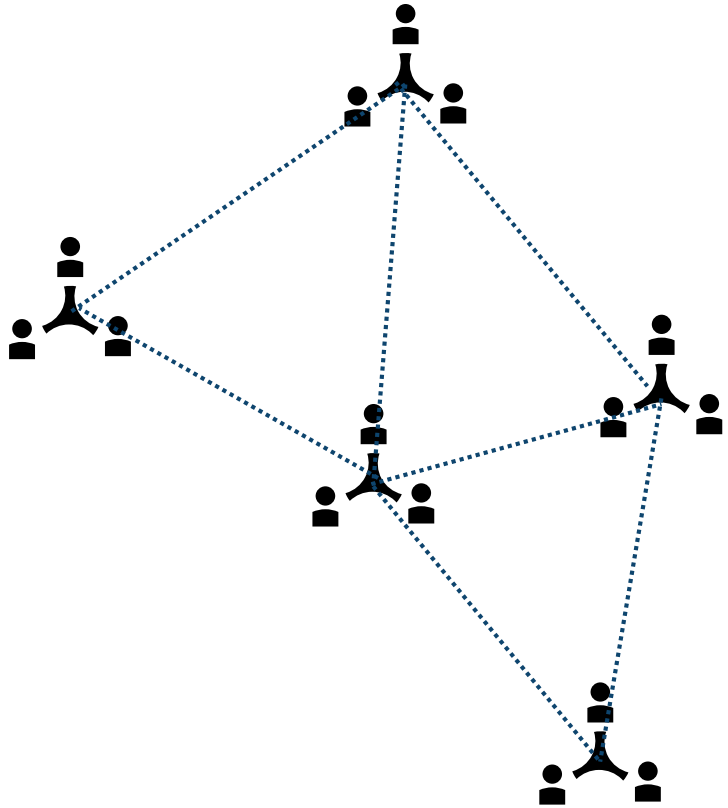
Office for Interoperability and Compatibility Technology Center sponsorship. OIC-TC ensures first responders and other operators served by S&T programs can exchange information (i.e., voice, video, or data) through any medium.

Project Motivation

The availability of Deployable Systems is a critical need for remote areas where complete coverage is not feasible and areas where installed resources are compromised. Broadband services and communications need to be maintained given any first responder scenario.

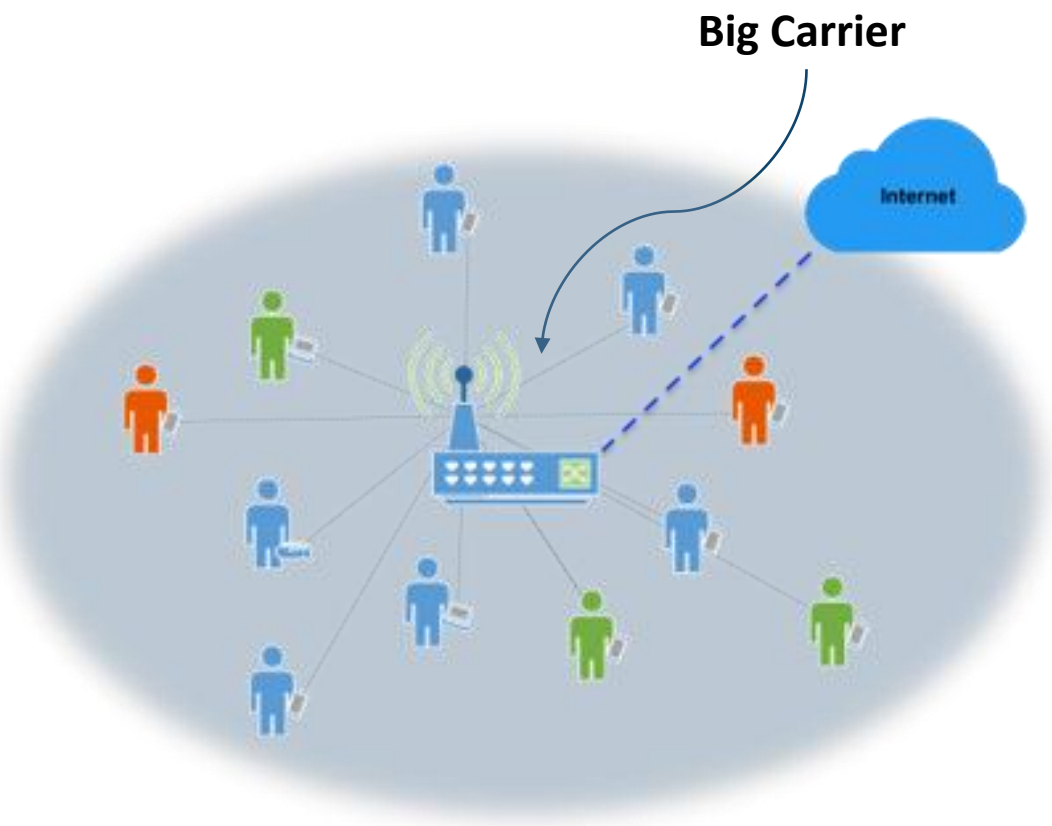


Project Goal

Perform research on the operation and intercommunication between components of a single and multiple Deployable Systems to share resources, information, and services among users.

Deployable Systems Research

Deployable Systems: Today



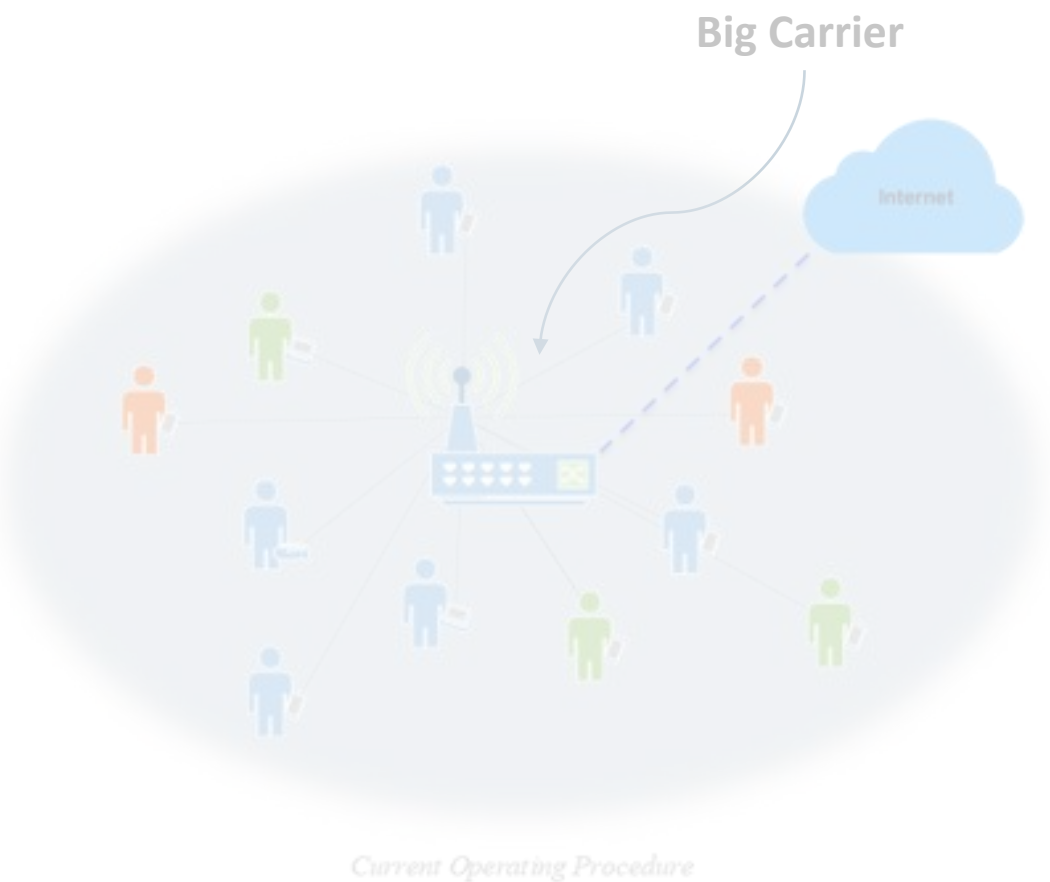
Current Operating Procedure

Public Safety Initiative

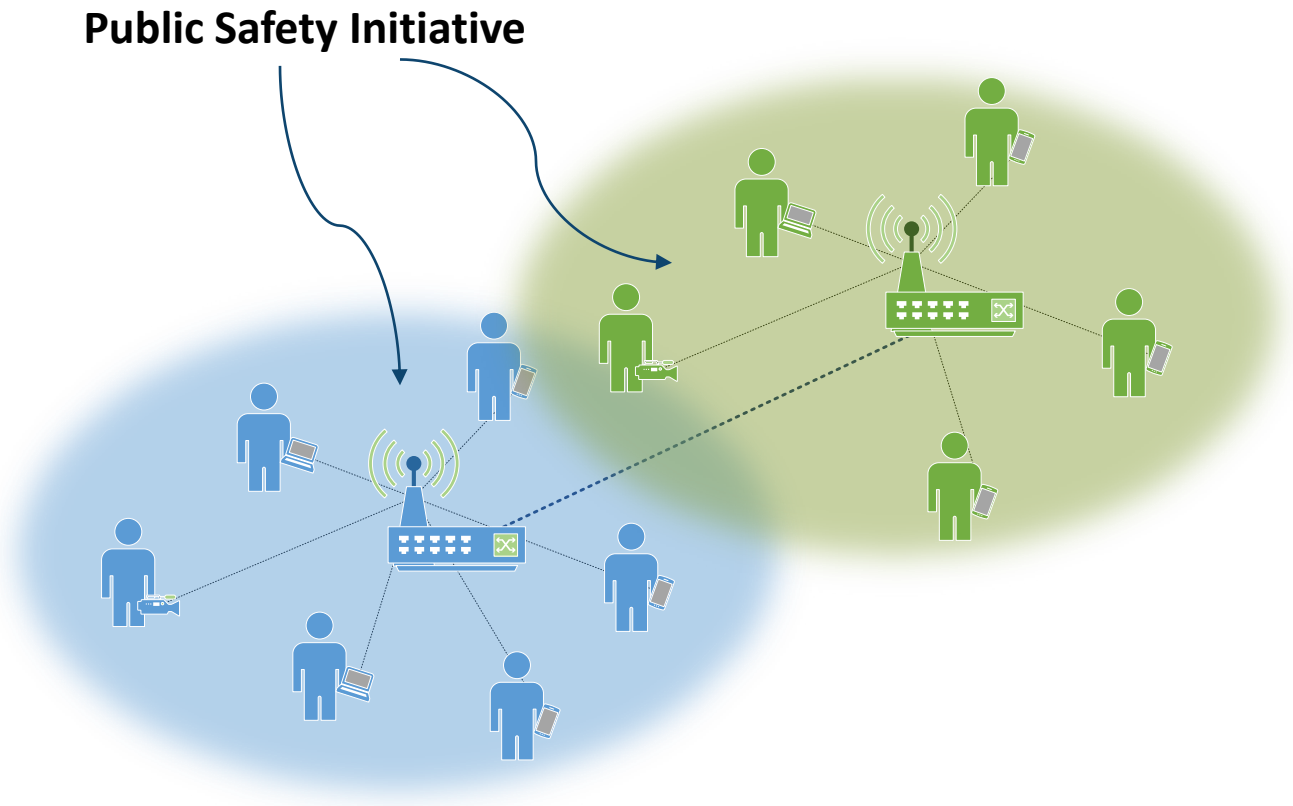
HMDN Research

Deployable Systems Research

Deployable Systems: Future



Current Operating Procedure

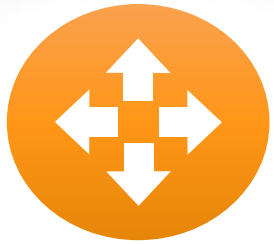


HMDN Research

Deployable Systems Research

Equipment Build

2017



Latency testing
Power consumption
Interference testing
Deployment testing
Mobile ad hoc network research

Stakeholder Engagement

2018

Round table meeting
Summit meeting
ICN for deployables
Overall architecture
Airborne simulation

Field Testing

2019

Ground vehicle-based testing
Tech to Protect Challenge
UAS field testing
Service load testing
Unlicensed spectrum
Access technologies

Testbed Integration

2020

Winter Institute
DEDUCE
Service federation
Coverage prediction
Service prediction

This Presentation

HIGHLY MOBILE DEPLOYED NETWORKS

Crux of the Issue

Spectrum Access

The ability to radiate on a specific frequency

Wireless Access Technology

The protocol/method to transmit data

HIGHLY MOBILE DEPLOYED NETWORKS

Crux of the Issue

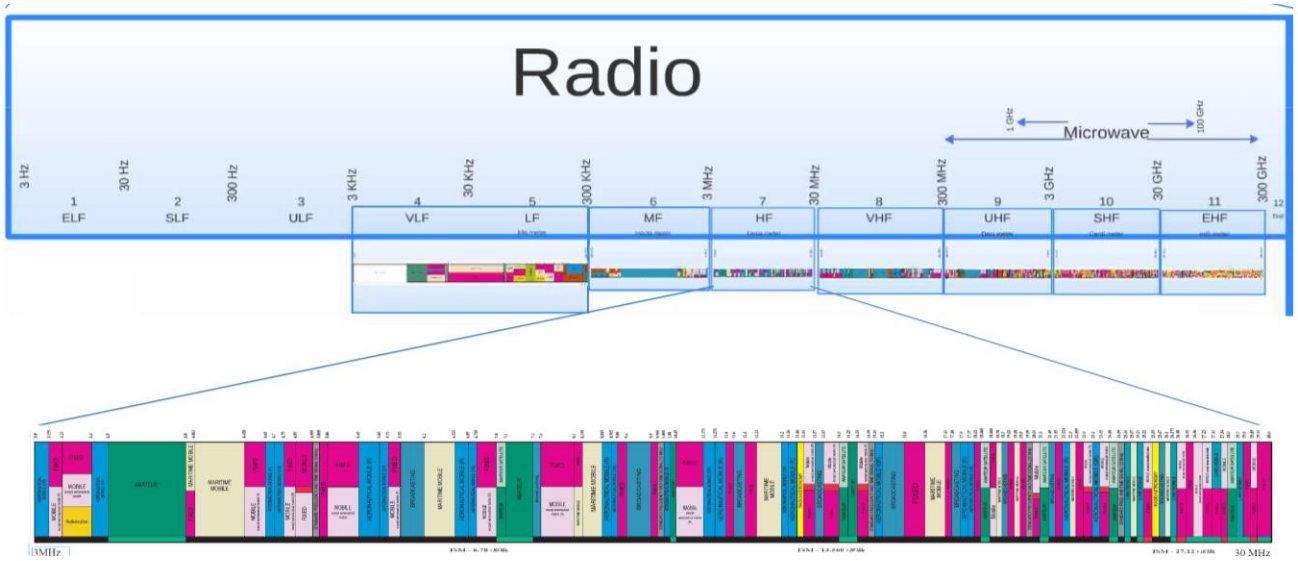
Spectrum Access

- Spectrum is very valuable
- Other technologies use spectrum, so it is not just about communication systems
- Ownership of spectrum is given to both private and government entities through the FCC with lots of debate/legal process
- Even in emergencies, could take several hours if not days to get special permission to use spectrum

Crux of the Issue

Spectrum Access

- Some public safety broadband spectrum exists
- Spectrum for Land Mobile Radio (LMR) (30–512 MHz)
- Spectrum for broadband (758 – 798 MHz, 4940-4990 MHz)
- Still not many options



Colorado 4.9 GHz Project

April 30, 2006

Lead Agency:

Parker Fire Protection District
10795 South Pine Drive
Parker, CO 80138
(303) 841-8783 Business
(303) 841-5961 FAX
http://www.parkerfire.org

Parker Fire Project Manager: Cheryl Poage

HIGHLY MOBILE DEPLOYED NETWORKS

Crux of the Issue

Wireless Access Technology

- Wireless industry has a few standards for various use cases
- Many times a wireless standard or technology is made for a specific piece of spectrum
- Cost of equipment can vary wildly based on market/technology
- Public safety does not drive the market very much, so not many solutions are tailored to public safety

ALLIANCE cbrs

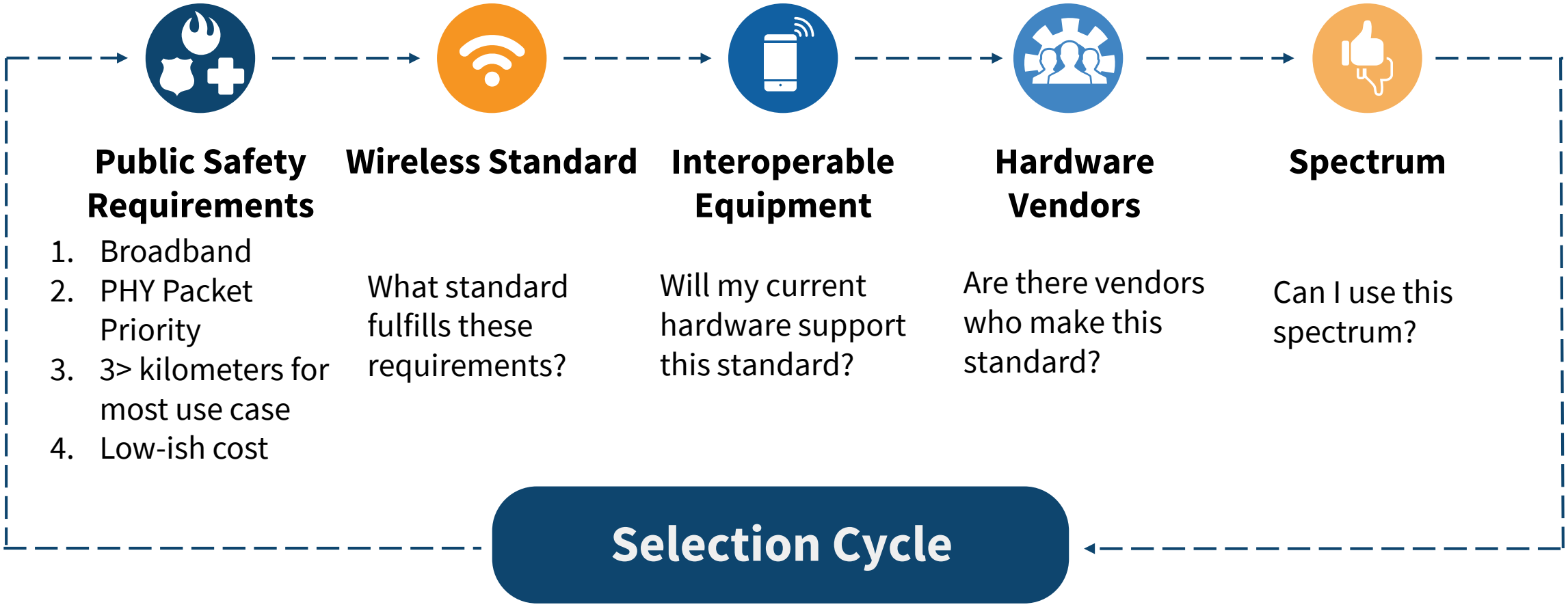
MULTEFIRE™

3GPP™ A GLOBAL INITIATIVE

Wi Fi

HIGHLY MOBILE DEPLOYED NETWORKS

Selection Process



HIGHLY MOBILE DEPLOYED NETWORKS

Selection Process

X	CBRS	✓	✓	?
✓	MulteFire	X	X	✓
X	HaLow	✓	?	✓
X	Wi-Fi	✓	✓	✓
✓	LTE	✓	✓	X

Selection Process

Citizens Broadband Radio Service

- Broadband
- Packet delivery priority and reliability
- Expected reasonable price points

- Requires internet
- Cannot move the system

- Expected handset support
- Standards based

- Some Vendors exist
- Plans for future existence

- Might not get access depending on location
- If spectrum is secured, then you have exclusive access

X	CBRS	✔	✔	?

Selection Process

MulteFire

- Broadband
- Some Packet delivery priority
- Expected reasonable price points

- Currently no known handset support
- Standards based

- Some base station vendors exist
- Not clear of future

- Uses unlicensed spectrum

✓	MulteFire	X	X	✓

Selection Process

HaLow (802.11ah)

- Not really broadband
- Not that great range
- Not priority packets

- Expected sensor support but no real expected handset support
- Standards based

- Do Vendors exist?

- Uses unlicensed spectrum

X	HaLow	?	?	✓

Selection Process

Wi-Fi (802.11x)

- Broadband
- No Packet delivery priority or reliability
- Poor range given protocol and policy
- Low price points

- Most handset support
- Standards based

- Multiple Vendors exist
- Plans for future existence

- All in unlicensed spectrum

X	Wi-Fi	✓	✓	✓

Selection Process

3GPP Cellular LTE

- Broadband
- Packet delivery priority and reliability
- Reasonable price points
- Long range

- Most handset support (few exceptions)
- Standards based

- Multiple Vendors exist
- Plans for future existence

- Requires ownership of spectrum

✓	LTE	✓	✓	X

Selection Process

X	CBRS	✓	✓	?
✓	MulteFire	X	X	✓
X	HaLow	?	?	✓
X	Wi-Fi	✓	✓	✓
✓	LTE	✓	✓	X

Candidate Solutions

Best two candidates
Wi-Fi and LTE

Fundamental Tradeoff

Wi-Fi does not have priority
Wi-Fi does not have range

⟷

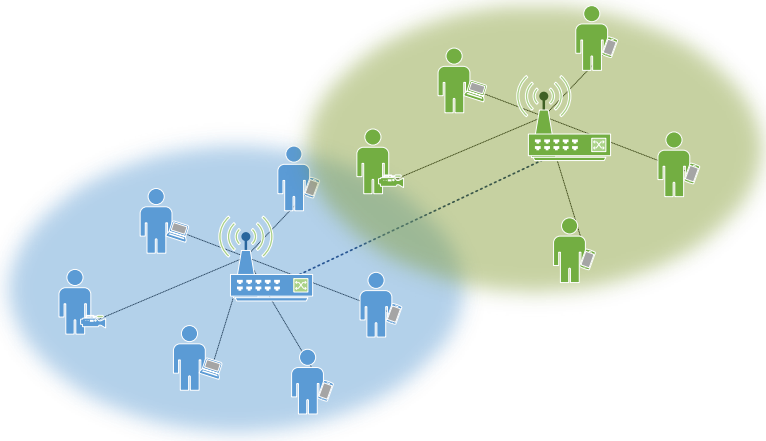
LTE requires spectrum

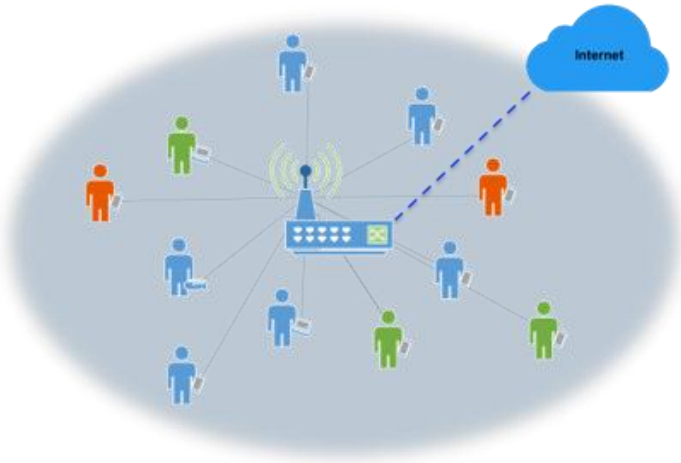
X	Wi-Fi	✓	✓	✓
✓	LTE	✓	✓	X

HIGHLY MOBILE DEPLOYED NETWORKS

Path Forward

X	CBRS
X	MulteFire
X	HaLow
?	Wi-Fi
?	LTE



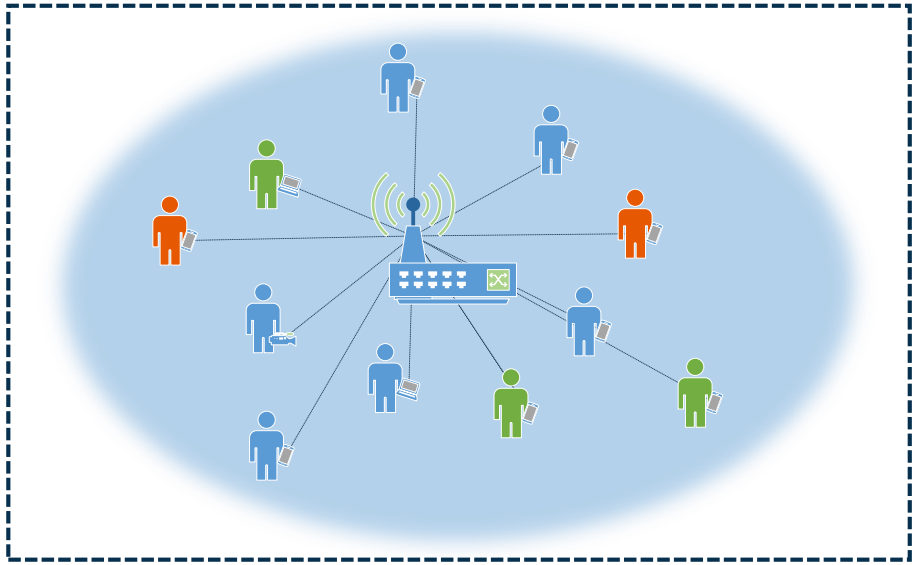


What can you do?

LTE

- Agency-owned deployable to be place in a specified geofence
- Agency-owned deployable backhauled to a spectrum access server
- Agency deployable that senses nearby towers
- Perhaps close by to a cached Cell-on-Wheels

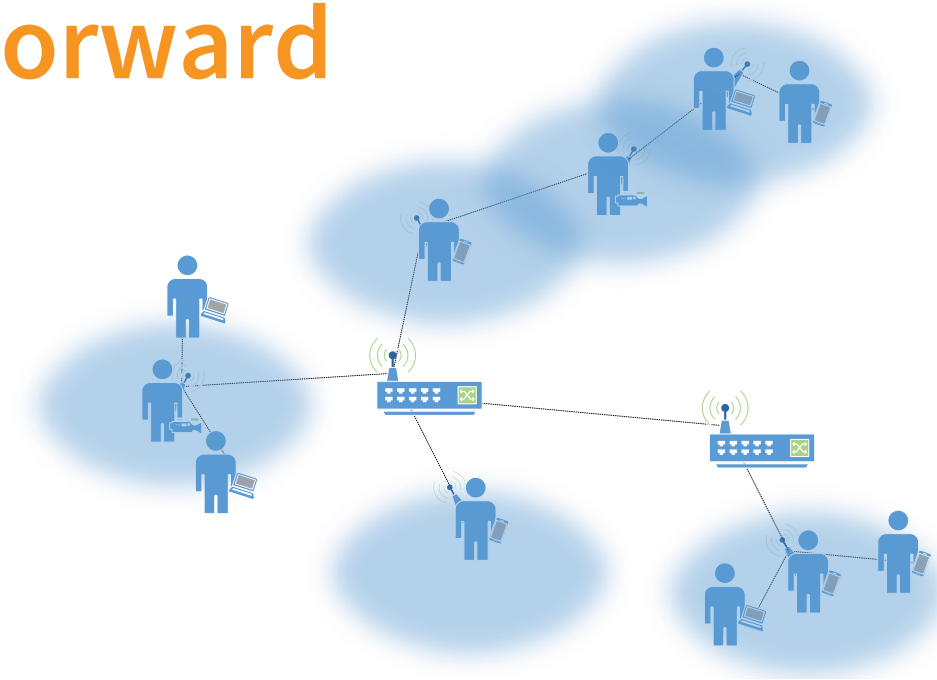
Geofence



HIGHLY MOBILE DEPLOYED NETWORKS

Path Forward

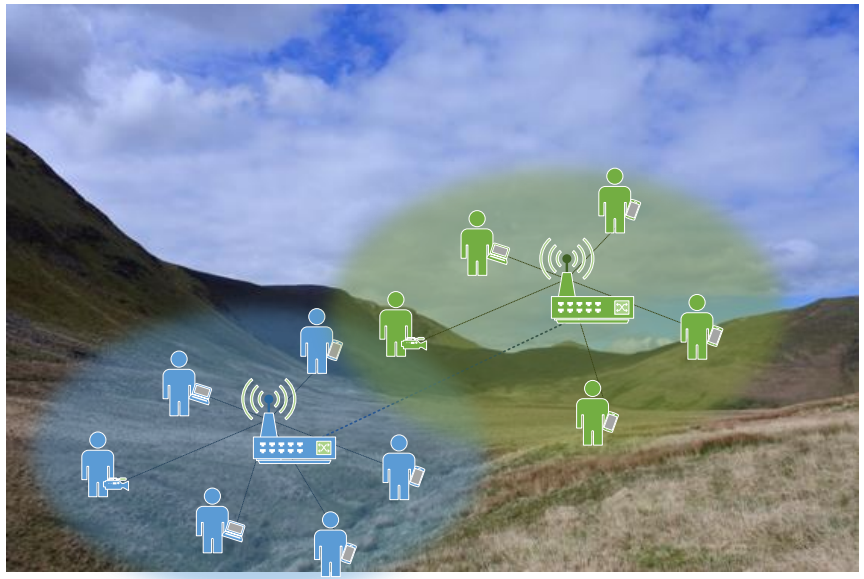
X	CBRS
X	MulteFire
X	HaLow
?	Wi-Fi
?	LTE



What can you do?

Wi-Fi

- Multiple Wi-Fi systems in remote locations
- Wi-Fi systems hosted on drones
- Wi-Fi systems linked together through MANETs



HIGHLY MOBILE DEPLOYED NETWORKS

Deployable Systems Research

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(303) 497 3775

THANK YOU

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4.9 GHz Public Safety

Broadband Spectrum for Public Safety

https://www.fcc.gov/49-ghz-public-safety-spectrum

The FCC allocated 50 MHz (a lot for communications!) in the 4.9 GHz band for fixed and mobile services. The following the types of uses have primary status

- Wireless LANs for incident scene management (ad hoc mobile networks)
- Mesh networks
- Temporary fixed communications
- Permanent fixed point-to-point/multipoint links
- Etc.

4.9 GHz Public Safety

Broadband Spectrum for Public Safety

https://www.fcc.gov/49-ghz-public-safety-spectrum

Issues with 4.9 GHz

"Range is limited. Radio waves at 4.9 GHz behave very much like visible light. If the Access Point antenna is not visible, the likelihood of maintaining a reliable connection is low, especially at the low power levels mandated by the FCC for 802.11 compatible devices."

Candidate Solutions

What can you do?

Range Issue

To fix the range issue, you could do Wi-Fi in owned spectrum, if you can get it, and control the number of nodes using that spectrum. Perhaps in the public safety 4.9 GHz band.

✓	Wi-Fi	✓	✓	✓
✓	LTE	✓	✓	X

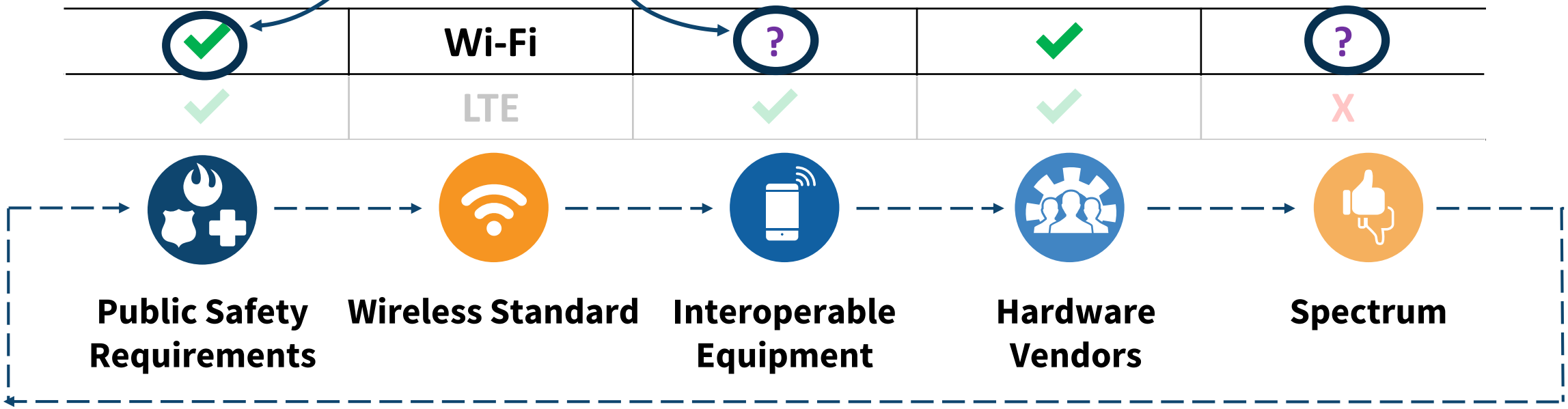
HIGHLY MOBILE DEPLOYED NETWORKS

Paths

What can you do?

Range Issue

To fix the range issue, you could do Wi-Fi in owned spectrum, if you can get it, and control the number of nodes using that spectrum. Perhaps in the public safety 4.9 GHz band.

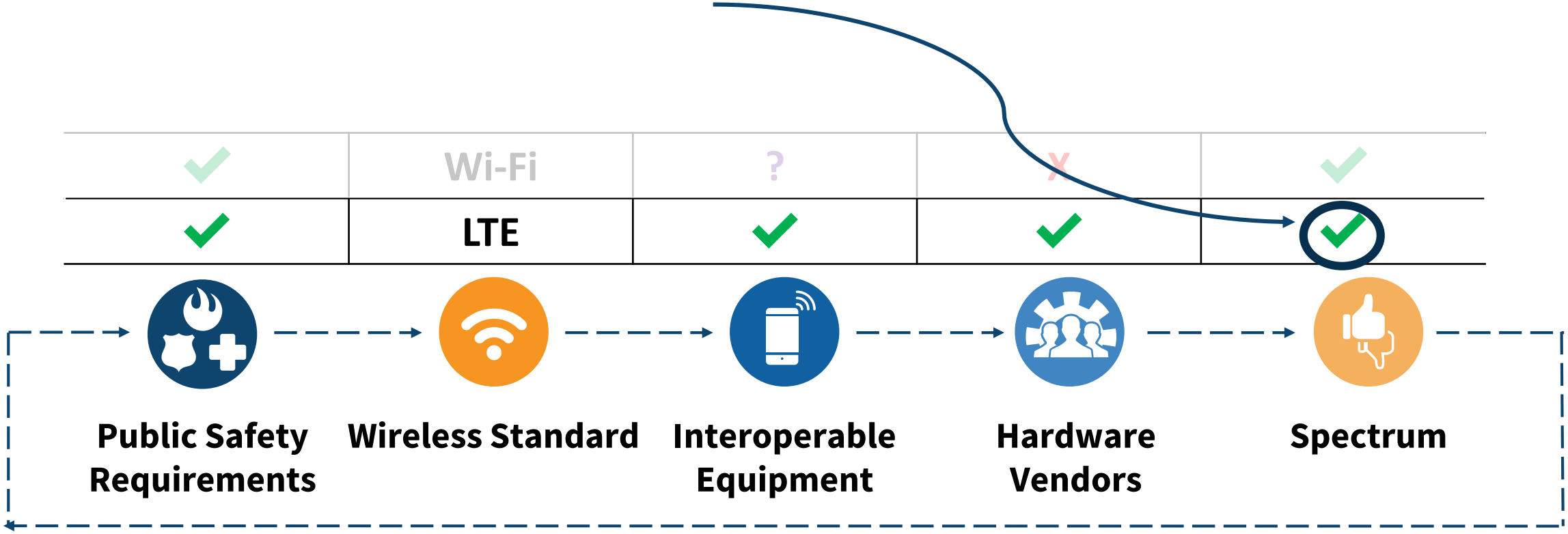


Candidate Solutions

What can you do?

What about LTE?

Could do LTE in owned spectrum, like 4.9 GHz, or find a way to get rights to the spectrum



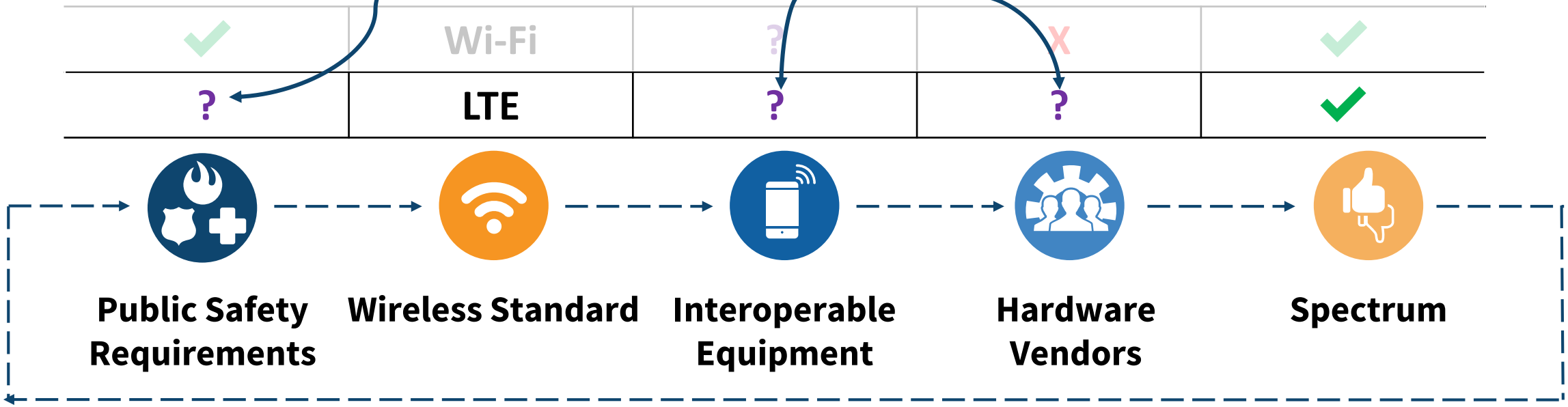
Candidate Solutions

What can you do?

Vendors do exist

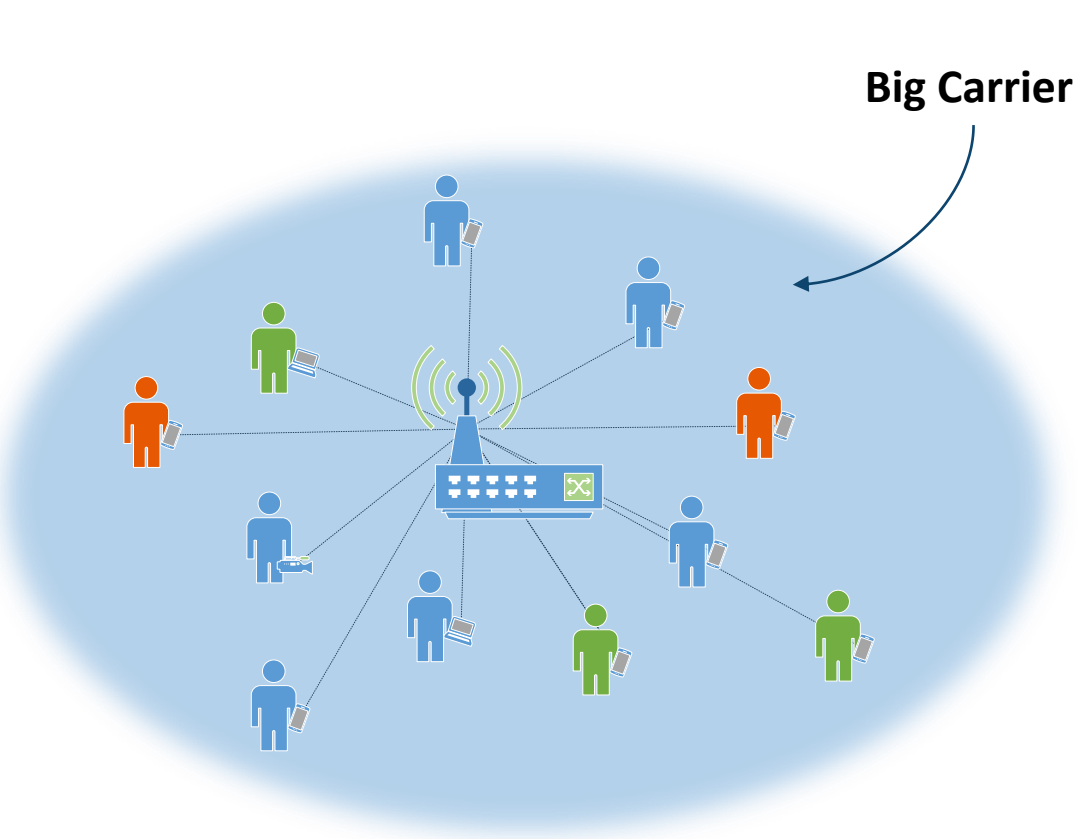
LTE in owned spectrum

Would require specialty vendors
Most handsets would not support this
Could be very costly

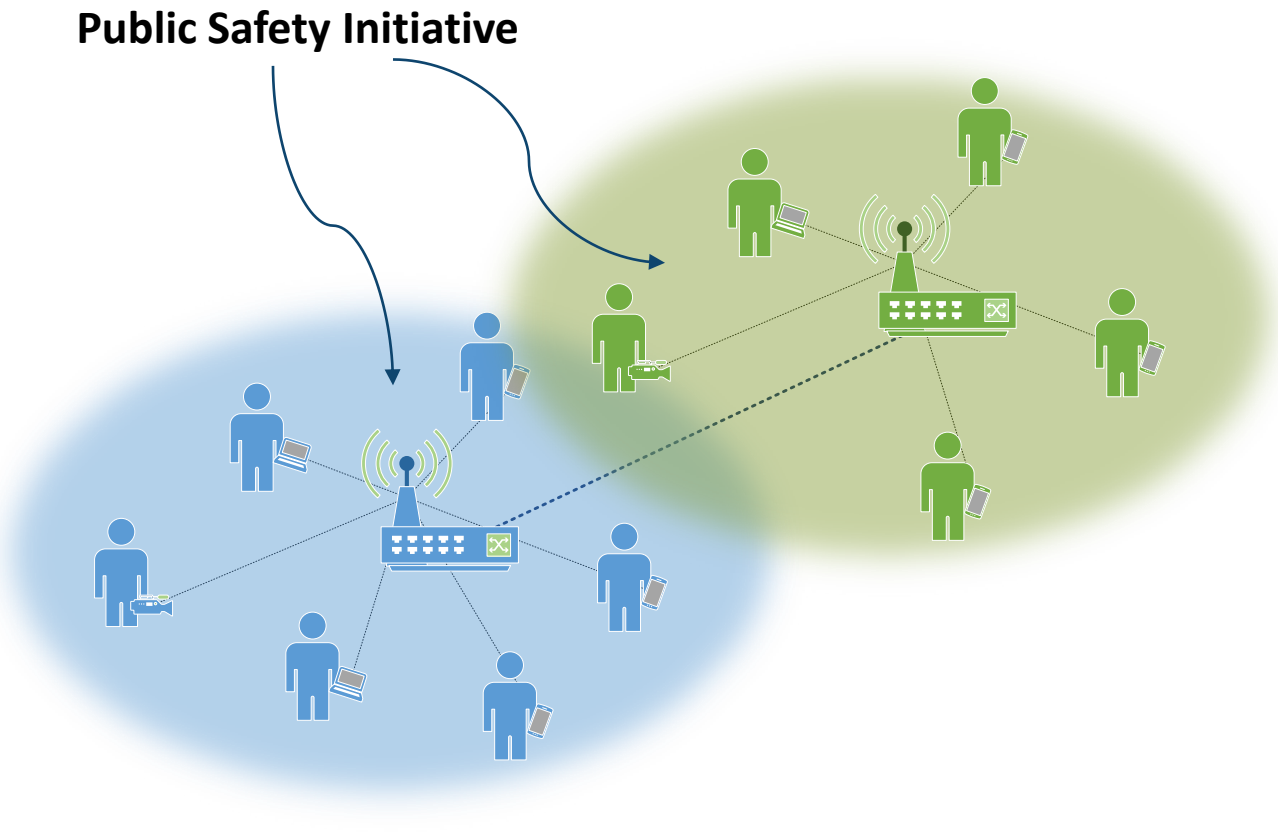


Deployable Systems Research

Deployable Systems



Current Operating Procedure



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