

Perspectives on Spectrum and Resilient Communication for the Grid

Tim Godfrey
Technical Executive

ISART: 5G SPECTRUM AND A ZERO-TRUST NETWORK
13 August 2020



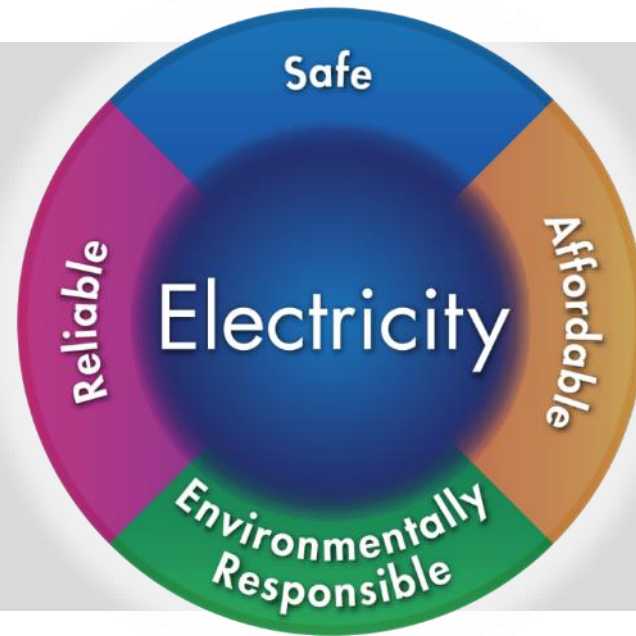
Agenda

- About EPRI
- Private LTE and the evolution to private 5G
- Impact of Unlicensed Operation in 6 GHz licensed spectrum
- Black Sky Communication without terrestrial infrastructure
- Extending the Microgrids concept to grid telecom networks

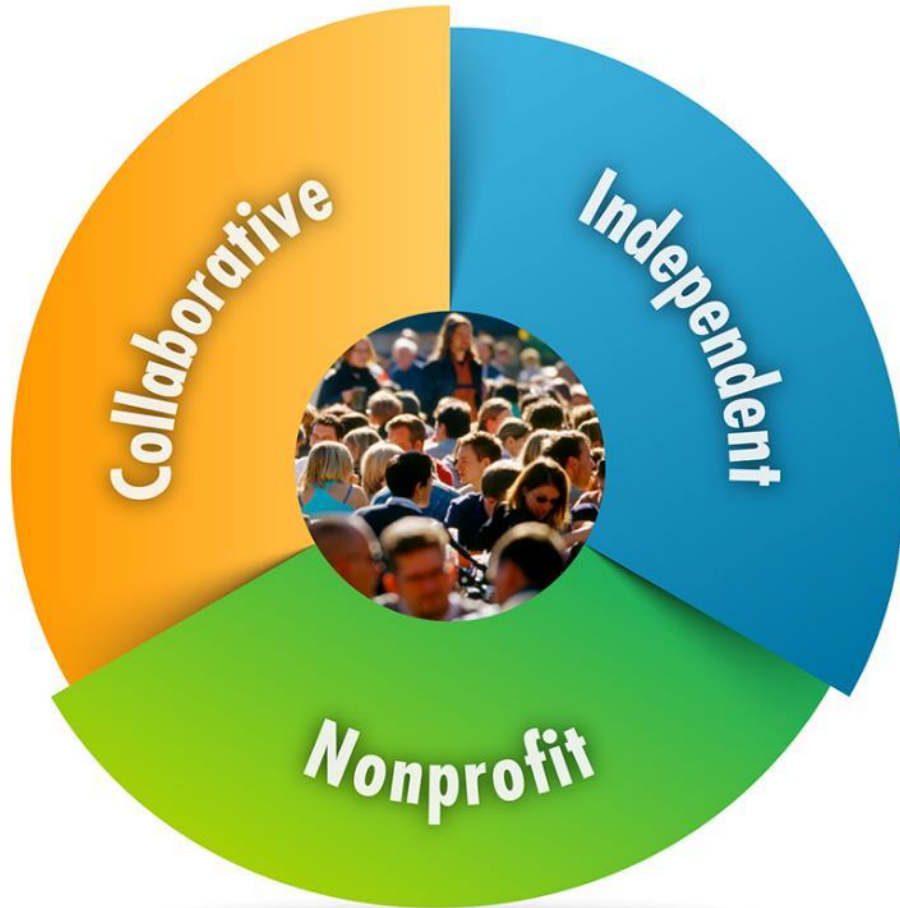
Spectrum Implications for Security of Supply and Grid Resilience

EPRI's Mission

Advancing *safe, reliable, affordable* and *environmentally responsible* electricity for society through global collaboration, thought leadership and science & technology innovation



Three Key Aspects of EPRI



Independent

Objective, scientifically based results address reliability, efficiency, affordability, health, safety, and the environment

Nonprofit

Chartered to serve the public benefit

Collaborative

Bring together scientists, engineers, academic researchers, and industry experts

Our Members...

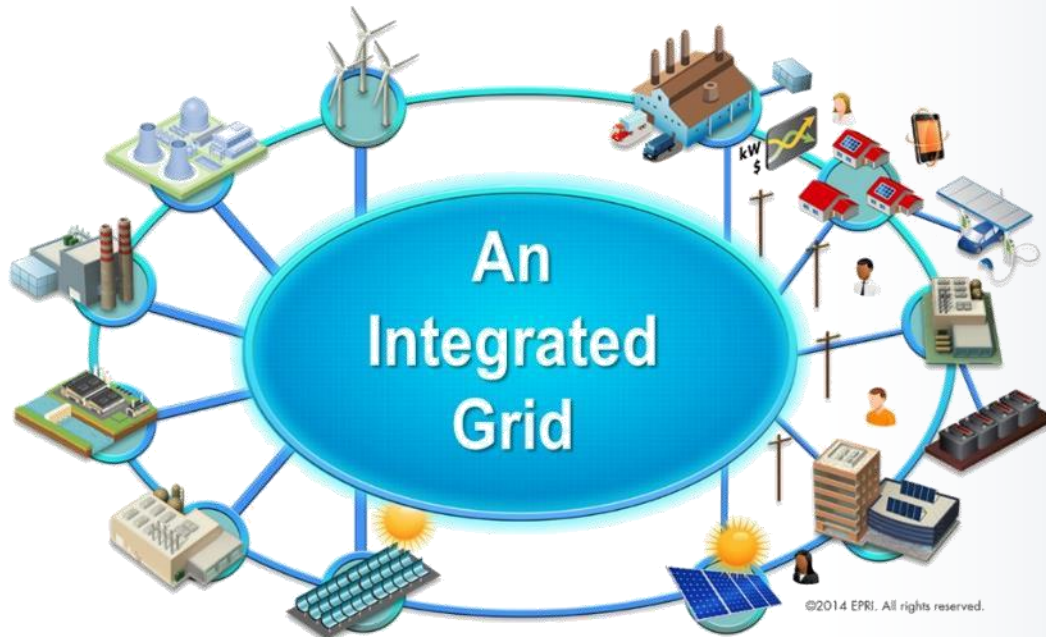
- 450+ participants in more than 30 countries
- EPRI members generate approximately 90% of the electricity in the United States
- International funding – nearly 25% of EPRI's research, development, and demonstrations



Drivers for the Utility Field Area Network

Carbon reduction goals require large scale adoption of DER and storage. This must be built on a modernized grid with advanced telecommunications

The Integrated Grid combines two rapidly evolving large system infrastructures – Electric Grids and Telecom Networks



Integration of:
Electricity,
Telecommunications, and
Customer Local Energy
Platforms

Why are utilities choosing private LTE over commercial?

- Reliability / Availability
 - Network can be built to utility reliability standards
 - Restoration can be done on utility schedule and priority
 - Network maintenance downtime fully visible and controlled by utility
- Cyber-security
 - All parts of network under utility management and ownership
- Cost
 - For Investor Owned Utilities (IOUs), capitalized expenses for investment projects are financially preferable over operational expenses
 - In many states, spectrum costs are also treated as capital
- Lifecycle
 - Utility life cycle for field devices longer than commercial networks
 - No stranded assets due to operator service discontinuation



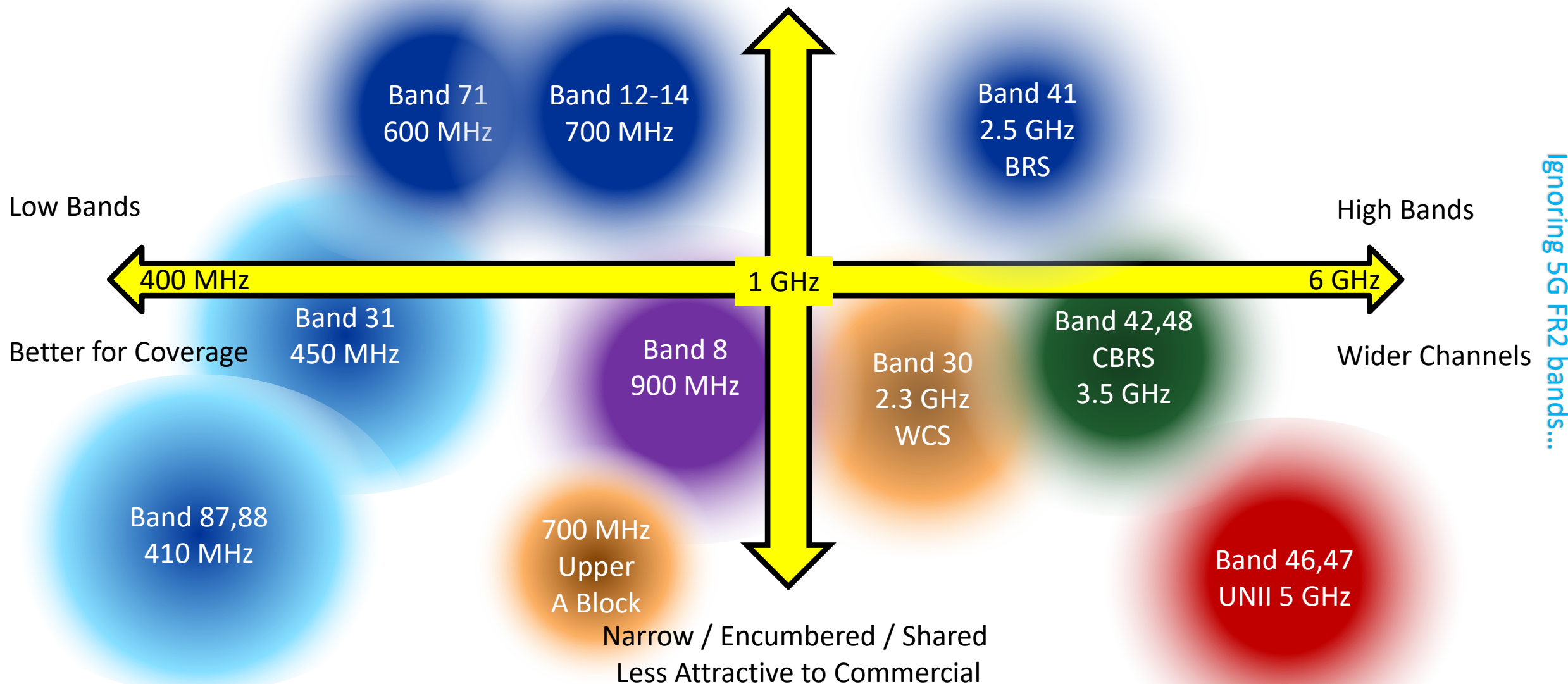
Challenges for Private LTE

- Cost and availability of licensed spectrum
 - US allocation model is FCC auction or secondary market
 - Priced per person covered – expensive in dense cities
 - Competing with commercial cellular operators
 - Important to capitalize spectrum investment
- Cost of required infrastructure to provide full coverage
 - Cost challenge increases for the higher frequency band options
- Cost and complexity of deploying and managing the LTE Core
 - Training, skill set, etc.



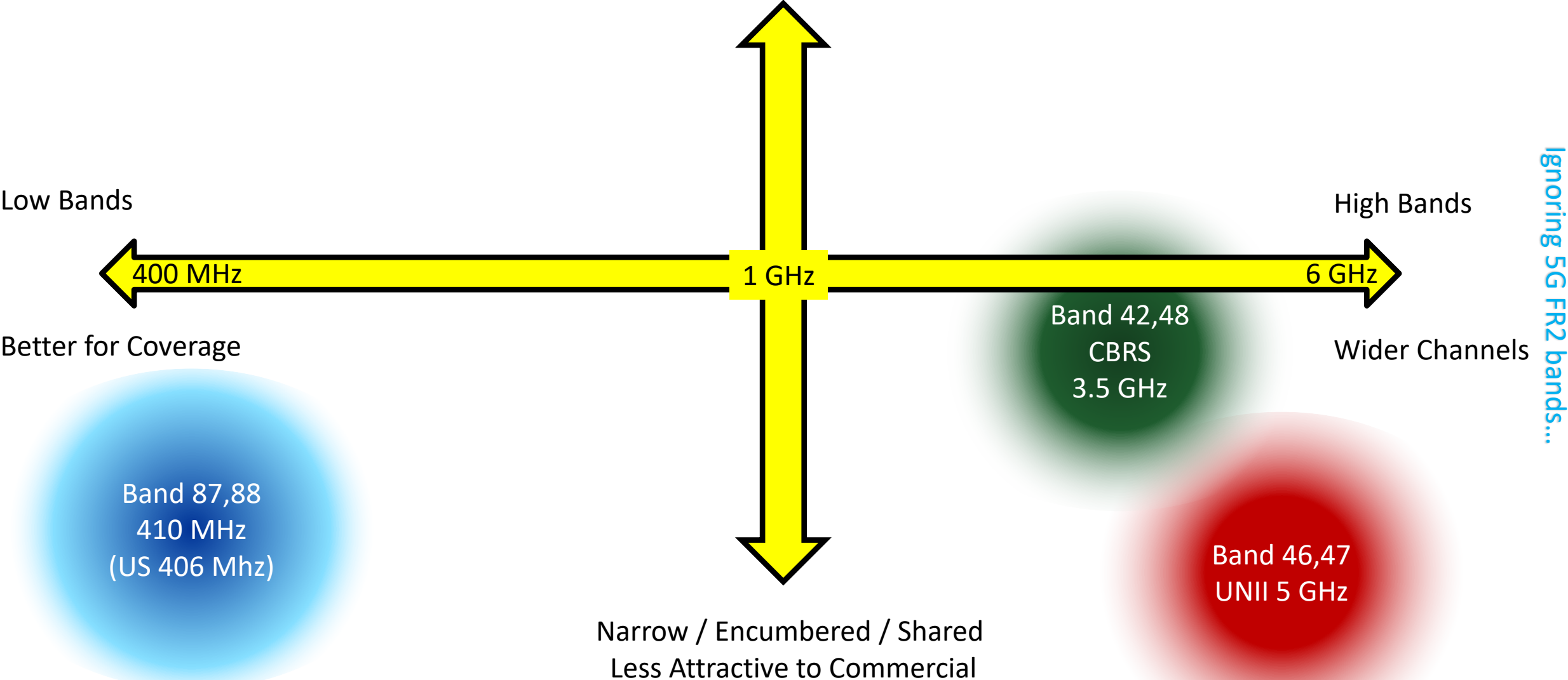
Private LTE/5G Spectrum Space

Prime Spectrum – Commercial Operator Bands



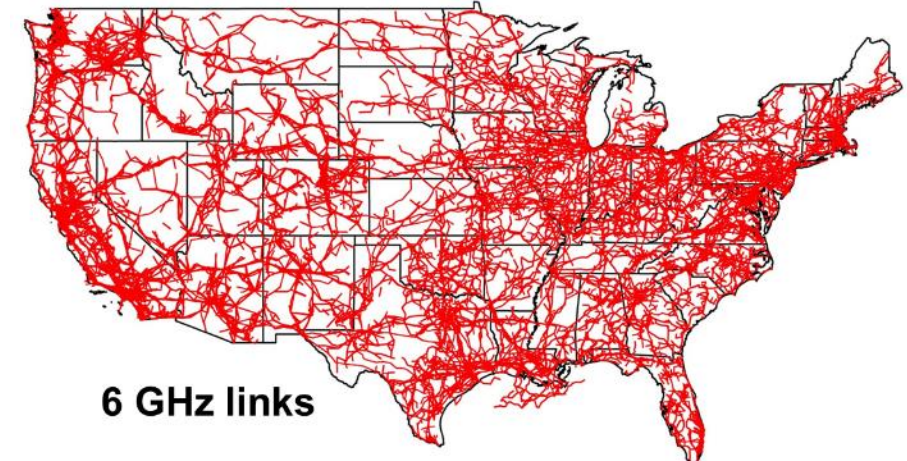
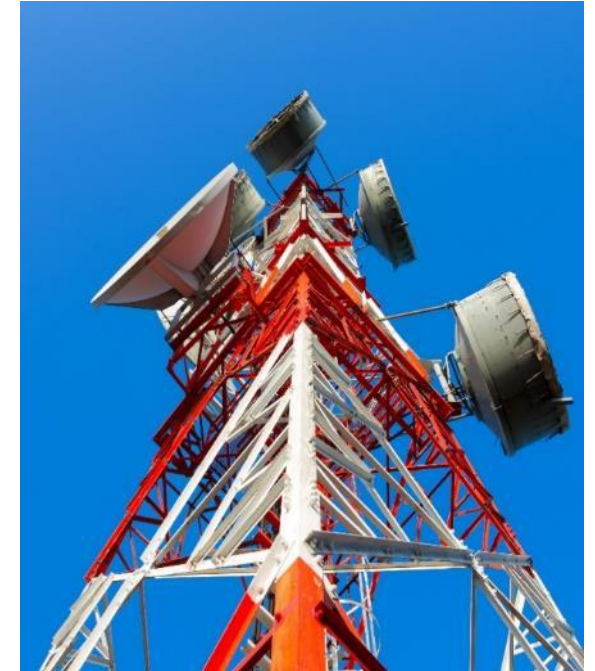
Private LTE/5G Spectrum Space (shared)

Prime Spectrum – Commercial Operator Bands



Unlicensed Use of the 6 GHz Band - FCC R&O / FNPRM

- [FCC Report and Order 20-51](#)
[Adopted](#): April 23, 2020
- [Published in the Federal Register](#)
 - **Effective date of the order is July 27, 2020**
- Entire band (5925 to 7125 MHz) opened
- Licensed 6 GHz links are used for utility critical wide area networks.
- Design reliability 99.999% (5 minutes outage per year) or 99.9999% (31 seconds outage per year)



6 GHz links

Source: FWCC

Unlicensed Use of the 6 GHz Band - Testing

- *This research conducted field testing to determine if unlicensed devices operating in compliance with the FCC R&O are capable of causing harmful interference to incumbent FS systems.*
- **Insights:**
 - The FS antenna sidelobes are vulnerable locations for a co-channel interferer. Sidelobes may easily be found experimentally in the field where LOS exists, but antenna sidelobe data is not included in the FCC ULS data from which automatic frequency coordination (AFC) exclusion zones will be derived.
 - The effective edge of an exclusion zone may be found experimentally in the field in front of the FS receiver out to several kilometers where LOS exists.
 - The FCC's proposed Automatic Frequency Coordination (AFC) system is similar in concept to SAS for CBRS spectrum sharing.



Test Results Summary: Public Report

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Unlicensed Use in the 6 GHz Band: Field Interference Test Results

Details

Product ID

3002019712

Date Published

Jul 24, 2020

Document Type

Technical Brief

Abstract

The Federal Communications Commission (FCC) Report & Order (R&O) 20-51 allows unlicensed device operation in the upper and lower licensed 6 GHz fixed service (FS) microwave radio bands. This research conducted field testing to determine if unlicensed devices operating in compliance with the FCC R&O are capable of causing harmful interference to incumbent FS systems.

This report shares key findings with industry stakeholders that may not be EPRI members. This is a summary report and detailed results are available to utilities participating in EPRI's Telecom 161G project set.

Program

2020 161 Information and Communication Technology

Report

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No Charge

This Product is publicly available

DOWNLOAD: PDF (2.07 MB)

Keywords

Field Testing

Interference

Telecommunications

Radio Local Area Network (RLAN)

Notes

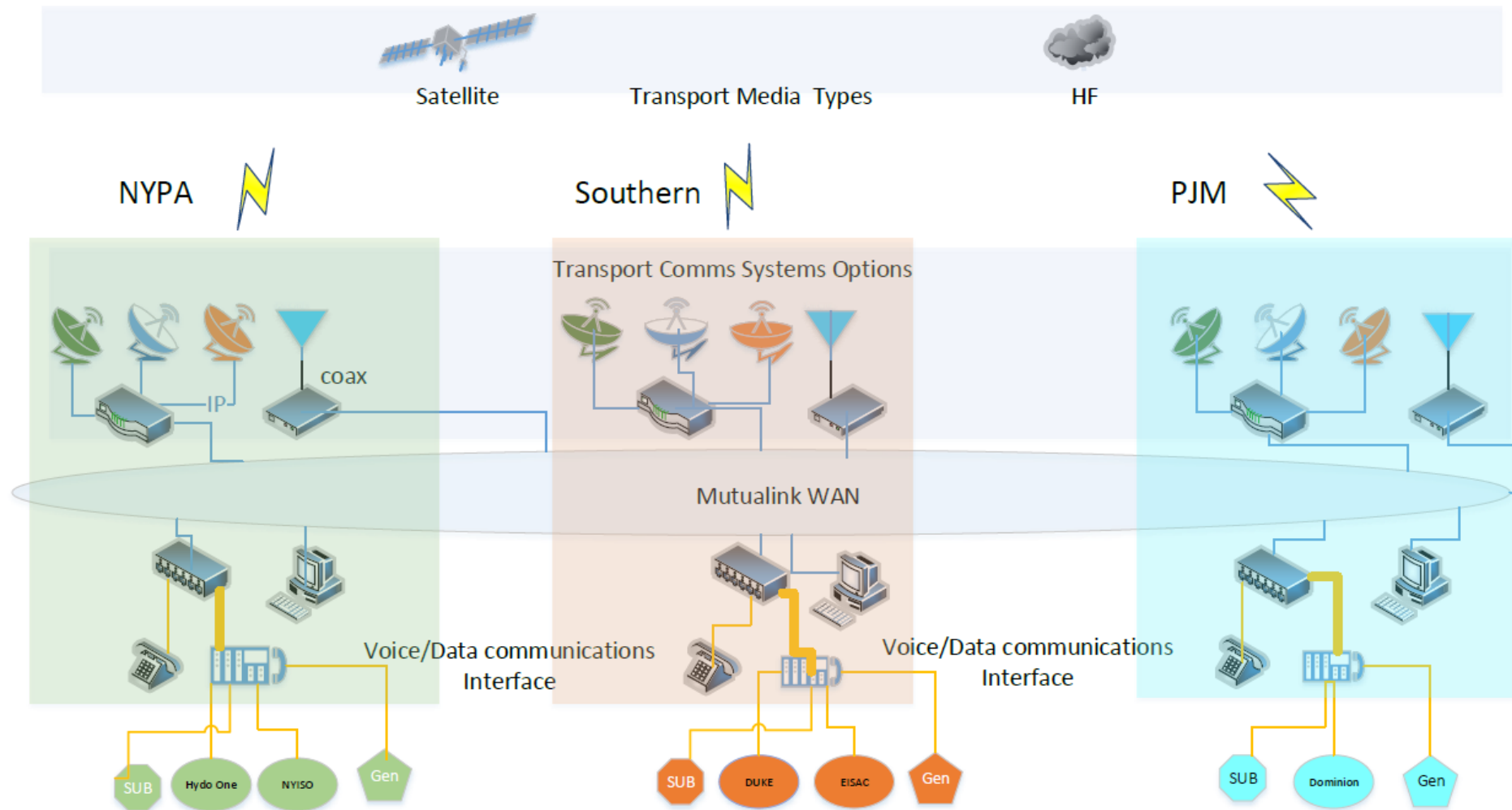
For further information about EPRI, call the EPRI Customer Assistance Center at (800) 313-3774 or email askepri@epri.com.

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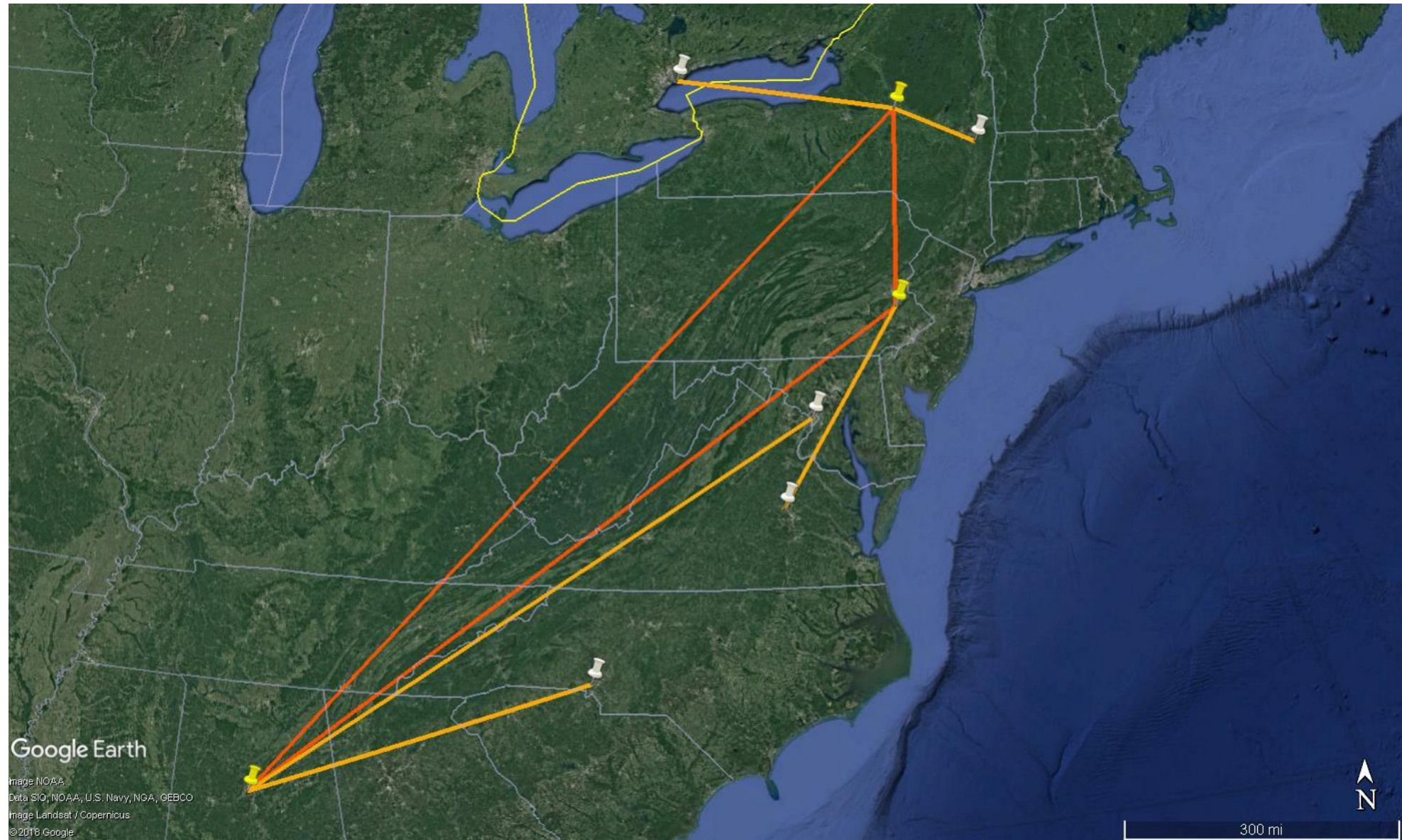
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<https://www.epri.com/research/programs/062333/results/3002019712>

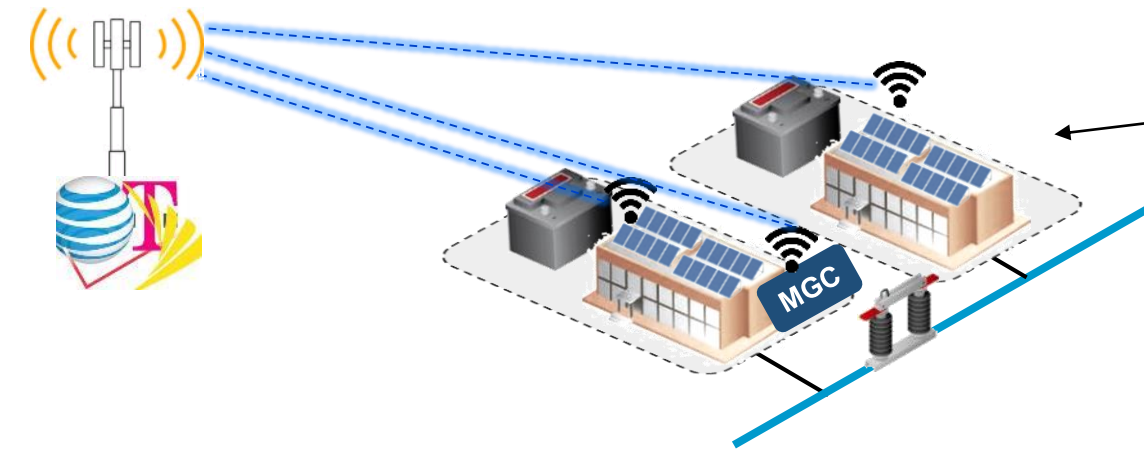
Black Sky Communications Demonstration Design



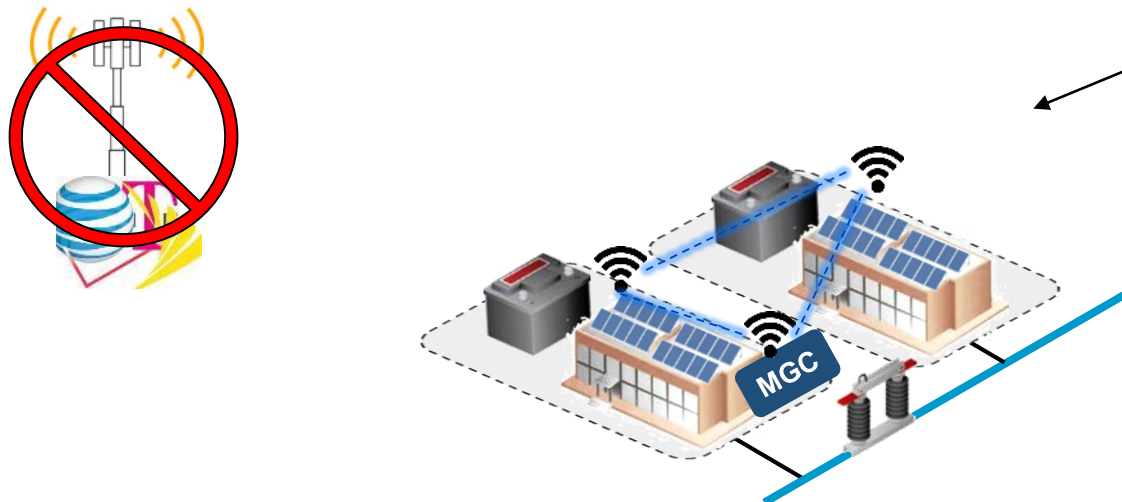
Black Sky Communications Demonstration



Autonomous Microgrid Communications



- State 1 – Normal: MicroGrid controlling devices in communication with commercial cellular infrastructure



- State 2 – Infrastructure unavailable due to extended power outage: Grid control devices transition to islanded, autonomous communication. Devices in microgrid-powered island establish peer-to-peer communications (e.g. ProSe / PC5 sidelink)
 - Cyber security is re-configured dynamically

Peer to Peer connections

Closing thought

- Research questions of cyber-security, telecommunications, security of supply, grid resilience and reliability, and emergency communications systems are highly interwoven with wireless spectrum.

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