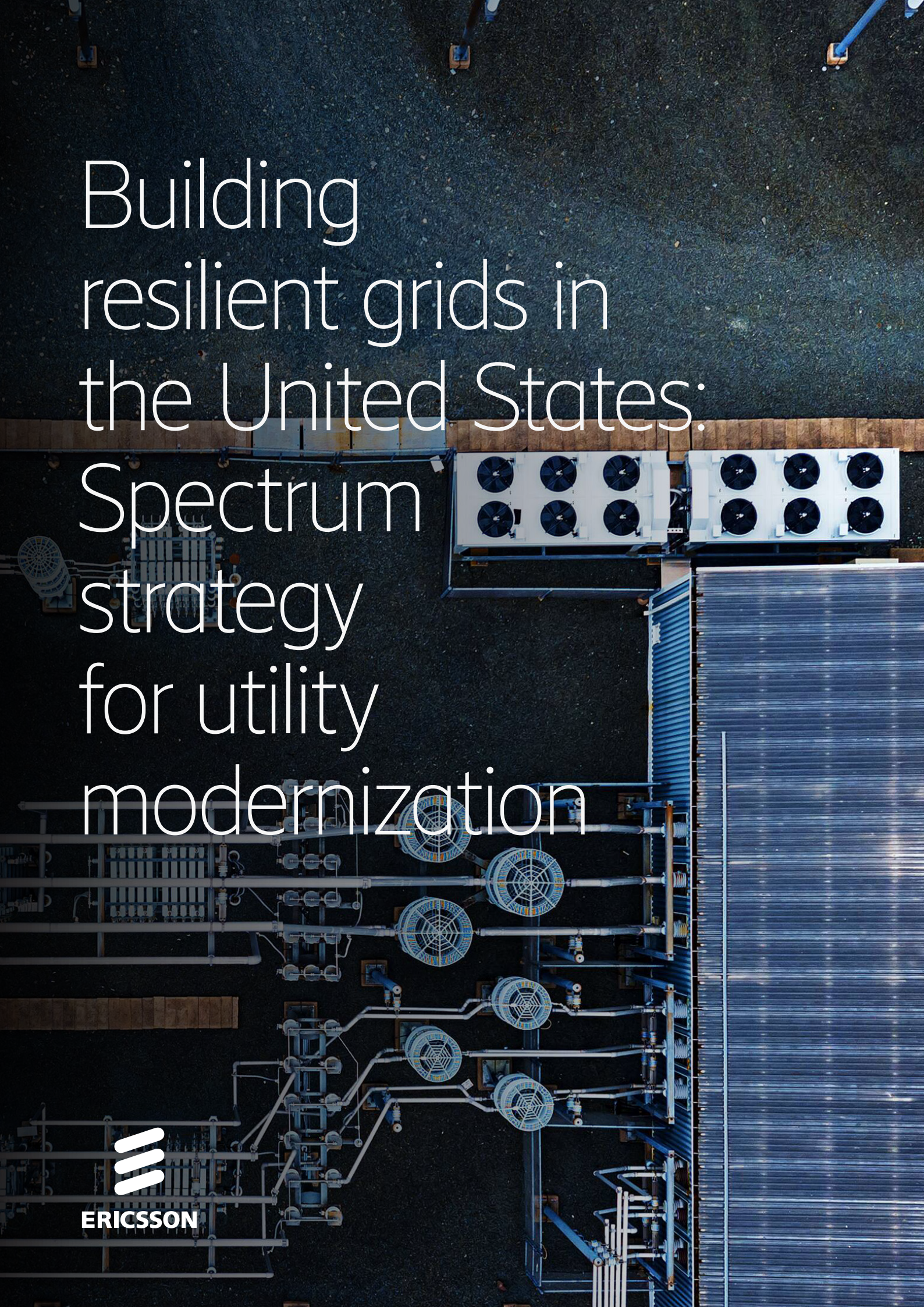


Building resilient grids in the United States: Spectrum strategy for utility modernization

ERICSSON

Table of contents

Key takeaways

To maximize efficiency, utilities should implement a well-planned strategy based on:

Prioritizing a licensed spectrum:
Ensure guaranteed interference protection and quality of service for critical infrastructure.

Establishing a robust device ecosystem:
Assess the availability of devices and form factors compatible with each spectrum band for seamless deployment.

Leveraging low-band for coverage:
Deploy 900 MHz (Band 106), 600 MHz (Band 71), and/or 850 MHz (Band 26) for wide-area coverage, ensuring reliable connectivity in remote areas.

Augmenting connectivity with mid-band:
Use 2.5 GHz (Band 41) and/or 2100 MHz (AWS-3) to address high data demands and workforce connectivity needs.

Utilizing the shared spectrum for flexibility:
Using CBRS in the mid-band offers a flexible and cost-effective option for augmenting network capacity for non-mission critical applications.

Introduction

The utility sector in the United States is undergoing a significant transformation, driven by the need for reliable, secure, private, and low-latency communication networks. As utilities modernize their grids and adopt advanced telemetry technologies, access to suitable spectrum bands tailored to use case capacity and coverage requirements has become crucial. This paper explores key spectrum options available to utilities, focusing on the following:

- Low-band spectrum (600 MHz to 1 GHz): Ideal for use cases involving long-distance communication in large and diverse areas and for indoor coverage. It provides the utilities with a robust macro footprint, making it an optimal solution for transmission, distribution, and metering networks.
- Mid-band spectrum (1 GHz to 6 GHz): Including Citizens Broadband Radio Service (CBRS), this spectrum acts as a complementary solution to low-band frequencies by offering utilities a wider range of mission-critical applications and offering the field workforce increased capacity using additional frequencies. Mid-band spectrum addresses the coverage needs of power generation facilities.
- High-band spectrum (24 GHz to 39 GHz): It is designed for high-capacity, low-latency applications in dense areas or specific utility sites requiring advanced automation and diagnostics, like indoor machine operations.

The table below provides a summary of different spectrum segments, including low-band, mid-band, and high-band, highlighting some of their use cases for utilities, key characteristics, and broader applications. The table below outlines some of the key characteristics and applications of each spectrum group discussed.

Spectrum	Use cases for utilities	Key characteristics	Other applications
Low-Band (600 MHz–1 GHz)	• Wide-area coverage for IoT devices • Smart grid management and protection • Penetrates deep indoors (For example, basements) • Mission-critical push-to-talk	• Wide coverage • Low traffic volumes • Infrequent communication • Ideal for rural areas • Amount of spectrum: 3+3 MHz, 5+5 MHz, or 7+7 MHz • Lower data cell throughput (10 to 100 Mbps)**	• Enables basic advanced metering infrastructure (AMI) functions like meter reading and remote monitoring in large, distributed networks.
Mid-Band (1 GHz–6 GHz)	• Capacity augmentation • Smart grid management and protection • Mission-critical push-to-x • Video surveillance • Remote inspection (drone) • Augmented reality for utilities	• Balanced capacity and coverage • Supports higher data cell throughput (10-500 Mbps)** • Moderate latency* • Amount of spectrum: Greater than 10 MHz	• Supports advanced AMI features like real-time data transmission, grid monitoring, outage detection, and demand response.
High-Band (24 GHz–39 GHz)	• Capacity boost for niche use cases (For example, extended reality) • Low-latency applications	• Focused coverage, such as indoor or outdoor, with line of sight (LoS) • Higher cell throughput (Gbps)** • Lower latency* • Requires 100+ MHz of spectrum for mmWave	• Enables ultra-low-latency use cases such as outage detection, remote service management, and automation.

* Latency depends on the network architecture.
** Throughput depends on available bandwidth.

Wide area coverage first

Low-band spectrum provides reliable, secure, and mission-critical communication performance. The Federal Communications Commission (FCC) assigned Band 106 (900 MHz) for utility use due to its proven reliability and ability to meet foundational connectivity needs.

However, the available 3 MHz x 3 MHz bandwidth may not be sufficient for data-intensive use cases or in areas where additional coverage may be required. Recently, the FCC released a notice of proposed rulemaking (NPRM) to expand this allocation to 5 MHz x 5 MHz, supporting the growing demand for wide-area, private, and secure wireless broadband networks for utilities.

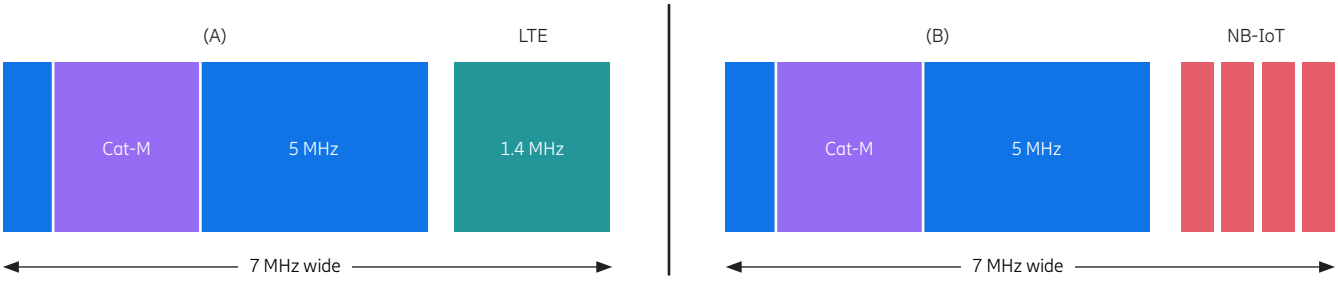
T-Mobile's nationwide 7 MHz x 7 MHz allocation in the 800 MHz spectrum (Band 26) offers utilities a complementary option to address coverage limitations. This band not only extends coverage but also enhances workforce capabilities through broader use of mission-critical services such as push-to-talk communication.

Band 26 also benefits from a larger device ecosystem. According to the Global Mobile Suppliers Association (GSA), more than 4,383 devices are available for Band 26, with 60 percent related to other form factors, such as modules, modems, industrial-grade Customer Premises Equipment (CPEs)/ routers/ gateways, asset trackers, cameras, and tablet PCs. Another option is 600 MHz (Band 71) for wide-area coverage, though its availability may be limited.

Flexible technology and service allocation

In the case of 7 MHz x 7 MHz spectrum allocation in Band 26, additional technologies can be integrated to enhance flexibility. For example, (A) deploying a narrow 1.4 MHz long term evolution (LTE) carrier alongside a 5 MHZ carrier; or (B) implementing narrowband IoT (NB-IoT) carriers.

Figure 1. Example of technology options to reflect the need for flexibility.

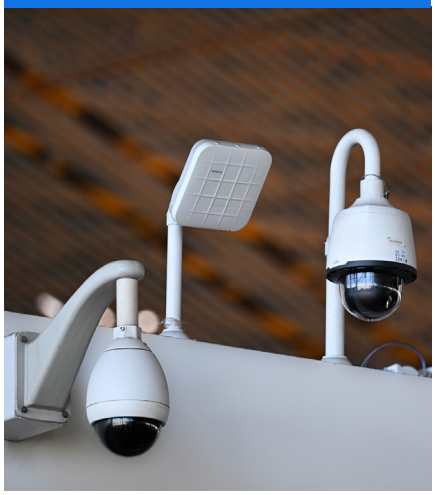


Enhancing capacity with mid-band spectrum

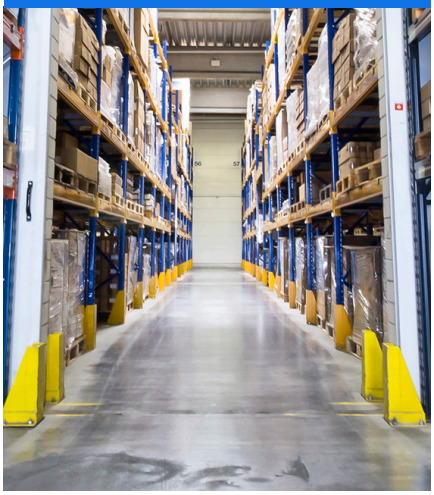
To address the demands of evolving applications, utilities can use the mid-band spectrum, which delivers reduced latency and greater bandwidth, making it ideal for broadband applications such as security, surveillance, and high-speed data transfer.

Areas that will benefit from the flexibility of the mid-band spectrum:

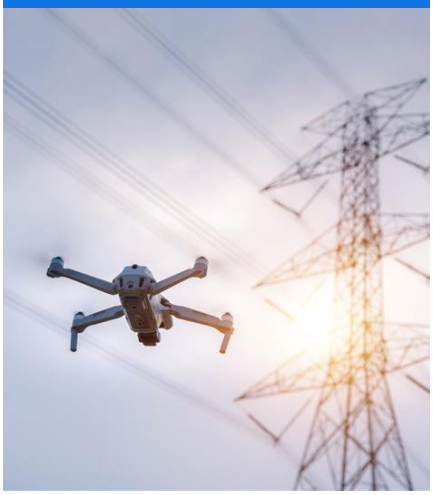
Video surveillance



Warehouse/storage spaces



Drone inspection



The licensed 2.5 GHz spectrum (Band 41) is particularly advantageous due to its larger bandwidth, enabling significantly faster speeds and capacity compared to lower bands. Band 41 also supports both outdoor and indoor systems, providing the flexibility required for diverse network deployments and applications.

Band 41 also benefits from a larger device ecosystem. For example, the GSA lists more than 10,381 devices available for Band 41, where about 57 percent relate to other form factors such as modules, modems, industrial-grade CPEs/ routers/ gateways, asset trackers, cameras, and tablet PCs.

In the event of no access to 2.5 GHz, utilities can consider shared spectrum options, such as the CBRS. CBRS supports 3rd Generation Partnership Project (3GPP)-based private LTE and provides a pathway to private 5G networks, ensuring a wide range of capabilities for mission-critical applications. This approach offers utilities the ability to scale their networks while maintaining operational reliability and performance.

On February 6, 2025, the FCC released an NPRM seeking comment on proposed updates to service-specific competitive bidding rules for the AWS-3 spectrum bands (1695 MHz to 1710 MHz, 1755 MHz to 1780 MHz, and 2155 MHz to 2180 MHz) that would harmonize the AWS-3 designated entity bidding credits. This NPRM is the first step toward an effective auction. Although this auction is not nationwide, it offers opportunities in some key areas that the utility sector can use. This band has a healthy ecosystem and favorable technical rules for macro mid-band FDD deployments. The spectrum availability varies by region from 5 MHz x 5 MHz to 10 MHz x 10 MHz.

Band 48 also benefits from an established device ecosystem. For example, the GSA lists more than 1,336 devices available for Band 48, where about 73 percent relate to other form factors such as modules, modems, industrial-grade CPEs/ routers/ gateways, cameras, and tablet PCs.

The FCC is also exploring uses for the Upper C-band, ranging from 3.98 MHz to 4.2 GHz. The commission will consider a notice of inquiry to explore multiple options to see how they could free up additional mid-band spectrum for new services in the Upper C-band.

Figure 2: Devices per category according to GSA (LTE bands)

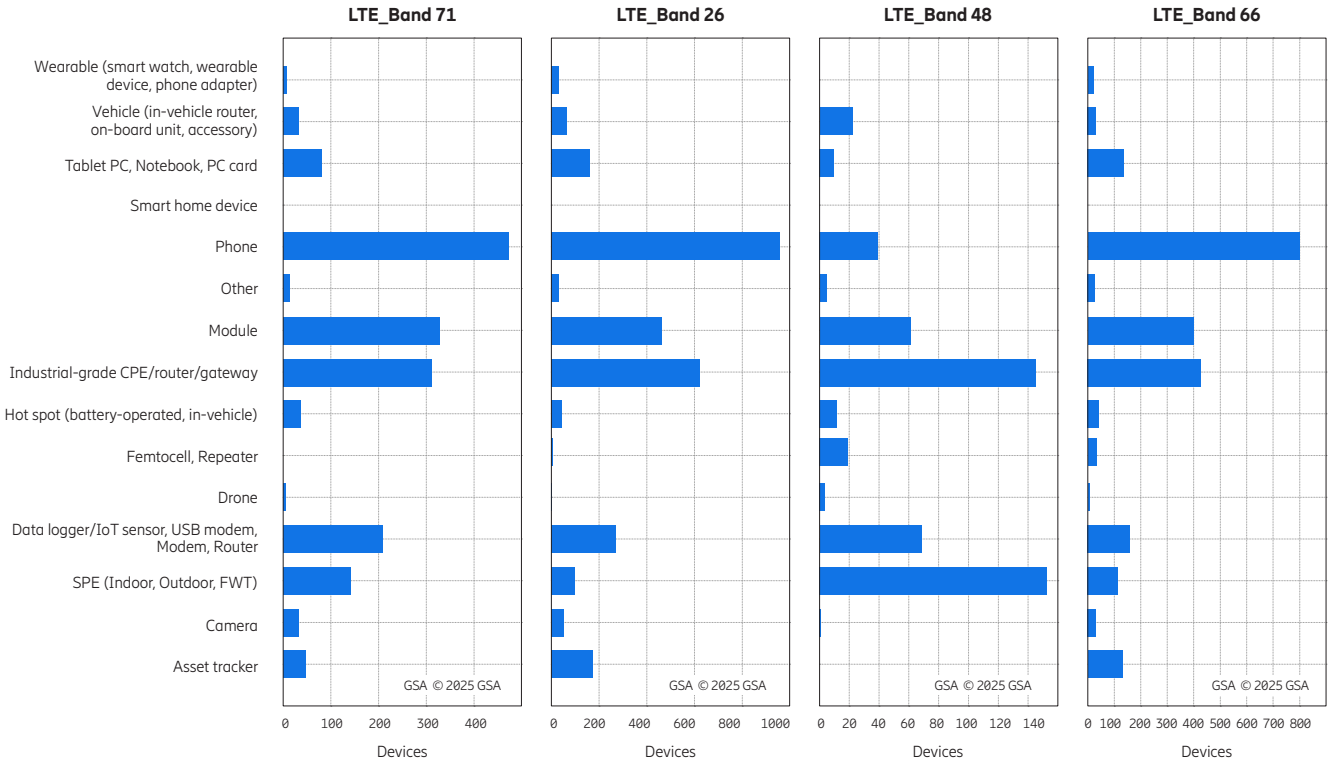
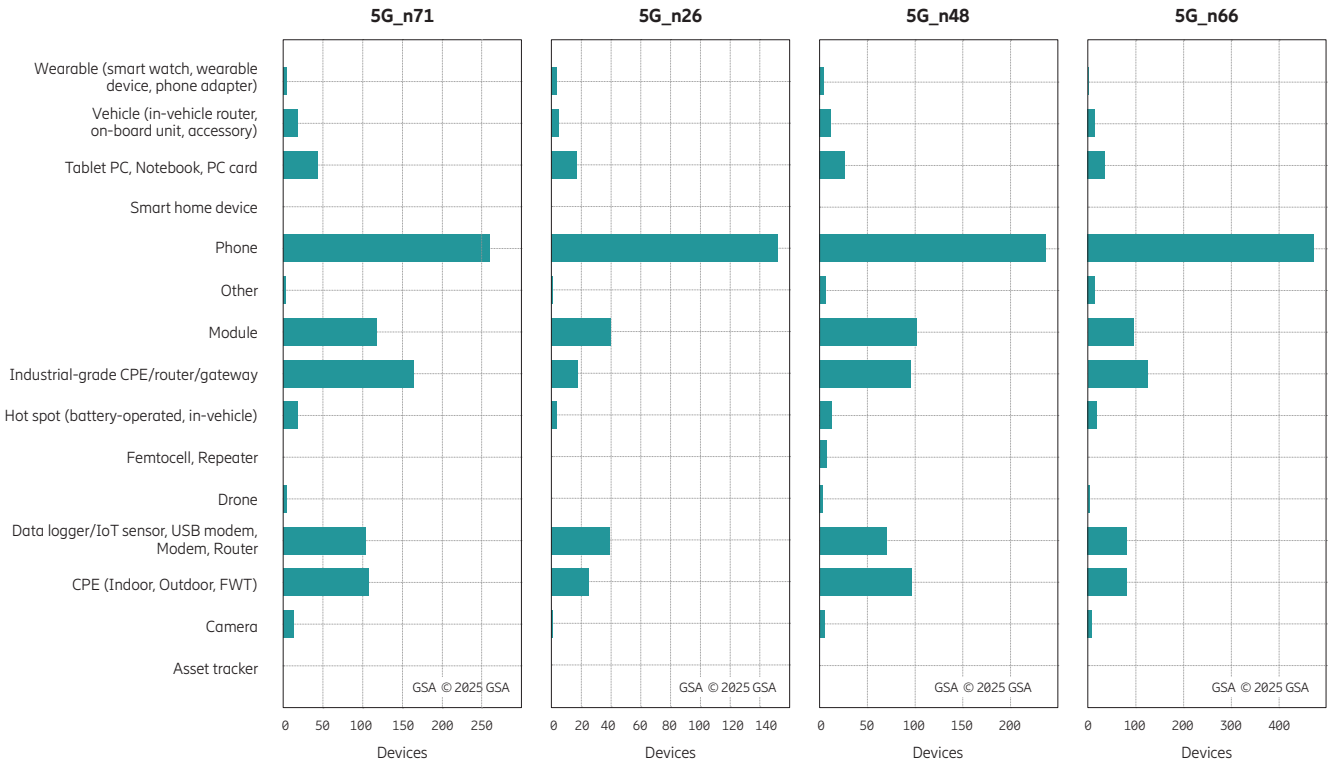


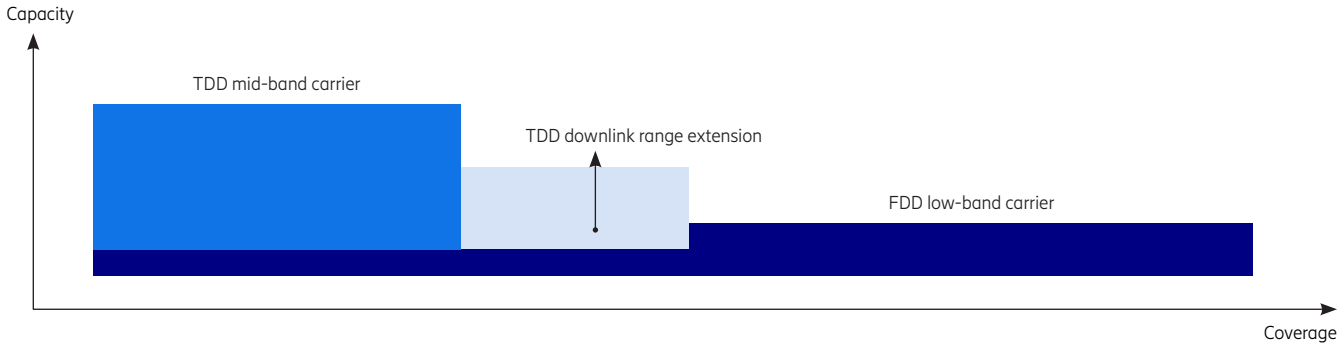
Figure 3: Devices per category according to GSA (5G bands)



The spectrum options presented are not comprehensive but are intended to illustrate the range of possibilities available.

Functionality to enhance spectrum usage

- **Carrier aggregation**
  Carrier aggregation (CA) in LTE is one of the most pivotal features, enabling up to five component carriers to be aggregated for a mobile terminal. It can assist private, mission-critical networks in boosting capacity and extending the reach of the mid-band frequencies by utilizing the low-band carrier as the anchor for uplink transmissions.
- **Roaming as a fallback option, partnership** with Communication Service Providers (CSP). As a strategic fallback, utilities can leverage roaming agreements with wireless operators as a secondary option while prioritizing private spectrum for mission-critical applications. Additionally, this approach can provide an extra level of resilience.



A strategic approach to spectrum optimization

We propose the following strategy to enhance spectrum utilization:

- Utilize low-band for coverage: Utilizing Band 106 and/or Band 26 for wide-area coverage of smart grid sensors and basic connectivity. This will enable efficient long-range connectivity for remote utility assets and control systems. Band 71 could be another alternative, if available.
- Supplement with mid-band: Use 2.5 GHz (Band 41) to add capacity in areas with higher data demands or for specific use cases requiring more bandwidth, like remote workforce data access.
- Consider licensed spectrum: For critical infrastructure, prioritize licensed spectrum to guarantee interference protection and quality.
- Leverage shared spectrum: Employ CBRS as a cost-effective way to augment capacity even further, or in case there is no or very limited 2.5 GHz license spectrum access.
- Evaluate and plan: Consider the availability of the device ecosystem and align strategic planning with current spectrum availability or plans for future access.
- Plan for future use of mmWave bands: As network infrastructure modernizes, prepare for the integration of mmWave spectrum (greater than 24 GHz) to support high-bandwidth applications.

When evaluating spectrum availability, consider the timeline required for spectrum clearance, any protection in place for incumbent users, or any coordination needed with other parties. The table below provides a summary of the current state of business for possible bands for utilities:

Utilities spectrum options		Spectrum bands								
		B71 600 MHz	**B106 900 MHz**	**B26 850 MHz**	**AWS-3 2.1 GHz**	**B41 2.5 GHz**	**CBRS 3.5 GHz**	**B77 (AMBIT) 3.45 GHz**	**B77 (C-Band) 3.7 GHz**	**B77 (Upper C-Band) 4 GHz**
Metrics	**Type**	Licensed	Licensed	Licensed	Licensed	Licensed	Shared/ lightly licensed	Licensed	Licensed	To be defined
	Coverage area	Macro-wide area	Macro-wide area	Macro-wide area	Macro-wide area	Macro-wide area	Limited coverage	Macro-wide area	Macro-wide area	Rules to be defined
	Availability	Limited, scattered Varies by country	Yes	Proposed	Auction 2025	Opportunistic Varies by country	Opportunistic Varies by country	Secondary market opportunities	Secondary market opportunities	To be auctioned
	Incumbent clearance	No	Yes 150 days after FCC filing	No	No	Overlay licenses	Incumbent at higher priority	Yes Coordination w/DoD in CPA's and PUA's	No	Yes NOI for expanded use
	Eco system	Good	Growing	Good	Good	Good	Good	Growing	Good	To be defined
	Bandwidth	5X5 MHz	3x3 MHz (NPRM 5X5 MHz)	7x7 MHz	5X5/10X10 MHz	10 MHz or more	10 MHz or more	10 MHz or more	20 MHz or more	To be defined
	Technology	LTE/NR FDD	LTE/NR FDD	LTE/NR FDD	LTE/NR FDD	LTE/NR TDD	LTE/NR TDD	NR TDD	NR TDD	NR TDD

By implementing this spectrum strategy, utilities can:
- modernize their grids efficiently
- improve security and reliability
- support a wide range of use cases from basic sensor connectivity to advanced applications
- ensure adequate coverage and capacity for future growth

Conclusions

A robust and complementary spectrum strategy is essential for utilities to meet the demands of a modernized grid. By effectively combining low-band spectrums (Band 71, Band 106, Band 26) with mid-band spectrums (CBRS PAL, Band 41, AMBIT, AWS-3, C-Band), utilities can build secure, efficient, and versatile communication networks. The unlicensed CBRS spectrum (GAA) can serve as an option, for example, to augment capacity when other licensed mid-band spectrums are unavailable or to increase the mid-band layer's capacity. This approach ensures utilities are well-positioned to support the grid of the future, addressing diverse coverage, capacity, and application requirements.

Given that the electric grid is a critical infrastructure, ensuring resilient and reliable communication is paramount to maintain operational continuity, security, and rapid response to disruptions. Utilities face unique challenges depending on their specific geographic regions. Rural areas demand extensive coverage over vast territories, while urban environments must handle high-density data traffic. Coastal or mountainous regions may encounter environmental constraints that impact network design, in addition to the spectrum options at hand.

A flexible spectrum approach allows each utility to customize its connectivity approach, considering these geographic and operational challenges, and ensuring that grid modernization efforts are both effective and sustainable. By utilizing a mix of licensed and unlicensed spectrum, utilities can enhance grid automation, enable real-time monitoring, and strengthen cybersecurity, ultimately protecting critical infrastructure while delivering reliable energy services to communities.

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Ricardo Omana is a product leader with more than 20 years of experience in the telecommunications industry. He has led business development and technical strategy across 5G evolution, Core, RAN, and 4G/5G Private networks. A trusted advisor within Ericsson's Regional Carriers, HCP, and Utilities team, Ricardo contributes to industry thought leadership while helping customers accelerate their digital transformation journeys.

He holds multiple master's degrees, including an MBA in International Management from the University of Texas at Dallas and a Master of Science in Business Analytics from Indiana University. He is currently pursuing a Master of Science in Data Science from Indiana University's Luddy School of Informatics, Computing, and Engineering to further his knowledge in AI/ML.

Acknowledgment

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[2] GSA – Global Mobile Suppliers Association

[3] Ericsson - Drivers for utilities to deploy mission-critical mobile networks

Glossary

AMBIT	America's mid-band initiative team (3.45 – 3.55 GHz)
AMI	Advanced metering infrastructure
AWS	Advanced wireless services
CBRS	Citizens broadband radio service
CPA	Co-operative planning area
CPE	Customer premises equipment
CSP	Communications service provider
DoD	Department of Defense
GAA	General authorized access
IoT	Internet of Things
NPRM	Notice of proposed rule making
PAL	Priority access licenses
PUA	Periodic usage area
GSA	Global mobile suppliers association

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