WHITE PAPER / **5G CELLULAR TECHNOLOGY**

UNDERSTANDING 5G IMPACTS ON UTILITIES AND PREPARING FOR SUCCESS

BY Matt Olson, PE

Fifth-generation (5G) cellular technology will dramatically increase the speed and capability of communications around the world. Utilities are in a unique position to benefit from 5G technological advances; they are critical in providing key services to establish the 5G network.

INTRODUCTION

According to the Ericsson Mobility Report, fifth-generation (5G) cellular communications technology adoption is growing at an even faster rate than expected. Subscriptions to 5G are expected to reach 1.9 billion, with 5G coverage reaching 45% of the global population by the end of 2024.

GSMA Intelligence projects that in the U.S. alone, 5G will reach 100 million mobile connections in 2023 and will be the central mobile network technology by 2025. If realized, the nation will undergo one of the fastest customer adoptions of 5G in the world.

As an enabler of everything from virtual reality to remote surgeries, the internet of things (IoT) to smart cities, it's easy to see why 5G technology adoption may be fast.

Utilities need to be ready to play an active part in providing the necessary infrastructure and support to help build out the network. In return, utilities can realize tremendous operational and efficiency benefits from using 5G technology in operations.

WHAT IS 5G?

Extremely high bandwidth to accommodate internet usage, high-density capability to handle online traffic, and ultra-low latency for faster, enhanced connections define and outline 5G's benefits. 5G reflects the advancement of wireless technology and, by definition, continues to evolve.

Generations of mobile network technology began in the 1980s when first-generation (1G) analog voice technology was introduced in car phones. A decade later, second-generation (2G) mobile communications moved to digital technology, adding texting capabilities in smaller phones. The 2000s presented a third-generation (3G) mobile phone that could play music, work as a camera and browse the internet as quickly as a desktop computer.

Smartphones were introduced later in the 2000s with fourth-generation (4G) technology that offered increased speed, sleeker design and mobile applications. Global speed and connection standards for 4G devices were established and referred to as Long Term Evolution (LTE), reflecting a substantial improvement in connectivity over 3G technology.

5G is the latest generation of mobile broadband, offering communication networks that are up to 100 times faster, support 100 times more devices and feature five times lower latency.

Projections for 5G technology are that it will provide the capability to support more data-intensive activities, more efficient industries and more immersive learning experiences. Because of its increase in speed and breadth of deployment, coupled with dramatically reduced latency, the use cases for 5G will continue to be defined for years to come.

Source: Ericsson

RIDING THE MILLIMETER WAVE

Available radio wave spectrums are filling up from hosting mobile devices, HAM radio, broadcast television and other communications. 5G uses different sections of the electromagnetic spectrum and will help open up bandwidth capacity in major metropolitan areas.

Radio spectrum bands in the U.S. have distinct characteristics, cover an enormous range and vary in their potential for supporting 5G technology:

- Low-band spectrum is the sub-1 GHz spectrum and includes 600 MHz, 800 MHz and 900 MHz. With longer wavelengths, the low-band range allows for robust signals that can travel long distances, but it is congested and offers lower speeds.
- Midband spectrum includes 2.5 GHz, 3.5 GHz and 3.7-4.2 GHz. What the midband gains in bandwidth, it loses in transmission distance, and it is hindered by buildings and obstacles. Additional technologies, such as beamforming that uses antennas to amplify the signal, can be used by 5G service to improve performance.
- High-band spectrum (also known as Millimeter wave or mmWave) jumps to 24 GHz, 28 GHz, 37 GHz, 39 GHz and 47 GHz ranges. The mmWave offers larger bandwidth and delivers significant speed benefits, but it has a lower coverage area and poor building penetration.

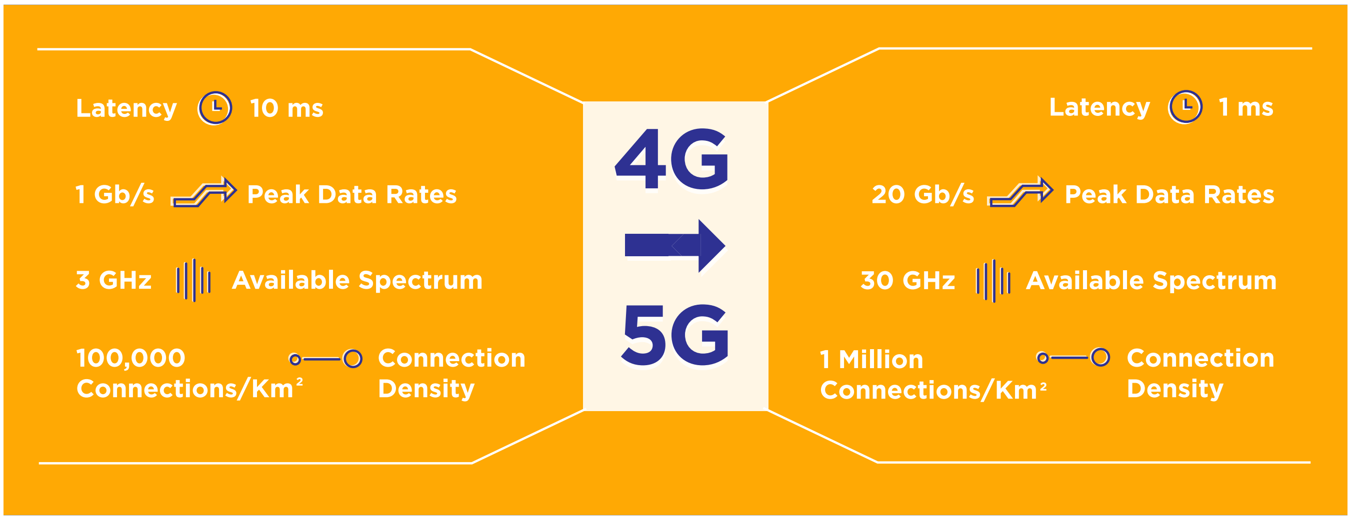
While 5G uses the low- and midband spectrums to offer incremental improvements, it is the potential of mmWave that enables 5G wireless to deliver unprecedented wireless speed.

THE 5G IMPACT ON UTILITIES

The impact of 5G on utilities is twofold: the immediate need to provide the infrastructure and support to enable 5G networks, and understanding the impact of 5G on utility operations.

TERMINOLOGY AND 5G STANDARDS SNAPSHOT:

- **Cellular technology** is the use of radio waves to send data to mobile devices, including phones, from cells mounted on cell towers. Each "generation" of cellular devices uses improved radio technology to boost speed and performance.
- **Small cell technology** features small-sized cellular radios mounted on a light posts, towers, buildings or other tall objects to receive and transmit 5G signals to a cellular communications carrier.
- **Generational standards** refer to the evolution of cellular communications technologies. Third generation (3G) was used in mobile phones through 2012 but not unified under a global standard. Fourth-generation (4G) technology was used in mobile phones until 2018, when the 4G Long Term Evolution (LTE) standard boosted data speeds. Fifth generation (5G) is the latest iteration of cellular technology engineered to increase speed, bandwidth and responsiveness of wireless networks.
- **3rd Generation Partnership Project (3GPP)** is an initiative composed of seven telecommunication associations from Asia, Europe and North America, along with other organizations, to serve as a standards organization for mobile technologies, including 5G.
- **Release 15** is 3GPP's finalized version of the global 5G new radio (NR) standard, primarily focused on enhanced mobile broadband (eMBB) services and making 5G a commercial reality. Future 3GPP releases will continue to further expand 5G standards to support capabilities.



INFRASTRUCTURE SUPPORT

While mmWave is the key innovation for 5G performance to carry much more data at higher speeds, the spectrum has a shorter range. Some part of the 5G network will require installing new equipment of differing shapes and sizes on existing towers and structures, plus a robust fiber-optic network.

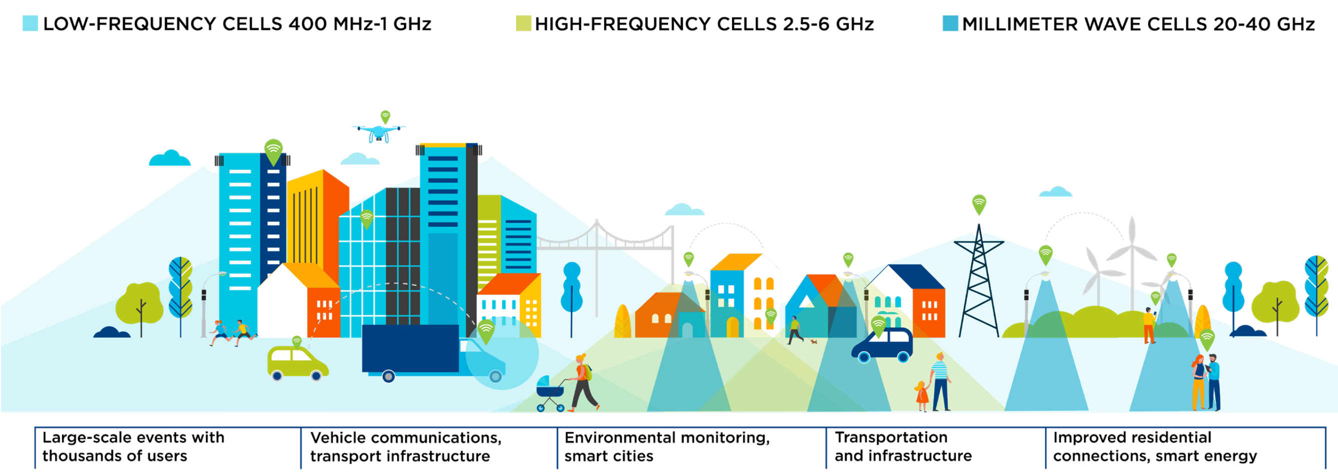
Likewise, telecommunication companies will need many smaller cells and antennas to be mounted closer together, instead of relying on large cell towers.

Charter Communications has estimated that 800,000 new small cells will need to be installed by 2025 to support 5G. These new installations, along with the other antenna requirements and ancillary installations, require coordination with and considerable support from utilities.

With the Federal Communications Commission (FCC) guidelines, utilities are under pressure to manage and execute installation applications within set timeframes and fee structures to support the ushering in of 5G technology.

5G CONNECTED SERVICE TYPES

5G application ideas continue to emerge, and many more will not be identified until after deployment and adoption. However, utilities should become familiarized with the



common use case groups that have emerged and convey the potential of 5G connectivity:

- **Enhanced Mobile Broadband** (eMBB) is about exceptional download and upload speeds, broadband access in crowded areas and immersive viewing experiences, all without a Wi-Fi connection but with the need of many small cells installed near each other. While a boon for consumers and broadcasters, eMBB opens up benefits for utility operations such as rapid firmware updates and images to remote equipment and critical security updates for smart meters.
- **Massive Internet of Things** (mIoT) makes possible the connection of a huge number of embedded sensors and low-complexity devices using efficient, lower-power protocols. Utilities will be able to leverage mIoT to monitor and control a vast number of devices and equipment, such as pipelines and water flows, in addition to smart meters, at lower cost, faster and more reliably.
- **Massive Machine Type Communications** (mMTC) will bring millions of connected devices and sensors online that will allow machines, devices, instruments and equipment to autonomously communicate with each other. Less dependent on low latency, mMTC will offer long battery life and leverage low-power wide area (LPWA) technologies already deployed using 4G networks, such as narrowband IoT(NB-IoT).
- **Ultra-Reliable and Low Latency Communications** (uRLLC) will provide some of the most impactful upgrades and new service capabilities for utilities. Suitable for mission-critical communications and applications, uRLLC will replace legacy technologies, such as handheld, push-to-talk devices, and deliver roundtrip latency in the 1-millisecond range. Remote monitoring, control and real-time reactivity of critical utility infrastructure are possible. Monitoring, protection and security of utility assets, plus connectivity of millions of networked devices, is expected to be both simplified and cost-effective.

PREPARING FOR 5G

Utilities must be prepared for how the impending volume of 5G infrastructure installation requests will be handled and which processes will be used to manage resources.

5G, PRIVATE NETWORKS AND UTILITIES

Utilities have different strategies, priorities and communication needs that are not ideally suited for using commercial networks and service providers. Using 5G for a dedicated communications network can provide utilities with new ways to optimize services and enhance security:

- **Staff safety.** During system outages, emergencies and routine operations, private networks give crews greater real-time insight into system conditions. More powerful monitoring and control help staff diagnose, isolate and repair issues remotely.
- **System visibility.** Direct ownership of a private network provides 24/7 visibility into all aspects of operations, outages, issues and the health of assets.
- **Uptime and availability.** During emergency situations, private networks provide immediate insight into service availability, enabling faster decisions and quicker solutions that help get services back online.
- **Strategic planning.** By owning the private network, utilities can better control investments, scheduling and life cycle costs of communication assets, as well as prioritizing service response needs and proactively administering network maintenance.

At the same time, utilities need to dedicate strategic thought to identify 5G capabilities and evaluate how this technology will be used in the future.

PROACTIVE PROCESSES

To manage the permits, paperwork, applications and requests to support the infrastructure needs for 5G, utilities need to prepare processes now. In the past, many utilities only received a few requests each month for pole attachments (access by non-pole-owning service providers to a utility's poles for installing fiber, cable or other equipment). Now, utilities need to brace for what could be hundreds of pole attachment requests during the same period.

FCC guidelines help to accelerate 5G installations, which will affect internal resources and obligate utilities to comply in accommodating infrastructure changes.

Utilities will need to consider how to proactively work with telecommunication companies to implement changes and streamline requests. They will evaluate existing geographic information system (GIS) data to create online maps that identify poles and assets available for installs and, likewise, flag those that will not be approved for use. To streamline applications and meet service needs, utilities can create a system that matches electrical service, fiber-optic connections and small cell requests against established standards and pre-approved locations to expediting responses.

OPERATIONAL PLANNING

While it can be difficult to plan for many of the yet-unknown advances and efficiencies that 5G will make possible for utilities, interested parties must stay alert of the potential of this technology.

Exploring opportunities, networking with other providers and staying connected with industry groups can help increase understanding of 5G and its possible use cases. A task force can be set up, or a point person identified, to gather information and stay abreast of this topical area.

Stakeholders should take time to think about the impacts, explore the potential applications of 5G and examine how these may affect efficiency, necessitate operational changes and even require new pricing structures. They should consider other initiatives and needs, including distributed generation and electric vehicles, to identify how a more robust communication network can increase efficiency and service levels.

Within this fast-moving market dynamic, utilities should evaluate how existing 3G and 4G networks can be used to meet immediate needs while preparing to onboard 5G advantages as coverage becomes available. A multimode approach will help future-proof investment and position organizations to be prepared.

CONCLUSION

5G technology offers the potential for remarkable change to how we all live and work. Utilities are an important part of the establishment of 5G networks, through the approval and installation of supporting infrastructure, but are also in position to take advantage of the new communication advances. Utilities must evaluate how to support — and benefit from — this new technology.

BIOGRAPHY

MATT OLSON, PE, is the projects director for the Networks, Integration & Automation department at Burns & McDonnell. In this role, Matt oversees the execution of telecommunications and automation projects within the transmission and distribution business. His team is dedicated to modernizing the grid by building converged OT and IT networks and automating substations and distribution feeders in a secure and reliable manner for electric utilities. These networks are for critical utility applications for automation, SCADA and protective relaying. In his nearly 20 years in this business, Matt has focused on application designs for critical, real-time applications to support protection, control and automation of the substation and field area networks, including fiber and wireless design, in addition to LAN and wide area routing and switching. Matt earned a Bachelor of Science and Master of Science in electrical engineering from the University of Tulsa and is a registered engineer in Kansas and New Jersey.

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