**White Paper**

# LTE: A Flexible Platform for Grid Management, Smart Lighting, and Smart City Applications

**Legacy AMI Networks Can Be Limited for Next-Generation Applications**

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# Introduction

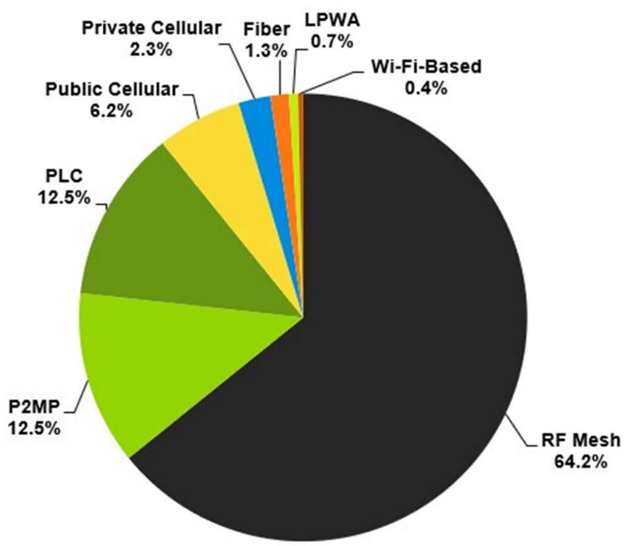
For more than a decade, power utilities across the US have raced to deploy advanced metering infrastructure (AMI), also known as smart meters. Spurred by the measurable cost benefits of eliminating human meter readers and the financial incentives provided to utilities in the American Reinvestment and Recovery Act of 2009, nearly 75% of electric meters across the country are served by smart meters. Guidehouse Insights expects that penetration level will approach 93% by 2030.

The majority of this installed base uses unlicensed radio frequency (RF) mesh technologies (Chart 1), but as utilities seek to layer new capabilities on these field area networks, legacy systems designed for meter reading and billing purposes (and funded by ratepayers) are not always ideal.

To meet safety, efficiency, and resiliency goals, utilities require greater visibility and lower latency control at the grid edge more than ever before. At the same time, industry transformation and new opportunities (and threats) are making the need for more robust and flexible connectivity throughout the distribution grid clear.

This Guidehouse Insights white paper explores how grid management, smart streetlighting, and smart city applications that utilities increasingly need or want to offer should no longer rely on legacy AMI networks for connectivity. It also explains why LTE-based wireless solutions—public or private—can provide grid-edge connectivity and support a multitude of emerging functions in a more cost-effective, flexible, and future-ready manner.

***Chart 1 Installed Base Electric AMI Network Protocols, US: Year-End 2022***




*(Source: Guidehouse Insights)*

# Edge Networking for Utilities Spans Grid Management, Smart Streetlighting, and Smart City Applications

Legacy AMI systems were designed to read meters and feed consumption data into centralized billing systems. However, once those networks were in place, many utilities began exploring new applications that could be layered on top, such as distribution automation or smart streetlighting applications. In some cases, low bandwidth smart city sensors (e.g., temperature, weather, water level sensors) were integrated with AMI networks.

But the smart metering networks used by most utilities were not designed for applications requiring higher bandwidth or lower latency. Particularly as advanced streetlighting control systems emerge as a platform in support of more demanding grid management and smart city functions, the need for utilities to delineate their AMI network strategies from other grid-edge connectivity needs is growing.

## AMI vs. Smart Streetlighting: The Past Is Not Prologue

Early smart lighting systems were integrated with legacy utility AMI networks for several reasons—most notably that the network was already paid for and in place. Early lighting control systems did not generate a large amount of data; latency requirements were not stringent; and the rate-based AMI network was eligible for use where streetlighting controls were part of a regulated offering. Also, adding lighting nodes to the mesh densified the network, improving the reliability of AMI data transmission. This collaboration between the metering and lighting organizations within a utility was logical, cost-effective, and mutually beneficial.

As of 2022, however, more sophisticated lighting control systems are widely available. They offer much greater functionality but require higher network bandwidth and lower latency. Efforts to build these more capable systems on top of existing AMI networks can create capacity constraints, forcing new investment in the AMI network or resulting in not prioritizing the lighting system traffic. These effects in turn limit the value and benefits of the advanced lighting control system—which can be significant.

## Advanced Streetlighting Offers a Robust Smart Cities Platform

With more than 50% of streetlights in the US under utility ownership, utilities are important players in the development of modern, energy efficient streetlighting. A growing number of utilities are recognizing the benefits of deploying LED lighting—which can cut energy costs in half—and implementing a connected streetlighting platform at the same time. These systems can enhance customer services, meet the energy and emissions goals of states and municipalities, and improve utility bottom lines by extending the life of the fixture and reducing maintenance costs. These systems can support a multitude of non-lighting solutions in an equally significant way, creating a ubiquitous platform for utility grid management and smart city applications.

Whether to use an existing AMI communications network is a significant consideration for utilities undertaking streetlighting upgrades. Although the AMI network is already in place, as Georgia Power has noted, “The existing AMI system is the revenue engine for the company. Any possible disruption is unacceptable.” Georgia Power, part of Southern Company and serving the greater Atlanta region, has implemented a separate network for smart lighting. The company notes that although a dedicated network increases overall project cost, it delivers a range of benefits “that easily justifies the additional spending.”

**The Benefits of Advanced Streetlighting Controls and Networks**

At the most basic level, lighting controls provide features such as remote on-off control, dimming, and scheduling functions. But with intelligent controls, a wide range of advanced functions are enabled, including the following:

- **Energy monitoring and billing:** Accurate information on energy consumption is an important element in reducing energy costs. In addition, as streetlighting becomes part of a more complex electricity system, accurate and real-time information on energy usage become more important for grid optimization and management. Some smart lighting solutions offer energy monitoring on the line side of the luminaire, which provides additional benefits of circuit monitoring and reporting.
- **Performance monitoring:** One of the most cited benefits of a networked streetlighting system is the ability of a manager to remotely monitor outages. This feature eliminates time spent on nighttime patrols to identify malfunctioning lights and ensures that problems can be fixed in a timely manner. Emerging dimming standards, such as Digital Addressable Lighting Interface 2, are creating new datasets that allow comprehensive asset management capabilities through the smart lighting controller.
- **Color controls:** Early LED lighting deployments were associated with a monotone, even harsh, light, but modern LED lights can be adjusted to select the color temperature of the white light provided by streetlamps. For example, lighting may be adjusted for public safety purposes, to fit with special events, or for the different needs of retail or business districts. Recent developments in full color tuning allow even greater control of illumination, allowing a broad range of color and temperature options.
- **Adaptive lighting:** Sensors that monitor local conditions can enable networked systems to adapt the brightness of streetlighting as necessary. For example, linking light controls to traffic volumes can provide considerable energy savings. If no traffic is present or traffic volume is low, then full brightness streetlighting is not necessary. Similar motion detectors can enable lighting levels to match street activity. Weather sensors can also enable adaptation to rain, snow, or other conditions. For example, lights may be turned up during rain showers and back down when the weather clears.
- **Emergency response:** Networked streetlighting systems give city managers a number of features for dealing with public safety issues and emergencies, such as flashing lights in front of a house that emergency workers are attempting to find or brightening lights at an accident or crime scene. Other common applications include the use of adaptive light controls to provide warnings to drivers in school safety zones.
- **Smart city sensor connectivity:** In addition, advanced lighting control networks have the potential to support a range of non-lighting applications as part of the broader deployment of Internet of Things (IoT) solutions for smart cities. These lower bandwidth sensors include air quality, water level, wind speed and direction sensors, etc., that can be connected on any street pole where there is a streetlight controller.

**Smart City Platform Applications**

Beyond the capabilities for advanced lighting control, streetlighting networks have the potential to support a range of narrowband to broadband non-lighting applications that include:

- **Traffic monitoring:** Traffic sensors connected to streetlighting can provide more accurate and flexible monitoring of traffic and congestion levels.
- **Smart parking:** Streetlighting networks can provide the network infrastructure for parking sensors embedded in parking spaces or the location to mount video cameras that use vehicle detection software to provide occupancy information.
- **Gunshot detection:** Gunshot detection systems can be deployed on lighting poles and use the network to transmit information on detected events to the operations center. Advanced systems can provide precise information on the specifics of the event, including the shooter's location and even integrated video monitoring.

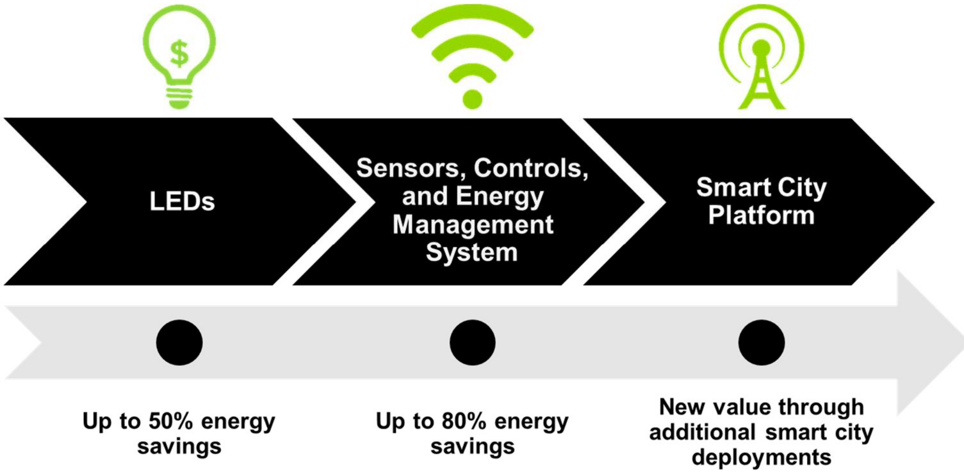
These applications may be deployed using sensors attached to the streetlighting controls. An even wider range of applications is enabled by sharing the same network infrastructure—if that network is robust. These applications include the following:

- **Traffic light controls:** Traffic lighting that is adaptive to congestion levels, weather conditions, accidents, or other events can improve traffic flow and reduce travel times, fuel consumption, and pollution.
- **Smart waste management:** Sensors in trash bins and dumpsters can provide data to optimize waste collection and to identify problems from overfilling. Waste sensors can use a common network to relay data to the waste management team to help them plan collection routes.
- **Public messaging/digital signage:** Public information networks span a range of devices, including traffic and parking information panels, public information broadcasts, and dedicated kiosk services. Linking public information to real-time urban monitoring systems such as smart parking systems provides more accurate and timely information. A common network also enables the relaying of public information through a range of devices including smartphones or in-car systems.
- **High definition (HD) video surveillance:** Many communities are using closed-circuit TV (CCTV) to provide video monitoring for traffic management and public safety. The bandwidth requirements for HD video traditionally require a fixed broadband network, but high bandwidth wireless networks are increasingly capable of supporting such applications.

*Many of these desired smart city applications must be delivered by utilities as an unregulated service. These use cases and bandwidth requirements are incompatible with regulated AMI networks.*

This vision of the lighting network as a smart city platform (Figure 1) enables deployment of a range of innovative solutions that can save and raise money, keep residents safe, improve sustainability, and attract new residents and businesses. Many of these desired smart city applications must be delivered by utilities as an unregulated service. These use cases and bandwidth requirements are incompatible with regulated AMI networks.

***Figure 1 The Evolution of Smart Streetlighting in Smart Cities: From LED Lighting to Networked Controls and Smart City Platforms***




*(Source: Guidehouse Insights)*

As Figure 2 demonstrates, the breadth of smart lighting and city applications requires a range of bandwidth capabilities that cannot be met by a single AMI network. In most cases, applications requiring broadband capacity would not be satisfied by legacy AMI networks. Only narrowband and a few of the medium bandwidth applications would be tolerated by an operational AMI network.

***Figure 2 Network Bandwidth Requirements for Smart Lighting and Smart City Applications***

| Network Technology | | |
|---|---|---|
| **Narrowband** | **Mediumband** | **Broadband** |
| • Basic lighting controls<br>• Environmental monitoring | • Basic lighting controls<br>• Environmental monitoring<br>• Advanced lighting controls<br>• Traffic monitoring<br>• Smart parking<br>• Waste management<br>• Digital signage<br>• Gunshot detection | • Traffic light controls<br>• HD CCTV<br>• Public Wi-Fi |

**Low Cost** ← → **High Cost**

*(Source: Guidehouse Insights)*

Figure 3 provides additional detail on the costs and networking requirements for system reliability, security, power, latency, and bandwidth for each of the smart city applications discussed. Note that a low requirement for latency indicates that low latency (i.e., high transmission speed) is not an important attribute for that application. Also, the more applications that a utility/city wants to offer across the network, the greater the demands will be on that network. Although traffic monitoring, smart parking, waste management, and air quality monitoring all have low bandwidth requirements individually, a community that wants all of these applications would require the utility provider to operate a higher capacity network.

***Figure 3 Smart City Applications: Communications Requirements and Expectations***

| Application | Upfront Cost Expectation | Ongoing Cost Expectation | Reliability Requirement | Security Requirement | Power Requirement | Latency Requirement | Bandwidth Requirement |
|---|---|---|---|---|---|---|---|
| **Basic Lighting Controls** | Low-Medium | Low-Medium | Medium | Medium | Very Low | Very Low | Very Low |
| **Advanced Lighting Controls** | Medium | Medium | Medium-High | Medium-High | Low-Medium | Low-Medium | Medium |
| **Environmental/Air Quality Monitoring** | Medium | Low-Medium | Medium-High | Medium | Low | Low | Very Low |
| **Traffic Monitoring** | Low-Medium | Low-Medium | Medium | Low-Medium | Low | Low | Low |
| **Smart Parking** | Medium | Low | Medium-High | Medium | Medium | Medium | Low |
| **Waste Management** | Medium | Low | Medium-High | Medium | Low-Medium | Medium | Low |
| **Traffic Light Controls** | Medium-High | Medium | High | High | Medium-High | High | Medium-High |
| **Public Messaging/ Digital Signage** | Medium | Medium | Medium | Medium-High | Medium-High | Low-Medium | Medium |
| **Gunshot Detection** | Medium | High | High | Medium-High | Low-Medium | Medium | Low-Medium |
| **HD CCTV** | High | High | High | High | High | High | High |

*(Source: Guidehouse Insights)*

**Additional Grid Management Applications Enabled by Advanced Lighting Control Networks**

Beyond the direct smart streetlighting and smart city benefits made possible by decoupling AMI networks from advanced lighting control networks, additional grid management capabilities may be enabled:

- **Demand response via lighting:** The utility can dynamically lower light output during a peak load event to provide an automated demand response solution.
- **Volt/volt-ampere reactive support:** The advanced lighting control network solution can provide line-side voltage readings at the fixture with enough accuracy and low enough latency to detect a dynamic voltage sag on a circuit. This ability allows for automatic activation of upstream capacitor banks to improve voltage quality.
- **Pole and fixture monitoring:** The network can detect pole or fixture tilt and vibration to determine pole movement, improper fixture installation, or pole footing damage.
- **Distribution grid asset monitoring:** This application includes monitoring of utility assets such as distribution transformers or non-lighting poles and structures.

## Other Considerations

Throughout the US, many cities do not own their streetlights. Rather, they may pay a fixed fee per light to the utility that owns and manages those assets. Therefore, cities may be unable to receive the benefits of dimming or other smart streetlighting features. This situation has led to a growing trend of municipalities buying their streetlight assets from utilities, especially if they feel that their utility is slow to adopt new technology.

*Utilities have an opportunity to provide valuable smart lighting and city services to communities if they invest in appropriate technologies, including future-proof networking.*

For example, in 2019, the city of Syracuse in New York acquired all 17,500 streetlights in the city from National Grid (NG) and is implementing an aggressive program to become an early adopter city for 5G connectivity by working with New York Power Authority and Verizon. Some state public utilities commissions have also begun to change the tariff structure by which utilities charge for streetlighting. In Colorado, for example, cities can be billed based on actual electricity consumption rather than a flat rate per light. Utilities have an opportunity to provide valuable smart lighting and city services to communities if they invest in appropriate technologies, including future-proof networking.

*Utilities should not stress these critical cash register systems by loading them up with non-AMI functions.*

Most AMI networks were not designed nor optimized (in terms of throughput and latency) for these grid management, smart lighting, or smart city functions. Utilities should not stress these critical cash register systems by loading them up with non-AMI functions. Rather, they should invest in networks that can support intelligent grid and smart city services.

# LTE-Based Networks Offer Advantages for Utilities

LTE-based networks, built on 3rd Generation Partnership Project (3GPP)-defined protocols, have become the global standard for wireless networking for voice and data applications, including industrial IoT and smart city functions. They also provide the basis for future 5G systems, which promise to enable a plethora of new and more advanced capabilities from which utilities and their customers are expected to benefit. Furthermore, LTE-based networks can be sourced from public carriers or built in a privately owned model.

## Leverage a Carrier Network

Historically, utilities have often been reluctant to rely upon public carrier networks. Pricing for data traffic and the SIM cards themselves could be high, and more importantly, utilities feared inadequate service level agreements (SLAs) or lack of prioritization during times of crisis—when a utility needs connectivity the most. Utilities were also wary of equipment obsolescence due to generational upgrades that could lead to stranded assets and costly rip and replace scenarios.

*LTE-based wireless solutions—public or private—can provide grid-edge connectivity and support a multitude of emerging functions in a more cost-effective, flexible, and future-proof manner.*

With 4G LTE and emerging 5G networks, industrial IoT overlays such as LTE narrowband-IoT (NB-IoT) or LTE Cat M1 can be done using software-defined networking that maintains backward compatibility with previous generations. With existing robust carrier networks and commitment for significant ongoing network investments, mobile operators are eager to serve industrial verticals such as utilities with competitive pricing and SLAs.

The security and uptime of carrier networks are robust and allow utilities extreme deployment flexibility. They offer true plug and play capability and deployment of nodes anywhere in their service territory due to nearly ubiquitous coverage. Carriers are generally able to serve the more rural parts of a utility's service territory as well as they serve the urban areas.

## Build a Private LTE Network

Several large investor-owned utilities (IOUs) are building out their own private LTE (PLTE) networks to consolidate what may be several dozen application-specific legacy networks. Currently, utilities may be maintaining different networks with different capabilities for applications ranging from metering to mobile workforce networks, SCADA networks, sensor networks, and more. Ameren, an IOU serving Illinois and Missouri, is planning to consolidate 20 separate networks with a single PLTE network. It will build the network on 900 MHz spectrum it has leased from Anterix (see below).

*Ameren, an IOU serving Illinois and Missouri, is planning to consolidate 20 separate networks with a single LTE network.*

Utilities may have a variety of wired and wireless, public and private systems performing different functions and aging out on differing schedules. For efficiency reasons in addition to a desire for a more holistic, future-proof strategy, PLTE is receiving growing interest from utilities as a way to cost-effectively and reliably serve a multitude of functions across an organization. Furthermore, new spectrum options are becoming available to utilities in the US, making PLTE a more viable long-term option.

There are two primary spectrum options for PLTE deployment in the US: citizens broadband radio service (CBRS) and 900 MHz spectrum owned by New Jersey-based Anterix:

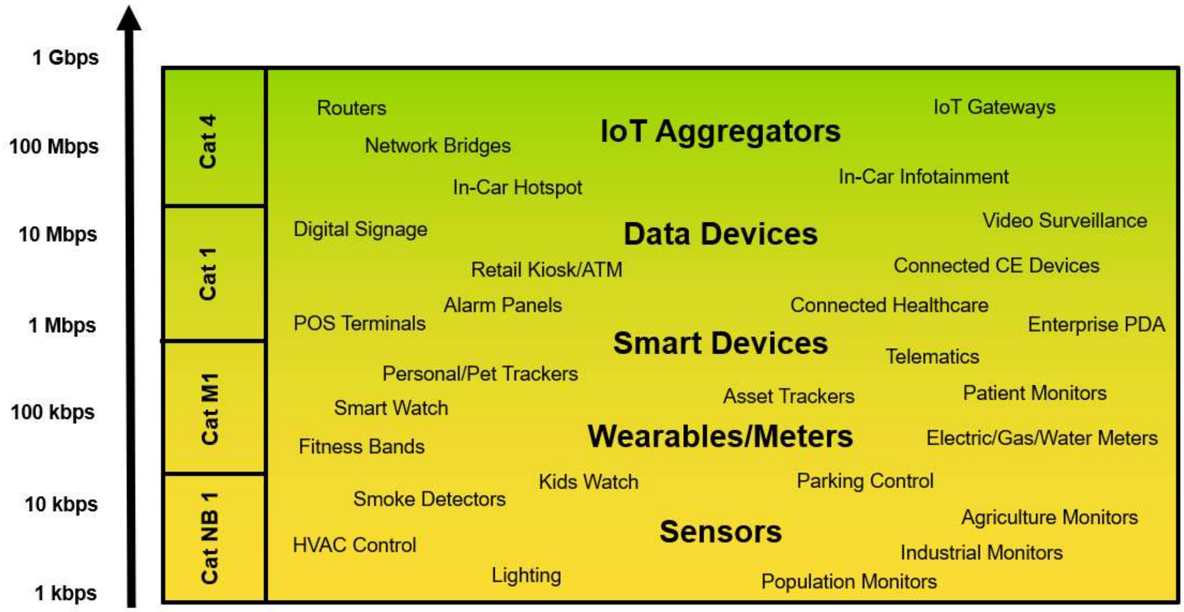
- **CBRS:** CBRS refers to 150 MHz of spectrum in the 3.5 GHz to 3.7 GHz band that the Federal Communications Commission (FCC) has designated for sharing among three tiers of users: incumbent users, priority access license (PAL) users, and general authorized access users. The incumbent tier is reserved for grandfathered users that had traditionally used the band, including the Navy as well as commercial fixed satellite stations. The PAL tier is for users that purchased spectrum licenses at auction in 2020. Numerous utilities acquired PALs for PLTE purposes, including Southern California Edison and San Diego Gas & Electric.
- **Anterix 900 MHz:** In May 2020, the FCC voted to approve usage of 6 MHz of 900 MHz spectrum for private networking by utility companies in the US. The 6 MHz is split between two 5 MHz holdings at 897.5-900.5 MHz and 936.5-939.5 MHz, previously designated for narrowband communications. These tranches are available for broadband licenses on a county-by-county basis and license owner Anterix is actively marketing them to the utility industry. Anterix holds 900 MHz spectrum in the mainland US, as well as in Hawaii, Alaska, and Puerto Rico. Its goal is to license 900 MHz spectrum and supply 900 MHz solutions to the utility sector to drive grid modernization, supporting the integration of renewable energy sources and other innovations.

## The Many Flavors of LTE

Infrastructure vendors, cellular service providers, and standards bodies worldwide have coordinated to develop several LTE-based specifications. In addition to broadband LTE protocols (used by smartphones today), LTE Cat 1, LTE Cat M1, and NB-IoT are relevant to intelligent grid, smart lighting, and smart city applications. Major carriers in the US offer all of these protocols.

Modem module manufacturers support multiple LTE protocols for global deployment. In addition, utilities can install an LTE-based intelligent grid, smart lighting, and smart city platforms and configure them with eSIM over-the-air for various mobile operators or their own PLTE network without having to change out the node hardware. Thus, LTE provides several options, based on the data latency and payload requirements of the device or application, whereas RF mesh, or AMI networks in general, have a specific low bandwidth allocation that limits what lighting control or IoT device applications can be supported. Figure 4 presents the data speeds and suggested applications for each LTE standard; descriptions of the basic attributes and use cases of each of the LTE-based network standards follow.

***Figure 4 LTE Applications by Category***




*(Source: Guidehouse Insights, Sequans)*

**NB-IoT**

NB-IoT, also known as Cat NB 1, operates at sub-gigahertz frequencies with the goal of provisioning low data devices and sensors with low power requirements. It can operate in all carrier frequencies and is expected to have the lowest cost and throughput of LTE-based networks. NB-IoT may be the most efficient choice for low data rate stationary devices that do not require low latency.

**LTE Cat M1**

LTE Cat M1 consumes more power than NB-IoT, but the protocol offers better downlink performance and interference immunity. LTE Cat M1 is appropriate for more battery-sensitive sensor or device needs, but it still has enough bandwidth for low latency communication and mobile devices. Most modems combine Cat M1 and NB-IoT into one module.

**LTE Cat 1**

LTE Cat 1 technology is suitable for many types of IoT/machine-to-machine applications. It offers broadband capabilities in more affordable packages than 4G. Also, LTE Cat 1 with throughput speed capped at 10 Mbps requires significantly less power than traditional 3G or 4G cellular nodes. Cat 1 may be appropriate for utility applications that need more robust throughput and lower latency.

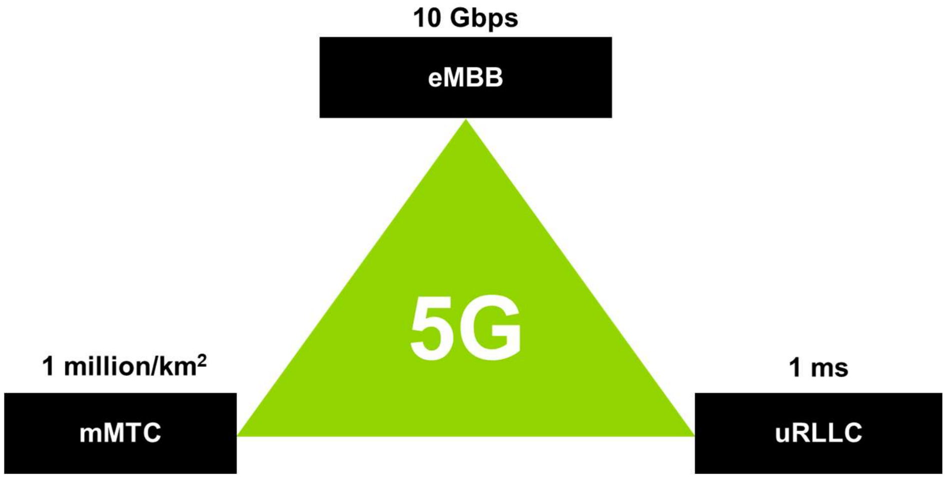
**4G LTE and 5G**

4G LTE is a broadband wireless network offering latencies as low as 10 milliseconds (ms) and bandwidth adequate for even the most demanding video applications. 4G LTE is used by public wireless carriers around the globe serving billions of customers. As a result, a large ecosystem of manufacturers and vendors exist, and economies of scale for equipment and software systems have already been achieved.

Furthermore, the next generation of wireless technology—5G—is an evolutionary overlay to existing 4G LTE networks. These new standards will allow for public and private LTE network operators to transition to 5G networks in an incremental fashion. This ability eliminates the obsolescence issue that has plagued industrial users of cellular technology in the past and enables high bandwidth solutions in the future.

The transition from 4G to 5G is expected to be more gradual than previous evolutions in cellular networks, with greater sharing of infrastructure and easier switching between service levels. 5G is anticipated to be a radically disruptive technology that not only delivers on the promises of early mobile technologies but also ushers in new uses and applications for utilities and cities.

***Figure 5 The Three Legs of 5G Networks***




*(Source: Guidehouse Insights)*

5G is not a single set of solutions. Rather, it encompasses a broad family of technologies that will provide enhanced services aimed at diverse requirements. The promise of 5G is commonly represented by three main pillars, as Figure 5 shows:

- **Enhanced mobile broadband (eMBB)** will provide significant improvements over existing 4G mobile networks. It promises up to 10 Gbps maximum throughput, latency of less than 5 ms, and support capability for up to 100 times more end users. Early deployments of 5G service are largely focusing on consumer services. However, as utilities and cities become increasingly reliant on the provision of mobile services (such as augmented reality) for employees, citizens, and visitors, the enhanced capabilities and capacity of 5G networks will be critical.
- **Massive machine-type communications (mMTC)** networks will support more than 10 times as many devices as 4G in any given area, supporting the millions of dispersed sensors that constitute the IoT. mMTC will support applications that are less dependent upon low latency and require longer battery life. Low power wide area network technologies, which have already been deployed over existing 4G networks (LTE Cat M1 and NB-IoT), are establishing the mMTC dimension of 5G networks. Given the importance of large-scale IoT deployment to utility and smart city programs across a wide range of use cases, mMTC is the area where 5G will have the greatest initial impact on utilities and cities.

- **Ultrareliable low latency communications (uRLLC)** will be used for mission-critical applications where guaranteed latency of 1 ms is essential. Examples of proposed uRLLC applications include automated vehicles, virtual reality for remote surgery, industrial applications, and support for emergency services. uRLLC applications rely upon millimeter wave spectrum bands (above 24 GHz) where fast signals are possible. uRLLC represents the third wave of 5G innovation and will require new infrastructure, high density cell sites, and extended coverage.

In short, these LTE-based standards will ultimately converge in the 5G networks of the future, providing a powerful and flexible platform for intelligent grid, smart lighting, and smart city applications that utilities can build and deploy today.

## LTE-Based Standards Are Widely Used for Smart Lighting and Smart City Applications

Communications infrastructure vendors and carriers alike are promoting LTE technologies in their pursuit of smart lighting/smart city/grid maintenance projects. Here, a few case studies involving LTE for several of these applications are described, including broadband applications that go well beyond the capabilities of most legacy AMI networks.

### City of Schenectady

In 2018, NG partnered with the City of Schenectady to further smart city efforts by proposing a Reforming the Energy Vision demonstration: a three-phase project where together the city and the utility could deploy and evaluate advanced streetlighting platforms. This project would animate the market for smart city technologies and services, and it included evaluation of both LTE-based solutions and solutions operating on RF mesh AMI networks.

Early in the project, the city and utility recognized that designing the smart city solution required the cross-functional collaboration of numerous municipal departments, including police, fire, public works, IT, and economic development. Together, Schenectady selected high priority use cases focused on public safety, smart infrastructure, and environmental monitoring.

In May 2020, Ubicquia, a provider of connected smart streetlighting, city, and small cell platforms, acquired CityIQ, the LTE-based IoT platform, from GE Current. Since then, Schenectady and NG have entered Phase 2 of the deployment. They have deployed 2,000 lighting nodes and remaining pilot zones were awarded to Ubicquia for creating an expanded multipurpose smart city network. There are nearly 500 intersections being monitored with traffic sensors and public safety cameras and the city has plans to add public Wi-Fi to the deployment.

### City of Los Angeles

In 2016, Los Angeles announced a comprehensive plan to create a connected streetlighting platform for future smart city and grid maintenance functions. While the coronavirus pandemic put the program on hold, as of 2022, it is back on track. Over the past several years, the city has tested solutions from Telensa, Roam, and Signify. It has uploaded more than 221,000 assets into the Ubicquia UbiVu GIS system that will be connected to smart lighting over the next few years. The city intends to extend the network to perform a variety of smart city and smart utility functions, including remote monitoring for gas and electric utilities, solar power, EV charging, security cameras, air quality meters, and acoustic sensing.

The smart nodes acquire key power quality parameters continuously and at scale, allowing the Bureau of Street Lighting to assess the quality of power supply to its network. By sharing this data with other public departments and utilities, grid managers are informed of outages for faster restoration. Connected streetlights also provide the Bureau of Street Lighting with luminaire health data to increase maintenance planning effectiveness and cost savings. This aggregated data coupled with grid health information is expected to enable advanced maintenance models for the city and its utilities.

**City of Las Vegas**

Las Vegas is working with Ubicquia to deploy 4,000 LTE-based network smart lighting controls that can operate on AT&T's public network or the city's planned PLTE network. The city is replacing existing photocells with Ubicquia's LTE-based streetlight controllers throughout the downtown innovation district.[1] The city is leveraging the LTE-connected streetlight controllers to integrate data and communications for air quality and water sensors throughout the city. Additionally, the city is working directly with Ubicquia to build out a citywide CBRS network using Ubicquia's Streetlight Small Cell solution. The CBRS spectrum network enables the bandwidth needed to support the dense deployment of security cameras in the city.

*Utilities should carefully evaluate the ability of their existing AMI networks to accommodate the many future grid management, smart lighting, and smart city applications that they may want to deploy before pressing legacy AMI networks into service.*

Las Vegas also announced in May 2020 that it has extended its smart city rollout with Japanese group NTT to cover HD optical and audio sensors at 14 locations across the city. The extension follows an initial trial that provided information to city personnel for improved situational awareness and traffic management data. The pilot has improved traffic congestion and wrong way driving.

With the expansion, the city will use a dashboard to access and view sensors, data streams, and analytics. The city will also set in motion an automated system to notify law enforcement and maintenance personnel about safety hazards such as large crowds, gunshots, breaking glass, and vandalism.

# Conclusion: Decouple Smart Lighting from AMI Networks

LTE-based wireless networks are expected to enable utilities to offer a multitude of grid maintenance, smart lighting, and smart city applications over one network. The global 3GPP ecosystem provides cost-efficient, future-proof products and services that will help utilities realize Industry 4.0 capabilities and prepare cities and communities for a more efficient, safe, and equitable future.

Utilities should carefully evaluate the ability of their existing AMI networks to accommodate the many future grid management, smart lighting, and smart city applications that they might want to deploy before pressing legacy AMI networks (whether RF mesh or other topography) into service. Although legacy AMI networks may support basic lighting control functions, the platform's inability to scale in range and

[1] Innovate.Vegas, www.innovate.vegas.

performance could prevent utilities from expanding their grid modernization programs and providing competitive smart city solutions within their service territory.

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# Acronym and Abbreviation List

3GPP ..... 3rd Generation Partnership Project

AMI ..... Advanced Metering Infrastructure

CBRS ..... Citizens Broadband Radio Service

CCTV ..... Closed-Circuit TV

eMBB ..... Enhanced Mobile Broadband

Gbps ..... Gigabits per Second

HD ..... High Definition

IoT ..... Internet of Things

IOU ..... Investor-Owned Utility

IT ..... Information Technology

kbps ..... Kilobits per Second

kHz ..... Kilohertz

LTE ..... Long Term Evolution

Mbps ..... Megabits per Second

MHz ..... Megahertz

mMTC ..... Massive Machine-Type Communications

Ms ..... Millisecond

NB-IoT ..... Narrowband-IoT

NG ..... National Grid

PLTE ..... Private LTE

RF ..... Radio Frequency

SCADA ..... Supervisory Control and Data Acquisition

SLA ..... Service Level Agreement

uRLLC ..... Ultrareliable Low Latency Communications

US ..... United States

## Scope of Study

Guidehouse Insights has prepared this white paper, commissioned by Ubicquia, to provide an independent analysis of the grid management, smart streetlighting, and smart city applications that utilities increasingly need. It explains why they should no longer rely on legacy AMI networks for connectivity. It also explains why LTE-based wireless solutions—public or private—can provide grid-edge connectivity and support a multitude of emerging functions in a more cost-effective, flexible, and future-ready manner.

## Sources and Methodology

Guidehouse Insights' industry analysts use a variety of research sources in preparing research reports and white papers. The key component of Guidehouse Insights' analysis is primary research gained from phone and in-person interviews with industry leaders including executives, engineers, and marketing professionals. Analysts are diligent in ensuring that they speak with representatives from every part of the value chain, including but not limited to technology companies, utilities and other service providers, industry associations, government agencies, and the investment community.

Additional analysis includes secondary research conducted by Guidehouse Insights' analysts and its staff of research assistants. Where applicable, all secondary research sources are appropriately cited within this report.

These primary and secondary research sources, combined with the analyst's industry expertise, are synthesized into the qualitative and quantitative analysis presented in Guidehouse Insights' reports. Great care is taken in making sure that all analysis is well-supported by facts, but where the facts are unknown and assumptions must be made, analysts document their assumptions and are prepared to explain their methodology, both within the body of a report and in direct conversations with clients.

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