OMDIA
Brought to you by Informa Tech

What value does private LTE bring to smart grids?

Publication date:
18 September 2024
Author:
Pablo Tomasi, Principal Analyst, Private Networks

The future smart grid requires a network capable of supporting new use cases with many distributed devices

The future smart grid must support new use cases to meet the industry's trends and needs. The future-proof smart grid must support distribution automation, precise load monitoring and control, distributed energy resources (DER) integration, advanced metering infrastructure (AMI), and non-utility, specific use cases. Common to these use cases is the fact that the grid will connect a much larger number of devices and applications and that these new devices will be connected in an extremely distributed environment. In these scenarios, the communication requirement will move well beyond the substation, with new assets being in remote areas, such as at the customer's home, on the road, or in solar fields. These scenarios require a network capable of delivering various needs, such as low latency (e.g., 20ms), high reliability (4 or 5 nines), and cost-effective, scalable coverage.

Distribution automation relies on a communication network that delivers high capacity and low latency, allowing for real-time monitoring and control of critical grid assets across an entire distributed environment. This requires maintaining sub-50ms latency across the entire grid, from high-voltage stations to low-voltage ones. The network must connect and support an increasing number of devices with varying degrees of quality of service (QoS) and bandwidth requirements to monitor, control, and automate grid functions. For load monitoring, the smart grid must be able to have real-time data to act pre-emptively in case of issues across a now widely distributed footprint.

DER requires a network that enables better control of bidirectional energy flows with near real-time network visibility. In a DER world, storage, enterprise microgrids, electric vehicles (EVs), and charging stations are all new sources of data that are decentralised and dispersed, often in areas with unreliable coverage. For the AMI use case, the grid will need to support a larger number of devices transmitting information more frequently, at 30- or even 15-minute intervals, leading to an increase in the data traffic.

Because of the expansion of these critical use cases, an average utility can expect to deploy hundreds of thousands or even millions of new connected grid assets in the coming years. This is a scale that cannot be accommodated by any legacy technology.

Legacy technologies cannot meet the new needs of the smart grid

More devices across a distributed environment means there is a larger volume of data to collect and process across wide areas that previously lacked mission-critical connectivity.

The new smart grid has various use cases with different connectivity requirements. For instance, in distribution automation, grid management, and telemetry, a latency of 50–100ms roundtrip is required. Precise load control requires control of devices that carry high voltage and a latency of around 10 –20ms roundtrip.

Historically, utilities have deployed various application-specific communications networks, so one network was used for AMI, another for line monitoring, and so on. This significantly increased opex while also reducing utilities' ability to coordinate across various grid applications.

This approach has become obsolete because the evolution of use cases requires reliable connectivity capable of supporting hundreds of thousands or millions of new devices and applications delivered across the whole footprint. These increased requirements highlight the limitations of existing technologies and the need to deploy a different communication network.

Mesh networks have limitations in terms of range, latency, and performance, which make them unsuitable for wide-area coverage. Power line communications (PLC) narrowband technologies have been used, but they are costly to scale in a completely distributed and mobile environment and cannot support higher data needs. Land mobile radio (LMR) technologies have also been used for specific tasks, such as push-to-talk (PTT), but they have bandwidth limitations and cannot support data-intensive use cases. LoRa can support sensor data over wide areas, but it cannot deliver on latency and bandwidth needs.

Traditional technologies cannot meet the needs of the power grid, which creates an opportunity for cellular technology to act as a single network that can support all use cases. These use cases include distribution automation, precise load control, AMI, and DER, as well as worker communications and drone infrastructure monitoring of the utilities. Cellular technology can support many devices and deliver high reliability, low latency, and high bandwidth. It can deliver these capabilities cost-effectively over wide areas, with a network that can be customised to utilities' needs. Additionally, it can support additional devices without requiring new investment in more infrastructure, as in the case of wired technologies.

The value of private LTE to support smart grid: One network that meets the security, device growth, and reliability needs of utilities

Cellular technology is the most suitable technology to support the evolution of the smart grid. It can support many devices, up to 80,000 users per cell site (with narrowband Internet of Things [NB-IoT]). It offers low latency of 50 or 20ms, supports high bandwidth of up to 300 Mbps, and can deliver high reliability of 4 or even 5 nines.

Among various deployment options, a private LTE network is the ideal choice for utilities to create a connectivity platform that supports current needs and future innovation. This is due to the specific needs of the utilities, such as security and performance. Security is a critical need for utilities because they are national critical infrastructure and can be the target of cyber attacks. Private LTE provides enhanced security with features, such as SIM security and traffic encryption. It also allows utilities to leverage additional security measures, such as traffic separation.

With private LTE, the networks are designed to meet the specific needs of utilities. This includes supporting a certain number of devices per site and ensuring capacity, reliability, and low latency. Private LTE allows utilities to prioritise traffic for specific applications while also providing a highly scalable network, as its coverage and capacity can be augmented in a cost-effective manner.

By choosing private LTE, utilities have control over the networks. This allows for scheduling of repairs and maintenance at the most convenient times and leverages a large ecosystem of devices. The networks are also more secure, as they are exclusively used by utilities and leverage cellular technology security credentials. These features mean that private LTE can become a single platform used to support distributed automation, precise load control, DER, AMI, and any other traditional or innovative use case.

Private LTE is valuable for the smart grid because it is the only connectivity option capable of fully serving all the use cases that will shape the utilities of tomorrow. Additionally, LTE being part of the 3GPP standard means that private LTE networks are future-proof and will transition to 5G smoothly, with its new capabilities, to further support the long-term evolution of the smart grid.

Author

Pablo Tomasi, Principal Analyst, Private Networks

askananalyst@omdia.com

Omdia Commissioned Research
This piece of research was commissioned by Huawei.

Citation policy
Request external citation and usage of Omdia research and data via citations@omdia.com.

Omdia consulting
We hope that this analysis will help you make informed and imaginative business decisions. If you have further requirements, Omdia's consulting team may be able to help you. For more information about Omdia's consulting capabilities, please contact us directly at consulting@omdia.com.

CONTACT US
omdia.com

customersuccess@omdia.com