BLACK & VEATCH

Private LTE:

Bridging the Data Gap in the Energy Transition

Introduction

The Energy Transition has created a dynamic energy landscape. The race towards decarbonization and electrification, coupled with the demand for affordable energy — brings incredible opportunity for utilities, but not without challenges. The integration of renewables, the influx of Distributed Energy Resources (DERs), and storm hardening efforts are adding size and complexity to the grid, requiring its infrastructure to be better, stronger, faster.

In response, utility strategies, and capital plans are focused on reliability, resiliency, and affordability. They are dialing into digitalization, investing in smart technology to bring their operations into clearer view, eager to use powerful data to improve operations, protect the grid and drive new business models.

The problem with big data. Utilities intent on integrating renewables and DERs, are looking to advanced applications like AMI, outage management, voltage regulation, and demand response to manage and monitor these distributed and diverse assets. But with these applications, comes big data to instantly gather, analyze and share across the enterprise, revealing a gap in the utility operation — the network.

Today's field area networks lack the capacity and speed to manage big data and provide real-time visibility into operations. Fiber is excellent but cannot be deployed and scaled to connect end devices at the speed and efficiency of wireless. To optimize grid investments, utilities need a high-bandwidth, low-latency field area network paired with edge computing capabilities to enable localized, intelligent decisions at the edge. Private LTE (pLTE) bridges the gap. The technology provides the reliable and secure connectivity needed to move, segment, and prioritize the abundant real-time data from thousands or even millions (with AMI) of edge devices. However, failure to consider the network early enough in the planning stage can lead to stranded assets and unrealized capital projects due to slow and unreliable data. This ebook addresses how pLTE can be the bridge to connect assets and provide the critical data needed for a dynamic grid system that works together in unison.

PLTE — Foundational Infrastructure for the Energy Transition

The Energy Transition is more complex than simply adding renewables to the generation mix. It requires managing bi-directional energy flows and increased communication and computing to enable instantaneous actions to balance the supply and demand of power.

Utilities need to prioritize network infrastructure upgrades, such as pLTE, to avoid being left with inefficient, disparate networks that drive O&M costs higher year-over-year. By aligning corporate business strategies with the network's role and capabilities, utilities can begin to view pLTE and its supporting IT networks as foundational infrastructure and essential to the Energy Transition.

Common Strategic Priorities	Network Infrastructure's Role
Decarbonization and Renewable Integration	Increases the grid's capacity to support DERs by extending visibility and teleprotection to the edge, improving grid safety and stability, and enabling two-way smart metering to measure consumption, voltage, current and power factor.
Disaster Preparedness and Resiliency	Delivers the data for real-time situational awareness to detect and rapidly respond to issues and keeps mission-critical operations connected and operating in extreme conditions.
Customer Engagement and Energy Management	Drives powerful data analytics for enhanced personalization and engagement through digital platforms, such as demand response, disaggregation, and energy efficiency programs to empower consumers to make informed decisions and actively manage their energy usage.
Cybersecurity	Protects critical operational and customer data through enhanced data encryption and protocols, network- and SIM-based authentication and access control, network segmentation, increased visibility and inherent security from 3GPP.
Digitalization and Operational Efficiency	Expands automation, monitoring, and control to the edge by supporting seamless data transmission required for smart grid applications, such as AMI, FLISR, Volt/VAR regulation, Phasor Measurement Units (PMUs), ADMS, or DERMs.
Asset Management and Predictive Maintenance	Supports proactive identification of equipment issues, predictive maintenance scheduling, and optimization of asset performance.

Take a Cue from LTE's Early Adopters

LTE has truly been transformational. If it wasn't for wireless carriers' strategic deployment of LTE networks over a decade ago, would we have realized data's immense capabilities today? From its inception, Black & Veatch provided leading carriers with program management, land management and acquisition, engineering, and construction solutions to build the foundational 4G LTE infrastructure that accelerated the world's adoption of the internet and mobile devices. Here are key considerations we've learned from working with leading wireless carriers to ensure a pLTE network's successful deployment.

1. **Coverage Area and Scalability:** Carriers start with determining the geographical areas to cover, prioritizing regions where demand for data services will likely be higher while maintaining reliability and performance. By adopting similar principles, a private network can focus on priority sites first, and be built to scale as needs grow. This ensures adequate coverage to handle data traffic efficiently in the future.
2. **Spectrum Availability:** Over the years, owning spectrum has been a critical and strategic asset that impacts a carrier's long-term growth. Much the same, a utility's spectrum strategy will have major implications on its network planning. It's important for utilities to weigh all options and frequencies available, such as:
   - frequency range and bandwidth
   - coverage area
   - availability
   - regulatory conditions
   - interference and adjacent spectrum
   - technology compatibility
   - spectrum efficiency and future network capacity
   - ability to lease to adjacent municipalities, utilities, or industries
   - cost and budget
3. **Infrastructure and Site Planning:** Carriers carefully consider how towers, base stations, and backhaul impact deployment and operating costs. Utilities have a major advantage from owning significant amounts of fiber and microwave for backhaul and structures for sites. How utilities use this infrastructure to build and scale their networks has a major impact on the total cost of operation. When analyzing how existing infrastructure can be used it's important to factor in spectrum efficiency, RF planning and coverage, network performance, and interference.
4. **Hybrid Network Architectures:** As carriers rely on dynamic spectrum sharing and roaming agreements to ensure customers have adequate service, utilities should make use of a pLTE hybrid network architecture to ensure adequate and complete network coverage. Utilities can extend a private network to critical sites, retaining all of the control and security advantages, while relying on a carrier-owned network for less-essential data and sites — creating flexible and agile infrastructure that can be easily migrated from public to private as needed.

TIP:

Carriers use Hydrogen Fuel Cells as a sustainable back-up power source and to lower site emissions. Contact Us to learn more about deploying this clean technology.

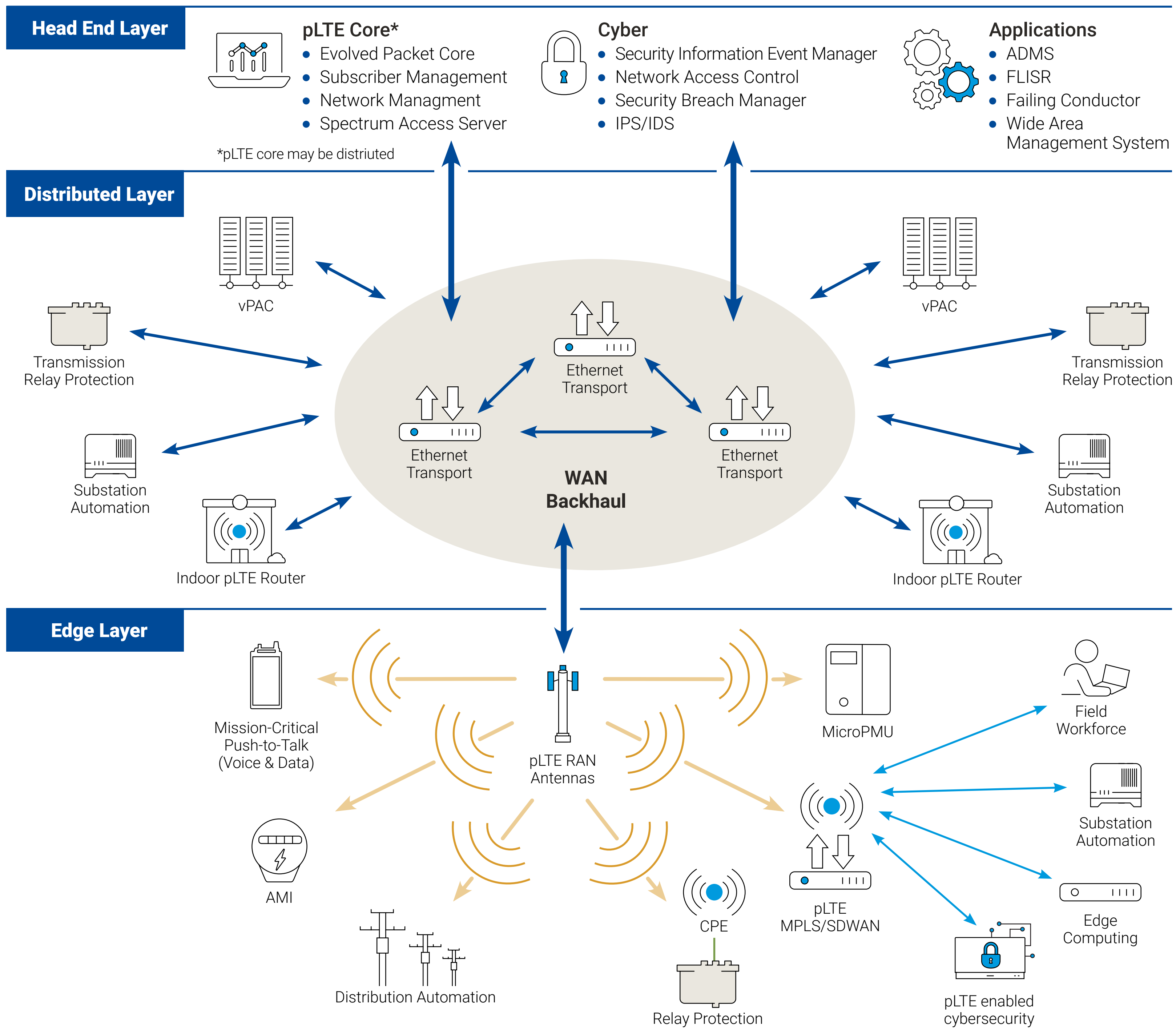
5. **Network Access Control:** Carriers understand LTE's inherent cybersecurity capabilities and implement both robust physical and security measures to protect user data and prevent unauthorized access. By implementing a pLTE network, the requirement for controlling network access is heightened. Because the LTE network is private, utilities can control and implement a higher level of security compared to a public network.
6. **Interoperability and Standardization:** Carriers use standardized equipment and network elements to ensure interoperability and ease of maintenance. As the utility pLTE network evolves, the industry will benefit from industry standardization and device certification to facilitate interoperability, network security, spectrum management, quality assurance, and network efficiency.
7. **Future-Proofing:** Both LTE and 5G are part of the Third Generation Partnership Project (3GPP), the worldwide standards organization. Thousands of manufacturers and products are designed to this standard to create a robust and secure ecosystem of technologies that will interoperate and be backward compatible for decades to come. This ecosystem is designed to scale and meet the increasing demand for exponentially more connections and provide a range of performance capabilities to accommodate different price points and form factors. LTE and 5G will be integrated as an embedded chip in more and more devices as well as all sorts of voice and data devices. Deploying LTE now ensures access to that ecosystem and all the advantages that it offers.

If pLTE Is the Bridge, Software-Defined Networking Is the Traffic Signals.

While pLTE serves as both the physical data bridge (the transport), and collection point (the access), Software-Defined Networking (SDN) is the traffic control. SDN is network architectures (the logic) that route, segment and prioritize data for better control and management of end devices and the gathered data traffic.

Together, integrating pLTE and SDN enables a future-proof, vertically integrated approach to utilize data effectively. By taking this end-to-end, strategically managed approach to network infrastructure, utilities will gain flexibility that allows them to adapt to evolving communication requirements and emerging technologies. All while effectively scaling to the growing number of grid-edge devices without significant network infrastructure modifications.

Many utilities already have IP/MPLS networks deployed in their core and distribution networks. Using pLTE to extend IP/MPLS or SDN to the grid edge allows for seamless integration and interoperability between different grid systems, such as Distributed Energy Resource Management Systems (DERMS), Advanced Distribution Management Systems (ADMS) and Customer Information Systems (CIS), and ensures efficient data flow and coordination across the grid ecosystem.



Optimize the Edge with pLTE and SDN

When SDN uses pLTE for data access and transport it brings several benefits that enhance network connectivity, security, and flexibility.

1. **Enhanced Coverage & Connectivity:** LTE significantly expands the connectivity that is currently possible with today's wired Wide Area Networks (WAN) and/or traditional wireless narrowband voice and/or data solutions. SDN combined with pLTE effectively expands connectivity to cover a wider area, guaranteeing dependable, scalable, and secure network access to grid edge devices, particularly in remote or challenging locations.
2. **Secure and Reliable Data Transmission:** The 3GPP LTE standard offers native robust security features. However, when integrated with SDN, this vertically integrated network architecture provides an even more secure and reliable infrastructure for reliable any-to-any data transmission of the grid's most critical applications. Whether pLTE is used as the primary transport to a site or as a backup circuit, the increased cybersecurity capabilities to the edge can exponentially increase network capabilities, reliability, and security required for the Energy Transition.
3. **Application Prioritization:** By properly engineering pLTE's native traffic prioritization capabilities with similar packet network attributes and combining SDN's power of customizable application-aware routing and intelligent path control features, utilities can achieve the ultimate traffic prioritization and control for their most critical applications. Real-time monitoring information or control signals from mission-critical assets can be prioritized over non-essential data traffic. This optimizes network resources and performance, assuring the timely delivery of crucial data, leading to more efficient grid operations.
4. **Flexibility and Scalability:** Once built, pLTE is easily scaled to meet growing network requirements. Incorporating SDN simplifies the process of scaling the network even further. SDN enables centralized management and automation of network policies and configurations and supports network segmentation and virtualization, creating multiple virtual networks across pLTE transport (or other network transport technologies). As new devices, applications, and sites are added to the grid, pLTE provides rapid connectivity and SDN allows ease of network configuration and policy implementation for vastly improved efficiency in network scalability.
5. **Resilience and Redundancy:** The combination of pLTE and SDN delivers robust redundancy capabilities. By deploying pLTE base stations, a utility can establish multiple data paths for transport to minimize network disruptions. Meanwhile, in the case of link degradation or failure, SDN can adeptly switch to alternative connections at an application-by-application level, ensuring uninterrupted dataflows and minimizing downtime.
6. **Edge Computing:** With pLTE, utilities can process and analyze grid data closer to the source, reducing latency and enabling real-time decision-making. SDNs facilitate efficient and secure data transfer between edge computing nodes and central control systems, optimizing overall grid operations.

TIP:

A pLTE network designed alongside a carrier network may allow overlapping coverage. So, if a radio goes down on one network, a separate network is there, ready to pick up the coverage.

Future Proof Your Investments

The power of LTE to transform has been proven over the last decade, and it will continue to revolutionize how companies use data, mobility, and automation. Companies will continue to learn how to operate more efficiently as well as how their customers use their products and services, so they may truly bring new desired solutions to market. With pLTE, utilities have the keys to unlock their infrastructure's potential and open up the many possibilities to thrive in the Energy Transition.

Black & Veatch plans, designs, and builds network infrastructure and the IT and cybersecurity platforms needed to optimize utility operations. By envisioning the Energy Transition as more than wind and solar-filled skylines and looking beyond to reveal the digital transformation behind the scenes, we advance utilities toward a sustainable and bright future.

Our energy solutions encompass transmission, distribution, and the automation and communications needed to connect, visualize, and optimize the grid. As your trusted infrastructure partner, we design and build resilient, reliable, efficient, and future-proof grid systems. Learn more about Black & Veatch's private network solutions for utilities.

How future proof is your grid investment?

Contact us