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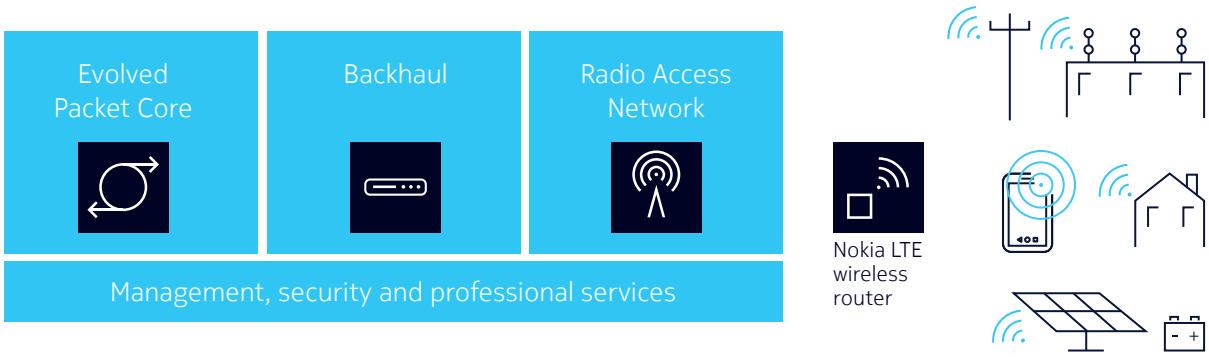
Optimizing distribution automation with private LTE networks

Use case

Distribution automation in medium and low voltage grids is one of the key requirements for power grid modernization. With automation, power utilities can improve electricity reliability, enhance operational efficiency and safety, and optimize grid performance. But the multiple, independent, and application-specific field area networks (FANs) that currently connect endpoints cannot support advanced distribution automation requirements. A single, purpose-built, private LTE broadband network provides the secure convergence, capacity, resiliency, and quality of service (QoS) needed for the volume and variety of data that will enable intelligent distribution automation.

Figure 1. Nokia's private LTE wireless broadband network solution



Challenges

As they evolve towards smart grid operations, power utilities are deploying intelligent electronic devices (IEDs) and applications that monitor, control, and automate grid functions. These applications collect, process, and communicate power line data, such as frequency, voltage, and current levels. In some cases, they may also send command and control signals that apply real-time adjustments to changes in load, generation and failure conditions without operator intervention. In some cases, this communications traffic is delivered to devices at adjacent sites and to central operations centers.

To support the communications requirements of different IEDs, many utilities have deployed multiple FANs. For example, a power utility may have one FAN for advanced metering infrastructure, another for line monitoring, and a third for protection. Typically, each FAN is based on different networking technologies and requires its own specific maintenance and support processes.

Although this segregated approach to FAN deployment provides oversight and control over distribution functions, it has left utilities with multiple discrete communication networks that must be managed and maintained separately. This creates higher operational and maintenance costs. It hampers control, co-ordination, and communications between various grid applications. It also becomes a barrier to application integration.

As more intelligent IEDs are deployed the existing FAN networks hamper efficient automation. With more IEDs, the volume of grid information that must be collected and processed increases significantly. The secure, highly reliable communications needed to support new mission-critical applications, such as distributed generation (DG) integration, automatic fault isolation and reclosing, and inverter control, cannot be provided by current FANs. In addition, deployed FANs have many limitations:

- Some are becoming obsolete (analog phone lines, DS0 leased circuits)
- Some are based on wireless narrowband mesh technologies with limited bandwidth, which makes them adequate for reading meter data, but not for distribution automation
- Some wireless point-to-multipoint (P2MP) technology deployments require line of sight, which requires extensive RF link design and hinders a utility's ability to move and add new IEDs

- Some use unlicensed spectrum which is vulnerable to interference
- Some offer no path redundancy (e.g., wireless P2MP) for applications that require highly reliable communications.

Solution: Private LTE mission-critical FAN

Private communications infrastructures built on IP/Multiprotocol Label Switching (IP/MPLS) and Long Term Evolution (LTE) wireless broadband provide the right technology combination to create FANs that support intelligent distribution automation for today and tomorrow.

Many power utilities have already started to migrate their core communications networks to IP/MPLS. With its virtual private network (VPN) capability, IP/MPLS enables utilities to build versatile, service-aware networks for individual applications with service-level privacy, security, and reliability. These virtual networks can be consolidated into a single converged architecture that provides the high QoS needed for critical applications, such as supervisory control and data acquisition (SCADA), land mobile radio (LMR)/private mobile radio (PMR) backhaul, and video surveillance.

LTE wireless broadband is the ideal complement to the VPNs enabled by IP/MPLS. With LTE, power utilities get an IP-based technology that offers the bandwidth, speed, reliability, low latency and high throughput needed for peer-to-peer communications. LTE also offers a Narrowband Internet of Things (NB-IoT) option for the extended range, low- and medium-rate connectivity requirements of advanced machine-to-machine (M2M) and IoT distribution automation applications, as well as Mobile Edge Computing (MEC) with very low latency for applications with data processing at network edge.

LTE also provides the flexible channel size that allows it to cater to different bandwidth requirements, ranging from hundreds of megabits per second to tens of kilobits per second. Its advanced QoS capabilities enable utilities to provide specific QoS levels to different applications. In addition, since LTE does not require line-of-sight, utilities can extend the reach of their FANs economically with the necessary bandwidth and QoS for intelligent operations. This makes it easier to add and move field devices as needed.

Nokia offers a private LTE wireless broadband solution that provides a unified and secure network for more efficient and intelligent distribution automation. This solution leverages:

- Standards-based technology that uses dedicated licensed spectrum to minimize the risk of interference as industrial IoT deployments that use unlicensed spectrum grow
- Nokia's broad product portfolio of IP/MPLS routers, wavelength division multiplexing (WDM) and microwave radios for the backhaul network
- A common communications management system for the radio access network (RAN), backhaul and core along with lifecycle device management that simplifies and reduces operating expenses
- Holistic security management that spans multi-vendor and multi-technology IT and OT environments, and provides a single pane of glass perspective.

From feasibility studies, conception and design to engineering, procurement, supply, implementation, operation and maintenance, Nokia provides an end-to-end solution approach structured to enable effective and efficient deployment of private LTE networks. In addition, our solutions are proven to work with products from a full ecosystem of partners, including management solution vendors, device manufacturers, manufacturers of ruggedized networking equipment, ruggedized handsets, and sensors.

Your private wireless broadband partner

- Nokia offers complete private LTE wireless broadband and IP/MPLS solution for power utilities built on:
- A 3GPP standard-based, private wireless broadband solution combined with a global carrier embedded base and a vibrant ecosystem to minimize investment risk
- An extensive product portfolio, which includes IP/MPLS routers, optical and microwave equipment, and software-defined networking (SDN) technologies to efficiently address diverse connectivity requirements
- Proven engineering, integration, and management services to help utilities transition from legacy networks to LTE
- Extensive experience enabling the transition to IP/MPLS for more than 120 utilities
- Leadership in all-IP and ultra-broadband networks

Benefits

By moving to a converged FAN grounded in LTE and IP/MPLS, power utilities can create a scalable, managed broadband network that provides secure, reliable connectivity for all grid applications. They can extend the reach of their existing wide area networks (WANs) to the edge of the FAN to address all distribution automation requirements. In addition, they can simplify operations by leveraging their WAN service, security and management environment to create a single, consistent operations environment for all communications.

LTE deployed in the FAN provides a communications foundation for a utility's IoT strategy. It can also be leveraged for the increasing communication demands of power utilities' mobile workforce. Personnel can use LTE-based FAN deployments to connect their tablets, laptops and devices for remote desktop access, real-time video services and applications enabling workforce automation. LTE group communications capabilities that include push to talk, push to video and alert messaging can be utilized for communications among the mobile workforce and with operations center. This allows utilities to make the most use of their converged FAN investment.

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Simplifying distribution automation with private LTE

Nokia private LTE wireless networks provide the broadband coverage, capacity, and QoS needed to:

- Connect and support many thousands or millions of IEDs with varying degrees of bandwidth and QoS requirements
- Enable current and future IP-based distribution automation applications, including those that use distributed computing
- Introduce new automatic fault isolation and reclosing, inverter control applications and distributed generation (DG)
- Secure critical systems through holistic security management that prevents threats from materializing by rapidly spotting and stopping suspicious behavior

Nokia's communication solutions provide power utilities with the critical connections to enable grids to operate more efficiently, reliably and safely. To learn more about Nokia's solutions for power utilities, visit www.networks.nokia.com/power-utilities/smart-grid.

About Nokia

We create the technology to connect the world. Powered by the research and innovation of Nokia Bell Labs, we serve communications service providers, governments, large enterprises and consumers, with the industry's most complete, end-to-end portfolio of products, services and licensing.

From the enabling infrastructure for 5G and the Internet of Things, to emerging applications in virtual reality and digital health, we are shaping the future of technology to transform the human experience.

Connect with our sales team

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