Electric Utility Streamlines Substation Operations with Cisco

Duke Energy standardizes on Cisco Connected Grid for migrating serial networks to a standards-based IP infrastructure.

Challenge

Duke Energy [NYSE:DUK] is one of the largest electric power companies in the United States, supplying and delivering energy to four million U.S. customers. Headquartered in Charlotte, North Carolina, its U.S. power portfolio comprises approximately 35,000 megawatts of wholesale electric generation capacity in the Carolinas and the Midwest, plus natural gas distribution services in Ohio and Kentucky. As well, the company's commercial and international businesses own and operate power generation plants in North and South America, including renewable energy assets.

As Duke Energy's U.S. infrastructure footprint has expanded, the company has been challenged by its increasingly complex network of substation systems. Legacy infrastructures have begun to limit the availability of real-time telemetry data, and systems are becoming limited in scalability. As well, much equipment now averages more than a decade in service, and the company's budget plan restricts quick upgrades.

To address these issues, managers began planning a series of initiatives to upgrade the utility's substations and integrate its networking capabilities, creating an automated smart grid built on Intelligent Electronic Devices (IEDs), protection relays, and IP-based networking.

Executive summary

Customer name:
Duke Energy (NYSE:DUK)

Industry:
Energy

Location:
Charlotte, North Carolina, US

Number of employees:
29,188 employees

Challenge

- Upgrade legacy SCADA systems
- Scale network to support growing number of telemetry devices
- Meet NERC/CIP, IEC 61850-3, and IEEE 1613 compliance

Solution

- Deployed Cisco 2010 Connected Grid Router and Cisco 2520 Connected Grid Switch as foundation of integrated power grid network
- Extended Cisco IP infrastructure in corporate environment to substations
- Implemented centralized security and management

Results

- Obtained highly flexible, intelligent foundation for cross-company applications
- Improved security and visibility into substation information
- Better monitoring and logging of telemetry data

These initiatives included:

- Creating a cohesive network across plant and corporate systems based on standardized protocols
- Helping ensure grid reliability with better situational awareness and real-time analysis
- Improving security while providing greater visibility into the performance and health of substation systems
- Implementing IEDs to help collect more telemetry data for monitoring, logging, and auditing
- Prolonging asset life with remote diagnostics and predictive maintenance

"We recognized that with the growing number of intelligent devices in the substation which rely on the IP protocol for communications, we needed highly reliable and rugged networking devices to meet these tough environmental conditions," said Elvis Landry, Duke Energy telecommunications data network design and support manager. "Cisco's Connected Grid router and switch fully addresses our environmental challenge while increasing operational flexibility."

Solution

Over the years, Duke Energy had deployed a variety of serial-based Remote Terminal Units (RTUs) and IEDs from different vendors in its substation networks. Many of these supported older, proprietary Supervisory Control And Data Acquisition (SCADA) protocols, and as a result were not as flexible or scalable as the IP network deployed in Duke's corporate systems.

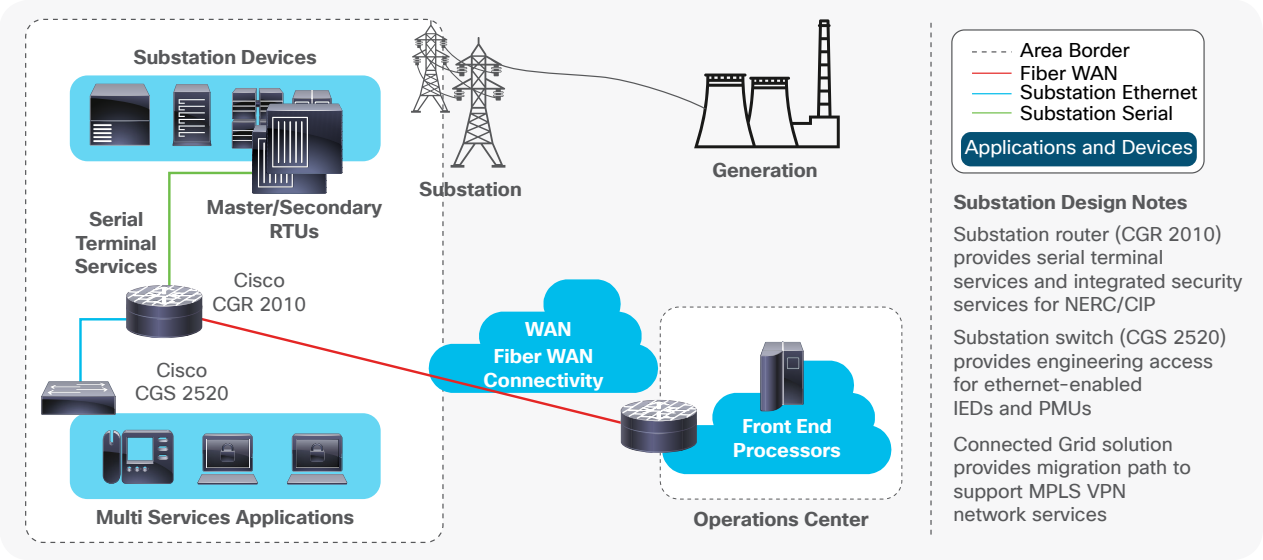
Today, however, many RTUs are now manufactured with Ethernet interfaces, enabling the extension of the corporate network into the grid. By migrating away from proprietary protocols, the company is no longer constrained by single-vendor solutions. Instead, the open IP-based network enables networking of IEDs from multiple vendors. This approach supports multiple network topologies and redundancy schemes for protection against link and node failures. In addition, IP allows Duke to migrate from serial to Ethernet devices over time, rather than demanding a single comprehensive upgrade. IP/Ethernet allows for the transport of legacy substation protocols such as Modbus and DNP3.

Duke Energy made the decision to embrace these industry standards to help ensure that equipment is reliable even within harsh substation environments. It selected the IEEE-1613 standard as its benchmark, using its specifications for hardening communications equipment to withstand electromagnetic interference, surge, and extreme weather.

Based on this protocol, the company decided on the Cisco® 2010 Connected Grid Router (CGR 2010) and the Cisco 2520 Connected Grid Switch (CGS 2520) as the IP network infrastructure for its primary substations. The Cisco Connected Grid platforms comply with the IEEE-1613 and IEC-61850-3 standard, and provide a modular design that offers maximum flexibility to add new interfaces as needed. Dual, hot-swappable power supplies make it easy to repower without taking the network out of service. These power supplies can be used interchangeably between the CGR 2010 and the CGS 2520, reducing spares and maintenance costs.

By extending the IP infrastructure from the enterprise, Duke is now able to support both operational and nonoperational data transmissions on a single network. For example, the IP network is used to monitor Ethernet-based Phasor Measurement Units (PMUs) and other sensors deployed in the substation. Virtual Local Area Networks (VLANs) are deployed to segment data traffic across a common IP infrastructure. Figure 1 shows the substation network design.

Figure 1. Duke Energy substation network



Deploying a secure network infrastructure was also paramount for Duke Energy to help address federal North American Electricity Reliability Corporation-Critical Infrastructure Protection (NERC-CIP) mandates for cybersecurity. The CGR 2010 integrates with any authentication server that adheres to the RADIUS or TACACS standard. This capability provides Duke with added flexibility to manage the substation's current and newly installed network equipment. The company also uses the Cisco ACS server, which was already deployed in its operations centers, to enable user authentication without having to invest in a separate authentication solution.

"To fully leverage the benefits of digital technology, Duke Energy is taking an end-to-end approach with smart grid that includes digital technologies on substations such as Cisco's Connected Grid solutions," said Mark Wyatt, vice president of Duke Energy's smart grid and energy systems program. "We recognize that this end-to-end approach requires many different parts, so to optimize across all of them today and in the future, we're counting on an IP-based network. Cisco is a recognized leader in network solutions, and we are pleased to partner with them."

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Results

Today, Duke Energy networks its substations, using the same common tools deployed in the corporate system, providing greater transparency and manageability of grid assets within each location. Improved visibility into and remote control of these devices has improved grid reliability and engineer productivity. As an existing Cisco customer, Duke also has been able to leverage its existing knowledge of Cisco to avoid the cost of retraining technicians. Because the Cisco Connected Grid solutions are based on open standards, they interoperate with existing network management tools.

This new level of automation has provided the foundation to allow management to create proactive maintenance programs based on more accurate and complete telemetry. The investment is further protected by having the groundwork in place to eventually add services such as wireless, Voice over IP (VoIP), and business video.

The full support by Cisco of the upcoming IPv6 protocol protects Duke Energy's investment, a critical issue as device counts across the industry expand inside the substation fence and along distribution feeders. Built-in support for IPv6 helps ensure that Duke can deploy new technologies to keep substation networks secure, reliable, and scalable for years to come.