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Smart Grids require intelligent communication networks to implement dispatch automation. >>

Preparing Smart Grids for IP/MPLS Networks

By Yuquan Zou, Network Architect, Huawei Fixed Network Product Line

On the morning of March 20, 2015, the Northern Hemisphere experienced a total solar eclipse. To astronomy fans, the eclipse was exciting; however, due to the quality of their grid management protocols, for the operators of Photovoltaic (PV) power grids, the temporary loss of direct sunshine was just another day at the office.

By the end of 2014, Germany had installed on the order of 1.5 million PV systems with a capacity of 38.5 GW, leading Europe and the world with 26 percent of all the PV capacity on earth and producing more than 30 percent of the nation's renewable electricity. During the sunniest hours of the year, Germany's PV systems provide up to 50 percent of the country's supply of electricity.

Prior to the 2015 solar eclipse, experts had predicted that a solar concealment event would result in "nothing interesting" for the European power grid. Per expectations, German PV systems managed to handle the steep ramp-down that began at 9:28 am. As the eclipse progressed, the electricity output of the German PV system plummeted by 1.2 GW — an effect equivalent to taking 10 nuclear power plants off-line simultaneously.

With the reappearance of full sun at noon, the PV systems had restored 1.9 GW of electrical power to the grid, the equivalent of nearly 20 nuclear power plants. In the end, this wide fluctuation of solar power posed no serious threat to power supply stability.

Intelligent Communications at Work

Smart Grids are making a worldwide contribution to the planning and implementation of progressive policies that support the advancement of national and regional electricity utilities. Unlike conventional power grids, Smart Grids make full use of advanced ICT technologies by enabling dependable, high-speed two-way communication channels for operation and management. Sensor-based measurement and control methods are combined with sophisticated ICT platforms that achieve reliable, cost-effective power grids that are secure, efficient, and environmentally friendly.

Electricity production and delivery is a real-time process in which consumption drives generation, transmission, and transformation in a dynamic equilibrium. Traditional grids provide a unidirectional flow from large-scale generators to end-users over high-, medium-, and low-voltage distribution lines — and, the majority of low- and medium-voltage circuits need minimum communication coverage. It is the addition of decentralized, renewable electricity generators — PV and wind — that require the expansion of intelligent control networks to manage the flow of energy from intermittent, often unstable, sources to and from large-scale storage fabrics and live transmission lines.

Smart Dispatching

Electric utilities are focused on implementing smart dispatching to expand command and control coverage, optimize real-time performance, and promote the intelligent use of electricity. The adoption of ICT solutions is an essential component to achieve these objectives.

Dispatching services include relay protection, Supervisory Control and Data Acquisition (SCADA), electricity metering, and a dispatching telephone system. These services have low requirements on bandwidth but demand reliability and real-time performance. Power-line communication networks have traditionally been constructed using Synchronous Digital Hierarchy (SDH) circuit switching. As more Smart Grids and digital substations appear, SCADA and dispatching telephone systems are gradually transitioning to IP-based communication platforms that, in turn, support the introduction of new services such as wide-area Phasor Measurement Units (PMUs) and wide-area System Protection Schemes (SPSs).

Huawei Empowers Intelligent Dispatching

To help Smart Grid operators implement intelligent dispatching, Huawei has launched the Smart Grid IP/MPLS Communication Solution. This solution supplements traditional communications functions with a flexible connectivity platform that handles the emergence of new access points, such as distributed power generation, large-capacity electricity storage

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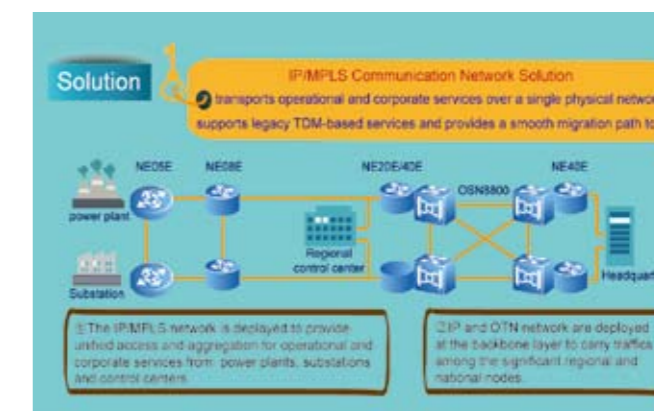
systems, and electric vehicle charging stations. Each of these components is designed to conveniently integrate with intelligent dispatching.

• **Carrier reliability:** The Huawei IP/MPLS communications network uses IP hard pipes to ensure secure and reliable real-time performance for Smart Grid dispatch communications. So, even when the network is congested, high-quality core services experience less than 5 ms transmission delays. This network solution also provides comprehensive equipment-level protection and end-to-end network-level protection so that fail-over services can be switched over within 50 ms of fault detection.

Huawei developed its own hard pipe technology for high-value customers to assure that strict, end-to-end jitter and delay requirements are met for relay protection services. Physically isolated in hardware, IP hard pipes deliver network performance at levels nearly equal to Synchronous Digital Hierarchy (SDH) technology. The deployment of hard pipe planes on IP/MPLS networks guarantees service-specific bandwidth completely free from congestion.

• **Efficiency and flexibility:** The Huawei IP/MPLS communications network includes a statistical multiplexing resource that improves packet channel network utilization by performing flexible Ethernet service processing. The solution provides quick, reliable protection for "Ethernet private Line" (E-Line) and "Ethernet transparent LAN" (E-LAN) services.

These features solve the lower efficiency of Traditional Time-Division Multiplexing (TDM) networks, which also lack flexibility in Ethernet service dispatching.

• **Powerful O&M:** The Huawei IP/MPLS communications network implements the U2000 unified Network Management System (NMS) to manage transmission, access, and routing equipment. U2000 provides an O&M dashboard that is derived from Huawei's SDH network interface and provides visualized IP network management and one-stop services deployment. Huawei's IP Flow Performance Measurement (IP FPM) function precisely detects packet loss ratios and signal path delays in real time to help users quickly locate faults in their networks. The uTraffic tool monitors and analyzes end-to-end service performance and provides users with detailed data analysis and network O&M reports referenced to published specifications.

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The Huawei Smart Grid IP/MPLS Communications Solution supports uniform access to many types of information services — including packet-switched services needed for intelligent dispatching and a full range of low bit-rate management services over the live distribution network — for the electric power industry.▲