All-IP Universal Bearer Solution for Power Grids

HUAWEI

Huawei NE routers: Empowering your network

Challenges

What's next for the power grid industry?

1 Pressure for more new services is creating a clear shift to broadband and IP for power grids

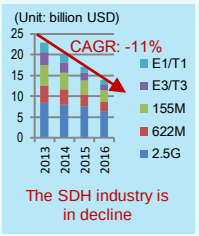
With the construction of smart grids and digitalized substations, new types of services are proliferating. These include high-bandwidth video surveillance, SCADA, and dispatch phone services that are gradually shifting to IP.

High bandwidth	High-bandwidth services with bursty traffic, the number of access terminals, and new data collection technologies are increasing.
Shift to All-IP	Dispatch phone: Analog phone → VoIP Relay protection: G.703 → C37.94 SCADA: IEC 101 → IEC 104 RS232/E&M → FE
Multipoint orientation	Services such as WAN relay protection and video conferencing require P2MP multicast.

2 Traditional power grids use SDH technology, making it difficult to deploy new services

Traditional power production networks use circuit-switched PDH/SDH technologies. With their low bandwidth, inability to use multicast, aging and outdated devices, and lack of post-sales services, these networks are unable to provide new power services.

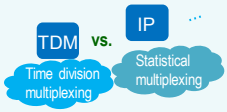
- Faults occur frequently among aging devices. This lowers reliability and increases maintenance costs.
- SDH is a sunset industry that lacks vendor support and spare parts.
- SDH supports only P2P, not multicast.
- Insufficient bandwidth resources are making it impossible to carry high-bandwidth services.



3 Multiple networks increase costs and overload management and O&M

Continuously upgrading and reconstructing multiple networks to provide new services cause skyrocketing investment costs and complicated management and O&M.

Various devices



Various technologies

- Multiple networks involve many sites and devices, increasing the optical fibers required and the cost of construction
- The use of many network technologies requires additional labor or more-specialized and expensive O&M
- Using multiple vendors and old and new devices make O&M inefficient and unified management by the NMS impossible

4 How does unified IP bearer meet the strict SLAs demanded by key power services?

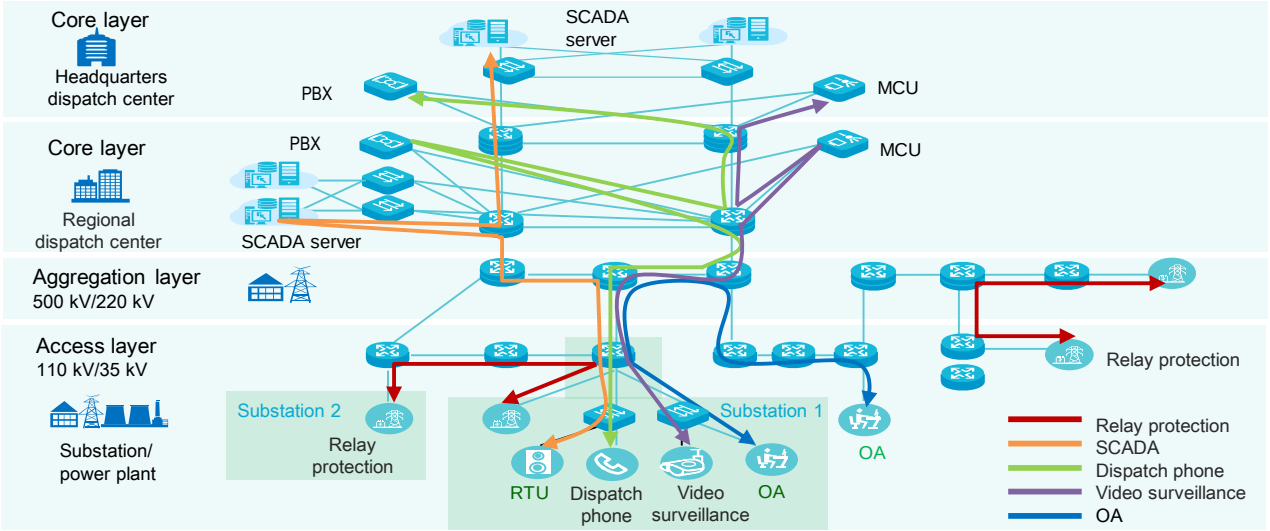
Transitioning to all-IP bearer lowers costs, provides high bandwidth, supports multicast, and makes possible future development. If All-IP is the optimal choice for power grids, the main issue then becomes how to enable IP networks to provide low latency, low jitter, and high reliability for power production services.

Power production services pose strict requirements on networks:

- BER ≤ 10^{-6}
- Relay protection service availability ≥ 99.995%
- Differential delay ≤ 5 ms
- Bi-directional delay difference for differential protection ≤ 200 μs

Solution

Huawei's all-IP universal bearer solution for transmission and transformation is designed to build a communications network that features service diversification, flattening, high security, and efficiency.



- An E2E IP/MPLS network is composed of access, aggregation, and core layers
- Access-layer devices have built-in PCM subcards that can directly access traditional low-speed services
- IP hard pipes carry key services such as relay protection; QoS is used to differentiate other services
- U2000 and uTraffic visualize SLAs, and simplify deployment and O&M

Benefits

All-IP modernizes your grid

- Advanced IP/MPLS technologies are highly scalable and support multicast, which modernize your grid
- High-performance NE routers provide high bandwidth and easily cope with the increasing service demands

Ensures high reliability of key services

- IP hard pipe technology provides SDH-like low latency and high reliability for key services
- FRR, BFD, bit error-triggered switching, NSR, NSF, and ISSU help prevent service interruptions

Minimizes investment costs

- A unified bearer reduces investment costs in sites, devices, and optical fibers
- Built-in PCM subcards provide low-speed interfaces that permit direct access to traditional services

Simplifies O&M; reduces costs

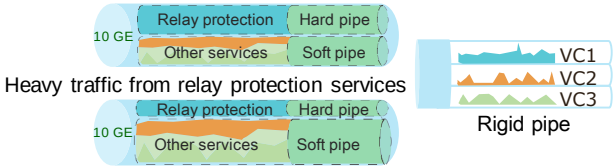
- U2000 unifies management of devices and simplifies O&M
- uTraffic and IP FPM visualize O&M and enable fast fault locating

Key Technologies

IP Hard Pipe

Chip-level dedicated channel technology provides SDH-like low latency, zero packet loss, and high reliability; it simplifies deployment, O&M, and management.

IP hard pipe differs from rigid pipes in that its bandwidth can be manually specified on demand.



Schneider Electric

Huawei worked with Schneider Electric to create IP hard pipes that carry relay protection services

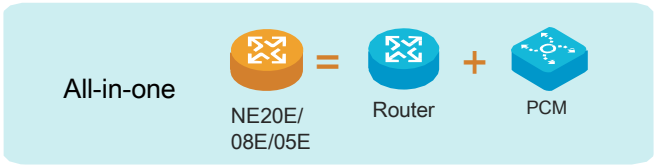
Test result: IP hard pipe fulfills the relay protection service requirements of Schneider Electric.

Item	Scenario	Hard Pipe	Soft Pipe
Connectivity	Long-packet and high-priority background traffic (1,518 bytes, EF)	Normal	Abnormal
Channel delay	Same as above	1.467 ms	Abnormal
Stability (72 hours)	Same as above	No packet loss	Abnormal
	Hybrid background traffic (64 bytes to 1,518 bytes, BE + AF1 + EF)	No packet loss	Packet loss
Switching	Path switching	15 ms	15 ms

Built-in PCM Subcard

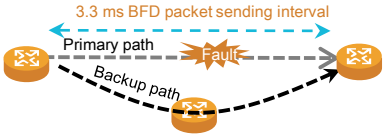
Provides multiple interfaces such as FXS/FXO, E&M, V.24/V.35/X.21, RS232/RS485/RS422, C37.94, and G.703.

Low-speed interfaces can directly access traditional power services.



Chip-based BFD Detection

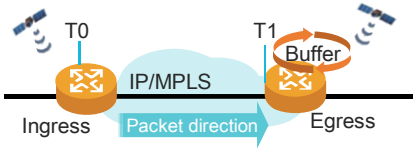
- Devices can exchange detection packets on any type of channel
- 3.3 ms minimum packet sending interval; 10 ms minimum fault detection
- Fast protection switching and automated fault rectification



BFD packets are processed by the NP on a line card, which does not consume CPU resources. BFD packets occupy no more than 100 bytes, just a small amount of network bandwidth.

Delay Compensation

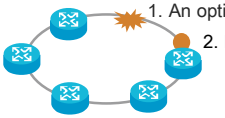
Adjusts the buffer time on the receive end to ensure that the E2E delay is the specified value. In this way, the bi-directional delay difference in differential protection scenarios is less than 200 μs, which prevents unwanted and denied operations.



1. 1588v2 or GPS is configured on the transmit and receive routers
2. Routers at both ends are configured with the same delay compensation value (D)
3. Packets on the ingress router carry the RTP timestamp (T0)
4. The egress router records the receipt time (T1)
5. Packets are buffered for [D – (T1 – T0)] before sending

Bit Error-triggered Switching

If the bit error count of an interface exceeds the predefined threshold, service switching is triggered promptly. This minimizes the impact of optical path jitter and line aging on services and enhances network reliability. A related alarm improves O&M efficiency.



1. An optical fiber fault occurs
2. Bit error statistics exceed upper threshold, triggering service switching and alarm

Recommended Products

NE40E Series Service Routers

Core Layer

NE40E-X16A	NE40E-X8A	NE40E-X3A
		

NE20E-S Series Service Aggregation Routers

Aggregation Layer

NE20E-S16A	NE20E-S8A	NE20E-S4	NE20E-S2F
			

NE08E & NE05E Series Service Access Routers

Access Layer

NE08E-S9	NE08E-S6/S6E	NE05E-S2	NE05E-SQ
			

Product Highlights

Highly reliable architecture

- Redundant main control boards, switch fabrics, power supplies, and fans
- Hot-swap and hot-standby support on all key components
- CPU + NP architecture, control-forwarding separation

Huawei-developed chip

- Solar 5.0 chipset offers good extensibility in products and features, and controllable evolution
- Chip-based BFD: 3.3 ms packet-sending interval and large-scale detection; link protection switching time ≤ 50 ms

Protection at all levels

- NSR, NSF, and ISSU — device-level reliability
- BFD, FRR, and HSB — network-level reliability
- VPN/VLL FRR and E-Trunk — service-level reliability

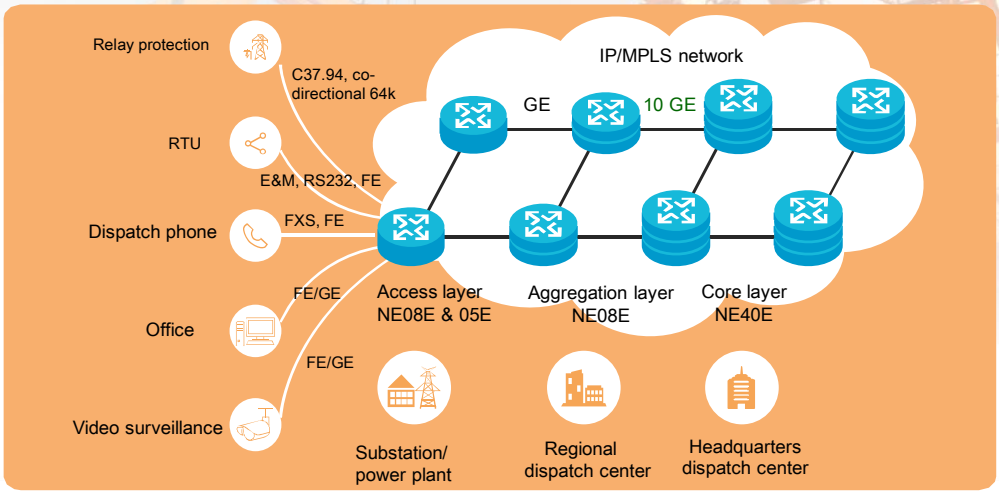
Industrial-grade design

- Dynamic, energy-saving
- Wide, industrial-grade temperature range (NE20E/NE08E/NE05E)

Case

All-IP Bearer Network for Colombia EPM

One of the largest energy suppliers in Latin America



Challenges

- Devices are aging and nearing EOS. Faults occur frequently and incur high O&M costs
- Converged SDH and IP networks make O&M and management difficult
- The SDH network is inefficient and unable to support new services such as video conferencing and video surveillance

Solution

- Huawei NE40E and NE08E/05E routers were used to construct an all-IP unified bearer network
- IP hard pipe technology transports key services such as relay protection
- Devices are equipped with built-in PCM subcards, reducing the total number of network devices
- Visualized deployment and O&M are implemented using U2000 and uTraffic

Benefits

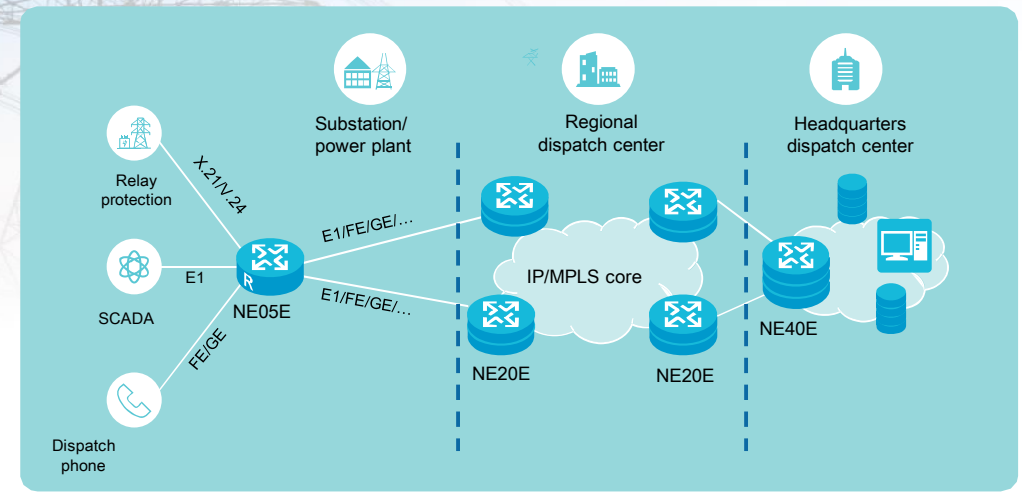
- Multiple protection technologies prevent key services from going offline and limit network delays
- Simplifying system maintenance and flattening the network help lower the technical knowledge required of O&M personnel and minimize O&M costs
- Power grid services and systems are shifted to IP, and support future evolution

Case

ENERGIE STEIERMARK IP-based Power Grid Reconstruction

ENERGIE STEIERMARK

Austria's fourth-largest power supplier



Challenges

- PDH devices are expensive, and low bandwidth creates bottlenecks. A low-cost network upgrade solution is badly needed
- PDH devices are outdated and fault-prone. Devices are nearing EOS, and spare parts and maintenance are hard to guarantee
- The company worries that its IP network is unreliable and unable to meet production service requirements

Solution

- Huawei NE routers were chosen for an E2E IP/MPLS network that carries multiple converged services
- PCM subcards access relay protection services
- GE/FE interfaces are used to access office services
- IP hard pipe technology is used to carry key services such as relay protection that ensures SDH-like low latency
- U2000 unifies management of devices and simplifies O&M

Benefits

- Production and office services are carried on the IP network, improving network performance and reducing costs
- Unified NMS helps improve O&M efficiency and minimize O&M costs
- IP hard pipe is used to ensure low latency and high reliability of the network and fulfill production service requirements
- IP/MPLS network is technically advanced, highly scalable, and meets the requirements of future development