

NOKIA

Nokia IP routing solutions
for mission-critical
utility networks



Market situation

Power utilities today face momentous challenges created by the combined forces of energy transition, AI data center build-out, electrification and climate change. They have an urgent need to modernize their aging grid infrastructure so they meet rising energy demands and ensure the reliability, resilience and security of essential energy services.

Utilities are addressing these challenges by stepping up their investments in smart grid technologies such as IEC 61850 and centralized protection, automation and control tools. These technologies promise to help them build agile and resilient grids that can respond to changing conditions in real time and withstand increasingly frequent inclement weather events. At the same time, utilities must continue supporting existing mission-critical substation applications such as protective relays and SCADA remote terminal units (RTUs). Adding to these requirements are heightened concerns about grid security. Utilities are strengthening their defenses against evolving cyberthreats, including the looming risks posed by quantum computing.

At the heart of this transformation is the mission-critical network, the digital foundation that connects substations, operations centers and data centers. This network needs to support an increasingly complex mix of technologies, from legacy time-division multiplexing (TDM) interfaces such as IEEE C37.94 and serial connections to intelligent electronic devices (IEDs) speaking Ethernet/IP-based IEC 61850 protocols, and compute resources running virtual protection automation and control (VPAC) and grid management applications in OT cloud.

This complexity is putting significant strain on aging SONET/SDH communication infrastructures. To keep pace, utilities need to transition to IP/MPLS networks and use their advanced capabilities to deliver application-aware communications for TDM and IP/Ethernet services. These capabilities will allow them to support legacy protective relays, SCADA RTUs and IEC 61850 IEDs with precise frequency and time synchronization distribution across the grid.

Utilities also need to counter escalating cybersecurity threats, including those enabled by quantum computing, by deploying advanced quantum-safe IPsec and MACSec encryptions. And because the pervasive use of substation CCTV cameras and sensors continues to drive up bandwidth use, they must ensure that their networks can scale to 100 GE and 400 GE to support these technologies and future high-capacity services.

To successfully navigate this transformation journey, utilities need to act now. Evolving their networks to IP/MPLS or Segment Routing (SR) will provide the foundation for meeting the evolving demands of the energy transition while enabling reliable, efficient and sustainable power delivery for the years ahead.



Nokia IP routing: Setting the standard for mission-critical networks

The Nokia IP routing portfolio sets the benchmark for reliability, flexibility and performance in mission-critical networks and supports tailored solutions for organizations in the energy, transportation and public sectors. The portfolio features many product families, each with variants designed to address evolving demands for access, aggregation, edge and core IP routing applications. It also includes data center switching and interconnect solutions for IT and operational technology (OT) clouds.

Utilities can choose from a comprehensive range of Nokia IP routers and switches purpose-built for substation environments:

- The 7705 Service Aggregation Router (SAR) product family provides interfaces for key technologies such as cellular, Ethernet, TDM and SONET/SDH.
- The 7250 Interconnect Router (IXR) product family provides high port density to enable scalable connectivity.
- The 7210 Service Access System (SAS) product family features utility-grade Ethernet substation switches that are passively cooled and rated up to IP50.

At the core of these products is the Nokia Service Router Operating System (SR OS) software, which delivers consistent, simplified and highly reliable IP network operation.



How Nokia IP routing meets the needs of mission-critical utility applications

Adaptable, high-performance architecture

The 7705 SAR uses a network processor-based architecture designed to deliver exceptional processing performance and continuous support to new applications and protocols. These capabilities ensure a long operational lifespan.

High-capacity, high-speed interfaces

The 7250 IXR platforms support scalable bandwidth up to 400GE interfaces. Pluggable 100ZR/ZR+ and 400ZR/ZR+ coherent optics enable seamless convergence of IP and optical networks with high bandwidth and speed.

Advanced synchronization and timing

Equipped with robust timing capabilities, including support for the 1588 Precision Time Protocol (PTP) telecom profile and power profile and the interworking of these profiles. Built-in Global Navigation Satellite System (GNSS) receivers add great value by enabling redundant network timing.

Feature-rich SR OS software

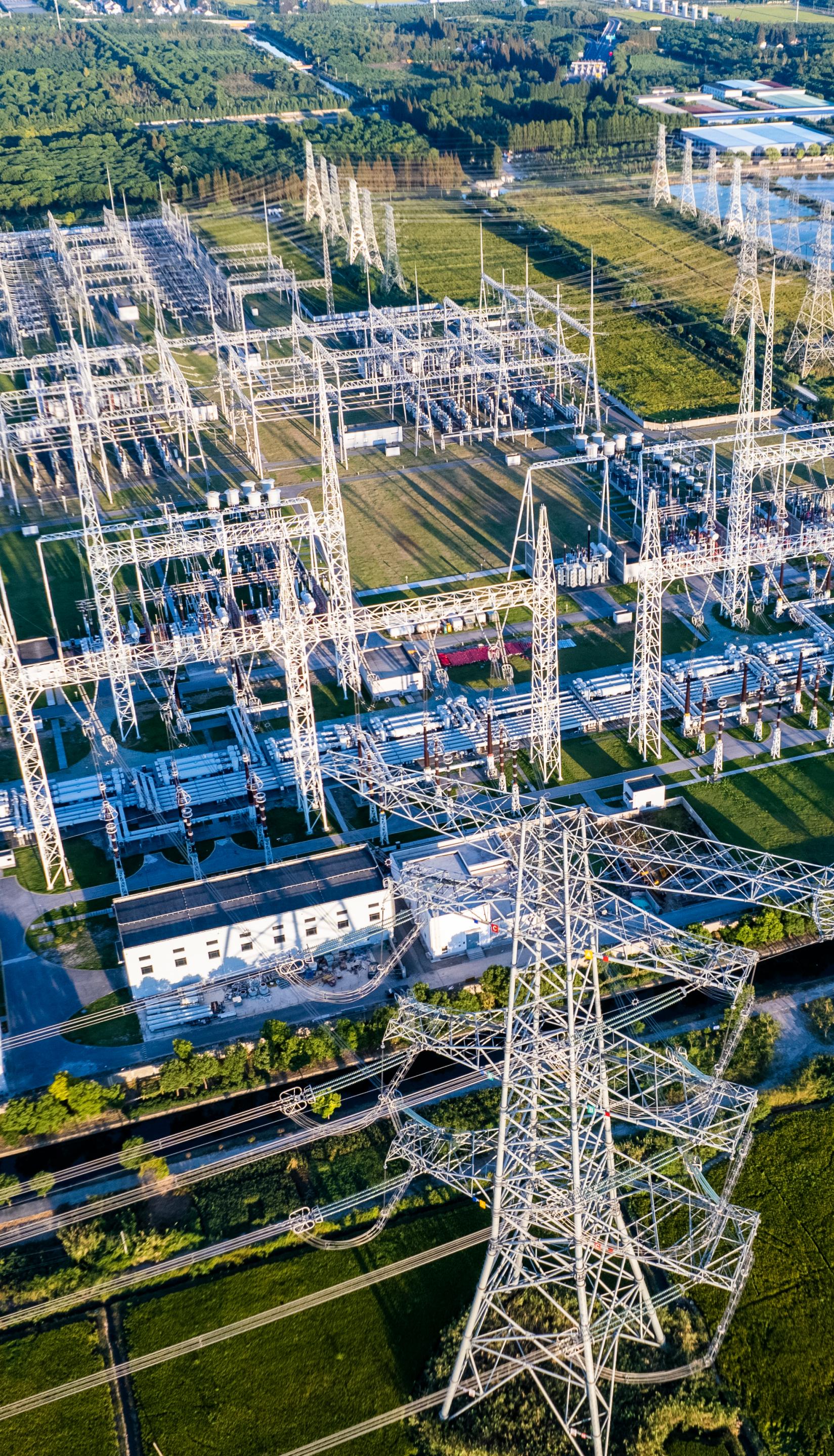
SR OS offers advanced IP/MPLS functionality and operations, administration and maintenance (OAM) features. These include Asymmetric Delay Control (ADC) for mitigating network asymmetry and Active Multipoint Pseudowire (AMP) for hitless redundancy protection, which ensure that the network can meet the stringent requirements of demanding applications such as differential protection.

Secure network connectivity

Our IP portfolio offers a multifaceted approach to network security. It provides strong data encryption using various methods, including MACsec, Nokia ANYsec, Network Group Encryption (NGE) and IPsec. The Network Address Translation (NAT) capabilities of the 7705 SAR family enhance security by obfuscating internal addresses and providing firewall-like functionality.

Rugged, reliable and energy-efficient design

Engineered to withstand extreme temperatures, humidity and harsh environmental conditions, our IP platforms feature a hardened design complemented by PCB enhanced plating (PEP), conformal coating and passive cooling for enhanced durability. The power-optimized system design significantly reduces energy consumption and lowers operating costs without compromising performance.



New additions to our IP routing portfolio

Nokia is committed to continuous investment in building reliable mission-critical networks. As part of this commitment and in response to customer demand, we are introducing the industry's first fully redundant, modular, fan-less IP/MPLS system, built specifically for power utilities, with integrated cybersecurity features.

Ruggedized for substations, the 7705 SAR-10x provides eight flexible adapter cards for both legacy and Ethernet applications.

Figure 1. 7705 SAR-10x



- Fully modular chassis design
- Redundant and hardened
- Passive cooling
- Built-in security features



Nokia IP routing portfolio for utility substations

Improving protocol support for utility applications

The 7705 SAR-10x, Mx and Hx platforms are compliant with IEEE 1613-Class 2 and IEC 61850-3 standards for power utility applications, with PEP and conformal coating for power supply units (PSUs) and fans. They share common HDVC/AC or low-voltage power supplies and adapter card modules that support legacy or Ethernet interfaces. Additionally, the 7705 SAR-10x is a fully redundant router engineered with no single point of failure and hot-swappable components for rapid, low-risk maintenance. The design maximizes uptime for mission-critical applications and supports modular upgrades to keep the investment relevant as bandwidth demands grow and as applications migrate to Ethernet-based interfaces.

Evolving network management interface

The Nokia SR OS offers a model-driven management layer alongside classic interfaces such as SNMP and CLI. The model-driven interface uses YANG models and model-driven APIs (MD-CLI, gRPC) to represent device configuration, state and operations in a consistent, machine-readable form. Utilities gain advanced programmability for structured, rule-based configuration and streaming telemetry that pushes real-time state and statistics to northbound systems. These capabilities help maintain a secure, resilient operational environment and achieve interoperable, deterministic, and highly observable substation and grid automation systems aligned with NIST Cybersecurity Framework and IEC 61850 best practices.

Bringing 4G/5G to FANs

The 7705 SAR-Hm/Hmc platforms support 4G and 5G New Radio (NR) with Reduced Capability (RedCap), part of the 3GPP Release 17 standard. With this 5G-capable platform, power utilities can leverage the reliability and security of 5G networks while benefiting from lower power consumption, reduced data rates, and lower device complexity.

Figure 2. Nokia IP routing portfolio for utility substations



Network automation for power utilities with NSP Utilities

Our IP portfolio is integrated with the Nokia Network Services Platform (NSP), a transformative network automation solution that enables utilities to manage their mission-critical communication networks with unparalleled efficiency, agility and reliability.

NSP Utilities supports the end-to-end management of converged IP/MPLS networks, packet optical and microwave transport, and the essential services that connect utility grid assets, ensuring seamless and proactive operations. It accelerates digital transformation and is a key enabler that helps utilities implement smart grid technologies and achieve their energy transition goals.

Five ways NSP helps utilities

1. Accelerated network deployment and flexibility

NSP Utilities reduces deployment times by more than 75% through intuitive, template-based configuration tools, automated provisioning and real-time auditing. This improved agility allows utilities to deploy smart grid applications efficiently and keep up with evolving demands.

2. Proactive service assurance

NSP Utilities leverages AI-based analytics, rules-based alarm notifications and advanced operations to help utilities prevent service disruptions before they affect grid operations. This can enable an 85% reduction in mean time to repair and improve grid reliability.

3. Enhanced grid resilience and efficiency

Through unified management of the IP/MPLS, FAN and wide area network (WAN) domains, NSP Utilities ensures reliable connectivity for critical applications, including Supervisory Control and Data Acquisition (SCADA), teleprotection and synchrophasor measurements. These capabilities improve grid performance while reducing operating costs.

4. Support for smart grid and sustainability goals

NSP Utilities supports IEC 61850 automation by enabling seamless integration of distributed energy resources and advanced grid capabilities such as fault location, isolation and service restoration (FLISR). This helps utilities achieve their net-zero emissions goals and transition toward greener energy.

5. Improved operational visibility and decision-making

NSP Utilities has robust analytics and reporting tools, including the Control Plane Assurance Manager (CPAM), that provide utilities with actionable insights into network performance and usage. These insights empower utilities to optimize their networks, reduce costs and anticipate future needs.

Nokia IP routing features and benefits

We provide a comprehensive portfolio of IP routing products and automation solutions that help utilities take network performance, reliability and security to new levels while simplifying their network operations. Meticulously tailored for utility applications, our portfolio simplifies the adoption of modern IEC 61850 standards for enhanced grid communication and control while supporting graceful TDM migration for critical legacy applications such as differential protection and SCADA.

Crucially for power grid operations, our IP routing portfolio uses advanced time synchronization capabilities such as the power profile, profile interworking and precise PTP performance monitoring to deliver the accuracy required for complex grid management applications.

The IP routing portfolio also forms the core of Nokia Quantum-Safe Networking (QSN), which enables utilities to protect their grid data against quantum-enabled cyberattacks. The QSN solution implements a layered, defense-in-depth security

approach featuring quantum-safe cryptography. It safeguards data confidentiality, integrity and authenticity against evolving cyber threats, including those posed by future quantum computers.

By enabling utilities to consolidate disparate networks and simplify maintenance processes, our IP routing portfolio delivers tangible benefits, reducing operating costs while boosting network reliability and security posture.

Leveraging the Nokia difference

Our hardware and software designs deliver performance, sustainability, resiliency, longevity and investment protection. They offer specialized connectivity that addresses all utility networking needs, including FANs, WANs, converged OT and IT, and network security. We back our utility solutions with expertise proven in more than 2800 customer environments. Nokia is the only vendor that offers a comprehensive portfolio of network equipment, software, services and licensing opportunities across the globe.

Our IP network products and solutions are built on a foundation of excellence and innovation in routing. They can help you:

- Build networks to connect your distribution systems, substations, operation centers and data centers.
- Scale your network efficiently and sustainably without compromising service quality.
- Meet national security requirements and provide secure and reliable connectivity for your grid infrastructure.



Learn more about our IP routing solutions for utilities

Industry web page: [Power utilities](#)

Product web page: [7705 SAR](#)

Product web page: [7250 IXR](#)

Product web page: [7210 SAS](#)

Brochure: [Network Services Platform for power utilities](#)

Portfolio web page: [IP networks portfolio](#)

IP routing poster: [Nokia IP routing portfolio](#)

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About Nokia

Nokia is a global leader in connectivity for the AI era. With expertise across fixed, mobile, and transport networks, powered by the innovation of Nokia Bell Labs, we're advancing connectivity to secure a brighter world.

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