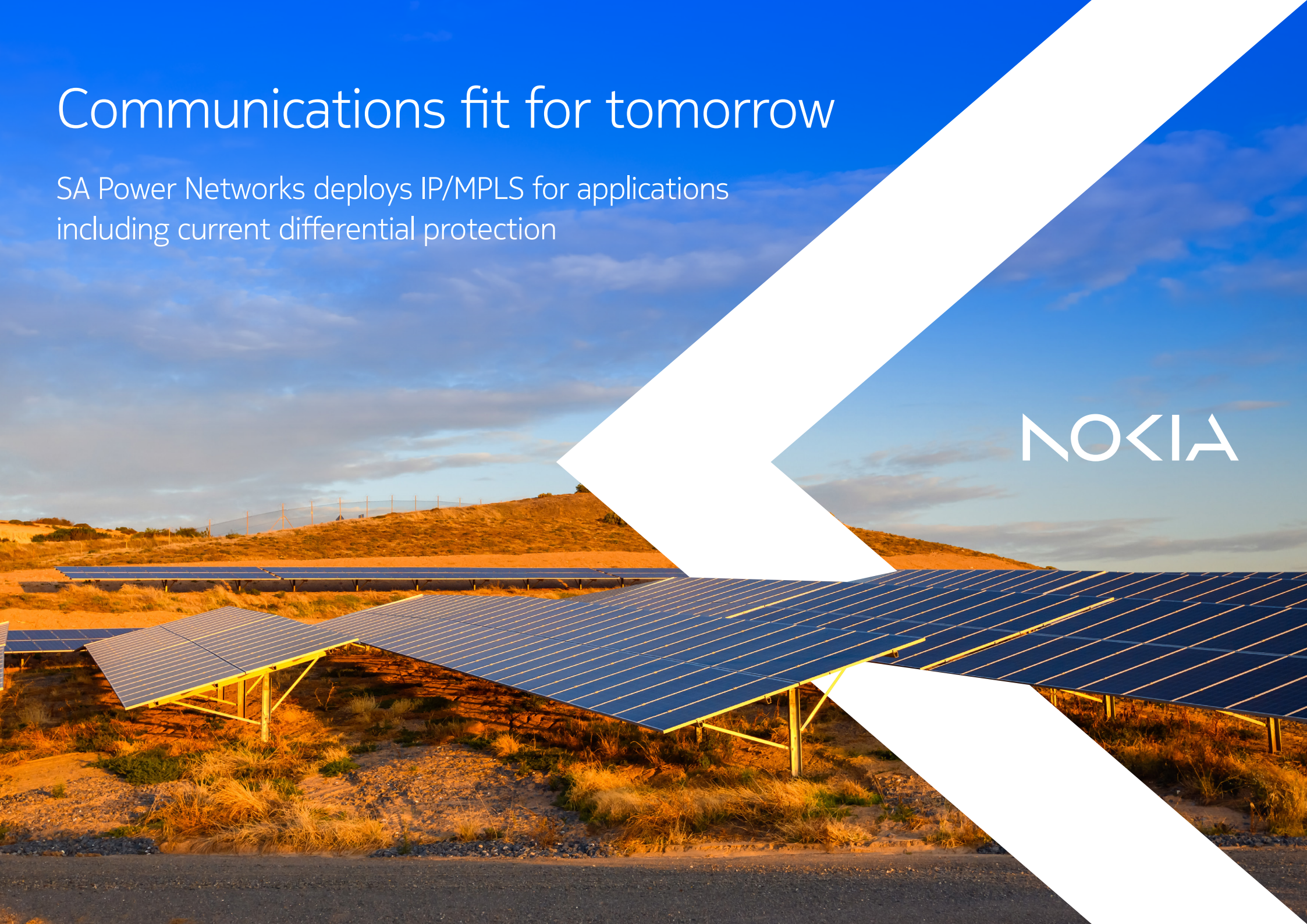


Communications fit for tomorrow

SA Power Networks deploys IP/MPLS for applications including current differential protection

NOKIA



SA Power Networks is the sole electricity distributor in South Australia, serving 900,000 homes and businesses. The company's creativity has been recognized by its inclusion in the AFR BOSS Most Innovative Companies List, which ranks Australian firms. SA Power Networks' innovations include training drones to use artificial intelligence for asset inspection, and sharing information on vegetation works with customers through an online portal. SA Power Networks is running a world-leading trial on solar power, enabling Adelaide households to export up to 10kW per phase from their panels.

To ensure the grid meets the changing energy demands of the future, effective communications will be vital. SA Power Networks' existing communications network used Nokia Dynanet and Dynaflex multiplexers, based on Plesiochronous Digital Hierarchy/Synchronous Digital Hierarchy (PDH/SDH) technologies. PDH/SDH infrastructure is becoming increasingly difficult to maintain as it approaches the end of its life.

While SA Power Networks' PDH/SDH network remains reliable and secure, it no longer meets the needs of the modern grid. For example, GOOSE, which is used by future protective relay communications, is an Ethernet-based protocol. A broad range of other applications for situational awareness and grid control, including CCTV and transformer monitoring, require IP.



About SA Power Networks

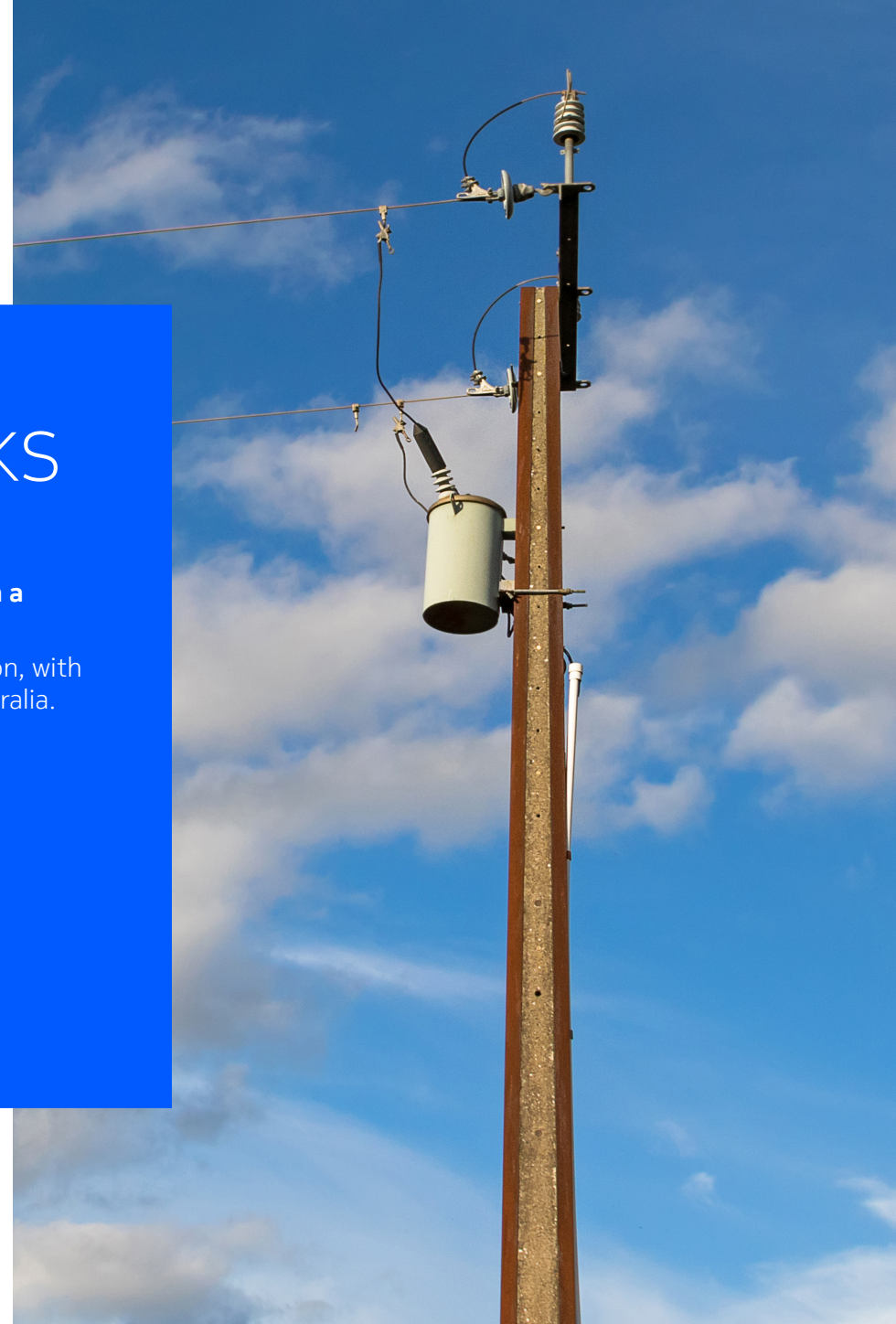
SA Power Networks has consistently ranked as the most efficient distributor on a state-wide basis in the Australian National Electricity Market (NEM).

SA Power Networks is at the forefront of the distributed energy resource disruption, with South Australia experiencing the highest level of solar rooftop penetration in Australia.

The SA Power Networks grid serves 900,000 homes and businesses.

It comprises:

- A 178,000km² service area
- 400 zone substations
- 77,800 street transformers
- 640,000 stobie poles
- 200,000km of overhead conductors and underground cables



Choosing IP/MPLS

Selecting a technology to replace the aging PDH/SDH infrastructure was a big decision. The new technology was to play a central role in grid reliability and versatility for the next ten years or more.

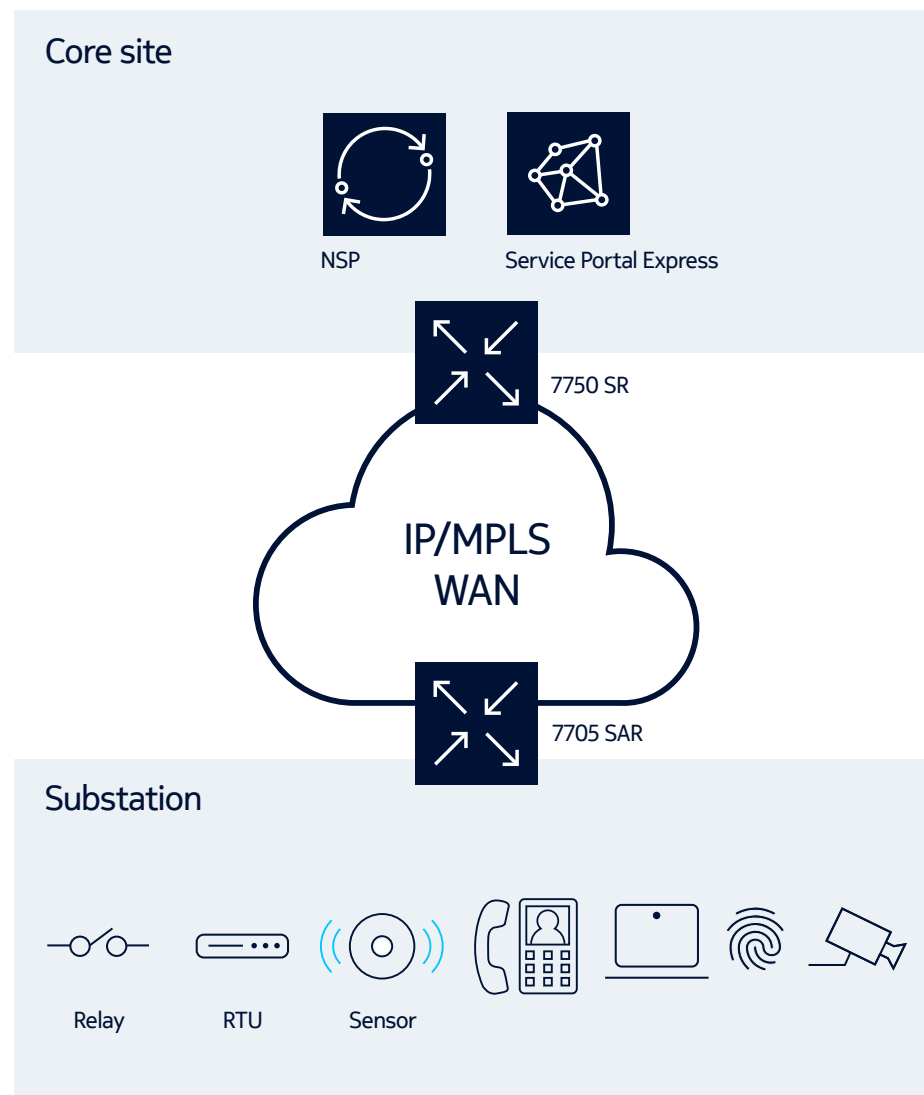
The answer? Internet Protocol/Multiprotocol Label Switching (IP/MPLS). It supports modern IP-based applications, and enables SA Power Networks to converge all its communications into a single network infrastructure. That includes current differential protection, distance teleprotection, SCADA, telephony and remote access and management. IP/MPLS is backed by mainstream telecommunications vendors, so SA Power Networks was confident the technology would have support for the network's lifetime.

The network infrastructure chosen is the well-proven Nokia IP/MPLS Mission-Critical WAN. This includes:

- Nokia 7750 SR-a8 routers at main core sites
- Nokia 7705 SAR router family (SAR-8, SAR-18, SAR-A and SAR-Hc) at substations to address specific bandwidth and interface needs
- Nokia Network Services Platform (NSP)
- Nokia Service Portal Express for Utilities

The Nokia routers provide network connectivity between substations and the control centers. In the substations, the routers offer a wide range of interfaces for connecting new and legacy equipment. These include RS-232 found on SCADA remote terminal units (RTUs), and C37.94 and G.703 co-directional interfaces on differential relays.

Using a single management system, SA Power Networks can create IP/MPLS services and manage the network from end to end. The new infrastructure is supporting legacy virtual leased line (VLL) and virtual private networks (VPNs). It is also supporting IP/Ethernet VPNs such as Virtual Private Routed Networks (VPRNs) and Virtual Private LAN Services (VPLS).



Communications for the modern grid

Using the new IP/MPLS infrastructure and IP/MPLS services, SA Power Networks can support a wide range of services with different Quality of Service (QoS) requirements.

These include:

- Current differential protection and teleprotection (C37.94, G.703 co-directional)
- SCADA for grid measurement data (serial and Ethernet)
- Remote engineering access
- Substation monitoring
- Substation security services, such as CCTV and access control
- Operational telephone - voice over IP (VoIP)
- Corporate LAN
- Remote access to protection and control (serial and Ethernet)
- Future GOOSE-based differential protection
- Full site environmental monitoring

The new network also provides a high-capacity, IP-enabled WAN. This supports SA Power Networks' future operating model, which anticipates growth in solar PV, microgrids, battery storage, and electric vehicle charging.



To ensure this critical network infrastructure transformation was a success, SA Power Networks involved the secondary systems and protection teams early on to ensure their buy-in. There was thorough testing across all the company's protection relay types.

Most importantly, SA Power Networks ensured that the IP/MPLS network was designed upfront for the stringent requirements of teleprotection. Current differential protection and distance teleprotection are working on the IP/MPLS network with no degradation. In some cases, they are more reliable on the new network than they were before. "We found that the IP/MPLS network operated more reliably with fewer bit error rate alarms compared with the previous PDH/SDH network in some instances," said Geof Axon, telecommunications planning and engineering manager, SA Power Networks.

Also key to the project's success was the close collaboration between SA Power Networks and Nokia as equal partners. Each company brought its domain expertise. As part of this collaboration, Nokia provided comprehensive professional services which included preparing requirements documents, detailed design documents, test plans, and migration strategies.

Using the new IP/MPLS network infrastructure and management software, SA Power Networks can create new network services more quickly with greater flexibility. The ability to use any network topology and transmission medium with IP/MPLS makes it easier for SA Power Networks to add new nodes.

Nokia NSP and Service Portal Express for Utilities give SA Power Networks end-to-end visibility of the health and performance of the communications network. The tools also enable SA Power Networks to troubleshoot and find the cause more quickly if there is a network fault.

The new network infrastructure can save money by converging all existing and future communication services.



Ready for tomorrow

Thanks to the Nokia IP/MPLS Mission-Critical WAN, SA Power Networks has a flexible, reliable, and secure communications infrastructure. It improves grid reliability today, and prepares the grid for the demands of tomorrow.

“We chose IP/MPLS because it allowed convergence of all our existing and future communications services, including current differential protection and distance teleprotection.”

Geof Axon, Telecommunications planning and engineering manager, SA Power Networks

- i **National Survey Report of PV Power Applications in Australia**, International Energy Agency Photovoltaic Power Systems Programme, 2019
- ii **Clean Energy Australia Report 2021**
- iii **Future energy - SA Power Networks**
- iv **SA Power Networks, Future Operating Model 2016-2031**

Challenges

- Replace the PDH/SDH network that was becoming difficult to maintain.
- Support new IP-based applications, including GOOSE and CCTV.
- Deliver a network with reliable deterministic QoS for teleprotection.
- Prepare the grid for the future operating model with greater penetration of solar power, microgrids, battery storage, and electric vehicle charging.

Solution

- SA Power Networks deployed the Nokia IP/MPLS Mission-Critical WAN.
- The full range of 7705 SAR industrial routers (SAR-8, SAR-18, SAR-A and SAR-Hc) at substations offers a rich set of interfaces for new and legacy equipment.
- Nokia NSP and Nokia Service Portal Express for Utilities provide a single end-to-end management solution for the communications network.
- The IP/MPLS infrastructure supports operational requirements including current differential protection and teleprotection, SCADA, substation monitoring, telephony and remote access and management.
- The network can also be used for other IP based services, including CCTV and operational telephone.
- Nokia worked closely with SA Power Networks on implementation and consultancy.

Benefits

- SA Power Networks can migrate away from the PDH/SDH network quickly, while keeping the lights on and minimizing risk.
- The new communications network is easier to manage, with a single infrastructure serving all of SA Power Networks' communications needs.
- SA Power Networks can easily add nodes as the grid grows, and can manage the network using a single end-to-end tool suite.

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At Nokia, we create technology that helps the world act together.

As a B2B technology innovation leader, we are pioneering networks that sense, think and act by leveraging our work across mobile, fixed and cloud networks. In addition, we create value with intellectual property and long-term research, led by the award-winning Nokia Bell Labs.

Service providers, enterprises and partners worldwide trust Nokia to deliver secure, reliable and sustainable networks today – and work with us to create the digital services and applications of the future.

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