Harness the power of n

Stories from optical networking heroes
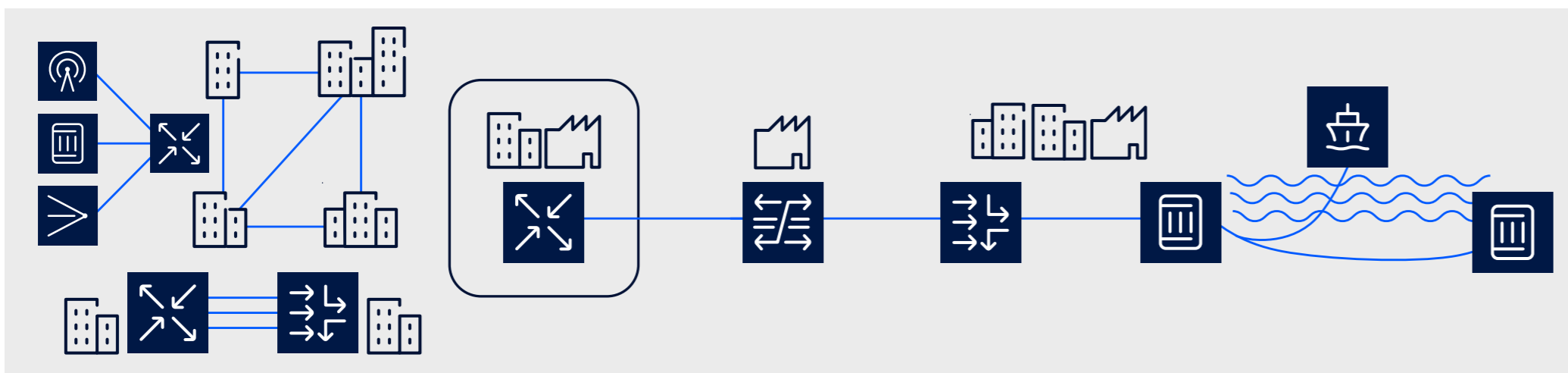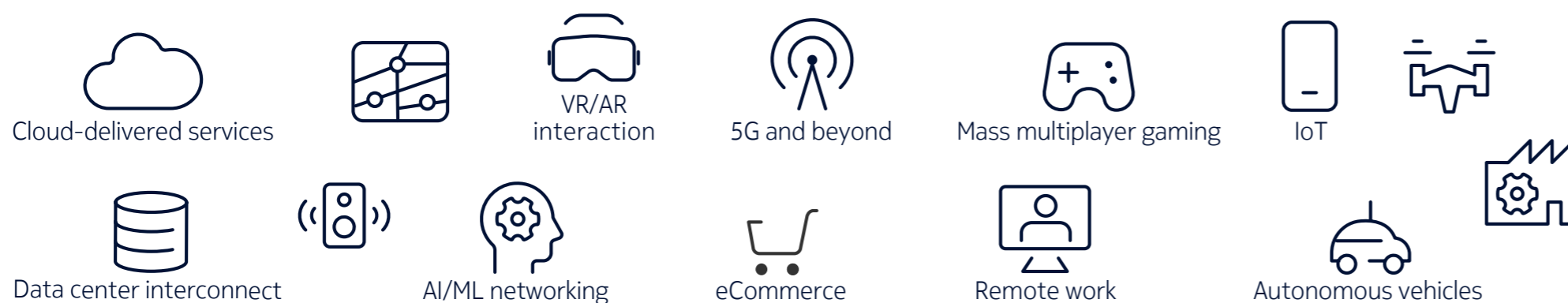
NOKIA

Optical networking **heroes**

Our service provider, webscale and network operator customers tell us that optical networks are critical to their goals of increasing network scale while lowering total cost of ownership (TCO). They provide the foundation for services that define the daily lives of people everywhere, delivering the robust redundancy and resilience required to enable always-on services.

Nokia optical networks make it easy to harness the exponential potential of networks to transform how we all live and work. They seamlessly scale capacity, support a wide range of existing and emerging protocols, and deliver guaranteed service level performance and security. In many cases, they rely

on optical transport network (OTN) technology to deliver time-division multiplexing (TDM) and packet services over a shared, common infrastructure while maintaining traffic separation between different users. These capabilities help service providers meet today's demands and prepare their networks for tomorrow's services.

We have heard many stories of how optical networks are helping to deliver new services with higher performance and better customer experiences in more cost-effective and sustainable ways. We would like to tell some of these stories through the eyes of the heroes that are making them happen – our service provider customers.

Industry trends impacting optical network evolution

Cloud-delivered services   VR/AR interaction   5G and beyond   Mass multiplayer gaming   IoT

Data center interconnect   AI/ML networking   eCommerce   Remote work   Autonomous vehicles

Networks that **transform**

Delivering the ultimate customer experience

Optical network transformation helps service providers create monetization opportunities by using high capacity and speed to offer advanced services such as cloud connectivity, virtual private networks (VPNs) and content delivery networks (CDNs). Many of our customers are finding innovative ways to generate new revenue and get the most out of their optical networks with high-value services that support new ways to work and play.

For Deutsche Telekom, offering the ultimate customer experience means using innovative products and technologies to provide the best fixed and mobile network coverage, bandwidth and stability. According to Dr. Erik Weiß, VP Optical Transport Core, "We are transforming our optical network to give our customers a highly differentiated service quality of experience, and to be more responsive to their new services needs while also reducing our network TCO."

Nokia helped Deutsche Telekom build a wavelength-division multiplexing (WDM) core and end-to-end OTN network, including the metro and access portions, to simplify network scaling and automation. By using OTN switching at regional distribution sites within Germany, the company can efficiently aggregate and groom traffic as it enters and exits the long-haul network . And by deploying Nokia coherent optics, including 600 Gb/s-capable fifth-generation Photonic Service Engine (PSE-V) line cards and the 1830 Photonic Service Switch (PSS) alongside the WaveSuite software platform, Deutsche Telkom can address growing demand for bandwidth in residential and industrial settings.

Swisscom faces surging bandwidth demands driven by increasing use of remote work and learning applications, video streaming, gaming and cloud computing.

The company believes that network modernization is the key to scaling the network so that it can address these demands. According to Christoph Aeschlimann, CIO and CTO, "Swisscom has set out its network expansion strategy...to equip the network for the new decade," He highlights Swissom's "commitment to delivering a high-capacity, fully automated nationwide optical backbone for Switzerland."

Nokia helped Swisscom modernize its optical network using the 1830 family of WDM/OTN platforms. This included providing OTN access at customer premises and WDM/OTN access and aggregation in the metro and core to improve capacity and bandwidth efficiency.

Swisscom also wanted to automate network and service management processes, with an emphasis on orchestration control across diverse network components to reduce operational effort and cost. Nokia addressed this need by using the WaveSuite portfolio of network automation applications to help with network commissioning, service enablement and analytics-driven operational improvements. Nokia WavePrime services, including Digital Twin as a Service, helped Swisscom use a cloud-hosted digital representation of the physical network to optimize network performance, reliability and resource utilization.

The network cloud paradigm is a new transformational shift for achieving an excellent user experience.

Networks that **scale**

Building networks to meet capacity demand

Service providers need to scale their optical networks to meet the growing demands of consumers and businesses for high-speed, high-capacity communication services. To keep pace with increasing adoption of video streaming, cloud and Internet of Things (IoT) services, optical networks need the ability to handle larger amounts of data with greater efficiency. By scaling their networks, providers can ensure that they have the capacity and capability to support new applications and revenue streams and deliver reliable, high-quality services.

Few providers know this better than India's largest communications service provider, Reliance Jio, which offers mobility, fiber broadband and enterprise services to a fast-growing subscriber base. The company is deploying Nokia optical transport solutions to enhance network capacity and reliability across their nationwide footprint.

These new solutions allow Jio to offer innovative, high-capacity services to underserved regions, along with a nationwide long-distance (NLD) service. According to Jyotindra Thacker, President at Reliance Jio, "Nokia's next-generation DWDM portfolio provides the ability to scale easily as Jio continues to expand the network to reach the underserved areas of India with digital services…"

Reliance Jio has deployed the Nokia 1830 PSS and 1830 Photonic Service Interconnect (PSI) product families across multiple network layers, from metro access to the core. The deployment uses the innovative PSE chipset to optimize capacity/reach, along with high capacity packet optical transport network (P-OTN) swtiches. It also uses GMPLS intelligence to support capacity management and restoration. Reliance Jio's deployment ensures that the company will be able to meet the changing needs of its customers and remain at the forefront of the industry.

WINDTRE, one of the leading telecommunications companies in Italy, was also looking to scale its optical backbone to provide high-capacity and reliable transport services to its customers throughout the country. The company deployed a cost-effective DWDM solution powered by the Nokia fifth-generation PSE-Vs chipset to support programmable line rates of up to 600G on a pure photonic infrastructure. This solution allows WINDTRE to optimize power consumption and reduce its network footprint.

Benoit Hanssen, Chief Technology Officer at WINDTRE, said that "Nokia's solution based on industry-leading coherent technology will help us provide next generation broadband services to both consumer and business customers in the most efficient way…"

The solution also features redundant nodes in a wave router configuration, a mesh structure and restoration based on Generalized Multiprotocol Label Switching (GMPLS). These capabilities enable the new infrastructure to instantly re-route traffic as needed to provide high reliability and service robustness.

Higher-capacity router interfaces drive the need for faster wavelengths. Today, the norm is 400GE, but 2023 and beyond will see a new surge in 800GE.

High performance and power efficiency
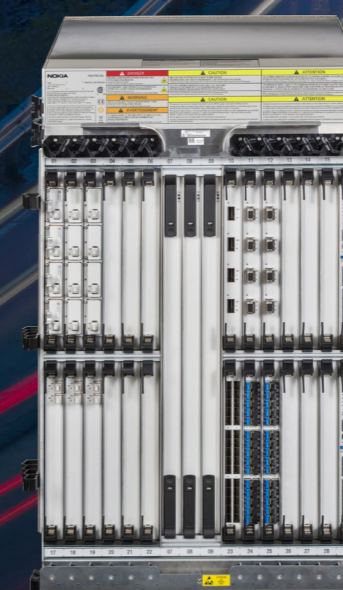
0.56 W/G

0.17 W/G

–69%
Reduction in power consumption

1830 PSS-24X

9.6Tb Gen 1

24Tb Gen 4

Networks that **connect**
Better optics for the evolution of data center interconnect

Big changes are happening in the world's data center market. The sector is growing and more workloads, applications and and data are moving to the cloud and becoming more distributed. Businesses and the webscale operators they depend on see an increasing need for massive scale and capacity to support this major transition.

Optical networks can support data center interconnect (DCI) by providing reliable, high-capacity and low-latency communication links between data centers. OTN also provides advanced network management and control capabilities that enable better monitoring and enhanced reliability. By using the strengths of optical technology, service providers can meet the growing need for data center connectivity and improve the performance and reliability of their networks.

In northern Europe, GlobalConnect is connecting all major cities, large data centers and global network hubs with new optical technology from Nokia. This robust and modern technology will enable the company to provide up to 100 times higher capacity, increase customer speeds to 400 Gb/s and reduce delivery time from months to a few days.

"By expanding and upgrading the network, we will be able to provide our clients with new opportunities in the shape of lightning-fast connections," said Martin Lippert, CEO of GlobalConnect.

Nokia and GlobalConnect recently demonstrated a record 1.2Tb/s coherent transmission over a single wavelength in a live network using Nokia PSE-6s optics. According to Martin Højriis Kristensen, Head of Market and Operations at GlobalConnect, "This trial highlights GlobalConnect's commitment to offering scalable and flexible high-bandwidth services across our Nordic backbone network."

NL-ix, Europe's largest distributed internet exchange, has deployed market-leading Nokia WDM/OTN technology to create multi-terabit optical links that significantly increase capacity between its European points of presence (PoPs). The new network supports client services from 1 Gb/s to 400 Gb/s, providing plenty of room for growth.

According to Jan Paul Dekker, CTO at NL-ix, "The modularity of Nokia's next-generation optical transport solutions enables us to adapt and respond quickly to market demand and provide an even better quality of service and connectivity experiences for our customers."

Viettel, Vietnam's largest telecom service provider, recently completed its first DWDM network, which operate at 600G per wavelength. The network uses innovative Nokia PSE-Vs optical engines transmitting at 600 Gb/s per channel in the C-band to connect Viettel's main core sites. This new DCI solution will enable Viettel to meet future requirements for robust, low-latency, high-capacity networking for 5G and cloud, and keep pace with growing consumer demand for online video and internet content.

The growing use of IoT devices and more sophisticated machine learning algorithms leads to higher demand for cloud computing power in data centers.

Omdia predicts that the global DCI market will reach US$7.2 billion by 2027.

Networks that **digitalize**

Harnessing the power of the cloud

Cloud service providers allow enterprises, webscale companies and other service providers to cut costs by using cloud services instead of operating their own infrastructure. To ensure that their customers can get the most from the cloud, cloud service providers need to connect data centers with high-speed, low-latency optical links.

For Liquid Intelligent Technologies, a leading provider of pan-African digital infrastructure, the requirements are clear. Shahzad Manzoor Khan, Group Chief Technology Officer, says that "Internet giants, established cloud service providers and other mega-organizations are demanding hyperscale data centers that can support high levels of performance, spikes in demand and redundancy while enabling massive availability."

The company chose to deploy next-generation optical transport based on the Nokia 1830 PSS to provide massive capacity to enterprises, hyperscalers and mobile operators. Khan adds, "Our new terrestrial fiber corridor is the first of its kind in Africa in terms of distance and capacity." The corridor links subsea landing stations in three countries and creates a digital highway with capacity up to 12 Tb/s.

The new optical backbone covers the sites with a colorless–flexgrid ROADM network that improves agility and flexibility. A GMPLS feature reduces network disruptions by enabling automatic rerouting to alternate paths as needed. With these capabilities, Liquid Intelligent Technologies can offer a best-in-class digital infrastructure to Africa's enterprises while strengthening the contintent's digital infrastructure.

Faced with growing demand for reliable high-speed connectivity between regions, NorthC, the largest regional data center provider in the Netherlands, implemented technology to enable integrated IP and optical data center interconnection. This involved creating a single virtual data center by connecting ten regional data centers in the Netherlands within a high-speed Region Connect Ring. Customers in any of these data centers can take advantage of high bandwidth and low latency for data applications, connections and cloud services.

According to Mario Hangjas, senior director of information technology at NorthC, "The Region Connect Ring allows customers to directly access network and cloud services that are not available in their own region." This was made possible by combining the high-performance Nokia 7750 Service Router with the high-capacity Nokia 1830 PSS and SDN automation enabled by the Nokia Network Services Platform (NSP). This combination helps NorthC meet its bandwidth, latency and performance needs while reducing service delivery times from days to hours.

Digital transformation requires the extraction of meaningful information from data, gathered by IoT sensors and devices. And the the high speed and low latency links needed to access this data.

Networks that **innovate**

Optical networks at the forefront of technology

Telecom networks are owned and operated by wholesale carriers that have developed new business models that involve selling their network as a service (NaaS). These carriers sell network capacity to other telecom service providers that, in turn, use it for services such as Wi-Fi and data center solutions. Upgrades to next-generation P-OTN solutions are creating significant opportunities for communication service providers (CSPs) to offer new services and grow revenue through wholesale service delivery.

The wholesale business model can support deterministic end-to-end services across traditional services and new segments. These include mobile network slicing and backhaul, data center interconnect, wholesale transport for retail CSPs or business customers, smart power grids and residential broadband backhaul. Each service has its own requirements for speed, latency, availability and security.

CSPs need to be able to scale capacity easily and support a wide range of existing and emerging protocols while delivering guaranteed service-level performance and security over a shared network infrastructure. OTN uses a digital wrapper to encapsulate TDM and packet services, providing a robust and efficient transport protocol that ensures hard isolation between different users across a common infrastructure. This proven optical transport technology helps CSPs scale their networks with more capacity and new service options while ensuring that they can meet strict SLAs.

Nokia OTN solutions have earned praise from customers for their capabilities in enabling wholesale service delivery. According to Wilfrid Puyo, Product Manager, Optical Transport at Swisscom, "Nokia's OTN

architecture and WaveSuite automation tools help us efficiently deliver existing 100 Mb links in large numbers, and soon expand that to 400 Gb links to meet the rising traffic demand for our fixed-mobile convergent networks while guaranteeing our customers the level of service they demand with relative ease."

Juan Jose Marfil Marquez, Director IP and Optical Networks, Telefonica Spain, says that Nokia "OTN and DWDM give us tremendous flexibility to scale networks in-step with our end customer needs for capacity, reliability and applications. It allows us to be responsive to our customers' needs." CSPs such as Swisscom and Telefonica see clear benefits from OTN networks that deliver high service-level performance and security in an efficient and scalable way.

OTN also offers high reliability. Jan Flemming Henriksen, Head of Optics, GlobalConnect, says, "By using OTN switching, we are able to offer our customers high-capacity 400GE DCI services while also improving our ability to support our classic low-capacity services in the future, with new high-availability options, increasing service reliability."

52%
of workloads are primariliy executed in public cloud environments.

Customers,also value OTN because it supports a broad mix of traditional and new services. Alberto Maria Langellotti, Head of IP, Transport & SDN Engineering, TIM Italy, says, "We see a great opportunity in using OTN as it enriches the value of our already performing photonic network, enabling the support of premium services for wholesale service providers and enterprises, ensuring to our customers high service-level performance and security, as well as providing an efficient and scalable way to support TDM service replacement."

Networks that **perform**
Mission-critical network evolution

Mission-critical networks provide organizations with an optimized, resilient, reliable, highly secure and scalable infrastructure. They play a critical role in sustaining communication in verticals where network outages are unacceptable, such as transportation, healthcare and smart cities.

Redes Energeticas Nacionais (REN), the Portuguese Transmission System Operator (TSO), wanted to upgrade its optical transport network to improve the capacity and reliability of its mission-critical network infrastructure. REN's optical transport layer connects more than 25 gas and electrical substations across the country with 1,600 km of optical fiber. The upgrade includes market-leading Nokia DWDM/OTN technology and maintenance services.

Inês Lucas, IT Director, REN, said, "We have partened with Nokia and Axians to upgrade REN´s optical transmission network and provide maintenance support during its full lifecycle." The solution brings new capabilities such as network slicing to guarantee capacity and latency for mission-critical communications services running over REN's high-capacity long-haul transmission network.

Similarly, Nokia is providing Red Eléctrica de España (REE), a Spanish TSO, with an IP/MPLS and DWDM solution to upgrade the company's existing network. REE uses this 800-site network to control and manage a nationwide transmission grid. The new IP/MPLS and optical transport networks from Nokia provide significantly more bandwidth to REE and its subscribers, with capacities up to 100 Gb/s. They also help REE improve efficiencies.

Manuel López Cormenzana, Director of Transmission Infrastructure Maintenance at REE, said, "REE is a key player in the energy transition…so we need to have

the best tools with which to carry out our mission with the highest possible quality, safety and efficiency. In this sense, modernizing our communications network is vital in order to advance in the digitalization of our processes and to enable advanced management of transmission assets."

Nokia is also supplying the world's largest power utility, State Grid Corporation of China (SGCC), with a backbone OTN network. This network gives SGCC the capacity, operational efficiency and intelligence it needs to support the Chinese power grid and provide highly reliable service to its broad customer base.

Bandwidth demands and complexity increase as power utilities such as SGCC adopt the IoT to support the creation of smart grids. The Nokia solution, which consists of the Nokia 1830 PSS-x P-OTN family, is helping SGCC make a swift transition to this new reality, while improving overall reliability of the power grid and significantly reducing daily operating costs. The rollout builds on a previous P-OTN deployment.

Zhang Huijian, Vice General Manager of SGCC Tianjin Electric Information & Communication Corporation, said, "The new OTN network can provide better technology support for communications, deliver higher levels of security and reliability for the power grid, and raise operational efficiency, while improving the business environment to help us deliver better services to our customers."

Utilities are a leading adopter of IoT, implementing smart grid solutions to drive efficiency. The focus on smart grids (IoT) and workforce mobility is creating new opportunities for service providers.

The road ahead

Service providers and network operators must be prepared to meet growing capacity demand as more devices and users connect to their networks. The development of the metaverse and the broadening of virtual worlds are directly tied to connectivity. They require high peak data speeds, ultra-low latency and greater reliability to deliver a uniform experience. In addition, the use of advanced machine learning and artificial intelligence algorithms will require huge amounts of computing power, real-time rendering and AI computing capabilities. High-speed optical networks have an important role to play in providing access to this data and serving up new services to consumers and businesses alike.

To prepare for these new demands, service providers need to invest in network infrastructure and technology to increase their capacity in a sustainable way. This may involve expanding fiber optic networks, upgrading data centers and adopting new technologies such as 5G and edge computing. Network operators must also consider the impact of new technologies such as IoT and artificial intelligence, which will generate even more data and require more capacity.

Service providers must also focus on network optimization to maximize capacity. This may involve implementing QoS mechanisms to prioritize certain types of traffic over others, or using transport slicing techniques to isolate different traffic flows based on underlying SLA requirements. Service providers can also use advanced analytics tools to monitor network performance and identify areas where capacity can be improved.

Finally, service providers must be prepared to manage the complexity of their networks as they grow. This includes ensuring that they have the right skills and expertise to manage their networks, as well as investing in automation tools to streamline network management processes. Service providers also need to be prepared to work with key partners to ensure that their networks can handle the demands of new and emerging technologies.

With their investment in optical networks from Nokia, our network heroes are already on a strong path to tackling new service opportunities as they arise.

Ready to chart your course?

Start here

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.