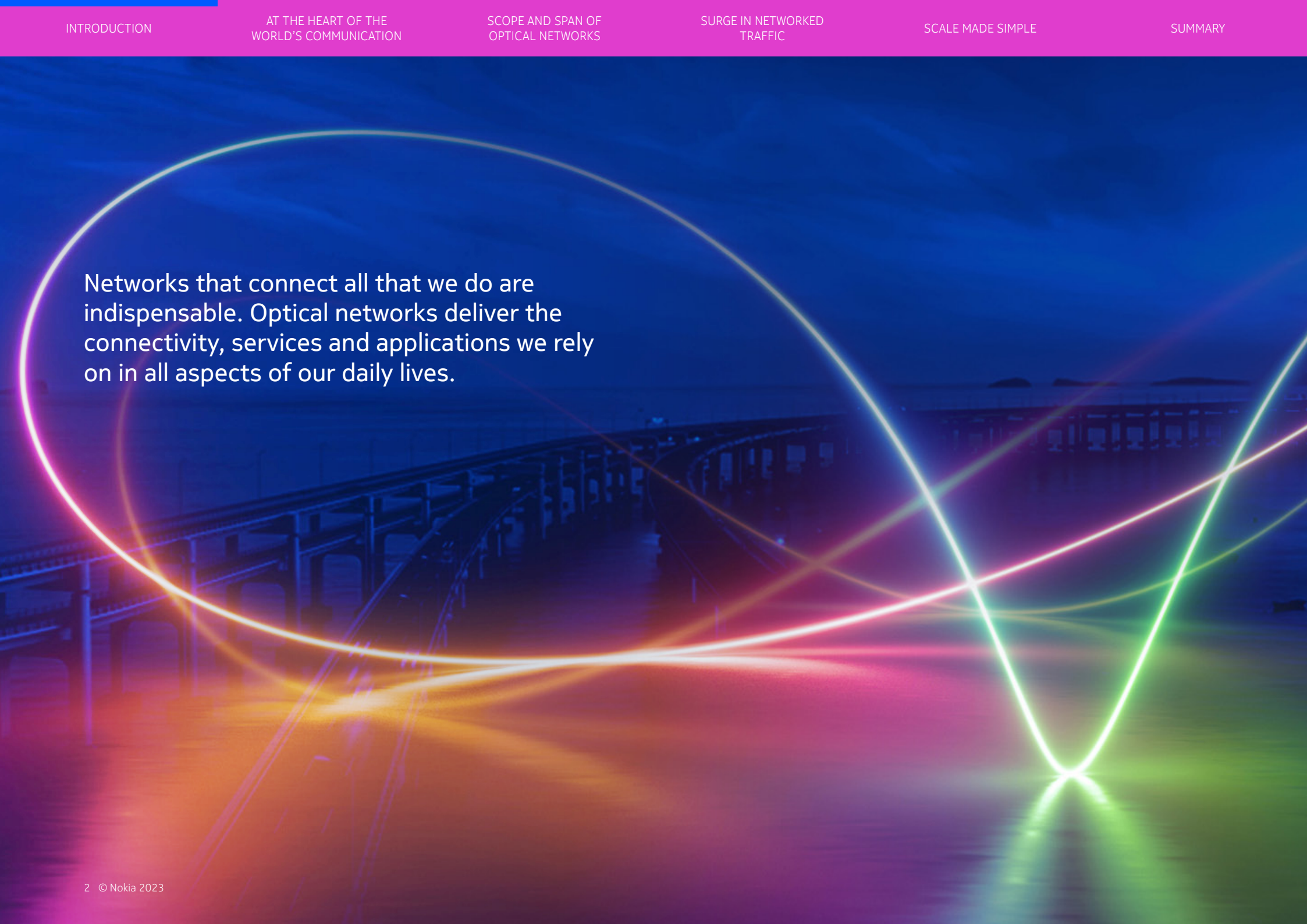


The background of the advertisement is a night cityscape with tall buildings and streetlights. A large, white, diagonal arrow-like shape points from the top-left towards the bottom-right. In the foreground, there are several glowing, colorful light trails in shades of blue, purple, and orange, suggesting motion and technology. The overall aesthetic is futuristic and high-tech.

NOKIA

SCALEMADESIMPLE

Innovate for scale, simplified operations and reduced complexity in optical networks



Networks that connect all that we do are indispensable. Optical networks deliver the connectivity, services and applications we rely on in all aspects of our daily lives.

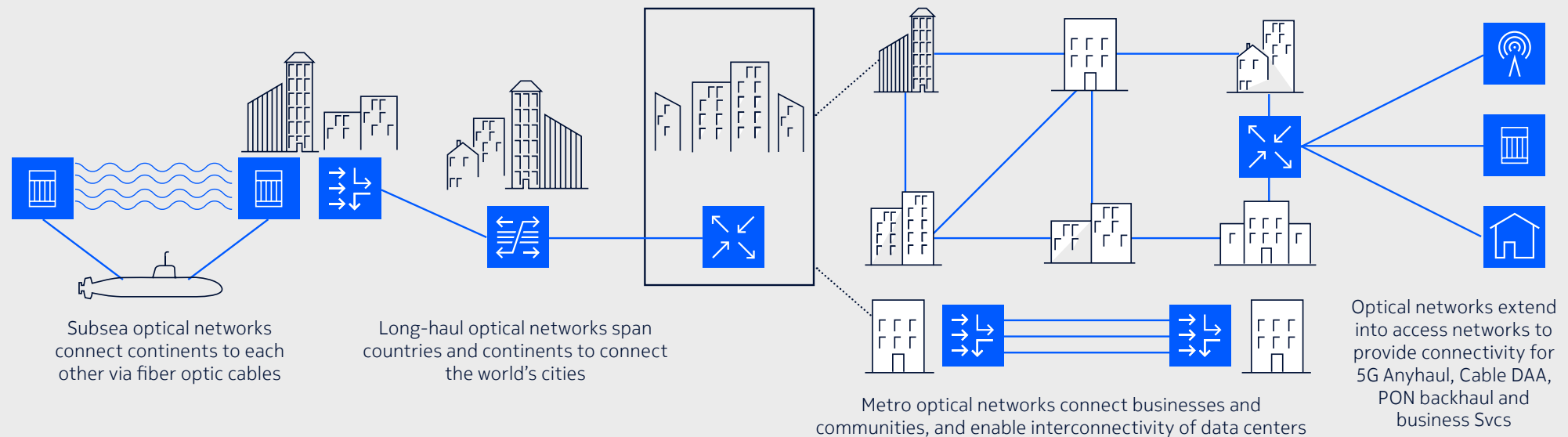
Optical networks at the heart of the world's communication

Today's services and applications consume and require the ability to transmit massive amounts of data across the globe. Whether we make a phone call or join a video-chat, stream our favorite show, order products online, or collaborate with co-workers remotely, the information that enables these interactions is comprised of digital data, which may originate anywhere on the globe and connects people over telecommunications networks.

The underlying infrastructure that enables this data to move around consists of optical networks. The benefit of optical networks is their ability to transmit massive amounts of data over practically any distance. No matter the access method used to connect the end-user – radio or microwave signal, copper or coax cable or fiber to the home – optical networks provide the most scalable and economical means of transferring massive amounts of users' data over distance: within and between data centers; across neighborhoods, cities and countries; and between continents.

Scope and span of optical networks

A wide range of network applications



New cables bring high-bandwidth intercontinental connections, creating a global web of connectivity over millions of kilometers of optical fiber.

National and continental optical networks require continual scaling, and provide the foundation for our and daily connectivity and national security.

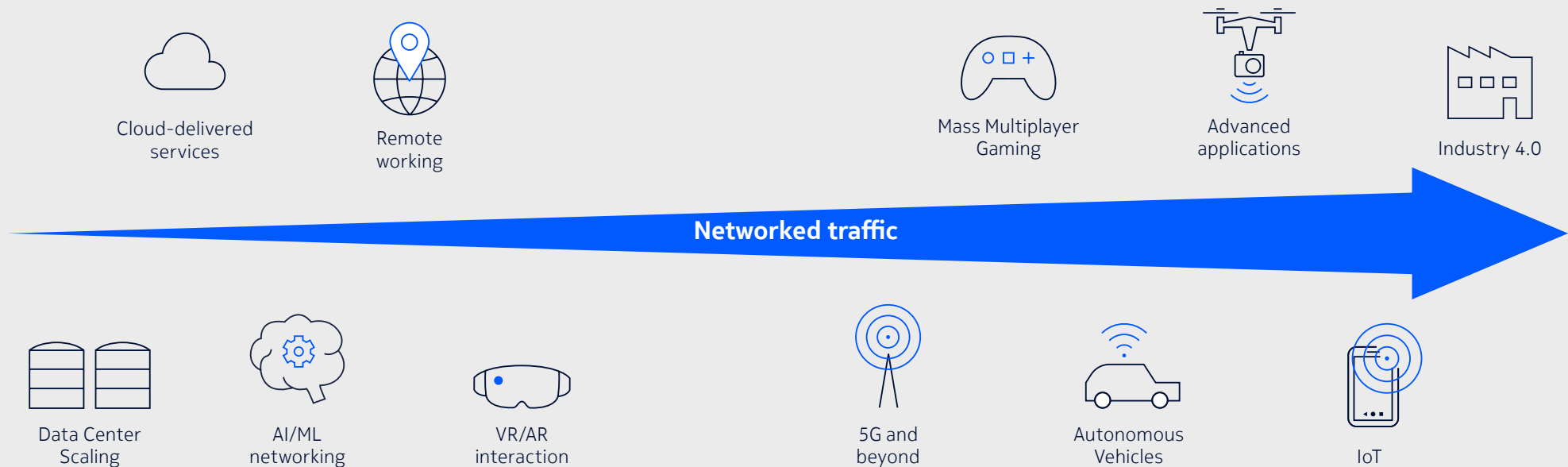
Metro networks are scaling to support all aspects of our data traffic growth. Cloud-hosted enterprises, interactive video for gaming and entertainment, ever-greater data center build-out and interconnection; all of these over metro networks.

Data connectivity originates at the edge. Whether the application is fiber-based PON connectivity, 6G, VR/AR, or cloud-hosted enterprise, the end-user always needs more bandwidth. Silicon photonics and coherent optics deliver this growth capability.

Surge in networked traffic

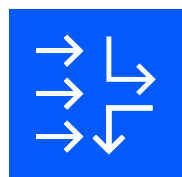
While global network capacity has grown a hundredfold in the past decade, it's still not enough to meet surging demand from new applications and more users, new users, and new and more advanced devices. The growth of bandwidth-intensive applications will require network capacity to yet another 100 times increase over the next decade.

To achieve the ever-growing capacity requirements, today's networks must prepare to scale without limits from its remote edges all the way to the core, while at the same time reducing complexity and increasing efficiency in day-to-day network operations.



SCALE MADE SIMPLE

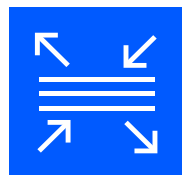
Scaling and simplicity of optical networks is enabled by continuous advances across four primary solution areas



Coherent optics provide the Photonic Service Engines that power optical networks, providing ongoing scaling of both capacity and reach to minimize cost/bit-km across metro, long-haul and subsea networks.



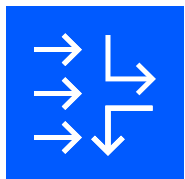
Optical Line Systems enable network scaling with Wavelength Division Multiplexing (WDM) solutions that maximize the capacity across the C and L bands of the fiber spectrum, with a full range of ROADM solutions that enable flexible wavelength management.



P-OTN Switching platforms optimized for edge, metro and core applications provide highly efficient, reliable and scalable solutions to manage a wide range of business, wholesale and transport services.



Optical network automation enables networks to adapt to outages in real-time, automatically retransmitting data along alternate paths, and help operators scale while streamlining their operations, reducing manual effort and improving reliability.

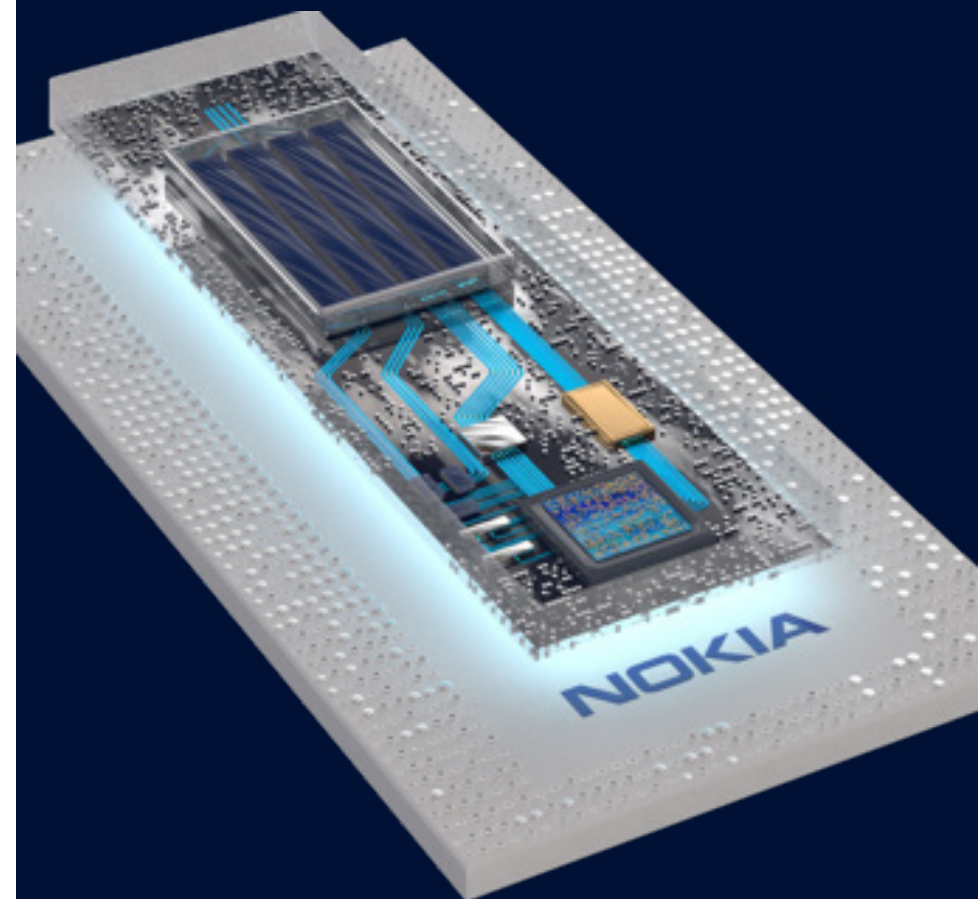


Coherent optics

Coherent optics power the “wavelengths” in Wavelength Division Multiplexing (WDM). Coherent optics are the coherent Photonic Service Engines that power optical networks, and scale the maximum data rate at which each wavelength can scale to.

For network operators, that means either transmitting over regional, long-haul or subsea networks, where either maximum capacity-reach performance is needed, or in metro networks, where simplicity and modularity scaling to the edge.

Photonic Service Engines (PSE) closely integrate coherent modems with high-speed optics in Digital Coherent Modules (DCOs). Nokia Compact PSEs optimized for low power and pluggability maximize scaling and reduce power consumption for metro-regional applications, while Super-Coherent PSEs enable the highest capacity-reach performance in regional, long-haul and subsea networks.





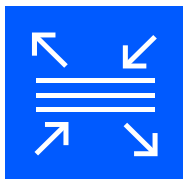
Optical Line Systems

Optical Line Systems light the fiber in optical networks. Optical Line Systems combine multiple coherent wavelengths into a single optical fiber, and can switch those wavelengths to different destinations, whenever needed. Optical line systems are the highways, autobahns and freeways of optical networks, sending data where it needs to go over any distance.

Continued growth in needed network capacity requires optical line systems to support ever-more wavelengths over the optical fiber networks, enable new fiber deployments to scale to even higher capacities, and scale reconfigurable wavelength switching over more wavelengths, bands, and directions.

The number of wavelengths transported and switched over optical line systems scales by using more spectrum in the fiber, in both the C-band and L-band. This doubles the capacity of an optical fiber, and today Nokia solutions enable scaling up 60 terabits per second of data per fiber, while new advances in fiber technology will enable even greater scaling.





P-OTN Switching

P-OTN Switching manages the end-to-end connection of end-user data over optical networks. While coherent optics and optical line systems enable the transfer of massive amounts between locations, P-OTN switches adapt and connect that data to its end-users.

Applications such as network slicing, network wholesale, synchronization-as-a-service and network-as-a-service (NaaS) require high-reliability, granular and managed bandwidth services. In other cases, business services, first responders, financial and utility operators and governments require survivable, secure and dynamic networks.

P-OTN switches provide the connectivity for guaranteed, always-on, scalable and efficient bandwidth management of this data. At the network edge, P-OTN platforms must adapt a wide range of packet, storage and TDM services to OTN containers, in compact and power-efficient form-factors. In core networks, P-OTN switches can switch tens of Terabits of bandwidth of traffic connecting metro and long-haul networks, with integrated coherent optics and supporting new data interface speeds such as 400 Gigabit Ethernet.





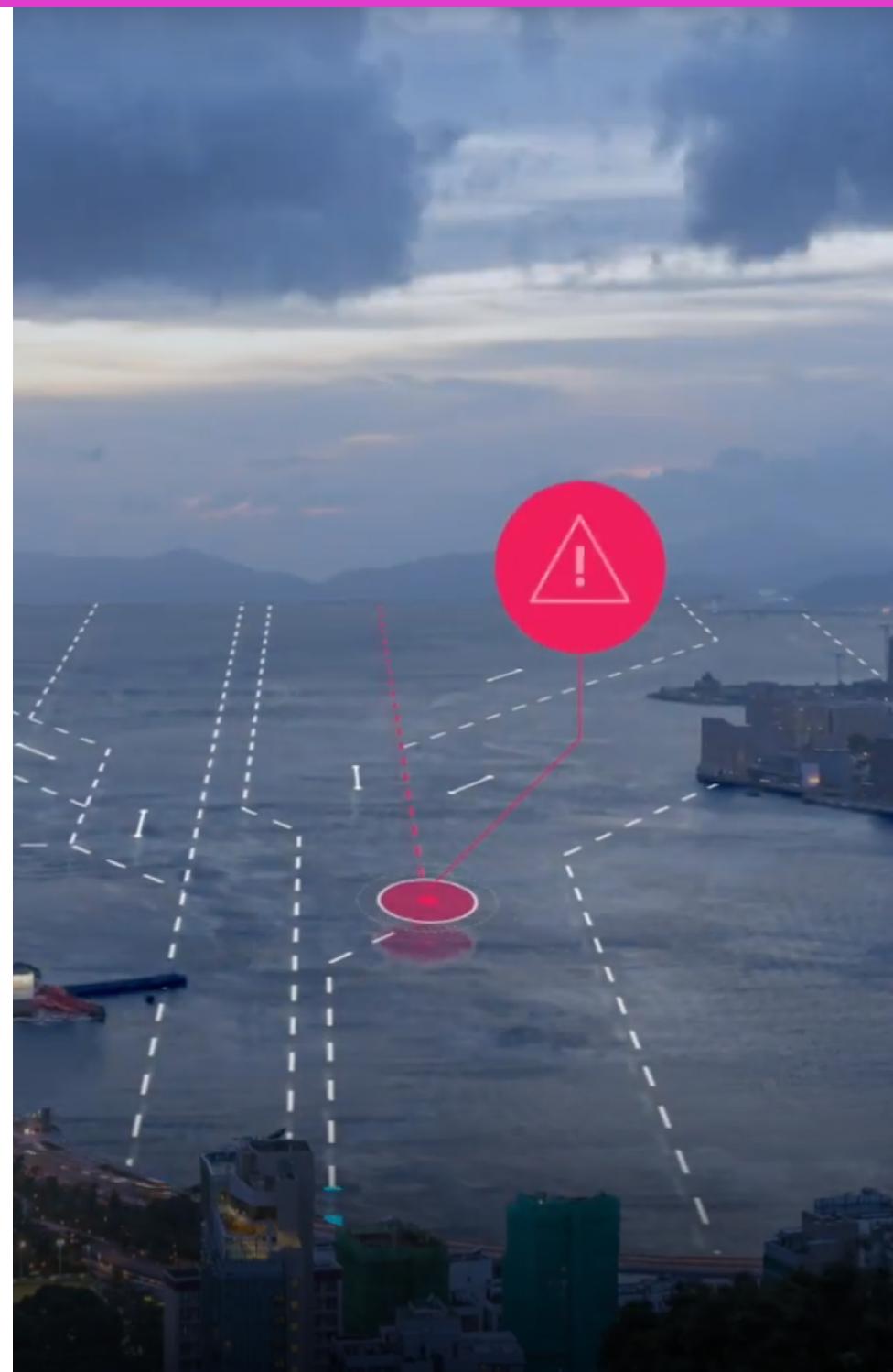
Optical network automation

Optical network automation leverages software to automate how networks are managed, reconfigured, and helps deliver the capacity that drives revenues. With ever-increasing bandwidth demands, the scale and size of optical networks is continually increasing, and the operational resources which govern them need to become faster, simpler and more efficient in order to keep pace, while helping grow new service and revenue opportunities. Optical network automation addresses the challenges to eliminate operational complexities and inefficiencies while delivering on a differentiated intent-driven customer experience.

Network automation allows operational tasks which have long been performed manually and potentially leads to errors and consequent downtimes or delayed service turn-up to be streamlined, automated and used to improve overall network performance.

Automation of network health and analytics activities leverages network troubleshooting, KPI and performance monitoring to reduce intensive and error-prone manual interventions. Key outcomes include resource optimization based on real-time network performance, and enables networks to adapt to outages in real-time, automatically retransmit data along alternate paths, reducing manual effort and improving reliability. Service enablement automation helps network operators enhance business agility, reduces operational costs and accelerates the development of new revenue-generating services.

Intent-driven and intelligent optical automation makes networks proactive rather than reactive giving operators peace of mind as they scale, while simultaneously streamlining their operations.



At Nokia, we are driving the evolution of optical networks.

Stay ahead of massive bandwidth demands, simplify and optimize architectures, while lowering costs of network operations.

That's scale made simple.

nokia.ly/scale-made-simple



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About Nokia

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

As a B2B technology innovation leader, we are pioneering the future where networks meet cloud to realize the full potential of digital in every industry.

Through networks that sense, think and act, we work with our customers and partners to create the digital services and applications of the future.

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