Coherent Routing

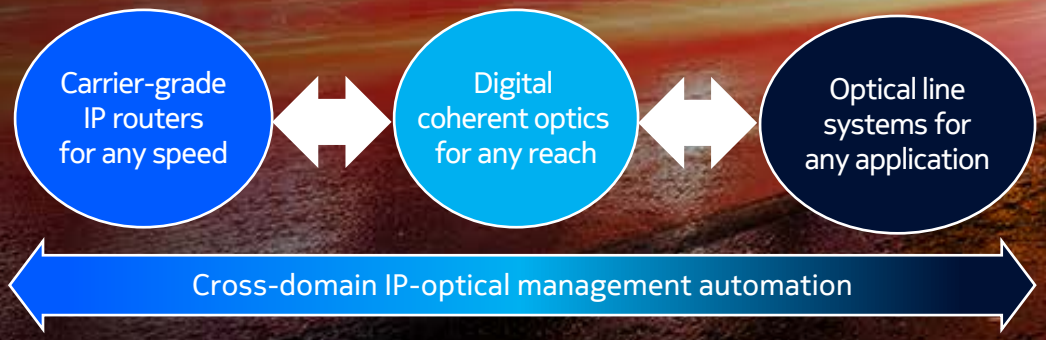
Build application-optimized IP-optical networks with digital coherent optics

NOKIA

Nokia coherent routing

Relentless demand for more capacity at a lower cost per bit is forcing network operators to constantly upgrade and optimize their IP-optical network designs. Coherent routing leverages a new breed of digital coherent optics (DCOs) that can be equipped in small pluggable form factors such as QSFP56-DD, to connect routers directly over DWDM Wavelengths.

The Nokia Coherent Routing solution lets you combine the power of digital coherent optics (DCOs) with Nokia IP routers, optical line systems and cross-domain network automation to build cost-efficient and scalable IP-optical network designs for 400GE and beyond.

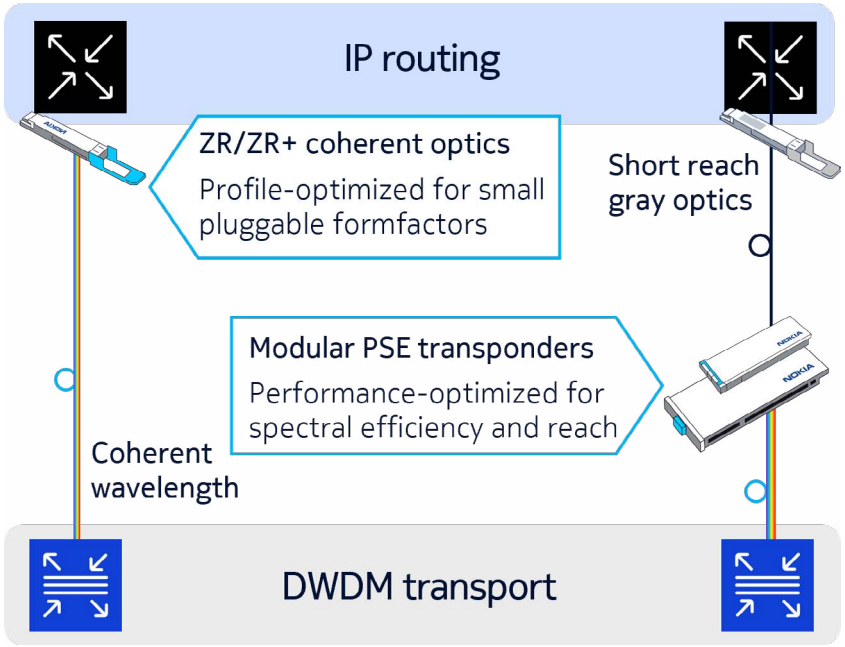


Digital coherent optics for any reach

Coherent routing applications must carefully balance performance requirements of coherent transceivers such as link capacity, reach and spectral efficiency, with operational constraints such as rack space, power and cooling facilities. Nokia offers a full range of pluggable and modular solutions in different formfactors to help network engineers optimize capacity, cost and performance for any link:

ZR and ZR+ DCOs are profile-optimized for small pluggable formfactors and can be equipped in Nokia 7750 SR, 7730 SXR and 7250 IXR routing platforms.

- **400ZR** QSFP-DD DCOs are profile-optimized for high-density, single-span fiber applications such as 400G data center interconnect.
- **400ZR+** QSFP-DD DCOs are optimized for multi-span metro-regional applications with ROADMs. They support flexible 100 - 400G bit rates, multiple modulation types and can reach up to 1000km with the use of optical line systems.



Modular PSE transponders are performance-optimized for reach and spectral efficiency and can be equipped in Nokia 1830 PSI and 1830 PSS optical line systems.

- **400G Multihaul DCOs** leverage Nokia's PSE-Vc DSP technology to extend the 400ZR+ feature set to both Ethernet and OTN clients, while offering a higher launch power of up to 3 dBm.
- **Integrated transponders** with Nokia's PSE-6 super-coherent optics support 100 – 800Gb/s Ethernet and OTN transport for long haul, ultra long-haul and subsea applications.

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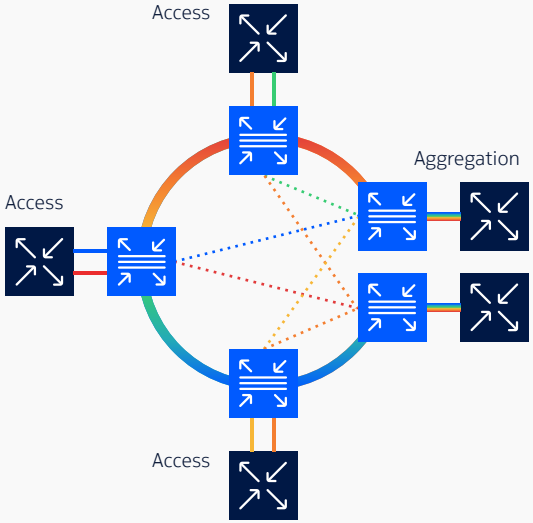
A full range of pluggable and modular coherent optics to cover any reach and application

Technology	100ZR (2H24)	400ZR	400ZR+	400G Multihaul	PSE transponder
Formfactor	QSFP28	QSFP56-DD	QSFP56-DD	CFP2, QSFP56-DD	Line card/sled
Line rate	100Gb/s	400Gb/s	100 - 400Gb/s	100 - 400Gb/s	Up to 1.2Tb/s
Reach (amplified)	Up to 300km	Up to 120km	Up to 1000km	Up to 1000km	Thousands of km
Modulation	dQPSK	16QAM	QPSK, 8/16QAM	QPSK, 8/16QAM	Shaped PCS
Power consumption	~5 Watt	~16 Watt	20 – 26 Watt	24 – 27 Watt	N/A
Transmit power	-8 to -4 dBm	-10 to -6 dBm	-10 to +1 dBm	0 to +3 dBm	>0 dBm
Client interfaces	100GE	400GE	100/400GE	100/400GE, OTU4/Cn	100/400/800GE, OTU4/Cn
ROADM support	Limited	No	Yes	Yes	Yes
Applications	Access	Metro	Metro/regional	Metro/regional	Metro/regional/Long haul

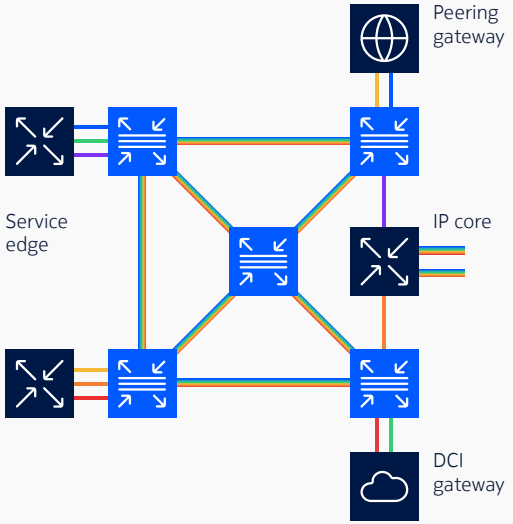
Metro access (dark fibres)

Data center interconnect (with amplifiers)

Metro-regional aggregation (C-F ROADMs)



Metro-regional edge/core (CDC-F ROADMs)



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Routers designed for pluggable coherent optics at any speed

While pluggable coherent optics use the same interface ports as short-reach gray optics, their power consumption and heat dissipation are much higher.

Nokia IP routers are designed and engineered for deployment of high-performance pluggable coherent optics at any speed with high port densities:

- Enhanced power and cooling for 400ZR and ZR+ QSFP-DD DCOs with 0 to 3 dBm output
- Line card options for both QSFP-DD and CFP2 DCOs on 7750 SR modular chassis
- All 7750 SR routers with FP5 hardware are future ready for 800ZR/ZR+ QSFP-DD DCOs

The Nokia IP routing portfolio enables you to deploy pluggable coherent optics anywhere in your network, for any application and at any speed:

- 100/400GE IP aggregation, edge, peering and data center interconnect. Nokia 7750 SR/SR-s (Nokia FP4)
- 100/400/800GE aggregation, edge, core, peering and data center interconnect. Nokia 7750 SR/SR-se (Nokia FP5)
- 100/400GE IP aggregation and edge. Nokia 7730 SXR service interconnect routers
- High density 100/400GE IP aggregation: Nokia 7250 IXR IP interconnect routers

Nokia 7750 SR-2se modular routing platform

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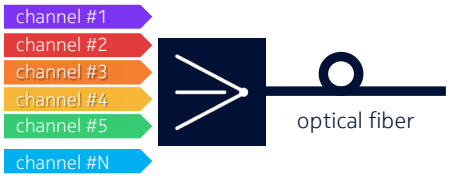
Optical line systems for any application

Optical line systems provide you with essential building blocks to deploy, coherent routing applications at scale with an optimal use of fiber assets.

Nokia 1830 PSS and PSI optical line systems let you efficiently deploy the full suite of IP over DWDM applications across any distance and topology.

DWDM multiplexors with in-line amplifiers let you maximize fiber capacity and reach for coherent wavelength transport.

Reconfigurable OADMs enable the dynamic provisioning and restoration of wavelengths between routers across any fiber topology, and transport IP traffic with the fewest number of routing hops and optical–electrical interface transitions.

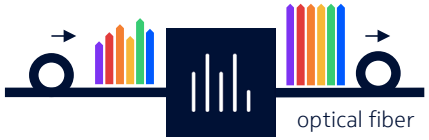


DWDM multiplexor

Combines wavelengths from multiple coherent optics into a single optical fiber to significantly increase fiber utilization compared to single-wavelength operation.

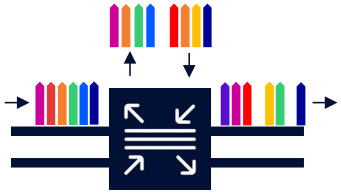
In-line optical amplifier

Monitor and boost power levels of wavelengths on fibers, increasing reach in a highly cost and power efficient manner over distances up to 1000 kilometers and more.



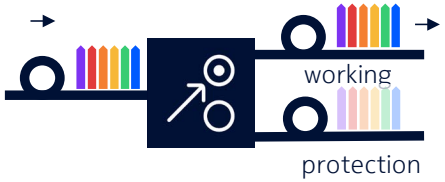
Dynamic gain equalizer

Integrated into optical amplifiers and ROADMs to ensure that the power levels of all WDM channels operate within optimized limits to maximize application performance.



Reconfigurable optical add-drop multiplexor

Selectively add/drop and switch wavelengths of any speed and color between multiple optical fibers and directions.



Optical Protection Switch

1+1 protection of wavelengths against fiber cuts or line-side equipment failure, avoiding the need for redundant IP interfaces.

Optical Time Domain Reflectometer (OTDR)

Real-time monitoring of fiber plant to detect and locate fiber cuts and signal degradation due to fiber impairments.

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The Nokia 1830 family of optical line systems offer an open and modular architecture that uses common hardware for ROADMs, in-line amplifiers and add/drop modules across a range of chassis sizes and formfactors.

The Nokia 1830 PSI-L is an open, disaggregated line system for IP-optical transport applications that do not require a coherent transponder, for example to interconnect IP routers with pluggable 400ZR+ DCOs.

The Nokia 1830 PSS is a modular, integrated optical line system that can optionally be equipped with coherent transponders for multi-service (Ethernet and OTN) transport over long distances, or for multiservice aggregation at speeds below 400Gb/s.

Nokia 1830 optical line systems deliver the following features and benefits for network operators:

Support for C and C+L band WDM transmission capabilities to maximize fiber capacity.

- Flexible and customizable equalized inline amplifiers (E-ILA), erbium-doped fiber amplifier (EDFA) and Raman-EDFA options maximize reach for the longest fiber spans.
- WDM multiplexing options for 400ZR/400ZR+ support point-to-point and ROADM-switched metro-regional applications.
- Colorless–Flexgrid (C-F) and Colorless, contention-less and Directionless Flexgrid (CDC-F) ROADM capabilities for optimal scale and topology flexibility.

The QSFP-DD-LS pluggable line system is a simple and compact solution for 400ZR applications.

It plugs into a 400G QSFP-DD router port and contains an 8-channel optical mux/demux with integrated Tx/Rx line amplifiers. While consuming only 3 Watts, it can interconnect up to eight 400ZR DCOs via a single fiber pair over distances up to 120km.

Nokia WaveSuite applications simplify network management, planning and assurance of your optical transport network and the provisioning of wavelength services end-to-end.

SDN-based control coordination through open, industry-standard APIs enable the programmability of optical line systems together with pluggable DCOs in routers.

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IP-optical management coordination

Interconnecting routers in metro and regional transport networks often requires provisioning IP link connections across multiple fiber spans with optical line systems such as ROADMs and amplifiers.

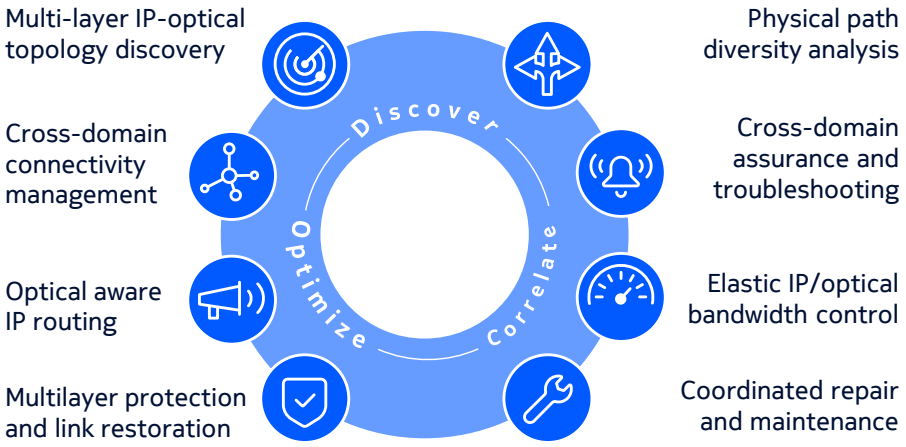
When using routers with 400ZR+ pluggable optics, parameters like bit rate, modulation type, optical channel frequency, power levels, grid spacing, filter settings, alien wavelength routes, path diversity and restoration options must be coordinated across the IP routing and optical transport network.

Coordinating these parameters manually across isolated IP and optical management silos will be cumbersome, error prone and time consuming. As networks grow in scale and complexity, operators need flexible and powerful tools to efficiently coordinate operations between IP and optical domains.

The Nokia Network Services Platform (NSP) supported by the optical management and contvrol applications of Nokia WaveSuite, lets you coordinate and automate IP-optical network operations efficiently from end to end, through a single pane of glass.

The NSP cross-domain IP-optical coordination capabilities enable the optical transport tetam to optimally configure coherent optics equipped in routers and minimizes exposure of the IP team to the complexities of managing optical line systems and alien wavelengths.

NSP cross-domain IP-optical coordination and automation use cases



The NSP uses the ONF Transport API (T-API) SDK to enable end-to-end wavelength visibility across IP and optical domains and coordinate management tasks. The T-API SDK also facilitates interworking of NSP with optical domain controllers in multivendor network deployments.

A growing catalog of pre-validated applications and use cases helps to get your teams up to speed quickly and with minimal deployment cost. Programmable and model-driven interfaces enable your network engineers and developers to build their own automation use cases and to customize service, network and device operations.

NSP utilizes the power of intent-based networking (IBN) and Zero-touch Provisioning (ZTP) to abstract the underlying network complexity and rapidly deploy services with minimal operator intervention.

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Partner with a global leader in IP and optics

As a global leader in IP and optics, Nokia is uniquely qualified to help you remove technology barriers and transform your IP-optical network for profitable growth:

Unleash the power of digital coherent optics and optical line systems to rev up your routers and light up your fiber for maximum capacity.

Optimize your deployment for any application across any packet transport architecture.

Streamline and automate your IP-optical network operations with our multivendor cross-domain management solutions.

Visit our web page to learn more about how our unique breadth and depth of expertise in the IP and optical domains can help you transition to coherent routing in the way that works best for your network and business objectives.

Resources

Nokia Coherent Routing eBook

Nokia IP network solutions

Nokia optical network solutions

Nokia IP-optical coordination

Nokia OYJ
Karakaari 7
02610 Espoo
Finland

Tel. +358 (0) 10 44 88 000

CID:210521

nokia.com

About Nokia

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.