Nokia WaveFabric advanced wavelength routing

Network agility and scale for the 5G and cloud era

Exponential growth in high-speed data, internet, mobile 5G data and video services is creating tremendous demand for optical bandwidth and capacity and high service availability. To keep pace, you need an agile and reliable transport network that can provide more capacity, connections and capabilities.

Take on the challenges now

The 5G and cloud era has arrived, bringing an urgent need for new or modernized transport networks. Your future success depends on your ability to meet several key challenges.

Scale capacity
Stay ahead of traffic growth and service demand spikes.

Boost performance and efficiency
Minimize total cost of ownership (TCO) by improving network utilization and reducing footprint and power consumption.

Automate
Adapt to dynamic traffic patterns, improve service velocity and simplify network resources.

Improve reliability
Ensure that the network can survive multiple failures.

Offer differentiated services
Meet customer capacity and flexibility demands, maximize network infrastructure utilization and increase return on investment (ROI).

Exceed expectations with Nokia WaveFabric advanced wavelength routing

Nokia WaveFabric advanced wavelength routing solutions help you take on these challenges with network agility, performance, automation and resilience that exceed expectations. They enable you to deliver differentiated services with a new generation of ROADMs and ultra-wideband capabilities complemented by advanced coherent digital service processor (DSP) technology and network control options.

These industry-leading technologies are proven in 5G-ready transport networks worldwide. You can use them to address the specific capacity, reach, flexibility, availability and service needs of a range of applications, from space- and power-constrained metro access networks to multi-service metro aggregation and high-capacity core backbones.

You can also use our wavelength routing solutions to exceed your business and financial expectations. They provide new capabilities that enable you to:

- Optimize CAPEX by maximizing network capacity and avoiding the cost of leasing additional fiber
- Reduce OPEX by minimizing your power consumption and footprint, simplifying planning and avoiding network disruptions
- Maximize ROI by deploying open and flexible solutions and differentiating your services

Coherent-optimized ROADMs
Our wavelength routing solutions are based on a family of integrated ROADMs (iROADMs) that are compatible with our 1830 Photonic Service Switch (PSS) platform. These coherent-optimized iROADMs use Colorless-FlexGrid (C-F) and Colorless Directionless Contentionless - FlexGrid (CDC-F) technology and are available in C-band and L-band versions.

We team these iROADMs with our Photonic Service Engine (PSE) coherent DSP, which features the industry-first probabilistic constellation shaping (PCS) algorithm. PSE also provides multilayer GMPLS and SDN control capabilities for network restoration, protection and system capacity optimization.

Application-optimized solutions
Unlike other vendors, we offer aggregated and disaggregated line system solutions in telco- and data center-optimized form factors based on a common set of proven technologies and cards. These solutions include the 1830 Photonic Service Interconnect – Line (PSI-L), a data center-optimized open-line system (OLS) shelf that uses open agents and 1830 PSS wavelength routing cards.

Our ROADM family includes the 1830 Optical Network Extender – micro ROADM (1830 ONE-m), a compact, disaggregated photonic solution optimized for multiservice metro access applications. The 1830 ONE-m complements the 1830 PSS portfolio in an open, seamlessly managed edge-to-core architecture.

What you get with WaveFabric advanced wavelength routing

Our advanced wavelength routing solutions let you meet growing, dynamic bandwidth demands while optimizing OPEX and reducing CAPEX. By combining them with advanced coherent DSP technology and network control options, you can maximize network utilization and resilience and simplify your operations.

Massive scalability and high performance

Recover up to 70 percent more network capacity with CDC-F ROADMs

Our CDC-F ROADMs provide FlexGrid channel spacing that can help you recover a much higher percentage of network capacity. Application-optimized add/drop solutions based on C-F and CDC-F maximize your ROI by supporting in-service migrations to match high-speed, PSE-based coherent (transponder) modulation and baud rate evolutions.

New PSE-based multi-modulation transponders support a wide array of baud rates and optical modulation schemes. They allow you to finely tune and optimize the capacity of wavelengths for specific optical routes. Many of these newer, higher-capacity modulation options require the flexible grid spacing available on CDC-F ROADMs.

Double network capacity with C+L wavelength routing

Our solution lets you use C-band and L-band optical frequencies to double

the available network capacity on each fiber pair and eliminate the cost of leasing additional fiber pairs.

Modular C-band and L-band configurations allow seamless, efficient upgrades as network capacity expands. You can deploy C-band transponders to meet your initial requirements, and then add L-band capacity as you need it. Our self-tuning solution automatically monitors and adjusts for so-called SRS tilt across the C and L bands to ensure simple, worry-free operations.

The Nokia C+L iROADM32 provides up to 4800 GHz channel spectrum in each band, which is equivalent to 192 50-GHz spaced channels.

Improve network performance and utilization with iROADMs

Our iROADMs deliver 4x more performance density by integrating the amps, OSC and WSS to enable a one-card-per-degree solution. This means you can deploy a four-degree CDC-F ROADM node in one 1830 PSS-16II shelf compared to a minimum of four shelves for previous generation solutions.

We provide an array of iROADM options to help network planners optimize route capacity and reach. We also use common, interoperable wavelength routing hardware and the same management system across telco- and data center-optimized platforms.

Together, these capabilities decrease footprint and power consumption and simplify design and planning. The end result is increased operational efficiency.

Optimize network performance with multi-layer control plane and CDC-F iROADMs

Our multilayer control plane capability combines GMPLS with the flexibility of CDC-F iROADMs to optimize the utilization and restoration of wavelengths and switches across the OTN and WDM layers. It provides several key advantages, including:

- High layer 0 scalability with efficient layer 1 grooming
- Efficient network utilization with fewer wavelengths and smaller or fewer OTN switches
- Increased resilience through cost-effective optical restoration and fast electrical protection

All of our wavelength routing platforms and open line systems use our advanced layer 0 GMPLS control plane to provide high scalability and multiple resiliency options based on

Nokia Bell Labs algorithms. Hit the metro access cost/performance sweet spot with the 1830 ONE-m ROADM

The 1830 ONE-m is a compact, two-degree ROADM designed for metro access networks. Its flexible, disaggregated OLS architecture supports multiple applications, enabling pay-as-you-grow scalability and simplified operations. Offering a small footprint and low power consumption, this 1 RU platform is well suited to metro access CAPEX and OPEX budgets.

Automation with open programmability

Automate your network for improved agility and resilience

With our advanced wavelength routing solution, you can use machine-driven adaptative reconfigurable networking to optimize network system capacity and resilience. Your network can automatically adapt to changing traffic patterns by using open agents, the multi-modulation PSE with PCS, and our WaveSuite Network Insight software applications.

Our mature GMPLS control capability uses built-in open programmability and CDC-F ROADMs to automatically re-route and restore traffic around multiple network faults. It lets you avoid the 50 percent capacity penalty imposed by dedicated 1+1 protection methods.

Service differentiation

Generate revenue with new and differentiated service offers

Your idle network capacity can help you meet your customers' demands for more, or more flexible, capacity. With terrestrial spectral sharing enabled by FlexGrid WSS-based iROADMs, PSE and open control and management, you can sell, light and manage slices of unused spectrum.

Get more from your network

Maximize capacity
Recover up to 70 percent more network capacity and increase overall capacity with CDC-F ROADMs.

Leverage your fiber plant investment
Double the capacity of your fiber by deploying C+L-band capability on up to 192 channels with no changes or upgrades to core ROADM or inline amplifier (ILA) nodes.

Boost performance
Simplify deployment, increase performance density and reduce power consumption with iROADMs.

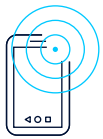
Enable programmability and automation
Optimize network operations and improve service velocity by combining CDC-F ROADMs with programmable DDWDM systems, open APIs and streaming telemetry agents, and multilayer control based on GMPLS or SDN.

Maximize network reliability
Re-route and restore traffic around network faults without a capacity penalty using advanced GMPLS or SDN optical layer restoration software that operates over CDC-F ROADMs.

Differentiate your service offerings
Meet your customers' capacity and flexibility demands, make full use of your network infrastructure and maximize ROI with terrestrial spectrum sharing.

Use cases:
See who's succeeding with Nokia advanced wavelength routing

Mobile service provider – subsidiary of e-commerce retailer



- **Goal**
  Build a greenfield nationwide meshed metro backhaul and backbone transport for a 5G cloud-native mobile network
- **Need**
  Scalable, resilient, low-latency transport to support 5G service delivery
- **Nokia solution**
  1830 PSS, PSE-3, CD/CDC-F iROADM, C+L-band capability

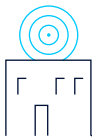
Mobile service provider

- **Goal**
  Deploy a multi-terabit international backbone
- **Need**
  5G and SDN network for scalable, reliable transport with flexible, dynamic network management and automated network optimization
- **Nokia solution**
  1830 PSS, PSE, CDC-F iROADM

Communications service provider

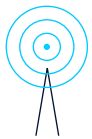
- **Goal**
  Build an international backbone for high-capacity broadband services
- **Need**
  Scalable, efficient, reliable transport for mobile and enterprise services
- **Nokia solution**
  1830 PSS, 1830 PSS-x (OTN), PSE-3, CDC-F iROADM, multilayer GMPLS

Webscale operators



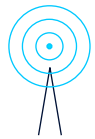
- **Goal**
  Implement data center interconnect (DCI)
- **Need**
  Scalable, future-proof OLS
- **Nokia solution**
  1830 PSI-L, CDC-F iROADM, C+L-band capability, OTDR, open agents

Digital infrastructure provider



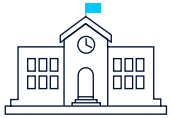
- **Goal**
  Modernize long-haul/subsea network to support higher-capacity DCI services
- **Need**
  Deploy a mesh network for secure, reliable, low-latency transport
- **Nokia solution**
  1830 PSS, 1830 PSI-M, PSE-3, CDC-F iROADM, OTDR

Regional ISP



- **Goal**
  Upgrade network, expand coverage and support services for local government and enterprises
- **Need**
  A simple, cost-effective upgrade of 10G FOADM rings
- **Nokia solution**
  1830 PSS, PSE, universal transponder/muxponder/uplink/ADM, iROADM

Municipal government



- **Goal**
  Deploy a next-generation metro backbone for a connected city
- **Need**
  Scalable, flexible, secure and reliable transport for enterprise and residential services
- **Nokia solution**
  1830 PSS, 1830 PSI-M, WaveLite, PSE-3, C-F/CDC-F iROADM

Let us help you

We're ready to help you use your optical network to meet the dynamic service demands of the 5G era. With our WaveFabric advanced wavelength routing solutions, you can use a new generation of integrated ROADMs and C+L-band solutions to take network agility and scale to new heights, deliver differentiated services and unlock new business opportunities.

Visit our web page to learn more about how our wavelength routing solutions can help you get the most from your network.

Ready to talk? **Connect with our sales team** to find out how to put our wavelength routing solutions to work for your business.

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About Nokia

We create the technology to connect the world. Only Nokia offers a comprehensive portfolio of network equipment, software, services and licensing opportunities across the globe. With our commitment to innovation, driven by the award-winning Nokia Bell Labs, we are a leader in the development and deployment of 5G networks.

Our communications service provider customers support more than 6.4 billion subscriptions with our radio networks, and our enterprise customers have deployed over 1,300 industrial networks worldwide. Adhering to the highest ethical standards, we transform how people live, work and communicate. For our latest updates, please visit us online www.nokia.com and follow us on Twitter @nokia.