

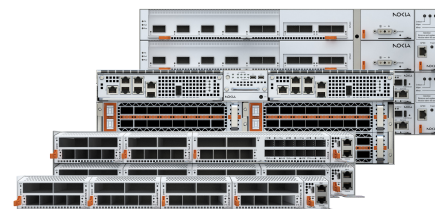
Nokia 1830 Global Express (GX) Compact Modular Transport

Pioneered by Nokia through the introductions of the 1830 Cloud Express (CX) compact modular transport in 2014 and then the 1830 Global Express (GX) G30 compact modular transport in 2016, compact modular platforms have repeatedly raised the bar for optical performance, operational flexibility, space and power efficiency, and automation. Originally built for internet content providers' (ICPs) point-to-point Ethernet metro data center interconnect applications, compact modular platforms' compelling technical and economic value has resulted in fast and consistent market adoption by a wide range of other network operators, including communication service providers (CSPs), cable and multiple systems operators (MSOs), research and education network operators, enterprises, and many others in a wide variety of networking applications. Leveraging the sled-based architecture of the Nokia 1830 GX and a pay-as-you-grow operational model, Nokia has implemented many key capabilities from 100G to 800G per wavelength and from FOADM to flexible-grid multi-degree ROADM and is evolving the platform with next-generation technologies like 1.2T per wavelength and Super C- and Super L-band to unleash the full potential of all transport network applications. The Nokia 1830 GX leads the industry with record-breaking performance in terms of speed and reliability, while offering unprecedented flexibility and low power consumption.

- Industry-leading performance for lowest total cost of ownership (TCO)
 - Largest wavelength capacity-reach
 - Reach of over 1,000 km for a single 800G wavelength with 100 Gbaud technology (Infinite Capacity Engine 6 [ICE6] Turbo)
 - Reach of approximately 3,000 km for a single 800G wavelength with 140 Gbaud technology (Infinite Capacity Engine 7 [ICE7])
 - Lowest power consumption – as low as 0.12 W per gigabit
 - Highest spectral efficiency with >8 bits/s/Hz for maximizing fiber utilization, e.g., >90T per fiber
- Unmatched configuration flexibility for lowest TCO
 - Transponders, muxponders, and switchponders
 - Open line system including flexible-grid ROADMs with Super C + Super L options
 - Mix of Xponders and open line system in the same system and chassis
 - Deployment in 300-mm, 600-mm, and 800-mm environments
 - Carrier-grade security and redundancy options
 - Native YANG-based standard open APIs and streaming telemetry

Benefits of the Nokia 1830 Global Express (GX) Compact Modular Transport

- Decrease capital and operating costs with more capacity at longer reaches, a compact footprint, and low power consumption
- Leverage modularity and a sled-based architecture to match equipment costs with capacity demands in a pay-as-you grow manner
- Maximize ROI with a sled-based architecture for a multi-generational optical engine and open line system platform
- Minimize the number of platforms
- Seamlessly integrate compact modular in any network with numerous carrier-grade features and open APIs
- Simplify turn-up and lifecycle management with easy installation, quick service turn-up, and intuitive management
- Automate the network with open APIs to streamline operations and reduce human error
- Deploy over third-party line systems to accelerate innovation onboarding
- Maximize fiber capacity with the industry's highest spectral efficiency and Super C- and Super L-band



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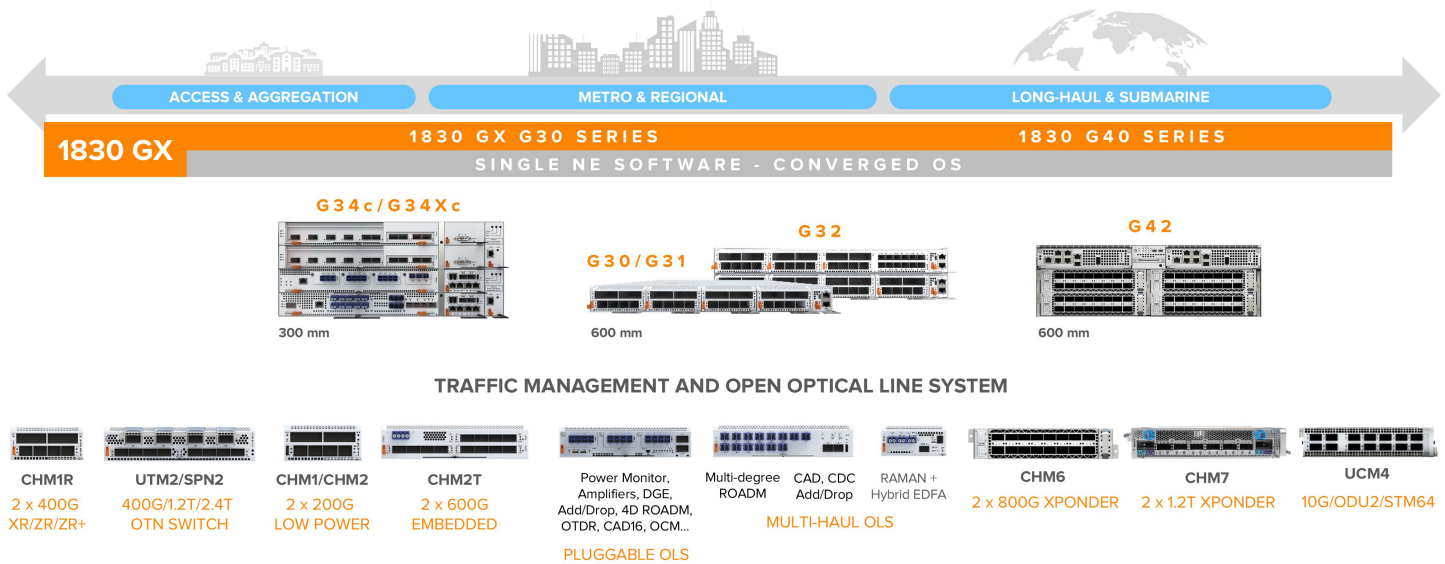
All 1830 GX products support the latest generations of industry-leading vertically integrated Infinite Capacity Engine (ICE) high-performance coherent optics technology and support multi-chassis single network element configuration and setup.

The 1830 GX supports a best-in-class next-generation converged network operating system, the Converged OS (C-OS), based on an open-source Linux operating system and using YANG OpenConfig and OpenROADM data models for programmability and extensibility. C-OS supports a modular microservices architecture for enhanced user experience, rapid development, faster upgrades, and better reliability. The services are containerized for agility and horizontal scalability. Nokia's C-OS software supports multi-chassis configurations.

The 1830 Global Express (GX) G42 is a 450-mm-deep compact modular solution with Xponder technology. Equipped with four service slots in 3RU, this carrier-grade platform offers full NEBS Level 3 compliance, redundant controllers, multi-chassis management, and enhanced programmability. It offers high capacity and low power consumption in a compact footprint, leveraging Nokia's 1.6T (2 x 800G per wavelength) ICE6 high-performance coherent optics and Nokia's 2.4T (2 x 1.2T per wavelength) ICE7 high-performance coherent optics. The 1830 GX G42 supports 100G to 1.2T line transponders and 10G to 800G client services, and is perfectly suited for CSPs, ICPs, and many other network operators that require high-capacity networking with maximum spectral efficiency.

The 1830 Global Express (GX) G30 Series is a 500-mm-deep compact modular solution with open line system (OLS) and Xponder technology. Equipped with four service slots in a 1RU 1830 Global Express (GX) G31 chassis or with eight service slots in a 2RU 1830 Global Express (GX) G32 chassis with redundant controllers, the 1830 GX G30 Series supports a wide range of client protocols such as SONET/SDH, OTN, Ethernet, and Fibre Channel with advanced transponder, muxponder, sub-wavelength aggregation, and fully featured OTN add-drop multiplexer (ADM) and switching functionality in a sled form factor. The 1830 GX G30 Series leverages Nokia's 1.2T (2 x 600G) CHM2T Xponder and 2.4T (2 x 1.2T per wavelength) ICE7 technology. It also supports the latest 400G ZR+ and Infinite Capacity Engine – Extensible (ICE-X) pluggable DCO with the 2 x 400G CHM1R Xponder sled, as well as OTN switching functionality with the UTM2 and SPN2 sleds. It also supports the latest OLS technology, including flexible-grid CD and CDC, Super C- and Super L-band technology, ROADMs, FOADMs, Raman amplification, and OpenROADM configurations addressing applications from metro to core to long-haul and subsea. OLS and Xponder sleds can be mixed in the same chassis for maximum configuration flexibility. The open line system is designed as a multi-haul line system supporting any transport network application from aggregation to metro to long-haul and is fully interoperable.

The 1830 Global Express (GX) G30c Series is a 260-mm-deep ETSI-compliant carrier-grade compact modular solution with OLS and Xponder support. The optical line system leverages the latest optical transport technologies ranging from simple ILA configurations to fixed grid to flexible-grid CDC ROADM configurations addressing metro, core, and long-haul applications. The Xponders utilize the same technology as the 1830 GX G30 Series, offering multi-service client support (SONET/SDH, OTN, Ethernet, Fibre Channel), and are fully interoperable with comparable 1830 GX G30 Series sleds. The 1830 Global Express (GX) G34Xc shelf variant supports a high-speed backplane for pairing OTN switching sleds.



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The Benefits of Nokia 1830 GX

The significant business and operational benefits of Nokia's 1830 GX can be summarized as follows:

Significantly reduced transport costs: The 1830 GX compact modular transport solutions disrupted the optical industry with their sled-based architecture, offering high port density in a compact footprint with low power consumption. Nokia builds upon this success by offering a complete portfolio of compact modular platforms leveraging 400G pluggables (ZR+, ICE-X pluggable DCO), ICE6, and ICE7 to further decrease capital and operating costs with more capacity at longer reaches, C+L-band support, Super C+L support, compact footprint, low power consumption, and better spectral efficiency. Operators have complete control over network configuration.

Multi-generational add-as-you-grow mode of operation: The sled-based design enables network operators to avoid the up-front cost of buying all the hardware on day one and the associated CapEx. Network operators can add capacity and change configuration through sleds when and how they want to, while scaling horizontally by adding new sleds and vertically through the addition of new chassis in a pay-as-you-grow operational model. Moreover, Nokia's game-changing Instant Bandwidth capacity activation model enables the quick, easy, and remote addition or modification of capacity without truck rolls. Instant Bandwidth enables a perfect match between the timing of CapEx and service revenue, while also accelerating time to revenue from months to minutes, and reduces OpEx by streamlining operations. The 1830 GX platforms are designed to support multiple generations of optical engines, and operators can quickly move to the latest generation of optical engine technology without having to onboard a new platform.

Carrier-grade features: Many platforms in Nokia's 1830 GX portfolio are designed to be carrier grade and are optimized for maximum efficiency, ensuring that data travels fast and securely, reducing latency, and improving overall network performance. Key features such as NEBS Level 3 compliance, hot-swappable redundant controllers, multi-chassis control, redundant AC/DC power supplies/feeds, and the ability to fit into 300-mm or 600-mm ETSI racks allow seamless deployment and integration into CSP networks, thus widening the application scope in various parts of the network.

Open and disaggregated principles: The 1830 GX is built around the principles of hardware disaggregation, open standards (e.g., OpenROADM, OpenConfig, Open XR Optics Forum), and open APIs (RESTCONF, NETCONF, gRPC/gNMI) with standard YANG models, which further facilitates multi-vendor interoperability and fast onboarding into any type of network. Moreover, a next-generation microservices-based software framework allows network operators to selectively deploy the microservices (e.g., fast streaming telemetry, service restoration, encryption management, etc.) they need, thus accelerating feature development, speeding up software upgrades, improving software scalability, and significantly improving user experience.



Simplified turn-up and lifecycle management: With the goal of having traffic up and running within minutes, Nokia's compact modular platforms have been designed from the ground up to allow easy installation, quick service turn-up using zero-touch provisioning (ZTP), and intuitive management, as well as proven, easy integration with third-party line systems.

Security: The 1830 GX supports comprehensive security features and is FIPS 140-2 certified. Hardware-anchored secure boot/signed image, secure key restoration, TACACS+, RADIUS, SSHv2, 2FA for SSH, NTP authentication, IPsec over DCN/AUX/OSC, RESTCONF security, TLS1.3, and Layer 1 bulk encryption are a few of the security features operators can utilize for building secure and reliable networks.

Built for automation: The 1830 GX supports numerous features and capabilities to automate tasks, streamline operations, and eliminate sources of human error. Such features include zero-touch networking, declarative configuration management, streaming telemetry (gRPC, gNMI), open APIs, and standards-based YANG models. Support for extensible NOS application agents enhances analytics while enabling better network-wide performance monitoring.

Optical Engine Technology Evolution

The 1830 GX supports Nokia's industry-leading vertically integrated Infinite Capacity Engine high-performance coherent optics technology, which is further evolving both pluggable and embedded transponder solutions to be optimized for a wide range of applications. With the 1830 GX, operators always stay ahead of the technology cycle and can realize the lowest cost of ownership with transport at the lowest cost per bit and lowest power per bit.

Wide Application Scope

With its sled-based architecture, carrier-grade features, and variety of chassis types, Nokia's compact modular portfolio can be deployed in a wide range of transport network applications, in all markets, and by all types of network operators. These include:

- Cost-effective optical transport in metro, regional, long-haul, and subsea networks
- Any data center interconnect application from metro to long-haul to subsea
- 5G and DAA networks, including for synchronization transport support
- Submarine line termination equipment (SLTE) Xponders with specialized features and modulation formats
- Transponder overlay for cost-effective high-speed 100 GbE/400 GbE/800 GbE services over any line system
- Multi-service client support, including OTN, Ethernet, SONET/SDH, and Fibre Channel
- Deployment under challenging conditions such as high span loss, high ROADM cascade, and more with innovative optical engine features
- Secure and open optical networking enabling open transponders, open optical line systems, and compact modular platforms, with standards-based open APIs and YANG data models

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.

With truly open architectures that seamlessly integrate into any ecosystem, our high-performance networks create new opportunities for monetization and scale. 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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