Nokia Coherent Modules 7 (CHM7) and 7X (CHM7X) Dual 1.2 Tb/s Wavelength Xponders

Minimize cost, space, and power while maximizing fiber

Leverage the latest 5-nm/140 GBaud coherent technology with ICE7

The CHM7 sled is supported in the 3RU 1830 Global Xpress (GX) G42 while the CHM7X coherent sled is supported in the 1RU 1830 GX G31 and the 2RU 1830 GX G32. Both sleds leverage Nokia's Infinite Capacity Engine 7 (ICE7), which includes a state-of-the-art 5-nm CMOS process node digital ASIC/DSP, an advanced optical front end, and high-performance packaging. ICE7 technology enables each CHM7/7X to deliver two independent wavelengths with data rates of up to 1.2 Tb/s each and baud rates of up to 140+ GBaud. Each CHM7/7X can be deployed in both transponder and muxponder applications. With a total of 2.4 Tb/s of line capacity per CHM7/7X, a single 3RU G42 equipped with four CHM7s or a 2RU G31 equipped with four CHM7Xs can deliver 9.6 Tb/s of line interface capacity, while a 1RU G31 equipped with two CHM7Xs can deliver 4.8Tb/s of line interface capacity. In addition, the CHM7 provides an ideal upgrade path for network operators that have already deployed the 1830 GX G42 with Infinite Capacity Engine 6 (ICE6)-enabled Coherent Module 6 (CHM6) sleds, including deploying CHM7 sleds in any spare slots.

Deliver a wide range of services

The CHM7/7X sleds are capable of supporting a wide range of clients including 800 GbE, 400 GbE, 100 GbE and OTU4. Bandwidth virtualization can enable extra client services by sharing a client over the two line interfaces, with examples including three 400GbE over two 600Gb/s line interfaces and five 400 GbE clients over two 1 Tb/s line interfaces. In combination with the Universal Channel Module 4 (UCM4) aggregation sled, the CHM7 can also support 10GbE, OC-192, STM-64, OTU2 and OTU2e clients. In combination with the Universal Transponder Module 2 (UTM2) aggregation sled, the CHM7X can also also support 1GbE, 1G Fibre Channel, STM-16, OC-48, 4G Fibre Channel, 10GbE, OC-192, STM-64, OTU2, and OTU2e clients. High service availability is enabled by redundant controllers (G42 and G32), redundant power and fans, and network protection mechanisms including 1+1 SNCP and 1+1 OCh wavelength protection which leverages optical protection switching in the optical line system (OLS). In addition, the encryption-capable versions of the CHM7 and CHM7X support wire-speed AES-256 Layer 1 encryption of ODUks on the line interfaces.

Figure 1: CHM7 dual 1.2T Xponder

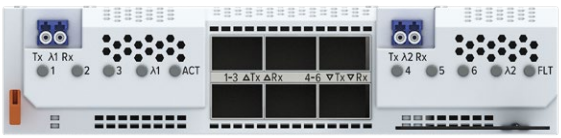

Figure 2: CHM7X dual 1.2T Xponder

The images shown are for illustration purposes only and may not be an exact representation of the product.

Benefits of CHM7/7X coherent sleds

- **Reduce** cost, space, and power, with savings in the 30% to 40% range
- **Extend** wavelength capacity-reach with 1.2 Tb/s wavelengths to 400+ km, 800 Gb/s wavelengths to 3,000+ km, and 600 Gb/s wavelengths to 5,500+ km (terrestrial)
- **Boost** submarine cable capacity by up to 15% while simultaneously reducing cost and power consumption with improved wavelength speeds, including 800+ Gb/s trans-Atlantic wavelengths
- **Increase** terrestrial fiber capacity by up to 40% with the 27% additional spectrum provided by Super C, together with spectral efficiency gains enabled by features including a continuously tunable baud rate and a 2% roll-off
- **Deliver** a wide range of high-speed client services and wire-speed Layer 1 encryption, plus the option for lower speed clients in combination with UCM4 (G42) and UTM2 (G31/G32) aggregation sleds
- **Deploy** the CHM7/7X in a wide range of applications leveraging bandwidth virtualization, high state-of-polarization rotation tolerance, and high chromatic dispersion tolerance

Reduce cost, power consumptionand footprint by ~30%-40%

The CHM7/7X support baud rates of up to 140+ GBaud with single-wavelength capacities from 200 Gb/s to 1.2 Tb/s leveraging probabilistic constellation shaping (PCS-64QAM, PCS-32QAM, and PCS-16QAM) or conventional QAM modulation (i.e., 64QAM to QPSK). The CHM7/7X can deliver 1.2 Tb/s to 400+ km, 1 Tb/s to 1,500+ km, 800 Gb/s to 3,000+ km, and 600 Gb/s to 5,500+ km in terrestrial networks. Deployment over aerial optical ground wire (OPGW) fiber is supported with state-of-polarization (SOP) rotation tolerance of up to 20 Mrad/s (mode dependent), while deployment over trans-oceanic uncompensated and space-division multiplexed (SDM) submarine cables is aided by chromatic dispersion tolerance that can exceed 800,000 ps/nm. With up to 50% more wavelength capacity at the same reach, CHM7/7X interfaces can deliver cost per bit, power consumption, and rack unit savings of between 30% and 40%, relative to the previous 7-nm/90+ GBaud generation of high-performance Xponders that includes the 1830 GX G42's ICE6-enabled CHM6 sleds. For example, typical power consumption in a fully loaded 1830 GX G42 excluding client pluggables is reduced by more than 30%, from less than 0.19 W/G with CHM6s to less than 0.13 W/G with CHM7s.

Boost fiber capacity with Super C, L-band and Super L

With optical engine spectral efficiency gains becoming incremental as we approach the Shannon limit, expanding the amount of spectrum is an increasingly attractive approach for maximizing fiber capacity. While also compatible with the 4.8 THz extended C-band, CHM7/7X widely tunable lasers can leverage an additional 27% (1.3 THz) of C-band spectrum with the 6.1 THz Super C-band that can be provided by the 1830 GX OLS or a third-party OLS. This can provide a cost-effective alternative to full C+L that still enables up to 55 Tb/s on a single fiber pair. The L-band variant of the CHM7 enables an additional 4.8THz of spectrum (total 9.6 THz) while the Super-L variant of the CHM7 enables an additional 5.5 THz (total 11.6 THz).

Optimize spectral efficiency with a continuously tunable baud rate

Furthermore, the CHM7/7X optimize spectral efficiency with features including continuous baud rate tunability and a configurable roll-off (typically 2%). Continuous baud rate tunability enables the wavelength's spectrum to align with the available ROADM passband more closely and to more optimally utilize any excess signal-to-noise ratio (SNR) margin, which can be especially valuable in submarine applications. The configurable roll-off can reduce the amount of additional spectrum required to accommodate the slopes at the sides of the wavelength, enabling wavelengths to be packed closer together, with 2% typically the optimal roll-off setting. Additional features that enhance spectral efficiency include an overhead-efficient Ethernet framing mode option and highly efficient 15% overhead forward error correction (FEC). Together these features contribute to capacity gains of up to 15% on submarine cables. CHM7/7X spectral efficiency gains, together with Super C, can lead to total fiber capacity gains of up to 40% in terrestrial networks.

Ideal for long-haul, submarine, and metro DCI networks

The CHM7/7X provides an ideal option for long-haul applications that require low cost per bit per kilometer and low power consumption, while also providing the option to maximize fiber capacity with Super C (CHM7/7X), C+L (CHM7), or Super C plus Super L (CHM7). On-card regen provides a simple and cost- effective option to regenerate the wavelength from one line port to the other line port on the same sled without the need for back-to-back client ports or the complex cabling required when using one line interface per direction. The CHM7/7X also provides an ideal option for maximizing the capacity of dispersion-managed, uncompensated, and SDM submarine cables while also reducing cost, space, and power. Furthermore, the CHM7/7X can provide a great option for high-capacity metro deployments, including data center interconnect (DCI), that are fiber-constrained or need to accommodate high ROADM cascades.

Complete solution including optical line system and automation software

Finally, the CHM7/7X can be deployed as part of a complete solution housed in an 1830 GX compact modular chassis with a Nokia OLS plus Nokia management and automation software. Nokia OLS options include the 1830 GX OLS, the 1830 Photonic Service Switch (PSS), 1830 Photonic Service Interconnect – Line (PSI-L), and the 1830 Flexible Intelligent Line System (FlexILS). When deployed with 1830 GX OLS, 1830 FlexILS or third-party OLS, management and automation is provided by the Transcend Network Automation Suite. When deployed over an 1830 PSS/PSI-L line system, management and automation can be provided by the Nokia WaveSuite platform.

Technical specifications

Applications

- Two independent transponders/ muxponders per CHM7/7X coherent sled (one per line interface)
- Transponder
  - Ethernet transponder (max 1.2 Tb/s per wavelength, overhead-efficient framing)
  - OTN transponder (max 800 Gb/s per wavelength)
- Muxponder
  - Ethernet muxponder (max 1.2 Tb/s per wavelength, overhead-efficient framing)
  - OTN muxponder (max 800 Gb/s per wavelength)
- OEO 3R regenerator
  - On-card regen without clients (Future)

Line Interfaces

- 2 x embedded line interfaces per CHM7/7X
- Maximum line capacity per 1830 GX G42:
  9.6 Tb/s (4 x CHM7 per 1830 GX G42)
- Maximum line capacity per 1830 GX G32:
  9.6 Tb/s (4 x CHM7 per 1830 GX G32)
- Maximum line capacity per 1830 GX G31:
  4.8 Tb/s (2 x CHM7 per 1830 GX G31)
- Data rate tunability: 200 Gb/s to 1200 Gb/s in 100 Gb/s increments
- Baud rate tunability:
  - 68 to 140+ GBaud
  - GBaud increments from 0.1 GBaud (lower baud rates) to 0.7 GBaud (higher baud rates)
- Configurable roll-off:
  - 0.1% to 100% in 0.1% increments
  - 2% roll-off is optimal in most scenarios
- Linear and non-linear compensation
- Equalization enhanced phase noise (EEPN) compensation
- CHM7/7X wavelength tunability range:
  1523.9 nm-1572.682 nm (190.625 THz to 196.725 THz)
  - Extended C-band: 1528.3 nm-1567.337 nm (191.275 THz to 196.125 THz)
  - Super C-band: 1523.916 nm-1572.682 nm (190.625 THz to 196.725 THz)
  - 50 MHz increments
- CHM7 L-band variants wavelength tunability range:
  - Extended L-band: 1569.183 nm to 1611.354 nm (186.050 THz to 191.050 THz)
  - Super L-band: 1575.161 nm to 1622.034 nm (184.825 THz to 190.325 THz)
  - 50 MHz increments
- Spectrum:
  - Extended C: 4.8 THz
  - Super C: 6.1 THz
  - Extended L: 4.8 THz (L-band variant of CHM7; 9.6THz with C+L)
  - Super L: 5.5 THz (Super-L variant of CHM7; 11.6THz with Super C + Super L)
- TX optical output power: -10 dBm to +1.5 dBm
- Modulation options:
  - Probabilistic constellation shaping (PCS)
    - PCS-64QAM (12 to 4 bits per symbol)
    - PCS-32QAM (10 to 4 bits per symbol)
    - PCS-16QAM (8 to 4 bits per symbol)
  - Conventional modulation: 64QAM, 32QAM, 16QAM, 8QAM, QPSK
- Soft-decision forward error correction (SD-FEC) with 15% overhead
- Overhead-efficient Ethernet framing mode (Ethernet transponder/ muxponder)
- Bandwidth virtualization over two wavelengths (e.g., 5 x 400 GbE over 2 x 1 Tb/s wavelengths)
- Chromatic dispersion tolerance dependent on baud rate:
  - >800,000 ps/nm at 68 GBaud
  - >300,000 ps/nm at 140 GBaud
- Max DGD: Up to 130 ps
- SOP rotation tolerance:
  Up to 20 Mrad/s dependent on mode

Client Interfaces

- 800 GbE:
  - CHM7: Max 3
  - CHM7X: Max 2 (Future)
  - QSFP-DD800: DR4, 2xDR4, LR4, 2xLR4, FR4
- 400 GbE: Max 6
  - QSFP-DD: DR4, FR4, LR4, PLR4
- 100 GbE/OTU4 (CHM7X OTU4 is future):
  - QSFP-DD with LC/CS/SN connectors:
  - QSFP-DD with 4 x 100G LR1 (max 24 100 GbE)
  - QSFP-DD with 4 x 100G FR1 (max 24 100 GbE)
  - QSFP-DD with 4 x 100G DR1 (max 24 100 GbE)
  - QSFP-DD with 2 x 100G LR4 (max 12 100 GbE, max 12 OTU4)
  - QSFP-DD with SMF-MPO12/APC
  - QSFP-DD 4 x 100GBASE-DR1 (max 24 100 GbE, max 16 OTU4)
- CHM7 with UCM4 aggregation sled:
  10 GbE, OC-192, STM-64, OTU2, OTU2e
- CHM7X with UTM2 aggregation sled:
  1GbE, 1G Fibre Channel. STM-16, OC-48, 4G Fibre Channel, 10GbE, OC-192, STM-64, OTU2, OTU2e

Performance Monitoring

- Trail-trace identifier (TTI) messages (ODUflex)
- Threshold crossing alerts (TCAs)
- Line interfaces (OTUk)
  - Number of background block errors
  - Background block error ratio
  - Number of errored seconds
  - Errored seconds ratio
  - Number of severely errored seconds
  - Severely errored seconds ratio
  - Number of unavailable seconds
  - Number of failure counts
- Line interfaces (FEC)
  - Number of corrected bit errors (FEC)
  - Number of uncorrectable words (FEC)
  - Q-factor
  - Q-factor margin

- Line interfaces (optical)
  - Transmitter optical power
  - Receiver optical power
  - Residual chromatic dispersion
  - Mean polarization mode dispersion
  - Optical signal-to-noise ratio
  - Second-order PMD (SOPMD) estimation
  - Polarization change rate estimation
  - Polarization-dependent loss (PDL) estimation
- Client ports
  - Transmitter optical power
  - Transmitter laser bias current
  - Receiver optical power
  - Ethernet RMON

Additional operational features

- PRBS test generation
  - Line
  - Client
- Loopbacks:
  - Client terminal/facility loopback
  - Line terminal loopback
- LDP snooping on client ports
- Alarm reporting for
  - Loss of signal (LOS)
  - Loss of frame (LOF)
  - Loss of multi-frame (LOM)
  - Alarm indication signal (AIS)
  - Backward defect indicator (BDI)
- Zero-touch provisioning/commissioning (ZTP/ZTC)

Management

- Management and control platforms:
  - Nokia Transcend Network Automation Suite
  - Nokia WaveSuite (for CHM7/7X over 1830 PSS/PSI-L optical line system)
- Command line interface (CLI)
- Syslog
- SNMP
- WebGUI
- NETCONF
- Native YANG data models
- OpenConfig
- gNMI/gRPC
- Declarative config
- In-band management on the line port
  - Generic Communications Channel (GCC)
  - FlexO Communications Channel (FCC)

Protection

- 1+1 OCh protection
  - With line system optical protection switch (e.g. GX OPSM)
  - Including coherent colorless add/drop with optical protection switch-pilot tone (e.g. GX OPSM-PT)
- 1+1 SNCP (CHM7 only)
- Y-cable (Future)

Encryption

- Line-side ODUk AES-256 encryption

Environmental

- 2x1.2Tb/s typical power (excluding client pluggables):
  - CHM7: 258W
  - CHM7X: 250W
- Operating temperature:
  - CHM7 in 1830 GX G42: -5° C to +55° C
  - CHM7X in 1830 GX G31/G32: +5° C to +40° C
- Transport and storage: -40° C to +70° C
- Storage humidity: 85% maximum

Regulatory and Compliance

- RoHS-6 compliant and lead-free per Directive 2002/95/EC
- GR-3160-Core Generic Requirements for Telecommunications Data Center Equipment and Spaces
- GR-326-Core Generic Requirements for Single-Mode Optical Connectors and Jumper Assemblies
- Telcordia GR-1435-Core Generic Requirements for Multi-Fiber Optical Connectors
- Emissions: FCC Part 15 Class A, EN55032/CISPR Class A Compliant, CE Laser Safety: ANSI Class 1M, IEC Class 1M, EN 60825-1/2, 21 CFR 1040 US FDA CDR, Class 1M
- Electrical safety: UL 62368-1, CSA22.2 62368-1, EN 62368-1, and IEC 62368-1

About Nokia

Nokia is a global leader in connectivity for the AI era. With expertise across fixed, mobile, and transport networks, powered by the innovation of Nokia Bell Labs, we're advancing connectivity to secure a brighter world.

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