Carrier Ethernet Switch Cards
1CE100, 12CE120, 12CE121

The Carrier Ethernet Switch Cards for the Nokia 1830 Photonic Service Switch (PSS) use state-of-the-art carrier-grade Layer 2 (L2) switches and the Nokia Service Router Operating System (SR OS) software to provide packet-optimized transport over wavelength division multiplexing (WDM) networks. These Carrier Ethernet Switch Cards are complementary to the Carrier Ethernet Muxponders, delivering the full set of Carrier Ethernet services in point-to-point and multipoint configurations with Layer 2 switching and networking over optical transport networks (OTN) with higher interface rates and higher Layer 2 switching capacities.

These cards are key components of the Nokia Integrated Packet Transport (IPT) solution for the 1830 PSS. IPT, built on scalable, packet-optimized WDM transport, enables the transformation to a converged metro aggregation network that cost-effectively delivers multiple services in a range of applications, including retail and wholesale business services, cloud services, as well as mobile and broadband backhaul. IPT uses the SR OS to enable a fully managed, end-to-end packet solution with a field-proven common service, operations, and management model across the Nokia Optical and Ethernet/IP/Multiprotocol Label Switching (MPLS) portfolio.

There are two main differences between the Carrier Ethernet Switch Cards and the Carrier Ethernet Muxponders: First, the Carrier Ethernet Switch Cards have a high capacity Layer 2 fabric interface to another Carrier Ethernet Switch Card in the adjacent slot. This allows the two cards to be used together as a single Layer 2 switch. Second, the Carrier Ethernet Switch Cards support Layer 2 switching among interfaces terminated on “Layer 1” cards (e.g., 20P200, 1UD200, S13X100) in the same shelf. Together these features extend both the flexibility and scalability for Layer 2 switching in the 1830 PSS, with any-to-any Layer 2 switching among interfaces — regardless of the card on which the interface is terminated. This allows a pair of Layer 1 and a pair of Layer 2 cards to be configured together as a Layer 2 switch with a packet switching capacity up to 480 Gb/s and a mix of Ethernet and OTN interfaces with interface rates from 0.1 to 100 Gb/s.
Key benefits of integrated packet transport

**Efficiency**
- Lower total cost of ownership (TCO) due to fault, configuration, account, performance, security (FCAPS) and fulfilment, assurance and billing (FAB) commonality based on Nokia SR OS
- Cost-optimized metro, regional, and global Carrier Ethernet portfolio enabled by scalable WDM
- Right-sized and bandwidth-efficient packet transport delivering on providers' quality of experience (QoE) requirements

**Reliability**
- Broad feature set delivered by a proven, robust, and reliable packet OS, deployed in more than 500 networks worldwide
- Equipment, interface, and network redundancy options for high-availability packet transport services
- Advanced carrier-grade packet networking: multiple classes of service (CoS), Ethernet operations, administration, and maintenance (OAM), and performance monitoring, as well as carrier-grade link and network protection protocols

**Versatility**
- Flexible L2 port role configuration as UNI (client), network-to-network interface (NNI) or E NNI with Ethernet (IEEE 802.3) and Ethernet over OTN (ITU-T G.709) interfaces on local ports or ports of associated Layer 1 cards
- Differentiated granular services enabled by feature-rich Carrier Ethernet
- Unconstrained use cases for business retail/wholesale services, fixed broadband and mobile backhaul, carrier cloud services, and network infrastructure applications with multiple demarcation options
- Efficient service aggregation among clients and across sites through packet layer statistical multiplexing
- Multiple networking choices with configuration, interconnection, and protection options for increased network flexibility and availability

**Technical specifications**

**Shelf compatibility**
- Compatible with 1830 PSS 8 and PSS 16II shelves

Layer 2 packet switching
- IEEE 802.1Q/802.1ad Provider Bridge (PB)
  - MEF service support: E-Line, E-LAN, E-Tree, E Access; Private (port-based) and virtual (VLAN based) services
  - L2 switching with VLAN push/pop/rewrite
  - Forwarding data base (FDB) management features include: retrieve FDB, static MAC configuration, clear MAC per service, MAC learning limit and disabling, MAC aging configuration or disabling, utilization watermark alarming, MAC move monitoring for loop detection and automatic blocking
  - IGMPv2/3 snooping, proxy, fast leave
- MPLS-TP (IETF, ITU-T G.8113.2) Connection-oriented packet transport
  - MEF E-Line services, bidirectional
  - Label Edge Router/Label Switched Router (LER/LSR) switching with label push/pop/swap
  - Single segment and multi segment pseudowires (SS PW and MS-PW)
  - Next Hop Ethernet addressing (RFC 7213)
  - GAL/G-Ach (RFC 5586 and RFC 6423)
  - MPLS-TP Identifiers (RFC 6370)
• Service management in provider bridge and MPLS-TP modes
  – Flexible EVC definition with MEF CE-VLAN bundling – multiple VLANs and/or VLAN ranges in one EVC (VLAN Range SAP)
  – Layer 2 Control Protocol (L2CP) tunnelling/filtering/peering option for MEF 6.1.1/45 compliance (including EPL Option 2)
  – Port mirroring (ingress and egress)
  – L2 access control list (ACL)
  – Ethernet and OTN port loopbacks in both directions with MAC DA/SA swapping option
  – IEEE 802.1AB Link Layer Discovery Protocol (LLDP), transmit and/or receive at 3 levels, independently configurable per port
  – Jumbo frames with configurable maximum transmission unit (MTU) 1514-9612 bytes

DiffServ QoS
• Forwarding class (FC) classification per service access point (SAP) at UNI based on:
  – VLAN priority code point (PCP)/p-bits
  – MAC source address (SA) and destination address (DA)
  – Ethertype/TPID
  – IPv4/v6 traffic class (TC)/differentiated services code point (DSCP)
  – IPv4/v6 SA/DA (including mask)
  – IPv4 protocol, IPv6 Next Header
  – TCP/UDP source and destination port
• tr-TCM metering/policing/marking (MEF 10.2 ingress bandwidth profile [BWP]) per SAP Ingress CoS
  – Provisionable committed information rate (CIR), excess information rate (EIR), committed burst size (CBS), excess burst size (EBS), color mode (CM)
  – Color-blind and color-aware (E-NNI) mode
  – L1/L2 option for metering/policing/shaping
• SAP ingress QoS profile management
• Queuing (8 queues per port)
• Tail drop and weighted random early detection (WRED)
• Deep packet buffers for congestion management and rate adaptation
• Egress PCP (re)marking
• Strict priority queuing (SPQ) and weighted round robin (WRR)/deficit weighted round robin (DWRR) scheduling
• Egress shaping per port/queue (MEF 10.2 egress BWP)

OAM and performance monitoring (PM)
• In both provider bridge and MPLS-TP modes:
  – IEEE 802.3ah Ethernet in the first mile (EFM) link OAM
  – IEEE 802.1ag/ITU-T Y.1731 Connectivity Fault Management (CFM), Continuity Check (CC), Loopback (LB), Link Trace (LT), Remote Defect Indication (RDI)/MEF 30.1 Service OAM (SOAM) Fault Management (FM)
  – ITU-T Y.1731 FM - alarm indication signal (AIS)
  – ITU-T Y.1731 PM - 2-way Delay Measurement (DM), Synthetic Loss Measurement (SLM), both on demand and proactive/MEF 35 — SOAM PM-1 solution
  – Link pass through (LPT) for point-to-point services or link loss forwarding (LLF)
  – ITU-T G.7710 General Transport PM with 15-minute/24-hour binning and thresholding (TCAs, TR only and TR/RTR methods)
  – Port PM counters according to RFC 2819, RFC 2863, RFC 3635, RFC 3273 MIBs
  – SAP (service) counters
  – SAP ingress meter/FC counters (color-aware)
  – Egress queue counters
  – ITU-T Y.1731/MEF 35 service level agreement (SLA) monitoring counters for SLM and DM
  – ITU-T G.8021-compliant FM processing
- User-controllable per-slot software upgrade
- OTN FM and PM consistent with other 1830 PSS Optical Transponders (OTs), including Wavelength Tracker™ photonic OAM encoding

• In MPLS-TP mode:
  - Label Switched Path (LSP) OAM: pro-active bidirectional forwarding detection – continuity check/continuity verification (BFD-CC/CV), (RFC 6428, RFC 5880) down to 3.33ms
  - LSP ping/trace on-demand (RFC 6426)
  - Virtual circuit connectivity verification (VCCV) ping/trace on-demand (RFC 6426)
  - Static PW status signaling (RFC 6478)

Protection
• In provider bridge mode:
  - ITU-T G.8032 (v2) Ethernet ring protection (ERP) on 1G and 10G UNI and NNI ports
  - Ethernet ring protection (ERP) instances configurable per port or per service or per group of services
  - Standard operator commands and timers (WtR, Guard, WtB, hold-off)
  - Sub-50ms protection switching
  - ERP interconnection with dual node interconnection (DNI) using sub-rings
  - With or without ring – automatic protection switching (R-APS) virtual channel
  - Equipment protection using MC-LAG and ERP on both client and network interfaces
  - ERP over LAG for scalability and reliability
  - Enhanced state reporting and notifications
• In MPLS-TP mode:
  - LSP 1:1 bidirectional linear protection (RFC 6378 and ITU-T G.8131) with operator commands and timers
  - PW redundancy (RFC 6718, RFC 6870, RFC 7771)
  - Equipment protection using MC-LAG on client interfaces and PW redundancy on network interfaces
• In both provider bridge and MPLS-TP modes:
  - IEEE 802.1AX link aggregation (LAG) with or without Link Aggregation Control Protocol (LACP)
  - LAG sub-groups for active/stand-by configuration
  - Partial link loss (PLL)/total link loss (TTL) thresholds
  - Multi-chassis link aggregation group (MC-LAG) for LAG across shelves

Synchronization
• ITU-T G.8261 Synchronous Ethernet
• ITU-T G.8262 Ethernet Equipment Clock (EEC), EEC Option1
• ITU-T G.781 Timing reference selection
• ITU-T G.8264 Ethernet Synchronization Message Channel (ESMC)
• IEEE 1588v2 Precision Time Protocol – OC and BC for time/phase distribution
• ITU-T G.8271/G.8271.1
• ITU-T G.8275.1 PTP telecom profile for phase/time synchronization with full on-path support
• ITU-T G.8273.2 T-BC/T-TSC timing performance
• Shelf-level timing scheme with synchronization inputs and outputs to and from interfaces on all cards in the shelf
Management of smart SFPs and remote L2 OAM
smart SFPs and cEDD

- Plug-and-play management from 1830 PSS using integrated proxy management agent or virtualized agent in the cloud
- OAM interworking with remote L2 OAM Smart SFPs and Smart compact Ethernet demarcation device (cEDD)
  - IEEE 802.3ah EFM OAM
  - IEEE 802.1ag CFM OAM
- Smart SFPs for circuit emulation services (12CE121)
  - Transparent PDH (E1, DS1) over Packet (TPoP)
  - Channelized SDH over Packet (CSoP)

Table 1. Capacities and interfaces

<table>
<thead>
<tr>
<th>Features</th>
<th>1CE100</th>
<th>12CE120</th>
<th>12CE121</th>
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### Table 2. Pluggable transceivers

<table>
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<tr>
<th>Pluggable transceivers</th>
<th>Wavelength (nm)</th>
<th>Reach (km)</th>
<th>1CE100</th>
<th>12CE120</th>
<th>12CE121</th>
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<td><strong>SFP+</strong></td>
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<td>10GBASE-ER/OTM-0.2</td>
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<td>10GBASE-R/OTM-0.2 DWDM 99 channel tunable, 50GHz, with integrated Wavelength Tracker Encoder (WTE)</td>
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<td>15</td>
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</table>

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