Carrier Ethernet Switch Cards

1CE100, 1CE100Q, 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, 1ETY100) in the same shelf.

1CE100 and 1CE100Q

12CE120 and 12CE121

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
- Transport slicing using flexible mix of hard and soft isolation
- 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-4II, 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, Access E-Line, Transit E-Line; 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
  - MEF E-LAN and E-Tree services with (H-)VPLS-TP
  - 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)
  - VPLS (RFC 4762) over MPLS-TP i.s.o. dynamic MPLS, i.e. (H-)VPLS-TP
  - Next Hop Ethernet addressing (RFC 7213)
  - GAL/G-Ach (RFC 5586 and RFC 6423)
  - MPLS-TP Identifiers (RFC 6370)

- Service management in provider bridge, MPLS-TP and VPLS-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 6.1.1/45.1 compliance (including EPL Option 2)
  - Port mirroring (ingress and egress)
  - Service mirroring
  - L2 access control list (ACL)
  - Ethernet and OTN port loopbacks in both directions with MAC swap
  - EVC/SAP loopback in both directions with MAC swap
  - 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
  - ITU-T Y.1564 service activation testing (SAT) embedded test head

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 traffic class (TC)/differentiated services code point (DSCP)
  - IPv4 SA/DA (including mask)
  - IPv4 protocol
  - TCP/UDP source and destination port
- tr-TCM metering/policing/marking (MEF 10.4 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
- Queuing (8 queues per port)
- SAP ingress QoS profile management
- 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) scheduling
- Egress shaping per port/queue (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 35.1 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), (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)
  - MAC Withdraw over static PW (RFC 7769)

Protection

- In provider bridge mode:
  - ITU-T G.8032 (v5) Ethernet ring protection (ERP) on all rates of UNI and NNI ports
  - Ethernet ring protection (ERP) instances configurable per port or per service or per group of services
  - Standard operator administrator 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
  - ERP over LAG for scalability and reliability
  - Enhanced state reporting and notifications
  - MEF 10.4 Per-service Frame Distribution (Clause 8.2) support for LAG
- 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.8262.1 enhanced Ethernet Equipment Clock (eEEC)
- ITU-T G.781 Timing reference selection
- ITU-T G.8264 Ethernet Synchronization Message Channel (ESMC)
- IEEE 1588 Precision Time Protocol (PTP) – OC and BC for time/phase distribution
- ITU-T G.8271/G.8271.1 Time/phase synchronization
- ITU-T G.8275.1 PTP telecom profile for phase/time synchronization with full timing support (FTS)

- 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 some I/O cards in the shelf

Management of Smart SFPs

- Plug & Play Smart SFPs for TDM circuit emulation services
  - TPoP - Transparent PDH (E1, DS1) over Packet (TPoP) (12CE121)
  - CSoP - Channelized SDH over Packet (12CE121)
  - TSoP - Transparent SDH/SONET (STM-1/OC-3, STM-4/OC-12, STM-16/OC-48) over Packet (12CE121/12CE120)

Figure 1. Carrier Ethernet Switch Cards

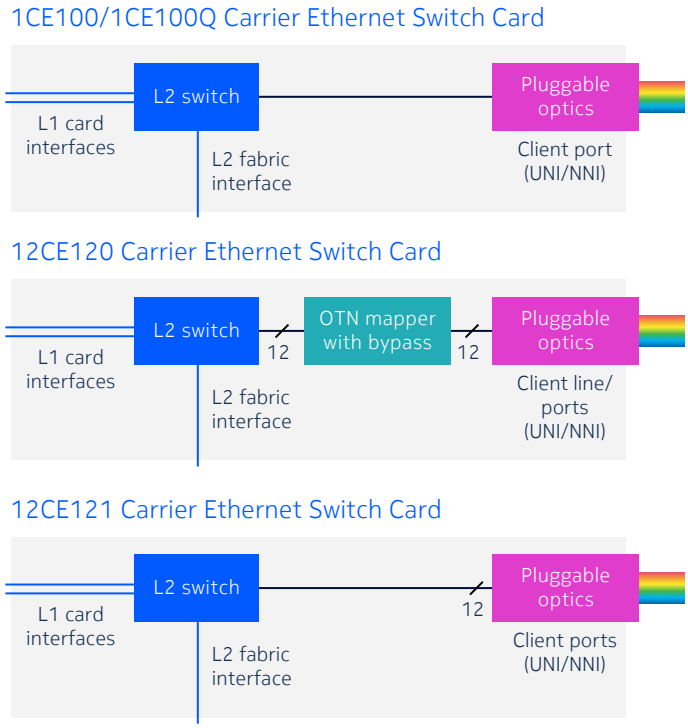

Table 1. Capacities and interfaces

Features	Carrier Ethernet Switch Cards			
	1CE100Q	1CE100	12CE120	12CE121
Size				
Full-height slots	1	1	1	1
Capacities				
Packet switching capacity (Gb/s)	220	220	240	240
FDB (MAC table) size	256K	256K	256K	256K
Configurable VLAN range	0-4094	0-4094	0-4094	0-4094
Interfaces				
10/100/1000BASE-T (IEEE 802.3)	–	–	–	✓
1000BASE-X (IEEE 802.3)	–	–	–	✓
10GBASE-R (EEE 802.3)	–	–	✓	✓
100GBASE-R (IEEE 802.3)	✓	✓	–	–
OTU2 (ITU-T G.709)	–	–	✓	–
OTU2e (UTI-T G.709)	–	–	✓	–
OTU1e (UTI-T G.sup43)	–	–	✓	–
STM-1/4 Channelized SDH over Packet (CSoP)	–	–	–	✓
STM-1/4 OC-3/12 Transparent SDH/SONET over Packet (TSoP)	–	–	–	✓
E1, DS1 (Transparent PDH over Packet CES (TPoP))	–	–	–	✓

Features	Carrier Ethernet Switch Cards			
	1CE100Q	1CE100	12CE120	12CE121
Interfaces (cont'd)				
200 Gb/s L2 fabric interface to L2 card adjacent slot	✓	✓	✓	✓
100-120 Gb/s interface to L1 cards in adjacent slots	✓	✓	✓	✓
Forward Error Correction (FEC) Options				
Standard Reed-Solomon forward error correction (RSFEC)	✓	✓	✓	–
Generic FEC (GFEC)	–	–	✓	–
Enhanced FEC (EFEC)	–	–	✓	–
No FEC	–	–	✓	–
Sockets for pluggable transceivers				
SFP/SFP+	–	–	–	12
SFP+	–	–	12	–
CFP4	–	1	–	–
QSDFP28	1	–	–	–
Operating environment				
-5 to +55°C	✓	✓	✓	✓

Table 2. Pluggable transceivers

Features			Carrier Ethernet Switch Cards			
Pluggable transceivers	Wavelength (nm)	Reach (km)	1CE100Q	1CE100	12CE120	12CE121
QSFP28						
100GBASE-SR4	–	0.07-0.1m	✓	–	–	–
100GBASE-LR4	–	10	✓	–	–	–
100GBASE-LR4/OTL4.4	–	10	✓	–	–	–
100GBASE-ER4f	–	20-40	✓	–	–	–
100GBASE-ZR4	–	80	✓	–	–	–
100GBASE-CWDM4	–	10	✓	–	–	–
100GBASE-FR1	1310	2	✓	–	–	–
100GBASE-LR1	–	10	✓	–	–	–
CFP4						
100GBASE-SR4	850	0.1	–	✓	–	–
100GBASE-LR4	1350	10	–	✓	–	–
100GBASE-LR4/OTL4.4	–	10	–	✓	–	–
SFP+						
10BASE-SR	850	0.3	–	–	✓	✓
10BASE-LR	1310	10	–	–	✓	✓
10GBASE-LR/OTM-0.2	1310	10	–	–	✓	✓
10GBASE-ER/OTM-0.2	1550	40	–	–	✓	✓
10GBASE-ZR/OTM-0.2	1550	80	–	–	✓	✓
10BASE-ER/OTM-0.2 CWDM	1471-1611	40	–	–	✓	✓

Features			Carrier Ethernet Switch Cards			
Pluggable transceivers	Wavelength (nm)	Reach (km)	1CE100Q	1CE100	12CE120	12CE121
10BASE-ZR/OTM-0.2 CWDM	1471-1611	70	–	–	✓	✓
10GBASE-R/OTM-0.2 DWDM 99 channel tunable, 50 GHz, with integrated Wavelength Tracker Encoder (WTE)	1529-1568	70	–	–	✓	–
10GBASE-R/OTM-0.2 DWDM 99 channel tunable, 50 GHz, without integrated Wavelength Tracker Encoder (WTE)	1529-1568	70	–	–	✓	✓
10GBASE-BX10-U/D	1270/1330	10	–	–	✓	✓
10GBASE-BX40-U/D	1270/1330	40	–	–	✓	✓
TSoP STM-16/OC-48 SR-16.1	1310	10	–	–	✓	✓
SFP						
1000BASE-SX	850	0.5	–	–	–	✓
1000BASE-LX	1310	10	–	–	–	✓
1000BASE-ZX	1550	70	–	–	–	✓
10/100/1000BASE-T	–	0.1	–	–	–	✓
1000BASE-ZX CWDM	1471-1611	80	–	–	–	✓
1000BASE-BX20-U/D	1310/1490	20	–	–	–	✓
1000BASE-BX40-U/D	1310/1490	40	–	–	–	✓
TSoP STM-1/OC-3 S-1.1	1310	15	–	–	–	✓
TSoP STM-1/OC-3 L-1.1	1310	40	–	–	–	✓
TSoP STM-4/OC-12 S-4.1	1310	15	–	–	–	✓
TSoP STM-4/OC-12 L-4.1	1310	40	–	–	–	✓
TPoP E1 120Ω (CES)	–	–	–	–	–	✓
TPoP T1 100Ω (CES)	–	–	–	–	–	✓
CSoP (channelized STM-1/OC-3 CES)	1310	15	–	–	–	✓

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.

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