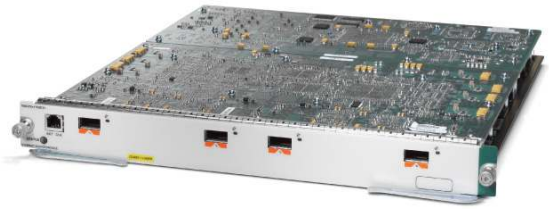
Ethernet Services Plus Line Cards on Cisco Catalyst 6500 Series Switches

Product Overview

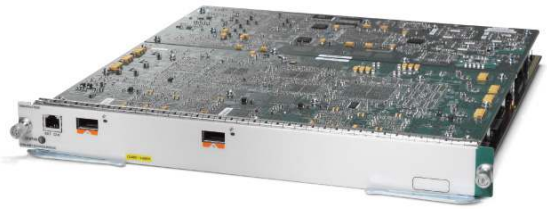
The Ethernet Services Plus (ES+) line cards use an extensible design that allows service prioritization for voice, video, and data services. Service providers and enterprises can benefit from the improved economics, density, advanced quality-of-service (QoS) features, and high performance of these fixed-configuration line cards. With the same basic architecture and features, Ethernet Services Plus Extended Transport (ES+XT) line cards support G.709 framing and Forward Error Correction (FEC) across dense wavelength-division multiplexing (DWDM) networks, enabling optical links to span greater distances.

The ES Plus cards' programmable interface processors protect network investments and reduce total cost of ownership. The design increases connectivity options and offers superior service intelligence through programmable interface processors operating at line rate. This data sheet contains the specifications for the ES Plus (ES+ and ES+XT) line cards (Figure 1) as supported on the Cisco Catalyst® 6500 Series Switches. This is a subset of the hardware and features supported on the Cisco® 7600 Series Routers. For more information about Cisco 7600 Series support, please visit http://www.cisco.com/en/US/products/hw/routers/ps368/products_data_sheets_list.html.

Figure 1. ES Plus (ES+ and ES+XT) line cards supported on Cisco Catalyst 6500 Series: 4-Port 10 Gigabit Ethernet and 2-Port 10 Gigabit Ethernet



ES+ Series 4-Port 10GE Line Cards



ES+ Series 2-Port 10GE Line Cards

Designed for interface flexibility and IP-over-DWDM integration in IP and Multiprotocol Label Switching (IP/MPLS) provider edge, WAN and metropolitan area network (MAN) applications, and data center interconnects (DCI), Ethernet Services Plus line cards support up to 40 Gbps of bandwidth with four ports of 10 Gigabit Ethernet interfaces, or 20 Gbps with two ports of 10 Gigabit Ethernet. The cards offer hierarchical QoS (H-QoS), Virtual Private LAN Service (VPLS), Advanced VPLS (A-VPLS) Ethernet over MPLS (EoMPLS), MPLS Layer 3 VPNs (L3VPNs), and full Layer 3 IP/MPLS routing.

The innovative architecture of these industry-leading, premium line cards is designed to deliver cost-effective, high-touch features, combining both application-specific integrated circuit (ASIC) and network processor technologies for an optimal combination of performance and flexibility. The ES Plus line cards provide distributed forwarding with proven ASIC technology in the forwarding path (routing, switching, NetFlow, and access control lists [ACLs]). Additionally, four (for the ES+40 line cards) or two (for the ES+20 line cards) programmable network processors are included in the forwarding plane to enable queuing, shaping, and special packet-processing functions. This technology combination offers customers the necessary flexibility for future service deployments and allows them to scale the system capacity as required.

Main Features and Benefits

Table 1 lists the features and benefits of the ES Plus line cards.

Table 1. Features and Benefits of ES Plus Line Cards

Feature	ES Plus Line Card	Benefit
Line-card form factor	4- and 2-port 10 Gigabit Ethernet	Offers economical, high-density, high-performance WAN services with excellent scalability
Performance	Line rate with services enabled	Provides line-rate forwarding performance on 10 Gigabit Ethernet interfaces with services enabled
Packet memory	512 MB	Provides Up to 200 milliseconds (ms) of combined bidirectional buffering (100 ms at ingress and 100 ms egress) at 10 Gbps
Switch-fabric connectivity	Two 20-Gbps fabric channels	Offers 40-Gbps fabric connectivity
Online insertion and removal (OIR)	Supports OIR for the line cards	Provides hitless OIR to reduce the negative effects of addition, change, and remove operations

Product Specifications

Tables 2 and 3 list the specifications of the ES Plus line cards, and Tables 4, 5, and 6 list features supported.

Table 2. Product Specifications

Description	Specification
Chassis compatibility	• Cisco Catalyst 6503-E Switch • Cisco Catalyst 6504 and 6504-E Switches • Cisco Catalyst 6506 and 6506-E Switches • Cisco Catalyst 6509, 6509-E, and 6509-V-E Switches • Cisco Catalyst 6513 and 6513-E Switches
Central-forwarding-engine compatibility	• The line cards are compatible with the Cisco Catalyst 6500 Series Supervisor Engine 720-3B/3BXL and Cisco Catalyst 6500 Series Supervisor Engine VS-S720-3C/3CXL • The ES Plus line cards require dual-channel switch-fabric connectivity; therefore, these line cards are not supported with the Cisco Catalyst 6500 Series Supervisor Engine 32 or in slots 1 through 8 of the Cisco 6513/6513-E chassis.
Distributed forwarding card (DFC)	• Choice of Cisco DFC 3C or 3CXL (DFC-3C or DFC-3CXL, respectively) • Line-rate distributed forwarding with services enabled; up to approximately 48 million packets per second (mpps) per line card • DFC 3C: ◦ Allows up to 256,000 hardware-based forwarding entries ◦ Allows up to 128,000 NetFlow entries • DFC 3CXL: ◦ Optimized for the IP/MPLS provider edge, offering multiple IP services such as Layer 3 VPNs, IPv6, and triple-play services (data, voice, and video) ◦ Up to 1 million hardware-based forwarding entries ◦ Up to 256,000 NetFlow entries
Minimum software	Cisco IOS® Software Release 12.2(33)SXJ1 or later
Packet memory	512 MB for 200 ms of combined input and output buffering at 10 Gbps (100 ms ingress and 100 ms egress)
Link encapsulations	Ethernet II and IEEE 802.1q encapsulations
Hardware queues	• ES+ and ES+XT 40-Gbps line cards: ◦ 128,000 ingress queues ◦ 128,000 egress queues • ES+ and ES+XT 20G line cards: ◦ 64,000 ingress queues ◦ 64,000 egress queues
MAC addresses	• Up to 96,000 MAC addresses per ES Plus line card • Hardware-based MAC learning at wire rate

Description	Specification
Environmental conditions	• Operating temperature: 32 to 104℉ (0 to 40℃) • Storage temperature: -40 to 167℉ (-40 to 75℃) • Relative humidity: 10 to 90 percent, noncondensing • Operating altitude: -60 to 2000m
MIBs	• Cisco Optical Transport Network MIB (CISCO-OTN-MIB) • Cisco Entity MIB (CISCO-ENTITY-MIB) • Cisco Entity Asset MIB • Cisco Entity Field-Replaceable Unit (FRU) Control MIB • Cisco Entity Alarm MIB • Interface IF MIB (RFC 2233) • Definitions of Managed Objects for Bridges (RFC 1493) • Evolution of Interfaces Group of MIB-II (RFC 1573) • Simple Network Management Protocol (SNMP) MIB II (RFC 1213) • Remote Monitoring (RMON) MIB (RFC 1757) • Switch Monitoring (SMON) MIB • Check the following MIB finder for more information: http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml
Network management	CiscoWorks, CiscoView and CiscoWorks Resource Manager Essentials (RME)

Physical specifications	• Occupies 1 slot in a Cisco Catalyst 6500 Series Switch
	• Dimensions (H x W x D): 1.75 x 15.375 x 16 in (4.445 X 39.053 X 40.64 cms)
	• Weight
	  ◦ 2-port 10 Gigabit Ethernet line card (7600-ES+2TG/76-ES+XT-2TG): 11.5 lb
	  ◦ 4-port 10 Gigabit Ethernet line card (7600-ES+4TG/76-ES+XT-4TG): 12.4 lb

Maximum power consumption (watts)	• Ethernet Services cards
	  ◦ 7600-ES+2TG3C: 269
	  ◦ 7600-ES+2TG3CXL: 297
	  ◦ 7600-ES+4TG3C: 371
	  ◦ 7600-ES+4TG3CXL: 399
	• Ethernet Services with Extended Transport cards
	  ◦ 76-ES+XT-2TG3C: 273W
	  ◦ 76-ES+XT-2TG3CXL: 301W
	  ◦ 76-ES+XT-4TG3C: 378W
	  ◦ 76-ES+XT-4TG3CXL: 406W

Indicators	Status: green (operational); red (faulty)
Regulatory compliance	CE Marking
Safety	• UL 60950 • CSA C22.2 No. 60950 • EN60950 • TS001 • IEC 60950 • AS/NZS3260
Electromagnetic compatibility	• FCC Part 15 Class A • ICES-003 Class A • VCCI Class A • EN55022 Class A • CISPR22 Class A • AS/NZS3548 Class A • EN61000-3-2 • EN61000-3-3 • EN61000-3-1 • EN55024 • EN50082-1 • EN300 386 • AS/NZS CISPR 22 Class A • EN61000-6-1

Description	Specification
Telecommunications standards	• ITU-T G.691 • ITU-T G.707 • ITU-T G.709 (OTN) • ITU-T G.783 Sections 9-10 • ITU-T G.784 • ITU-T G.803 • ITU-T G.825 • ITU-T G.826 • ITU-T G.841 • ITU-T G.957 Table 3 • ITU-T G.958FCC Part 15 Class A

Table 3. DWDM Line Interface Specifications

Description	Specification
Bit rate	• 9.953280 Gbps +/- 4.6 ppm • 10.3125 Gbps +/- 4.6 ppm • 11.049 Gbps +/- 4.6 ppm • 11.0957 Gbps +/- 4.6 ppm
Spectral width at 20 dB (lambda delta 20)	≤ 30 GHz
Optical Transmitter	
Type	Lithium niobate external modulator
Output power (PTmin to PTmax)	-1 dBm, + 3 dBm
Required optical return loss, minimum (ORLmin)	27 dB
Extinction ratio, minimum (reminx)	> 9 dB
Laser safety class	1
Optical Receiver	
Type	Avalanche photo diode (APD)
Chromatic dispersion tolerance (DLRmax)	Up to 1600 ps/nm
Minimum BER (BERmin) **FEC off** **FEC on** **E-FEC on**	 • 10E-12 • 10E-15 • 10E-15
Reflectance between far-end Tx and near-end Rx (maximum)	-27 dB
Input wavelength bandwidth (lambdac_rx)	1260 to 1607 nm
Connector type (Tx/Rx)	LC, duplex

Table 4. Feature Support

Description	Specification
IP/MPLS network protocols	• IPv4 unicast and multicast • IPv6 unicast and multicast • MPLS Provider Edge Layer 2 and 3 VPNs • MPLS Traffic Engineering (MPLS-TE) • MPLS Fast Reroute (FRR) • Differentiated Services (DiffServ)-aware MPLS-TE • Generic Routing Encapsulation (GRE) and IP-in-IP tunneling • VPLSoGRE • A-VPLSoGRE • Ethernet over MPLS (EoMPLS) • VPLS
QoS	• Modular QoS CLI (MQC) • Policing granularity down to 64 kbps and supported on both ingress and egress • Access control lists (ACLs) • Classification, marking, policing, and queuing • Differentiated services code point (DSCP) • Complex remarking of Ethernet and IP/MPLS headers
Congestion avoidance	Weighted Random Early Detection (WRED) based on IP precedence and DSCP
Queuing and shaping	• Enhanced Class-Based Weighted Fair Queuing (CBWFQ) • Egress Low-Latency Queuing (LLQ) • Ingress and egress shaping
Traffic classification and bandwidth policing	Classification based on: • Extended ACL • IP precedence and IP DSCP • MPLS Experimental Bits (EXP) • VLAN • Input VLAN • Class of service (CoS): Inner and outer • Policer: One-rate two-color and two-rate three-color policers on both ingress and egress
ACLs and security	• Up to 32,000 ACL entries with no forwarding degradation • Hardware counters for ACL hits
Layer 2 and 3 VPNs	• Layer 2 VPNs • EoMPLS • VPLS • MPLS L3 VPN (RFC 2547-bis) • Inter-Autonomous Systems (AS) and Carrier-Supporting-Carrier • Multicast VPN (mVPN) • mVPN Extranet
Protection and bundling	MPLS FRR

Table 5. Optical Transport Network (OTN) Feature Support

Description	Specification

Protocol support	• OTN G.709 compliant; selectable
	• Mapping of IEEE 802.3ae 10GBASE-R signal into an overclocked
	  ◦ OPU1e running at 11.0491 Gbps
	  ◦ OPU2e running at 11.0975 Gbps
	• Internal (system) and line (network) loopback
	• Local (internal) or loop (recovered from network) timing
	• ±100 parts per million (ppm) local clock accuracy over operating temperature

Description	Specification
Alarms and performance monitoring	• Alarm reporting ◦ Loss of signal (LOS) ◦ Loss of OTN frame (LOF) ◦ Loss of OTN multiframe (LOM) ◦ OTU alarm indication signal (OTU-AIS) ◦ OTU backward defect indication (OTU-BDI) ◦ ODU alarm indication signal (ODU-AIS) ◦ ODU open connection indication (ODU-OCI) ◦ ODU locked (ODU-LCK) ◦ ODU backward defect indication (ODU-BDI) ◦ ODU payload type identifier mismatch (ODU-PTIM) ◦ OTU incoming alignment (OTU-IAE) • OTU_SF_BER and OTU_SD_BER alarms based on the monitoring of OTU BIP errors with a user-settable threshold • Error counts: OTU BIP, OTU BEI, ODU BIP, and ODU BEI • Threshold crossing alerts (TCAs) for OTU BIP errors (SM-TCA) and ODU BIP errors (PM-TCA) with user-settable threshold
FEC features	• No FEC: ability to turn off error correction for use with non-FEC supporting interfaces • GFEC: standard G.709 • EFEC: standard G.975.I.4 • FEC statistics for corrected errors (EC), last-second corrected errors (EC), and uncorrected words (UC)

Table 6. SONET/SDH WAN PHY Feature Support

SONET/SDH Features and Functions	Ethernet WAN Interface	Comments
Synchronization	Supported	Ethernet WAN interface cannot be used in SONET/SDH rings
Section, line, and path BIP8	Supported	Errors are detected and counted
Section trace	Supported	
Pointer operation and action	Supported	H1 and H2 are used to get the location of SPE
Defects or anomalies: LOS, SEF, LOF, S-BIP, L-BIP, AIS- L, RDI-L, AIS-P, LOP-P, P-BIP, and PLM-P	Supported	Counters for section, line, and path BIP errors

Interface Module Support

Table 7 lists the interface modules supported.

Table 7. ES Plus Line Card XFP and SFP Modules Supported

Part Number for ES Plus Line Cards 10-Gbps Small Form-Factor Pluggable (XFP)	Wavelength	Mode	Distance
XFP-10GZR-OC192LR, LAN-PHY	1550 nm	Single mode (SM)	49.7 mi (80 km)
XFP-10GER-OC192IR+, LAN-PHY	1550 nm	SM	24.8 mi (40 km)
XFP-10GLR-OC192SR, LAN-PHY	1310 nm	SM	6.2 mi (10 km)

Ordering Information

Tables 8 and 9 provide ordering information for the modules and line cards.

Table 8. Ordering Information for Cisco ES Plus Line Cards: 10 Gigabit Ethernet DWDM XFP Modules
Note: The DWDM XFP products in Table 8 can be ordered as spares only.

Product Number	Description	ITU Channel
DWDM-XFP-60.61=	10GBASE-DWDM 1560.61 nm XFP (100-GHz ITU grid)	21
DWDM-XFP-59.79=	10GBASE-DWDM 1559.79 nm XFP (100-GHz ITU grid)	22
DWDM-XFP-58.98=	10GBASE-DWDM 1558.98 nm XFP (100-GHz ITU grid)	23
DWDM-XFP-58.17=	10GBASE-DWDM 1558.17 nm XFP (100-GHz ITU grid)	24
DWDM-XFP-56.55=	10GBASE-DWDM 1556.55 nm XFP (100-GHz ITU grid)	26

Product Number	Description	ITU Channel
DWDM-XFP-55.75=	10GBASE-DWDM 1555.75 nm XFP (100-GHz ITU grid)	27
DWDM-XFP-54.94=	10GBASE-DWDM 1554.94 nm XFP (100-GHz ITU grid)	28
DWDM-XFP-54.13=	10GBASE-DWDM 1554.13 nm XFP (100-GHz ITU grid)	29
DWDM-XFP-52.52=	10GBASE-DWDM 1552.52 nm XFP (100-GHz ITU grid)	31
DWDM-XFP-51.72=	10GBASE-DWDM 1551.72 nm XFP (100-GHz ITU grid)	32
DWDM-XFP-50.92=	10GBASE-DWDM 1550.92 nm XFP (100-GHz ITU grid)	33
DWDM-XFP-50.12=	10GBASE-DWDM 1550.12 nm XFP (100-GHz ITU grid)	34
DWDM-XFP-48.51=	10GBASE-DWDM 1548.51 nm XFP (100-GHz ITU grid)	36
DWDM-XFP-47.72=	10GBASE-DWDM 1547.72 nm XFP (100-GHz ITU grid)	37
DWDM-XFP-46.92=	10GBASE-DWDM 1546.92 nm XFP (100-GHz ITU grid)	38
DWDM-XFP-46.12=	10GBASE-DWDM 1546.12 nm XFP (100-GHz ITU grid)	39
DWDM-XFP-44.53=	10GBASE-DWDM 1544.53 nm XFP (100-GHz ITU grid)	41
DWDM-XFP-43.73=	10GBASE-DWDM 1543.73 nm XFP (100-GHz ITU grid)	42
DWDM-XFP-42.94=	10GBASE-DWDM 1542.94 nm XFP (100-GHz ITU grid)	43
DWDM-XFP-42.14=	10GBASE-DWDM 1542.14 nm XFP (100-GHz ITU grid)	44
DWDM-XFP-40.56=	10GBASE-DWDM 1540.56 nm XFP (100-GHz ITU grid)	46
DWDM-XFP-39.77=	10GBASE-DWDM 1539.77 nm XFP (100-GHz ITU grid)	47
DWDM-XFP-38.98=	10GBASE-DWDM 1538.98 nm XFP (100-GHz ITU grid)	48
DWDM-XFP-38.19=	10GBASE-DWDM 1538.19 nm XFP (100-GHz ITU grid)	49
DWDM-XFP-36.61=	10GBASE-DWDM 1536.61 nm XFP (100-GHz ITU grid)	51
DWDM-XFP-35.82=	10GBASE-DWDM 1535.82 nm XFP (100-GHz ITU grid)	52
DWDM-XFP-35.04=	10GBASE-DWDM 1535.04 nm XFP (100-GHz ITU grid)	53
DWDM-XFP-34.25=	10GBASE-DWDM 1534.25 nm XFP (100-GHz ITU grid)	54
DWDM-XFP-32.68=	10GBASE-DWDM 1532.68 nm XFP (100-GHz ITU grid)	56
DWDM-XFP-31.90=	10GBASE-DWDM 1531.90 nm XFP (100-GHz ITU grid)	57
DWDM-XFP-31.12=	10GBASE-DWDM 1531.12 nm XFP (100-GHz ITU grid)	58
DWDM-XFP-30.33=	10GBASE-DWDM 1530.33 nm XFP (100-GHz ITU grid)	59

Table 9. Ordering Information for Ethernet Services Plus Line Cards

Product Name	Part Number
Cisco 7600 Series Ethernet Services Plus 20G Line Card, 2-port 10 GE XFP and DFC-3C	7600-ES+2TG3C
Cisco 7600 Series Ethernet Services Plus 20G Line Card, 2-port 10 GE XFP and DFC-3CXL	7600-ES+2TG3CXL
Cisco 7600 Series Ethernet Services Plus 40G Line Card, 4-port 10 GE XFP and DFC-3C	7600-ES+4TG3C
Cisco 7600 Series Ethernet Services Plus 40G Line Card, 4-port 10 GE XFP and DFC-3CXL	7600-ES+4TG3CXL
Cisco 7600 Series ES Plus XT, LAN/WAN PHY, OTN/G.709, 2x10GE, XFP, DFC3C	76-ES+XT-2TG3C
Cisco 7600 Series ES Plus XT, LAN/WAN PHY, OTN/G.709, 2x10GE, XFP, DFC3CXL	76-ES+XT-2TG3CXL
Cisco 7600 Series ES Plus XT, LAN/WAN PHY, OTN/G.709, 4x10GE, XFP, DFC3C	76-ES+XT-4TG3C
Cisco 7600 Series ES Plus XT, LAN/WAN PHY, OTN/G.709, 4x10GE, XFP, DFC3CXL	76-ES+XT-4TG3CXL

Visit the Cisco Software Center to download Cisco IOS Software Release 12.2(33)SXJ1 (or later) used with Supervisor Engine 720-3B or VS-S720.

Service and Support

Cisco offers a wide range of services programs to accelerate customer success. These innovative services programs are delivered through a unique combination of people, processes, tools, and partners, resulting in high levels of customer satisfaction. Cisco Services can help you protect your network investment, optimize network operations, and prepare your network for new applications to extend network intelligence and the power of your business. For more information about Cisco Services, refer to Cisco Technical Support Services or Cisco Advanced Services.

For More Information

For more information about the Ethernet Services Plus and Ethernet Services Plus Extended Transport 20- and 40-Gbps line cards, visit http://www.cisco.com/ or contact your local Cisco account representative.

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