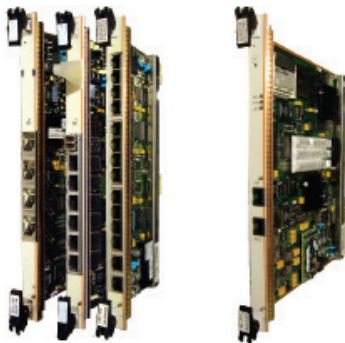


Alcatel-Lucent ISA-ES16 Series

INTEGRATED SERVICE ADAPTOR ETHERNET SWITCH FOR ALCATEL-LUCENT OMSN PRODUCTS

The Alcatel-Lucent Integrated Service Adaptor Ethernet Switch (ISA-ES) series circuit packs provide feature-rich Ethernet service capabilities for the undisputed market leaders of multiservice networks, the Alcatel-Lucent Optical Multi-Service Node (OMSN) products.

Alcatel-Lucent ISA-ES16 variants provide native Fast Ethernet (FE) and Gigabit Ethernet (GigE) interfaces and Ethernet over SDH (EoS) ports within a 4.8-Gb L2 switching engine.



ACCESS CARDS

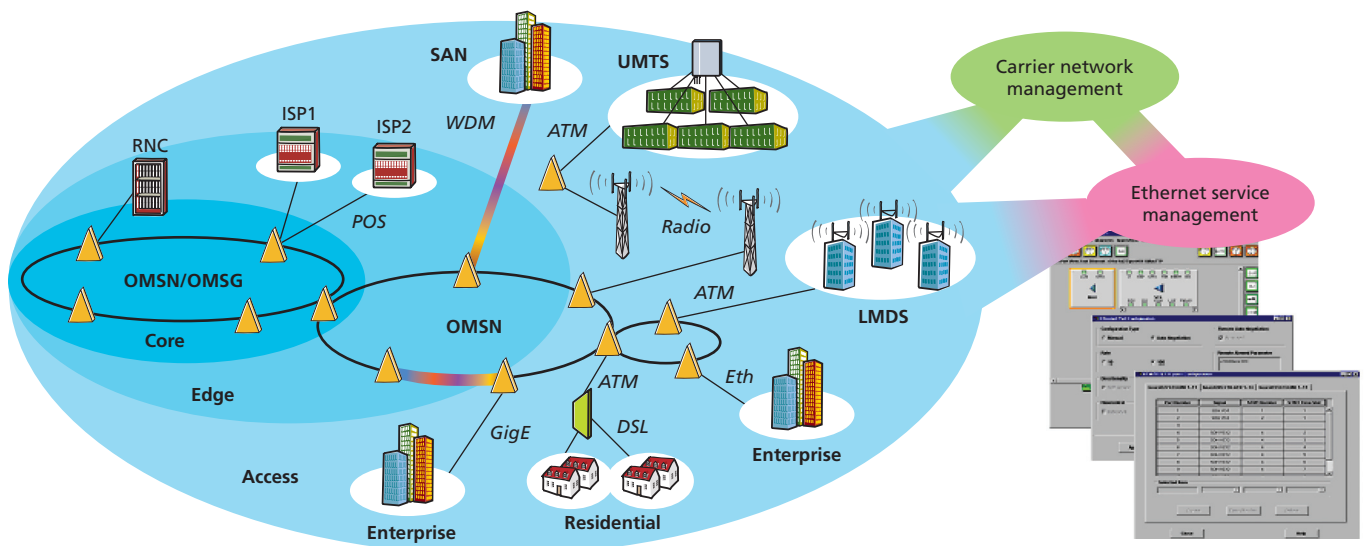
ISA-ES16

The Alcatel-Lucent OMSN family of multiservice nodes is deployed world-wide. The Alcatel-Lucent ISA-ES modules, with their capability to aggregate and switch Ethernet into SDH transport, offer service providers a powerful tool to leverage their SDH investments to offer Ethernet services.

Carrier-grade Ethernet must conform to stringent performance standards, with high availability and layered network and service management.

SDH infrastructures built on the Alcatel-Lucent OMSN products have powerful quality of service (QoS) management with high availability and resiliency. Integrated Ethernet services based on the Alcatel-Lucent ISA-ES are simple to implement with embedded end-to-end data-service management. The ISA-ES empowers network transformation for service providers seeking to gain maximum return from their network investments (see Figure 1).

Figure 1. End-to-end data-services management



The Alcatel-Lucent ISA-ES series meets the Ethernet technology needs of Tier-1 and Tier-2 service providers, service-provider carriers, multisystem operators or mobile service operators (MSOs), cable operators, power utilities and government institutions.

Each Alcatel-Lucent ISA-ES module has a configurable IP address and User Datagram Protocol (UDP) port for network management to manage Ethernet services, including implementation, alarms retrieval and QoS performance monitoring (PM).

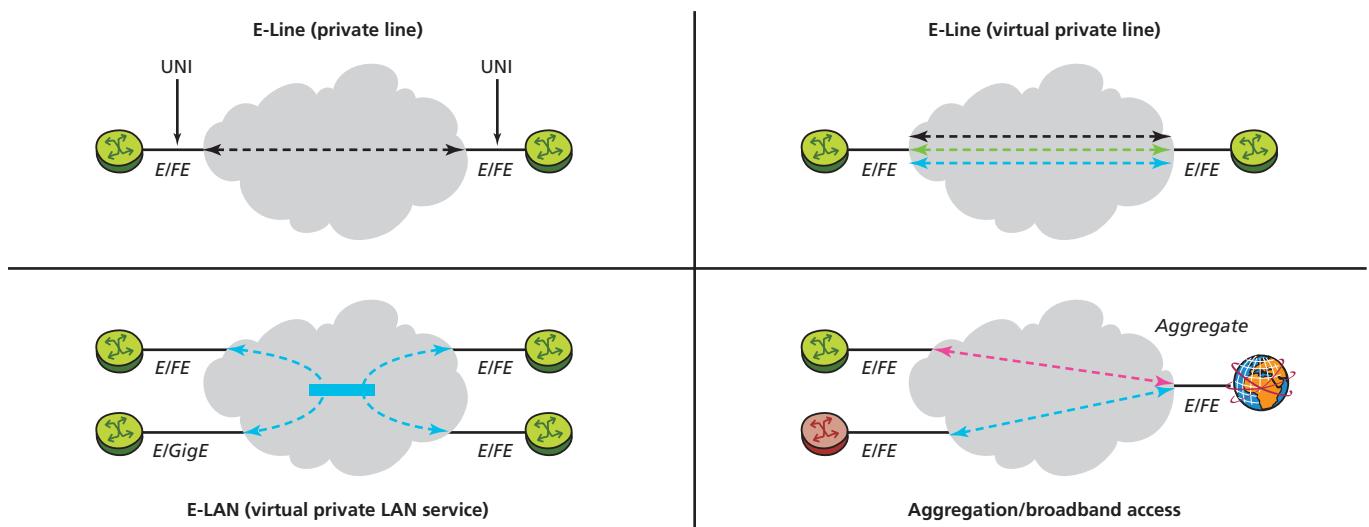
Alcatel-Lucent ISA-ES16 circuit-pack overview

- Electrical and optical FE/GigE interfaces, with small form-factor pluggable (SFP) optics
- Comprehensive set of:
 - Ethernet switching features (IEEE 802.1D/Q/ad)
 - Resiliency features: xSTP, Link Aggregation Group (LAG), Link Capacity Adjustment Scheme (LCAS), SDH-based protection

- QoS features: for example, policing, priority marking, per class queuing, weighted random early detection (WRED), weighted deficit round robin (WDRR)
- Ethernet PM counters
- Ethernet operations, administration and maintenance (OAM) suite (ITU T Y.1731/IEEE 802.1ag)
- EoS adaptation suite, using generic framing procedure (GFP) (ITU-T G.7041), link access procedure over SDH (LAPS), virtual concatenation (VCAT) (ITU-T G.707)
- Flexible data architecture options (see Figure 2):
 - Point-to-point
 - Hub-and-spoke
 - Multipoint-to-multipoint
- “Bridge none mode” for transparent packet switching
 - Unidirectional/bidirectional point-to-point
 - Unidirectional/bidirectional point-to-multipoint

- Multiprotocol Label Switching (MPLS) Martini encapsulation
 - MPLS label switch router (LSR)
 - MPLS over Ethernet
 - MPLS over SDH (PPP/HDLC/SDH)
- Optical transport options within Alcatel-Lucent OMSN products:
 - Multiplex section protection (MSP): 1+1, 1+n
 - Multiplex Section-Shared Protection Ring (MS-SPRing) 2f
 - Subnetwork Connection Protection (SNCP) I/N
- Efficient network management with dedicated Ethernet manager suite and MPLS tunnel manager
- Hardware-based Electrical Protection Switching (EPS) 1+1 functionality to give maximum resilience on carried traffic

Figure 2. Alcatel-Lucent ISA-ES16: supported Ethernet services



To help meet service level agreements (SLAs), each Alcatel-Lucent ISA-ES module allows service providers and carrier operators to specify per-flow QoS. Traffic is specified by a set of parameters to control its maximum and mean rates and the relative burst window size in bytes (see Figure 3).

Policing parameters are specified according to:

- Committed information rate (CIR)
- CIR burst window size (CBS)
- Peak information rate (PIR) or excess information rate
- PIR burst window size (PBS)

Supported SLAs in Alcatel-Lucent ISA-ES16:

- Guaranteed traffic
- Best-effort traffic
- Regulated traffic

The Alcatel-Lucent ISA-ES16 Ethernet Switch module supports four to sixteen virtual container (VC)-4s, with aggregate trunking capacity dependent on housing equipment and slot position. The ISA-ES16 switch module services three distinct access-module models, supporting fourteen E/FE ports, seven FX ports, or four GigE ports (see Figure 4).

Figure 3. SLA support

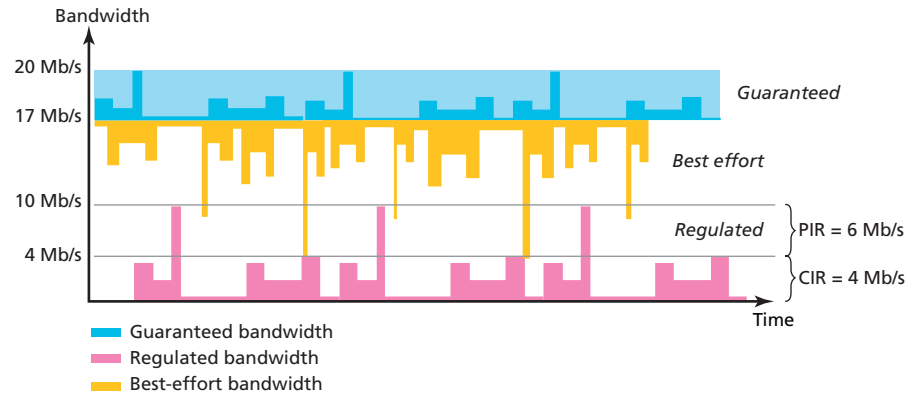
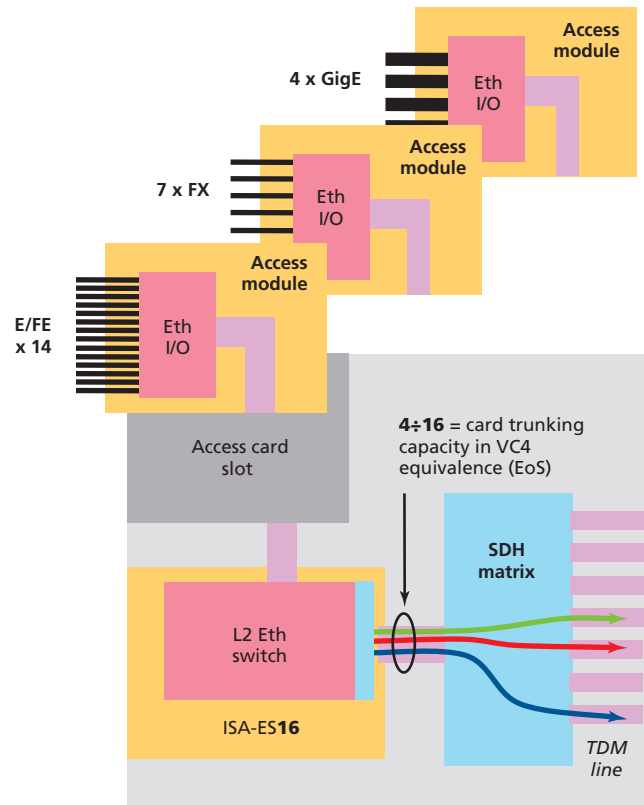


Figure 4. ISA-ES16 with access-card combinations



For the GigE and FX access modules, the ISA-ES16 offers hardware-based EPS 1+1 protection (see Figure 5). The ISA-ES16 can be configured to support a wide range of VC-12, VC-3 and VC-4 combinations for flexible, full-featured Ethernet/MPLS over SDH. Figure 6 charts the aggregate bandwidth transported for various VC-x x Nv VC-concatenation combinations on an ISA-ES16.

Figure 5. ISA-ES16 in EPS 1+1 configuration

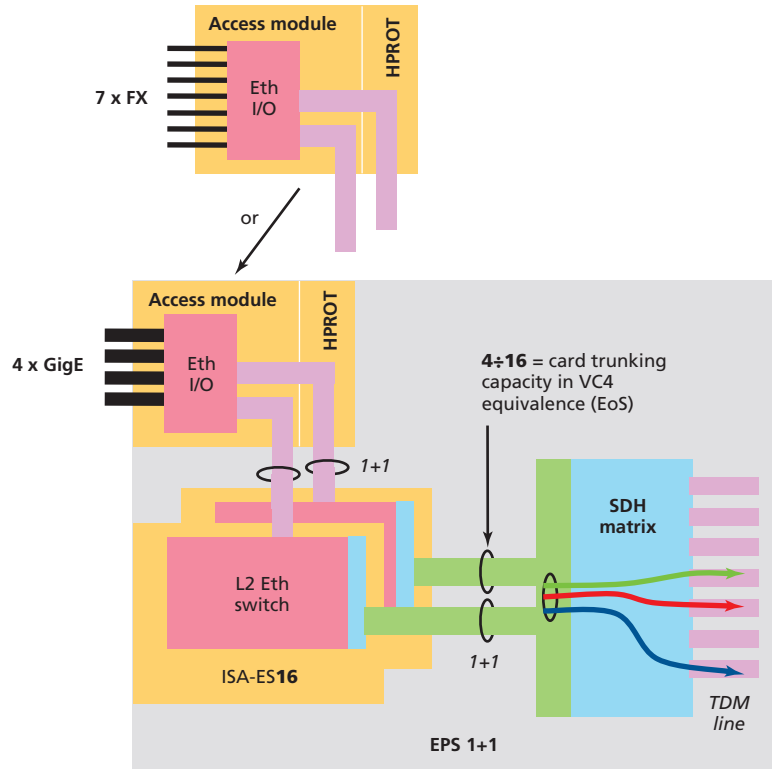


Figure 6. Transported bandwidth in different VC-x concatenations

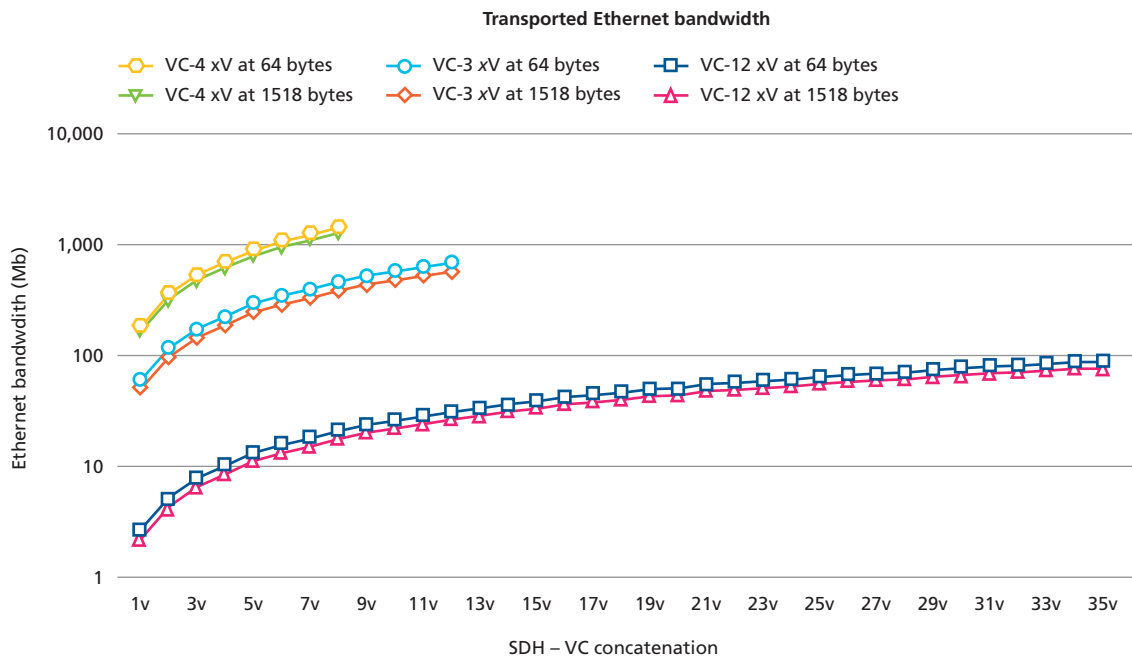


Figure 7. Transported bandwidth in VC-4 and GFP-F

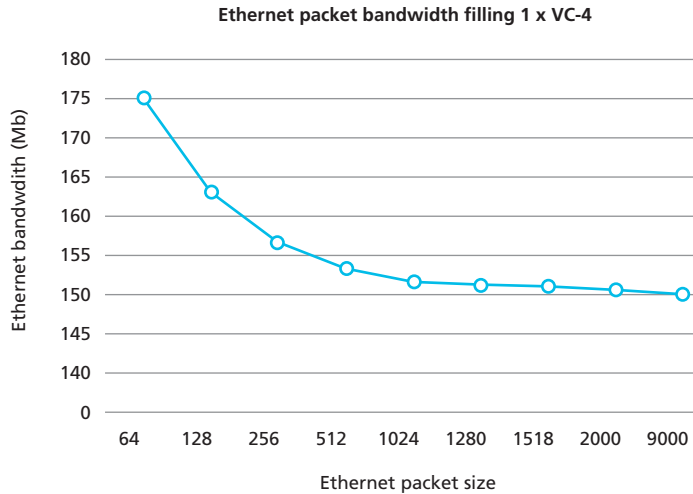


Figure 7 and Table 1 present specific Ethernet-packet transportation-bandwidth values for a single VC-x.

The Alcatel-Lucent ISA-ES16 card is hosted on the Alcatel-Lucent OMSN family of multiservice provisioning platforms: the Alcatel-Lucent 1660 Synchronous Multiplexer (SM), Alcatel-Lucent 1662 SM Compact (SMC) and Alcatel-Lucent 1650 SMC.

Table 2 presents a detailed view of ISA-ES16 capacities in terms of Ethernet-over-SDH capability: maximum L2 switch bandwidth, EoS ports, maximum VC-12/3/4, VC groups (VCGs), VC 12/3/4 per VCG, and differential delay. The possible equipment configurations with derived Ethernet ports and L2 bandwidths are provided in Table 3. The total number of Ethernet/FE/GigE ports per node is directly related to the

Table 1. Packets over SDH in a single VC-x

PACKET SIZE	VC-4 1-V	VC-3 1-V	VC-12 1-V
BYTES	Mb	Mb	Mb
64	174.7	56.4	2.54
128	163.0	52.7	2.37
256	156.6	50.6	2.27
512	153.2	49.5	2.23
1024	151.5	48.9	2.20
1280	151.2	48.8	2.20
1518	150.9	48.8	2.19
2000	150.6	48.6	2.18
9000	149.9	48.4	2.17

number of hosted ISA cards. For larger quantities of Ethernet ports with a bigger L2 switch core, the Alcatel-Lucent 1850 Transport Services Switch (TSS) family is an ideal alternative. Table 4 shows a detailed view of ISA-ES16 switch and access modules and the Alcatel-Lucent OMSN equipment on which they are supported.

Table 2. Alcatel-Lucent ISA-ES16 Ethernet-over-SDH capacities

ALCATEL-LUCENT ISA-ES16 CAPABILITY	1650 SMC	1662 SMC	1660 SM, REL. 4	1660 SM, REL. 5/6
Ethernet L2 core switch (Gb/s)	4.8	4.8	4.8	4.8
Ethernet ports L2 switch bandwidth (Gb/s)	4.2	3.6	4.2/3.6	2.4
EoS bandwidth L2 switch (Gb/s)	0.6	1.2	0.6/1.2	2.4
EoS ports quantity	64	64	64	64
VC-12 max. available	252	252	252	252
VC-3 max. available	12	12	12	12
VC-4 max. available	4	8	4/8	16
VCG at VC-12	64	64	64	64
VCG at VC-3	12	12	12	12
VCG at VC-4	16	16	16	16
VC-12 per VCG	63	63	63	63
VC-3 per VCG	12	12	12	12
VC-4 per VCG	4	8	4/8	16
Max. differential compound delay in VCAT (ms)	48	48	48	48
Max. differential compound delay in LCAS (ms)	24	24	24	24

Table 3. Ethernet capacities with Alcatel-Lucent ISA-ES16 in Alcatel-Lucent OMSN products

OMSN EQUIPMENT	TRUNK NETWORK	ISA-ES-16 CARDS (MIN./MAX.)	ETHERNET PORT CAPACITIES			BANDWIDTH CAPACITIES (Gb/s)		
			PORTS GIGE (MIN./MAX.)	PORTS ETH/FE (MIN./MAX.)	PORTS FX (MIN./MAX.)	TRUNK BW (EACH CARD)	L2 TRUNK BW (MAX.)	L2 SWITCH BW (MIN./MAX.)
1650 SMC	2 x STM-4	1/3	4/12	14/42	7/21	0.6 Gb/s	1.2 Gb/s	4.8/14.4 Gb/s
1662 SMC	2 x STM-16	1/8	4/32	14/112	7/56	1.2 Gb/s	4.8 Gb/s	4.8/38.4 Gb/s
1660 SM, Rel. 4	2 x STM-16	1/8	4/32	14/112	7/56	0.6 or 1.2 Gb/s	4.8 Gb/s	4.8/38.4 Gb/s
1660 SM, Rel. 4	4 x STM-16	1/8	4/32	14/112	7/56	0.6 or 1.2 Gb/s	9.6 Gb/s	4.8/38.4 Gb/s
1660 SM, Rel. 5/6	4 x STM-64	1/8	4/32	14/112	7/56	4.8 Gb/s	38.4 Gb/s	4.8/38.4 Gb/s

Table 4. Alcatel-Lucent ISA-ES16 switch and access-card ordering part numbers

ISA-ES16 CARD	NAME	FUNCTION	1650 SMC	1662 SMC	1660 SM, REL. 4	1660 SM, REL. 5/6
3AL 81915 AB**	ISA-ES16 HC	Core L2 switch main or spare board	•	•	•	•
3AL 80404 AA**	ISA-ETH ACCESS	14 x E/FE access for main board	•	•	•	•
3AL 80411 AB**	ISA-GBE ACCESS/2	4 x GigE access for main board	•	•	•	•
8DG 15238 AA**	7xFX SFP ACCESS	7 x FX access for main board	•	•	•	•
3AL 36510 AA**	HIGH SPEED PROT	¹ Access plug for spare ISA-ES16 to work in EPS 1+1	•	•	•	•

¹ Do not apply to 3AL 80404 AA**

Technical specifications

Interfaces¹

- FE: 10/100BASE-T
- FX: 100BASE-FX
- GE: 1000BASE-X

Physical Ethernet interfaces

- 10/100BASE-T
 - Connector: RJ-45
 - Transmission: full-duplex
 - Range: 100 m (328.08 ft)
 - Ports: autonegotiation supported
- 100BASE-X: SFP, LC connector
 - LX: 10 km (6.21 mi), single-mode (SM) fiber
 - FX: 2 km (1.24 mi) multimode (MM) fiber
- FE electrical SFP for BASE-X
 - 100 BASE-T
 - Connector: RJ-45
 - Range: 100 m (328.08 ft)
- 1000BASE-X: SFP-based, LC connector
 - ZX: 80 km (49.71 mi), SM fiber
 - LX: 5 km (3.11 mi), SM fiber
 - SX: 550 m (341.77 mi), MM fiber

Ethernet switching features

- Technology
 - Application specific integrated circuit (ASIC)-based
 - Parallel store-and-forward
 - Virtual switch ETS or MPLS mode
- Bridging
 - IEEE 802.1D: Media Access Control (MAC) bridge
 - IEEE 802.1Q: virtual bridge
 - IEEE 802.1ad: provider bridge
- Class-forwarding criteria
 - Per port
 - Per virtual LAN (VLAN) (IEEE 802.1 Q)
 - Per priority bit (IEEE 802.1 p)
 - IEEE 802.3 MAC DA
- Flow control (IEEE 802.3)
 - In full-duplex only, E-Line mode, congestion control symmetric and asymmetric
- Address table
 - 64,000 MAC entries
- Layer 2 switching core
 - 4.8 Gb/s per card
 - ETS flows: 10,000
 - MPLS flows: 32,000

- VLAN IDs (IEEE 802.1Q)
 - 4094 VLAN IDs
 - Maximum 4K active VLAN IDs (802.1Q and 802.1ad)
- MPLS features in MPLS mode
 - Per-port label-space management
 - MPLS "Martini" without control word
 - MPLS label EXP bits (L-LSP)
 - MPLS label push, swap, pop
 - Maximum MPLS labels: 32,000
 - MPLS TTL management
 - MPLS unicast traffic forwarding
 - MPLS Differentiated Services (DiffServ) conformance L-LSP
 - Default traffic behavior
 - Assured forwarding type 1 traffic
 - Expedited forwarding traffic
 - Hitless bandwidth modification
 - Dual attach protection protocol

Port trunking features

- Ethernet over:
 - GFP-F (ITU-T G.7041)
 - LAPS (X.86)
 - MPLS (Martini draft)

- MPLS over:
 - GFP-F (ITU-T G.7041)
 - PoS (HDLC-PPP)
 - Ethernet physical
- VCG over:
 - GFP-F (ITU-T G.7041)
 - LAPS (X.86)
 - HDLC-PPP
- VCAT (ITU-T G.707)
 - See Table 2 EoS
- Rate limiting per VCG
 - 10 Mb
 - 100 Mb

Protection features

- EPS 1+1 (ISA ES HW based)
 - 4 x GigE access
 - 7 x FX access
 - EoS all

Protection features: UNI LAG (FE/FX/GigE)

- Edge node capability
 - BPDU (UNI STP) tunneling
 - VRRP tunneling

¹ Alternative access cards

Protection features: NNI

- Spanning Tree Protocols
 - Spanning Tree Protocol (STP)
 - Rapid Spanning Tree Protocol (RSTP)
 - Multiple Spanning Tree Protocol (MSTP)
 - PVSTP (for VLAN applications; proprietary per-VLAN RSTP)
- LCAS (ITU-T G.7042)
 - Hitless bandwidth modification²
 - LCAS diversity route management at management system
 - LCAS protection at VC-12 <150 ms³
 - LCAS protection at VC-3 <100 ms³
 - LCAS protection at VC-4 <50 ms³
- SDH-based protection
 - VC-x: SNCP-N
 - VC-x: SNCP-I (<50 ms)⁴
 - Multiplex section protection:
 - MSP 1+1 (<50 ms)⁴
 - MSP N:1 (<100 ms)⁴

Multicast features

- IGMP snooping v2
 - IGMP snooping
 - IGMP proxy/fast-leave

QoS features

- Policer
 - Metering: single-rate and dual-rate policer token bucket
 - Marking: two colors (green, yellow)
 - Dropping: out of profile
- Class of service (CoS) classes
 - Best-effort traffic: PIR >0; CIR = 0
 - Guaranteed traffic: CIR >0; PIR = CIR
 - Regulated traffic : CIR >0; PIR >CIR
- Advanced QoS
 - IEEE 802.1p
 - 5P3D, 8P0D, 6P2D, 7P1D
- Differentiated services
 - code point (DSCP)
 - filtering/marking

- Scheduler
 - 8 output queues per UNI port
 - 2 strict-priority queues
 - 6 WDRR queues
 - WRED on all queues
- Untagged traffic in IEEE 802.1ad
 - Mapped into a dedicated S-Tag

Packet-based monitoring

Monitoring counters

- Total received correct octets (TRCO)
- Total received correct frames (TRCF)
- Total transmitted octets (TTO)
- Total transmitted frames (TTF)
- Total discarded frames (TDF) due to congestion
- Total received service errored frames (TRSEF)

Counter application

- Per port
 - User network interface (UNI)
 - Network node interface (NNI)
- Per flow (after classification)
 - Per VLAN: priority bits
 - Per classification: green, yellow
 - Unicast, multicast, broadcast
- Per maintenance activity
 - Selections among all available counters

Counter history

- CD (current counter value)
- HD 1 h/15 min (counter history)
- HD 24 h (24-h counter history)

OAM features

- Metro Ethernet Fourm (MEF)
- OAM assisted by network management system
- ITU-T Y.1731/IEEE 802.1ag
 - Maintenance entity (ME)
 - Maintenance entity group (MEG)
 - Maintenance end point (MEP)
 - Maintenance intermediate point (MIP)
 - Continuity check (CC)
 - Link trace (LT)
 - Link loopback (LB)
- Physical loopbacks
 - E/FE, FX, GigE line loopback
 - E/FE, FX, GigE network loopback

- EoS VC-4 (-3,-12) line loopback
- EoS VC-4 (-3,-12) network loopback
- Link loss forwarding
 - Client signal fail (CSF)
 - Server signal fail (SSF): GFP server

Data certification

- MEF 9, Ethernet services
- MEF 14, traffic management
- MEF 21, Link OAM

Network management

ISA is remotely managed through the Alcatel-Lucent 1350 Optical Management System (OMS) network-management suite, comprising:

- Element Manager (EMS)
- Regional Manager (RM) SONET/SDH/ wavelength division multiplexing (WDM)
- Packet Manager (PKT): data services
- Standard management support, including:
 - Open System Interconnection (OSI) stack with Q3 interface per SDH part of management
 - Simple Network Management Protocol (SNMP)v2c, SNMPv3 for Ethernet management
 - IP-over-OSI tunneling: out-of-band management
 - Remote software download
 - Unsolicited alarm collection
 - Historical performance-monitoring collection
 - Export of alarms through ISN and IOO interfaces

Local management

- Craft terminal PC-based for local management, with:
 - Microsoft® Windows XP
 - Local interface (RS-232)
 - Local software download
- Operator handbook suited for specific software release (on CD media)

End-to-end network-managed services

- Bridge (IEEE 802.1D)
 - Ethernet private line (EPL)
 - Ethernet private LAN (E-LAN)

- Virtual bridge (IEEE 802.1Q)
 - Ethernet Virtual Private Line (EVPL)
 - Ethernet Virtual Private LAN (EVP-LAN)
- Provider bridge (IEEE 802.1ad)
 - EVPL
 - EVP-LAN

Dimensions

- One basic card slot to plug the core switch card
- One access card to plug the access switch card
- Pluggable in:
 - Alcatel-Lucent 1650 SMC
 - Alcatel-Lucent 1662 SMC
 - Alcatel-Lucent 1660 SM

Power supply

- -36 V DC to -75 V DC (-48 V)
- Redundant, hot-swappable
- Power consumption: 60 W maximum

Environmental

- ETSI EN 300 019-1-3, Class 3.2: partly temperature-controlled locations

IEEE standards compliance

- IEEE 802.1D, Spanning Tree
- IEEE 802.1p, priority queuing
- IEEE 802.1Q, VLAN tagging
- IEEE 802.1w, Rapid Spanning Tree
- IEEE 802.1s, Multiple Spanning Tree
- IEEE 802.1ad, provider-edge bridges
- IEEE 802.3ad, link aggregation
- IEEE 802.1ag, Ethernet OAM
- IEEE 802.3, Ethernet physical layer
 - Clauses 24/25: 100Base-T
 - Clauses 13/14: 10Base-T
 - Clause 28: autonegotiation
- IEEE 802.3u, FE
- IEEE 802.3x, flow control
- IEEE 802.3z, GigE
- IEEE 802.3ah, Ethernet in first mile

² One VC-x step at a time

³ Multiple VC-x (with VCAT and LCAS)

⁴ Single VC-x (without VCAT/LCAS)

IETF specifications

General

- RFC 768, User Datagram Protocol
- RFC 783, Trivial File Transfer Protocol (TFTP)
- RFC 791, Internet Protocol
- RFC 792, Internet Control Message Protocol
- RFC 793, Transmission Control Protocol
- RFC 826, Ethernet Address Resolution Protocol
- RFC 854, Telnet Protocol Specification
- RFC 1122, Requirements for Internet Hosts – Communication Layers
- RFC 1518, An Architecture for IP Address Allocation with CIDR
- RFC 1519, Classless Inter-Domain Routing
- RFC 1542/951, Clarifications and Extensions for the Bootstrap Protocol
- RFC 1812, Requirements for IPv4 Routers

DiffServ

- RFC 2474, Definition of the Differentiated Services Field (DS Field) in IPv4 and IPv6 Headers
- RFC 2475, DiffServ core and edge routing functions
- RFC 2597, DiffServ assured forwarding
- RFC 3140, Per Hop Behavior (PHB) Identification Codes
- RFC 3246/2598, Expedited Forwarding PHB

MPLS

- RFC 2702, Requirements for Traffic Engineering over MPLS
- RFC 3031, MPLS Architecture
- RFC 3032, MPLS Label Stack Encoding

MEF certification

- MEF 9, MEF 14
 - EPL
 - EVPL
 - E-LAN
- MEF 21



Support information

Support for the Alcatel-Lucent ISA-ES16 is provided through the Alcatel-Lucent Global Technical Support Organization with specifying information on hardware and software-hosting equipment.

Please refer to www.Alcatel-Lucent.com to contact Alcatel-Lucent worldwide support organizations.