Alcatel-Lucent 7705 SAR

SERVICE AGGREGATION ROUTER | RELEASE 3.0

The Alcatel-Lucent 7705 Service Aggregation Router (SAR) delivers industry-leading IP/MPLS and pseudowire capabilities in compact platforms with the ability to reliably groom and aggregate multiple media, service and transport protocols onto an economical packet transport infrastructure.

Alcatel-Lucent 7705 SAR-F

Alcatel-Lucent 7705 SAR-8

The Alcatel-Lucent 7705 SAR is optimized for multiservice adaptation, aggregation and routing, especially onto a modern Ethernet and IP/MPLS infrastructure. Leveraging the powerful Service Router Operating System (SR OS) and 5620 Service Aware Manager (SAM), it is available in compact, low power consumption platforms delivering highly available services over resilient and flexible network topologies.

The 7705 SAR is well suited to the aggregation and backhaul of 2G, 3G and LTE mobile traffic — providing cost-effective scaling and the transformation to IP/MPLS networking. Business Services modernization is supported in the transition from legacy to consolidated, packet-based operation. Hugely reduced equipment footprints are achievable with reduced energy costs. Enterprise and Vertical organizations (such as energy utilities, transportation and government agencies) can deploy with confidence, achieving reliable and resilient support of legacy and advanced services.

The Alcatel-Lucent 7705 SAR owes much of its development heritage to the Alcatel-Lucent Service Router (SR) product line. Sharing much of the market-leading feature set of that product line, the Alcatel-Lucent 7705 SAR brings a powerful, service-oriented capability to the RAN, specifically in form factors and at-price points that are particularly appropriate for cell sites and hub locations. With end-to-end service management under the Alcatel-Lucent 5620 management portfolio, the Alcatel-Lucent 7705 SAR greatly augments the IP/MPLS RAN transport solution from Alcatel-Lucent.

Service aggregation and networking

To provide the most efficient transport solution, the Alcatel-Lucent 7705 SAR employs pseudowire encapsulation methods to map services end to end. The use of pseudowires ensures that the key attributes of the service are maintained, while using a cost-effective packet environment to aggregate services. In addition to pseudowire transport, IP routing and forwarding is supported. Services such as ATM, ATM IMA, Ethernet and TDM traffic can be natively switched across the 7705 SAR.

The Alcatel-Lucent 7705 SAR supports RFC 5086 — Structure-Aware TDM Circuit Emulation Service over Packet Switched Network (CESoPSN) and also RFC 4553 — Structure-Agnostic TDM over Packet (SAToP) for the encapsulation and transport of TDM traffic; for example, from mobile 2G, TDM-attached base stations. The use of circuit emulation service (CES) ensures that

only the active time slots are transported, keeping bandwidth usage to a minimum. Also, the Alcatel-Lucent 7705 SAR supports RFC 4717 — Encapsulation Methods for Transport of ATM over MPLS Networks; N:1 cell mode is supported. Multiple access ATM ports are bundled together to attain higher speeds using IMA. The IMA protocol is terminated on the Alcatel-Lucent 7705 SAR, and only the cells containing user data that belong to a virtual circuit/virtual path (VC/VP) structure are transported. RFC 4448 — Encapsulation Methods for Transport of Ethernet over MPLS Networks is also supported. To offer greater scalability, all the traffic out of an Ethernet port can be carried over a single Ethernet pseudowire or, alternatively, a pseudowire can be created for each VLAN that is assigned to a different service or end-customer. IP pseudowires are supported and provide the ability to deterministically carry IP traffic between disparate media. For example, IP traffic can be carried between a PPP (or ML-PPP) access point and an Ethernet connection. The 7705 SAR product line supports BGP/MPLS Virtual Private Networks (VPNs) to allow the separation of Layer 3 traffic between different groups of users or organizations. Analog voice encoding and transport is available on the 7705 SAR-8. Voiceband analog traffic can be carried over a modern network infrastructure between two analog devices using either traditional T1/E1 network interfaces or over Ethernet or ML-PPP interfaces.

Highly flexible network infrastructure options include the use of MPLS, IP or GRE (Generic Routing Encapsulation) tunneling for aggregated traffic. When dynamic MPLS signaling is deployed, the end-to-end pseudowire is established using targeted label distribution protocol (T-LDP) and the MPLS tunnel using LDP. In addition to efficient LDP-based dynamic signaling, static provisioning of both the MPLS tunnel and the pseudowire is supported. GRE or IP tunneling allows low-cost, ubiquitous IP networks to be used for backhauling; for example, for the transport of HSPA (High Speed Packet Access) off-loaded traffic using DSL access media.

Label switched routing

The 7705 SAR can be configured as either a Label Edge Router (LER) or a full Label Switched Router (LSR). Label Switched Paths (LSPs) can be signaled via either the Label Distribution Protocol (LDP) or the Resource Reservation Protocol with Traffic Engineering (RSVP-TE). The 7705 SAR brings a strong suite of traffic engineering and resiliency capabilities via functions such as Constraint-based Shortest Path First (CSPF) routing, Fast Reroute (FRR), primary and secondary LSPs and redundant pseudowires.

Quality of service and traffic management

It is critical to maintain the end-to-end quality of service (QoS) for packet traffic. Not all types of traffic have the same set of requirements. Voice traffic in particular requires low latency and jitter (latency variation) as well as low loss, whereas data traffic often has less stringent delay requirements but may be very sensitive to loss, as packet loss can seriously constrain application throughput. To offer the required treatment throughout the network, traffic flows with different requirements are identified at the access and marked in-line with the appropriate QoS metrics. Traffic classification and marking are carried out based on the following categories:

Classification (Layer 1/Layer 2/Layer 2.5 and/or Layer 3 header):

- Time slot/port
- Ethernet port/VLAN
- ATM service category (CBR/rt-VBR/nrt-VBR/UBR)
- ATM VC
- Ethernet 802.1p/VLAN
- IP DSCP/MPLS EXP

Marking:

- Layer 2 (802.1p)
- Layer 2.5 (EXP) both for tunnel and PWE3
- Layer 3 (DiffServ)

The Alcatel-Lucent 7705 SAR utilizes extensive traffic management policies to ensure fairness with detailed classification and hierarchical scheduling including: minimum/maximum, queue type-based weighted round robin or strict priority and profiled scheduling, as well as multi-tier policing to differentiate and prioritize individual services and flows.

Operations, administration and maintenance

In order to ensure continuity of services, the Alcatel-Lucent 7705 SAR has a full set of operations, administration and maintenance (OAM) features including:

- LSP ping
- LSP traceroute
- Service distribution path (SDP) ping
  - ¬ Verifies, for example, tunnel connectivity and round trip delay
- Virtual circuit connectivity verification (VCCV)
  - ¬ Verifies, for example, service level existence and round trip time
  - ¬ Extends OAM to pseudowire services
- Ethernet OAM functions for example:
  - ¬ 802.3ah: Ethernet in the First Mile
  - ¬ 802.1ag: Connectivity Fault Management
  - ¬ Y.1731: Ethernet OAM mechanisms for fault management — mainly at a service level
- Service Assurance Agent (SAA)
  - ¬ Runs in background, periodically collecting network "health" information from OAM mechanisms (such as VCCV) and monitoring for problems (such as SLA transgressions)

These features, when under the control of the Alcatel-Lucent 5620 management portfolio, ensure rapid fault detection as well as efficient troubleshooting. In particular, SLAs can be proactively monitored by the SAA. This powerful capability allows the specification of test suites, policies and schedules. The tests are then auto-created, and the results obtained are automatically compared to predefined SLA metrics. Any transgressions detected are automatically reported through the SAA to operations staff.

Table 1. Features and benefits

FEATURES	BENEFITS
Cost-effective migration from E1/T1-based backhaul to economical and flexible IP/MPLS-based transport, leveraging Ethernet or ISP network services over a wide range of first mile media	Transition from PDH-based connectivity to modern Ethernet and/or IP-based networking infrastructures can greatly reduce recurring operating expenditures such as line lease costs.
Resiliency and redundancy including: one-for-one hitless control and switch module failover (7705 SAR-8), synchronization redundancy, network uplink resiliency and redundancy of power feeds plus temperature hardening	Advanced resiliency features lead to improved network uptime, which can positively impact customer retention and allow critical services to be offered for increased revenue.
Powerful, service-aware OAM capabilities complemented by the Alcatel-Lucent 5620 management portfolio for GUI-based network and element configuration, provisioning, and fault and performance management	Rapid fault detection and powerful commissioning and troubleshooting tools can improve productivity of operations staff and reduce network downtime.
Dense adaptation of multiple converged services onto an efficient economical packet infrastructure	Multiprotocol and convergence capabilities (with flexible and granular QoS) reduce equipment instances needed to carry multiple traffic types. Compact, energy efficient platforms reduce power and cooling costs.
Extends service routing IP/MPLS dynamic capabilities to the remote site, hubs and network edge in compact form factors with low power consumption	Modular, flexible architecture alleviates the burden of complex pre-engineering and future scenario planning. Compact, rugged form factors allow remote sites to be addressed.
Breadth of synchronization solutions with flexible operation, redundancy and independent validation of accuracy	Accurate synchronization allows cost-effective deployment over packet infrastructure and improves the user experience (for example, less data loss and minimal dropped calls in mobile applications).

An auto-discovery protocol is supported to allow rapid commissioning of remote devices.

Synchronization

Cell sites rely on the backhaul network to provide synchronous interfaces for the proper delivery of data. In addition, cell sites may rely on the network interfaces as stable references with which to derive radio frequencies and to ensure reliable subscriber handover between cell towers. Accurate synchronization is also important in wireline networks in maintaining network operational integrity; for example, avoiding data underflows and overflows and transmission 'slips.'

The Alcatel-Lucent 7705 SAR supports external reference timing, line timing, adaptive clock recovery (ACR) timing, synchronous Ethernet and also timing distribution via 1588v2. Accuracy and high performance of timing over packet solutions, such as ACR and IEEE 1588v2, are accomplished by a combination of built-in architectural features, efficiently tuned algorithms and powerful QoS mechanisms to minimize the delay experienced by synchronization traffic. These capabilities are cornerstones of the design of the Alcatel-Lucent 7705 SAR. A built-in Stratum-3 clock is provided to assist in synchronization maintenance during unavailability of a primary source.

7705 SAR Family Chassis options

- Industry-leading scalability and density is provided in the 7705 SAR-8, a two rack unit (2 RU) version of the 7705 SAR that supports up to 96 T1/E1 Any Service, Any Port (ASAP) ports. The platform can be optionally configured with a redundant control and switch module and uplinks. The Alcatel-Lucent 7705 SAR-8 has eight slots; two are allocated for control and switch modules (CSMs), with the remaining six being available for user traffic adapter cards. The Alcatel-Lucent 7705 SAR-8 has a compact, modular architecture, constructed to allow flexible use of line adapter cards so operators can optimize the configuration to meet the specific requirements of a site. With the modular architecture comes additional resilience and flexibility. The solution can optionally support 1+1 fully redundant CSMs. This industry-leading, independently validated High Availability feature has been inherited from the Service Router product line and is a strong contributor to overall network uptime.
- Each of the six adapter card slots in the 7705 SAR-8 chassis can be used for any adapter card type, removing the burden of complex pre-engineering and future scenario planning. The seven supported adapter card types are: a 4-port OC-3/STM-1 clear channel card, a 2-port OC-3/STM-1 channelized card, a 16-port ASAP T1/E1 adapter card, an 8-port Ethernet adapter card, a 4-port DS3 card, a 6-port E&M card and a 12-port Serial Data Interface (SDI) card. The 4-port OC-3/STM-1 clear channel card supports ATM and Packet over SDH/SONET (POS) in clear channel mode with ports configurable for SDH or SONET operation. The 2-port OC-3/STM-1 channelized card supports ATM, inverse multiplexing over ATM (IMA) and ML-PPP with ports configurable for SDH or SONET operation. The ASAP adapter card supports ATM, inverse multiplexing over ATM (IMA), TDM and multiclass MLPPP. The Ethernet adapter card has six ports of auto-sensing 10/100 Base-TX ports plus two further ports supporting 10/100/1000 Ethernet with small form factor pluggable (SFP) optics. The 4-port DS3 card supports clear channel ATM and PPP access. The 6-port E&M card supports analog voice encoding and transport. The 12-port SDI card can be configured for RS232 or V.35 operation. Each slot is connected to the switching fabric on the CSM using a 1 Gb/s link to host existing and future interface types.
- The 7705 SAR-F is a fixed configuration version of the Service Aggregation Router. The 7705 SAR-F is packaged in a one-rack unit (1 RU) high form factor that supports up to 16 T1/E1

Any Service, Any Port (ASAP) ports. The ASAP ports can be configured to support ATM, inverse multiplexing over ATM (IMA), TDM and MLPPP. Six 10/100 Base-T auto-sensing Ethernet ports are provided, plus two further ports supporting 10/100/1000 Base-TX with small form factor pluggable optics (SFPs).

- For both chassis configurations, network uplink connectivity options are: Ethernet, Fast Ethernet (FE), Gigabit Ethernet (GigE), n × T1/E1 multi-link point-to-point protocol (MLPPP) or n × T1/E1 ATM IMA. Integrated DS3 point-to-point trunking is supported via a small form factor pluggable (SFP) device or, on the 7705 SAR-8, via the 4-port DS3 adapter card.

Chassis-Dependent specifications

Alcatel-Lucent 7705 SAR-8

Modules and adapter cards

- Control and switch module (CSM)
- 8-port Ethernet adapter card (six ports of 10/100 Ethernet, two ports of 10/100/1000 Ethernet), DS3 point-to-point trunking is supported via a small form factor pluggable (SFP) device
- 16-port T1/E1 Any Service, Any Port (ASAP) adapter card
- 4-port OC-3/STM-1 clear channel adapter card
- 2-port OC-3/STM-1 channelized adapter card
- 12-port SDI (Serial Data Interface) card
- 4-port DS3 adapter card
- 6-port E&M adapter card

Redundancy and resiliency

- Control
- Fabric
- Synchronization
- Uplinks
- MPLS tunnel
- Pseudowires
- Power feeds
- Cooling fans

Physical dimensions

- Height: 2 RU, 8.9 cm (3.5 in.)
- Depth: 25.4 cm (10 in.)
- Width: 43.9 cm (17.3 in.)
- Rack mountable in a 48.2 cm rack, 30 cm depth (standard 19-inch equipment rack, 12-inch depth)

Power

- Two feeds: -48/-60V DC or Two feeds: +24V DC
- Third-party sourced AC power solutions available: 100 – 240V AC

Cooling

- One tray of eight fans with redundancy

Operating environment

- Normal operating temperature range: -40°C to +65°C (-40°F to 149°F) sustained
- Normal humidity: 5% to 85%
- Short term (96 hours) extended humidity range: 5% to 95%

Alcatel-Lucent 7705 SAR-F

Modules and adapter cards

- N/A – Fixed configuration with integrated control and switch module, six ports of 10/100 Ethernet, two ports of 10/100/1000 Ethernet and 16 T1/E1 Any Service, Any Port (ASAP) ports, DS3 point-to-point trunking is supported via a small form factor pluggable (SFP) device

Redundancy and resiliency

- Synchronization
- Uplinks
- MPLS tunnel
- Pseudowires
- Power feeds
- Cooling fans

Physical dimensions

- Height: 1 RU 4.45 cm (1.75 in.)
- Depth: 25.4 cm (10 in.)
- Width: 43.9 cm (17.3 in.)
- Rack mountable in a 48.2 cm rack, 30 cm depth (standard 19-inch equipment rack, 12-inch depth)

Power

- Two feeds: -48/-60V DC or Two feeds: +24V DC
- Third-party sourced AC power solutions available: 100 – 240V AC

Cooling

- Built-in 5-fan array with redundancy

Operating environment

- Normal operating temperature range: -40°C to +65°C (-40°F to 149°F) sustained
- Normal humidity: 5% to 95% non-condensing

Service Aggregation Router specifications

Services

- TDM pseudowires
  - ¬ RFC 5086 Structure-Aware Time Division Multiplexed (TDM) Circuit Emulation Service over Packet Switched Network (CESoPSN)
  - ¬ RFC 4553 Structure-Agnostic Time Division Multiplexing (TDM) over Packet (SAToP)
- ATM pseudowires
  - ¬ RFC 4717 Encapsulation Methods for Transport of Asynchronous Transfer Mode (ATM) over MPLS Networks
  - ¬ N:1 cell mode, virtual circuit connection and virtual path connection
  - ¬ ATM IMA
- Ethernet pseudowires
  - ¬ RFC 4448 Encapsulation Methods for Transport of Ethernet over MPLS Networks
  - ¬ Raw and tagged mode
  - ¬ MEF 9- and MEF 14-certified
- IP pseudowires
  - ¬ PPP (as per RFC-1661) and ML-PPP (as per RFC-1990) access to IP pseudowires
  - ¬ Ethernet (null, tagged) access to IP pseudowires
- Analog voice encoding and transport
  - ¬ A law, μ-law
  - ¬ Traffic transported on a TDM pseudowire IP or MPLS infrastructure
- IP VPN
  - ¬ RFC 4364 BGP/MPLS IP Virtual Private Networks (VPNs)

Synchronization

- External reference timing
- Line timing
- Adaptive timing
- Synchronous Ethernet
- Built-in Stratum-3 clock
- IEEE 1588v2
- Synchronization Status Messages (SSMs) support for quality level determination, source selection and timing loop avoidance

Traffic management and QoS

- Hierarchical queuing
- Multi-tier scheduling
- Profiled (in and out of profile) scheduling
- Queue type-based scheduling
- Ingress policing and egress shaping
- Up to 8 queues per service
- Memory allocation per queue (CBS, MBS per queue)
- Premium, assured and best-effort forwarding classes
- WRED on ingress and egress
- Classification based on:
  - ¬ Layer 1/Layer 2/Layer 2.5 and/or Layer 3 header
  - ¬ Timeslot/port
  - ¬ Ethernet port/VLAN
  - ¬ ATM service category (CBR/rt-VBRrt-VBR/UBR)
  - ¬ ATM VC
  - ¬ Ethernet 802.1p/VLAN
  - ¬ IP DSCP/MPLS EXP
- Marking based on:
  - ¬ Layer 2 (802.1p)
  - ¬ Layer 2.5 (EXP) both for tunnel and PWE3
  - ¬ Layer 3 (DiffServ)

Security (node access)

- User ID/password-based authentication and authorization
  - ¬ Exponential login backoff for brute force attacks
  - ¬ Local or remote storing of user information
- Remote authentication/authorization via Remote Authentication Dial In User Service (RADIUS) and Terminal Access Controller Access-Control System (TACACS)
- Secure Shellv2, Secure File Transfer Protocol and Simple Network Management Protocol (SNMP) Version 3
  - ¬ Secure open interfaces
- Syslog
  - ¬ Capture security logs on local or remote server
- Alarm on suspicious sequence of operations
- Nodal attack
- Basic firewall with filtering of control plane traffic
- Denial of service (DoS) attack prevention (rate-limiting and prioritization)
- Data security
- Transfer over peer-to-peer tunnel (MPLS)
- MD5 authentication
- Sequence numbers prevent replaying of data
- Statistics available on suspicious behavior

Management

- Fully-featured, industry-standard command line interface
- Service assurance tools, including LSP ping, LSP traceroute, SDP ping, VCCV
- ATM In-band Management
- SSH and Telnet
- FTP, Trivial File Transfer Protocol and Secure Copy Protocol
- RADIUS (AAA)
- TACACS+
- SNMP v2/v3

Safety, EMC, environmental and telecom compliance

- Safety:
  - ¬ UL/CSA 60950-1
  - ¬ IEC/EN 60950-1
  - ¬ AS/NZS 60950-1
  - ¬ IEC/EN 60825-1 and 2 (LASER Safety)
- EMC:
  - ¬ EN 55022 2006 (Class A)
  - ¬ FCC Part 15 2008 (Class A)
  - ¬ ICES-003 Issue 4 2004 (Class A)
  - ¬ EN 300 386 V1.4.1
  - ¬ AS/NZS CISPR 22: 2006 (Class A)
  - ¬ Telcordia GR-1089 Issue 4
  - ¬ RRL Notice No. 2008-38 (Class A)
  - ¬ RRL Notice No. 2008-39
- Telecom:
  - ¬ IC CS-03 Issue 9
  - ¬ ACTA TIA-968-A
  - ¬ AS/ACIF S016 (Australia/ New Zealand)
  - ¬ ITU-T G.703
  - ¬ ITU-T G.707
  - ¬ ITU-T G.712
  - ¬ ITU-T G.957
  - ¬ ITU-T V.24
  - ¬ ITU-T V.36
  - ¬ ITU-T X.21
- Network Equipment and Building Standards (NEBS):
  - ¬ NEBS Level 1 and 3
  - ¬ Telcordia GR-63-CORE, Issue 3
  - ¬ Telcordia GR-78-CORE, Issue 2
  - ¬ Telcordia GR-1089, Issue 4
  - ¬ ATT-TP-76200
  - ¬ VZ.TPR.9305
  - ¬ ANSI T1.315-2001
- Environmental:
  - ¬ Telcordia GR-63-CORE, Issue 3
  - ¬ ETSI EN 300 019-2-1 v2.1.2 (Class 1.2)
  - ¬ ETSI EN 300 019-2-2 v2.1.2 (Class 2.3)
  - ¬ ETSI EN 300 019-2-3 v2.2.2 (Class 3.2)
  - ¬ ETSI 300 132-2 v2.2.1
- Directives:
  - ¬ EU Directive 1999/5/EC R&TTE
  - ¬ EU Directive 2002/96/EC WEEE
  - ¬ EU Directive 2002/95/EC RoHS
  - ¬ China: Ministry of Information Industry order No. 39 – CroHS

Standards and protocols

Standards compliance Ethernet

- IEEE 802.1p/Q VLAN Tagging
- IEEE 802.1ag Service Layer OAM
- IEEE 802.3 10Base-T
- IEEE 802.3ah Ethernet OAM
- IEEE 802.3u 100Base-TX
- IEEE 802.3x Flow Control
- IEEE 802.3z 1000Base-SX/LX
- ITU-T Y.1731 OAM functions and mechanisms for Ethernet-based networks

Protocol support

LDP

- RFC 5036 LDP Specification

MPLS

- RFC 3031 Multiprotocol Label Switching Architecture
- RFC 3032 MPLS Label Stack Encoding
- RFC 4379 Detecting Multi-Protocol Label Switched (MPLS) Data Plane Failures

RSVP-TE and Fast Reroute

- RFC 2430 A Provider Architecture DiffServ and TE
- RFC 2702 Requirements for Traffic Engineering over MPLS
- RFC 2747 RSVP Cryptographic Authentication
- RFC 3097 RSVP Cryptographic Authentication
- RFC 3209 Extensions to RSVP for Tunnels
- RFC 4090 Fast reroute extensions to RSVP-TE for LSP Tunnels

OSPF

- RFC 1765 OSPF Database Overflow
- RFC 2328 OSPF Version 2
- RFC 2370 Opaque LSA Support
- RFC 3101 OSPF NSSA Option
- RFC 3137 OSPF Stub Router Advertisement
- RFC 3630 Traffic Engineering (TE) Extensions to OSPF Version 2
- RFC 4203 Shared Risk Link Group (SRLG) sub-TLV

BGP

- RFC 1397 BGP Default Route Advertisement
- RFC 1997 BGP Communities Attribute
- RFC 2385 Protection of BGP Sessions via MD5
- RFC 2439 BGP Route Flap Dampening
- RFC 2547bis BGP/MPLS VPNs

- RFC 2918 Route Refresh Capability for BGP-4
- RFC 3107 Carrying Label Information in BGP-4
- RFC 3392 Capabilities Advertisement with BGP-4
- RFC 4271 BGP-4 (previously RFC 1771)
- RFC 4360 BGP Extended Communities Attribute
- RFC 4364 BGP/MPLS IP Virtual Private Networks (VPNs) (previously RFC 2547bis BGP/MPLS VPNs)
- RFC 4456 BGP Route Reflection: Alternative to Full-mesh IBGP (previously RFC 1966 and 2796)
- RFC 4724 Graceful Restart Mechanism for BGP – GR helper
- RFC 4760 Multi-protocol Extensions for BGP (previously RFC 2858)

IS-IS

- RFC 1142 OSI IS-IS Intra-domain Routing Protocol (ISO 10589)
- RFC 1195 Use of OSI IS-IS for routing in TCP/IP and dual environments
- RFC 2763 Dynamic Hostname Exchange for IS-IS
- RFC 2966 Domain-wide Prefix Distribution with Two-Level IS-IS
- RFC 2973 IS-IS Mesh Groups
- RFC 3373 Three-Way Handshake for Intermediate System to Intermediate System (IS-IS) Point-to-Point Adjacencies
- RFC 3567 Intermediate System to Intermediate System (IS-IS) Cryptographic Authentication
- RFC 3719 Recommendations for Interoperable Networks using IS-IS
- RFC 3784 Intermediate System to Intermediate System (IS-IS) Extensions for Traffic Engineering (TE)
- RFC 3787 Recommendations for Interoperable IP Networks
- RFC 4205 for Shared Risk Link Group (SRLG) TLV draft-ietf-isis-igp-p2p-over-lan-05.txt
- RFC 5309 Point-to-Point Operation over LAN in Link State Routing protocols

BFD

- draft-ietf-bfd-mib-00.txt Bidirectional Forwarding Detection Management Information Base
- draft-ietf-bfd-base-05.txt Bidirectional Forwarding Detection
- draft-ietf-bfd-v4v6-1hop-06.txt BFD IPv4 and IPv6 (Single Hop)
- draft-ietf-bfd-multihop-06.txt BFD for Multi-hop Paths

GRE

- RFC 2784 Generic Routing Encapsulation (GRE)

Differentiated services

- RFC 2474 Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers
- RFC 2597 Assured Forwarding PHB Group
- RFC 2598 An Expedited Forwarding PHB
- RFC 3140 Per Hop Behavior Identification Codes

TCP/IP

- RFC 768 User Datagram Protocol
- RFC 1350 The TFTP Protocol (Revision 2)
- 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 1812 Requirements for IPv4 Routers

PPP

- RFC 1332 PPP Internet Protocol Control Protocol (IPCP)
- RFC 1661 The Point-to-Point Protocol (PPP)
- RFC 1989 PPP Link Quality Monitoring
- RFC 1990 The PPP Multilink Protocol (MP)

ATM

- RFC 2514 Definitions of Textual Conventions and OBJECT-IDENTITIES for ATM Management, February 1999
- RFC 2515 Definition of Managed Objects for ATM Management, February 1999
- af-tm-0121.000 Traffic Management Specification Version 4.1, March 1999
- ITU-T Recommendation I.610 – B-ISDN Operation and Maintenance Principles and Functions version 11/95
- ITU-T Recommendation I.432.1 – B-ISDN user-network interface – Physical layer specification: General characteristics
- GR-1248-CORE – Generic Requirements for Operations of ATM Network Elements (NEs), Issue 3, June 1996
- GR-1113-CORE – Asynchronous Transfer Mode (ATM) Adaptation Layer (AAL) Protocols Generic Requirements, Issue 1, July 1994

Pseudowires

- RFC 4385 Pseudowire Emulation Edge-to-Edge (PWE3) Control Word for Use over an MPLS PSN
- RFC 4447 Pseudowire Setup and Maintenance using the Label Distribution Protocol (LDP)
- RFC 4448 Encapsulation Methods for Transport of Ethernet over MPLS Networks
- RFC 4553 Structure-Agnostic Time Division Multiplexing (TDM) over Packet (SAToP)
- RFC 4717 Encapsulation Methods for Transport of Asynchronous Transfer Mode (ATM) over MPLS Networks
- RFC 5085 Pseudowire Virtual Circuit Connectivity Verification (VCCV): A Control Channel for Pseudowires
- RFC 5086 Structure-Aware Time Division Multiplexed (TDM) Circuit Emulation Service over Packet Switched Network (CESoPSN)

RADIUS

- RFC 2865 Remote Authentication Dial In User Service (RADIUS)
- RFC 2866 RADIUS Accounting

SSH

- draft-ietf-secsh-architecture.txt SSH Protocol Architecture
- draft-ietf-secsh-userauth.txt SSH Authentication Protocol
- draft-ietf-secsh-transport.txt SSH Transport Layer Protocol
- draft-ietf-secsh-connection.txt SSH Connection Protocol
- draft-ietf-secsh-newmodes.txt SSH Transport Layer Encryption Modes

TACACS+

- IETF draft-grant-tacacs-02.txt

Network management

- ITU-T X.721: Information technology-OSI-Structure of Management Information
- ITU-T X.734: Information technology-OSI-Systems Management: Event Report Management Function
- M.3100/3120 Equipment and Connection Models
- TMF 509/613 Network Connectivity Model
- RFC 1157 SNMPv1
- RFC 1907 SNMPv2-MIB
- RFC 2011 IP-MIB
- RFC 2012 TCP-MIB
- RFC 2013 UDP-MIB
- RFC 2138 RADIUS
- RFC 2571 SNMP-Framework-MIB
- RFC 2572 SNMP-MPD-MIB
- RFC 2573 SNMP-Applications
- RFC 2574 SNMP-User-Based-SM-MIB
- RFC 2575 SNMP-View-Based-ACM-MIB
- RFC 2576 SNMP-COMMUNITY-MIB
- RFC 2665 Ethernet-like-MIB
- RFC 2819 RMON-MIB
- RFC 2863 The Interfaces Group-MIB
- RFC 2864 Inverted-Stack-MIB
- RFC 3014 Notification-Log-MIB
- RFC 3273 HCRMON-MIB
- RFC 3411 An Architecture for Describing Simple Network Management Protocol (SNMP) Management Frameworks
- RFC 3412 Message Processing and Dispatching for the Simple Network Management Protocol (SNMP)
- RFC 3413 Simple Network Management Protocol (SNMP) Applications
- RFC 3414 User-based Security Model (USM) for version 3 of the Simple Network Management Protocol (SNMPv3)
- RFC 3418 SNMP MIB
- draft-ietf-disman-alarm-mib-04.txt
- draft-ietf-mpls-ldp-mib-07.txt
- IANA-ifType-MIB

Plus support for an extensive range of proprietary MIBs.

Alcatel·Lucent