Nokia 7705 Service Aggregation Router

Release 26

The Nokia 7705 Service Aggregation Router (SAR) portfolio provides service adaptation, aggregation and routing over an efficient, feature-rich Ethernet and IP/MPLS/segment routing infrastructure. With interfaces supporting a wide range of access protocols, it is well suited for mission-critical and enterprise applications.

Overview

Leveraging the powerful Nokia Service Router Operating System (SR OS) and the Nokia Network Services Platform (NSP), the 7705 SAR delivers industry-leading IP/MPLS/segment routing and pseudowire capabilities. Designed for scalability, it utilizes programmable processors to accommodate new standards and requirements associated with data plane operation.

The 7705 SAR is available in compact, power-efficient indoor and outdoor platforms that support highly available services and applications over flexible network topologies.



7705 SAR-8



7705 SAR-X



7705 SAR-Ax



7705 SAR-Hc



7705 SAR-Wx

Easy legacy TDM migration

The 7705 SAR portfolio offers a comprehensive set of T1/E1, T3, SONET/SDH, serial data, electrical utility teleprotection and analog voice interfaces along with software features for asymmetrical delay and jitter compensation. These interfaces and features ensure that legacy applications perform exactly as they did on TDM networks.

To ensure application performance, mission-critical traffic is expedited when using either high-speed Ethernet or legacy low-bandwidth links. Numerous migration features allow network operators to gracefully move their applications onto their new IP/MPLS/segment routing network.

Routing and resiliency

The depth of its IP/MPLS/segment routing protocol implementation and robust operations, administration and maintenance (OAM) capabilities at all levels set the 7705 SAR apart from its competitors. A thorough implementation of the standards provides greater resiliency and more options and flexibility for service definition.

The 7705 SAR's IP and MPLS scalability gives operators the potential to grow their networks, adding many end users and applications without having to make additional capital investment.

The 7705 SAR provides excellent resiliency to link or equipment failures through redundancy and the ability to quickly reroute traffic. The 7705 SAR delivers network reconvergence in tens of milliseconds using a strong suite of dynamic routing and recovery capabilities.

Superior network resiliency reduces network down time and improves the productivity of operations staff, helping to reduce operating costs, improve end-user satisfaction, and allowing service providers to offer higher-value service level agreements (SLAs).

Robust security

The 7705 SAR provides a robust set of security features to maintain network integrity in the face of cyberattacks such as session hijacking, spoofing and denial of service (DoS) attacks.

For increased protection the 7705 SAR supports MACsec cryptography. In enhanced IEEE 802.1AE MACsec (ANYsec), it applies standard MACsec cryptography to SR-MPLS, enabling encryption of the SR-MPLS PDU payload. Combined with standard IEEE 802.1AE MACsec cryptography for native Ethernet links, the 7705 SAR delivers a consistent, standards-based security model across both SR-MPLS and Ethernet transport.

The 7705 SAR firewall is application-aware and mitigates attacks such as Domain Name System (DNS)/Internet Control Message Protocol (ICMP) replay. Application-level gateways ensure extra security for FTP/T-FTP connections. Hardware-based encryption features, including IPsec, Network Group Encryption (NGE) and advanced key exchange algorithms, prevent man-in-the-middle attacks.

All 7705 SAR security features provide high throughput levels while minimizing latency.

The portfolio is FIPS 140-2 compliant on both the control and data planes. Operators can use the 7705 SAR to safeguard critical infrastructures and address regulatory requirements such as North American Electric Reliability Corporation (NERC) Critical Infrastructure Protection Version 5 (CIP V5).

Quality of service

The Nokia SR OS software provides superior quality of service (QoS) on the 7705 SAR. The same level of deep buffering and support for ingress and egress shaping that is available on Nokia's edge and core routing platforms is also available on the 7705 SAR aggregation platform.

Consistency of traffic engineering and shaping across the network provides higher packet routing performance overall with differentiated service treatment. This facilitates the convergence of fixed and mobile traffic for service providers as well as the convergence of operational and business services traffic for mission-critical network operators.

The SR OS software allows for advanced service offerings and delivers efficient network resource usage, customer satisfaction and retention.

Precise timing and synchronization

The 7705 SAR provides microsecond timing and accurate synchronization to support mobile base station requirements and the migration of TDM-based services onto the packet network.

Timing accuracy and performance over packet are enabled by a combination of built-in architectural features, integrated Global Navigation Satellite System (GNSS) receivers, Nokia Bell Labs algorithms, accurate hardware time-stamping, and powerful QoS mechanisms. Together, these capabilities minimize the delay and delay variation experienced by synchronization traffic.

Microwave awareness

When used together, the 7705 SAR and Nokia Wavence microwave systems have a number of features that improve routing performance and resiliency over microwave links.

A 7705 SAR and its subtending microwave systems are treated as a single network element with one IP address, simplifying operations and administration. This allows for bandwidth notification, IEEE 1588 synchronization, faster fault detection, and rerouting with various microwave redundancy architectures supported.

The microwave systems can be powered from the 7705 SAR system, reducing space requirements and cost.

Field longevity

The 7705 SAR portfolio is packaged in a wide range of form factors to accommodate the density and types of services required at any location. It provides both indoor and outdoor mounting solutions combined with extended temperature range and power-over-Ethernet (PoE) options. Fanless and conformal-coated variants allow the 7705 SAR to be used in harsh environmental conditions.

The 7705 SAR platforms are mechanically hardened with a robust electromagnetic compatibility (EMC) design. Several platforms comply with the IEEE 1613, IEC 61850-3 and EN 50121-4 standards for power substations and railway environments.

Software features

7705 SAR models support, but are not limited to, the following features.

Services

- Point-to-point Layer-2 virtual private network (VPN) services
  - Ethernet VPN - Virtual Private Wire Service (EVPN-VPWS)
  - Virtual leased line (VLL)/pseudowire
    - Targeted Label Distribution Protocol (T-LDP)-based ATM, Frame Relay High Level Data Link Control (HDLC), IP, Ethernet and TDM pseudowires
- Multipoint Layer-2 Virtual Private LAN Service (VPLS)
  - EVPN-VPLS
    - Route type 2: MAC/IP advertisement
    - Route type 3: Inclusive multicast (without point to multipoint communication) Ethernet tag route for broadcast, unknown unicast and multicast traffic
    - Route type 4: Multihoming with single active and active-active
    - Route type 5: IP reachability
  - T-LDP-based VPLS
- IP VPN services (IPv4 and IPv6)
- 6PE
- Internet Enhanced Service (IES)
- Circuit Emulation Services (CES)
  - Structure Agnostic TDM over Packet (SAToP)
  - CES over Packet-Switched Network (CESoPSN)
  - Metro Ethernet Forum (MEF) 8 - Implementation Agreement for the Emulation of PDH Circuits over Metro Ethernet Networks
  - Asymmetric delay control with active/active and active/standby network redundancy
- Raw socket IP transport for asynchronous RS-232 serial data

Interfaces

- Ethernet
- Packet over SONET/SDH (POS)
- ATM, ATM-Inverse Multiplexing for ATM (ATM-IMA)
- Frame Relay
- HDLC
- Point-to-Point Protocol (PPP), Multi-Class PPP (MCPPP), Multi-Link PPP (MLPPP)
- TDM

Network protocols

- Segment routing (SR)
  - Intermediate System-to-Intermediate System (SR-ISIS) and Open Shortest Path First (SR-OSPF)
  - Traffic engineering (SR-TE)

- MPLS Label Edge Router (LER) and Label Switch Router (LSR) functions
  - Resource Reservation Protocol - Traffic Engineering (RSVP-TE)
    - RSVP-TE Label Switched Path (LSP) shortcuts for Interior Gateway Protocol (IGP) route resolution
    - Path Computation Element Protocol (PCEP) support
  - LDP with loop-free alternate (LFA) and remote LFA (rLFA)
- Seamless BFD (sBFD) with controlled return path
- IP routing
  - Multi-topology IS-IS (IPv4 and IPv6, unicast and multicast)
  - OSPFv2 and OSPFv3
  - Constraint-based Shortest Path First (CSPF)
  - Routing Information Protocol (RIP) Border Gateway Protocol (BGP) with multiprotocol extensions
  - BGP label unicast routes as defined in RFC 3107
- IPv6
  - IPv6 VPN Provider Edge (6VPE) for MPLS and IPsec VPRN
  - Dynamic Host Configuration Protocol (DHCP)
  - v6 server/relay
  - IPv6 over IPSecv4 tunnels
  - LDPv6
- Multicast functionality at L3 and L2
  - L2 multicasting via Internet Group Management Protocol (IGMP)/Multicast Listener Discovery (MLD) snooping in VPLS with traffic flow from L3 to L2
  - IGMP/MLD snooping translation into Protocol Independent Multicast (PIM) for Routed VPLS (RVPLS)
  - Protocol Independent Multicast – Source Specific Multicast (PIM-SSM) with both IGMPv1/2/3 and MLD v1/2 LDP
  - Next-generation multicast VPNs (NG-MVPN) over MPLS encrypted via NGE
- PIM (SM, SSM) stitching via L2 PIM snooping
- Next generation multicast VPNs with MP-BGP MVPN-IPv4 address family and dynamic MLDP PMSI tree
- T-LDP
- Generic Routing Encapsulation (GRE)

SDN

- Topology discovery: BGP-Link State (BGP LS)
- Path Computation Engine delegation
- Local CSPF fallback

Load balancing and resiliency

- IEEE 802.3.ad Link Aggregation Group (LAG) and multi-chassis LAG
- Pseudowire redundancy
- Primary and secondary LSPs
- Fast reroute (FRR)
  - BGP
  - IP (OSPF and ISIS)
  - RSVP-TE
    - LDP with LFA and rLFA
    - LDP LFA via SR stitching
    - SR with rLFA and topology independent LFA (TI-LFA)
- Automatic Protection Switching (APS) and multi-chassis APS for SONET/SDH
- IPv4 and LDP LSR equal-cost multi-path (ECMP)
- Virtual Router Redundancy Protocol (VRRP)
- Entropy label (RFC-6790)
- Line card redundancy (LCR) for DS1/E1 ports Non-stop routing, non-stop services
- ITU-T G.8032v2 Ethernet ring protection switching

Quality of service and traffic management

- Hierarchical QoS (H-QoS)
- Intelligent packet classification, policing, scheduling
- Deep buffering
- Ingress and egress shaping on per forwarding class, service access point (SAP) or VLAN, per customer multiservice site (MSS) and port basis

Operations, administration and maintenance

- IEEE 802.3ah: Ethernet in the first mile
- IEEE 802.1ag: Connectivity fault management
- ITU-T Y.1731: Fault and performance management
- LSP/MPLS statistics
- Microwave performance statistics
- Port, SAP and ACL based mirroring
- Two-Way Active Measurement Protocol (TWAMP), TWAMP light
  - TWAMP-light launch via OAM-PM
- ITU-T Y.1564 (RFC 2544) test head
- Per-port and per-SAP loopback with MAC swap
- 10 ms Bidirectional Forwarding Detection (BFD)
- Micro-BFD on LAG
- Cflowd including IPFIX
- Auto configuration (plug-and-play) with VLAN discovery
- Event handling system (EHS)
- Simple Network Management Protocol (SNMP) v3

Security

- Secure Shell (SSH)
  - Hash-based message authentication code (HMAC) secure hash algorithms (SHA2)
  - Strong prime numbers for Diffie-Hellman (DH) key exchange
- Dot1x tunneling
- Enhanced IEEE 802.1AE MACsec (ANYsec) cryptography for SR-MPLS
  - Encryption of the payload of the SR-MPLS PDU using the IEEE 802.1AE encryption engine
  - SR-MPLS tunnel encryption
  - SR-MPLS service encryption for VPRN auto-bind, EPIPE, VPRN L3 Spoke-sdp, IES L3 spoke-sdp and CPIPE
  - Supported on any 7705 SAR platform supporting IPsec
- IEEE 802.1AE MACsec cryptography (7705 SAR-8)
- IP Security (IPsec) encryption over MPLS
- L2 services (VLL, VPLS over GRE) over IPsec
- TCP Maximum Segment Size (MSS) adjustment for IPsec
- Transport layer security (TLS 1.2, TLS 1.3 with PQC)
- Network address translation (NAT)
- Stateful firewall with multi-channel support
- NGE for IP/MPLS services, L3 user and control traffic, and select L2 control traffic
- Public Key Infrastructure (PKI) supporting X.509v3 certificates, Certificate Management Protocol version 2 (CMPv2), Certificate Revocation List (CRL), Online Certificate Status Protocol (OCSP), RSA/DSA keys
- PQC algorithms supported
- FIPS 140-2 compliant

Hardware features

The 7705 SAR is available in a range of models to suit a broad range of applications. Select 7705 SAR products are also available with conformal coating as an orderable option to provide added protection against environmental contaminants.

Table 1. 7705 SAR platform specifications (part 1)

	7705 SAR-8*	7705 SAR-X
System throughput Full duplex (FD)	30 Gb/s	27 Gb/s
Adapter card/ module slots	• 2 x 10 Gb/s slots • 4 x 2.5 Gb/s slots	None
Service interfaces	N/A	• 2 x SFP+ 10 Gb/s • 8 x SFP 10/100/1000 Mb/s • 4 x Combo SFP/RJ-45 10/100/1000 Mb/s • 8 x RJ-45 T1/E1 • GPON ONT SFP support
Control interfaces	Console, management	Audible alarm cutoff (ACO), console, management, external alarms
Timing	• Built-in Stratum 3 clock • ITU-T SyncE • IEEE 1588v2 – MC, BC, SC – Profiles: IEEE 1588v2 default, ITU-T G.8265.1, G.8275.1 full on-path, G.8275.2 (PTS, APTS) – UDP/IP (v4, v6) and Ethernet encapsulation • IEC/IEEE 61850-9-3 power utility profile • C37.238-2017 power profile • Profile interworking from G.8275.1 to power profiles • IETF RFC 1305, 5905 NTP • ACR, DCR • Sync in/out, Time of day (ToD) in/out	• Built-in Stratum 3 clock • ITU-T SyncE • IEEE 1588v2 – MC, BC, SC, Time Clock (TC) – Profiles: IEEE 1588v2 default, ITU-T G.8265.1, G.8275.1 full on-path, G.8275.2 (PTS) – UDP/IP (v4, v6) and Ethernet encapsulation • IEC/IEEE 61850-9-3 power utility profile • C37.238-2017 power profile • Profile interworking from G.8275.1 to power profiles • IETF RFC 1305 Network Time Protocol (Version 3) • IETF RFC 1305, 5905 NTP • ACR, DCR • Sync in, ToD/1 pulse per second (1PPS) out
Common equipment redundancy	Control, switch fabric, power feeds, cooling fans	Power feeds, cooling fans
Dimensions	• Height: 2 RU, 8.9 cm (3.5 in) • Width: 44.5 cm (17.5 in) • Depth: 26.4 cm (10.4 in) • Rack-mountable in a 48.2-cm rack, 30-cm depth (standard 19-in equipment rack, 12-in depth)	• Height: 1 RU 4.37 cm (1.72 in) • Width: 44.2 cm (17.4 in) • Depth: 25.4 cm (10 in) • Rack-mountable in a 48.2-cm rack, 30-cm depth (standard 19-in equipment rack, 12-in depth)
Power	• Two feeds: -48 V DC/ -60 V DC, or +24 V DC • AC power solutions available: 100 V AC to 240 V AC, 50 Hz/60 Hz	• Two feeds: -48 V DC/ -60 V DC, or +24 V DC
Cooling	One tray of eight fans with redundancy	Built-in five-fan array with redundancy
Normal operating temperature range	-40°C to +65°C (-40°F to +149°F) sustained	-40°C to +65°C (-40°F to +149°F) sustained
Normal humidity	5% to 95%, non-condensing	5% to 95%, non-condensing
Shipping and storage temperature	-40°C to +70°C (-40°F to +158°F)	-40°C to +70°C (-40°F to +158°F)

* See Table 4 for 7705 SAR-8 adapter cards

Table 2. 7705 SAR platform specifications (part 2)

	7705 SAR-Ax	SAR-Hc	SAR-Wx
System throughput (FD)	5 Gb/s	2.5 Gb/s	5 Gb/s
Service interfaces	• 4 x Combo SFP/RJ-45 10/100/1000 Mb/s • 8 x SFP 10/100/1000 Mb/s	• 2 x RJ-45 10/100/1000 • (PoE/PoE+ capable) • 2 x RJ-45 10/100/1000 Mb/s • 2 x SFP 100/1000 Mb/s • 2 x RS-232 (async)	• 3 x SFP 100/ 1000 Mb/s • 2 x RJ-45 100/ 1000 Mb/s • Variant 2: PoE+ on one RJ-45 Ethernet port
Control interfaces	Console, management	ACO, console, management, external alarms	Console, management, external alarms
Timing	• Built-in Stratum 3 clock • ITU-T SyncE • IEEE 1588v2 – MC, BC, SC, TC – Profiles: IEEE 1588v2 default, ITU-T G.8265.1, G.8275.1 full on-path, G.8275.2 (PTS) – UDP/IP (v4, v6) and Ethernet encapsulation • IEC/IEEE 61850-9-3 power utility profile • C37.238-2017 power profile • Profile interworking from G.8275.1 to power profiles • IETF RFC 1305, 5905 NTP • Sync in, ToD/1PPS out, GNSS receiver	• Built-in Stratum 3 clock • ITU-T SyncE • IEEE 1588v2 – MC, BC, SC, TC – Profiles: IEEE 1588v2 default, ITU-T G.8265.1, G.8275.1 full on-path, G.8275.2 (PTS) – UDP/IP (v4, v6) and Ethernet encapsulation • IEC/IEEE 61850-9-3 power utility profile • C37.238-2017 power profile • Profile interworking from G.8275.1 to power profiles • IETF RFC 1305, 5905 NTP	• Built-in Stratum 3 clock • ITU-T SyncE • IEEE 1588v2 – MC, BC, SC, TC – Profiles: IEEE 1588v2 default, ITU-T G.8265.1, G.8275.1 full on-path, G.8275.2 (PTS) – UDP/IP (v4, v6) and Ethernet encapsulation • IEC/IEEE 61850-9-3 power utility profile • C37.238-2017 power profile • Profile interworking from G.8275.1 to power profiles • IETF RFC 1305, 5905 NTP • Variant 2: GNSS receiver
Dimensions	• Height: 1 RU 4.3 cm (1.7 in) • Width: 43.79 cm (17.24 in) • Depth: 20.1 cm (7.9 in) • Rack-mountable in a 48.2-cm rack, 30-cm depth (standard 19-in equipment rack, 12-in depth)	• Height: 17.8 cm (7 in) • Width: 9.14 cm (3.6 in) • Depth: 15.24 cm (6 in) • DIN rail and wall/panel-mountable	• Height: 9.7 cm (3.8 in) • Width: 35.6 cm (14 in) • Depth: 16.5 cm (6.5 in) • Pole-, wall-, strand-mount brackets • Carrying kit • Weather-proof cable termination kits • EMC Class B • IP65
Power	• Two feeds: -48 V DC/-60 V DC, or +24 V DC • AC power solutions available: 100 V AC to 240 V AC, 50 Hz/60 Hz	• ±20 V DC to 75 V DC • HV power solution available: 100 V AC to 240 V AC, 50 Hz/60 Hz; 88 V DC to 300 V DC	• AC: 100 V AC to 240 V AC, 50 Hz/60 Hz • Power over coaxial cable: 90 V AC, 50 Hz/60 Hz, quasi-square wave
Cooling	Passively cooled	Passively cooled	Passively cooled
Normal operating temperature range	• -40°C to +65°C (-40°F to +149°F) sustained with a minimum airflow rate of 0.5 m/s • -40°C to +60°C (-40°F to +140°F) in a still air environment	• -40°C to +70°C • (-40°F to +158°F) sustained with a minimum airflow rate of 0.5 m/s • -40°C to +65°C (-40°F to +149°F) in a still air environment	-40°C to +65°C (-40°F to +149°F) sustained
Normal humidity	5% to 95%, non-condensing	5% to 95%, non-condensing	• 2% to 100%, condensing • Element-proof enclosure/connectivity
Shipping and storage temperature	-40°C to +70°C (-40°F to +158°F)	-40°C to +70°C (-40°F to +158°F)	-40°C to +70°C (-40°F to +158°F)

7705 SAR-8 adapter cards

The 7705 SAR portfolio supports an extensive range of adapter cards and modules that are optimized to address different network and service requirements. Each of the six adapter card slots in the 7705 SAR-8 can be used to house the following adapter card types.

Table 4. 7705 SAR-8 adapter cards*

Card name	Details
6-port 10GE, GE	• 2 x SFP+ 10 Gb/s • 4 x SFP 100/1000 Mb/s • Hardware-based IPsec, NGE • MACsec available on some models
8-port GE	• 8 x SFP 10/100/1000 Mb/s • Hardware-based IPsec, NGE on some models
4-port OC-3/STM-1 or 1-port OC-12/STM-4	• 4 x SFP configurable for SONET or SDH - configurable as 4 x OC-3/STM-1 or 1 x OC-12 STM-4 • Supports TDM and PPP/MLPPP in channelized mode and POS in clear channel mode
32-port ASAP T1/E1	ATM, ATM-IMA, TDM, Frame Relay, HDLC, MCPPP/MLPPP and IP
4-port DS3/E3 V2	• 4 sets (Tx/Rx) of DIN 1.0/2.3 connectors • Clear channel and channelized (on DS3 only) TDM, Frame Relay, PPP and ATM service (on DS3 only)
12-port Serial Data Interface v3 (SDIv3)	12 serial ports can be configured as RS-232, V.35, X.21, and RS-422/RS-530 interfaces for TDM, Frame Relay, HDLC and IP (TDM-only for RS-232) with additional speeds, synchronization functionality, and maintenance capability
6-port E&M	6 x RJ-45
8-port C37.94 teleprotection card	• 8 x SFP LC single-mode or multi-mode • IEEE 1613 Class 2 compliant
8-port voice and teleprotection	• 2 x Foreign eXchange Subscriber (FXS) and 2 x Foreign eXchange Office (FXO) ports for analog voice • 2 x ITU-T G.703 co-directional ports • 2 x IEEE C37.94 optical teleprotection ports
6-port FXS voice	3 x RJ-45, with 2 x FXS ports per connector - loop start/private line automatic ringdown (PLAR) signaling
8-port FXO voice	4 x RJ-45, with 2 x FXO ports per connector – loop start signaling
Integrated services	Supports Multi-Drop Data Bridging (MDDB), PCM multidrop bridging SCADA applications, Voice Conference Bridging (VCB)
GNSS receiver	1 x RF, receives frequency and time from a GNSS antenna
Auxiliary alarm	24 digital alarm inputs, 2 analog inputs and 8 output relays
Microwave interface	• Interface to Nokia Wavence microwave transport • 2 x SFP 10/100/1000 Mb/s with microwave-aware Ethernet ports • 2 x RJ-45 10/100/1000 Mb/s with microwave-aware Ethernet ports • 4 x SFP 10/100/1000 Mb/s
Microwave power injector	• 2 x RJ-45 • Supplies power to Nokia Wavence

* See Nokia 7705 SAR adapter cards data sheet for more details

Standards compliance[1]

Tables 8 through 12 provide information on how the 7705 SAR variants comply with international regulatory and telecom standards.

Table 5. EMC industrial, regulatory and customer standards compliance

Standard	Title	7705 SAR-8	7705 SAR-X	7705 SAR Ax	7705 SAR-Hc	7705 SAR-Wx
IEEE 1613:2009 + A1:2011	IEEE Standard Environmental and Testing Requirements for Communications Networking Devices Installed in Electric Power Substations	✓[3]	✓[2]	✓[4]	✓[4]	X
IEEE 1613. 1-2013	IEEE Standard Environmental and Testing Requirements for Communications Networking Devices Installed in Transmission and Distribution Facilities	✓[6]	✓[7]	✓[8]	✓[8]	X
IEEE Std C37.90	IEEE Standard for relays and relay systems associated with Electric Power Apparatus	✓	✓	✓	✓	X
IEEE Std C37.90.1	Surge Withstand Capability (SWC) Tests	✓	✓	✓	✓	X
IEEE Std C37.90.2	Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers	✓	✓	✓	✓	X
IEEE Std C37.90.3	IEEE Standard Electrostatic Discharge Tests for Protective Relays	✓	✓	✓	✓	X
EN 50121-4	Electromagnetic Compatibility – Part 4: Emission and Immunity of the Signalling and Telecommunications Apparatus	✓	✓	✓	✓	✓
IEC 62236-4	Electromagnetic Compatibility – Part 4: Emission and Immunity of the Signalling and Telecommunications Apparatus	✓	✓	✓	✓	✓
IEC 61000-6-2	Generic standards – Immunity for industrial environments	✓	✓	✓	✓	✓
IEC 61000-6-4	Generic standards – Emissions standard for industrial environments	✓	✓	✓	✓	✓
IEC 61000-6-5	Generic standards – Immunity for equipment used in power station and substation environment	✓	✓	✓	✓	X
IEC 61850-3	Communication networks and systems for power utility automation - Part 3: General requirements	✓	✓	✓	✓	✓
IEC/AS 60870.2.1	Telecontrol equipment and systems. Operating conditions. Power supply and electromagnetic compatibility	✓	✓	✓	✓	X
IEC 61000-4-2	Electrostatic discharge immunity test	✓	✓	✓	✓	✓
IEC 61000-4-3	Radiated electromagnetic field immunity test	✓	✓	✓	✓	✓
IEC 61000-4-4	Electrical fast transient/burst immunity test	✓	✓	✓	✓	✓
IEC 61000-4-5	Surge immunity test	✓	✓	✓	✓	✓
IEC 61000-4-6	Immunity to conducted disturbances	✓	✓	✓	✓	✓

1 System design intent is according to the listed standards. Please refer to product documentation for detailed compliance status.

Table 5. EMC industrial, regulatory and customer standards compliance (continued)

Standard	Title	7705 SAR-8	7705 SAR-X	7705 SAR Ax	7705 SAR-Hc	7705 SAR-Wx
IEC 61000-4-8	Power frequency magnetic field immunity test	✓	✓	✓	✓	X
IEC 61000-4-9	Pulse Magnetic field immunity test	✓	✓	✓	✓	X
IEC 61000-4-10	Damped Oscillatory Magnetic Field	✓	✓	✓	✓	X
IEC 61000-4-11	Voltage dips, short interruptions and voltage variations immunity tests	✓[9]	✓	✓[9]	✓[9]	✓
IEC 61000-4-12	Oscillatory wave immunity test	✓	✓	✓	✓	X
IEC 61000-4-16	Conducted immunity 0 Hz - 150 kHz	✓	✓	✓	✓	X
IEC 61000-4-17	Ripple on d.c. input power port immunity test	✓	✓	✓	✓	X
IEC 61000-4-18	Damped oscillatory wave immunity test	✓	✓	✓	✓	X
IEC 61000-4-29	Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests	✓	✓	✓	✓	X
IEC 61000-3-2	Limits for harmonic current emissions (equipment input current <16A per phase)	✓[9]	✓	✓[9]	✓[9]	✓
IEC 61000-3-3	Limits for voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current <16A	✓[9]	✓	✓[9]	✓[9]	✓
ITU-T K.20 (DC Ports)	Resistibility of telecommunication equipment installed in a telecommunications centre to overvoltages and overcurrents	✓	✓	✓	✓	✓
ETSI 300 132-2	Power supply interface at the input to telecommunications and datacom (ICT) equipment; Part 2: Operated by -48 V direct current (dc)	✓	✓	✓	✓	X
ETSI EN 300 132-3:2003	Power supply interface at the input to telecommunications equipment; Part 3: Operated by rectified current source, alternating current source or direct current source up to 400V	X	✓	✓[9]	✓[9]	✓
EN 300 386	Telecommunication network equipment; ElectroMagnetic Compatibility (EMC)	✓	✓	✓	✓	✓
ES 201 468	Electromagnetic compatibility and Radio spectrum matters (ERM); Additional ElectroMagnetic Compatibility (EMC) requirements and resistibility requirements for telecommunications equipment for enhanced availability of service in specific applications	✓	X	✓	X	✓
ETSI EN 301-489-I	Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements; Harmonised Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU and the essential requirements of article 6 of Directive 2014/30/EU.	✓	X	✓	X	✓

Table 5. EMC industrial, regulatory and customer standards compliance (continued)

Standard	Title	7705 SAR-8	7705 SAR-X	7705 SAR Ax	7705 SAR-Hc	7705 SAR-Wx
EN 55024	Information technology equipment - Immunity characteristics - Limits and methods of measurements	✓	✓	✓	✓	✓
Telcordia GR-1089-CORE	EMC and Electrical Safety – Generic Criteria for Network Telecommunications Equipment	✓	✓	✓	✓	✓
AS/NZS CISPR 32	Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement	✓[10]	✓[10]	✓[10]	✓[10]	✓[11]
FCC Part 15, Subpart B	Radio Frequency devices- Unintentional Radiators (Radiated & Conducted Emissions)	✓[10]	✓[10]	✓[10]	✓[10]	✓[11]
ICES-003	Information Technology Equipment (ITE) — Limits and methods of measurement	✓[10]	✓[10]	✓[10]	✓[10]	✓[11]
EN 55032	Electromagnetic compatibility of multimedia equipment - Emission requirements	✓[10]	✓[10]	✓[10]	✓[10]	✓[11]
CISPR 32	Electromagnetic compatibility of multimedia equipment - Emission requirements	✓[10]	✓[10]	✓[10]	✓[10]	✓[11]
GS7 EMC	Electromagnetic Standard Compatibility (BT standard)	✓	✓	✓	X	✓
KC Notice Emission (KN32) and Immunity (KN35) (South Korea)	EMS standard: NRRA notice	✓	✓	✓	✓	X

2 Performance Class 1
3 Performance Class 1 (Class 2 with optics interfaces only)
4 Performance Class 2
5 Zone A; Performance Class 1
6 Zone A; Performance Class 1 (Class 2 with optics interfaces only)
7 Zone B; Performance Class 1
8 Zone A; Performance Class 2
9 With external AC/DC power supply
10 Class A
11 Class B

Table 6. Environmental standards compliance

Standard	Title	7705 SAR-8	7705 SAR-X	7705 SAR Ax	7705 SAR-Hc	7705 SAR-Wx
IEEE 1613:2009 + A1:2011	Environmental and Testing Requirements for Communications Networking Devices	✓[12]	✓[12]	✓	✓	X
IEC 61850-3	Communication networks and systems for power utility automation - Part 3: General requirements	✓[13]	✓[13]	✓[13]	✓[13]	X
IEC 60068-2-1	Environmental testing – Part 2-1: Tests – Test A: Cold	✓	✓	✓	✓	✓
IEC 60068-2-2	Environmental testing – Part 2-2: Tests - Test B: Dry heat	✓	✓	✓	✓	✓
IEC 60068-2-30	Environmental testing – Part 2: Tests. Test Db and guidance: Damp heat, cyclic (12 + 12-hour cycle)	✓	✓	✓	✓	✓
IEC 60255-21-2	Electrical relays – Part 2-1: Vibration, shock, bump and seismic tests on measuring relays and protection equipment – Section Two: Shock and bump tests	✓	✓	✓	✓	X
ETSI 300 753 Class 3.2	Acoustic noise emitted by telecommunications equipment	✓	✓	✓	✓	✓
Telcordia GR-63-CORE	NEBS Requirements: Physical Protection	✓	✓	✓	✓	✓
ETSI EN 300 019-2-1, Class 1.2	Specification of environmental tests; Storage	✓	✓	✓	✓	✓
ETSI EN 300 019-2-2, Class 2.3	Specification of environmental tests; Transportation	✓	✓	✓	✓	✓
ETSI EN 300 019-2-3, Class 3.2	Specification of environmental tests; Stationary use at weather protected locations	✓	✓	✓	✓	X
ETSI EN 300 019-2-4, Class T4.1	Specification of environmental tests; Stationary use at non-weather protected locations	X	X	X	X	✓
Telcordia GR-3108-CORE	Generic Requirements for Network Equipment in the Outside Plant (OSP)	✓[14]	✓[14]	✓[14]	✓[14]	✓[15]
Telcordia GR-950-CORE	Generic Requirements for ONU Closures and ONU Systems	X	X	X	X	✓
GR-3108 Class 3 Section 6.2 IEC 60068-2-52 - Severity 3 MIL-STD-810G Method 509.5 EN 60721-3-3 Class 3C4 EN 60068-2-11: Salt Mist EN 50155 Class ST4	Conformal coating[16]	✓	✓	X	✓	X

12 Forced air system, uses fans
13 Normal environmental conditions per IEC 61850-3 ed.2
14 Class 2
15 Class 4
16 Conformal coating is available as an orderable option.

Table 7. Safety standards compliance

Standard	Title	7705 SAR-8	7705 SAR-X	7705 SAR Ax	7705 SAR-Hc	7705 SAR-Wx
UL/CSA 60950-1	Information technology equipment - Safety - Part 1: General requirements	✓	✓	✓	✓	✓
IEC/EN 60950-1	Information technology equipment - Safety - Part 1: General requirements	✓	✓	✓	✓	✓
UL/CSA 62368-1	Audio/video, information and communication technology equipment - Part 1: Safety requirements	✓	X	✓	X	✓
IEC/EN 62368-1	Audio/video, information and communication technology equipment - Part 1: Safety requirements	✓	✓	✓	X	✓
AS/NZS 62368-1		✓	✓	X	X	✓
AS/NZS 60950-1	Information technology equipment - Safety - Part 1: General requirements	✓	✓	✓	✓	✓
IEC/EN 60825-1 and 2	Safety of laser products - Part 1: Equipment classification and requirements Part 2: Safety of optical fibre communication systems (OFCS)	✓	✓	✓	✓	✓
UL/CSA 60950-22	Information Technology Equipment - Safety - Part 22: Equipment to be Installed Outdoors	X	X	X	X	✓
CSA–C22.2 No.94	Special Purpose Enclosures	X	X	X	X	✓
UL50	Enclosures for Electrical Equipment, Non-Environmental Considerations	X	X	X	X	✓
IEC/EN 60950-22	Information technology equipment. Safety Equipment installed outdoors	X	X	X	X	✓
IEC 60529	Degrees of Protection Provided by Enclosures (IP Code)	IP20	IP20	IP40	IP40	IP65

Table 8. Telecom interface compliance

Standard	Title	7705 SAR-8	7705 SAR-X	7705 SAR Ax	7705 SAR-Hc	7705 SAR-Wx
IC CS-03 Issue 9	Compliance Specification for Terminal Equipment, Terminal Systems, Network Protection Devices, Connection Arrangements and Hearing Aids Compatibility	✓	✓	X	X	X
ACTA TIA-968-B	Telecommunications - Telephone Terminal Equipment - Technical Requirements for Connection of Terminal Equipment to the Telephone Network	✓	✓	X	X	X
AS/ACIF S016 (Australia)	Requirements for Customer Equipment for connection to hierarchical digital interfaces	✓	✓	X	X	X
ATIS-06000403	Network and Customer Installation Interfaces- DS1 Electrical Interfaces	✓	✓	X	X	X
ANSI/TIA/EIA-422-B (RS-422)	Electrical Characteristics for balanced voltage digital interfaces circuits	✓	X	X	X	X
ITU-T G.825	The control of jitter and wander within digital networks which are based on the synchronous digital hierarchy (SDH)	✓	X	X	X	X
ITU-T G.703	Physical/electrical characteristics of hierarchical digital interfaces	✓	✓	X	X	X
ITU-T G.712 (E&M)	Transmission performance characteristics of pulse code modulation channels	✓	X	X	X	X
ITU-T G.957	Optical interfaces for equipments and systems relating to the synchronous digital hierarchy	✓	X	X	X	X
ITU-T V.24 (RS-232)	List of definitions for interchange circuits between data terminal equipment (DTE) and data circuit-terminating equipment (DCE)	✓	X	X	✓	X
ITU-T V.28 (V.35)	Electrical characteristics for unbalanced double-current interchange circuits	✓	X	X	X	X
ITU-T V.36 (V.35)	Modems for synchronous data transmission using 60-108 kHz group band circuits	✓	X	X	X	X
ITU-T V.11/X.27 (RS-422)	Electrical characteristics for balanced double current interchange circuits operating at data signalling rates up to 10 Mb/s	✓	X	X	X	X
ITU-T X.21 (RS-422)	Interface between Data Terminal Equipment and Data Circuit-terminating Equipment for synchronous operation on public data networks	✓	X	X	X	X
IEEE 802.3at (POE)	Data Terminal Equipment Power via the Media Dependent Interfaces Enhancements	X	X	X	✓	✓

Table 9. Directives, regional approvals and certifications

Standard	Title	7705 SAR-8	7705 SAR-X	7705 SAR Ax	7705 SAR-Hc	7705 SAR-Wx
EU Directive 2014/30/EU (EMC)	Electromagnetic Compatibility (EMC)	✓	✓	✓	✓	✓
EU Directive 2014/35/EU (LVD)	Low Voltage Directive (LVD)	✓	✓	✓	✓	✓
EU Directive 2012/19/EU WEEE	Waste Electrical and Electronic Equipment (WEEE)	✓	✓	✓	✓	✓
EU Directive 2011/65/EU RoHS2	EU Directive 2011/65/EU Restriction of the use of certain Hazardous Substances in Electrical and Electronic Equipment (Recast) Directive (including Commission Delegated Directive (EU) 2015/863)	✓	✓	✓	✓	✓
EU Directive 2014/53/EU (RED)	Radio Equipment Directive (RED)	✓	X	✓	X	✓
CE Mark		✓	✓	✓	✓	✓
CRoHs Logo; Ministry of Information Industry order No.39		✓	✓	✓	✓	✓
China (MII NAL) Network Access License		✓	X	X	X	X
South Korea (KC Mark)		✓	✓	✓	✓	X
United Kingdom (UKCA Mark)		✓	✓	✓	✓	✓
Australia (RCM Mark)		✓	✓	✓	✓	✓
Japan (VCCI Mark)		✓	✓	✓	X	X
NEBS Level 3		✓	✓	✓	✓	✓
TL9000 certified		✓	✓	✓	✓	✓
ISO 14001 certified		✓	✓	✓	✓	✓
ISO 9001 certified		✓	✓	✓	✓	✓

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