Nokia 7950 Extensible Routing System

Release 15

The Nokia 7950 XRS is a next-generation core routing platform that delivers the scale, efficiency and versatility needed to stay ahead of evolving service demands driven by the cloud, LTE/5G and the Internet of Things.

Scale, efficiency and versatility are critical success factors for network operators in order to sustain profitable growth in a fiercely competitive market where the only constant is change.

Proven innovations lie at the heart of the 7950 XRS family, from its silicon to its software and its integration capabilities. It allows building a core network with headroom to meet capacity demands well into the next decade while covering the full range of capabilities to cost-effectively address your IP routing, Internet peering, multiprotocol label switching (MPLS) and infrastructure service requirements on a common core platform.

The conventional wisdom is that cost-efficient scaling of core networks can only be achieved by reducing the scope of functionality and range of flexibility. However, just adding more capacity inevitably results in unwieldy, multi-tier core networks with rapidly diminishing returns and poor investment protection. The 7950 XRS achieves scale and efficiency without compromising versatility. This enables network operators to rethink these conventions and build a capable and converged core network that can scale in a smart way, with superior returns on investments.

The 7950 XRS is deployed globally by telecom, cable, mobile, utility and private network operators of any size as well as major Web-scale operators and internet exchange providers.

7950 XRS family overview

The 7950 XRS family consists of three systems that are designed to meet the needs of global, national, regional and private network operators of all sizes: the 7950 XRS-20, -20e and -40.

It offers a common platform that addresses the full spectrum of networking needs for public and private internet backbones and peering points, metropolitan and regional aggregation hubs as well as cloud, data center and mobile core infrastructure. This will enable network operators to deliver the immersive ultra-broadband service experiences that consumers aspire to today and will expect tomorrow.

One platform for all services

The 7950 XRS addresses the full range of core routing requirements using common hardware that is powered by programmable FP3 routing silicon and runs the proven, resilient and feature-rich Service Router Operating System (SR OS).

A flexible, pay-as-you-go software licensing model allows you to build a versatile, reliable and converged core network that evolves with your needs while protecting your hardware investments.

Scale with superior economics

A modular and extensible hardware design ensures granular and economical scaling of switching capacity and port density. A 7950 XRS chassis equipped with FP3 hardware delivers up to 16 Tb/s (up to 80 100GE or 800 10GE ports) in a single 19-in rack, and consumes only a single Watt per gigabit of traffic switched. System capacity can be expanded to 32 Tb/s in a back-to-back chassis configuration and each chassis is designed to scale much higher with next generation FP hardware.

IP/optical integration

Tunable 10G and integrated 100G coherent PM-QPSK tunable DWDM optics enable the 7950 XRS to directly interface with the photonic transport layer without requiring optical transponders.

A standards-based GMPLS user-network interface (UNI) enables IP/optical control plane integration, allowing the 7950 XRS to efficiently coordinate IP routing and transport requirements across administrative boundaries and to dynamically set up optical segments and end-to-end transport connections.

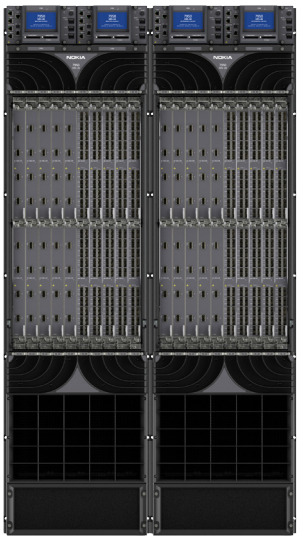
Cross-domain management

The 7950 XRS is managed by the Nokia Network Services Platform (NSP), supporting integrated element and network management with end-to-end orchestration of network resource provisioning and assurance operations. Operational tools, including the Nokia 5650 Control Plane Assurance Manager (CPAM), provide additional visibility and flexibility in monitoring and trouble-shooting IP control plane issues.

Carrier SDN integration

The 7950 XRS and SR OS enable multivendor SDN control integration through OpenFlow, PCEP and NETCONF/YANG. Network operators can leverage the 7950 XRS in combination with the NSP to introduce scalable and integrated carrier SDN control across IP, MPLS, Ethernet and optical transport layers.

The NSP supports unified service automation and network optimization with comprehensive path computation capabilities to enable source-based routing and traffic steering with segment routing support, online traffic engineering and resource optimization, and elastic bandwidth services for dynamic cloud applications.



7950 XRS-40

The Nokia 7950 XRS-40 provides 32 Tb/s of routing capacity in a single system when fully equipped with FP3 hardware. The system comprises 40 slots in a dual-chassis configuration of two 7950 XRS-20 or two 7950 XRS-20e systems, with each slot supporting 400 Gb/s of full duplex aggregate interface capacity. The two systems are interconnected through optical backplane cabling and can be placed up to 30 meters apart. One chassis will act as the master and assume system control over the extension chassis as well.

Designed to meet the needs of today's largest Internet backbones and aggregation points, a single 7950 XRS-40 core router can handle up to 160 100GE or 1600 10GE interfaces without oversubscription and achieve full port density without requiring cabling breakout panels.

7950 XRS-20

The Nokia 7950 XRS-20 provides 16 Tb/s of routing capacity in a single 19-in rack when fully equipped with FP3-based hardware, and its chassis and common hardware is designed to scale much higher in the future.

With 20 slots, each initially capable of 400 Gb/s of full duplex aggregate interface capacity, the system supports up to 80 100GE or 800 10GE ports in a single rack using standards-based pluggable optics and without requiring additional breakout panels for cabling.

The 7950 XRS-20 system is available in an extensible and a stand-alone configuration. The extensible configuration is equipped with optical backplane connectors and can be upgraded in-service to a 7950 XRS-40 back-to-back configuration to double system capacity. The standalone configuration can be made extensible by exchanging the Switch Fabric Modules.

7950 XRS-20e

The Nokia 7950 XRS-20e runs SR OS release 13.0 or higher and is functionally compatible with the XRS-20. All XRS-20 hardware components except the fan trays and XRS Control Modules are interchangeable.

The "Universal" chassis variant supports all AC and DC power options and is equipped with a Power Connection Panel at the rear. The "AC/HVDC" variant is cabled at the front and has a blank rear panel.

The 7950 XRS-20e introduces a new XRS Control Module (XCM) with additional air-intake capacity. Air movement and noise levels are further improved through an upgraded cooling fan assembly with slanted centrifugal impeller trays and 2+1 redundancy.

Common elements and attributes

The 7950 XRS core router family shares fundamental attributes that ensure consistency, operational ease of use, and investment protection for network operators.

Routing silicon

The 7950 XRS leverages internally developed NPU routing silicon to ensure optimal performance and scaling of a rich and complete Layer 2 and Layer 3 feature set that addresses all core deployment scenarios. The 400G FP3 chipset is the third-generation NPU and provides the perfect geometry for high-density 10, 40, 100 and 400G interface modules. It offers deterministic forwarding performance with advanced traffic management features and energy-efficient power gating techniques.

These silicon innovations drive the high level of flexibility and performance needed for converged backbone and metro core deployments, including IP routing and peering, MPLS switching, VPN infrastructure services and data center interconnection applications.

Interface modules

The Nokia 7950 XRS uses a pair of complementary modules to support current and future interfaces. XMA Control Modules (XCMs) contain a slot-level control plane subsystem and switch fabric interface. XRS Media Adapters (XMAs) contain the forwarding complex and provide a wide range of GE, 10GE, 40GE and 100GE interface options.

A flexible software licensing scheme allows for customizing XMAs for diverse core router applications, with configurable quality of service (QoS) granularity. This enables operators to consolidate core routing systems on a single platform, and to rapidly respond to evolving requirements with minimal impact and maximum investment protection.

Operating system

The 7950 XRS family is based on the proven SR OS, carrying forward over a decade of experience in the IP networks of more than 750 network operators worldwide. With a single common OS across the Nokia routing portfolio, network operators benefit from an extensive track record of reliability in the field and a full suite of features to enable resiliency, high availability and in-service software upgrade (ISSUs).

Optical integration

Many operators are looking to optimize the overall efficiency of the core through closer integration of the IP and optical domains. Tunable, pluggable DWDM optics for 10GE and 100GE interfaces are available for all platforms. Multi-vendor IP/optical control plane integration is supported by means of the GMPLS UNI.

Power and cooling efficiency

The 7950 XRS system design incorporates intelligent power management capabilities to monitor power consumption of individual components, assure power safety thresholds, and manage power-up and power-down priorities in the event of degraded power availability. Other key enhancements include clock gating techniques that dynamically reduce power to system components not in use.

Redundant, modular fan trays that are linearly modulated provide appropriate and efficient cooling with reduced noise levels. The 7950 XRS-20 uses two linear, 1+1 redundant fan trays in a stacked configuration for primary system cooling while the XRS-20e uses three impeller fan trays in a side-by-side configuration.

A “pull” airflow design, in combination with impedance panels and air guides, ensures an even distribution of air to every section of the system. Hot air exhaust through the back of the chassis ensures a clean separation between the hot and cold aisles. An optional top plenum accessory is available for the 7950 XRS-20 to enable hot air exhaust at the top of the chassis for additional cooling efficiency.

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Hardware overview

All common equipment components are redundant and field replaceable to maximize system uptime.

Chassis Control Modules (CCMs)

Redundant CCMs support operator access to the Nokia 7950 XRS control and management interfaces. The CCMs are located at the top, and each CCM has an LCD touch-screen display and supports interfaces for timing, management, alarms and memory expansions.

Advanced Power Equalization Modules (APEQs)

APEQs provide power for the 7950 XRS and include built-in intelligence to monitor and communicate available power budget versus actually consumed power. The low voltage DC APEQs deliver up to 2800W each. The high voltage DC APEQs take 260-400 V and provide 3000W each. AC APEQs take 200-240 V single phase and deliver 3000W each. APEQs support cost-effective modular expansion as required.

Fan trays

Fan trays provide system cooling for the 7950 XRS. Redundant fans can be controlled independently and fan speed is linearly modulated to allow for the optimal balancing of cooling, power and noise. The 7950 XRS-20 supports two stacked horizontal fan trays with 1+1 redundancy. The XRS-20e chassis variants support three side-by-side impeller fan trays with 2+1 redundancy.

Switch Fabric Modules (SFMs)

SFMs enable the line-rate connectivity between all slots of a 7950 XRS chassis. The fabric cards are N+1 redundant with active redundancy and graceful capacity degradation in case multiple SFMs fail. There are two types of SFMs. The first is dedicated to standalone system operation of the 7950 XRS-20 and XRS-20e. The second is equipped with optical connectors to support back-to-back configuration in a 7950 XRS-40 system.

Control Processor Modules (CPMs)

CPMs provide the management, security and control plane processing for the Nokia 7950 XRS. Redundant CPMs operate in a hitless, stateful, failover mode. Central processing and memory are intentionally separated from the forwarding function on the interface modules to ensure utmost system resiliency. Each CPM contains a full FP3 complex to protect against Denial of Service attacks.

XRS Media Adapters (XMAs)

XMAs provide the interface options for the 7950 XRS, including high-density GE, 10GE, 40GE and 100GE interfaces. They contain an FP3-based forwarding complex that performs typical functions such as packet lookups, traffic classification, processing and forwarding, service enablement and QoS. Each XMA also provides specific interface ports, physical media and optical functions. The range of interface modules and slot capacity will expand over time, along with overall system capacity, in order to accommodate the evolving needs of network operators while protecting their 7950 XRS hardware investments.

XRS Control Modules (XCMs)

XMAs are equipped in an appropriate XCM. The XCMs contain a slot-level control plane subsystem and fabric interface to interconnect to the switch fabric modules (SFMs) via the chassis mid-plane. XMCs connect via a mid-plane to deliver 800 Gb/s full duplex slot capacity to a pair of 400G XMAs or 200G C-XMAs. The XCM variants for the 7950 XRS-20 and XRS-20e each deliver 800 Gb/s full duplex slot capacity and support the full range of FP3 XMAs and C-XMAs. The flexibility and modularity of XCMs and XMAs allow network operators to granularly configure each Nokia 7950 XRS with its desired range of Ethernet interfaces to meet the demands of growing core networks.

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Technical specifications

Table 1. Technical specifications for the Nokia 7950 XRS family

	7950 XRS-40	7950 XRS-20	7950 XRS-20e
System capacity (half duplex)	32 Tb/s (dual-chassis)	16 Tb/s (stand-alone)	16 Tb/s (stand-alone)
System expansion	—	32 Tb/s (back-to-back)	32 Tb/s (back-to-back)
System design	Mid-plane	Mid-plane	Mid-plane
Interface slots	40	20	20
Number of XMAs (400G line card)	40 per system	20 per system	20 per system
Number of C-XMAs (200G line card)	40 per system	20 per system	20 per system
Common equipment redundancy	CPM (1+1), CCM (1+1), DC APEQ (N+1), AC APEC (N+N), SFM (14+2), fan trays (1+1), power termination (1+1)	CPM (1+1), CCM (1+1), DC APEQ (N+1), AC APEC (N+N), SFM (7+1), fan trays (1+1), power termination (1+1)	CPM (1+1), CCM (1+1), DC APEQ (N+1), AC APEC (N+N), SFM (7+1), fan trays (2+1), power termination (1+1)
Hot-swappable modules	CPM, CCM, XCM, XMA, C-XMA, APEQ, SFM, fans	CPM, CCM, XCM, XMA, C-XMA, APEQ, SFM, fans	CPM, CCM, XCM, XMA, C-XMA, APEQ, SFM, fans
Dimensions	2 x standard 19-in racks 39 RU • Height: 173 cm (68.25 in) • Width: 44.5 cm (17.5 in) • Depth: 91 cm (36 in)	1 standard 19-in rack 39 RU (44 RU with top plenum) • Height: 173 cm (68.25 in) • Width: 44.5 cm (17.5 in) • Depth: 91 cm (36 in)	1 standard 19-in rack 44 RU (no top plenum) • Height: 195.6 cm (77 in) • Width: 44.5 cm (17.5 in) • Depth: 106.3 cm (41.9 in)
Weight* (max)	1,070.5 kg (2360 lb)	535.2 kg (1180 lb)	612.35 (1350 lb)
Power	• -48 V DC (2 x 12 60A/80A inputs) • 260-400 V DC (2 x 12 inputs) • 200-240 V AC (2 x 12 inputs)	• -48 V DC (12 60A/80A inputs) • 260-400 V DC (12 inputs) • 200-240 V AC (12 inputs)	• -48 V DC (12 60A/80A inputs) • 260-400 V DC (12 inputs) • 200-240 V AC (12 inputs)
Cooling	Front/bottom to top/back	Front/bottom to top/back	Front/bottom to back

* Weights and dimensions are approximate and subject to change. Refer to the appropriate installation guide for the current weights and dimensions.

Table 2. Nokia 7950 XRS XMA/C-XMA support per chassis type

XMA type	Ports per XMA	Connector type	Maximum port density		
			XRS-40	XRS-20	XRS-20e
1GBASE (200G C-XMA)	36/72	SFP/CSFP	1440/2880	720/1440	720/1440
10GBASE (200G C-XMA)	20	SFP+	800	400	400
10GBASE (400G XMA)	40	SFP+	1600	800	800
40GBASE (200G C-XMA)	6	QSFP+	240	120	120
100GBASE (200G C-XMA)	2	CFP	80	40	40
100GBASE (400G XMA)	4	CXP, CFP2	160	80	80
100G DWDM (200G XMA)	2	LC (OTU4)	80	40	40
400G DWDM (400G XMA)	1	LC (dual carrier)	40	20	20

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Feature and protocol support highlights

Protocol support within the 7950 XRS family includes (but is not limited to):

- Intermediate System-to-Intermediate System (IS-IS), Open Shortest Path First (OSPF), and Multiprotocol Border Gateway Protocol (MBGP) IPv4 and IPv6 unicast routing
- Internet Group Management Protocol (IGMP), Multicast Listener Discovery (MLD), Protocol Independent Multicast (PIM), and Multicast Source Discovery Protocol (MSDP) IPv4 and IPv6 multicast routing
- MPLS Label Edge Router (LER) and Label Switching Router (LSR) functions, with support for seamless MPLS designs
- Label Distribution Protocol (LDP) and Resource Reservation Protocol (RSVP) for MPLS Signaling and Traffic Engineering with Segment Routing support, Point-to-Point (P2P) and Point-to-Multipoint (P2MP) Label Switched Paths (LSPs) with Multicast LDP (MLDP) and P2MP RSVP, weighted Equal-Cost Multi-path (ECMP), Inter-AS Multicast VPN (MVPN) and Next Generation Multicast VPN (NG-MVPN)
- P2P Ethernet virtual leased lines (VLLs), Ethernet VPNs (EVPNs), EVPN-MLDP, EVPN-VPWS, Virtual Extensible LAN (VXLAN), EVPN-VXLAN to VPLS/EVPN-VPLS gateway functions
- Multipoint Ethernet VPLS and IP VPNs for use in delivering core infrastructure services
- Ethernet port expansion through remote Nokia 7210 Service Access Switch (SAS) Ethernet satellites, each offering 24/48GE ports over a 4 x 10GE Link Aggregation Group (LAG) under 7950 XRS control
- Unicast Reverse Path Forwarding (uRPF), RADIUS/TACACS+, and comprehensive control plane protection features for security
- Extensive OAM features, including Cflowd, Ethernet Connectivity Fault Management (CFM) (IEEE 802.1ag, ITU-T Y.1731), Ethernet in the First Mile (EFM) (IEEE 802.3ah), Two-Way Active Measurement Protocol (TWAMP), Bi-Directional Fault Detection (BFD), and a full suite of MPLS OAM tools including GMPLS UNI
- Intelligent packet classification, queue servicing, policing and buffer management
- Industry-leading high availability, including nonstop routing, nonstop services, ISSU, fast reroute, pseudowire redundancy, ITU-T G.8031 and G.8032, weighted mixed-speed link aggregation
- Management via CLI, SNMP MIBs, NETCONF/YANG and service assurance agent (SAA) with comprehensive support through the Nokia 5620 SAM
- Multivendor SDN control integration through OpenFlow, PCEP, BGP-LS interface support

Environmental specifications

- Operating temperature: 5°C to 40°C (41°F to 104°F)
- Operating relative humidity: 5% to 85%
- Operating altitude: Up to 4000 m (13,123 ft) at 30°C (86°F)

Safety standards and compliance agency certifications

- IEC/EN/UL/CSA60950-1 Ed2 Am2
- FDA CDRH 21-CFR 1040
- IEC/EN 60825-1
- IEC/EN 60825-2

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EMC emission

- ICES-003 Class A
- FCC Part 15 Class A (with EMI/Protection panel)
- EN 55032 Class A
- CISPR 32 Class A
- AS/NZS CISPR 32 Class A
- VCCI Class A
- KN 32 Class A
- EN 61000-3-2
- EN 61000-3-3

EMC immunity

- ETSI EN 300 386
- EN 55024
- KN 35

Environmental

- ETSI EN 300 019-2-1 Storage Tests, Class 1.2
- ETSI EN 300 019-2-2 Transportation Tests, Class 2.3
- ETSI EN 300 019-2-3 Operational Tests, Class 3.2
- ETSI EN 300 019-2-4, pr A 1 Seismic
- ETSI EN 300 132-2 DC Power Supply Interface
- ETSI EN 300 132-3-1 HVDC Power Supply Interface
- WEEE
- RoHS
- China CRoHS

Network Equipment Building System (NEBS)

- NEBS Level 3
- RBOC requirements
  - ATIS-0600020
  - ATIS-0600010.3
  - ATIS-0600015
  - ATIS-0600015.03
  - ATT-TP-76200
  - VZ.TPR.9205 TEEER
  - VZ.TPR.9305

MEF certifications

- CE 2.0
  - Certified (on E-LAN, E-Line, E-Tree and E-Access MEF service types)
  - 100G Certified (on E-Line and E-Access MEF service types)
- CE 1.0 (MEF 9 and MEF 14)
  - Certified

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