

## Nokia 7750 SR-s Service Router

### eXpandable Media Adapters

The Nokia 7750 SR-s series of eXpandable Media Adapters (XMA-s) provides high-density 10GE, 100GE and 400GE interfaces. With highly scalable IP/MPLS routing and packet processing capabilities to support the full array of edge, core and smart aggregation applications, the XMA-s delivers up to 12 Tb/s full duplex (FD) per slot.

Nokia's FP4 routing silicon powers the 7750 SR-s XMA-s with high density 100G QSFP28 and 400G QSFP Double Density (QSFP-DD) configurations. Support includes 400G ZR and 400ZR+ QSFP56-DD optics along with 10GE and 100GE breakout options. The XMA-s delivers up to 4.8 Tb/s FD capacity per slot. With intelligent aggregation (IA), the slot capacity rises to 12 Tb/s FD.

Universal connectors give the XMA-s the flexibility to configure any connector for any Ethernet speed: 10GE, 100GE or 400GE. The modularity of the XMA-s gives the 7750 SR-s flexible interface expansion options and economic scaling of switching capacity, density and connector type.

With the XMA-s and FP4 silicon, a flexible, pay-as-you-go software licensing scheme offers capacity and functional license options and enables each XMA-s to support multiple combinations of these licenses. This allows operators to pay for only the features they require and allows for seamless growth options through in-place feature upgrades without changing the XMA-s hardware.

The versatility and flexibility provided by the XMA-s enable operators to support the full array of IP network functions and services, to protect hardware investments over time and take advantage of the programmability to rapidly respond to evolving requirements with minimal impact and capital outlay.



36-connector 4.8 Tb/s 400G QSFP-DD XMA-s



36-connector 2.4 Tb/s 100G QSFP28 XMA-s



18-connector 1.2Tb/s 100G QSFP28 XMA-s

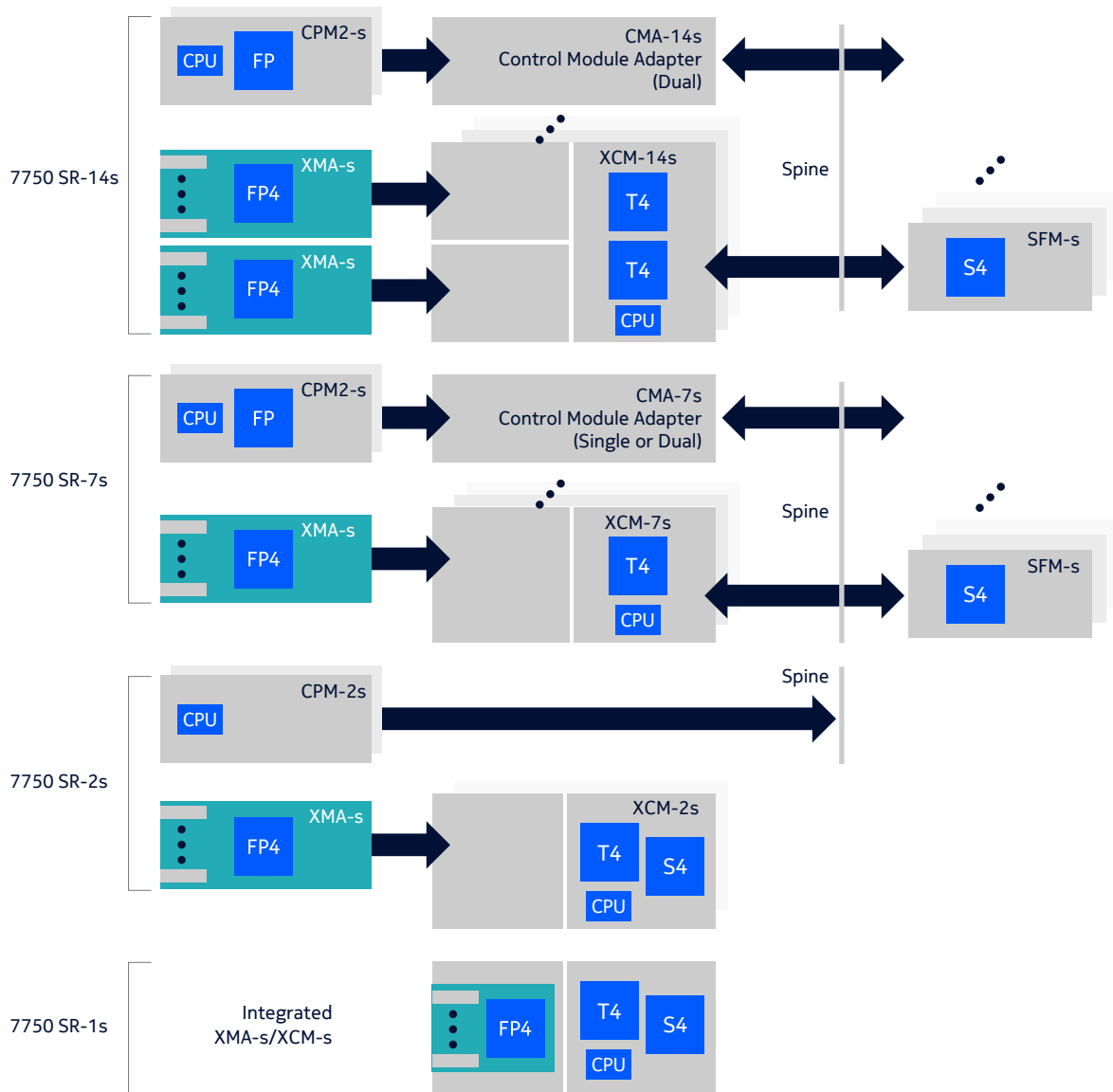
The XMA-s has 36 front faceplate connectors and contains one, two, three or four FP4-based forwarding complexes that perform functions such as packet lookups, traffic classification, processing and forwarding, service enablement and QoS.

XMA-s adapters are equipped in an XMA-s Control Module (XCM-s), which contains a slot-level control plane subsystem with a dedicated multicore CPU (see Figure 1). For the SR-7s and SR-14s, the fabric interface is based on ST4-chips to interconnect to the system switching fabric modules (SFM-s). For the SR-2s, each XCM-2s supports a tap as well as ST4-chips that integrate both tap and switch fabric functions on-card.

Each 7750 SR-14s XCM-s delivers 9.6 Tb/s FD forwarding capacity, supporting a pair of XMA-s adapters. Each 7750 SR-7s and 7750 SR-2s XCM-s delivers 4.8 Tb/s FD slot capacity supporting a

single XMA-s. The Control Processing Module 2-s (CPM2-s) and CPM-2s provides the management, security and control plane processing for the 7750 SR-s.

Figure 1. XMA-s and XCM-s modular hardware architecture



The XMA-XCM concept (see Table 1) enables exceptional modularity and investment protection by decoupling the forwarding logic from control and switching logic. It allows network operators

to mix and match XMA-s types in a single chassis and provides the licensing flexibility to upgrade to higher system slot capacity and density without needing to replace existing XMA-s adapters.

Table 1. Hardware combinations and system configurations

	Expandable Media Adapters (XMA-s)	XMA Control Modules (XCM-s)	Switch Fabric Modules (SFM-s)
	Forwarding complex and connectors	Slot-level control and memory	Switching fabric
SR-14s	12 XMA-s with dual CPM2-s	6 XCM-14s: Two XMA-s per 6 XCM-14s	7+1 SFM-s: installed at rear
SR-7s	6 XMA-s with dual CPM2-s	5 or 6 XCM-7s: One XMA-s per XCM-7s	3+1 SFM-s: installed at rear
SR-2s	2 XMA-s with dual CPM-2s	2 XCM-2s: One XMA-s per XCM-2s	Integrated SFM-s ASIC per XCM-2s
SR-1s	One integrated XMA-s and XCM-s in a fixed form factor		

The XCM concept also gives a cost-efficient option to pre-equip XMA-s modules by powering only those that are providing services. Distributing control plane capabilities on the XCM-s also improves control plane scalability and in-service hardware upgrade performance.

The 7750 SR-1s fixed configuration system has an integrated XMA-s/XCM-s with a simplex control plane. It comes in base variants of 36 connectors of QSFP-DD at 9.6 Tb/s HD with support for 10 x 10GE and 2 x 100GE breakout options and 36 connectors of QSFP28 at 4.8 Tb/s HD, with support for 4 x 10GE and 10 x 10GE optical breakout options. It is available in a number of licensable configurations to provide flexible entry points, grow capabilities and scale services through in-place software licensing options, including intelligent aggregation options, without hardware replacement.

## Features and benefits

### FP4 silicon deterministic performance

The XMA-s leverages Nokia FP4 silicon, which combines a disaggregated, fully buffered silicon architecture and intelligent memory design to provide deterministic packet forwarding performance at scale, without compromise, even when complex processing-intensive operations are required.

With the FP4 traffic manager, buffering is always deterministic, ensuring consistent system performance even when IP, MPLS, QoS and access control list (ACL) capabilities are scaled concurrently. The 7750 SR-s delivers line-rate performance that does not degrade as advanced capabilities and applications are enabled.

By contrast, products with partially buffered silicon architectures typically result in non-deterministic performance and unpredictable system behavior as the scale on the silicon increases.

### Scalable capacity and density

The XMA-s is available in four base adapters:

- 36 connectors of QSFP-DD at 4.8 Tb/s FD
- 36 connectors of QSFP28 at 3.6 Tb/s FD
- 36 connectors of QSFP28 at 2.4 Tb/s FD
- 18 connectors of QSFP28 at 1.2 Tb/s FD.

Smaller licensed versions of these base versions are available with lower capacities and densities to provide flexible entry points and grow capacity with intelligent aggregation options—without hardware replacement. It provides up to 360 10GE, 120 100GE or 24 400GE interfaces with flexible 10GE and 100GE breakout options. By distributing forwarding, control and the switch fabric on a per-slot basis, overall system capacity and density scales linearly with the addition of each XMA-s to the system.

Traditional edge and core routers deploy custom ASICs that optimize forwarding capacity and interface density but often trade off service capabilities, QoS, scale or deterministic performance at the cost of throughput.

### 400GE IP-optical integration

The 7750 SR-s is ready for the 400GE era. The QSFP-DD XMA-s supports 400ZR and 400ZR+ pluggable transceivers in QSFP56-DD form factors to optimize density and performance for high-capacity data center interconnect, regional access, edge and core network applications.

Foresight drove innovative power and cooling designs of the QSP-DD XMA-s at product inception to anticipate the future introduction of higher-powered optics. These innovations enable operators to equip 400ZR and 400ZR+ optics in deployed systems and in any adapter cage without changing hardware.

## Versatile configurations

Where other routers resort to multiple line card variants and different platforms to cover the spectrum of routing needs, the 7750 SR-s delivers a single versatile platform capable of satisfying multiple roles in a network.

For webscale companies, the 7750 SR-s supports data center edge functions, including aggregation, gateway, interconnect and internet/peering. In the PoP it supports internet/peering edge and core router functions.

For service providers, the 7750 SR-s is deployed in WAN and aggregation networks to support IP edge and gateway functions, including: access aggregation for broadband services and Broadband Network Gateway (BNG) for residential subscriber management; PE for enterprise VPN, internet access, and cloud and data center interconnect (DCI) services; PE for backhaul, IPsec and security gateway, WLAN gateway and hybrid access gateway in IP mobile anyhaul. In data centers, support includes gateway, interconnect and internet/peering. In network backbones, core routing function support includes Border Gateway Protocol (BGP) peering, MPLS switching, and Layer 2/Layer 3 virtual private network (VPN) infrastructure services.

For enterprises, the 7750 SR-s provides high-performance IP routing, including connectivity to the data center, internet and WAN applications.

## Pay-as-you-grow licensing

A flexible FP4 pay-as-you-grow licensing model provides a choice of entry points for immediate requirements and the ability to scale in-place for evolving needs with software-only upgrades.

Capacity licenses provide bandwidth, connector density and intelligent aggregation mode options. Functional licenses provide service scale through control options on egress hardware queues and egress policers.

Each XMA-s supports multiple combinations of these licenses to scale all attributes of capacity and functionality to cost-effectively scale while protecting hardware investments. Alternatively, all XMA-s variants can be operationalized without the need to ever have to deal with license upgrades.

## Energy efficiency for sustainability

Energy-efficient design innovations of the 7750 SR-s increases the sustainability of IP networks through reduced emissions.

The FP4 silicon architecture enables line card designs with fewer FP4 complexes and fewer components on each board to lower power consumption. The FP4 memory architecture is also exceptionally power-efficient. Power consumption scales with licensing level to drastically reduce power when only a fraction of a line card is in use. With Nokia FP4 silicon, these and other mechanisms are dynamic, enabling each 7750 SR-s system to quickly and automatically adapt to lower power consumption.

The innovative XMA-s design has dedicated air cooling channels, dual-sided circuit boards and no stacked optical cages. This design improves energy efficiency with reduced component pre-heating and even cooling to all cages to support 400G ZR and 400G ZR+ optics in all cage positions.

## Intelligent aggregation

To cost-effectively meet the most stringent high-density aggregation scenarios and maximize asset utilization, the 7750 SR-s delivers unprecedented intelligent aggregation capabilities. This is a leading capability with FP4 silicon, enabling an XMA-s to handle more aggregation than capacity in an exceptionally smart way.

The pre-classification and pre-buffering capabilities of silicon enable the XMA-s to support up to 2.5 times intelligent aggregation per XMA-s. This enables a single 4.8 Tb/s FD XMA-s to support up to 12 Tb/s FD of intelligent aggregation, with up to 64 GB of packet buffering plus micro-buffering consisting of a 12 million packet pre-buffer for strict priority pre-classification and scheduling, ensuring that aggregation is always intelligent and fully scheduled.

This differentiated approach to aggregation allows multiple network layers to be collapsed into a single layer, enables superior peering capabilities, and provides industry-leading support for a high degree of fractional flows. Where competing solutions do not support native aggregation or will drop traffic indiscriminately when oversubscribed, all generations of FP are always deterministic and fully scheduled based on strict QoS priorities.

## Innovation to rely on

A revolutionary and innovative platform, the 7750 SR-s leverages a number of data center platform design concepts but delivers on them with a superior future-ready design. Each XMA-s has a mid-mount mechanical design that allows components to be stacked top and bottom per PCB, avoiding stacked SFP cages and reducing air pre-heating. The net result is superior optics performance compared to designs with stacked SFP cages and a system that runs cooler and is more power efficient. A Faraday cage and a unique mechanical ejector design are innovations that ensure the system will meet future EMI requirements as Serializer/Deserializer (SERDES) speeds evolve over time. Designs without these two innovations will be a challenge to upgrade in the future.

The design of the 7750 SR-7s and SR-14s relies on orthogonal direct cross-connect to couple line cards to fabric cards. This does away with a backplane/midplane, providing upgradeability well beyond traditional system designs.

In conjunction with these innovations, the 7750 SR-s leverages field-proven and time-tested technology. FP routing silicon has consistently evolved with seamless feature upgradeability and significant investment protection built into each generation of silicon.

## Proven OS, simplified integration

Running the Nokia Service Router Operating System (SR OS), Nokia delivers a single OS across all 7750 SR platforms. Common across all Nokia IP routing platforms, the SR OS leverages over 20 years of software innovation, field validation and maintenance.

Ground-breaking reliability features such as nonstop routing and nonstop services were first introduced in the SR OS and set new industry standards on availability. With the SR OS, capacity and functional licenses can be unlocked through a simple in-place software upgrade.

Operators familiar with the SR OS will find qualification and operational integration of the 7750 SR-s effortless. The Nokia Network Services Platform (NSP) enables operators to minimize operational costs and complexity with a converged and consistent management and an SDN WAN solution that spans the entire IP routing portfolio and select products in optical transport, access and wireless.

## Connector flexibility

QSFP-DD and QSFP28 connectors allow for maximum flexibility with support for optical breakouts and any speed on any connector:

- QSFP-DD connectors: 4 x 10GE and 1 x 40GE with QSFP+; 1 x 100GE and 10 x 10GE with QSFP28; 2 x 100GE with QSFP-DD; 4 x 100GE with QSFP56-DD; 1 x 400GE with QSFP56-DD
- QSFP28 connectors: 10 x 10GE and 1 x 100GE with QSFP28; 4 x 10GE and 1 x 40GE with QSFP+

Optics support for the QSFP-DD XMA-s includes 400G ZR and 400G ZR+ QSFP56-DD pluggable transceivers.

The XMA-s is common across the 7750 SR-2s, SR-7s and SR-14s to optimize investments and sparing. Pluggable optics with digital diagnostic monitoring (DDM) for extended operations, administration and maintenance (OAM) support.

## Seamless operation

The XMA-s runs the same SR OS binary for reliable, seamless and consistent performance. An extensive OAM tool set provides tightly integrated visibility, management and control of the platform, network and services. In addition, modules are hot-swappable.

Multivendor software-defined networking (SDN) control integration is provided by Model-Driven CLI (MD-CLI), NETCONF and gRPC/gNMI using YANG models. Service automation and cross-layer network management is provided by the Nokia NSP.

## Technical specifications

Table 2. Nokia 7750 SR-s XMA-s variant and licensing overview for the 7750 SR-2s, SR-7s and SR-14s

XMA-s base hardware description	Capacity licenses		Maximum density per slot		
	Connectors	Capacity	10GBASE	100GBASE	400GBASE
1.2 Tb/s FD 100G QSFP28 XMA-s: • Flexible 10GBASE breakout options • Functional licenses: Core, edge and high-scale edge routing	6	0.6 Tb/s	60	6	—
	12	1.2 Tb/s	120	12	—
	18	1.2 Tb/s with IA of 1.8 Tb/s	180	18	—
2.4 Tb/s FD 100G QSFP28 XMA-s: • Flexible 10GBASE breakout options • Functional licenses: Core, edge and high-scale edge routing	16	1.6 Tb/s	160	16	—
	24	2.4 Tb/s	240	24	—
	36	2.4 Tb/s with IA of 3.6 Tb/s	360	36	—
3.6 Tb/s FD 100G QSFP28 XMA-s: • Flexible 10GBASE breakout options • Functional licenses: Core, edge and high-scale edge routing	36	3.6 Tb/s	360	36	—
4.8 Tb/s FD QSFP-DD XMA-s: • Flexible 10GBASE, 2 x 100GBASE and 4 x 100GBASE breakout options • Functional licenses: Core, edge and high-scale edge routing	36, QSFP28	3.6 Tb/s	360	36	—
	36	3.6 Tb/s	360	36	—
	36	4.8 Tb/s	360	48	12
	36	4.8 Tb/s with IA of 12 Tb/s	360	120	24

Table 3. Nokia 7750 SR-s maximum density

Ethernet speed	7750 SR-1s	7750 SR-2s	7750 SR-7s	7750 SR-14s
10GBASE	360	720	2,160	4,320
100GBASE	48/120*	96/240*	288/720*	576/1,440*
400GBASE	12/24*	24/48*	72/144*	144/288*

\* With intelligent aggregation



Table 4. XMA-s weights and dimensions

XMA-s type	Weight	Dimensions		
		Height	Width	Depth
18-connector 1.2 Tb/s QSFP28 Universal XMA-s	11.2 kg (24.6 lb)	6.27 cm (2.47 in)	41.30 cm (16.26 in)	30.09 cm (15.39 in)
36-connector 2.4 Tb/s QSFP28 Universal XMA-s	11.2 kg (24.6 lb)	6.27 cm (2.47 in)	41.30 cm (16.26 in)	30.09 cm (15.39 in)
36-connector 3.6 Tb/s QSFP28 Universal XMA-s	11.4 kg (25.0 lb)	6.27 cm (2.47 in)	41.30 cm (16.26 in)	30.09 cm (15.39 in)
36-connector 4.8 Tb/s QSFP-DD Universal XMA-s	12.9 kg (28.4 lb)	6.27 cm (2.47 in)	41.30 cm (16.26 in)	30.09 cm (15.39 in)

Note: Refer to the 7750 SR-s product and release documentation for system details on dimensions, weights, hardware, safety standards, compliance agency certifications and protocol support.

## About Nokia

At Nokia, we create technology that helps the world act together.

As a B2B technology innovation leader, we are pioneering networks that sense, think and act by leveraging our work across mobile, fixed and cloud networks. In addition, we create value with intellectual property and long-term research, led by the award-winning Nokia Bell Labs.

Service providers, enterprises and partners worldwide trust Nokia to deliver secure, reliable and sustainable networks today – and work with us to create the digital services and applications of the future.

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Document code: (June) CID205422