Delivering up to 12 Tb/s full duplex (FD) per-slot performance, the Nokia 7750 SR-s series of eXpandable Media Adapters (XMA-s) provides high-density 10GE, 40GE, 100GE and 400GE interfaces with highly scalable IP/MPLS routing and packet processing capabilities to support the full array of IP network functions, services and applications.

Nokia’s industry-leading 2.4 Tb/s FP4 network processor powers the 7750 SR-s XMA-s with ultra-high-density 100GE QSFP28 and 400GE QSFP Double Density (QSFP-DD) configurations and includes support for 2 x 100GE and up to 10 x 10GE breakout options. The XMA-s delivers up to 4.8 Tb/s FD capacity per slot. With intelligent fan-in/fan-out, the slot capacity rises to 12 Tb/s FD.

With the XMA-s and FP4, a flexible, pay-as-you-go software licensing scheme allows for controls on connector bandwidth, forwarding plane resources and service scale functions with configurable quality of service (QoS) granularity. 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, services and applications, to protect hardware investments over time and to take advantage of the programmability to rapidly respond to evolving requirements with minimal impact and capital outlay.

The XMA-s has 36 front faceplate connectors and contains one, two or four FP4-based forwarding complexes that perform functions such as packet lookups, traffic classification, processing and forwarding, service enablement and QoS.
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 without having to replace existing XMA-s adapters.
The XCM concept also gives a cost-efficient option to pre-equip XMA-s modules by only powering 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 has an integrated XMA-s/XCM-s with a non-redundant control plane. The control plane function and CPU are housed on the integrated XMA-s/XCM-s. It comes in base variants of 36 connectors of QSFP-DD at 4.8 Tb/s FD and 36 connectors of QSFP28 at 2.4 Tb/s FD, and includes support for 2 x 100GE and 10 x 10GE optical breakout options. It is available in a number of licensable configurations to provide flexible entry points and grow capabilities and scale services through in-place software licensing options, including intelligent fan-in/fan-out options, without hardware replacement.

Features and benefits

Scalable capacity, fully deterministic

The XMA-s is available as three base adapters: 36 connectors of QSFP-DD at 4.8 Tb/s FD, 36 connectors of QSFP28 at 2.4 Tb/s FD and 18 connectors of QSFP28 at 1.2 Tb/s FD. Smaller licensed versions of these base versions are available to provide flexible entry points and grow capacity with intelligent fan-in/fan-out options—without hardware replacement. By distributing forwarding, control and the switch fabric on a per-slot basis, overall system performance scales linearly with the addition of each XMA-s to the system.

Traditional edge 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. The Nokia 7750 SR-s rejects compromises and avoids dilemmas by leveraging programmable 2.4 Tb/s network processing silicon, the Nokia FP4 chipset, to always be deterministic, with QoS, with scale, with services and while consistently maintaining high throughput. The XMA-s delivers line-rate performance that does not degrade as advanced capabilities and applications are enabled.

Breakthrough innovation

State-of-the-art 16nm 2.5/3D FinFET+ technology enables FP4 to deliver 6 times the scale and twice the efficiency of FP3. As well, it adds enhanced packet intelligence and control capabilities to support emerging requirements for dynamic flow optimization, network slicing and distributed denial of service (DDoS), making the network part of the solution for next-generation DDoS mitigation as opposed to a basic redirection pipe. Mitigation for cloud, 5G and IoT applications are also all enabled via the silicon and software capabilities native to FP4.

Versatile configurations

Where alternative 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. In addition, the tremendous forwarding performance and hardware flexibility of the 7750 SR-s provide clear differentiation compared to competing platforms, all within a system architecture that provides the leading industry investment protection. Line card licenses add flexibility for tailoring and tuning the 7750 SR-s system to customers’ evolving needs. Capability-level licenses provide growth options on the number of connectors, total connector bandwidth and intelligent aggregation mode. Functional-level licenses provide growth options to scale services through egress queues and egress policer controls (see Table 4). The full array of IP routing features, functions and applications with advanced QoS capabilities can be unlocked through a simple license upgrade, without hardware changes or maintenance windows. Alternatively, all card variants can be operationalized without the need to ever have to deal with license upgrades if required.

Intelligent aggregation

Intelligent fan-in/fan-out is a leading capability with FP4, enabling an XMA-s to handle more aggregation than capacity in an exceptionally smart way. The pre-classification and pre-buffering capabilities of FP4 enable the XMA-s to support up to 2.5 times intelligent aggregation per XMA-s. This enables a single 4.8 Tb/s XMA-s to support up to 12 Tb/s of intelligent fan-in/fan-out. With pre-buffering per MAC ASIC of up to 1 million packets and strict priority pre-classification and scheduling, aggregation is always intelligent and fully scheduled.
This differentiated approach to aggregation allows multiple network layers to be collapsed into a single layer. It also enables superior peering capabilities and 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.

**Performance and resource efficiency**

The FP4 chipset offers deterministic packet forwarding performance under full load, even when complex packet lookup and advanced traffic management operations are required. The P4 chip performs packet processing and integrates intelligent lookup memory to optimize packet lookup operations with traffic management performed separately by the Q4 chip. This approach provides the flexibility to optimize line cards designs for different queuing and scheduling requirements.

The 2.4 Tb/s FP4 chipset enables line card designs with an optimal geometry for 100GE and 400GE interfaces at full rate and paves the way to supporting terabit-rate clear channel interfaces.

Smart 2.4 Tb/s silicon also helps to reduce the number of hardware components. Each XMA-s adapter shares up to four FP4 complexes and enables 36 QSFP28 connectors at 100 Gb/s rates or 36 QSFP-DD connectors at 400 Gb/s rates.

Conversely, competing line card designs with lower speed silicon typically replicate memory for each forwarding complex in separate hardware slices leading to reduced reliability, demonstrate choppy forwarding performance with limited traffic management, and are unable to support 1 Tb/s interfaces in the future.

**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-proof 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 more efficiently compared to competing designs. A Faraday cage and a unique mechanical ejector design innovations ensure that the system will meet future EMI requirements as SERDES speeds evolve over time; designs without these two innovations will be a challenge to upgrade in the future.

The design of the SR-7s and SR-14s relies on orthogonal direct cross-connect in order 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. The FP4 network processors that power the 7750 SR-s are the same devices that power the 7950 Extensible Routing System (XRS) and the larger 7750 SR family. Currently in its fourth generation, FP routing silicon has consistently evolved with huge feature upgradability and significant investment protection built into each chipset.

**Proven OS, simplified integration**

Running the Nokia Service Router Operating System (SR OS), Nokia delivers a single OS across all 7750 SR platforms, and common across all Nokia IP routing platforms, to leverage over 15 years of software innovation, field validation and maintenance. Ground-breaking reliability features such as nonstop routing and services were first introduced in the SR OS and set new industry standards on availability.

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 a Carrier SDN WAN solution that spans the entire IP routing portfolio and select products in optical transport, access and wireless.

**Leading performance**

- QSFP-DD and QSFP28 connectors allow for maximum flexibility with 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 QSFP28-DD; 1 x 400GE and 4 x 100GE with QSFP56-DD
- QSFP28 connectors: 1 x 100GE and 10 x 10GE with QSFP28; 1 x 40 GE and 4 x 10GE with QSFP+

- The XMA-s is common across the 7750 SR-2s, SR-7s and SR-14s to optimize investments and sparing.

Seamless operation
- Runs the same SR OS binary for reliable, seamless and consistent performance
- Extensive OAM tool set provides tightly integrated visibility, management and control of the platform, network and services
- Hot-swappable
- Multivendor SDN control integration through CLI, NETCONF and gRPC/gNMI using YANG models
- Service automation and cross-layer network management through the Nokia NSP

Technical specifications

<table>
<thead>
<tr>
<th>XMA-s and optics pluggable type</th>
<th>Connectors</th>
<th>Packet buffering</th>
<th>Maximum density</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.6 Tb/s QSFP28 Universal XMA-s</td>
<td>6</td>
<td>16 GB, plus micro buffering consisting of a 3 million packet pre-buffer</td>
<td>60 6 6 —</td>
</tr>
<tr>
<td>1.2 Tb/s QSFP28 Universal XMA-s</td>
<td>12</td>
<td>16 GB, plus micro buffering consisting of a 3 million packet pre-buffer</td>
<td>120 12 12 —</td>
</tr>
<tr>
<td>1.2 Tb/s QSFP28 Universal XMA-s with intelligent fan-in/fan-out of 1.8 Tb/s (base adapter)</td>
<td>18</td>
<td>16 GB, plus micro buffering consisting of a 3 million packet pre-buffer</td>
<td>180 18 18 —</td>
</tr>
<tr>
<td>1.6 Tb/s QSFP28 Universal XMA-s</td>
<td>16</td>
<td>32 GB, plus micro buffering consisting of a 4 million packet pre-buffer</td>
<td>160 16 16 —</td>
</tr>
<tr>
<td>2.4 Tb/s QSFP28 Universal XMA-s</td>
<td>24</td>
<td>32 GB, plus micro buffering consisting of a 4 million packet pre-buffer</td>
<td>240 24 24 —</td>
</tr>
<tr>
<td>2.4 Tb/s QSFP28 Universal XMA-s with intelligent fan-in/fan-out to 3.6 Tb/s (base adapter)</td>
<td>36</td>
<td>64 GB, plus micro buffering consisting of a 12 million packet pre-buffer</td>
<td>360 36 36 —</td>
</tr>
<tr>
<td>3.6 Tb/s QSFP28 Universal XMA-s</td>
<td>36</td>
<td>64 GB, plus micro buffering consisting of a 12 million packet pre-buffer</td>
<td>360 36 36 —</td>
</tr>
<tr>
<td>3.6 Tb/s QSFP-DD Universal XMA-s</td>
<td>36</td>
<td>64 GB, plus micro buffering consisting of a 12 million packet pre-buffer</td>
<td>360 36 36 —</td>
</tr>
<tr>
<td>4.8 Tb/s QSFP-DD Universal XMA-s</td>
<td>36</td>
<td>64 GB, plus micro buffering consisting of a 12 million packet pre-buffer</td>
<td>360 36 48* 12</td>
</tr>
<tr>
<td>4.8 Tb/s QSFP-DD Universal XMA-s with intelligent fan-in/fan-out of 12 Tb/s (base adapter)</td>
<td>36</td>
<td>64 GB, plus micro buffering consisting of a 12 million packet pre-buffer</td>
<td>360 36 120** 24**</td>
</tr>
</tbody>
</table>

* Requires future 4 x 100G QSFP56-DD breakout to get to 48 interface density
** Intelligent fan-in/fan-out
Table 3. Nokia 7750 SR-s maximum density summary

<table>
<thead>
<tr>
<th>Ethernet speed</th>
<th>7750 SR-1s</th>
<th>7750 SR-2s*</th>
<th>7750 SR-7s</th>
<th>7750 SR-14s</th>
</tr>
</thead>
<tbody>
<tr>
<td>400GBASE</td>
<td>12/24*</td>
<td>24/48*</td>
<td>72/144*</td>
<td>144/288*</td>
</tr>
<tr>
<td>100GBASE</td>
<td>48/120*</td>
<td>96/240*</td>
<td>288/720*</td>
<td>576/1,440*</td>
</tr>
<tr>
<td>40GBASE</td>
<td>36</td>
<td>72</td>
<td>216</td>
<td>432</td>
</tr>
<tr>
<td>10GBASE</td>
<td>360</td>
<td>720</td>
<td>2,160</td>
<td>4,320</td>
</tr>
</tbody>
</table>

* Intelligent fan-in/fan-out

Table 4. Nokia 7750 SR-s XMA-s functional feature licenses

<table>
<thead>
<tr>
<th>Functional level</th>
<th>Number of egress hardware queues</th>
<th>Number of egress policers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core routing</td>
<td>1,024</td>
<td>1,024</td>
</tr>
<tr>
<td>Edge routing</td>
<td>16,384</td>
<td>16,384</td>
</tr>
<tr>
<td>High scale edge routing</td>
<td>No restriction</td>
<td>No restriction</td>
</tr>
</tbody>
</table>

Dimensions and weights

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

Feature and protocol support highlights

Feature and protocol support within the 7750 SR-s series includes, but is not limited to, the following:

IP and MPLS routing features

- IP unicast routing: Routing Information Protocol (RIP), Intermediate System-to-Intermediate System (IS-IS), Open Shortest Path First (OSPF), Multiprotocol Border Gateway Protocol (MBGP), Unicast Reverse Path Forwarding (uRPF), comprehensive control plane protection features for security, and IPv4 and IPv6 feature parity
- IP multicast routing: Internet Group Management Protocol (IGMP), Multicast Listener Discovery (MLD), Protocol Independent Multicast (PIM), Multicast Source Discovery Protocol (MSDP), and IPv4 and IPv6 feature parity
- MPLS: Label edge router (LER) and label switch router (LSR) functions with support for seamless MPLS designs, MPLS-Transport Profile (MPLS-TP), Label Distribution Protocol (LDP) and Resource Reservation Protocol (RSVP) for MPLS signalling and traffic engineering and includes GMPLS UNI, Point-to-Point (P2P) and Point-to-Multipoint (P2MP) label switched paths (LSPs) with Multicast LDP (MLDP), P2MP RSVP and weighted Equal-Cost Multi-Path (ECMP)

Segment routing and SDN features

- Multiple instance IS-IS and OSPF Segment Routing support with shortest path tunnel, Segment Routing - Traffic Engineering (SR-TE) LSP, and static and BGP SR policy. The implementation provides LFA, remote LFA and Topology-Independent LFA (TI-LFA) protection for all types of tunnels. The Path Computation Element Communication Protocol (PCEP) allows the delegation of the SR-TE LSP to the Nokia NSP or a third-party PCE function.
- Programmable forwarding tables via gRPC-based RIB API feature and MPLS forwarding policy
- Extensive set of capabilities using ACL logic to steer routes/flows towards various target types, such as IP next-hop, SR-TE/RSVP-TE/MPLS-TP LSP and VRF, and in a wide range of routing and service contexts such as Global Routing table, VPRN, VPLS and E-PIPE service; supports control interfaces such as OpenFlow, FlowSpec, CLI and NETCONF
- Multivendor SDN control integration through OpenFlow, PCEP, BGP-LS and BGP SR Policy support
Layer 2 features

- Ethernet LAN (E-LAN): BGP-VPLS (Virtual Private LAN Service), Provider Backbone Bridging for VPLS (PBB-VPLS), Ethernet VPN (EVPN) and PBB-EVPN
- E-Line: BGP-VPWS (Virtual Private Wire Service), EVPN-VPWS and PBB-EVPN
- E-Tree: EVPN and PBB
- EVPN: EVPN-VXLAN (Virtual eXtensible LAN) to VPLS/EVPN-MPLS gateway functions

Layer 3 features

- IP-VPN, enhanced internet services, EVPN for Layer 3 services with integrated routing and bridging (EVPN-IRB), and Multicast VPN (MVPN), which includes Inter-AS MVPN and Next Generation MVPN (NG-MVPN)

System features

- Ethernet satellites: Port expansion through local or remote Nokia 7210 Service Access Switch (SAS)-S series GE, 10GE, and 100GE, offering 24/48 x GE ports or 64 x GE/10GE ports over 10GE and 100GE uplinks
- OAM: Extensive fault and performance Operations, Administration and Maintenance (OAM) includes Ethernet Connectivity Fault Management (CFM) (IEEE 802.1ag, ITU-T Y.1731), Ethernet in the First Mile (EFM) (IEEE 802.3ah), Bidirectional Forwarding Detection (BFD), Cflowd, Two-Way Active Measurement Protocol (TWAMP), and a full suite of MPLS OAM tools
- Timing: ITU-T Synchronous Ethernet (SyncE), IEEE 1588v2 (PTP), Network Time Protocol (NTP), BITS ports (T1, E1, 2M), and 1PPS

Management features

- Model-driven network element management through CLI, NETCONF and gRPC/gNMI using YANG models
- Full SNMP management support, including configuration
- Comprehensive network and node management through the Nokia NSP

Refer to the 7750 SR-s data sheet and product documentation for full system details on safety standards, compliance agency certifications and protocol support.

* Requires redundant CPM-s modules

About Nokia

We create the technology to connect the world. Powered by the research and innovation of Nokia Bell Labs, we serve communications service providers, governments, large enterprises and consumers, with the industry’s most complete, end-to-end portfolio of products, services and licensing.

From the enabling infrastructure for 5G and the Internet of Things, to emerging applications in digital health, we are shaping the future of technology to transform the human experience. networks.nokia.com

Nokia operates a policy of ongoing development and has made all reasonable efforts to ensure that the content of this document is adequate and free of material errors and omissions. Nokia assumes no responsibility for any inaccuracies in this document and reserves the right to change, modify, transfer, or otherwise revise this publication without notice.

Nokia is a registered trademark of Nokia Corporation. Other product and company names mentioned herein may be trademarks or trade names of their respective owners.

© 2019 Nokia
Nokia Oyj
Karaportti 3
FI-02610 Espoo, Finland
Tel. +358 (0) 10 44 88 000

Document code: SR1908037716EN (August) CID205422