Nokia 7750 SR and VSR Portfolio

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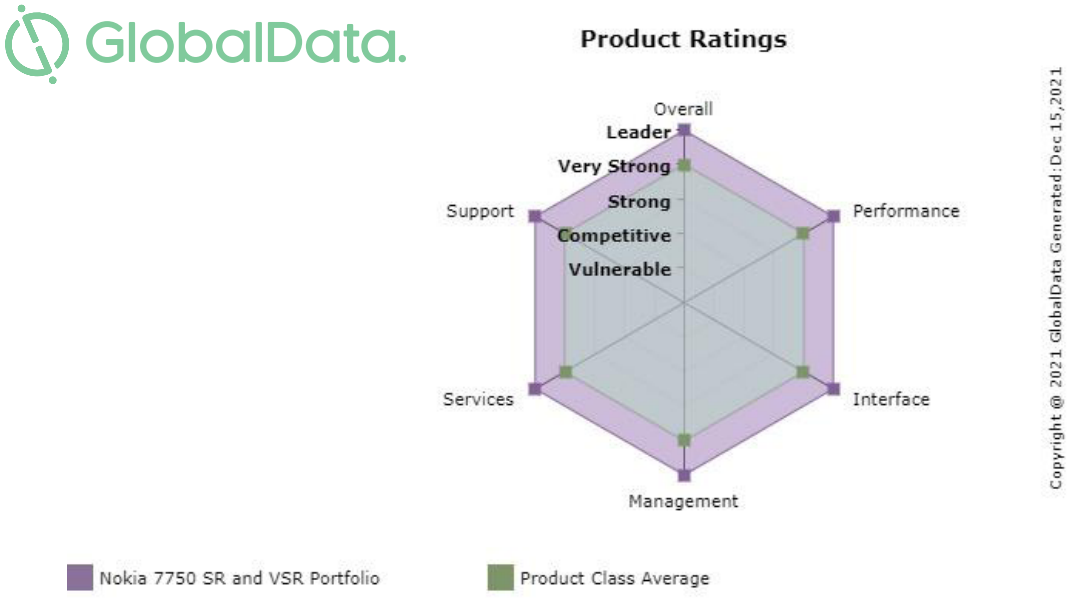
PRODUCT ASSESSMENT REPORT - IP EDGE ROUTER

REPORT SUMMARY

Nokia's FP5 launch, its fifth generation IP routing silicon, enables CSPs to scale network capacity, support high-density 800GE routing interfaces, reduction in power consumption by 75%, and add embedded line-rate encryption.

SUMMARY



WHAT'S NEW

- **September 2021:** Nokia launched the FP5, its fifth generation of high-performance IP routing silicon to efficiently scale network capacity, enable new higher-speed IP services, and protect against escalating network security threats. Nokia raises the bar by adding support for high-density 800GE routing interfaces, a 75% reduction in power consumption and line-rate encryption capabilities.
- **September 2021:** Nokia announced that it would deploy an IP/optical solution to connect NorthC data centers in the Netherlands via high-speed region connect ring.
- **July 2021:** Nokia and Vodafone have completed a trial connecting Asia and Europe with the intercontinental 1 Terabit (1T) IP interface to increase the capacity of Vodafone networks and support next generation application and access technologies.

- **July 2021:** Nokia was selected by Telefonica to transform its IP architecture to provide high-speed connectivity in rural and remote areas. Nokia's 7250 IXR products introduced new advantages in Telefonica's IP network by providing end-to-end support for advance segment routing to enable network slicing.
- **July 2021:** Nokia announced that it would deploy a new 5G-ready network for Africell in Angola.
- **May 2021:** Nokia announced it is providing the 7220 Interconnect Router (IXR) for data center switching platforms and SR Linux to OpenColo. The provider has also installed the 7750 Service Router (SR) to provide IP routing within and between its data centers, including peering and interconnection to multiple service providers.

PRODUCT OVERVIEW

Product Name	7750 SR, Virtualized Service Router (VSR)
Description	Nokia's IP router portfolio addresses the service edge, IP core, mobile backhaul/ aggregation, and Ethernet access/aggregation for communications service providers (CSPs). The portfolio also addresses data center edge, PoP edge, and backbone router functions for web-scale networks. The portfolio also addresses the enterprise segment, providing high performance IP routing, including connectivity to the data center, Internet, and WAN applications. The Virtualized Service Router (VSR) delivers high performance and flexibility for x86-based server environments and is based on Nokia's Service Router Operating System (SR OS). The VSR brings a versatile set of features and capabilities found in the 7750 SR to the virtualized domain. The IP edge portfolio, like other Nokia platforms, is managed by the Nokia Network Services Platform (NSP), which also provides SDN management and control support for multi-layer network environments of fixed and wireless operators.
Components	• 7750 SR series, 7750 SR-s series , 7750 SR-a series, 7750 SR-e series • VSR • Network Services Platform (NSP)
Key Customers	• Africell (Angola) • Bharti Airtel (India) • BT (UK) • China Mobile • China Unicom • CGates • DE-CIX (Germany) • France-IX • Star Telecom (Taiwan) • Three (UK) • True (Thailand) • U Mobile (Malaysia) • Windstream • U Mobile (Malaysia) • Globe Telecom (Philippines) • IndoSat (Indonesia) • KOSC Telecom (France) • NorthC (Netherlands) • OpenColo (U.S.) • Proximus • SiFi Networks • SPTel (Singapore)

Key Rivals	• Cisco • Huawei • Juniper • ZTE

ESSENTIAL ANALYSIS

Strengths

- **Broad Portfolio:** The 7750 SR and the VSR support service automation and network optimization across IP, MPLS, Ethernet, and optical transport layers. The portfolio supports Layer 2 and 3 VPNs, mobile and residential services, and IP edge network functions for CSP data center, WAN, and aggregation networks. For webscale companies, it supports data center edge functions and Internet/peering edge and backbone router functions. For enterprises, the 7750 SR provides connectivity to the data center, Internet, and WAN applications.
- **High Performance:** Nokia's FP4- and FP5-based 7750 SR-s and 7750 SR Series deliver needed capacity and deterministic performance under stringent traffic loads, provide real-time telemetry data, and signature-based DDoS protection with IPsec and MACsec encryption. The FP5 delivers a 75% decrease in power consumption over the FP4 with deterministic performance, with full features and functions enabled, and under all network operating conditions.
- **Network Management:** The Nokia Network Services Platform (NSP) provides operators with an efficient way to automate, optimize, and assure network services and resources across multiple network layers, physical/virtual infrastructure, and equipment from multiple vendors. For webscale data centers, Nokia has added the Fabric Services Platform.
- **Virtual Routing:** The 7750 SR portfolio and the VSR provide complete high-availability features such as non-stop routing, in-service software upgrades (ISSU), and fast reroute. Resiliency is a mandatory requirement of carrier services and web-scale networking.

Limitations

- **Cautious Market:** Aside from 5G-related WAN deployments, service providers in general remain highly selective on infrastructure spending.
- **Strong IP router Competition:** The launch of the FP5 elevates Nokia's stance in the IP edge market for CSPs, but competitors are following similar roadmaps with new lower power silicon equipped with embedded security capabilities.

CURRENT PERSPECTIVE

LEADER

The Nokia 7750 SR IP edge router series is a leader in the IP edge router market because it supports massive increases in line speed and switching capacity needed to meet webscale infrastructure and CSP requirements. The scale of the 7750 SR is complemented with a broad range of networking functions and features to deliver highly scalable and high-quality, manageable IP services. The 7750 SR is also suitable for enterprises that require high performance IP routing, including connectivity to the data center, Internet, and WAN applications. The series was recently enhanced by the introduction of Nokia's fifth generation of IP routing silicon, the FP5, raising the bar for performance, power consumption and security.

Nokia's NSP provides multi-technology, multi-domain carrier SDN service provisioning, automation, real-time network optimization and flow control, dynamic assurance, and analytics, as well as management for IP/MPLS, Ethernet, optical, and integrated IP/optical networks. The new silicon engine delivers IPsec and MACsec encryption to address the growing treats from DDoS and related malware attacks.

The company notes that within IP routing, its FP4 7750 SR series has won 350+ projects deployed by CSPs, webscales, enterprises, and smart cities worldwide. Use cases include applications spanning services, infrastructure, and network functions, with a focus on investment protection and future extensibility. Advanced telemetry and insight-driven automation have been key drivers including: 5G-ready mobile backhaul (access and aggregation), cloud core, connections for DSL/FTTH/FTTP networks, 400G/800G interfaces, and IP/MPLS edge and core network upgrades.

COMPETITIVE RECOMMENDATIONS

PROVIDER

- Nokia should promote its new FP5-based systems and intelligent aggregation (IA) line cards delivering up to 19.2Tbps and routed interfaces reaching 400 Gbps, 800 Gbps and 1.6 Tbps clear channel (with FlexE). Nokia should further stress the mechanical design of its systems and line cards supports 400G/800G coherent optics in all cages, enabling full router density without losing ports without the need to change fans or cooling algorithms.
- Nokia should Nokia should its ability to deliver on its 'insight-driven' network operations claims, by combining the inherent capabilities of its networking silicon, common network operating system (SR OS), and NSP to address demanding network requirements. The combination provides it with a compelling solution that can appeal to both traditional service providers as well as webscale operators.
- Nokia should highlight its silicon-based DDoS protection and embedded end-to-end encryption ('ANYsec')- without compromising the performance of functions or services. Nokia should also highlight in-place upgrade to FP5 with the ability mix and match FP4 and FP5 line cards at full capacity, scale, and features, and reuse of the control processor, power, and fan modules. The programmability of FP and SR OS integration ensures adaptation of new standards and features without hardware upgrades which demonstrate investment protection.

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COMPETITORS

- Cisco should counter Nokia's claims by stressing its new Cisco 8000 series routers, with 14.4 Tbps line cards, which provide agility, packet optical convergence, and petabits-per-second system scale. Cisco should counter the Nokia NSP with its Crosswork Automation suite, which supports virtualization and programmability to deliver high-bandwidth mobile, video, and cloud services to end users.
- Huawei should counter the Nokia 7750 SR-s Series with its new Network Engine 8000 Series metro optimized router, and stress improved power/space efficiency through the use of advanced thermal techniques and network programmability via its 'Solar 5' silicon. Huawei should also counter NSP with its iMaster Network Cloud Engine (NCE), which features integrated end-to-end analytics to improve overall efficiency and coordinate network resources.
- Juniper should contrast the capabilities of its high-scale MX Series Edge routers, which uses its Penta chipset, with Nokia's FP5-based platforms. Juniper should note that it has been delivering 2/3 Tbps line cards. Juniper should also rev up its Open Cloud Interconnect DCI message, which combines coherent optics with open, programmable routing, switching, security, and virtualization technologies to optimize multi-layer networks for greater network automation, visibility, and control. Juniper should also counter Nokia's NSP with its Paragon Automation portfolio.

BUYERS

- **Revisit IP Edge and Core Strategies:** Network operators should consider the benefits of the Nokia FP4 and FP5-powered platforms. Those currently using the 7750 SR and 7950 XRS should consider the increased scale and ability to leverage the built-in telemetry and NSP analytics to automate and optimize network operations and secure systems and data with ANYsec line rate encryption and network-integrated DDoS protection. The 7750 SR series routers with 400G/800G systems and line cards, have capabilities to handle rising demands of network traffic.
- **Investment Protection:** Existing Nokia 7750 SR-s customers should consider deploying the new FP5 line cards (with full backwards compatibility and no speed degradation when mixing FP4), when available, for locations needing increased scale and connectivity. The programmability of FP4 and FP5 silicon and SR OS integration ensures quick adaptation of new standards and features without the need for hardware-based upgrades.
- **Consider Network Analytics:** Network virtualization brings great promise, but also a level of complexity and lack of visibility. Operators should evaluate potential IP core and edge router upgrades based on full lifecycle issues, including real-time analysis of traffic patterns, the ability to resolve network congestion issues rapidly and establish policy-driven operational procedures to automate fundamental network functions.

METRICS

ROUTER PORTFOLIO

Physical router models:	**Edge:** The 7750 SR includes the 7750 SR-s series, 7750 SR series, 7750 SR-e series, and the 7750 SR-a series **Aggregation Layer:** 7250 IXR-R6, 7250 IXR-R4, 7250 IXR-s, 7250 IXR-X, 7250 IXR-e, 7250 IXR-ec, 7210 SAS, and 7705 SAR
Virtual router models/ applications supported (PE, RR, etc.):	The VSR applications span the full range of IP/MPLS services for mobile, enterprise, and residential environments, encompassing: • **Enterprise services:** Provider Edge (PE) for enterprise networking and interconnection of branch offices, the cloud, and data centers over Ethernet and IP VPNs • **Residential services:** Broadband Network Gateway (BNG), Layer 2 Tunneling Protocol (L2TP) Network Server (LNS), and Virtualized Residential Gateway (vRGW) • **Mobile services:** Wireless LAN (WLAN) gateway • **IP infrastructure services:** Data Center Gateway, Border Gateway Protocol (BGP) Route Reflector (RR), Network Address Translation (NAT), Mapping of Addresses and Ports using Translation (MAP-T) • **Value-added services:** Enabled through Application Assurance (AA) with Layer 7 Stateful Firewall for GTP Roaming (GRX), Gi, and SeGW • **Security:** Security Gateway (SeGW), non-stop encryption with Network Group Encryption (NGE) when VSR is used with the PE VNF

Management System:	• Network Services Platform (NSP) delivers highly automated network and service management over the full lifecycle and supports multi-vendor interoperability, SDN resource control, orchestrated network slicing across transport and core domains with resource optimization and service assurance. Provides an open programmable platform to help operators automate operations and ease integration with orchestrators and OSS systems.
Other:	• The Nokia 7750 SR Extended Services Appliance (ESA) is mounted external to the 7750 SR and 7750 SR-s system and extends the level of networking functionality and generalized processing for IP/MPLS routing applications for integrated services. The 7750 SR/SR-s forwards traffic from a selected port to the Nokia 7750 SR ESA, relieving high performance slots from needing to host service processing, value-added service, and network functions. Integrated capabilities include application assurance (AA), Layer 7 stateful firewall, CG-NAT, L2TP Network Server (LNS), IPsec, IP tunneling, and WLAN gateway.

SYSTEM PERFORMANCE AND ARCHITECTURE

Rating:	**Leader**
Backplane Switching Capacity (H-Duplex):	• 7750 SR: up to 27 Tbps; • 54Tbps/rack (2 chassis) • 7750 SR-s: backplane-free design, up to 345.6 Tbps (in a single chassis). The backplane free design is only constrained in terms of capacity by current generation connectors. With an expandable power shelf design and next generation connectors, the system is designed to grow perpetually into the future.
Per Slot Capacity Available (Half-Duplex):	• 7750 SR: 3.0 Tbps, up to 8.0 Tbps with intelligent aggregation (fully deterministic and scheduled based on strict QoS) • 7750 SR-s: 28.8 Tbps, up to 38.4 Tbps with intelligent aggregation (fully deterministic and scheduled based on strict QoS)
Number of Line Card/ Services Slots:	• 7750 SR: 10 • 7750 SR-s: 12
Multi-Chassis Support:	• 7750 SR: MC-LAG, ITU-T 8032v2 • 7750 SR-s: MC-LAG, ITU-T 8032v2
Switch Fabric Redundancy:	• 7750 SR-12e: Quad active SFM6-12e; 3+1 redundancy • 7750 SR-s: Orthogonal direct cross connect (with no midplane/ backplane) SFM-s: SR-7s- 3 +1 redundancy; SR-14s-7+1 redundancy
Power Consumed per Gbps of data transported:	• 7750 SR: not provided • 7750 SR-s: not provided

Other Capabilities:	• Nokia intelligent aggregation, with pre-classification and pre-buffering capabilities of FP4/FP5 allow the 7750 SR-s/7750 SR to support up to 2.5/3 times more bandwidth per slot for intelligent aggregation that is deterministic and scheduled and based on QoS priorities; Nokia Flex; provides integrated DDoS mitigation capabilities per FP4/FP5 line card and systems can make each router part of the solution to next-gen DDoS providing cost savings to an overall network deployment, while driving down network wide risk. DDoS capabilities can also be uniquely provisioned to protect network infrastructure or as a value-add source of revenue. These capabilities are specific to Nokia and FP4/FP5.

INTERFACES AND PORT DENSITY

Rating:	**Leader**
# 1T Ethernet Ports, line card density:	• Presently not commercialized but can be supported in hardware with FP4 and the recently launched FP5.
# 400G Ethernet Ports, line card density:	• 7750 SR: 96 7750 SR-s: 576
# 200G Ethernet Ports, line card density:	• 7750 SR: 108 • 7750 SR-s: 432
# 100G Ethernet Ports, line card density:	• 7750 SR: 384 • 7750 SR-s: 2304
# 40G Ethernet, line card density:	• 7750 SR: 108 • 7750 SR-s: 432
# 10G Ethernet, line card density:	• 7750 SR: 2,160 • 7750 SR-s: 4,320
# 1G Ethernet, line card density:	• 7750 SR: 80 x 1GE per slot and 800 per system using MDA-e adapters; 7210 SAS satellite platforms, offer 24/48-GE ports, 64GE/10GE ports, or legacy SONET/SDH ports over 10GE, and 100GE uplinks. • 7750 SR-s: Gigabit Ethernet (and 10GE) port expansion through the 7210 SAS-Sx series GE, 10GE, and 100GE satellites over 10GE and 100GE uplinks.

# DWDM, line card density:	• 7750 SR: CWDM and tuneable DWDM pluggable optics in 1G and 10G (see chassis densities for 1G Ethernet and 10G Ethernet above) • 7750 SR-s: not supported
IPoDWDM:	• 7750 SR: 60 with CFP2-DCO ports; • 7750 SR-s: 144 with CFP2-DCO ports
Other Interfaces:	• 7750 SR-s: QSFP-DD includes 800G and 400G (includes 400ZR/ZR+ optics) without changing hardware, SFP-DD 10GE/25GE/100GE, CFP2-DCO • 7750 SR: QSFP-DD includes 400GZR/ZR+ optics without changing hardware, SFP28 10GE/25GE, CFP2-DCO, CFP2; Supported legacy interfaces include multiservice Any Service Any Port (ASAP) interfaces for ATM, frame relay (FR), and SONET/SDH. • Optical breakout options include 8 x 100GE, 2 x 400GE, 4 x 100GE, 2 x 100GE, 10 x 10GE, 4 x 25GE and 4 x 10GE.

MANAGEMENT AND CONTROL CAPABILITIES

Rating:	**Leader**
Netconf / Yang Support:	• Supported on the NSP: The 7750 SR, 7750 SR-s, 7750 SR-e, 7750 SR-a support model-driven management through the CLI, NETCONF and gRPC/gNMI using YANG models, streaming telemetry through gRPC/gNMI subscriptions- all supported via the using the model-driven approach of the NSP
TOSCA Support:	• Supported via CloudBand (CBIS), Nokia Container Services (NCS)
SDN Control:	• Supported by the NSP, the 7750 SR, 7750 SR-s, 7750 SR-e and 7750 SR-a combined with SR OS enables multivendor software-defined networking (SDN). Control integration is enabled through OpenFlow, Path Computation Element Protocol (PCEP), and model driven network element management through CLI, NETCONF, and gRPC/gNMI using YANG models.
Northbound API's:	• Supported via NSP
IP Sec:	• Supported via physical or virtualized routers (7750 SR or VSR), MACsec is also supported
Other:	• The Nokia 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. The NSP supports insight driven automation of network and flow optimization as well as DDoS attack protection.

SUPPORTED SERVICES

Rating:	Leader
Business Oriented Services:	• VPN, cloud, and data center interconnect and DDoS protection services, includes EVPN VXLAN to VPLS/EVPN-MPLS/EVPN-VXLAN gateway functions, MEF CE 2.0 and 3.0-certified VPLS or ELAN (includes BGP-VPLS, PBB-VPLS, EVPN and PBB-EVPN), VLL or E-Line services (includes BGP VPWS, EVPN-VPWS and PBB-EVPN), E-Tree (includes EVPN and PBB-EVPN) and E-access; 100G certified on E-Line and E-Access MEF service types; Ethernet access to IP VPNs; VLL or E-Line services; VXLAN or MPLS tunnels seamlessly to link Layer-2 and Layer-3 VPN instances to interconnect data centers and WAN in SDN gateway and cloud gateway applications using integrated DDoS mitigation capabilities and EVPN Virtual eXtensible LAN (VXLAN) to VPLS/EVPN-MPLS/EVPN-VXLAN gateway functions; IP-VPN and EVPN for Layer 3 unicast services and Optimized Inter-Subnet Multicast (OISM) services with integrated routing and bridging (EVPN-IRB); IPsec for encrypted security.
Internet Oriented Services:	• IPv4/IPv6 VPNs, multicast VPNs (includes Inter-AS MVPN and Next Generation MVPN (NG-MVPN), Application Assured IP VPN, Ethernet VPN with application-level visibility/control; native carrier Ethernet or MPLS-based services; standards-based H-VPLS; and pseudowire encapsulation capabilities (PWE3); and integrated DDoS mitigation capabilities.
Residential Oriented Services:	• Broadband services support includes IP aggregation, peering edge and the following multi-access broadband network edge functions: Broadband Network Gateway (BNG); Security Gateway (SeGW); Trusted Wireless Access Gateway (TWAG); Hybrid Access Gateway (HAG); Disaggregated BNG; and Network Enhanced Residential Gateway (NERG). TR-101 (BNG) and TR-059 (BRAS)-compliant solution with operational compatibility with legacy PPPoE and IPoE-based BRAS systems; IPv4/IPv6 dual-stack implementation to support flexible CG-NAT migrations models.
Mobile Backhaul Services:	• Packet processing (gateway integrated ADC and stateful firewall) and security gateway (IPsec); multi-service IP/MPLS for any-G RAN aggregation; interoperability with cell and aggregation sites; mobile core functions via MG-ISM; WiFi support with WLAN Gateway and ePDG; GE- 100 GE support and resiliency and timing features; 3GPP security gateway (SeGW) supports different IPsec tunnel types for macro/small cell backhaul.
Application- and Service-aware QoS:	• Application Assurance (AA) enables Layer 3 to Layer 7 visibility and intelligent control of IP applications with stateful analysis, non-stop services, line-rate service performance, flexible service-aware hierarchical QoS implementation with hardware support for multi-tiered shaping and two-tiered, class fair hierarchical policing hierarchies, ACLs, extensive per-subscriber/application/VPN policies, lawful intercept and Layer 7 stateful firewall for mobile gateways

Service Resiliency Support:	• Non-stop routing provides instant recovery from control plane failures. Non-stop service support that preserves subscriber and service states during switchover of a control processor or node failure. ISSU leverages non-stop routing and non-stop services for software updates on in-service systems with no or minimal service impact. Other features include MPLS fast reroute (FRR), BFD, Multi Chassis-LAG, service router redundancy protocol (SRRP), virtual router redundancy protocol (VRRP), Ethernet and MPLS OAM, IP and MAC spoofing protection.
MEF CE 2.0:	• MEF 3.0 services and MEF 2.0 CE are supported and MEF 2.0 and 3.0 certified
MPLS:	• Supported
Segment Routing:	• Supported with shortest path tunnels, SR-TE LSPs, flexible algorithms, static and BGP policies and industry leading label depth. The implementation provides Loop Free Alternate (LFA), remote LFA and Topology-Independent LFA (TI-LFA) protection for all types of tunnels as well as end-to-end protection with primary/secondary paths for SR-TE tunnels and SR Policies.
Data Center Interconnect:	• Supported, including EVPN Virtual eXtensible LAN (VXLAN) to VPLS/EVPN-MPLS/EVPN-VXLAN gateway functions
Tunneling, VXLAN or MPLS:	• Supported
Timing and Synchronization:	• ITU-T Synchronous Ethernet (SyncE), IEEE 1588v2, BITS, and DTI, and distributes them over the backplane on a per-slot or per-port basis

VIRTUAL ROUTER ARCHITECTURE AND CAPABILITIES

Rating:	• **Not rated**
Architecture:	• Based on SR OS. The VSR is an x86-optimized implementation of the Nokia SR OS to deliver high performance and elastic scalability with advanced resiliency mechanisms including non-stop routing (NSR) and non-stop services (NSS). Management options include open frameworks (e.g., OpenStack) and/or the Nokia NSP and MANO (CloudBand).
Commercially available VNFs:	• Route Reflector (RR), Provider Edge (PE) with an option for Network Group Encryption (NGE), Broadband Network Gateway (BNG), Residential Network Gateway, Application Assurance (AA), Layer 7 Stateful Firewall for GTP Roaming (GRX) and Gi, Security Gateway (SeGW), Wireless Gateway, L2 Tunneling Protocol Network Server (LNS), Network Address Translation (NAT), Mapping of Address and Port Using Translation (MAP-T) Border Relay, and SR Simulator (vSIM).
Other:	• --

SERVICE & SUPPORT CAPABILITIES

Rating:	• **Leader**
Maintenance Services:	• Technical support, repair and exchange, field maintenance, and advanced, predictive, and proactive software support services, to deliver cost-effective and responsive support for technical queries, drive rapid problem resolution, and help prevent faults from occurring with anticipatory, knowledge-based techniques.
Operational Support:	• Support is provided to address network capacity demands, through transitioning legacy architectures to support new data-intensive services and applications; to maximize financial performance, through reducing network complexity, providing management services for legacy networks, reducing the number of contracts and vendors, and all-IP network transformation; and to establish a sustainable differentiation, through migration strategies, testing and validation, and new service launch plans.
Network and System Integration Services::	• Support is provided for service provider and enterprise customers for network and business evolution, with a focus on transformation services: network design, integration, optimization, and migration expertise; OSS/ BSS, service delivery platform (SDP), and service-oriented architecture (SOA); and fixed, mobile, and multi-screen multimedia integration services.
Managed Services:	• Support is provided for service provider and enterprise customers for network and business evolution, with a focus on transformation services: network design, integration, optimization, and migration expertise; OSS/ BSS, service delivery platform (SDP), and service-oriented architecture (SOA); and fixed, mobile, and multi-screen multimedia integration services.
Business and Operations Enablement:	• Provides consulting to facilitate back-office services and inclusion of OSS/ BSS functionality to instrument automation and establish templates to apply industry best practices and tools. A single-point-of-contact model is provided for maintenance/support of multivendor products, consolidating multiple vendor interfaces, and providing support.
Multivendor Support:	• Provides multivendor model-driven framework (via Nokia NSP) enabling accelerated development and automation for network equipment adapters (for southbound communication via NETCONF/YANG, CLI, SNMP) as well as YANG-based auto-generation of configuration user interfaces and northbound REST APIs. Multivendor model-driven applications provide both northbound REST API support and user interfaces for service fulfilment, configuration, templates, workflow management, and network assurance. Multivendor control via programmable YAML workflows enables full life-cycle management, including OA&M validation with service activation, network software upgrades, certificate management, elastic link aggregation, and migration of service endpoints to different ports. A developer portal and professional services provide access to the technical experts, processes, tools development, and remote virtual network labs for both internal staff and third-party business partners and other equipment manufacturer (OEM) relationships.

Other:	• Deployment services offer site engineering, installation, and commissioning to enable the rapid rollout of equipment into new or growing customer networks. Nokia's deployment expertise and experience allows customers to realize accelerated time-to-market, reduced operating cost, and minimized risk.

MARKET MOMENTUM

Installed base/units shipped:	• Since inception, over 1.3 million (Q3 2020) service router platforms, which have been adopted by more than 1,100 service providers and webscale customers.
Other:	• Ongoing 7750 SR-s, FP4, and FP5-based enhancements; the FP5 was launched recently and is included in these overall metrics.