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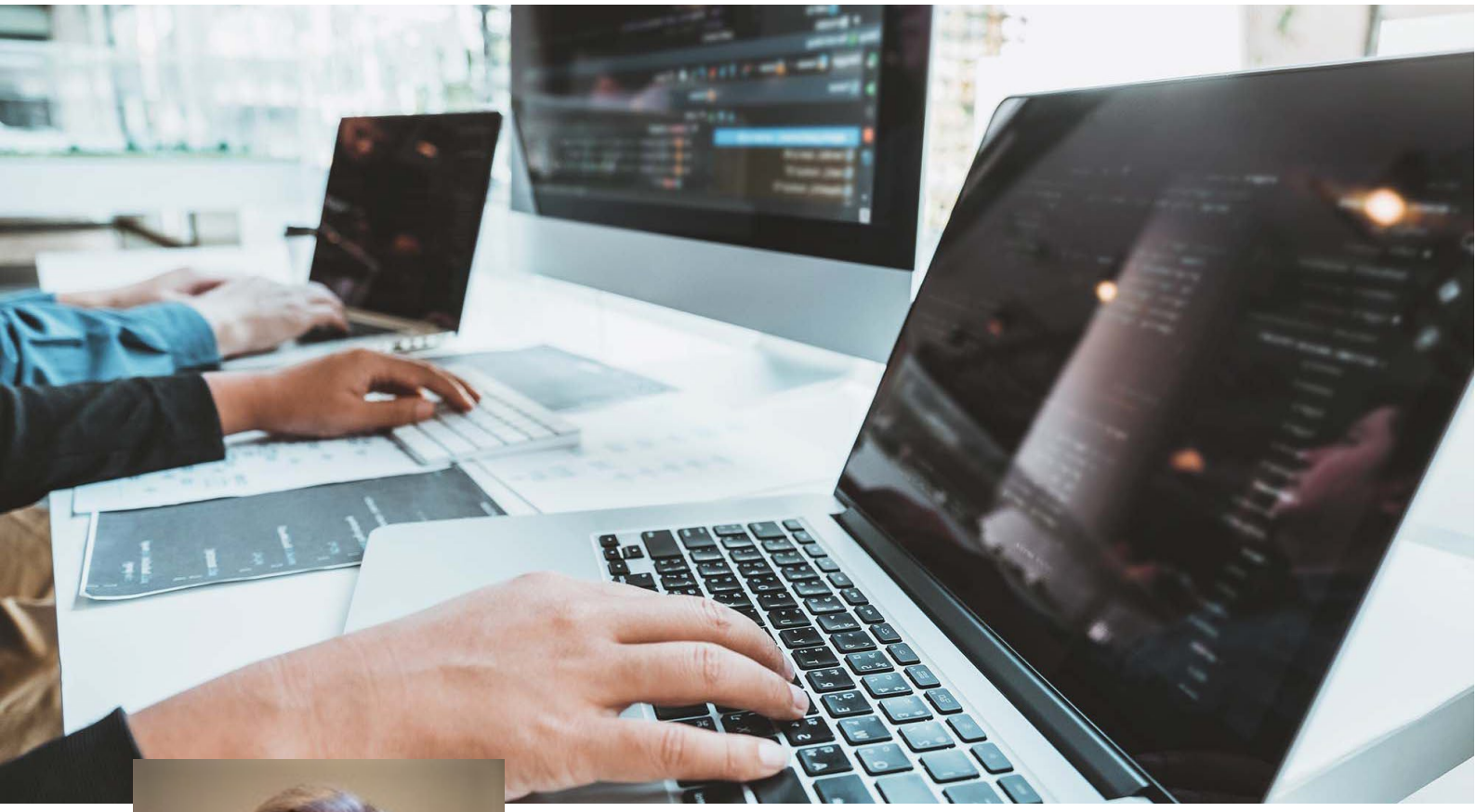

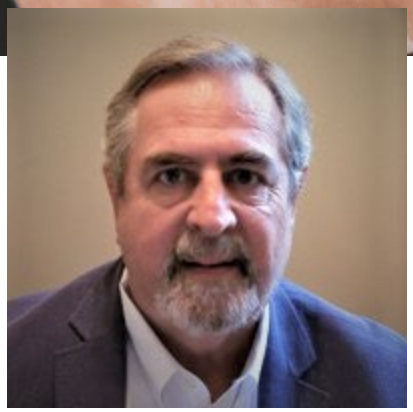

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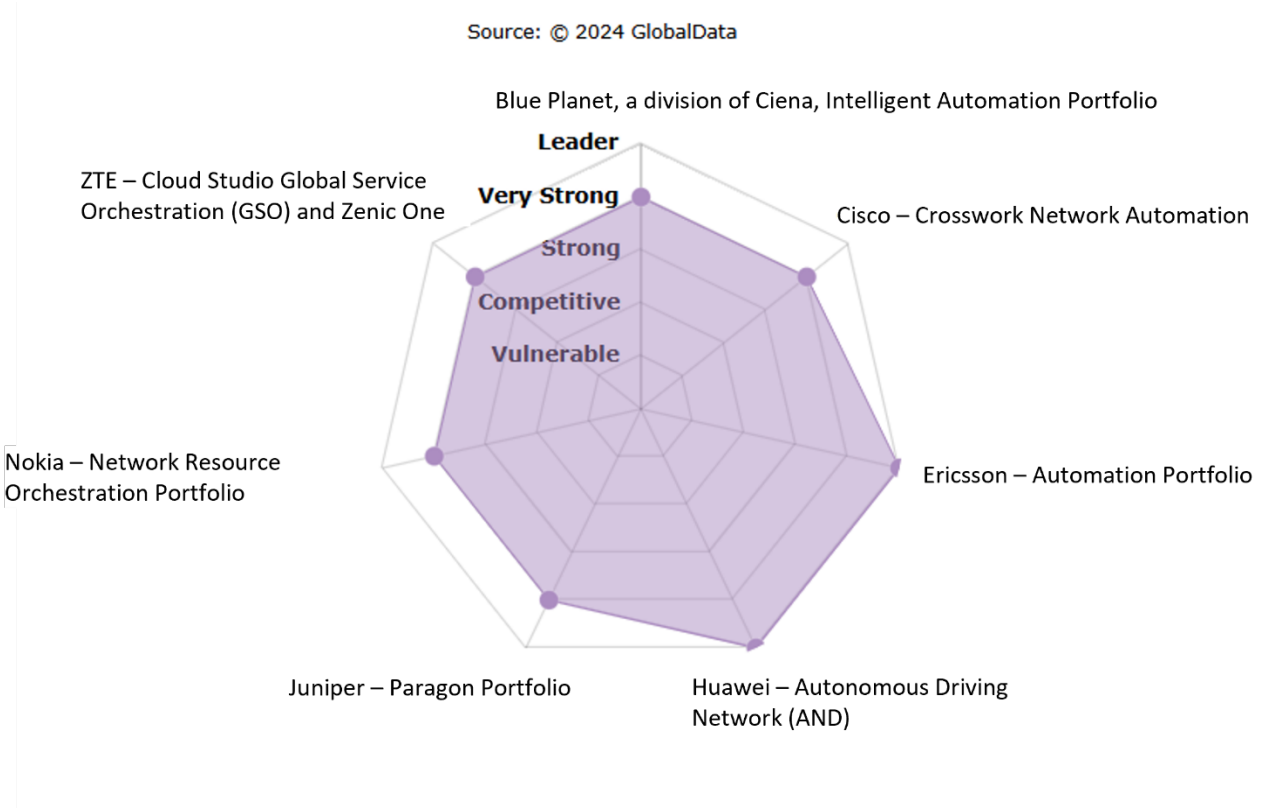
Network Resource Orchestration:
Competitive Landscape Assessment

Competitive Landscape Assessment: Network Resource Orchestration

Report Summary:

Network resource orchestration solutions have advanced to deliver dynamic E2E network slicing with greater automation and intelligence to help CSPs deliver flexible 5G services that address growing 5G use cases across multiple network domains.

Product Class Scorecard

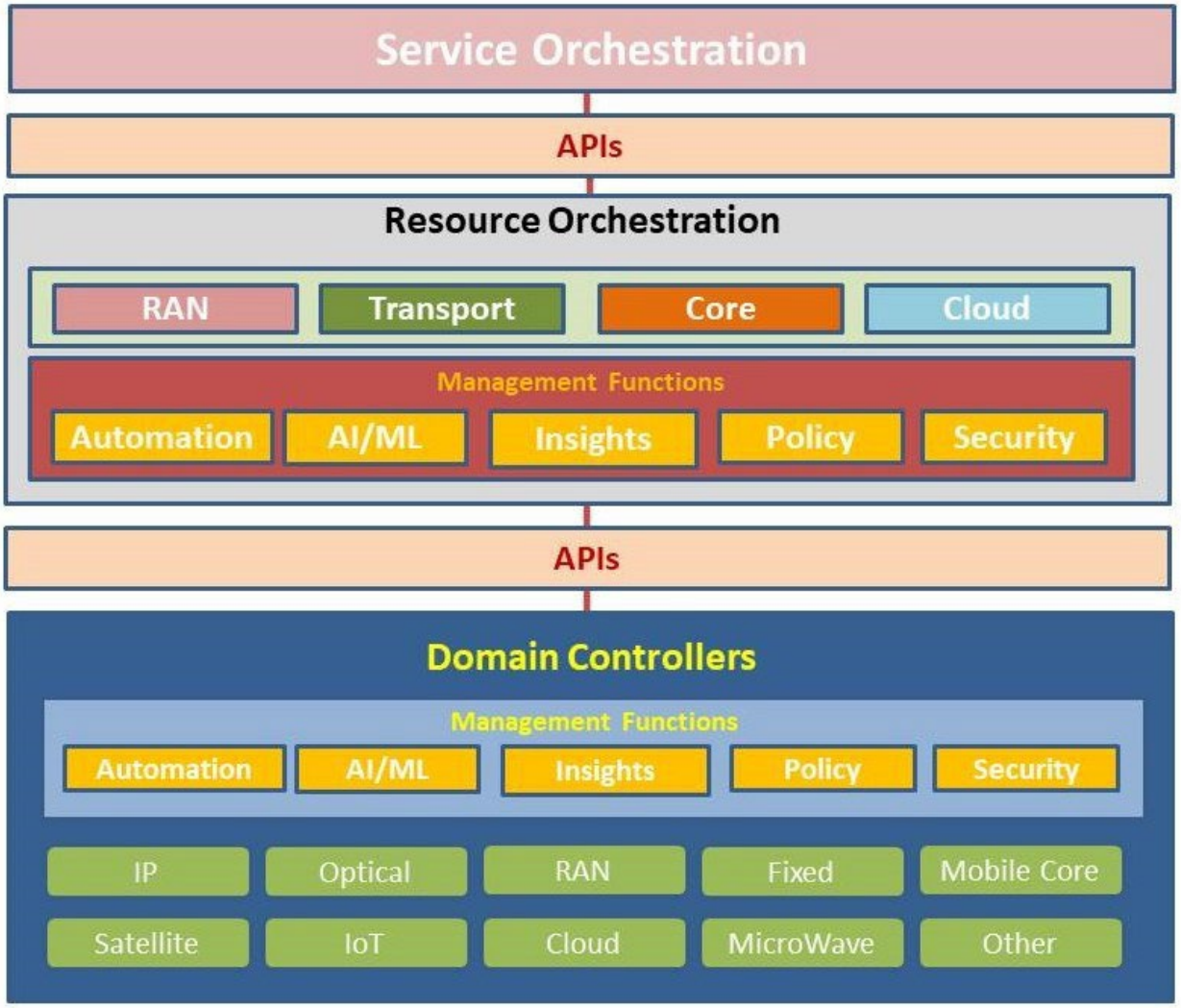


Market Overview

Product Class	Network Resource Orchestration (NRO)
Market Definition	GlobalData's NRO report provides a comprehensive assessment of the competitive landscape in the network infrastructure resource orchestration and lifecycle management (LCM) sector. It examines vendor products and solutions that configure resources and instantiate services. NRO, working in conjunction with service orchestration and the business support system (BSS) layers, plays a crucial role in delivering telco services. It integrates with domain controllers and lower-level functions to ensure the smooth operation of network services. The report highlights the advancements in software defined networking (SDN), network virtualization, cloud-native technologies, telemetry, security, automation, network slicing, analytics, and the use of large language model (LLM), artificial intelligence (AI), and machine learning (ML) that contribute to the realization of 5G's potential. Resource orchestration plays a vital role in ensuring the availability and allocation of network, compute, and storage resources within the network infrastructure. This guarantees the efficient delivery of network services and the execution of specific functions. The solutions discussed in the report adhere to industry standards and guidelines, enabling their compatibility across various domains of the service provider network. The report primarily focuses on the management and orchestration of network elements and related functions and examines the solutions offered by network equipment manufacturers (NEMs). **Related Analysis:** • Network Services Orchestration - Competitive Landscape Assessment addresses the services layer supported by the underlying network infrastructure • 5G IP Transport - Competitive Landscape Assessment covers IP-based 5G transport routers positioned to serve functions in 5G mobile network including fronthaul, midhaul, and backhaul.
Rated Competitors	• Blue Planet, a division of Ciena, Intelligent Automation Portfolio • Cisco - Crosswork Network Automation • Ericsson - Automation Portfolio • Huawei - Autonomous Driving Network (ADN) • Juniper - Paragon Portfolio • Nokia - Network Resource Orchestration Portfolio • ZTE - Cloud Studio Global Service Orchestrator (GSO) and Zenic One
Changes Since Last Update	**Major Moves and Changes:** **Ericsson:** • Ericsson's Service Orchestration and Assurance which guarantees SLA assurance through closed loop automation and facilitates data-driven operations, was announced in February 2024. • Ericsson's Dynamic Network Slicing which automates end-to-end network slicing and creates slices on demand to address the 5G business opportunities, was announced in February 2024. • Ericsson's Transport Automation Controller which uses AI and machine learning to provide advanced analytics and automation for microwave, IP and optical fronthaul networks, was announced in November 2023.

Market Assessment

- GlobalData's NRO competitive landscape report analyzes products that provide the functions and processes to address the LCM of the network infrastructure elements used to instantiate network services. This typically includes layers 1-4 of the IP network, layers 0-3 of the optical transport network, as well as microwave for mobile backhaul (5G xHaul). NRO also covers virtualized resources and supporting functions for fixed and mobile networks (Radio Access Network (RAN) and mobile core). The report covers multiple access technologies including: WiFi, fixed access (XGS-PON, xDSL), and non-terrestrial networks (NTN).
- NRO functions include planning, design, on-boarding, operation, and end-of-life. Advances in SDN, network virtualization, cloud-native, telemetry, security, automation, network slicing, analytics, and AI/ML combine to deliver on the promise of 5G. The following graphic outlines the scope of resource orchestration as covered in this report.



Source: GlobalData

The goal of NRO is to ensure there are sufficient network, compute, and storage resources available and that they are dynamically assigned within the network infrastructure to deliver a network service or function. Solutions follow general standards and industry guidelines, and, depending on the scope and architecture of the network, will be guided by one or more industry forums. Resource orchestration encompasses the end-to-end lifecycle of network resources made up not only of physical network nodes but of virtual network functions (VNFs) and cloud-native microservices and containerized network functions (CNFs). Telcos must now manage multiple types of resources in their service delivery environments:

- at the edge
- in the core
- in a cloud
- in the RAN (Open RAN)

The industry is addressing end-to-end resource orchestration including LCM, element/function configuration, service assurance, security, real-time resource inventory, and network insights through multiple industry efforts. The list below provides a snapshot of key initiatives driving the architecture and implementation of resource orchestration solutions; the diversity of the contributors demonstrates significant participation by operators, standards organizations, and industry forums:

- ETSI's Zero-touch network and Service Management (ZSM) and TeraFlow SDN controller
- TM Forum's Open Digital Architecture (ODA)
- TM Forum's Autonomous Networking TN
- ONAP use cases such as 5G, BBS, CCVPN, voice over LTE (VoLTE), and vCPE
- MEF's Lifecycle Service Orchestration (LSO)
- Telecom Infrastructure Project's Open Optical & Packet Transport, AI, and Applied Machine Learning (ML); and Mandatory Use Case SDN Transport (MUST)
- 3GPP standards initiatives (3GPP Release 16, 17, 18, and emerging 19)
- 3GPP and IETF Network slicing to deliver SLA performance, and assured end-to-end services, including RAN
- China Communications Standards Association
- Open RAN Alliance (O-RAN) Service Management and Orchestration (SMO) platform

Support for 5G services requires a fully programmable cloud-native network infrastructure capable of supporting automated operations spanning the service lifecycle. Legacy management solutions lack the agility to meet the demands of 5G services; however, the transition to cloud-native will take time and will need to leverage existing virtualized technologies while evolving.

Market Drivers

- **Monetizing and Growing 5G Capabilities:** End-to-end network slicing has emerged to enable new revenue opportunities for CSPs with support for advanced 5G use cases such as edge, IoT, and emerging industrial applications requiring low latency, high performance, and traffic separation. Network automation coupled with effective slice management and intent-model-driven capabilities are key network and service orchestration capabilities.
- **Network Complexity:** To cope with network complexity and achieve service agility, all layers of the network need automation between the services layer and the resource layer as well as within each domain in a multi-vendor, multi-layer infrastructure. The increasing complexity inherent in 5G architectures exceeds the capabilities of traditional manual processes. AI and ML capabilities have grown significantly and have been infused into all solutions to improve automation and quality of experience.
- **Domain Intelligence:** Each network domain, in addition to working with the network resource orchestration layer, must have inherent intelligence to provide network insights, support policy-based decisions, and instantiate resources to support demanding service needs. Each domain needs to react and act when faced with changing conditions such as a fiber cut, node failure, or signaling storm (DDoS) to assure uninterrupted service.
- **5G Drives Cloud-Native:** Telcos are implementing 5G and migrating from a virtual machine (VM)-based to cloud-native architectures, although both will co-exist in the near term. Cloud-native requires new management tools based on open-source to free operators from vendor lock-in through common toolsets. Many automation objectives are not achievable through existing VNF and monolithic architectures.
- **5G Transport and Virtual/Open RAN Emerges:** 5G transport requires new levels of diversity of site types and deployment strategies. This is driven in part by network disaggregation/virtualization and the introduction of 5G radios, which results in a complex 5G transport (encompassing fronthaul, midhaul, and backhaul) architecture. The RAN is becoming more disaggregated and programmable to accommodate new 5G services. The Open RAN Alliance's (O-RAN) SMO platform applies automation at scale to simplify operations, improve performance, enhance the customer experience and minimize RAN operational costs.
- **Dealing with Legacy Management Models:** A typical telecom service spans multiple infrastructure domains that have each been guided by separate standards, industry forums, and timeframes. Operators need solutions that can manage existing infrastructures while transitioning to a software-defined solution based on cloud-native technologies and microservices. Solutions that support interoperability between multiple network types and technology generations have become top-of-mind concerns for all operators.

Buying Criteria

- **Portfolio Scope:** This metric evaluates the network domains supported by the vendors solution portfolio and includes IP, optical, mobile, fixed access, non-terrestrial-network (NTN), and IoT, which are part of a typical operator network. Partner components are considered if fully integrated and managed.
- **Functional Capabilities:** This metric evaluates the functions provided by the solution, including inventory, configuration, policy, security, network slicing, edge computing, cloud, and hybrid physical/virtual management. Typical use cases include L2/L3 services; MEF 3.0 carrier Ethernet; virtual and physical network functions (VNF, CNF, PNF), network slicing; and support for private networks.

- **Standards and Openness:** This metric assesses the use of proprietary and/or open-source tool sets, cloud-native architecture, and open and standards-based APIs. The industry has yet to reach a consensus in many of these areas, and standards vary based on network domain. Applicable standards include TM Forum, 3GPP, IETF, MEF, ETSI, ORAN (increasing in importance), CNCF, and other domain-specific interfaces and data models.
- **Lifecycle Automation:** This metric evaluates the resource and service lifecycle support from initial configuration to service deployment, end-to-end provisioning, optimization, self-healing, ISSU, rollbacks, CI/CD, network slicing, AI/ML, analytics, as well as testing/verification and service assurance.
- **Production Experience:** This metric evaluates key operator deployments, integrations with third parties, supported use cases, and indicators of market acceptance. Since solutions mature by adjusting to real-world conditions, this category considers commercial deployments, proofs of concept (PoCs)/trials, a vendor's largest and most complex deployments, as well as the breadth of supported devices.

Vendor Recommendations

- **Multi-Cloud Agnostic:** As operators and enterprises move to deploy resources across edge/public/hybrid/multi-cloud environments, these capabilities should be highlighted or prominently placed on product resource orchestration roadmaps. Vendors should note their ability to minimize increased lifecycle management costs for products and deployments caused by operator preferences to support different cloud platforms.
- **Cross-Domain and Vendor Boundaries:** Vendors should tout their ability to orchestrate resources within their respective product domains; however, they should also add proof points showing capabilities in adjacent multi-technology domains in order to bolster their credibility as providers of end-to-end resource orchestration. Examples include converged IP/optical, support for multi-vendor and multi-cloud networks.
- **Expand the Ecosystem:** Vendors need to expand partnerships (formal or informal) in order to broaden the appeal of their solutions. With virtualization and disaggregation, the level of multi-vendor equipment in operator networks will continue to increase; but operators will want network management to be as integrated as possible.

Buyer Recommendations

- **Scale and Deployment Requirements:** Operators should ensure that vendor solutions can scale appropriately and manage resource deployment at the edge, metro, and core as well as support both cloud- and premise-based models. As 5G matures, the need to deliver services over any media and any topology will be critical to meeting traffic demands for capacity, latency, and cost.
- **Open Solutions:** Operators should ensure that the vendor's interfaces (APIs) and architecture (cloud-native) match their evolution strategy, especially regarding lower-level functions where there are still competing approaches. Operators should closely follow the release of new standards, such as 3GPP Release 18 and beyond, and understand vendor roadmaps for compliance.
- **Security and Network Insights:** Operators should press vendors to construct solutions that provide security (MACsec/IPsec) and a level of intelligence (AI, ML) at each layer of the network. Complexity increases as networks become more disaggregated, a trend now moving into the RAN domain. This requires the ability to automate OAM processes and export network insights to deliver on customer expectations.

Rated Competitors

Product Name	Ericsson - Automation Portfolio	
Current Perspective	The Ericsson Orchestrator is part of its orchestration portfolio within Ericsson Cloud Software and Services and holds a market-leading position in resource orchestration for CSP networks. Ericsson focuses on end-to-end management of the mobility assets (including cloud RAN) and telco infrastructure (5G transport and microwave). For resource orchestration, Ericsson leverages the Ericsson Orchestrator and the Ericsson Network Manager. Multi-domain service orchestration and slice service management support is provided by Ericsson's Service Orchestration and Assurance product, which is integrated with the Ericsson Order Care and Ericsson Catalog Manager. Related solutions include Ericsson Dynamic Network Slicing - a modular, pre-integrated and use case driven solution to manage, orchestrate, and seamlessly assure the slice lifecycle; Ericsson Expert Analytics - a cross-domain, big data analytics tool that provides customer-centric insights with actionable intelligence for network and subscriber monitoring; and Ericsson Network IQ Statistics for performance management of multi-vendor and multi-technology environments. Ericsson recently added the Ericsson Intelligent Controller the non-RT RIC solution - for multivendor and multi-technology RAN automation; and the Ericsson Transport Automation Controller, for advanced analytics and automation for microwave, IP, and optical fronthaul networks.	
Buying Criteria Rating	**Functional Capabilities** Leader **Lifecycle Automation** Leader **Portfolio Scope** Very Strong	**Production Experience** Leader **Standards and Openness** Very Strong
Product Scores	**Leader**	
Strengths	• Ericsson Service Orchestration and Assurance is a multi-domain, multi-technology product enabling cross-domain service orchestration and assurance spanning access, transport, and core. It addresses communication service providers' needs of simplifying open and programmable networks through automation of the service lifecycle to grow revenues profitably. • Ericsson Orchestrator delivers complete lifecycle management of virtual machine and container-based functions for private, public, and hybrid clouds including lifecycle management for cloud RAN/ORAN. • Ericsson has demonstrated production experience with more than 1,000 Ericsson Network Manager contracted systems and 285 Ericsson Orchestrator contracts. In addition, Ericsson has 36 commercial contracts for Ericsson Service Orchestration and Assurance and 35 completed proof of concept engagements. • Ericsson provides pre-integrated testing and onboarding capabilities to reduce time-to-service through a dynamic CI/CD pipeline.	
Limitations	• Primary deployments are in support of end-to-end mobile network infrastructures, but lack the fixed network depth of competitors such as Nokia and Huawei. • Offers a framework (SB Adapter toolkit [i.e., SDK]) for integration with transport controllers but lacks specific fixed access infrastructure (i.e., XGS-PON).	