
NOKIA
Drive data center network innovation with Nokia SR Linux
Run your data center network on your terms

Contents

The new data center fabric requirements

The data center fabric is the connectivity engine that business applications and services rely on to meet their performance and scalability goals. But cloud-native architectures and the next generation of services are creating challenging new data center fabric requirements.

In today's cloud era, delivering the best service experience to end users is a key business imperative. The deluge of new consumer and business services, often driven by the deployment of new technologies such as 5G, IoT, artificial intelligence (AI) and machine learning (ML), has put massive pressure on data center network operators to deliver greater service agility with more scale and higher performance.

Despite these new traffic demands, what is of paramount importance for operators is to maintain business continuity. Operators value a reliable network they can count on when traffic demands are high and unexpected events inevitably happen. They want a network that just works. However, in many networks this is more of a luxury than the status quo.

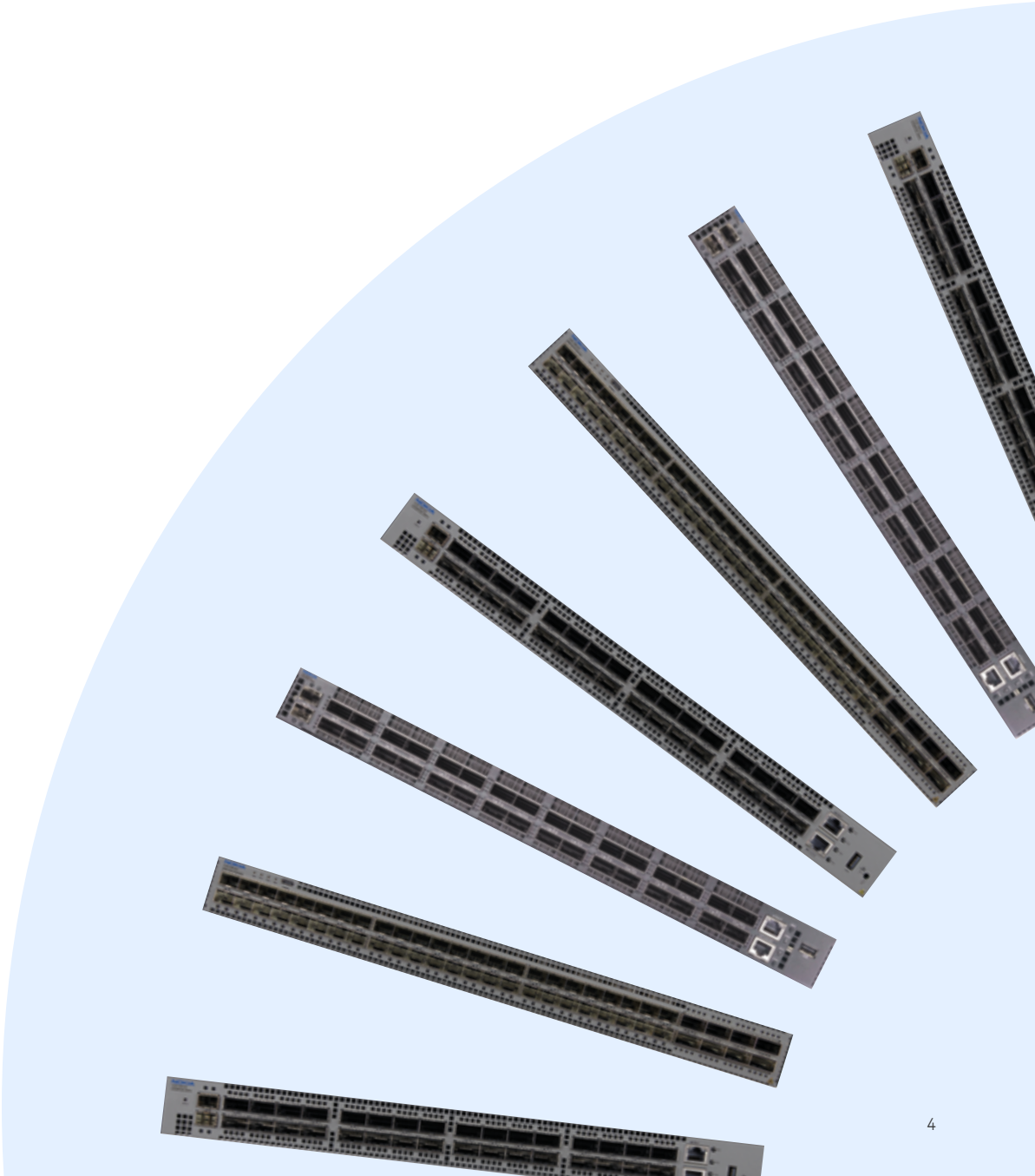
Handling these new traffic demands will require more automation. Operators will need to implement intent-based network automation across the different phases of the data center fabric's lifecycle from design, deployment, and operations. However, automation has never really met its promise. One of the reasons for this is because networks can be fragile and often there is a concern that automation at scale will simply amplify this fragility.

The last imperative that operators must accommodate is for their data center fabric solution to be adaptable to fit into various heterogeneous environments while also being customizable to address unique operational requirements. As reflected by the massive growth of data center infrastructure management (DCIM) tools, many companies choose a DIY approach to fulfill their NetOps platform needs and integrate their own tools or open-source projects into their environments. This means that each operational environment is unique, with their own bespoke needs requiring an open and flexible solution.

A network fabric built for innovation

As data center fabric operators began to embrace NetOps, they found that existing data center fabric solutions could not easily meet their operational needs and often delayed the growth of automation. Nokia recognized this gap and collaborated with leading hyperscalers and companies working to embrace DevOps approaches to find out more about their successes and challenges. Nokia applied these learnings to network operations with the goal of helping to drive NetOps automation in any environment. Our aim was to design a data center fabric solution from the ground up to provide the openness and extensibility data center and cloud builders would need to thrive with NetOps.

The resulting solution combines our high-performance data center fabric switching platforms, the 7220 Interconnect Router (7220 IXR) and the 7250 Interconnect Routers (7250 IXR-6e/7250 IXR-10e), with a fully open and extensible NetOps-based network operating system (NOS) called SR Linux.

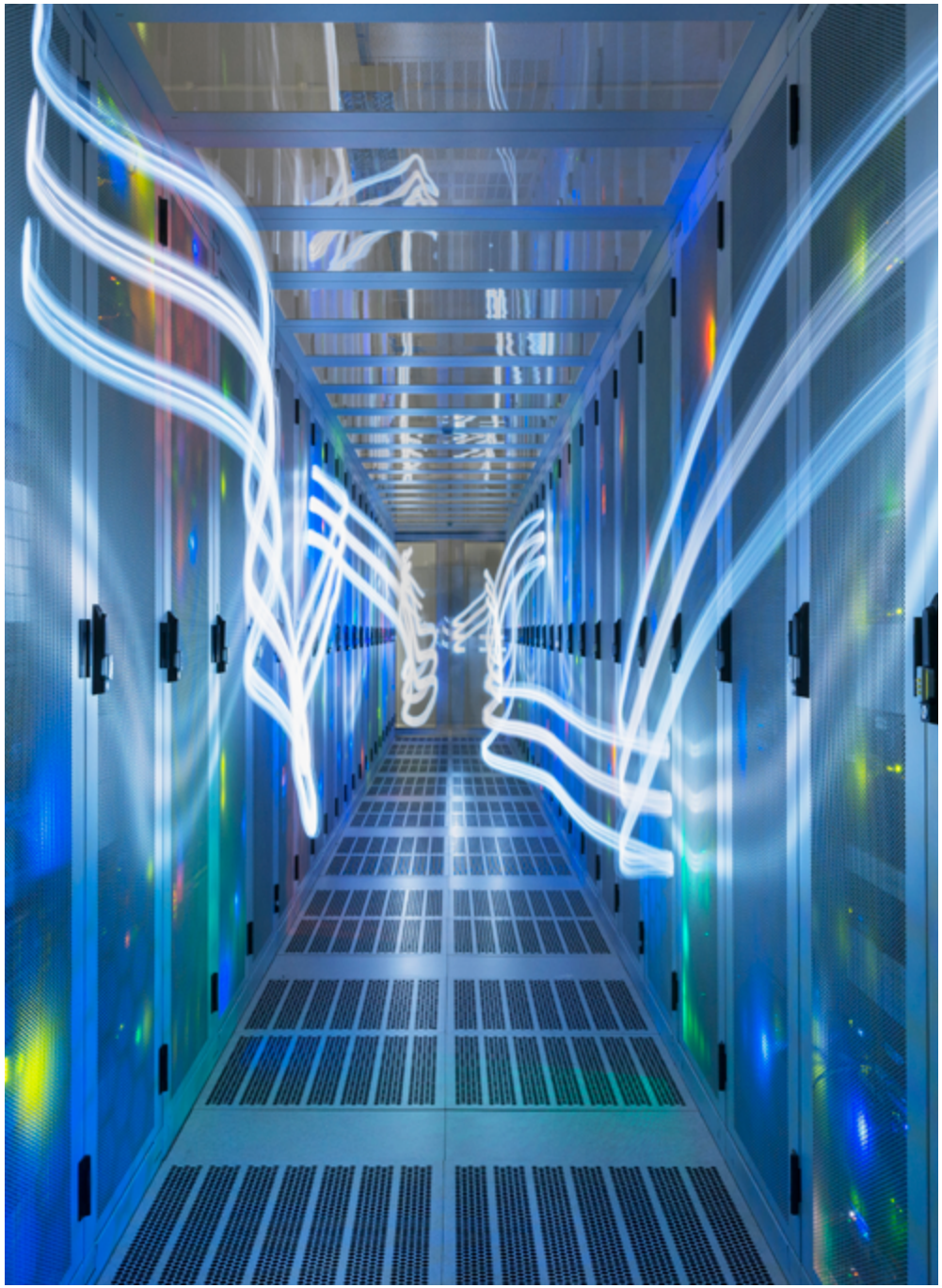


Building blocks of Nokia SR Linux

We designed our solution to innovate and break traditional boundaries in NetOps automation, to be extensible to facilitate the creation of new tools, and to be flexible and adaptable enough to be deployed in any environment. With these building blocks, data center operators can realize the full potential of NetOps automation, create the tools they need and get maximum value from their existing environments.

Below are some of the aspects of SR Linux that sets it apart:

- Built on top of an unmodified Linux kernel ensuring reliability, portability and easy application development
- A microservices-based model-driven management design leverages independent YANG data models to provide granular and broad access to network data
- Modern standard interfaces such as gNMI and gRPC and others provide efficient and consistent ways to communicate with the network
- A NetOps Development Kit (NDK) and open-source CLI plugins allow data center and cloud builders to create their own customized operational tools
- An open and scalable telemetry framework leverages on-change streaming telemetry and gNMI to provide new levels of network visibility
- Tested, hardened and field-proven routing capabilities (e.g., EVPN, MPLS, BGP, VXLAN) inherited from SR OS provide proven performance at scale.



Data center networking on your terms

SR Linux allows you to remove operational barriers that may have slowed you down or impacted your services in the past. With SR Linux, these barriers are removed and your networking fabric will just work.

There are several aspects that allows this to happen:

- SR Linux was built with reliability and quality from the beginning. This allows it to survive traffic spikes and other unexpected events and disruptions while still passing service traffic.
- SR Linux is designed to enhance automation. It does this by providing new levels of network visibility while also adding guardrails to automation allowing automation to be executed at scale.
- SR Linux will adapt to your own unique environment. Integration into different heterogeneous ecosystems is made easy through its standard interfaces and protocols. Customizing and extending SR Linux is made easy through on-box tools that are easy to use. Finally, SR Linux has grown a community of interest that work together to get the most out of SR Linux and other NOS's, creating a true collaborative environment.

Built for reliability and quality

Data center operators seek business continuity and resilience in the face of constant change. Operators are looking for networks that just work so they can transition their staff to less mundane and stressful work items to more rewarding and innovative tasks.

“Why was Nokia ideally suited to build a data center fabric operating system?”

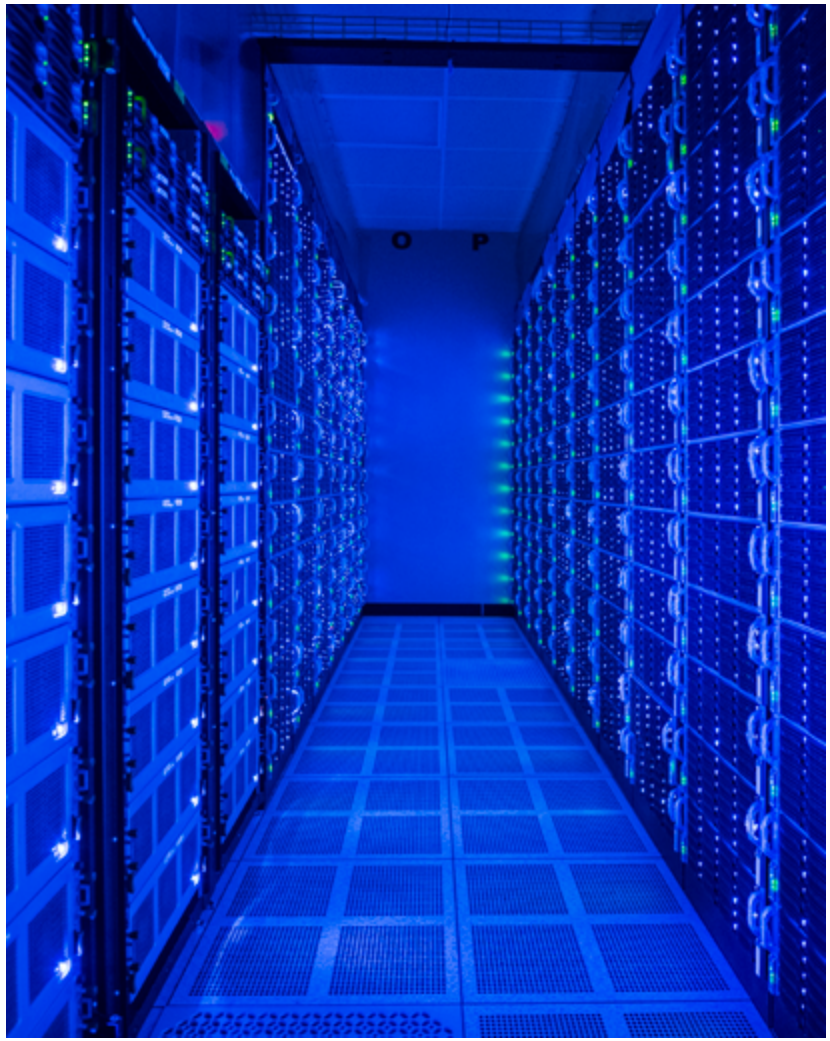
Nokia’s data center fabric solution is built within Nokia’s Network Infrastructure (NI) division, which also builds an industry leading family of routers ranked by Dell-Oro as #1 Service Router in the industry. In fact, over 1.8 million Nokia routers have been deployed in over 1600 cloud and CSP customers, and over 1250 digital industry and government customers, with no major network outages requiring emergency patches in over 15 years. Nokia’s NOS is SR OS and has a world class pedigree of both quality and reliability, and this same commitment to quality and reliability has been inherited by SR Linux when it was built.

“What makes SR Linux the gold standard in reliability?”

SR Linux was able to take a leap forward in innovation by implementing the latest and greatest protocols and standards into its design. SR Linux inherited the same routing stack that was proven in SR OS over decades within the largest and most demanding networks in the world. This includes essential routing protocols like EVPN, VXLAN, and BGP which Nokia not only supports but also leads the industry in its development. SR Linux is built and maintained differently than most industry NOS’s. Some key aspects include: 1:1 ratio of software developers to test engineers with a heavy investment in test automation and regression testing. SR Linux shares one code base for all protocols and applications with over 350K+ shared test cases.

Simplify Integrations

Many operational environments include open-source projects and DIY platforms that enable advanced monitoring, inventory management, provisioning, analysis, troubleshooting, security and much more. This diverse ecosystem must be compatible and symbiotic with the data center fabric solution.



> How can we integrate a modern data center networking fabric into a complex automation environment with limited disruption and cost?

SR Linux minimizes integration concerns by seamlessly integrating into existing open-source projects. It was built from the ground up to remove many proprietary and non-standard elements that do not support easy or efficient interoperation with open-source projects and DIY tools. Its cloud-based model-driven management design provides a consistent basis for communicating with various existing systems.

> How can we be sure that our network fabric will seamlessly operate with no additional integration costs as we add more open-source projects and DIY systems?

SR Linux eliminates complex and costly integration and testing projects today and well into the future. A Nokia Bell Labs business case analysis tool has determined that by using SR Linux, data center fabric operators reduce effort by up 25 percent during new integrations with northbound systems, when compared with a legacy implementation.

To date, we have integrated SR Linux into many open-source projects, including Grafana, Promethius, gNMIc, Loki, Promtail, Harbor, Gitlab, Pytest, Runner and more.

Extending and customizing your NOS

With a culture that emphasizes doing more with less while driving scale and performance, data center fabric operators value the flexibility to extend and customize their operational environment, including their network fabric.

Operators can use the extensibility and customizability of SR Linux to address a unique network issue, or to take back control from the vendor so they can operate their fabric their way. Having the ability to customize the way the network fabric behaves and communicates with the broader operational ecosystem provides operators the confidence they need to operate on their terms.

“How do we take back control from our network vendor and minimize reliance on software releases and uncertain vendor roadmaps to address our immediate needs?”

SR Linux offers tools that operators can use to extend and customize their NOS. These capabilities shift control into the operator’s hands and can eliminate the need to wait for new features or fixes from the vendor that may not be tailored to the operator’s specific environment. These tools include an NDK that allows operators to write their own on-box custom applications that can deeply integrate with the rest of the system. These applications can be written in any programming language (e.g., Python, Go, C#, C, C++, Java, JS). SR Linux also includes a programmable CLI, which is a Python-based plugin framework that lets operators customize their own CLI.

“Are there examples of applications that were built from this NDK?”

We used the NDK to build an AI assistant for SR Linux. This application allows the operator to use natural language instead of CLI when issuing commands to SR Linux-based data center platforms. It does this by sending an API call to OpenAI along with contextual network information and relevant documentation.

This application is integrated into SR Linux’s system architecture and uses the same management layer as all other native services. This level of deep integration gives the application access to all systems, services and state, removing restrictions to what it can do.

Visit our developer portal to get a more detailed view of these capabilities and download from a catalog of existing NDK applications.

New levels of network visibility

Data center fabric operators that rely on automation, open-source projects and DIY tools need real-time access to network data, including state. For example, it is essential for a network monitoring system to have full access to network data. A troubleshooting platform that detects suspicious patterns in the network is only as effective as the data it receives. A system that maintains the single source of truth for the network requires a broad and deep understanding of the network and its configuration and state.

Scott Brookshire, CTO and co-founder of OpenColo says, “With SR Linux, our team had ubiquitous access to precisely the network data we needed (and when we needed it) to power both our Grafana dashboards as well as informing other automation tools like our customer onboarding tool.”

“Will SR Linux provide us with the network data and state we need to support northbound operations and business support systems (OSS/BSS)?”

SR Linux ensures that these systems will have easy and consistent access to their network data, including state. With SR Linux, all northbound clients will be sent network updates immediately when there is a change in configuration or state. This capability makes network communication much more efficient while enhancing operation of these systems (e.g. monitoring, automation, troubleshooting, etc.).

“How does SR Linux provide this level of network data?”

These capabilities are enabled by an open and scalable telemetry framework that leverages on-change streaming telemetry. SR Linux uses the gNMI management interface to efficiently deliver the required network and state data. A cloud-based model-driven management architecture is implemented where each service in the NOS uses its own YANG data model allowing for consistent, unrestricted access to each service’s data tree.

A Nokia Bell Labs business case analysis tool has determined that by using the enhanced monitoring capabilities enabled through SR Linux, data center fabric operators can reduce the effort involved in validating service or infrastructure changes in the network by up to 43 percent compared to a legacy implementation.

Reduce barriers of validation

Operators often find it difficult to validate and test the way a new NOS would function within an existing environment. This is especially true in multivendor environments that include multiple operating systems. Most operators do not have the time or money to set up a new lab to test a new NOS suitably and accurately.

“How can we test SR Linux to become comfortable with its CLI syntax and the way it works?”

From the beginning, we focused on making it easy for operators to test and validate SR Linux. We’re breaking down barriers of validation and testing by enabling operators to:

- Download documentation that gives them a quick start on how to use and benefit from the system
- Connect, engage and collaborate with online communities of SR Linux users, by interacting with the Learn SR Linux community page and the SR Linux Discord channel
- Download and test a containerized version of SR Linux
- Download an open and free virtual lab called “containerlab” to quickly and easily stage and test multivendor networks.

“How can we validate our SR Linux elements with other operating systems?”

Containerlab is becoming an important part of the SR Linux community. More and more of our customers are using it to test and validate multivendor network setups. With containerlab, customers are finding that any subsequent lab setup time is reduced dramatically, often by up to 80 percent.

By using containerlab during continuous integration (CI) regression testing, we have found that setup time can be reduced by 75 percent, and that we can find regressions 50 percent faster. In general, containerlab also increases cross-team collaboration through a centralized Lab-as-Code repository sharing infrastructure.

Enhance network automation

Network automation is needed to scale operational tasks, increase productivity and agility, while eliminating human errors.

Some examples of network automation include:

- Abstracting the network and using intent-based automation to facilitate and scale the provisioning, deployment and operations of the network
- Automating network troubleshooting processes by constantly monitoring and analyzing the network to proactively detect and mediate issues before they impact the network
- Deploying continuous integration and continuous deployment (CI/CD) pipelines for the network to automate many operational processes such as upgrades, maintenance.

“We use several interfaces to extract the network data we need. Is there a faster and more efficient way?”

With SR Linux, operators can access granular real-time network data across the system to optimize their existing automation capabilities using a single API call of their choice (e.g., gNMI, RESTCONF, CLI). They can do this because all services across the NOS are built in the same modular way and have their own independent data model. With gNMI, a single open and scalable telemetry framework is used to stream network data to the subscriber when a change takes place in the data. Without this consistency across the entire NOS, automation will become more difficult.

“How can we accelerate our automation plans and drive scale without exposing the fragility of our network?”

The fragility the network has so far kept operators from realizing the full potential of automation. Many operators worry that network automation will make their networks more fragile.

One way to express how automation can guard against the fragility of the network is by drawing a comparison with pre-flight checks that are performed before a commercial airplane takes off. In the networking world, similar checks can be automated and performed before a more elaborate automation task is executed. For example, an automation system could use an intent-based framework to ensure that the network is behaving according to desired intent. These network checks could include verifying that ports are all operationally up, all interfaces are up, all EVPN services are up, all congestion levels are within acceptable thresholds and all BGP peers are up.

With the model-driven management architecture of SR Linux, these checks can be more granular and precise and can be conducted across the entire NOS in a faster, more accurate and more consistent manner.

Ready for the future with Nokia SR Linux

The world is embracing new technologies at an unprecedented pace, and data center fabric operators have to be prepared for whatever comes next. Nokia SR Linux provides the building blocks these operators need to seamlessly integrate the best new innovations into the network and adapt to change now and in the future.

Visit our Networking at Webscale page to learn more about how SR Linux can transform your operating environment.

Learn More

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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