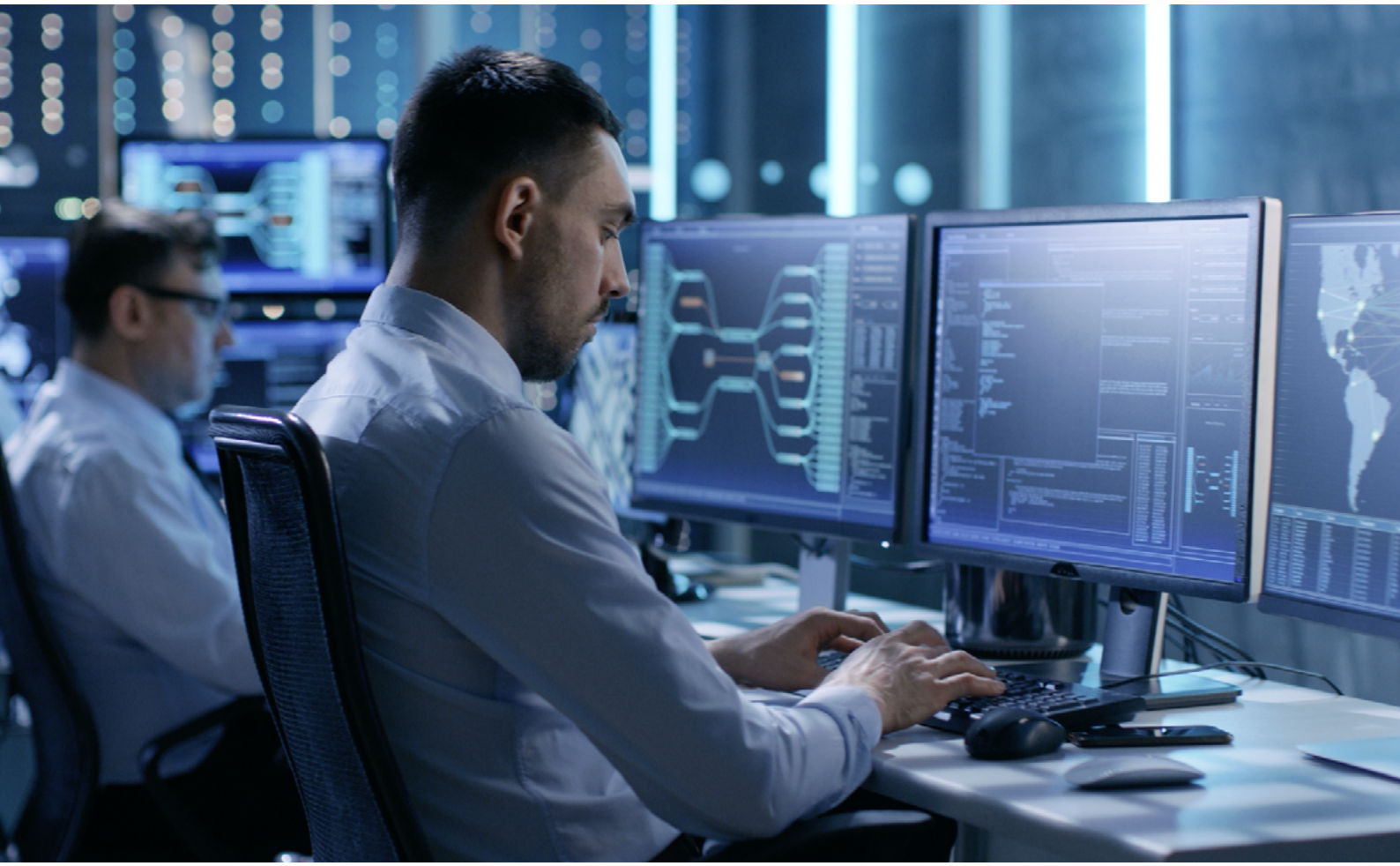
NOKIA



Nokia Fabric Services Platform

A declarative, intent-based automation and operations toolkit

Product description

NOKIA

Abstract

The challenge facing data center network operators is to balance the need to constantly scale their networks and operations against the increasing costs of designing, building and operating these critical networks. Evolving application needs and the increasing adoption of distributed data centers is driving the need to rethink how data center networks are designed and operated.

The Nokia Fabric Services Platform is a declarative, intent-based automation and operations toolkit that delivers agile and scalable network operations for data center and cloud environments.

This document describes the Fabric Services Platform and explains its foundational elements and key capabilities.

NOKIA

Contents

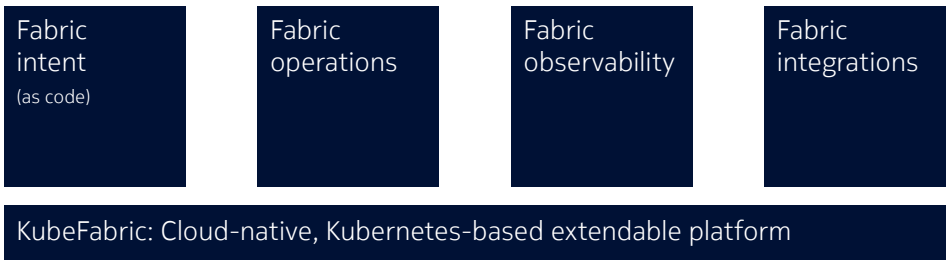
Introduction

Network management inside data centers is becoming increasingly automated, driven by the need for agile and simplified network operations. As data center and cloud environments get bigger and more complex, we need to automate all phases of network management. Technically, automation at scale can only be delivered via intent.

The Nokia Fabric Services Platform is designed from the ground up for intent- based automations for all phases of data center fabric operations, including Day 0 design, Day 1 deployment, and Day 2+ configuration, operation, measurement and analysis of a data center fabric.

As shown in Figure 1, the Fabric Services Platform architecture relies on four key pillars: declarative fabric and workload intent, fabric operations, fabric observability and fabric integrations. These pillars address all stages of the life cycle of a fabric with specific focus on operations at scale for both on-premises and cloud environments.

Figure 1. Fabric Services Platform: Key pillars



Day 0, Day 1, Day 2+

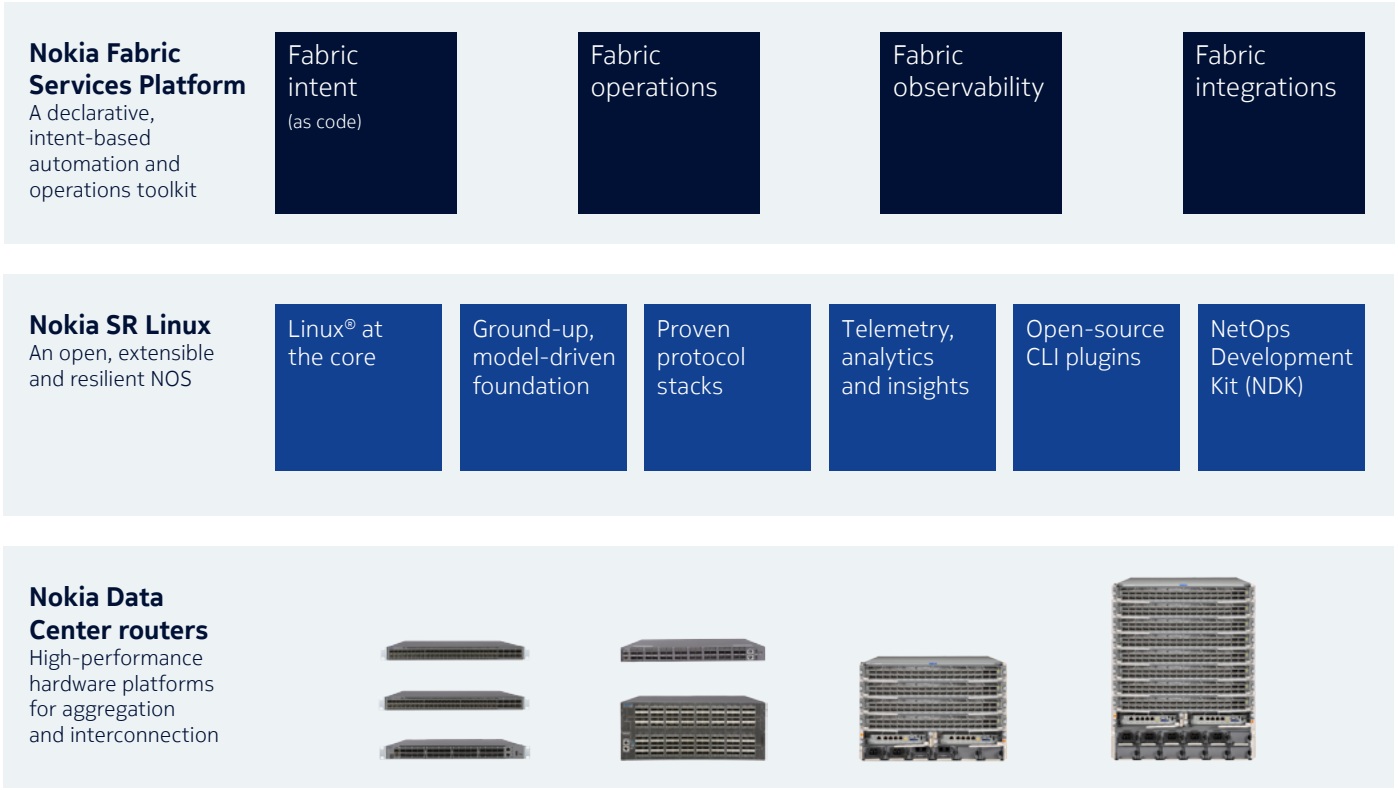
The Fabric Services Platform is a key component of the Data Center Fabric solution (see Figure 2), which also includes the following products:

- Nokia Service Router Linux (SR Linux): An open, extensible and resilient network operating system (NOS) based on Linux® that enables scalability, flexibility and efficiency in data center and cloud environments.
- Nokia Data Center routers: A portfolio of routers that deliver massive scalability, openness, aggregation and interconnection for data center and cloud environments.

The Nokia Data Center Fabric solution enables data center operators to rapidly design and deploy, easily adapt and integrate, and confidently operate and automate data center network fabrics at scale.

The solution leverages Nokia expertise in IP routing and network operations, the Nokia Service Router Operating System (SR OS), our IP network automation solutions, and our proven track record of building business-critical Ethernet and IP/MPLS networks for service providers, webscale companies and enterprises globally.

Figure 2. Nokia Fabric Services Platform and the Nokia Data Center Fabric solution



This document describes the Fabric Services Platform. For details about the Data Center Fabric solution, SR Linux and our portfolio of Data Center routers, see the “Learn more” section at the end of this document.

Nokia Fabric Services Platform architectural goals

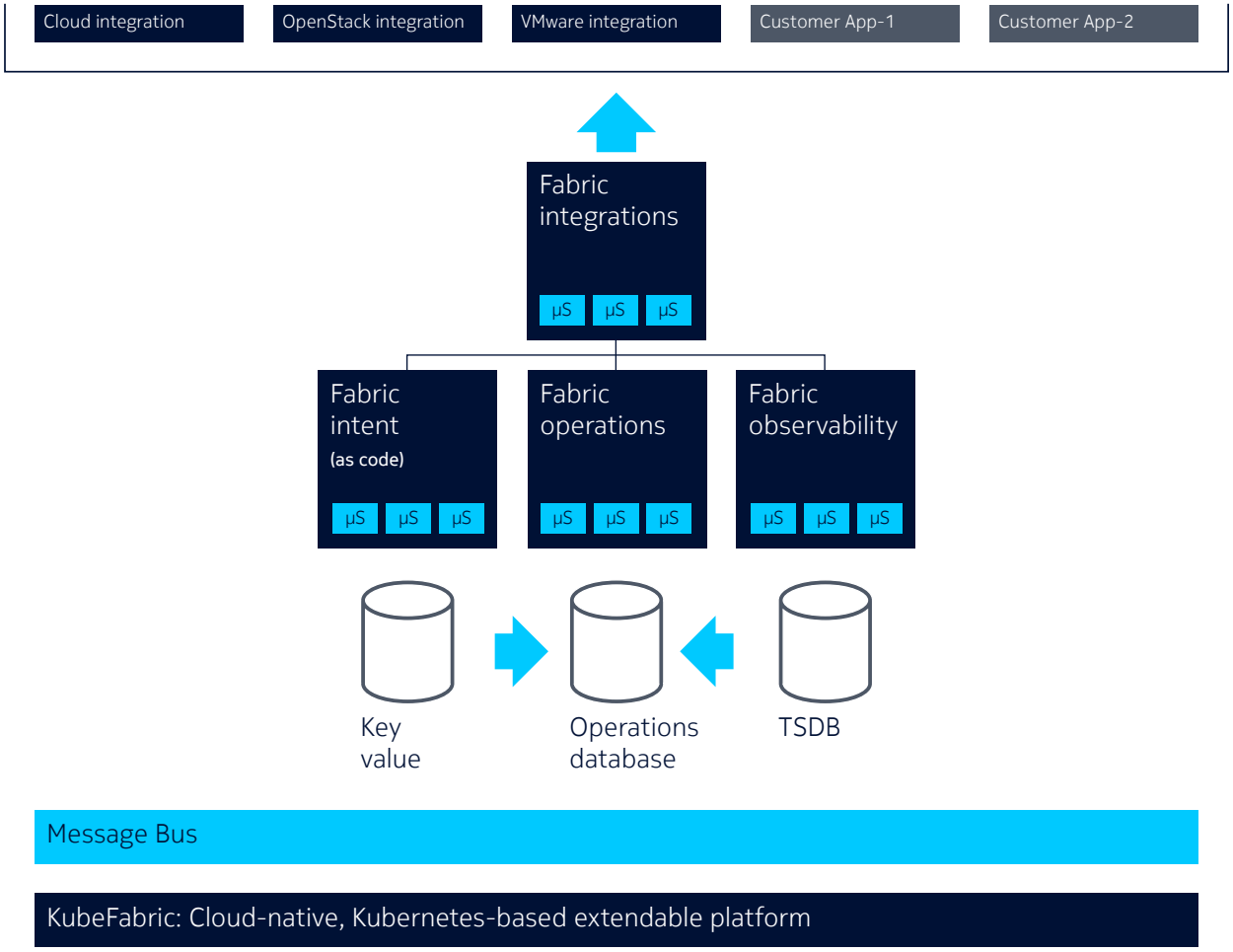
Data center operators want to simplify network designs using a standardized IP fabric while also providing customized solutions so their tenants can stay ahead in an increasingly competitive environment.

A fabric is a group of switches managed as a single logical unit. The ability to manage multiple switching elements as a logical unit has been the abstracted management model for decades. The line cards within a physical chassis are a good example of such an abstraction, which network vendors have been delivering via embedded platforms that include the hardware and operating system.

With the advent of software defined networking, the industry has experimented with separation of the management, control and data plane. For scalable and faster convergence in large-scale data center networks, the architectural approach that has gained industry momentum is a combination of distributed routing running on data center switches with the necessary network-wide control and automation functions implemented in an external controller. The Fabric Services Platform takes this modern architectural approach to deliver a scalable automation and operations toolkit rather than a traditional network management system.

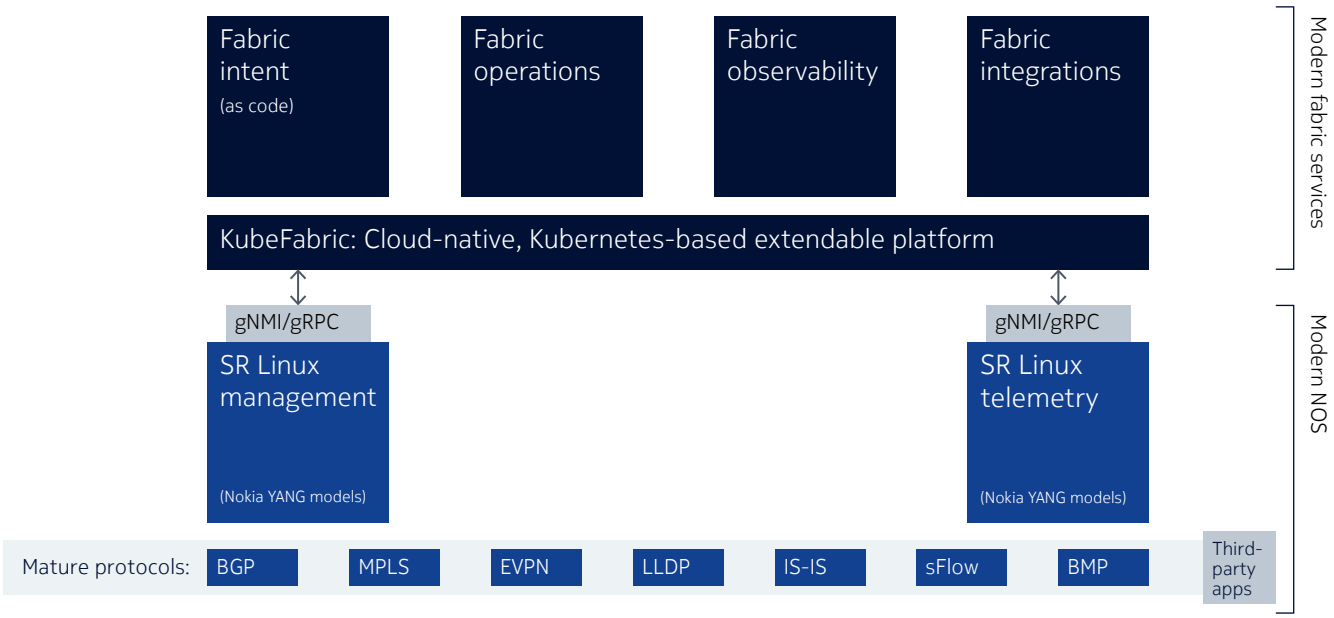
The Fabric Services Platform also takes a cloud-native approach to build a scalable and distributed automation and operations platform for data centers. It relies on a Kubernetes framework so there is no need to reinvent key platform components. Instead, Nokia uses the large set of community stabilized open components that are combined with our specific innovations to deliver a unique platform foundation called ”KubeFabric” (see Figure 3). All fabric services use a distributed microservices approach, allowing us to deliver a truly cloud-native automation and operations platform for data center and cloud environments.

Figure 3. Cloud-native Kubernetes foundation



The Fabric Services Platform’s declarative intent combined with the open management and telemetry of our model-driven SR Linux NOS (see Figure 4) enables declarative, intent-based life-cycle management of data center fabrics as well as operations at scale.

Figure 4. Fabric Services Platform complements open model-driven operating systems



Another key architectural goal for the Fabric Services Platform is that data center operations must be designed into the platform from the ground up. Traditionally, fabric operations have been considered an afterthought. However, with the advent of DevOps, fabric operations as the last mile within DevOps need to be designed for scalability and agility.

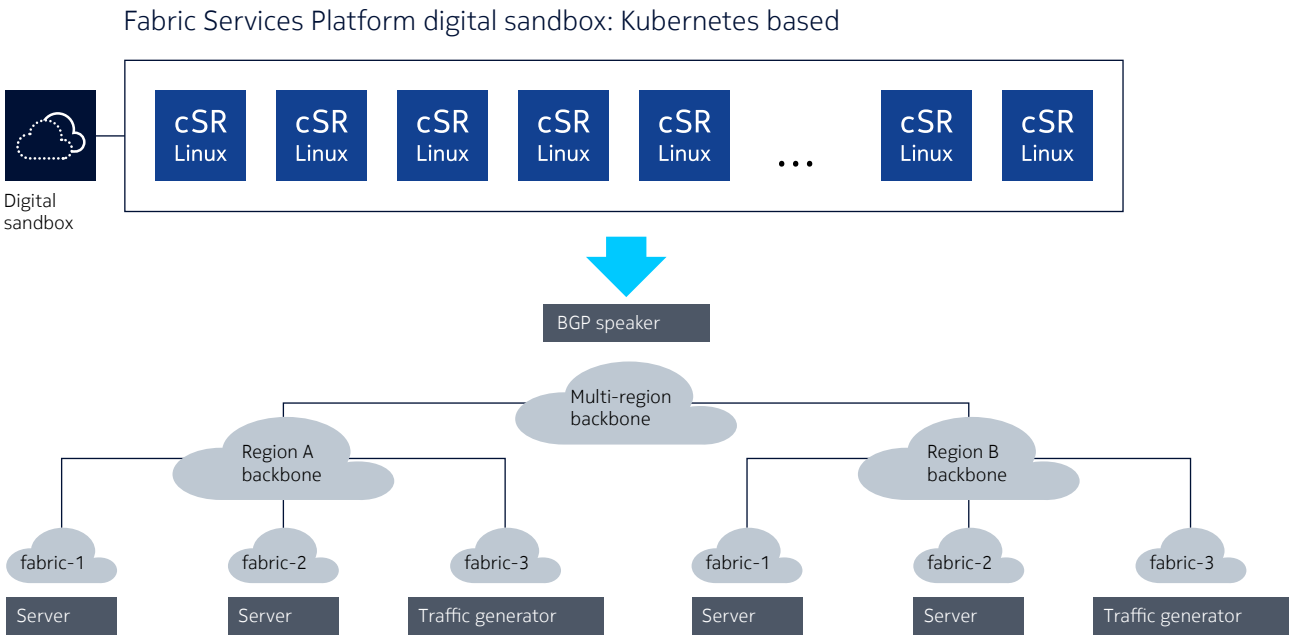
The operations team does not have the tools to be as fast as the development teams. In addition, security, compliance and auditing considerations tend to keep the infrastructure locked down (changes are restricted) or implementing changes is slow.

By contrast, modern data center fabrics require operations that are fast and scalable. Also, to deliver operations at scale for Day 0, Day 1 and Day 2+ of the life cycle, the four Fabric Services Platform pillars need to be designed from the ground up for interdependencies and cannot be an afterthought. The key requirement for modern data centers is the ability to make faster, periodic changes while still managing the risk of a change.

To enable this, the Fabric Services Platform delivers a cloud-native digital sandbox (see Figure 5) that is a true emulation of a single data center router as a containerized SR Linux instance along with a fabric of multiple containerized SR Linux instances. The Fabric Services Platform digital sandbox as an operational tool can emulate a data center fabric, application workloads and external Border Gateway Protocol (BGP) speakers.

The Fabric Services Platform integrates the cloud-native digital sandbox into all its workflows to provide design validation and change management flexibility, thereby reducing the risk of changes in a dynamic data center environment.

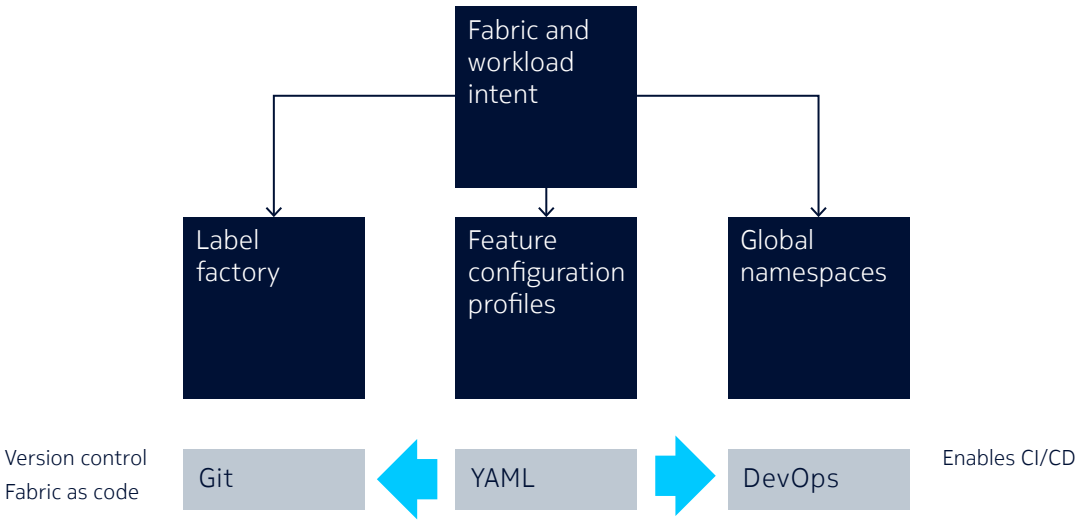
Figure 5. Fabric Services Platform digital sandbox



Fabric intent (as code)

The Nokia Fabric Services Platform is designed from the ground up to represent fabric as code (see Figure 6). We represent all the intent and configuration state of the data center fabric in a declarative way in YAML format; this lays a strong foundation for continuous integration/continuous deployment (CI/CD) of network infrastructure, thereby fitting into the bigger movement toward infrastructure as code.

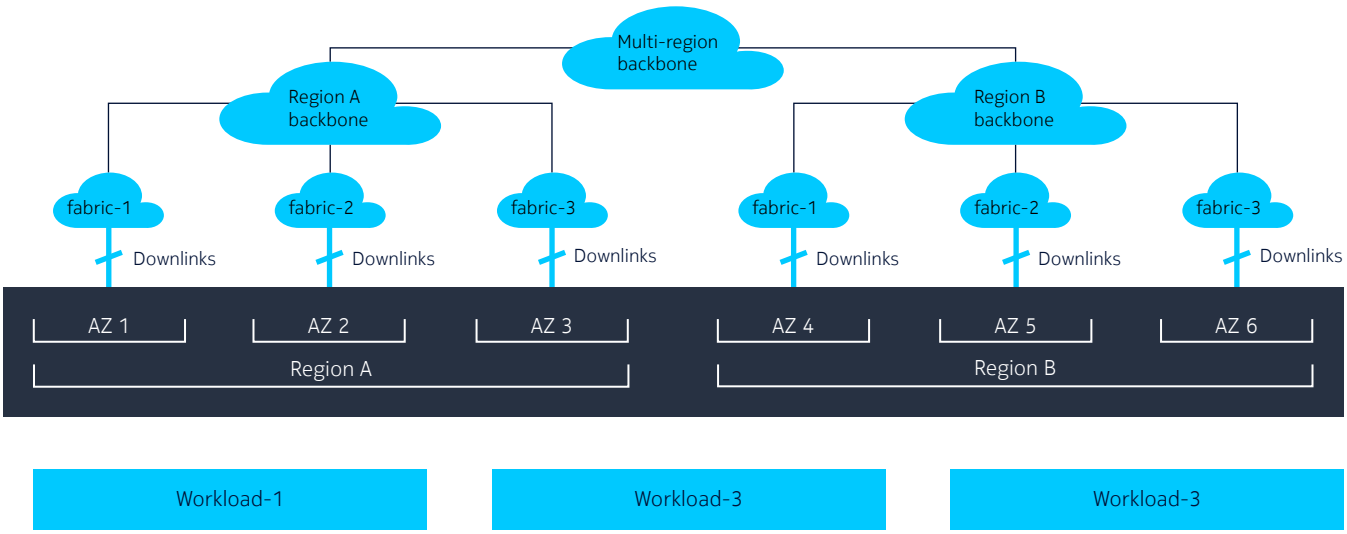
Figure 6. Fabric intent as code



Abstracted fabric and workload intent

The Fabric Services Platform intent infrastructure focuses on defining an abstracted intent to quickly build fabrics and enable application workloads (see Figure 7). The Fabric Services Platform uses the higher-level inputs from design teams to generate detailed per-node configurations to build BGP-based underlay fabrics and BGP EVPN-based application workload connectivity. In addition, the workload intent accommodates various QoS and security policies on a per-application workload.

Figure 7. Intent-based fabric design and workload connectivity



AZ = Availability Zone

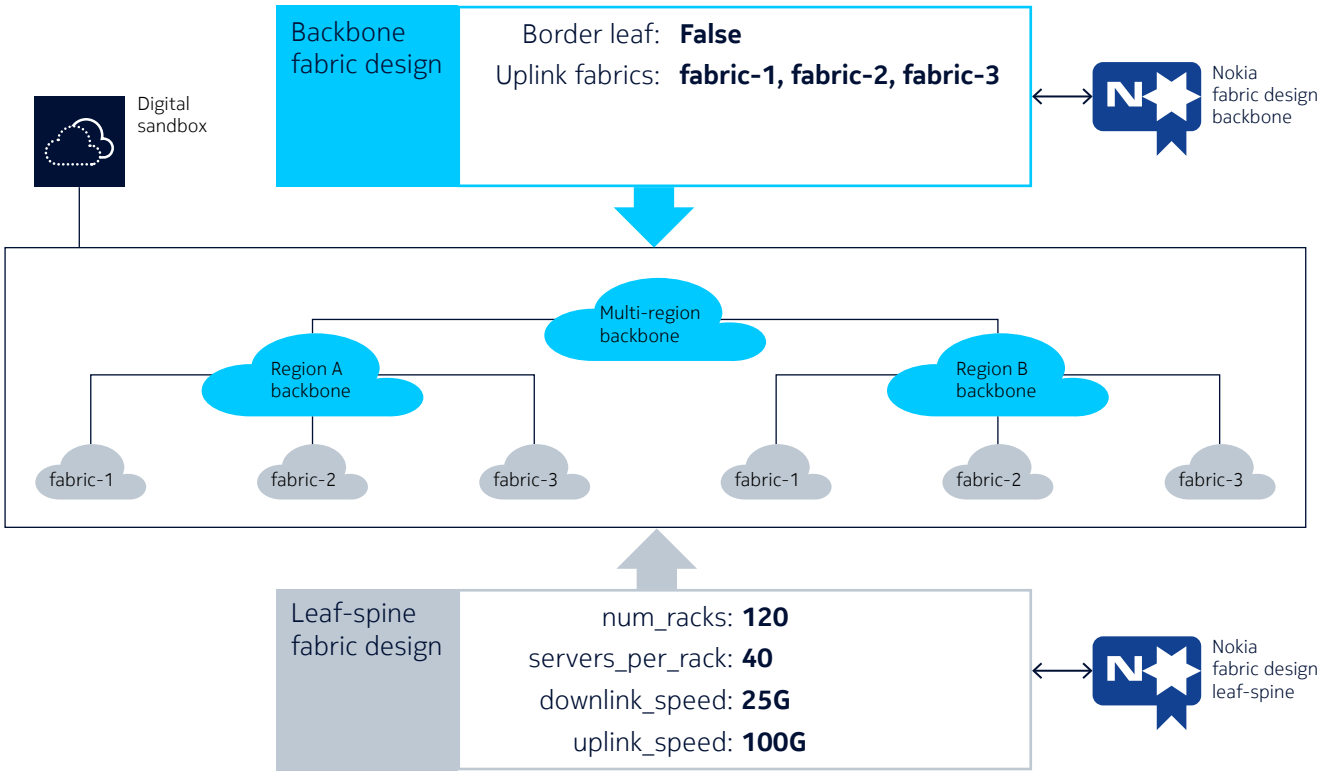
Fabric design intent (Day 0)

The Fabric Services Platform takes an abstract, intent-based approach and enables the data center operator to focus on high-level intent, which is to identify the minimal information needed to build data center fabrics; for example, the number of racks and the number of servers per rack. Using this information, the platform auto-generates the rest of the attributes, including detailed cable connections from Nokia design templates.

The fabric design intent enables a modular approach of building multiple leaf spine fabrics (see Figure 8) in a data center and connecting them using another fabric called a backbone fabric. This modular way of expressing fabric intent enables customization per fabric.

The Nokia design templates enable auto-generation of the configuration needed to build a standard BGP-based IP fabric. The configuration can also be customized—and so can all the attributes generated by the design templates.

Figure 8. Declarative fabric design intent



The Fabric Services Platform digital sandbox as an operations tool enables the abstract, intent-based fabric design and automations to be validated quickly and cost effectively with a single click.

Application workload intent

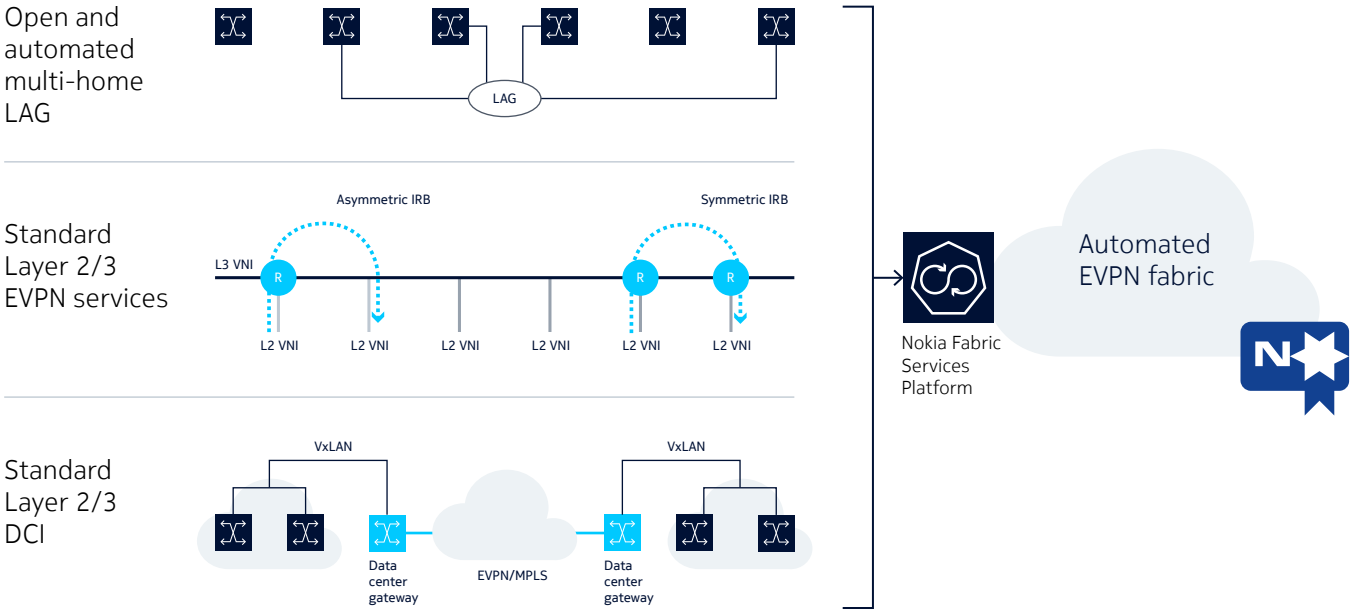
After the fabric is built, the next logical step for a data center operator is to onboard application workloads. Applications require Layer 2 or Layer 3 reachability across the data center fabric. The Nokia Data Center Fabric solution uses a standard and interoperable EVPN-based implementation to deliver multi-homed link aggregation group (LAG), Layer 2 or Layer 3 services within and across data centers for the east-west subnets.

Enabling BGP EVPN-based Layer 2/Layer 3 EVPNs in a data center fabric requires many variables to be configured. Although EVPN is a standardized protocol, it often takes an advanced skillset and significant effort to correctly configure EVPN for hundreds of workloads.

The Fabric Services Platform simplifies EVPN configuration by supporting an abstract intent-based approach. This approach enables the data center operator to focus on high-level intent, which is to identify the set of downlinks an application workload uses to connect to the fabric.

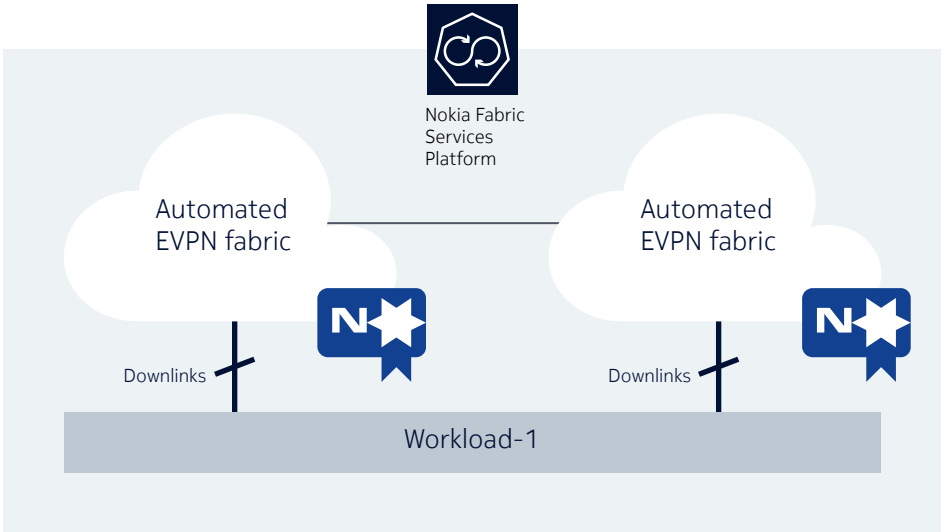
Complexities such as switch-to-switch EVPN and allocation of VXLAN network identifiers, route distinguishers, route targets, Ethernet segment IDs and Ethernet virtual interfaces are left to the Fabric Services Platform, which automates EVPN connectivity for application workloads (see Figure 9).

Figure 9. Fabric Services Platform application workload intent



The automated EVPN fabric exposes simplified Layer 2 and Layer 3 services described as a set of downlinks or sub-interfaces (see Figure 10).

Figure 10. Fabric Services Platform automated EVPN fabric



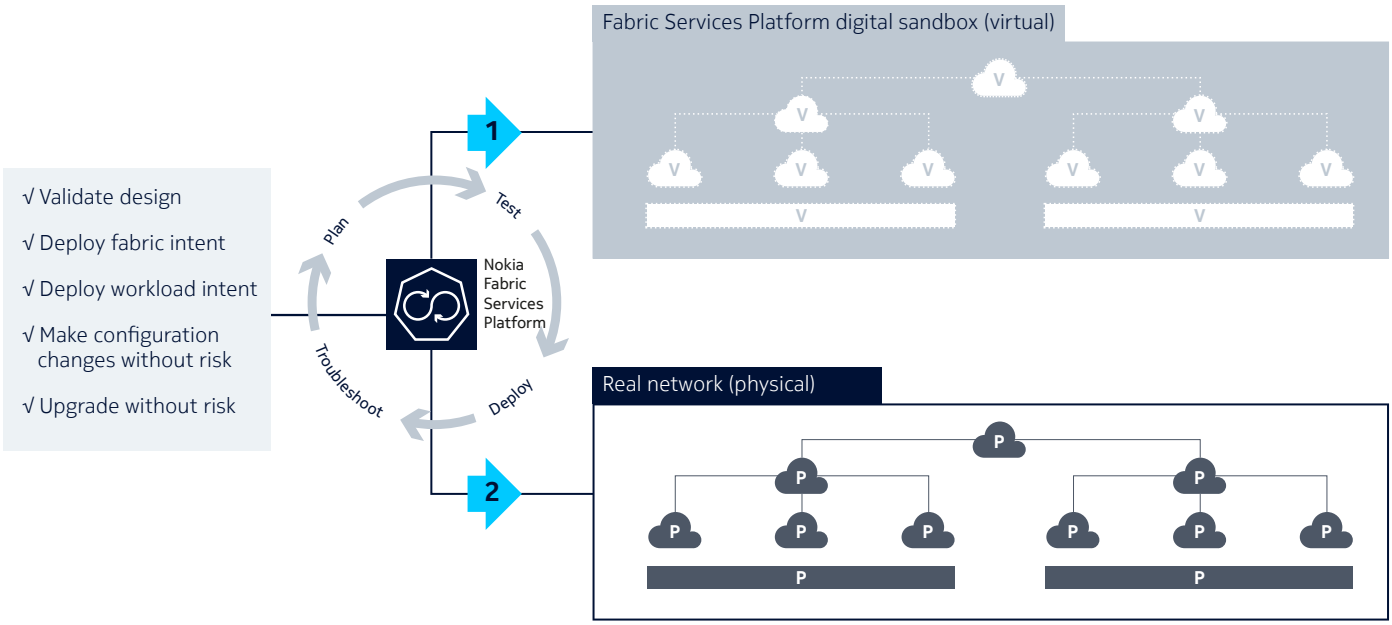
Both fabric design intent and workload intent can be validated by the Fabric Services Platform digital sandbox.

The amount of configuration change in data center networks is continuously increasing. Although data center fabrics are built once, onboarding new workloads and making policy changes for existing workloads is a constant and frequent task for data center operators. The operations team needs to mitigate the risk of making these changes.

The Fabric Services Platform digital sandbox allows the operator to first try out the planned changes on the virtual platform, where detailed validations can be performed. After validation, the operator can apply the changes to the physical production network.

Figure 11 highlights various change management operations that are enabled by the digital sandbox.

Figure 11. Mitigating risk of change with the digital sandbox



Intent-deviation alerts

A key requirement for data center operations is advanced auditing and alerts for intent deviations.

Because the fabric and workload intent trigger automated provisioning of various features on data center fabrics, they are continuously monitored to ensure that the fabric's current configuration and operational state is aligned with the desired state defined as intent in the Fabric Services Platform.

If the network configuration or state does not reflect the design defined by the intent, deviations are displayed visually for the user in an intent alert log.

Where deviation of configuration is expected or acceptable, such as for troubleshooting or during upgrades, the Fabric Services Platform supports alert snooze functionality, which stops notification of an alert for a certain amount of time.

The platform also allows the user to accept or reject the configuration on the switch as the new desired state.

Fabric observability

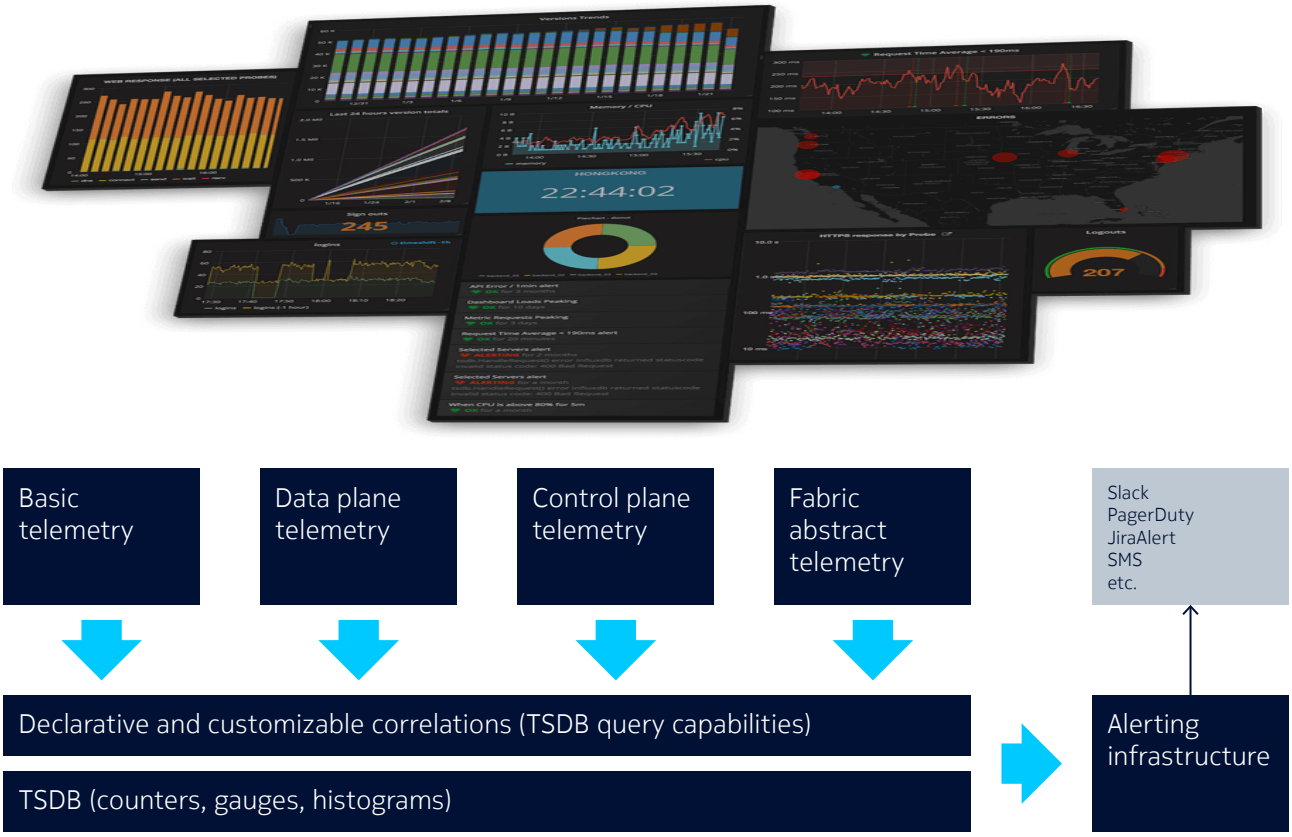
Fabric observability is achieved through a combination of telemetry and log data collected from the data center fabric to monitor and provide visibility into the east-west and north-south traffic. The Nokia Fabric Services Platform constantly receives network state and statistics as telemetry data via the SR Linux gNMI interface.

The Fabric Services Platform enables a cloud-native scale-out collector architecture to ensure that collection capabilities are highly distributed. It uses an open time series database (TSDB) that naturally fits into a cloud-native Kubernetes framework such as Prometheus.

Figure 12[1] shows the overall telemetry data, which is collected by the Fabric Services Platform and pushed into a TSDB as Nokia-defined metrics.

Based on the metrics collected, the Fabric Services Platform performs correlations to provide insights to the data center operator. In addition, the platform interfaces with a pluggable alerting infrastructure to alert the data center operator about useful alerts. The platform uses Grafana to render all the data collected and stored as various metrics in a TSDB and provides useful time series insights.

Figure 12. Fabric Services Platform observability telemetry architecture

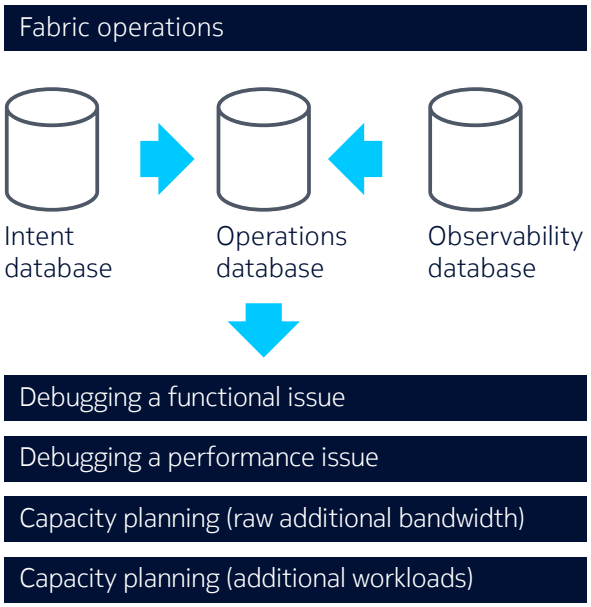


1 Source: Example visualization rendered using Grafana

Fabric operations

Fabric operations—the ability to combine design intent with all the telemetry data collected from the fabric and present the data in a context relevant to the operational task—is another key pillar of the Nokia Fabric Services Platform (see Figure 13). The platform takes an approach of contextual operational views that enable a user to quickly debug a functional or performance issue or perform an accurate capacity planning action.

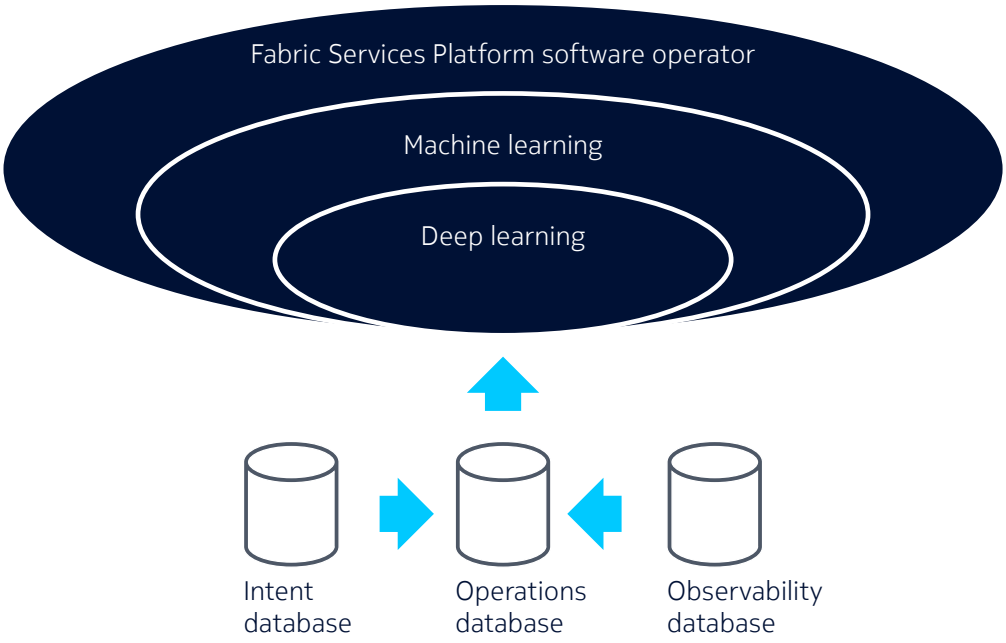
Figure 13. Fabric Services Platform fabric operations framework



These contextual views combined with the Fabric Services Platform digital sandbox enable the operations team to deliver agility with confidence and the remove barriers between cross-functional teams. The Fabric Services Platform uses open tools such as Grafana and Kibana to render and display useful metrics and logs. The platform also has very customized screens to display the combination of configuration and telemetry data.

It is difficult for a human operator to observe and process multi-dimensional insights because the huge amount of data collected and presented in raw form limits how much a human operator can analyze. The operations database enables a human operator and also feeds the multi-dimensional data to the Fabric Services Platform software operator, which uses various machine learning techniques to perform baselining, anomaly detection and predictive analytics (see Figure 14).

Figure 14. Fabric Services Platform advanced insights and analytics with machine learning

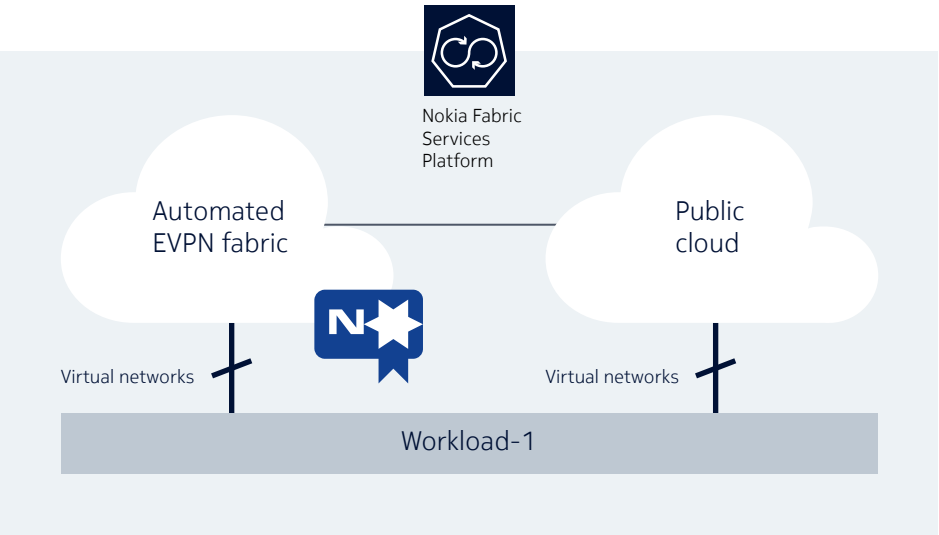


Fabric integrations

The Nokia Fabric Services Platform uses a flexible, cloud-native approach for integration in customer environments, resulting in faster, customized integration. The platform can be tightly integrated with compute virtualization solutions such as VMware vSphere or a Kubernetes cluster deployment. The platform can also be integrated with a software defined storage solution or with in-house operational tools such as ServiceNow and PagerDuty.

With the growing adoption of hybrid clouds, a key Fabric Services Platform use case is integration into a cloud environment. The platform enables hybrid workload intent to be applied through policy translation to application workloads running in the cloud and on-premises. In this way, the platform delivers consistent policies across a hybrid cloud deployment (see Figure 15).

Figure 15. Consistent policy across cloud environments with Fabric Services Platform integrations



In addition, firewalls and load balancer services can be enabled via policies modeled through Fabric Services Platform workload intent. The platform supports tight integrations with vendors' firewall and load balancer via northbound application programming interfaces (APIs). This capability enables an automated data center for well-known services.

The cloud-native integration model using the Kubernetes framework and the Fabric Services Platform's open-API-compliant declarative REST APIs enables data center teams to develop their integrations in a loosely coupled fashion.

Summary

As the demands on data center networks continue to drive openness and efficiency, the Nokia Data Center Fabric solution, which includes the Nokia SR Linux NOS, the Nokia Fabric Services Platform and the Nokia Data Center routers, is ready to meet the challenge.

The Fabric Services Platform delivers abstract intent where automation and simplification is needed while also delivering detailed insights by monitoring every aspect of a fabric. This combination of abstract intent-based automations and detailed visibility allows the data center operator to perform Day 0 design, Day 1 deployment, and Day 2+ configuration, operation, measurement and analysis of a data center fabric.

Learn more

To learn more about the Nokia Data Center Fabric solution:

- Visit the Nokia Data Center Fabric solution web page
- See the Nokia Data Center Fabric solution eBook
- Read the Nokia Service Router Linux product description

Read the data sheets:

- Nokia Service Router Linux
- Nokia 7250 IXR-10/IXR-6 Interconnect routers for SR Linux
- Nokia 7220 IXR-D series Interconnect routers for SR Linux

Abbreviations

API	application programming interface
BGP	Border Gateway Protocol
BMP	BGP Monitoring Protocol
CD	continuous deployment
CI	continuous integration
CLI	command line interface
cSR Linux	containerized Service Router Linux
DCI	Data Center Interconnect
DevOps	development and operations
EVPN	Ethernet VPN
gNMI	gRPC Network Management Interface
gRPC	generalized Remote Procedure Call
IP	Internet Protocol
IS-IS	Intermediate System to Intermediate System
LAG	link aggregation
LLDP	Link Layer Discovery Protocol
ML	machine learning
MPLS	multiprotocol label switching
NDK	NetOps Development Kit
NetOps	network operations
NOS	network operating system
SMS	short message service
SR OS	Nokia Service Router Operating System
TSDB	time series database
VM	virtual machine
YAML	YAML Ain't Markup Language (data serialization language)

Nokia Oyj
Karakaari 7
FI-02610 Espoo, Finland
Tel. +358 (0) 10 44 88 000

Document code: SR2007045885EN (August) CID207605