NOKIA

Creating new data freedom with the Shared Data Layer

Helping operators to realize the full business potential of their core network data

White Paper

NOKIA

Contents

1. Executive Summary: Simplified core architecture for a new connectivity age

Within a few years, networks running 5G technology will be offering a vast variety of connectivity services to people, organizations, industries and machines, all with widely differing needs. These networks will connect everything, from smart home devices to self-driving cars and industrial robots. This will open new opportunities for operators to win business in other, vertical sectors through fixed-mobile integration, digital content and the Internet of Things (IoT).

Markets will develop rapidly. Operators will need to be able to respond quickly to adapt their networks and businesses to new trends and service needs. Services with development and deployment times measured in months will no longer be viable. Networks must be able to support the roll out of services in days or even hours – matching and surpassing the IT industry's best practices.

Networks must be able to efficiently support radically different and more complex business models to enable the operator to swiftly change from competing with OTT players to partnering with them and sharing their success – and revenues.

Core networks have changed dramatically in recent years, becoming cloud based with virtualization technology transforming conventional servers, functions and entire networks. This has brought significant benefits to operators in the shape of greater flexibility and lower costs. Yet, if increasingly diverse demands are to be supported, further core network transformation will be needed.

By storing all data, including subscriber and session data, in a separate Shared Data Layer (SDL), cloud-based virtualized network function (VNF) machines can become stateless. This means the VNFs no longer need to manage their own data and will run only the required service business logic, making them easier and faster to develop. Stateless VNFs substantially simplify networks by moving network functions to a generic layer, making the architecture far more flexible.

Simplifying the core network in this way will bring many benefits to operators.

They will be able to innovate faster, matching OTT innovation cycles, coupled with telco grade reliability as a key differentiator. An open ecosystem around the core network will allow greater flexibility for third party services to use operator infrastructure. Operators will enjoy potentially unlimited scale and elasticity to meet the needs of the largest next generation converged networks. And all this will come with substantially lower Total Cost of Ownership (TCO).

With the Shared Data Layer at its heart, the new cloud-native core network will give operators flexibility to ensure sustainable business in a rapidly changing world and gain from the increased demand for high performance connectivity.

2. Core networks must continue to evolve

Core networks have conventionally been based on standard 3GPP architecture with self-contained network elements that handle specific functions or services. Each network element stores and processes the subscriber and service data it needs to perform its function. New elements need to be added to meet growing subscriber numbers and demand, and to support new services and functions.

This hierarchical and distributed architecture successfully met operator needs for many years. However, as communications services became more numerous and more sophisticated, these networks inevitably grew increasingly complex with intricate data transfer and signaling flows between the network elements. Scaling up such a network to meet rapidly rising demand is difficult, time-consuming and uses costly dedicated hardware.

Furthermore, the need to allocate subscribers and their service profiles to dedicated network elements means limited flexibility for operators to meet new demands. Traditionally, core networks could only be expanded by individually scaling up each network element, which added complexity and restricted the level of optimization possible.

Recently, the rise of the telco cloud has tackled some of these issues. Network elements are being replaced by Virtualized Network Functions (VNFs) in the form of software running on cost-effective, readily-available standard server hardware. Operators are better able to cope with unpredictable data growth with their pool of resources. Application capacity can be automated by rapid shifting processing to where it is needed to match service demand. Capacity can be shared across the network, even straddling geographical borders and time zones. In addition, the time needed to install and commission a new service can be shortened from weeks to minutes, enabling operators to launch services quickly to take early advantage of rising market trends.

Another development has been the centralization and consolidation of subscriber data. This has led to more efficient Subscriber Data Management (SDM) solutions and enabled the integration of third party applications on top of a highly available subscriber database.

Looking ahead, 5G will usher in a new era of extreme broadband, ultra-robust, low latency connectivity and massive networking for people and the IoT. 5G networks will support a much wider range of use cases compared to today's networks that primarily deliver high speed fixed and mobile broadband. In addition, core networks will need to cope efficiently with the growing complexity of heterogeneous networks (HetNets) comprising multiple access technologies and ultra-dense cellular populations. Yet not all network capabilities are needed by all the different use cases at the same time, so the core network must be

flexible and scalable on demand.

Meeting these challenges will require further evolution of the core network beyond virtualizing network functions. New and simplified core network architecture will be necessary to achieve the cost efficiency and flexibility needed by operators.

3. Separating data storage from processing

The key evolutionary step to simplify core networks is to optimize VNF machines for the cloud by making them stateless and moving all data into a new Shared Data Layer. Such a data-centric network will be more robust, enable massive scaling, have much reduced signaling traffic and be easier to manage.

3GPP standardization is also evolving in this direction, for example by introducing a Data Storage Function (DSF) as a new element in the 5G core network.

This new architecture splits the data storage from the service logic to introduce a fully virtualized, distributed, highly available and strongly secured Shared Data Layer. It will store and make available all the data required by all the VNFs including subscription data, policy data, charging data and session data, which includes VNF state information. The data held by the Shared Data Layer will be accessible by the network's family of VNFs via industry standard protocols.

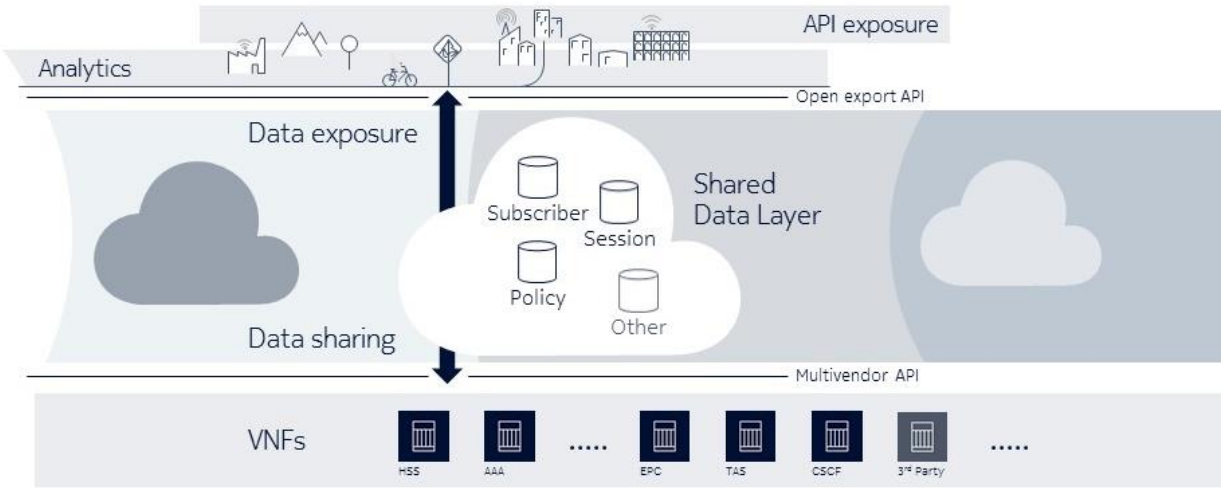

Figure 1: The role of the Shared Data Layer: A shift towards a data centric network architecture

Consolidating all data into one layer also makes it easily available through standard northbound interfaces to data analytics and third-party applications.

The new architecture introduces a generic and efficient data handling mechanism to replace the different application-specific solutions currently in use, eliminating much complexity in conventional core networks. Fewer points of integration are needed, less

data needs to be routed around the network, data duplication is eliminated and signaling is reduced by avoiding the need to transfer subscribers and sessions between network elements.

With simplified software architecture, stateless VNFs are less complex and easier to manage than conventional VNFs. Furthermore, should one VNF fail or suffer a problem, another VNF can be activated and immediately access the same data held in the Shared Data Layer to maintain seamless service continuity.

The Shared Data Layer also provides common information on the capabilities of the network to the various running services and can even update these in real time according to their actual status and utilization. QoS data is easily available to the VNFs without them needing to retrieve and manage such information. Not only does this reduce the required data storage capacity, but it also helps to avoid data errors, inconsistencies and duplication.

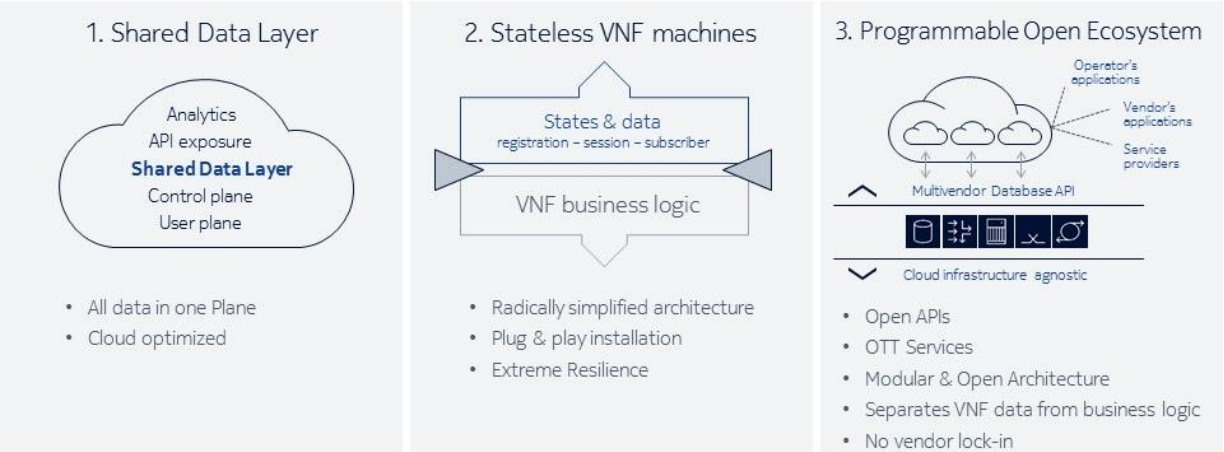

Figure 2.: The new cloud-native core network architecture comprises stateless VNFs that access all the required data held in a separate layer. This data is also made available to other applications and services through an open ecosystem.

4. More flexibility, fewer costs

The advantages for operators of the Shared Data Layer core network architecture fall into three broad areas:

- New business and revenue opportunities
- Greater business agility
- Lower Total Cost of Ownership (TCO)

4.1 New business and revenue opportunities

Mobile operators are in a strong position to work with other players by building an open ecosystem around their networks that enable seamless integration with third-party services and applications. The Shared Data Layer allows data to be exchanged between services and applications while ensuring security and data privacy. New business opportunities for operators, such as subscription and identity management in mobile IT services, are supported by the Shared Data Layer.

The ecosystem with open APIs enables flexible service control, integration and optimization across different service verticals like IoT and interworking with social media. Combined with analytics that can access the telco data via northbound interfaces, this integration creates a powerful monetization opportunity for operators by enabling new service verticals with access to network data.

The Shared Data Layer will provide the infrastructure to support data analytics safely and efficiently to provide better insight into customer usage patterns and preferences. This will allow much more detailed and accurate customization of offers to help grow revenue.

Common data management infrastructure for network entities benefits analytics applications by improving their accuracy and efficiency. Better insight into customer usage patterns and preferences allows more detailed and accurate customization of offers to help grow revenue. Applying big data analytics and AI algorithms to understand and predict user and network behavior can help operators gain a new competitive advantage.

In addition, Self-Organizing Network (SON) applications can use the same interfaces to access network data. This enables connectivity to be optimized to increase the quality of experience and reduce churn.

4.2 Greater business agility

Transforming radio and core networks to the telco cloud will enable operators to adapt their networks and businesses rapidly to market trends and to support widely differing needs.

A core network with a Shared Data Layer enables operators to introduce innovative services and achieve revenue more quickly. Innovation cycles can be as rapid as those run by Internet players, but with the key differentiator of telco grade reliability. Stateless VNFs can be created rapidly and their simplicity means less coding and debugging is needed.

The new core architecture also takes full advantage of cloud technologies, enabling capacity to be scaled in or out elastically as demand fluctuates. There is effectively no upper limit on how much capacity can be added, enabling operators to cater for even the largest next generation converged networks.

New software features can be implemented faster and updates deployed automatically to ensure the operator is using the most advanced software, which also creates a competitive advantage by offering the latest services and features to subscribers.

4.3 Lower Total Cost of Ownership (TCO)

By adopting tiered core network architecture, operators can focus their capital investments where they will bring the greatest benefit. Separate business logic and data storage layers have different hardware characteristics and software license deployments which can be scaled independently, making more efficient use of investment budgets.

The Shared Data Layer is key, enabling data to be shared and used by different services and functions. For example, while mobile edge computing relies on the VNF business logic being deployed close to the end user to minimize latency, a significant amount of the data can be obtained from the shared layer.

In addition, network simplification and less signaling result in reduced traffic, less CPU load, lower power consumption, improved network and application reliability and higher QoE, all of which help to reduce TCO.

5. Nokia Shared Data Layer development

Nokia is a prominent vendor in core networks with a strong leadership position in Subscriber Data Management (SDM). This foundation has enabled Nokia to develop an overall Shared Data Layer concept that supports the cloud-native core. The Nokia Shared Data Layer vision is to create information infrastructure engineered for the next generation cloud-based core network. Nokia's use of open control plane and data access APIs, standards and data models provides operators with the freedom to choose products from a wide range of vendors that best suit their needs.

Nokia Shared Data Layer is part of an end-to-end cloud-based ecosystem and offers a wide range of capabilities:

Data resiliency: Real-time data availability and reduced signaling

Flexibility: Unified data privacy, unified approach to security, data zoning and data sharing

SLA-based service: High availability of data, simple automated operation and capacity usage/prediction

Multivendor interface: Common cloud storage, seamless Integration and reduced time to market

Real-time, low latency: Ready for session data and subscriber data with proven, real-time geo-redundancy robustness

VNF efficiency and scalability: Simplified VNF operations, simplified VNF scalability, faster time to market and reduced signaling

Nokia is a leading contributor to 3GPP 5G standardization for service based architecture, with the Shared Data Layer being a key enabler. Nokia also participates in the definition of the Network Exposure Function (NEF) to support the benefits of sharing data between different services and exposing data for third party applications.

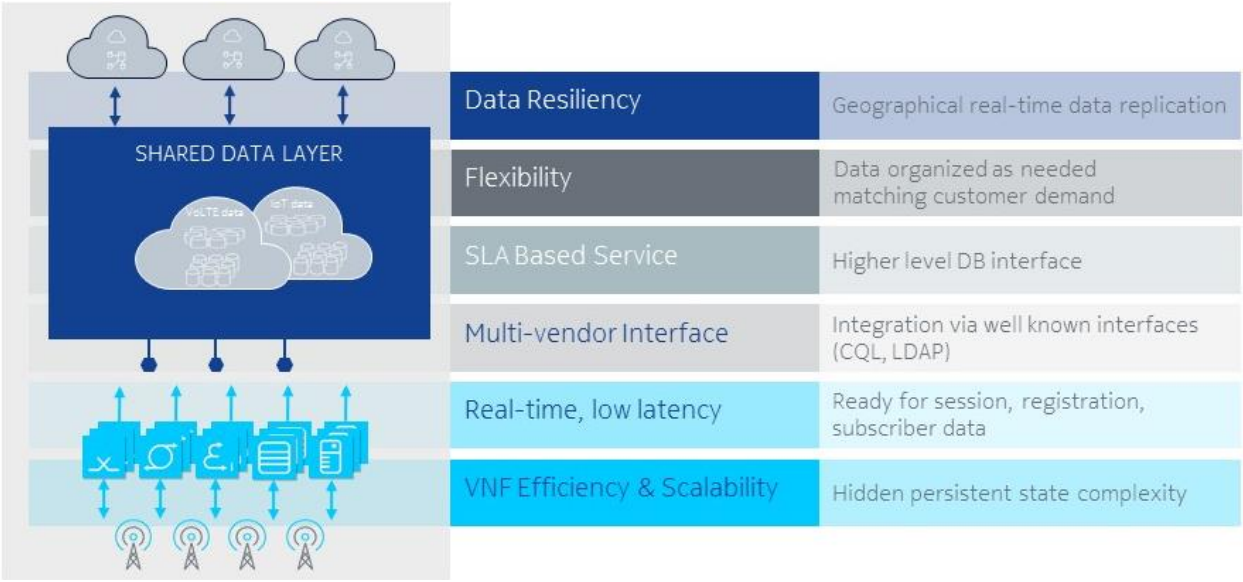

Figure 3.: Nokia Shared Data Layer provides a range of capabilities

5.1 Protecting the data

Protecting their customers' data is vitally import for operators. While the Shared Data Layer implements many security functions, such as authentication functions, further security functions must be performed by dedicated security VNFs or security management services. These functions include traffic filtering, access control, encryption, DoS protection, analytics and orchestration.

Nokia security experts help operators to define and implement tailored security safeguards that cost-effectively provide all the cloud Shared Data Layer benefits of flexibility, mobility, scalability and automation. The security architecture supports defense layers, security zones and security functions, while Nokia´s security orchestration, analytics and response technologies gather and analyze data to enable faster, (semi-) automated responses.

Nokia reference architecture defines the Nokia Telco Cloud perimeter security, host hardening, VNF security architecture, security orchestration, security analytics and data security used in Nokia telco cloud. Nokia's long experience in security, both for telco- and IT-technology, and its participation in security standardization enable it to guide operators through the full life-cycle of security, from customization to operations.

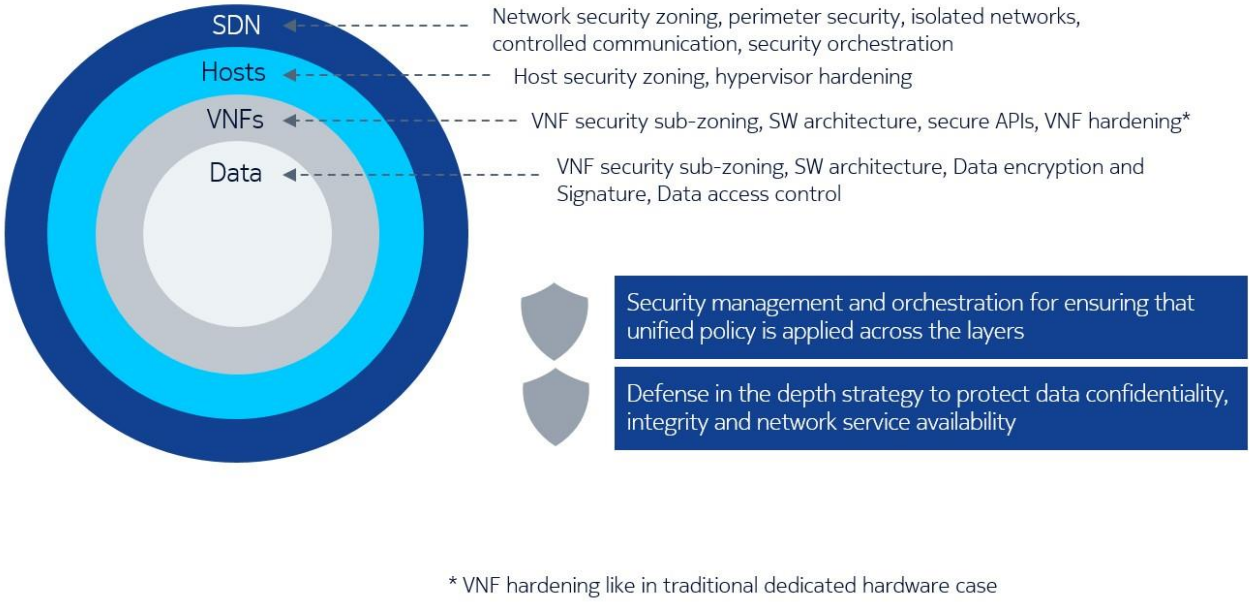

Figure 4.: Reference Architecture for Telco Cloud Security – layers of defense

5.2 Building an ecosystem around shared data

The Shared Data Layer is the foundation for the development of innovative services that make use of network data. Being cloud-based, it supports the rapid development and deployment of new capabilities and services typical of the IT world, while also maintaining the high security and data protection standards of the telco world.

Applications can focus on the business logic, leaving the Shared Data Layer to take care of complex distribution, resiliency, scaling, upgrade and migration issues. Applications can also “cooperate” by securely sharing data.

Development kits, toolsets and a verification environment are available on the Nokia API developer portal (developer.nokia.com).

Nokia is also building a community that brings potential partners together (Open Ecosystem Network –www.open-ecosystem.org) and encourages communication between the operator, application developers and VNF vendors to add value to the operators’ network.

6. Conclusions

Technological advances in IT are helping to transform the telco industry. Powerful centralized data centers based on low cost hardware and fast networking are creating new ways for the telco industry to transform networks.

Nokia is using all these technological advances to evolve its market-leading SDM solution

and create an innovative 5G-supporting cloud solution that goes beyond simply rebuilding current network architecture in the cloud.

The vision of the Shared Data Layer is to create an information infrastructure engineered for the next generation cloud-based core network. Using its expertise as the leading SDM vendor and long experience of the telco cloud, Nokia has built its Shared Data Layer with four key goals in mind:

- To enable operators to innovate faster, run rapid innovation cycles and offer telco grade reliability as a key differentiator
- To foster ecosystem development to enable third party services to use operator infrastructure, while ensuring security and data privacy
- To support massive (potentially unlimited) scale and elasticity to meet the demands of next generation converged networks
- To offer best-in-class Total Cost of Ownership (TCO) with serviceability and operability as key design considerations.

As a central component of the cloud-native core network, the Nokia Shared Data Layer represents a substantial advance in network capability that will create new value for operators globally.

Abbreviations

3GPP	3rd Generation Partnership Project
5G	Fifth Generation
AI	Artificial Intelligence
API	Application Programming Interface
CQL	Cassandra Query Language
CPU	Central Processing Unit
DoS	Denial of Service
DSF	Data Storage Function
HetNets	Heterogenous Networks
IoT	Internet of Things
LDAP	Lightweight Directory Access Protocol
NEF	Network Exposure Function
OTT	Over The Top
QoE	Quality of Experience
QoS	Quality of Service
SDL	Shared Data Layer
SDM	Subscriber Data Management
SLA	Service Level Agreement
SON	Self-Organizing Network
TCO	Total Cost of Ownership
VNF	Virtualized Network Function

Further reading

White paper: Building a cloud-native core for a 5G world

Webpage: Nokia Shared Data Layer

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