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Creating new data freedom with the Shared Data Layer

Helping CSPs realize the full business potential of their core network data

White paper

5G technology requires significant changes in the core network, predominantly the introduction of virtual network functions (VNFs) running on service-based architecture within the telco cloud. The Shared Data Layer is the cornerstone of this move to consolidate subscriber and session data within a highly reliable and scalable repository. Separating data from processing boosts business agility, making it easier to explore new services and revenue opportunities, many based on third-party cloud applications. The Shared Data Layer also simplifies the network architecture, thereby reducing TCO. Implementing the Shared Data Layer should be achieved with minimal user disruption.

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Executive summary: Simplified core architecture for a new connectivity age

Networks running 5G technology will soon be offering a 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 communications service providers (CSPs) to win business in other, vertical sectors through fixed-mobile integration, digital content and the Internet of Things (IoT).

Markets will develop rapidly. CSPs 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 CSP 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 to become cloud-based. Virtualization technology is transforming conventional servers, functions and entire networks. This has brought significant benefits to CSPs 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 CSPs.

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 CSP infrastructure. CSPs 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 CSPs flexibility to ensure sustainable business in a rapidly changing world and gain from the increased demand for high performance connectivity.

Core networks evolution to 5G

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 CSP 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 CSPs to meet new demands.

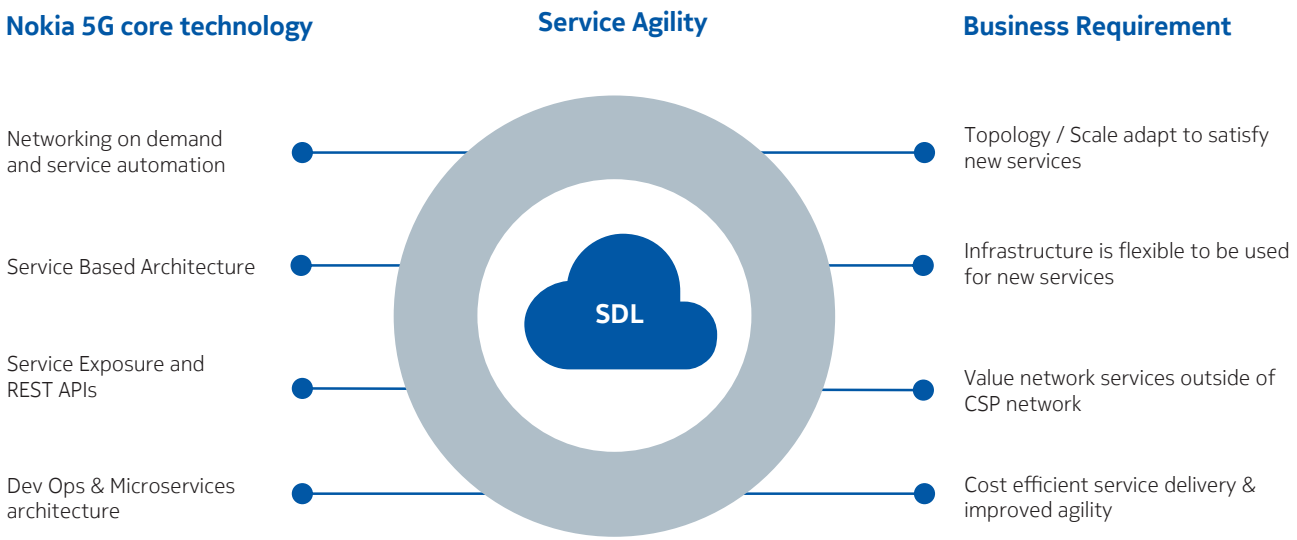
Traditionally, core networks could only be expanded by individually scaling up each network element, which added complexity and restricted the level of optimization possible. Recently, the rise of the telco cloud has tackled some of these issues. Network elements are being replaced by Virtualized Network Functions (VNFs) in the form of software running on cost-effective, readily-available standard server hardware. CSPs 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 CSPs 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, the imminent arrival of 5G is ushering 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, which primarily deliver high-speed fixed and mobile broadband. While consumers remain an essential part of the CSP business model, 5G will shift the focus towards vertical industries.

To support these new business opportunities, CSPs will need to compose and organize their network according to the different types of customer and their demands. In this context, service agility and the programmability of the network (as illustrated in Figure 1) will be even more important than it is when serving traditional consumers.

Figure 1. Service agility is required for a programable network separating data storage from processing



Serving different vertical industries typically demands dedicated network resources (i.e. network slices) and needs a database service layer that flexibly meets deployment requirements with application-defined redundancy models. These business needs can be supported by end-to-end service automation, using open APIs to orchestrate and configure network functions.

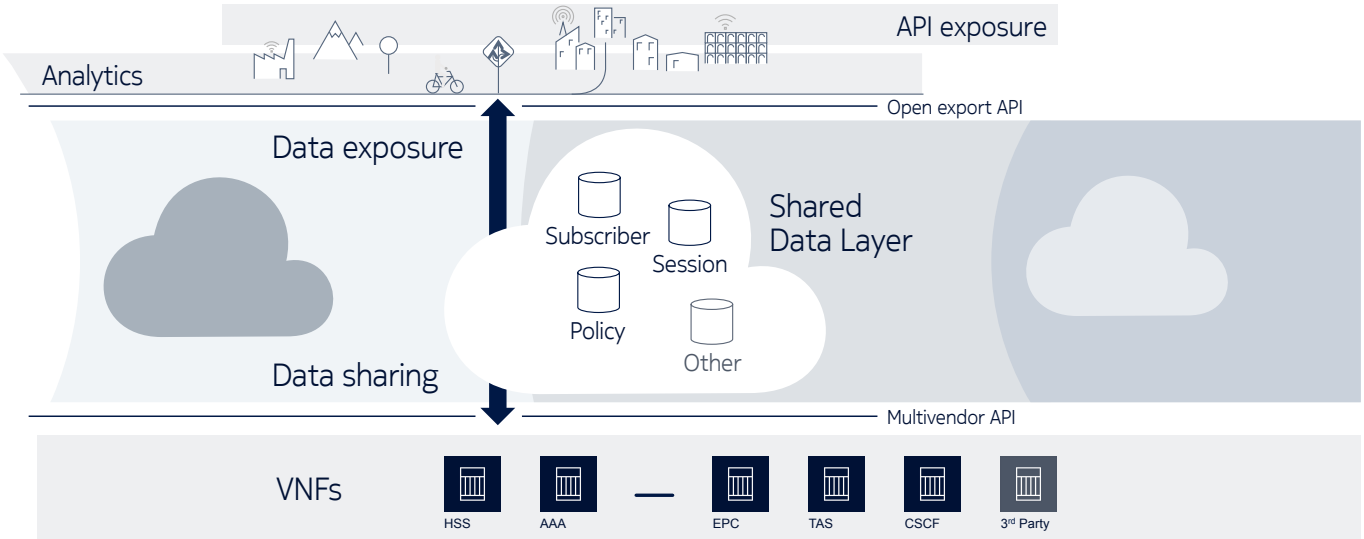
5G has adopted service-based architecture as a key design principle for a cloud-native core network. This provides great flexibility since it removes dependencies between the different network functions. It means that services are clearly defined and can be served by network functions without imposing any specific network organization. This flexibility provides agility and makes it easier to provide new services.

DevOps and micro-service architecture are key attributes of cloud-native network functions, enabling scale, efficient delivery and fast time to market. This enables CSPs to adapt rapidly and cost effectively to new opportunities as they arise. Micro-services-based design is now commonly used in industry, and its adoption in the telco sphere is gaining momentum for its speedy and efficient evolution of the core network.

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 2. The role of the Shared Data Layer: A shift towards a data-centric network architecture

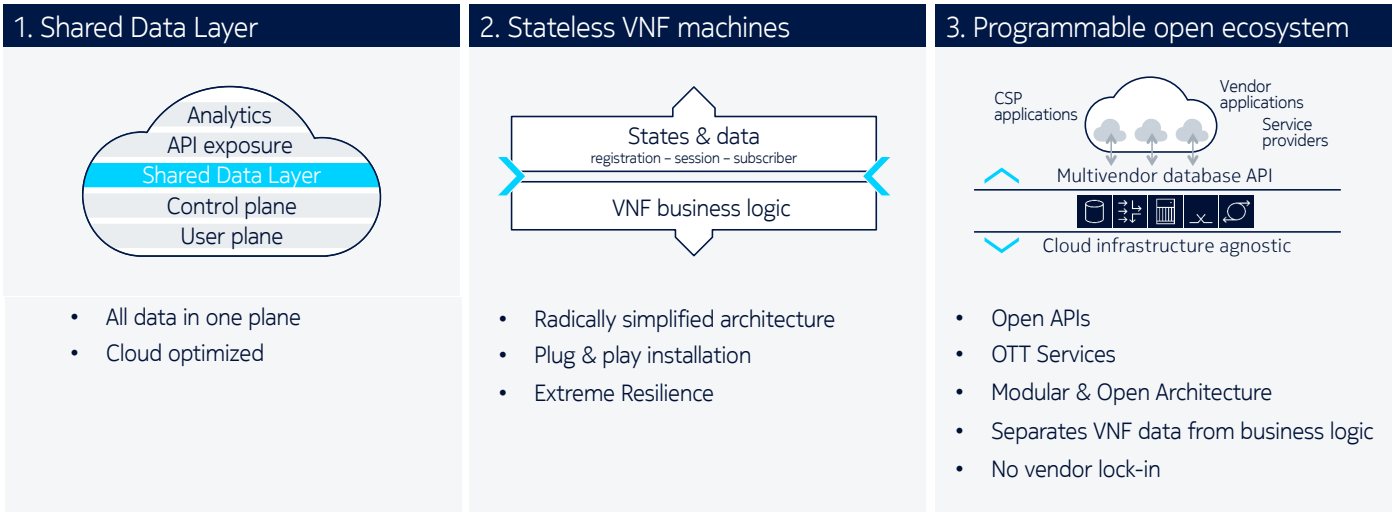


Consolidating all the data into one layer also makes it easily available through standard interfaces to data analytics and third-party applications.

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 3. Cloud-native core network architecture comprises stateless VNFs that access the required data held in a separate layer. This data is also made available to other applications and services through an open ecosystem



More flexibility, fewer costs

The advantages for CSPs 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)

New business and revenue opportunities

Mobile CSPs 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 CSPs, 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 CSPs 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 CSPs gain a new competitive advantage.

Greater business agility

Transforming radio and core networks to the telco cloud will enable CSPs 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 CSPs 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 CSPs to cater for even the largest next generation converged networks.

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

Lower Total Cost of Ownership (TCO)

By adopting tiered core network architecture, CSPs 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.

Shared Data Layer development

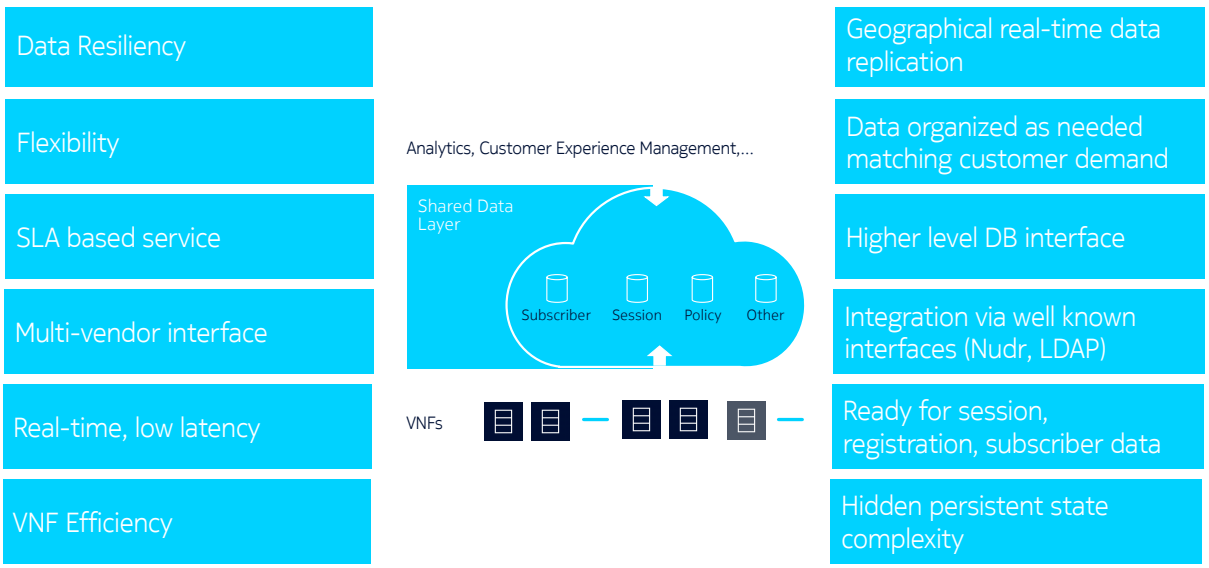
Nokia is a prominent vendor in core networks with a strong position in Subscriber Data Management (SDM). This foundation has enabled Nokia to develop an overall Shared Data Layer concept that supports the cloud-native core. The Nokia Shared Data Layer provides an information infrastructure engineered for the cloud-based core network. Nokia's use of open control plane and data access APIs, standards and data models provides CSPs 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 4. Nokia Shared Data Layer provides a range of capabilities



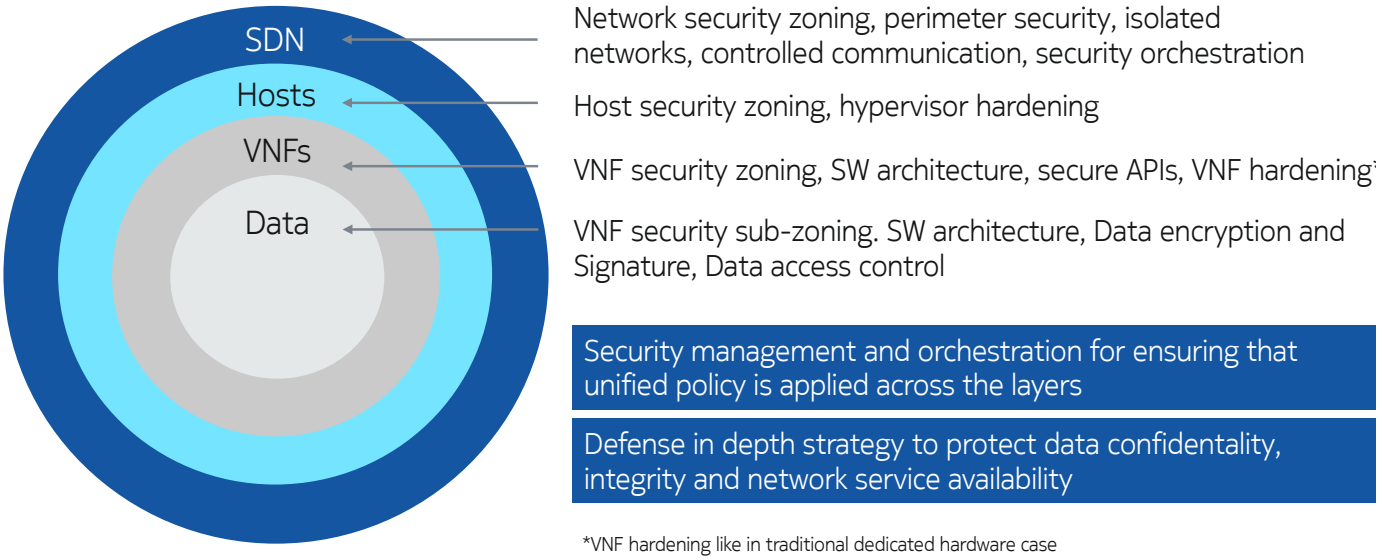
Protecting the data

Protecting their customers' data is vitally important for CSPs. 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 CSPs 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 CSPs through the full life-cycle of security, from customization to operations.

Figure 5. Reference Architecture for Telco Cloud Security – layers of defense



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 has built a community that brings partners together (Open Ecosystem Network –www.open-ecosystem.org) and encourages communication between the CSP, application developers and VNF vendors to add value to the CSP's network.

Secure data exposure in the 5G era

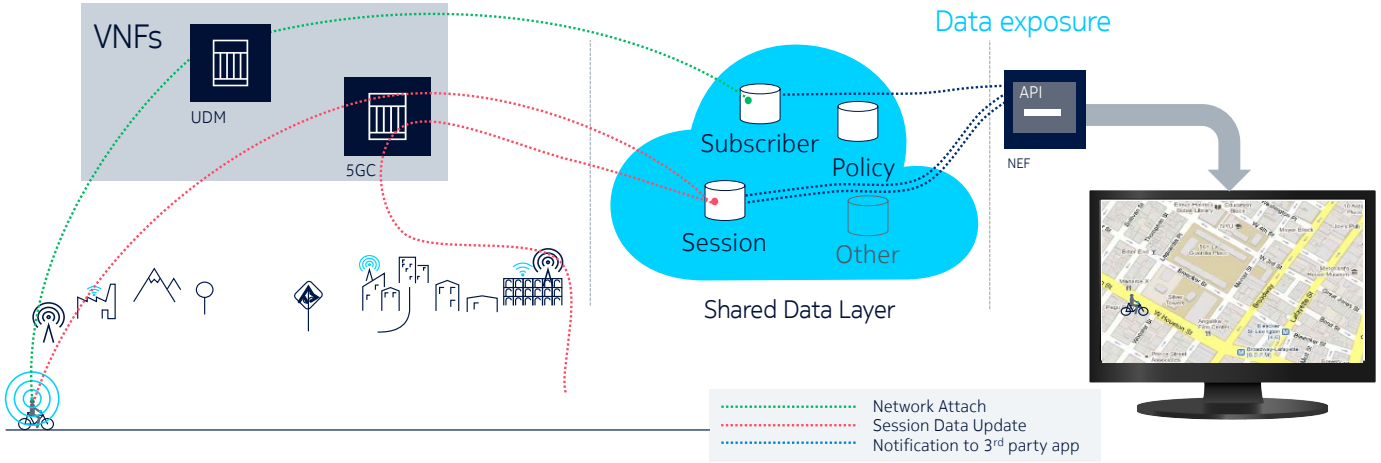
New 5G services boost the creation of applications to realize 5G-related use cases. These applications will benefit from instant and secure access to data within the Shared Data Layer.

Shared Data Layer will be accessible to developers via its Open APIs in the 5G core. It is imperative to handle this asset securely. Third-party cloud applications may access data, but they must also fully respect how data privacy regulations apply to subscriber and session data.

Nokia Network Exposure Function is a 3GPP compliant asset with a common API gateway to securely expose Shared Data Layer services and data through RESTful APIs to third party applications.

Nokia Shared Data Layer provides built-in capabilities for CSPs to extract stored data, analyze it and present the results via rich graphical user interfaces or export it via RESTful APIs to data lakes for post-processing to enable data monetization and the building of new services.

Figure 6. An example of SDL, NEF and third party application interworking



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Evolution to the Shared Data Layer from existing SDM deployments

The Nokia Shared Data Layer provides flexible capabilities and enables CSPs to migrate their existing Nokia Subscriber Data Management (SDM) deployments, using Nokia One-NDS (Network Directory Server), towards Shared Data Layer. It includes a flexible framework to migrate subscribers rapidly and robustly without any impact on real-time applications and/or provisioning during the migration process.

The flexible migration framework has a micro-services cloud-native architecture. It features automated workflows that require minimal user intervention and offer real-time monitoring of migration performance complemented by on-demand scaling for managing the speed of migration. As well as working with the Nokia Shared Data Layer, the migration framework can be customized by Nokia to serve as a migration platform for non-Nokia SDM deployments, enabling rapid migration towards Shared Data Layer with well-defined automation workflows and a consistent user experience.

Summary

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 CSPs 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 CSP 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 CSPs globally.

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Abbreviations

3GPP	3rd Generation Partnership Project
5G	Fifth Generation
API	Application Programming Interface
CPU	Central Processing Unit
DoS	Denial of Service
DSF	Data Storage Function
IoT	Internet of Things
NEF	Network Exposure Function
OTT	Over the Top
QoE	Quality of Experience
QoS	Quality of Service
REST	Representational State Transfer
SDL	Shared Data Layer
SDM	Subscriber Data Management
SLA	Service Level Agreement
TCO	Total Cost of Ownership
VNF	Virtualized Network Function

Further reading

White paper: Nokia Airgile Cloud-native core whitepaper
https://resources.nokia.com/asset/200888

Webpage: Nokia Shared Data Layer
https://networks.nokia.com/solutions/shared-data-layer

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