

Creating a new data freedom with the Shared Data Layer

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

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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. Market development will be rapid, calling on operators to be super-agile to be able to quickly adapt their networks and businesses to new trends and service needs.

Services with development and deployment times measured in months or even years 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.

Radically different and more complex business models have to be supported efficiently by the network architecture, allowing 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 transformation of the core network 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 cater to the demands of the largest of 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 programmable core network will give operators the business agility they need 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 are based on standard 3GPP architecture with self-contained network elements built to handle specific functions or services. Each network element stored and processed the subscriber and service data it needed to perform its function. As subscriber numbers and demand grew, and as new services and functions were introduced, networks were expanded by adding new entities.

This hierarchical and distributed architecture successfully met operators' 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. And 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 that was 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 shift of processing where 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 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 human beings and the Internet of Things. 5G networks must 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 must be able to efficiently cope 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 the virtualization of the 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 the 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.

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.

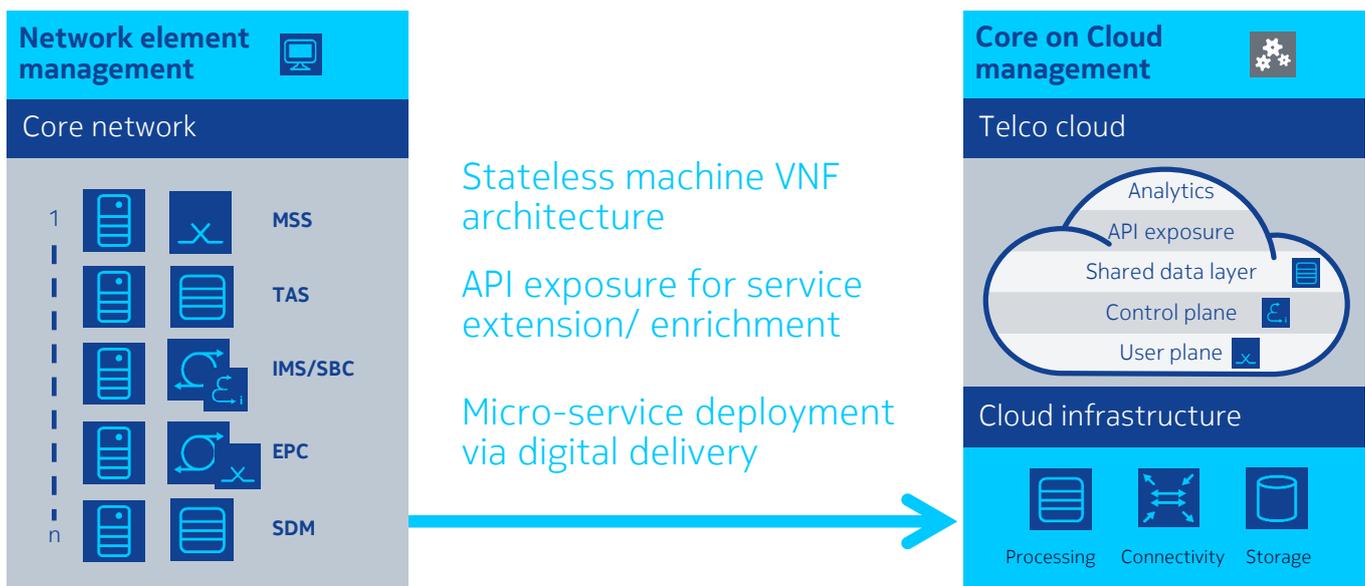


Figure 1 : Moving from network element management to cloud-based core network management.

Consolidating all the 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, thus eliminating much of the complexity of 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 services that are running 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.

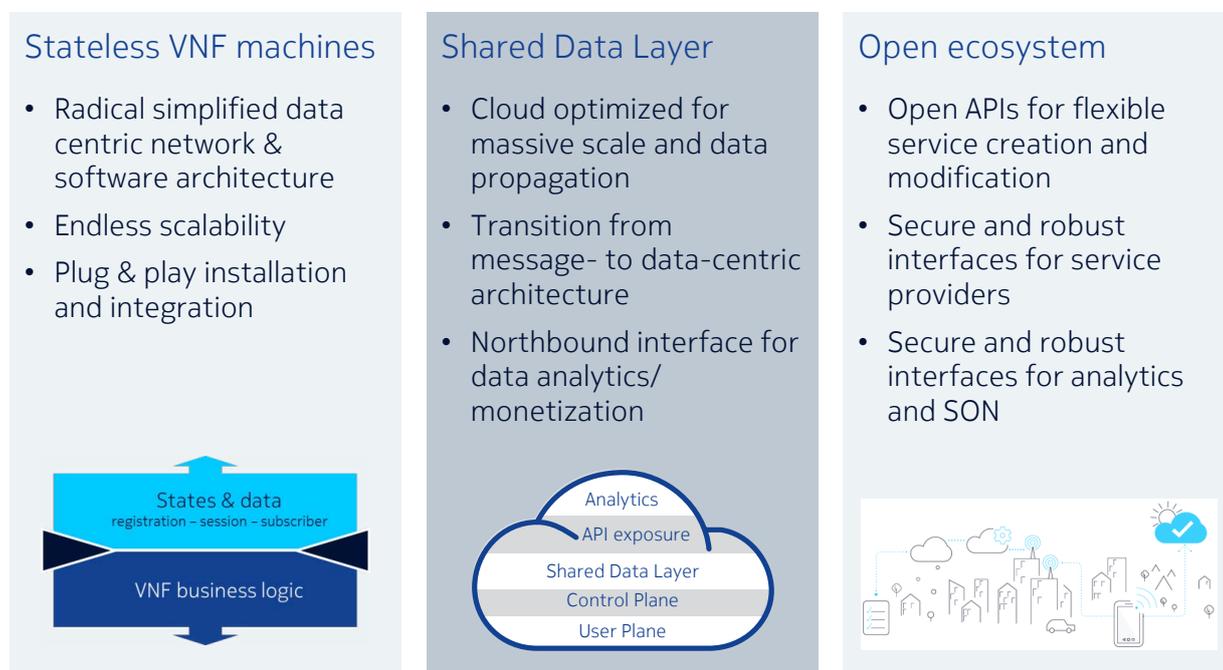


Figure 2 : The new cloud-optimized core network architecture comprises stateless VNFs that access all required data held in a separate layer. This data is also made available to other applications and services through an open ecosystem.

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)

Each of these advantages plays a fundamental role for the operator business case.

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 is a key part of this approach because it allows an agile exchange of data between services and applications while ensuring security and data privacy. Subscription and identity management in adjacent areas such as mobile IT services is an example of how the Shared Data Layer will support new business opportunities for operators.

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 SDL 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.

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

4.2 Greater business agility

Greater business agility is the prime motivator for many operators to transform their radio and core networks to the telco cloud because future success will depend on being able 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 reduce turnaround times for introducing innovative services and achieve revenue more quickly. Innovation cycles can be as rapid as those run by Internet players, but with the added benefit of telco grade reliability as a key differentiator. There is no need to set up and deploy new infrastructure, while 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 to the demands of 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)

Cost reduction is another important reason for many operators to move to the telco cloud.

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 signalling 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 evolve its existing database domains into an overall SDL concept that supports the programmable core. The Nokia vision of the shared data layer is to create an 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 designed to be 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

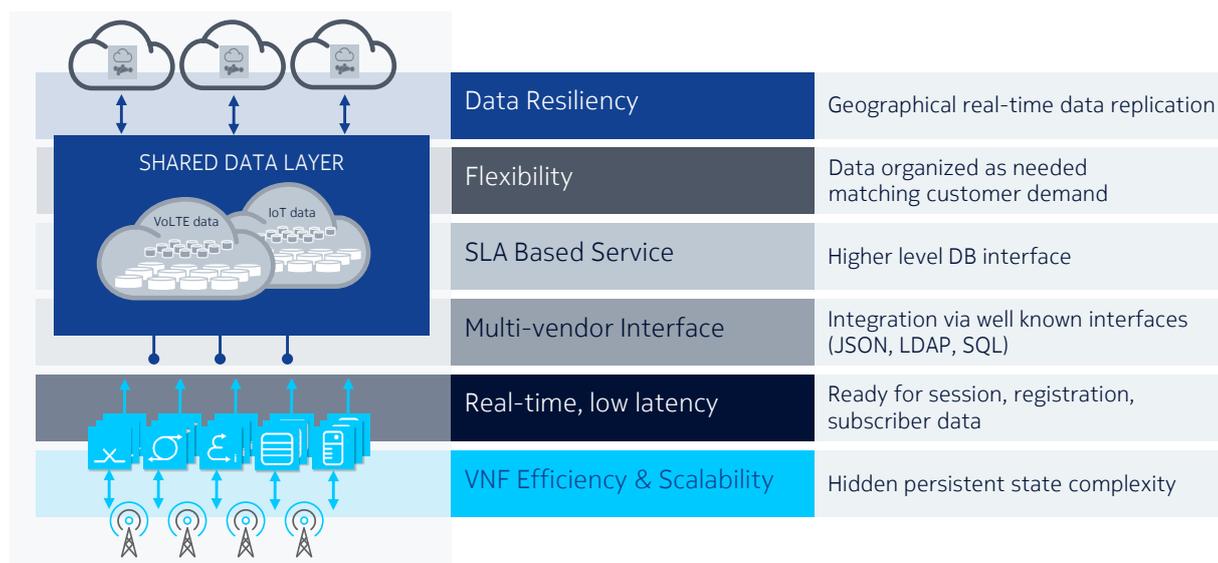


Figure 3 : Nokia Shared Data Layer provides a range of capabilities

5.1 Protecting the data

Operators enjoy a trusted relationship with their customers that must be protected and which can be enhanced by the introduction of cloud-based services that bring new flexibility, mobility, scalability and automation to improve network security and ensure the privacy of subscriber data.

The Nokia Shared Data Layer fits within a security ecosystem that has telco cloud security as a main objective. Telco cloud architecture tackles the fundamental issues of defining the defense layers, security zones and security functions. The data stored in the Shared Data Layer is subject to Nokia Telco Cloud Security reference architecture. The reference architecture is defined by Nokia Security services and is part of Nokia's overall Security Management. This reference architecture defines the Nokia Shared Data Layer perimeter security, host hardening, VNF security architecture, security orchestration, virtual security functions, service chaining and data security used in Nokia telco cloud.

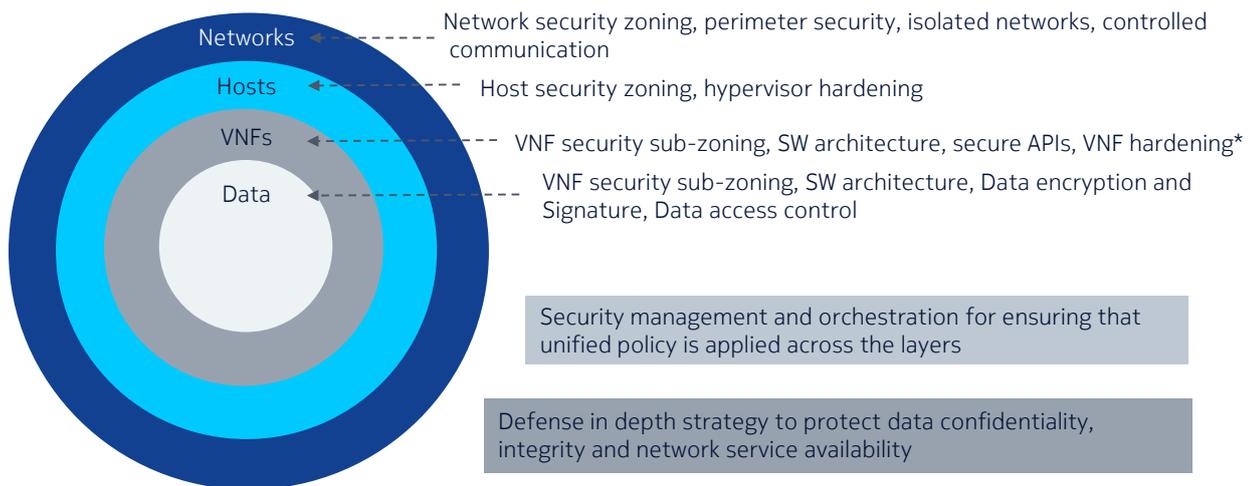


Figure 4 : Reference Architecture for Telco Cloud Security – layers of defense

6 Conclusion

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, match OTT innovation cycles and offer telco grade reliability as a key differentiator
- To foster ecosystem development for greater flexibility for third party services to use operator infrastructure, while ensuring security and data privacy
- To support massive (potentially unlimited) scale and elasticity to cater to 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 programmable core network, the Nokia Shared Data Layer represents a substantial advance in network capability that will create new value for operators globally.



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