Core Engineered Systems

The low risk, efficient and fast way to deliver essential end-user services

White paper

By building core network services in the cloud, Communications Service Providers (CSPs) can rapidly monetize essential 5G services for end users, while also laying the groundwork for more innovative and differentiated services. Core Engineered Systems help CSPs achieve shorter time to market by reducing integration effort.

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Introduction

As telco core networks have evolved to enable a larger number and greater sophistication of customer services, they have also become more complex. Consequently, CSPs face a growing range of implementation and delivery choices, particularly in multivendor networks.

Conventionally, CSPs have selected best-in-class products from different vendors, which then take substantial time to integrate and deploy, while also making working systems complex to upgrade and maintain. To manage this complexity, CSPs have typically depended on support from the vendors of each individual product.

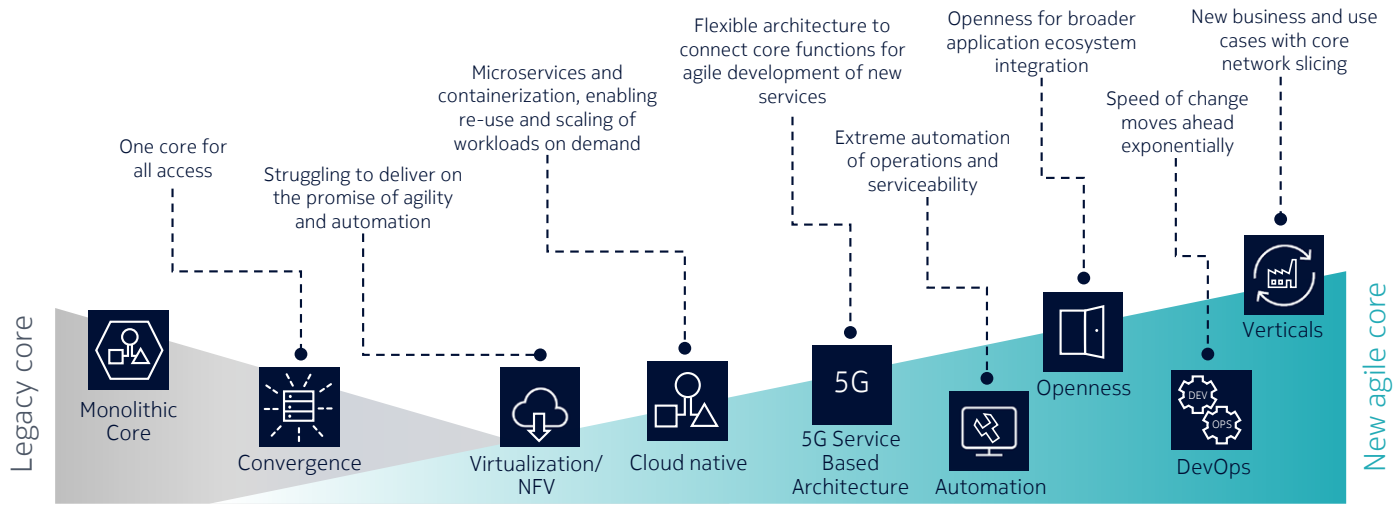
Today, with the roll out of 5G, a new approach is recommended, especially for systems that provide essential end-user services, such as subscriber data management, data, voice, video and messaging. To enable many CSPs to stay competitive and keep pace with rapidly changing market demands, the time taken to integrate, deploy and upgrade core networks must be reduced. This can be achieved by pre-defined, pre-integrated, certified, operations-ready systems that provide essential end-user services as the main building blocks of a complete core network.

This paper explores the relevant market demands that make such Core Engineered Systems valuable to many CSPs and describes their key characteristics and value.

The rise of telco complexity

Communications networks have become increasingly complex, especially with 5G networks being introduced while previous generations remain in operation. The result has been ever more Network Functions (NFs) and products in core networks. These products are typically implemented as classic appliance (bare metal) or as virtual machines. Today, there is a move towards a new, agile, cloud-native core with automation that supports new business cases, such as those based on network slicing technology.

Figure 1. The evolution of networks from legacy monolithic core network to agile, cloud-native deployments



Virtualization and cloud-native architecture help to simplify networks

Network Function Virtualization (NFV), enabled by rapidly evolving commercial computing solutions, aimed to resolve the complexity created by the ballooning number of services and multiple, typically proprietary platforms. Consequently, with the promise of well-defined reference points in ETSI-specified NFV architecture, many CSPs selected different vendors for hardware, Virtualized Infrastructure Manager (VIM), Virtual Network Function (VNF) applications and orchestration.

The resulting mix of best-in-class components calls for careful management of product lifecycle and test compatibility, as well as operability. Multivendor networks require integration and testing at deployment, as well as when NFs, VIM, VNF Manager or orchestrator are upgraded. The hypervisor-based virtualization layer and the fact that applications are run inside large Virtual Machines (VMs) with a guest operating system limits the frequency and granularity of upgrades and updates, as well as the level of automation that can be achieved.

Therefore, ETSI NFV-based virtualization does not always deliver the simplification some CSPs expect and can create additional challenges in operability and upgradeability.

Cloud-native architecture based on Cloud-native Network Functions (CNFs) further addresses complexity by enabling continuous delivery and simplified updates by applying software changes only to the affected microservices. Microservices are independent of the underlying architecture, allow shorter deployment times, zero downtime in the event of a software change and fault testing and therefore enable automation.

Microservice architecture though does not solve all interoperability challenges in multivendor networks, especially those related to hardware, Core-as-a-Service (CaaS) and CNF interoperability, their integration and upgrades.

5G creates new service opportunities

5G widens the potential service offers to new areas, such as Internet of Things (IoT) devices. 5G also enables low latency and mission-critical applications, while network slicing provides independent logical networks on the same physical infrastructure to meet specific needs, such as speed, latency, bandwidth, Quality of Service (QoS) and service availability.

With 5G being an emerging technology, the introduction of new NFs and frequent software changes is inevitable to keep up with market demands and standardization. At the same time, 5G enables more openness in core networks in terms of NF to NFVI and NF to NF interworking, as well as by enabling exposure of network data related to subscribers and/or sessions, which allows additional services with various business models.

While cloud-native architecture and 5G help to address the ever-increasing complexity of networks, interoperability in a multivendor environment remains a significant challenge for CSPs. A solution is needed to eliminate these challenges and address the difficulties CSPs face with lengthy integration/upgrade projects.

Core Engineered Systems strip out complexity for CSPs

An alternative to the traditional way of CSPs selecting best-in-class core network products for the delivery of essential end-user services is the best-of-suite, plug and play approach. This entails one vendor taking on responsibility for the design, deployment, upgrade and maintenance of end-user services in collaboration with the CSP.

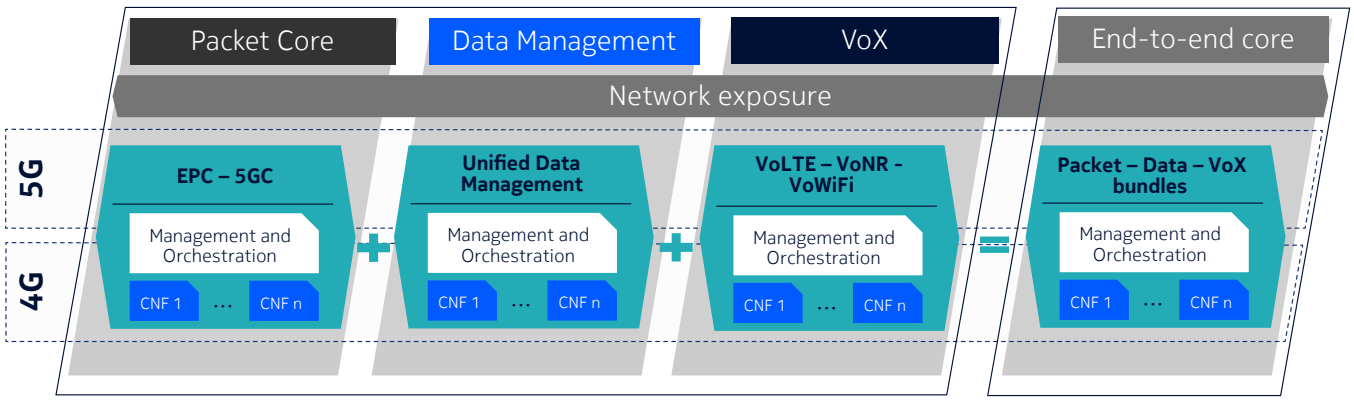
Core Engineered Systems is a best-of-suite approach that CSPs can adopt to use pre-defined, certified, operational-ready systems delivering essential end-user services. It meets the needs of many CSPs for an efficient and low risk way to quickly offer essential end-user services and maintain them at low cost, despite their inherent complexity. It also frees up CSP resources to focus on exploring new business opportunities.

Core Engineered Systems incorporate defined system level architecture (minimum configuration, local and geo-redundancy, upgrade strategy), reference configuration (system parameters with recommended values) and a system roadmap, including lifetime management. They comprise integrated products, with functionality, lifecycle management, operability, performance stability and robustness fully certified. Such systems are ready for operation, with aspects such as integration, deployment, upgrade and care achieved in the most efficient, fastest way.

The range of end user services offered by Core Engineered Systems is dynamic and shaped according to market demand. They encompass the latest 5G functionality:

- 4G/5G packet core
- 4G/5G unified data management
- 4G/5G Voice over LTE/NR and Wi-Fi

Figure 2. Core Engineered Systems for each of the essential services are seen individually or as an end-to-end core system bundle



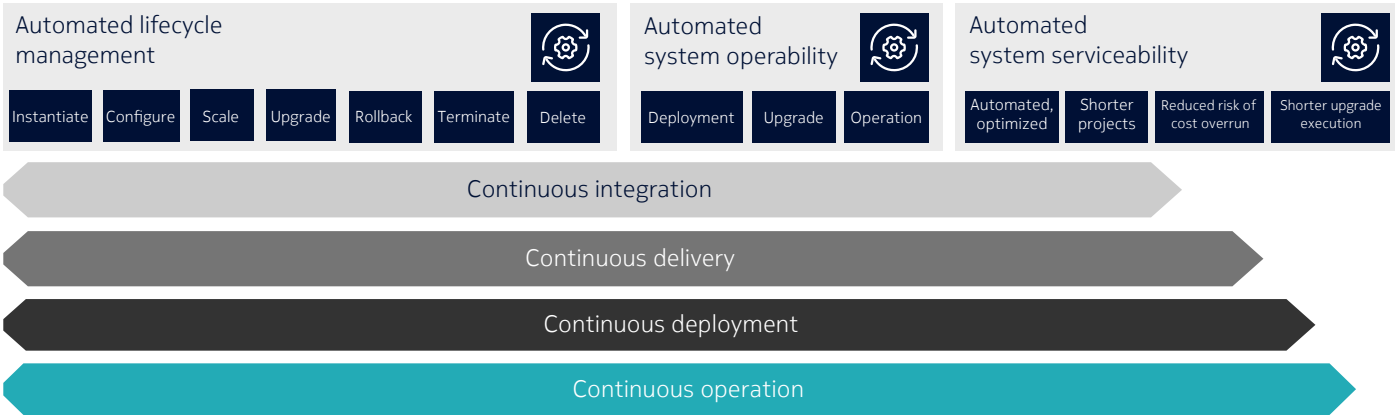
Core Engineered Systems support NFV architecture and container infrastructure through Kubernetes orchestration. They are full stack, including the NFVI application layer that can be deployed on any cloud.

The key features of Core Engineered Systems that contribute to CSP competitiveness include automated operability, serviceability, openness and continuous evolution.

Automated operability and serviceability at the system level

Automated lifecycle management of NFs is the current industry practice including instantiation, configuration, scaling, upgrade, roll-back, termination and deletion. This is supplemented by Continuous Integration/Continuous Delivery (CI/CD) and DevOps techniques to create automated deployment, upgrade and operation. Automated deployment includes software, delivery of artefacts and deployment, and on to automated vertical and horizontal integration testing.

Figure 3. Operability and serviceability automation



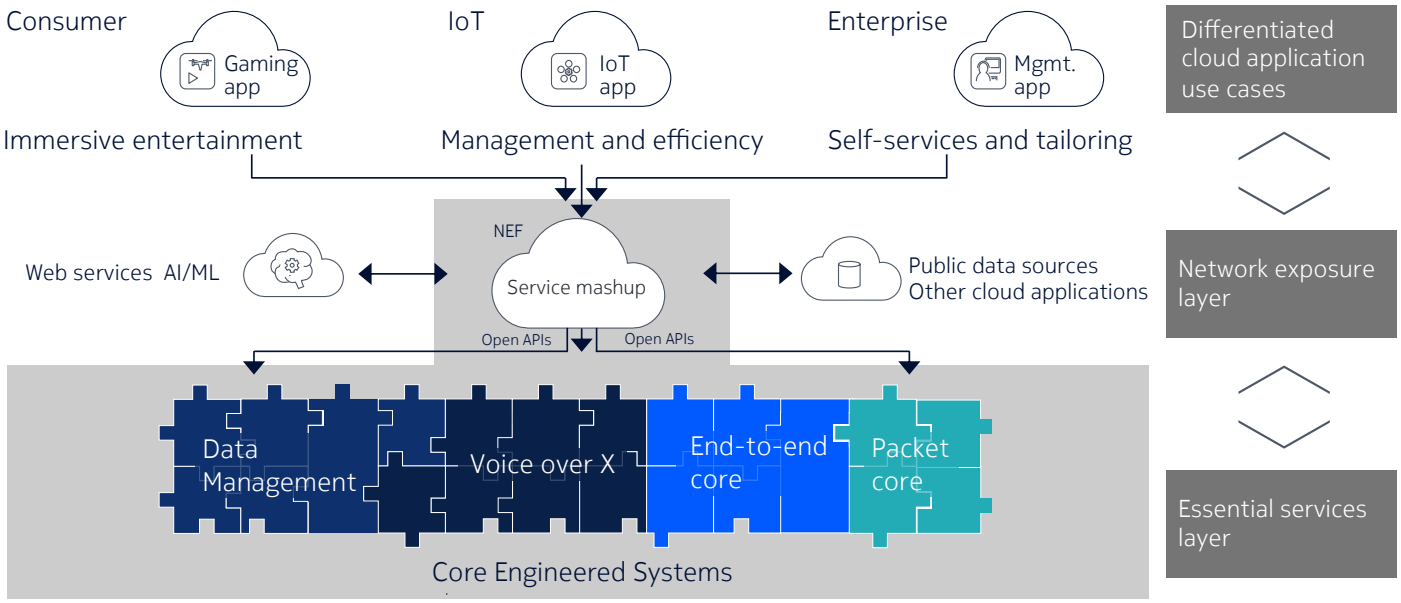
Automated upgrades include comprehensive checks, culminating in one-touch upgrades that do not disrupt services. Automated operation, including preventive maintenance, is achieved via health checks and NF diagnostics that can trigger automated scaling to improve performance.

Automated operability results in automated serviceability at a system level. This enables quicker introduction of new services with low risk of cost overruns; rapid, optimized upgrades to ensure CSPs stay current; and highly efficient systems operation.

Openness of Core Engineered Systems

Core Engineered Systems can support CSPs' needs to quickly implement essential end-user services and through openness, offer the ability to differentiate with innovative, add-ons like IoT and enterprise services. Network Exposure Function (NEF) is a part of each Core Engineered System, providing Application Programming Interfaces (APIs) to applications in a way that is content-controlled, secure, scalable and compliant with Service Level Agreements (SLAs). These applications use the exposed subscriber and session data for add-on, differentiating services. Using service mashup, the functionality of NEF APIs can be transformed, composed and orchestrated - APIs can be transformed into RESTful ones, several APIs can be linked to form a single API and API notification can be orchestrated and sent to multiple applications. Service mashup can use input data from public data sources or web services Artificial Intelligence/Machine Learning (AI/ML).

Figure 4. Openness of Core Engineered Systems enabling service mashups using data from various sources



The openness of Core Engineered Systems enables cloud-based applications, allowing CSPs to offer differentiated use cases for consumers, IoT or enterprises.

Continuous evolution of Core Engineered Systems

The aim of Core Engineered Systems is to provide essential end-user services that incorporate the latest technology. They are not static systems - they continuously evolve. The first pillar of evolution is 5G architecture. They serve the non-Standalone option 3/3x and the Standalone option 2 5G architecture, while soon, Release16 Model C, D using SCP and service mesh are being considered.

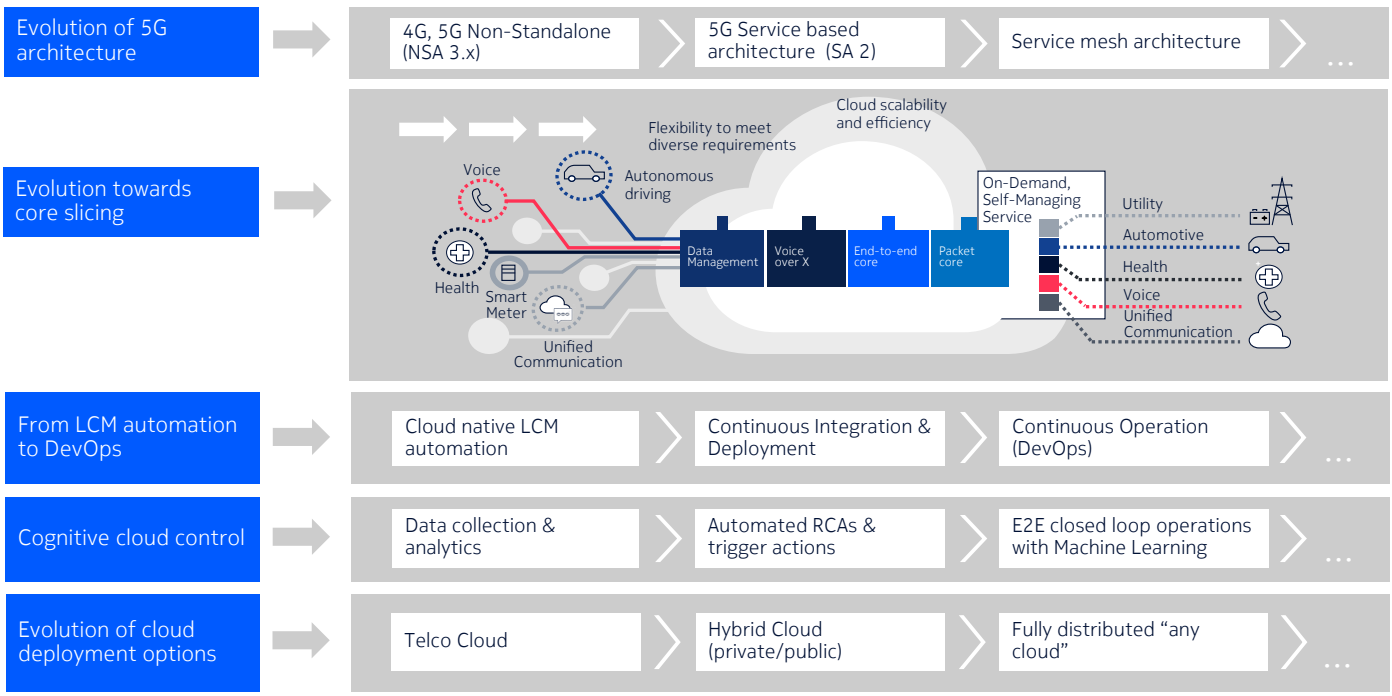
The second direction of evolution is core slicing, where systems can be sliced automatically to serve different SLAs. In the future, system slices will evolve to zero touch, ensuring efficient operation according to SLAs via closed loop actions.

One of the most important evolution pillars is automation. According to industry practice, the systems offer cloud-native automation and will offer CSPs the option of continuous integration and deployment and continuous operation (DevOps).

Systems have all aspects of cognitive cloud control, including analytics and automated Root Cause Analysis that trigger actions, which will also in future see the advent of end-to-end closed loop operations with ML.

Ultimately, deployment of systems is of paramount importance. They can be deployed in telco and hybrid cloud forms, with an evolution path to fully distributed 'any cloud'.

Figure 5. Continuous evolution of Core Engineered Systems



With technology under constant evaluation, the direction of evolution of Core Engineered Systems is subject to constant revision to meet the evolving CSP needs.

Table 1. Transition from today's networks to new, more agile networks

Today's networks	Future Networks	Enabler
Small number of traditional voice and data services	Large number of services, including many diverse digital applications	NEF, slicing, automation, DevOps
Limited performance requirements	Stringent end-to-end performance needed for many services	Network Slicing with SLAs
Static services with limited scalability	Dynamic scalability required for digital services	Network Slicing with SLAs
Monolithic networks	Service, domain and function-level slicing	5G, slicing
Physical or Virtualized Network Functions with aggregated functionality	Cloud-native networks with granular functionality	Cloud-native
Limited automation	Cognitive operations with significant automation	Cloud-native, 5G
Multivendor environment, separate components / sub-networks per technology	Dynamic, complex networks	Single integrated solution: Core Engineered Systems

Essential vendor support for CSPs

To enable CSPs to take full advantage of the simplicity and rapid deployment of Core Engineered Systems, the vendor needs to support the whole lifecycle of the system. Vendor support must include services for planning and design, deployment, testing, software changes and care.

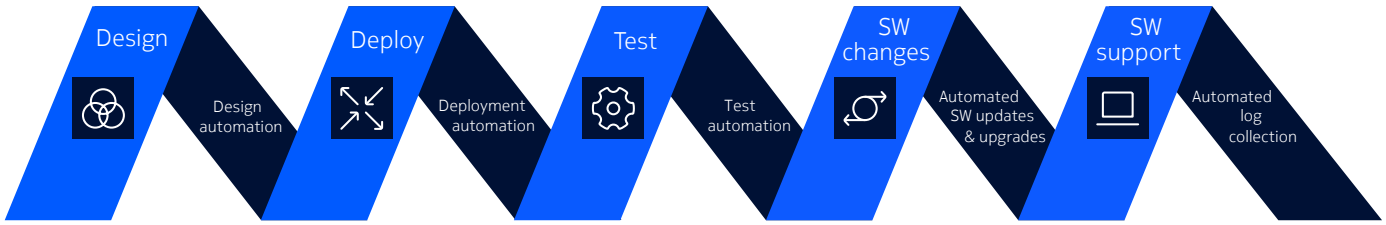
These vendor services need to be ready-to-go for rapid results and offered as an integral part of the value to CSPs of Core Engineered Systems. The benefits for CSPs will include:

- Less work to define the solution and requirements
- Reduced design effort due to pre-defined designs, data builds (configuration data) and testing
- Less implementation works due to optimized NF installation and standard health checks
- Faster, more reliable deployment. As the system is pre-integrated, more focus can be put on ensuring reliable connectivity and using automated testing of external interfaces and end-to-end use case integration for rapid time to market. In addition, the whole implementation phase is complemented with advanced project management methodologies and tools to minimize deployment risks.
- Fewer trouble tickets. As well as the usual product support, solution support helps resolve incidents by reducing the complexity of the overall support chain, with one single point of contact for all incidents. This leads to simpler network operations with fault localization and emergency management requiring less effort.
- Faster, more reliable software upgrades. Pre-integration encompasses software changes to accelerate updates with lower risk. Pre-validated software changes reduce the risk of faults, delays and potential roll backs caused by compatibility issues, not just during the update but also in subsequent operation.
- Matched to business needs. Core Engineered Systems include qualified customization of infrastructure and applications that are based on open standards-based interfaces, APIs and configuration settings to meet the needs of different CSP environments.

Nokia DevOps and Agile service delivery methods, in which people and processes seamlessly work together in a highly automated and efficient way, are increasingly being adopted across the entire spectrum of network deployment and operation. Vendor services for Core Engineered Systems also use these methods to:

- Use Design Artefacts to automatically create project deliverables and speed up the planning and design phase.
- Deploy automation of NFs on top of Core Engineered Systems platforms.
- Automate testing with defined test scripts executed by test tools to validate deployed products and solutions in networks.
- Automate software updates and upgrades by using intelligent pre- and post-upgrade health checks to accelerate network software changes and reduce the risk of errors.
- Automate log collection and analysis by using an integrated knowledge base with digital assistants to find and fix problems faster.

Figure 6. Continuous Integration and Continuous Delivery chain



Benefits of Core Engineered Systems

Accelerated time to market

Essential end-user services can be brought to market quickly, boosting CSP competitiveness in the 5G era. Rapid, smooth deployment also generates a positive view among users of new technologies and their benefits, improving the CSP's brand perception. Having introduced essential services, CSPs have the time and resources to differentiate, composing innovative consumer and enterprise services to compete, satisfy customer needs, find new revenue streams and reduce churn.

Low risk deployment and operation

The incorporation of certified, pre-integrated products and the use of cloud native and CI/CD techniques helps to simplify deployment and assure efficient, automated operation.

Always up to date

Core Engineered Systems help CSPs to stay ahead of their competitors. Certified system upgrades reduce the risk of faults, delays and potential roll backs, while automated upgrades that include pre- and post-upgrade checks simplify the process.

Reduced Total Cost of Ownership

Reduced CSP workload during deployment and operation. Core Engineered Systems use pre-integrated products, fully automated operation and assured lifecycle management. CSPs do not need to select products individually, conduct complex and repetitive integration work or formulate tailored lifetime plans.

Figure 7. Value to CSPs of Core Engineered Systems

Conclusion

One of the most important targets of all CSPs is to provide valuable new services to their customers. To do this, it is essential they keep their telco networks up to date with the latest innovations and newest capabilities, following 3GPP standards. For many CSPs, Core Engineered Systems are the most effective way to achieve this aim by enabling them to take advantage of a pre-integrated solution that avoids the complexity and delay of integrating and managing solutions from multiple vendors.

Core Engineered Systems offers the most cost-effective and reliable route for CSPs to provide a range of essential end-user services, leaving them free to create innovative, add-on services that will differentiate them in areas such as IoT and enterprise services. For many CSPs, Core Engineered Systems is an attractive solution that will enable them to monetize 5G services rapidly.

Abbreviations

3GPP	3rd Generation Partnership Project
4G	4th Generation (mobile radio)
5G	5th Generation (mobile radio)
5GC	5G Core
AI/ML	Artificial Intelligence/Machine Learning
API	Application Programming Interface
CaaS	Core-as-a-Service
CI/CD	Continuous Integration/Continuous Delivery
CNF	Cloud-native Network Function
CSP	Communications Service Provider
ETSI	European Telecommunications Standards Institute
IoT	Internet of Things
LTE	Long Term Evolution
NEF	Network Exposure Function
NF	Network Function
NFV	Network Function Virtualization
NFVI	NFV Infrastructure
NR	New Radio
QoS	Quality of Service
SLA	Service Level Agreement
VIM	Virtualized Infrastructure Manager
VM	Virtual Machine
VNF	Virtual Network Function

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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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