Innovate and execute with a simplified 5G core

Cloud-native and extreme automation for the 5G era

White paper

In the 5G era, a universal adaptive core becomes the critical key, freeing Communications Service Providers (CSPs) to thrive by offering different services to everyone and everything. This white paper examines how CSPs can simplify the core, allowing them to innovate, execute, and take advantage of new opportunities.

Contents

Introduction

When working on the core, Communications Service Providers (CSPs) often struggle with the complexity created by successive mobility generations, circuit-to-packet conversions, and cloud technologies. CSPs also need to balance yesterday's price pressured mass-market consumer-oriented broadband with a full pursuit of 5G's markets, industries and services.

This paper examines trends, challenges and criteria for a 5G core that can help CSPs pursue new opportunities built on 5G, cloud-native software and extreme automation. We believe that Nokia 5G core's cloud-native technology and extreme automation simplify the 5G core's design, deployment and operation, ensuring CSPs can innovate, execute and pivot to new opportunities.

In the 5G era, a Nokia universal adaptive core becomes the critical key, a valued differentiator, a common platform for any access or market segment, enabling CSPs to thrive by offering different services to everyone and everything.

Trends

In terms of business, customers' expectations of their CSPs are changing. Consumers enjoy many communication choices and embark on new ways to share augmented experiences. Enterprises enjoy a broadening set of platforms (WebEx, Teams, Slack, etc.), and industries need to remake their operations with Industry 4.0. All seek to expand their communications from people to things, while protecting communications from increasing cyber-security threats.

In terms of competition, CSPs face newly agile competitors including web-scale internet giants, greenfield CSPs, and established CSPs that are transitioning to cloud-native technologies and deployments.

What about the core?

Successive mobility generations improved bandwidth and coverage. For the core and its operations, those generations and waves of packetization and virtualization have produced layers of complexity, making small improvements, but never a transformative gain in agility, efficiency and time-to-market.

Offering the same broadband, voice and messaging services to everyone is no longer competitive. Instead, stimulated by software's digitalization of everyday life and work, consumers, enterprises and industries understand, need, and embrace a diversity of services. While access and transport undergo their own generational change, it is the core that provides a CSP's customers with services or connects them to what they need.

Today's cores are reliable yet static, which limits CSPs' ability to innovate and execute. Innovation for value creation is achieved by openness to a wider ecosystem, cloud resource optimization, and 5G's new use-cases. Execution is achieved by using new methods to create and deliver services, including continuous software delivery pipelines and deploying onto any cloud, anywhere. The result is that the core is freed from providing limited static services to everyone, instead enabling CSPs to thrive by offering different services to everyone and everything.

However, to achieve this, CSPs will need to overcome some challenges.

Challenges

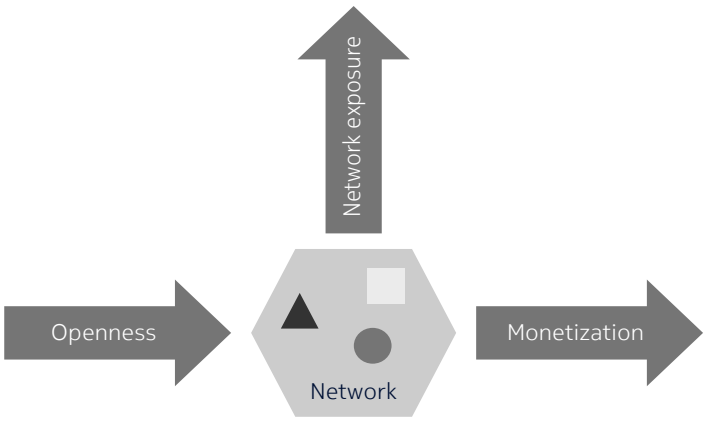
Traditional and new markets

CSPs' primary markets, within this paper's scope, are telecom (selling fixed and mobile broadband, voice, messaging) and a wider ecosystem (selling to ecosystem partners in the digital value chain).

The telecom market is disrupted by new entrants who are not encumbered by legacy cores. New entrants use cloud-native software based on web-scale technologies, advances in Artificial Intelligence and Machine Learning (AI/ML) and automation, and new approaches to designing, deploying and operating networks. Additional cloud-native competitors include some early-mover CSPs, as well as web-scale providers whose applications entice consumers and enterprises to shift their usage from telecom to web platforms. CSPs can counter the threats by embracing cloud-native cores, allowing them to compete better in the telecom market and sell to a wider market.

By building for openness and flexibility, CSPs can enable partners, third parties, and business model innovation in the ecosystem market's digital value chain. Together, the ecosystem can create compelling applications or services. Let's consider three angles, as seen in Figure 1.

Figure 1. Digital value chain's ecosystem



- **Openness**. Cloud-native helps CSPs deploy the core flexibly onto any cloud. It enables innovation by rapidly integrating apps (with network exposure Application Programming Interfaces (APIs)) and network functions into the core's Service Based Architecture (SBA), which communicates internally by means of flexible APIs instead of difficult protocols. Cloud-native Network Functions (CNFs) also aid automation, because stateless microservices are much easier to manipulate than large monolithic Virtualized Network Functions (VNFs), so that operations become fast and easy for less troublesome deployment, fulfilment and assurance.
- **Network exposure APIs**. 5G helps CSPs use the 3GPP Network Exposure Function (NEF), particularly if it includes a developer community and the same NEF extends to the 4G SCEF, and securely extends innovation to the wider ecosystem market. This includes third-party application developers using the core's APIs to mash-up or create new services, enterprises administering their own slices (such as by provisioning their own employees), partners administering their application on a Multi-access Edge Compute (MEC) edge cloud, and businesses who apply analytics to anonymized subscriber and network data.

- **Monetization**. CSPs can participate in a digital value chain that enables innovation in partnerships and business models. Instead of a downward spiral of rating, metering, and bundling, CSPs can let people choose what and how to consume, and what and how to pay. Alternatively, they can experiment with other forms of innovative pricing models, helping them pursue new business in a manner attractive to those users. These offers can include gamers' data plans, slices for smart cities' public works departments, pricing frameworks that implement energy tariffs, generic subscription identifiers, factory robotics communications, and so on.

The core's challenges

CSPs' current challenges, even before 5G, include struggling to securely serve more devices and more traffic, with cost curves exceeding revenue curves. Adding 5G into the mix brings more challenges, including how to rapidly create new applications and services. This might require managing per-slice characteristics, such as latency, bandwidth, security, etc., because different services have different network requirements. It may also need re-training and innovative business models to pursue new markets. All this must be done while protecting the CSP's brand value, for example, when dealing with mission critical applications such as robotics or autonomous driving, which depend on ultra-reliable low-latency communications (URLLC).

What's needed?

These challenges create a three-fold need for the CSP's core:

- CSPs can **profit from opportunities** by building the right core for their needs. This can be done by harnessing new technologies such as AI, network slicing, continuous software delivery pipelines (CI/CD DevOps), service automation, security orchestration, and by opening up to third-party innovation with APIs and the ecosystem. By embracing radical new technology, CSPs can win against traditional and new competitors, while also best serving existing telecom and new ecosystem markets. CSPs will also want to reduce operational complexity.

- By building a converged core with **limitless flexibility** for re-architecting the network and its operations, CSPs can avoid any kind of lock-in to just one cloud deployment model, while meeting their customers' preferences for a variety of access networks. Enabling zero-touch closed-loop operations will also allow CSPs to work at speed. CSPs are faced with doing this in an environment where the technology and market drivers are rapidly changing. Moving to a cloud-native core and operations requires a significant change to a company's culture, methods and practices.

- Achieving the right core will give CSPs **confidence** that it offers the lowest possible risk and maintains the service reliability they are known for, even as they proceed to disrupt the market with innovative offers. Priorities for CSPs include reinventing their business while at the same time protecting their brand value, particularly for ultra-reliable services, such as factory robotics and assisted driving. Yet based on their proven track record in providing telecommunications at scale, CSPs are well-positioned to be the 5G era's trusted provider for ultra-reliable mission-critical applications and services.

Defining the new core

What is the new core? Its definition is driven by the CSP's new business opportunities, so it must enable profitability, limitless deployment & operation, and confidence. Let's examine the metrics that define it.

Profitability

The two primary markets (telecom services and the wider ecosystem) require far more speed and flexibility than previously seen. Profits are earned by going beyond the core's reliable yet static mass-market services, so that the CSP becomes the source of a dynamic mixture of applications and services, enabling different applications and services to be sold to different people and things. This needs to be done at speed to meet the urgent needs of the CSP's demanding customers. This in turn relies on simplifying the core and its operations. Key criteria to consider include:

- Adopt network slicing and build virtual networks with finely tuned SLAs.
- Automation (CI/CD, DevOps, Deploy, LCM, slicing, etc.) for improved efficiency (reduced cost, greater agility, etc.). Dramatically lower the operational costs and rapidly bring services to market.
- Insight-driven analytics. Deploy AI/ML to keep the core at optimal health and capacity in real time.
- Improved protection of the core and the CSP's customers against increasing cyber-threats.
- Value creation through openness, including SBA and NEF APIs, and the ecosystem's digital value chain. Embrace openness with a cloud-native core. Bring in innovations quickly and safely.
- Common core products across fixed and all mobile generations, either for smooth evolution from the present to the future, or for re-homing older access networks on to a common set of core products.

Limitless

The continuing rapid shift in consumption patterns, preferred user experiences, and the tremendous economic growth promised by Industry 4.0 will mean that today's deployment will be less suitable tomorrow. Cores designed and deployed today need the inherent flexibility to evolve to new models, without having to restart from scratch. In a nutshell, this is portability of the core's software. Key criteria to consider include:

- Ability to deploy the core as cloud-native on bare metal or any cloud: private, public, or hybrid. And the ability to move a deployed core across those platforms.
- Adopt a distributed cloud model across central, regional and edge clouds, and move functions to where they are best placed.
- Use web-scale technology such as dynamic optimization and self-healing.
- Access agnostic (fixed, unlicensed, and any-G).
- Enhanced performance from an optimized footprint, including User Plane Function (UPF) performance at scale.

Confidence

The ability to evolve with confidence, and protect the CSP's brand value, requires technology and partners that can be trusted. The shift to 5G and cloud-native is the biggest change of all, because it touches and rearranges every aspect of the network, operations, and business. Success in this shift will take a disciplined, programmatic approach. Key criteria to consider include:

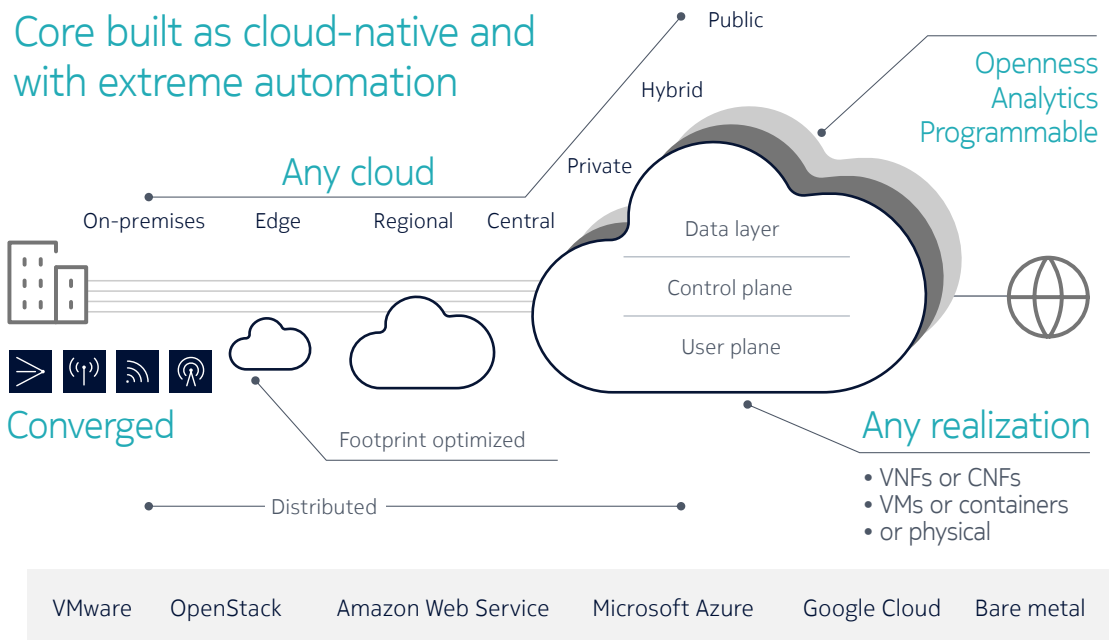
- A core that is built cloud-native from the ground up and is aligned with 3GPP and the Broadband Forum.
- Portfolio coverage and expertise that spans network and operations.
- Services' experience in designing, integrating, optimizing and testing large-scale cloud deployments.
- A trusted partner with proven reliability over hundreds of cloud deployments.
- Using well-defined core engineered systems will help regional and smaller CSPs to reduce time-to-market, cost, and risk, which will meet the challenges of integration and ongoing upgrades.

Summing up the network's new core

CSPs can capture new opportunities from the intersection of 5G, cloud and automation by adopting a core that is flexible, dynamic and simplified. Combined with a vendor with multi-domain expertise (core, operations, security, wireless, IP routing, cloud) that closely aligns to their business strategy, they can transform their network into a flexible engine. As seen in Figure 2, CSPs can achieve this by deploying a core that is:

- Cloud-native, for diverse new services, without limitations
- Equipped with extreme automation, ensuring CSPs can profit from opportunity
- Highly reliable, to protect brand value

Figure 2. What's needed for the network's new core?



Business benefits

How might the new core help a CSP's CMO, CIO and CTO achieve their objectives? They benefit in the following ways.

Business results

Although network capital expense is a key component, profitability is most influenced by the bigger numbers of top-line revenues and ongoing operational costs. Considering the respective interests of the CMO and CIO in those two areas:

- A core designed to scale quickly in response to highly variable demands of services that are unlike traditional broadband or voice. New markets of IoT/MMTC, AR/VR, etc.
- A core that is sliceable for selling new use cases, such as video surveillance with edge cloud analytics processing, smart cities vehicle fleet management, industrial control processes, and so on.
- 3GPP's enhanced security capabilities of the 5G Core. Deploying a security orchestration solution that reduces risk caused by advanced persistent threats.
- A core that is ultra-reliable yet highly flexible for URLLC such as robotics, assisted driving, etc.
- Extreme automation that greatly reduces operational complexity, CI/CD DevOps for an ongoing software pipeline, scaling quickly especially for peaky services such as Industry 4.0, self-healing that improves customer experience and reduces churn, etc.

Open, agile, flexible

CTOs are responsible for building the core and making it work. The network is the foundation of the CSP's livelihood because it enables trusted services, compelling experiences and economically viable offers. In the era of 5G and cloud, the opportunity is to create a far more open, agile and flexible core. The benefits to the CTO include:

- Unrestricted business benefits while transforming the core. Flexible deployment options and a choice of vendors ensure there is no 'lock-in'.
- Transforming the core to cloud-based software protects investments.
- The core, including slicing, can be whatever is needed to meet the CSP's business goals.

Reliable

Massive projects incur special risks, so new technologies must prove themselves and gain trust. Also, when the new core is up and running, serving much more of consumers' daily lives, businesses' operations, and industries' processes, it must be reliable and resilient. The CIO and CTO rely on a core and its operations to provide:

- Peace of mind, such as deployments that are right the first time.
- Delighted internal stakeholders that rely on a network platform delivering everything they need.
- Protection of brand value.

Nokia universal adaptive core

Nokia simplifies the core by applying two design principles: building it from the ground up using cloud-native technology and equipping it with extreme automation. Nokia's universal adaptive core, as seen in Figure 3, has three characteristics.

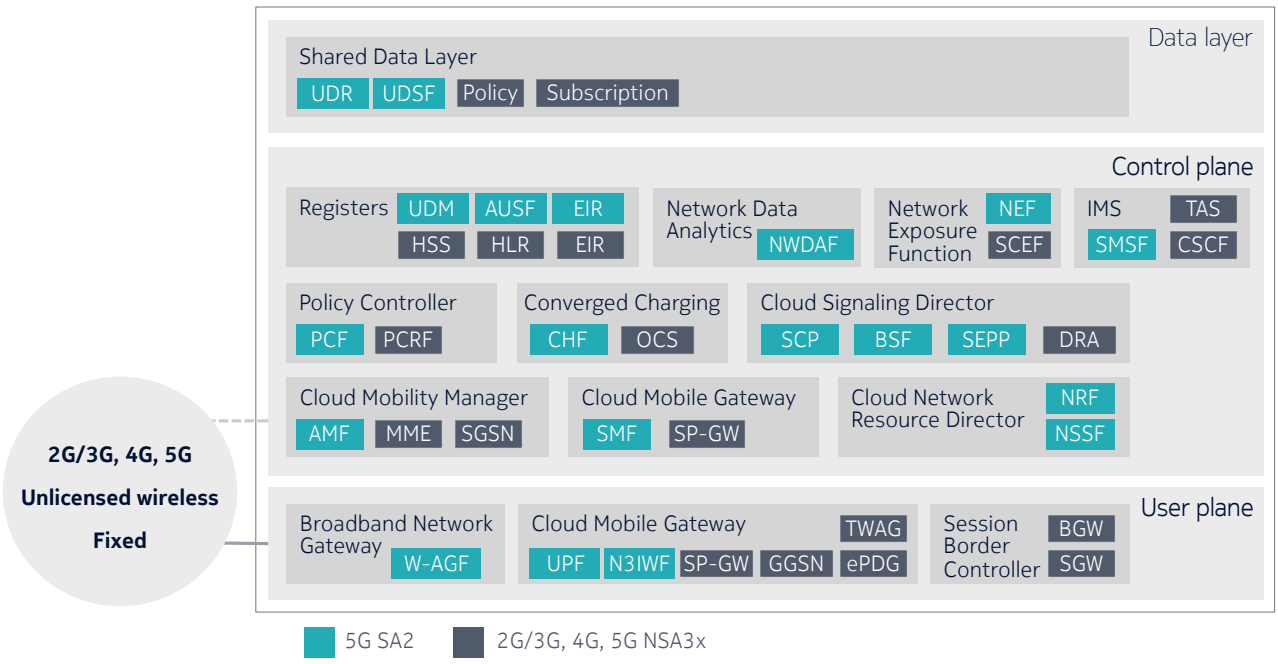
First, it is a core that is done right: cloud-native and infrastructure-agnostic from the ground-up as a pure software product. CSPs can deploy it on any cloud (private or public) and deploy it anywhere (centralized or at the edge), using virtual machines or containers, running on the cloud or bare metal. This gives the freedom to choose the deployment model and to rearrange the network as business needs change. Learnings from hundreds of cloud deployments and our Design for Security program are applied to ensure the core is tuned for cloud, operable, and secure.

Second, it is done now: taking advantage of innovations in automation, AI/ML, DevOps, and web-scale infrastructure advances (such as container based microservices), and performing as a common platform for any access (2G/3G, 4G, 5G, wireless unlicensed, fixed), it delivers the innovation engine needed to generate a strategic business advantage – today.

Third, it is made real: a core that meets the stringent reliability required of premier service providers and created by the vendor with the broadest portfolio and geographic experience of all network equipment providers. The core is built by a company with hundreds of in-service cloud deployments, and which forms part of the multi-vendor core in the world's first nationwide launch of standalone 5G at T-Mobile US.

Nokia's universal adaptive core provides the foundation for standalone and non-standalone 5G networks, aligned to 3GPP and Broadband Forum standards. The same products provide a core for 4G, and 2G/3G, as well as fixed access and unlicensed wireless. It is open and multi-vendor, and at the same time simplifies complexity by integrating with Nokia's advanced solutions for network management, fulfillment, assurance, orchestration, and security.

Figure 3. Nokia universal adaptive core



Customer references

CSPs use Nokia's core across 5G (Non-standalone and Standalone), Voice over New Radio (VoNR), 4G EPC & VoLTE, 2G/3G including packet core & IMS Centralized Services, unlicensed wireless, and Fixed Access including business enterprise services. They are using it to:

- Deploy on any cloud to suit their business requirements
- Extend services to any access from a universal adaptive core
- Innovate and create value with partners using a network exposure framework and ecosystem
- Reduce risk with field-proven experience across mobile, IP, and cloud-native.

Highlights that include Nokia's end-to-end 5G portfolio can be seen on our page for 5G in action.

Why Nokia?

Looking across the 5G core solution, the three most beneficial items are:

- **Risk reduction**. Nokia understands the networks and operational complexity of CSPs because of its global footprint, which brings hands-on lessons, decades of experience, hundreds of cloud deployments, and extensive experience with systems integration, testing, security, and tuning cloud-deployments for production. The Nokia core is deployable onto bare metal or any cloud (private or public).
- **Revenue opportunities**. Nokia helps CSPs earn more by how it builds its software - cloud-native from the ground up, using CNCF principles and carrier-grade web-scale technologies. The results are fewer touch points and therefore fewer errors, with faster service deployment and faster service utilization.
- **Efficiency**. Because the Nokia universal adaptive core serves all accesses, is built cloud-native and integrated with its fulfillment, assurance, security and orchestration solutions, CSPs enjoy extreme network automation, as well as operations that are seamlessly integrated, helping keep operational complexity to a bare minimum.

Conclusion

CSPs are keen to simplify how their core is integrated, deployed and operated, allowing them to serve and optimize, innovate and execute, pivot and create. With 5G, the core gains its own identity, because 5G and cloud enable CSPs to differentiate with the core, as all services either come from it or are connected by it. Whether a CSP is a disruptive new entrant, an established provider seeking efficiency and optimization, or somewhere in-between, Nokia sees that the strategic need is for a converged cloud-native core with corresponding automation and operations.

CSPs can get more out of their communications investment by focusing on their business, optimizing it for today's rapid technology changes, and simplifying operations, with a partner they can trust. With Nokia's cloud-native universal adaptive core, CSPs can turn the tables on competitors.

Abbreviations

AI	Artificial intelligence
API	Application programming interface
AR/VR	Augmented / virtual reality
CD	Continuous delivery
CI	Continuous integration
CIO	Chief information officer
CMO	Chief marketing officer
CNCF	Cloud native computing foundation
CNF	Cloud-native network function
CSP	Communication service provider
CTO	Chief technology officer
EPC	Evolved packet core
IMS	IP multimedia subsystem
IoT	Internet of things
LCM	Lifecycle management
MEC	Multi-access edge compute
ML	Machine learning
MMTC	Massive machine triggered communications
NEF	Network exposure function
SBA	Service based architecture
SCEF	Service capability exposure function
SLA	Service level agreement
UPF	User plane function
URLLC	Ultra-reliable low-latency communications
VNF	Virtualized Network Function
VM	Virtual Machine
VoLTE	Voice over LTE

About Nokia

At Nokia, we create technology that helps the world act together.

As a B2B technology innovation leader, we are pioneering networks that sense, think and act by leveraging our work across mobile, fixed and cloud networks. In addition, we create value with intellectual property and long-term research, led by the award-winning Nokia Bell Labs.

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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