NOKIA

Telco Network Exposure

The route to 5G core Open APIs and beyond

White paper

All types of API, whether enterprise, IT or telco related, require a secure exposure platform that simplifies the application developer's task, offers an agile way to create services and hides back-end system complexity. In 5G, where many new services are expected, APIs and the exposure platform will have an additional important role for CSPs. They can help CSPs find new monetization opportunities by opening their network to third-party application and service providers. All of this requires a new open ecosystem based on 5G APIs, in which each stakeholder can achieve its business goals.

NOKIA

Contents

NOKIA

Executive summary

Telco-based Application Programming Interfaces (APIs) have a similar role as their more familiar IT and enterprise-based APIs, which is to support third-party applications. To do this, they must also offer similarly clear, straightforward rules and adequate information for developers. Both IT and telco-based APIs require an exposure platform to access programmable assets, rather than many different access points and protocols. This platform must have an API Gateway that serves different customer types in different verticals with different needs.

As with IT, a telco exposure platform must offer the ability to customize APIs. Beside the similarities, the main difference between telco and IT exposure is that Communications Service Provider (CSP) programmable assets are often provided by different vendors and may have different APIs with a similar purpose. As well as providing a single gateway for developers, a telco exposure platform also handles security aspects and gives the maximum support for development tasks, with information, documentation and Software Development Kits (SDKs).

Telco networks are on the threshold of 5G technology, creating additional requirements for network exposure. Telco API exposure must support access to microservices architecture-based network functions, as well as new service scenarios which require a different customized set of APIs from the 5G core. These scenarios include:

- Extreme Mobile Broadband embracing use cases such as ultra-high definition video and Augmented Reality (AR)/Virtual Reality (VR).
- Massive Machine Type Communication with Internet of Things (IoT) use cases where millions of different devices may communicate with each other.
- Ultra-Reliable Low Latency Communication (URLLC) where robot, drone and emergency use cases require instant response time with the highest possible availability and reliability.

As well as supporting 3GPP standards, 5G exposure platforms must offer more to developers than standard fulfillment. Differences between CSPs mean they need an exposure framework suited to telco needs in the new 5G world. As the main stakeholders in the telco API era, CSPs can take advantage of Open APIs to monetize and reform their business models. To do this, they need a flexible enabler platform where 5G core network APIs can be exposed as service-mashup APIs tailored for service cases. CSPs may use these service enablers in the best way if they look at their network as a platform for the monetization of new services. This view will allow them to build an open ecosystem that includes third party application developers and the CSP's enterprise customers and in which each stakeholder can meet its business objectives.

In this White Paper, we highlight Nokia's method of 5G API exposure. This is based on service mashup APIs and the plug-in concept, which provides extreme openness in Network Exposure Function (NEF) interfaces and allows the exposure of third-party APIs. This framework gives flexibility for CSPs to build an application ecosystem in a way that maximizes their participation in the creation of 5G services.

NOKIA

Telecommunication enabled with Open APIs

APIs in a CSP's business

APIs have been prevalent in CSP networks for a long time. They have been used partly for internal purposes, for example to integrate Customer Relationship Management (CRM) or other commercial management elements to a CSP's charging mechanism or even simply to integrate their IT platform resources to telco platforms. These uses of APIs improved operational efficiency and reduced Operational Expenditure (OPEX).

APIs are also used to provide programmable interfaces for third party applications, which may be integral part of a CSP's service portfolio and employing them as enablers of external services. Providing programmable interfaces for third party applications allows for an ecosystem that creates new, differentiating services and leads to increased revenues. Creating services using APIs usually offers faster time to market and improved customer satisfaction. Innovation is continuous and rapid, where third parties as well as CSPs see great potential in the creative possibilities of using APIs.

Any CSP's API strategy must fit its short- and long-term business aspirations, and account for third party service providers who are their competitors in service creation. A CSP's network can become a platform by providing access for developers to its data and programmability resources. Pre-5G digital networks provide many programming interfaces to developers. Becoming a platform provider for a live application ecosystem holds much promise for the telco provider but they must deal with the problem of network complexity. Most CSP networks are multivendor. Even pre-5G core network components, which may have their own APIs, may be based on different kinds of API access, different SDKs, and completely different API functions.

CSP challenges around APIs

CSPs own the enabler network assets, which means they face unique challenges in creating the API exposure strategy:

- Multivendor core network elements may have different APIs and different SDKs, while its own network and infrastructure related management APIs may differ. Integration into a single management system will entail a large amount of work.
- They must secure their network from access by third party applications and must also set rules about how untrusted applications may or may not access the APIs.
- Different vendors' SDKs and documentation for APIs are available in different portals. If a CSP wants to encourage third party developers to compose new cloud applications using their network, using many different portals will slow this creation.
- CSPs in many use cases would like to monetize the use of their APIs based on transactions. There must be a monetization engine which cooperates with the CSP's charging method.

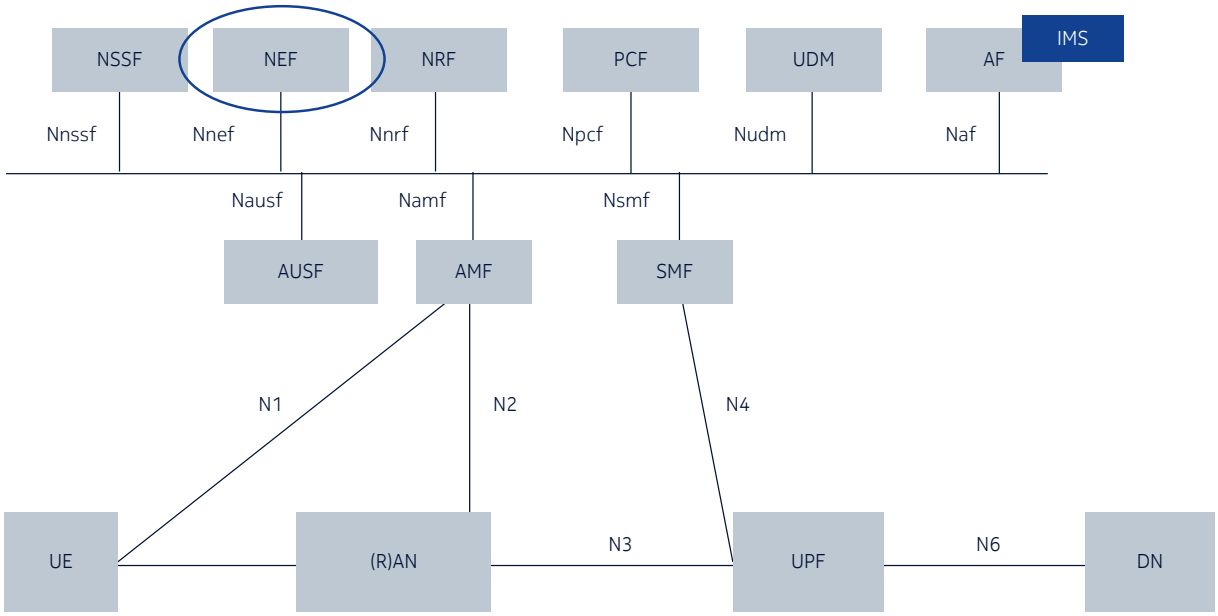
The above threats increase time to market because of the complexity developers might need to deal with. As well as this, the security aspects of using APIs may need attention - since the telco network traditionally must fulfill very high availability and Service Level Agreement (SLA) demands, its access by third parties must be secure and governed by rules. The above challenges also have a commercial aspect – there must be smooth and secure integration of charging related elements. As well as the issues with the exposure framework itself, the industry is further complicating the picture with the addition of 5G and its impact on network architecture.

5G impact on CSP core network APIs

New service scenarios and new core architectures

Pre-5G core network architectures seldom used RESTful APIs, but with 5G these can be exploited fully. RESTful APIs have http-based inquiries, simplifying core network evolution to Service-Based Architecture (SBA). The internal communications of network functions also use the http protocol. Pre-5G network APIs are currently used in commercial applications – Telecom Application Server (TAS) APIs for call management functions and narrowband IoT related use cases where provisioning and IoT function related queries are managed using APIs.

Figure 1. Service-based representation of core network, with message bus concept for control plane interactions



5G service scenarios also determine the development of 5G core technology. The 5G core is a service-based architecture where new 5G specific network functions ensure high-level flexibility. The following use cases are examples of a wide range of services that can be developed in 5G:

- eMBB (enhanced Mobile Broadband), an example would be UHD video live-streaming by fans at a sporting event. These applications may invoke 5G core APIs to provide an appropriate (Quality of Service (QoS) for a stream.
- mMTC (massive Machine Type Communications) use cases are set for an exponential increase in the number and variety of IoT devices connected to the network, requiring the 5G core network to be adapted. As new functions appear, different authentication and provisioning methodologies will be needed to manage the continuous connection of IoT devices with special supervision demands.
- URLCC is used where response time is critical, such as remote surgery. Once the network has enabled the ultra-low latency, it needs to guarantee it according to the SLA. Multi-Access Edge Computing (MEC) is a major enabler of URLCC which requires operational access to QoS and user location management. These functions in the 5G core network can be managed by APIs accessing MEC functions.

NOKIA

The new era of the 5G application ecosystem

Open ecosystems are communities that create value in mutually beneficial relationships. Transparency and trust are needed for this to work. One main pillar of this openness is partnering, in which CSPs become part of the third-party service innovation and where service providers get closer to the service enabler elements. Both parties contribute their own assets to grow the business and satisfy customers. The benefits include improved time to market and the creation of innovative services.

With its openness and programmability, the CSP's 5G core network can act as a key service enabler. CSPs, as key stakeholders in the incubation of new services, can benefit from new business opportunities. However, CSPs also require future-proof solutions that will be safe even if their core infrastructure is supplied by several vendors. 5G adds many new enablers which CSPs can more quickly and more deeply take advantage of by partnering with third parties .

The new application ecosystem will be about:

- For CSPs: customize programmable assets as a platform for collaboration and innovation
- For developers: use the open assets to accelerate development of new apps and services
- For customers: tailored services, provisioned rapidly.

CSP goals with new 5G API-based services

CSPs have an important role in the 5G world, where the opportunities for Open APIs are increasing.

- Gain the desired business agility with new Open API-based services using the 'short time to market, fast to fail' concept.
- Build a successful model to develop consumer services, find the differentiators and the opportunities for monetization.
- Service creation for enterprise customers. Identify the needs of verticals and open their network as a platform for collaboration.
- Simplify management systems for enterprises.

The greatest benefits for CSPs will come when these aims are achieved using as much of their current infrastructure and APIs as possible. Often, these will come from a number of vendors.

CSPs can transform their businesses by making full use of their current Operations Support System (OSS) / Business Support System (BSS) and providing an API platform for developers that supports the creation of new services and cloud applications. A well-constructed API exposure framework is key to achieving these goals.

All stakeholders will need common rules for creating applications that support developers and provide a high level of security for the network. An ideal exposure platform meets both of these conditions.

CSPs have two further requirements:

- Deal with multivendor core APIs through a single point of access, the API gateway.
- Offer customizable APIs to make developers' tasks easier.

NOKIA

High level API management framework

How exposure platforms support telco APIs in 4G and 5G

Telco related APIs and their exposure frameworks are currently based on 4G technology. 3GPP releases define how a management platform should function, with release 13 and above regulating the Service Capability Exposure Function (SCEF). This platform has many advanced capabilities, such as monitoring and notification between IoT application servers and user equipment. As millions of IoT devices attach to the cellular network, SCEF ensures they are as energy efficient as possible.

As the telco world moves towards 5G, 3GPP has defined the new API exposure platform to serve all the needs of new 5G service scenarios. It has also prepared the platform for even more flexibility and openness in 3GPP release 15 and beyond.

The requirements include:

- Support 5G service-based architecture and expose their network functions
- Guarantee 5G core stability with rate limitations
- Exposure of RESTful APIs
- Single API gateway function for all core APIs
- Monitoring and provisioning functions
- Policy and charging functions
- Exposure of core network internal capabilities for analytics.

These requirements produce framework capabilities that support developers and make it easier to create new services. But do they really solve CSPs' main concerns? The multivendor core must be exposed through a single API gateway. Overlapping APIs must be structured, and developers need information about the SDKs and a description of the exposed APIs. They need tailor-made advanced exposure which makes it easier to create cloud applications and services for their customers.

CSPs' enterprise customers come from different industries, for example public safety or eHealth related firms, which may need different high-level APIs. Consequently, the type of cloud applications required are different.

To meet these needs, CSPs require new ecosystem-based business models that lead to new key criteria for a successful exposure platform:

- Powering developer programs, designing and publishing new APIs, managing their traffic and guaranteeing their security
- Managing the entire API portfolio, exposing a catalog of capabilities
- Properly documenting all functions and SDKs
- Security and integrity of the back-end system through authentication and rate limiting
- Supporting interworking between different systems and different APIs.

Nokia's approach to open API ecosystems

A common exposure platform

Nokia believes in a common exposure platform for CSPs, developers and third-party application providers, based on clear rules, ease of creation and openness to help CSPs meet their goals as they move to 5G. A good network exposure platform will have the following functions:

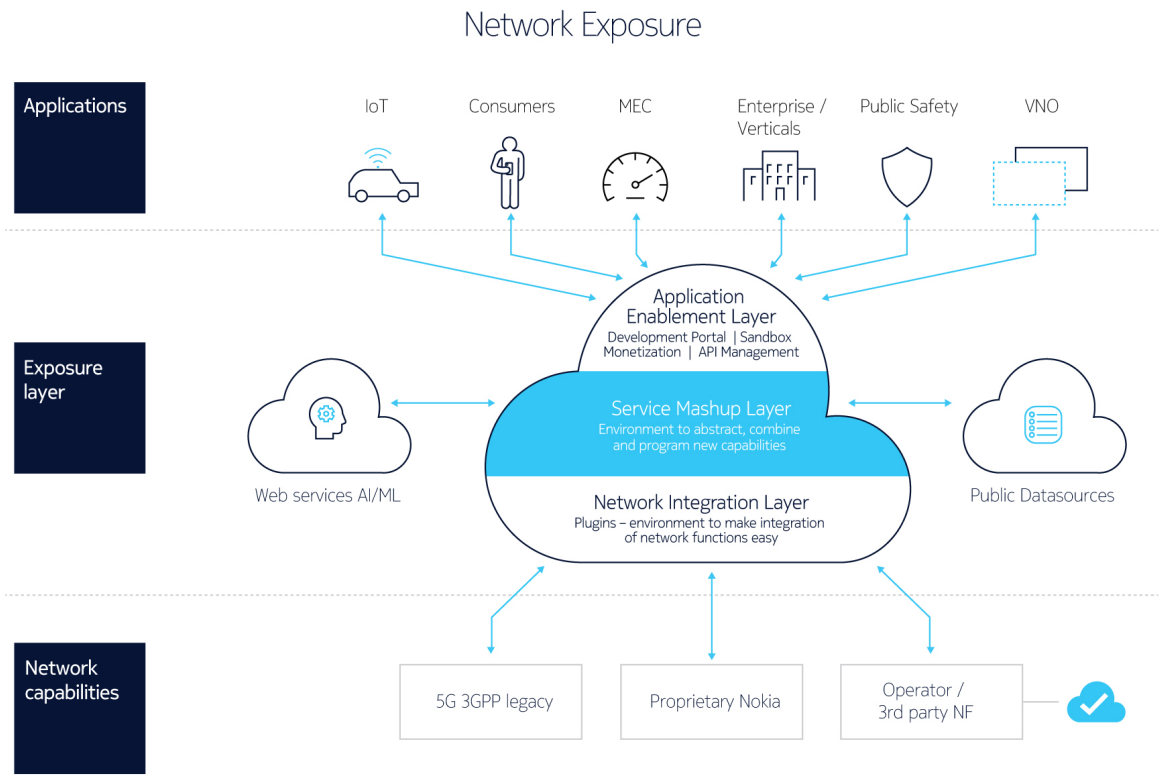
- Expose network services to third party applications via APIs.
- Developer environment and SDK for CSP and community.
- Service mashup to create end-to-end offers that combine all network assets.
- Integration layer to connect to CSP's network elements.

The Nokia Network Exposure Function (NEF) gives CSPs a robust platform to consolidate APIs and offer unified access to the API framework, for both the CSP and third-party developers.

Exposure of advanced application capabilities

In addition to exposing the mandatory functions defined by 3GPP, Nokia NEF supports API plug-ins. These make it possible to create complex API exposure areas with ease, which may be extended as the exposure platform evolves to meet changing customer needs. Third party plug-ins can provide extreme openness for CSPs with a multivendor core and overlapping APIs. Nokia NEF provides this comprehensive plug-in facility.

Figure 2. Nokia Network Exposure function with service mashup APIs for verticals and advanced Nokia plug-ins



NOKIA

Exposure of other vendors' network elements APIs

Using NEF southbound protocols, other vendors' network element APIs can be integrated by adapting and transforming their protocols as RESTful APIs. This feature is provided by Nokia NEF as an advanced capability. Other vendors' APIs may be integrated as a single plug-in under the exposure platform. CSPs can deal with overlapping APIs by structuring and exposing them in a single gateway to simplify the applications/ services creation process.

The advanced Nokia API plug-ins

The plug-in facility allows new API integrations and compositions, as well as using pre-defined ones. These provide instant access to the respective area APIs, allowing the developer to reduce the time to market and complexity of the new service.

Plug-ins are composed around the following areas:

- The TAS call management plug-in has many features, with functions to redirect calls, handle triggers from user interactions, call control and handling call logs. Many existing commercial applications have proven the benefits of the TAS Open API.
- Shared Data Layer: Subscriber and session related data may be exposed from the Shared Data Layer. NEF handles data distribution and data sharing with third party applications.
- Telco cloud infrastructure management, network function instantiation and scaling. This type of API exposure may benefit those enterprise customers that already have operational control software, in which southbound interfaces may have integrated functions with secure exposure of the NEF.
- WebRTC for in-browser related real-time communications is an important pillar of NEF southbound plug-ins. A typical CSP use case is to enable multi-device services for their customers. These services are extended via web browsers to provide a feature rich, contextual mobile experience. Developers can use these communication assets via WebRTC APIs to create appealing mobile services and customized web applications. CSPs can unlock revenue streams and use cases by exposing their assets to web developers securely, to control media and signaling streams across the IP Multimedia Subsystem (IMS) network.
- The data analytics and messaging NEF plug-ins offer advanced exposure of big data, machine learning and rich communication services.
- Multi-access edge computing to manage the locations of edge network resources, for example, user plane functions for endpoint bandwidth and latency management. Edge specific network information will be exposed with this function according to a Nokia roadmap.

Special plug-in to ensure backward compatibility of IoT APIs

IoT analytics, device management and provisioning was an early IoT-related API exposure use case. Nokia supported these scenarios in 3G and 4G architectures by fulfilling 3GPP release 13 regulations with its Service Capability Exposure Function (SCEF). The SCEF specifications were further refined with RESTful APIs (T8 interface) in 3GPP release 15.

SCEF is used predominantly for Narrowband IoT (NB-IoT) and LETOM communications. The supported use cases include:

- Monitoring events and status, e.g. device reachability
- Service configuration, e.g. power saving mode
- Network resource management, e.g. background data transfer
- Control plane messaging, e.g. NIDD
- Policy and Charging control, e.g. chargeable party.

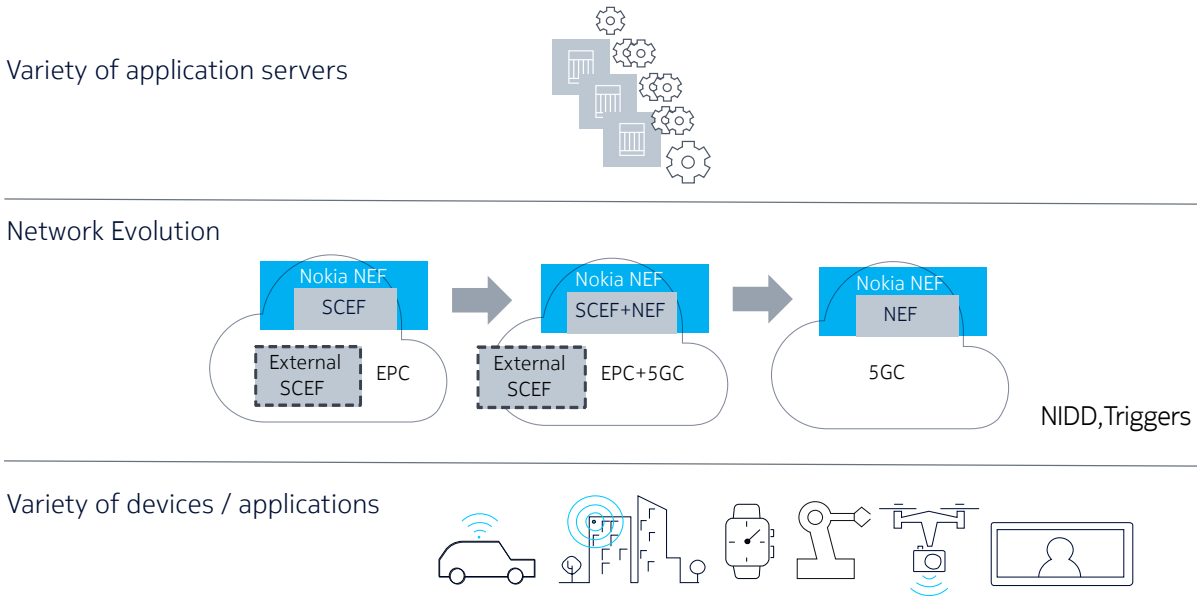
With recent developments in 5G network exposure platform, NEF now must fulfill two main criteria:

- Provide backwards compatibility of the established SCEF based IoT managment platforms
- Fulfill the requirements 5G API exposure with NEF as an integral part of the 5G core in the service-based architecture.

These requirements are achieved by NEF, which supports SCEF and 5G NEF scenarios. The following principal architectures exist:

- External SCEF supports the Evolved Packet Core (EPC) network, NEF acts as a gateway for external applications
- NEF supports EPC and 5G core for IoT API exposure in a single API Gateway.

Figure 3. Embedded or External SCEF in NEF architecture



Service mashup APIs

The key success factor for API integration for third party applications and services is their ease of use. The core API features must meet the user's needs, which they can realize by invoking telco cloud APIs.

The following verticals may have different business needs for a set of higher-level APIs:

- Consumers, Health and Home
- IoT / Connected Cars
- MEC
- Connected utilities, enterprise
- Smart cities
- Public Safety

The NEF service mashup function transforms core APIs into services, lifting them into the higher abstraction layer. This means developers may not need to learn all the related core APIs and SDKs. Instead, they will have a customized form of service creation with much larger building blocks of API functions tailored to their type of services.

Conclusion

5G core network architecture is changing to service-based architecture, while 5G network functions are evolving and supporting new 5G service scenarios. In parallel, open API requirements are also changing, with a clear and well-defined need for an API exposure framework with a single API gateway. This framework must fulfill all telco specific API exposure needs while also meeting 3GPP standards.

CSPs face the challenge of dealing with their multivendor core and with an overlapping API structure. In addition, application developers require an API mashup capability for a customized set of APIs to meet the needs of different verticals.

As providers of the programmable platform, CSPs already have an API strategy, which should reflect their aims in the forthcoming 5G API era. It is also important that CSPs view their programmable network as a platform and use it as a way of partnering in and supporting the creation of applications, contributing to building a new 5G telco API based ecosystem.

If the API exposure platform is well designed and allows openness for other APIs, then developers are one step closer to implementing their business logic in new services. Nokia Network Exposure Function is designed to achieve this.

NOKIA

Abbreviations

3GPP	3rd Generation Partnership Project
API	Application Programming Interface
AR	Augmented Reality
BSS	Business Support System
CRM	Customer Relationship Management
CSP	Communications Service Provider
eMBB	enhanced Mobile Broadband
IoT	Internet of Things
LTE-M	Long Term Evolution for Machines
MEC	Multi-Access Edge Computing
mMTC	massive Machine Type Communications
NB-IoT	Narrow Band IoT
NEF	Network Exposure Function
OPEX	Operational Expenditure
OSS	Operations Support System
QoS	Quality of Service
SCEF	Service Capability Exposure Function
SDK	Software Development Kit
SDL	Shared Data Layer
SLA	Service Level Agreement
TAS	Telecom Application Server
UHD	Ultra-High Definition
URLCC	Ultra Reliable Low Latency Communications
VNF	Virtualized Network Function
VR	Virtual Reality
WebRTC	Web Real Time Communications

Further reading

White paper: Building a cloud-native core for a 5G world https://onestore.nokia.com/asset/200888

Nokia open ecosystem https://open-ecosystem.org/

NOKIA

About Nokia

We create the technology to connect the world. Only Nokia offers a comprehensive portfolio of network equipment, software, services and licensing opportunities across the globe. With our commitment to innovation, driven by the award-winning Nokia Bell Labs, we are a leader in the development and deployment of 5G networks.

Our communications service provider customers support more than 6.4 billion subscriptions with our radio networks, and our enterprise customers have deployed over 1,300 industrial networks worldwide. Adhering to the highest ethical standards, we transform how people live, work and communicate. For our latest updates, please visit us online www.nokia.com and follow us on Twitter @nokia.

Nokia OYJ
Karakaari 7
02610 Espoo
Finland
Tel. +358 (0) 10 44 88 000

Document code: SR2003042473EN (March) CID206254