

SOLUTION BRIEF

Capture new
opportunities
with Advanced 5G

5GA

NOKIA

Design your path to Advanced 5G

Nokia Advanced 5G is a set of software solutions that provides a platform for new exciting opportunities.

We have built these solutions on the strong foundation of our industry-leading radio and baseband products and our latest innovations, while leveraging inputs from standards, customers and partners.

We focus on what matters most to our customers:

- **Enhanced end-user experience** enabled by premium performance, which is also reflected in network KPIs.
- **New monetization opportunities** and service revenues enabled by end-to-end network capabilities.
- **Efficient and sustainable use of resources** and the possibility to build on existing 5G investments to drive down costs.



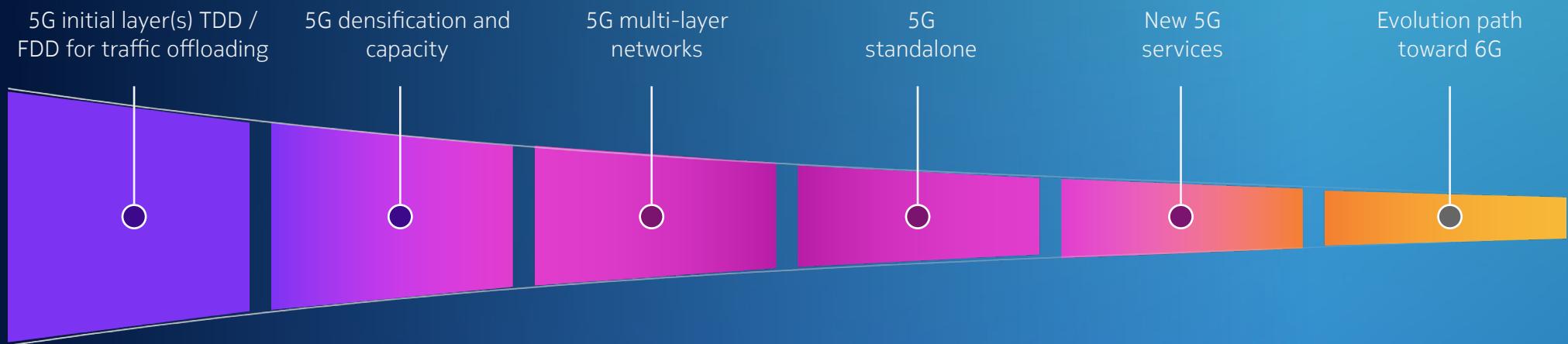
- **Next-level AI efficiency** for intelligent optimization and autonomous network operations.

In addition to 3GPP developments, also other complimentary areas play a role in 5G evolution, such as cloudification, end-to-end slicing and open APIs.

We provide true flexibility for our customers to select the optimal combination of capabilities that supports their evolution journey.

This solution brief describes our Advanced 5G software solutions, which help our customers differentiate user experiences, drive additional revenue growth and optimize the total cost of ownership (TCO) for their radio networks.

5G Standalone is key to unlocking full benefits of Advanced 5G



5G is the fastest-deployed radio access network generation. From 2018 till today, Nokia has deployed 5G with over 300 customers globally.

In the first phases, the focus was in 4G to 5G subscriber migration and coverage densification in busy urban and indoor areas.

In fact, 5G has been very successful in maximizing data rates and delivering high capacity for mobile broadband use cases and fixed wireless access.

To fully benefit from Advanced 5G, a transition to multi-layer 5G Standalone is essential.

We can help you move to 5G Standalone, building the foundation for new use cases and revenue models that Advanced 5G enables, and paving a seamless evolution path to 6G.

Nokia Advanced 5G solutions with all-encompassing AI

Nokia Advanced 5G software solutions focus on user experience, revenue growth, a sustainable TCO and AI efficiencies.



Enhance user experience

Enabling premium performance beyond current 5G

Network performance is at the heart of mobile users' quality of experience.

From technology perspective, delivering premium performance is a combination of several contributing factors. These include uplink and downlink data rates, latency, mobility, packet loss, coverage, consistency and availability.

With Advanced 5G, we are further enhancing our comprehensive suite of beamforming algorithms and Massive MIMO techniques to expand 5G capacity and coverage and optimize spectrum utilization.

We will ensure smooth, uninterrupted service with less interference, providing optimized data rates from cell center to cell edge.

Smartphones need to support increasingly high processing loads, which has an impact on device battery life and mobile users' perception of service.

Our Advanced 5G software capabilities help enhance device power efficiency.

For example, we will reduce signaling overhead, enable user equipment to stay longer in an idle state and monitor the control channel less frequently.

Network transformation is driven by the desire to improve customer experience and enable new services.

Source: GSMA Intelligence

Enhance user experience

Ultra Performance for boosting throughput and spectral efficiency

As network demands escalate due to the proliferation of AI-based device applications, live broadcasting, AR/VR and gaming, our Advanced 5G solutions provide the essential capabilities to build ultra-performing networks.

The increasing volume of both downlink and uplink traffic necessitates a significant boost in network capacity and performance. Our Advanced 5G Ultra-Performance solution is engineered to meet these challenges, offering a suite of innovations that enhance network efficiency, user experience and revenue potential.

Business outcome	Solution highlights
<ul style="list-style-type: none">• Boost network capacity and ensure optimal spectrum usage, which is essential in accommodating exponential growth in data traffic.• Improve uplink performance in diverse network conditions for applications such as IoT, live broadcasting and AR/VR.• Uninterrupted service quality even in high-density or high-mobility scenarios.	<ul style="list-style-type: none">• Increased spectral efficiency and thereby average downlink cell throughput, using zero-forcing multi-user MIMO.• Higher uplink throughputs with advanced uplink Tx switching, enabling 2 uplink single-user MIMO layer transmission.• Flexible configuration of Downlink Carrier Aggregation across multiple gNBs for enhanced user experience.

Unlock more revenue

Powering new use cases and monetization opportunities

Our Advanced 5G capabilities supported by flexible network architectures help our customers capture new market opportunities.

We enable user and service differentiation beyond what is possible today. Our customers will be able to offer premium services with guaranteed SLAs and enable real-time experiences at live events.

Advanced 5G plays a key role also in accelerating the digital transformation of industries.

New capabilities such as precise positioning support advanced use cases where precise location information is critical, including industrial automation, logistics, autonomous vehicles and public safety.

For mission-critical services such as emergency response and for critical industrial applications that must operate without interruption, we ensure high reliability and availability.

As the 5G ecosystem expands with new types of IoT use cases and low-cost consumer devices, we will see many more services developing around technologies such as RedCap and slicing.

The next sections describe in more detail examples of our Advanced 5G solutions that enable new monetization opportunities.

Unlock more revenue

Enhanced RedCap powering wearables and industrial IoT

The introduction of RedCap expanded the 5G ecosystem with potentially billions of new connected low-cost, low-complexity devices that require lower data rates.

Enhanced RedCap is an example of our Advanced 5G solutions that can unlock new business opportunities for operators, enterprises and industries.

Business outcome	Solution highlights
<ul style="list-style-type: none">Enables increased capacity to support a massive number of devices.Provides an evolutionary path for IoT applications currently served by low-end IoT devices.Ensures high reliability and low latency for 5G IoT industrial applications.Extends 5G wearable device battery life by enabling deep sleep for the device.	<ul style="list-style-type: none">Extended discontinuous reception (eDRX) for radio resource control (RRC) Idle and Inactive states.Support for low-complexity devices with modest data rate requirements.



Unlock more revenue

Dynamic Slicing for new revenue opportunities and tailored QoS

Dynamic Slicing is an example of our Advanced 5G solutions that helps our customers unlock new monetization opportunities with consumer and enterprise services.

With Dynamic Slicing, our customers can optimize and prioritize the use of network resources for targeted use cases. It enables guaranteed level of performance, latency and availability for premium broadband services such as fixed wireless access, on-demand services and other tailored slices.

Business outcome

- Opens more market opportunities for premium broadband services for consumers and enterprises.
- Enables tailored network slices such as on-demand priority slicing in an event, application-based slicing, guaranteed performance slicing with SLAs and slicing for differentiated services.
- Enhances end user experience for use cases that require low latency and high bandwidth.

Solution highlights

- Slice-aware admission control allows flexible partitioning of upper layer radio resources at the Control Plane, ensuring isolation between resource groups.
- Slice-aware scheduler with QoS fairness enhances radio resource partitioning with a QoS-based common resource pool.
- Scheduling Request (SR) and proactive grants optimization delivers cell-level admission control and pre-emption for SR resources to ensure fair and equitable allocation of shared capacity.



Unlock more revenue

Differentiated Services for immersive experiences

To enable large-scale deployments of real-time applications, we go beyond today's congestion control mechanisms, delivering constantly low latencies no matter how busy the network is.

Together with Elisa, a leading mobile operator in Finland, we implemented a successful proof of concept of L4S technology in Elisa's 5G network, demonstrating how it can reduce latency for a live 360-degree video stream.

Business outcome

- Enables consistently low latencies for use cases such as extended reality, cloud gaming, enterprise applications, digital twins and remote control of industrial equipment.
- Enables AI-driven industrial use cases such as predictive maintenance by meeting stringent latency requirements for rapid communication with edge AI models. This ensures real-time decision-making.
- Guarantees QoS for service assurance.
- Enables real-time connected experiences built into live sporting events and concerts.

Solution highlights

- Low latency, low loss, scalable throughput (L4S) is based on pioneering Nokia Bell Labs research. It minimizes latency and jitter for real-time applications by reducing packet buffering.
- Delay-critical guaranteed bit rate (GBR) service introduces maximum data burst volume (MDBV) as a QoS parameter along with more stringent packet delay budgets.
- Service-based scheduling request prioritization based on data radio bearer (DRB) priority ensures high-priority traffic is not impacted by congestion.

More than

90%

Measured reduction in latency with L4S in Elisa's 5G network when live streaming a hockey game using a 360-degree video.

Unlock more revenue

Precise Positioning for enhanced accuracy and safety

Precise location information can enhance efficiency and safety in a wide variety of use cases. Examples include industrial automation, logistics, autonomous vehicles and public safety.

Precise Positioning enables enhanced cellular positioning accuracy indoors, including tunnels and industrial buildings, and outdoors, complementing the global navigation satellite systems.

Business outcome

- Unlocks new revenue opportunities for operators offering high-accuracy positioning services.
- Enables better resource allocation for enterprises with efficient tracking of personnel, assets and equipment.
- Enhances safety by tracking employees' location in hazardous environments such as construction sites or chemical plants.
- Helps track medical equipment, locate patients and monitor staff at hospitals.
- Enables safer and more accurate navigation for autonomous vehicles and drones.

Solution highlights

- Enhancing timing advance (TAdv) resolution improves the accuracy of calculating user equipment (UE) position. This technique enables higher precision of the timing adjustment and finer granularity of the Tadv range reported to the Location Server when the NR Enhanced Cell ID (NR E-CID) positioning method is used.
- Our indoor positioning techniques provide accurate location tracking in non-line-of-sight areas.

Unlock more revenue

Critical Services for prioritizing and optimizing mission-critical traffic

As we proceed through the 5G era on the way to 6G, the market is driven by the increasing need to:

- Modernize critical infrastructure.
- Enhance public safety and security.
- Improve real-time situational awareness.
- Support advanced industrial automation.

Business outcome
<ul style="list-style-type: none">• Enables transformation, automation and optimization of critical networks.• Delivers essential services for smarter, safer, more sustainable urban environments.• Unlocks new revenue streams across sectors like railways, utilities and smart cities.

Solution highlights
<ul style="list-style-type: none">• Support for 3GPP standardized 5QI values (65, 66, 67, 69, and 70), specifically designed for mission-critical and push-to-talk services.• Enables dedicated QoS for mission-critical services and provides a mechanism for prioritizing these services, ensuring their performance even under congested network conditions.

Achieve sustainable TCO savings

Smart Green Networks for optimizing energy savings

Mobile network energy efficiency is one of the pressing concerns for operators. Our product and service portfolio helps our customers deliver more traffic while minimizing RAN energy consumption in all traffic conditions.

Our AI/ML-based solution automates and optimizes the configuration of energy-saving software features at the cell level while maintaining KPIs such as throughput, latency and reliability at the required level.



Business outcome

- Automated RAN energy management enhances energy efficiency while maintaining QoS and network KPIs at the required level.
- The solution is future-proof and capable of self-optimization for energy efficiency.
- Helps reduce carbon footprint on the path to net-zero networks.
- Drives down network electricity costs.

Solution highlights

- Machine learning-based energy optimization approach uses deep learning to predict traffic loads and determine activation periods for switching off layers and MIMO muting.
- Intelligently turns on/off thresholds ensuring optimal QoS for diverse traffic patterns.

up to

20%

Measured reduction in energy consumption on top of RAN energy-saving features in a semi-urban site with 1 TDD + 2 FDD layers.

Note: Nokia MantaRay SON is a pre-requisite for Smart Green Networks software subscription.

Enable next-level AI efficiencies

AI for RAN enables optimization based on real-time patterns

AI for RAN means that we apply artificial intelligence to augment radio access networks.

Each radio technology generation has increased the traffic volumes and the number of parameters that allow to fine-tune the network.

Previously, most RAN optimization tasks have been handled manually by expert engineers.

With our AI-based solutions, our customers can optimize RAN

performance, increase network capacity and enhance operational efficiency in real-time without manual intervention.

A concrete example is MantaRay AutoPilot for autonomous RAN operations, introduced in the next section.

We are also developing more AI capabilities to further enhance RAN spectral efficiency and quality of experience by enabling radio networks to learn and adapt resources in real-time.



Read AI for RAN
white paper

Enable next-level AI efficiencies

MantaRay AutoPilot for AI-driven autonomous RAN operations

MantaRay AutoPilot represents a giant step in automation. By harnessing artificial intelligence, it helps our customers simplify operations, maximize network performance, optimize efficiencies and minimize operational costs.

AI can handle routine operations significantly faster and produce better quality than previous network optimization tools and methods.



Read MantaRay
AutoPilot solution
brief

Business outcome	Solution highlights	Results from a customer trial:
<ul style="list-style-type: none">Enhances network quality by optimizing performance and reducing human error.Autonomously detects degradation of performance compared to an objective.Helps reduce TCO for RAN operations and maintenance.Optimizes resource efficiency.	<ul style="list-style-type: none">Uses established AI algorithms such as K-means clustering for contextualization and enhanced algorithms for supervised learning and reinforcement learning.Uses cell contextualization to identify network issues, applies the right corrective actions by running the related optimization modules, verifies the results and if needed, takes further corrective actions.	<ul style="list-style-type: none">>1 million autonomous operations in 5 days without human intervention.30% enhancement in cell utilization.10% average enhancement in downlink throughput.

Note: Nokia MantaRay SON is a pre-requisite for MantaRay AutoPilot software subscription.

Why Nokia?



Strong foundation of innovation

Nokia Advanced 5G solutions are built on the solid foundation of our own innovations while leveraging inputs from standards, customers and partners.

Industry leadership in network slicing

We support all flavors of slicing, enabling our customers to isolate and monetize high-value traffic and enhance user experience with guaranteed service level agreements.

Industry leadership in AI for RAN

We provide all-encompassing AI capabilities to augment radio networks and lead the industry in AI-RAN research.

AI is built into AirScale base stations, our software solutions and services portfolio. Our customers have already achieved significant business outcomes with our AI-based solutions.

True flexibility for a future-proof evolution

With our anyRAN approach, we help our customers with their network transformation journey by offering a flexible combination of capabilities and network architectures that meet their business targets.

We enable safe investments with a future-proof evolution path to 6G.

Focusing on business outcome

With our Advanced 5G solutions, we help our customers achieve key business objectives: enhancing end-user experience, reducing TCO, maximizing efficiencies and unlocking new revenue streams.



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The Nokia logo is displayed in a large, white, sans-serif font. The letters are outlined in white, creating a high-contrast look against the blue background. The 'N' is a standard 'N', the 'O' is a circle, the 'K' has a diagonal stroke, the 'I' is a single vertical line, and the 'A' has a diagonal stroke on the right side.

Nokia is a global leader in connectivity for the AI era. With expertise across fixed, mobile, and transport networks, powered by the innovation of Nokia Bell Labs, we're advancing connectivity to secure a brighter world.

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