

Towards the largest software system in the world

Software engineering for 6G

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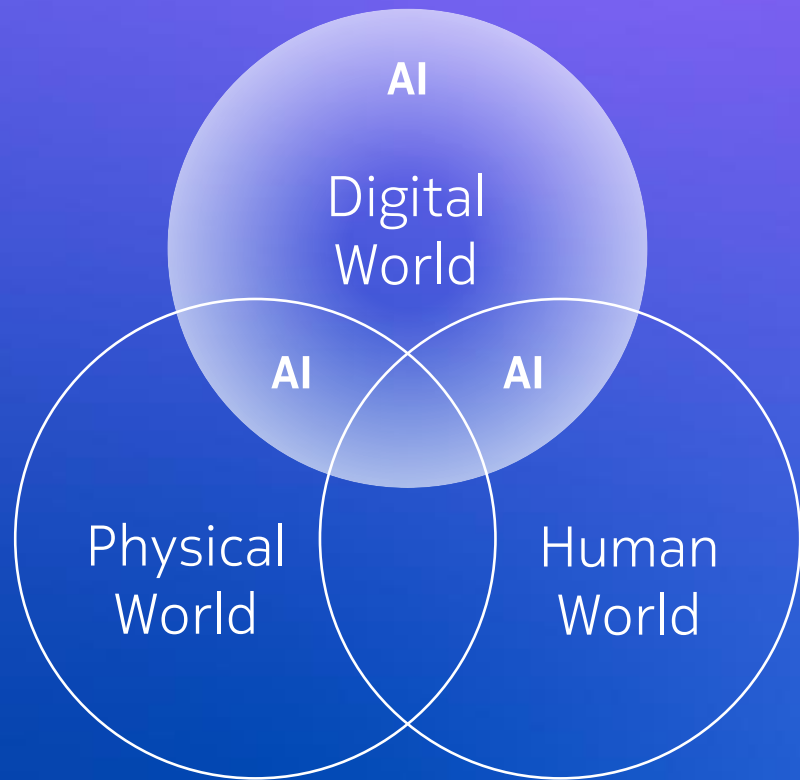
Mobile Networks, Nokia

May 12, 2025

The Nokia logo is a large, white, stylized 'N' shape that serves as a background element on the right side of the slide. It is composed of two thick diagonal lines meeting at a point in the center, forming a large arrow-like shape pointing towards the left.

NOKIA

Digital acceleration toward the quantum era



Macrotrends get stronger and more persistent.

AI is the primary engine of innovation over the next decade.

The AI revolution and industrial automation, along with increased security, and sustainability and monetization requirements, are driving a steady **evolution of the networks towards 6G**

The first decade of AI – software & data perspective

Artificial intelligence

Generative AI is transforming our relationship with information.

- LLMs revolutionize natural language interaction, and GenAI also drives discovery – e.g., new drugs, new materials
- Usefulness of AI solutions will depend on the amount and quality of data
- AI-assisted SW engineering covers all phases of the SW development lifecycle.

Quantum compute

Most quantum computing (QC) applications will be hybrid and consumed aaS.



Security

While cyber security and privacy needs are rising, AI and quantum technology are game changers, offering great benefits and new challenges.

ESG

Green, ethical and ESG compliant software is on the rise.

Global race to 6G

‘The global race to 6G has begun and the stakes are high, as 5G and 6G-enabled activity are estimated to generate €3 trillion in growth by 2030 worldwide. Businesses and countries are competing to build the next level of 6G mobile networks. The competition for 6G is also motivated by the need to ensure leadership in the technology and ensure the EU's digital sovereignty’

Source: European Parliament (2024). Path to 6G.

The push and pull trends point to the need for 6G

Trends and challenges



Demand for higher network performance

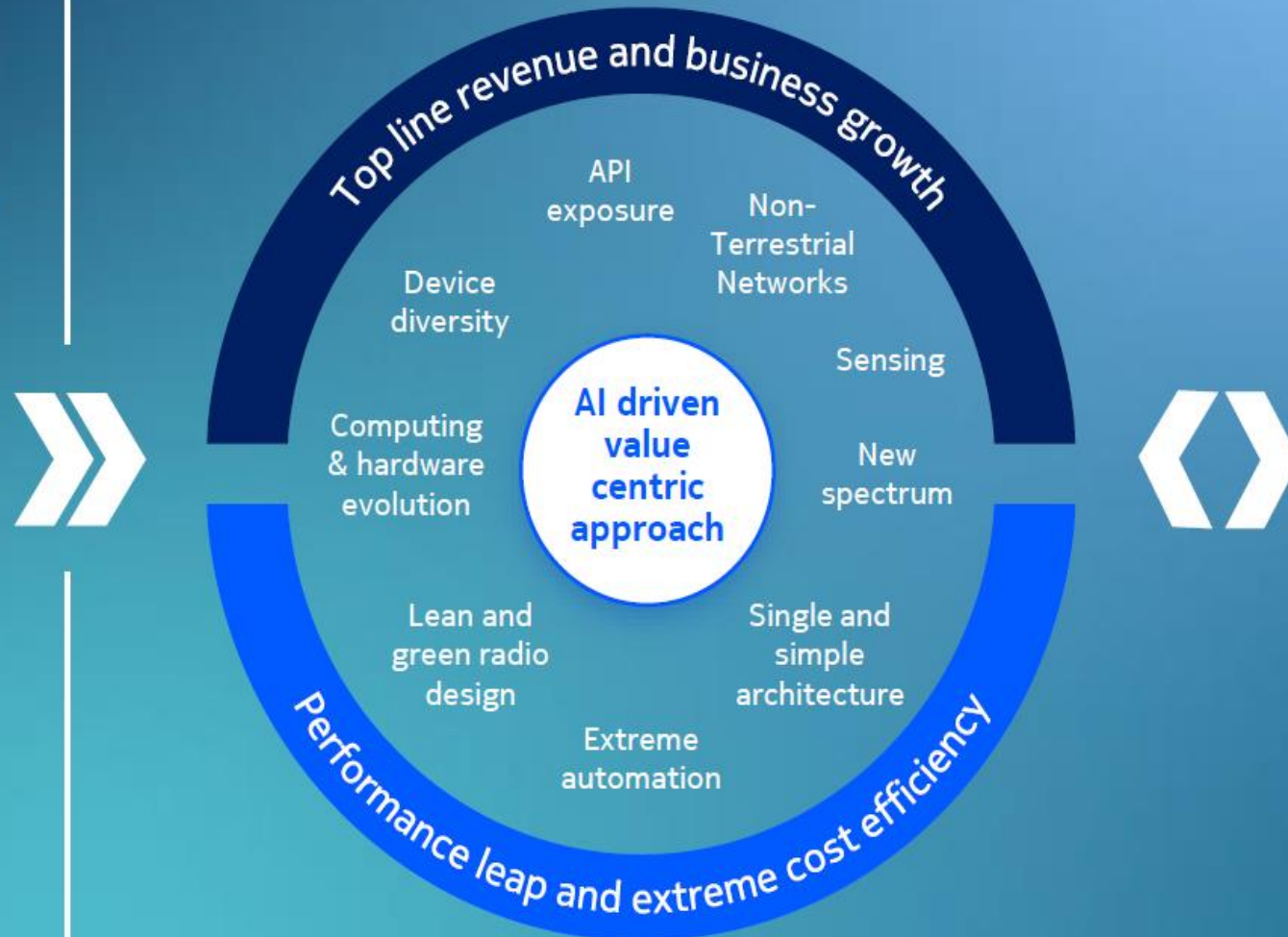


The vastly growing device ecosystem



The surging power of AI and emergence of the API economy

How 6G can address them



Design principles for 6G



Sustainable



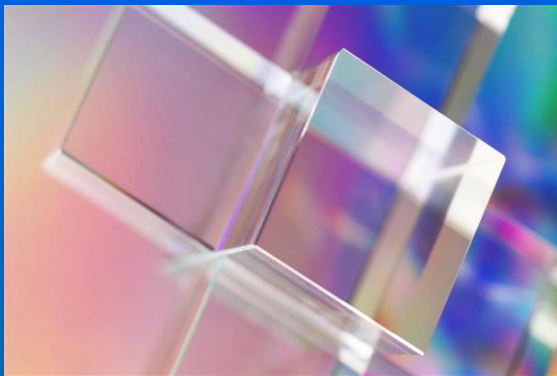
Resilient & Secure



Digital inclusive

Anticipated data traffic growth and technological evolution are shaping future wireless network

Key considerations for architecting a 6G network



Value-centric

Driving performance, network efficiency, innovation, and unlocking a new spectrum to fuel economic growth



Intelligent

Leveraging AI for network design, optimization, and operation, while ensuring seamless connectivity for devices and applications



Sustainable

Supporting a low-carbon, circular future, whereas fostering greater equity for people and the planet.

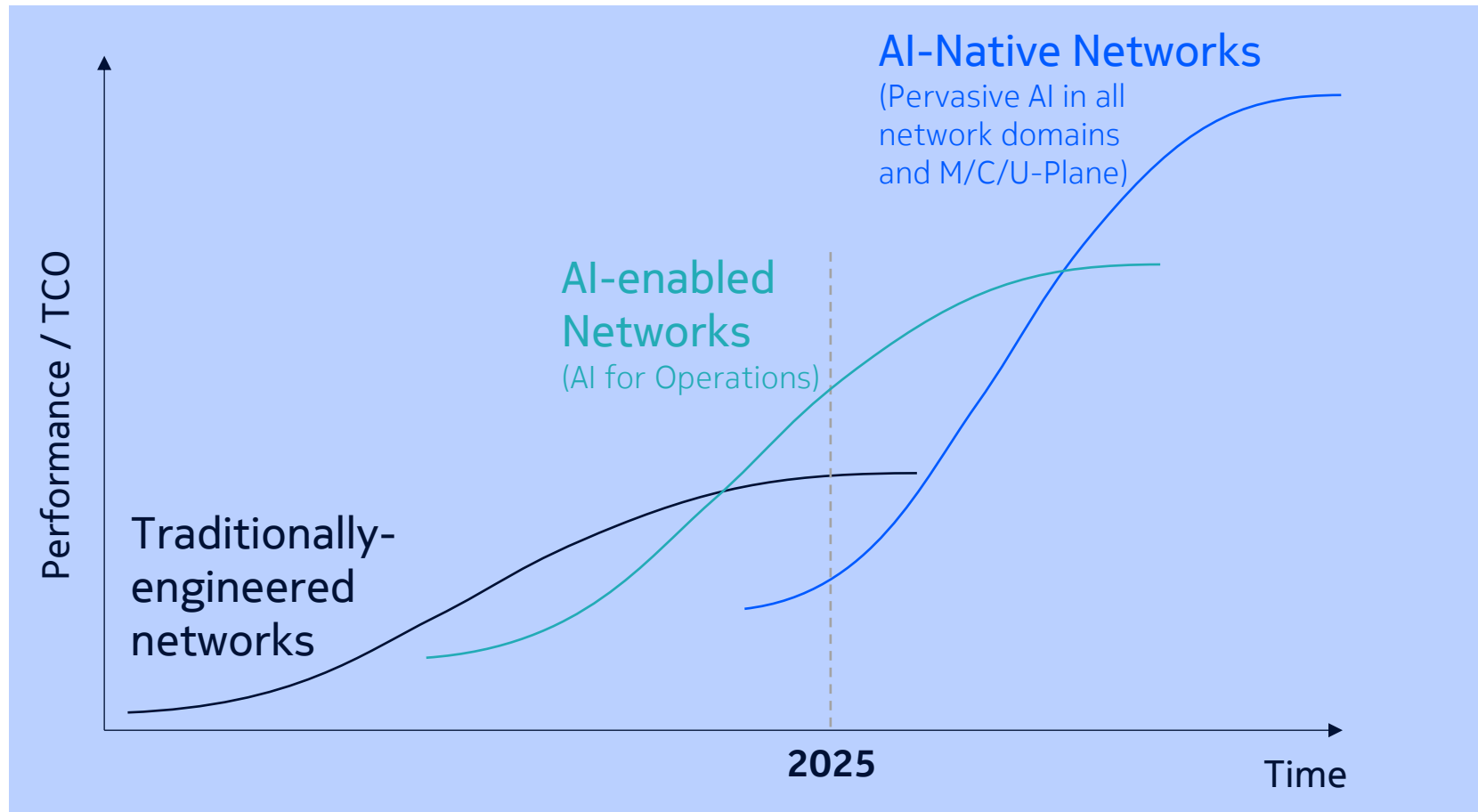


Cyber-resilient & secure

Focusing on innovative security measures and pioneering quantum-safe technologies

Intelligent - the rise of autonomous networks

Through an AI-native approach



Innovation “S-Curves”

AI will help to break limits in networking and can lead to a major innovation “S-curves” for what networks can achieve in terms of performance / cost ratios

**6G will be built on
AI and for AI**

Need for software engineering capabilities for 6G

Cloud-/AI-Native Network Architecture

Software engineering needed to design and implement microservices, containerization, and orchestration solutions for efficient network management

Core and Radio Access Network functions

Software engineering is needed to design and implement the software-defined and AI-enabled network functionalities & solutions for 6G

Applications and Services

Software engineering is needed to develop applications and services that leverage 6G capabilities for industrial IoT and immersive experiences, such as augmented reality, virtual reality, and holographic communication (e.g. industrial metaverse)

Security and Privacy

Software engineering is needed to develop security solutions to protect 6G networks and user data from cyber threats, including encryption, authentication, and intrusion detection.



Role of software engineering in 6G era

Software engineering is a fundamental pillar of 6G

6G will involve complex technologies like AI, cloud computing, and edge computing, requiring specialized software engineers with specific expertise.



Developing software engineering for 6G requires a collaborative approach

Joint-efforts needed together with diverse stakeholders from industry, academia, and government. This collaboration is essential to ensure interoperability, standardization, innovation, and responsible deployment of 6G technologies

Case examples from Nokia Veturi programs

QLEAP PROJECT: CONTAINERS AS THE QUANTUM LEAP IN SOFTWARE DEVELOPMENT

FEBRUARY 7, 2025

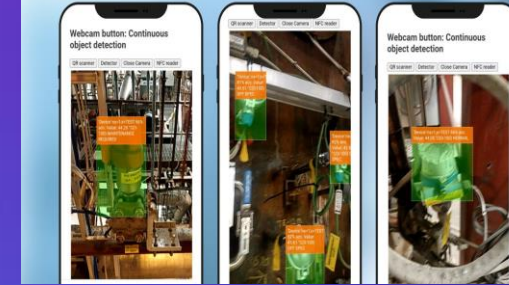
The QLeap project (2022-2024), funded by Business Finland and industry partners, explored how containers – small, flexible units of software that package applications and their dependencies – are changing modern software development.

Project consortium included Bittium, M-Files, Solita, Vaadin and University of Jyväskylä. The project was supported by Veturi companies Nokia and TietoEvry, and DIMECC-led [SW4E ecosystem](#). The motivation for the project stemmed from the growing adoption of microservices and continuous deployment, with containers increasingly replacing monolithic architectures (where all code runs as one big block) and Virtual Machines (VMs) to improve scalability, modularity, and resource efficiency.

While containers are widely used in cloud computing, QLeap focused on solving challenges beyond traditional cloud environments. As Professor Tommi Mikkonen (University of Jyväskylä) explains:

“We sought best practices and practical challenges in container technology usage outside pure cloud environments. These include regulated development, containerization of AI, and containers in IoT environments.”

Nokia: Speeding up AI and audio-visual trials in 5G environments



Artificial intelligence and high-speed wireless communications (5G) are key technologies in the ongoing industrial revolution. The AISA (AI-based Situational Awareness) project strengthens the ability of Finnish industrial companies and research institutes to apply these technologies at the forefront.



VTT, Nokia and Sandvik take steps together towards safe autonomous underground mining supported by 5G and edge intelligence

SoC HUB

Ecosystem initiative for a world-class co-developed Finnish System-on-Chip

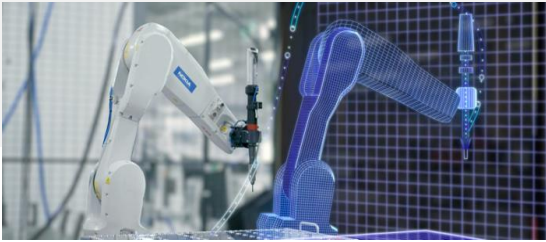
RF SAMPO project strengthens Finland's competitiveness in radio technologies

RF Sampo is the lead ecosystem project for the Optimized Antenna Technology theme under the Nokia Veturi program.

A consortium of major industrial and academic stakeholders led by Nokia and coordinated by the University of Oulu will start a massive project aiming to speed up the development of RF and antenna technologies and accelerate the transition from 5G to 6G. The project contributes to creating new jobs and new business opportunities through

Key implications – Call to action

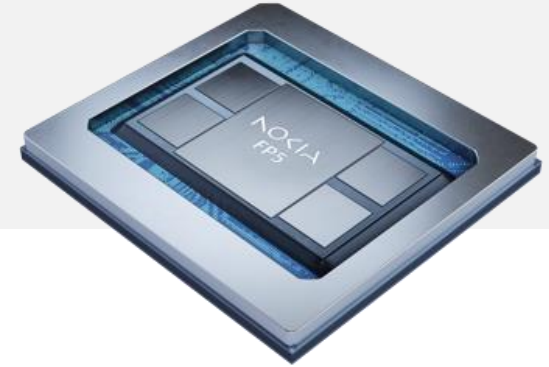
Towards the largest software system in the world in Finland



- The exact features, functionalities, and applications of 6G are still being defined. A broader scope will require new software engineering capabilities. For example, competence in network architecture, cloud computing, AI/ML, security, and application development will be crucial
- **Increasing need** for software engineers



- Developing 6G requires a **collaborative approach** that brings together diverse stakeholders from industry, academia, and government. This collaboration is essential to ensure interoperability, standardization, innovation, and responsible deployment of 6G technologies
- **Need** for joint-efforts with academia



- Significant growth potential at the multiple levels
- As 6G evolves, the demand for software engineers will continue to grow. It will be a massive collaborative effort involving a large and diverse pool of software engineering talent
- **Need for investments** on AI-native software engineering, high-quality R&D, education and platform-based market development

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