

5G Evolution and beyond

Transformation in Technologie und Wertschöpfung

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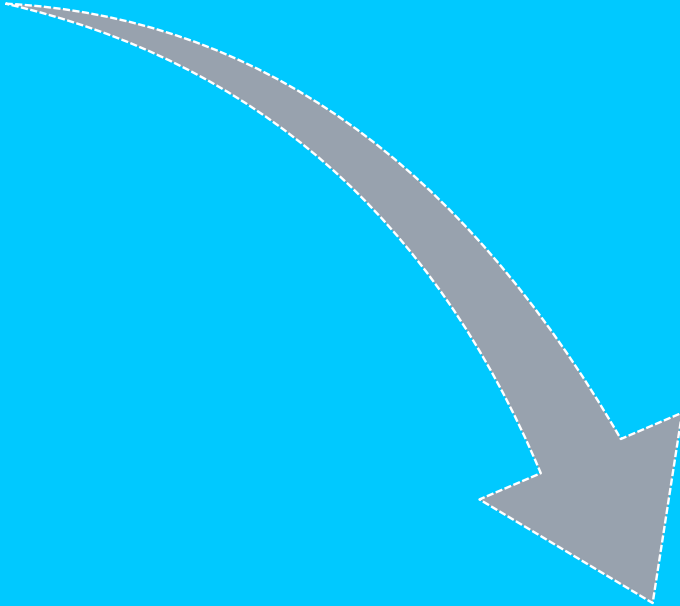
Stuttgart Innovation Days
26. November 2019

2019

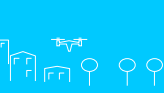
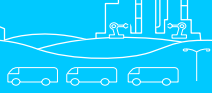
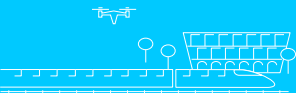
Year 15 of 5G research

Year 1 of 5G deployments

Year 0 of B5G/6G research



The World Beyond 5G



South Korea: the first massive 5G deployment

2000

TB/day

Sectors in
3.5 GHz band

>150k

Share of 5G
traffic

>10%

Planned population
coverage by end of
2019

80%

kt

SK telecom

LG U+

NOKIA

Nokia 5G performing well in Korea



kt 5G

SKT 5GX

U+ 5G

Peak DL throughput in the field 1.45 Gbps

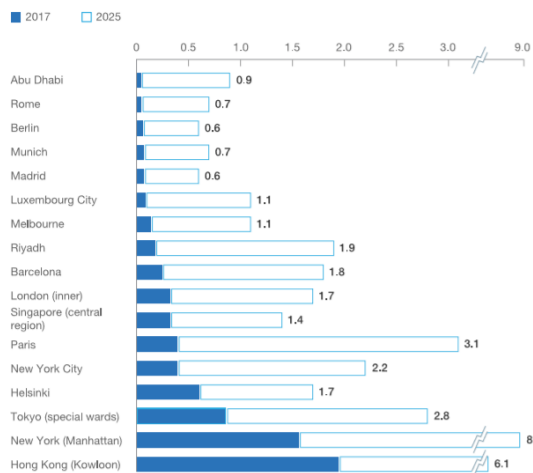
Live throughputs when drive testing (LTE+5G)
400-600 Mbps

NOKIA

New digital experience defines network requirements for 5G evolution

Seemingly infinite capacity

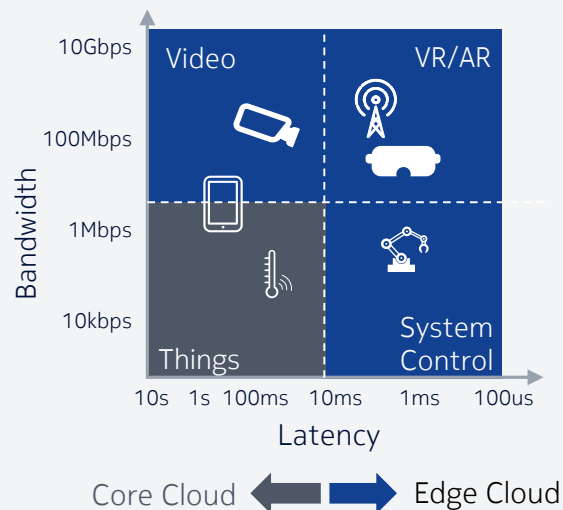
Traffic density in city area,¹
petabyte per square kilometer



¹Unless specified, excludes areas outside the smallest definition of "city," that is, "metropolitan" or "urban" areas.

Source: *The road to 5G, McKinsey, 2018*

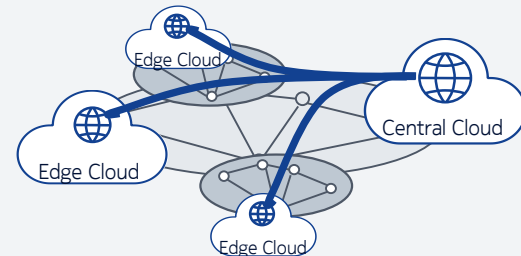
Imperceptible latency



Global-local alliance

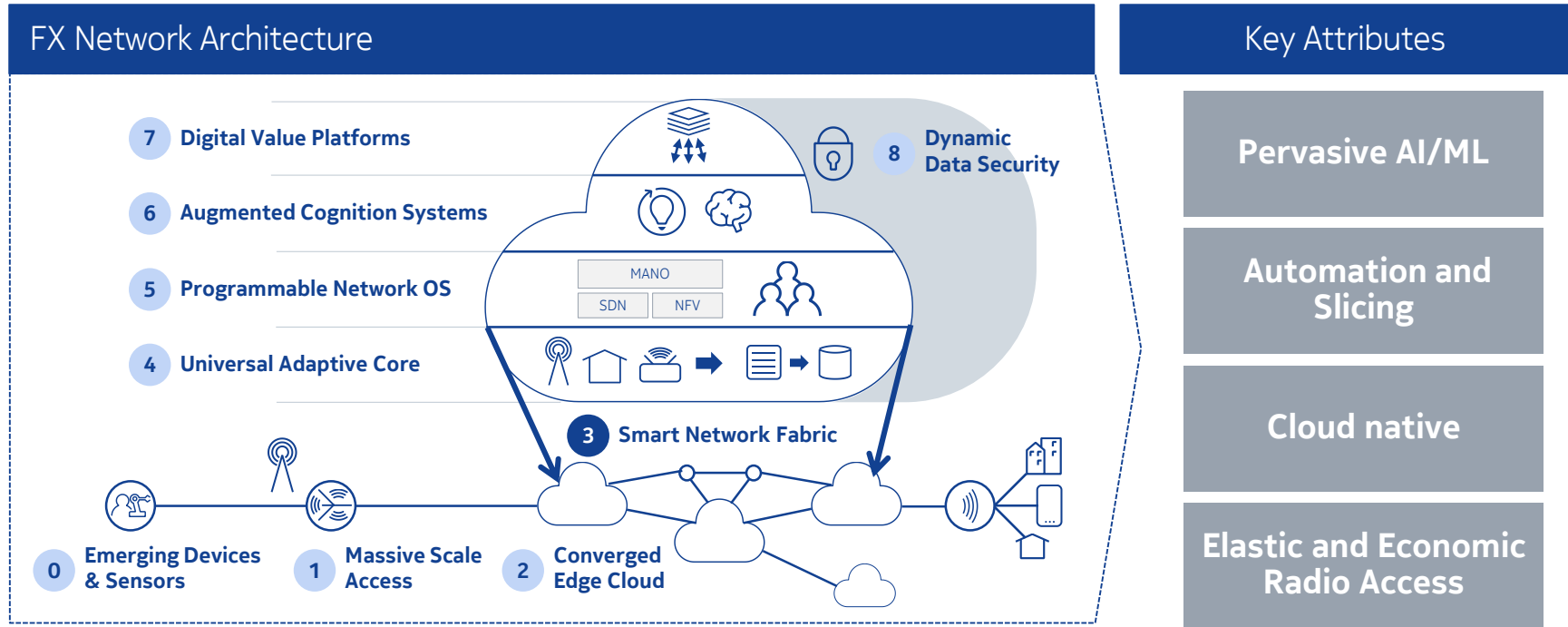
Local delivery with global reach

- New global-local value chains
- Disruptive business models
- Local service performance, efficiency and customization



>100x more capacity and >10x lower latency in < 10 years

Anchoring strategies in FX network architecture, to drive new value creation



Programmable FX networks enable unique cost & service structure, driving willingness to pay

E2e 5G portfolio and solution metrics

Bell Labs differentiation for the future

Fixed wireless access

FastMile FWA CPE

Wireless PON

Access slice controller

Altiplano

Massive Scale RAN

AirScale RRHs

AirScale Baseband

AirFrame Virtual RAN

Converged Core

Shared Data Layer

Cloud Packet Core

DevOps Business Agility

Converged Transport

Converged Any-Haul

FP4 routing

PSE3 coherent optical

Advanced 5G Services

Digital Design

Digital Twin

Digital Deployment

Unified services platform

38%
Lower TCO

4 x 9s
Higher reliability

12m
Faster TTM

E2E
5G

Fixed Wireless
Access

Massive Scale
RAN

Converged
Core

Converged
Transport

Advanced 5G
Services

NOKIA Bell Labs

New AI/ML tools for verifiable network optimization

Cost & performance optimized mMIMO, mmWave & vRAN

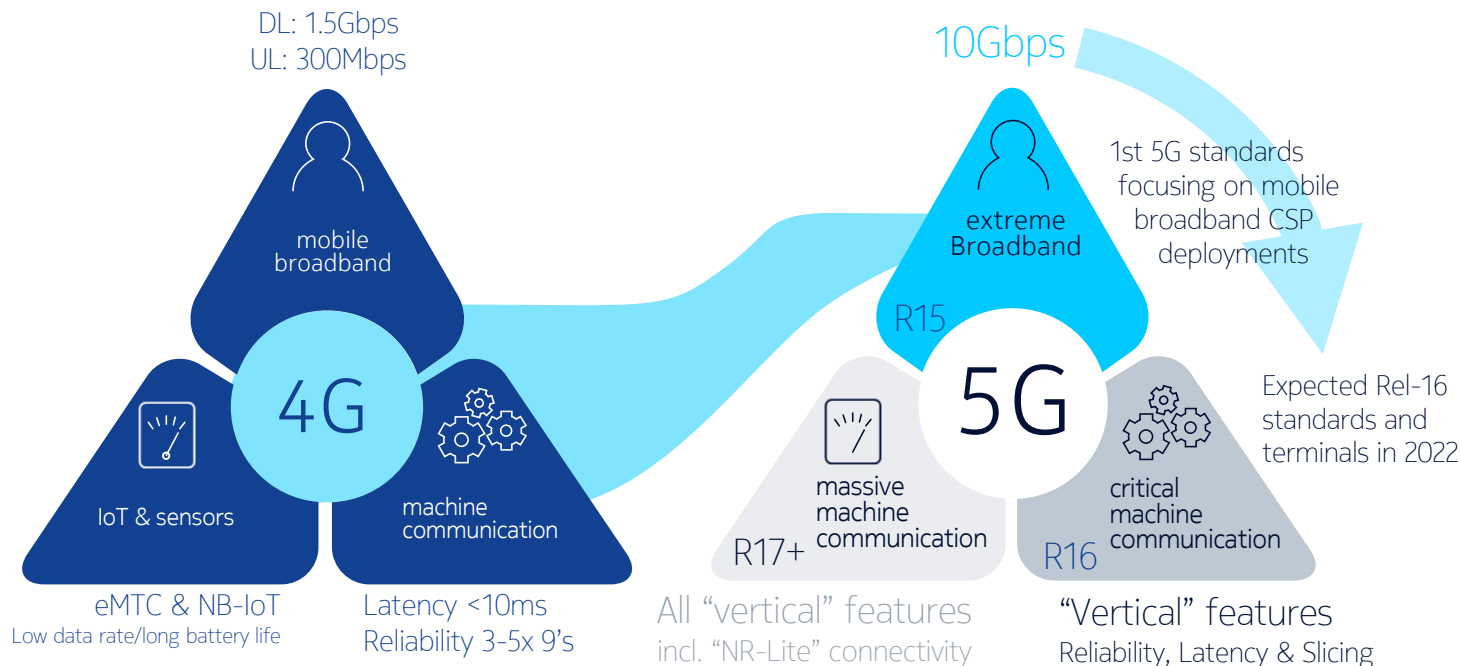
Autonomously scalable, serverless distributed cloud

Terabit capacity with massive spatial parallelism

Autonomous, self-optimizing E2E services

Realizing the full promise of 5G through 3GPP evolution

5G connectivity fabric builds on existing LTE deployments



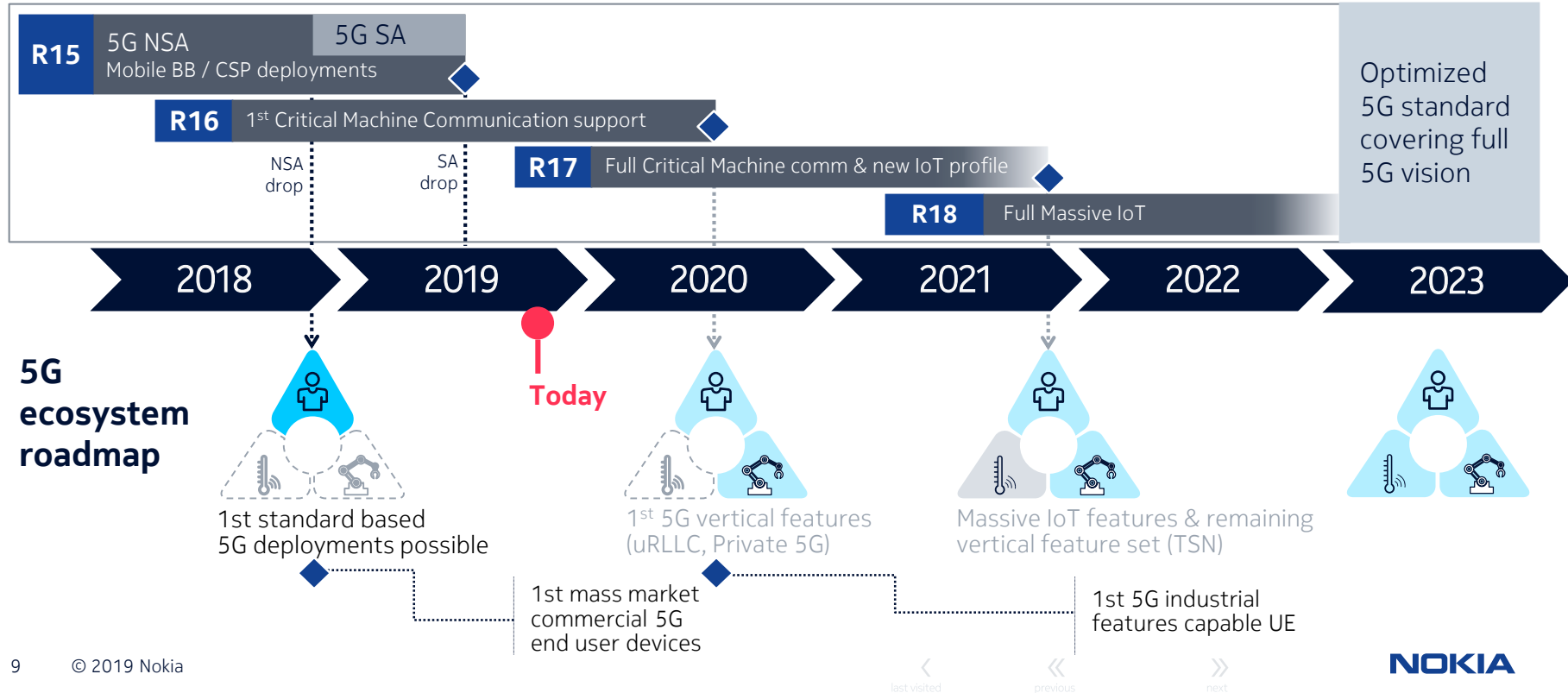
End-to-end 5G will redefine the human condition and industrial productivity paradigm

3GPP standardization timeline

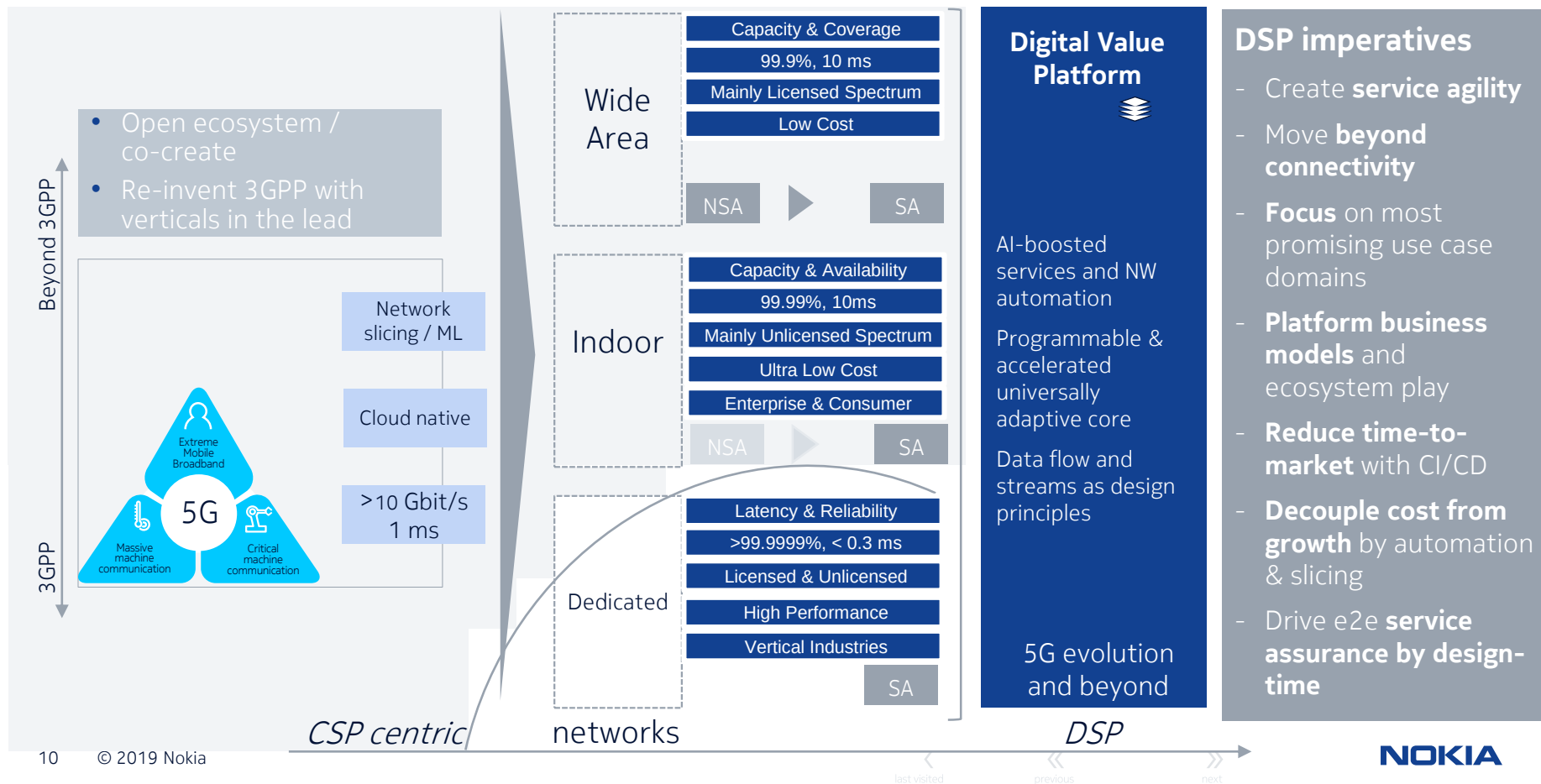
Early CSP 5G deployments with Release 15, IIoT capabilities starting R16



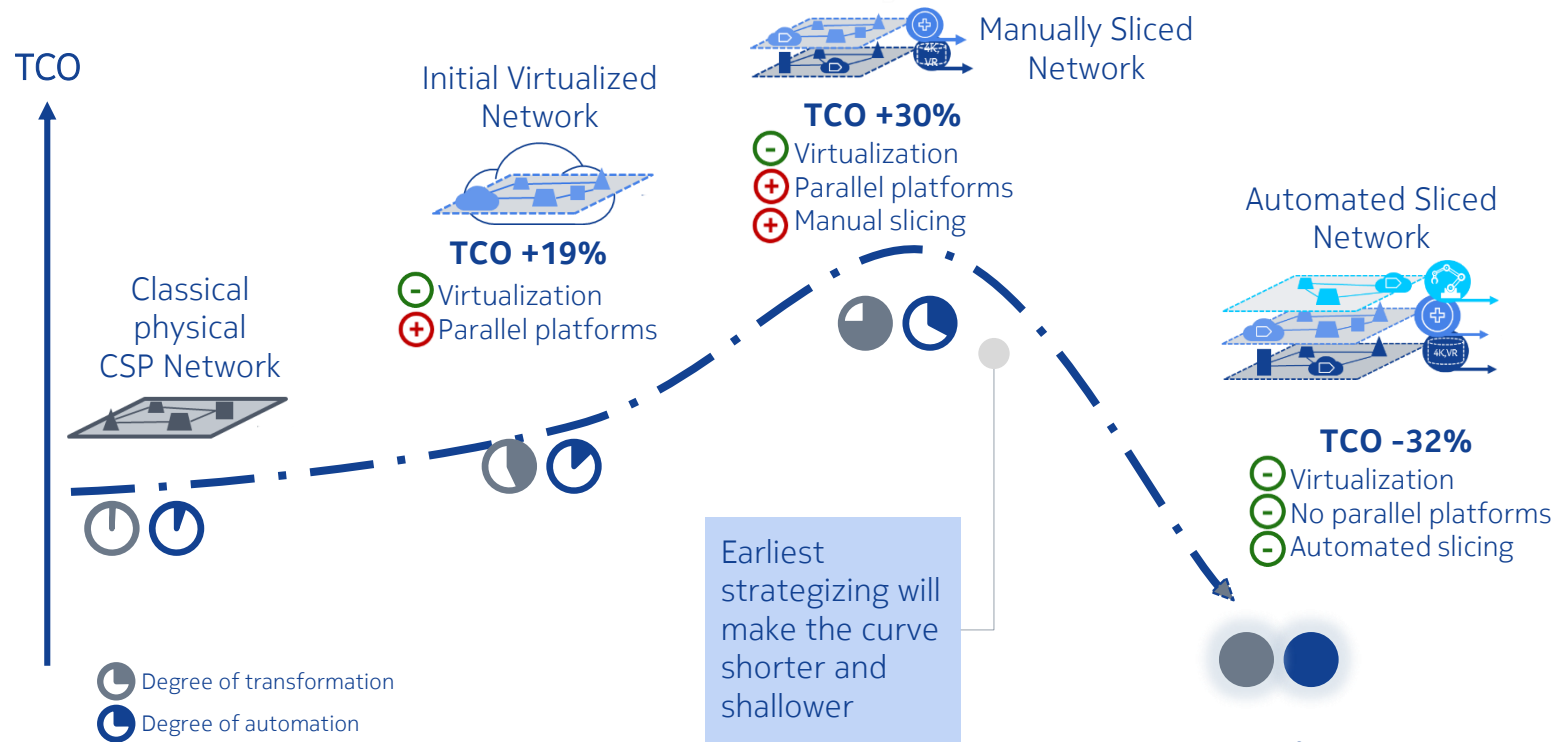
5G standard releases roadmap



Evolution of 5G strategic direction – transforming the business model

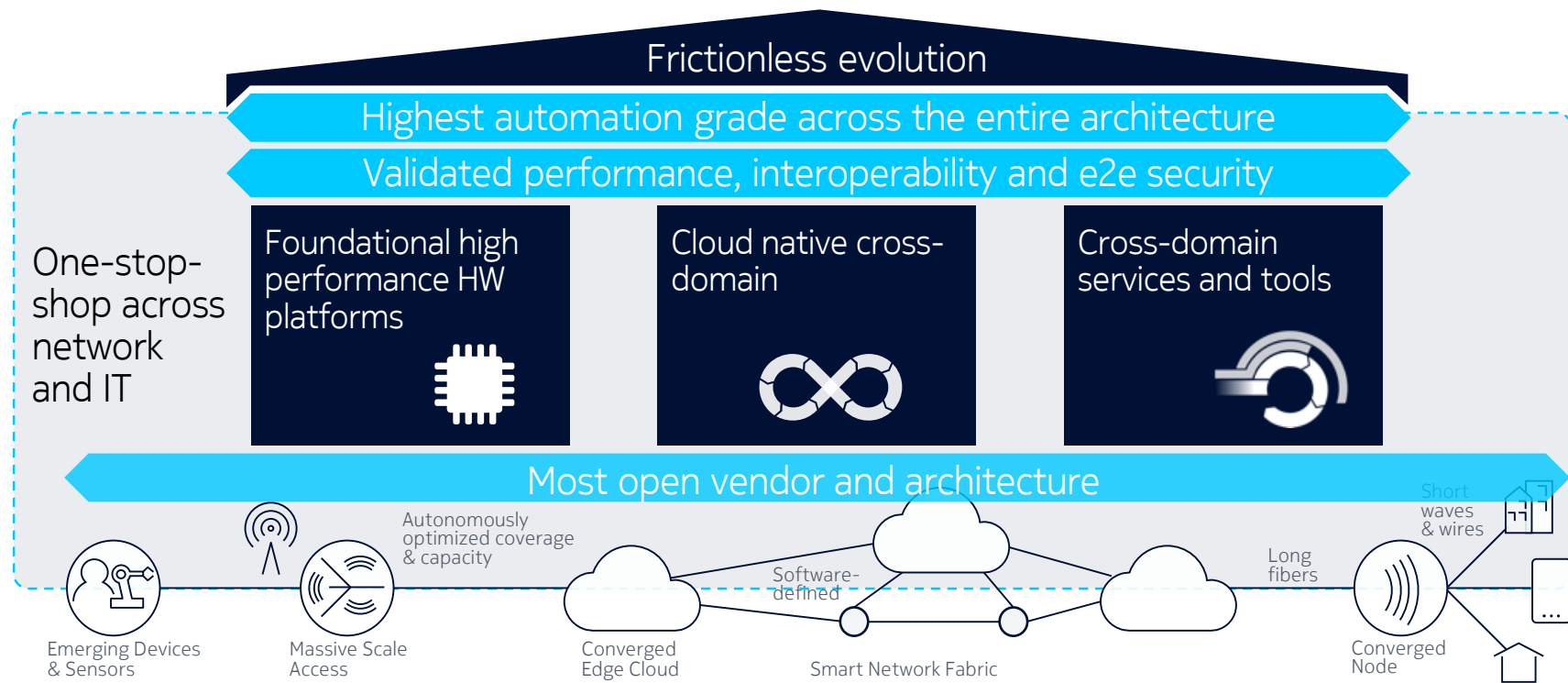


Decoupling cost from growth in operations is critical – early adoption of the transformation path is key

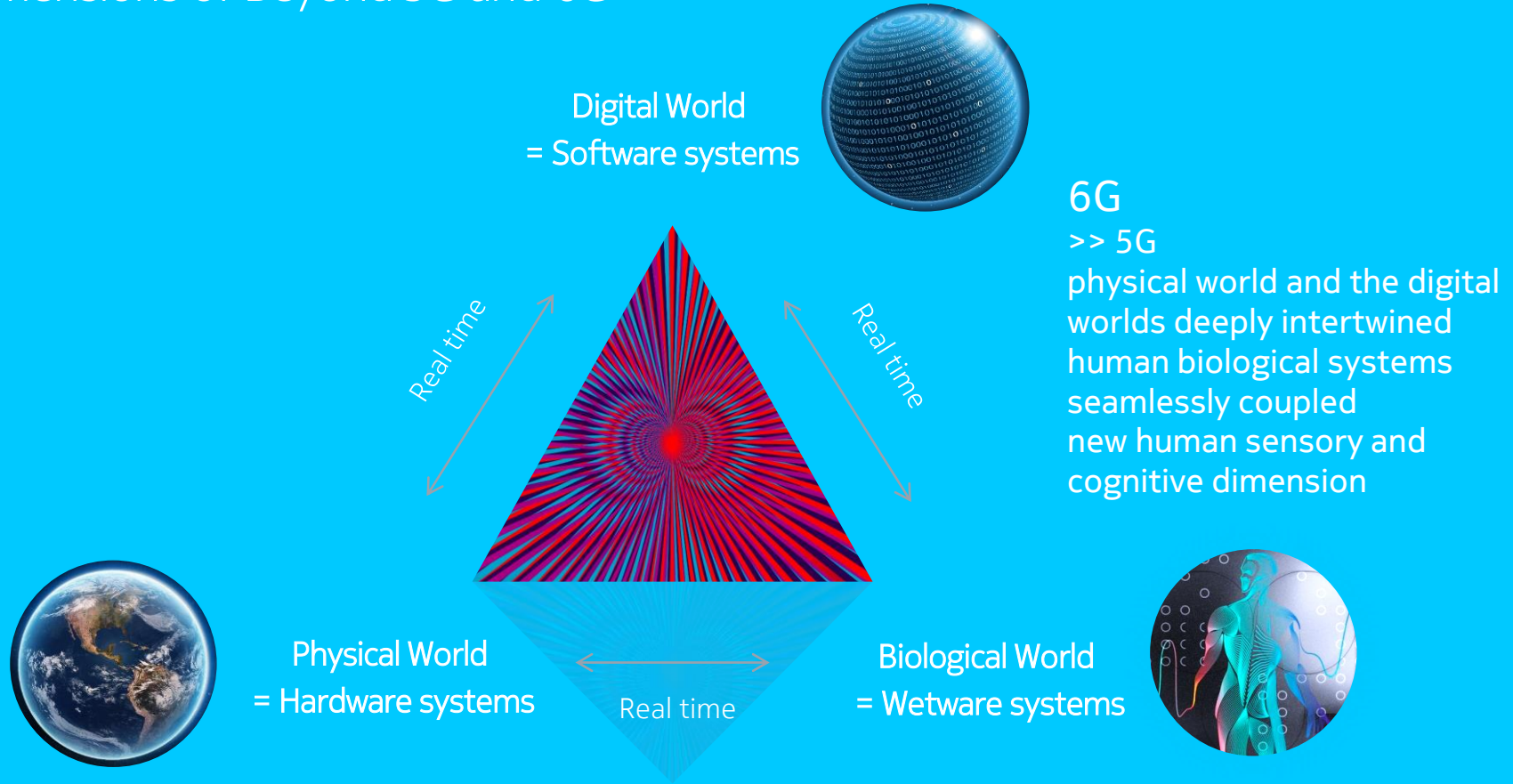


De-risk 5G deployment – with a cross-domain solution out of one hand

Nokia end-to-end value proposition



Dimensions of Beyond 5G and 6G



Technology research domains for 6G

Enabling augmented worlds

Ubiquitous and pervasive wireless access to AI and quantum computes

Tera-bps, microsecond delay

THz comms, full duplex, M-MIMO, AI optimized networking

Enabling augmented hyper-reality with real-time audio and video overlays

Microsecond synchronicity & jitter

Dynamic Deterministic Networks as a Service (advanced TSC)

Unbreakable privacy & security with user controlled data filtering

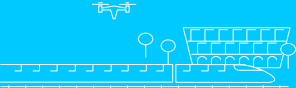
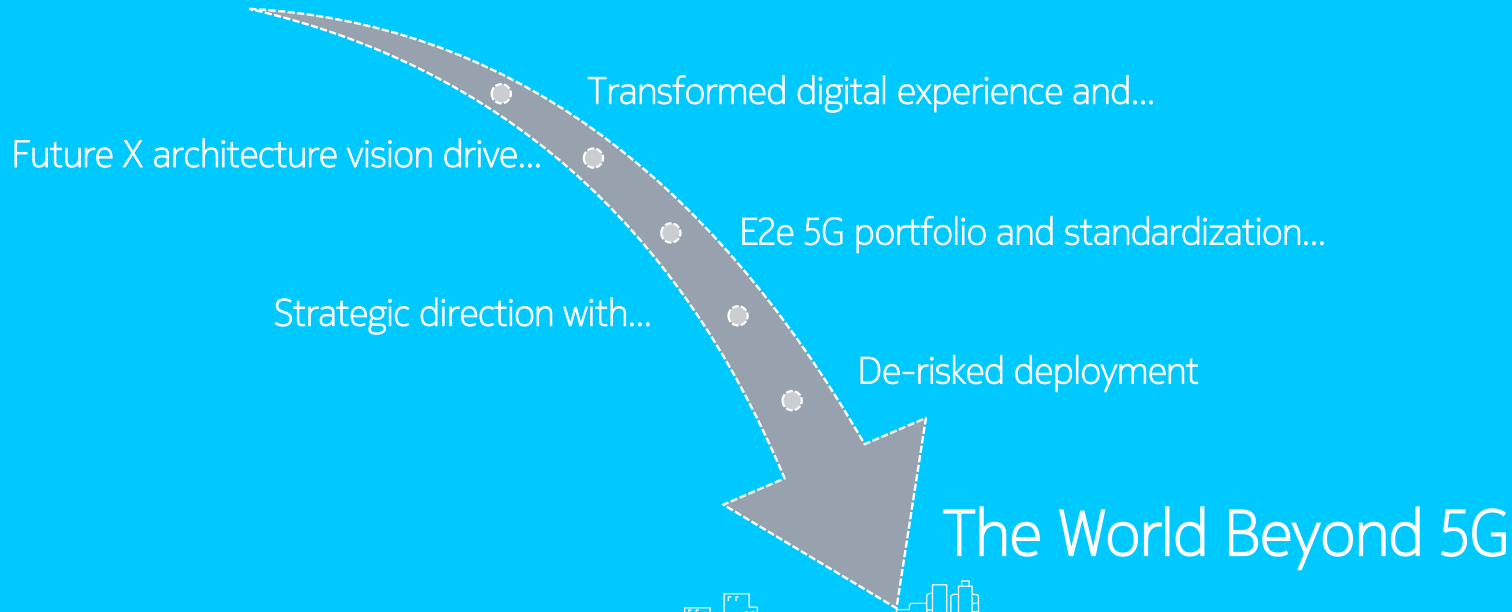
100% K-anonymity

Formal verification security, multi-layer secure ID

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