

Bringing strategy and technology together to lead the opportunities of the future

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Lay the path for Nokia's future technology innovation

Identify the most promising areas for new value creation



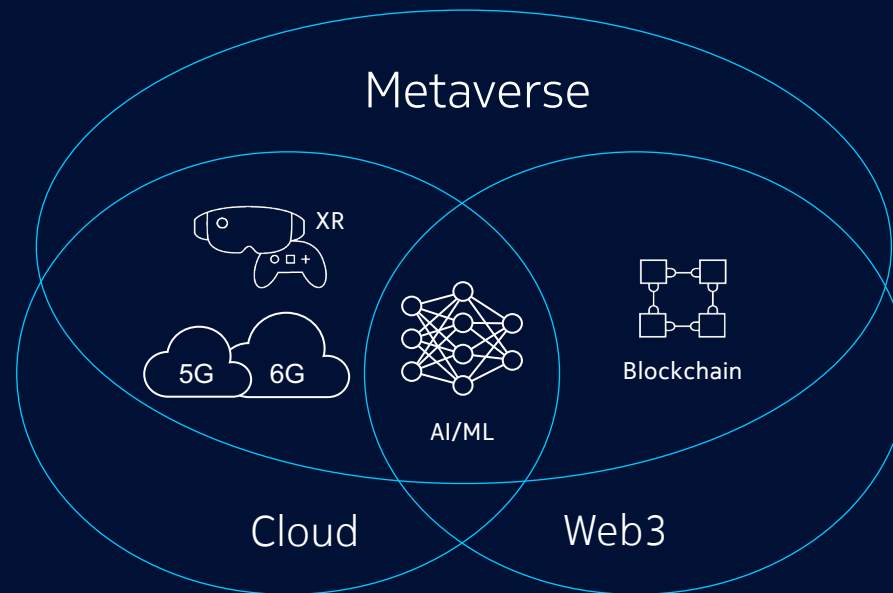
Key trends shaping the world of 2030

Driving requirements for the ecosystem and the network

Socioeconomic & geopolitical

Deglobalization	State-driven innovation
Cybersecurity	Sustainability

Technology



User needs

Industry-Enterprise-Consumer-Developer

Evolved experiences	Digital-first
Service-optimized connectivity	New purchasing priorities

We have a clear and definitive vision of the metaverse opportunities

Concepts of 'Human Augmentation' and 'Digital-Physical Fusion' frame this vision

Metaverse enablers



Human Augmentation

Handhelds
VR HMDs
Tethered AR glasses
Haptic-enabled remote control

Connected bio-medical implants
Industrial exoskeletons
Ergonomic, untethered XR glasses
XR interoperability



Digital-Physical Fusion

Basic, organization-level digital twins
Smart sensor networks
Persistent virtual worlds & objects

Complex, enterprise-wide digital twins
Ecosystem interoperability
Interactive 3D digital twins
6G network sensing

Metaverse opportunities

Consumer Metaverse



Enterprise Metaverse (IT-centric)



Industrial Metaverse (OT-centric)

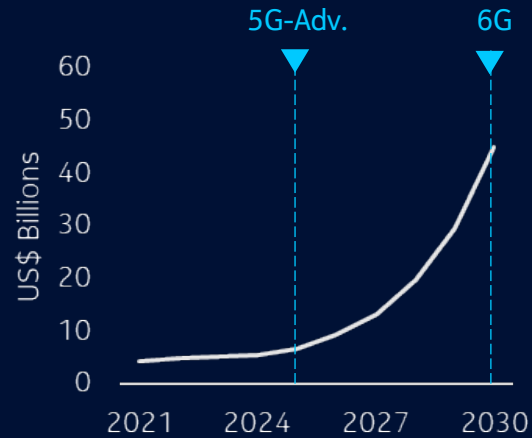


**Nokia well ahead of the current 'meta-hype':
based on Nokia Bell Labs research over 5+ years**

Industry is expected to lead metaverse commercialization

Consumer Metaverse

Virtual spaces revenue (global markets)¹

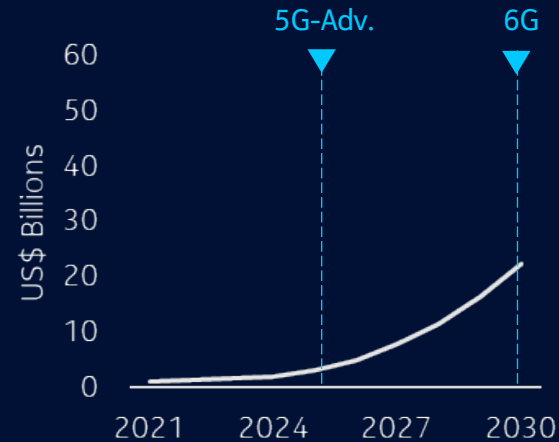


- Consumer appeal driven
- Reliant on trends and network effect
- Fragmented monetization, with growth from ~2026

Metaverse usage could exceed time spent on OTT video by 2028⁴

Enterprise Metaverse

Immersive collaboration and related cloud revenue (global markets)²

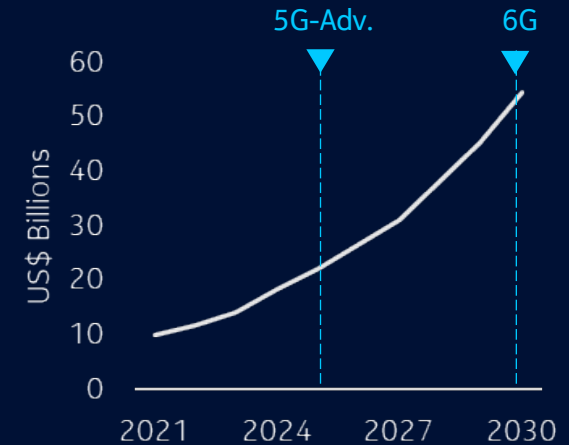


- Business value driven
- Solution & device innovation
- Good monetization potential, with growth from ~2025

Metaverse could drive up to 9x higher bandwidth consumption in enterprise data usage by 2030⁵

Industrial Metaverse

Digital twin & simulation and industrial XR HMD shipment revenue (global markets)³



- Operational results driven
- Industrial automation focus
- High monetization potential, with early traction

Metaverse could drive up to 100x growth in bandwidth consumed by industrial applications delivered from on-premise and edge networks by 2030⁵

1 ABI Research: 2022 Consumer Metaverse Market Update, June 2022

2 ABI Research: Enterprise Metaverse: Future of Work, March 2022

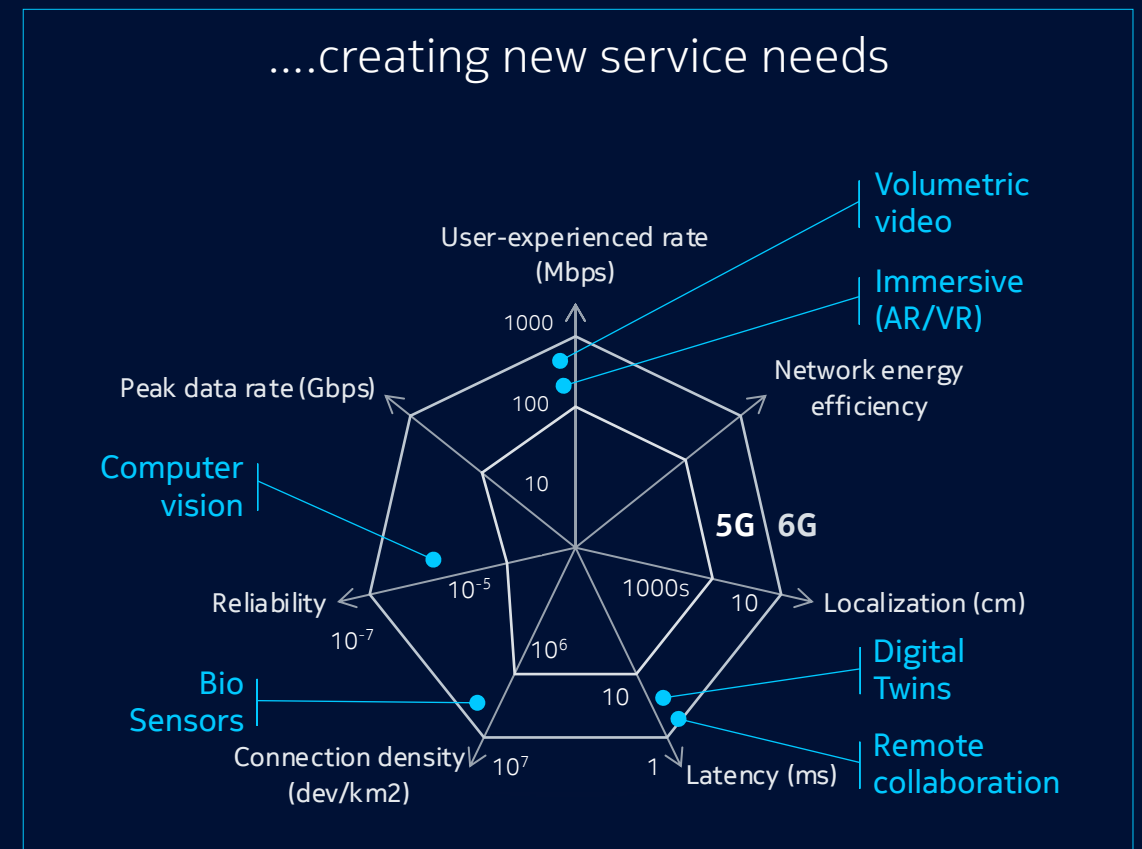
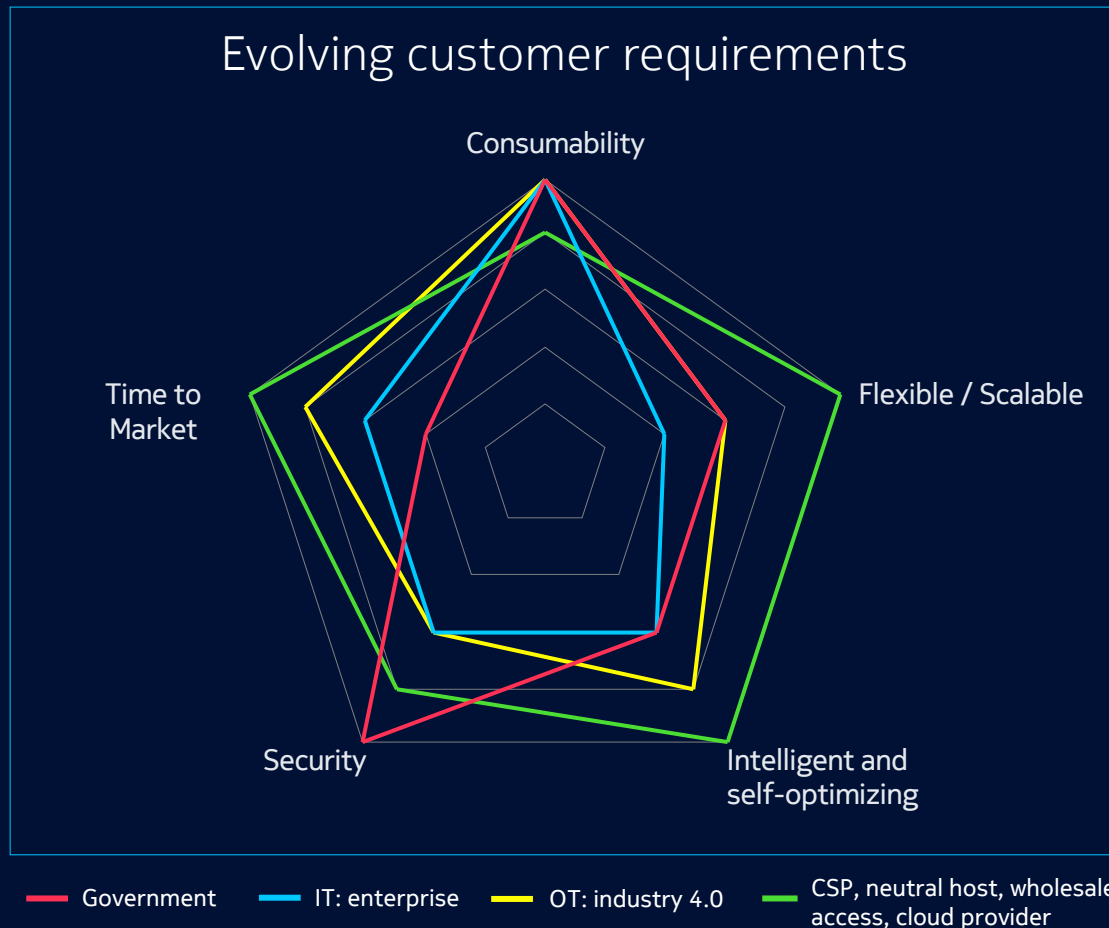
3 ABI Research: The Future of Work, Augmented and Mixed Reality, Virtual Reality Market Data, August 2022

4 Bell Labs Consulting: Spectrum study done for a US mobile operator

5 Bell Labs Consulting: Studies on enterprise & industrial services demand growth 2021-2030 (disruptive scenarios)

Customer and service requirements for metaverse

... will be different than today's

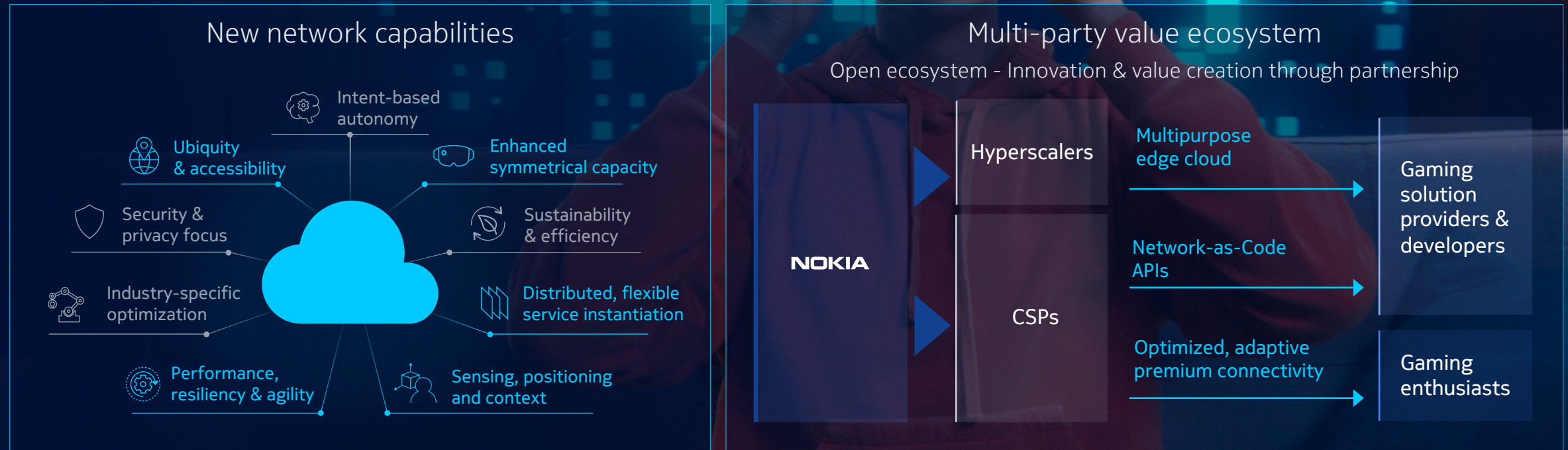


The network will be key to realizing those opportunities
... requiring transformed capabilities and versatile integrations



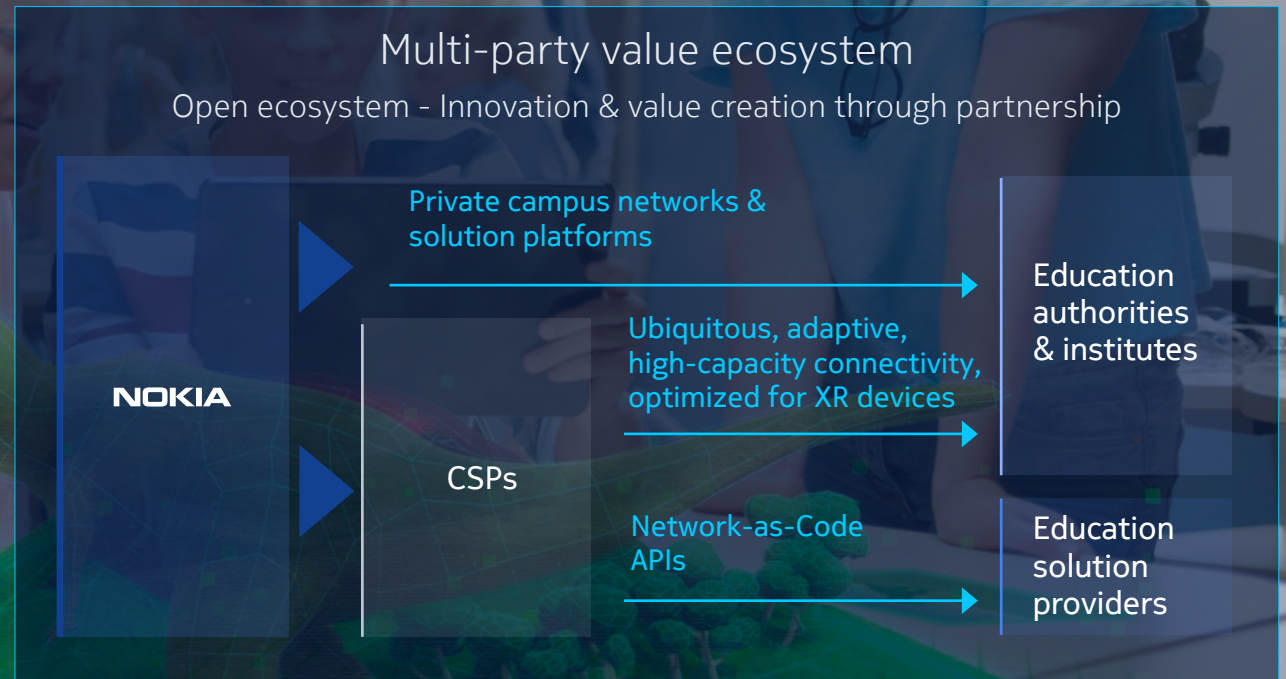
Driving the 2030 metaverse value chain

Example: Consumer Metaverse – Immersive Gaming



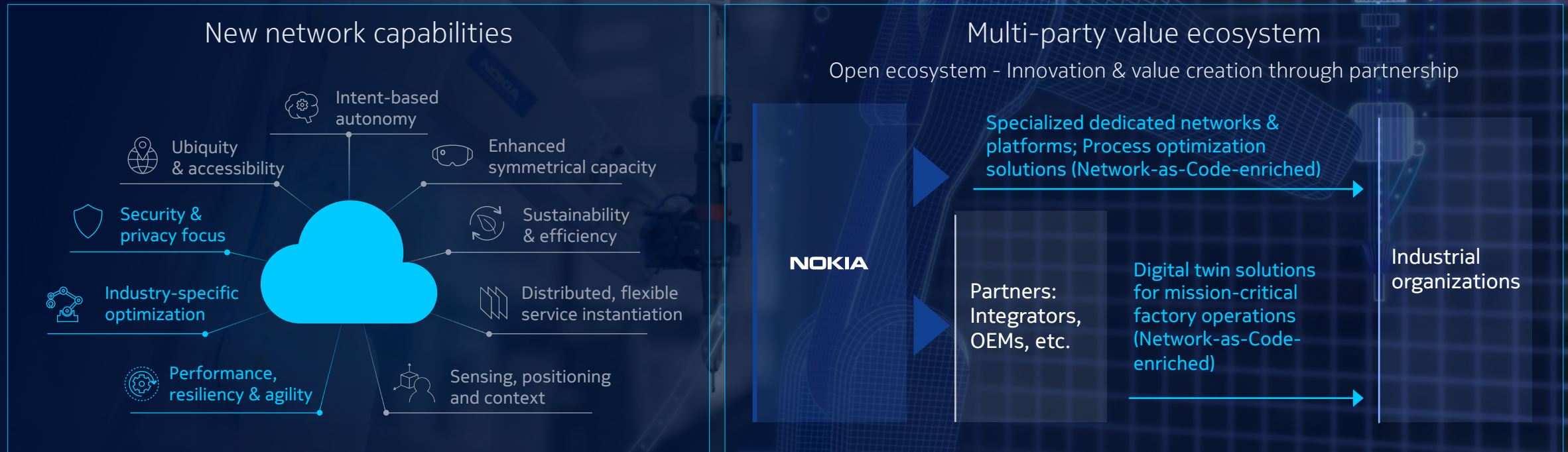
Driving the 2030 metaverse value chain

Example: Enterprise Metaverse – XR for Education

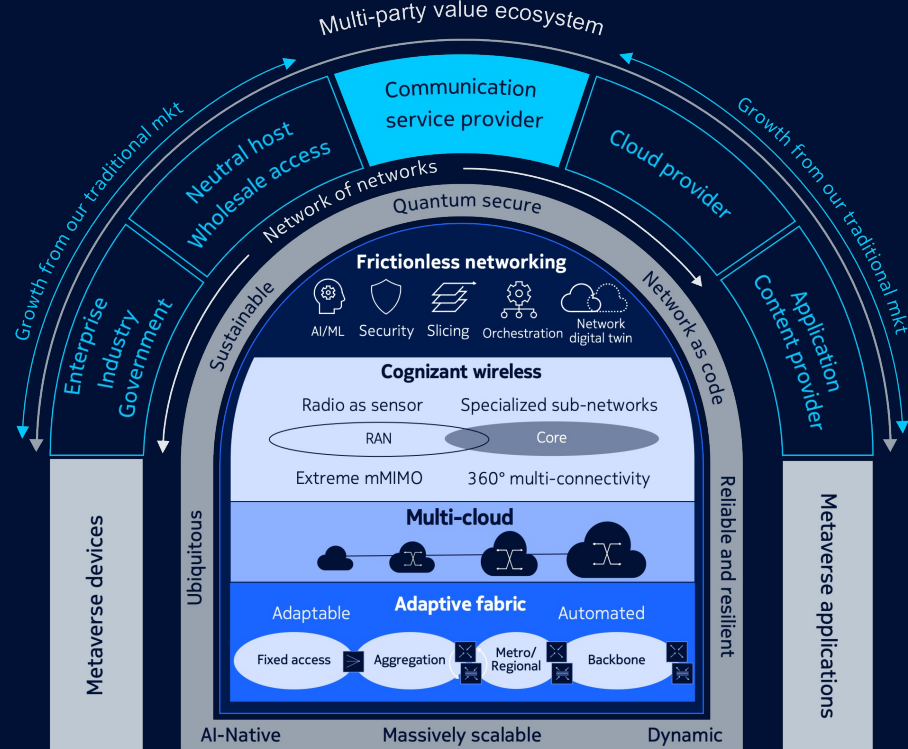


Driving the 2030 metaverse value chain

Example: Industrial Metaverse – Real-time Digital Twin for factory operations



Nokia's differentiating role and capabilities in the metaverse value chain



Transformational

Consumability

Nokia technology becomes easy to consume

Software

Handling the complexity

AI

Embracing AI/ML through the stack

Foundational

Security

Foundational to critical networks

Semiconductor

System-on-Chip remains critical

Sustainability

Minimize footprint, maximize handprint

Innovation

Creating the future. The basis for everything.

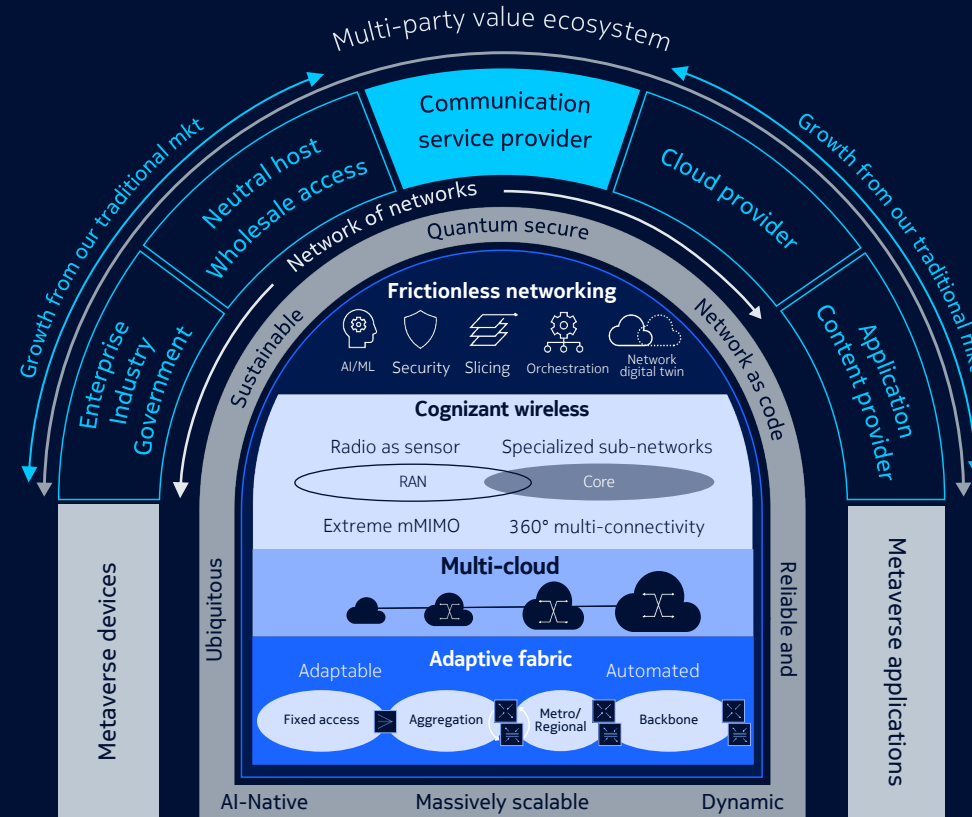
Nokia's transversal technology strategy drives our company portfolio

Cognizant wireless

Extreme mMIMO
5G-Advanced, 6G
EasyMesh WiFi
Private networks

Adaptive fabric

Coherent routing
800G and beyond
25G PON
Adaptive cloud networks



Frictionless networking & Multi-cloud

Network as code
Software as a service
SA core
Digital automation cloud

Applications & devices

Audio visual
Sensors
IOT
AR/VR devices
Bio-wearables

Bell Labs Core Research

Network architecture
Systems
Devices

Nokia Standards

Industry ecosystem
and standardization
enablement

Bell Labs Solutions Research

System architecture & solution design
AI & algorithms
Software & data systems

Bringing our vision of the metaverse to life

Collaboration is key

The metaverse will be created by an ecosystem of partners, working together to bridge industries and fuse the digital and physical.

Network
is the heart of
the metaverse
ecosystem

Nokia as a critical partner

Strongly positioned to build the network and drive the collaborative advantages of the metaverse value chain.

The image features the Nokia logo in white, bold, sans-serif capital letters, centered horizontally. The background is a dark blue gradient with a subtle, glowing hexagonal grid pattern that recedes into the distance, creating a sense of depth and technology.

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