

Meta-worlds

Alessandro Bovone
CTO North & West Europe



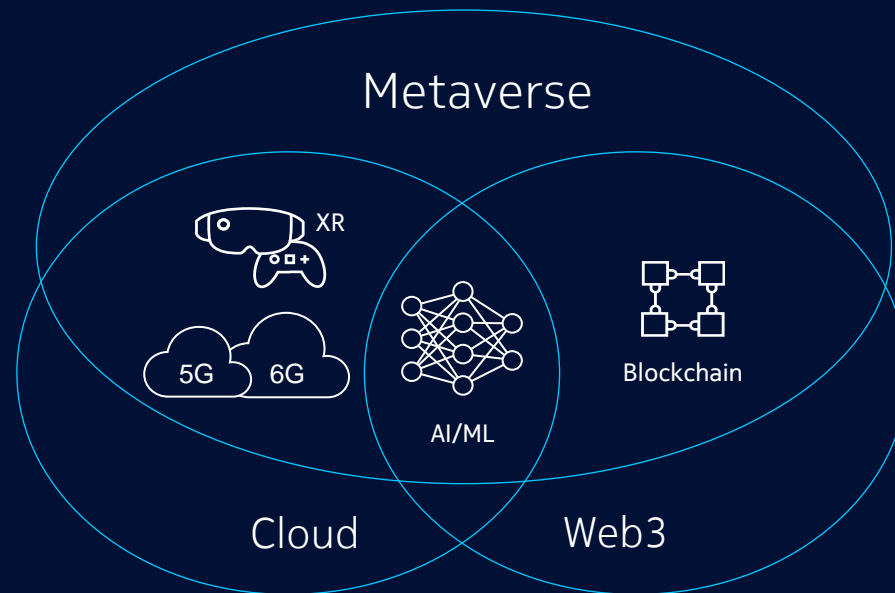
Key trends shaping the world of 2030

Driving requirements for the ecosystem and the network

Socioeconomic & geopolitical

Deglobalization	State-driven innovation
Cybersecurity	Sustainability

Technology



User needs

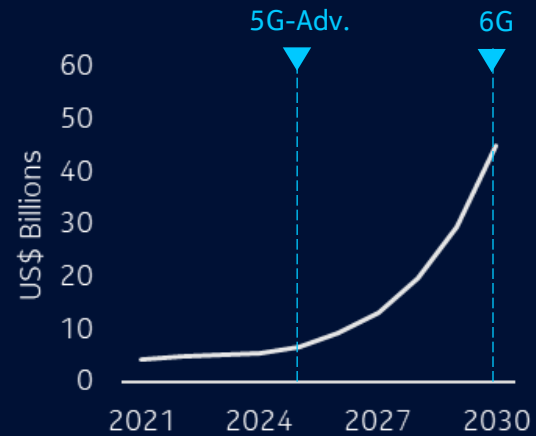
Industry-Enterprise-Consumer-Developer

Evolved experiences	Digital-first
Service-optimized connectivity	Consumability

Industry is expected to lead metaverse commercialization

Consumer Metaverse

Virtual spaces revenue (global markets)¹

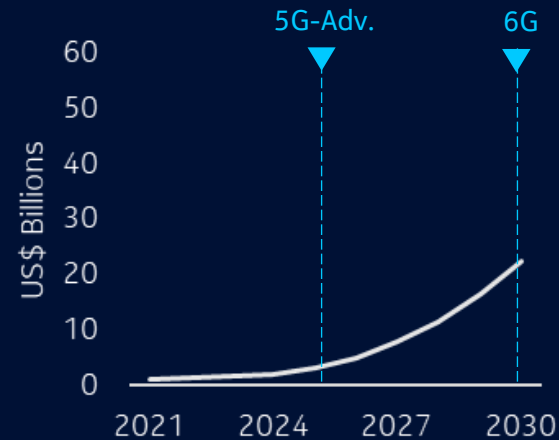


- Consumer appeal driven
- Reliant on trends and network effect
- Fragmented monetization, with growth from ~2026

Metaverse usage could exceed time spent on OTT video by 2028⁴

Enterprise Metaverse

Immersive collaboration and related cloud revenue (global markets)²

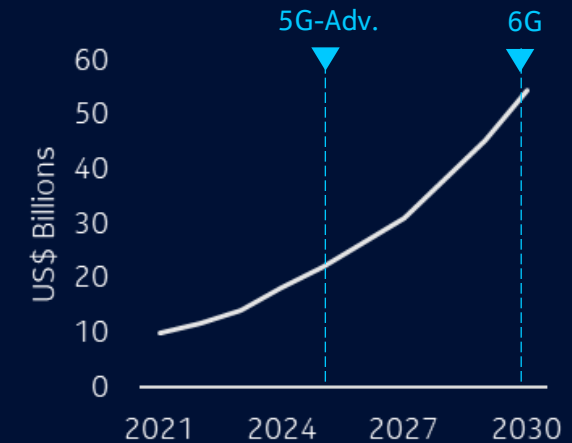


- Business value driven
- Solution & device innovation
- Good monetization potential, with growth from ~2025

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

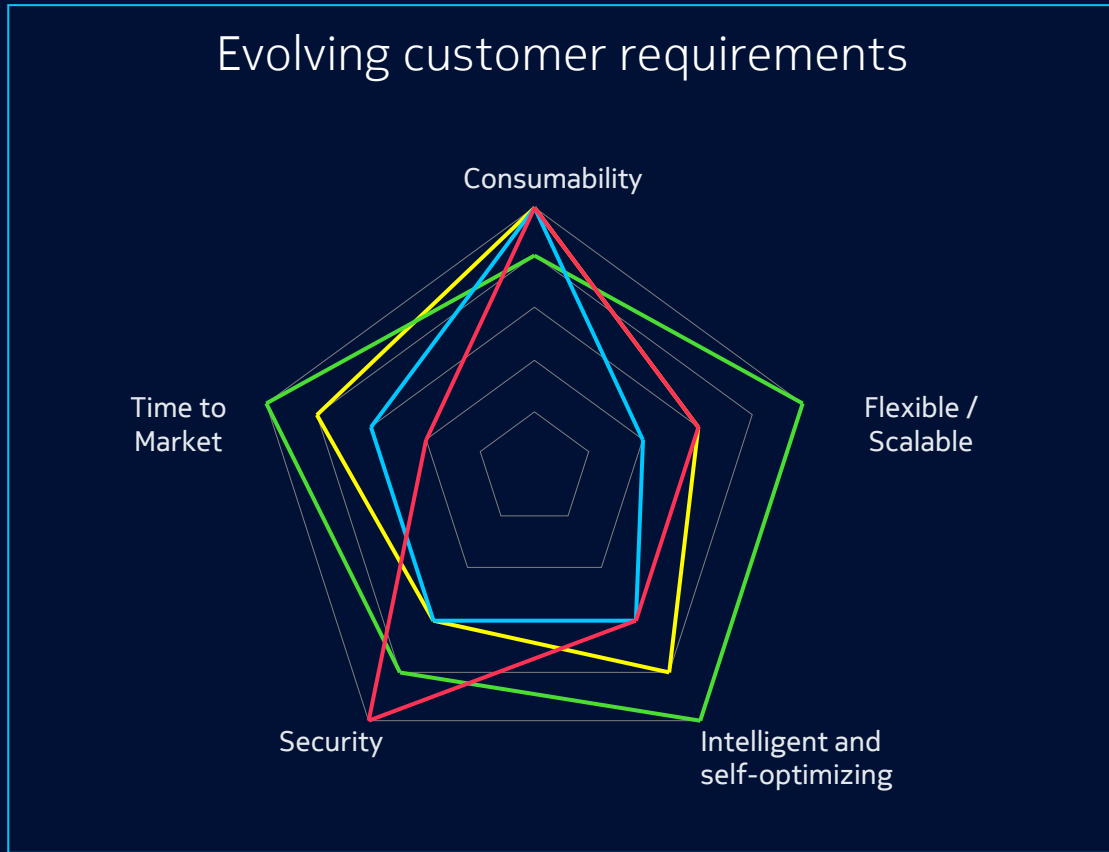
³ ABI Research: The Future of Work, Augmented and Mixed Reality, Virtual Reality Market Data, August 2022

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

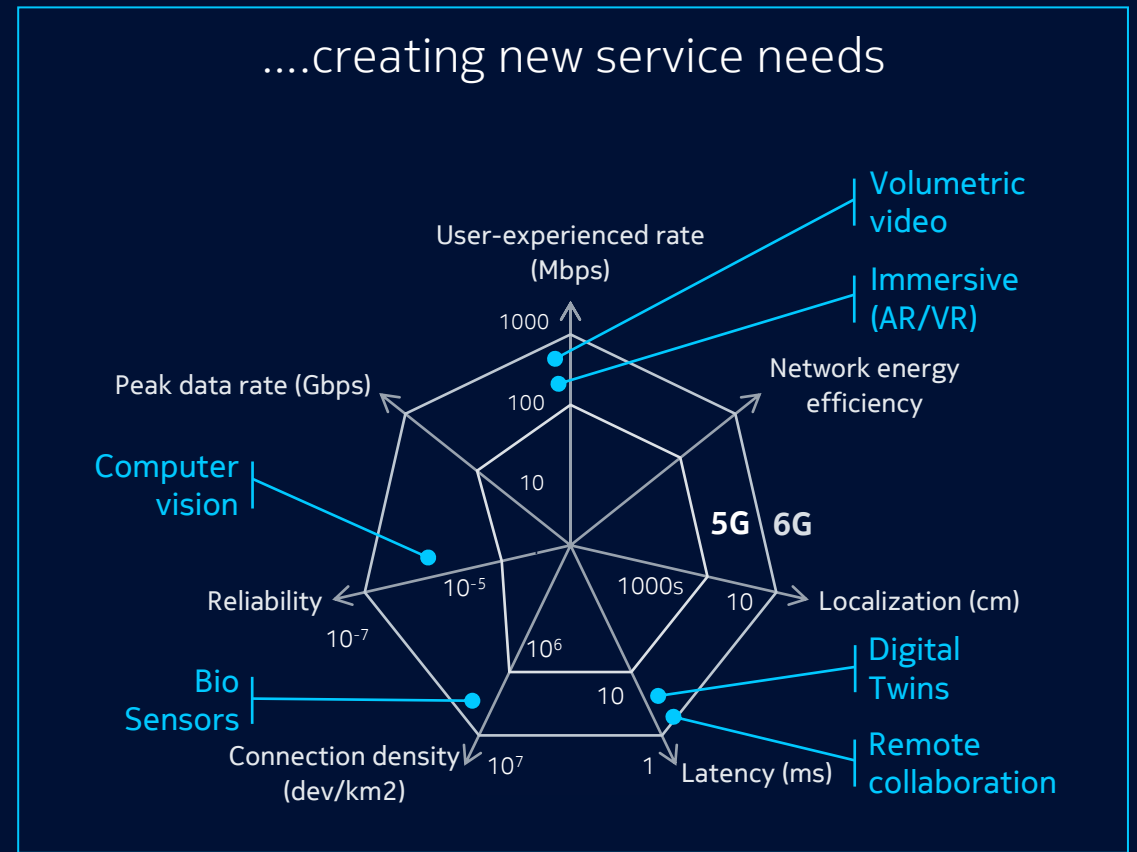
⁵ Bell Labs Consulting: Studies on enterprise & industrial services demand growth 2021-2030 (disruptive scenarios)

Customer and service requirements for metaverse

... will be different than today's



— Government
 — IT: enterprise
 — OT: industry 4.0
 — CSP, neutral host, wholesale access, cloud provider



Metaverse – network requirements as we know today



- >50Mbps
- mostly on mobile



- >200Mbps
- 5-15ms latency
- mostly on fixed

Network

5G-A / 6G

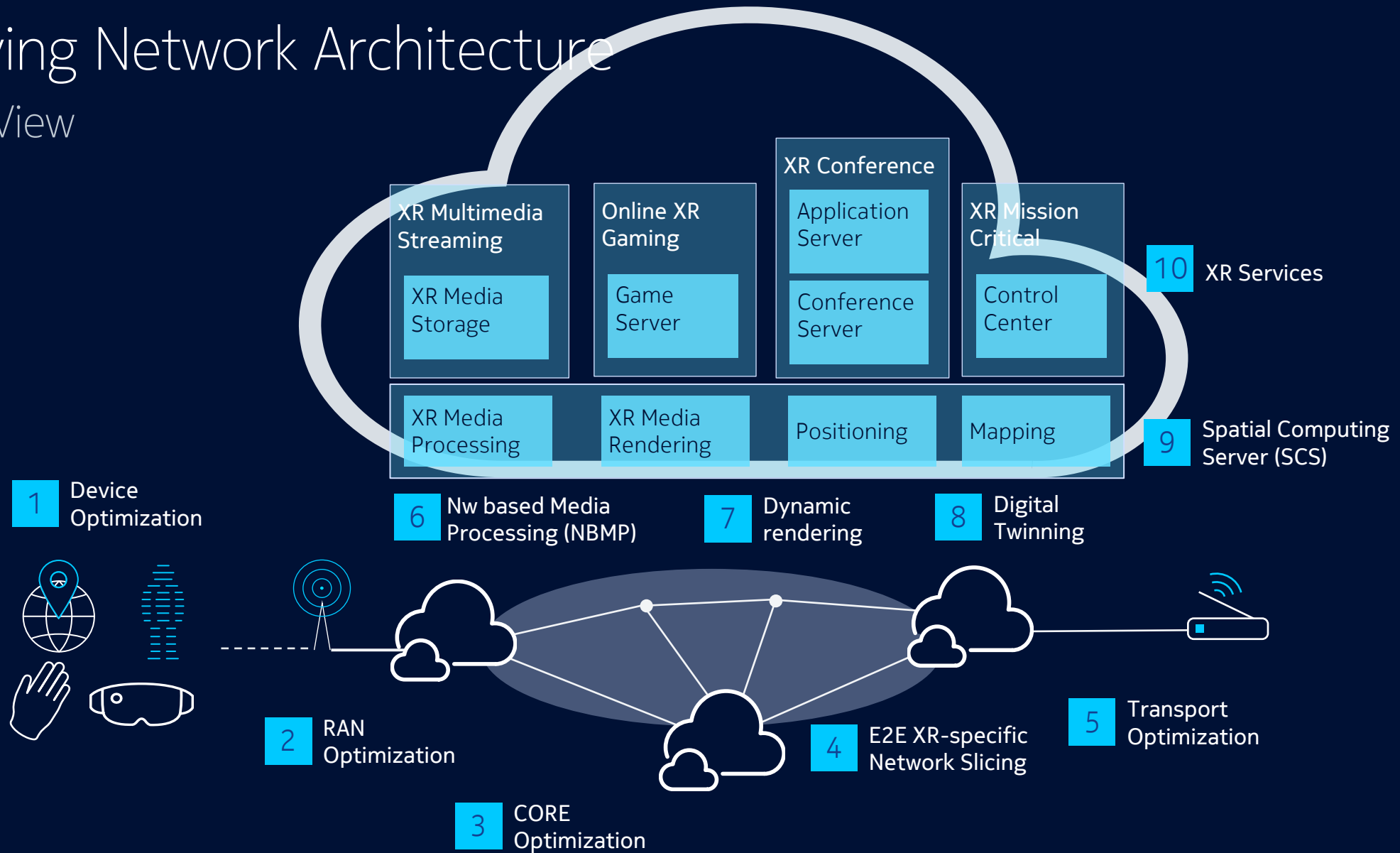
- **New Devices**
 - limited battery capacity
 - limited CPU performance
 - **New traffic requirements**
 - DL/UL symmetry
 - high bandwidth
 - low latency
 - reliable mobility
 - **Enhanced QoS framework**
e.g. multi-source/-destination and L4S congestion control
 - **Media driven data streams**
3D-video, -audio, -objects
→ news standards/open APIs
 - **Network as Code (NaC)**
network to become part of App developer coding
-
- UE Energy Efficiency
 - Capacity incl. UL improvements
 - Low latency
 - Mobility enhancements
 - Edge
 - local processing (e.g. rendering)
 - low latency
 - local break-out
 - open APIs (network & UE related)
 - Slicing for enhanced QoS framework and L4S
 - Automation in Operations
 - Network as Code (NaC)
for network integrated into App developer coding

- **Metaverse Success** = Content/Apps + Devices + Network + open APIs + immersive media (video/audio)
- **Opportunities** for new user experience (data growth), efficiency gains¹⁾, new markets²⁾ and monetization³⁾

1) Immersive collaboration, AR guided maintenance, ... 2) VR shopping, VR learning, virtual property, ... 3) Network exposure (NaaC), latency as new pricing parameter, ...

Evolving Network Architecture

Nokia View





At Nokia, we create technology that helps the world act together.