



# NOKIA

## Path to 6G era Platform and XR Future

Dr Volker Ziegler

Senior Advisor, Chief Architect

Strategy and Technology

October 23, 2024



**NEM Summit 2024**  
in Brussels on  
**23/24 October 2024**

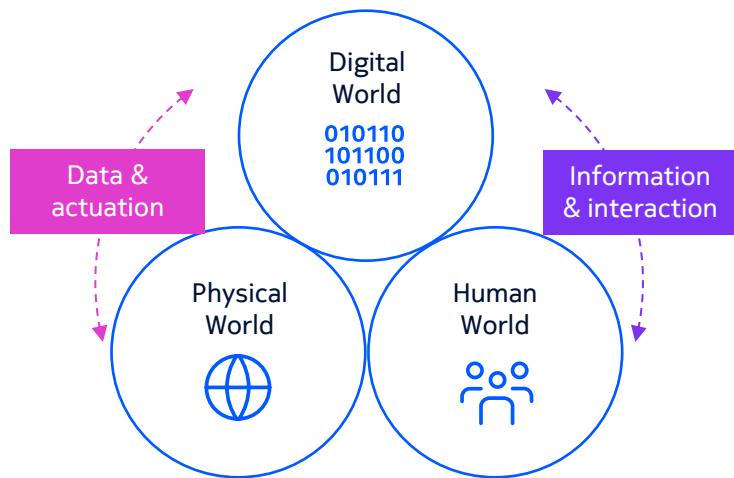
**"Emerging virtual words for a new digital society"**

📍 VRT (Vlaamse Radio- en Televisieomroeporganisatie) Headquarter

# Agenda

1. **Vision and digital transformation now**
2. 6G era platform
3. XR and digital twin
4. Topics for long term research

# The 6G era will be defined by digital-physical fusion and human augmentation

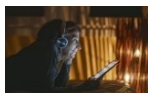


# Realization of this 6G vision comes in stages

## Technology enablers and services

### 6G day-one focus

- Extreme MIMO on existing grid
- Smooth migration and core evolution
- Programmable networks and API native
- Framework for native AI
- Framework for energy efficiency
- Non-Terrestrial Networks (NTN) support for all UE types



NextG mobile broadband



Fixed Wireless Access (FWA)



Immersive /Cloud gaming



Extended Reality



IoT/LPWA native support

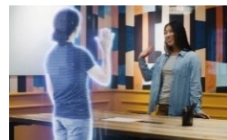


"Integrated" global connectivity

### 6G evolution and beyond

The human, physical and digital worlds will become seamlessly integrated in the 6G era

- From connectedness to **togetherness**: immersive holographic experience, connect the unconnected
- From information to **knowledge**: cognitive and complete context awareness, leveraging ambient IoT, digital twins, sensing
- From efficiency to **purpose**: mission & life-critical services supported by subnetworks



6G to build on 5G success and do so in a more efficient, economical, scalable and sustainable way

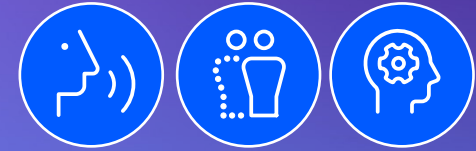
Augmenting humanity and the full realization of digital-physical fusion

# The world of technology is rapidly evolving

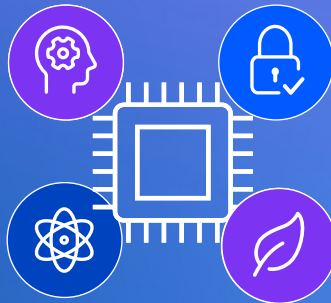
Macro trends get stronger and more persistent



The smart world ahead feels more human



Bedrock technologies experience rapid advancement

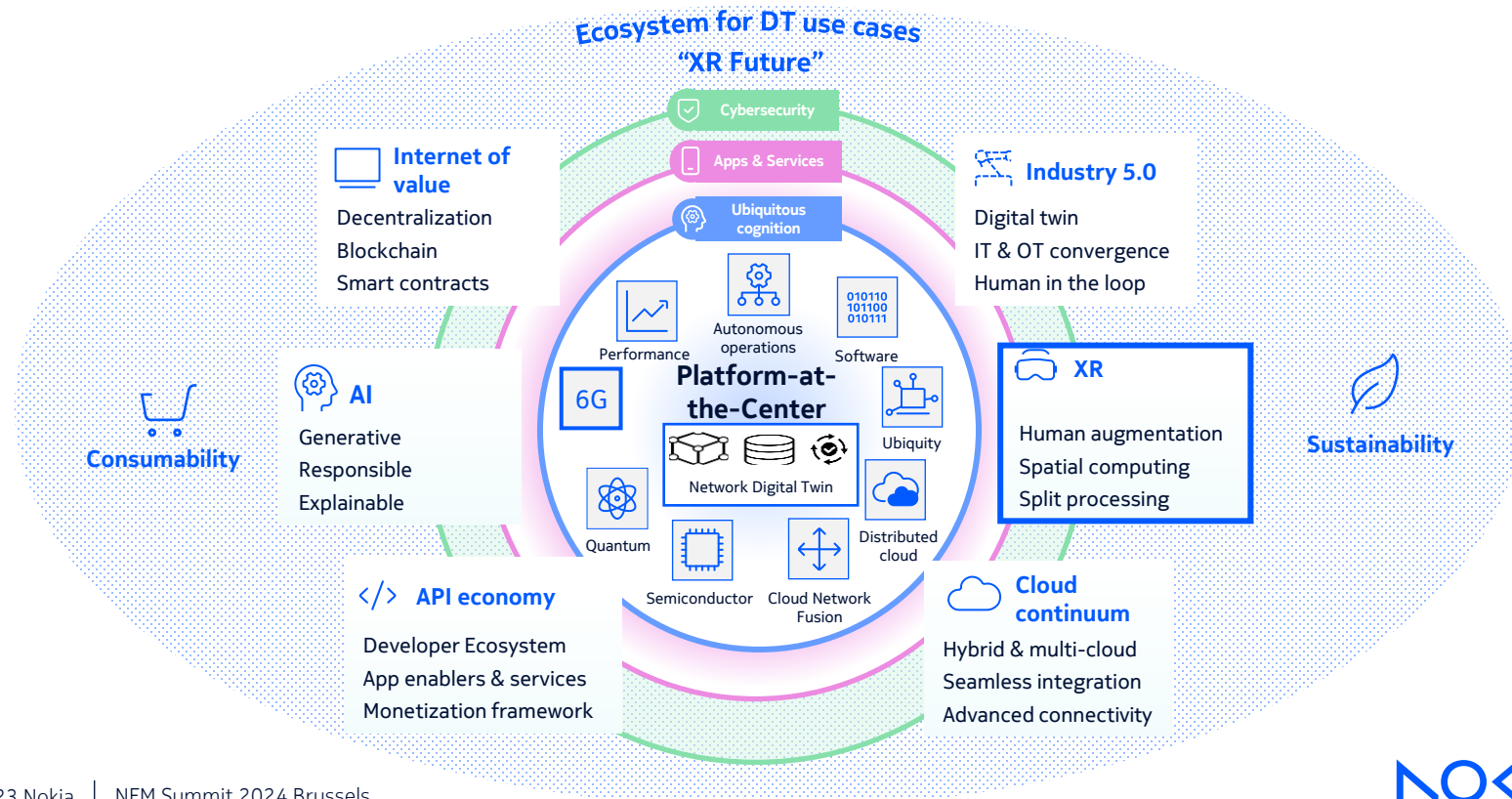


Steady evolution in network capabilities



# The network and digital economy interplay

Evolution of network technologies will shape the future of the 6G era





# Agenda

1. Vision and digital transformation now
- 2. 6G era platform**
3. XR and digital twin
4. Topics for long term research

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

## Trends and challenges



Demand for higher network performance



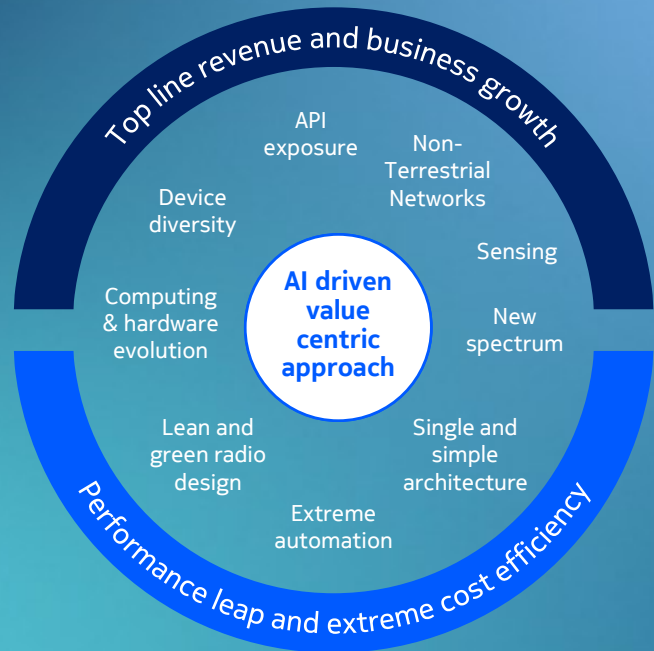
The vastly growing device ecosystem



The surging power of AI and emergence of the API economy



## How 6G can address them



## Design principles for 6G



Sustainable



Resilient & Secure

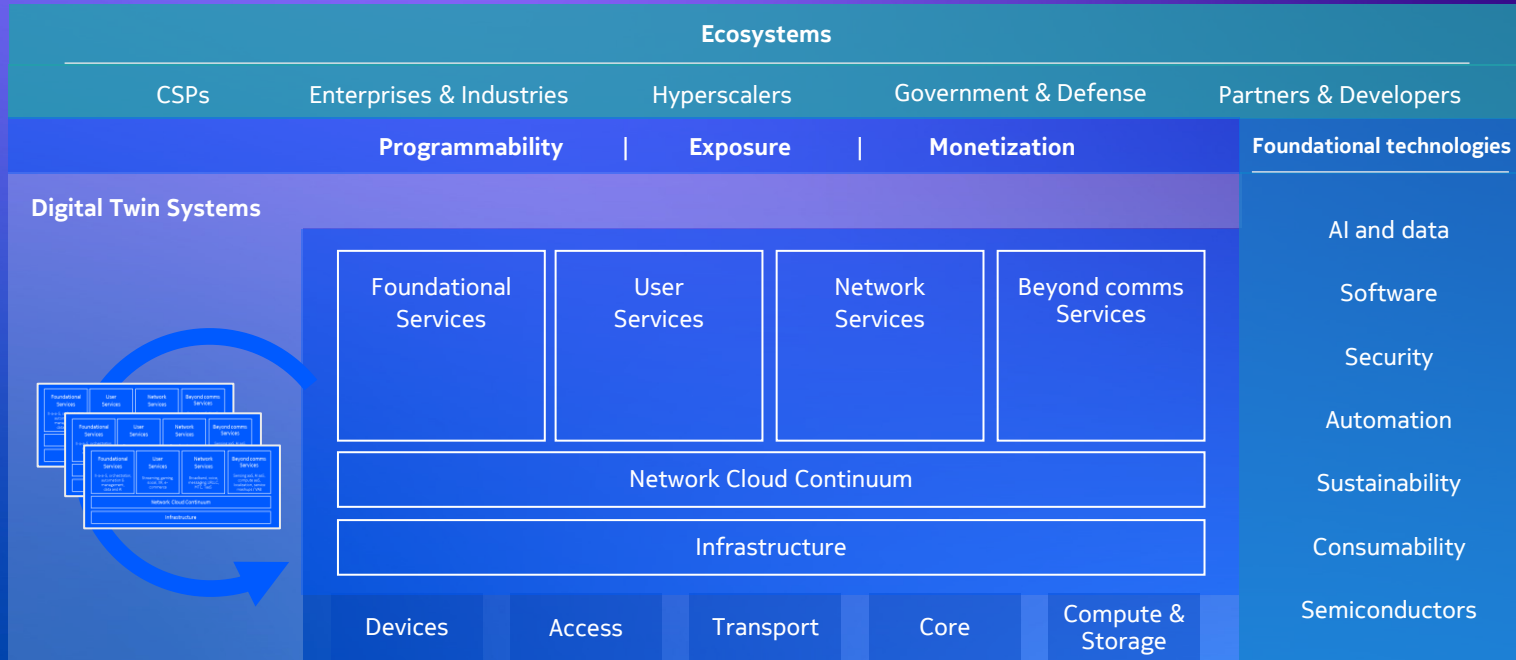


Digital inclusive





# 6G era communications network platform





# Agenda

1. Vision and digital transformation now
2. 6G era platform
- 3. XR and digital twin**
4. Topics for long term research

# Revenue opportunities will exhibit different growth dynamics

Industrial metaverse opportunities are already revealing traction

## Industrial Metaverse (OT\*-centric)



- XR-enabled workforces
- Digital twin enhanced production & condition monitoring

## Enterprise Metaverse (IT\*-centric)



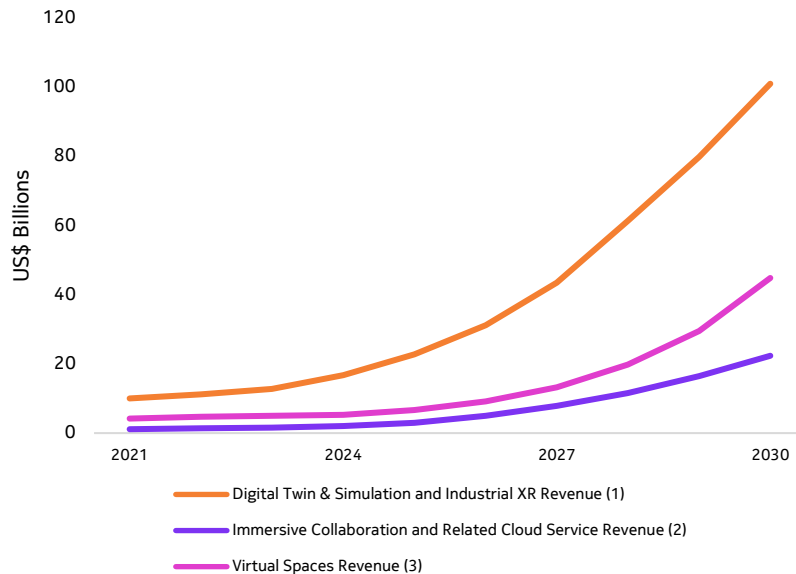
- Immersive team collaboration
- Digital co-design
- XR-based training & learning

## Consumer Metaverse



- Immersive gaming
- XR-enhanced social & retail interaction
- Virtual tourism

## Metaverse revenue forecast examples (global)



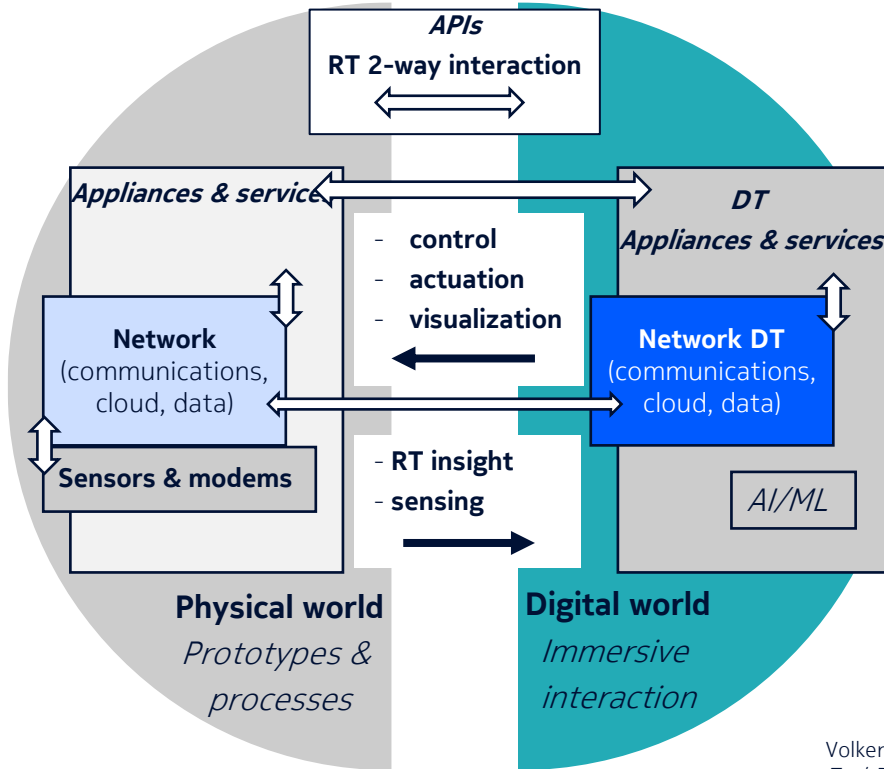
1 ABI Research: The Future of Work, Augmented and Mixed Reality, Virtual Reality Market Data, November 2022

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

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

\* IT: Information Technology | OT: Operational Technology

# Digital twin framework paradigm for the 6G era



## Enabling the metaverses

- use cases enabled by an accurate, high spatial resolution and real-time digital representation of the physical world, the so-called real-time Digital Twin (DT)
- sophisticated information processing and immersive interaction capabilities

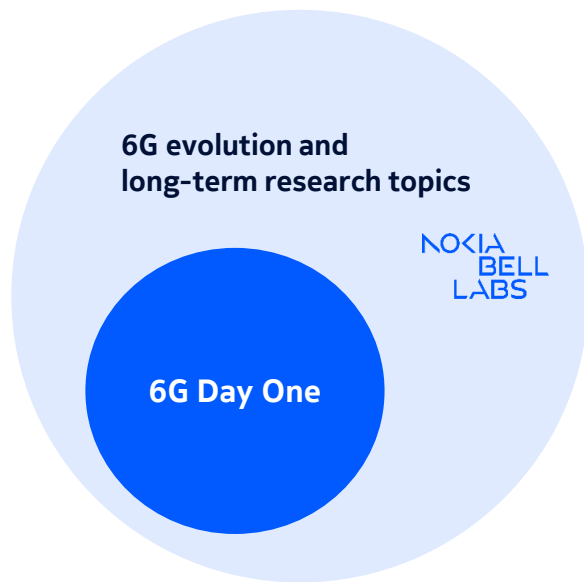
Volker Ziegler, Harish Viswanathan, Nishant Batra. How 6G will enable the Industrial Metaverse. *TechRxiv*. May 21, 2024. DOI: [10.36227/techrxiv.171625811.11421491/v1](https://doi.org/10.36227/techrxiv.171625811.11421491/v1)

# Agenda

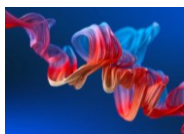
1. Vision and digital transformation now
2. 6G era platform
3. XR and digital twin
- 4. Topics for long term research**

# 6G evolution and long-term research

To achieve the full realization of digital-physical fusion



**Accelerate digital-physical fusion** through Integrated communications and sensing



**Harness the full potential of AI** to create learning networks that can understand their surroundings and human intent



**Transform networking systems and software** to a Unified Networking Experience (UNEXT)



**Take energy efficiency to the next level** by researching energy-efficient ASIC technology



**Open up new spectrum frontiers** in the SubTHz bands to augment our access, backhaul and sensing capabilities



NOKIA