Oulun innovaatioallianssi

BUSINESS FINLAND **6GBridge** **EMETA.FI**

OULU INNOVATION ALLIANCE

Oulussa innovaatiot ja niiden kehittäminen perustuvat toimijoiden väliseen läheiseen yhteistoimintaan. Eri alojen ekosysteemeissä ja klustereissa ovat monipuolisesti edustettuina koulutus, tutkimus, liike-elämä ja julkinen sektori, joiden yhteistyötä tukemaan perustettiin vuonna 2009 verkostojen verkosto, Oulun innovaatioallianssi eli OIA.

Metaverse use cases, ICT requirements and system architecture(s)

EUROOPAN PARAS DIGITAALISUUDESTA GLOBAALIA LISÄARVOA TUOTTAVA EKOSYSTEEMI

KOHDEALAT

Digitalisaatio kaupunkiympäristön muutoksessa

Digitaaliset hyvinvoinnin ja terveyden ratkaisut

Kestävä kiertotalous ja puhtaat ratkaisut

Startup-yrittäjyys, osaaminen ja jatkuva oppiminen   Kaupunki Smart City -ratkaisujen kehitysalustana

VETURIYRITYKSET, EKOSYSTEEMIT JA VERKOSTOT

KÄRKIOHJELMAT

Tulevaisuuden tietoverkot

Autonomisten ajoneuvojen ja laitteiden kehitysalusta

Data-analytiikka

Data ja ratkaisut yhteiskunnan resurssina osana ennakoivaa ja tukevaa terveydenhuoltoa

Paremmat palvelut kuntalaisille virtuaalipalvelutuotannon avulla

Sote-palveluntuottajien innovaatio- ja testaustoiminnan kehittäminen

Kontinkankaan hyvinvointikampus

Uuden sukupolven energiatuotteet ja -palvelut

Epäorgaanisten sivuvirtojen uudet ratkaisut

Ympäristömyönteinen teräs ja siihen liittyvät arvoketjut

Vesiosaamisen kehittäminen ja kaupallistaminen

OULU   OAMK OULUN AMMATTIKORKEAKOULU   Luke LUONNONVARAKESKUS

UNIVERSITY OF OULU   TECHNOPOLIS   VTT   Pohde Pohjois-Pohjanmaan hyvinvointialue   OSAO
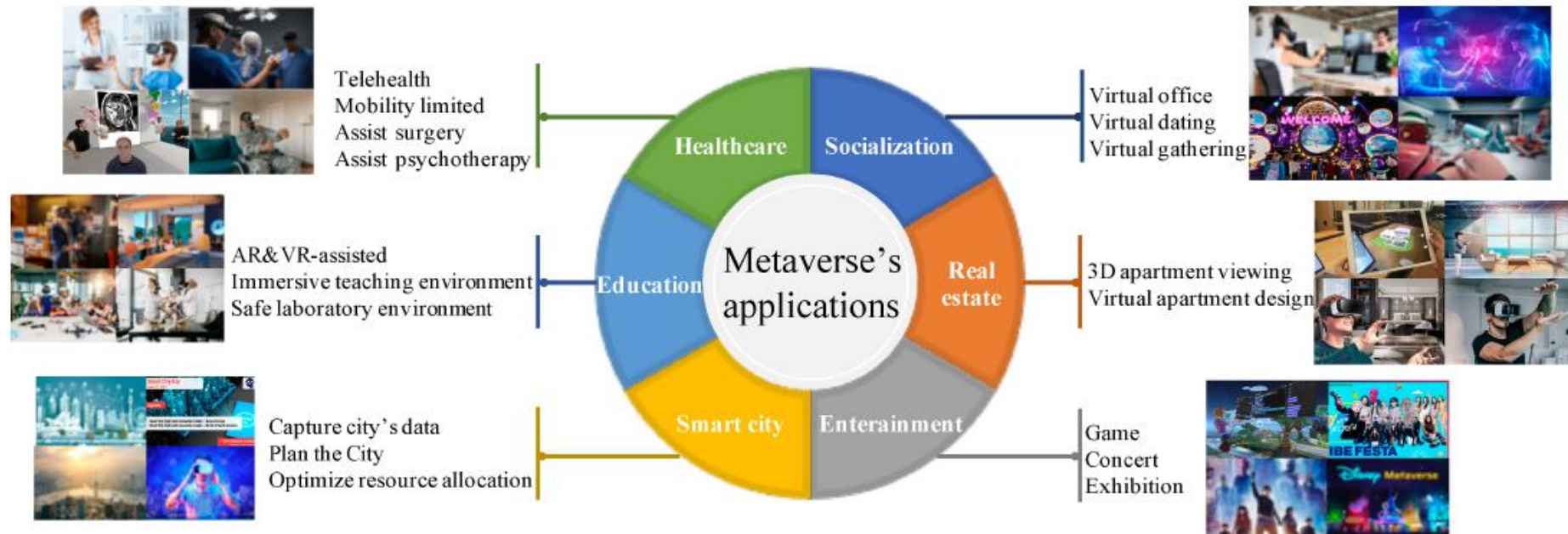

EMETA

Home Overview Material Consortium Co-operating activities Events Contacts

Metaverse – an extensive new business opportunity for the ICT industry

Metaverse integrates seamlessly virtual and physical living spaces by enabling control of physical space resources from virtual space, utilization of virtual space resources from physical space and sharing of the same experiences through virtual and physical participation.

EMETA (Enabling Metaverse) project

Main goal of the project is to improve understanding about the practical Metaverse ICT requirements, develop 5G Evolution/Advanced based communication and computing, real-time multi-user 3D Digital Twin, AR/VR/XR and blockchain technologies and solutions for Metaverse key features. The project will also implement test environments and proof-of-concepts which demonstrate the control and utilization of smart building resources and facilities as well as enable collaboration between users and environments both in physical and virtual spaces. Read more about the project.

News

Save the date.
The first results and co-operation workshop in Oulu on 29.08.2023.

Specification of metaverse for multitude of applications

- Key features, elements and use cases
- ICT for metaverse infrastructure consisting of existing commercial solutions, 5G Advanced and 6G research-based innovations.

- System architecture of open innovation environments considering open interfaces, dynamics, flexibility, continuous evolvement, and upcoming needs of special business verticals.

Telehealth
Mobility limited
Assist surgery
Assist psychotherapy

AR&VR-assisted
Immersive teaching environment
Safe laboratory environment

Capture city's data
Plan the City
Optimize resource allocation

Healthcare   Socialization

Education   Metaverse's applications   Real estate

Smart city   Enterainment

Virtual office
Virtual dating
Virtual gathering

3D apartment viewing
Virtual apartment design

Game
Concert
Exhibition

Terminology

Meta, a company, formerly *Facebook*

meta- (prefix), 1. <u>later or more highly organized or specialized form</u> of 2. : change : transformation 3. [metaphysics]: more comprehensive : transcending - usually used with the name of a discipline <u>to designate a new but related discipline designed to deal critically with the original one.</u> [https://www.merriam-webster.com/dictionary]

metaverse, Digital representation of entity (object/environment) existing in physical world. The following requirements apply 1) Two-way interactions between virtual and physical world and object within them, including avatars, 2) Persistence (state preserving and common to all users) 3) Co-existence/shared experience. Stephenson coined the term: "Virtual environment parallel to physical world".

metaspace, 1. virtual representation of physical entity created from default state for limited time period, space or purpose. In a sense, metaspace is synonymous to metaverse. *2.* Physical environment (e.g., room) equipped to support creation of transient virtual *metaspaces.*

Metaverse, integrated set of separate co-operating *metaverses* or *metaspaces*. Spelled with capital letter, <u>Metaverse indicates a persistent infrastructure and collection of metaverses, similarly to the Internet.</u> Indeed, Metaverse has been referred to as a next version of Internet.

There is only one Metaverse
The metaverse is a platform - just as there is only one Web
The metaverse will enable diverse 'worlds', spaces' and 'experiences' etc.
Just as the Web enables 'pages' and 'apps' etc.
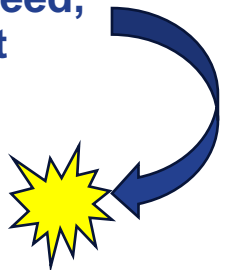
Metaverse Standards Forum 2023

University of Oulu

Forbes, iLRN, Virbela

Enhanced student learning and engagement by transforming how educational content is delivered

Microsoft Flight Simulator

Realistic environments where users can import their own authored assets

Open AR Cloud, Niantic

Augmenting Reality with persistent geo-locking, linking, occlusion and realistic scene illumination

Roblox, Minecraft, Manticore

Virtual spaces where gamers create their own content

Fortnight, PUBG, Valheim

Realtime, multi-user gaming and socialization

Metaverse Standars Forum 2023: Enterprise use cases

PTC, AREA

Augmented Reality used in guided tasks and remote assistance are proven to boost productivity

Algorand, Sports Tomorrow

Virtual Sports Leagues and immersive viewing of sports events

GE, Siemens, Bentley, NVIDIA

Digital twins - virtual representation of a product, process, or place that measures mirrors and its physical counterpart - for monitoring, optimizing and prediction

OGC, Cesium, NVIDIA

Spatially indexing and streaming the digitized world for planning, visualization and simulation
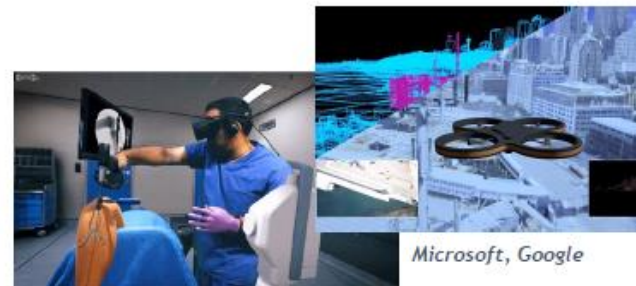
Microsoft, Google

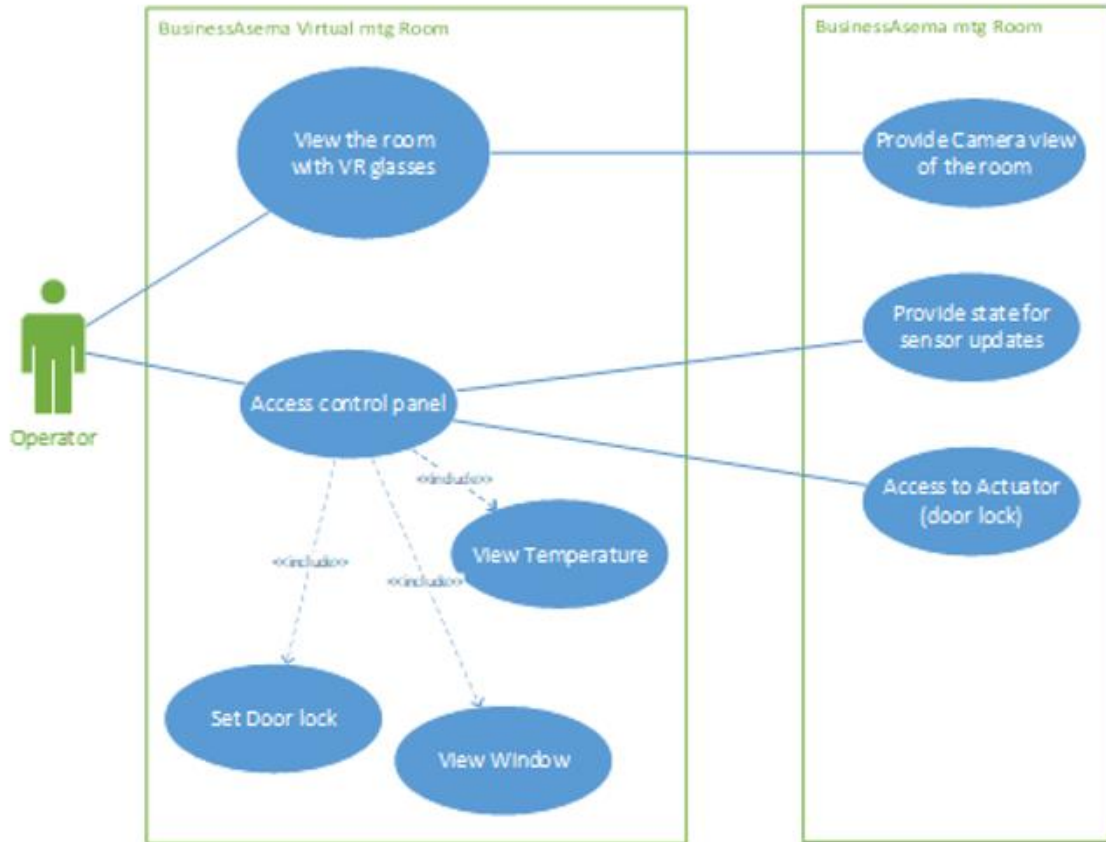Immersive Training significantly increases understanding and retention

NVIDIA Omniverse

3D application interoperability for real-time immersive collaborative simulation and design

University of Oulu

Emeta Use Cases

Use case group A: Virtual meeting

- *Control of BusinessAsema physical resources from digital twin based virtual space*
- *Meeting between participant in digital space/room and physical meeting participants inside BusinessAsema*
- *Mobile case with 5G and beyond*

Use case group B: Virtual design

- *Sharing of dimensionally accurate 3D model*
- *Model update of built environment*

Use case group C: Advanced use cases

- *Ambient IoT*
- *IoT communication and computing infrastructure*
- *Interaction between MetaSpace instances*
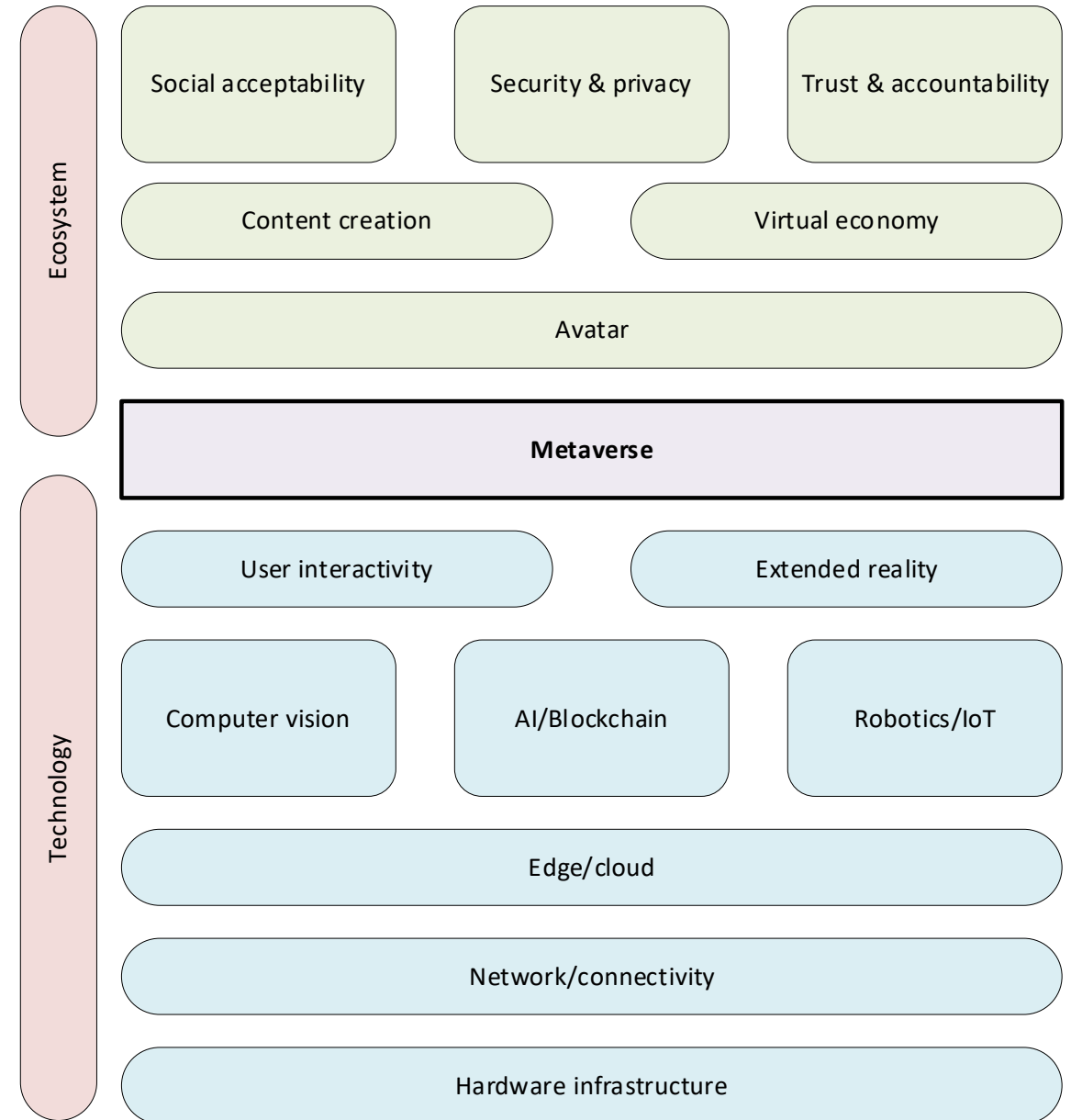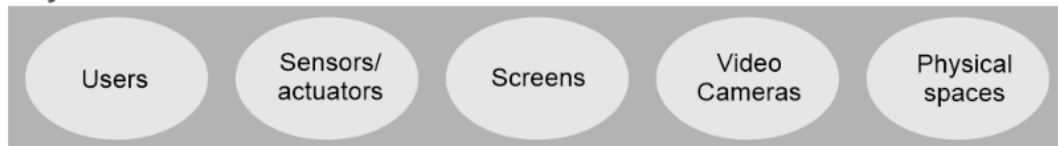- *5G-A/pre6G radar based real-time indoor digital twin*

Metaverse components

Virtual world
- Avatars
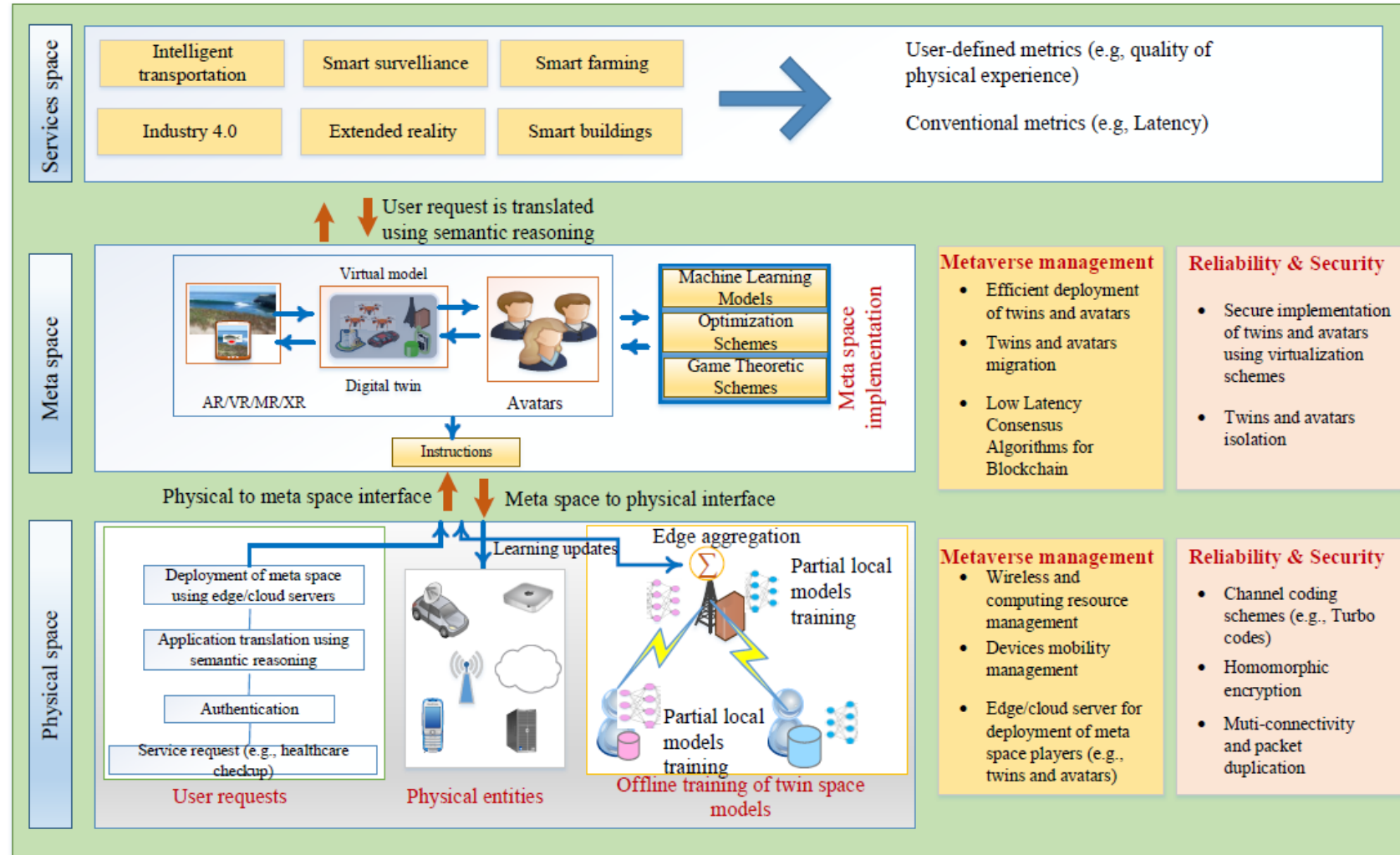- Virtual control panels
- Virtual screens
- Virtual views in AR/VR
- Virtual spaces

Metaverse engine
- Service provider: Connectivity
- Computation Storage
- Metaverse platform
- NFT/B lockchain
- Digital twins

Physical world
- Users
- Sensors/actuators
- Screens
- Video Cameras
- Physical spaces

Ecosystem
- Social acceptability
- Security & privacy
- Trust & accountability
- Content creation
- Virtual economy
- Avatar

Metaverse

Technology
- User interactivity
- Extended reality
- Computer vision
- AI/Blockchain
- Robotics/IoT
- Edge/cloud
- Network/connectivity
- Hardware infrastructure

Adapted from Xu et al., 2022

Metaverse architectures

Khan et al., 2023

Metaverse architectures

Xu et al., 2022

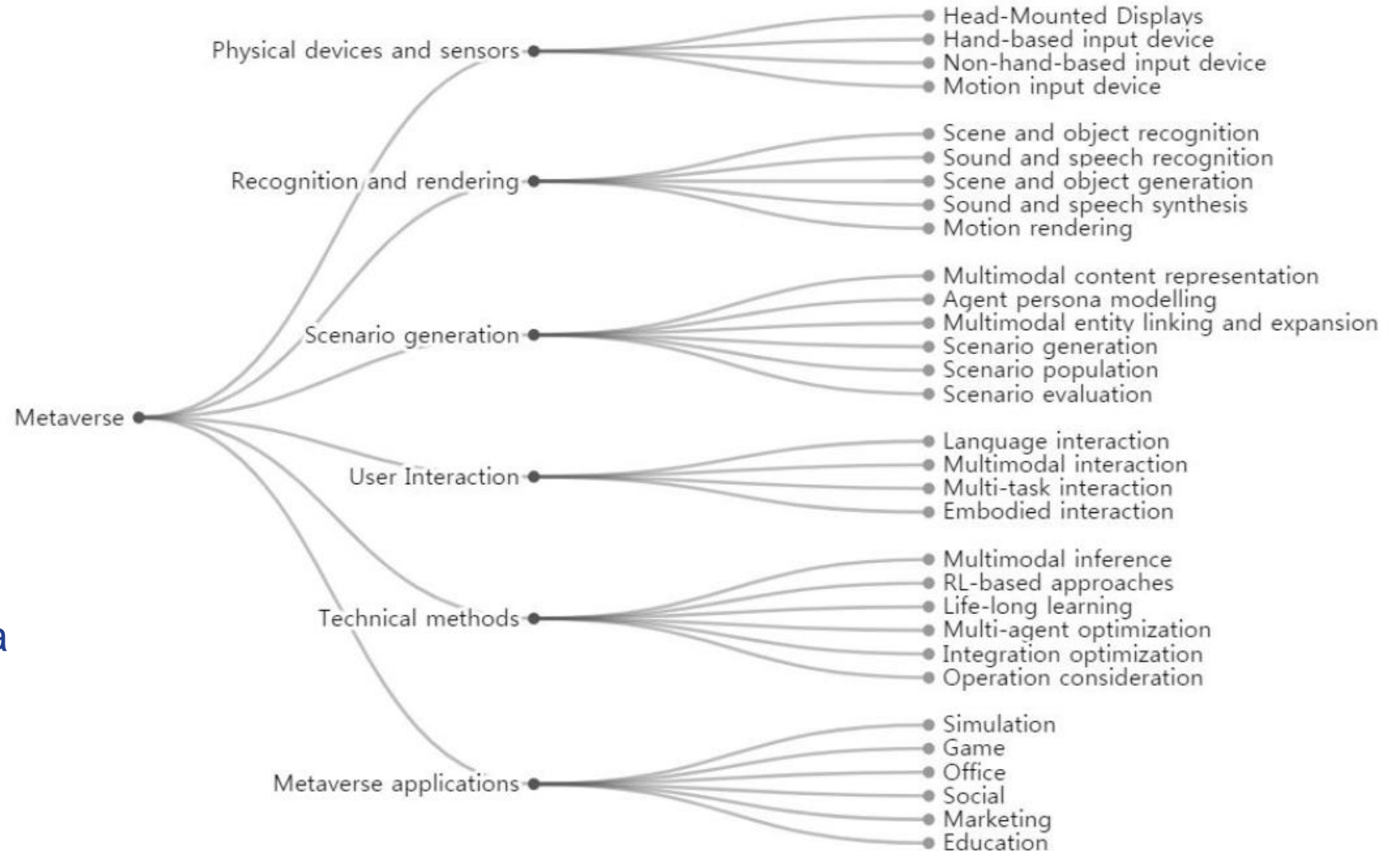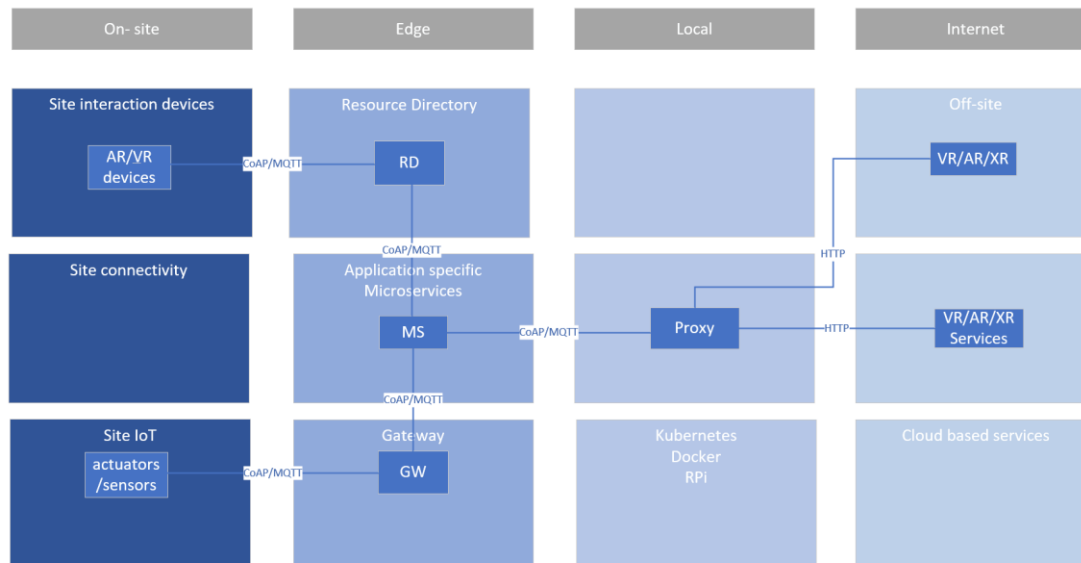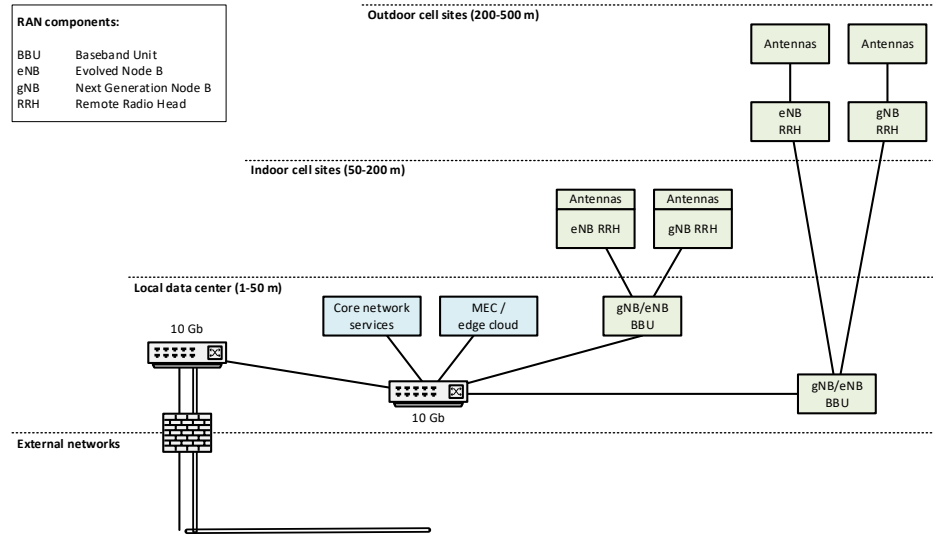University of Oulu
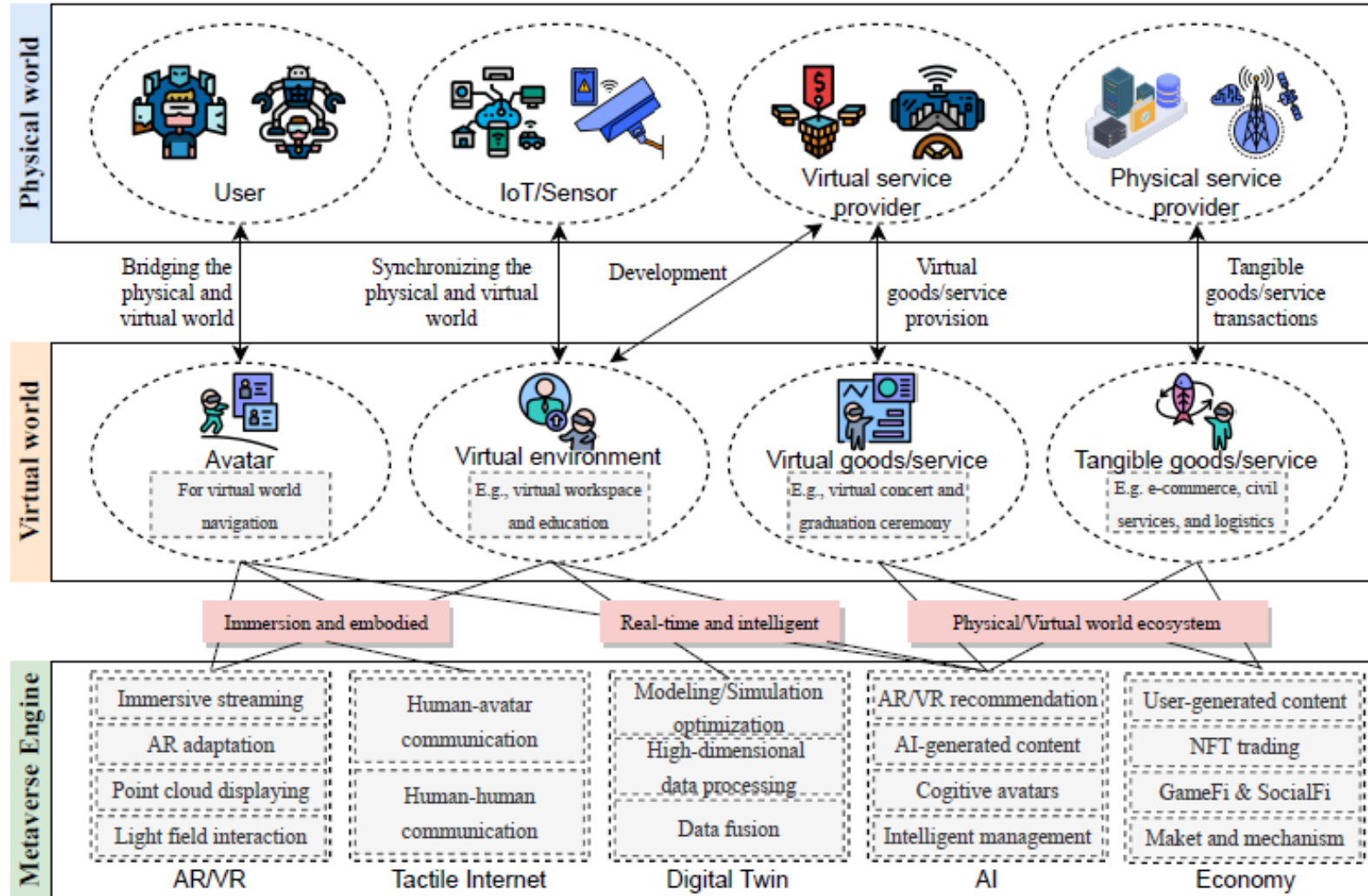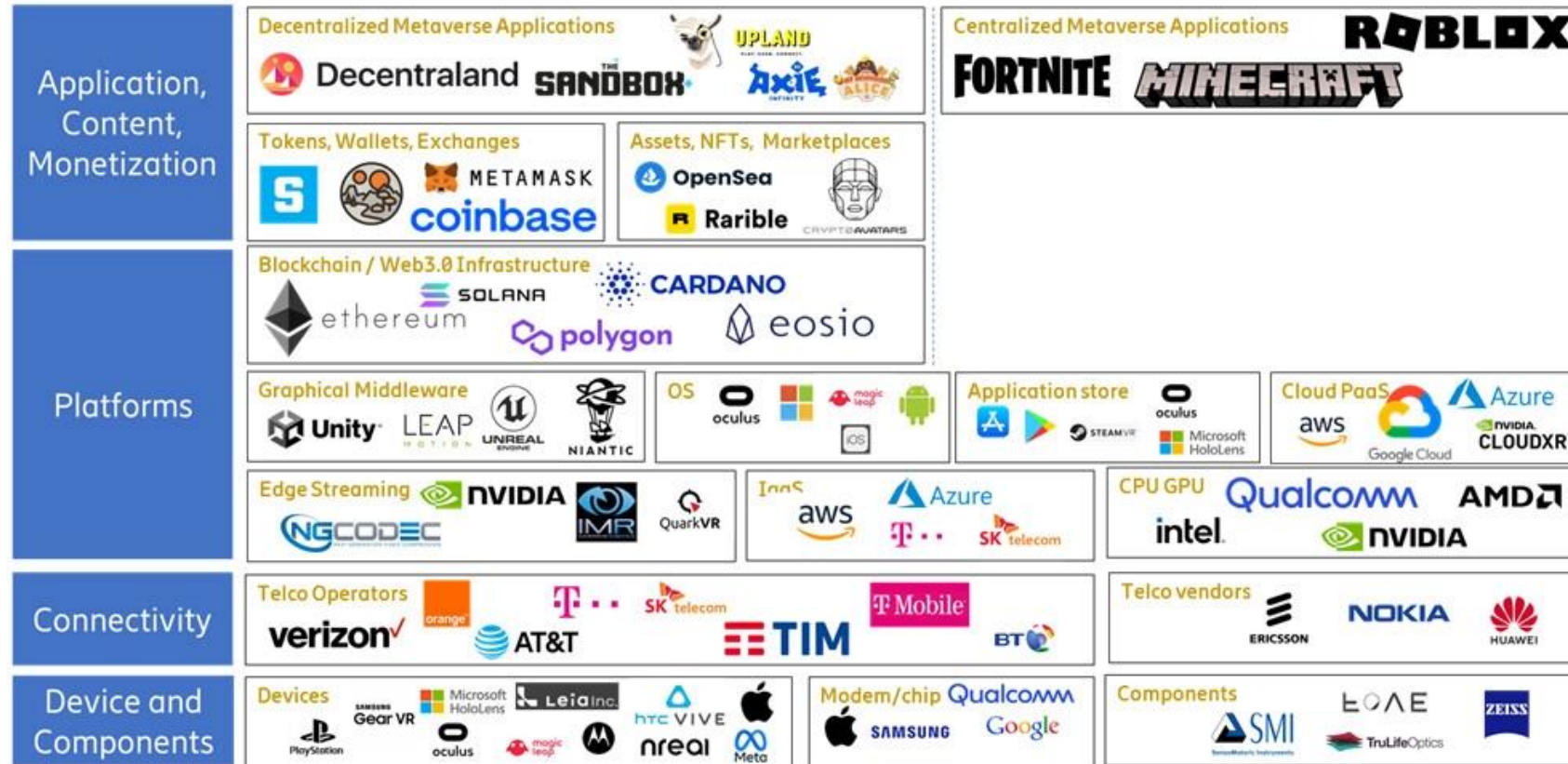
Metaverse ecosystem

Metaverse taxonomy

Park & Kim, 2022

Note: This paper includes a table on nearly 50 different definitions for metaverse found from literature!

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Key research questions

How to build *the Metaverse* from separate instances?

- There should be fluent interoperability and mobility within the Metaverse.

- What are the enabling technologies and standards? *Metaverse protocol* needed?

Metaverse system architecture including 5G, B5G and 6G?

- Technical and Functional requirements of metaverse?

- Real time two-way interactions between physical and virtual?

➢ Assumingly edge computing, MBB, URLLC and eventually **6G** are key metaverse enablers

Network KPIs for metaverse

Type of interaction / use case	Network KPI requirement	Fair-experience In the fair-experience phase, most content is 4K, and the terminal screen resolution is 2K to 4K.	Comfrotable-experience In the comfortable-experience phase, most content is 8K, the terminal screen resolution is 4K to 8K	Ideal-experience In the ideal-experience phase, most content is 12K or 24K. The terminal screen resolution is 8K to 16K.
Weak-interaction Users select view and location, but do not interact with entities in the virtual environment. For example IMAX, 360 video, live broadcast, music, education.	Bitrate	≥ 40 Mbit/s (4K)	Full-view: ≥ 90 Mbit/s FOV: ≥ 50 Mbit/s	Full-view: ≥ 290 Mbit/s (12K) ≥ 1090 Mbit/s (24K) FOV: ≥ 155 Mbit/s (12K) ≥ 580 Mbit/s (24K)
	Bandwidth requirement	≥ 60 Mbit/s (4K)	Full-view: ≥ 140 Mbit/s FOV: ≥ 75 Mbit/s	Full-view: ≥ 440 Mbit/s (12K) ≥ 1600 Mbit/s (24K) FOV: ≥ 230 Mbit/s (12K) ≥ 870 Mbit/s (24K)
	Recommended network RTT	≤ 20ms	≤ 20ms	≤ 20ms
	Packet loss requirement	≤ 9e-5	≤ 1.7e-5	≤ 1.7e-6
Strong-interaction Users can interact with virtual envirnomnets through interactive devices. The virtual space displayed needs to respond to interactions in real time. For example gaming, fitness, social networking, real estate, engineering, healthcare, shopping.	Bitrate	≥ 40 Mbit/s	≥ 90 Mbit/s	≥ 360 Mbit/s (8K) ≥ 440 Mbit/s (16K)
	Bandwidth requirement	≥ 80 Mbit/s	≥ 260 Mbit/s	≥ 1000 Mbit/s (8K) ≥ 1500 Mbit/s (16K)
	Recommended network RTT	≤ 20 ms	≤ 15 ms	≤ 8 ms
	Packet loss requirement	≤ 1e-5	≤ 1e-5	≤ 1e-6

Siniarski et al., 2022

Thank You!

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