

The logo features the text '6G-XR' in a bold, white, sans-serif font. The 'X' is stylized with a double-stroke effect. The background is a dark purple gradient with faint, light-colored geometric shapes like a cube and a sphere, and abstract circuit-like lines.

# 6G-XR – SNS project with open call opportunities for media community

**Dr Jussi Haapola**

*University of Oulu*

**NEM Summit: Future communications networks – a media perspective**

*25 May 2023*



**6GSNS**

[www.6g-xr.eu](http://www.6g-xr.eu)

# Project Overview



**Full Name:** 6G eXperimental Research infrastructure to enable next-generation XR services

**Stream:** C-01-01

**Project Coordinator:** Dr Jussi Haapola, *University of Oulu*

**Technical Manager:** Jonathan Rodriguez, Instituto de Telecomunicacoes

**Objective:** strengthen European leadership in 6G technologies by enabling next-generation XR services and infrastructures that will provide beyond-state-of-the-art capabilities towards the 6G era.

 **15**  
*partners*

 **8**  
*countries*

 **36**  
*months*

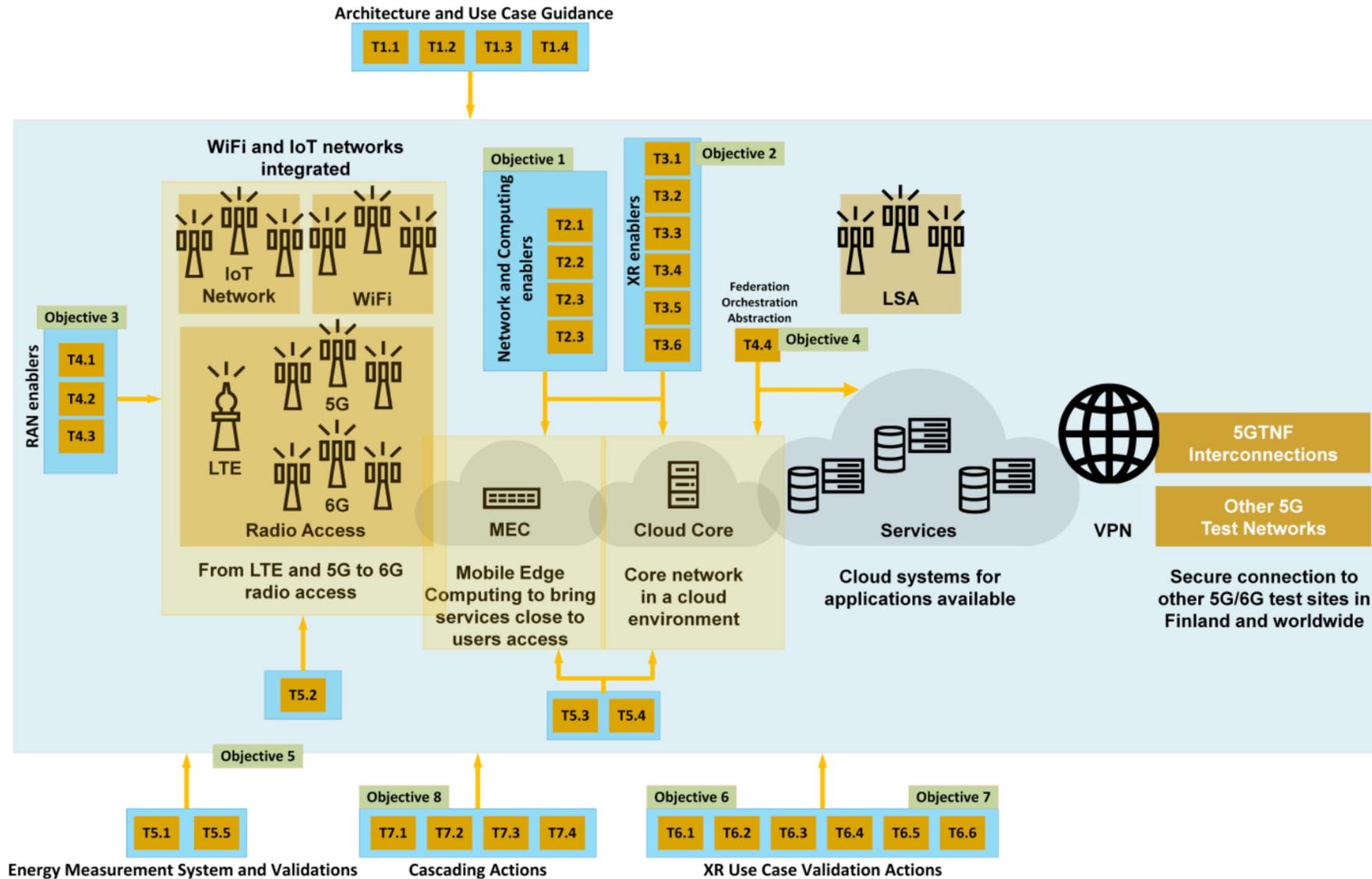
# The consortium



## Project Key Objectives:

- **Build a multisite Research Infrastructure (RI)** that can provide validation platform for multitude of foreseen (extreme) 6G use cases by developing enablers for networking and computing, radio access technologies beyond 5G, enablers for XR services with in-built federation, trial management, abstraction tools as well as energy measurement framework.
- **Validate multi access edge computing scenarios** and their integration into a complete cloud continuum, support innovative use cases with vertical actors, beyond 5G capabilities, and support showcasing events.
- **Demonstrates and validates performance of innovative 6G applications** with a focus on demanding immersive applications such as holographics, digital twins, and XR/VR.

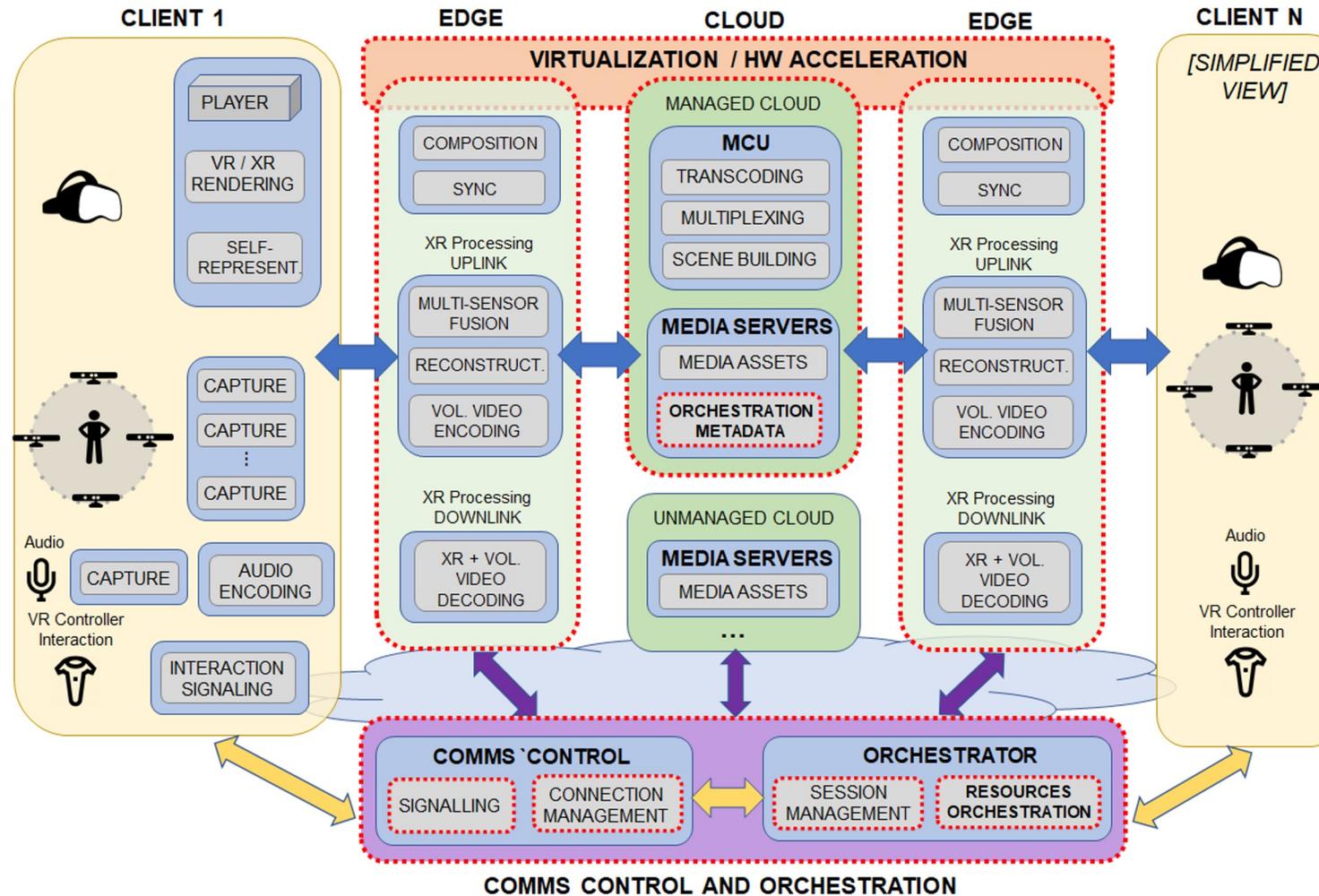
# Methodology



# Initial Use Cases



## Holographic Communications



## Objective 6: Develop and deploy holographic validation environments

**Expectation:** Real-time holographic communications bring the promise to become a dominant social interaction and communication medium in the years to come.

**6G-XR contribution:** The project will contribute with innovative and disruptive enablers to evolve and optimize adaptive, scalable, and high-quality holographic communications.

The validation environment requires:

- i. adaptation of the holographic communication application for proposed 6G architecture,
- ii. preparation of 6G XR infrastructure for this application, and
- iii. testing, validation, and analysis of results.

KPI6.1: Adaptation and deployment of **at least two proof-of-concepts** (AR by Matsuko, and VR (Virtual Reality) by i2CAT) for multi-party holographic communications.

KPI6.2: **Increase of visual quality:** x2 fps (from 15 to 30 fps, i2CAT platform), x2 resolution (i2CAT platform).

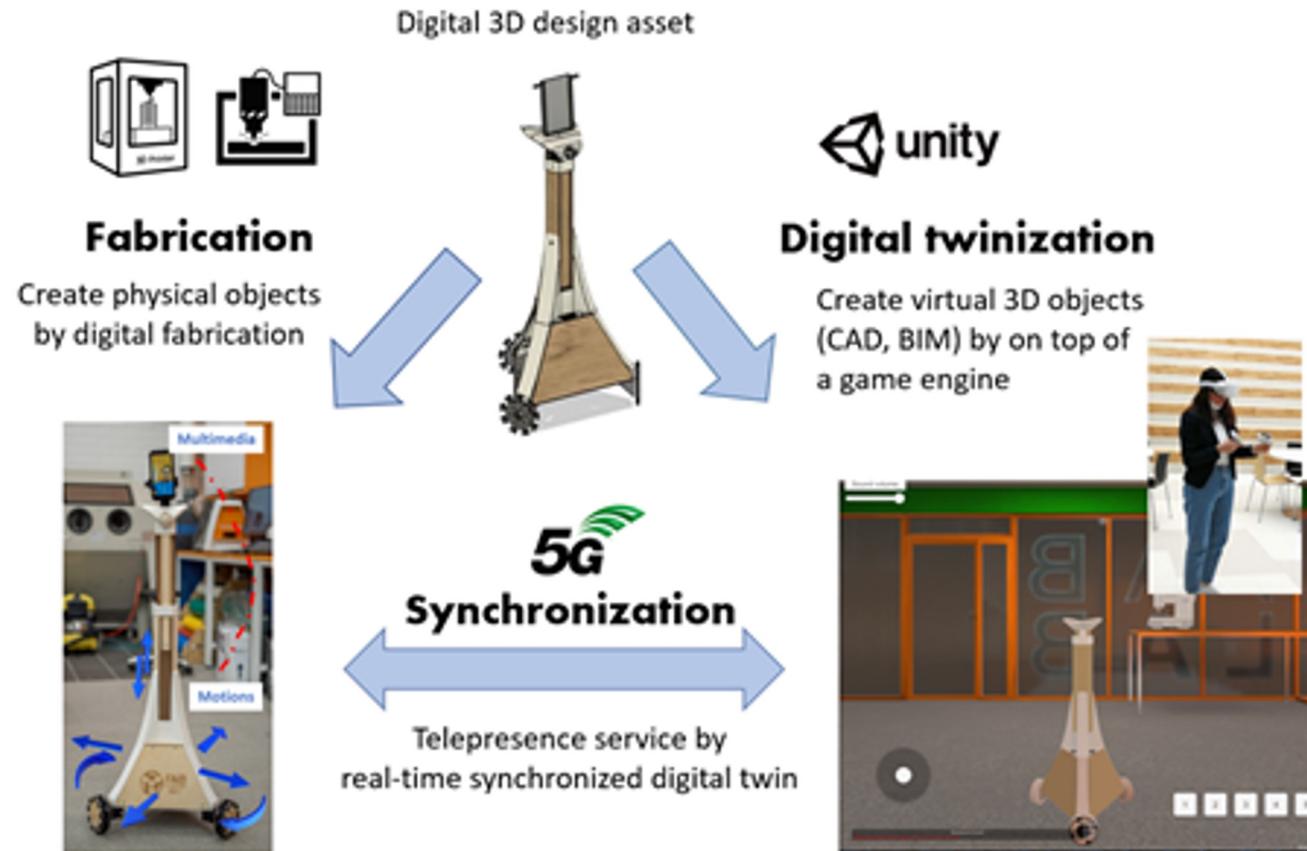
KPI6.3: Increase of up **x2 the number of concurrent users** per session (from 6 to 12, i2CAT platform).

KPI6.4: Horizontal scalability regarding the number of concurrent sessions (subject to availability of infrastructure).

KPI6.5: **Assessment of at least 6 cross-layer KPIs / QoS metrics** in objective tests, in line with the expected levels detailed in Objective 2.

KPI6.6: **Assessment of at least 3 QoE metrics via questionnaires**, involvement of at least 40 end users and 10 professional users in pilot actions (i2CAT platform).

## Virtual Remote Control in 3D Digital Twins



K. Komatsu, P. Alaves, A. Pauanne, T. Hänninen, O. Liinamaa and A. Pouttu, "Leveraging 5G in cyber-physical system for low-cost robotic telepresence," *2022 Joint European Conference on Networks and Communications & 6G Summit (EuCNC/6G Summit)*, Grenoble, France, 2022, pp. 399-404, doi: 10.1109/EuCNC/6GSummit54941.2022.9815653.

## Objective 7: Develop and deploy 3D Digital Twin with XR remote control capability

### Expectation:

- Enabling multi-user cyber-physical systems.
- Integrating 6G-XR contributions and immersive user interfaces from 3D Digital Twin environments.
- Providing recognizable affordances for remote operation and novel interactions in VR for collaborative teleoperation of robots and machines.

**6G-XR contribution:** Allows the assessment of the benefits for end-users, but more importantly validations and demonstrations to certify the readiness and benefits of the 6G-XR infrastructure and enablers.

KPI7.1: Implementation, deployment and successful **piloting of a multi-user cyber-physical system prototype.**

KPI7.2: Verification of **physical machine and VR human interworking.**

KPI7.3: **Predictive safety, efficiency** utilizing AI/ML in cyber world feedback into physical world operation.

KPI7.4: **Assessment of at least 4 cross-layer KPIs / QoS metrics** in objective tests, in line with the expected levels detailed in Objective 2.

KPI7.5: **Assessment of at least 3 QoE metrics via questionnaires and interviews**, with at least 40 end users in a user study with statistically significant benefits of 6G-XR enablers in comparison with the state-of-the-art.

The logo for 6G-XR is displayed in a large, white, stylized font. The '6' is a simple, rounded shape. The 'G' is a thick, blocky letter. The 'XR' is rendered in a more complex, futuristic font where the 'X' and 'R' are interconnected. The background of the top half of the image is a dark purple gradient with faint, light-colored geometric lines and shapes, including a cube and various curved lines, suggesting a technical or digital theme.

**6G-XR**

# 6G-XR Open Calls

[www.6g-xr.eu](http://www.6g-xr.eu)

6G-XR will provide a wide set of innovative, modular and disruptive network, cloud continuum and XR enablers deployed or deployable over reference and consolidated (toward) 6G research experimentation infrastructures.

- **Third Parties** will be invited through Open Calls to develop, test, and trial applications and functions specifically driven by AR/VR/XR realms and metaverse.
- **~ 30 projects** to be selected in three waves
- Third party projects duration: 6 months
- Total budget: **1.800.000 EUR**, ~ 60,000 EUR per project
- Mentorship and guidance to third parties by consortium partners

## 3 waves:

- ✓ **6G-XR OC1: 6G-XR Platform and Network Enablers:** targeting development and extension of 4 research infrastructures: i) Networking and Computing enablers; ii) XR enablers; iii) RAN enablers; iv) Sustainability enablers (Planned for Sept-Nov 2023, to be published on [www.6g-xr.eu](http://www.6g-xr.eu) and on Funding & Tenders Portal)
- ✓ **6G-XR OC2: Stream B enablers** targeting accepted Stream B projects (to be defined). Some topics: system architecture, wireless communication technologies and signal processing, communication infrastructure technologies and devices (Summer 2024)
- ✓ **6G-XR OC3: Vertical Replicability enablers** to allow third-party agents to leverage 6G-XR's enablers, infrastructure facilities and testbeds to deploy, replicate and validate the verticals of their interest. (Spring 2025)

- All organisations eligible for participation in HE programme. Emphasis on SME, Industry, Research/scientific organisation, Academia.
- **Eligibility criteria:**
  - Type of Activity
  - Type of organisation
  - Eligible countries: EU Member State or Associated Country
  - English-language
  - Submission system (Call management tool)
  - Deadline
  - Absence of conflict of interest
  - GDPR compliant

## Evaluation criteria

- Clarity and methodology
- Ambition
- Impact technology and domain fit to 6G-XR scope and objectives
- Replicability
- Contribution to standardization

- Team capacity, knowledge, expertise, commitment, research domain & track record
- Value for money
- SME participation (50%)
- Gender dimension awareness
- Maturity, trajectory of organisation/development

The logo for 6G-XR is rendered in a bold, white, sans-serif font. The '6' and 'G' are large and blocky, while the 'XR' is smaller and more stylized, with the 'X' and 'R' having a slightly irregular, hand-drawn appearance. The logo is centered in the upper half of the image, set against a dark purple background with faint, light-colored geometric lines and shapes, including a cube and various curved lines.

**6G-XR collaborative 3D Digital twin**

[www.6g-xr.eu](http://www.6g-xr.eu)

# Collaborative 3D digital twin

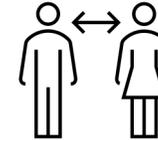


## 3D Digital Twin:

- Transformative convergence of digital and physical worlds, offering unparalleled opportunities for innovation and growth across industries.
- Leverages the power of 5G connectivity, extended reality (XR) technologies, and advancements in artificial intelligence and machine learning (AI/ML)
- This fusion of technologies will enable more immersive, interactive, and intelligent virtual environments, unlocking new possibilities for communication, collaboration, and automation, and driving the next frontier of human-machine interaction.



Social

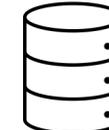
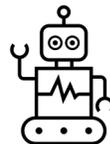


Collaborative  
3D Digital  
Twin

Physical  
Replica



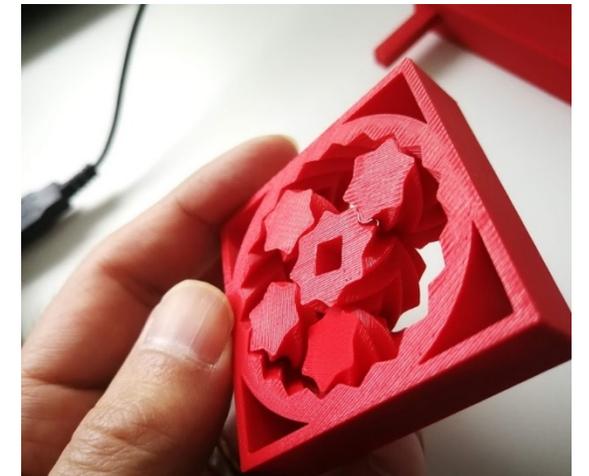
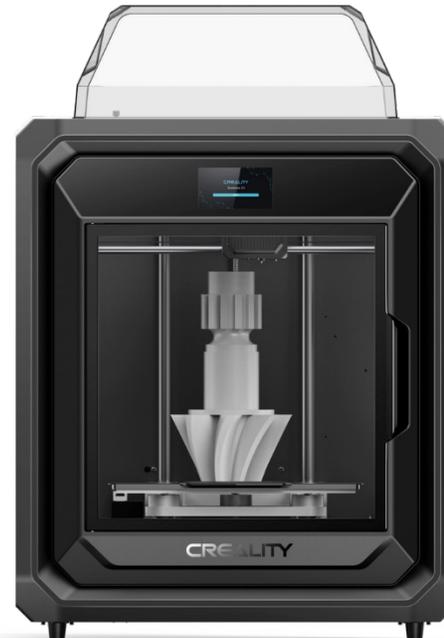
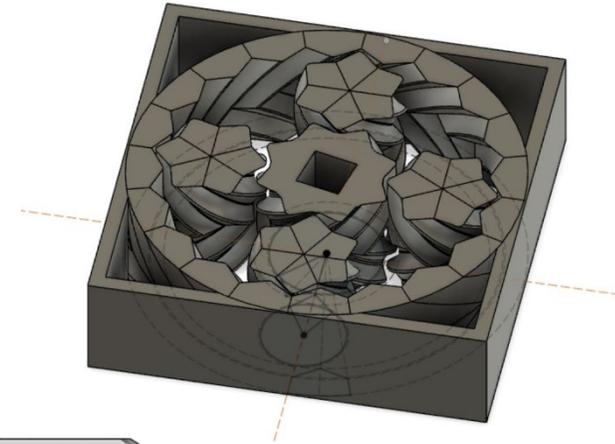
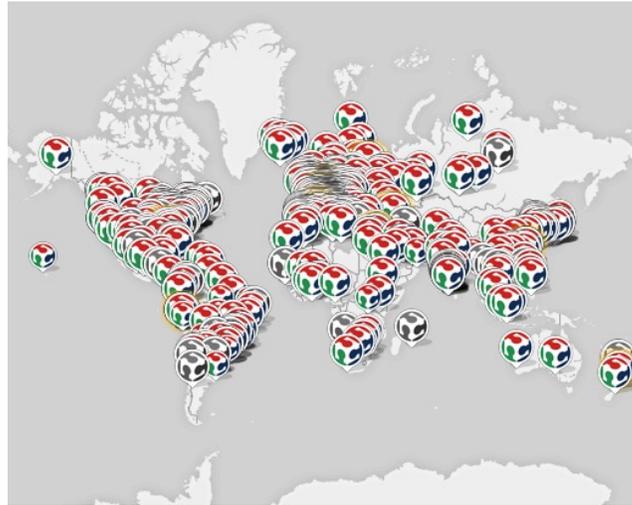
Digital Data  
Management



Our primary areas of interest:

- To explore how individuals can collaborate with remote peers in the digital space, breaking the limits of distance in real-time using 5G networks.
- To verify how people can interact with machine controls and work together as a social community.

# Fab Lab, Digital fabrication community worldwide



**Fab Lab Oulu is one of few Super Fab Labs in the world** where anyone can design, quick-prototype, and fabricate their own products and hardware.

- Fab Lab Oulu is a **Nordic Super Node**, a fabrication laboratory with versatile capability for digital fabrication. Fab Lab Oulu complies with **open innovation concept developed by MIT** in the United States. We operate within University of Oulu premises.
- In Fab Lab Oulu we provide a large set of tools, equipment, software, and practices - shared according to the [Fab Lab concept](#). Fab Lab provides access and support for the following equipment:

- 3D printers

- 3D scanners

- Laser cutters

- Vinyl cutters

- CNC precision milling machine

- CNC router

- Electronics workbenches

- Open source design software

# 3D Digital Twin Fab Lab Remote 3D Printer Use Case



**Digital Twin Environment**



This block illustrates the digital twin environment. It features a male avatar on the left, a 3D model of a gear-like object in the center, a virtual 3D printer interface in the middle, and a female avatar on the right. The background is a blue gradient.

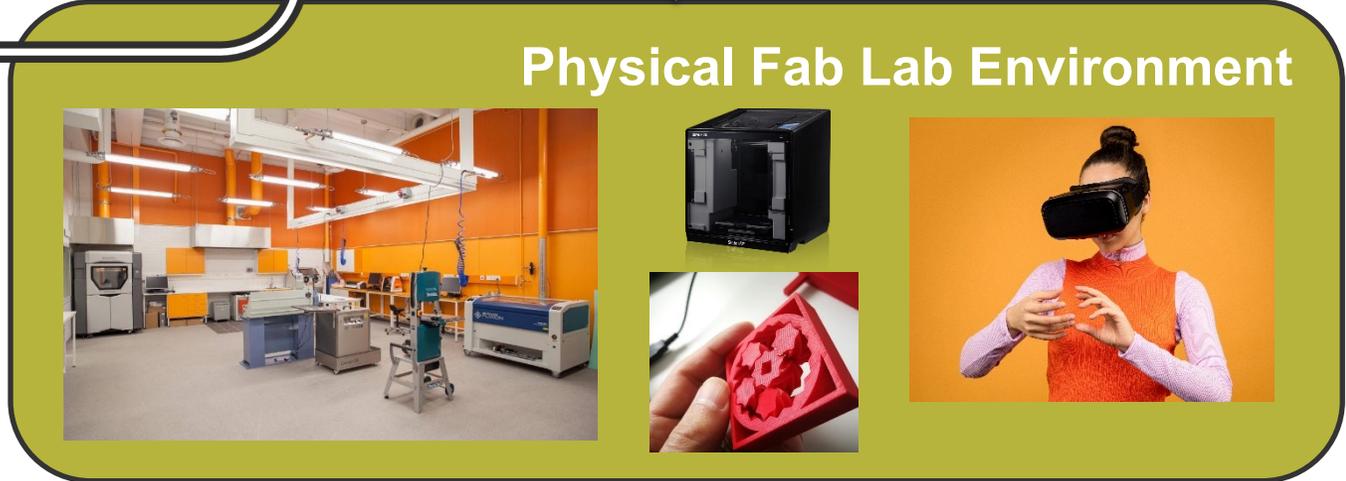


**Remote Place**



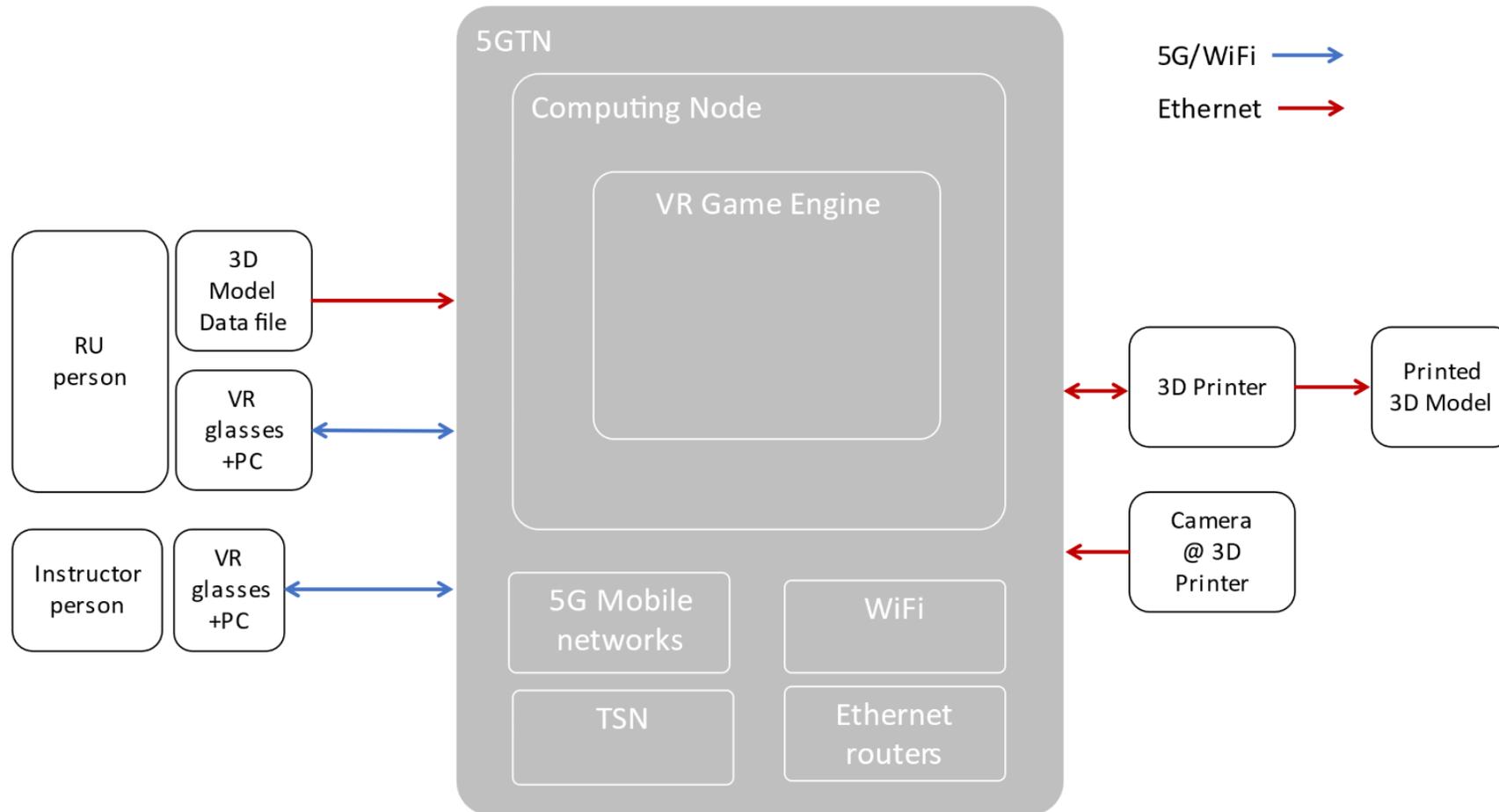
A photograph of a person wearing a VR headset, representing the remote user interacting with the digital twin.

**Physical Fab Lab Environment**

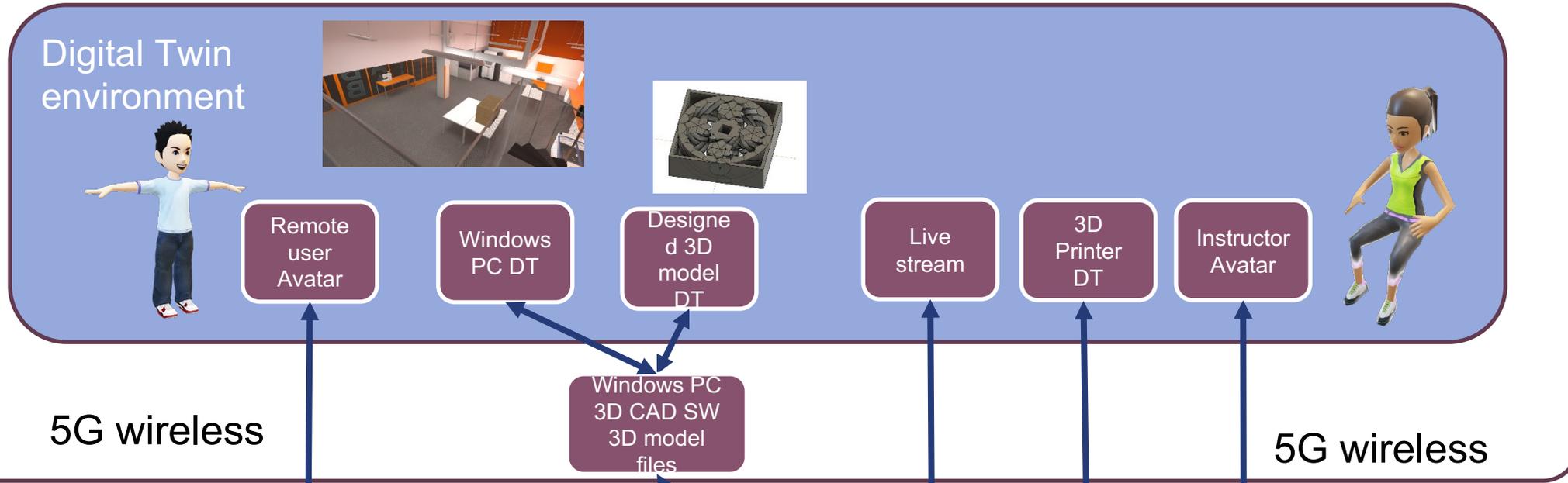


This block illustrates the physical fab lab environment. It features a photograph of a real 3D printer, a 3D model of a gear-like object, and a photograph of a person wearing a VR headset. The background is a green gradient.

# 3D Digital Twin System Diagram

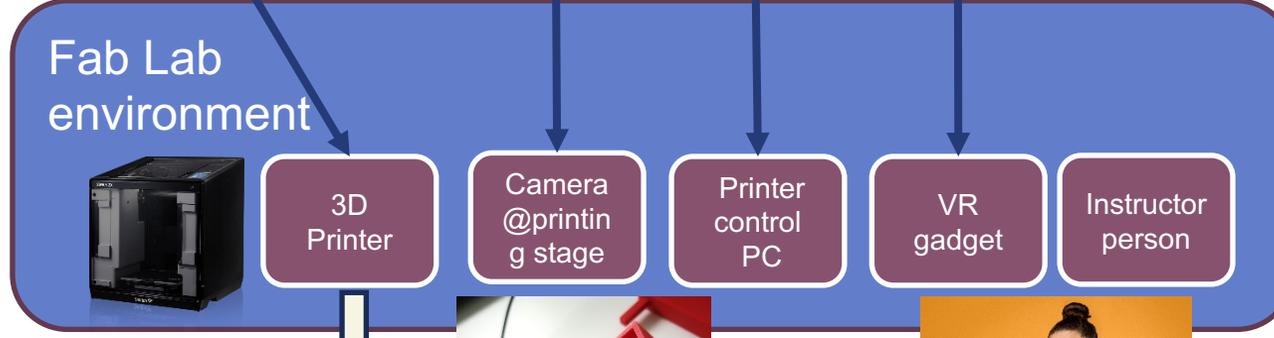
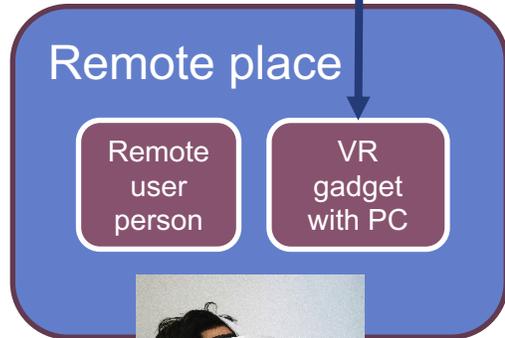


# 5GTN



5G wireless

5G wireless



Printed Object



3D model design

3D model data review

3D printer settings

Finishing the 3D printing

# 6GXR

# Thanks



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the European Union

**6G**SNS

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