Chair of Communication Networks, Prof. W. Kellerer
Department of Electrical and Computer Engineering
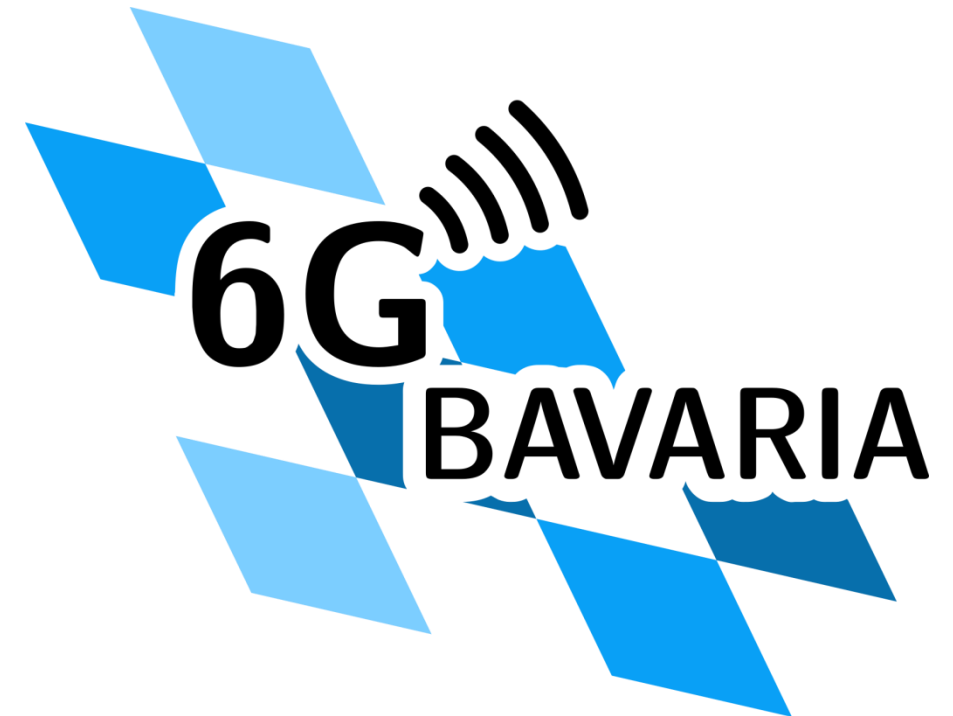Technical University of Munich

TΠΠ

6G Zukunftslabor Bayern - 6G Future Lab Bavaria

Prof. Dr.-Ing. Wolfgang Kellerer
Project Coordinator

Thinknet 6G Summit
September 16, 2022

Bavarian 6G Initiative

- Launched in the Kabinettsitzung on Sept. 14, 2020
- Consists of three pillars

1. **6G-Pilot: „6G Zukunftslabor Bayern – 6G Future Lab Bavaria" @ TUM**

2. Networking platform for academia and industry: „Thinknet 6G" @BI

3. Call for 6G Collaboration Projects (started in Spring 2021)

Digitale Transformation gemeinsam gestalten – innovativ, intelligent, vernetzt

CYBERSECURITY | 6G | DIGITAL PRODUCTION & ENGINEERING | DIGITALISIERUNG IM ENERGIEBEREICH | DIGITALES PLANEN UND BAUEN | SMART CITIES & REGIONS | VERNETZTE MOBILITÄT

6G Future Lab Bavaria

- Started on May 1, 2021
- 4 Million € for 3 years
- 13 Principal Investigators in 8 Subprojects

- research on **selected fundamentals of 6G**
- focus on the coupling of the digital and the physical world („**Digital Twin**"), as well as on sustainability, resilience and security.
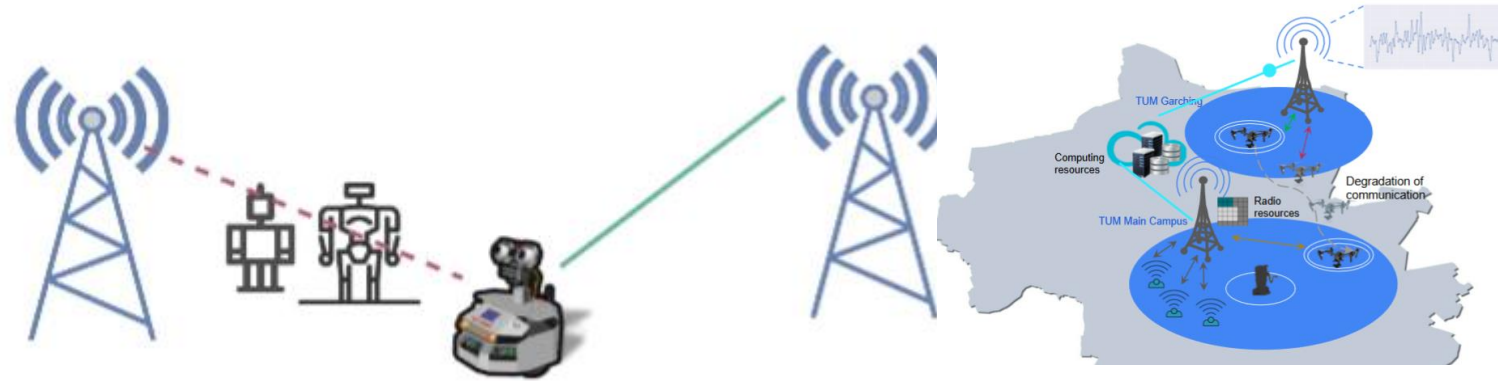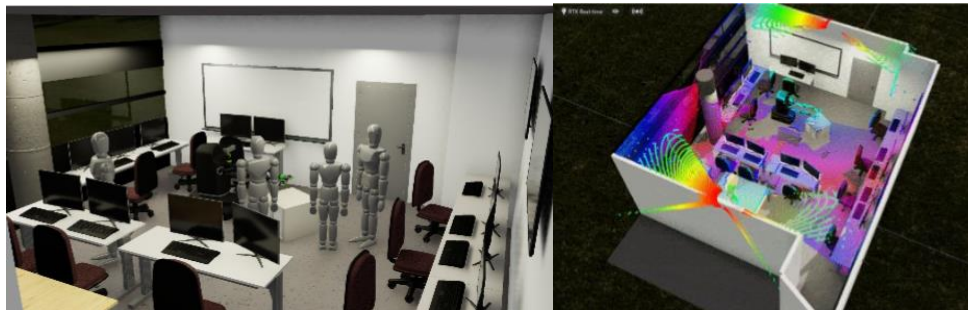
6G fundamental research - 6G experimental platform - 6G roadmap

Partners → Fundamental, interdisciplinary research

- Prof. Eckehard Steinbach, Media Technology
- Prof. Reinhard Heckel, Machine Learning
- Prof. Klaus Diepold, Data Processing

application, AI, digital twin

- <u>Prof. Wolfgang Kellerer</u>, Communication Networks
- PD Carmen Mas Machuca, Communication Networks
- Prof. Georg Carle, Network Architectures and Services, Informatics
- Prof. Jörg Ott, Chair of Connected Mobility, Informatics

flexible, resilient and sustainable end-to-end network

- Prof. Holger Boche, Theoretical Information Technology
- Prof. Gerhard Kramer, Communications Engineering
- Prof. Wolfgang Utschick, Signal Processing Methods
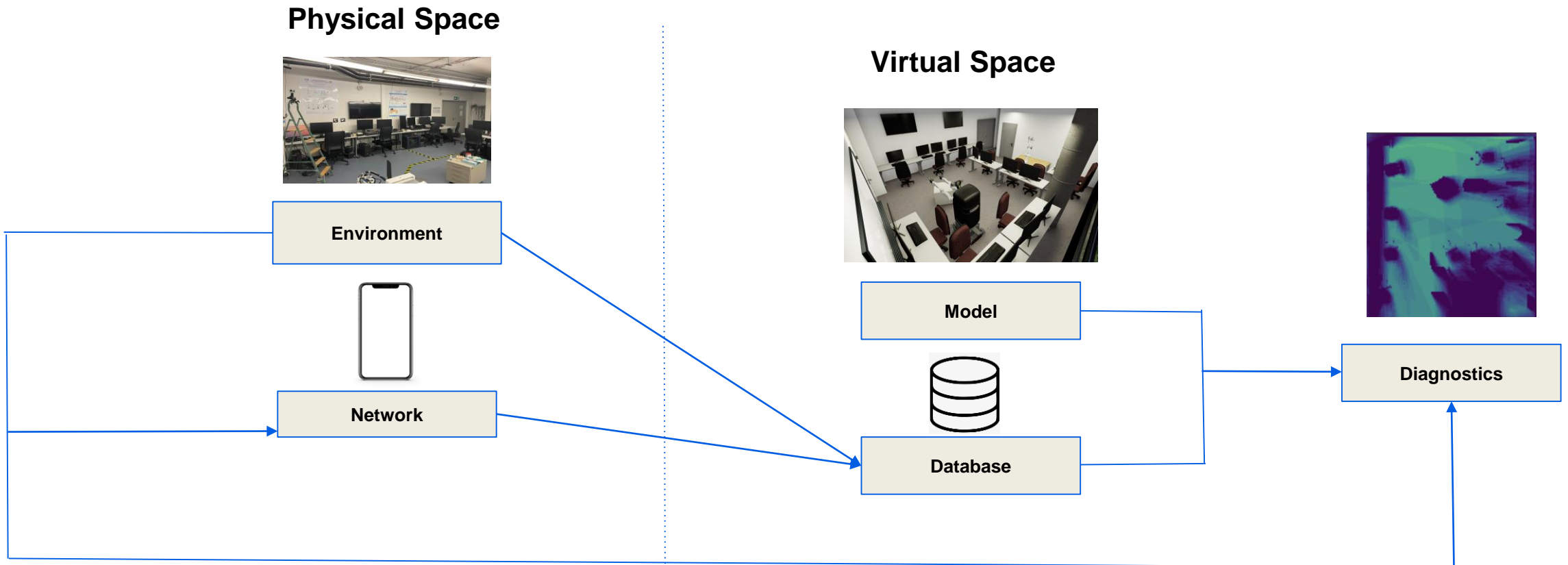- Prof. Antonia Wachter-Zeh, Coding for Communication and Data Storage

resilient, sustainable cognitive radio

- Prof. Andreas Herkersdorf, Integrated Systems
- Prof. Georg Sigl, Security in Information Technology
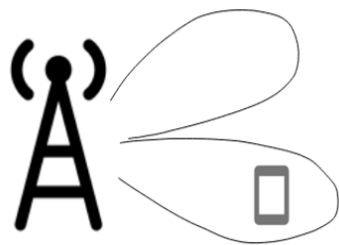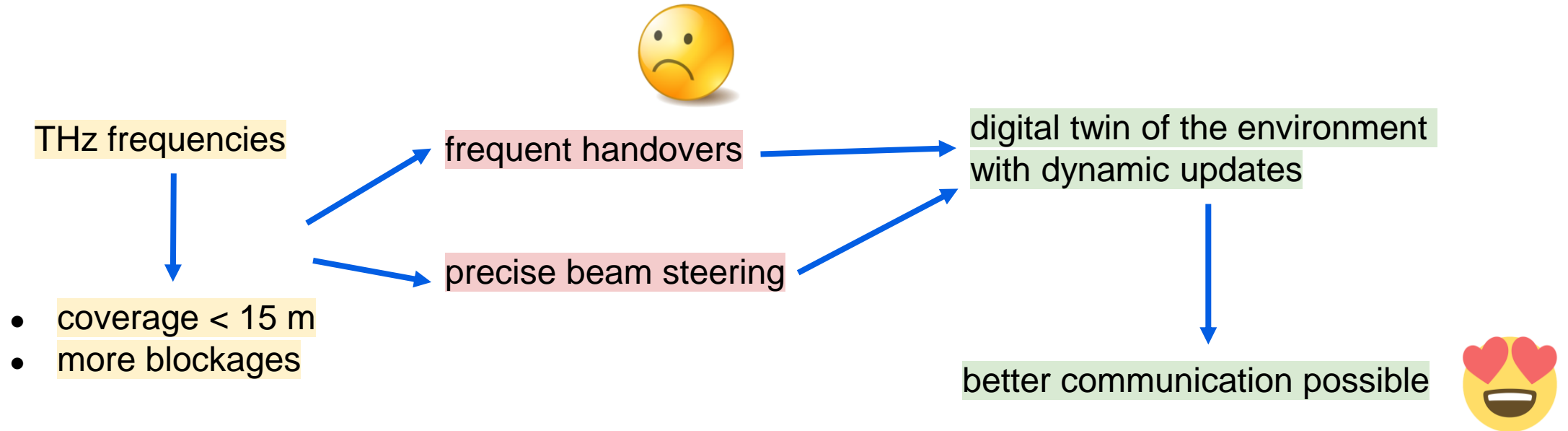
hardware platform and security

Digital Twin (DT) in 6G

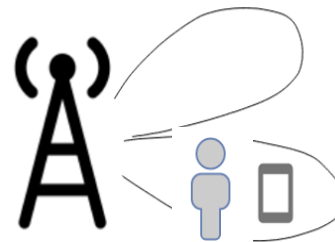- General Concept for the DT: Establish real-time connection between real and virtual spaces

example results of joint subproject of Prof. Eckehard Steinbach and Prof. Wolfgang Kellerer

Benefit of using a Digital Twin in 6G

- Example: Mobility Management

THz frequencies

- coverage < 15 m
- more blockages

frequent handovers

precise beam steering

digital twin of the environment with dynamic updates

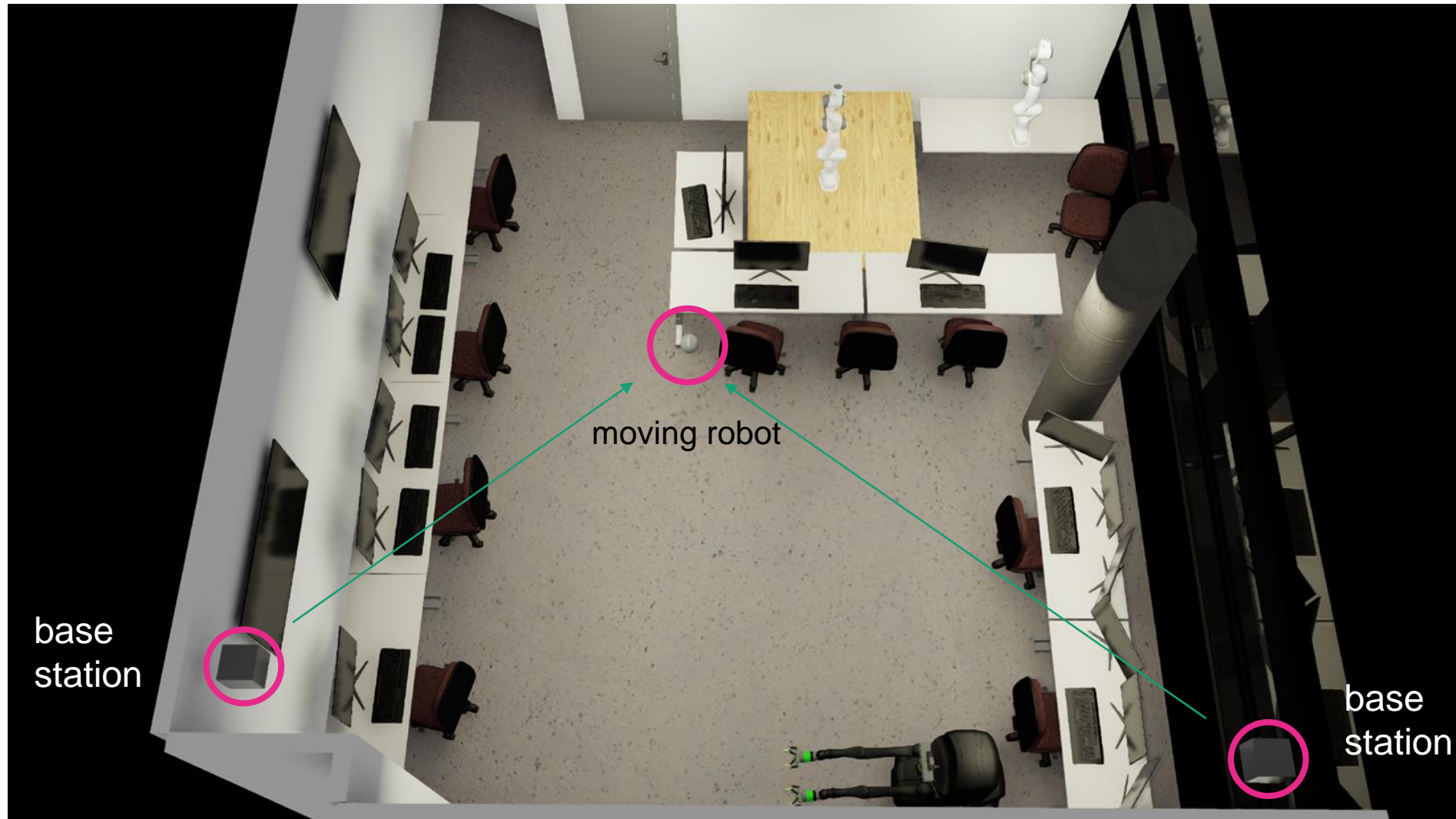better communication possible

Line of sight

Line of sight is blocked
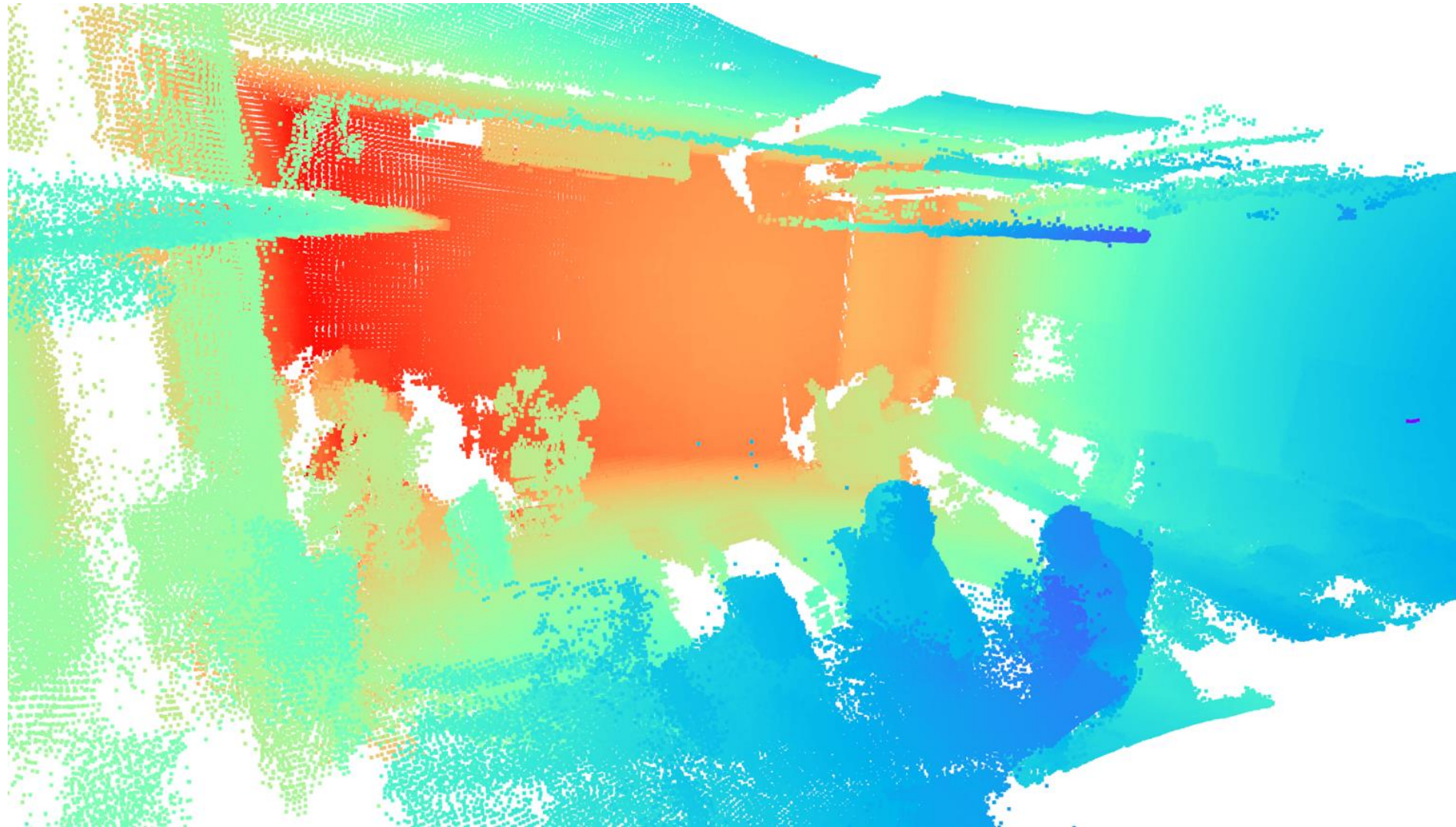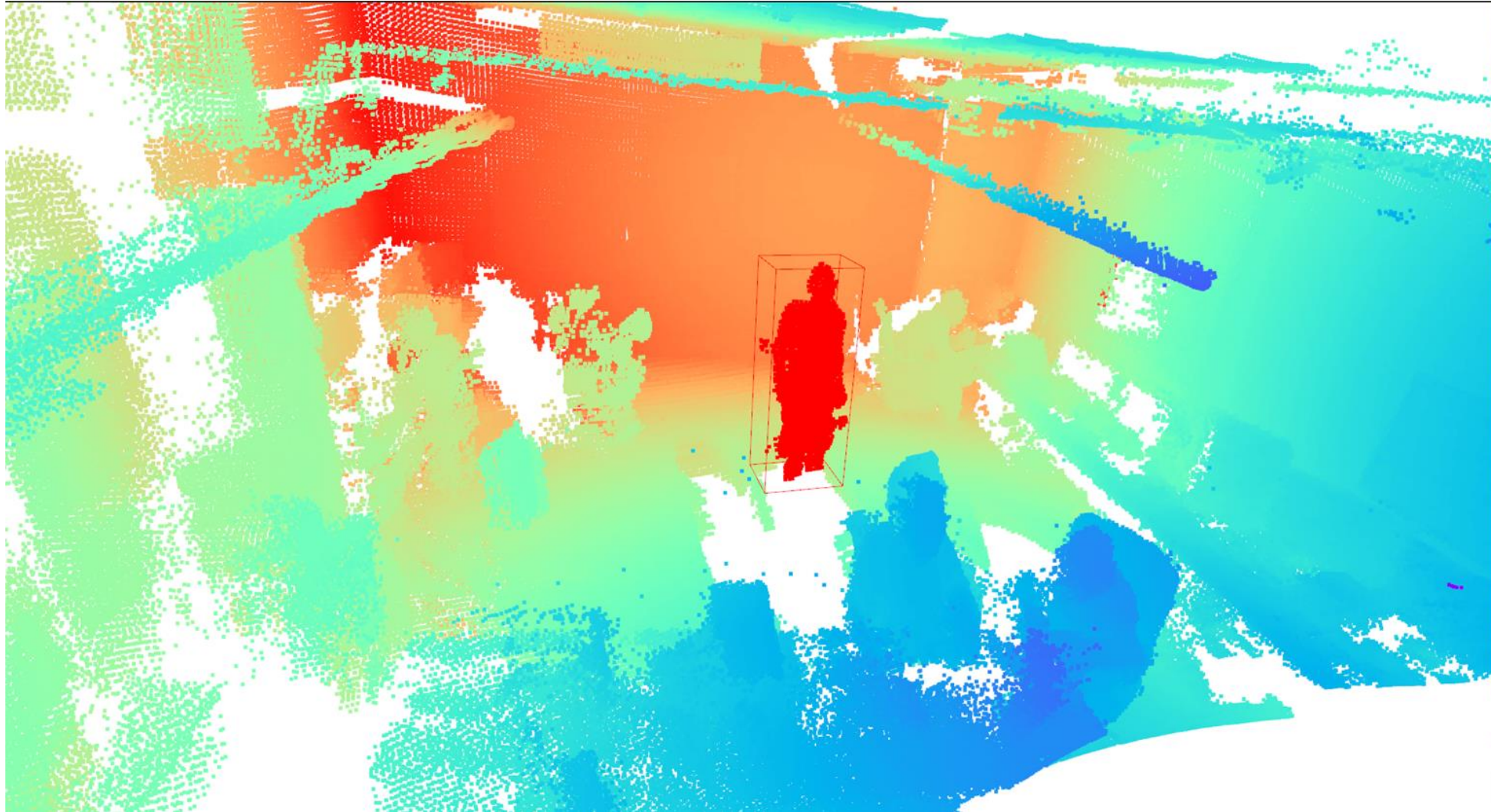
→ Proactive handover

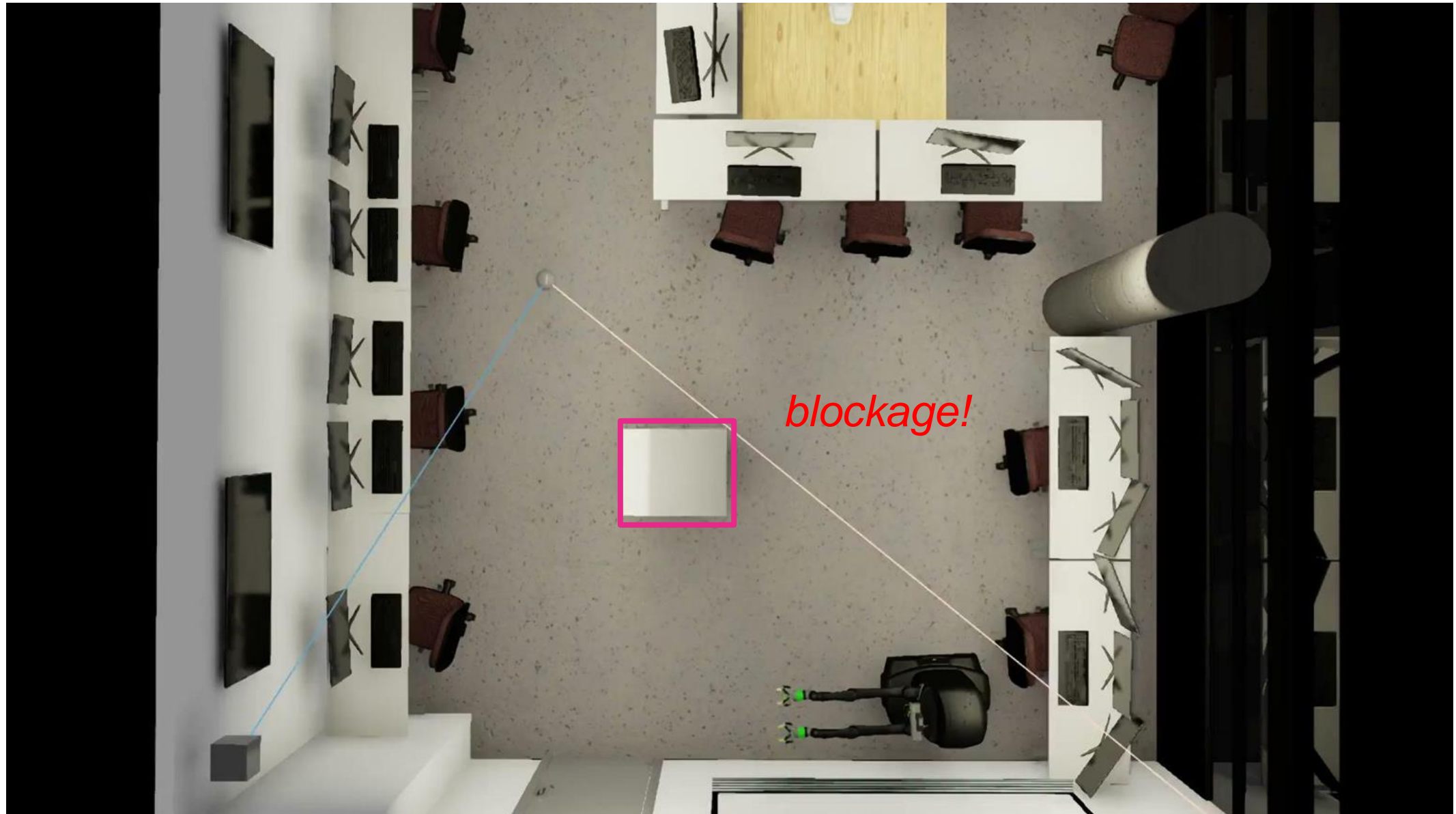# Digital Twin of an Indoor Environment
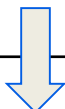
First Scan

First Scan

Second Scan

Second Scan

Digital Twin: Handover Prediction

Mobility-related evaluation

Handover	Handover rate	Outage time (s)
Standard	0.098	96.6
Blockage-aware	0.052 **~45 %**	87.0 **~10 %**

Standard   Blockage-aware

Reduces outage time

Reduces handover rate

Reduces signaling

Less computational effort
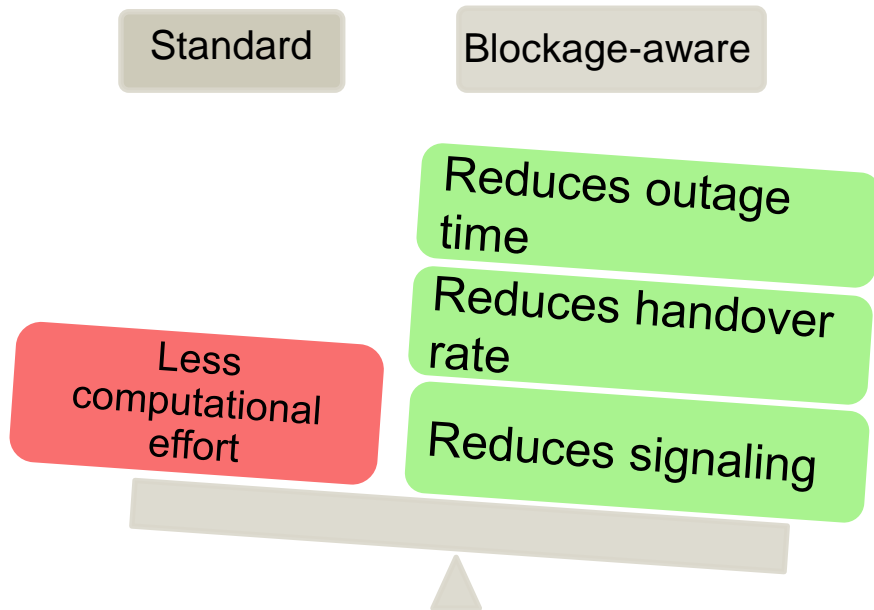
→ **Smooth connectivity**

6G Experimental Platform

- Based on 5G Testbed
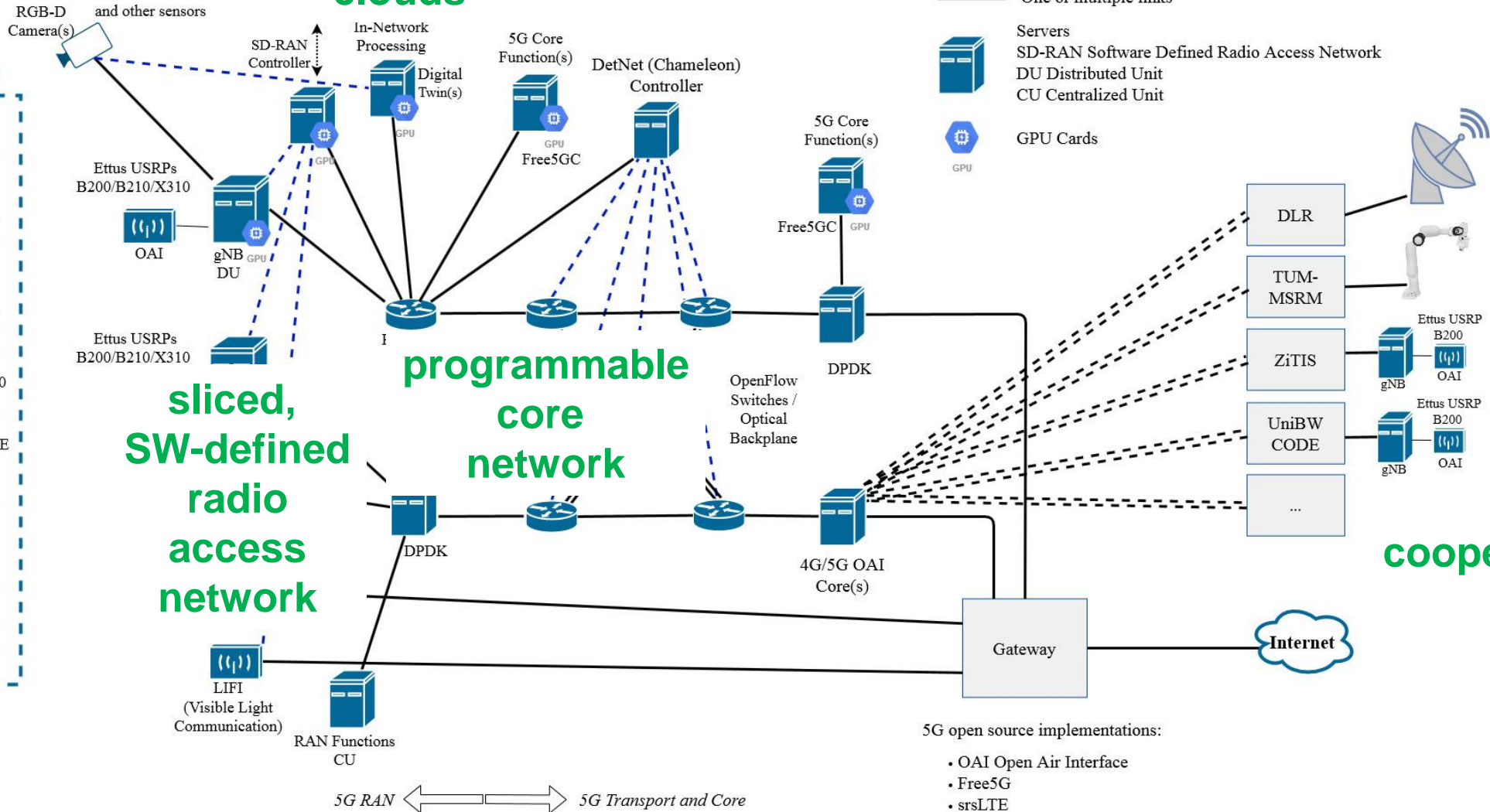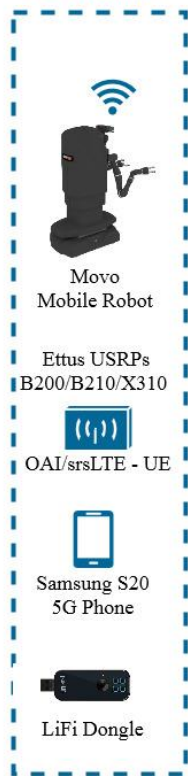
5G / 6G Testbed at Chair of Communication Networks / Chair of Media Technology

Foto: TUM / Heddergott

5G CampusNetz @ TUM

(under development)

6G-life
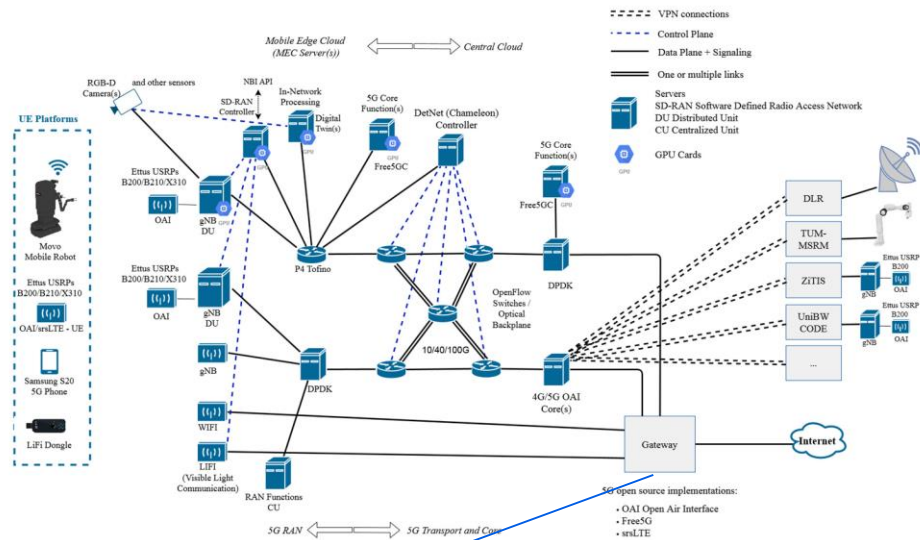
ACES Lab at Chair of Theoretic Information Technology

TUM Campus Garching
Informatics (FMI)
and ZEI

TUM Carl-Zeiss-Strasse
MIRMI (Robot Lab)

TUM Georg-Brauchle-Ring
Munich Inst. of Robotics and
Machine Intelligence (MIRMI)
(Robot Lab)

Deutsches Museum
KI.Fabrik (in discussion)

TUM Main Campus
Chair of Communication Networks
(RAN and Core Network)

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6G Experimental Platform

https://www.5g-munich.de/html/demo.html
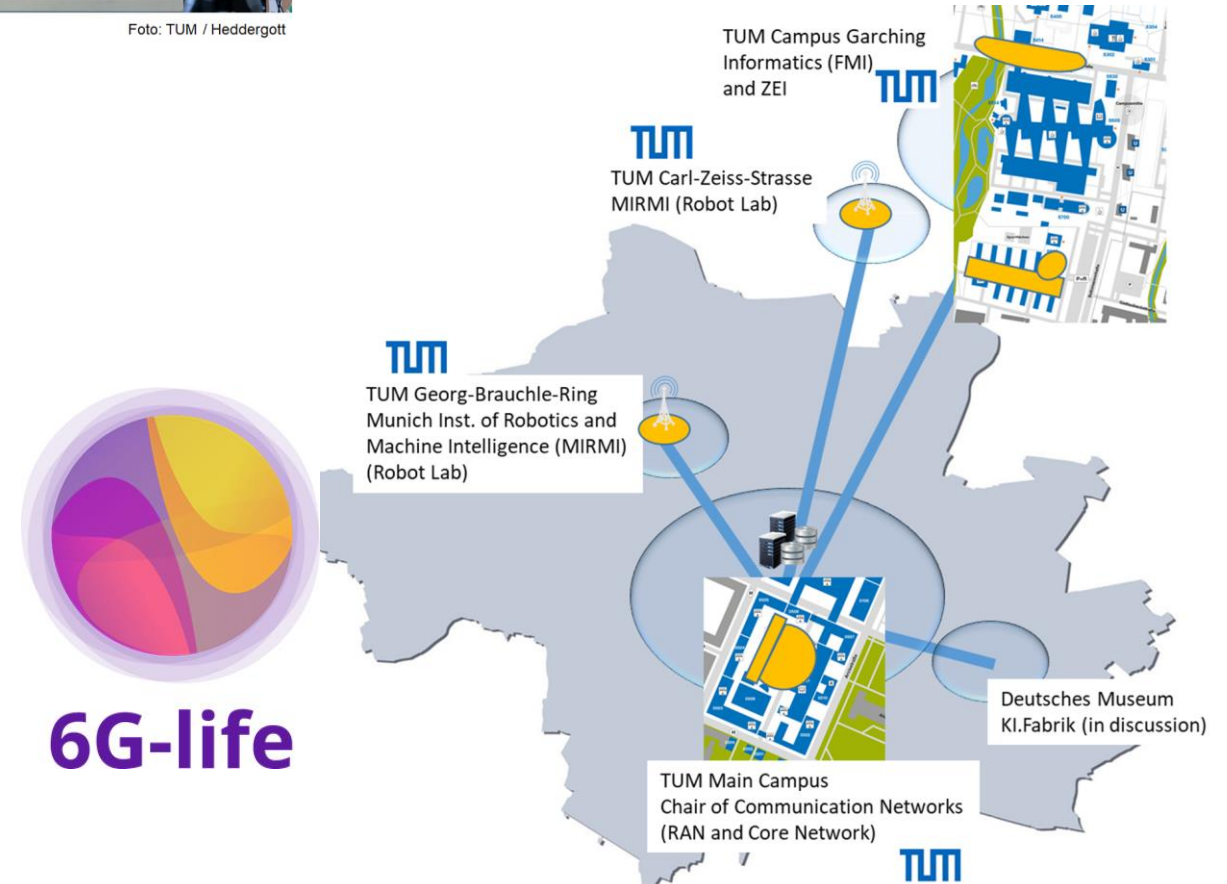
Joint lab of Chair of Communication Networks (Kellerer) and Chair of Media Technology (Steinbach)

Foto: Heddergott / TUM

Thank you

https://www.6g-future-lab.de/