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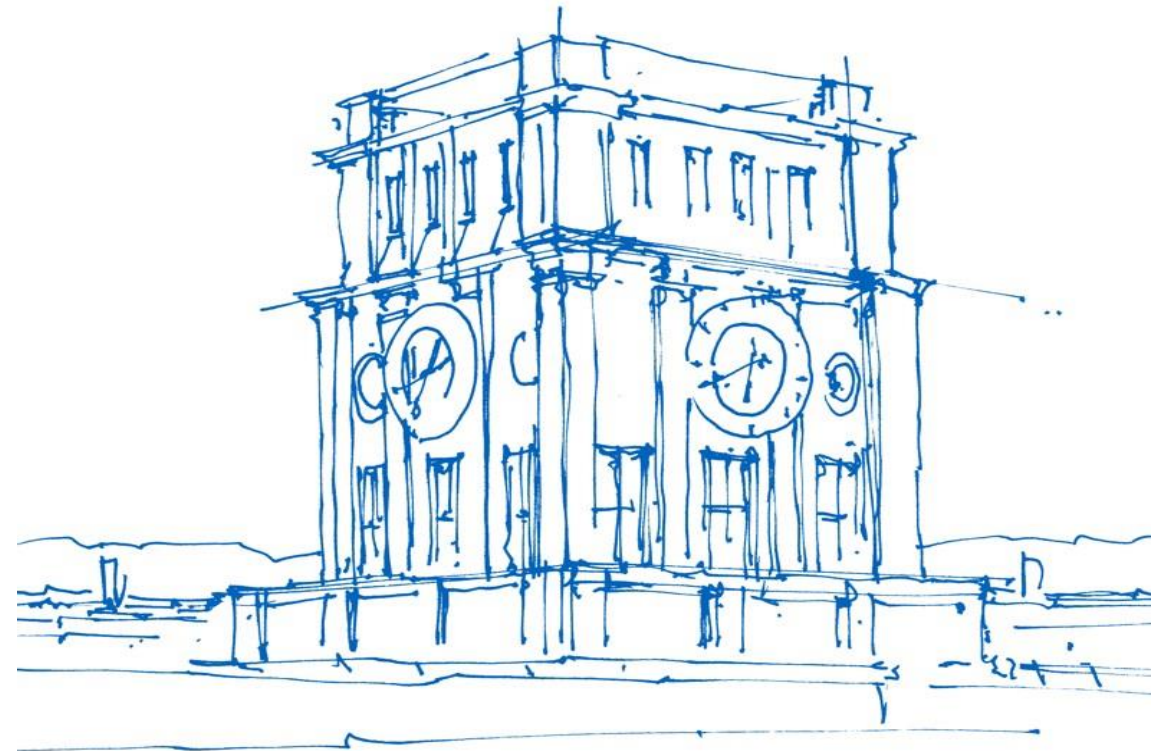Technical University of Munich

TUM

6G Activities in Bavaria –
The 6G Future Lab at Technical University of Munich

Prof. Dr.-Ing. Wolfgang Kellerer

Tech Days 2021

June 8. 2021

Uhrenturm der TUM

What is new in Bavaria in 6G?
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 (1st round in Spring 2021)

What is new in 6G?

- 5G: machine-to-machine communication
- 6G: *the human in the center – extension of the human intelligence and human abilities*

- *Network adaptation (communic. + processing + storage)*
- *Network-as-a-Sensor*
- *AI/ML-native communication*
- *Sustainability: end-to-end energy efficiency*
- *Security, privacy and trust by design*
- *Beyond paradigms: Post Shannon communication*

6G

Processing

Storage

Energy

Spectral efficiency

5G

4G

Space
(smaller cells)

Spectrum
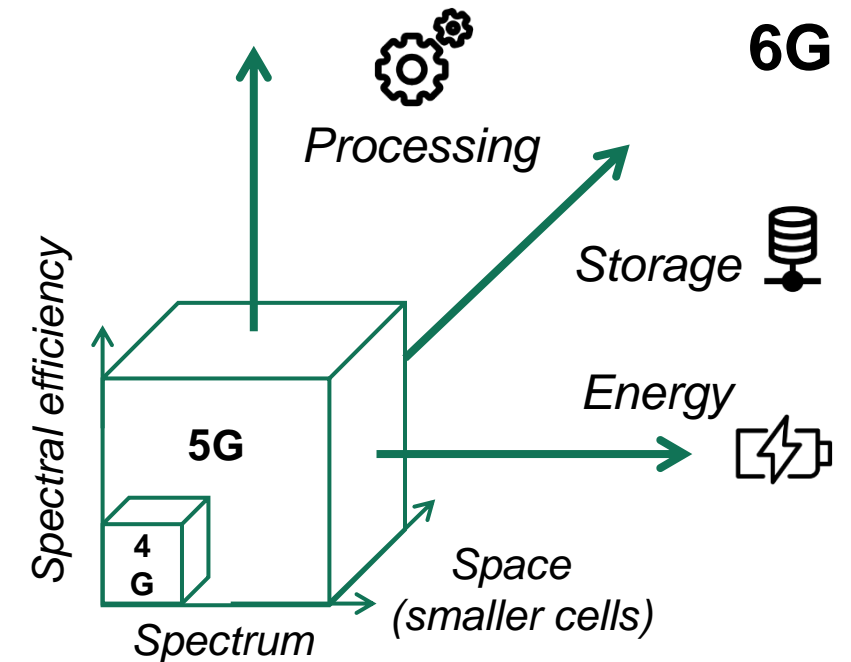
Processing, storage and energy are
included in the 6G system optimization
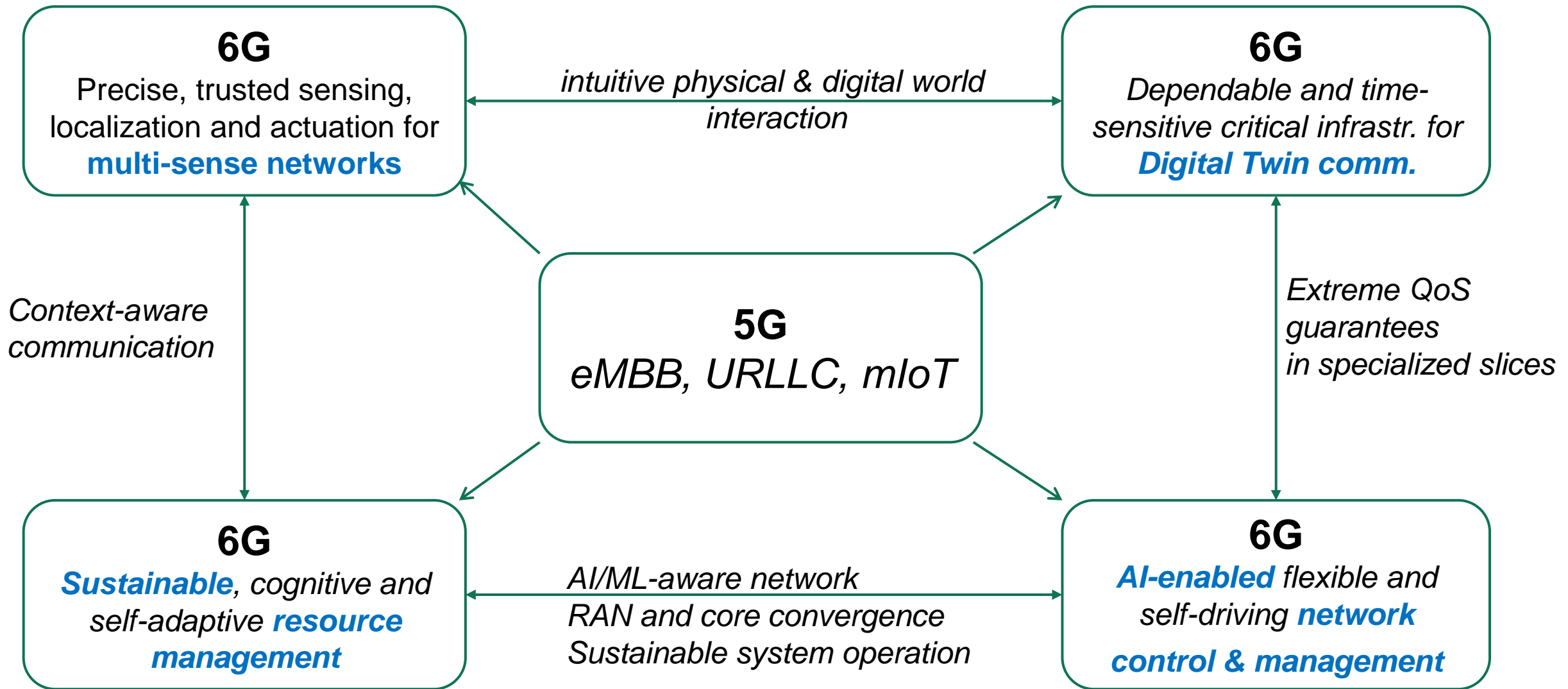
6G Future Lab Bavaria

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

- The lighthouse project at TUM researches on selected fundamentals of 6G and prepares them for further investigations, development and standardization. Research focus is on the coupling of the digital and the physical world („digital twin"), on flexible network management, sustainability, resilience and security.

6G fundamental research - 6G experimental platform - 6G roadmap

6G Future Lab core research areas

TUM

6G
Precise, trusted sensing, localization and actuation for **multi-sense networks**

intuitive physical & digital world interaction

6G
Dependable and time-sensitive critical infrastr. for ***Digital Twin comm.***

Context-aware communication

5G
eMBB, URLLC, mIoT

Extreme QoS guarantees in specialized slices

6G
Sustainable*, cognitive and self-adaptive* **resource management**

AI/ML-aware network RAN and core convergence Sustainable system operation

6G
AI-enabled *flexible and self-driving* **network control & management**
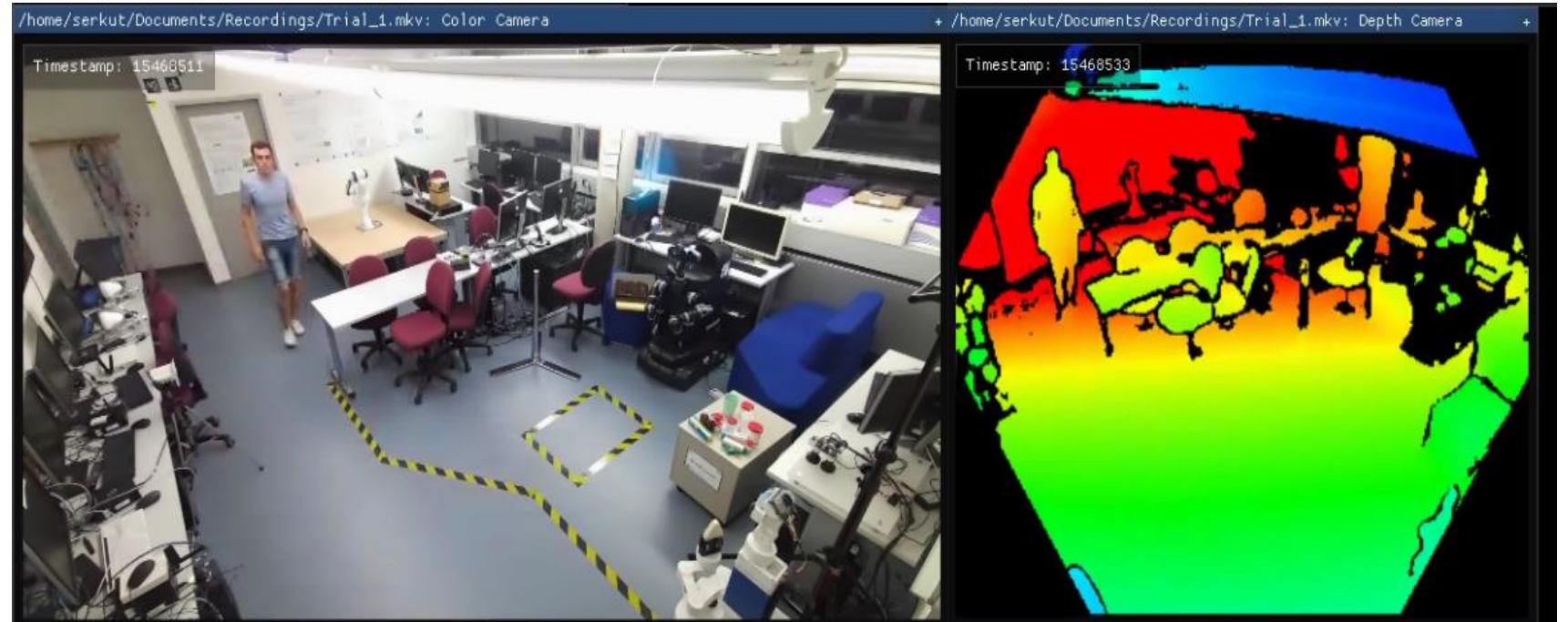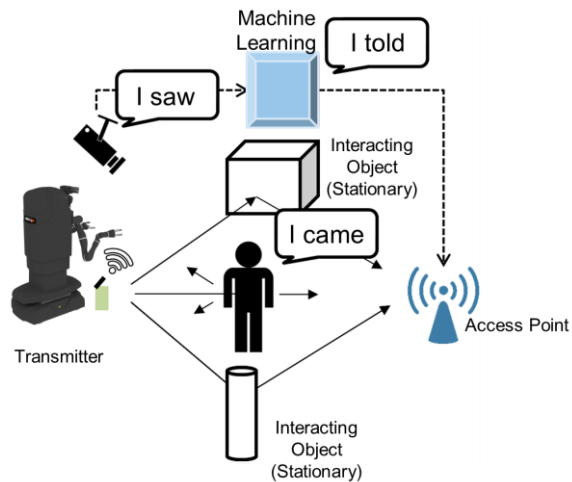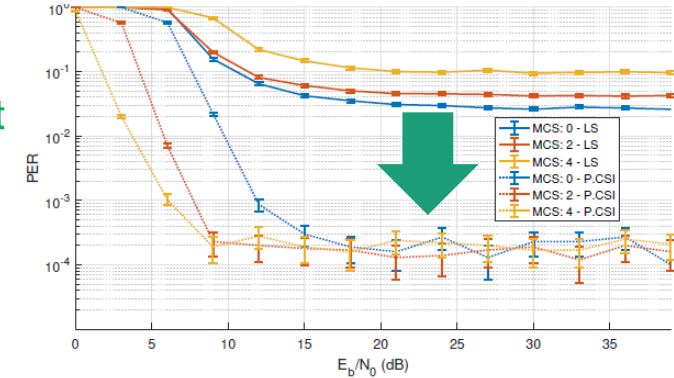
Example: Video Image information for 6G resource management

Concept

- Channel estimation based on video image processing
- AI-based estimation is performed in edge cloud
- Significant increase in throughput and reliability

Packet Error Rate

Serkut Ayvaşık, H. Murat Gürsu, and Wolfgang Kellerer. 2019. Veni Vidi Dixi: reliable wireless communication with depth images.
In Proceedings of the 15th International Conference on Emerging Networking Experiments And Technologies (CoNEXT '19).

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>, 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
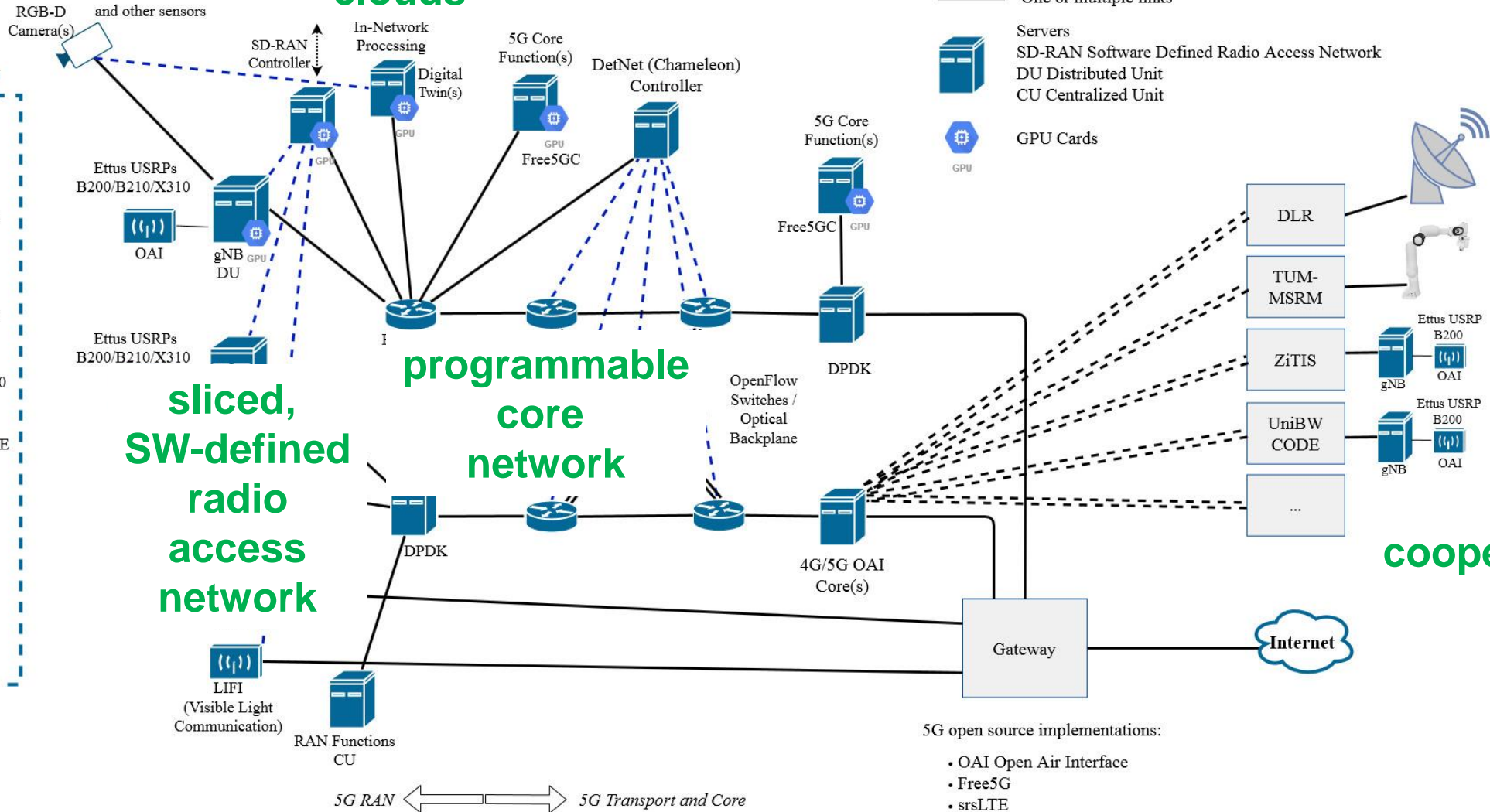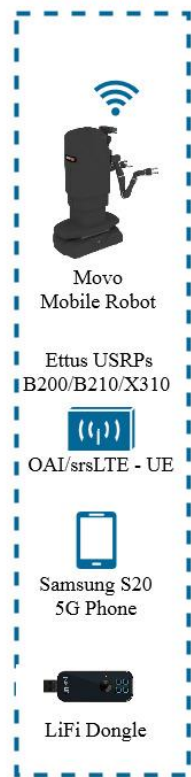
hardware platform and security

6G Experimental Platform

- Based on 5G Testbed

platforms

AI-enabled edge clouds

programmable core network

sliced, SW-defined radio access network

cooperations

6G Experimental Platform

https://www.5g-munich.de/html/demo.html

Thank you

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