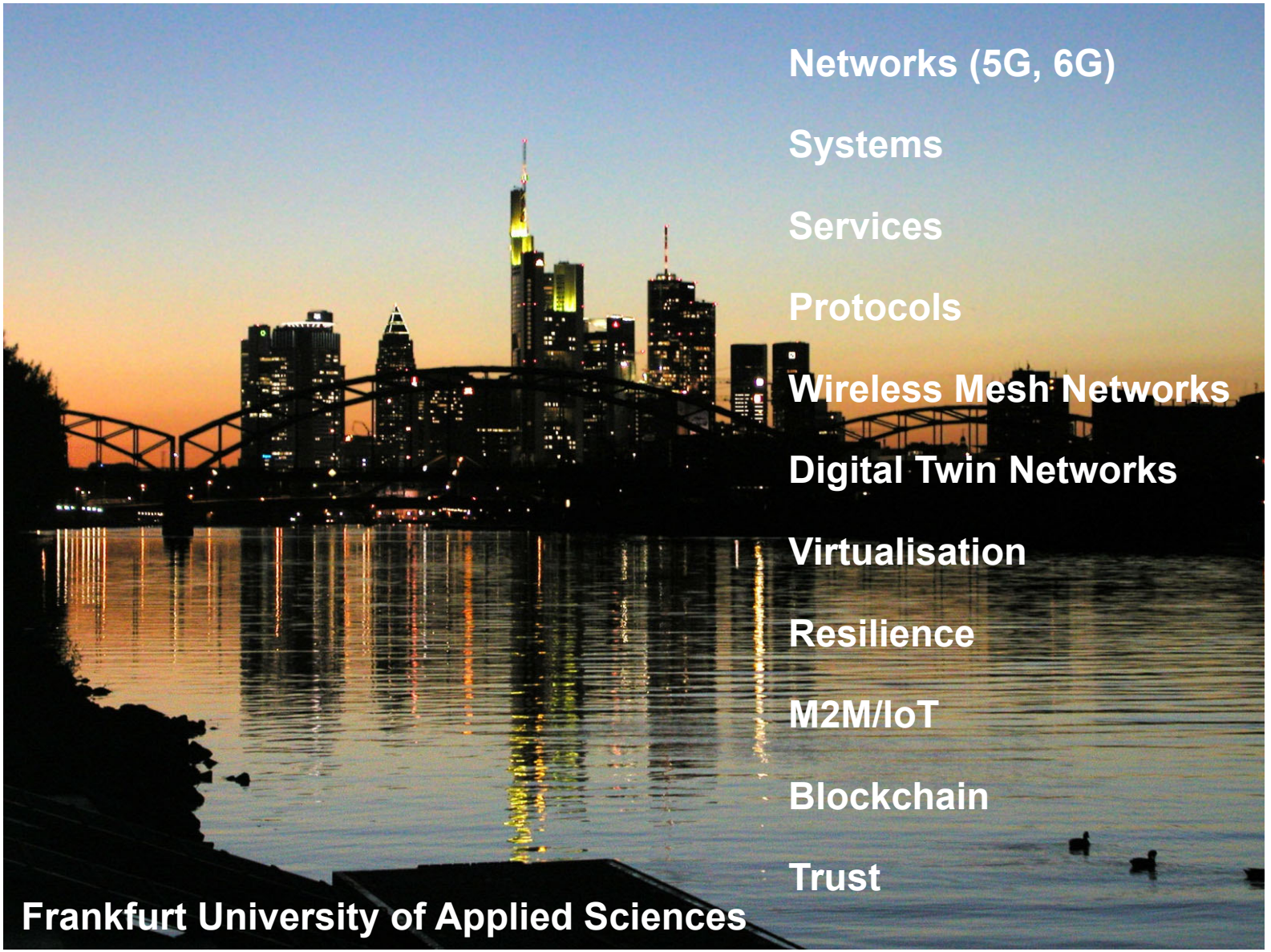
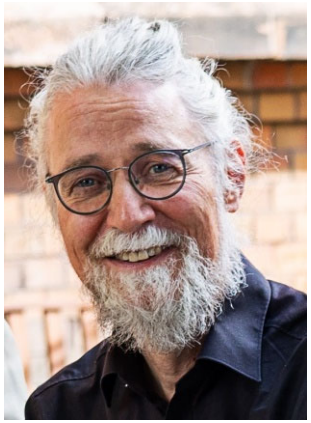
Research Group for Telecommunications Networks



Frankfurt University of Applied Sciences
Forschungsgruppe für
Tele-
kommunikationsnetze

Prof. Dr.-Ing. U. Trick
Prof. Dr. A. Lehmann

Research Group for Telecommunications Networks



Prof. Dr. Ulrich Trick
Telecommunications Networks

Prof. Dr. Armin Lehmann
Programming in
Information Technology

+ approx. 10 students

M.Sc. Alexander Seng

M.Sc. Rami Khaldi

Dr. Besfort Shala

Subjects

- **Modelling, optimisation and migration of networks** (e.g. 5G, 6G)
- **Session Initiation Protocol** (SIP), **WebRTC and SIP**
- **Future communication services and Application Servers incl. testing**
- **Peer-to-Peer** (P2P) **communication with Multimedia over IP**
- **NGN-systems and architectures, Wireless Mesh Networks** (WMN), **resilience**
- **Network Functions Virtualisation** (NFV), **network slicing, virtualisation technologies, Cloud Computing technologies**
- **Digital Twin Networks** (DTN)
- **Smart Home, Smart Grid and Smart Market**
- **Machine-to-Machine Communications** (M2M)/**Internet of Things** (IoT)
- **Trust, Blockchain, Distributed Ledger**
- **Software Engineering in Telecommunications**

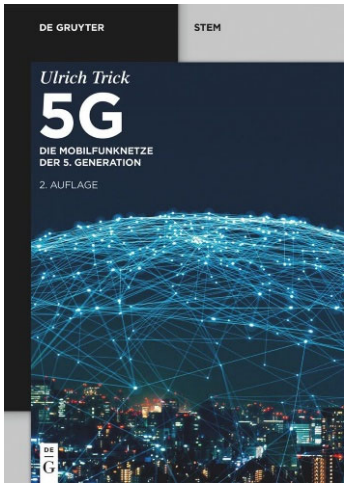
Research Group Activities 1

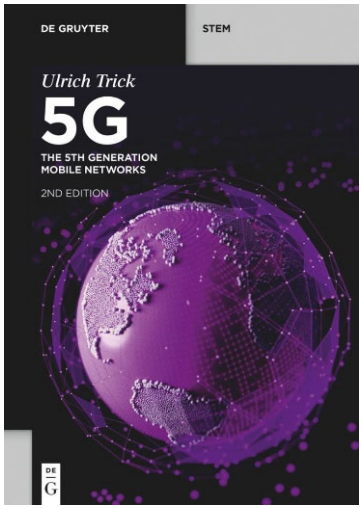
- **R&D activities cover the entire cycle from requirements to concepts and implementations to evaluation and testing**

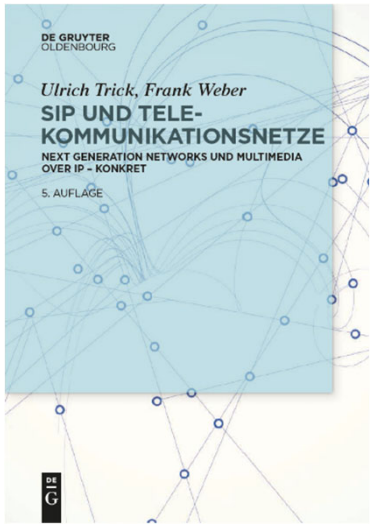
- **Performed R&D projects: 7 BMBF, 11 companies, 5 internal**

- **Currently 2 PhD students, 1 postdoc, 2 professors**
- **Currently 1 company project, 2 internal R&D projects, 1 DISTR@L-Projekt**

- **More than 100 publications**



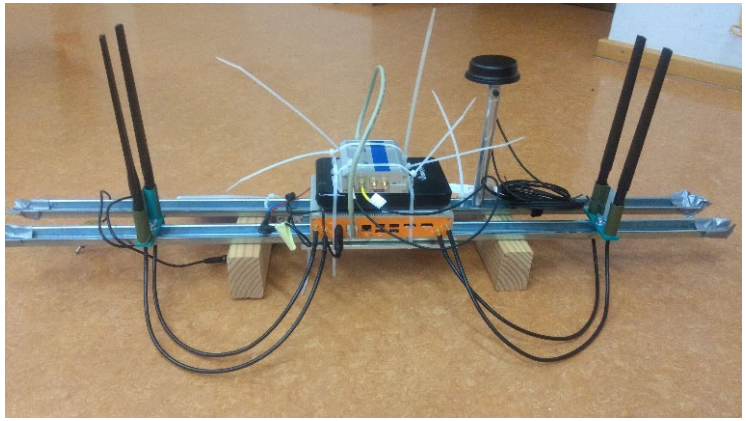




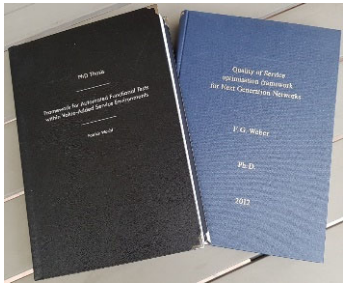
- **Partners so far:**
  - **4 universities**
  - **18 companies**
  - **1 public authority**

Research Group Activities 2

- **Laboratory for Telecommunications Networks**



- **Close collaboration with CSCAN at the University of Plymouth since 2006**
- **Since 2015 PhD Frankfurt Node of the University of Plymouth**
- **Since 2012 8 PhDs**



- **Member of the Hessian Promotionszentrum für Angewandte Informatik** (PZAI) **since its foundation in November 2017**

Completed Research and Development Projects 1

- **Future telecommunication infrastructure**; 07/2002-03/2003 (Univ. of Applied Sciences)
- **Optimisation of heterogeneous, packet switched telecommunication networks**; 10/2003-04/2005 (BMBF)
- **Development of a concept for a new telecommunication network**; 01/2005-03/2005 (company project)
- **Emergency call with Voice over IP**; 05/2005-01/2006 (company project)
- **Requirements for Carrier Class VoIP networks**; 08/2005-01/2006 (company project)
- **Anti-spam and Click-to-Dial with Voice over IP**; 08/2005-02/2006 (company project)
- **Complete integration of IP networks for multi-media communication** (Next Generation Network); 09/2005-12/2005 (Univ. of Applied Sciences Frankfurt/M.)
- **High Quality Audio VoIP technology for broadcasting stations**; 10/2005-03/2006 (company project)
- **Conceptual Study for the monitoring of Quality of Service with VoIP** (Voice over IP) **in an NGN** (Next Generation Network); 03/2006-11/2006 (company project)
- **Services in NGN**; 10/2006-04/2007 (company project)
- **Services and architectures in future telecommunication networks** (DazTel); 11/2005-04/2008 (University of Applied Sciences Frankfurt/M.)

Completed Research and Development Projects 2

- **Improvement of Quality of Service across networks with SIP-based VoIP communication** (QoSSIP); 10/2005-04/2008 (BMBF)
- **Multimedia over IP and security**; 11/2007-05/2008 (company project)
- **Provisioning and Developing of Value-added Services in NGN**; 02/2009-03/2009 (company project)
- **NGN Core technology**; 10/2008-10/2009 (company project)
- **IMS- or P2P-based provisioning and development of services for customer-specific communication processes** (TeamCom); 05/2007-05/2010 (BMBF)
- **Unified Communications System**; 04/2008-08/2010 (company project)
- **Test-controlled evolution and automated provisioning of communication services** (ComGeneration); 07/2009-09/2012 (BMBF)
- **Easy-Service Creation for Home and Energy Management** (e-SCHEMA); 10/2011-09/2014 (BMBF)
- **Optimised P2P service architecture for high-available M2M applications** (P2P4M2M); 04/2015-03/2019 (BMBF)
- **Optimising Wireless Mesh Networks with Network Virtualisation for Disaster Operations** (VirtO4WMN); 10/2017-09/2021 (BMBF)

Completed Research and Development Projects 3

- **Virtualization and Energy Consumption Optimization in WMN** (VirtEnWMN); 10/2021 - 03/2022 (internal project)
- **Security and Test Optimisation of Decentralised M2M Application Services** (SecTOptM2M); 04/2019-04/2022 (internal project)
- **Distributed Orchestration and Resilience in WMN** (OrchResWMN); 10/2021 - 08/2024 (internal project)

Current Research and Development Projects 1

- **Barrier-free Digital Passenger Announcements Using Speech-to-Text & Auracast™**; 04/2025 – 09/2026 (DISTR@L-project)
- **Network Slicing for WMN** (NS4WMN); 11/2020 - 04/2026 (internal project)
- **Digital Twin for Heterogeneous 5G/6G Subnetworks**; 09/2023 – 08/2026 (internal project)
- **SIP-Routing Infrastructure for Audio over IP**; 04/2011-12/2025 (company project)

Current Research and Development Projects 2

- **NS4WMN – Network slicing in WMN**

A wireless mesh network can extend the coverage with Wi-Fi on large areas. However, it is not possible to change the architecture dynamically to fit the requirements of specific services or support multitenancy.

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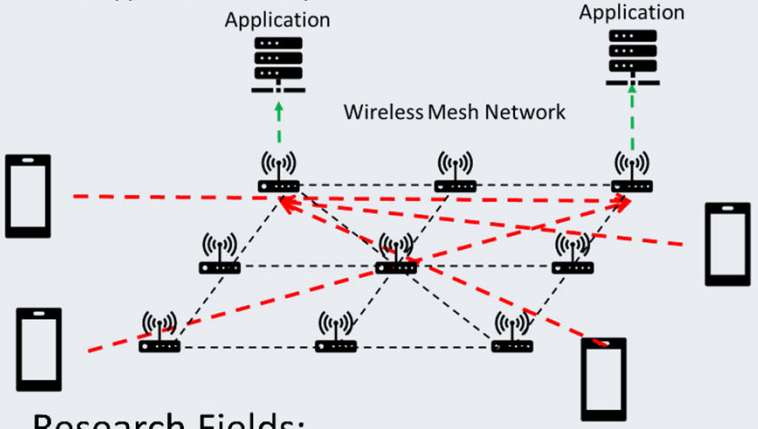
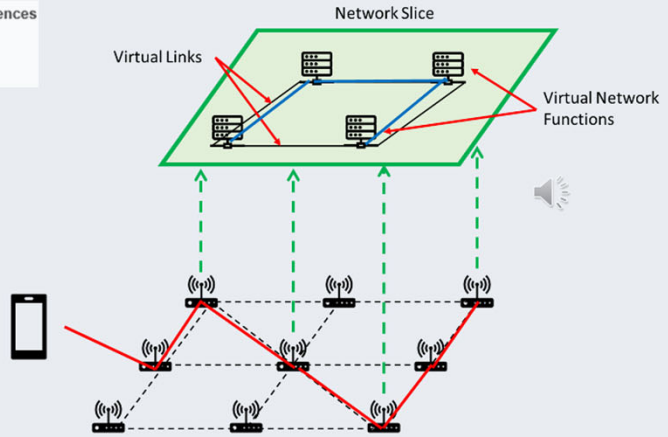


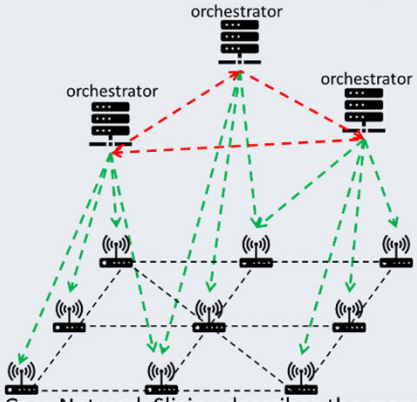
Network Slicing provides a solution for this problem through virtualisation of the network and the functionality.



This allows the creation of multiple independent, autonomous and isolated networks on the same physical infrastructure. These networks can be adapted to the services provided.

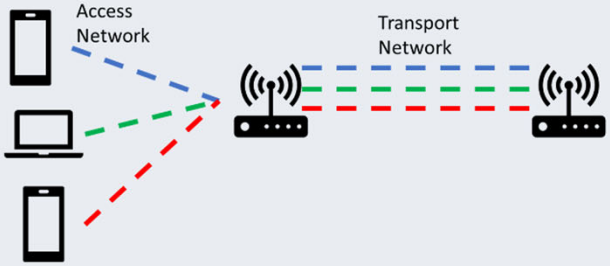
Research Fields:

Core Network Slicing



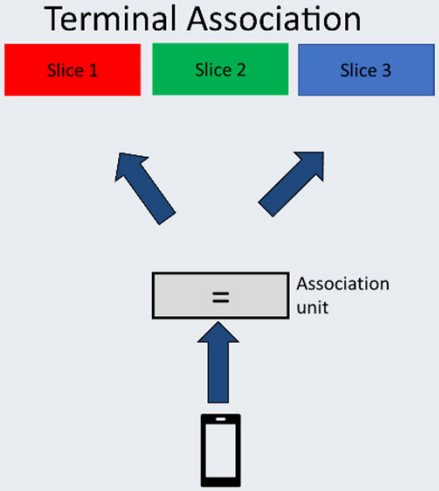
Core Network Slicing describes the management and orchestration of the slices and the logical connection between the virtual network functions

Access and Transport Network Slicing



Access Network Slicing describes the mechanisms for association and multiplexing of the radio resources in the network

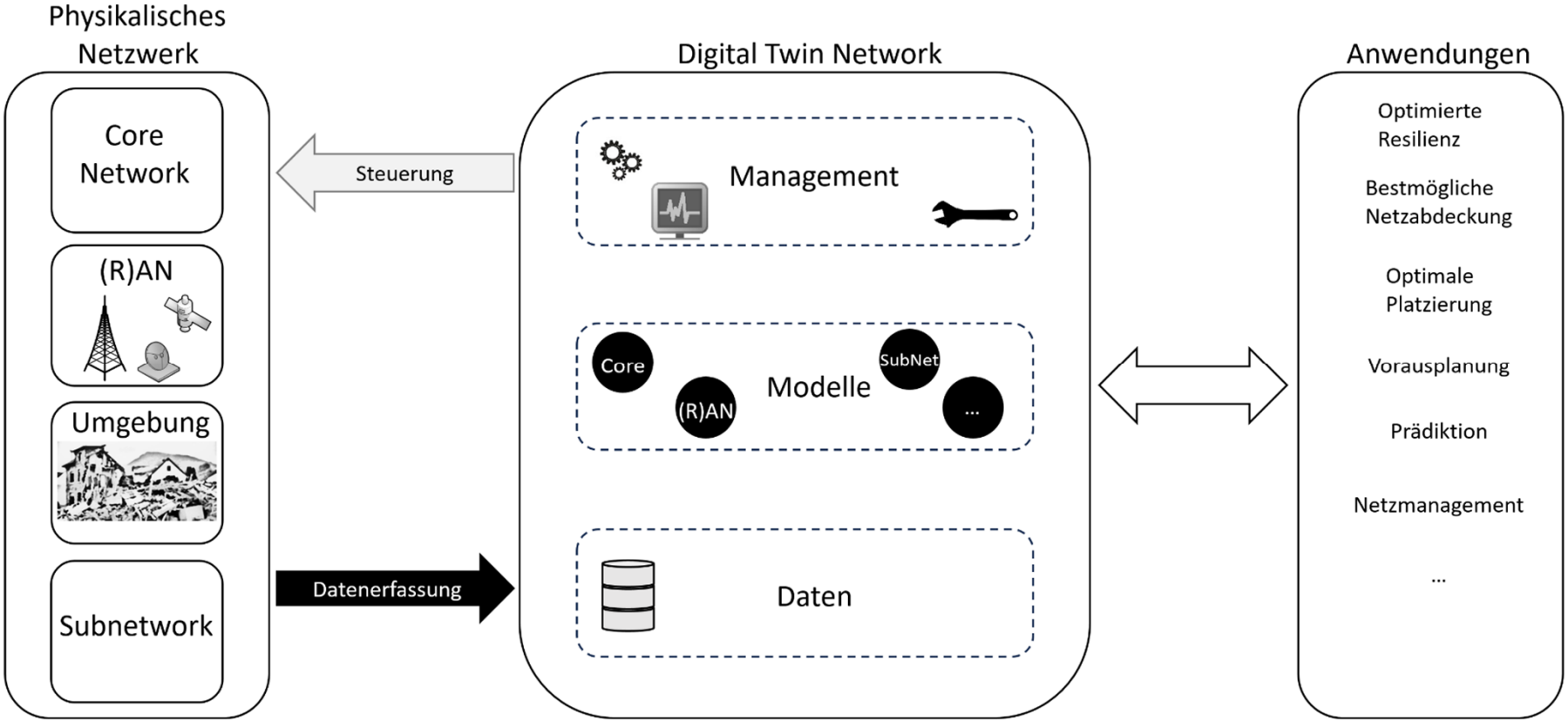
Terminal Association



Terminal association is the procedure of assigning a terminal device to a slice and corresponding services. This should be done without prior

Current Research and Development Projects 3

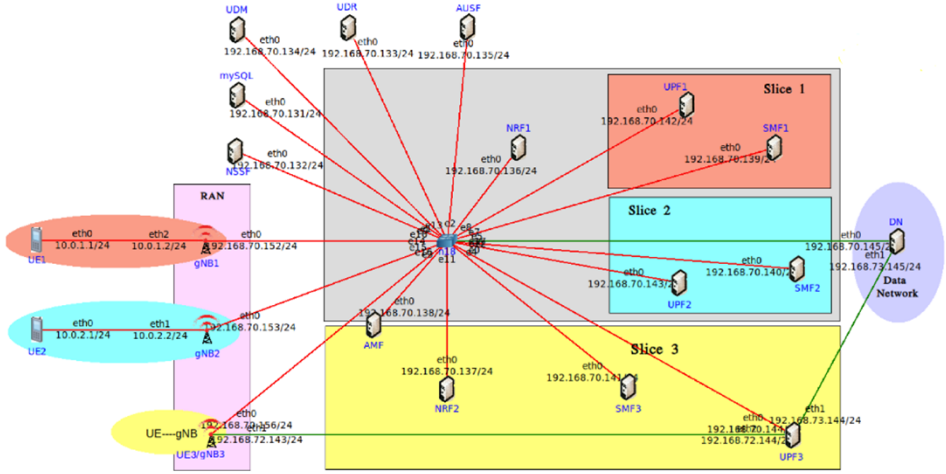
- **Digital Twin for Heterogeneous 5G/6G Subnetworks**



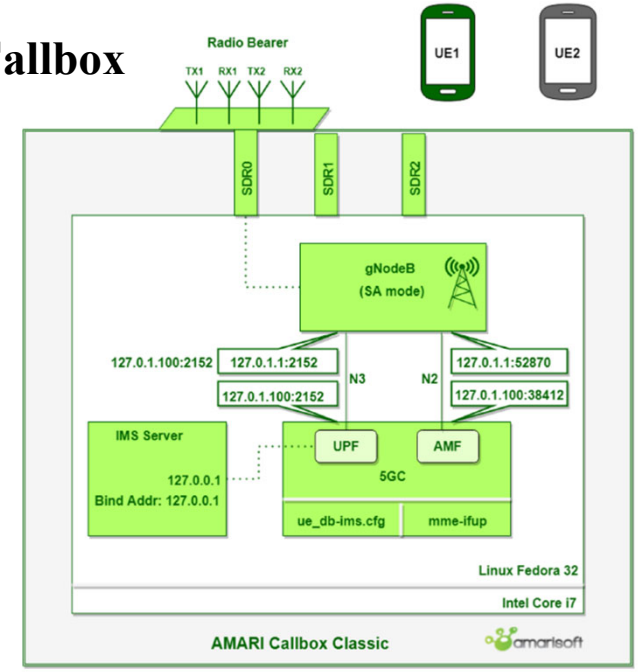
5G Solutions at Frankfurt UAS

- **5G with Open Source SW UERANSIM** (UE, gNB) **and OpenAirInterface** (5GC) **with Docker in CORE Network Emulator**

- **5G with Open Source SW Open5GS**



- **5G Testbed with Amari Callbox**



- **Own campus license for 3,7 – 3,8 GHz** (100 MHz)

Research and Development Partners

AETA Audio Systems, Le Plessis Robinson/Frankreich	**ARD-Sternpunkt, Frankfurt**	**BT Germany, München und Frankfurt**
Centre for Security, Communications and Network Research (CSCAN) – Plymouth University	**Detecon International. Bonn**	**EVL Energieversorgung Limburg**
GIP, Mainz	**HEAG MediaNet, Darmstadt**	**h_da** HOCHSCHULE DARMSTADT UNIVERSITY OF APPLIED SCIENCES **aida** INSTITUT FÜR ANGEWANDTE INFORMATIK DARMSTADT
Hochschule Osnabrück, Mobilkommunikation (Prof. Dr. Tönjes)	**JDSU, Eningen u.A.**	**NetModule, Eschborn**
NRM Netzdienste Rhein-Main, Frankfurt	**R-KOM, Regensburg**	**Robert Bosch, Stuttgart**
Tekelec, Morrisville/USA	**Teliko, Limburg**	**TH Köln, Institut für Nachrichtentechnik** (Prof. Dr. Grebe) Technology Arts Sciences TH Köln
Technisches Hilfswerk, Bonn	**TransTel, Hamburg**	**T-Systems, Darmstadt**
Vodafone, Eschborn	**Vodafone, München**	**Sittig Technologies, Frankfurt**

PhD Topics

- PhD thesis, Frank Weber: **Quality of Service optimisation framework for Next Generation Networks**. Finished in September 2012
- PhD thesis, Armin Lehmann: **Service composition based on SIP peer-to-peer networks**. Finished in August 2014
- PhD thesis, Thomas Eichelmann: **Automated creation and provisioning of value-added telecommunication services**. Finished in April 2015
- PhD thesis, Patrick Wacht: **Framework for automated functional tests within value-added service environments**. Finished in August 2016
- PhD thesis, Michael Steinheimer: **Autonomous decentralised M2M application service provision**. Finished in July 2018
- PhD thesis, Besfort Shala: **On Trust Optimisation for Decentralised M2M Services**. Finished in November 2021
- PhD thesis, Auberlin Paguem Tchinda: **Optimisation of Wireless Disaster Telecommunication Network Based on Network Functions Virtualisation Under Special Consideration of Energy Consumption.** Finished in December 2022
- PhD thesis, Gregor Frick: **Optimisation of the Resilience of a Wireless Mesh Network for Disaster Scenarios Through Network Functions Virtualisation with Distributed Orchestration.** Finished in April 2024

- PhD working title, Alexander Seng: **Network Slicing for Wireless Mesh Networks**
- PhD working title, Rami Khaldi: **Digital Twin of Body Area Networks**