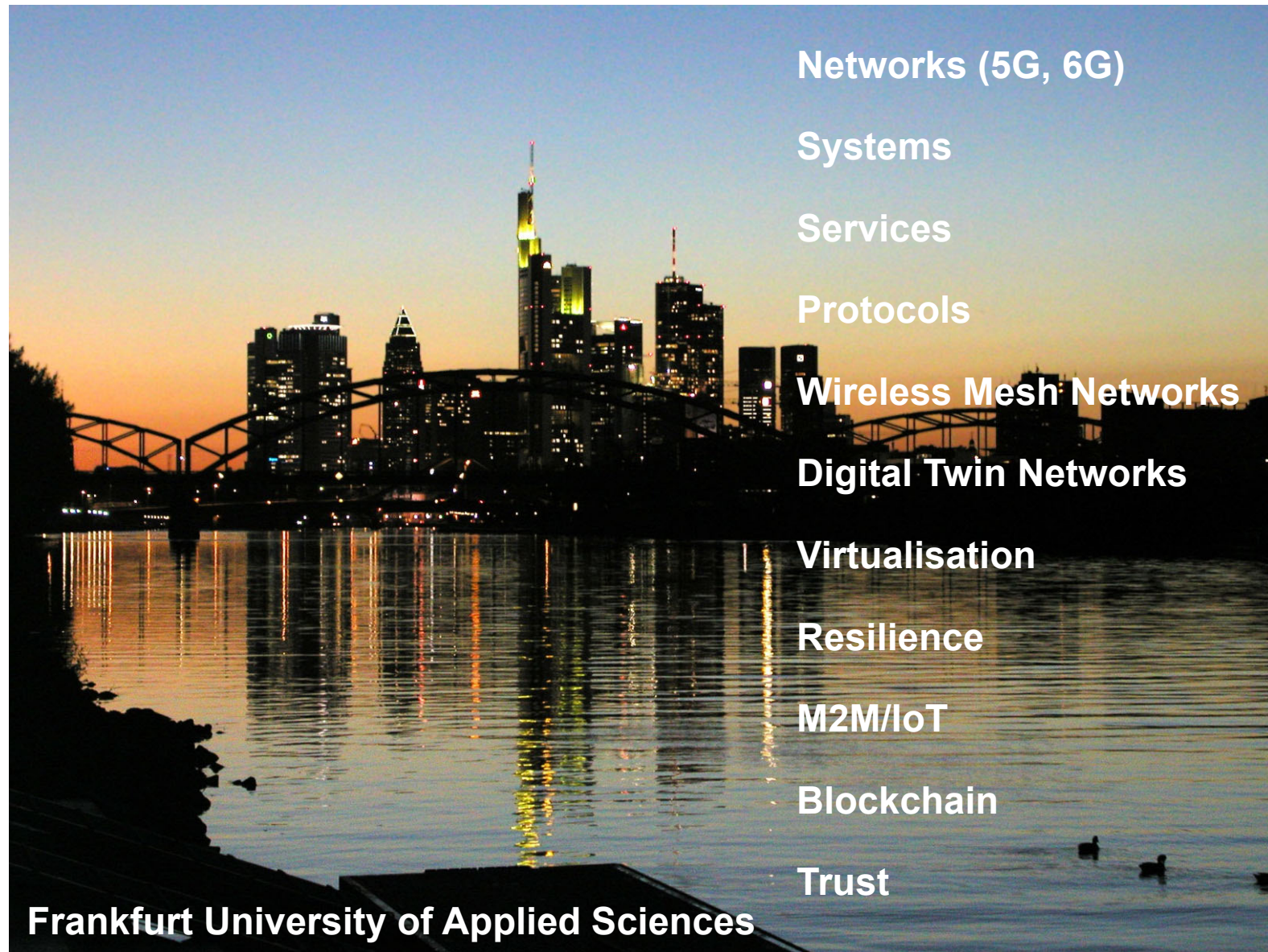


# Research Group for Telecommunications Networks



Networks (5G, 6G)

Systems

Services

Protocols

Wireless Mesh Networks

Digital Twin Networks

Virtualisation

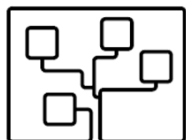
Resilience

M2M/IoT

Blockchain

Trust

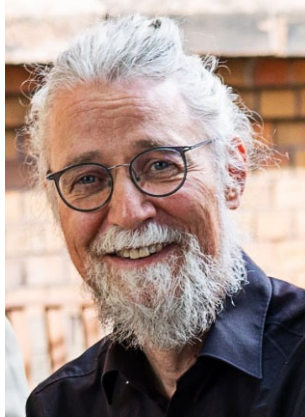
Frankfurt University of Applied Sciences



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

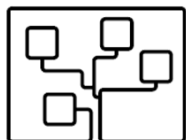
+ approx. 10 students



**M.Sc. Rami Khaldi**

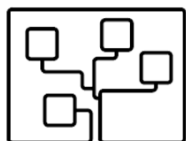


**M.Eng. Hung Bui Tran Hai**



# Subjects

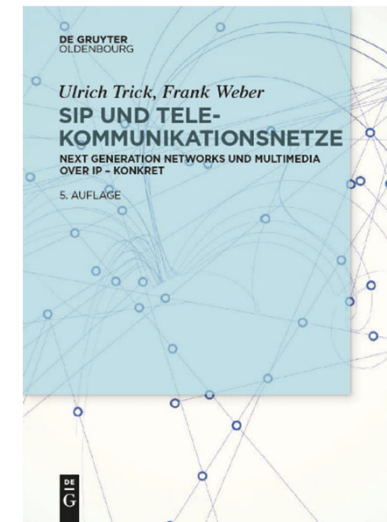
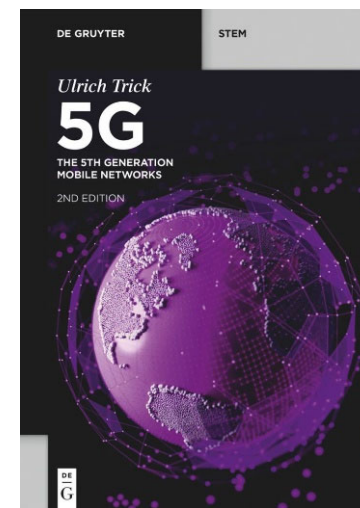
- **Modelling, optimisation and migration of networks** (e.g. 5G, 6G, 5G campus network)
- **Session Initiation Protocol (SIP), WebRTC and SIP**
- **Future communication services and Application Servers incl. testing**
- **Peer-to-Peer (P2P) communication with Multimedia over IP**
- **NGN-systems and 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**



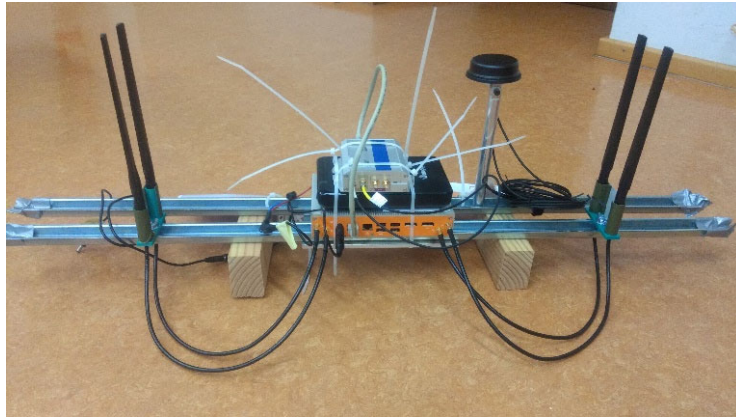
- **R&D activities cover the entire cycle from requirements to concepts and implementations to evaluation and testing**
- **Performed R&D projects: 7 BMBF, 11 companies, 7 internal**
- **Currently 1 PhD student, 2 professors**
- **Currently 1 company project, 1 internal R&D project, 1 DISTR@L-Projekt**

- **More than 110 publications**

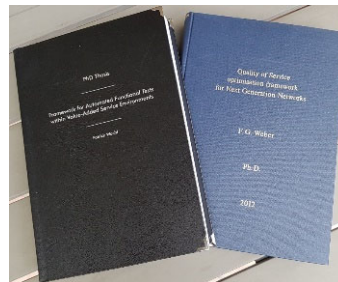
- **Partners so far:**
  - **4 universities**
  - **18 companies**
  - **1 public authority**



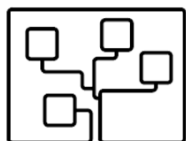
- **Laboratory for Telecommunications Networks**



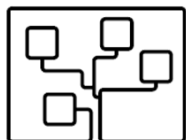
- **Close collaboration with CSCAN at the University of Plymouth since 2006**
- **Since 2015 PhD Frankfurt Node of the University of Plymouth**
- **Since 2012 9 PhDs**



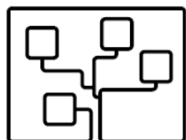
- **Member of the Hessian Promotionszentrum für Angewandte Informatik (PZAI) since its foundation in November 2017**



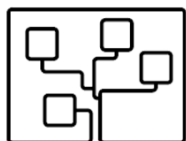
- **Future telecommunication infrastructure**; 07/2002-03/2003 (Univ. of Applied Sciences)
- **Optimisation of heterogeneous, packet switched telecommunication networks**; 10/2003-04/2005 (BMBF)
- **Development of a concept for a new telecommunication network**; 01/2005-03/2005 (company project)
- **Emergency 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.)



- **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)

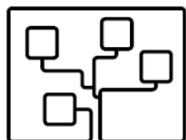


- **Virtualization and Energy Consumption Optimization in WMN** (VirtEnWMN); 10/2021 - 03/2022 (internal project)
- **Security and Test Optimisation of Decentralised M2M Application Services** (SecTOptM2M); 04/2019-04/2022 (internal project)
- **Distributed Orchestration and Resilience in WMN** (OrchResWMN); 10/2021 - 08/2024 (internal project)
- **Network Slicing for WMN** (NS4WMN); 11/2020 - 04/2026 (internal project)


























# Current Research and Development Projects

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



# Research and Development Partners

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

# 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 thesis, Alexander Seng: **Network Slicing for Wireless Mesh Networks**. Finished in May 2026
- PhD working title, Rami Khaldi: **Agentic-AI Framework for Digital Twin Networks**