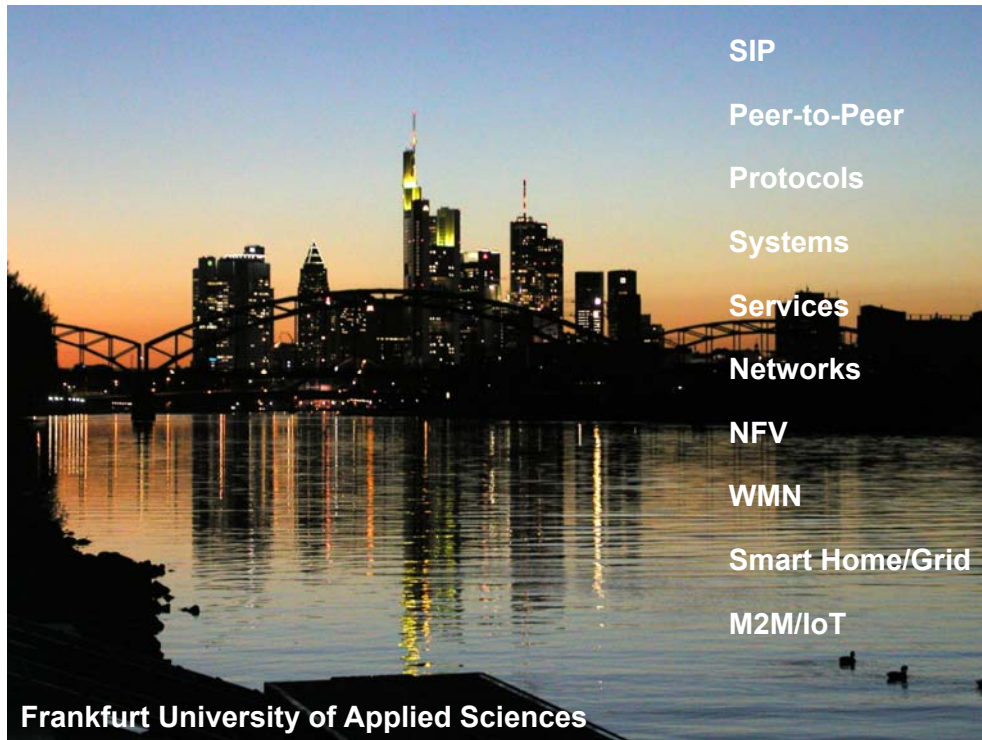
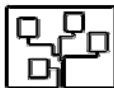


Research Group for Telecommunication Networks



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Prof. Dr.-Ing. U. Trick

Research Group for Telecommunication Networks



Prof. Dr. Ulrich Trick
Telekommunikationsnetze



Prof. Dr. Armin Lehmann
Programmieren in der
Informationstechnik



M.Sc. Michael Steinheimer

approx. 10 students



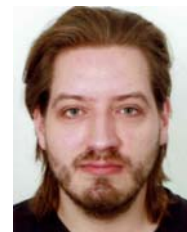
M.Sc. Auberlin Paguem



M.Sc. Besfort Shala



M.Sc. Olaf Reich



M.Eng. Gregor Frick

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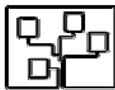
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Prof. Dr.-Ing. U. Trick

Subjects

- **Modelling, optimization and migration of networks**
- **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)**
- **Smart Home, Smart Grid and Smart Market**
- **Machine-to-Machine Communications (M2M)/Internet of Things (IoT)**
- **Network Functions Virtualisation (NFV), virtualisation technologies, Cloud Computing technologies**
- **Software Engineering in Telecommunications**

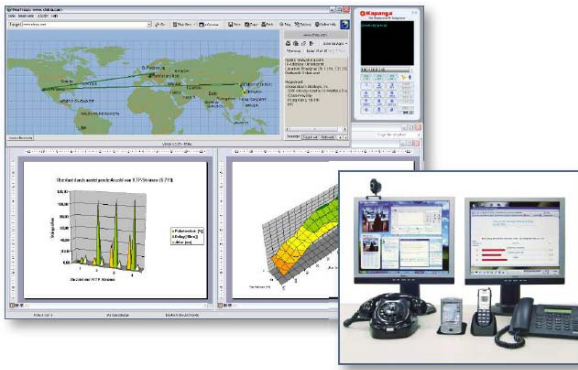
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Prof. Dr.-Ing. U. Trick

Current Research Focuses



- **Services in future telecommunication networks**
 - **Requirements, ideas**
 - **Development and deployment**
 - **Value added services**
 - **Application Server, Service Delivery Platform**
 - **Services for Smart Grid, Smart Home and M2M/IoT**
 - **Testing**
 - **Security, Trust**
- **NGN-systems and networks**
 - **Network elements**
 - **Network architectures**
 - **Unified Communications**
 - **IPv6**
 - **Test network**
 - **WMN, disaster networks**
- **Platforms and services**
 - **Smart Home/Grid/Market**
 - **M2M/IoT**
 - **P2P**
 - **Virtualisation, clouds**

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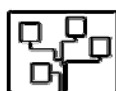
Completed Research and Development Projects 1

- **Future telecommunication infrastructure**; 07/2002-03/2003 (Univ. of Applied Sciences)
- **Optimization 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

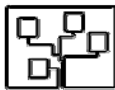
- **Improvement of Quality of Service across networks with SIP-based VoIP communication** (QoSSIP); 10/2005-04/2008 (BMBF)
- **Multimedia over IP and security**; 11/2007-05/2008 (company project)
- **Provisioning and Developing of Value-added Services in NGN**; 02/2009-03/2009 (company project)
- **NGN 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)



Current Research and Development Projects

1

- **SIP-Routing Infrastructure for Audio over IP**; 04/2011-12/2017 (company project)
- **Optimised P2P service architecture for high-available M2M applications** (P2P4M2M); 04/2015-03/2019 (BMBF)
- **Network Function Virtualisation and Wireless Networks**; 01/2016-12/2017
- **IoT and Disaster Networks**; 01/2017-12/2019
- **Optimierung von Wireless Mesh Networks mit Netzwerkvirtualisierung für den Katastropheneinsatz** (VirtO4WMN); 10/2017-09/2021 (BMBF)



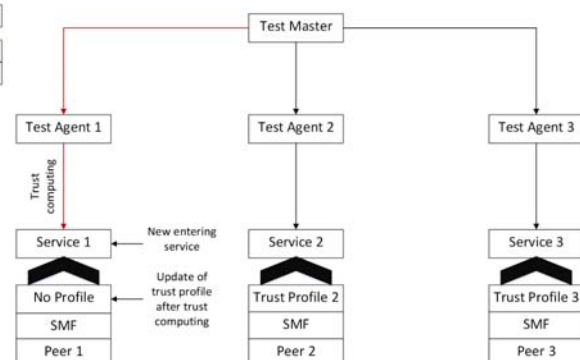
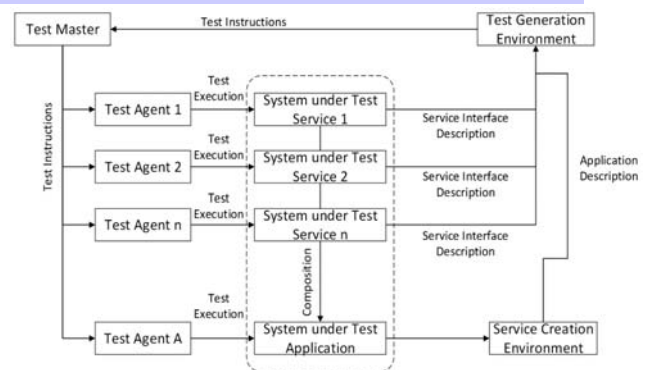
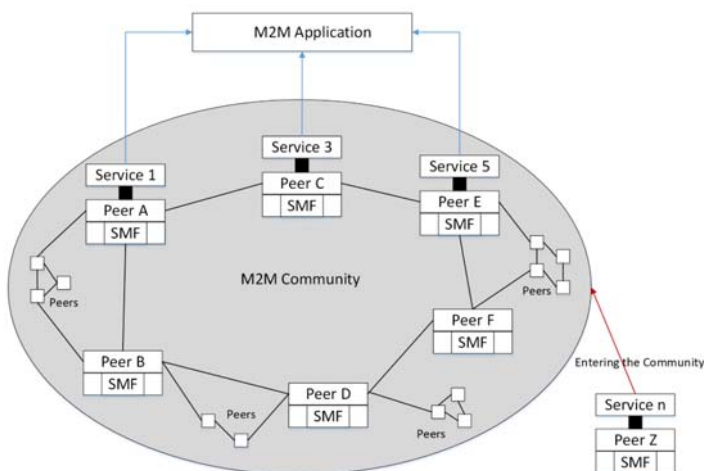
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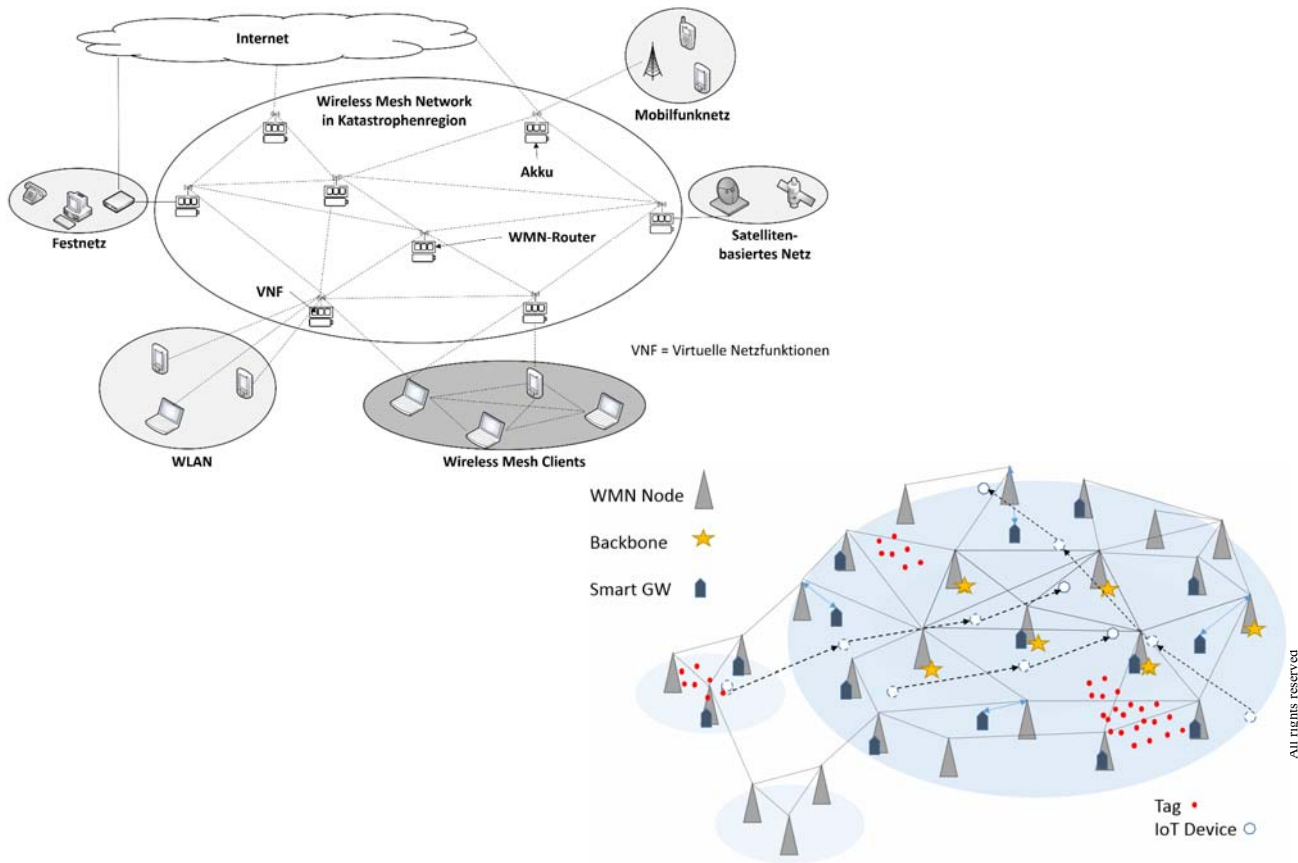
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Current Research and Development Projects

2



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Research and development partners

AETA Audio Systems, Le Plessis Robinson/Frankreich 	BT Germany, München und Frankfurt 	Detecon International, Bonn Consulting
FH Köln, Institut für Nachrichtentechnik (Prof. Dr. Grebe) Fachhochschule Köln University of Applied Sciences Cologne	FH Osnabrück, Mobilkommunikation (Prof. Dr. Tönjes) Fachhochschule Osnabrück University of Applied Sciences	GIP, Mainz
HEAG MediaNet, Darmstadt 	JDSU, Eningen u.A. Enabling Broadband & Optical Innovation Artera Test & Measurement Solutions	R-KOM, Regensburg
Robert Bosch, Stuttgart 	Tekelec, Morrisville/USA 	TransTel, Hamburg
T-Systems, Darmstadt 	Vodafone, Eschborn 	Vodafone, München
ARD-Sternpunkte, Frankfurt 	Centre for Security, Communications and Network Research (CSCAN) – Plymouth University 	h_da HOCHSCHULE DARMSTADT UNIVERSITY OF APPLIED SCIENCES ald INSTITUT FÜR ANGEWANDTE INFORMATIK DARMSTADT
EVL Energieversorgung Limburg 	NRM Netzdienste Rhein-Main 	teliko

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- 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 working title, Michael Steinheimer: **Autonomous decentralised application provision in M2M networks**. Transfer report approved in February 2014
- PhD working title, Auberlin Paguem Tchinda: **Optimisation of wireless disaster telecommunication network based on Network Functions Virtualisation under special consideration of energy consumption**
- PhD working title, Besfort Shala: **Security and high availability optimisation of P2P-based M2M applications and integration of testing**
- PhD working title, Olaf Reich: **Internet of Things based on Fog Computing in a disaster network on a Wireless Mesh Network basis**



- PhD working title, Gregor Frick: **Optimisation of Wireless Mesh Networks for disaster scenarios based on virtualisation with distributed orchestration**

- **Prof. Trick and Research Group for Telecommunication Networks in close cooperation with CSCAN and Plymouth University since 2006**

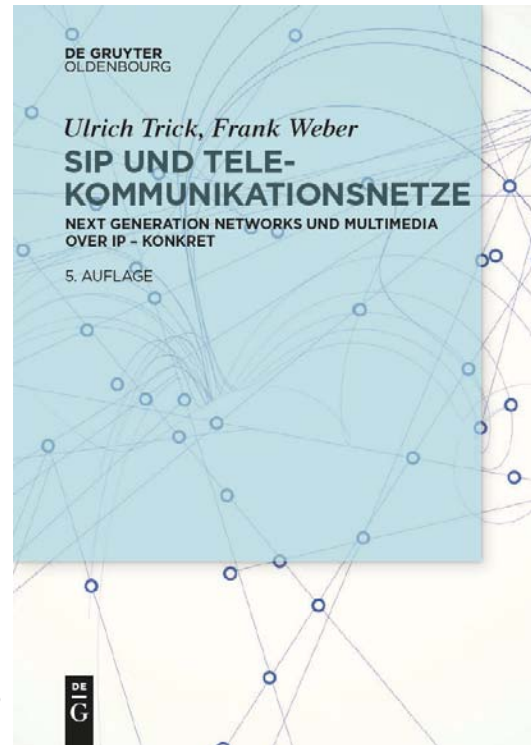
- **Member of competence Centre “Networks and Distributed Systems” at Frankfurt-UAS**



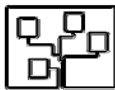
Current Publications

- More than 80 publications in the last 14 years with the subjects
 - NGN
 - Voice/Multimedia over IP
 - Smart Grid/Home
 - Emergency call
 - Mobility
 - Peer-to-Peer communication
 - Services and Application Server incl. testing
 - M2M
 - Network modelling
 - Network migration
 - WMN

- NGN book:
SIP und Telekommunikationsnetze.
5. Auflage. De Gruyter Oldenbourg, Mai 2015



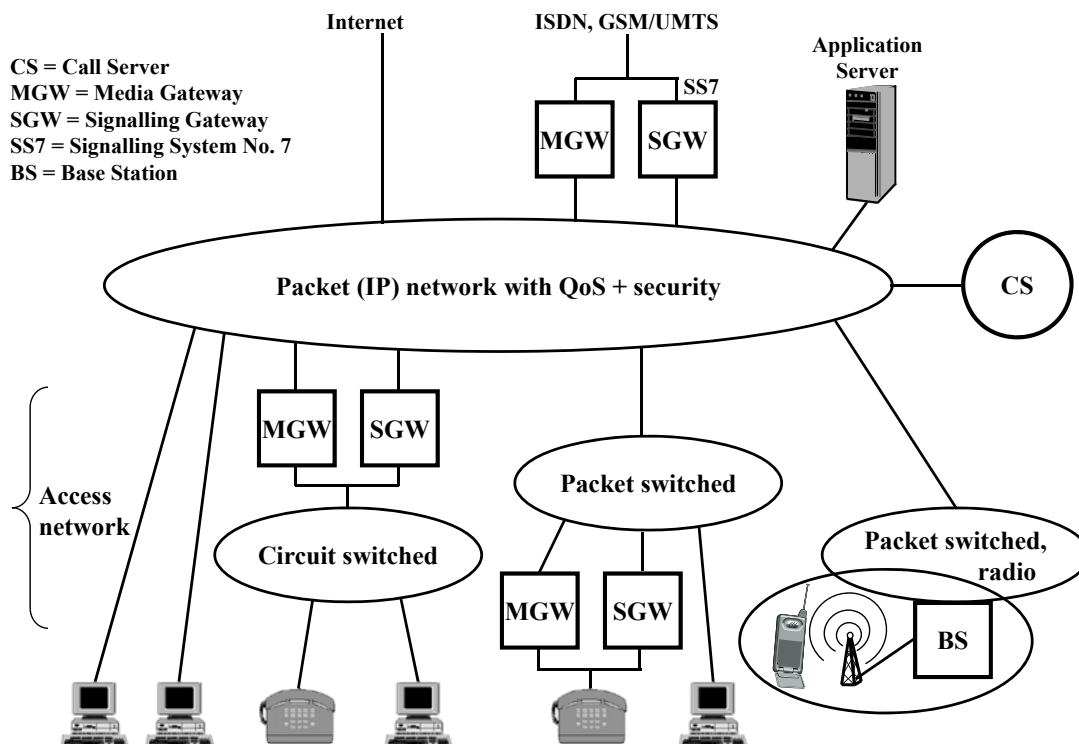
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Laboratory for Telecommunication Networks with NGN



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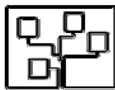


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Equipment of the NGN Laboratory @ FH Frankfurt 1

- **Multimedia over IP infrastructure with Call Servers, Gateways, Session Border Controller etc., with focus on SIP and services**
- **IP networks, WLANs, HW-IP-Router, Linux-based IP-Router, fiber optical cabling**
- **10 Gbit/s (link aggregated up to 40 Gbit/s) infrastructure, public IP addresses**
- **Virtualisation (Proxmox, container virtualisation (Docker, LXC), OpenStack), NFV, SDN**
- **MoIP (Multimedia over IP), SIP, H.323, MGCP**
- **SER (SIP Express Router)/Kamailio as Call Server**
- **Mobicents as SIP Application Server with JAIN SLEE framework**
- **Asterisk as Session Border Controller and Gateway**
- **Net-Net 3800 (Oracle) and Mediant 800 (AudioCodes) as Session Border Controller**



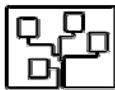
Equipment of the NGN Laboratory @ FH Frankfurt 2

- **CMS-3000 (Radisys), Asterisk, SEMS (SIP Express Media Server) and Kurento as Media Server**
- **Server for Text to Speech and speech recognition (e.g. Loquendo)**
- **Hard- (snom, AudioCodes) and Soft-IP-phones**
- **Lync 2013 as Unified Communication System**
- **Protocol analysis and simulation (e.g. Tektronix, Wireshark)**
- **M-Bus, EnOcean, ZigBee, KNX, Z-Wave, digitalStrom, HomeMatic devices**
- **OSGi (Open Services Gateway initiative)**



- **Bachelor Elektrotechnik und Kommunikationstechnik**
 - Lecture „Grundlagen der Telekommunikation“
 - „Software-Projekt“ (Java)
 - Lecture „Digitale Vermittlungstechnik“
 - Laboratory acc. to „Digitale Vermittlungstechnik“
 - Lecture „Kommunikationsnetze“
 - Laboratory acc. to „Kommunikationsnetze“
 - Student projects
 - Bachelor theses

- **Master Information Technology**
 - Lecture „Methods, Systems and Networks for Digital Communication“
 - Lecture „Digital Switching and Routing“
 - Laboratory acc. to „Digital Switching and Routing“
 - Lecture „Mobile Computing“
 - Projects acc. to „Mobile Computing“
 - Student projects
 - Master theses



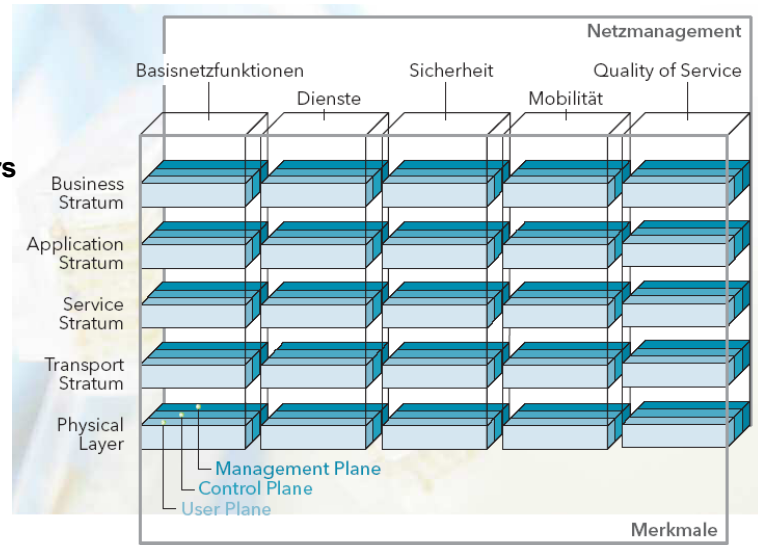
- **Bachelor Wirtschaftsinformatik**
 - Lecture „Webbasierte Anwendungen“

- **Bachelor Informatik**
 - Laboratory acc. to „Computer Networks“
 - Lecture „Operating Systems“
 - Lecture „Object Oriented Programming“

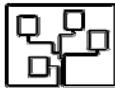


Possible areas of Cooperation

- **Research and Development for Companies**
- **Conceptual Studies**
- **Workshops**
- **Advanced training seminars**



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