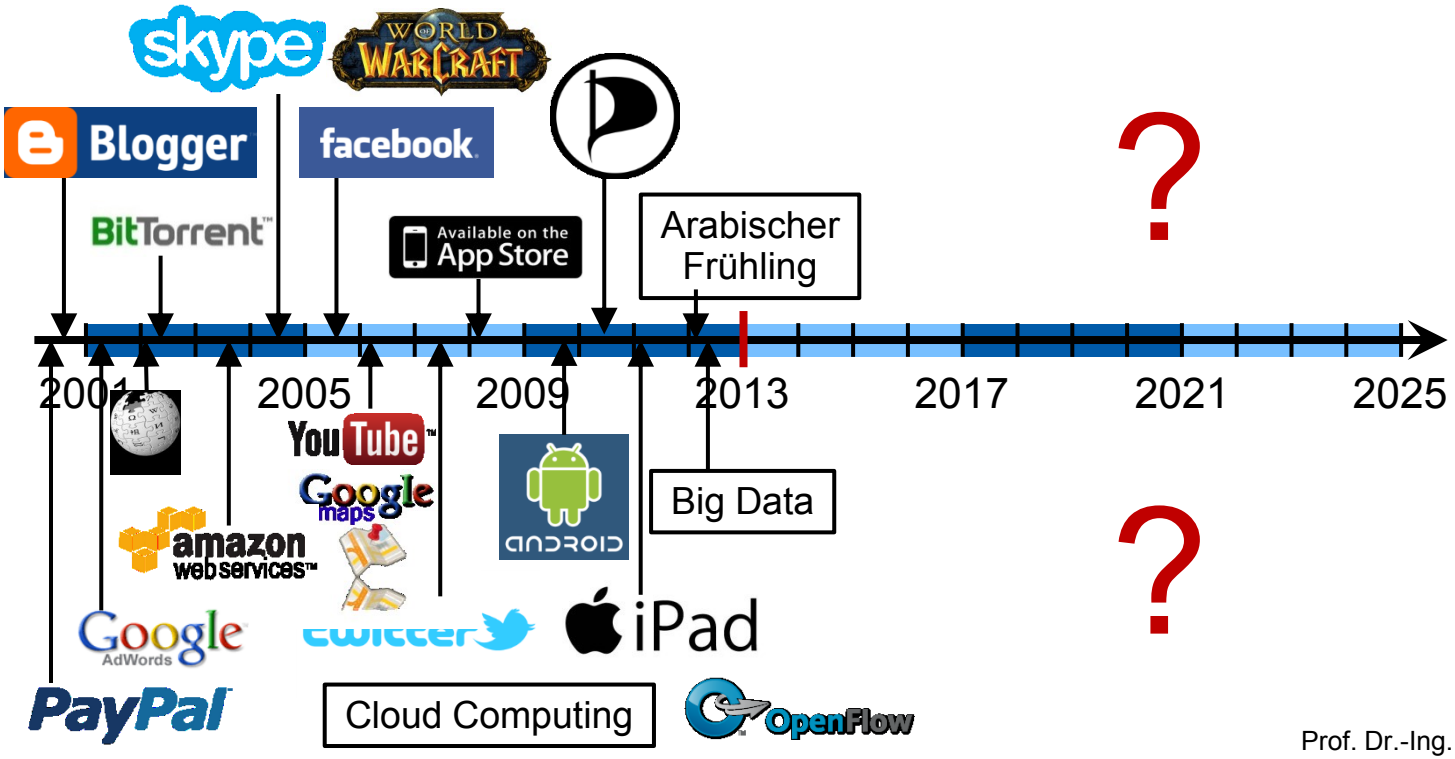
Key Issues for the Future Internet

TECHNISCHE UNIVERSITÄT DARMSTADT

3. July 2013

Workshop on Mechanismen for the future Internet
GI Regional Group, DE-CIX Meeting Center, Frankfurt,
GI and “eco Kompetenzgruppe E-Commerce”



Prof. Dr.-Ing. Ralf Steinmetz
KOM - Multimedia Communications Lab

Overview

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1 Motivation
2 Research Cluster at TU Darmstadt - Future Internet

3 DFG SFB 1053: MAKI – Multi-Mechanism Adaption for the Future Internet
4 Example of a Concrete Situation in the „Future Internet“
5 Approach

6 Architecture to approach the Research of Transitions
  6.1 Methodological Fundamentals for the Construction of Multi-Mechanisms (Modeling, Design, Realization)
  6.2 Project Area B: Adaption Mechanisms
  6.3 Project area C: Communication Mechanisms

7 Transition: Basic Research Questions
8 The Impact of the Future Internet

Infrastructure
Transport – Energy - Communications

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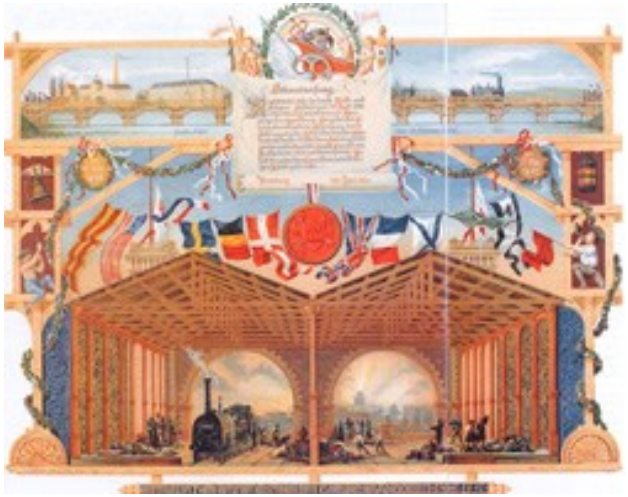

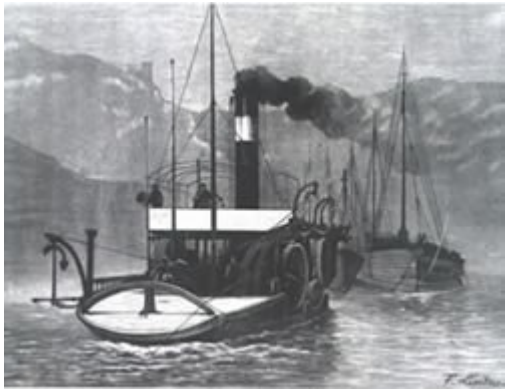

Telephony

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Image source: Wikimedia Commons

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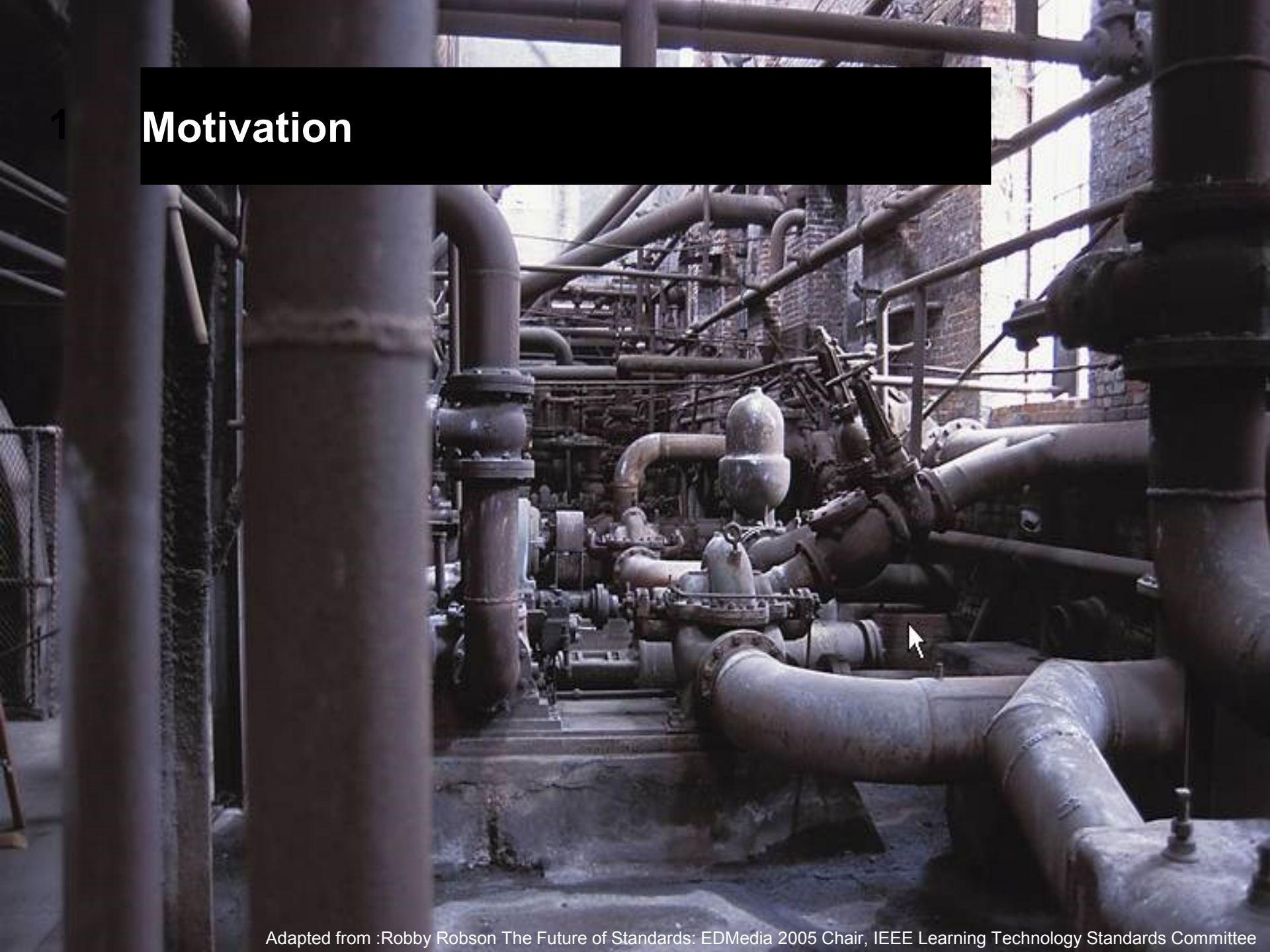
Motivation



Adapted from :Robby Robson The Future of Standards: EDMedia 2005 Chair, IEEE Learning Technology Standards Committee

1960: Looking at the Future → Future Internet

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20xx: Looking at the Future → Future Internet

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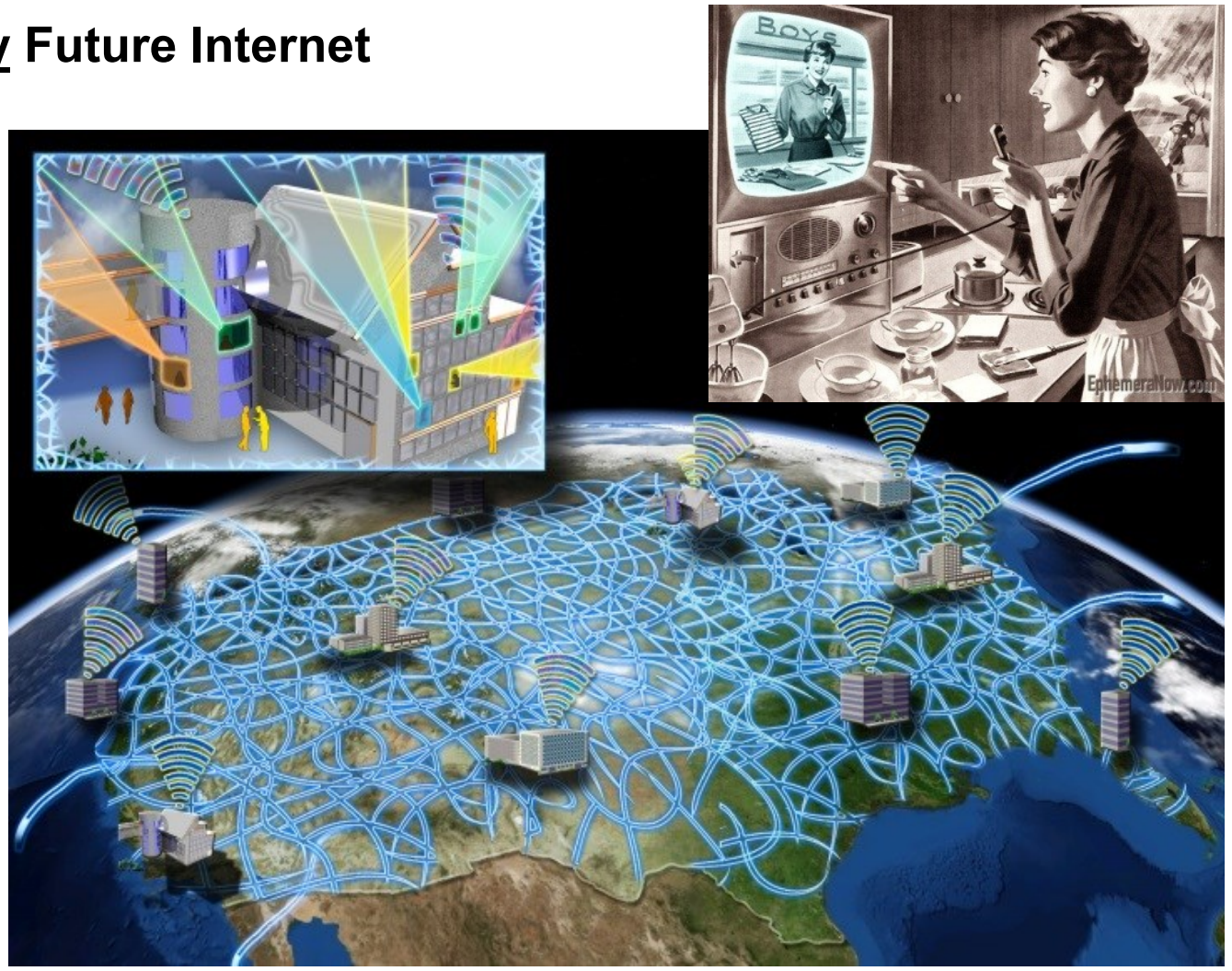
to approach <u>jointly</u> Future Internet

- Communications
- Documents
- Security



taking into account

- Future Internet
  - Economy
  - Infrastructure
  - Usage

2 Research Cluster at TU Darmstadt - Future Internet

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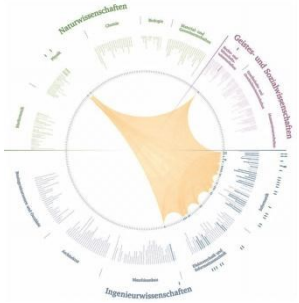
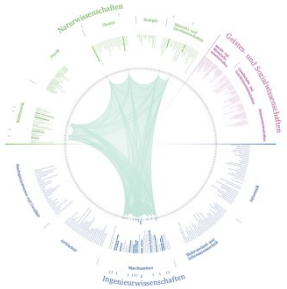
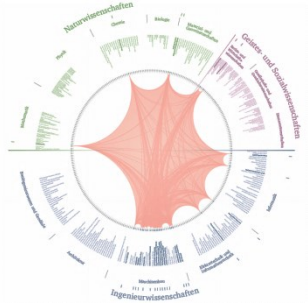


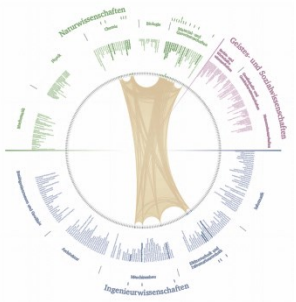
Future Internet



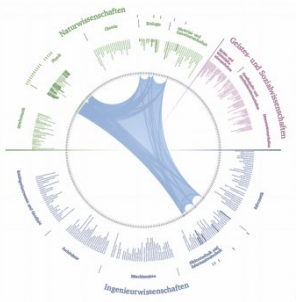
Thermofluiddynamik und Verbrennungstechnologie



Integrierte Produkt- und Produktionstechnologie



Moderne Materialien und Werkstoffe



Teilchenstrahlen und Materie

Future Internet - Communications @ TU Darmstadt

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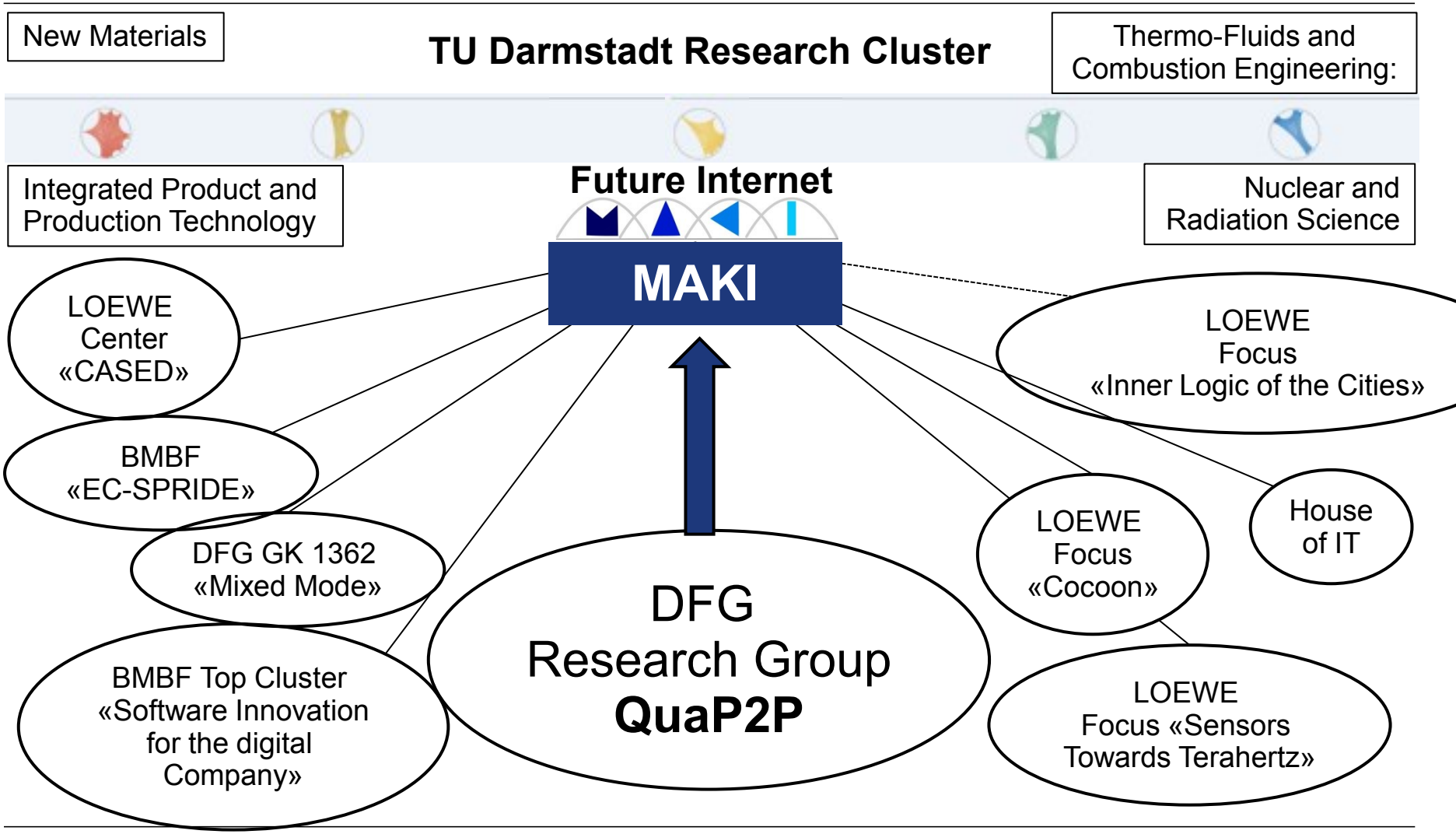

20xx: Research Cluster Future Internet @ TUD
→ „3 Colums Plus“

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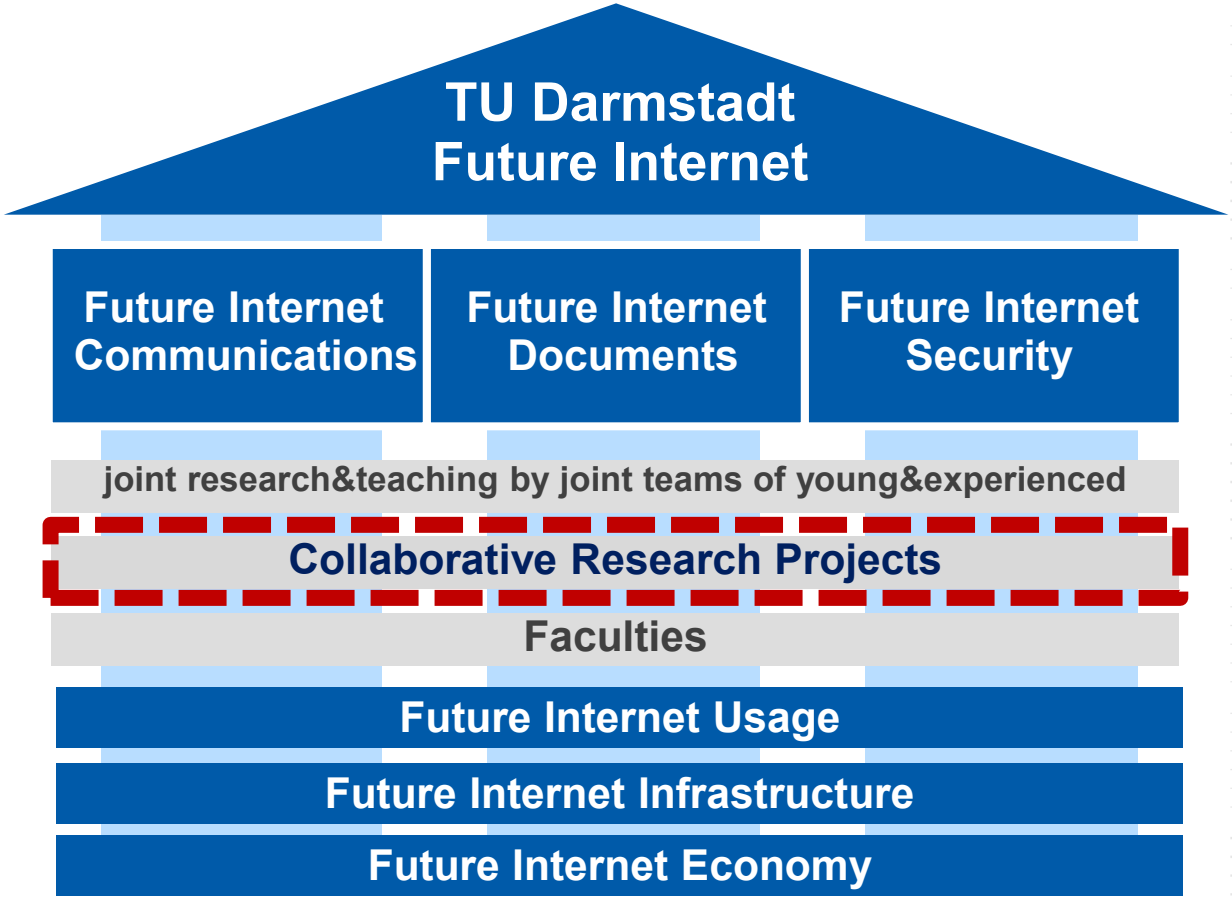

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Prof. Dr. M. Waldner	FhG SIT
Prof. Dr.-Ing. A. M. Zoubir	Elektrotechnik und Informationstechnik
Emeritiert oder Pensioniert	
Prof. Dr.-Ing. S. A. Huss	Informatik
Prof. Dr.-Ing. Peter Meissner	Elektrotechnik und Informationstechnik

Collaborative Research Projects

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Most recently

DFG SFB MAKI
Multi-Mechanism Adaptation for the Future Internet

- new DFG Collaborative Research Center
- 1. Jan. 2013 - 2017 .. - 2025

In place

CASED

LOEWE – Landes-Offensive zur Entwicklung Wissenschaftlich-ökonomischer Exzellenz

and …

House of IT

and …

- GK TICMO
  GK Mixed Mode
  …

Deutsche Forschungsgemeinschaft DFG

DFG Collaborative Research Center

TECHNISCHE UNIVERSITÄT DARMSTADT

(Sonderforschungsbereiche, SFBs) are

- long-term university research centers
- in which scientists and academics work together
- within a cross-disciplinary research program

In addition to promoting excellent research in networks,

- the development of core research areas in universities
- is an important structural objective of the program.

Multimedia Communications - Alumni

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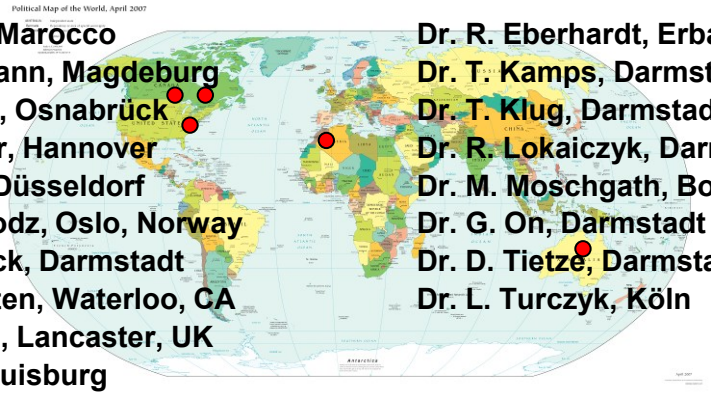
@ Scientific.World



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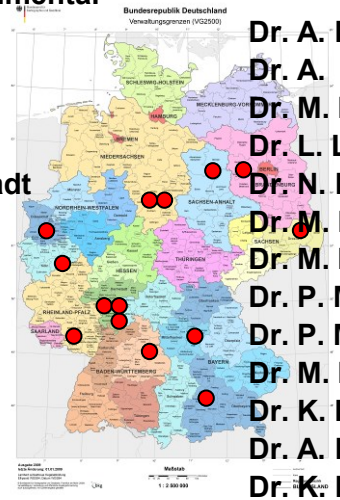

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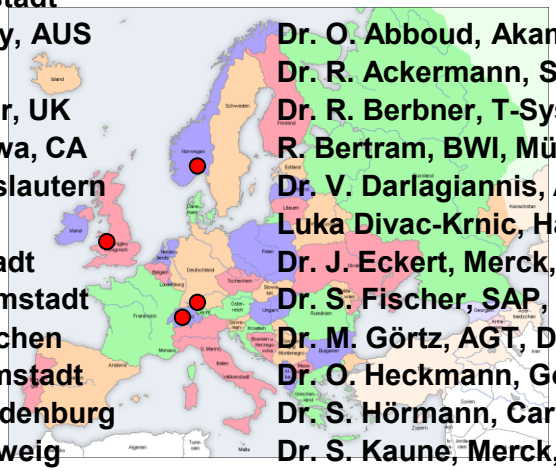

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KOM Research
Research Areas

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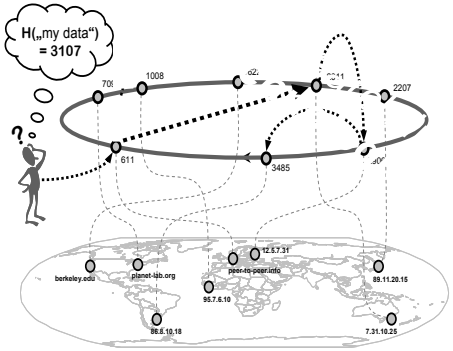
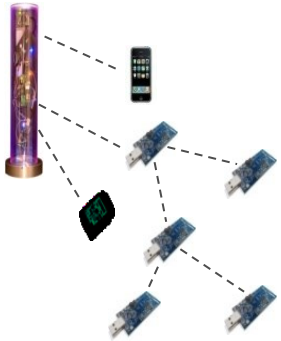
- Knowledge & Educational Technologies
- Multimedia Technologies & Serious Games
- Mobile Systems & Sensor Networks
- Self-organizing Systems & Overlay Communications
- Service-oriented Computing

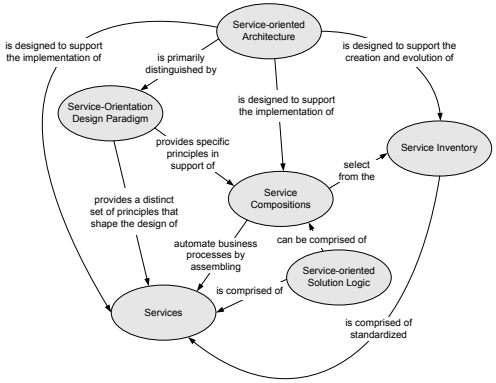
Knowledge & Educational Technologies



Self-organizing Systems & Overlay Communications



Mobile Systems & Sensor Networks



Service-oriented Computing

Multimedia Technologies & Serious Games

3 DFG SFB 1053: MAKI – Multi-Mechanism Adaption for the Future Internet

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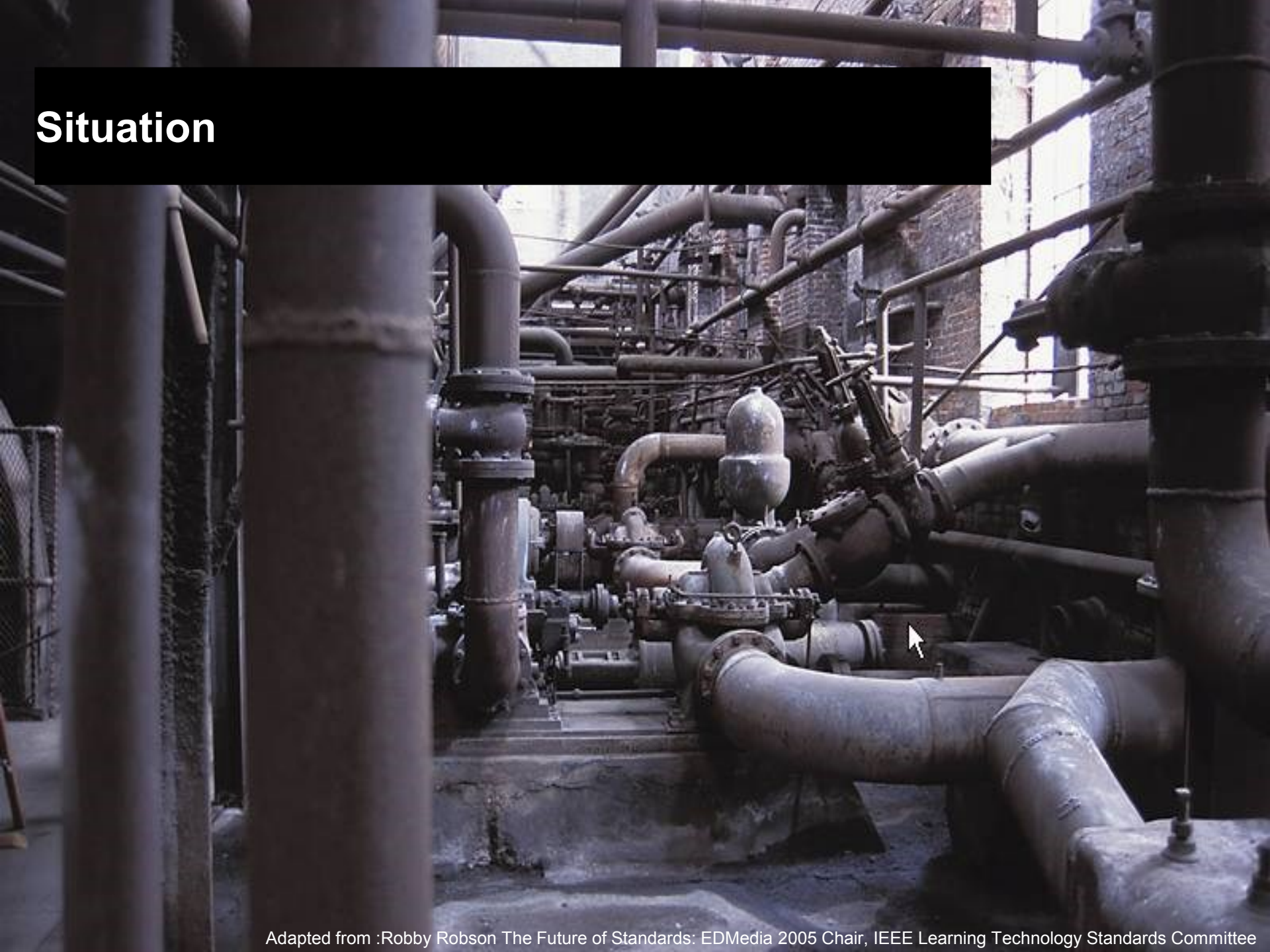
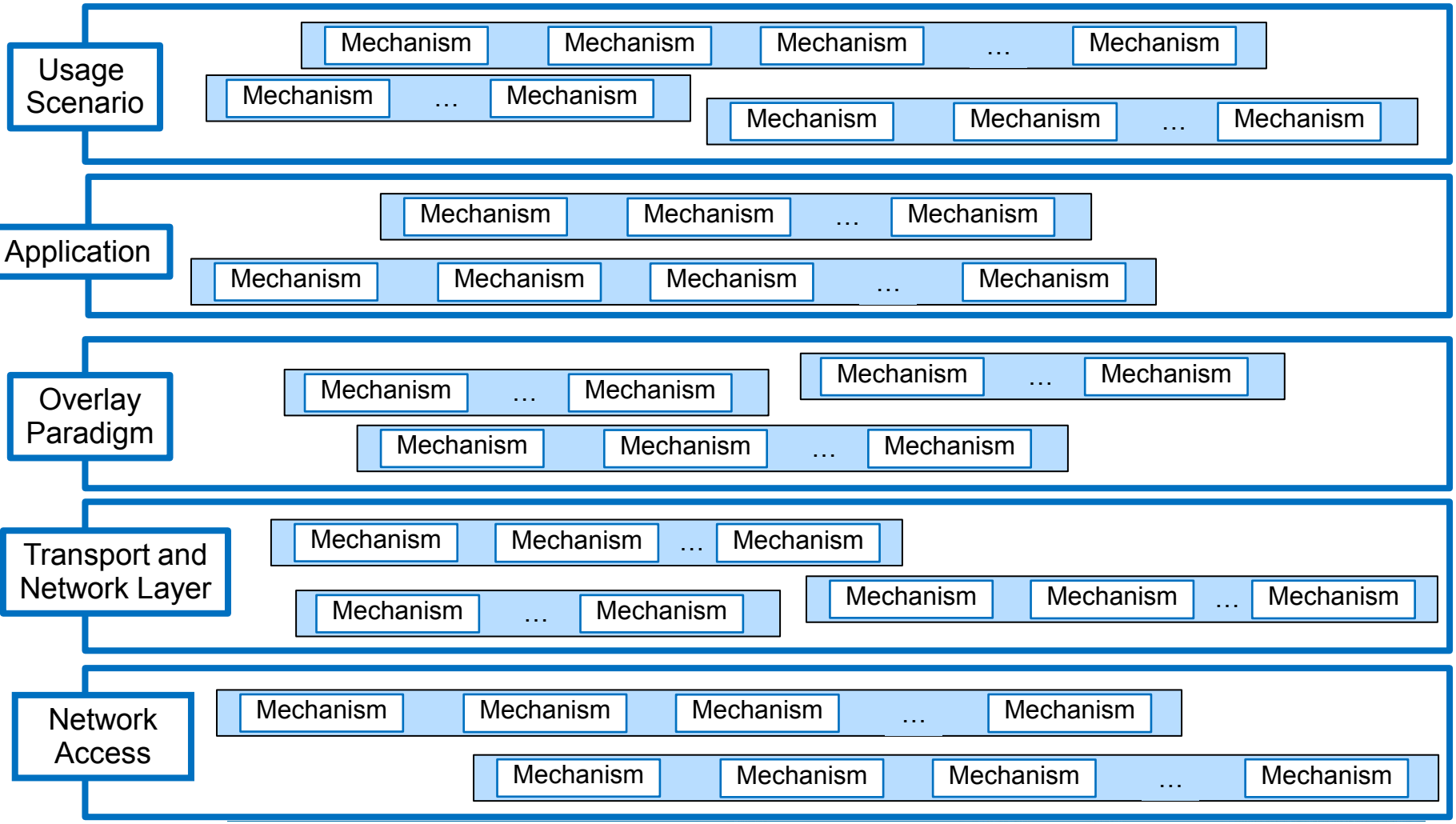
Prof. Dr. Silvia Santini
Prof. Dr. rer. nat. Andy Schürr
Prof. Dr.-Ing. Ralf Steinmetz
(Chairman and Coordinator)
Prof. Dr.-Ing. Thorsten Strufe
Prof. Dr. Karsten Weihe
Prof. Dr.-Ing. Klaus Wehrle (RWTH Aachen)

Situation



Adapted from :Robby Robson The Future of Standards: EDMedia 2005 Chair, IEEE Learning Technology Standards Committee

Situation in the "Future Internet



Goal and Long-term Impact

Goal: Research of

- New construction methods, models und algorithms
- to enable automated, coordinated und cross-layer Transitions between mechanisms with similar functions

Expected long-term impacts:

- Design of a **transition methodology** to realize transition-enabled communication systems
- **Transition capability** as an integral part of future communication systems
- **Paradigm change** during design and development of connected applications, services, and protocols

4 Example of a Concrete Situation in the „Future Internet“

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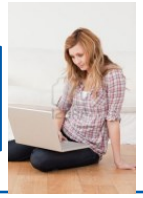
Anywhere

Usage Scenario




...


...


Any size

Application


...

...

Any kind

Overlay Paradigm

PubSub

Event-based

RPC

Streaming

Transport- and Network Layer

Unicast

TCP

Broadcast

UDP

Multicast

SCTP

IPv4

IPv6

Network Access

Cellular

...

Mesh

...

Ad-hoc

...


Motivation:
Concrete Situation in the „Future Internet“

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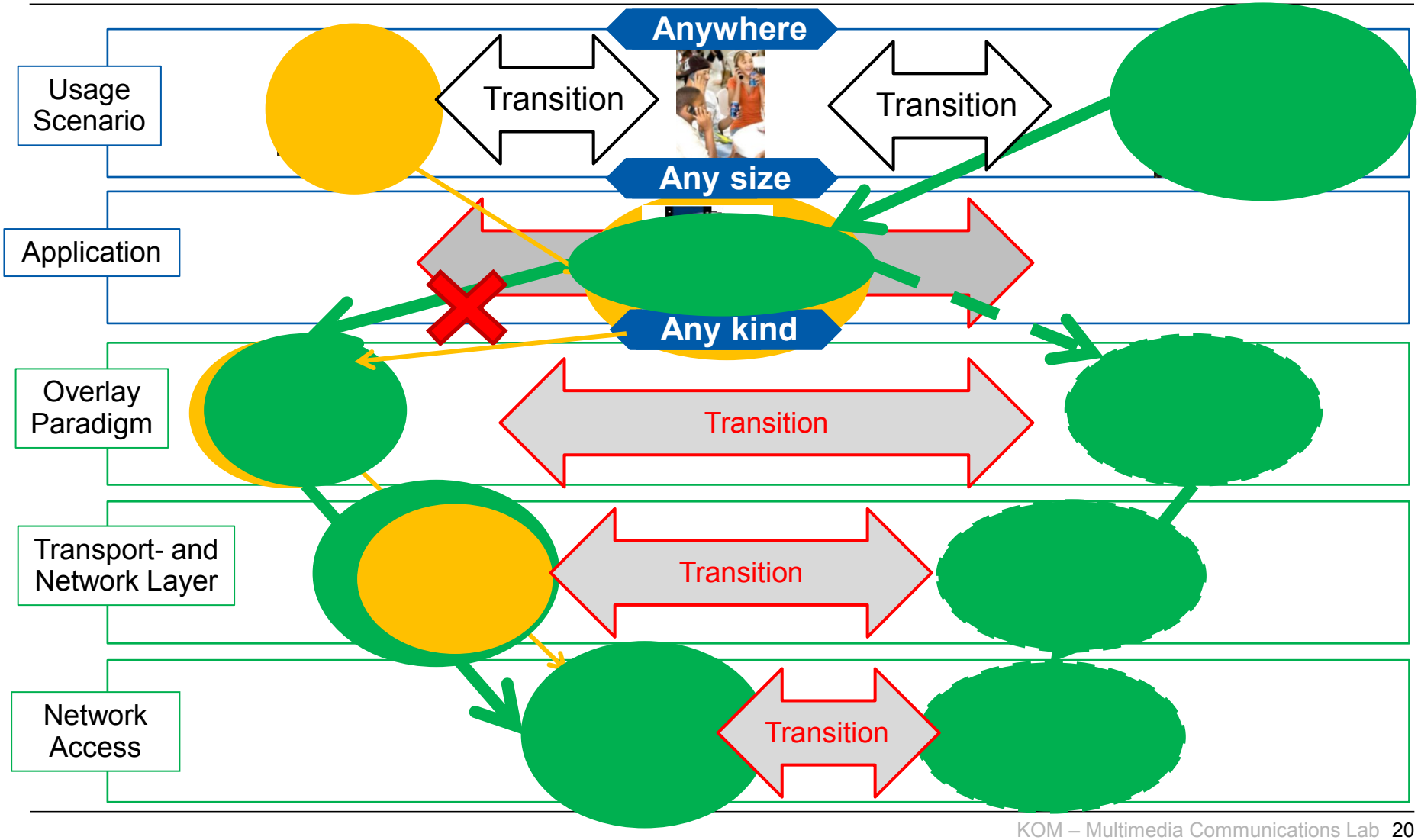
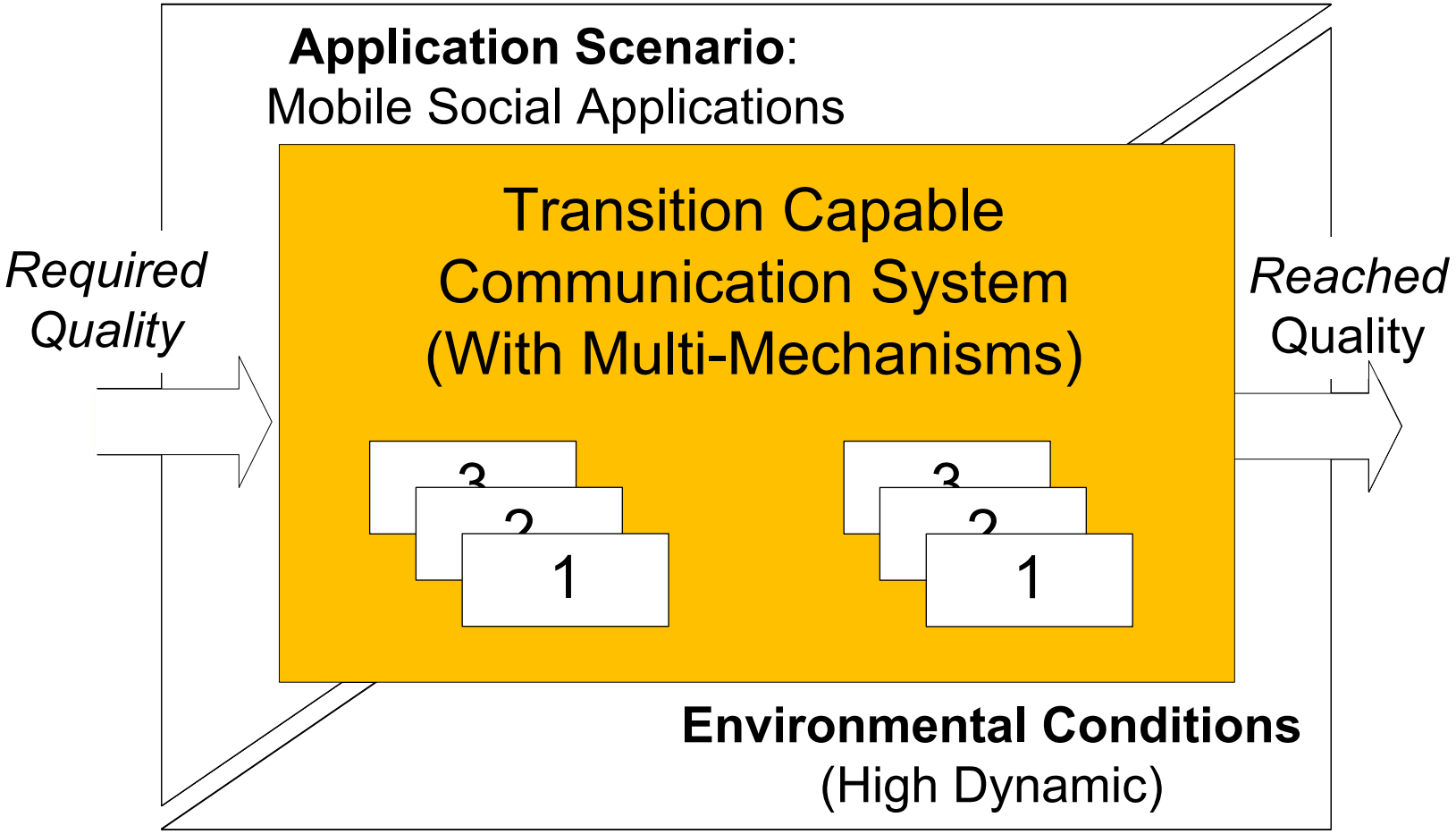
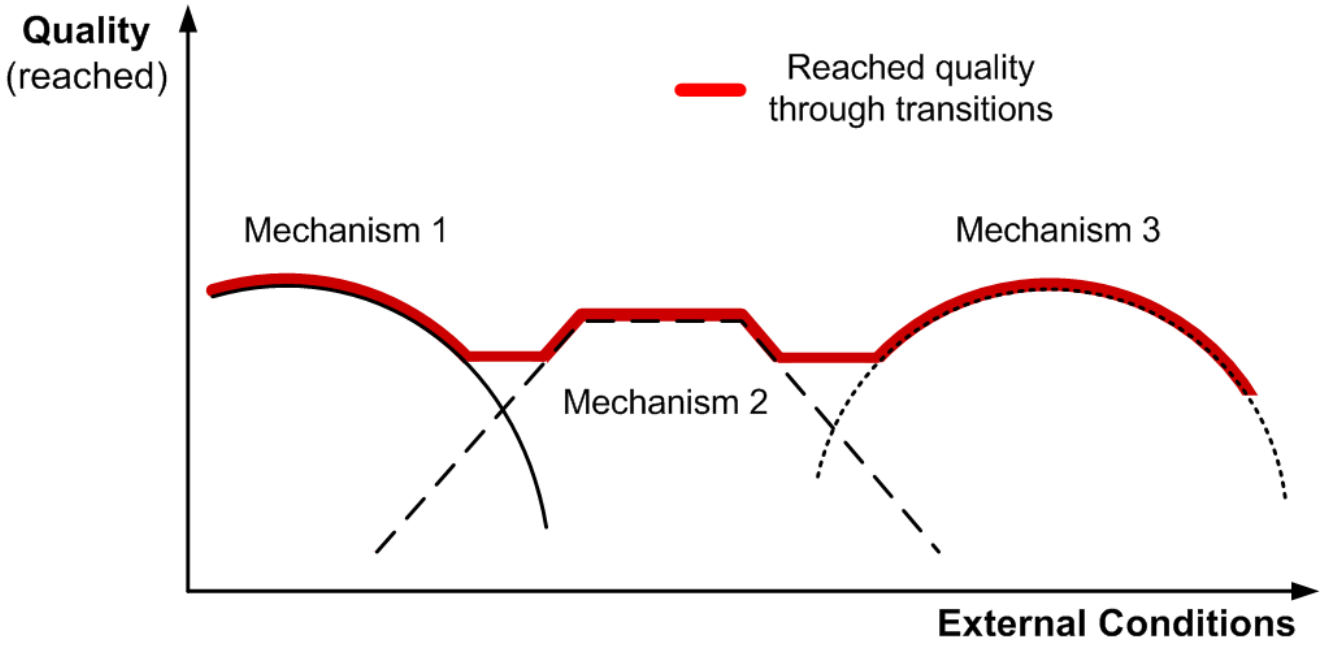


5 Approach


Application Scenario:
Mobile Social Applications
Transition Capable
Communication System
(With Multi-Mechanisms)
3
2
1
3
2
1
Required
Quality
Reached
Quality
Environmental Conditions
(High Dynamic)

The Concept of a Transition



(Desirable) Switching between two Mechanisms

- Comparable Functionalities
- But different Algorithms
  and Realizations
- Depending on the external conditions
- Within a communication system

6 Architecture to approach the Research of Transitions

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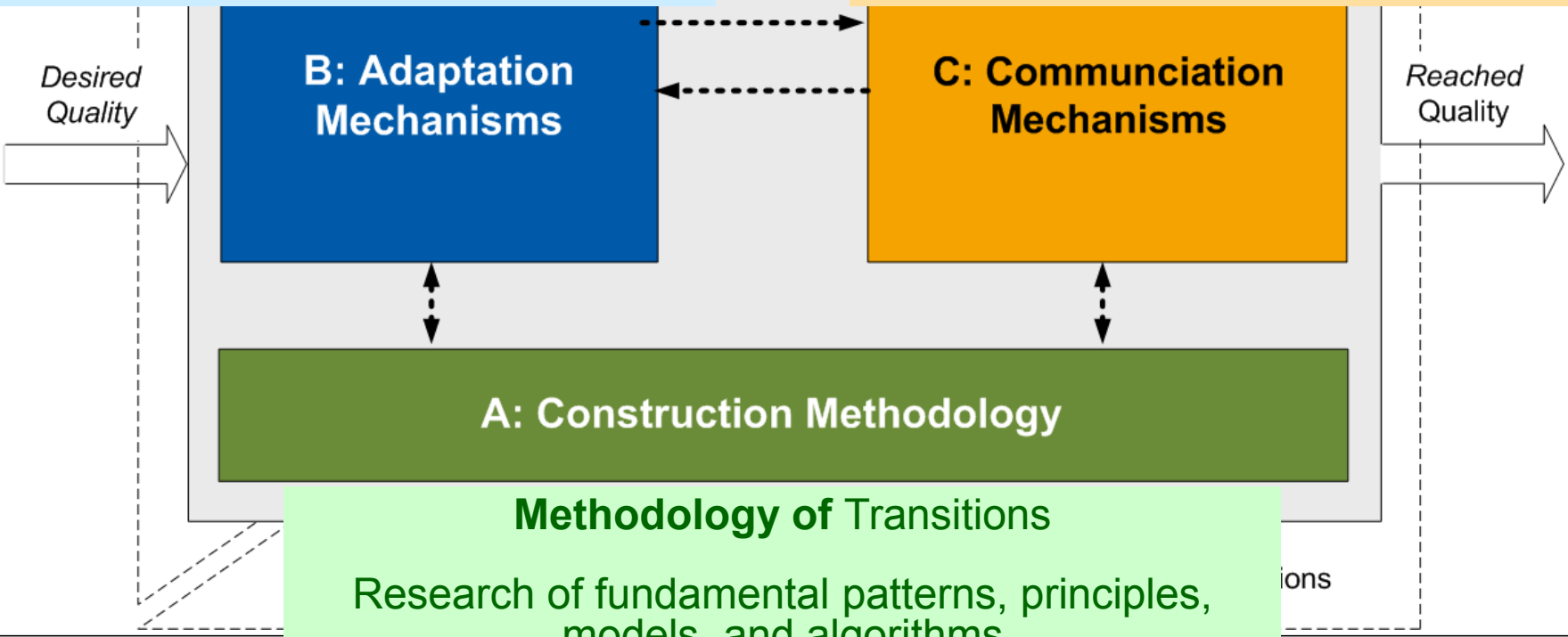
Addressing „**Cross-layer**“ Transitions

Coordinated Transition with status management, planning, and coordination

Mechanisms become „**Transition-capable**“

Especially study of comparable mechanisms regarding their performance



Methodology of Transitions

Research of fundamental patterns, principles, models, and algorithms

H2 Methodological Fundamentals for the Construction of Multi-Mechanisms (Modeling, Design, Realization)

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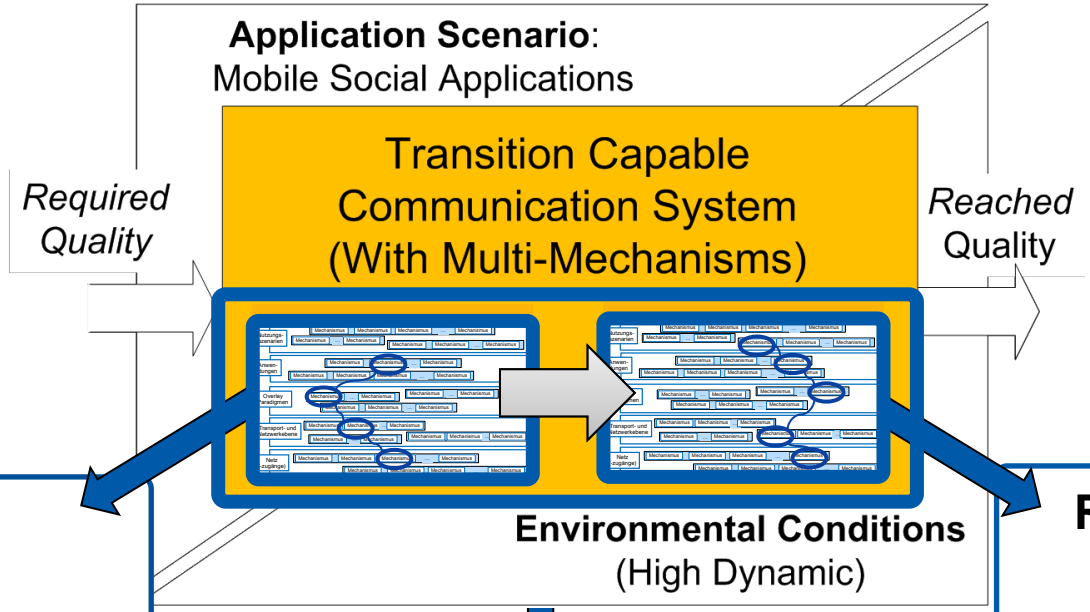

Model-based Development:

- Graph-Transformation
- Local Algorithms

→ **Modeling (A01)**

Dynamic System Architecture For transition-capable Mechanisms:

- Modular
- evolutionary

→ **Construction Methodology (A02)**

Realization:

- Transition
- Warm Start

→ **Migration (A03)**

Project Area A: Construction Methodology

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A. Schürr

M. Mühlhäuser

A: Construction Methodology

A02: Design

A01: Modeling

A03: Migration

M. Hollick

K. Wehrle

K. Wehrle

A. Buchmann

6.2 Project Area B: Adaption Mechanisms

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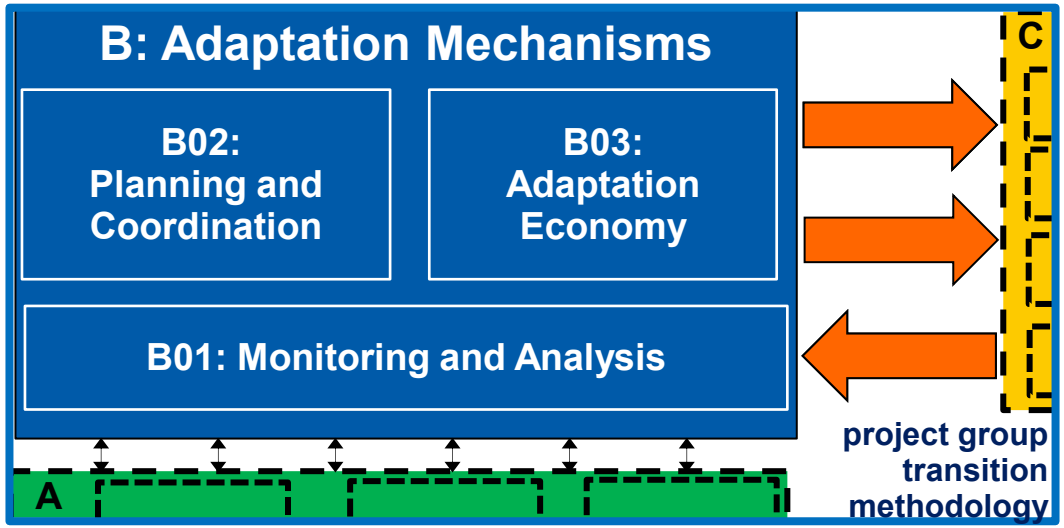
Goal: Research on
cross-layer
coordinated transitions

as part of the adaptation cycle
monitoring (i.e. info gathering)
→ *planning* (includes decisions)
→ *coordination* (execution of transitions)



Research questions (selection):

- How can transition related *monitoring* be supported cross-layer in a heterogeneous communication system?
- How can the ‚currently preferrable' (wrt. *optimization*) set of mechanisms be *computed* und *enabled* (by means of cross-layer coordinated transitions)?
- How can ‚currently preferrable' sets of mechanisms be *self-organized*?
- How can the full cross-layer *adaptation cycle* be conceptualized and realized?

Project Area B: Adaption Mechanisms

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K. Weihe

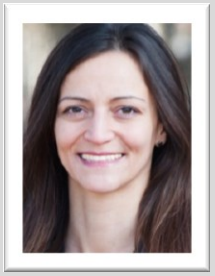
M. Mühlhäuser

B: Adaptation Mechanisms

B02: Planning and Coordination

B03: Adaptation Economy

B01: Monitoring and Analysis



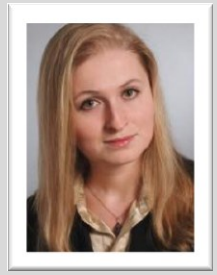
S. Santini

A. Schürr

R. Steinmetz

A. Klein

D. Hausheer



N. Akchurina

6.3 Project area C: Communication Mechanisms

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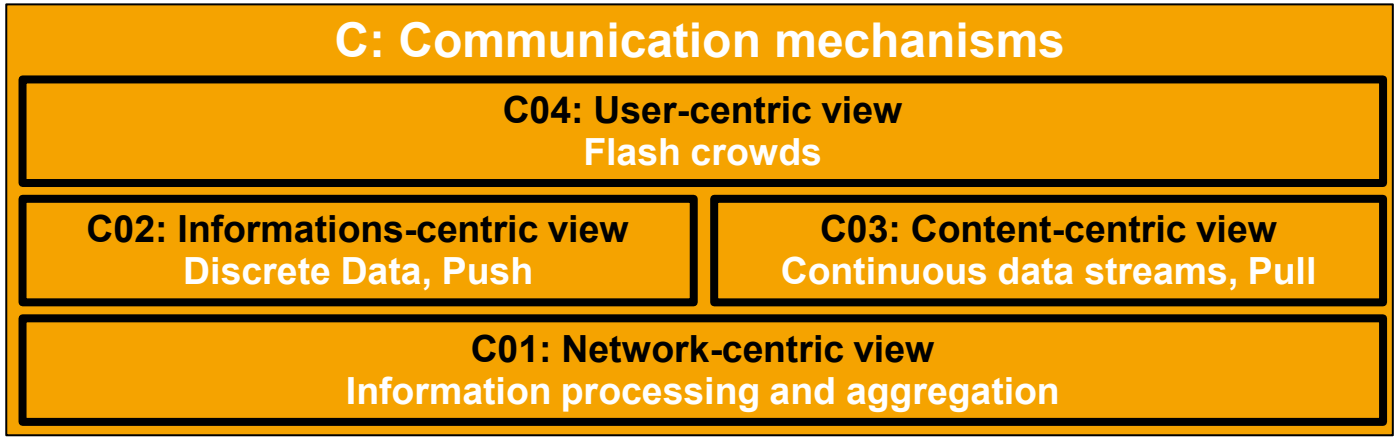
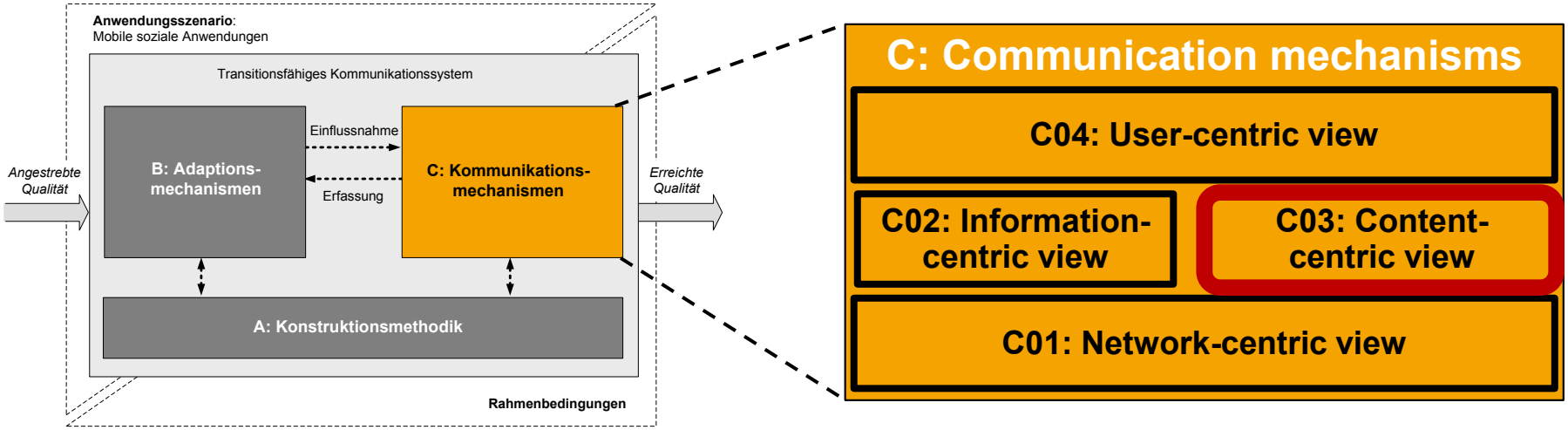
Goal: Investigation of transition-aware communication mechanisms from different views on the communication system



Scientific questions (extract):

- Performance of comparable mechanisms with different external conditions?
- Between which mechanisms and how can a transition be performed?
- Which interdependencies exist between mechanisms?

C03: Content-centric view – Adaptive Video-Streaming



W. Effelsberg

R. Steinmetz

C03: Motivation and goals

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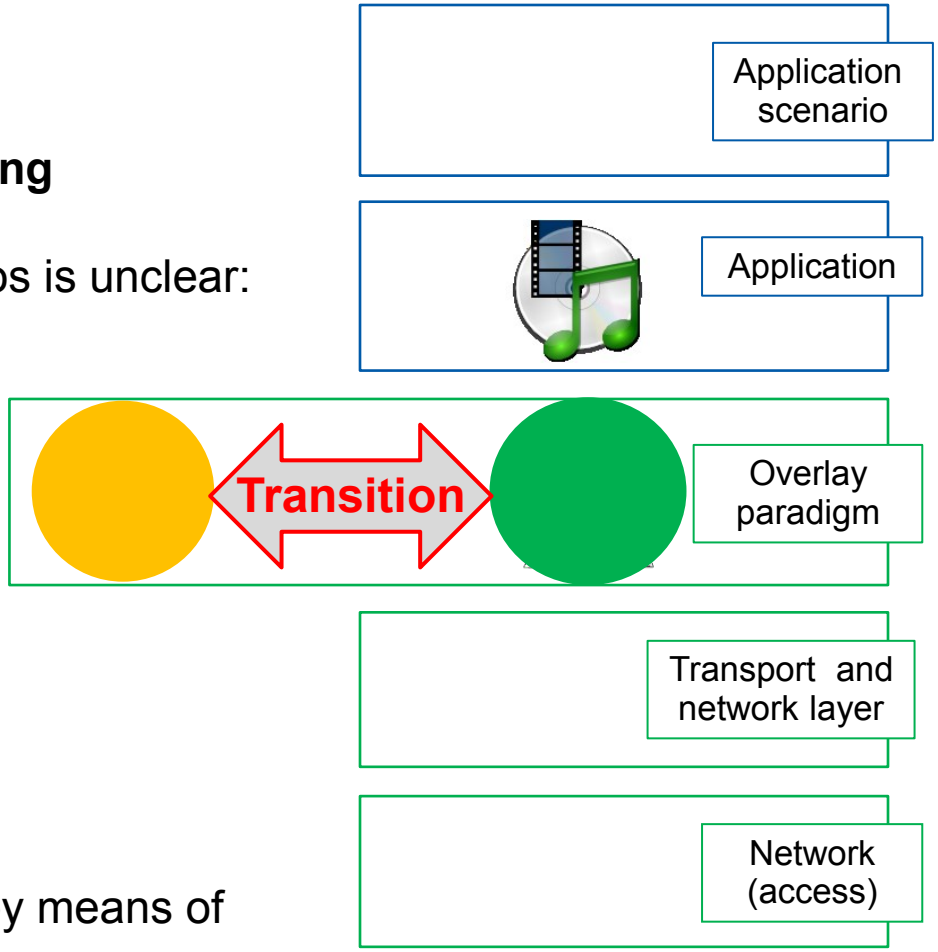
Motivation

- Increasing dissemination of videos, especially on mobile terminals
- Available resources are **heterogeneous** and **strongly fluctuating**
- Beneficial distribution structure for videos is unclear:
  - Client/Server?
  - P2P-Streaming?
  - Caching at Web?
- **Adaptive** Video-Streaming leads to transitions in the network, e.g.
  - Client/Server → P2P
  - UMTS/LTE → Ad-Hoc-Network



Goal

- Dynamic adaption of video streaming with respect to the external conditions by means of transitions

C03: Adaptive Video-Streaming

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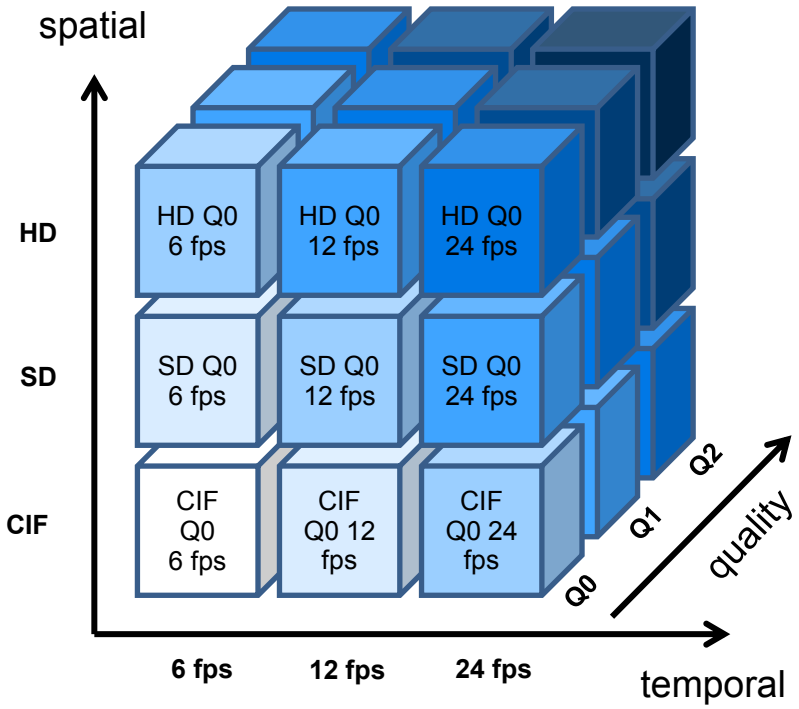
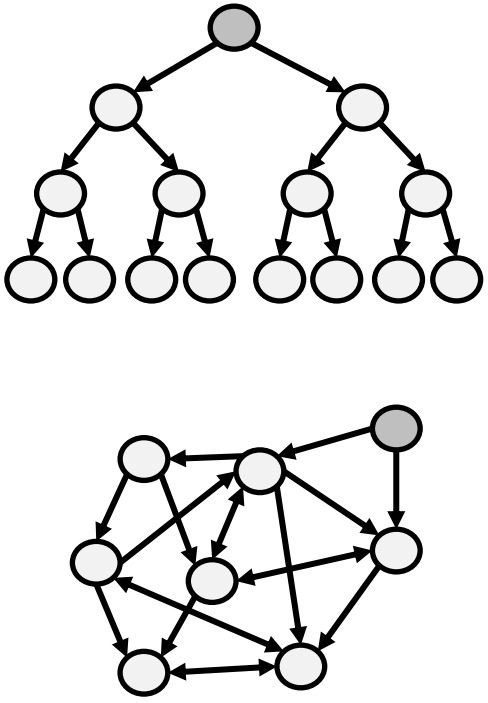
1. Project aspect: Network related adaptation of the video quality with MPEG-4 SVC



2. Project aspect: Transition between distribution structures



C03: Adaptive Video-Streaming

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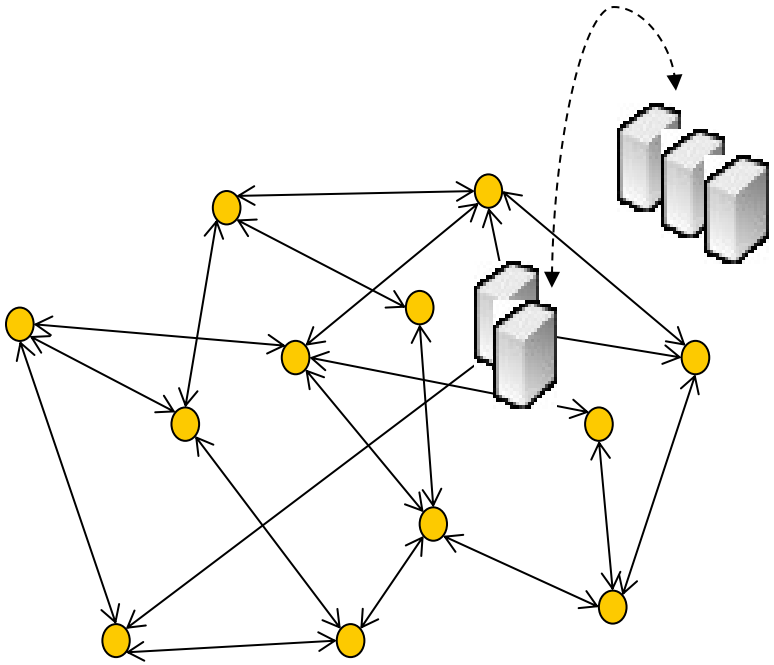
3. Project aspect: Optimisation of server capacities



4. Project aspect: Preloading for a short start delay

Video Streaming and Adaptation

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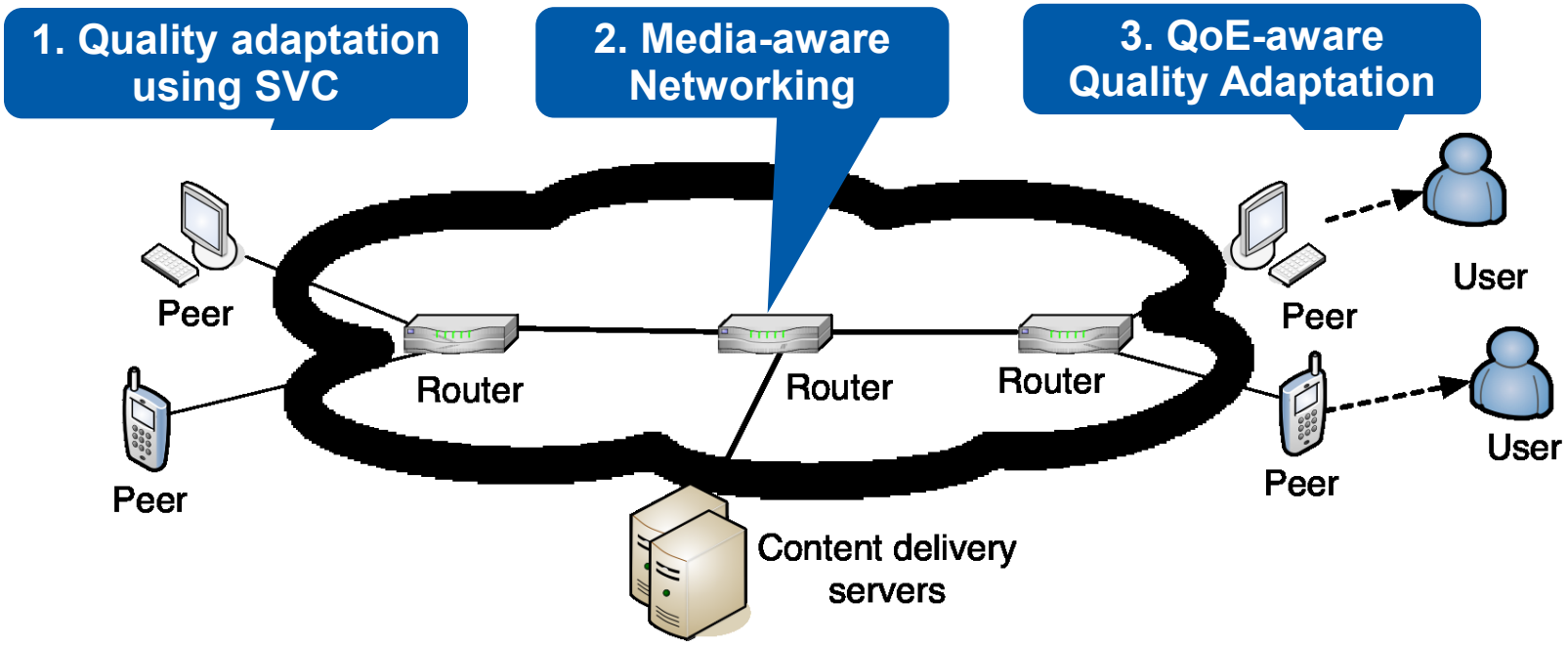
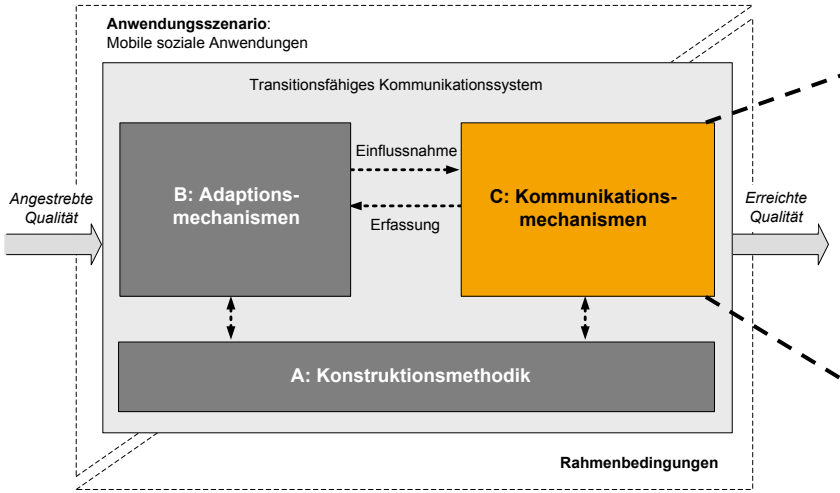
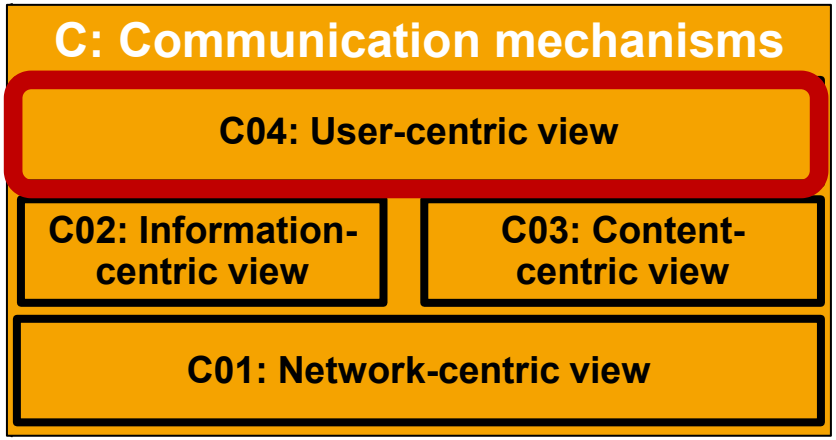
Adaptive video codecs essential to enable adaptation

- At the receiver (and sender) → adapt to dynamics
- In the network → react to congestions and bottlenecks
- Objective QoE considerations (receiver) → consider impact of adaptation



C04: User-centric view – Flash crowds as a cause for network transitions






W. Effelsberg


M. Löw


T. Strufe

C04: Motivation and Goals

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Motivation:

- User concentrations lead to increased requirements for communication networks
- Automatic and network supported recognition and explanation of concentrations
- Identification of flash crowds as an example for urban concentrations

Goal: Explanation, prediction and technical realisation

- Analytical concatenation of the real space and the cyberspace
- Analytical concatenation of the social and the technicality
- Investigation and modelling of user motivation, user groups and user routines

C04: Approach

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Trend analysis and interpretation of messages in social news networks

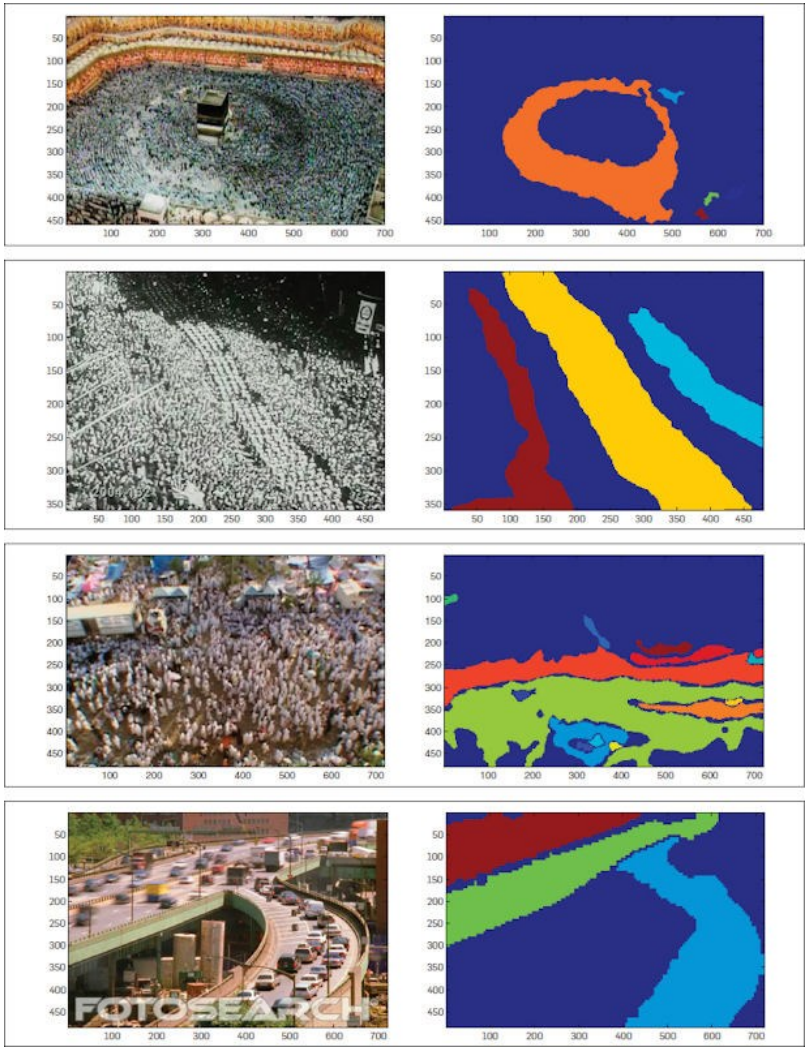
- Collection of aggregated social media news
- Trend analysis to detect hot spots

Analysis of the motivation and dynamic of flash mobs

- Participating observation of flash crowds
- Interviews with participants in Stuttgart and Leipzig

Video analysis of flash crowds in two cities

- Recording with several cameras
- Automatic content analyis of flash crowds



Project area C: Communication mechanisms

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A. Buchmann


K. Nahrstedt


R. Steinmetz

C: Communication mechanisms

C04: User-centric view

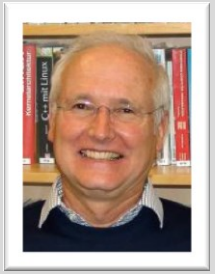
C02: Information-centric view

C03: Content-centric view

C01: Network-centric view


A. Klein


M. Hollick


W. Effelsberg


R. Steinmetz


M. Löw


W. Effelsberg


T. Strufe

7 Transition: Basic Research Questions

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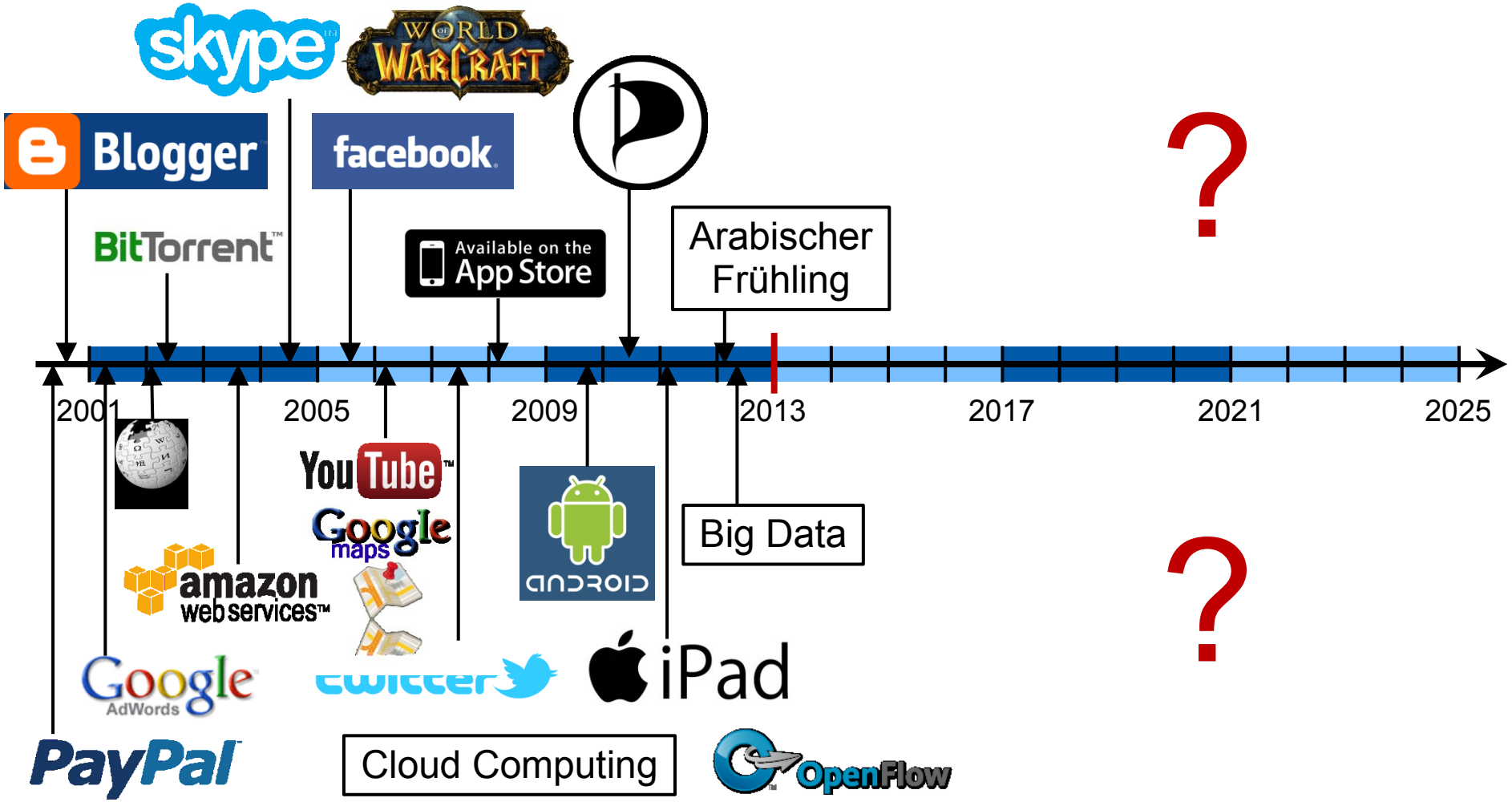
- How can T.-related monitoring be done cross-layer?
- How should a T. happen?
- Where is it efficient to perform a T.?
- Who decides in a distributed environment?
- When does it pay off to make a T.?
- How can a T. be forced?
- How high are the costs of a T.?
- What is the status information of a T.?

- How can T.-approaches be generalized?
- How to avoid loss of state information due to a T.?

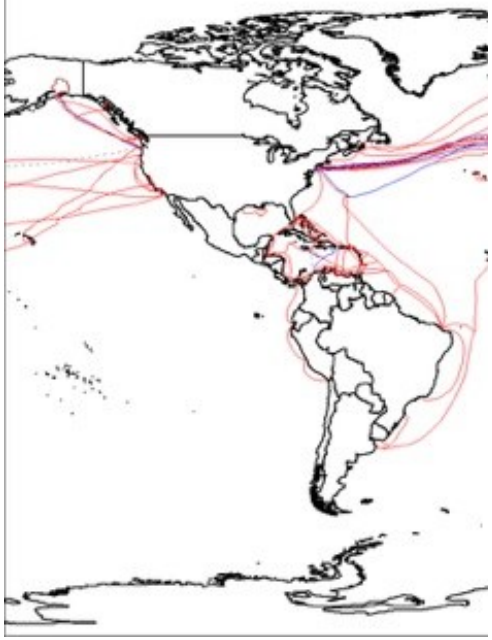
- Why is a mechanism more suitable for a T. under a certain environmental conditions?
- What are the interdependencies between different multi-mechanisms?
- How can a T. be done cross-layer? How local and how distributed?
- How is a high quality possible? Through which T.? Under which environmental conditions?
- How long should a T. last? And why?

- How should a T.-capable system idealy look like?
- How can one reduce the complexity of a T.?
- How can modeling of topologies und local optimization during a T. be performed?

8 The Impact of the Future Internet



Usage of the Internet



Example: Network Impact of the iPhone Evolution

Network Load changes due to End-Device Evolution

iPhone 4/iOS 5

- 50% increase in signaling over iPhone 4/iOS 4 due to iCloud, iMessage, SIRI

iOS 6 OTA Update

- 10-35% updated their iPhone OTA
- 25% more iPhones used the network on that day

iPhone 5

- iPhone5 performs 27-58% faster on 3G UMTS than iPhone4
- iPhone5 performs 14% faster on 2G GPRS than iPhone4

iOS 6 on iPhone 4/4S

- Delivers 24-33% increase in performance over iOS5 on UMTS networks

Slide 4 - Markus Hofmann

Bell Labs

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MAKI – Multi-Mechanism Adaptation for the future Internet

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Constant Change…

„The principle … rvive indefinitely. „

From **Heterogeneity** and **regular Change** as a **Problem**...

RFC 1958: Architectural Principles of the Internet

Goal: Research of

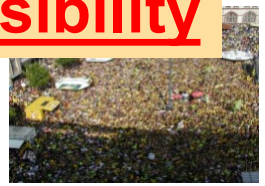
- New construction methods, m… rithms
- to enable automated, coordina… layer Transitions between mechanisms with similar functions

MAKI

... to **Multi-Mechanism Adaptation** through **continuous Transitions** as **Solution Possibility**








Questions & Contact

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Multimedia Communications Lab - KOM

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