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Applied Sciences

Internet Research, Education and Collaboration

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Prof. Dr. Rolf Winter
Networks Group - HSANet
net.hs-augsburg.de

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The city of Augsburg

In the heart of Europe. Next door to Munich.

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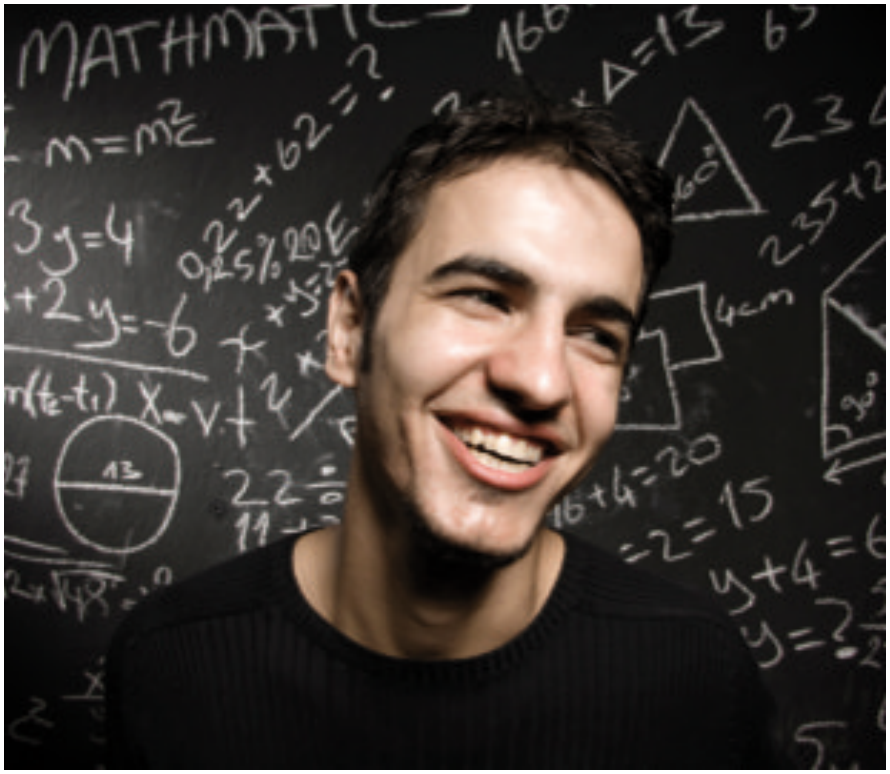
5.800 students …

… from 65 nations!



150 professors • 300 lecturers • 290 academic support staff

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A wide variety of choice …

7 faculties • 15 bachelor programs
• 17 master programs • 4 part-time programs

Our faculties …

- Architecture and Civil Engineering
- Business
- Computer Science
- Design
- Electrical Engineering
- Liberal Arts and Sciences
- Mechanical and Process Engineering

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Resource Efficiency

Our mutual interdisciplinary research focus in the fields of:

- Mechatronic
- Environmental technology
- Composite engineering
- Production and logistics
- Financial System
- Energy efficiency design
- Human machine interface
- Interactive media systems
- …

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INTERNET RESEARCH

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Internet Research

HSANet – University of Applied Sciences Networks Group
net.hs-augsburg.de

Our main research activities …

- Collaborative Research Projects (with academics and industry – public funding)
- Contracted Research (with industry)
- Student projects (e.g. SNMP – the Student Network Management Project)
- Software development (e.g. GLIMPSE – more later)
- Internet protocol standardization

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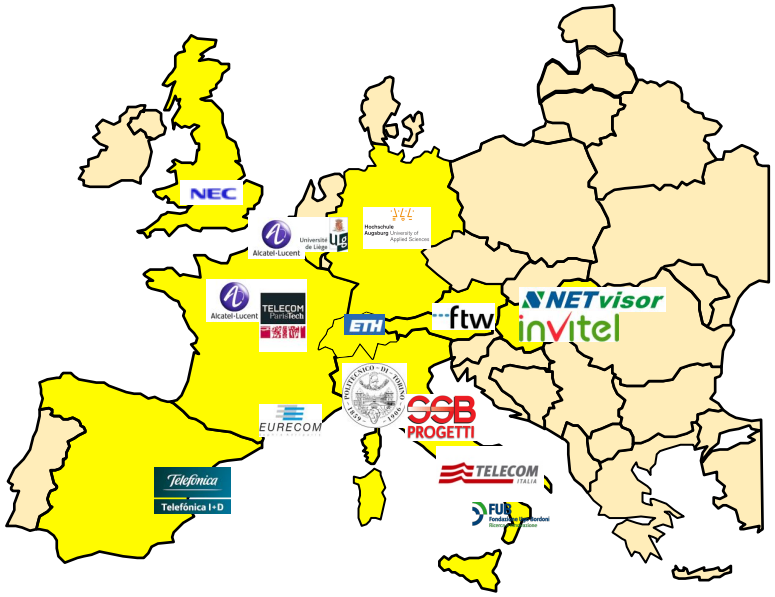
Collaborative Research Project - Example

EU Project mPlane



Project fact sheet ...

- Researching an Internet-scale, distributed measurement plane
- 16 European partners (academia and industry)
- 36 month duration (start date: Nov. 2012)
- Focus at HSANet: development of an end-host-based measurement infrastructure called GLIMPSE (GLobal Internet Measurement and Probing SystEm)

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EU Project mPlane

The Problem

*"The Internet is the first thing that humanity has built that humanity doesn't **understand**, the largest experiment in **anarchy** that we have ever had."*

Eric Schmidt – ex Google Exec. Chairman

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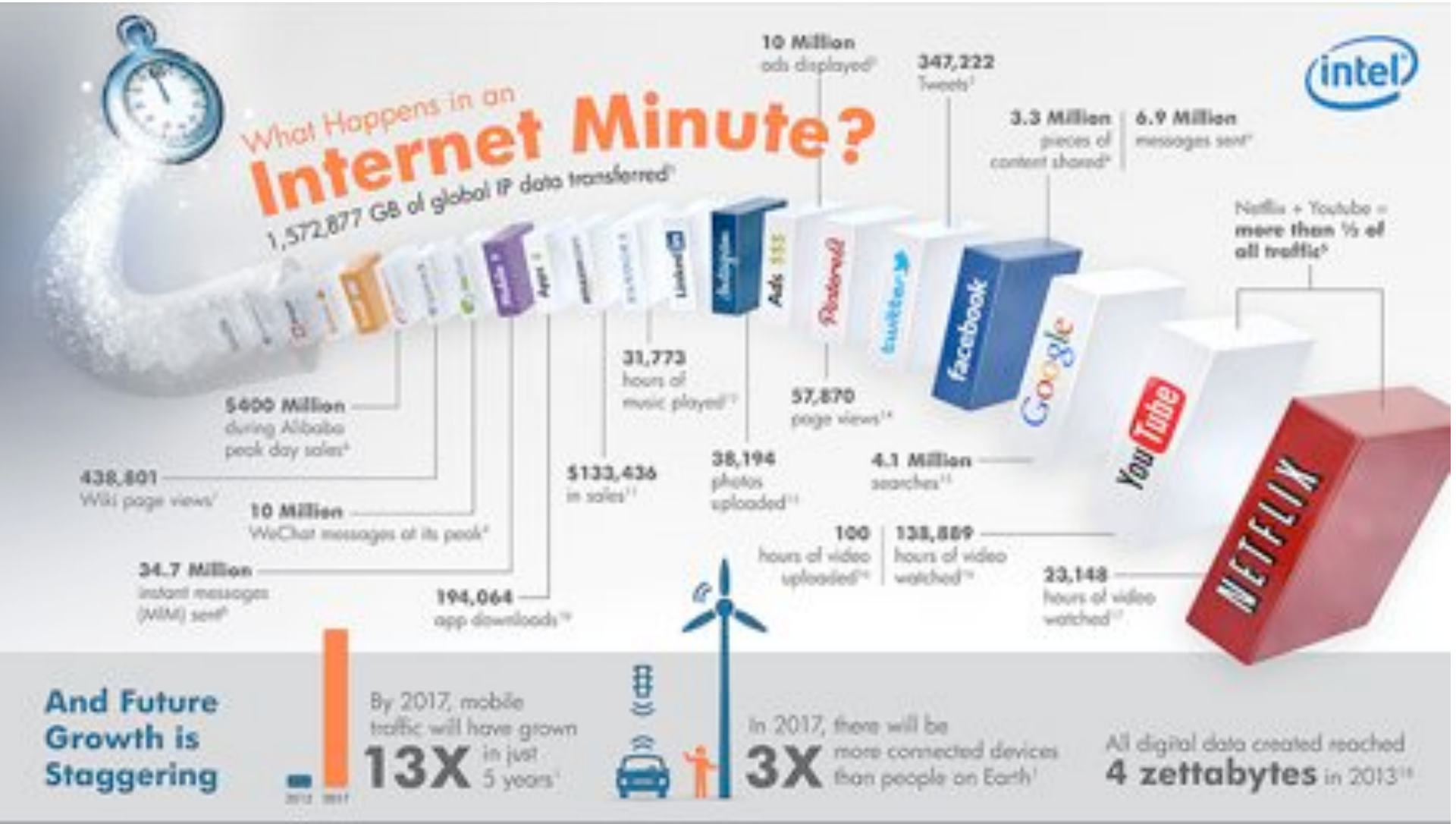
EU Project mPlane

Another view of the „problem“



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Network management (across administrative boundaries)

- Identifying network problems timely is challenging in complex networks
- Tool support often rudimentary at best, in particular across administrative boundaries
- Imagine the following situation: A customer tells you YouTube access is slow or Skype is not working properly. Who to blame? Where to look for the problem? (end host, home gateway, access provider, transit provider, CDN, server...)
- Even network professionals resort to crude tools such as http://www.downforeveryoneorjustme.com/

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The Internet is ...

(amongst other things)

- A critical infrastructure (business communication, eCommerce, social interaction...)
- Complex, ill understood and brittle in places
- Growing fast in all dimensions (topology, end hosts, SW complexity, bandwidth requirements, technologies used etc.)

- How to manage all this? mPlane

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A Measurement Plane is useful for ...

(amongst other things)

- Better network management
  - E.g. troubleshooting
- Network evolution
  - E.g. network planning
- Verification of Service Level Agreements
  - Customers want proof of network performance
- Regulatory agencies
  - Monitoring of network quality and related issues (e.g. net neutrality)

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HSANet work in mPlane

GLIMPSE (GLobal Internet Measurement and Probing SystEm)

- An end-host based measurement system
  - For users: an App really
- Runs on popular platforms (Android, Windows, Mac OS, Linux and others)
- Implements common measurement „methods“ (no root privileges)
  - Ping
  - Traceroute
  - Speedtest
  - ...
- The collection of users form a measurement community
  - Like „SETI@Home“ but for network analysis where users donate bandwidth instead of CPU time
  - Iterative analysis of network problems

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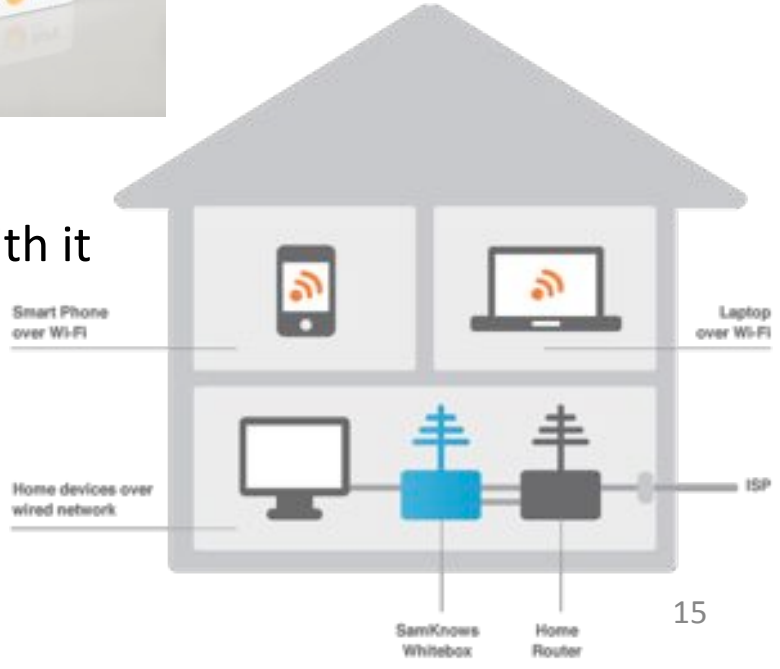
Not a revolutionary new goal

But unique in design and capabilities

- Broadband America (FCC)
- SamKnows (EU, Broadband America, Brasilien)
- Atlas (RIPE NCC)
- Initiative Netzqualität (BNetzA)
- Netalyzr (UC Berkeley)
- Speedtest.net
- ...

- Standards Developing Organizations deal with it
  - IETF LMAP WG
  - BBF (TR-69)



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Why an App

Why another app really

- Because SW is easier to maintain and update than HW
- Real end-to-end measurements possible
- Trivial collection of relevant meta data (e.g. via UPnP)
- App market machinery can be utilized (notifications about updates e.g.)
- Because sometimes user feedback is important (e.g. only Skype has problems)
- Because apps are everywhere (market penetration)
- Because apps have less ristrictions compared to e.g. browser plug-ins

App Store

Google play

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An app also comes with a lot of problems

- End-systems often connected wirelessly
- NAT
- User behaviour
- Privacy
- CPU, I/O etc.
- DDoS
- …

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The probably biggest challenge is ...

- Motivating people to actually install the app
  - We hope for altruism and general interest (e.g. SETI@home)
    - Statistics about all and individual measurements are made public
  - For experts: the app offers all measurement methods to be used manually, results are displayed instantly
  - For non-experts: the app can be used to help troubleshoot network problems with the click of a single button


glimpse.
Home
History
Available Up
Open as win
Settings
Help
Change pas
Logout
Quit
Notifications

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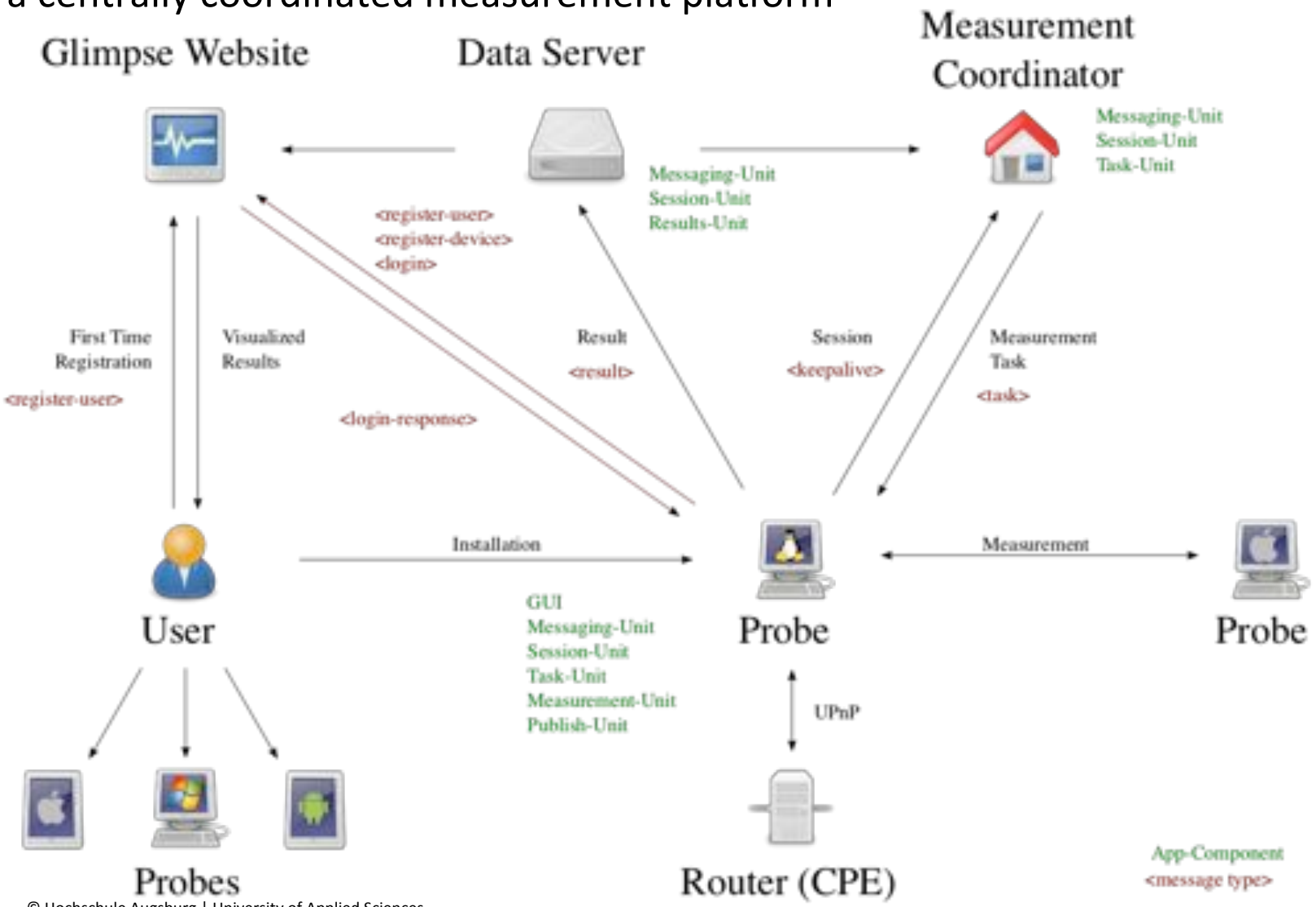
GLIMPSE is really more than an app

It is a centrally coordinated measurement platform



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And this is GLIMPSE, too

The people behind GLIMPSE

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You can be part of GLIMPSE, too

We will (hopefully) soon go public (beta)

- Download the app and donate bandwidth
- We also have a command line version (also runs on ARM platforms – Raspberry Pi, BeagleBone Black etc.)
- Tell your friends about GLIMPSE via social media

- But wait a little bit ... we‘re not quite there yet

  www.measure-it.net

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Resource Efficiency

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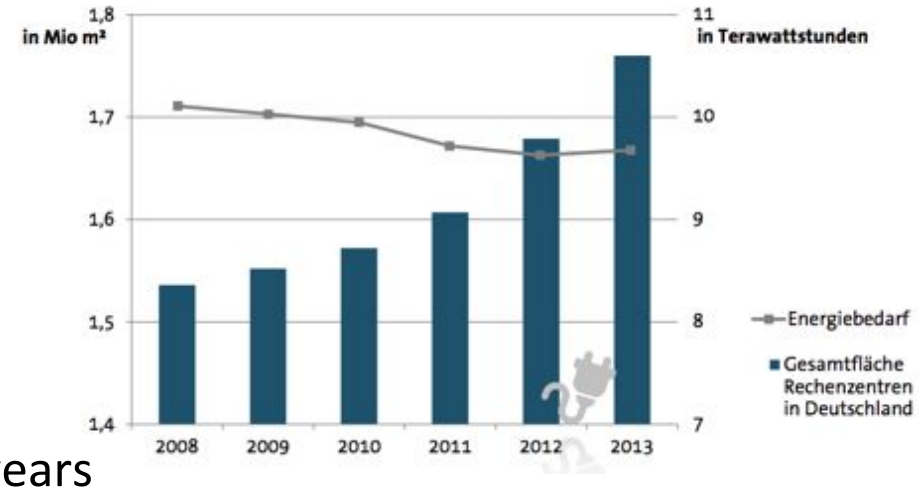
Resource Efficiency

Our (the whole university) research focus area

- Resource Efficiency is also a networking/IT management topic (but not a new on)
- Google
  - Google continuously lowers the Power Usage Effectiveness (PUE): the ratio between the total power consumption and the total power consumption for IT equipment (currently at 1.12)
- Ebay:
  - Within 4 years, they have halved the power consumption while doubling the computational power
- German Government:
  - "Initiative Green-IT", 48% energy savings in the IT-sector within 5 years



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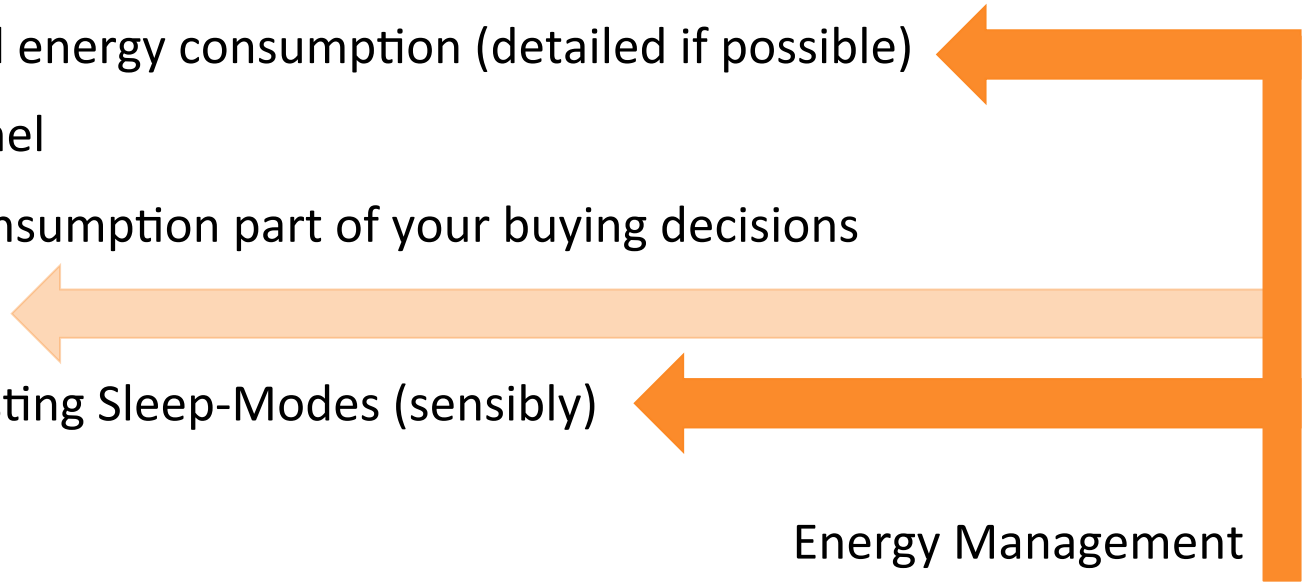
Thinks that can be done

Examples

- Meter the actual energy consumption (detailed if possible)
- Educate personnel
- Make energy consumption part of your buying decisions
- IT-Virtualization
- Make use of existing Sleep-Modes (sensibly)
- …



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Metering the actual energy consupmtion

(Some of) The problems

- Many proprietary (often quite expensive) solutions (EnergyWise et al.)
- Often missing metering infrastructure (including a data interface and network connection)
- Often no real interest in the topic (that goes beyond damnation of politics and energy industry)
- ...

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We need a standard (Internet) protocol

IETF Energy MANagement Working Group (EMAN)

- Energy Management with a standard SNMP (Simple Network Management Protocol) Management Information Base (MIB)
- IETF RFC 6988 - Requirements for Energy Management
  - Soon more standards available
- First implementations known
- Not just monitoring but also control (sleep modes)
- Universally useful (not *just* for IT)
- Done for a large Japanese electronics company

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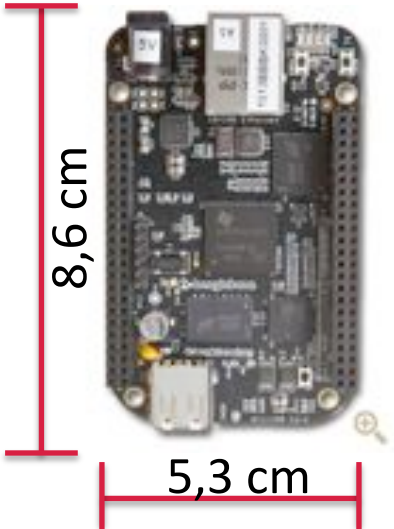
HSANet energy management project

An energy metering system

- A sensor reading logging and analysis system
  - Sensor readings are energy meter readings but also things like CO2-concentration of the air, humidity, temperature etc.
- The system mainly consists of
  - A web interface for the operator
  - A HW/SW-platform for the actual logging and transmission (COTS)
  - A backend system for data storage and analysis



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INDUSTRIAL NETWORKED SYSTEMS

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Industry 4.0 (smart factories)

The next industrial revolution

- We had a number of industrial revolutions already
  - Steam engine, conveyor belt/assembly lines, automation
- All pushed towards mass productions (economies of scale)
- The 4th industrial revolution is about producing individual goods at cost and rate of mass production today
- Requires (amongst other things) coordination (networking)

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The SINeLab

Secure Industrial Networked Systems

- A laboratory where multiple professors collaborate in the general area of “Industry 4.0” (Computer Science, Electrical Engineering, Mechanical Engineering)

IT Security
Prof. Gordon T. Rohrmair

Data Networks
Prof. Rolf Winter

Wireless
Prof. Alexander v. Bodisco

Safety
Prof. Wolfgang Zeller

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Examplary SINeLab activities – hacking industrial systems

Credits go to Prof. Rohrmair

- Step 1: finding targets

- Search engine reveals relevant target systems
- Targeted search for vulnerabilities allows even automatic attacks

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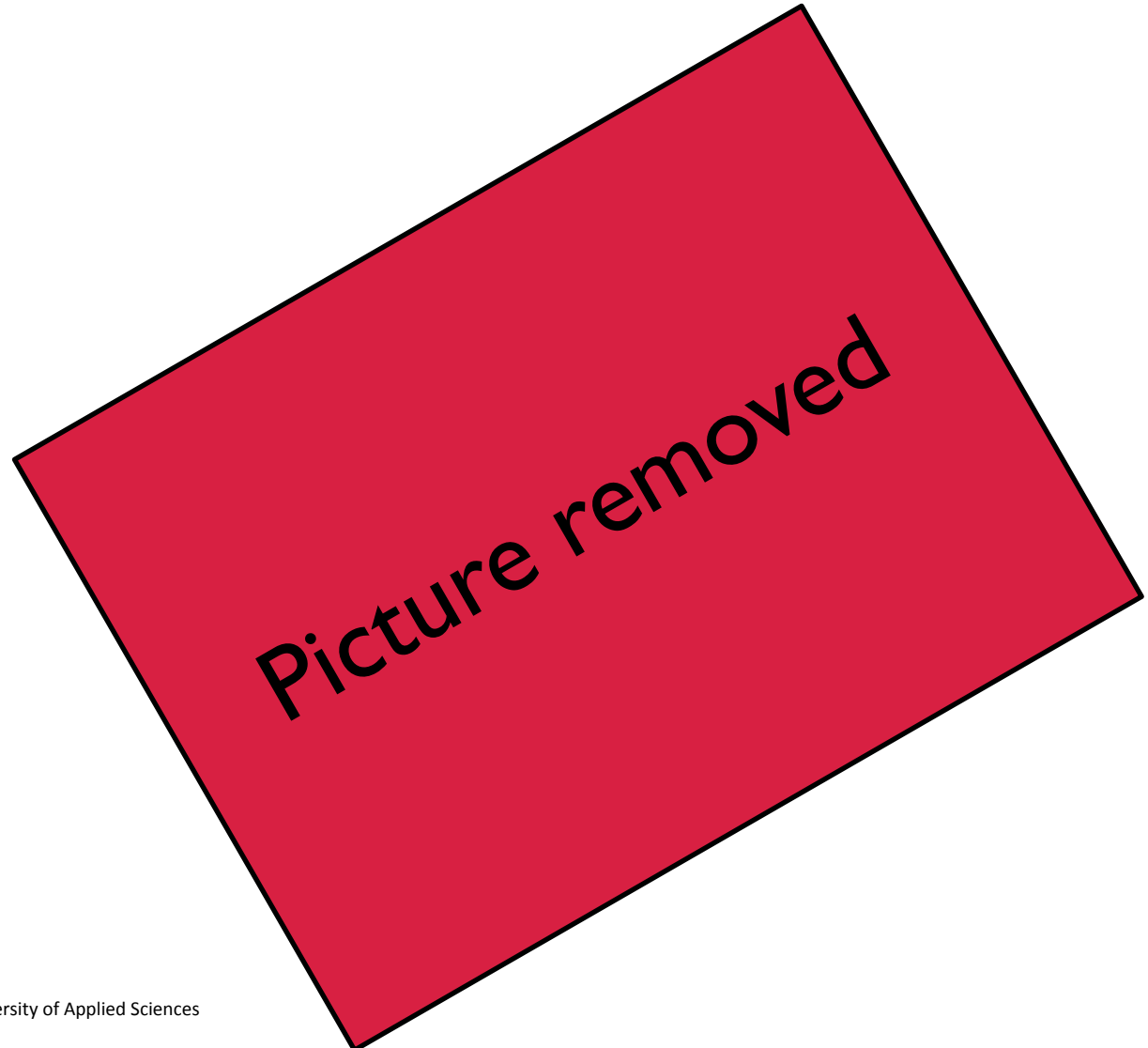
Control System of a funicular in France

scary



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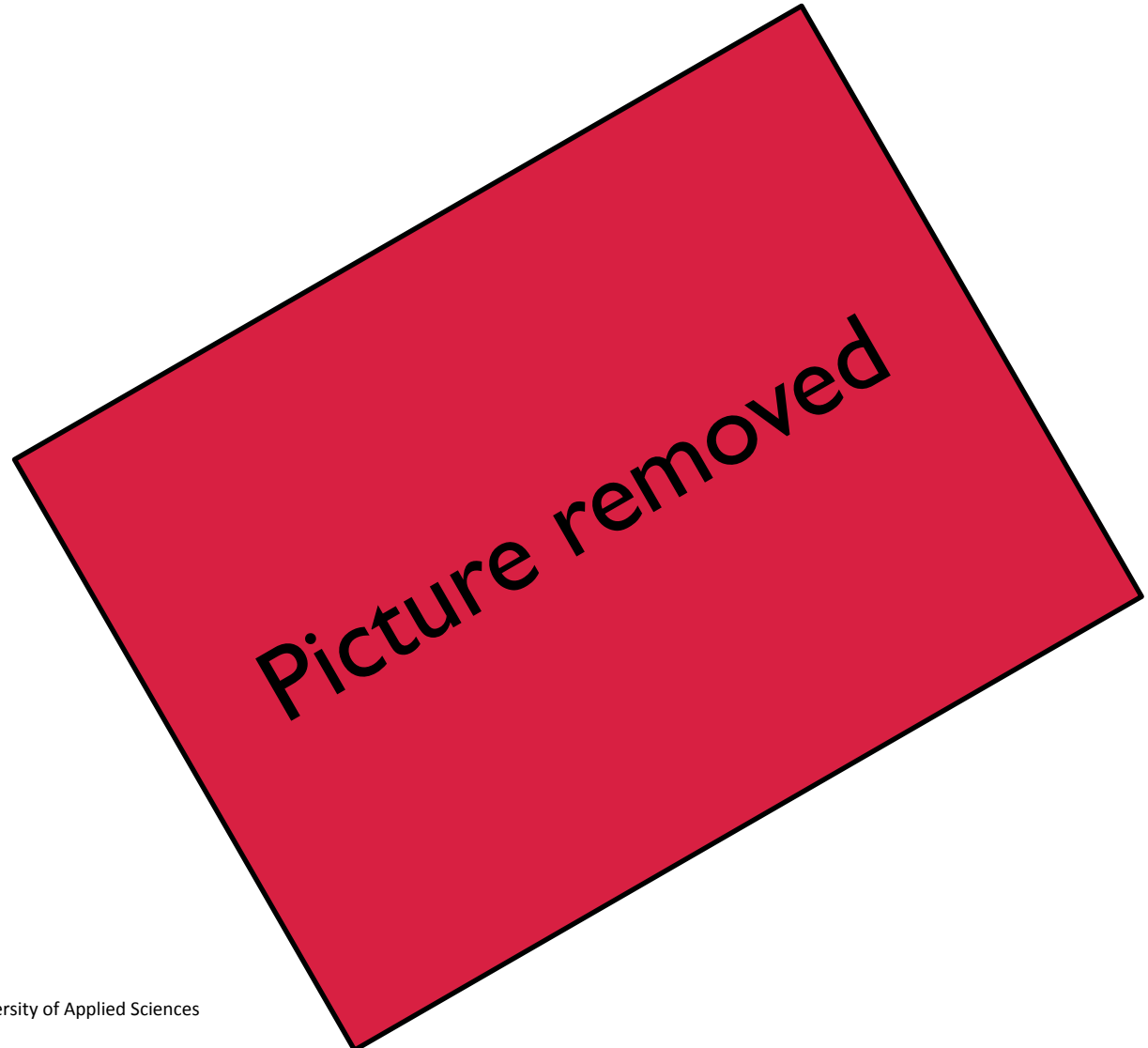
Control System of a gas tank depot

Really, really scary



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CLOSING WORDS ON COLLABORATION

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Research Collaboration

Doing research together

- The mPlane project has a concept called “Collaborating Institutions”
  - External institutions can participate in the project - project results are shared and you can come to project meetings
  - No responsibilities in terms of delivering results - but also no funding
- Funded research collaboration (e.g. EU-Japan collaboration)
  - Example project: „GreenICN“
  - KDDI, NEC, Panasonic, Tokyo University, Waseda University, Osaka University + European partners
- Individual collaboration
  - DAAD - German Academic Exchange Service (www.daad.de)
    - Scholarships for students, professors and everything in between
    - Travel grants, living expenses etc.
  - JSPS - Japan Society for the Promotion of Science
  - …

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The HSA International Office (IO)

Helping you with your stay in Germany

- The IO is a small team of people that help you with organizational aspects before you come to Germany ...
  - E.g. finding an appartment, paperwork, identifying a suitable scholarship
- ... while you are in Germany
  - E.g. with a bank account, doctors appointment
- ... after your stay in Germany
  - E.g. receiving certification of courses etc.

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