

Peer-to-Peer Services

Dienste auf Basis neuartiger Peer-to-Peer Technologien

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<http://www.google.com/search?hl=com&q=Ralf+Steinmetz>

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1 Motivation

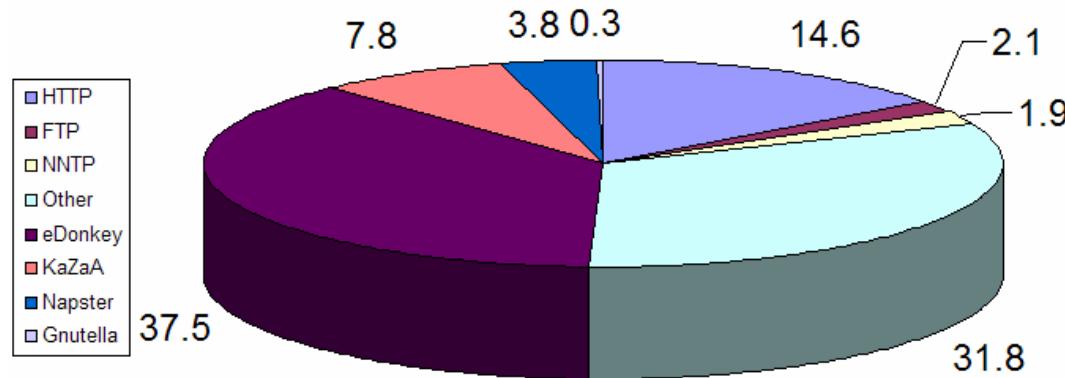




Motivation

Largest Amount of Traffic in Internet: P2P Filesharing

- See e.g. N.B. Azzouna & F. Guillemin: “Analysis of ADSL traffic on an IP backbone link”, IEEE Globecom 2003



- Sum P2P: 49.6% + large part of “Other” (31.8%)

However, Peer-to-Peer is much more than Filesharing:

- P2P based voice over IP (VoIP)
 - Ebay pays \$4 billion for P2P VoIP Provider Skype
- Microsoft...
 - bought P2P Groupware Groove
 - uses P2P technology Avalanche to distribute patches in future OS
- DFG is financing Peer-to-Peer projects as fundamental research

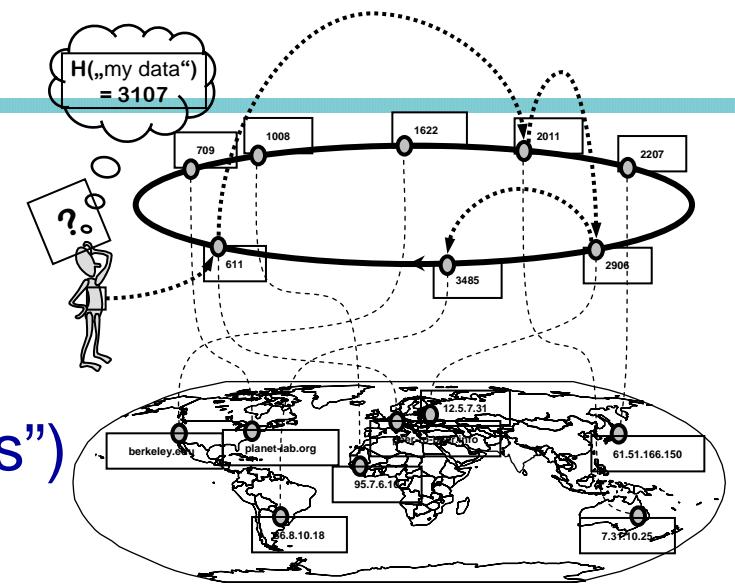


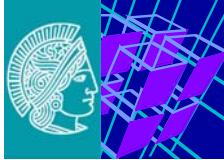
1.1 What is Peer-to-Peer?

Science

9 Characteristics of
P2P Systems:

- Relevant resources located at nodes at the edges (“peers”)
- Peers share resources
- Resource locations
 - widely distributed
 - most often largely replicated
- Variable connectivity is the norm
- Combined Client and Server functionality
- Direct interaction (data transfer) between peers (no central control)
- Peers with significant autonomy and mostly having similar rights
- No central control or centralized usage of a service
- Self organizing system (ad-hoc like)





1.2 Example: Filesharing

P2P Filesharing Applications



- Mostly illegal (copyright protected) content
- Zero costs for users, therefore low quality expectancy
- Increasing amount of law suites against users
- NOT the future of peer-to-peer



1.3 Example: P2P based VoIP

Skype Services

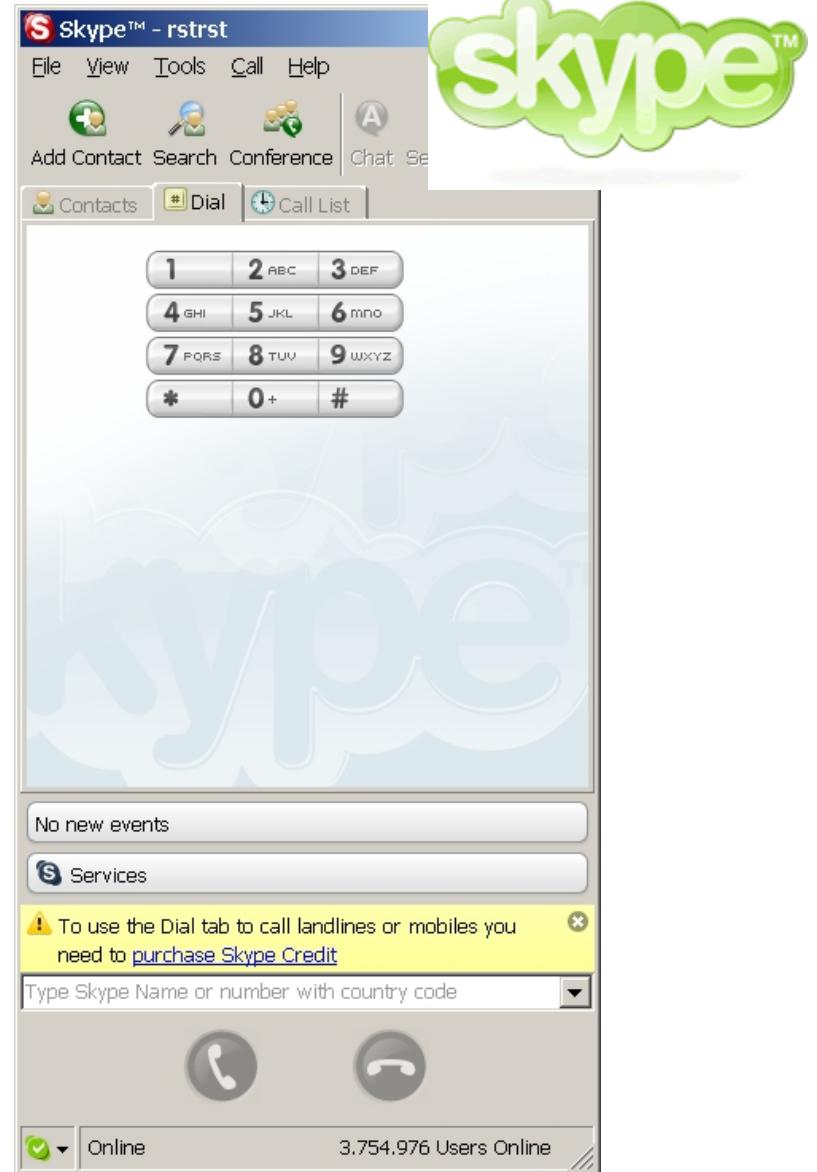
- IP Telephony
- Video conferencing
- File sharing
- Instant messaging

Skype Features

- KaZaA P2P technology
- High media quality
- Encrypted media delivery
- Multi-platform

Further Information

- Extremely popular
 - often >4 million users online,
>250 million downloads
- Bought by Ebay for \$4 billion
- Only authentication centralized
 - control remains with Skype company
- Other infrastructure completely decentralized (P2P)
 - huge cost savings



see www.skype.com



1.4 Example: P2P Groupware

"Groove virtual office is software that allows teams of people to work together over a network as if they were in the same physical location."

Groove allows to

- share files
- share calendar
- hold meetings
- chat
- ...

Groove....

- does not require any central server installation (just clients)
- automatically synchronises data between different machines (even through firewalls)
- was bought by Microsoft, will be integrated in future Office versions.

see groove.net

The screenshot shows the Groove interface. At the top, there's a menu bar with File, Edit, View, Options, Help, and a Workspaces dropdown. Below the menu is a toolbar with icons for Add Files..., Save Files..., Start Co-Edit, and Download. The main area has two panes: a left pane labeled 'Folders' showing a tree view of 'Dateien (Root Folder)', 'Bewerbungen', 'Experiment - Sandra, Oli', 'Forschergruppe', 'P2P Forschungslandschaft', and 'VD_thesis'; and a right pane labeled 'Dateien' showing a list of files with columns for Name, Size, Type, Modified Date, and Modified By. The files listed are: 'Stellenausschreibung_P2Pa' (6KB, Microsoft Word-Dokument), 'stellenausschreibung_EFL-1' (11KB, Microsoft Word-Dokument), 'Stellenausschreibung_P2Pa' (61KB, Adobe Acrobat Document), 'Stellenausschreibung_P2Pb' (63KB, Adobe Acrobat Document), and 'Stellenausschreibung_P2Pb' (6KB, Microsoft Word-Dokument). The bottom part of the interface displays a research project listing:

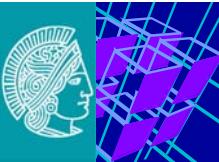
Department of Computer Science is looking for a

**Research Assistant (Wissenschaftlicher Mitarbeiter)
in the area of
peer-to-peer and overlay networks**

The candidate will undertake research within a national research project on peer-to-peer and overlay networks. The candidate is supposed to work simultaneously towards a Dr.-Ing. (Ph.D.). The goal is to research and implement peer-to-peer technology, new potential applications for peer-to-peer networks, and scalable methods for analysing peer-to-peer mechanisms.

Project Tasks:
Contribute to a national research project on peer-to-peer computing, the tasks to be carried out include but are not limited to:

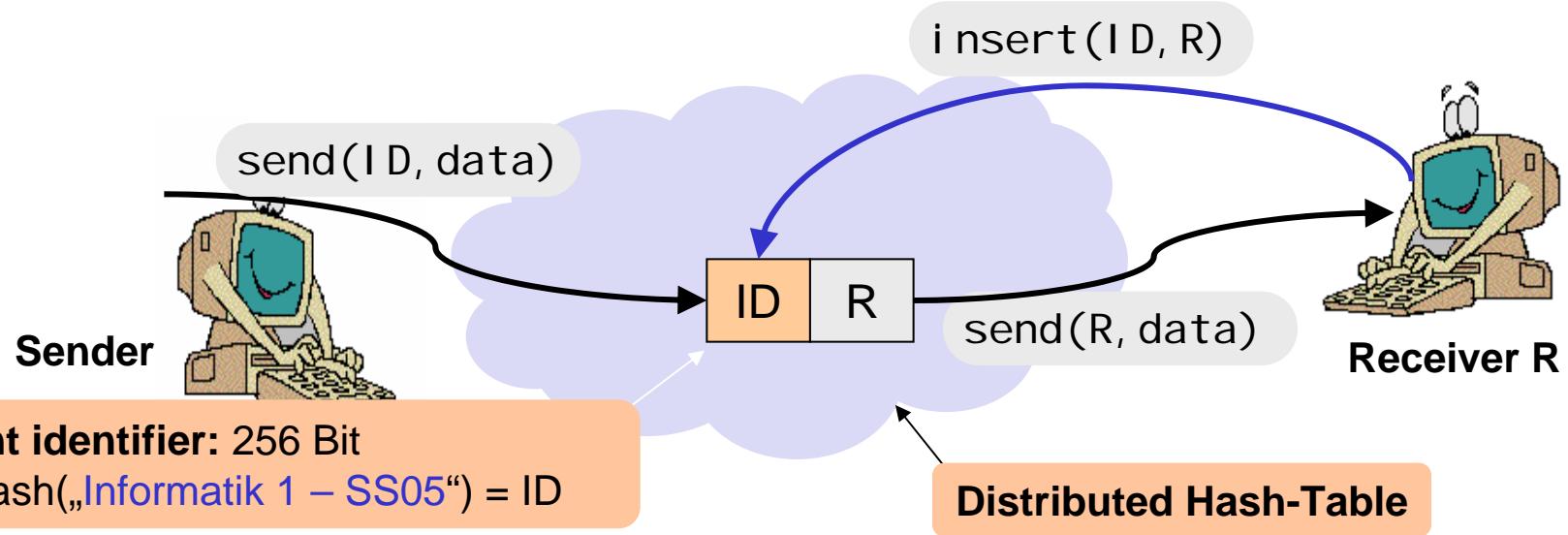
- Develop new peer-to-peer protocols
- Develop new overlay network management algorithms
- Simulation of large peer-to-peer resp. overlay networks to further analyse the developed mechanisms/protocols
- Simulation tools were developed at KOM; further development of these mechanisms is part of this job

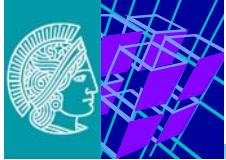


1.5 Example: Perspective - Internet Indirection Infrastructure (i3)

Internet Indirection Infrastructure (i3) /Stoica-Wehrle

- Content-oriented communication with indirection
- Data / Service addressed with 256-bit identifier (ID)
- Receiver „subscribes“ data/service with trigger (ID, R)
- Sender sends data to ID – Forwarding to receiver R





2 Research Challenges

Peer-to-Peer is

- based on a new communications paradigm
- with tremendous impact on business

→ raises many research challenges

2.1 Research Challenges: Self-Organization

2.2 Research Challenges: Quality



P2P Research in Germany





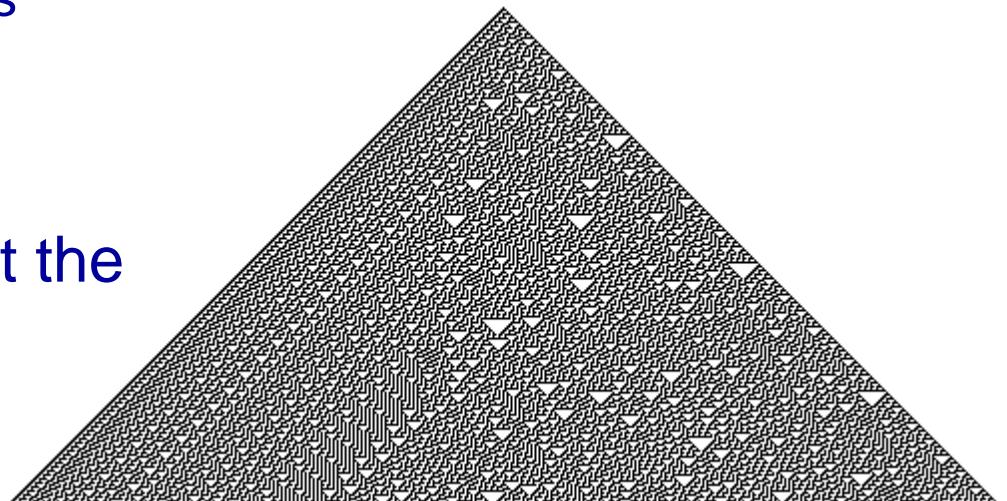
2.1 Research Challenges: Self-Organization

Self-Organization (generally)...

- refers to a process in which the internal organization of a system improves automatically without being guided or managed by an outside source
(see e.g. wikipedia.org)

Self-Organization

- is well known from chemistry, physics, biology etc
- is in contrast to:
 - Centralized systems
 - Blueprints
 - Recipes
 - Templates
- keeps complexity at the component level much lower



Cellular automaton here running Stephen Wolfram's "rule 30", a mathematical construct displaying self-organization (from wikipedia.org)



Research Challenges: Self-Organization

Status:

Many systems (e.g. networks or servers) are

- extremely complex and
- difficult/expensive to administrate

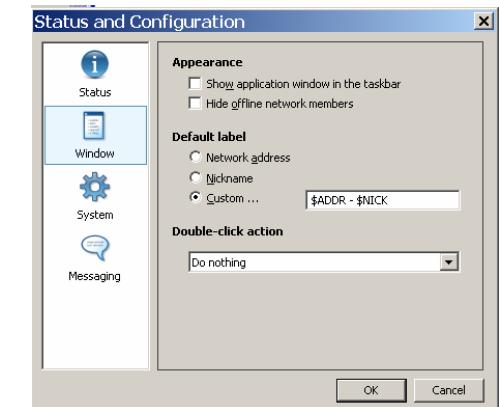
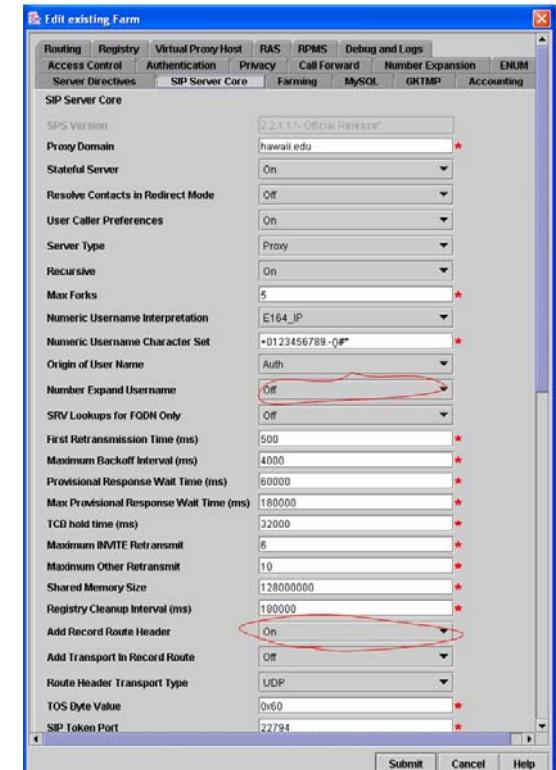
Next Generation:

Self-organizing systems promise to be

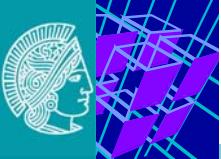
- less complex
- need less or even zero administration
- probably cheaper
- could become self-healing
- ...

→ P2P systems are self-organizing

Application areas: e.g. network management

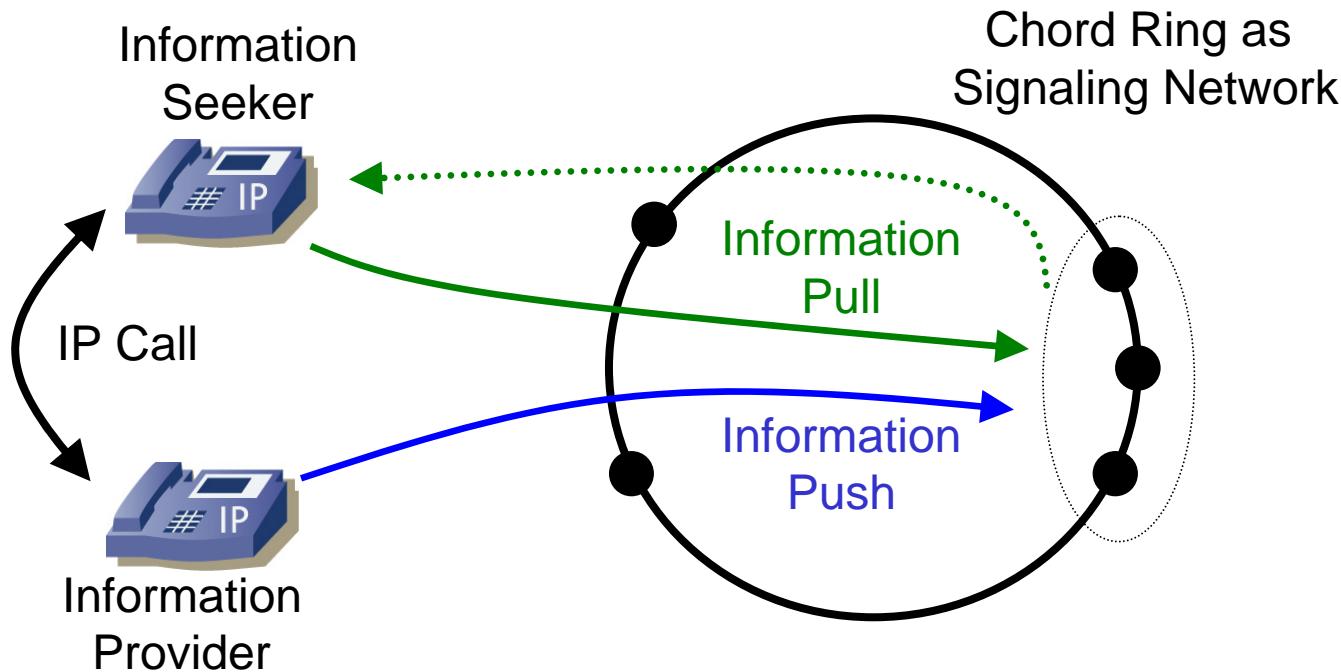


Pictures from mit.edu/sip and hamachi.cc

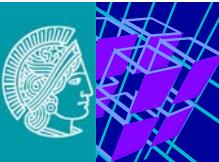


2.2

Research Challenges Quality: E.g. P2P Voice-over-IP Signaling using Chord



Information: e.g.
nick-name & current IP-address
&
user profile



Mean Search Delay

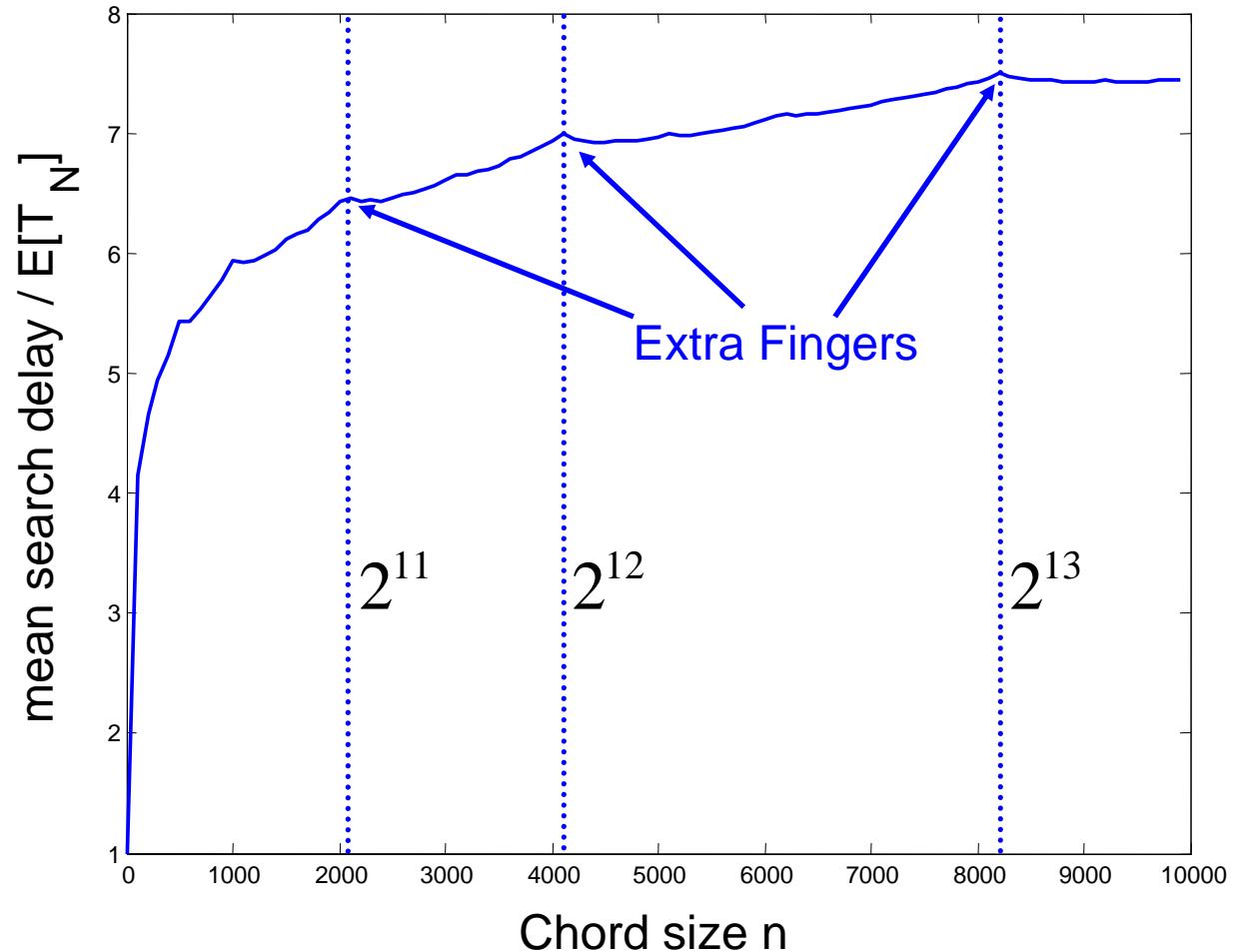
$$T_N = T_A$$

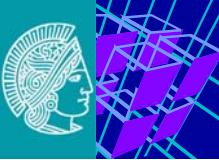
T_N : negative-binomially distributed

Two moments of the network delay:

$$c_{T_N} = 1$$

$$E[T_N] = 50 \text{ ms}$$





2.3 Research Challenges: Quality

P2P for „serious“ or even business critical applications

- requires minimum quality of service

Example:

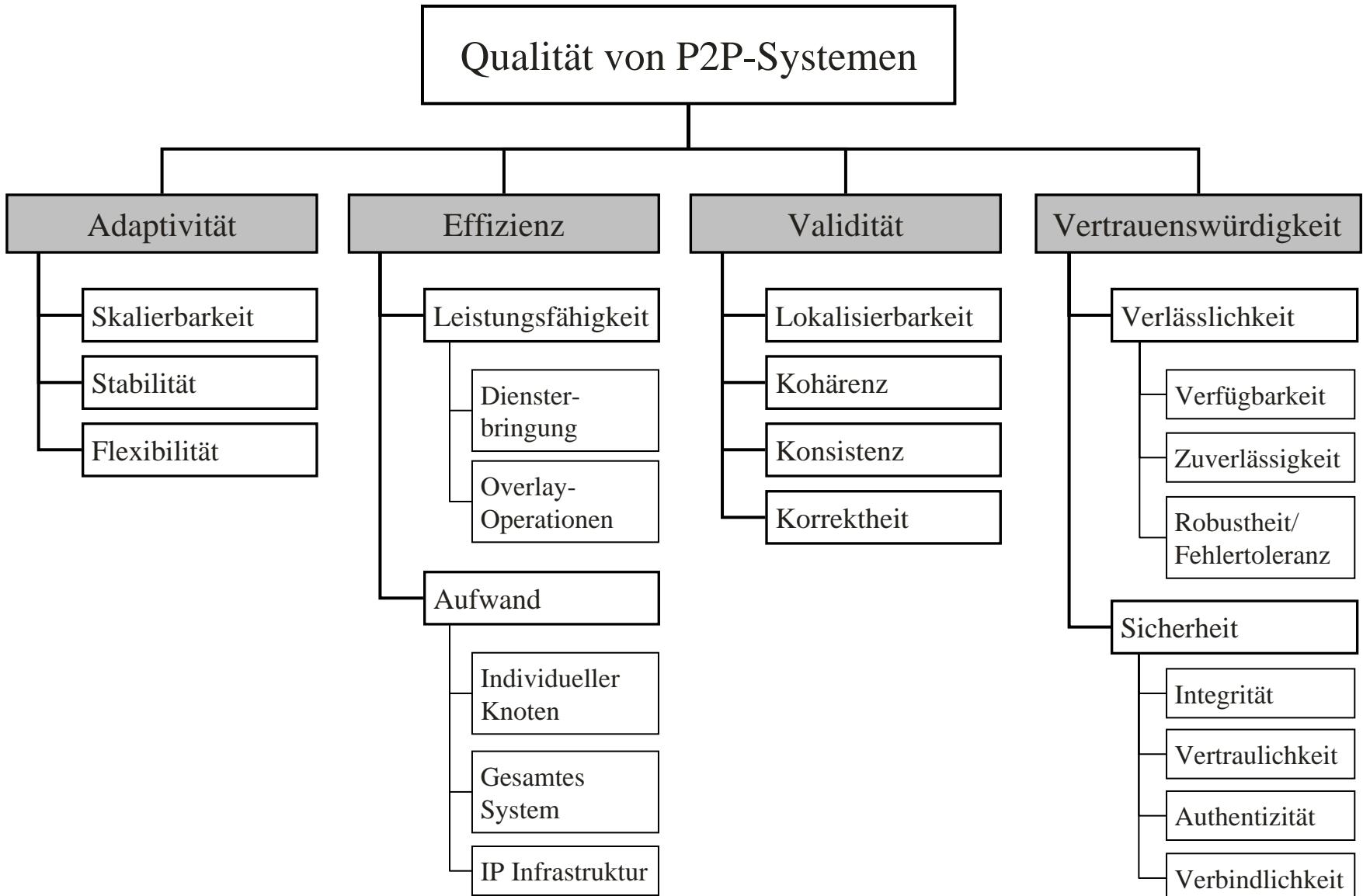
- Assume a search in an P2P network yields no results
- Does this guarantee that the searched file or service is not available?
 - Today:
 - search mechanisms are fast but, typically not reliable
 - In future P2P networks:
 - search mechanisms become more reliable, consistent, correct

different quality aspects depend on each other researched

- How can the quality be improved?
- How can the trade-off between different quality aspects (e.g. reliability and efficiency) be quantified?
- How shall the trade-off be resolved?



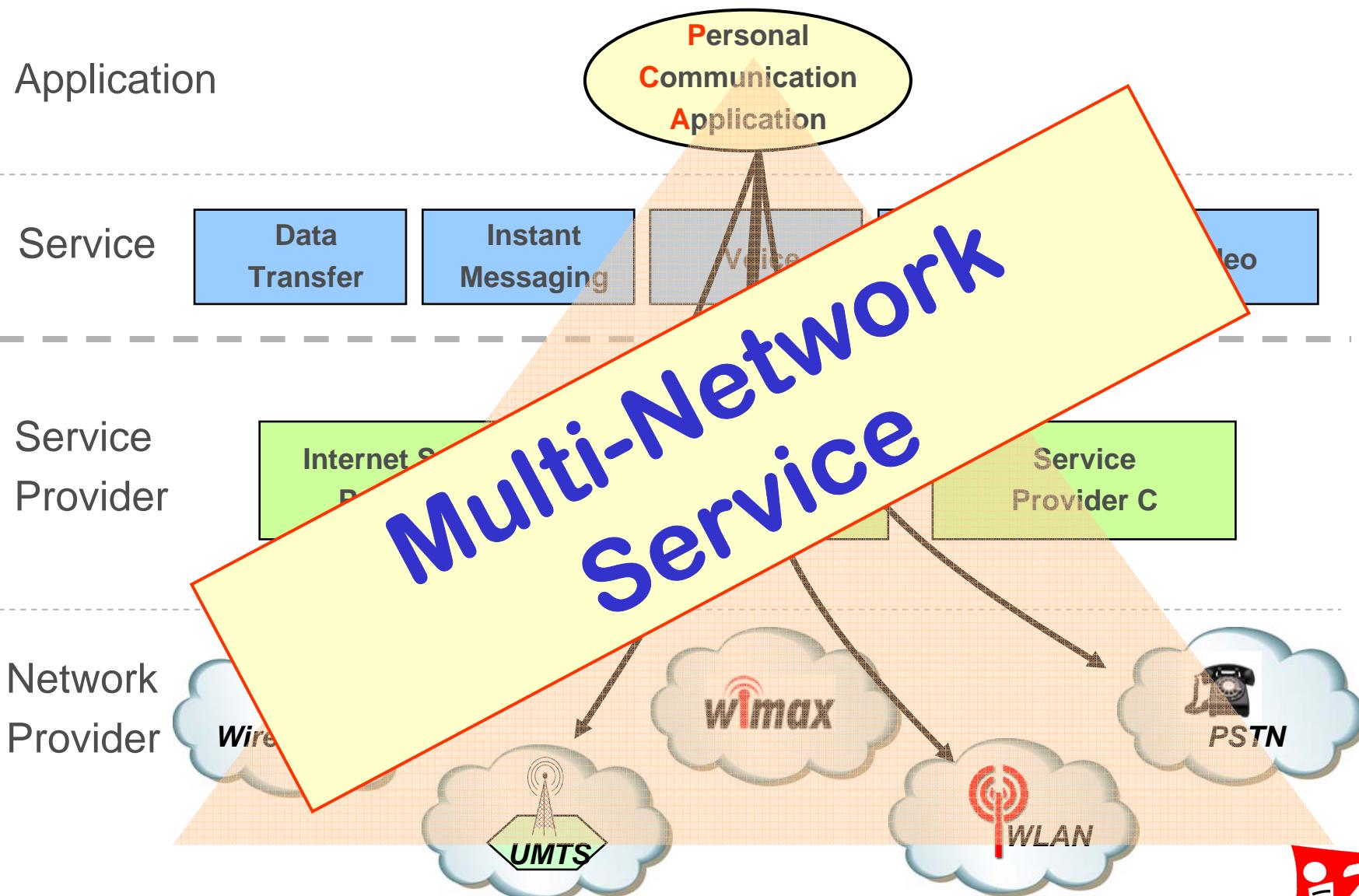
Research Challenges: Quality Properties (German)





3

Selected Hot Topics: towards Application-centric - Multi-Network Service





3.1 P2P Communication System for Catastrophes

Consider the 2004/5 Tsunami or Hurricane Katrina

- Central infrastructure is damaged or destroyed
- Many different organizations become involved ad-hoc
- Network topologies can change rapidly, nodes can go on- and offline all the time

→ exactly situation in which P2P applications are needed

- P2P system Groove
 - used for collaboration after the Tsunami

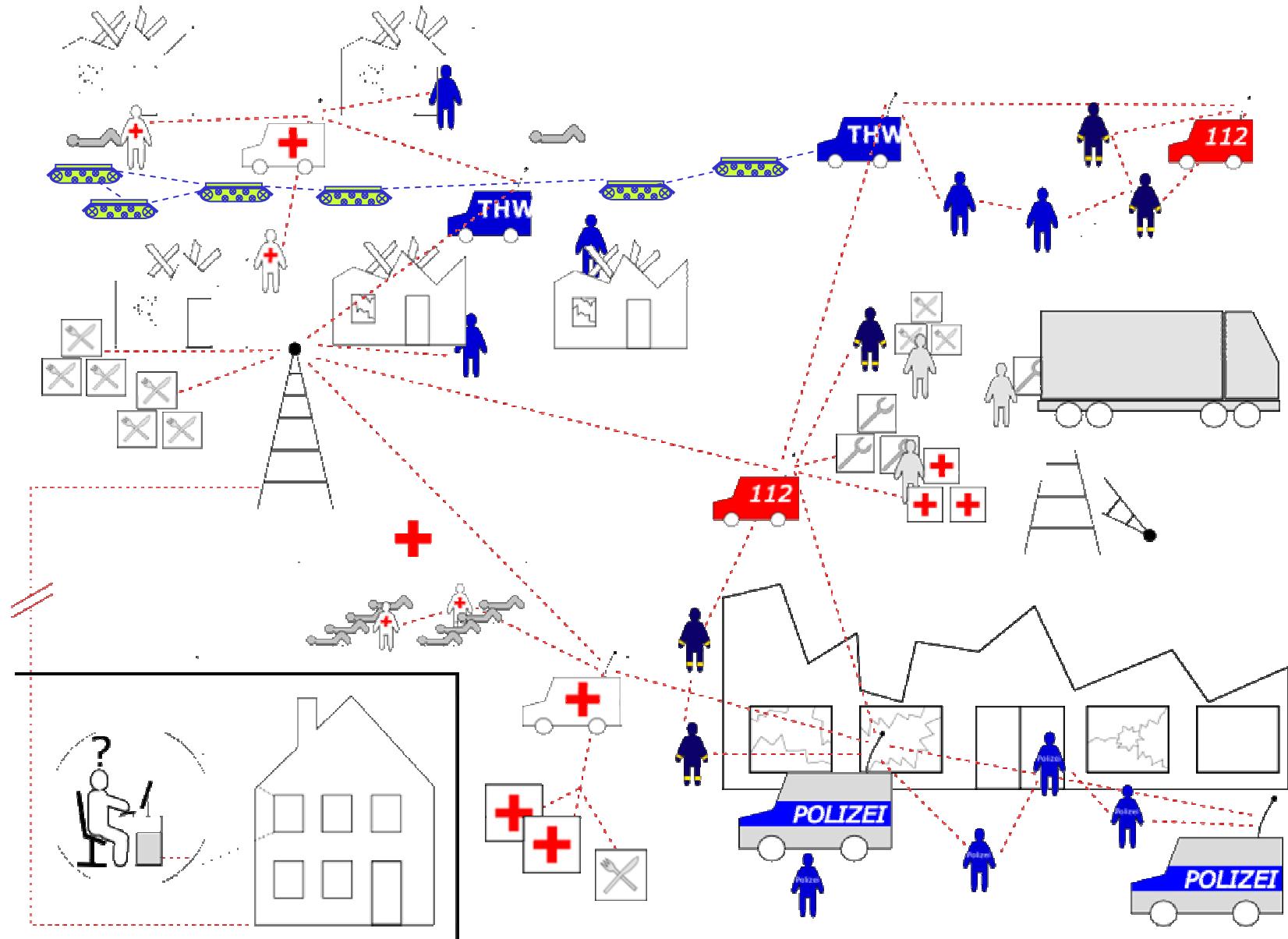


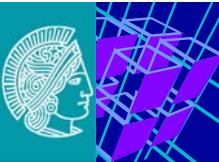
from www.katrinahelp.com



P2P Communication System for Catastrophes

www.kom.tu-darmstadt.de
www.httc.de





3.2 P2P in SoA (Service oriented Architectures)

Dienst-Vermittlung auf P2P-Basis

- Information Broker ist ein Peer im P2P-Netzwerk, der mittels einer Web Service Schnittstelle angesprochen werden kann
- Die zu vermittelnden Dienste werden im P2P-Netzwerk veröffentlicht und können so von anderen „Vermittlungsstellen“ gefunden werden.

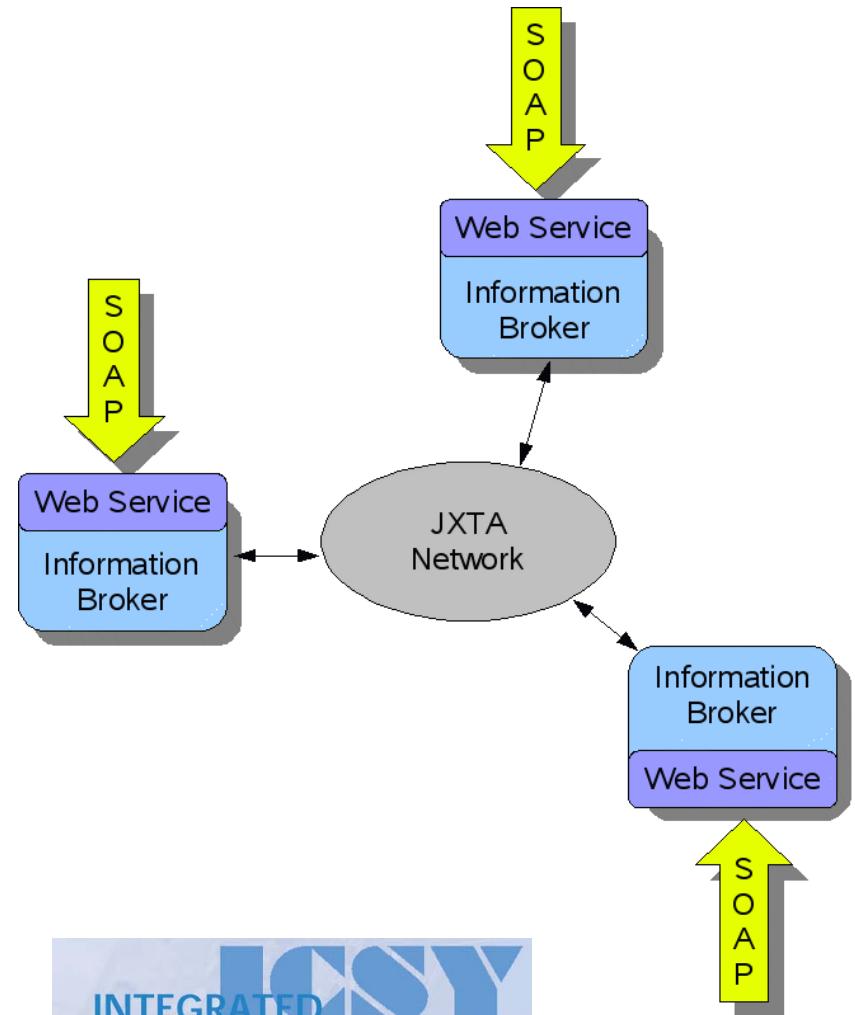
Dezentralisierung erhöht die Zuverlässigkeit

- Ausfall eines Peers beinhaltet nicht den kompletten Verlust der Dienst-Vermittlung, sondern nur den Ausfall einer „Vermittlungsstelle“.
- Alle bereits veröffentlichten Dienste können weiterhin genutzt werden, d.h. aber auch das nur die Zuverlässigkeit der Vermittlung selbst, nicht aber die Zuverlässigkeit der Dienste erhöht wurde.

Abstraktion vom P2P-Netzwerk durch Web Services

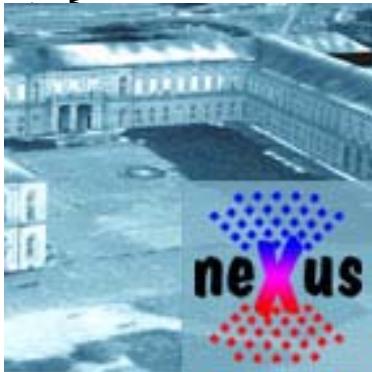
- Komplexität von P2P wird verborgen
- transparenter Austausch durch andere Technologien oder P2P-Netzwerke möglich

i.e. Neuer Ansatz für P2P Middleware





3.3 Location Aware Services and P2P



Location-aware services...

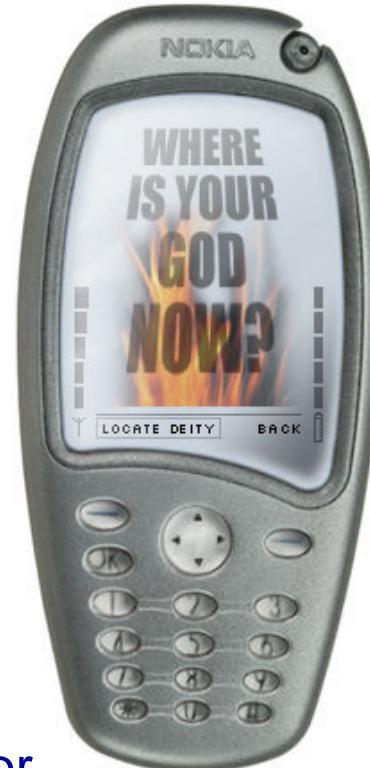
- are highly attractive for end-users and providers
 - they can offer highly personalized services based on the user's location
- e.g.:
 - Walking at the Prenzlauer Berg
 - I am hungry, need some Italian food
 - Context (location) aware mobile networked device (with GPS)
 - Returns list with
 - only those restaurants within walking distance
- GPS devices become cheap & ubiquitous

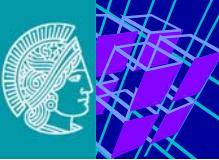
Offering location-aware services seems like a good source of income for

- e.g. Mobile Phone Service Providers.

Alternative & complementary approach

- P2P system offering these services practically for free
-First prototypes exist...

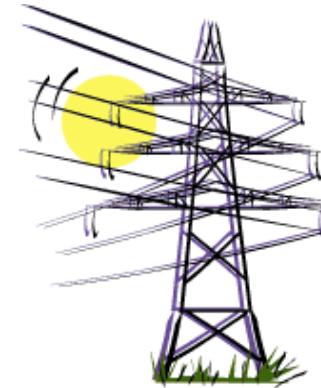




3.4 Self-Organization and Internet Economy: SESAM

Internet allows for

- self organizing networks
- spontaneous activity of participating



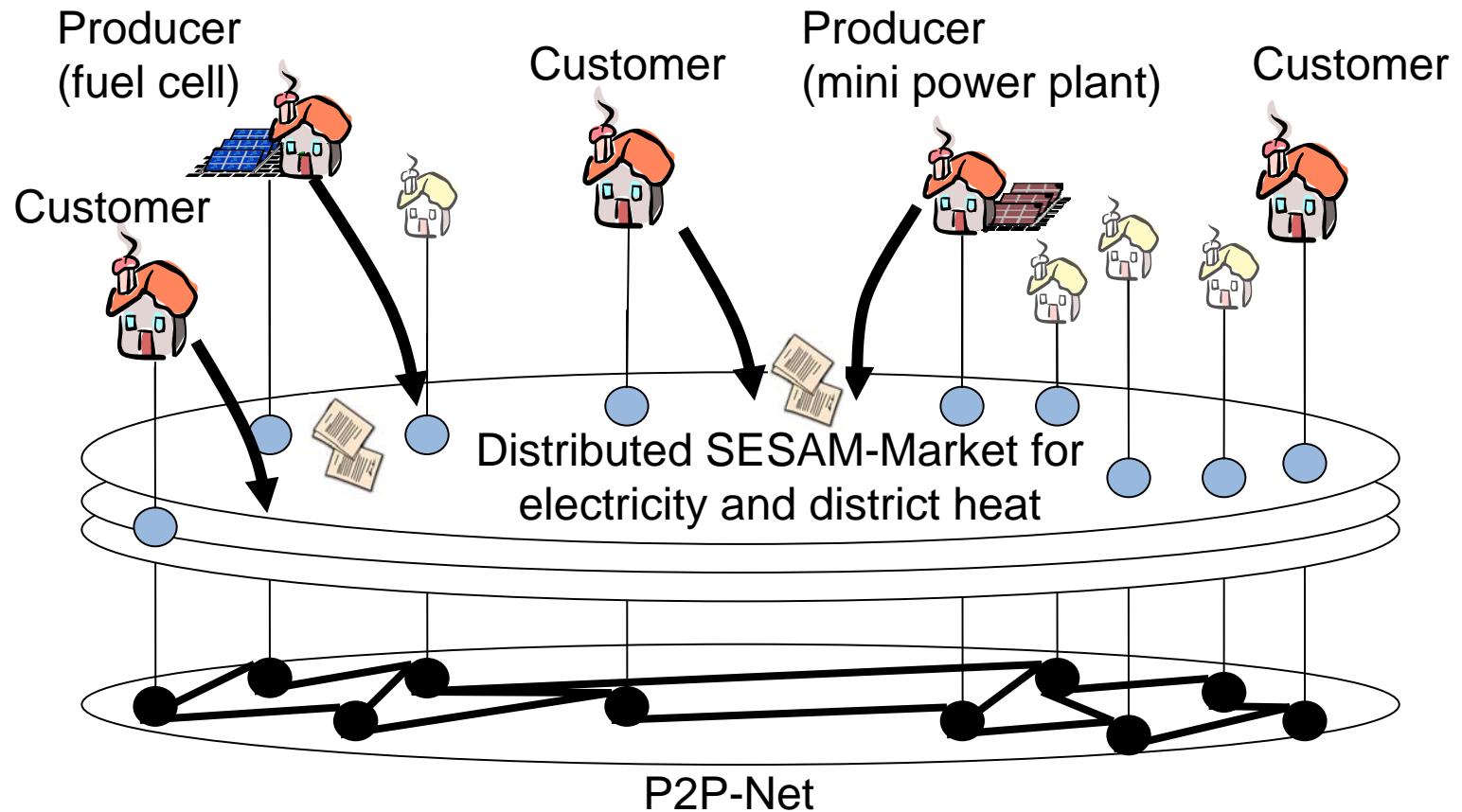
“Virtuelles Kraftwerk”

- “Dezentrale Stromversorgung”
 - “Brennstoffzelle, MiniBHKW, Windrad als Energiequelle”
- “Gerät verkauft selbstständig seine Kapazitäten”
 - “Dynamische Preisfindung”
 - “Käufer und Verkäufer”
- “Automatischer Vertragsschluss”



Self-Organization and Internet Economy: SESAM

Virtual power plant scenario

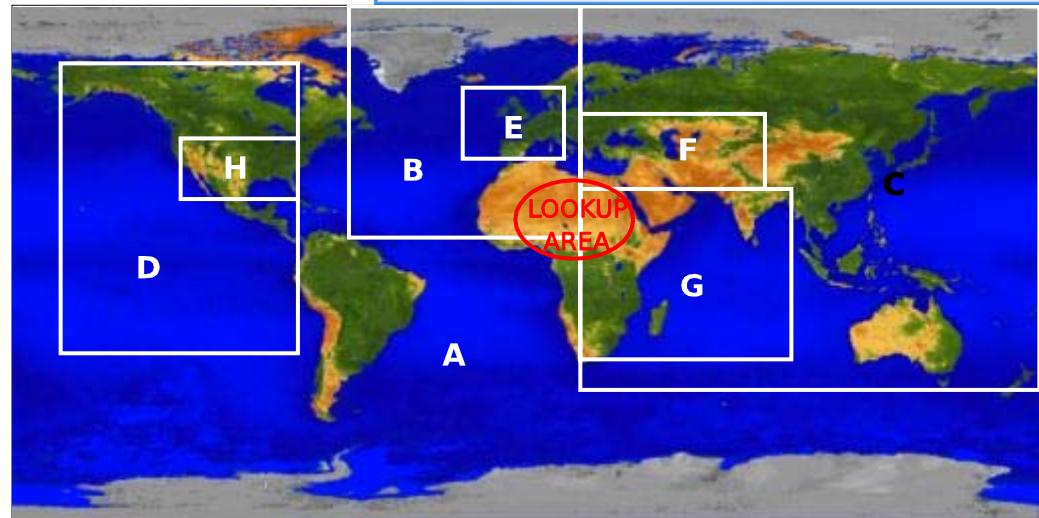
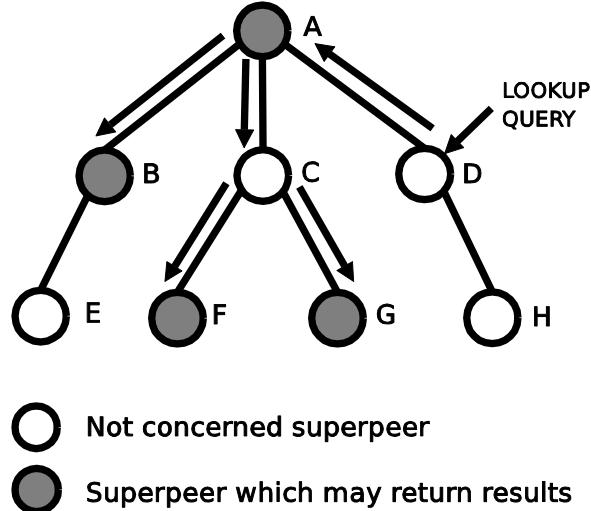


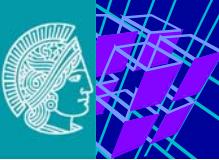


Example: TUD's & httc's CamNet Application

P2P Network of webcams supporting

- Metadata-based search:
 - Search all the webcams with the description “Alps”
- Efficient P2P location-based area search:
 - “Find all webcams in a certain area”





3.5 P2P Network Games

Network Games boom

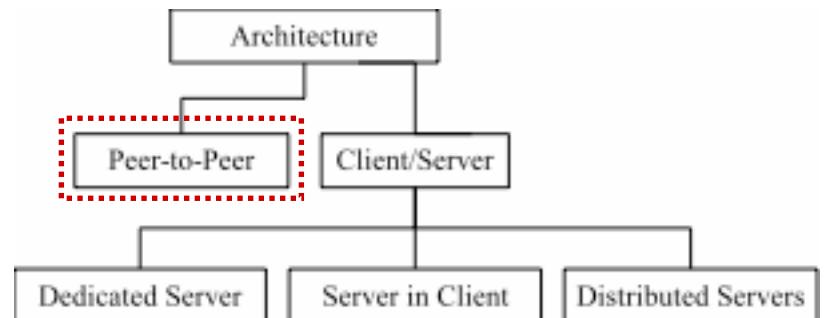
- From 96 million EUR in 2003 to 589 million EUR in 2007
 - jupiterresearch.com
- Production costs of modern computer games
 - in the order of magnitude of Hollywood movies
- Games for mobile end devices boom



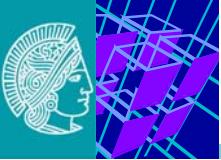
World of Warcraft
forums.worldofwarcraft.com/screenshots

P2P technology already used in some games

- e.g. in World of Warcraft to distribute patches

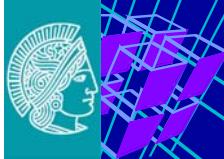


from O. Heckmann - The Competitive ISP



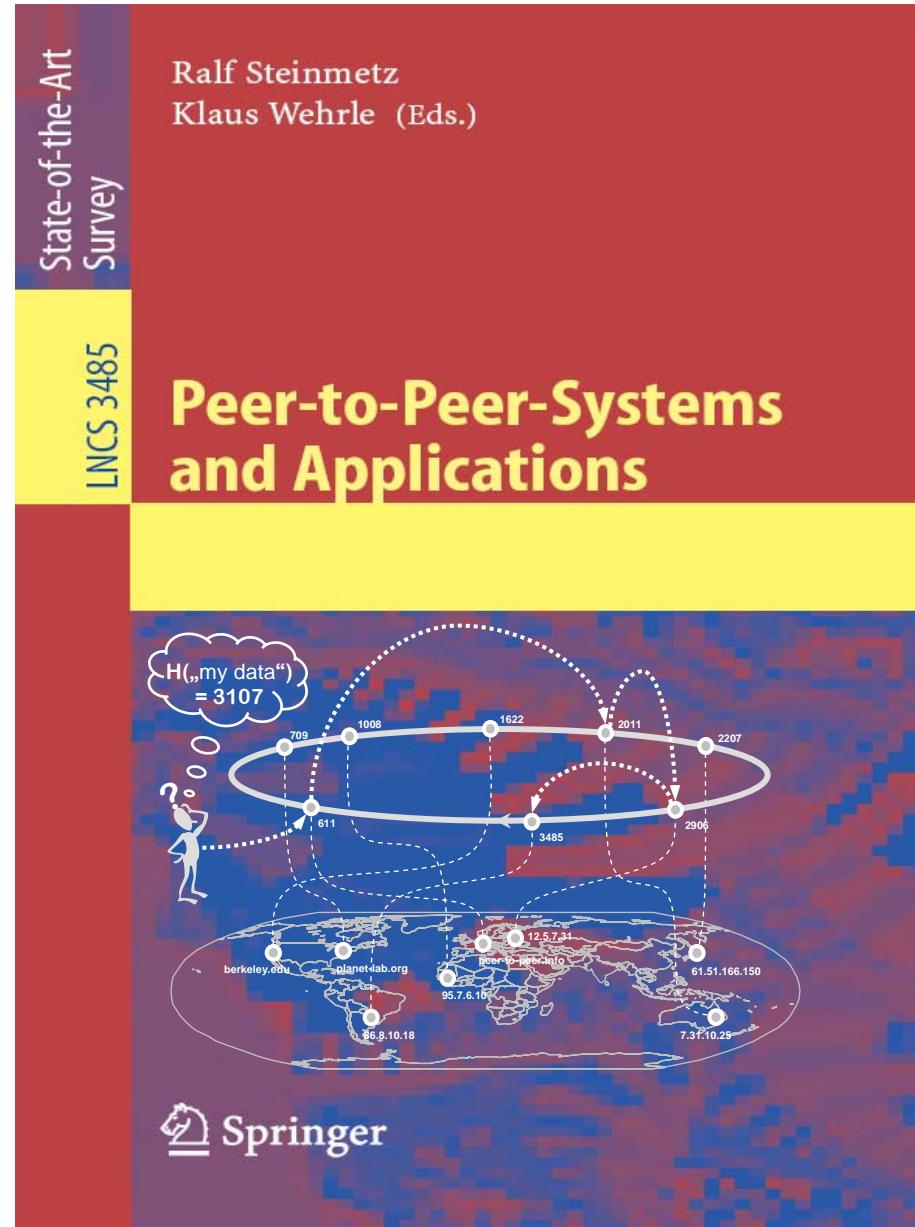
4 Summary & Conclusions

1. Peer-to-Peer is much more than just file sharing
2. Peer-to-Peer is based on a different communication paradigm (not client-server)
3. Peer-to-Peer is a disruptive technology,
it will have very strong impact !
 - → It can and will be used somehow "against" established businesses models
 - E.g. damage done to music (movie?) industry
 - → It can and will be used by innovative businesses drivers (D?, EU?, US, ASIA, China, ..)
 - to reduce costs
 - for rapid deployment of new services
 - to increase the scalability of applications
 - ...
 - E.g. Skype, creating \$4billion value with somehow minimal infrastructure



More Information

e.g.

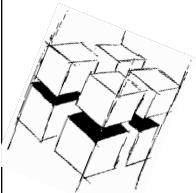




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