

Seminar Ubiquitous Computing for Bachelor/Master Fall 2007/2008 Distributed Ubiquitous Systems Group

Institute of

Operating Systems and Computer Networks

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Matthias Kranz

TU Braunschweig

Institute of Operating Systems
and Computer Networks

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Introduction: Ubiquitous Computing

Ubiquitous Computing

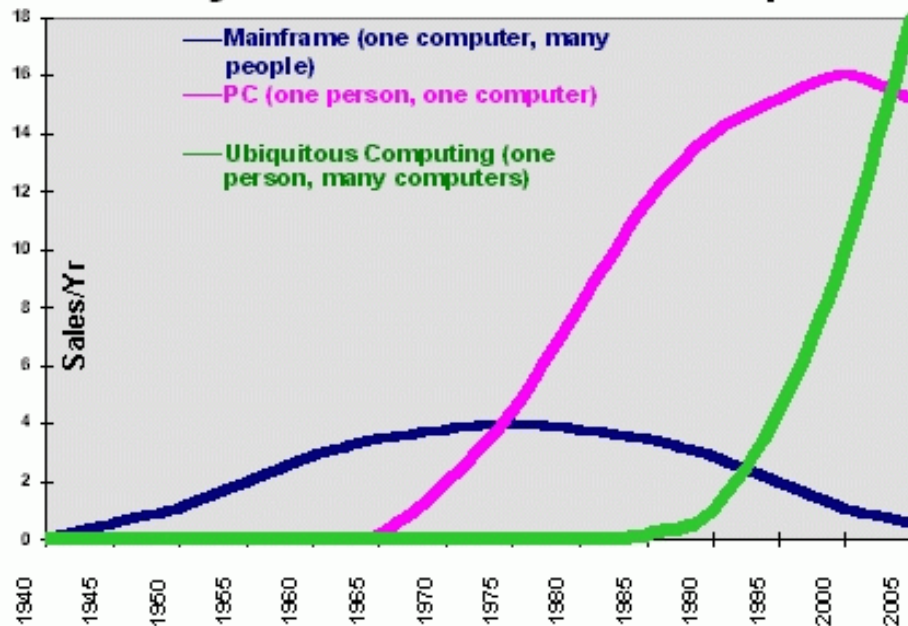
Ubiquitous Computing

- **“The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.” (Mark Weiser, *The Computer of the 21st Century*, 1993)**
- **Computers and User Interfaces are invisibly, unobtrusively, and calmly integrated in**
 - the environment
 - in everyday objects
 - ...
- **no longer: interaction with computers at the desktop and applications**
- **now: appliances, specialized tools**

Ubiquitous Computing

- **Moore's Law: computing power increases!**
- **technological advances: size of computers and sensors and actuators decreases, new materials, new RF technologies, ...**

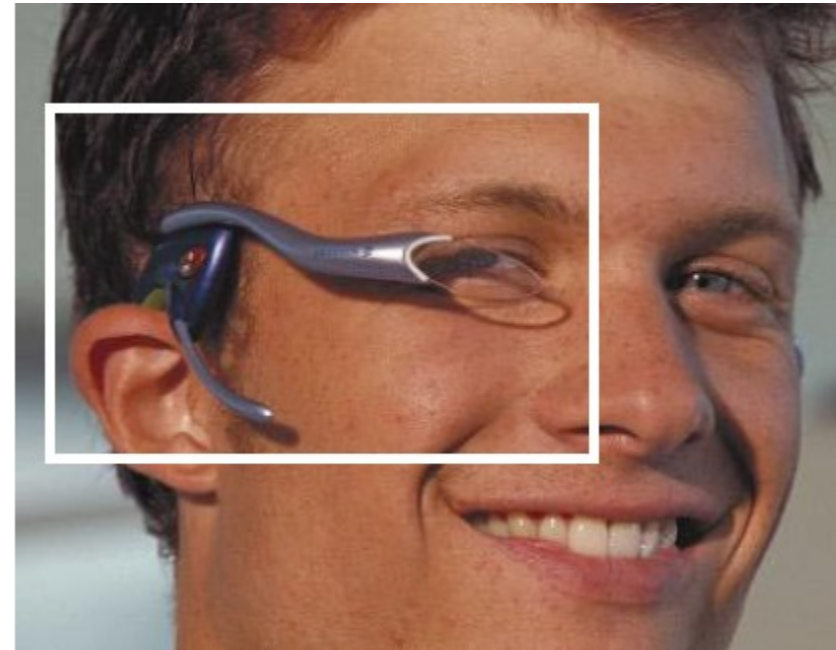
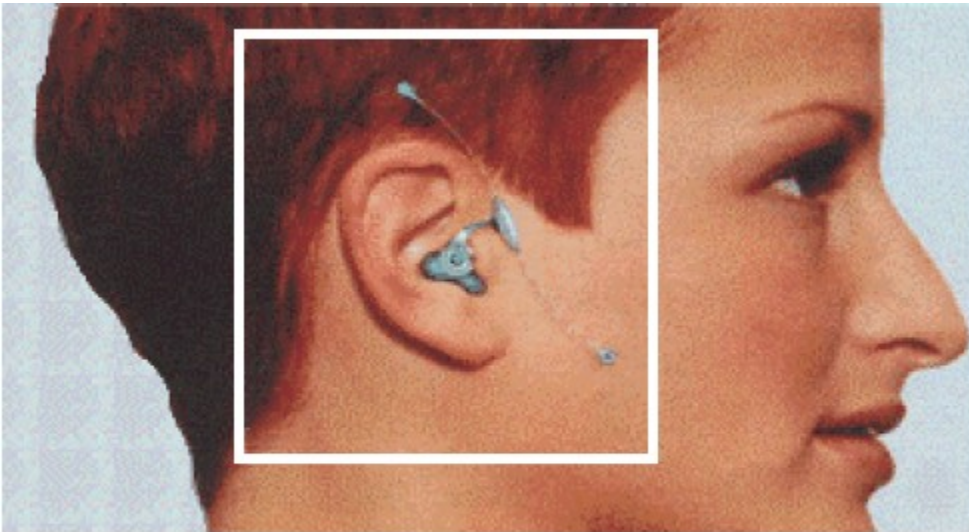
The Major Trends in Computing



<http://www.ubiq.com/hypertext/weiser/UbiHome.html>

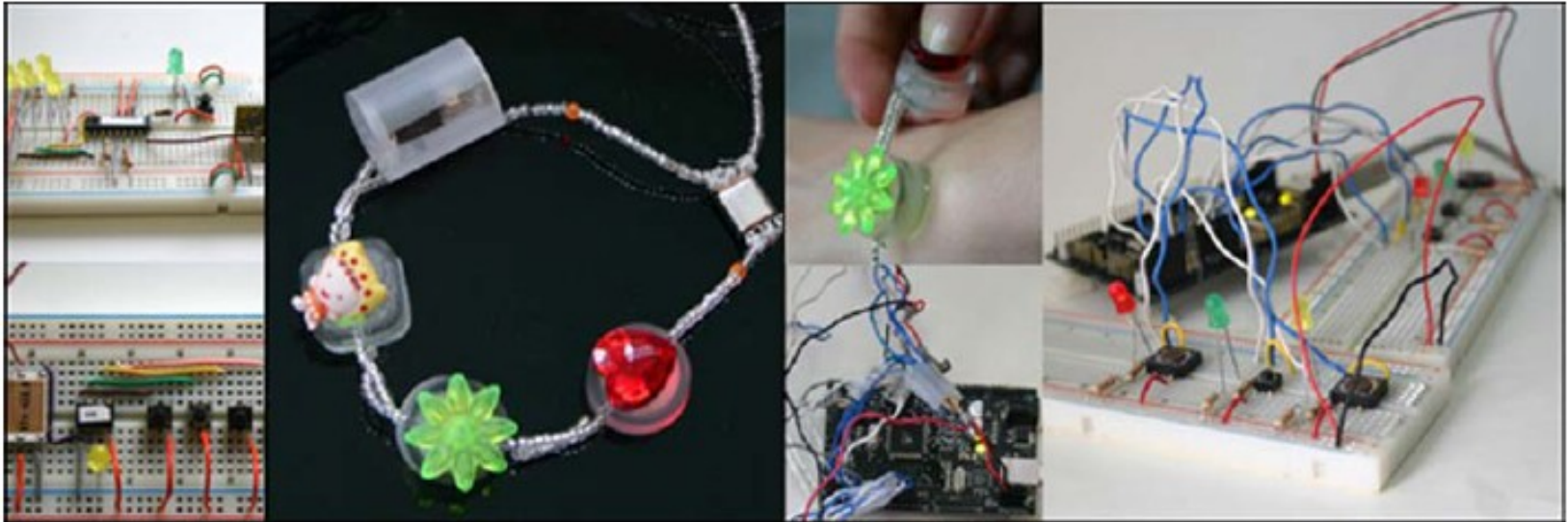
Ubiquitous Computing – Example: Wearable User Interface

- left: mobile phone head set
- right: head mounted display (visual see-through)



Ubiquitous Computing – Example: “Intelligent” Jewellery

- smart jewellery: emotional user interfaces, affective computing



BuddyBeads: techno-jewelry for non-verbal communication, Pers Ubiquit Computing, 2006
<http://static.howstuffworks.com/gif/digital-jewelry-bracelet.jpg>

Ubiquitous Computing – Example: Wearable User Interface

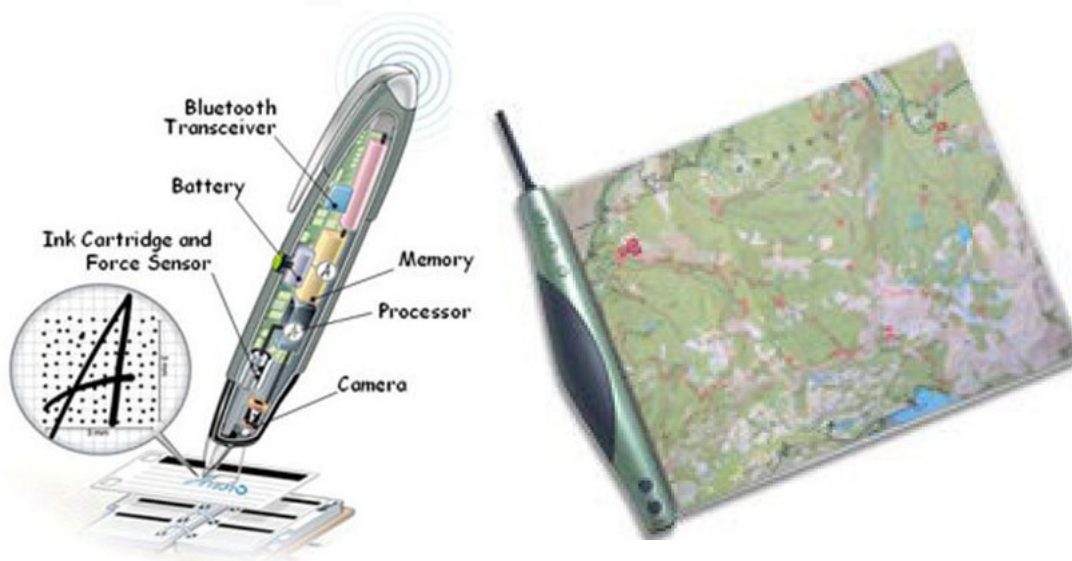
- **“hug shirt”**: a wearable user interface for emotions and feelings of presence (thinking of someone).

“a Hug Shirt (Bluetooth with sensors and actuators), a Bluetooth java enabled mobile phone with the Hug Me java software running (it understands what the sensors are communicating), and on the other side another phone and another shirt. If you do not have a Hug Shirt but know that your friend has one you can still send them a hug creating it with the HugMe software and it will be delivered to your friend’s Hug Shirt!”



Ubiquitous Computing – Example: Smart Paper and Pens

- left: Anoto digital pen (camera, Bluetooth, paper with special grid printed on)
- middle and right: flexible, bendable, digital paper displays



<http://www.bimobi.com/Images/tech1.jpg>
,<http://www.vs.inf.ethz.ch/events/slides/lad2/Mattern1.pdf>
<http://www.ibr.cs.tu-bs.de/dus>

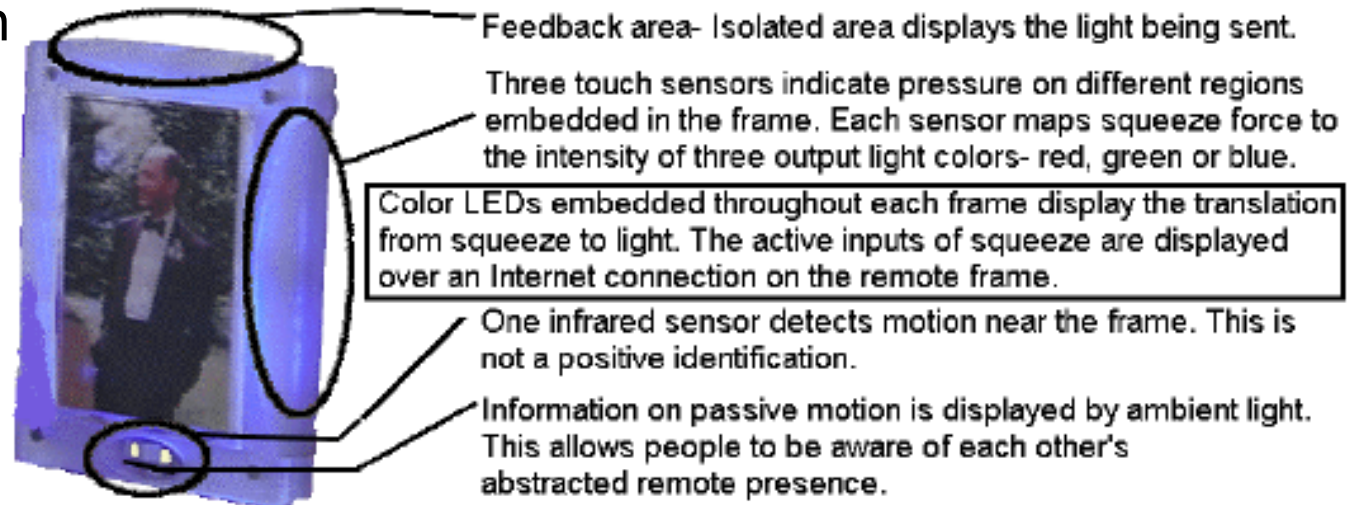
Ubiquitous Computing – Example: Emotional Communication

Emotional communication using everyday objects.
The object, a picture frame, already is connected to the person whose image is inside it.

Touching =
ambient
communication

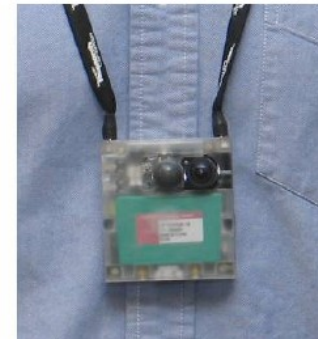
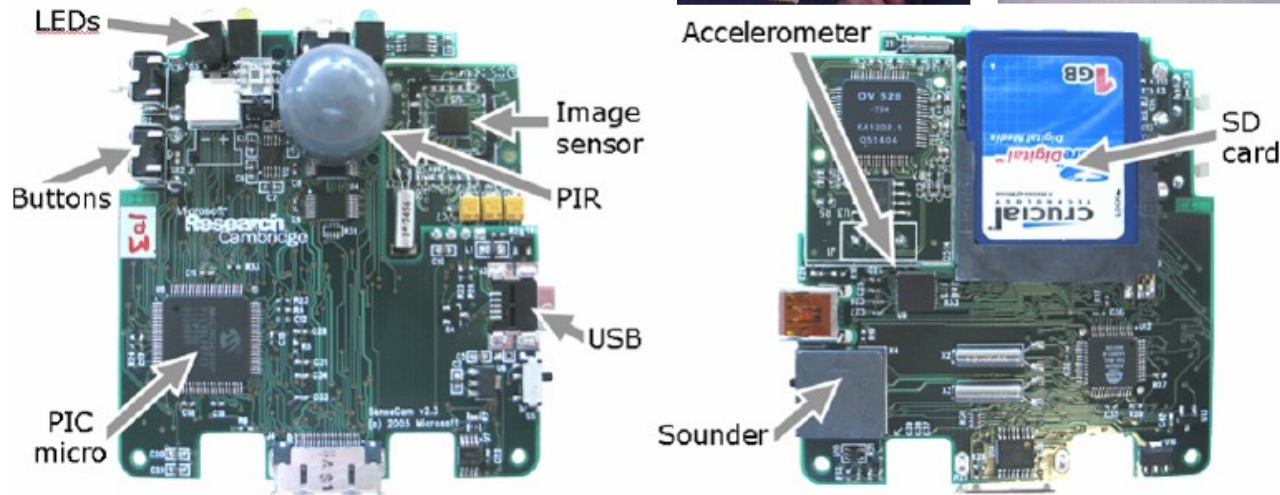


Figure 2: Attention requirement spectrum



Ubiquitous Computing – Health Care Application SenseCam

Highly integrated ubiquitous computing technology enables the capture and recording of events during the day. Sensors “detect” interesting actions and start the capture.



SenseCam: A Retrospective Memory Aid, Hodges et al., UbiComp 2006

Ubiquitous Computing – Example: PlaceLab



Figure 1: The PlaceLab living room and kitchen, office, and master bath. All of the observational sensing is built directly into the cabinetry. Although the sensors are ubiquitous, they become part of the design aesthetic (small black windows). Pilot volunteers have expressed that they are easy to forget. The inset in the left image shows a microphone.



Figure 2: Annotation software permits the researcher to study data collected from the PlaceLab by watching 4 streams of automatically-selected “good” video views, listening to one automatically selected audio stream, and displaying sensor activations on a floor plan of the environment. Here the floor plan shows all switch sensors currently installed in the lab (small dots) and temperature sensor output. The researcher can use particular sensor activations to reduce the search and annotation time.

Seminar Topics

Seminar Topics

Seminar Ubiquitous Computing for Bachelor/Master

Topic 1: Overview and Comparison on Wireless Sensor Node Technologies

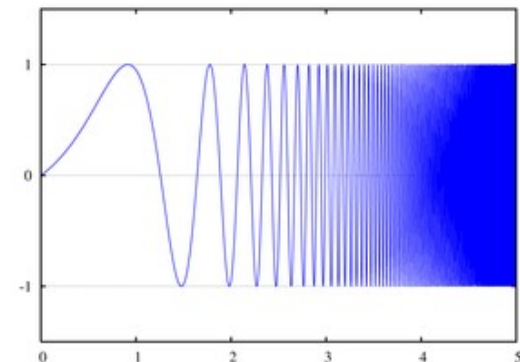
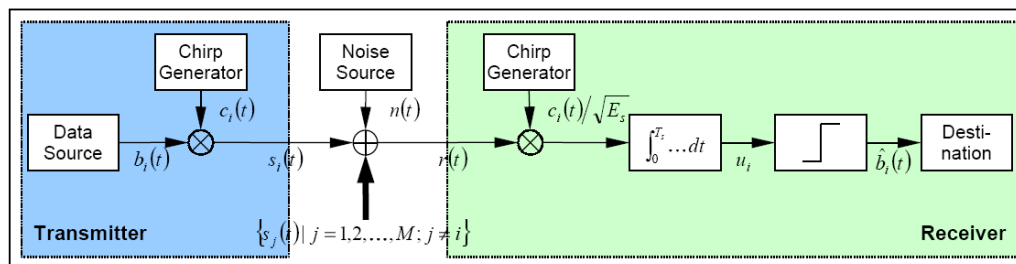
- **wireless sensor nodes are core technologies**
 - environmental monitoring e.g. pollution, birds
 - building, facility and production management, e.g. intrusion detection, dangerous goods monitoring
 - body sensor networks
- **in the recent years, many wireless sensor node technologies have been proposed**
 - different processors and computational power
 - transceiver vs. transmitter
 - bandwidth, communication protocols, synchronization
 - extensions with sensor boards
 - tool chain support, programming, reuse
 - applications

▪ **goal: overview and comparison**

Topic 2: Chirp Modulation Techniques for Wireless Sensor Networks

Hintergrund

- **Bisher:**
 - Funkbasierte Lokationsmessung über Messung der Feldstärke (RSSI) und...
 - Lernen/Vergleichen-Ansätze
- **Neue RF-Chipsätze im Bereich Ubicomp**
 - ermöglichen Einsatz anderer Verfahren
 - Bsp: Chirp-Technologie



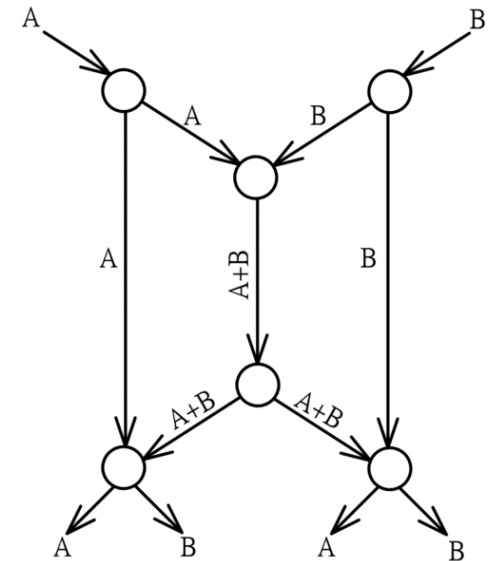
Topic 3: Network Coding in Wireless Sensor Networks

▪ Hintergrund

▪ Idee von Network Coding (NC):

- Normalerweise: Nur Weiterleiten einer Nachricht pro Kanal
- Bits mathematisch durch „xor“-Operator kombinieren
→ Codierung im Netzwerk
- Ergebnis: Informationen A und B können gleichzeitig übertragen werden (denn „ $A \text{ xor } A+B = B$ “)
- Erhöhung des Durchsatzes

▪ Theorie verspricht Verbesserung der Netz-Leistungsfähigkeit durch Kombination von existierenden und neuen Informationen



Topic 4: Context Recognition in Ubiquitous Computing

- **interaction is no longer limited to the desktop PC**
- **computation is embedded in the physical world**
- **interaction occurs in context**
- **sensor nodes, novel sensors and their deployment make it possible to detect the context in which interaction and activities occur**
- **context can be inferred or computed by**
 - e.g. sensor fusion
 - domain knowledge
 - plentitude of algorithms, e.g. HMM, NN, ...
 - using respective frameworks, e.g. Context Toolkit
- **goal: overview of algorithms, comparison of algorithms and toolkits/frameworks, fields of application, ...**

Topic 5: Overview and Comparison of Middleware for Ubiquitous Computing

- **ubiquitous computing is characterized by a plentitude of heterogeneous devices:**
 - mobile phones, PDAs, MDAs, “smart objects”, sensor nodes, desktop computers, ...
 - networked appliances, services, ...
- **middleware as glue in between**
 - specialized, e.g. for table top interaction; general, e.g. for smart environments
 - tool chain, testing, reuse outside the initi
- **goal: comparison and overview on current middleware technologies for ubiquitous computing**

Topic 6: Ubiquitous Computing in Smart Spaces

- **increasing computational density enables not only small appliances, but fully fledged “smart” spaces.**
- **complexity increases:**
 - more devices (small, ..., large)
 - different technologies
 - data storage
 - communication architecture: publish/subscribe, blackboard, ...
 - interaction concepts: interaction with objects, walls, ...
 - ...
- **concepts for smart spaces**
- **room size, building size**
- **goal: overview on current smart spaces**

Topic 7: Comparison, Overview and Applications for Location Technologies in Ubiquitous Computing

- **location information is an important information for e.g. context-aware services**
- **technologies for locating**
 - time of flight
 - triangulation
 - ...
 - Wlan, RF, ultrasonic, IR, ...
- **applications of location technologies, e.g. automatic phone call forwarding; activity detection**
- **goal: overview of location technologies for ubiquitous computing and applications**

Topic 8: Interaction in Ubiquitous Computing Environments

- **interaction in ubiquitous computing is not limited to desktop computers**
- **novel interaction concepts**
 - Tangible User Interfaces
 - tabletop and wall interaction
 - specialized appliances
 - gestures
 - single user/multi user interaction
- **goal: overview on current interaction techniques in ubiquitous computing; applications**

Seminar Ubiquitous Computing

Contact:

Monty Beuster

TU Braunschweig

Institute of Operating Systems
and Computer Networks

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