

**WELCOME
TOMORROW**

150 JAHRE ETH ZÜRICH

Friedemann Mattern

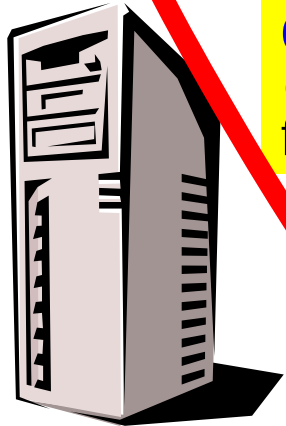
ETH Zürich

Institut für Pervasive Computing

Size

Number

Computing: A Clear Trend



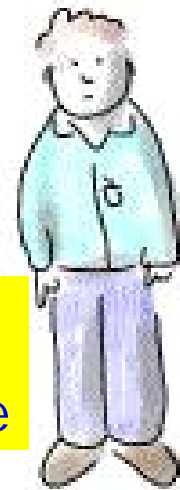
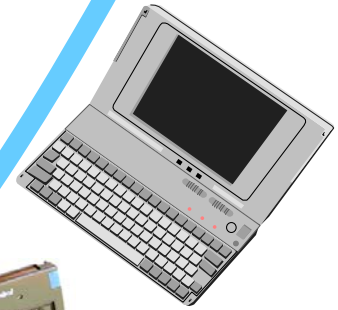
One computer
(mainframe)
for many people



One computer
(PC)
for
everyone

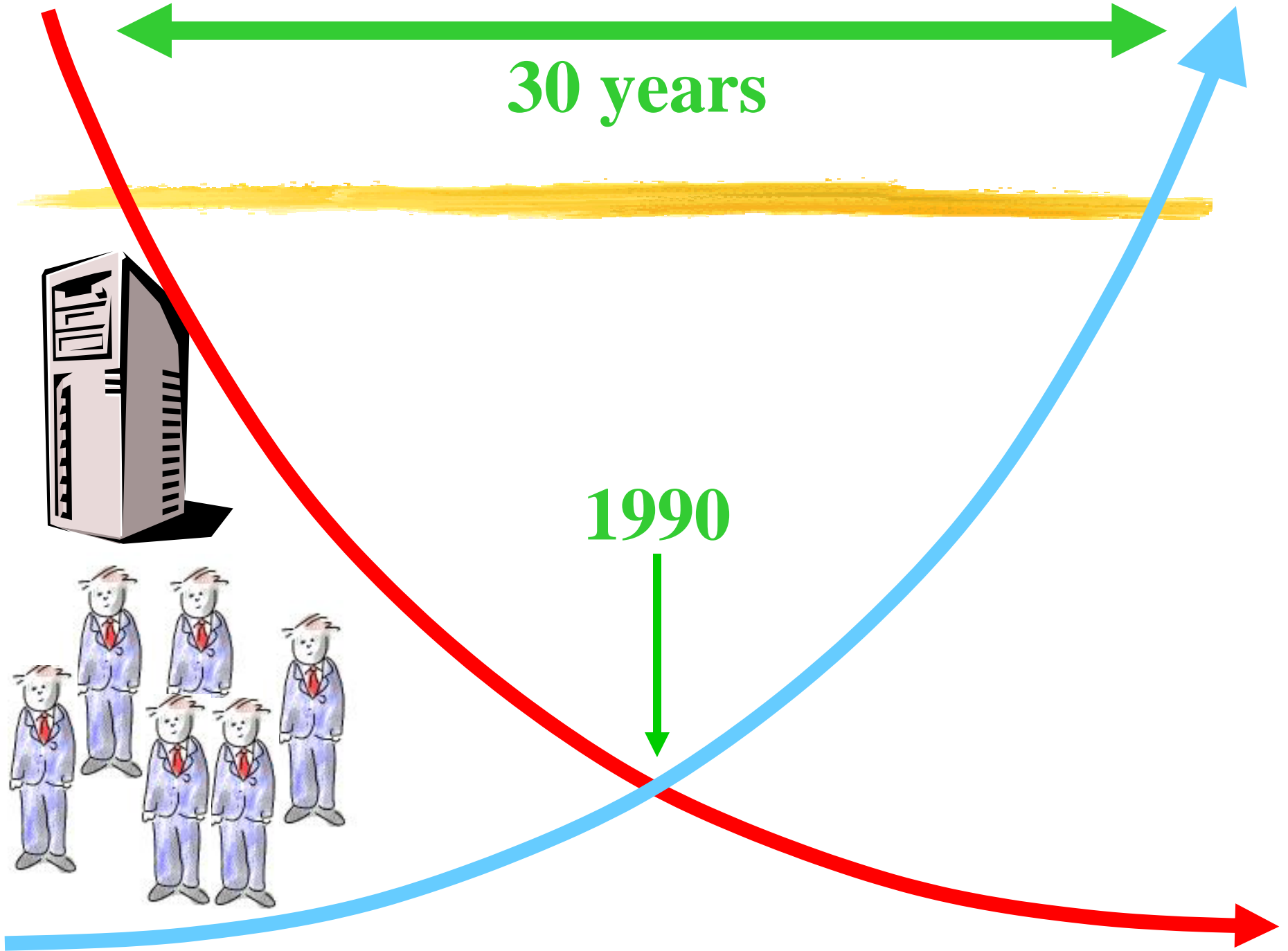
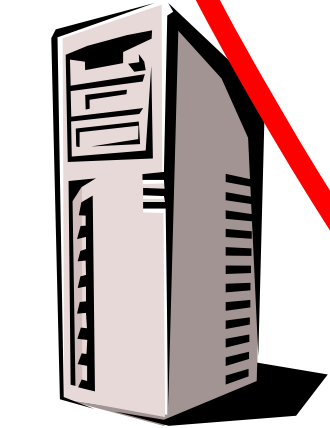


Many
computers
for everyone



30 years

1990



“The Computer for the 21st Century”



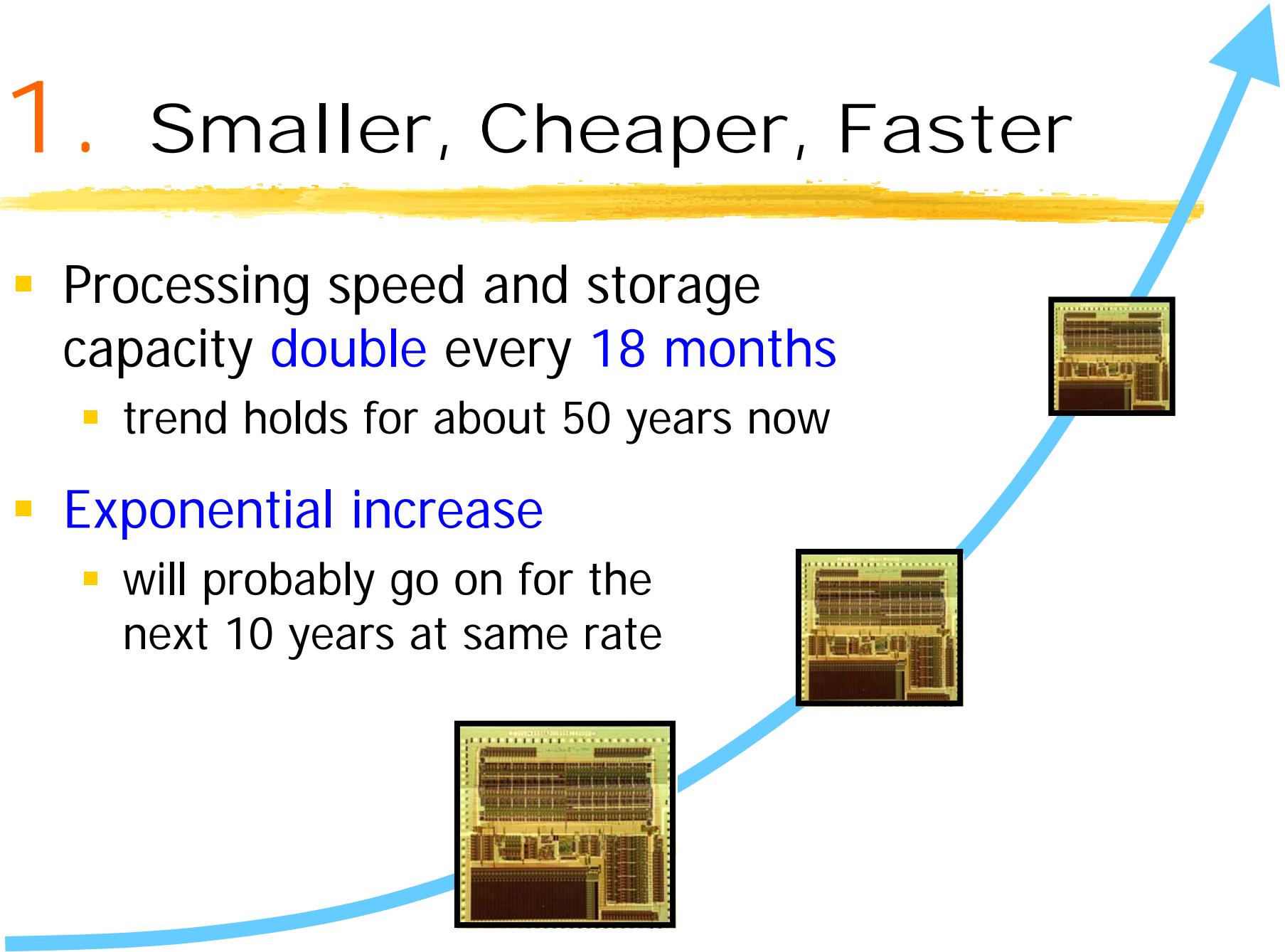
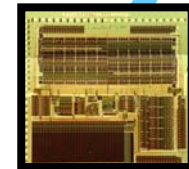
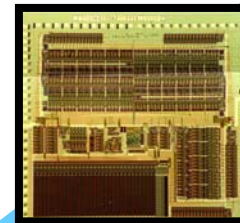
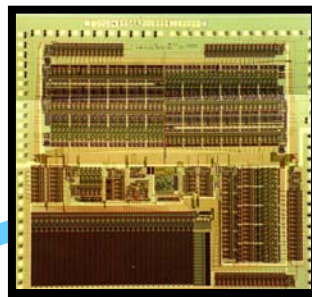
Mark Weiser (1991):
The Computer for the 21st Century, Scientific American

„In the 21st century the technology revolution will move into the everyday, the small and the invisible...“

The Trends

1. Smaller, Cheaper, Faster

- Processing speed and storage capacity **double** every **18 months**
 - trend holds for about 50 years now
- **Exponential increase**
 - will probably go on for the next 10 years at same rate





Dr. **Michael Beigl**

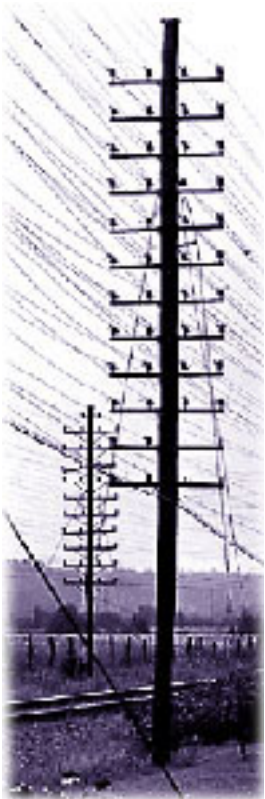
Universität Karlsruhe
Institute for Telematics,
Telecooperation Office



Prof. Dr. **Dirk Timmermann**

Universität Rostock
Institut für Angewandte
Mikroelektronik und Datentechnik

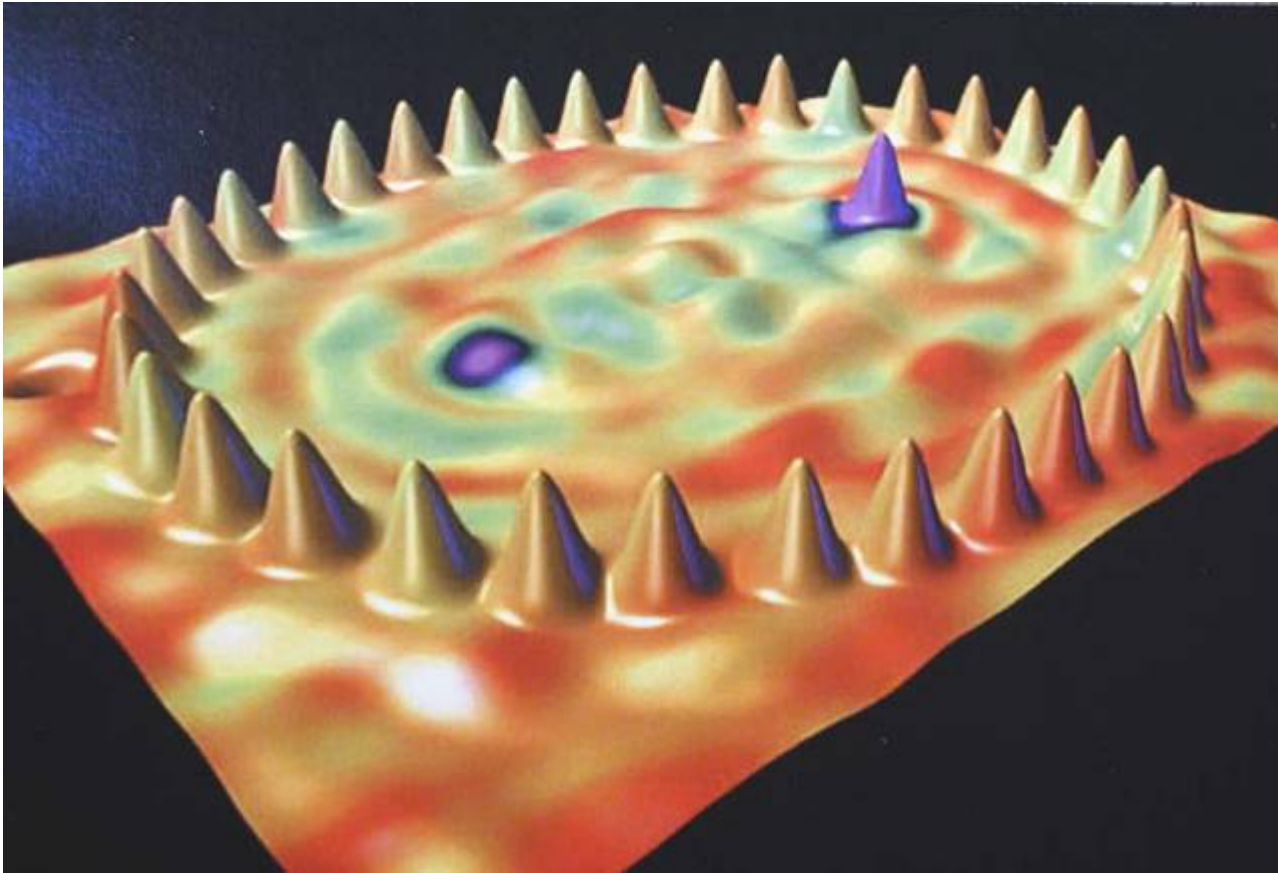
2. Progress in Communication Technologies



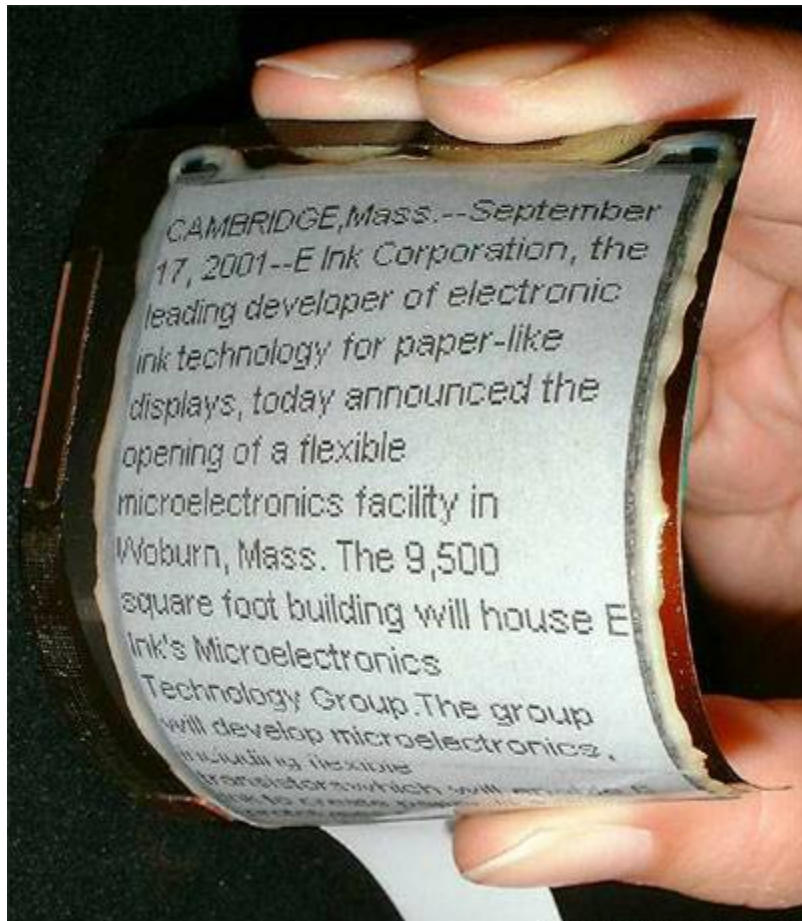
Nostalgia



3. New Materials



Consequences: Smart Paper, Electronic Ink



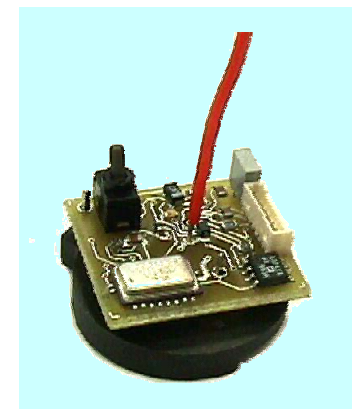
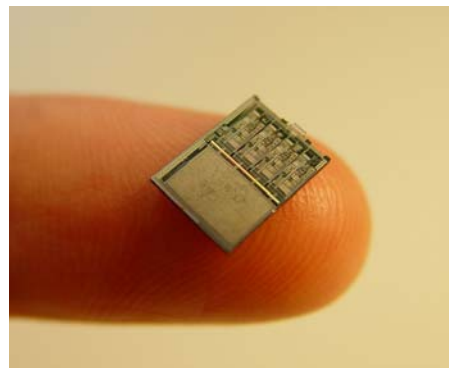
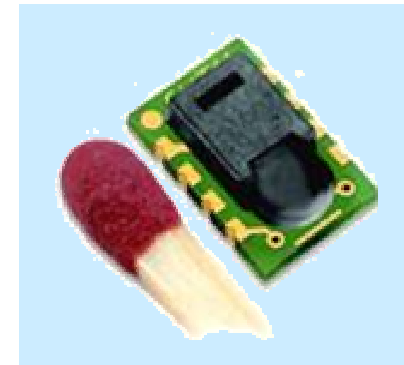
E-Ink, 2001



Siemens, 2003

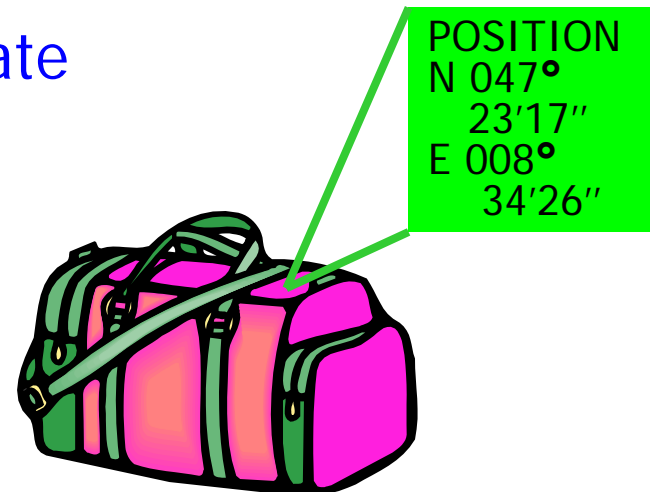
4. Better Sensors

- Miniaturized cameras, microphones,...
- Fingerprint sensor
- Sensors for
 - temperature, humidity, acceleration,...



5. Location

- Progress in technology
 - smaller, cheaper, more accurate
- More and more “smart” mobile objects
 - assets, devices, products, everyday objects, people
- New applications
 - e.g., never get lost, find valuable objects



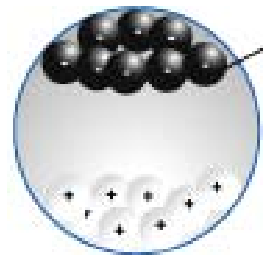
Where Does All the Technological Progress Lead To?



Wireless high-speed communication



Better sensors



New materials

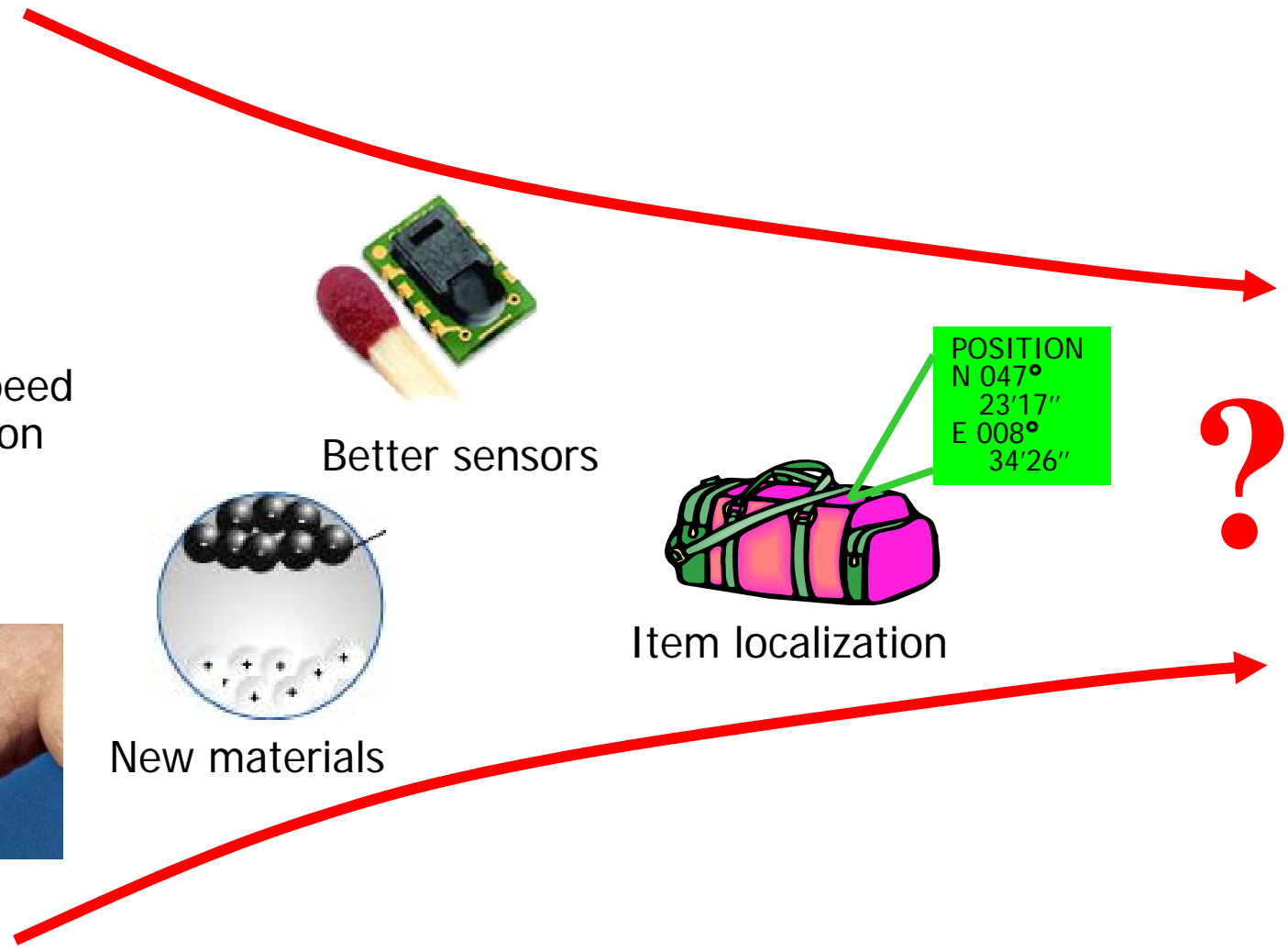


Moore's law



Item localization

POSITION
N 047°
23'17"
E 008°
34'26"



The Vision

The Vision



„In the 21st century the technology revolution will move into the everyday, the small and the invisible...“

Mark Weiser (1952 – 1999), XEROX PARC

- Small, lightweight, cheap, mobile **processors** and sensors
 - in almost all **everyday objects** („**embedded computing**“)
 - on your **body** („**wearable computing**“)
 - embedded in the **environment** („**sensor networks**“)

From an Internet of Computers... To an Internet of Things?



Cooperating Smart Everyday Things?

When the **tooth brush**
communicates with the
bathroom **mirror**

- animated **cartoon** appears
on the mirror
- brushing the teeth
becomes a **computer
game**, the tooth brush
becomes a **joy stick**
- high-score lists, collect
rewarding **points**,...

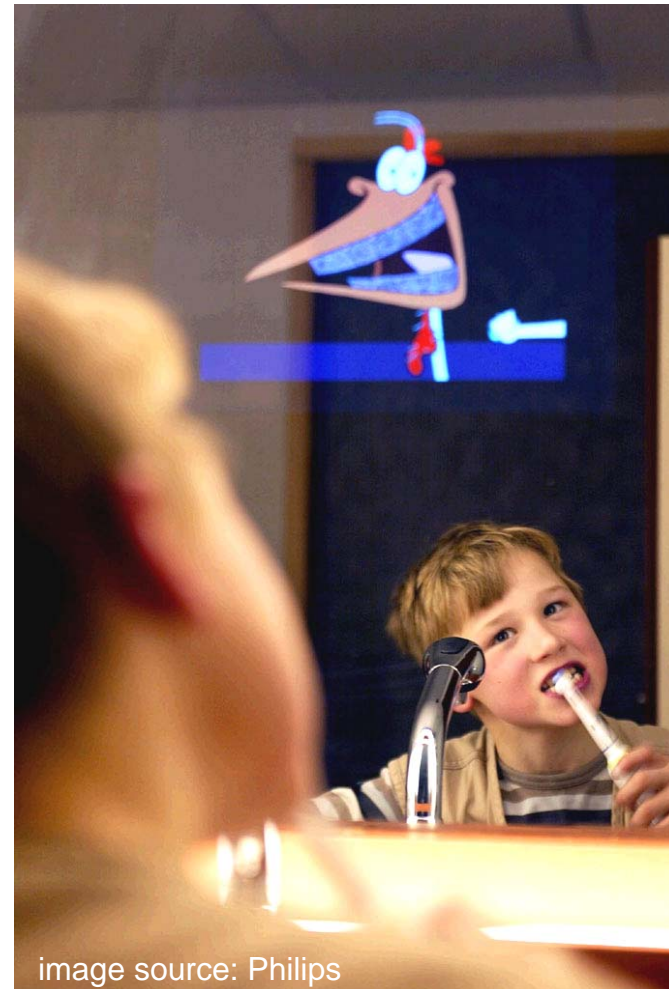


image source: Philips

How do we Interact with Disappearing Computers?





Dr. **Albrecht Schmidt**

Ludwig-Maximilians-Universität
München

Institut für Informatik

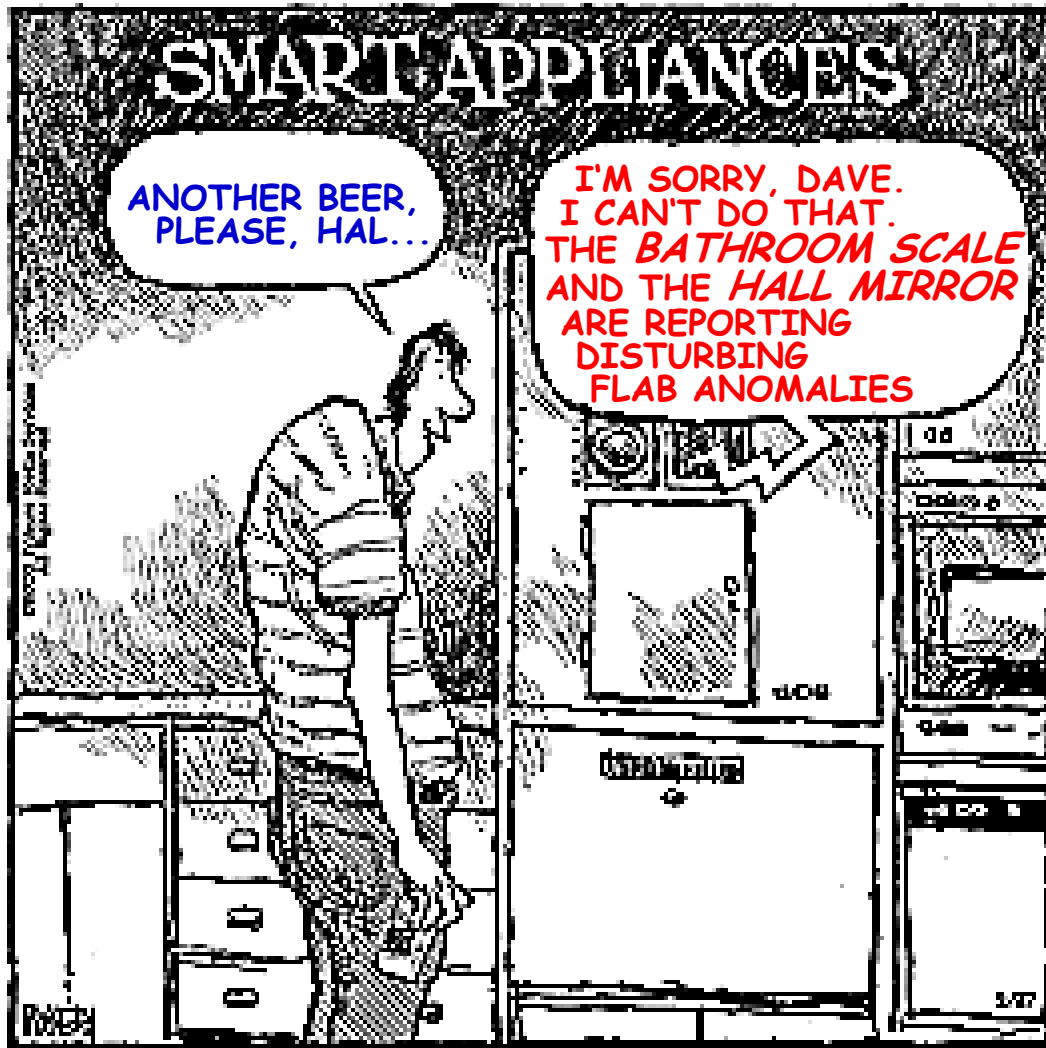


Dr. Dr. **Norbert A. Streitz**

Fraunhofer-Institut für
Integrierte Publikations- und
Informationssysteme (IPSI)

Darmstadt

When the Smart Fridge Communicates with the Hall Mirror...





Prof. Dr. **Lorenz M. Hilty**

Eidgenössische Materialprüfungs-
und Forschungsanstalt EMPA

St. Gallen

The Vision

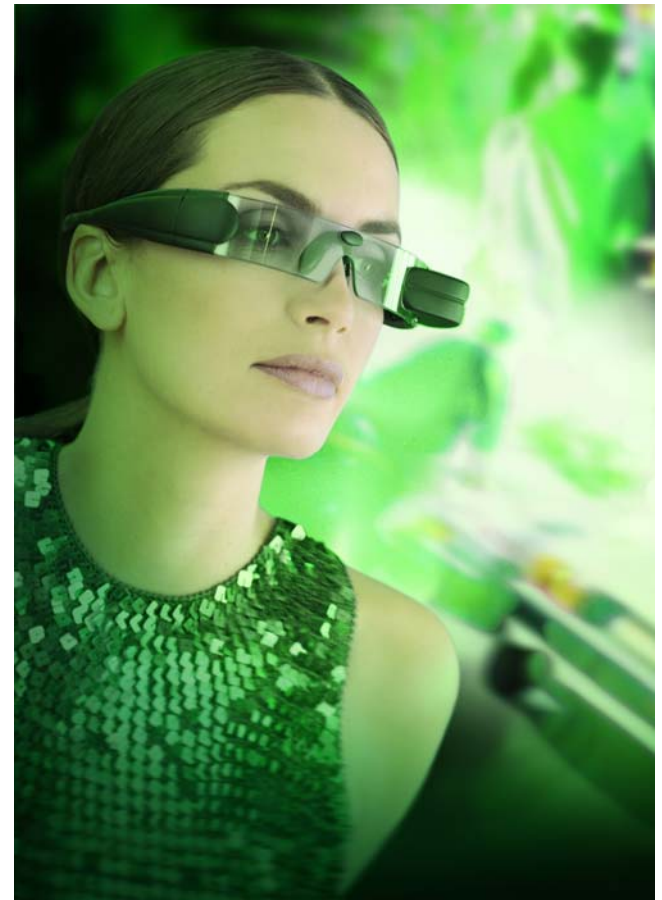


„In the 21st century the technology revolution will move into the everyday, the small and the invisible...”

Mark Weiser (1952 – 1999), XEROX PARC

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 - embedded in the **environment** („**sensor networks**“)

Wearable Computing





Prof. Dr. **Gerhard Tröster**

ETH Zürich

Wearable Computing Lab

Augmented Reality – Application Scenario





Prof. Dr. **Alois Ferscha**

Johannes Kepler Universität Linz
Institut für Pervasive Computing

The Vision



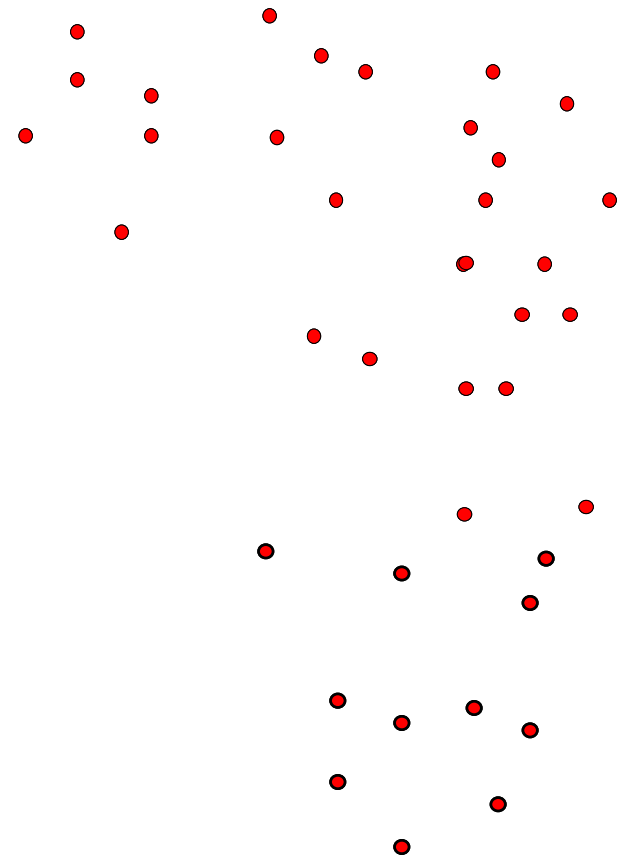
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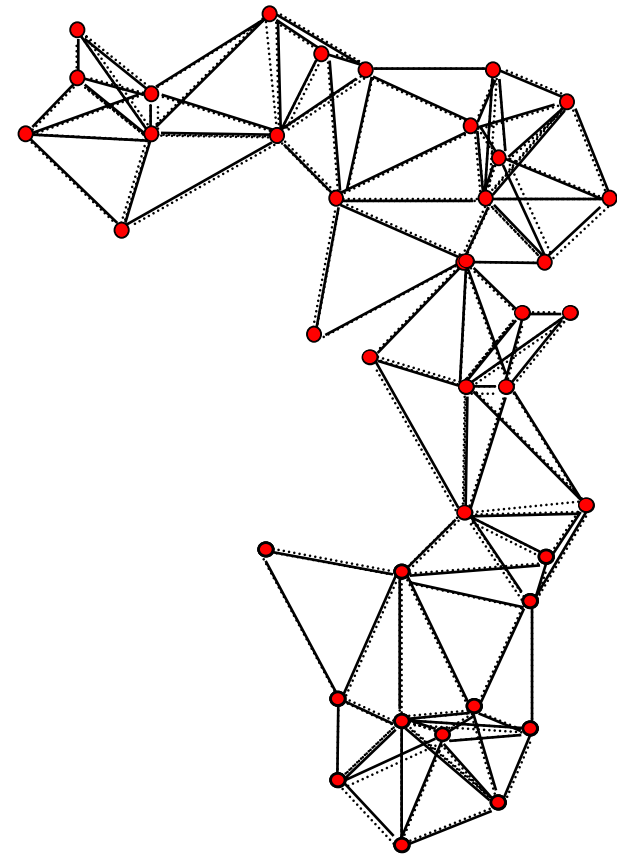
Wireless Sensor Networks

- Embed into the **physical world**
numerous distributed sensors



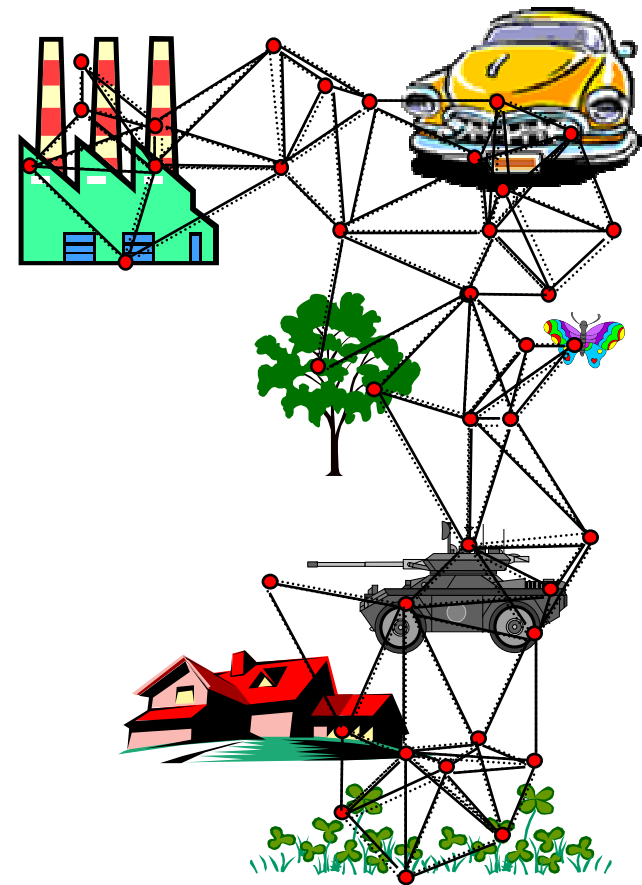
Wireless Sensor Networks

- Embed into the **physical world** numerous distributed sensors
- Network these sensors so that they can **coordinate** to perform **higher-level tasks**



Wireless Sensor Networks

- Embed into the **physical world** numerous distributed sensors
- Network these sensors so that they can **coordinate** to perform **higher-level tasks**
- **Monitor** the world and recognize relevant events and situations





Prof. Dr. **Kurt Rothermel**

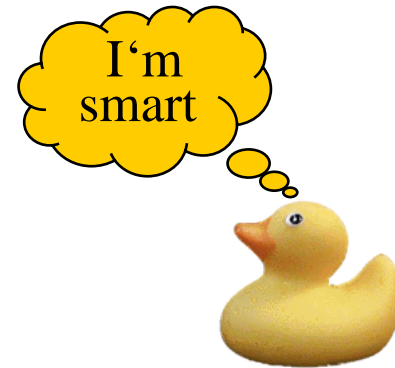
Universität Stuttgart

Institut für Parallele und Verteilte
Hochleistungsrechner IPVS

Applications?

What If Everyday Objects Become Smart?

- What **applications** might then be possible?
- Implications on **business**?





Prof. Dr. **Elgar Fleisch**

Institut f. Technologiemanagement

Universität St. Gallen (HSG)

und

Department of Management,

Technology and Economics

ETH Zurich



Prof. Dr. **Peter Welzel**

Universität Augsburg

Lehrstuhl für Volkswirtschaftslehre



Prof. Dr. **Rolf Pfeifer**

Universität Zürich

Institut für Informatik

Implications?

Child Locators?

- „We'll map your child's location within feet and provide the closest street address“
- Privacy?



Endangered Societal Values?

- Freedom of expression
 - loss of privacy
- Self-determination, being in control
 - humans out of the loop in automatic procedures
- Dependability
- ...



The Digital Revolution Reverses Defaults

1001110100011111001100111000
0001001110100011111001100111
1110100011111001100111000111
1010001111100110011100011110
0011101000111110011001110001
0001001110100011111001100111

- What was once **private** is now **public**
- What was once **hard to copy** is now **trivial to duplicate**
- What was once **forgotten** is now stored **forever**





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Universität Freiburg i. Brsg.
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Marc Langheinrich

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Prof. Dr. iur. **Alexander Roßnagel**

Universität Kassel

Institut für Wirtschaftsrecht (IWR)

und

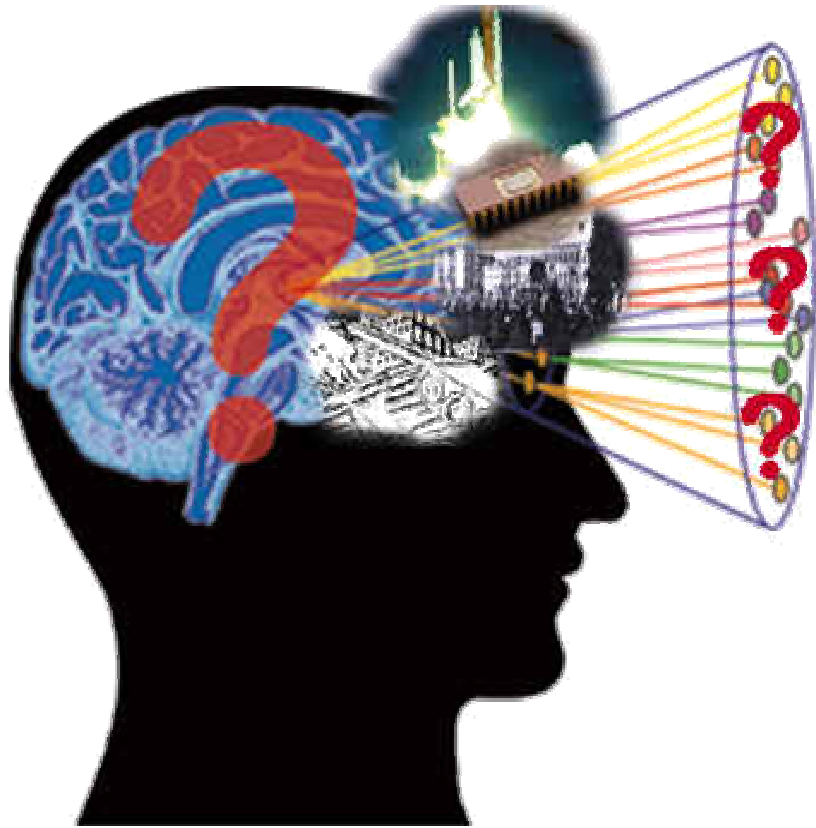
Forschungszentrum für

Informationstechnik-Gestaltung

(ITeG), Fachbereich

Wirtschaftswissenschaften

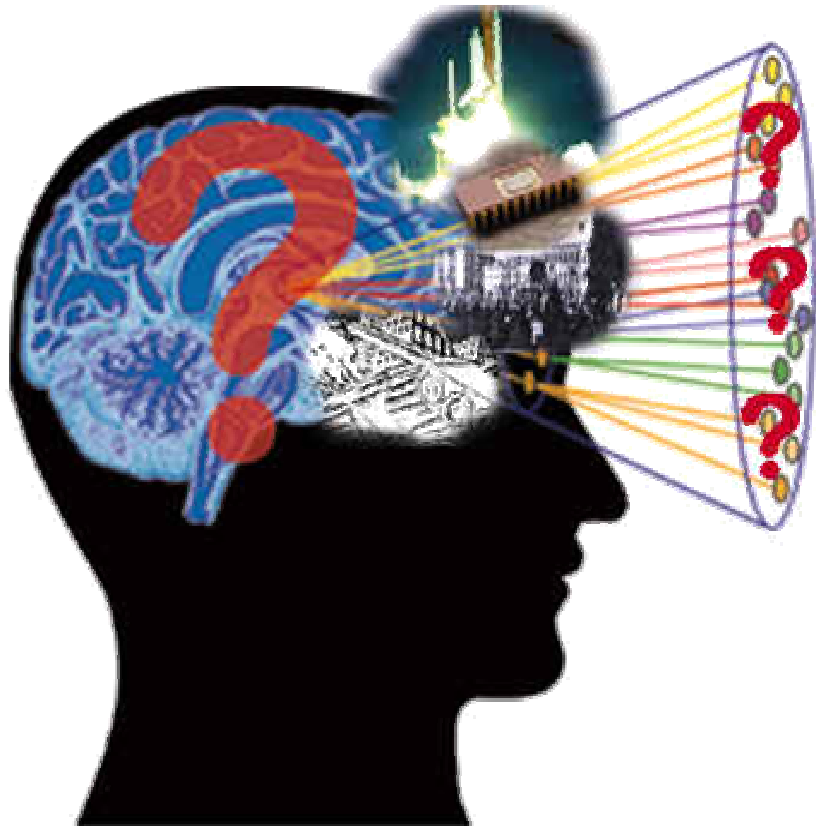
Why Care About the Future?



"We should all be concerned about the future because we will have to spend the rest of our lives there".

Charles F. Kettering

Why Care About the Future?



"We are always very bad at predicting how a given technology will be used and for what reasons"

Bran Ferren

A Better World?





Vlad Coroama

ETH Zürich

Institut für Pervasive Computing



Matthias Handy

Universität Rostock

Institut für Angewandte
Mikroelektronik und Datentechnik

Living in a Smart Environment

- **Consequences of Ubiquitous Computing**

- social, economic, privacy
- everyday life, work, home,...

- What alternatives do we have when **shaping a „smart“ world?**

- **Gottlieb Daimler- & Karl Benz Foundation**

- supported 7 groups (DE, CH), Jan 02 – Jan 05
- scenarios, demonstrators, papers
- discussions and discourses



Ladenburg Discourses



**WELCOME
TOMORROW**

150 JAHRE ETH ZÜRICH

Friedemann Mattern

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