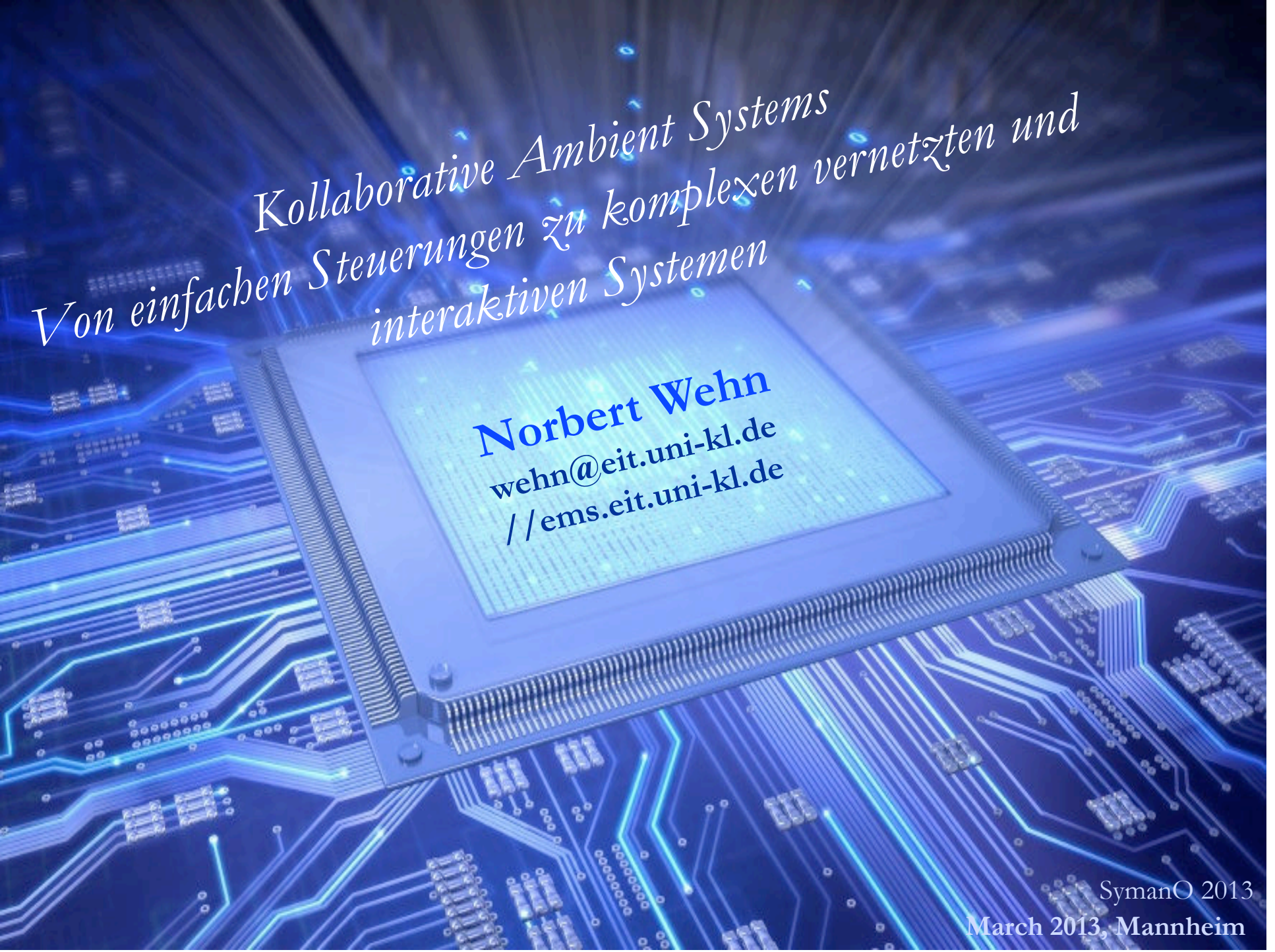

Kollaborative Ambient Systems
Von einfachen Steuerungen zu komplexen vernetzten und interaktiven Systemen
Norbert Wehn
wehn@eit.uni-kl.de
//ems.eit.uni-kl.de
SymanO 2013
March 2013, Mannheim

History of Computer

- *„I think there is a world market for maybe five computers“*
  Thomas Watson, CEO IBM, 1943

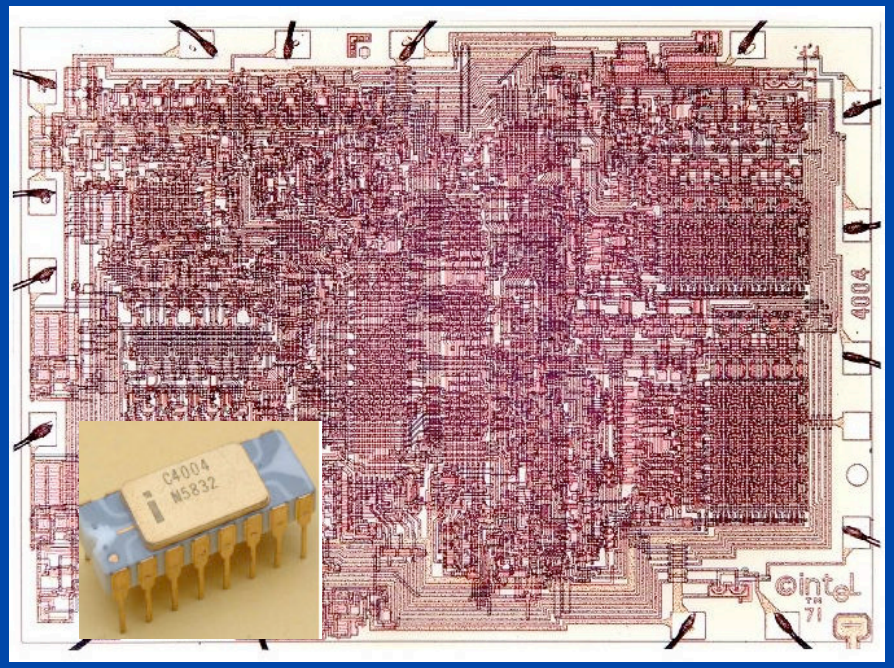
- *„There is no reason for any individual to have a computer in his home“*
  Ken Olsen, CEO DEC, 1977

- *„Internet is only a Hype.“*
  Bill Gates, CEO Microsoft, 1995

- *„The most profound technologies are those that disappear...“*
- *„...a new way of thinking about computers in the world, one that takes into account the natural human environment and allows the computers themselves to vanish into the background...“*
- **Marc Weiser, Xerox Parc, 1991 „The Computer of the 21st Century“**

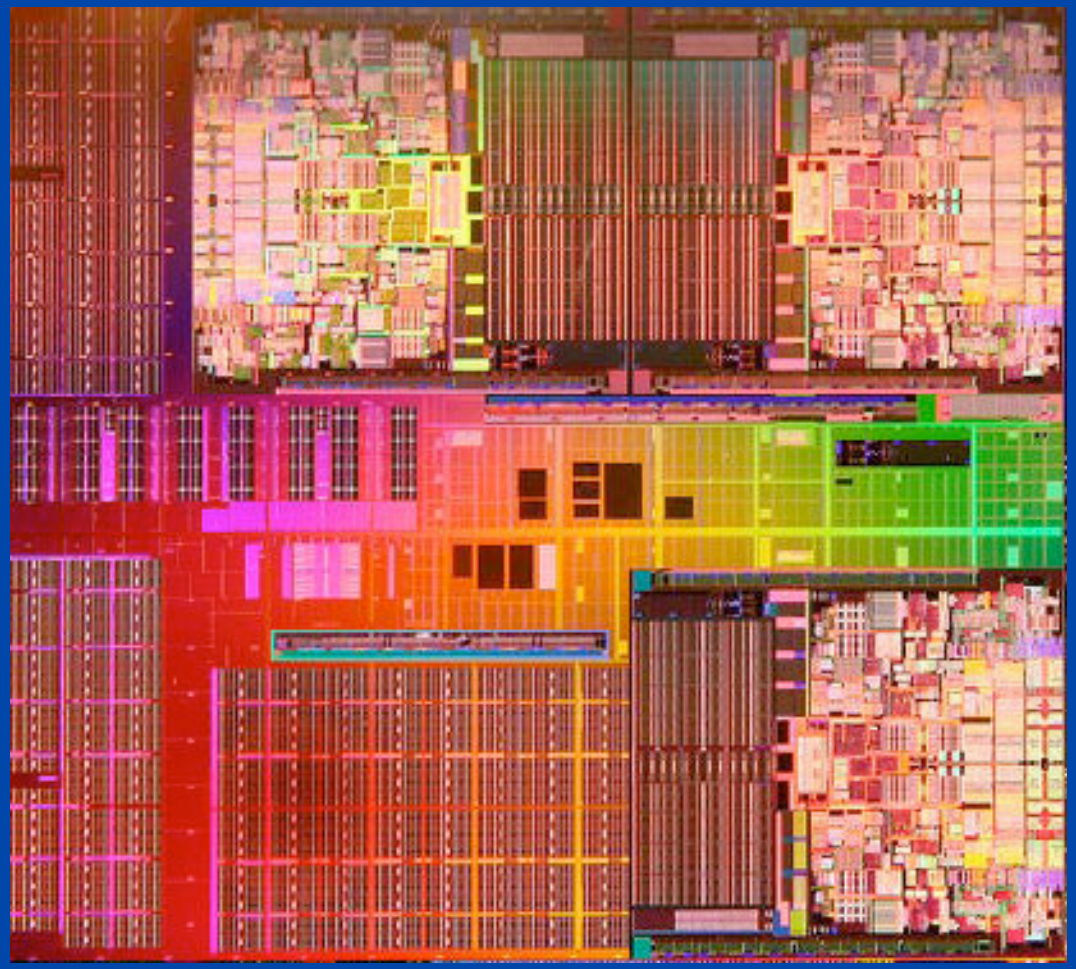
History PC

First microprocessor (1972): 2250 transistors, 108KHz, 10um



Today: >1 billion transistors, 10.000.000KHz, 0.028um

Intel Dunnington

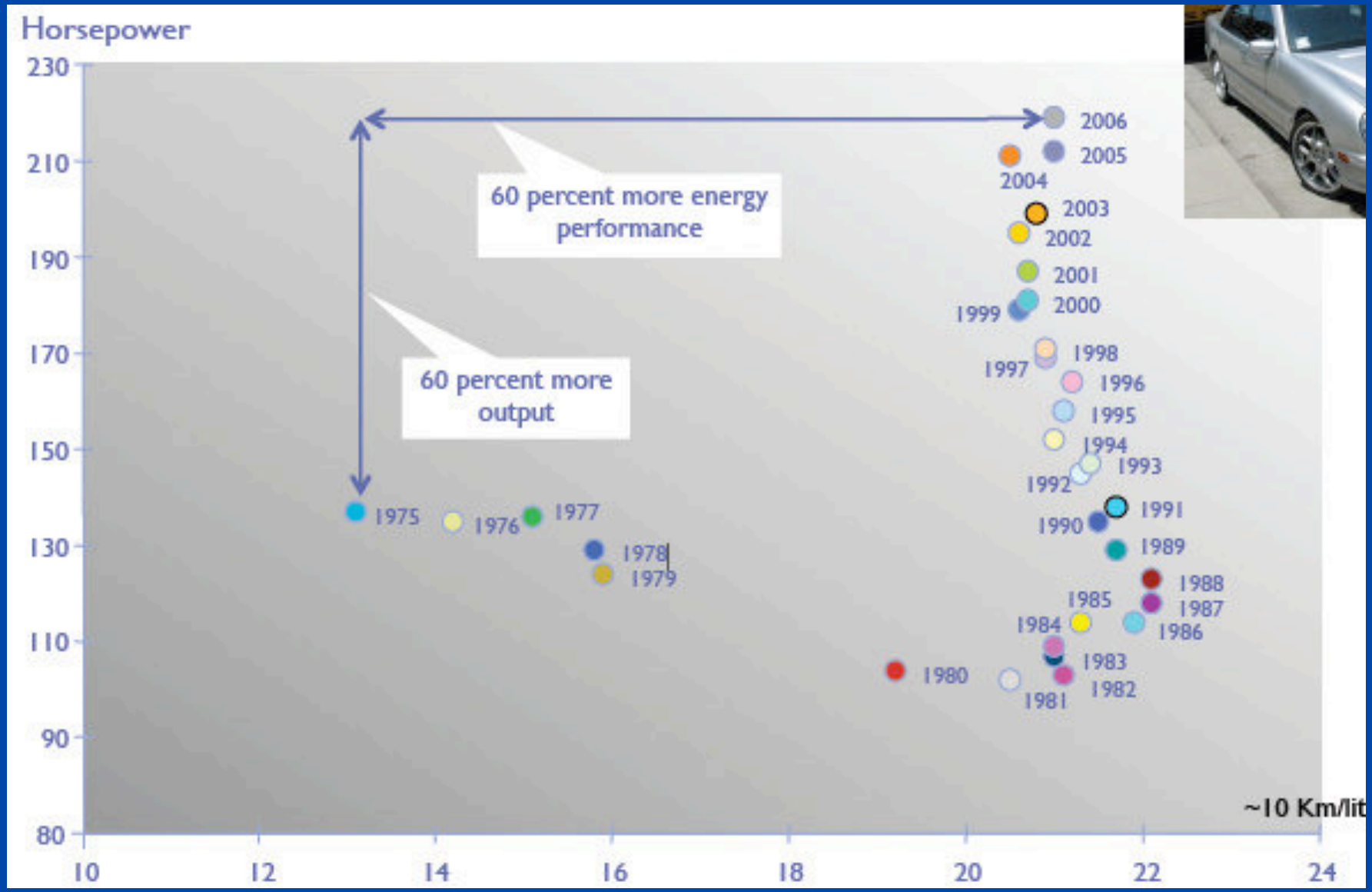


- 6 Core processor
- 1900 Mill. Trans.
- 2.66 GHz, 45nm
- 403 mm2
- >130 Watt

#Transistors x 106 #Frequency x 30.000

#Feature size x 200 # Chip size x 40

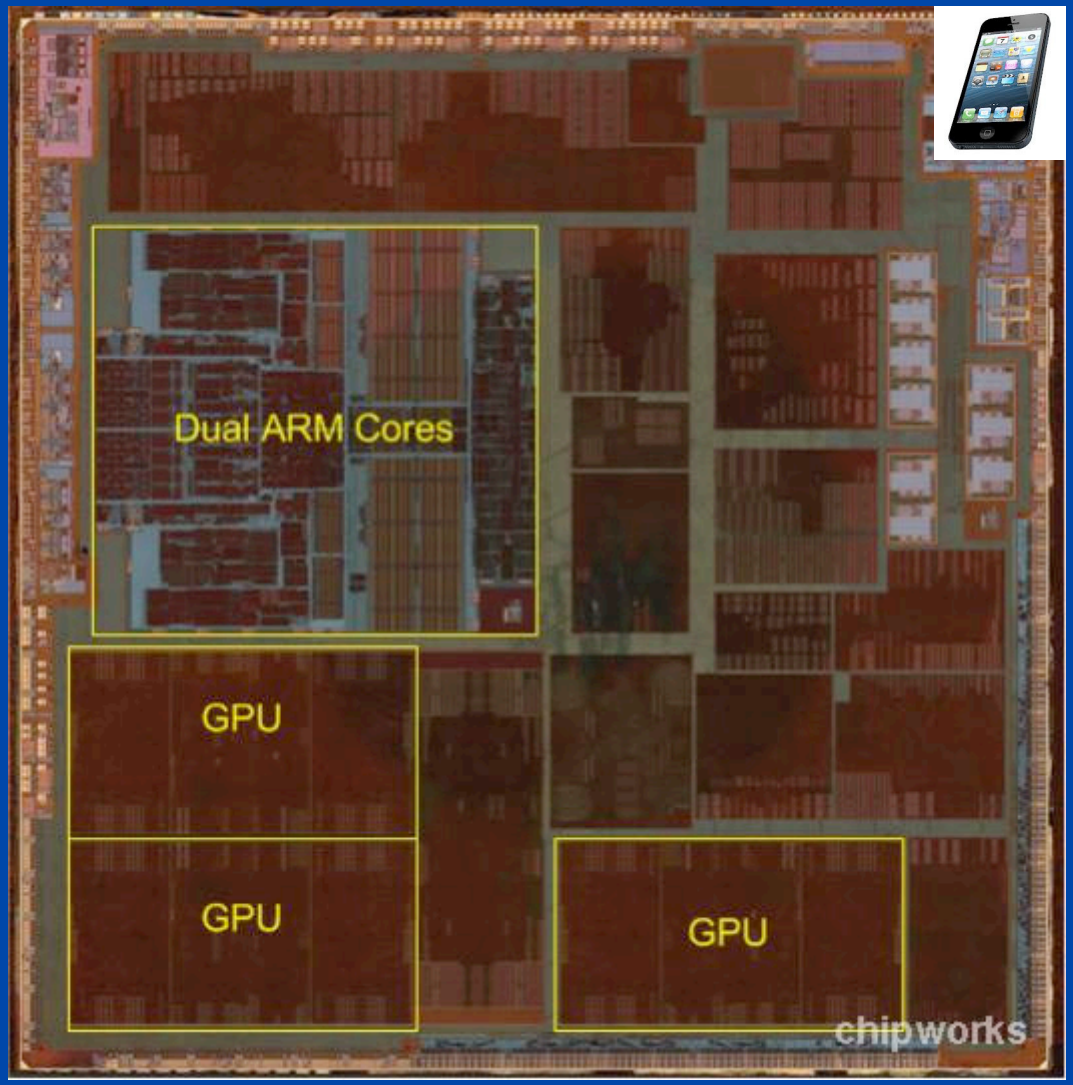
Comparison Car



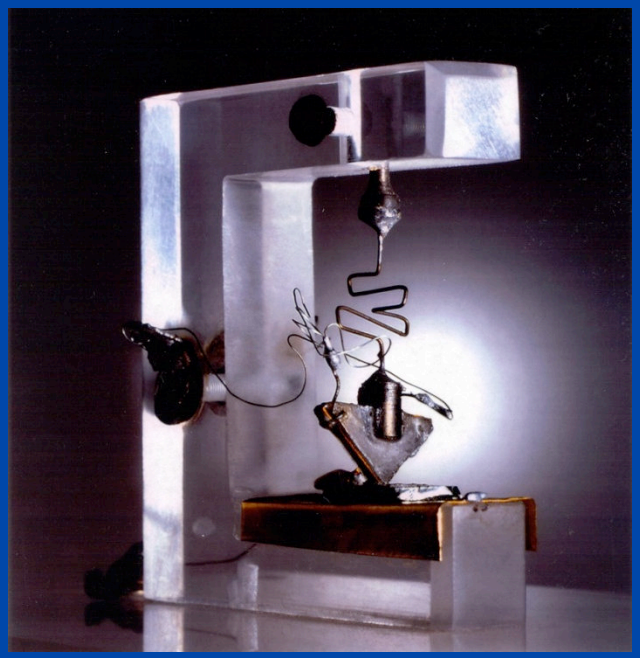

iPad

Apple A6 Multi-Core Processor

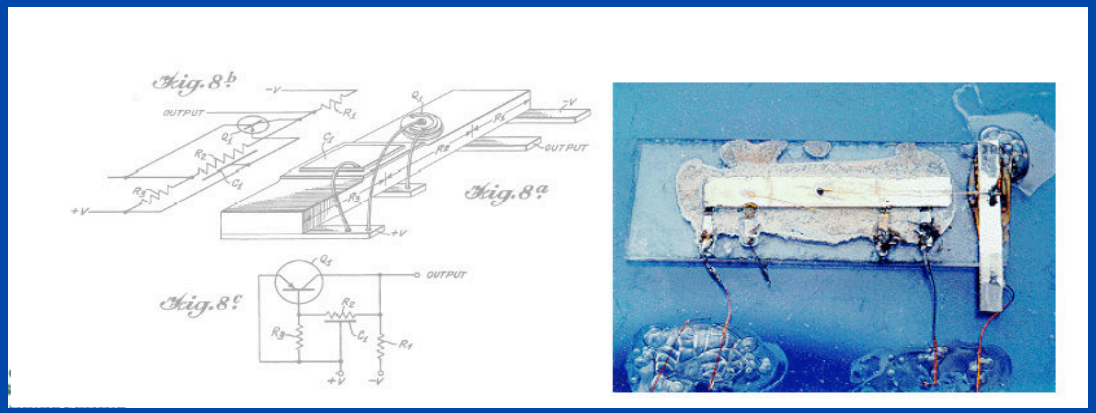
- 32nm HKMG process
- 96,7 mm2
- 800MHz-1.3GHz
- Package-on-package
- 2x faster than 4S



First Transistor (1947)



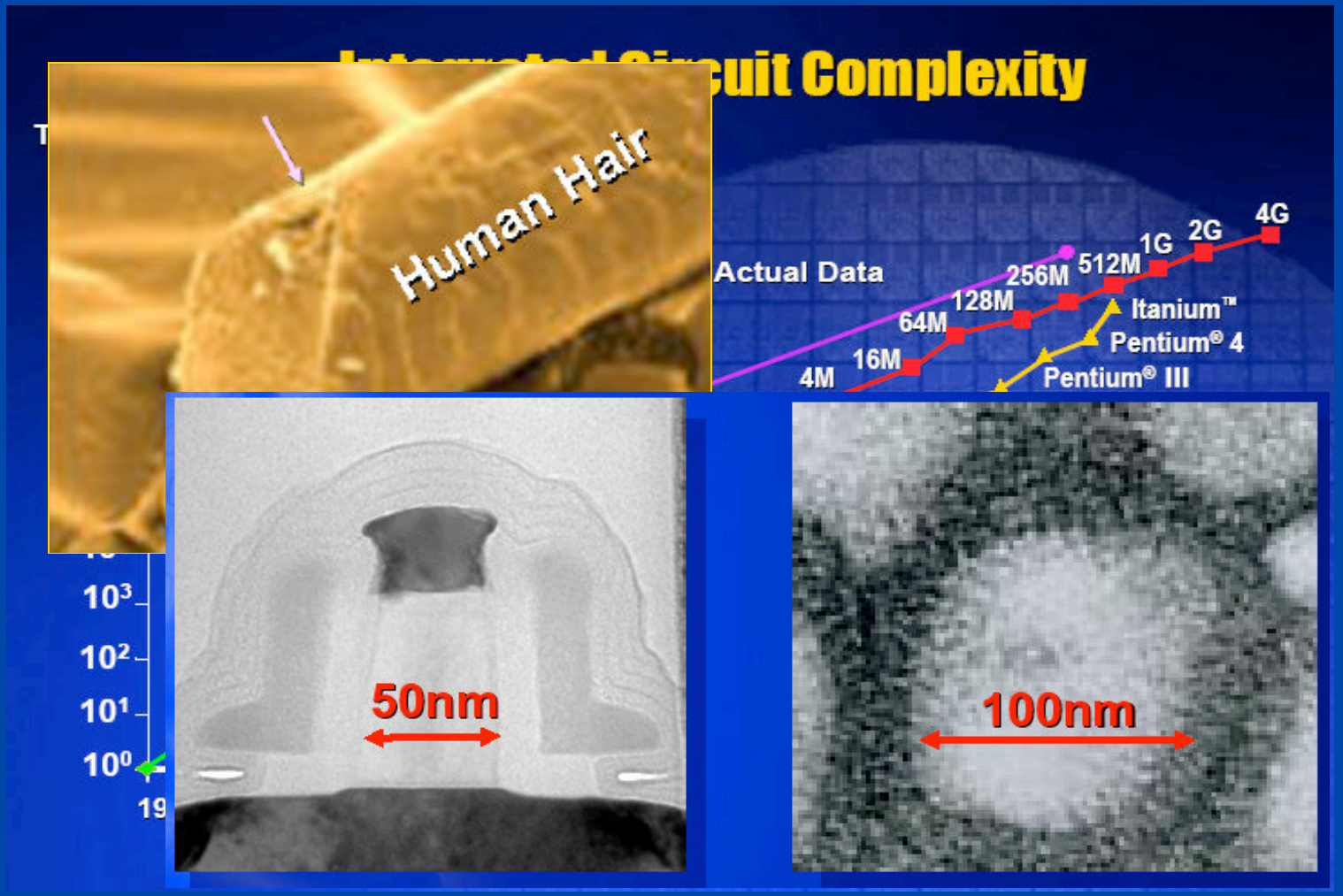
- Christmas 1947 (Bell)
- Bardeen, Brattain discover Transistor
- 1956 Nobel prize together with Shockley



1958 (TI)

- Kilby starts with miniaturization
- 2000 Nobel prize

Moore's Law (1965)



Post-PC Ära

1000 Chips/Computer

0.01 Computers/Person

10

1

1

>100

Großrechner → **PC** → **Post-PC Era**

Data Processing

Multimedia, Internet

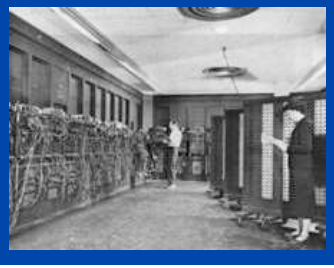
„Ubiquitous Computing“

Scientific Computing & Bunsiness

Personal Computing

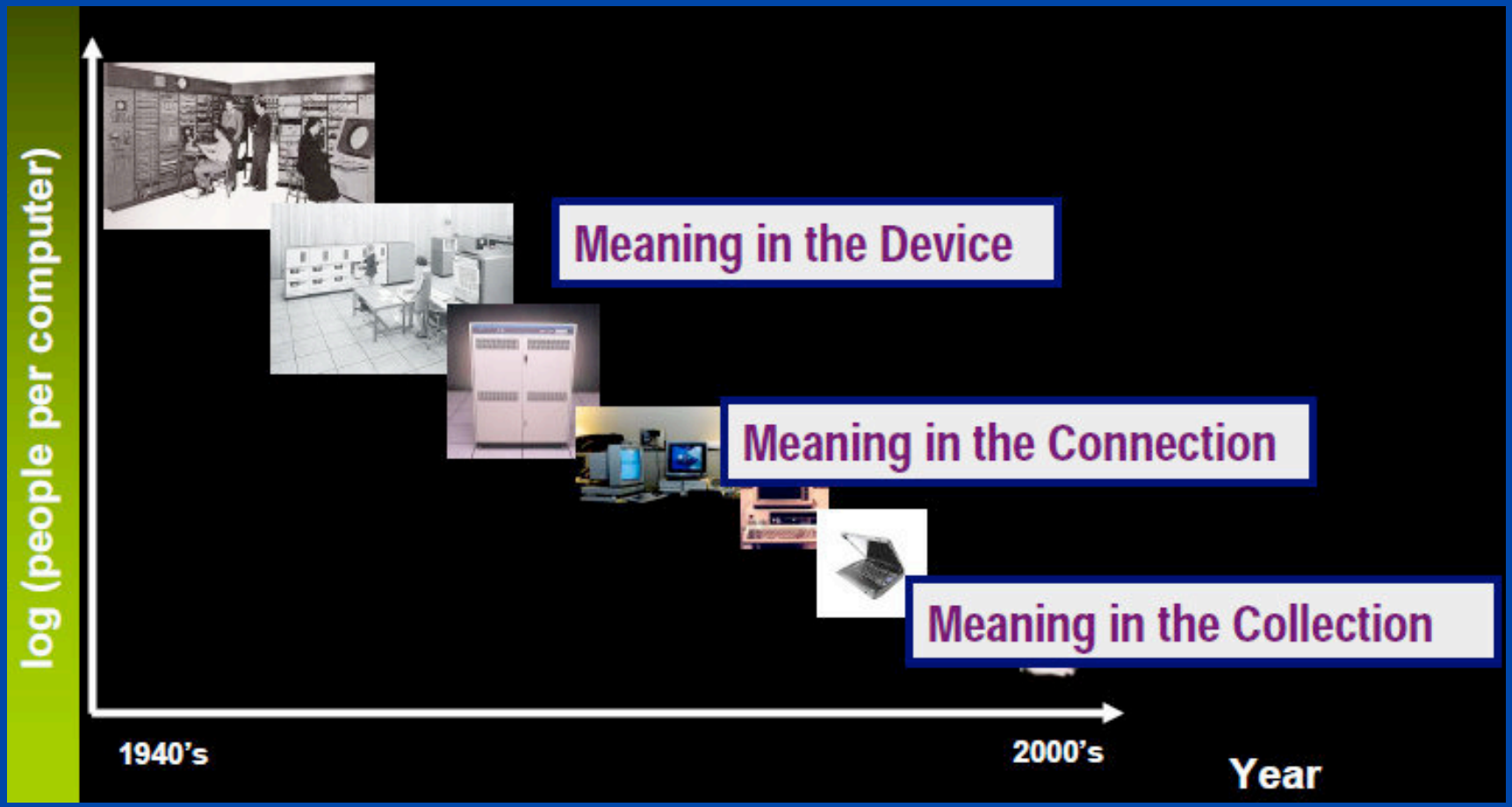
Mobile Computing

60 **70** **80** **90** **00** **10**



>10 Billion processors/year

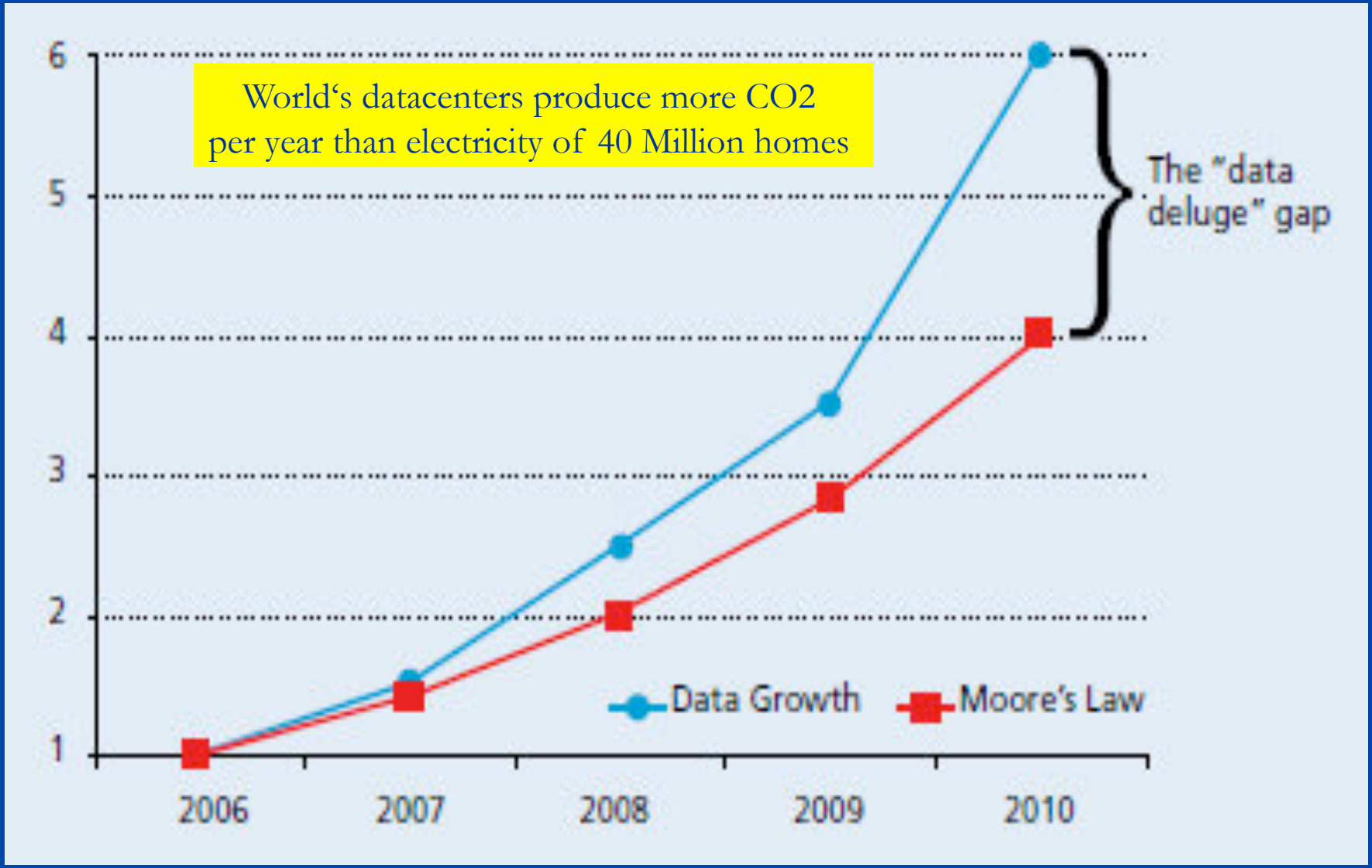
Change in the World of Computing



Source: R. Newton

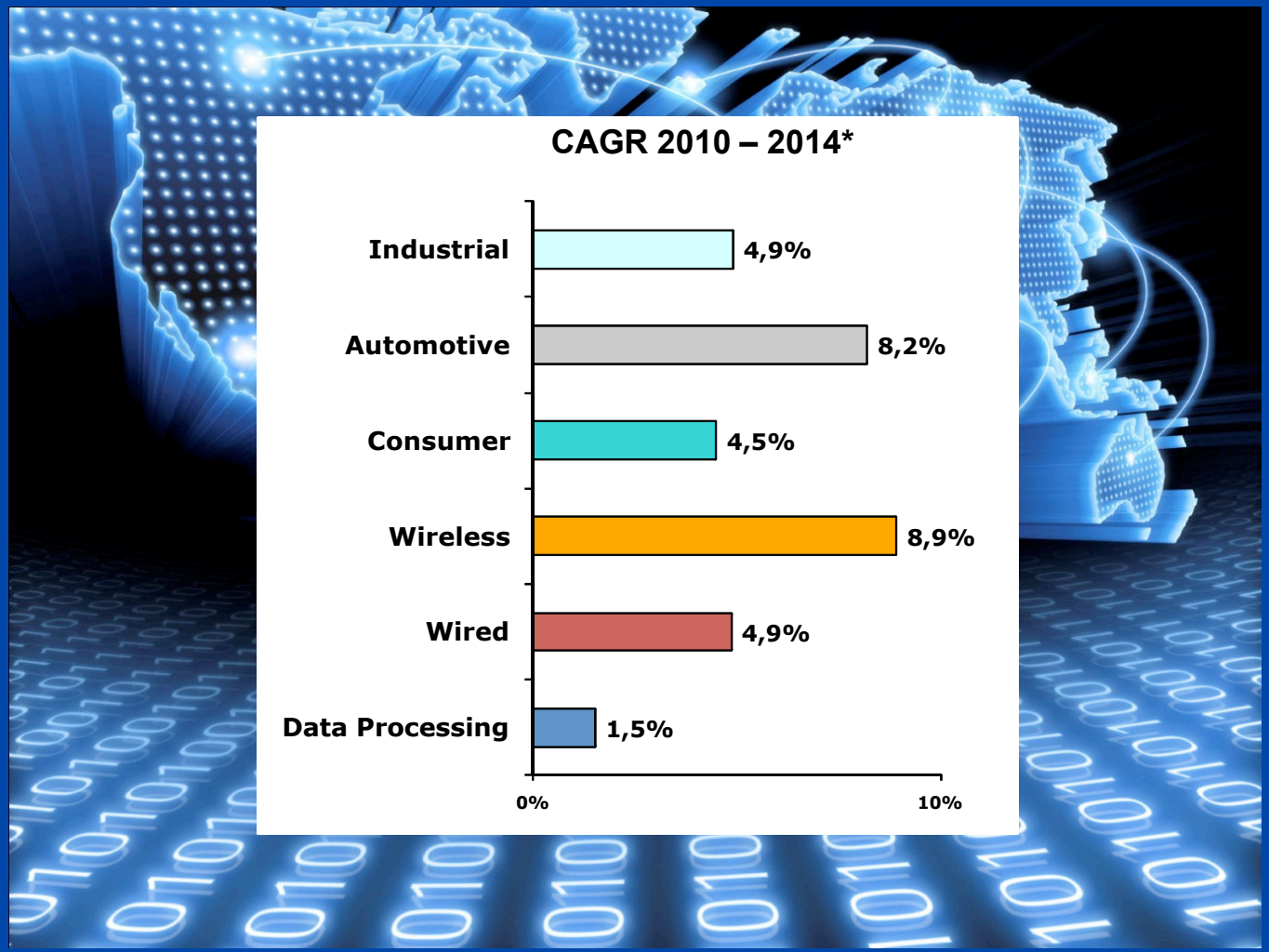
Information Collection

Flooding of Information



Communication Centric World

„Any where, any time, any one, any information“



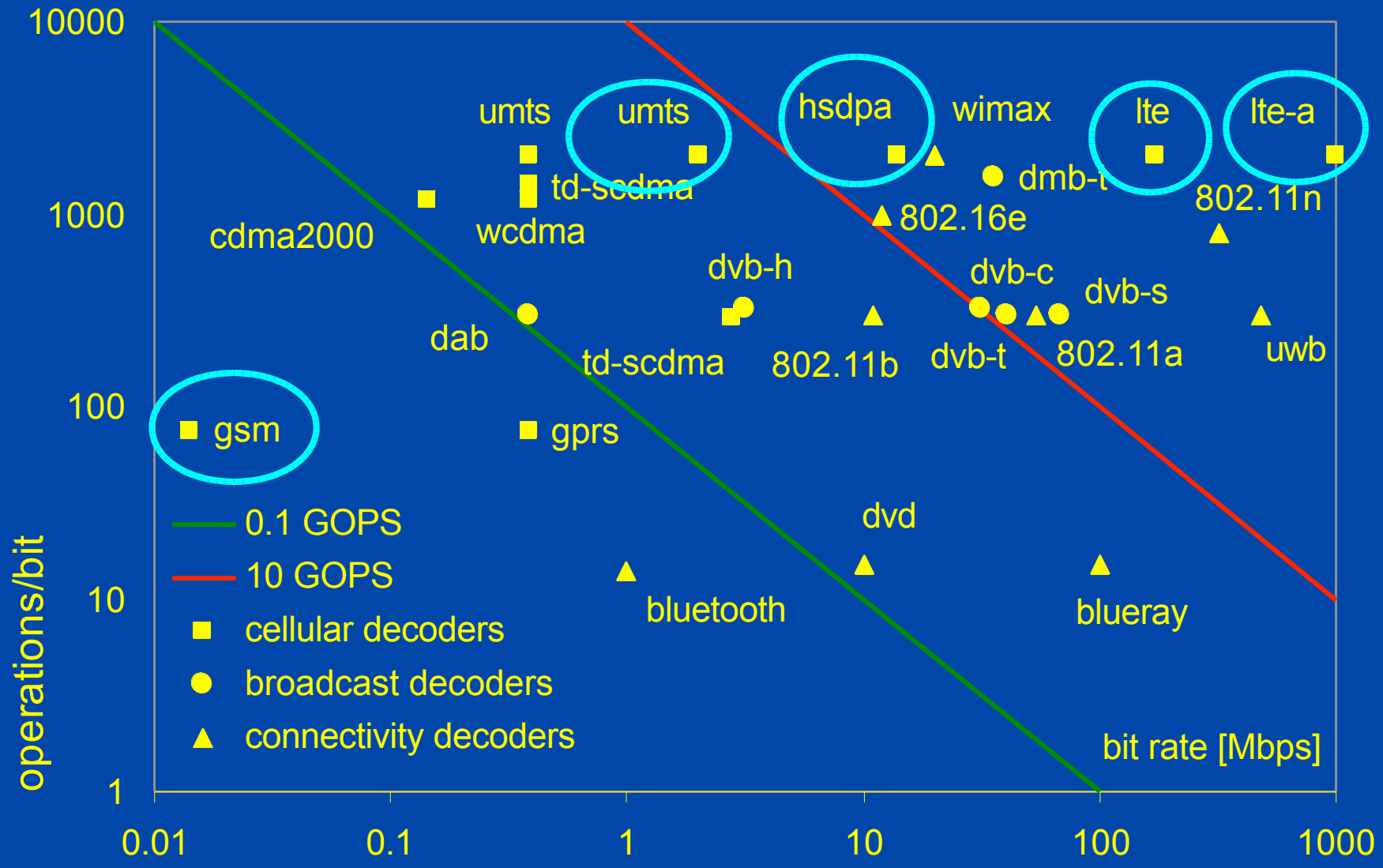
- New cellular mode is added every 3 years, new frequency band every year
- Continuous demand for higher data rates and more services

Communication Centric World

- ~ 4 Billion Mobile subscribers worldwide
- ~ 1 Billion new mobiles/year
-
-
-

- Computational power of „Smartphones“
  - Today: 100 Gops @ 1 Watt
  - Factor 10 every 5 years

Mobile Phone Trends



Source: Kees van Berkel, MPSoC

Our World becomes Smart

From simple microcontrollers to multicore architectures

- HPC in embedded computing

Sensors everywhere

- Increased context sensitivity

High throughput wireless communication standards & Internet

- Large connectivity of systems/objects
- Increased interaction between embedded systems and consumer devices

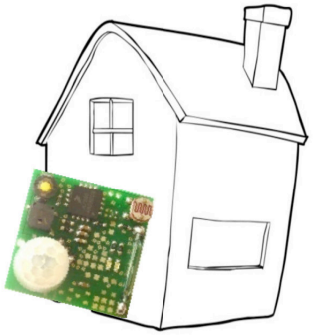
Internet 2012

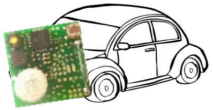
- > 2 Billion people connected
- > 1 Trillion connected “objects” (Internet of Things)

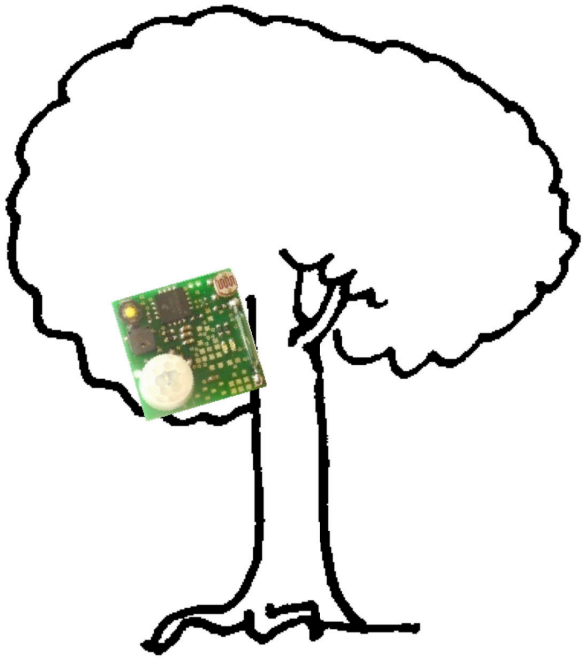
Blurring border between physical and digital world

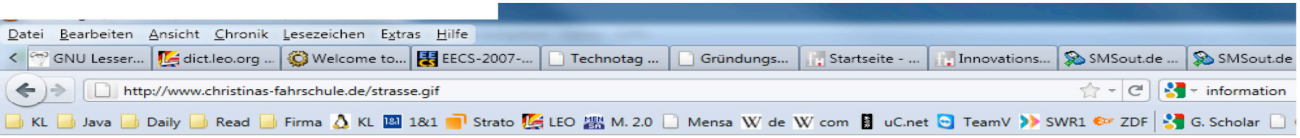
Information aggregation based on connected “objects”

Increased interaction of environment and human beings





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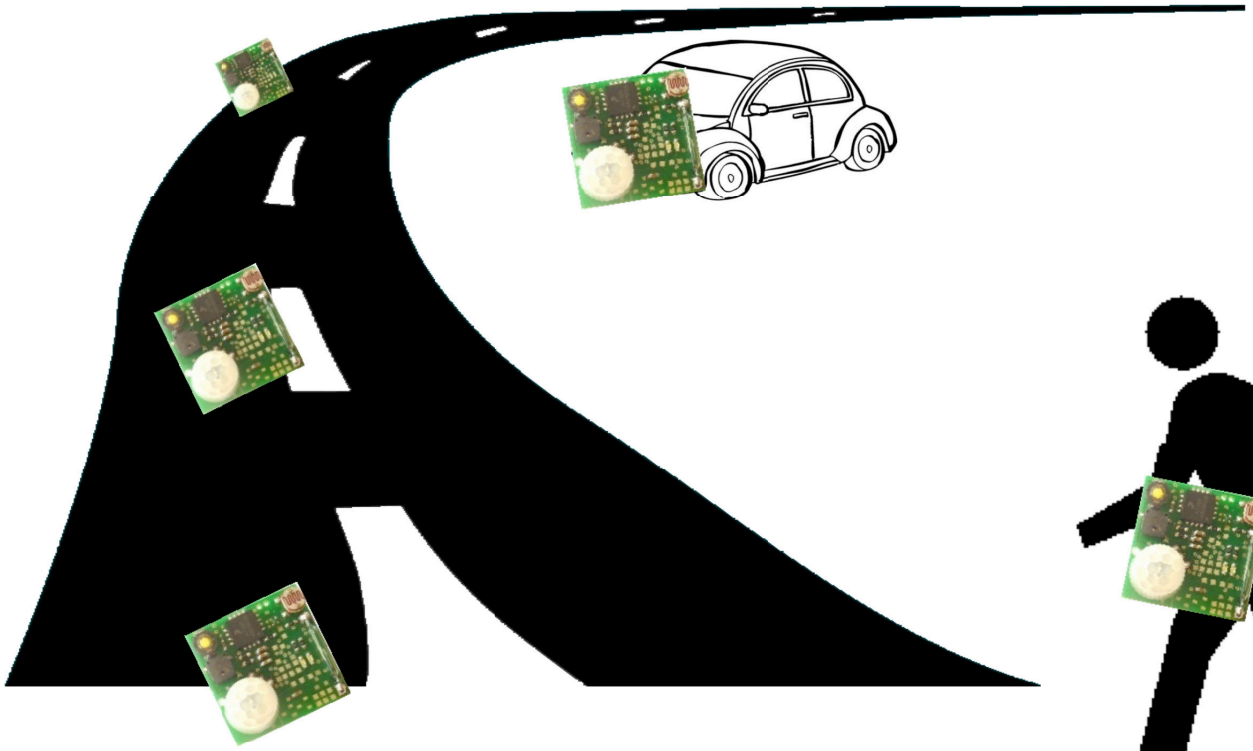
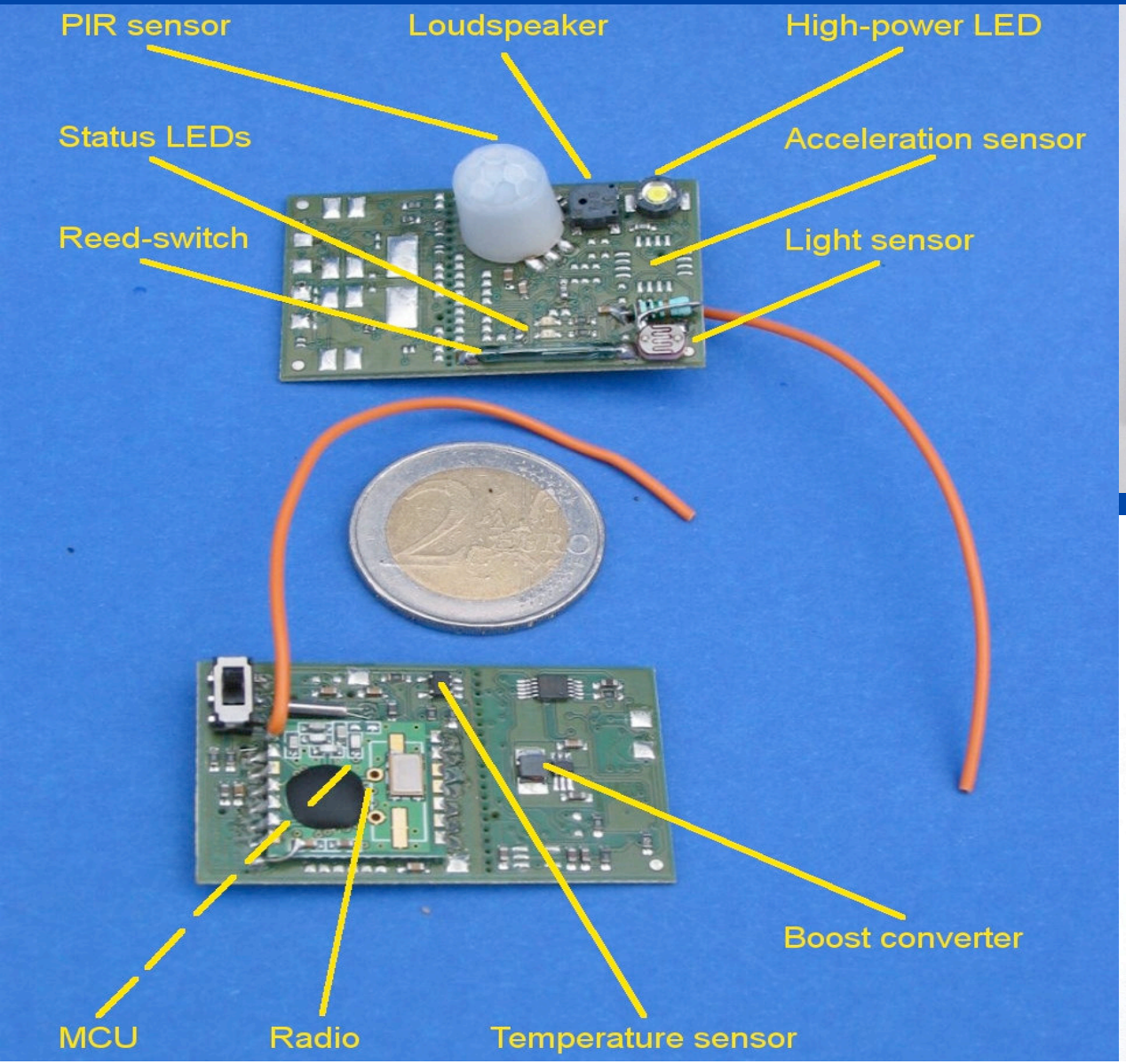
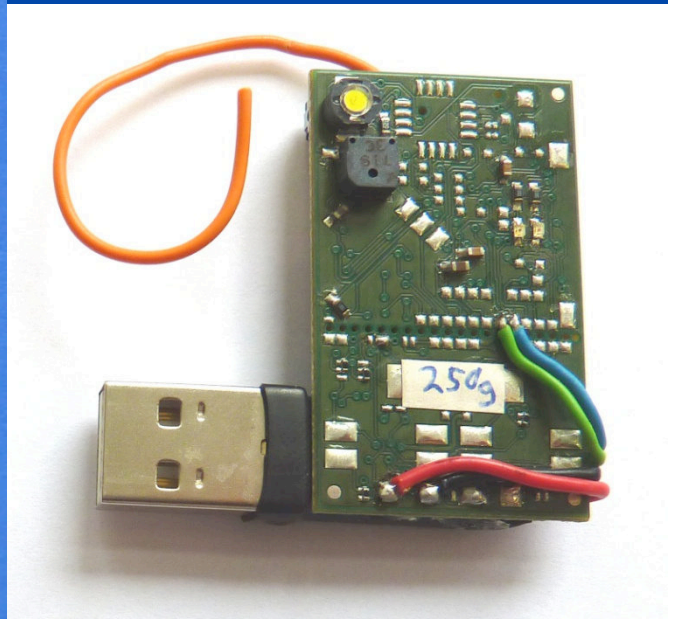


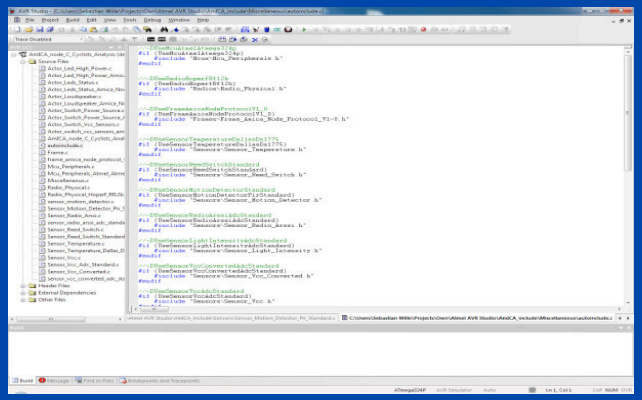
Example Sensor Nodes - AmICA

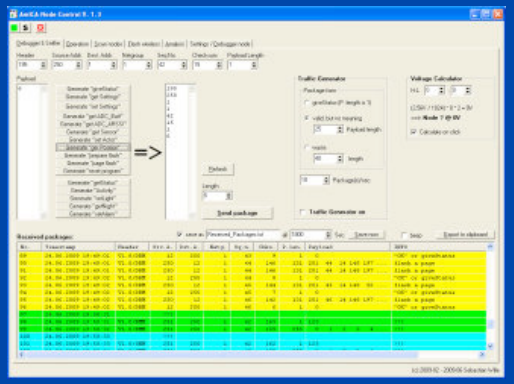




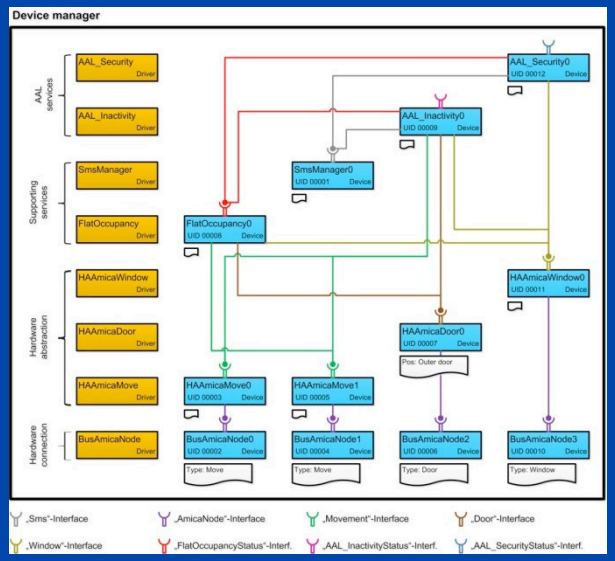
AmICA Platform

Software Development Framework & Debugger toolkit

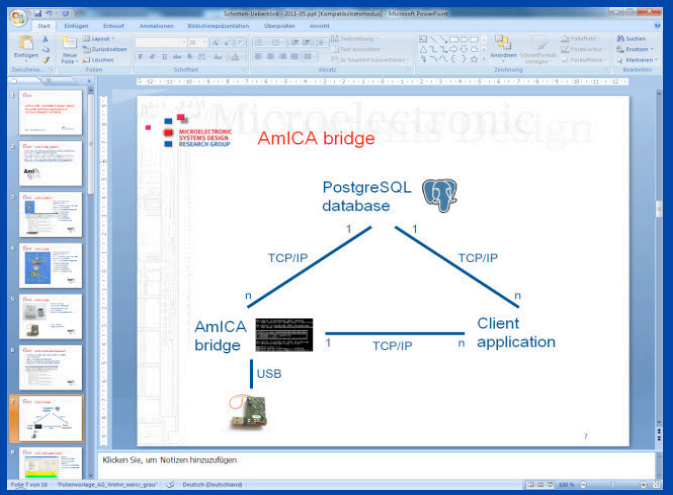




TinySEP middleware



Flexible PC Framework



Application Assisted Living

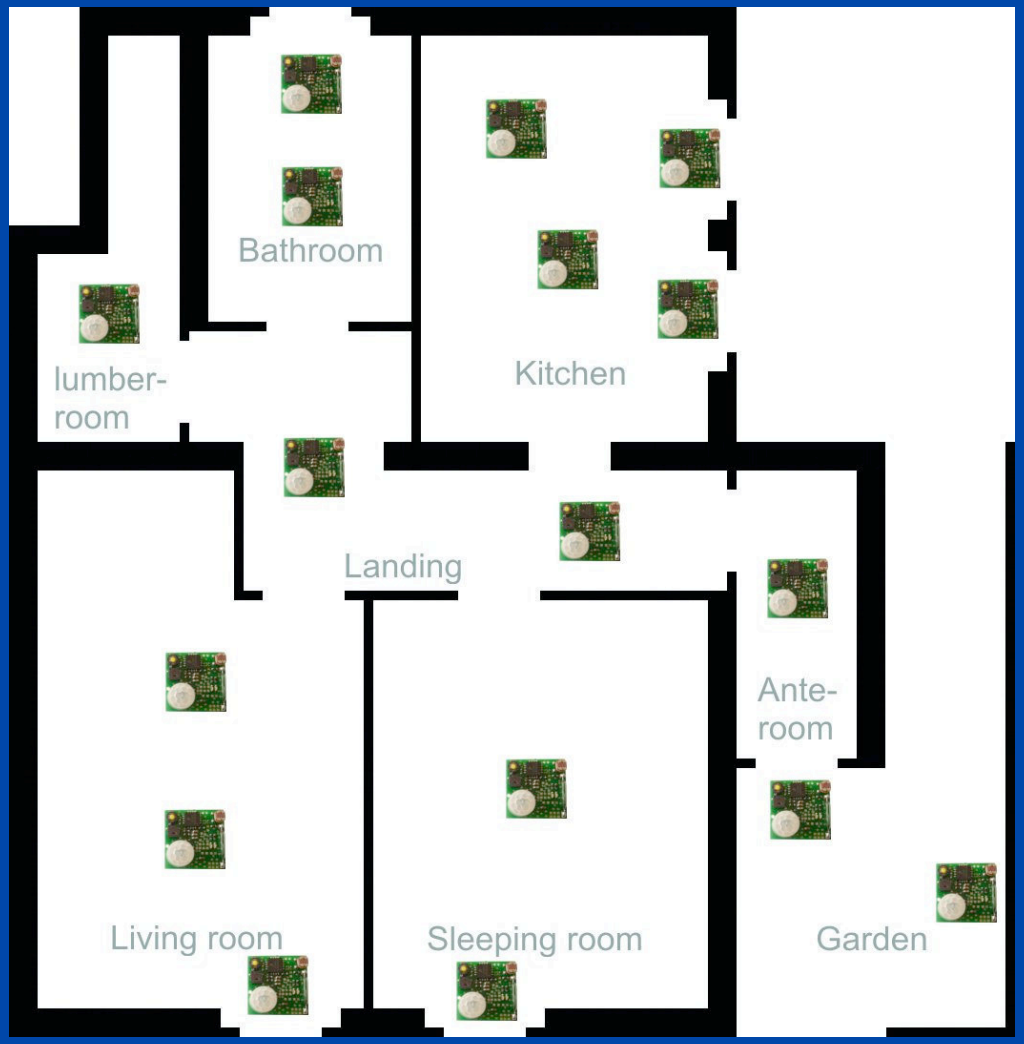
17 AmICA nodes

Sensor:

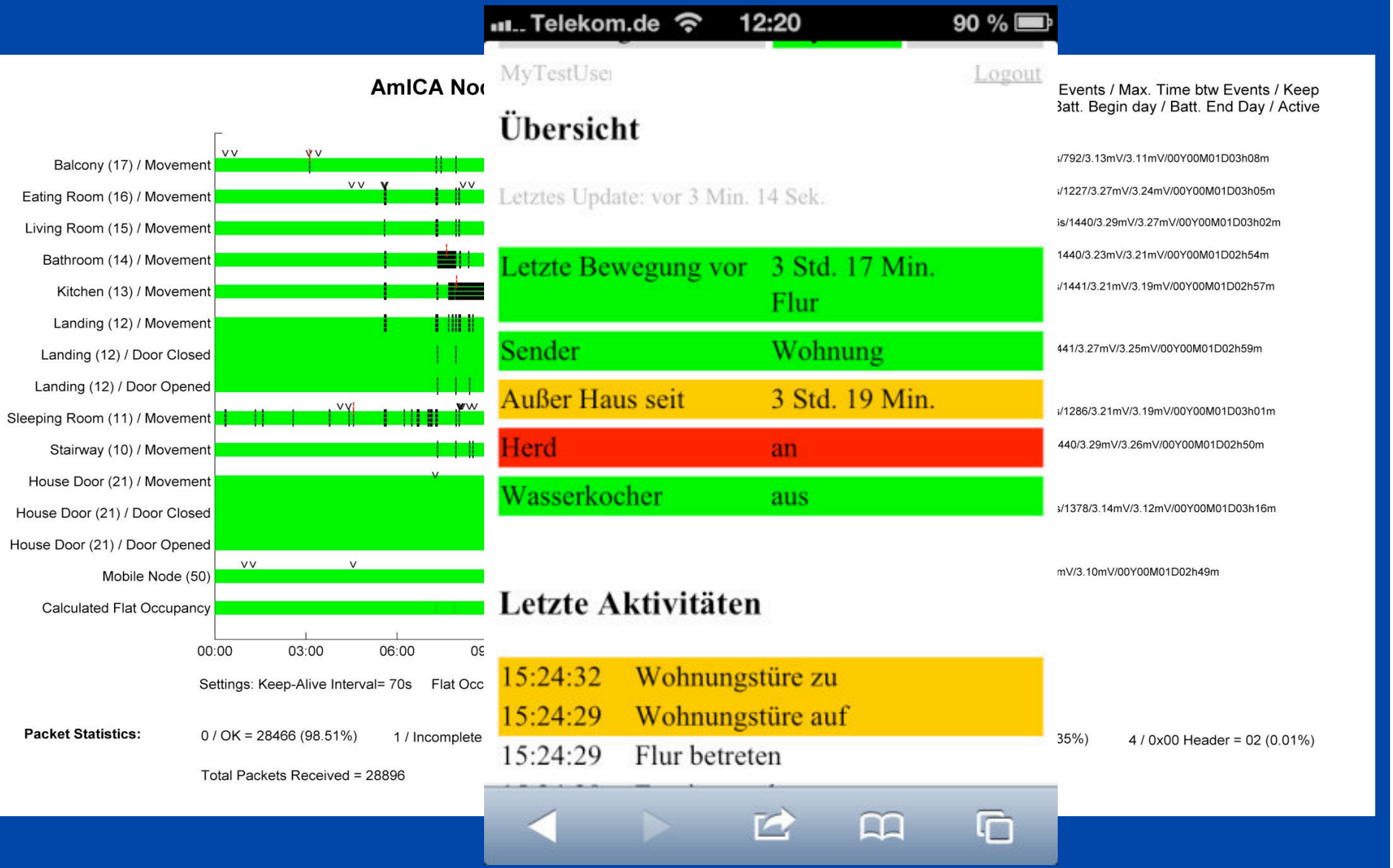
- 17x temperature
- 13x movement
- 12x light
- 9x windows
- 7x door
- 1x garden door
- 1x cooker
- 1x letter box

Actors

- 4x shutter blender control
- Light
- Heating



Application Assisted Living



Further AmICA Applications

Cooperation with „Rusty Jumpers“ from Kaiserslautern

- On-node processing and detection of jumps
- Displaying count of jumps and jumps/seconds

Spinning for Fireman

- Sensor node extended with a hear-beat-receiver and pedal sensor
- Up to 20 AmICA nodes in parallel
- Visualization of Data

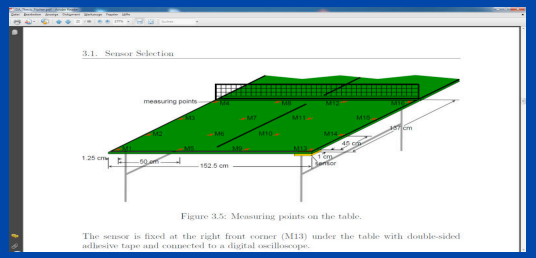
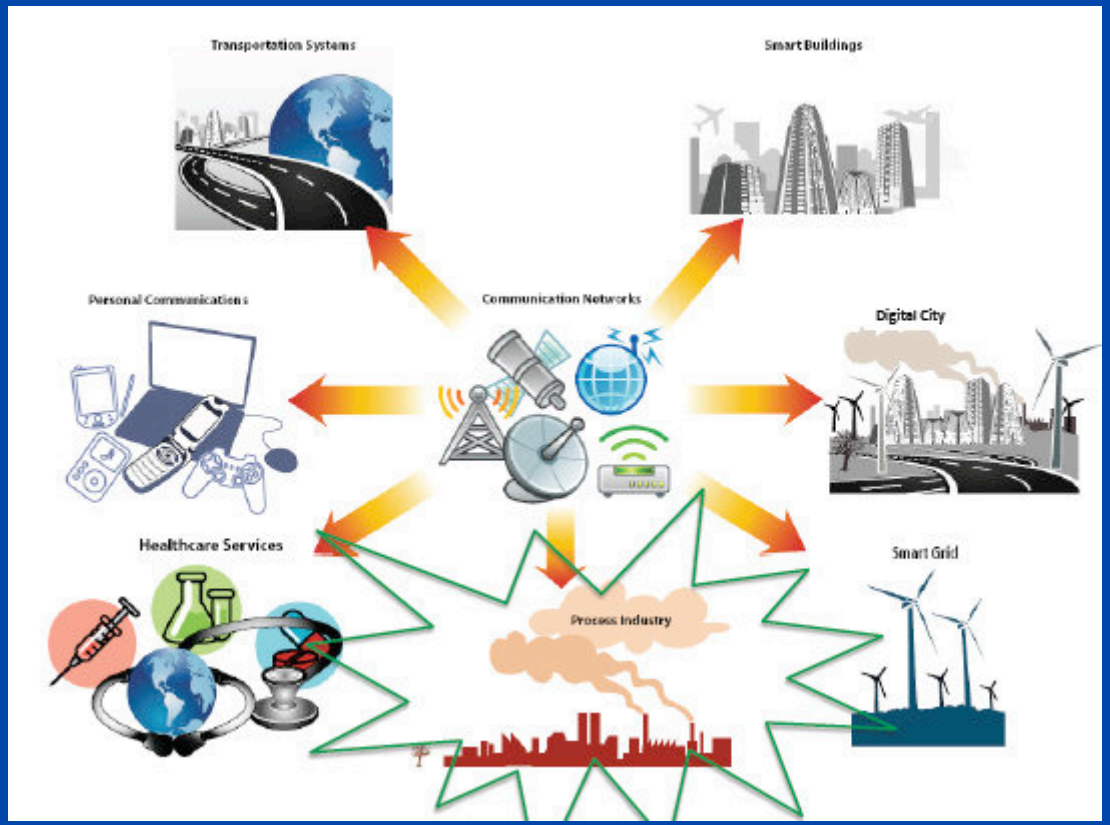


Table tennis

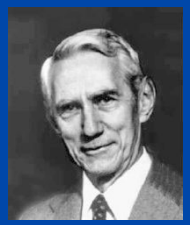
- Automatic detection of ball impact

Towards Cyber-Physical Systems

Ubiquitous Computing → Monitoring Environments Wireless Sensor Networks → Closing the loop Critical Infrastructure



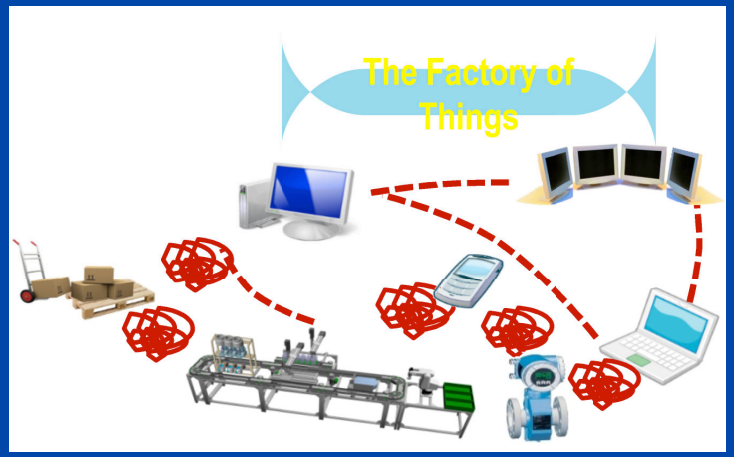
Alan Turing



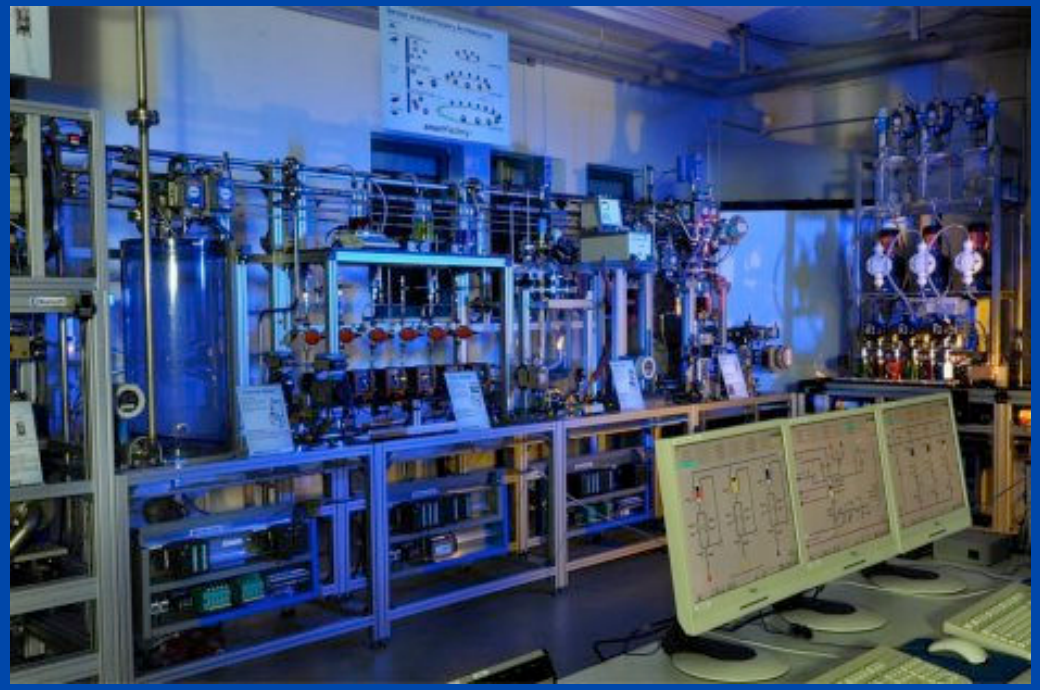
Claude Shannon

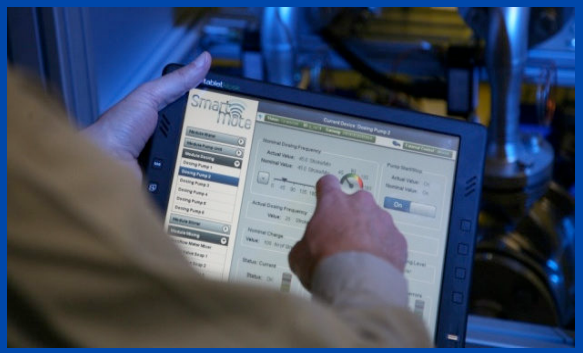
Harry Nyquist

Example Smart Factory TU Kaiserslautern



- Flexible control networks with ad-hoc communication
- Decentralized, context adaptive production and logistic (“intelligent product”)
- Location based services

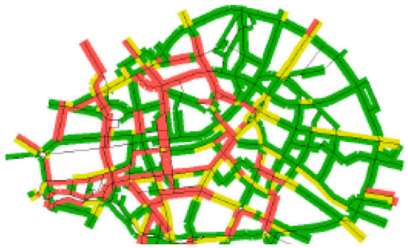




smart Factory KL
die intelligente Fabrik der Zukunft

„Green Mobility/Transportation“

Global Traffic Management



City level traffic optimization
Safety, Time, Energy, CO2

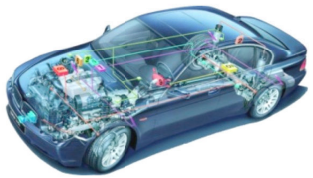
Local Traffic Control

Local optimization
Time, Energy, CO2

car2infrastr.

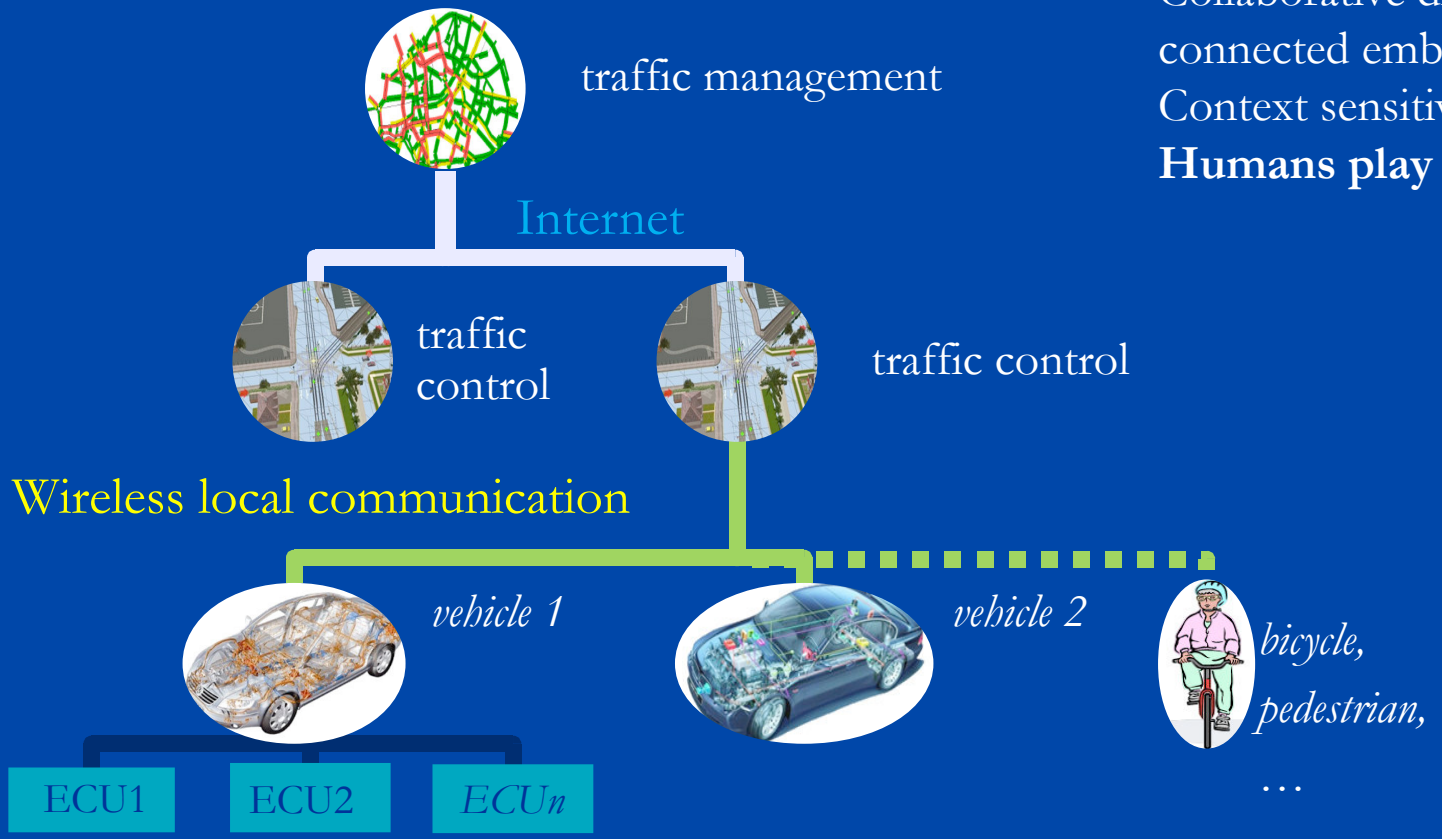
Vehicle Network

car2car com.



- Driver Assistance
- Body Control
- Entertainment

Underlying Network



Collaborative distributed highly connected embedded systems
Context sensitivity
Humans play central role

Towards Cyber-Social Systems

- CPS: integration of computation, communication and physical world
- Next step: Integration/interaction with human's activity and social behavior

Thank you for attention!

For more information please visit

http://ems.eit.uni-kl.de