Cool Silicon for Europe

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Cork

September 5th, 2011

COOL SILICON

energy efficiency innovations from silicon saxony

Subsidized by

Bundesministerium für Bildung und Forschung

STAATSMINISTERIUM FÜR WISSENSCHAFT UND KUNST

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Outline

Starting Point: Cool Silicon Overview

Relevant Trends

Priorities for the Call

Summary

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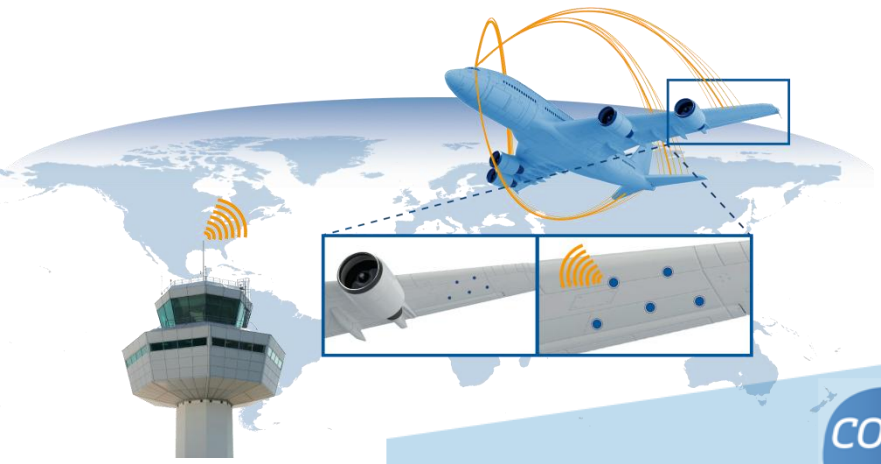
Problem Definition and Goal of the Project

- The world wide usage of electronic devices will keep on growing for many more years to come
- This development is only sustainable if the total energy consumption of electronic devices is kept at a constant level
- As a result the energy efficiency of electronic devices needs continuous and significant improvement
- Cool Silicon is working in all areas of the value chain to make the constant energy reduction in electronics an integral part of the design and fabrication process of electronic devices.
  Because Saxony has a leading role in this area this focus offers a competitive advantage for the cluster partners

Project Overview – technical projects



COOL SiLiCON

Networked Sensors

Communication Systems*

Micro-/Nanoelectronics Technology & Production

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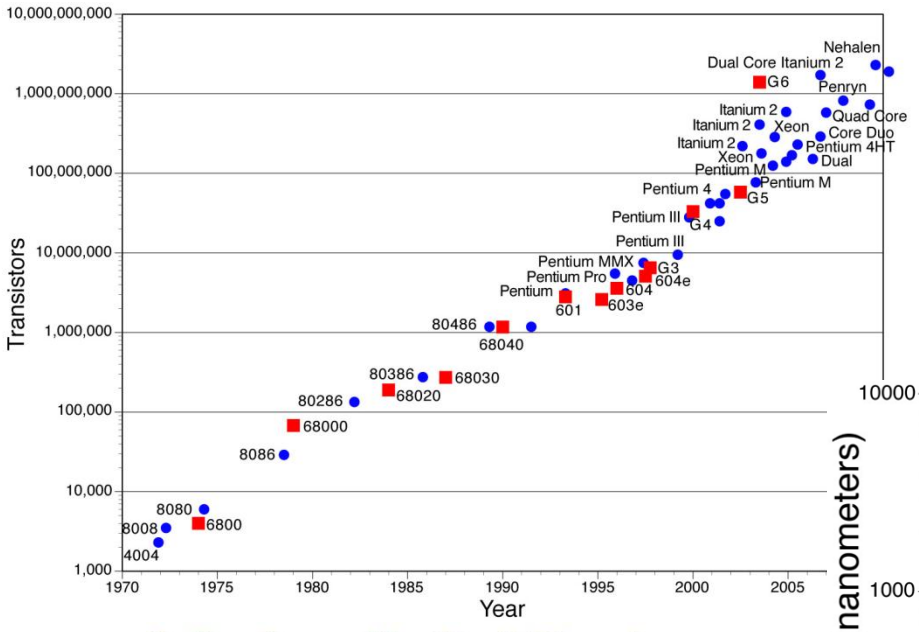
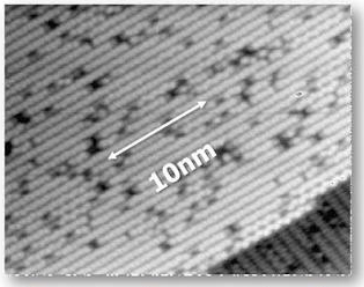
Relevant Trends – Moore´s Law

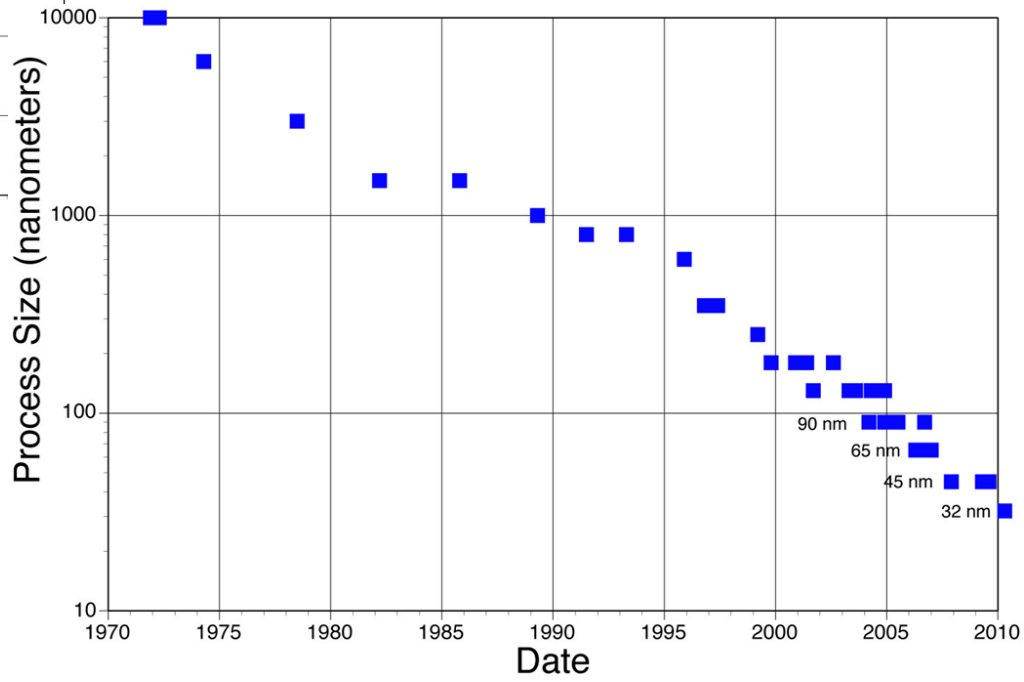


Scaling: Approaching Atomic Dimensions

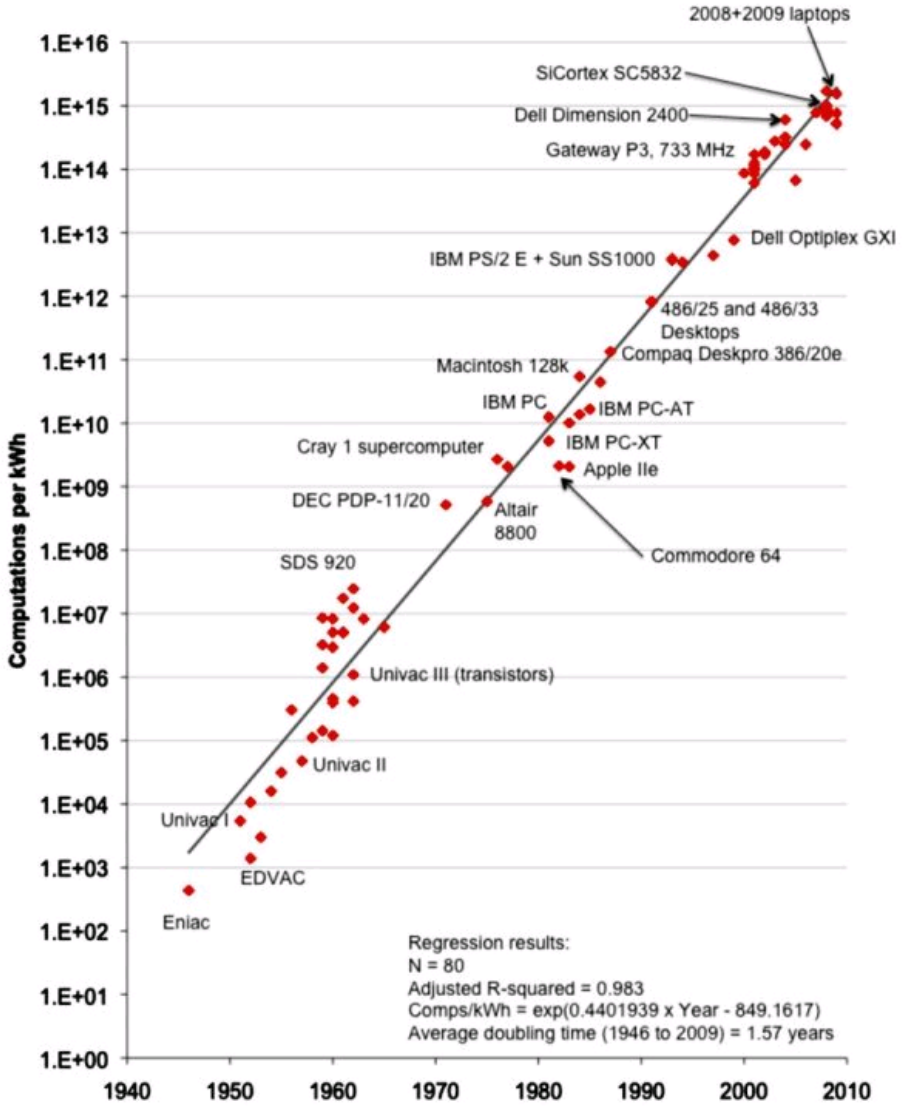


Scanning tunneling microscope image of a silicon surface showing 10nm is ~20 atoms across

- The success of semiconductor technology is based on the continues scaling of minimum feature sizes
- Scaling is connected to higher energy efficiency



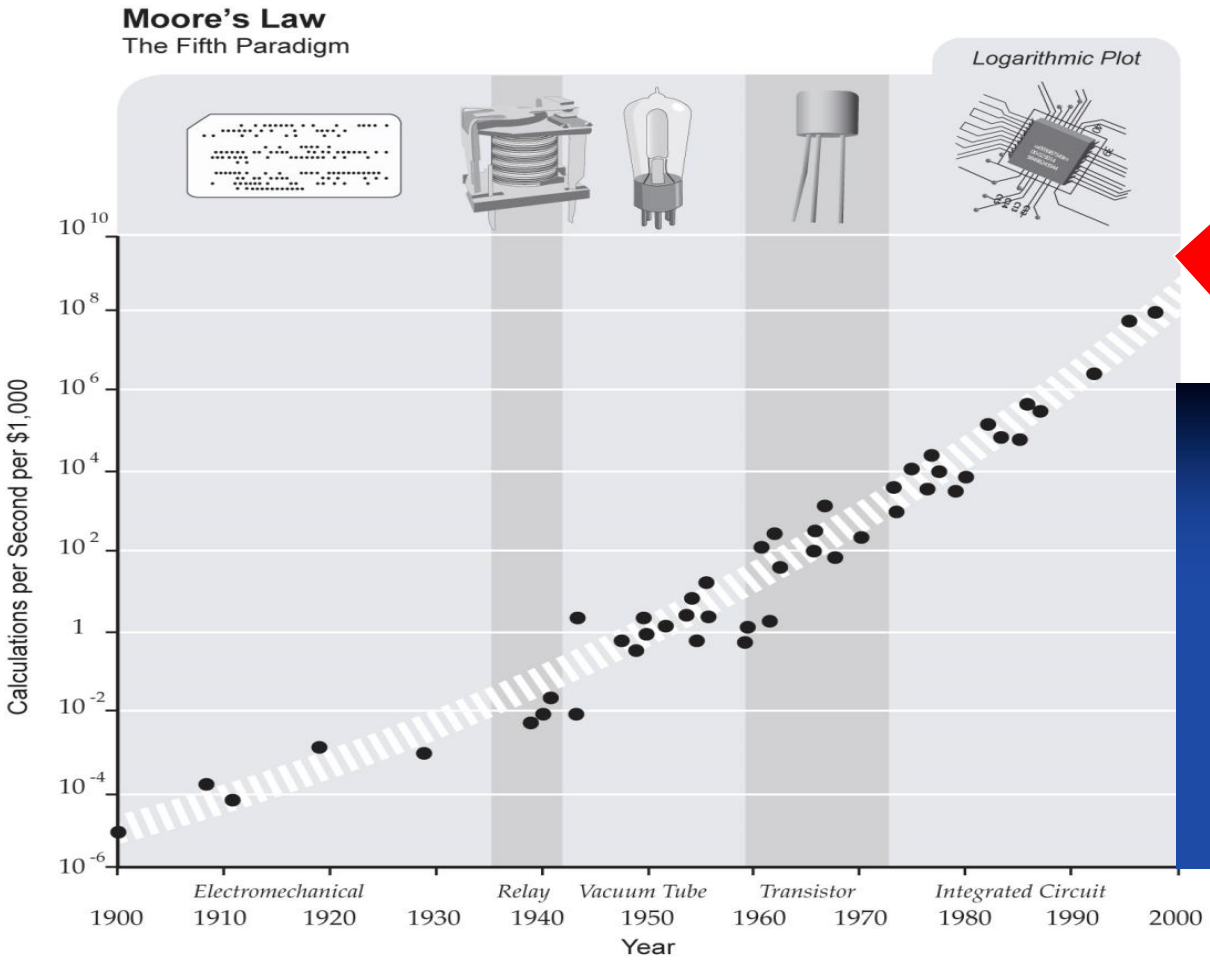
Relevant Trends – Moore´s Law

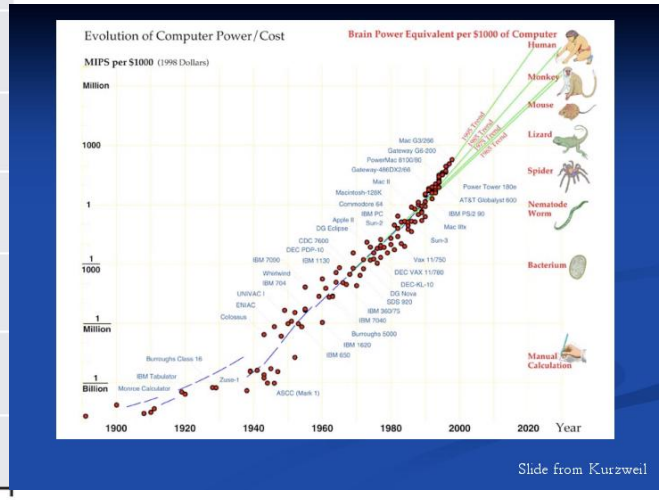


- Need for even stronger energy efficiency trend to keep total power consumption constant

Relevant Trends – the sixth paradigm

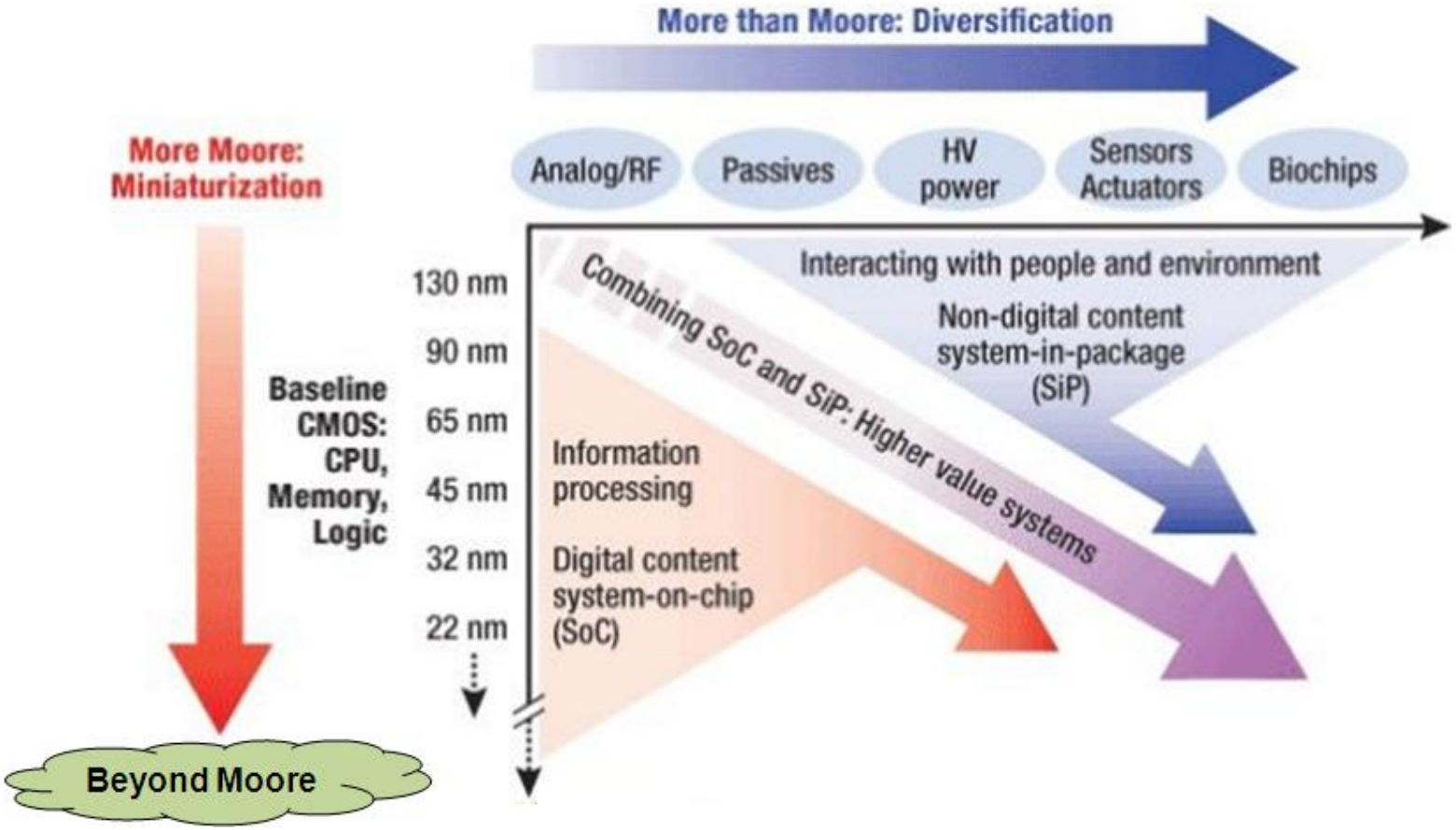
- Exponential growth did start long before IC technology!
- It is likely that (exponential) growth will expand beyond IC technology





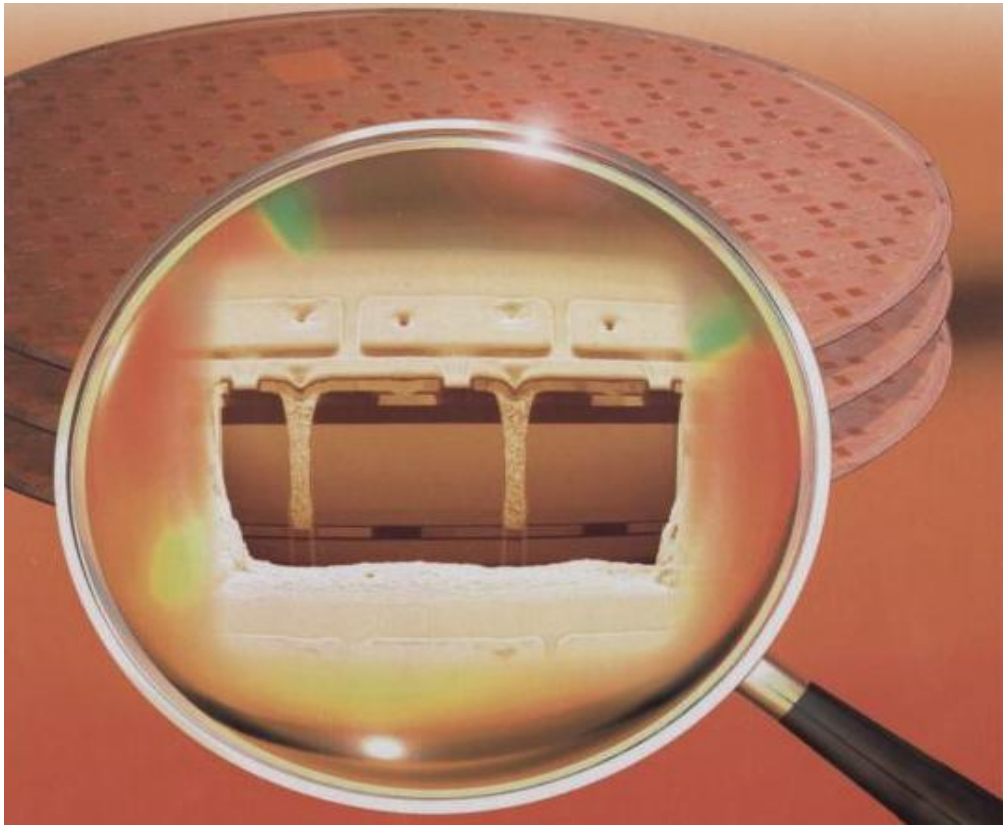
Relevant Trends – More than Moore

- New Functions are added to silicon!
- Power electronics can help to increase energy efficiency of many systems



Relevant Trends – 3D Integration

- 3rd dimension allows to increase complexity beyond Moore´s Law
- Cost and performance effective heterogenous integratio of independently optimized technologies



Relevant Trends - Summary

■ Moore´s Law is dominating the energy efficiency trend during the last 45 years

However: Optimization was mostly towards more performance

➔ Total power consumption is increasing exponentially

■ Need to maintain cost scaling, performance improvement and energy efficiency improvement after scaling stops in about one decade

■ Need to enhance energy efficiency beyond the conventional scaling trends

■ What after Moore?

-New disruptive technology?

- 3D integration?

- something else?

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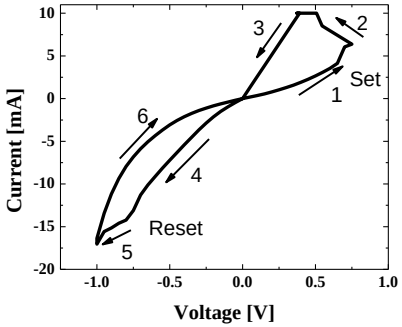
Priorities for the Call: Technology and Devices

- New disruptive device technologies
- Needs to clearly show the potential improvement compared to the ultimate CMOS device
- Possibilities:

  Reconfigurable Devices and wiring
  e.g. electrical polarity control
  memristive devices



- Nonvolatile Memory Devices
  - ✓ High density data storage: Large potential for data centers etc.
  - ✗ However: only little industrial activity left in Europe
    e.g. resistive switching HDDS is investigated by leading industry players with large resources
  - ✓ embedded Memories

- Energy efficient 3D Systems

Priorities for the Call: Circuits

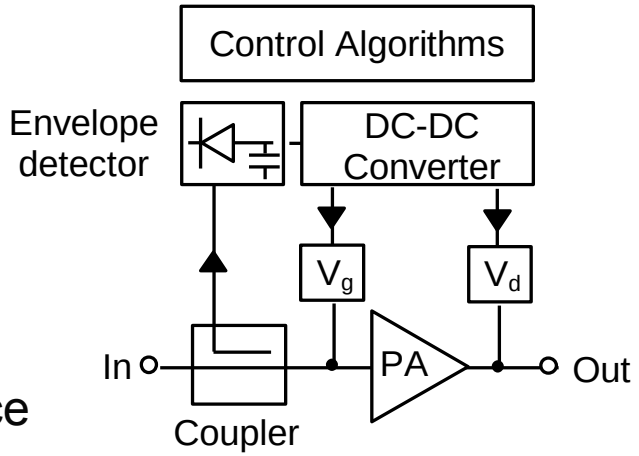
- Make systems adaptive:

  1. sense, 2. adjust, 3. supply

  e.g. regarding data rates/bandwidth, clock frequency, supply current & voltage,

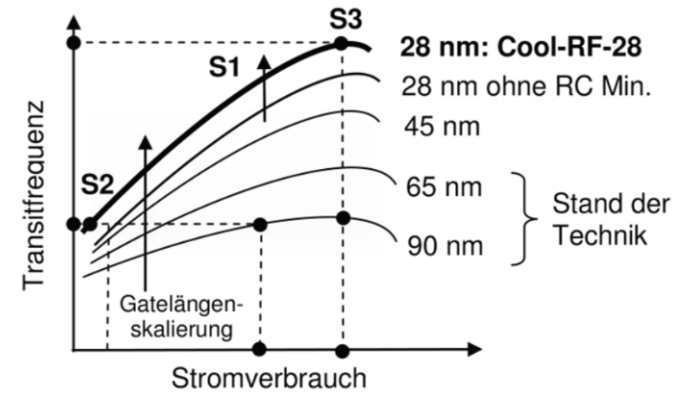
  “Real-time” control very efficient, challenging for device speed and system stability

  Challenge: Low distortions



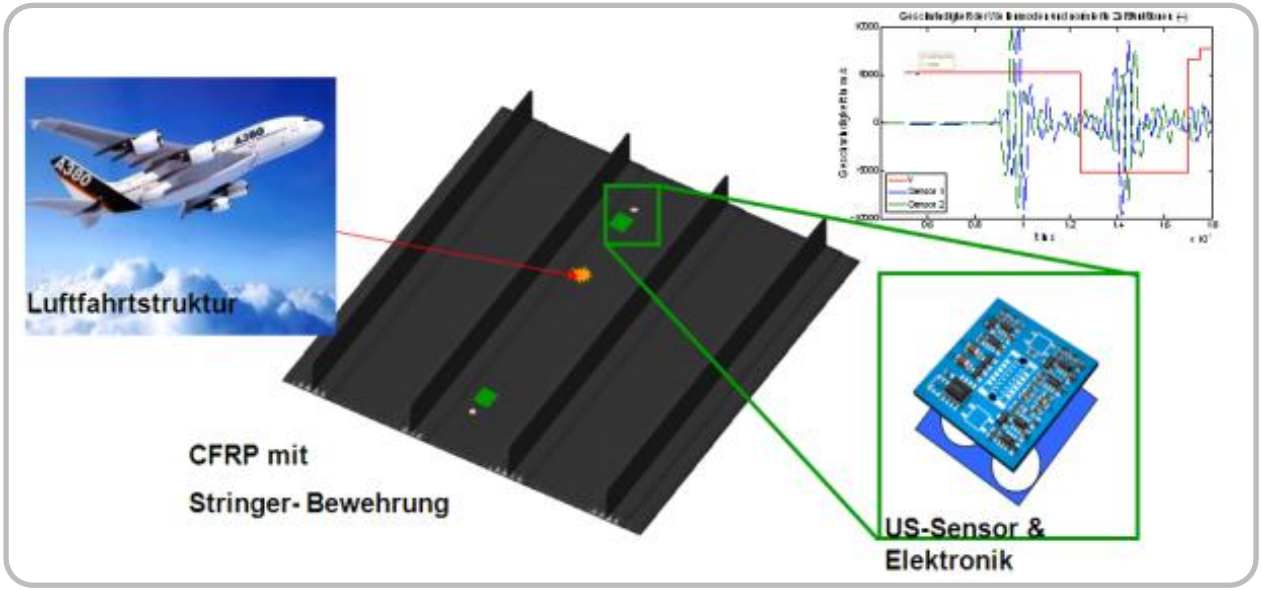
- Smart hierarchical stand-by and wake-up functions

- Make extensive use of benefit of Moore´s for energy efficiency



Priorities for the Call: Sensors

- Energy harvesting concepts for autonomous sensor systems
- Depends on application scenario



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Technical Topics

■ New Device Concepts enabling reconfigurability

■ Design solutions including adaptivity, sleep and wake up

■ Energy harvesting concepts for autonomous sensors to enable cyber physical systems

General Aspects

■ System design is crucial:
Interdisciplinary has to mean that all levels from Material to system (including software) have to be interconnected
■Energy efficiency has to be established as a boundary condition for system design that is as important as performance and cost
➔ include education

Thank you for your attention!

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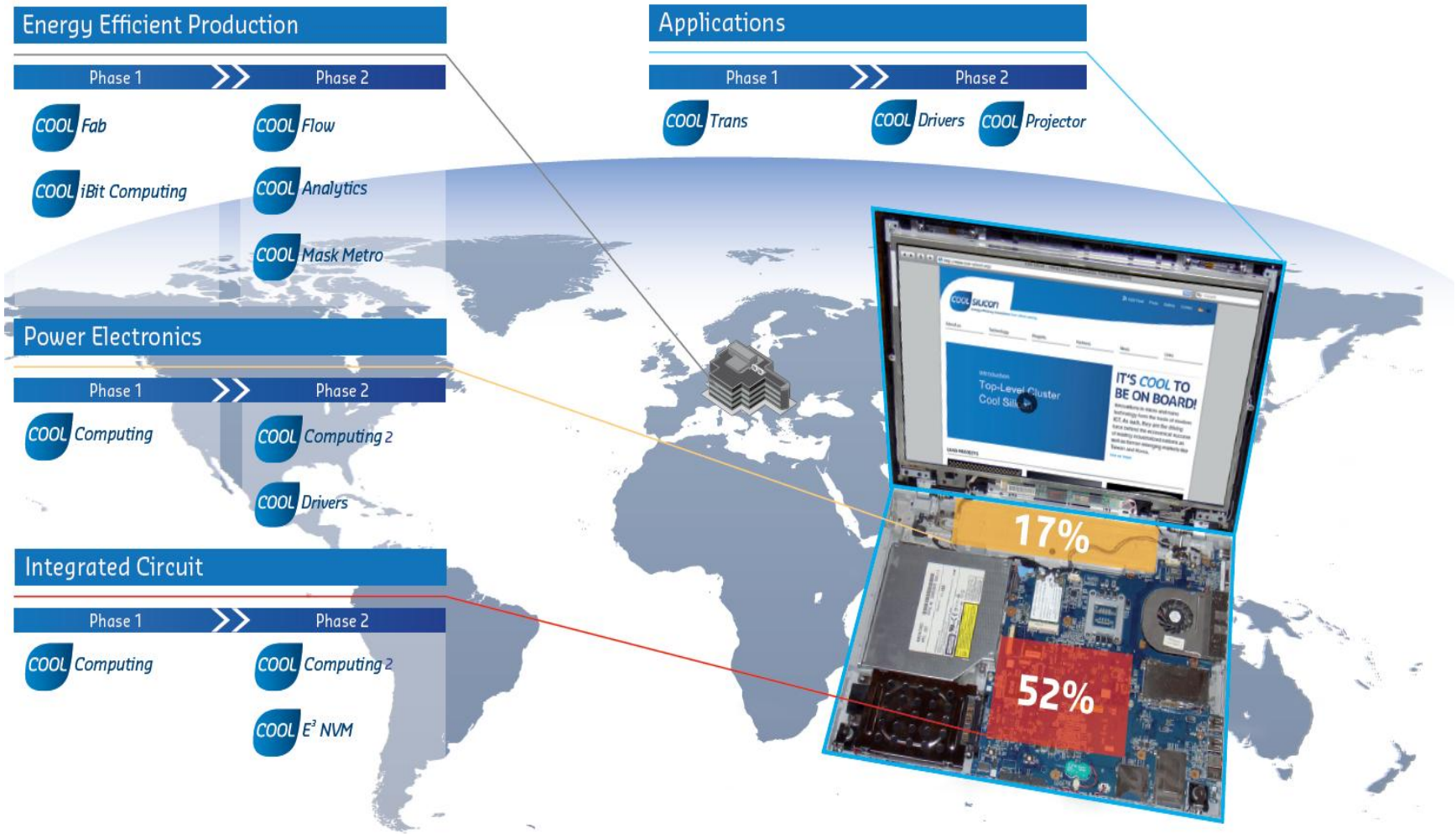
BACKUP

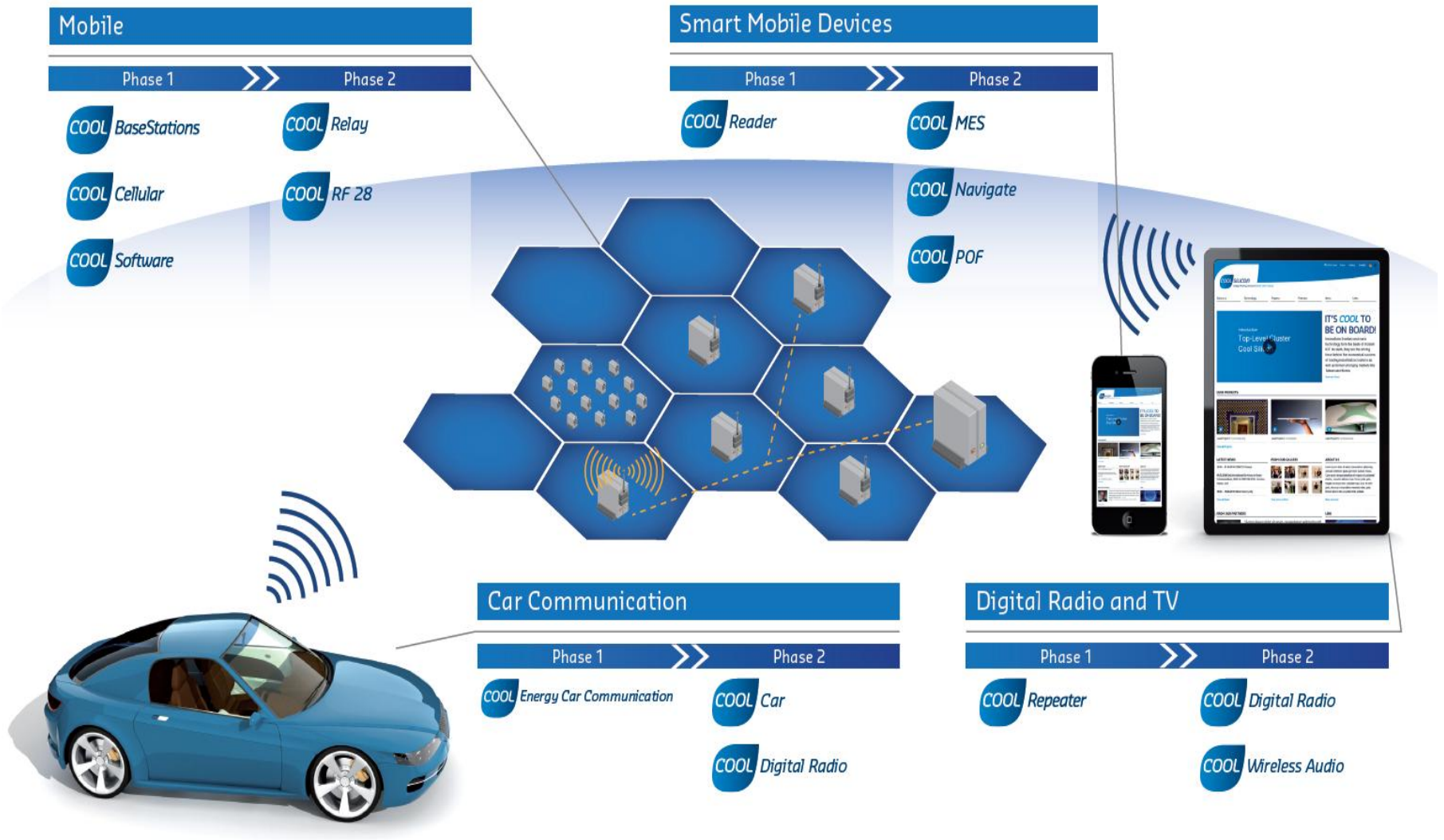
Project Overview

Area I: Micro- und Nanotechnology



Project Overview – Phase

Area II: Communication Technology



Project Overview –
Area III: Networked Sensors

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System Design

Phase 1

- COOL SAW
- COOL Sensornet
- COOL Sens
- COOL ConSens

System Integration

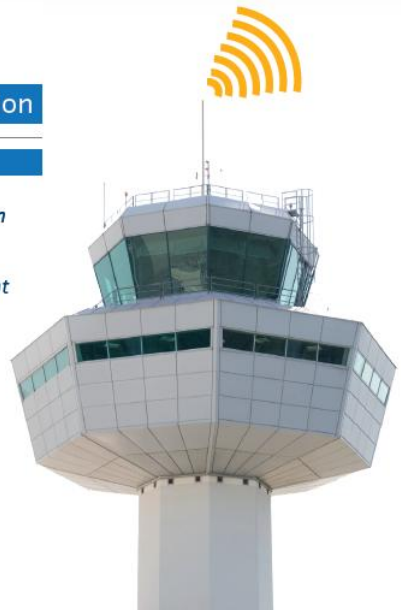
Phase 1

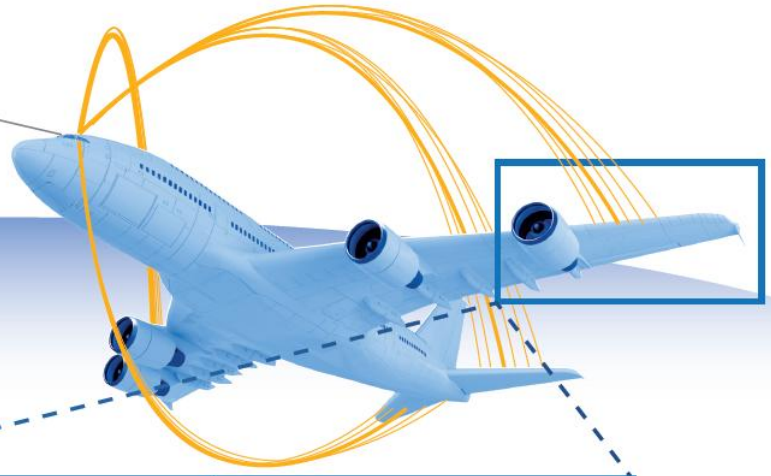
- COOL Sensor Integration
- COOL Sensor Implement

Energy Harvesting

Phase 1 >> Phase 2

- COOL Sensornet
- COOL Maintenance
- COOL Network Planning
- COOL POD





Applications

Phase 2

- COOL Display
- COOL RailSens
- COOL Energy Car Communication
- COOL Tool
- COOL Public Transport Information

Contact

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