Research Unit for Integrated Sensor Systems

Introduction and Overview

Georg Gaderer

ÖAW Austrian Academy of Sciences

Research Unit for Integrated Sensor Systems

Austrian Academy of Sciences

- Governmental funded research organization in Austria
  - Multi-disciplinary
  - Learned society as expertise background
    - Some members: Christian Doppler, Erwin Schrödinger, Victor Hess, Julius Wagner-Jauregg, Konrad Lorenz
  - Research body organized in institutes (HEPHY), research units (FISS), commissions (Medieval History Research)
    - ~1100 Employees (Research Administration)
- Current President: Peter Schuster (chemistry)

(Pre) History

- Several sensor research projects…
  - Capacitive angular rate sensors
  - Flow sensors
- … yielded fundamental insights into design methodology:
- You ought not
  - start with ASIC design after the transducer concept has been fixed
  - think of transducer non-idealities as post-design, purely ASIC-related issues
- Vision:
  - Integrated Development of Integrated Sensor Systems (~2001)
  - Research Unit for Integrated Sensor Systems (2004)

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Status

- Start in April 2004
  - 4 years start-up phase
  - Funded by Austrian National Bank and the province of Lower Austria
- 28 team members
  - Plus 3 technology experts at the Vienna University of Technology
- Part of "Technopole" Wiener Neustadt
  - Research institutes and companies working in
  - Surface technology
  - Electrochemistry
  - Tribology
  - Microsystems

Modern Sensor Systems

- Local intelligence
  - Complex, mostly digital multi-level signal processing
  - Advanced functionality
- Sensor fusion
  - Combination of different (cost efficient) sensors
  - Compensation of disturbing effects
- Networking
  - Distributed sensor networks, “networked embedded systems”
  - Interconnection to higher-level systems

- Need for integrative, system-oriented solutions

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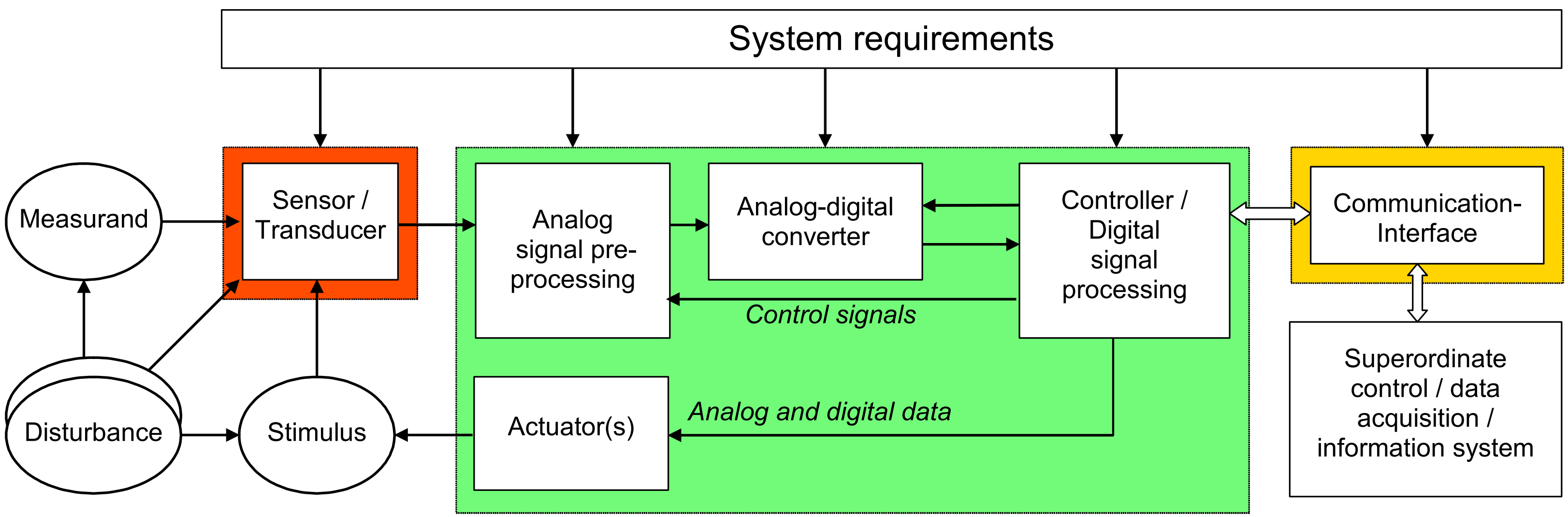
Preferred System Concept

- "Closed-loop" structure
  - Stimulus of transducer can be controlled
  - Higher fault tolerance and accuracy
  - Adaptive systems
  - Higher dynamic range



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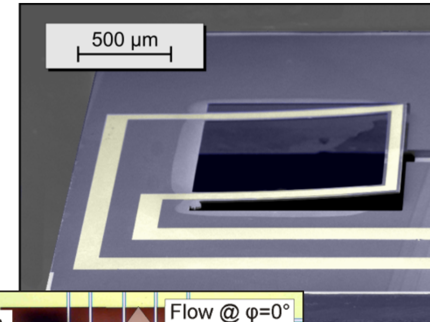
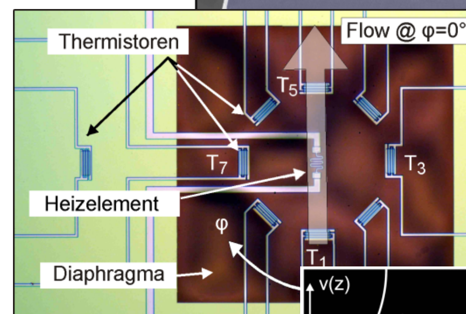
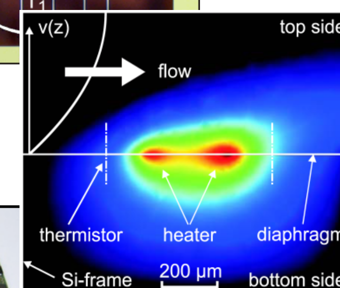
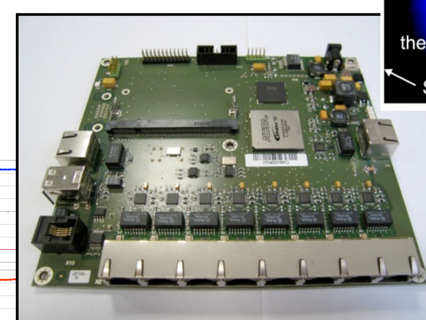
Research Focus and Expertise

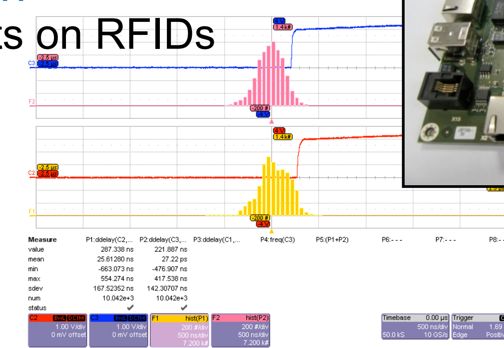
- Resonant and inertial sensors
  - Viscosity measurement
  - Magnetic field measurement
- Miniaturized thermal sensors
  - Flow measurement
  - Thermal conductivity measurement
- Capacitive sensors
- Architectures for smart sensor systems
  - Modular FPGA-based system-on-chip architectures
  - Signal processing for smart sensors
- Clock synchronization in sensor networks
  - Hard- and software support
- Security aspects
- Vertical integration
  - Software agents on RFIDs











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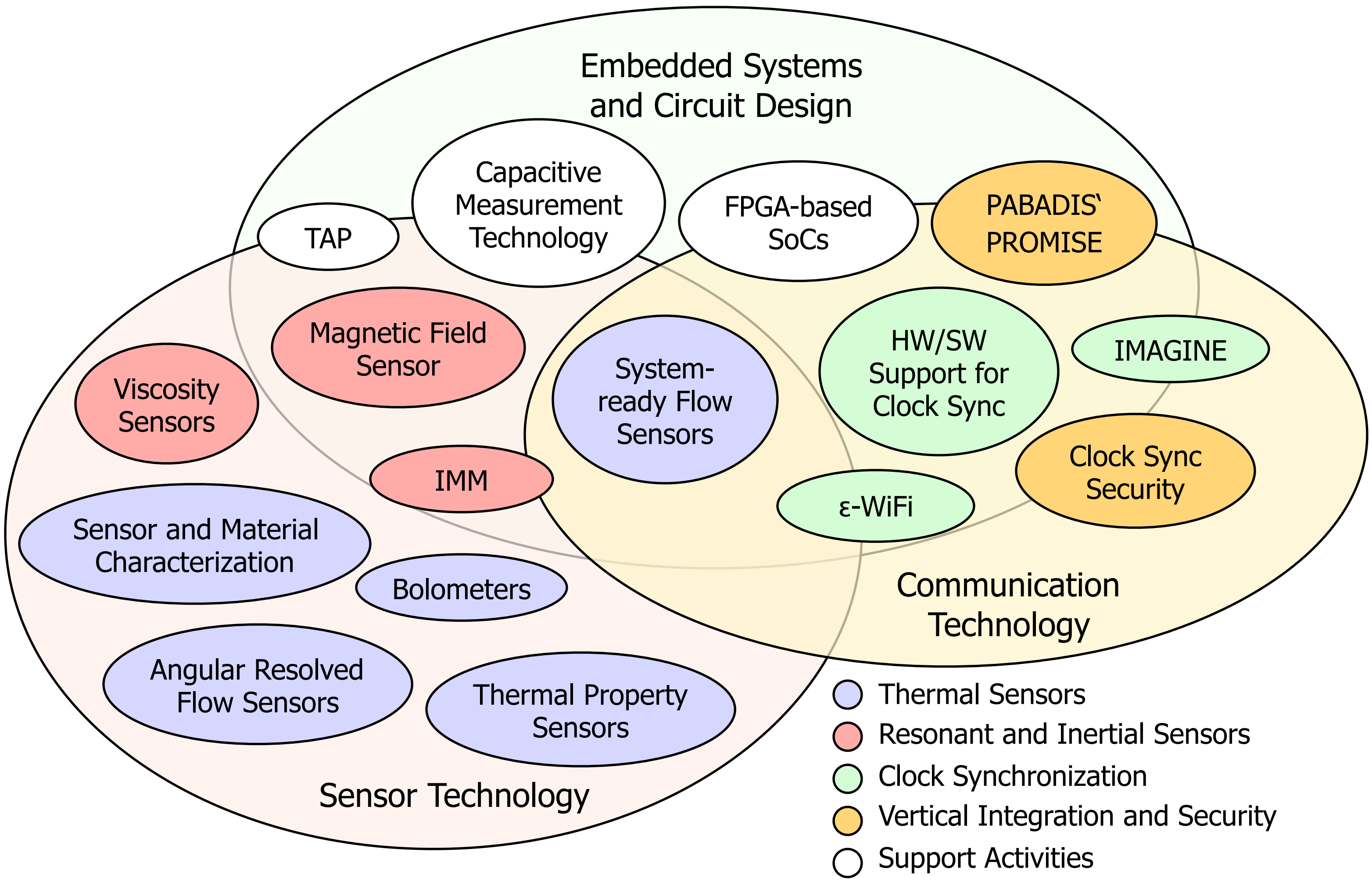
Projects and Core Expertise Fields

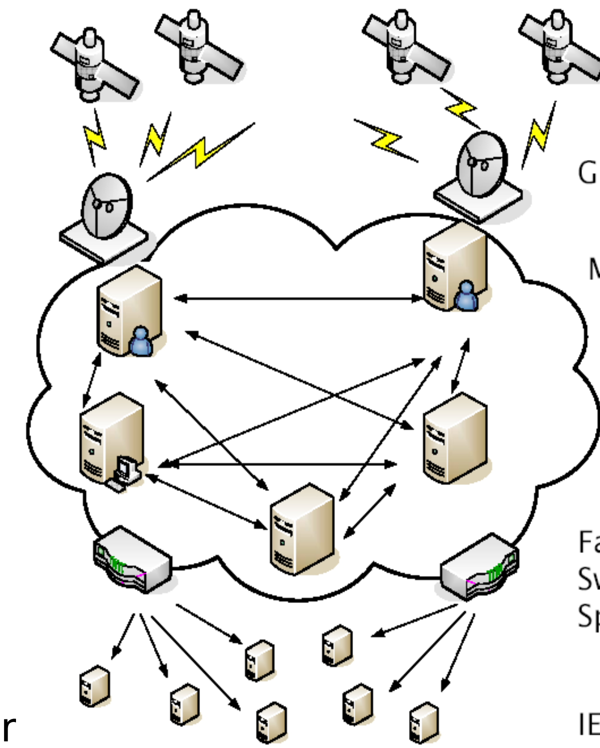


Clock Synchronization Activates

- Background
  - Several years of activities (group from Vienna University of Technology
  - SynUTC, PSynUTC
  - Spin-Off: Oregano Systems
  - Begin of IEEE1588 Standardization Activities
- Clock Synchronization Group
  - Current Status
    - 12 members (11 FTE)
    - 3 base funded, 9 third party funded
  - Activities
    - Fault Tolerant Clock Synchronization
    - Localization Services
    - Industrial Clock Synchronization
    - Security Aspects
    - IEEE 1588 standardization
    - Society/Teaching
      - ISPCS, Special Section TIM,

Oregano Systems

Master Group Concept IMAGINE

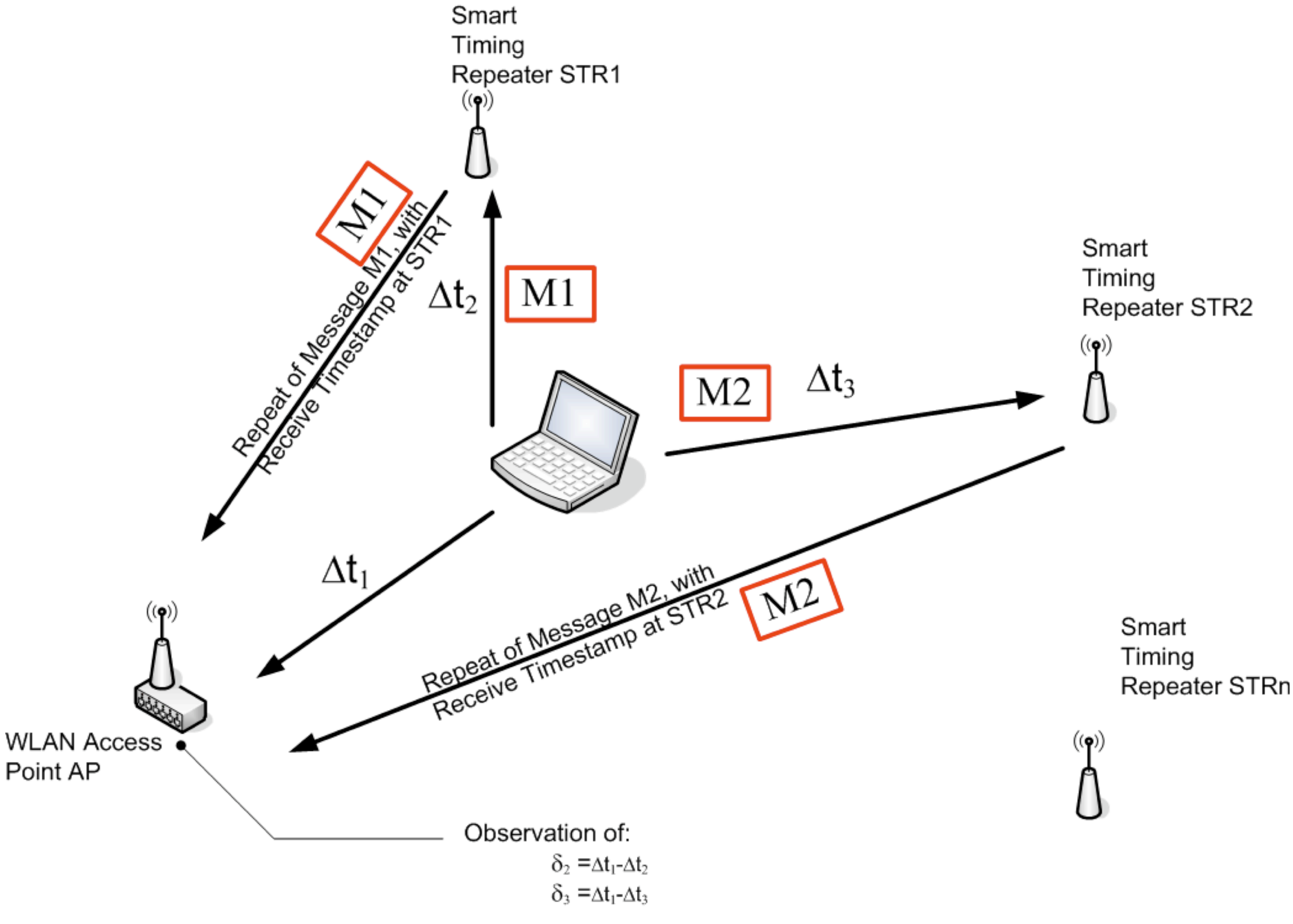


- Master Group
  - SynUTC group
  - Fault tolerant
  - Some nodes with GPS
  - Backup nodes
- IEEE1588 Slaves
  - Synchronized standard compliar
  - Less traffic between Master Group speaker and slaves
- New efficiency with m masters

$$\eta_{\text{hybrid}} = \frac{(m-1)+n}{m \times (m-1)+n} = \frac{m+n-1}{m^2-m+n}.$$

usual case: m<<n

Localization services using synchronized Clocks



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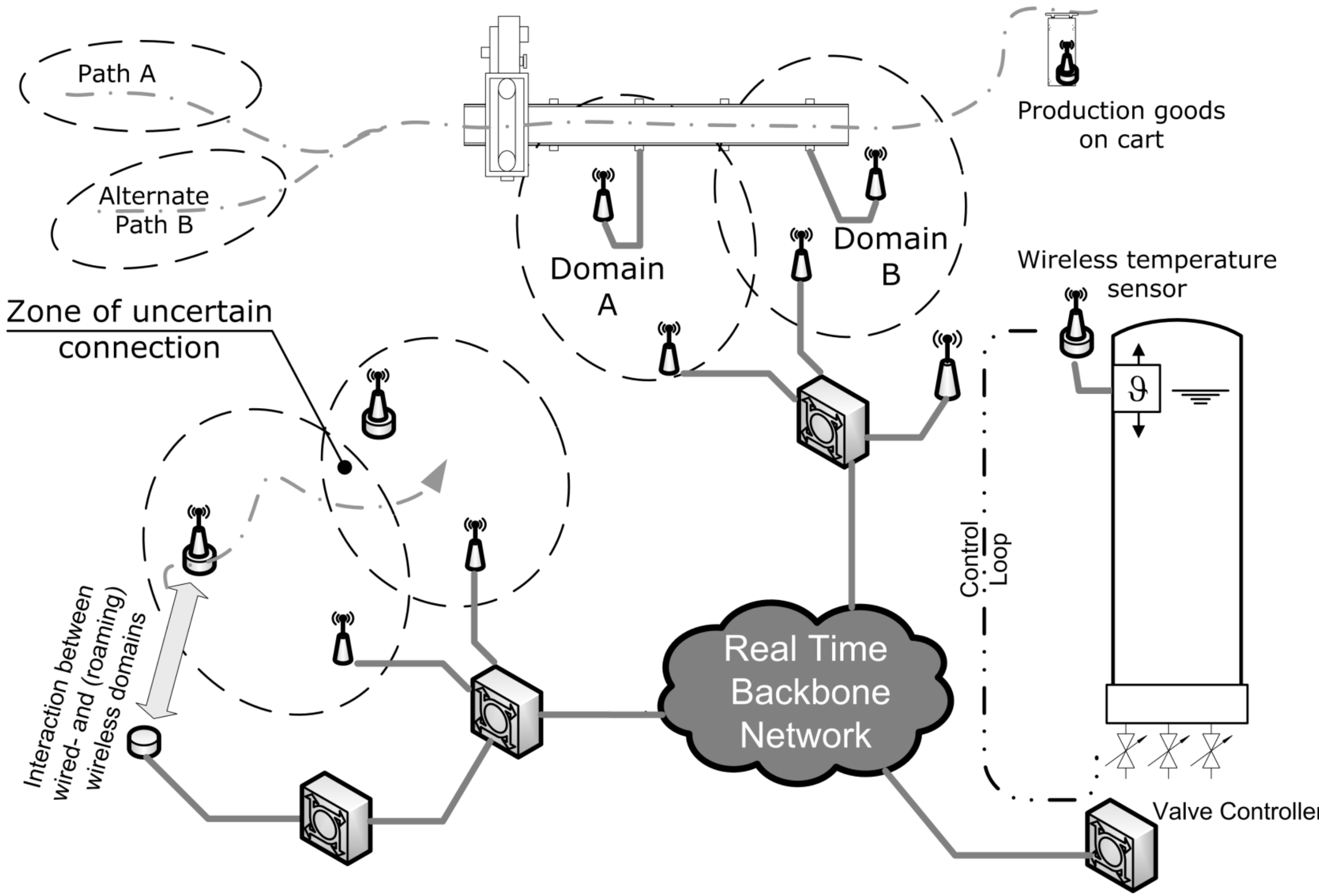
FlexWARE Project: Flexible Wireless Automation in Real-Time Networks



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Thank you for your attention

Georg Gaderer

Georg.Gaderer@oeaw.ac.at