Challenges in Designing Modern Systems

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25 January 2011, ICONS' 2011 Panel, St. Maarten, The Netherlands Antilles

Challenges in Designing Modern Systems: Sensors-oriented Systems

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25 January 2011, ICONS' 2011 Panel, St. Maarten, The Netherlands Antilles
**Status**

- Technological limitation (below 100 nm)
- Smart sensor systems should be intelligent and intelligent sensor system should be smart
- Next step from MEMS sensors to MEMS sensor systems should be made

**Vision**

- System design approach should be used (technological + structural algorithmic design approaches at the same time)
- New signal domain: frequency (period, time) instead of traditional analog or current
- New methods of measurements (MDC)
- New components (UFDC-1, USTI ICs)
- Trained engineering personnel
Solution

- Road maps corrections: AMA Association for Sensor Technology, IEEE, EPoSS, etc.
- TEMPUS projects
- Advanced engineering training courses
- Other?
Challenges in Designing Modern Systems
(service-oriented view)

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Status

**Service Oriented Middleware**
- Orchestration Engine
- Deployment
- BPEL Translator
- Simulation & Validation
- Generates BPEL Script
- HLPN/TNCES Translator
- Generates Formal Representation
- User/Operator Orchestration Developer

**Communication Backbone**
- IP
- UDP
- TCP
- HTTP
- XML Parser
- Message Processing
- DPWS
- BPEL Parser

**Hosted Services**
- S1
- S2
- S3
- S4
- S

**Service Registry**
- Orchestration Engines

**Decision Support System (DSS)**

**http://www.socrades.eu**
Vision

- *System Development Lifecycle* for service-oriented solutions has to be defined.

- Right level of details has to be selected when defining a service.

- Role shift: “Programmer” → “Knowledge engineer”

- *Value chain* has to be established.
SWS Value chain: Example

Cyber-Physical Systems for Designing Modern Systems

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Czech Republic

*Panel ICONS contribution*

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Embedded systems

- **Definition:** Embedded systems are information processing systems embedded into enclosing products
- **Embedded software** is software integrated with physical processes (technical problem is managing time and concurrency in computational systems)

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**Cyber-physical systems**

- **Definition:** Cyber-Physical Systems (CPS) are integrations of computation and physical processes
Cyber-physical systems design

The integration of physical systems and processes with networked computing has led to the emergence of a new generation of engineered systems: Cyber-Physical Systems (CPS)

- CPS use computations and communication deeply embedded in and interacting with physical processes to add new capabilities to physical systems
- Embedded computers allow designers to add capabilities to physical systems that they could not feasibly add in any other way
- By merging computing and communication with physical processes and mediating the way we interact with the physical world, cyber-physical systems bring many benefits: they make systems safer and more efficient, they reduce the cost of building and operating these systems, and they allow individual machines to work together to form complex systems that provide new capabilities
CPS properties

CPS domain paradigm:

application requirements (time constraints defined by physical processes), and

implementation aspects (computation and communication capacity constraints)

• Functionality = services delivery in the form and time fitting requirement specifications

• Dependability = property of a system that allows reliance to be justifiably placed on the service it delivers

Dependability measures:

• Availability = ability to deliver shared service under given conditions for a given time (e.g. elimination of denial-of-service vulnerabilities)

• Security = ability to deliver service under given conditions without unauthorized disclosure or alteration of sensitive information

• Safety = ability to deliver service under given conditions with no catastrophic affects
CPS networking

= hierarchically interconnected networks: Internet, local area wired and wireless networks, and wireless sensor networks.

Embedded systems and their components can be attached to Ethernet with TCP/IP protocol stack but also through various wired Fieldbuses or wireless technologies such as ZigBee or Bluetooth

Sensor networks bring an important pattern with single base station connected to a wired network on one side and wirelessly to smart sensors on the other side
Migrating from Mobile RFID to NFC

NS 2011, St. Maartens

Jia-Ning Luo
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Information and Telecommunications Engineering
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Mobile RFID

Mobile Radio-Frequency Identification (MRFID)
Near field communication
• combines the interface of a smartcard and a reader into a single device.
• compatible with existing contactless infrastructure already in use for public transportation and payment.
• primarily aimed at usage in mobile phones
Goal

Uses NFC framework to replace Mobile RFID infrastructure.

Design NFC Payment protocols, includes:
- Authentication protocol
- Authorization protocol
- Accounting protocol
ICONS Panel Discussion:
Challenges in Designing Modern Systems

Validation of Traffic Flow Models

6th International Conference on Systems
ICONS 2011
St. Maarten, The Netherlands Antilles

Jochen Palmer (IT-Designers GmbH)
2011-01-25

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Background: Kerner’s Three Phase Traffic Theory

- Three traffic phases – F, S and J
  - F – Free Flow
  - S – Synchronized Flow
  - J – Wide Moving Jam

- Spatio temporal traffic patterns
  - SP – Synchronized pattern
  - GP – General pattern
  - EP – Expanded pattern


a) Collective averaged measurements

- Knowledge about traffic reality ("Ground-Truth") is incomplete.
- Collective traffic measurements (a) are available. They do NOT describe individual vehicles.
- Individual vehicle trajectories are available. Penetration rates of < 1% owned by private companies.
- Individual vehicle trajectories (b) are required:
  - Science: Validation and verification of traffic flow theories and models.
  - Industry: Development of new traffic engineering applications. Using individual vehicles as mobile sensors.

b) Individual vehicle trajectory measurements

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<th>State change</th>
<th>Phase transition</th>
<th>Synchronized Flow</th>
<th>Wide Moving Jam</th>
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<tbody>
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<td>Zeit</td>
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<td>Bottleneck</td>
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<td>Location</td>
<td>Speed [km/h]</td>
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Vision: Combining Simulations and Better Data Acquisition

1st Step: Using traffic flow models for the simulation of vehicle trajectories. Challenge: Validation of models used for the simulations.


Combined results: More complete real world coverage, validated simulations and more accurate traffic flow theories.

Traffic DB <<Server>>