

Embedded Performance Analysis for Organic Computing

3rd OC Kolloqium
Stuttgart, 15.09.2006

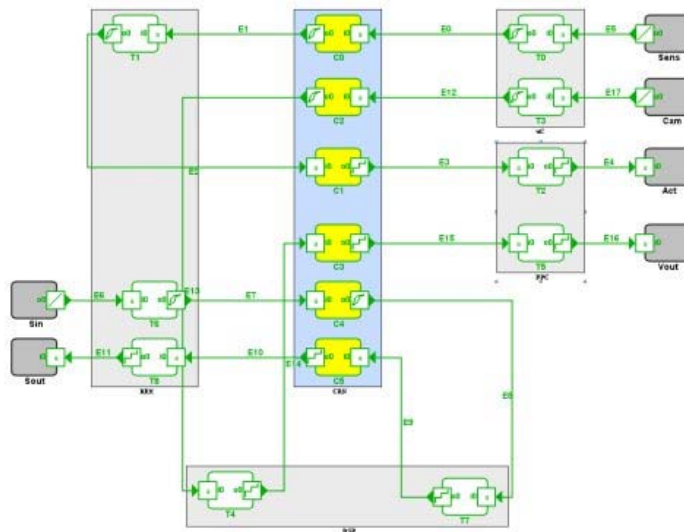
Steffen Stein

Outline

- Project Background
- Short Recap
 - Project Overview
 - Project Plan
- Current Status
- Applications
- Future Work / Outlook

Project Background

Offline formal performance analysis
for heterogeneous systems (SymTA/S)



- Industrial strength analysis framework
- Spin-off company (SymtaVision, AutoSAR)
- Use-cases in automotive industry
- Used for network and ECU design at several OEMs and suppliers

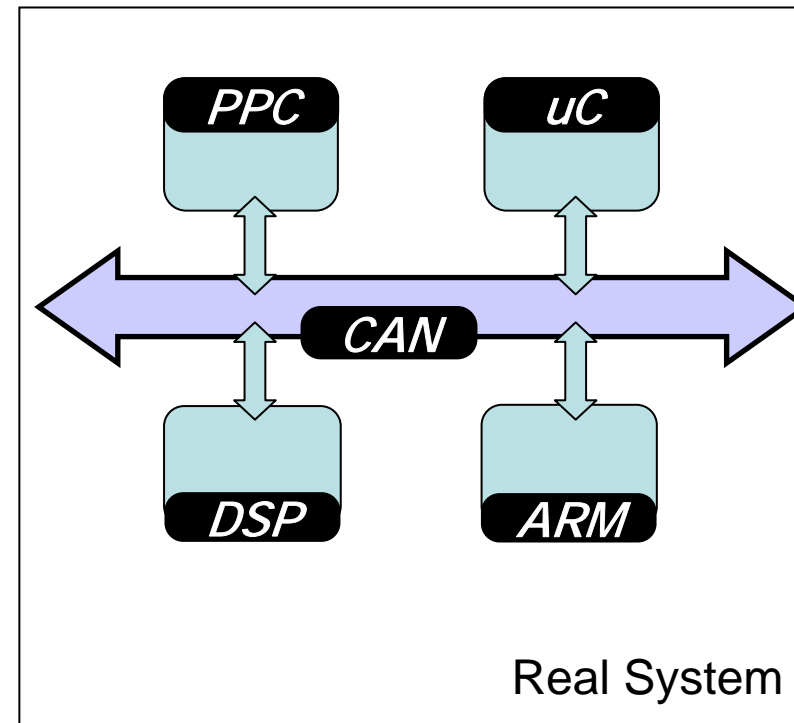
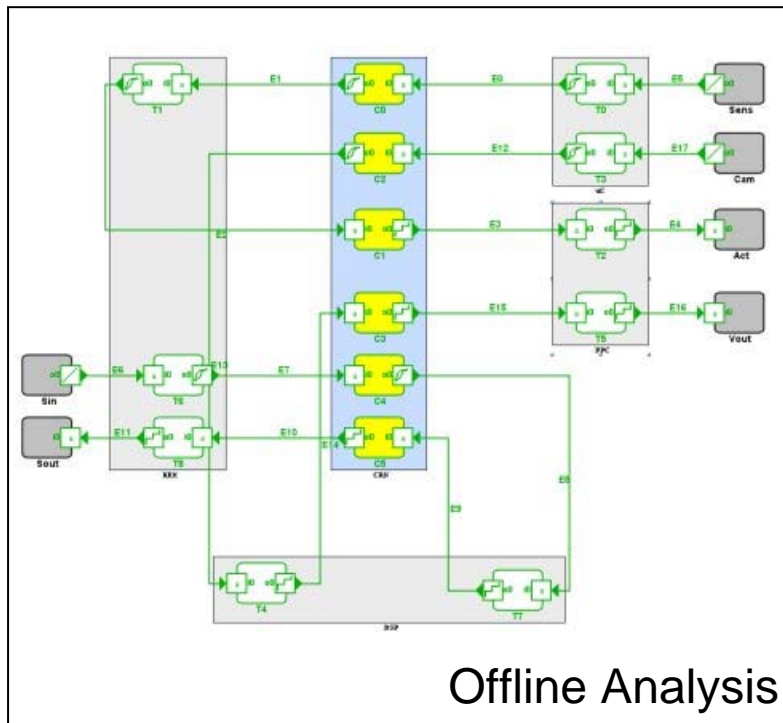
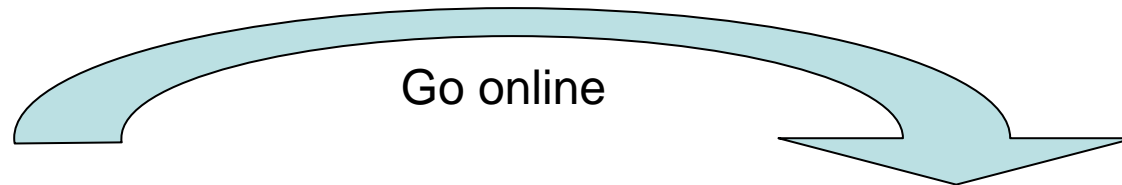
Future automotive requirements



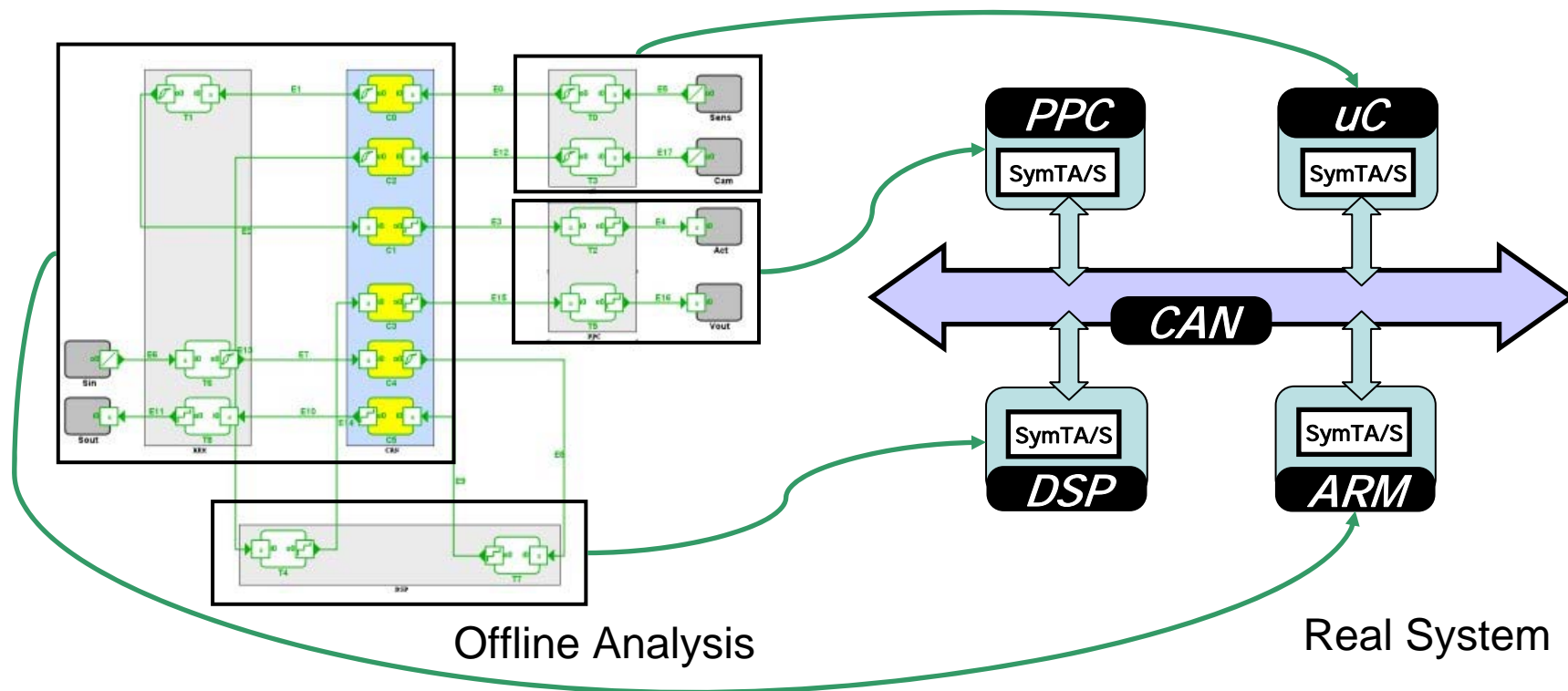
- online configuration and upgrades of automotive electronic networks
- needs protection from tampering (security) and overload (real-time)
- increasing vehicle-to-vehicle interaction
- confusing variety best addressed with self-configuration and –protection
- perfect OC application



Project Description – Step 1



Project Description – Step 2



Approach

- define distributed analysis model (year 1)
- develop algorithm to determine platform architecture and establish analysis network (year 1)
- distributed analysis (year 2)
- online Analysis (year 3-4)
 - Lightweight analysis SW – memory, run-time
 - Replace offline “clairvoyance” by “self-measurement” and “self-monitoring” of busses, gateways, ...

Folie 7

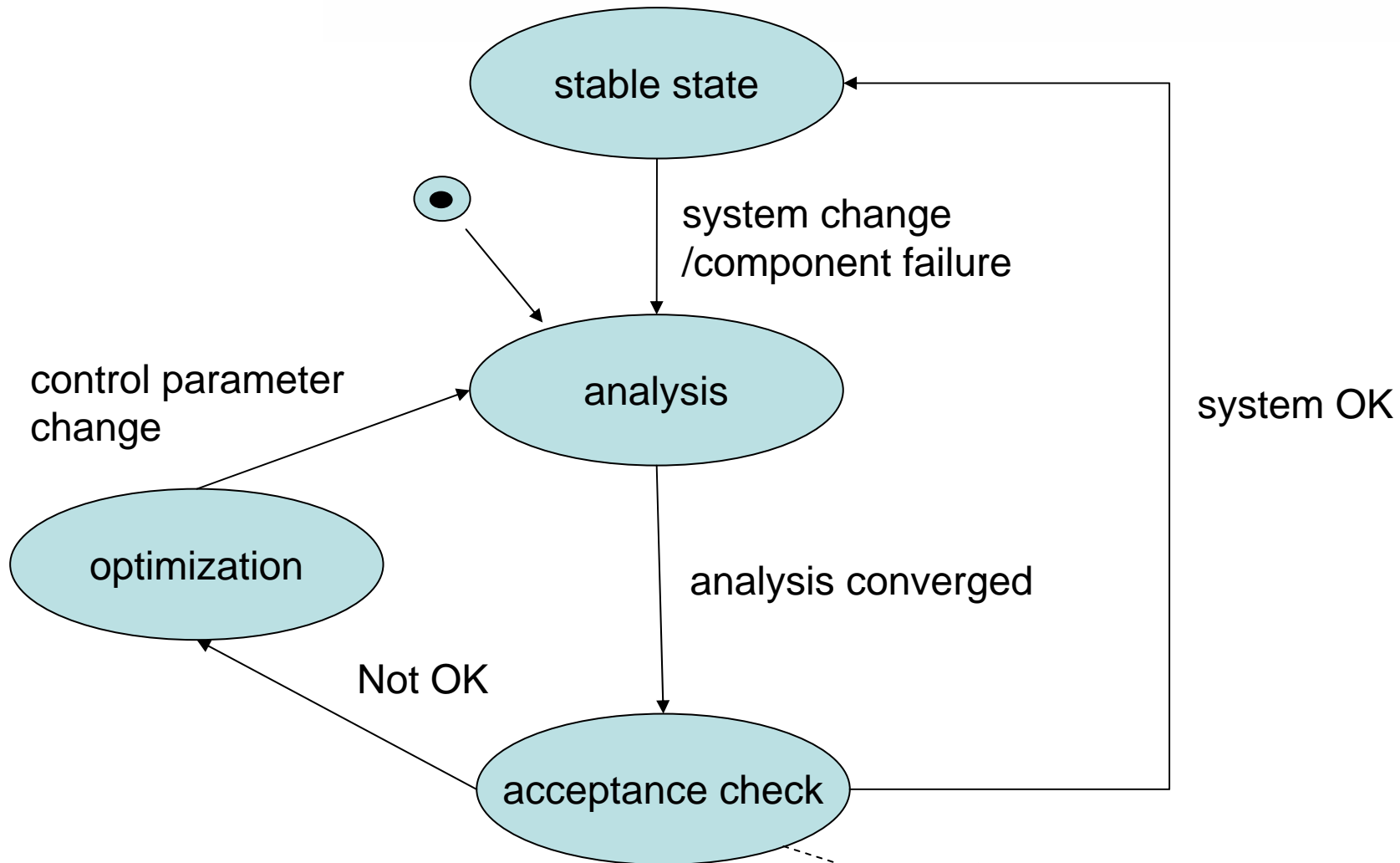
er3 **Änderung der ersten Bullet**
ernst; 14.09.2006

er5 **geändert**
ernst; 14.09.2006

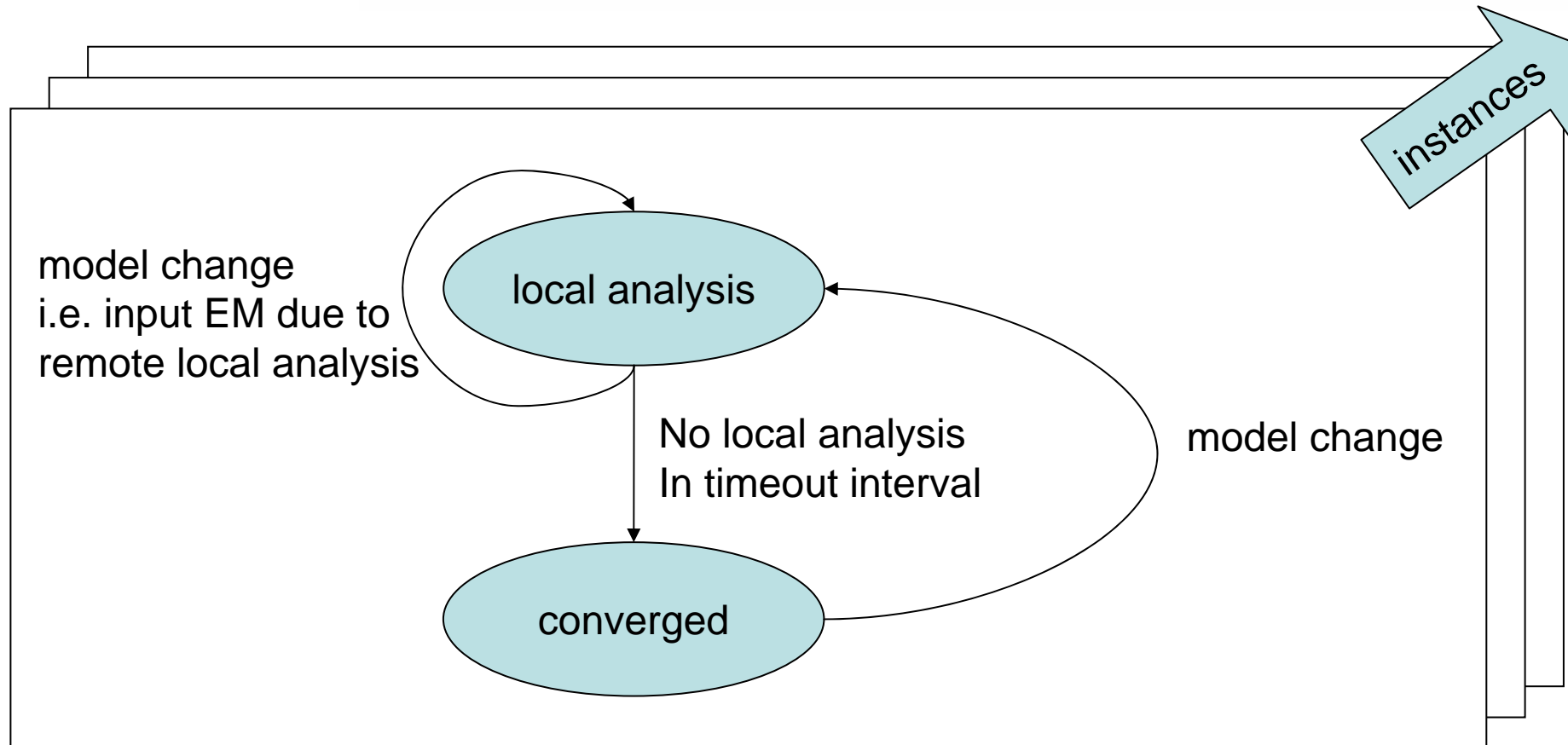
Outline

- Project Starting Point
- Short Recap
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 - Project Plan
- **Current Status**
 - Online System Analysis
 - Online Acceptance Test
 - Online Optimization
 - Online Architecture exploration
- Applications
- Future Work / Outlook

System & Analysis Timing

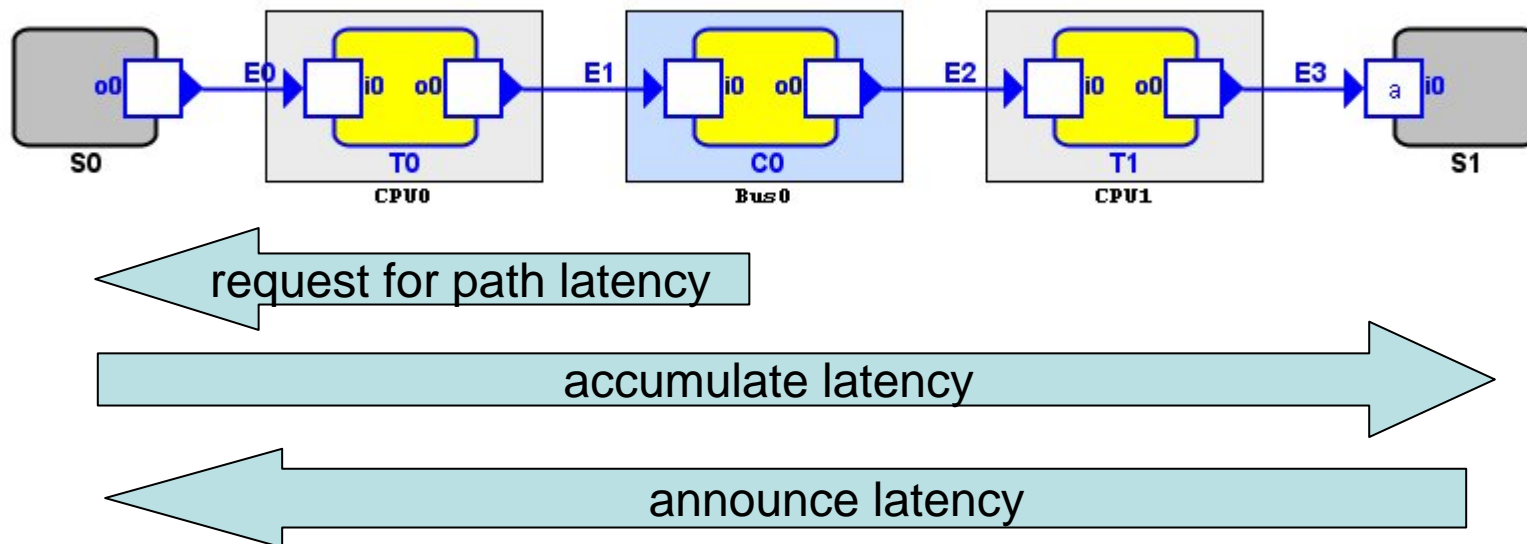


Live Analysis



Acceptance Check

1. local overload situation
2. global constraints:

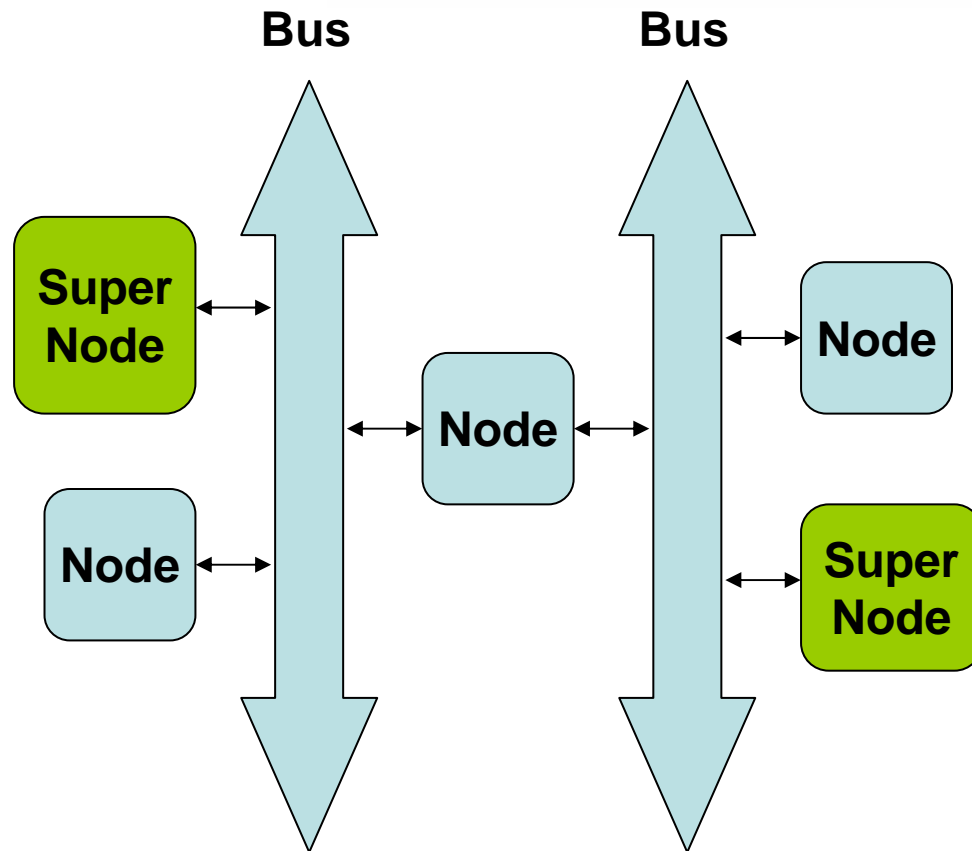


3. compare with latency constraints

Optimization/ Adaptation

- Triggered by NOK message of acceptance check
- distributed heuristic optimization algorithm
- path information gathered for acceptance check reused
- optimization of task priorities

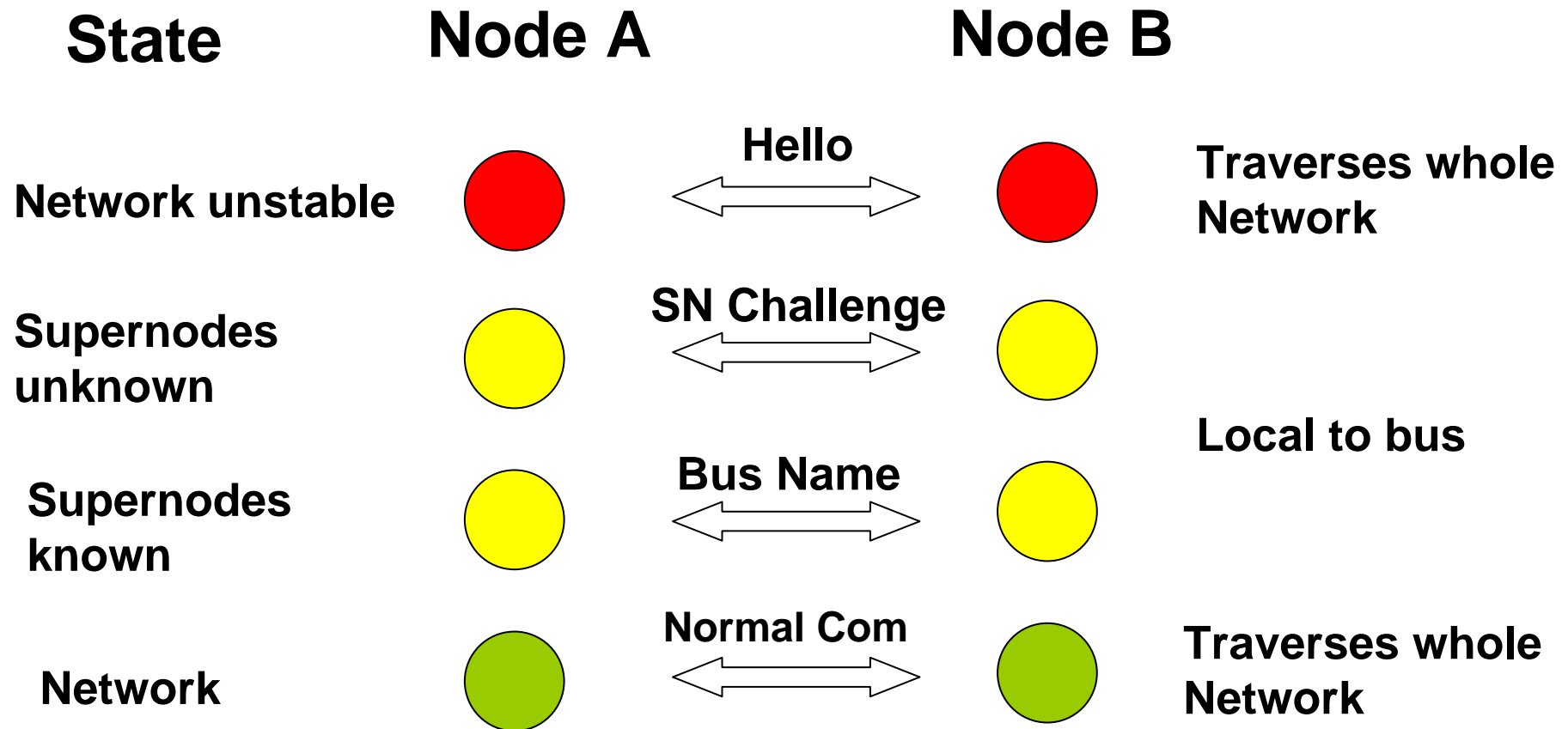
Architecture exploration



Challenges

- unique names for nodes
- unique names for buses

Architecture exploration



Evaluation of algorithms

task	execution time
local analysis	< 5ms (PC)
communication	< 5ms (demonstrator)
architecture exploration	< 50ms (demonstrator)

- **analysis in ~10 iterations: < 100ms**
- **acceptance check scales with task chains**
- **optimization in < 10 iterations: < 2s**

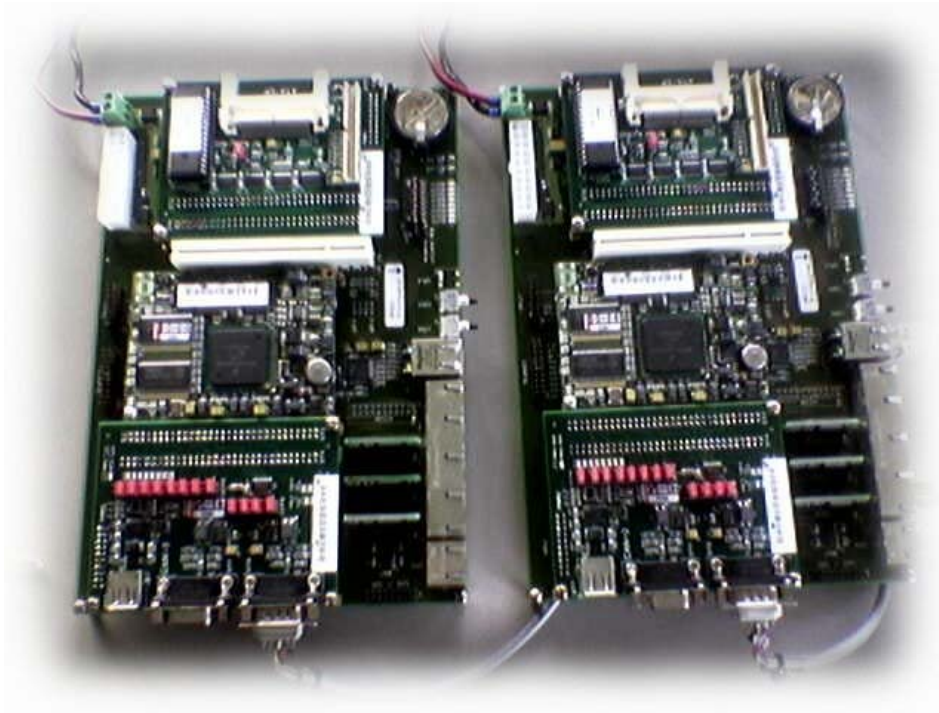
Outline

- Project Starting Point
- Short Recap
- Current Status
- Applications
 - Demonstrator
 - SFB 562
- Future Work / Outlook

Application – Demonstrator

- applicability in embedded sector
- implementation of communication environment
- testing platform
- implementation of self-measurement framework (year 3-4)

Application - Demonstrator



- Freescale MPC5200 based platform
- PPC603e
- CAN network
- close to automotive system



Application – SFB 562



- parallel robots
 - computationally intensive hard real-time tasks
 - control node cluster
 - find „good“ task distribution to meet real-time requirements
 - OC approach for dependability

Publications

- *Steffen Stein, Arne Hamann and Rolf Ernst, Real-Time Property Verification in Organic Computing Systems, in Proc. of the 2nd International Symposium on Leveraging Applications of Formal Methods, Verification and Validation (ISoLA), Cyprus, 2006*
- *Steffen Stein, Arne Hamann and Rolf Ernst, Real-time Management in Emergent Systems, in Proc of the 36th Jahrestagung der Gesellschaft für Informatik, Dresden, 2006*
- *Steffen Stein, Simon Schliecker, Rolf Ernst, Timing Complex Systems by Integrating Dataflow Graphs with Compositional Performance Analysis, submitted for acceptance at Design, Automation and Test in Europe (DATE), Nice, 2007*

Going Online (year 3-4)

- light analysis SW – computation load, memory
- replace offline “clairvoyance” by organic computation approach
 - develop strategies for real-time fail-safety and fault-tolerance (integrity and persistency)
 - develop observation and monitoring functions for “self-measurement”, “self-monitoring” of busses, gateways, ...
 - develop real-time control functions such as robustness analysis or watchdogs

Future Work (cnt'd)

- automated model analysis
 - execution time prediction -> e.g. wormhole project
 - online formal WCET and communication analysis
- demonstrator extension
 - observation and control function implementation (watchdogs, ...)
- cooperation with SFB 562 (ongoing)
 - Organic Real-Time Control in production technology
- cooperation within SPP1183 (potential)
 - architecture and design methodology for autonomic system-on-chip

Conclusion

- project is on time
 - distributed analysis algorithms
 - architecture exploration algorithms
- collaborative work with other Projects
 - SFB 562
 - Architecture and Design Methodology for Autonomic System on Chip (ASoC)
- future work
 - implement framework on embedded system
 - develop real-time capable adaptation techniques

Thanks for your attention

Any Questions?