Modelling and Validation of Distributed Systems
- some selected topics and outlook 2007/8

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The ComBack State Space Exploration Method
[AsCoVeCo project]

DYMO Routing Protocol for Sensor Networks
[SensoByg project]

VNE: Virtual IP Networking Environment
[Teaching NPaI Course]
State Space Exploration

- One of the main approaches model-based verification of concurrent systems:

- The ASCoVeCo project (2006-2009): development of efficient state space exploration methods.

Nodes → reachable states
Arcs → transition executions
Paths → execution sequences

Highly automatic
Rich set of properties
Diagnostic information
The state explosion problem
The ComBack Method
[Westergaard, Kristensen, Brodal, Arge (ICATPN’07)]

- Memory efficiency using hash Compaiction:
  
  \[0110001100011000111000111000101\]  
  \[0110001100011000111000111000101\]  
  Compressed state descriptor

- State reconstruction using Backtracking

\[\text{bits} = |\text{reach}(s_I)| \cdot (w_H + 3 \cdot \lceil \log_2 |\text{reach}(s_I)| \rceil + \lceil \log_2 |T| \rceil)\]

- Ensures full coverage.
- Promising experimental result.
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Sensor Networks

- Autonomous wireless networks of small devices.
  - Large constructions
  - Houses
  - Concrete elements
  - Hardening process

- Application areas:
  - Environmental monitoring
  - Home automation

- Research challenges:
  - Constrained devices
  - Fault tolerance and scalability
DYMO for Sensor Networks

[Romain Thouvenin, M.Sc project]

- **On-demand routing protocol** being developed by IETF.
- **Implementation and evaluation under TinyOS2 and the Tmote platform.**

- **Input and recommendations to IETF WG.**
- **Candidate for multi-hop routing protocol on TinyOS2.**

### Processor
- **Type:** 16-bit RISC
- **Clock rate:** 8 MHz
- **Program Flash memory:** 48 kB
- **Measurement serial Flash:** 1204 kB
- **RAM:** 10 kB

### Radio Transceiver
- **Frequency band:** 2.4 to 2.483 GHz
- **Data rate:** 250 kbps
- **Outdoor range:** 75 to 100 m

### Other
- **Battery:** 2 AA batteries
- **Size:** 65 x 31 x 6 mm
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Network Protocols and Internetworking (NPai course)

**LO3:** *conduct configuration and protocol analysis on TCP/IP networks*

- Providing IP networking laboratory facilities is a challenging task:

  ![Participants Graph](image)

  **Ericsson Telebit A/S 2003/2004**  
  **Bush-019 2005/2006**
Virtual Networking Environment
[Dorland, Kristensen, Kristensen, Fleicher, Salihefendic]

- Provides a virtual IP networking laboratory to each course participant.
Outlook 2007/2008

- **ASCoVeCo project** [+2 PostDoc, +1 Stud. prog]
  - Release of ASCoVeCo State Space Analysis Platform (ASAP).
  - Industrial applications via collaboration with TietoEnator DK.
  - Continue research on state space exploration techniques.

- **SensoByg project** [+1 PhD student]
  - Middleware and sensor network protocols for structural health monitoring.

- **Network Protocols and Internetworking (NPaI)**
  - Use and evaluate of the Virtual Networking Environment
  - Release public version of VNE.

- **Model-based Requirement Analysis**
  - Towards formal modelling of reactive systems using UML+CPN.
  - Guidelines for distinguishing system and environment in models.
  - Code generation from models of reactive systems.