Design of networked embedded systems

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Outline

- Definition of networked embedded system (NES)
- Traditional design flow for embedded systems
- New design flow for NES
- Concepts to be explained
Networked embedded systems

- Networked embedded systems are an important class of devices
  - Network functionalities are at the core of design objectives
  - Network requirements come together with traditional requirements
- Distributed embedded systems are group of networked embedded systems (NES) which are connected together using network interfaces, standardized protocols and channels
  - Example: Temperature control of a building
Temperature control of a building

- **Scenario:**
  - Hundreds of concurrent tasks.
  - Heterogeneous tasks.
  - Devices with different capabilities.
  - Wireless and wired channels.
  - Many communication protocols.
  - Nodes position affects system performance.

- **Questions:**
  - How many nodes?
  - How to assign tasks to nodes?
  - Which network protocols?
  - Which intermediate systems?
Traditional design flow for embedded systems

Application requirements: functional & non-functional

Model-driven design

Platform description: IP blocks (CPU, memory, ASIC)

Design-space Exploration (DSE)

HW/SW partitioning

Final result
HW/SW partitioning

\[ a = b \text{ AND } c \]
**Hardware design**

**High level function model**

\[ F(a,b,c) = a \text{ AND (not } b) \text{ AND } c \]

**Automatic Synthesis**

**Mapping**
Software development

- Functionality is described with different languages and an automatic process is used to generate assembly code for different target CPU’s
- **Modeling** of the functionality: High level languages
- **Automatic synthesis**: Compilers
New design flow for NES

Steps of state-of-the-art system design flow

- Application requirements
- Computational and communication requirements

Formal network model

- Channel & protocol description
- Network-aware description of the application

NW DSE & Network Synthesis

Design-space exploration of nodes

Platform description
Concepts to be explained

- Model-driven design
- SystemC/TLM
- Simulation of the network
- Network synthesis
- Network-driven verification