A Framework for Embedded System Design for MPSoCs

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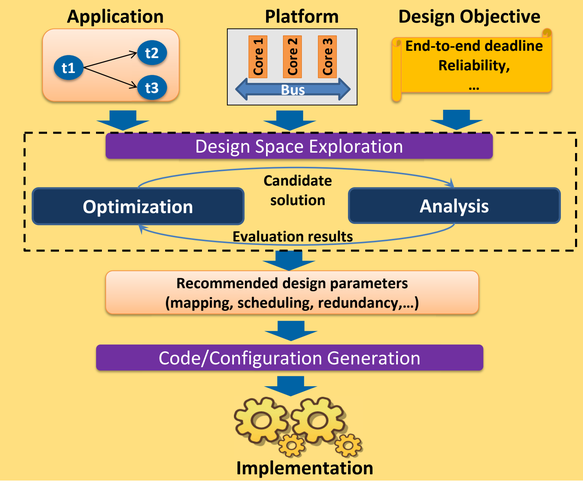
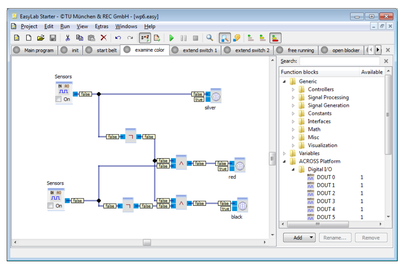
Overview

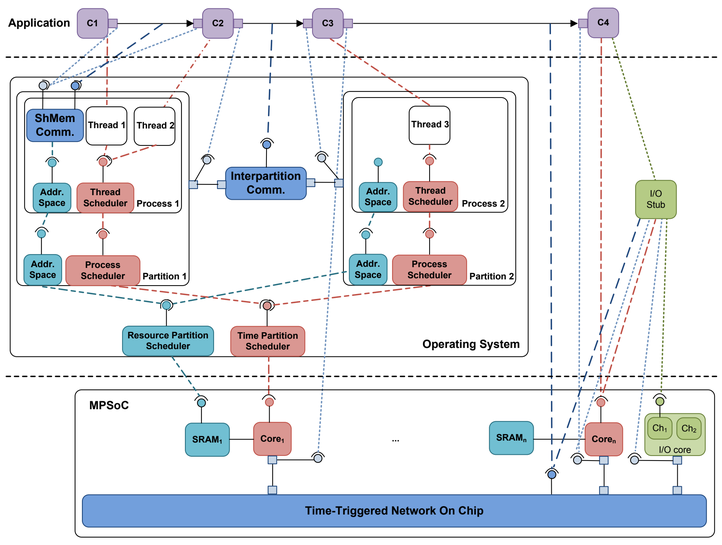
- **Framework** for implementing model-driven development tools for complex embedded platforms based on Eclipse EMF.
- Automatic Analysis & Optimization, Code Generation & Platform Configuration.
- Evaluation of approach:
  - Application of framework in **tool-chain for Multiprocessor System on a Chip (MPSoC) platform provided by ACROSS project**.
  - Validation using **industrial control demonstrator**.



Modeling Approach



[IEC 61131-3 FBD & system model of case study (ACROSS MPSoC, OS)]



- **Platform components** represent system **resources** (further classified by resource type & arbitration strategy). E.g., time-triggered network-on-chip, general purpose and dedicated system cores (I/O, …) , OS (partitions, processes, threads, inter-partition communication).
- **Application models** are annotated with **requests** for platform resources. The behavior of domain-independent **Kahn Process Networks** (with timing annotations) can be specified with **domain-specific models** (IEC 61131).
- **Allocation models** describe mapping & scheduling.

Reliability Analysis & Design Space Exploration

- **Automated design optimization** that evaluates trade-off between user-specified **design objective models** (end-to-end latency, reliability, resource consumption).

The ACROSS Project

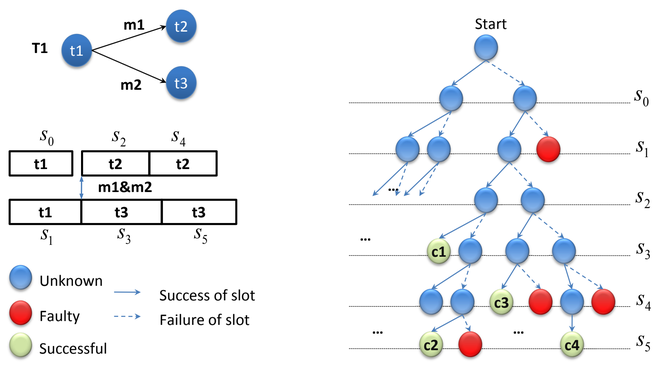
- **Problem Statement:** Exchange and reuse of technology between different application domains of embedded systems is difficult.
- **Approach:** Cross-domain HW/SW platform for the realization of mixed-criticality applications.
- **Results:** Time-triggered MPSoC, software environment (OS, middleware) and tool-supported development methodology. Assessment in automotive, aerospace and industrial control case studies.

- Tree-based **system-level reliability analysis** in the presence of **active redundancy** and **voting**.
- Visualization of tradeoffs & recommended deployments.

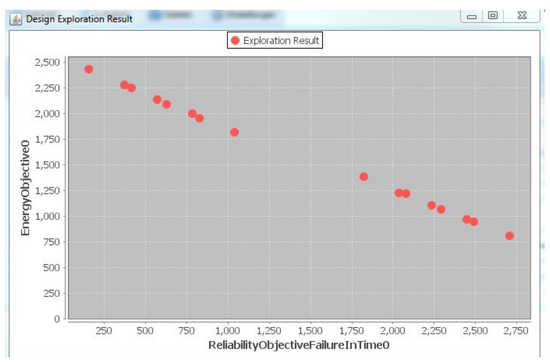
Platform Configuration & Code Generation

Facilitate deployment to target platform by automatic generation of:

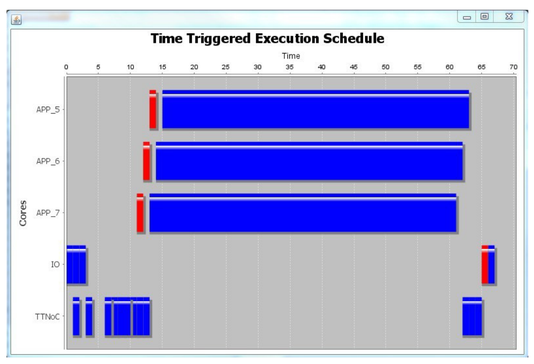
- **Functional C code** for application behavior.
- **Structural C code** for component organization, communication, etc.
- **Platform configuration**: hardware configuration (network & task schedule), OS configuration.



[Reliability Analysis Procedure]



[DSE result: Pareto Optimal Design Alternatives]



[Recommended schedule for case study]

Industrial Control Demonstrator

- **Objective:** Demonstrate tool supported implementation of safety critical automation task on ACROSS platform.
- **Function:** Sort work-pieces by material properties.
- **Reliability Goal:** tolerate single fault of a random component.
- **Application of Development Methodology:**
  - **Input**: IEC 61131-3 **models of sorting task** embedded into Kahn process network model as well as **models of ACROSS MPSoC** and **PikeOS operating system**, **reliability goal**.
  - **Output**: Fault-tolerant deployment (here: Triple Modular Redundancy scheme). Automatic generation of application code as well as configuration of ACROSS MPSoC and PikeOS instances.

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