

Mixed-Criticality Workshop 

DREAMS


Distributed REal-time Architecture
for Mixed Criticality Systems



Roman Obermaisser
University of Siegen



MIXED-CRITICALITY CLUSTER
Centrex DREAMS PROXIMA

Project General Information 

- Project full title: Distributed REal-time Architecture for Mixed criticality Systems
- Project duration: October 1, 2013 – Sept. 30, 2017
- Type of project: Integrated Project (IP)
- Budget Total: 15.5 mill. EUR

| | | | | | |
|----------|----------------------|---------|---------------|--------------------|---------|
| Industry | Thales SA | France | Research Org. | ONERA | France |
| | Alstom Wind S.L. | Spain | | Ikerlan | Spain |
| | STMicroelectronics | France | | SINTEF | Norway |
| | TÜV Rheinland | Germany | | Fortiss | Germany |
| SME | TTTech | Austria | Univ. | Universität Siegen | Germany |
| | RealTime-At-Work | France | | TU Kaiserslautern | Germany |
| | Virtual Open Systems | France | | UPV | Spain |
| | FENTISS | Spain | | TEI | Greece |

27.03.2015 6

MIXED-CRITICALITY CLUSTER
Centrex DREAMS PROXIMA

Project Description



Mixed-criticality architecture based on networked multi-core chips

1. Architectural style and modelling methods
2. Virtualization technologies for security, safety, real-time performance, integrity in networked multi-core chips
3. Adaptation strategies for mixed-criticality systems
4. Development methodology and tools based on model-driven engineering
5. Certification and mixed-criticality product lines
6. Feasibility of DREAMS architecture in real-world scenarios
7. Promoting widespread adoption and community building

27.03.2015



7

Overall Timing of Project



PHASE 1: Requirements Analysis

PHASE 2: Definition of architectural style, development process and high-level design of virtualization methods

PHASE 3: Development of 1st version of models, virtualization and development methods, demonstrator designs

PHASE 4: Development of final models, virtualization techniques, development methods, demonstrator designs

PHASE 5: Demonstration, validation, training

M1 ... M6 M7 .. M10 M11..M18

Intermediate
Integration

M20..M34

Final
Integration

M36..M48

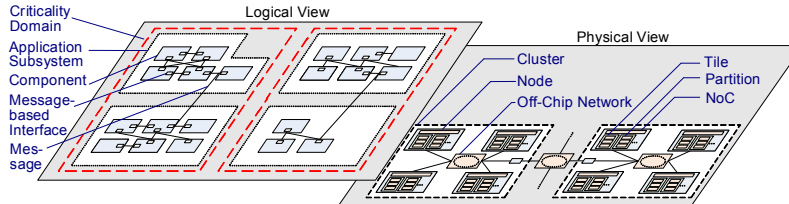
Milestone: Final DREAMS Architecture



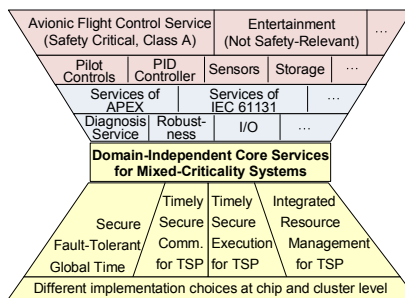
DREAMS Architectural Style



System Model of a Mixed-Criticality System



Logical Architectural Structure with Platform Services



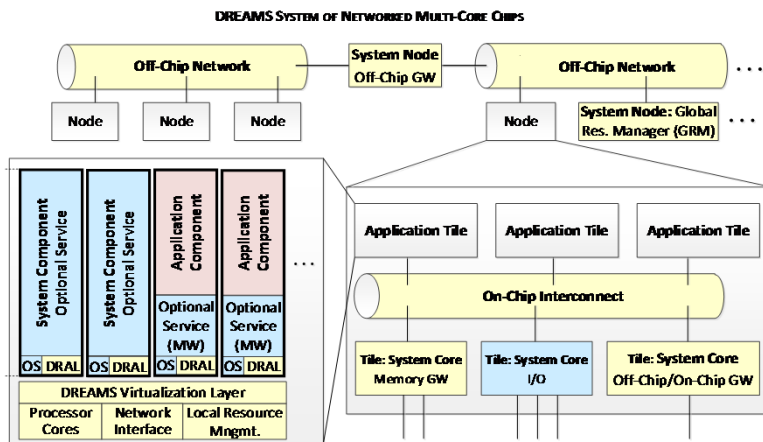
27/03/2015

9

DREAMS Architectural Style (2)



Realization of Platform Services in Networked Multi-Core Chips



MIXED-CRITICALITY CLUSTER
 Centrex DREAMS PROXIMA

Virtual Platform

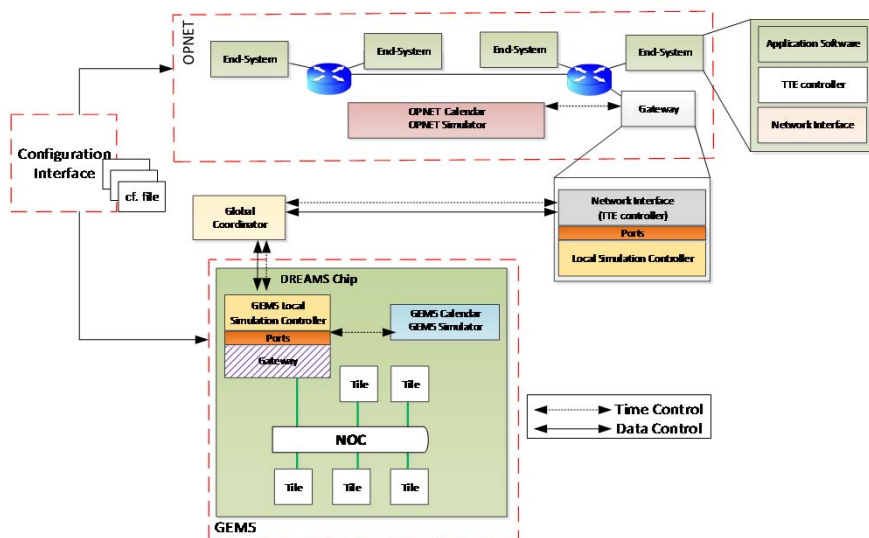


- Architecture exploration at cluster level, chip level and hypervisor level
- Early feedback on design decisions for developers of mixed-criticality systems
- Cosimulation of cluster level, chip level and hypervisor
- Simulation components for DREAMS architectural building blocks
 - ◆ Network on chip with local resource schedulers and routers
 - ◆ Gateways between on-chip and off-chip networks
 - ◆ Off-chip networks and end-systems at cluster level
 - ◆ Hypervisor for partitions within computational cores

27.03.2015

11

Simulation of Networked Multi-Core Chips



27.03.2015

12

Coordination of the Simulation Tools DREAMS

- **Global Coordinator**
 - ◆ Responsible for blocking control

- **Local Controller**

27.03.2015
MIXED-CRITICALITY CLUSTER
C6ntrex DREAMS PROXIMA
13

Examples of Architectural Building Blocks DREAMS

Local Resource Schedulers for Communication

- Support for time-triggered, rate-constrained and best-effort communication on top of event-triggered networks-on-a-chip
- Fault isolation, temporal predictability and composability

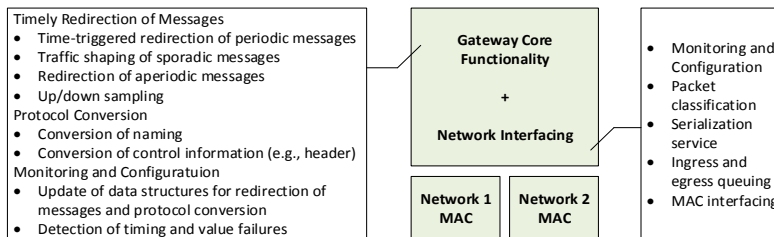
27.03.2015
Monitoring and Configuration Interface
14

Examples of Architectural Building Blocks

Gateways



- Selective redirection of messages between on-chip and off-chip networks
- Temporal and spatial partitioning between application subsystems of different criticality



27.03.2015



15

Demonstrators for Real-World Scenarios



- Avionic demonstrator: avionics display with different levels of criticality
- Wind power demonstrator: Wind turbine control system combining safety-critical application for the pitch control with non safety-critical services
- Healthcare demonstrator: body gateway for a remote patient monitoring application



