MEM4CSD: Model-based Engineering Methods for Complex Systems Design

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- **One of the top French public engineering school (Grande Ecole)**
  - Founded in 1878 as a school specializing in telegraphy

- **LTCI Lab: ACES research group**
  - Autonomic and Critical Embedded Systems

- **Work supported by the ISC Chair on Complex Systems Engineering**

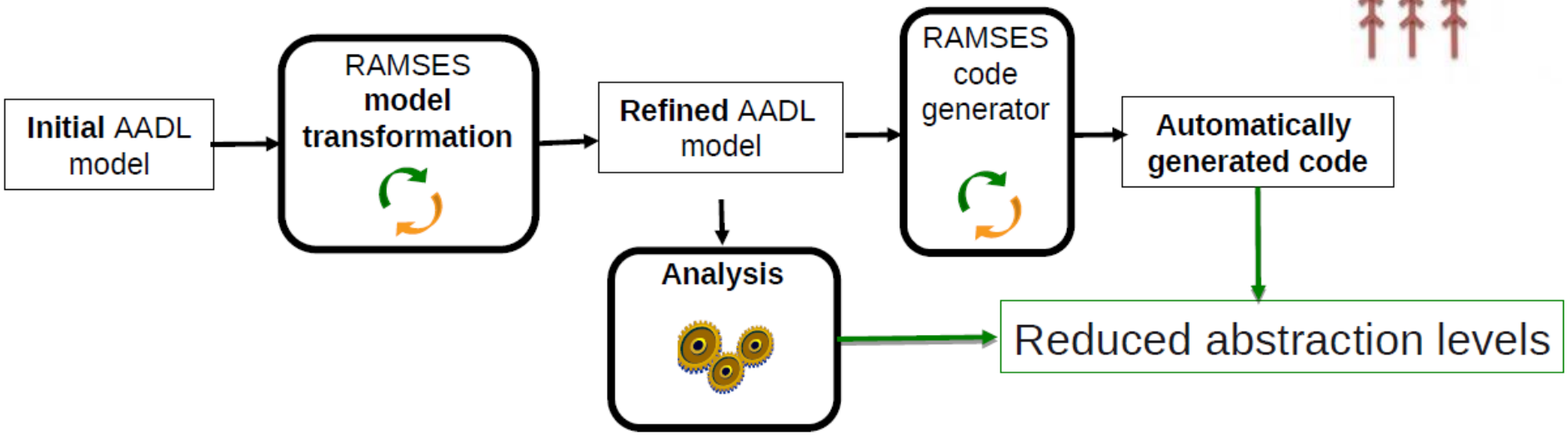
MEM4CSD: Model-based Engineering Methods for Complex Systems Design

- https://mem4csd.telecom-paristech.fr/

- **Methods and tools (not all shown on website):**
  - **RAMSES: Refinement of AADL Models for the Synthesis of Embedded Systems**
  - **MC-DAG: Mixed-Criticality scheduling of Directed Acyclic Graph of tasks**
  - AADL -BA: Behavior Annex frontend
  - SEFA: Switched Ethernet Flows Analysis
  - RDAL: Requirements Definition and Analysis Language
  - OSATE-CLI: Command Line Interface for OSATE
  - Workflow management tool for model processing

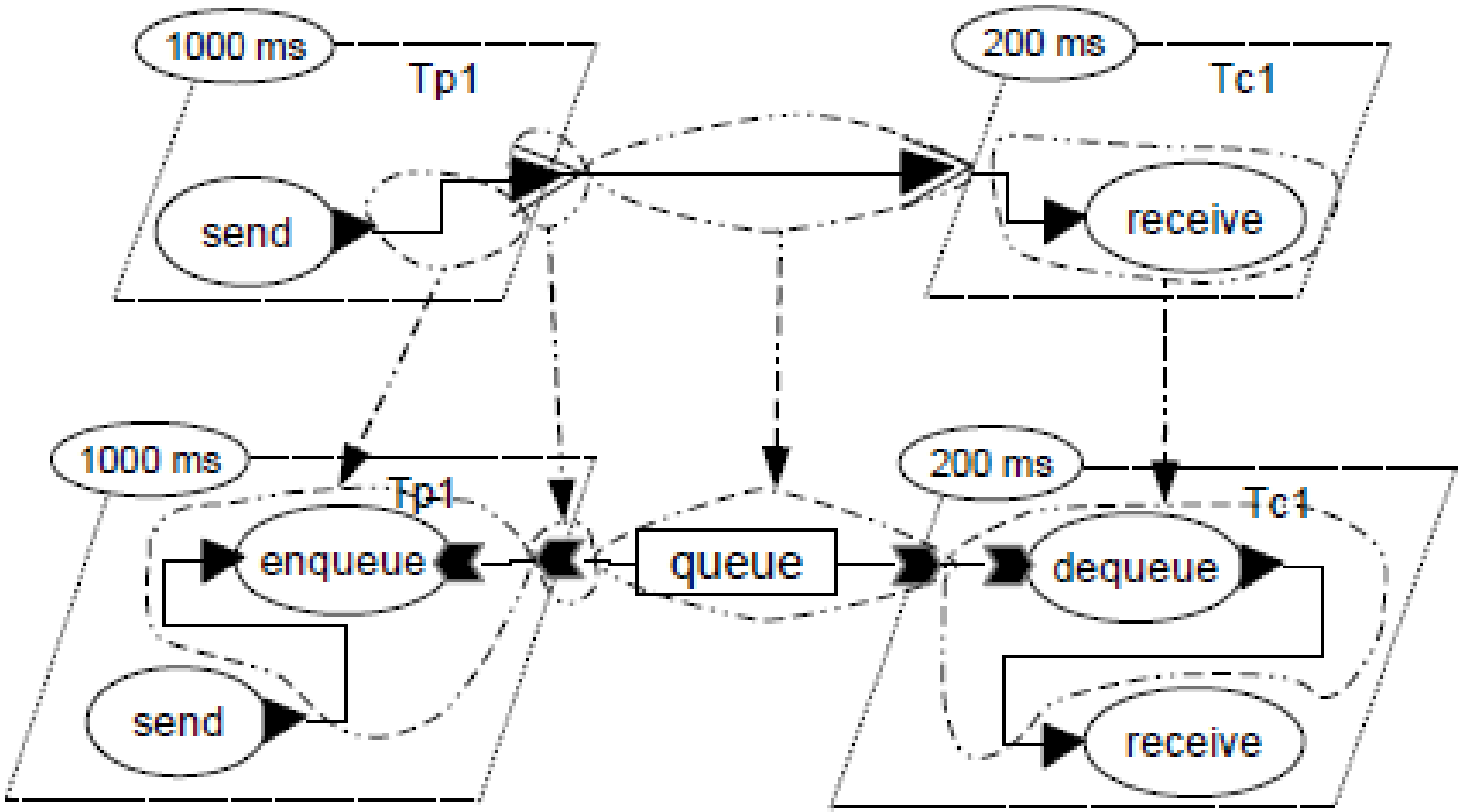
RAMSES: Refinement of AADL Models for the Synthesis of Embedded Systems

- **RAMSES approach**



- **Add-on tool to OSATE**
- **Automatically launch AADL Inspector for analyses**

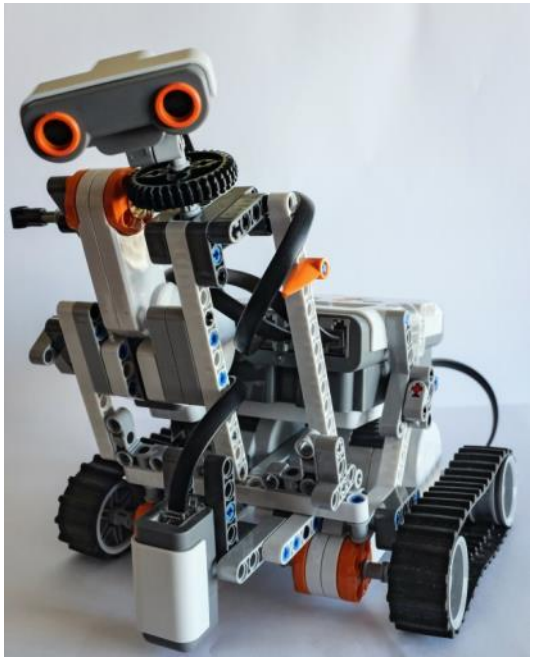
Example RAMSES Refinement Rule: Local Communications



Supported Platforms

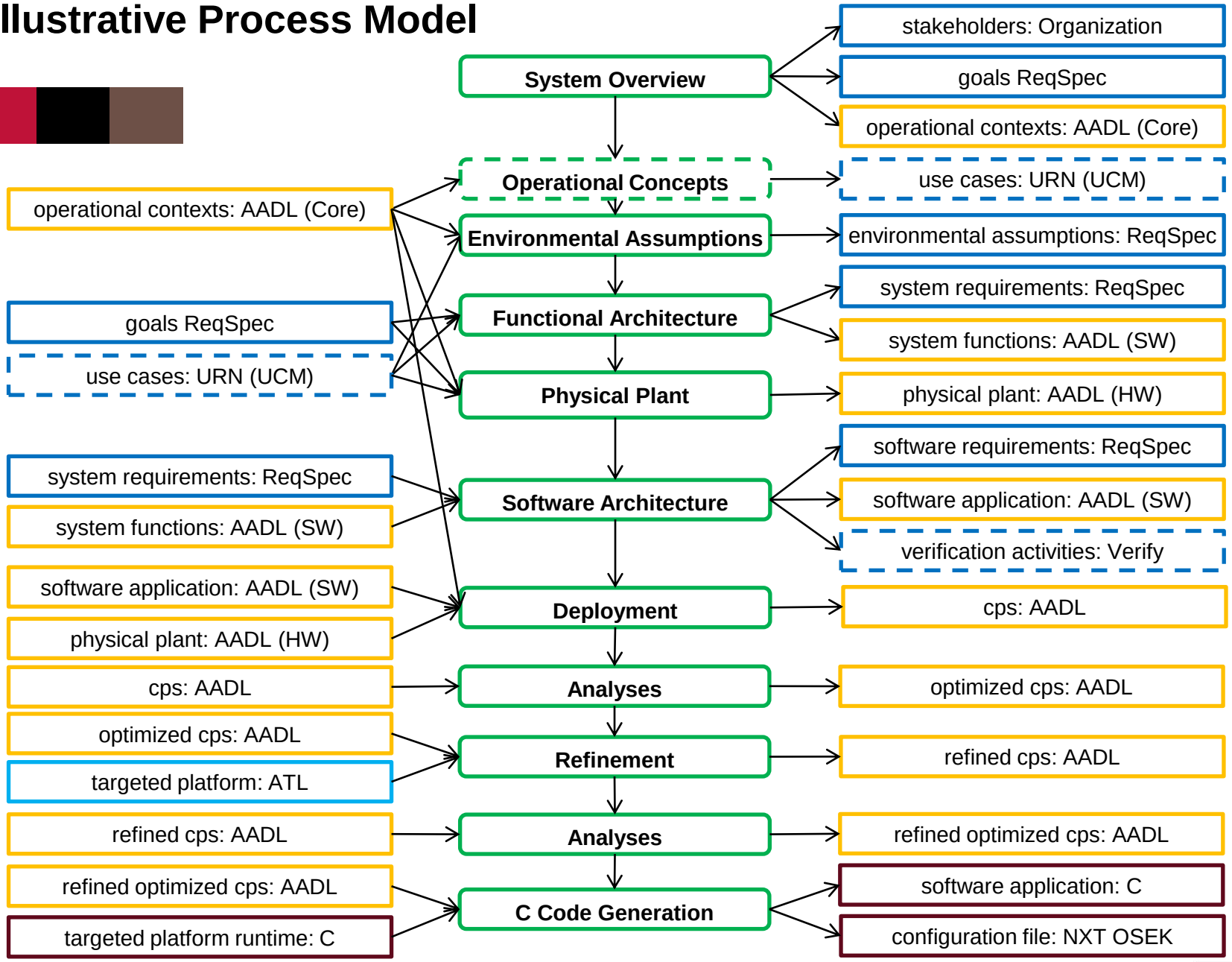
- **POSIX**
  - Linux
- **ARINC653:**
  - POK: https://pok-kernel.github.io/
  - VxWorks: https://www.windriver.com/products/vxworks/
  - Standard
- **OSEK**
  - nxtOSEK: http://lejos-osek.sourceforge.net/

Illustrated with Example Robot Cyber-Physical System

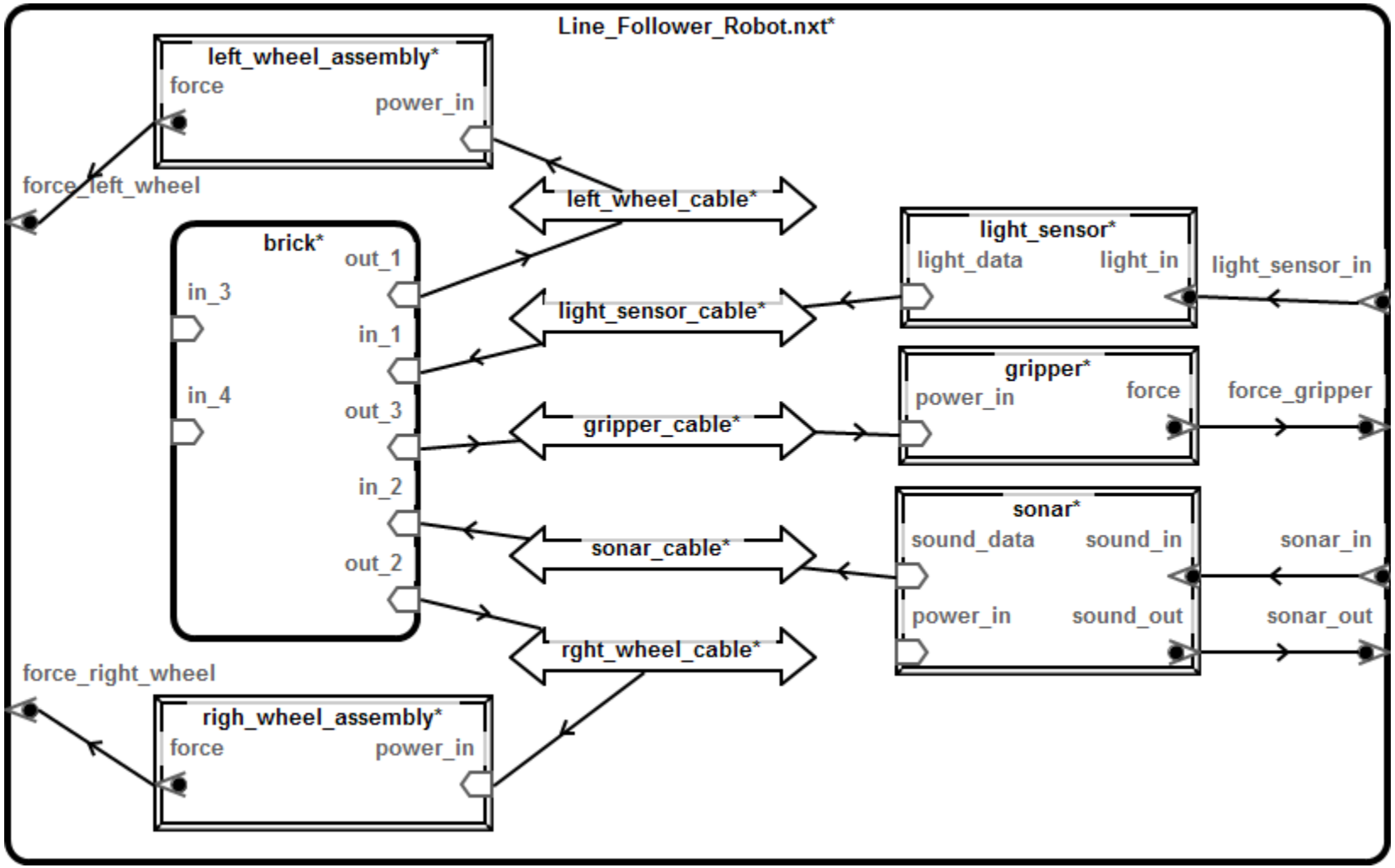


- **NXT Mindstorm Lego Robot**
- **Automatic C code generation from AADL models with RAMSES**
  - NXT OSEK middleware
- **Well documented**
  - Hardware developer kit
  - NXT OSEK (http://lejos-osek.sourceforge.net/)
  - Example line follower application on the web

Illustrative Process Model



Complete AADL Modeling: Plant, Operational, Software, Deployment



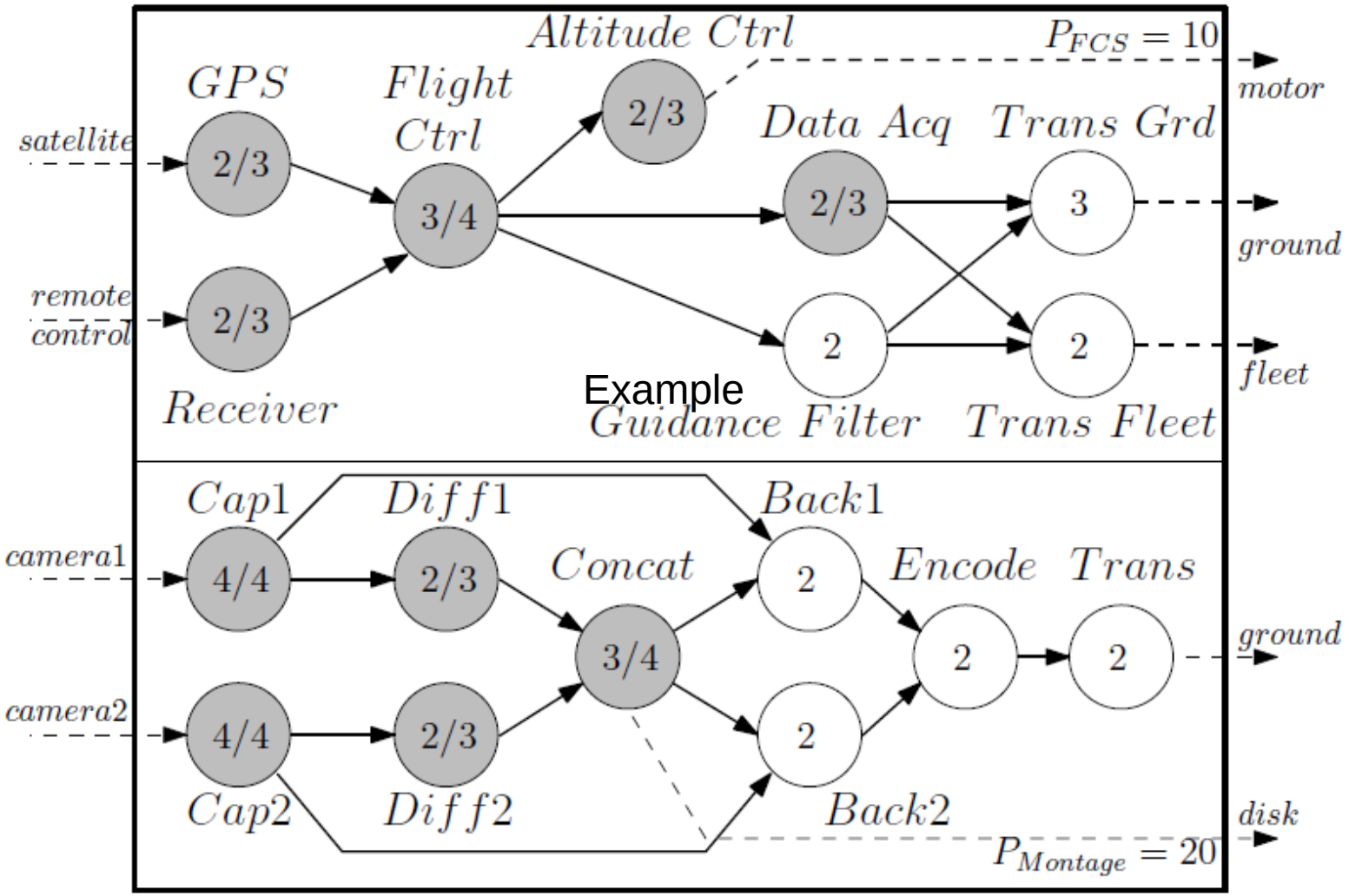
Mixed-Criticality Scheduling on Multi-Core Architectures

- *Scheduling Multi-Periodic Mixed-Criticality DAGs on Multi-Core Architectures*, Medina et al., RTSS conference 2018.
- Developed the so-called MH-MCDAG heuristic.
- Principle: execute HI criticality tasks as late as possible, giving more flexibility for the execution of LO-criticality tasks

MC-DAG Toolset

- Simple DSL to represent MC DAGs
- Easy to use to develop schedulers
- Usable alone without an Architecture Description Language (ADL)
- Integrated with AADL via model transformations
- Can also be used with other ADLs:
  - AUTOSAR, AF3, MARTE, SysML, etc.

MC-DAG Scheduling: Mixed-Criticality UAV Example



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