MBSE 2020

TASTE: a toolchain for multicore TSP applications

Authors:

Laura Gouveia
GMV, lasequeiragouveia@gmv.com

Maxime Perrotin
ESA, maxime.perrotin@esa.int

Thanassis Tsiodras
ESA, thanassis.tsiodras@esa.int

Jérôme Hugues
CMU/SEI, jhugues@andrew.cmu.edu

Daniel Silveira
GMV, daniel.silveira@gmv.com

Presenter:

Laura Gouveia
GMV, lasequeiragouveia@gmv.com

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  - AIR
- Deploying TSP application on TASTE
- TASTE improvements:
  - AADL
  - Code generation
  - Build system
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Overview

What is TASTE

The ASSERT Set of Tools for Engineering

http://taste.tools

- TASTE is a development environment dedicated to embedded, real-time systems.
- Based on formal languages and the concept of building "correct by construction" software.

What is AIR

air

REAL-TIME HYPERVISOR
COMPLIANT WITH ARINC 653 and IMA-SP

- AIR is a type-1 hypervisor that guarantees **TSP** in the target hardware
- Allows multiple avionics applications with **different criticalities** to run independently in the same hardware resource

Prototyping → Development → Integration

What is AIR

SPARC

OS	IO
Bare	Ethernet
RTEMS5	MIL1553
RTEMS48i	SpaceWire
	CAN

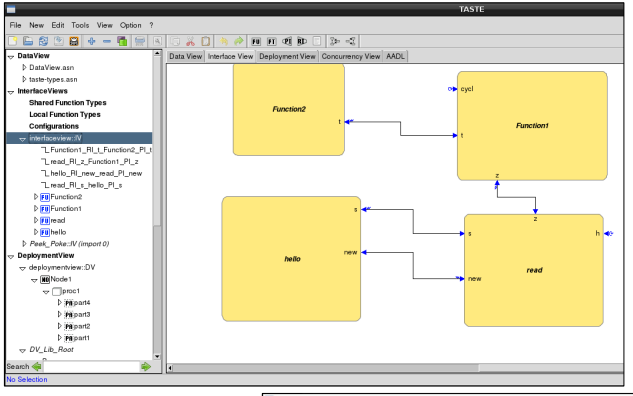
ARM

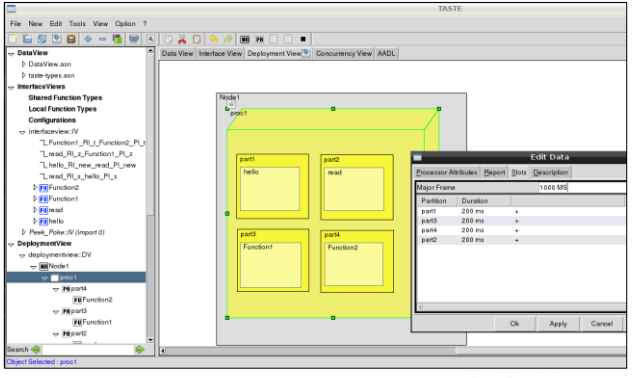
OS	IO
Bare	TSN
RTEMS5	UART
	CAN

TSP on TASTE

Deploying TSP applications on TASTE

- TSP applications are deployed as standard TASTE applications
- TSP properties added as extensions to TASTE process.

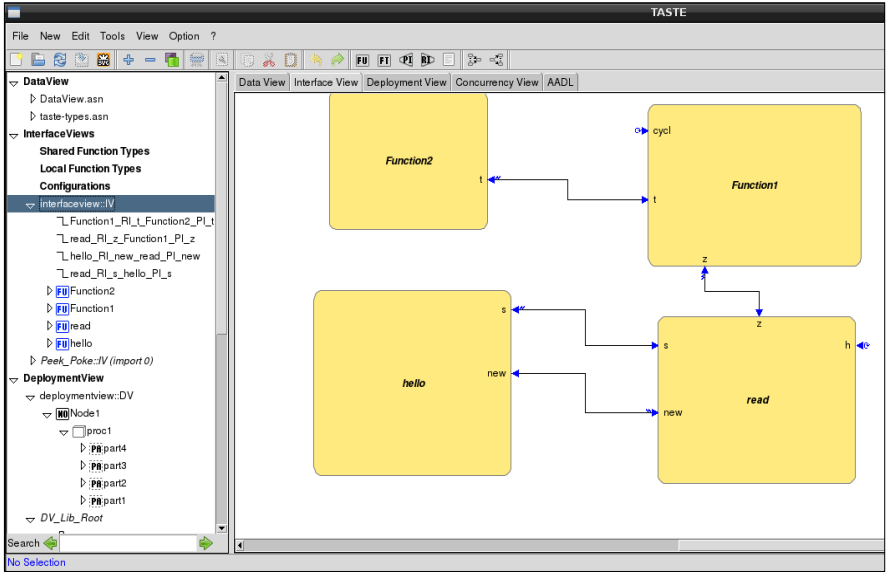




Deploying TSP applications on TASTE

Interface View

- Defines logical functions and interactions.
- Code skeletons are generated from the model.
- User specifies function behaviour:
  - Programming language – C, C++, Ada or Micropython
  - Modelling language – SDL or Simulink

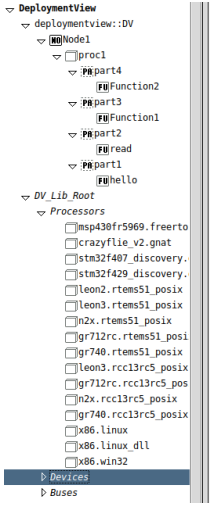


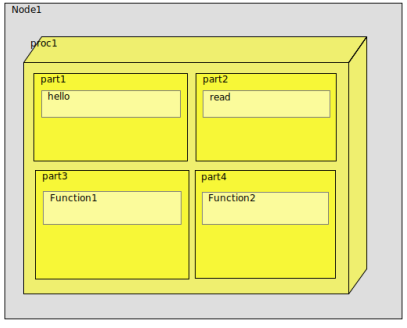
Interface View unchanged for TSP applications

Deploying TSP applications on TASTE

Deployment View

- Logical functions deployed on hardware.
- AADL library allows reusing of hardware components.
- Configuration parameters configure the system on target platform.



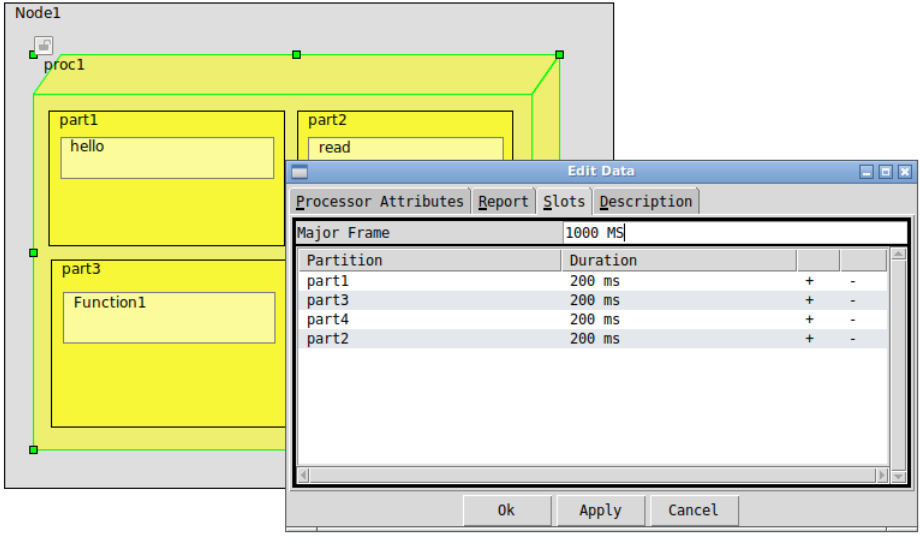


Deployment View features TSP specific entities and attributes

Deploying TSP applications on TASTE

Deployment View

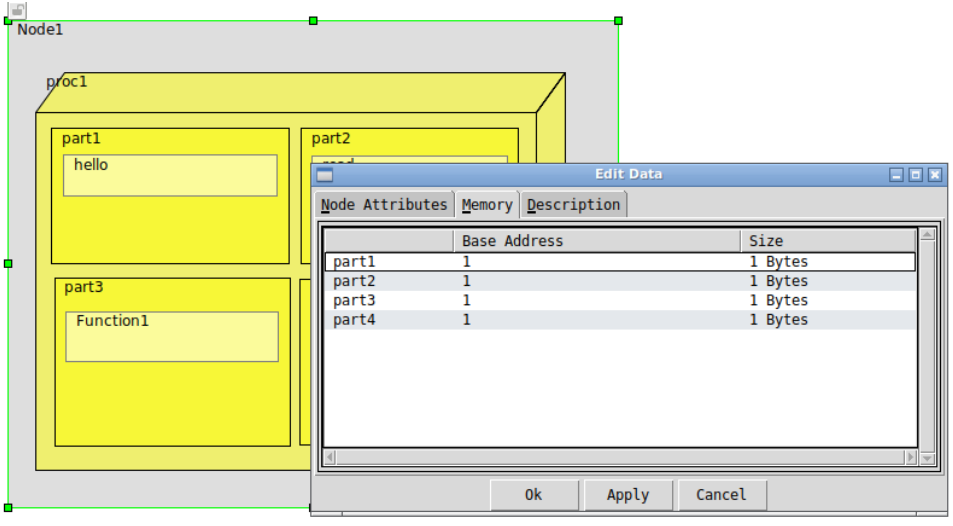
- Time partitioning:
  - Partition scheduling attributes within processor



Deploying TSP applications on TASTE

Deployment View

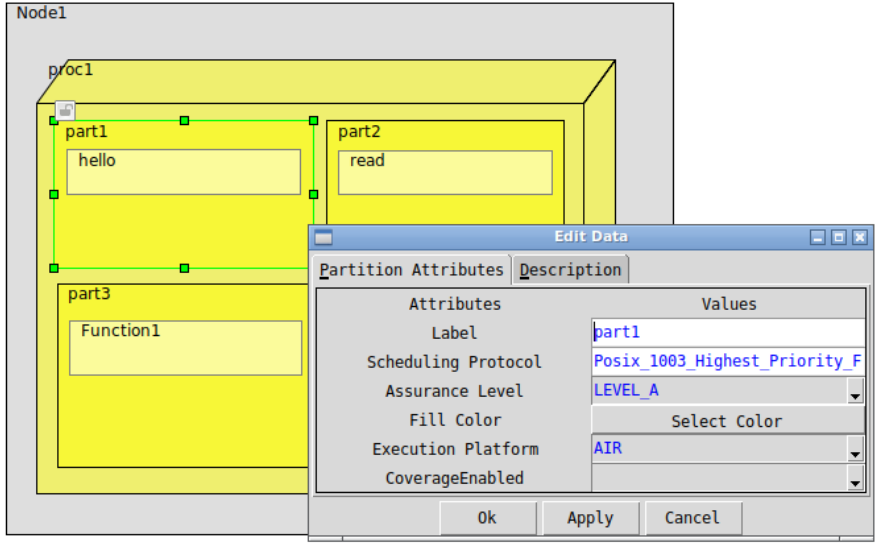
- Space partitioning:
  - Memory segments specified per partition.



Deploying TSP applications on TASTE

Deployment View

- Criticality level per partition.



Deploying TSP applications on TASTE

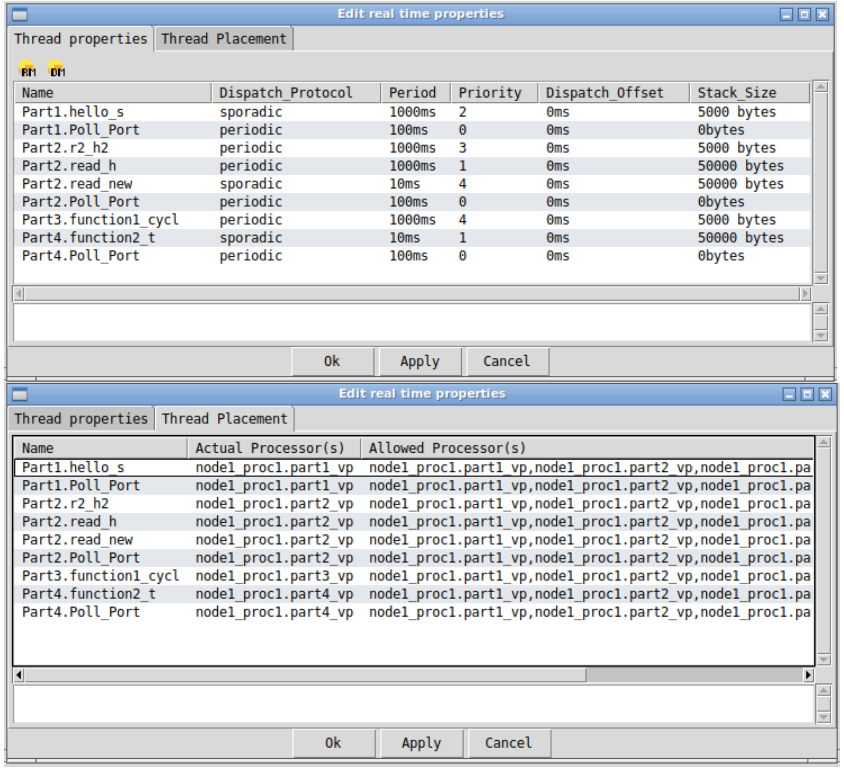
Concurrency View

- Automatic model transformation from Interface View and Deployment View.
- Provides scheduling analysis.

Deploying TSP applications on TASTE

Concurrency View

- SMP properties can de defined:
  - Task allocation to core.
  - Task priority.
  - Stack size.



Build System

Code generation improvements

PolyORB-HI

- Main execution platform in TASTE

- Provides:
  - Task handling
  - Data types
  - Communication interfaces
  - Device drivers

- Upgraded to support:
  - Latest RTEMS5
  - AIR hypervisor

Build system improvements

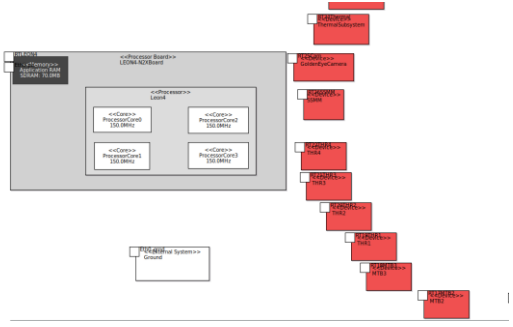
Kazoo

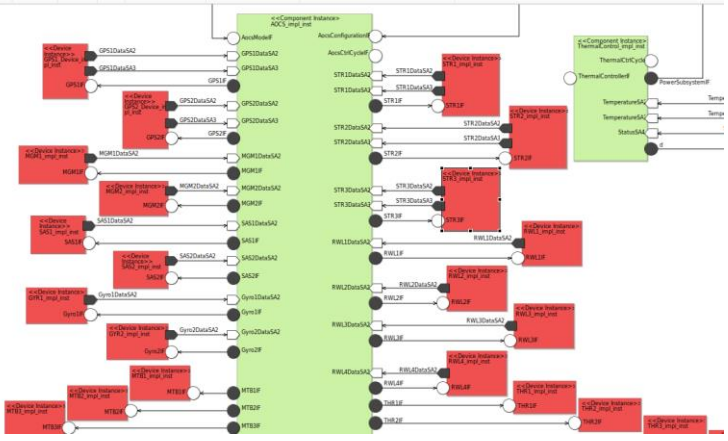
- Novel build system of TASTE.
- Flexible design based on templating engine.
- Generates Concurrency View and ensures orchestration with PolyORB-HI.
- Extended to deploy threads on TSP Partitions.

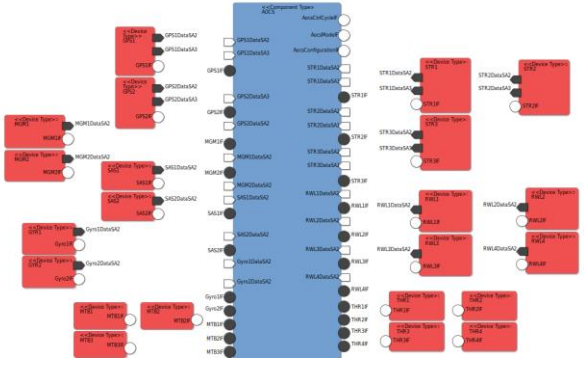
Use Case

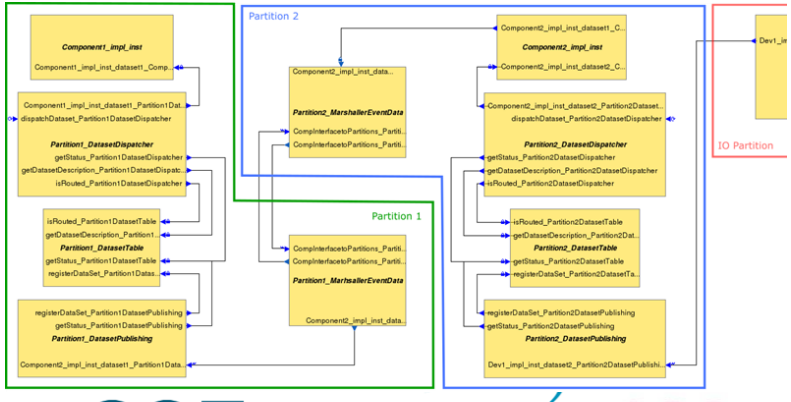
Use case

EAGLEEYE USE CASE MODEL





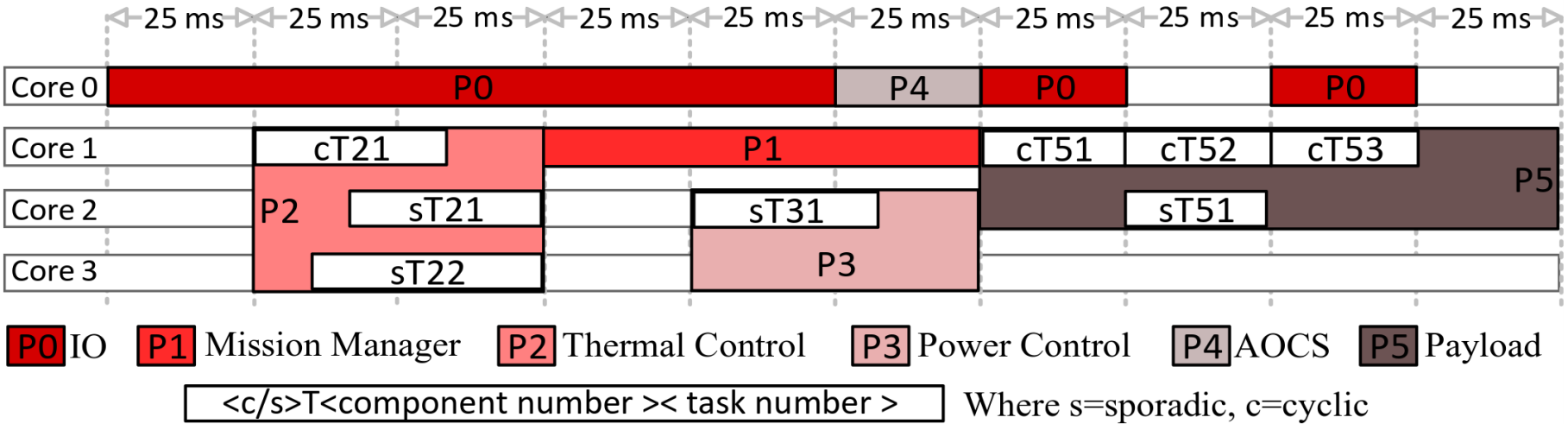




Use Case

EagleEye

Several EagleEye scheduling scenario have been drawn including partitions running in multiple cores with **RTEMS 5 SMP.**



Future work

So far...

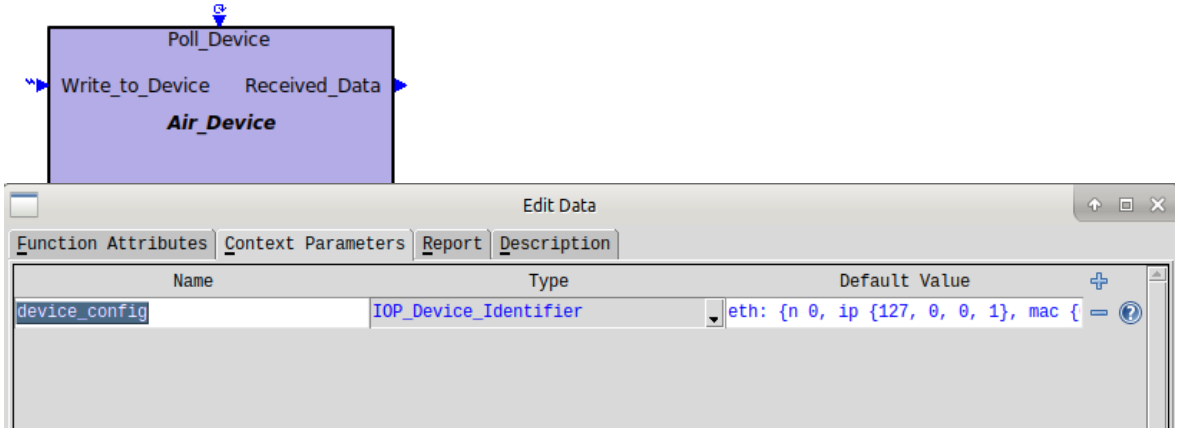
- TASTE allows for multi-partition communicating systems, supported by AIR.
- Full TSP system prototyped by TASTE.
- TASTE tools extended to support AIR as an execution platform.
- One step further from manual, error-prone development lifecycle.

Much to be done…

- Support for IO Partition.
- Scheduling analysis for TSP systems.
- Specification of processor core usage in multi-partition systems.

Much to be done…

- Support for IO Partition.



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THANK YOU

laura.gouveia@gmv.com

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