CoRA MBAD

ADCSS – 16/10/2018

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Presented by Marco Panunzio

ThalesAlenia Space
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Table of contents

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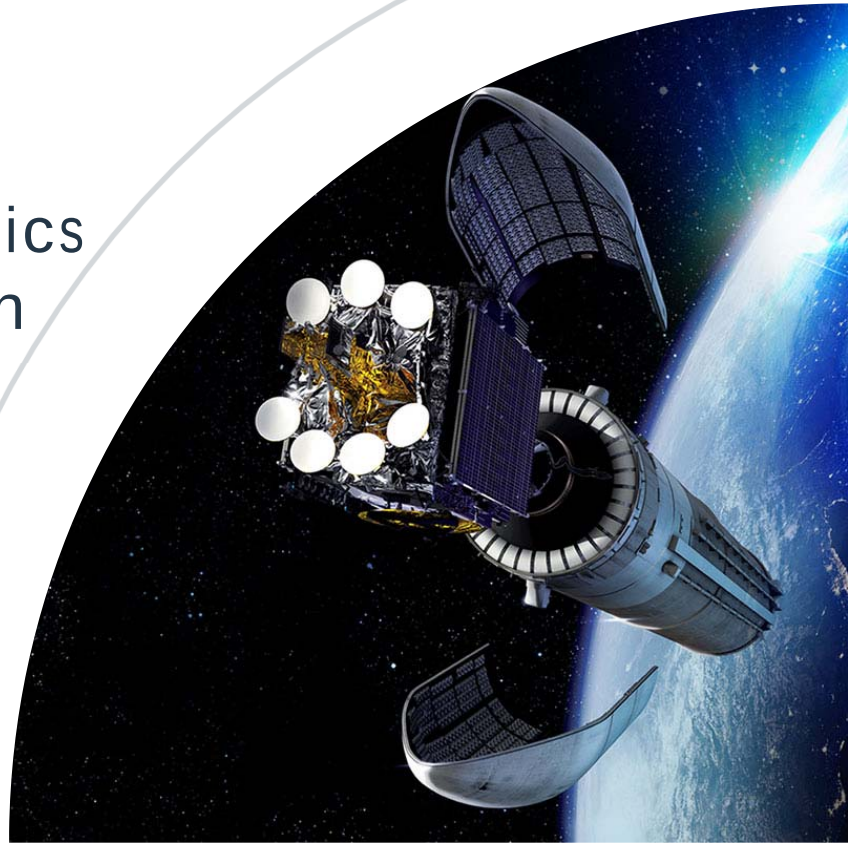
Overview of the CoRA MBAD activity

Overview of the Compact Reconfigurable Avionics – Model-Based Avionics Design (CoRA-MBAD) activity



Overview of CoRA MBAD Activity

- Parallel to CoRA-MBAD activities : CoRA RDHC and SAGE
- Prime Contractor : Thales Alenia Space in France
- Study Manager : Patricia Lopez Cueva
- From October 2017 to April 2019

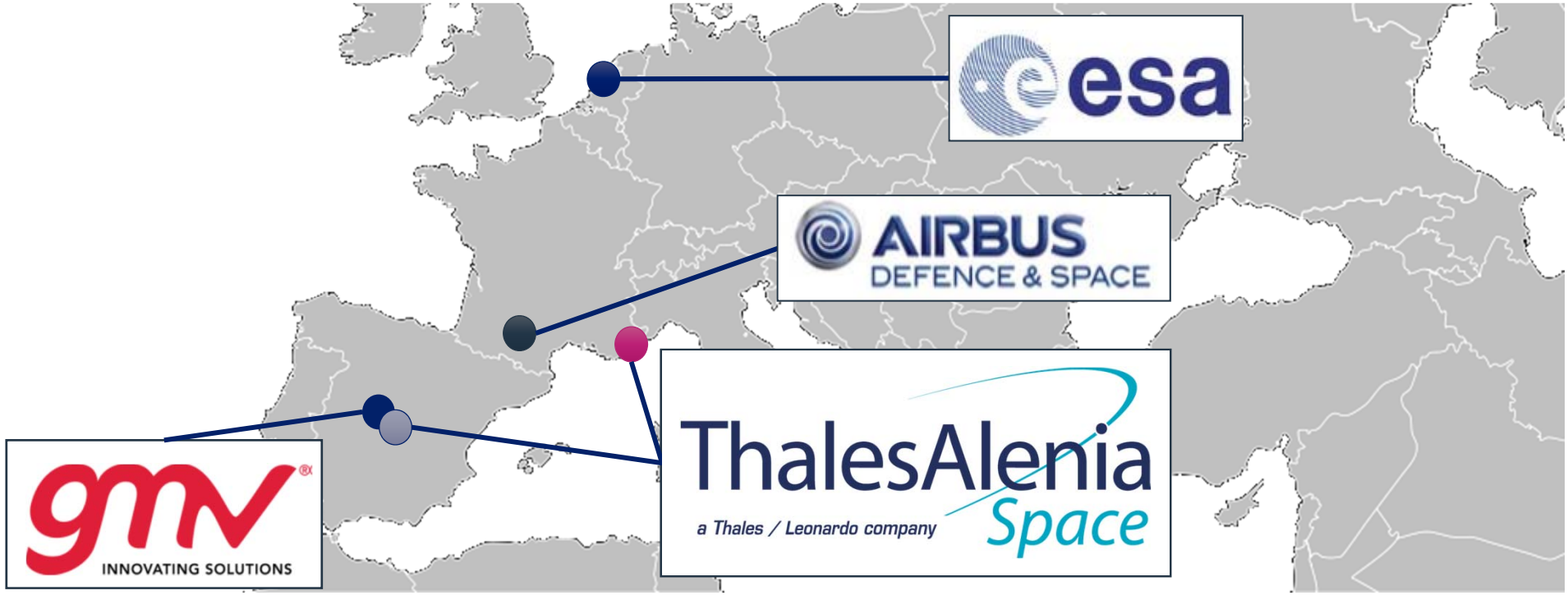
Objective of CoRA MBAD activity

To develop a Model Based Avionics Design Environment and Process permitting the HW/SW co-design at a high abstraction level, and intensively relying on automatic code generation to optimize the development and the performances of compact Reconfigurable Avionics

Reconfigurable Data Handling Core composed of
- a multi-core high performance General Purpose Processor
- In-flight dynamically reconfigurable FPGA

AOCS use-case :
- AOCS/GNC sensors that can be integrated in a Central OBC
- Communication networks for a centralised Avionics paradigm,
- Application Reconfiguration depending on the mission phase

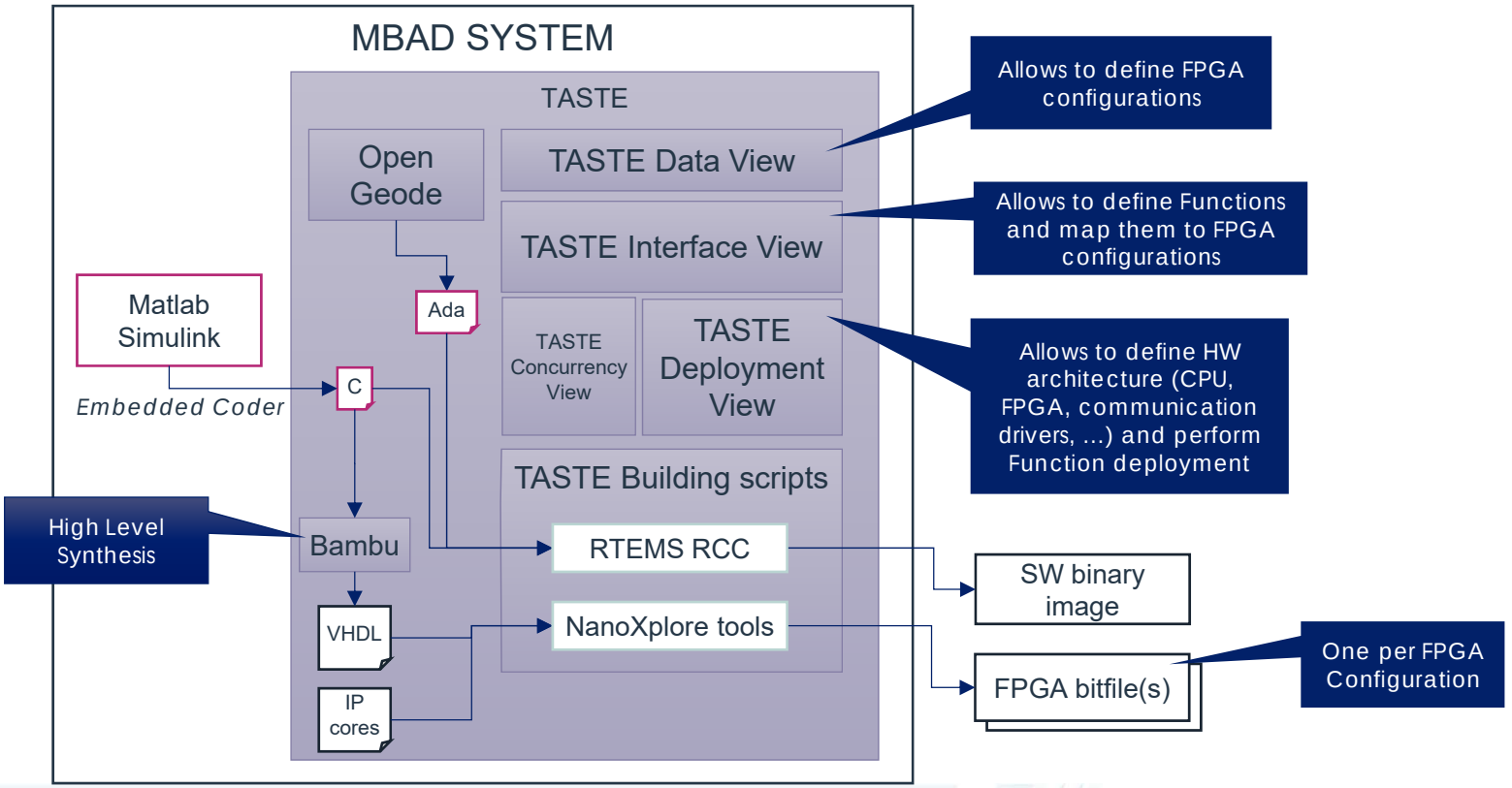
CoRA MBAD Team



Overview of MBAD System

- MBAD System will allow to model the mission phase transitions in the form of state machines
- Mission Phase state machines will drive the reconfiguration of the system
  - By notifying a change of mission phase to SW functional blocks
  - By reconfiguring the FPGA
- MBAD System will automatically generate:
  - All data types and functional blocks interface
  - All functional blocks skeletons
    - So that users only have to worry about implementing functional code
  - Code for communicating SW functions running on the CPU between them and with HW functions executing on the FPGA
- MBAD System will automatically build
  - The binary to be deployed on the CPU
  - The different bitfiles corresponding to the FPGA configurations defined

Overview of MBAD System



MBAD Use Case Architecture

TM/TC Proxy

- TM/TC Communication via LVCUGEN PUS Library

FPGA Reconfiguration

- In charge of driving the reconfiguration of the FPGA and informing other blocks of the status of the FPGA, i.e. reconfiguring, active, error.

Equipment

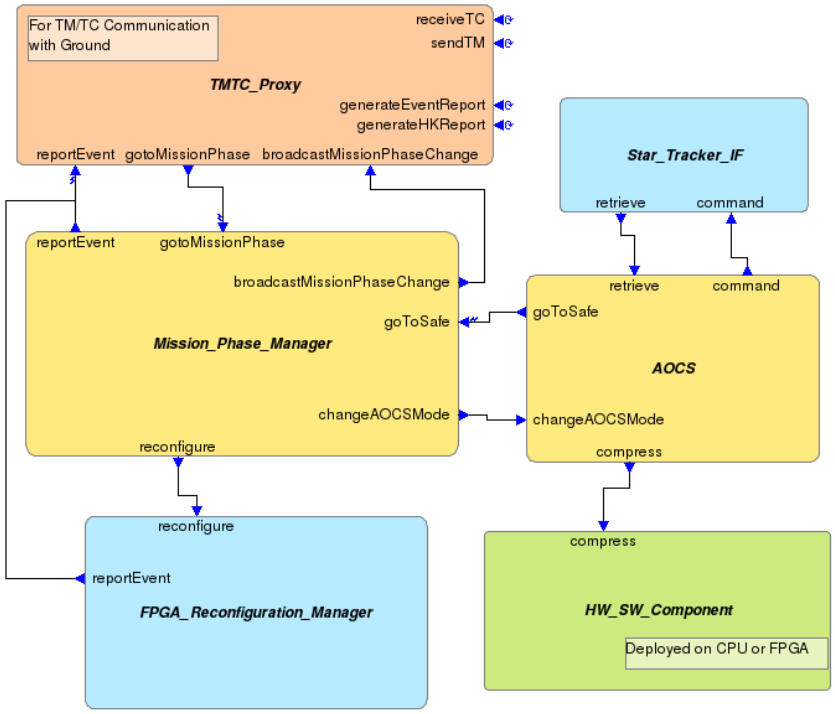
- Dedicated blocks will deal with communication with equipment such as the Star Trackers

Mission Phase Manager

- In charge of managing the current mission phase and any mission phase transition
- A mission phase transition might require reconfiguring the FPGA

HW-only or HW/SW components (VHDL, C or Simulink)

- HW-only can be activated only on certain FPGA configurations
- HW/SW can be deployed on CPU or on FPGA depending of the FPGA configuration



Challenges

- Code generators and build system need to manage the variability in FPGA configurations in order to
  - Correctly generate the mapping of HW accelerators so that all parameters are correctly placed in FPGA internal memory
  - Correctly synthesize a unique bitfile per FPGA configuration with all functional blocks declared as active on that FPGA configuration
  - Correctly generate the inter-functional block communication code taking into account the current FPGA configuration and whether the functional block is deployed in CPU or FPGA for that configuration
- Future vision
  - MBAD System has been designed and is being developped with future support for partial reconfiguration in mind

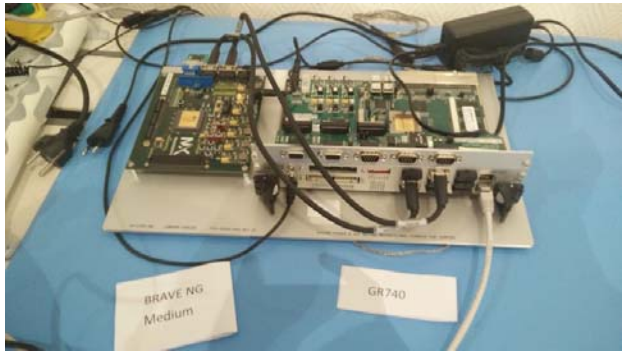
What has been done?

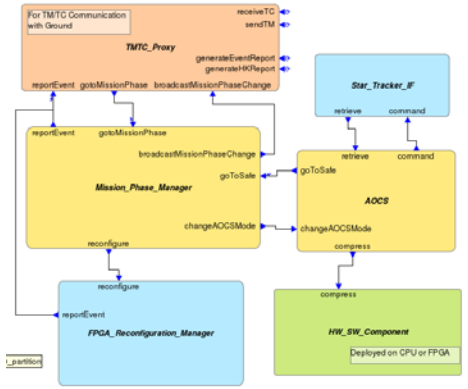
- Analysis of the Domain of the study has been completed
  - Needs and constraints related to target hardware architecture => CoRA RDHC
    - HW requirements related to interfaces (I/O and between CPU and FPGA) and memory needed
    - Reconfiguration requirements
    - Basic Software and IP Library requirements.
  - Needs and constraints related to modeling tools and coding languages => CoRA SAGE
    - Needs of CoRA SAGE Use Cases as requirements for MBAD System
    - Constraints related to selected tools (TASTE, Bambu, Simulink for autocoding, etc.), coding languages (coding standards) as input for CoRA SAGE Use Cases
      - Constraints related to Simulink for autocoding were based on outputs of ESA studies on code generation for AOCS Flight Software
- Specification and Architectural Design of MBAD System has been completed
  - Necessary modifications to TASTE Toolset
  - Architecture of a CoRA Use Case
  - EGSE Architecture

What is left to do?

- Development activities started in July
  - Partial development of code generators iteratively being tested on Bread Board of Target Platform
  - TASTE Template Project for CoRA Use Cases currently being developed => CoRA SAGE
- Internal Use Cases (ADS and TAS-F) currently being developed for internal validation of MBAD System once development activities are finished
  - FPGA Reconfiguration
  - External Interfaces
  - STR Based Safe Mode
  - Image Compression algorithm (CCSDS 122.1-B-1)
- Installation of MBAD System on Elegant Bread Board of Target Platform to be done on the last month of the activity

Questions?





CoRA-MBAD

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