Integrating a Simulink System Target File with MOSAIC for Efficient Model Transfer to SMP and EuroSim

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March 28th, 2017
SESP 2017 Conference
ESTEC, The Netherlands

Overview

- Automatic model transfer: Introduction / Context
- Simulink System Target File (STF)
- Integration of STF with MOSAIC
- Status / Follow-on steps
- Concluding remarks

Introduction: Automatic model transfer

- Purpose
  - Re-use of models during a complete project life-cycle to reduce cost, time, effort

- Approach
  - Automate model transfer between COTS tools and model standards

- Product
  - MOSAIC

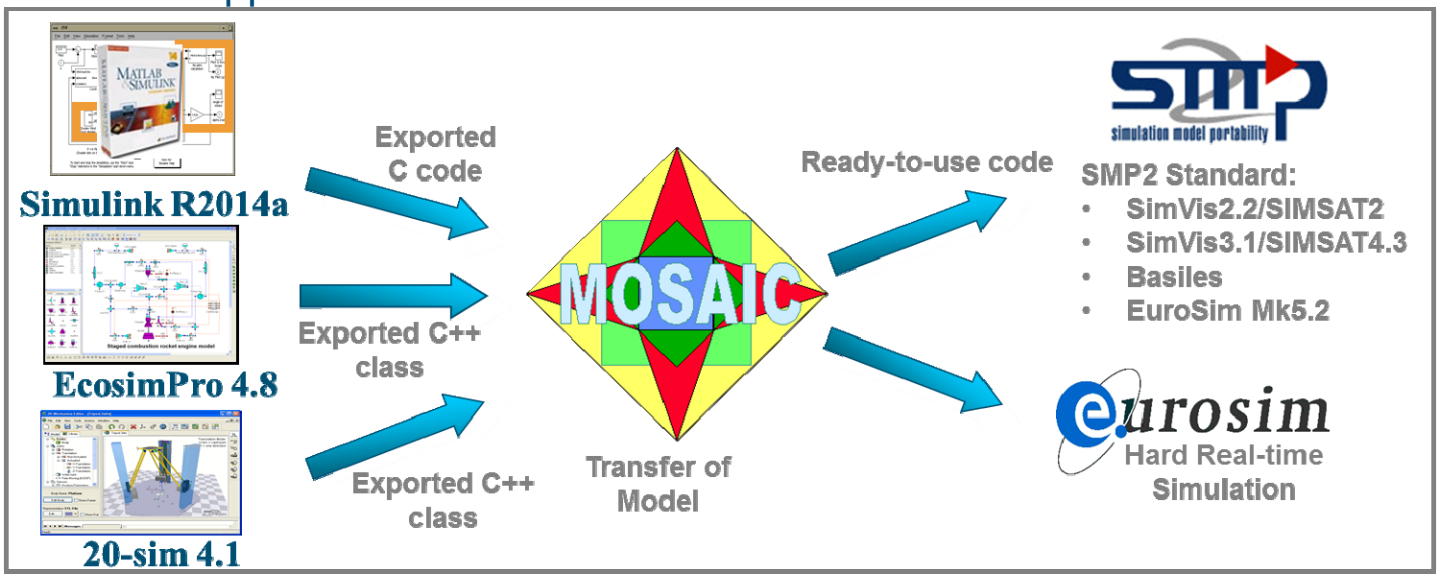
Model-Oriented Software Automatic Interface Converter

Modelling tools:
- Simulink
- EcosimPro
- 20-sim
- Modelica
- ..

MOSAIC Usage

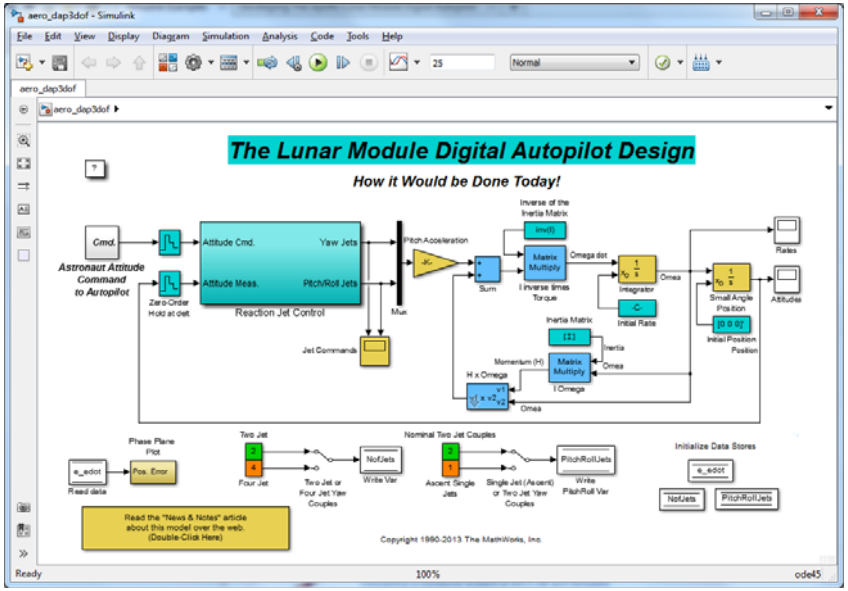
- Usage principles
  - Model adaptation in originating environment
  - MOSAIC treats model as black box
  - Analyses the model code / API and adds interfacing code to it
  - End-to-end support

- Free-of-charge license in ESA member states
- Used in European space industry
  - For more than 15 years
  - In a large number of projects
- Latest external version: MOSAIC 10



Alternative method: Simulink integration with MOSAIC

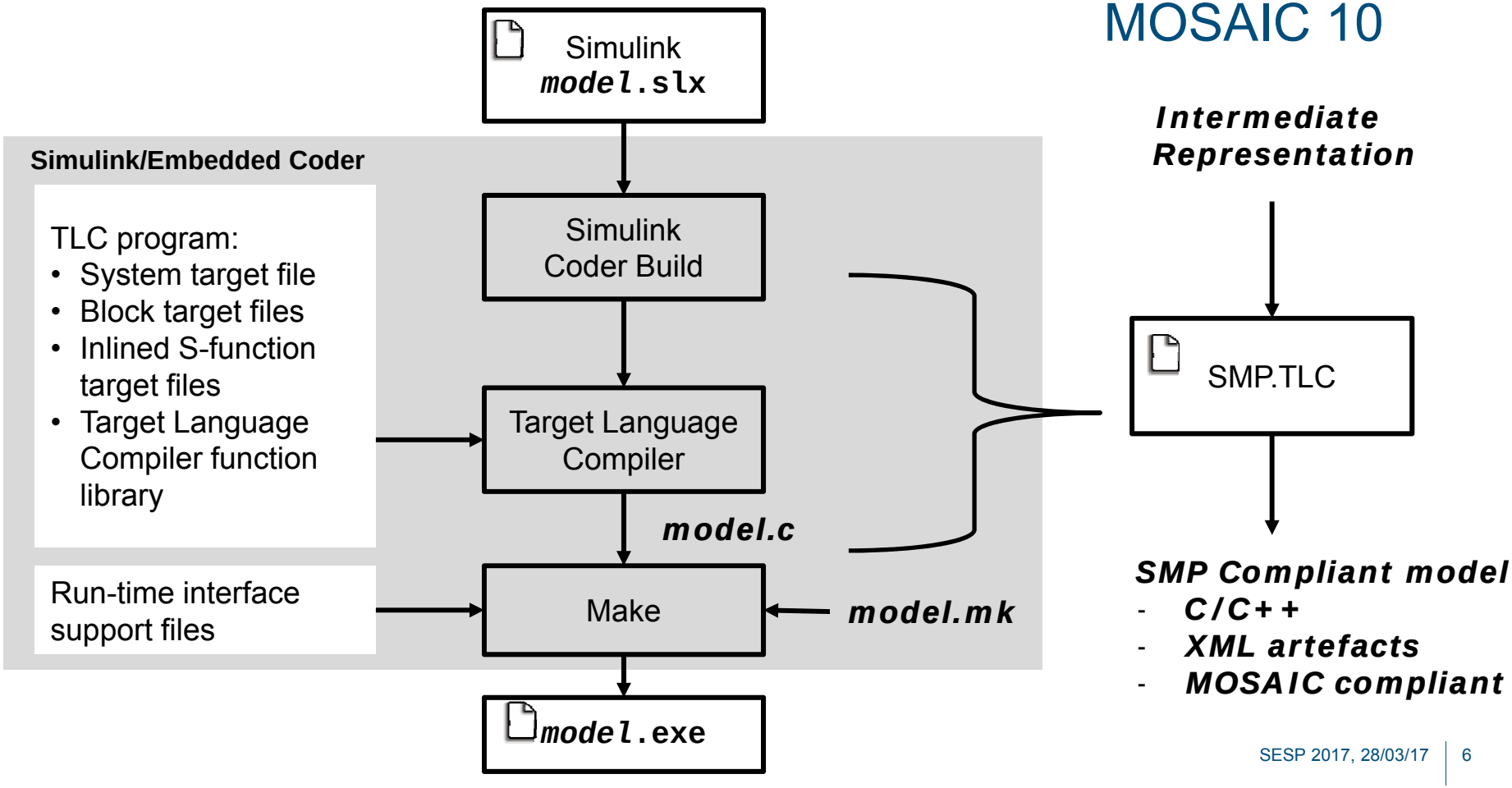
Simulink



- Direct export of SMP compliant code from Simulink
- Simulink System Target File (STF)
- Analysed during MOSAIC 10 activity

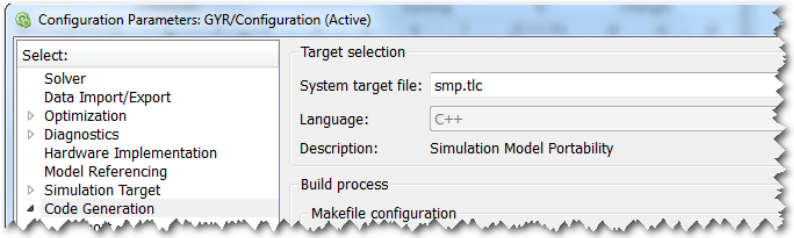
Embedded Coder

Generate custom C/C++ code with TLC

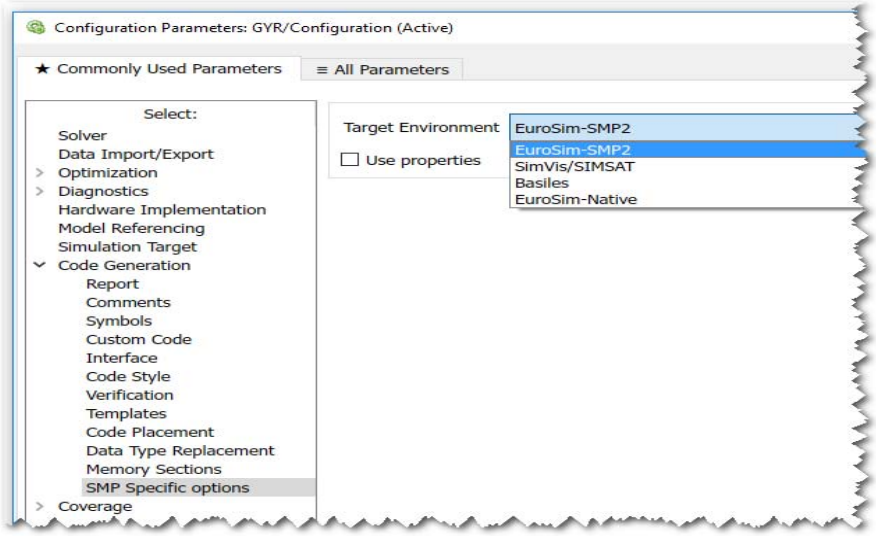


From a Simulink User perspective

1. User selects the correct System Target File: “smp.tlc”



2. Next, the user selects the correct Target environment



3. Finally, user generates SMP files

Benefits of the STF

+ **User-friendly:** Stronger link between Simulink and SMP2.

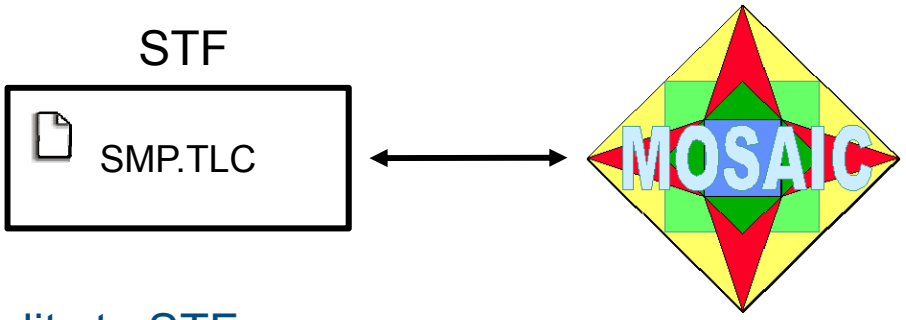
+ **Efficiency:** the meta-information of a Simulink model is accessed directly, rather than by parsing the exported C code.

+ **Maintainability:** Minimal development effort is expected during updates of STF to new MATLAB releases.

Δ Duplication/Reusability: In MOSAIC 10, the STF was in charge of custom SMP files generation as MOSAIC already does. To be merged in follow-on versions.

Integration of the two methods

- One integrated tool
- Take ‘best of both’
- Avoid duplication of functionality
- Ensure efficient maintainability

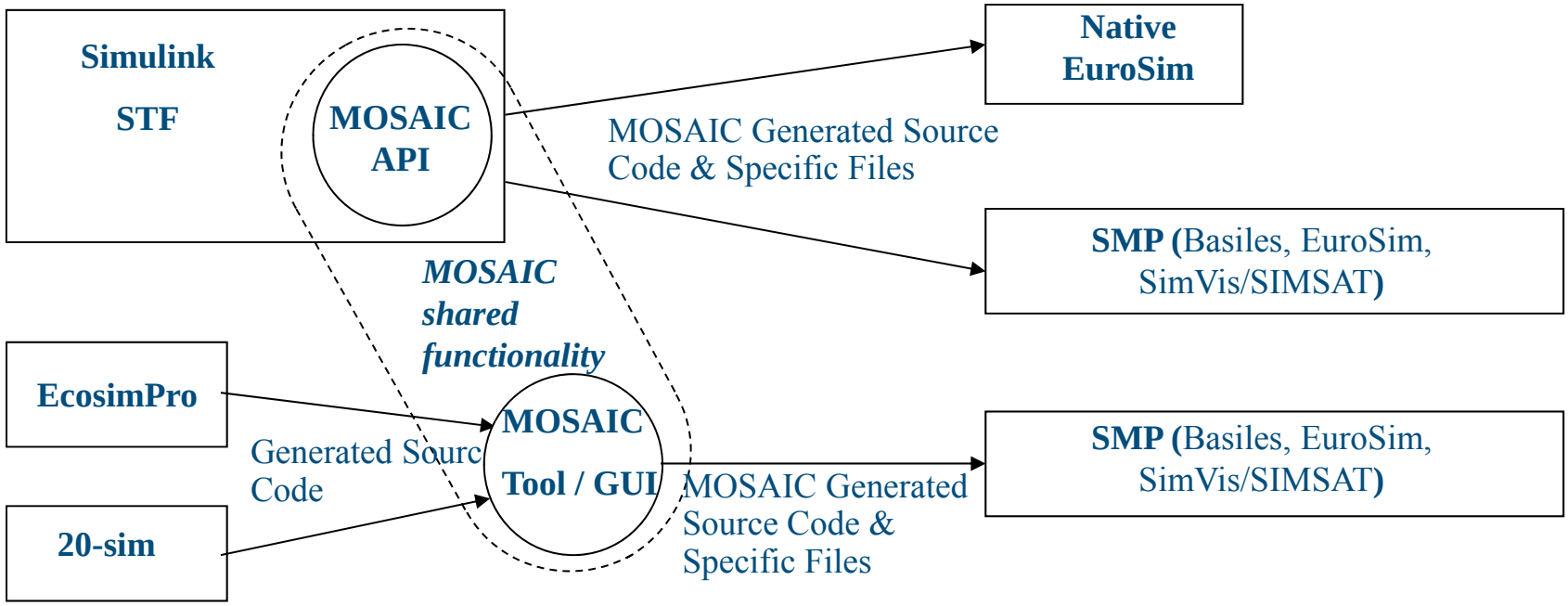


Approach

- Move all Simulink specific functionality to STF
- Use existing MOSAIC capability for
  - Support of input formats (e.g. EcosimPro and 20-sim)
  - Support of specific features of target simulation platforms
  - Optimisation of specific SMP related issues - such as UUID - on a generic level

Integrated transfer tool (1)

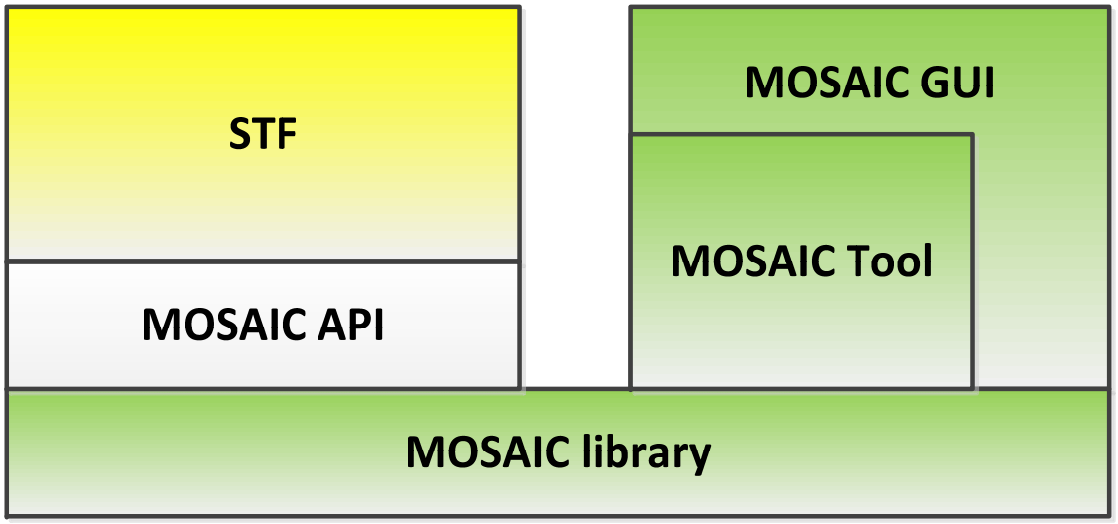
Porting scheme (same transfer cases as MOSAIC 10):



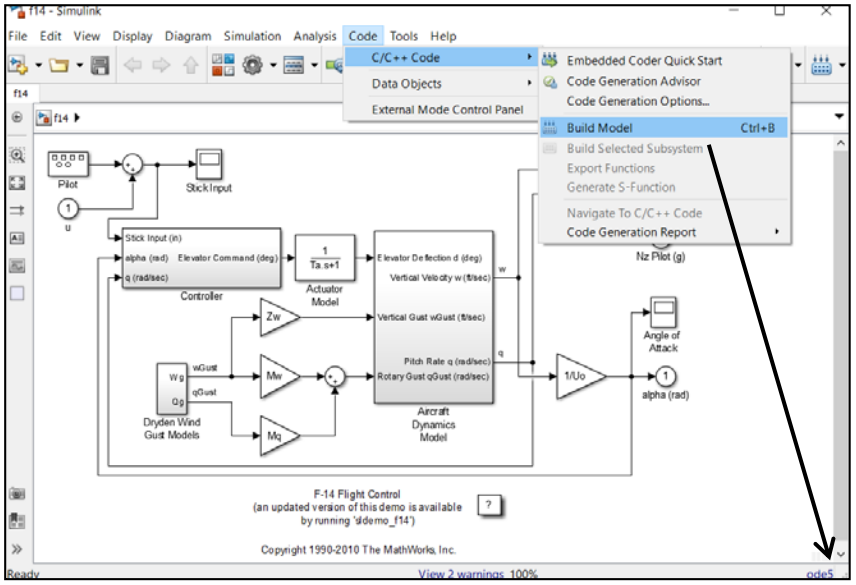
MOSAIC integrated in STF as a dynamic library

Integrated transfer tool (2)

- Architectural layers (‘side view’)
- Right stack already covered by MOSAIC 10

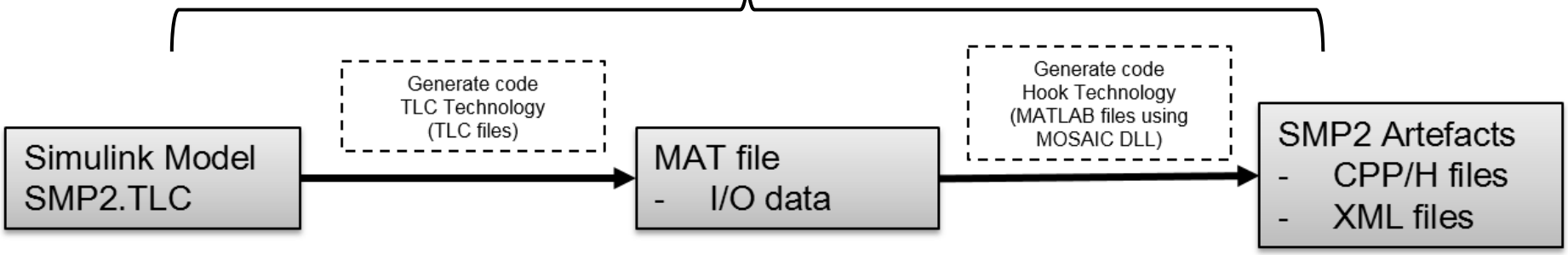


Integrated transfer tool (3)



One step execution from Simulink User Interface

Underlying workflow



Current status

MOSAIC 11

MOSAIC 11 :

- First integrated version of STF and MOSAIC
- Runs with Embedded Coder
- Experimental version, not released externally

- Still with limitations (with respect to the Simulink use case), e.g:
  - Atomic model transfer only (treating one whole model as a black box)
  - Only transfer to SMP (no native-EuroSim yet)

- *Base created for development of an external release : MOSAIC 12*

MOSAIC 12 activity: On-going work

MOSAIC 12

Enhancements:

- Support of Simulink Coder
- Model transfer from Simulink to native EuroSim
- Multiple model transfer of Simulink submodels
  - Building blocks to restore the data flows between the submodels

- Other Simulink specific items (see paper)

- Solution for SMP2 Universally Unique Identifier (UUID) issue (see paper)

Concluding remarks (1)

- Integrated Simulink STF / MOSAIC tool:
  - Tight integration between Simulink and SMP
  - Meta-information of a Simulink model is accessed directly (instead of parsing the exported C code)
  - Easy alignment with new MATLAB releases

- Existing MOSAIC capability re-used for
  - Support of other input formats (e.g., EcosimPro and 20-sim)
  - Support of specific features of target simulation platforms
  - Optimisation of specific SMP related issues (e.g. UUID) on a generic level

- Library approach:
  - No functionality is duplicated, which reduces maintenance cost
  - Other third-party tools can integrate MOSAIC functionality as well

Concluding remarks (2)

- MOSAIC availability:
  - Free-of-charge in ESA member states
  - License request: mosaic@nlr.nl
  - MathWorks Connections Program

- New external version planned for July 2017 : MOSAIC 12

- Effective collaboration between ESA/NLR/MathWorks

- Contribute to high-level objectives:
  - Cost reduction of space system development
  - Efficient harmonization of System Modelling & Simulation (SM&S)

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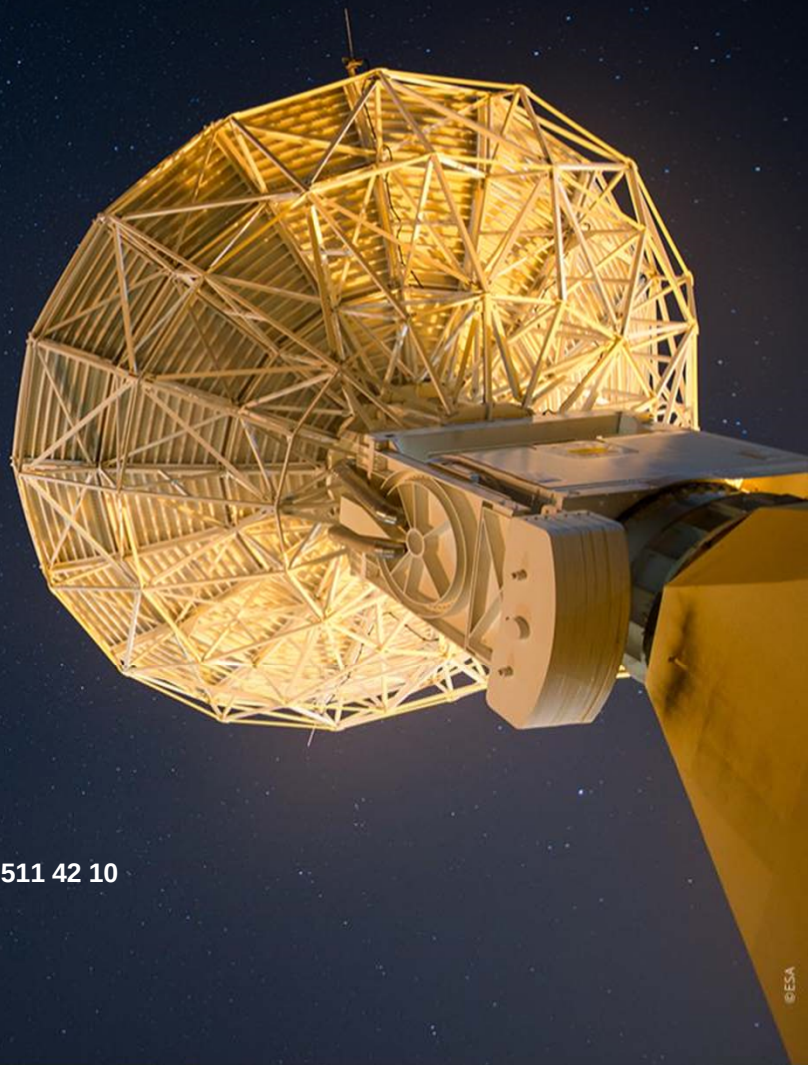

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