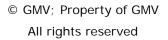
## **ADCSS 2014**

SOFTWARE REFERENCE ARCHITECTURE – OSRA SPECIFICATION

## THE COMPONENT MODEL EDITOR PROTOTYPE (CORDET-3) A COMPLETE TOOL CHAIN FROM COMPONENTS TO BINARY (CORDET-2)

2014, October 27<sup>th</sup>







### CONTENTS

- □ Introduction.
- COrDeT-2 tool chain.
- □ COrDeT-3 graphical model editor.
- Conclusions.

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# INTRODUCTION





### **CORDET-2 AND CORDET-3 STUDIES**

- COrDeT studies have been supporting SAVOIR-FAIRE on the definition of the OSRA.
- □ In the scope of these studies two tool chains have been built up:
  - COrDeT-2 tooling framework.
    - Intended to demonstrate the <u>whole OSRA process</u>: from the design of the user model to the generation of the final executable.
    - It demonstrated that the approach is feasible.
  - COrDeT-3 tooling framework.
    - COrDeT-3 study is intended to provide the OSRA specification.
      - The tool supports the OSRA specification process  $\rightarrow$  proof of concept.
    - COrDeT-3 tool focuses on a specific part of COrDeT-2 toolset: <u>the design of the</u> <u>user model</u>.
      - It refines the COrDeT-2 graphical editor.

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• It is based on open source tools.

### CORDET-2 & CORDET-3 TOOLS

COrDeT-3 takes as input the COrDeT-2 Graphical Editor.

#### **Capabilities**:

File Edit Diagram Navigate Seg	rch Project C	ORDET3 <u>Bun Window Help</u>		
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		Name	III GNC	
Boot a				

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	COrDeT-2	COrDeT-3
Capabilities	<ul> <li>o Graphical model editor.</li> <li>o Verification and analyses tools.</li> <li>o Code generation.</li> </ul>	<ul> <li>Graphical model editor.</li> </ul>

The COrDeT-3 toolset can be extended to integrate the COrDeT-2 capabilities.

#### Design Environments:

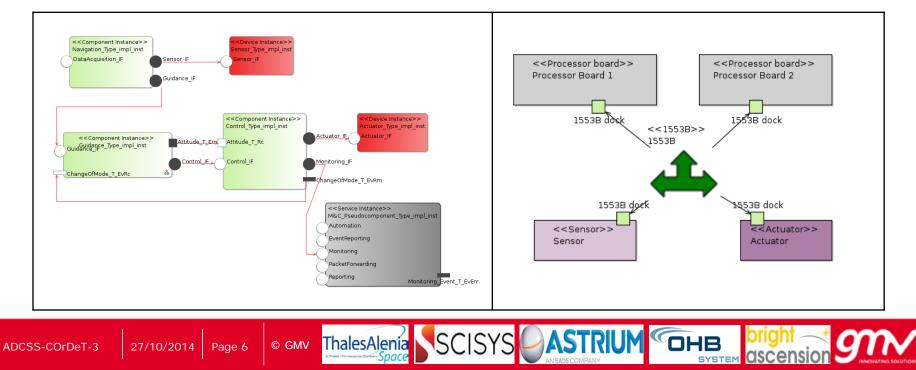
	COrDeT-2	COrDeT-3
Development Environment	<ul> <li>o Eclipse 3.</li> <li>o Obeo Designer.</li> <li>o Integrated with TASTE.</li> </ul>	<ul><li>o Eclipse 4.</li><li>o Sirius.</li></ul>

### **FUNDAMENTAL CONCEPTS**

- Separation of concerns.
  - Design views.
- Component-Based Development Engineering (CBDE).

#### □ Model-Driven Engineering (MDE).

1		Component View
1	4	Deployment View
1	-	Hardware View
1	4	M&C View
1	4	Non-functional View



## CORDET-2 TOOL CHAIN



### **OBJECTIVES**

#### COrDeT-2 produced the COrDeT-2 Tooling Framework.

Goal:

Component layer				
Interaction layer				
Avionics services Monitoring and Control services Domain neutral services Future services				
Execution platform layer				

- <u>Support the definition of the On-Board Software Reference</u> <u>Architecture definition</u>.
  - Methodological approach for developing Space Applications.
  - The prototype toolset elaborates the Component Layer, the Interaction Layer and some representative Platform Services.
- Prototype the most important interfaces:
  - Monitoring and Control (M&C) pseudo-components (e.g., Monitoring Service, Housekeeping Service).
  - Avionics SOIS services (e.g., CDAS, MTS, TAS).
  - Automatic generation of the Execution Platform code.

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Automatic generation of Ground.

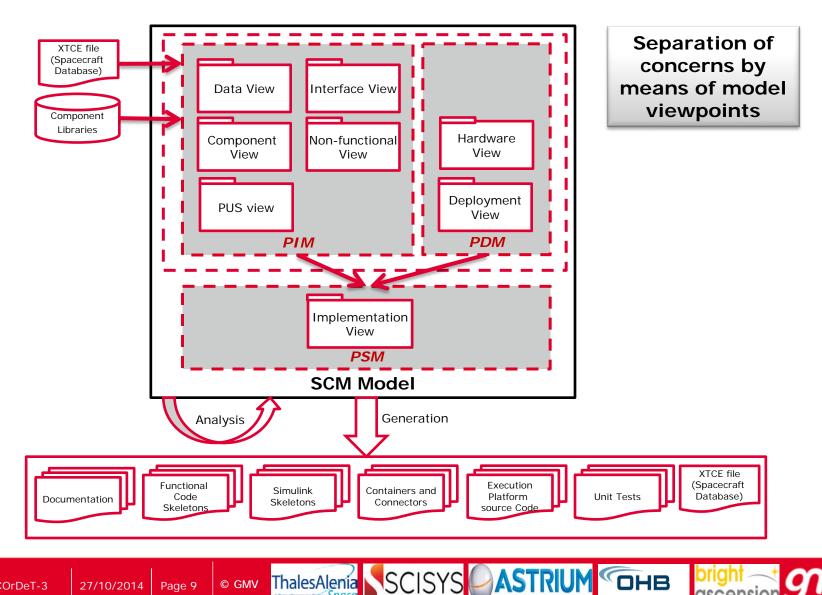
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#### **METHODOLOGICAL APPROACH**



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## FEATURES (1/2)

#### **SCM** meta-model and SCM model Editor:

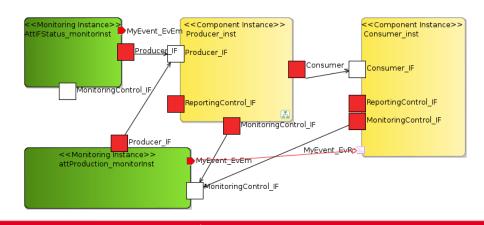
- Ecore meta-model and source code.
- EMF-based editor for manipulating SCM models.

#### Graphical Model Editor:

- Library management.
- Design views.

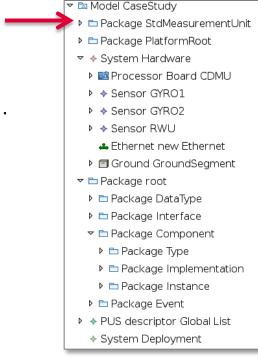
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Representations: diagrams and tables.



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## FEATURES (2/2)

- Verification and Analysis Tools.
  - Schedulability analysis.
  - Model verification analyses.

#### Code Generators.

- Generation of source code skeletons.
- Generation of the execution platform services.
- Generation of the executable.

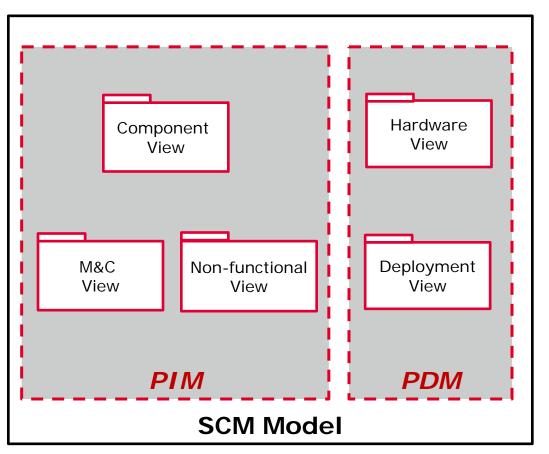
CM SCM Model Editor: select	×		
CC Select the extension you want to e	)RDET-2		
Name Description			
SCM to TASTE model checker	This analysis engines checks the compliance of the SCM mod		
SCM versus SDB Analysis Engine analysis engine SDB versus SCM Models			
Schedulability Analysis	Performs the scheduability analysis on the AADL model suppo		
Selected engine: SCM to TASTE mo	▶ > > > > > > > > > > > > > > > > > > >		
ок	Cancel		

## CORDET-3 GRAPHICAL MODEL EDITOR





#### **METHODOLOGICAL APPROACH**



Separation of concerns by means of model viewpoints

- The number of views has been reduced to 5:
  - Component View: Definition of the SW system.
  - Non-functional View: Specification of non-functional properties (e.g., concurrency kind, groups) of the components.
  - M&C View: Specification of M&C features (e.g., observability).
  - Hardware View: Definition of the HW topology.

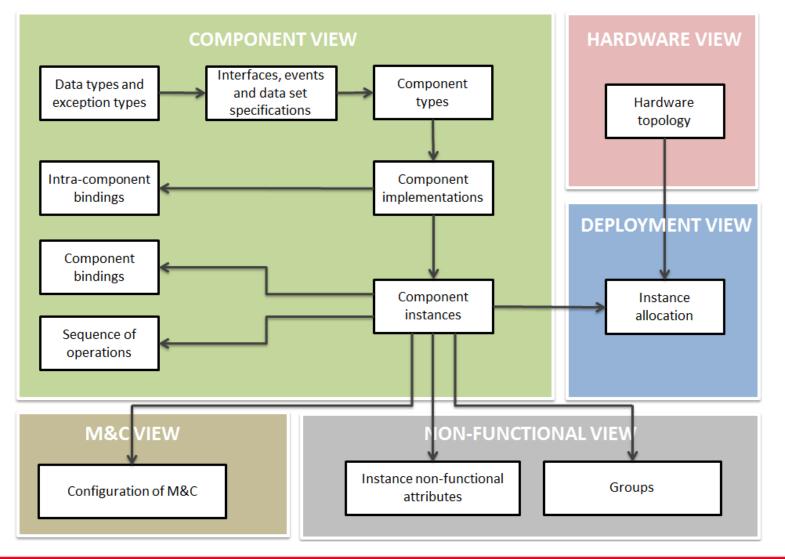
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 Deployment View: Allocation of components onto nodes.

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## **DESIGN DEPENDENCIES**



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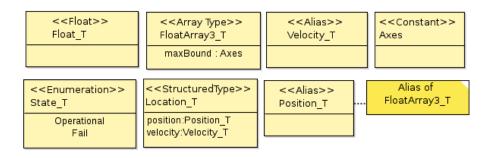
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## COMPONENT VIEW (1/3)

□ Definition of **Data** and **Exceptions** types.

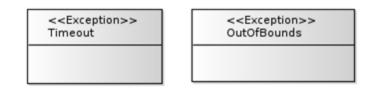
- Data Types:
  - Elementary and structure data types.
  - Alias, constants and constrained data types.



Exception Types:

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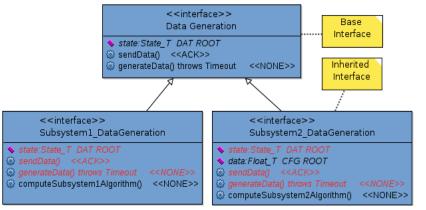
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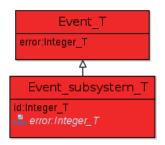
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## COMPONENT VIEW (2/3)

- Definition of Interfaces, Events and Data Set Specifications.
  - Interfaces:
    - Inheritance.
    - Interface attributes:
      - Kind: DAT (read-only), CFG (read-write).
      - Accessibility : ROOT, LEAF, ROOT AND LEAF.
    - Interface operations:
      - Interaction patterns: SEND, REQUEST, SUBMIT, INVOKE and PROGRESS.
      - Exceptions.
  - Events:
    - Inheritance.
    - Event parameters.
  - Data Set Specifications.





<<Data Set Specification>> Attitude\_T

> position:Position\_T velocity:Velocity\_T

> > онв

<<Component Implementation>>

<Device Implementation>> Actuator Type impl

Guidance Type impl

ChangeOfMode T EvRc

Guidance IF

tuator If



<<Component Implementation>>

Monitoring\_IF

Actuator IF

hangeOfMode T

Control Type impl

Control IF

Attitude\_T\_Rc

ChangeOfMode T EvRc dhangeOfMode T InitialNode

<<Interface attribute access>> SET Guidance IF.mode

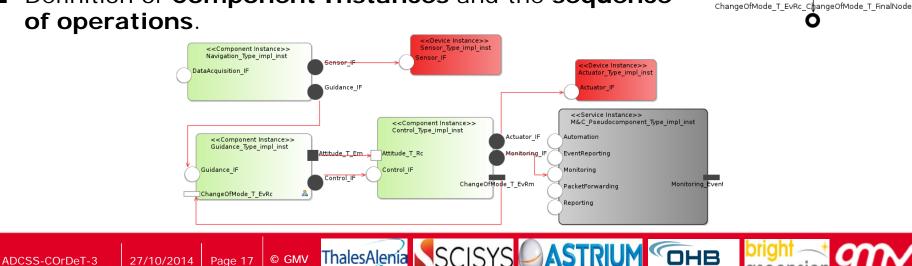
Control IF

Attitude T Em

## **COMPONENT VIEW (3/3)**

- Definition of **Component Types** and **Implementations**.
  - Interaction:
    - Provided/Required Ports.
    - Data Emitter/Receiver Ports.
    - Event Emitter/Receiver Ports.
  - Definition of component type/implementation attributes.
  - Definition of the intra-component bindings of the operations/events of the component implementations.





<<Component Implementation>>

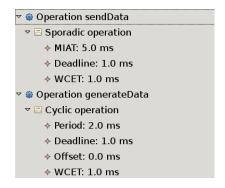
ataAcquisition IF

Navigation\_Type\_impl Guidance\_IF

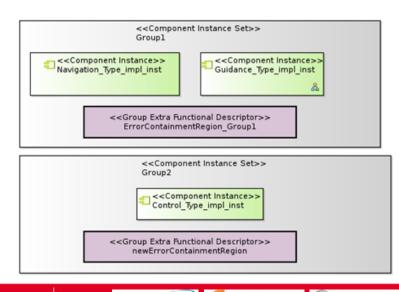
Sensor\_IF



Operations/Event/Data handlers Non-Functional Descriptors:



#### Definition of **Groups**:



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## MONITORING AND CONTROL VIEW

#### Observability and Modifiability.

The observability/modifiability descriptor specifies if the interface attributes or events can be observed/modified from ground.

🖩 Component1 - Observability/Mo	odifiability Table រ	3		
	Observable [X]	Modifiable [X]	Accessibility	Accessibility Level
🔻 🕄 Component Instance Compon				
<ul> <li>Interface Attribute state</li> </ul>	х		LEAF	1
<ul> <li>Interface Attribute str</li> </ul>	х	х	ROOT	0
Event Emitter Slot Event_s	х			

#### Commandability.

 A commandability descriptor is added to those interface operations that can be commanded from ground.

	Commandable Operation [X]
¬	
Operation sendData	х
Operation generateData	х

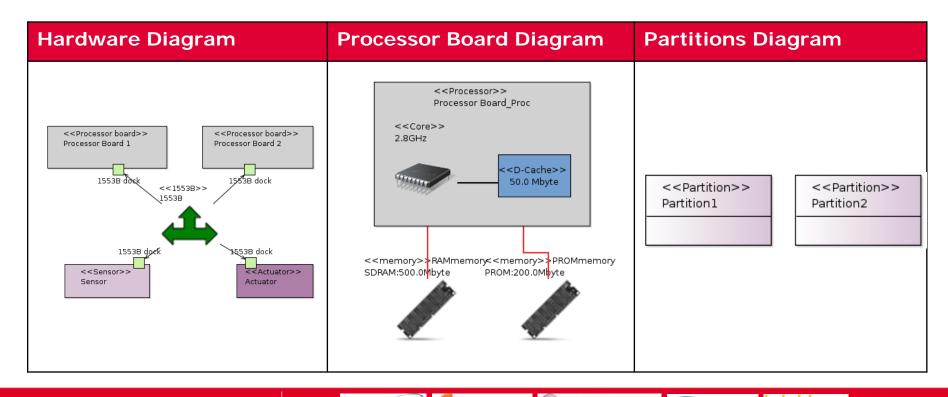
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#### HARDWARE VIEW

Definition of the Hardware topology. It includes:

- Mono-core and multi-core systems.
- Non-TSP and TSP platforms.



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## **DEPLOYMENT VIEW**

#### □ Software deployment: Non-TSP and TSP:

	Processor Core
▼ 🗐 Component Instance:Control_Type_impl_inst	
Deployment Descriptor	Processor Core PB1_core1
Component Instance:Guidance_Type_impl_inst	
Component Instance:Navigation_Type_impl_inst	

#### Device deployment:

	HW Device
Instance:Actuator_Type_impl_inst	
<ul> <li>Deployment Descriptor</li> </ul>	Actuator Thruster
¬	
<ul> <li>Deployment Descriptor</li> </ul>	Sensor Star Tracker

#### **Bindings deployment:**

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	Slot binding	Deployed on
🔻 🔶 System Deployment System De		
<ul> <li>Slot Binding Deployment Desc</li> </ul>	Data Slot Binding Guidance_Type_in	MIL STD 1553B 1553B
Slot Binding Deployment Desc	Event Slot Binding Control_Type_imp	MIL STD 1553B 1553B
Slot Binding Deployment Desc	Interface Slot Binding Control_Type_	MIL STD 1553B 1553B
<ul> <li>Slot Binding Deployment Desc</li> </ul>	Interface Slot Binding Control_Type_	MIL STD 1553B 1553B

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		Partition
▼ ♦ Component Instance Set Group1		
<ul> <li>Deployment Descriptor</li> </ul>		Partition Partition1
▼		
<ul> <li>Deployment Descriptor</li> </ul>		Partition Partition2
	Process	
<ul> <li>Deployment Descriptor</li> </ul>	Oeployment Descriptor     Process	
Deployment Descriptor     Proc		or Core PB2 core1

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# CONCLUSIONS





## CONCLUSIONS

#### □ COrDeT-2 toolset has demonstrated:

 Feasibility to develop the whole on-board software development: from the design of the user model to the generation of the executable.

#### COrDeT-3 toolset:

- It is in line with the OSRA specification.
- It can be extended to include the functionalities of COrDeT-2.
- It is supported by open-source tools.

## Thank you!

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Space Systems Business Unit Avionics & On-Board SW Division

