



## Top 10 reasons why Capella is different

CAPELLA DAY STUTTGART, MARCH 13<sup>TH</sup> 2018

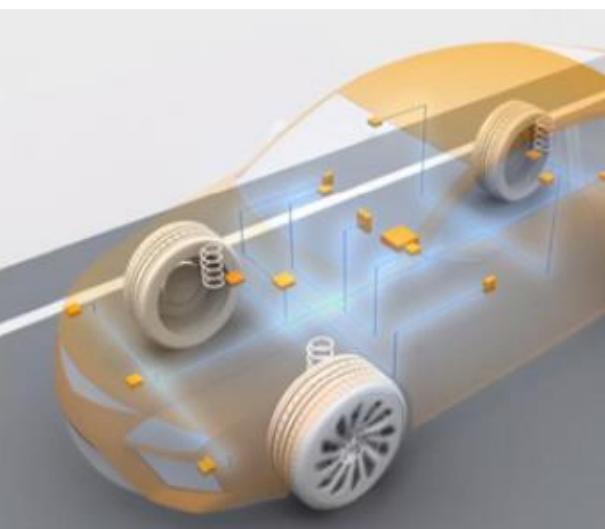
**Stéphane Bonnet**

In charge of Thales Corporate MBSE Coaching & Community  
Capella Design Authority

[stephane.bonnet@thalesgroup.com](mailto:stephane.bonnet@thalesgroup.com)

[www.thalesgroup.com](http://www.thalesgroup.com)





## #1 - Scope

What are Arcadia and Capella meant for?

# Scope

This document may not be reproduced, modified, adapted, published, translated, in any way, in whole or in part or disclosed to a third party without the prior written consent of Thales - © Thales 2015 All rights reserved.

Enterprise Architecting (operational capabilities and need, orientations, etc.)

Multi-physics:  
3D,  
power  
models,  
thermal  
models,  
etc.

Algos,  
Real-time  
Analysis,  
NF,  
Etc.

## System Architectural Design

## SW/HW/FM Architectural Design

V&V

Detailed design, development

# Scope

Enterprise Architecting (operational capabilities and need, orientations, etc.)

Multi-physics:  
3D,  
power  
models,  
thermal  
models,  
etc.

Algos,  
Real-  
time  
Analysis  
NF,  
Etc.



ARCADIA

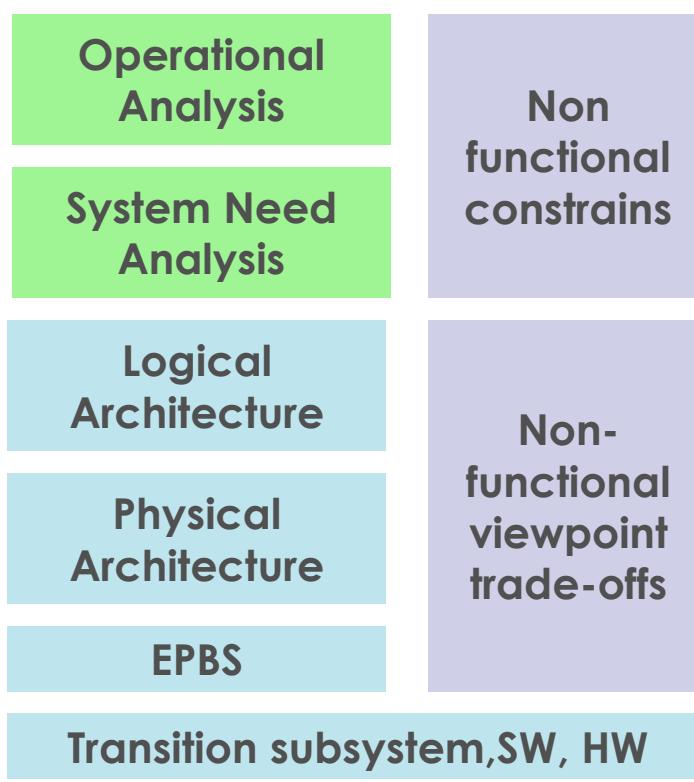
Method



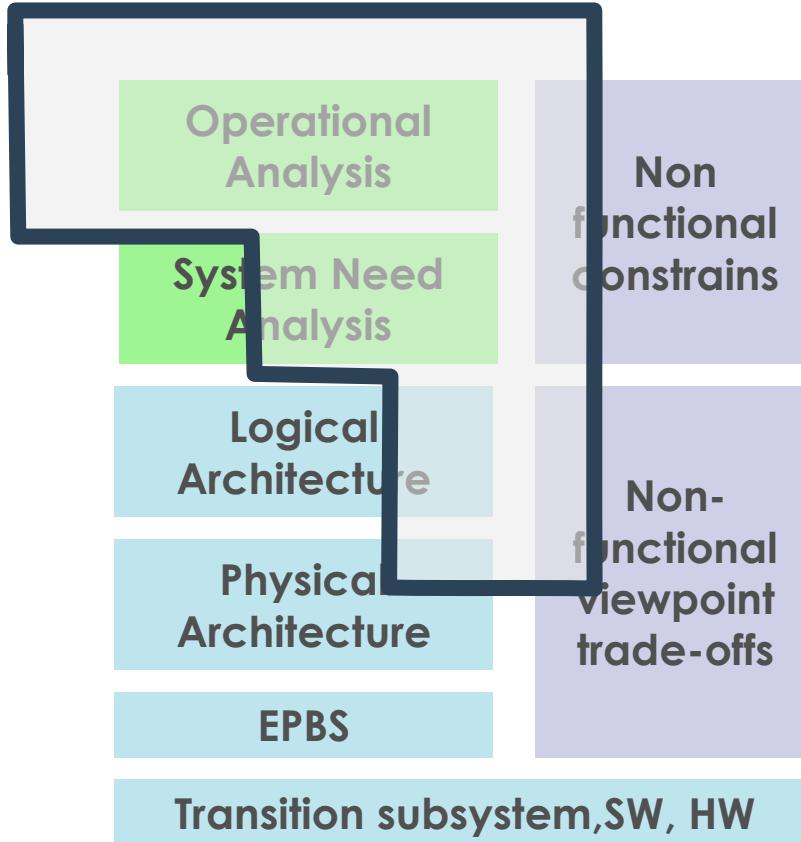
Workbench

V&V

Detailed design, development



# Arcadia and Architecture Frameworks



## Similar concepts

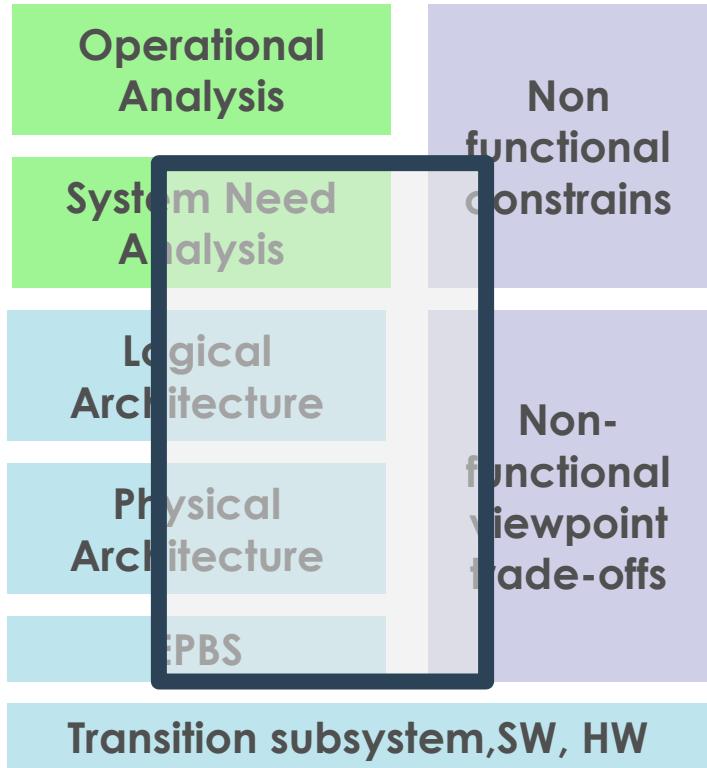
- Operational Entities, Actors, Roles
- Operational Activities, Processes
- States and modes, functions, data flows, etc.
- System Nodes, equipment
- Traceability between operational & system

## Similar diagrams

- OV2, OV4, OV5, OV6, OV7;
- SOV;
- SV1, SV2, SV4, SV5, SV10...

# Arcadia & SysML

This document may not be reproduced, modified, adapted, published, translated, in any way, in whole or in part or disclosed to a third party without the prior written consent of Thales - © Thales 2015 All rights reserved.



## Main differences

- Method vs Language
- Activity diagrams vs functional dataflows
- Management of types and instances

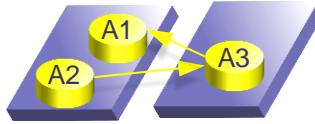
## Arcadia additions

- Operational analysis
- Functional analysis

## #2 - Arcadia

Field-originated, model-based engineering method

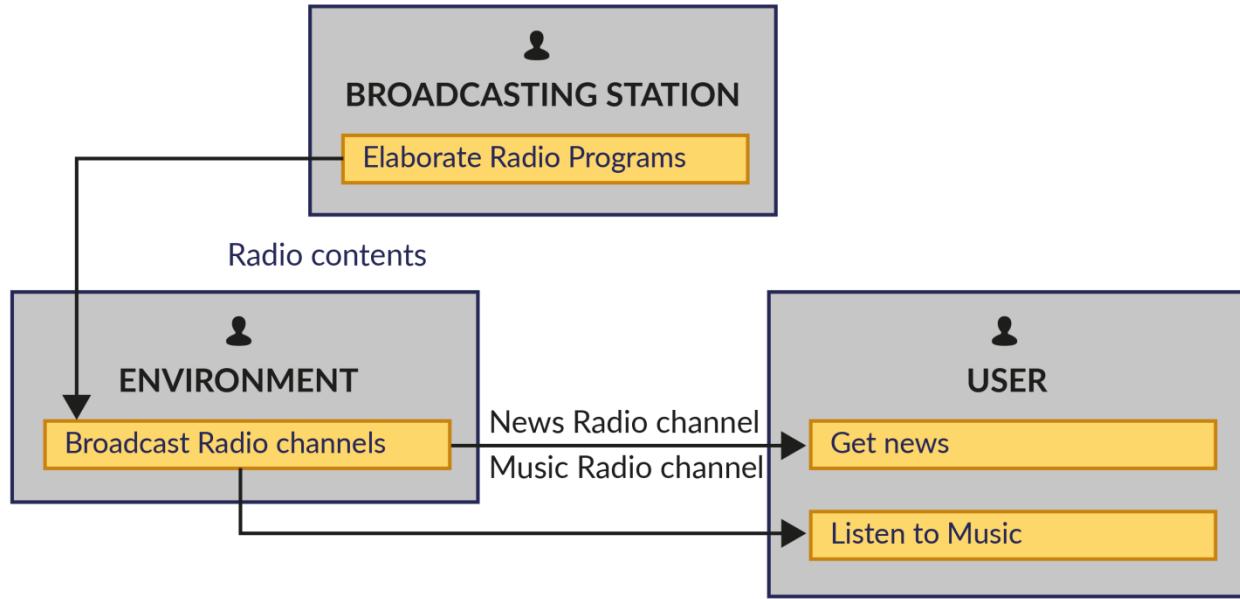
METHOD STEPS	TASKS	SAMPLE MODEL	CONCEPTS	DESCRIPTION MEANS
NEED	<b>Customer Operational Need Analysis</b> What the users of the system need to accomplish	<ul style="list-style-type: none"> <li>✓ Define operational capabilities</li> <li>✓ Perform an operational need analysis</li> </ul>	<ul style="list-style-type: none"> <li>- Operational capabilities</li> <li>- Actors, operational entities</li> <li>- Actor activities</li> <li>- Interactions between activities &amp; actors</li> <li>- Information used in activities &amp; interactions</li> <li>- Operational processes chaining activities</li> <li>- Scenarios for dynamic behaviour</li> </ul>	<p>Dataflow: functions, op. activities interactions &amp; exchanges</p>
	<b>System/ SW/HW Need Analysis</b> What the system has to accomplish for the Users	<ul style="list-style-type: none"> <li>✓ Perform a capability trade-off analysis</li> <li>✓ Perform a functional and non-functional analysis</li> <li>✓ Formalise and consolidate requirements</li> </ul>	<ul style="list-style-type: none"> <li>- Actors and system, capabilities</li> <li>- Functions of system &amp; actors</li> <li>- Dataflow exchanges between functions</li> <li>- Functional chains traversing dataflow</li> <li>- Information used in functions &amp; exchanges, data model</li> <li>- Scenarios for dynamic behaviour</li> <li>- Modes &amp; states</li> </ul>	<p>Scenarios: actors, system, components interactions &amp; exchanges</p>
SOLUTIONS	<b>Logical Architecture Design</b> How the system will work so as to fulfil expectations	<ul style="list-style-type: none"> <li>✓ Define architecture drivers and viewpoints</li> <li>✓ Build candidate architectural breakdowns in components</li> <li>✓ Select best compromise architecture</li> </ul>	<p><b>SAME CONCEPTS, PLUS :</b></p> <ul style="list-style-type: none"> <li>- Components</li> <li>- Component ports and interfaces</li> <li>- Exchanges between components</li> <li>- Function allocation to components</li> <li>- Component interface justification by functional exchanges allocation</li> </ul>	<p>Functional chains, operational processes through functions &amp; op. activities</p>
	<b>Physical Architecture Design</b> How the system will be developed & built	<ul style="list-style-type: none"> <li>✓ Define architectural patterns</li> <li>✓ Consider reuse of existing assets design a physical</li> <li>✓ Design a physical reference architecture</li> <li>✓ Validate and check it</li> </ul>	<p><b>SAME CONCEPTS, PLUS :</b></p> <ul style="list-style-type: none"> <li>- Behavioural components refining logical ones, and implementing functional behaviour</li> <li>- Implementation components supplying resources for behavioural components</li> <li>- Physical links between implementation components</li> </ul>	<p>Modes &amp; states of actors, system, components</p>
	<b>Development Contracts</b> What is expected from each designer/ sub-contractor	<ul style="list-style-type: none"> <li>✓ Define a components IVVQ strategy</li> <li>✓ Define &amp; enforce a PBS and component integration contract</li> </ul>	<ul style="list-style-type: none"> <li>- Configuration items tree</li> <li>- Parts numbers, quantities</li> <li>- Development contract (expected behaviour, interfaces, scenarios, resource consumption, non-functional properties...)</li> </ul>	<p>Breakdown of functions &amp; components</p>
				<p>Data model: dataflow &amp; scenario contents, definition &amp; justification of interfaces</p>
				<p>Component wiring: all kinds of components</p>
				<p>Allocation of op.activities to actors, of functions to components, of beh.components to impl.components, of dataflows to interfaces, of elements to configuration items</p>

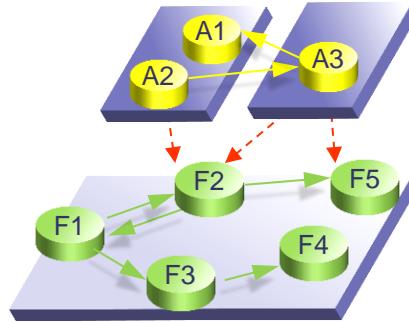


## Operational Analysis

WHAT THE USERS/STAKEHOLDERS  
NEED TO ACCOMPLISH

Support of discussions  
with the customer,  
capabilities, scenarios  
and processes

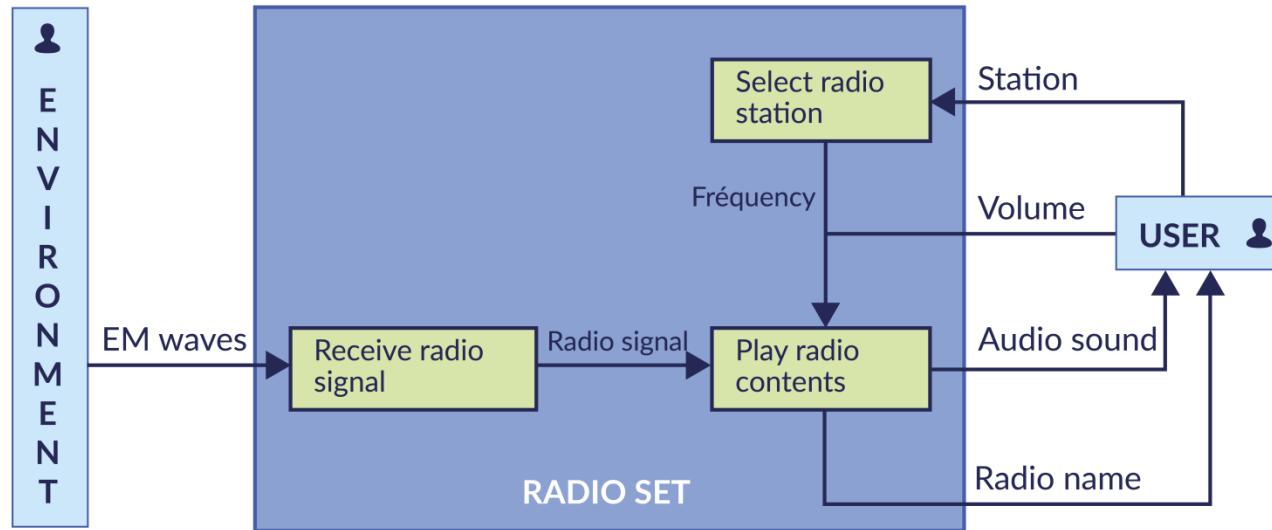


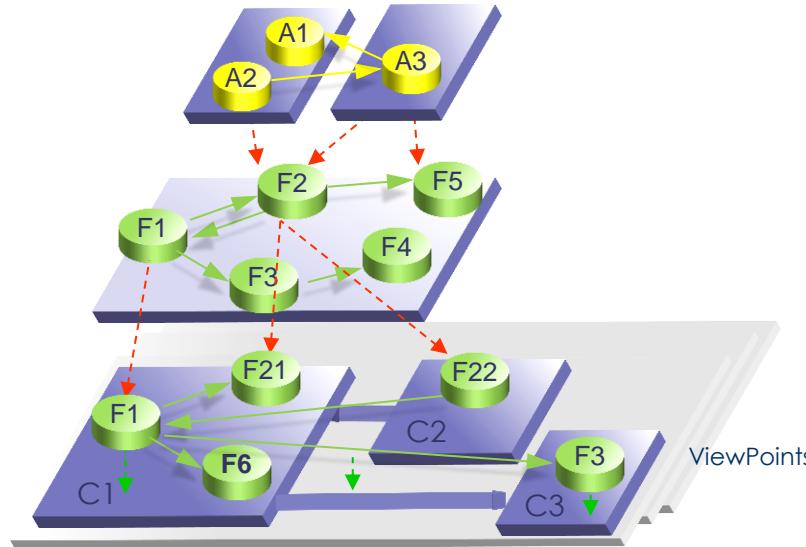


## System Need Analysis

WHAT THE SYSTEM HAS TO ACCOMPLISH FOR THE USERS

Boundaries, external interfaces, specification, v&v procedures, feasibility of requirements

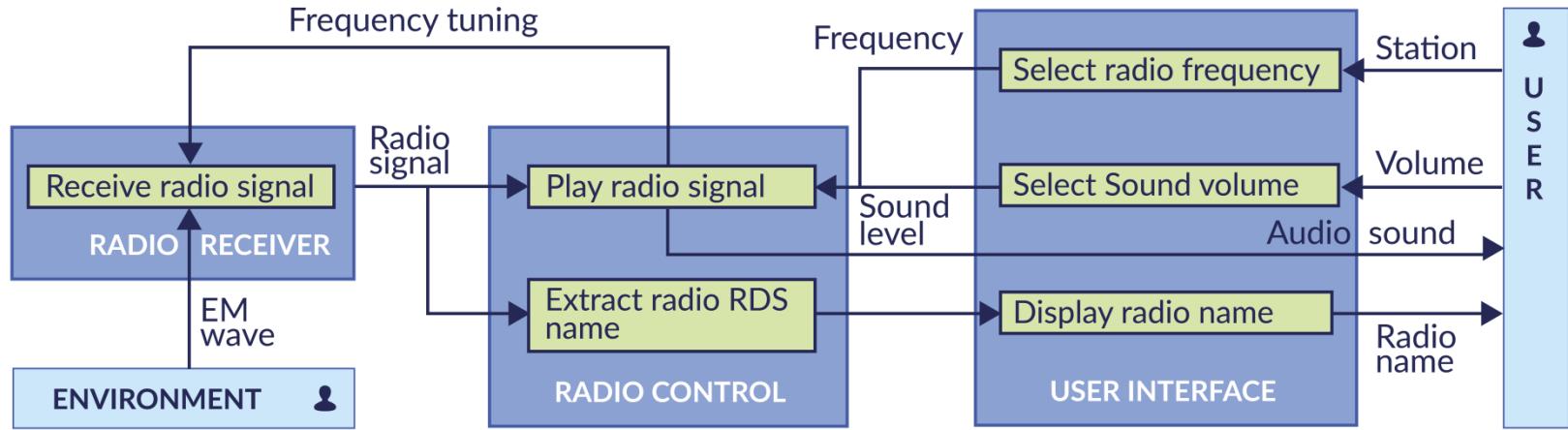


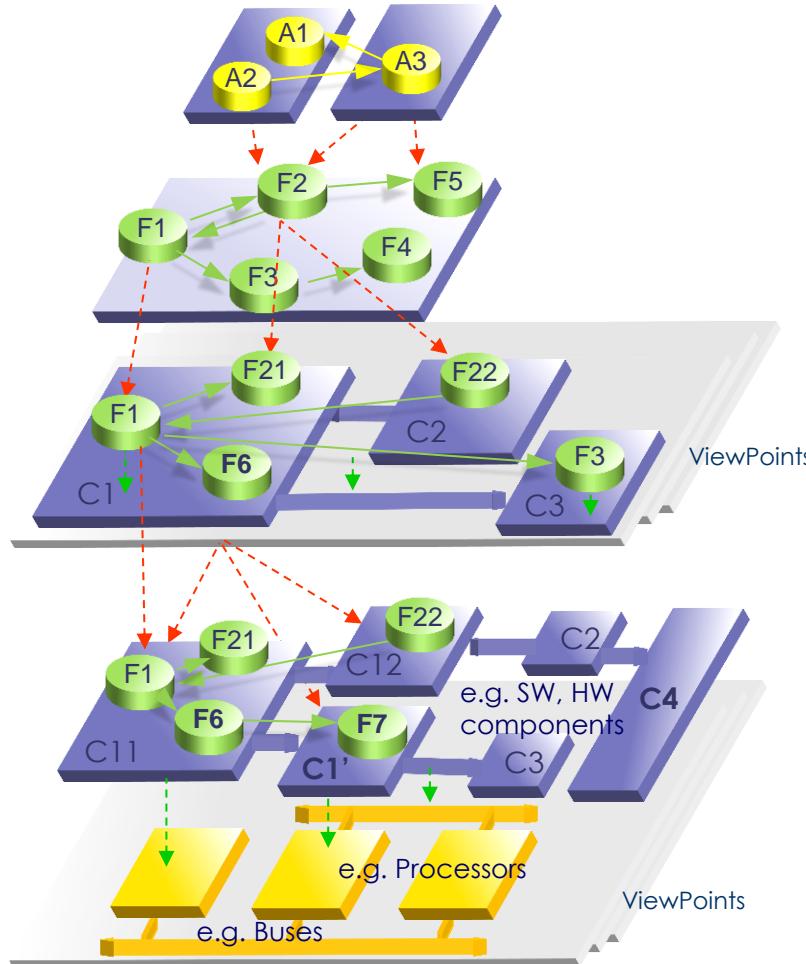


# Logical Architecture

HOW THE SYSTEM WILL WORK SO AS TO FULFIL EXPECTATIONS

High-level architecture description, functional refinement, architectural drivers, functional allocation, first trade-offs, modes and states analysis

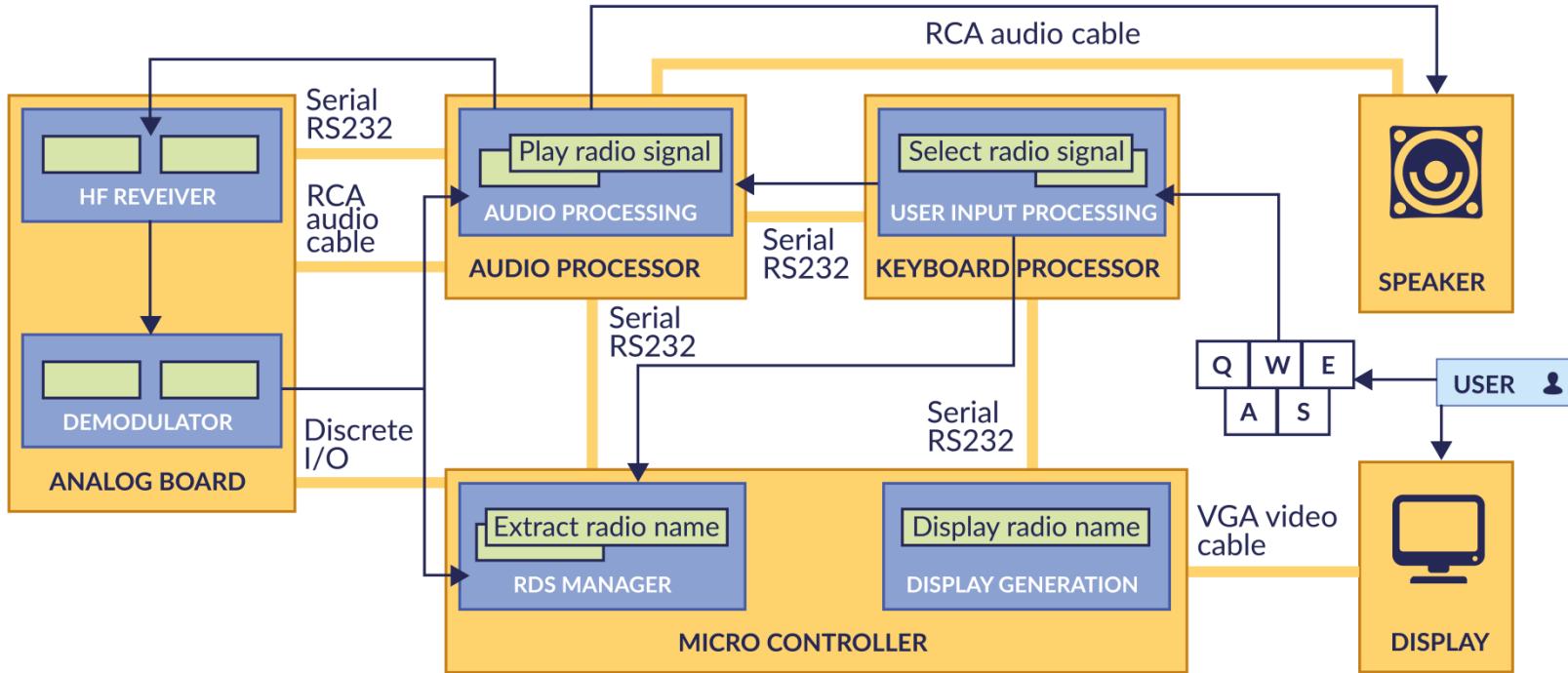




# Physical Architecture

HOW THE SYSTEM WILL BE  
DEVELOPED AND BUILT

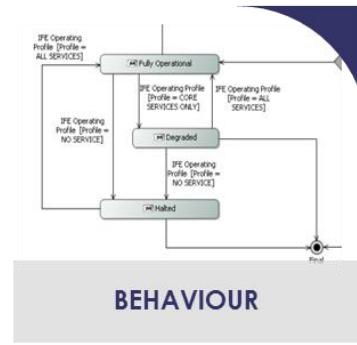
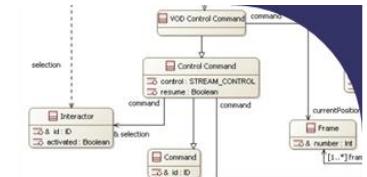
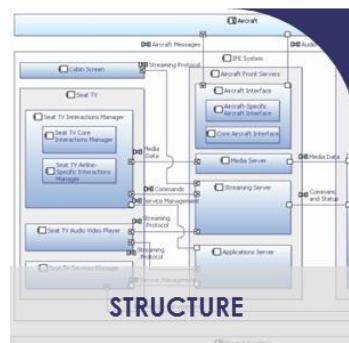
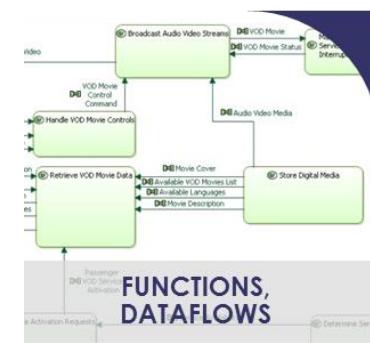
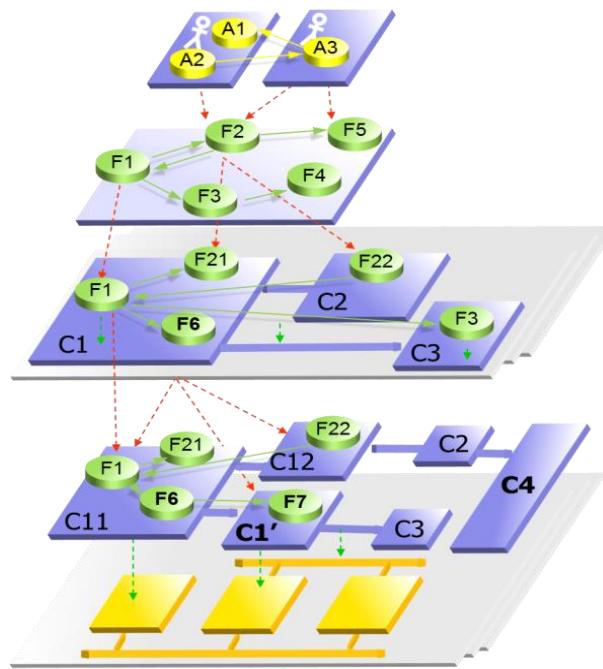
Implementation constraints,  
reuse, refined trade-offs,  
M/T/B strategy,  
finalized detailed interfaces



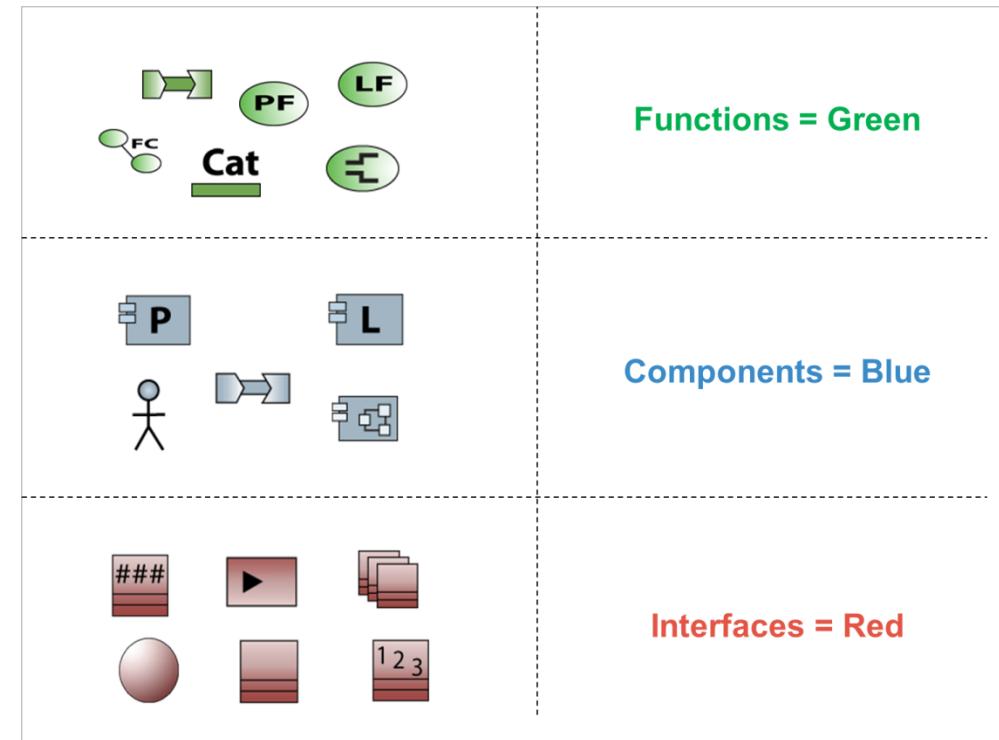
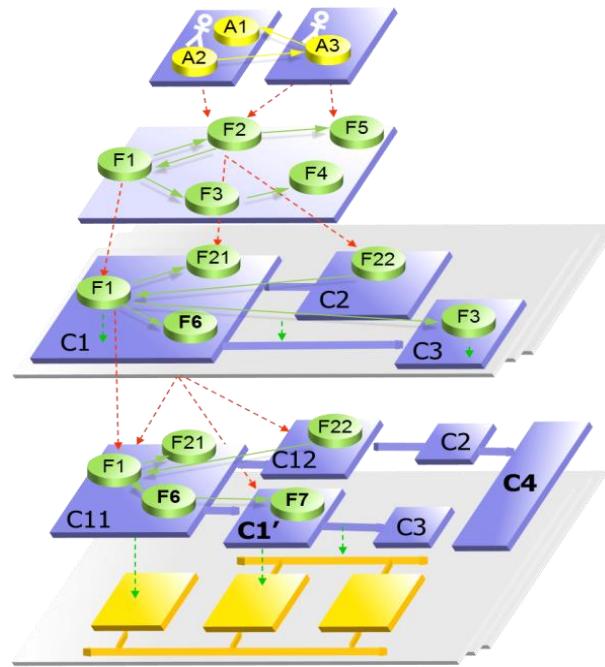


## **#3 - Method-coupled**

What does this mean?

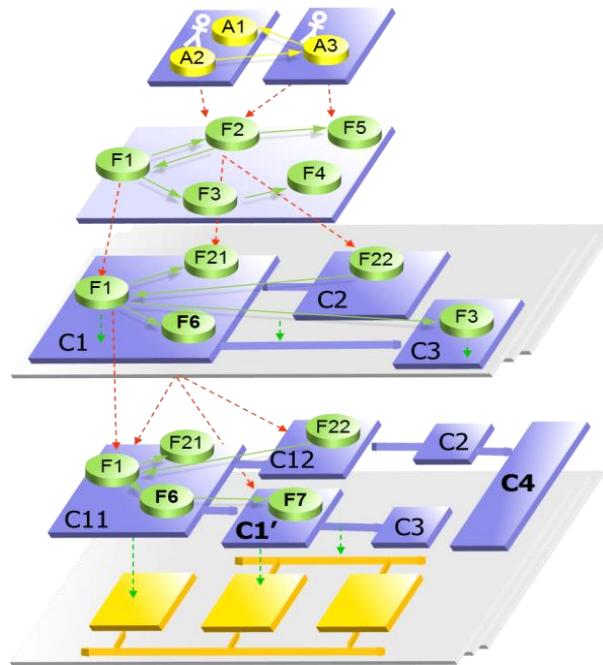


Capella



Capella

THALES



\*In-Flight Entertainment System - Activity Explorer X

## Logical Architecture ▾

System Analysis Logical Architecture Develop System Architectural Design Physical Architecture

▶ Transition from System Functions

▼ Refine Logical Functions, describe Functional Exchanges

[LFBD] Create a new Functional Breakdown diagram

[LDFB] Create a new Functional Dataflow Blank diagram

[FS] Create a new Functional Scenario

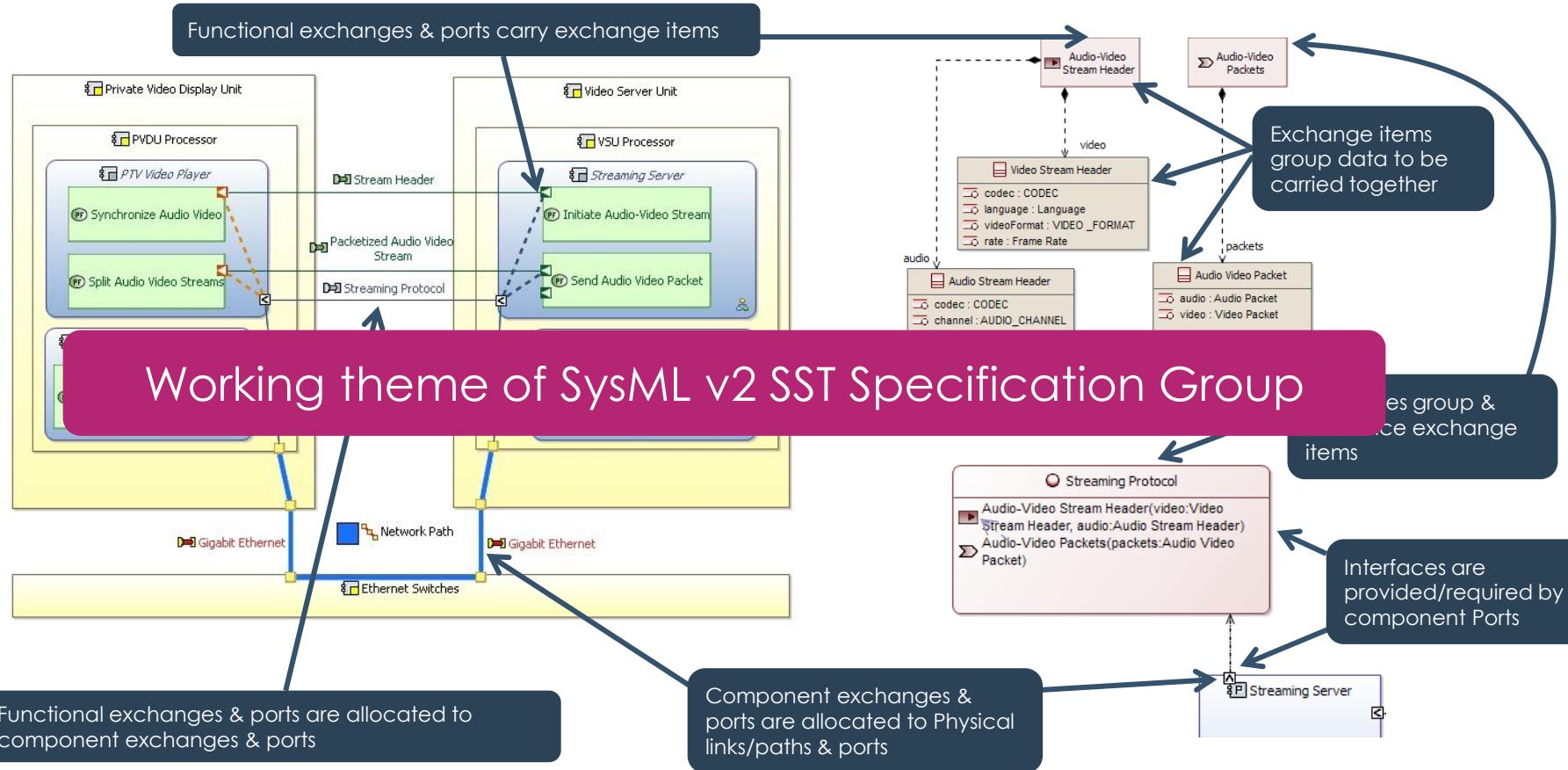
▶ Define Logical Components and Actors

▶ Allocate Logical Functions to Logical Components



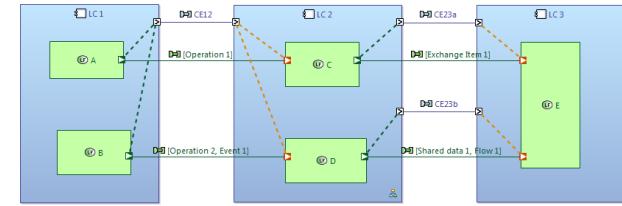
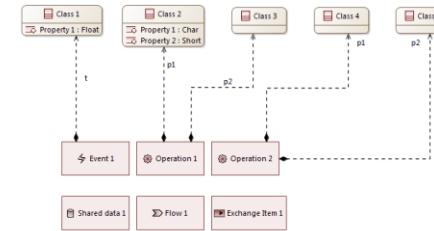
## **#4 – Support of Functional Analysis**

Proper integration with structure and interfaces





# DEMO

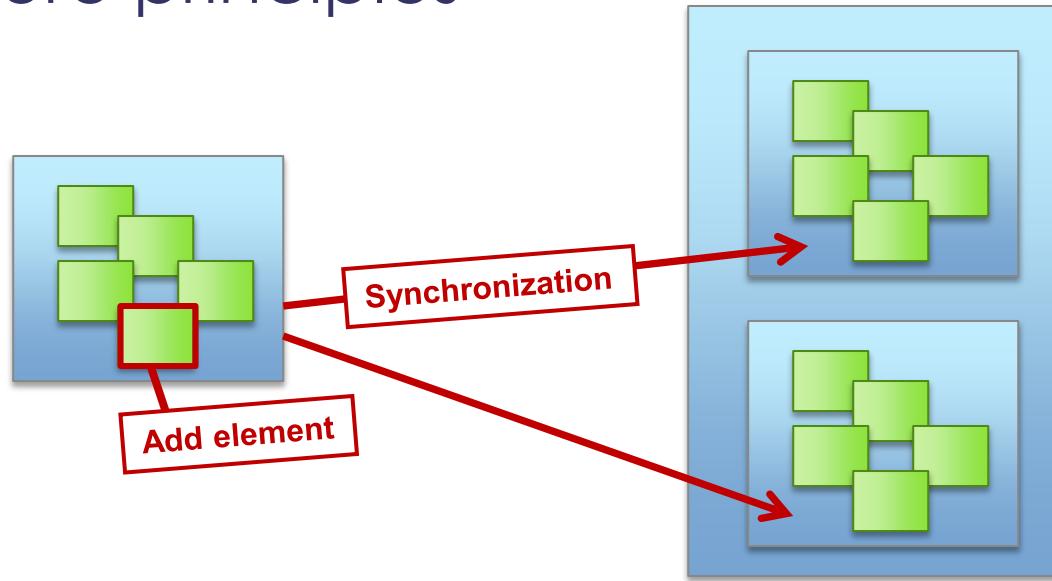


Properties	Information	Semantic Browser	Level	Rule id	Rule set
<b>Message</b>					
↳ Capella (2 items)					
↳ Design (1 item)					
↳ Well-Formedness (1 item)					
↳ Interfaces (1 item)					
↳ Missing Exchange Item on Interface "CE12" : "Operation 1" which is conv			Error	DWF_I_23	
↳ Integrity (1 item)					

## **#5 – Replicable Elements (REC-RPL)**

Model instances, manage building blocks

# Core principles



Synchronized copies  
Different compliance rules

Blackbox

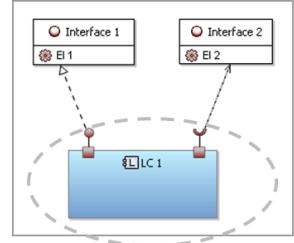
Constrained Reuse

Inheritance

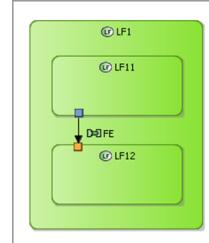
•  
•  
•

Customized

# Examples of replicable elements



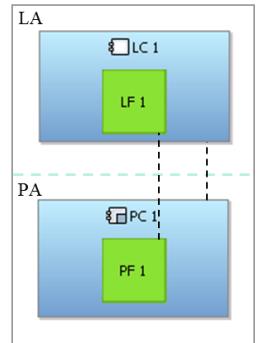
A Component, with references towards its provided / required Interfaces



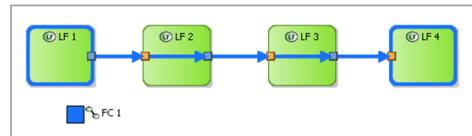
A Function and its children  
(mono root)



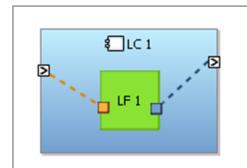
Two Functions and their  
Functional Exchanges (multi root)



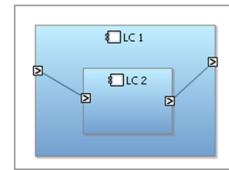
A Physical Component and the  
Logical Components it realizes,  
including Functions, etc.



A Functional Chain and its Functions /  
Functional Exchanges

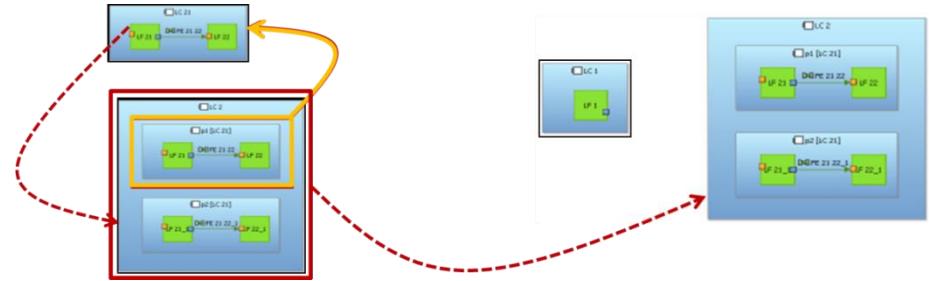
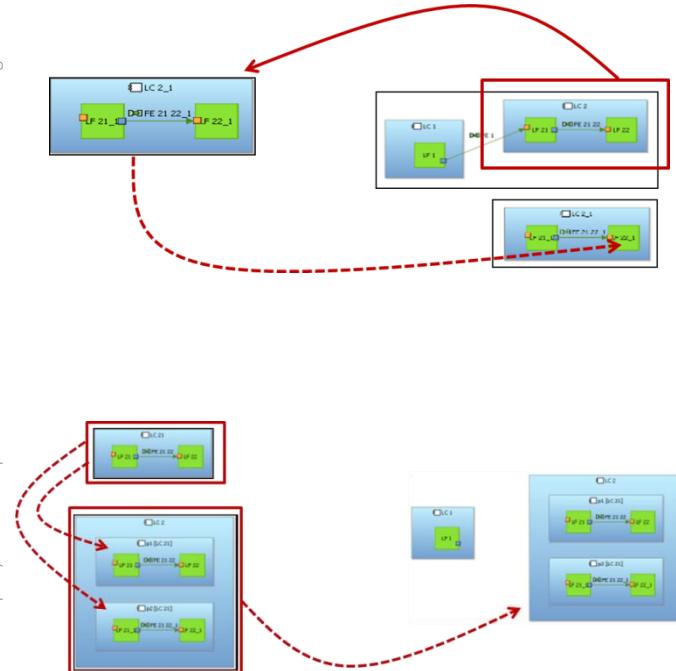


A Component and its  
allocated Functions



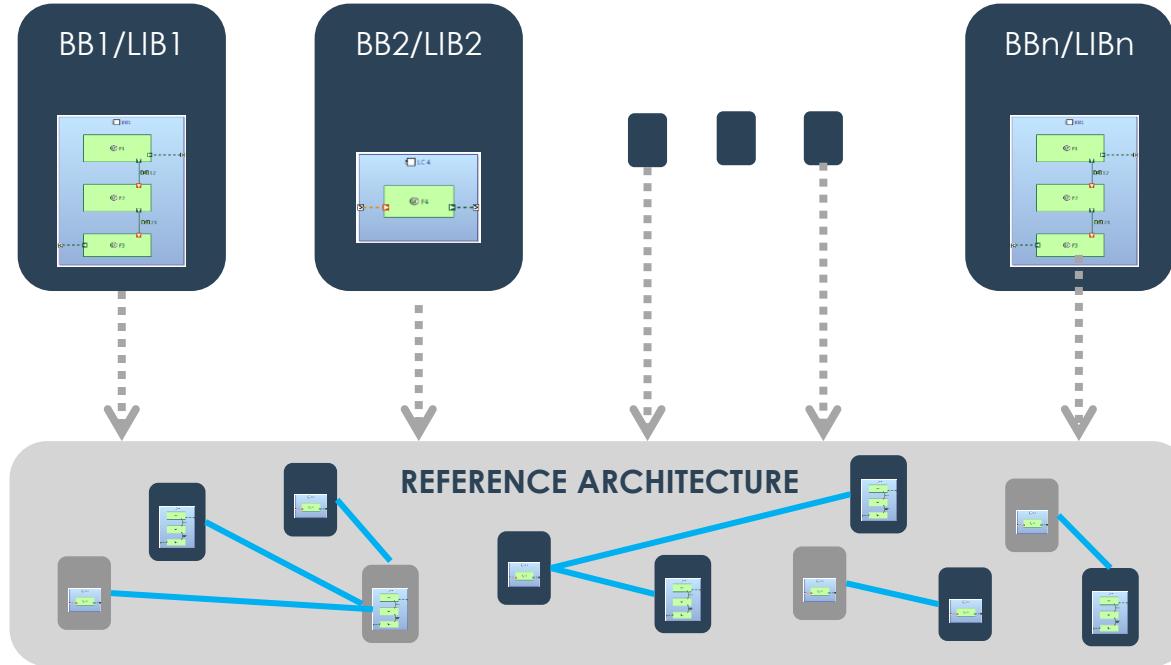
A Component and its Sub  
Components

# « Usages » and « Definitions », very different workflows



Working theme of SysML v2 SST Specification Group

# One library = One REC



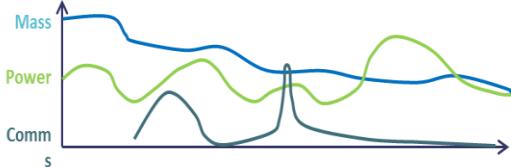
Easier REC management, enable “REC” versioning (see Yuzu)

# #6 - Comprehensiveness

## Architecture evaluation

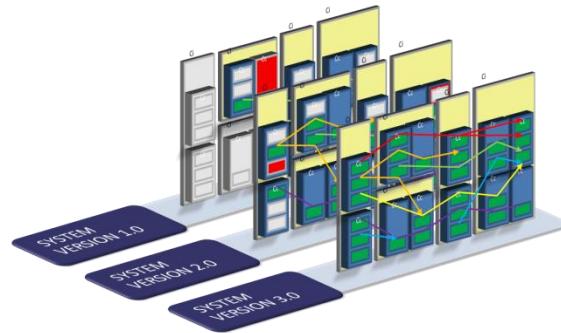
# Other important (and addressed) aspects of engineering

Mission	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
System	Mode 1	Mode 2	Mode 3	Mode 4	Mode 2	Mode 3
Subsystems	1 Mode A	Mode B	Mode C	Mode A	Mode C	Mode A
2	Mode X	Mode Y	Mode Z	Mode X	Mode Y	
3	Mode I	Mode J	Mode I	Mode J	Mode I	Mode J



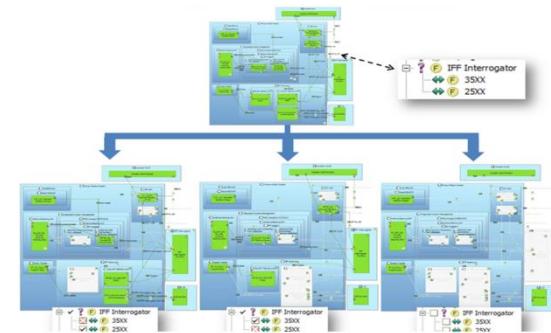
## Modes and states

Analyzing the variability of the system during its operation



## Model-based V&V

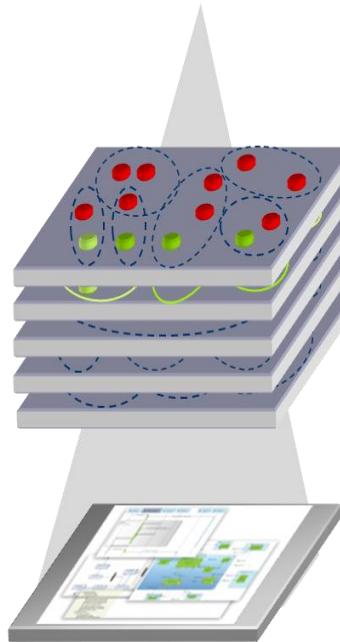
Driving v&v activities by expected functional content



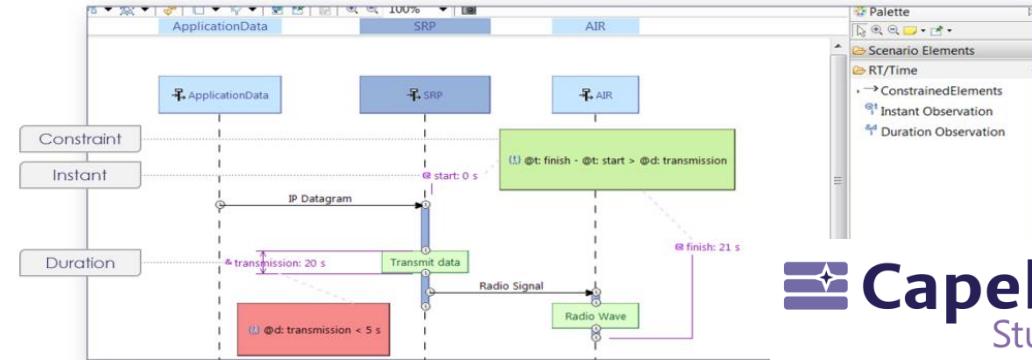
## Product line

Variability management based on feature models

# Architecture early evaluation

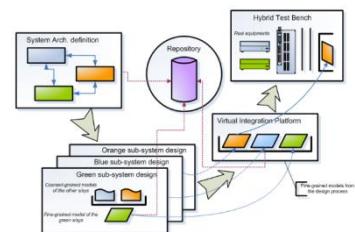


## Autonomous viewpoints

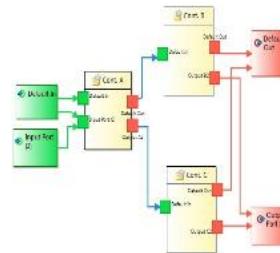


**Capella**  
Studio

## Bi-directional coupling with specialty tools



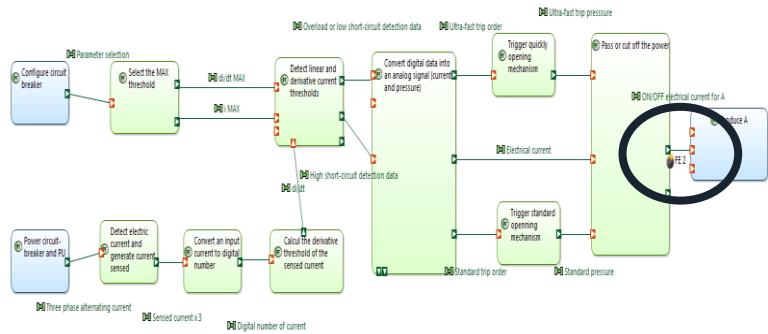
Citrus  
simulation  
env.



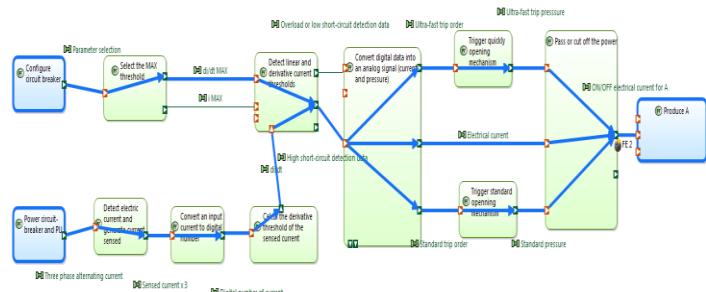
All4Tec  
Safety  
Architect

# Example: Capella – Safety Architect (All4Tec)

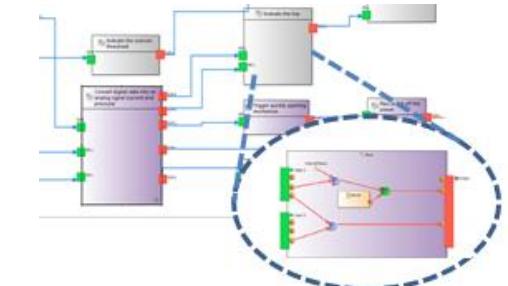
Feared event added to Capella dataflows (viewpoint)



In Capella, visualization of fault trees as critical functional chains

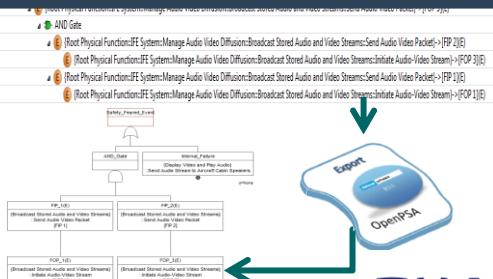


In Safety Architect, analysis of block local failure conditions



Functional Hazard Analysis (FHA)

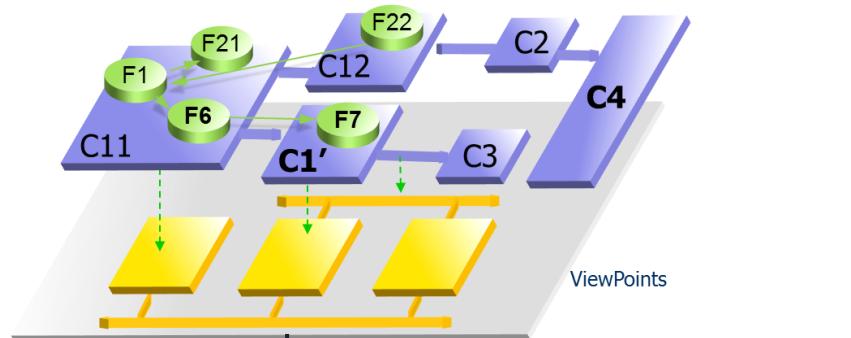
In Safety Architect, automated generation of fault-trees



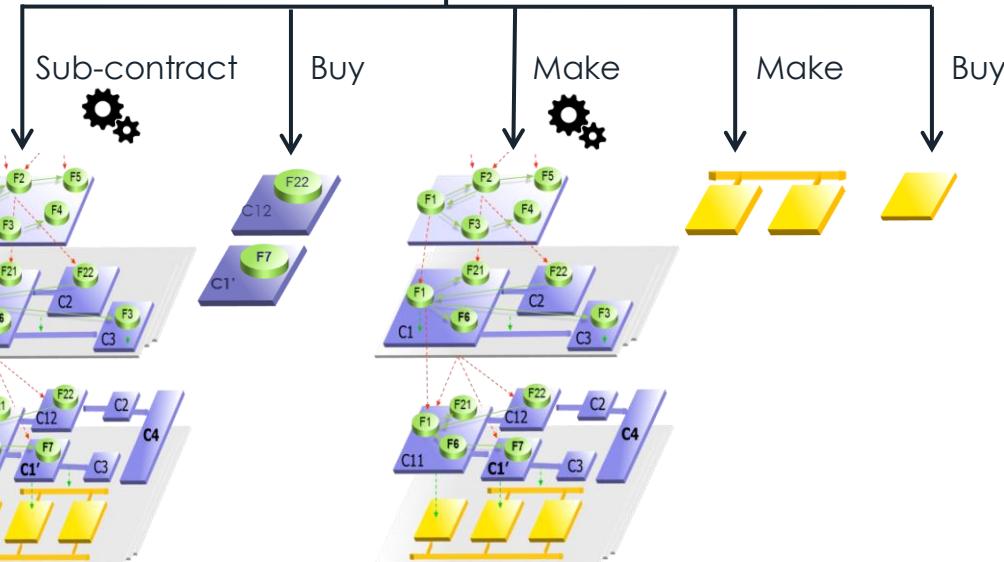
THALES

# **#7 - Engineering continuity**

## From wishful thinking to implementation



## SYSTEM PHYSICAL ARCHITECTURE



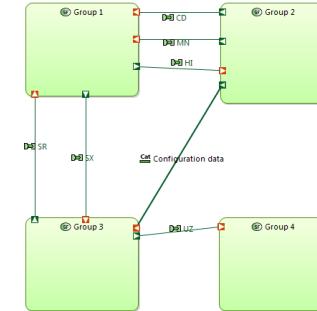
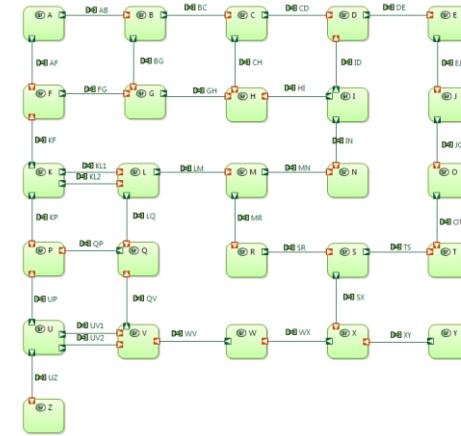
## AUTOMATICALLY INITIALIZED AND MAINTAINED SUBSYSTEM

# #8 - Scalable

## Cope with complexity

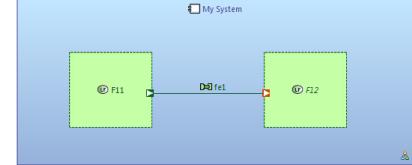
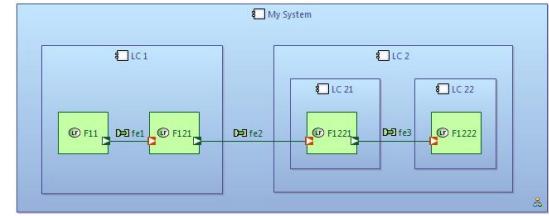
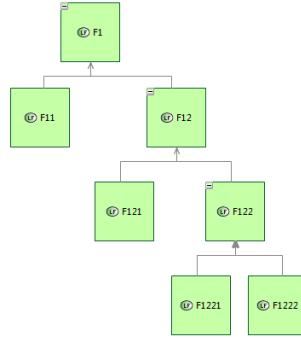


# DEMO





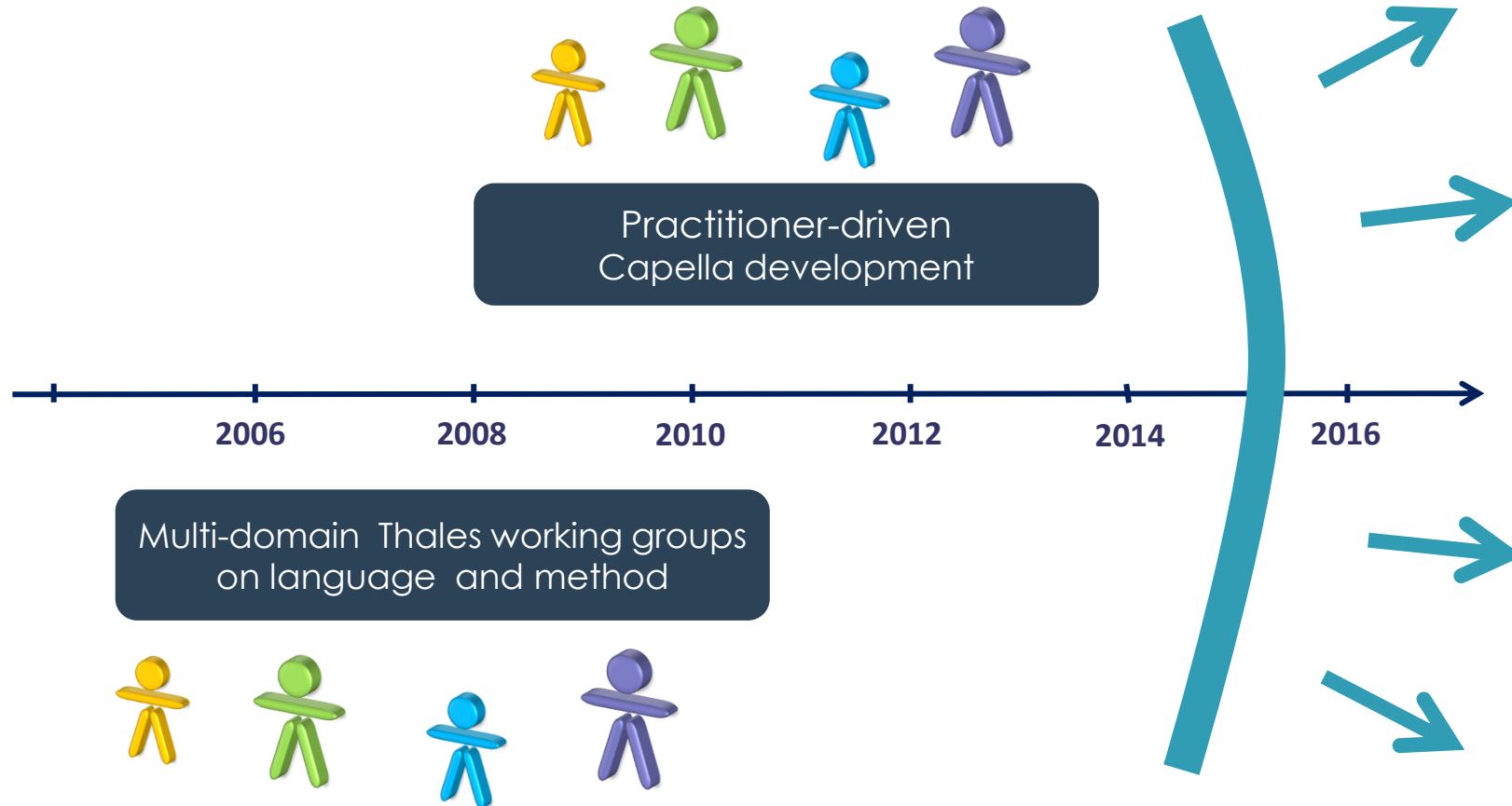
# DEMO



# #9 - Open Source

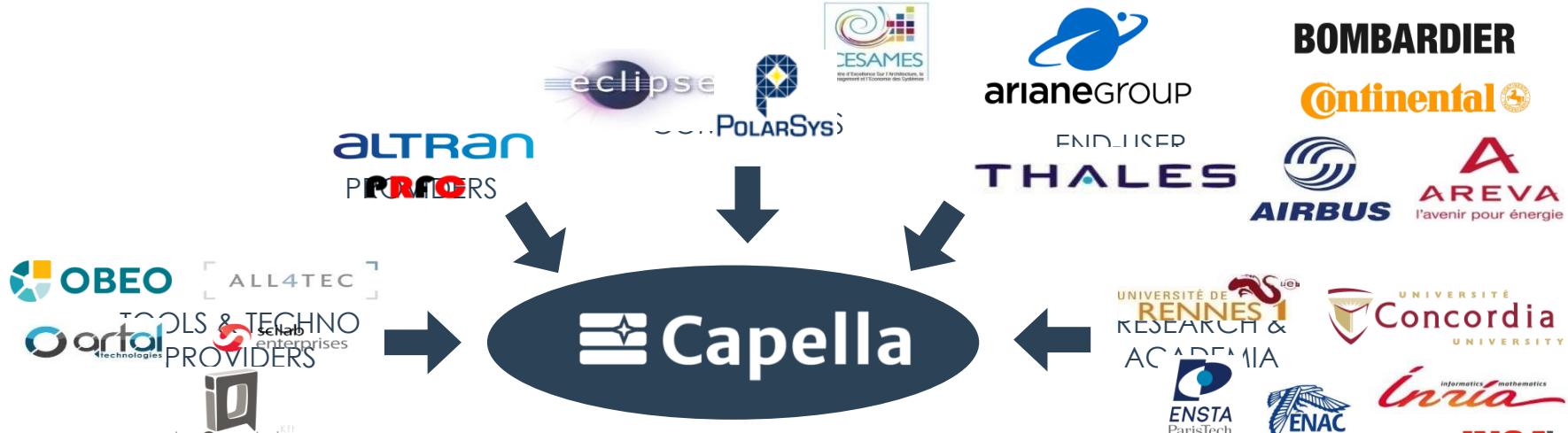
## What does it mean FOR YOU?

# A practitioner-driven journey started in Thales...



# ... now open source (it's free!)

This document may not be reproduced, modified, adapted, published, translated, in any way, in whole or in part or disclosed to a third party without the prior written consent of Thales - © Thales 2015 All rights reserved.



Collaborative funded projects

Capella Industry Consortium

## CASE-STUDIES



AEROSPACE

**ArianeGroup**

Model-Based Systems Engineering must become a team sport!!

[READ MORE](#)



ENERGY

**AREVA NP**

Progressive deployment of MBSE methods in French nuclear industry

[READ MORE](#)



AUTOMOTIVE

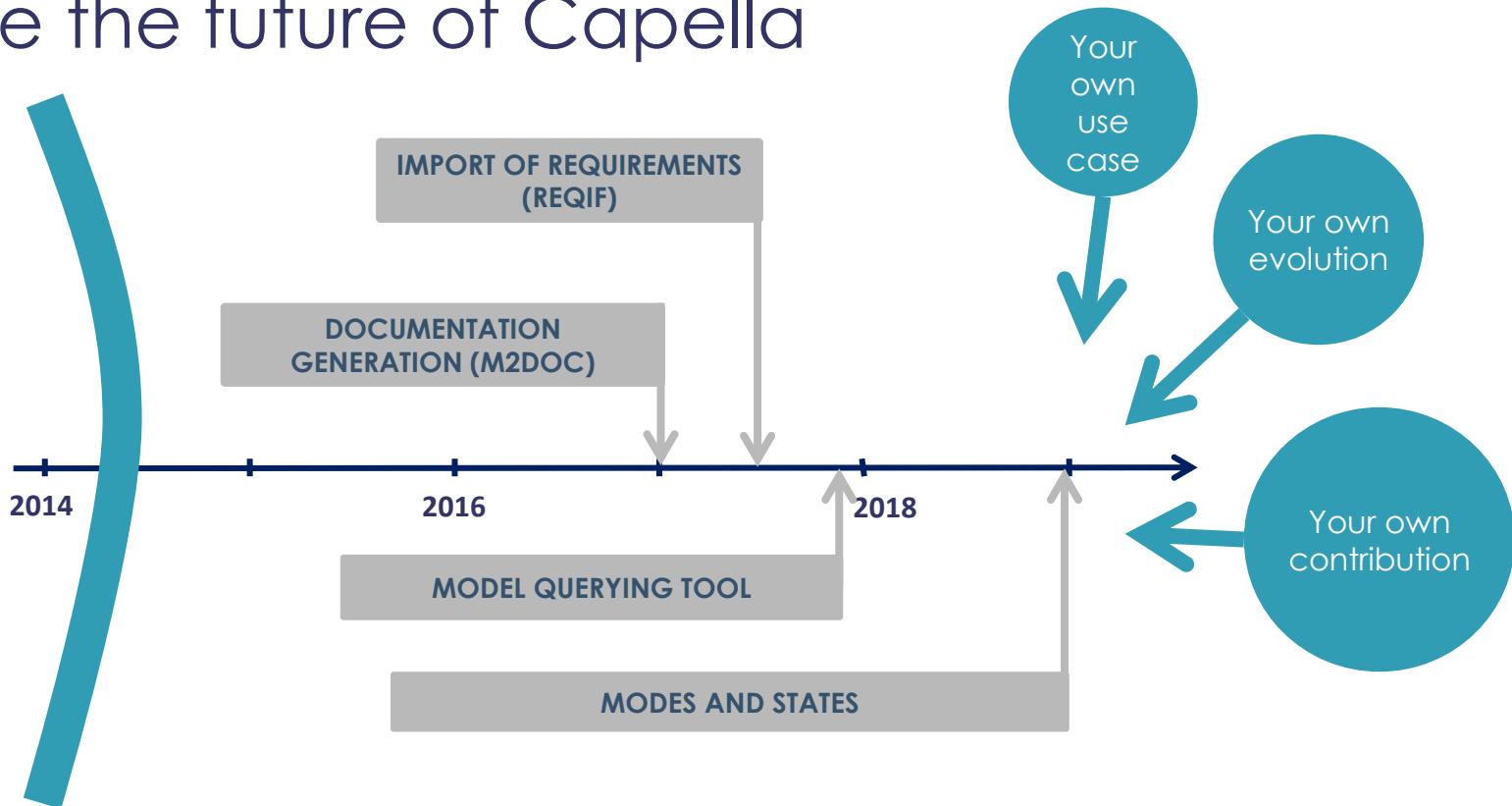
**Continental Automotive**

Driving intelligent transportation systems with Capella

[READ MORE](#)

# Shape the future of Capella

This document may not be reproduced, modified, adapted, published, translated, in any way, in whole or in part or disclosed to a third party without the prior written consent of Thales - © Thales 2015 All rights reserved.



Public APIs, forums, wiki, commercial offers

## #10 - User-driven

Specified (and monitored) by its end-users



Enabling  
components



Thales modeling  
community



Thales need  
capture



Open Source  
Community



Shared, public  
repositories



Partnerships

Thales end-user needs

Capella Industry  
Consortium

Funded evolutions

Collaborative projects



## Current Sprint & Demo registration



Sprint starts on **24 Apr 2017** and the demonstration will be **05 May 2017** - 11h-12h.

**Sprint #58**

Click to register

All voters :

(If you want to have a permanent invitation to assist to all demos, don't hesitate to send a mail to Michel BISPO (Product Owner)... [✉](#) or register to [this Outlook meeting \(iCalendar\)](#))

<b>&gt; Current Sprint Goal:</b> Provide a new connector for Melody 4.2.1 compatible with both Orchestra 5.5.2 (TOSA specific Work On Quotation) and Orchestra 5.6	Status
--	--------



Schedule:

1. coming soon...

See topics below with tags DEMO or PRES

<b>5.7(*)</b> 	1. (TC) [MA-NC-003-3] Integrate a new DiffMerge release to simplify merge policies (technical debt) 2. (TC) OCD 2017 [MA-NC-001] Upgrade of Eclipse Neon and foundation components : Team for Capella - Melody 4.3 based on Neon	1. <span style="background-color: grey; border: 1px solid black; padding: 2px;">NO DEMO</span> 2. <span style="background-color: grey; border: 1px solid black; padding: 2px;">NO DEMO</span>
<b>5.6.1(*)</b> 	1. (US)  MELODY-7868 [OCD MA-NC-011] Ease the Constraint edition for Guards, Pre/Post condition, Exchange Context, Change Event, Time Event and Owned Specification 2. (US)  MELODY-7869 [OCD MA-NC-011] Diagram palette tool ergonomy: merge insert Function and insert Actor Function tools	1. <span style="background-color: green; border: 1px solid black; padding: 2px;">DEMO</span> 2. <span style="background-color: green; border: 1px solid black; padding: 2px;">DEMO</span>
<b>5.5.2(*)</b> 	1. (US)  CONMELODY-577 [WOQ003-TOSA] Provide a new connector for Melody 4.2.1 compatible with both (for TOSA) Orchestra 5.5.2 and Orchestra 5.6 2. (US)  (WoQ TAS) EI management from functional analysis towards Interfaces: Propagate EI to Function	1. <span style="background-color: grey; border: 1px solid black; padding: 2px;">NO DEMO</span> 2. <span style="background-color: green; border: 1px solid black; padding: 2px;">DEMO</span>

[Personnes](#)[Historique des constructions](#)[Relations entre les projets](#)[Vérifier les empreintes numériques](#)[Disk usage](#)

#### Fil d'attente des constructions

Pas de construction en attente.

#### État du lanceur de construction

##### Status 3/4

En construction [capella-v1.1.x #118](#)  
En construction [capella-gerrit #3043](#)  
En construction [capella-studio-gerrit #404](#)  


## Jobs Status

# Capella

[Bugzilla](#)[Gerrit](#)[Sonar](#)

All	Capella Addons	Capella Studio	Capella Viewpoints	Capella-master	Capella-v0.8.x	Capella-v1.0.x	Capella-v1.1.x	Console
S	W	Tâche ↓			Dernier succès	Dernier échec	Dernière durée	
		capella-addon-docgen-master			2 mo. 27 j (#736)	10 h (#821)	6 mn 49 s	
		capella-addon-docgen-v0.8.x			9 mo. 18 j (#130)	N/A	4 mn 27 s	
		capella-addon-docgen-v1.0.x			10 h (#479)	1 j 10 h (#478)	5 mn 32 s	
		capella-addon-docgen-v1.1.x			2 mo. 26 j (#8)	10 h (#92)	4 mn 22 s	
		capella-addon-transitionsystem2subsystem-gerrit-others			22 j (#28)	23 j (#27)	3 mn 3 s	
		capella-addon-transitionsystem2subsystem-gerrit-v0.8.x			4 mo. 17 j (#16)	4 mo. 17 j (#15)	2 mn 13 s	
		capella-addon-transitionsystem2subsystem-master			22 j (#468)	2 j 3 h (#469)	3 mn 27 s	
		capella-addon-transitionsystem2subsystem-v0.8.x			20 j (#459)	N/A	2 mn 42 s	
		capella-addon-transitionsystem2subsystem-v1.0.x			4 mo. 4 j (#94)	N/A	2 mn 52 s	
		capella-addon-transitionsystem2subsystem-v1.1.x			4 mo. 4 j (#6)	N/A	4 mn 25 s	
		capella-addon-xmlpivot-gerrit-others			3 mo. 23 j (#32)	N/A	4 mn 22 s	
		capella-addon-xmlpivot-gerrit-v0.8.x			N/A	N/A	N/A	
		capella-addon-xmlpivot-master			3 mo. 23 j (#322)	N/A	3 mn 32 s	
		capella-addon-xmlpivot-v0.8.x			20 j (#122)	N/A	2 mn 57 s	
		capella-addon-xmlpivot-v1.0.x			4 mo. 11 j (#26)	N/A	2 mn 3 s	

Icône: S M L

[Légende](#)[toutes les constructions](#)[tous les échecs](#)[pour les dernières constructions seulement](#)

## Thank You! Questions?

Capella website:

<http://www.polarsys.org/capella/>

LinkedIn Discussion Group 

<https://www.linkedin.com/groups/8605600>

Twitter 

[https://twitter.com/capella\\_arcadia](https://twitter.com/capella_arcadia)

Arcadia public forum:

<https://polarsys.org/forums/index.php/f/12/>

Capella public forum:

<https://polarsys.org/forums/index.php/f/13/>

IFE model & documentation:

<http://polarsys.org/capella/community.html>

[www.thalesgroup.com](http://www.thalesgroup.com)

