

Arcadia and Capella: Augmenting requirements with models to improve the articulation between systems engineering levels and optimize V&V practices

INCOSE SYMPOSIUM 2019

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THALES



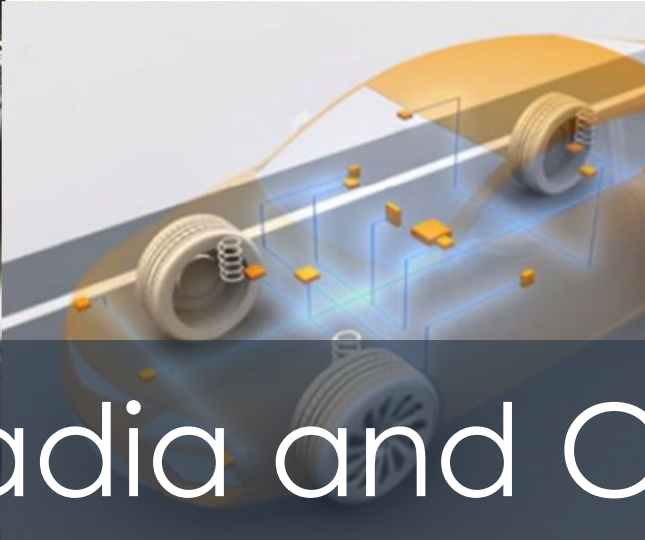
1. Preamble: Arcadia method and Capella workbench

2. Model elements ARE requirements

3. Contracts between engineering levels: workflow

4. (Happy) consequences on V&V and incremental development strategy

5. Instantiated workflow



1. Arcadia and Capella

Methodology and
high level concepts
and viewpoints



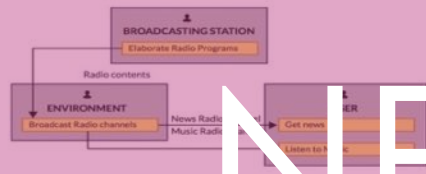
Purpose-built to
provide the
notation and
diagrams fitting the
Arcadia approach



Customer Operational Need Analysis

What the users of the system need to accomplish

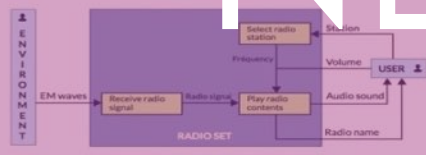
- ✓ Define operational capabilities
- ✓ Perform an operational need analysis



System/SW/HW Need Analysis

What the system has to accomplish for the Users

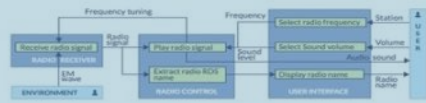
- ✓ Perform a capability trade-off analysis
- ✓ Perform a functional and non-functional analysis
- ✓ Formalise and consolidate requirements



Logical Architecture Design

How the system will work so as to fulfil expectations

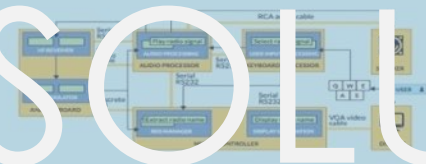
- ✓ Define architecture drivers and viewpoints
- ✓ Build candidate architectural breakdowns in components
- ✓ Select best compromise architecture



Physical Architecture Design

How the system will be developed & built

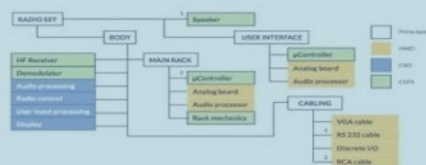
- ✓ Define architectural patterns
- ✓ Consider reuse of existing assets design a physical architecture
- ✓ Design a physical reference architecture
- ✓ Validate and check it



Development Contracts

What is expected from each designer/sub-contractor

- ✓ Define a components IVVQ strategy
- ✓ Define & enforce a PBS and component integration contract



- Operational capabilities
- Actors, operational entities
- Actor activities
- Interactions between activities & actors
- Information used in activities & interactions
- Operational processes defining activities
- Scenarios for dynamic behaviour

- Actors and system capabilities
- Functions of system & actors
- Dataflow exchanges between functions
- Functional chains traversing dataflow
- Information used in functions & exchanges, data model
- Scenarios for dynamic behaviour
- Modes & states

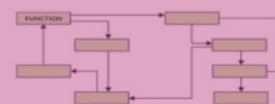
SAME CONCEPTS, PLUS :

- Components
- Component ports and interfaces
- Exchanges between components
- Function allocation to components
- Component interface justification by functional exchanges allocation

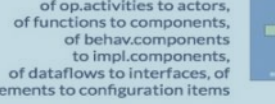
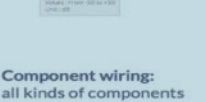
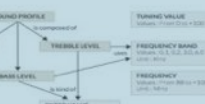
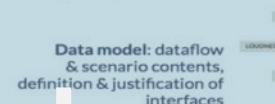
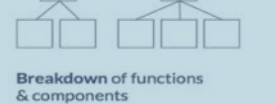
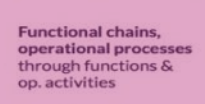
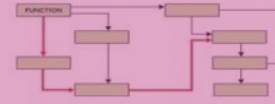
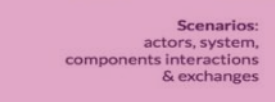
SAME CONCEPTS, PLUS :

- Behaviours, components refining logical one and implementing functional behaviour
- Implementation components supplying resources for behaviours
- Physical link between implementation components

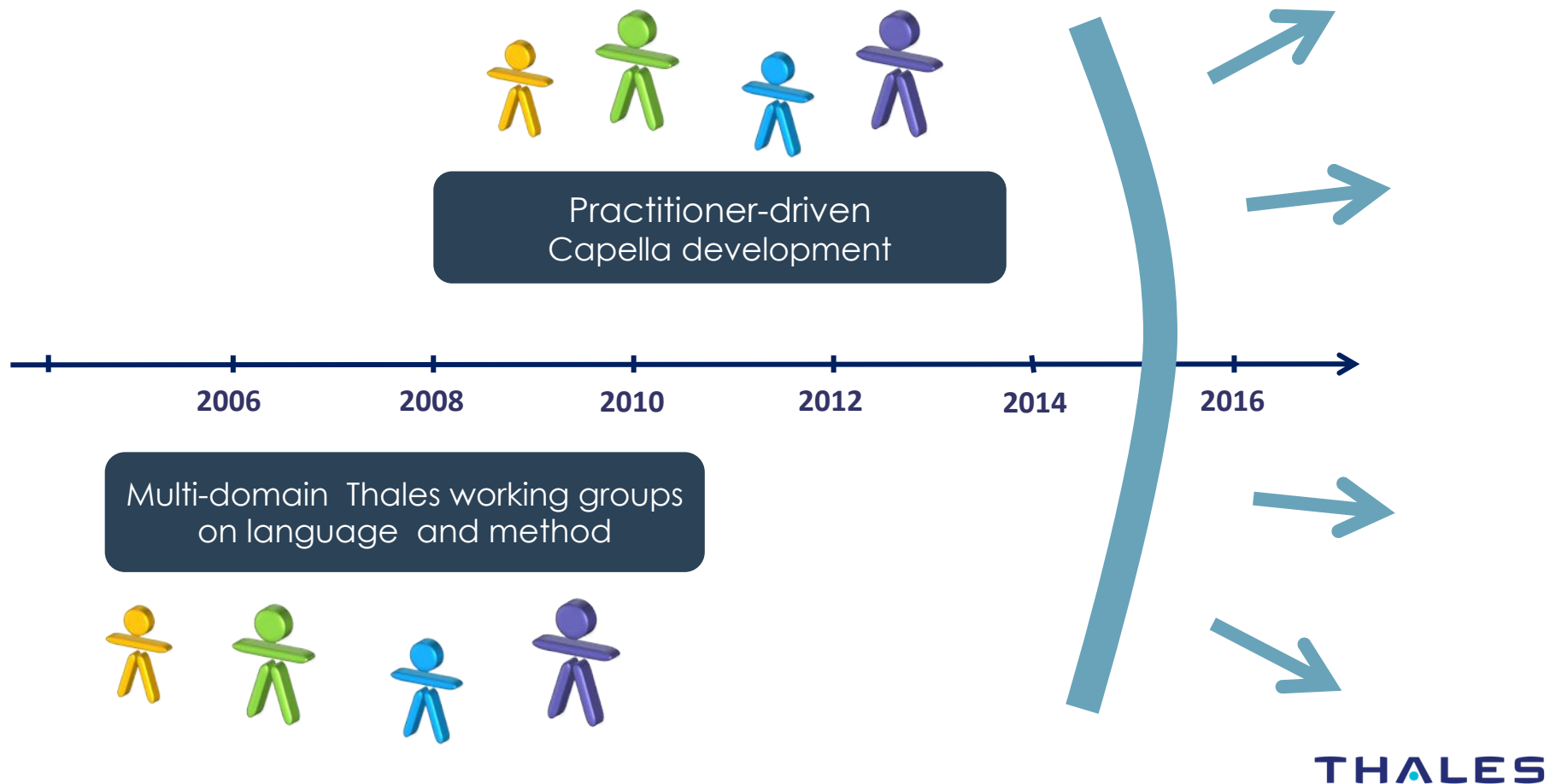
- Configuration items tree
- Parts numbers, quantities
- Development contract (expected behaviour, interfaces, scenarios, resource consumption, non-functional properties...)



Dataflow: functions, op. activities interactions & exchanges

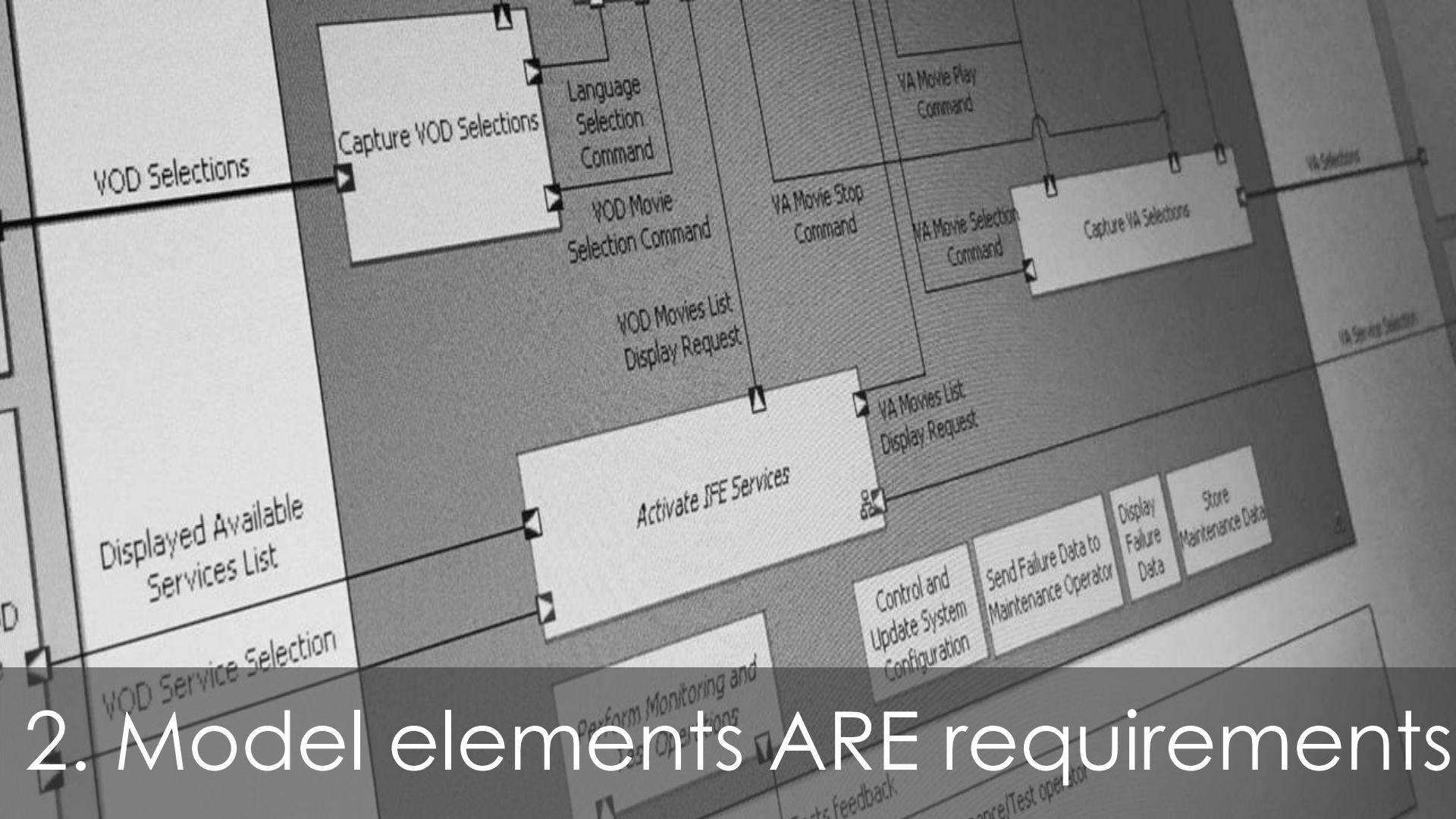


A practitioner-driven journey started in Thales...



... and now continuing beyond





2. Model elements ARE requirements

Need model

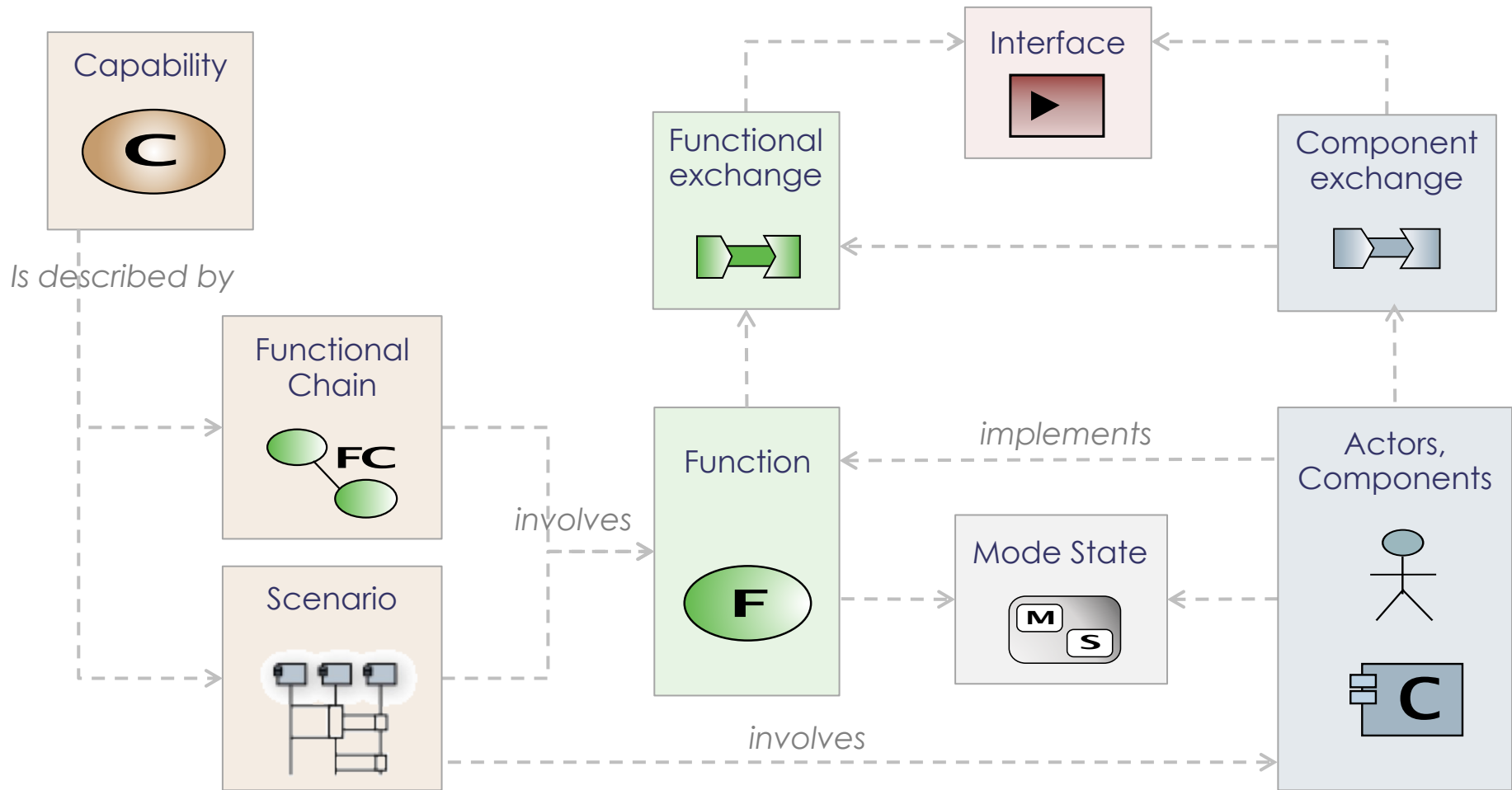
helps formalize and
consolidate
customer and
system requirements

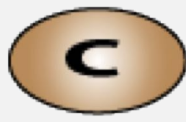
Textual requirements

are at the heart of
the current
engineering
practices

Solution model

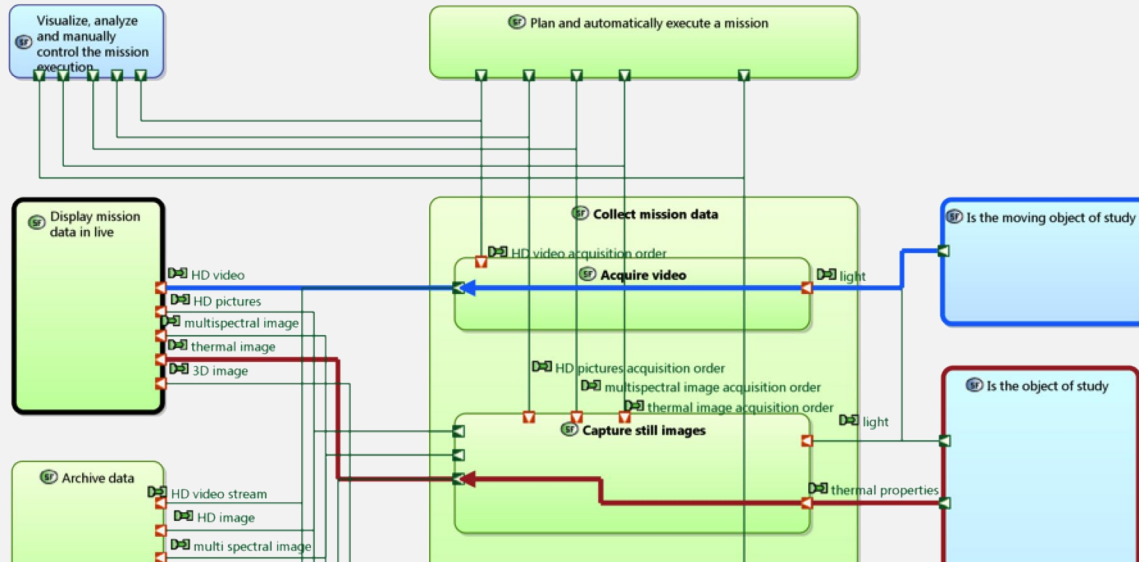
helps validate
feasibility,
elicit/justify new
requirements for the
system/subsystems





Visualize data in live during flight

- FC Display acquired HD video in live ■
- FC Display multi-spectral image in live
- FC Display thermal image in live ■
- FC Visualize all collected mission data
- FC Visualize substance level in live

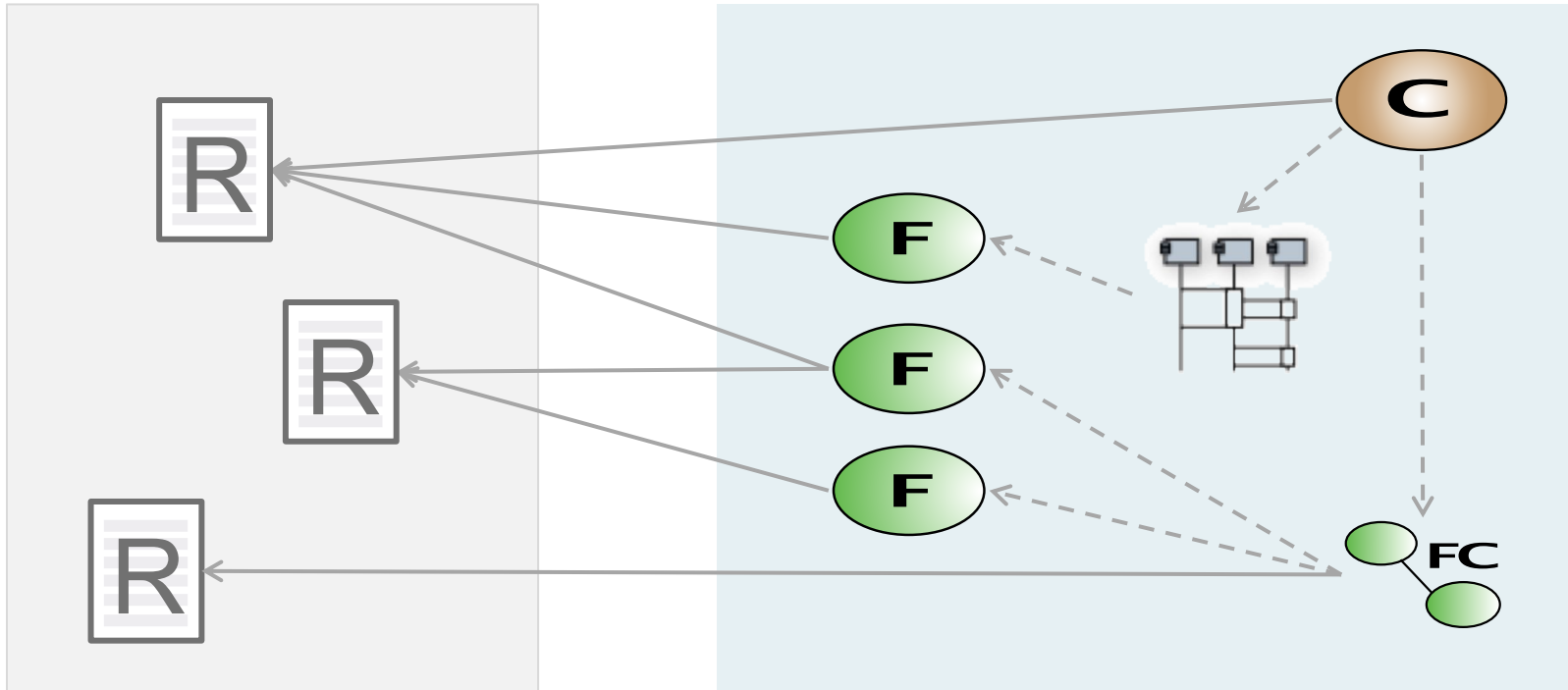


Models add rigor to need expression / solution description

Models enable automated processing

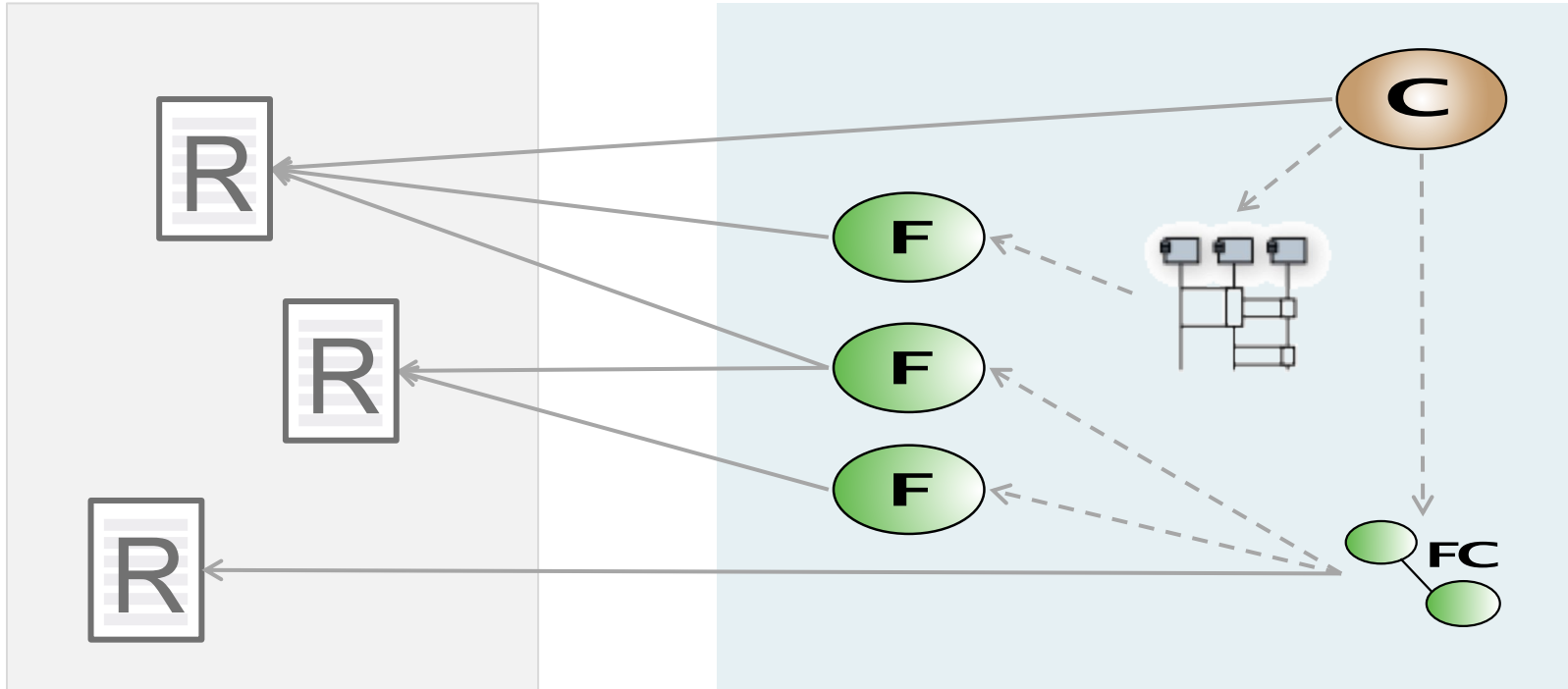
Requirements

Model elements

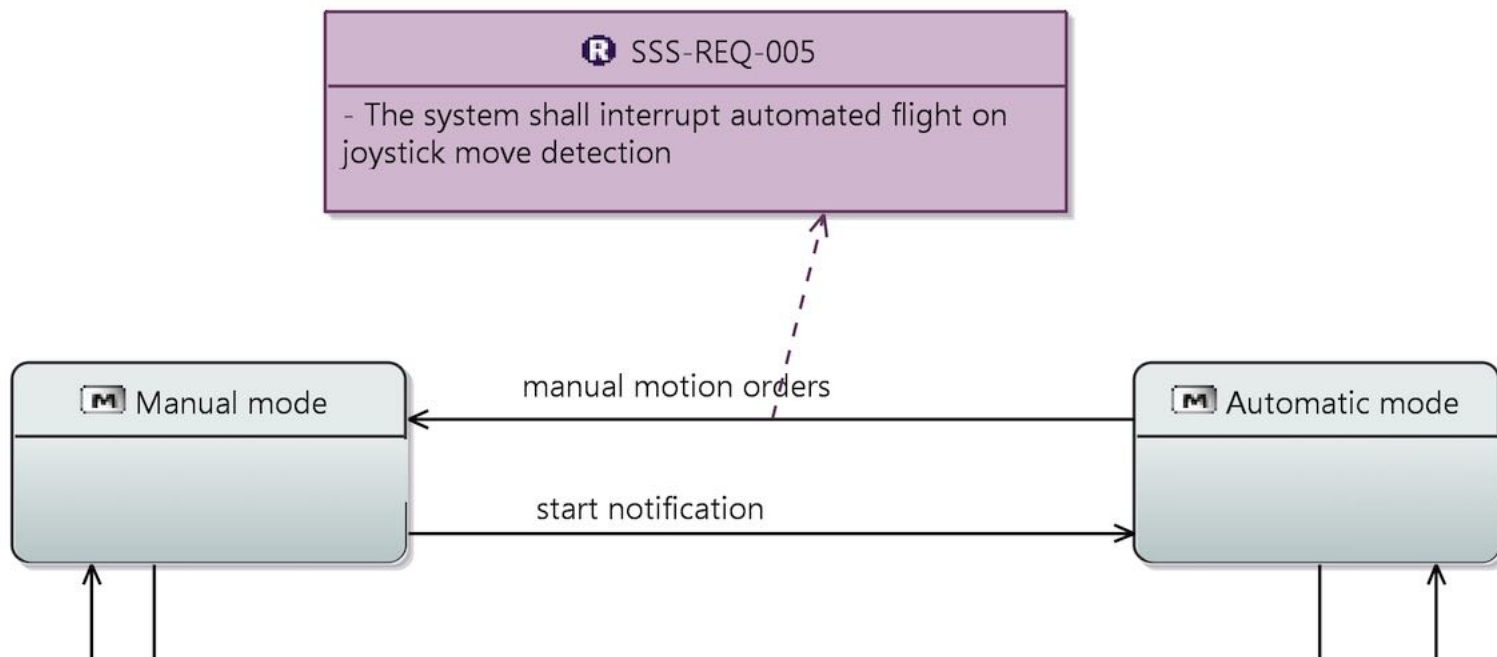


Textual Requirements

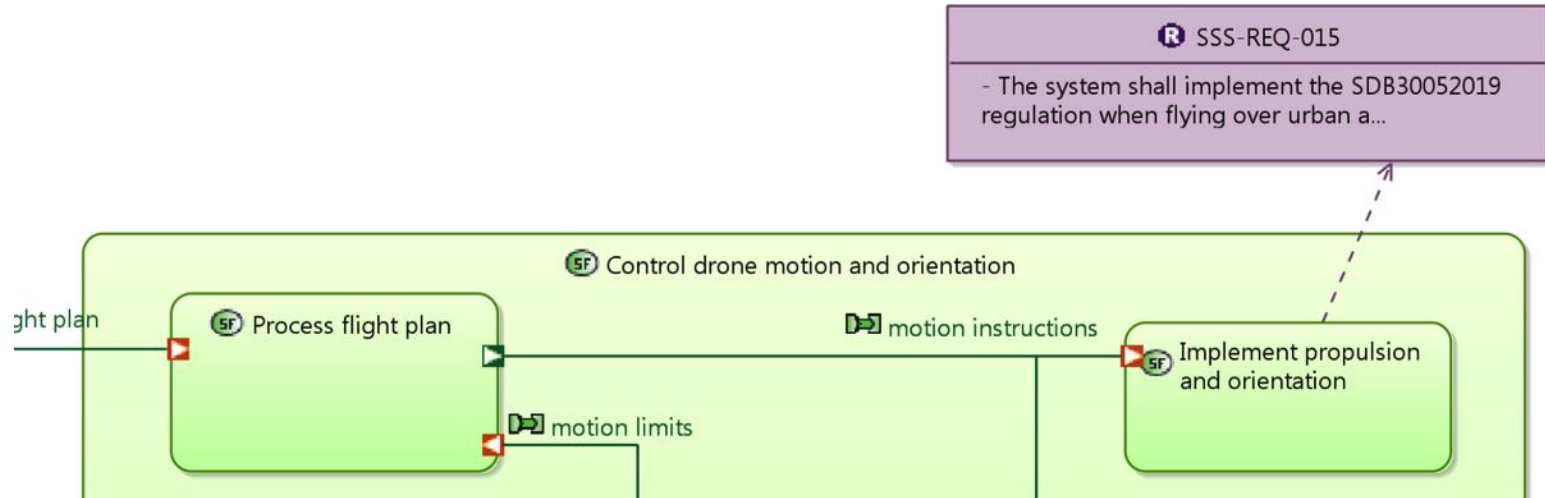
Model elements Requirements



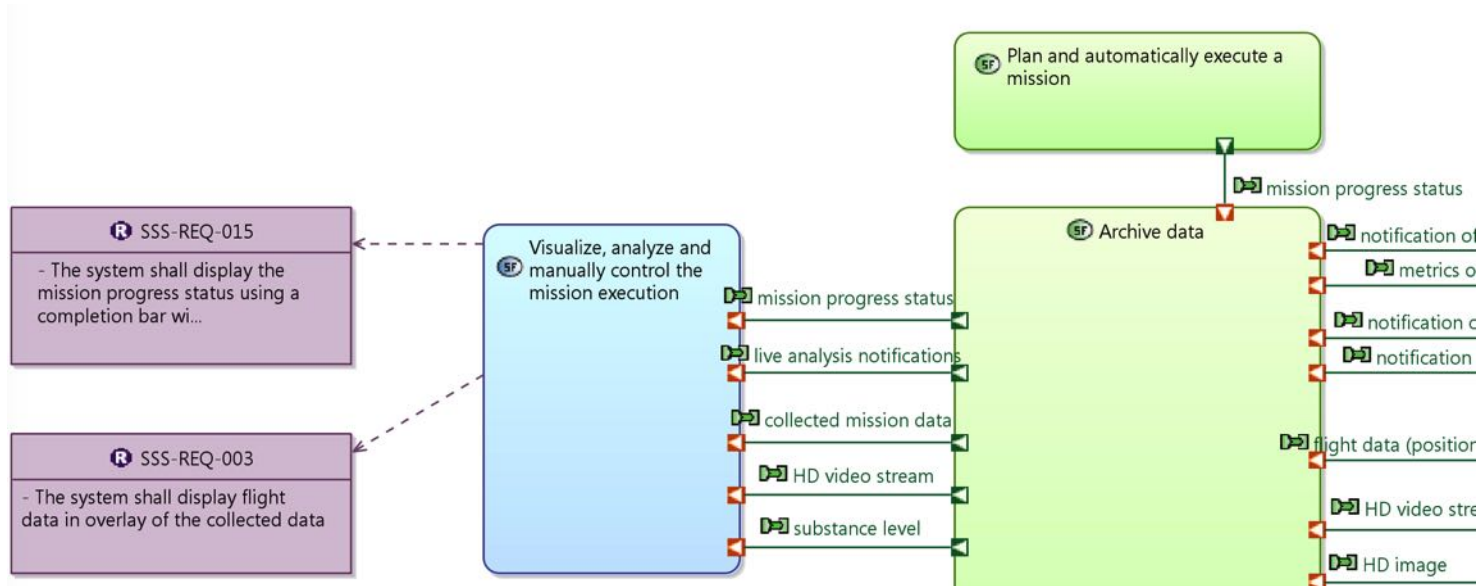
A model requirement can formalize a textual requirement and explicit its effects and ramifications



Some expectations (environmental, regulations, etc.)
are easier to express with textual descriptions.



Some expectations on a model element at a given engineering level do not require a formal modeling (which is left to subsystem design)





Tooling support

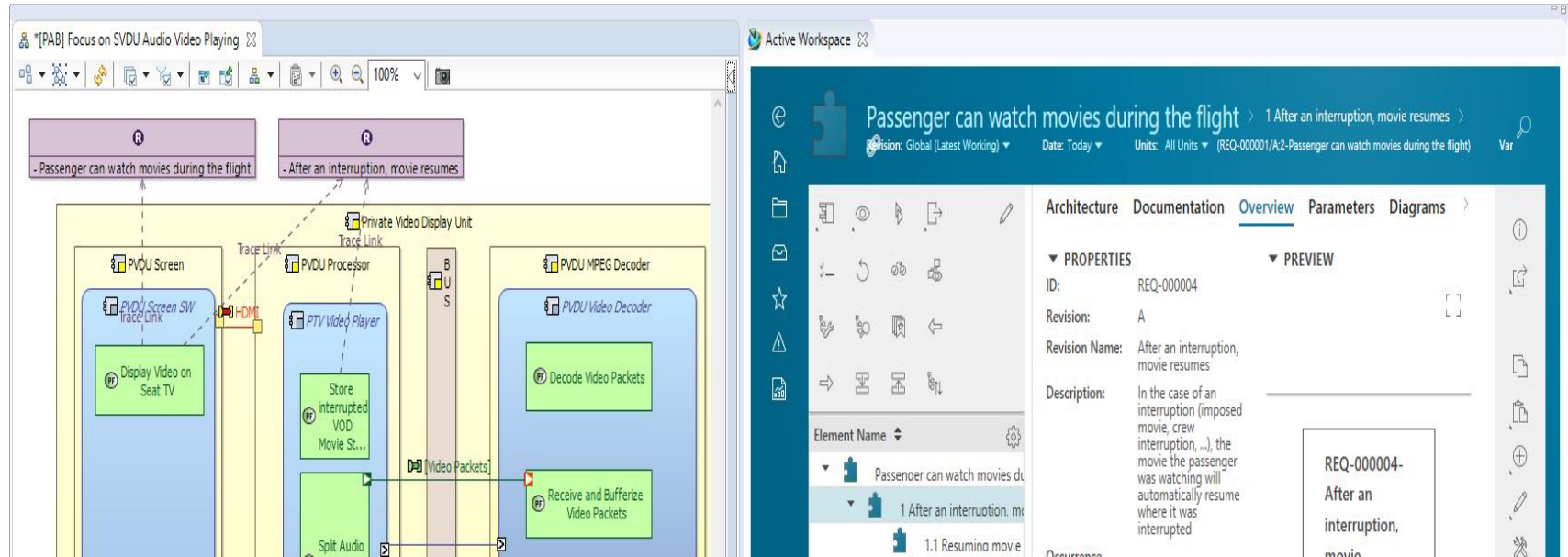
Coupling models and textual requirements

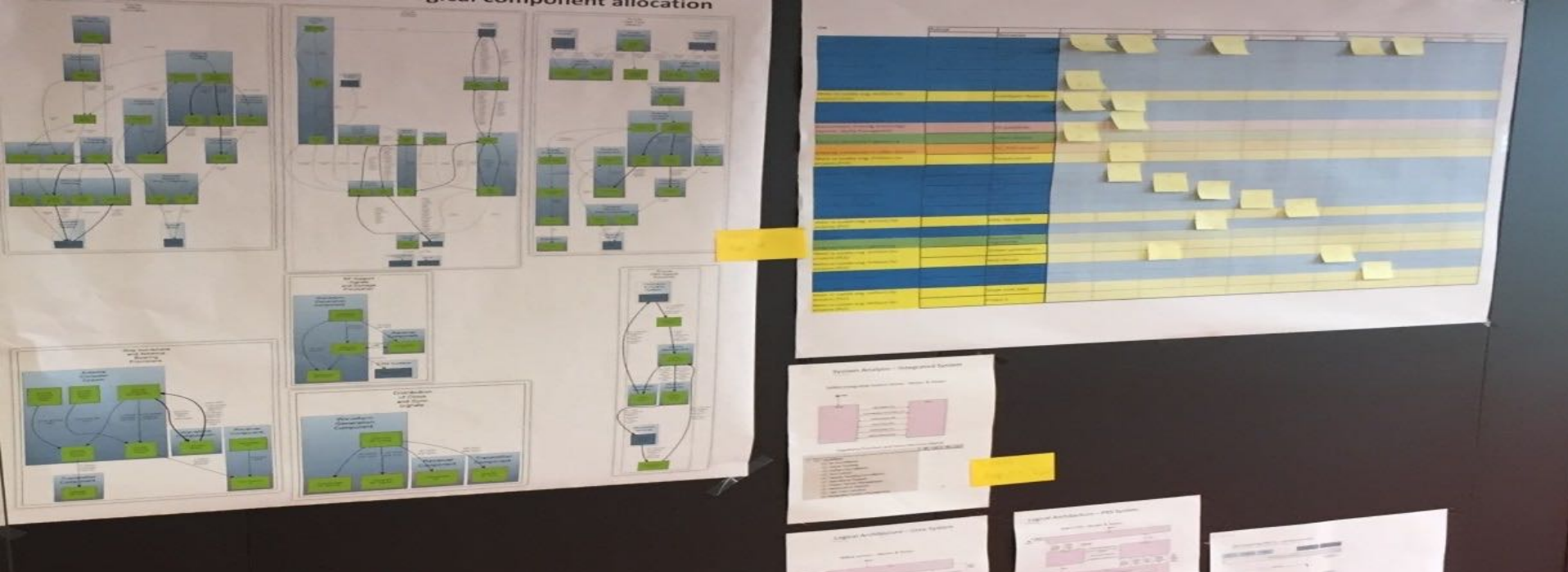
RAT (The Reuse Company) authoring in Capella

The screenshot displays the Capella IDE environment. The main workspace shows a UML diagram with actors 'Aircraft' and 'Cabin Crew' interacting with capabilities 'C'. A requirement box states: 'The Aircraft shall Provide Video Gaming Services'. The left sidebar shows the 'Capella Project Explorer' with a tree structure including 'In-Flight Entertainment System', 'System Requirements', and 'System Functions'. The bottom panel features the 'RAT Plugin for Capella' window, which includes a text editor for authoring requirements using the 'Stakeholder Functional Requirement' pattern. The text in the editor reads: 'The Aircraft shall pr'. A dropdown menu lists various capabilities like 'Provide Access Management Control', 'Provide Access to Digital Media', etc. To the right of the editor is a 'Correctness metrics summary' table.

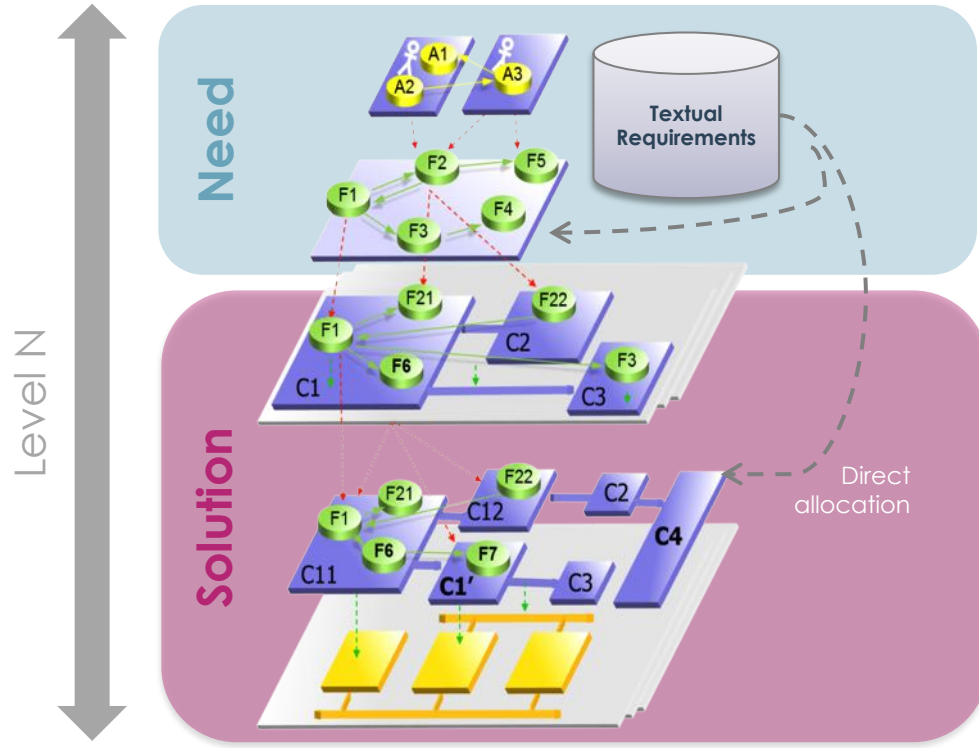
High Quality	
Metric	Value
✓ R19 Singularity - TRC - Text length (words)	3
✓ R44 Uniformity Of Language - Style guide (Enforce)	0

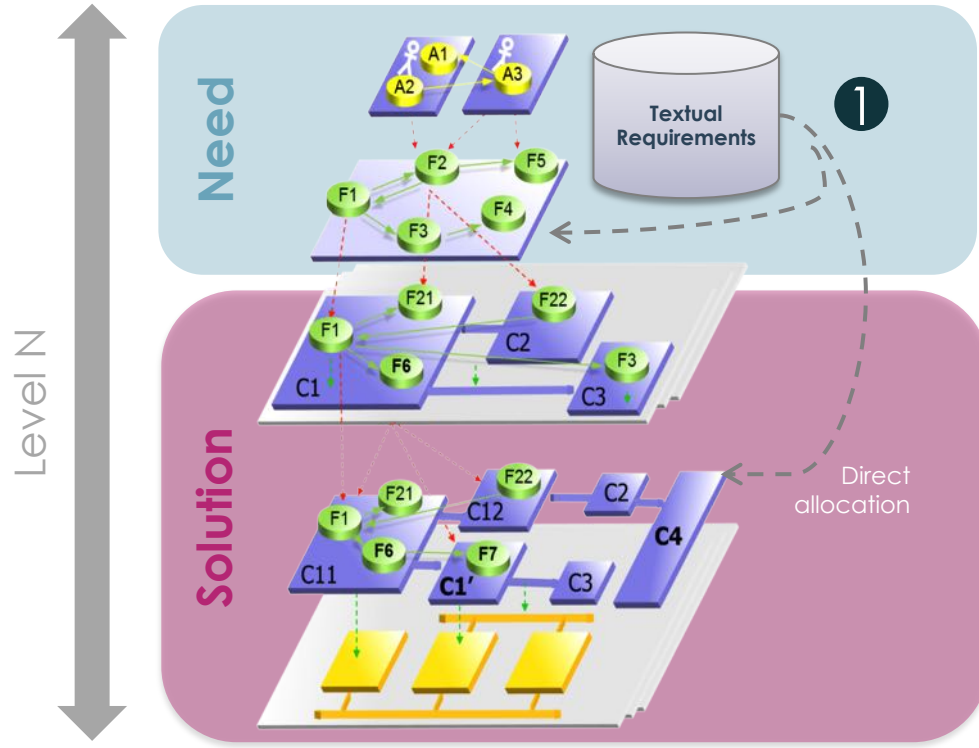
Capella in Siemens TeamCenter via Obeo SMW



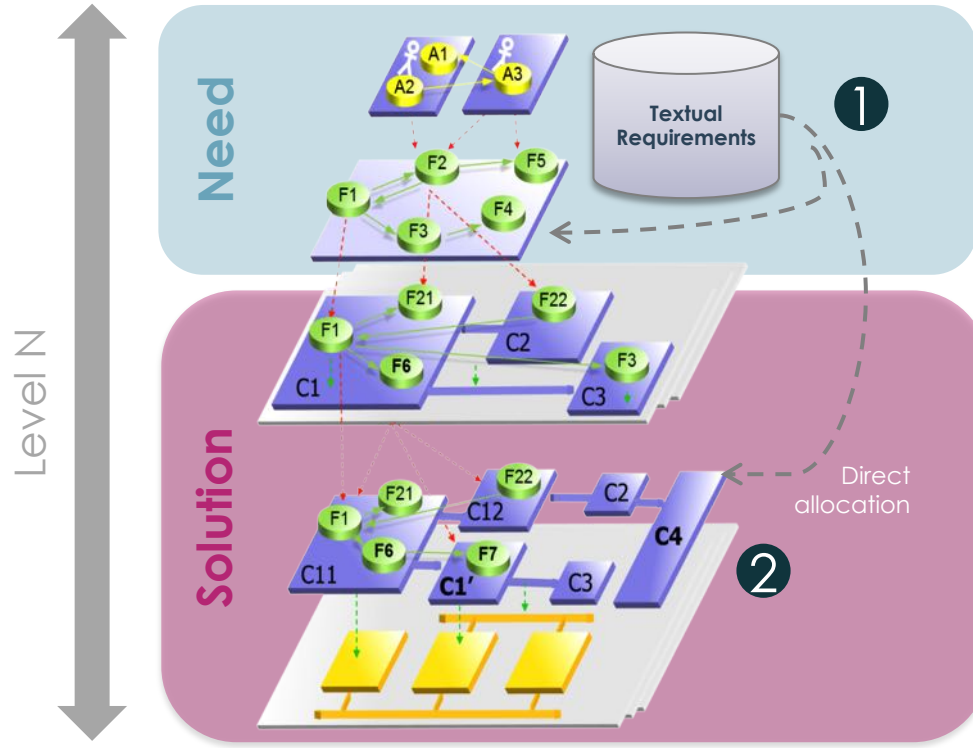


3. Contracts between engineering levels: workflow





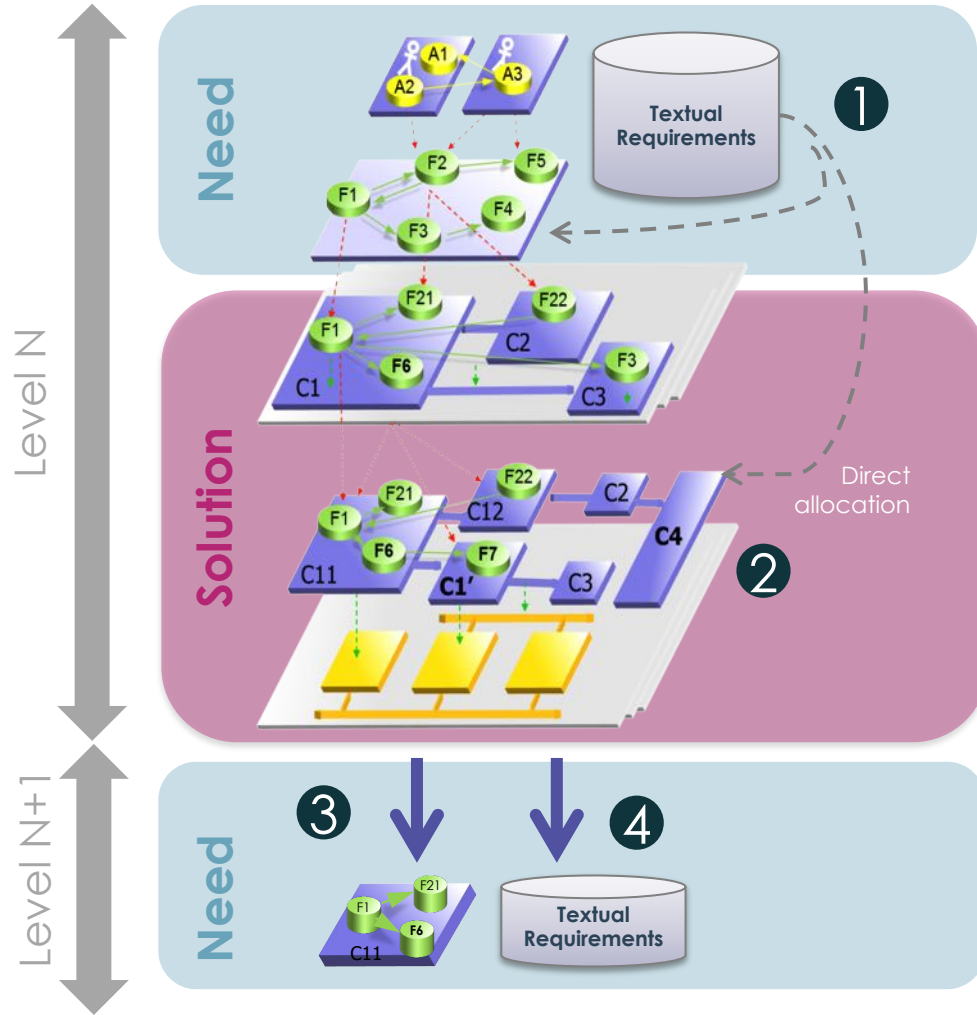
1.
Elicitation of model
and textual
requirements on the
system



2.

Architecture description specifies with the adequate level of detail how the system works and what is expected from each constituent

The goal here is to prepare the contracts for all subsystems and guarantee their proper integration.



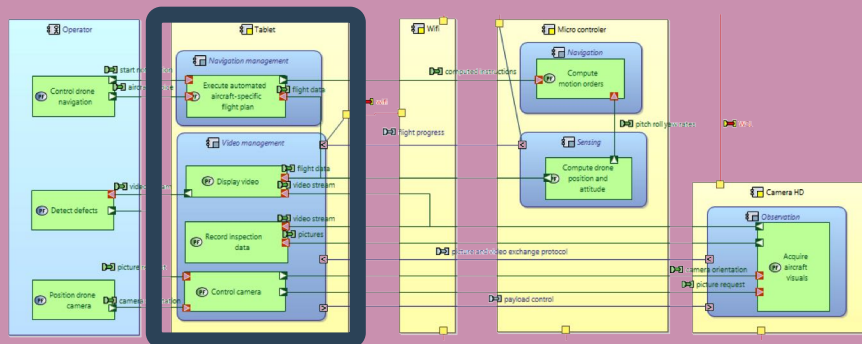
3.

The context of a given system constituent is entirely computed (anything contributing to the definition of this constituent including allocated Functions, interfacing Components, etc.)

4.

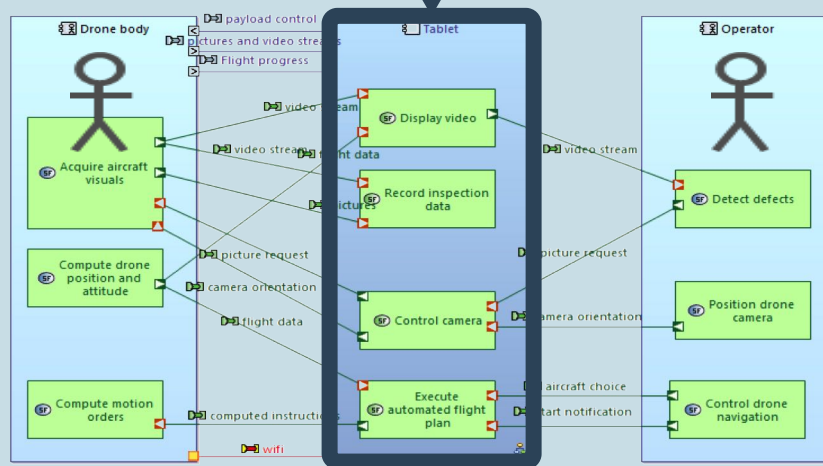
Textual requirements are created when needed, in addition to the model requirements: legal, non-functional, additional specification of internal expected behaviour

Tablet is a
constituent of a
drone-based
system



3

Tablet is the
(sub)system
of interest

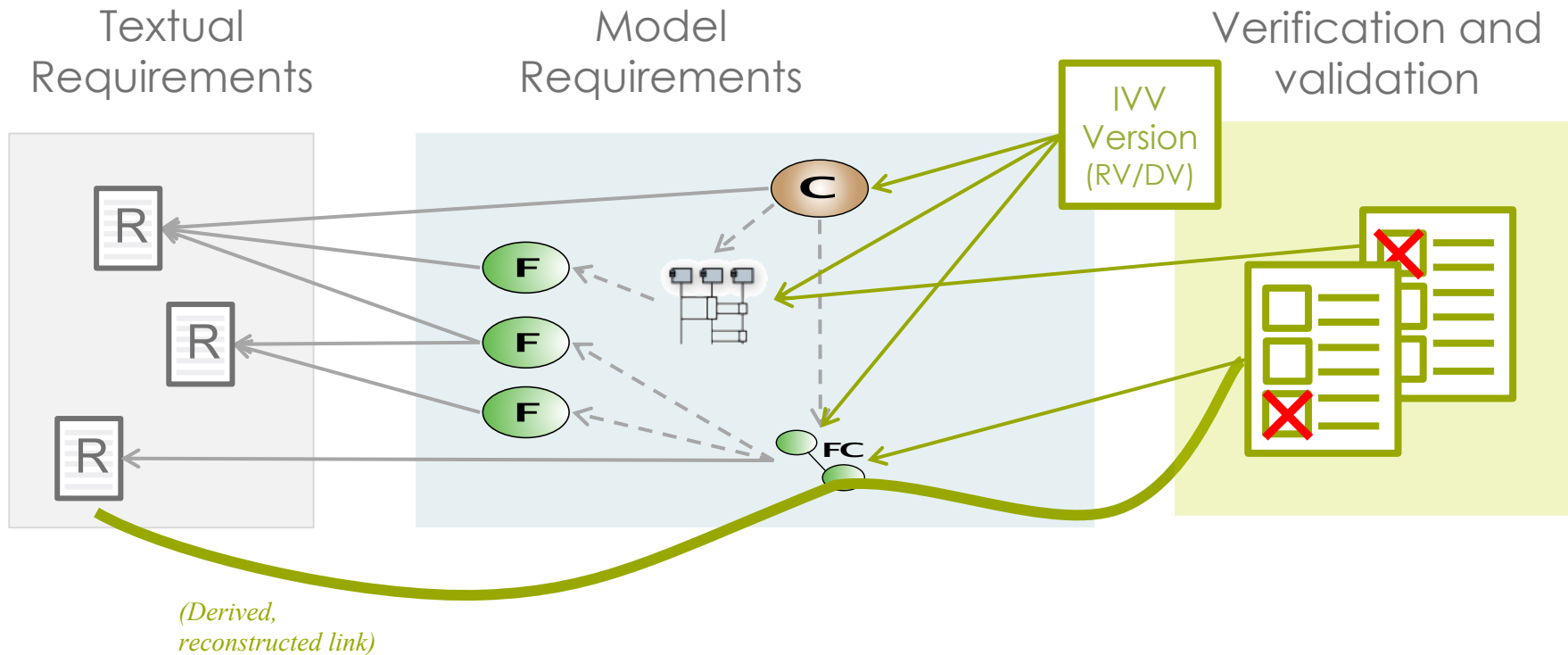


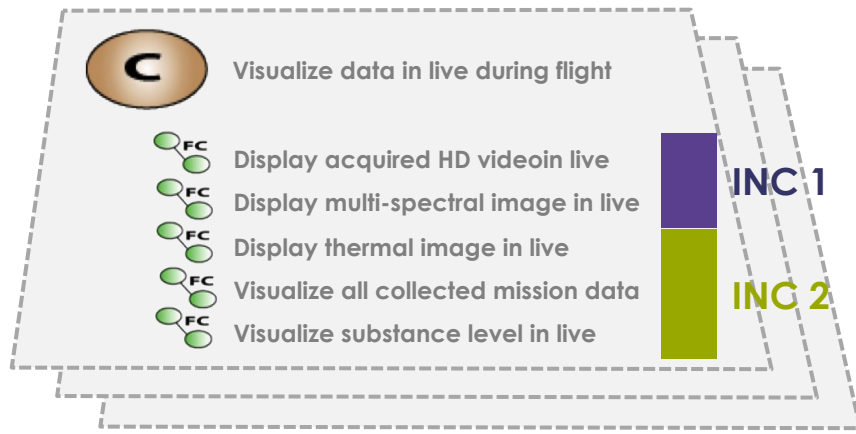


Model-based workflow favors co-engineering over the traditional differentiation between “customer” requirements and “system” requirements



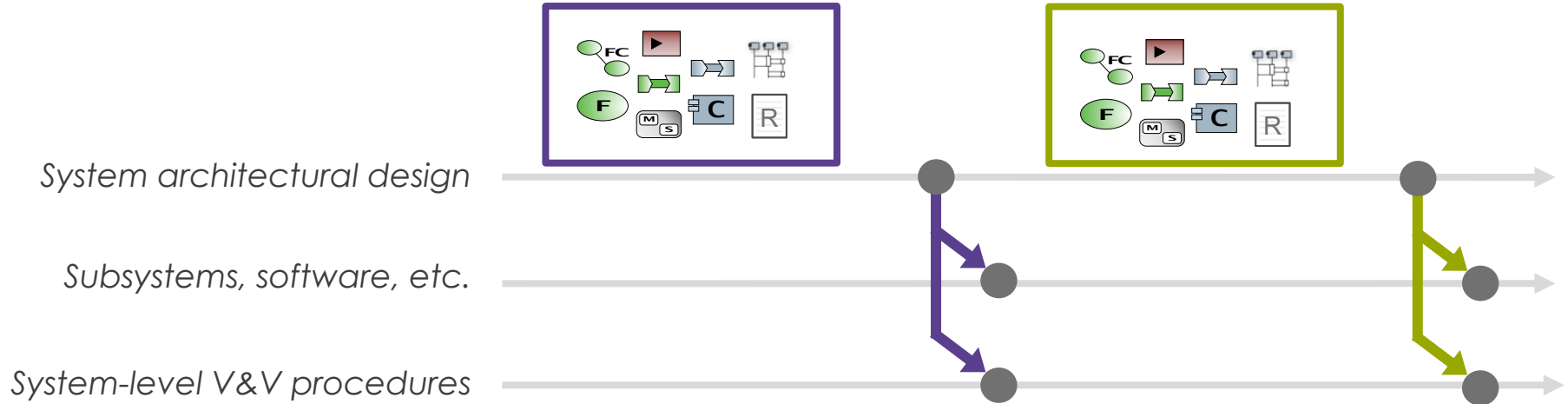
4. (Happy) consequences
on V&V and incremental
development strategy





Definition of increments with expected functional chains (user stories)

Vertical slices of architectural design across need and solution models

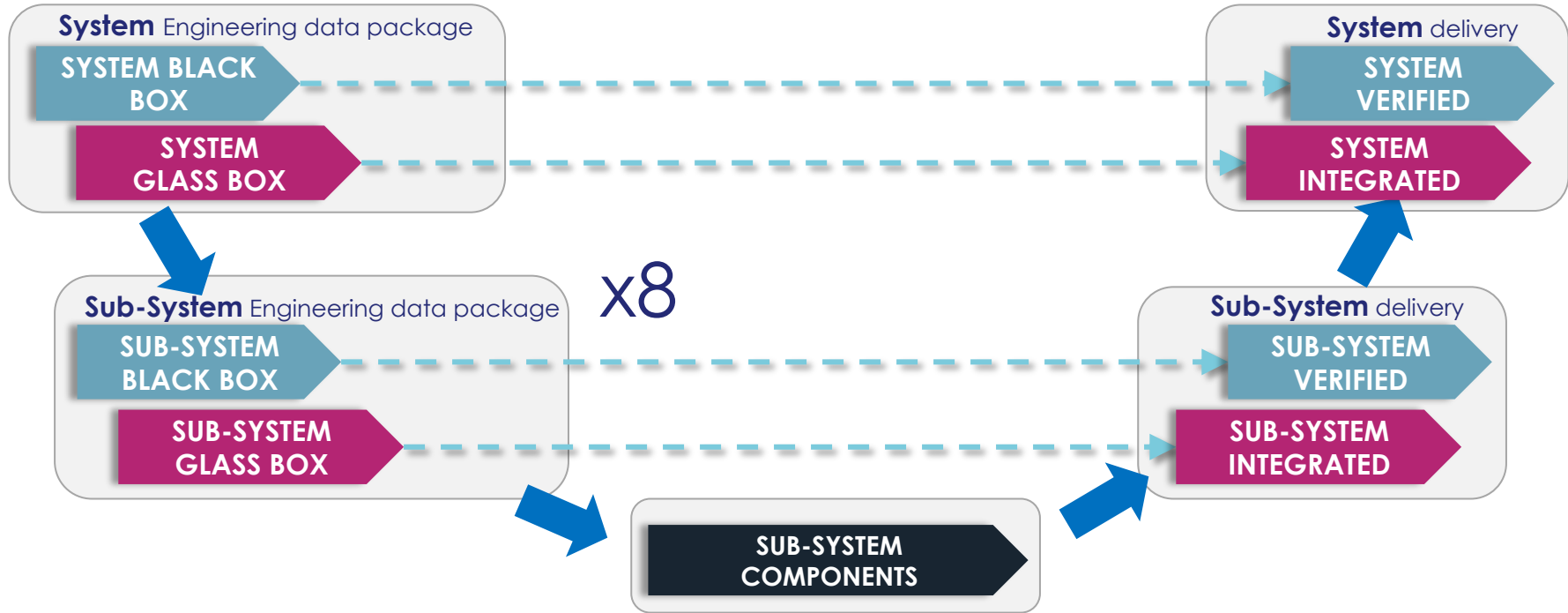




5. Instanciated workflow

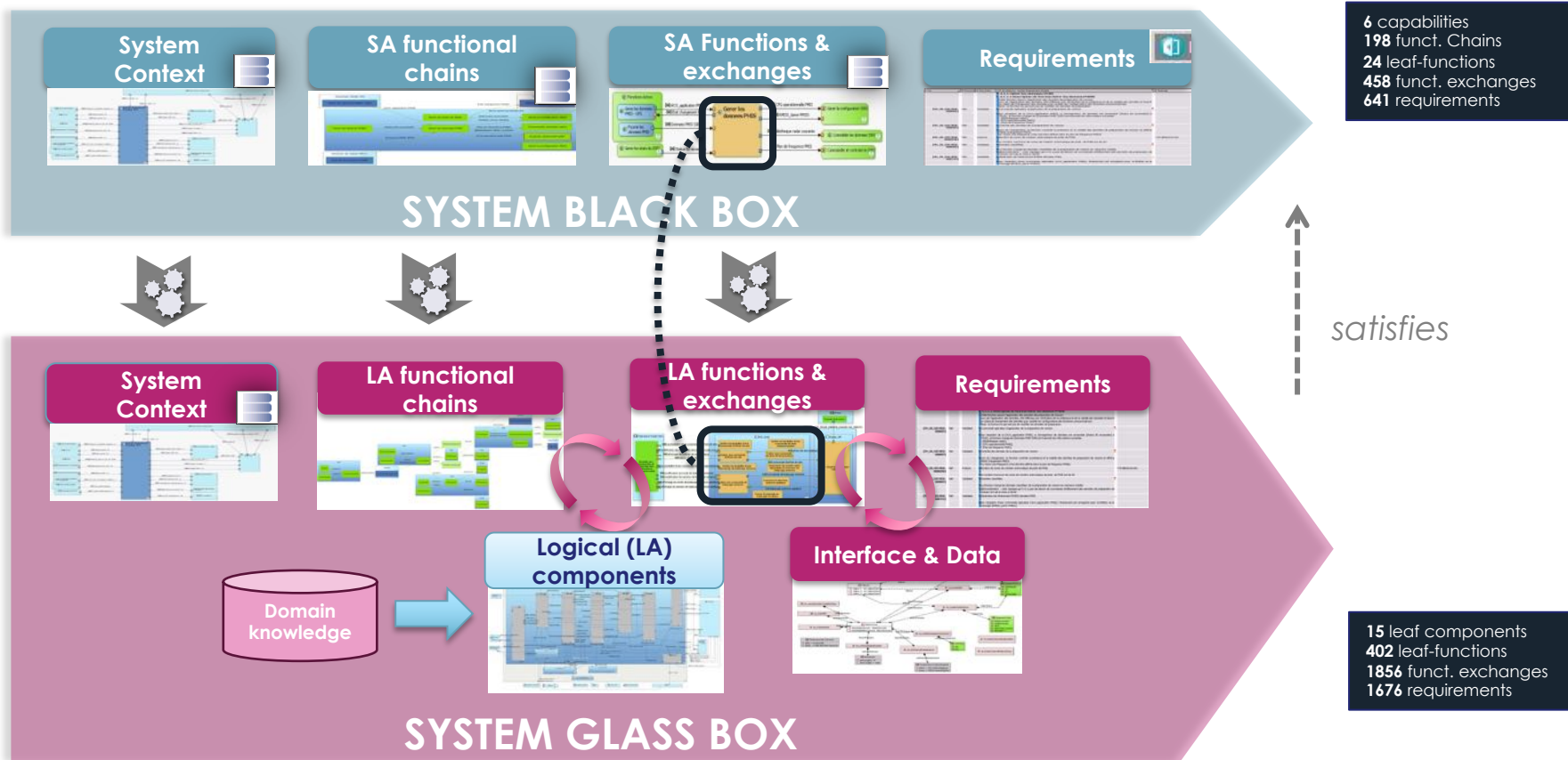
Two years, 30 persons

Classic scheme, rolled out by increments

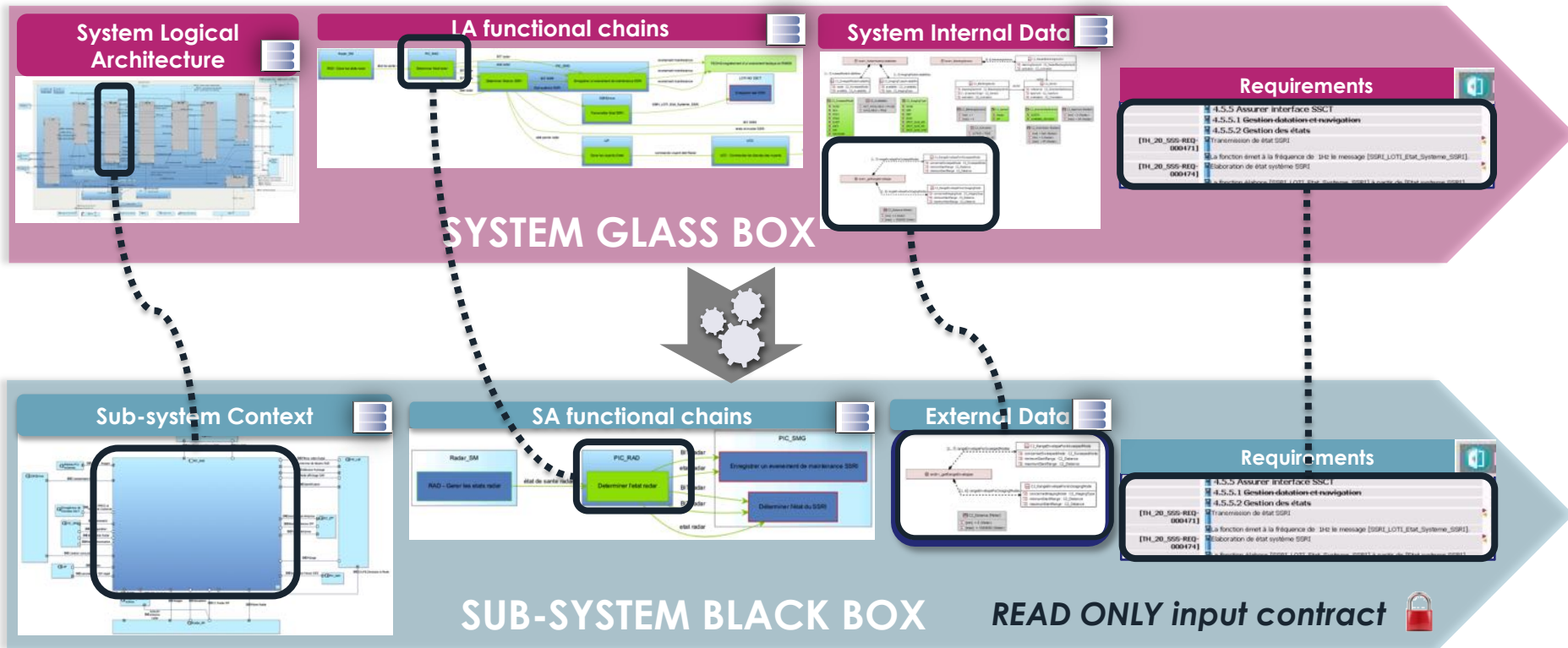


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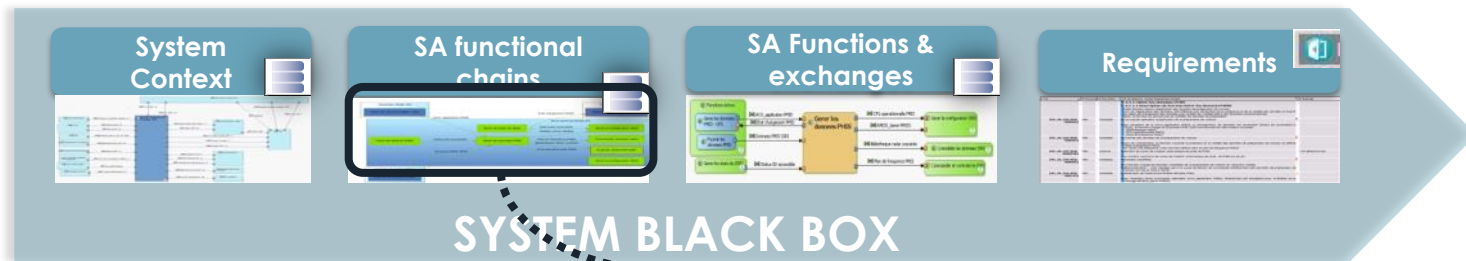




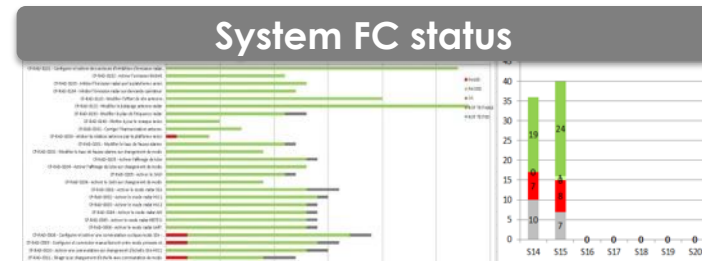
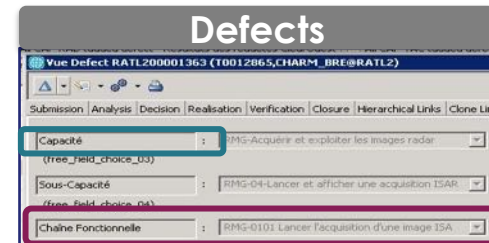
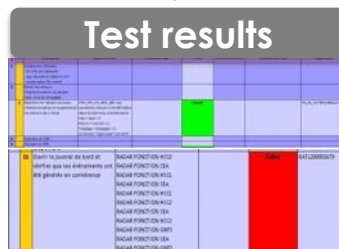
Automated transitions



System verification: enhanced progress monitoring



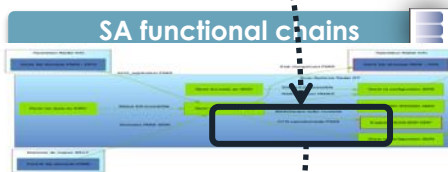
VERIFICATION ACTIVITIES



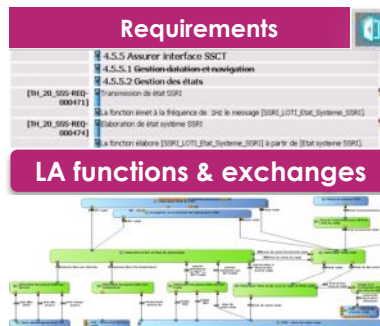
Test results: models facilitate analyses

Test suites

Each to summary	Report test cases
Test suite 1	Test case 1
Test suite 2	Test case 2
Test suite 3	Test case 3
Test suite 4	Test case 4
Test suite 5	Test case 5
Test suite 6	Test case 6
Test suite 7	Test case 7
Test suite 8	Test case 8
Test suite 9	Test case 9
Test suite 10	Test case 10



Check of consistency with specification



Impact analysis

Component Defects

Vue Defect RATL200001363 (10012065,CHARM_BRE@RATL2)

Submission | Analysis | Decision | Realisation | Verification | Closure | Hierarchical Links | Clone Link

Capacité (free_field_choice_03) : [RNG-Acquiesce et exploiter les images radar]

Sous-Capacité (free_field_choice_04) : [RNG-08 Lancer et afficher une acquisition (DAB)]

Chaîne Fonctionnelle : [RNG-0103 Lancer l'acquisition d'une image DAB]

Specification Defects

Vue Defect RATL200001363 (10012065,CHARM_BRE@RATL2)

Submission | Analysis | Decision | Realisation | Verification | Closure | Hierarchical Links | Clone Link

Capacité (free_field_choice_03) : [RNG-Acquiesce et exploiter les images radar]

Sous-Capacité (free_field_choice_04) : [RNG-08 Lancer et afficher une acquisition (DAB)]

Chaîne Fonctionnelle : [RNG-0103 Lancer l'acquisition d'une image DAB]

Component Evolution

Vue Defect RATL200001363 (10012065,CHARM_BRE@RATL2)

Submission | Analysis | Decision | Realisation | Verification | Closure | Hierarchical Links | Clone Link

Capacité (free_field_choice_03) : [RNG-Acquiesce et exploiter les images radar]

Sous-Capacité (free_field_choice_04) : [RNG-08 Lancer et afficher une acquisition (DAB)]

Chaîne Fonctionnelle : [RNG-0103 Lancer l'acquisition d'une image DAB]



Tooling support

Managing increments with Capella

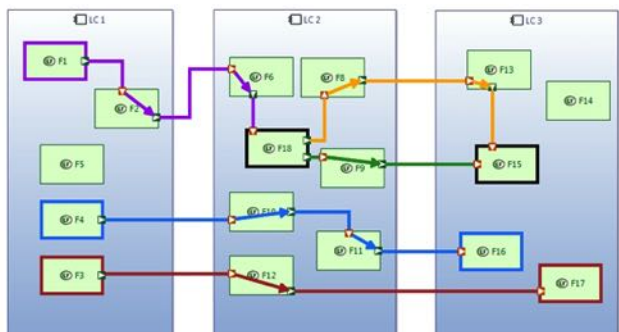


Associate functional chains to increments

Compute, visualize and compare the footprints
in terms of expected components and functions

Focus on the dedicated tooling

Global architecture



- FunctionalChain 5
- FunctionalChain 4
- FunctionalChain 2
- FunctionalChain 3
- FunctionalChain 1

RV 1 expected content



[Requested Version] RV 1

Elements

To add an element to this version, drag it from th

Element	Correction
FunctionalChain 3	
FunctionalChain 4	
FunctionalChain 5	

RV 2 expected content



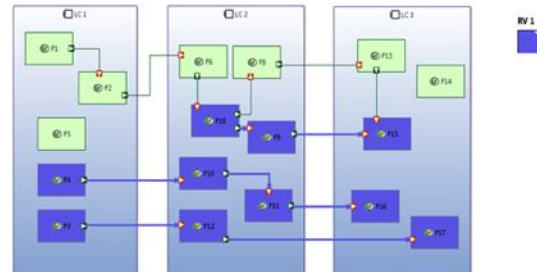
[Requested Version] RV 2

Elements

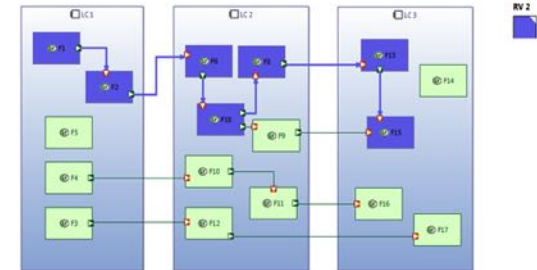
To add an element to this version, drag it from tl

Element	Correction
FunctionalChain 1	
FunctionalChain 2	

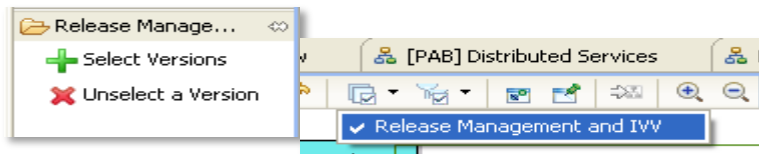
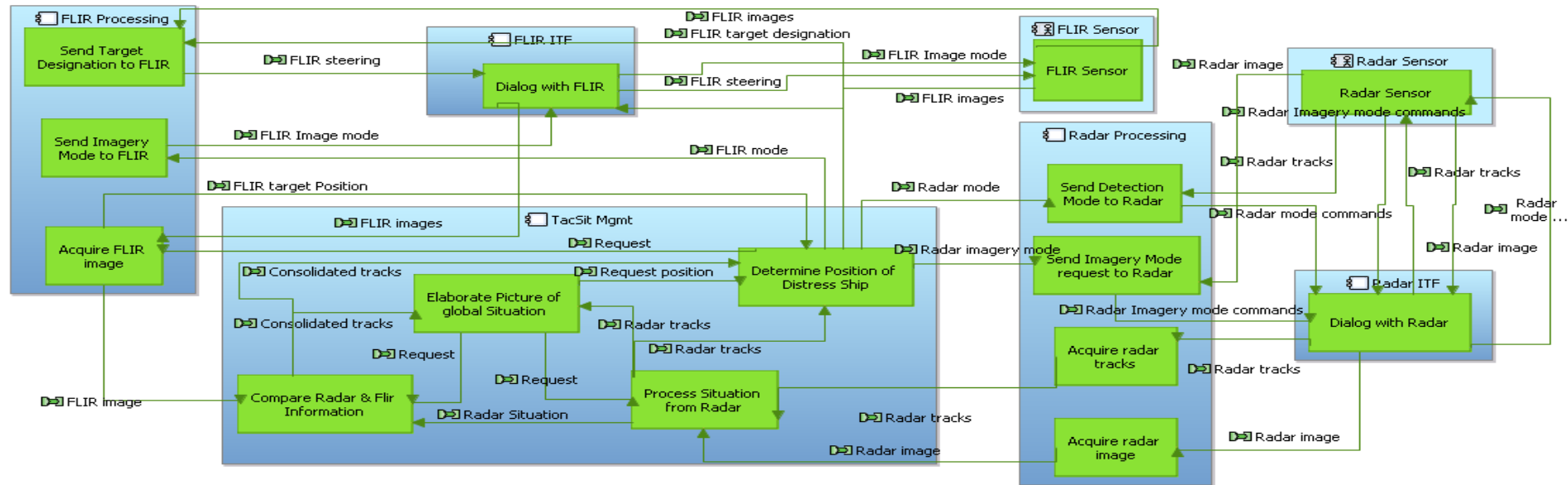
REV 1 footprint



REV 2 footprint



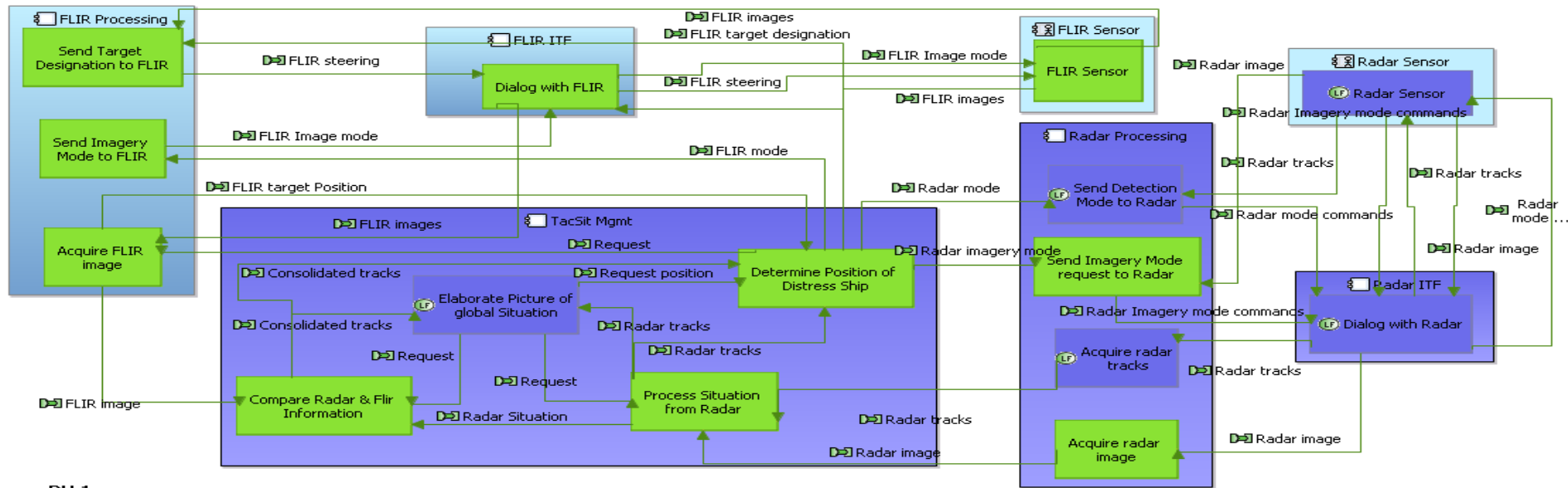
Preview of functional increments footprints



Release management viewpoint:
Automated visualization of versions



Preview of functional increments footprints



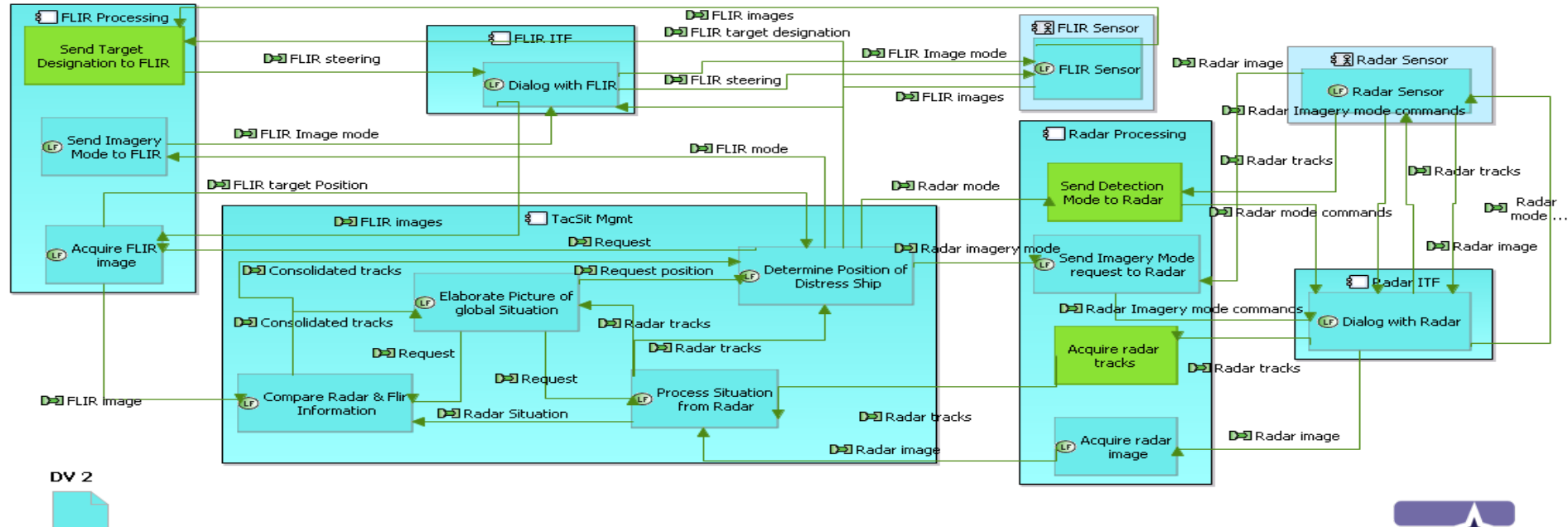
DV 1

Developed Version 1
Available elements in BLUE



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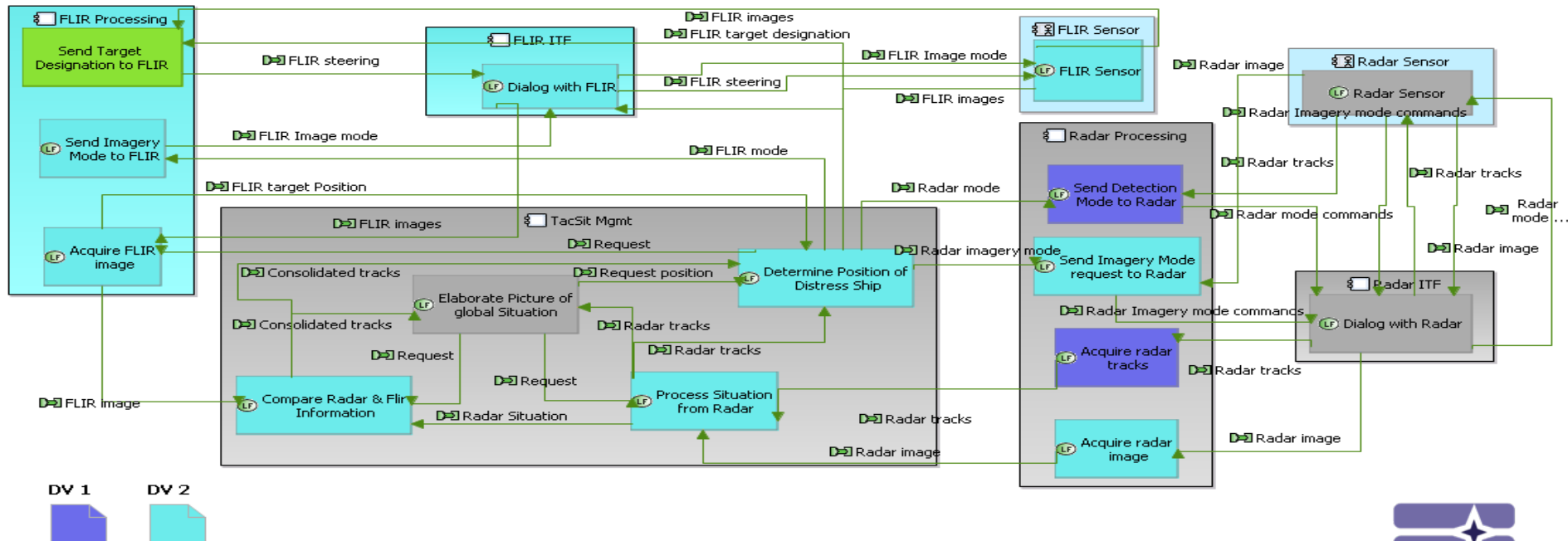
Preview of functional increments footprints



Developed Version 2
Available elements in CYAN



Preview of functional increments footprints



Developed Versions 1 & 2
Common available elements in GREY





Resources

Public forums, webinars and Youtube channel

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Admin: | [Reported Messages \(5\)](#) | [Custom Avatar Queue \(2\)](#) | [Group Manager](#)

[Home](#) » **Capella**

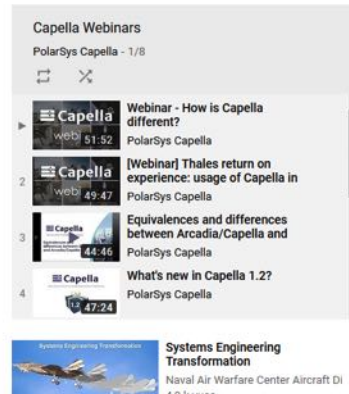
Forum	Messages	Topics	Last message
Capella - Capella Modeling Workbench and Arcadia MBSE Method - Click +/- to expand/collapse			
 General information Latest news about Capella Moderators: Michel.BISPO benoit.langlois.thalesgro	171	65	Mon, 29 October 2018 By: stephane.lacrampe.obeo.fr ⚡
 Arcadia The Arcadia model-based engineering method Moderators: Michel.BISPO benoit.langlois.thalesgro	214	50	Wed, 21 November 2018 By: xurenfei.glaway.com ⚡
 Capella workbench Any tool-related question, suggestions, problem, etc Moderators: Michel.BISPO benoit.langlois.thalesgro	1625	363	Thu, 06 December 2018 By: zhangtonghui.glaway.com ⚡
 Capella Studio Capella Studio related questions. Moderators: Michel.BISPO benoit.langlois.thalesgro	296	85	Mon, 03 December 2018 By: yvan.lussaud.obeo.fr ⚡

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<https://polarsys.org/forums/index.php/f/10/>



Webinar - How is Capella different?



<https://www.youtube.com/playlist?list=PLfrEYVpSGVLxEFR ODSWUTP8N5i3NTG4o->

Capella website



ARCADIA METHOD ▾

WORKBENCH ▾

SERVICES

COMMUNITY

CONTACT

DOWNLOAD

OPEN SOURCE SOLUTION FOR MODEL-BASED SYSTEMS ENGINEERING

Comprehensive, extensible and field-proven MBSE tool and method
to successfully design systems architecture

<https://polarsys.org/capella/index.html>



CapellaDay

MUNICH 2019

bit.ly/CapellaDay2019
Sept. 16th 2019



Thank You! Questions?

Capella website:

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

LinkedIn 

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

Twitter 

https://twitter.com/capella_arcadia

Arcadia forum:

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

Capella forum:

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

IFE model & doc.:

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

www.thalesgroup.com

