



Applying UAF and the Airbus MBSE Framework within Future Combat Air System Development

DEFENCE AND SPACE

Lalitha Abhaya, Dr. Dominique Ernadote, Dr. Jörg Wirtz

AIRBUS

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1. Context
 - a. Airbus Defence & Space & FCAS
 - b. Digital Collaboration in FCAS
2. Rationale for using both frameworks
 - a. According to the main frameworks objectives: SoS versus System levels
 - b. Company SE guidelines versus customer requirements on deliverables(FR GE Spain MODs)
 - c. UAF for Mission, Operational and Services architecture
 - d. MOFLT for low-level systems details including simulation
3. Challenges & solution approach
 - a. Several metamodels ==> how to mitigate the confusion of modelers, readers, reviewers?
 - b. How to ensure the consistency btw models in different frameworks?
 - c. Multiformat deliveries versus 1 source model: the need for interoperability standards
4. MBSE and extended enterprise : EUREcA
- 5 conclusions and outlook.



WHAT WE DO?

**PIONEERING SUSTAINABLE
AEROSPACE FOR A SAFE
AND UNITED WORLD.**

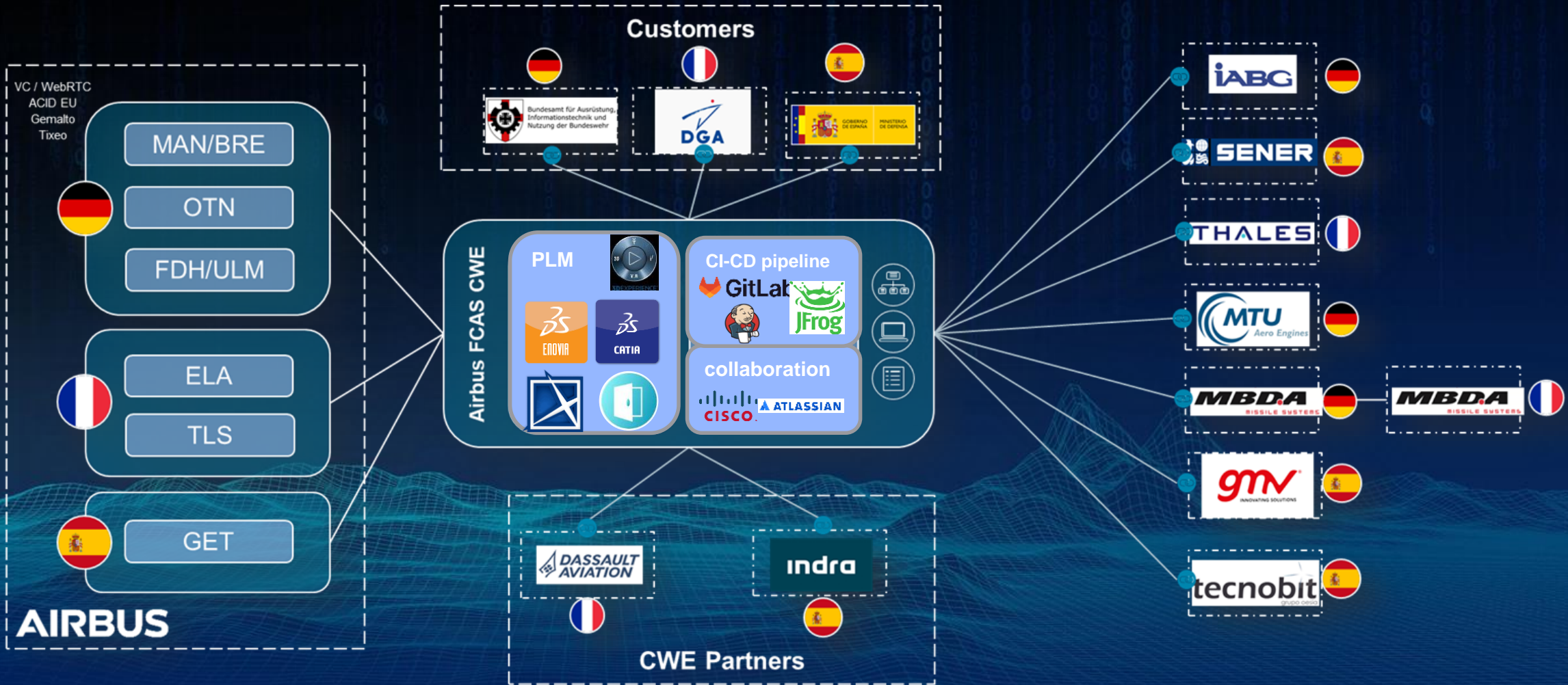
Airbus always has been at the forefront of innovating new technologies, with a pioneering spirit that has redefined the aerospace industry. Our products bring people closer together, helping them unite and progress. We strive to continually push the boundaries on what is possible to safeguard our world for future generations.

1 FCAS: THE System of Systems Project

Beyond the capabilities and behaviors of each system (vehicle), the capabilities and behaviors of the **connected systems** define the performance of the mission.



3 FCAS Common Working Environment (CWE)

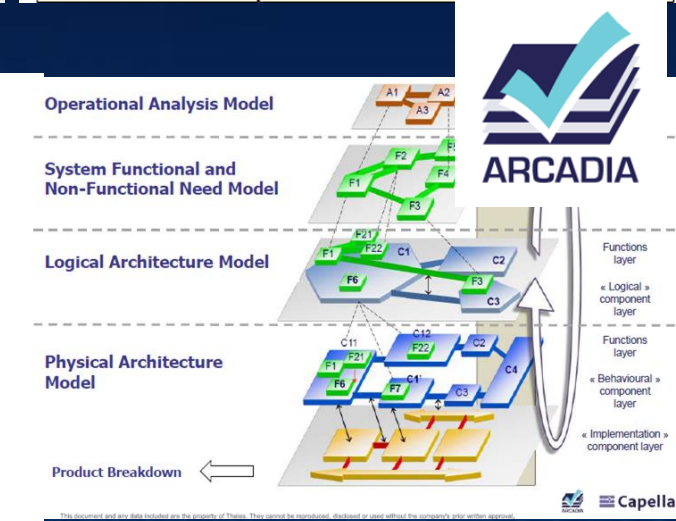
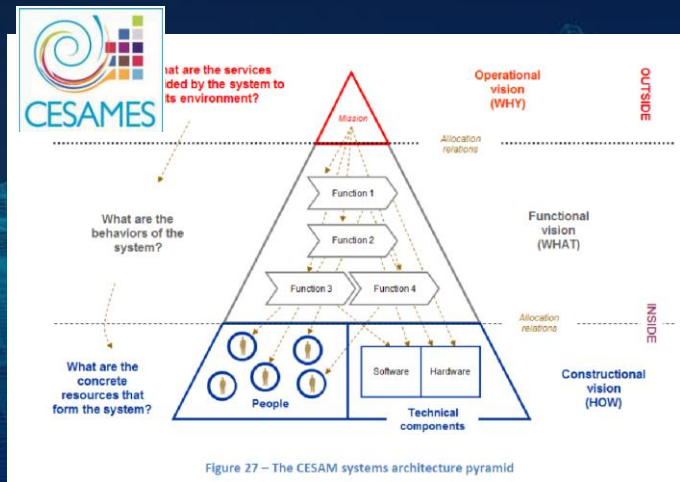
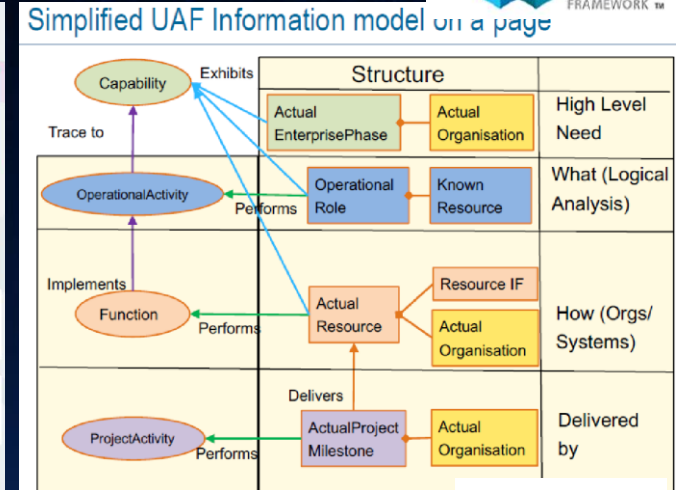
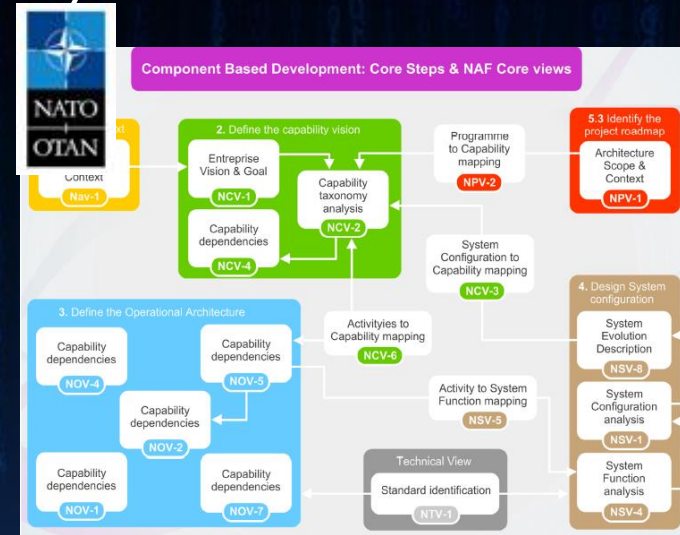


FCAS collaboration between System Development partners based on a military restricted cloud.

The Needs for Multiple Complementary Architecture Frameworks



- Typical architecture frameworks (AF's) as defined by ministries of defence (NAF, MODAF, DODAF and now UAF adopted by OMG) provide precise semantic constructs especially for **capability acquisition**.
- Being a relevant concern at the level of **system of systems (SoS)**, the needs are more oriented towards to **physical aspects** as far as we dive into the system details.
- As a conclusion **Airbus DDMS decided to develop an autonomous but still complementary Systems Engineering Framework (MOFLT)** on the base of SysML taking best breed from other analyses AF.

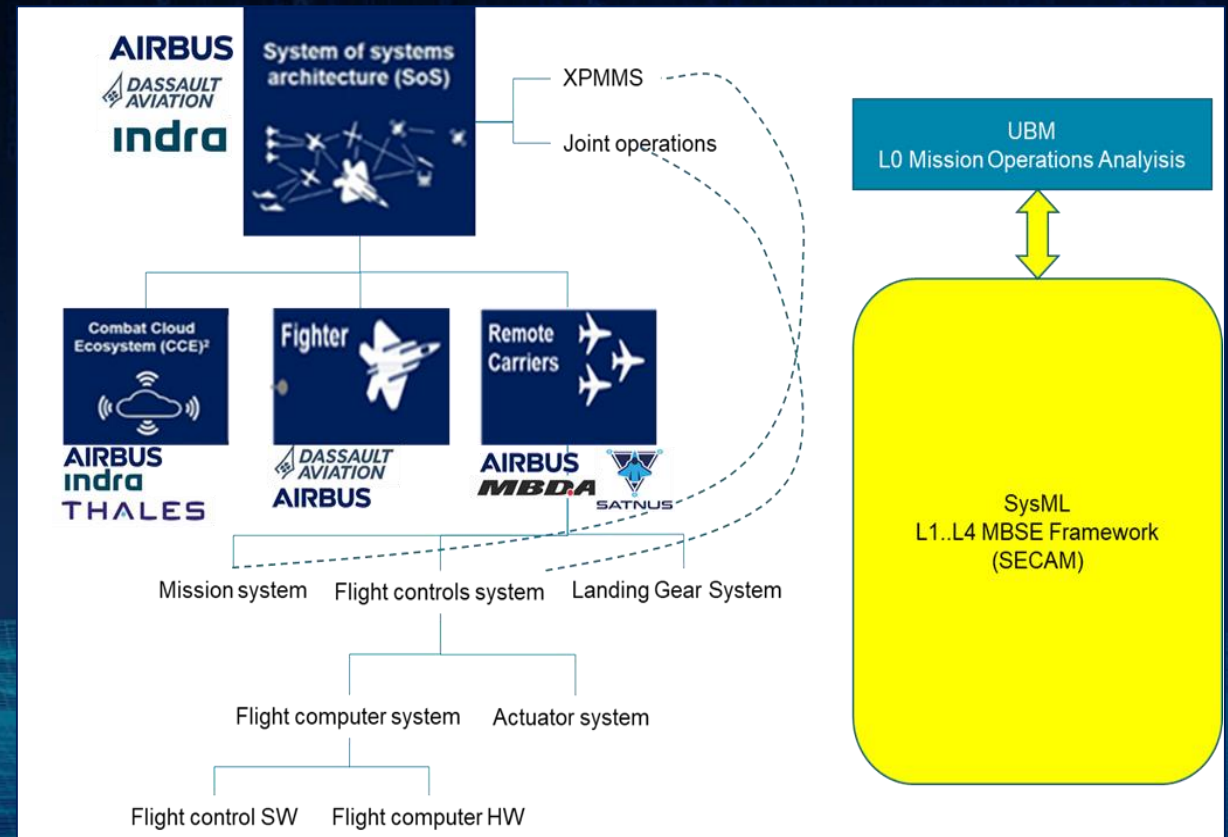


Combined usage Airbus MBSE Framework and UAF

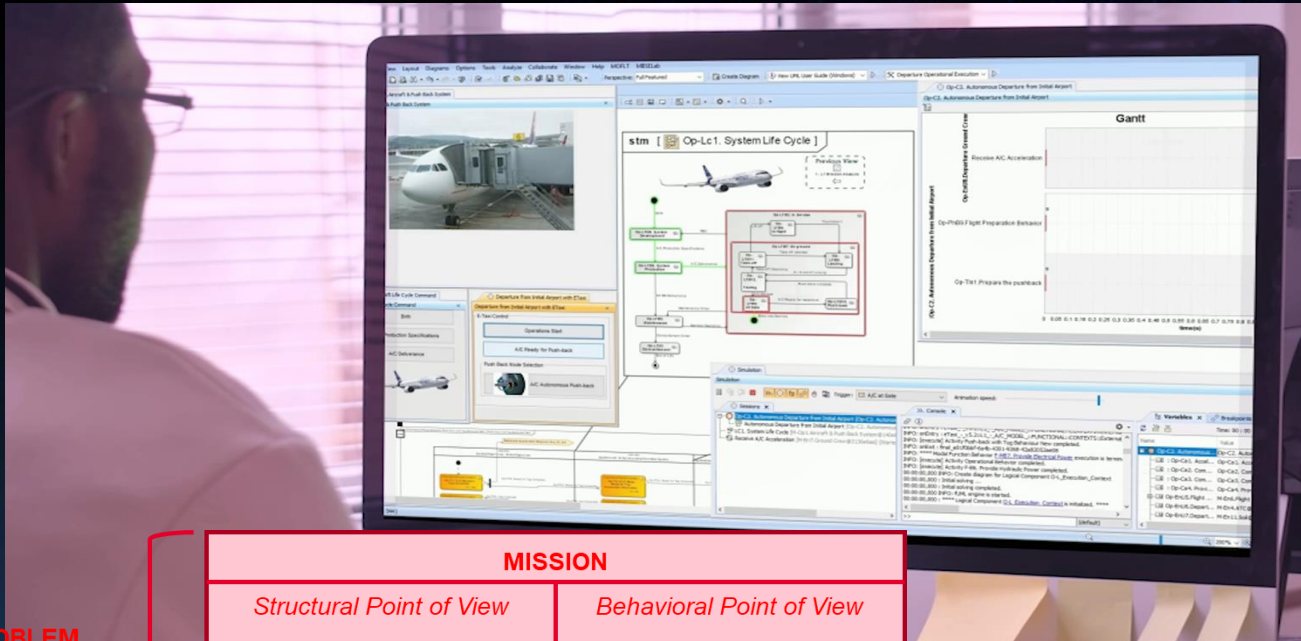
Since the customers expect the System of Systems Level (L0) of FCAS to be delivered as NAF models in different versions, it was decided to use the UAF profile.

However on the System design levels (L1, L2...) the usage of the Airbus MBSE Framework (MOFLT) is preferred in order to take advantage of the advanced modelling capabilities on the F,L,T view and link into the 3D Experience platform and take advantage of the parametric modelization and link into simulation tools.

As a consequence the challenge comes up to ensure a model consistency between the UAF and MBSE Fmk model.




3 The Airbus MBSE Framework (MBSE Fmk)



PROBLEM SPACE

SOLUTION SPACE

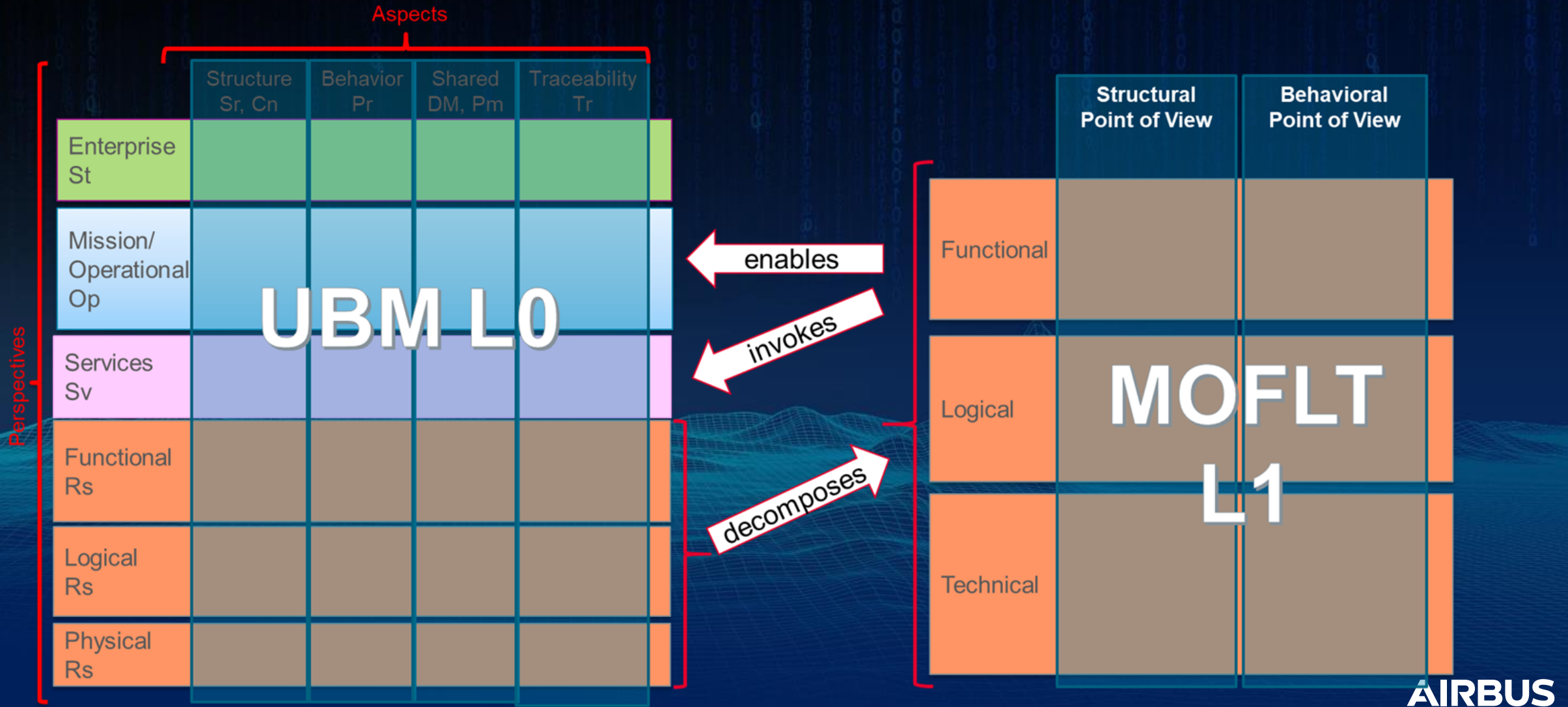
MISSION	
<i>Structural Point of View</i>	<i>Behavioral Point of View</i>
OPERATIONAL ARCHITECTURE	
<i>Structural Point of View</i>	<i>Behavioral Point of View</i>
FUNCTIONAL ARCHITECTURE	
<i>Structural Point of View</i>	<i>Behavioral Point of View</i>
LOGICAL ARCHITECTURE	
<i>Structural Point of View</i>	<i>Behavioral Point of View</i>
TECHNICAL ARCHITECTURE	
<i>Structural Point of View</i>	<i>Behavioral Point of View</i>

- **Method:** Tool & Language agnostic / Based on SE technical Processes
- **Handbook:** Tool : CAMEO & Language : SysML / Based on Method
- **Plugin:** CAMEO  customization aligned with Handbook & SysML implementation of SECAM
- **Example:** illustration of Method & Handbook application on a concrete example
- **Training :** Presentation & Application of the MOFLT framework on a case study

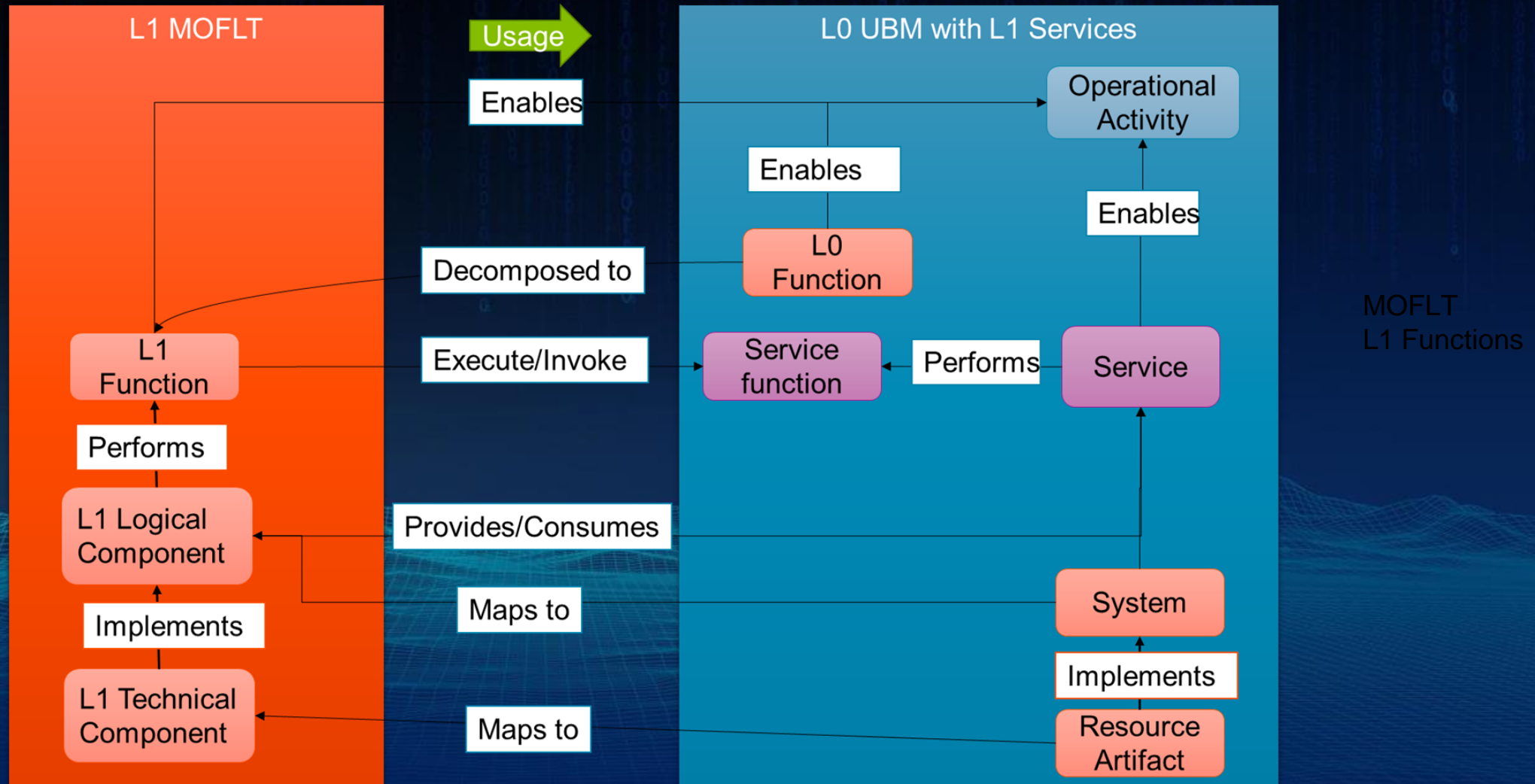
UBM Grid and related NAF 3.1 Views

		Aspects				
		Structure Sr, Cn	Behavior Pr	Shared DM, Pm	Traceability Tr	
Perspectives	Strategic St	NCV-1 NCV-2 Goals, Capabilities		KPI, Requirements	NCV-6 Capability x Op Activity Capability x Op Performer	Capabilities are required to achieve goals
	Operational Op	NOV-1 NOV-2 NOV-4 Operational Performers	NOV-5 NOV-6b Operational Activities	NOV-3 Operational Information, MoE, Constraints, Requirements	Operational exchanges consistency	Capabilities are provided by Op Performers/Op activities
	Services Sv	Services NSOV-2	Service Functions		Op Activity x Service NSOV-4	Op Activities are enabled by the Services
	Functional Rs		NSV-4 NSV-10b Functions	NSV-11 NSV-7 Data, MoP, Constraints, Requirements	Op Activity x Function NSV-6 Functional exchanges consistency	Op Activities are enabled by the Functions
	Logical Rs	Interfaces NSV-1 Systems			Function x System NSV-3	Functions are implemented within Systems
	Physical Rs	Resource Artifacts NSV-1			System x Resource Artifact NSV-3	Logical Structures are realized by the Physical Structures

Transition from UBM L0 (SoS) to MBSE Fmk L1 (System)



Traceability between UBM model elements with MBSE Fmk elements



Traceability between UBM model elements with MBSE Fmk elements

Example 1
 MOFLT L1 Functions to
 the UBM L0 functions in
 L0 SoS

The screenshot displays a software interface with two main panels. The left panel, titled 'Containment', shows a hierarchical tree structure. At the top is 'CAMEO-project', followed by 'Model'. Under 'Model', there are 'Relations' and two sub-models: 'FoFIMS UBM Model' and 'UBM RCFFT SoI Model', both highlighted with pink boxes. Below these are 'RMOFLT - L1 USS' and '27 L1 - UAV Surveillance System'. The '27 L1' system is expanded to show '27.4 FUNCTIONAL' and '27.4.4 FUNCTIONS'. Under '27.4.4 FUNCTIONS', there are 'Relations' and three matrices: '1 - Functions Definition Table', '2 - L1 Functions to L0 Standard Functions Realization Matrix', and '3 - L0 SoS Collaborative Functions to L1 Functions Traceability Matrix', which is highlighted in blue. The right panel shows a 'Criteria' section with 'Row Element Type: Function', 'Row Scope: Functional Architecture', and 'Dependency Criteria: Trace'. Below this is a 'Legend' section with a 'Trace' icon and labels for 'MOFLT L1 Functions' and 'UAF L0 Functions'. At the bottom, a table titled 'L1 Fire Monitoring & Controls' lists various functions like 'Analyze images & capture data' and 'Assess damages', with columns for '2' and '1'.

Traceability between UBM model elements with MBSE Fmk elements

Example 2
 MOFLT OTR to the
 UBM Operational
 activities in overall
 LO SoS

- 27 L1 - UAV Surveillance System
 - 27.1 REQUIREMENTS
 - 27.2 MISSION
 - 27.3 OPERATIONAL
 - 27.4 FUNCTIONAL
 - 27.4.1 OPERATIONAL TASK REALIZATIONS
 - 27.4.2 CONTEXTS
 - 27.4.3 ARCHITECTURE - SOI
 - 27.4.4 **FUNCTIONS**
 - 27.4.5 FUNCTION BEHAVIORS
 - 27.4.6 INTERFACE TYPES
 - 27.4.7 FLOW TYPES
 - 27.4.8 OPERATIONAL to FUNCTIONAL Transition
 - 1 - OTR to OT Realization Matrix
 - 2 - Operational Flows to Functional Flows
 - 3 - OTR to OA Realization Matrix [custo]
 - 27.4.9 CLASSIFICATIONS & CATEGORIES
 - 27.5 LOGICAL
 - 27.6 TECHNICAL
 - 27.7 [BETA] PARAMETRIC ANALYSIS
 - 27.8 ACRONYMS & TERMS
 - 27.9 HELPERS

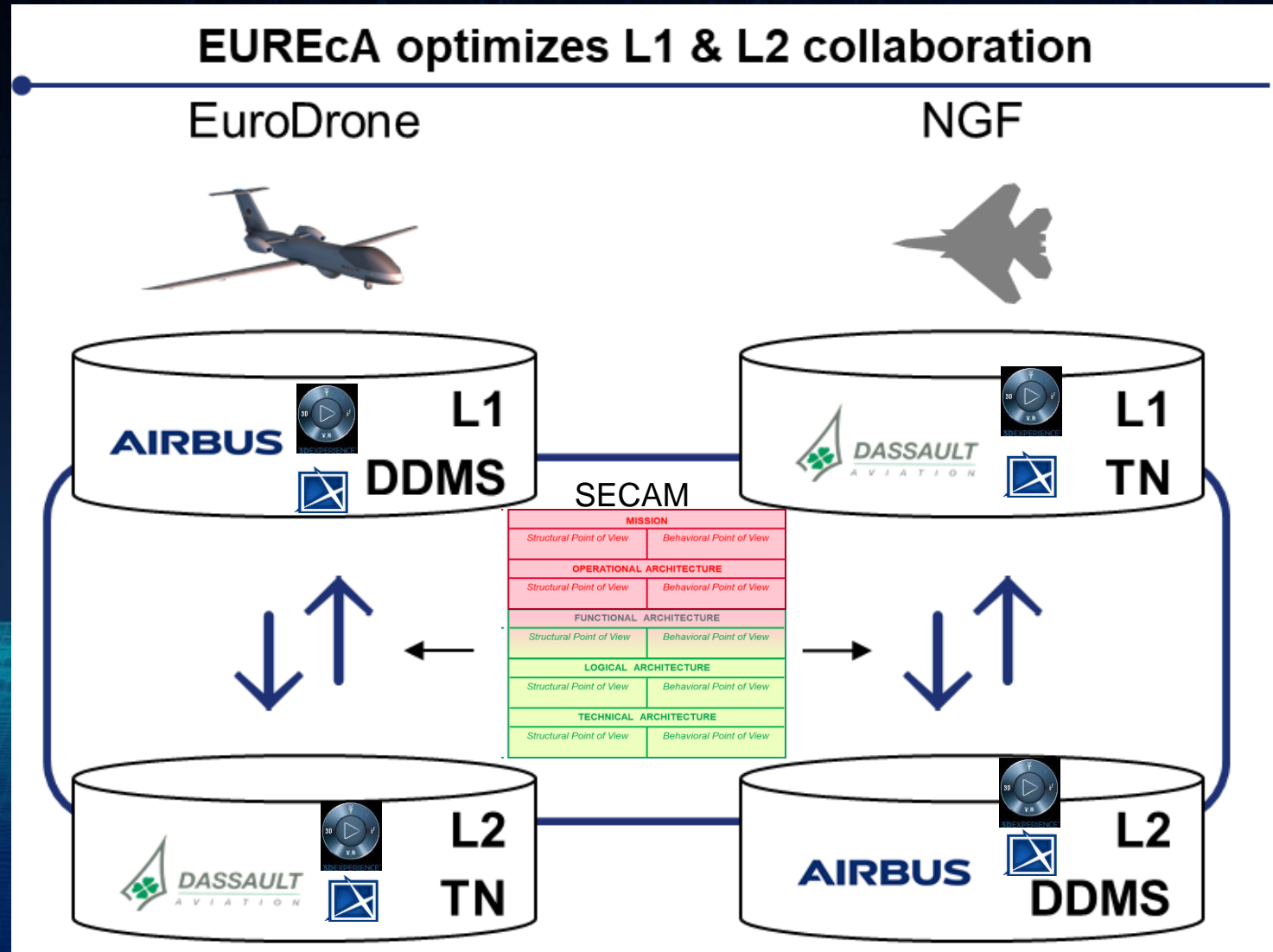
UAF

MOFLT

	Acknowledge mission task	Acknowledge the area of interest	Activities that can be deleted	Coordinate with ATC	Execute surveillance flight plan	Generate report	Launch intervention	Merge search findings	Monitor surveillance task	MW1 OPlan Activities	Perform search task	Process request	Provide feedback	Provide flight status	Provide observation data	Receive feedback	Receive observation data	Receive order	Request observation data	Review Observation Data	Search area	Task assets	Task search	Task surveillance assets	Transmit search findings	Validate request	Visualize observation data types
27.4.1 OPERATIONAL TASK REALIZATIONS	1	1		1	2						1	2	2	1			1	1			1			1			
OTR1 - Check a perimeter	5																										
OTR2 - Fly to the target perimeter to control	5																										
OTR3 - Initiate an observation flight	5																										

3 the EUREcA approach with Dassault aviation

- **EUR**opean **E**cosystem for **A**erospace & **D**efence is a joint initiative between Dassault Aviation and Airbus with Dassault Systemes to provide 3D Experience PLM solutions
- Agreed Data Model SECAM with Dassault Aviation for Eurodrone and FCAS Next Generation Fighter
- Aligned common collaboration principles and cross company collaboration architecture
- Application of the EUREcA aligned approaches in Eurodrone and FCAS programs



conclusions & way ahead

Huge systems of systems (SoS) projects involves **multiple contributors and customers** (e.g. MoDs). **Each partner comes with its** own method, tool set, and **frameworks**.

The customers are often **imposing standard frameworks** (e.g. UAF).

Each **AF addresses dedicated concerns**: capability acquisition (UAF), system evaluation (MOFLT), ...

Conclusion: There is a **need to use multiple frameworks**.

However, **global consistency is still to fulfill** and thus traceability mechanisms **shall traverse the different AFs**.

Combining multiple AFs is possible today.
The common **SysML foundations helps** that.

A **particular attention** shall be paid to the **notions overlapping the different AFs**.
The different vocabularies addressing common purposes **could confuse the users**.
Transparent “**translation**” mechanisms are **required**.