

Open Source Tools for Embedded Systems

Introduction to PolarSys and Use Cases

Gaël Blondelle, Eclipse Foundation

Ada Conference, June 2014



PolarSys Working Group

- ✓ Open Innovation to create better methods and tools
- ✓ Software tools for critical systems
- ✓ Interoperability based on Open Standards
- ✓ Foster exchanges between academics and industrial partners
- ✓ Quality and maturity assessment
- ✓ Very Long Term Support for more than 10 years

Technologies

Members

About Us

Component Highlight

TOPCASED migrates to PolarSys

One of the original reasons why PolarSys has been created is for organizing the Very Long Term Support of TOPCASED. Now that PolarSys begins to be operational, it is time to start migrating TOPCASED components to their new home. This migration will occur component by component and step by step: preparation of the source code, adaptation of the dependent plug-ins, code freeze, IP

Events

SAE AeroTech Congress and Exhibition

Date & Time:

September 24, 2013 - 12:00 to September 26, 2013 - 13:00

Join us for the [SAE AeroTech](#) conference in Montreal this September.

[Read more](#)

News

PolarSys talk at SAE Aerotech

Dominique Toupin, from **Ericsson** and **Patrick Farail** from **Airbus**, will present a talk entitled: [More](#)

New Community link

Maybe you have noticed the new [Community](#) item on PolarSys front page? [More](#)

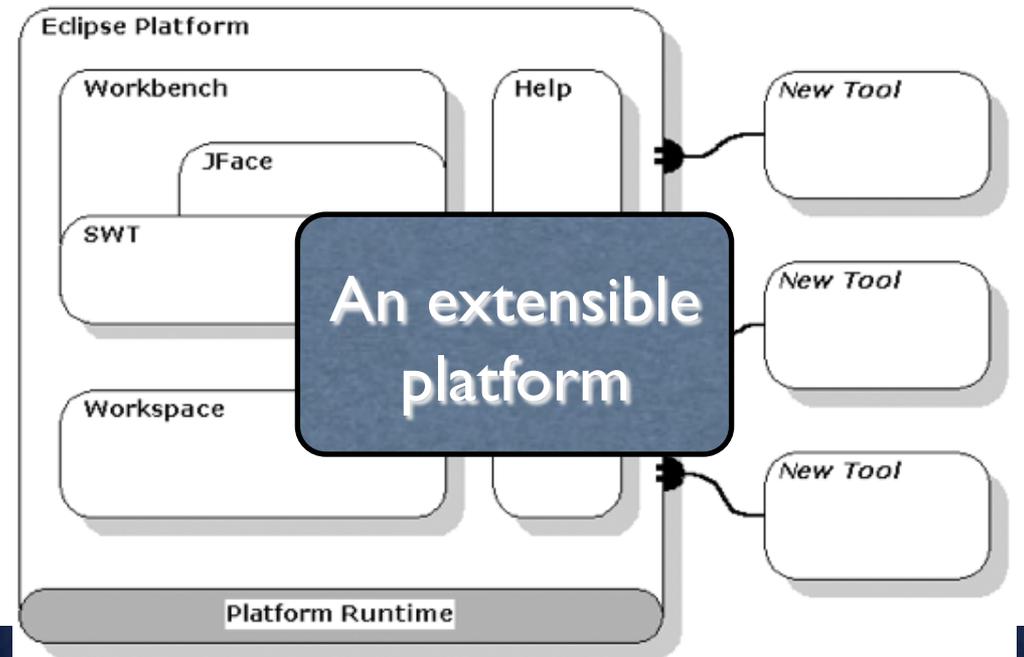
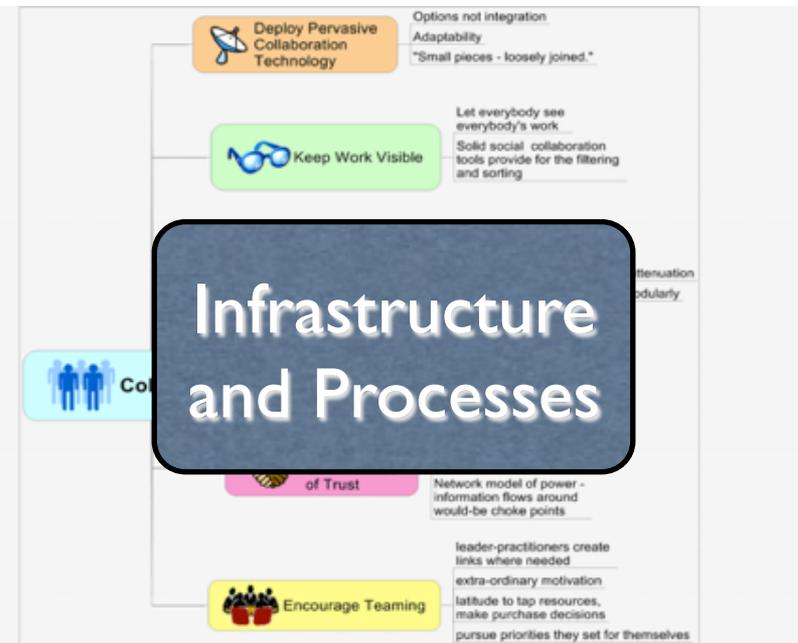
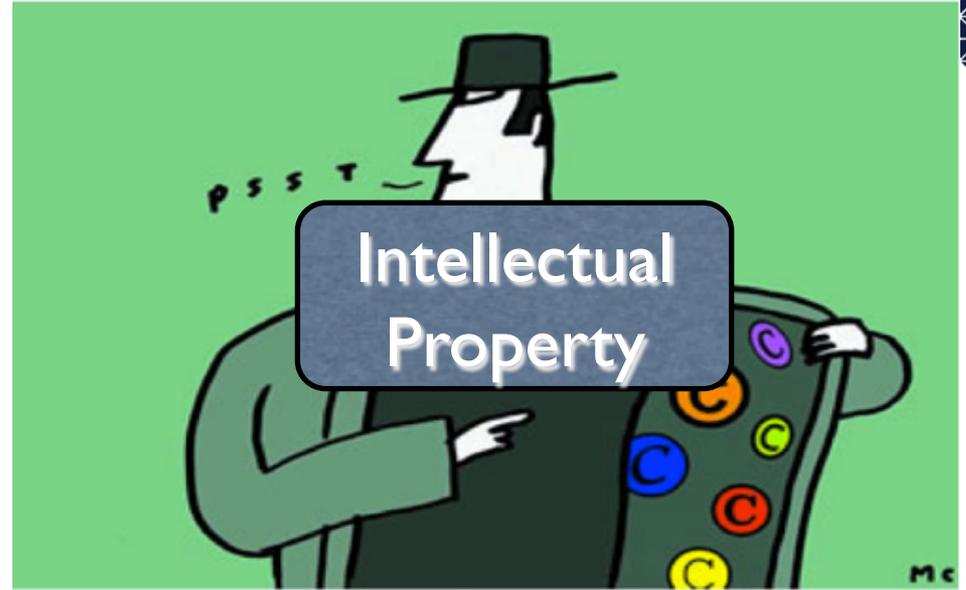


eclipse



History

- 2001 - Eclipse Project by IBM
- 2004 - Rich Client Platform
- 2004 – Independent Organization: Eclipse Foundation
- 2006 - Callisto Release Train
- 2008 - Top Level Runtime Project
- 2009 - Industry Working Groups
- 2013 – Eclipse Foundation Europe GmbH is incorporated



An eco system relying on an extensible platform



- Identify precisely what your competitive differentiators are for your customers
- Focus all possible energies there, and acquire everything else from OSS, or help build it in OSS

**Value
Innovation**

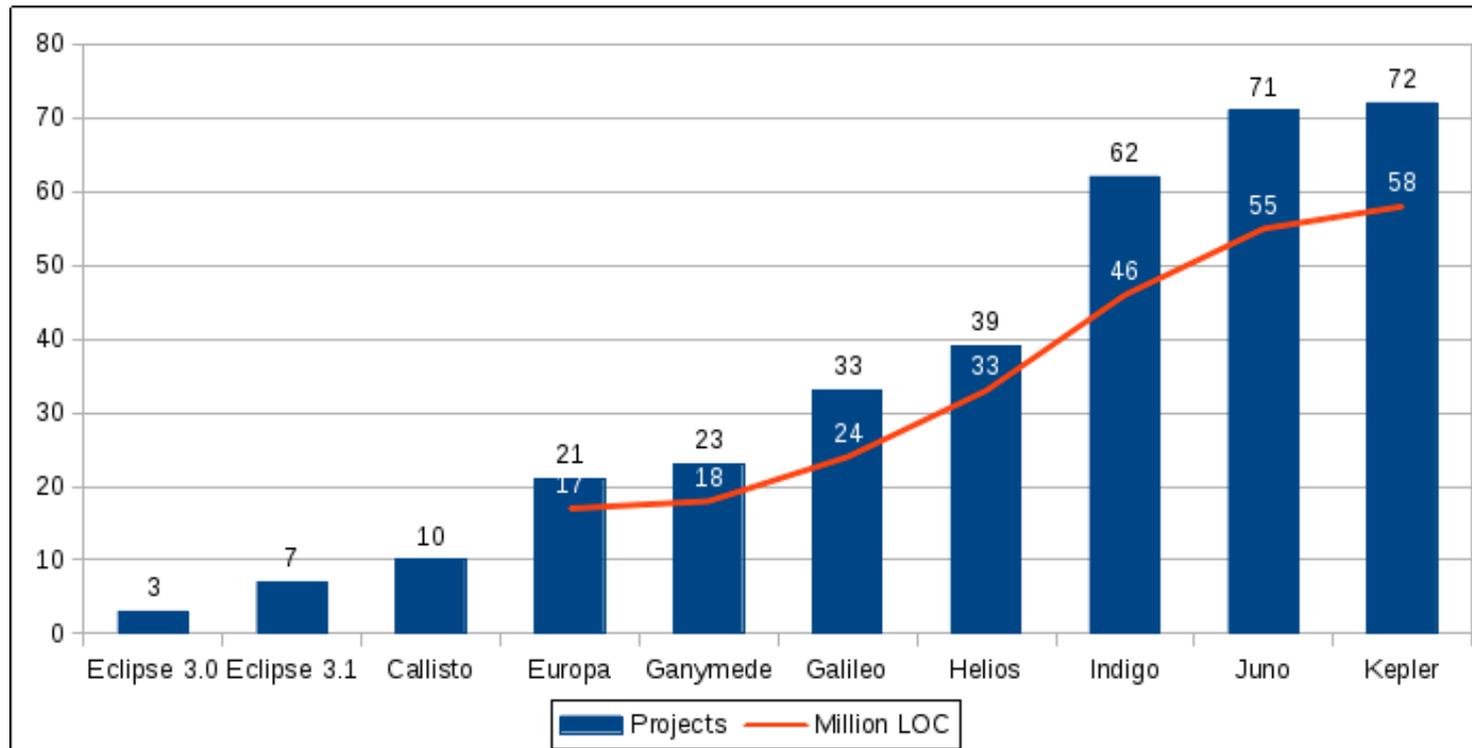
Compete on (commercial) products

Platform

Build this in and with open source, even if that means working with your direct competitors.

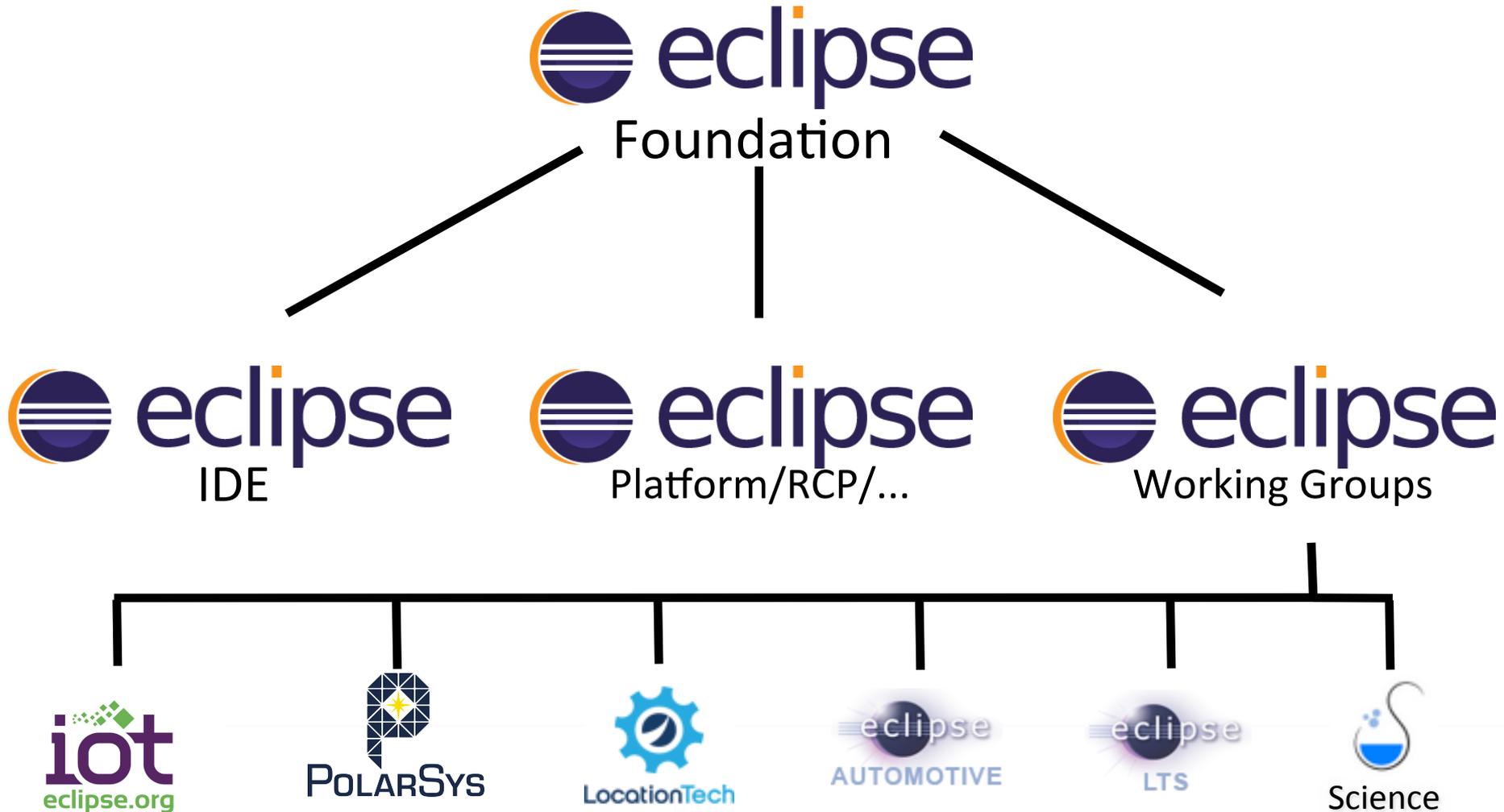


72 Projects, 58 MLOC



**Next release « Luna »
to be launched this Wednesday!**

Eclipse Working Groups





Members of Eclipse





So Eclipse Has...

- Millions of users
- Thousands of products
- One thousand developers
- Hundreds of companies, hundreds of projects
- Predictable schedules
- World class intellectual property management
- ~20 employees



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PolarSys Members (2014/06)



Steering Committee Members



AIRBUS
AN EADS COMPANY

THALES



ERICSSON



Participating members



Atos

COMBITECH



the Brainware company



Academics / Universities

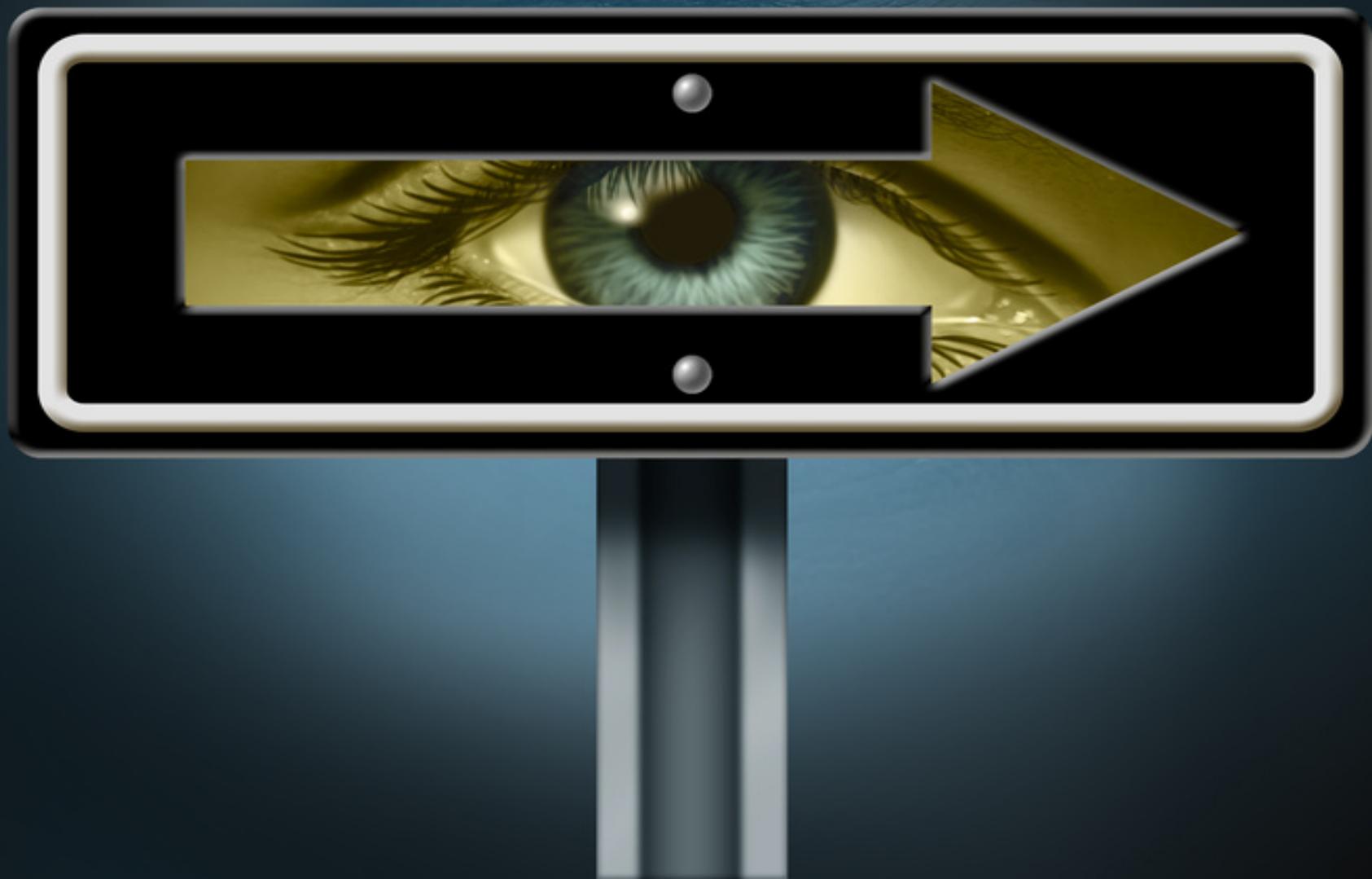


UNIVERSITY
OF SKÖVDE



ÉCOLE
POLYTECHNIQUE
M O N T R É A L

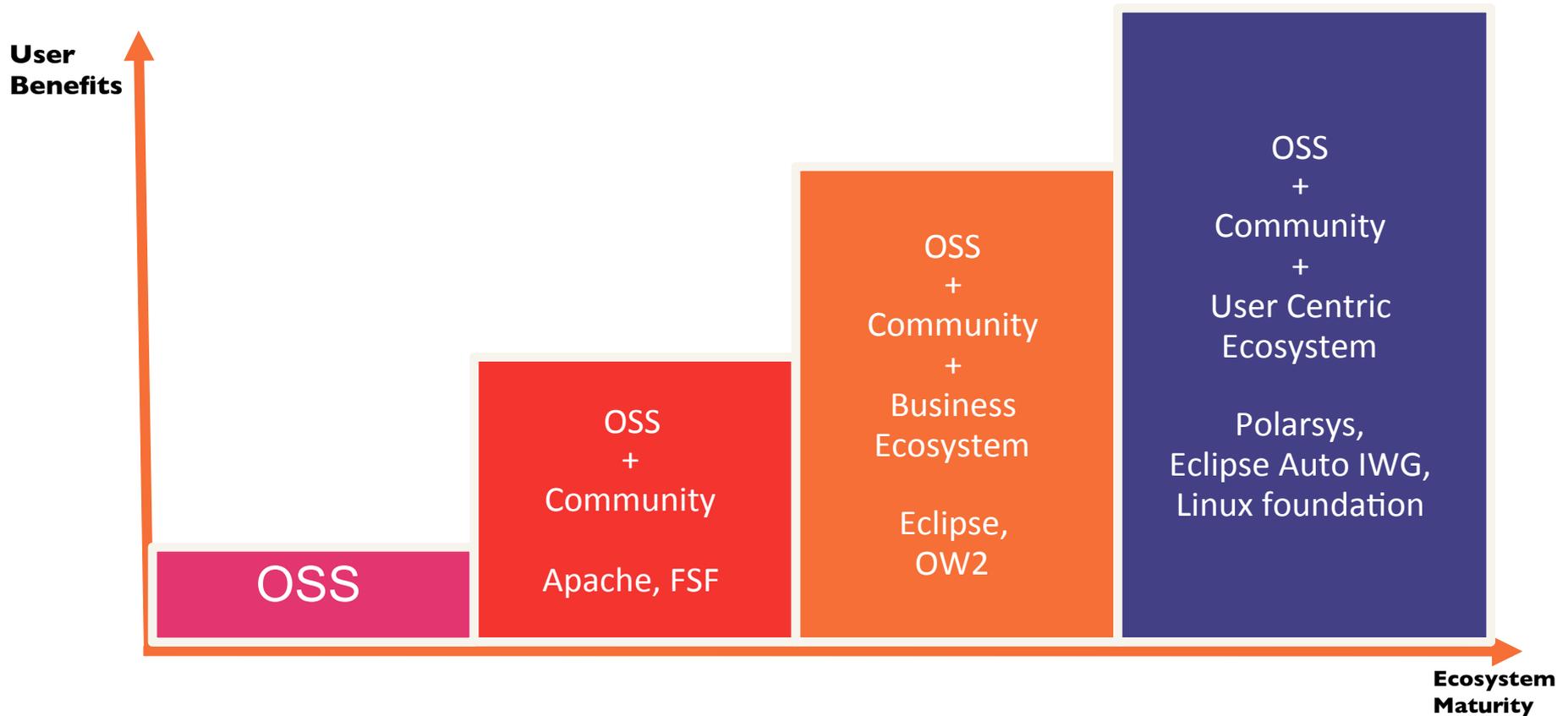
More universities joining



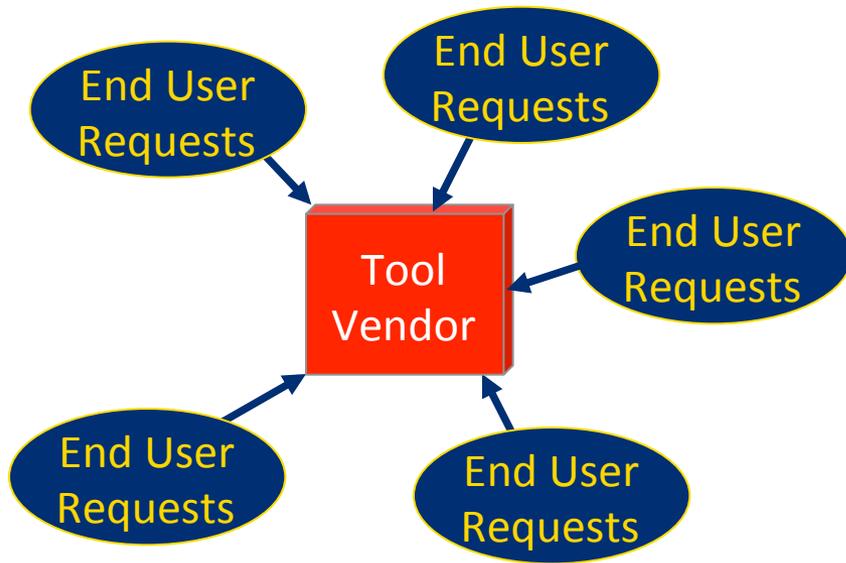


Super communities

New generation of OSS ecosystems



A balanced ecosystem where users Control and Secure their Destiny!



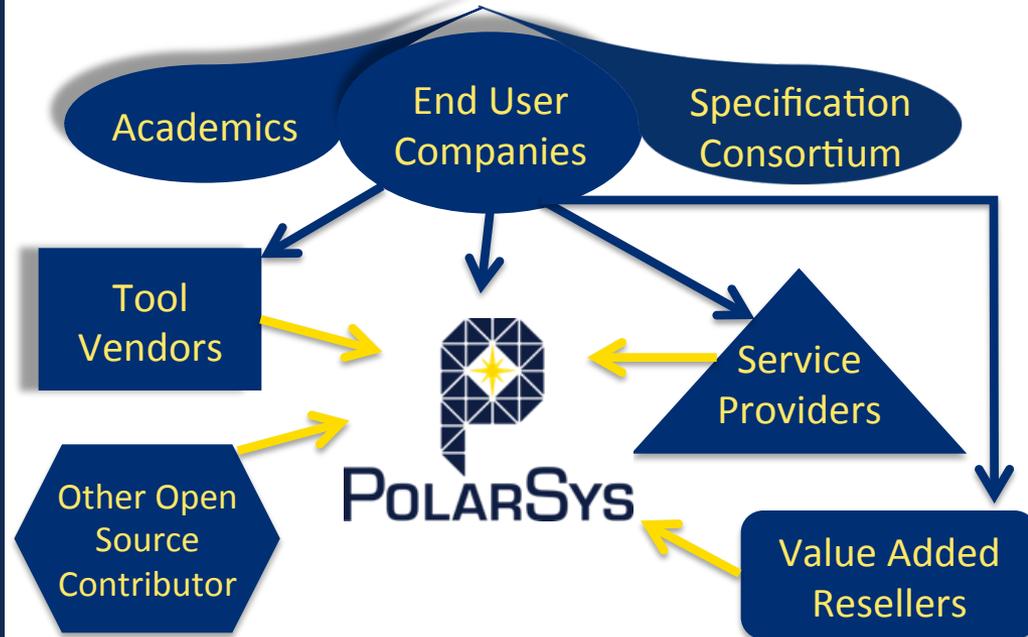
Typically less than **20%** of Requests For Enhancement (RFE) get into the tool



Proprietary Tool Vendor Ecosystem

No lock-in!

You or many third party can add features



100 % of RFE are able to get into the tool
e.g. **80%** generic, **20%** as user extensions



PolarSys Open Source Ecosystem

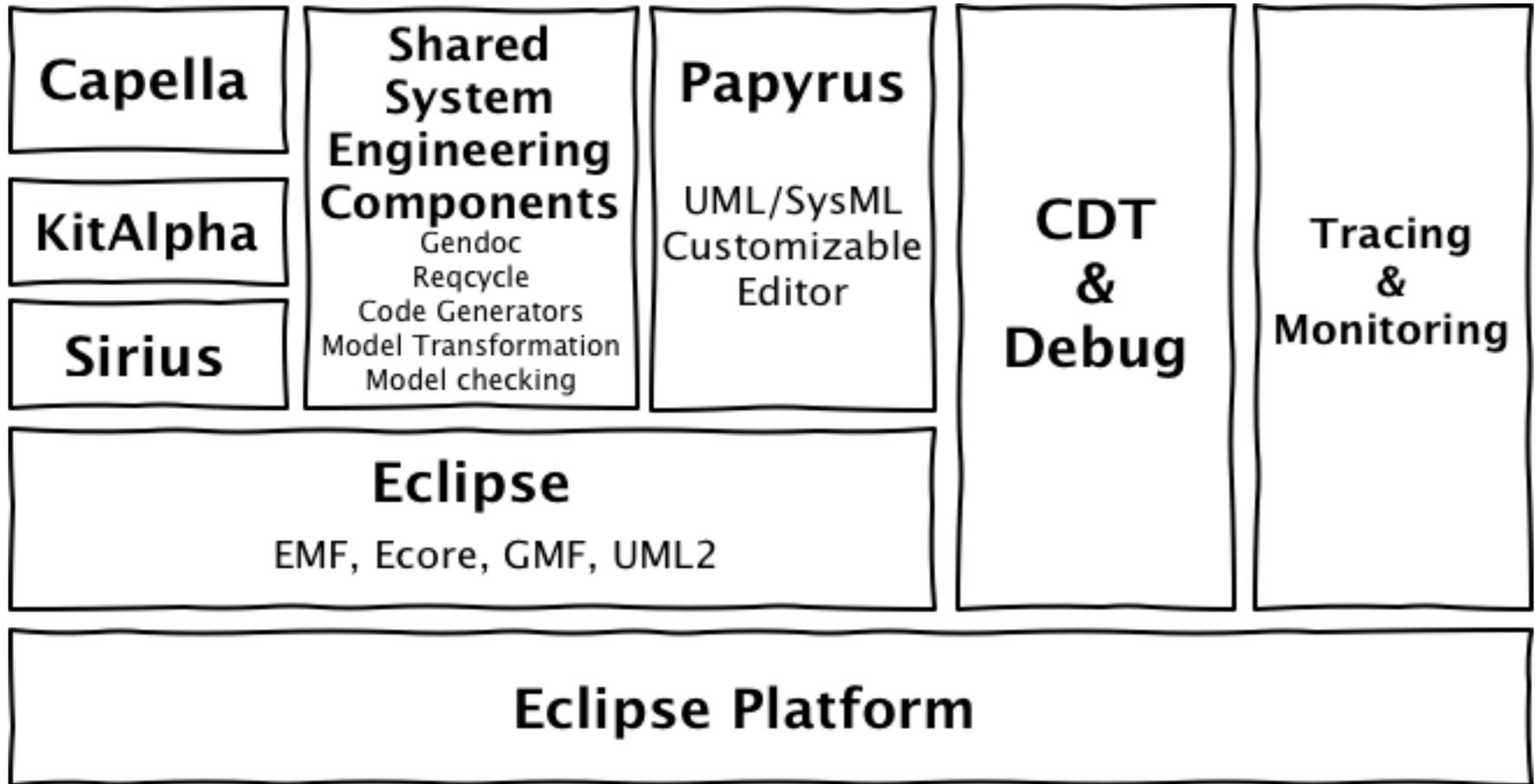


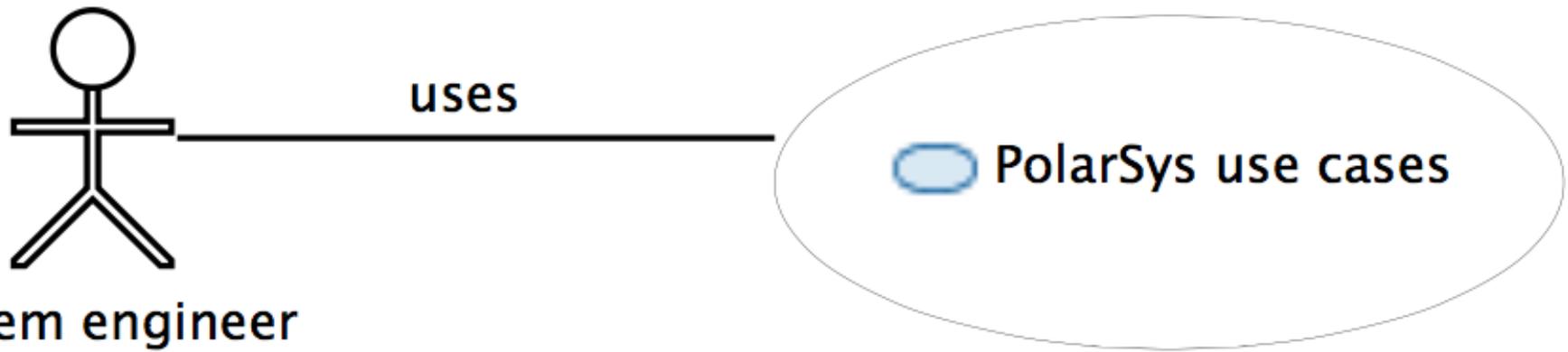
- Automotive
- **Aeronautic**
- **Aerospace**
- **Defense**
- **Energy**
- Health
- **Telecom**
- Railway





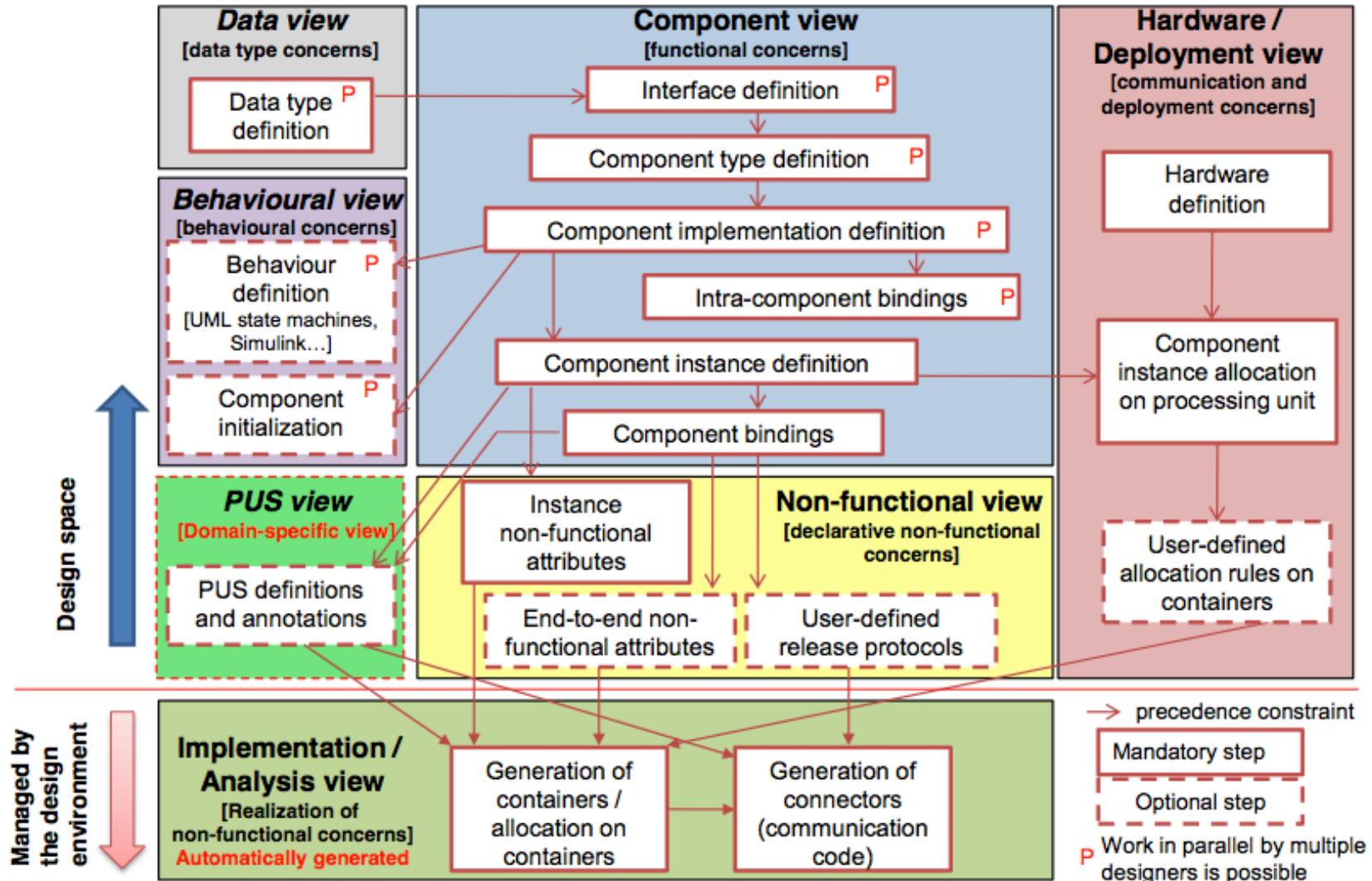
A technology vision





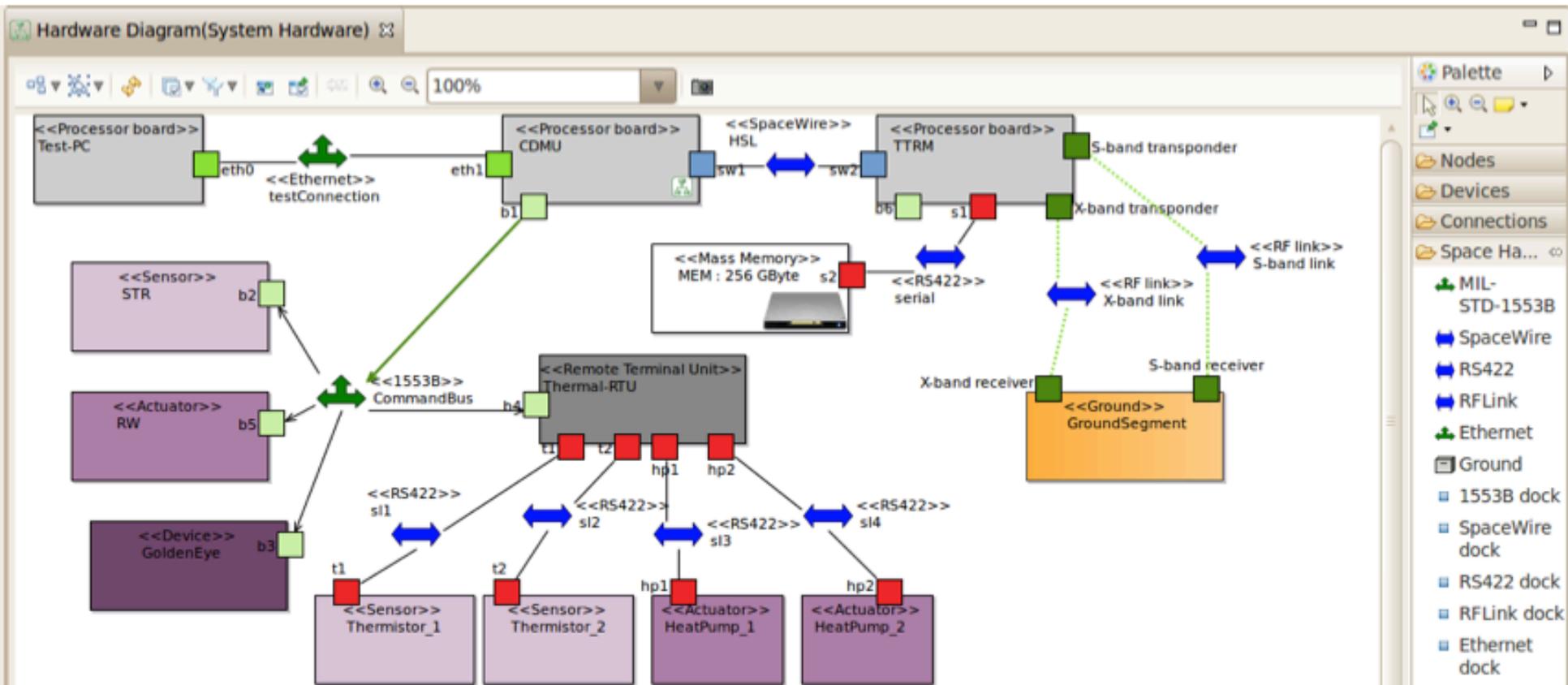
ESA use case: Cordet

Developed by University of Padova



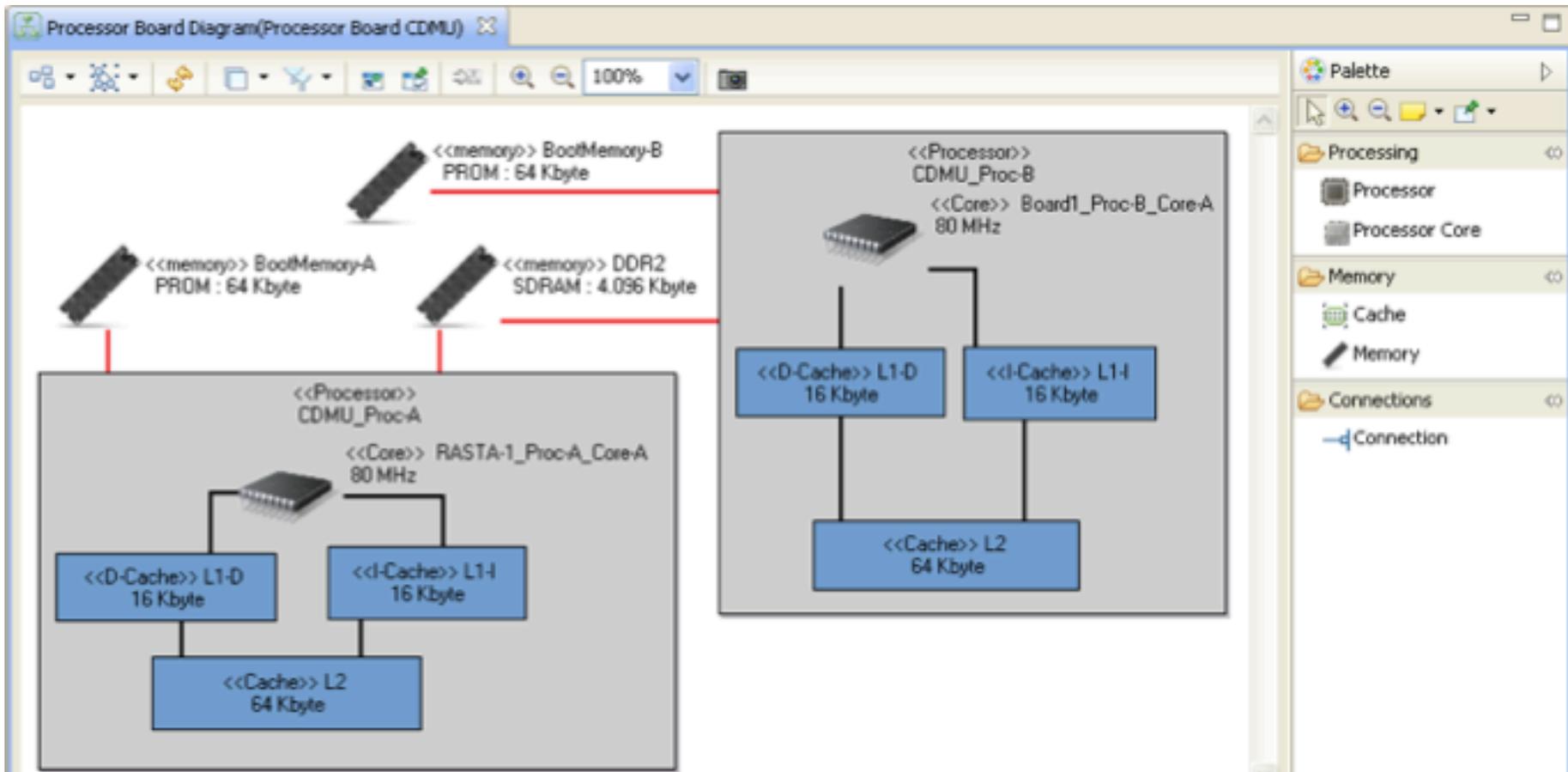


Cordet: Hardware Diagram





Cordet: Process Board Diagram





Chess Goals

Definition of a Multi-Concern Component Methodology and Toolset

- Provide a Multi-Concern Component Modeling Language and a Graphical Modelling Environment that fits multiple industrial domains
- Enable the specification of functional and extra-functional properties of software components
- Integrate tools for the verification of extra-functional properties
- Preserve verified properties at code level and run time



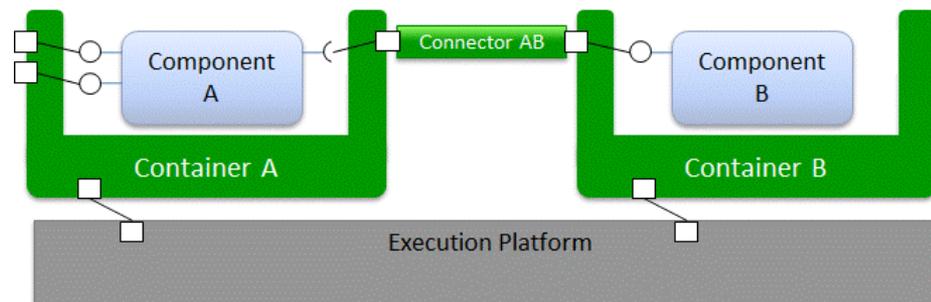
Chess Goals

Adaptation of standards and open sources

- OMG modeling languages
- Eclipse Environment
- Validation through multi-domain industrial case studies

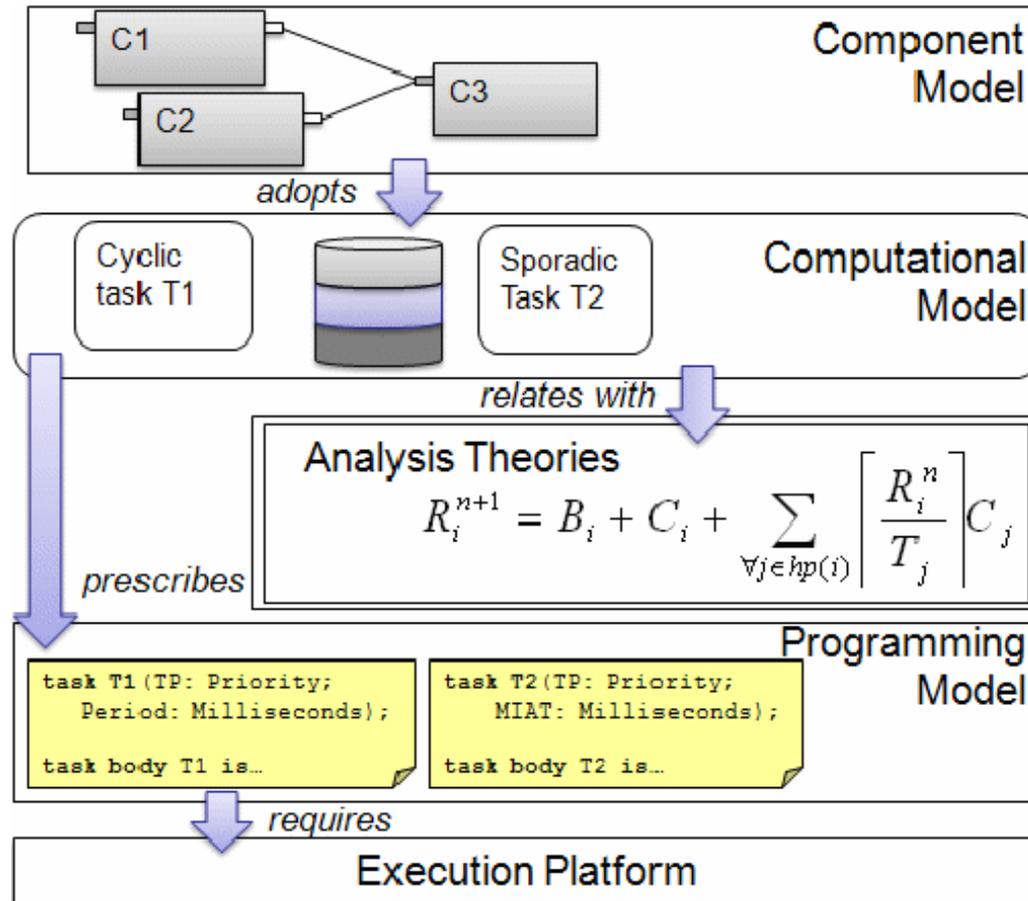
Chess results contributed to PolarSys

Chess Continued by the Concerto project





Chess methodology





Chess modeling tools

Papyrus customization by Intecs and Univ of Padova

The screenshot displays the Eclipse IDE interface with the Papyrus UML editor. The main window shows a UML Component Diagram for 'protectedOperationModel'. It features two abstract components: 'Producer' and 'Store_C'. 'Producer' has a 'Produce()' operation. 'Store_C' has 'Flush()' and 'Store(+ in i: Integer(unique))' operations. Below these are their concrete implementations: 'Producer_impl' and 'Store_impl', both marked as 'statefulSoftware' and implementing the abstract components via 'Realization' relationships.

In the bottom right, a 'Schedulability Analysis Report' dialog box is open, displaying the following data:

The system is schedulable

HW Instance	Utilization	Result
System_CPU0_inst	80.00%	OK

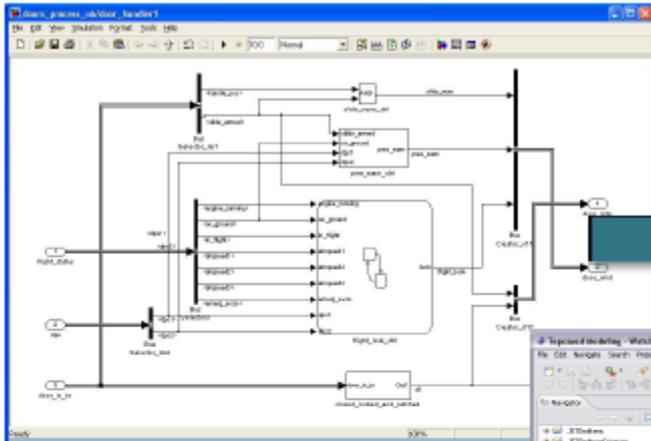
SW Instance	Operation	Response Time	Deadline	Result
SwSystem_Producer_inst	Produce	55.0ms	125.0ms	OK
SwSystem_Consumer_inst	Consume	100.0ms	125.0ms	OK



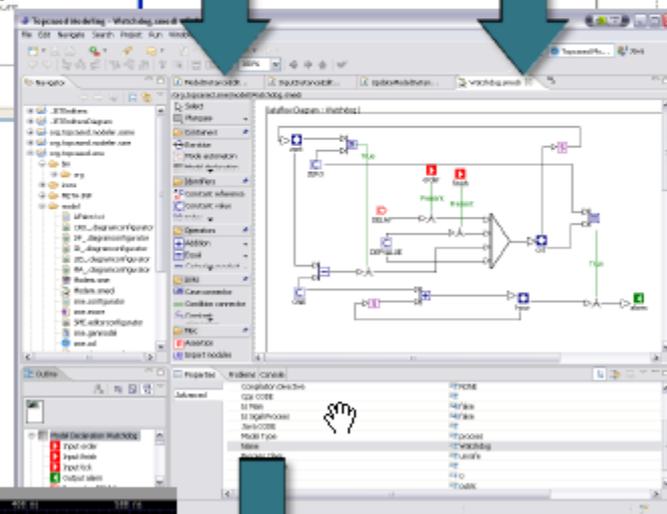
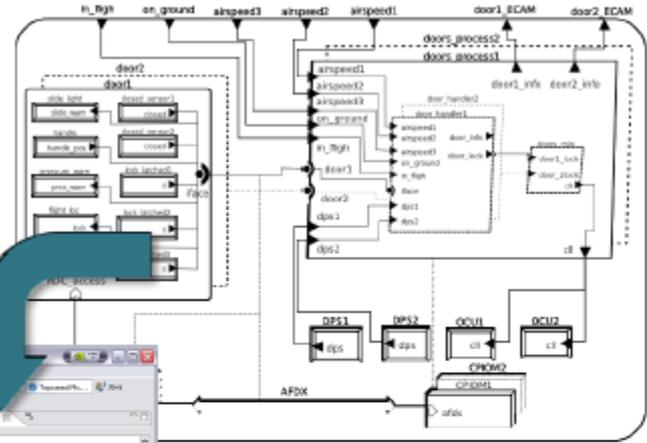
POP

Contributed by Inria

Simulink functional models



AADL architecture model



verification and simulation code generation infrastructure

VCD interface



Co-simulation, profiling, scheduling, verification, performance evaluation



Fast Papyrus customization by Airbus

The screenshot displays the Papyrus software interface for functional analysis modeling. The main window shows a UML diagram with a component box labeled «part» containing a box for «Compute hydro. fluid ctrl. order». This component is connected to data flow ports: an output port labeled «hydro. fluid transmission ctrl. order» and an input port labeled «hydro. fluid pressure ctrl order». A data flow labeled «Mechanical torque» is also shown entering the component.

On the left, a tree view shows the project structure under «Functional Analysis Modeling», including «System Function Root» and «Additional Resources». Below this, another tree view shows «Architecture Modeling» with «Operational Elements» and «Operations».

The bottom window displays an activity diagram with a start node leading to a decision diamond. The diamond has two outgoing paths: one labeled «[FULL]» leading to activity node «O.12.1 Receive an alert that leads to a GOIF aircraft dispatch status», and another labeled «[CORE]» leading to activity node «O.12.2 Receive an alert». From «O.12.1», the flow goes to another activity node (partially obscured). From «O.12.2», the flow goes to activity node «O.12.4 Analyse the available information». The diagram is titled «Analyse consequences in term of Aircraft dispatch technical status».

On the right, two palettes are visible. The top palette is for «Decomposition» and includes «System Function», «Data Flow», «Output Data Flow Port», and «Input Data Flow Port». The bottom palette is for «Control» and includes «Initial node», «Control Flow», «Decision node», «Merge node», «Fork node», «Join node», «Data Items», «Consume Item», «Write Item», «Trigger», «Link», and «Operational Elements».

At the bottom, a properties window is open for the selected activity, showing the following details:

Parameters	Value
Number	O.12
UML Name	Analyse consequences in term of Aircraft dispatch technical status
Profile	
Appearance	
Default duration	-1
Duration unit	ms



Tophoo

Papyrus customization by Airbus

The screenshot displays the Papyrus IDE interface. On the left, the Project Explorer shows a project structure with folders like 'DEV_HMI_v0010204_AA' and 'Source-code-generator'. The Model Explorer shows a UML diagram with components like 'HMI_HMI' and 'HMP_TRANSMISSION_PROCESSING'. The main editor shows a UML diagram with a 'non Terminal Machine' component and its associated 'HLB_LIBRARIES' and 'HMP_TRANSMISSION_PROCESSING' components. The diagram includes relationships like 'use' and 'use*'. Below the diagram, the generated code is visible, showing C++ templates for service generation.

```
[template private genService(exportableService : ExportableService)]  
[let op : Operation = exportableService.getBaseElementOfExportableService().oclAsType(uml::Operation)]  
[genServiceReturnType(op)] [op.name/] [op.genFormattedServiceParameterList()/]  
/* [protected('for ' + op.name + ' body */'  
/* [protected] for [op.name/] body */  
[/let]  
[/template]  
  
[template private genServiceProto(op : Operation)]  
[genServiceReturnType(op)] [op.name/] [genFormattedServiceParameterListProto()/]  
[/template]  
  
[template private genFormattedServiceParameterList(op : uml::Operation) post(trim())]  
[if (not( hasParameters(op)))](void){  
[else]  
[genOperationParameters()/)] {[/if]  
[/template]  
  
[template private genFormattedServiceParameterListProto(op : uml::Operation) post(trim())]  
[if (not( hasParameters(op)))](void){  
[else]  
[genOperationParameters()/)] {[/if]  
[/template]
```

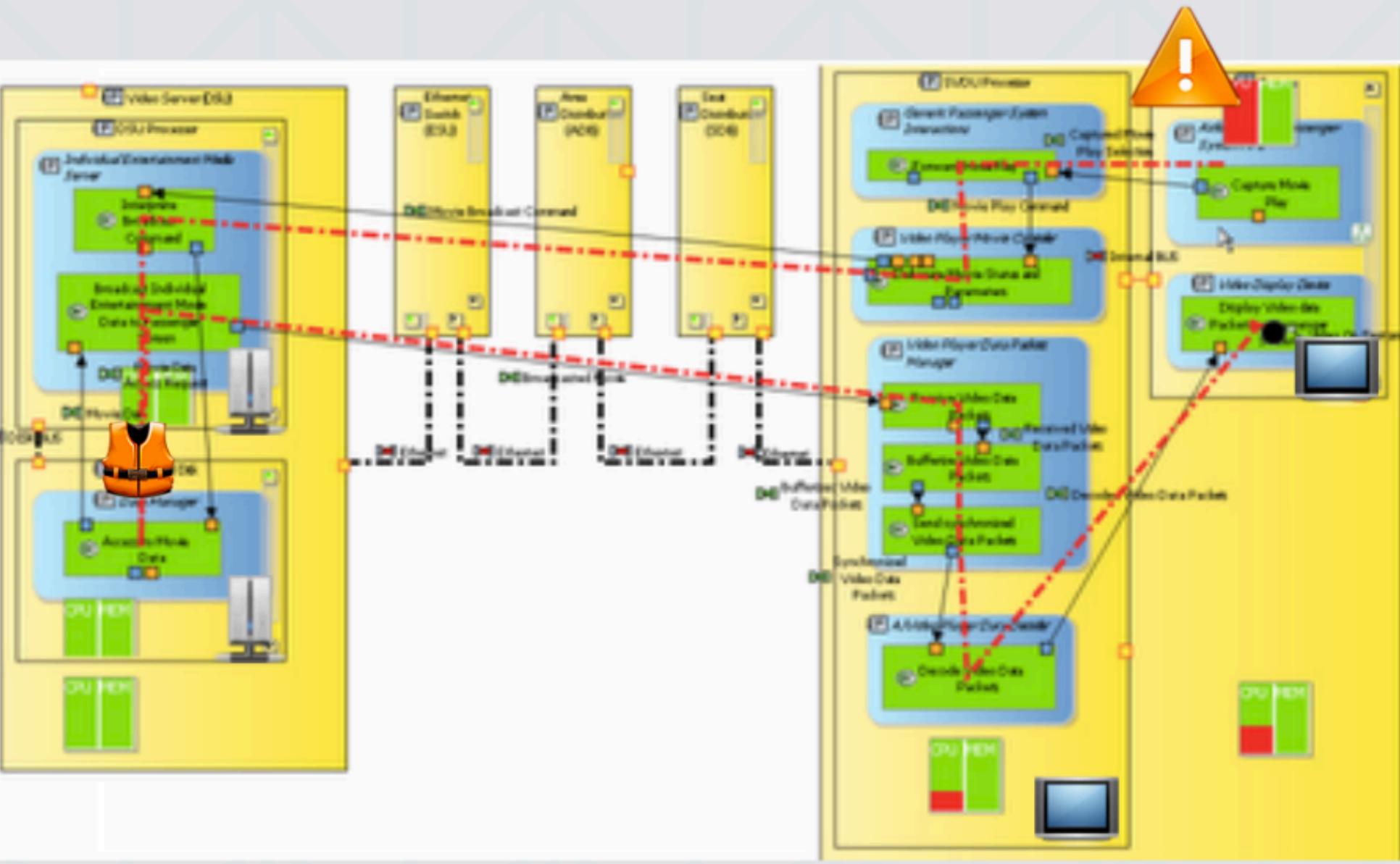
Can generates multiples files as needed
C module, C header and C include files from a single terminal machine

Template based generation

Requests are expressed in OCL

Capella

Thales contributes Melody Advanced tools



Capella

Thales contributes Melody Advanced tools



The screenshot displays the Capella software interface, showing a Logical Architecture diagram and a Semantic Browser for the 'Measure Temperature' function.

Logical Architecture Diagram: The diagram illustrates the flow of data and control between various components. Key elements include:

- Launch a Capture** (Green box)
- Schedule Measurement Campaigns** (Blue box)
- Subscribe to Capture Campaigns** (Blue box)
- Validate & Publish Captured Data** (Blue box)
- Proceed to a Set of Measurements** (Green box) - This box contains several sub-components:
 - SensorFork**
 - Measure Wind Strength**
 - Measure Moisture**
 - Measure Wind Direction**
 - Measure Temperature**
- Transmit Captured Data** (Green box)
- Process Captured Data** (Green box) - This box contains several sub-components:
 - Submit Captured Data to Validation**
 - Format Captured Data**
 - Store Captured Data**

Semantic Browser [Logical Function] Measure Temperature: The browser displays the following structure:

- Referencing Elements:**
 - Active In Modes
 - Active In States
 - Allocation Block
 - Meteorological Data Acquis
 - Incoming Interactions
 - Raw Temperature Value
 - Make Meteorological Da
 - Temperature Capture
 - SensorFork
 - In Flow Ports
- Current Element:**
 - Measure Temperature
 - Breakdown
 - Parent
 - Proceed to a Set of Measure
 - Diagrams
 - All Relative Diagrams
 - [LAB] EOLE - Logical Archite
 - [LDFB] EOLE - Logical Data I
- Referenced Elements:**
 - Internal Outgoing Interactions
 - Out Flow Ports
 - FunctionOutputPort1
 - Outgoing Interactions
 - Temperature Measurement
 - Transmit Captured Data
 - Realized Functions
 - Requirements



Other domains

- Safety

ID	System Function	Function	Failure mode	IMP
1	Recovery	Recovery	System Failure	NOPE
2	Spatial Error			
3	Recovery			
4	Recovery			
5	Internal Failure	Sensor	Internal Failure	NOPE
6	Recovery			
7	Recovery			
8	Recovery			
9	Recovery			
10	Recovery	Primary		
11	Internal Failure			
12	Recovery			
13	Recovery			
14	Recovery			
15	Recovery			
16	Recovery			
17	Recovery			
18	Recovery			
19	Recovery			
20	Recovery			
21	Recovery	Vote		
22	Internal Failure			
23	Recovery			
24	Recovery			
25	Recovery			
26	Recovery			
27	Recovery			
28	Recovery			
29	Recovery			
30	Recovery			
31	Recovery			
32	Internal Failure			
33	Recovery			
34	Recovery			
35	Recovery			
36	Recovery			
37	Recovery			
38	Recovery			
39	Recovery			
40	Recovery			
41	Recovery			
42	Recovery			

- Doc Generation

- Simulation

Items to Deploy	Detail (Simulation)
✓ FGL Main Exec Node	SimuNode_2 [Type]
✓ FGL.DB	[Implem] FGLDb
✓ engine_1 : Engine [Engin	
✓ landinggear_1 : LandingC	
✓ ATA0_ExecNode[ATA0.A	SimuNode_1 [Type]
✓ LandingGear_ExecNode_	SimuNode_1 [Type]
✓ bsc_1 : bsc	[Period] 10 [Rank
✓ lgers_1 : lgers	[Period] 10 [Rank
✓ LandingGear.db	[Implem] Landin
✓ Visu_ExecNode[Visu.Visu.	SimuNode_1 [Type]
✓ SubNode	
✓ External_ExecNode	SimuNode_3 [Type]
✓ syn.cdve_1 : SYN.Cdve	
✓ Vimosac_ExecNode[Visu.	
✓ vimosac_1 : vimosac [

OPPORTUNITY





UML or DSL?

DSL

with

Sirius 1.0
& Capella

AND

UML/SysML

with

Papyrus 1.0



MINS. SECS.

-00:11

APOLLO COUNTDOWN

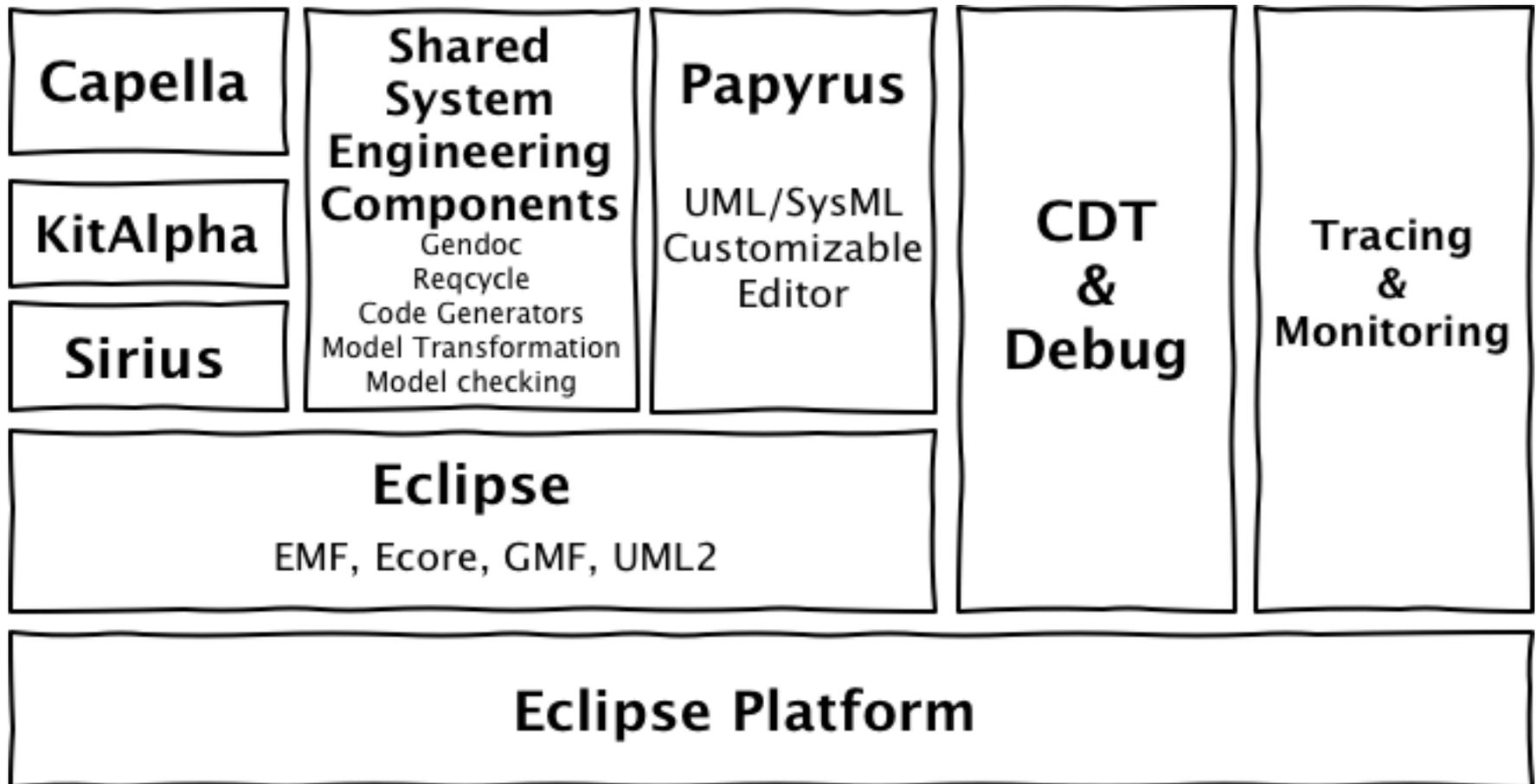
Luna





Add new components

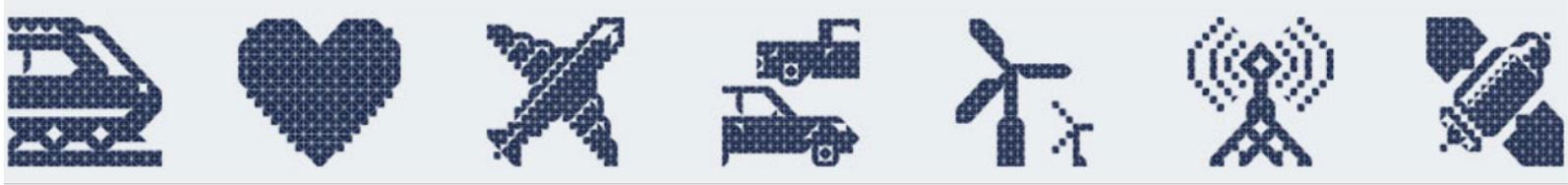
Integrate the components





Join the initiative!

- Not only modeling
- We welcome
 - Users
 - Software vendors
 - Universities
- Open Governance
- Open to new technologies
- Outreach to a larger community of industrial users and partners





Photos credits

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