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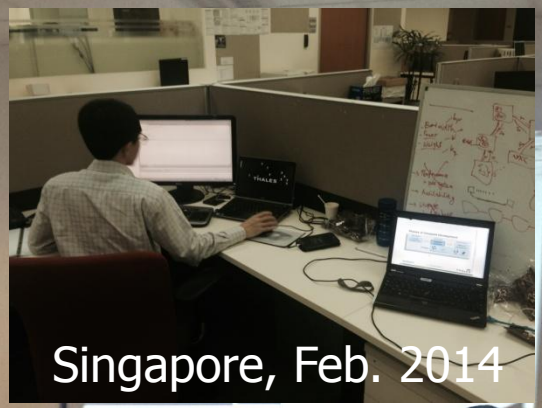
Large-Scale DS(M)L Deployment in Thales

ITSLE Workshop – Sept. 15th, 2014

Stéphane Bonnet, Daniel Exertier, Benoît Langlois

THALES

Toronto, July 2013



Singapore, Feb. 2014

Melbourne, June 2014

Modelling workshop for a new operational project

Agenda

Who, What — Thales, method & workbench for System, Software and Architecture definition

How, How+ — Rationale for DSL, technological choices, Sirius, Kitalpha

Deployment — Key enabling factors

Agenda

Who, What

Collective intelligence for a safer world

Whenever critical decisions need to be made, Thales has a role to play.
In all its markets — aerospace, space, ground transportation, defence and security — **Thales solutions help customers to make the right decisions at the right time and act accordingly**.

World-class technology, the combined expertise of **65,000 employees** and operations in **56 countries** have made **Thales a key player in keeping the public safe and secure**, guarding vital infrastructure and protecting the national security interests of countries around the globe.

Employees

65,000 (workforce under management at 31 Dec. 2012)

Global presence

56 countries

Research and development

2.5 billion euros
(approx. 20% of revenues)

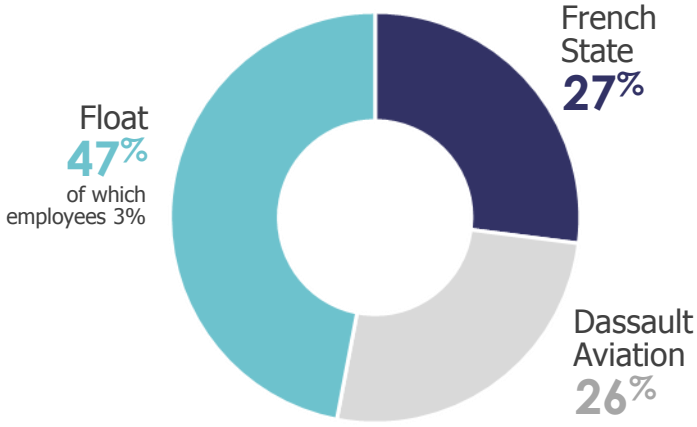
A balanced revenue structure

Revenues in 2012

€ **14.2** billion euros

Shareholders

(at 31 May 2013)



Thales : Markets we serve

Dual markets
Military & Civil

Thales : A Wide Spectrum of Complex Systems

N 1 worldwide

Payloads
for telecom satellites

Air Traffic Management

Sonars

Security for interbank transactions

N 2 worldwide

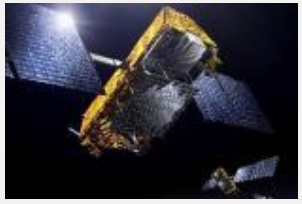
Rail signalling systems

In-flight entertainment
and connectivity

Military tactical
radiocommunications

N 3 worldwide

Avionics



Civil satellites

Surface radars

€14 billion in revenues

Need for an Engineering Transformation

Market

- Systems are more complex
- Scope changes (from equipments to integrated systems)
- Do more… cheaper and faster

Model-Based Systems Engineering

- Objectives
  - Better quality of the systems: Integration, seamlessness, coherency, traceability
  - Early validation
  - Better productivity of engineering activities
  - Collaborative engineering
  - Best practice & know-how capitalization

ARCADIA

Capella

Arcadia : MBSE Scalable and Adaptable Method

How to improve quality, productivity, agility and flexibility of overall engineering?

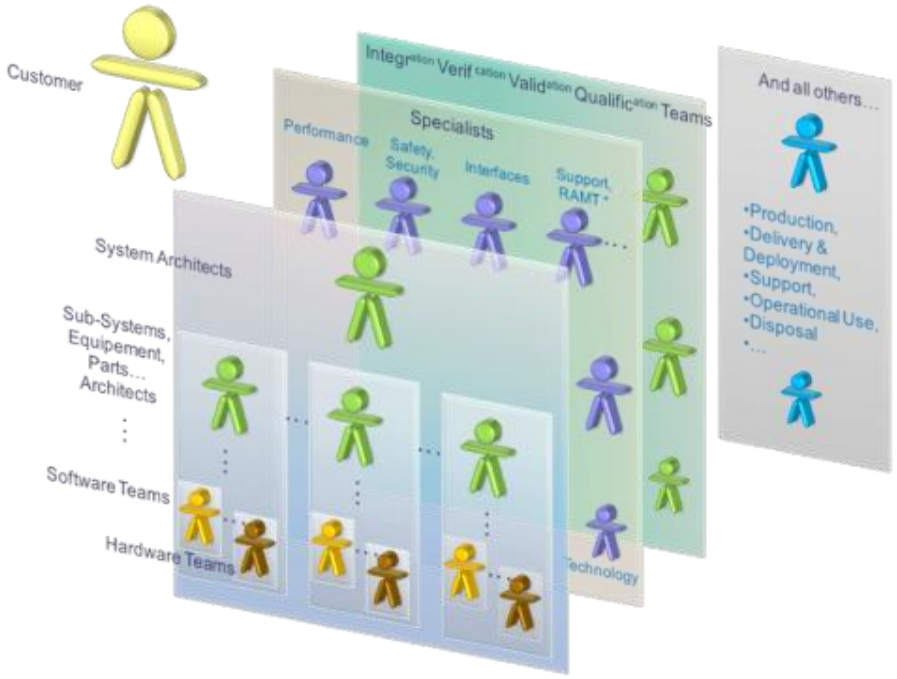
ARCADIA

Arcadia : MBSE Scalable and Adaptable Method

How to improve quality, productivity, agility and flexibility of overall engineering?

ARCADIA

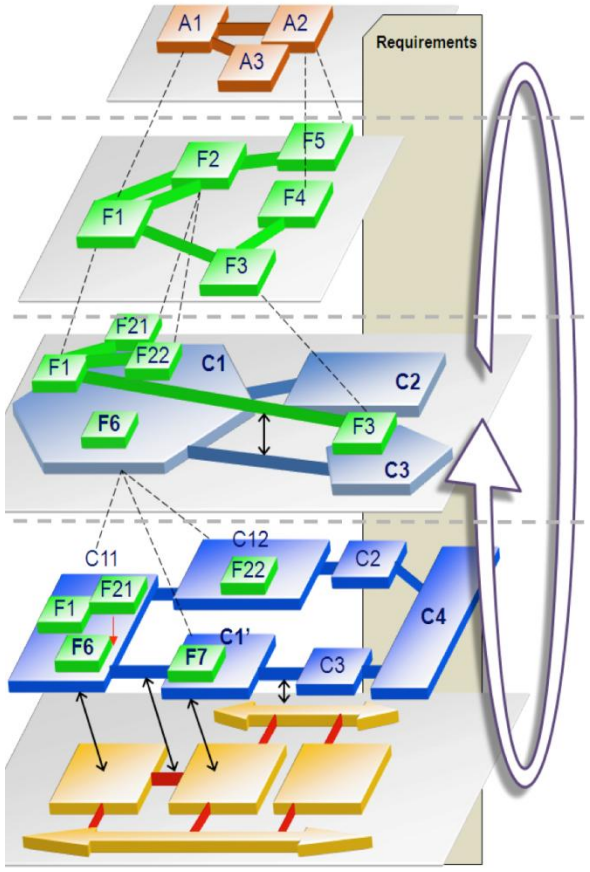
- Eco-system wide collaboration
  - A single architecture reference



Arcadia : MBSE Scalable and Adaptable Method

How to improve quality, productivity, agility and flexibility of overall engineering?

- Eco-system wide collaboration
  - A single architecture reference
- Complexity mastering
  - Multi-level engineering
  - Separation of concerns



Operational

Functional

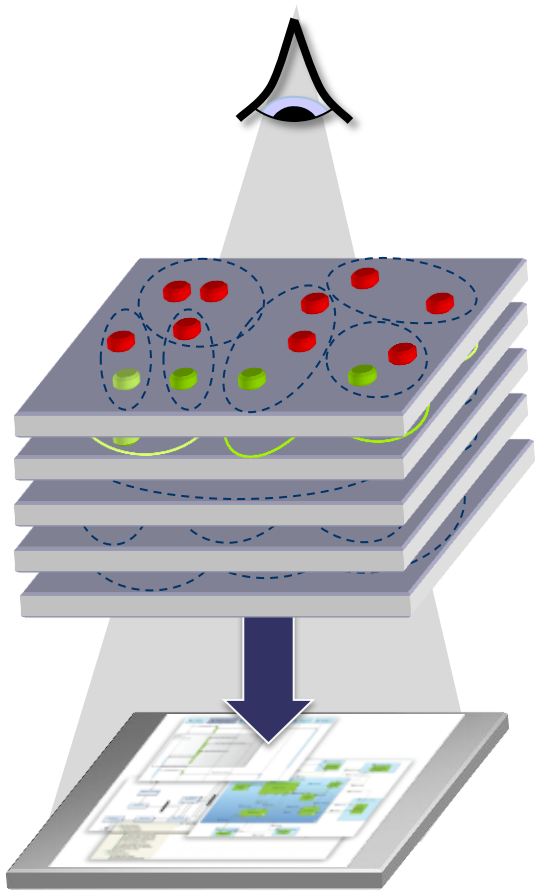
Logical

Physical

Arcadia : MBSE Scalable and Adaptable Method

How to improve quality, productivity, agility and flexibility of overall engineering?

- Eco-system wide collaboration
  - A single architecture reference
- Complexity mastering
  - Multi-level engineering
  - Separation of concerns
- Early validation
  - Integrated specialty engineering
  - Trade-off analysis
  - Short decision loop



ViewPoints

etc.

Product Line

Human Factors

Performance

Security

Safety

Evaluation Rules

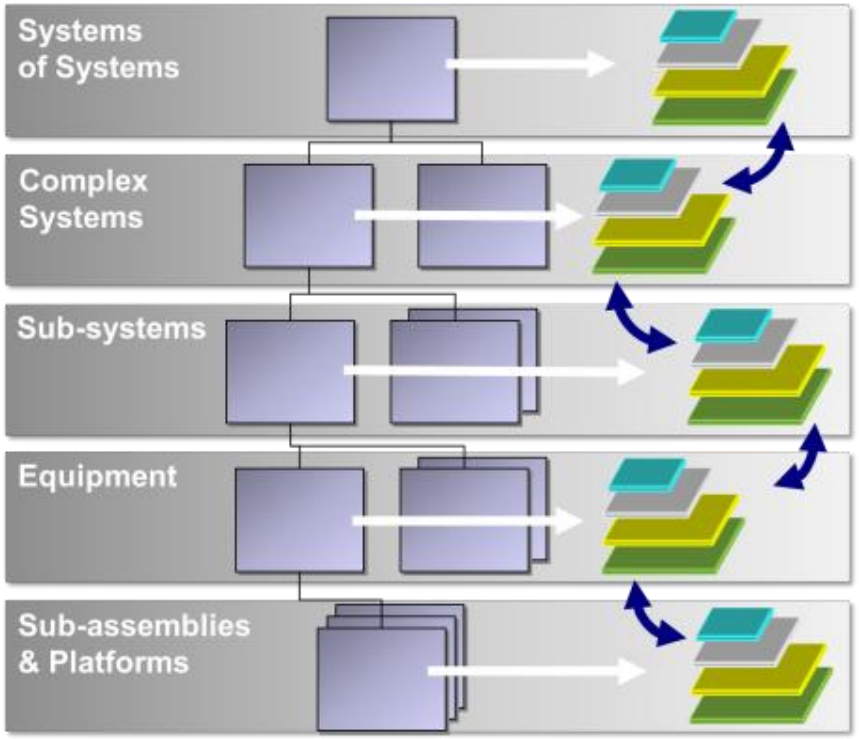
Solution Architecture

Arcadia : MBSE Scalable and Adaptable Method

How to improve quality, productivity, agility and flexibility of overall engineering?

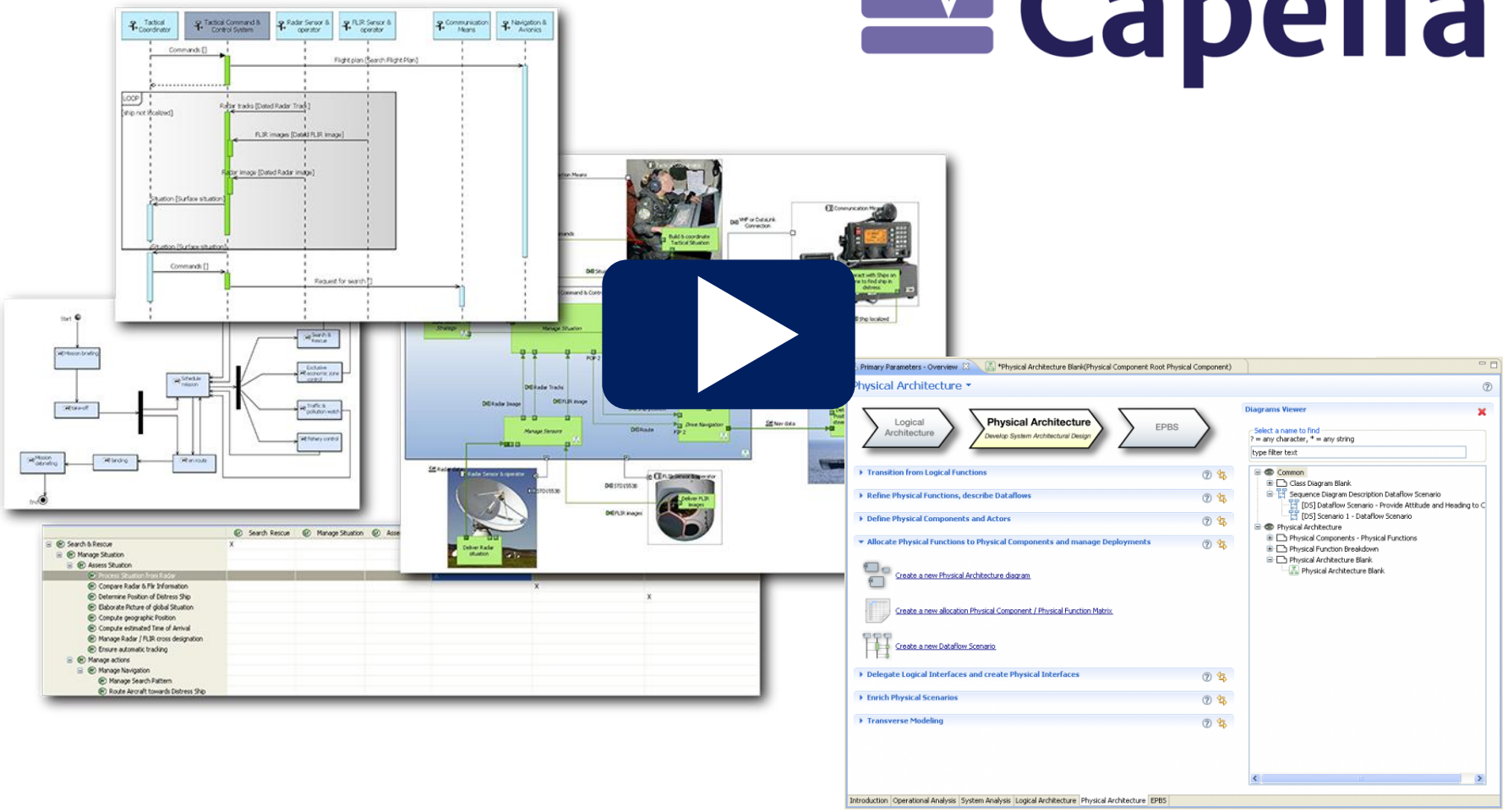
ARCADIA

- Eco-system wide collaboration
  - A single architecture reference
- Complexity mastering
  - Multi-level engineering
  - Separation of concerns
- Early validation
  - Integrated specialty engineering
  - Trade-off analysis
  - Short decision loop
- Mastering transitions
  - Information refinement
  - Coherency maintenance
  - Multi-level impact analysis

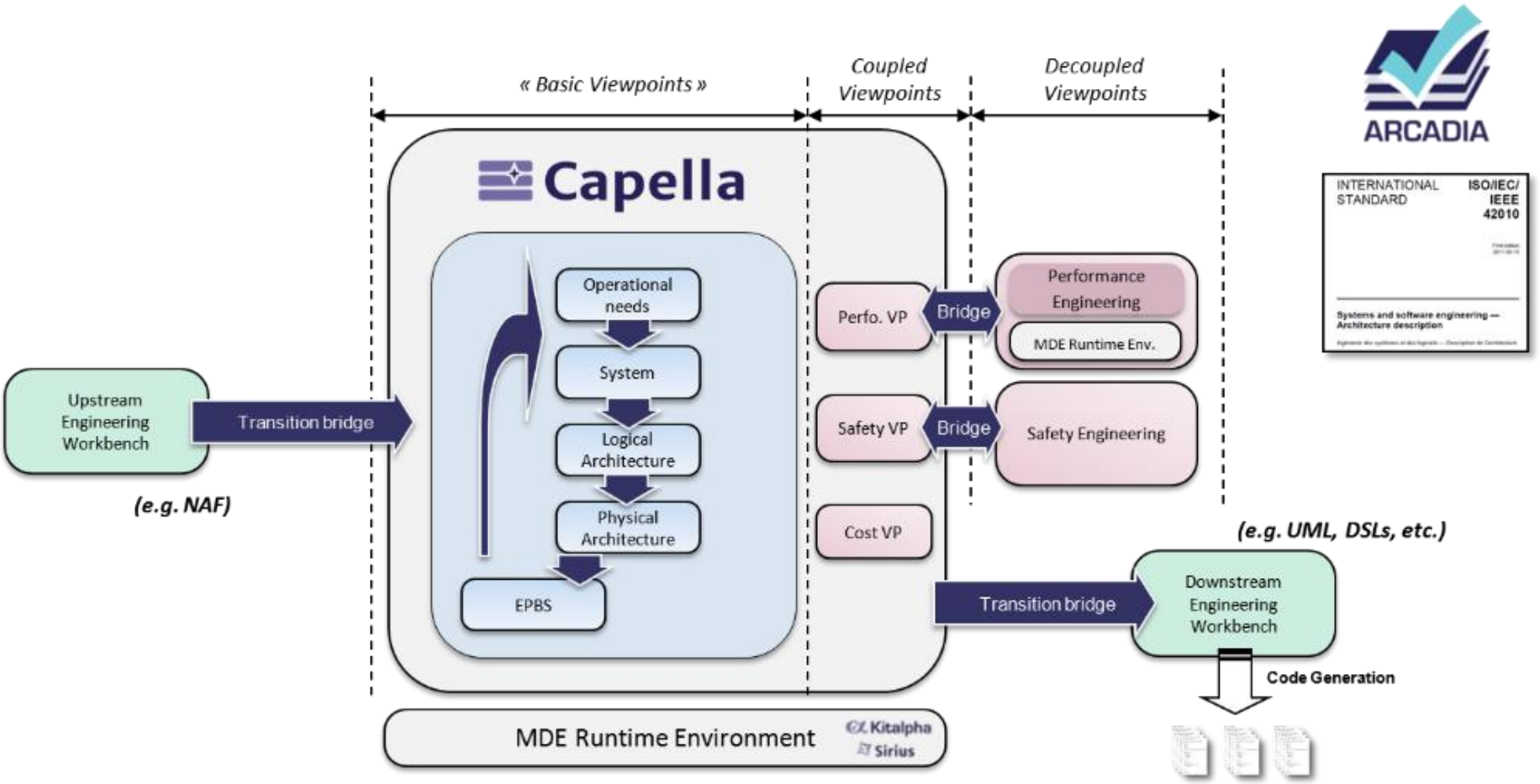


Capella : A DSL++ Supporting the Arcadia Method

Capella



Capella : The Ecosystem Big Picture



Capella Operational Deployment within Thales

Critical Information Systems

Ground Exploitation Systems

Command & Control (air, sea, railways…)

Large secured Communication Networks…

Satellite Control Networked Ground Stations

Users worldwide

###

Operational Projects

##

Embedded Systems

Combat Systems (Radar, Self Protection, Optronics…)

Mission Systems (Air, Sea, Ground)

Satellite Constellations

Avionics Suites

Computing Systems

Electrical Power Systems

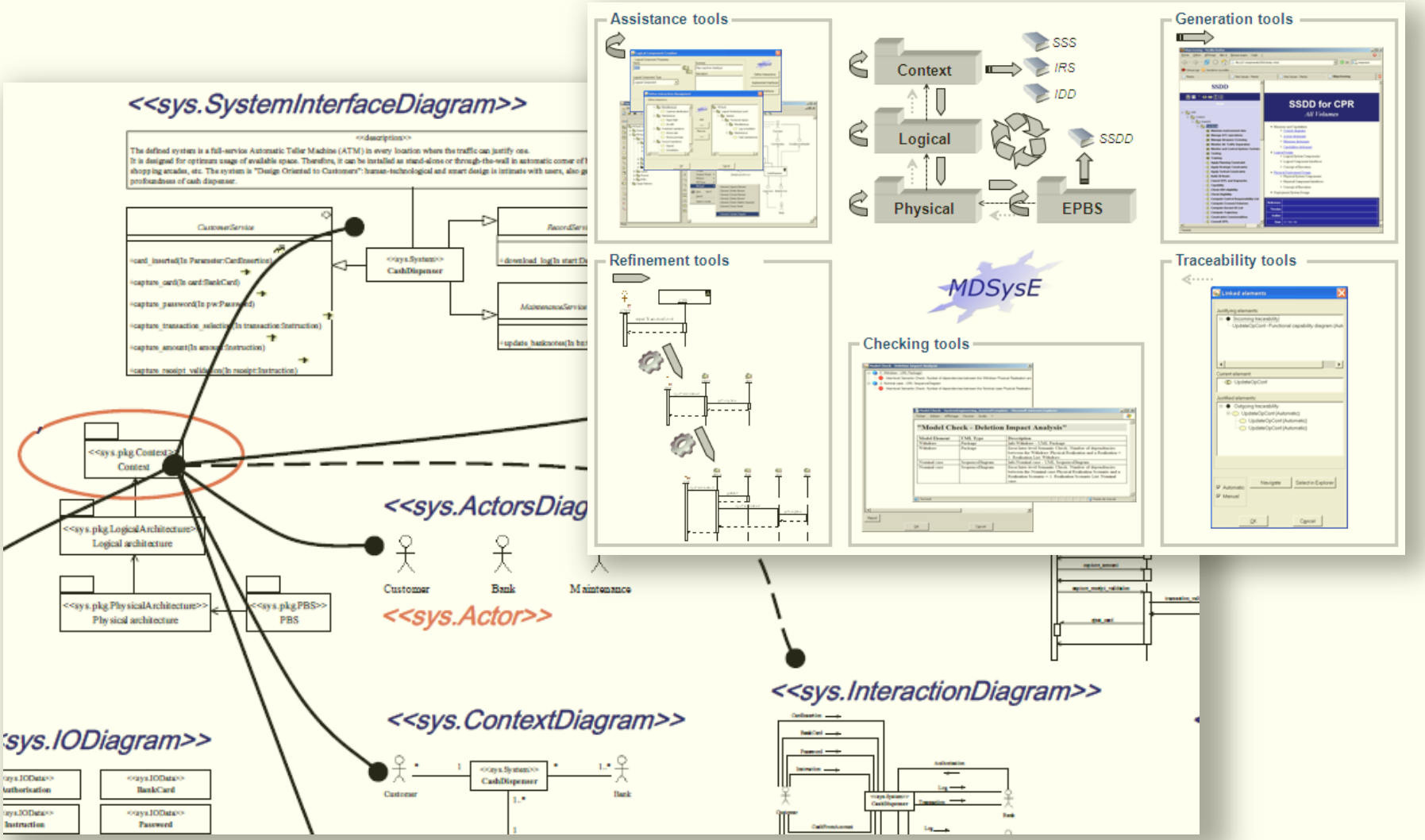
Thermal Cooling Systems

Railways signalling Systems

Agenda

How

2004 - Advanced UML Profiling for Systems Engineering

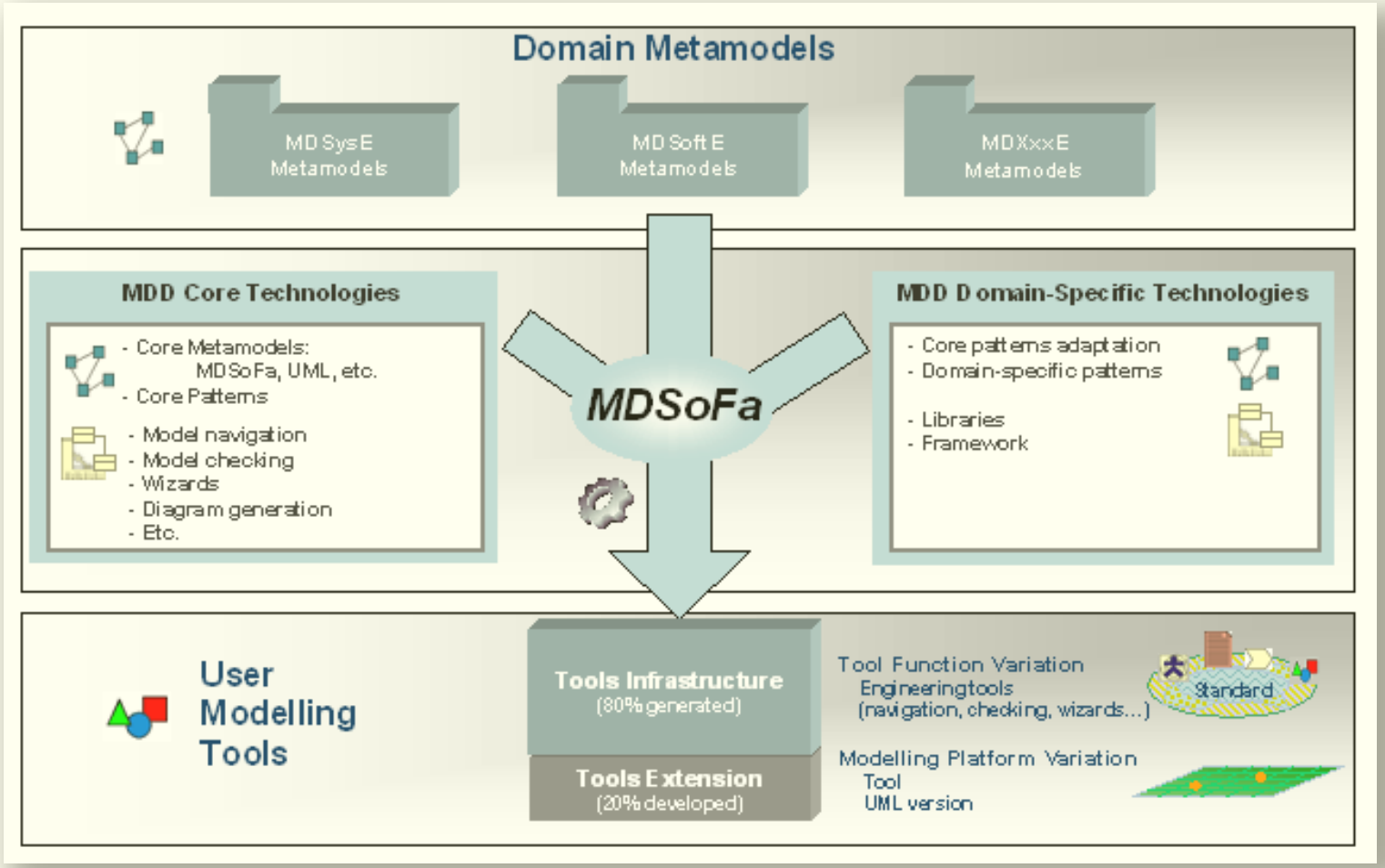


Extracted from 2004 slides

THALES

2004 - Advanced UML Profiling for Systems Engineering

EMF outside Java/ Eclipse ☺



Extracted from 2004 slides

Thales Choice for ARCADIA: a Graphical DSML

Graphical DSML

- Tight fit with exact domain and needs
- Short learning curve thanks to familiar terms and concepts
- Complete freedom in expressivity (language and representations)

Profiling UML/SysML

- Usually well-accepted in Thales by Software engineers, less by System engineers
- Language complexity
- Limited capabilities regarding diagram customizations
- Restraining the usage of a UML tool to selected scope of concepts is difficult

Graphical DSML or UML/SysML Profile?

Graphical DSML

- Cost … **until Sirius!**

Profiling UML/SysML

- Easier interoperability with standards
- Widely understood (or misunderstood)

From a Specific Need to Sirius

Thales previous experiences with UML Profiling

- Poor adoption by system engineers
- Meta-models constrained by UML concepts
- Representations constrained by existing UML diagrams

Need for graphical DSMLs

- Freedom both in language and representation
- Heavier and more technical (GMF) developments
- Originally 2 or 3 foreseen modeling workbenches

Separation workbench / business concerns

- Generic infrastructure for model management and representations
- Focus on business added-value
- Capitalisation

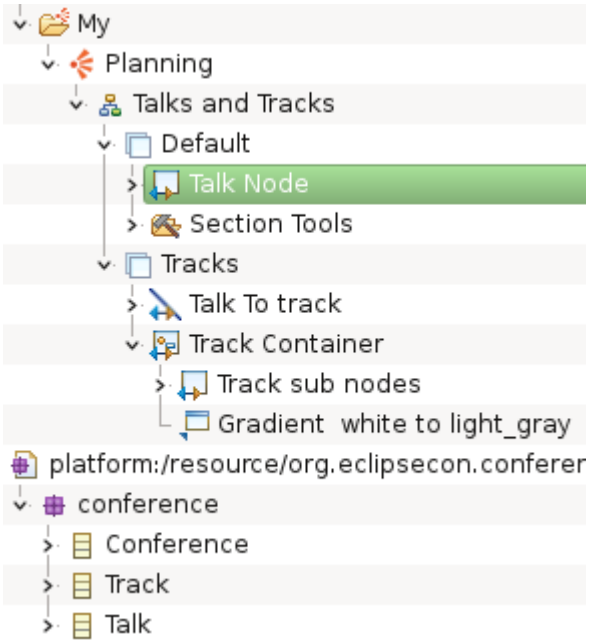
What is Sirius?

Provides the **specification tools** to define, test, and distribute **graphical modeling workbenches** (diagram, table and tree editors) on top of the Eclipse platform, **with little technical knowledge**

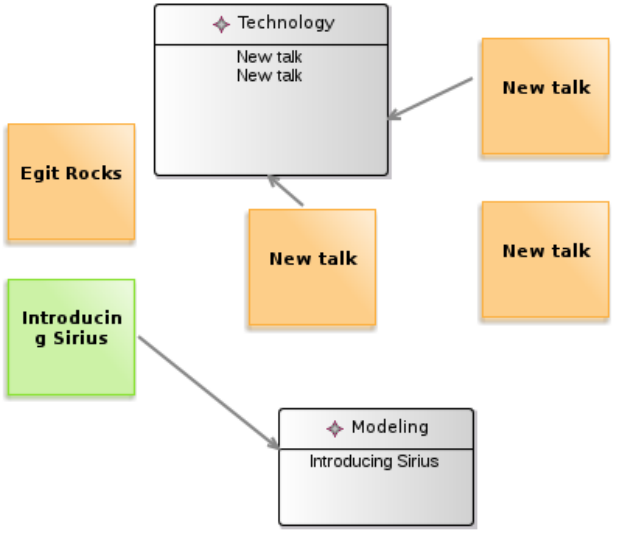
Provides the associated **runtime environment**

What is Sirius?

Workbench Configuration



Runtime



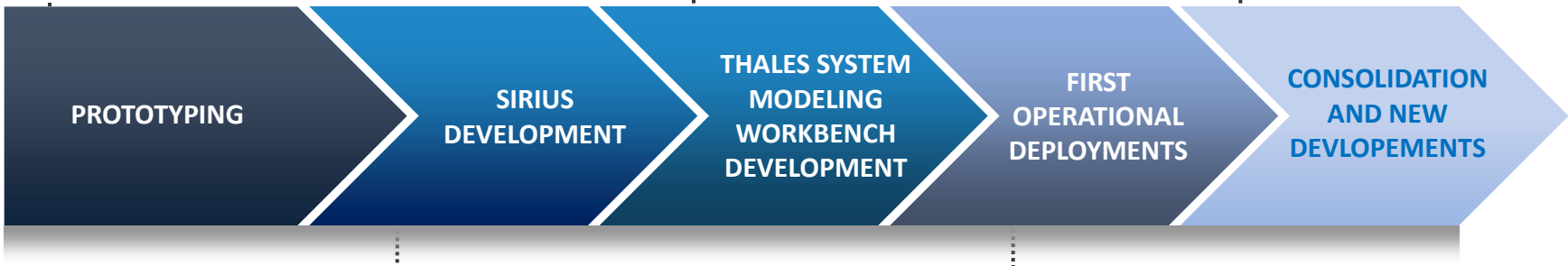
Now Open Source!

Sirius: A Collaboration Thales / Obeo

2007 First Obeo/Thales prototype to validate the concepts

2008 Thales Capella modelling workbench

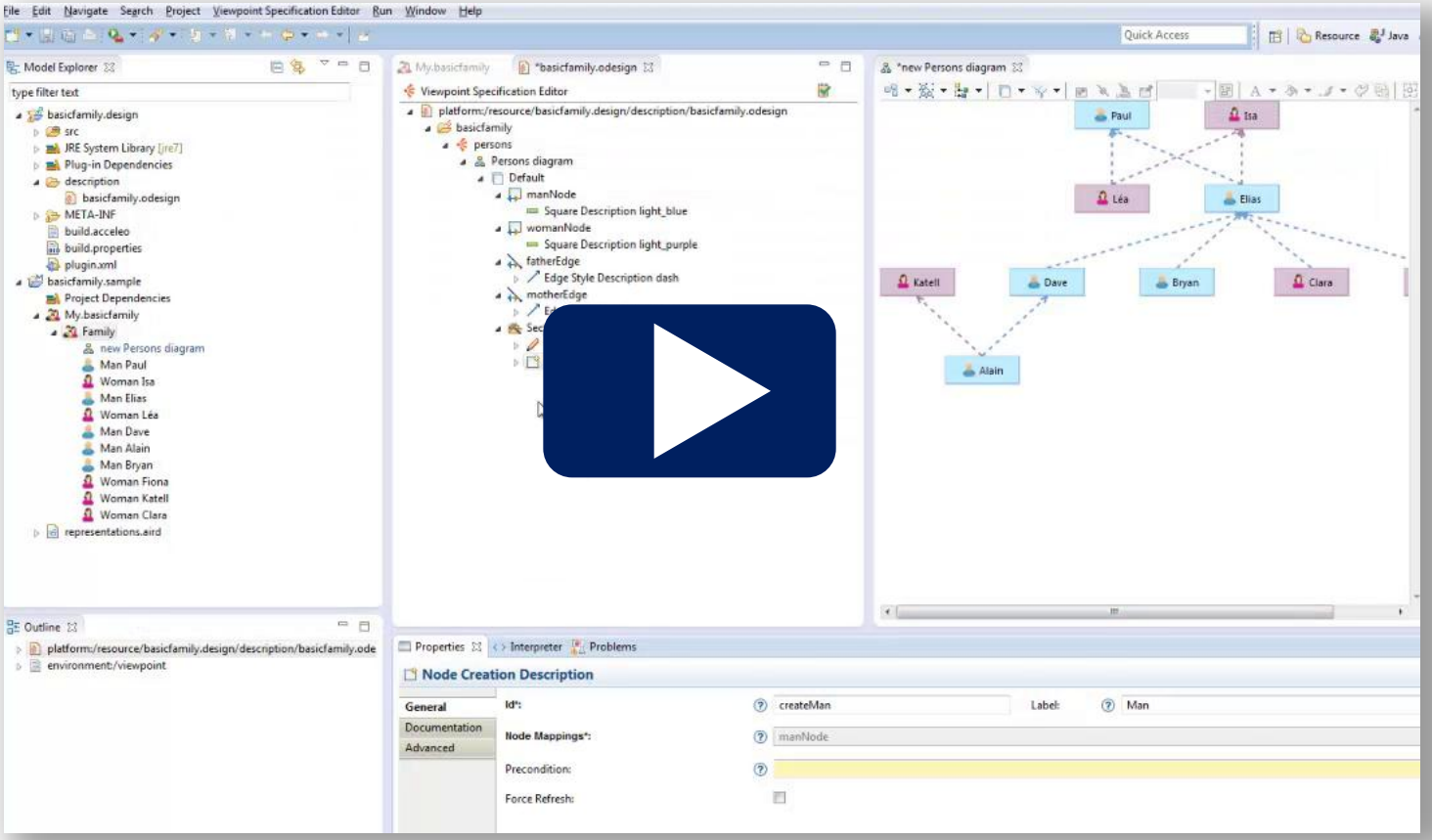
2009-Present Mature product



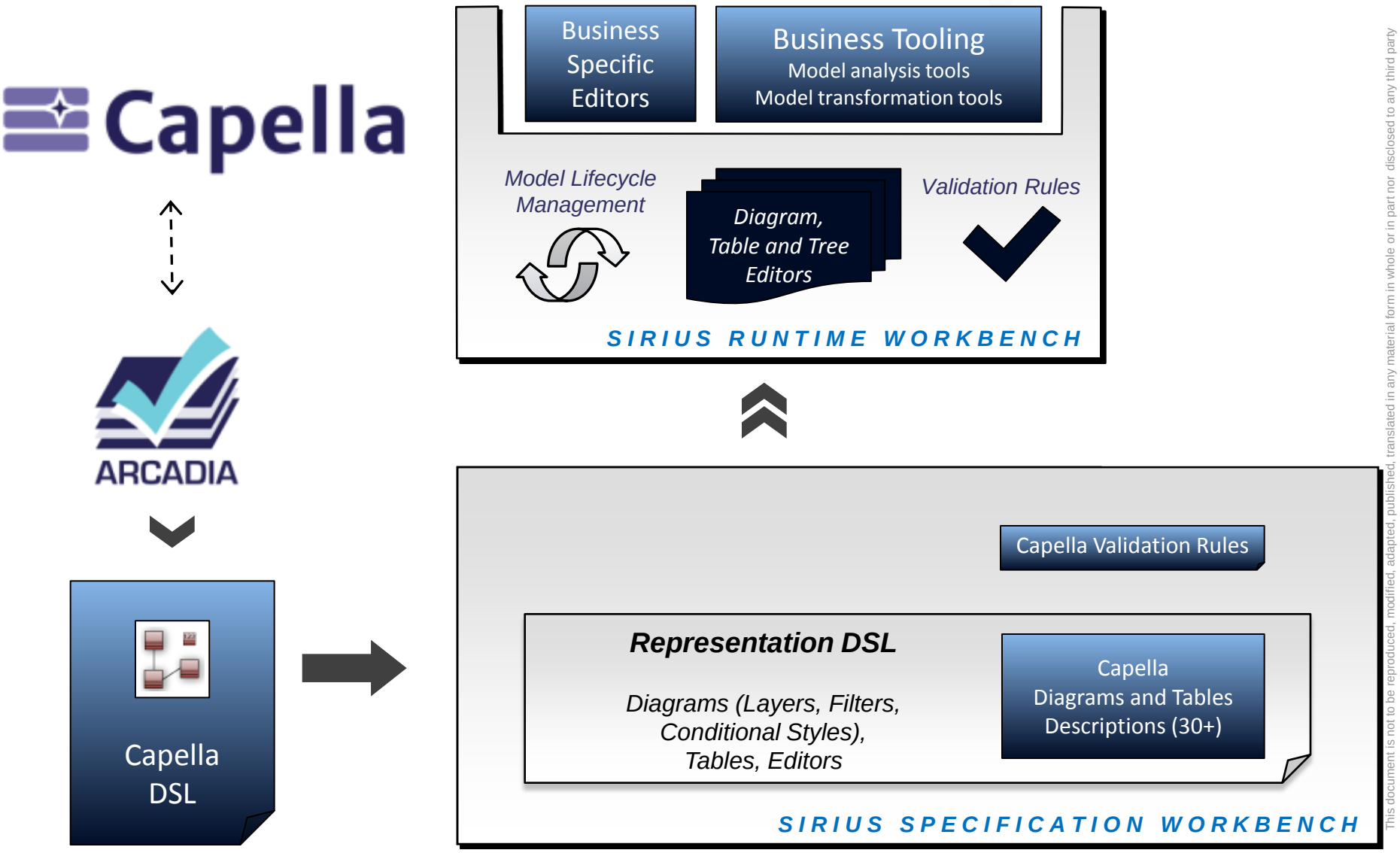
2008 Specification and development of Sirius foundations

2009 First operational pilot projects, launch of Obeo Designer, based on Sirius

Sirius: Tiny Tutorial



Creation of a Modeling Workbench with Sirius

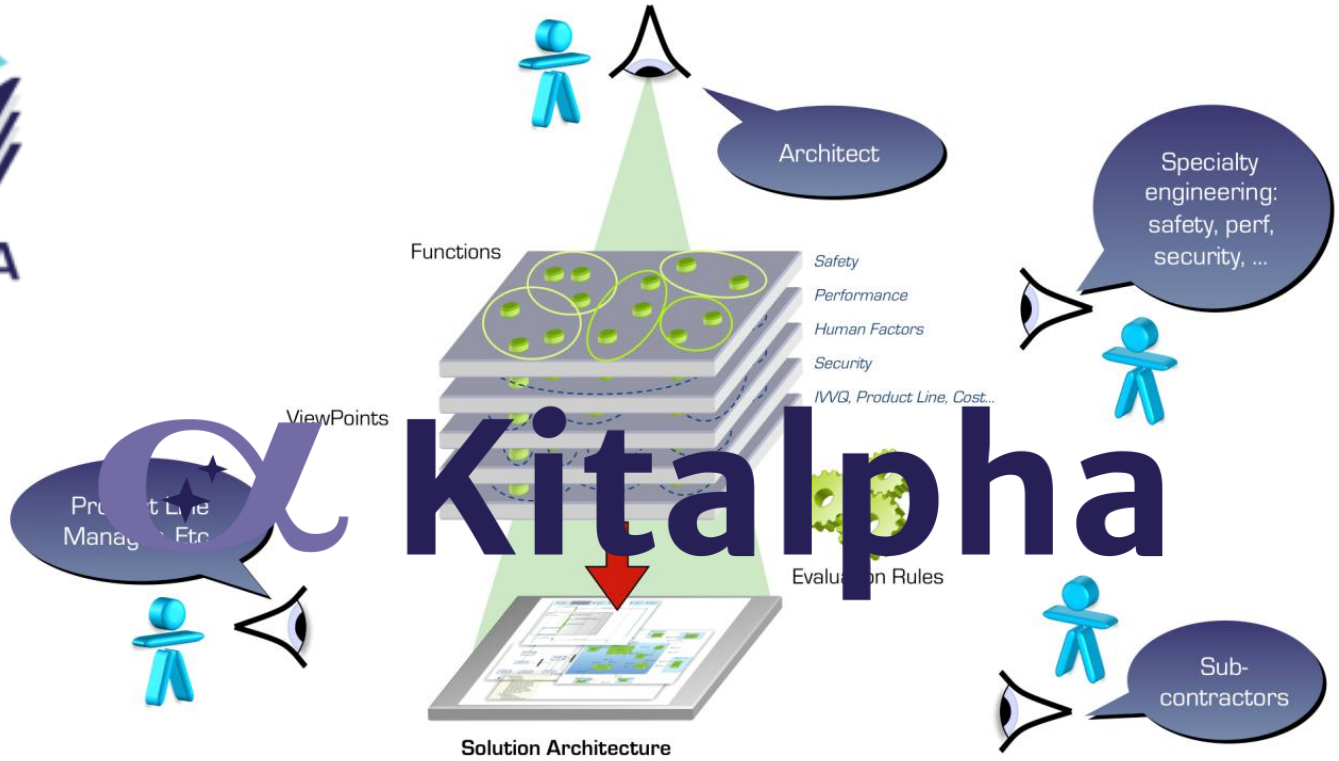


Agenda

How+

A comprehensive development environment for enriching DSMLs

Reminder: Multi-Viewpoint Analysis is the DNA of Arcadia



Thales Corporate Engineering provides the Capella workbench and a few generic-purpose viewpoints

Development and runtime environment for viewpoint-based modelling workbenches

Thales BUs often need to develop specialty engineering viewpoints

What is a viewpoint? – ISO Definition

ISO/IEC WD3 42010 (2010-06-08)

"An **architecture framework** establishes a common practice for creating, interpreting, analyzing and using **architecture descriptions** within a particular domain of application or stakeholder community."

What is a viewpoint? – ISO Definition

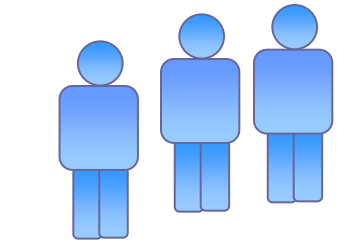
ISO/IEC WD3 42010 (2010-06-08)

"An **architecture description** includes one or more architecture views. Each architecture view (or simply, view) addresses one or more of the system concerns held by the system's stakeholders.

Each **architecture view** expresses the architecture of the system-of-interest in accordance with an architecture viewpoint (or simply, viewpoint). Each viewpoint frames one or more system concerns. Each concern can be framed by one or more viewpoints.

Each view is governed by its viewpoint: the **viewpoint** establishes the conventions for constructing, interpreting and analyzing the view to address concerns framed by that viewpoint. Viewpoint conventions can include languages, notations, model kinds, design rules, and/or modelling methods, analysis techniques and other operations on views."

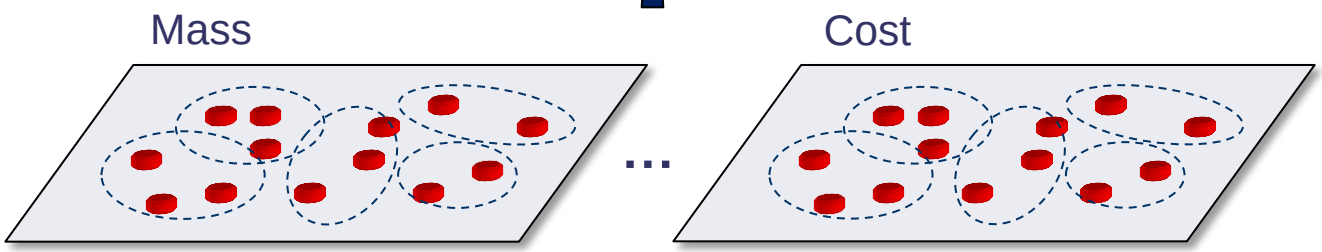
Viewpoint-Based Architecture Description of Complex Systems



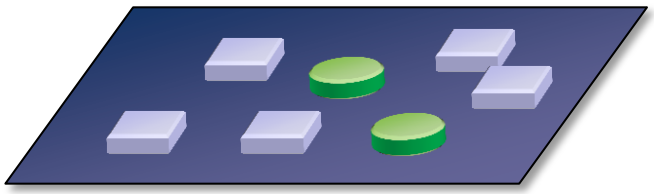
Stakeholders

Viewpoints

Metamodels
Rules
Representations
Tools
Services



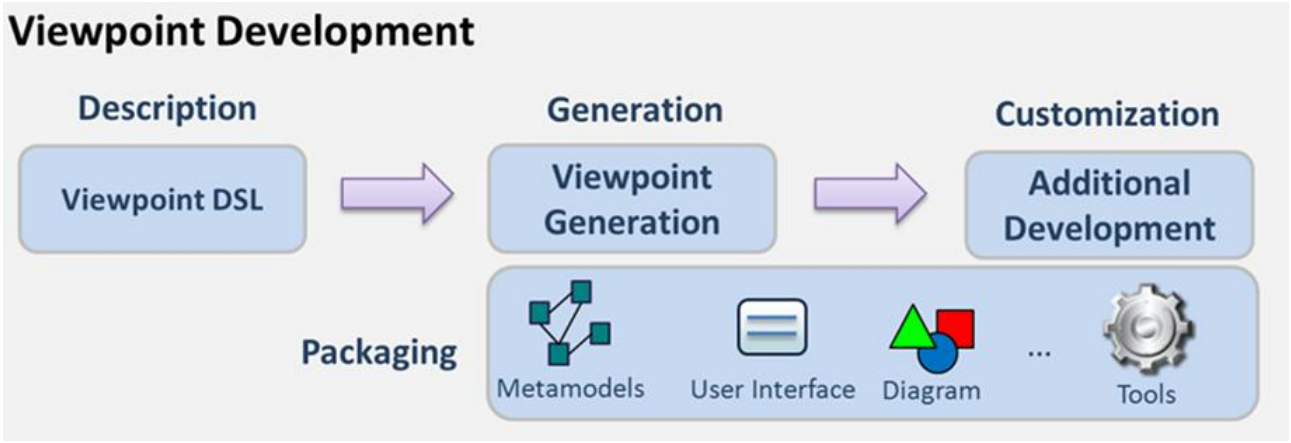
Architecture Description



System of interest

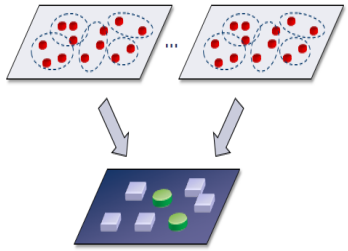
Kitalpha: Development and Execution Environments

Development



Kitalpha

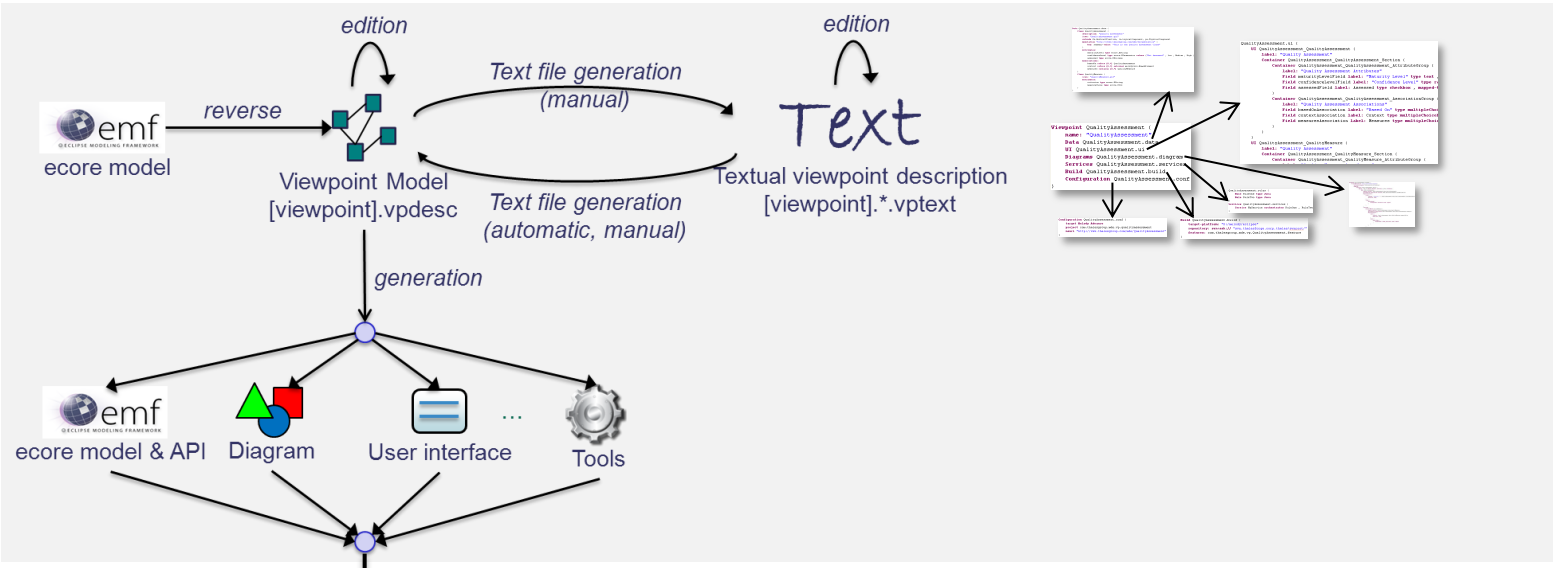
Execution



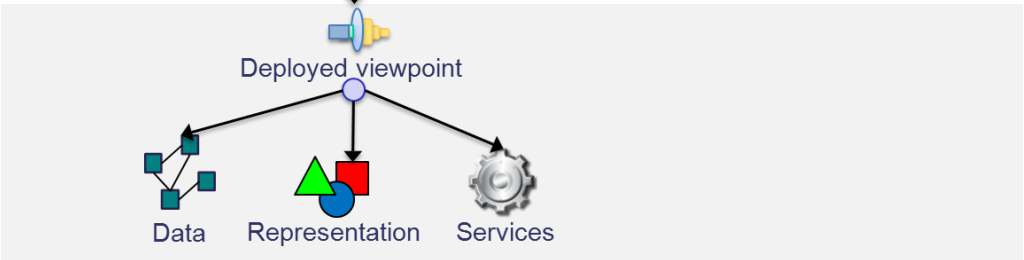
Viewpoint-based modelling workbench

Focus on Kitalpha Viewpoint DSL

Development



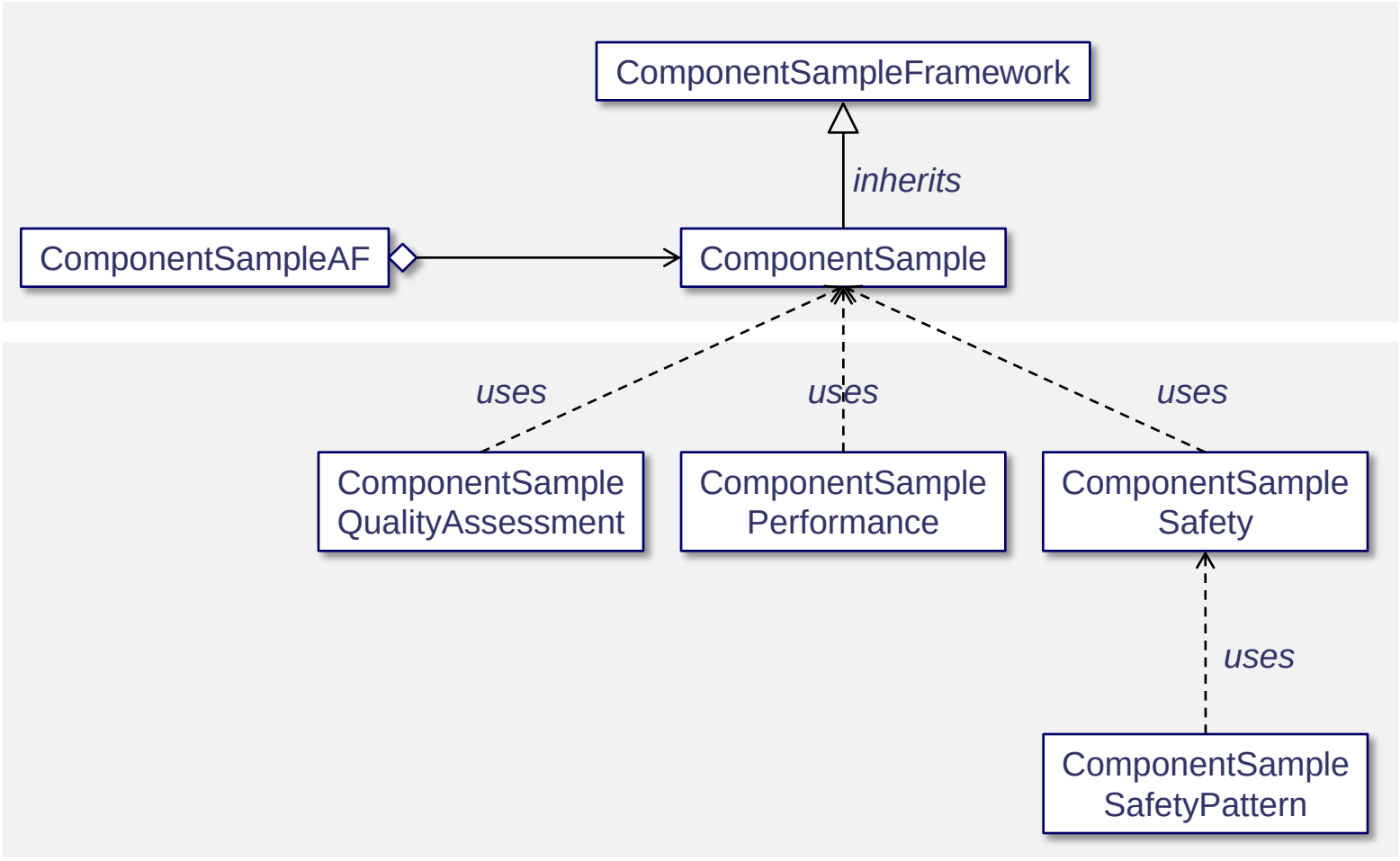
Use



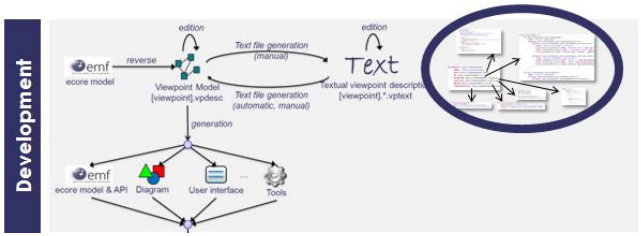
Kitalpha Viewpoint DSL: Example

Architecture Description

Extensions



Kitalpha Viewpoint DSL: Example



Kitalpha

```
Viewpoint QualityAssessment {
    name: "QualityAssessment"
    Data QualityAssessment.data
    UI QualityAssessment.ui
    Diagrams QualityAssessment.diagram
    Services QualityAssessment.services
    Build QualityAssessment.build
    Configuration QualityAssessment.conf
}
```

```
Data QualityAssessment.data {
    Class QualityAssessment {
        description: "Quality Assessment"
        icon: "QualityAssessment.gif"
        extends fa.AbstractFunction, la.LogicalComponent, pa.PhysicalComponent
        Annotation "http://www.thalesgroup.com/mde/documentation" {
            key: summary value: "This is the Quality Assessment Class"
        }
        Attributes:
            maturityLevel type ecore.EString
            confidenceLevel type ecore.EEnumerator values ("Not Assessed" , Low , Medium , High )
            assessed type ecore.EBoolean
        Associations:
            basedOn refers [0,*] QualityAssessment
            context refers [0,*] external melodycore.NamedElement
            measures contains [0,*] QualityMeasure
    }
    Class QualityMeasure {
        icon: "QualityMeasure.gif"
        Attributes:
            criterion type ecore.EString
            measureValue type ecore.EInt
    }
}
```

```
QualityAssessment.ui {
    UI QualityAssessment_QualityAssessment {
        label: "Quality Assessment"
        Container QualityAssessment_QualityAssessment_Section {
            Container QualityAssessment_QualityAssessment_AttributeGroup {
                label: "Quality Assessment Attributes"
                Field maturityLevelField label: "Maturity Level" type text
                Field confidenceLevelField label: "Confidence Level" type ra
                Field assessedField label: Assessed type checkbox , mapped-t
            }
            Container QualityAssessment_QualityAssessment_AssociationGroup {
                label: "Quality Assessment Associations"
                Field basedOnAssociation label: "Based On" type multipleChoi
                Field contextAssociation label: Context type multipleChoiceI
                Field measuresAssociation label: Measures type multipleChoic
            }
        }
    }
    UI QualityAssessment_QualityMeasure {
        label: "Quality Assessment"
        Container QualityAssessment_QualityMeasure_Section {
            Container QualityAssessment_QualityMeasure_AttributeGroup {
```

```
QualityAssessment.rules {
    Rule RuleOne type Java
    Rule RuleTwo type Java
}
Services QualityAssessment.services {
    Service MyService orchestrates RuleOne , RuleTwo
}
```

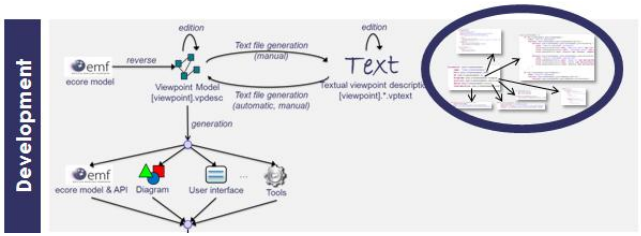
```
Configuration QualityAssessment.conf {
    target Melody Advance
    project com.thalesgroup.mde.vp.qualityassessment
    nsuri "http://www.thalesgroup.com/mde/QualityAssessment"
}
```

```
Build QualityAssessment.build {
    target-platform: "D:/melody/eclipse"
    repository: svn+ssh:// "svn.thalesforge.corp.thales/svnroot/"
    features: com.thalesgroup.mde.vp.QualityAssessment.feature
}
```

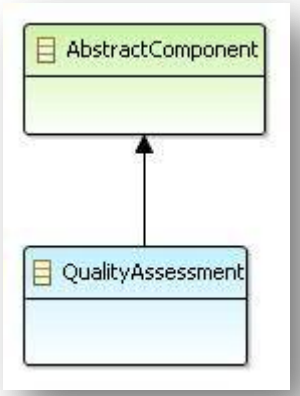
OPEN

THALES

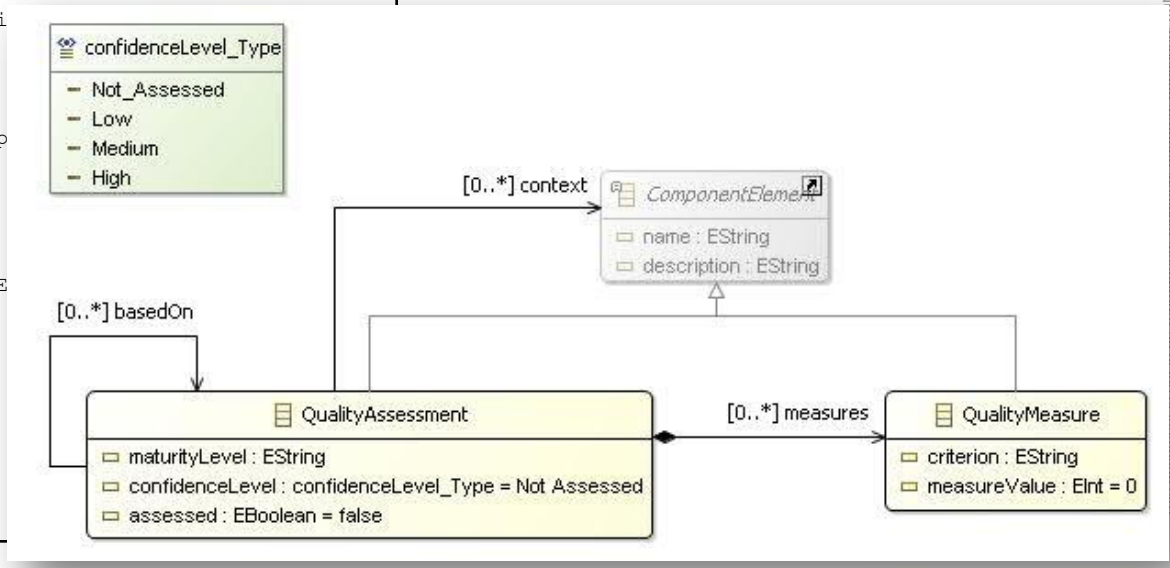
Kitalpha Viewpoint DSL: Example



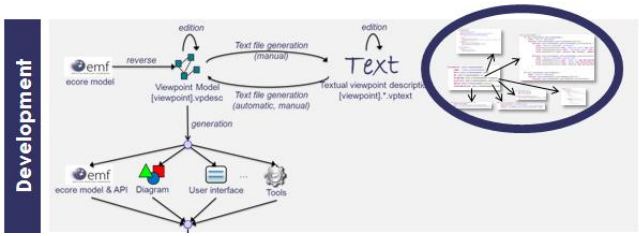

```
import external "http://www.polarsys.org/kitalpha/ComponentSample"

Data ComponentSampleQualityAssessment.data {
   Class QualityAssessment {
      description: "Quality Assessment"
      icon: "QualityAssessment.png"
      extends ComponentSample.AbstractComponent
      superClass external ComponentSample.ComponentElement
      Attributes:
         maturityLevel type ecore.EString
         confidenceLevel type ecore.Eenumerator
                values ( "Not Assessed" , Low , Medi
         assessed type ecore.EBoolean
      Associations:
         basedOn refers [0,*] QualityAssessment
         context refers [0,*] external ComponentSamp
         measures contains [0,*] QualityMeasure
   }
   Class QualityMeasure {
      icon: "QualityMeasure.png"
      superClass external ComponentSample.ComponentE
      Attributes:
         criterion type ecore.EString
         measureValue type ecore.EInt
   }
}
```



Extension



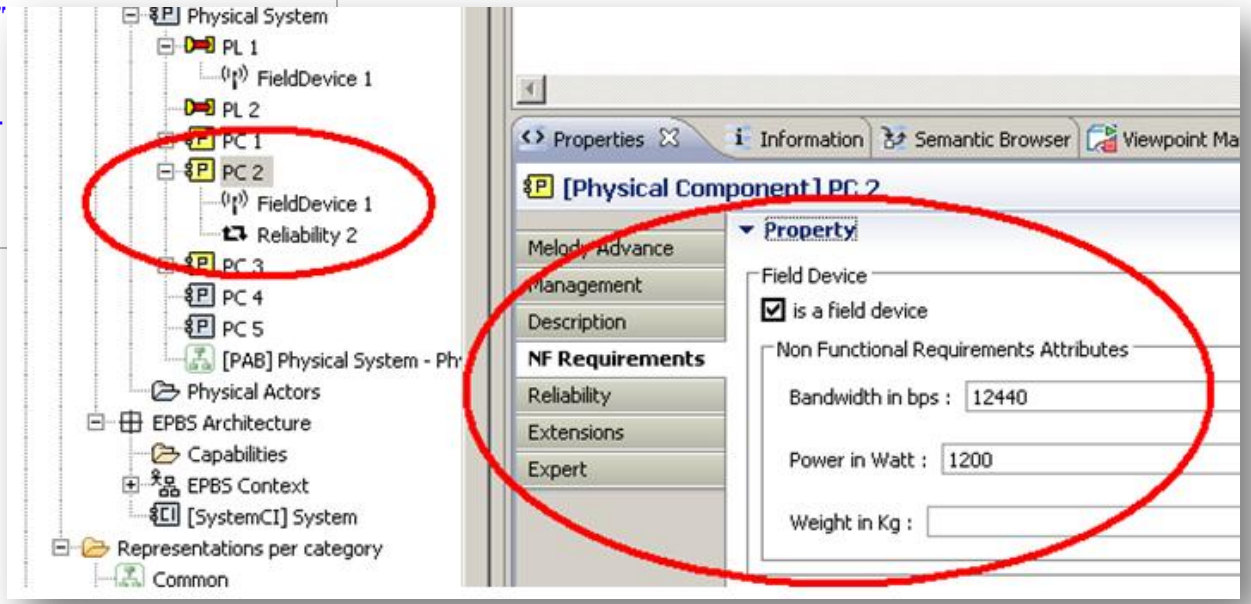
Kitalpha Viewpoint DSL: Example




```
QualityAssessment.ui {
    UI QualityAssessment_QualityAssessment {
        label: "Quality Assessment"
        Container QualityAssessment_QualityAssessment_Section {
            Container QualityAssessment_QualityAssessment_AttributeGroup {
                label: "Quality Assessment Attributes"
                Field maturityLevelField label: "Maturity Level" type text , mapped-to QualityAssessment.data.QualityAssessment.
                Field confidenceLevelField label: "Confidence Level" type radiobox , mapped-to QualityAssessment.data.QualityAss
                Field assessedField label: Assessed type checkbox , mapped-to QualityAssessment.data.QualityAssessment.assessed
            }
            Container QualityAssessment_QualityAssessment_AssociationGroup {
                label: "Quality Assessment Associations"
                Field basedOnAssociation label: "Based On" type multipleChoiceList , mapped-to QualityAssessment.data.QualityAss
                Field contextAssociation label: Context type multipleChoiceList , mapped-to QualityAssessment.data.QualityAssess
                Field measuresAssociation label: Measures type multipleChoiceList , mapped-to QualityAssessment.data.QualityAsse
            }
        }
    }
    UI QualityAssessment_QualityMeasure {
        label: "Quality Assessment"
        Container QualityAssessment_QualityMeasure_Section {
            Container QualityAssessment_QualityMeasure_AttributeGroup {
                label: "Quality Measure Attributes"
                Field criterionField label: Criterion type text , mapped-to QualityAssessment.data.QualityMeasure.criterion
                Field measureValueField label: "Measure Value" type text , mapped-to QualityAssessment.data.QualityMeasure.measu
            }
        }
    }
}
```

Kitalpha Viewpoint DSL: Example

```
Class FieldDevice {
    description: "Field Device"
    icon: "FieldDevice.gif"
    extends pa.PhysicalComponent, cs.PhysicalLink, cs.PhysicalPort
        Annotation "http://wwww.thalesgroup.com/mde/documentation" {
            key: summary value: "Non-functional requirement"
        }
    Attributes:

        bandwidth type ecore.EInt
        Annotation "http://wwww.thalesgroup.com/mde/documentation" {
            key: note value: "Value in bps"
        }

        power type ecore.EInt
        Annotation "http://wwww.thalesgroup.com/mde/documentation" {
            key: note value: "Value in Watt"
        }

        weight type ecore.EDouble
        Annotation "http://wwww.thalesgroup.
            key: note value: "Value in Kg"
        }

        isFieldDevice type ecore.EBoolean
```



HOW and HOW+

Viewpoint DSL is only one of multiple Kitalpha components. More information to come on the Kitalpha project page

https://www.polarsys.org/projects/polarsys.kitalpha

benoit.langlois@thalesgroup.com

Kitalpha

Sirius is now part of Eclipse's Modelling Distribution and is the foundation of Ecore Tools 2.0. It is receiving a warm welcome from the Community

http://www.eclipse.org/sirius

Sirius

Deployment

Deployment Enabling Factors

Strong support from management (*)

Important and renewed funding

Group recommendation

(*) Double-edged sword

Deployment Enabling Factors

Strong involvment of end-users

Initial definition of the DSL (Do it right!)

Clear and democratic process for the definition of evolutions and roadmaps

Business-driven maturation of low-TRL solutions

Deployment Enabling Factors

Tool maturity and added-value

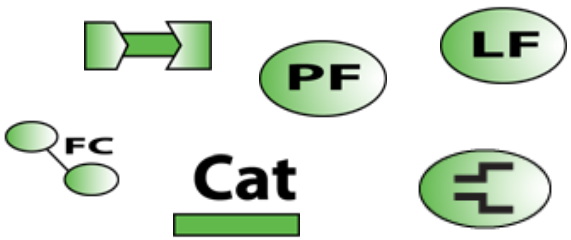
Stability + Ergonomics + Performance are MANDATORY

Focus on what is missing in COTS

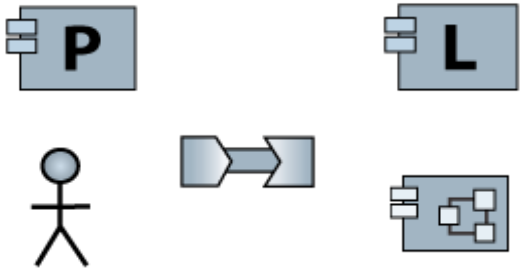
User experience with diagram interactions is essential

Engineers spend hours in front of the tool every day!

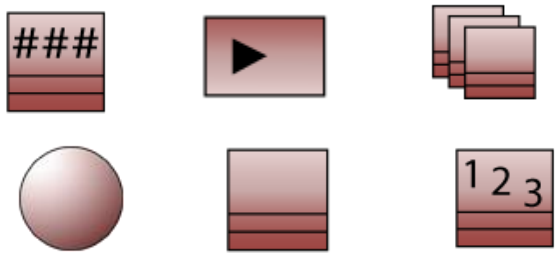
Deployment Enabling Factors: Ergonomics



Functions = Green



Components = Blue



Interfaces = Pink

Deployment Enabling Factors: Capella Key Features

Brush diagram layouts	**Transition System Subsystem**	**Live collaboration**
Replicable elements	**Progress monitoring & model review**	**IVV and Product Line viewpoints**
Automated contextual diagrams	 **Capella** **Key added-value features**	**HTML output**
Unsynchronized diagrams		**Batch quickfixes**
Fast Linker	**Validation profiles**	**IncQuery & Acceleo requests**
Model Patterns	**Semantic delete with preview**	■ ■ ■

Deployment Enabling Factors

Methodological support

The tool is just a mean to implement the engineering approach

The availability of the embedded methodological guidance has had a direct impact on operational deployment

Coaching

Initial training is not enough, ugly architectures with models are still possible!

Coaching: Definition of modeling objectives and strategies, stopping criteria, identification of achievable benefits, etc.

Deployment Enabling Factors

Development of a MBSE community

Regular thematic workshops (method experts, tool/modelling experts and operational practitioners)

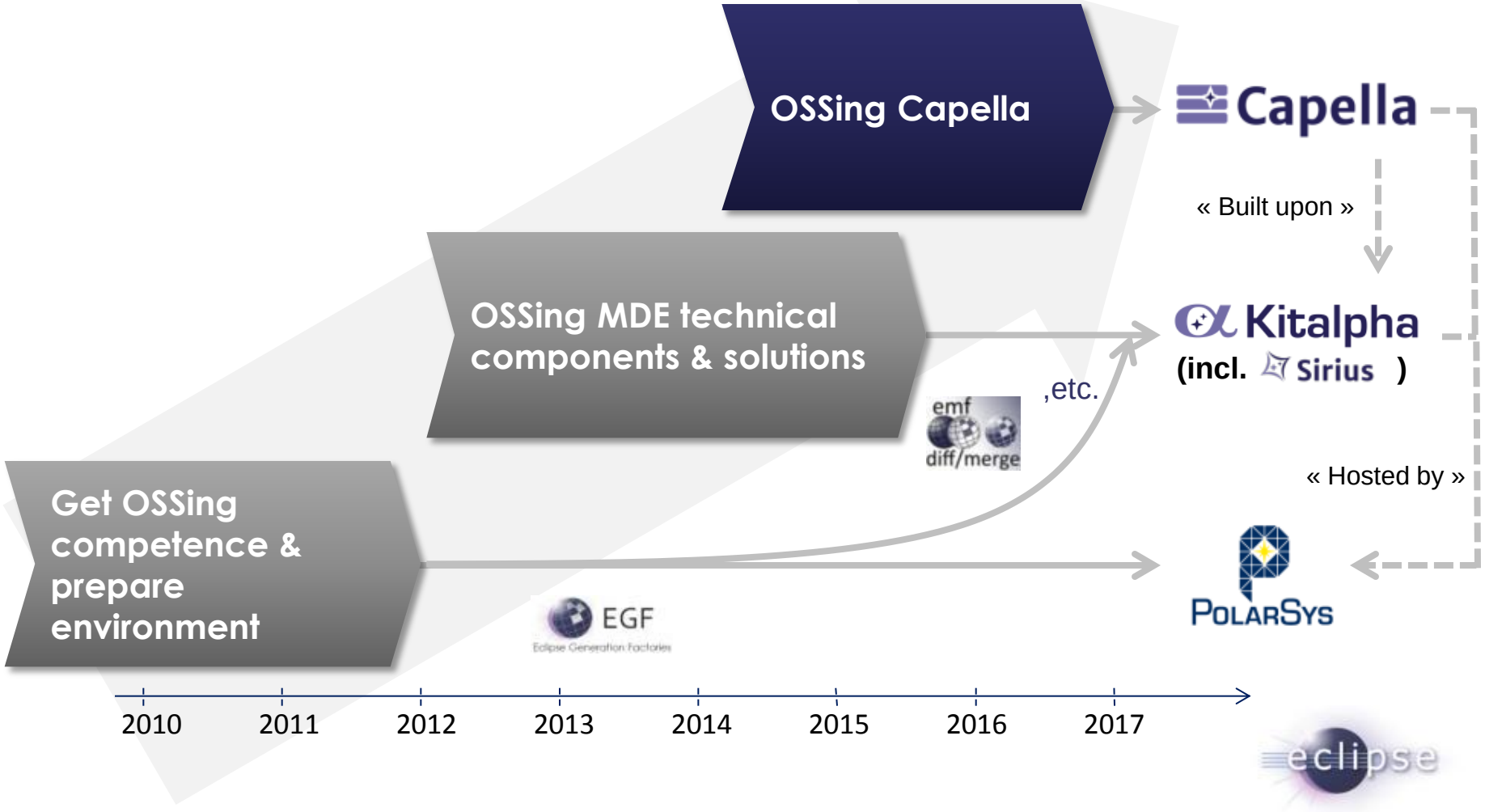
Identification of MBSE "champions" in Business Units

Favor the exchange of experiences

Favor the sharing of add-ons / viewpoints

Next steps

Thales MDE OSSing Phases & Roadmap



Large-Scale DS(M)L Deployment in Thales

Thank you for your attention!

Any Questions?