Enabling Digital Engineering

with the

Systems Model Exchange Framework

SODIUS

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Introduction

Sodius Corp. is a U.S. company and is the global leader in **software solutions for data transformation in classified and non-classified environments, enterprise interoperability, and model-based code generation** to improve data exchange, transformation, traceability, and the linking of engineering data in mission- and safety-critical industries thereby enabling digital engineering workflows.

We're also, totally Trade Agreements Act (TAA) compliant.

We primarily deploy our solutions in:

- **U.S. Aerospace & Defense Companies**
- **DoD Agencies**
- **Automotive**

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Presenter's Bio

LinkedIn: linkedin.com/in/jeffpilato

Over the past several years, **Jeff Pilato** has spoken frequently at the following symposiums and conferences; International Council of Systems Engineers, Global Product Data Interoperability, National Defense Systems and Mission Engineering, Digital Engineering for Defense, MBSE Cyber Systems, as well as numerous IBM ELM events about how the Sodius software solutions aid in enabling the thread of digital engineering for mission/safety critical complex systems.

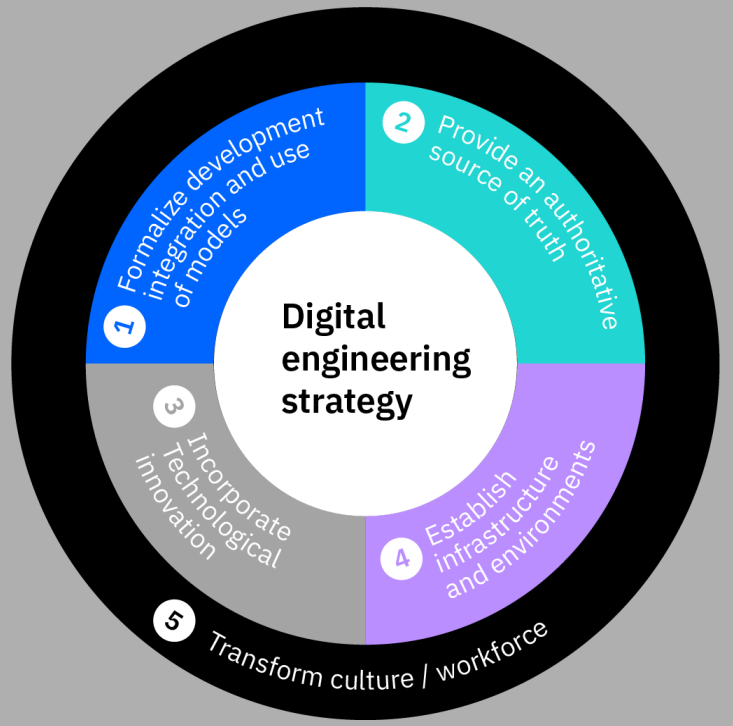
Jeff's role as the Chief Strategy Officer at Sodius Corp. has spanned about six years. He has broad responsibilities in supporting Sodius' executive leadership team in defining and executing the company's long-term strategies and key business development initiatives. In addition, he's responsible for Sodius Corp.'s global sales revenues for the systems model transformation business as well as the negotiation of all associated legal agreements.

Jeff has been in business development for almost 40-years and has worked for companies such as Harris, Mentor Graphics, Wind River, IBM, Oracle, and Ansys. His areas of expertise are primarily within the aerospace, defense, and automotive industries.

Why Digital Engineering?

As stated by the U.S. DoD, digital engineering is now a mandate for improving the efficiency, effectiveness, and affordability of its acquisition programs.

- **Improved decision-making:** leveraging simulations and models that can be used to assess different design options before physical prototypes are built.
- **Reduced costs:** identifying and resolving problems early in the design phase, avoiding costly rework later, and fostering reuse.
- **Better communication and collaboration:** providing a central repository for all project data improves communication and collaboration between different stakeholders.
- **More effective requirements definition:** models ensure that requirements are clear, concise, and achievable.
- **Increased innovation:** fosters exploration of new and innovative design concepts for cutting-edge systems.



"…such engineering environments will allow DoD and industry partners to evolve designs at conceptual phase, reducing the need for expensive mockups, premature design lock, and physical testing."

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Industry leaders trust Sodius to help them improve productivity

LOCKHEED MARTIN

BOEING

NORTHROP GRUMMAN

Raytheon

BAE SYSTEMS

AIRBUS

Dynetics
A Leidos Company

L3HARRIS™

SAIC

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Commercial Item Description (CID) for the Publisher from NAVAIR

Sodius Corp. is excited to announce that in April 2023, we received CUI from the U.S. NAVAL AIR SYSTEMS COMMAND HEADQUARTERS with a **Commercial Item Description (CID) for the Publisher for Rhapsody** per definitions (1)(i) and (1)(ii) of FAR 2.101 for a commercial product **that enables single source of truth data for the MQ-25 Stingray MBSE program.**

Defense Contract Management Agency (DCMA) Commercial Item Group (CIG) stated that **this CID will make it much easier for systems engineers to leverage the Publisher for Rhapsody on other DoD programs.**

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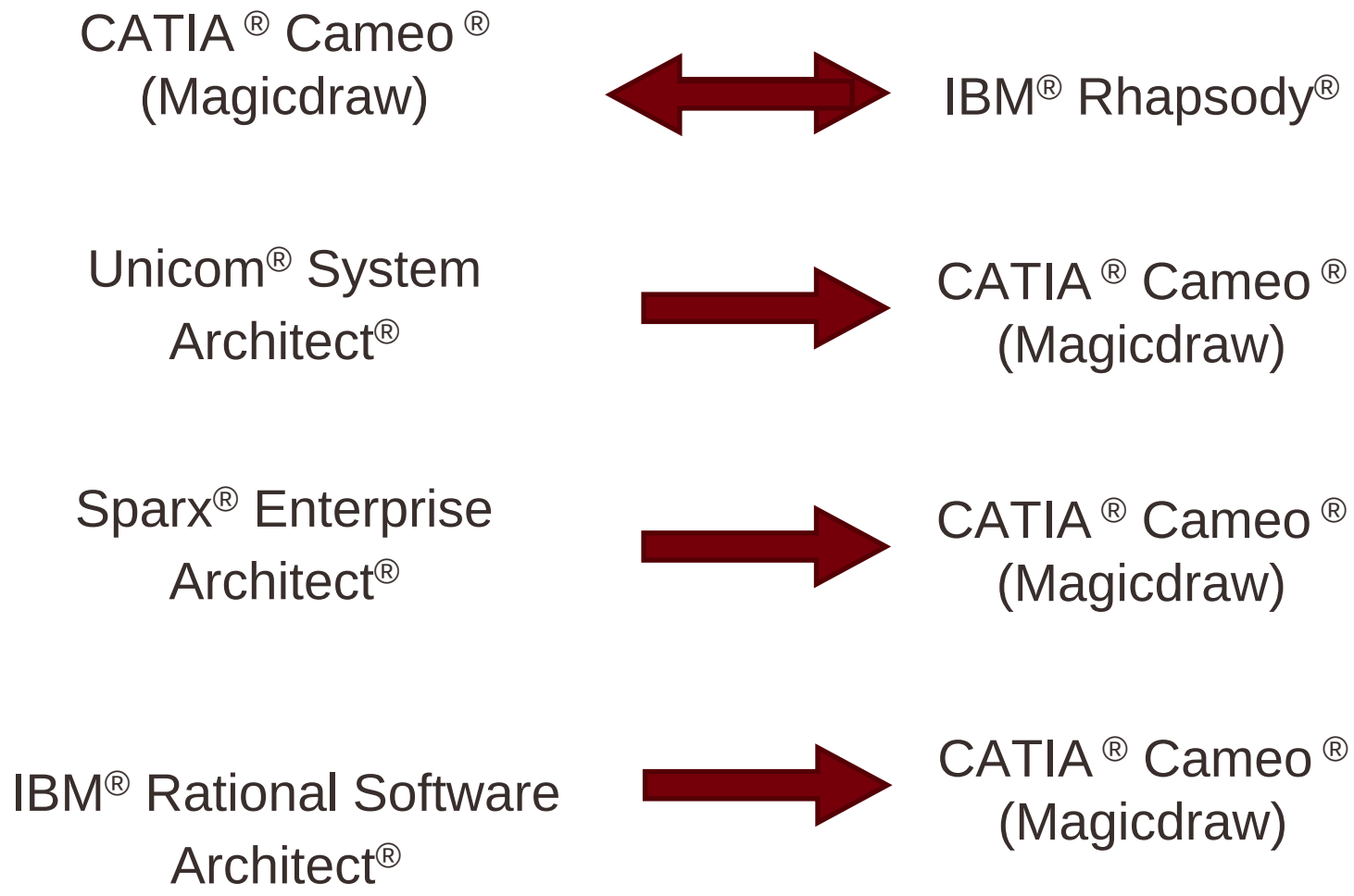
System Model Exchange between different modeling tools

Sodius Publisher family of products are the only fast, automatic, and proven solutions used to overcome systems model exchange challenges



Framework for System Model Exchange between different modeling tools

If you want to:

- **Design in one modeling tool and deliver in another**
- Or, **Migrate from one modeling tool to another**

You'll need to be able to **export and publish your model data from Cameo (MagicDraw), Rhapsody, System Architect, Sparx Enterprise Architect, or Rational Software Architect.**

The industry challenge . . . there was no comprehensive solution, and you would have encountered three key challenges:

- ***How do you get years of modeling IP exported and imported quickly?***
- ***How do you transfer data consistently and accurately for very large models?***
- ***How do you transfer thousands of diagrams?***

Why not use XMI out-of-the-box, right?

- **XMI doesn’t include diagram layouts**: This is where 90% of the modeling work is done. Diagrams provide a specific view in the specification and are laid out to communicate clearly and easily. Losing these is losing a lot of the intended communication of the author.

- **XMI doesn’t map standard profiles across tool implementations**: Publisher maps the way SysML, for example, is implemented in the different tools so the resulting model looks like it was natively created in the target tool.

- **XMI doesn’t handle different tool implementations of the UML or XMI standards**. Every tool supports UML differently and exports XMI differently. As the author of the Rhapsody XMI Toolkit, and after working with Cameo’s XMI for 12 years, we know all the differences in how UML is supported, and the XMI is produced, so we can map the concepts consistently across implementations. Examples include Object containment and Authorized relationships that are different in Cameo and Rhapsody.

- **Over 40 person years of effort in Publisher family of products**.

Customer Proof Points

Raytheon
Integrated Defense Systems

Content to export: 200 diagrams, 18,000 elements.

Expected time w/o Publisher: “a quick computation leads to 18 weeks of remodeling and validation without the reproducibility and confidence brought by automated solution.”

Total time to export: ~ 1 hours

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"By leveraging the MagicDraw Publisher for Rhapsody, the total time to export the end-customer deliverable was less than two hours.”

Chris Finlay – Project Manager

Content to export: 37,331 files in Rhapsody UML format with 812,405 elements and 703 diagrams

Expected time w/o Publisher: ”This kind of transformation, if done manually, would take man-years to complete.”

Total time to export: Less than half a day

--

“The Publisher for Rhapsody quickly enabled us to automate the migration from Rhapsody UML models to Cameo/MagicDraw SysML models.”

Sean F., Dynetics Project Manager and Lead Systems Architect
Redstone Arsenal

NORTHROP GRUMMAN

Content to export: 220,000 elements and 300 diagrams in Rhapsody SysML

Expected time w/o Publisher: ”Redoing an entire model that months were spent on because of tool changes, would have been a huge waste of resources.”

Total time to export: 20 minutes

--

“We like it, and the management is very pleased. Redoing an entire model that months were spent on because of tool changes, would have been a huge waste of resources.”

Maxwell Yavaraski., Principal System Engineer

How Publisher family of products have helped our customers

SAVE ENGINEERING TIME
(faster)

Save months or years of critical engineering resources converting and validating manually re-written models.

With the **Publisher for Rhapsody or Cameo model Importer for Rhapsody**, users can **automate the export and publish models** to meet industry standards within minutes or hours.

MAINTAIN DATA INTEGRITY
(better)

With a fully automated transformation, data is checked and converted consistently within and between projects, in a **reproducible** way.

Any transformed data is uniquely identified **preserving traceability** after the conversion.

INCREASE ROI
(cheaper)

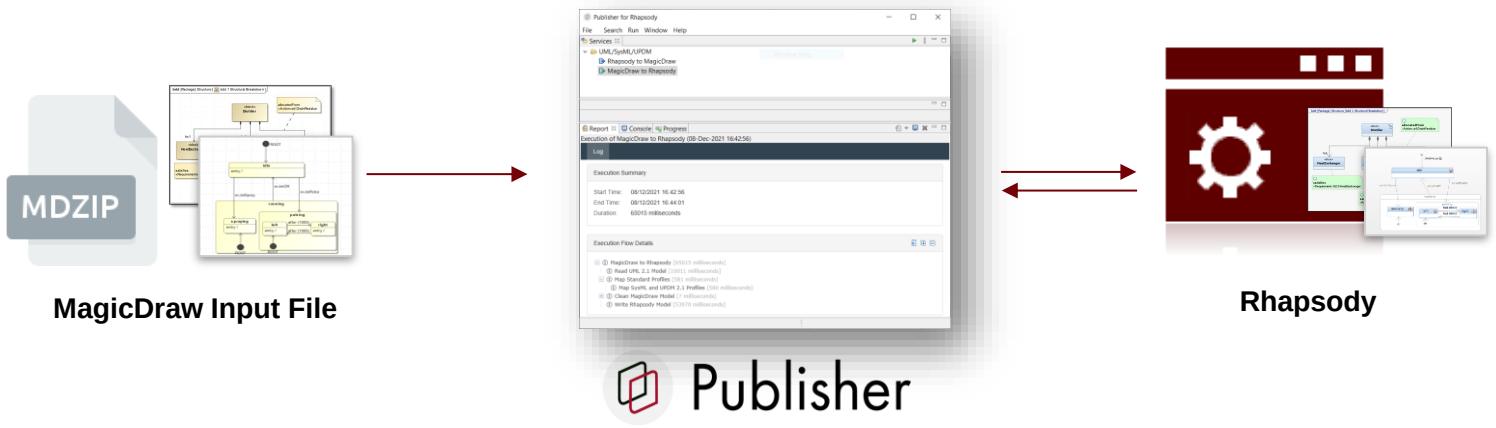
By converting semantic and diagrams in the transformation process, you preserve the modeling intent. Your **engineering added-value is transferred to your new target environment increasing the ROI of modeling activities** in your organization by saving months to years of manual re-modeling.

Cameo Model Importer for Rhapsody

Cameo Model Importer for Rhapsody

Simplifies the model exchange process from MagicDraw to Rhapsody

Enables automated import of Cameo/MagicDraw UML, SysML or UPDM models into Rhapsody for System / Sub-System or System-to-Software scenarios



MagicDraw Input File

Rhapsody

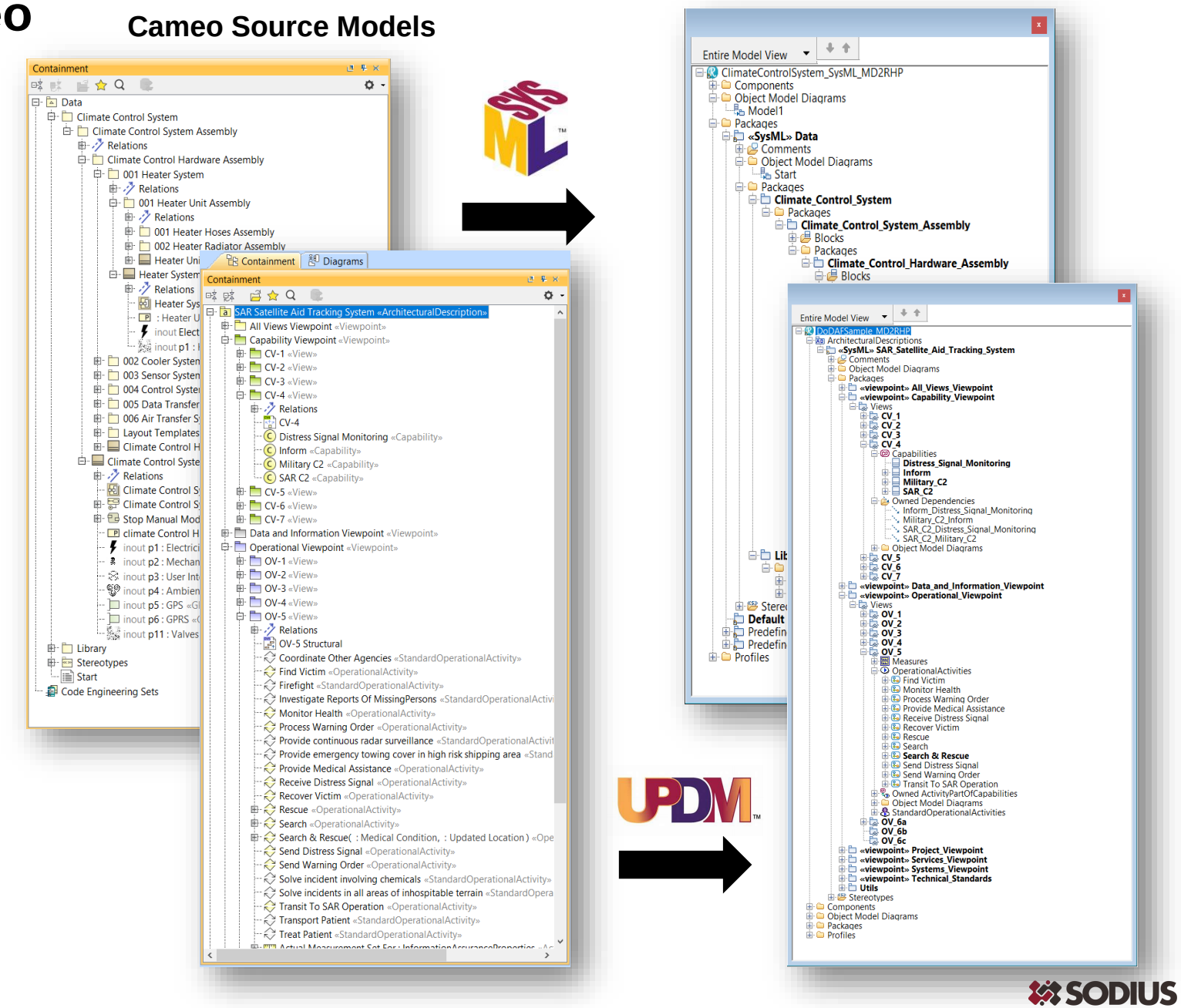
Consistent way to achieve Import / Export / Publish scenarios between Cameo and Rhapsody including:

- **Unique ID generation**
- **Alignment of profiles and libraries in both directions**

DoDAF & SysML from Cameo to Rhapsody

This new service of the Publisher includes:

- **Mapping of UPDM/ SysML elements**
  - Hierarchy, elements and relationships for UPDM, Architecture Description, Packages and Viewpoints
- **Import Cameo diagrams into Rhapsody**
  - Import of Structural and Behavior diagrams
  - Specialization of UPDM diagram import



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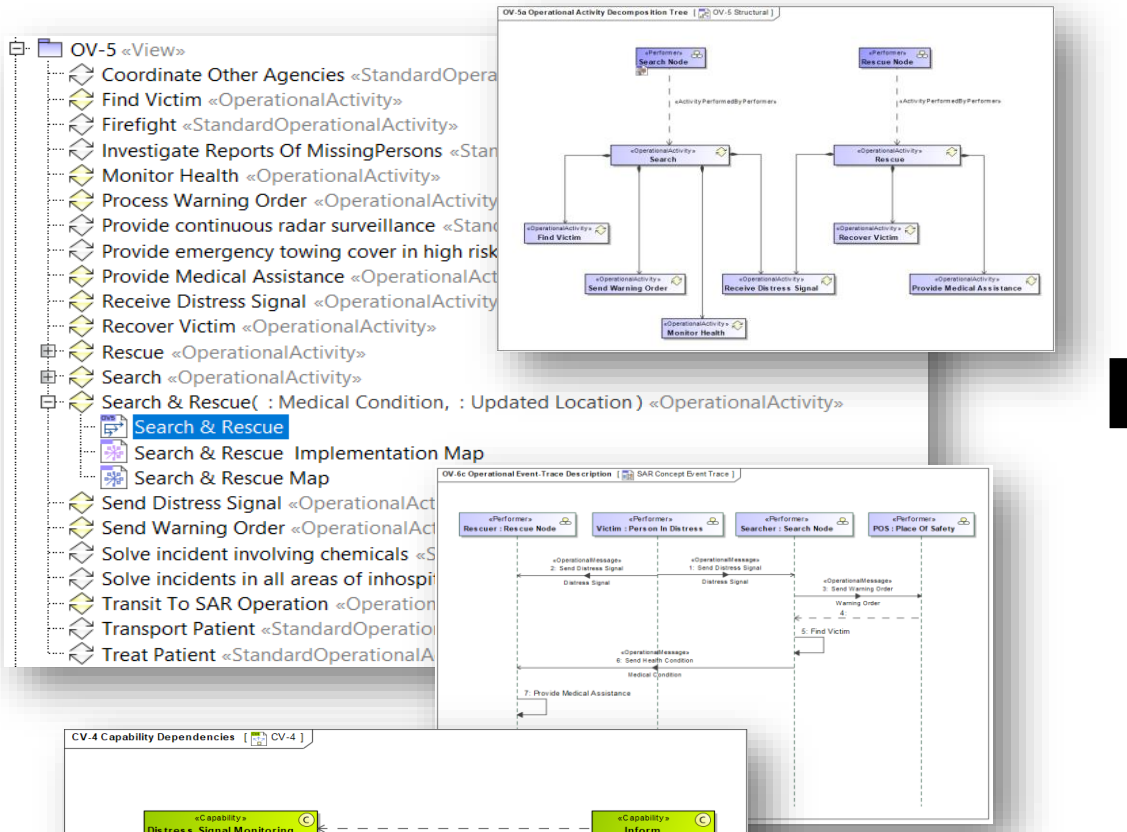
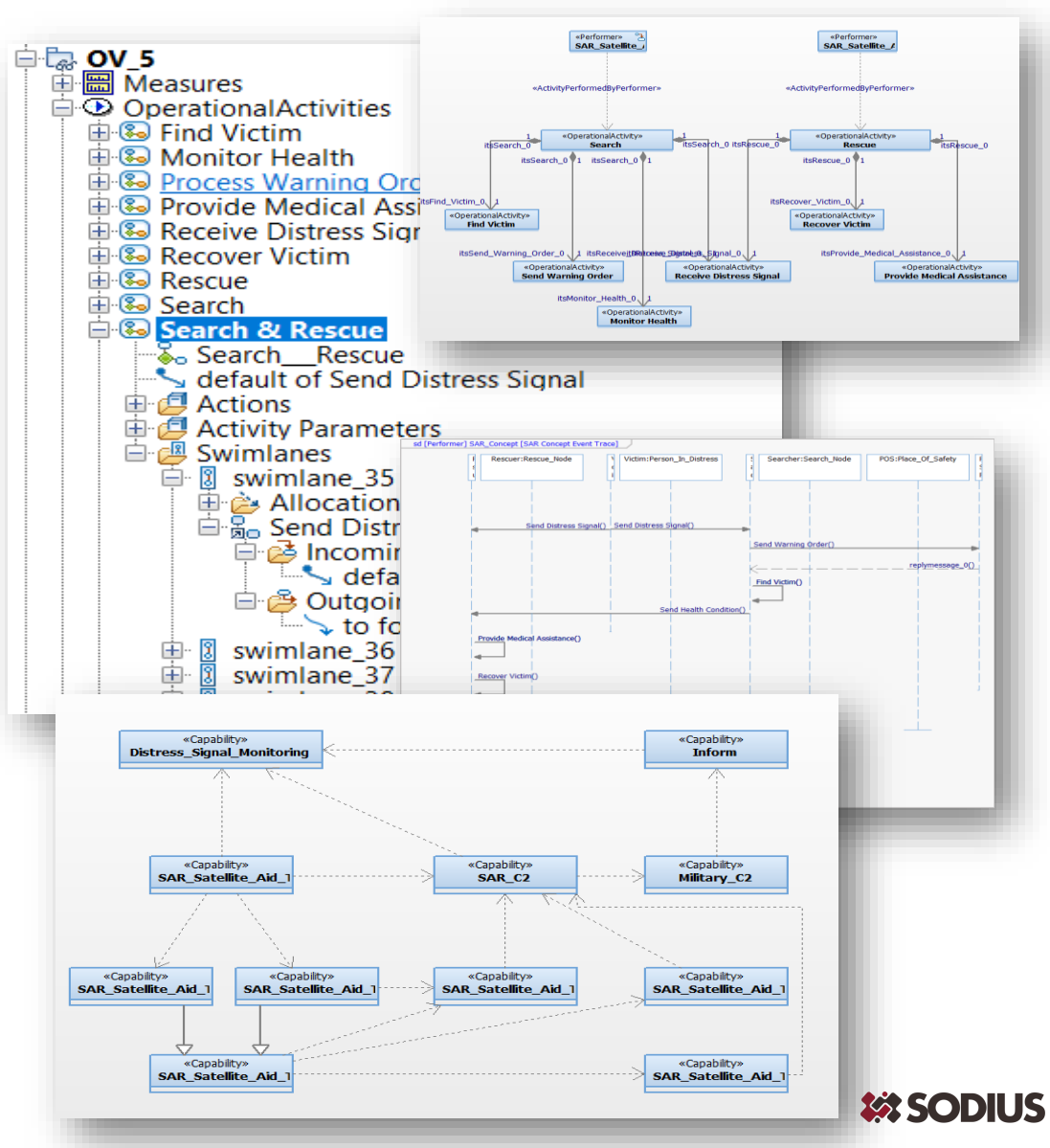
Semantics and Diagrams From Cameo to Rhapsody





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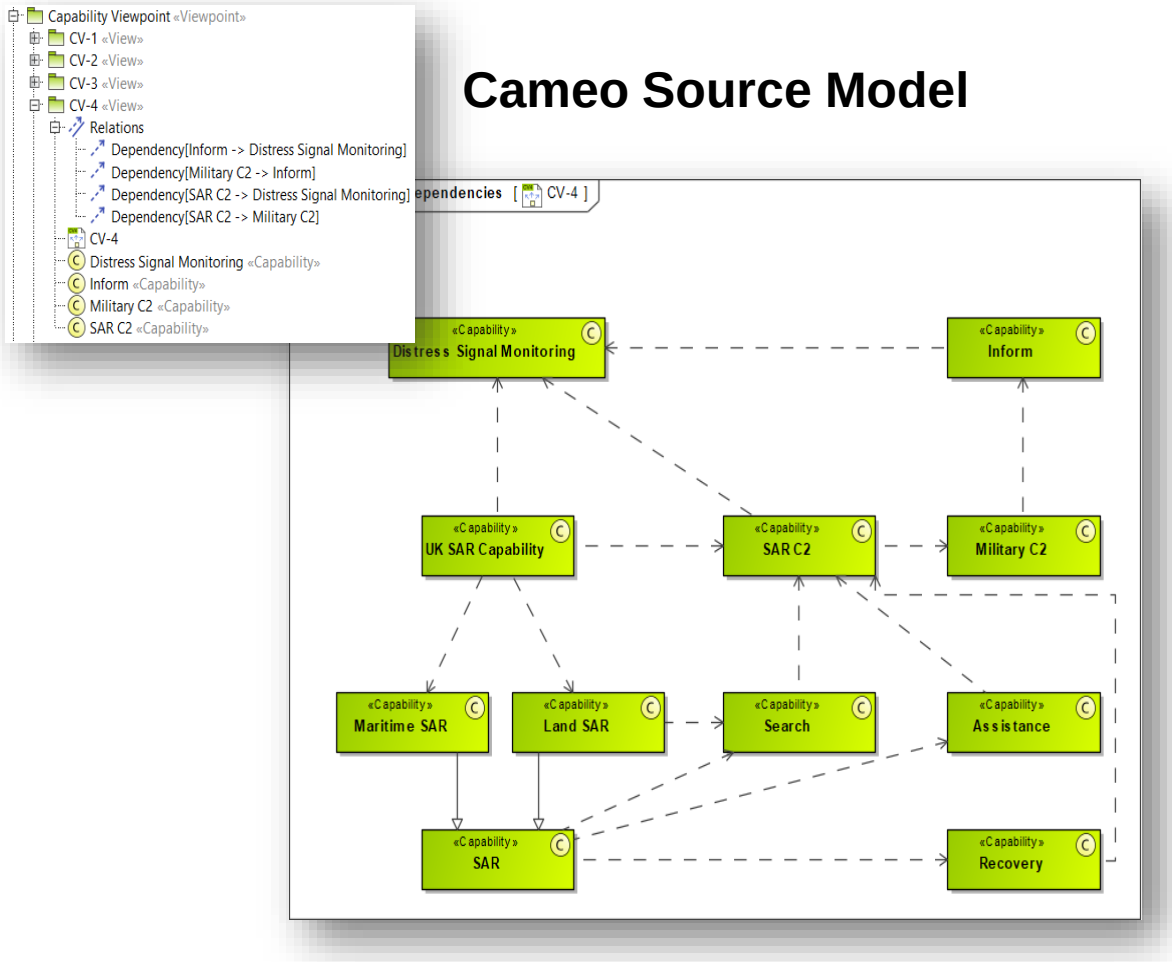
Model Elements and Structure Diagrams

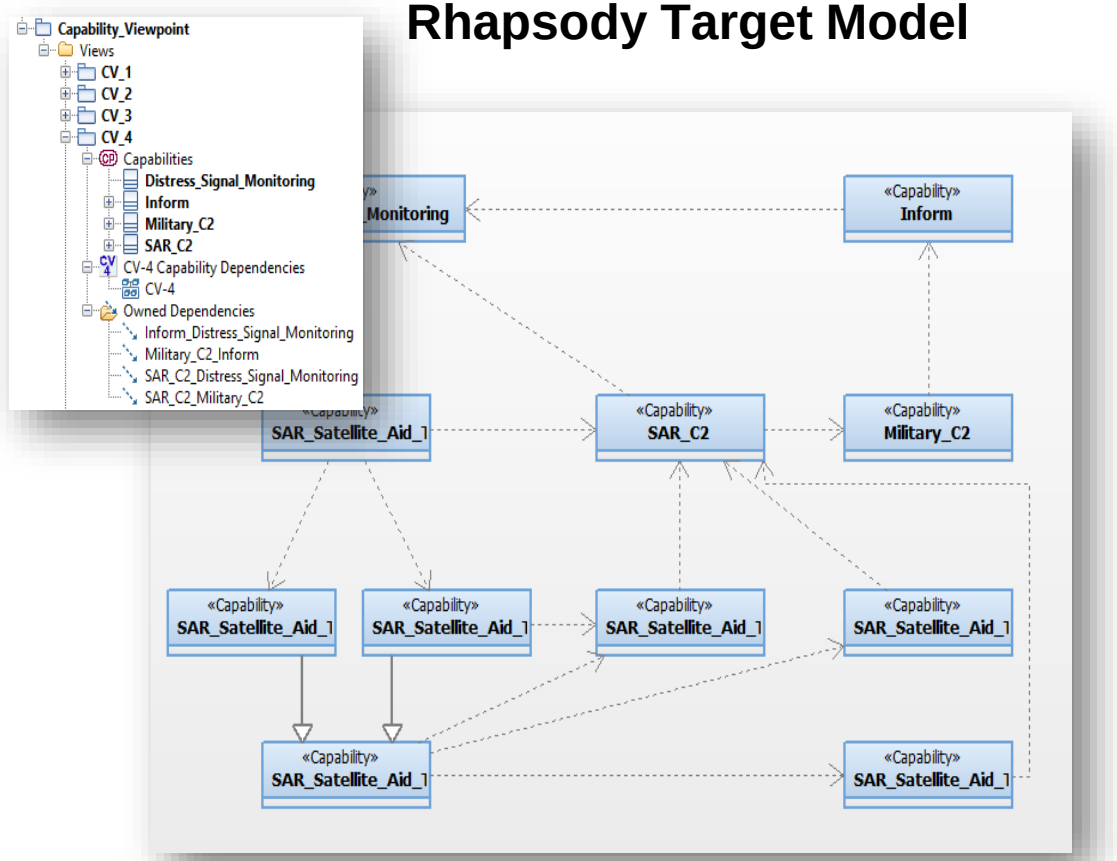
Convert any kind of structural items, including elements, relationships, and tagged values.

Example: Class Diagram / CV-4

Cameo Source Model



Rhapsody Target Model



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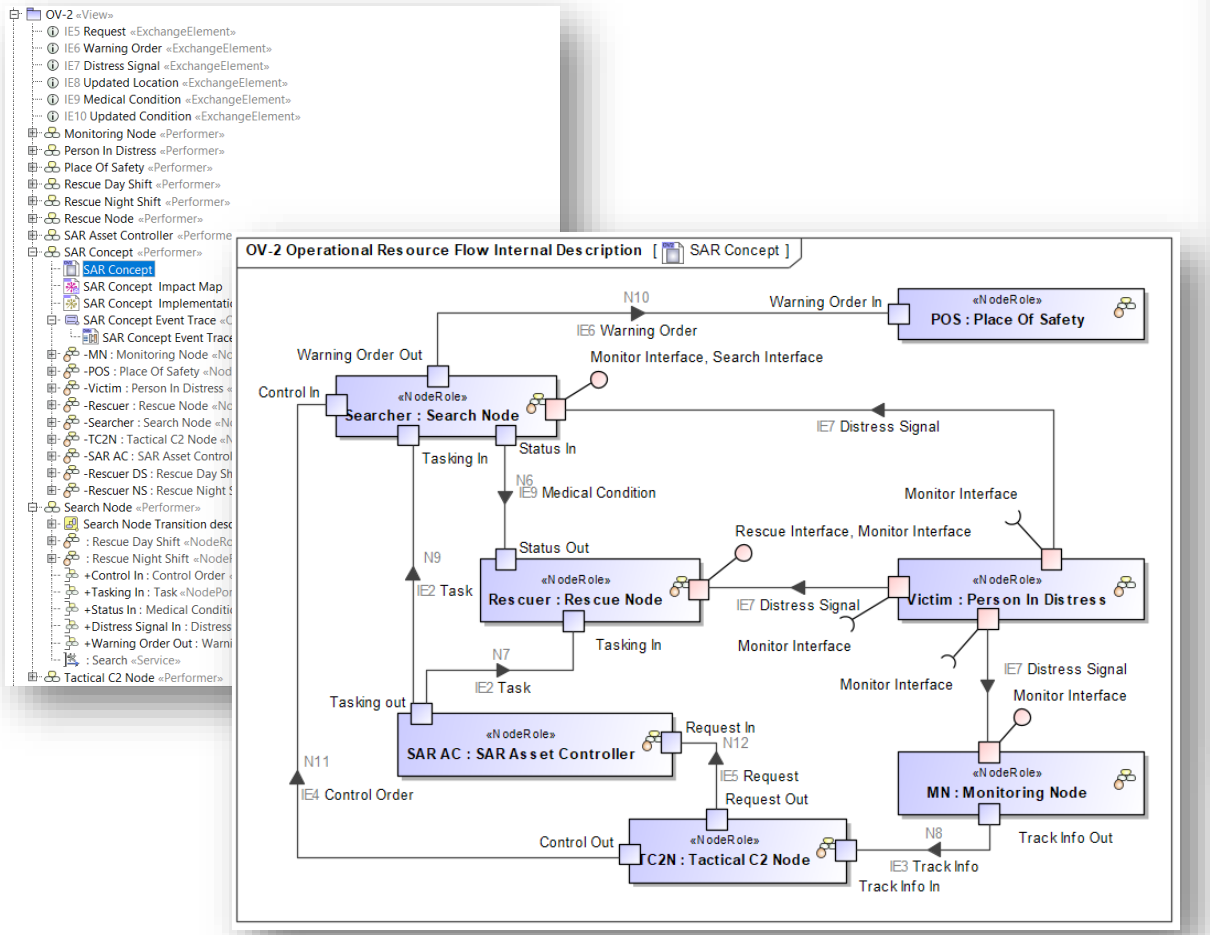
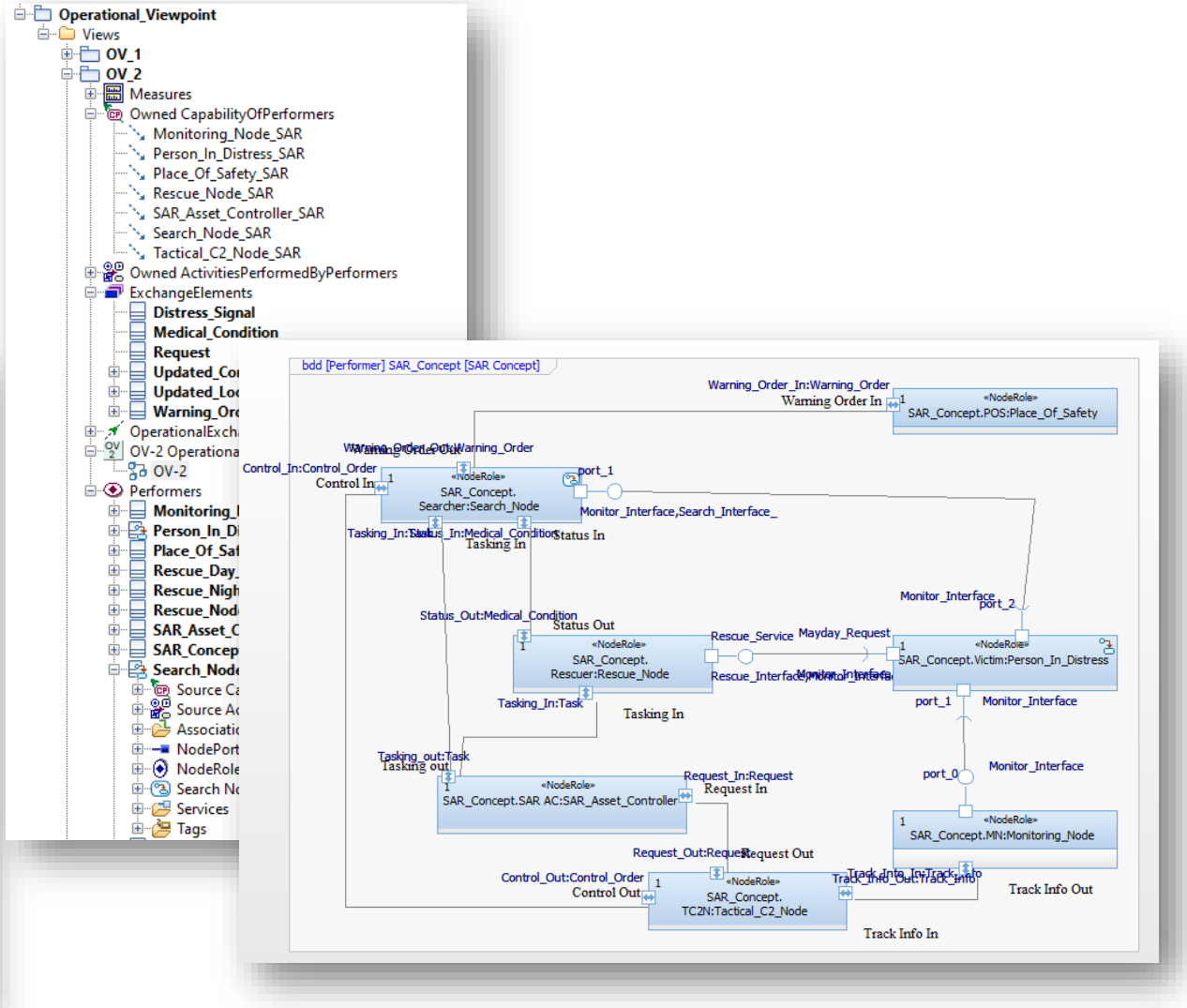
Composite Diagrams

- **Support for Composite Diagrams**



Cameo Source Model



Rhapsody Target Model

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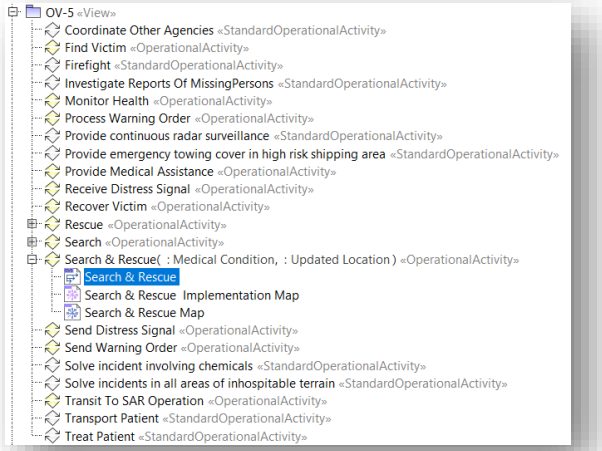
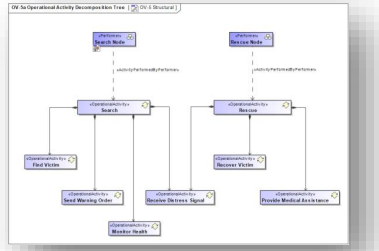
Behavior Diagrams

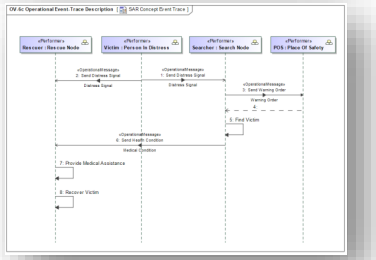
All Behavior Diagrams are Published:

- Use Case
- Activity
- State
- Sequence

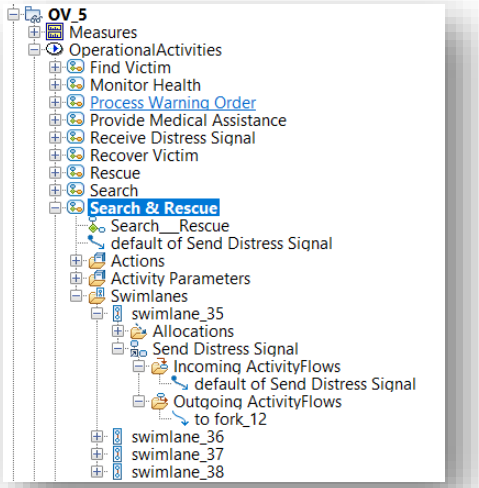
Cameo Source Model

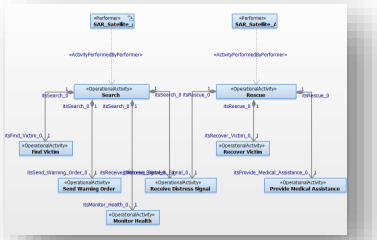


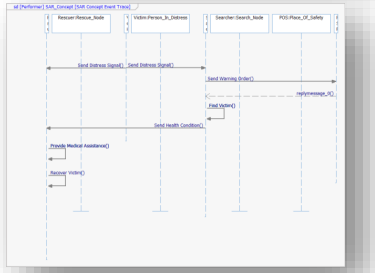




Rhapsody Target Model





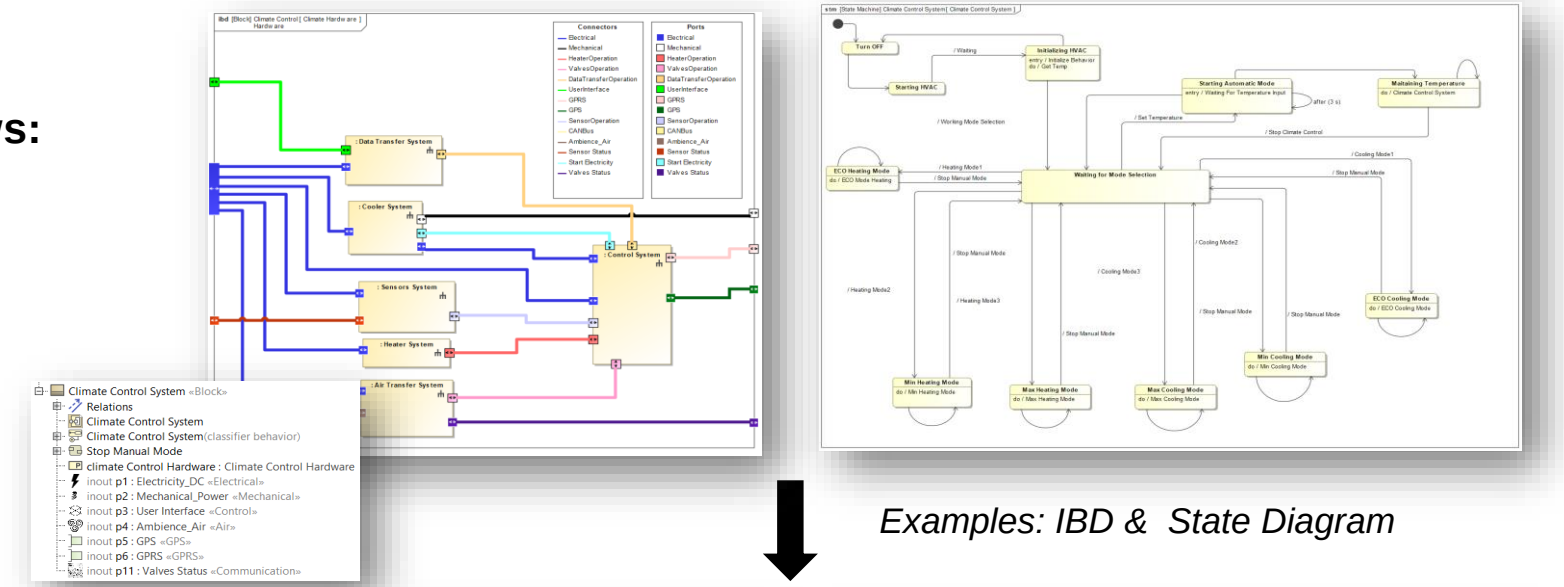


Other SysML Examples

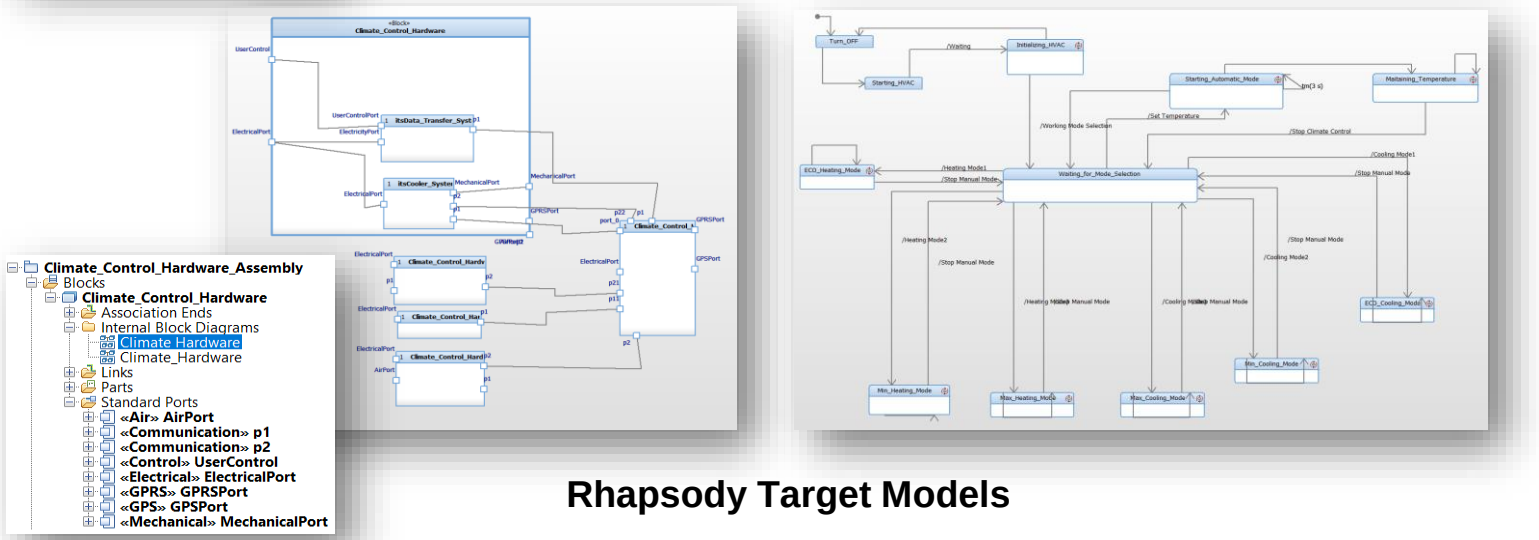
Support for Standard SysML views:

- Activity diagram
- Block definition diagram
- Internal block diagram
- Package diagram
- Parametric diagram
- Requirement diagram
- Sequence diagram
- State machine diagram

Cameo Source Models



Examples: IBD & State Diagram



Rhapsody Target Models

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September Publisher v3.3.0 – Cameo to Rhapsody Enhancements

- Based on collaboration with the U.S. AIR FORCE LIFE CYCLE MANAGEMENT CENTER (AFLCMC/EBRD)
- Enhanced diagraming display options and non-UML elements supports

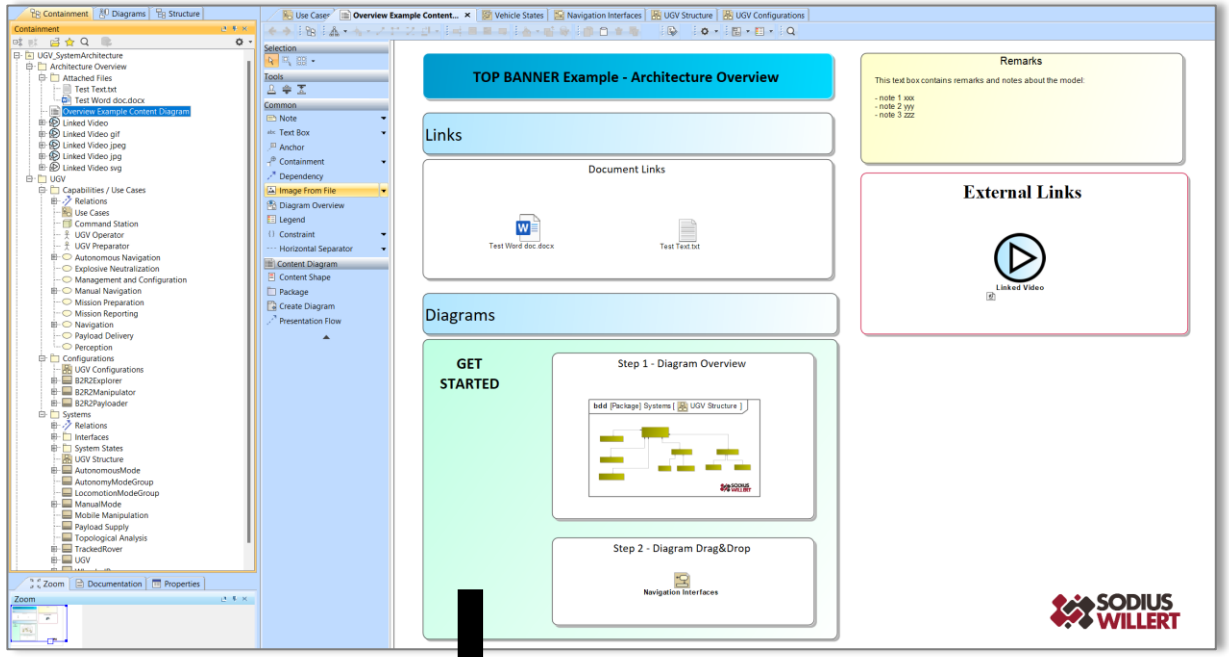
  - **Content Diagram and ‘Free’ Shapes *(non-UML elements)* Support**

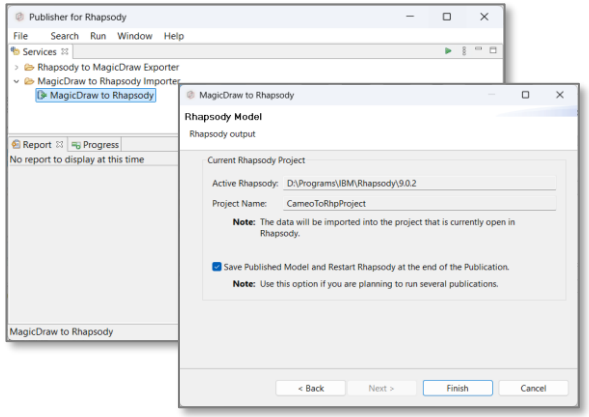
    - Content Diagram is a free « documentation » diagram of Cameo, used to create for example reading path across models. This type is not supported by Rhapsody, BUT we have mapped it to Object Model Diagram and added many options to support free shapes, hyperlinks, and file attachments.

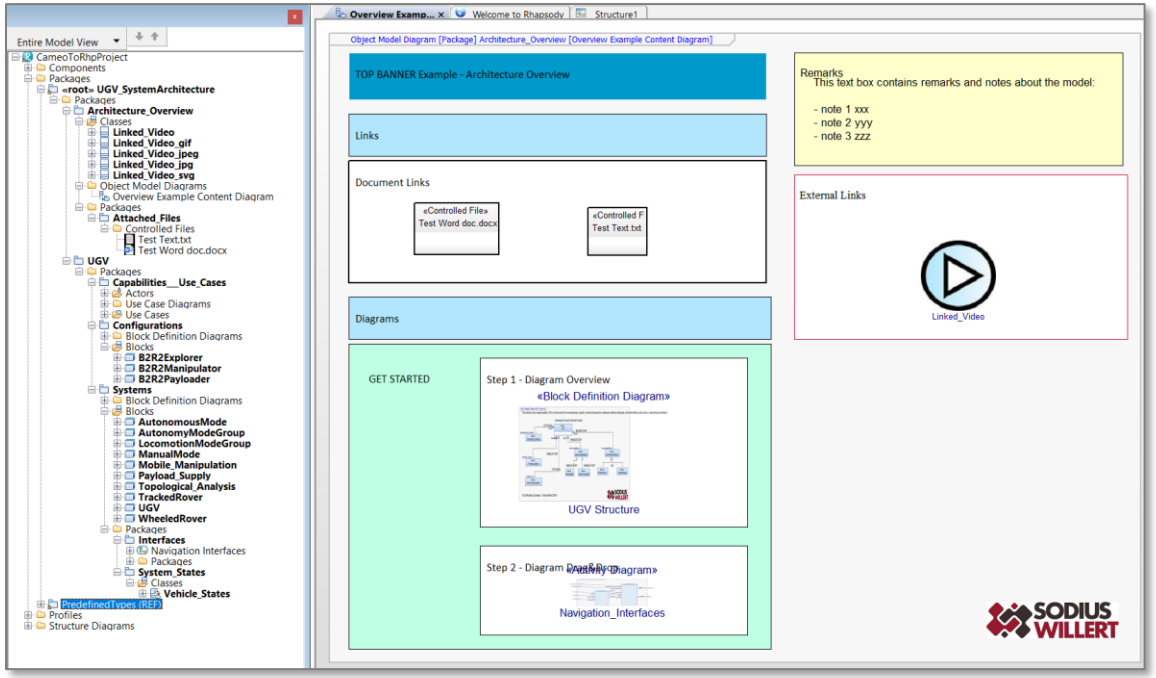
List of Enhancements

- **Content Diagrams support the following capabilities:**
  - Images conversion (various formats: jpeg, jpg, gif, svg, etc.)
  - Free shapes: textbox and rectangle with colors (background and border)
  - Attached files (mapped to Controlled Files in Rhapsody)
  - Hyperlinks
  - Improvement of Font Family and size
  - Activating Diagram Preview in Rhapsody

Example – Cameo to Rhapsody

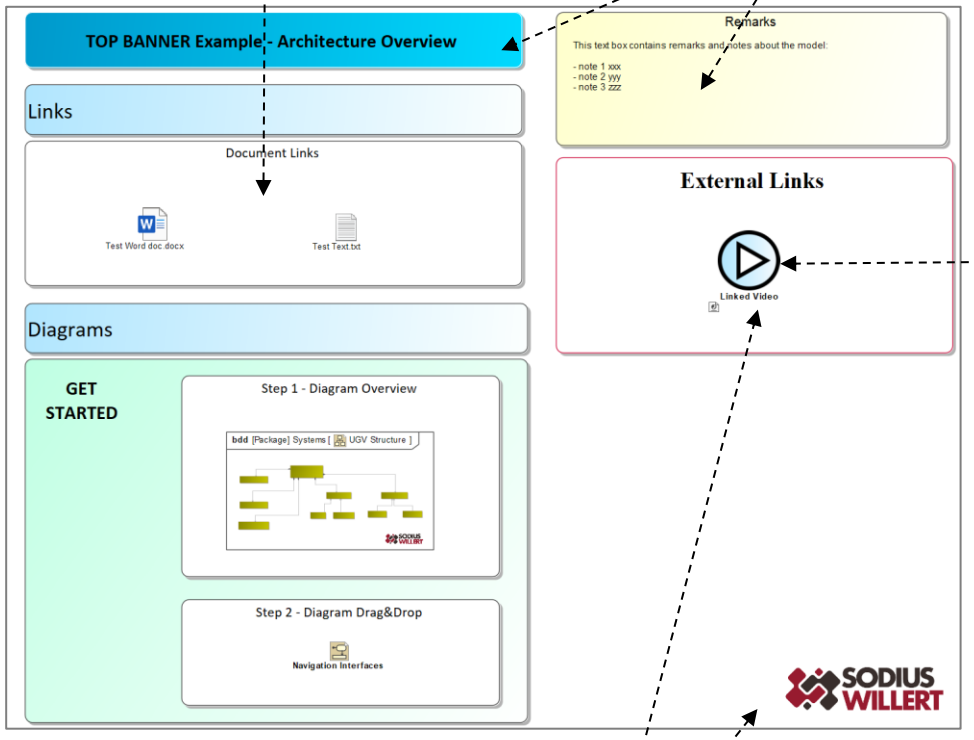




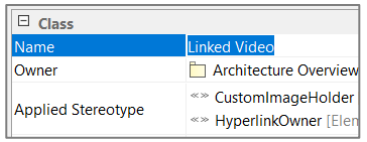


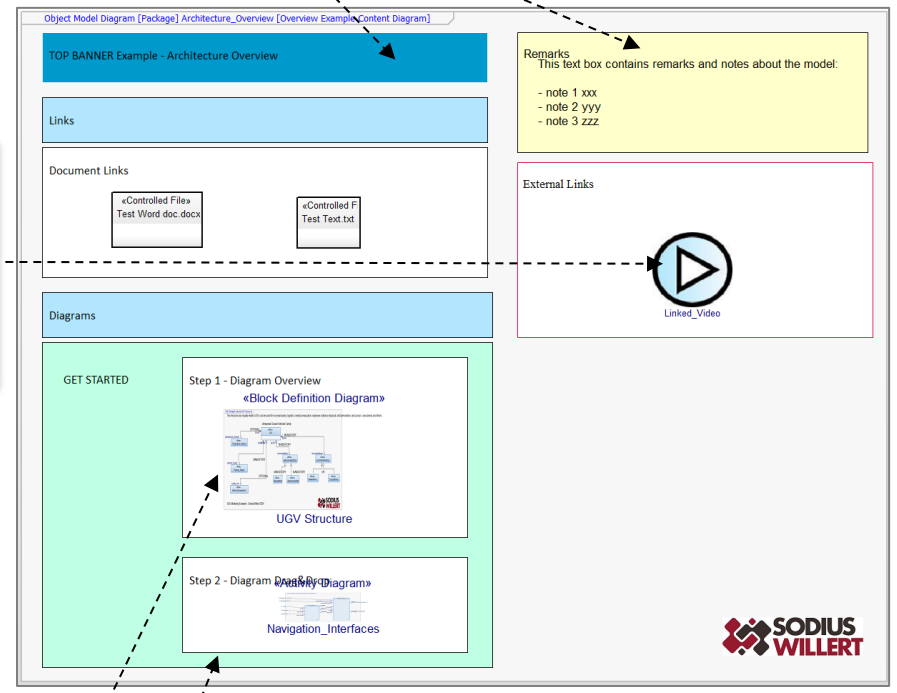
Attached files (hyperlinks AND content)

Free shapes: textbox and rectangle with colors (background and border)



Hyperlinks <<HyperLinkOwner>> + <<CustomImageHolder>> Class



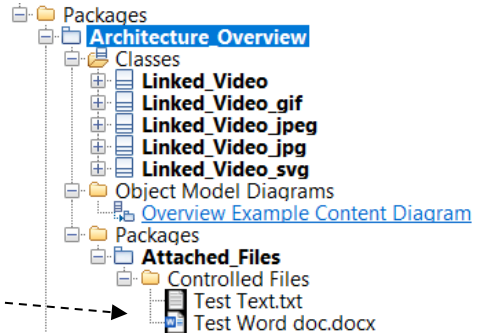


Cameo/MagicDraw

Images conversion (various formats: jpeg, jpg, gif, svg, etc.)

Activating Diagram Preview in Rhapsody

Rhapsody



Attached files (controlled files transferred in Rhapsody)

Publisher

for Rhapsody®

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Publisher for Rhapsody

The Publisher for Rhapsody is a plug-in that automatically generates complete **SysML/ UML/ UPDM2** MagicDraw models from Rhapsody, including:

- **Model elements, structure,** and **hierarchy**
- **Diagrams** maintaining layout and colors
- **Logs** of model transformation actions
- **Metrics** and **Reporting**
- **User Configurable Options**

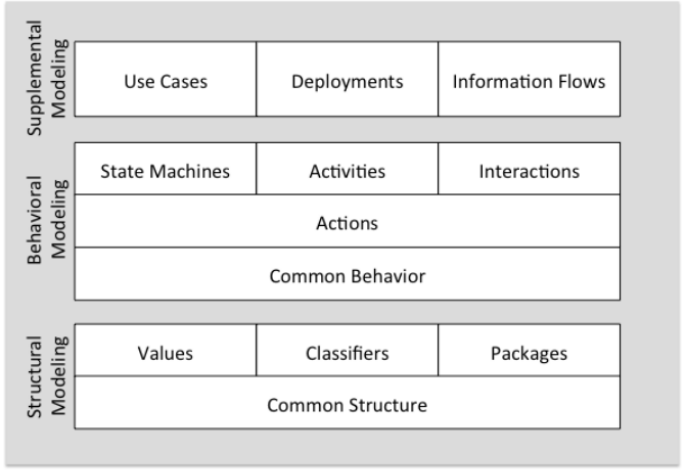
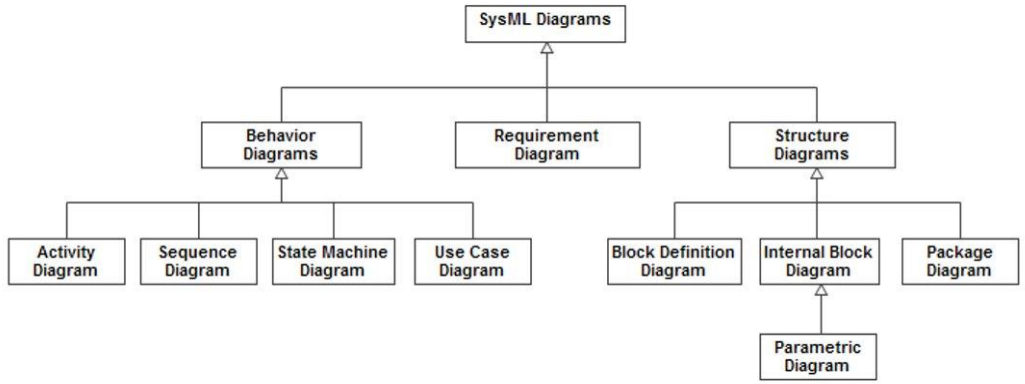


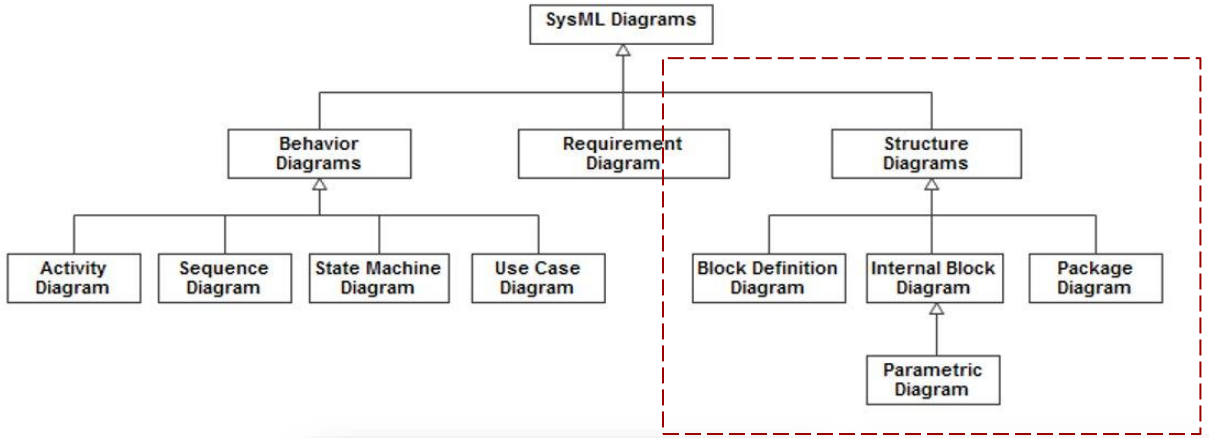
Figure 6.1 Semantic Areas of UML

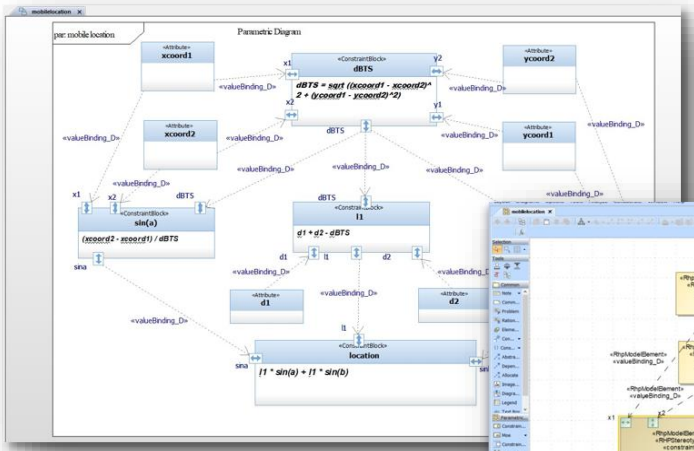


SysML Structure Diagrams

The Publisher converts SysML Structure Diagrams:

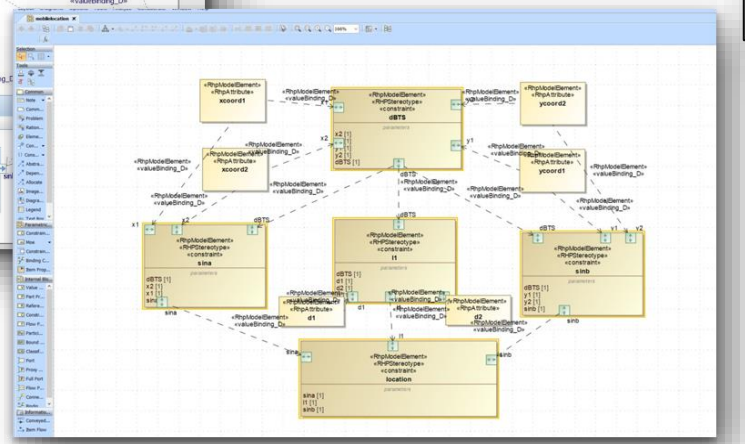
- Block Definition Diagrams
- Internal Block Diagrams
- Package Diagrams
- Parametric Diagrams

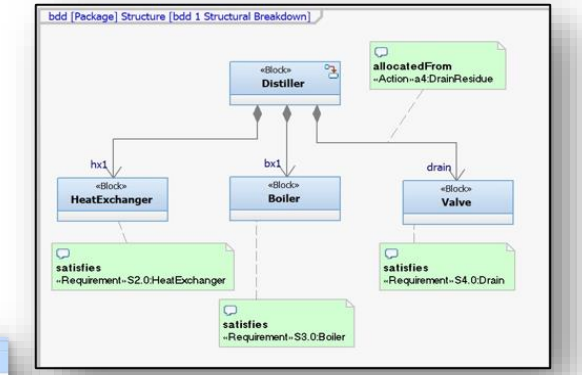




Rhapsody

MagicDraw





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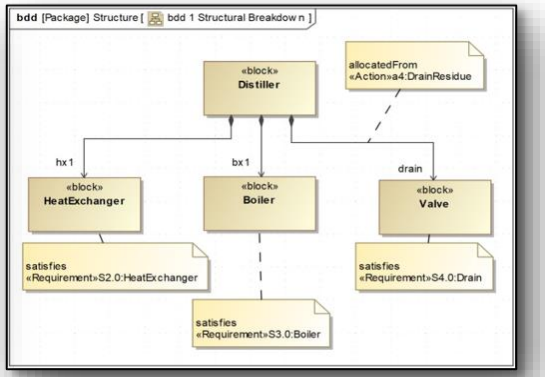
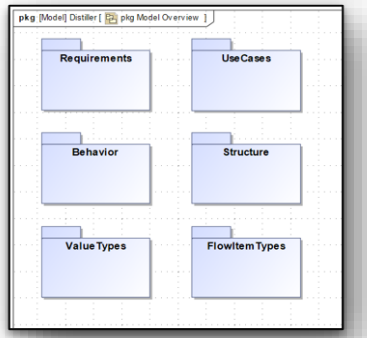


MagicDraw



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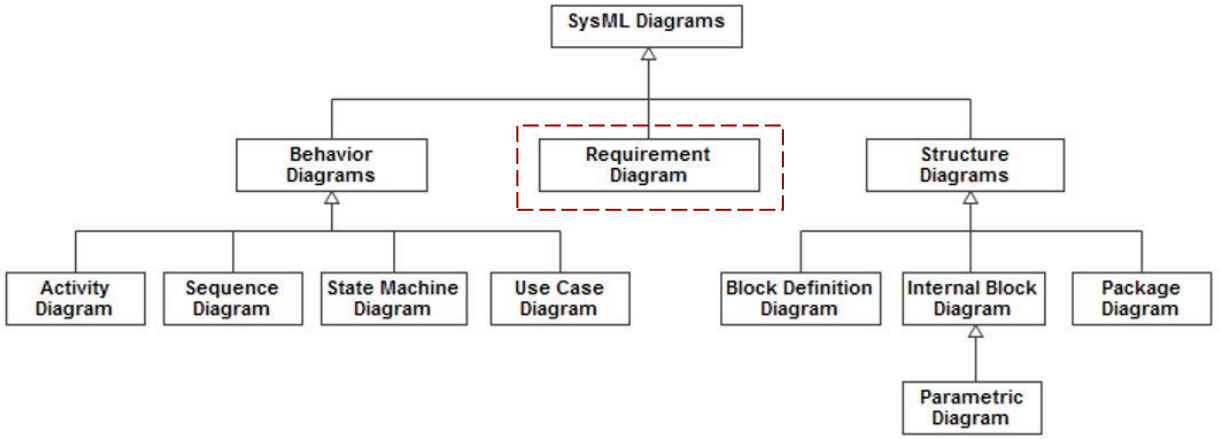
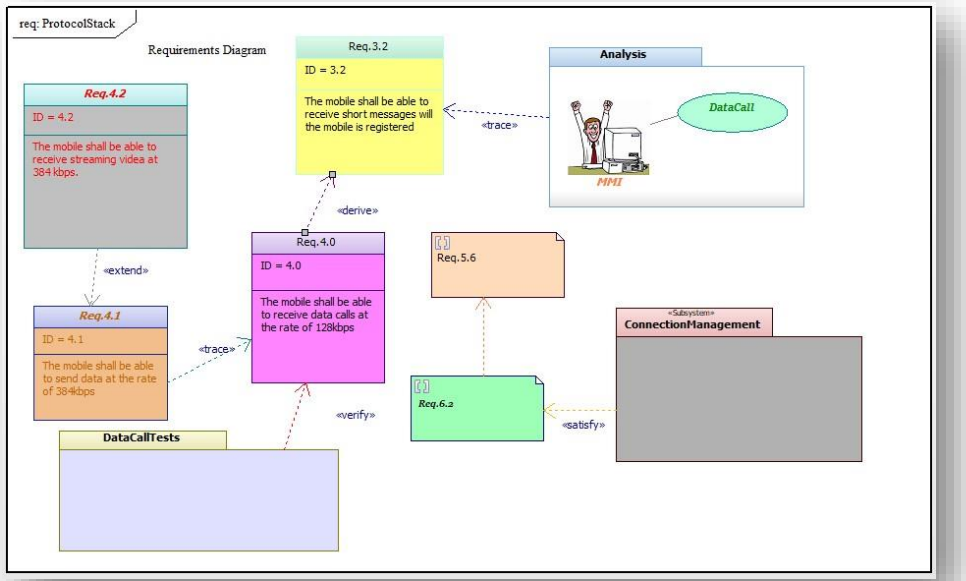
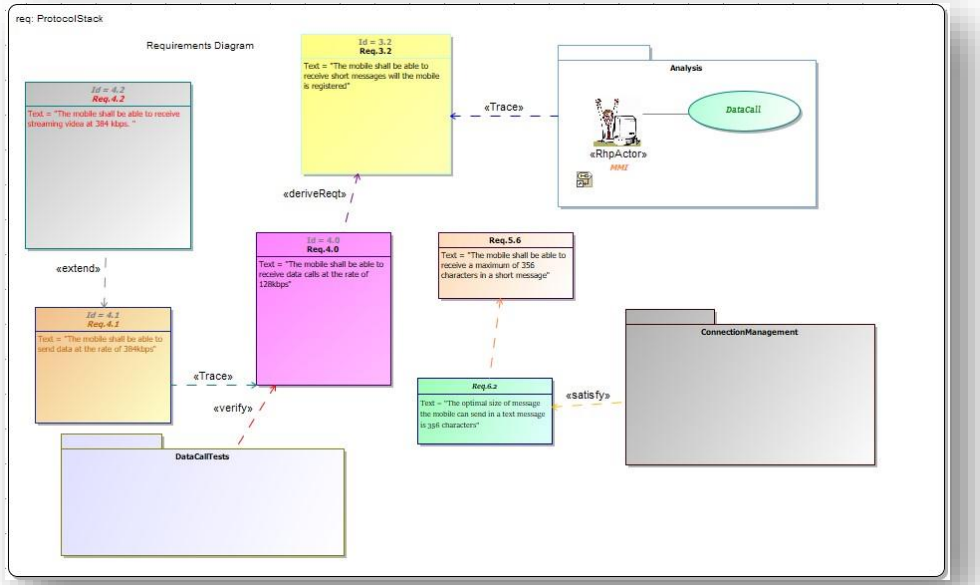
SysML Requirement Diagrams

Requirement Diagrams Conversion





Rhapsody



MagicDraw

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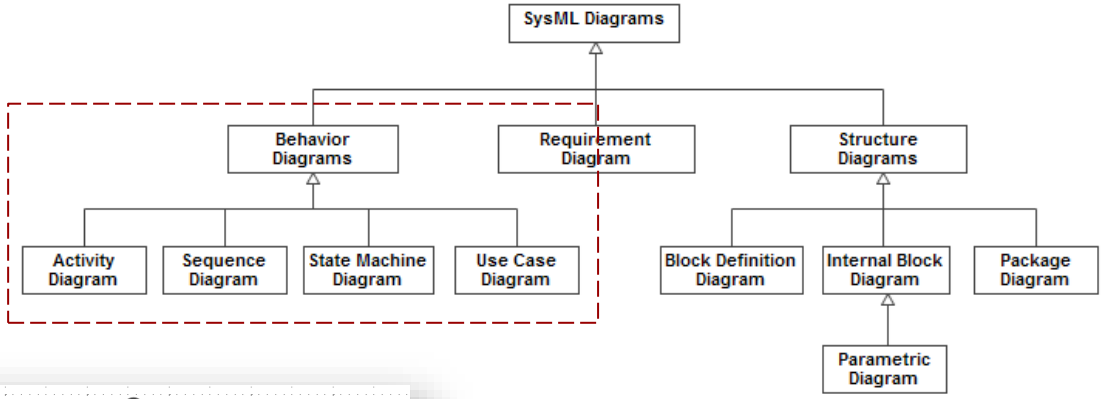
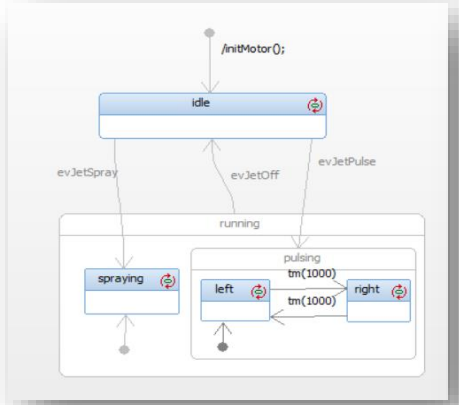
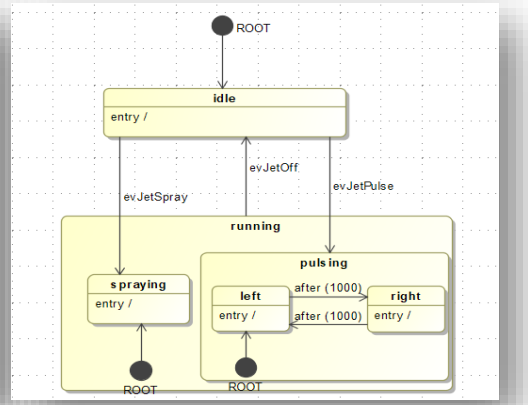
SysML Behavior Diagrams

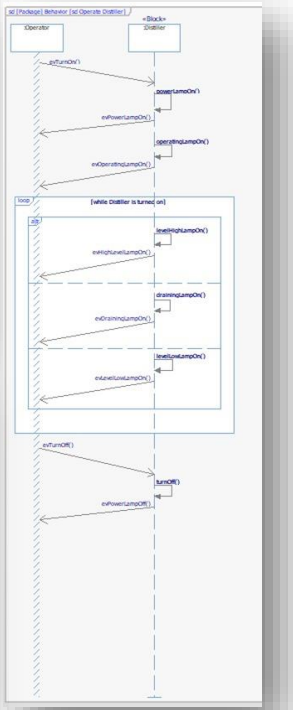


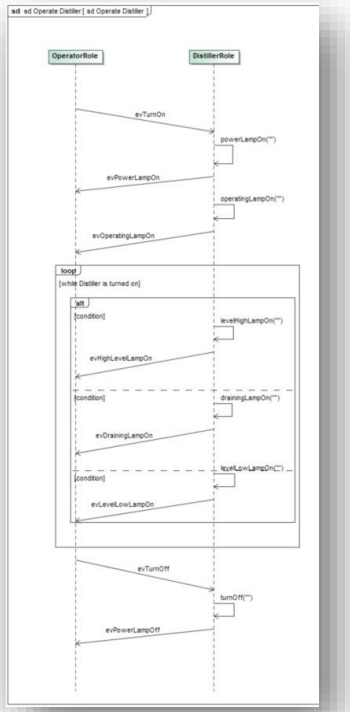
SysML Behavior Diagram Conversion:

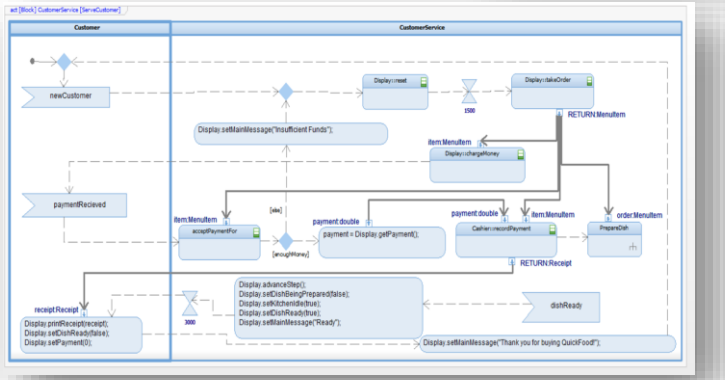
- Activity Diagrams
- Sequence Diagrams
- State Machine Diagrams
- Use Case Diagrams



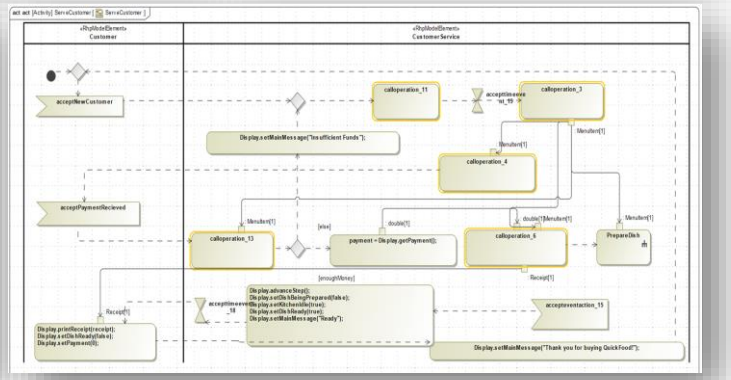








Rhapsody



MagicDraw

Rhapsody

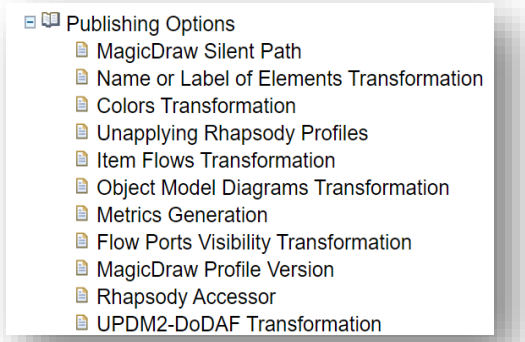
MagicDraw

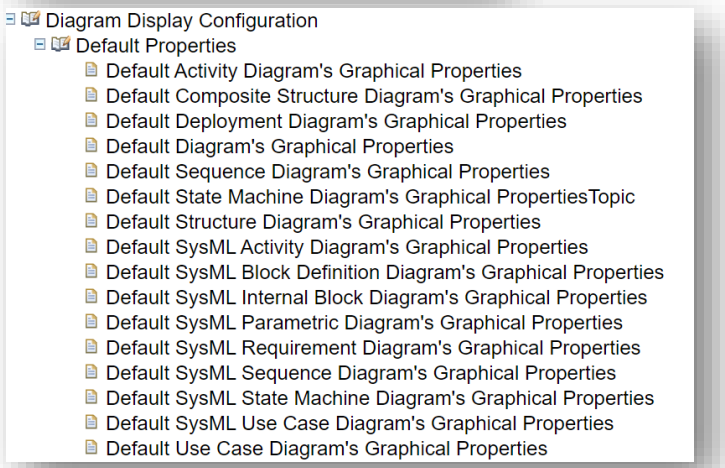
SODIUS

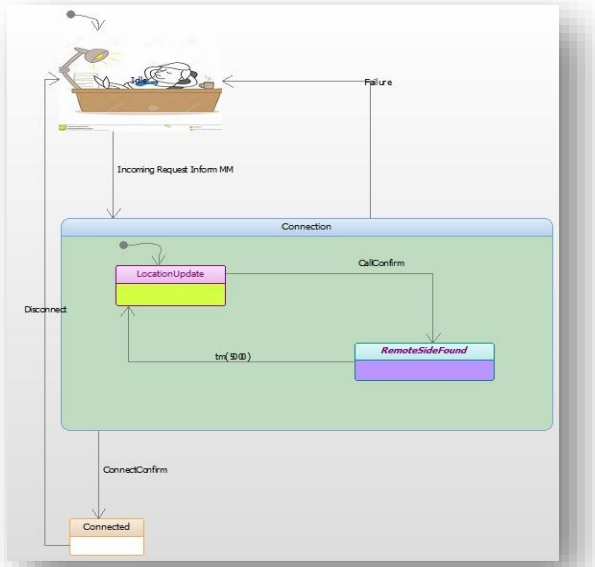
User Configurability

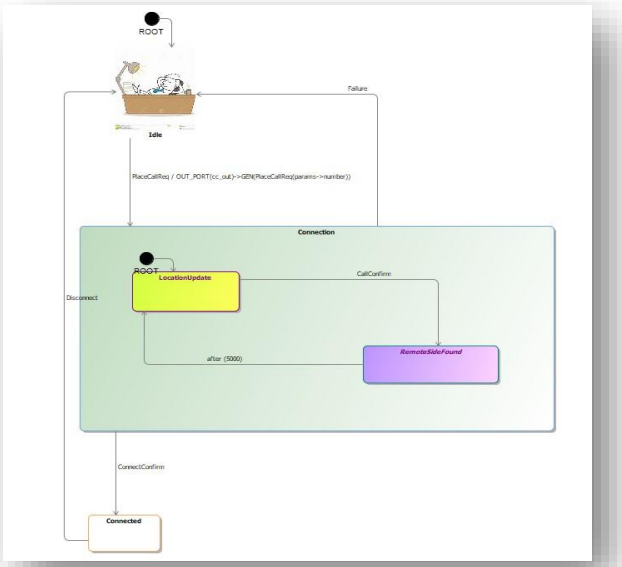
Customers have User Configuration

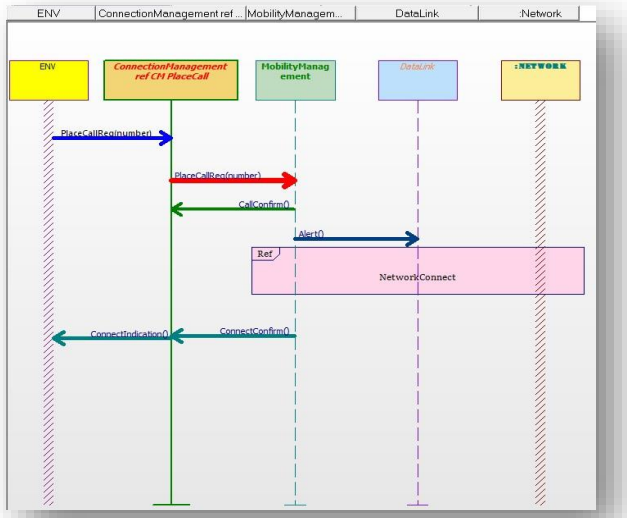
- The publisher provides two configuration files allowing different teams to control and consistently apply their defined methods and styling



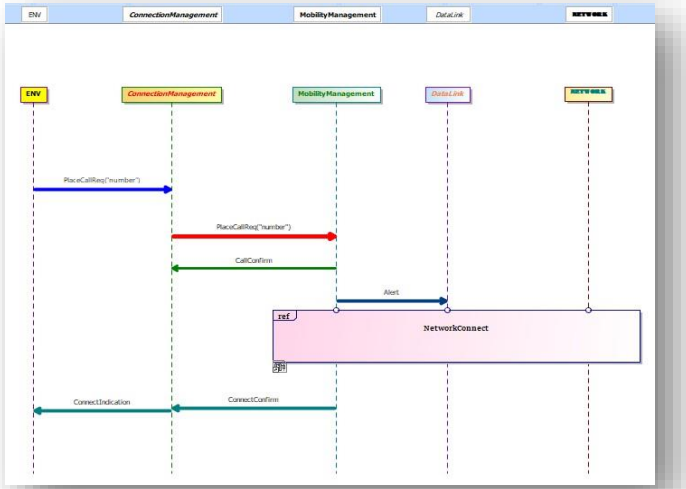








Rhapsody



MagicDraw

SODIUS

Silent Batch Mode

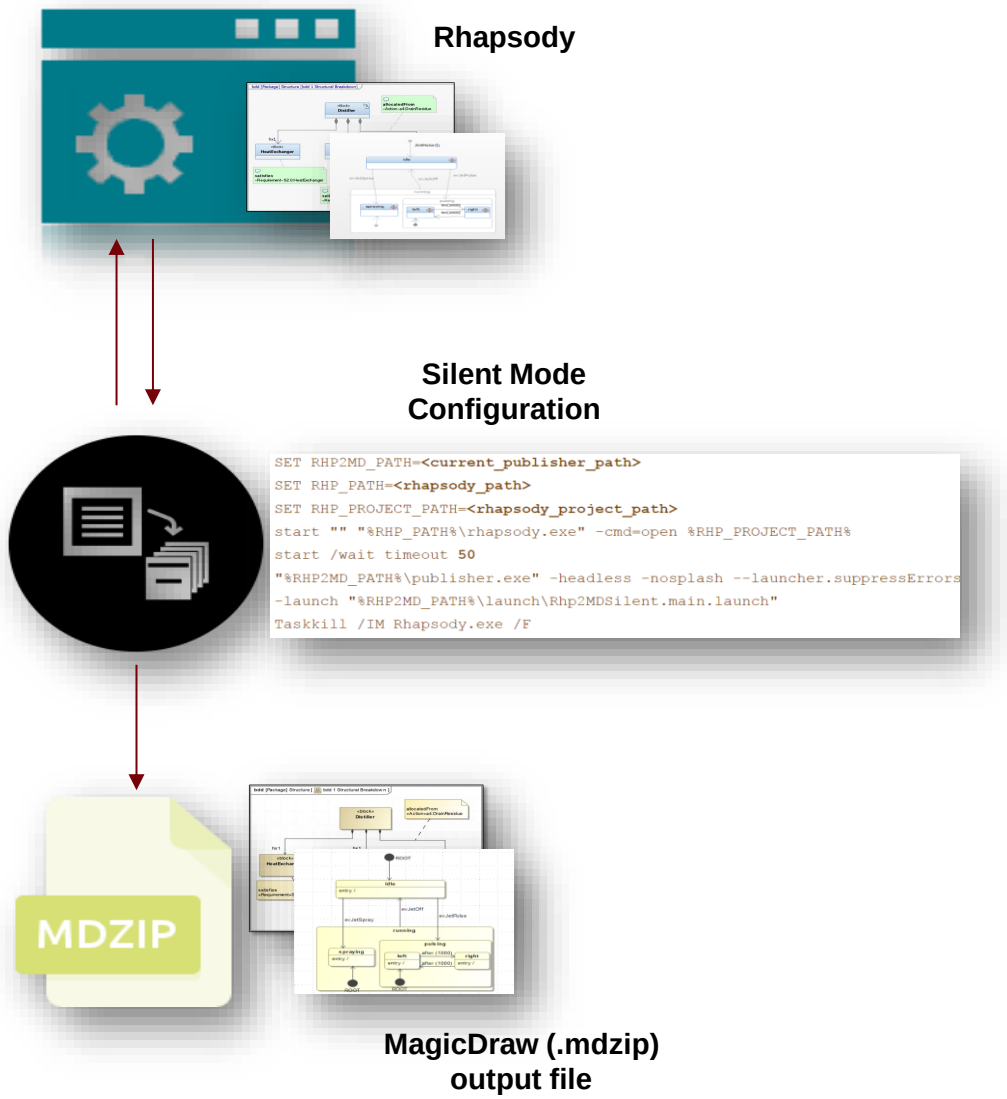
The Publisher can fully automate your publication activities in Silent Mode by using the batch mode and a fully configurable options set.

The Rhp2MDSilent.bat file will automate the following actions:

- Launch Rhapsody
- Open a project in Rhapsody
- Run the Rhapsody to MagicDraw transformation
- Close Rhapsody

Silent Mode also handles typical options:

- Rhapsody model file path
- Semantic options
- Diagram formatting configurations
- Cameo .mdzip output file path

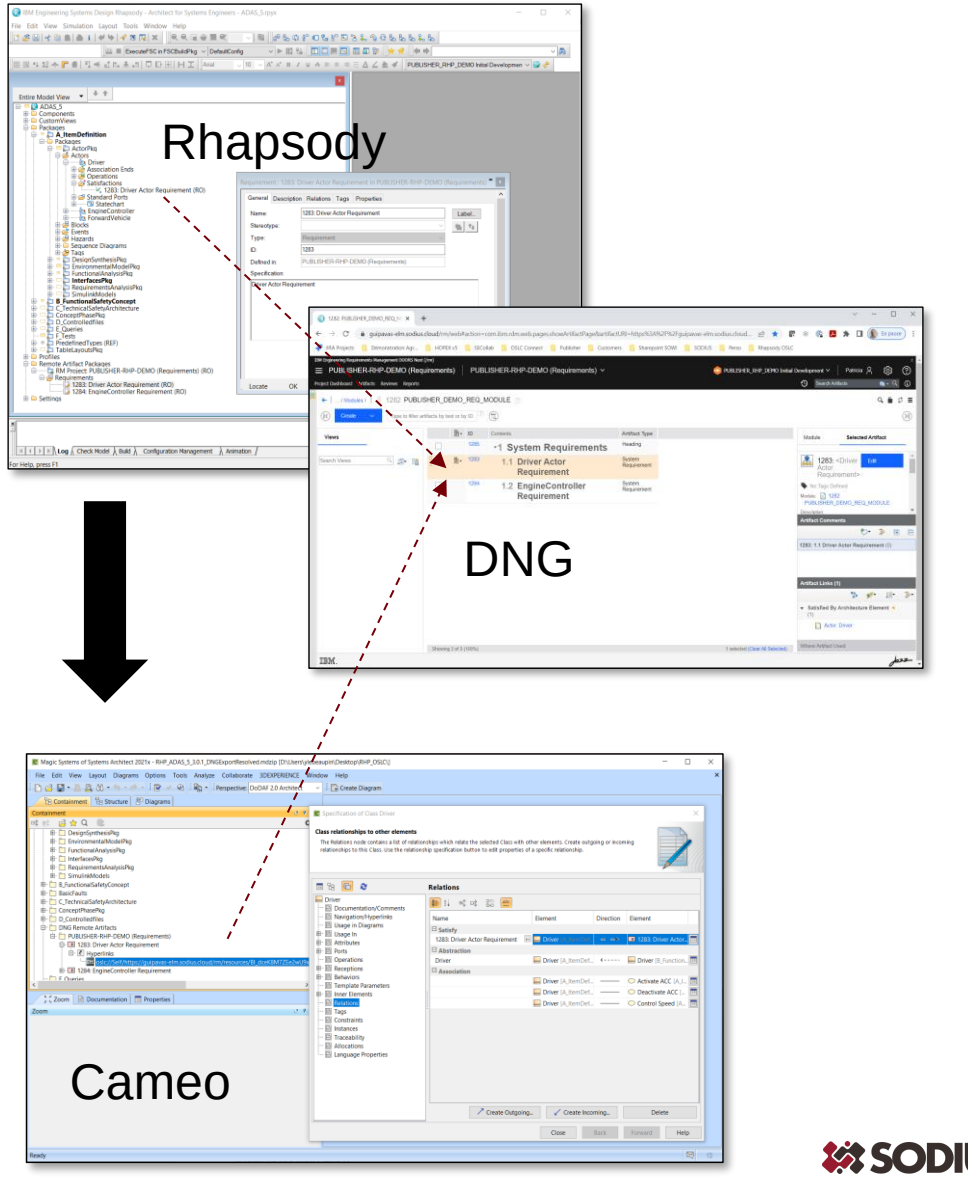


Publisher add-on - OSLC DOORS Next Links Export

As a new add-on for the Rhapsody Publisher, Sodius released a new feature: **OSLC DOORS Next Links Export to Cameo**.

This feature will **export OSLC links between Rhapsody elements and DOORS Next requirements to a Cameo model**.

- This add-on exports the DOORS Next links as **proxy requirements AND OSLC hyperlinks** into the target Cameo model.
- Using OSLC hyperlink syntax used in Cameo Data Hub (optional), it allows you to open and navigate within the Cameo model to the DOORS Next requirements. The Cameo model will point to the exact requirement and version used in Rhapsody.



Publisher

for System Architect®

SODIUS

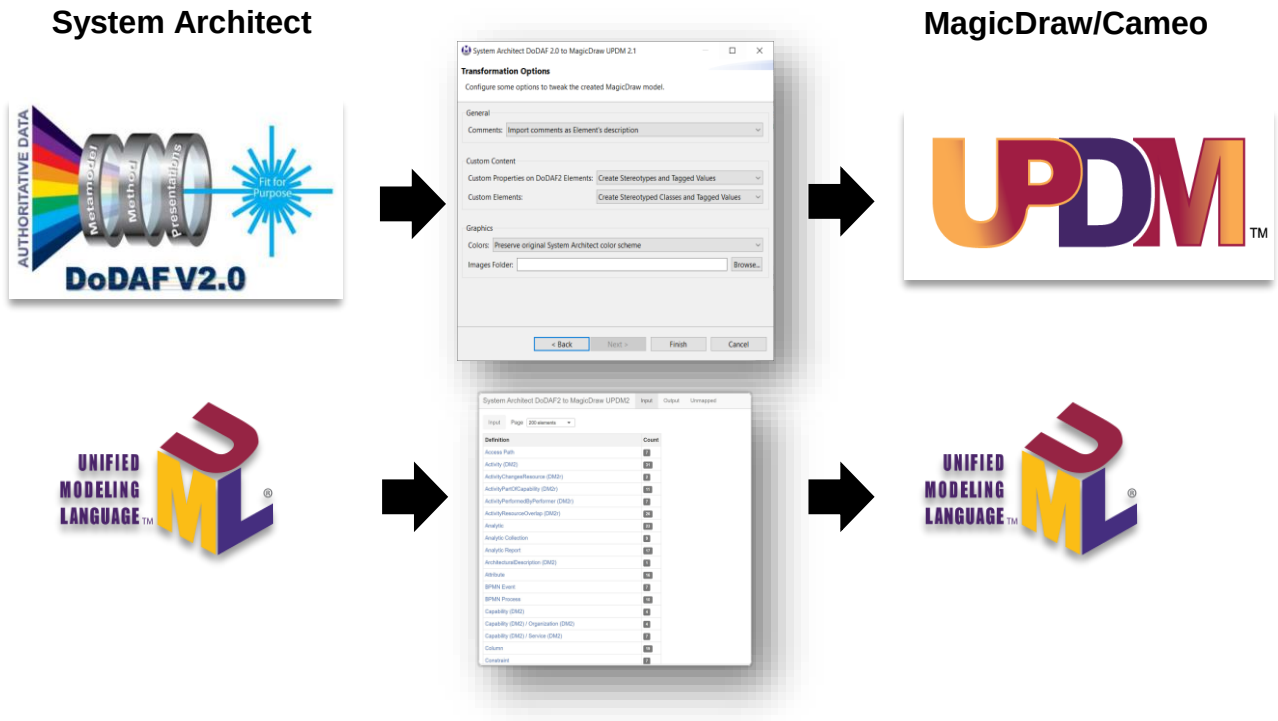
Publisher for System Architect

Publisher for System Architect is a plug-in that automatically generates complete MagicDraw models from System Architect including:

- DoDAF 2.0 to UPDM 2.1
- DoDAF 1.5 to UPDM 2.1
- UML to UML

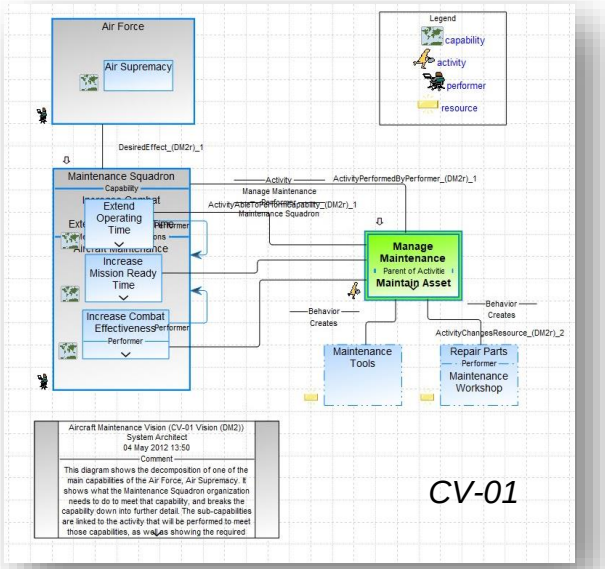
The ruleset includes the publisher of the following:

- **Model Elements, structure,** and **hierarchy**
- **Diagrams** - maintaining layout and colors
- **Full Logging** of model transformation actions



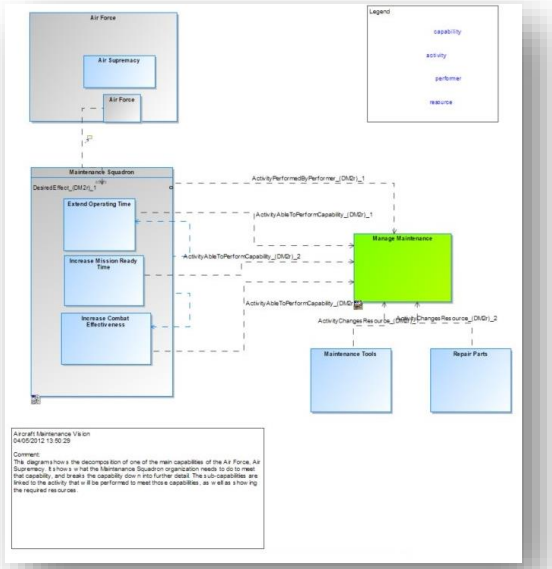
DoDAF 2.0: Capability & Operational Examples

System Architect

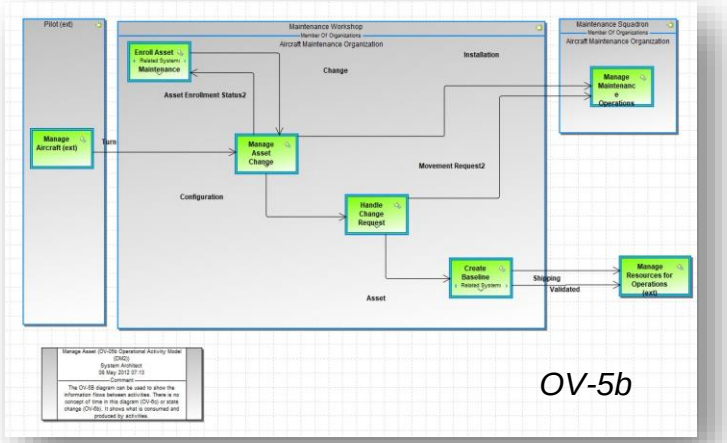


CV-01

MagicDraw

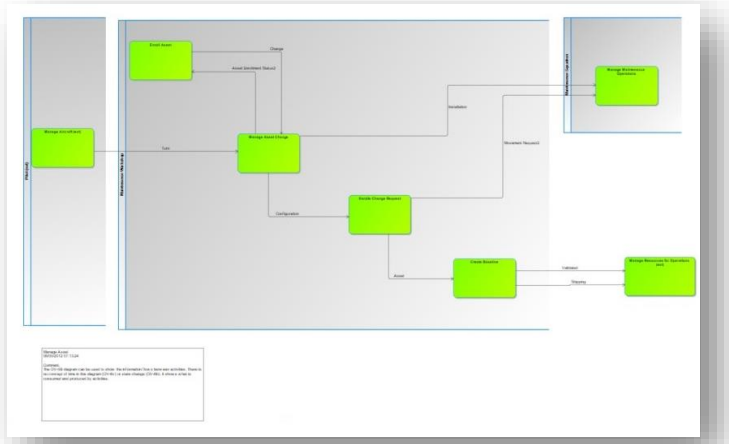


System Architect

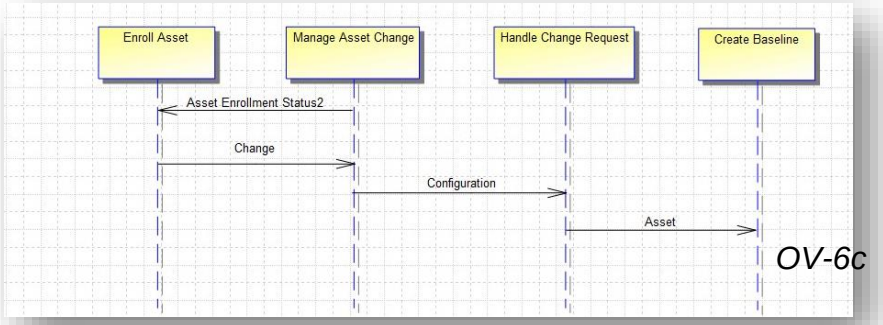


OV-5b

MagicDraw

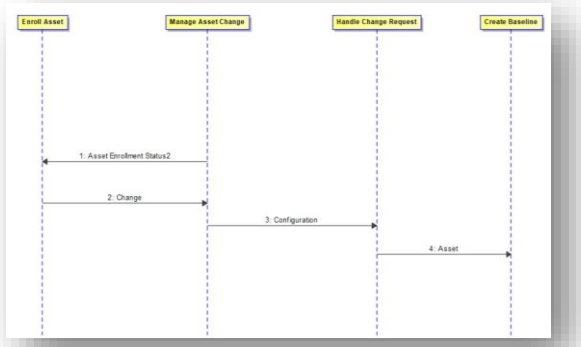


System Architect



OV-6c

MagicDraw



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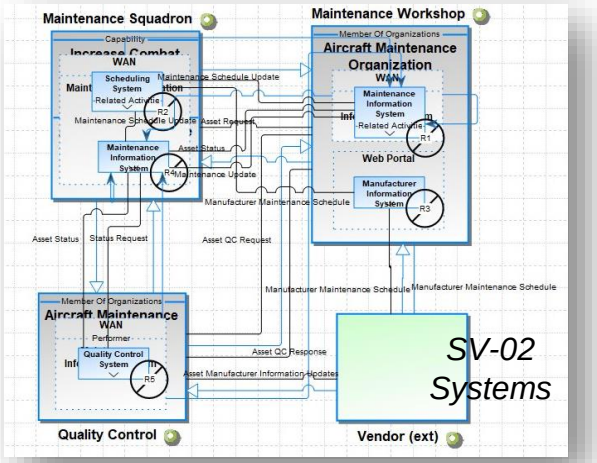
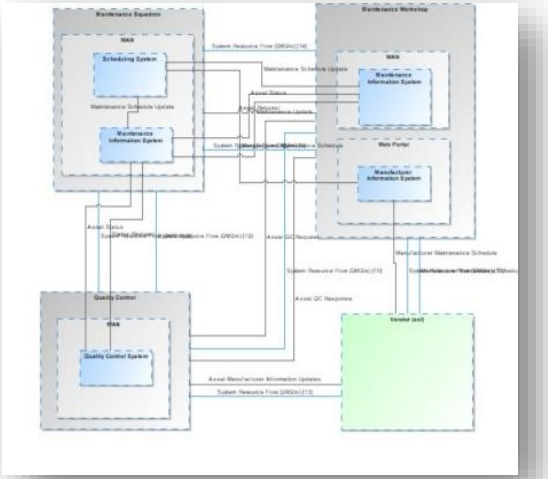
DoDAF 2.0: Systems & Services Viewpoints + Logical Data model examples

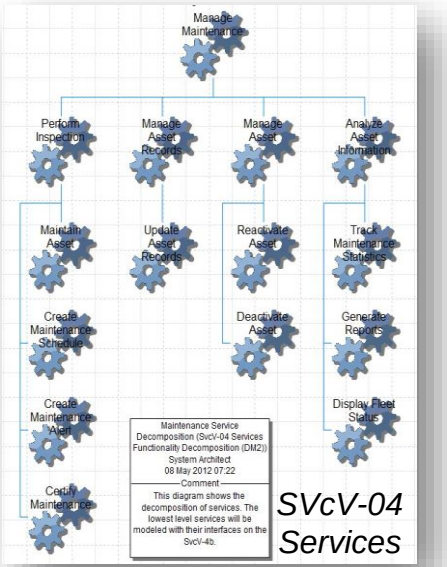
System Architect



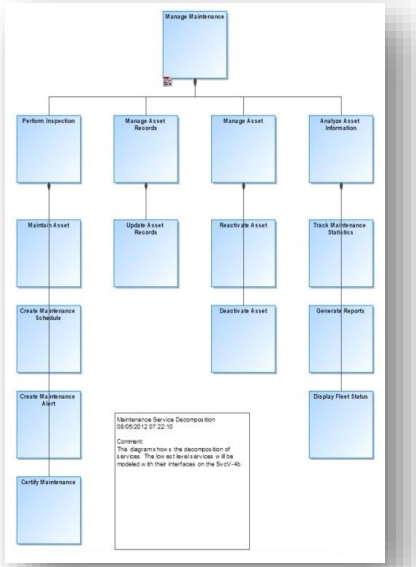
MagicDraw



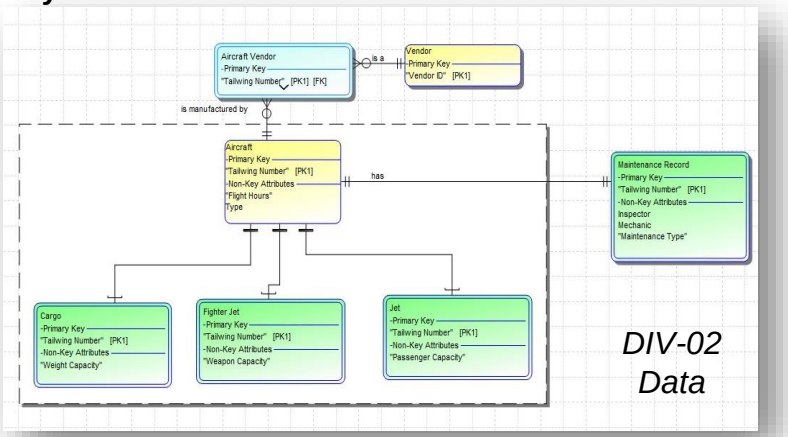
System Architect



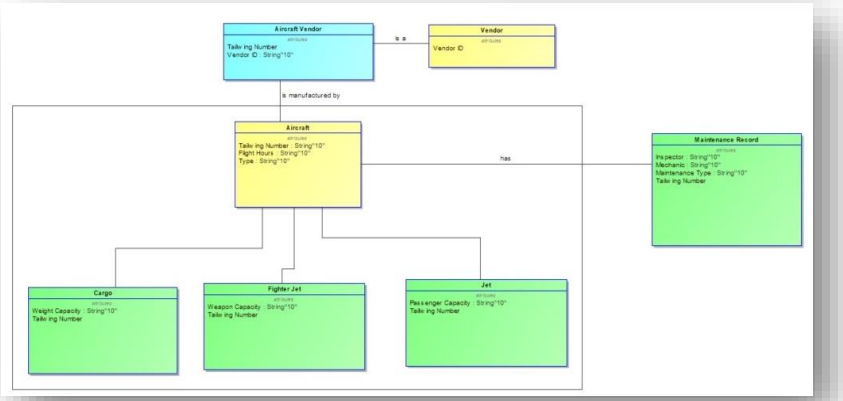
MagicDraw



System Architect



MagicDraw



UML Examples

Publisher for System Architect is a plug-in that automatically generates complete MagicDraw models from System Architect including:

- **Model Elements, structure,** and **hierarchy**
- **Diagrams** - maintaining layout and colors
- **Full Logging** of model transformation actions

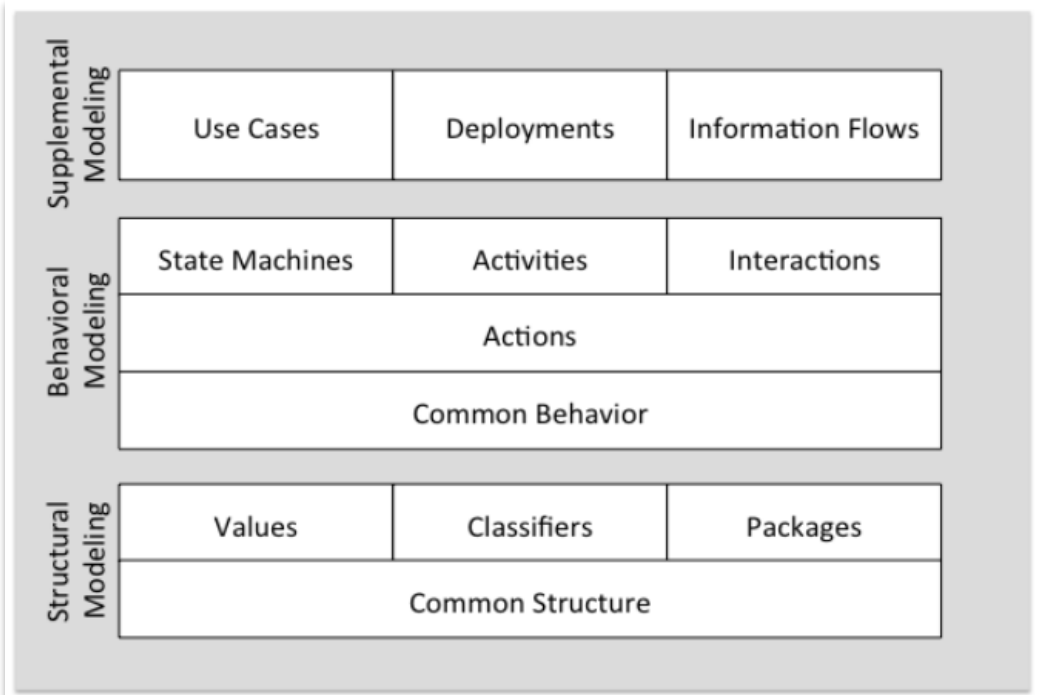
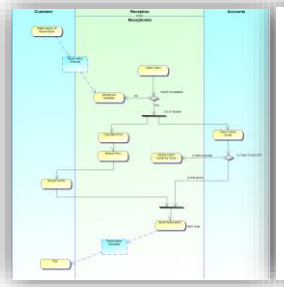


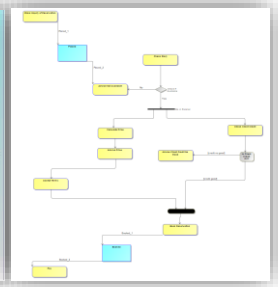
Figure 6.1 Semantic Areas of UML

Examples of Published UML diagrams in MagicDraw format

Activity Diagrams

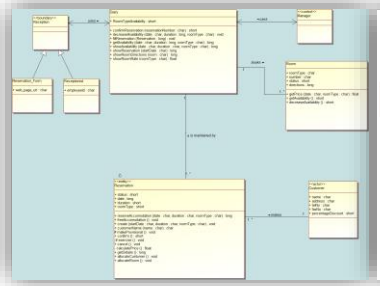


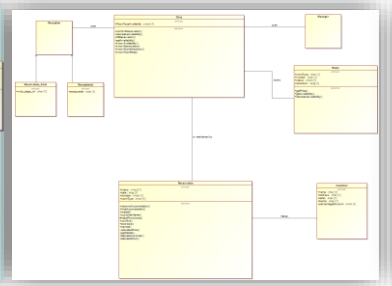
System Architect



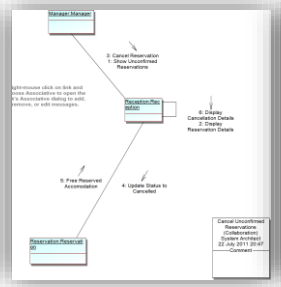
MagicDraw

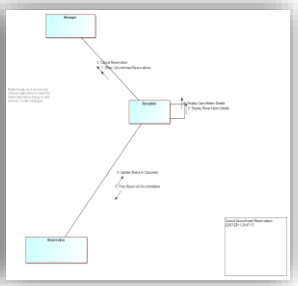
Class Diagrams



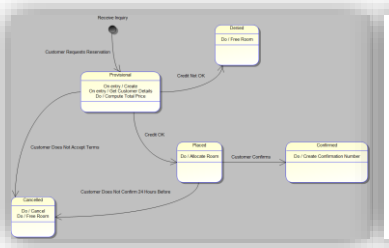


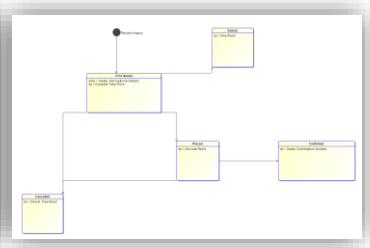
Collaboration Diagrams



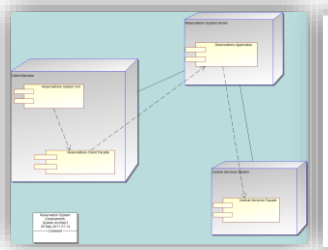


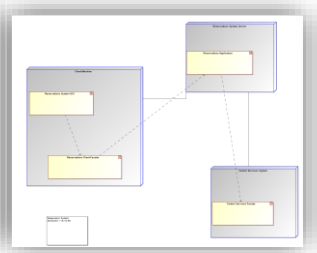
UML State Diagrams



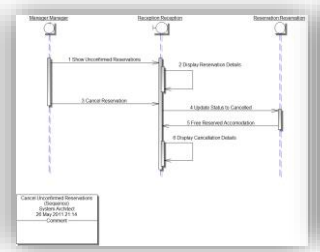


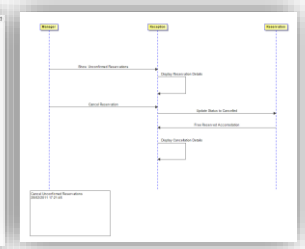
Deployment Diagrams



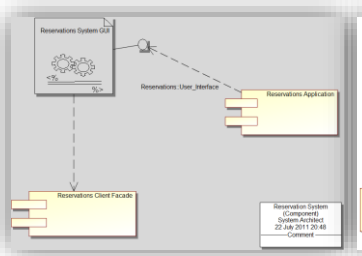


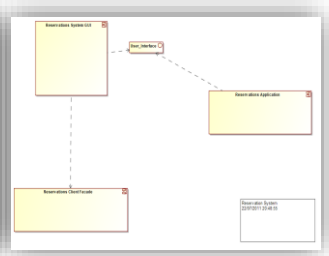
Sequence Diagrams





Component Diagrams





SODIUS

Publisher

for Sparx EA to Cameo

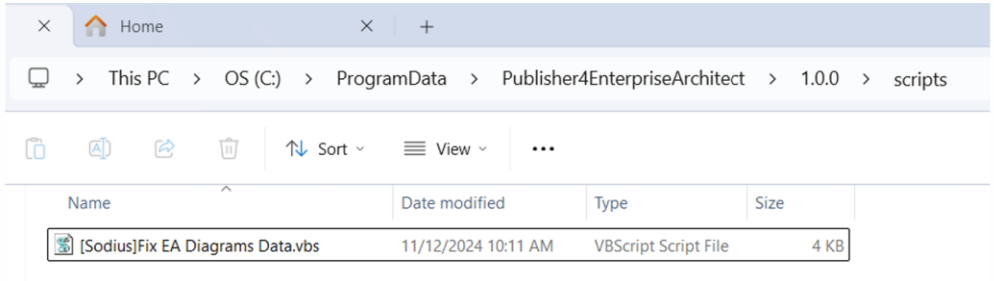
SODIUS

Supported versions

With Publisher for Enterprise Architect, you'll be able to export and publish your data from Sparx Enterprise Architect (13.5 and greater) to Cameo (19 and greater – MagicDraw/Cameo/CATIA Magic)

Diagrams created in 13.x versions and not edited in 14/15/16/17 versions of Enterprise Architect can contain invalid layout positions, especially in sequence diagrams.

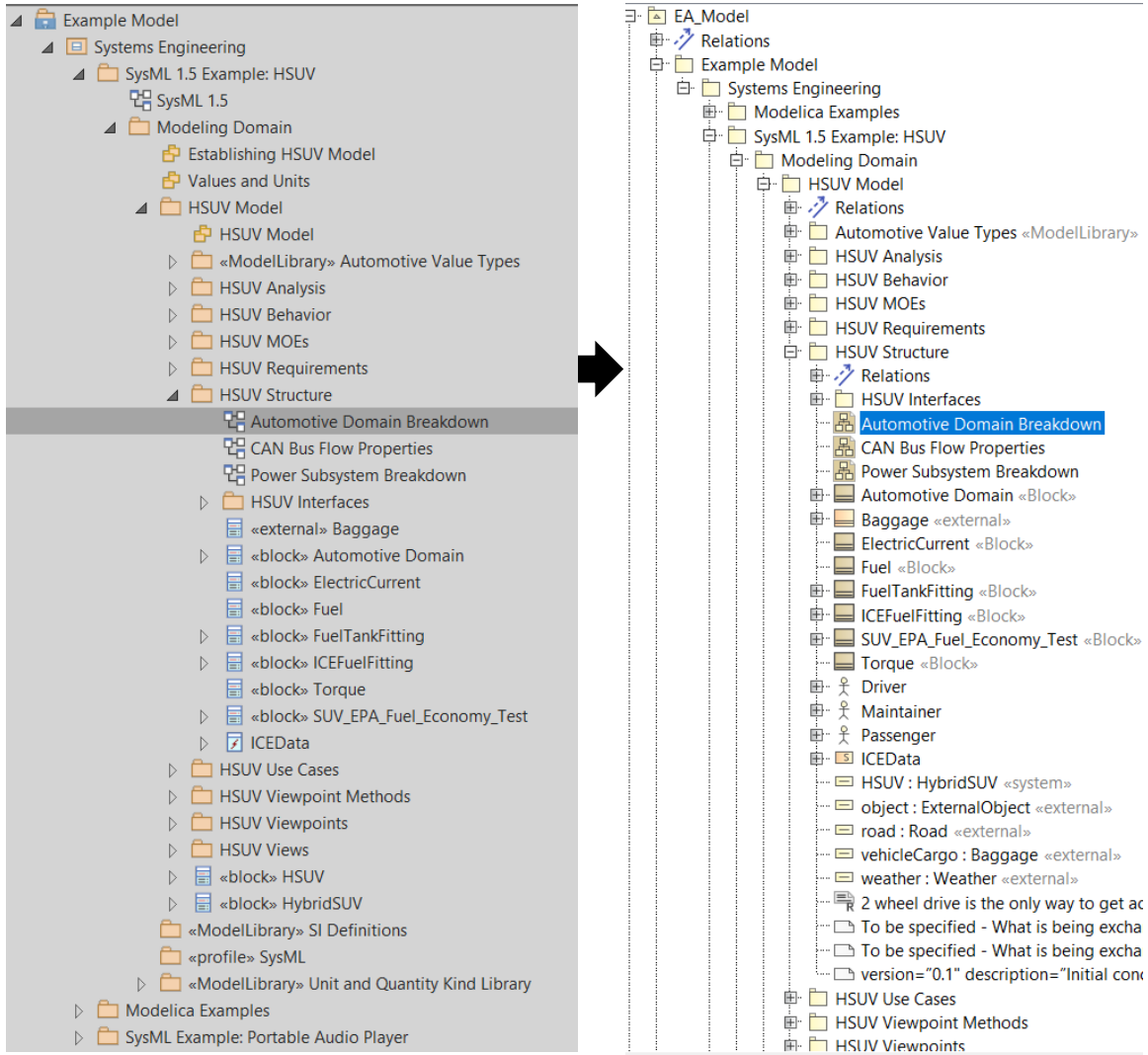
We've provided a VB script that is forcing save of all diagrams (and update of positions) (script is located in the ProgramData share folder)



Publisher for Sparx Enterprise Architect

Publisher for Enterprise Architect:

- Enables Cameo model conversion from Enterprise Architect models, including:
  - Full UML/SysML support
  - Structure & Semantics
  - Diagrams
  - Custom Profile Transformation



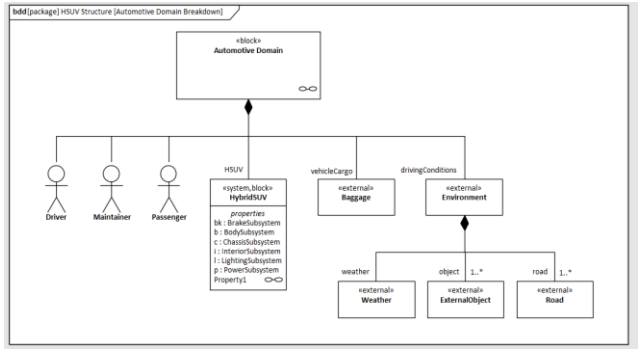
Enterprise Architect **Cameo/MagicDraw**

SODIUS

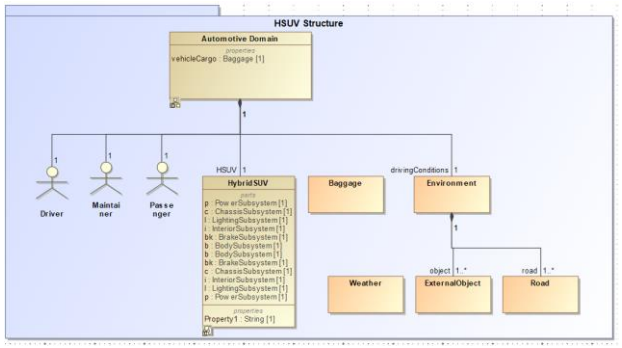
Main Features

The Publisher generates complete MagicDraw models from Enterprise Architect, including:

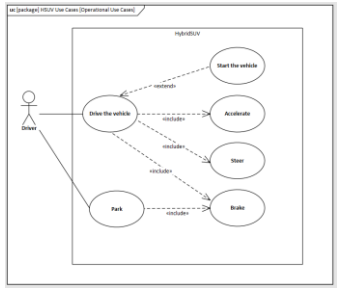
- All model elements, structure, and hierarchy
- SysML Diagrams - maintains layout
- Custom profiles
- Full logging of model transformation actions
- Batch mode

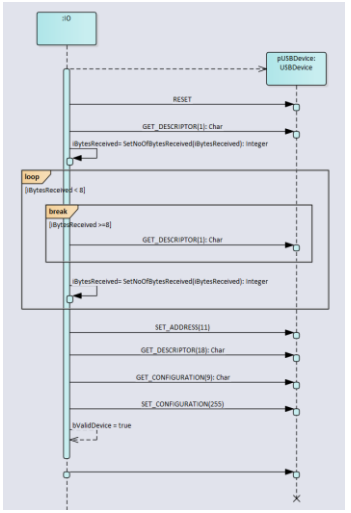


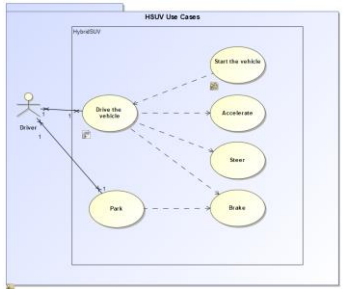
Enterprise Architect

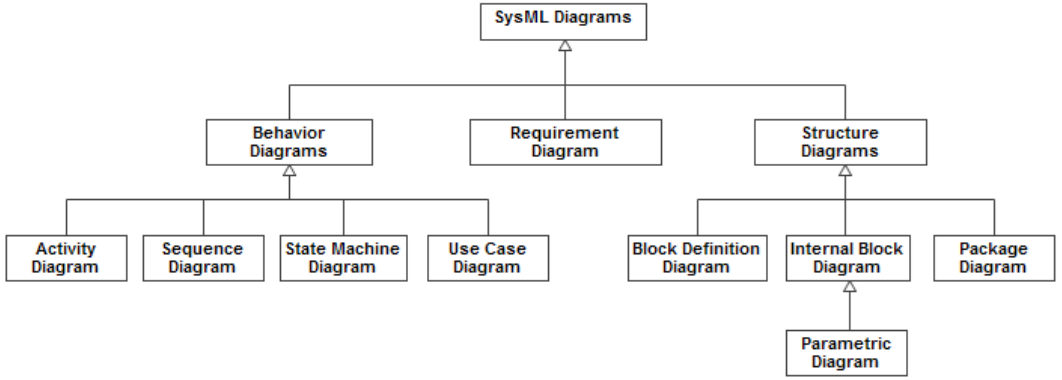


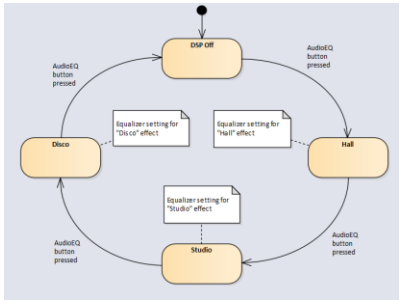
Cameo/MagicDraw

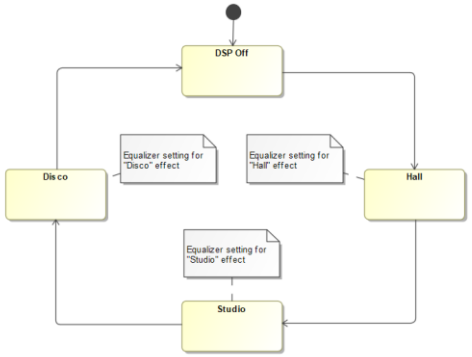












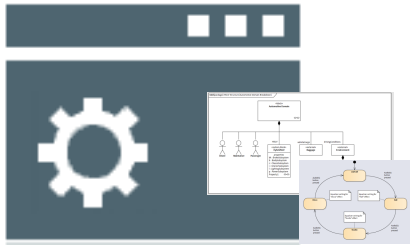
SODIUS

How it works

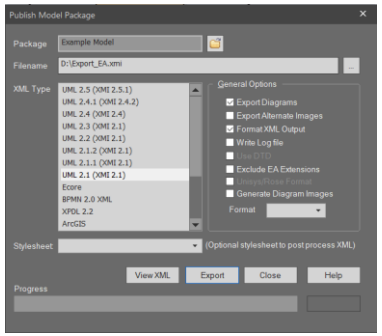
MagicDraw Publisher for Enterprise Architect is publishing a model:

- From a project in Enterprise Architect *(requires an Enterprise Architect license in this model)*
- Or a previously exported XMI 2.1 file *(.xmi file with EA diagram extensions)*

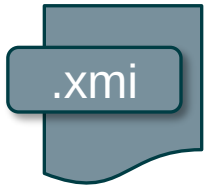
- To an output MagicDraw file (.mdzip):
  - Just by using the .mdzip file. It doesn't require Cameo software, license or any plugin for the Cameo/MagicDraw environments.

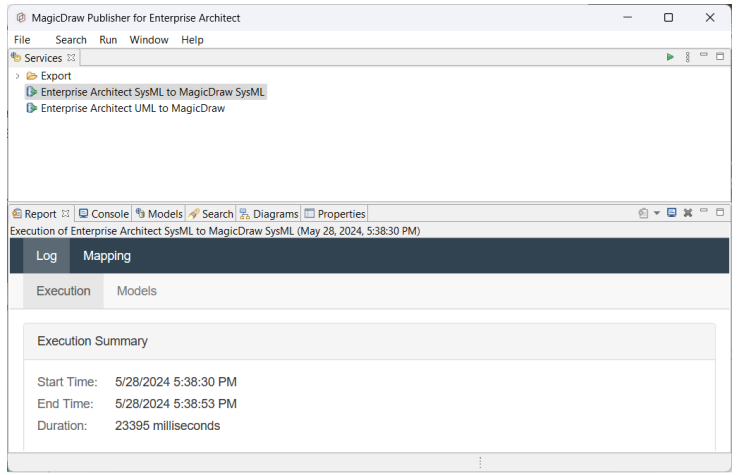


Enterprise Architect Application

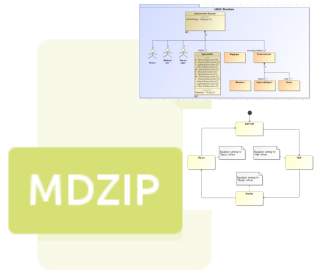


EA XMI File (*with diagram extensions*)





Publisher



Cameo/ MagicDraw Output File

SODIUS

Known Limitations

- Enterprise Architect is lacking strong UML/SysML semantic constraints. It leads to usage of invalid UML/SysML elements in diagrams (not allowed in the other UML tools fulfilling the standards):
  - Usage of invalid UML elements in diagram (not allowed in UML and especially Cameo)
  - Wrong usage of relationships in composite structure (connectors vs associations)
  - Inconsistency between semantic and diagram containment (composed state machines structures need to be reconciliated)
  - Invalid XMI format of technical profile extensions (relations without source or target)
  - Etc.

- Sodius is managing those inconstancies in the publisher conversion. We log known patterns and will add new ones if not resolvable programmatically (or implying to modify programmatically the EA output)

Checker code	Description
CHECK001	**Detect invalid Diagrams containing ports connected with Associations instead of Connectors** In UML, Associations are drawn between Classifiers for describing that there can be links between instances typed to those Classifiers. In general links between Ports are Connectors for describing a connection between them, or InformationFlows for a more abstract data flow relationship.
CHECK002	**Detect invalid Diagrams containing associations between Instance Specifications** In UML, Associations are drawn between Classifiers for describing that there can be links between instances typed to those Classifiers. An Instance Specification is not a Classifier.
CHECK003	**Detect invalid DeploymentDiagrams drawing Activities** In UML, Activity content as ActivityEdges or ActivityNodes is not allowed in a DeploymentDiagram.
CHECK004	**Detect invalid Diagrams containing Associations between Activity Nodes** In UML, an Association is not allowed between Activity Nodes in an Activity Diagram
CHECK005	**Detect invalid Diagrams containing Decision Node having more than 2 incoming edges** In UML, a Decision Node can only have a maximum of 2 incoming edges. If this happens, MagicDraw can remove extra edges.

Model Checking report

The report is available in the log file head generated after publishing

```
2024-09-12 04:26:39.204 info - PUBLISHING - 2 ModelChecker(s) in error.
2024-09-12 04:26:39.205 info - PUBLISHING - > ModelChecker CHECK002 Detect invalid
Diagrams containing associations between Instance Specifications
2024-09-12 04:26:39.205 info - PUBLISHING - 1 Element(s) in error
2024-09-12 04:26:39.205 info - PUBLISHING - 0001... CommunicationDiagram
EA_Model::CommunicationPackage::Communication between Components
2024-09-12 04:26:39.206 info - PUBLISHING - > ModelChecker CHECK001 Detect invalid
Diagrams containing ports connected with Associations instead of Connectors
2024-09-12 04:26:39.206 info - PUBLISHING - 2 Element(s) in error
2024-09-12 04:26:39.207 info - PUBLISHING - 0001... DeploymentDiagram
EA_Model::Deployment::Component deployment in target platform
2024-09-12 04:26:39.207 info - PUBLISHING - 0002... CompositeStructureDiagram
EA_Model::Structure::Component Structure Diagram
```

Publisher

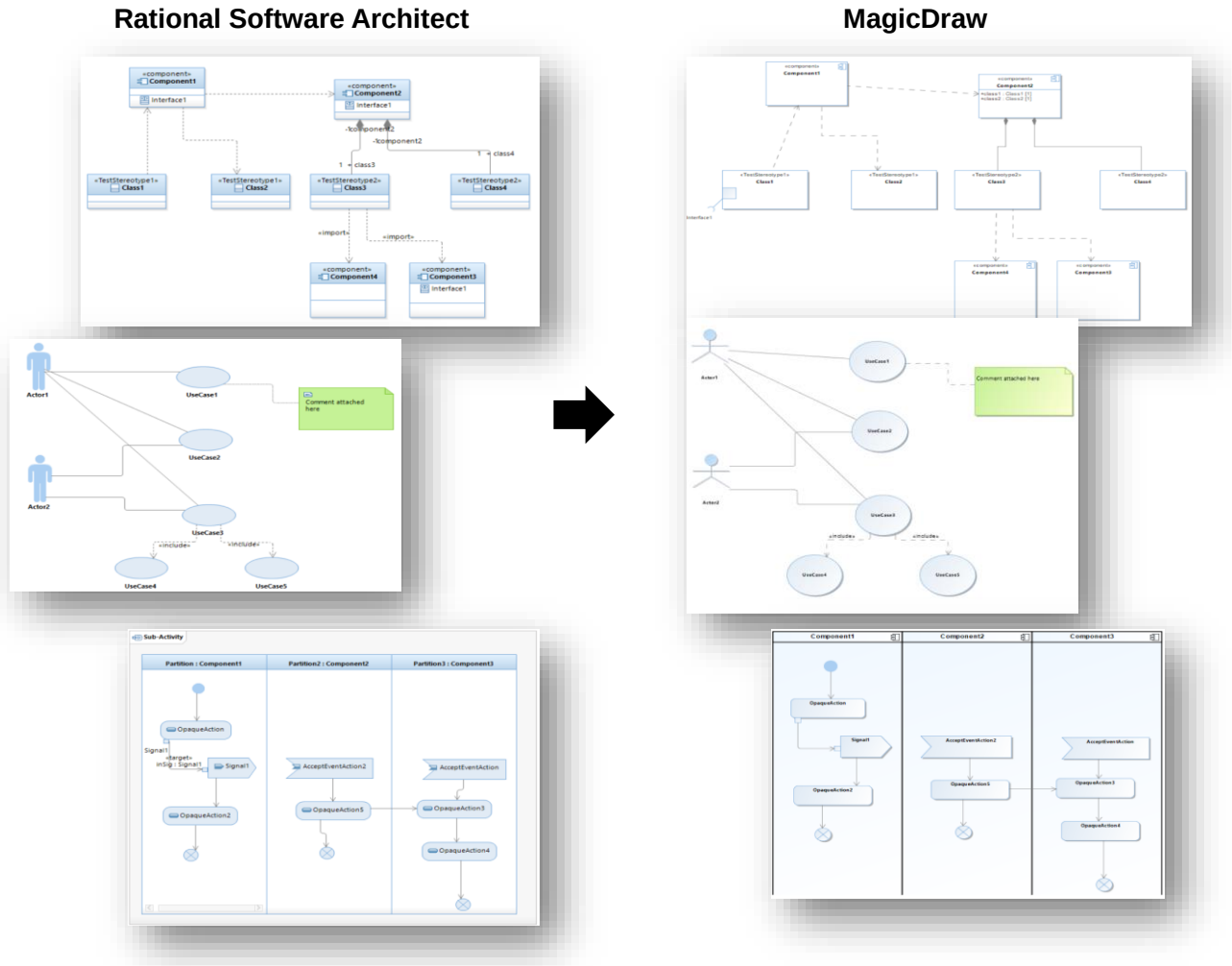
for Rational® Software Architect

SODIUS

Publisher for Rational Software Architect

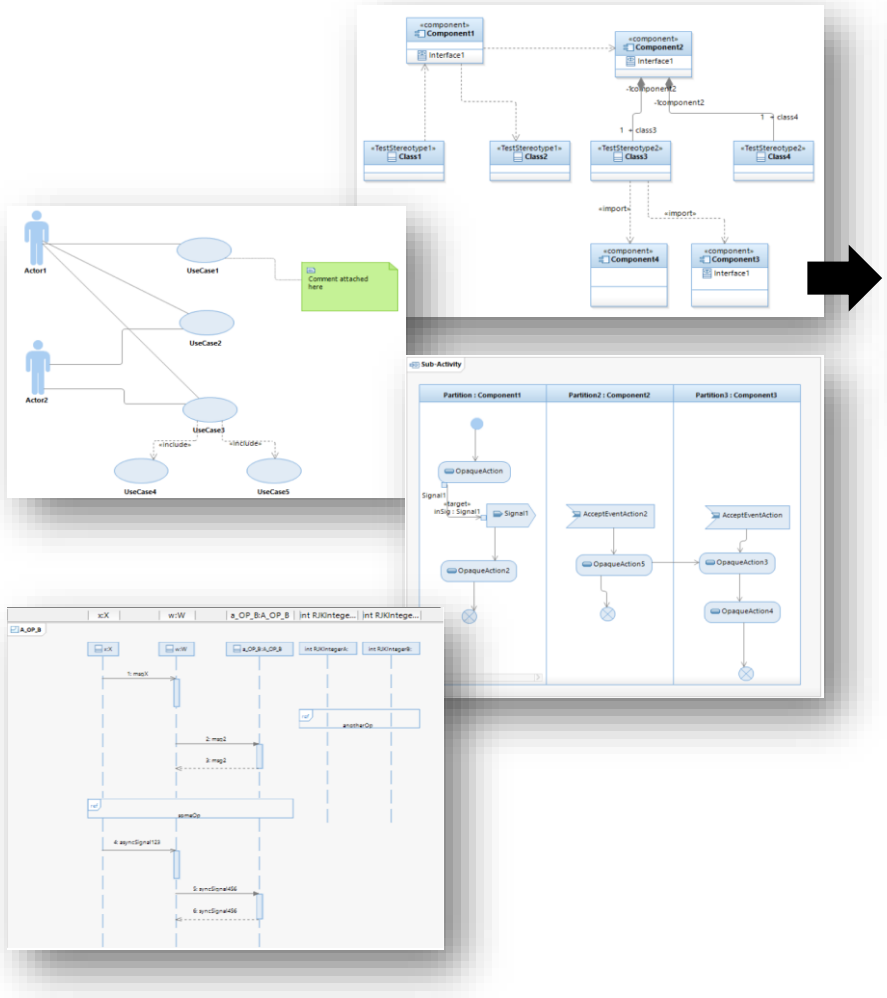
Publisher for Rational Software Architect is a plug-in that generates complete UML MagicDraw models from RSA UML and UPIA, including:

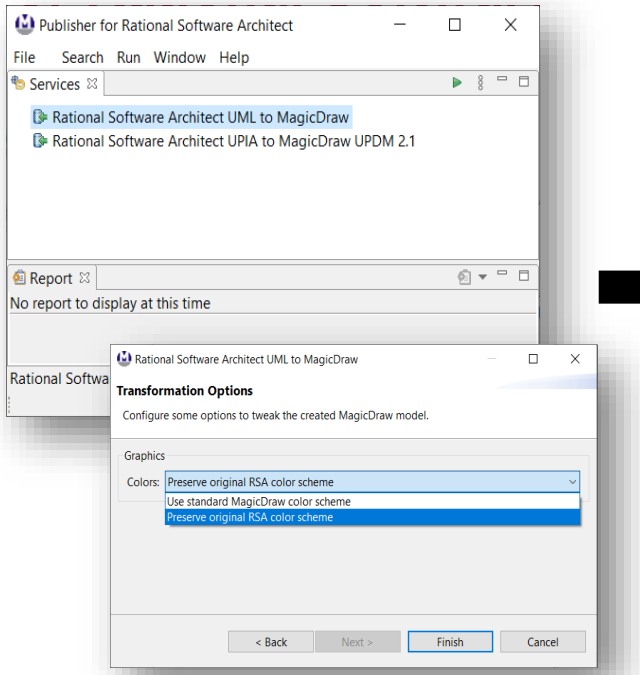
- **All model elements, structure,** & **hierarchy**
- **Custom Profiles**
- **Diagrams** - maintaining layout
- **Full logging** of model transformation actions
- **Transforms large models**
  - *U.S. Army: 7,000 diagrams/ 850,000 elements*



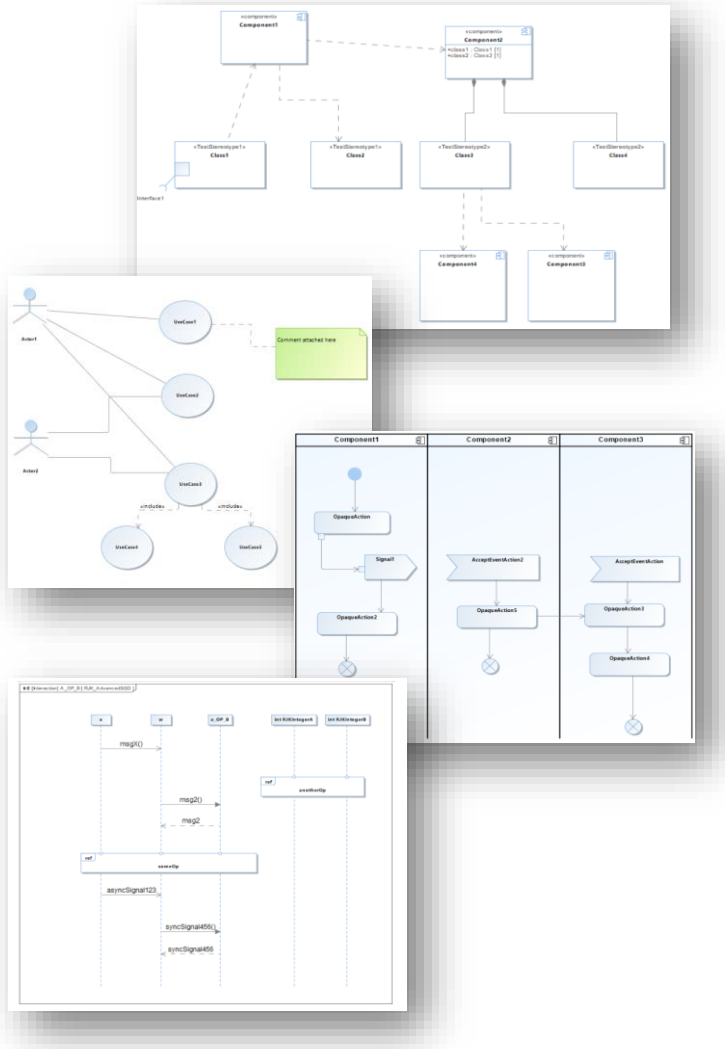
IBM Rational Software Architect Examples

Rational Software Architect





MagicDraw



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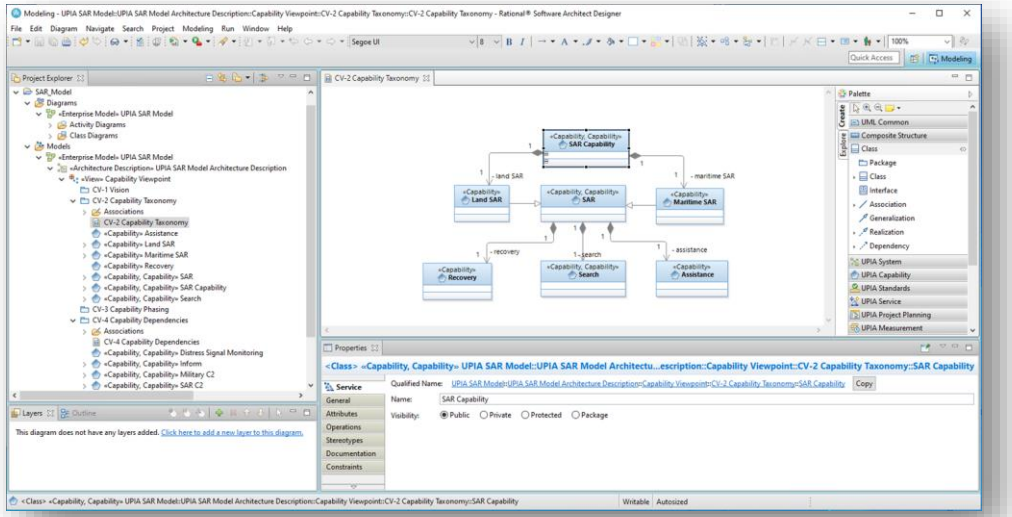
Add-on: Publisher for RSA UPIA

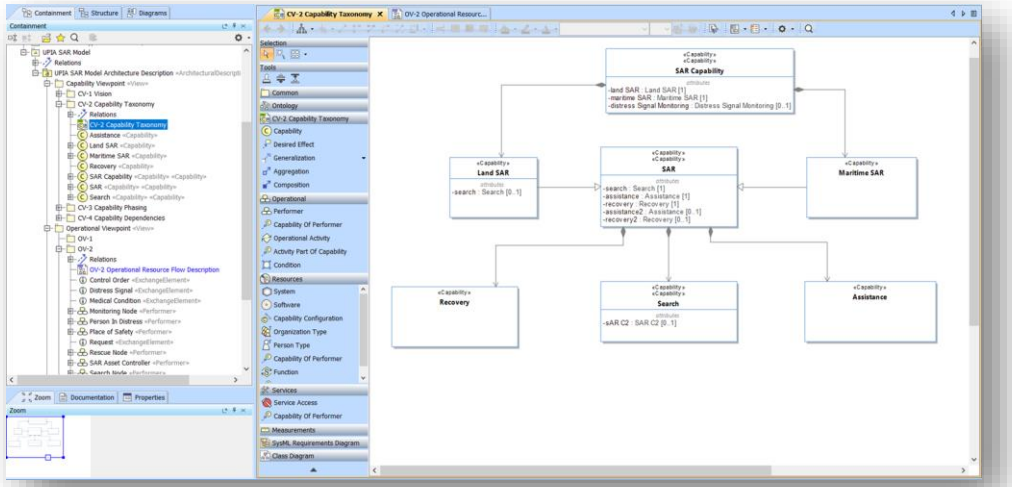
- **The Publisher for Rational Software Architect UPIA add-on enables support for RSA's UPIA profile.**

- Elements stereotyped with the UPIA profile are automatically converted into MagicDraw with the UPDM 2.1 profile.

Rational Software Architect UPIA



MagicDraw UPDM 2.1



Licensing and Support

Licensing & Support

Licensing

- Program Based
- One-year Term or Perpetual licenses
- Floating and Node-locked
- Designed for use in both Secure and Non-secure Lab Environments
- Enterprise (unrestricted - available upon request)

Try before you buy

- Full software, with only a disclosure watermark on the diagrams
- No network connection necessary
- Adjust the many user configurable styling settings to your team's preferences
- See the actual exported model in Cameo or Rhapsody file formats
- Manipulate the new model accordingly

Technical Support

- Online Support 24/7 from our team of technical experts in the tools and their usages
- Online User Documentation
- Knowledge Base Articles
- Download Portals

The Value of the Publisher Products

- ✓ The ability to Export and Publish very large models *(successfully exchanged 12,000 diagrams and 900,000 elements)*
- ✓ No manual work or cleanup is needed by leveraging user-configurable settings and display styling
- ✓ Model checking is implemented to identify, log, and report inconsistencies in the source model with the potential to cause rework or cleanup in the target model *(maintains or improves model quality)*
- ✓ Extremely fast
- ✓ Models can be manually changed after publish and export
- ✓ Same form and function model, but in a different tool

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