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Approaches to Marking and Validating Sensitive MBSE Models

For the 2019 NDIA Systems & Mission Engineering Conference

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Background

Quick Overview

- In some industries, there are policies and procedures for protecting sensitive information
 - Example: Department of Defense (DoD) Information Security Program for classified information (DoD Manual 5200.01)
 - Example: Organizational internal policies and procedures to protect their inventions and trade secrets
- Marking and identification is a key component of these processes
 - If the information is properly marked, then it's clear how the information should be handled
- Traditional documents and information media have well-defined marking and identification procedures
 - Example: DoD has explicit procedures for marking documents, briefing slides, e-mail, web pages and even instant messages (DoD Manual 5200.01 Volume 2)

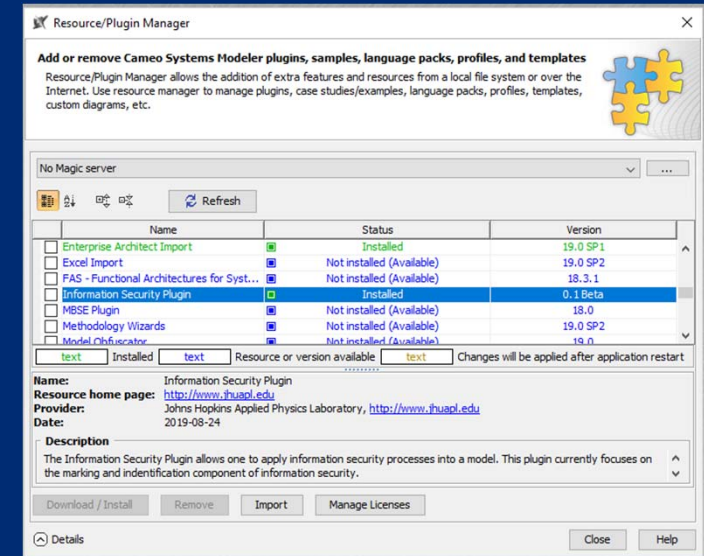
Background

What makes MBSE models a unique challenge to marking and identification?

- There are not many well-defined procedures for models
 - Now, there are general policies and organizations uphold these policies to MBSE models
 - However, lack of procedures creates inconsistency across organizations and the industry
- The information structures can be complex
 - In the case of SysML models, there are many element types and only some are easily shown on diagrams
 - Beyond SysML models, the integration of MBSE tools and the transformation of data between tools can lead to multiple different information structures that need to be considered
- It can be difficult to assess information in context
 - Classification by Compilation – At what point do I add too much information where the combined sum of information is a higher level of sensitivity marking?

APL's Contribution

- In October 2018, APL started an internal research and development (IRAD) project which explored classification markings in models
- In May 2019, we demonstrated some of these IRAD concepts in No Magic MBSE Cyber Experience Symposium
- In August 2019, we packaged these concepts into a MagicDraw plugin package (Information Security Plugin Version 0.1 Beta)
 - Complete Plugin Package: Is installable using MagicDraw's Resource Manager and is accompanied by a user manual
- Currently reviewing requests from interested organizations to distribute this plugin under government usage licenses



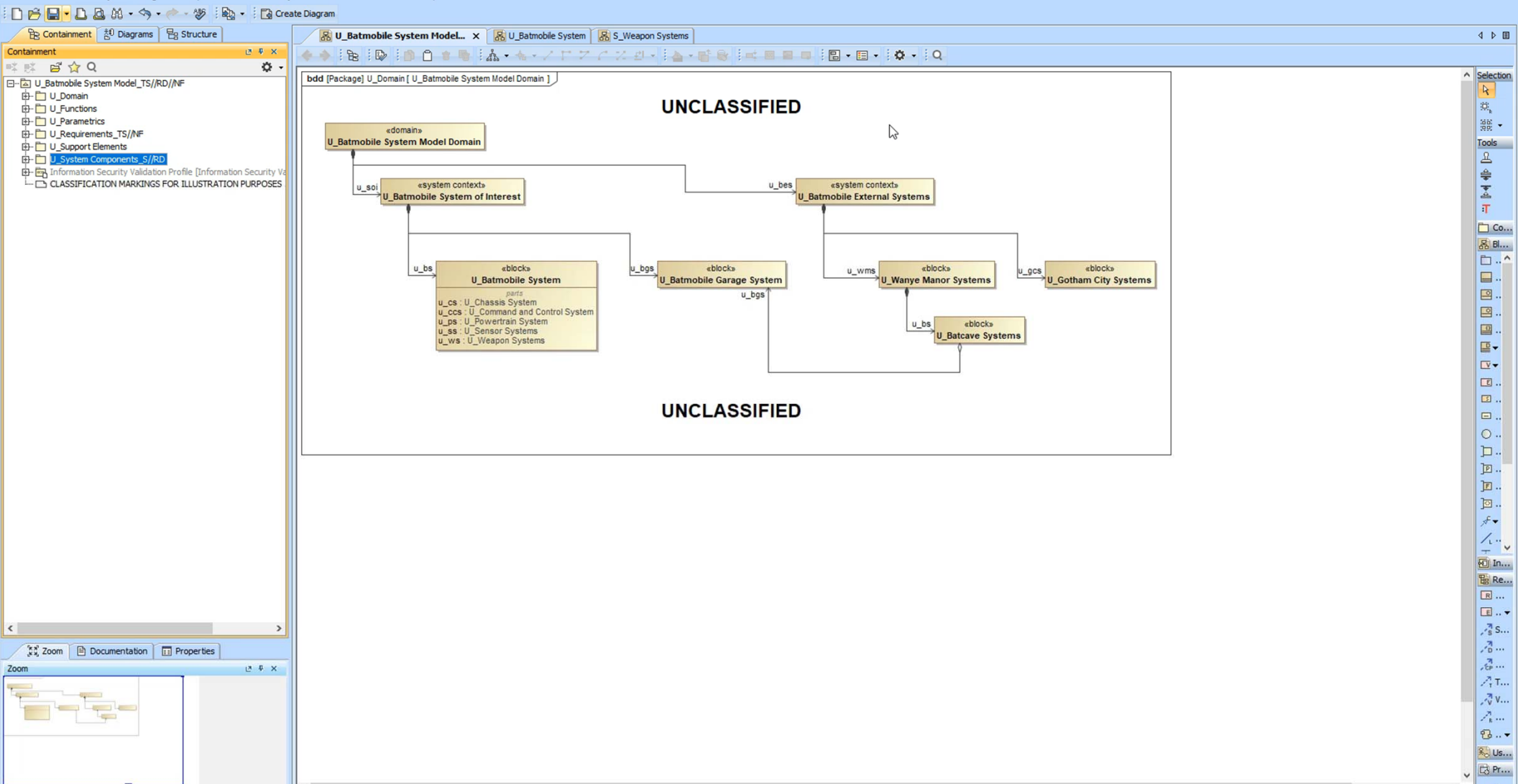
MagicDraw Resource Manager with the Information Security Plugin Installed

Case Study Example

Batmobile Development Program



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Selected Concepts

Overview

For marking and identification, here are some questions that we can start to answer using these concepts:

Question of Interest (“How do we...?”)	Concept
... mark individual model elements?	Marking Standard: Embedding Markings in Key Fields
... make it easier for the model user to apply markings?	Right-Click Context Menu
	Automatic Banner Labeling of Diagrams
... verify that the model elements are properly marked?	Marking Validation Rules
... apply custom markings?	Loading a Custom Markings Database
... better describe a marked element?	Linking Elements to Security Classification Guide

In 0.1 Beta Plugin

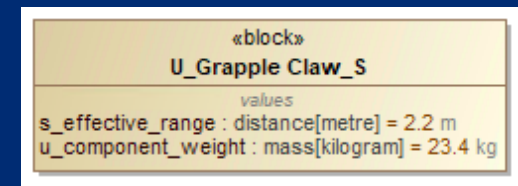
Selected Concepts

Marking Standard: Embedding Markings in Key Fields

- There are various approaches to marking SysML models (As of MagicDraw 19.0 SP2):
 - Stereotype Labels
 - Stereotype Attributes
 - Legend Coloring
 - Embedding Markings
- The challenge is having a marking approach that is clear, consistent and visible
- The approach we take is to embed the markings into the key field of an element
- There are a few advantages of using embedded markings:
 - Marking is always visible both in the containment tree and within diagrams
 - Markings can align to existing formatting standards



Stereotype Labeling and Attribute Examples



Embedded Marking Example

Selected Concepts

Marking Standard: Embedding Markings in Key Fields (Continued)

- Once an approach is selected, a standard can be developed and documented
- Regardless of the approach, a standard needs to be defined in order for custom verification tools to be built

Batmobile System Model Marking Standard

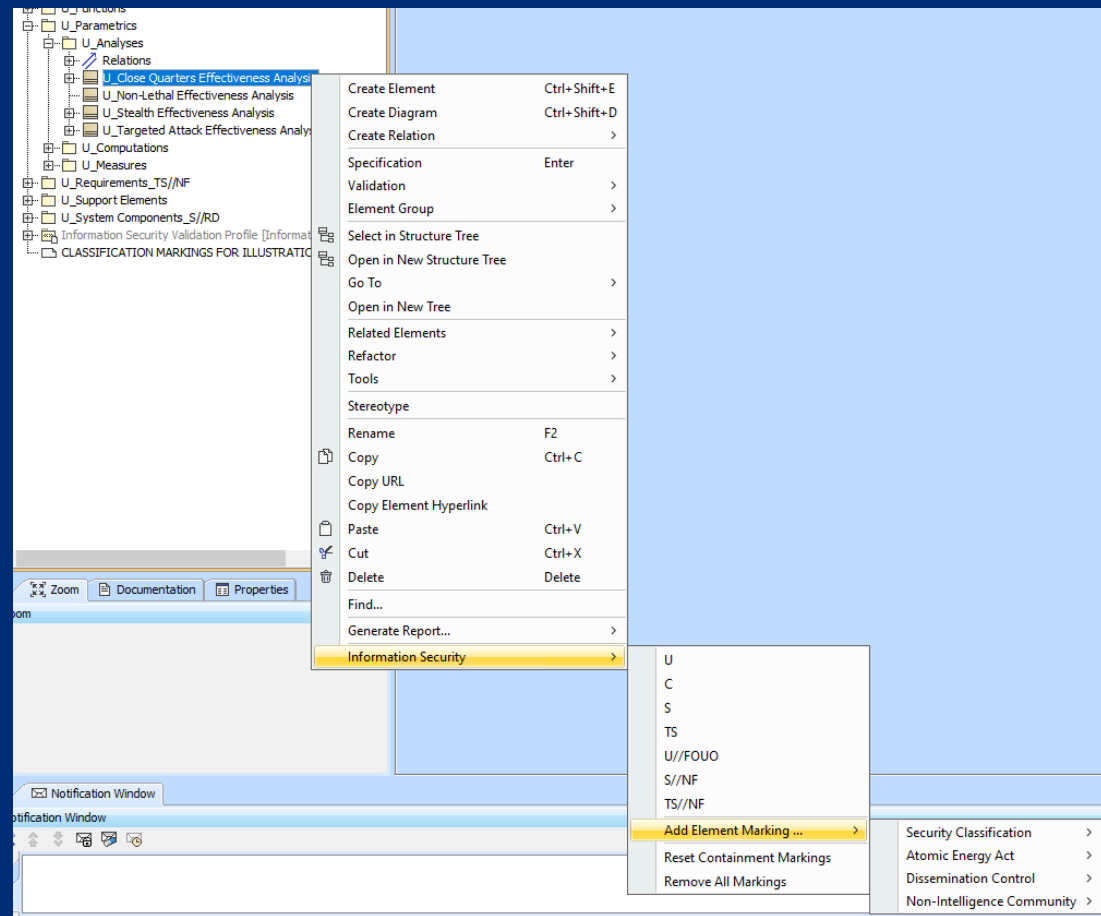
- Markings are applied model elements & model elements are the lowest portion marking
 - Anything lower (e.g., documentation fields, slot values, etc.) is not currently utilized by the plugin
- Markings are applied to an element's key field (name or body)
- Element's key field takes on the following format: <Prefix Markings>_<Rest-of-the-Field>_<Suffix Markings>
 - Underscore () separates key field's components
- Prefix, suffix and banner markings follow the marking standard defined in the DoD Manual 5200.01 Volume 2
 - Double forward slashes (//) separate markings from different categories
 - Single forward slash (/) separates markings from the same categories

<i>Element</i>	<i>Key Field</i>	<i>Prefix Markings?</i>	<i>Suffix Markings?</i>	<i>Other Markings and Notes</i>
Model	Name	Y	If >Unclassified, Y	
Package	Name	Y	If >Unclassified, Y	
Block	Name	Y	If >Unclassified, Y	
Value Property	Name	Y	N	Markings can be in lower case
Part Property	Name	Y	N	Markings can be in lower case
Activity	Name	Y	If >Unclassified, Y	
Diagram	Name	Y	N	Banner markings on top and bottom
Comment	Body	Y	N	

Selected Concepts

Right-Click Context Menu

- Since the marking standard is tied to a model element's key field, it can be a hassle to enter the marking every time
- To make entering markings easier, the plugin has a right-click context menu for information security actions
 - Whenever an action is selected from the menu, it will apply the action to the selected elements in the containment tree
- Actions can be applied to multiple model elements by CTRL or SHIFT clicking all of the desired element



Example of Right-Click Context Menu

The screenshot shows a software interface with a 'Containment' tree on the left and a 'Properties' window at the bottom. The 'Containment' tree shows a folder named 'Test Model'. The 'Properties' window has tabs for 'Element', 'Tags', 'Traceability', and 'Allocations'. The 'Element' tab is active, showing a table with the following data:

Model	
Name	Test Model
Owner	
Applied Stereotype	
To Do	
Author	
Version	

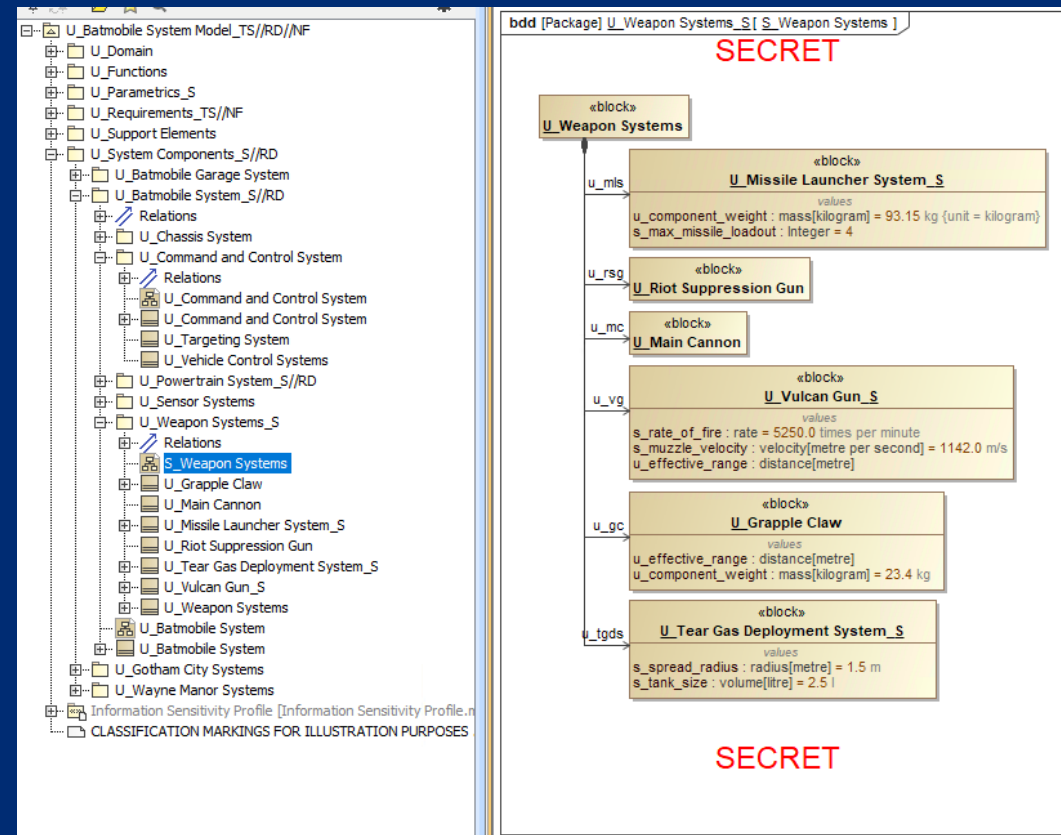
Below the table, there is a section for '(Name) (Description)'.



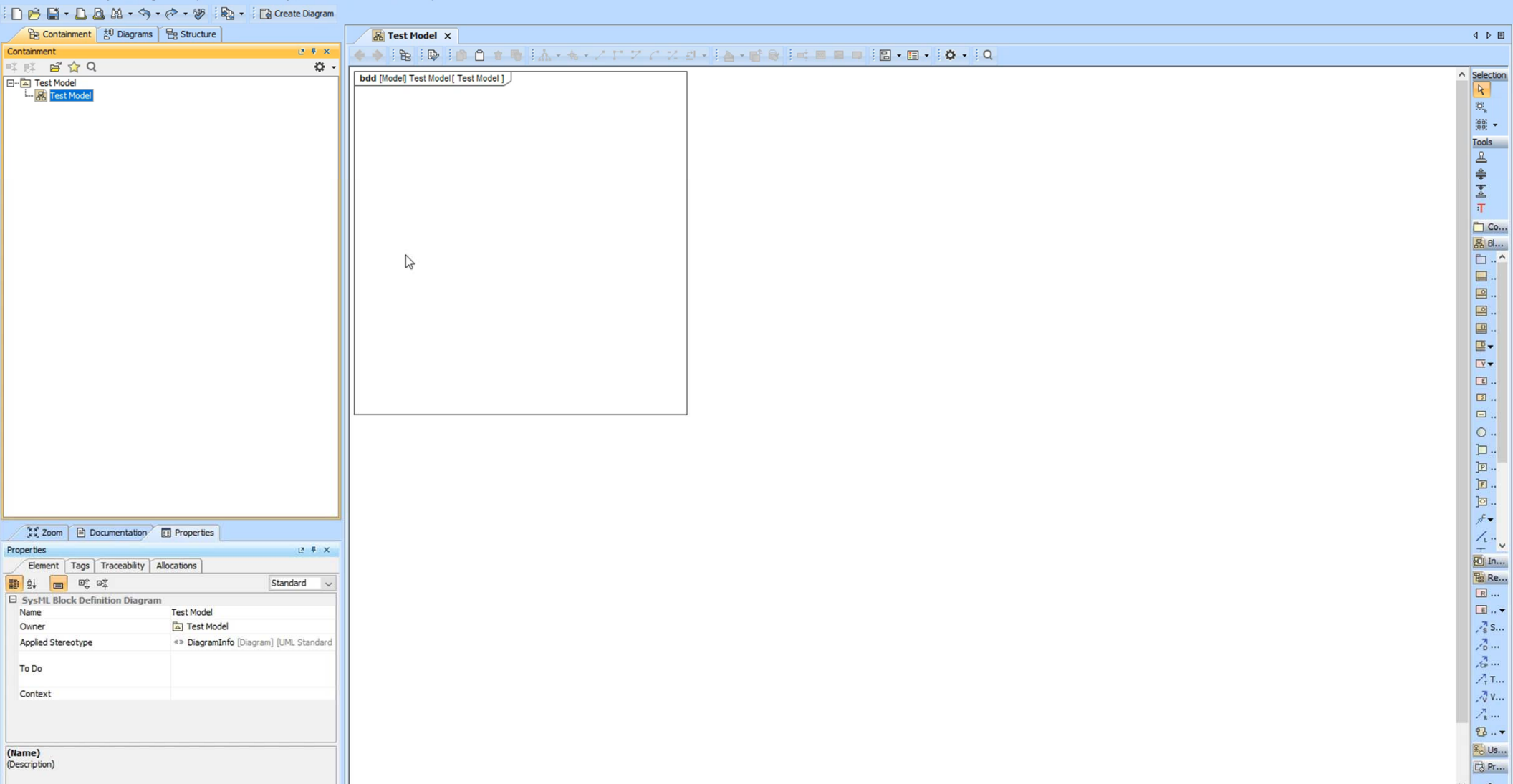
Selected Concepts

Automatic Banner Labeling of Diagrams

- Since the key marking identifier for diagrams is in the name, we can use that as the primary marking for the diagram
 - Banner markings become secondary markings dependent on the diagram's name
- The plugin has the capability to adjust the diagram's banner markings based on the diagram's name



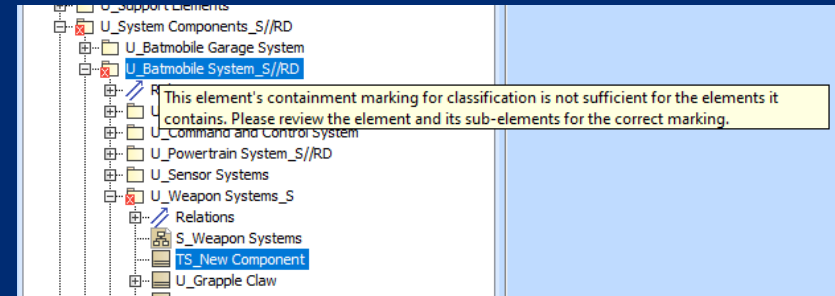
“SECRET” Banner Markings driven by “S_” in Diagram Name



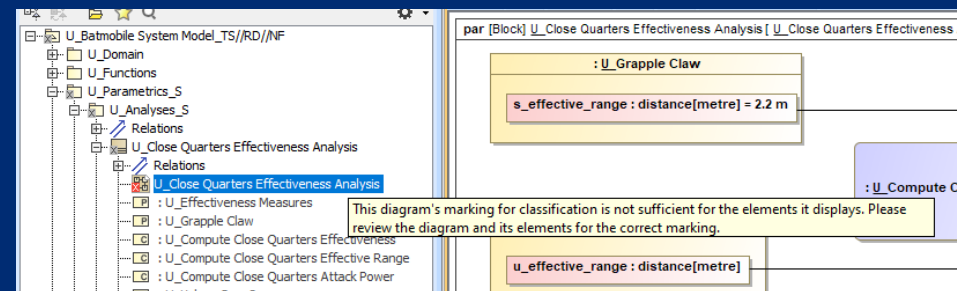
Selected Concepts

Marking Validation Rules

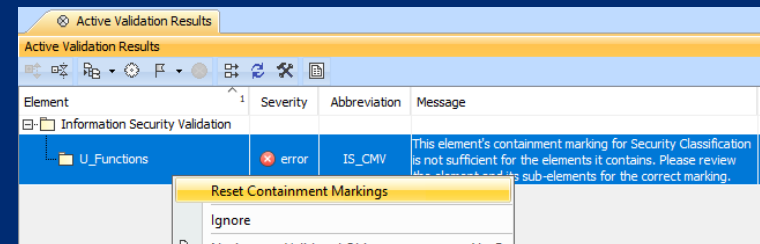
- We can use validation rules to keep ourselves consistent with the marking standard
- The plugin has validation rules which check for:
 - The model being packaged properly in the containment tree
 - Diagrams being marked properly for the content that they diagrams display
- Also, the validation rules include recommended actions to assist the user with the appropriate model correction



Example of Validation Rule testing for Package Containment



Example of Validation Rule testing for Diagram Content



Example of Validation Rule Recommend Action

The screenshot shows a software interface with a 'Containment' tree on the left and a large empty workspace on the right. The tree is expanded to show the following structure:

- U_Batmobile System Model_TS/RD/NF
 - U_Domain
 - U_Functions
 - U_Parametrics
 - U_Requirements_TS/NF
 - U_Support Elements
 - U_System Components_S/RD
 - U_Batmobile Garage System
 - U_Batmobile System_S/RD
 - Relations
 - U_Chassis System
 - U_Command and Control System
 - Relations
 - U_Command and Control System
 - U_Command and Control System
 - U_Targeting System
 - U_Vehicle Control Systems
 - U_Powertrain System_S/RD
 - U_Sensor Systems
 - Relations
 - U_Sensor Systems
 - U_Radar System
 - U_Radio Communication System
 - U_Sensor Systems
 - U_Weapon Systems_S
 - U_Batmobile System
 - U_Batmobile System
 - U_Gotham City Systems
 - U_Wayne Manor Systems
 - Information Security Validation Profile [Information Security Va
 - CLASSIFICATION MARKINGS FOR ILLUSTRATION PURPOSES

Selected Concepts

Loading a Custom Markings Database

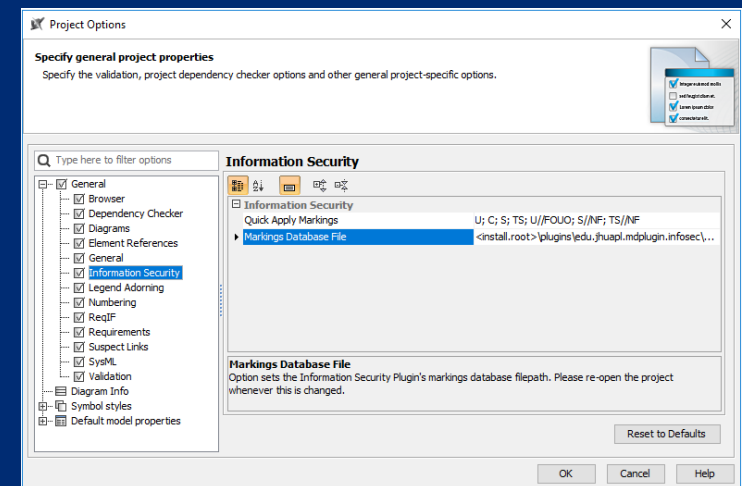
- The plugin utilizes the markings in a XML-based file
 - The plugin's capabilities (e.g., right-click actions, validation rules, etc.) are tied to the markings in the database file
- If needed, the user could develop their own markings database file and point the project to that file
 - This allows the user to customize the markings for specific needs (e.g. Special Program Requirements)
 - The plugin's capabilities can be applied to the new markings

```

12  <markingCategory id="DC">
13    <name>Dissemination Control</name>
14  </markingCategory>
15  <markingCategory id="NIC">
16    <name>Non-Intelligence Community</name>
17  </markingCategory>
18 </markingCategories>
19 <markings>
20 <marking id="TS" category="SC">
21   <bannerMarkingFull>TOP SECRET</bannerMarkingFull>
22   <bannerMarkingShort>TOP SECRET</bannerMarkingShort>
23   <portionMarking>TS</portionMarking>
24   <overmarks>
25     <overmark>U</overmark>
26     <overmark>C</overmark>
27     <overmark>S</overmark>
28   </overmarks>
29   <bannerColor>255,128,0</bannerColor>
30 </marking>
31 <marking id="S" category="SC">
32   <bannerMarkingFull>SECRET</bannerMarkingFull>
33   <bannerMarkingShort>SECRET</bannerMarkingShort>
34   <portionMarking>S</portionMarking>
35   <overmarks>
36     <overmark>U</overmark>
37     <overmark>C</overmark>
38   </overmarks>
39   <bannerColor>255,0,0</bannerColor>
40 </marking>
41 <marking id="C" category="SC">

```

Markings Database



Database File Path in Project Options

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The screenshot displays a software interface with two main windows. On the left is a 'Containment' tree view showing a hierarchical structure of system components, including 'U_System Components_TS/RD' and 'U_Weapon Systems_TS'. On the right is a Notepad++ window titled 'U:\database-sap.xml - Notepad++' showing XML code. The XML code defines marking categories and markings. The marking categories include 'Security Classification', 'Special Access Programs', 'Atomic Energy Act', 'Dissemination Control', and 'Non-Intelligence Community'. The markings include 'TOP SECRET' and 'CONFIDENTIAL', each with associated banner, short, and portion markings, overmarks, and a banner color of 255, 128, 0.

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- © 2019 The Johns Hopkins University Applied Physics Laboratory LLC. All Rights Reserved. -->
<markingsDatabase>
  <markingCategories>
    <markingCategory id="SC">
      <name>Security Classification</name>
    </markingCategory>
    <markingCategory id="SAP">
      <name>Special Access Programs</name>
    </markingCategory>
    <markingCategory id="AEA">
      <name>Atomic Energy Act</name>
    </markingCategory>
    <markingCategory id="DC">
      <name>Dissemination Control</name>
    </markingCategory>
    <markingCategory id="NIC">
      <name>Non-Intelligence Community</name>
    </markingCategory>
  </markingCategories>
  <markings>
    <marking id="TS" category="SC">
      <bannerMarkingFull>TOP SECRET</bannerMarkingFull>
      <bannerMarkingShort>TOP SECRET</bannerMarkingShort>
      <portionMarking>TS</portionMarking>
      <overmarks>
        <overmark>U</overmark>
        <overmark>C</overmark>
        <overmark>S</overmark>
      </overmarks>
      <bannerColor>255,128,0</bannerColor>
    </marking>
    <marking id="S" category="SC">
      <bannerMarkingFull>SECRET</bannerMarkingFull>
      <bannerMarkingShort>SECRET</bannerMarkingShort>
      <portionMarking>S</portionMarking>
      <overmarks>
        <overmark>U</overmark>
        <overmark>C</overmark>
      </overmarks>
      <bannerColor>255,0,0</bannerColor>
    </marking>
    <marking id="C" category="SC">
      <bannerMarkingFull>CONFIDENTIAL</bannerMarkingFull>
    </marking>
  </markings>
</markingsDatabase>
```

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Looking Ahead

- Further developing marking and identification:
 - Classification by compilation
 - Other marking verification checks, usability updates, software responsiveness, etc.
- Other areas in MBSE and information security:
 - Processes for developing models across development environments of different sensitivity
 - Processes related to the integration of MBSE tools
 - Evolution of MBSE tools and standards (e.g. SysML 2.0)
- Other areas in MBSE and the defense industry:
 - Outside of security classification, there are areas that unique to or important for the defense industry
 - e.g., collaboration between contractor and government environments, systems engineering technical reviews, data rights management, etc.
 - What are we (as members of the defense industry) doing to influence tool vendors to add capabilities that meet our needs?

Questions?

Contact Information

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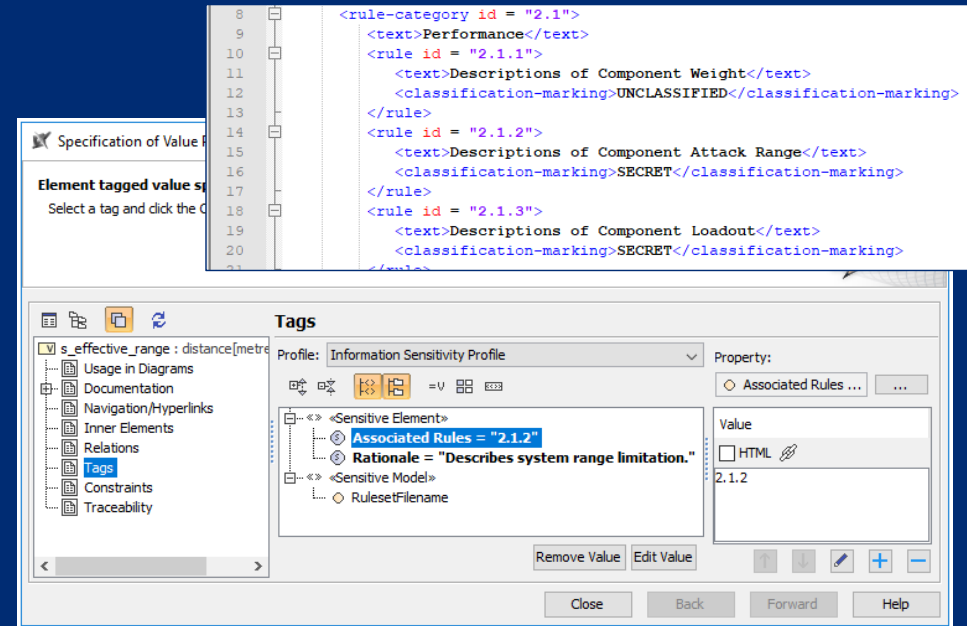
11100 Johns Hopkins Road
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Backup

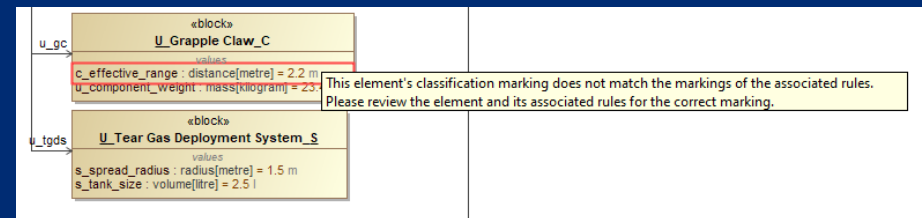
Selected Concepts

Linking Elements to Security Classification Guide

- SysML models have the capability to define attributes to elements
 - Something that is not easy to do with traditional documentation
- If a development program requires, we could:
 - Embed the associated rules and rationale to sensitive elements to justify the marking used
 - Check whenever the markings do not match the associated rules
- This capability is not included in the 0.1 Beta plugin
 - We are exploring this area in a follow-on IRAD effort



Linking Elements to an XML Version of the Security Classification Guide



Validation Rule Check when Associated Rules don't Match



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