



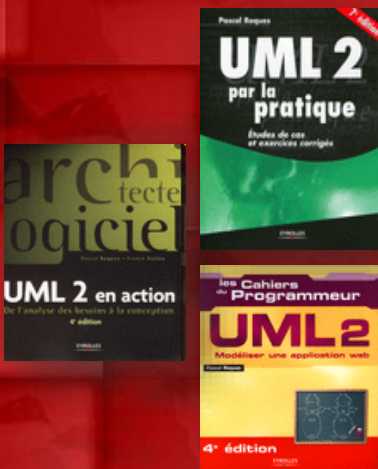
# Requirements Modeling with SysML

Pascal Roques  
INCOSE Webinar  
17 July 2013

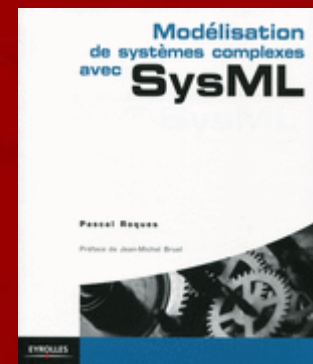
# The Speaker: Pascal Roques



- Senior Consultant & Trainer, 25 years of experience in modeling
  - ✓ SADT, OMT, UML, SysML
- OMG Certified on UML2 and SysML
- Co-founder of  association



- Author of UML best-sellers in France
- ... and of the first French SysML book



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# What is SysML?

- SysML™ is a general-purpose graphical modeling language for specifying, analyzing, designing, and verifying complex systems that may include hardware, software, information, personnel, procedures, and facilities



# SysML = UML2 Profile

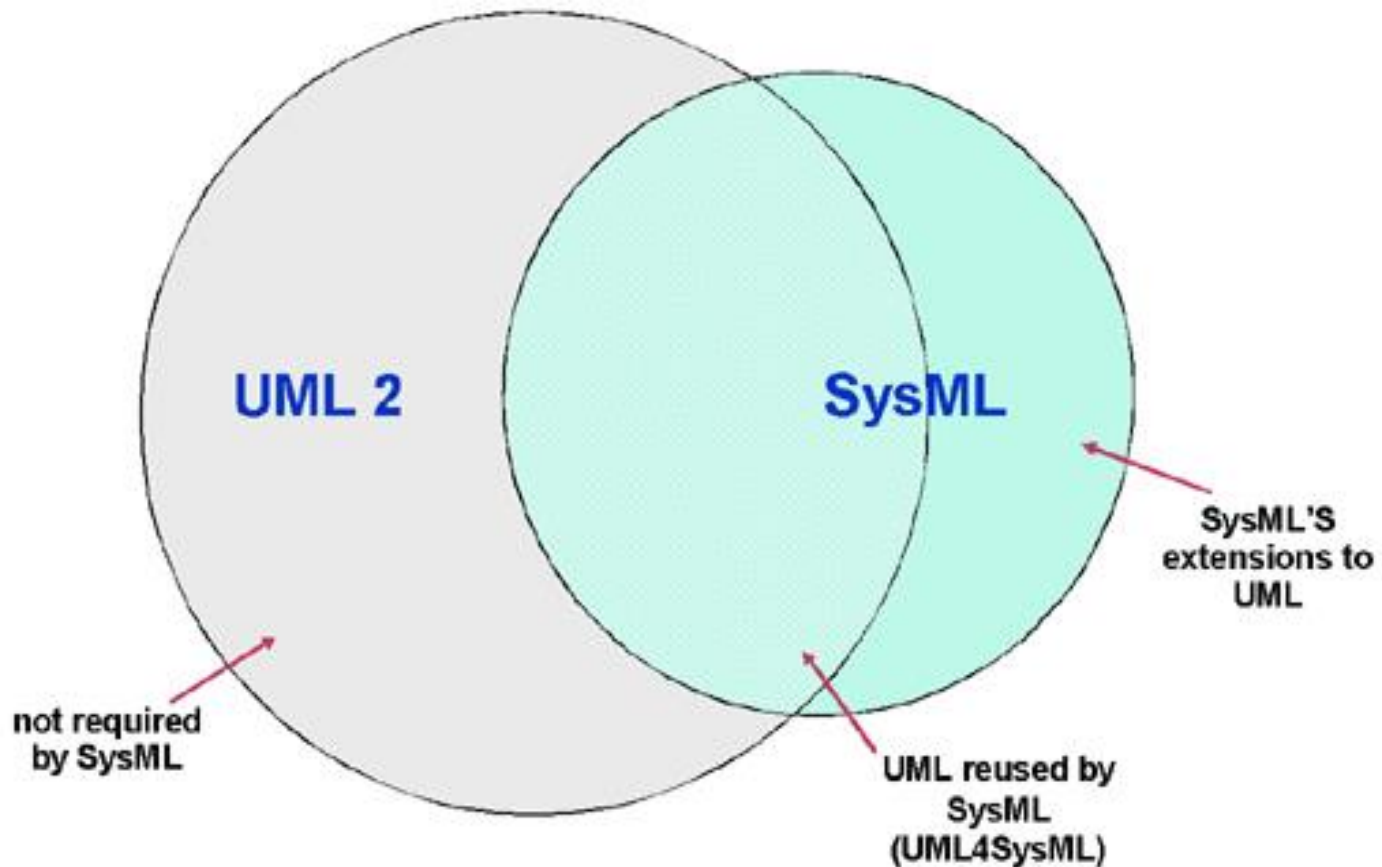


Figure 1. Relationship between SysML and UML

# SysML Diagram Types

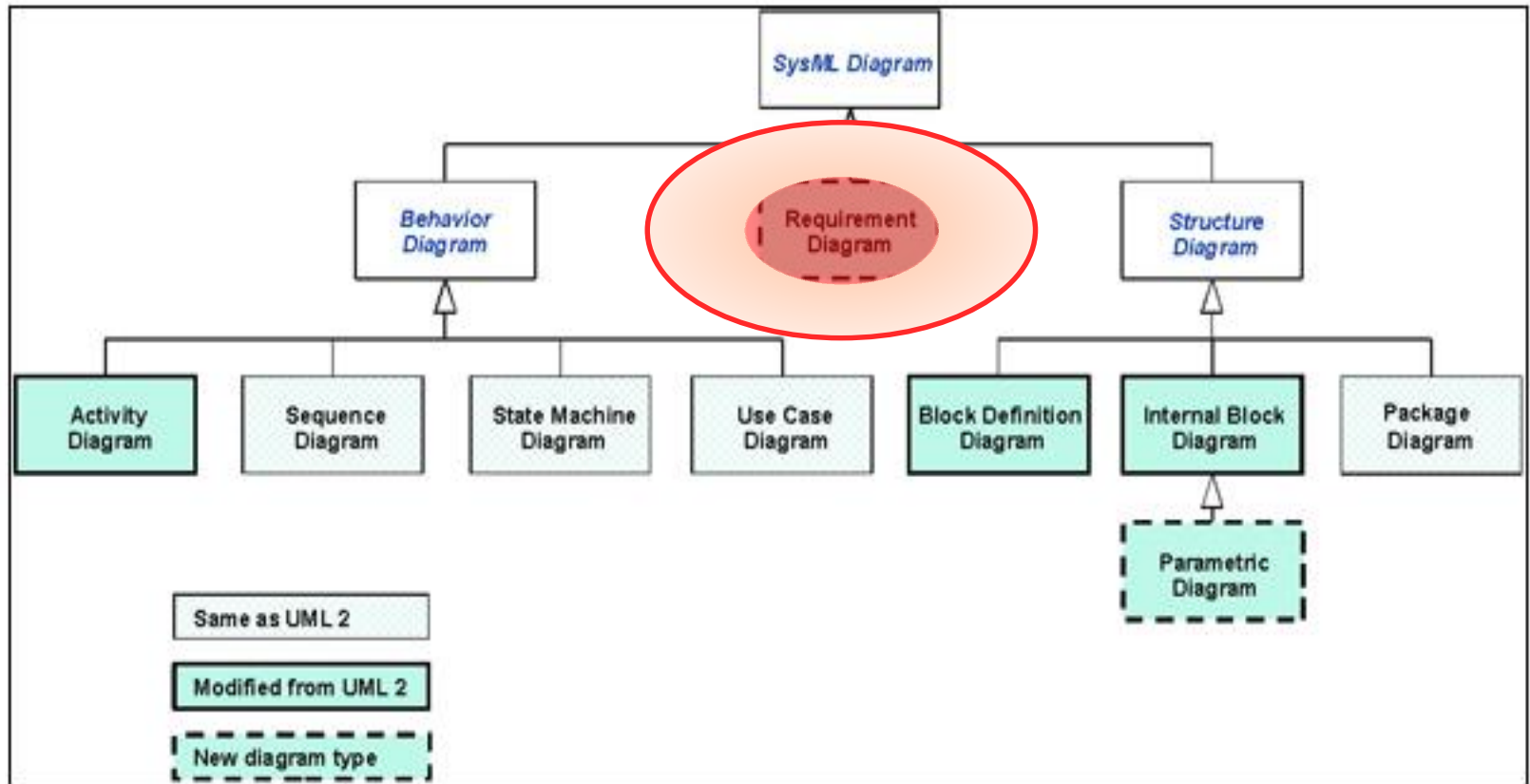
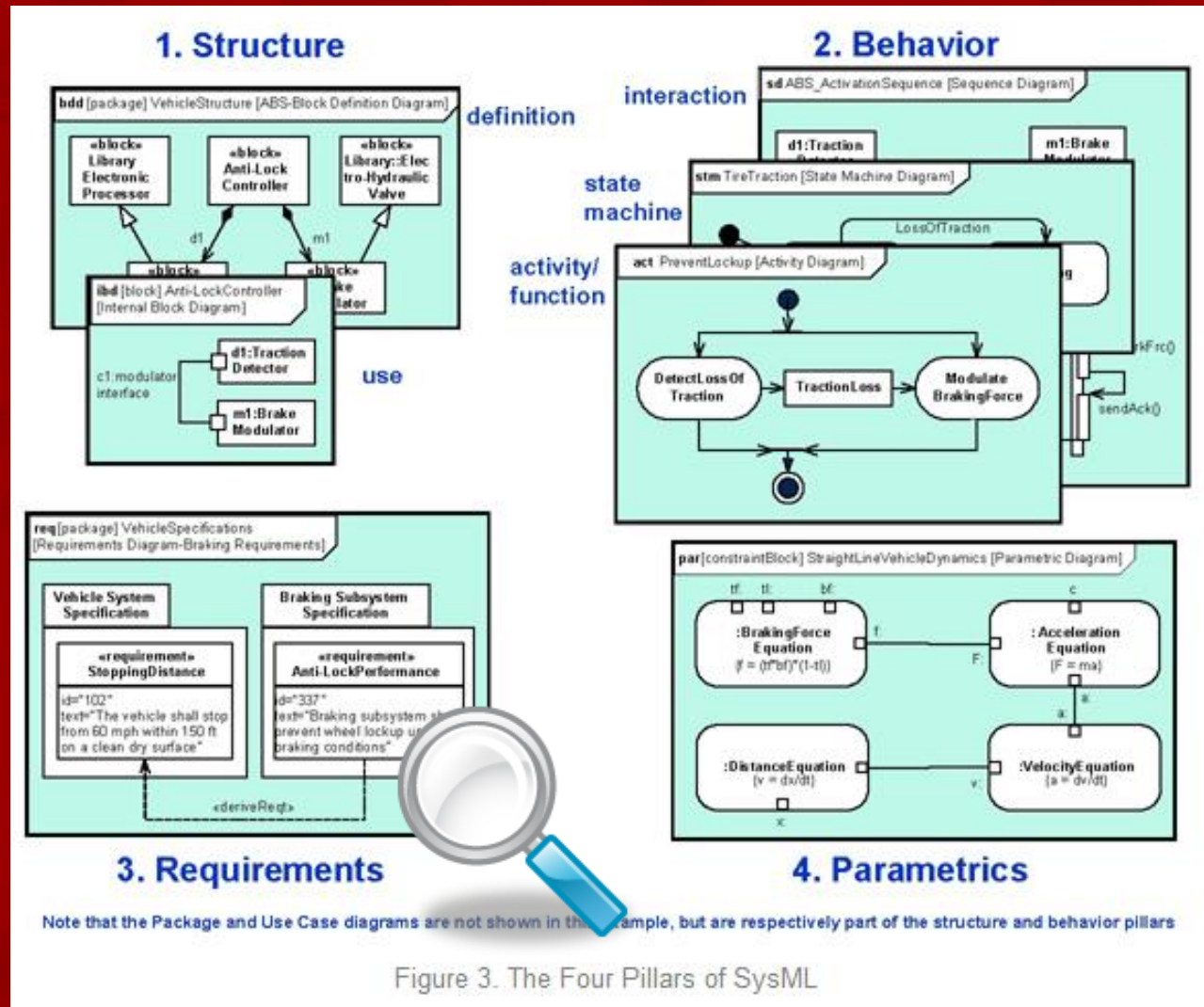


Figure 2. SysML Diagram Types



# The Four « Pillars » of SysML



# Requirements in SysML (1/3)

- A requirement specifies a capability or condition that must (or should) be satisfied
- A requirement may specify a function that a system must perform or a performance condition a system must achieve
- Use cases are typically effective for capturing the functional requirements, but not as well for non-functional

# Requirements in SysML

## (2/3)

- SysML provides modeling constructs to represent text-based requirements and relate them to other modeling elements
  - The requirements diagram can depict the requirements in graphical, tabular, or tree structure format
  - A requirement can also appear on other diagrams to show its relationship to other modeling elements



# Requirements in SysML (3/3)

- A standard requirement includes properties to specify its unique identifier and text requirement
  - Additional properties such as verification status, can be specified by the user
- Several requirements relationships are specified that enable the modeler to relate requirements to other requirements as well as to other model elements

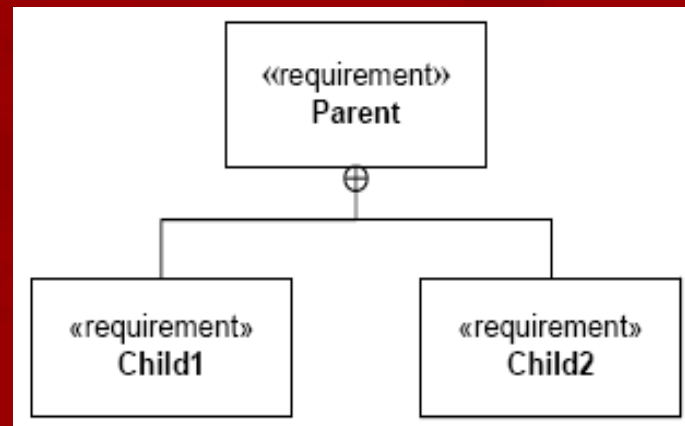
«requirement»

Requirement name

text="The system shall do"  
Id="62j32."

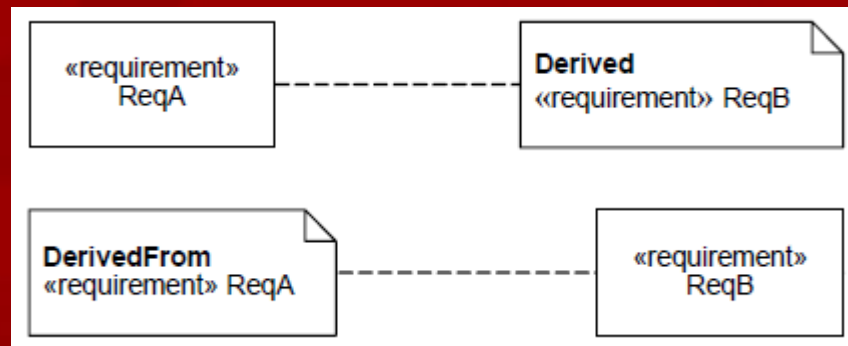
# Composite Requirement

- A Composite Requirement can contain sub requirements in terms of a requirements hierarchy, specified using the namespace containment mechanism



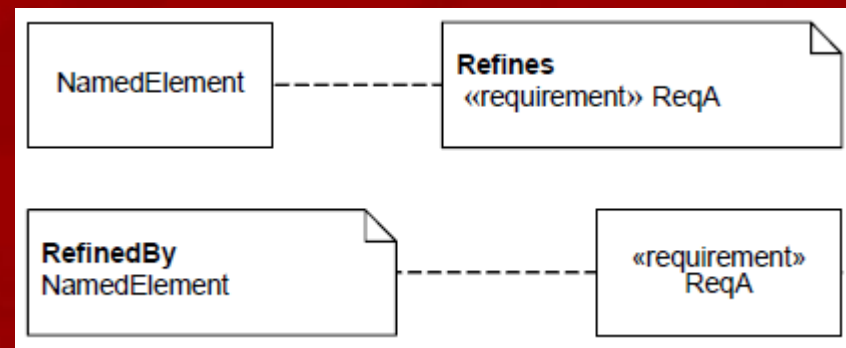
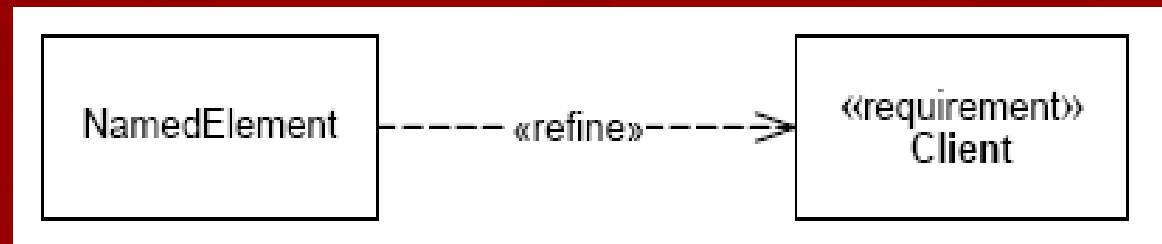
# Derive Relationship

- The derived requirements generally correspond to requirements at the next level of the system hierarchy



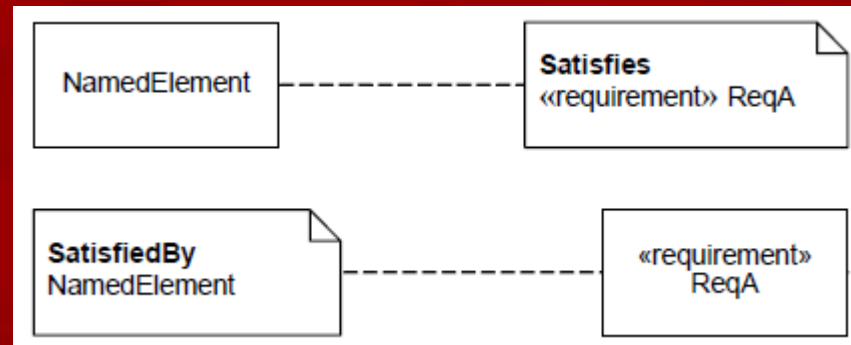
# Refine Relationship

- The refine requirement relationship describes how a model element or set of elements can be used to further refine a requirement



# Satisfy Relationship

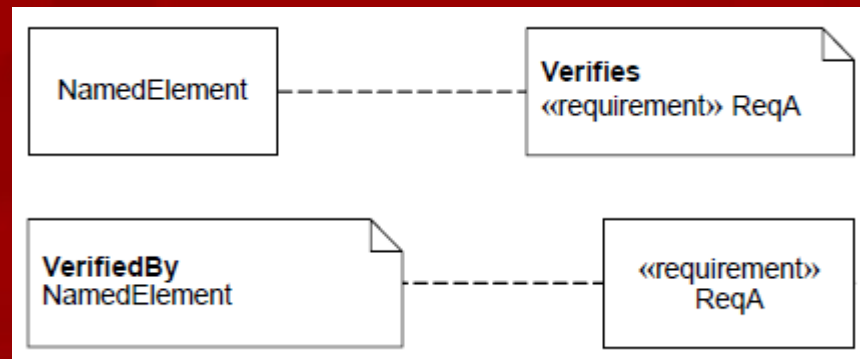
- The satisfy relationship describes how a design or implementation model element satisfies one or more requirements





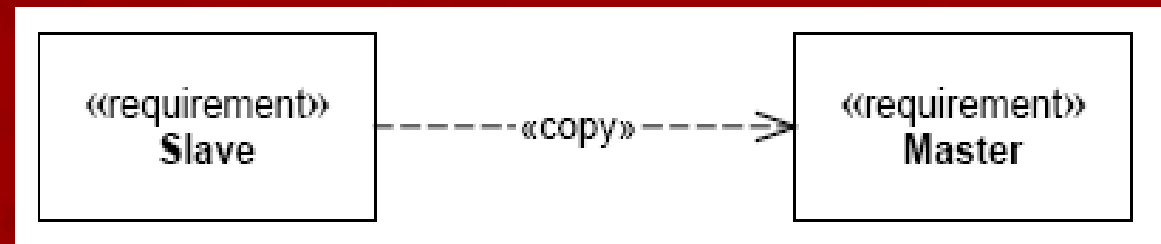
# Verify Relationship

- The verify relationship defines how a test case or other model element verifies a requirement



# Requirement Reuse

- There is a real need for Requirement reuse across product families and projects
- SysML introduces the concept of a slave requirement



# Trace Relationship

- A generic trace requirement relationship provides a general-purpose relationship between a requirement and any other model element

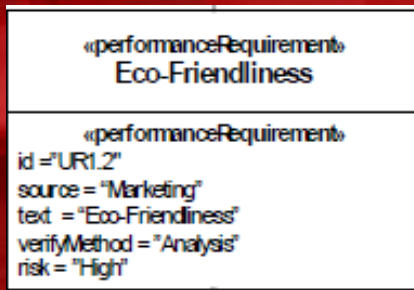
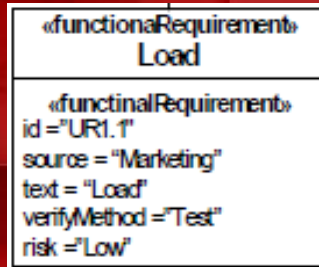


## Warning: Arrow direction!



- Most requirement relationships in SysML are based on the UML dependency
- In SysML, the arrowhead direction is opposite of what has typically been used for requirements flow-down where the higher-level requirement points to the lower-level requirement!

# Requirement Subclasses



- Modelers can customize requirements taxonomies by defining additional subclasses of the Requirement stereotype
  - For example, operational, interface, performance, physical, storage, design constraints, etc.
- Some potential Requirement subclasses are defined in Non-normative Extensions



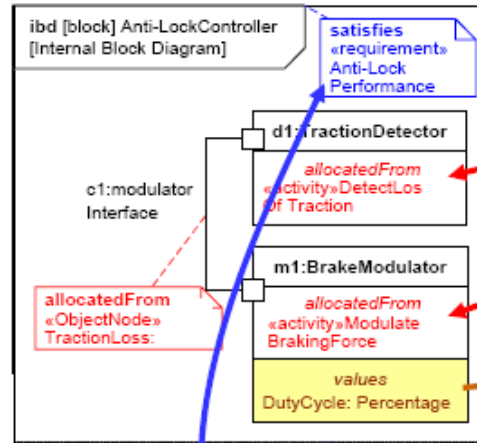
# Requirements Table

- The Requirement diagram has a distinct disadvantage when viewing large numbers of requirements
- SysML embraces the concept of displaying results of model queries in tables as well as using tables as a data input mechanism, but the specifics of generating tables is left to the tool implementer

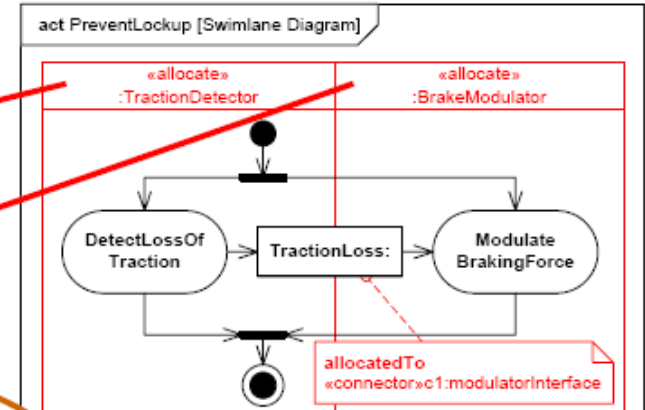
# Other Ways to Represent “Requirements”

- Nearly all SysML diagram types can represent Requirements!
  - Use Case Diagram
  - Sequence Diagram
  - State Diagram
  - Activity Diagram
  - Block Definition Diagram
  - Internal Block Diagram
  - Parametric Diagram

## 1. Structure

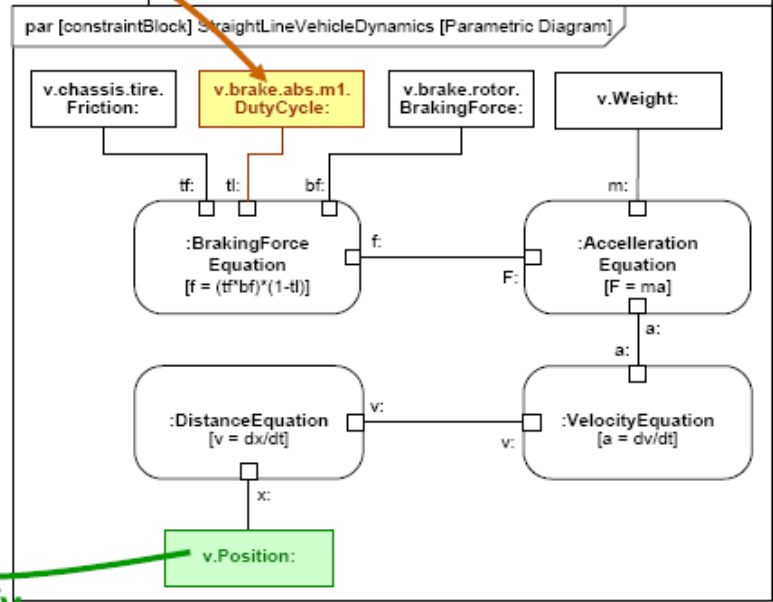
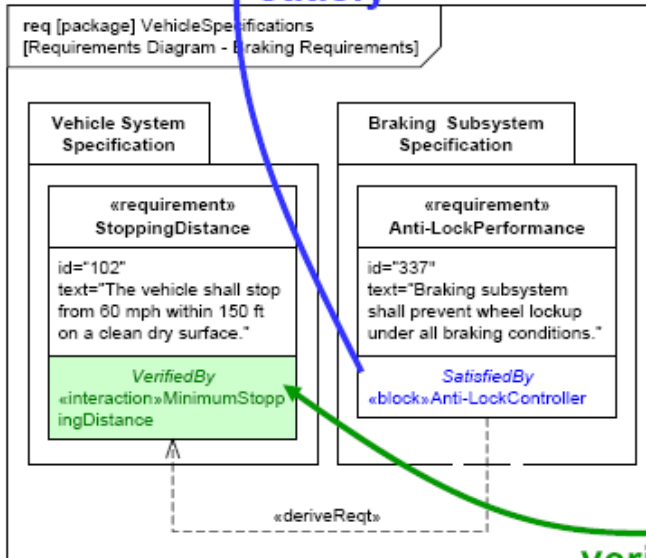


## 2. Behavior



value binding

satisfy



verify

## 3. Requirements

## 4. Parametrics

# Industrial Feedback

- SE<sup>2</sup> and APE Case Study
  - Large telescope SysML Model
- Guidelines for modeling Requirements:
  - Distinguish Objectives, Stakeholder Requirements, System Requirements and Analysis elements (e.g. Use Cases)
  - Modeling can be used for requirements specification
  - Above a certain number of requirements, they become difficult to visualize graphically. It is better to use the tabular format
  - SysML requirements are a visualization aid for architectural important requirements

## Cameo Systems Modeler

[INTRO](#)[FEATURES](#)[RELATED](#)

No Magic Cameo Systems Modeler key benefits include:

### Requirements Management

- SysML Requirements Model
- Support for SysML Requirements diagram
- Requirements Traceability. Ability to manage traces between requirements and satisfying elements, requirements and test cases, requirements and refining elements and requirements of different levels of abstraction
- Predefined satisfy requirement and verify requirement matrices
- Requirements tabular representation view
- Automated Requirements numbering; requirement numbers active uniqueness check
- Requirements Versioning control
- Custom schemes support for requirements versioning and prioritization

<http://www.nomagic.com/products/cameo-systems-modeler.html>



## Conclusion (1/2)

- A Requirements Model can provide information that helps determine if the requirements meet their desired attributes
- SysML requirements modeling provides a 'link' between the text requirements and the rest of the model elements
- ... But for the moment, SysML requirements are not a complete replacement of RM tools

## Conclusion (2/2)

- SysML Requirement modeling concept should not remain just a buzz!
- It can be a real breakthrough for people who do not master yet a tooled Requirements Management process
- It can be also valuable for people used to Requirements Management tools
  - Models can help a lot to formalize requirements (state machines, block diagrams, etc.)
  - Diagrams are a very powerful communication tool between all stakeholders