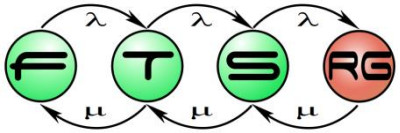
SysML Miscellaneous Grab Bag

Systems Engineering BSc Course

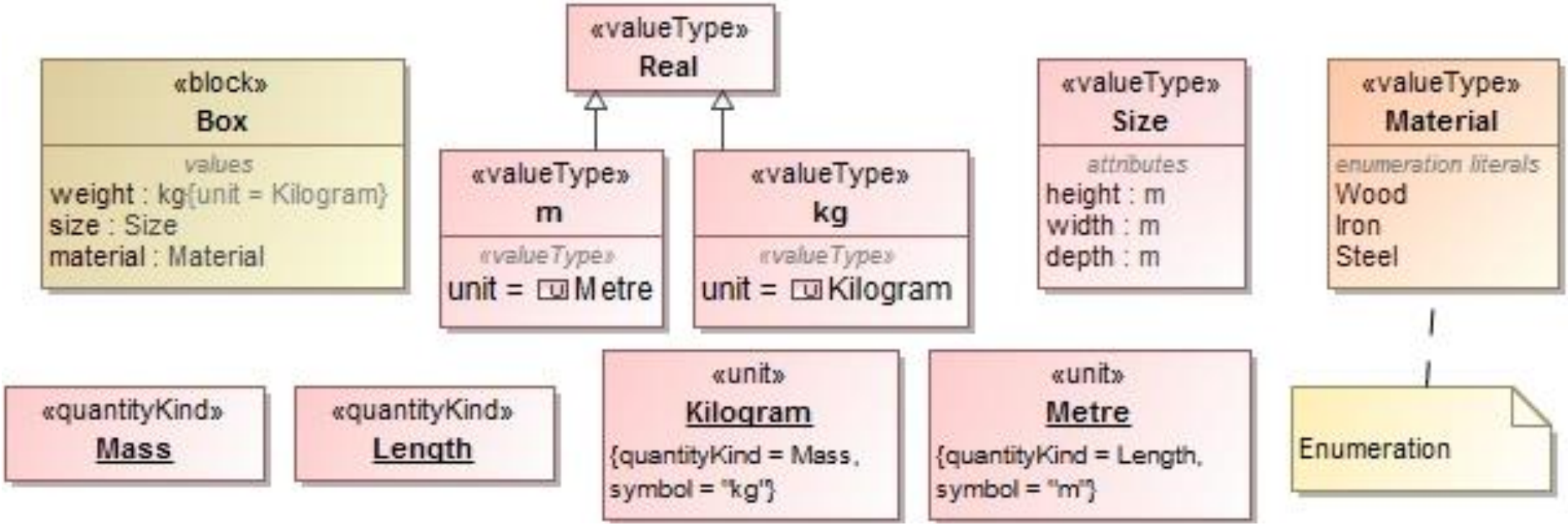


Modeling of logical and physical data

Using block definition diagrams

Value type (Data type)

- Primitives: Boolean, String, Complex, etc.
- Can have Unit and/or QuantityKind (formerly dimension)
  - QuantityKind: Length, Energy, Time, etc.
  - Unit: meter, inch, Watt, secundum, etc.
    - Has a QuantityKind



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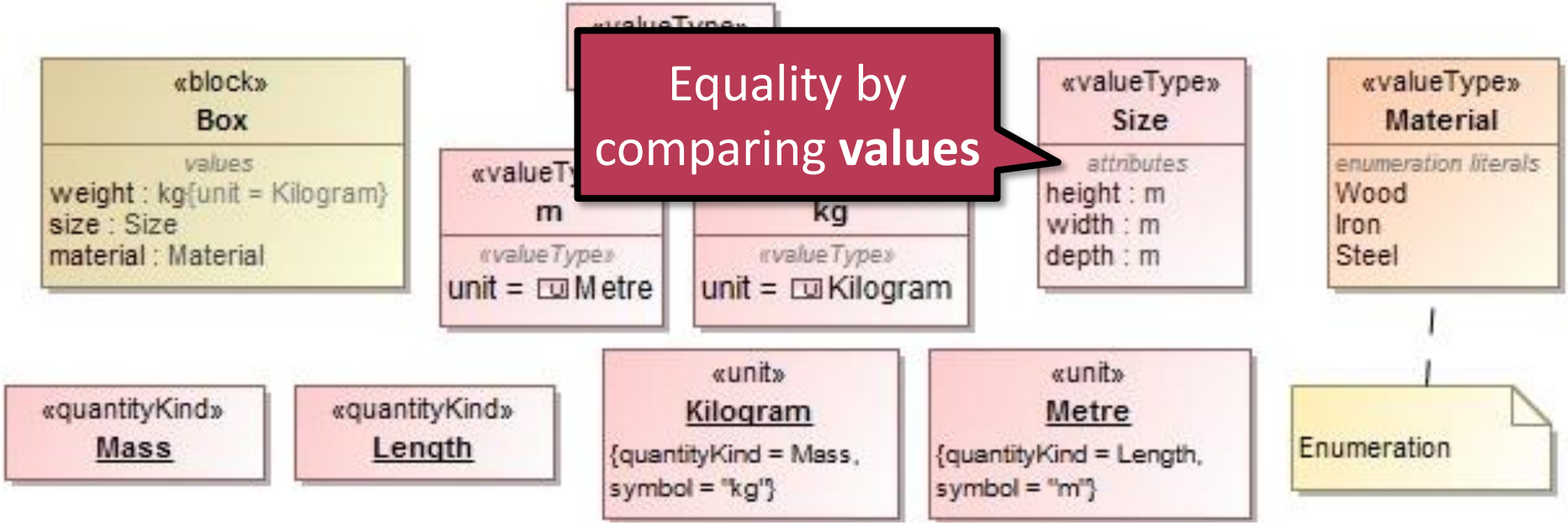
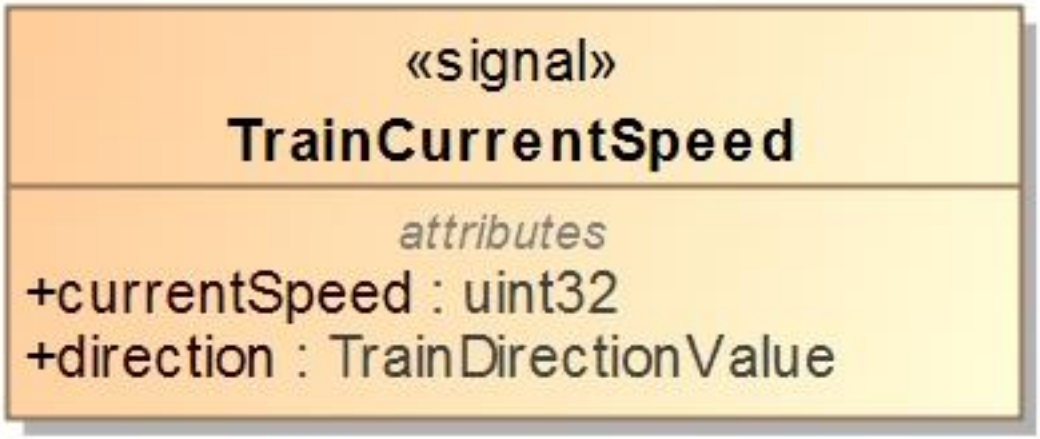


Data of a block

- Blocks can have attributes and/or values
- Value given by / restricted by
  - Definition (bdd)
    - e.g. in a specialized block (motorized =„true”)
  - Use (ibd)
  - Runtime
    - The value may change over time

Signal, Block

- A **signal** defines a message that can be sent and received by a block.
  - Has a set of attributes
  - Used by interfaces



Well-formedness constraints

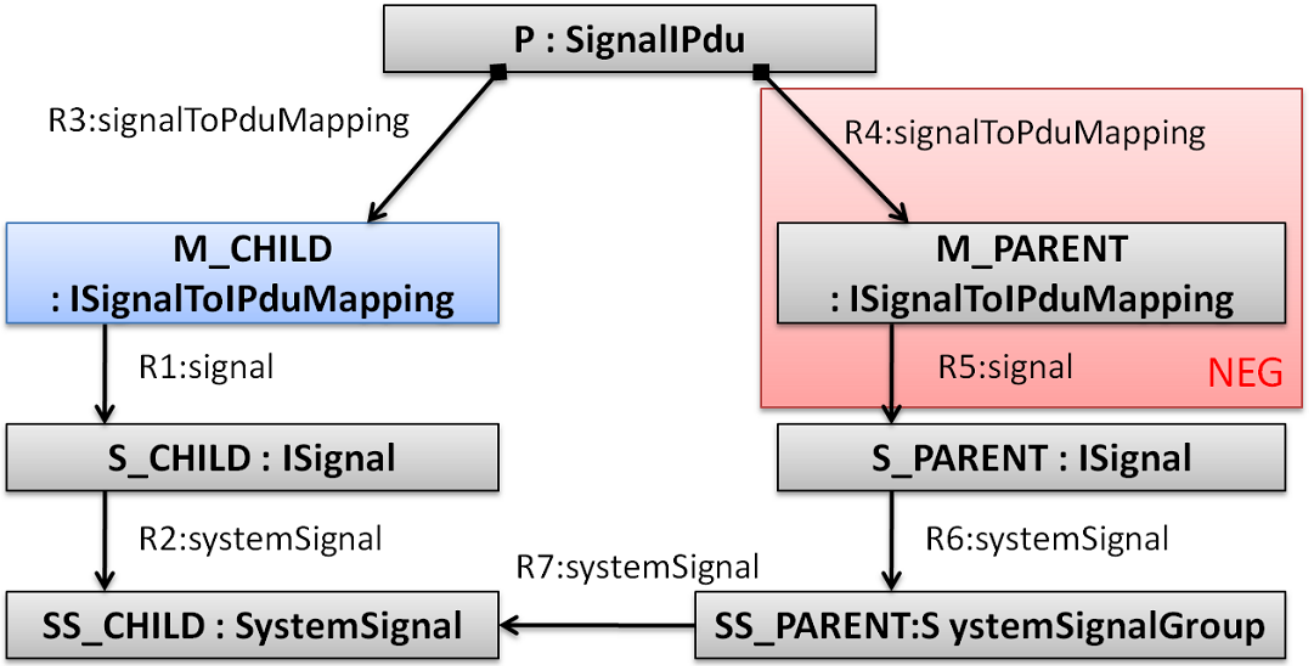
Well-formedness constraints

- Describes additional constraints that should be satisfied on every instance
- Structural constraint
  - A turnout sensor should be connected to exactly one zone controller
- Value constraint
  - The operator should be at least 175 cm tall
  - Components should have a unique name
- Behavioral constraint
  - CPU should receive 12V +- 1V electricity

Motivation: Early validation of design rules

SystemSignalGroup design rule (from AUTOSAR)

- A *SystemSignal* and its group must be in the same *IPdu*
- Challenge: find **violations** quickly in large models
- New difficulties
  - reverse navigation
  - complex manual solution



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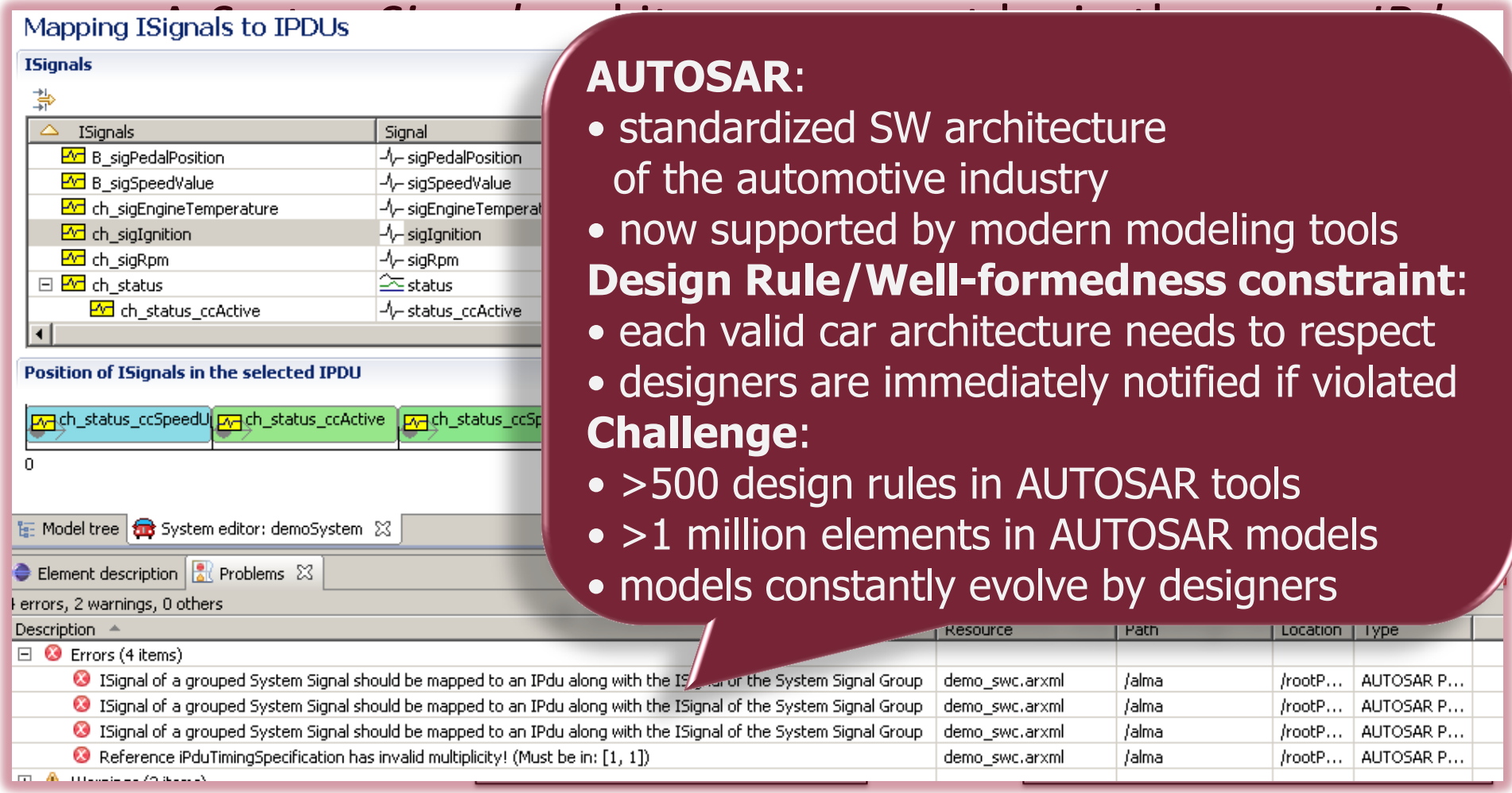
SystemSignalGroup design rule (from AUTOSAR)



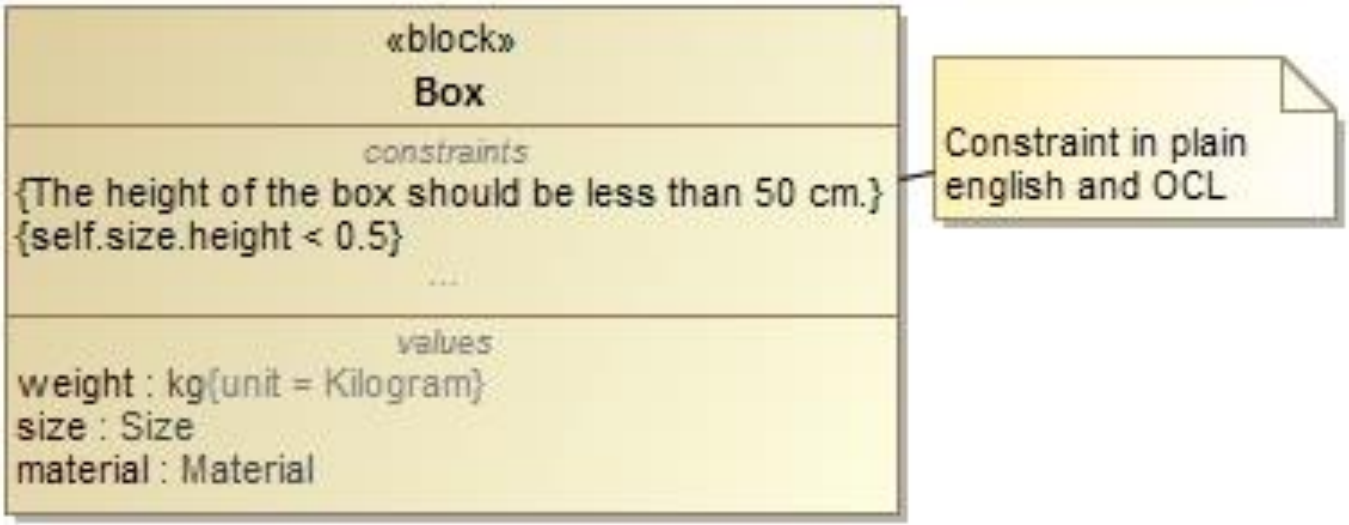
AUTOSAR:
- standardized SW architecture of the automotive industry
- now supported by modern modeling tools

Design Rule/Well-formedness constraint:
- each valid car architecture needs to respect
- designers are immediately notified if violated

Challenge:
- >500 design rules in AUTOSAR tools
- >1 million elements in AUTOSAR models
- models constantly evolve by designers

SysML Constraints

- Different semantics can be used
  - plain english vs formal languages (OCL, Javascript, etc.)
  - formal language can be used for automatic validation
- Can also be defined as a separate block with <<constraint>> stereotype

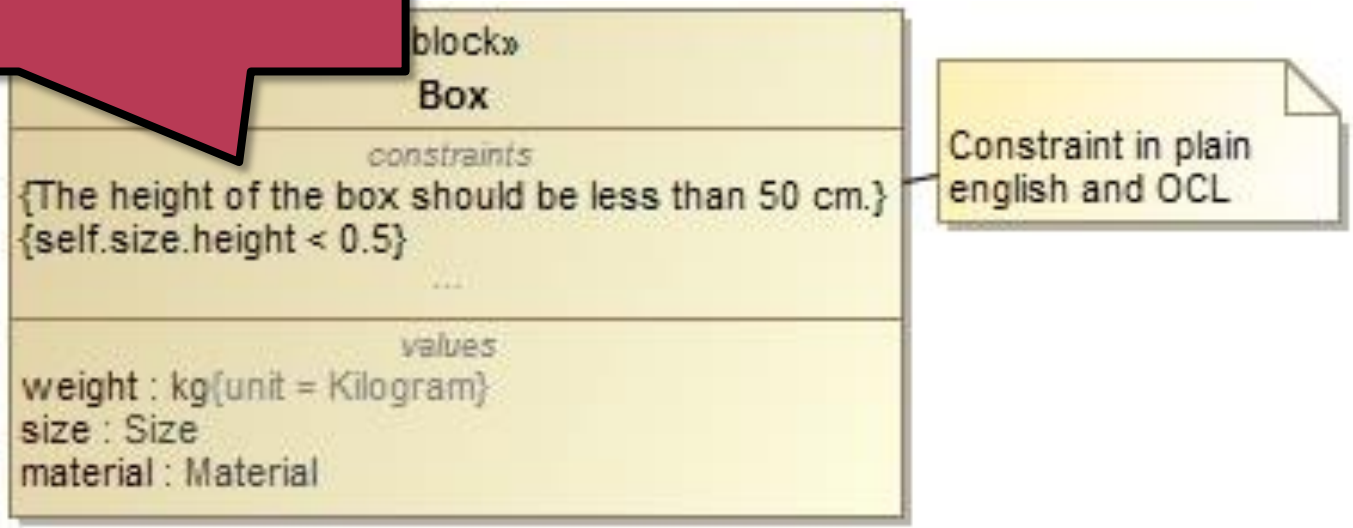


SysML Constraints

- Different semantics can be used
  - nguages (OCL, Javascript, etc.)
  - used for automatic validation
  - arate block with
  - pe

Don't confuse with SysML Parametrics Diagram!

- Constraints are given by the designers
- Parametrics diagram considers the behaviour of nature (will cover later)



OCL: an OMG Standard

- Object Constraint Language
- Declarative language for defining constraints

- Unique name constraint defined by OCL:
  - ```
    context Component inv:
      Component.allInstances()->
      forAll(c1, c2 |
            c1 <> c2 implies c1.name <> c2.name)
    ```
    ```

VIATRA

- VIATRA is an open source Eclipse project
  - Affiliated with the research group
- VIATRA Query Language
  - Graph pattern matching
  - Can evaluate queries incrementally upon changes
- Unique name constraint defined by VQL

```
pattern nameCollision(c1, c2){
  Component.name(c1,name1);
  Component.name(c2,name2);
  c1 != c2;
  name1 == name2;}
```

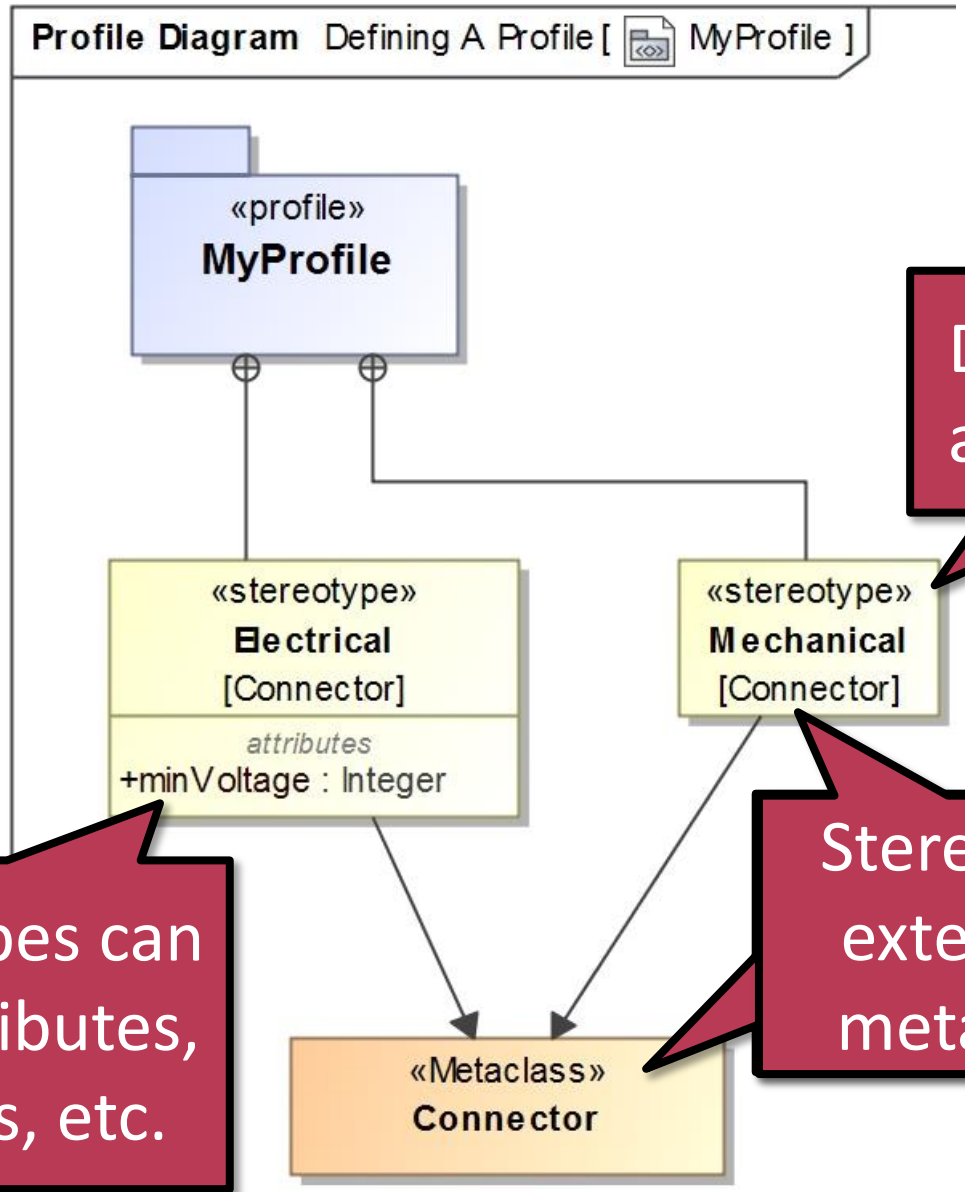
Profiles

for extending UML/SysML

UML Profiles

- Profiles can be used to extend the UML/SysML language.
- Examples
  - SysML is defined as a profile on a subset of UML.
  - SYSMOD (a methodology for SysML) also defines a profile for SysML
  - MARTE (which is an OMG standard) profile is used for modeling real-time and embedded applications.
  - Tools usually support the creation of custom profiles.

Defining a Profile



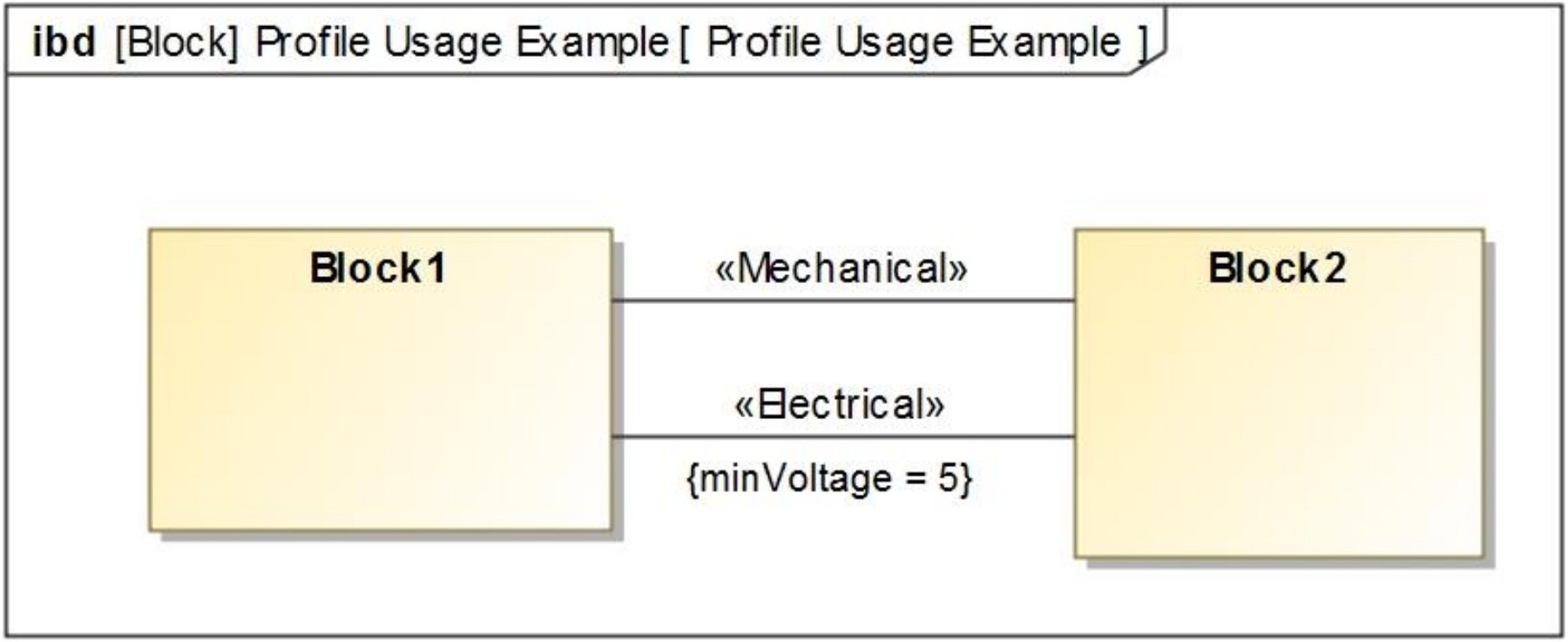
Definition of a stereotype

Stereotypes can have attributes, relations, etc.

Stereotype extends a metaclass

Using a Profile

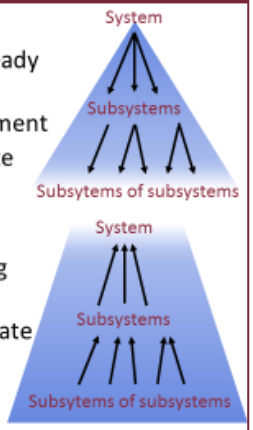
- A profile should be applied to the project to use



Summary

Top-down and bottom-up design

- Top-down: using decomposition
  - ☺ When designing a subsystem, its goal is already known
  - ☹ There are no working parts during development
  - ☹ Problems, needs of subsystems revealed late
- Bottom-up: using composition
  - ☺ Subsystems can be tested one-by-one
  - ☺ There are always some working parts during development
  - ☹ Exact roles of the subsystems are revealed late
- (Not only in structural modeling…)
- Meet-in-the-middle approach
- Iterative approaches



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Ports

- What is a port?
  - Interaction points with external entities limiting and differentiating the possible connection types

REST API:

Method	URL	Payload	Result
POST	/api/InventoryItem	CreateInventoryItemCommand (input)	Creates a new inventory item
GET	/api/InventoryItem	InventoryItemListDataCollection (output)	Returns all items
PUT	/api/InventoryItem/{id}	RenameInventoryItemCommand (input)	Renames an item

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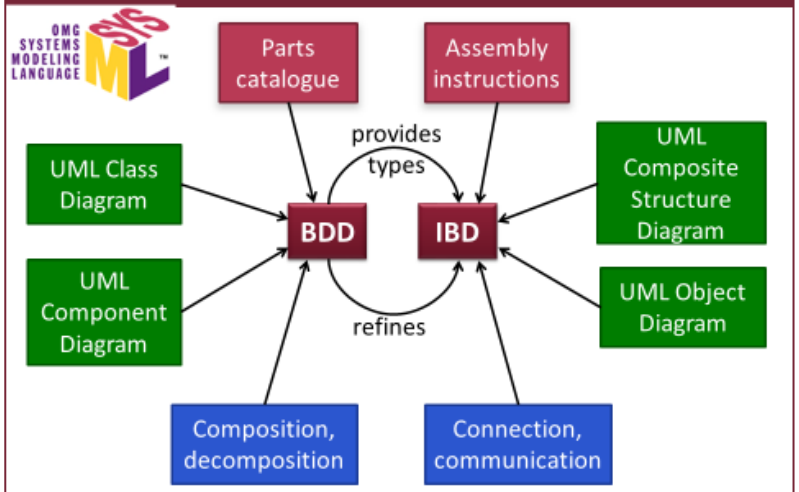
Block Definition Diagram vs Internal Block Diagram



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