FROM RESEARCH TO INDUSTRY

cea tech

list

SYSML
SHORT INTRODUCTION

8/10/2013

CEA LIST

Matthieu Perin

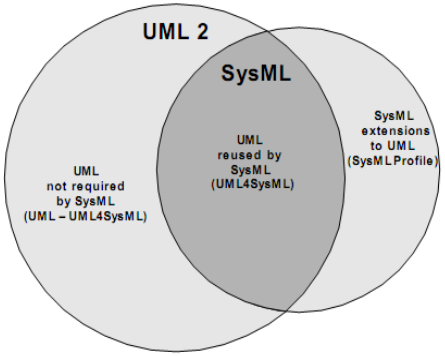
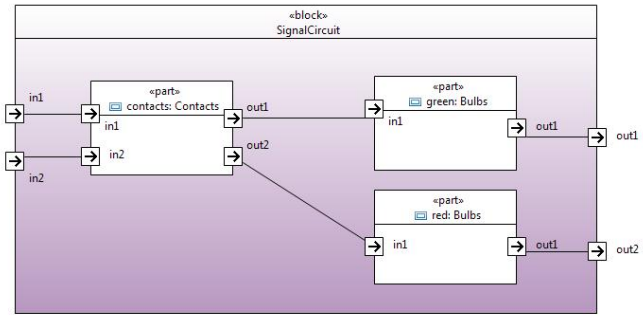
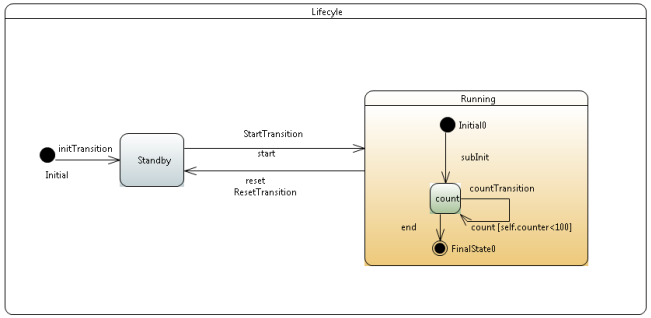


Figure 4.1 - Overview of SysML/UML interrelationship





PRESENTATION PLAN

- What is SysML ?
- ARCHITECTURE MODELING WITH SYSML
- BEHAVIOR MODELING WITH SYSML

WHAT IS SYSML ?

- **A customization (“profile”) of UML2**
  - The specification defines language concepts, …
  - Semantics (= meaning) & Notation (= representation)
  - … **but no methodological aspects** (Methodology and tool independence)

- **A graphical modeling language**
  - In response to the UML for System Engineering RFP developed by the OMG, INCOSE, and AP233 WG

SysML support the specification, analysis, design, verification, and validation of systems or systems of systems

- **OMG SysML specification status**
  - First version finalized in Sept. 2007
  - Current version 1.3

  http://www.omg.org/spec/SysML/1.3/

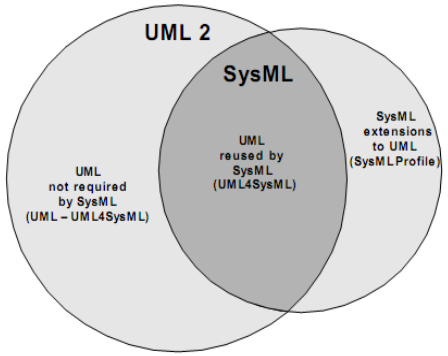
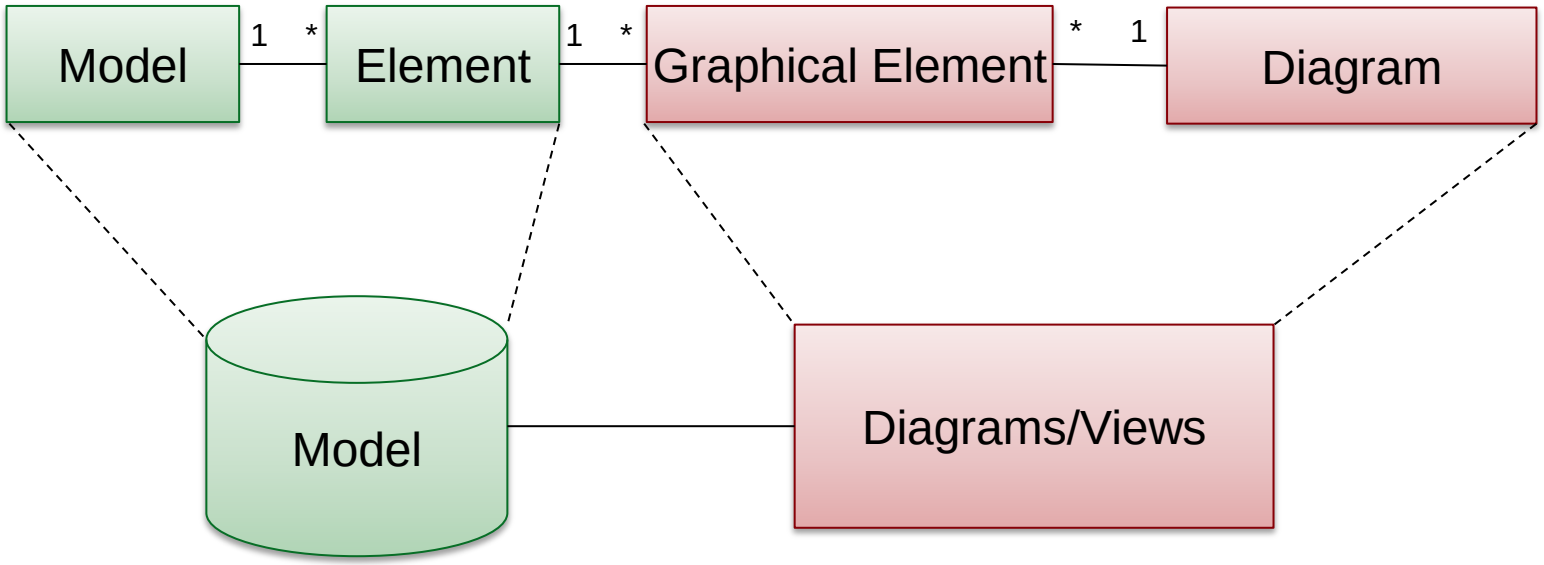


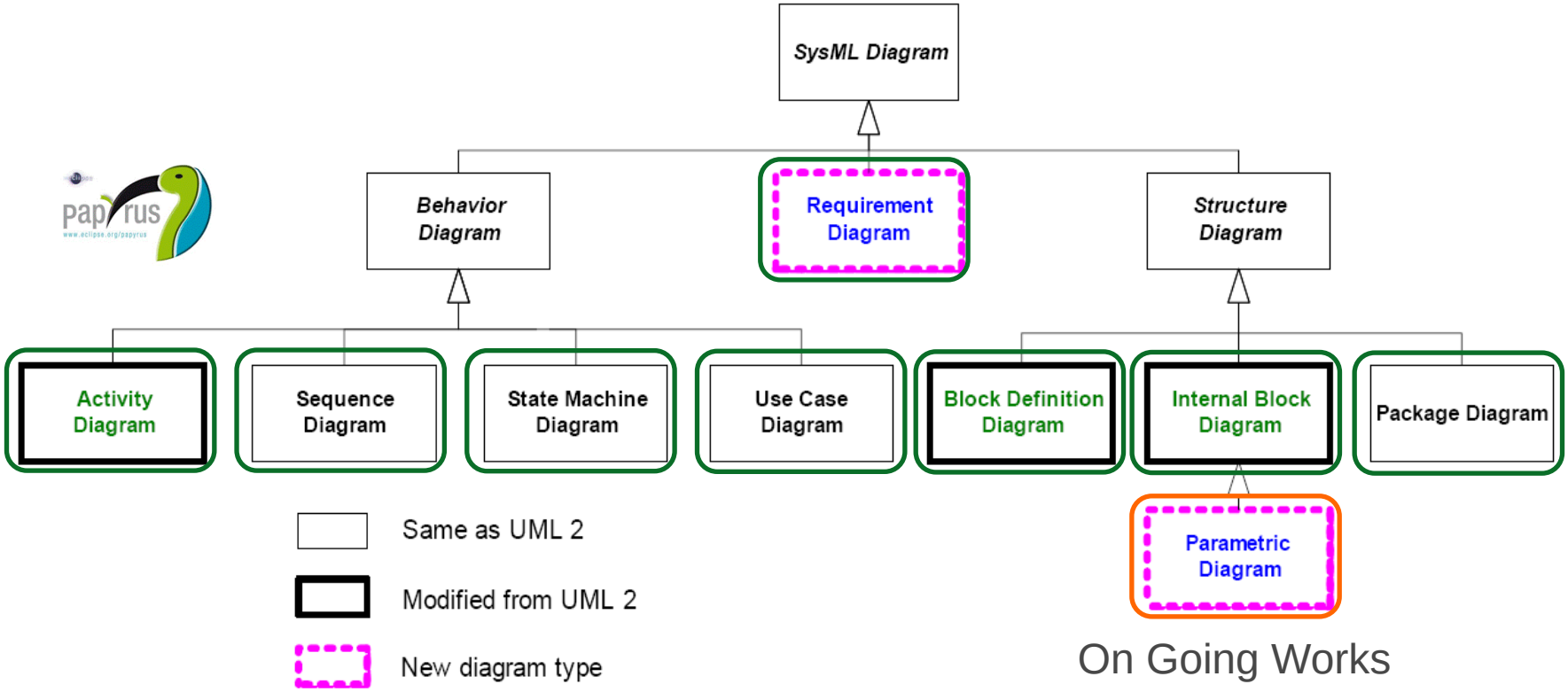
Figure 4.1 - Overview of SysML/UML interrelationship

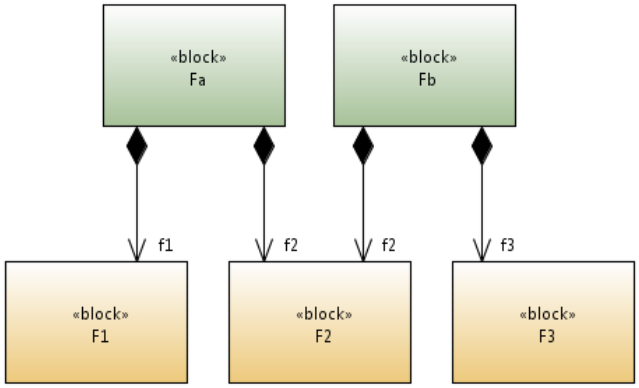
WHAT IS SYSML ?
MODEL – DIAGRAM LINK

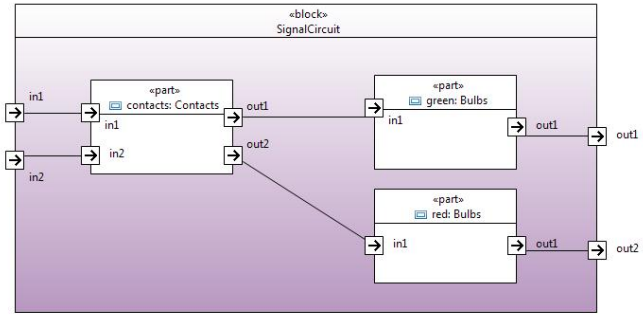


- **This means that**
  - Delete an element from the model => delete all its graphical elements from the diagram.
  - Delete a graphical element => DO NOT delete the corresponding element in the model.

WHAT IS SYSML ?
DIAGRAMS





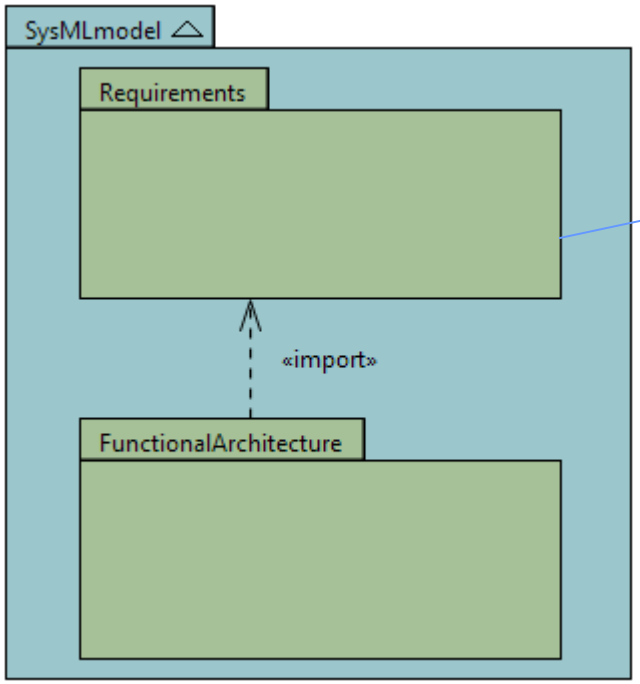


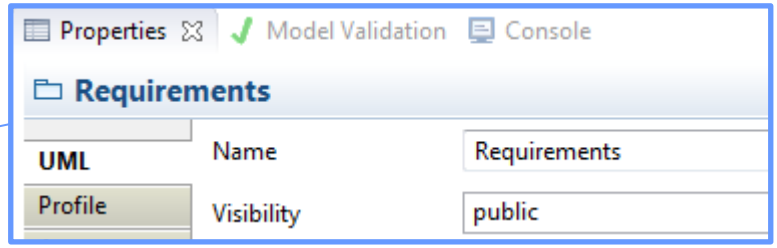
ARCHITECTURE MODELING WITH SYSML

- PACKAGE DIAGRAM
- BLOCK DEFINITION DIAGRAM (BDD)
- INTERNAL BLOCK DIAGRAM (IBD)

PACKAGE DIAGRAM

- **Scope**
  - Organizes of the model content
  - Defines a namespace for the model elements
- **Main element**
  - Package (a Model is a specific Package)

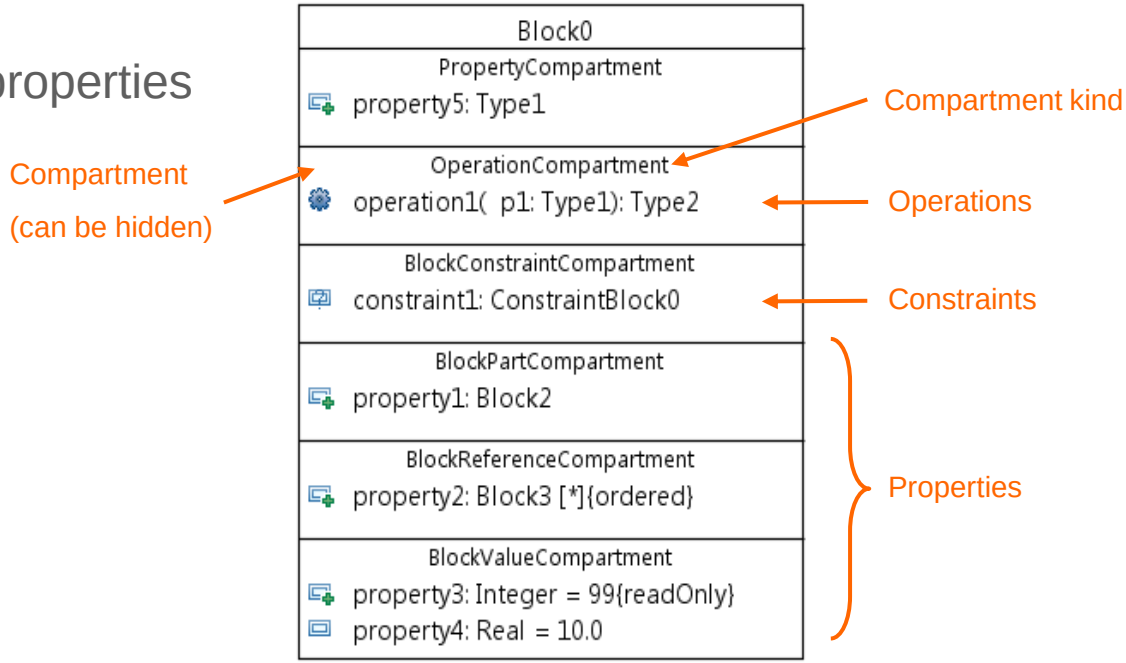




- **Relationships**
  - Containement
  - Import

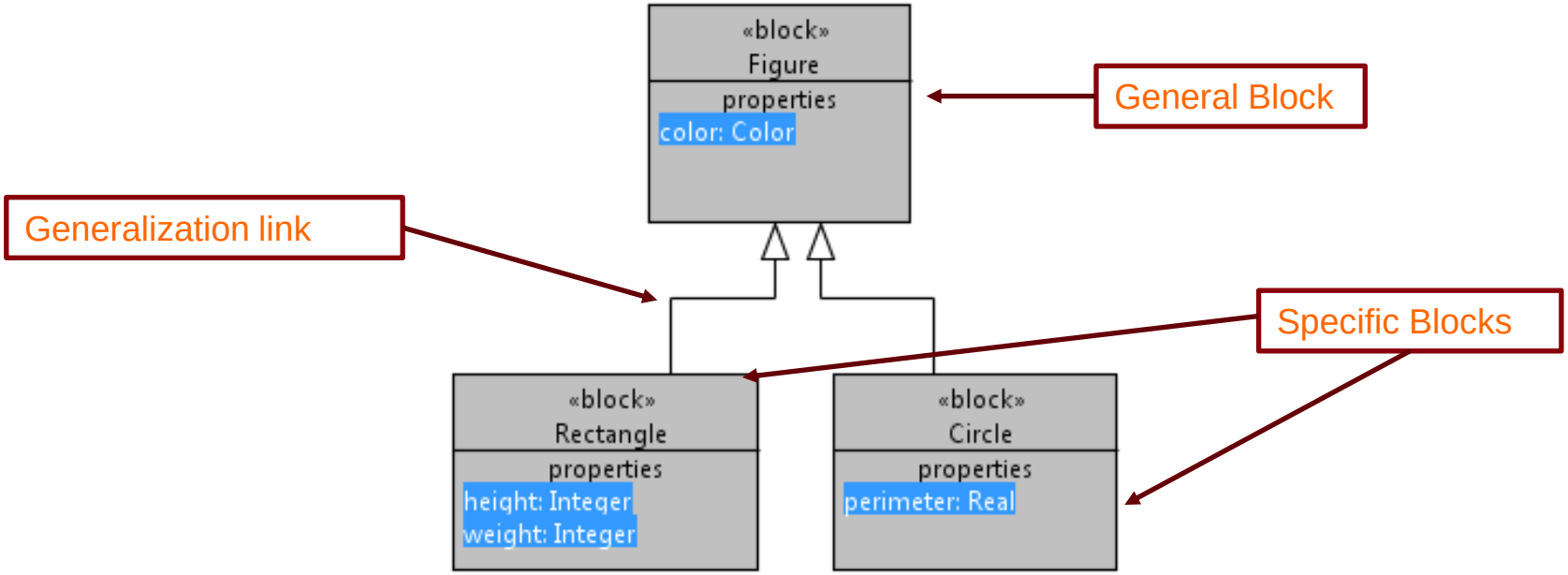
BLOCK DEFINITION DIAGRAM (BDD)

- **Scope**
  - Blocks = modular units of system description
  - No restriction on the represented entity (hardware, software…)
  - Definition of types, reusable in multiple contexts
- **Constituents**
  - Relations between block entities (decomposition, reference, generalization…)
  - A block has **typed** properties
    - DataTypes
    - ValueTypes
    - Constraints
    - Ports
    - Operations



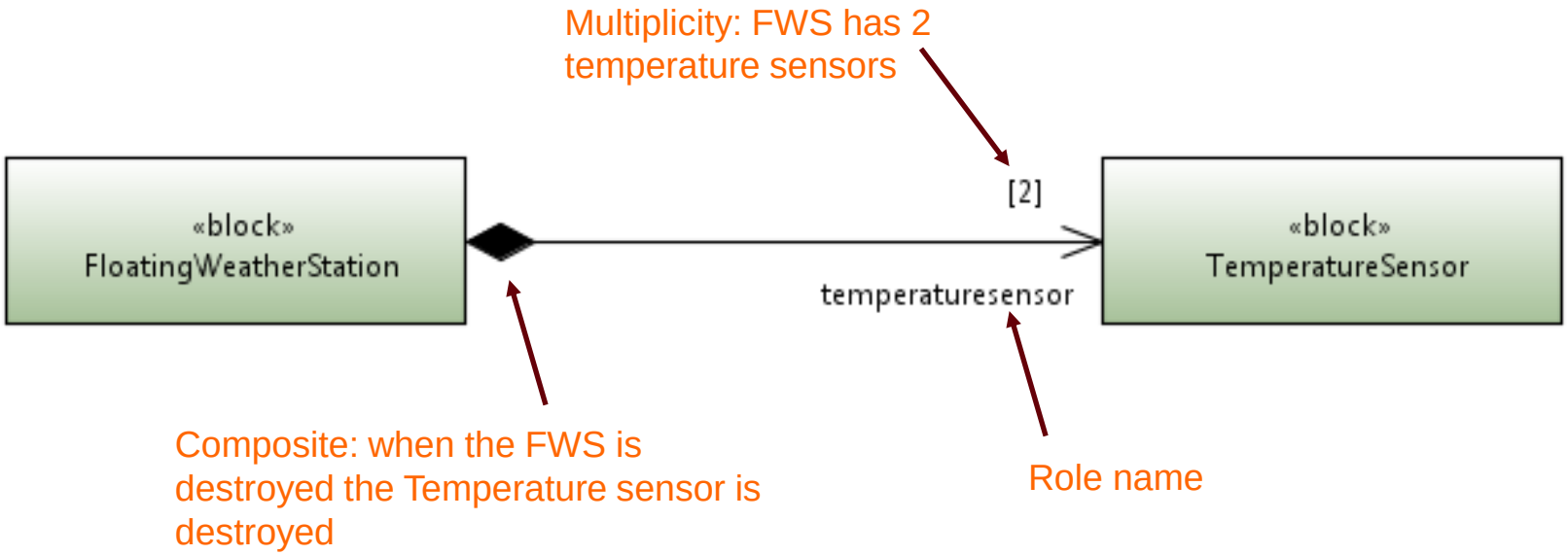
BDD RELATIONSHIPS: GENERALIZATION

- **Like a Class a Block may be a specialization of other Block(s)**
  - Inherits features (properties, operations) of general Blocks and adds its own features
  - Instances of the specific block is also an instance of the general block
  - Mean for factorization of features (reuse)
  - Works also for types (except for Enumeration)



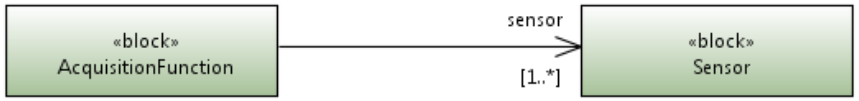
BDD RELATIONSHIPS: DECOMPOSITION

- **Composition relationship (PartAssociation)**
  - Used to model decomposition of blocks (owner-owned relationship)
  - Specifies a multiplicity
  - Specifies a role

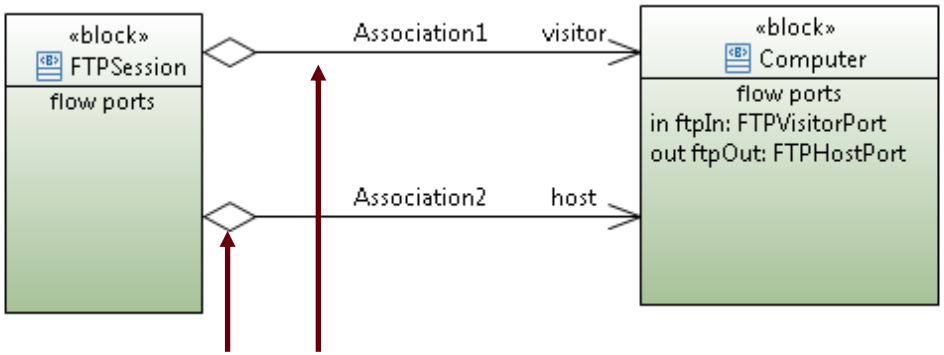


BDD RELATIONSHIPS: REFERENCES

- **Association (ReferenceAssociation)**
  - Simple reference (no containement relationship between blocks)



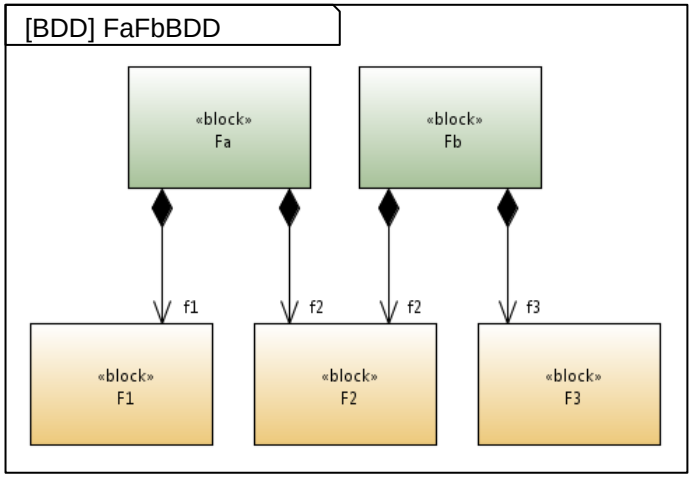
- **Aggregation**
  - Kind of virtual "composition"
  - Referenced block is shared with other blocks
  - Notion of hierarchical containment

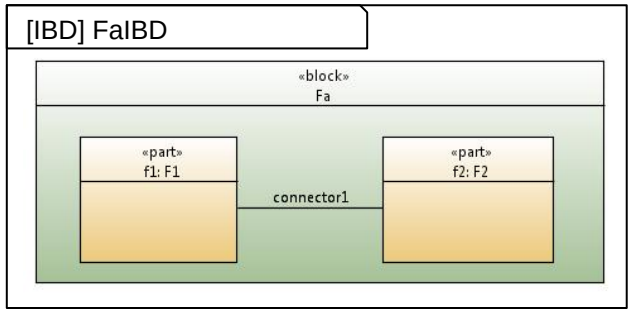


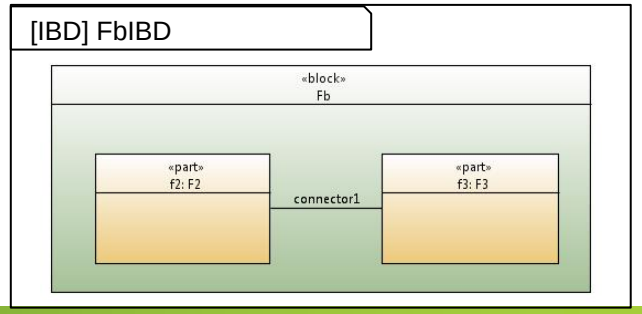
aggregation: when the FTPSession is destroyed visitor and host computers are not destroyed

INTERNAL BLOCK DIAGRAM (IBD)

- **Scope**
  - Describes the internal structure of a block (connections between its properties)
  - Describes a contextual usage of blocks
- **Constituents**
  - A root block (context)
  - Properties (parts and references) of the root block
  - Ports (interaction points) of properties
  - Connectors between ports/properties

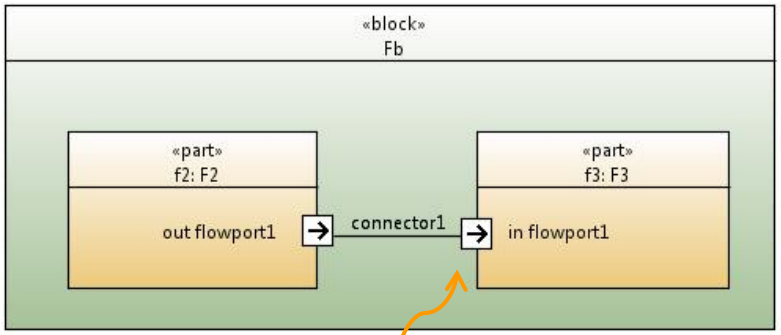


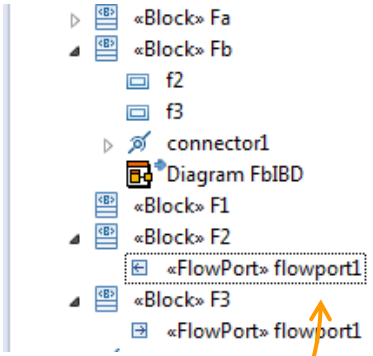




IBD (&BDD) ITEM: FLOW PORTS

- **Scope**
  - Specialization of UML Ports
  - A FlowPort is an interaction point (input and/or output may flow from it)
- **Properties**
  - Name
  - Direction = {IN, OUT, INOUT}
  - Type: type of item sent or received on the port
  - Multiplicity (by default = 1)



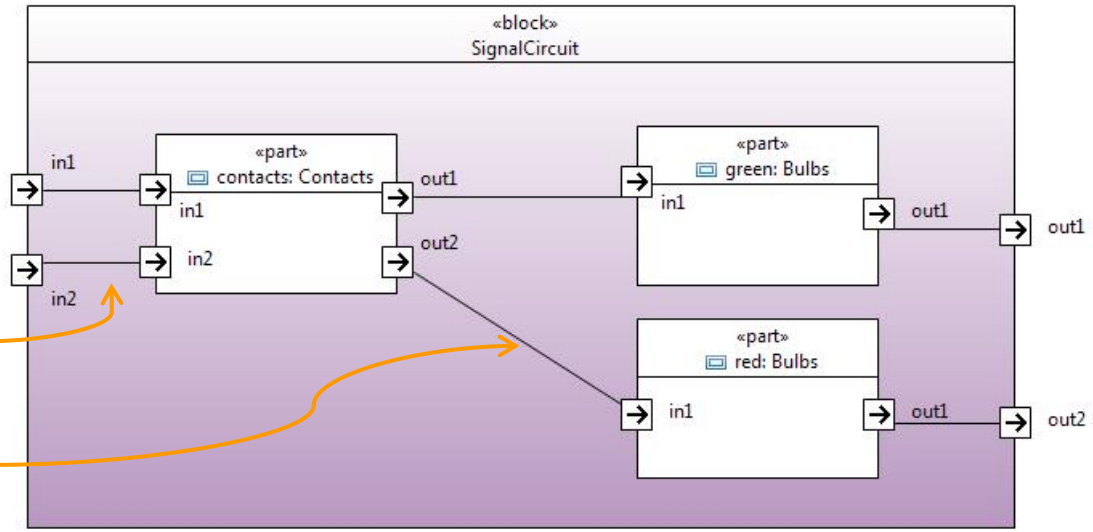


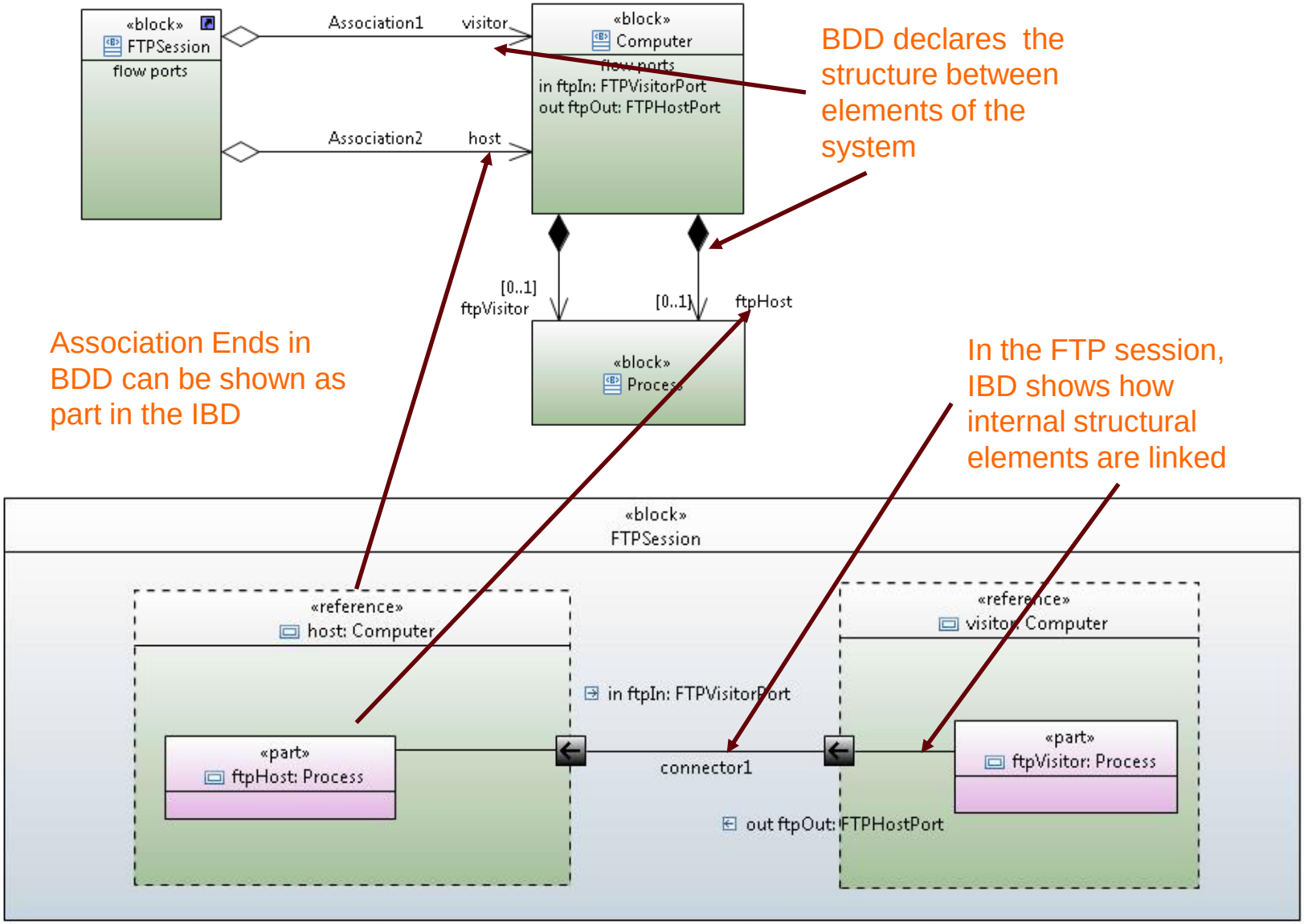
When a port is added in the part (IBD), it is also added in its typing block ➔ Do not forget to reuse ports of the block when it makes sense !

IBD ITEM: CONNECTORS

- **A Connector specifies links that enables communication between two or more ports or parts.**

- **Connected FlowPorts must have a compliant definition**
  - Opposite direction on each side (or inout on both sides) for part-to-part connectors (Assembly types)
  - Same direction on each side for part-to-block connectors (Delegation types)

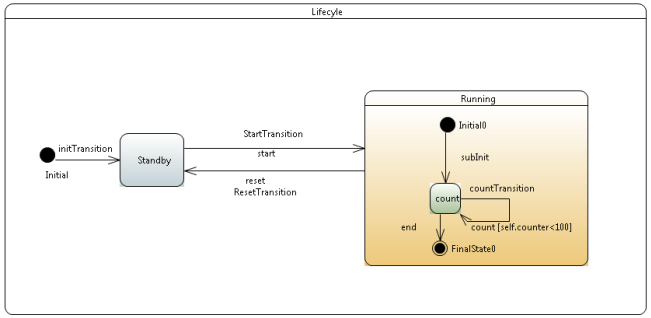


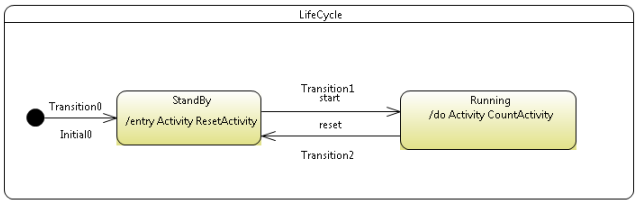


BDD declares the structure between elements of the system

Association Ends in BDD can be shown as part in the IBD

In the FTP session, IBD shows how internal structural elements are linked



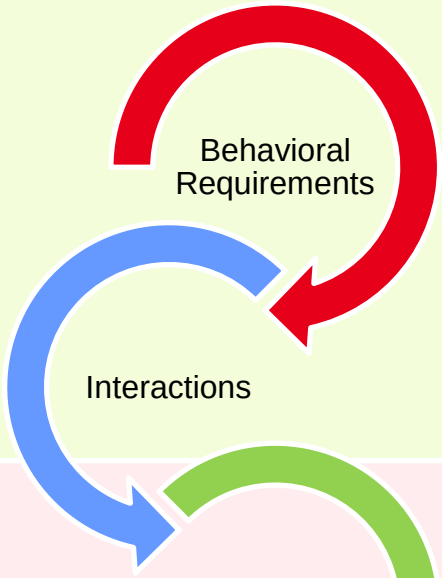


BEHAVIOR MODELING WITH SYSML

- **STATE MACHINE**

BEHAVIOR OVERVIEW

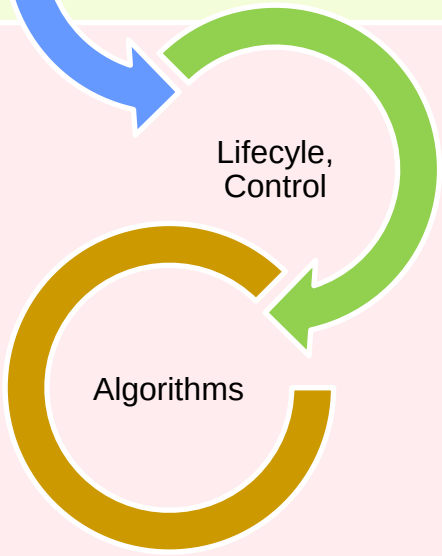
Global Behavior



- Requirement Diagram
- Use Case Diagram

- Sequence Diagram

Local Behavior



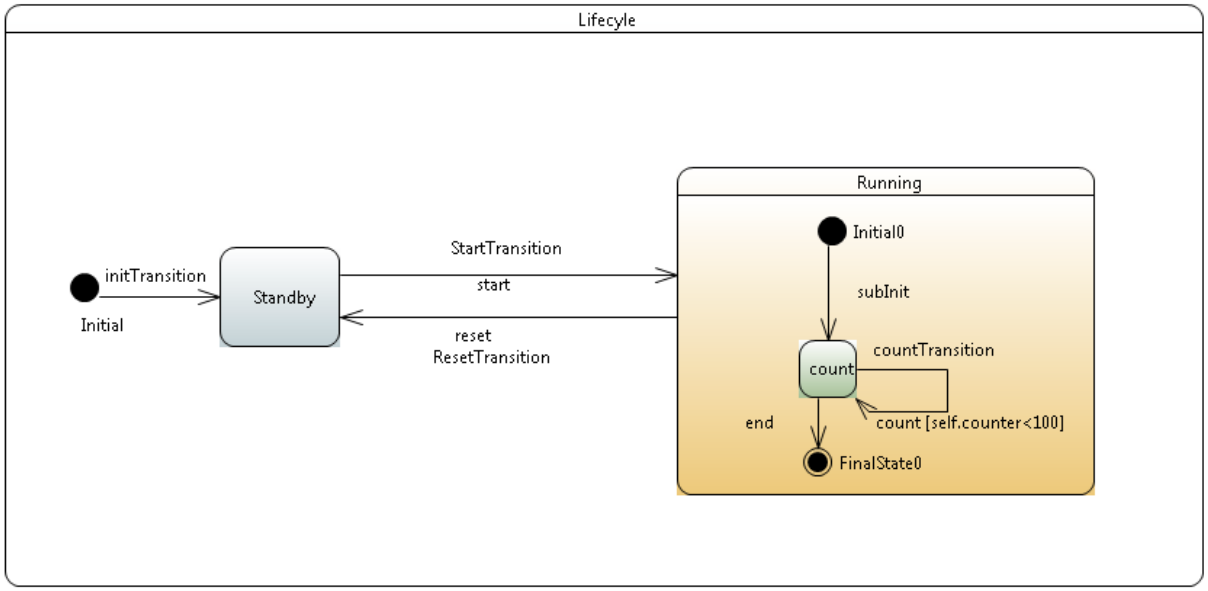
- StateMachine Diagram

- Activity Diagram

STATE MACHINE

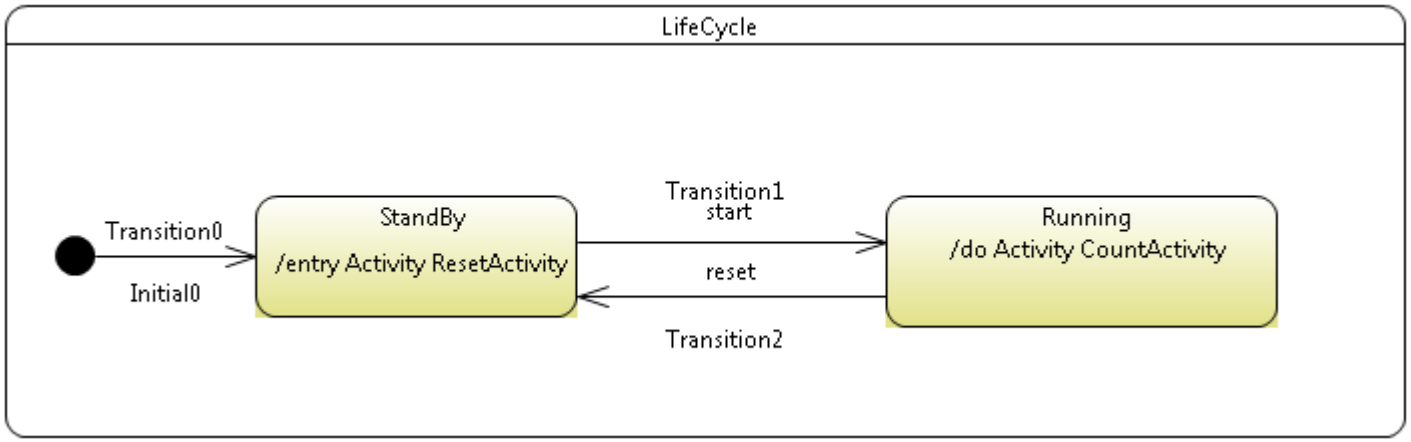
- **Scope**
  - Behavior of objects (actives blocks especially)
  - Behavior holder: launching other behavior (nested state machine, activities, sequence diagram)

- **Constituents**
  - States
  - Pseudo States
  - Transitions



STATE MACHINE ITEMS: STATES AND PSEUDO STATES

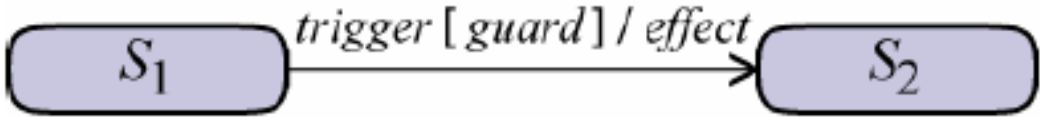
- **Pseudo state**
  - States with specific behavior
  - States with some forbidden capabilities
  - Example: Initial, decision nodes, join, fork, merge, …
- **States**
  - May be described by a name
  - May be composite (containing regions with sub state machine)
  - May have actions: entry, exit and do (as long the state is active)



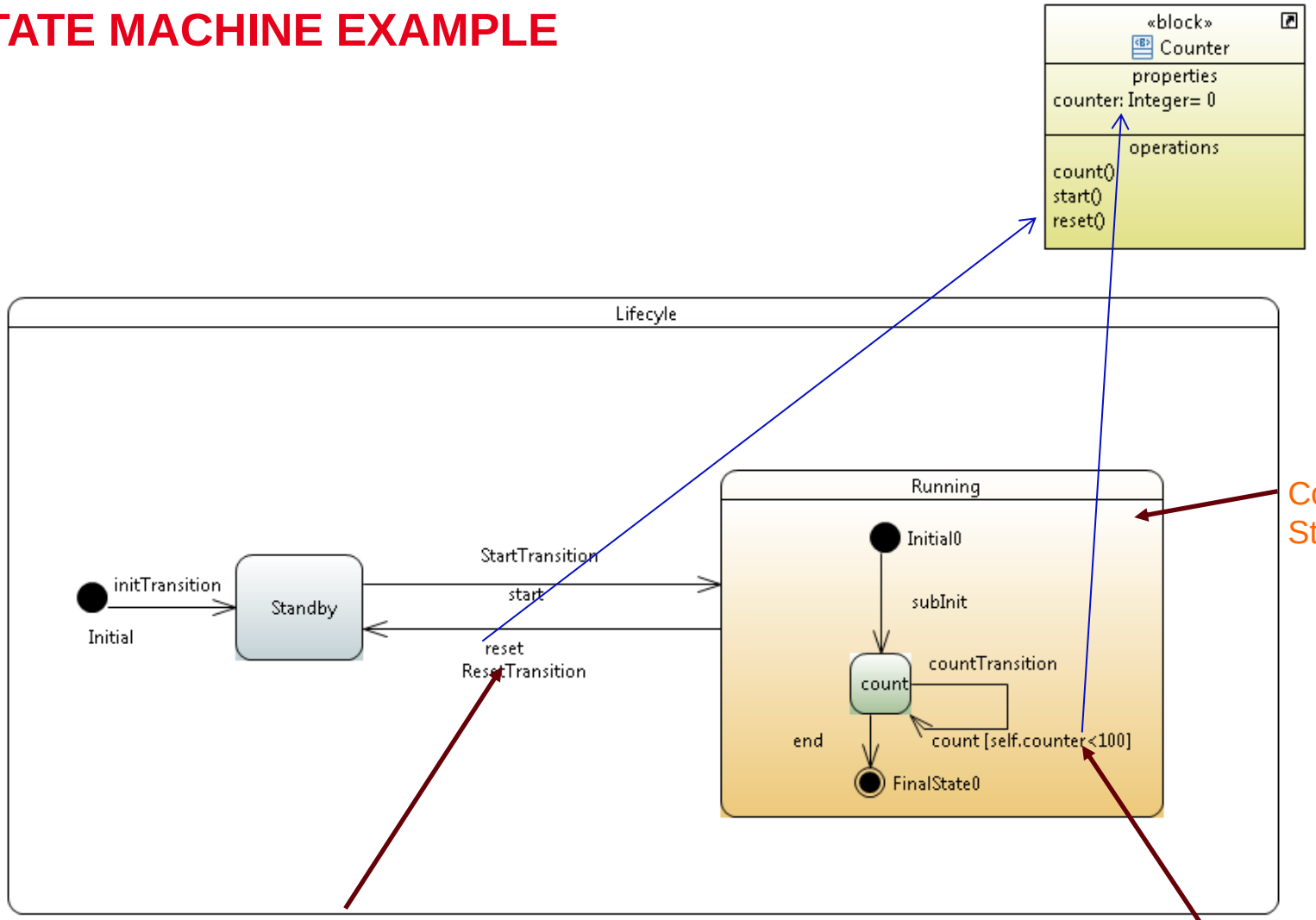
STATEMACHINE: TRANSITIONS

- **A transition is:**
  - A directed relationship between a source vertex and a target vertex,
  - Taking the state machine from one state configuration to another,
  - Representing the complete response of the state machine to an occurrence of an event of a particular type.

- **A transition have:**
  - A trigger (event) use to fire the take the transition
  - A Guard (Boolean) that must be evaluated to True to allow transition taking
  - Effect (actions) that will be performed as soon as the transition is taken



STATE MACHINE EXAMPLE



HELP LINKS

Help links related to SysML

- **SysML Norm :**
  - Papyrus supported, 1.2 : http://www.omg.org/spec/SysML/1.2/
  - New version, 1.3 : http://www.omg.org/spec/SysML/1.3/

- **SysML tutorial :**
  - Official : http://www.omgsysml.org/INCOSE-OMGSysML-Tutorial-Final-090901.pdf

- **If needed, a formation session dedicated to SysML and/or Papyrus may be held at CEA (France) Within WP3 or WP6**

FROM RESEARCH TO INDUSTRY

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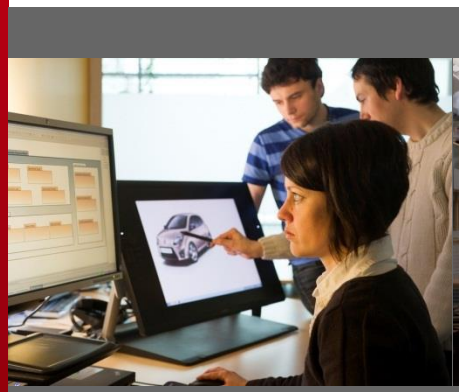
Thanks!



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