UML & SysML Overview

Ákos Horváth

Dept. of Measurement and Information Systems
UML

Modeling Language (not only) for Software Engineers
Unified Modeling Language

- An OMG (Object Management Group) standard

1.x series

- 1997 – Initial version (v1.1 – first adopted version)
  - by James Rumbaugh, Grady Booch, Ivar Jacobson at Rational
- 2000 – v1.3, v1.4
- 2003 – v1.5

2.x series

- 2005 – v2.0
- 2007 – v2.1.2
- 2009 – v2.2
- 2010 – v2.3
- 2011 – v2.4.1
- 2012 – v2.5 – „In Process“
Related Standards

- **MOF – Meta Object Facility Core**
  - 2011 – v2.4.1
  - Modeling language for defining modeling languages

- **OCL – Object Constraint Language**
  - 2012 – v2.3.1
  - Textual language for formulating constraints and queries over models

- **fUML – Foundational UML**
  - 2013 – v1.1
  - Semantics of a Foundational Subset for Executable UML Models

- **ALF – Action Language for Foundational UML**
  - 2012 – v1.0.1 Beta3
  - Concrete Syntax for a UML Action Language

- **XMI – XML Metadata Interchange**
  - 2011 – v2.4.1
  - XML representation of models

- **DD – Diagram Definition**
  - 2012 – v1.0
  - for modeling and interchanging graphical notations
UML Diagram Taxonomy

Diagram

Structure Diagram
- Class Diagram
  - Profile Diagram
  - Composite Structure Diagram
- Component Diagram
  - Deployment Diagram
- Object Diagram
  - Package Diagram

Behaviour Diagram
- Activity Diagram
- Use Case Diagram
  - Interaction Diagram
  - State Machine Diagram

Notation: UML
SysML

Modeling Language (not only) for Systems Engineers
Systems Engineering

- Systems Engineering is a multidisciplinary approach to develop balanced system solutions in response to diverse stakeholder needs

- ~ Integration Engineering
  - Software engineering
  - Hardware engineering
  - Mechanical engineering
  - Safety engineering
  - Security engineering
  - ...

- ~ Process Engineering

- System
  - Military, airplane, car, aviation, railway interlocking, notebook, etc.
SysML overview

- „UML for Systems Engineering”
  - Supports the specification, analysis, design, verification and validation of systems that include hardware, software, data, personnel, procedures, and facilities
- Developed by OMG and International Council on Systems Engineering (INCOSE)
- OMG SysML™ (http://www.omgsysml.org)
  - RFP – March 2003
  - Version 1.0 – September 2007
  - Version 1.1 – November 2008
  - Version 1.2 – June 2010
  - Version 1.3 – June 2012
Relationship Between SysML and UML

UML 2

SysML

UML4SysML

UML not required by SysML (UML - UML4SysML)

UML reused by SysML

SysML extensions to UML

SysML Profile
SysML Diagram Taxonomy

- **SysML Diagram**
  - Behavior Diagram
    - Activity Diagram
    - Sequence Diagram
    - State Machine Diagram
    - Use Case Diagram
  - Requirement Diagram
  - Structure Diagram
    - Block Definition Diagram
    - Internal Block Diagram
      - Parametric Diagram
    - Package Diagram

Icons:
- White rectangle: Same as UML 2
- Black rectangle: Modified from UML 2
- Pink dashed rectangle: New diagram type
Aspects of SysML

Diagram
- Structure
  - Block definition diagram
  - Internal block diagram
  - Parametric diagram
  - Package diagram
- Behavior
  - Activity diagram
  - Use case diagram
  - State machine diagram
  - Sequence diagram
- Other
  - Requirement diagram, stereotype, model view, AP-233, XMI Metadata Interchange format

Model
- Structure model
- Behavior model
Diagram Frames in SysML

- Each SysML diagram represents a model element
- Each SysML diagram must have a diagram frame
- Diagram context is indicated in the header
  - Diagram kind
    - e.g. act for Activity Diagrams
  - Model element type
    - e.g. Package, Block, Activity
  - Model element name
    - the represented model element
  - Diagram description
    - e.g. „Context model for Cyber-Physical Agricultural System”
SysML Diagram Kinds

- pkg – Package Diagram
- bdd – Block Definition Diagram
- ibd – Internal Block Diagram
- par – Parametric Diagram
- uc – Use Case Diagram
- act – Activity Diagram
- sd – Sequence Diagram
- stm – State Machine Diagram
UML & SysML Diagrams
Organizing Models with Packages

Package Diagrams
Package Diagrams
Modeling Aspect

How to organize the model?
Objectives

- Packages are used to group elements
  - Provides a containment hierarchy for model elements
  - Similar to directories for files
- Provides a namespace for the grouped elements
  - Modeling elements are identified by their qualified name
    - E.g. Cyber-Physical Agricultural System::System Design::Structure::Cyber Physical Agricultural System
- Not for modeling real world entities
Special packages

- **Profile (UML)**
  - extends metamodel

- **Model (UML)**
  - contains set of elements that describe the domain of interest

- **Model library (SysML)**
  - contains reusable elements
Package relationships

- Containment
  - Packageable elements
  - Other packages

- Package import
  - Import all elements from another package to the namespace

- Element import
  - Import one element from another package to the namespace
Package example

Pkg [package type] package name [diagram name]

Package name

Containment

package 1

«block» Contained element

Imported package

Element import

Containment

package 2

«block» Imported element
Summary

- **Goal**
  - Group model elements hierarchically
  - Provide namespace for model elements

- **Modeling aspect**
  - *How to organize the model?*
  - Not real modeling