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SysML v2 Submission Team (SST)
SysML v2 Update

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Presentation Purpose

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- 1 Year after RFP Issued and SysML v2 Submission Team Established
  - Share preliminary progress & directions with broader community
  - Highlight some differences and benefits relative to SysML v1
- Slides derived in part from previous presentations:
  - SysML v2 Overview and Demo to OMG SE DSIG 2018-12-11 – Friedenthal/Seidewitz
  - SysML v2 and MBSE: The Next Ten Years 2018-10-16 Models Conference - Seidewitz
  - Future Directions for MBSE with SysML 2018-05-22 No Magic Symposium - Friedenthal

Systems Modeling Language™ (SysML®)

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Supports the specification, analysis, design, and verification and validation of complex systems that may include hardware, software, information, processes, personnel, and facilities

- SysML has evolved to address user and vendor needs
  - v1.0, adopted in 2006; v1.5, current version; v1.6, in process
- SysML has facilitated awareness and adoption of MBSE
- Much has been learned from using SysML for MBSE

SysML v2 Objectives

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Increase adoption and effectiveness of MBSE by enhancing…

- Precision and expressiveness of the language
- Consistency and integration among language concepts
- Interoperability with other engineering models and tools
- Usability by model developers and consumers

SysML v2 Functional Enhancements

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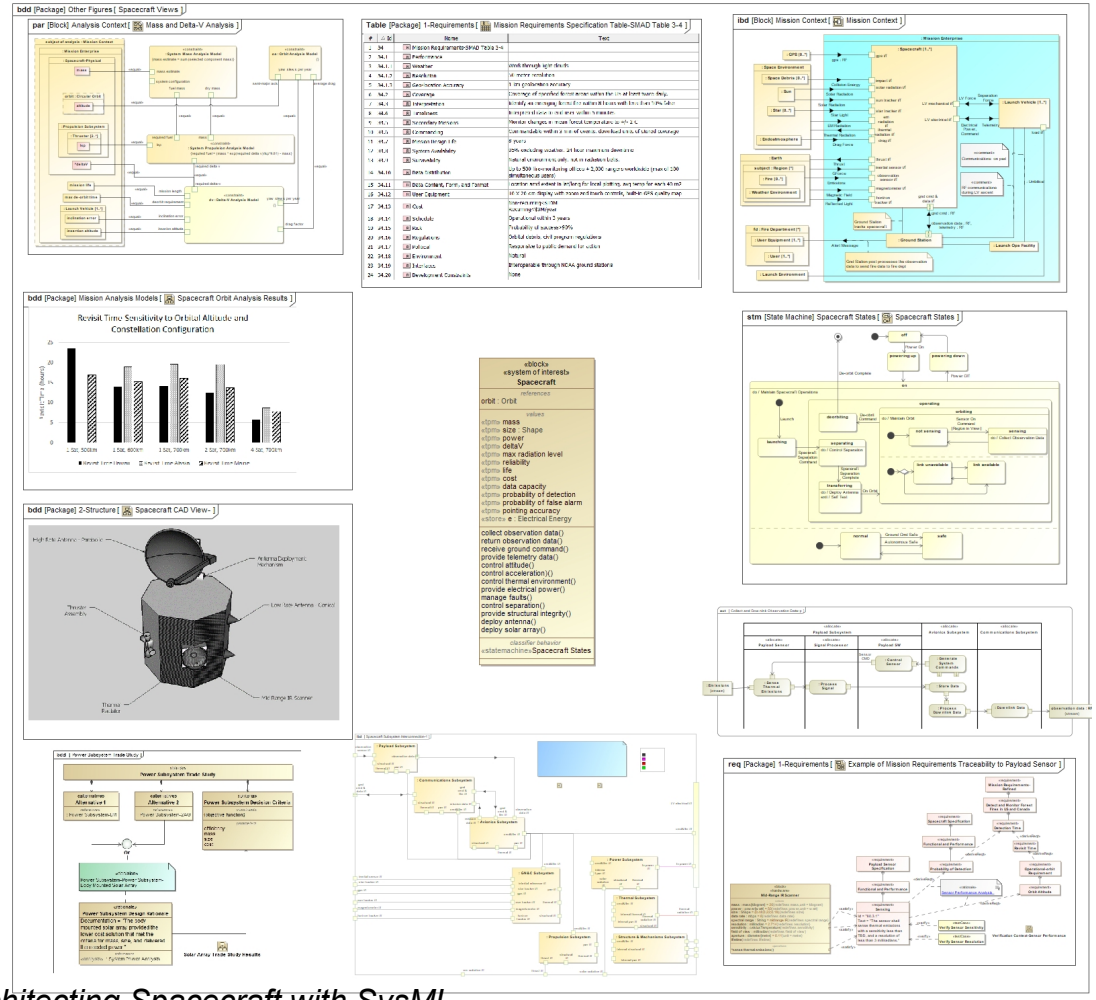
Improved integration with analysis

Variant Modeling & Design Configurations



Geometric View

Improved integration between Behavior & Structure

Trade Studies

Property-based requirements

Friedenthal and Oster, Architecting Spacecraft with SysML

Visualization

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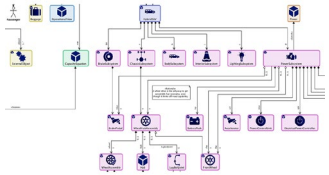
SysML models must support flexible visualizations

Diagram

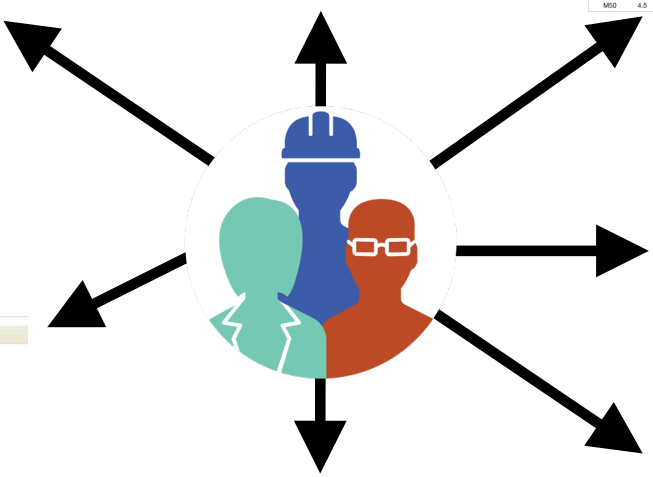


Table

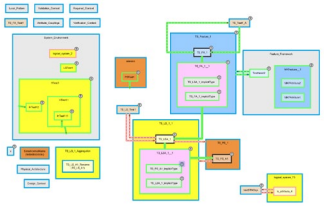
Name	Thread pitch (mm)	Minor diameter tolerance	Nominal diameter (mm)	Head shape	Price for 50 screws	Available at factory outlet?	Number in stock	Flat or Phillips head?
M4	0.7	4g	4	Pan	$10.08	Yes	276	Flat
M5	0.8	4g	5	Round	$13.89	Yes	183	Both
M6	1	5g	6	Button	$10.42	Yes	1043	Flat
M8	1.25	5g	8	Pan	$11.98	No	298	Phillips
M10	1.5	6g	10	Round	$16.74	Yes	488	Phillips
M12	1.75	7g	12	Pan	$18.26	No	998	Flat
M14	2	7g	14	Round	$21.19	No	235	Phillips
M16	2	8g	16	Button	$23.57	Yes	292	Both
M18	2.1	8g	18	Button	$25.87	No	664	Both
M20	2.4	8g	20	Pan	$29.09	Yes	486	Both
M24	2.55	9g	24	Round	$33.01	Yes	982	Phillips
M28	2.7	10g	28	Button	$35.66	No	1067	Phillips
M36	3.2	12g	36	Pan	$41.32	No	434	Both
M50	4.5	15g	50	Pan	$44.72	No	740	Flat

Text

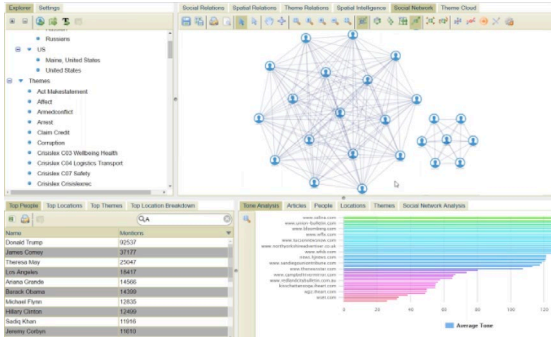
```
part vehicle_C1: VehicleDefinitions.Vehicle {
        part frontAssembly: AxleAssembly {
                part frontWheel: Wheel[2];
                part frontAxle: Axle;
        }
        part rearAssembly: AxleAssembly {
                part rearWheel: Wheel[2];
                part rearAxle: Axle;
        }
}
```



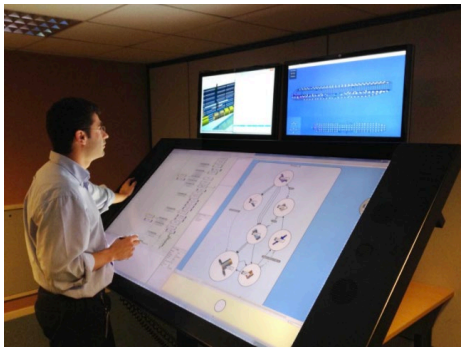
Model Differencing



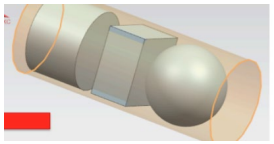
Dynamic Visualization



Interactive Display



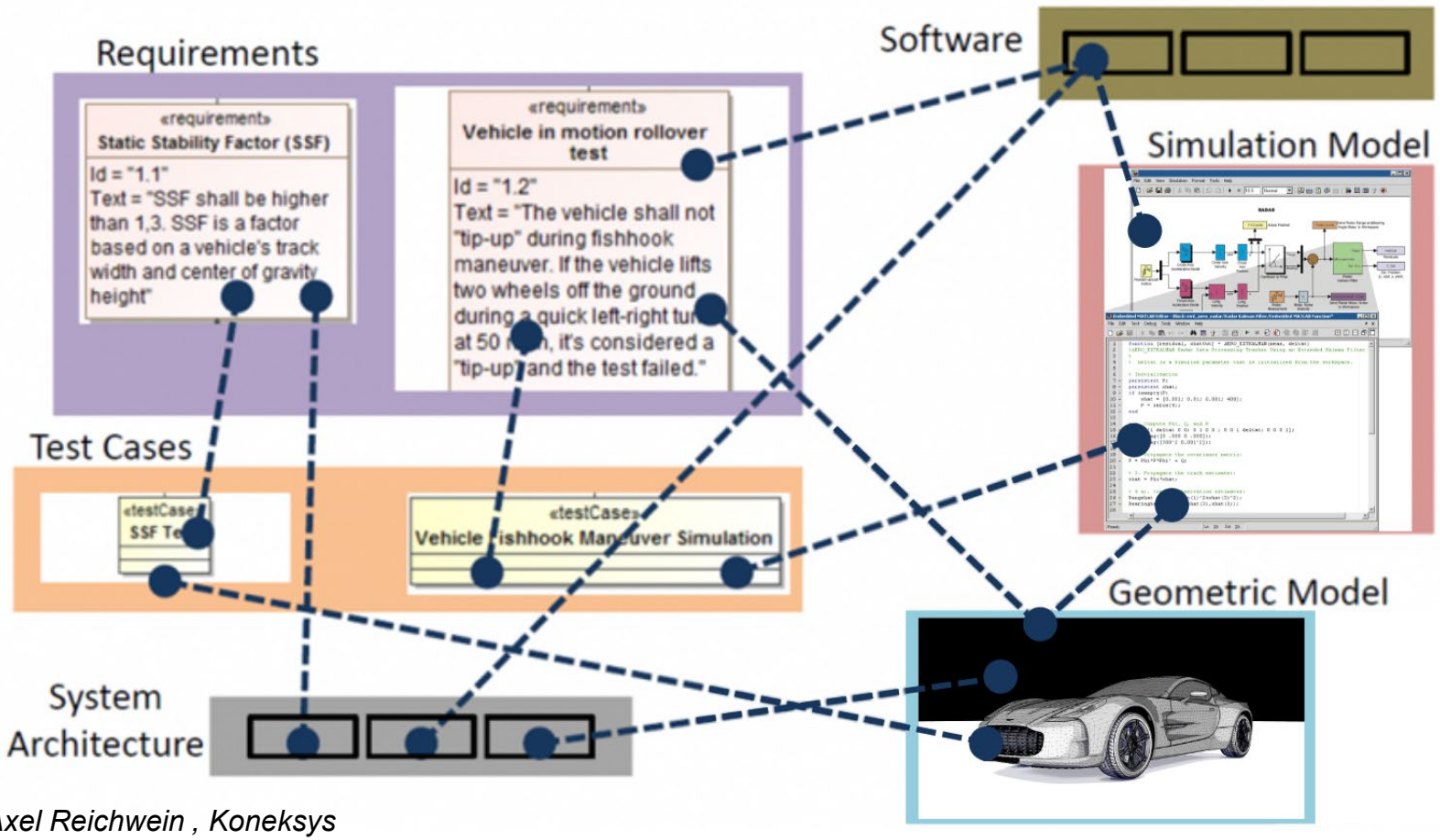
Physical Envelope



Source: C. Schreiber, J. Feingold, M. Sarrel

Interoperability

SysML tooling must interoperate with other tools



Axel Reichwein , Koneksys
SysML v2 Model Interoperability & Standard API Requirements

SysML v2 Requests for Proposals *SST*

- SysML v2 RFP issued December, 2017
  - Initial Submission: November, 2019
  - Revised (Final) Submission: November, 2020
- SysML v2 API & Services RFP issued June, 2018
  - Initial Submission: February, 2020
  - Revised (Final) Submission: February, 2021
- SysML v2 Submission Team (SST) formed December 2017
  - Leads: Sandy Friedenthal, Ed Seidewitz

SysML v2 Submission Team (SST) *SST*

- A broad team of end users, vendors, academics, and government liaisons
  - Currently 96 members from 60 organizations
- Developing submissions to both RFPs
- Driven by RFP requirements and user needs

SST Participating Organizations

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Academia/Research
End User

Tool Vendors
Government Rep

INCOSE rep *

- Aerospace Corp
- Airbus
- AIST
- ANSYS medini
- Aras
- ARDEC
- BAE
- BigLever Software
- Boeing
- CEA
- Christian Doppler Laboratory
- Contact Software
- Draper Lab
- Elbit Systems of America
- European Space Agency
- Ford
- Franhofer
- General Motors
- George Mason University
- GfSE
- GTRI/Georgia Tech
- IBM
- IncQuery Labs
- Innovative Decisions
- InterCax
- Jet Propulsion Lab
- John Deere
- Kenntnis
- Lieber Lieber
- Lightstreet Consulting
- Lockheed Martin
- LSST
- Maplesoft
- MITRE
- Model Driven Solutions
- Model Foundry
- NIST
- No Magic
- OOSE
- Ostfold University College
- Papyrus Industry Consortium (PIC)
- Phoenix Integration
- PTC
- Raytheon
- Rolls Royce
- SAF Consulting *
- SAIC
- Siemens
- Sierra Nevada Corporation
- Simula
- System Strategy *
- Tata Consultancy Services
- Thales
- Thematix
- Tom Sawyer
- University of Cantabria
- University of Alabama in Huntsville
- University of Detroit Mercy
- Vitech
- 88solutions

Key Elements of SysML v2

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- New Metamodel that is not constrained by UML
  - Grounded in formal semantics
- Robust visualizations based on flexible view & viewpoint specification and execution
  - Graphical, Tabular, Textual
- Standardized API to access the model

SST Agile Collaborative Approach

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Concrete Syntax (Textual Grammar)

NamespaceDefinition:
PackageDefinition | ClassifierDefinition

PackageDefinition:
PackageDeclation “{“ PackagedElement* “}”

PackagedElement: NamespaceDefinition | …

ClassifierDefinition: ClassDefinition | …

ClassDefinition:
ClassDeclaration “{“ ClassMember* “}”

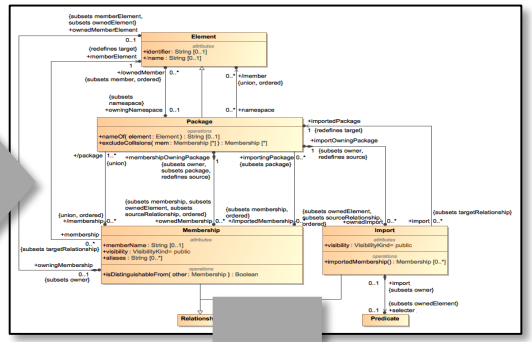
ClassMember: FeatureDefinition | …

FeatureDefinition: AttributeDefinition | …

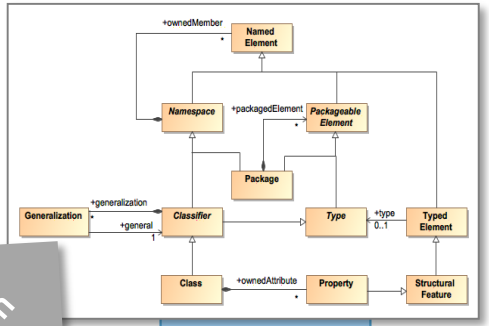
AttributeDefinition:
Visibility Name “:” QualifiedName

Parse

SysML Abstract Syntax



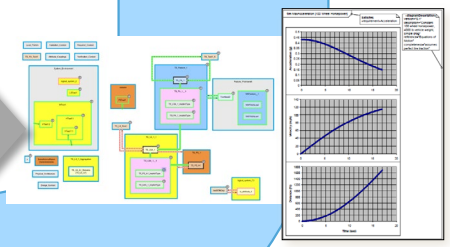
UML Abstract Syntax / Profile



Store

Transform

Visualization / Analysis



Guide

Repository

Services

Generate

Export

Requirements / User Needs

Feedback

Semantic Tooling / OWL

Initial SST Validation Cases

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- The following 11 validation cases capture initial required functionality in SysML v2
  - Parts Tree
  - Parts Interconnection
  - Function-based Behavior
  - Functional Allocation
  - State-based Behavior
  - Individuals and Snapshots
  - Variant Configuration
  - Requirements
  - Verification
  - Analysis & Trade Studies
  - View and Viewpoint

Reflects approximately ½ of the SysML v2 RFP requirements

Usage Focused Modeling Approach

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A paradigm shift to make SysML v2 more precise and intuitive to use

- Emphasizes modeling of *usages (e.g., parts on an ibd)*
  - Decompose, connect, relate, and group usages
- Supports other language requirements
  - variant design configurations, individuals, analysis, verification, …

Usage Focused Modeling Approach
Multiple Views of a System

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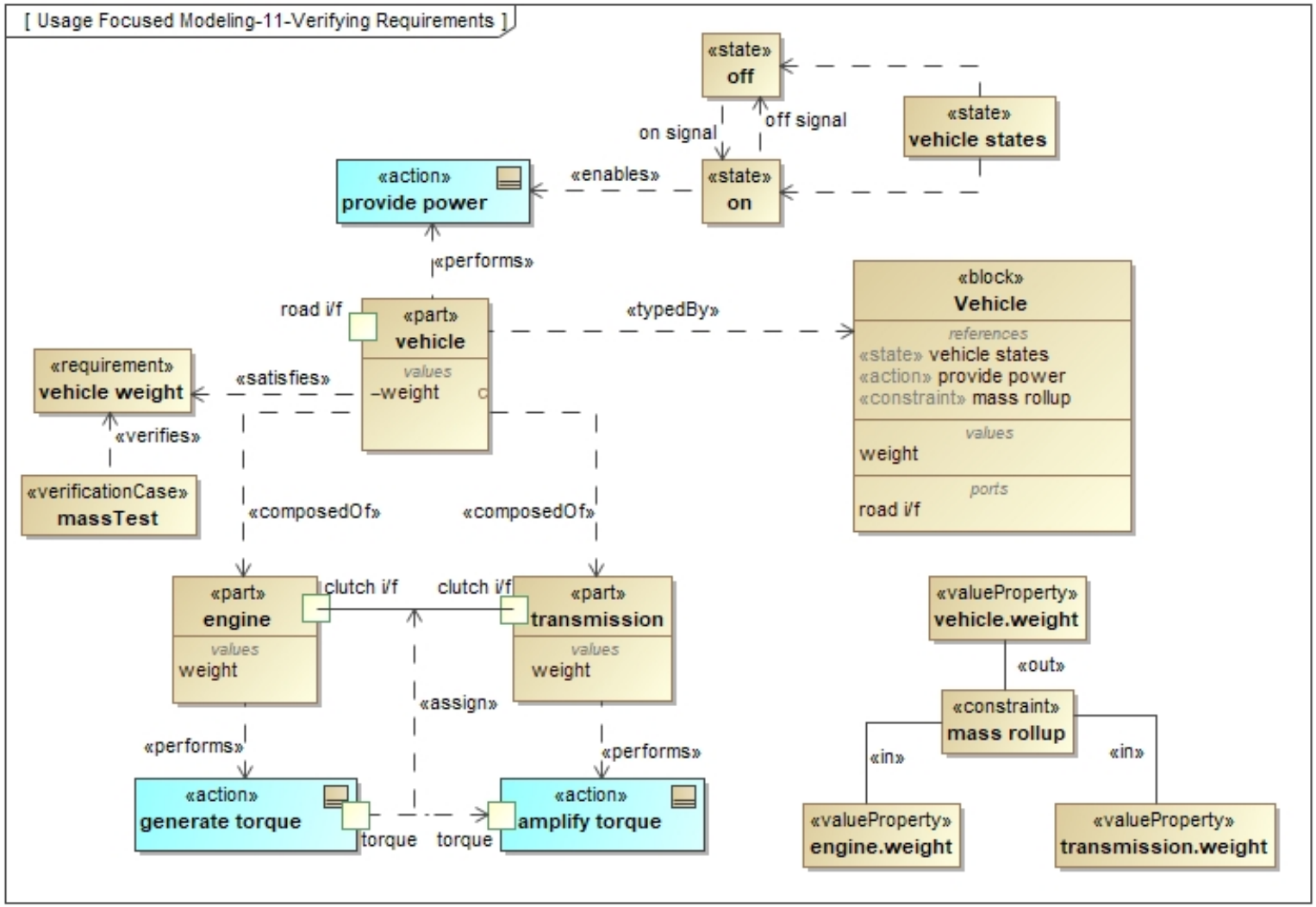
Graphical notation for illustrative purposes only



APIs and Services

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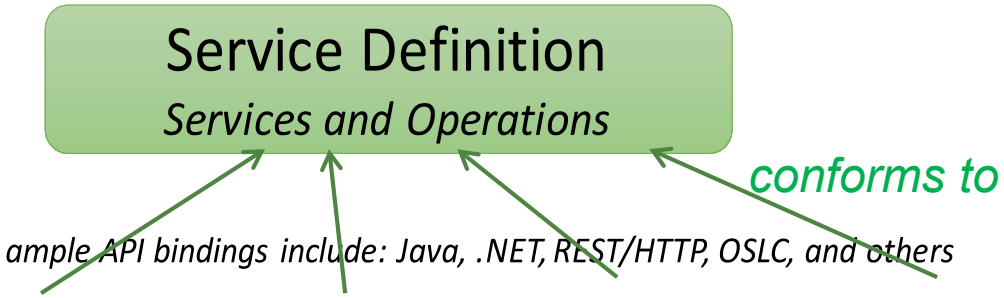
Standard APIs and services provide a mechanism for tool interoperability.



From: SysML v2 API & Services RFP

Summary

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- SST is addressing RFP requirements and issues associated with SysML v1 to improve
  - Precision and expressiveness
  - Consistency and integration among language concepts
  - Interoperability with other engineering models and tools
  - Usability by model developers and consumers
- Initial approach
  - SysML v2 metamodel that overcomes fundamental UML limitations
  - Flexible graphical notations and textual notation
  - Formal semantics
  - Standardized API for interoperability
- Working towards initial submission

OMG SysML v2 RFP Requirements Development References

SST

- Friedenthal, S, Burkhart, R. Evolving SysML and the System Modeling Environment to Support MBSE, INCOSE INSIGHT, Model-Based Systems Engineering, August 2015 (*August 15 Volume 18 Issue 2, Pg 39-42*)
  - Capabilities, effectiveness measures, and driving requirements for a **system modeling environment (SME)** to support MBSE
- Friedenthal, S. Evolving SysML and the System Modeling Environment to Support MBSE-Part 2, INCOSE INSIGHT, (*December 16 Volume 19 Issue 4, Pg 76-80*)
  - Concept for a **system modeling environment (SME)** to support MBSE
- Friedenthal, S. Requirements for the Next Generation Systems Modeling Language (SysML® v2) INCOSE INSIGHT, (*March 18 Volume 21 Issue 1, Pg 21-25*)
  - SysML v2 RFP Requirements
- OMG SysML v2 RFP Working Group Wiki
  - http://www.omgwiki.org/OMGSysML/doku.php?id=sysml-roadmap:sysml_assessment_and_roadmap_working_group