SysML v2 Submission Team (SST)
A Look Ahead at SysML v2

SST

Wasatch INCOSE Chapter

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Presentation Purpose

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- Share SysML v2 Submission Team (SST) approach
  - Background and motivation
  - What to expect from SysML v2
  - Contrast SysML v2 with SysML v1
  - Progress and plans

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; v1.6, current version; v1.7, 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
- Extensibility to support domain specific applications
- Migration path for SysML v1 users and implementors

SysML v2 Requests for Proposals *SST*

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

*Initial and revised **submission** dates reflect extensions accepted by OMG*

SysML v2 Submission Team (SST) *SST*

- A broad team of end users, vendors, academics, and government liaisons
  - Over 100 members representing 65+ 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
- ANSYS medini
- Aras
- Army Aviation & Missile Center
- Army Office of Chief SE
- BAE
- BigLever Software
- Boeing
- Army CCDC Armaments Center
- CEA
- Contact Software
- DEKonsult
- Draper Lab
- Elbit Systems of America
- ESTACA
- Ford
- Fraunhofer FOKUS
- General Motors
- George Mason University
- GfSE
- Georgia Tech/GTRI
- IBM
- Idaho National Laboratory
- IncQuery Labs
- Intercax
- Itemis
- Jet Propulsion Lab
- John Deere
- Kenntnis
- KTH Royal Institute of Technology
- LieberLieber
- Lightstreet Consulting
- Lockheed Martin
- MathWorks
- Maplesoft
- Mgnite Inc
- MITRE
- ModelAlchemy Consulting
- Model Driven Solutions
- Model Foundry
- NIST
- No Magic/Dassault Systemes
- OAR
- Obeo
- OOSE
- Ostfold University College
- Phoenix Integration
- PTC
- Qualtech Systems, Inc (QSI)
- Raytheon
- Rolls Royce
- SAF Consulting *
- SAIC
- Siemens
- Sierra Nevada Corporation
- Simula
- Sodius Willert
- System Strategy *
- Tata Consultancy Services
- Thales
- Thematix
- Tom Sawyer
- UFRPE
- University of Cantabria
- University of Alabama in Huntsville
- University of Detroit Mercy
- University of Kaiserslautern / VPE
- Vera C. Rubin Observatory
- Vitech
- 88solutions

SST Tracks / Leads

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1. Project Management – Ed Seidewitz, Sandy Friedenthal
   - Infrastructure – John Watson, Chris Delp
2. Requirements V&V – Sandy Friedenthal
3. Profile Development – Yves Bernard, Tim Weilkiens
4. Metamodel Development – Chas Galey, Karen Ryan
5. API/Services Development – Manas Bajaj
6. Pilot Implementation – Ed Seidewitz

SST Incremental Approach

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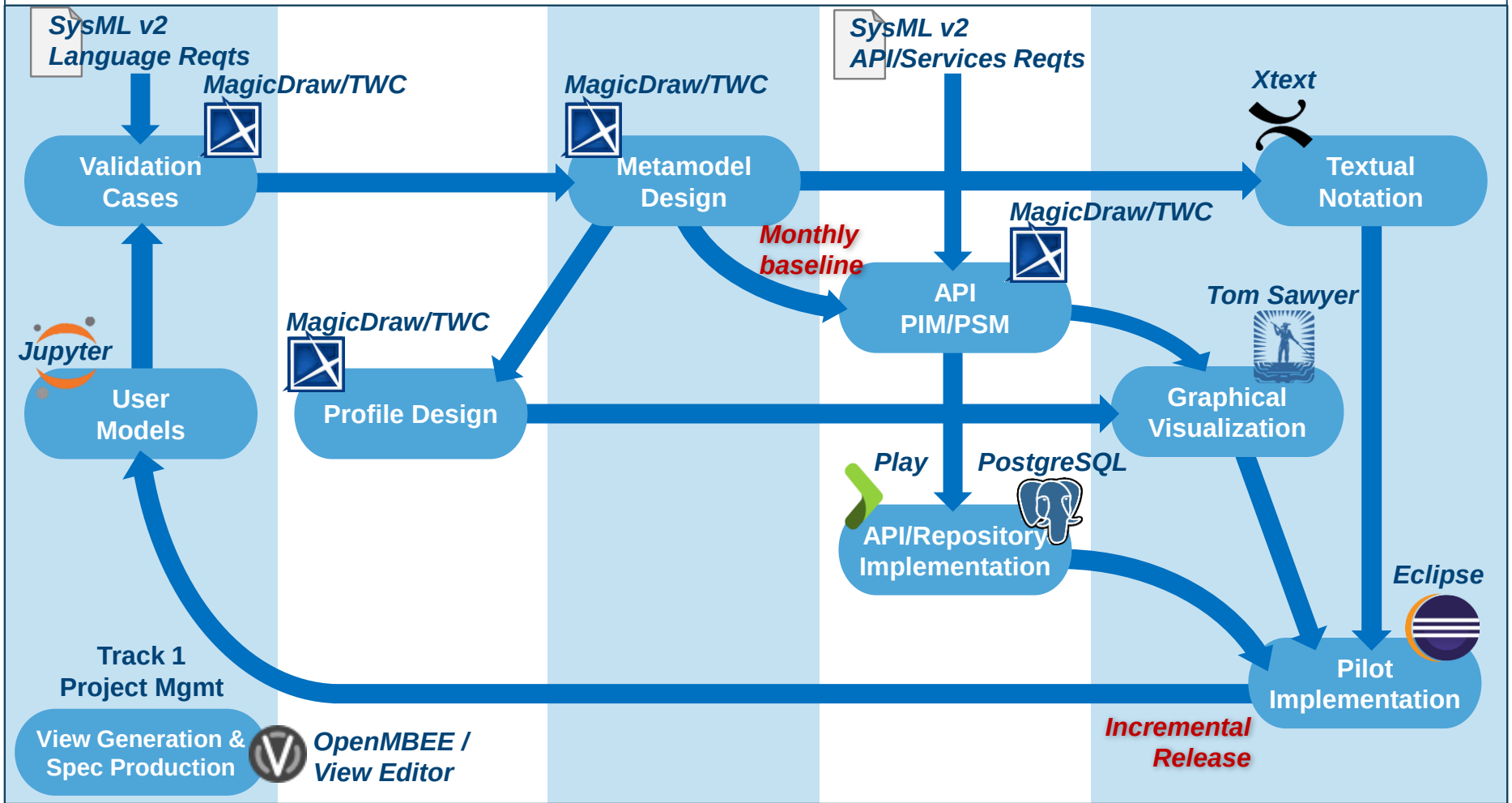

SysML v2 Validation Cases

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- The following 16 validation cases capture initial required language functionality

  Reflects 2/3 of the SysML v2 RFP requirements

  - 1-Parts Tree
  - 2-Parts Interconnection
  - 3-Function-based Behavior
  - 4-Functional Allocation
  - 5-State-based Behavior
  - 6-Individuals and Snapshots
  - 7-Variant Configuration
  - 8-Requirements
  - 9-Verification
  - 10-Analysis and Trades
  - 11-View and Viewpoint
  - 12-Dependency Relationships
  - 13-Model Containment
  - 14-Language Extension
  - 15-Properties, Values, & Expressions
  - 16-Proxy validation case

Current preliminary design baseline and pilot implementation

In work

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

Usage Focused Modeling Approach

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A paradigm shift to make SysML v2 more precise and more 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, …

Usage Focused Modeling Approach
Multiple Views of a System

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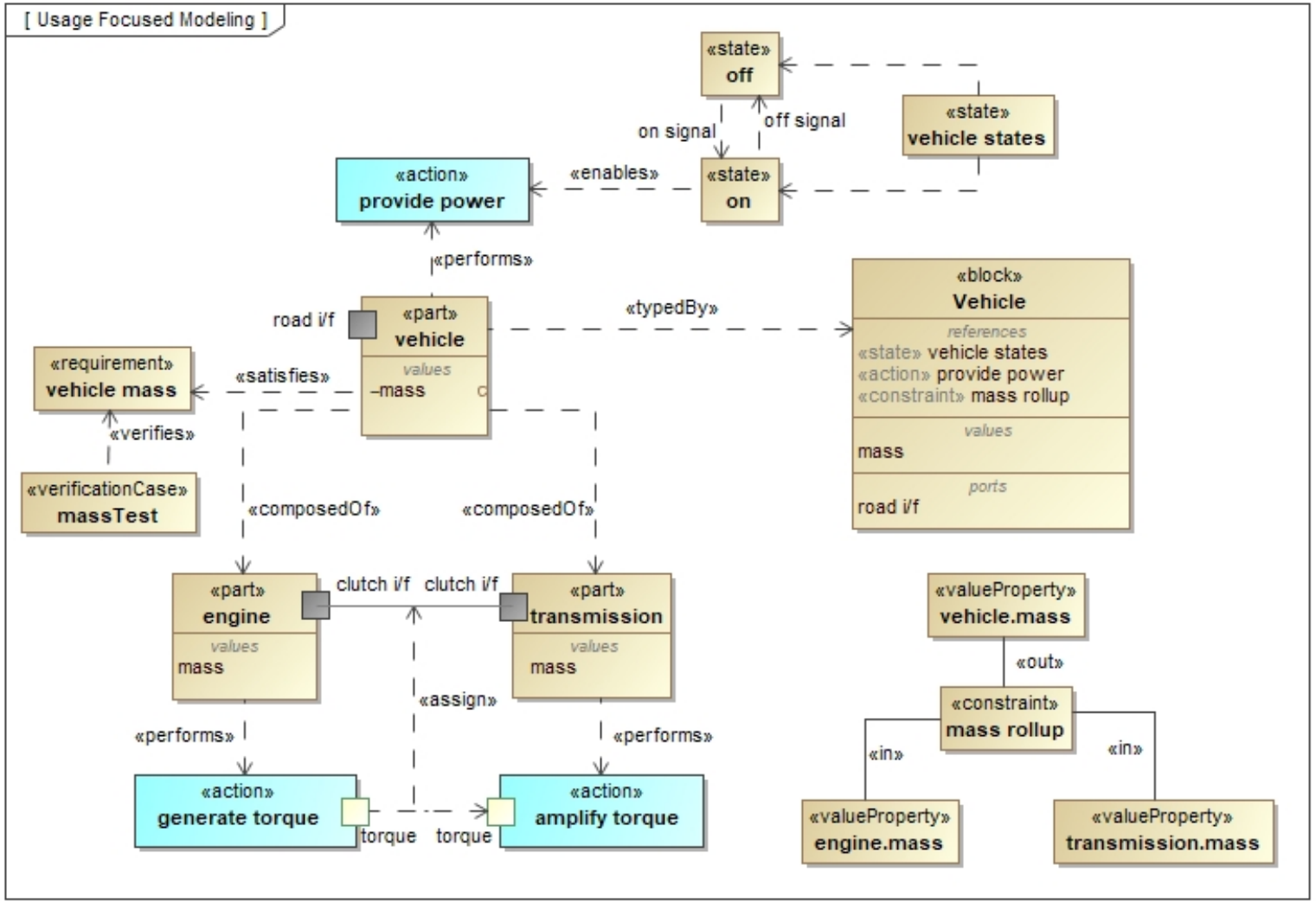
Graphical notation for illustrative purposes only



Usage Focused Modeling Approach
Usage & Definition

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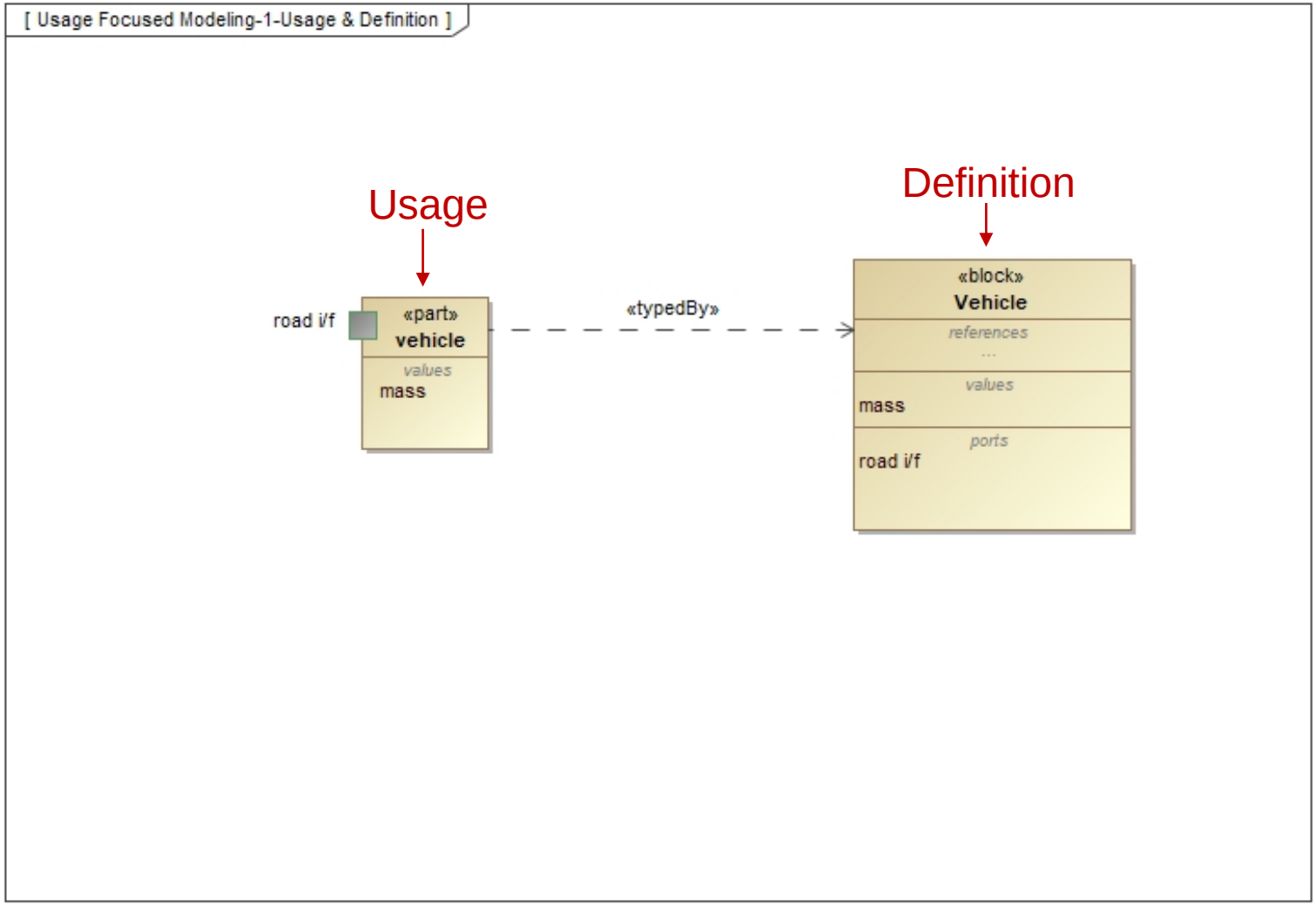

Usage Focused Modeling Approach
Decomposing Parts

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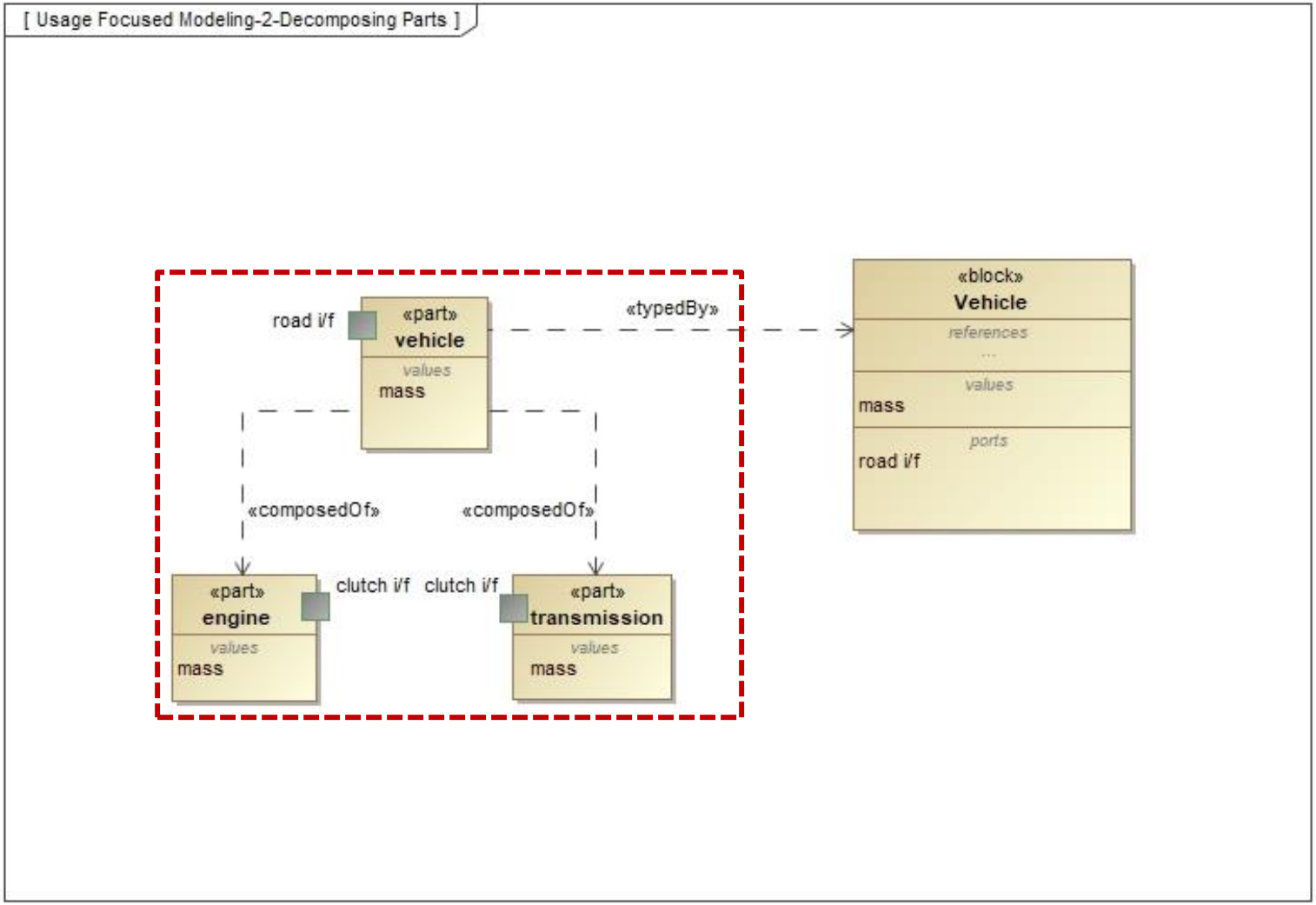

Usage Focused Modeling Approach
Connecting Parts

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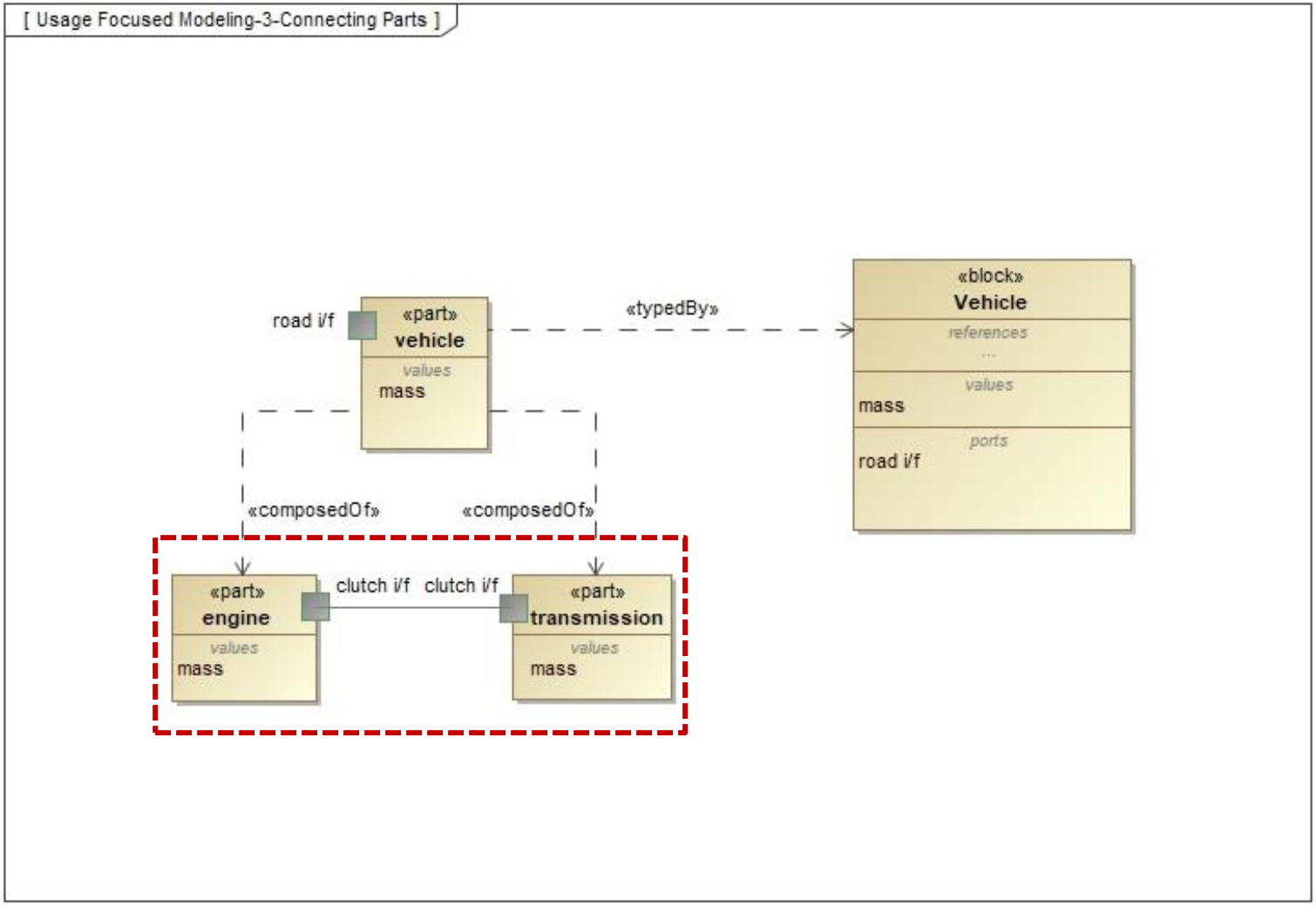

Usage Focused Modeling Approach Satisfying Requirements

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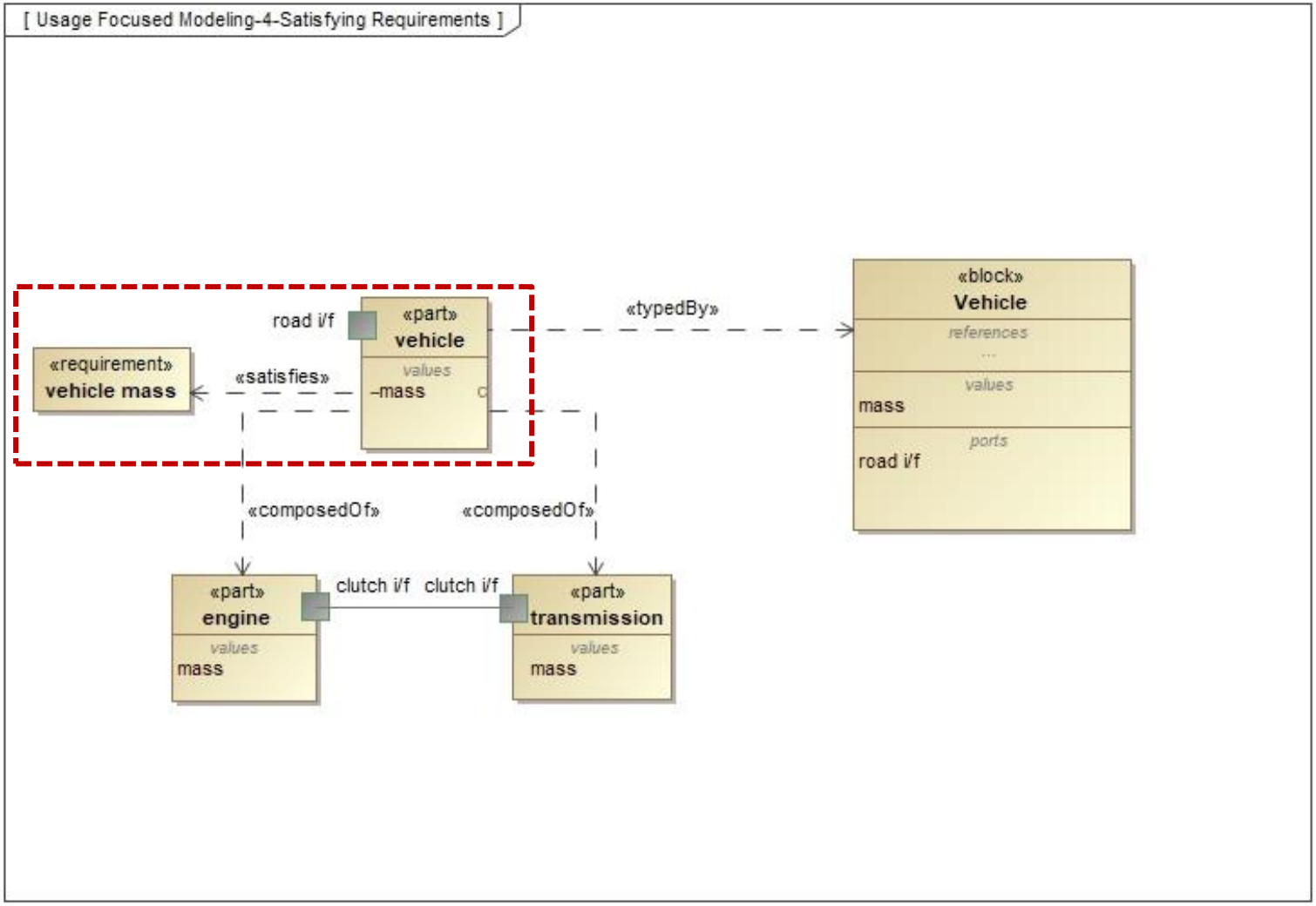

Usage Focused Modeling Approach
Constraining Properties

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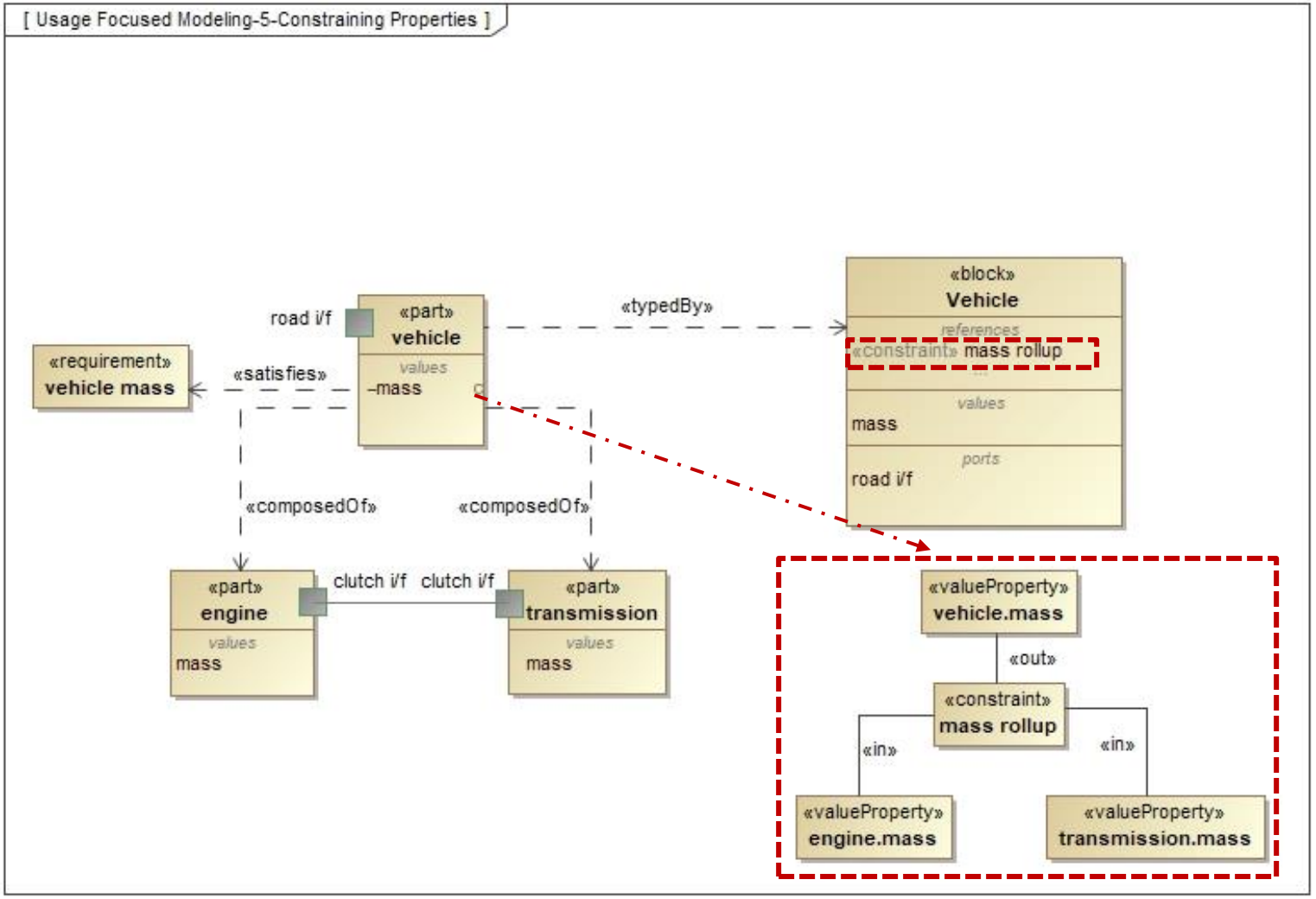

Usage Focused Modeling Approach
Performing Actions

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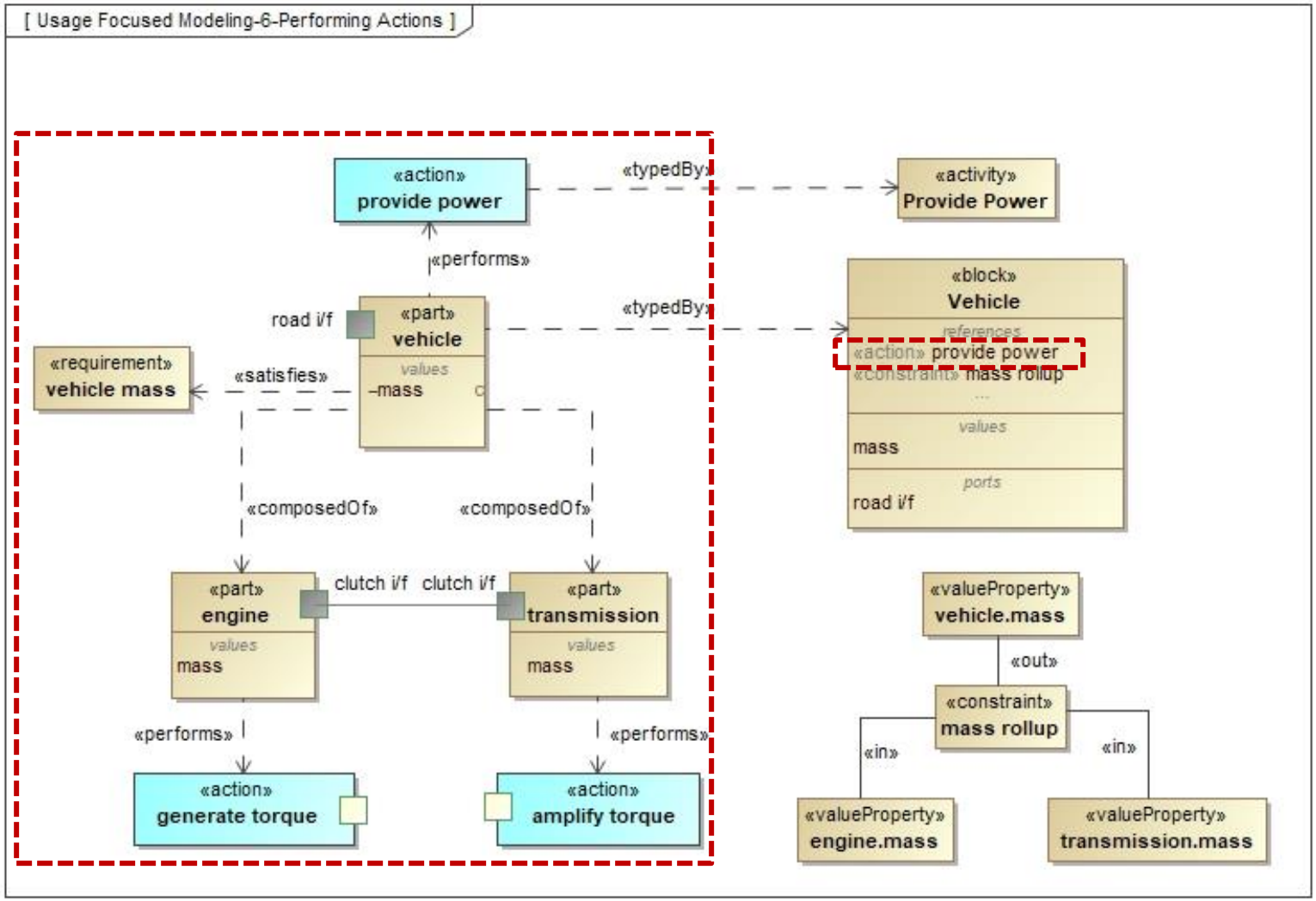

Usage Focused Modeling Approach
Decomposing Actions

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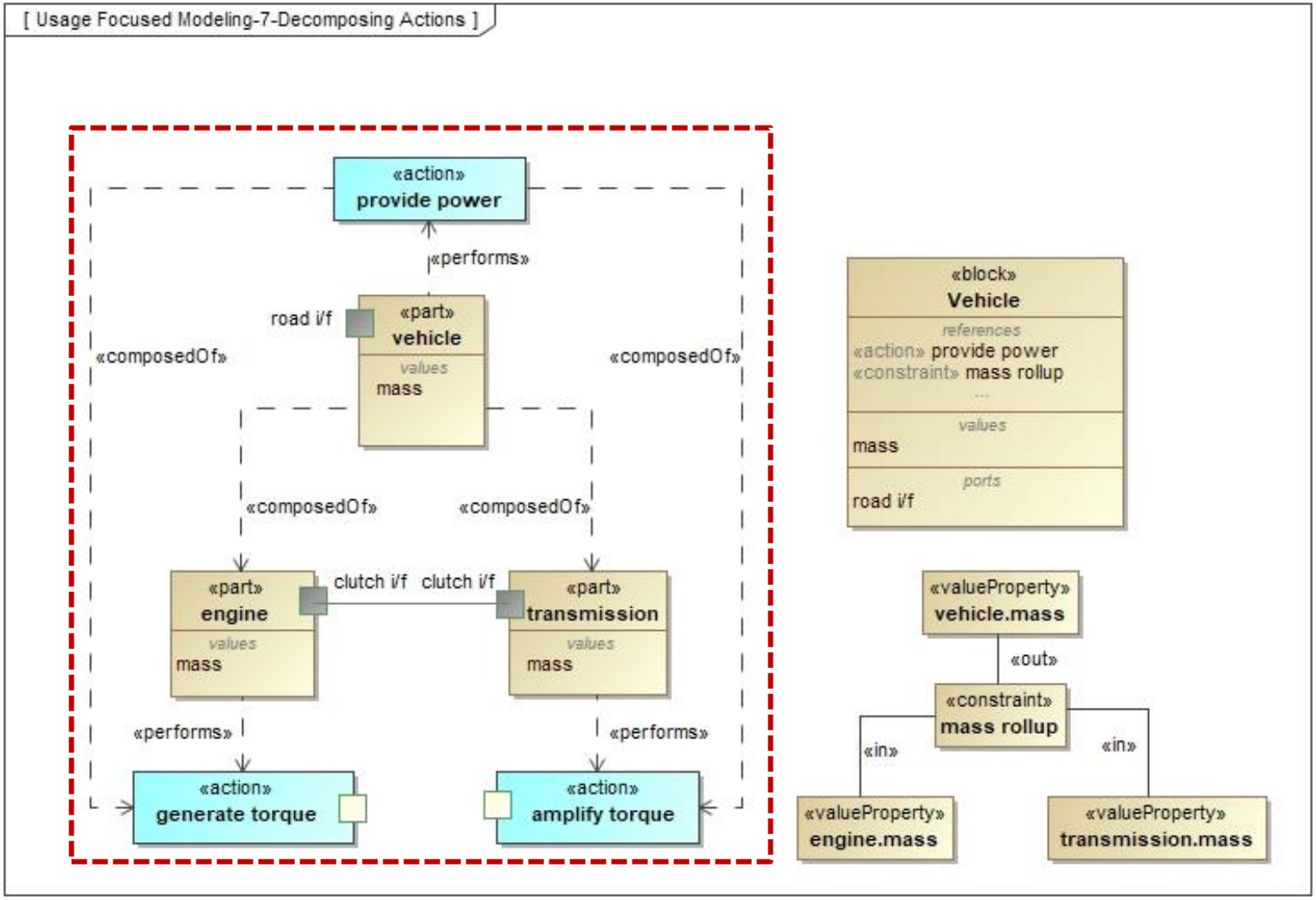

Usage Focused Modeling Approach
Assigning Input/Output to Ports

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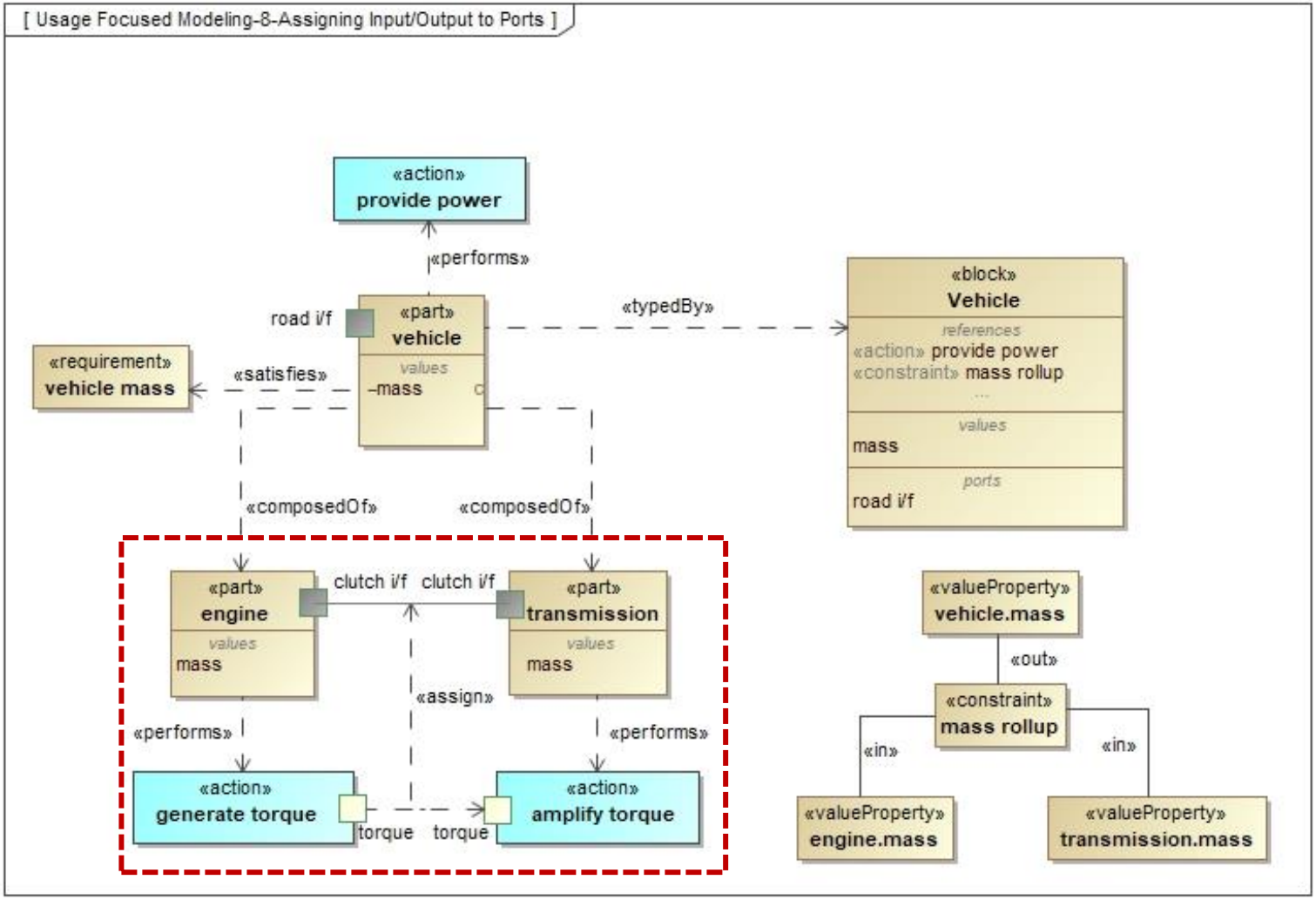

Usage Focused Modeling Approach
Enabling Actions in States

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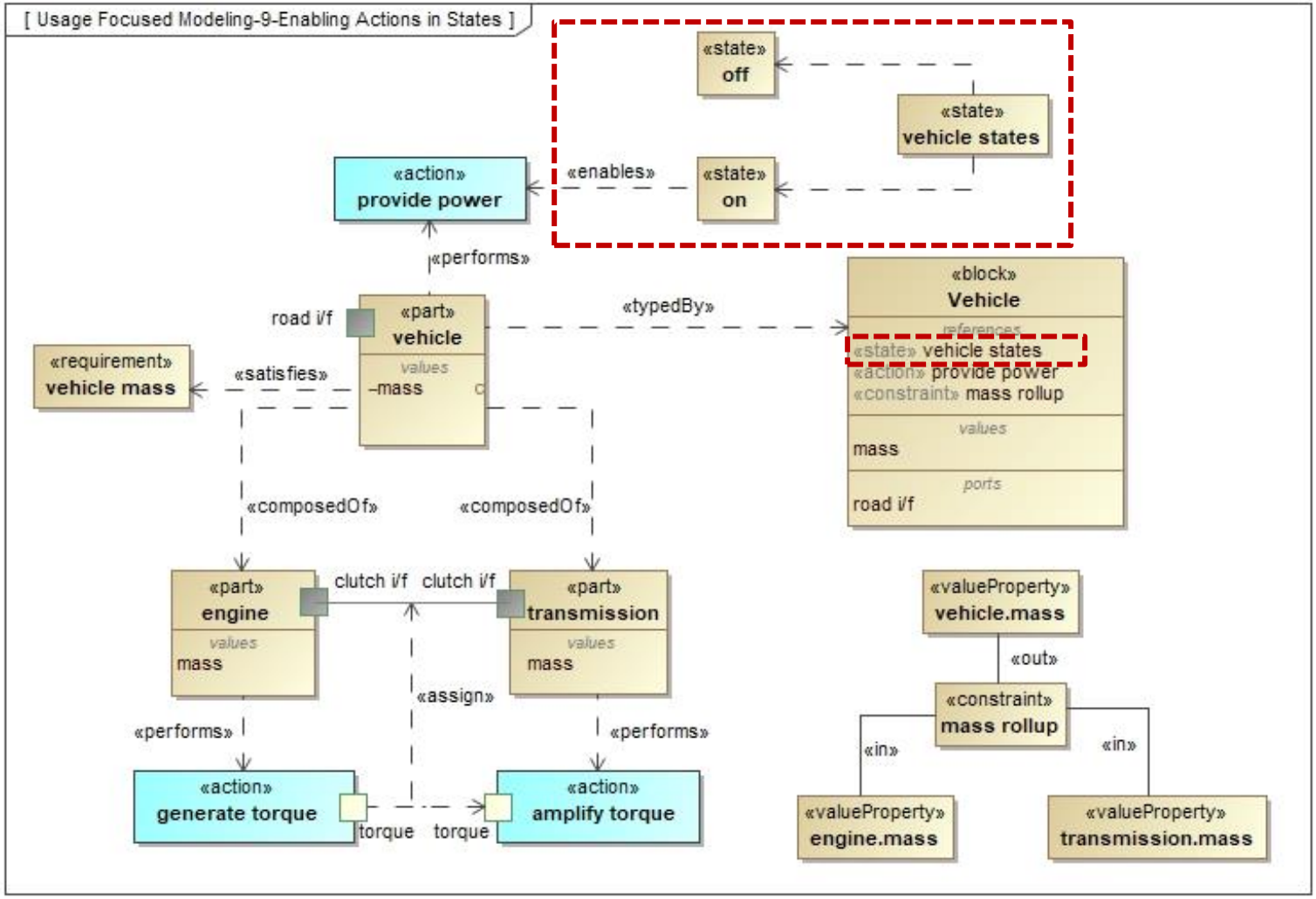

Usage Focused Modeling Approach
State Transitions

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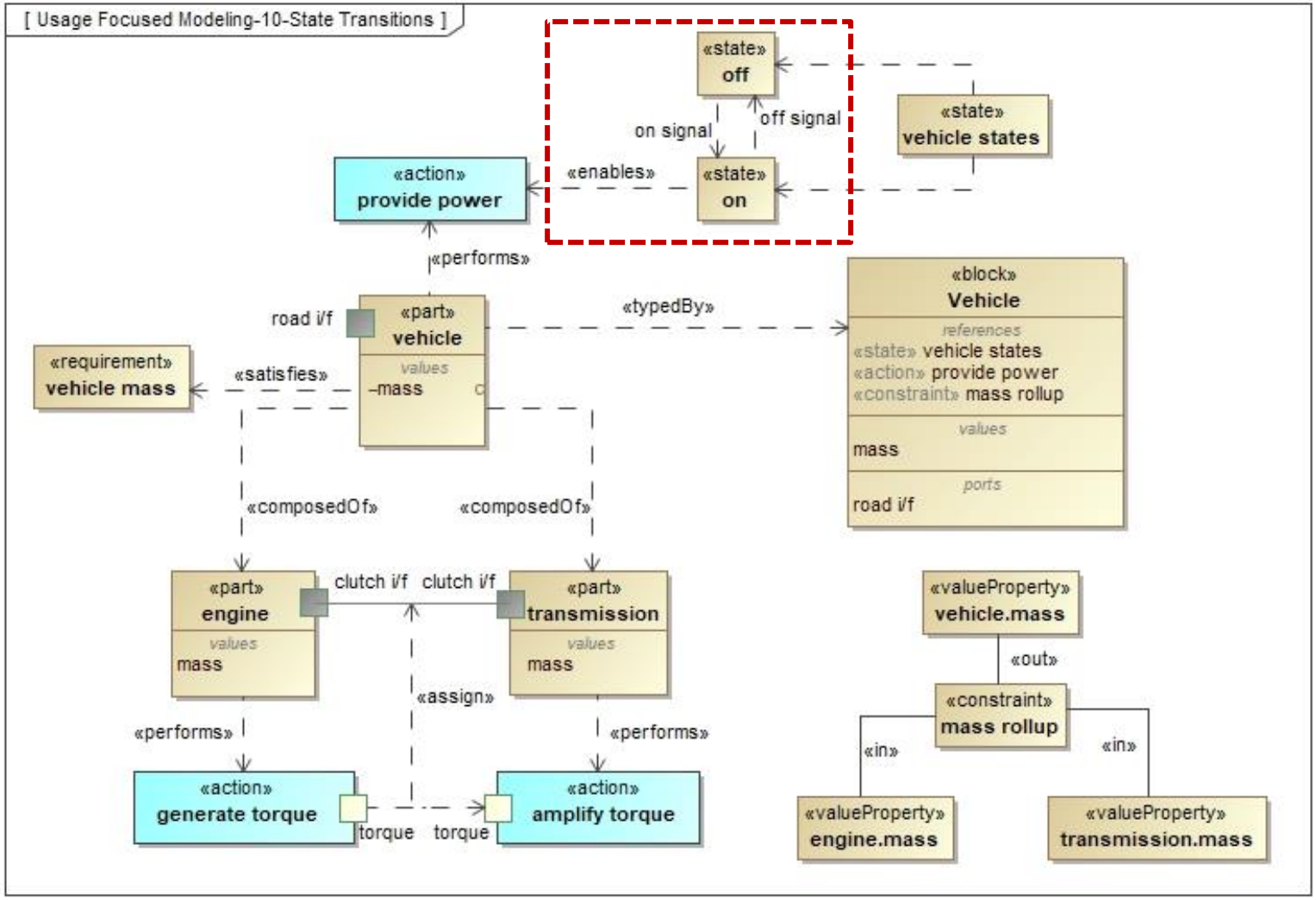

Usage Focused Modeling Approach
Verifying Requirements

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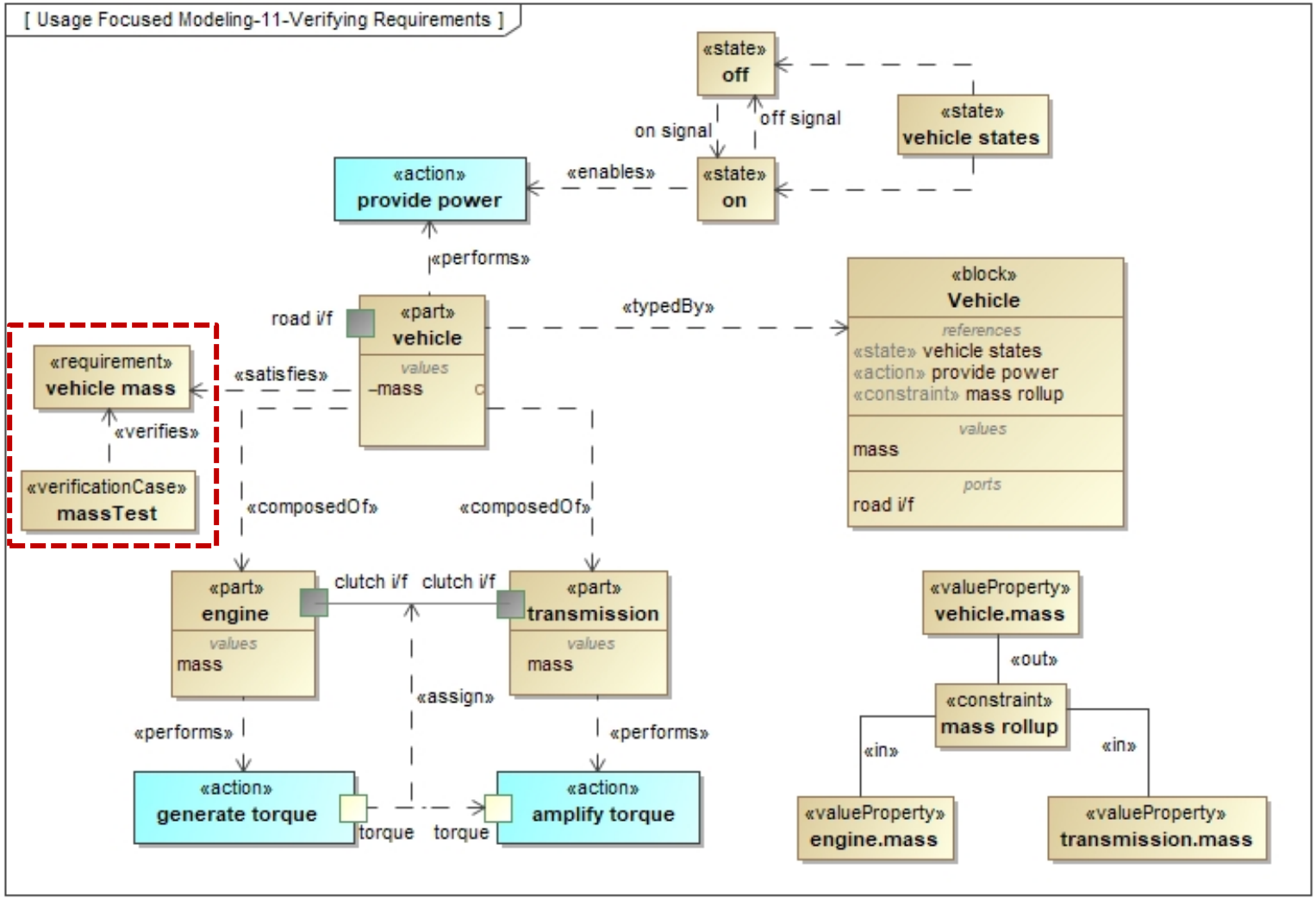

Usage Focused Modeling Approach
Multiple Views of a System

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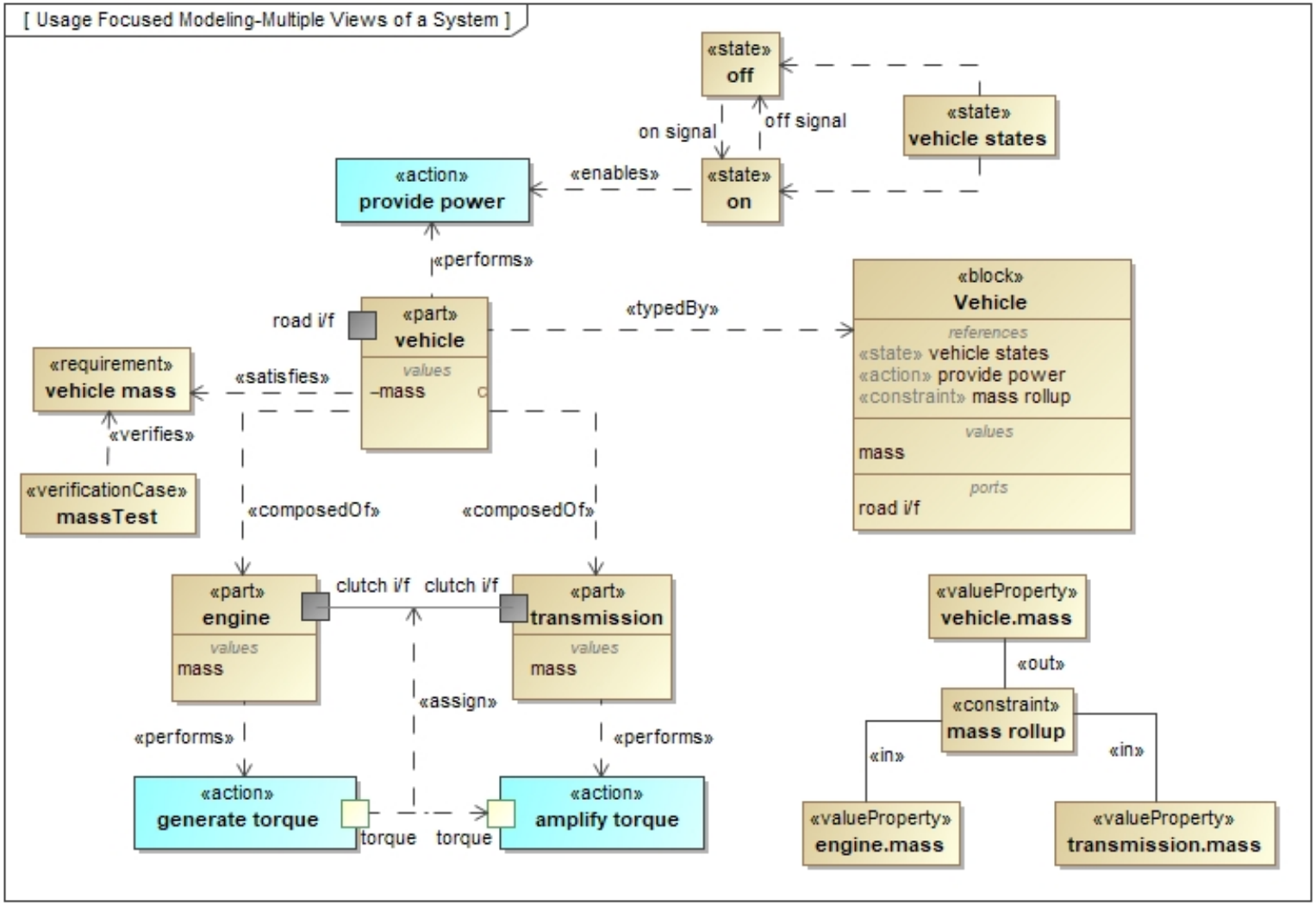
Graphical notation for illustrative purposes only



Example Using Textual Notation Definitions

SST

```
package sfriedenthal_VehicleModel_1{
   package Definitions{
      package PartDefinitions{
         block Vehicle {
            value mass :> ISQ::mass;
         }
         block Engine;
         block Cylinder;
         block Transmission;
      }
      package PortDefinitions{
         port def FuelCmdPort;
         port def VehicleToRoadPort;
      }
      package ActionDefinitions{
         activity ProvidePower (
            in fuelCmd:FuelCmd,
            out wheelToRoadTorque:Torque[2]
         );
      package StateDefinitions {
         state def VehicleStates;
         state def ControllerStates;
      }
      package ValueDefinitions{
         import ScalarValues::*;
      }
   }
```

Some simplifications have been made for the purposes of presentation

Example Using Textual Notation Usages/Configuration_a

SST

```
package VehicleConfigurations{
    import Definitions::*;
    package VehicleConfiguration_a{
        package VehiclePartsTree{
            part vehicle_a:Vehicle{
                value mass redefines mass=1750;
                part frontAxleAssembly:AxleAssembly{
                    part frontAxle:Axle;
                    part frontWheels:Wheel[2];
                }
                part rearAxleAssembly:AxleAssembly{
                    part rearAxle:Axle;
                    part rearWheels:Wheel[2];
                }
            }
        }
    }
```

vehicle_a is typed by Vehicle

Some simplifications have been made for the purposes of presentation

Example Using Textual Notation Usages/Configuration_b

SST

```
package VehicleConfiguration_b{
    import VehicleConfiguration_a::*;
    package VehiclePartsTree{
        part vehicle_b :> vehicle_a{
            value mass redefines vehicle_a::mass=2000;
            port fuelCmdPort:FuelCmdPort;
            port vehicleToRoadPort:VehicleToRoadPort{
                port wheelToRoadPort1:WheelToRoadPort;
                port wheelToRoadPort2:WheelToRoadPort;
            }
            perform VehicleActionTree::providePower;
            exhibit States::vehicleStates;
```

vehicle_b is a kind of vehicle_a

vehicle_b value property

vehicle_b port

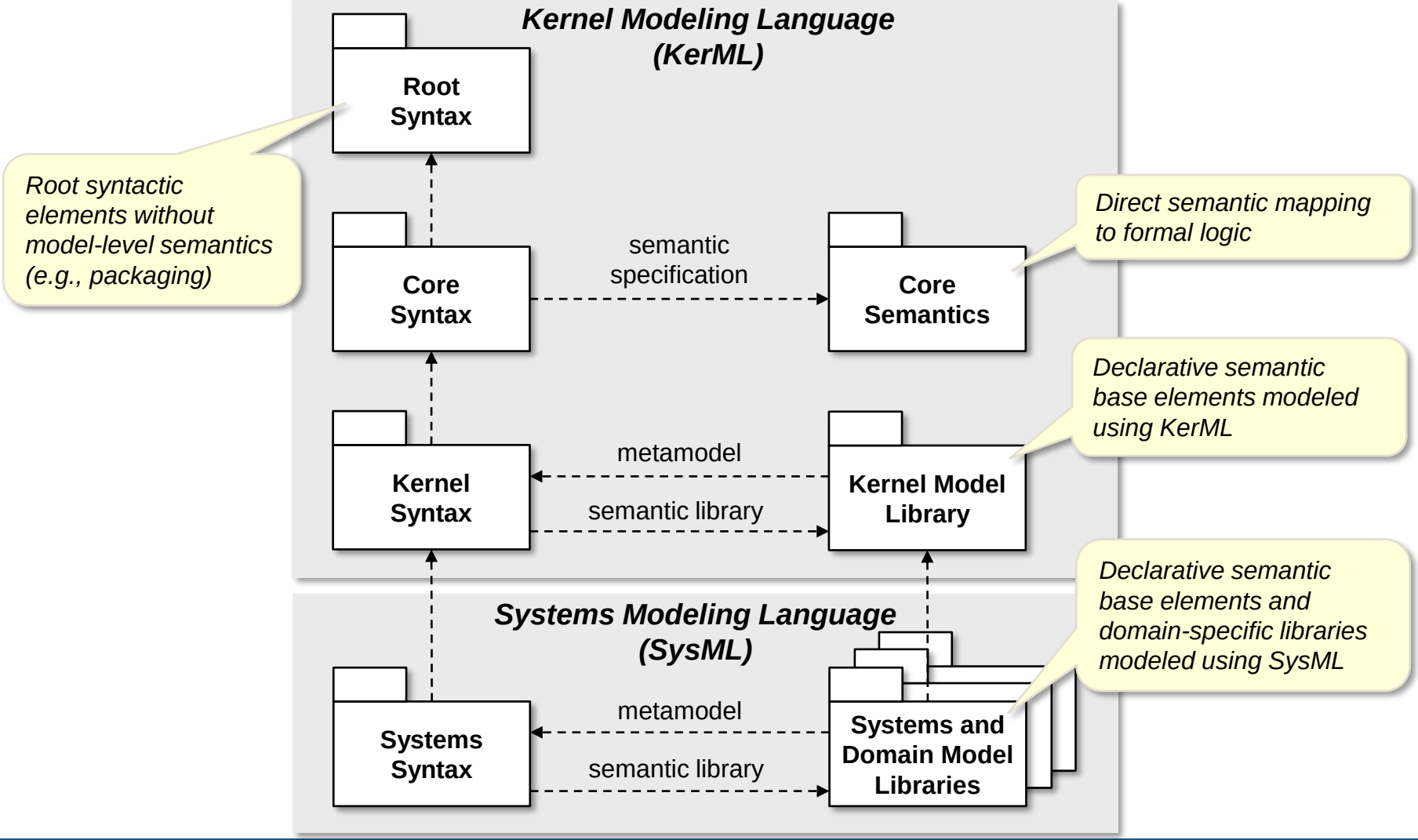
vehicle_b function

vehicle_b states

Some simplifications have been made for the purposes of presentation

SysML v2 Language Architecture

SysML v2 Language Architecture SST



SysML v2 API & Services

11 June 2020

SysML v2 API & Services

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- Enables other tools and applications to access SysML models in a standard way
- Provides services to:
  - Create, update, and delete elements
  - Query and navigate model
  - Other services including support for model management, analysis, view generation, transformation, and file export generation
- Facilitates use of different implementation technologies such as Rest, Java, and OSLC

Pilot Implementation Using Standard API

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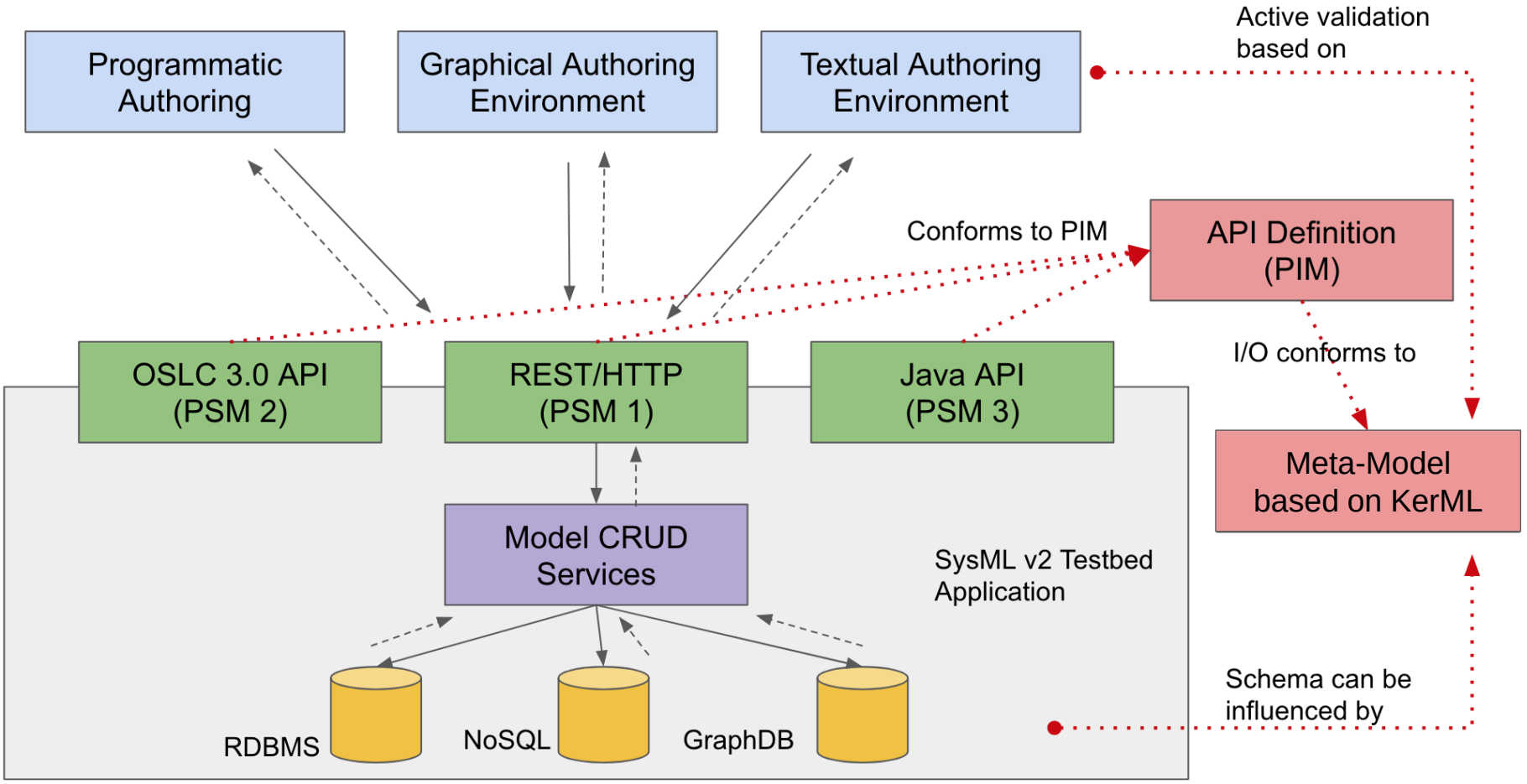
High-Level Architecture of SysML v2 Testbed



Summary

Next Public Incremental Release (2020-03 release)

SST

- Publicly available on Google Drive
- Google group for comments and questions
- Content
  - Read me file (includes installation instructions)
  - Specification documentation (Parts 1, 2, 3)
  - Training material for SysML textual notation
  - Installation file for Jupyter tooling
  - Installation site for Eclipse plug-in
  - Web access to Tom Sawyer tooling/repository

Summary

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- SST is addressing RFP requirements and issues associated with SysML v1 to improve adoption and effectiveness
  - 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

Thank you!!