SysML
Past, Present, and Future

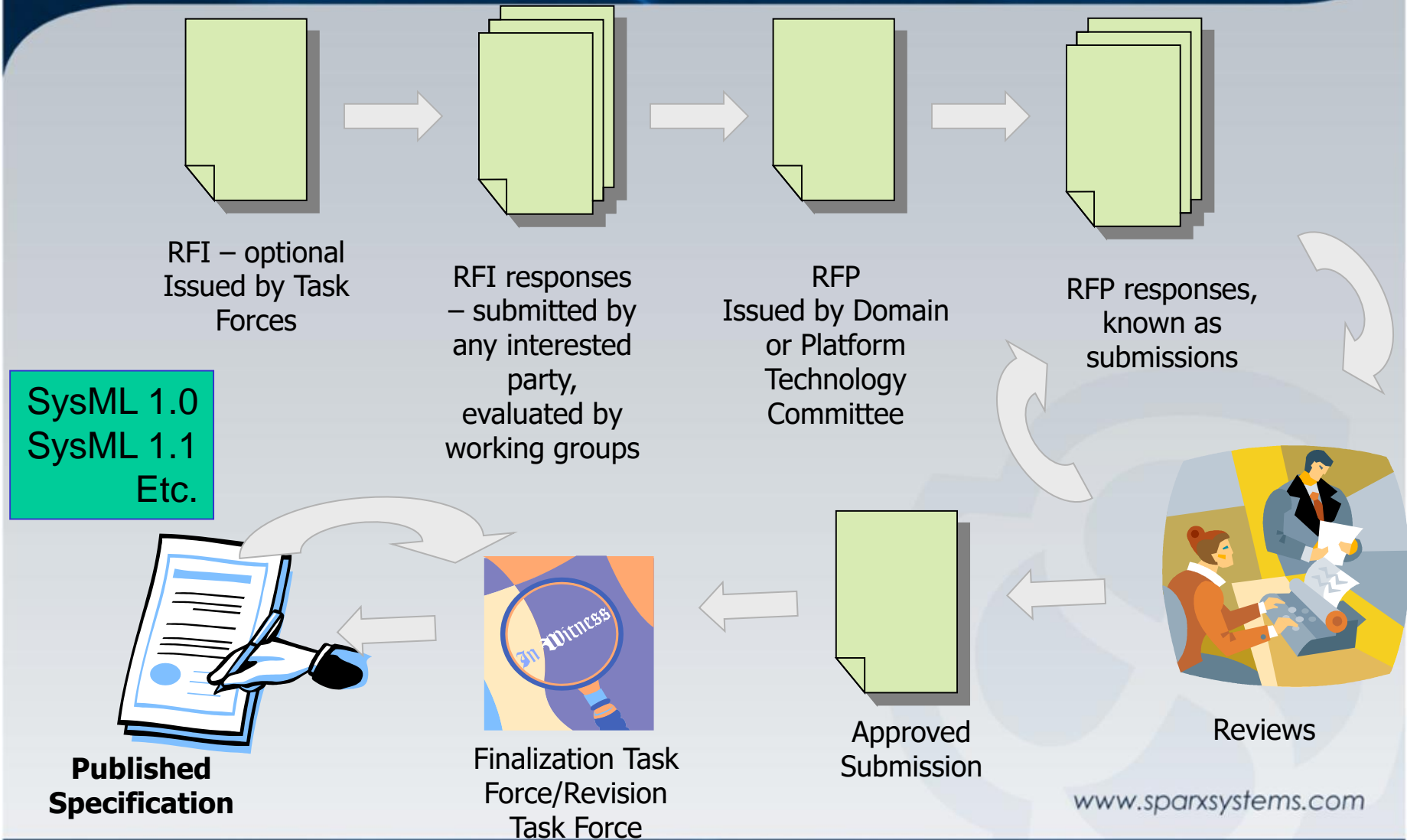*J.D. Baker*

Sparx Systems Ambassador

Sparx Systems Pty Ltd

A Specification Produced by the OMG Process

RFI – optional Issued by Task Forces

→

RFI responses – submitted by any interested party, evaluated by working groups

→

RFP Issued by Domain or Platform Technology Committee

→

RFP responses, known as submissions

SysML 1.0
SysML 1.1
Etc.

Reviews

Approved Submission

Finalization Task Force/Revision Task Force

Published Specification

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9/12/2018

What is SysML?

A graphical modelling language in response to the UML for Systems Engineering RFP developed by the OMG in coordination with INCOSE

  a UML Profile that represents a subset of UML 2 with extensions

Supports the specification, analysis, design, verification, and validation of systems that include hardware, software, data, personnel, procedures, and facilities

Supports model and data interchange via XML Metadata Interchange (XMI®)

SysML is Critical Enabler for Model Driven SE

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Status

Specification status

    Adopted by OMG in May '06

    Finalization Task Force Report in March '07

    Available Specification v1.0 June '07

    Revision task force chartered for SysML ® v1.1 in March '07

    Final Report for OMG SysML ® v1.1 submitted June 2008.

    OMG SysML® v1.1 published December 2008.

    OMG SysML ® v1.2 published June 2010

    OMG SysML ® v1.3 published June 2012

    OMG SysML ® v1.4 published August 2015

    OMG SysML ® v1.5 published May 2017

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Revision Task Force (RTF)

A Task Force with a closed membership of named individuals, responsible for clarifications of and minor modifications to an OMG Formal Specification.

In some specific circumstances an RTF (but not an FTF) may recommend changes that extend a Specification. Under all other circumstances enhancement of a Formal Specification shall only be accomplished by a new adoption process

SE DSIG

Led by Sandy Friedenthal

    INCOSE rep to OMG

    Former chair of the INCOSE MBSE Initiative

    Co-author of <u>A Practical Guide to SysML</u>

MBSE Wiki

    http://www.omgwiki.org/MBSE/doku.php

OMG RFPs Explained

RFPs are proposed by Task Forces
  For SysML this is the Analysis and Design Task Force
RFPs and published by Technology Committees
  For SysML this is the Platform Technology Committee
Responses to an RFP are called submissions
  It is not uncommon for RFP authors to be members of a submission team
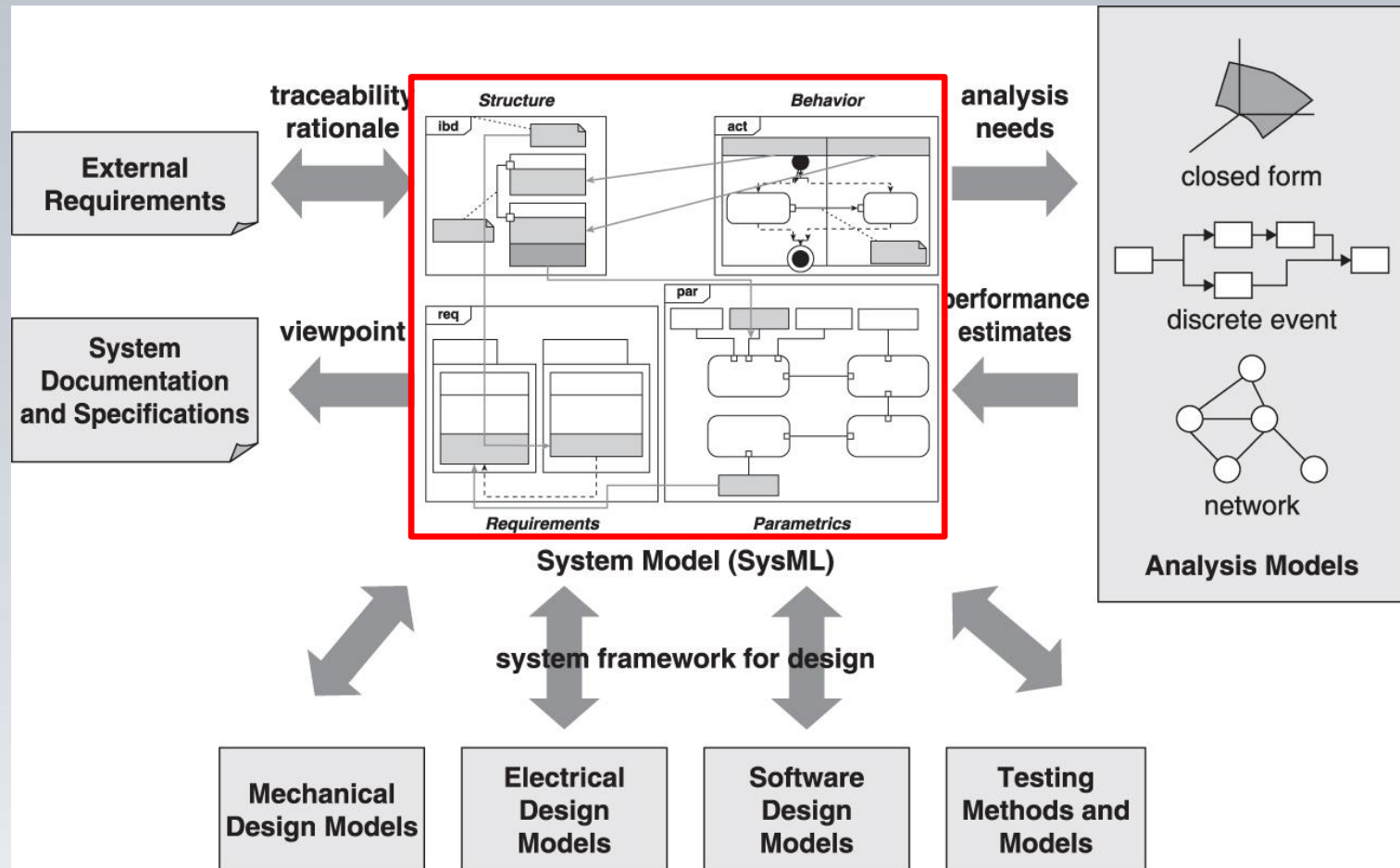
Language RFP

The SysML® v2 RFP was issued on December 8, 2017. This culminated an 18-month effort to develop the requirements for the next-generation systems modeling language, which is intended to improve the precision, expressiveness, and usability over SysML v1. The requirements reflect lessons-learned from applying model-based systems engineering (MBSE) with SysML since its adoption more than 10 years ago.

The RFP requires the specification to include both a SysML profile of UML® and a SysML metamodel, and a mapping between them. In addition, submitters have the option to specify additional features that include model interchange and formal semantics.
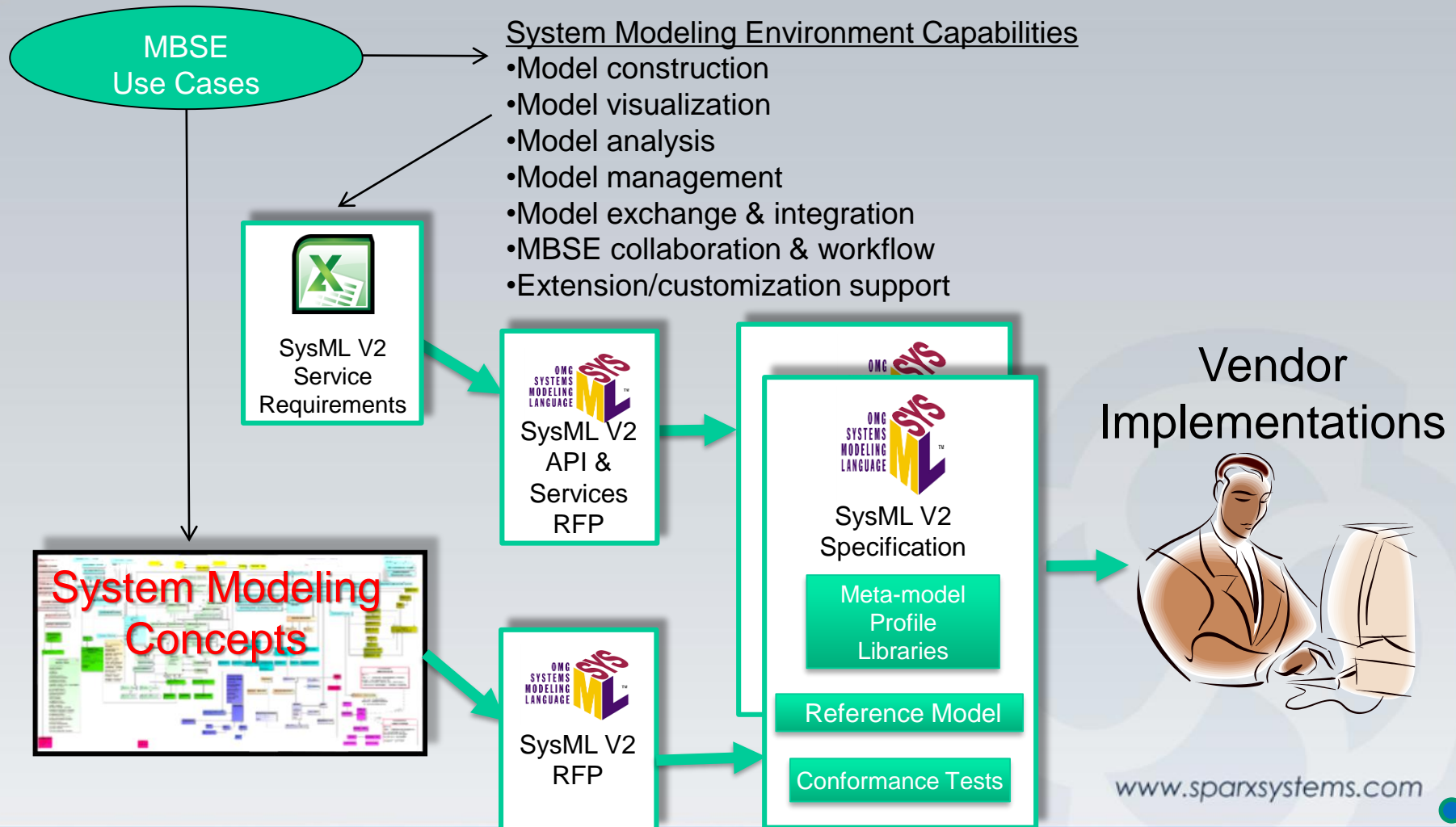
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Using SysML Model
as an Integration Framework

Source: A Practical Guide to SysML 3rd Ed: Figure 18.1

SysML v2 Specification Development

MBSE
Use Cases

System Modeling Environment Capabilities
- Model construction
- Model visualization
- Model analysis
- Model management
- Model exchange & integration
- MBSE collaboration & workflow
- Extension/customization support

SysML V2
Service
Requirements

System Modeling
Concepts

SysML V2
API &
Services
RFP

SysML V2
RFP

SysML V2
Specification

Meta-model
Profile
Libraries

Reference Model

Conformance Tests

Vendor
Implementations

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SysML v2 Requirements Summary

SysML v2 Language req'ts 167 (+38 requirement groups)

- Language & Formalism req'ts   23 (+7 for conformance)
- Data Model req'ts   137

Number fully, partially, and not addressed by SysML v1

- Fully addressed   42
- Partially addressed by   59
- Not addressed   66

⎫
⎬ 101
⎭

The scope of the SysML v2 data model requirements is similar in scope to the original SysML v1 mandatory and optional requirements:

SysML v1 Language reqt's 190

- Mandatory req'ts   163
- Optional req's   27

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SysML v2 Approach
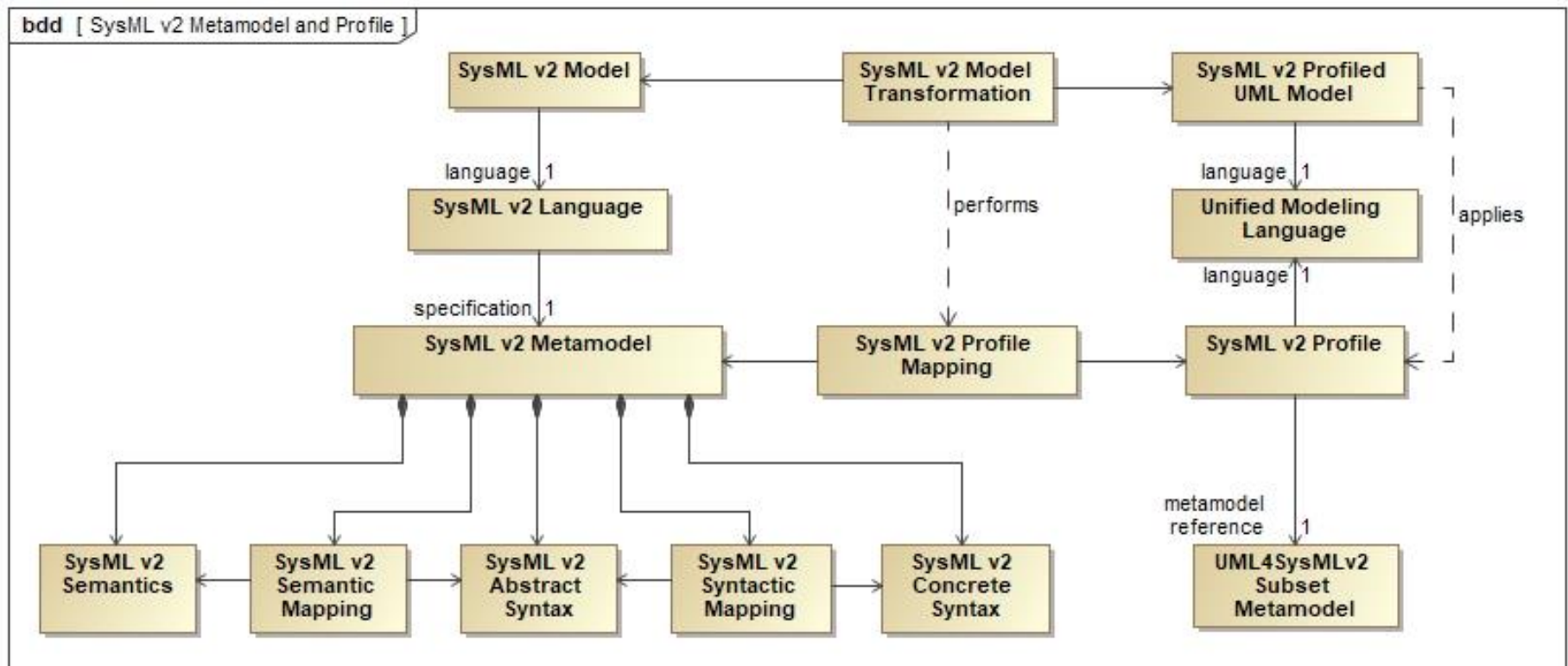
SysML v2 profile and metamodel

Similar in scope to SysML v1.x

Based on industry standards for systems engineering
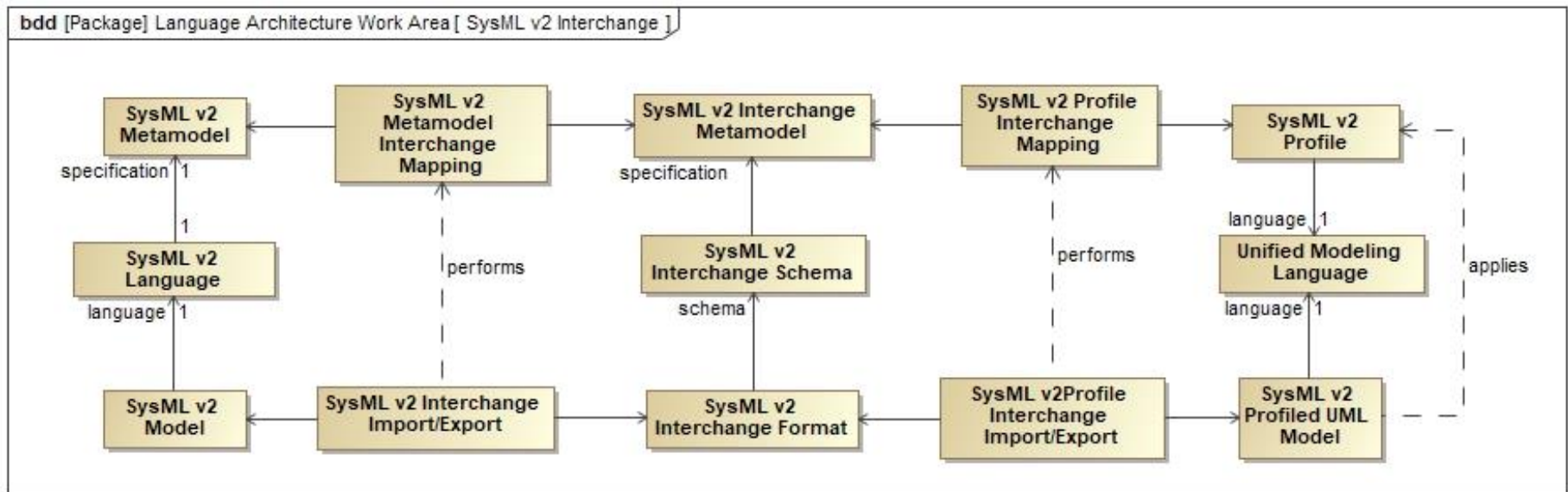
Grounded in logical formalisms

SysML v2 Metamodel and Profile

SysML v2 profile facilitates transition for current SysML vendors
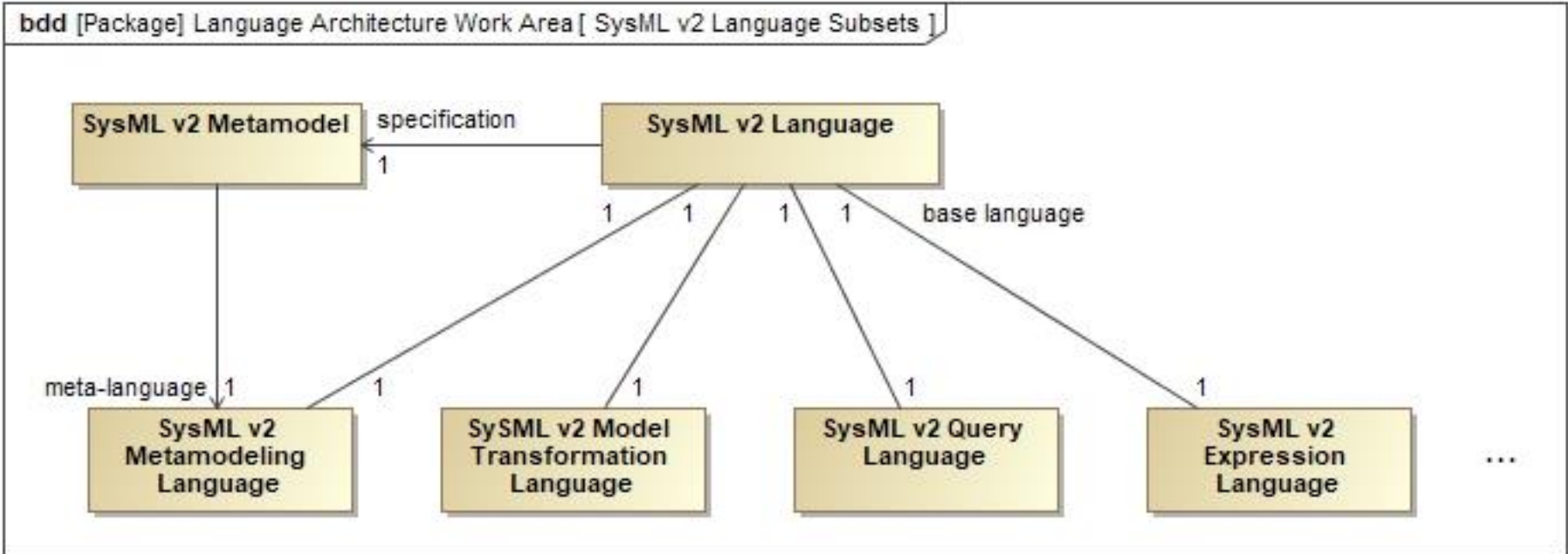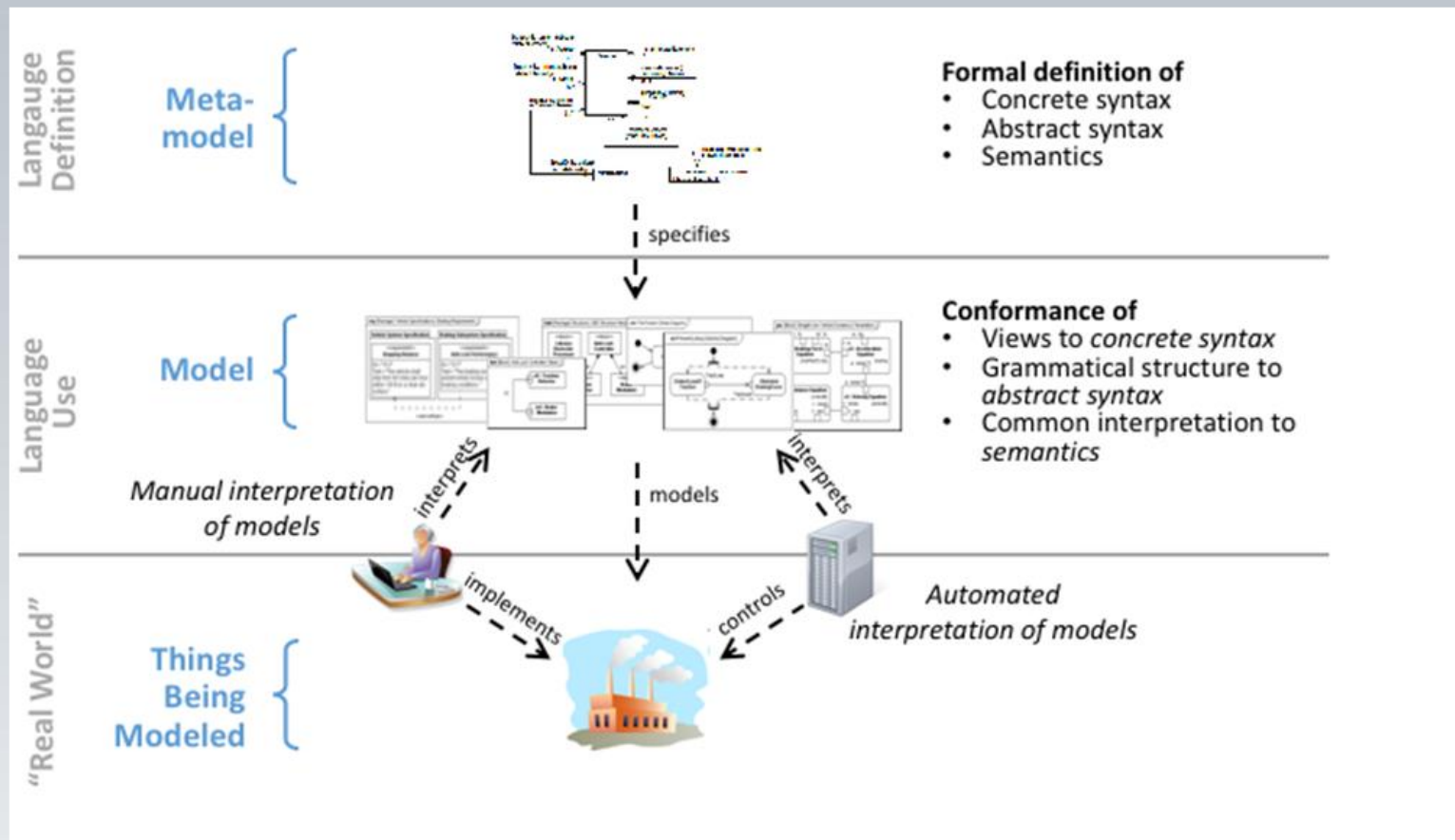SysML v2 metamodel not constrained by UML

SysML v2 Model Interchange

SysML v2 Language Subset

bdd [Package] Language Architecture Work Area [SysML v2 Language Subsets]

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Language Formalism and Uniform Interpretation

Source: Derived from SysML Formalism WG Presentation dated March 21, 2017

Semantics Requirements

- SysML v2 semantics shall be grounded in a declarative semantics expressed using mathematical logic.
  - Semantics are defined formally to reduce ambiguity.
  - Declarative semantics enable reasoning with mathematical proofs.
  - This contrasts with operational semantics that requires execution in order to determine correctness.
- SysML v2 semantics shall be modeled with SysML v2 model libraries.
  - Simplifies the language when model libraries are used to extend the base declarative semantics without additional abstract syntax.
  - Enables SysML to be improved and extended more easily by changes and additions to model libraries, rather than always through abstract syntax.

Conformance Tests

The RFP will require submitters to provide

a conformance test suite with test cases traced to SysML v2 language feature requirements

a reference model demonstrating substantive use of SysML v2 features

Submitters will be expected provide a pilot implementation that satisfies all conformance tests and can manage the reference model

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Language RFP Timetable

Event or Activity	Date
Letter of Intent (LOI) deadline	24 September, 2018
Initial Submission deadline	4 November, 2019
Voter registration closes	25 November, 2019
Initial Submission presentations	2 December, 2019
Revised Submission deadline	9 November, 2020
Revised Submission presentations	7 December, 2020

Objective – SysML v2 API and Services RFP

Specifies the requirements for an Application Programming Interface (API) that includes services to operate on SysML v2 models, and

Connect SysML v2 models with models in other disciplines

API shall be implemented by SysML v2 modeling environments and shall support a wide range of operations related to model query, model construction, model view/viewpoint management, model analysis, model management, and model transformation for SysML v2 models.

Complements the SysML v2 RFP (language RFP)

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Fundamental problems that motivate

SysML v2 API and Services RFP

Problem 1: Standard approach for programmatically interacting with a SysML model

> XMI (Import/Export), Non-standardized native APIs

Problem 2: Portability of your applications (apps)

> Rewriting your app for each SysML environment -> less time improving app

Problem 3: Enterprise-ready services for wider SysML deployment

> File-based to service-based, Import/export -> APIs, Scaling up (users, model size, etc.)

Problem 4: Building an integrated system model (aka "digital twin")

> Connecting SysML models to other models and repositories, bi-directional compare and synchronization services

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What is an API?

API stands for Application Programming Interface

API = Interface for software/services to communicate with each other

For any software, we will typically have

  GUI = Interface for humans to interact

  API = Interface for other software/services to interact

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Why does SysML v2 need an API?

We have always needed to access system model and automate
- Document generation
- Model validation
- Model generation/transformations
- Analysis and reasoning, and many such tasks…

Today
- We write plugins / scripts for a specific SysML tool
- Application logic subject to tool-specific implementation of SysML / UML
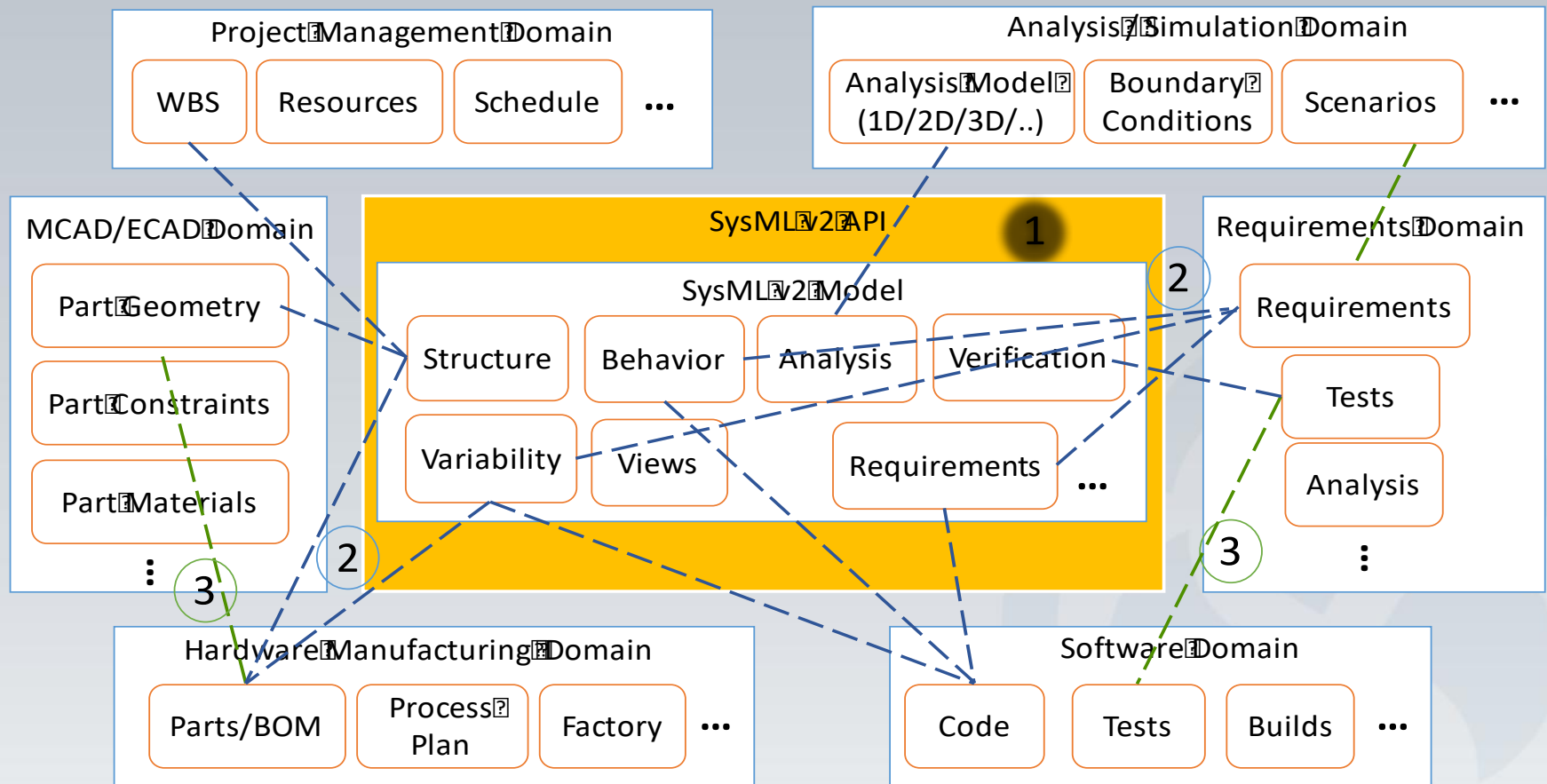
SysML 2 API will make it possible to
- Write application (business) logic using standard services independent of a specific tool
- Deploy the application for each SysML Modeling Environments
- Focus on business logic and not portability

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Scope of SysML v2 API and Services RFP

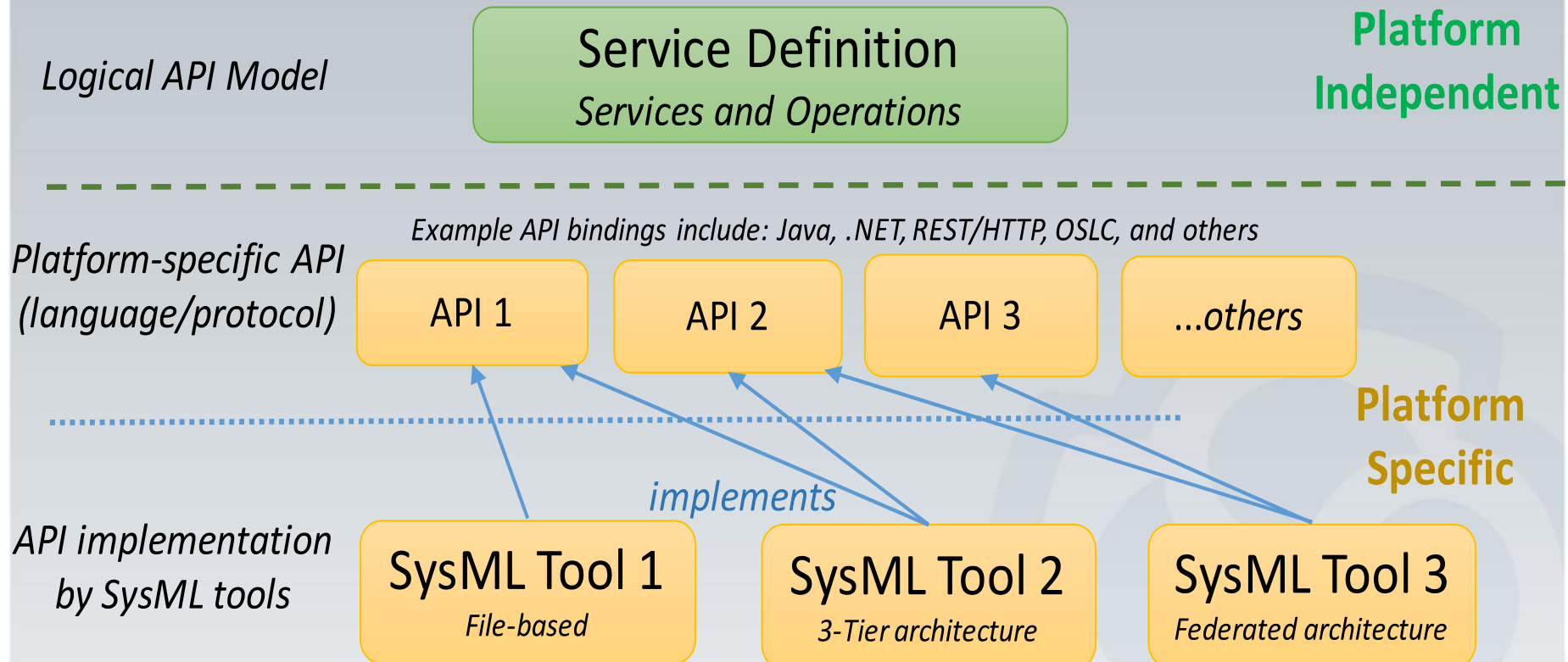(1) and (2) are in scope, (3) is out of scope

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SysML v2 API and Services Architecture
PIM and PSM

Logical API Model

Service Definition
Services and Operations

Platform Independent

Platform-specific API (language/protocol)

Example API bindings include: Java, .NET, REST/HTTP, OSLC, and others

| API 1 | API 2 | API 3 | ...others |

Platform Specific

implements

API implementation by SysML tools

SysML Tool 1
File-based

SysML Tool 2
3-Tier architecture

SysML Tool 3
Federated architecture

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Leveraging other open standards

OMG standards / RFPs

    SysML 2 RFP – defines the meta-model for SysML 2 API and Services I/O

    MOF/SMOF

    [API4KB] Application Programming Interfaces (API) to Knowledge Bases (KB) RFP

    [DOL] Distributed Ontology, Model, and Specification Language

    [MOFVD] Versioning and Development Lifecycle TM (MOFVDTM)

    [QVT] Query View Transformation TM (QVTTM)

    [SPMS] Structured Patterns Metamodel Standard (SPMS™)

    [UTP] UML Testing Profile

    …

Non-OMG standards

    OpenAPI (Open API Initiative)

    ISO 10303 (STEP)

    OSLC

    …

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RFP submission for review at OMG Boston

Document: ad/2018-05-01

Mandatory Requirements

 API and Services Architecture and Conformance

 Service Scope, Conditions, and Response

 Model Navigation, Creation, Update, Deletion Services

 External Relationship Management Service

Non-Mandatory Requirements

 Model Query Service

 Advanced Model Construction Services

 Model Visualization Services

 Model Analysis Services

 Model Management Services

 Model Transformation Services

 General Services – Timestamp and UUID generation, API Call Back

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Schedule

Event or Activity	Date
Letter of Intent (LOI) deadline	10 December 2018
Initial Submission deadline	4 weeks before Mar 2020 OMG Meeting (date TBD)
Voter registration closes	2 weeks before Mar 2020 OMG Meeting (date TBD)
Initial Submission presentations	Mar 2020 OMG Meeting (date TBD)
Revised Submission deadline	4 weeks before Mar 2021 OMG Meeting (date TBD)
Revised Submission presentations	March 2021 OMG Meeting (date TBD)

Questions

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