OMG Standards Work relevant to Industrial Systems

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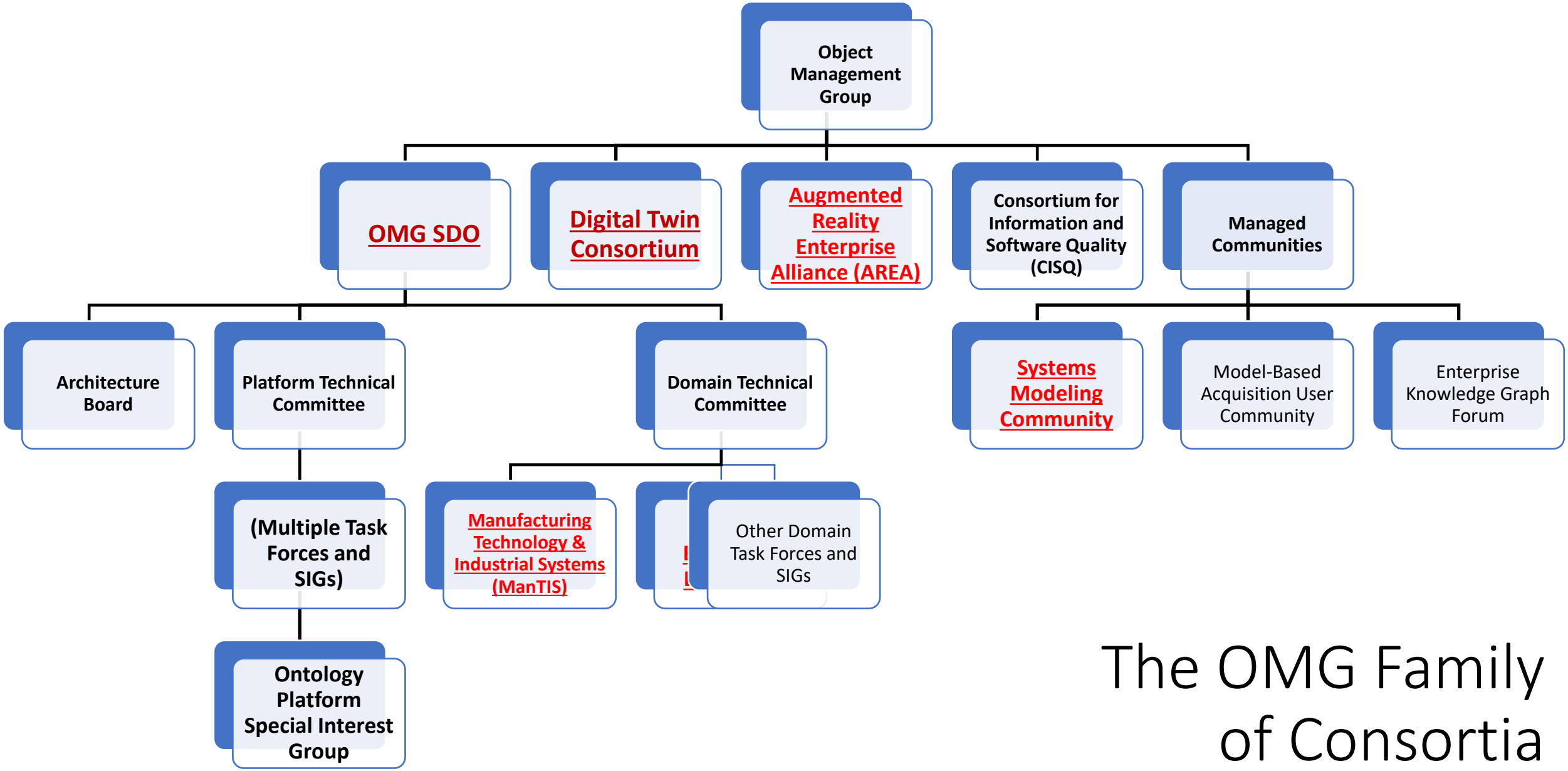
Intro and Outline

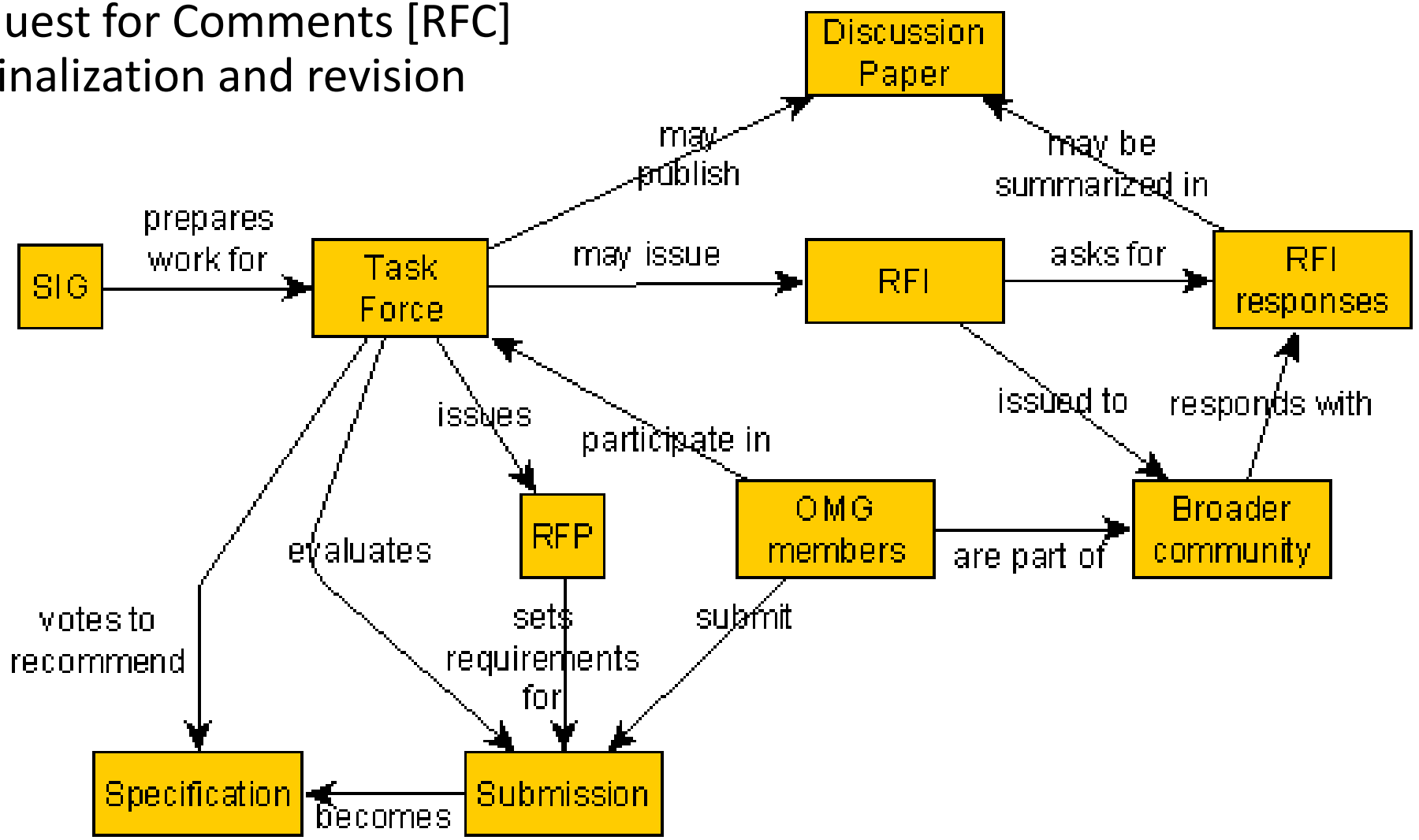
- The OMG Standards Development Organization covers a lot of topics, divided into “domain” and “platform” areas
- It is all about model-driven architecture and interoperability
- This includes:
  - System Modeling Language (SysML)
  - Ontologies and supporting mechanisms (ODM, COntL)
  - Product lifecycle management specs (from ManTIS Task Force)
  - Middleware standards, e.g. DDS for data distribution
  - Agent and Event Modeling
  - Upcoming AI standard (starting with a neural network metamodel)
- Also relevant are general software development and business modeling standards such as UML and BPMN



The OMG Family of Consortia

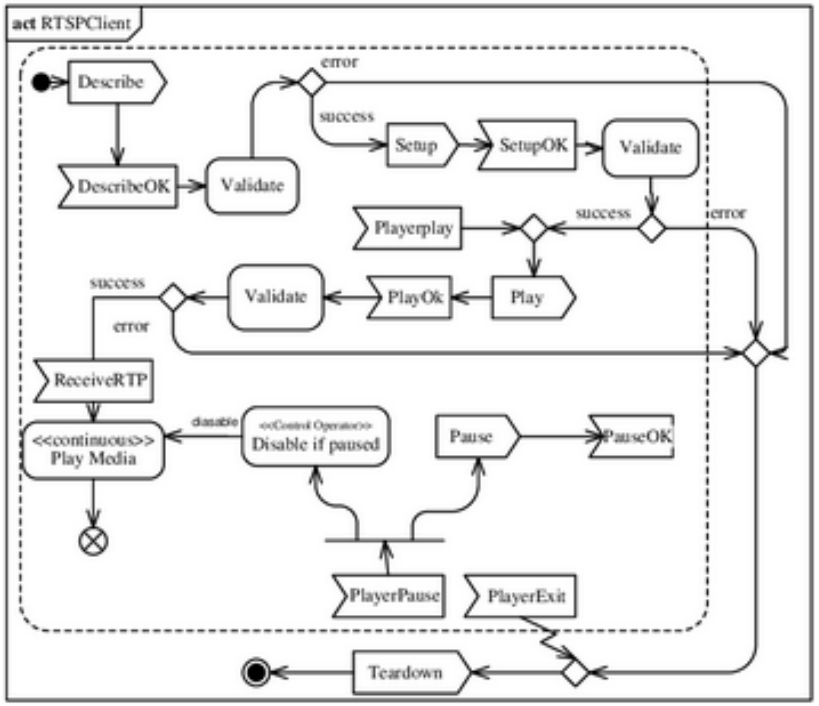
How OMG Specs Are Born (simplified)

(omitting the Request for Comments [RFC] process and the finalization and revision task forces)



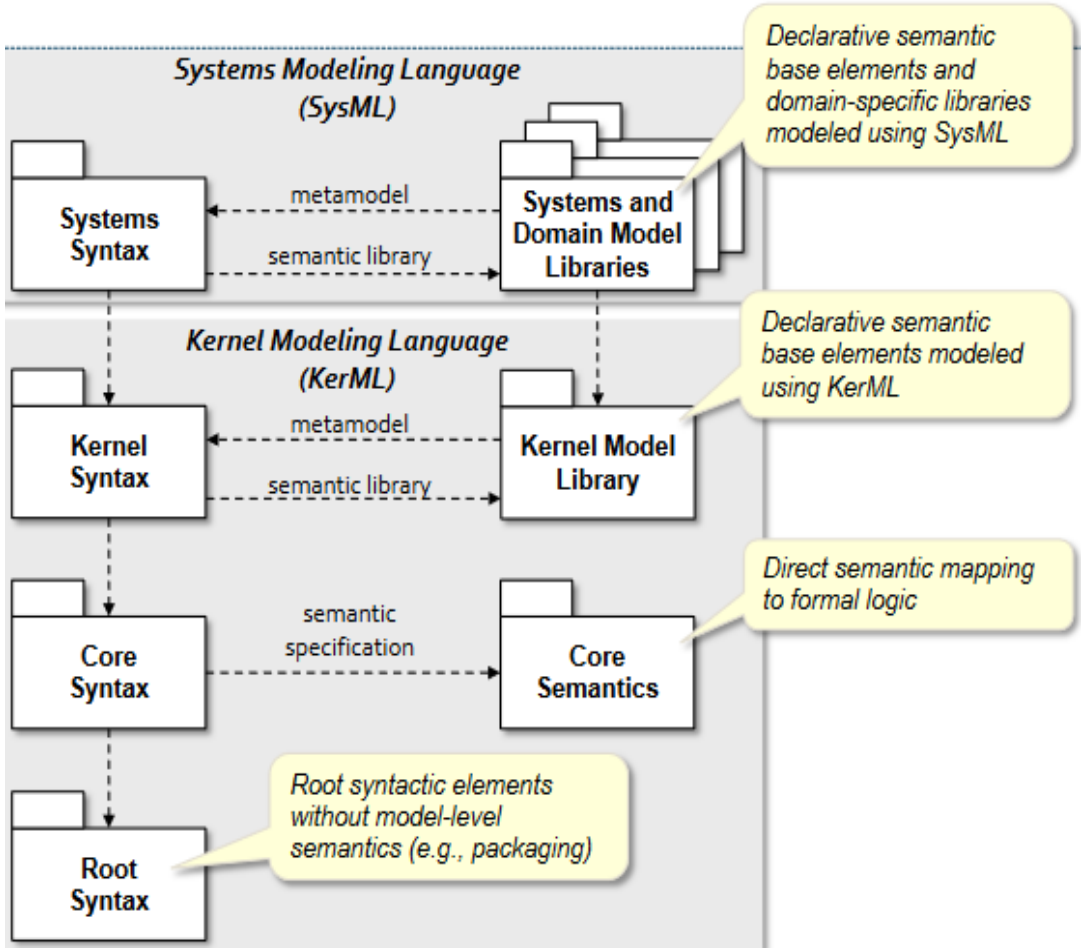
Systems Modeling Language (SysML)

- Originated in INCOSE/OMG collaboration in 2001
- Adopted in 2006, evolving to v1.7 in 2022
- The universally recognized standard for model-based systems engineering (MBSE)
- V1 is based on (i.e., a *profile* of) the Unified Modeling Language (UML) but made smaller through removal of some software-centric constructs
- 9 diagram types covering system structure, requirements, behavior
  - 7 inherited from UML and 2 new ones (requirement and parametric diagrams)
- Adds allocation relationships and allocation tables
- Allows performance and quantitative analyses



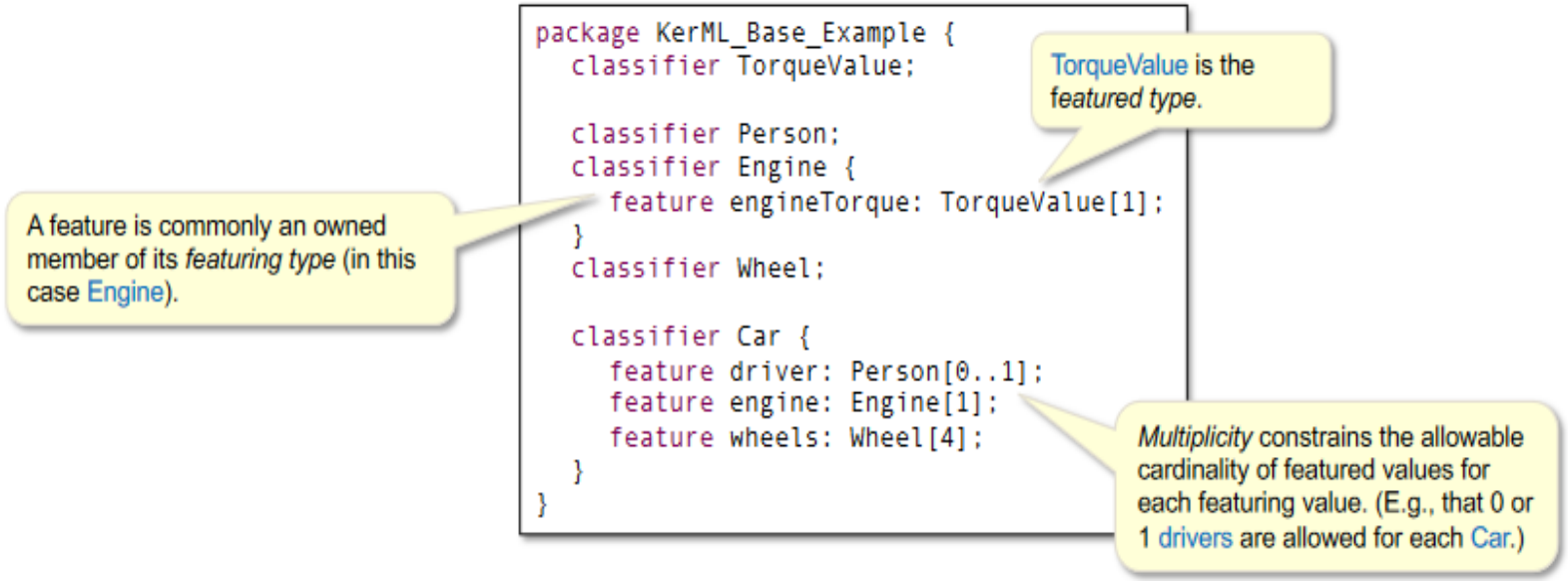
SysML v2

- Adopted by the Analysis & Design Platform Task Force in 2023
- More than a dozen tool vendors have committed to supporting v2
- Key changes from v1
  - New metamodel not constrained by UML
  - Grounded in formal semantics
  - Based on model libraries
  - Multiple visualizations, including a textual representation
  - Standardized API to access the model
- Defines a new Kernel Modeling Language (KerML) instead of being UML-based



KerML: the Kernel Modeling Language

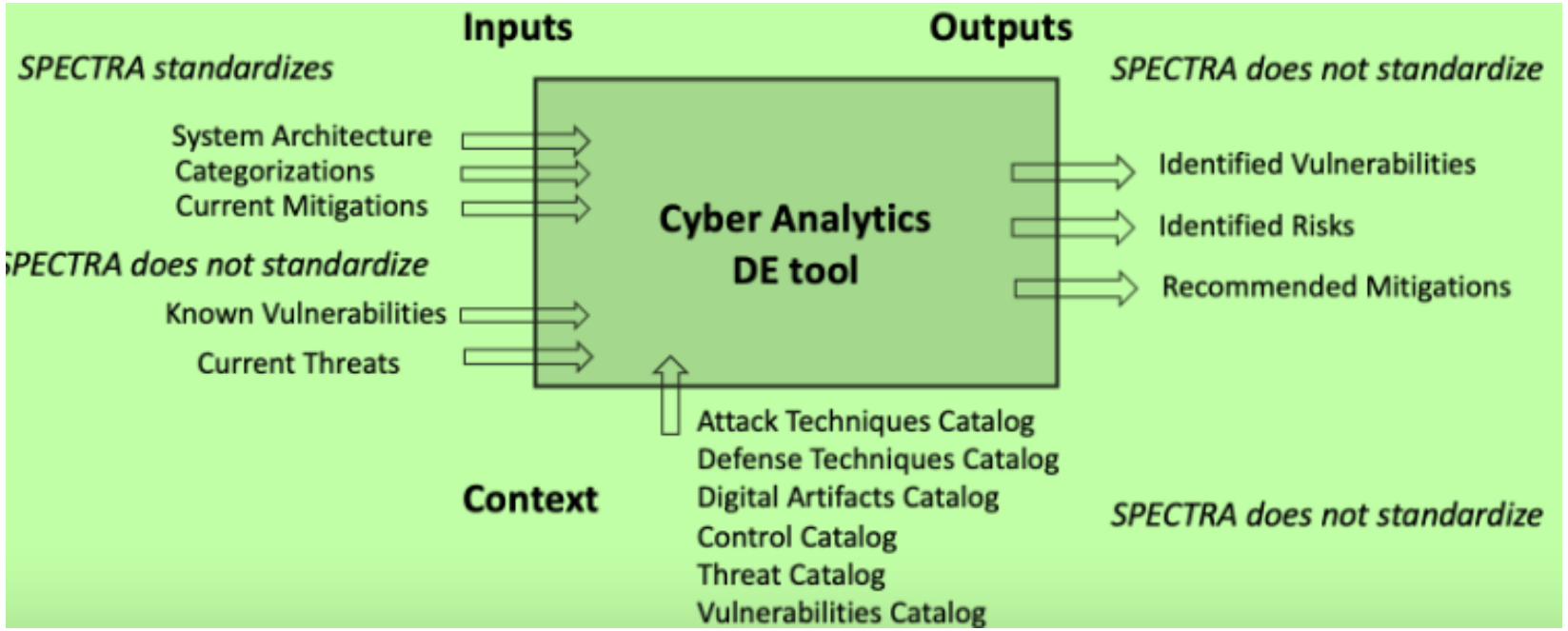
- Rich set of semantic concepts
  - Rigorous mathematical semantics
  - Types, classifiers, specialization, features
  - Attribute value, item, port, connection, action, occurrence, link, …
  - Relationships
- Adopted by OMG in 2023
  - Undergoing finalization by mid-2025
- Invented to support SysML v2, but applicable to other uses



See Ed Seidewitz's tutorial at https://tinyurl.com/ewhtj9n7

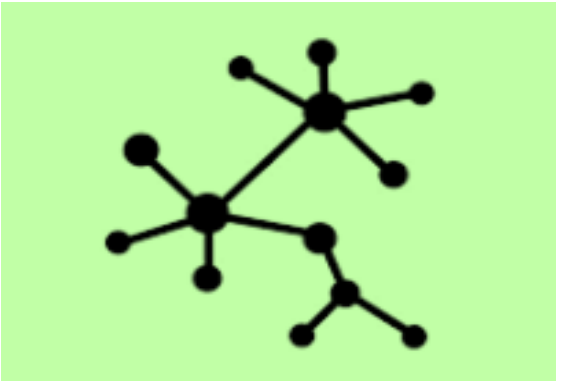
SPECTRA: System Profile for Effective Cyber Threat-based Risk Assessment

- “A language for describing cyber and cyber-physical systems for the purposes of risk assessments, cybersecurity assessments and vulnerability assessments”
- “Cybersecurity implies a filter for the level of technical detail, compared to other disciplines involved in the system lifecycle”
- Takes the form of SysML v1 and SysML v2 profiles
- Enables “digital engineering tools”
- Adoption in progress



Ontology Work at OMG

- Relevance: foundation for semantic interoperability of systems
- Mechanisms
  - Ontology Definition Metamodel (ODM)
    - Facilitates the engineering of ontologies, linking Common Logic, OWL and RDF
  - Distributed Ontology, Model and Specification Language (DOL)
  - API for Knowledge Platforms (API4KP)
  - Common Ontology Library – a set of small, easy to reuse ontologies
    - Discussed with AIOTI the potential use of Commons for IoT and digital twins
- Contributions to domain ontologies
  - Financial Industry Business Ontology (FIBO)
  - Languages, Currencies and Codes (LCC)
  - Robotic Service Ontology (ROSO)
  - Retail Industry Ontology (RIO)



Where Ontology, Industrial Systems, IoT and Digital Twins Meet…

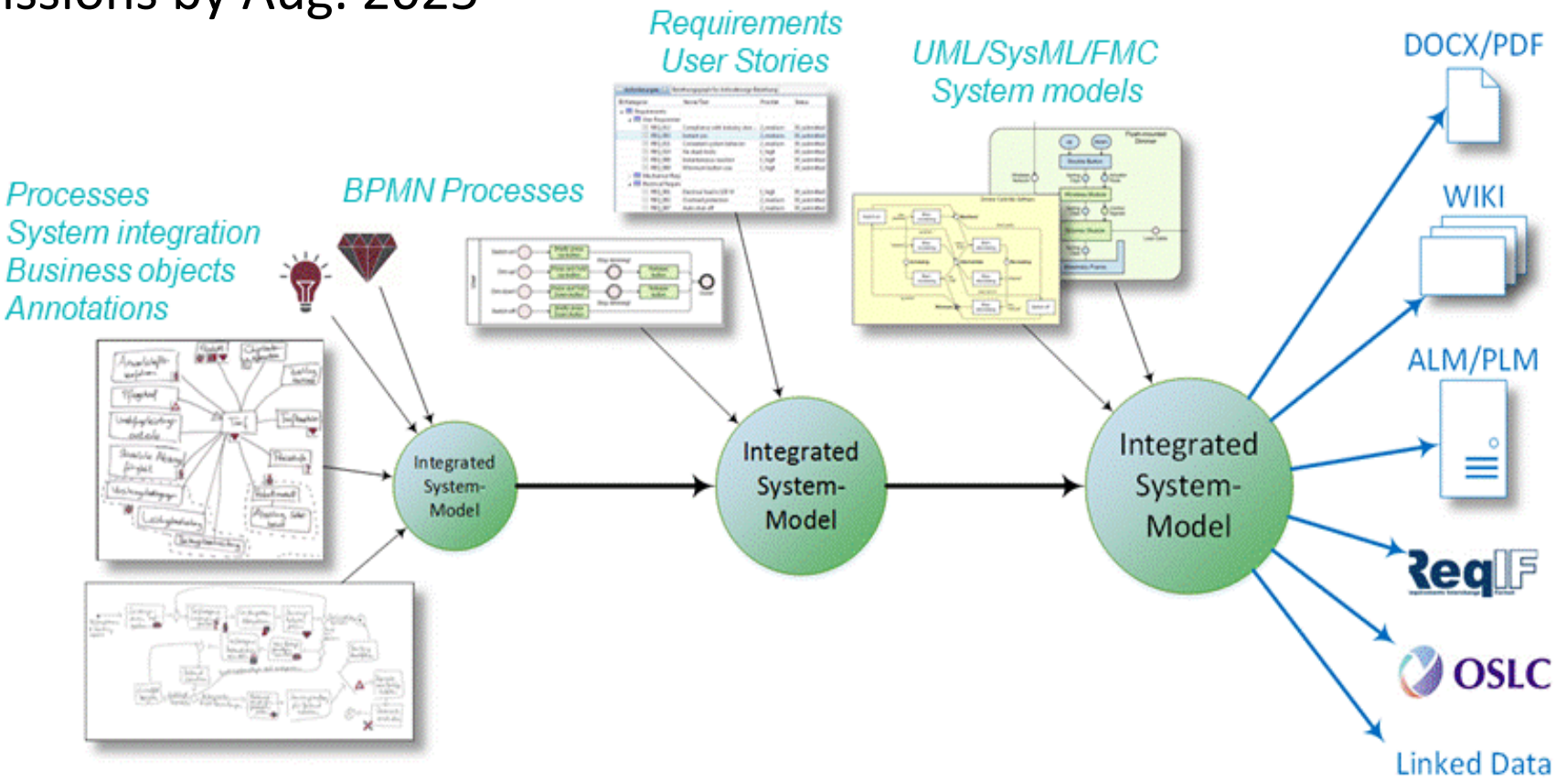
- Official workshop report: upcoming, ask Dave Raggett, dsr@w3c.org
- Unofficial summary: ask claude@omg.org
- We also contributed to the "Landscape of Digital Twin Standards" of the European Observatory on Standards (EUOS), https://bit.ly/4mpiBEe

Manufacturing Technology & Industrial Systems (ManTIS)

- Past deliverables
  - EXPRESS metamodel
  - Product Lifecycle Management (PLM) Services
  - Simplified Electronic Notation for Sensor Reporting (SENSR)
    - An example of a collaboration between two OMG consortia
  - SysML Extension for Physical Interaction and Signal Flow Simulation (SysPhS)
- Future deliverables
  - CASCaDE
  - Product Knowledge Framework (PKF)?
- See www.omg.org/mantis

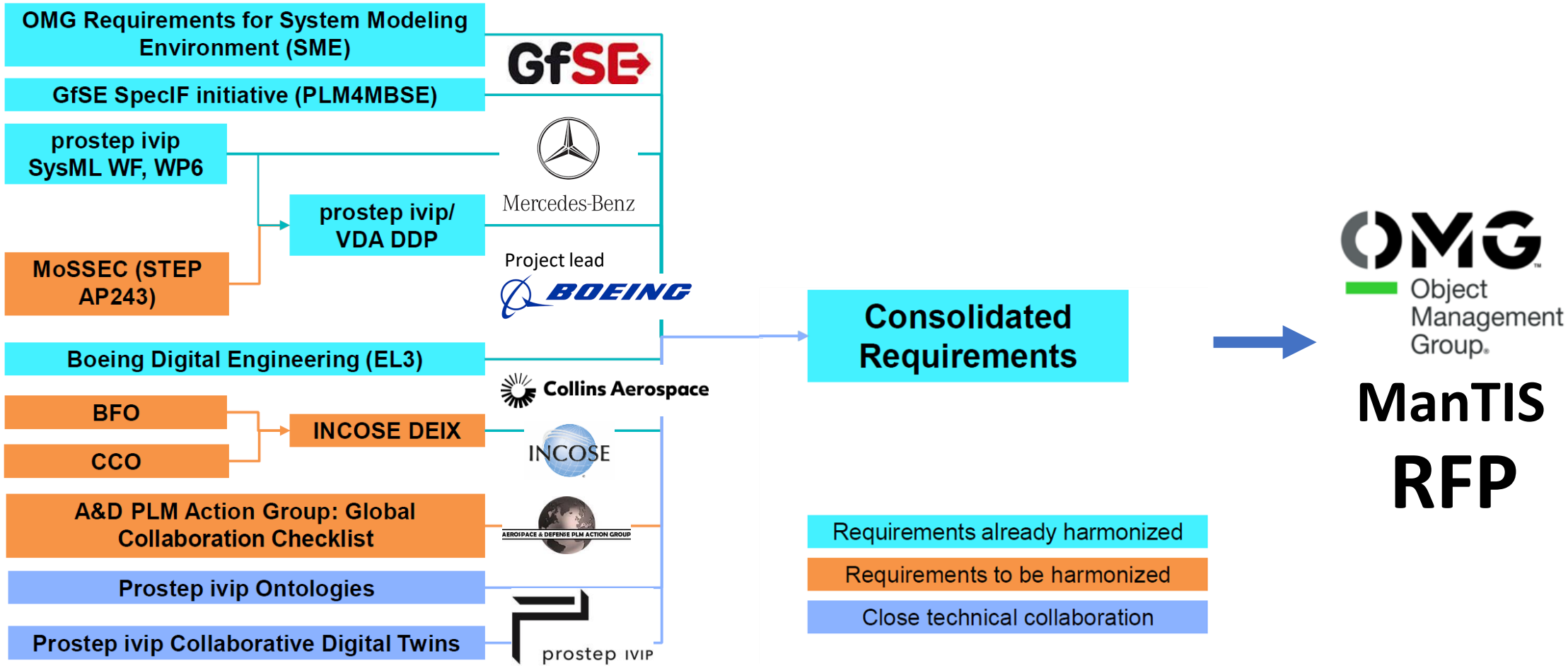
New ManTIS Work in 2025: CASCaDE

- Collaborative Artifact, Specification, Context and Data Exchange
  - New RFP issued in Dec. 2024 for a standard to support digital engineering collaboration among industrial partners
  - Soliciting submissions by Aug. 2025



ManTIS (continued)

- CASCADE's goal is to "harmonize" the industry for digital collaboration
- Requirements compiled from a number of different consortia and companies



Middleware

- MARS Platform Task Force = Middleware and Related Services
  - DDS = Data Distribution Service
    - Publish-and-subscribe mechanism for data distribution
    - Extensible data types
    - Strong security
    - Quality of Service parameters
    - DDS/OPC-UA Gateway (another standard requested by IIC and developed by OMG)
  - Enterprise Resource Metadata Attributions (ERMA)
    - Metadata to operate a risk-managed computing environment (hardware, software, network)
    - Result of a collaboration with a member of the Digital Twin Consortium
  - … and many other specifications, dating back to CORBA
- See www.omg.org/mars/

Agent and Event Modeling

- Upcoming Agent and Event Metamodel and Profile (AgEnt)
  - Extending UML with capabilities to model agents and agent-based software, and the sensing and interpretation of events (monitoring, filtering, aggregation, and correlation)
- Relevance to digital twins demonstrated in a paper on “Distributed AI Modeling and Simulation for Smart Airport Digital Twin Applications
- See www.omg.org/agent/

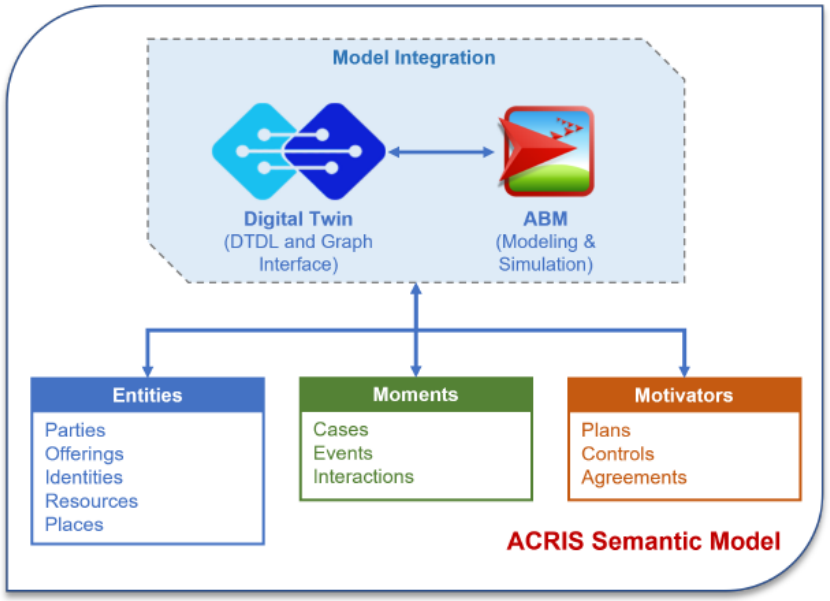


Fig. 3 Digital Twin and Agent-Based Model Integration with Basic Module Package Organization of the ACRIS Semantic Model

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