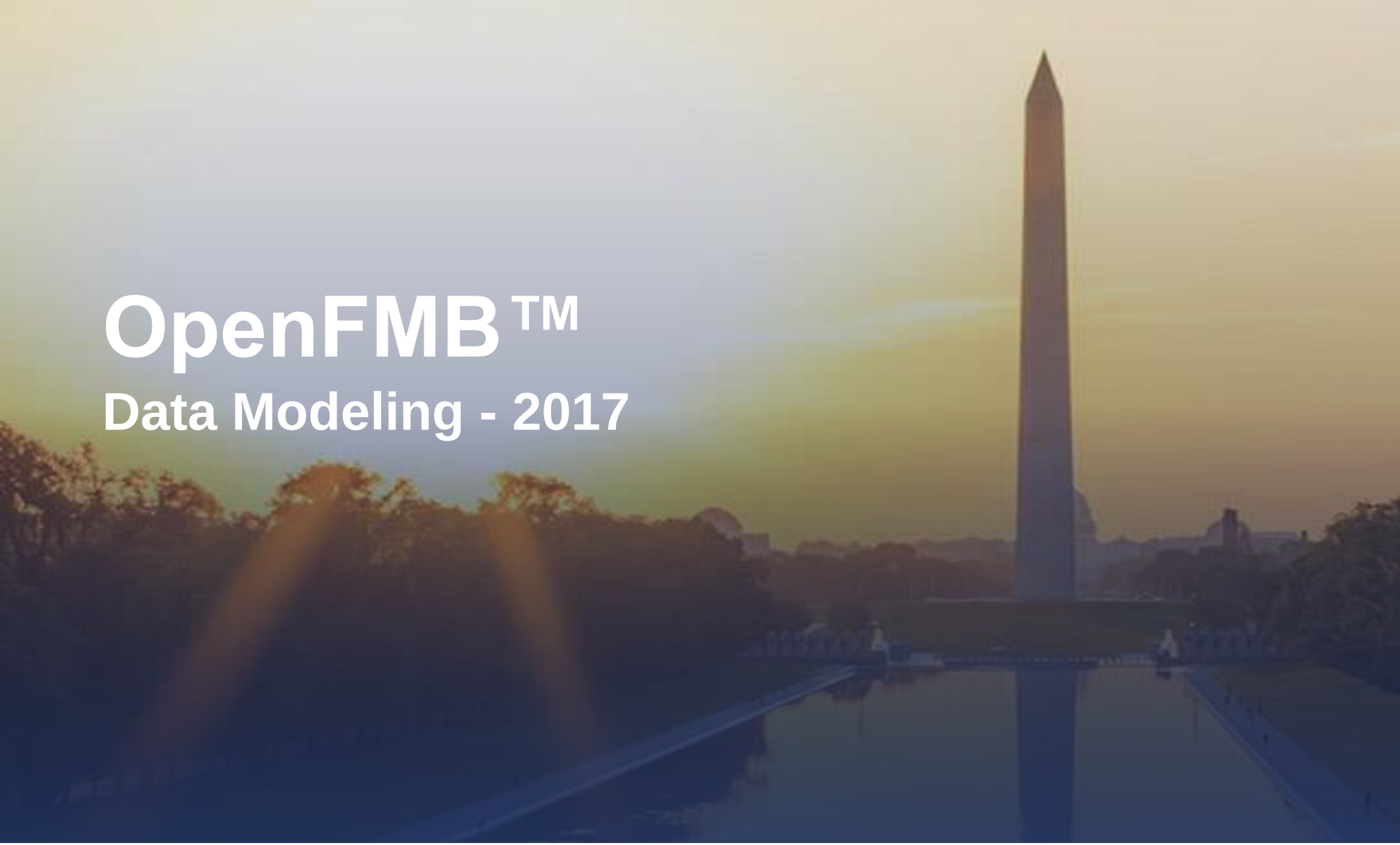

OpenFMB™

Data Modeling - 2017

GRID EVOLUTION SUMMIT SEPA

A National Town Meeting

2017 Technical Program

OpenFMB/Data Modeling

OpenFMB Data Modeling

GRID EVOLUTION SUMMIT SEPA

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Antitrust Guidelines for SEPA Meetings & Conferences

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The antitrust laws and other business laws apply to SEPA, its members, funders, and advisers; violations can lead to civil and criminal liability. SEPA is committed to full compliance, as well as to maintaining the highest ethical standards in all of our operations and activities.

These guidelines apply to all occasions: before, during, and after SEPA meetings and conferences, including in the hallways, over lunch, cocktails and at dinner.

- **SEPA'S MISSION** – is to facilitate the utility industry's smart transition to a clean energy future through education, research, standards, and collaboration.
- **YOUR ROLE AT SEPA MEETINGS AND CONFERENCES** – varies based on what you are attending, but could include sharing information with and learning from peers, potential partners, and industry experts and/or to provide guidance to SEPA on its activities. Consult with your company counsel if at any time you believe discussions are touching on sensitive antitrust subjects such as pricing, bids, allocation of customers or territories, boycotts, tying arrangements and the like.
- **DO NOT DISCUSS** – pricing, price terms, such as, for example, discount and credit policies, promotions, or product category pricing levels and industry pricing levels, production capacity, or cost information which is not publicly available; confidential market strategies or business plans; or other competitively sensitive information. Do not disparage suppliers and/or competitors of SEPA and/or SEPA Members and participants.
- **BE ACCURATE, OBJECTIVE, AND FACTUAL** – in any discussions of goods and services offered in the market by others, including your competitors, suppliers, and customers.
- **SEPA DOES NOT RECOMMEND** – the use of particular vendors, contractors or consultants. SEPA will not promote or endorse commercial products or services of third parties. You must draw your own conclusions and make your own choices independently.
- **DO NOT AGREE WITH OTHERS** – to discriminate against or refuse to deal with (i.e., "boycott") a supplier; or to do business only on certain terms and conditions; or to set price, divide markets, or allocate customers.
- **PLEASE BE AWARE** – that an agreement regarding price need not relate to a specific price, but may relate to levels, discounts policy, allowance policy, and other terms affecting price levels or movements and may be inferred from a discussion and ensuing conduct.
- **DO NOT TRY TO INFLUENCE** – or advise others on their business decisions, and do not discuss yours (except to the extent that they are already public).
- **ASK** – for advice from your own legal department, if you have questions about any aspect of these guidelines or about a particular situation or activity at SEPA; or ask the responsible SEPA manager to contact SEPA's Legal Counsel.

OpenFMB Modeling Approach

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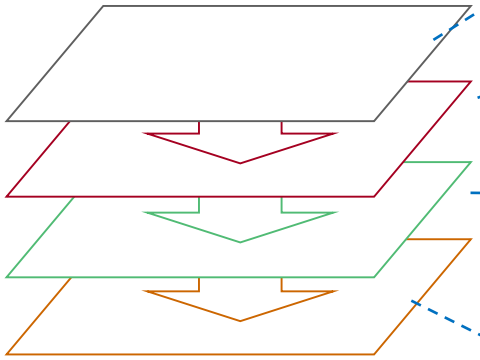
- Top-down business driven
- Layered architecture
  - Start with use cases and requirements
  - Structured in a single UML model
    - Using Sparx EA as modeling tool
  - Traceability among the layers
- Model driven artifacts generation

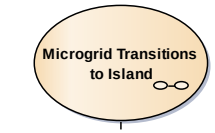


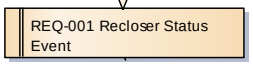
Use Case Layer

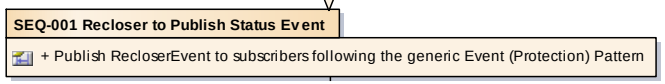
Data Requirements Layer

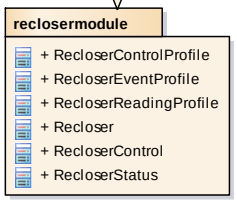
Integration Design Layer

Data Model Layer









Use Case Layer

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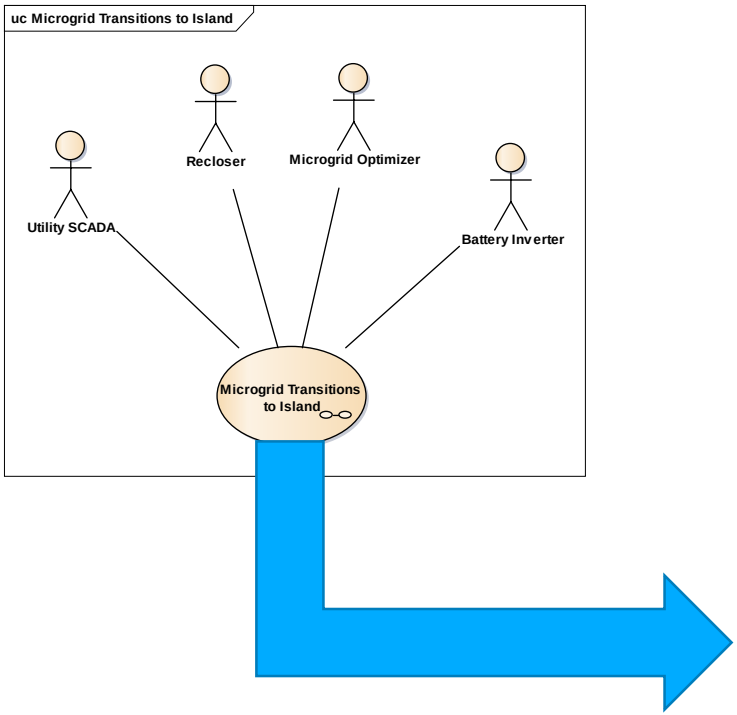
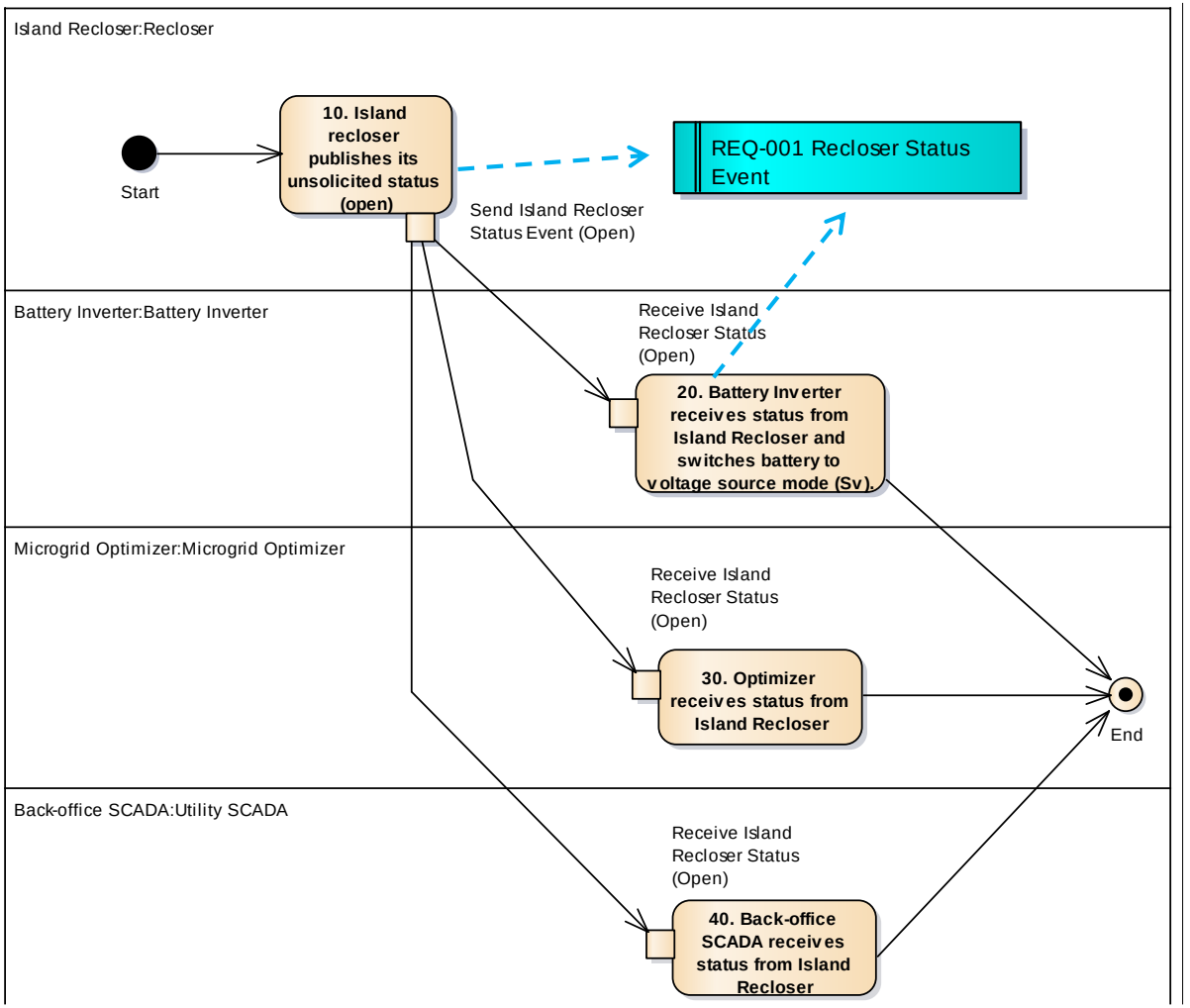
Standard UML Activity Diagram used to model use cases (e.g. Transition to Island)





Data Requirements Layer

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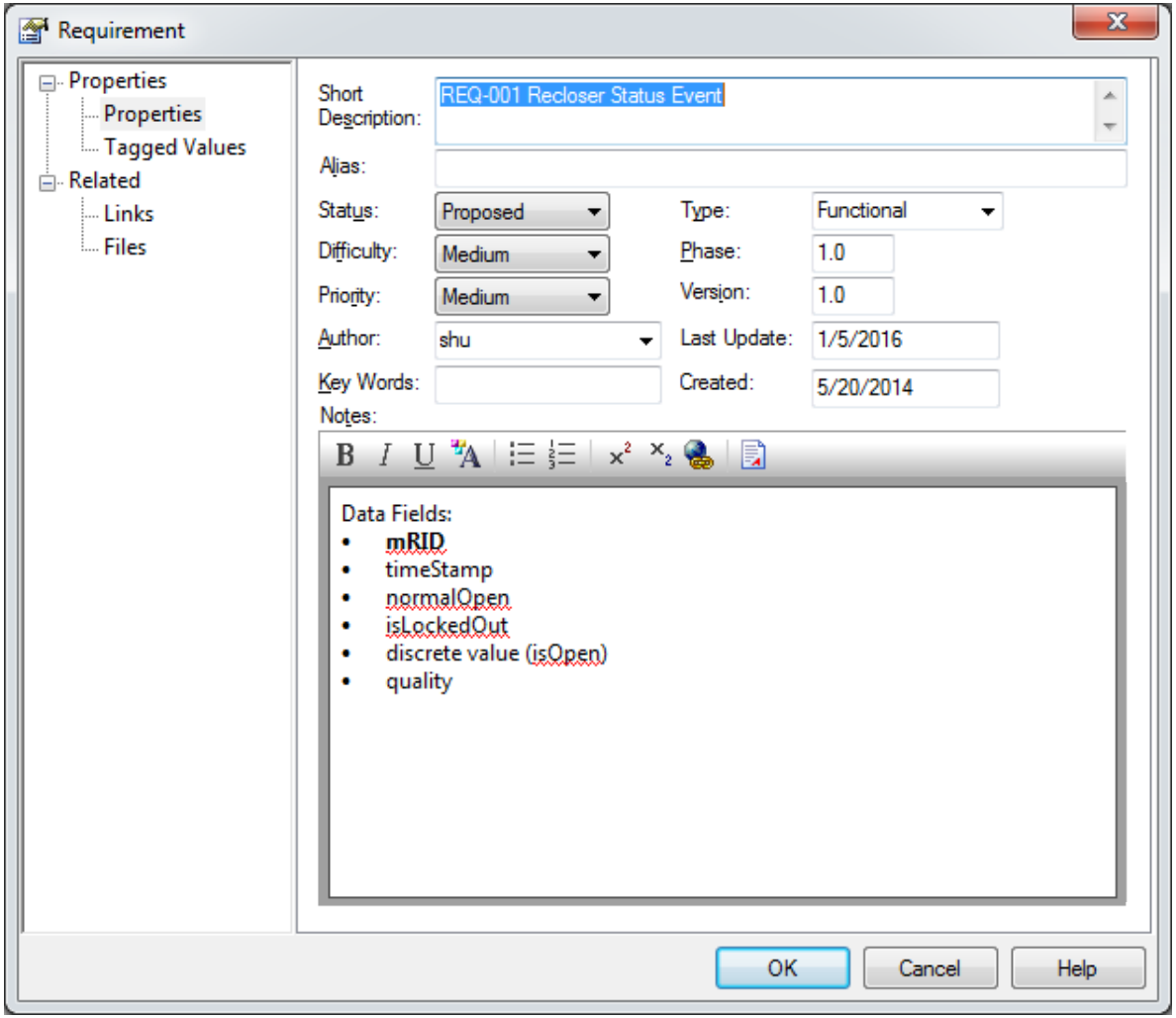
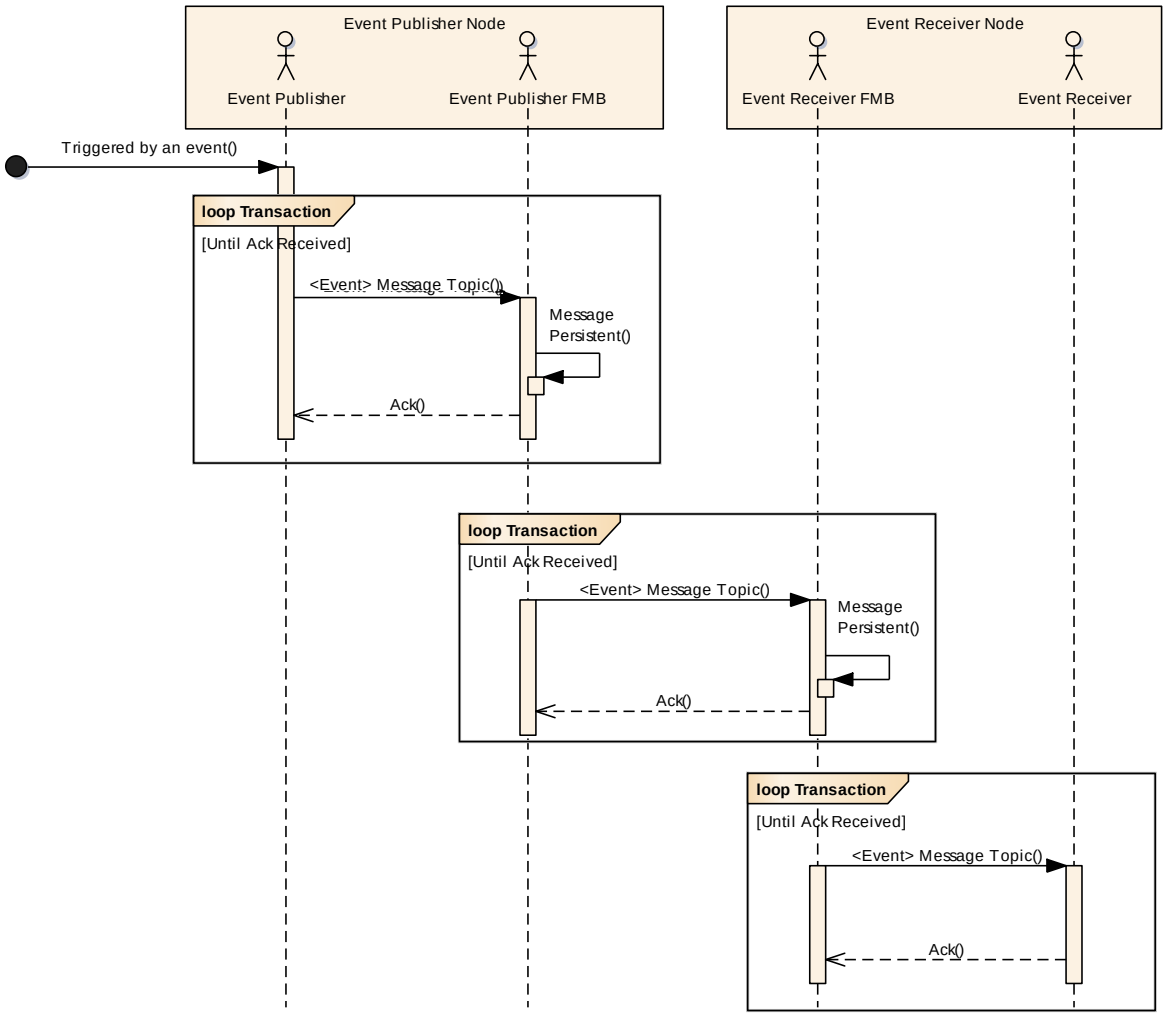
Data requirements are identified in the use case modeling process and modeled using UML Requirement element.



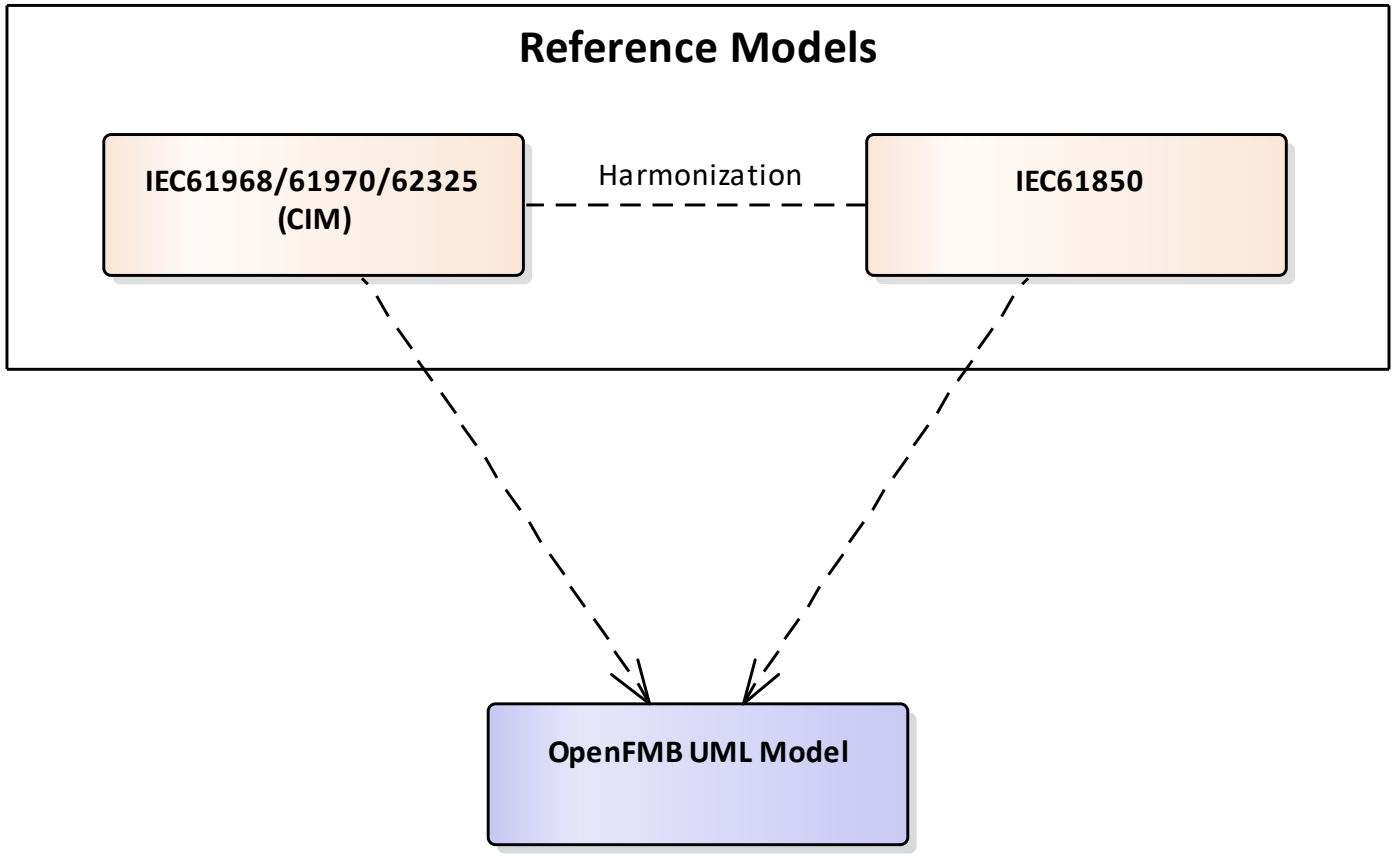
Integration Design Layer

- UML Sequence Diagram used to model interactions
- Patterns based on Quality of Service



Data Model Layer

The data exchanged between the devices and systems are modeled in UML Class Diagrams based on standards.



OpenFMB Data Modeling

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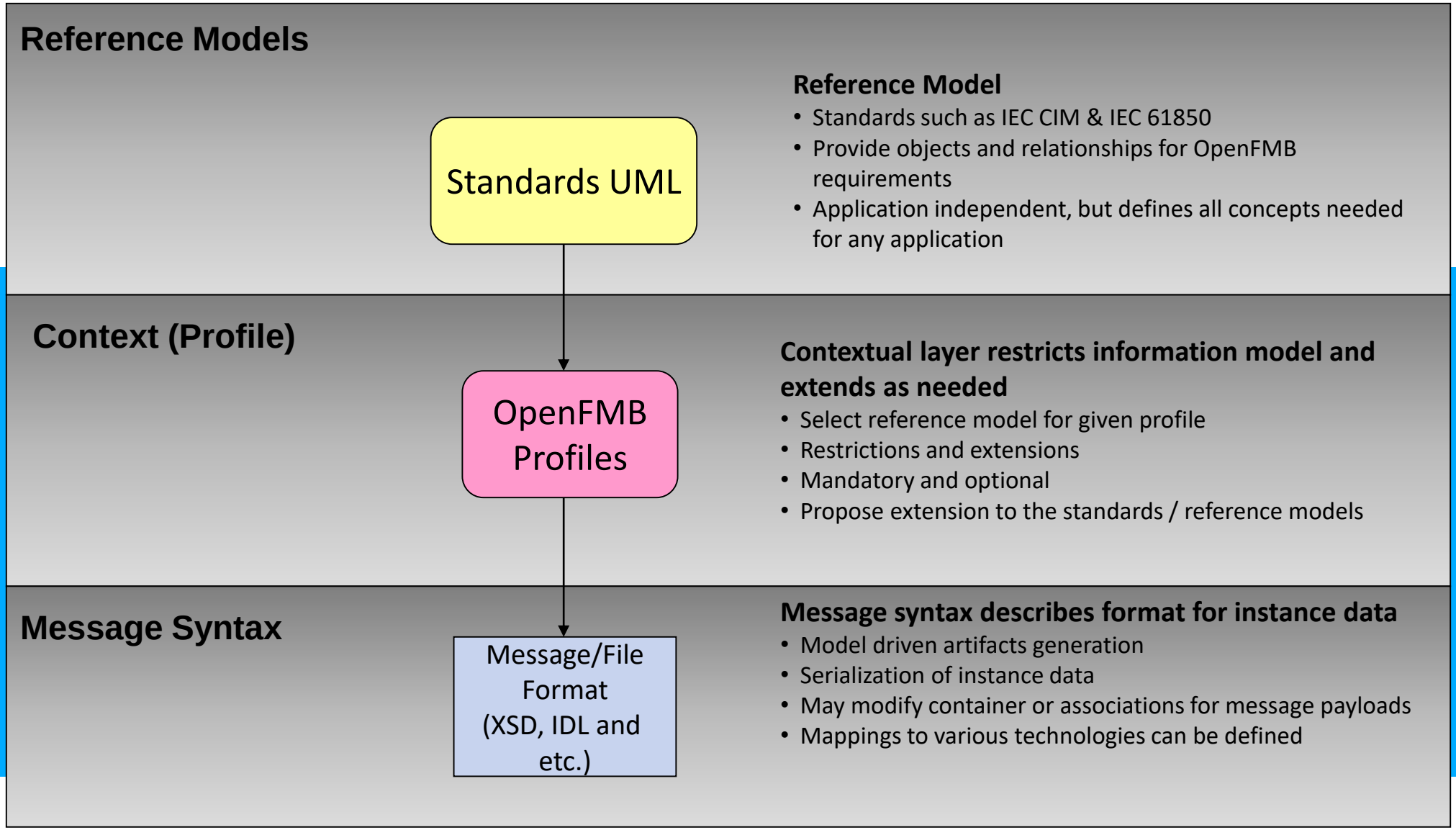
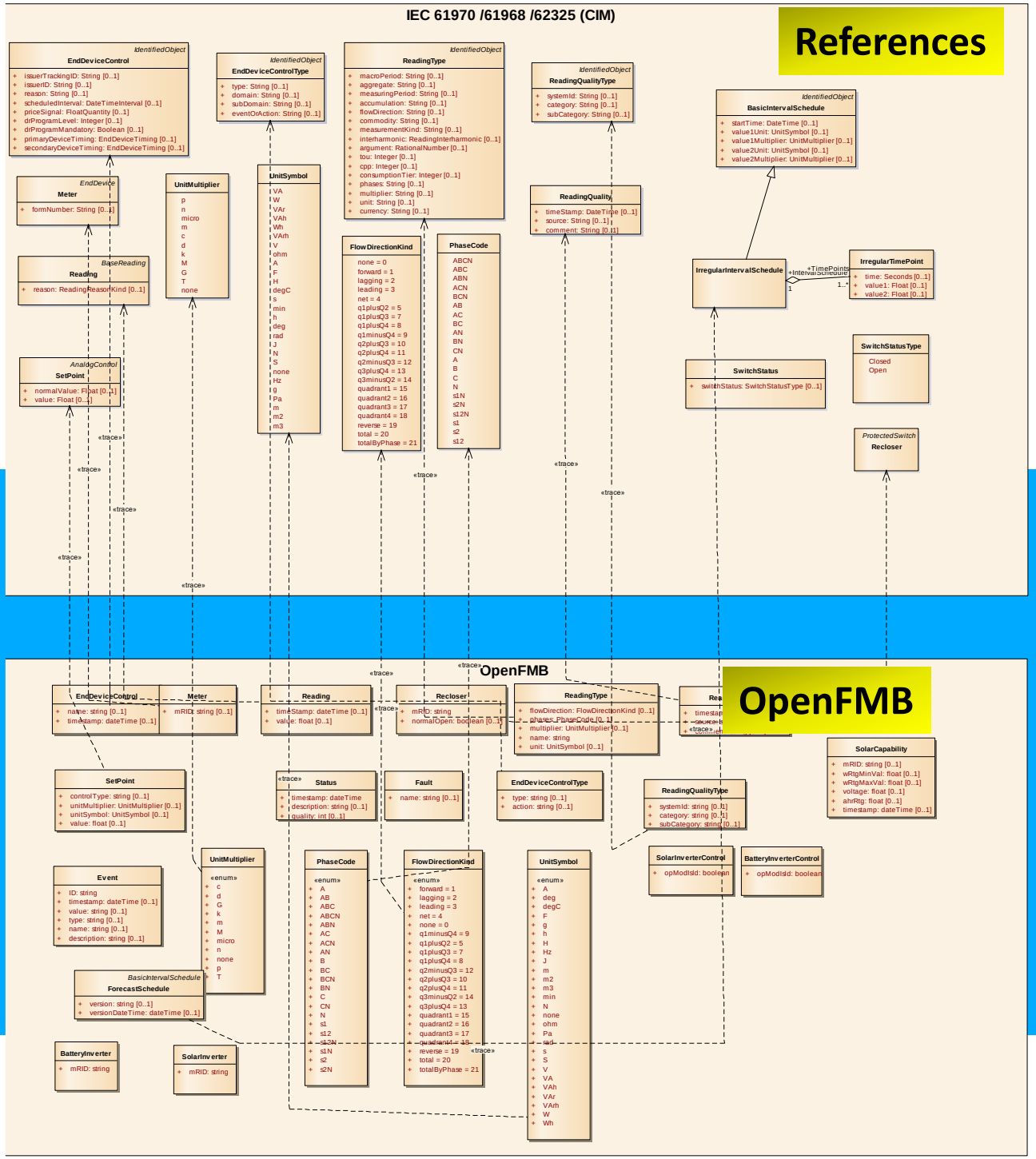
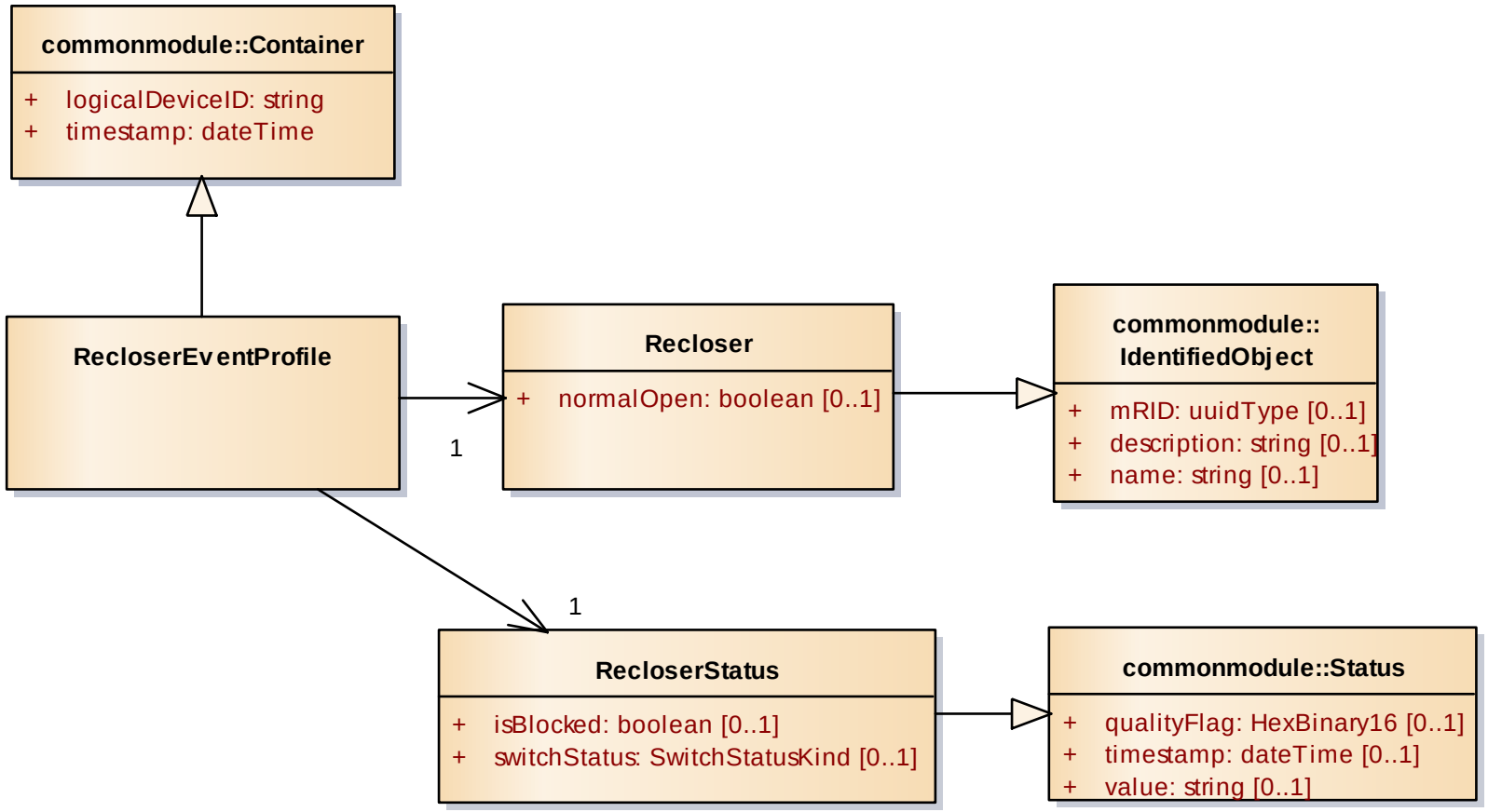


Traceability



Platform Independent Model

Logical model (Profile) built based on the data requirements



Platform Specific Model

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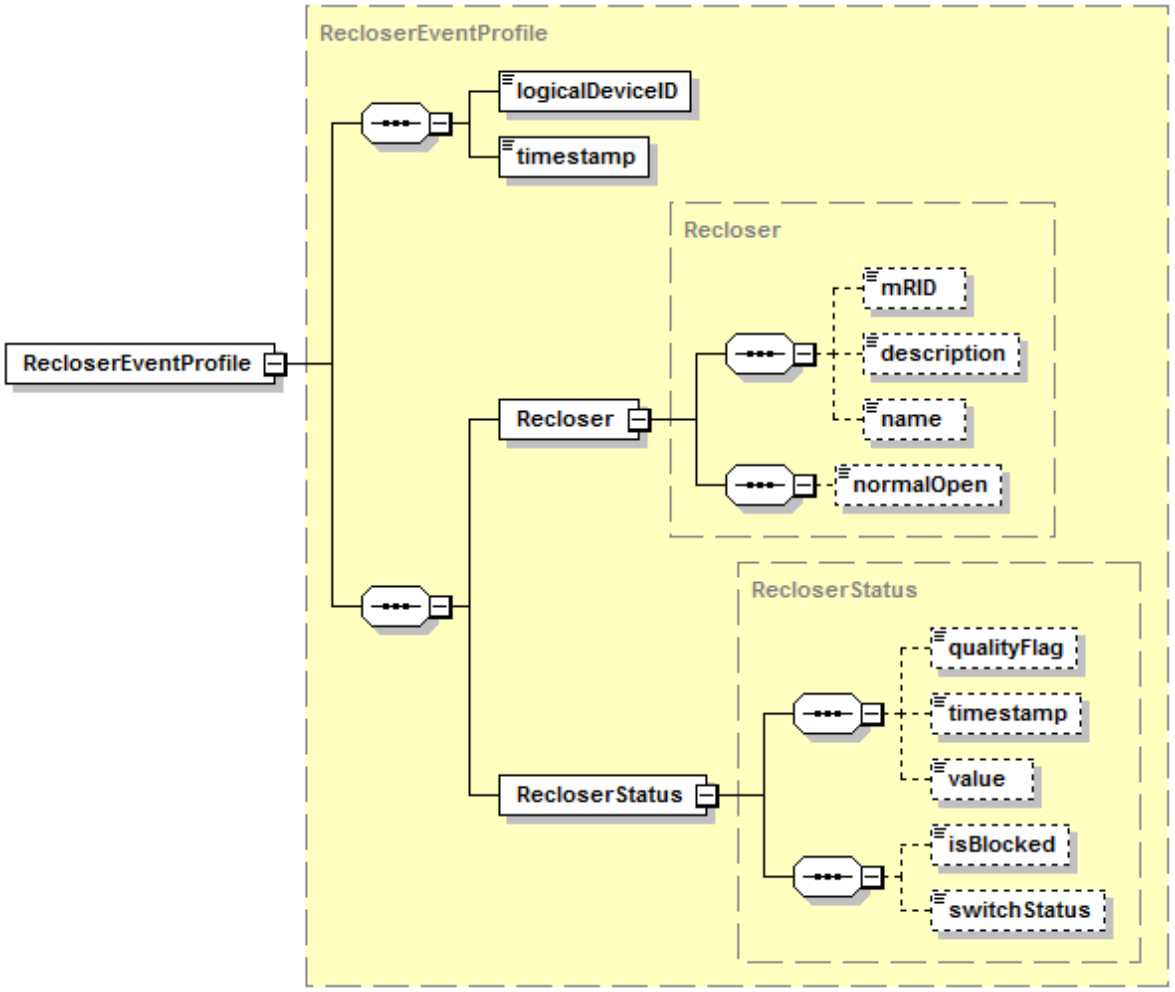
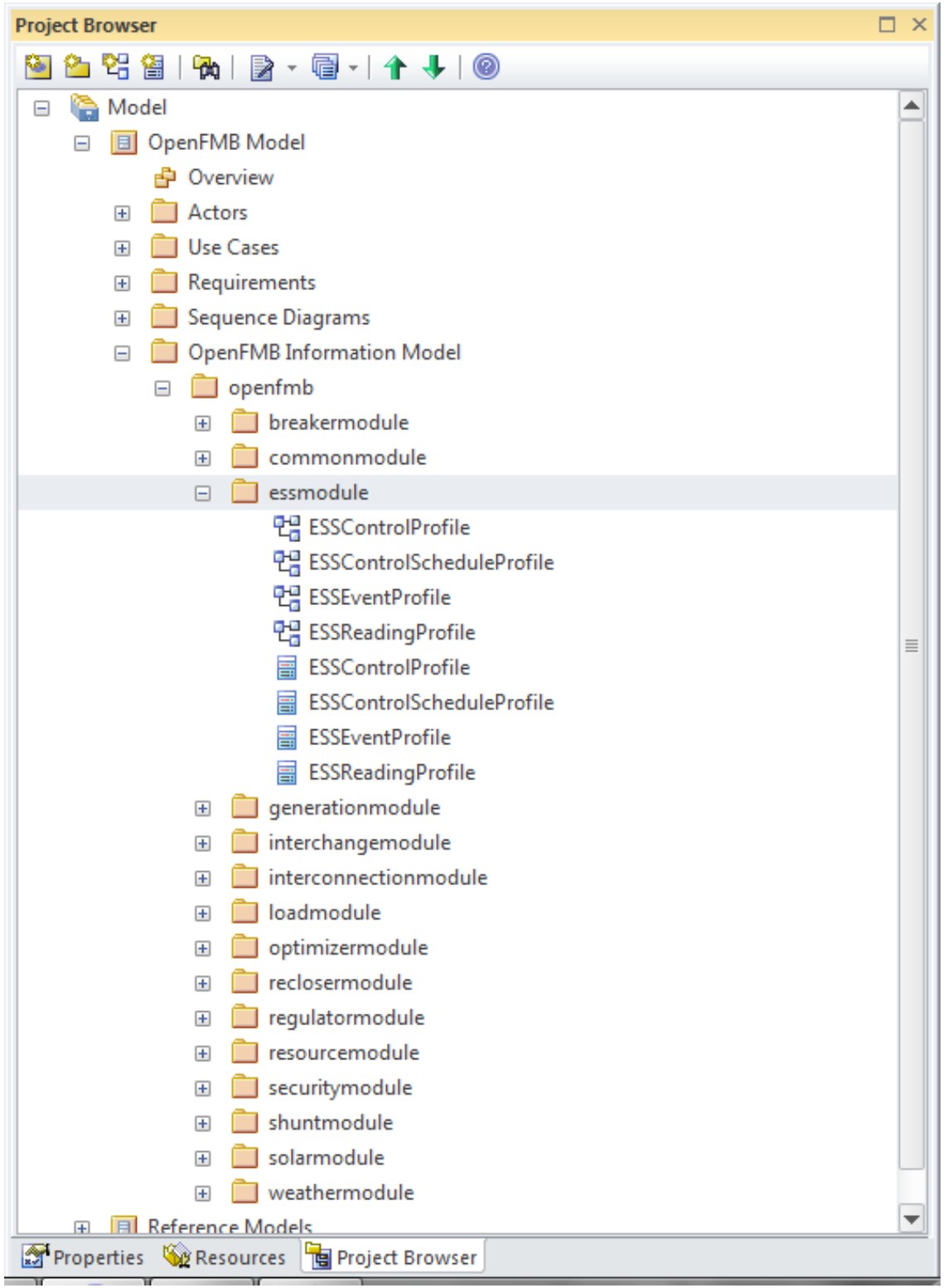
Physical implementation artifacts such as XSDs & IDLs are generated directly from the logical model.



Module Structure

Overall model
package structure



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XSD Generation Tool

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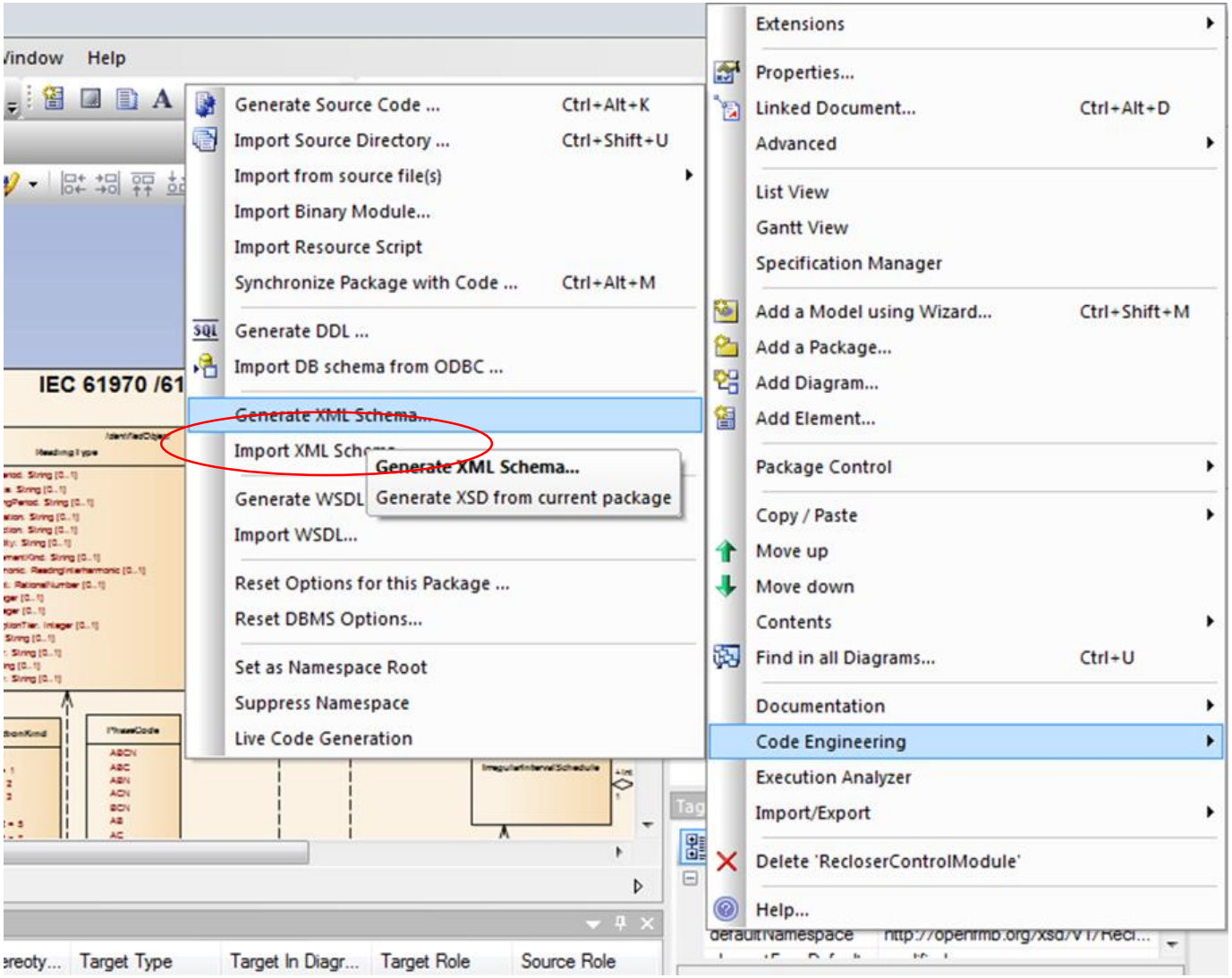
Native Sparx EA tool used for XSD generation



IDL Generation Tool

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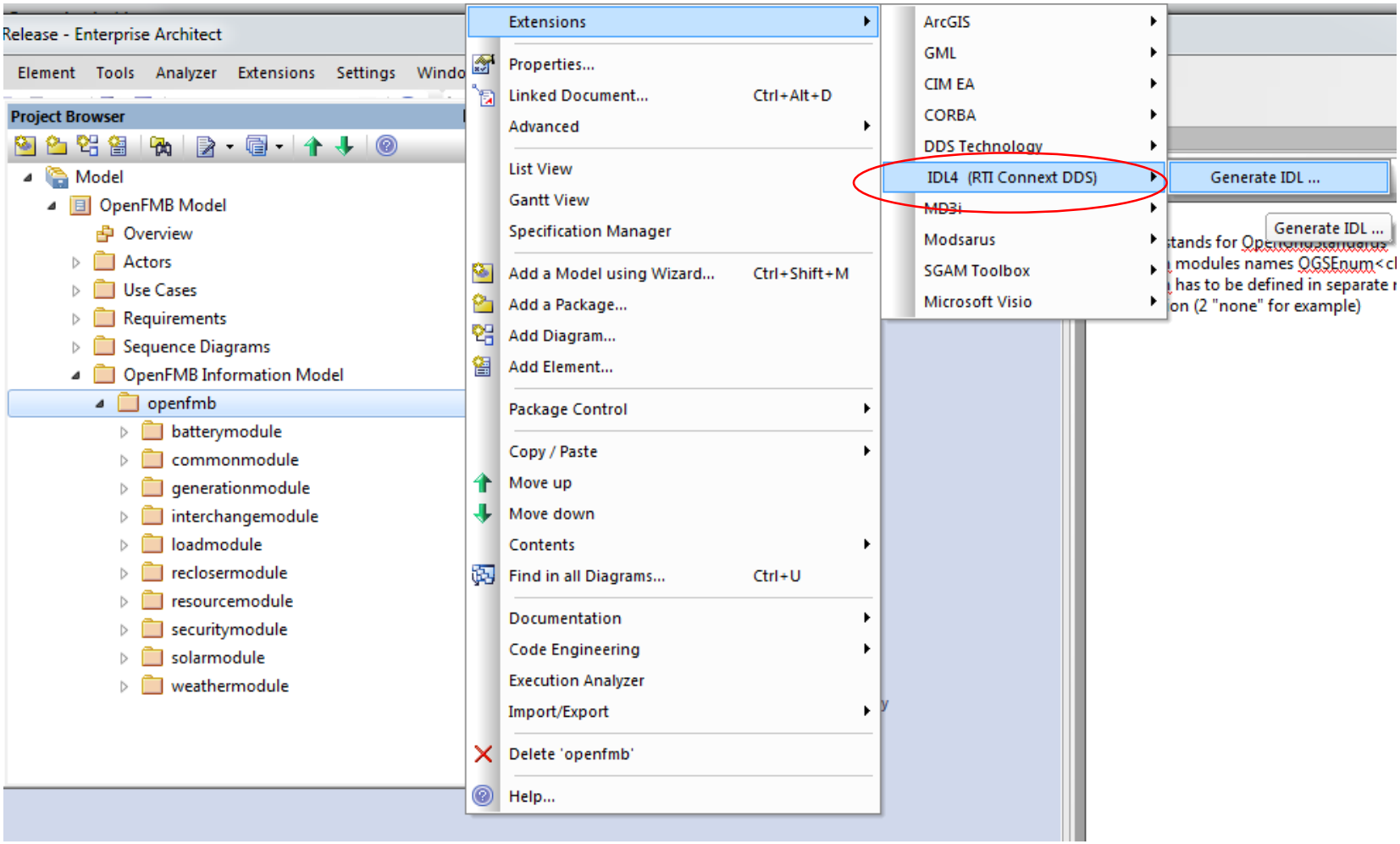
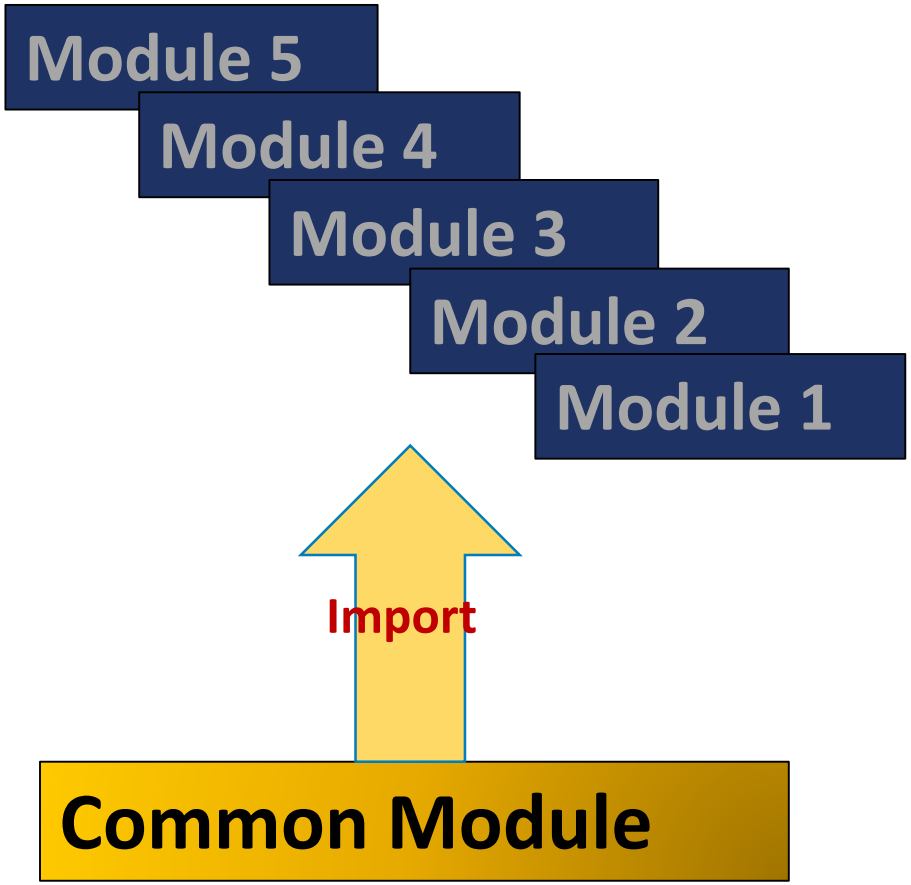
RTI IDL4 for IDL generation



Common Module

- Common Module contains reusable classes shared (imported) across other modules
- Each module may contain multiple profiles



Namespace

- Namespace for all individual module
  - http://openfmb.org/<version #>/openfmb/<Module Name>
    - e.g. http://openfmb.org/2017/05/openfmb/reclosermodule

Version Control

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Two types of update in terms of version control:

- Backward NOT Compatible:
  - Namespace updated with new version #
  - Version # updated in header
- Backward Compatible:
  - Namespace NOT updated
  - Version # updated in header

Version Control Defined in the Model

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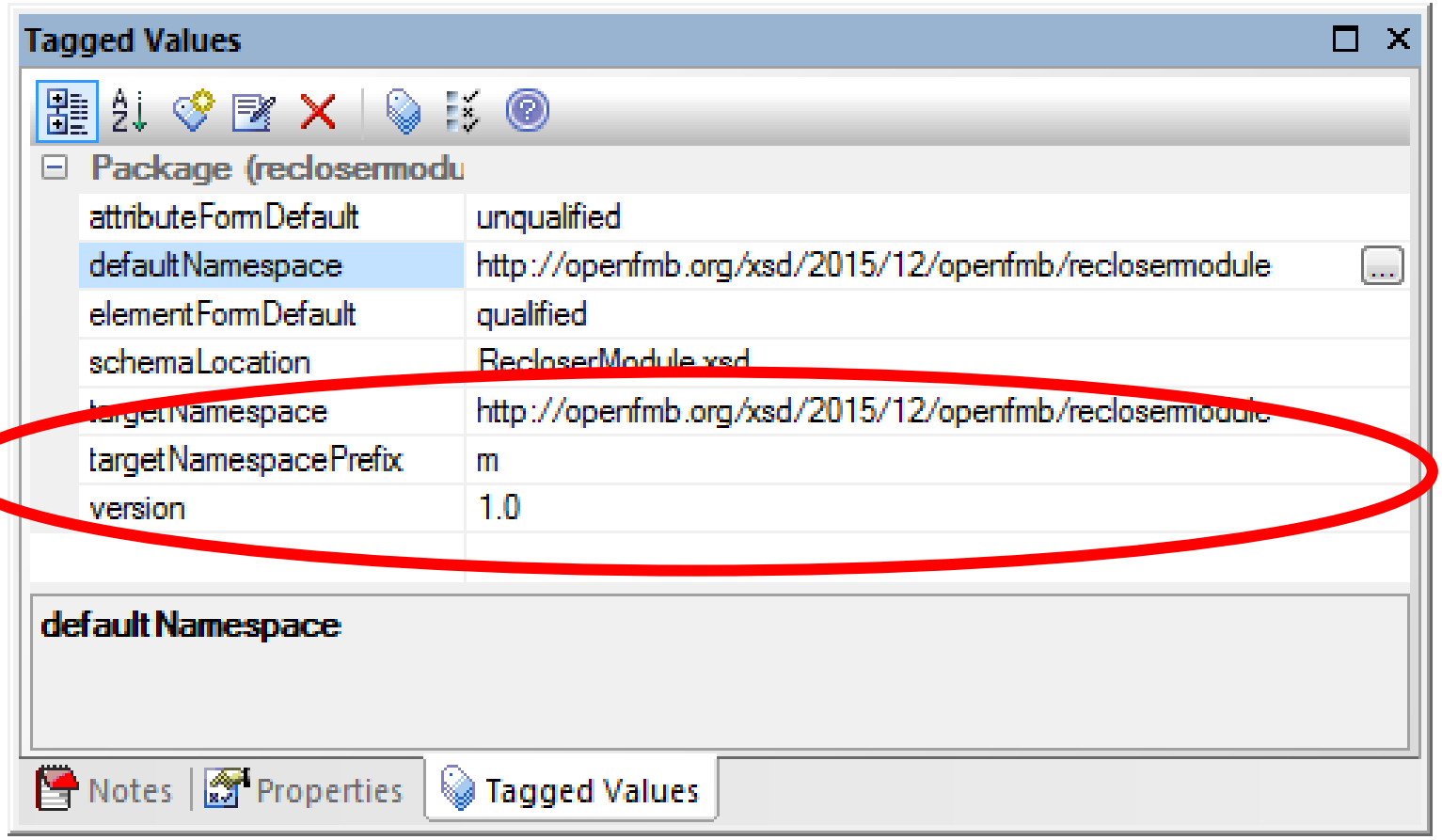
UML Tagged Value used for version attributes



Version Control Example – Backward Incompatible

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Version 1 updated but not backward compatible

- Both targetNamespace and version attribute updated

```
<xs:schema ... targetNamespace="http://openfmb.org/xsd/2015/11/openfmb/reclosermodule"
version="1.0">
        <xs:annotation>
                <xs:documentation>
                        Version 1.0 created 2015/11
                </xs:documentation>
        </xs:annotation>
```

T

```
<xs:schema ... targetNamespace="http://openfmb.org/xsd/2015/12/openfmb/reclosermodule"
version="2.0">
        <xs:annotation>
                <xs:documentation>
                        Version 2.0 created 2015/12
                </xs:documentation>
        </xs:annotation>
```

Version Control Example –Backward Compatible

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Version 1 updated and backward compatible

```
<xs:schema ... targetNamespace="http://openfmb.org/xsd/2015/11/openfmb/reclosermodule"
version="1.0">
        <xs:annotation>
                <xs:documentation>
                        Version 1.0 created 2015/11
                </xs:documentation>
        </xs:annotation>
```

To →

```
<xs:schema ... targetNamespace="http://openfmb.org/xsd/2015/11/openfmb/reclosermodule"
version="1.1">
        <xs:annotation>
                <xs:documentation>
                        Version 1.1 created 2015/12
                </xs:documentation>
        </xs:annotation>
```

Naming and Design Rules for XSD

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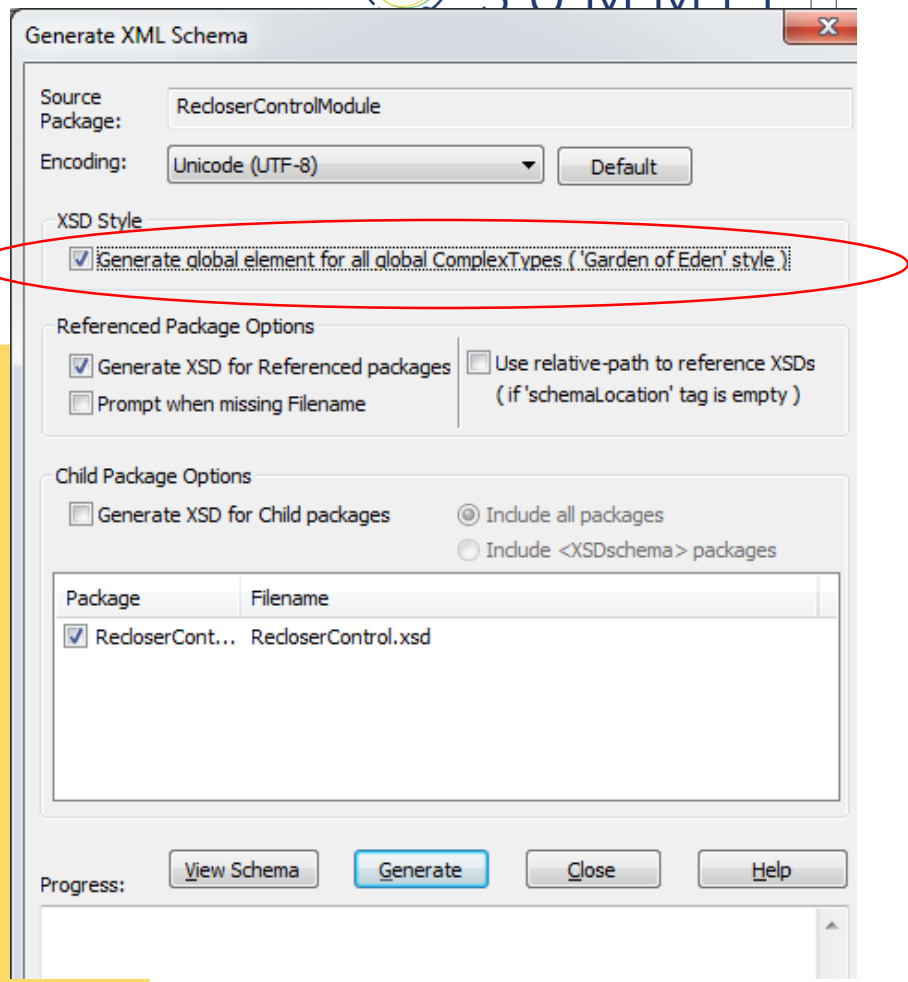
Naming and Design Rules (NDRs)

- Garden of Eden type with elements and types defined at the global level for profiles and only type (complex & simple) for the CommonModule
- Element sequence using xs:sequence
  - mRID listed at the top
  - simpleType listed alphabetically
  - complexType listed alphabetically
  - Inherited attributes listed above native attributes

XSD Style

- Global level element & Type
  - Garden of Eden

```
<xs:element name="Employee" type="EmployeeType"/>
<xs:element name="ErpPerson" type="ErpPersonType"/>
<xs:element name="ErpAddress" type="ErpAddressType"/>
<xs:complexType name="EmployeeType">
    <xs:sequence>
        <xs:element name="ErpPerson" type=”ErpPersonType”/>
        <xs:element name="ErpAddress" type=”ErpAddressType”/>
    </xs:sequence>
</xs:complexType>
<xs:complexType name="ErpPersonType">
    <xs:sequence>
        <xs:element name="lastName" type="xs:string"/>
        <xs:element name="firstName" type="xs:string"/>
    </xs:sequence>
</xs:complexType>
<xs:complexType name="ErpAddressType">
    <xs:sequence>
        <xs:element name="streetNumber" type="xs:string"/>
        <xs:element name="streetName" type="xs:string"/>
    </xs:sequence>
</xs:complexType>
```



Message Types

- Reading (both analog & discrete)
- Control (& Control Schedule)
- Event
  - Alarm
  - Informational
  - Protection
  - Workflow

Quality of Service

Interaction Pattern	QoS policy name	Policy value applied
Reading	RELIABILITY	BEST_EFFORT
	DURABILITY	VOLATILE
Control	RELIABILITY	RELIABLE
	DURABILITY	VOLATILE
	LIFESPAN	5 sec
Event	RELIABILITY	RELIABLE
	DURABILITY	TRANSIENT
	LIFESPAN	5 sec

Modeling Topics for Discussion

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Data Model

- Use of 61850/CIM harmonization model
  - Include 61850 Logical Node (LN)
- Model structure
  - Common module & individual modules
- Restricted data type
  - Enumerations
  - Specialization
- XSD style (top level element)
  - Venetian Blind style
- Model management (centralized server proposed)

Model Structure Change from Phase II

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- Use the 61850/CIM harmonization MeasurementValueSource & MeasurementValue as profile foundation

- Specialization:
  - Specialized IED at root (e.g. ResourceReadingIED)
  - Specialized MeasurementValue (e.g. ResourceReadingMeaValue)
  - Specialized IEC61850 LN (e.g. ResourceReadingMMXU)
  - Specialized data types (e.g. MV, BCR and etc.)

- Common module package

Use of IEC61850 (PoC)

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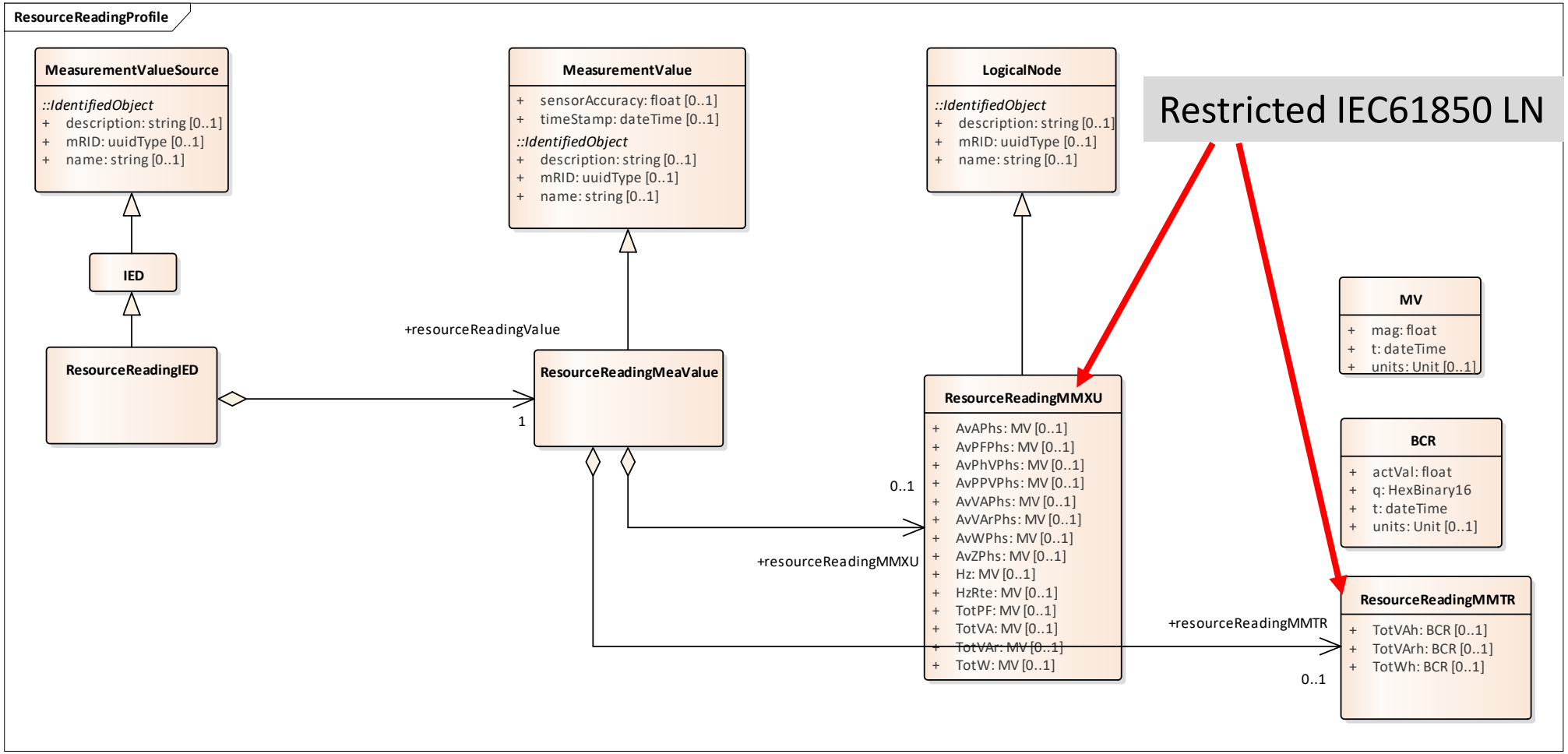
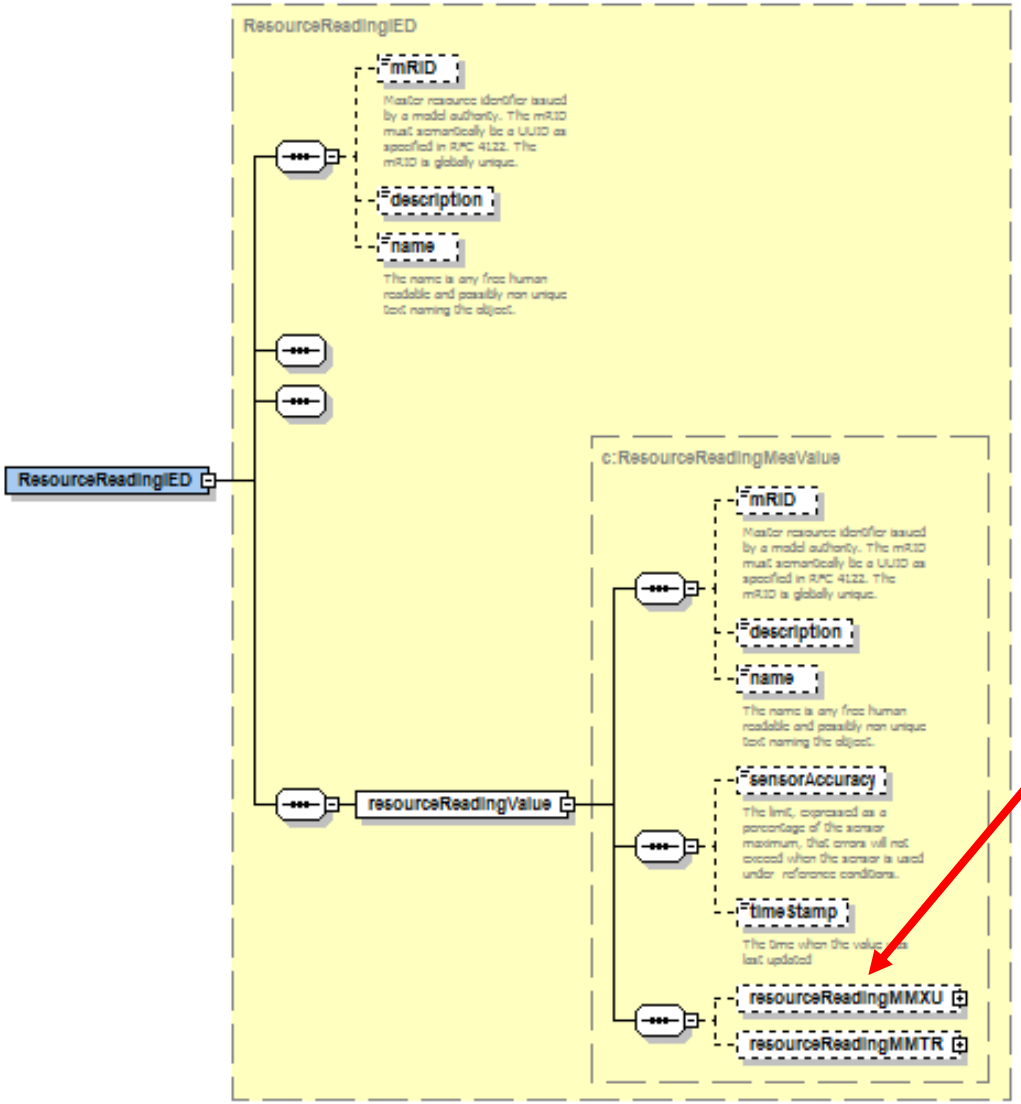


XSD Structure



Restricted IEC61850 LN

Discussion – Q&A