# INTRODUCTION TO CIM
## FOR THE NAESB COMMUNITY

206-06-04
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GRIDOPTIMIZE

STABLE GRIDS. FLEXIBLE THINKING.

# Before We Start…

The CIM was developed by electricity industry experts for use by the **electricity industry**

The CIM is a collection of 2,0000+ classes documented using **Unified Modeling Language (UML)**

Our first few slides provide a brief introduction to the UML

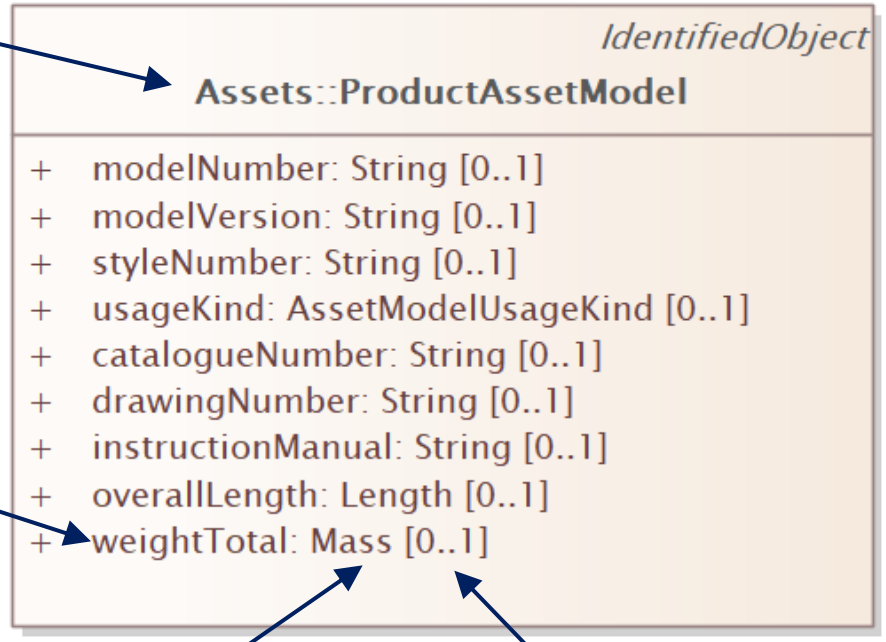
# UML Basics: Classes & Attributes

**Class**
Equivalent to a database table

**Attribute**
Equivalent to a database column

**Attribute Type**
Here, units of Mass

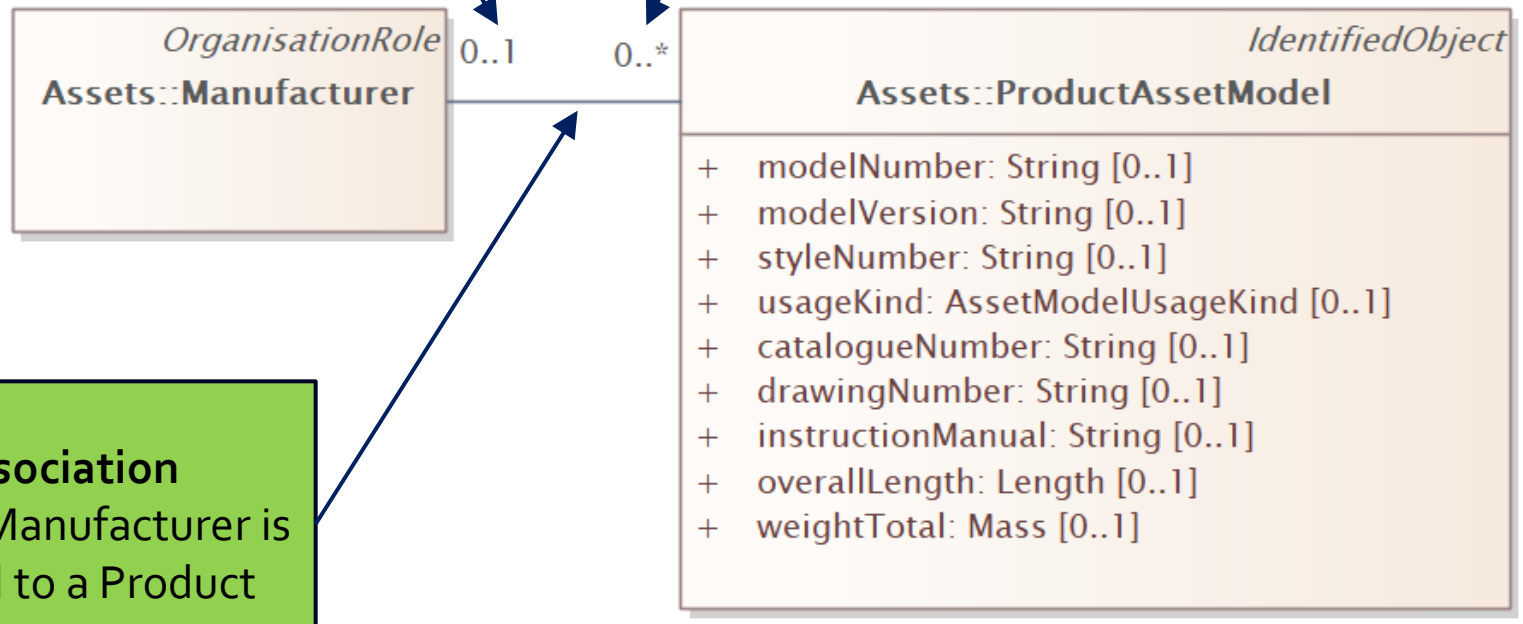
**Attribute Multiplicity**
How many can be listed.
Here, zero or one (aka "optional")



# UML Basics: Associations

**Multiplicity (Right-to-Left)**
A Product is related to zero or one Manufacturer, i.e. a Product cannot have multiple Manufacturers

**Multiplicity (Left-to-Right)**
A Manufacturer is related to zero to many Products

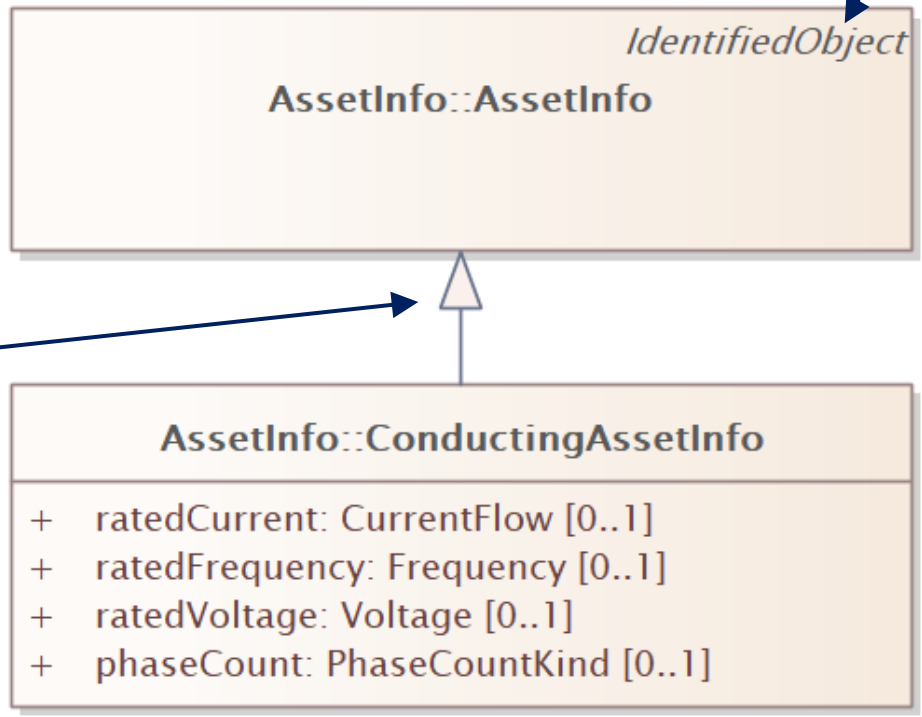



**Association**
Here, a Manufacturer is related to a Product

# UML Basics: Inheritence

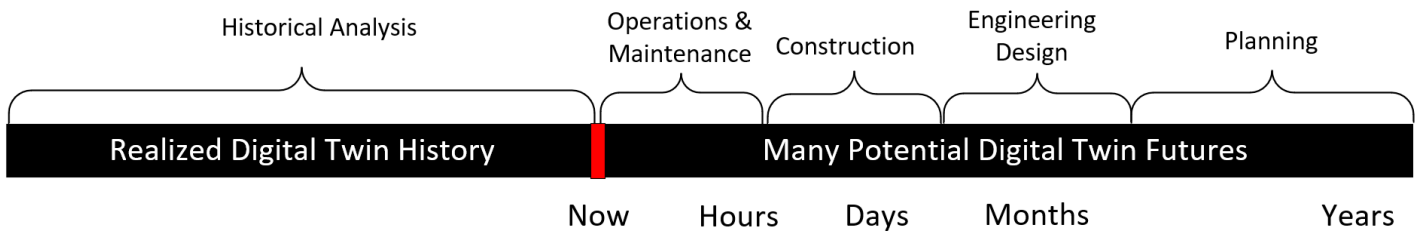
**Inheritance**
A parent class not shown on the diagram.
Here, AssetInfo inherits from IdentifiedObject

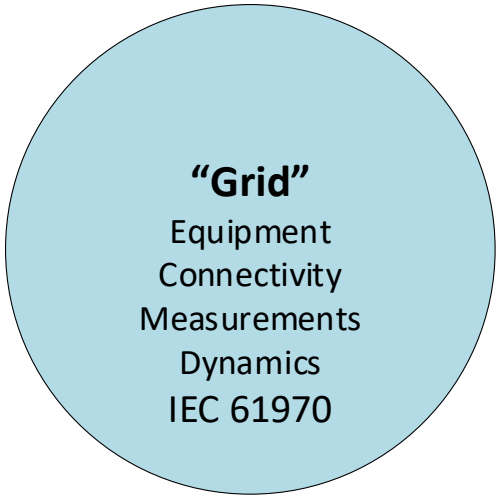
**Inheritance**
The "pointed to" class is the parent class and the child class inherits all Attributes and Associations of the parent.
Here, ConductingAssetInfo inherits from AssetInfo



# The “Grid” Package

- Any power grid can be described and used as the basis for utility software solutions, such as planning analysis simulators and real-time grid management tools
- The ability to create a representation of the power grid was the motivation behind the original CIM development work and the core of many interoperability successes around the world
- The representations of a particular grid is not static, the CIM tracks current, past, and many potential future grid configurations.

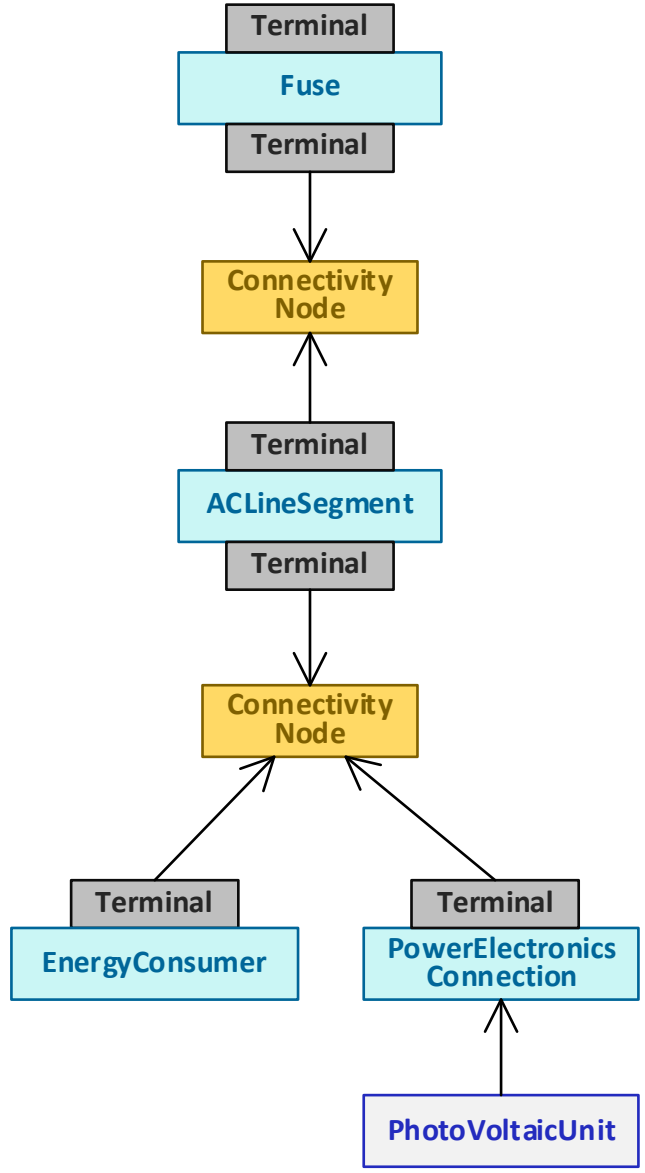


# Grid Profiles

Data exchanges for "digital twins" of T & D Grids are performed using "chunks" of the CIM called profiles:

- **Connectivity (CN)** maps each piece of Equipment though one or more Terminals to Connectivity Nodes; a true network representation
- **Electrical (EL)** adds the relevant data needed for planning and operations to use these models, such as impedances, tap changer settings, and voltage limits
- **Asset (AA)** provides Asset data for the specific devices deployed in the field. CN and EL profiles simulate potential future grid configfurations; the Assets "plug into" the Equipment roles.



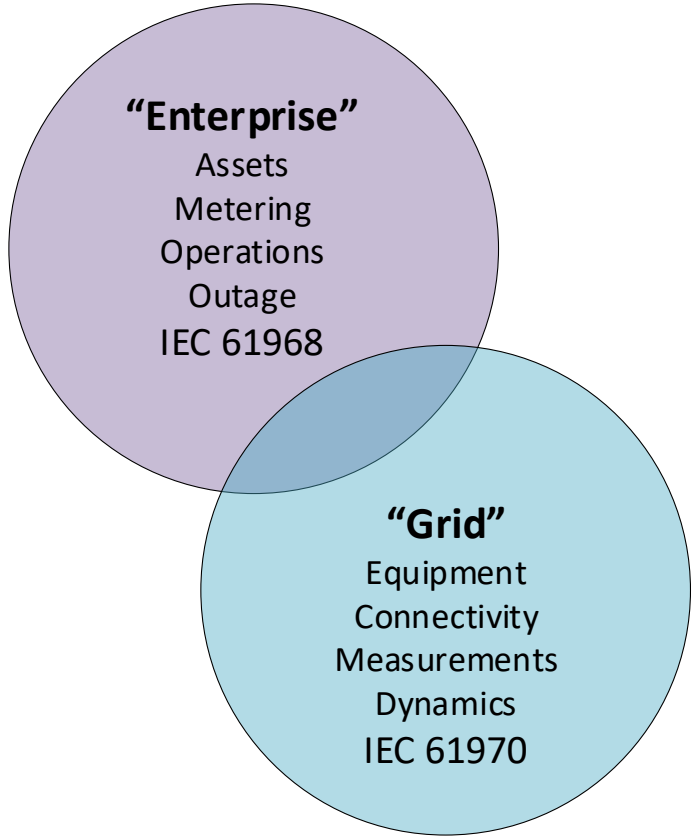
# Grid Profiles (Continued)

Additional profile "layers":

- **Geographic Location (GL)** adds the geospatial location of the equipment.
- **Diagram Layout (DL)** adds a schematic layout for display in tools and wallboards
- **Dynamics (DY)** add additional details to simulate dynamic response
- **Measurement Configuration (MC)** tracks how field devices report information
- **Topology (TP)** collapses the representation and identifies islands
- **Steady-State Hypothesis (SSH)** documents the inputs to a power flow analysis
- **State Variables (SV)** documents the outputs of a power flow analysis.

# The “Enterprise” Package

- The “Enterprise” Package tracks the transaction information across the power system.
- covers many functions to support the various utility systems including a meter data management system (MDMS), an customer information systems (CIS), an outage management system (OMS), a work management systems (WMS), an asset management systems (AMS), etc.
- Tracking individual transactions among utility systems, all with unique identifiers, allows for data correlation and orchestration.



# Enterprise Profiles

## IEC 61968-3: Network Operations (NO)

- Measurements & Controls
- Switching Plans, Actions, & Events
- Planned & Unplanned Outates
- Incidents, Faults, and Trouble Tickets

## IEC 61968-4: Records And Asset Management (AM)

- Catalogue Management
- Asset Record Management
- Asset Monitoring & Decision Support
- Maintenance & Inspection

## IEC 61968-6: Maintenance & Construction (MC)

- Service & Work Requests
- Maintenance, Service, Switching, and Trouble Orders

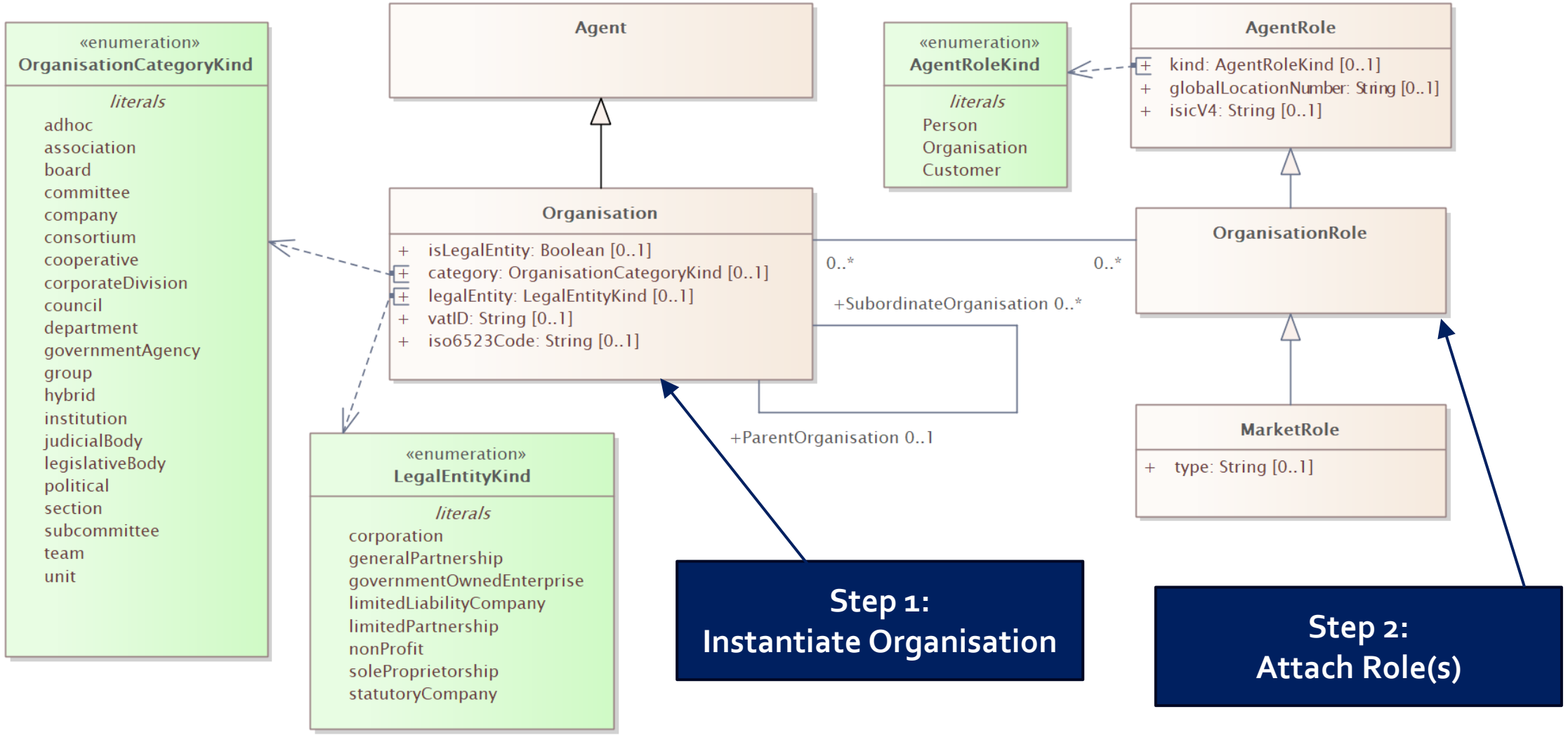
## IEC 61968-8: Customer Support (CS)

- Customers & Service Locations
- Accounts & Agreements
- Pricing Structures
- Transactions & Payments

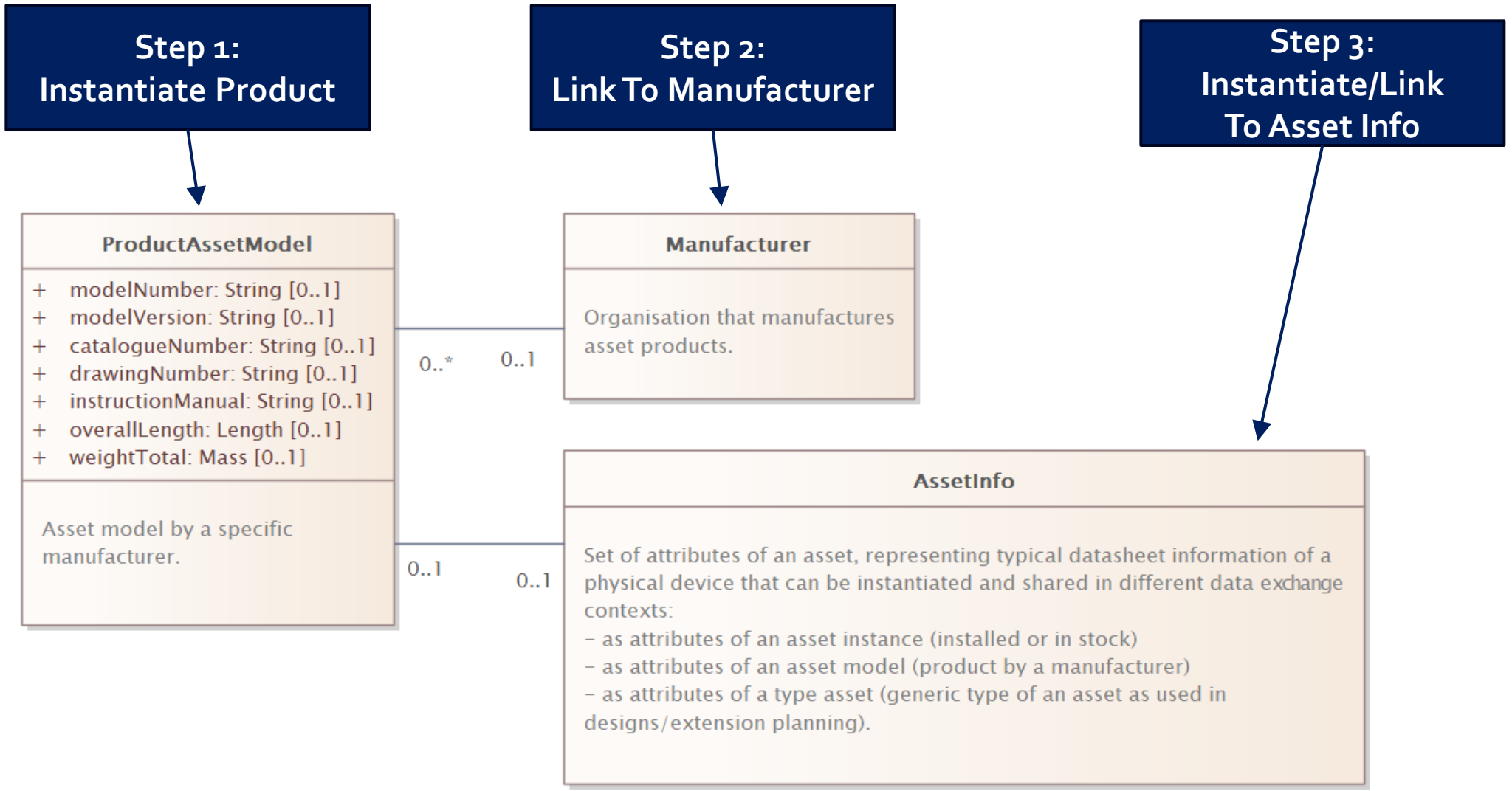
## IEC 61968-9: Meter Reading & Control (MR)

- Locations & Communicatios Configuration
- Usage Readings
- Events & Controls

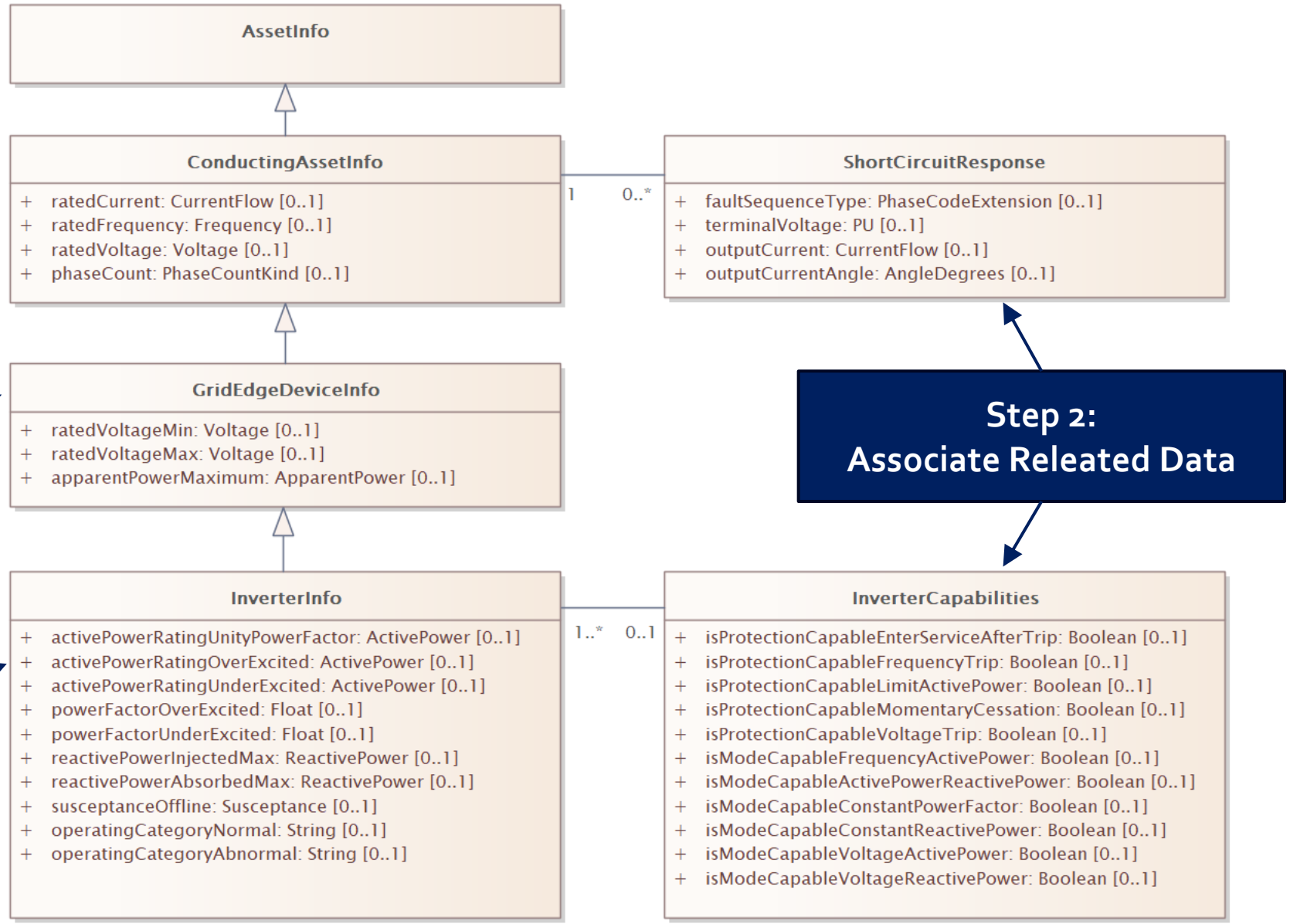
# CIM: Organasation & Organisation Role



# UML: Asset Catalog



# UML: Grid-Edge Device Asset Info

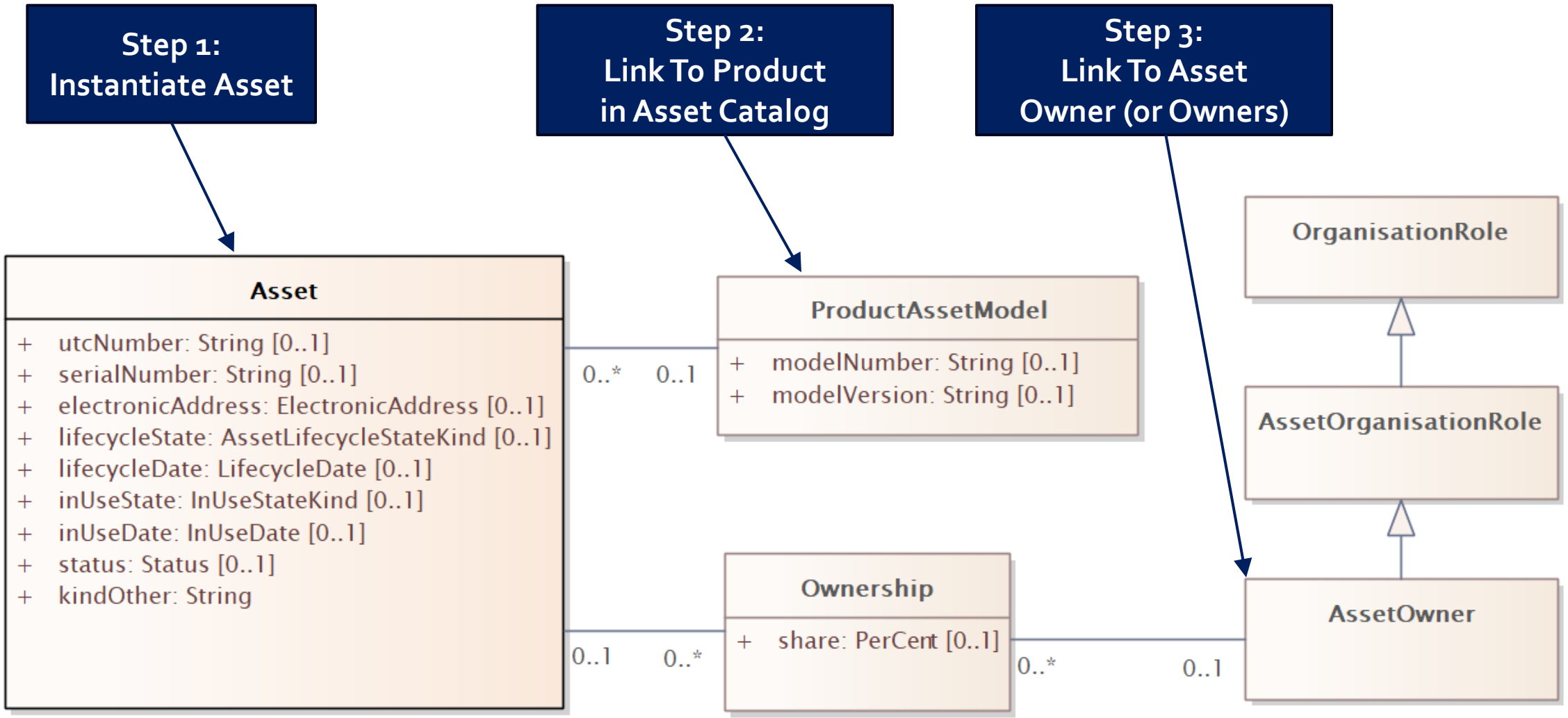



**Step 1: Instantiate Grid-Edge Device**

***Here, Specialized as an Inverter***

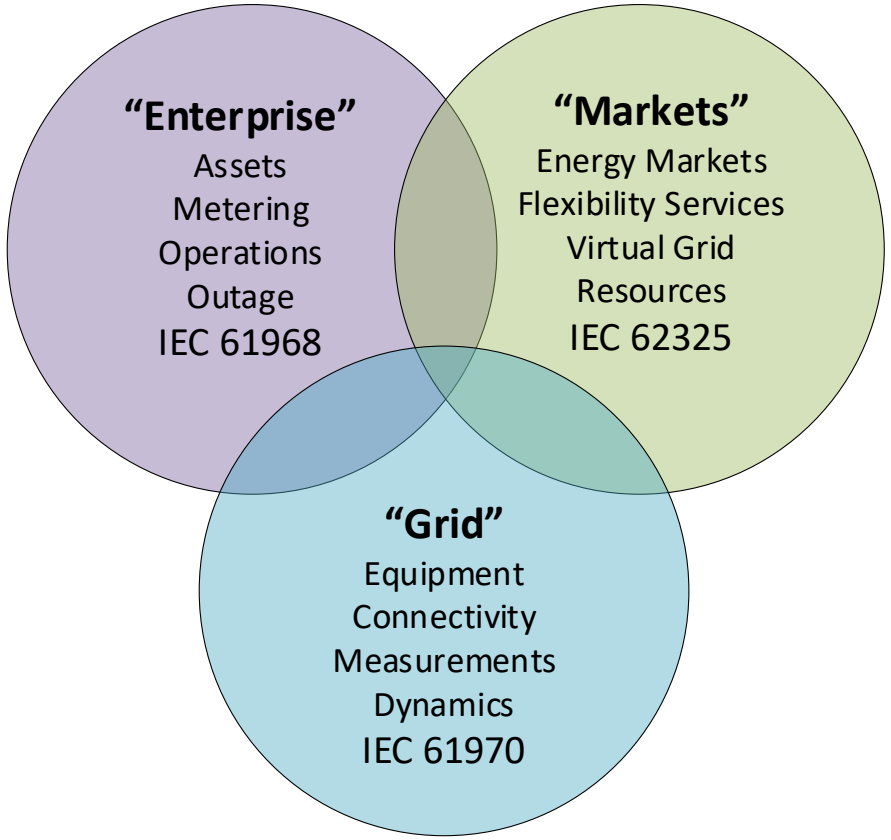
**Step 2: Associate Releated Data**

# UML: Asset


Step 1:
Instantiate Asset
Step 2:
Link To Product
in Asset Catalog
Step 3:
Link To Asset
Owner (or Owners)
Asset
+ utcNumber: String [0..1]
+ serialNumber: String [0..1]
+ electronicAddress: ElectronicAddress [0..1]
+ lifecycleState: AssetLifecycleStateKind [0..1]
+ lifecycleDate: LifecycleDate [0..1]
+ inUseState: InUseStateKind [0..1]
+ inUseDate: InUseDate [0..1]
+ status: Status [0..1]
+ kindOther: String
0..*
0..1
ProductAssetModel
+ modelNumber: String [0..1]
+ modelVersion: String [0..1]
0..1
0..*
Ownership
+ share: PerCent [0..1]
0..*
0..1
OrganisationRole
AssetOrganisationRole
AssetOwner

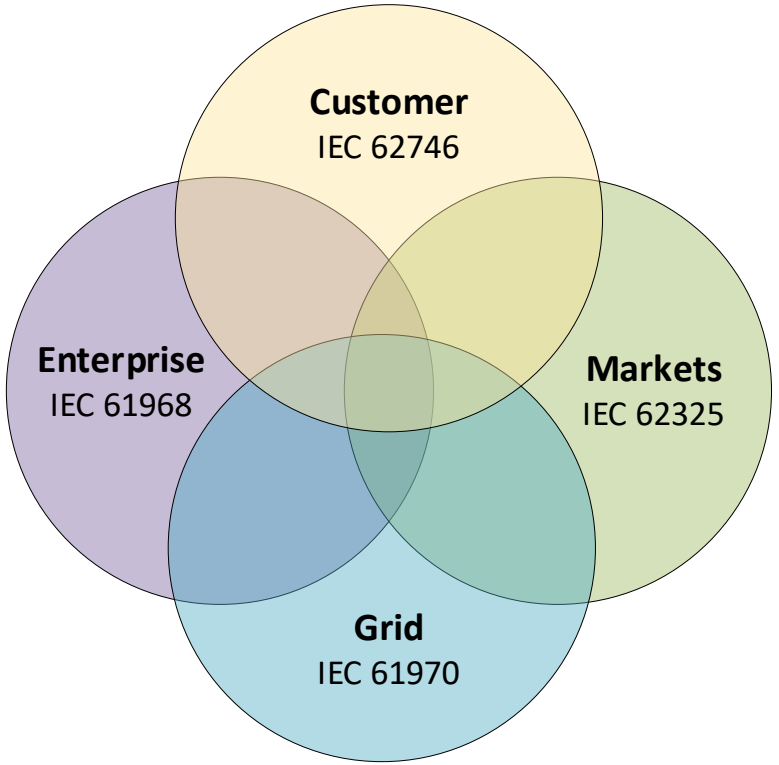
# The “Markets” Package

- Transactions like bids and offers, clearing results, dispatches, and settlement information are all modeled to support energy, capacity, and Essential Reliability Service markets.
- Includes the concept of locational marginal pricing and, not surprisingly, ties directly to the “Grid Package” so that financial transactions can be aligned with the physics of the power system.

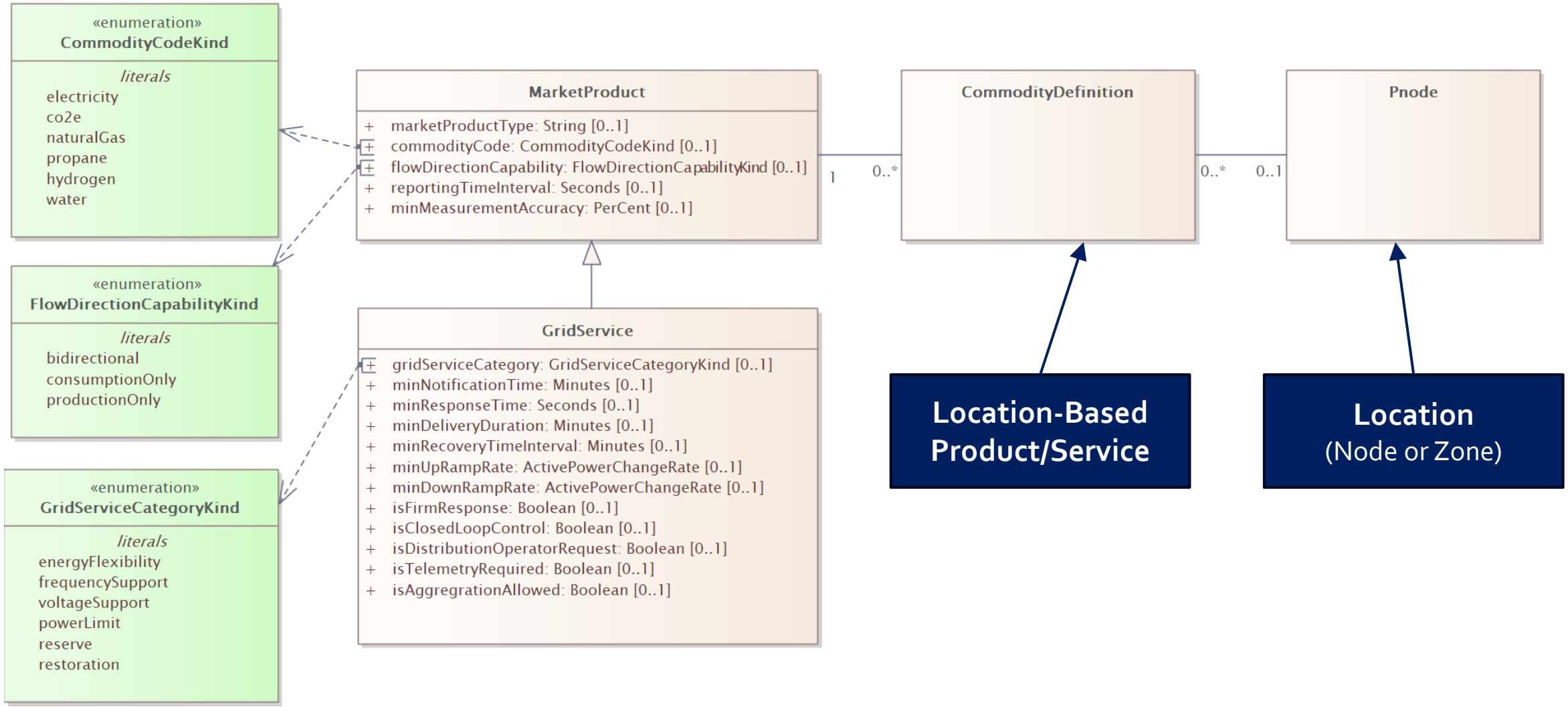


# IEC 62746: The Customer Interface

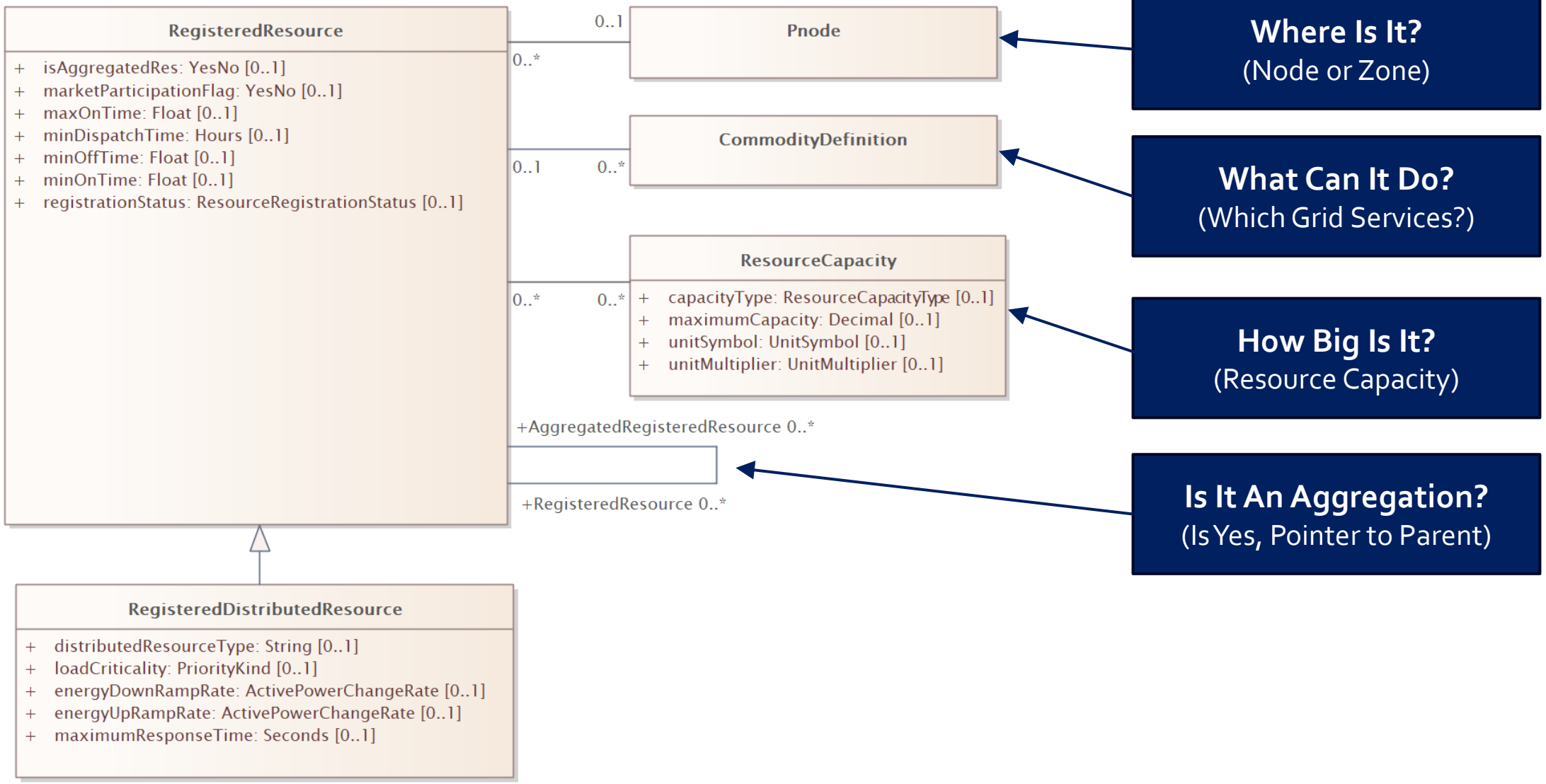
- IEC 62746 is the newest CIM series which manages information exchanges between utility systems and customer systems
- First release covers:
  - **Resource Definitions**
  - **Offers & Schedules**
  - **Clearing Awards & Instructions**
  - **Time-Series Data Submission**
  - **Price-Based Service/Dispatch**



# CIM: Market Product & Grid Service



# CIM: Virual Power Plants



# Thank You

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