New Generation CIM - XML new Topology Interface

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Maintenance Intelligence of Tomorrow
Overview

- Common Information Model (CIM) – motivation and definition
- CIM XML
- CIM’s concepts of ConnectivityNodes (CNs) and TopologicalNodes (TNs)
- Bus-Branch and Node-Breaker Modeling
- IPS-ENERGY Topology Manager – The IPS model
- The IPS and CIM model interoperability
- PSS/E®ODMS – IPS – CAPE data exchange process
- IPS-ENERGY Topology Manager – Graphical Editor
- IPS-ENERGY Topology Manager – Connection to IPS-ENERGY location/asset model
Common Information Model (CIM) - Motivation

- Power system operations need to model their systems and portions of neighboring systems.
- Electric utility organizations need to exchange operational system models.
- Need for unified platform to support:
  - system planning functions
  - energy management
  - control center applications
  - maintenance of operational power system models
- Solution is expected to be:
  - Platform independent
  - Vendor independent
  - Supported by international standards
Common Information Model (CIM) - Definition

- The CIM defines the common power system entities and their relationships.
- The CIM specifies common semantics for power system resources, their attributes and relationships.
- CIM provides a comprehensive, logical view of EMS information for transmission network analysis, generation control, SCADA, and operator training simulation.
- The CIM represents the modeling information which is relevant for model exchange.

**Simple Definition**

*Open data format for power system model to be used for data exchange between power system organizations including vendors.*
CIM XML

- XML stands for eXtensible Markup Language.
- The XML syntax is a hierarchical structure of elements and attributes.
- The CIM XML language introduces a power system oriented vocabulary.
- The CIM XML language basically defies CIM in XML format.
- The CIM XML enables a model to be exchanged as a document.
- Accepted by group of interested parties, including major EMS vendors and modeling tool suppliers.
CIM XML – Schema for Zone (Sample)

```xml
<?xml version="1.0"?>
< CIM DTDVERSION="2.2" CIMVERSION="2.3">
  < DECLARATION >
    < DECLGROUP >
      < CLASS NAME="CIM_Zone" SUPERCLASS="CIM_ConnectivityCollection" >
        < QUALIFIER NAME="Version" TYPE="string" TRANSLATABLE="true" TOSUBCLASS="false" >
          < VALUE >2.10.0</VALUE>
        </ QUALIFIER >
        < QUALIFIER NAME="UMLPackagePath" TYPE="string" >
          < VALUE >CIM::Device::FC</VALUE>
        </ QUALIFIER >
        < QUALIFIER NAME="Description" TYPE="string" TRANSLATABLE="true" >
          < VALUE >A Zone is a group of Ports, Endpoints, Nodes, Zones, and NamedAddressCollections that are managed collectively by the same domain. The managing domain is indicated by the HostedCollection association. For Fibre Channel, a Zone indicates a set of members that are participating together in the fabric.</VALUE>
        </ QUALIFIER >
        < PROPERTY NAME="ElementName" TYPE="string" PROPAGATED="false" CLASSORIGIN="CIM_Zone" >
          < QUALIFIER NAME="Required" TYPE="boolean" OVERRIDABLE="false" >
            < VALUE >true</VALUE>
          </ QUALIFIER >
          < QUALIFIER NAME="Override" TYPE="string" TOSUBCLASS="false" >
            < VALUE >ElementName</VALUE>
          </ QUALIFIER >
          < QUALIFIER NAME="Write" TYPE="boolean" >
            < VALUE >true</VALUE>
          </ QUALIFIER >
          < QUALIFIER NAME="Description" TYPE="string" TRANSLATABLE="true" >
            < VALUE >A user-friendly name for the Zone that is unique within the AdminDomain.</VALUE>
          </ QUALIFIER >
        </ PROPERTY >
      </ CLASS >
    </ DECLGROUP >
  </ DECLARATION >
</ CIM >
```
Common Information Model (CIM) - Standardization

- EPRI (Electric Power Research Institute) CCAPI (Control Center Application Programming Interface) Task Force
- NERC (North American Electric Reliability Council) - Data Exchange Working Group
- IEC (International Electrotechnical Commission) TC57 WG13
Note that ACLineSegments might get merged if they are electrically indifferent. This is not considered a topic if this deck and in the example they will just remain separate.

One breaker is open for the sake of example.
The previous CN model corresponds to these topological nodes, bridging all closed switches.

- All CNs and equipment within the same TN has (practically) the same voltage level.

Note that an open switch "breaks apart" substation internals into separate TNs.
The TN-based model of the same grid is a simplification, and will thus look like this.

- Note that all equipment objects (line segments, open switches, etc) of the TN model is exactly the same as in the CN-model, and their Ids remain. Only the connection between them has changed.
Bus-Branch and Node-Breaker Modeling

- The system planning functions because of the model’s size are usually reduced to into bus/branch oriented models.
- The CIM representation of bus/branch model is the CIM TN-based representation.
- Real-time power system operation requires far greater detail about the field equipment and its connectivity.
- These models must include the substation bus segments, switches, and measurement details and known as a node/breaker model.
- The CIM representation of node/breaker model is the CIM CN-based representation.
The IPS model – Topology Manager

The model implemented in IPS-ENERGY Topology Manager is match the CIM connectivity node (CN) based representation.

The IPS model extends the standard CIM model related to following information:
- Implements specific protection functionality placement to exact place in CN-based representation
- Implements CT, VT and CVT placement to exact place in CN-based representation
- Implements CT modeling related to certain protection functions
- Provides full connectivity to IPS-ENERGY asset/location model
- Identifies concept of feeders in topology model
The IPS and CIM model interoperability

- The IPS implements „topology” based on connectivity node representation.
- IPS-ENERGY provides 1 to 1 mapping between IPS model and the CIM CN-based representation.
- The IPS specific implementation is „encoded” in CIM as a standard CIM extension.
- The IPS model could be created from CIM and vice versa. The IPS model could be exported in CIM XML format (CN-based representation).
- IPS „topology” also supports TN-based model and even a combination of two models (CN and TN based representation) at the same time.
IPS-ENERGY is capable to import PSS/E ODMS CIM XML export file based on CN-based representation.

- After proper mapping of ODMS CIM the model is enriched with relay, CT and VT specific connectivity information.

- The new enriched model could be exported in CIM format (with CIM extensions).

- The IPS enriched CIM model could be imported by CAPE and various analysis could be performed in CAPE.

- Functionality expected to be available July 2013.
IPS-ENERGY Topology Manager - Functionality

- Graphical Editor for CN-based and TN-based model drawing
- CN-based model representation
- Connection to IPS-ENERGY assets and locations available in asset management
- Full network model is available related to CB-based model elements
- The IPS topology model is the integral part of the entire IPS-ENERGY model (the zones for instance are defined in IPS topology model only).
IPS-ENERGY Topology Model – Sample Graphical View