CIM, PI AF and SISCO CIM Adapter Create New Application Opportunities for Utilities

Presented by

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SISCO
SYSTEMS INTEGRATION SPECIALISTS

Topics

- Review of Applicable Standards
  - Common Information Model (CIM)
  - IEC 61850 Power System Communications

- How CIM and IEC 61850 Help PI AF Modeling

- SISCO CIM Adapter in a Model-Driven Process

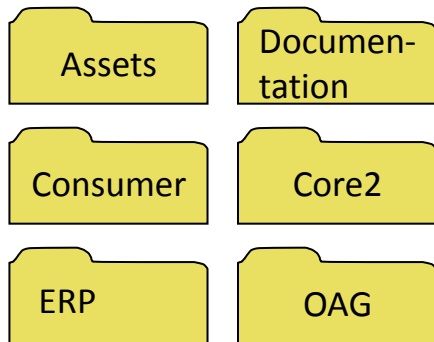- Integration with Events and Disturbances using COMTRADE

Common Information Model (CIM) is an Information Model of the Power System
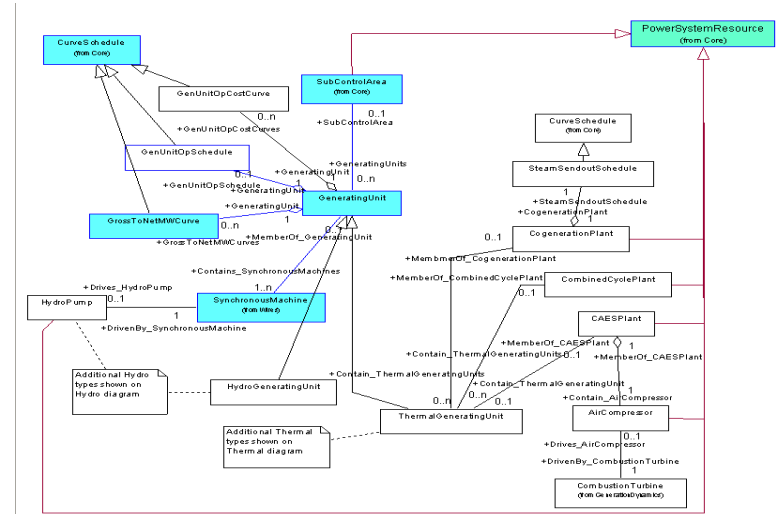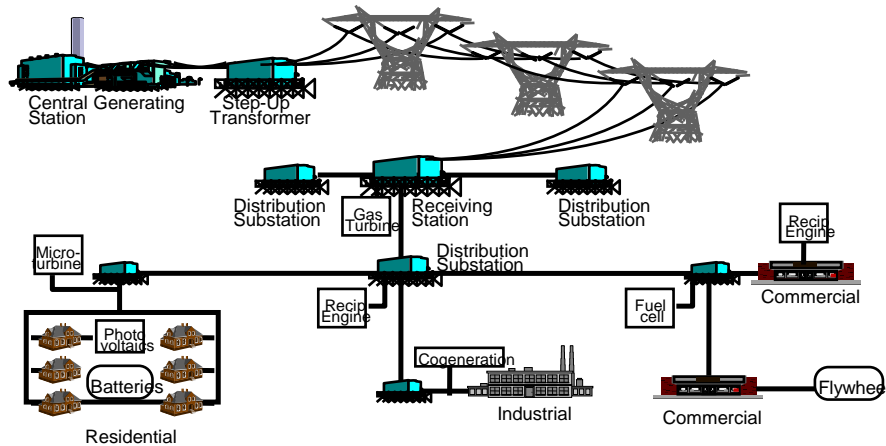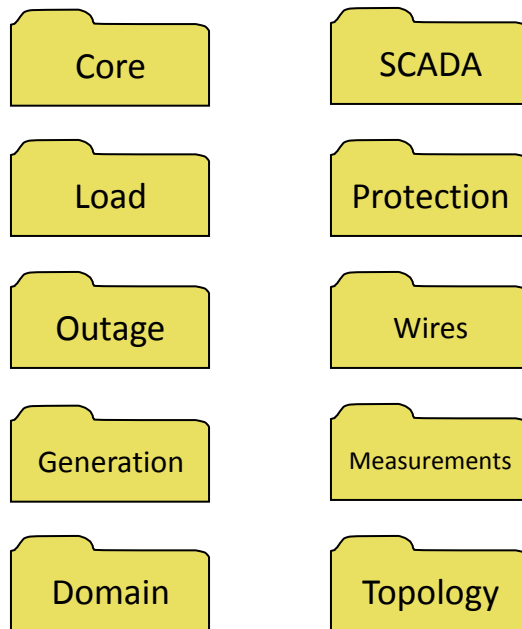

UML – Unified Modeling Language

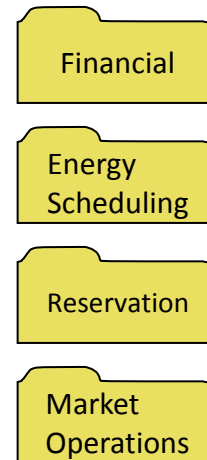# CIM is a Comprehensive Model for Utilities

IEC 61970 from IEC TC57 WG13

Core

SCADA

Load

Protection

Outage

Wires

Generation

Measurements

Domain

Topology

IEC 61968 from IEC TC57 WG14

Assets

Documen-tation

Consumer

Core2

ERP

OAG

Financial

Energy Scheduling

Reservation

Market Operations

IEC 62325 from IEC TC57 WG16

Distribution

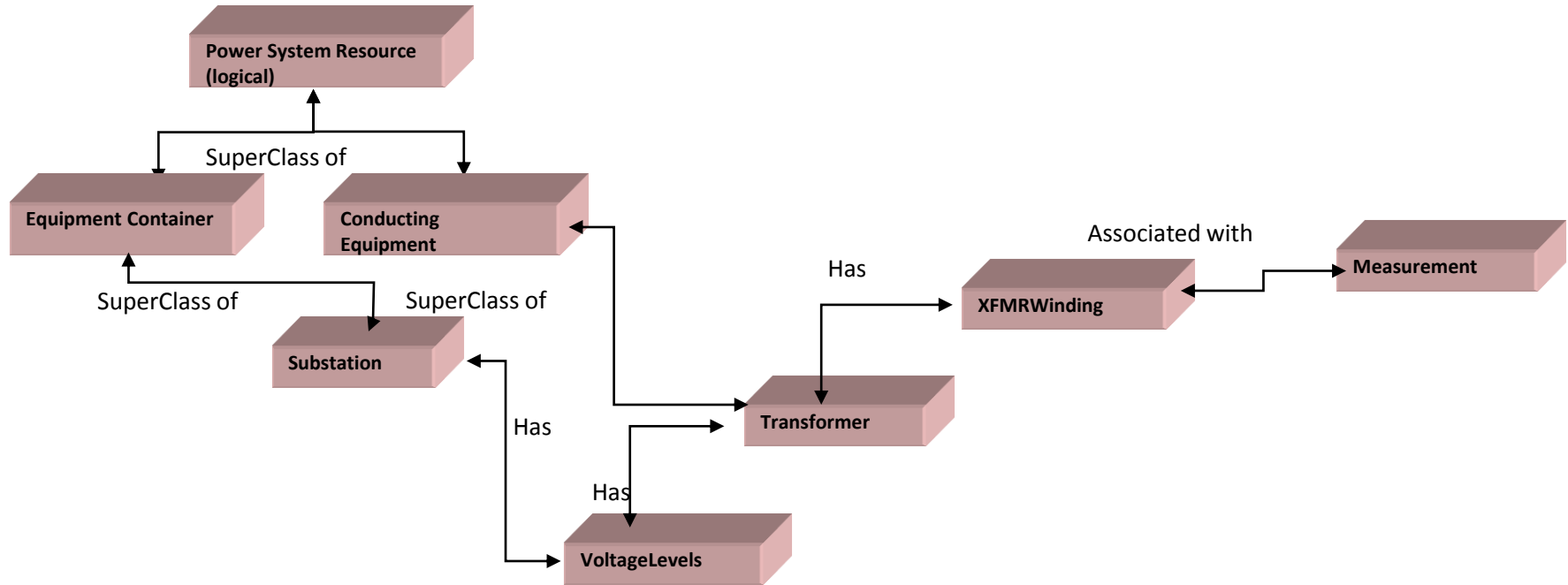EMS, Transmission & Planning
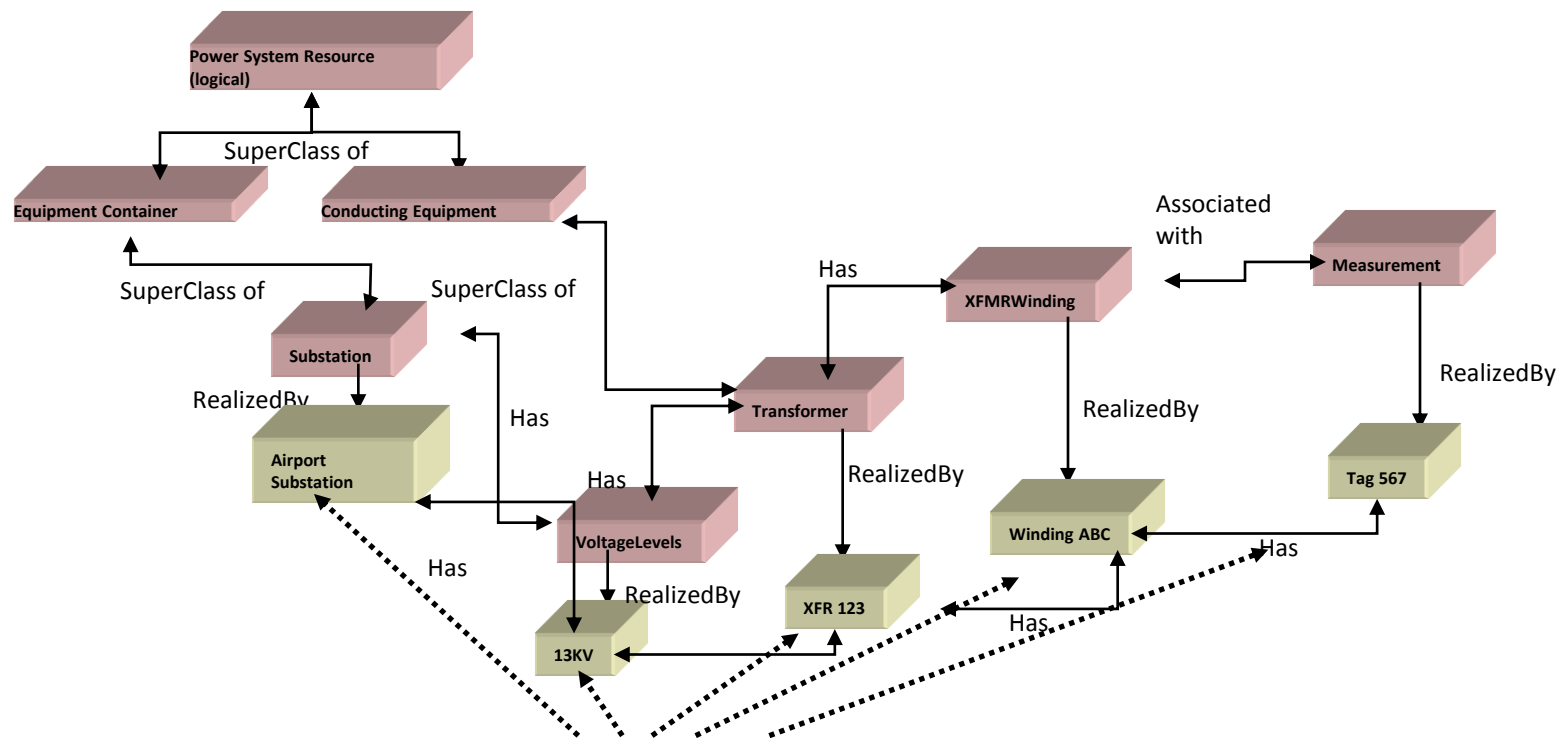
Markets (Euro & NA)

The Common Information Model Defines Objects and Relationships – The Schema

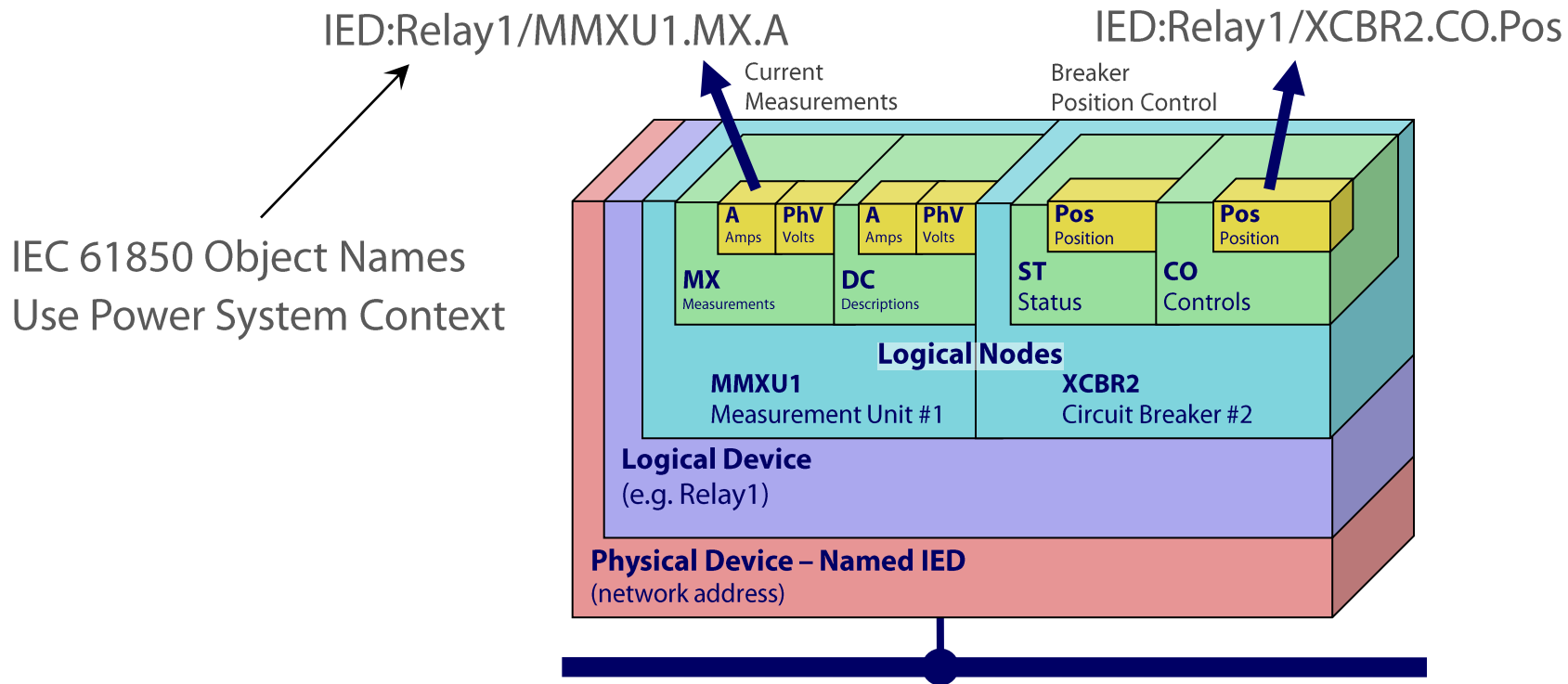# CIM is also a Populated "Instance" Model

Object Instances – AND there are MANY instances in a utility

IEC 61850: A New Approach to Power System Communications

- IEC 61850 is much more than a protocol:
  - Standardized **Device and Object Modeling**
    - Logical Devices, Logical Nodes, Common Data Classes, etc.
    - Extensions unique to specific applications (Hydro, Distributed Energy Resources (DER), Wind power, etc.)
  - Standardized Service/Behavior Modeling
  - Standardized **XML and a <u>Design Process for System Description and Device Configuration</u>**
  - Standardized Communications Profiles (Protocols) for Many Use Cases
  - Standardized Conformance Test Cases

IEC 61850 Data Model

IED:Relay1/MMXU1.MX.A

IED:Relay1/XCBR2.CO.Pos

IEC 61850 Object Names
Use Power System Context

Current
Measurements

Breaker
Position Control

| A Amps | PhV Volts | A Amps | PhV Volts | Pos Position | Pos Position |

MX Measurements   DC Descriptions   ST Status   CO Controls

Logical Nodes

MMXU1
Measurement Unit #1

XCBR2
Circuit Breaker #2

Logical Device
(e.g. Relay1)

Physical Device – Named IED
(network address)

Impact of CIM and IEC 61850 on PI AF

- CIM and IEC 61850 have modeling information that can be leveraged by PI AF to provide context and meaning to PI data.

- Using data models to drive integration and application development is a proven method to manage the complexity of large scale systems.

- CIM and IEC 61850 provide a good starting point for most of a utilities modeling needs and a process for customizing it to meet your individual needs.

- Building custom models from the ground up is wasteful and can lead to many non-interoperable models for each functional requirement.

SISCO CIM Adapter Enables CIM & IEC 61850 for PI AF

- Enables **any** model in CIM-XML format to be imported into PI AF.

- Find data in the context of the power system.

- Supports a **Model-Driven Process** to manage all application models.
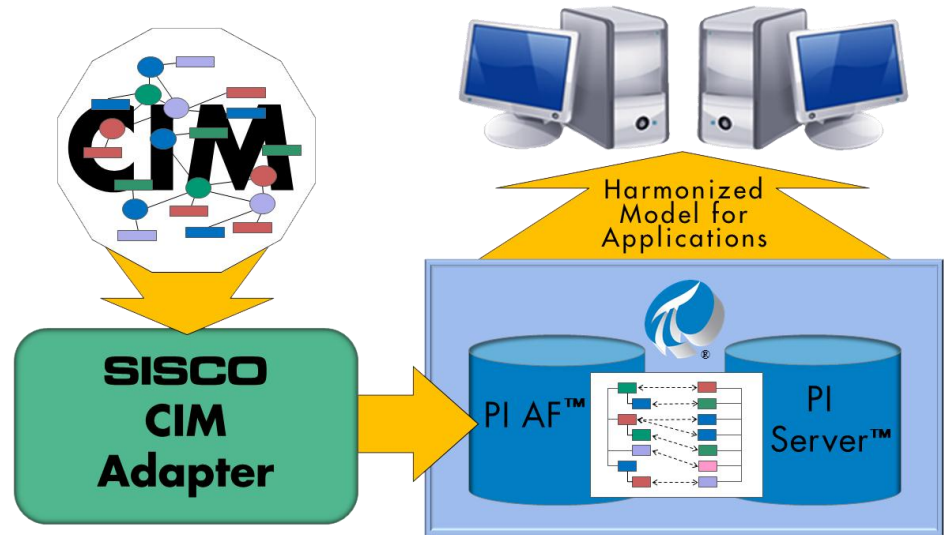
Typical Approach for Application Data Models?

- Each group looks at its own application requirements and develops a data model that is optimized for its own use:

  - Only data needed for its application is considered.
  - New data model elements are added as needed based on immediate requirements of the individual applications.

- The "Ad-Hoc" Approach
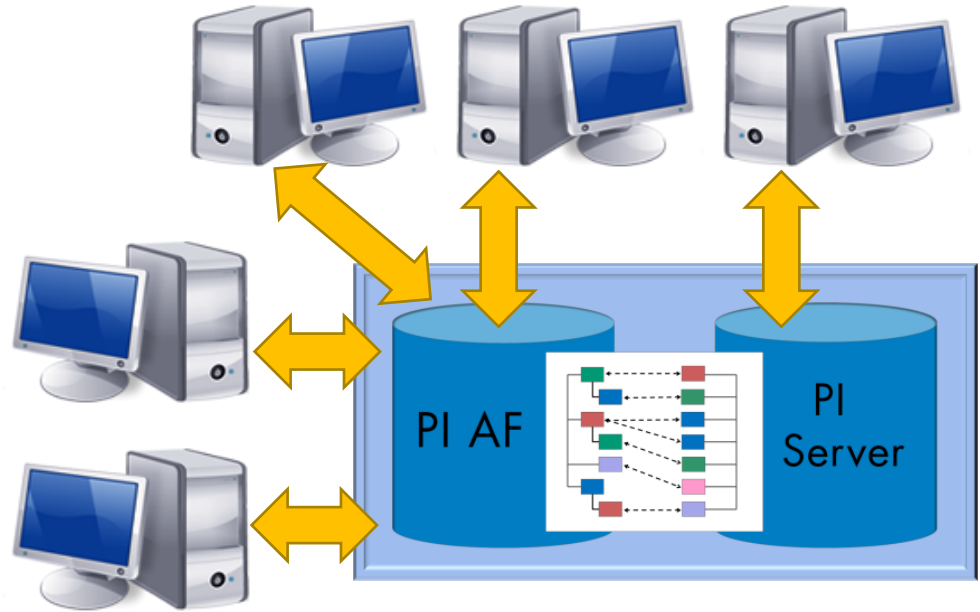
Ad Hoc Approach for Line Rating Application

Line Rating Application
└ Control Area
  └ Corridor
    ─ Line Segment 1
    ─ Line Segment 2
      ─ Ambient Temp
      ─ Wind Speed
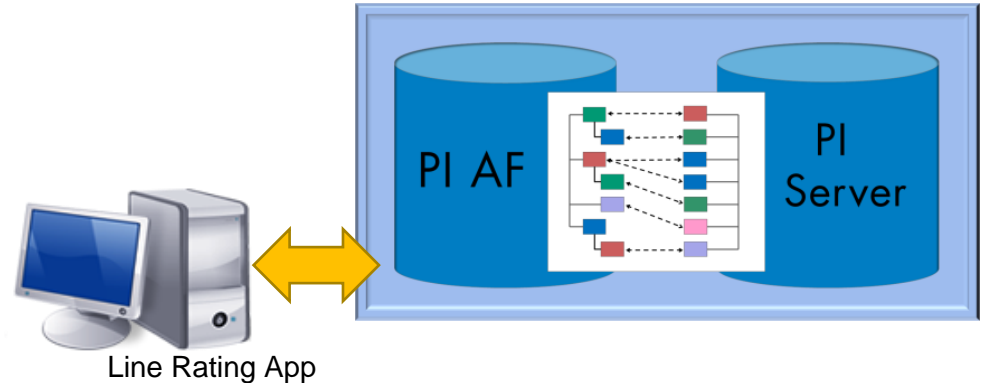   ─ Wind Direction
      ─ Current
      ─ A Line
        ─ LineTemp
        └ Sag
      ─ B Line
        ─ LineTemp
        └ Sag

Line Rating App

PI AF

PI Server

Ad Hoc Approach for Remedial Action Schemes

Remedial Action Application
└ Corridor
   ├ North-South Interconnect
      ├ Line Trip RAS
      ├ Generator Trip RAS
         ├ Airport Substation
         ├ Sydney Sub
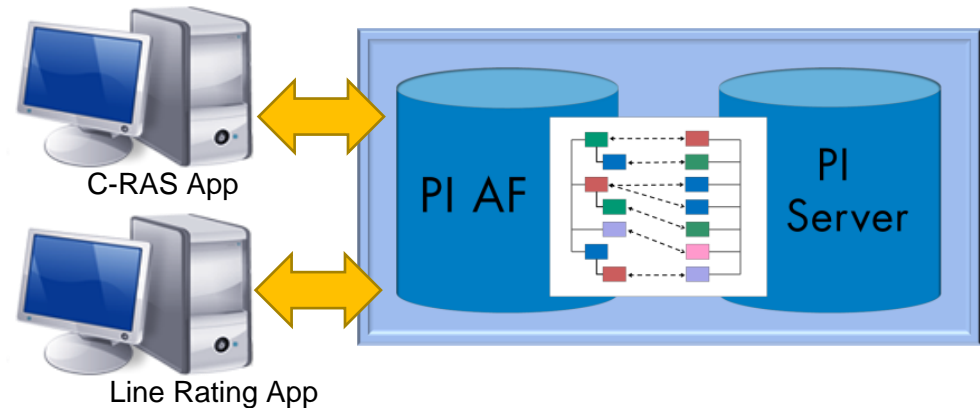   ├ West Dam Sub
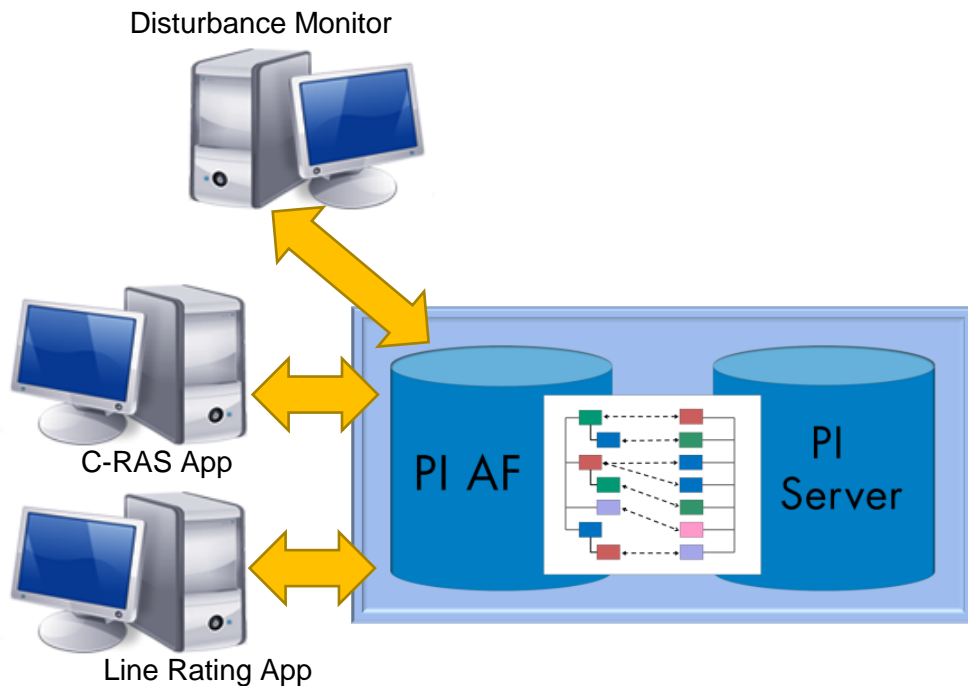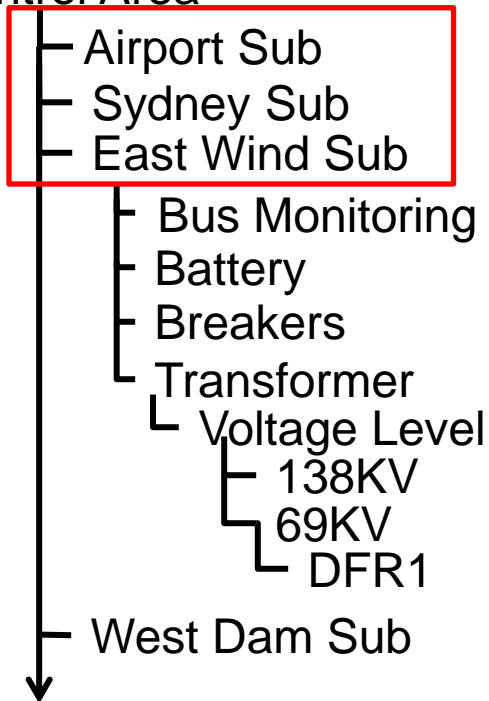   ├ East Wind Sub
         ├ Line Status
            ├ Current
            └ Margin
         ├ Line Rating
         ├ RAS Arming

C-RAS App

Line Rating App

PI AF

PI Server

Ad Hoc Approach for Disturbance Monitoring

Disturbance Monitor App
└ Control Area
  ├ Airport Sub
  ├ Sydney Sub
  ├ East Wind Sub
    ├ Bus Monitoring
    ├ Battery
    ├ Breakers
    └ Transformer
      └ Voltage Level
        ├ 138KV
        └ 69KV
          └ DFR1
  ├ West Dam Sub

Disturbance Monitor

C-RAS App

Line Rating App

PI AF

PI Server

Ad Hoc Approach for CBM Applications

Condition Based Maintenance
- Circuit Breakers
  - Sydney Sub
    - 69KV
    - 138KV
      - Breaker Q1A1
      - Breaker Q1A2
      - Breaker Q1A3
      - Breaker Q2B1
      - Breaker Q2B2
        - Last Operate
        - NumOperations
- Transformers
  - Sydney Sub
  - West Wind Sub

Disturbance Monitor · CBM · C-RAS App · Line Rating App · PI AF · PI Server
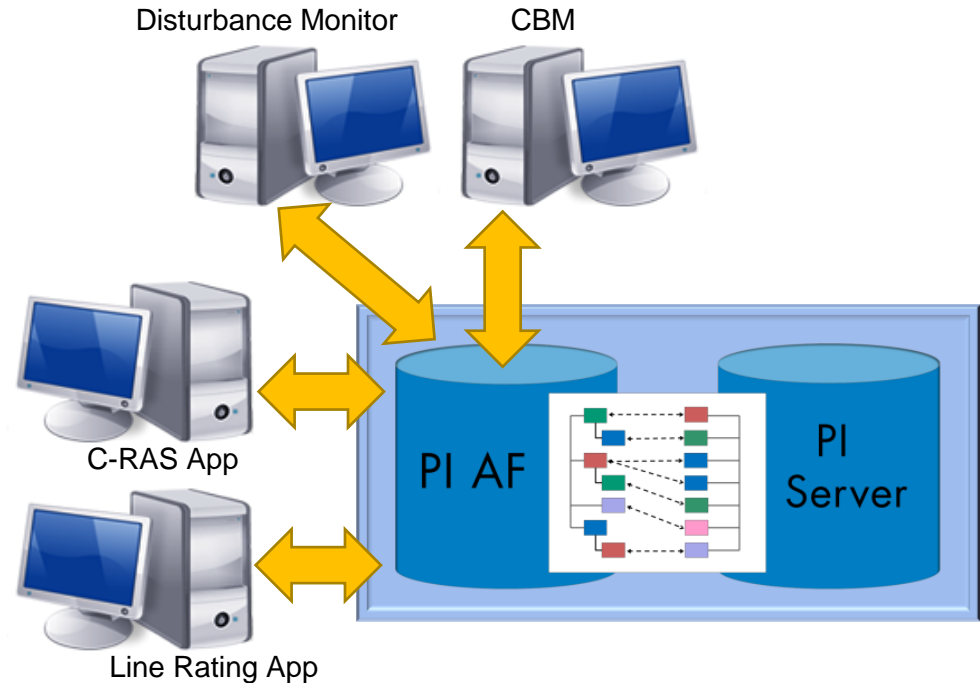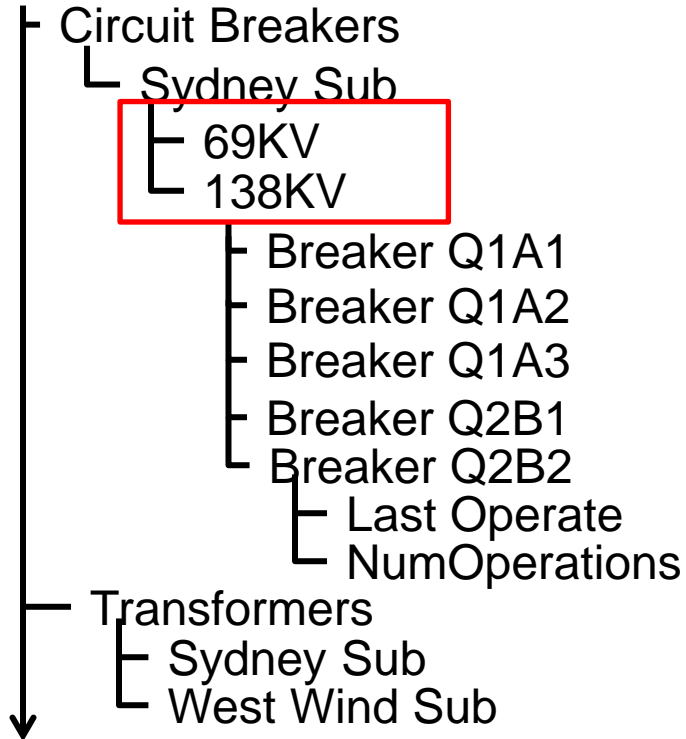
Impact of Ad Hoc Approach for Application Data Models

- PI AF can accept as many models as you have space for.

- Impact of cross-organizational integration and data sharing ignored.

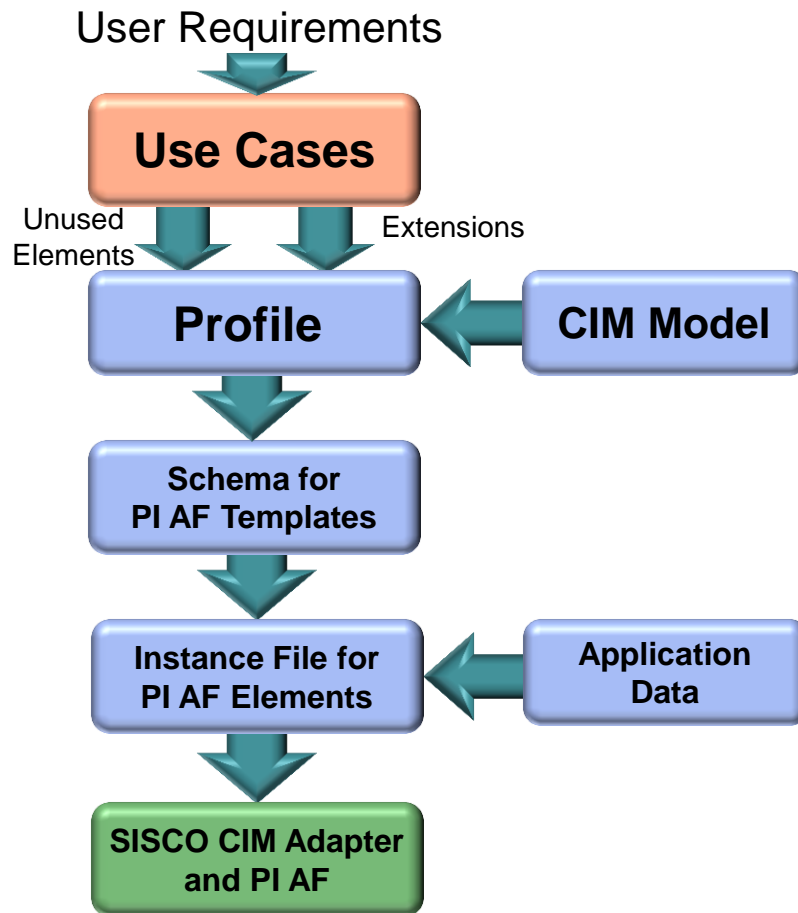- Each group is individually satisfied with their own custom view until…..
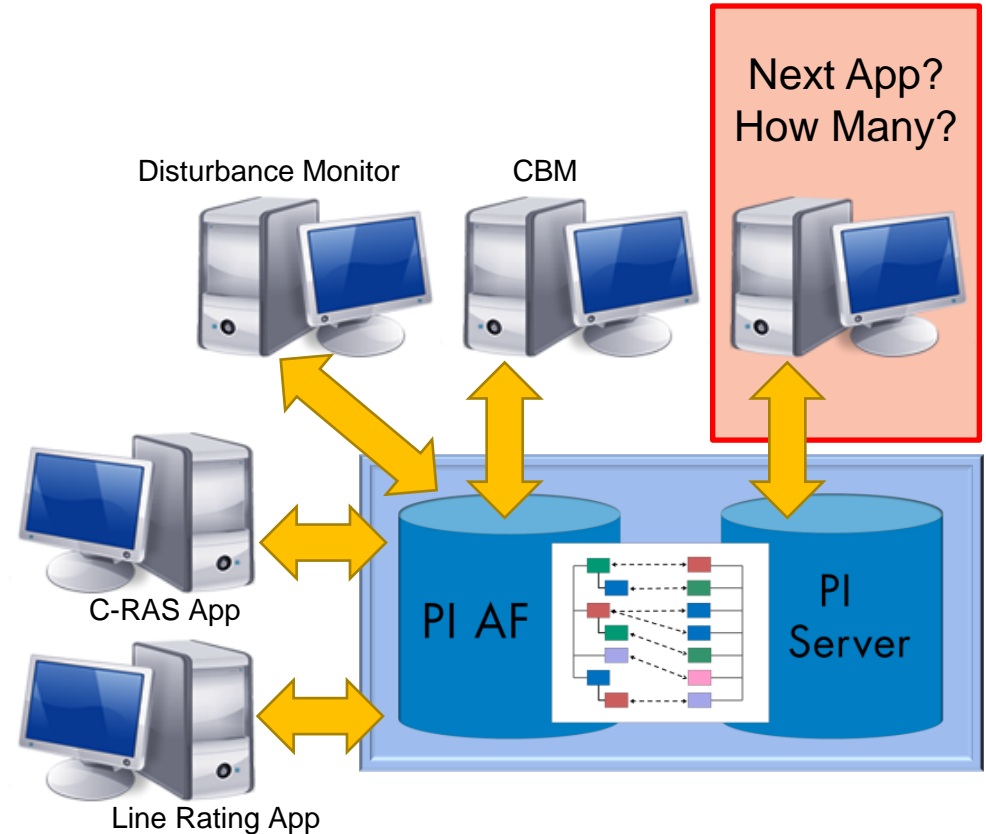
Change Happens

- Addressing change becomes too difficult when each application uses its own incompatible data modeling:
  - Business needs demand organizational changes and new levels of data sharing and integration.
  - New technology must be addressed (e.g. renewables, DER, "deregulation", etc.

- Result: **Application rewrites, reintegration, project delays, barriers to data sharing.**
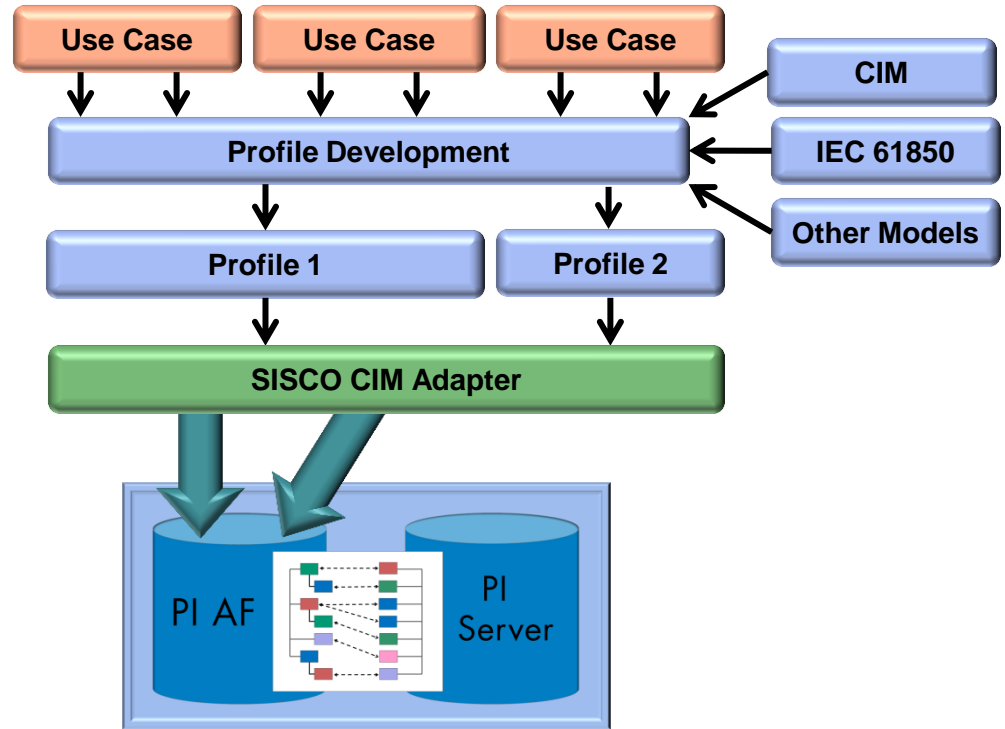
The CIM Model-Driven Process

- CIM is flexible to accommodate:
  - Extensions for non-standard business needs
  - Eliminate the complexity of unused models

- Profiles are created based on use cases to address your specific needs

- Instances created to relate existing data to the CIM Profile schema

- SISCO CIM Adapter used to configure PI AF Templates and Elements

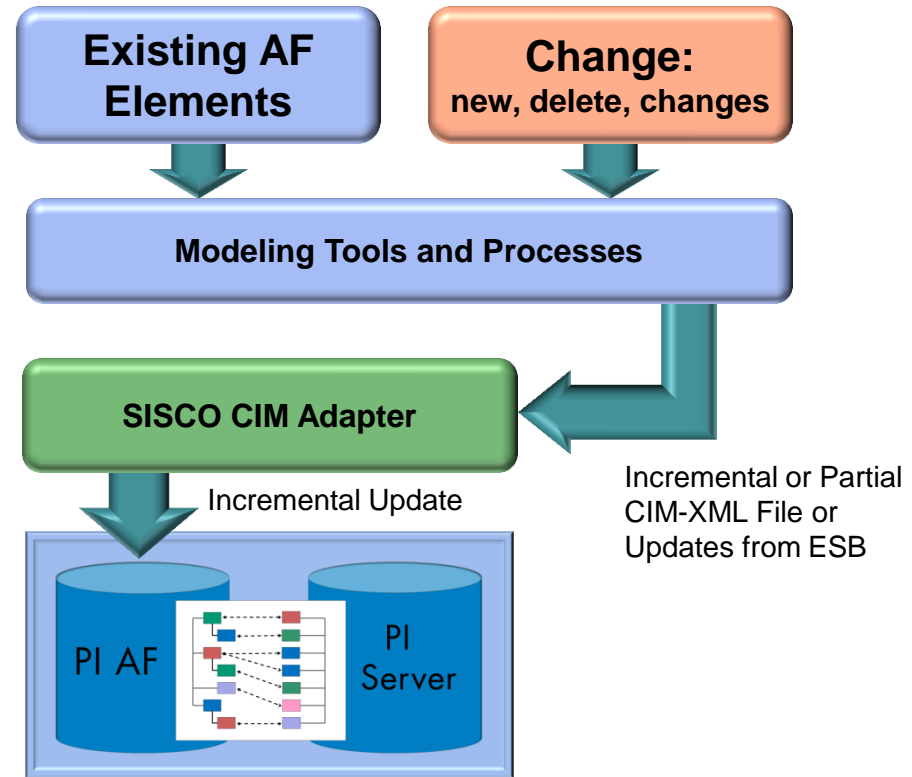- User applications use models to access data eliminating tag name dependency.

User Requirements

↓

Use Cases

Unused Elements ↓   ↓ Extensions

Profile ← **CIM Model**

↓

Schema for PI AF Templates

↓

Instance File for PI AF Elements ← **Application Data**

↓

SISCO CIM Adapter and PI AF

CIM Adapter and PI AF Deliver Flexibility

- Multiple uses cases can be addressed with one profile.

- Multiple profiles can be supported for use cases that can't share a profile

- PI AF is flexible to support many models

- A disciplined modeling process with SISCO CIM Adapter brings it all into the PI System

CIM Adapter Helps You Embrace Change

- The model driven process captures change and creates incremental updates

- SISCO CIM Adapter incrementally updates PI AF models.

- The individual hierarchies can be updated and kept synchronized with each other.

Existing AF Elements

Change: new, delete, changes

Modeling Tools and Processes

SISCO CIM Adapter

Incremental Update

Incremental or Partial CIM-XML File or Updates from ESB

PI AF

PI Server

PI AF with CIM Works Across Applications

- SISCO COMTRADE Utility brings disturbance data into the PI System using PI Event Frames

- CIM and PI AF models help correlate all the data in the context needed by the individual application needs.
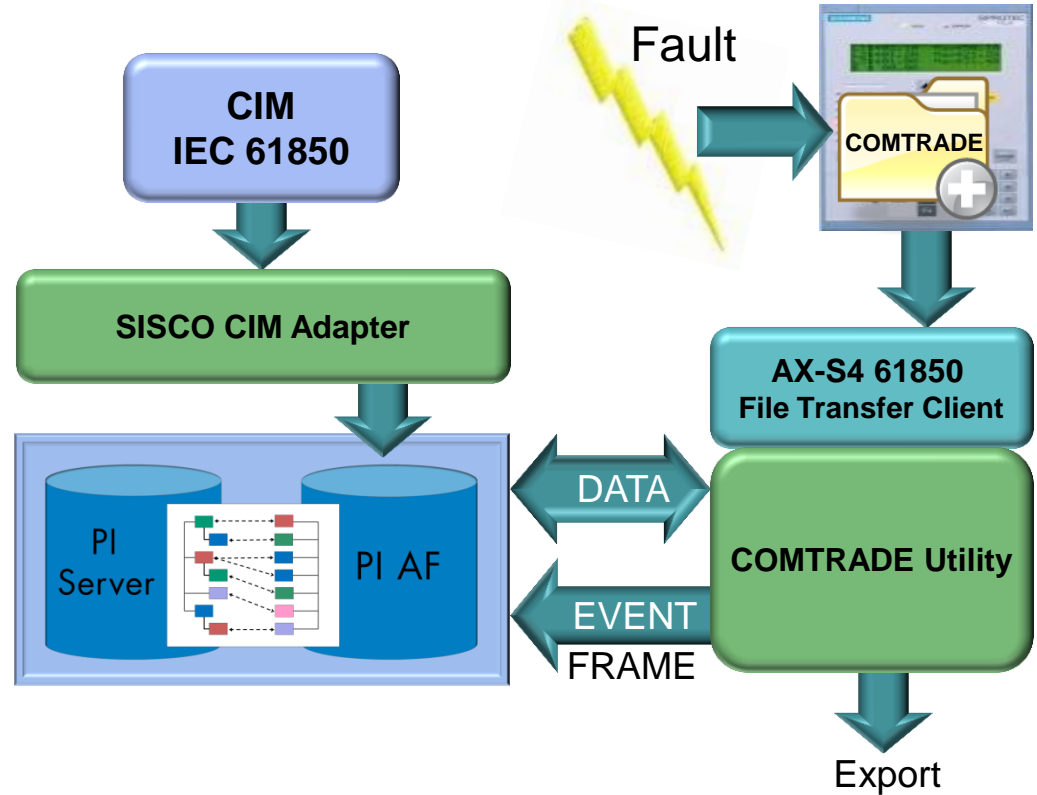
Result of Integration with PI AF

Classes per CIM with Extensions

Substation with calculated differential frequency measurement from synchronizing relay

IEC 61850 Object Name:

AMHERST9_RSYN1MXDifHzClc$f

Result of Integration with PI AF

Angle separation across the Amherst Bowman line is ~8.5°

NorthAMHE400BBOWM8/RSN1MXDifAngClc$f

Summary

CIM is a pre-existing standardized utility oriented data model that provides a platform to build an application data model that addresses enterprise level needs.

IEC 61850 provides a data model that provides context and meaning to telemetry data that can be associated to CIM

PI AF and SISCO CIM Adapter provide an excellent foundation to support effective application of application data models for utilities.
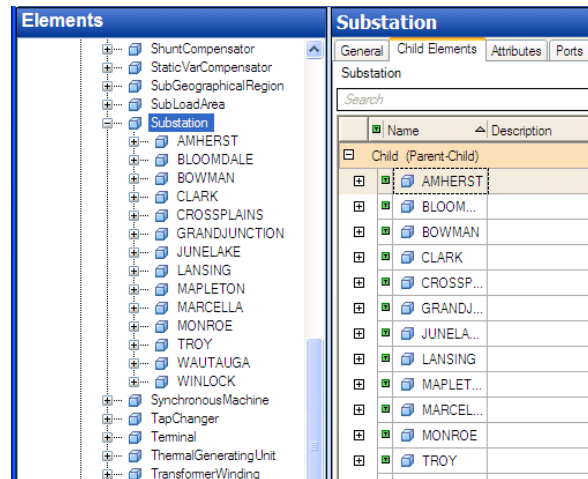
Business Challenge

- Taking advantage of application data models that meets individual group needs while supporting enterprise wide integration and data sharing that can be adapted to changes.

Solution

- PI AF to organize all PI System data
- SISCO CIM Adapter to automate PI AF modeling
- CIM based model driven process to manage change

Results and Benefits

- A single enterprise level based for PI AF that can be optimized for individual application needs
- Flexibility to minimize effort adapting to change

Merci de votre attention

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