ERCOT Training CIM – Part 1

CIM in a Nutshell

Part I

Presented By
Margaret Goodrich

Presented to
“ERCOT NMF Meeting”
Taylor, TX May 17, 2007

Topics

- The Common Information Model (CIM)
  - Overview
  - CIM Packages
  - Definitions
  - UML Notation– A diagramming tool
  - Examples
- Standards Overview
  - Origin of Standards Activities
  - Standards Bodies
  - Current Standards Activities
- CIM User's Group
- ERCOT Data Dictionary

CIM - What It Is -- And Isn't

- CIM = Common Information Model
- CIM is:
  - A model defining classes and their relationships to other classes
- CIM is not:
  - a database (object or relational)
  - Specifies relationships, not how you store them

The Common Information Model (CIM)

- An information model representing real-world utility objects (or classes) found in transmission and distribution operation and management
  - Includes classes (i.e.objects), their attributes and relationships between classes/objects
- A tool to enable data access in a standard way
  - Common language to navigate and access complex data structures in any database. It provides a hierarchical view of data for browsing and access
  - To define information exchange models
- A tool to enable integration of applications/systems
  - Provides a common language for exchanging messages between systems

CIM Overview

- Each package and class is represented in the CIM Standard document using:
  - UML Diagrams
  - Text containing the attributes with a description and a list of its parameters
  - *Handout CIM Example*
- Each Package contains a set of object/classes
- Each object/class is defined in terms of:
  - Attributes
  - Relationships (associations both within and between other packages)

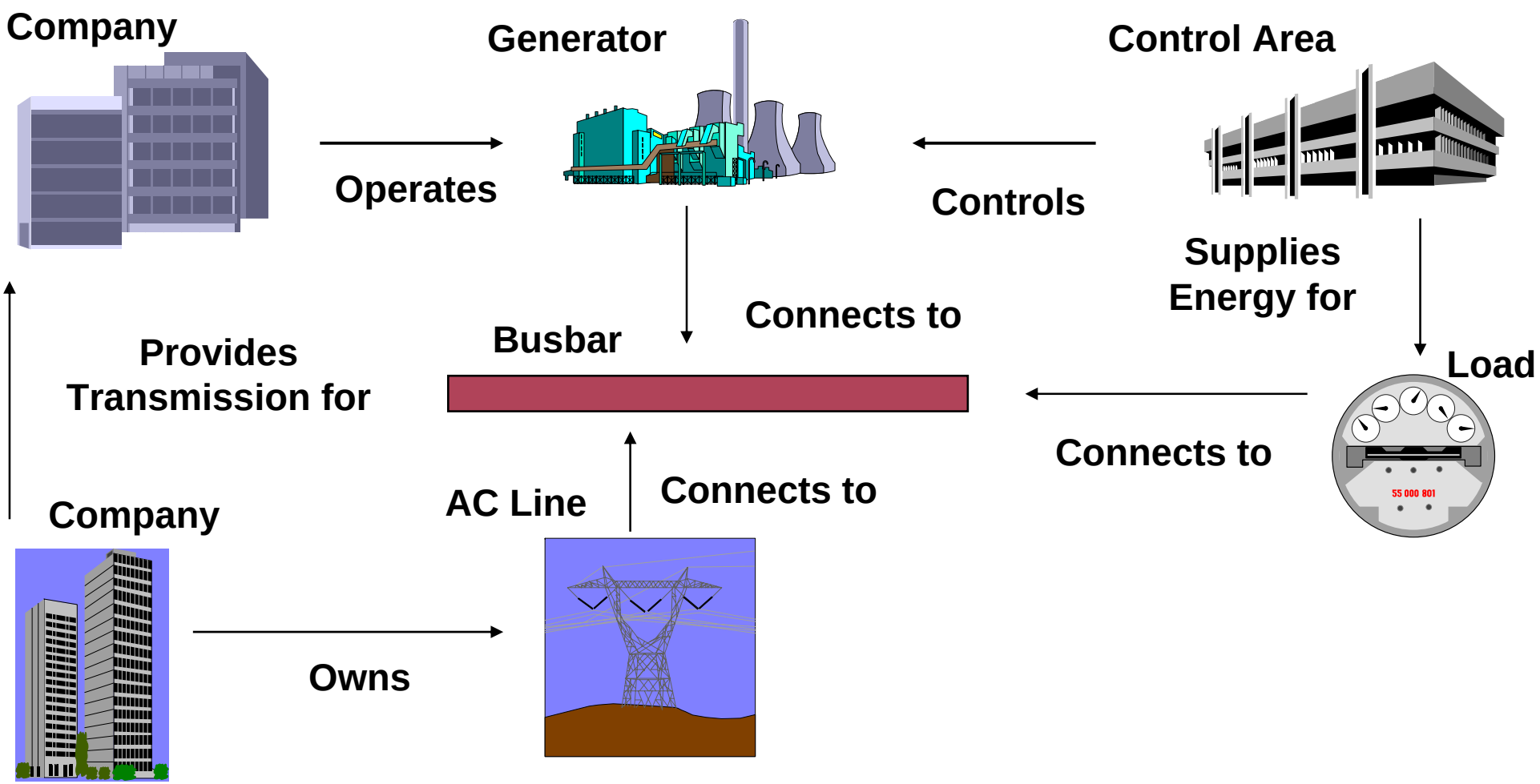
CIM Overview

- A Power System Resource (PSR) is a class that represents an asset within the Utility
  - i.e. a Generating Unit, a Line Segment, a Transformer
- Attributes describe the PSR:
  - For AC Line Segments some of the attributes are the serial numbers, spatial positions, length, voltage, etc.
  - For Transformer Winding the attributes include Susceptance, Conductance, Resistance, etc.

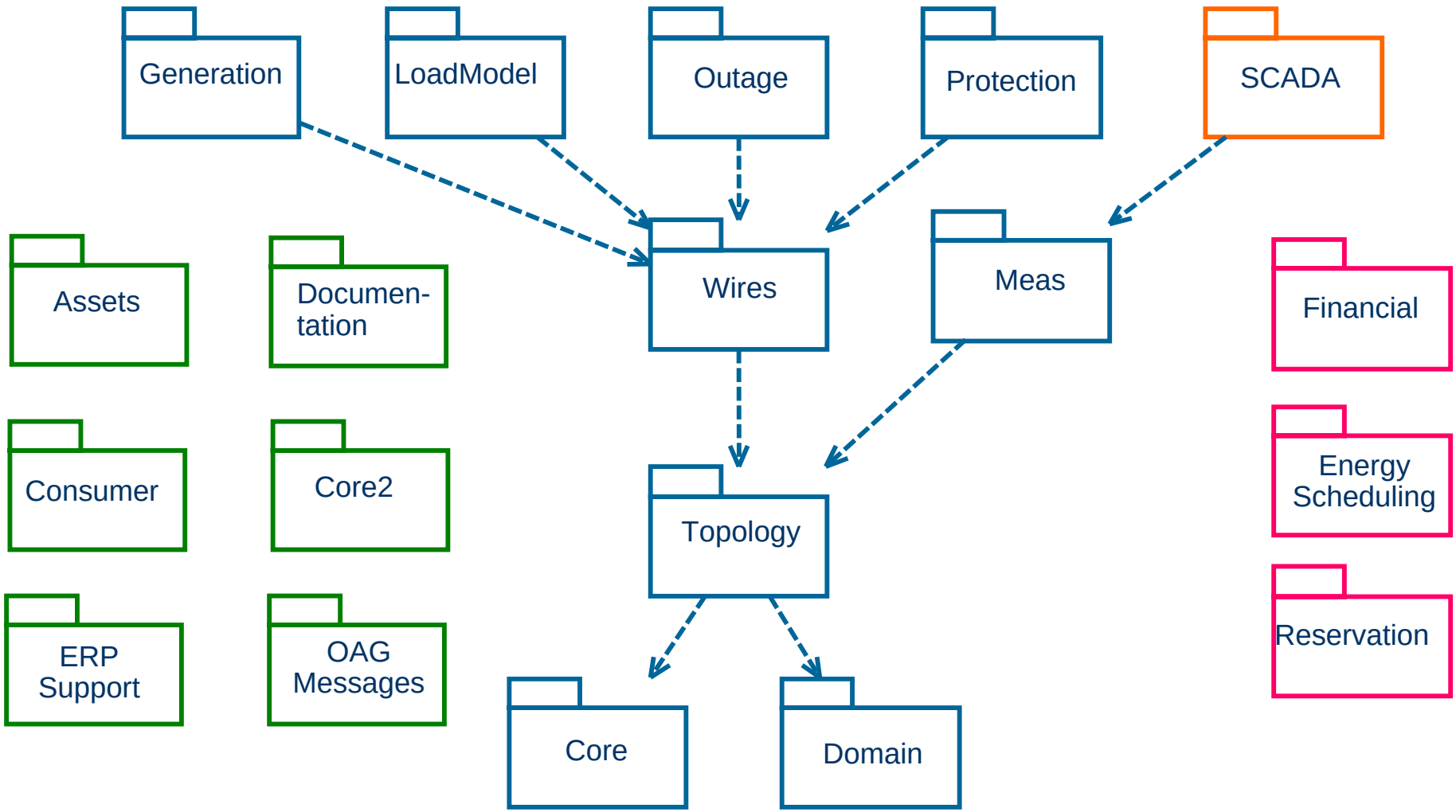
CIM Overview

- The Relationship is either:
  - Connected To
  - Member Of
  - Owned By
  - Measured By
  - Has A
  - Etc.

The Common Information Model Defines Power System Resources, Attributes and Relationships



CIM Overview - Packages



61970 Part 301 Base – Core, Topology & Wires Packages

- Core
  - Contains the core PowerSystemResource and ConductingEquipment entities shared by all applications
- Topology
  - Extension to the Core Package that models Topology information independently of the other electrical characteristics
- Wires
  - An extension to the Core and Topology package that models information on the electrical characteristics of Transmission and Distribution networks

Definitions

- Metadata: Information about data
  - Used to define the possible relationships/associations of data, resulting in an information model
- Data: The actual data
  - CB1, CB2 (Breaker Names)
  - Open or Closed (Breaker Status or Breaker Measurement)
- Instances: Instance information describes the specific contents of one or more classes that exist within the system.
  - Class Instance: The data contained in all the attributes of the Transformer Class – that is, an instance of a transformer class would have all the attributes of that transformer included in the result.
  - Database Instance: A database containing the data for a full power system model – a copy of this database would be another instance.

Definitions

- Class or Object
  - Is usually an asset or a “thing” in the real world such as a Transformer, Breaker, Work Order, etc.
- XML Schema
  - Structure of data with type and element definitions
  - Does not include instance data
- Schema or Logical Schema: Refers to database organization
  - Represents a specific *database* design (consisting of tables and relationships for a relational database) that implements a meta data model so that instance information (Class Instance) can be stored within the database

CIM Modeling Approach – UML Diagrams

- CIM Model uses Unified Modeling Language (UML)
  - Packages containing class diagrams and class specifications
  - Rational ROSE used for model definition and maintenance
- Can be viewed with Rational Rose, Visual Studio and other tools
- IEC standards use Microsoft Word

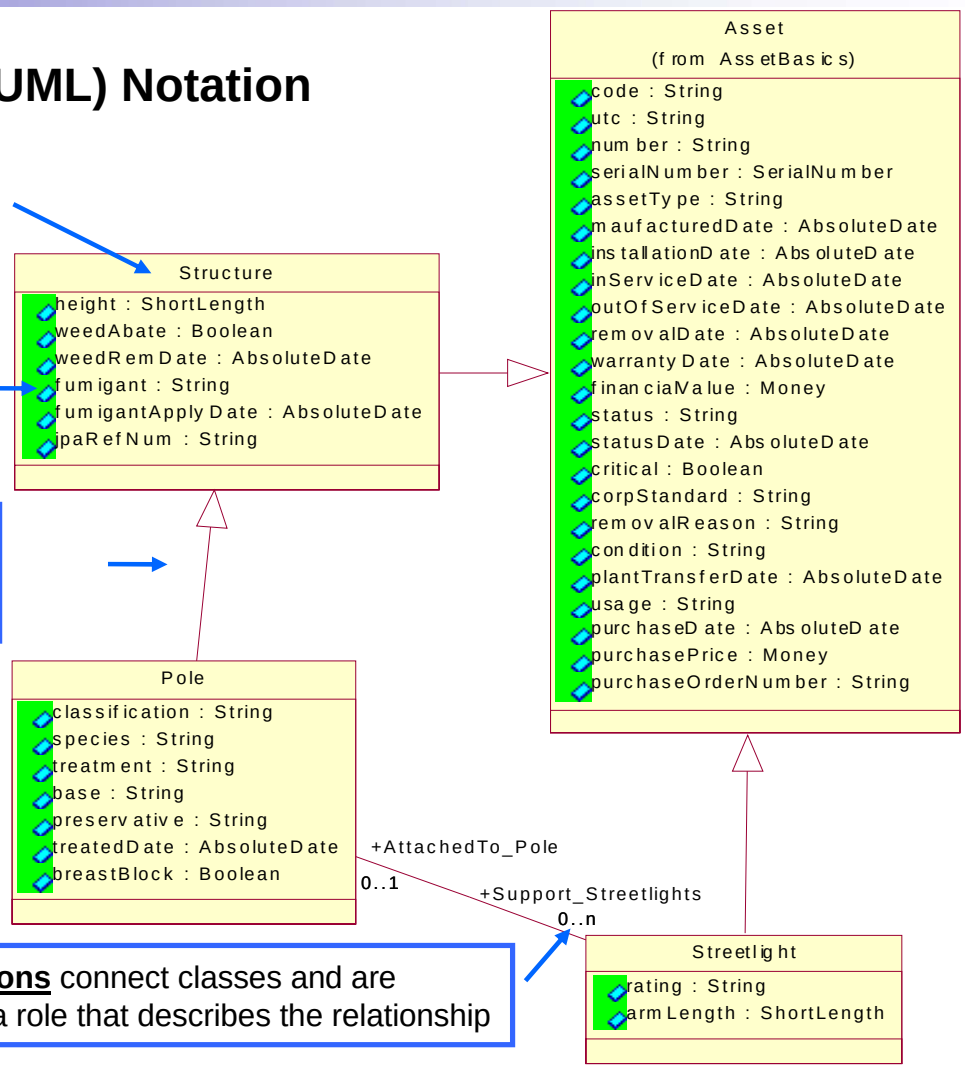
The CIM Is Expressed In Unified Modeling Language (UML) Notation*

A Bit On Unified Modeling Language (UML) Notation

Class Name usually describes things in the real world

Class Attributes describe significant aspects about the thing

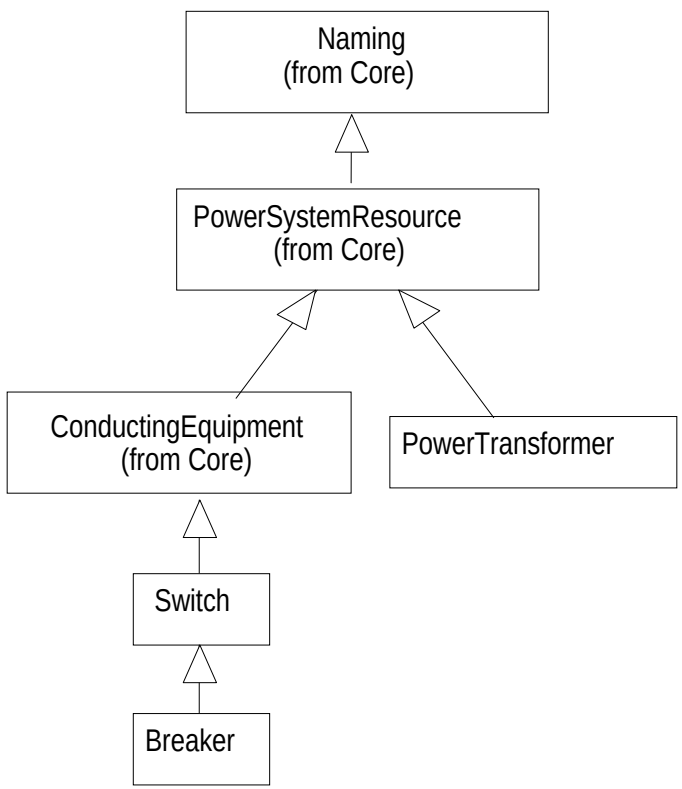
This **Specialization** indicates that a "Pole" is a type of "Structure." Since a "Structure" is a type of "Asset," the Pole inherits all of the attributes from both Structure and Asset



Associations connect classes and are assigned a role that describes the relationship

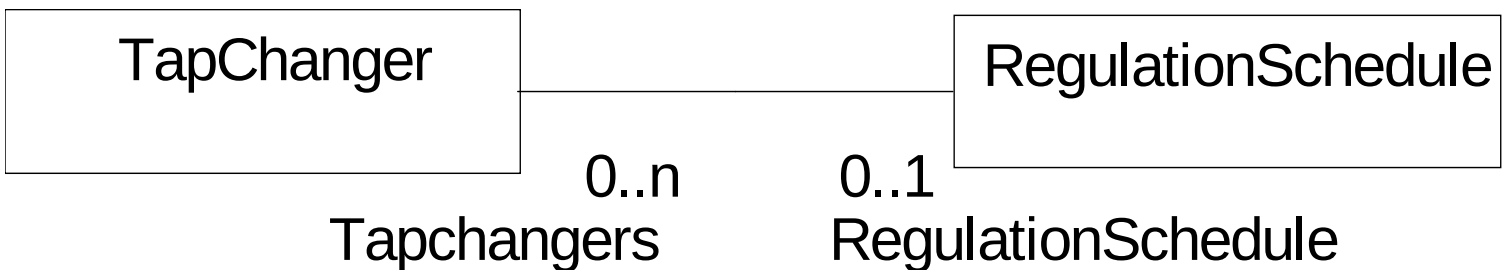
* For more information on UML notation (a standard), refer to Martin Fowler's book "UML Distilled," Addison-Wesley

UML Concepts: Generalization/Inheritance



- Breaker: Specialization of Switch
- Switch: Specialization of Conducting Equipment
- ConductingEquipment: Specialization of PowerSystem Resource

UML Concepts: Simple Association/Relationship



- Tap Changer has 0 or 1 regulation schedules
- Regulation Schedule applies to 0 to n Tap Changers

This is a one-to-many relationship/association

UML Concepts: Aggregation/Composition – AKA Containment

A Topological Island comprises 1 to n Topological Nodes

Topological Nodes are Contained within Topological Islands

(This is how a bus is defined in the CIM)

Black Diamond – Composition

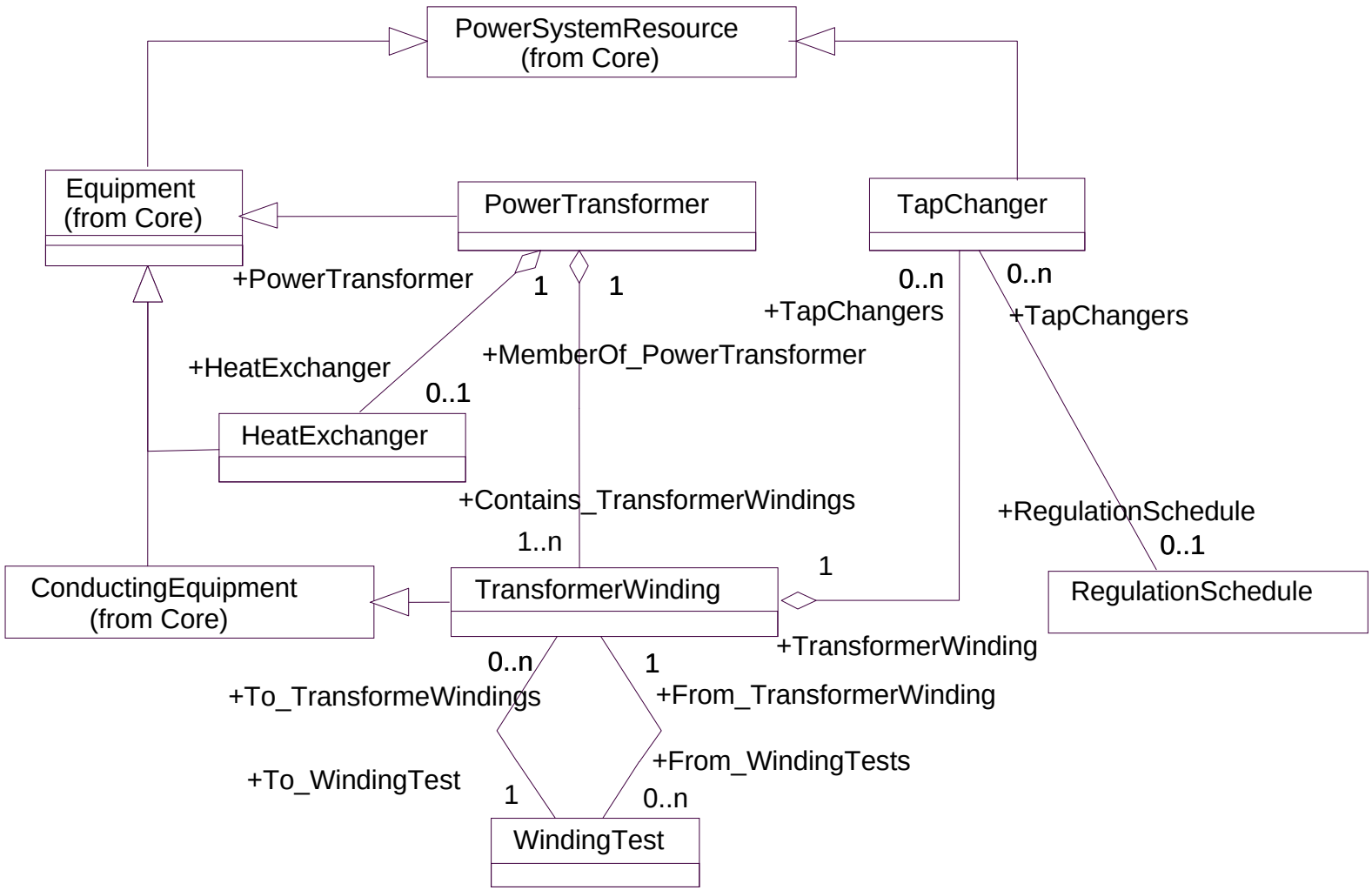
Child cannot exist without parent

White Diamond – Aggregation

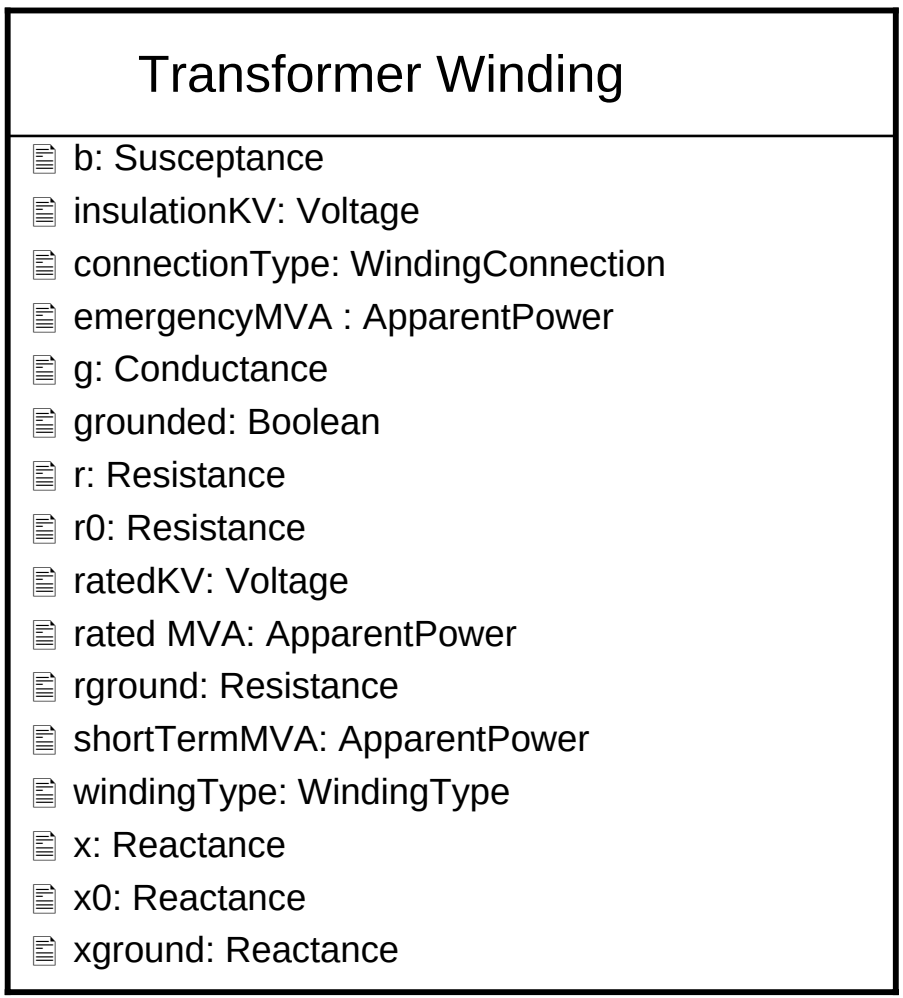
Child can exist without parent

Diamonds always point to the parent or “whole” part of the relationship. Implied multiplicity of Parent is 0..1 unless specified as 1. The Child is fully contained within the parent – it is a “part” of the whole.

Transformer Class (Model) From CIM



Transformer Winding Attributes



Topics

- The Common Information Model (CIM)
  - Overview
  - CIM Packages
  - Definitions
  - UML Notation– A diagramming tool
  - Examples
- Standards Overview
  - Origin of Standards Activities
  - Standards Bodies
  - Current Standards Activities
- CIM User's Group
- ERCOT Data Dictionary

Origin of Standards Activities

- Software Standards have been around for many years but prior to the late 80's they were mostly DOD/Defense
- The Utility Standards effort for software began during this same period with the work on ICCP and other protocols
- In 1991, EPRI began an initiative called the Control Center Application Program Interface (CCAPI) to develop a set of standards that could be used to bring the software deployed within the utility industry closer to a plug n' play integration framework or architecture.
- The CCAPI was composed of over 200 utilities and vendors
- The CCAPI work would feed the IEC TC 57 working groups that would be created as a result of this effort.

Origins of Standards Activities

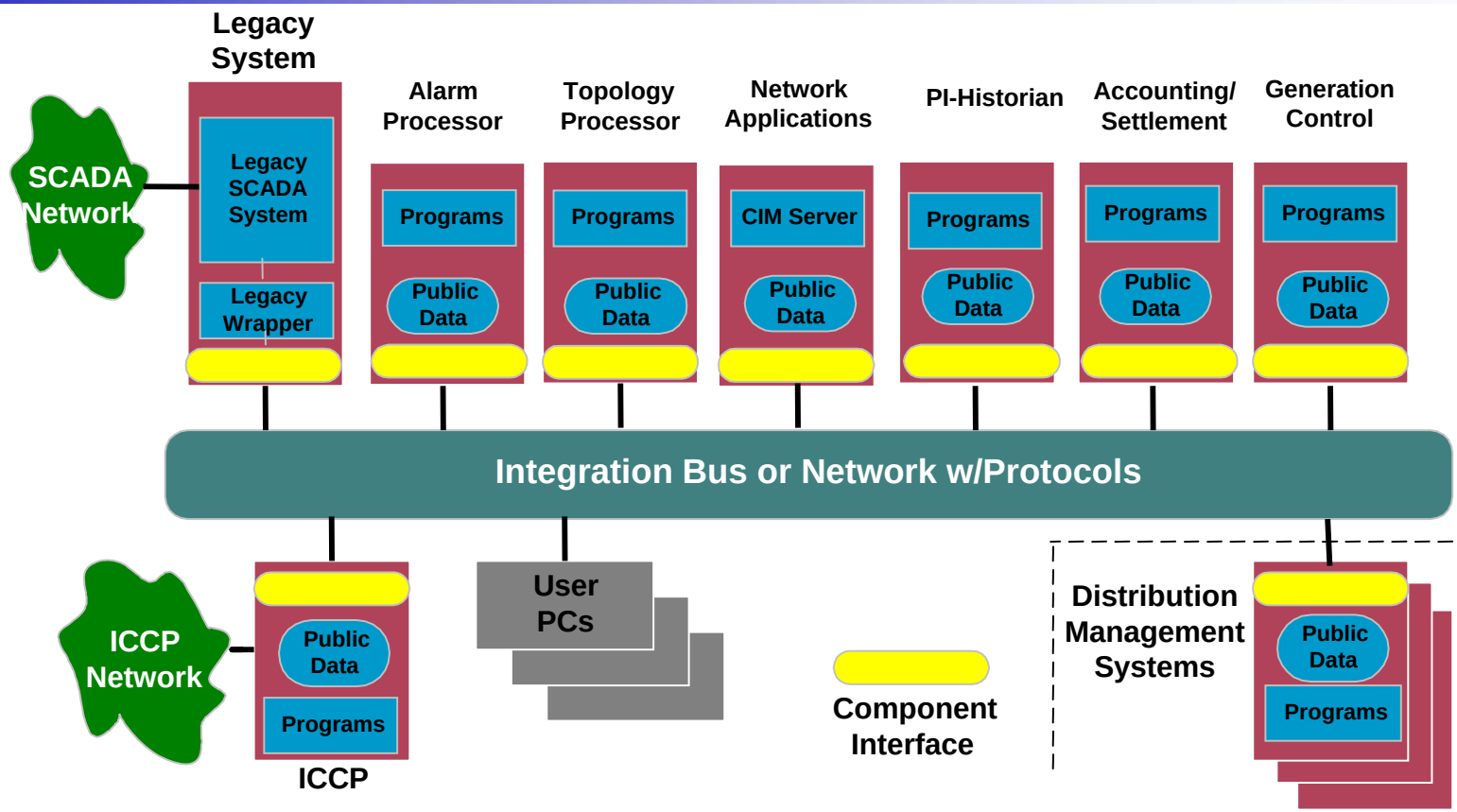
CCAPI Task Force Charter:

- Develop integration framework to facilitate information exchange between applications/systems
- Focused on integration of generation and transmission systems from an Energy Management System (EMS)/SCADA perspective:
  - Applications developed independently by different vendors
  - Entire EMS systems developed independently
  - EMS system and other systems concerned with different aspects of power system operations, such as distribution management systems (DMS)

Origin of Standards Activities

- CCAPI developed the following Initial Draft Standards:
  - Common Information Model (CIM)
  - Generic Interface Definition (GID)
  - Common Power System Model (CPSM)
- These were submitted to IEC WG13 (formed out of CCAPI participants) for review, approval and progression as a standard.
- WG13 has since developed several other companion standards to ensure data exchange would work (i.e., CIM XML and RDF standards).

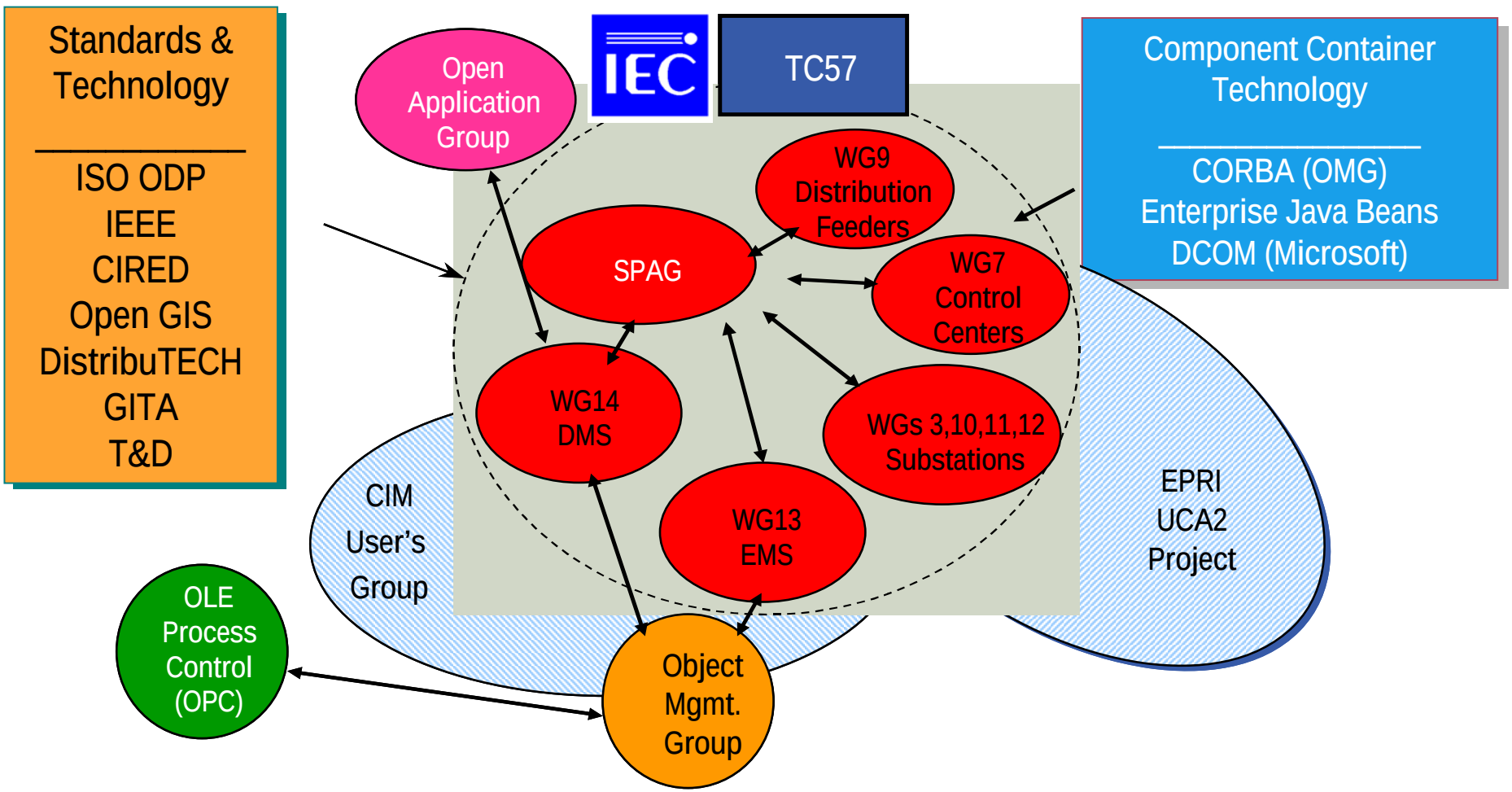
CCAPI as an Integration Framework



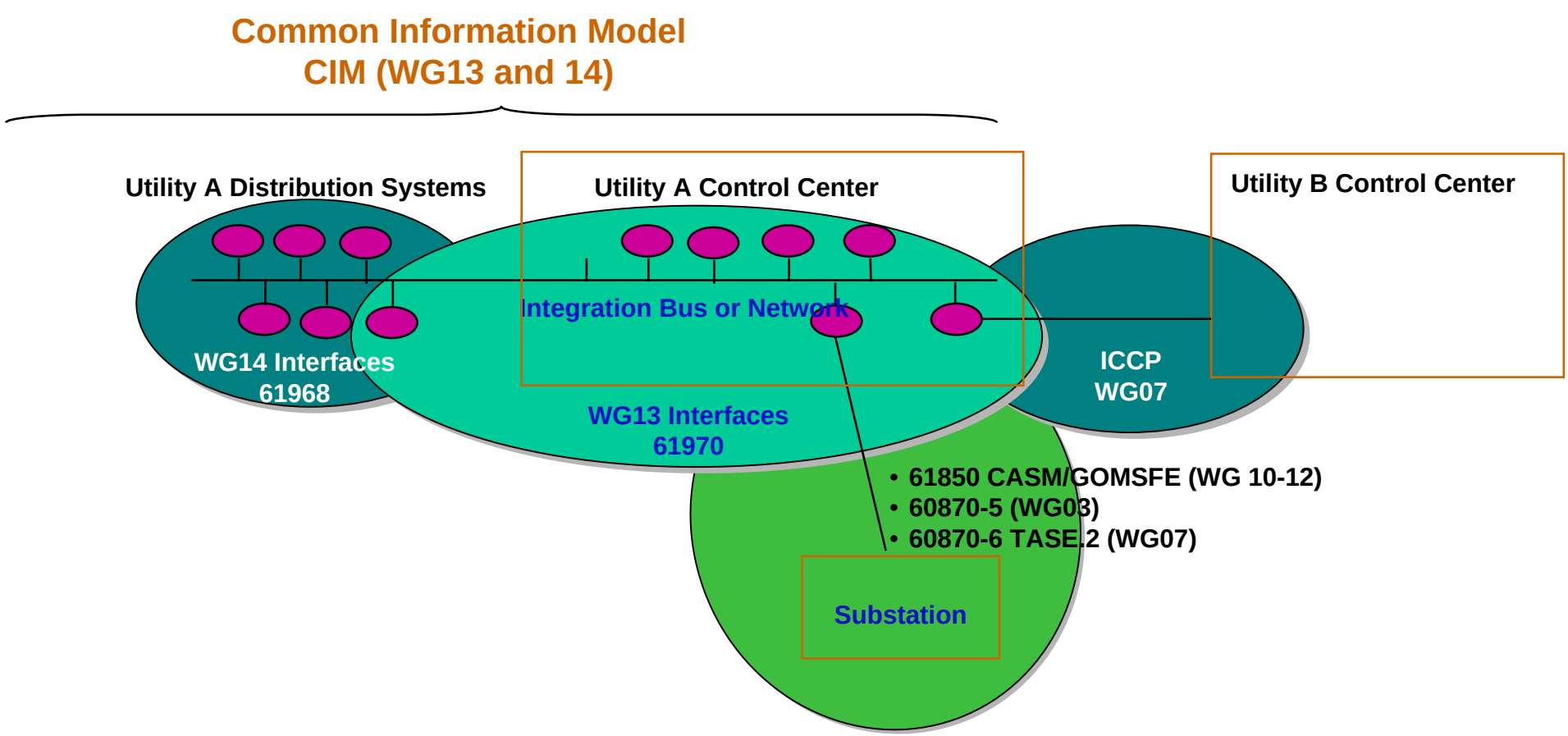
Standards Organizations Which Have Standards Based on the CIM

- International Electrotechnical Commission - Technical Committee 57 (IEC TC 57)
  - Working Group 13 (WG13) - Energy Management Systems & GID Interfaces
  - Working Group 14 (WG14) - Distribution Management System Interfaces
- Object Management Group (OMG) – GID Interfaces
- OPC Foundation – GID Interfaces
- Other organizations endorsing the CIM
  - EPRI
  - NERC

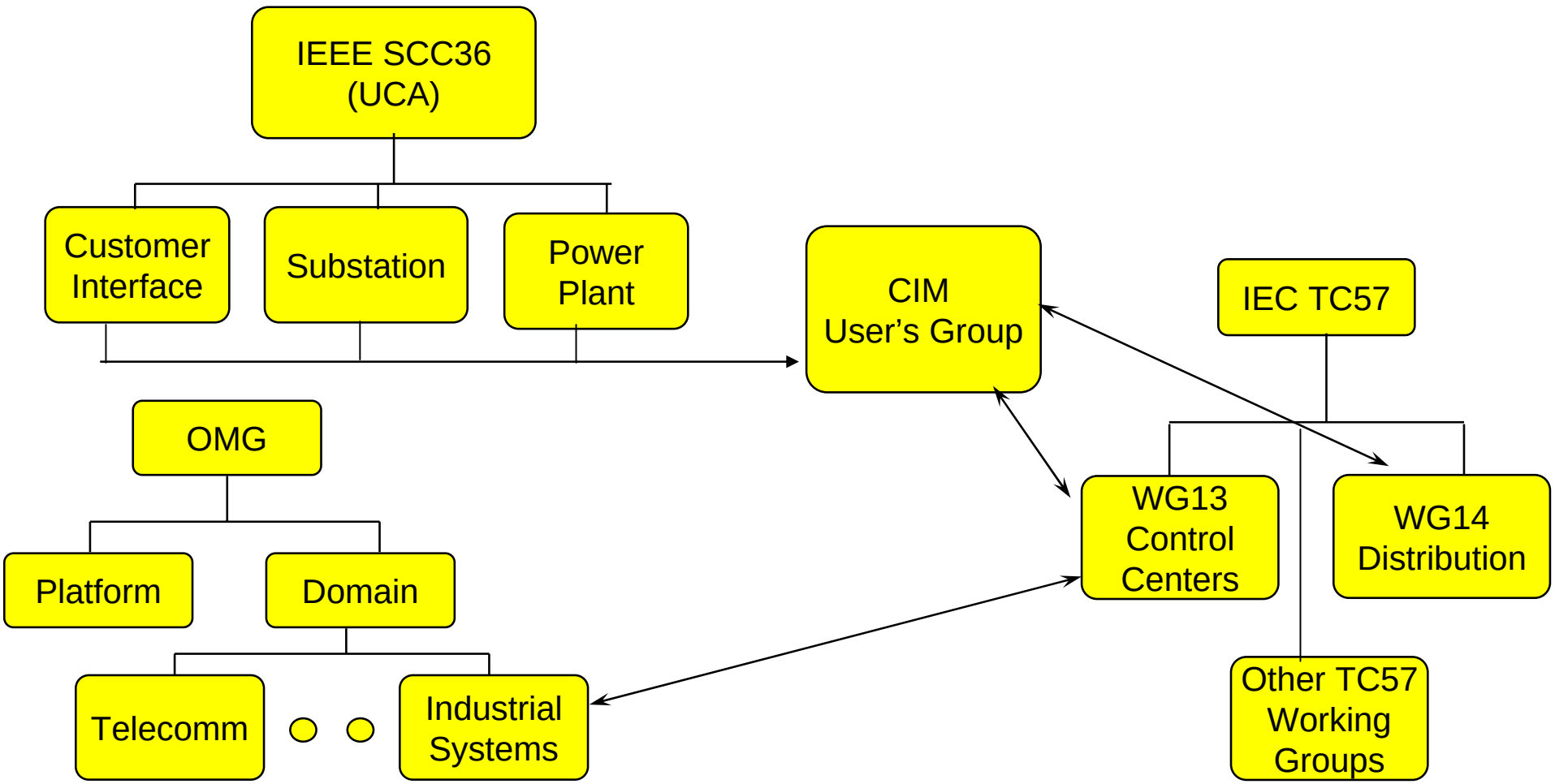
Standardization Activities



IEC TC57 Standards and Scope



Coordination of Standards Groups



IEC 61970 CIMXML And GID Specifications Currently Available

- CIM - Common Information Model
  - CIM Base in UML -301
  - CIM Energy Scheduling, Reservations & Financial -302
  - CIM SCADA -303
- CIS - Component Interface Specifications
  - GID - Generic Interface Definition
    - Common Services -402
    - GDA - Generic Data Access -403
    - HSDA - High Speed Data Access -404
    - GES - Generic Eventing and Subscription -405
    - TSDA - Time Series Data Access -407
  - CIM Model Exchange Format (NERC profile) -452
- CIS Implementation Bindings (Companion Standards)
  - CIM RDF Schema (UML->RDF) -501
  - CIM XML Model data Exchange Format -552-4

Topics

- The Common Information Model (CIM)
  - Overview
  - CIM Packages
  - Definitions
  - UML Notation– A diagramming tool
  - Examples
- Standards Overview
  - Origin of Standards Activities
  - Standards Bodies
  - Current Standards Activities
- CIM User's Group
- ERCOT Data Dictionary

UCAIUG (CIM User's Group) - Mission

- Advancing Interoperability for the Utility Enterprise via support for international standards:
  - Educational Activities
  - Improvement Process for International Standards
  - Testing and Certification
  - Promotional Activities

UCAIUG – Technical Focus

- **Communications**
  - IEC 61850 – Substation Automation
  - IEC 61850 based extensions for wind, hydro, distributed generation, etc.
- **Application Integration**
  - Common Information Model (CIM) IEC 61970 and IEC 61968
  - Generic Interface Definition (GID) IEC 61970
- **Metering and Demand Response**
  - OpenAMI – Information/data models, reference designs and interoperability guidelines based on IntelliGrid and IEC standards.

ONE MEMBERSHIP

Benefits of Membership

- Shorten learning curve with access to educational materials and experts
- Gain timely access to information on standards activities
- Gain valuable insight from peers and benefit from sharing/accessing common solutions
- Support and participate in a community effort to establish useful standards for our industry
- Make your company's leadership visible in the industry

Educational Activities

- Utility University at DistribuTECH

- Technical papers and panel sessions:
  - DistribuTECH
  - IEEE PES T&D Expo – Dallas, TX (May 2006)
  - IEEE PSCE – Atlanta, GA (Oct/Nov 2006)

Bottom-Line Benefits

- Test and certification activities that lower costs for users
- Provide input to international standards activities at no additional cost and no travel to Standards Meetings
- Members only access to:
  - Resolution of technical issues related to standards
  - Industry experts via a global help desk
  - Technical documents and best practices from existing users
  - On-line discussion forums
- Discounts on paid seminars and exhibitions

Membership Options

Revenue	Annual Member Fee	# of Members
Corporate Member < US$1M in Revenue	$1,000	2
Corporate Member US$1M - US$10M	$2,000	4
Corporate Member US$10M - US$100M	$3,000	6
Corporate Member US$100M - US$1B	$4,000	8
Corporate Member > US$1B in Revenue	$5,000	10
Government Agency	$5,000	2
Trade Association	$1,000	2
User Group	$1,000	2
University	$1,000	2
Standards Group	$1,000	2
Individual	$ 250	1

Who Should Join?

- Every small utility, supplier or consultant should have at least one individual member for access to information.

- Every med/large utility, supplier or consultant should be a corporate member to maximize benefits and obtain voting and full participation privileges.

join@ucausersgroup.org

Topics

- The Common Information Model (CIM)
  - Overview
  - CIM Packages
  - Definitions
  - UML Notation– A diagramming tool
  - Examples
- Standards Overview
  - Origin of Standards Activities
  - Standards Bodies
  - Current Standards Activities
- CIM User's Group
- ERCOT Data Dictionary

ERCOT Data Dictionary

- The Data Dictionary is a spreadsheet with separate worksheets for the following:
  - Classes
  - Attributes
  - Associations
  - Enumerated Data Type
- Each worksheet contains specific information. For example, the Class worksheet contains:
  - Class Name
  - Inheritance Path
  - Namespace
  - Description
  - Profile

ERCOT Data Dictionary

- The Attribute worksheet contains:
  - Class Name
  - Attribute Name
  - Data Type
  - Initial Value
  - Namespace
  - Description
  - Profile
- There Profiles allow the NMMS to identify what data is required for each of the following systems:
  - EMS
  - MMS
  - CRR
  - Settlements & Billing

Contact for Additional Information

- For additional information, send an email to mgoodrich@ercot.com
- Or Call – Off: 512-248-3814 or Cell: 903-477-7176