EPRI | ELECTRIC POWER RESEARCH INSTITUTE

EPRI CIM/GID International Conference

Lakeside Conference Center B
Midwest ISO Office
701 City Center Drive
Carmel, Indiana
November 1-2, 2005

Agenda

Tuesday, November 1

Time	Topic	Speaker
8:00 am	Registration Continental Breakfast courtesy of Midwest ISO	
9:00 – 12:00	**Morning Session** – *Executive Voice*	
9:00 am	Introductions	D. Becker
9:15 am	Agenda Review	T. Saxton
9:30 am	1. CIM – Part of An Overall Utility Information Technology Strategy	M. Hervey
10:00 am	2. TVA – CIM Experience	T. Tyler
10:30 am	Panel Discussion	Executive Speakers
10:45 am	Break	
11:05 am	3. EPRI - Standards-IntelliGrid and CIM/GID	R. Lordan
11:30 am	4. Real-Time Power Flow in a Planning Environment at LIPA	D. Becker
12:00 pm	Lunch	
1:00 – 5:00	**Afternoon Session** - *Utility Experiences with CIM, GID, and Messaging Standards*	
1:00 pm	5. Using the CIM Class Model in the Development of Web Services	G. Congleton
1:30 pm	6. EDF Feedback on CIM Standard	A. Maizener
2:00 pm	7. CIM-Enabled Service Oriented Architecture (SOA) at CAISO	T. Saxton
2:30 pm	Break – soft drinks courtesy of Midwest ISO	
2:50 pm	8. Status of IEC TC57 CIM/GID/Messaging Standards	T. Saxton
3:10 pm	9. NERC Reliability Coordinators (RCC) perspective on the CIM	D. Zwergel
3:40 pm	10. Guidelines on how to apply standards and extend the CIM (use of CIS documents, examples from messaging, MDI, use cases)	T. Saxton
4:00 pm	11. CIM Maintenance and Version Management	K. Hunter
4:30 pm	Discussion and Q/A	
5:00 pm	*Adjourn*	
6:30 pm 7:15 pm	*Reception* *Dinner* – both events are sponsored by EPRI at the Ritz Charles, 12156 N. Meridian Street, Carmel	

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Wednesday, November 2, 2005

Time	Topic	Speaker
8:00 am	Continental Breakfast courtesy of Midwest ISO	
9:00 – 12:00	**Morning Session**: *Utility experiences with CIM, GID, and messaging standards*	
9:00 am	12. The Common Information Model as a Software Framework	A. McMorran
9:30 am	13. LIPA CIM/GID Unified Data Model for the Enterprise	B. Desai
10:00 am	14. SCE – CIM Experience	T. Kikkawa
10:30 am	Break	
10:50 am	15. The CIM within Exelon	D. Hengst
11:20 am	16. NSTAR experience with CIM/XML power system model import to build EMS model	E. Margalejo
11:50 am	Q/A	
12:00	Lunch	
1:00 – 5:00	**Afternoon Session** – *Testing and Issues*	
1:00 pm	17. CIM-GID Interoperability Test 7 Report	M.Goodrich
1:30 pm	18. IEC TC57 Standards Harmonization Efforts and Future Vision	P. Skare
2:00 pm	19. Compliance Testing 19a. Compliance Discussion – M.Goodrich 19b. Midwest ISO Data Exchange Issues – D. Dieser 19c. Compliance Requirements and Recommendations – E.Haq 19d. Thoughts on Compliance Testing – T. Saxton	Panel Session
2:45 pm	Break – soft drinks courtesy of Midwest ISO	
3:00 pm	20. CIM User Group Plans and Status	G. Congleton
3:30 pm	21. CIM Issues – The Work to Be Done	G. Congleton
4:00 pm	Discussion Forum – Q/A time	
5:00 pm	*Adjourn*	

Long Island Power Authority

More choice... Better service!

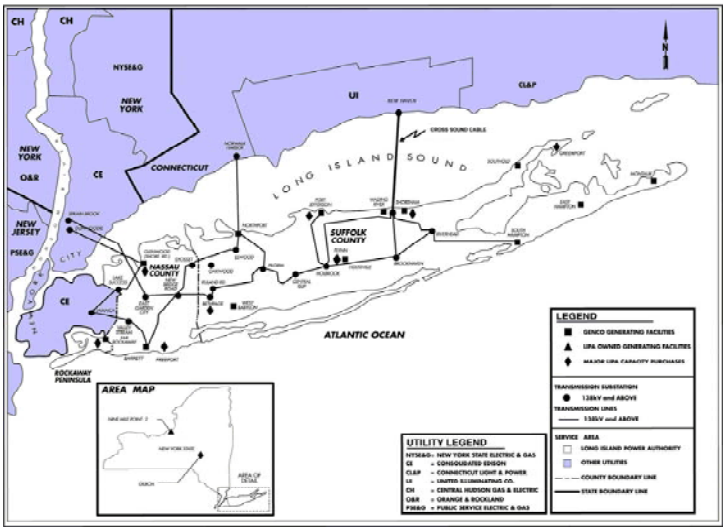
CIM — Part of An Overall Utility Information Technology Strategy

Michael Hervey, Executive Director of T&D Operations
Long Island Power Authority

EPRI CIM Users Group
November 1, 2005

www.lipower.org

LIPA's Service Area



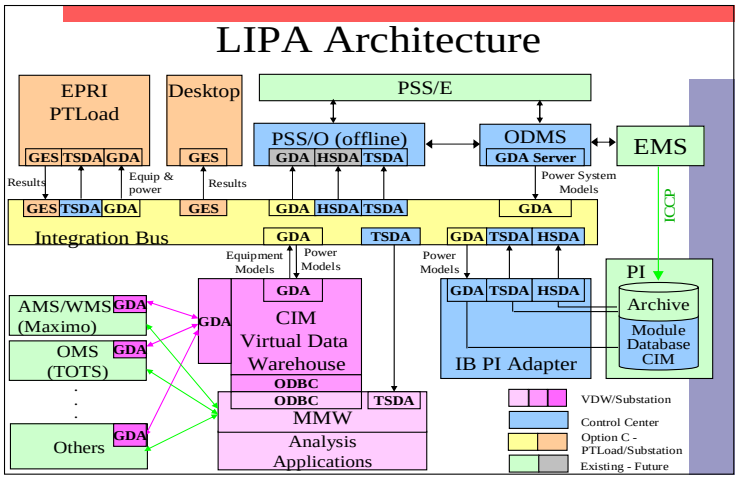
1

LIPA's strategy for future information systems includes a policy for all contractor-provided software

- Ownership clearly delineated.
  - LIPA may exercise the option of direct ownership (or licensing) of any new system or system enhancements.
- All information systems must:
  - Provide the maximum amount of flexibility and compatibility to address growth and integration opportunities.
  - Be based on commercially available software from financially secure software vendors with a substantial electric utility customer base.
  - Be easily operable and accessible by LIPA.
  - Have a clear, defined upgrade and integration path.
  - Conform to a standard architecture and integration strategy (discussed later in this presentation).
  - Be at least compatible with the last supported version of a vendor's product. LIPA must be notified, in advance, of any proposed implementation of a new release. LIPA reserves the right to approve or reject any release upgrade of a vendor's product.

2

CIM Architecture in System Operations



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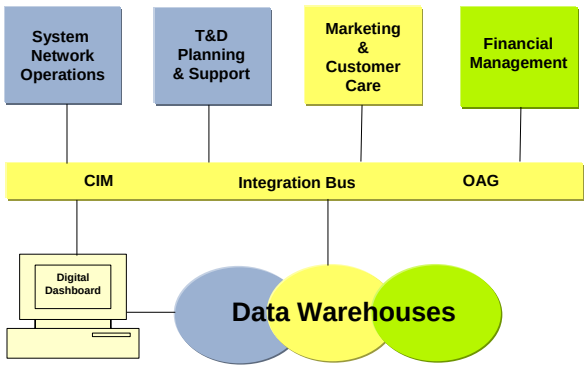
LIPA's Vision of CIM



4

LIPA's Actions to Date to Establish CIM

- Implemented CIM for System Operations.
- Performed Fatal Flaw Analysis for rolling out CIM to remainder of the T&D business enterprise.
- Beginning implementation for T&D Operations and Support — specific to newly implemented GIS and adapters to CYMDist and other applications.
- Evaluating implementation of CIM for other functions, such as customer care, market operations, etc.

5

Fatal Flaw Analysis — Advantages

- Creates a common data model
  - Everybody needs one.
  - Why reinvent the wheel?
- CIM is extensible
  - Missing data elements can be added through the standards process.
- No delay in software development
  - Approval of standards can occur after implementation…CIM is in continuous evolution.
- Widely accepted
  - 40 vendors, over 60 applications and almost 60 utilities — piggy back on best-in-class experience.
- Cost savings
  - Faster implementation of new systems and modules.
  - Ability to stage CIM implementation as new systems are added or major modifications are made to existing systems.

6

Fatal Flaw Analysis — Risks & Strategies

- Maturity of CIM
  - Over ten years in use.
- Not a database
  - Which is a good thing since it establishes logical model.
  - But physical model can be created to fit individual organizations needs.
- Limited number of applications
  - Expect continued growth as model is extended to T&D, power markets, and customer care.
- Utilities use different naming conventions
  - Use of wrappers/adapters is easier to build than rewriting interfaces.
- Concerns over throughput of integration bus
  - Can be mitigated by layering of applications, but the CIM architecture remains.

7

Results of Fatal Flaw Analysis of CIM Helped Develop LIPA's Plan Going Forward

- Remain committed to CIM as ***THE*** architecture.
- Continue to extend CIM/IB to remainder of the LIPA enterprise.
- Take advantage of major system upgrades or replacements to control timing and costs of CIM/IB implementation.
- Increase LIPA's flexibility to add new service providers and/or IT systems as market conditions change and long term strategies evolve.

8

Questions?

9

The Industry's Need for CIM

Terry Tyler
TVA

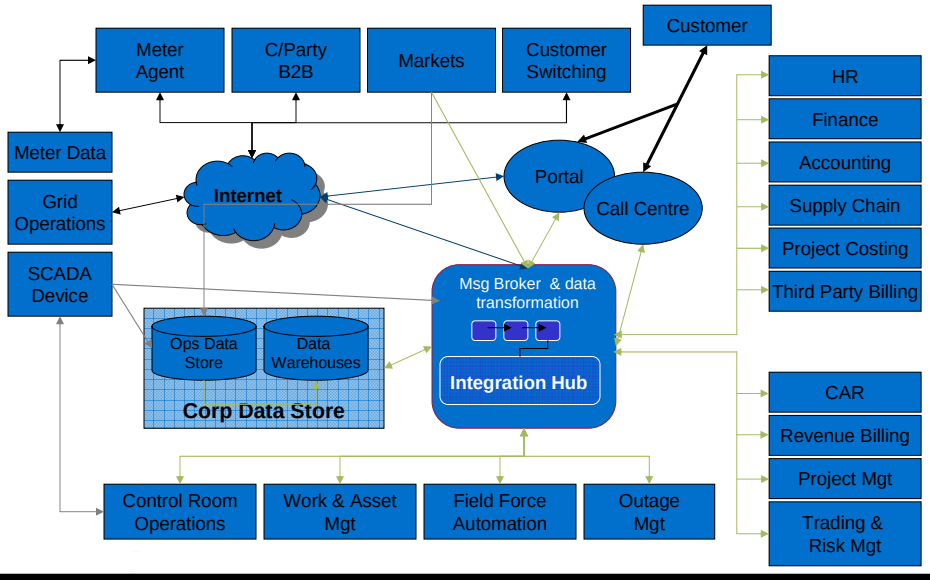
EPRI CIM/GID International Conference

November 1, 2005

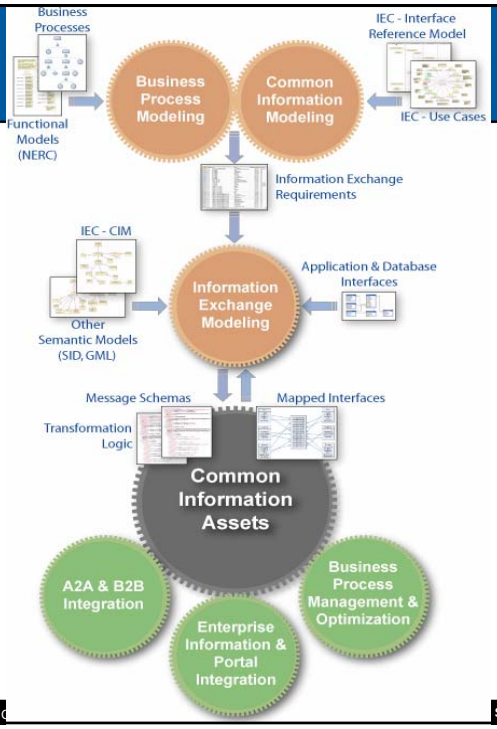
What do the following have in common?

- APQC
- SCOR
- MIMOSA
- IAI
- ISO 15926
- CIM
- SOA

Each of these standards organizations want to play a role in the meta data modeling and naming to make this integration model work



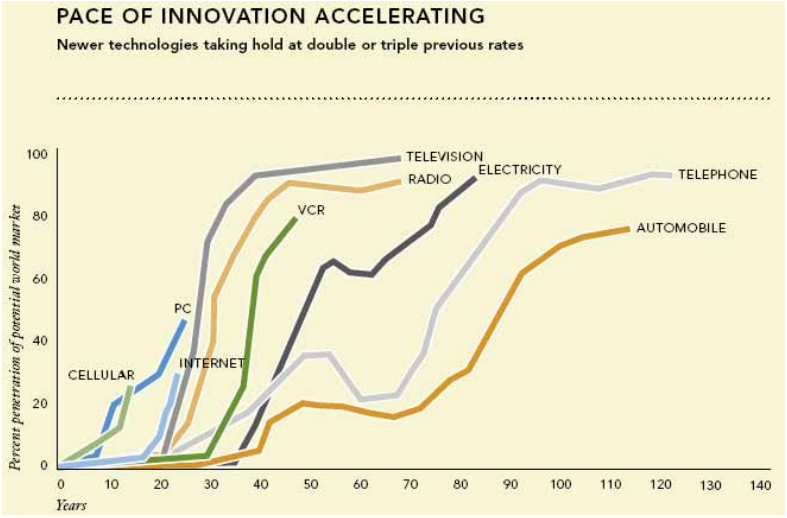
Design Time Process for Model Driven Integration



In case this is not confusing enough

Look what the future might hold

"Technopoly – Culture's Surrender to Technology"



Source: IBM GIO 2004

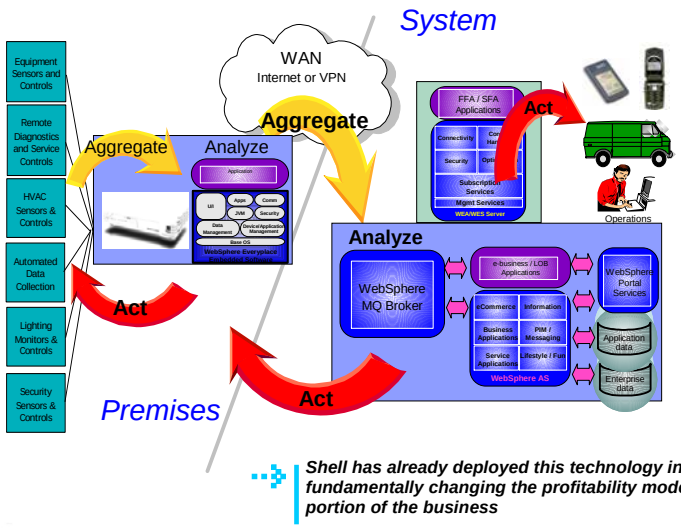
Energy Trends Point to Unique Opportunities for Investors, Industry, and Policy-Makers, Reports Clean Edge

- A variety of issues have aligned to offer unique opportunities in the clean-energy sector including security issues, energy uncertainty, the need for power reliability, technological advances, environmental issues, the rise of the developing world, and investment commitments by government, corporations, and venture capitalists.

- The report reveals five trends to watch in the near- to mid-term:
  - The Energy Web: the emerging marriage of the energy, telecom, and software sectors that is creating a whole new breed of ``smart'' appliances, buildings, and vehicles
  - The Hydrogen "ECONOMY" Infrastructure: the assemblage of products, services, and systems that will enable the manufacture, storage, and transportation of hydrogen for use in stationary and portable fuel cells
  - Bringing Solar to Scale: the mass commercialization and build-up of large-scale solar-cell manufacturing that will result in significant economies of scale
  - The Microtization of Fuel Cells: the application of micro fuel cells for use in a wide range of portable electronic devices including cell phones, personal digital assistants, and laptop computers
  - "NANOTECHNOLOGY" Carbon Nanotubes: tiny fabricated tube-shaped molecules that are optimal for hydrogen storage -- and are getting close to commercial viability.

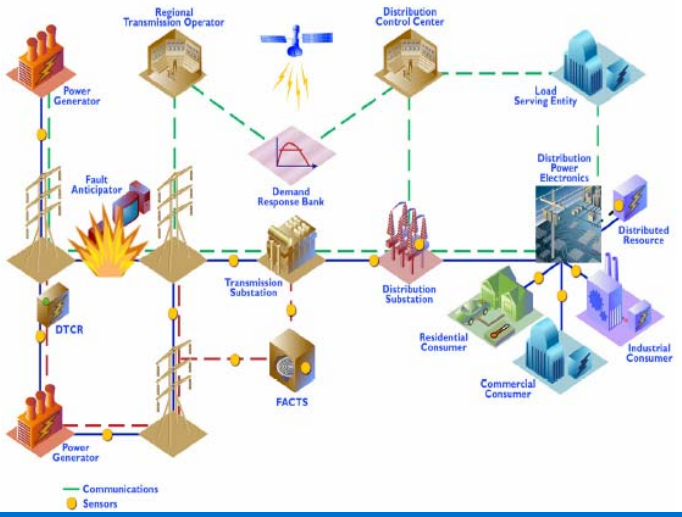
Source: Cleanedge.com January 3, 2002

Nanotechnology is fundamentally change sensors allowing them to be embedded in every aspect of the business setting the stage for a new era of maintenance practices and operations



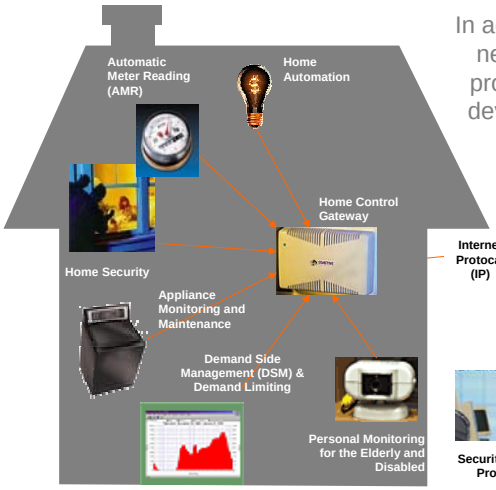
Shell has already deployed this technology in the e-Station, fundamentally changing the profitability model for this portion of the business

Consortium for Electric Infrastructure to Support a Digital Society (CEIDS) has embarked upon the infrastructure to support a digital society

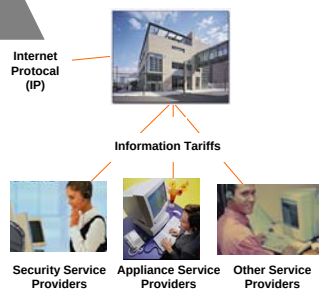


"The best minds in electricity R&D have a plan: Every node in the power network of the future will be awake, responsive, adaptive, price-smart, eco-sensitive, real-time, flexible, humming – and interconnected with everything else."
-- Wired Magazine, July 2001The Energy Web

Bridging the last mile and last inch will enable the next major change to the traditional energy company business model

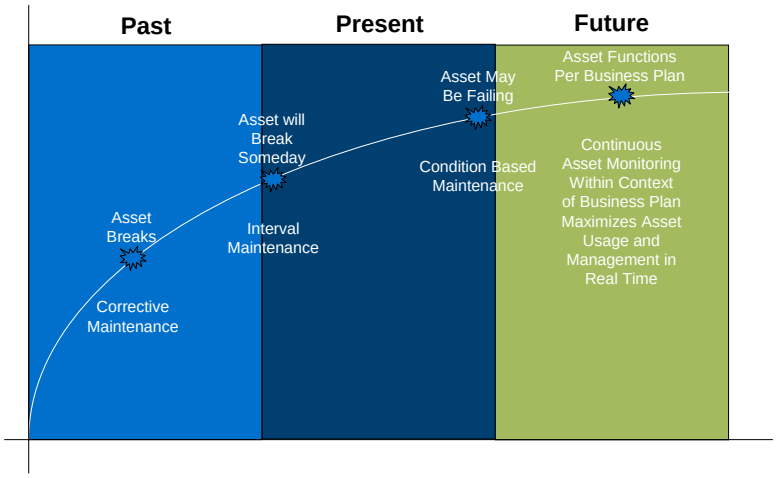


In addition to an energy control network, third party service providers are able to access devices in the home network through the IP network



Technology advancement across several fronts is poised to fundamentally change every aspect of the traditional industry value proposition

Our ability to manage is shifting out along the asset availability continuum



Managing in near real time shifts a company's focus and style of management

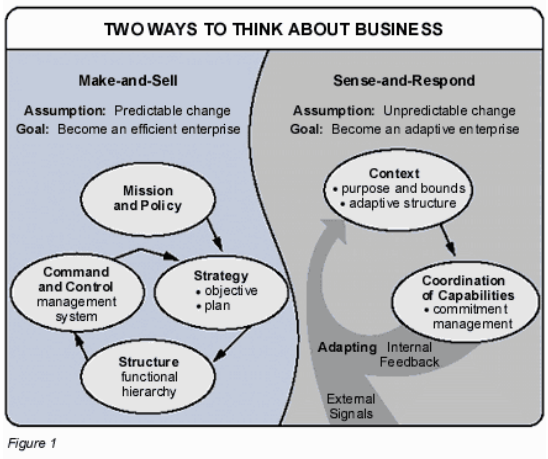


Figure 1

Source: The Adaptive Enterprise, Dr Stephan Haeckel

Who are the leaders in making this transition to managing in near real time?

- e-Bay
- Cisco
- Delta Airlines
- Alcoa
- Dupont
- GE
- Landstar
- Motorola
- McDonalds
- IBM
- GM
- Xcel Energy
- Exelon
- Edison International
- Genentech
- World class benchmark companies

In conclusion

- Models like CIM and compliance thereto are critical today but will be absolutely essential to future company success
- Technology is making matters worse today and will significantly complicate matters in the not too distant future
- Your attendance at this event is a first step
- Your commitment to supporting the future of the CIM model are essential to all of our collective future success

Appendix

Additional Information on Other Efforts Similar to CIM

ISO 15926

- The Oil and Gas (ISO 15926) : Integration of life-cycle data for oil and gas production facilities (Oil & Gas). This initiative includes standardization of the data associated with the engineering construction and operation of oil and gas production facilities.
- ISO 15926-2:2003 specifies a conceptual data model for computer representation of technical information about process plants. The information required by the following activities is within the scope of ISO 15926-2:2003:
  - specification of requirements to produce, process, and transport process materials;
  - specification of functions required to produce and process the required materials, including the following:
    - hydrocarbon process and conditioning systems,
    - injected gas and water conditioning and injection systems,
    - oil and gas product transport systems,
    - safety and control systems,
    - electricity generation and supply systems,
    - steam generation and supply systems,
    - structures,
    - buildings and accommodation;
  - specification and selection of materials and equipment to provide the required production and processing functions, including information about market available materials and equipment;
  - installation and commissioning of plant equipment;
  - production and process operations, including process conditions and consumption, yields and quality of process material;
  - maintenance and replacement of equipment.

http://www.iso.ch/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=29557&ICS1=25&ICS2=40&ICS3=40

Machinery Information Management Open Systems Alliance

- MIMOSA is a not-for-profit trade association dedicated to developing and encouraging the adoption of open information standards for Operations and Maintenance in manufacturing, fleet, and facility environments. MIMOSA's open standards enable collaborative asset lifecycle management in both commercial and military applications. MIMOSA is composed of progressive process and discrete manufacturing corporations, facility management companies, military organizations, capital equipment OEMs, and suppliers of asset management software systems including Human-Machine Interfaces (HMI), Manufacturing Execution Systems (MES), Plant Asset Management (PAM) systems, Enterprise Resource Planning (ERP), Enterprise Asset Management (EAM/CMMS) systems, Operational Data Historian Systems (ODHS), and Condition Monitoring (CM) systems.

http://www.mimosa.org

Supply Chain Reference Operations model (SCOR)

- The Supply-Chain Council was organized in 1996 by Pittiglio Rabin Todd & McGrath (PRTM) and AMR Research, and initially included 69 voluntary member companies. The Supply-Chain Council now has closer to 1,000 corporate members world-wide. The Supply-Chain Council's membership consists primarily practitioners representing a broad cross section of industries, including manufacturers, services, distributors, and retailers.

  The Supply-Chain Operations Reference-model (SCOR) is a process reference model that has been developed and endorsed by the Supply-Chain Council as the cross-industry standard diagnostic tool for supply-chain management. SCOR enables users to address, improve, and communicate supply-chain management practices within and between all interested parties.

http://www.supply-chain.org

International Alliance for Interoperability (IAI)

- IAI is an alliance of organizations dedicated to bring about a coordinated change for the improvement of productivity and efficiency in the construction and facilities management industry (*Building Smart*). Our members engage in national-industrial programmes that aim to change the organisation, process and technology of the industry.

- ***IFC/ifcXML Common Model***: We have developed a common building model (ifc/ifcxml), which forms the basis of our technologies that delivers our Building Smart mission. Click here for latest IFC/ifcXML specifications of the model.

  Software: Major vendors of Building Information Model (BIM) have implemented support for IFC in their products. Many downstream applications (such as Structural engineering, HVAC design, Thermal analysis, Code checking, Quantity take-off, Cost estimation, etc.) have also implemented IFC support in their products. Click here for the lists of available IFC compatible software.

http://www.iai-international.org

STANDARDS- IntelliGrid and CIM/GID

Integrated Energy and Communications System Architecture

Rich Lordan
Technology Director
EPRI

November 1, 2005

EPRI

IntelliGrid Mission

IntelliGrid℠

Mission

To accelerate the transformation of the power delivery infrastructure into the intelligent grid needed to support our future society.

EPRI

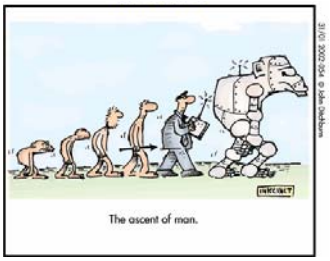
Vision of a Transformed Electricity Enterprise

Vision:

- *Self-Healing* and *Adaptive*
- *Interactive* with consumers and markets
- *Optimized* to make best use of resources and equipment
- *Integrated*
- *Secure*

How is the Intelligent Grid Created? The Premise

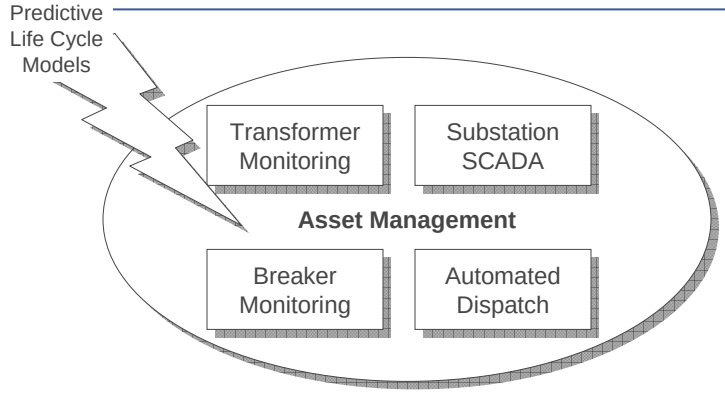
- Intelligent Systems will be deployed by utilities to perform a specific application that addresses a ***business or regulatory driver***
- Every utility will have different drivers; therefore, each utility will deploy different Intelligent Systems at different rates; therefore, taking a different path towards creating their intelligent grid.
- Over time new applications will reuse pieces for existing Intelligent Systems



How is the Intelligent Grid Created?

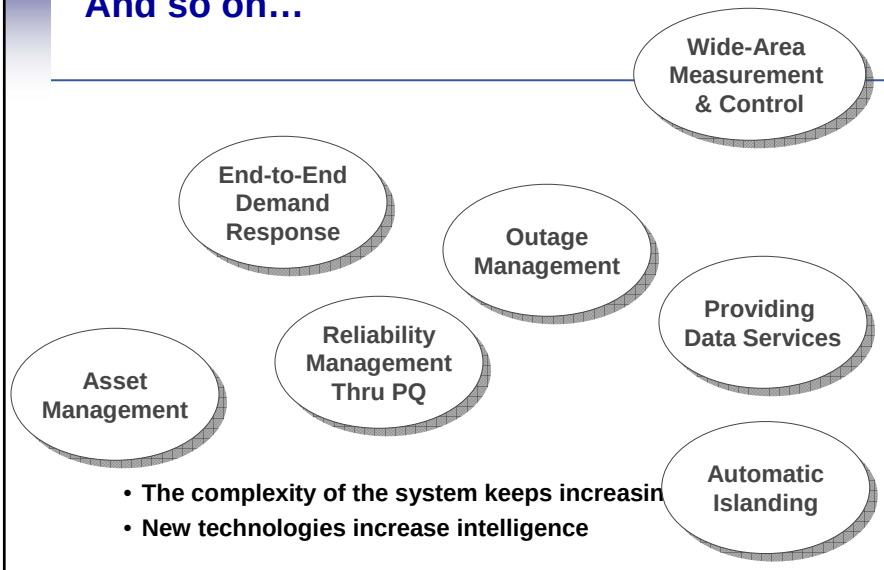
- Start with existing intelligent systems
- Progressively link them together
- Add new knowledge and technologies
- Create NEW intelligent systems with
  - Wider scope
  - Greater ability to adapt
- For example…

Example: Asset Management



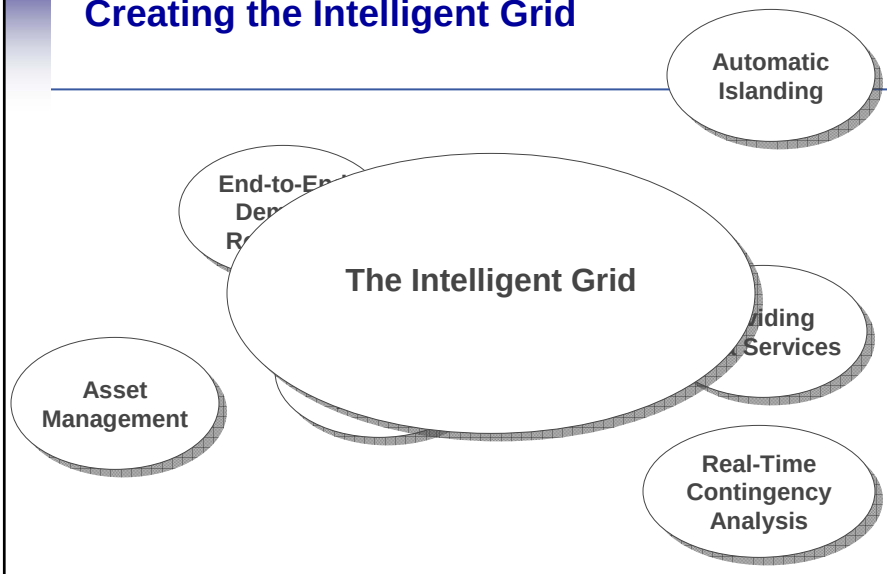
- **A utility sets up basic equipment monitoring…**
- **Adds a few more advanced capabilities…**
- **With the addition of some advanced technology,**
- **Creates a next-generation automation application**

And so on…



- The complexity of the system keeps increasin
- New technologies increase intelligence

Creating the Intelligent Grid



What is Impeding the Industry Towards the intelligent Grid?

- Lack of interoperability
- Limited methods or tools for designing complex communications systems
- Incomplete, overlapping and conflicting standards
- Utility practices and culture

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How Do We Overcome These Barriers?

Other industries have faced similar problems

- Integration of disparate systems
- Large complex systems
- Need for interoperability, scalability, upgradeability and security

Aerospace, Software, Telecom, and Power Industries

- **Enterprise architecture**
- **Systems Engineering methods**
- **Modeling - UML**
- **Open Standards**

CIM

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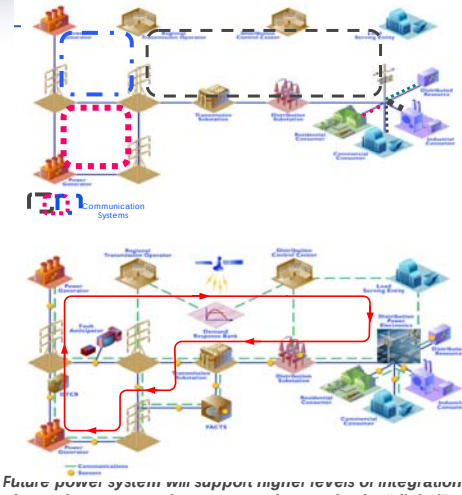
The IntelliGrid Architecture



Future power system will support higher levels of integration and federated systems services to meet the needs of a "digital" society

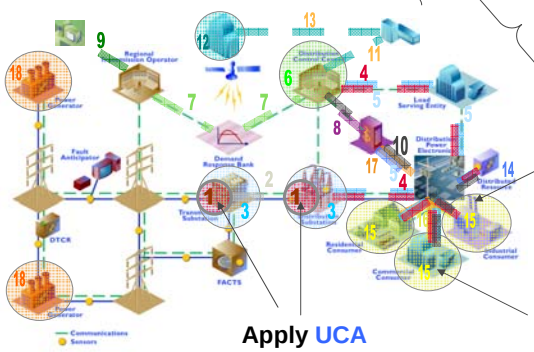
Both CIM/GID standards and the IntelliGrid Architecture is an open, standards-based architecture for integrating the data communications networks and intelligent equipment needed to support the Power Delivery System of the Future

Examples of IntelliGrid Architecture Recommendations

Develop and implement consistent systems management and security policies

Apply CIM for Enterprise Data Sharing

R&D: Harmonize UCA and CIM Standards



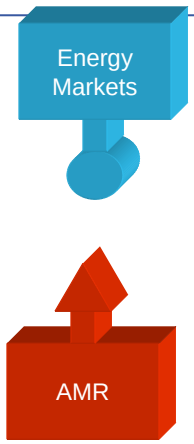
Apply ANSI C12 for Revenue Metering

Apply UCA for Real-Time Controls

Apply ASHRAE BACnet™ for Building Automation

CHALLENGES OF INTEGRATION:

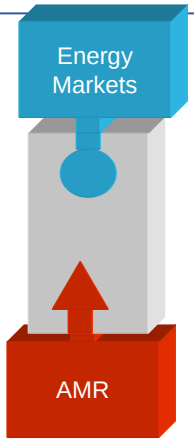
Building Isolated Systems



- Utilities tend to develop intelligent systems in isolation
- For example, AMR and participation in energy markets
- Neither project is typically developed with the other in mind.

CHALLENGES OF INTEGRATION:

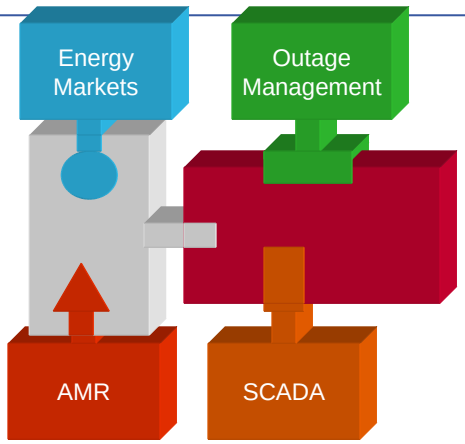
One-Off Integration



- Integration is typically done after the fact
- Cost is significant

CHALLENGES OF INTEGRATION:

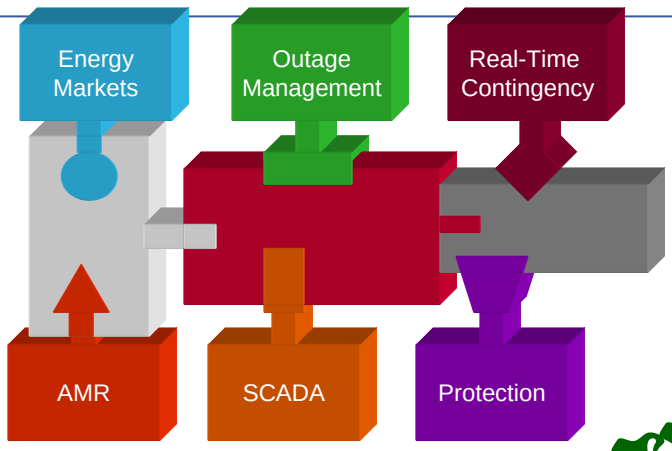
Doing it the Next Time



- Now want to link in new systems
- Must first make the old system expandable
- Then must do another “one-off” integration

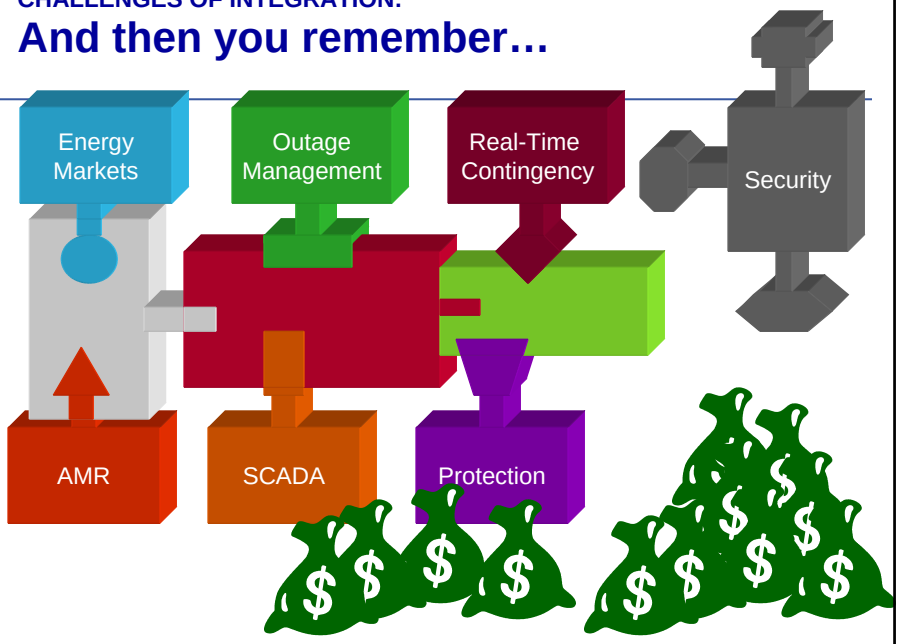
CHALLENGES OF INTEGRATION:

And again…

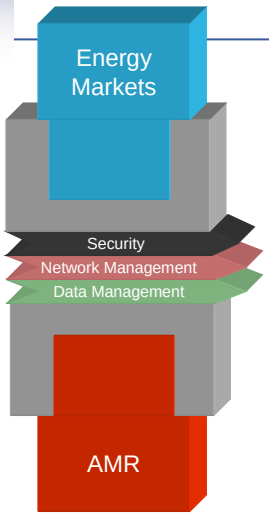


CHALLENGES OF INTEGRATION:

And then you remember…

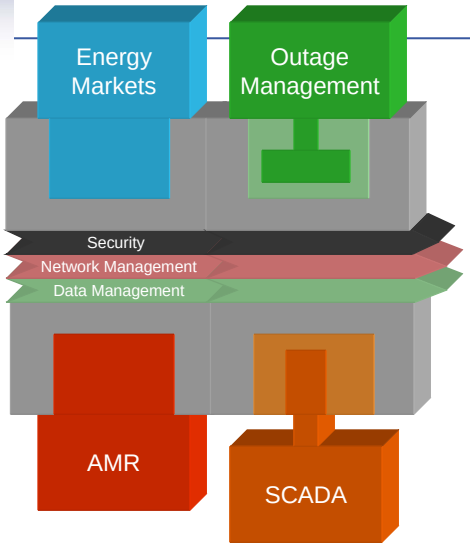


A More Efficient Way



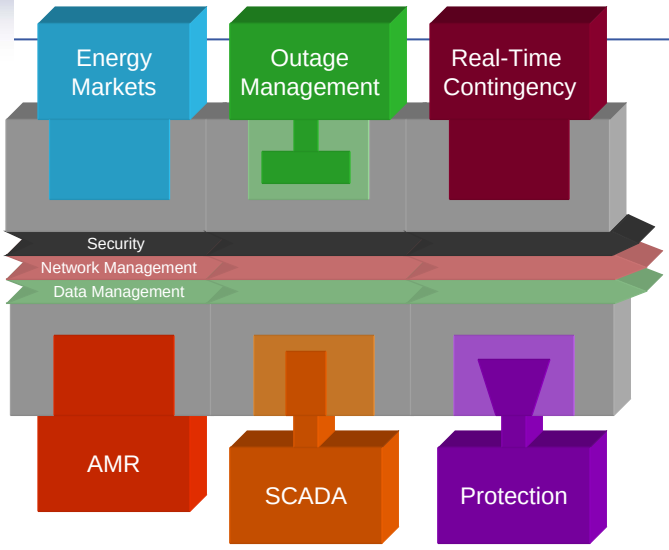
- Define standardized interfaces first
- Incorporate security, network management and other strategies right from the beginning
- Initial costs are a bit more than one-off integration, but not much more
- New applications can build directly to the new architecture

The Next Phase



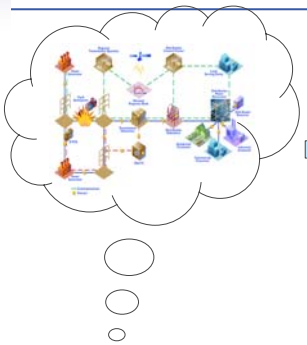
- Can re-use the development from the first phase
- Expansion was expected
- Adaptation to legacy systems was planned in advance
- Overall costs much lower

And so on…



- Benefits INCREASE with time
- Opposite of the old way

The IntelliGrid Architecture Project Processes



Establish the Vision of the Future Energy System

Work with Stakeholders to Refine Vision, Define Requirements and Analyze

Initial Results

Methods and Tools

Recommendations

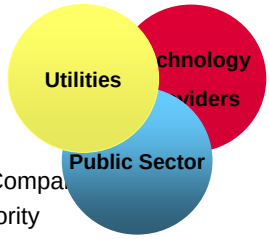
Available for Download and Public Use:

www.epri-intelligrid.com

www.intelligrid.info

Intelligrid Consortium Partners

U.S. Utilities
- Public Service Electric & Gas
- Long Island Power Authority
- Salt River Project
- TXU
- We Energies
- Bonneville Power Administration
- Consolidated Edison Compa
- New York Power Authority



International Utilities
- Polish Power Grid Company
- Electricite de France

Public Agencies
- U.S. Department of Energy
- California Energy Commission

Manufacturers
- ABB
- Hitachi

Demonstration Projects

- California Energy Commission/California Investor Owned Utilities: Demand Response/Advanced Metering Development
- Texas Utilities: Advanced Metering Infrastructure Development
- Long Island Power Authority: Enterprise Architecture Development
- Salt River Project: Transfer Station Equipment Monitoring
- Electricite de France: Application of IntelliGrid Unified Modeling Language Model

EPRI

Real-Time Power Flow in a Planning Environment at LIPA

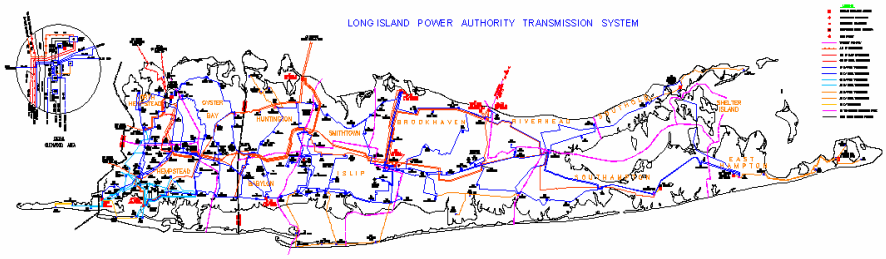
Dave Becker

CIM/GID Conf – November 1,2005

Who Is LIPA?

- State utility located on Long Island New York
- Long Island Power Authority owns T&D
- Keyspan owns the power plants and manage T&D for LIPA

LIPA Transmission Map



LIPA T&D Statistics

- Service Area……..1,230 sq. miles
- Electric Customers…1,085,000
- All-Time Peak…….5,267 MW (8/5/05)
- Substations……..142
- Distribution Circuits….812
- O. H. Transmission…..1,037 circuit miles
- U. G. Transmission.....245 circuit miles
- Generation……5069 MW
- Six Interties……1462 MW

4

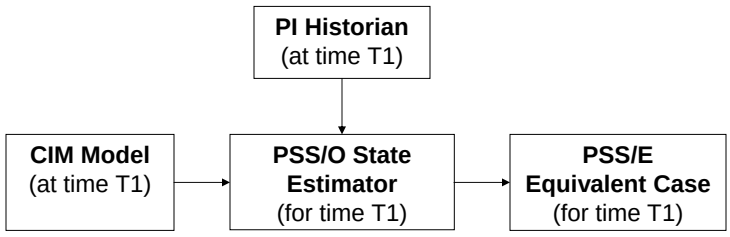
Control Center Project Requirements

- Accurately model the transmission system for any point in time
  - Past EMS model not available
  - Past EMS SCADA is available
  - Prior Procedure:
    - Modify a planning load flow to match real time
    - Very time consuming and low accuracy

5

Control Center Proposed Solution

- Build CIM model from GE Harris EMS model
- Track network changes to recreate historical model
- Retrieve Measurement Data from PI Historian
- Run PSS/O to support Operations with real-time load flow analyses
- Create PSS/E load flow models for Electric Planning



6

What is GID & UIB?

Generic Interface Definition:

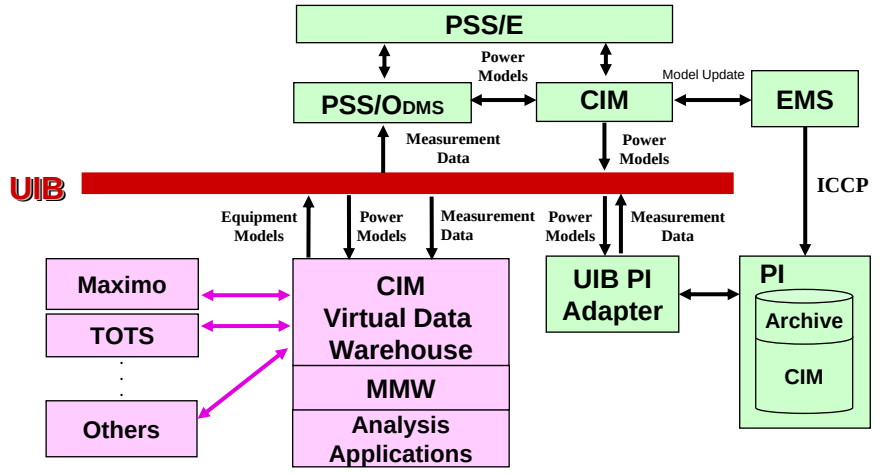
- Emerging standard for exchanging CIM data
- Composed of messages protocols:
  - GDA: Generic Data Access
  - HSDA: High-speed Data Access
  - TSDA: Time-series Data Access
  - GES: Generic Eventing and Sequencing

Utility Integration Bus:

- SISCO's Implementation of the GID

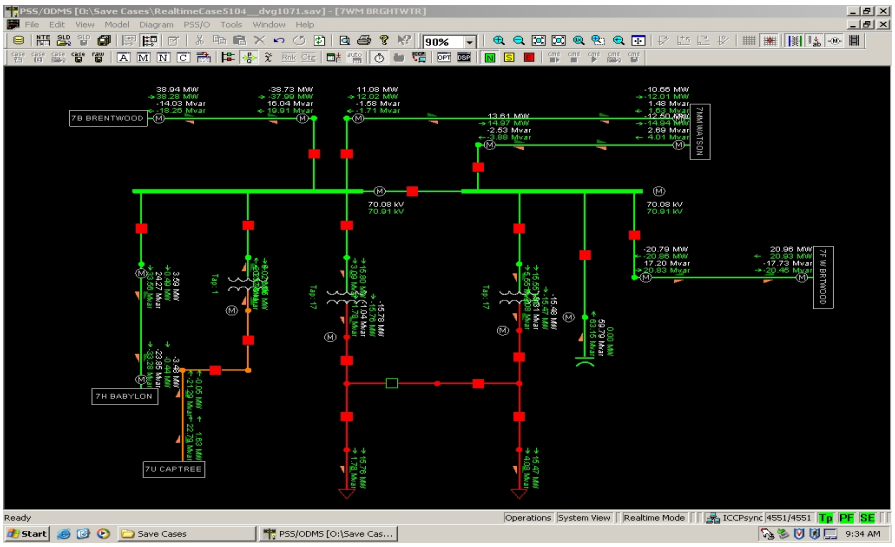
7

Solution Architecture



8

PSS/O Display



Experience Gained So Far on CIM Application

- It is critical to define in great detail the scope of the application. The Control Center Project took a year to spec out
- All the departments involved must buy in the project
- Requires long term management support
- Detailed implementation schedule must be established
- Schedule of acceptance tests must be developed
- Commitment to update the model must be established

Major Issues

- Make sure all EMS data points including quality points are broadcasted to the UIB bus
- Resolve all State Estimator convergence problems
- Accurately map all data points to model

11

State Estimator Convergence Tips

- Data Points and Quality points required
- Add data points for outside world
- Add Pseudo measurements to the outside world to make the area observable
- Small distribution transformers may cause low voltage if high side telemetering is not accurate
- Correct transformer and Phase Shifter tap settings
- Breaker position (open/close) must match equipment flow
- Develop a step procedure that checks key data which prevent the State Estimator to converge

12

Operations Computer System Tips

- Ensure you receive a well-documented solution and your computer group is involved with every upgrade. They will eventually “own” this system
- Make sure performance, and usability issues are addressed early
- Computer group must have a good understanding of what the final product will be
- Make sure adequate resources are allocated to support and maintain the project
- Make sure deliveries are under configuration control
- Give vendor VPN access
- Give vendor full access to test the system

13

Project Status

- Real Time Load Flow – Operational
- State Estimator – Operational
- Export Real Time Case to PSS/E – Operational
- Export Historical Real Time Case to PSS/E – Under Testing

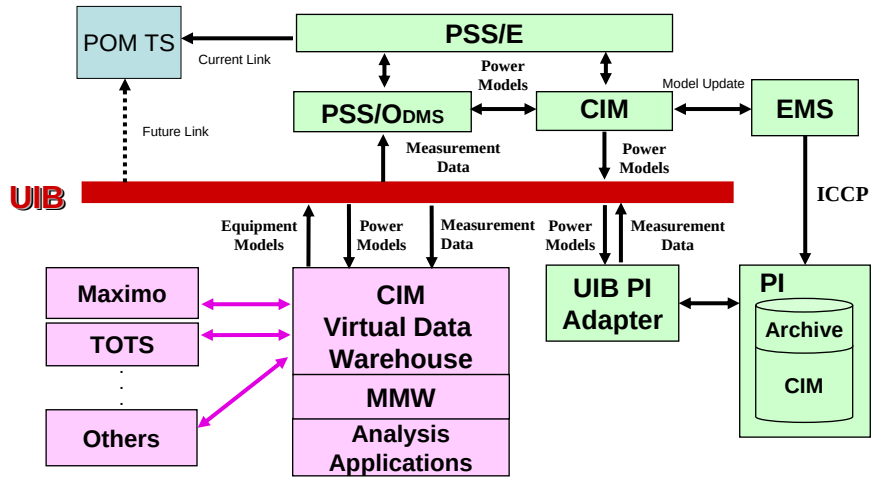
14

What's Next?

- Using the PSS/E output from the Control Center project run near term System Stability assessment to support ESO clearance during major construction projects
- Use the current system configuration as base to maintain future planning system configurations (future projects)
- Integrate the load flow cases generated by the Control Center project to facilitate the determination of actual transmission system losses and providing assistance to reduce them
- Integrate PRA (POM + PRI) to the UIB bus therefore providing real time Reliability Assessment analysis (PRI) and advance N-1, N-2 contingency analysis warning as system load increases
- EPRI commitment to add a CIM extension including Stability data

15

Solution Architecture



16

Naming Conventions and Definitions

- CIM – Common Information Model
- PSS/E = Power System Simulator for Engineering (Version 29+)
- PSS/O = Power System Simulator for Operations (Version 7+)
- ECI = EPRI CIM Installer (a base set of ODMS functionality)
- EMS = Energy Management System
- PI = XA/21 EMS Real Time Data Repository
- PNA = Power Network Analysis
- PSM = Power System Model
- MMW = Maintenance Management Workstation
- XA/21 = General Electric Network Solution EMS System.
- UIB = Utility Integration Bus
- GDA = General Data Access
- TSDA = Time-Series Data Access
- HSDA = High-Speed Data Access
- GID = Generic Interface Definition
- GES = Generic Event Sequencer
- ESO = Electric System Operations
- LIPA = Long Island Power Authority
- DPE = Distribution Performance Engineering
- EP&F = Electric Planning and Forecasting
- VDW = Virtual Data Warehouse
- ODBC = Open Data Base Connectivity
- XML = Extensible Markup Language
- PRA = Physical Reliability Assessment
- PRI = Physical Reliability Index
- POM = Physical and Operational Margins
- V&R Energy = EPRI Contractor which develop POM

TVA and CIM

Internal Integrity and Interchange

Greg Congleton
TVA

TPSIM

Data Repository

What is TPSIM?

Transmission / Power Supply Information Model

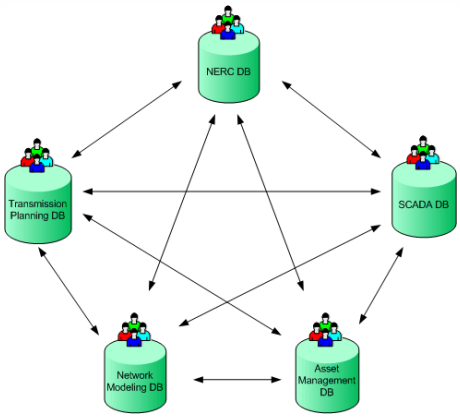
What is TPSIM?

- Database of the TPS transmission assets, designed to be CIM-compliant

What is TPSIM?

- Database of the TPS transmission assets, designed to be CIM-compliant
- Required interaction from all TPS departments

Pre-CIM



Introducing the CIM

- Potential for increased connectivity
- Data consistency

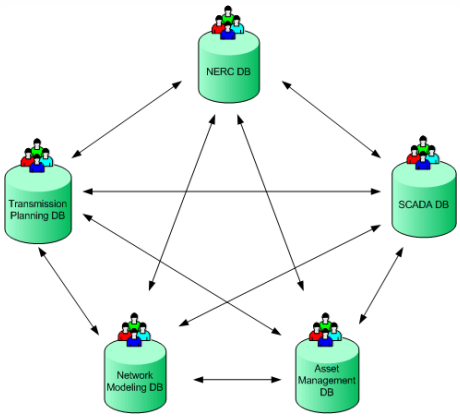
Mapping to the CIM

- Manual collection of data
- Identification table connecting CIM to TPS

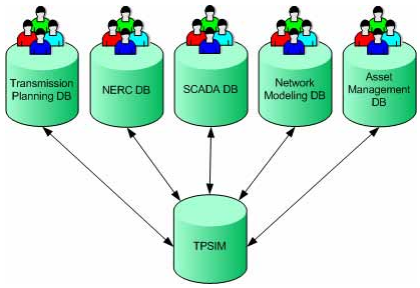
Extending the CIM

- Added TPS-specific tables
- TPS Identifiers, application-specific requirements, equipment types

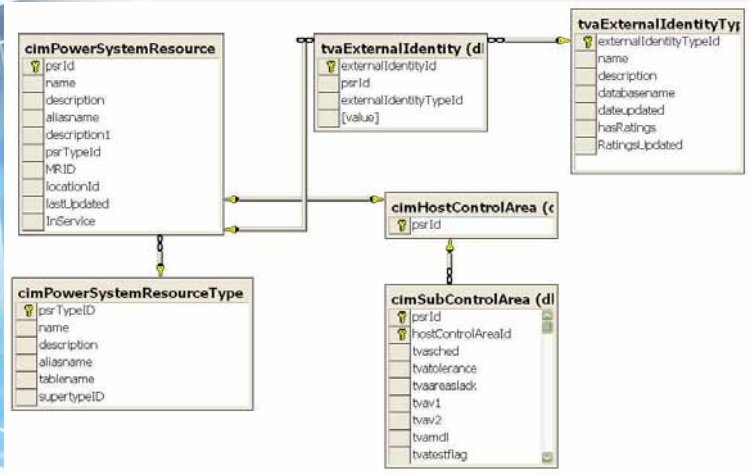
From this...



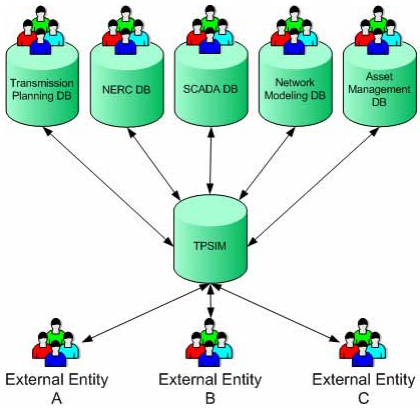
to this, so we can...



Cross Reference IDs...



do this.



Benefits

- Better interaction among departments
- Increased data access
- Better data consistency
- Plug-and-Play

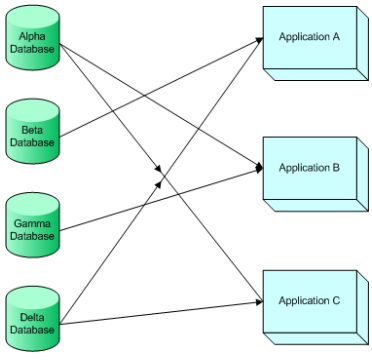
Challenges

- Mapping data to multiple departments
- Limited resources
- Maintaining data integrity

Web Services

Data Retrieval

The Problem



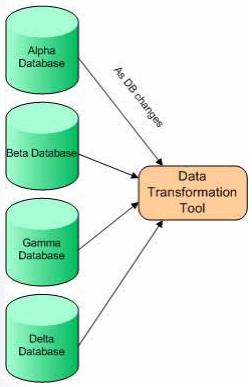
The Scope

- Over 300 different applications
- Over 100 different databases

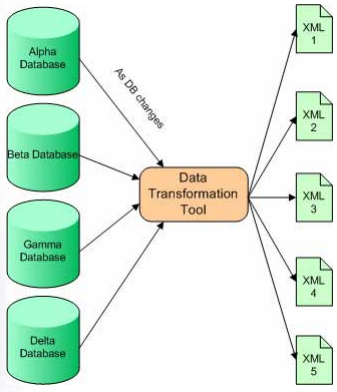
The Solution

- Provide a standard Web Service interface for all data requests
- Have the data content mapped to CIM and TVACIM labels

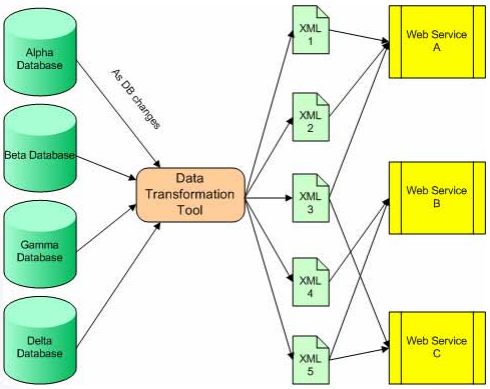
The Solution



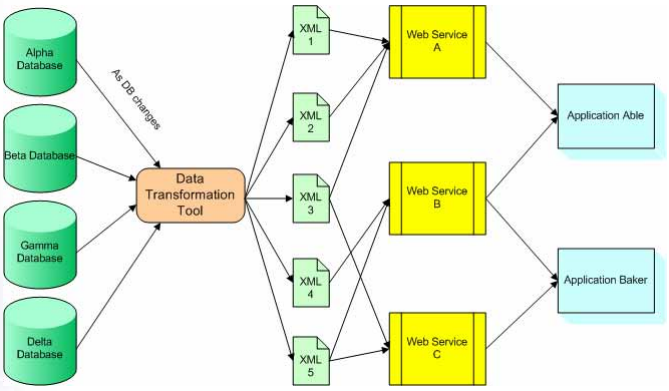
The Solution



The Solution



The Solution



XML

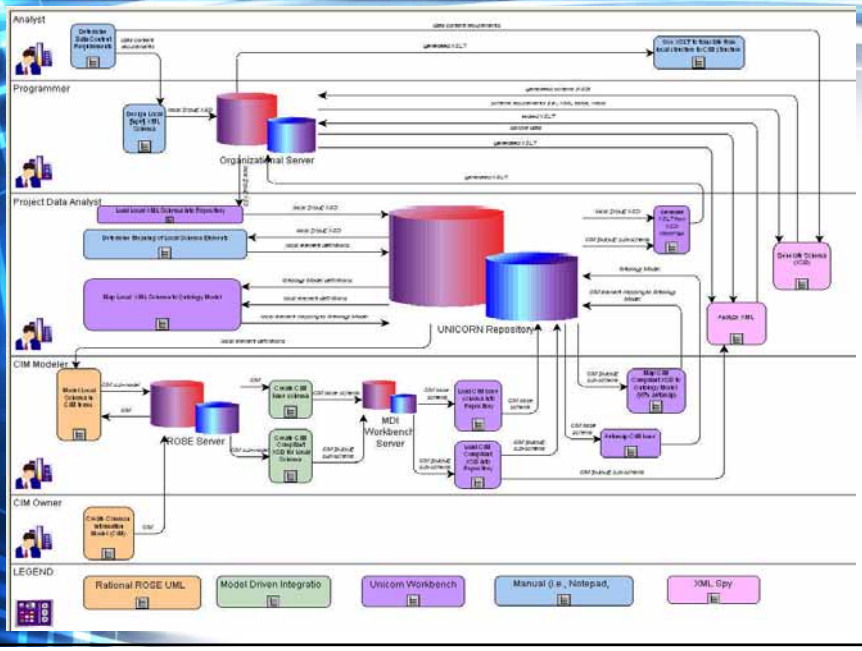
```
<Substation diffgr:id="Substation16" msdata:rowOrder="15"
diffgr:hasChanges="inserted" TPSIMID="161"
TPSIMName="8SULLIVA" TPSIMDescription="SULLIVAN, 500 KV
GENERAL, EJ1" ANAVoltage="500" TPSIMSubControlAreaID="27"
SubControlArea="TVA" />

 <Substation diffgr:id="Substation17" msdata:rowOrder="16"
diffgr:hasChanges="inserted" TPSIMID="162"
TPSIMName="5CALVERT" TPSIMDescription="CALVERT, KY"
ANAVoltage="161" TPSIMSubControlAreaID="27"
SubControlArea="TVA" />
```

CIM Map

```
<CimMap diffgr:id="CimMap1" msdata:rowOrder="0"
diffgr:hasChanges="inserted" FieldName="TPSIMID"
CimName="Substation.tvaid" />
<CimMap diffgr:id="CimMap2" msdata:rowOrder="1"
diffgr:hasChanges="inserted" FieldName="TPSIMName"
CimName="Substation.aliasName" />
<CimMap diffgr:id="CimMap3" msdata:rowOrder="2"
diffgr:hasChanges="inserted" FieldName="TPSIMDescription"
CimName="Substation.description" />
<CimMap diffgr:id="CimMap4" msdata:rowOrder="3"
diffgr:hasChanges="inserted" FieldName="ANAVoltage"
CimName="Substation.VoltageLevel.BaseVoltage.nominalVoltage.value" />
<CimMap diffgr:id="CimMap5" msdata:rowOrder="4"
diffgr:hasChanges="inserted" FieldName="TPSIMSubControlAreaID"
CimName="Substation.SubControlArea.tvaid" />
<CimMap diffgr:id="CimMap6" msdata:rowOrder="5"
diffgr:hasChanges="inserted" FieldName="SubControlArea"
CimName="Substation.SubControlArea.aliasName" />
```

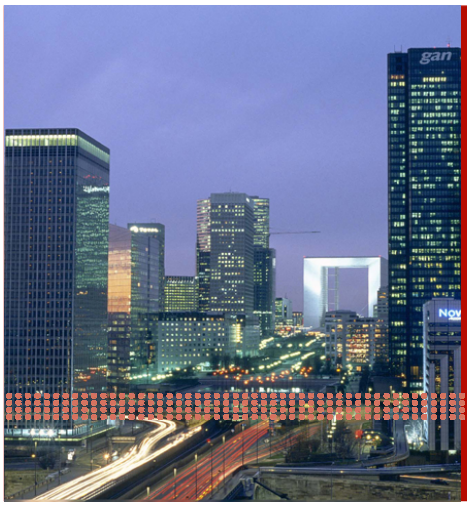
Swim Lane Model of Web Services Message Development



Why?

- Provides an unambiguous label for each data element
- Provides potential 3rd party recipients with the ability to accurately process the data


Summary
• Better data integrity
• Faster data access
• Simpler data interchange



EDF Feedback on CIM Standard

Eric Lambert and Andre Maizener
EDF R&D Division

PLAN

1. EDF GROUP
2. EDF R&D FEEDBACK: CIMERGY PROJECT
3. KEY POINTS TO IMPROVE CIM USAGE
4. CONCLUSION

1

EDF GROUP : Key figures

1.1 EDF GROUP

- Annual income : 46.9 Billions € (56,3bi $) | 161000 employees
- 42 .1 Millions of Customers | 125 000 MW of installed capacity

2

EDF R&D CIMERGY PROJECT

2.1 Cimergy Project key numbers

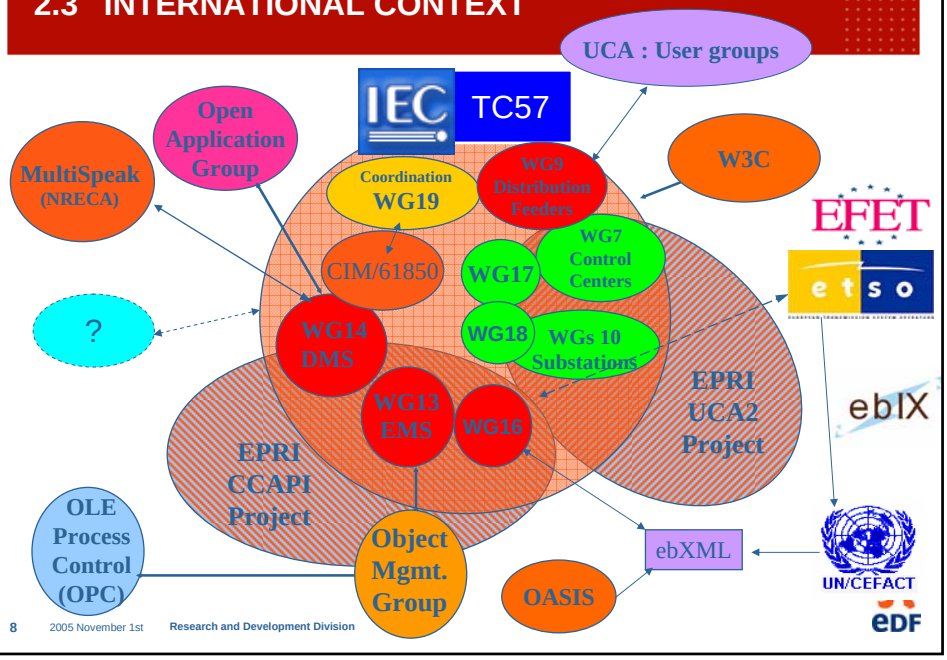
- Started as an innovative action in 2003
- Labelized as an EDF R&D project in 2004
- Budget : 1,5 M USD / year
- Team ~ 7 people

2.2 GOALS OF CIMERGY

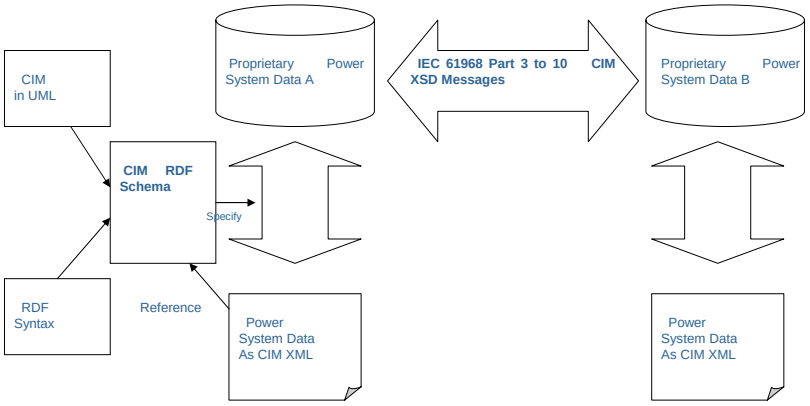
- Define methodology and tools requirements in order to use IEC TC57 standards 61970, 61968.
- Participate actively in the TC57 standardization effort
- Promote the methodology inside EDF
  try and provide related tools
- Promote the standard inside EDF
- Understand and help the harmonization process
  - IEC TC57 61970/61968 and 61850
  - IEC TC57 and UN-CEFACT, ETSO, ebIx
- Reduce the gap between IT people and Automation people
  Tools should help

CIM training course for our people

2.3 INTERNATIONAL CONTEXT



2.4 Technical Context : RDF, XSD for Transmission & Distribution



2.5 CIM APPROACHES

- Bottom-up approach : *field driven specific applications*
  - Load Profiling
  - Low Voltage Planification function
  - Medium Voltage Load Calculation
  - CIM API for PRAO (MV Planification Function)

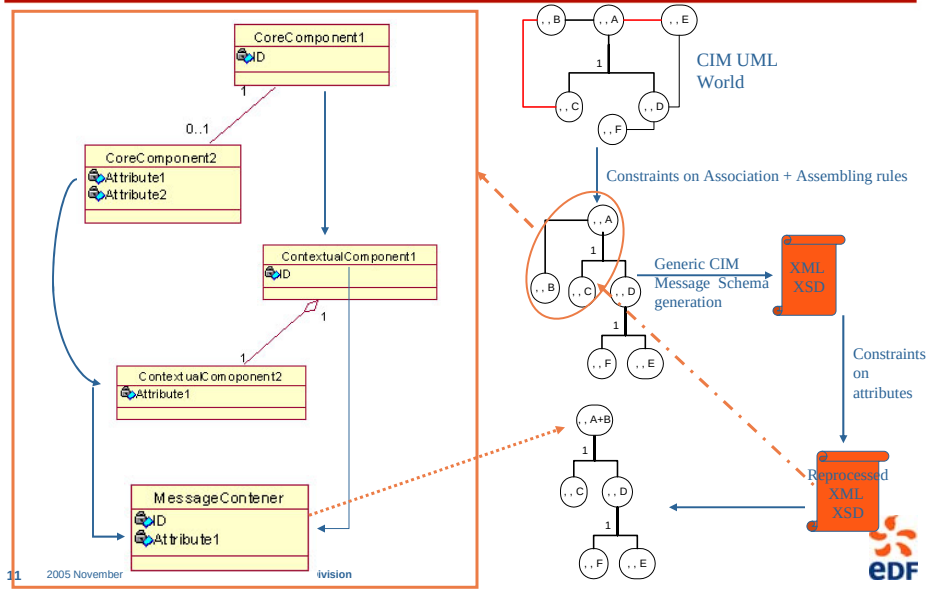
  → Distribution
  - CIM API for Eurostag (HV Load Flow)
  - UCTE DEF to CIM CPSM format

  → Transmission (RTE)
  - Generation Supervision prototype

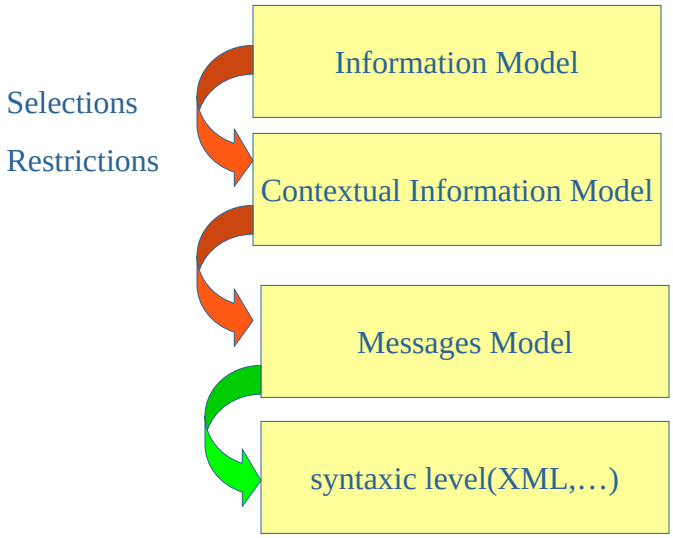
  → Generation
- Top-Down Approach : *from IM to Messages*
  - Model Driven Integration approach
  - Based on the UN-CEFACT Modeling Methodology (called Core Components Technical Specification), CIM Model, and ISO 1179

  « How to derive an XML Message from a UML model ? »
  Uses cases completed with Distribution Division
  - CIM Products experimented : MDI (Xtensible Solutions) ,UIB (Sisco)
  - Customer switching

2.6 Methodology : combining CIM & UN-CEFACT Core Component Technical Specification



Methodology : from Information Model to Message



3

KEY POINTS TO IMPROVE CIM usage

3.1 Publish official examples of CPSM compliant XML files and CIM compliant XML files

Justification :

Experience shows that CIM users don't agree on the interpretation of the model.

Recommandation :

Validate IOP tests files as CPSM reference

3.2 Get a consistent approach for interoperability tests

Justification

Inconsistencies between CIM Model, nerc profile flag in UML, CPSM v1.9 specification, tool to generate RDF schema, and tool to validate an instance file. RDF schema does not contain all CIM UML elements

Recommandation

Have a consistent set (CIM model, Profiles, Generation & Validation Tools, Instance files, Documentation).

3.3 Publish a CIM standard release 2

Justification

Only 10% of CIM classes are used in interoperability tests

Recommandation

CIM standard release 2 (61970-301)
should include
- a major revision on comments (compliant to ISO1179)
  - => Some Utilities want to translate these definitions…
- a major revision on Datatypes
- some packages provided by WG14

3.4 Global picture of CPSM real use in North America

Justification

Promoting CPSM in Europe, and at least having a CIM profile for European countries based on CIM

Recommandation

Document explaining how CPSM is used, and which tools are used by North American Utilities.

3.5 Put in place in 2006 interoperability tests on Message Types provided by WG14

Justification

Having more interoperability, and using XML XSD message types

Recommandation

Set up a task force for organizing these tests in 2006
Validate CIM for Distribution Networks

3.6 Put in place interoperability tests on CIM-61850

Justification

Important harmonization issue handled by IEC TC57 WG19

Recommandation

Set up a task force for organizing these tests in 2006

3.7 CIM profile including a Bus Branch Model

Justification

Several tools are based on a Bus Branch Model and not a Switch/node model.

Recommandation

Propose this evolution in CPSM, or in a European Profile

3.8 Gap between CIM standard, and CIM working versions

Justification

> Too many CIM working versions per year.
> Difficulties to choose one
> Big gap with the CIM standardized (61970-301)
> Difficult to upgrade applications based on a previous CIM version

Recommandation

A new CIM 61970-301 release, and less working versions

3.9 CIM User Group will be useful

– CIM approach and integration issues not easy to be explained at managerial level

– CIM users group can help to share experience and provide valuable Materials

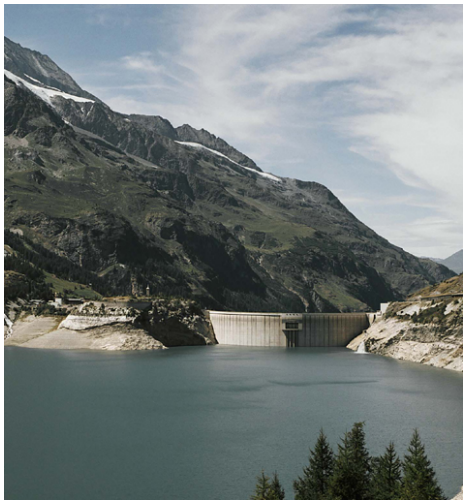
4

CONCLUSION

4.1 To summarize…

- CIM provides an interesting integration scheme
- A new CIM standard release must be issued
- Interoperability test files and procedures must be pre-checked before interoperability tests
- Harmonization issues must be adressed (CIM, 61850, …)
- Combining CIM & UN-CEFACT standards seems to be valuable

Thanks for your attention…
and good workshop !

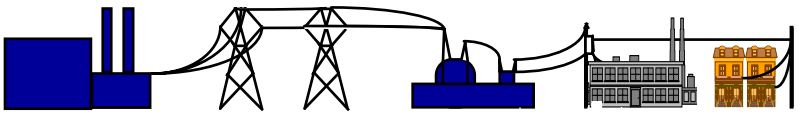


QUESTIONS ?

CAISO Perspective - Use of CIM/MDI Methodology to Implement a Service Oriented Architecture (SOA)

Terry Saxton

EPRI CIM/GID Workshop
MISO
November 2005



Xtensible Solutions

Topics

- Introduction
- Business and technology drivers
- Service Oriented Architecture (SOA)
- MDI/CIM – enabling SOA
- Benefits

Xtensible Solutions

Introduction

- CAISO is in the process of designing a new power market system
  - Multi-year program that involves many vendors, new systems, as well as numerous legacy systems
    - Includes EMS, Full Network Model, Outage Management, PI Historian, Market Systems, many others
    - External interfaces to Market Participants included
- Integration Competency Center decided on a Service Oriented Architecture (SOA) for the integration framework
  - Based on Web services
  - CIM and Model Driven Integration (MDI) methodology used to define information exchange
- The ISO is to achieve flexibility, scalability, and cost savings through this approach

Xtensible Solutions

 3

Business and Technology Drivers

- Need to integrate technology provided by many vendors with significant technical diversity
- Increase the agility/flexibility of the integrated solution – change is the only constant!
- Increase the quality of data – as a public good corporation data is a critical asset and must be managed as such
- Reduce cost of implementation and maintenance
- Integration goes beyond sharing of information, it needs to support process integration and business intelligence.
- Ensure that all new systems and applications are “built-to-integrate” and achieve loose coupling
- Meet performance and availability requirements

Xtensible Solutions

 4

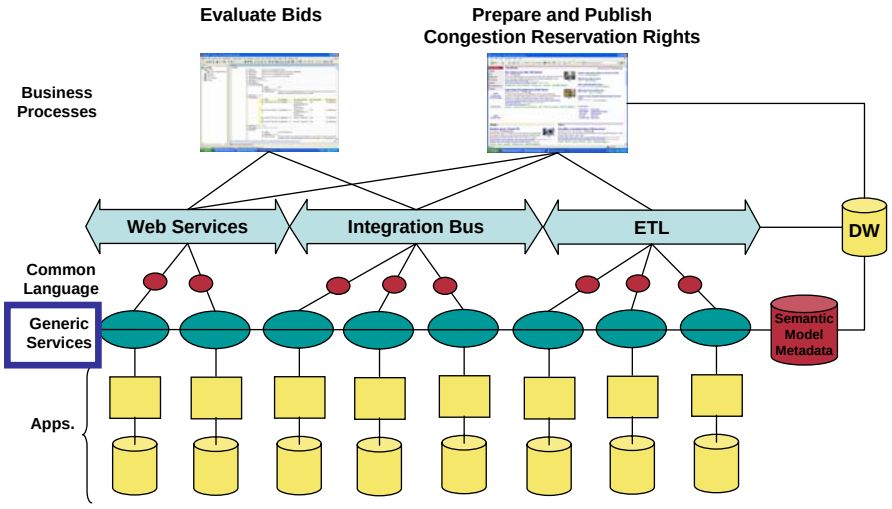
Integration Strategy

- Implement Service-Oriented Architecture (SOA)
  - Force all new applications and systems to be "Integration Ready" with service-enabled interfaces
  - Achieve Loose Coupling
- Data Integration
  - Enterprise Information Integration as Objective
- Business Process Orchestration
  - Unlocking of rigid processes through run-time configuration as much as possible

Xtensible Solutions

 5

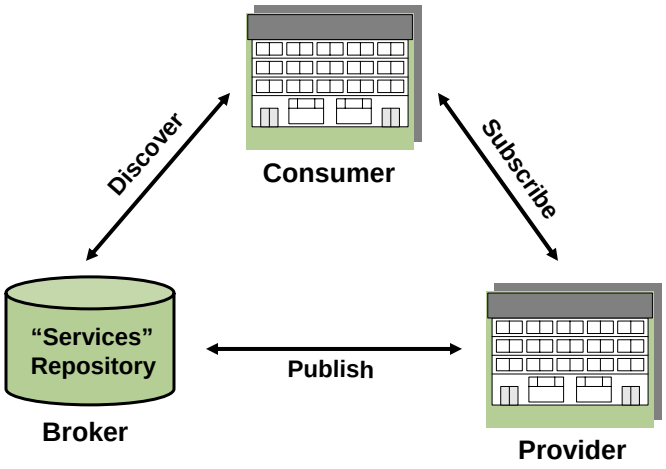
Business Process-Driven Integration



Xtensible Solutions

 6

Service-Oriented Architecture



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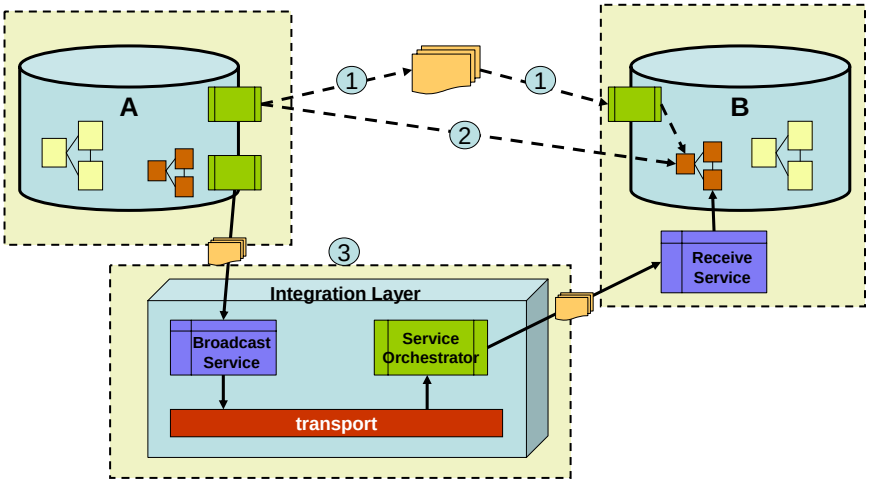
Interface vs. Service



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Service Definition Guidelines

- BPMs
  - Gathering and reviewing business processes, systems, applications, and databases information
- Use Cases and Sequence Diagrams
  - Develop/Elaborate To-Be service orchestration requirements in the forms of Use Cases and Sequence Diagrams
- CIM/CME
  - Develop common semantic based service payload definition in the form of the UML diagram
  - Extend the CIM/CME, where necessary, to accommodate CAISO requirements
  - The extended CIM/CME is the Common Semantic Model for the MRTU program

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Service Definition Guidelines (cont'd)

- Payload - Create CIM base and service payload XML Schema files
  - Map source and target data format(s) to the common semantic model based service payload definitions. Document any business rules of service payload and mappings
- Payload Template
  - Verify and validate XML Schema files, and create sample XML instance data files for reference
- WSDL
  - Develop WSDL service definition files using a WSDL template, and validate WSDL files
- Document the service definition artifacts in one document for a given business integration (interface) area

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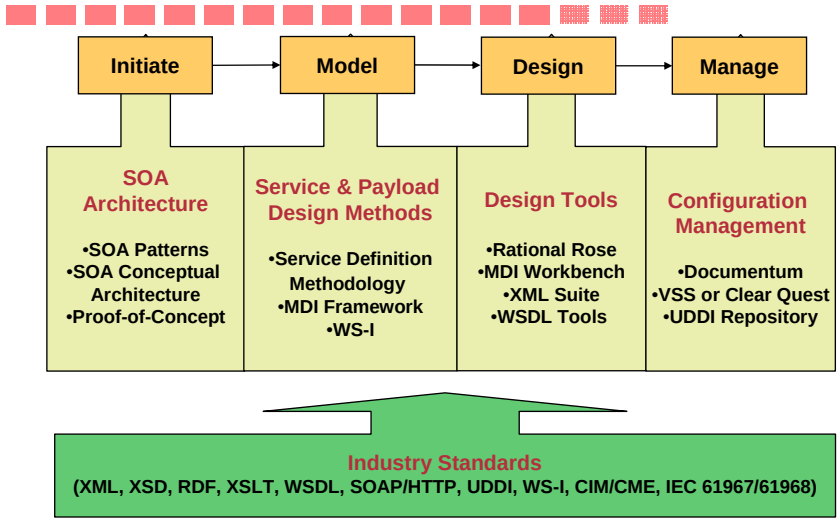
Frameworks, Standards & Tools



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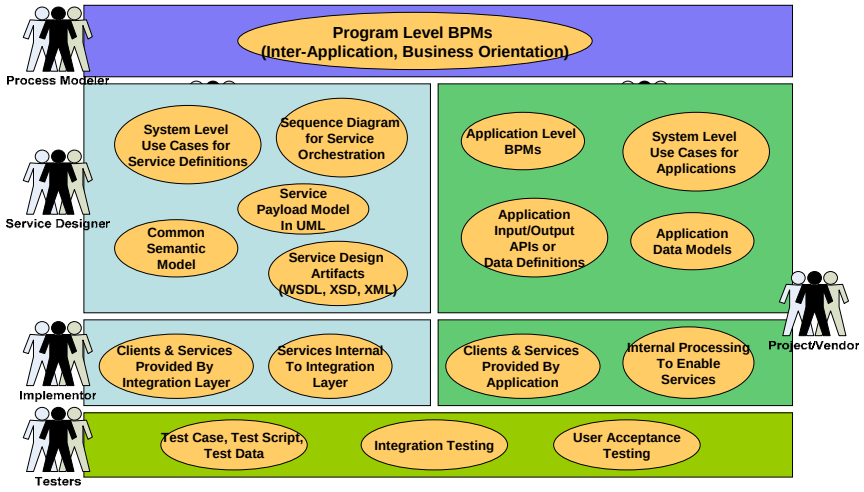
Roles & Responsibilities



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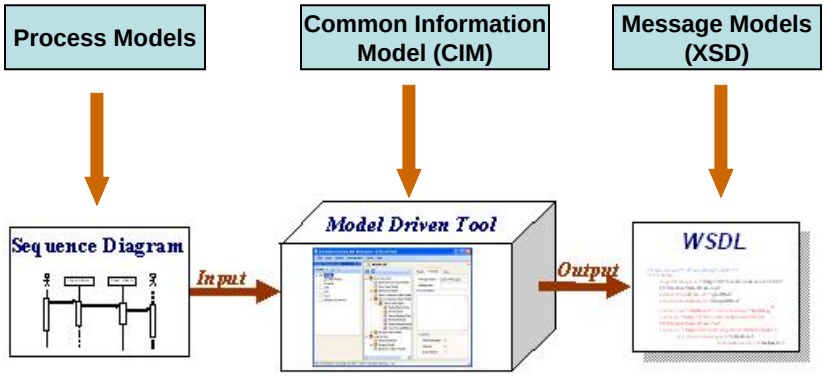
MDI/CIM Enabled SOA Design



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Interface Examples:

Interface Type	*Example*	*Implemented by*	*Utilized by*	*Description*
Information Creation	**submitBid(XML)**	**Vendor**	**Enterprise**	**These interfaces are for creating or modifying information within a system of record.**
Information Transfer	**publishCleanBidSet(XML)**	**CAISO**	**Vendor**	**These interfaces are for transferring information and releasing custody.**
Information Interest	**receiveCleanBidSet(XML)**	**Vendor**	**EAI**	**These interfaces are implemented by vendors to allow systems to receive information as it becomes available. This indicates a subscription type interest in data.**
Information Sharing	**getResourceInfo(XML) XML**	**Vendor**	**Enterprise**	**These interfaces are implemented by the vendors to surface information currently within custody to the enterprise.**

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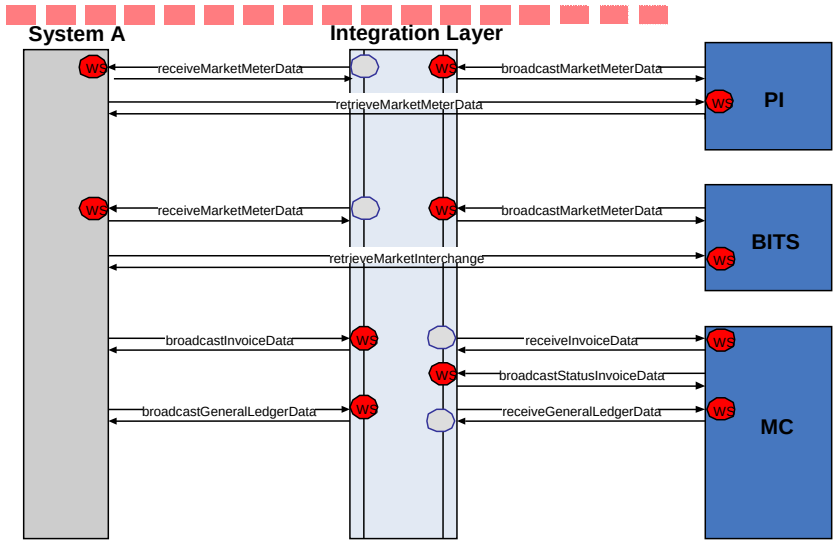

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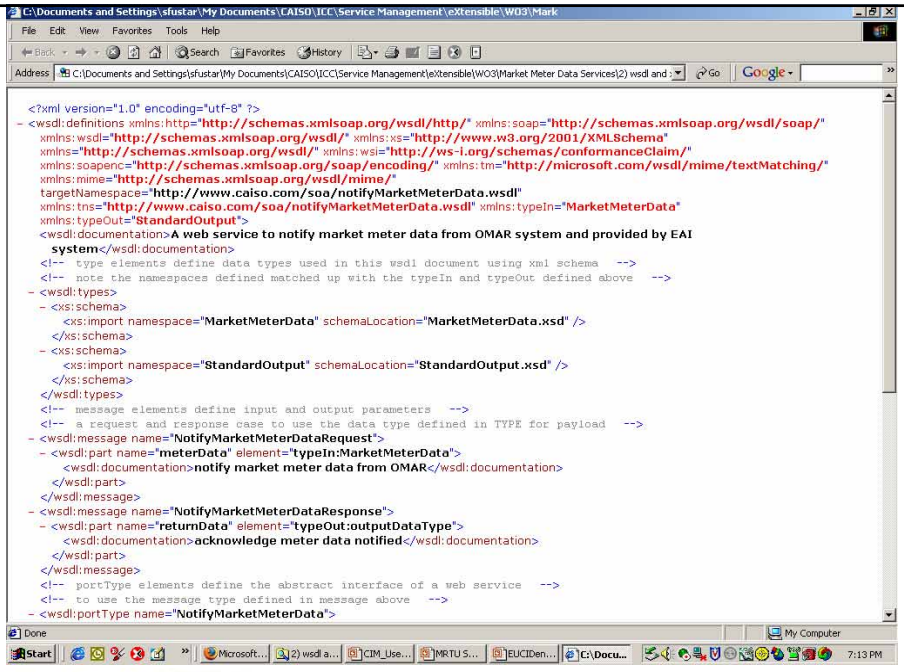

```
<?xml version="1.0" encoding="utf-8" ?>
- <wsdl:definitions xmlns:http="http://schemas.xmlsoap.org/wsdl/http/" xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/"
    xmlns:wsdl="http://schemas.xmlsoap.org/wsdl/" xmlns:xs="http://www.w3.org/2001/XMLSchema"
    xmlns="http://schemas.xmlsoap.org/wsdl/" xmlns:wsi="http://ws-i.org/schemas/conformanceClaim/"
    xmlns:soapenc="http://schemas.xmlsoap.org/soap/encoding/" xmlns:tm="http://microsoft.com/wsdl/mime/textMatching/"
    xmlns:mime="http://schemas.xmlsoap.org/wsdl/mime/"
    targetNamespace="http://www.caiso.com/soa/notifyMarketMeterData.wsdl"
    xmlns:tns="http://www.caiso.com/soa/notifyMarketMeterData.wsdl" xmlns:typeIn="MarketMeterData"
    xmlns:typeOut="StandardOutput">
    <wsdl:documentation>A web service to notify market meter data from OMAR system and provided by EAI
      system</wsdl:documentation>
    <!--  type elements define data types used in this wsdl document using xml schema  -->
    <!--  note the namespaces defined matched up with the typeIn and typeOut defined above  -->
  - <wsdl:types>
    - <xs:schema>
        <xs:import namespace="MarketMeterData" schemaLocation="MarketMeterData.xsd" />
      </xs:schema>
    - <xs:schema>
        <xs:import namespace="StandardOutput" schemaLocation="StandardOutput.xsd" />
      </xs:schema>
    </wsdl:types>
    <!--  message elements define input and output parameters  -->
    <!--  a request and response case to use the data type defined in TYPE for payload  -->
  - <wsdl:message name="NotifyMarketMeterDataRequest">
    - <wsdl:part name="meterData" element="typeIn:MarketMeterData">
        <wsdl:documentation>notify market meter data from OMAR</wsdl:documentation>
      </wsdl:part>
    </wsdl:message>
  - <wsdl:message name="NotifyMarketMeterDataResponse">
    - <wsdl:part name="returnData" element="typeOut:outputDataType">
        <wsdl:documentation>acknowledge meter data notified</wsdl:documentation>
      </wsdl:part>
    </wsdl:message>
    <!--  portType elements define the abstract interface of a web service  -->
    <!--  to use the message type defined in message above  -->
  - <wsdl:portType name="NotifyMarketMeterData">
```

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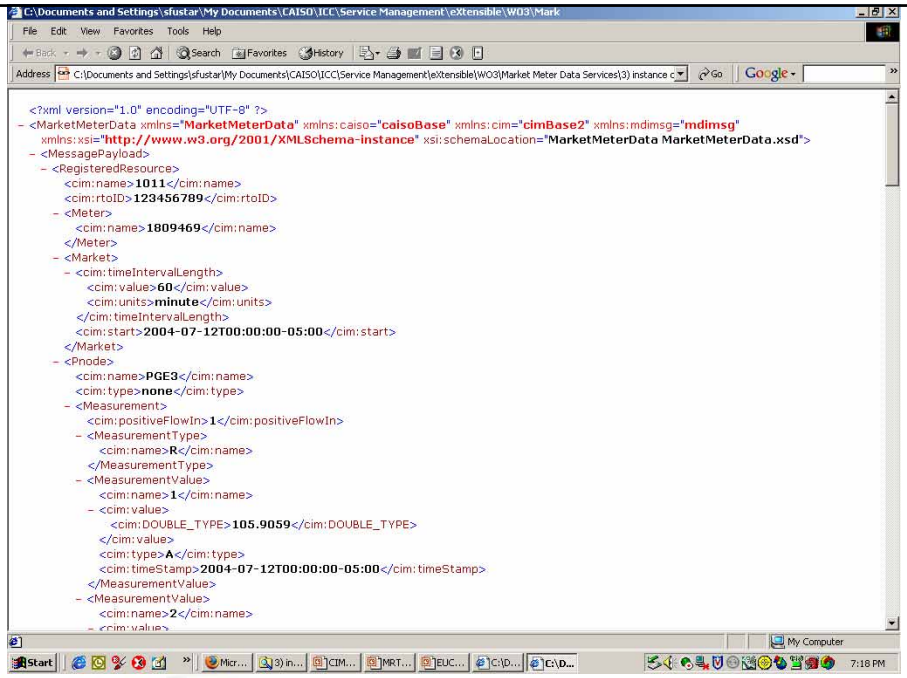

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Vision Of Standard Services

- Leverages CIM
  - All payloads are forward engineered from CIM
- Standard Services
  - WSDL (serves as Interface Definition Language)
  - Message payloads
    - XML Schema
    - XML Templates (message instances – send/response)
- Benefits
  - True Plug-And-Play functionality
  - Publicly Available
  - Easy Interoperability Testing
    - Can be provided On-line

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Benefits of MDI/CIM enabled SOA

- Expose information through common mechanism and common semantics
- Seamless information flow across the enterprise
- Deliver the right information at the right place at the right time
- Enforcing data quality and consistency at the service level
- Flexibility/agility in responding to business organisation and process changes
- Technology agnostic
- Utilizes widely adopted and proven standards
- Reduce total cost of ownership
- Provides traceability/mapping of business processes

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 19

Status

- Examples of the systems that have been service enabled:
  - Areva (Settlement)
  - Siemens (Bid Interface, SCUC)
  - ABB (EMS)
  - Nexant (CRR)
  - Legacy applications
- One of most important applications of CIM standards
  - Gives control of the integration environment to the utility
  - Information exchange contents/format driven by business process/use case exchange of business objects
    - Not driven by application provider interfaces
    - WSDLs form contract with suppliers for information exchange based on the CIM

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 20

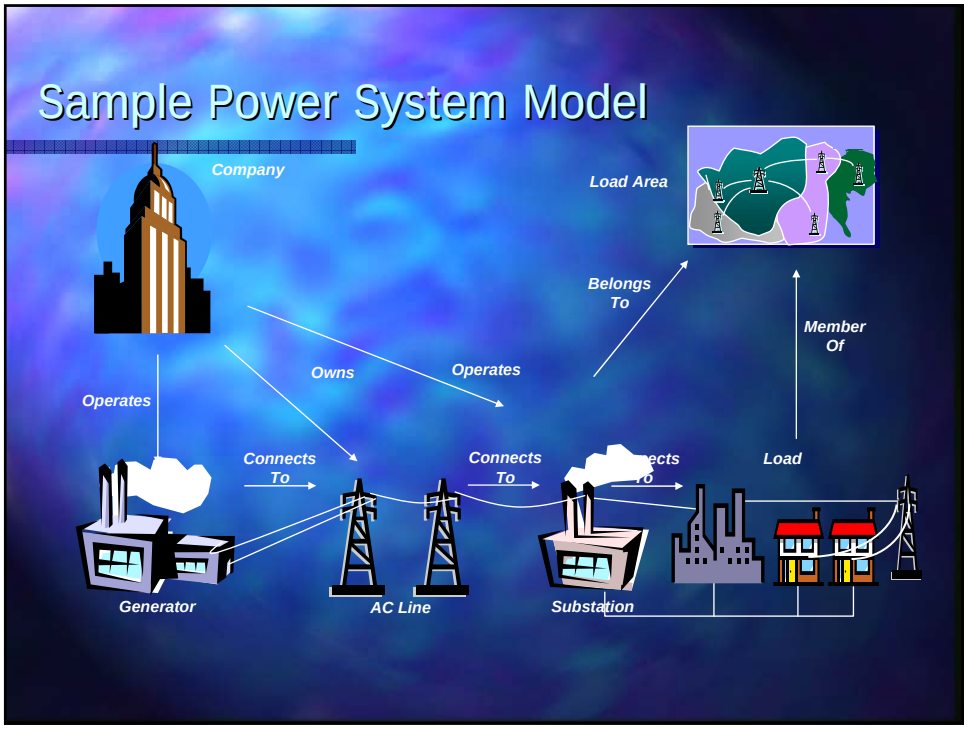
Status of CIM/GID/Messaging Standards

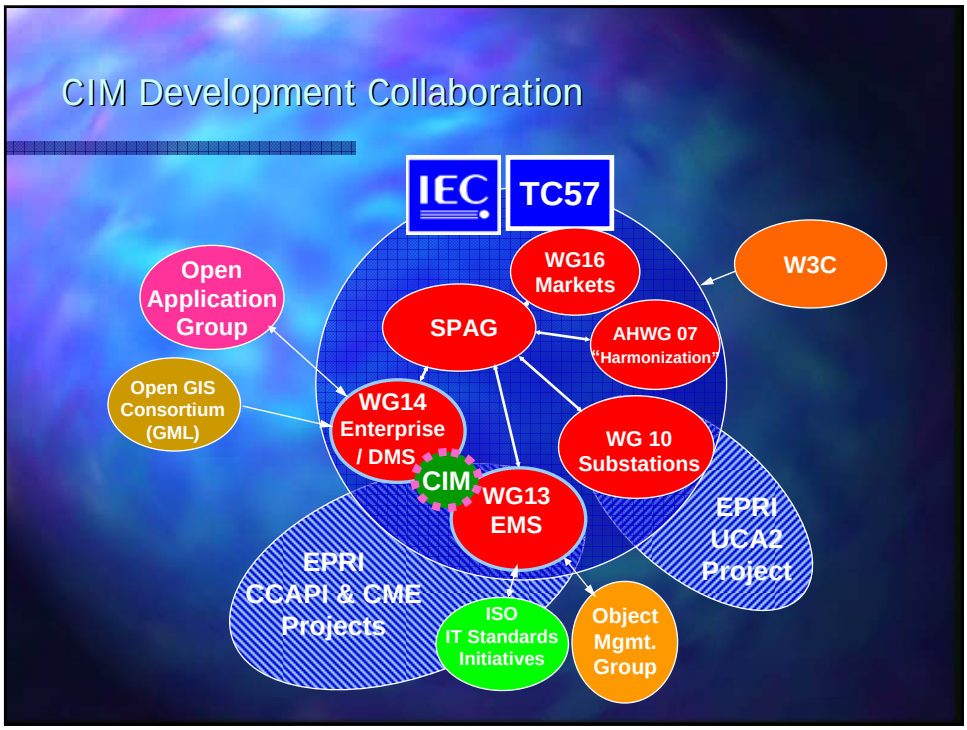
EPRI CIM/GID International Conference
MISO, Indianapolis
November 2005

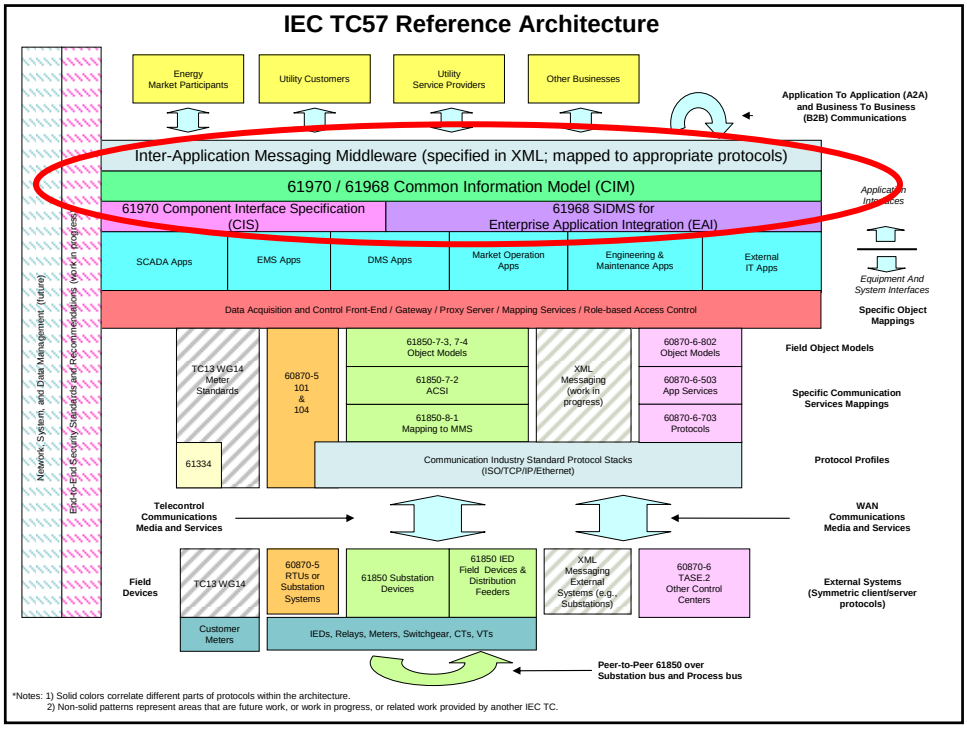
Terry Saxton
Xtensible Solutions, Inc.
Minneapolis, Minnesota
tsaxton@xtensible.net

The IEC Common Information Model (CIM) - What Is It?

- A Unified Modeling Language (UML) based information model representing real-world objects and information entities exchanged within the value chain of the electric power industry
  - Maintained in IBM's Rational Rose modeling tool.
- A tool to enable ***integration*** and ***information exchange***
- Enable data access in a standard way
  - Common language to navigate and access complex data structures in any database
    - Provides a hierarchical view of data for browsing and access with no knowledge of actual logical schema
  - Inspiration for logical data schemas (e.g., for an operational data store)
- Enable integration of applications/systems
  - Provides a common language for exchanging messages between systems
  - Basis for defining information exchange models
- Not tied to a particular application's view of the world
  - But permits same model to be used by all applications to facilitate information sharing between applications
  - Also provides consistent view of the world by operators regardless of which application user interface they are using


Sample Power System Model
Company
Load Area
Belongs To
Member Of
Owns
Operates
Operates
Connects To
Connects To
Load
Generator
AC Line
Substation


CIM Development Collaboration
IEC
TC57
Open Application Group
WG16 Markets
W3C
SPAG
AHWG 07 "Harmonization"
Open GIS Consortium (GML)
WG14 Enterprise / DMS
CIM
WG 10 Substations
WG13 EMS
EPRI UCA2 Project
EPRI CCAPI & CME Projects
ISO IT Standards Initiatives
Object Mgmt. Group



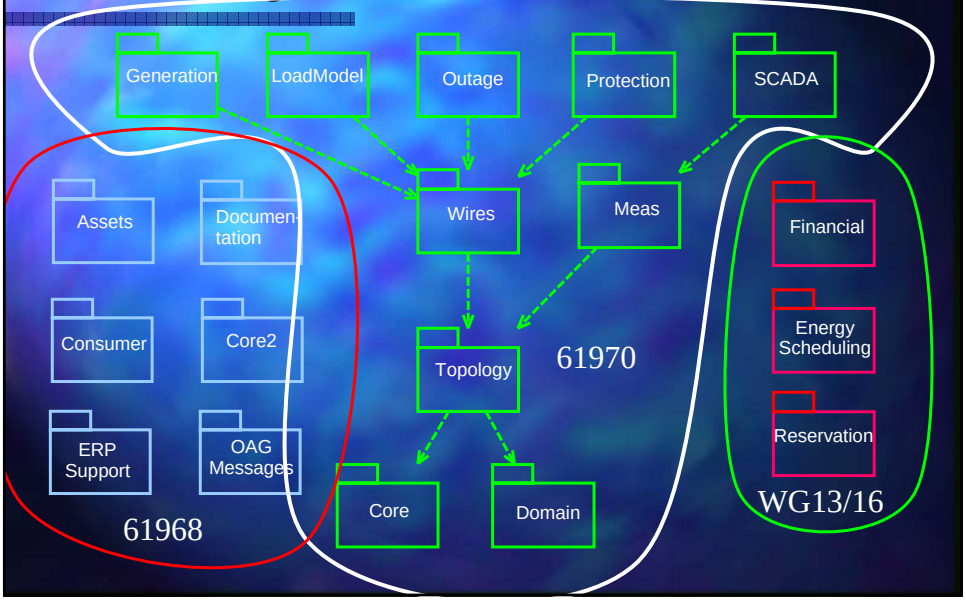
Where are all the CIM-Related Standards Found (IEC official standards and drafts)

- CIM as an information model
  - Standardizes classes, attributes, and relationships in UML
  - Provides dictionary of standard objects
  - 61970-3XX series and 61968-11
- CIM as common language
  - Standardizes Messages in XML
  - Provides sentences with selected to parts of CIM to support specific use cases
  - 61968-3 to 10
- Generic Interfaces (PIM)
  - 61970-401 to 449
- Component Interface Specifications (PIM)
  - Specific interface services plus selected CIM content
  - 61970-450 to 499
- Technology Mappings for CIS (PSM)
  - 61970-5XX

CIM Electronic Models

- IEC Official Releases
  - Owned by IEC
  - Directly related to paper standards
    - CIM UML models (61970-3XX and 61968-11)
    - CIM-based message schemas (61968-3 to 10)
    - 1:1 correspondence
- Unofficial releases
  - May contain additional packages and/or other changes
    - Ex: CIM with market extensions
  - RDF Schema versions in XML
    - Based on some identified CIM UML release
- Currently electronic models available on various Web sites
- Near term plan
  - All electronic versions managed by CIM Model Manager (CMM)
  - Available on CIM User Group Web site
  - Project-specific versions may also be maintained in repository

CIM Packages



IEC TC57 WG13 - EMS API

- Objectives
  - Reduce the cost and time needed to ***add new applications*** to an EMS or other system
  - Improve the capability to ***exchange information*** between disparate systems both within and external to the control center environment
- Technical approach
  - Provide an ***integration framework*** for interconnecting existing applications/systems that is
    - Based on a ***common architecture and information model***
      - CIM
      - Generic Services
    - Independent of the underlying technology (PIM)
      - Mappings to specific technologies (PSM)
- 61970 series of standards

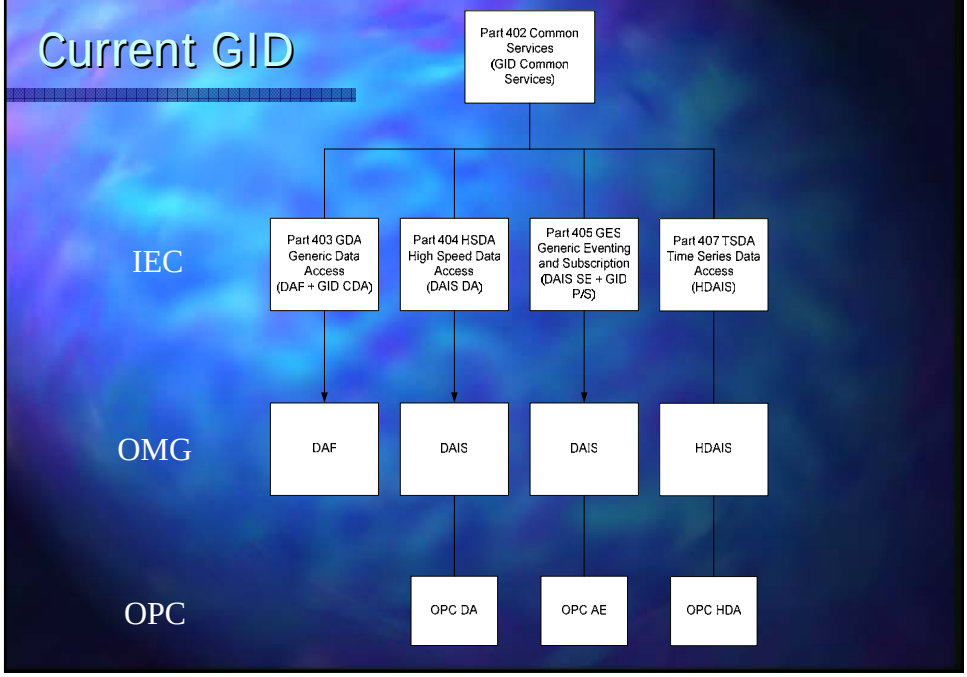
61970 Document Structure

- Part 1: Guidelines and General Requirements
- Part 2: Glossary
- Part 3XX: Common Information Model (CIM)
  - Provides common language for information exchange
- Part 4XX: Component Interface Specifications (CIS)
  - Provides Platform Independent Models (PIM)
- Part 5XX: CIS Technology Mappings
  - Provides Platform Specific Models (PSM)
  - Correlation with 4XX documents
    - Ex: 403 maps to a 503 document
  - Specific technologies identified with a "-X"
    - -0 through 3 are reserved for future use
    - -4 for XML
    - -5 for CORBA
    - -6 for COM
    - -7 for 'C'
    - -8 for Web Services
    - -9 for Java
  - Ex: C implementation of GDA – 403 and 503-7

4XX – Generic Services

- Part 401: CIS Framework
  - Provides an overview of the CIS series of standards and an explanation of how to use the standards in system implementations and system integration projects
- Parts 402 – 449: Generic services to be supported by component interfaces
  - Describe in narrative text and Unified Modeling Language (UML) notation the interface functionality that is standardized
  - Define the generic services that can be used by any application to exchange information with another application or for public data access

Current GID



4XX – Specific Interfaces

- Part 450: CIS Information Exchange Model
  - Provides an overview of the use case process used to define information content and examples of system integration using the CIS standards
  - Provides common requirements for the future Part 451-499 specifications
- Parts 451 – 499: Specifications that address the specific information exchange requirements for typical application categories
  - Define the information content of the standard information exchanges between applications
  - Defined as events but may be exchanged in a variety of ways, including
    - Published as messages
    - Notifications followed by a request
    - XML documents
  - Identifies properties and methods to be supported by each interface
  - Supporting documentation includes use cases and event sequence diagrams.

WG13 Document Tree

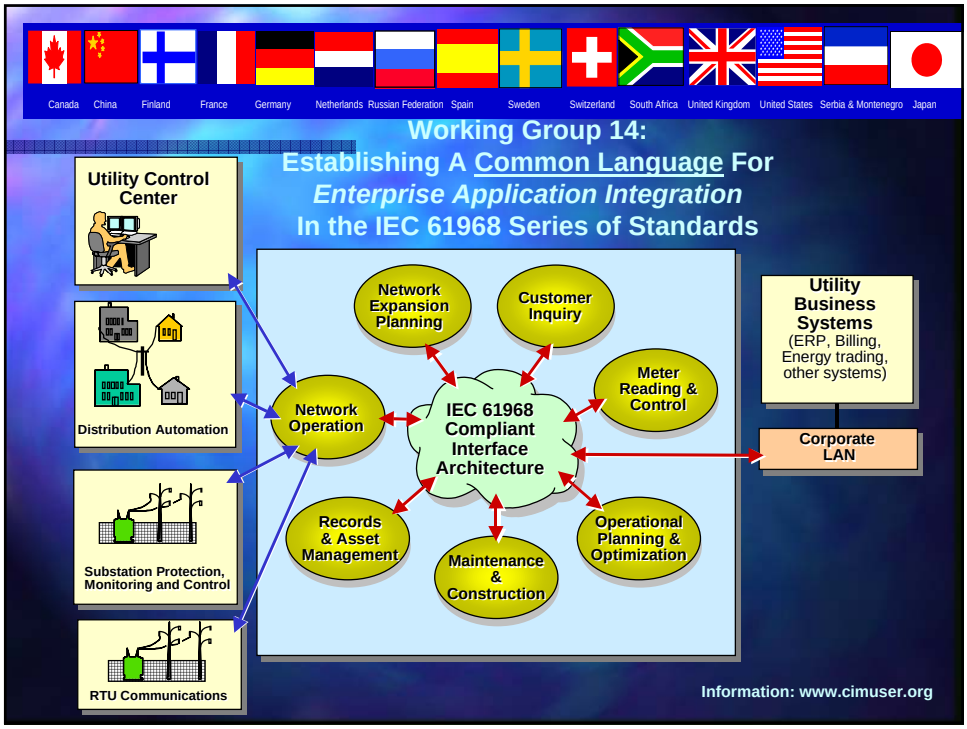
Part 1 - Guidelines and General Requirements						
Part 2 - Glossary						
Part 301 - CIM Base		Part 302 – Energy Scheduling, Financial, Reservations				
Part 401 - CIS Overview and Framework						
Part 402 - Common Services	Part 403 - Generic Data Access	Part 404 - Hi-Speed Data Access	Part 405 - Generic Eventing & Sub		Part 407 - Historical Data Access	
Part 450 - CIS Information Exchange Model Guide						
Part 451 SCADA CIS	Part 452 CIM Model Exchange Spec.	Part 453 Graphics Exchange				
Part 500 - Technology Mappings						
Part 501 - CIM RDF Schema	Part 503-5 GDA CORBA Mapping	Part 503-7 GDA C Language Mapping	Part 552-4 CIM XML Model Exch. Format			

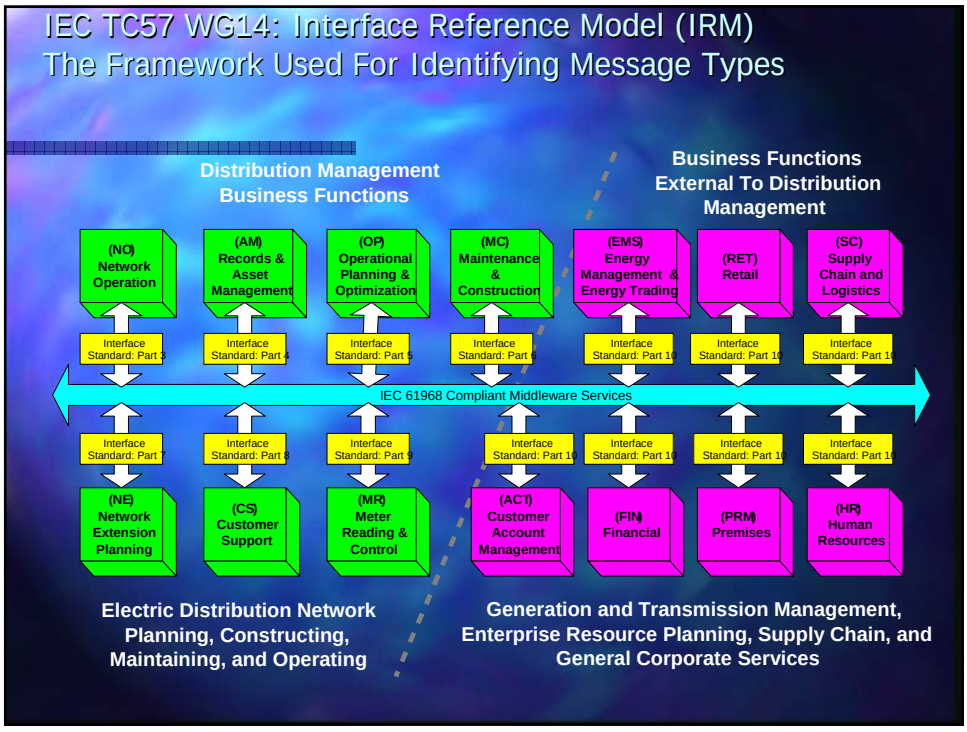
Document Status

Part	Title	Current Status
1	Guidelines and General Requirements	FDIS
2	Glossary	TS
301	CIM Base	IS
302	CIM Energy Scheduling, Reservations, Financial	CD on hold
401	CIS Overview and Framework	DTS
402	Common Services (Base Services)	CD
403	Generic Data Access (Request and Reply)	CD
404	High Speed Data Access	CD
405	Generic Eventing and Subscription (Events and Subscription)	CD
407	Historical Data Access	CD
450	CIS Information Exchange Model Specification Guide (CIS Data Content)	WD
451	SCADA CIS	WD
452	CIM Model Exchange Specification	WD
453	Graphics Exchange	WD
501	CIM RDF Schema	FDIS
552-4 (503)	CIM XML Model Exchange Format	CD

WG13 – Current Focus

- Progress Part 4XX and 5XX standards
  - Parts 402 – 407 new drafts based on UML
  - Part 453 Common Graphics Exchange
- Part 3XX CIM Maintenance
  - CIM Issues
  - CIM Maintenance procedures
  - CIM Release 2
    - Part 301 CIM Base Second Edition
    - Part 302 Market Operations
- Coordination with new CIM User Group


Canada
China
Finland
France
Germany
Netherlands
Russian Federation
Spain
Sweden
Switzerland
South Africa
United Kingdom
United States
Serbia & Montenegro
Japan
Working Group 14:
Establishing A Common Language For
Enterprise Application Integration
In the IEC 61968 Series of Standards
Utility Control Center
Distribution Automation
Substation Protection, Monitoring and Control
RTU Communications
Network Expansion Planning
Customer Inquiry
Network Operation
IEC 61968 Compliant Interface Architecture
Meter Reading & Control
Records & Asset Management
Maintenance & Construction
Operational Planning & Optimization
Utility Business Systems
(ERP, Billing, Energy trading, other systems)
Corporate LAN
Information: www.cimuser.org


IEC TC57 WG14: Interface Reference Model (IRM)
The Framework Used For Identifying Message Types
Distribution Management Business Functions
Business Functions External To Distribution Management
(NO) Network Operation
(AM) Records & Asset Management
(OP) Operational Planning & Optimization
(MC) Maintenance & Construction
(EMS) Energy Management & Energy Trading
(RET) Retail
(SC) Supply Chain and Logistics
Interface Standard: Part 3
Interface Standard: Part 4
Interface Standard: Part 5
Interface Standard: Part 6
Interface Standard: Part 10
Interface Standard: Part 11
Interface Standard: Part 12
IEC 61968 Compliant Middleware Services
Interface Standard: Part
Interface Standard: Part 8
Interface Standard: Part 9
Interface Standard: Part 13
Interface Standard: Part 14
Interface Standard: Part 15
Interface Standard: Part 16
(NE) Network Extension Planning
(CS) Customer Support
(MR) Meter Reading & Control
(ACT) Customer Account Management
(FIN) Financial
(PRM) Premises
(HR) Human Resources
Electric Distribution Network Planning, Constructing, Maintaining, and Operating
Generation and Transmission Management, Enterprise Resource Planning, Supply Chain, and General Corporate Services

"The building of the tower of Babel"

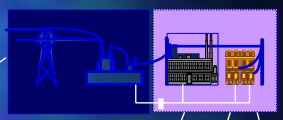
by Pieter Bruegel, 1563

Oil on oak panel, Kunsthistorisches Museum, Vienna

Inter-Application Integration Solutions *Always* Experience *Scaling Problems* Without A Common Language For Information Exchange

How Some Utility Implementations Are Using A Standards-Based Semantic Data Model

The "Common Language" provides a semantic layer based on the Utility's Ontology, which is derived from a combination of the IEC's Common Information Model (CIM), Other Applicable Models, and Necessary Extensions



= Generic Adapter Tailored For Each Application

Grid Wires Model

DAC

Dist Wires Model

VRU

Ontological Repository

Data Warehouse

EMS

Distribution Management

Distribution Automation

Customer Information

"Application Integration" = Middleware + Common Language

Event History

AM/FM/GIS

ERP

Work Management

Substation Automation

Metering Reading

IEC 61968
A Series Of Standards

- **IEC 61968 Part 1: The Interface Architecture**
  - **Provides for an Adaptable Utility Infrastructure**
    - **Partitions Business Systems based on:**
      - Things that are stable
        - *Abstract Application Component Interfaces (refer to IRM)* represent stable elements
      - Things that can be controlled by Utilities & Suppliers
        - Middleware Services that can be changed inexpensively
    - **Provides a stable basis for Enterprise-Wide Integration**
      - It Transcends the Life-Cycle of individual Application Systems and Middleware
- **Part 2: The Glossary**

IEC 61968
A Series Of Standards

- **Parts 3-10: Inter-Application Message Exchange:**
  - **Each Part covers a different Business Function identified In the Interface Reference Model (IRM)**
    - Interfaces are defined for each Business Sub-Function
  - **Use Cases and Activity Diagrams are used to articulate Information Exchange Requirements among Interfaces**
    - These are available in Part 12
  - **Message Types are then defined for each required Information Exchange:**
    - Message Types may be implemented using different protocols
    - A Message Type is a Canonical Data Model based on the CIM
    - WG14 defines Message Types using XML Schema (XSD)

IEC 61968
A Series Of Standards

- **Part 11: Common Information Model**
  - The CIM defined by WG14, which is an extension of the CIM that is defined by WG13 (IEC 61970).
- **Part 12: Technical Report: DMS Use Cases**
  - Upon The Completion Of Parts 1-10, A Final Report Will Be Submitted To IEC That Will Contain All Use Cases That Were Utilized During The Development Of IEC 61968.
- **Part 13: Common Distribution Power System Model Exchange**
  - (XML RDF, compatible with 61970)

Next Steps for 61968 Series of Standards

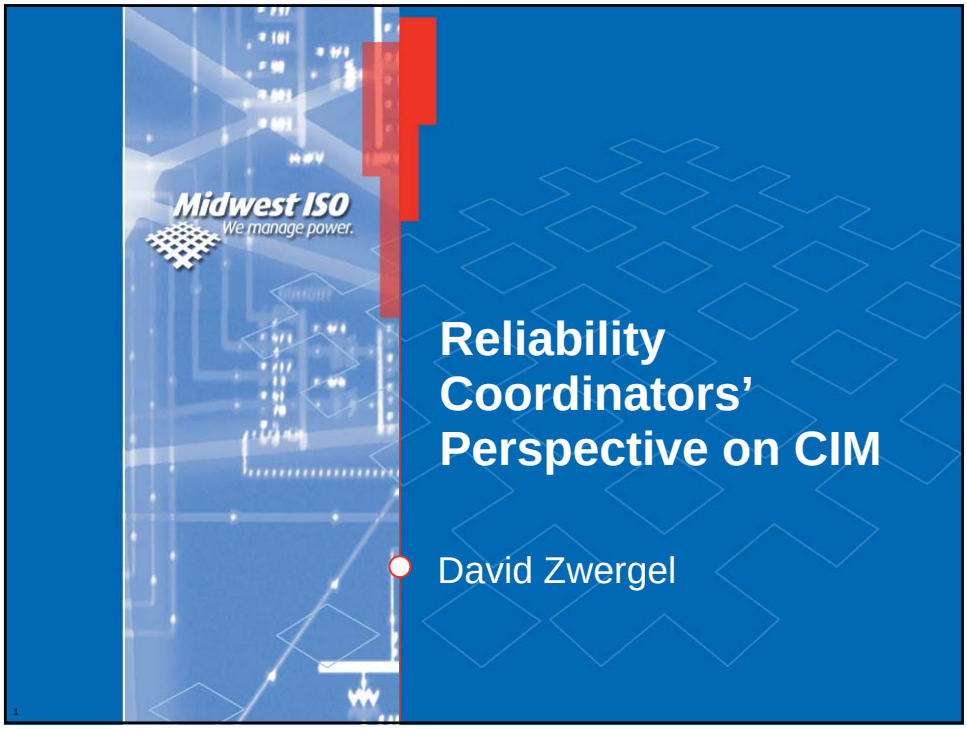
- Part 1: Interface Architecture and General Requirements
  - (maintenance cycle) Revised document to IEC by 17 February 2006
- Part 2: Glossary
  - (maintenance cycle) Revised document to IEC by 17 February 2006 (may be necessary to delay based on coordination being performed by WG19)
- Part 3: Network Operations
  - (maintenance cycle) Revised document to IEC by 17 February 2006
- Part 4: Records & Asset Management
  - CDV ready to go to IEC by 30 November 2005. However, since it will be dependent on Part 1, it may be better to wait until Part 1 is released. What is the IEC's preference?
- Part 5: Operational Planning and Optimization
  - NWIP & initial CD to IEC by 17 February 2007
- Part 6: Maintenance & Construction
  - NWIP & initial CD to IEC by 17 February 2006
- Part 7: Network Extension Planning
  - NWIP & initial CD to IEC by 17 February 2007
- Part 8: Customer Support
  - NWIP & initial CD to IEC by 17 February 2006
- Part 9: Metering Reading and Control
  - Revised CD to IEC by 17 February 2006
- Part 11: Common Information Model for DMS
  - NWIP & initial CD to IEC by17 February 2006
- Part 12: Use Case Technical Report
  - NWIP & initial CD to IEC by17 February 2006
- Part 13: Common Distribution Power System Model
  - Revised CD to IEC by 31 December 2005

CIM Acceptance and Uses

- Many EMS vendors support power system model exchange using CIM/RDF/XML, some with CIM-based databases behind the scenes
- EPRI has sponsored seven interoperability tests
  - Multiple vendors, including ABB, Areva, EDF, GE, PTI, Siemens, SISCO, SNC Lavalin, and others
  - Complete and partial models as well as incremental updates
  - GID interfaces
- Utilities have implemented CIM-based integration using EAI technologies
  - Utilities have used the CIM as the basis for developing common messages for integration
- Asset and work management vendors as well as GIS application vendors are starting to support CIM/XSD standards
- CIM is being extended into the power market and provides a foundation for Service-Oriented Architecture (SOA) implementation
- Vendors have developed tools to build CIM-based information exchange messaging, GID interfaces, and repository applications that can process CIM-aware data
- EPRI and others sponsored many international workshops and seminars on CIM/GID standards
  - Nov 1-4, 2005 at MISO in Indianapolis, IN, USA

CIM Acceptance

- Over 50 utilities, ISOs and NERC
- 60+ applications based on CIM
- 30+ suppliers sell application/products based on CIM
  - See CIM Reference List for Details
- Endorsed by other standards organizations
- Foundation for Model-Driven Integration (MDI) architecture
- New CIM User Group now formed to deal with questions and issues arising from increased use
  - Current site: www.cimuser.org



Reliability Coordination

Midwest ISO
We manage power.

- What is Reliability Coordination?
- The Reliability Coordinator has a wide area view, the operating tools, processes and procedures, including the authority, to prevent or mitigate emergency operating situations in both next-day analysis and during real-time conditions.
- Why CIM is important to Reliability?

2

RC Requirements

- Wide Area View
- Operating Tools
- Processes
- Visualization
- Training
- Staffing
- Facilities

3

Wide Area View

- Monitor all Bulk Electric System facilities, including sub-transmission information, within its Reliability Coordinator Area and adjacent Reliability Coordinator Areas as necessary to ensure that the Reliability Coordinator is able to determine any potential System Operating Limit and Interconnection Reliability Operating Limit violations within its Reliability Coordinator Area.

4

Wide Area View

- Reliability Coordinator must notify neighbors of an operational concerns that it identifies within the neighboring Reliability Coordinator's Reliability Coordinator Area. The Reliability Coordinator shall coordinate any actions with neighboring Reliability Coordinators, including the provision of emergency assistance, required to mitigate the operational concern.

5

Operating Tools

- SCADA Alarming
  - Actual flows against limits, voltages, and breaker changes to indicate generation and transmission changes.
- Topology Processor
  - Runs every 10 seconds, doesn't rely on state estimator solution, and updates distribution factors.
- State Estimation
  - New solution on demand or triggered every 90 seconds
  - On site 24 X 7 engineering support – very high availability
- Real Time Contingency Analysis
  - 7500 Contingencies run at least every five minutes

6

Operating Tools- SE Model

	Internal	External	Total
Substations	8737	11389	20126
Buses	12834	17873	30707
Gen Units	1516	3138	4654
Loads	10786	14619	25404
Lines	13063	17237	30300
Breakers/Sw	69079	68283	137362
XFMRs	2941	6043	8984
CAPs	1588	3359	4947
Reactors	241	393	634
ICCP/Analog			74310
ICCP/Status			78573
ICCP Total			152883

7

Processes

- Outage maintenance Coordination
- Next Day Security Analysis
- Unit Commitment
- Security Constrained Economic Dispatch
- Redispatch
- Switching
- Load Reduction

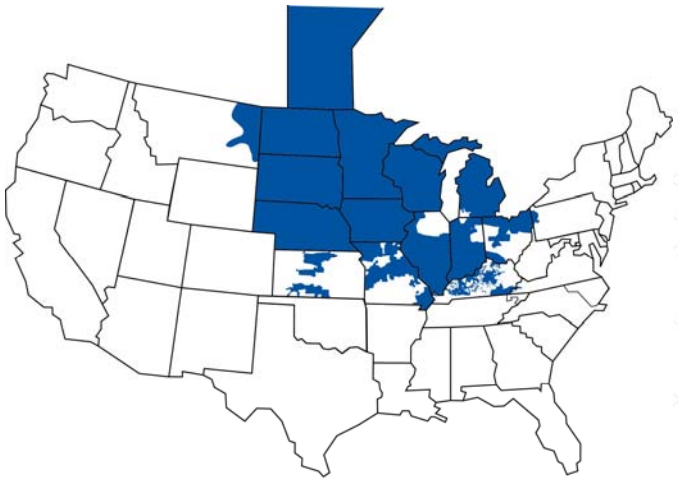
8

Visualization

- Visualization is required to help the Reliability Coordinator have situational awareness and assimilate large amount of information.
- Need to leverage visualization to present operating tool results such that Reliability Coordinator can quickly understand and anticipate changes on the power system.

9

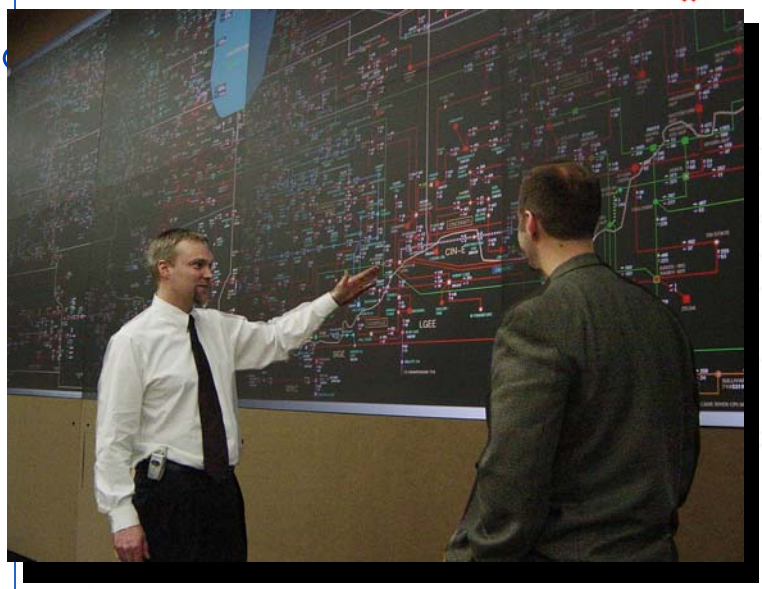
MISO RC Area



Midwest ISO Regional Reliability Area

10

Video Wall



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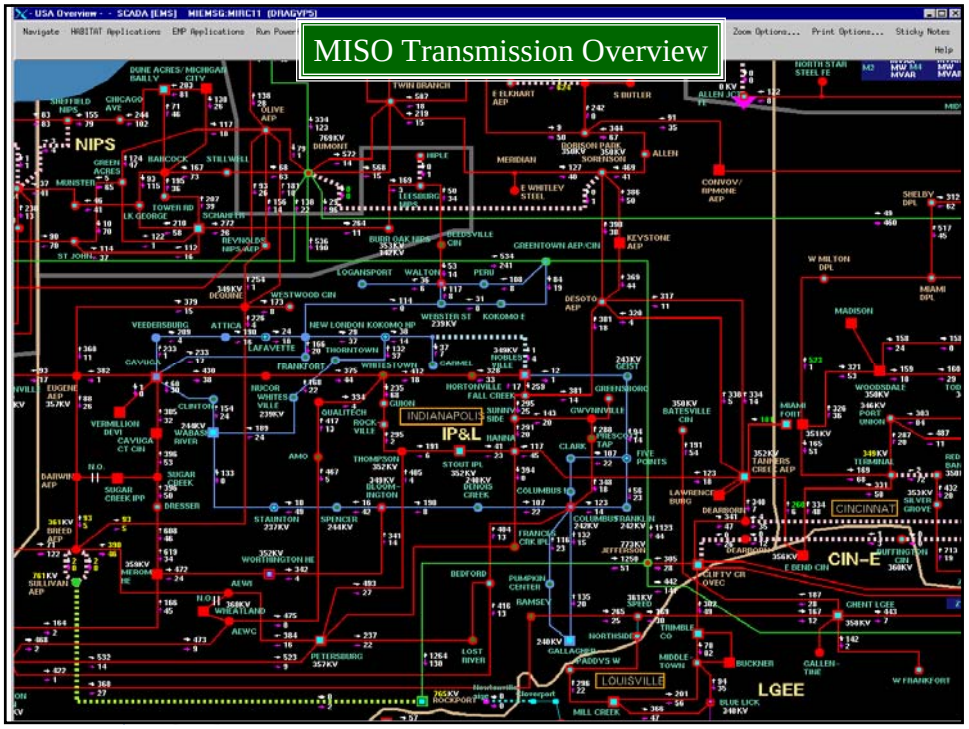
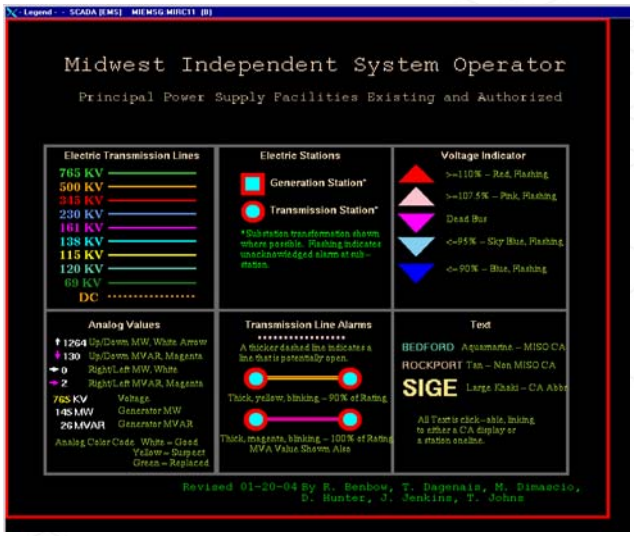
Carmel, Indiana

St. Paul, Minnesota

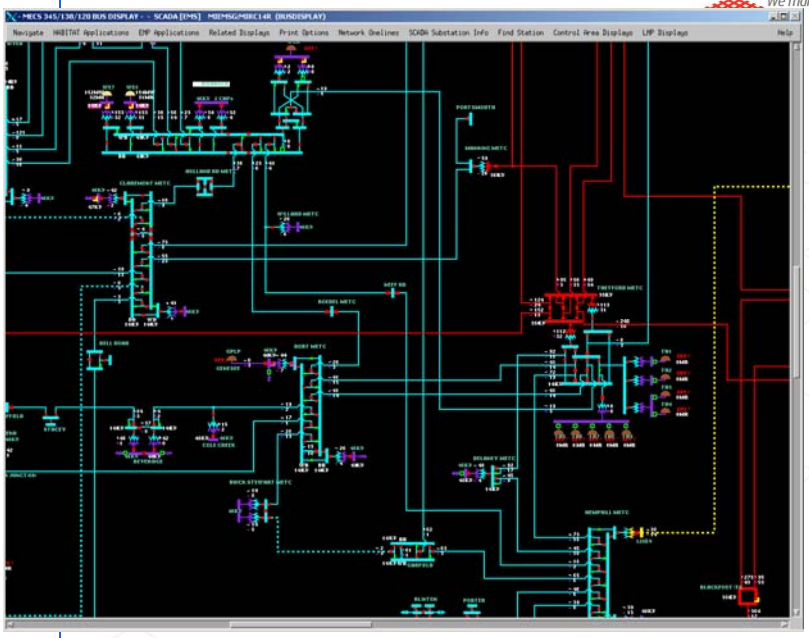
12



MISO Transmission Overview (Legend)



Midwest ISO
We manage power.



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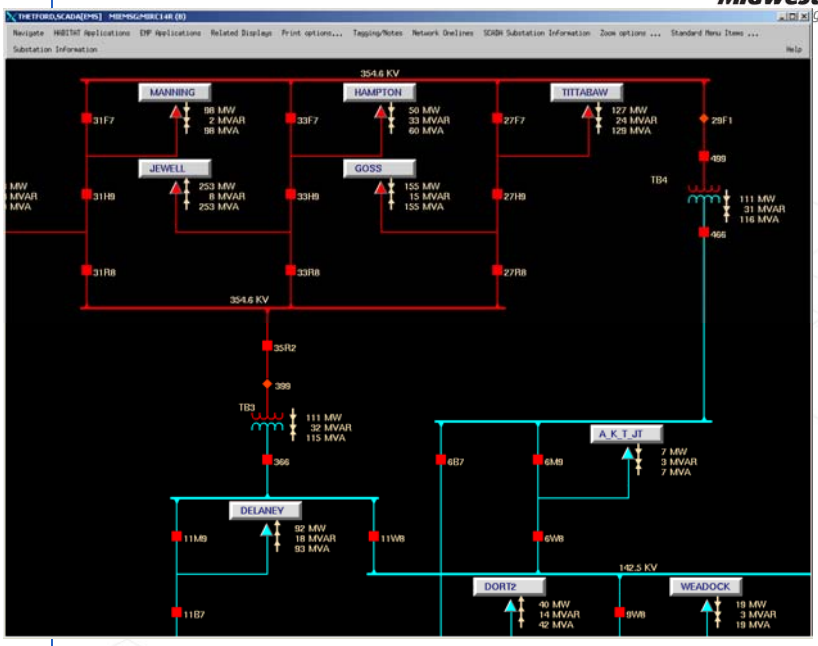
Midwest ISO
We manage power.



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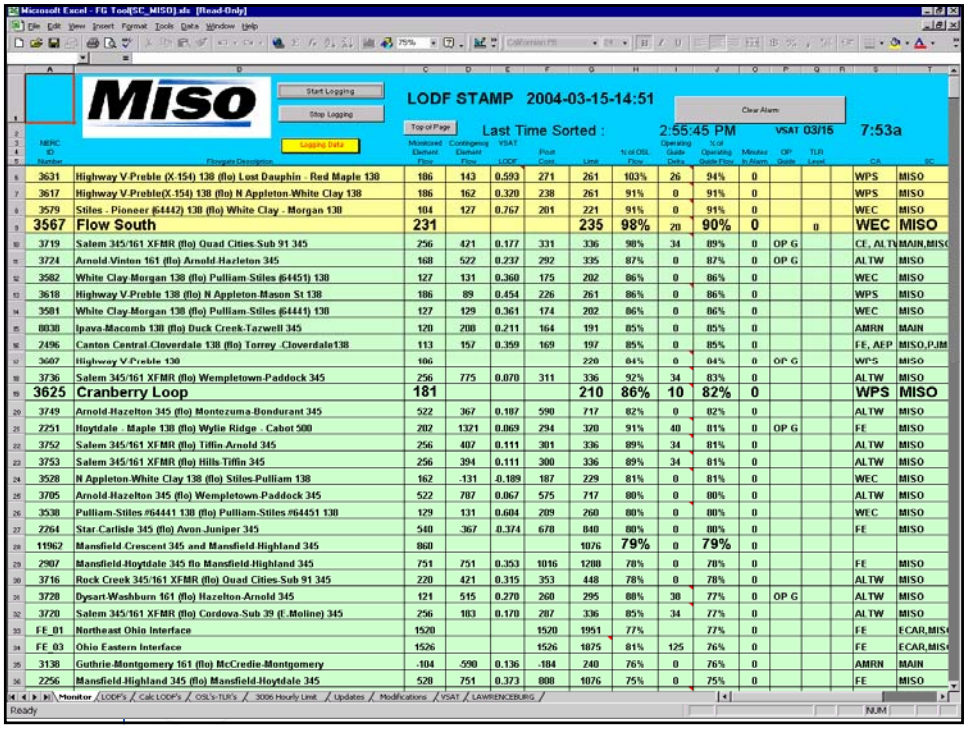
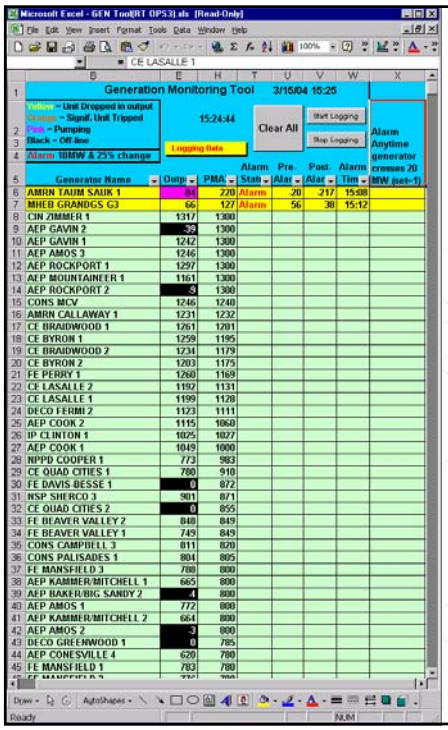


LODF STAMP 2004-03-15-14:51

Last Time Sorted : 2:55:45 PM VSAT 03/15 7:53a

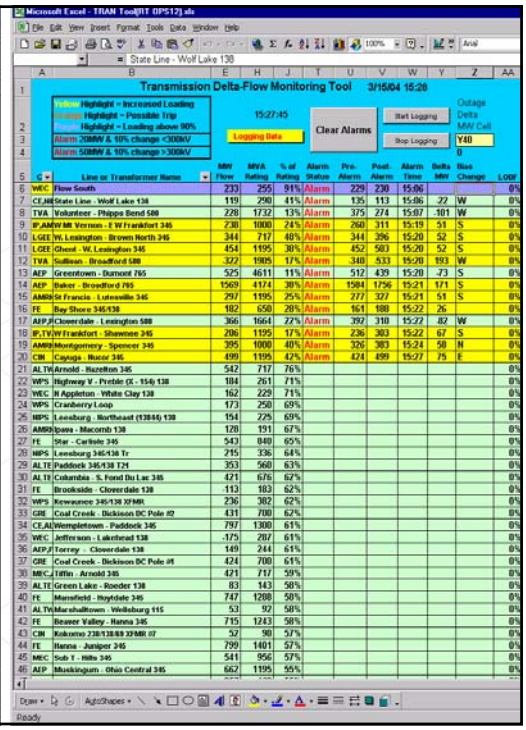
NERC ID Number	Flowgate Description	Monitored Element Flow	Contingency Element Flow	VSAT LODF	Post Cont. Limit	N-1 OSL Flow	Operating Guide Delta	% of Operating Guide Flow	Minutes in Alarm	OP Guide	TLR Level	CA	IC
3631	Highway V-Preble (X-154) 138 (flo) Lost Dauphin - Red Maple 138	186	143	0.593	271	261	103%	26	94%	0		WPS	MISO
3617	Highway V-Preble(X-154) 138 (flo) N Appleton-White Clay 138	186	162	0.320	238	261	91%	0	91%	0		WPS	MISO
3579	Stiles - Pioneer (64442) 138 (flo) White Clay - Morgan 138	184	127	0.767	201	221	91%	0	91%	0		WEC	MISO
3567	**Flow South**	**231**				**235**	**98%**	**20**	**90%**	**0**	**0**	**WEC**	**MISO**
3719	Salem 345/161 XFMR (flo) Quad Cities-Sub 91 345	256	421	0.177	331	336	98%	34	89%	0	OP G	CE, ALTW	MAIN,MISO
3724	Arnold-Vinton 161 (flo) Arnold-Hazleton 345	168	522	0.237	292	335	87%	0	87%	0	OP G	ALTW	MISO
3582	White Clay-Morgan 138 (flo) Pulliam-Stiles (64451) 138	127	131	0.360	175	202	86%	0	86%	0		WEC	MISO
3618	Highway V-Preble 138 (flo) N Appleton-Mason St 138	186	89	0.454	226	261	86%	0	86%	0		WPS	MISO
3581	White Clay-Morgan 138 (flo) Pulliam-Stiles (64441) 138	127	129	0.361	174	202	86%	0	86%	0		WEC	MISO
8038	Ipava-Macomb 138 (flo) Duck Creek-Tazwell 345	120	208	0.211	164	191	85%	0	85%	0		AMRN	MAIN
2496	Canton Central-Cloverdale 138 (flo) Torrey -Cloverdale138	113	157	0.359	169	197	85%	0	85%	0		FE, AEP	MISO,PJM
3607	Highway V-Preble 138	186				220	84%	0	84%	0	OP G	WPS	MISO
3736	Salem 345/161 XFMR (flo) Wempletown-Paddock 345	256	775	0.070	311	336	92%	34	83%	0		ALTW	MISO
3625	**Cranberry Loop**	**181**				**210**	**86%**	**10**	**82%**	**0**		**WPS**	**MISO**
3749	Arnold-Hazelton 345 (flo) Montezuma-Bondurant 345	522	367	0.187	590	717	82%	0	82%	0		ALTW	MISO
2751	Hoytdale - Maple 138 (flo) Wylie Ridge - Cabot 500	202	1321	0.069	294	320	91%	40	81%	0	OP G	FE	MISO
3752	Salem 345/161 XFMR (flo) Tiffin-Arnold 345	256	407	0.111	301	336	89%	34	81%	0		ALTW	MISO
3753	Salem 345/161 XFMR (flo) Hills-Tiffin 345	256	394	0.111	300	336	89%	34	81%	0		ALTW	MISO
3528	N Appleton-White Clay 138 (flo) Stiles-Pulliam 138	162	-131	-0.189	187	229	81%	0	81%	0		WEC	MISO
3705	Arnold-Hazelton 345 (flo) Wempletown-Paddock 345	522	787	0.067	575	717	80%	0	80%	0		ALTW	MISO
3530	Pulliam-Stiles #64441 138 (flo) Pulliam-Stiles #64451 138	129	131	0.604	209	260	80%	0	80%	0		WEC	MISO
7764	Star-Carlisle 345 (flo) Avon-Juniper 345	540	-367	-0.374	678	840	80%	0	80%	0		FE	MISO
11962	Mansfield-Crescent 345 and Mansfield-Highland 345	860				1076	79%	0	79%	0			
2907	Mansfield-Hoytdale 345 flo Mansfield-Highland 345	751	751	0.353	1016	1288	78%	0	78%	0		FE	MISO
3716	Rock Creek 345/161 XFMR (flo) Quad Cities-Sub 91 345	220	421	0.315	353	448	78%	0	78%	0		ALTW	MISO
3728	Dysart-Washburn 161 (flo) Hazelton-Arnold 345	121	515	0.270	260	295	88%	38	77%	0	OP G	ALTW	MISO
3720	Salem 345/161 XFMR (flo) Cordova-Sub 39 (E.Moline) 345	256	183	0.170	287	336	85%	34	77%	0		ALTW	MISO
FE_01	Northeast Ohio Interface	1520			1520	1951	77%		77%	0		FE	ECAR,MISO
FE_03	Ohio Eastern Interface	1526			1526	1875	81%	125	76%	0		FE	ECAR,MISO
3138	Guthrie-Montgomery 161 (flo) McCredie-Montgomery	-104	-590	0.136	-184	240	76%	0	76%	0		AMRN	MAIN
2256	Mansfield-Highland 345 (flo) Mansfield-Hoytdale 345	528	751	0.373	808	1076	75%	0	75%	0		FE	MISO



Generation Monitoring Tool 3/15/04 15:25

15:24:44

Generator Name	Outpi	PMA	Alarm Stat	Pre-Alar	Post-Alar	Alarm Tim
AMRN TAUM SAUK 1	84	220	Alarm	20	217	15:08
MHEB GRANDGS G3	66	127	Alarm	56	38	15:12
CIN ZIMMER 1	1317	1300				
AEP GAVIN 2	-33	1300				
AEP GAVIN 1	1242	1300				
AEP AMOS 3	1246	1300				
AEP ROCKPORT 1	1297	1300				
AEP MOUNTAINEER 1	1161	1300				
AEP ROCKPORT 2	-5	1300				
CONS MCV	1246	1240				
AMRN CALLAWAY 1	1231	1232				
CE BRAIDWOOD 1	1261	1201				
CE BYRON 1	1259	1195				
CE BRAIDWOOD 2	1234	1179				
CE BYRON 2	1203	1175				
FE PERRY 1	1260	1169				
CE LASALLE 2	1192	1131				
CE LASALLE 1	1199	1128				
DECO FERMI 2	1123	1111				
AEP COOK 2	1115	1060				
IP CLINTON 1	1025	1027				
AEP COOK 1	1049	1000				
NPPD COOPER 1	773	983				
CE QUAD CITIES 1	780	910				
FE DAVIS BESSE 1	0	872				
NSP SHERCO 3	901	871				
CE QUAD CITIES 2	0	855				
FE BEAVER VALLEY 2	848	849				
FE BEAVER VALLEY 1	749	849				
CONS CAMPBELL 3	811	870				
CONS PALISADES 1	804	805				
FE MANSFIELD 3	788	800				
AEP KAMMER/MITCHELL 1	665	800				
AEP BAKER/BIG SANDY 2	4	800				
AEP AMOS 1	772	800				
AEP KAMMER/MITCHELL 2	664	800				
AEP AMOS 2	-3	800				
DECO GREENWOOD 1	0	785				
AEP CONESVILLE 4	620	700				
FE MANSFIELD 1	783	780				



Transmission Delta-Flow Monitoring Tool 3/15/04 15:28

15:27:45

G	Line or Transformer Name	MW Flow	MVA Rating	% of Rating	Alarm Status	Pre-Alarm	Post-Alarm	Alarm Time	Delta MW	Bias Change	LODF
WEC	Flow South	233	255	91%	Alarm	229	230	15:06			0%
CE,IM	State Line - Wolf Lake 138	119	290	41%	Alarm	135	113	15:06	22	W	0%
TVA	Volunteer - Phipps Bend 500	228	1732	13%	Alarm	375	274	15:07	-101	W	0%
IP,AM	W Mt Vernon - E W Frankfort 345	230	1000	24%	Alarm	260	311	15:19	51	S	0%
LGEE	W. Lexington - Brown North 345	344	717	48%	Alarm	344	396	15:20	52	S	0%
LGEE	Ghent - W. Lexington 345	454	1195	38%	Alarm	452	503	15:20	52	S	0%
TVA	Sullivan - Broadford 500	327	1905	17%	Alarm	340	533	15:20	193	W	0%
AEP	Greentown - Dumont 765	525	4611	11%	Alarm	512	439	15:20	-73	S	0%
AEP	Baker - Broadford 765	1569	4174	38%	Alarm	1584	1756	15:21	171	S	0%
AMRN	St Francis - Lutesville 345	297	1195	25%	Alarm	277	327	15:21	51	S	0%
FE	Bay Shore 345/138	182	650	28%	Alarm	161	188	15:22	26		0%
AEP,P	Cloverdale - Lexington 500	366	1664	22%	Alarm	392	310	15:27	-82	W	0%
IP,TV	W Frankfort - Shawnee 345	206	1195	17%	Alarm	236	303	15:22	67	S	0%
AMRN	Montgomery - Spencer 345	395	1000	40%	Alarm	326	383	15:24	58	N	0%
CIN	Cayuga - Nucor 345	499	1195	42%	Alarm	424	499	15:27	75	E	0%
ALTW	Arnold - Hazelton 345	542	717	76%							0%
WPS	Highway V - Preble (E - 154) 138	184	261	71%							0%
WEC	N Appleton - White Clay 138	162	229	71%							0%
WPS	Cranberry Loop	173	250	69%							0%
MPS	Leesburg - Northeast (13844) 138	154	225	69%							0%
AMRN	Ipava - Macomb 138	128	191	67%							0%
FE	Star - Carlisle 345	543	840	65%							0%
MPS	Leesburg 345/138 Tr	215	336	64%							0%
ALTE	Paddock 345/138 T21	353	560	63%							0%
ALTE	Columbia - S. Fond Du Lac 345	421	676	62%							0%
FE	Brookside - Cloverdale 138	113	183	62%							0%
WPS	Kewaunee 345/138 XFMR	236	382	62%							0%
GRE	Coal Creek - Dickinson DC Pole #2	431	700	62%							0%
CE,AL	Wempletown - Paddock 345	797	1300	61%							0%
WEC	Jefferson - Lakefield 138	-175	287	61%							0%
AEP,P	Torrey - Cloverdale 138	149	244	61%							0%
GRE	Coal Creek - Dickinson DC Pole #1	424	700	61%							0%
MEC,A	Tiffin - Arnold 345	421	717	59%							0%
ALTE	Green Lake - Roeder 138	83	143	58%							0%
FE	Mansfield - Hoytdale 345	747	1288	58%							0%
ALTW	Marshalltown - Wellsburg 115	53	92	58%							0%
FE	Beaver Valley - Hanna 345	715	1243	58%							0%
CIN	Kokomo 230/138/69 XFMR #7	52	90	57%							0%
FE	Hanna - Juniper 345	799	1401	57%							0%
MEC	Sub T - Hills 345	541	956	57%							0%
AEP	Muskingum - Ohio Central 345	662	1195	55%							0%

Why CIM is Important

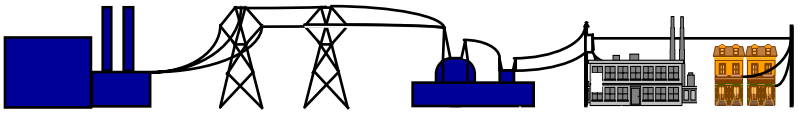
- A Wide Area View without a correct model is a threat to reliability.
- A Wide Area View without adequate real time data is of minimal value.
- Model exchange on a timely basis provides a significant improvement in the tools available to RCs.

19

How to Apply the CIM Standards and Extend for Project Specific Needs

Terry Saxton

EPRI CIM/GID International Conference
MISO
November 2005



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Presentation Contents

- How the CIM works to support system integration
- Need for project specific extensions
- How to Extend the CIM
- Summary

Xtensible Solutions

How the CIM Standards Are Used

- Support information exchange between systems supporting business functions for planning, constructing, maintaining and operating the electric transmission and distribution (T&D) network and for market operations
- Common language for understanding information:
  - Consistent meaning and organization of data into objects and attributes
    - Project teams come and go
    - Semantic model adds overarching stability
  - Provides a semantic layer in the integration framework architecture
    - independent of projects and software applications/systems
- Common operations to share information:
  - Request data from distributed databases
  - Send messages with updates to distributed databases

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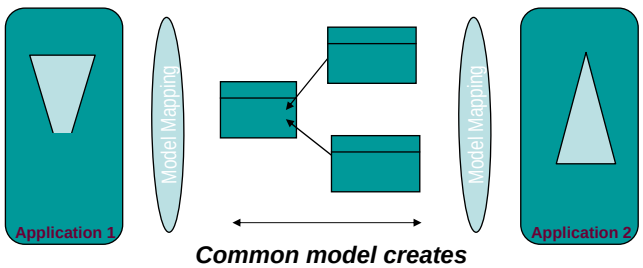
 3

Application of Information Model



Common model creates understanding

SISCO SYSTEMS

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 4

"The building of the tower of Babel"

by Pieter Bruegel, 1563

Oil on oak panel, Kunsthistorisches Museum, Vienna

Inter-Application Integration Solutions *Always* Experience *Scaling Problems* Without A Common Language For Information Exchange

Xtensible Solutions

CIM Provides Vocabulary - CIM XML Provides Standard Messages

- Webster's Dictionary = CIM
  - Provides standard data semantics and data types
- Sentence structure = CIM- based XML messages
  - Just as you must have structured sentences to communicate orally, you must have standard messages to share data electronically
- Standard messages are needed to
  - Ensure interoperability both within and between utilities
  - Remove seams
  - Define that part of CIM that must be supported by an application
- Adapters provide CIM <-> proprietary data mappings used by applications

Xtensible Solutions

How the CIM is Used to Enable Integration Based on a Semantic Model

- Used to define a common language for the sharing information:
  - Common language for all systems/applications to communicate via an integration bus
  - Common model for accessing data in any database:
    - Permits navigating/browsing and formulating requests for data according to the CIM model, not the internal database schema
- Used to automatically generate XML based on the CIM:
  - Files for sharing power system models
  - Standard XML message payloads based on CIM
- Model Driven Integration (MDI)
  - CIM provides semantic model for MDI
  - Define messages in UML based on CIM
  - Apply extensions and restrictions for specific utility needs
  - Auto-generate XML schemas for message payloads
  - Translate at run-time to/from native XML schema

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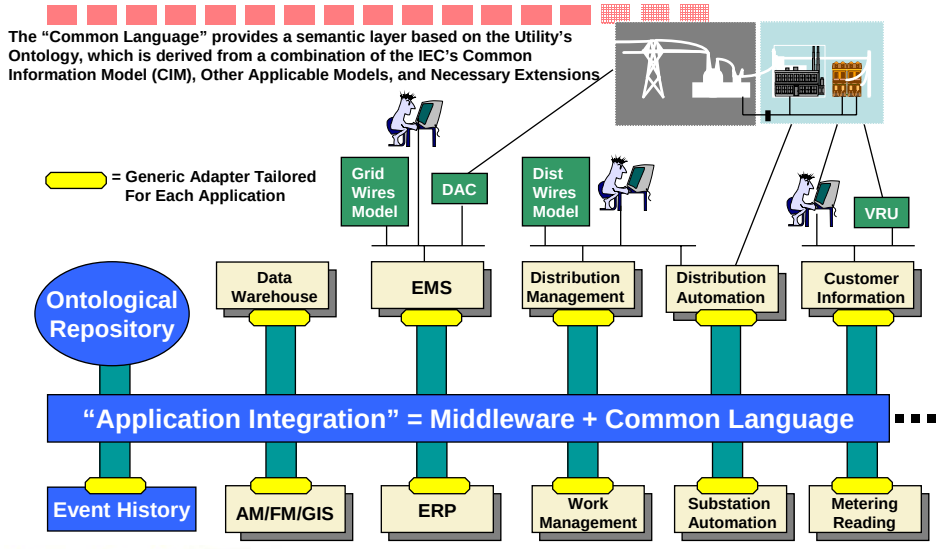
How Some Utility Implementations Are Using A Standards-Based Semantic Data Model

The "Common Language" provides a semantic layer based on the Utility's Ontology, which is derived from a combination of the IEC's Common Information Model (CIM), Other Applicable Models, and Necessary Extensions



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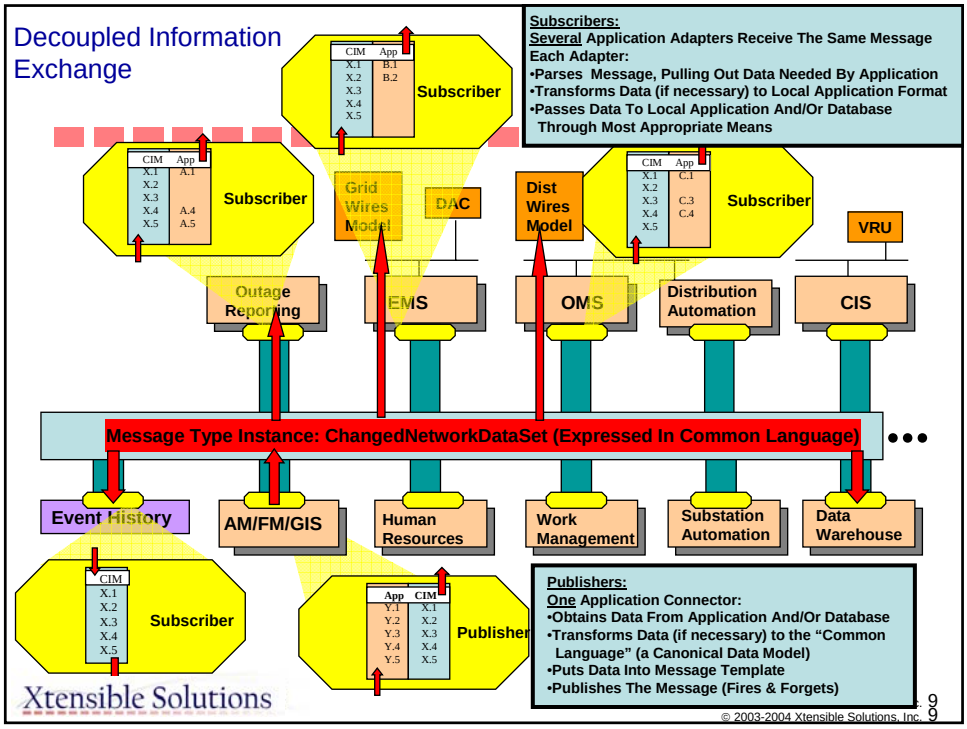

CIM for Information Exchange Between Enterprises

- Possibility for common meaning and usage across multiple enterprises
  - Ideal for inter-utility data exchange
  - Independence of protocol layer ensures stability and needed flexibility to accommodate change and growth
- Support transmission reliability
  - Exchange of power system models between Security Coordinators based on CIM/XML
- Support market operations

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 10

How to Deal with Project Extensions

- CIM and message schemas should be viewed as a “starter” kit
- Standards anticipated the need to customize for specific project needs
  - Adapt to utility’s business processes rather than changing utility’s processes and applications to adapt to the CIM
- Key is to define semantic model that serves the needs of the utility for ***ALL*** information exchanges

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 11

How to Extend the CIM

- Start with the existing CIM UML model in Rational ROSE
- Extensions may be added in any of several ways that are available in UML
- Approach is to inspect the current model and determine the best way to build off of the existing class diagrams
- Extensions may take several forms:
  - Adding additional values to existing attributes in a class
  - Adding additional attributes to existing classes
  - Adding new classes that are specializations of existing classes
  - Adding new classes via associations with existing classes
- The main objective
  - Reuse the existing CIM to the maximum extent possible
  - Do not change packages that are stable

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 12

How to Use the CIM

- Design Time Environment
- Start with business processes to be enabled
  - Start with standard use cases (WG13/14) and augment as needed
- Create new Name Space for Project
  - Import standard CIM into this new Name Space before modifying
- Develop activity diagrams and sequence diagrams
  - Start with standard versions and extend as needed
  - Identifies specific information exchanges (messages)
- Develop message payloads
  - Start with standard message definitions and extend as needed
  - Work in UML of adding classes, attributes, relationships
  - Tools to add business constraints to XML schema definitions
- Define specific profile to be supported by interfacing systems
  - CIM compliance testing is against profile and message schemas

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 13

How to Use the CIM

- Run-Time Environment
  - Map generic services onto EAI platform services
  - Provide transformation service in adapter between native XML schema and CIM-based XML schema definitions
  - Validate each message (instance data) against business constraints applied in design time environment

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 14

Rules for Extending CIM

- Rational Rose is used to maintain the CIM UML model
  - Maintenance depends on features available in Rational Rose
- Divide the model into UML packages with well-defined dependencies to improve model modularization
  - Extensions should be made to existing Packages where possible
  - If extensions comprise a new domain of application, create a new Package for the additions
  - Minimize relations between packages
- Divide the UML model in several model files where each file has it's own versioning to lessen the file versioning problem
- Organize files in directories to lessen the file management problem
- Define model extension rules to ensure consistency in model

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How to Extend the CIM

- Changes should be collected in separate packages and existing packages left unchanged.
  - Contents in existing packages should be changed only to correct errors or to incorporate well-founded revisions of how the model is structured in packages
- When creating new packages the general rules are
  - keep related information in the same package
  - If there are many associations between classes in different packages, consider relocating one of the classes
  - Basic rule is that circular references between models are to be avoided
    - This means that extensions to a model should be made so that existing and frozen parts are left unaffected.

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How to Extend the CIM

- The techniques for extensions:
  - Extensions (new attributes or associations) are placed in new classes that specialize existing classes using inheritance
  - Extensions are placed in new packages separate from the existing packages
    - Extensions are only loaded when needed for application
  - If existing classes are extended with new associations, the associations should be added to the new package

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 17

MDI Summary

- Builds on industry standards.
- Leverages best practice integration architecture frameworks.
- Provides:
  - One integrated methodology
  - One set of integrated tools
  - One enterprise integration semantic model
  - One enterprise reuse repository for: business processes, services, messages, key information assets (bundling of data, message, & service), and application connectivity.
- Is a complete and standards based design time solution from top to bottom (from processes all way to applications), and can be built upon many different integration platforms for run time.
- Builds the foundation for a service-oriented and event-driven business integration infrastructure.

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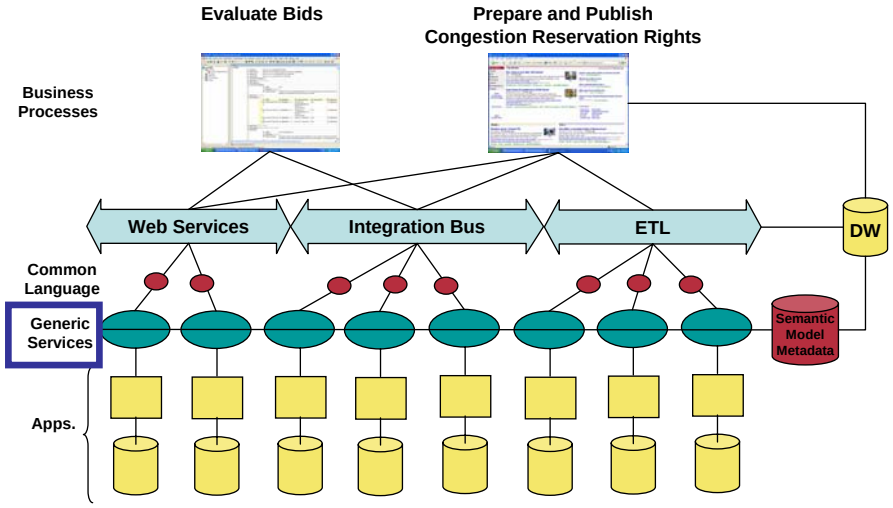
 18

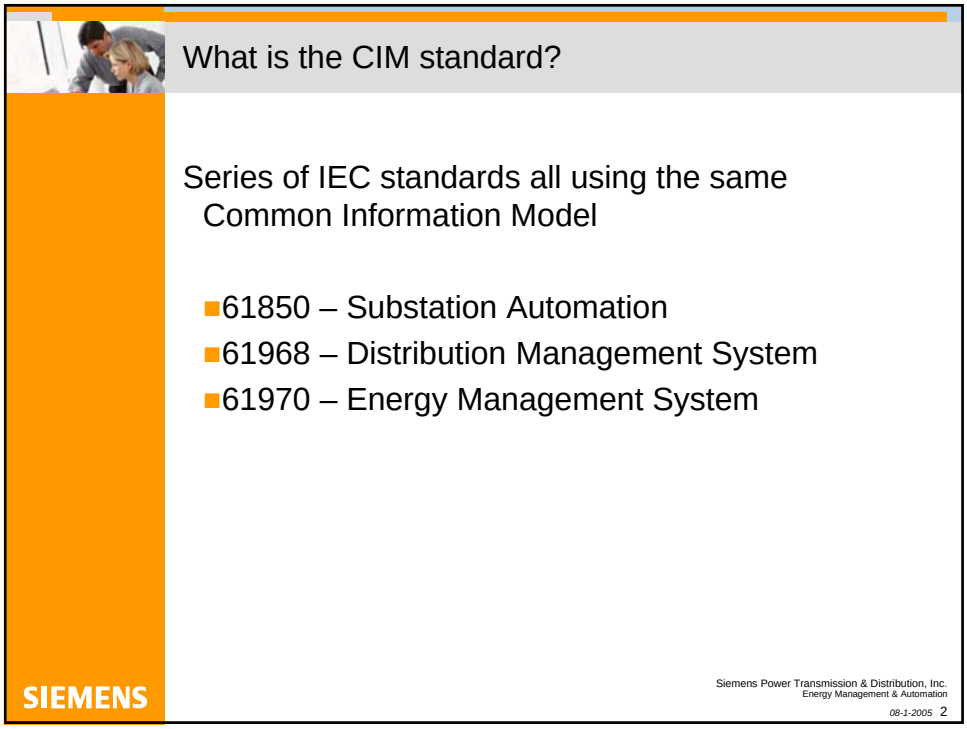
Business Process-Driven Integration



Xtensible Solutions

 19


PTD Energy Management & Information Systems
CIM Maintenance and Version Management
Kurt Hunter
SIEMENS


What is the CIM standard?
Series of IEC standards all using the same Common Information Model
61850 – Substation Automation
61968 – Distribution Management System
61970 – Energy Management System
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Siemens Power Transmission & Distribution, Inc.
Energy Management & Automation
08-1-2005 2

What is the CIM standard?

Standards developed by Working Groups under IEC Technical Committee 57 (TC57)

- WG10, WG11, WG12 – Substation Automation
- WG13 – Energy Management System Application Program Interface
- WG14 – Distribution Management System Interfaces
- WG16 – Deregulated Electricity Market Communications
- WG19 - Harmonization

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What is the CIM standard?

- WG's responsible for different portions of the CIM
- CIM divided into packages, which are maintained independently
- WG19 handles areas of overlap between WGs

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Current WG13 CIM Maintenance Process

Issues List

- Issues received from:
  - WG members
  - National Comments (from standardization voting process)
  - Interoperability Tests
  - Individuals working with CIM
- Issues Addressed In Order Received
  - WG meetings
  - Conference Calls

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Current WG13 CIM Maintenance Process

Sample Issue List

Issue No.	Source	Date	Clause/ Subclause/ Paragraph/ Figure/ Table	COMMENTS	Proposed change	Decision	Person Assigned	Due Date	Status
19	Magnus J	00-11-28		The ConductingEquipments has a 0..* relation to Terminal meaning that any number of terminals might be attached to a ConductingEquipment. However, all equipment do have a well specified number of terminals, e.g. Switch has two, Conductor has two, Connecto	Make the number of terminal explicit for each type.	WG13: Terminals attribute deleted from ConductingEquipment. Table of required number of terminals for each equipment type will be added to Part 301. Erich will prepare table for review			Complete (See Issue 87)
59	Magnus J	1/31/01		Additional properties slope and voltageSetPoint for SVC is needed.		WG13: Agree to add slope and voltageSetPoint to StaticVARCompensator (type undetermined). Lars to ask Magnus to determine type. 3/12 - voltageSetPoint - voltage, Slope - perunit per kvolts base MVAR			Complete
204	L. Osterland /H. Diehl	6/22/04	Part 301	Need to explain situations where there are multiple possible parents where at least one parent is mandatory (e.g., Bay may be a child to either Substation or VoltageLevel).	Add text to Part 301				Open. Deferred to PL on Equipment/Naming hierarchies

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Current WG13 CIM Maintenance Process

- Issue Resolutions Implemented by volunteers
- Model Versions Maintained using Groove

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Current WG13 CIM Maintenance Process

Three Stages of Model Development

- Standard (Released and Frozen)
- Release Candidate
- Project (Working Model)

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Current WG13 CIM Maintenance Process

IEC Standardization Process

- Documents to be standardized go out to national committees for comments and votes
- IEC Document Stages
  - CD (Committee Draft) – comments returned
  - CDV (Committee Draft for Vote) – comments and vote returned
  - FDIS (Final Draft International Standard) – vote to be returned
  - IS (International Standard)

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CIMug Maintenance Process Changes

CIM Model Manager

- Coordinates maintenance process across WG's
- Maintains single issues list for all CIM WG's

CIMug Technical Committee

- Prioritize issues
- Propose resolutions to WG's

Working Groups still have final decision on all changes

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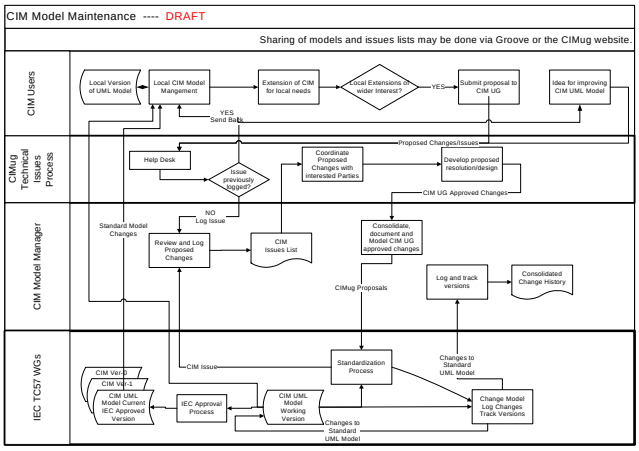
CIMug Maintenance Process Changes

Proposed CIM Maintenance Process



The Common Information Model as a Software Framework

Alan McMorran

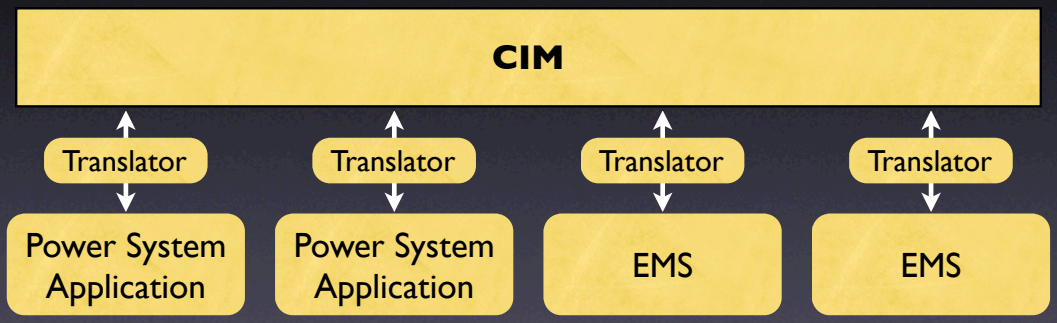
INSTITUTE FOR ENERGY AND ENVIRONMENT

University of Strathclyde Glasgow

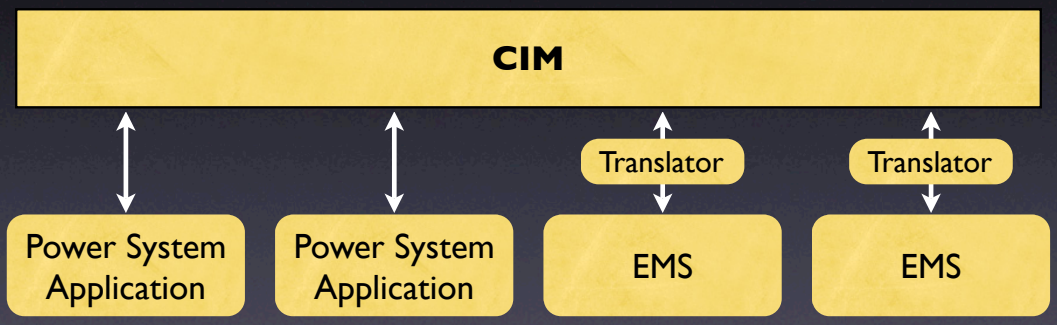
Introduction

- The CIM Java Framework
  - The *Origin* and *Model* classes
  - The *Model Library*
- Mercury - a CIM Power Systems Toolkit
  - CIM Network Model Creator
  - Model Visualisation
  - Network Model Integration
  - Model Exporting
- Future Avenues of Research

Beyond Translation



Beyond Translation



Beyond Translation

- Currently the CIM is primarily used for exchanging data between EMS systems
- This requires data to be translated to and from an application's own internal data format and the CIM
- The Object-Oriented design of the CIM standard raises the possibility of it being used as a software framework

CIM Java Framework

- The CIM Class structure can be mapped to almost any Object-Oriented language
- Java was chosen for its cross-platform compatibility and flexibility
- The same modules can be used for CLI applications, Applets and Servlets

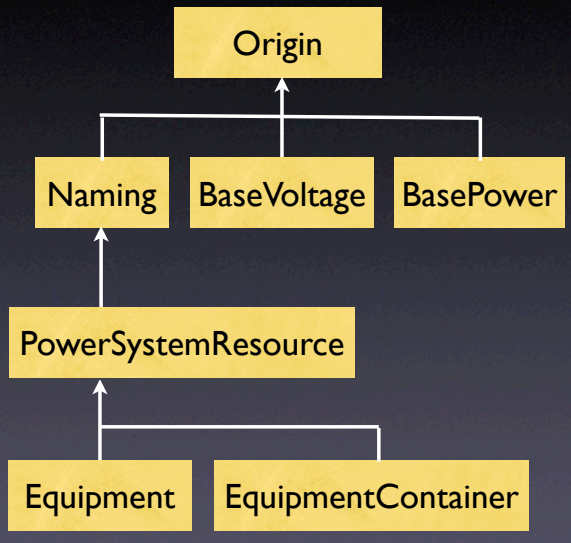
CIM Java Framework

- The CIM UML model was converted to native Java classes requiring only minimal changes
- Basic methods were created to modify the attributes and associations within an object
- This provided a mechanism for storing and extracting CIM data as Java objects

CIM Java Framework

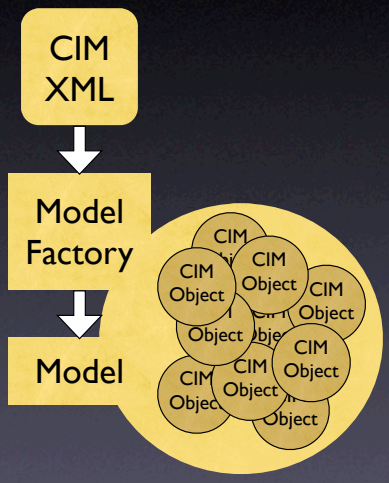
- The hierarchy was modified with the addition of a single *Origin* class from which all other CIM classes inherit

  The addition of this class allows common methods to be added to all CIM Objects e.g. *getXML(), getUri()*



CIM Java Framework

- A new *Model* class was created to contain power system models instantiated as CIM Java Objects
- The *ModelFactory* class imports and converts CIM XML files into these self-contained CIM Java Models



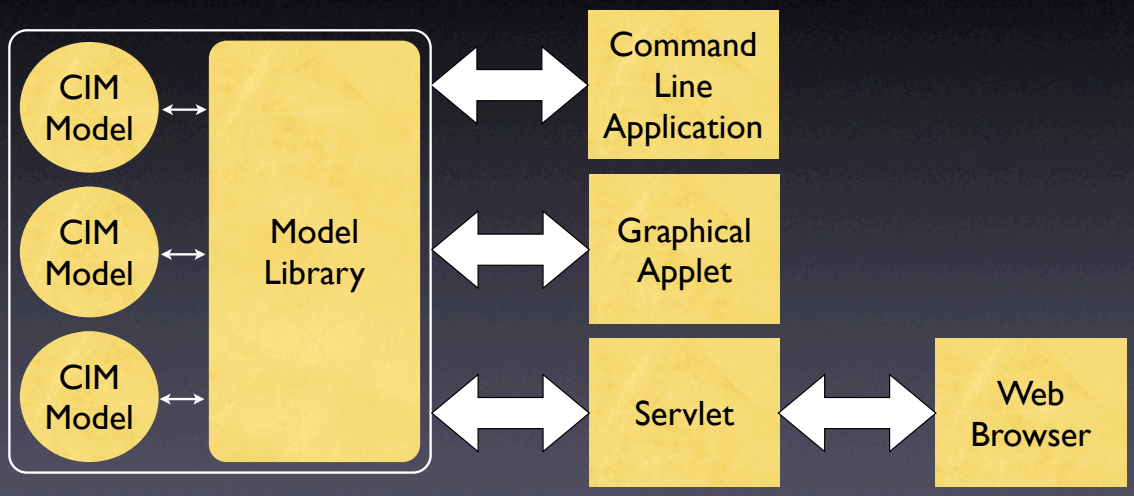
CIM Java Framework

- The *Model* class API contains methods for exporting and interrogating the CIM power system model
- The API includes methods to:
  - Export the model as full CIM XML
  - Add, remove and update objects within the model
  - Create Topological Nodes
  - Validate the topological integrity
  - Return a copy of the model as a new, separate *Model* instance

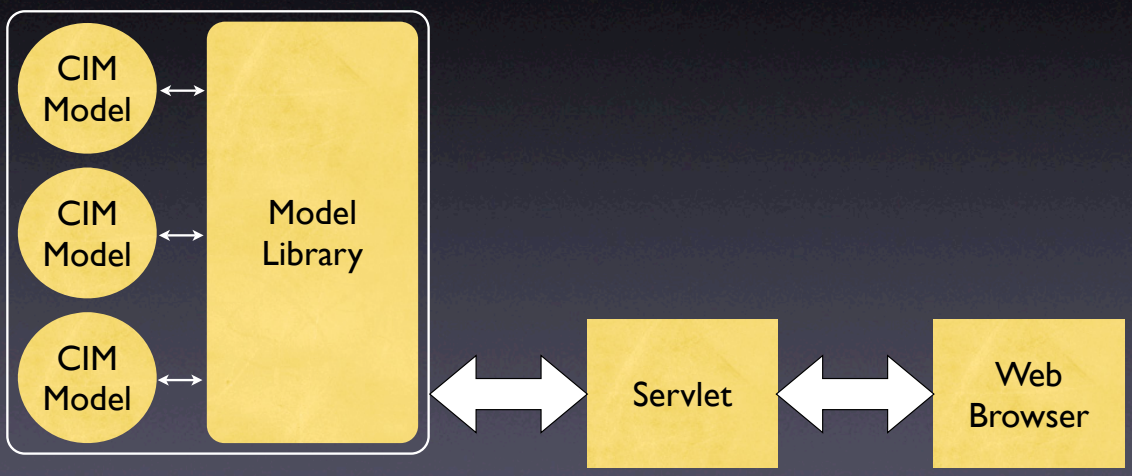
The Model Library

- The CIM *Model* class is used to store CIM networks as memory resident Java objects
- The *Model Library* is used to store and manage these *Models*
- Due to the memory resident nature of the *Models*, the *Model Library* tracks changes to all models within its index so that the library can be rebuilt if the system crashes

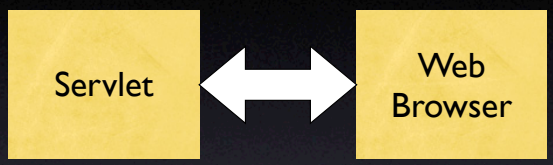
The Model Library



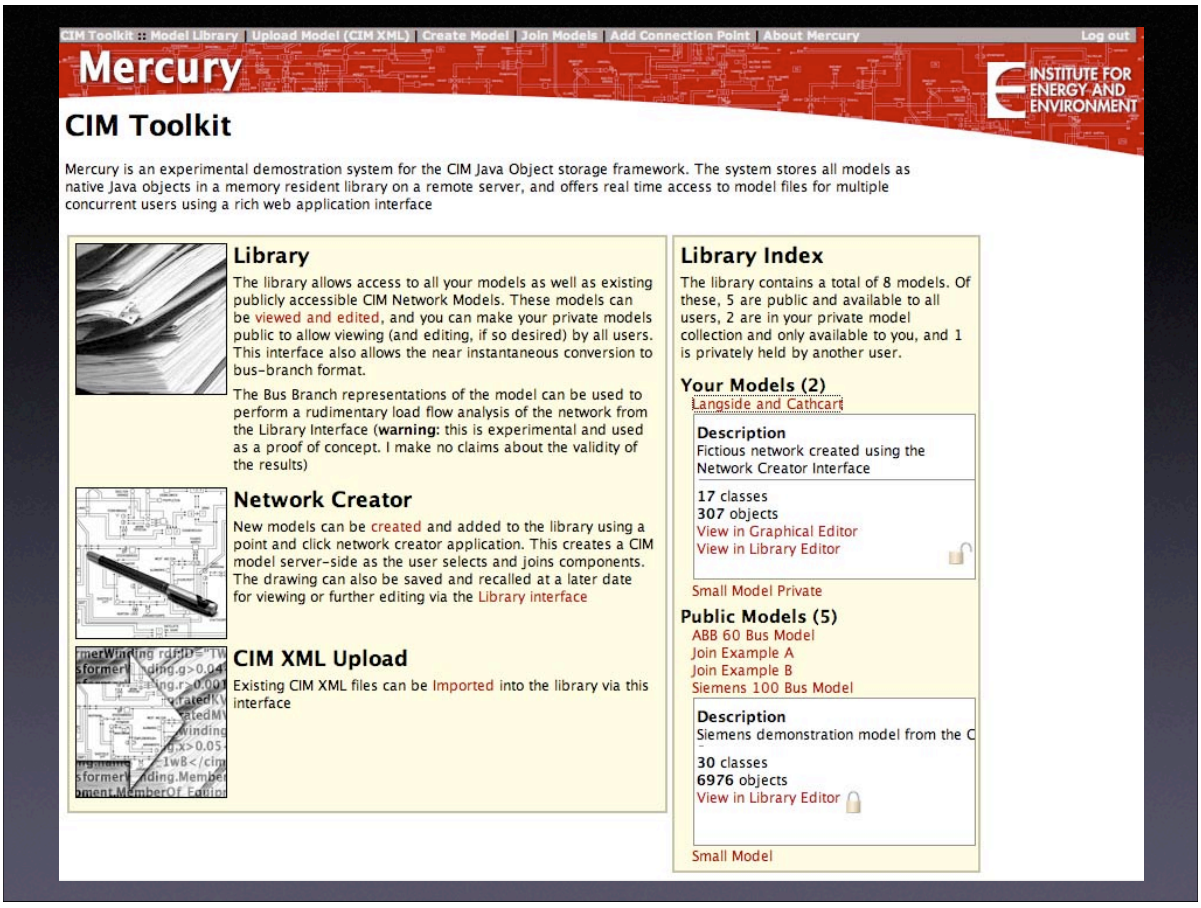
The Model Library



Mercury

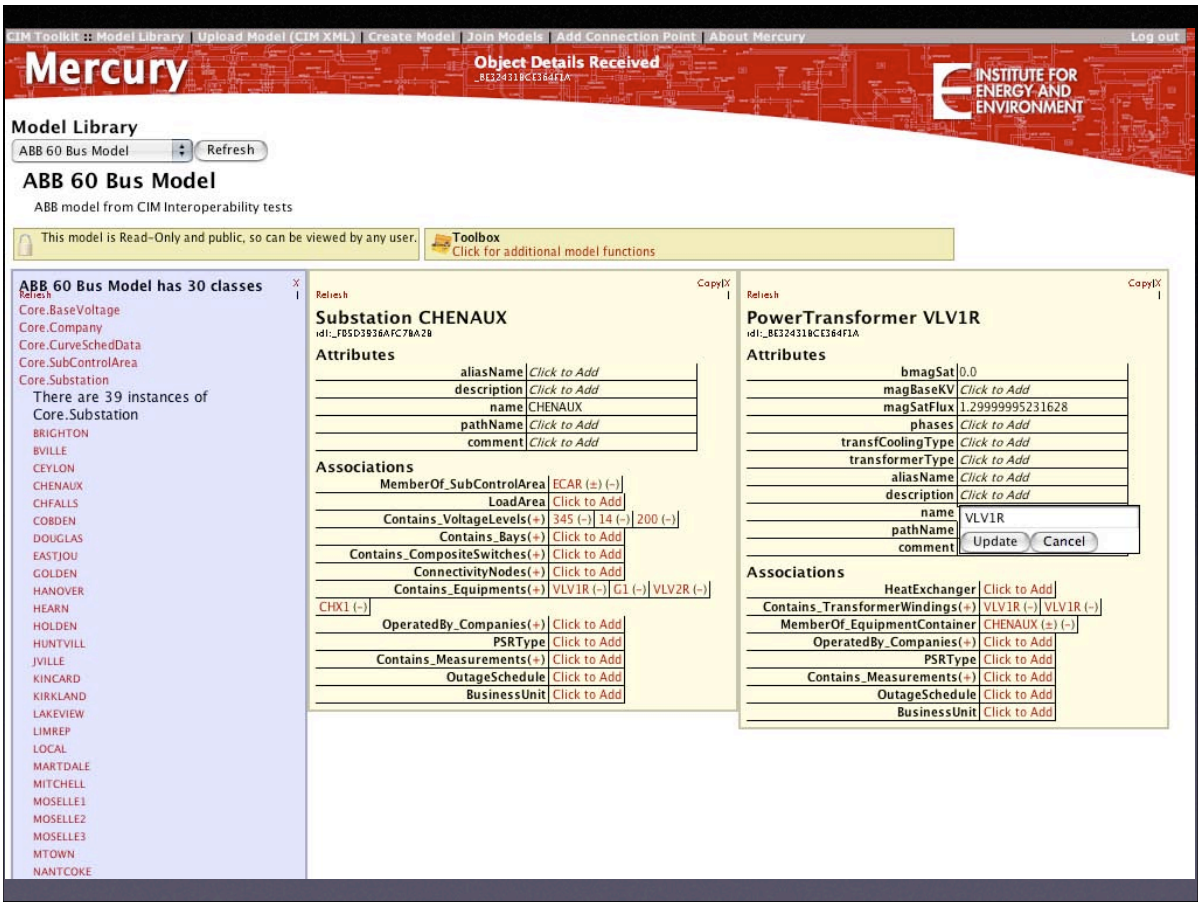


- Mercury is a Power Systems toolkit based on the CIM Java Framework with a Rich Web Application front end
- The toolkit runs under Apache Tomcat on the server side and requires only a web browser on the client side



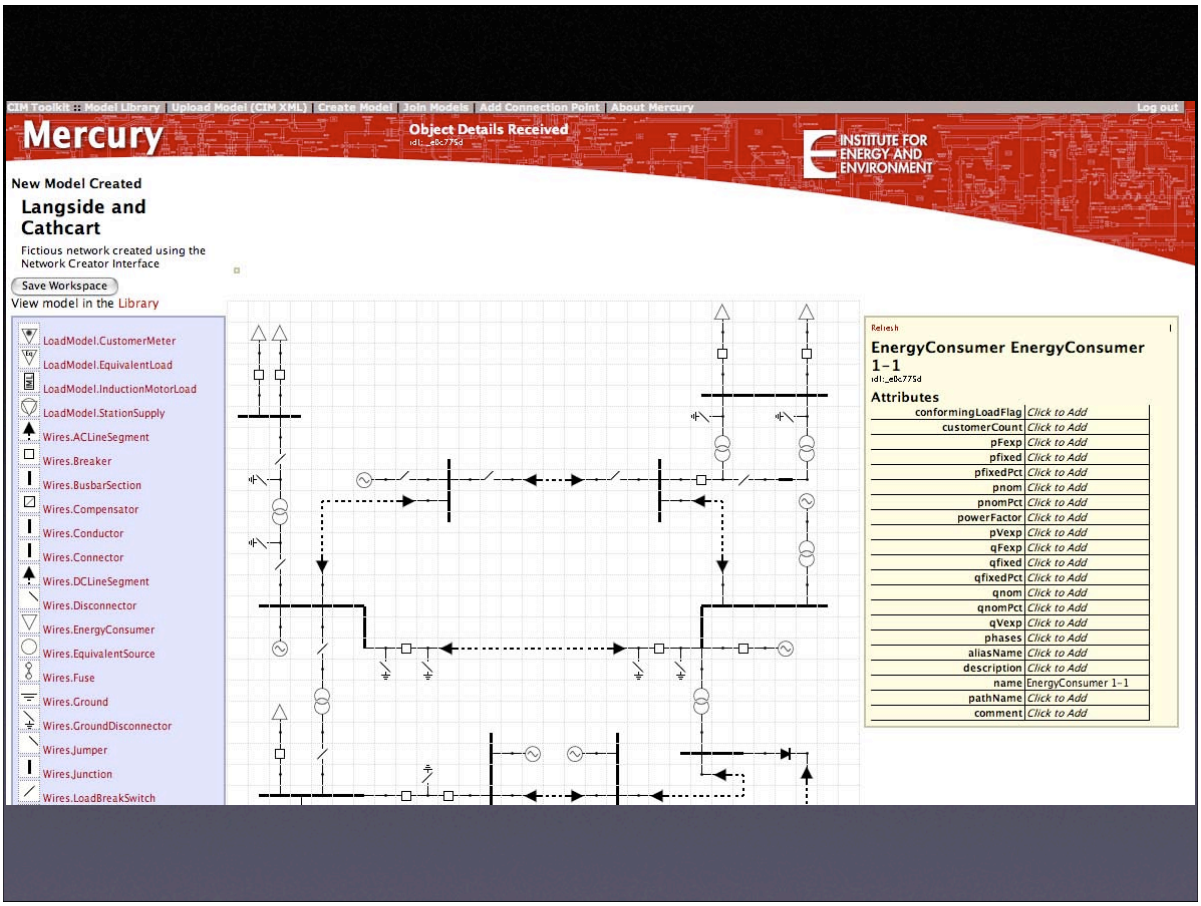
Network Model Maintenance

- Allows the user to view and edit CIM Power System Models
- Modify attributes and associations
- Create new network objects
- View the model in Bus-Branch format
- Uses AJAX to provide an desktop-application like environment on the Web

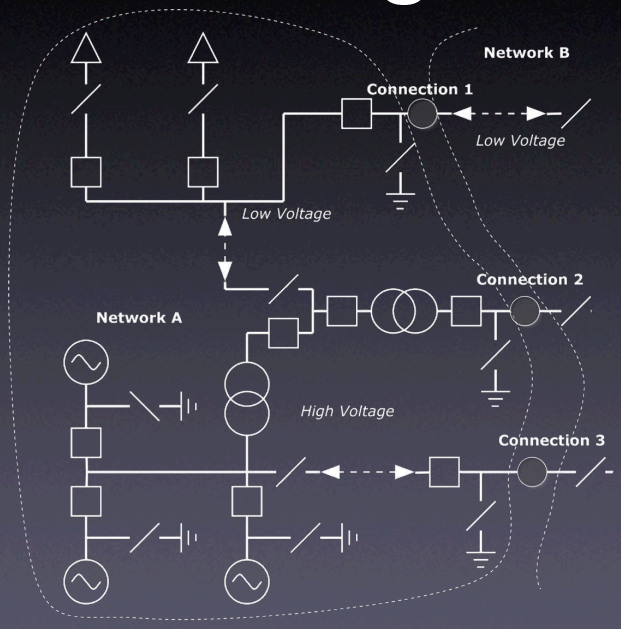


Network Model Creation

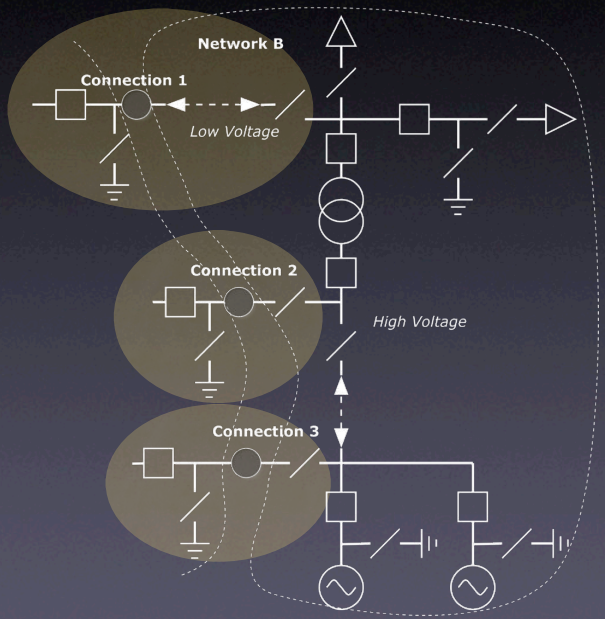
- Create new CIM Power System Models with a graphical point and click interface
- Save the model layout to edit and modify at a later time
- Uses background server communications to create the CIM objects in the library
- Can be expanded to use future CIM Extensions with only minor modifications



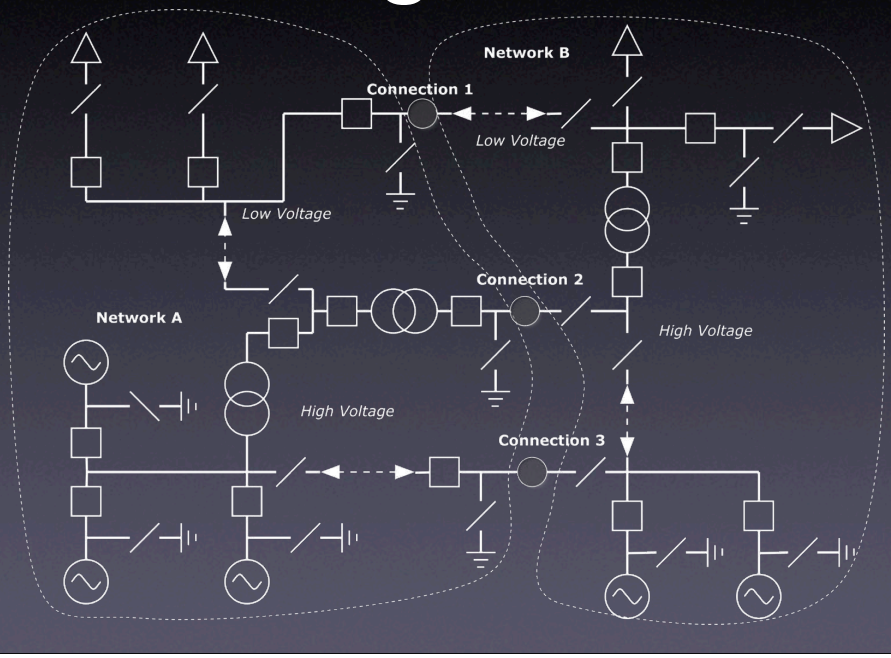
Network Model Integration



Network Model Integration



Network Model Integration

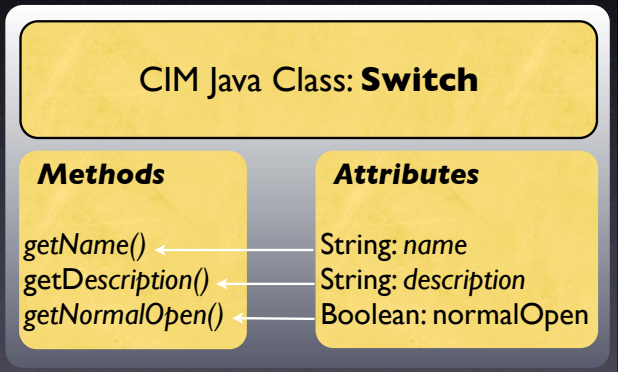


Future Avenues

- Real Time CIM Data
- Alarm Processing
- Using CIM in Online Diagnostic Systems
- CIM as an ontology for Multi-Agent Systems

Real Time CIM Data

- The CIM Java Objects store attributes as integer, floating point, boolean or String values
- The values are accessed via *getAttribute()* and *setAttribute()* methods
- These methods can be altered to read the data from other locations



Real Time CIM Data

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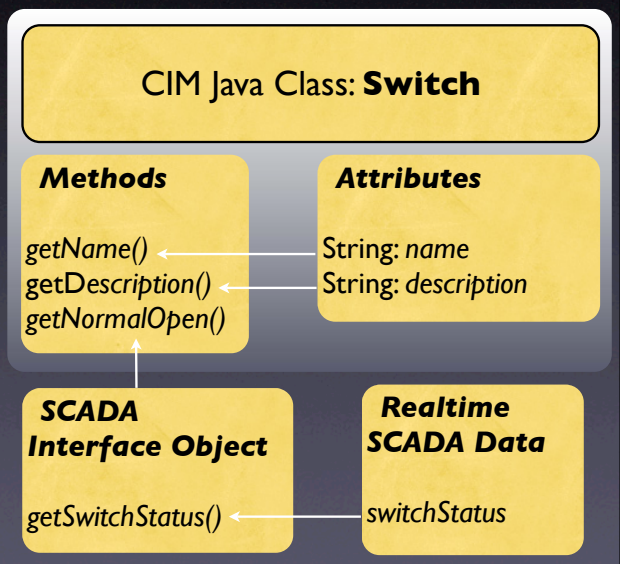
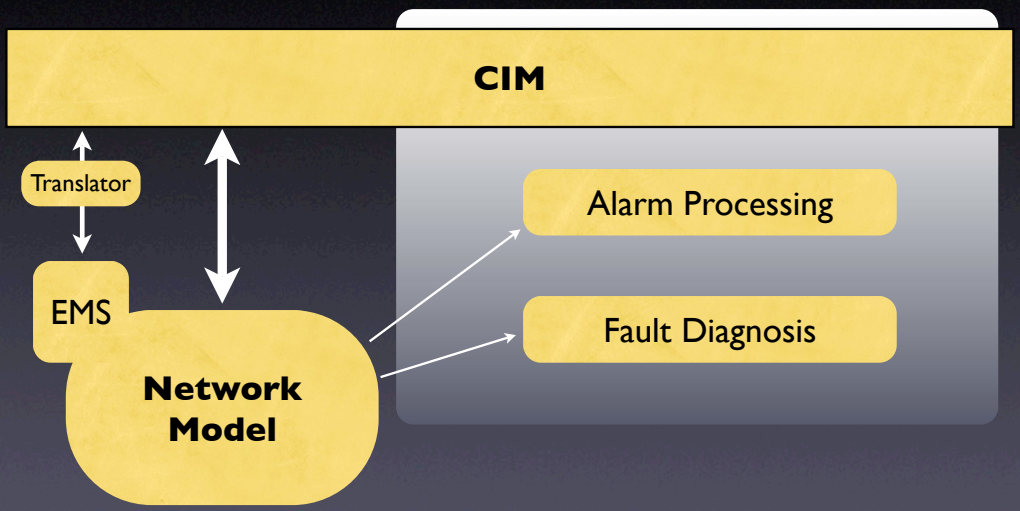
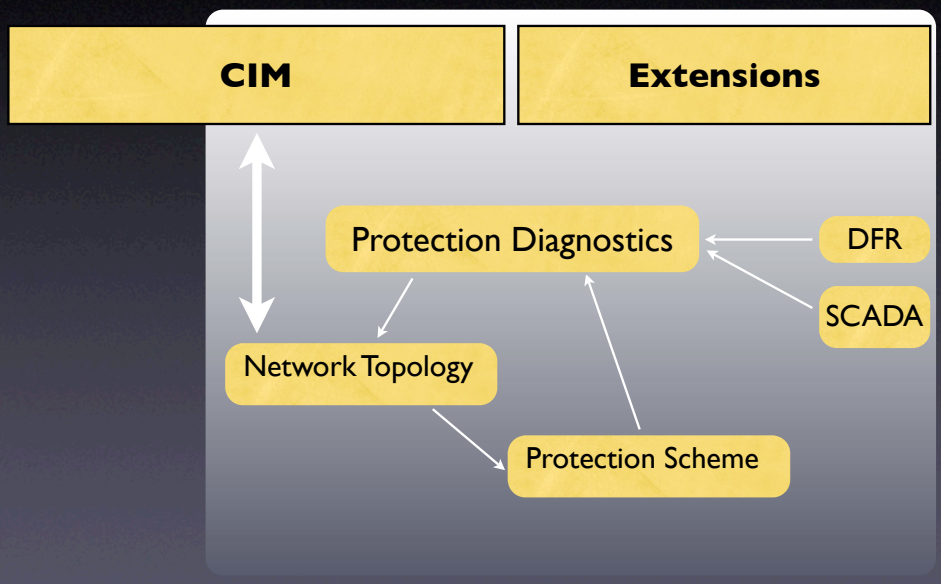


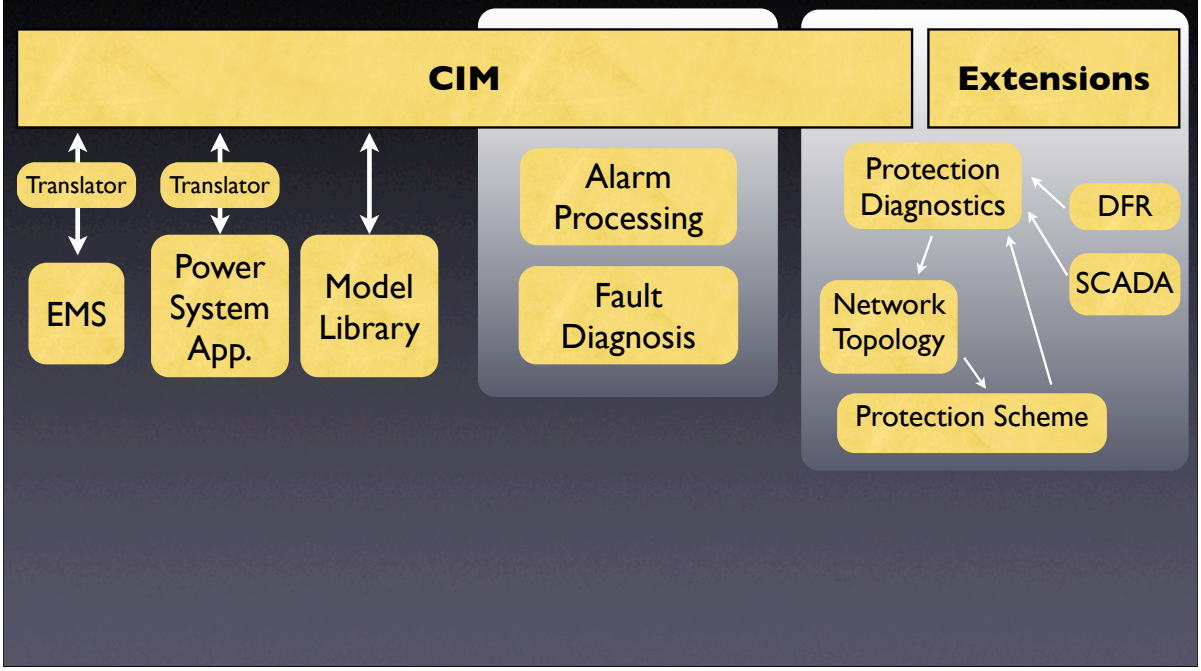
Control Centre Diagnostic Systems



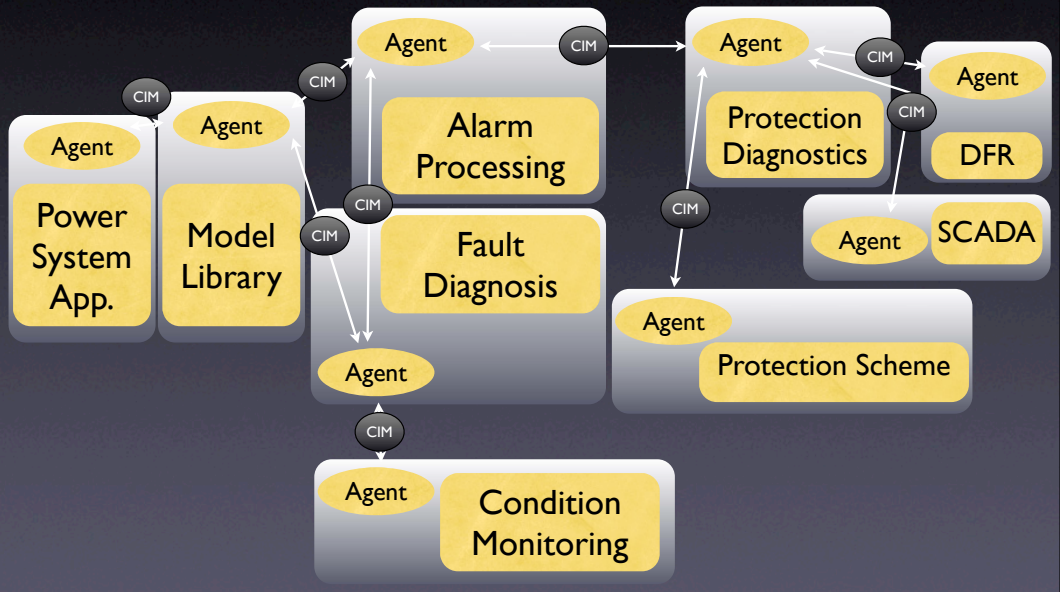
Online Diagnostic Systems



CIM Applications



CIM as an Agent Ontology



Summary

- The CIM offers a powerful foundation for creating Power System applications
- Enhancements to the CIM Standard can be integrated into the framework with minimal modification
- Embedding functionality within the CIM Classes provides a powerful API on which applications can be built

Summary

- Example applications already implemented include the Model Library, Network Creator, Model Integrator, Bus-Branch conversion and Model Visualisation
- Future research will focus on extending and enhancing the Mercury Toolkit's suite of applications and integrating it with existing Power System Applications

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CIM/GID Unified Data Model at LIPA for the Enterprise

EPRI
- Raymond Lings
- Bhavin Desai

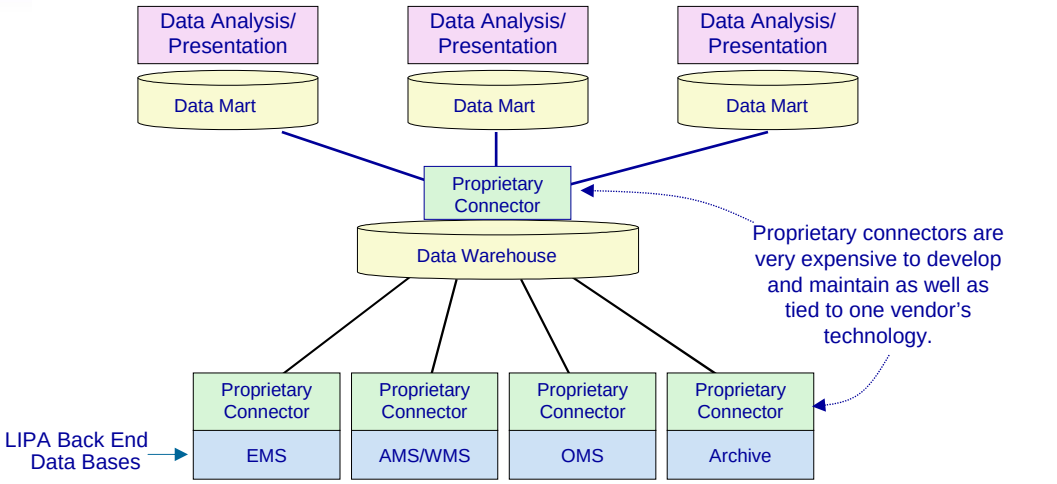
LIPA
- Mike Hervey
- Ron Clare
- Joe Odierna
- Richie Soper
- Steve Wasylenko
- Brigitte Wynn

Presented at:
EPRI CIM/GID International Conference
Midwest ISO
Carmel, Indiana, USA

EPRI ELECTRIC POWER RESEARCH INSTITUTE

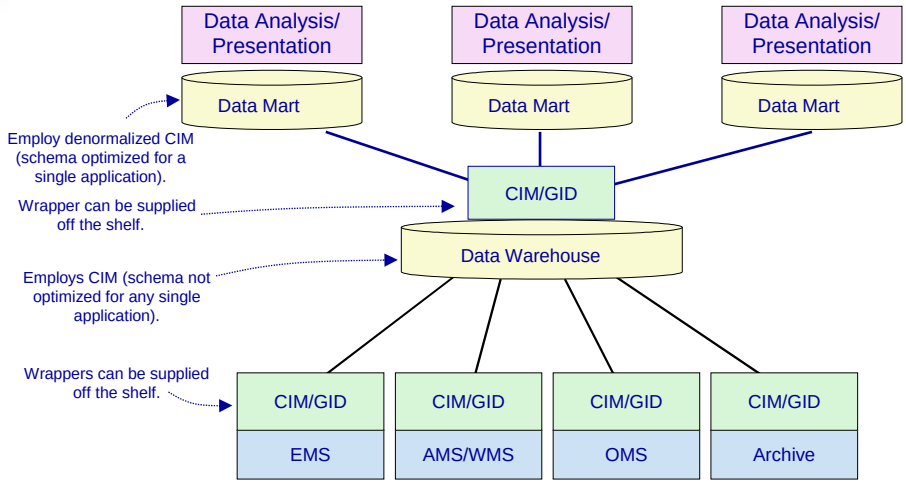
Traditional Data Warehouse

LIPA Long Island Power Authority



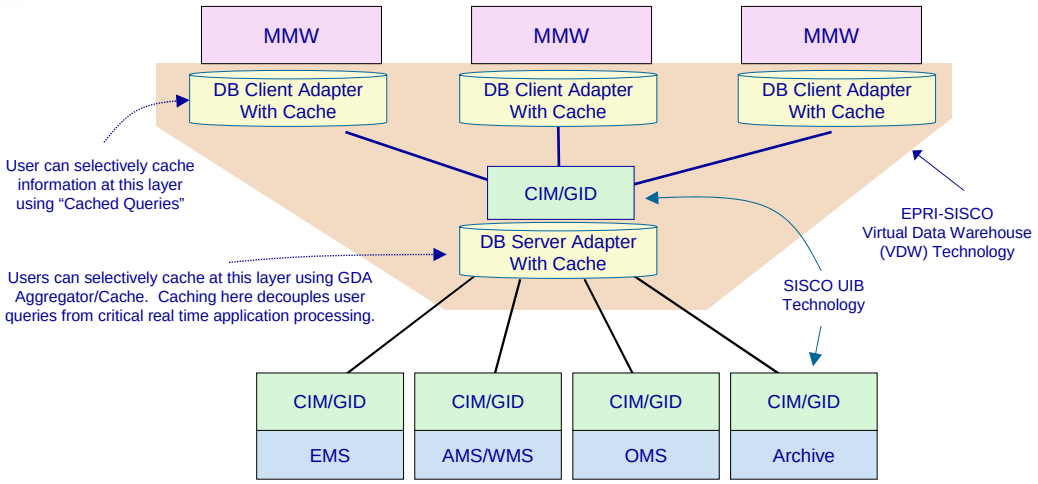
Users query the warehouse to discover current conditions and trends

CIM/GID Data Warehouse



The CIM standardizes the "what". The GID standards the "how"

Intended Vision for EPRI's CIM/GID Virtual Data Warehouse



Not all data needs to be copied

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Potential Benefits

LIPA Long Island Power Authority

- Non intrusive integration of data from existing databases
  - Wraps legacy databases with CIM compliant GDA interface
  - Application adapters can be supplied off the shelf
    - EMS Systems
    - Database Systems
    - Potential exists for additional **standard** adapters to be developed
- Open standards based architecture
  - Components interconnect using standard services
  - Enables best of breed use of tools
  - Puts vendors on a level playing field
  - Enables 3rd party deployment
- Support standard database/data mining clients
  - Supports ODBC clients
- Deployment flexibility
  - Not all data not necessarily duplicated in cache
- Enables more up to date data
  - Data from a message bus and legacy databases can be joined
  - Standards support updating data in cache as data changes in legacy systems and databases
    - Not available yet in VDW, but system is evolving in this direction

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Current LIPA Project Status

LIPA Long Island Power Authority

- Proof of concept test conducted to verify CIM/GID Virtual Data Warehouse concept (shown in slide # 2).
- To verify this concept EPRI Maintenance Management Workstation (MMW) was installed and integrated with the CIM/GID Virtual Data Warehouse.
- Key challenges
  - Data Engineering,
  - Up-front buy-in & Process Consistency.
    - Understanding what you have? - Understanding your legacy databases and how they relate to each other
    - Understanding the Common Information Model
    - Mapping
- A sample set of 5 business applications were used to verify that queries that ran within these business applications successfully returned data
- These queries were written to retrieve data from CIM data fields and return results
- As part of this test the following components were also installed and used:
  - VDW Database Client Adapter
  - VDW Database Servers Adapter installed
- During this test the following issues were noted:
  - Backward compatibility issues – e.g. different instances of Oracle used in laboratory test versus proof of concept test environment.
  - Overall Performance without any caching
    - Query Run Times – time taken to return data sometimes significantly more than “traditional environment”.

- Above noted issues require diligent solutions and careful thought process moving forward.
- As follow up, a 2 day brainstorm session was held as follow up during first week of October 2005.

Critical Next Steps:
A Transition to fully operational VDW and UIB

- In-house and production testing to conformance.
- Implement remaining MMW business applications – a mix of those that need aggregator and non-aggregator data (13 in total).
- Data mapping between PSS/ODMS and MMW
  - Full scale conformance testing
  - Industry wide buy-in and support of concept.
  - The infrastructure to test this approach between two utilities.

Critical Next Steps:
A Transition to fully operational VDW and UIB

- Improve performance
  - Ultimate objective – query run time should be comparable to “Traditional Environment” settings
  - Steps to accomplish objective/goal – 2006 activities
    - Implement selective Database Server Adapter caching (cache at the middle “data warehouse” level)
    - Implement selective Database Client Adapter caching (cache at the top “data mart” level)

The Ultimate Vision for LIPA and the utility community – Long Term

- A risk management platform consists of
  - A Data Integration Infrastructure,
  - Automated analysis of integrated views from operational, asset and energy market information.
- The VDW currently integrates asset and operational data.
- Inclusion of energy market data in the VDW would allow a risk management application to get a unified view of required data
- Hence, the ultimate vision/goal lies in achieving the ability to apply integrated data management philosophy for an Enterprise wide Risk Assessment approach.
  - To Analyze Potential Returns or Losses Associated With The Operation Of Utility Assets
  - Quantitative analysis which combines financial information and asset data to allow for
    - Return of Investment analysis
    - Address Aging Infrastructure Issues
    - Continuous risk and performance assessment using asset and operational data

Contact Details

From Long Island Power Authority

- Mike Hervey
- Ron Clare
- Joe Odierna
- Rich Soper
- Steve Wasylenko
- Brigitte Wynn

From The Electric Power Research Institute

- Raymond Lings, Area Manager, Transmission & Distribution
  - lings@epri.com, 650-855-2177.
- Bhavin Desai, Project Manager, Substations Maintenance Optimization
  - bdesai@epri.com, 704-717-6463.

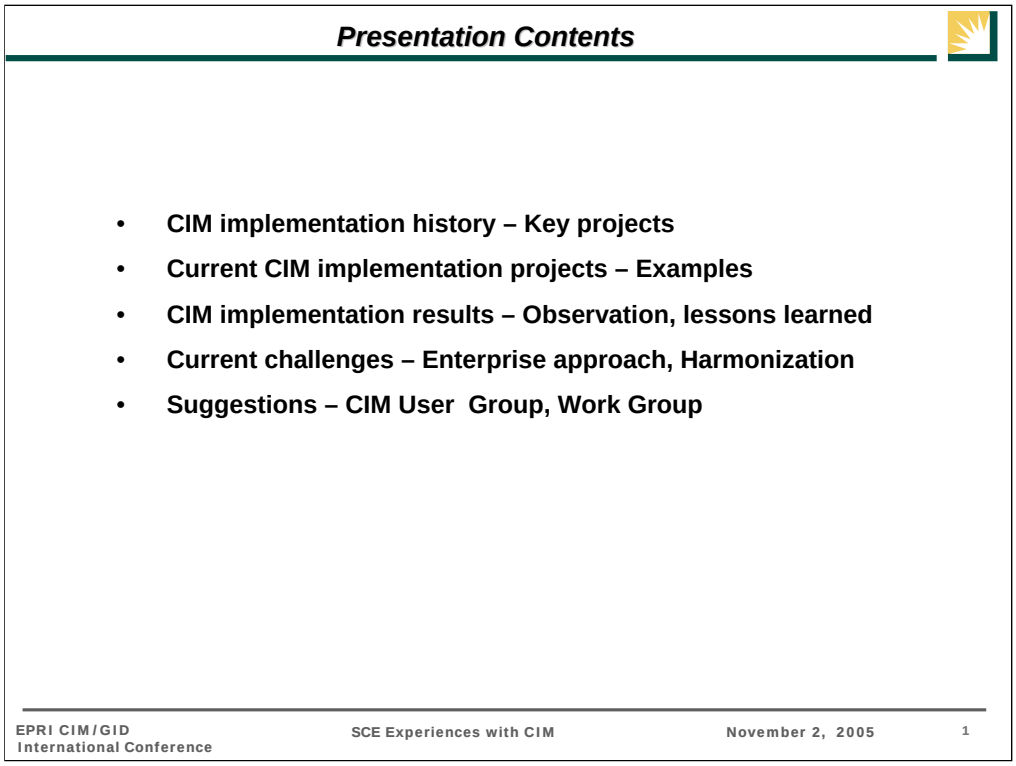
Southern California Edison (SCE) Experience with CIM (IEC TC57 WG 14)

Taka Kikkawa

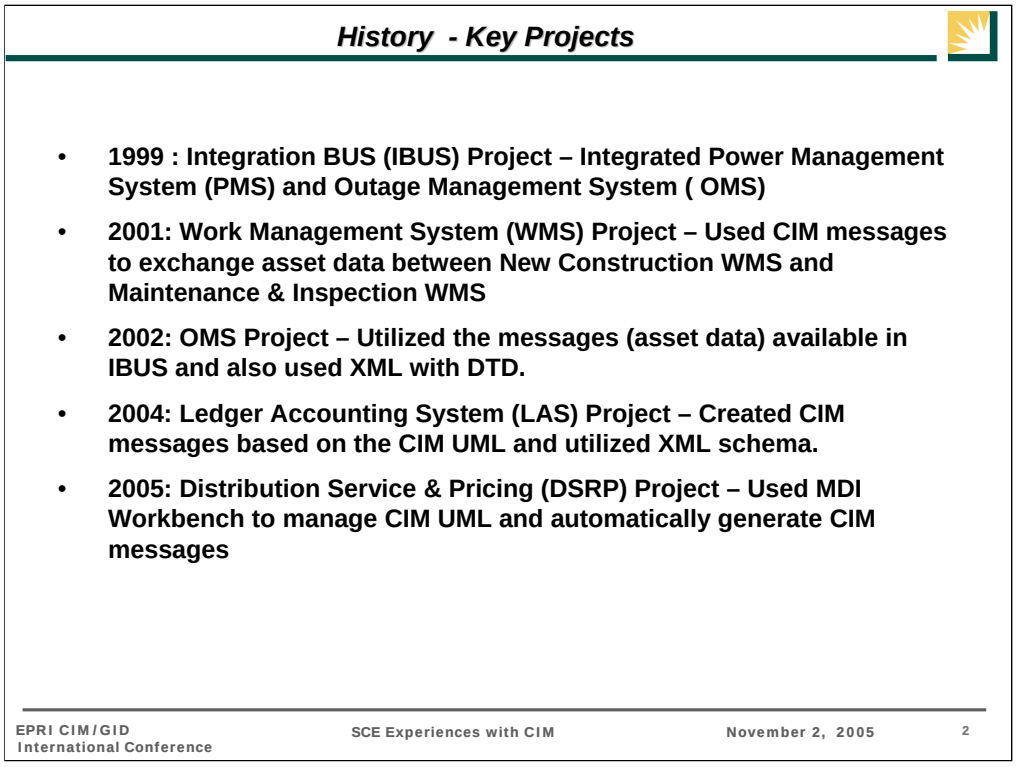
November 2, 2005

EPRI CIM/GID International Conference

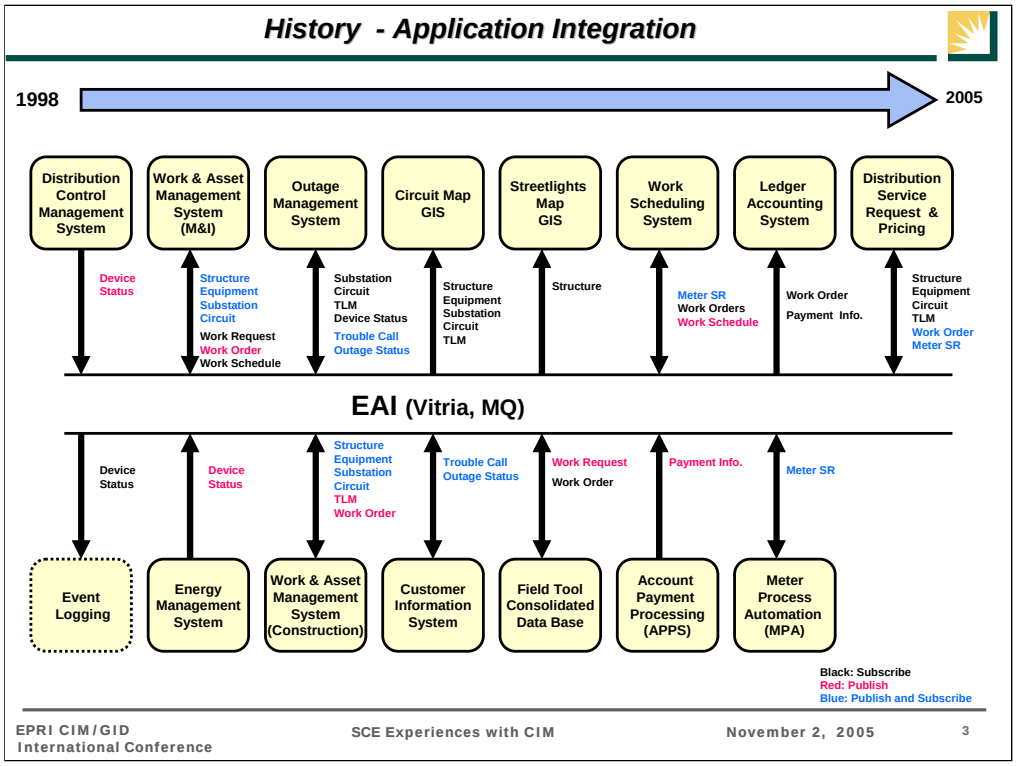
- The objective of this present is to share SCE's experience to implement IEC TC 57 WG14 CIM with the CIM user community, other utilities and CIM work group members.
- The presentation is focused more on CIM implementation environment at SCE, i.e. applications to be integrated and methodology used for the CIM implementation.



- The characteristic of CIM implementation at SCE to date is “evolutionary” and “project based.
- CIM implementation history shows these characteristics.
- Current CIM implementation projects present SCE’s intention to use Model Driven Integration approach.
- CIM implementation results summarizes lesson learned and some observations.
- Current challenges present SCE’s attempt to (a) CIM implementation at Enterprise Level (b) Harmonization with other CIM specifically with ERP
- SCE’s suggestions for CIM activities to CIM Working Groups and User Community.



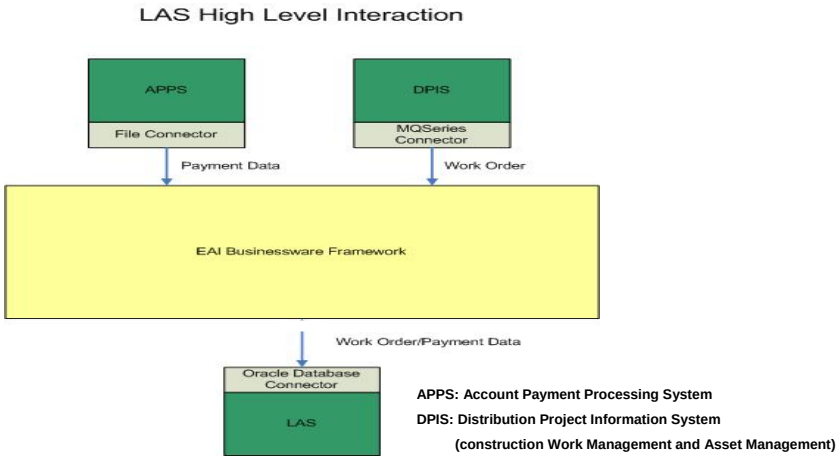
- SCE's CIM implementation is project based.
- These are key projects for CIM implementation.
- Note that SCE's experience to date is mostly in the Distribution Management space i.e. IEC TC57 WG14 subject area, (IEC 61968)
- Significance of LAS and DSRP projects are to apply Model Driven Integration approach introduced to SCE by Xtensible Solutions.



- This diagram depicts integration of legacy applications (mainly Distribution Management functions) starting from 1998 until now. (From left to right in sequence)
- Publish only, subscription only and both subscription/publishing messages are presented by different color.
- Currently we are working on development of Distribution Service Request & Pricing (DSRP) System and integrating this application with existing applications.

Current Project Example – Ledger Accounting System (LAS)

Message and Process Integration



APPS: Account Payment Processing System
DPIS: Distribution Project Information System
(construction Work Management and Asset Management)
LAS: Ledger Accounting System

- LAS project is the first project to apply BPM function of Vitria Integration Bus.
- This diagram depicts the high-level interaction of various applications in the LAS interface.
- The applications are:

  APPS: Account Payment Processing System

  DPIS: Distribution Project Information System (Perform various functions, such as construction work management and asset management)

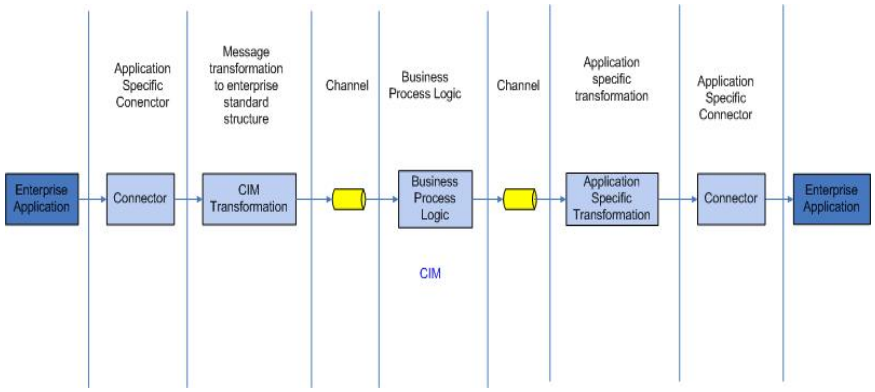
  LAS: Ledger Accounting System.
- APPS – Publish Payment Information.

  DPIS – Publish Work Order information.

  LAS – Subscribe Work Order information and Payment Information
- EAI Business Ware persists Payment and Work Order information and check conditions for LAS to subscribe the Work Order and Payment information.

Current Project Example – Ledger Accounting System (LAS)

Conceptual CIM Message Flow



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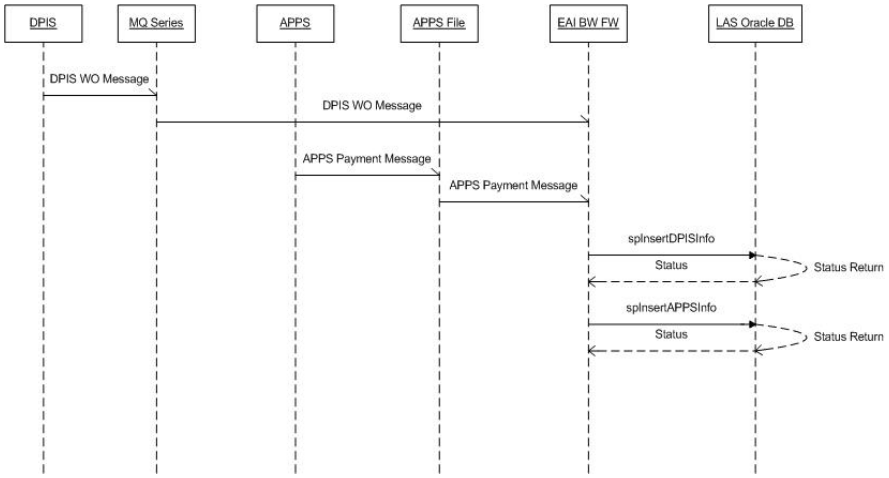
- This is CIM message flow architecture.
- Enterprise applications are DPIS, APPS and LAS in the previous slide.
- Connectors are File Connector, MQSeries Connector and Oracle Database connector in the previous slide.
- CIM message transformation and message persist are performed in the EAI Businessware Framework.

Current Project Example – Ledger Accounting System (LAS)

DPIS and APPS publish Work Order and Payment Messages to the EIA layer and are then subscribed by LAS



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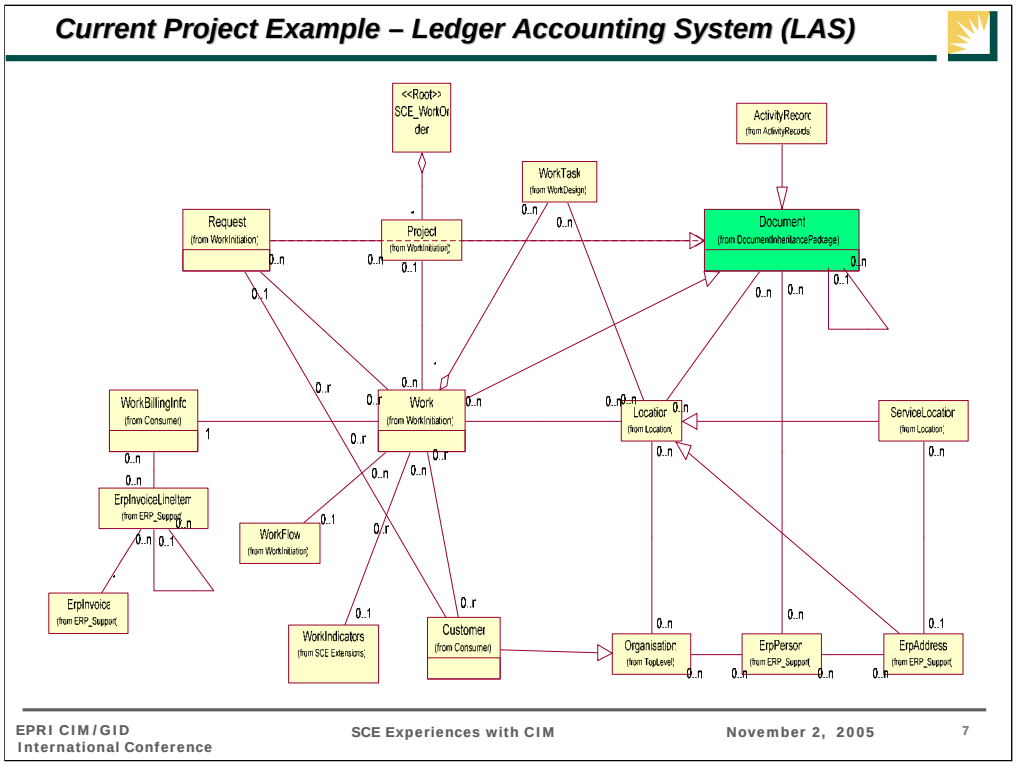
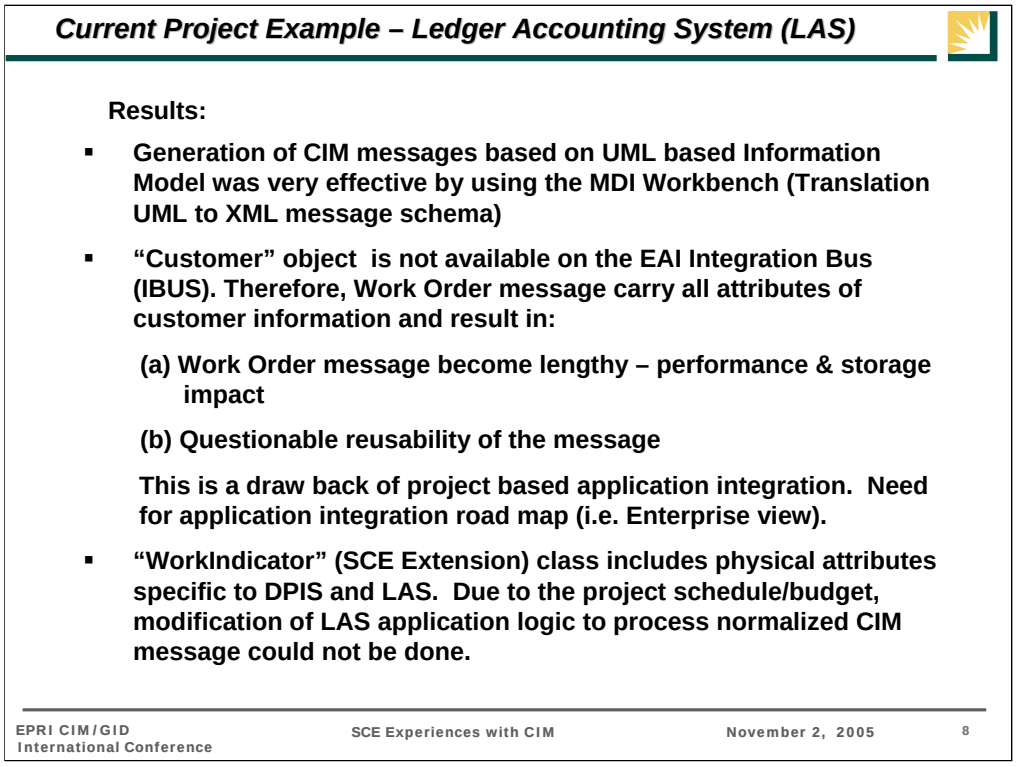
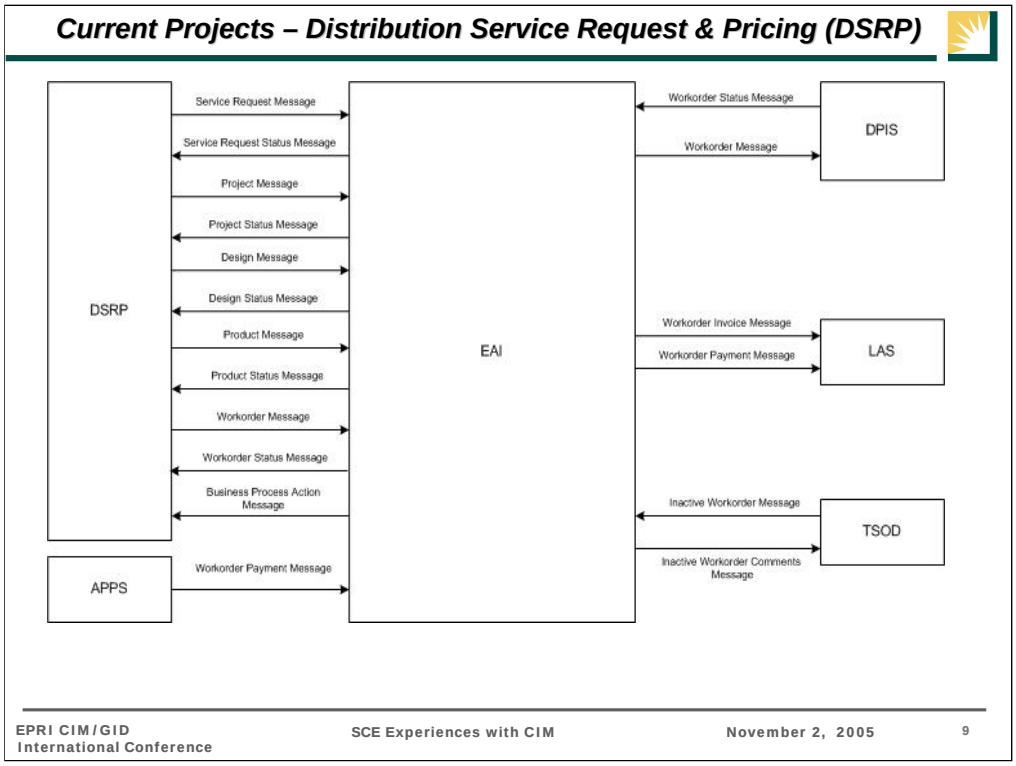
- The sequence diagram depicts the flow of events between DPIS, LAS and EAI layer (Vitria).
- The two applications namely DPIS and APPS publishes Work Order and Payment Messages to the EAI layer and are then subscribed by LAS.
- The EAI layer persists these messages and identify a payment with associated work order. When association is found the Work Order Message and the Payment Message are sent to LAS.



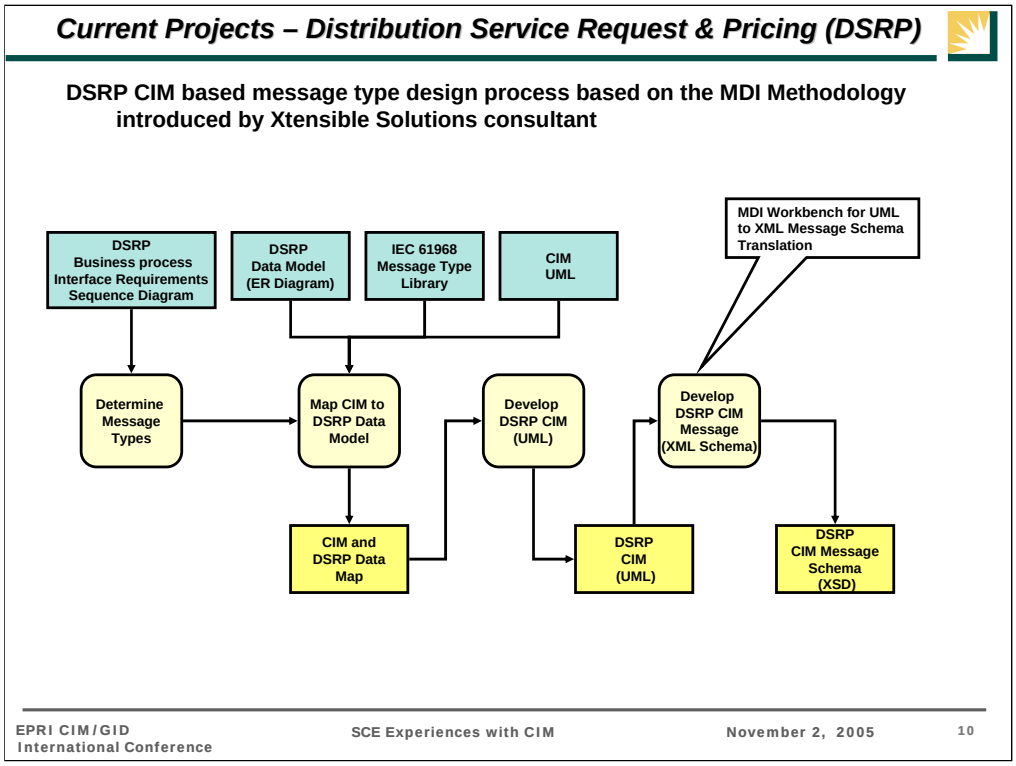
- This is the UML based logical information model for the LAS Project.
- Note that classes from WG 14 CIM and ERP CIM (which was provided by MDI workbench) and SCE extension.
- LAS Project is to interface with financial applications, ERP classes became important entities.
- Customer Class: Since customer data is not on the current SCE Integration Bus (IBUS), the Work Order message include customer information.
- Work Indicators class: This is SCE extension class in which many DPIS specific information are capture and used by LAS.
- Due to the project constraints, we could not modify the LAS application to process CIM based message. We created SCE extension to handle legacy application specific attributes for now. In the future we'd like to update legacy applications to be able to process CiM based messages.



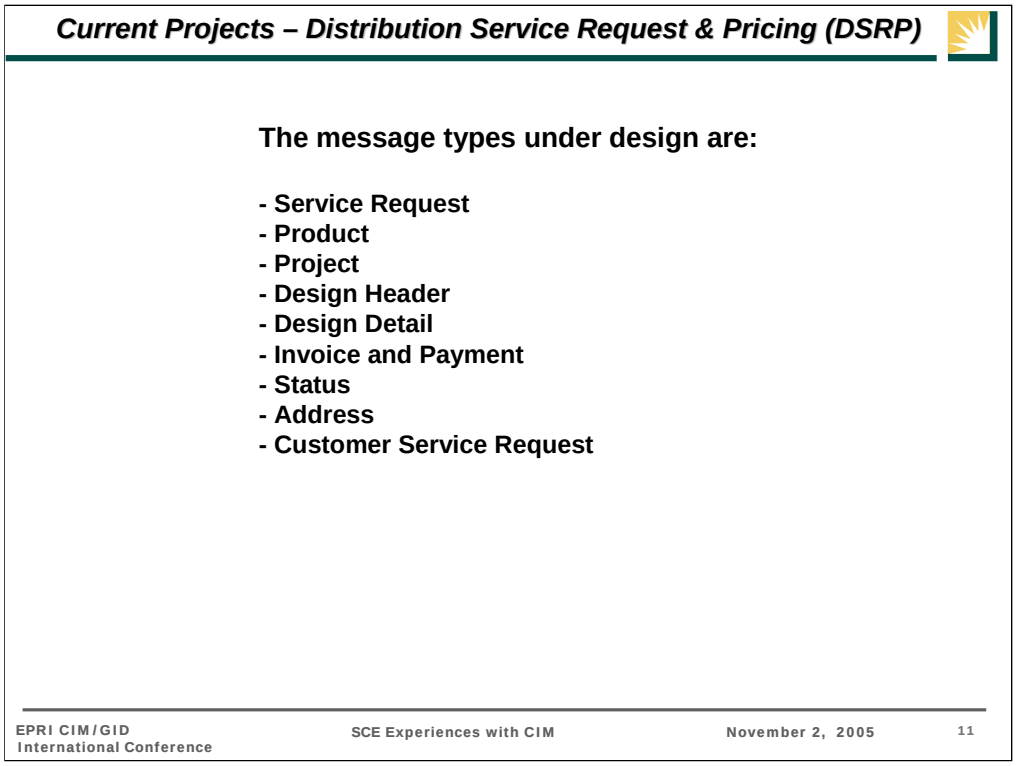
- The first bullet is a very positive experience.
- The second and the third bullet are the results of "Project Based" application integration and associated CIM implementation effort.
- XML message design have impact on performance and storage requirements. For this project, due to the project constraints, the Work Order message became very long and experienced negative impact.
- In the SCE environment and may be in other utilities this is always the issue we need to deal with.
- However, the third bullet is not totally negative result. We isolated the problem and the applications could be modified in the future to process CIM messages.



- Distribution Service Request & Pricing (DSRP) System is being developed internally by SCE which provided us more flexibility for designing CIM messages.
- This diagram depicts five enterprise applications interfacing to DSRP via the EAI layer.
- Note that many messages are passed between DSRP and EAI. EAI layer maintains status which are used to execute various DSRP components to satisfy Business Process requirements.



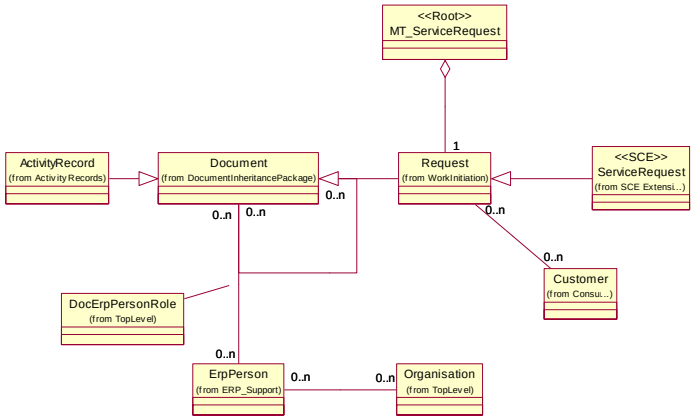
- The team reviewed the DSRP business processes, integration context, interface data requirements, and sequence diagrams.
- For each of the message types under scope:
  - The team reviewed the relevant entities of the current DSRP data model. Entities and attributes that are to be published and/or consumed by the services were reviewed.
  - The team then reviewed the latest version of the Common Information Model (CIM) as well as the message type library of the IEC 61968 provided by the MDI Business Model of Xtensible Solutions.
  - Relevant CIM classes, relationships, and attributes were then reviewed and mapped to see if there are any extensions needed.
  - SCE DSRP extensions were then developed in a package that is outside of CIM, for future evolution.
  - The DSRP message types were then developed using UML class diagrams. The relevant classes and relationships were then selected in the class diagrams to represent the logical model of the message types.
  - The MDI Workbench was then used to import the DSRP UML model. Message types were then developed in the form of XML Schema.
  - The entire design set of deliverables was then packaged in the form of UML model files, XSD files, and this design document.
  - The message design package was reviewed for final adjustment and approval for the DSRP detail integration design.



- Service Request message include the information needed to create a new request for service.
- Product message contains work and financial information related to a design of service request.
- Customer Service Request message contains, from the customer point of view, a list of service request from that customer.

Current Projects – Distribution Service Request & Pricing (DSRP)

Service Request UML Diagram.



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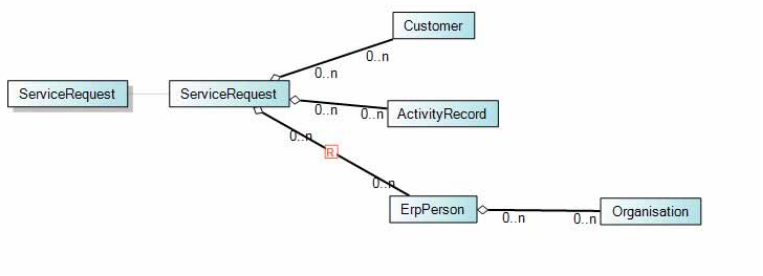
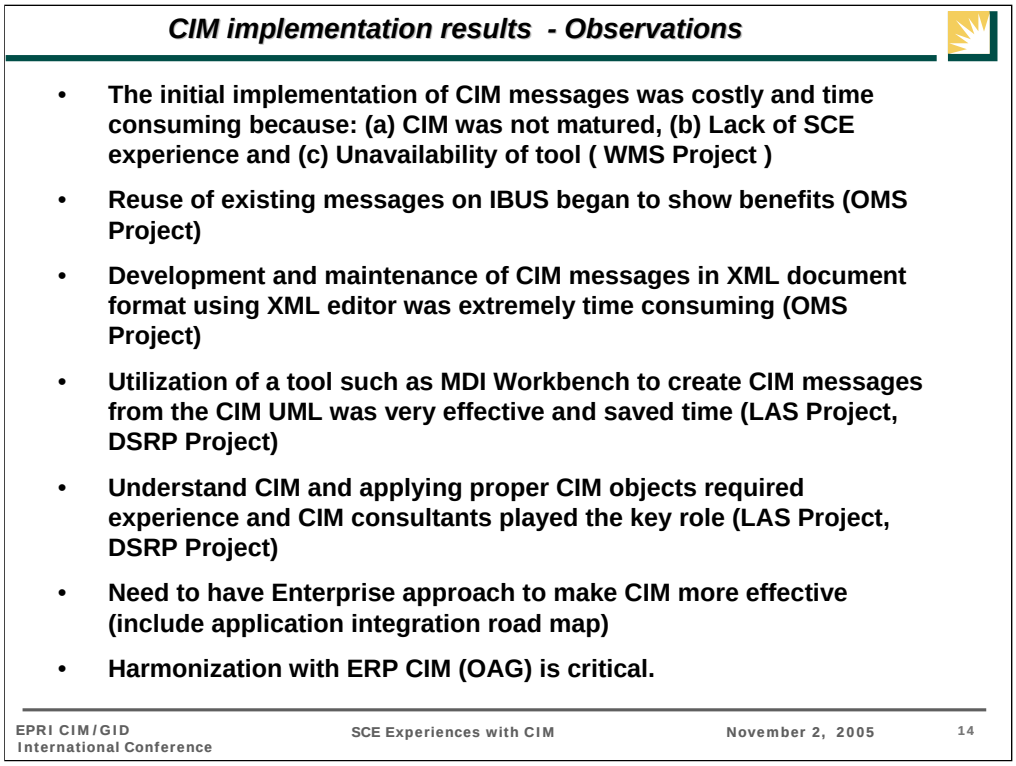
- MT_ServiceRequest MT is message type.
- SCE extension is needed for SCE specific service request attributes.
- Te DocErpPersonRole class is used to specify what role the ErpPerson performs in the given situation.

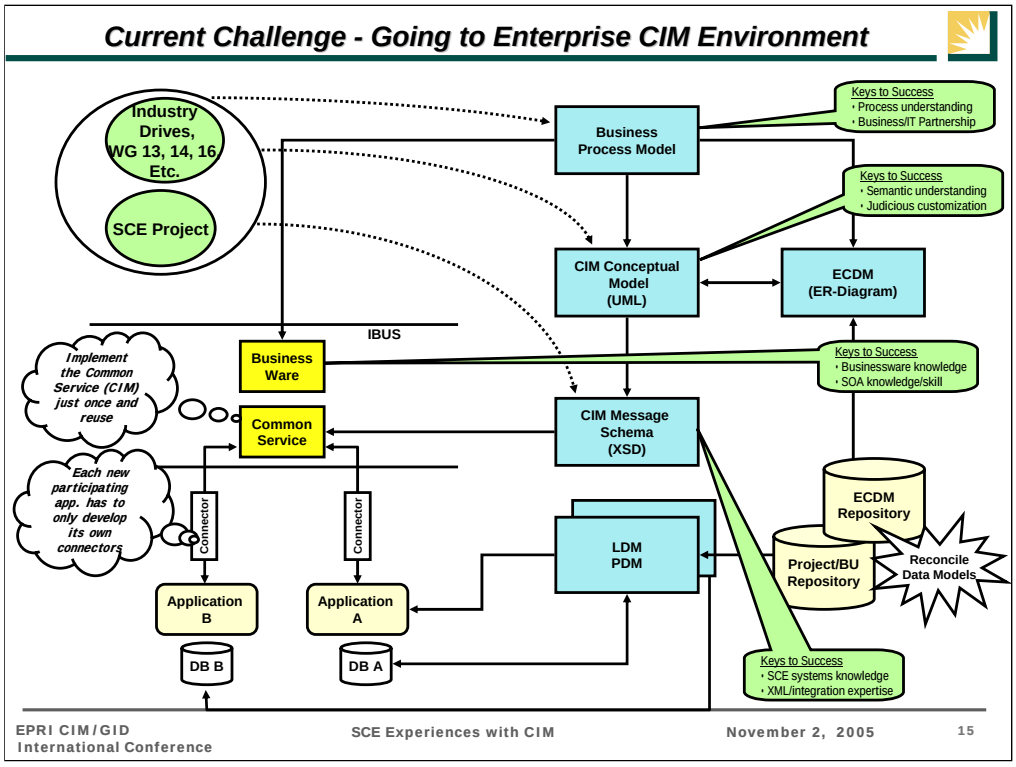
The XML Schema logical diagram



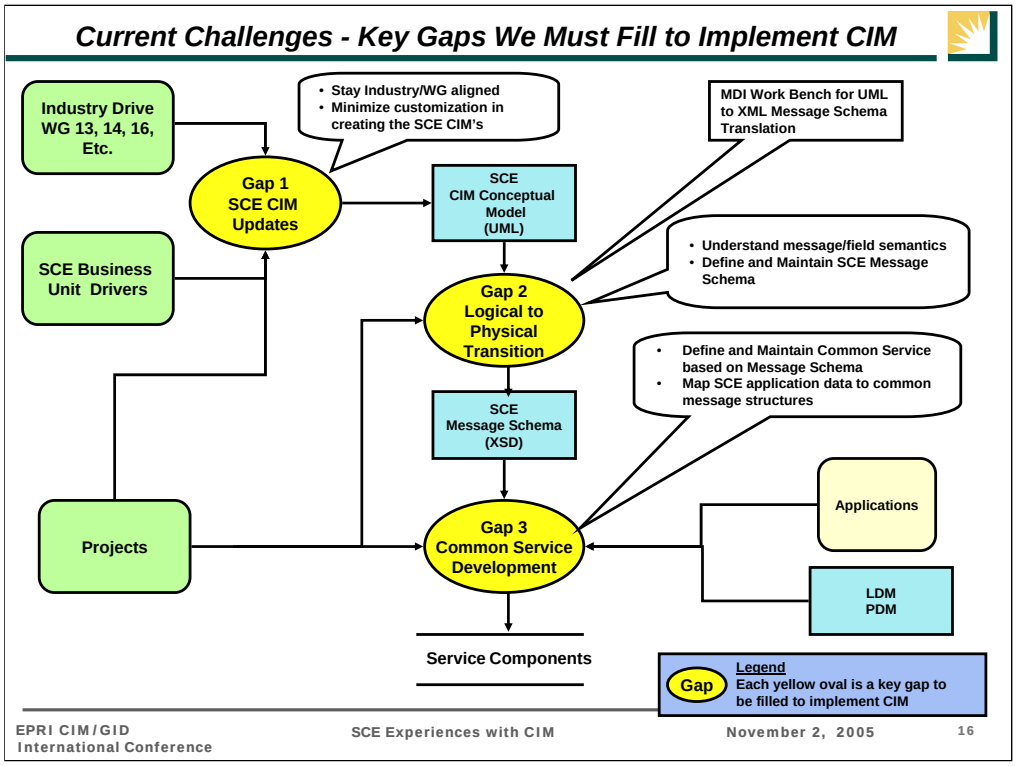
- The diagram produced by the MDI Workbench depicts logical structure of the message type.
- It looks quite different from the UML model, which has inheritance and implied relationship.
- The semantic shown on this diagram comes from the CIM UML model so they are consistent.



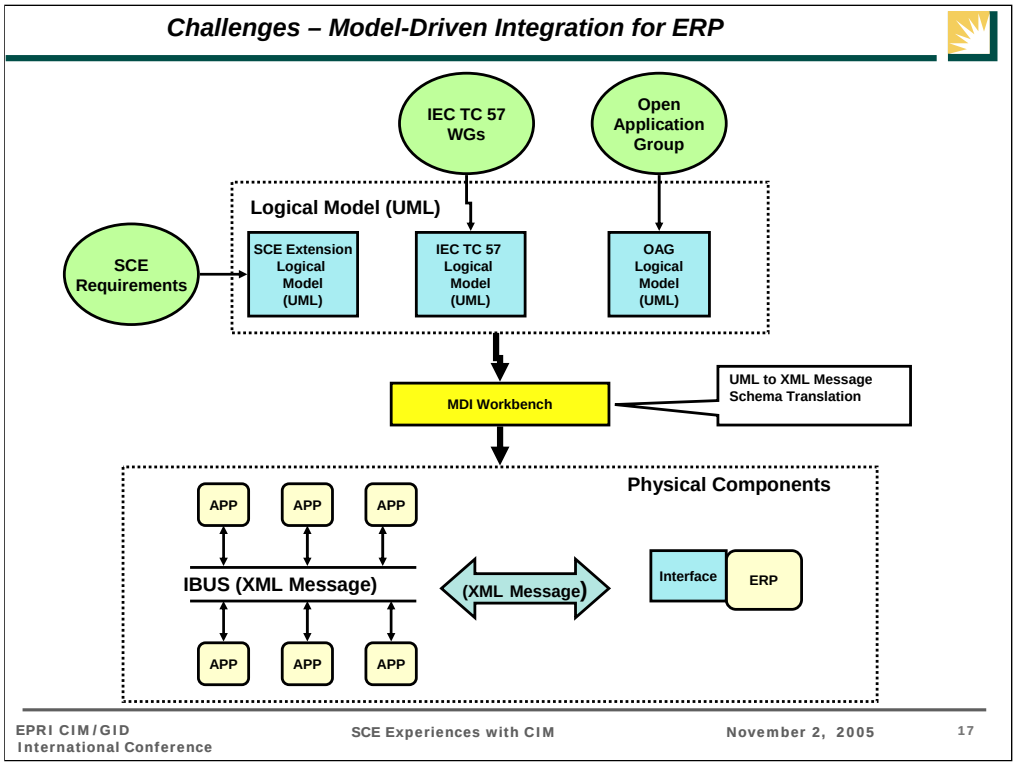
- SCE came a long way from 1999 to now yet we are still in the infant state for effective usage of CIM. There are still many SCE extension CIM messages on the IBUS.
- We believe that CIM (and CIM message type) should be defined and maintained in Logical Model (UML for our case).
- Project based CIM implementation had been a practical approach, however the drawback is it tends to create point-to-point solutions.
- We are working on establish an organization (may be a virtual organization) to handle data issues. CIM implementation and maintenance activities could be done in that organization. (See the Current Challenge slide)
- It became obvious that we need to have many ERP classes for Enterprise CIM implementation. (See the Current Challenge slide)



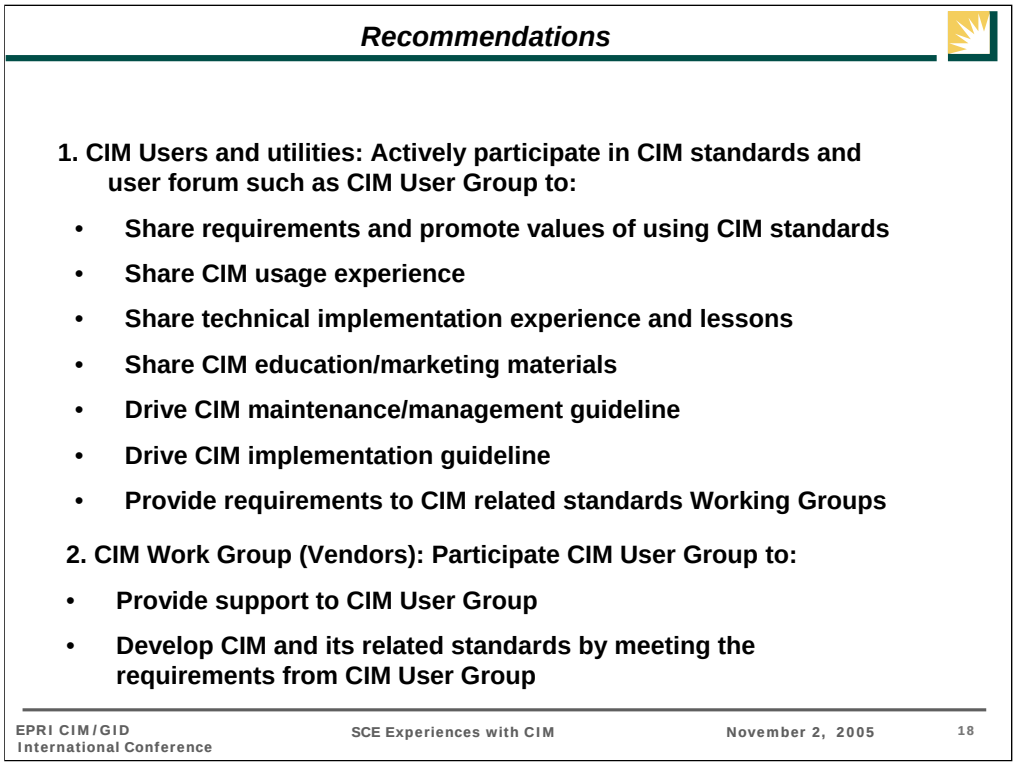
- This diagram promote understanding of the CIM implementation environment at SCE. (Promote Enterprise view)



- This diagram identify gaps for successful Enterprise Level CIM implementation environment at SCE. (Promote Enterprise view)
- We need to be associated with CIM User Group to stay top on the current/future directions. (Gap 1)
- We need to obtain and maintain skills within SCE and MDI Workbench is a big help. (Gap 2)
- Ideally CIM messages should be provided to projects as “Service” , (Gap 3)



- ERP to legacy applications integration based on CIM based messages.
- Currently OAGIS messages are available in XML schema
- Effort is underway to develop UML
- As OAGIS develop UML we can integrate ERP to legacy applications based on the logical model and use MDI Workbench for UML to XML translation



- We plan to actively involved in the CIM User Group activities.

SCE Contacts

Southern California Edison CIM Contacts

Shigetaka (Taka) Kikkawa Shigetaka.kikkawa@sce.com **CIM UG, WG 14, Enterprise Architecture**

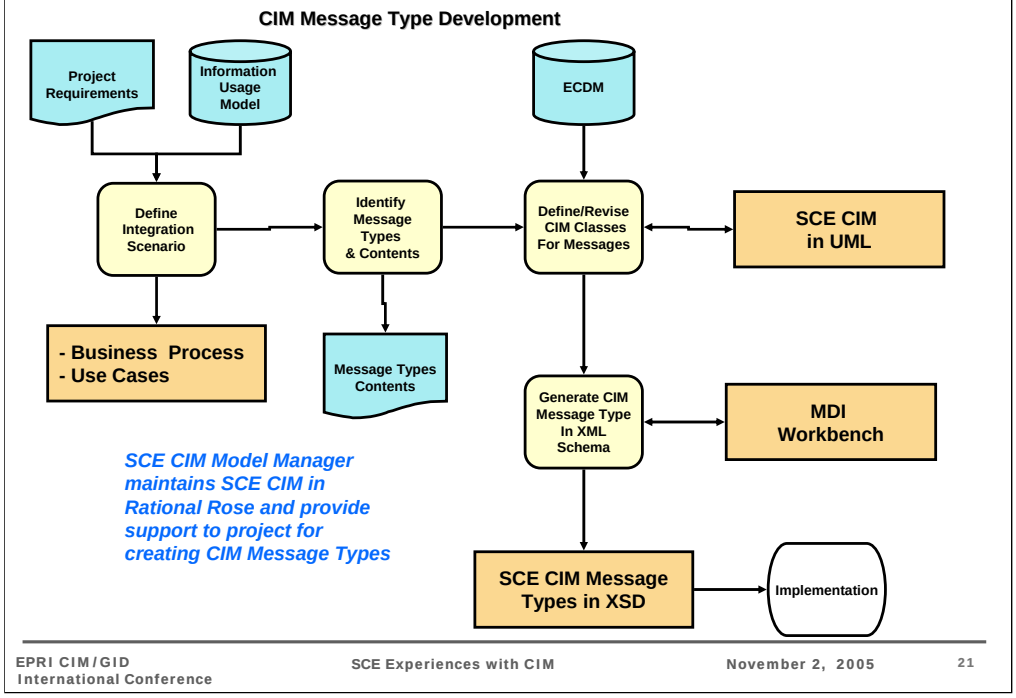
Hugo Reyes Hugo.Reyes@sce.com **CIM UG, WG 13**

Robert Yinger Robert.Yinger@sce.com **UCA, CIM Coordination in SCE**

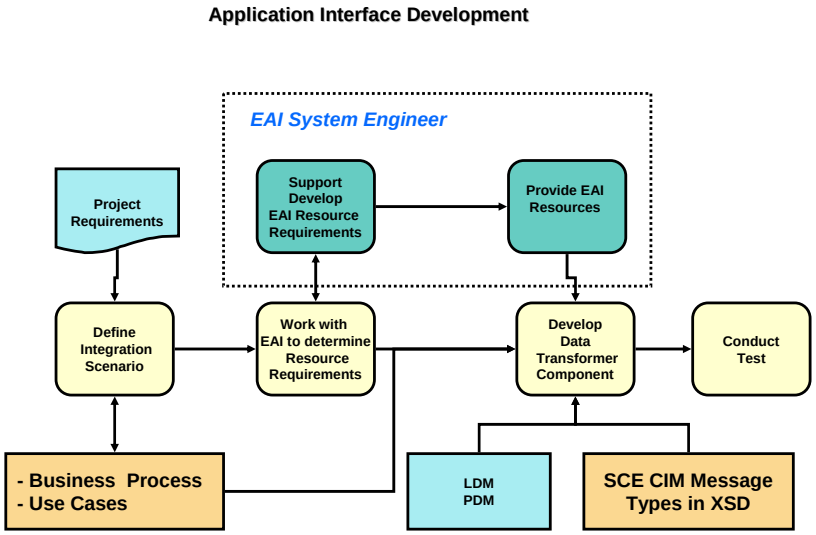
- Please feel free to contact us for any questions or comments.
- Hugo Reyes and/or Taka Kikkawa for the CIM technical issues.
- Robert Yinger represents SCE for UCA (as an UCA Executive Committee member)


Support Slides
EPRI CIM/GID
International Conference
SCE Experiences with CIM
November 2, 2005
20

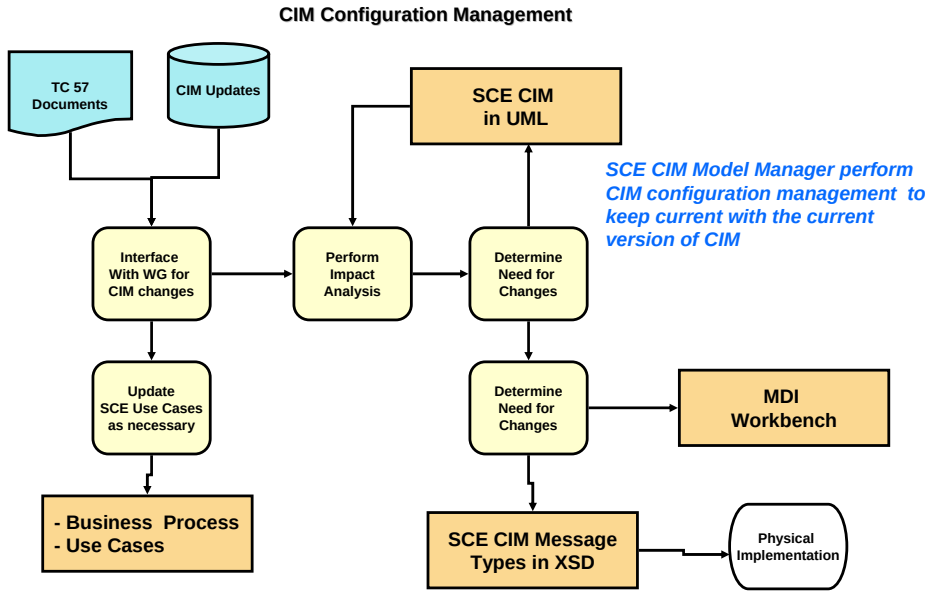
Current Initiative – Going to CIM Environment



CIM Implementation Process– Going to CIM Environment



CIM Configuration Management Process



The CIM within Exelon

Dean M. Hengst
Lead Analyst
Exelon Business Services, Information Technology

EPRI CIM/GID International Conference
November 1-2, 2005

The CIM within Exelon

- Company Overview
- Project Background
- Project Implementation
- Building an Enterprise Standard for Exelon
- Lessons Learned
- Questions

Who we are....

- Parent Company Exelon
  - A Generation Company
  - An Energy Delivery Company serving Chicago, Northern Illinois and the Philadelphia Area serving 5.1 Million Customers
  - A Power Marketing Company
  - Serves 460,000 Gas Customers in the Philadelphia area
  - Corporate Headquarters – Chicago, Illinois

ComEd
An Exelon Company

PECO
An Exelon Company

3

The CIM within Exelon

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4

CIM Related Projects

- Current Projects
  - Powertools
    - Consists of three major applications in the West (ComEd)
      - Outage Management System (OMS)
      - SCADA System
      - Control Area Management System (CAMS)
- In-Flight projects
  - Common Customer System
    - Leverage West OMS interfaces
- Future Projects under Consideration
  - Enterprise Mobile Workforce Management
  - SCADA in the East (PECO)

5

Powertool's Decision to use the CIM

Within the Powertools Project, there are many systems that need to be integrated together. Thus, a model was needed to ensure that the interfaces would have a common language.

- The project needed a message model quickly and the CIM had most components already modeled
- The CIM is easily extendable if not all of the components were modeled and future expansion if necessary
- The CIM is a utility standard and endorsed by the Standards Bodies
- The CIM model was being utilized in the transmission area
- Striving to become a top quartile Energy Delivery Company by creating reusable practices

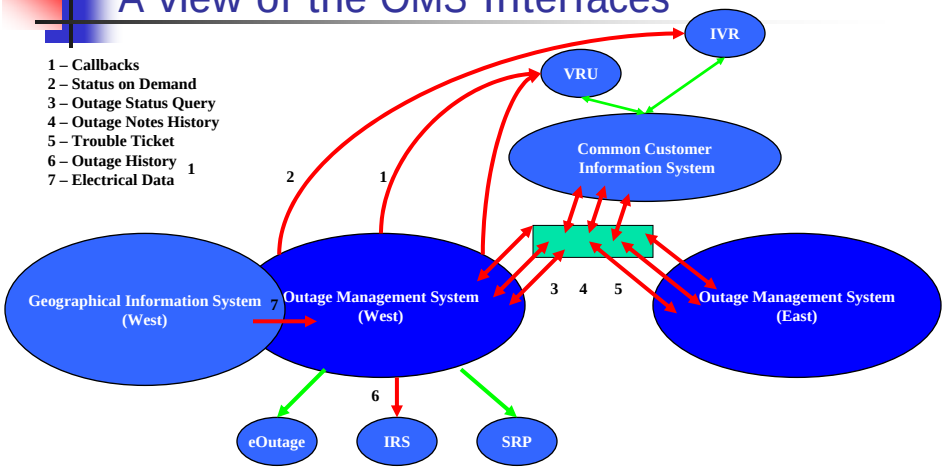
6

CIM Compliant Areas within PowerTools

- OMS
  - Status On Demand
  - Trouble Ticket
  - Outage Status
  - Outage History
  - Callbacks
  - Electrical Configuration Data
- SCADA
  - Storage of Data
    - Transmission
    - Distribution
    - Telemetry (CIM Extended for this model)

7

A view of the OMS Interfaces



The same language is important once multiple systems are involved in data transfer.

8

The CIM within Exelon

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9

Messages

- Keep the message simple
- Ensure all attributes from the originating system is modeled
- Pick an acceptable message format (for example: XML)
- Document attribute mappings in an easy to understand format
- Have system matter experts on hand to work with the message mapping team
- Keep future and current systems in mind while doing the mappings
- Knowledge of the technology transport can be beneficial to the message mapping team

10

Applying the CIM to messaging

Perform message mapping from Application A to CIM to Application B.

Message: Outage Status Inquiry Return
Originating Application: Outage Management System
Destination Application: Customer System

OMS Attribute	Type	CIM Equivalent	Comment
outageNo	String	OutageRecord.name	Master Ticket Number
Status	String	OutageRecord.docStatus	Outage Status
timeStamp	DateTime	OutageRecord.startDateTime	Outage Begin Time
estRepairTime	DateTime	OutageStep.estRestoreDateTime	Estimated Restore Time
outageCmnt	String	ActivityRecord.remarks	Outage Comment
curCustAff	Integer	OutageReport.totalCustomers	Current number of customers affected
causeCodes	String	OutageRecord.outageType	Cause Codes

Map application attributes to CIM equivalent. Determine transformation requirements.

11

Creating CIM-based messages

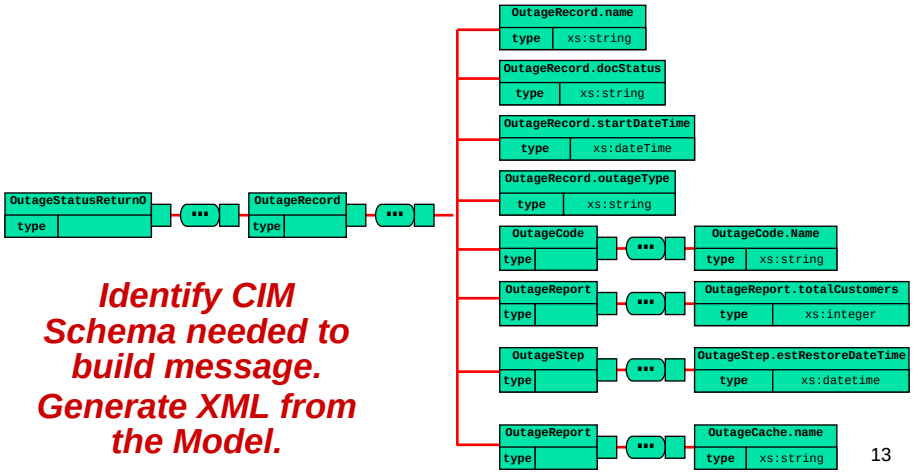
Sample CIM Document – Outage Status Return

```
<?xml version="1.0" encoding="UTF-8"?>
<OutageStatusReturnO xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="OutageStatusReturnO.xsd">
  <OutageRecord>
    <OutageRecord.name>String</OutageRecord.name>
    <OutageRecord.docStatus>String</OutageRecord.docStatus>
    <OutageRecord.startDateTime>20011217 093047</OutageRecord.startDateTime>
    <OutageRecord.outageType>String</OutageRecord.outageType>
    <OutageCode>
      <OutageCode.name>String</OutageCode.name>
      <OutageCode.name>String</OutageCode.name>
      <OutageCode.name>String</OutageCode.name>
    </OutageCode>
    <OutageReport>
      <OutageReport.totalCustomers>0</OutageReport.totalCustomers>
    </OutageReport>
    <OutageStep>
      <OutageStep.estRestoreDateTime>2001-12-17T09:30:47
</OutageStep.estRestoreDateTime>
    </OutageStep>
    <TroubleTicket>
      <ActivityRecord.remarks>String</ActivityRecord.remarks>
    </TroubleTicket>
  </OutageRecord>
```

12

Creating CIM-based messages

CIM Schema Definition – Outage Status Return



Identify CIM Schema needed to build message. Generate XML from the Model.

13

Technology Transport

- Pick a technology transport that is suitable for your needs. In our case:
  - Websphere MQ
  - Websphere MQ Integrator
  - FTP
- Choose how to utilize your technology transport. In our case:
  - Clustered Queue Managers
  - Point to Point Connections

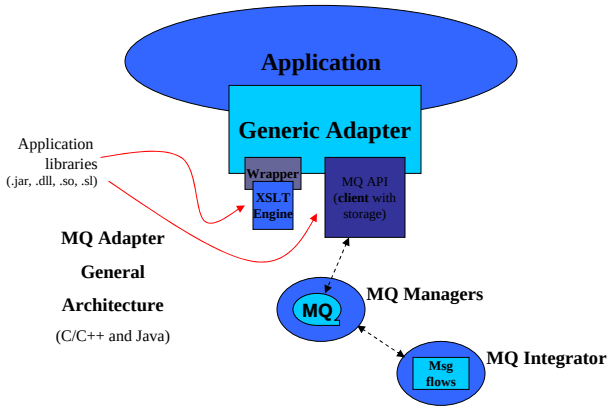
14

Adapters

- Wrote two adapters
  - C++
  - Java
- Shared with our vendor for consistency
- Shared with other groups in Exelon IT for reusability and defining a standard
- Both adapters have slightly different functionality based upon available libraries for each programming language
- Can be used to transform messages

15

Developing a Middleware Adapter



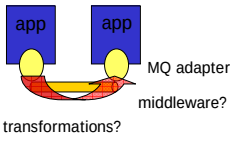
A Generic Adapter was designed for use with ComEd and Vendor Applications.

16

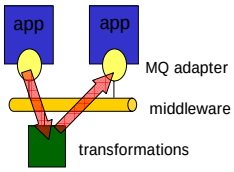
Exelon

Message Transformation Decisions

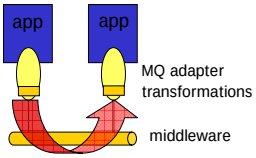
- Problem: applications have differing data models
- Solution: perform data model mapping either in the adapters or in a centralized "mapping" server



Option A
"Traditional Point-to-Point"



Option B
"Traditional EAI"



Option C
"Distributed EAI"

Our Generic Adapter worked well with all three solutions.

17

Exelon

Evolutions of the Adapter

- Castor – uses an XSD to generate Java Classes that represent XML messages
  - Put – Passing the Java Class
  - Get – Passing the Java Class
- Compression/Decompression of Large messages

18

The CIM within Exelon

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19

Building an Enterprise Standard for Exelon

- Currently the CIM Model is not an Enterprise Standard within Exelon
- Enterprise Architecture taking ownership instead of projects
- Enterprise Architecture would be responsible for educating the company on the CIM
- Future projects should leverage the PowerTools integration framework

20

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21

Project Lessons Learned

- Bring in experienced consultants throughout the design, development and testing cycles
- Spend more time upfront planning and “proto-typing”
- Recognize that a broad base of skills, technologies and tools are involved
- Don’t under estimate the configuration and testing involved
- Bring in experts in the different technologies in order to make the integration smoother
- Don’t expect your application vendors to be experts in EAI
- Leverage existing corporate standards and infrastructure where possible
- Communicate strategy and direction

22

Corporate Lessons Learned

- There needs to be Executive Sponsorship
- Assign an Owner (Enterprise Architecture)
- Build a detailed knowledge owner to prep new projects on the CIM and our EAI architecture
- Communicate, Educate, Re-Enforce and Celebrate Successes
- Participate in Industry events to stay current and help drive the direction
- Don't expect immediate payback – critical mass not achieved immediately
- Understand there can be more points of failure in the overall interface design
- Ensure all owners of the infrastructure and software are willing to co-operate during interface problems

23

The CIM within Exelon

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24

Questions?

Creating the NSTAR New EMS Network Model using CIM

EPRI CIM/GID Conference, November 1-2, 2005

by Enrique Margalejo, EMS/SCADA Implementation Project Manager, NSTAR
and Suzanne Caron-André, Core Software Engineering Manager, SNC-Lavalin ECS

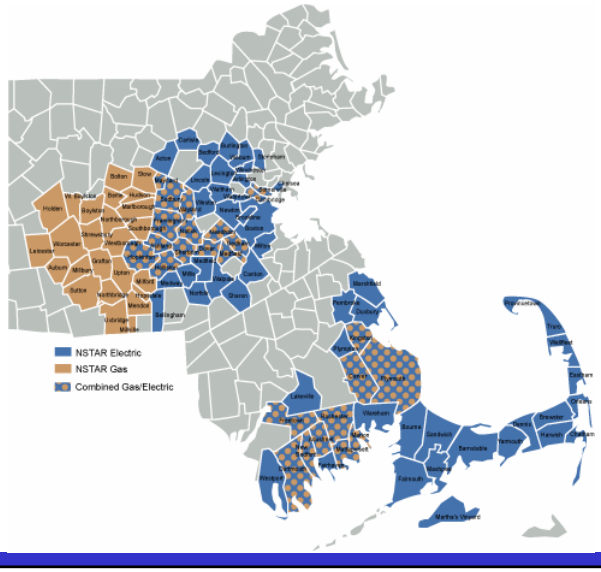
Overview

- Massachusetts' largest investor-owned electric and gas utility
- Headquarters in Boston
- Delivers electricity and natural gas to over 100 Eastern Massachusetts communities.
- 1.4 million residential and business customers
- 3000+ employees.

2

NSTAR

Service Territory



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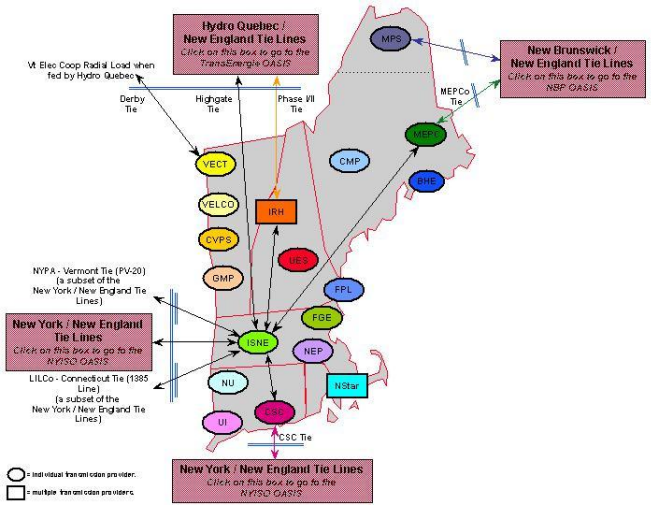
NSTAR

Transmission Context



4

New EMS System

- NSTAR commissioned a GEN-4 system from SNC-Lavalin ECS as its new EMS-SCADA system, in replacement of the current GEN-3 SCADA system.
- The EMS will support NSTAR Electric Operations and will allow NSTAR to function as a satellite control center for ISO-NE, for NSTAR's service territory.

5

EMS Network Model

- NSTAR's EMS Network Model comprises:
  - A Full ISO-NE transmission network (External Model)
  - The NSTAR's internal bulk transmission network (Internal Network)
- NSTAR licensed ODMS from Power Technologies International (PTI) to create, expand and merge the Internal and External Models into a CIM-compliant database
- Iterative CIM-based file transfers between ODMS and the EMS were used to arrive at a working EMS Network Model and Model Management Process.

6

NSTAR's Model Build

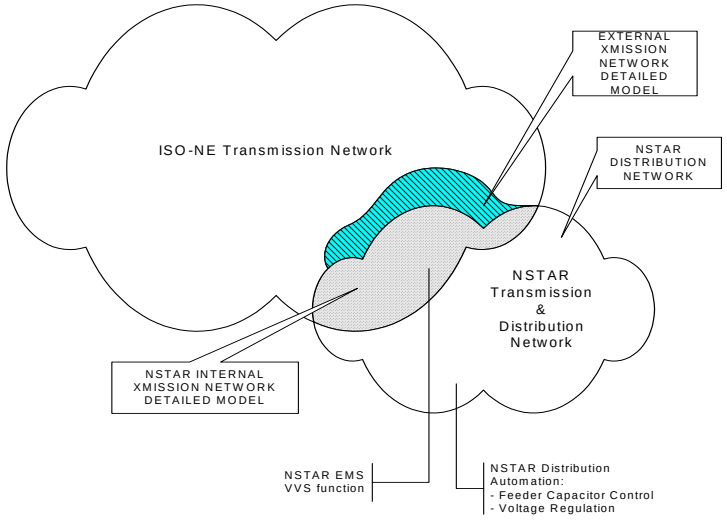


Figure 1

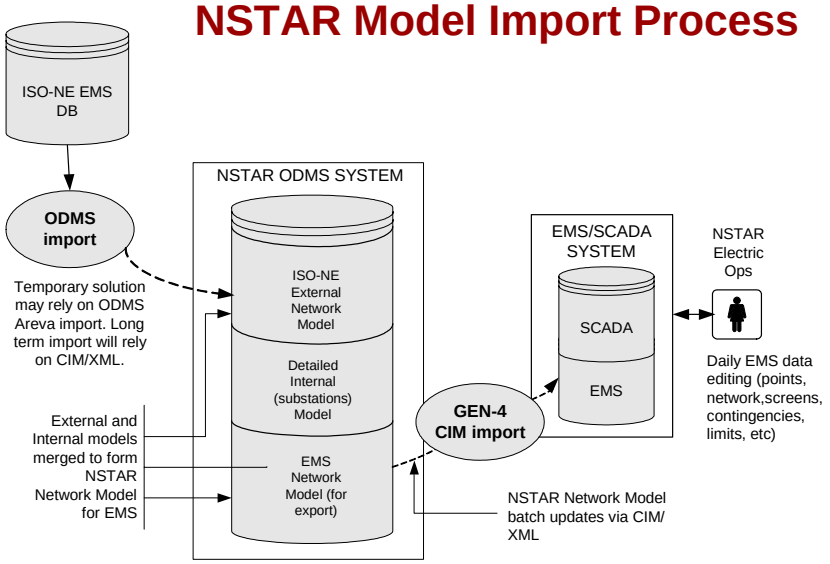
7

Model Development & Management Strategy

- Use CIM/XML as the data import/export format for model data transfers
- Import ISO-NE's Network model as the External Network
- Gradually develop the details of the NSTAR Internal Model
- Follow up on the footsteps of ISO-NE network model releases:
  - Match ISO-NE periodic releases (now every 3 months)
  - Implement a model building process including periodic model merging and CIM incremental updates

8

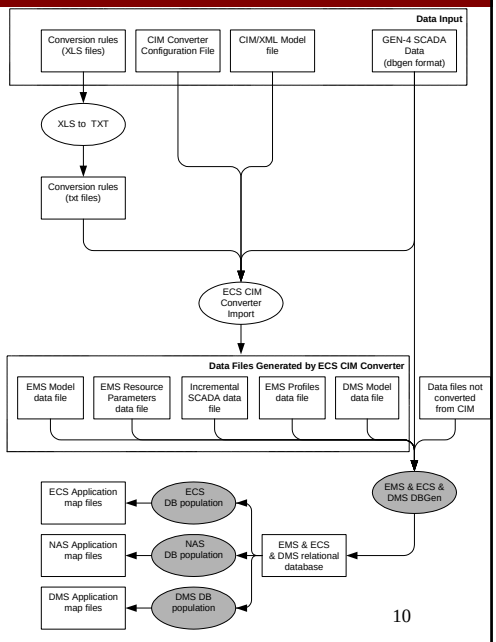
NSTAR Model Import Process



9

NSTAR Model Import Process

- GEN-4 CIM Importer uses configurable rules to:
  - Filter data to be imported
  - Provide user-defined default values for missing class attributes, based on business rules
  - Link the CIM/XML data with existing SCADA data
  - Generate additional SCADA data.



10

Lessons Learned

- Adopt ISO naming conventions
- Rely on ISN ICCP file definitions for ICCP data
- Use iterative approach to CIM data transfer
- Be careful with:
  - Placement of measurements
  - Transformers and shifter taps
  - Limits
  - Duplicate object IDs

11

Lessons Learned

- Team up System Planning and Operations
- Develop SCADA-to-EMS data checking tools
- Use load flows at both CIM data ends for data validation
- Harmonize / adapt CIM model implementations and CIM import/export tools
- Use CPSM NERC Profile as the main source to clarify CIM implementation issues

12

NSTAR CIM Model Import Experience

- CIM PSR Hierarchy not entirely compatible with EMS model:
  - For example, ODMS model augmented to include HostControlArea class to correspond to EMS InterchangeArea class
- Convention required for Measurement Types and Units:
  - For example, Importer expected these to correspond to the standard sets of the ISN DDF format, but the CIM export file contains only a limited set of basic units (MW, MVAR, KV, …)

13

NSTAR CIM Model Import Experience

- Modeling differences for equivalent networks such as negative resistance lines, lines connecting different voltage levels,....
  - Conversion rules were designed to bridge the model differences
- Different sets of data validation rules caused data rejections during import

14

NSTAR CIM Model Import Experience

- Unique object Id and RDF ID were not persistent across re-imports and cannot be used for future incremental updates
  - A specification was designed to generate unique, persistent object names, which will be used as persistent key for incremental updates
- Modeling of Limits: use only the CIM LimitSet class rather than attributes of specialized PSR classes

15

NSTAR CIM Model Import Experience

- Important enhancement to consider: systematical use of CIMValidator to detect invalid syntax. New validation tool required to detect:
  - references to non-existent objects
  - invalid or missing CPSM class attributes
  - validation rules violations.
- These tools should be designed/enhanced for performance for large files (last NSTAR export approx. 200 Mb)

16

NSTAR CIM Model Import Status

- June 05 ISO-NE External network model expanded with 70 NSTAR Stations imported and converged in EMS (1000 Station model)
- Complete CIM/XML import process (including validation, data corrections and running the EMS State Estimator) takes approximately 1 week. This time should be reduced once tighter process controls are in place.

17

NSTAR CIM Model Future Developments

- Next challenge will be integration of incremental update tools in the Network Model Management process
  - will require harmonization of CIM Incremental Updates between the different parties with the primary objective of minimizing disruption to the on-line EMS system

18

Creating the NSTAR New EMS Network Model using CIM

Questions?

CIM-GID
Interoperability Test 7 Report

Testing A Standardized Integration Strategy

Margaret Goodrich
Project Consultants, LLC

Topics

- What is the Interoperability (IOP) Test
- Purpose of the IOP Test
- IOP History
- IOP 7 Participants
- IOP 7 Contents
- IOP7 Highlights
- General Issues & Solutions
- Future IOP Contents

What is the Interoperability Test

- Test the Interoperability of CIM XML extracts produced by various vendors
- Ensure the NERC CPSM Profile for Data Exchange can be implemented as specified
- Test the Interoperability of the Generic Interface Definition (GID) Standards
- Test the Interoperability of WG14 CIM Standards
- Test the Interoperability of WG14 Messaging Standards

Purpose of the IOP Test

- To verify that the applications developed using the IEC standards can interoperate
- To provide an opportunity for the industry to identify any deficiencies in the standard or the use cases under test

IOP Test History

- The concept for an Interoperability Test was initially conceived at a CCAPI meeting by the XML Breakout Team to test the CIM XML exchange standard
- The vendors approached EPRI about sponsorship and EPRI agreed to act as sponsor and provide independent verification
- Vendors began work on Test Implementation
- IOP Tests have been on-going for the past 5 years
- IOP Tests now include all WG13 and WG14 standards as they become available

IOP 7 Participants

- EPRI
- ABB
- Areva
- EDF
- Siemens PTI
- Siemens
- SISCO

IOP 7 Contents

- CIM XML Exchange tests including:
  - Full Model Exchange
  - Incremental Model Exchange
  - Partial Model Exchange
  - Power Flow Solutions
- GID Interoperability Tests including:
  - High Speed Data Access (HSDA)
  - Time Series Data Access (TSDA)
- Discussion Sessions were held two of the four days to address issues encountered during the test preparation or the actual testing activities.

IOP 7 Highlights

- Full Model Exchange test between Areva, EDF, Siemens, Siemens PTI and SISCO
- Incremental changes were exchanged between EDF and Siemens
- Siemens was able to generate Incremental change files that were then used and validated by EDF
- Partial Model Exchange test at the substation level between Areva, Siemens and Siemens PTI
- Siemens and Areva were both able to generate Partial Model files that were used and validated

IOP 7 Highlights

- EDF successfully completed the Power Flow Solution tests
- ABB, EDF, Siemens, Siemens PTI and SISCO were all able to demonstrate High Speed Data Access (HSDA) exchanges
- The HSDA test utilized four different types of middleware
- Siemens PTI and SISCO exchanged historical data via a Time Series Data Access (TSDA) client/server pair using message bus middleware

IOP 7 Highlights

- Many participants used multiple models to complete the exchange tests including a 100 bus model from Siemens, a 60 bus model from Areva, a 40 bus model from ABB and two models from EDF (a 27 node from EDF and a 14 node using the UCTE format)
- The discussion sessions discovered 100 issues and provided over 60 proposed solutions.
- All issues and proposed solutions will be forwarded to the appropriate Working Group for consideration and final resolution.

General Issues and Solutions

- On Monday prior to the IOP 7 test, CAISO hosted a workshop for the IOP participants and the Utilities and ISO that had implemented project using the CIM XML Exchange standards
- Major Workshop Issues
  - Lack of CIMXML file compliance to CPSM
  - Naming Issues
  - Modeling Issues
  - Lack of rigid rules and practices in the CIM Standard or Profiles
  - More/Better CIM tools

General Issues & Solutions

- Continue Rigorous review of CIM XML models to ensure compliance to CPSM and other profiles
- Increase the working sessions to address issues, develop resolutions and include these issues in the tests to verify the resolution
- Work closely with the IEC Working Groups to obtain the latest changes to the standards and ensure the tests fully validate these
- Obtain input from the Utilities to ensure the tests cover needed areas
- Generate more elaborate or real-world models

Future IOP Contents

- Expand the exchange tests to include distribution models and other profiles
- Add tests to verify Messaging Standards defined in WG14
- Add tests for the GES interface standard
- Expand test for GDA and TSDA to include more methods and middleware technologies

Technical Committee 57

POWER SYSTEMS MANAGEMENT AND
ASSOCIATED INFORMATION EXCHANGE

Paul Skare

1906-2006
The electric century

TC 57

1906-2006
The electric century

IEC TC57 Standards
Harmonization Efforts and Future Vision

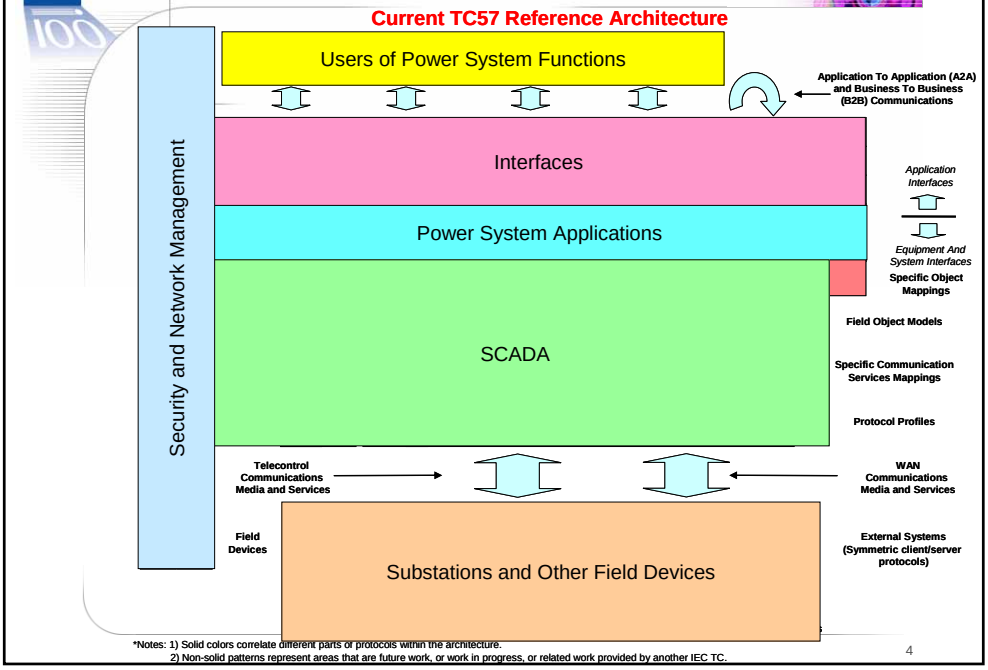
Carmel, IN - 2005-11-02

Paul Skare, Siemens
Convenor, WG19

What is TC57?

- Power systems management and associated information exchange
- Scope: To prepare international standards for power systems control equipment and systems including EMS (Energy Management Systems), SCADA (Supervisory Control And Data Acquisition), distribution automation, teleprotection, and associated information exchange for real-time and non-real-time information, used in the planning, operation and maintenance of power systems. Power systems management comprises control within control centers, substations and individual pieces of primary equipment including telecontrol and interfaces to equipment, systems and databases, which may be outside the scope of TC 57.
- Note 1: Standards prepared by other technical committees of the IEC and organizations such as ITU and ISO shall be used where applicable.

Current Overview



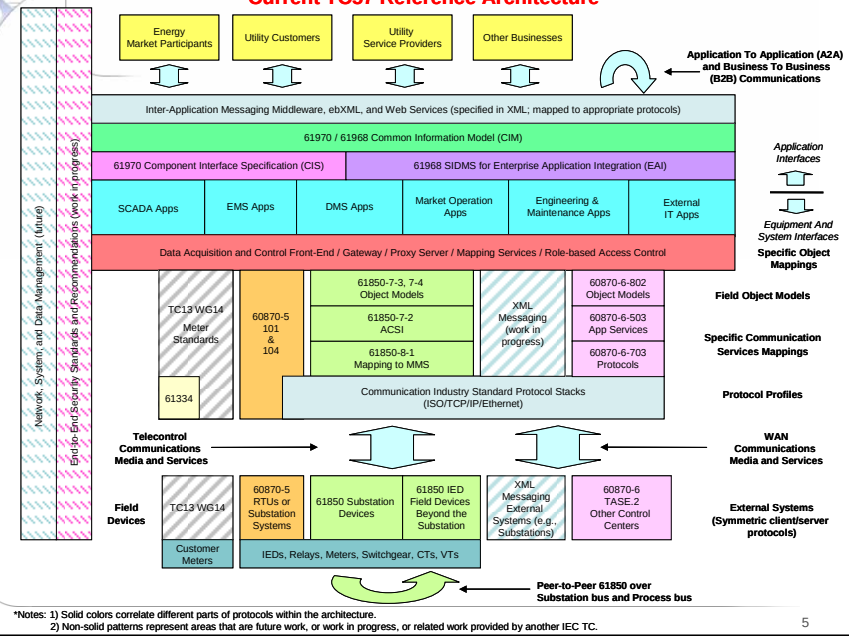
*Notes: 1) Solid colors correlate different parts of protocols within the architecture.
2) Non-solid patterns represent areas that are future work, or work in progress, or related work provided by another IEC TC.

TC 57

Current Detail

WG 19 Status

Current TC57 Reference Architecture



*Notes: 1) Solid colors correlate different parts of protocols within the architecture.
2) Non-solid patterns represent areas that are future work, or work in progress, or related work provided by another IEC TC.

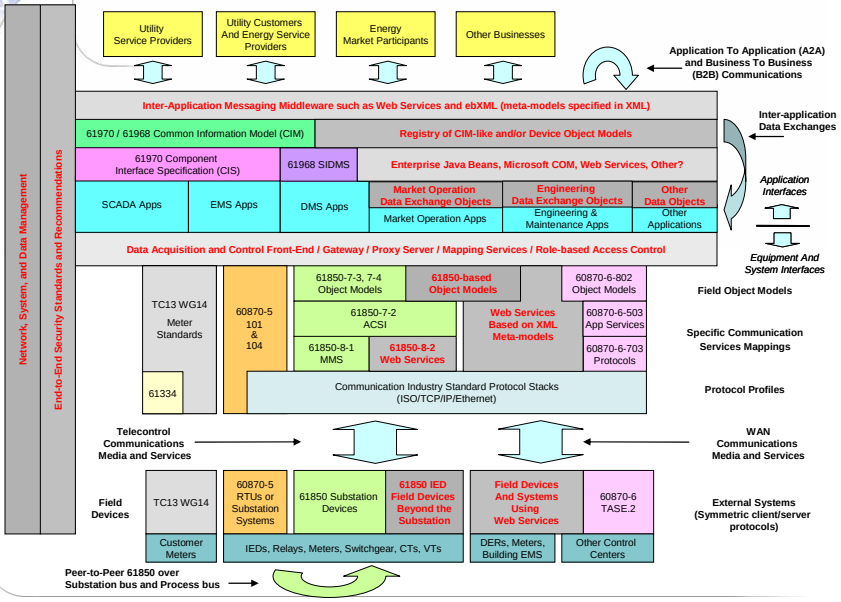
5

TC 57

Future Detail

WG 19 Status

Future TC57 Reference Architecture*



*Notes: Red wording indicates new standards work that needs to be done, improved upon, and/or incorporated from other standards

6

What is WG19?

- "Interoperability within TC 57 in (the) long term"
- In October, 2005 a new AHWG was created(07).
- In January, 2005, AHWG07 was converted to WG19. NP:
  - As quality codes impact the work of other working groups with regard to work on the CIM (IEC 61970, IEC 61968), and extensions to the CIM that were recommended for IEC 61850, it is clear that quality codes must be in the overall data model as well. Therefore, it is clear that a central repository and process for the overall TC57 CIM work be created. Exclusions: Current versions of standards are not proposed to be changed – rather each standard can then address this issue in its normal maintenance cycle.
  - With regards to the CIM, this new working group would be the coordinator of the electronic model for TC57, ensuring harmonization of the expansion of the CIM. Each working group in TC57 which does CIM related work would have access to a WG specific section of the CIM, with this working group ensuring that the overall CIM remains intact, and creates released versions which all working groups can reference in their publications.

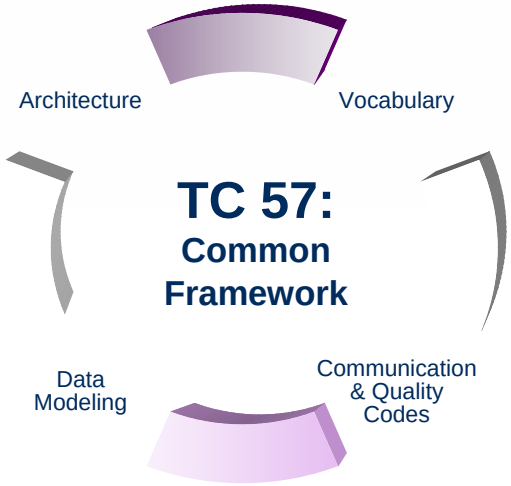
Vision Statement

- "All new TC57 standards should use/extend the CIM as the common semantics for their configuration/engineering modeling, and 61850 for [SCADA oriented / IED / field] communications. Other existing standards would likely take a mapping approach. Services could also be addressed (61850 services, Web services, security, operations, SOA and GID services could be harmonized). Mainstream Information Technologies shall be evaluated prior to creating new equivalent approaches."
- WG19 conceptually is the technical architecture board of TC57.
- We started discussing a roadmap for the CIM – this will be needed for 61850, showing how these are envisioned to progress across working groups from a lifecycle process perspective. Help focus on a 'Seamless Architecture' – not only statically, but over time. The CIM must be a living standard that considers existing implementation impacts.

Vision

- **A common data modeling approach across TC 57**
  - Start with UML 2.0 and XMI 2.0 – next step to plan timeframe for this change (allows other tool use) (Short to Mid term) (We wish to be tool independent)
  - Each WG to have a workable file that can combine to a common model
  - Share files using SharePoint – eRoom being investigated? Internal to TC57. Release only at agreed points with no problems.
  - CMM agreed to coordinate model issues with WG19
  - Started drafting a vision statement to share with TC57 – to be incorporated in the Reference Architecture
  - Investigating ontologies and lifecycle issues

Common but Decentralized Approach



Meeting Summary

- Meetings since Summer, 2005
  - Philadelphia, Pennsylvania USA — September, 2005
    - Meet in conjunction with WG 13, 14, 16 (2.5 day meeting)
- Planned Meetings
  - Zurich, Switzerland — January, 2006
    - In conjunction with WG 13, 14, 16 (1-1.5 day)
  - Spain or Mexico — March, 2006
    - In conjunction with WG 10, 17, 18 (1-1.5 day)
  - London, England — June, 2006
    - In conjunction with the SPAG
  - Unknown — Fall 2006
    - In conjunction with WG13 (2 days)

Work Overview

Publication No.	Description	Date Published	Review Date	Maintenance Result Date	Responsible WG19 Lead	Current Status
IEC 60050(371)	IEV	1984	AMW	CD: 2005-02 CDV: 2006-02 FDIS: 2007-02 IS: 2007-10	E. Dobrowolski	In progress
IEC 60050(371) A1	IEV	1997-09	AMW	CD: 2005-02 CDV: 2006-02 FDIS: 2007-02 IS: 2007-10	E. Dobrowolski	In progress
IEC TR 62357 57/732/INF	61850/61970 Harmonization	2003-07	AMW		P. Skare	Published
SB1/74/INF	TC57 Reference Architecture	2000-12	AMW		T. Saxton	Update in progress to 5g
57/733/NP	Quality Codes			CD 2006-06-01 IS 2007-12-01	H. Falk	In progress

Reference Architecture

- **Team Leader: Terry Saxton**
- Current version being worked on is r5f
- Diagram showing the different views on one piece of primary equipment to be in the document
- Each WG to have a separate section in the document with a diagram, example, and text
- Allows each WG to provide input into overall architecture, but maintains an overall view and consistency
- Intelligrid vision is being brought in
- Reviewed missing points identified in Intelligrid
- Joint Task force created with WG10 to look at modeling and representation – report available

Vocabulary (IEV)

- **Team Leader: Ed Dobrowolski**
- The purpose is to publish in the IEC Global Vocabulary an updated glossary of terms used in TC57.
- Working on conflicts – some terms used differently in different working groups
- Many obsolete terms.

Quality Codes

- **Team Leader: Herb Falk**
- The purpose is to map existing uses of quality codes across SCADA systems and subsystems, and set the standard for all new uses of quality codes.
- Just getting started – we have some SCADA QCs, 61850 QCs, and OPC quality bits now.

New Topics

- A new work item proposal was just passed, and assigned to WG19: To extend 61850 to the control center.
  - Additional NPs coming: to extend 61850 to substation to substation (assigned to WG10)
  - Migration plan for IEC 60870-5 to move to 61850 (assigned to wg3) (Issue for DNP as well)
- Support other information models (Federation of Ontologies or other concepts)
  - DMTF CIM
  - OWL
- Lifecycle Planning (Roadmaps)

IEC TC 57

1906-2006 The electric century

Thank you for your attention. Any questions?

Paul Skare
paul.skare@siemens.com
+1 (952) 607-2071

Project Consultants, LLC

CIM Compliance Panel Discussion

Margaret Goodrich, Project Consultants, LLC

Presented at the
EPRI CIM-GID International Conference
Carmel, IN November 1, 2005

CIM Compliance Test Organization Requirements

- Must be an independent group that is not affiliated with any Vendor
- Must not have any products that are being sold to the Utility Industry and must not have any owners/members that have any affiliation with a Vendor engaged in the Power Utility Industry
- Must be a Non-Profit Organization
- Must have personnel that are knowledgeable about the IEC standards, the CIM and the Industry Needs
- Must have personnel that are knowledgeable about Power Systems
- Must have the skills and tools to complete a 100% validation of the product or project under test.
- Must not use any personnel that may be affiliated with any vendor or that may have a conflict of interest

Compliance Organization Recommendation

- Use an Independent Non-Profit Company to Perform all Certifications
- Use either NERC, IEC, or some other Body to Certify the Test Procedures, Processes and the Company itself.
- The Certifying company will produce the real-world models and other files that are used in the testing
- The Certifying company will produce the tools required to test the products
- The Certifying company will charge to perform Product and Project certifications to pay for the services and products provided

Models the Midwest ISO has been successful in converting

Midwest ISO
We manage power.

- PJM
- NYISO
- MAPP
- AEP
- MECS
- IMO
- MISO

2

Issues arising from conversions

- Multiple ways of interpreting the CIM structure which produces slightly different variation in each model received.
- Different aspects of vender specific properties are being introduced into the way a vender produces a CIM/XML file.
- These differences make it necessary to have different conversion routines for each model received.
- When a difference is found it is hard to determine whose interpretation of the CIM standard is correct.

3

Recommendation for making the CIM/XML format user friendly.

- Create a “STANDARD” test XML for each common piece of equipment that is in a power system. The CIM/XML is almost there, it just needs to have real constraints imposed on it. Keep the test cases as simple as possible
- Examples:
  - Create a standard CIM/XML for a loads that include the following.
    - 2 or more conforming loads with a Load Area Schedule.
    - 2 non-conforming loads, one constant current and the other a constant impedance with schedules.
    - Minimum set of ICCP measurements to the loads.
    - Include in the XML the “required” topology and relations.
    - Loads should include both schedules and a solved value.

4

Recommendation for making the CIM/XML format user friendly continued.

- Create a standard CIM/XML for transformers to include the following
  - A standard transformer with no taps.
  - A standard transformer with fixed primary, and an LTC on the secondary.
  - A standard transformer with a fixed secondary and an LTC on the primary.
  - A standard transformer with a LTC on the primary and and secondary.
  - A phase shifter
  - Voltage schedules, Impedance correction tables.
  - The “required” topology and relational requirements.
  - A minimum set of Iccp measurements defined for MW, Mvar, Tap
- Create CIM/XML for Generation Units, Synchronous Condensers, DC Lines, Shunts, Lines, Switches, Breakers

5

Make the test cases readily available

- These test cases should be made generally available. In order for a CIM/XML file to be considered CIM Compliant, it should have to conform to the standards of the test files.
- Finally Large scale test should be conducted which will export a CIM from company A’s system, be imported into company B’s system re-exported and imported back into company A’s system. A difference should then be conducted on both Company A’s version and Company B’s version to determine the completeness of the data exchange and explain any differences.

6

CALIFORNIA ISO

CIM COMPLIANCE REQUIREMENTS AND RECOMMENDATIONS

Enamul Haq
Sr. Engineer, EMS Services
California ISO
Folsom, CA 95630
November 1, 2005

CALIFORNIA ISO

CIM Compliance Requirements

- Must be an Independent Group
  - All parties must have no vendor responsibility or connection in any way.
  - All parties must be completely free of any conflict of interest.
- Must have real-world models to use in the compliance test
- Must have real tools to validate test
- Must validate that RDF IDs are persistent
- Tests based on inputs from Utility Engineers.
- Must validate all aspects of standards – must include data issues and must provide 100% sample size for all CIM XML files verified to the CIM and Exchange standards (see next 2 slides for example data validation)

CALIFORNIA ISO

Sample Compliance Issues for Data Validation

- Data Validation Examples
  - For “Voltage Control” Transformers the Type should not be set to “FIXED”.
  - For “Regulating Transformers” the “Regulated” bus must be present.
  - For “ACLineSegment” the “BaseVoltage” must be present.
  - “For some Shunt Compensators the attribute “MVArPerSection” was set to Zero, but “NominalMvar” was populated.
  - For some compensators the “CompensatorType” attribute was wrong (series compensator was set to shunt).
  - For some Regulating Shunt Compensators the Regulation Schedule was missing.
  - For Shunt Compensators, the attribute “maximumSections” was set to zero.
  - For Shunt Compensators, the attribute “normalSections” was was set greater than “maximumSections”.

CALIFORNIA ISO

Sample Compliance Issues for Data Validation - Continued

- Data/Exporter Issues
  - The unit of X-axis of “MVArCapabilityCurve” must be set to MW
  - The Y-axis Type of some “MVArCapabilityCurve” must be set to “twoYValues”.
  - Verify no “Orphan” Terminals get exported in the RDF files.
  - In some model “lowVoltageLimit” and “highVoltageLimit” were associated with “voltageLevel” class, in other cases these were absent.
  - In some models multiple “basePower” was specified.
  - In some models “CimVersion” class was not specified.
  - The attributes “minimumKV” and “maximumKV” were used for voltage regulation even if regulation voltage schedule is present in the model

CALIFORNIA ISO

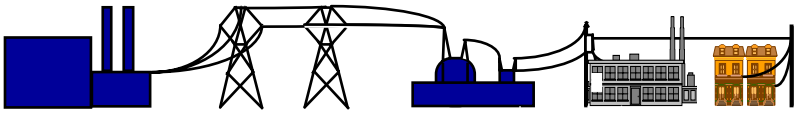
RECOMMENDATION

- Remove all ambiguity in the CPSM Profile
  - Provide clear explanation and usage instructions \in the CPSM document
  - Use CPSM profile for compliance testing in North America
  - Come up with a benchmark network model for compliance testing
- Use the IEC Organization to Ensure Compliance
  - IEC would certify the tests and oversee the execution of the tests.
  - IEC would ensure no conflict of interest exists in the testing environment or with those performing the test
  - IEC would issue certificates of compliance for Products
  - If possible, they would appoint IEC personnel to conduct the tests

Thoughts On Compliance Testing

Terry Saxton

EPRI CIM/GID International Conference
MISO, Indianapolis
November 2005



Xtensible Solutions

Levels of Conformance

- Transport
- Syntax / form / structure
- Content
- Scenario/process
- Interoperable with other solutions
- Implementation Testing for Project

Xtensible Solutions

Types of Testing: Conformance to Implementation

Implementation Testing (Actual project)

Trading partner testing of BOD, Interchange, Scenario & Transport.

Interoperability Testing

Vendor to vendor test of BOD, Interchange, & Scenario Testing

Conformance Testing

BOD (Message Payload) or XML document), Interchange, & Scenario Conformance Testing

3

Xtensible So

 3

What Does CIM Compliance Mean?

- First, the CIM is not a database – it is an information model (i.e., meta data)
- CIM compliance has meaning only at the public interface where information exchange occurs
- Two types of compliance – meta data and instance data
  - Bottom line: Compliance deals with messages/data exchanged or accessed at a public interface, not internal organization of data.

Xtensible Solutions

 4

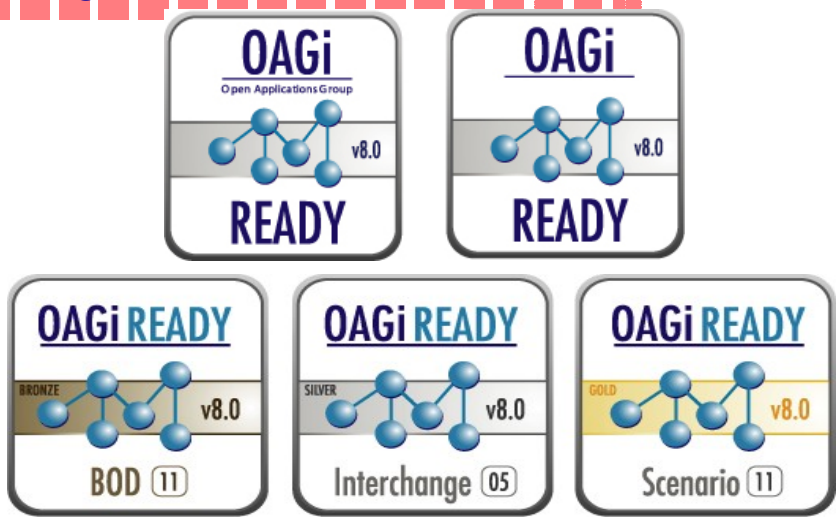
What CIM Compliance Does Not Mean

- There is a database organized exactly like the CIM class diagrams
- All aspects of the CIM are included in an implementation
  - Profiles can be defined for compliance purposes
  - NERC has defined a Common Power System Model (CPSM) with mandatory and optional conformance points (i.e., classes, attributes, associations)
  - Other profiles can be defined and added to the CIM model as well
- No extensions have been made to the standard CIM
  - Extensions are OK as long as have explicit namespace prefix in XML schema
  - EX: xyz.transformerType vs. cim.transformerType
  - XML elements prefixed byh “xyz” can be ignored
- Business constraints beyond CIM standard
  - Important for project testing, but not CIM compliance

Xtensible Solutions

 5

CIM Badges Similar to OAGi Ready Badges



6

Xtensible Solutions

 6

CIM User Group Status and Plans

Greg Congleton - TVA
EPRI CIM/GID Seminar
MISO Carmel, Indiana
November 2, 2005

MOTIVATION

- Information technology trends support application integration and semantic consistency both within the enterprise and with trading partners.

- These trends go beyond exchange of network models or updates to network models.

- Transactional messages about CIM concepts and events that touch on CIM concepts will need to be designed and coordinated for semantic and syntactic consistency.

CIM User Group Status and Plans

Objective

•The objective of the CIM User Group (CIMug) is to ensure that the affected parties have the means to coordinate these developments in an efficient and effective manner.

•The CIMug will be the primary means for developing
consensus and consistency across the industry as well as managing and communicating issues concerning the CIM model.

CIM User Group Status and Plans

- **Table 1, CIMug Prioritized Objectives.**

A. CIM Knowledge/Artifact Exchange 43%

- Forum for all CIM users
- Share artifacts derived from standards
- Promote interest in and use of CIM and related standards
- Share user experiences
- Clearinghouse for CIM related questions
- Provide training materials
- Conduct workshops
- Electronic newsletter
- Lists of CIM-compliant products
- Provide product advertising opportunities

CIM User Group Status and Plans

- **Table 1, CIMug Prioritized Objectives - continued.**

B. CIM Model Management, Maintenance, and Methodology 27%

- CIM editor funding support
- CIM XML tool maintenance

C. Test support 20%

- Compliance test support
- Interoperability test support – CIM XML, GID, XML messages
- Form partnerships for exchanging CIM-compliant messages

D. Harmonization 10%

- Integration, harmonization and coordination with other standards

CIM User Group Status and Plans

Objective

- The abstract nature of the CIM leads to flexibility and competing demands on its enhancement. Because of this a CIMug needs both an open forum where these enhancements can be arbitrated as well as committed management of the model artifacts supported by durable organizational knowledge about its evolution.

- The CIMug must serve vendors who produce and market CIM compliant products, consulting firms who support the understanding and use of the CIM, and utility and energy companies using CIM compliant products and applying CIM concepts and artifacts to their information management practices

CIM User Group Status and Plans

UCA International Users Group Organization

CIM User Group Status and Plans

CIM User Group Task Force

Formed after January 2005 meeting at TVA

Membership:
Jay Britton, ARVEA, Inc
Greg Congleton, TVA
Ed Dobrowolski, KEMA Consulting
Thierry Godart, AREVA, Inc
Andre Maizener, EDF
Scot Neumann, UISOL
Hugo Reyes, SCE
Terry Saxton, Xtensible Solutions
Shigetaka Kikkawa, SCE
James G. Waight, Siemens

CIM User Group Status and Plans

1. Negotiations with UCAIUG Board and Officers via email, phone calls
2. and a meeting in Columbus, Ohio May 2005.

3. UCAIUG Board votes to accept CIMug TF changes to their charter, bylaws.

4. UCAIUG Board votes to fund CIMug activities.

5. First Organizational Meeting at Exelon – Chicago August 2005
   - Issues list developed
   - Web site requirements developed – written up by Scott Nuemann
   - Nomination and voting procedures set for initial positions

CIM User Group Status and Plans

Voting and Nomination Results

Executive Committee 3 additional "CIM" members

Technical Oversight Committee 1 at large member
Dean Hengst – Exelon

CIM Model Manager 1 year rotational position among vendors
Also member of the Harmonization Committee
Kurt Hunter – Siemens

CIM Technical Committee Co-Chairs – 1 Utility 1 Vendor
Also members of the Technical Oversight Committee
Greg Congleton – TVA
Terry Saxton – Xtensible Solutions

CIM User Group Status and Plans

Volunteering Results

Marketing Committee any number of additional members
May form a Sub-Committee focused on marketing CIM

- Dave Becker - EPRI
- Greg Robinson - Xtensible

CIM Technical Committee any number of additional members

- Randy Curtis, WAPA Rocky Mountain Region
- Dave Becker - EPRI
- Erich Wuergler - Siemens
- John Gillerman - SISCO
- Heather Forsythe - PJM
- Mike Nazarek - PJM
- Suzanne Caron-André - *SNC-Lavalin Energy Control Systems*
- David Brown - *SNC-Lavalin Energy Control Systems*
- Jay Britton - AREVA
- others - AREVA
- Terry Saxton - Xtensible
- Greg Robinson - Xtensible
- Joe Zhou - Xtensible
- Harry Garton - Xtensible
- Greg Congleton - TVA
- Mark E. Browning - Exelon
- Lars-Ola Osterlund - ABB
- Ed Dobrowolski - KEMA
- Others from UISOL, PacifiCorp, etc

CIM User Group Status and Plans

PLANS

Meetings

•Meet as the CIM Technical Committee at least once a year, usually in conjunction with the UCAIUG meeting or with a large T&D conference.

•

•Meetings will be for sharing of results, defining issues and conducting some of the administrative business of the group.

•During the first year(s) more than 1 meeting a year may be called for.

CIM User Group Status and Plans

PLANS

Working Groups

1. Form working groups focused on CIM issues of interest and importance to the membership.
2. Working groups define issue scope, resolution plan and deliverable.
3. Working groups work and coordinate between face to face meetings.
4. Working groups are for peer review of issue resolution.
5. Working groups deliver products to wider membership for review, use, acceptance and delivery where appropriate to the IEC working groups.

CIM User Group Status and Plans

PLANS

CIM Model manager (CMM) and CIM issue resolution
Kurt covered this yesterday

Help Desk

- Staff an email list of people with CIM expertise willing to answer questions.

- Questions will be submitted via the web site and then allocated to experts by a help desk monitor or may be automatically distributed to those on the CIM help desk distribution list.

CIM User Group Status and Plans

PLANS

Web Site

- Use the UCAIUG web site to store documents, educational materials, white papers, help desk area, mailing lists and links to other relevant web sites.
- Voting for positions and on issues
- May provide access to a repository with a searchable version of the CIM class model and any messages or other metadata artifacts that are related to it.
- FAQs
- Issue List

CIM User Group Status and Plans

PLANS

Use our time this week to

- **educate**
- **promulgate**
- **organize**
- **prioritize**

Send a proposed budget to the UCAIUG based on

- **priority issues**
- **future meetings**
  - **schedule and format**

CIM User Group Status and Plans

- Use Thursday and Friday to form working groups that will address some of our most pressing issues.
- These working groups will continue to work after this week.

??????

CIM User Group Processes

Issues from the August 2005 meeting

CIM User Group Processes

The CIM processes were split up into 3 separate items with a small breakout group to discuss each:

1. Web site/Repository requirements
2. Technical Issues List/Help Desk process
3. Marketing of CIM & the CIM UG

CIM User Group Processes

Web site/Repository

The web site should have repository/archiving capability.

1. What types of artifacts need to be stored?
2. What search capability is needed?
3. Scott Nuemann has created a draft requirements document. It has been forwarded to Kay at UCAIUG.

CIM User Group Processes

Technical Issues List/Help Desk process

1. The Help Desk should be a two level function.
   - Level 1 is for questions and simple research items.
   - Level 2 is for dealing with issues.
2. A process will need to be established and a liaison with the CMM will be required to handle issues.
3. Issue resolution needs to be slotted to specific releases of the CIM.
4. Testing of new releases and the identifying and assessing the effect on interfaces is required.

CIM User Group Processes

Marketing of CIM & the CIM UG

1. The message needs to be focused to the specific technology:
   - CIM
   - IEC61850 (Substation Automation)
   - Open AMI/Open DR (Demand Response)
   - One for the overall group
2. Some thought that users don't drive the group, but others won't join without a strong user presence. Therefore, marketing needs to be targeted to users.
3. Several levels need to be addressed:
   - Operations – Need to be sold on the technology and that for those implementing the technology joining the group has significant benefits.
   - Executives – Need support to justify the operations desire to take part. Would like to target these…but how? Perhaps using:
     - NERC, EEI, FERC
4. There are various events at which we might be able to promote the group.
5. We need to staff the marketing subcommittee and possibly a CIM UG Marketing Task Force. **This is an urgent need.**
6. Chair of a CIM UG Marketing TF – Probably from a vendor to drive the group, schedule meetings, set objectives, etc. In general, this person will need to make stuff happen.
7. Utility Co-chair of the Marketing Subcommittee – Dave and Bhavin will inquire within EPRI members for a new marketing co-chair for the SC.
8. There may be a need for different marketing in Europe as opposed to the US.

CIM User Group Processes

- Please pick one of these areas and give some thought, time and energy to help get these processes established.

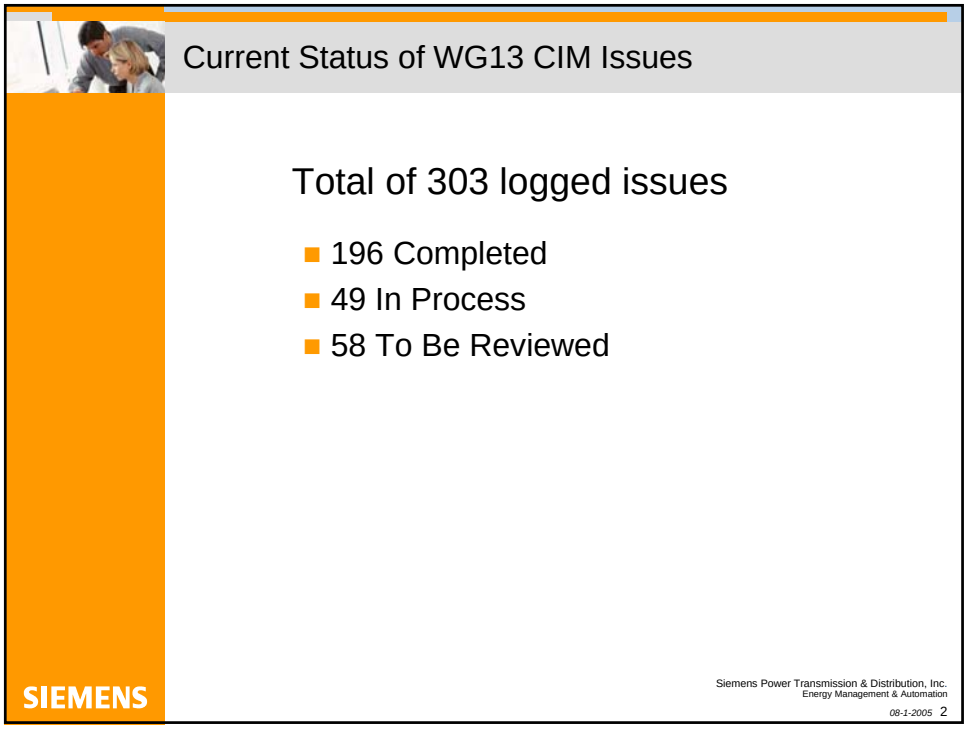
1. Web site/Repository/Help Desk interface
2. Technical Issues List/Help Desk process
3. Marketing of CIM & the CIM UG

CIM User Group Processes

- One of the working groups will address User group
  - Processes
  - Issues
- These working groups will continue to work after this week.

??????


PTD Energy Management & Information Systems
CIM Issues
Greg Congleton
SIEMENS


Current Status of WG13 CIM Issues
Total of 303 logged issues
196 Completed
49 In Process
58 To Be Reviewed
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Energy Management & Automation
08-1-2005 2

Current Status of WG13 CIM Issues

"In Process" Issues categories include:

- Documentation Changes
- Waiting for Detailed Proposals or Use Cases
- Checking with other WG's
- Proposals Under Review
- Major Issues

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Current Status of WG13 CIM Issues

Proposals Under Review

- Split of Compensator class into two classes ShuntCompensator and SeriesCompensator
- DC Line Model (currently incomplete)

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Major Issues

Equipment Naming/Hierarchies Issues

- Differentiate owner and operator of resources
- Clearly defined naming hierarchies
- Clarify situations where multiple possible parents exist and at least one parent is mandatory

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Major Issues

Time Issues

- Need clearly defined format for date and time
- Need time series model (event oriented)
- Clarify how to define time on X-Axis of a CurveSchedule
- Change/Correct time based primitive data types

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Major Issues

Data Typing Issues

- Clean up Numeric data type
- Clearly define all primitive data types (add documentation)
- Clarify all UML DataTypes
- Add string, decimal, and integer as primitive data types

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Major Issues

Line Containment Issues

- Containment needed for line related resources outside of Substations
- In distribution network a ConnectivityNode does not have an explicit EquipmentContainer
- Need better modeling for tapped lines

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Major Issues

SI Units Issues

- IEC requires use of base SI units (i.e. volts, not kV; watts, not MW, etc.)
- Affects attribute data types, attribute names (ratedMVA, initialMW, etc.)

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Interoperability Issues

- Exchange profile defined too flexibly
  - Multiple options for containment hierarchy
  - Multiple options to represent equipment (e.g. series devices can be specified as either a Compensator or an ACLineSegment)
- Exchange profile does not clearly define required and optional attributes and associations
- Use of Abstract classes should be discouraged
- What side (UML role) to use in an association is not clear

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