Use of CIM in AEP Enterprise Architecture

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Introduction

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- AEP Project Description and Goals
- CIM Adoption
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- Summary

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AEP Statistics

- AEP comprises three main energy areas; Generation, Distribution, and Transmission
- AEP owns nearly 38,000 megawatts of generation capacity in the United States.
- AEP also has the largest US electricity transmission system with an approximately 39,000-mile network.
- AEP distribution units operate in 11 states, including Ohio, Michigan, Texas, Virginia, West Virginia, Tennessee, Indiana, Kentucky, Oklahoma, Arkansas, and Louisiana.

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AEP Project Description and Goals

- AEP's *grid**SMART*** initiative is a comprehensive approach to improving system efficiency and lowering operating costs, providing new services to customers, and allowing consumers to better control energy usage and costs.
- After completion of a pilot program involving 10,000 customers to test gridSMART technology in South Bend, Indiana, several new projects are underway:
  - Plans to install one million smart meters in Texas over the next several years.
  - The DOE has awarded $75 million to AEP in an ARRA Demonstration Project to deploy 130,000 smart meters in central Ohio
  - Plans are being finalized to deploy 15,000 meters in Oklahoma to demonstrate conservation effects of in-home displays and other smart grid technologies

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CIM Adoption

- AEP made a strategic decision to adopt the CIM standards for the integration of its back office systems.
- They worked with consultants from companies serving on the CIM standard committees and participated in the CIM standard refinement activities.
- Build a foundation to adopt IEC 61968 and IEC 61970.
- AEP is using the IEC CIM standard in the ARRA Demonstration Project for all back office systems involved in the project.

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CIM Adoption - Continued

- To minimize the complexity of the ARRA project, AEP made the decision to use a Canonical Data Format where participating applications would only have to translate their internal proprietary data format to and from a single Canonical Data Model, in XML format, before sending out their messages.
- AEP created a CIM Based Canonical Data Model for each AEP business function in the project, including Meter On Demand Reading, Meter Control (Meter Connect/Disconnect & On Demand Peak Reset), Meter Status, Meter Data Synchronization, Premise Data Synchronization.

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CIM Adoption - Continued

- The Canonical Data Models used attributes from the classes in Part 9 of the IEC 61968 standard with a few attributes from the IEC 61970 standard.

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CIM is a major commitment and highly complex undertaking without clear planning and adoption strategy

Establishing CIM Adoption Strategy

- Understand Why CIM?
- Utility's Vision for CIM
- Identify CIM Tooling
- Criteria for CIM based integration
- Understanding of current state
- Knowledge and Training Needs

CIM Adoption Roadmap

- CIM Training & Workshops
- Well defined System Integration Requirements
- Alignment with Enterprise Architecture
- Review business processes and implementation strategy
- Understand use cases

CIM based Modeling and Development

- Define CIM based Messages
- Modeling and Profiling
- Define CIM Extensions
- Develop CIM based service design (XSD, WSDLs)
- Repeatable processes and Templates

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CIM Implementation Tasks

- The architect team started by creating a superset of the data attributes of all participating applications of a particular business function.
- A business data glossary where a catalog of business data attributes, their names, structure, and usage was defined.
- Then we mapped each data attribute to the corresponding CIM Data Objects.
- When possible the existing IEC Part 9 Profile message definitions were used or extended to create AEP's CIM Based Canonical Message Format.

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CIM Implementation Tasks - Continued

- Used the profiles to create the XSD for each message payload.
- Identified and defined a few CIM extensions, which were submitted back into the IEC WG14 and WG13 CIM Standard Committee for inclusion in the CIM Data Objects.
- 90% of the extensions have been adopted by the CIM standard committee and these will be included in the next revision of the standard.
- A header was added to the payload, the WSDLs were created, and the developers started building the code to translate the internal application data format into the CIM Based Canonical message format.

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Inputs

- Consolidated Interface Catalog
- Integration Architecture Blueprint
- Services Framework and Architecture
- Integration Patterns

Activities

1. Review interface catalog and determine prioritization using CIM Adoption Decision Matrix
2. For each integration scenario to be CIM-enabled, perform the following set of activities:
3. Collect requisite API and data structure definition documents for all end-point systems including respective meta-definitions
4. Develop canonical model consisting of common fields and unique fields for all end-point systems involved
5. Map canonical model to CIM UML Model, identifying required CIM extensions
6. Define Utility's AMS Implementation Profile
7. Create XML Message Definitions (XSDs)

CIM Adoption

Utility's CIM Model

- Utility's AMS Implementation Profile
- Utility's-specific CIM Model

CIM-Based Message Model

- Message Types (XSDs)
- Service Definitions (WSDLs)

Recommendations to IEC

- Submission of CIM Extensions
- Submission of new Message Types

Project Pre-requisites and Accelerators

IEC CIM Model 61968 and 61970 and its Message Model

Software Modeling Tool with CIM plug-ins

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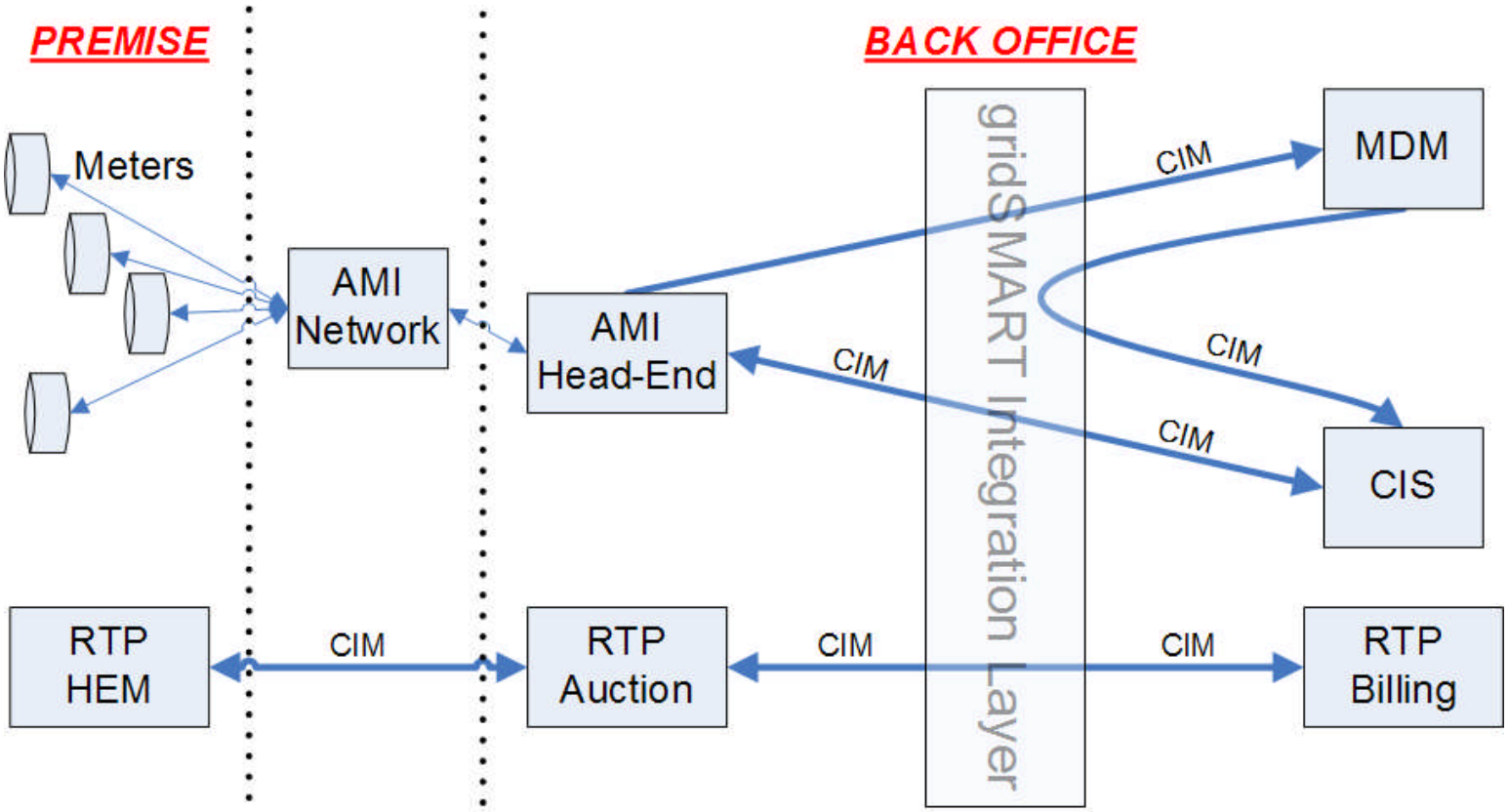
ARRA Project: System Context Diagram



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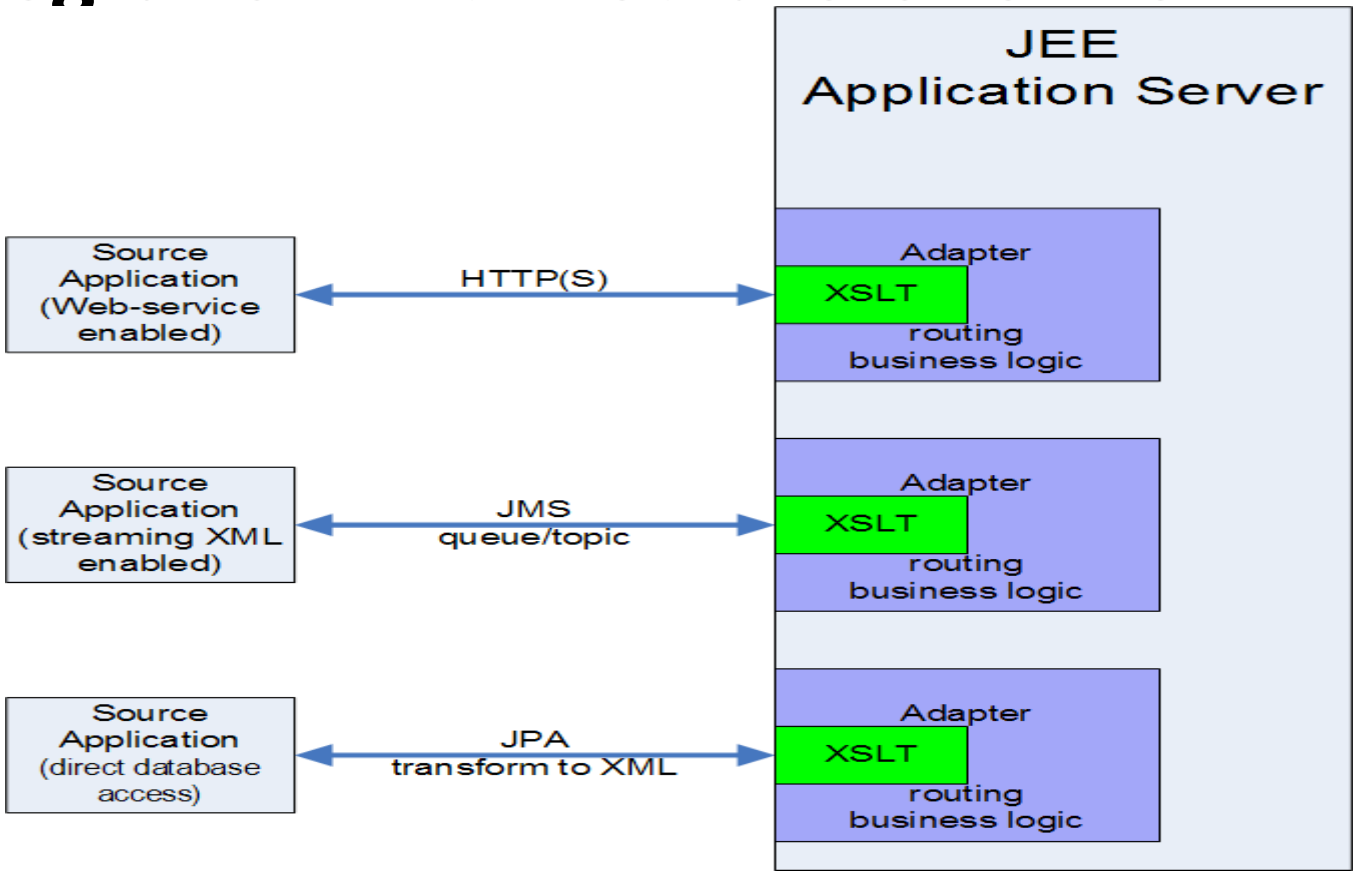
Integration Architecture Overview



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Architectural Rationales for CIM

- The smart grid space technology space is still immature and rapidly evolving
- Core AEP use case: two different AMI systems!
- Impractical to staff both skill sets and build out two parallel chains of artifacts – and what about AMI #3 ?
- Interoperability goals of ARRA project
  - IEC 61970/61968 listed in NIST “Framework and Roadmap for Smart Grid Interoperability” (Special Publication 1108)
  - ***We would have needed to do this anyway***

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Messages Used

- EndDeviceEvent
- EndDeviceControl (for Meter Control Operations: Disconnect/Reconnect, Peak Demand Reset, etc.)
- GetDeviceStatus (New and not accepted by IEC)
- GetMeterReadings
- MeterReadings
- HAN/PAN Messages (adopted in Part 9 as attribute additions to EndDeviceEvent and EndDeviceControl messages)

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New Messages for ARRA Project

- RTP Messages (under consideration for adoption as part of IEC WG21 messages)
  - RetailBill
  - PriceNotification
  - DistributionUtilization
  - EnergyManagementUnitConfig
  - ObjectLinkageConfig-ACLineSegmentToSDPLocation
  - ObjectLinkageConfig-UsagePointLocationToEnergyManagementUnit
  - UsagePointLocationDemandBid

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Summary – Critical Tasks for Success

- Review, Analyze and Validate integration approach
- Complete Training and Workshops for CIM
- Capture the requirements for use of CIM
- Map Legacy Message Data to CIM
- Define a Utility specific message model based on CIM
- Generate XSD Messages using CIM model
- Develop a CIM-based Service Design

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Summary – Critical Tasks for Success (Cont'd)

- Generate an IEC Submission Package that includes:
  - Use Cases
  - XSDs
  - Snapshot of UML changes
  - Documentation of all requested extensions that provide justification and other information
- Contact an IEC representative to present the submission or, request attendance to an IEC meeting as a guest and request to be placed on the agenda.

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Project Summary and Results

- AEP participated in the IEC CIM Interoperability tests to ensure compliance with the CIM standards. We passed all tests we participated in.
- AEP's adoption of the CIM Data Models has simplified the interoperability between applications and will benefit future use of business rules, security, and overall service governance.

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