Case Study:
Leveraging Industry Standards & Model-Driven Development for Enterprise Information Management & Semantic Integration at Long Island Power Authority (LIPA)

Predrag Vujovic, Phillip Jones, Fran Clark, Stipe Fustar
Topics

- Real-world Case Study of how LIPA are using a Model-Driven approach, leveraging an Enterprise Semantic Model (ESM) to:
  - Implement Semantic Integration
  - Implement Persistent Data Stores (e.g. for Analytics, Data Warehouses)

- Our Story:
  - LIPA Smart Grid Business Drivers (Why?)
  - Target Architecture and Enablers (What?)
  - Semantic Integration Approach (How?)
  - Persistent Data Stores (How?)
LIPA has adopted a model-driven process for defining, designing, developing and deploying:

- Services on the Enterprise Service Bus
- Persistent data stores for analytics (ODS, Data Warehouse, Datamart)

The Model-driven approach leverages industry standards (e.g. CIM) wherever possible to:

- Promote reusability
- Accelerate development cycles
- Facilitate visibility, governance and change management

Four key models

- Enterprise Semantic Model
- Service Model
- Exchange Model
- Data Model

Process & Governance
ODW Conceptual Technical Architecture
LIPA Smart Grid Road Map

**2009**
- **Infrastructure**
- **System Operation**
- **Gaps, Goals, Schedule**

**2010**
- **Customers**
- **AMI Pilots**
- **Lessons Learned**
- **AMI Requirem.**
- **AMI RFP**
- **MDMS Spec**
- **MDMS RFP**
- **AMI Implementation**
- **Integration with Rates Implementation**
- **Integration with Operations Spec**
- **Communication backbone**
- **SG infrastructure**
- **Integration of existing data with enterprise data and SOA.**

**2011**
- **EDM Architecture, Data Modeling, Interoperability**
- **GIS Data Consolidation**

**2012**
- **Integration of phasor relay data with regional system.**
- **Implementation of data backhaul across T&D O&M, AMI, Customer systems.**
- **Integration of smart relays data into enterprise data and SOA.**
- **Dynamic real-time adjustment of operation and loading of transformers and overloading protection based on actual operating conditions and individual asset condition.**

**2013**
- **SMART**
- **1st Generation Smart Grid: Optimization, Visualization, Automation**

**2015**
- **Upgrade ASU switches with reclosing capability.**
- **Increase use of remote PMH control with fault detection and remote reporting.**
- **Substation online monitoring, integration with enterprise-wide data management system and SOA for asset condition monitoring.**

**LIPA Standards & Model Driven Approach**

**LIPA Confidential**
LIPA Model-driven Architecture Business Drivers

- Reduce cost of implementations and integrations
  - including maintenance / change management
- Reduce risk to implementations and integrations
- Increase speed of implementations and integrations
- Improve ability to solve business problems by choosing best of breed applications and services
- Avoid vendor- and technology lock-in’s
- Support Multiple Service Providers

Architecture:
- “Near Plug and Play”, Flexibility, Agility & Portability
- Consistent semantics for data in-flight and persisted for analytics
- Flexibility of Business Intelligence Options
- Open to new technology, solutions, applications
  - the key to leveraging investment in Smart Grid infrastructure and many new players, functionality, data consumers & -producers
Accomplish this by:

- Establishing a loosely-coupled SOA architecture through:
  - Leveraging an Exchange Model (EXM) for model-driven “development”, that …
  - mediates all interfaces through a LIPA Enterprise Semantic Model (ESM), …
  - which is based on available industry standards (e.g. CIM)

- Using a model-driven design and development process to:
  - Speed development process
  - Improve reusability
  - Improve governance and change management

- Require that any new vendor applications:
  - Where possible, conform to LIPA canonical interfaces
  - When not possible, conform to some industry standard interface
  - Publish interfaces / APIs so that knowledge of underlying database structures is not required for integration (transactional or analytical)
LIPA Model-Driven approach

- End-to-End Model-Driven approach
- Paradigm Shift compared with the conventional approach
- Bridges the gap (chasm?) between design, development and run-time
- Increased Agility, Responsiveness, Speed
- Decreased Time, Cost, Risk
- Enabler for implementation of new functionality, processes and analytics solutions
LIPA started pilot projects in utilizing industry standards for interoperability of systems in 2000
LIPA Recognized the need for an innovative model-driven approach in 2007
LIPA’s New Model-Driven Approach :
  – Enables semantic integration through the use of a common semantic model
  – Supports “automated” maintenance, testing, and updates of enterprise data model across company systems
Projects Track Record

- Projects comprised integration solutions and persistent data stores (ODS’s and Data Warehouses)
- The LIPA Model-Driven Semantic Integration approach has consistently performed under budget and on time under complex and challenging conditions.
- Trend of reduced cost and improved delivery speed is based on:
  - Model-driven approach + governance + processes + tools for
    - “automated/integrated” development, testing, implementation, and maintenance of the model
  - Reuse of data and interfaces across company systems and SOA
Projects Track Record

- Projects completed & in-flight include:
  - Energy Trading Solution
  - Customer Outage Communication (Web Outage Map)
  - Customer Outage Communication (Text Messaging)
  - Meter Data Management
  - Outage Management (OMS – in progress)
  - Customer Consumption Data integration
Model-driven Workflow: “Lossless” Metadata

ESM (Semantic Model)

- CIM

Centralized Data Model

- ESM

Information Architecture

- Local requirements

ESM (Semantic Model)

EXM (Exchange Model)

- Implement the Exchange Model integrating with the necessary systems and performs initial data transformation testing

EXM

Centralized Mapping, Design

- Run-time components are generated, re-tested and passed to the operations team for deployment

Testing

- Perform complete testing, including process execution and exception handling.

Integration Team

- Distributed run-time

ESB

Operations Team

- Stateless for scalability
- Runs in any Java container
- Connects to any bus

Perform complete testing, including process execution and exception handling.

Operations Team deploys components in the production environment.

Continuous Testing

- Operations Team deploys components in the production environment.

Extend and enhance the common data model with local requirements

Centralized Data Model

- CIM

ESM

Information Architecture

- Local requirements

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Continuous Testing
Key Elements of LIPA Semantic Integration

- Centrally Managed Semantic (Data) Model (ESM)
  - Heterogeneous interfaces mediated through common model
  - Based on industry standards (IEC CIM)

- Centrally Managed Exchange Model (EXM)
  - Semantic Mapping and Business Rules
  - Integrate & Reuse Business Rules, transformations, mappings
  - Automate gap analysis, documentation
  - Centrally Managed Mapping and Run-Time Deployment
  - Generate ready-to-go SOA services (Deploy the Model, No code written)
  - Continuous testing
  - Deploy into any Java runtime environment
  - Automate impact analysis on change
Semantic Integration Value Proposition

- Make all run-time interoperability decisions at semantic layer
  - Configuration rather than coding
    - Automate implementation
  - Simplified testing
    - Test mappings, transformation and business rules using design-time tool (DXSI)
  - Effective change management, maintenance and updates!!!
LIPA ESM and Integration Concept

**Design-Time**
- Open Standards
- Enterprise Semantic Model (ESM) & Exchange Model (EXM) (Mapping)
- Business Definitions
- Applications Metadata

**Run-Time**
- Application Information
- Process Integration
- BPM/Workflow
- Business Intelligence

Enterprise Integration Platforms
LIPA Data Warehouse, BI and Reporting Business Drivers

LIPA Data Warehouse Key Requirements and Drivers

- Provide business users with rapid, reliable and consistent access to information for making business decisions
  - Business Intelligence (Historic perspective) uses ESM-based data warehouse
    - Provide data mining features at ODW or DM level for various analyses (e.g. statistical, time series)
  - Operational Intelligence (near-real-time perspective, which includes Visualization tools) utilize ESM-based near-real time data store, ESM-based data warehouse and Canonical data services.

- Gain efficiencies by eliminating need for business users to reconcile semantic interpretation of data

- Show value in near-term but build to support future
  - Support both event-driven and batch-oriented data and process integration, as required.
  - Leverage existing and future data services for ensuring minimal latency between data in applications and the data warehouse / datamart / ODSs’
Logical View of LIPA Analytics Vision

Operations Intelligence (near-real time perspective) Analytics / Reporting / Visualization

Operational Dashboard/Visualization
(Could be any one of Siebel Analytics, Bus Objects, Spotfire or Composite apps)

Solution #1
Solution #2

Advanced Apps
App #1

Business Intelligence (historic perspective) Analytics / Reporting / Visualization

Customer BI Solution
(Siebel Analytics, Bus Objects or Spotfire)

BI Presentation
Oracle BI Server

Operations BI Solution
(Siebel Analytics, Bus Objects or Spotfire)

Spotfire Solution #1
Spotfire Solution #2

Customer DW
Events, Alarms, Measurements (PI)

ODS (ESM)
Operational Data Warehouse (ESM)

Staging

Data Marts

Integration Layer

ESB
ETL

Data Sources Layer (e.g. Applications’ DBs)

OMS
CAS
GIS
EMS
Maximo
LI Aspen, Cascade, LI Insp. Data, LI CYME

Cloud-based Data Sources
(e.g. Weather, etc)

Enterprise Data Layer

De-coupled Layers; Common Analytic Models & Services

Freedom to use any BI or DV Tool on the dataset(s)

Applications can be upgraded or replaced without impacting the Analysis & Reporting functions

Business Vocabulary

LIPA ESM & EXM

Oracle BI Server

LIPA

LI Aspen

Cascade

LI Insp.

LI CYME

Standardizes/canonical interface definition
Governance and Change Management

- **Guiding Principles**
  - Models are central to all governance and change management activity
  - Automated processes will be used to reduce effort and errors

- **Change Management**
  - Version and Source Control – Process for managing and packaging changes to services
  - Defect Fixing
  - Enhancements

- **Governance** – Process for managing all of the above and insuring highest quality and reusability
  - Design Time – checks and controls to insure best possible design prior to implementation
  - Runtime – enforcement of defined policies
Use Cases pertain to information exchange / integration and are derived from business analysis.
Key Take-Away Points

- Innovative Integration approach with benefits of
  - “Near Plug and Play” for systems and Analysis Solutions
  - Model Driven Development, End-to-End
  - Benefits of automation for integration, testing, maintenance, updates
  - Significantly Lower Life Cycle Cost and more effective system deployments

- Model-driven approach that leverages Industry Standards (CIM) for interoperability

- Scalable (Structured, planned, model-driven approach)

- Semantic understanding is guaranteed (explicit, not implicit);
  - availability of strongly typed syntactical interfaces is not a requirement for success any more

- Easier updating and tracking of standards development
Thank You

- Predrag Vujovic
  - pvujovic@lipower.org
- Phillip Jones
  - pjones@xtensible.net
- Fran Clark, Arpeggio Technology
  - fclark@arpeggiotech.com
- Stipe Fustar
  - sfustar@powergrid360.com