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May 2013
Oracle Spatial and Graph
User Conference

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Oracle Spatial and Graph User Conference

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Ronald Reagan Building and International Trade Center
Washington, DC USA

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Implementing Enterprise GIS at Southern California Edison

Challenges and Opportunities

Program Agenda

- Introduction to SCE GIS

- Enterprise GIS System Architecture

- Data management considerations
  - Data transformation
  - Conflict resolution
  - Network modeling
  - Metadata modeling
  - Symbology management
  - Global IDs
  - Performance considerations
- Conclusions

About SCE

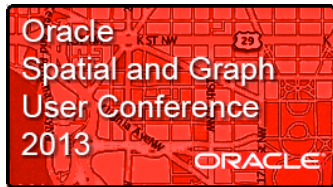o **Provide power to nearly 14 million people**

o **50,000 square miles of service area**
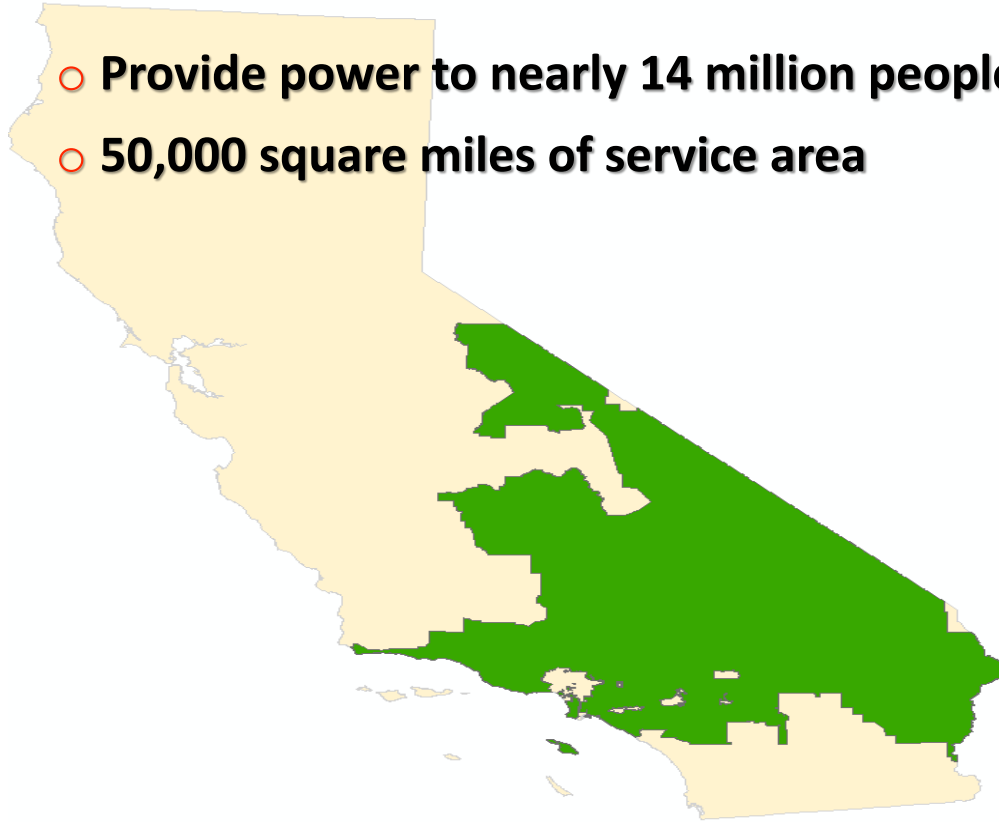
About SCE
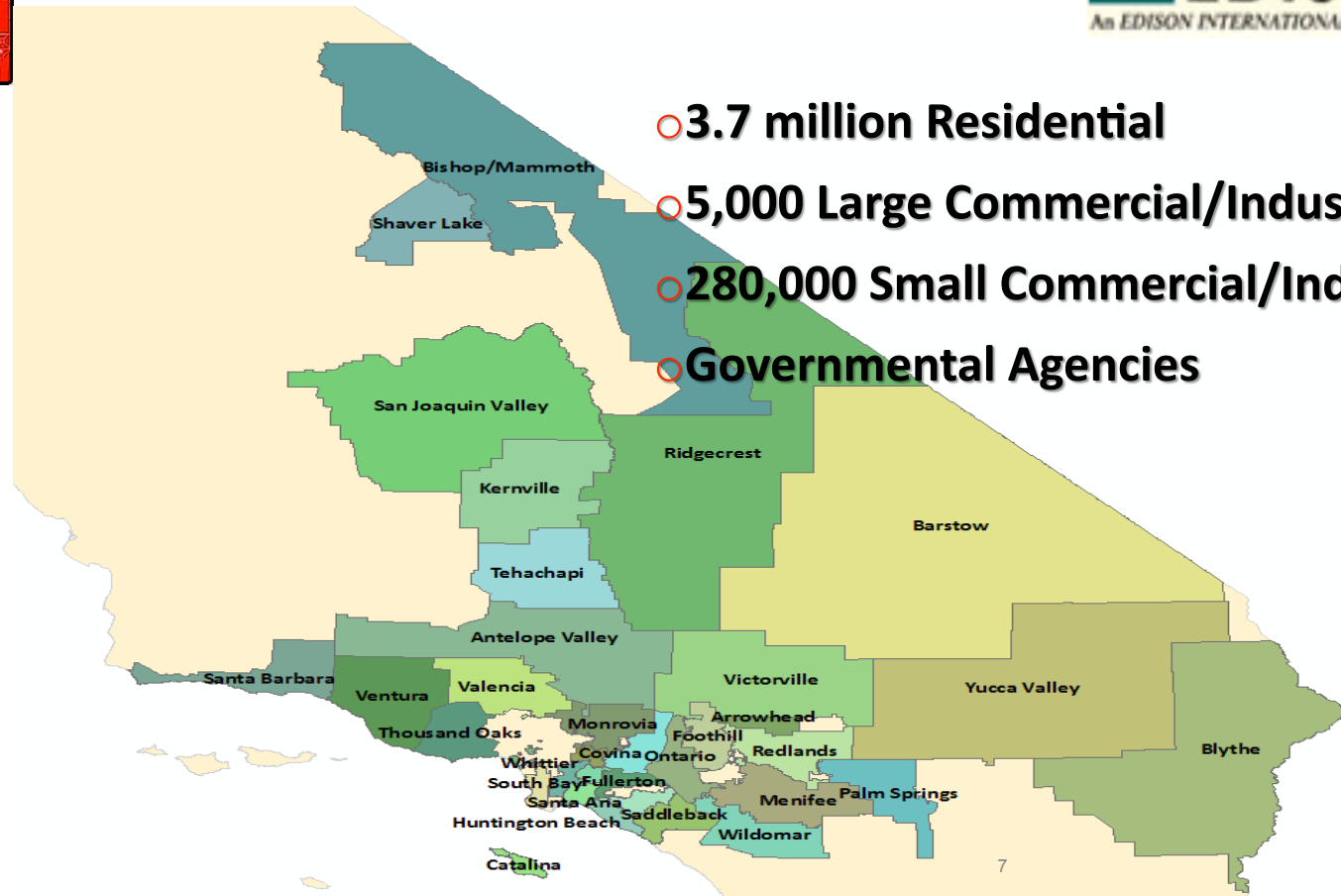
o **3.7 million Residential**

o **5,000 Large Commercial/Industrial**

o **280,000 Small Commercial/Industrial**

o **Governmental Agencies**

GIS at SCE

Transmission & Distribution

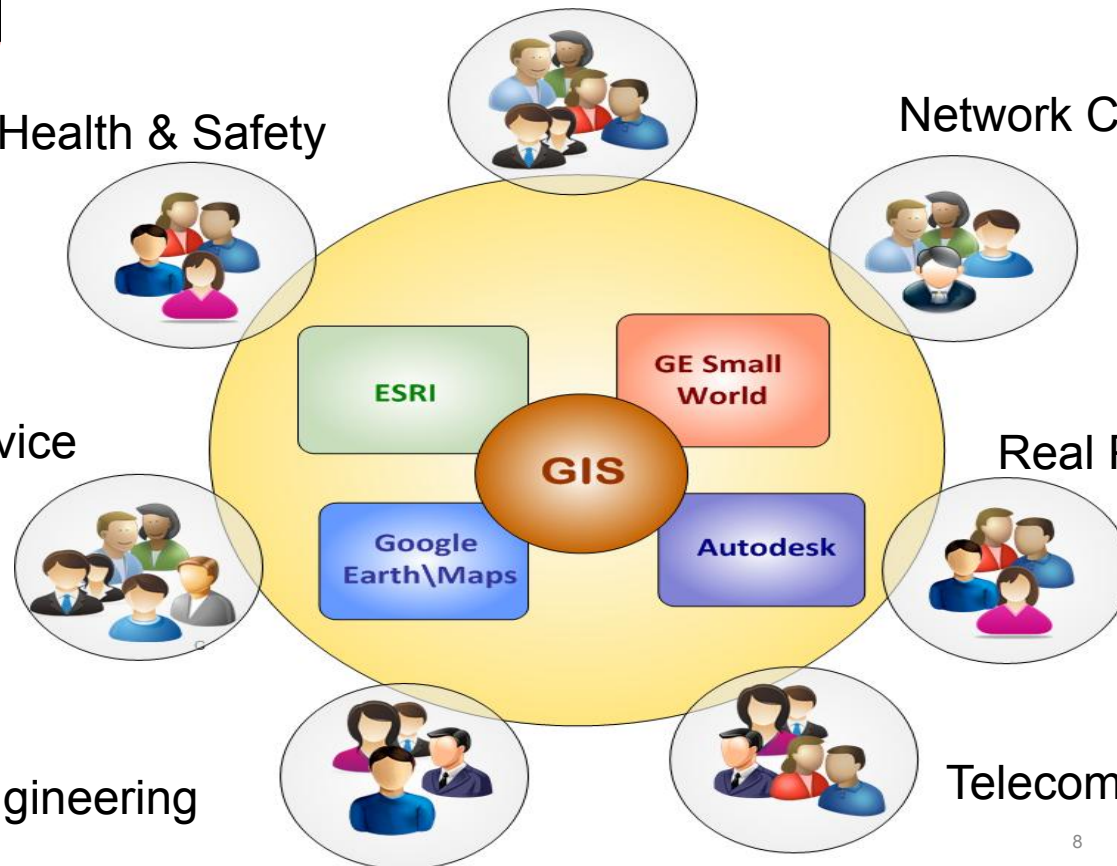Network Communications

Environmental Health & Safety

Real Properties

Customer Service

Engineering

Telecom

ESRI

GE Small World

GIS

Google Earth\Maps

Autodesk

SCE and Spatial Technologies

- Long time users of geospatial technologies
- Many systems evolved
  - AutoCAD – general mapping
  - Autodesk Utility Design – electrical design
  - Smallworld GIS – circuit mapping, streetlight mapping
  - ESRI – real estate, environmental and other mapping products
- Disparate systems, multiple land bases and data quality issues caused significant challenges
  - Safety, Reliability, Compliance
  - Costly to maintain
- An enterprise-level consolidation effort was necessary

Program Guiding Principles...

- A common data management environment is critical to the program
  - One landbase
  - A centralized data repository
- A decision was made to retain existing platforms where feasible
  - Extensive application interfaces were already in place
  - Minimize impact on organizational change management
  - Some exceptions: Street light system, mapping to Map3D
- Oracle Spatial and Graph to provide the underlying data management capabilities for the system

Spatially Enabled Applications
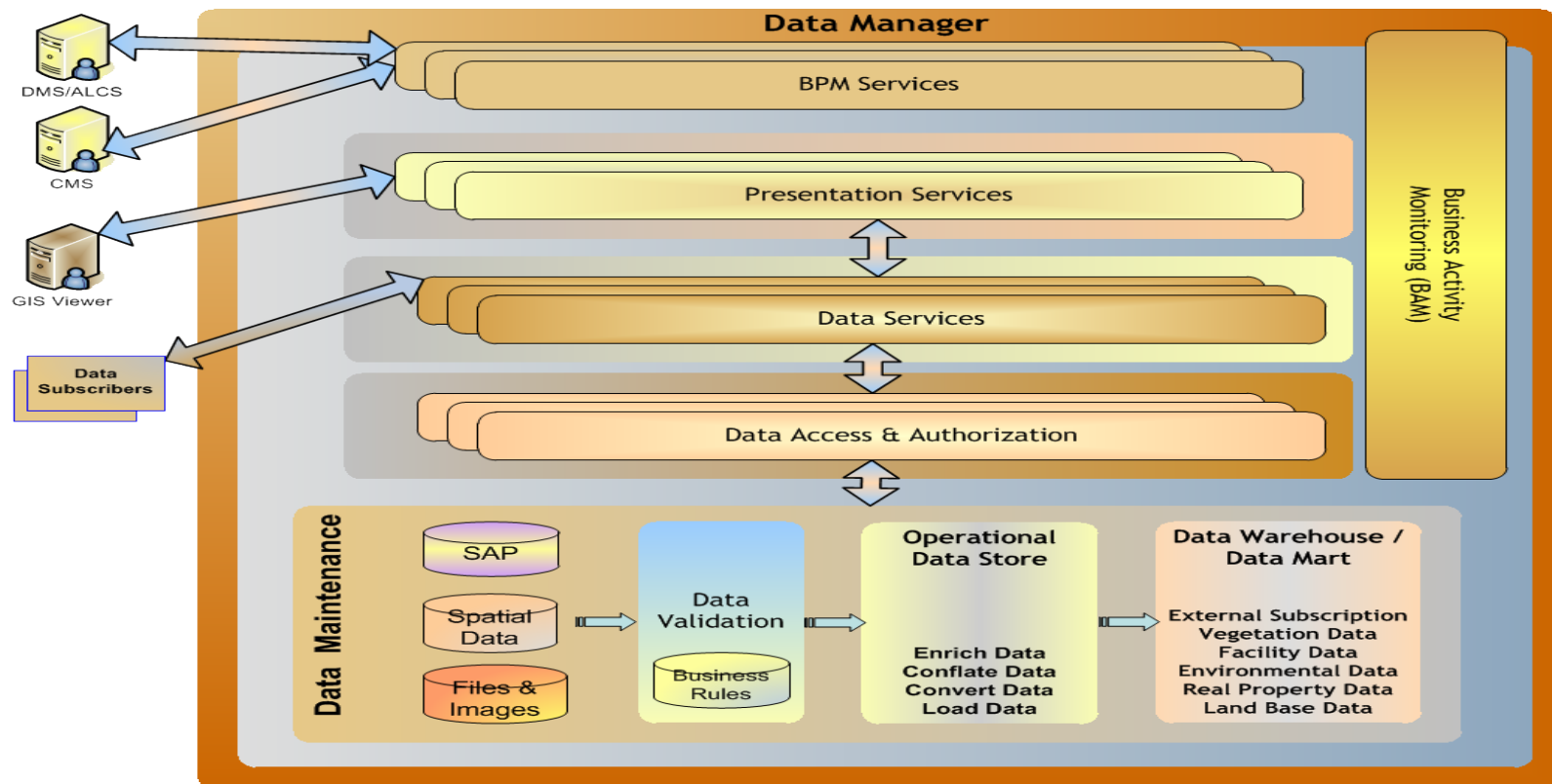
Day in the Life Overview (IPSEC Model)

Legend:
- Initiatives in flight (yellow rectangle)
- Applications in service (green ellipse)
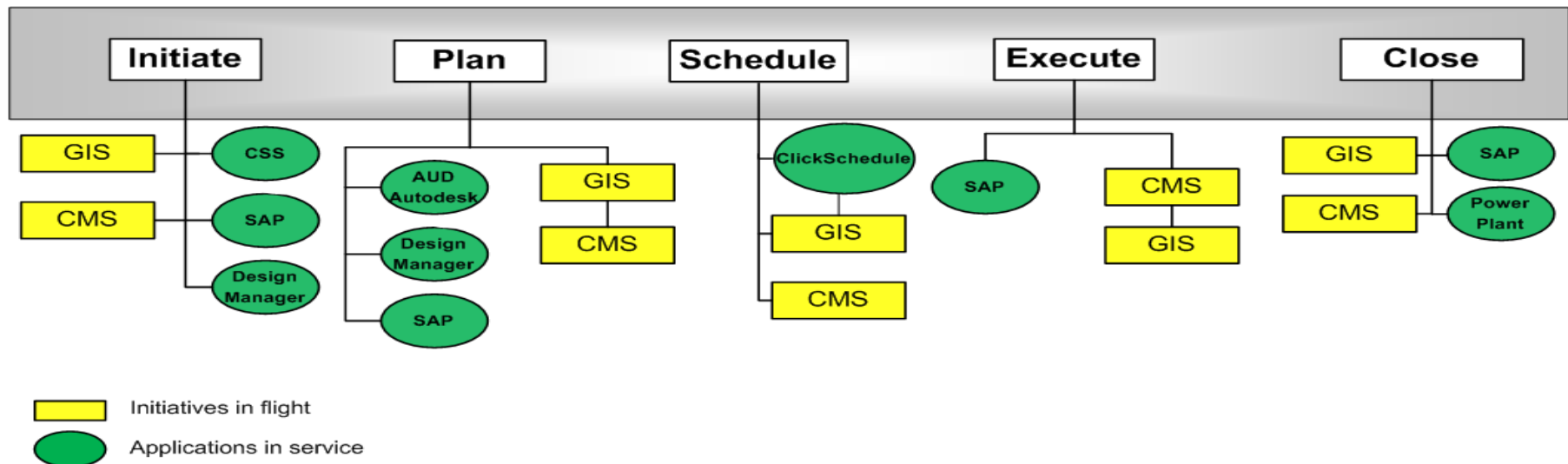
Enterprise GIS System Architecture
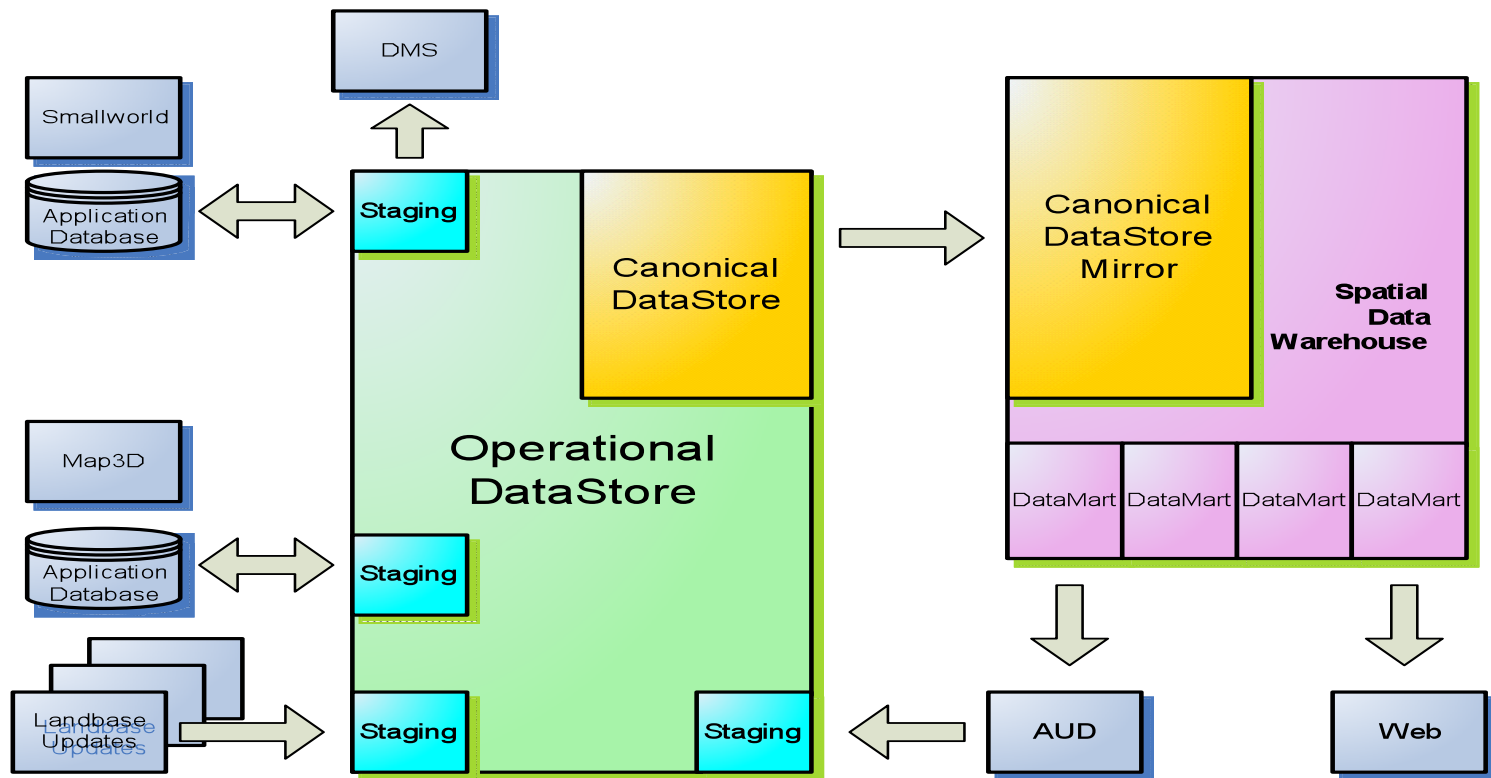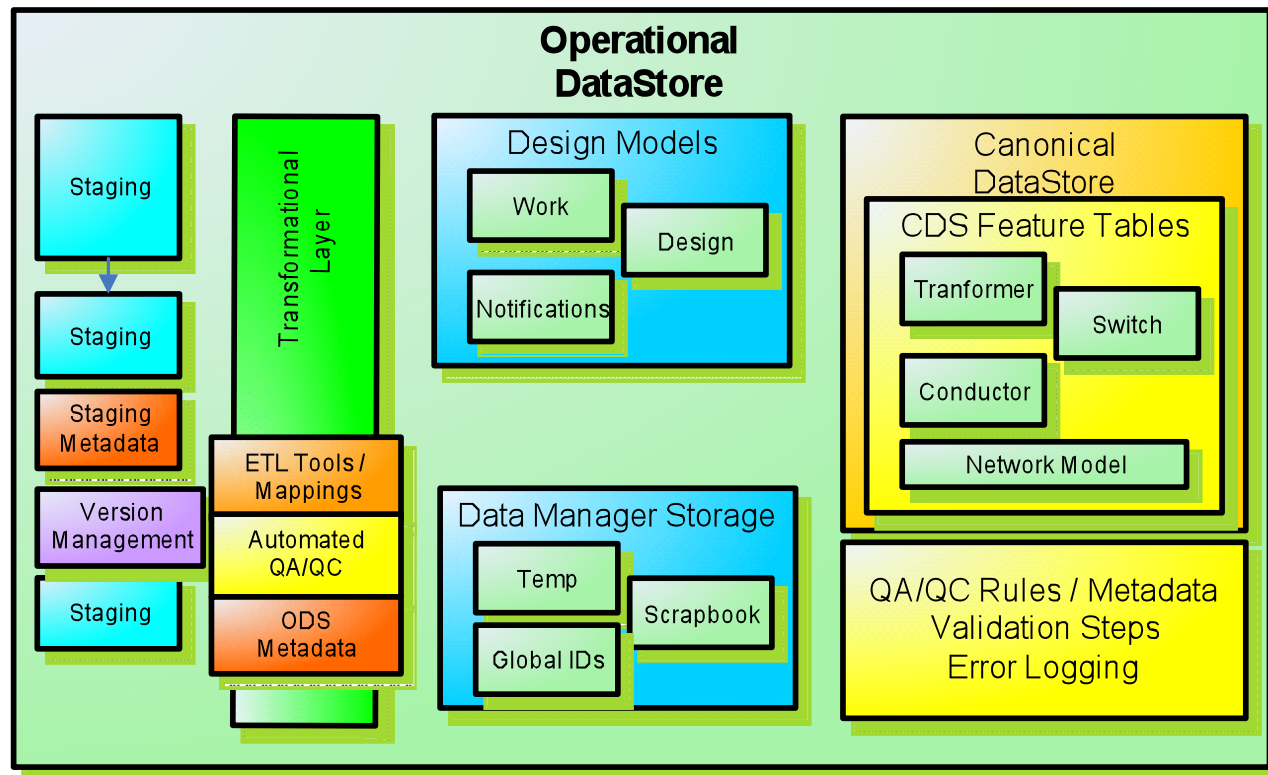
High Level System Architecture

Terminology – Data bases

- Application databases
  - Databases used to support specific applications, e.g. Smallworld Cornerstone, North American Data Model, ESRI, SAP, EO
- Operational datastore
  - The operational database that includes staging models, metadata models, administration tables and the canonical data store.
- Canonical datastore
  - Application independent representation of the SCE "Real World Objects" with mappings back to the application view of the data
- Spatial data warehouse
  - A consolidated view of the entire GIS database that is isolated from the changes occurring in the ODS. The spatial data warehouse mirrors the canonical data store and provides application specific data marts to support SCE business requirements such as analytics and temporal modeling

High Level Data Architecture

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DMS

Smallworld

Application Database

Staging

Canonical DataStore

Operational DataStore

Map3D

Application Database

Staging

Landbase Updates

Staging

Staging

Canonical DataStore Mirror

Spatial Data Warehouse

DataMart | DataMart | DataMart | DataMart

AUD

Web

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ODS Architecture

SDW Architecture
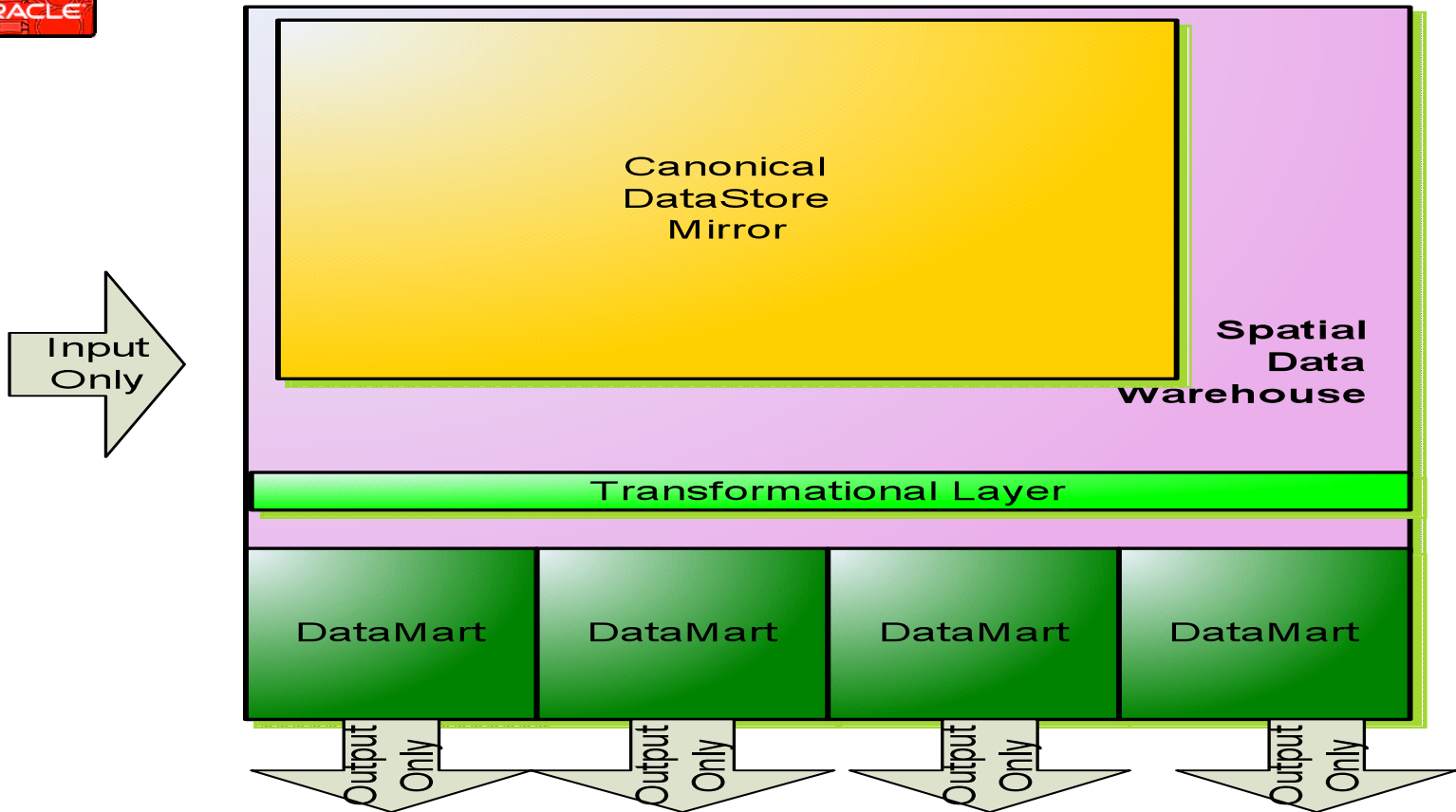
Data Manager Architecture

Data Quality Rules

Presentation Layer

Business Process

BPM (SAP PO)

Canonical Data Model

SDW

Dashboard

Data Manager (ETL / ESB / BPM)

Systems of Record

SAP

GIS Apps

Update

ODS
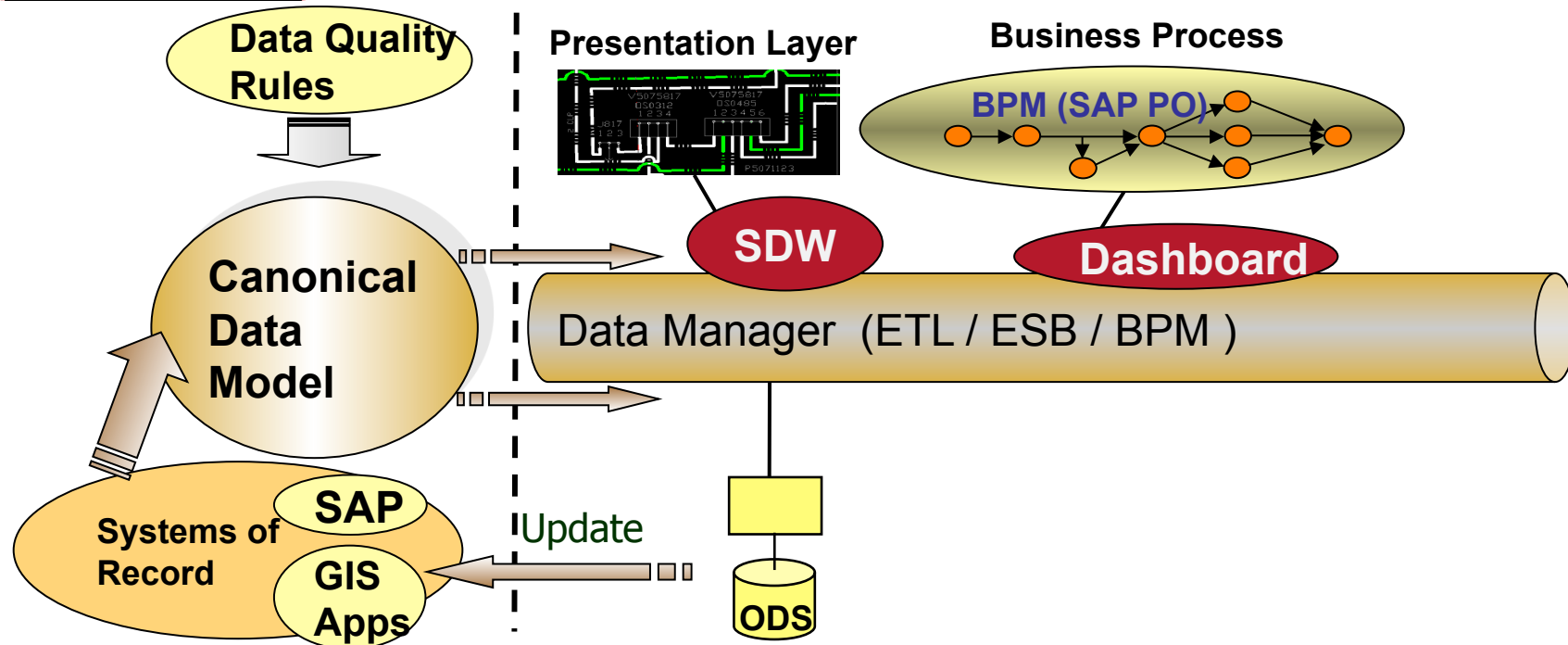
 Data Manager will control flow of consistent data across systems, enabling complete workflow from work initiation to work closing.
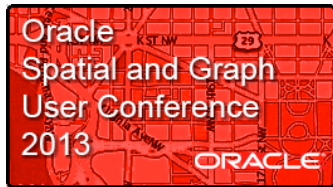
ODS/CDS/SDW Design Considerations

- Performance
- Data integrity
- Application independence
- Data isolation
- Architectural support for advanced applications
  - Network-based business requirements
  - Historical visualization
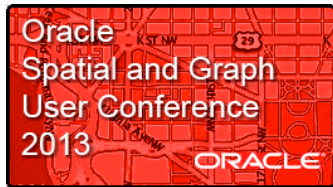 - Meaningful analytics

Data Management Considerations

Data Management Considerations

- GIS/CAD systems have their own proprietary mechanisms for interacting with their product-specific application databases
  - SCE cannot rely on these mechanisms in a multi-platform GIS/CAD environment
- These capabilities must be addressed within the SCE spatial data management environment
  - Cross-system conflict resolution
  - Support for multiple data models / Data validation
  - Integration support / Services for other applications, e.g. SAP
- These functions are addressed via the Spatial Gateway

Application Context Diagram

T&D Data Editors   Enterprise Data and Application Services   Data Consumers
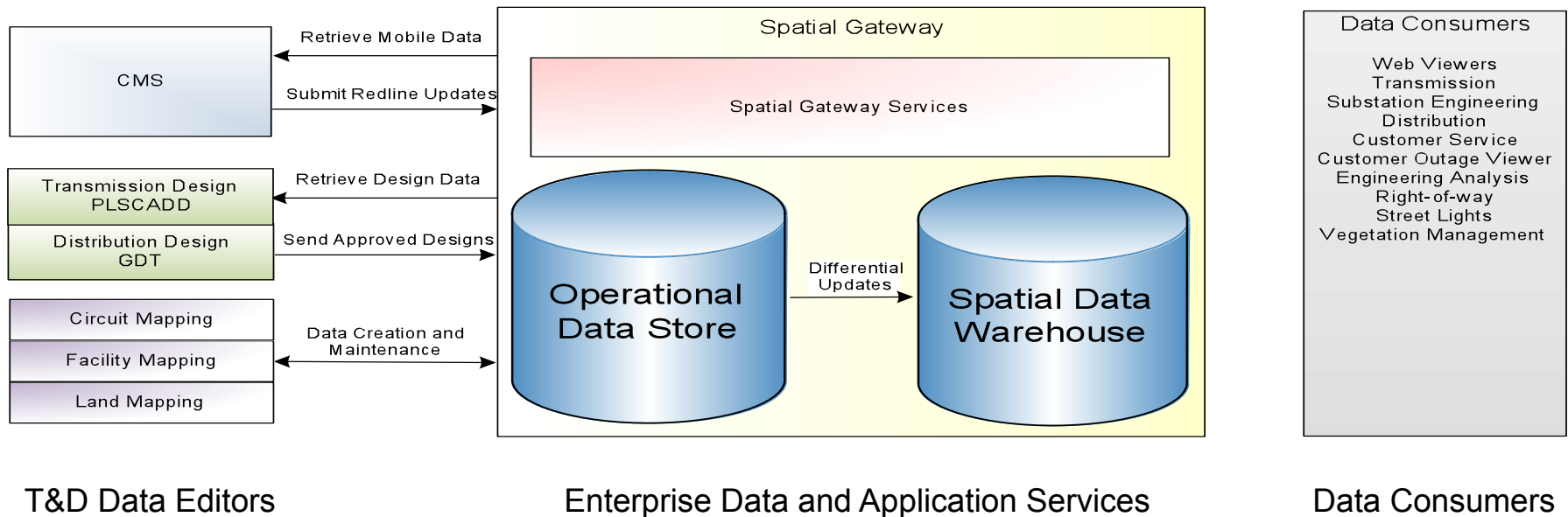
Spatial Gateway Architecture Diagram

- COTS components
  - Oracle Spatial and Graph
  - Safe FME + Plug-ins
  - Oracle MapViewer
  - SAP PI
- Services used to address specific business requirements

Data Manager

Data Services
- Version Management Services
- Metadata Services
- Synchronization Services
- Data Access Services
- Data Validation Services

Operational Data Store
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Application Services
- Analytical Services
- Visualization Services
- Map Product Services
- Network Modeling Services

System Services
- Global ID Management
- Enterprise Service Bus

Spatial Gateway and the ODS

- Data Access: FME and plug-ins

- Data Transformation: FME and custom transformers

- Data Synchronization: plug-ins and staging difference tables

- Version Management: Oracle WM

- Conflict resolution: Oracle workspace manager with extensions

- Global ID: Based on Oracle / FME

- Data Validation: Based on FME / Oracle

- Metadata: Based on FME / Oracle

- Application Services: By application

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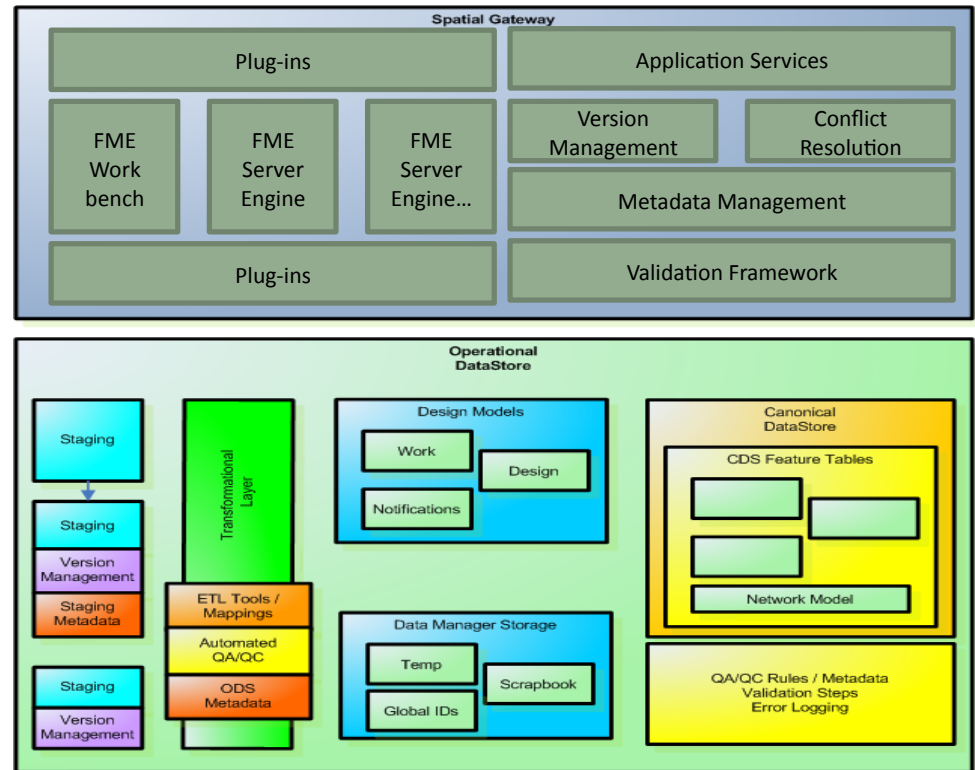
Data Transformation and Synchronization

- A key design goal is to transform different data models
  - Supports use of vendor and industry standards
  - ODS canonical model is tuned to the SCE business
- Applications, APIs and services are required to expose mechanisms to insert/update and delete ODS data
- Key components:
  - Safe Software FME / FME Server
  - OSpatial Plug-in (SBS Spatial Gateway)
  - OSGeo FDO can fill the role where appropriate

Reasons for using FME

- Data model transformation support
  - Attribute modification / Feature merging and splitting
  - Validation
  - Relationship generation / Topology generation
- Scalability via the use of FME Server
- COTS support, particularly for upgrades
- Error handling with notifications via email, logs, tweets, NT Service logs
- Web based initiation, interaction and resolution of synchronization processes
- Flexibility to support current and future format requirements

# Use of the OSpatial Plug-in with FME

- Extended data extraction, including
  - Data model, Changes, Network data, Symbology, Metadata
  - Application configuration
- Sequence mapping to force automated join resolution
- Support for GIS "Internal World" constructs
- Support for Oracle Workspace Manager
  - Change detection
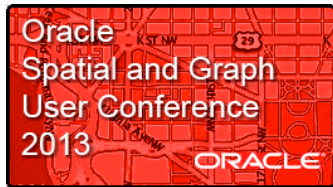- Integration with system authorization models

Interoperability Data Flows
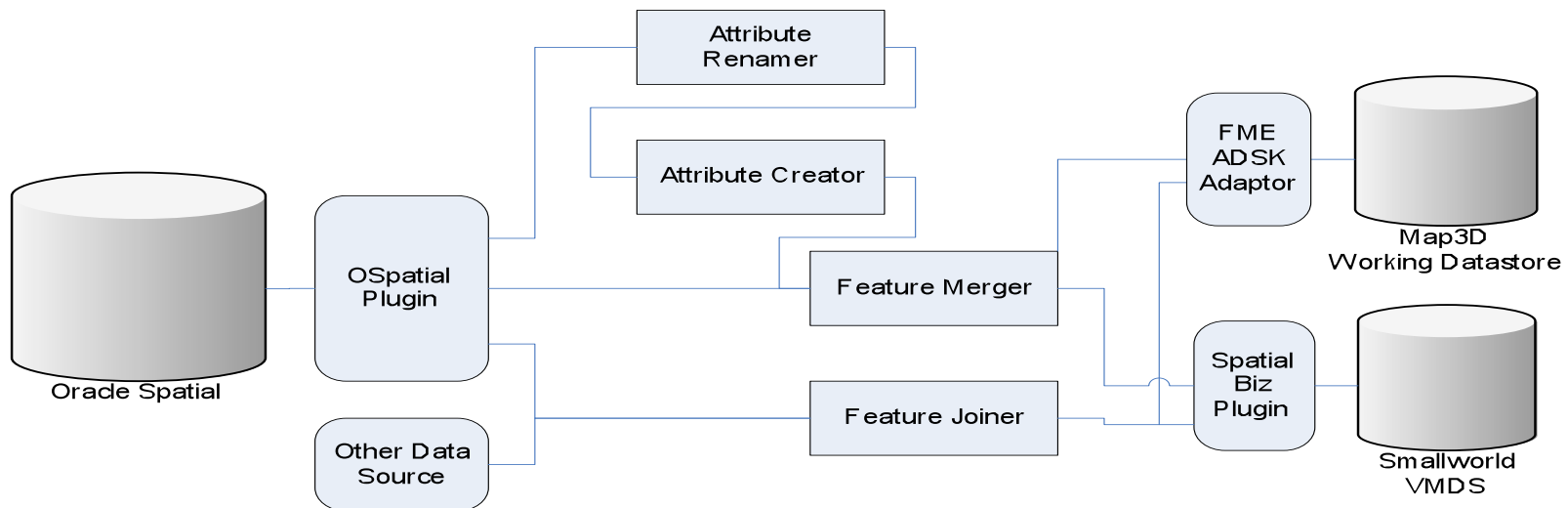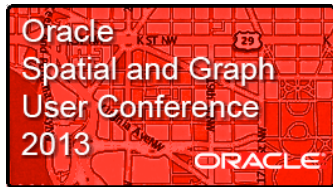
Data Synchronization Services

- Data sources synchronized with ODS
  - GE Smallworld Circuit data
  - Map3D
  - Michael Baker Landbase (ESRI)
  - AUD data added, not synchronized
- Synchronization approach is dependent upon change detection support mechanisms of specific GIS environments
  - Incremental changes in SWLD supported via Spatialbiz plug-in
  - Map3D (FDO supports insert/update/delete transaction flagging)
  - ESRI (various ESRI formats support concepts of inserts/updates/deletes)

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Conflict Resolution

- As data is merged and posted between workspaces, the potential for conflicts in the long transaction data exists

- Oracle Workspace Manager provides tools for comparing changes from different workspaces and can identify sources of data change conflict

- Such situations occur when two users modify the same feature at the same time, but in different workspaces.

- In this case merge / post operations may result in overwriting one user's data in favor of the other

- It is necessary to provide a tool to visualize the changes and for a GIS technician to compare and resolve the changes through semi-automated or manual processes.

Conflict Resolution (2)

- Major issue is the support for multiple users operating under a long transaction model

- Objective is to leverage source and target tools for detecting and resolving conflicts

- Designated alternatives for read/write operations used for synchronization operations

- Conflicts can be identified and resolved in the system, resolution results are sent to the peer

- Use of the fme_db_operation attribute supports tolerance of redundant changes

Network Modeling

- Oracle Spatial and Graph Network Data Model
  - Spatial Network with extensions for feature references
- Multiple Models to Reflect Source
  - Electric
    - Transmission / Distribution / Secondary
  - Structural
    - Pole Route / Conduit / Trench
 - Transportation
    - Roads / Rail

Network Modeling (2)

- Built / Updated automatically by FME plug-ins
- Partitioning by Circuit
  - Landbase partitioning not defined as yet
- Custom / SDO_NET tracing engines to support
  - Applications
  - Validation
  - Synchronization

Metadata Modeling

- Numerous approaches exist – intent was to keep it very straightforward
  - Auto generation where possible
  - Stored in the ODS
- Three level, transaction-oriented model
  - Job, Feature & Attribute levels
- Archival requirements are to be determined
- One key use is to support temporal modeling
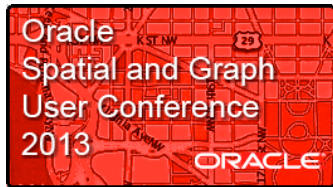
Symbology Management

- Multiple symbol sets from source applications
- Necessary to persist some in the ODS
- SW Symbols used directly in some viewers
- Symbol and Text Stroking used for Web / Thin client deployment
  - Converts point and text to multi-linestring with symbol/font/size/ orientation embedded
  - Implemented via FME Transformers

Stroking Transformer

- Reads template libraries and replaces FME Geometry with the stroked representation
- Works for both Symbols and Text

SymbolStroker Parameters	
Transformer Name:	SymbolStroker
Library Name:	sce_symbols
Symbol Name:	SYM_LOCATION
Text String:	
Orientation:	ORI_LOCATION
Scale:	10.0
Text Alignment:	CL

Help   Defaults   OK   Cancel
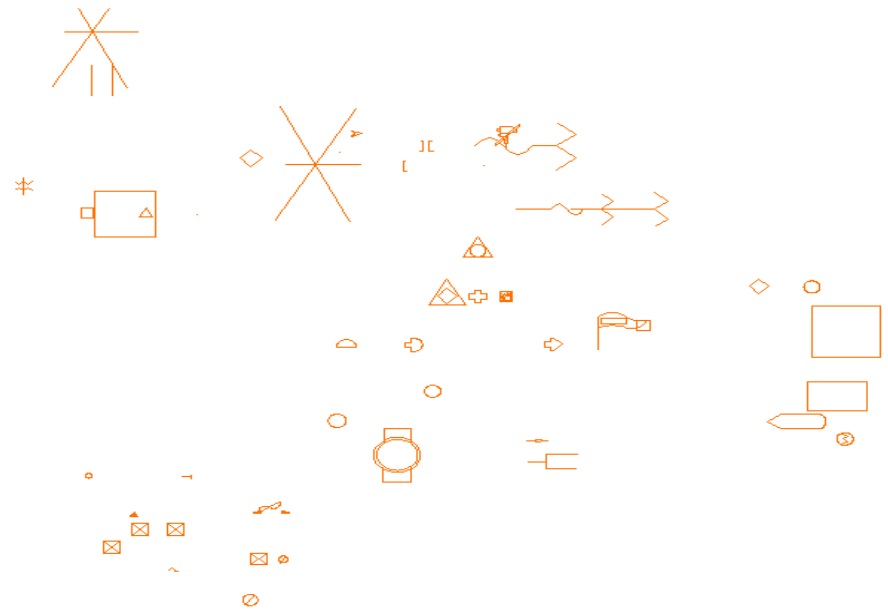
Global ID Model

- GUID_REGISTRY

GUID	ODS_FEATURE	SOURCE_FEATURE	SOURCE_SYSTEM	KEY
838A824642694819A857C85CCE8C190E	Pole	TCG3001_POLE	Conversion	12345
89BF656D6AC940EFBF1D493F04C71D48	Pole	TCG3001_POLE	Conversion	23456
0C69A44D707648C999E3A37FC81DB07C	Pole	TCG3001_POLE	Conversion	34567
9BAA7FA7B04E488ABDCAF688082897C7	Pole	TCG3001_POLE	Conversion	45678
751712180E4646FF8A637B2FD1BA477B	Pole	TCG3001_POLE	Conversion	56789

– Repository / Mapping for each instantiated GUID

– ODS Feature: ODS object where this object acts as a Primary Key

– Source Feature: Identifier for the specific feature this data is brought over from, in the source system.

– Source System: System where this data existed previously

– Key: Unique Identifier for this record in the Source System, for the Source Feature object (These 3 values combine with the specific ODS Feature to form a Unique Index on GUID_REG)

Global ID Model

- Each Source Feature/Source System/Key combination for a piece of data would yield a separate record for a given GUID
  - GUID is **not** a unique column, as multiple sources can/will exist
  - Used for forward / reverse lookups
    - Key fields, Foreign Key fields

- GUID_FEATURE_ALIAS
  - Contains systems-specific aliases/nicknames for given objects
    - To support non-key lookups for a feature

Performance Considerations

- Domain table performance
  - Will be validated during next stages of development
- Metadata management
  - Can be implemented on an optional basis
  - Data retention based on business needs
- Workspace manager
  - Implement on staging tables
  - Will not use on CDS
- Physical performance enhancements will be implemented in future stages (partitioning, archiving, parallelization)

Conclusions

- **Consolidate physical, electrical, and spatial attributes of all TDBU assets so SCE can:**
  - Correct missing / inaccurate asset information
  - Correct inaccurate Transformer Load Management data
  - Establish overall electrical connectivity model from meter to substation

- **This will enable SCE to:**
  - Provide more accurate asset data to our planners and crews, to better ensure safety and reliability of our system
  - Pro-actively identify and address vulnerabilities in our system
  - Provide more accurate/timely data to customers/regulators