The OpenO&M Information Service Bus Model (ISBM) and the OpenO&M Common Interoperability Registry (CIR)

Ken Bever
CTO, MIMOSA
kbever@mimosa.org
www.mimosa.org

new collaborative work process

planners

outside operator

field workers

management

ADAPTIVE → IMPROVEMENT

maintenance

board operator

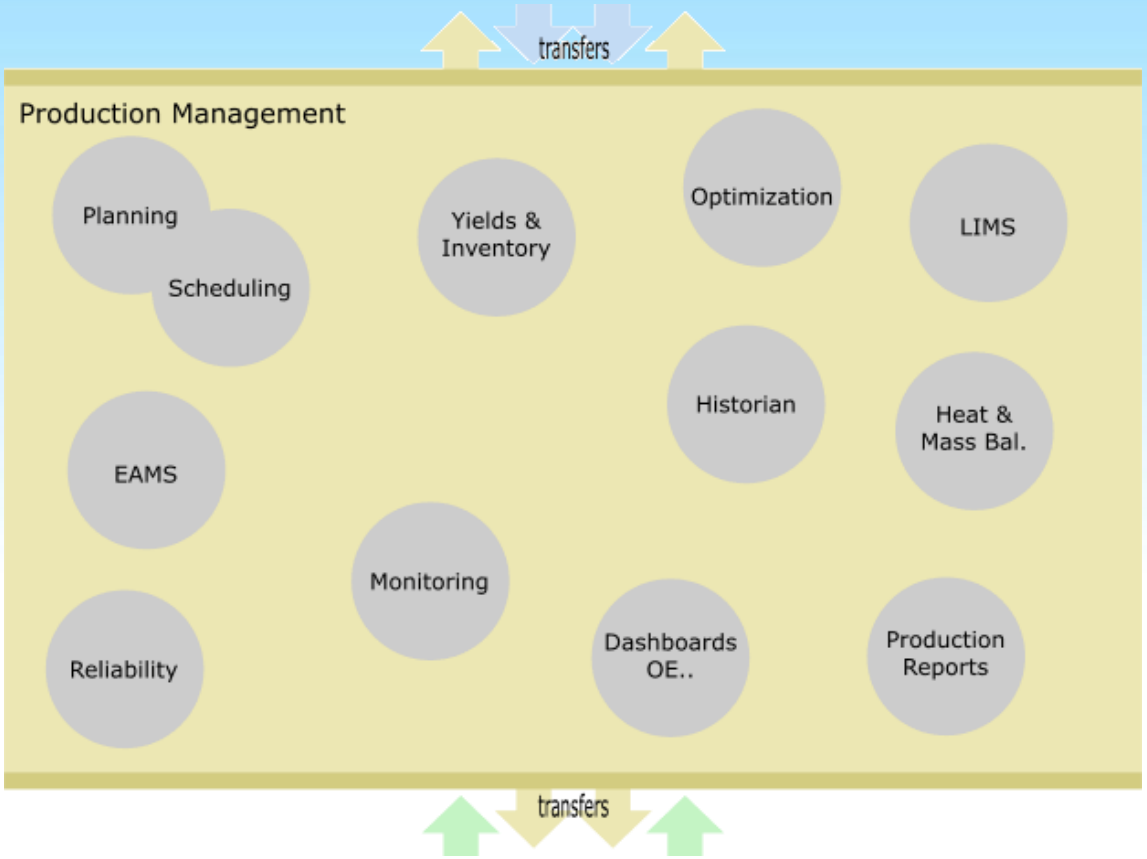
auditable

event-driven

the production management domain

- intense interoperability between users and applications needed in this space

Sample work process – tank line up



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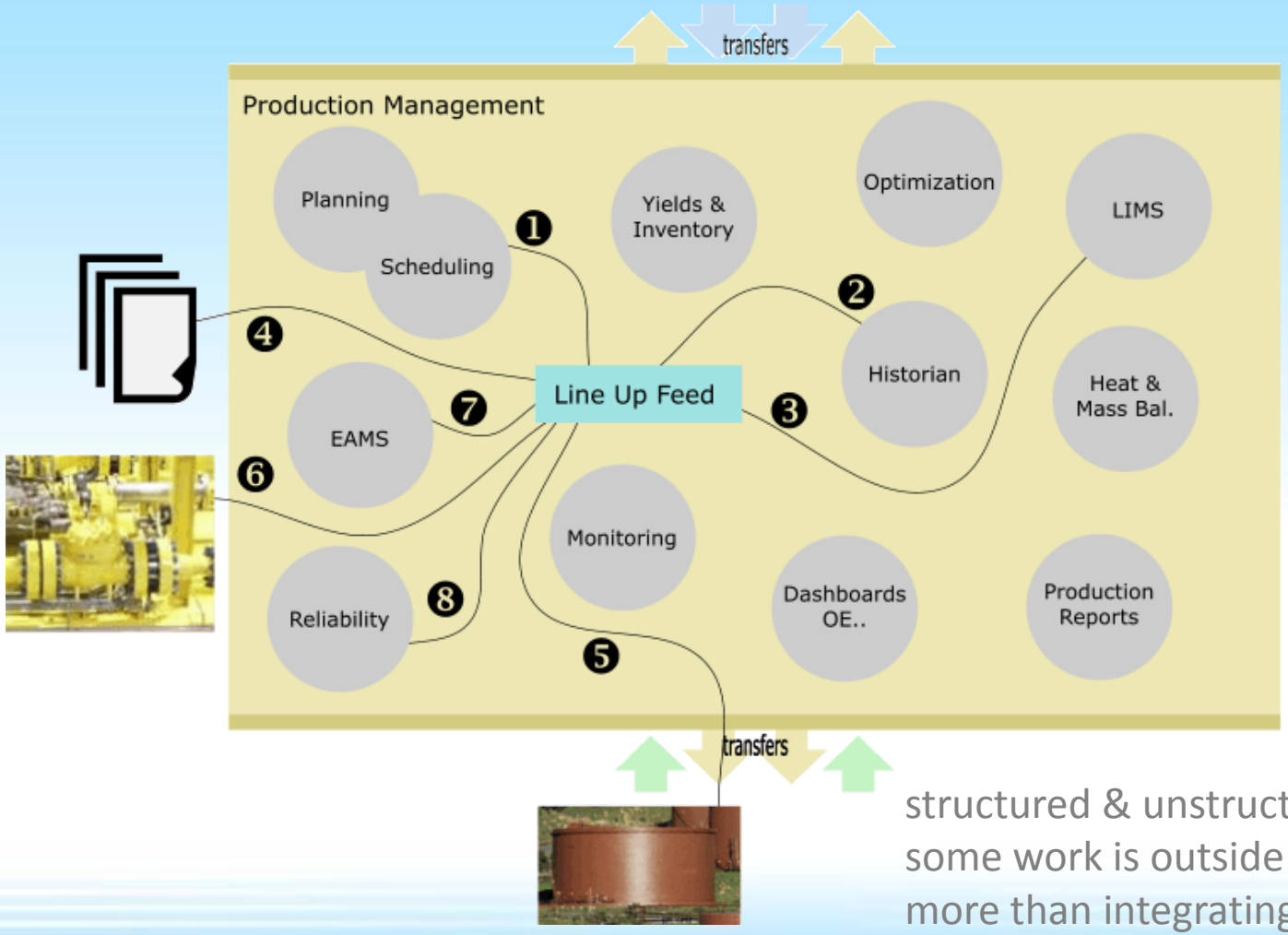

structured & unstructured data
some work is outside the applications
more than integrating data

Industrial Asset Management Data Integration Challenges

How Can I Access My Engineering Designs & Reliability Study Data?

(P&ID Designs and OEM Component Part Cut Sheet Data)

Industrial Asset Management Data Integration Challenges

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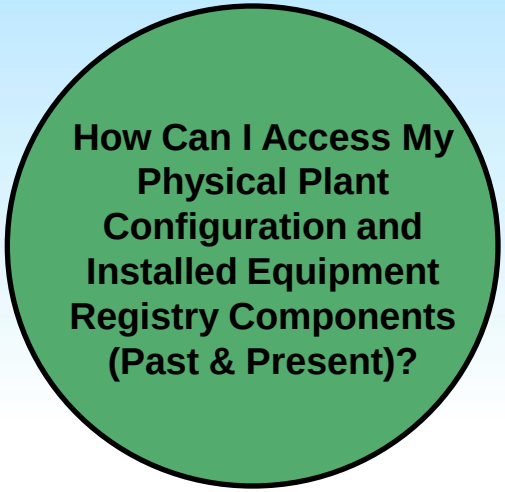

Industrial Asset Management Data Integration Challenges

How Can I Access My Engineering Designs & Reliability Study Data?
(P&ID Designs and OEM Component Part Cut Sheet Data)

How Can I Access My Physical Plant Configuration and Installed Equipment Registry Components (Past & Present)?

How Can My Control Systems, Plant Data Historians & Plant Asset Health/Safety/Environmental Systems Provide Timely and Relevant Data and Events to all Other Enterprise Systems?

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Industrial Asset Management Data Integration Challenges

How Can I Feed Asset Capability Data Into My Production Optimization, Planning & Scheduling Systems?

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Industrial Asset Management Data Integration Challenges

How Can I Feed Current and Future Plant Capability To My ERP System? (KPIs, Order Management, Supply Chain, Financial, Materiel, Logistics, HR)

How Can I Feed Asset Capability Data Into My Production Optimization, Planning & Scheduling Systems?

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Industrial Asset Management Data Integration Challenges

Enterprise HR, Financial, Supply Chain, & Order Management Data

Production Optimization, Planning & Scheduling Data

EPC & OEM Engineering Product Design Data & Reliability Study Data

Serialized Asset Registry & Lifecycle Configuration Management Data

Maintenance System Data

Control Systems, Plant Data Historians & Plant Asset Health/Safety/Environmental Systems Data

current situation

lab

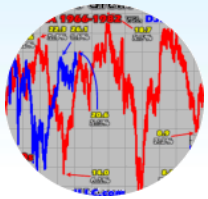
marketing

accounting

planning

reliability

Data Silos



trading

maintenance

control

Supply & distribution

management

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Need Interoperability

Enterprise Business Systems
Enterprise Resource Planning (ERP)

Engineering

Operations & Maintenance

Physical Assets
Control Systems

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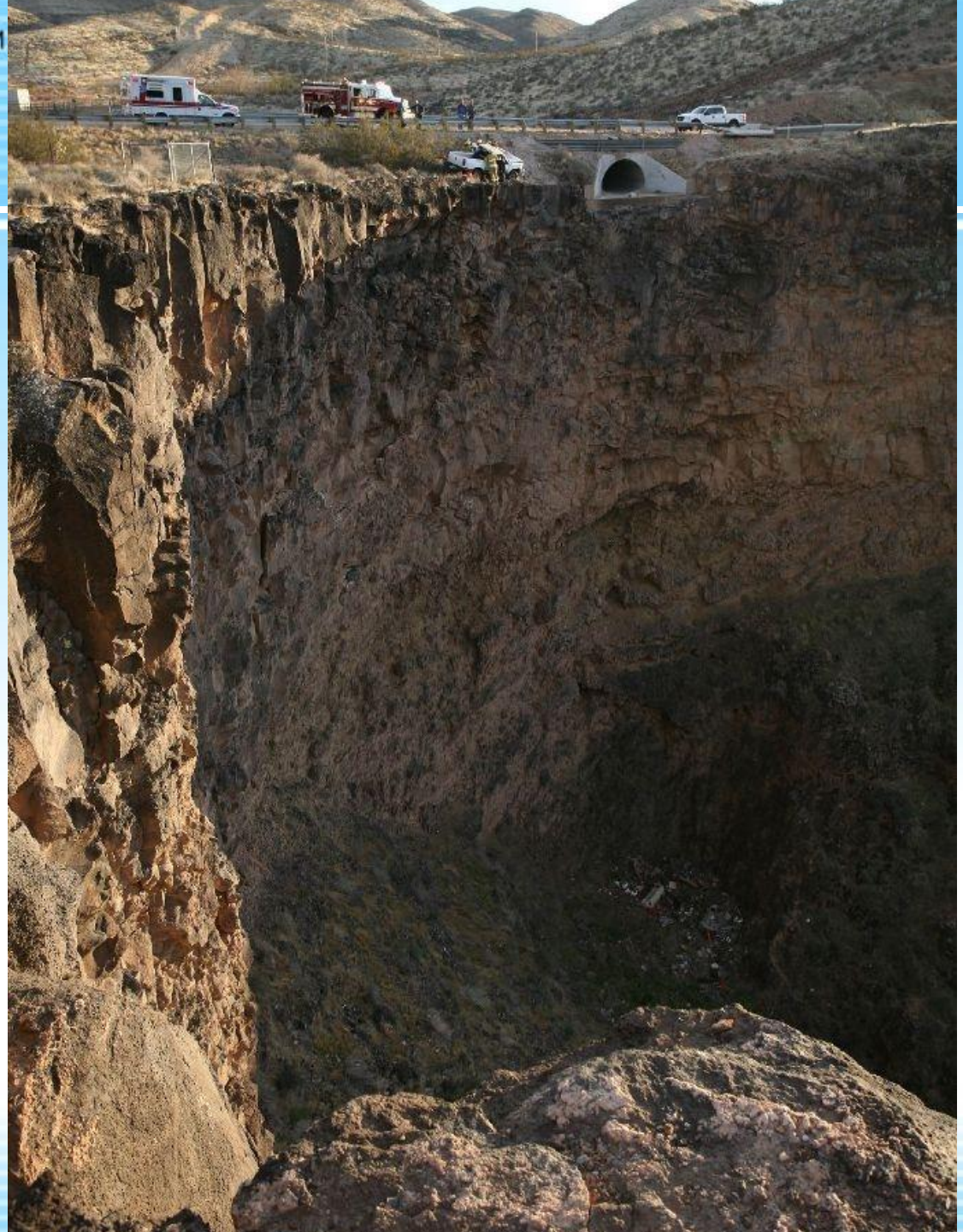
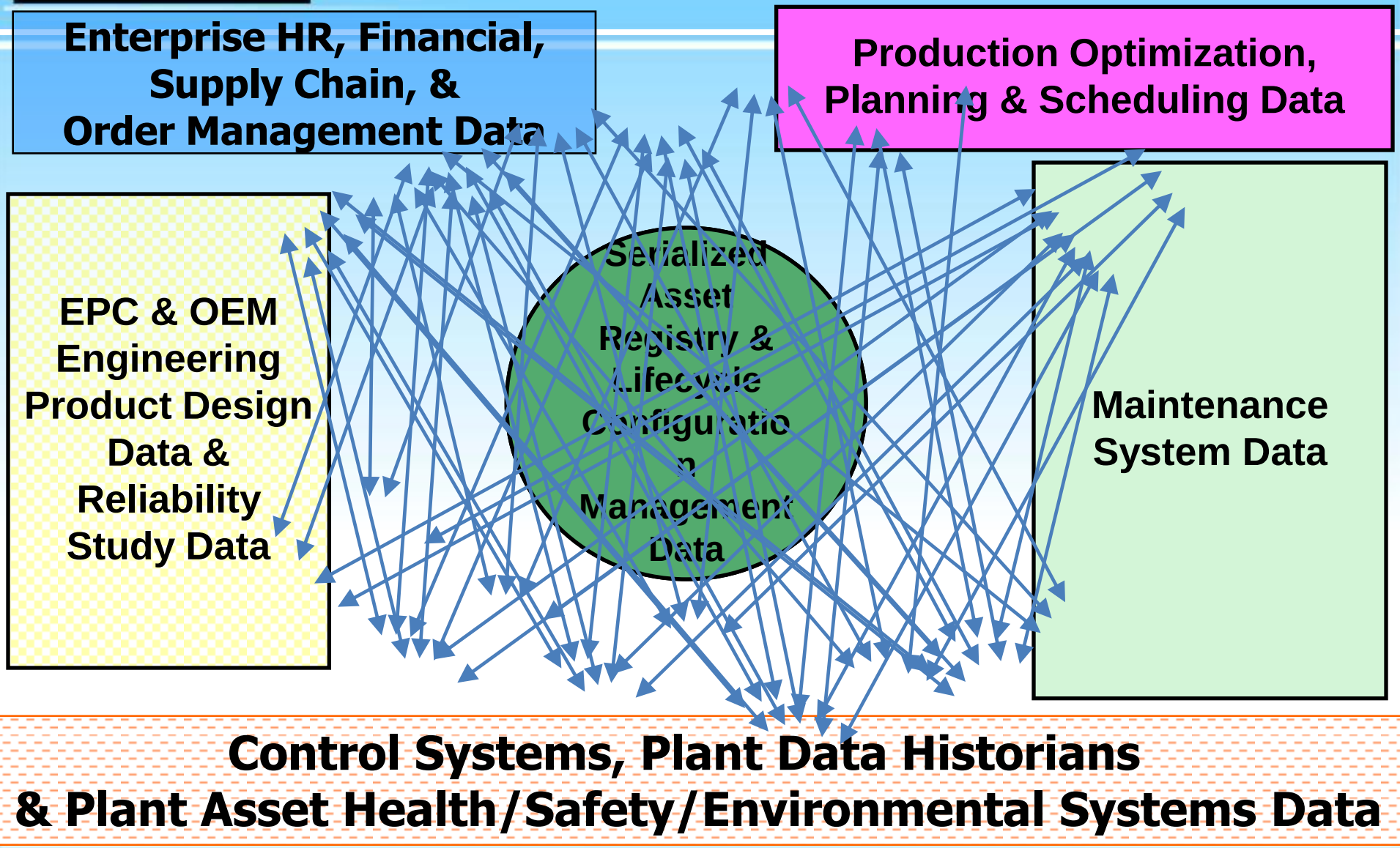


One Approach – Point-to-point Web Services



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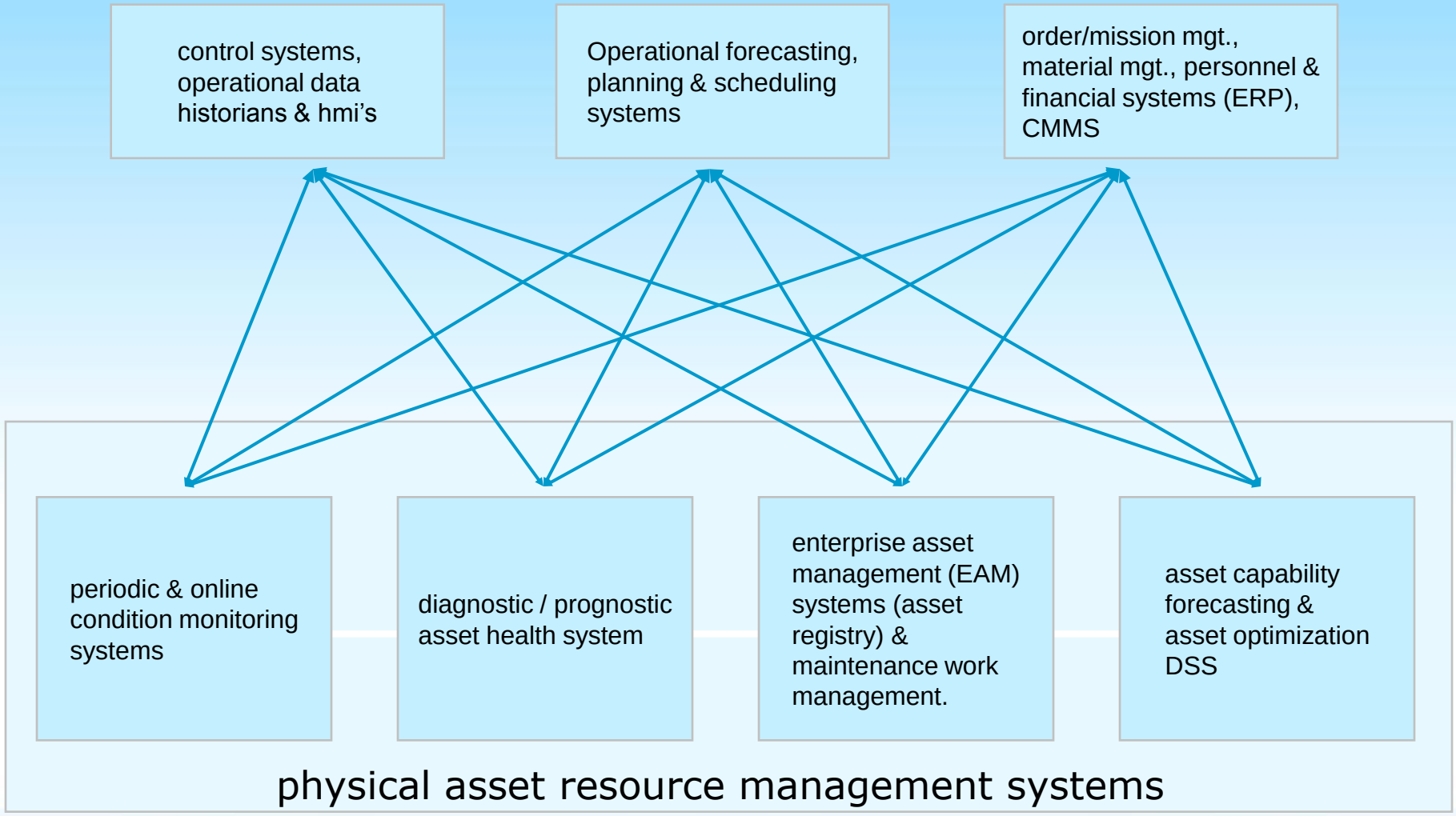
One Approach – Point to Point Web Services



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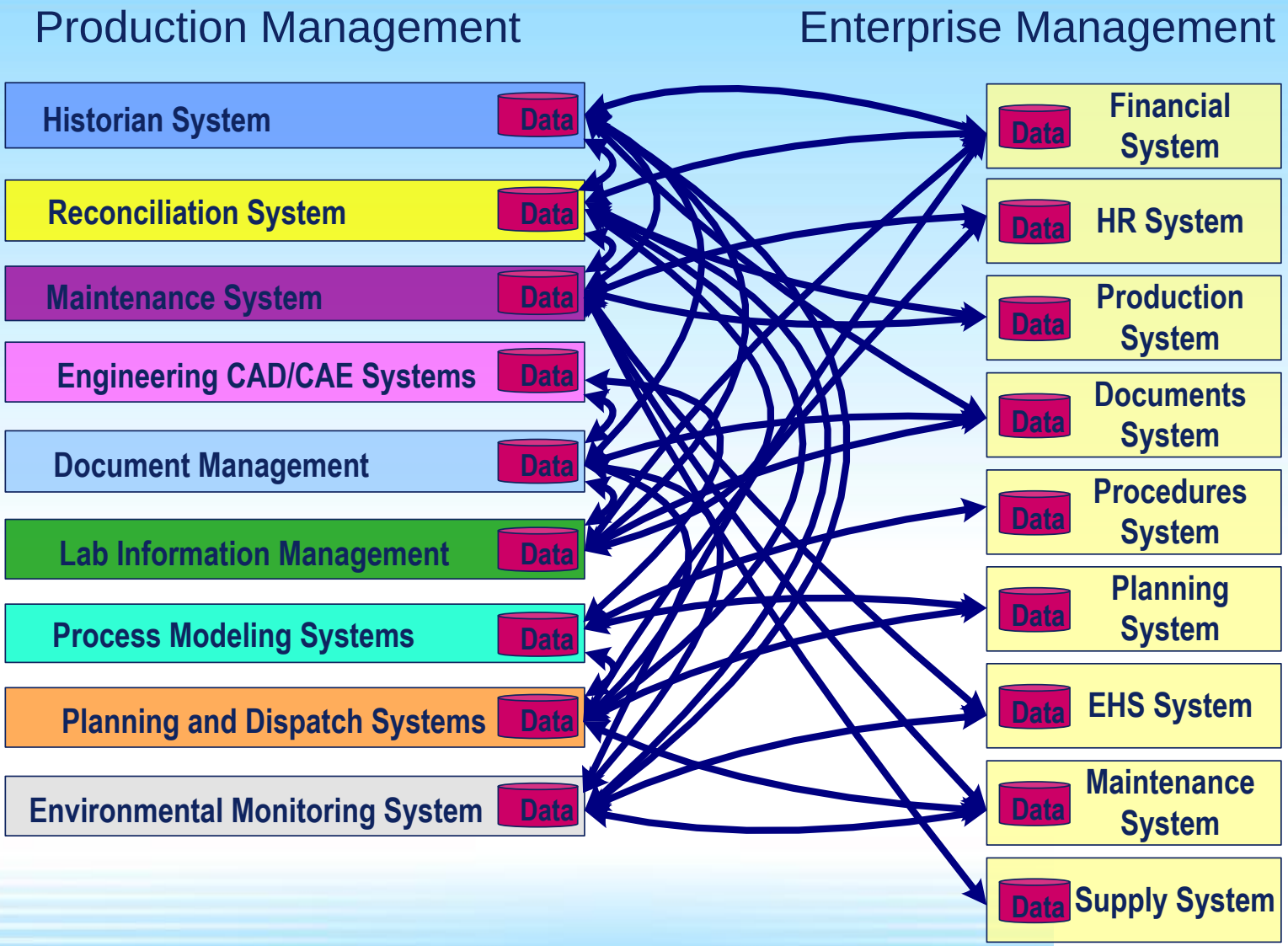
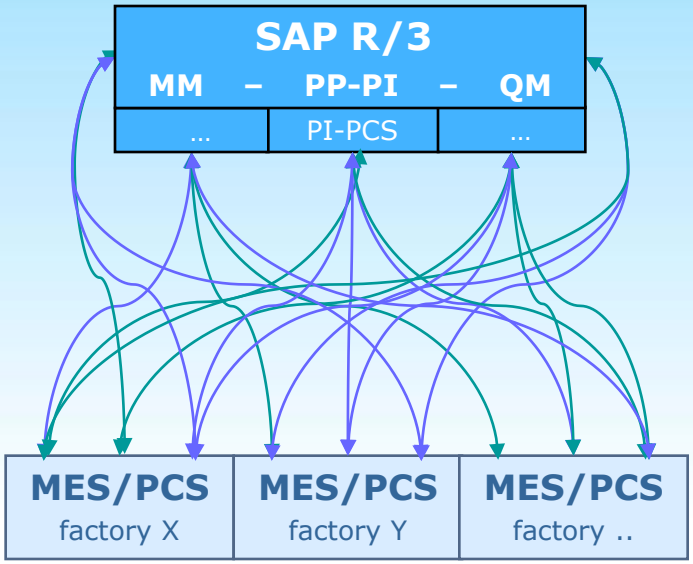
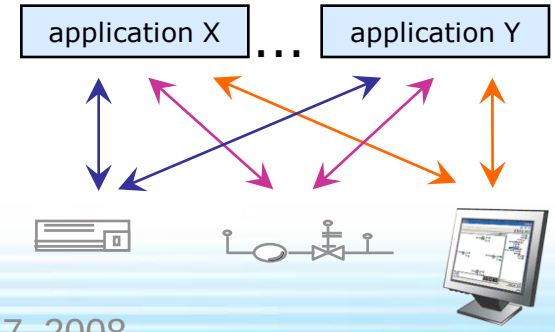


One Approach – Point to Point Web Services

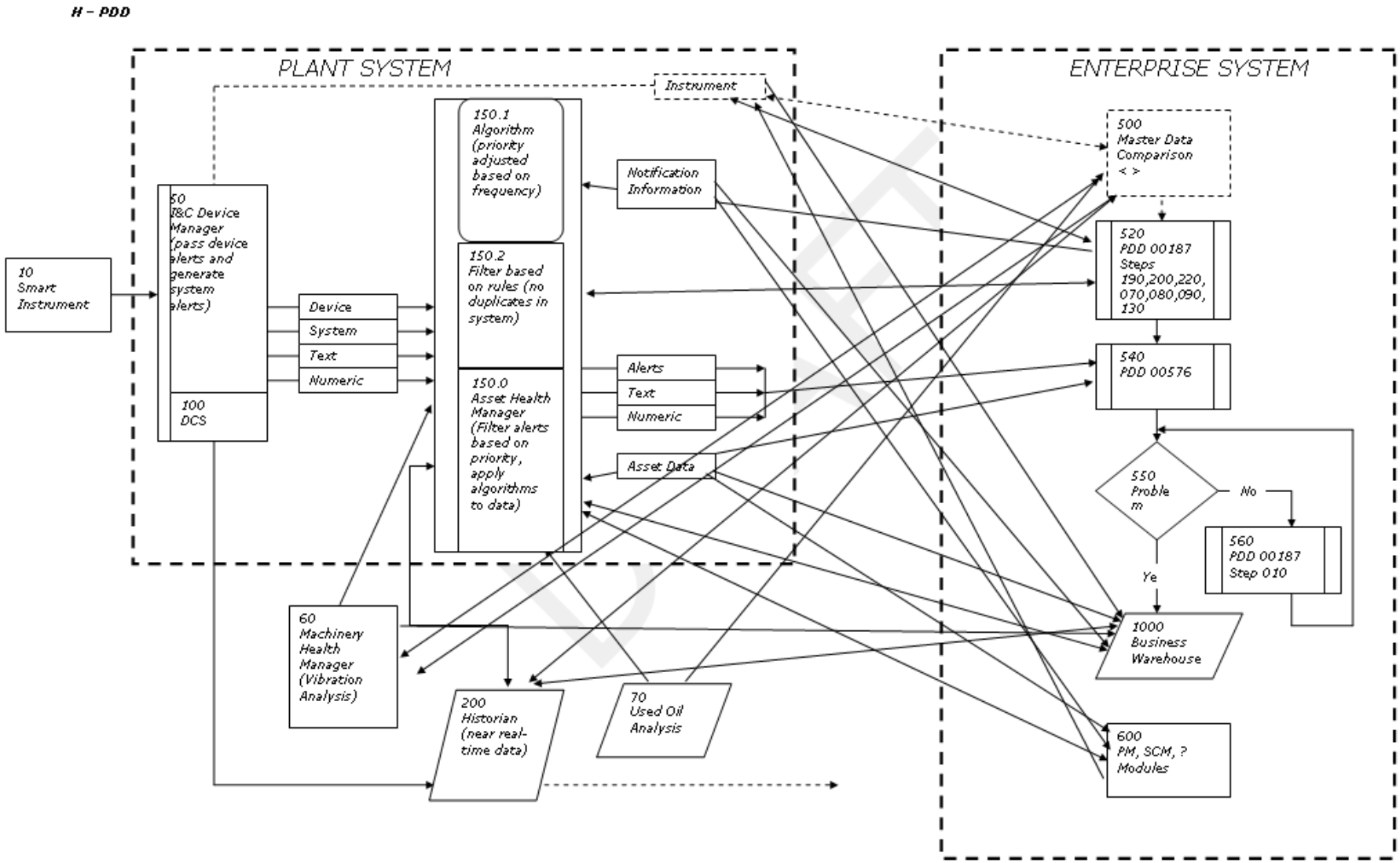
scenario 1

several proprietary ”standard” solutions





Actual Proposed Design



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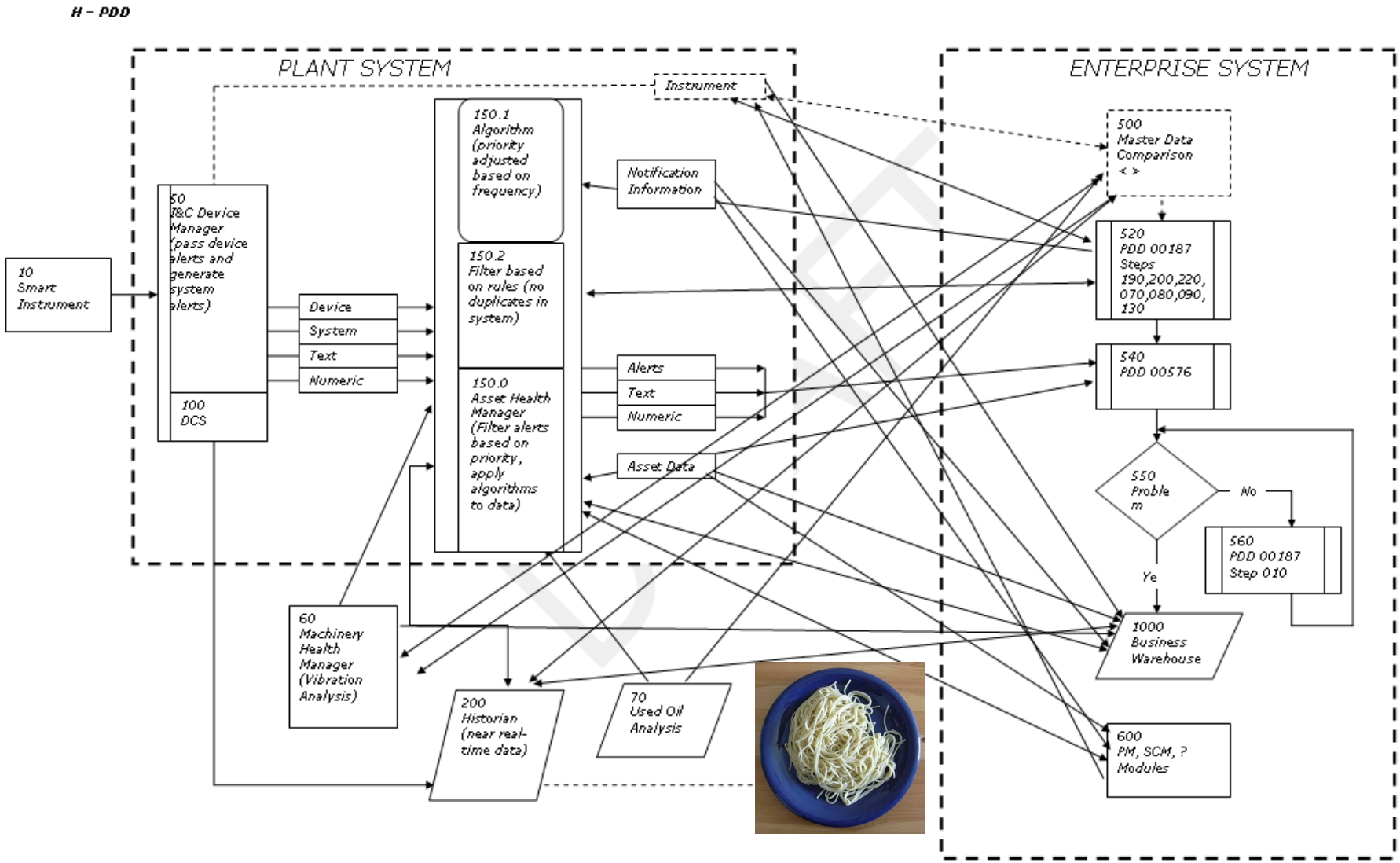
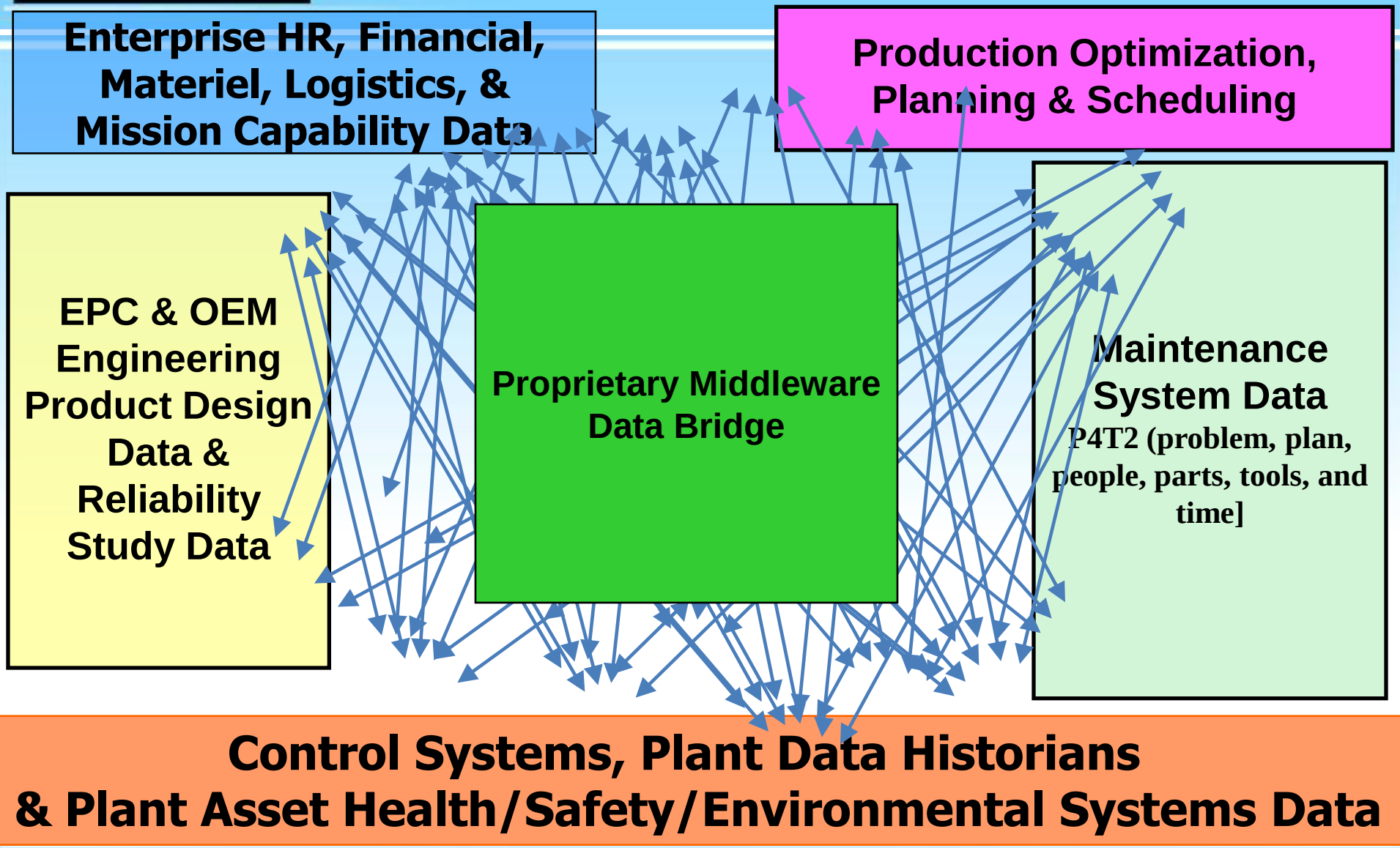


Another Approach – Proprietary Middleware



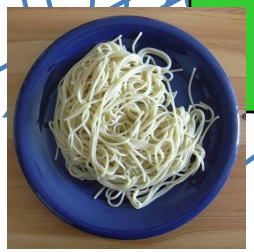
Another Approach – Proprietary Middleware

Enterprise HR, Financial, Materiel, Logistics, & Mission Capability Data

Production Optimization, Planning & Scheduling

EPC & OEM Engineering Product Design Data & Reliability Study Data

Proprietary Middleware Data Bridge



Maintenance System Data

P4T2 (problem, plan, people, parts, tools, and time]

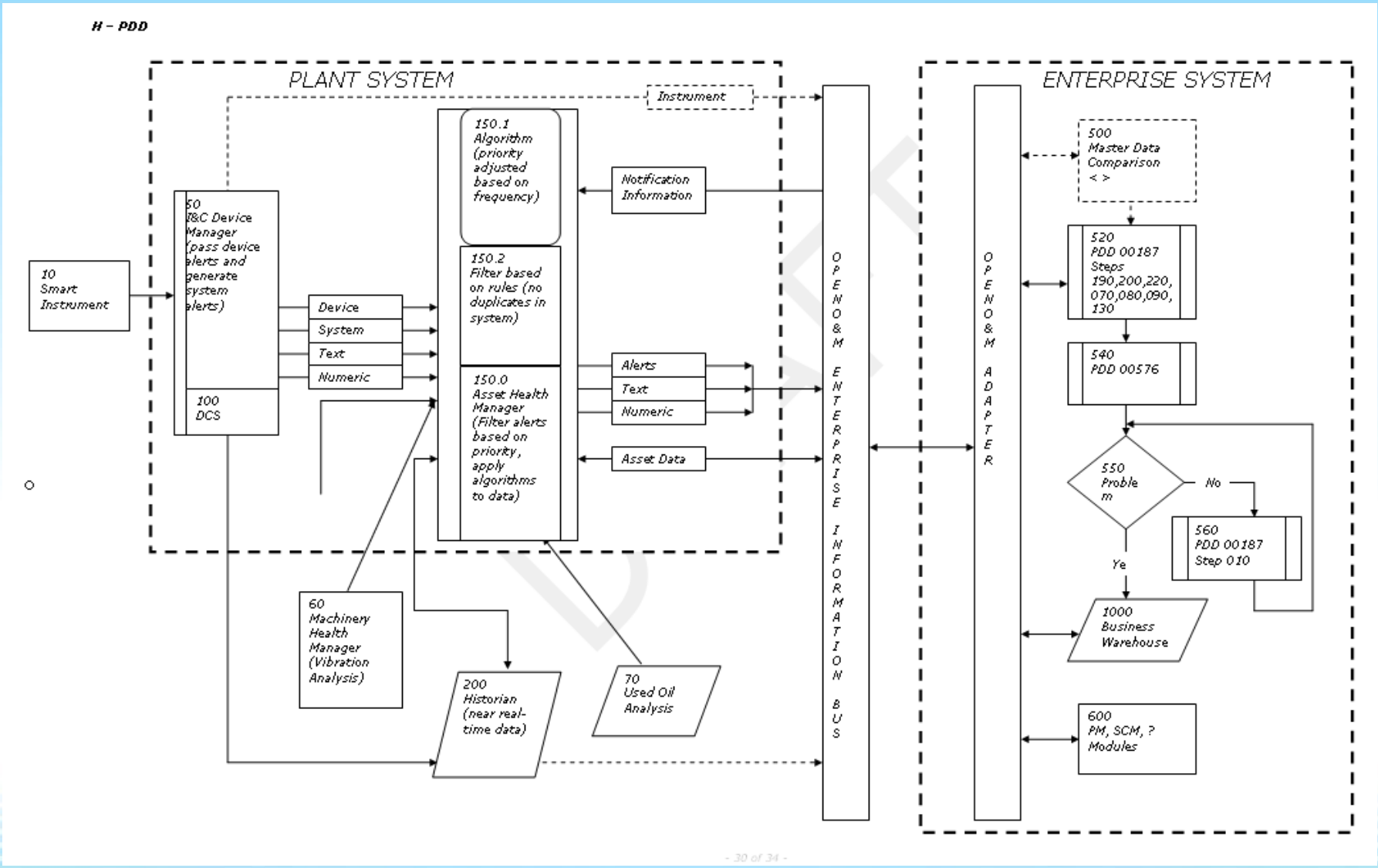
Control Systems, Plant Data Historians & Plant Asset Health/Safety/Environmental Systems Data

Stop the Spaghetti – Use an OpenO&M Information Bus

Introduction: the need for OpenO&M

Interoperability of people + work processes + information

Better Approach



Oil & Gas/Process Industry Information Domains

Domain	Engineering	Procurement	Construction	Operations	Capability (Maintenance, Asset Management, & Reliability)	Enterprise Risk Management / Financial Management / Contract Management / Business Intelligence / KPI's
Materials	Material Specifications	Piping Specifications Material Master Catalogs	Tool Catalogs	Crude Assays Material Safety Data Sheets (MSDS)	Spare Parts Lists Stores Inventory Material Reliability Data Model Part Reliability Data	Environment Regulatory Requirements
Equipment	Vendor Catalogs	Bill of Material	As-Installed Equip. Data	Operations Procedures Tag Locations Associated with Process/Equipment Alarm Configuration Operating Envelopes / Tank Limits	As-Maintained and Operated Equip. Data Maintenance Procedures Job Plans Component Remove/Replace Data As-Operated Reliability Data CBM Monitoring Locations	Equipment Lifecycle Cost Requirements Operational Performance KPI's
Personnel	Vendor Contracts Engineering Contracts Eng. Capability Assess.	Service Contracts	Contracted Services Tracking	Operator Unit Knowledge	Trade Skills Register Root Cause Analysis Data	Health & Safety Requirements

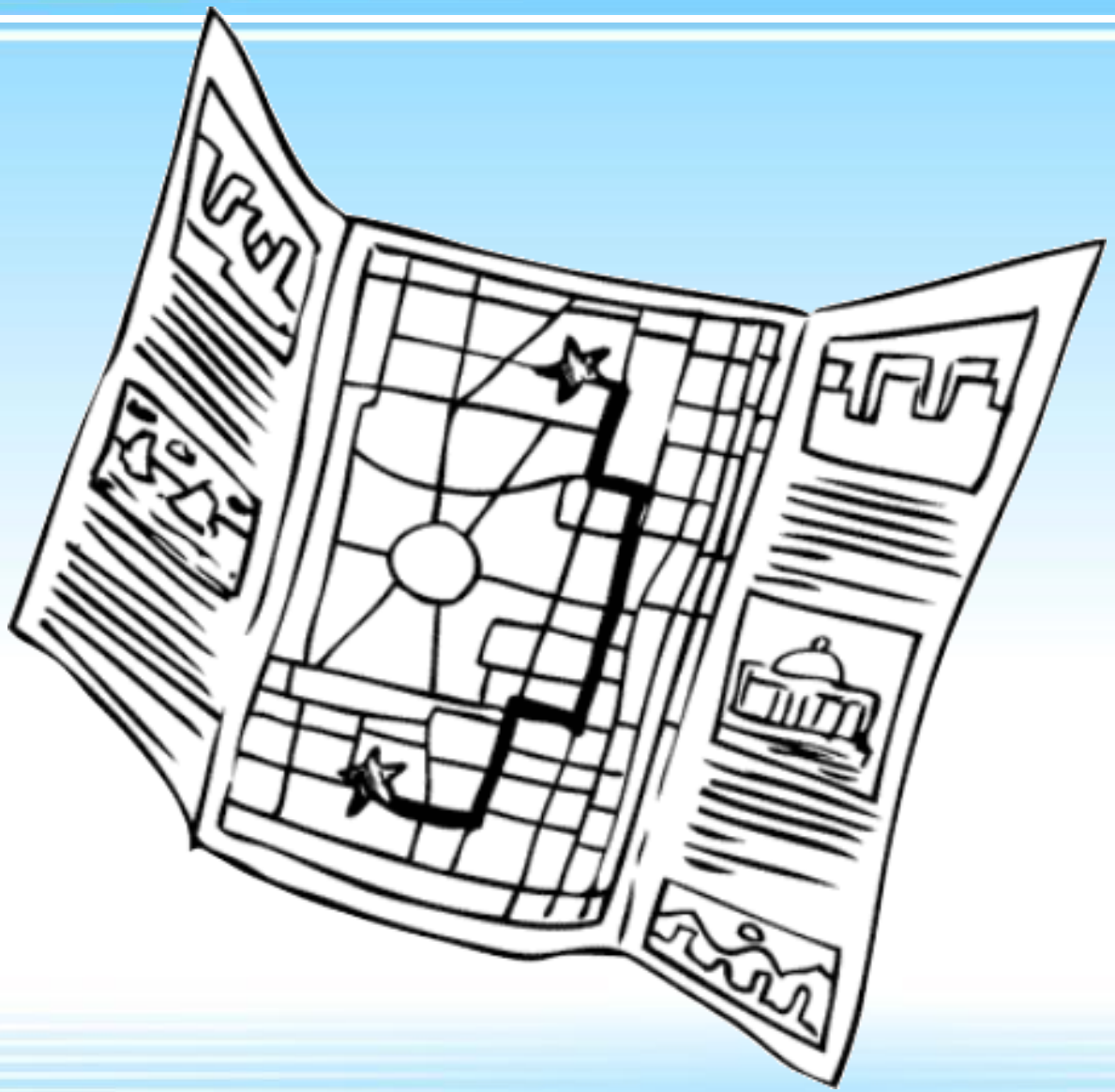
Oil & Gas/Process Industry Information Domains

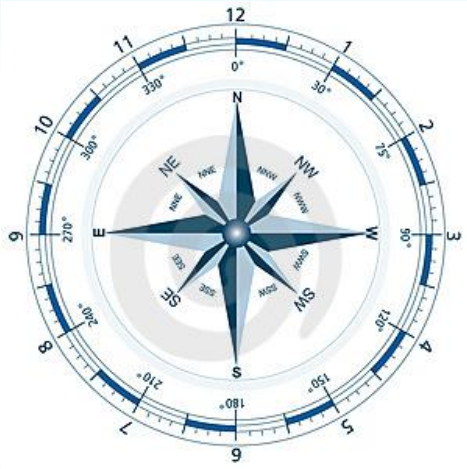
Domain	***Engineering***	***Procurement***	***Construction***	***Operations***	***Capability (Maintenance, Asset Management, & Reliability)***	***Enterprise Risk Management / Financial Management / Contract Management / Business Intelligence / KPI's***
Plans	Design Requirements Re-Design Requirements	Purchase Requests	Construction Schedule	Shift Roster Daily Plans Oil Movement Plans Final Product Blending Plans Price Sets Product Sampling Plans Process/Equipment Capability Requirements	RCM/FMECA Analysis Data PM Program CBM Condition Monitoring Plan Equipment Lubricating Oil Sampling Plan Inspection Schedule Maintenance Work Requests (Service Notifications) Maintenance Work Order Management Maintenance Personnel Roster / Skill Registry Equipment Calibration Schedule Planned Downtime Schedule Projected Process/Equipment Health & Future Capability	Business KPI Reporting Plan Environmental Monitoring & Reporting Plan Equipment Lifecycle Cost Plan Health & Safety Monitoring & Reporting Plan O&M Incident (non-EH&S) Monitoring & Reporting Plan

Oil & Gas/Process Industry Information Domains

Domain	***Engineering***	***Procurement***	***Construction***	***Operations***	***Capability (Maintenance, Asset Management, & Reliability)***	***Enterprise Risk Management / Financial Management / Contract Management / Business Intelligence / KPI's***
Actuals	Calculations Project P&ID's	Purchase Orders Invoices	As-build P&ID's Hazop Minutes	Process Data & Alarms (current & historical) Event Management (Near-misses, Excusions, Operating Envelope Exceedances) Tank Inventories Product Sampling Lab Results Bill of Lading Transfer Advices Operator Logs Process Configuration Management Logs	Process/Equipment Downtime / Slowtime "Raw" and "Computed" CBM Data & Exceptions Equipment Lubricating Oil Sampling Results Process/Equipment Uptime & Current Capability Actuals Component Tracking/ Equipment Configuration Management Logs Inspection/Calibration/ Maintenance Work Records (Includes time & materials) Work Permits	Business KPI Actuals Environmental Monitoring Data and Incident Reporting & Tracking Equipment Lifecycle Data & Reporting Health & Safety Monitoring Data & Incident Reporting O&M Incident (non-EH&S) Monitoring Data & Reporting

so how do you get there





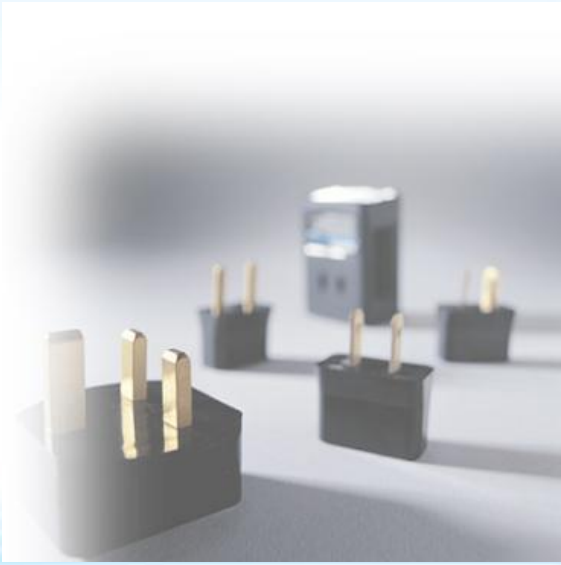
Important Definitions

- **Interoperability**
  - *The ability of two or more systems or components to exchange information and to use the information that has been exchanged*
    - IEEE Standard Computer Dictionary: A Compilation of IEEE Standard Computer Glossaries. New York, NY: 1990
- **Standard**
  - *Something set up and established by authority as a rule for the measure of quantity, weight, extent, value, or quality*
    - Merriam Webster Online Dictionary

standards liberate us

standards → agility

- lower TCO
- share costs
- faster transformation to mainstream IT
- agility
- not proprietary
- interoperability



The Benefits of Standards-based Interoperability

- Increases economic competitiveness
- Compresses time to market
- Reduces infrastructure vulnerability
- Expands markets for companies
- Decreases supply chain communication costs
- Provides global access for software vendors

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"The cost of inadequate interoperability in the U.S. capital facilities industry: $15.8 billion per year."

NIST GCR 04-867

NIST U.S. Department of Commerce
Technology Administration
National Institute of Standards and Technology

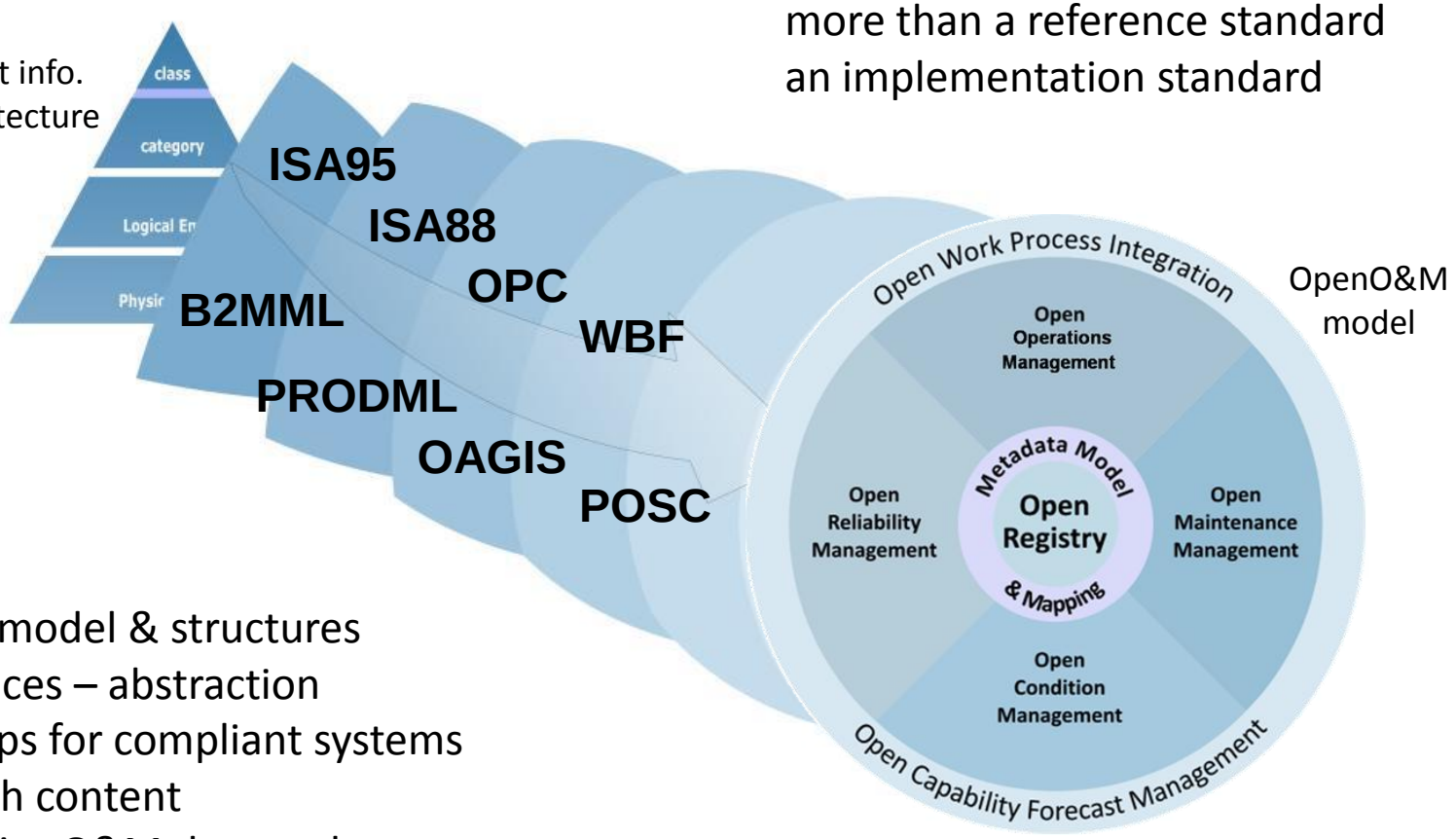
Advanced Technology Program
Information Technology and Electronics Office
Gaithersburg, Maryland 20899

Abstract

Interoperability problems in the capital facilities industry stem from the highly fragmented nature of the industry, the industry's continued paper-based business practices, a lack of standardization, and inconsistent technology adoption among stakeholders. The objective of this study is to identify and estimate the efficiency losses in the U.S. capital facilities industry resulting from inadequate interoperability. This study includes design, engineering, facilities management and business processes software systems, and redundant paper records management across all facility life-cycle phases. Based on interviews and survey responses, $15.8 billion in annual interoperability costs were quantified for the capital facilities industry in 2002. Of these costs, two-thirds are borne by owners and operators, which incur most of these costs during ongoing facility operation and maintenance (O&M). In addition to the costs quantified, respondents indicated that there are additional significant inefficiency and lost opportunity costs associated with interoperability problems that were beyond the scope of our analysis. Thus, the $15.8 billion cost estimate developed in this study is likely to be a conservative figure.

an implementation standard

target info.
architecture



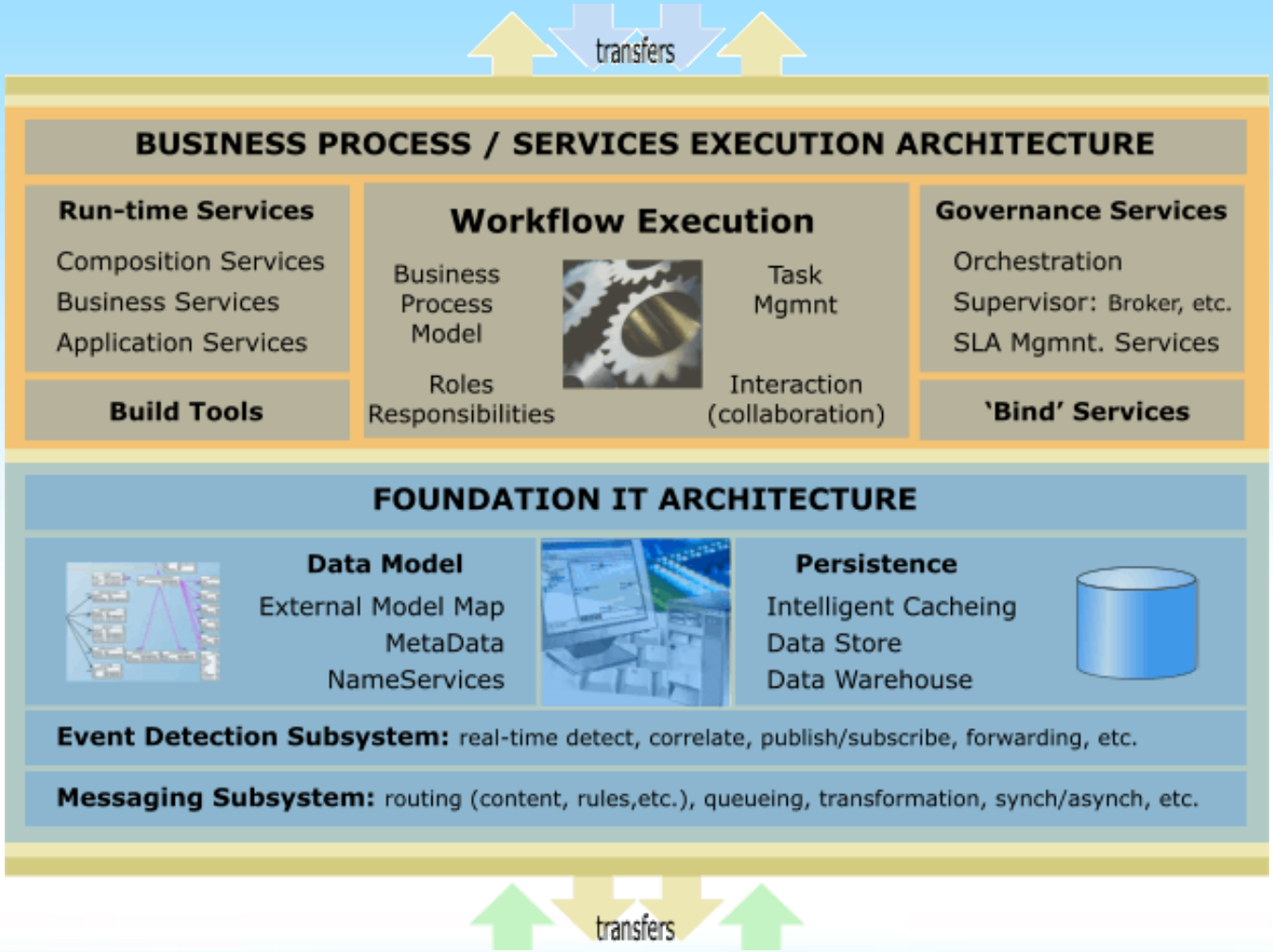
more than a reference standard
an implementation standard

OpenO&M model

- metadata model & structures
- nameservices – abstraction
- model maps for compliant systems
- defines rich content
- commoditize O&M data exchange
- non-proprietary interoperability

OpenO&M harmonizes the standards

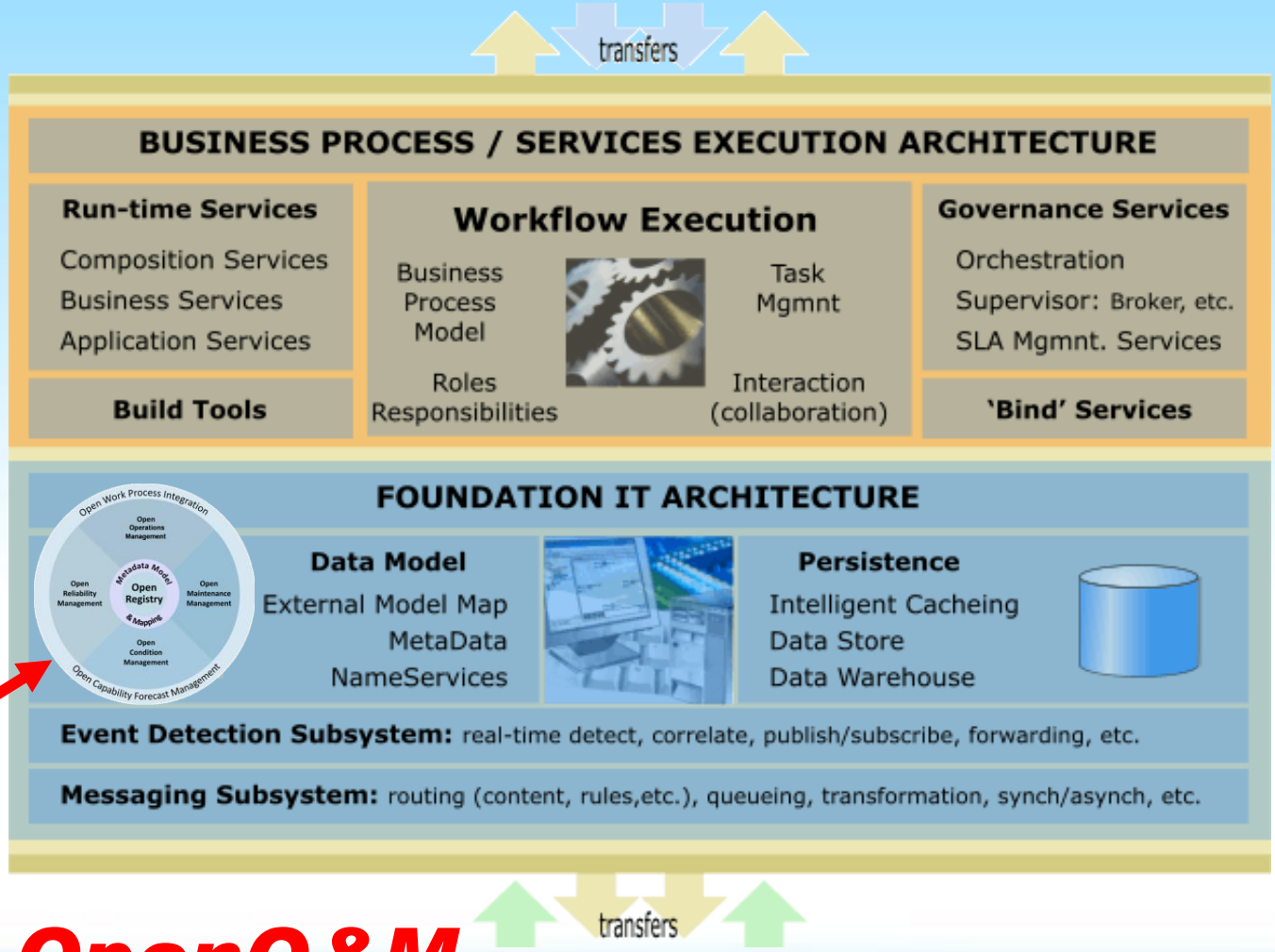
High-level architecture



2

1

strategic fit



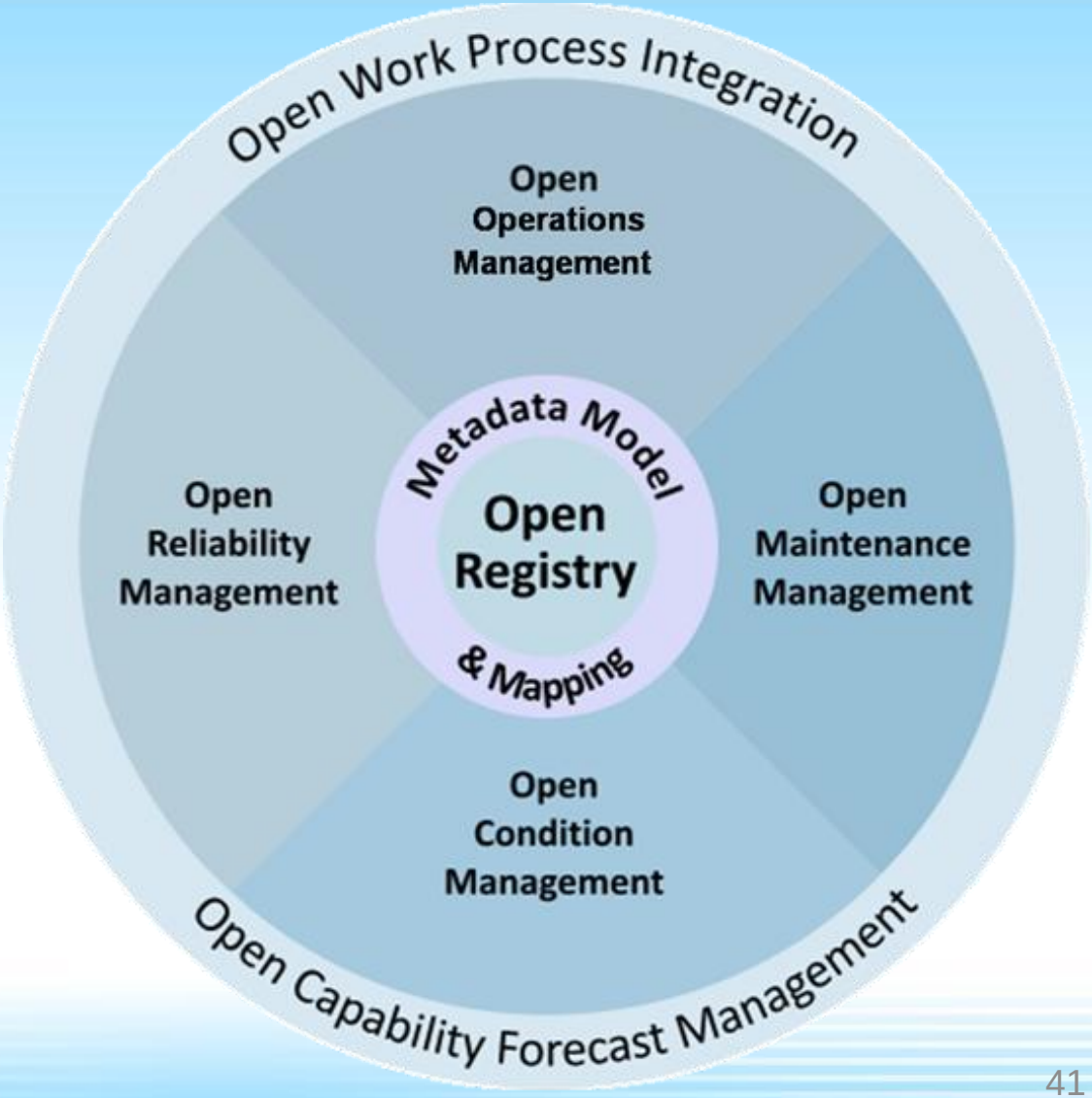
2

1

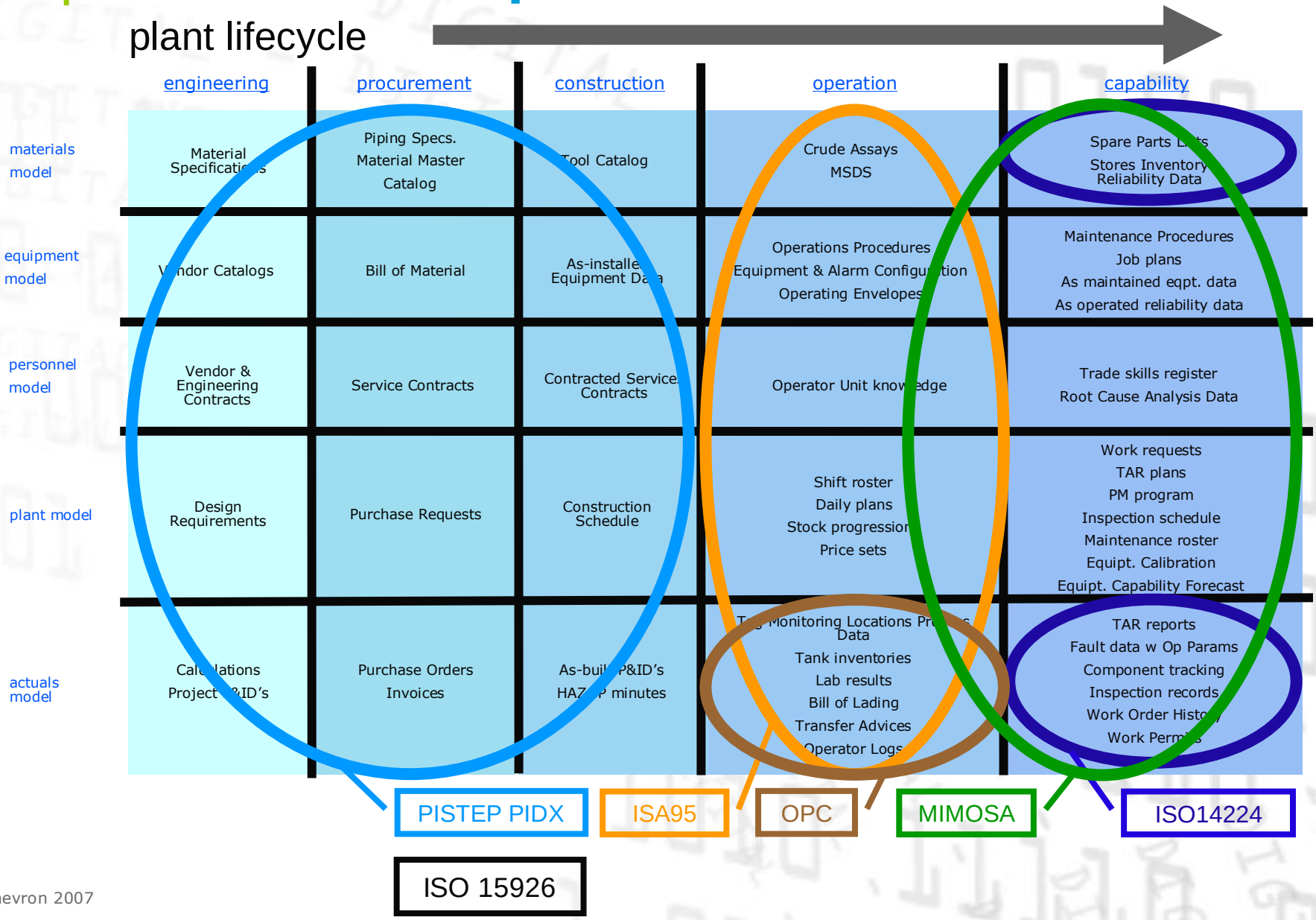
OpenO&M

OpenO&M summary

- name services
- metadata
- model maps
- abstraction
- not proprietary
- interoperability



bp data model map

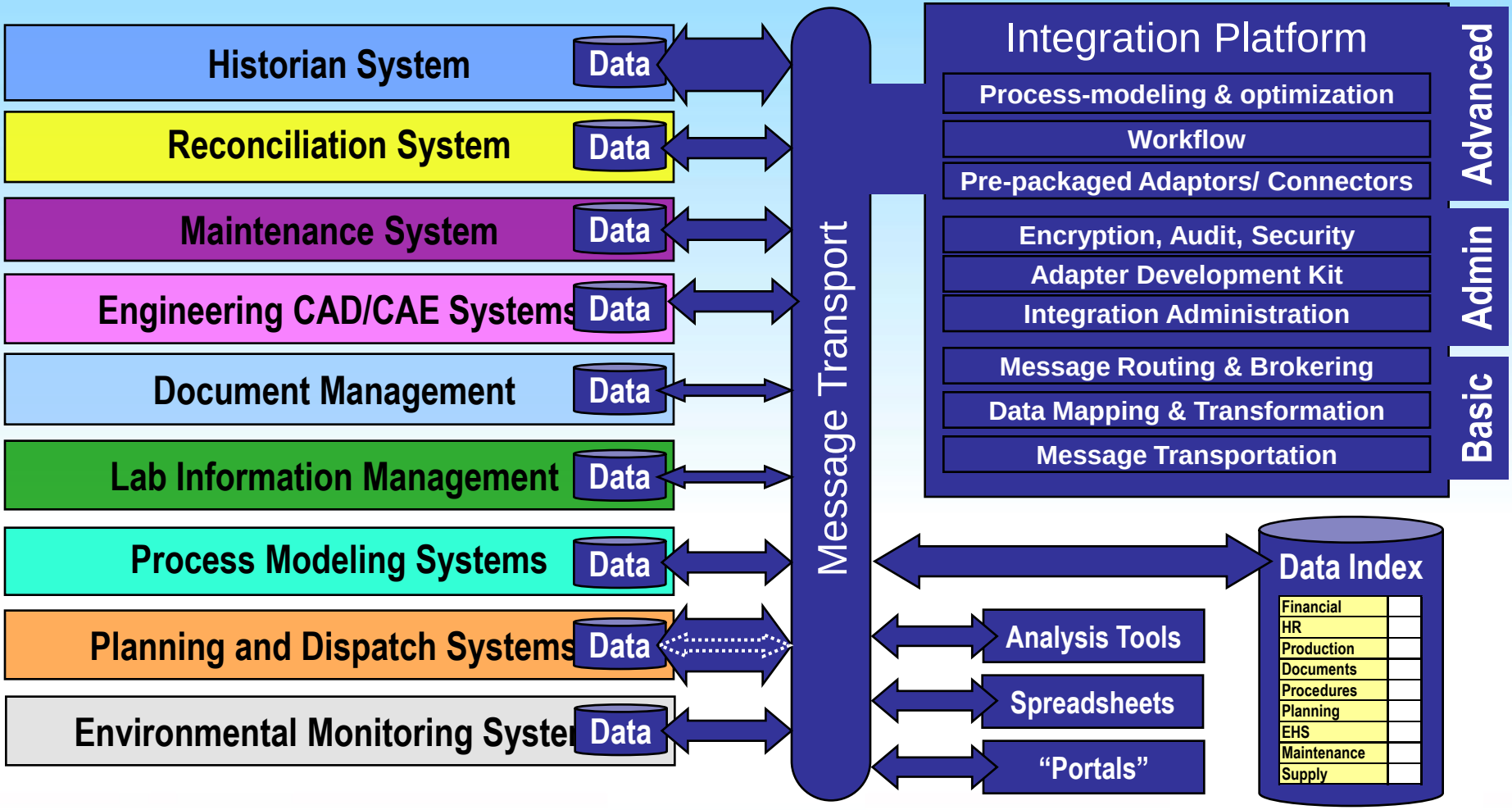


bp data model map

	engineering	procurement	construction	operation	capability
materials model	Material Specifications	Piping Specs. Material Master Catalog	Tool Catalog	Crude Assays MSDS	Spare Parts Lists Stores Inventory Reliability Data
equipment model	Vendor Catalogs	Bill of Material	As-installed Equipment Data	Operations Procedures Equipment & Alarm Configuration Operating Envelopes	Maintenance Procedures Job plans As maintained eqpt. data As operated reliability data
personnel model	Vendor & Engineering Contracts	Service Contracts	Contracted Services Contracts	Operator Unit knowledge	Trade skills register Root Cause Analysis Data
plant model	Design Requirements	Purchase Requests	Construction Schedule	Shift roster Daily plans Stock progressions Price sets	Work requests TAR plans PM program Inspection schedule Maintenance roster Equipt. Calibration Equipt. Capability Forecast
actuals model	Calculations Project P&ID's	Purchase Orders Invoices	As-built P&ID's HAZOP minutes	Tag Monitoring Locations Process Data Tank inventories Lab results Bill of Lading Transfer Advices Operator Logs	TAR reports Fault data w Op Params Component tracking Inspection records Work Order History Work Permits

openO&M standards
(based on MIMOSA, OPC, ISA95, etc.

Suncor View -- A Coordinated Approach to Full Integration within the Enterprise



OpenO&M Approach –Each System Engineered to Speak a Common O&M Language over a Common Information Bus

the openO&M™ initiative

OAGi Open Applications Group

Enterprise HR, Financial, Materiel, Logistics, & Mission Capability Data

Production Optimization, Planning & Scheduling

ISO 15926

EPC & OEM Engineering Product Design Data & Reliability Study Data

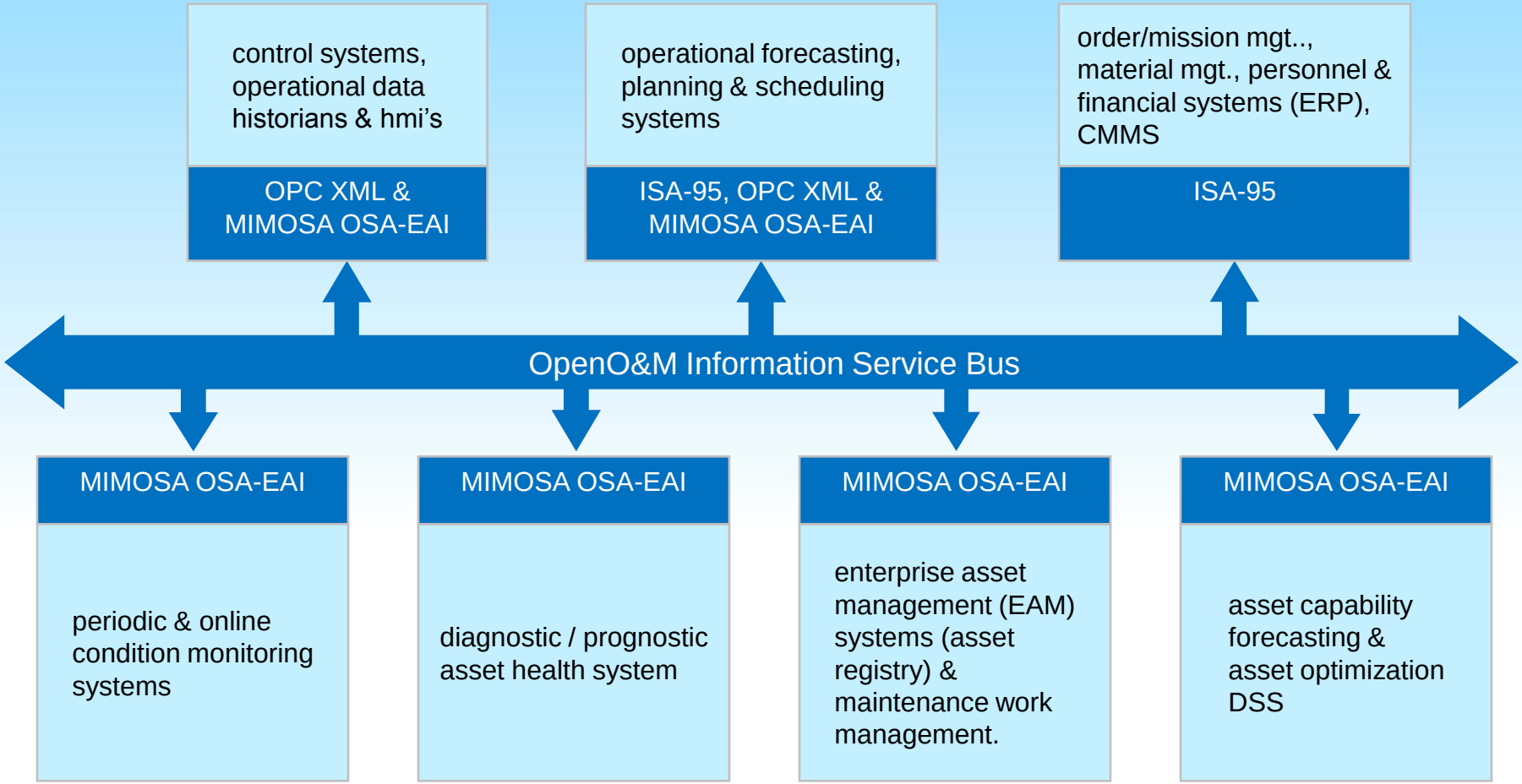
Serialized Asset Registry & Lifecycle Configuration Management Data

Maintenance System Data

P4T2 (problem, plan, people, parts, tools, and time]

Control Systems, Plant Data Historians & Plant Asset Health/Safety/Environmental Systems Data

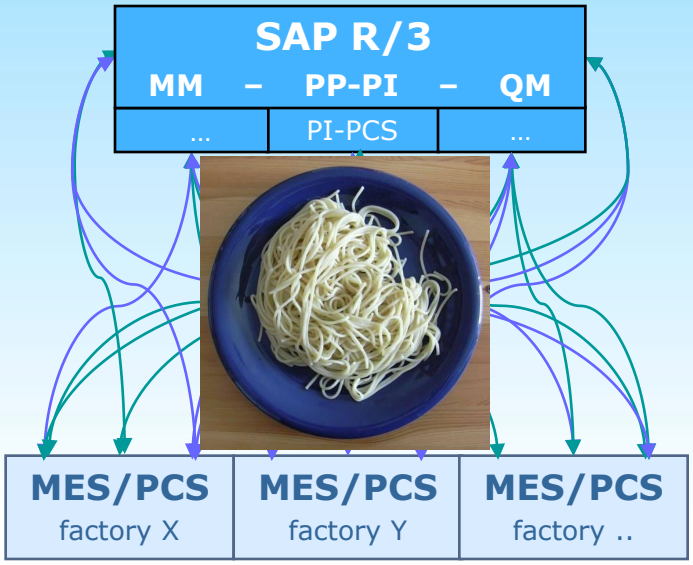
OpenO&M Approach –Each System Engineered to Speak a Common O&M Language over a Common Information Bus

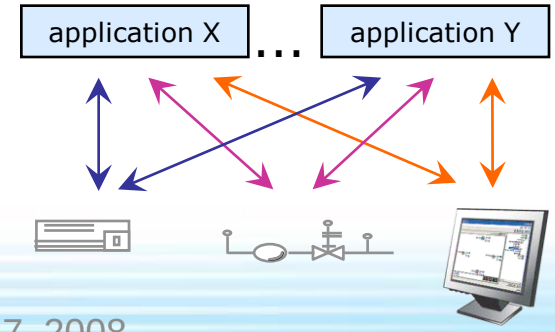


OpenO&M Approach –Each System Engineered to Speak a Common O&M Language over a Common Information Bus

scenario 1

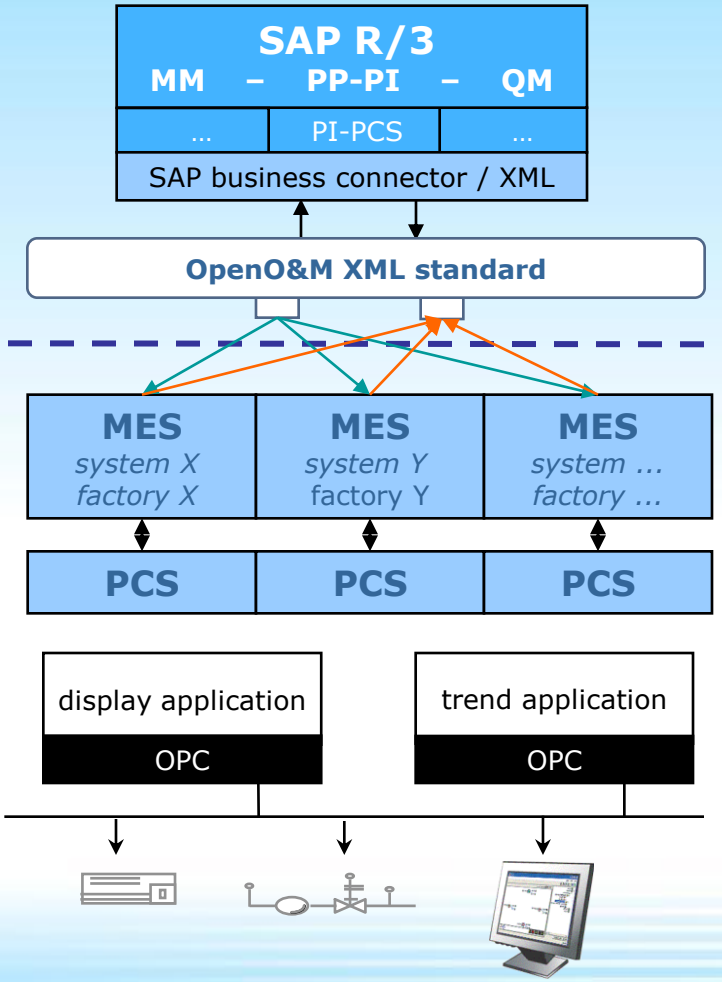
several proprietary ”standard” solutions





scenario 2

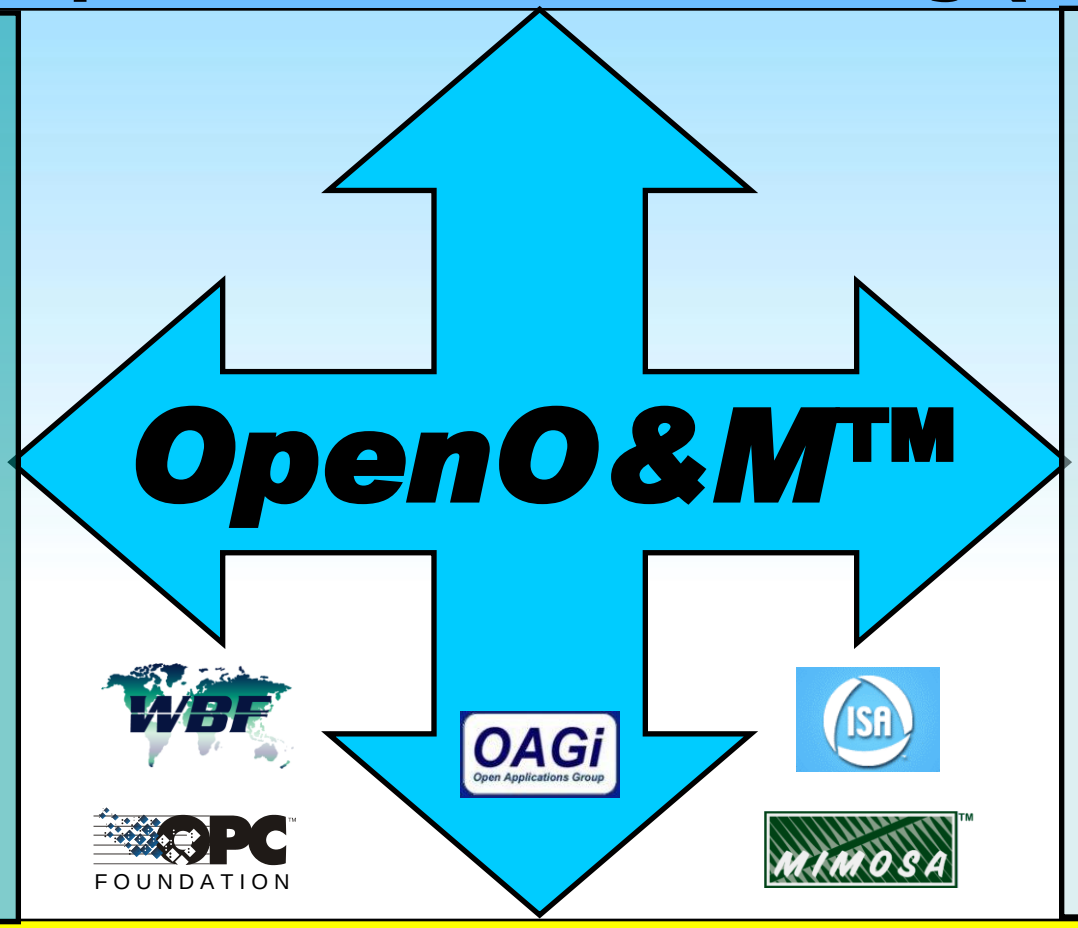
one vendors’ ”standard” solution



The OpenO&M™ Solution: Open Standards & Collaboration

Enterprise Business Systems
Enterprise Resource Planning (ERP)

Operations



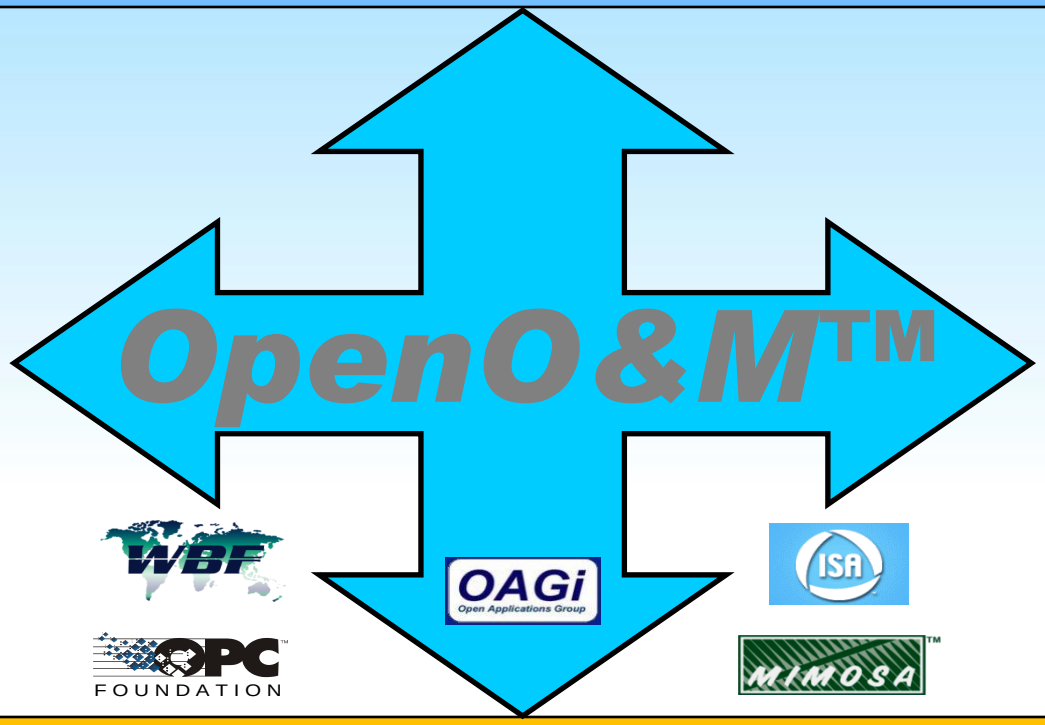
Maintenance

Physical Asset Control
Real-time Systems

the open O&M™ initiative

Enterprise Business Systems
Enterprise Resource Planning (ERP)

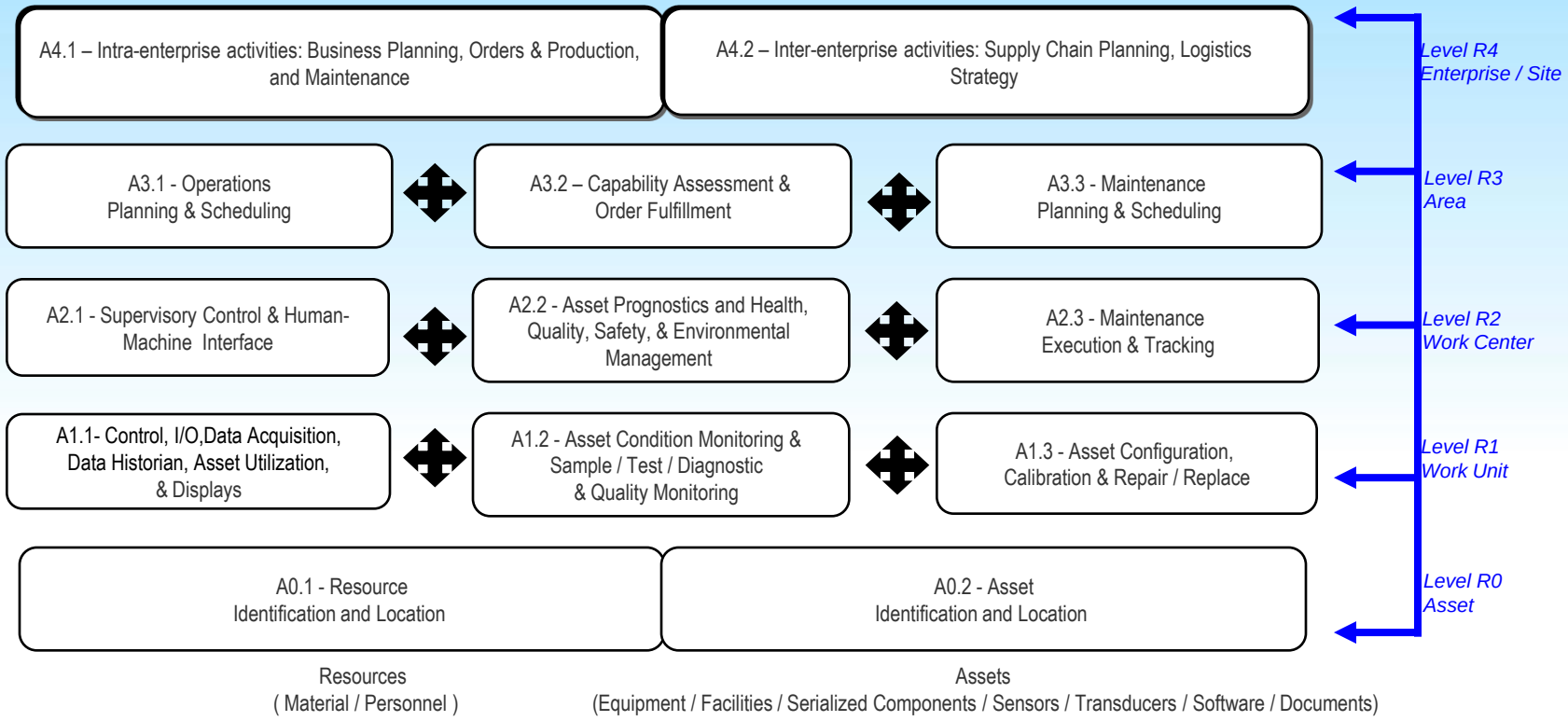
Operations



Maintenance

Physical Asset Control
Real-time Systems

ISO 18435
Application Domain Integration Diagram



What is a Common Information Model?

- Representation of the information objects required for the business
- Contains the things of importance in an organization and how they relate to one another
- Provides a basis for physical database design. The physical design of a database involves deep use of particular database management technology.
- People often get confused with the difference between an information model and a physical data model. They are very different in their objectives, goals and content. Following are some key differences.

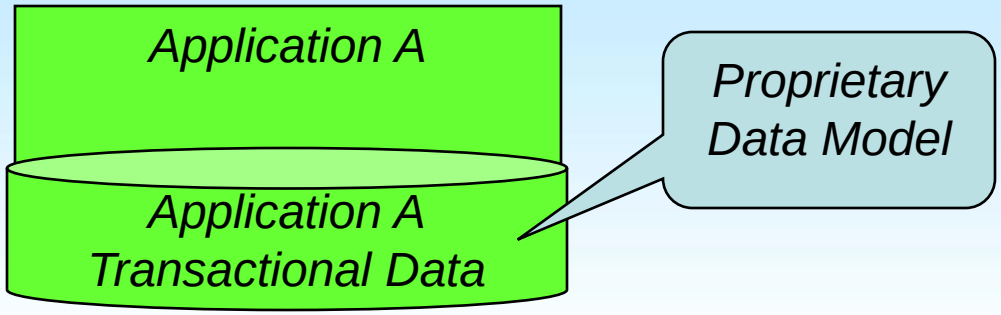
Information Model	***Physical Data Model***
Includes entities/tables, attributes/columns/fields and relationships	Includes tables, columns, keys, data types, validation rules, database triggers, stored procedures, domains, and access constraints
Uses business names for attributes	Uses abbreviated column names limited by the database management system (DBMS)
Is independent of technology (platform, DBMS)	Includes primary keys and indices for fast data access.
Is normalized to 4th normal form	May be de-normalized to meet performance requirements
Does not include any redundant or derived data	May include redundant columns or results of complex or difficult to recreate calculation columns
Business Analysts validate and approve the model	Physical Modeler lead the modeling activity

Why Use a Common Information Model?

- Helps common understanding of business requirements
- Provides foundation for designing databases and bulk binary datastores, and data warehouses
- Facilitates data re-use and sharing
- Decreases development and maintenance time and cost
- Focuses on information requirements independent of technology and changing processes
- Decreases system development time and cost
- Becomes a template for the enterprise
- Facilitates data re-use and sharing
- Faster ROI
- Gathers metadata
- Fosters seamless communication between applications
- Focuses communication for data analysis and project team members
- Establishes a consistent naming scheme

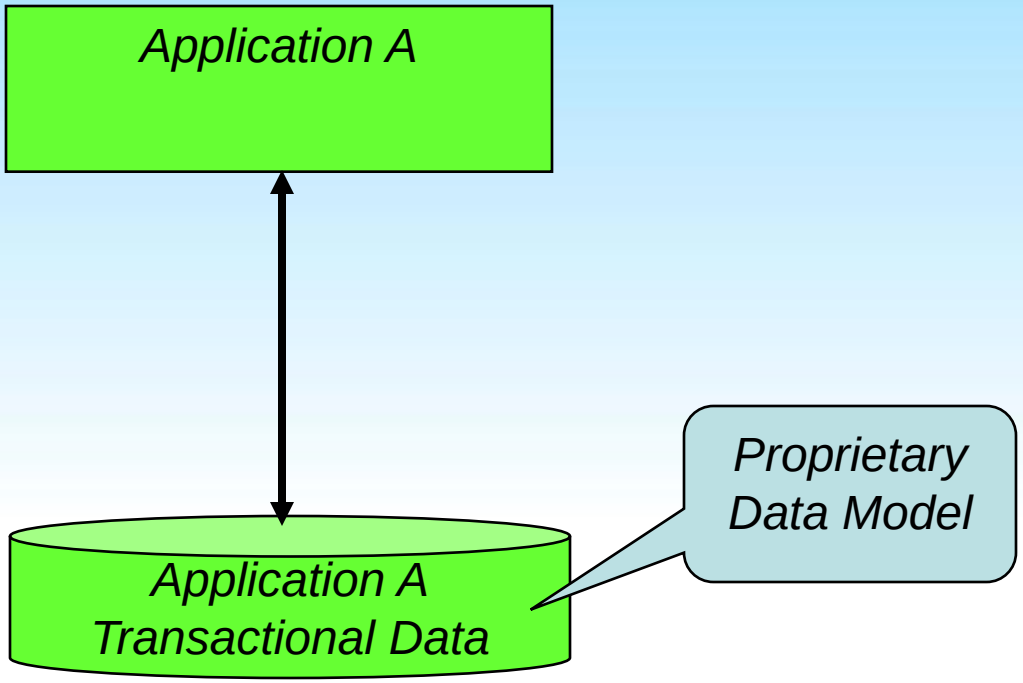
Why Use a Common Information Model?

Most Current Applications Are Designed to Work Closely-Coupled to a Supplier-Specific Proprietary Database



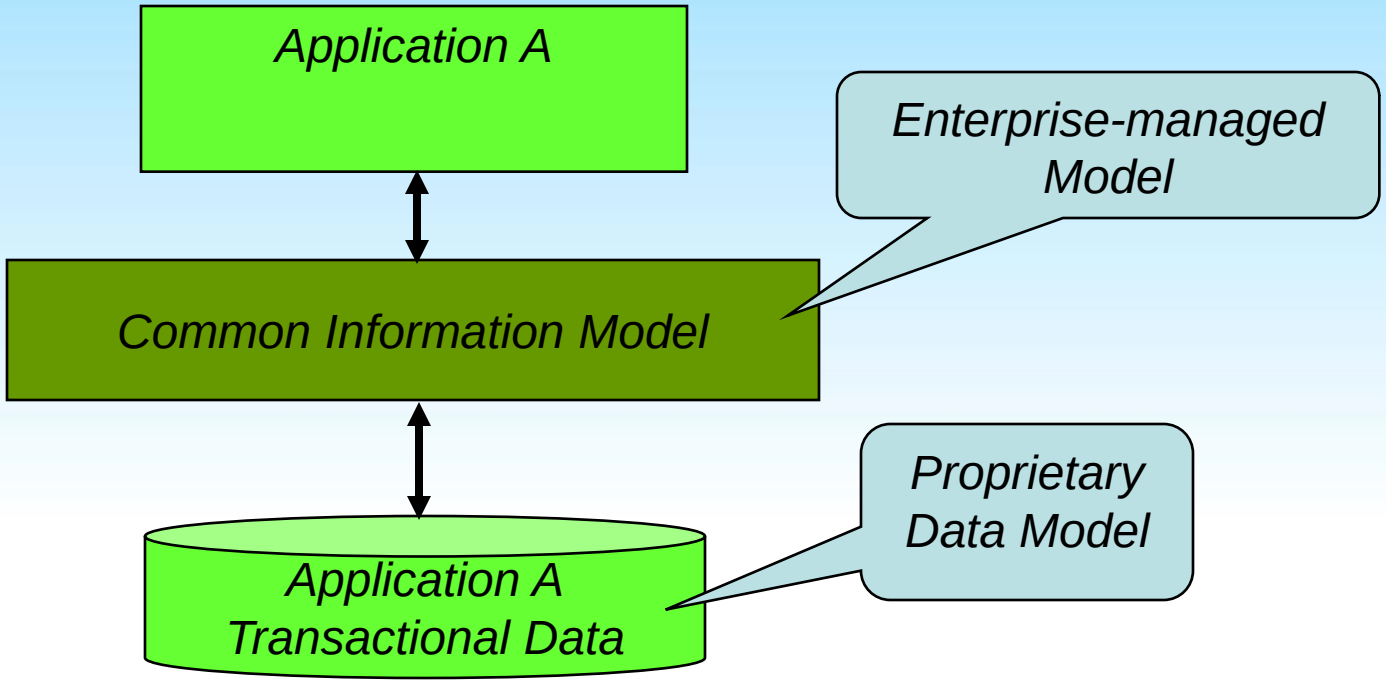
Why Use a Common Information Model?

Software Engineering Best Practice Dictates A Separation of the Application from the Required Data it Needs



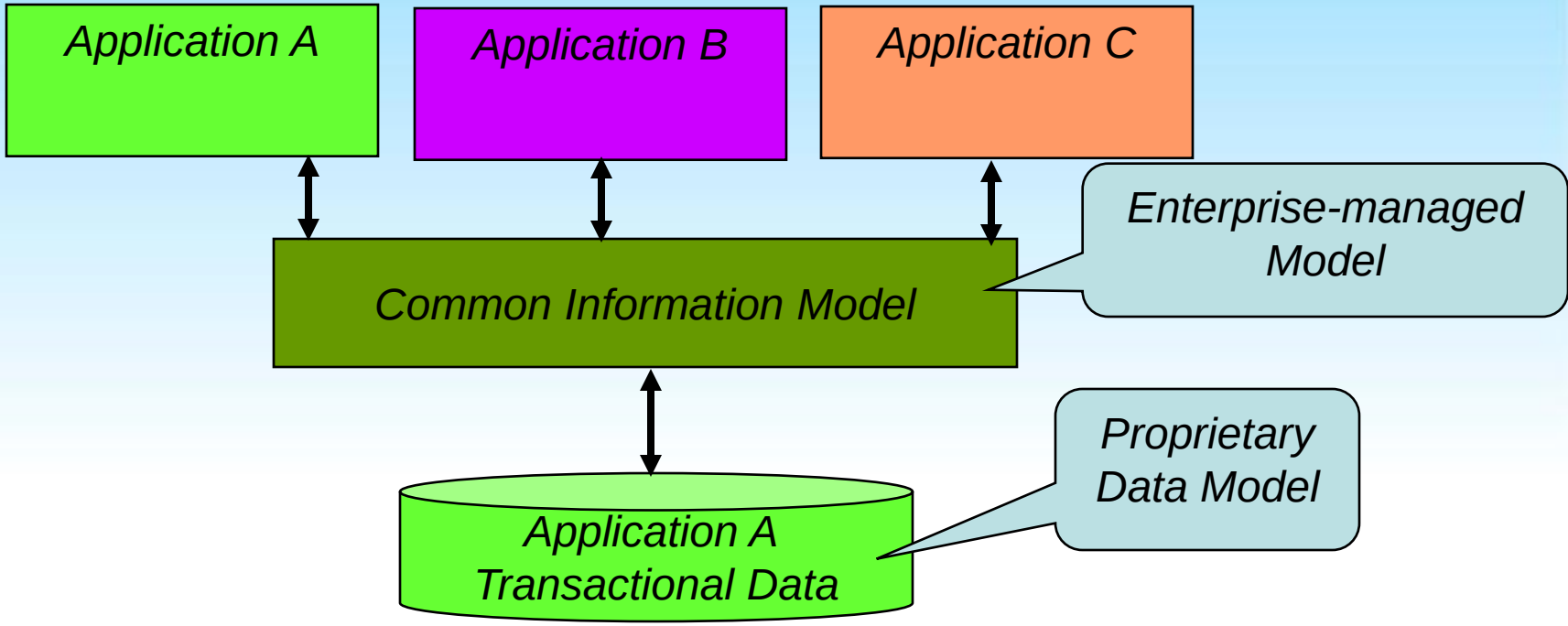
Why Use a Common Information Model?

World Class Enterprises Are Now Utilizing an Enterprise-managed Information Model Abstraction Layer Which Hides Proprietary Data Models



Why Use a Common Information Model?

This Allows Many New Applications to be Built With Just Knowledge of the Common Information Model

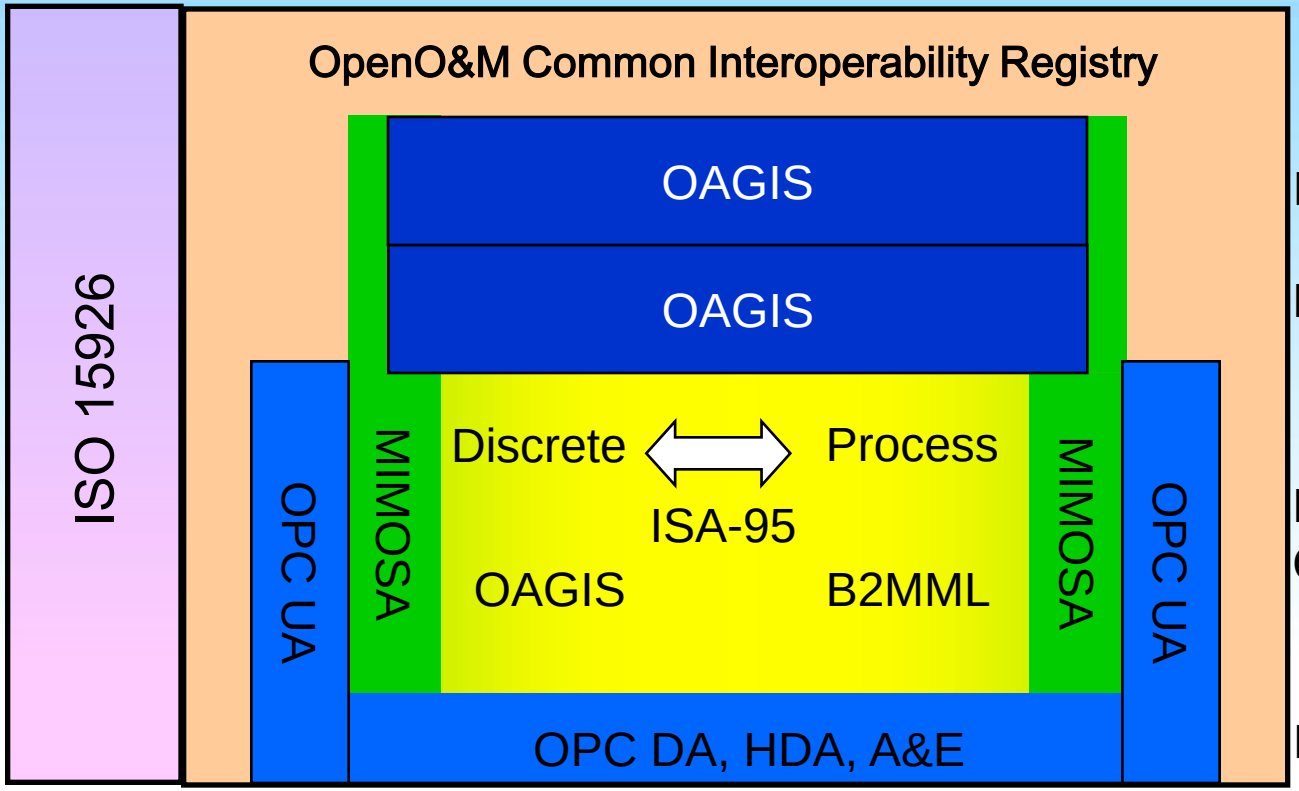


What Is The OpenO&M™ Initiative?

- The OpenO&M Initiative is an applied standards activity with multiple participating standards organizations who are collaborating to enable open standards-based interoperability for Operations and Maintenance (O&M) related people, processes and systems.
  - ISA
  - MIMOSA
  - OAGIS
  - OPC Foundation
  - WBF B2MML
- OpenO&M is NOT a standard.
- The OpenO&M Initiative solutions process is developing industry-driven solutions architectures which are platform, supplier and product neutral in conjunction with multiple vertical industries.
  - Industry **Use-Case** Driven
  - **Owner/Operator** Leadership
  - Participation of key **Suppliers**
  - Participation of key **Standards Organizations**

OpenO&M™ Initiative Solutions Process

Manufacturing JWG Domain Mapping



Inter-Enterprise

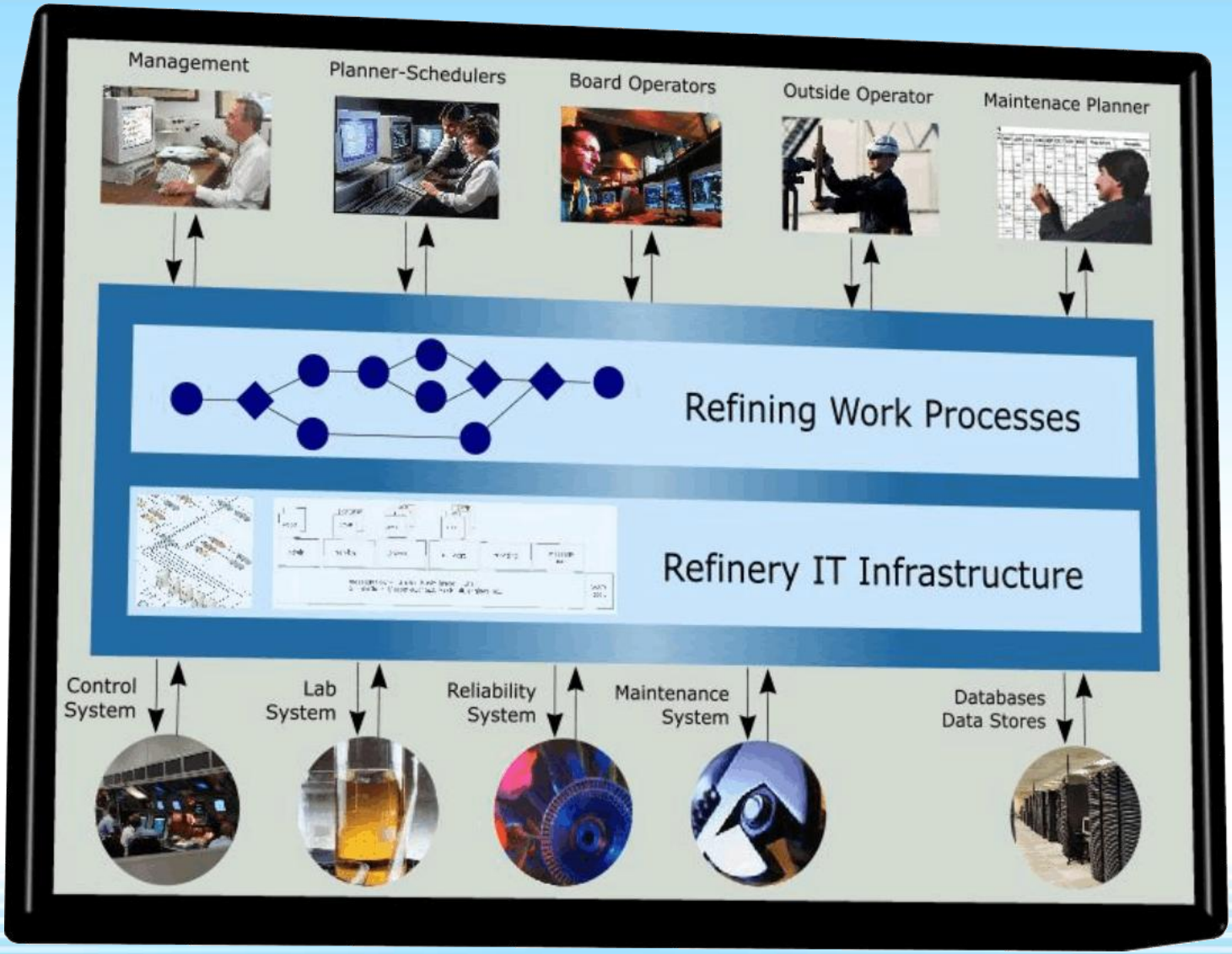
Enterprise

Manufacturing Operations & Maintenance

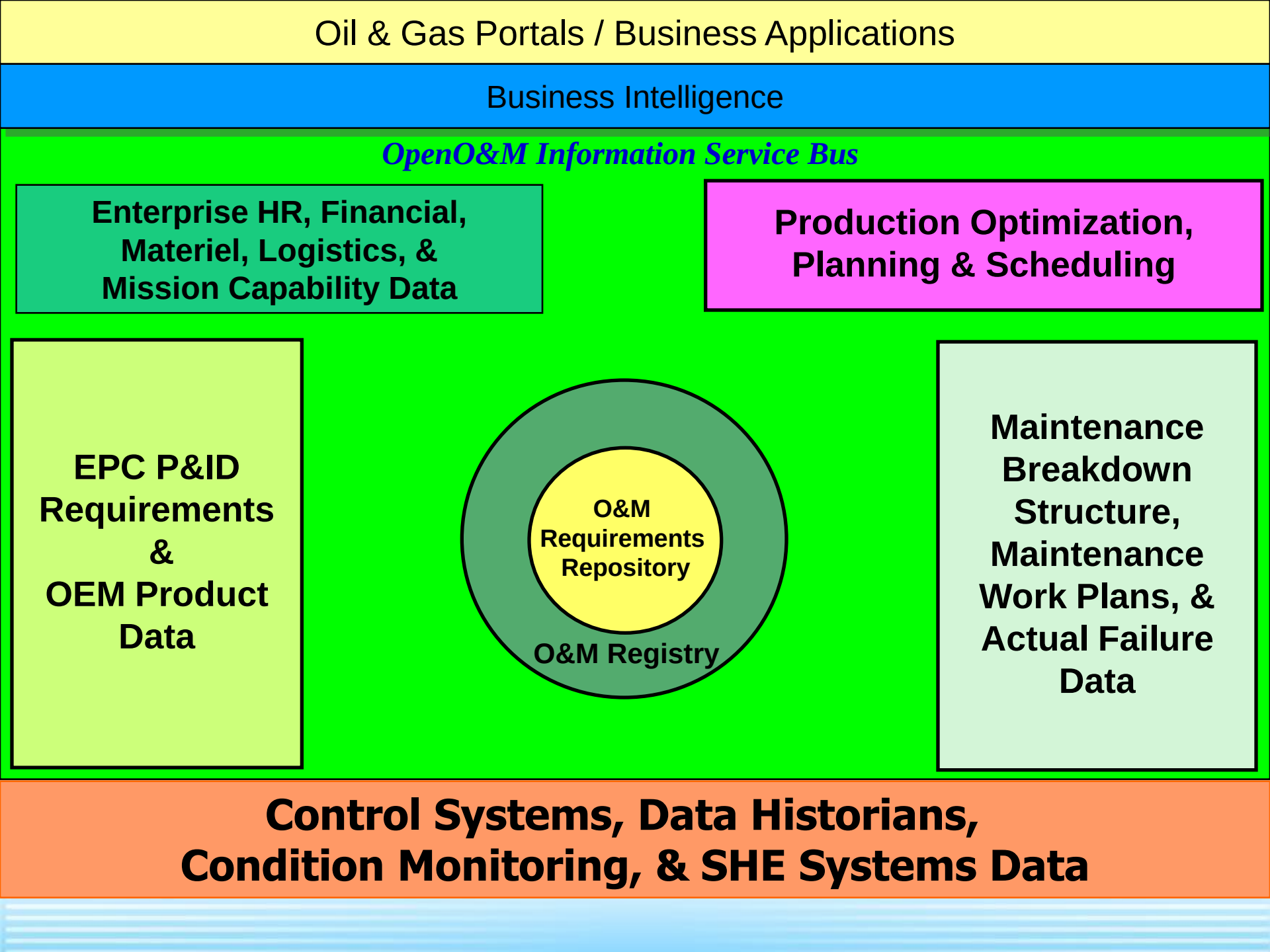
Machine

the open O&M initiative™

High-level architecture

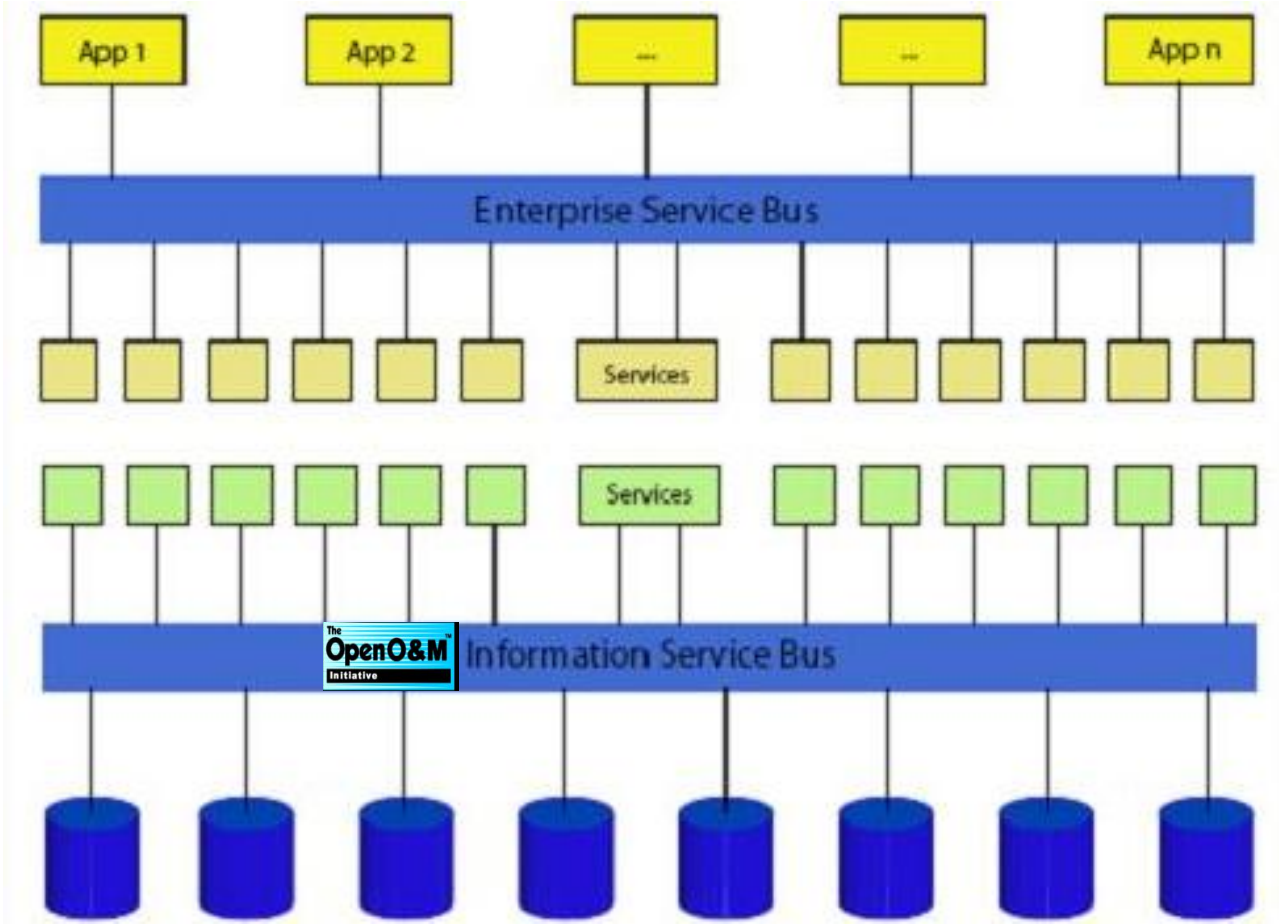


Enabler #1: Guaranteed-Delivery OpenO&M Information Service Bus


Oil & Gas Portals / Business Applications
Business Intelligence
OpenO&M Information Service Bus
Enterprise HR, Financial, Materiel, Logistics, & Mission Capability Data
Production Optimization, Planning & Scheduling
EPC P&ID Requirements & OEM Product Data
O&M Requirements Repository
O&M Registry
Maintenance Breakdown Structure, Maintenance Work Plans, & Actual Failure Data
Control Systems, Data Historians, Condition Monitoring, & SHE Systems Data

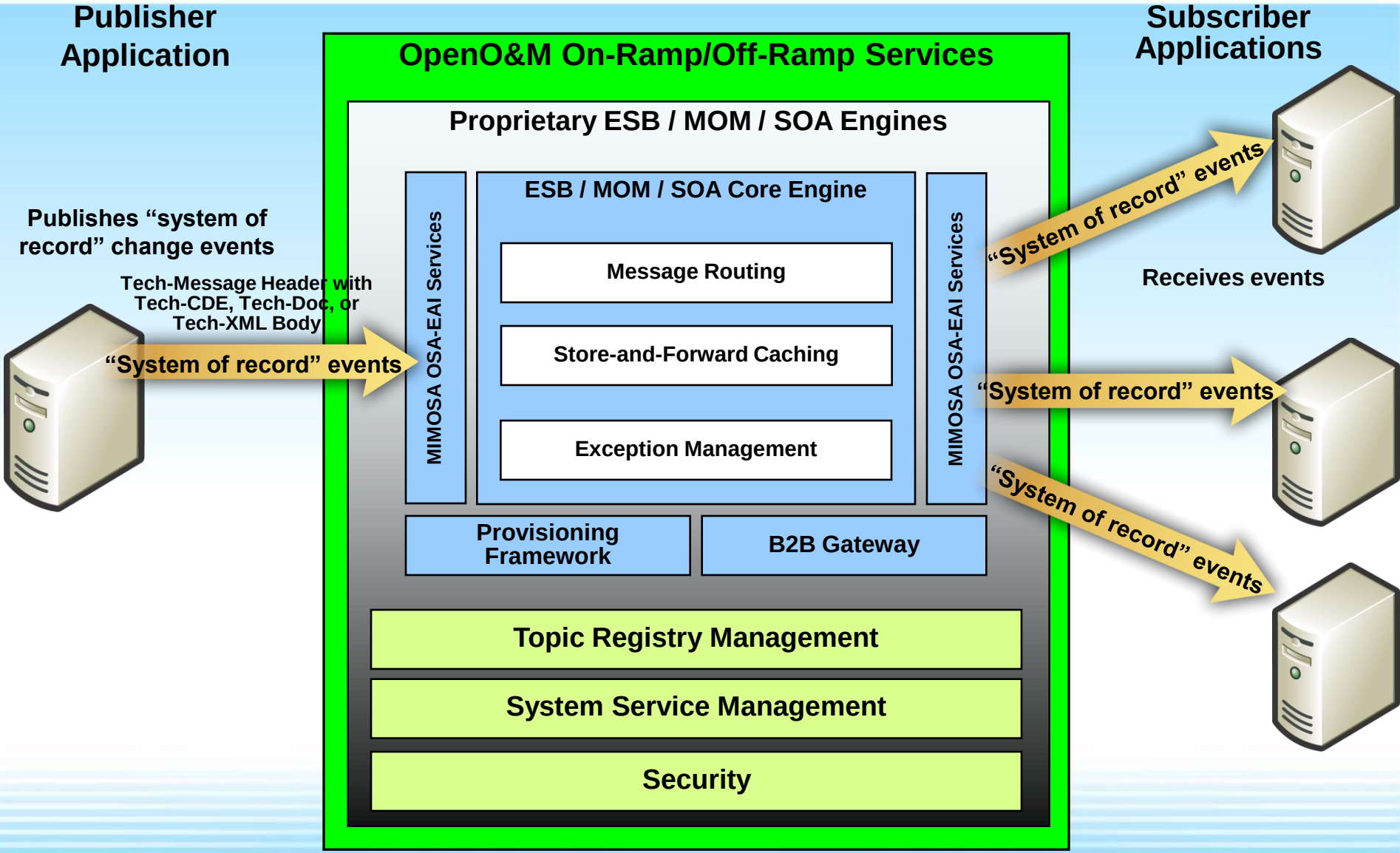
OpenO&M Information Service Bus

End-User Proprietary “Added-Value” Applications

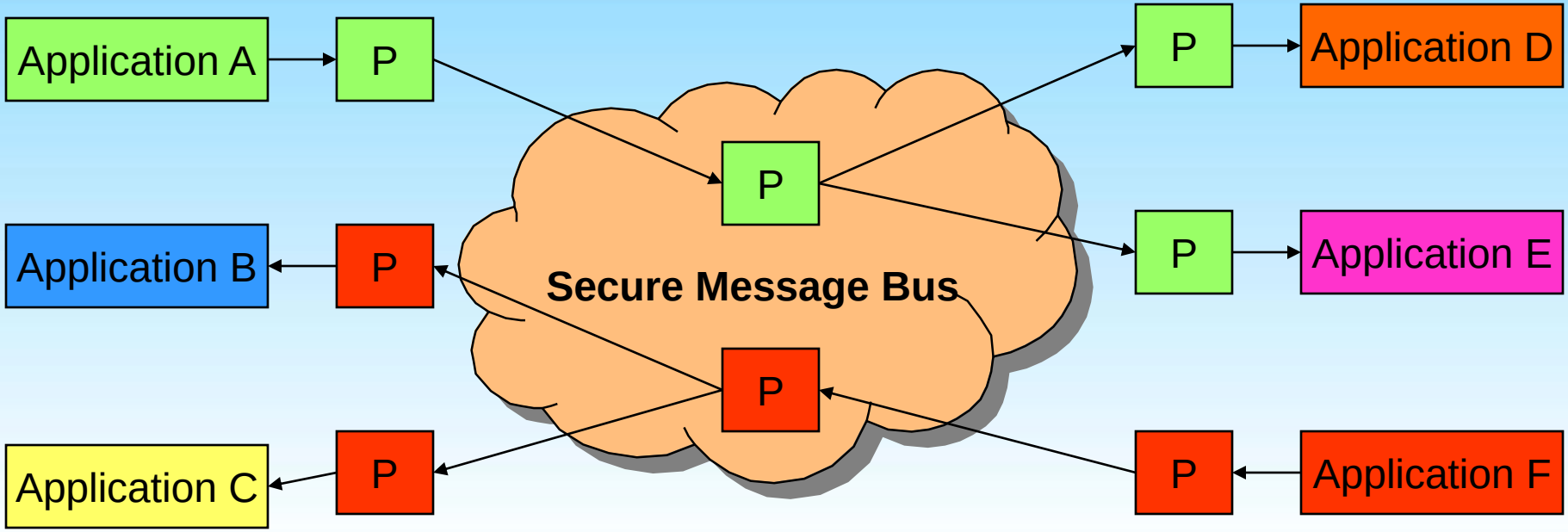


Software System Provider Databases

Support for "Fire-and-Forget" Pub/Sub Architecture



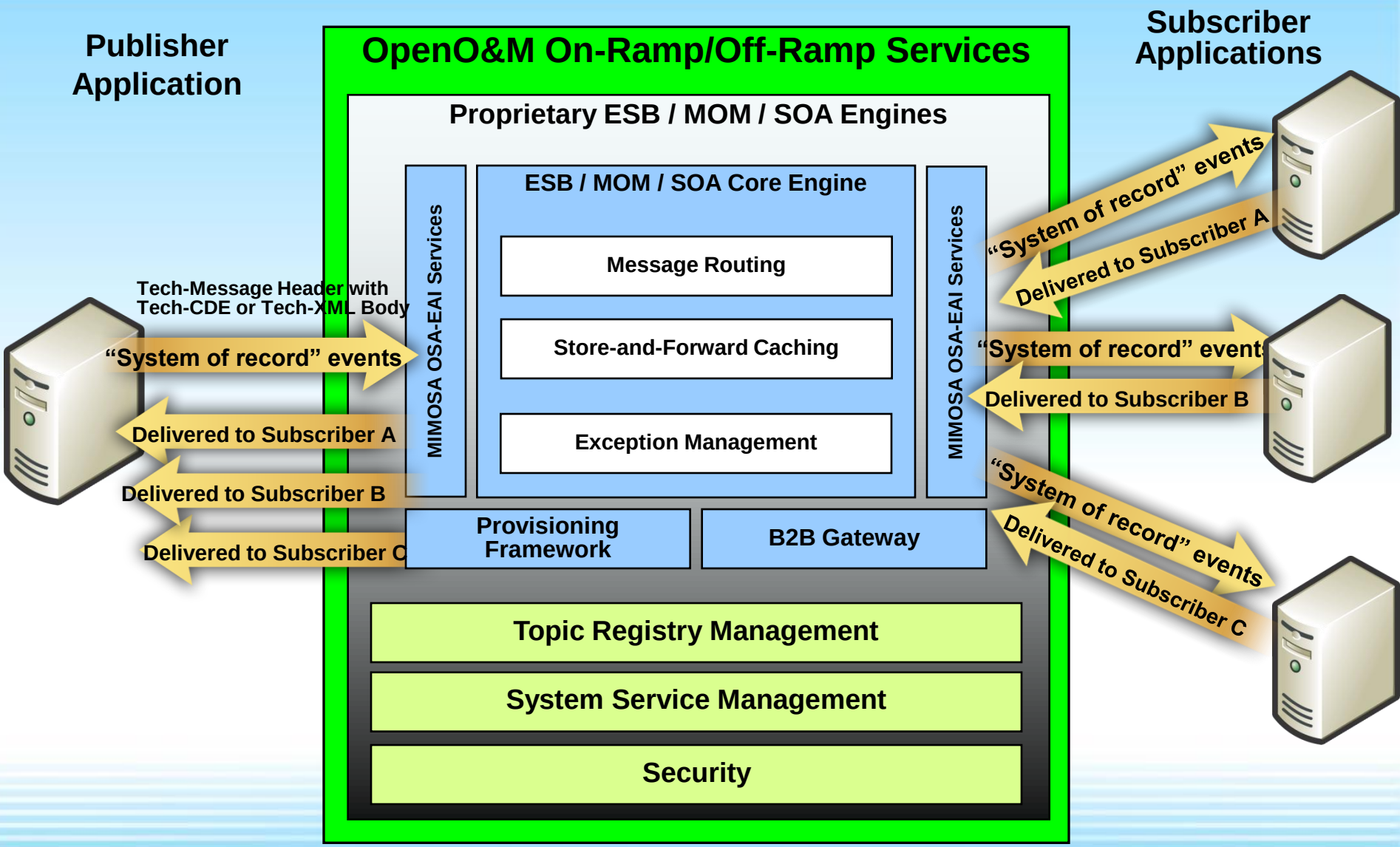
“Fire and Forget” Pub/Sub Messaging Example



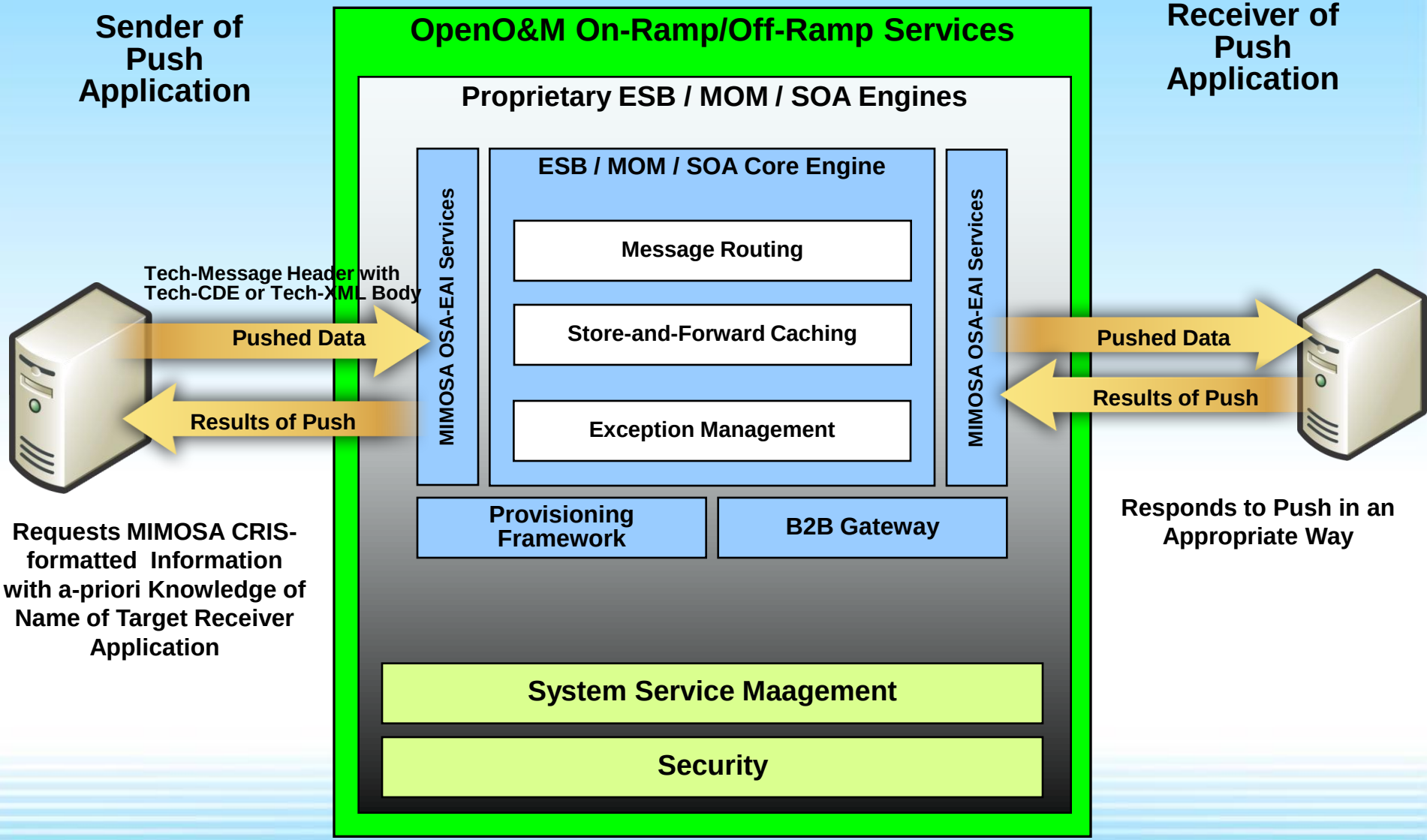
P **Published Message from Application A which Applications D & E have Subscribed To Receive**

P **Published Message from Application F which Applications B & C have Subscribed To Receive**

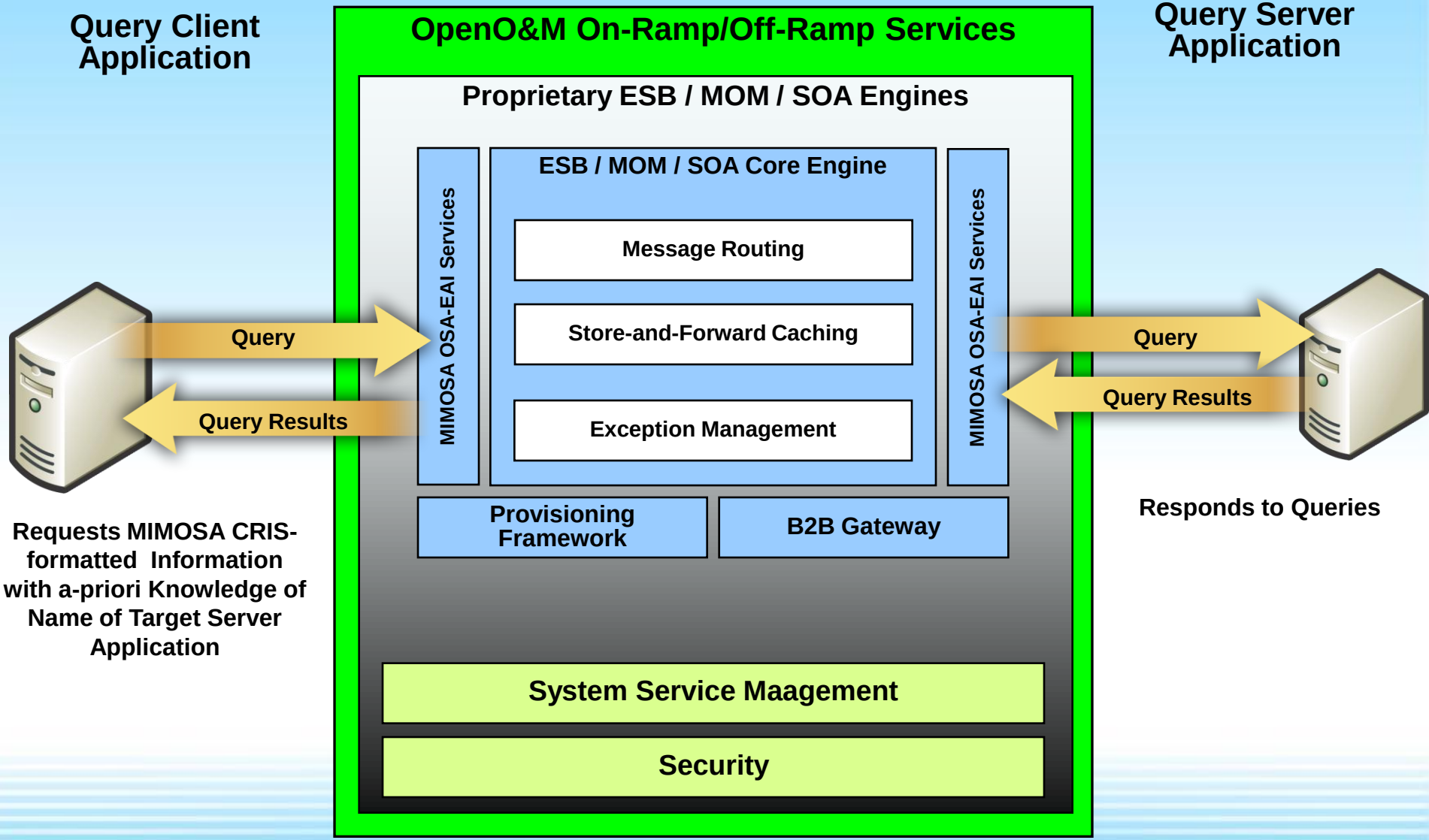
Support for "Sync" Pub/Sub Architecture



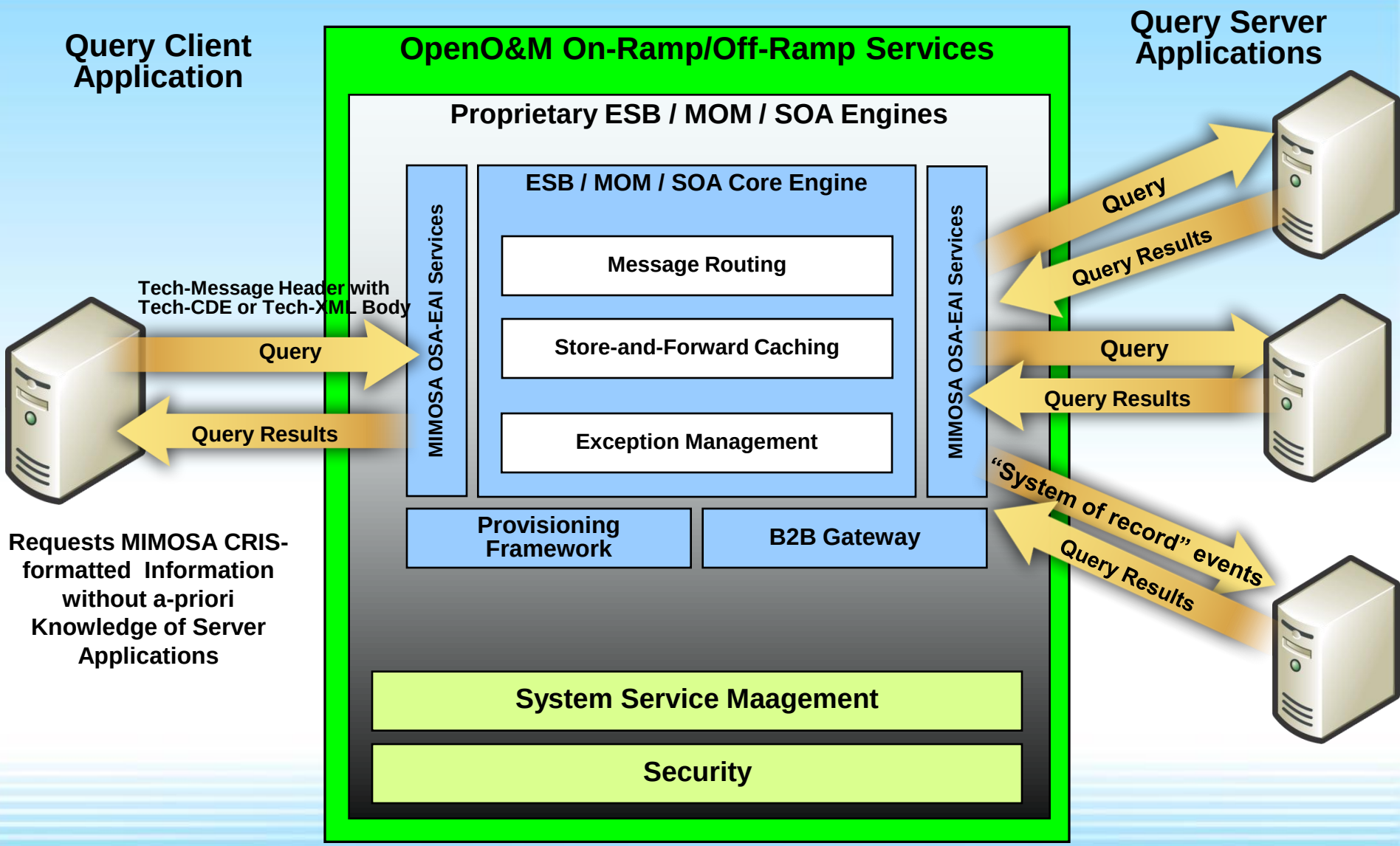
Support for Targeted "Push" Architecture



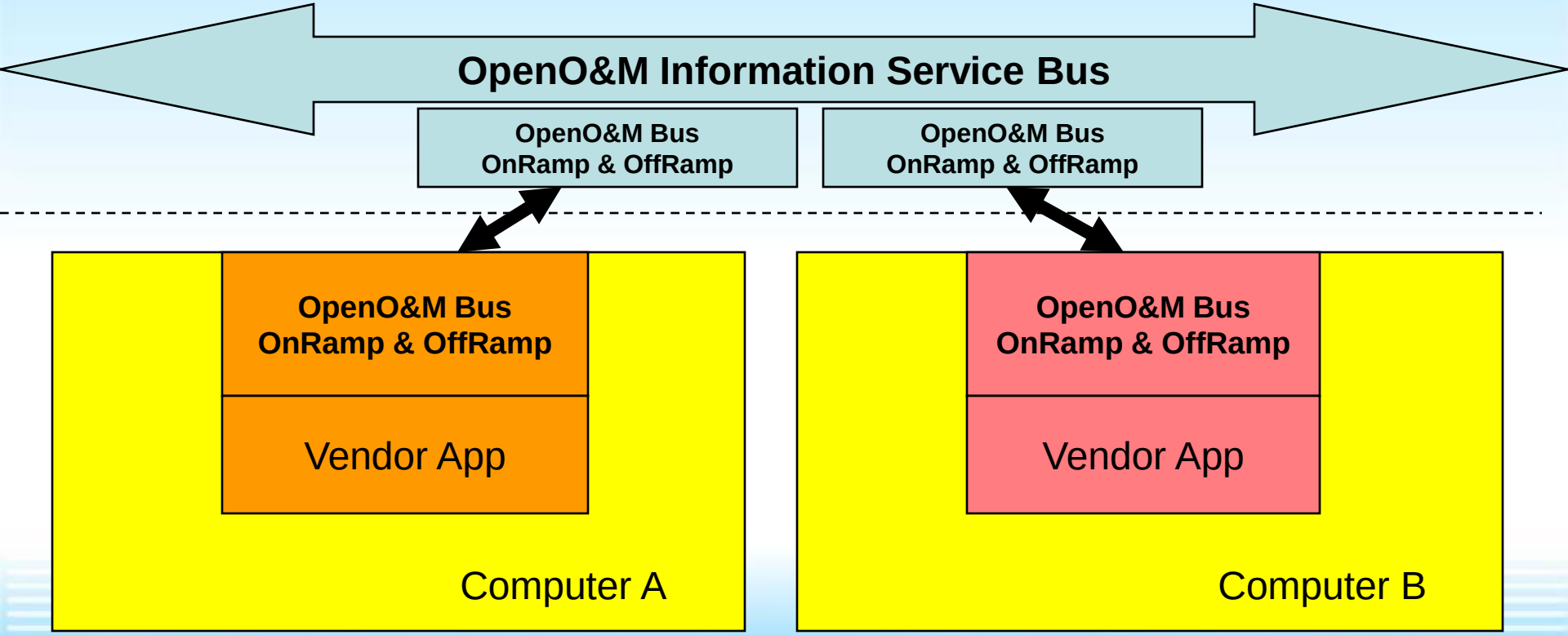
Support for Targeted "Pull" Architecture



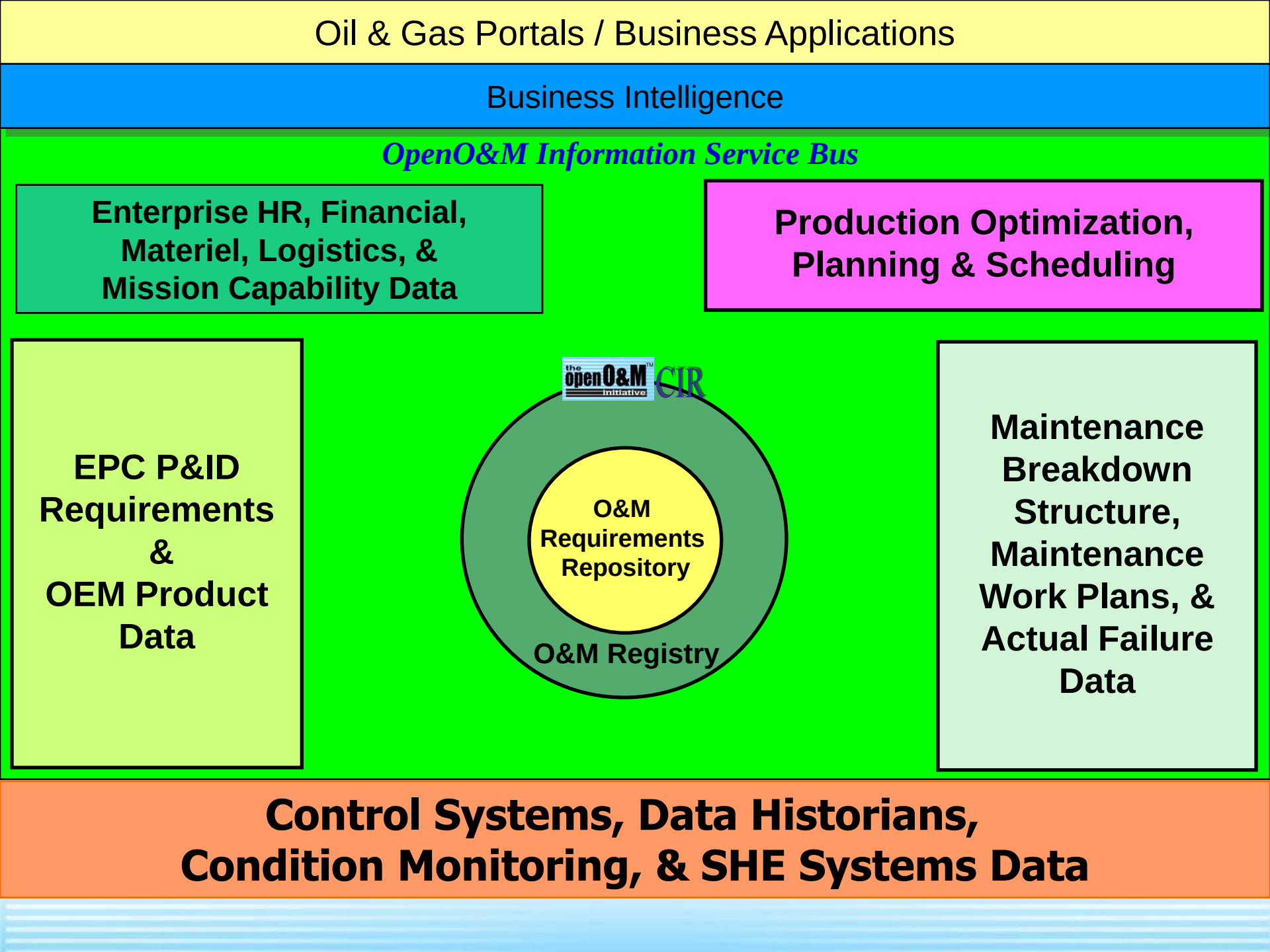
Support for Untargeted "Scatter/Gather" Architecture



OpenO&M Information Service Bus Design



Enabler #2: OpenO&M Common Interoperability Registry (CIR)


Oil & Gas Portals / Business Applications
Business Intelligence
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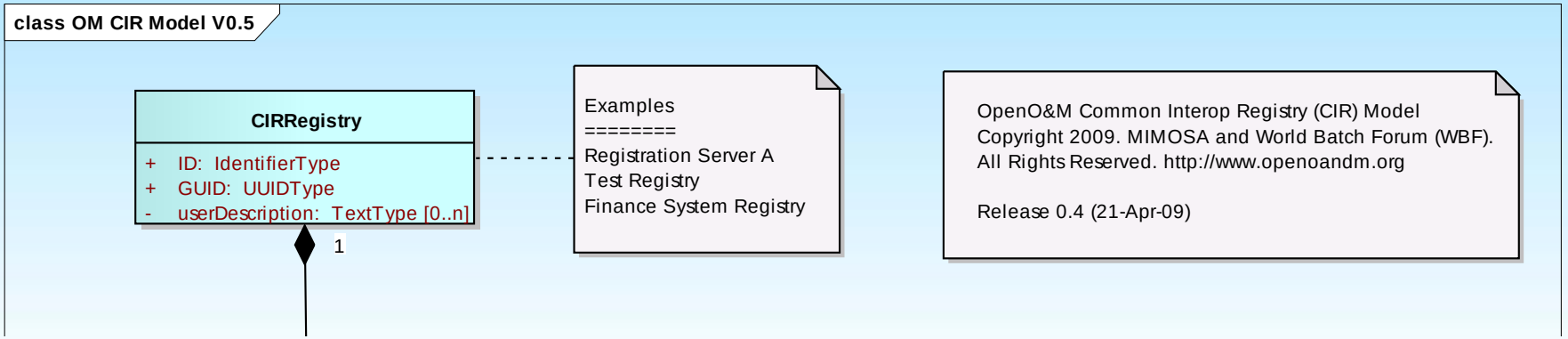
Enterprise HR, Financial, Materiel, Logistics, & Mission Capability Data
Production Optimization, Planning & Scheduling
EPC P&ID Requirements & OEM Product Data
the openO&M Initiative CIR
O&M Requirements Repository
O&M Registry
Maintenance Breakdown Structure, Maintenance Work Plans, & Actual Failure Data
Control Systems, Data Historians, Condition Monitoring, & SHE Systems Data

OpenO&M Common Interoperability Registry (CIR)

- Provides the “Yellow-Pages” lookup for all systems to locate an identical object in another system
- Glue to tie systems together which have different Identifiers for the exact same object but never had to talk “on-line” before
- Provides a globally-unique CIR Identifier (CIR Id) to link “local” object IDs

OpenO&M Common Interoperability Registry UML Model



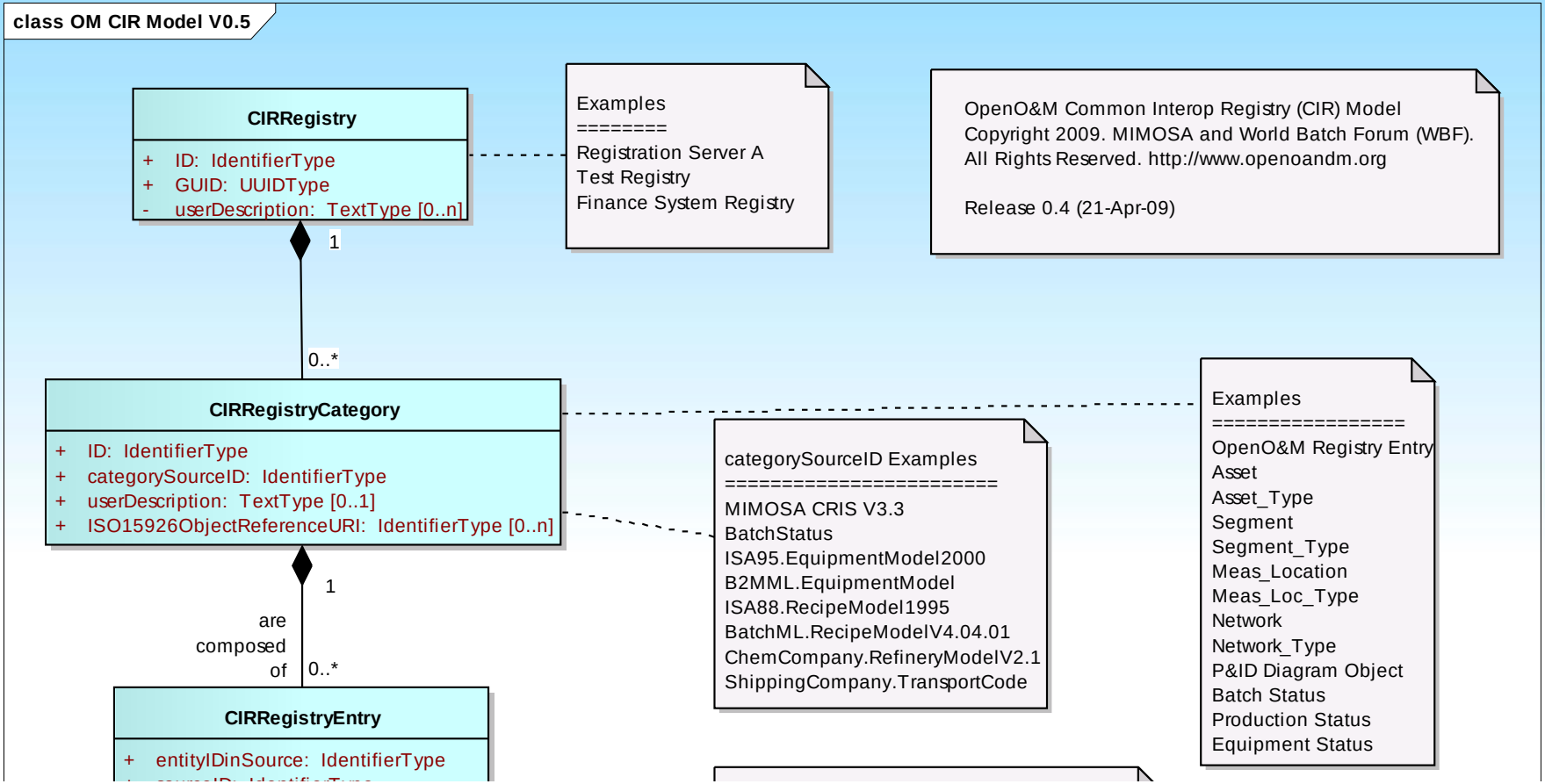
OpenO&M Common Interoperability Registry UML Model

CIRRegistry

A CIRRegistry object is the container object for a set of registration categories. Examples of multiple registries include: test registry, active registry, local site registry, global corporate registry.

ATTRIBUTES		
Attribute	**Description**	**Restrictions**
ID	User supplied ID of the registry. This must be unique within the registry server.	Required
GUID	System assigned globally unique ID for the registry. This is unique across all registry servers.	Required
userDescription	User description of the registry and expected use of the registry.	Multiple values allowed for multiple languages or alternate descriptions

OpenO&M Common Interoperability Registry UML Model



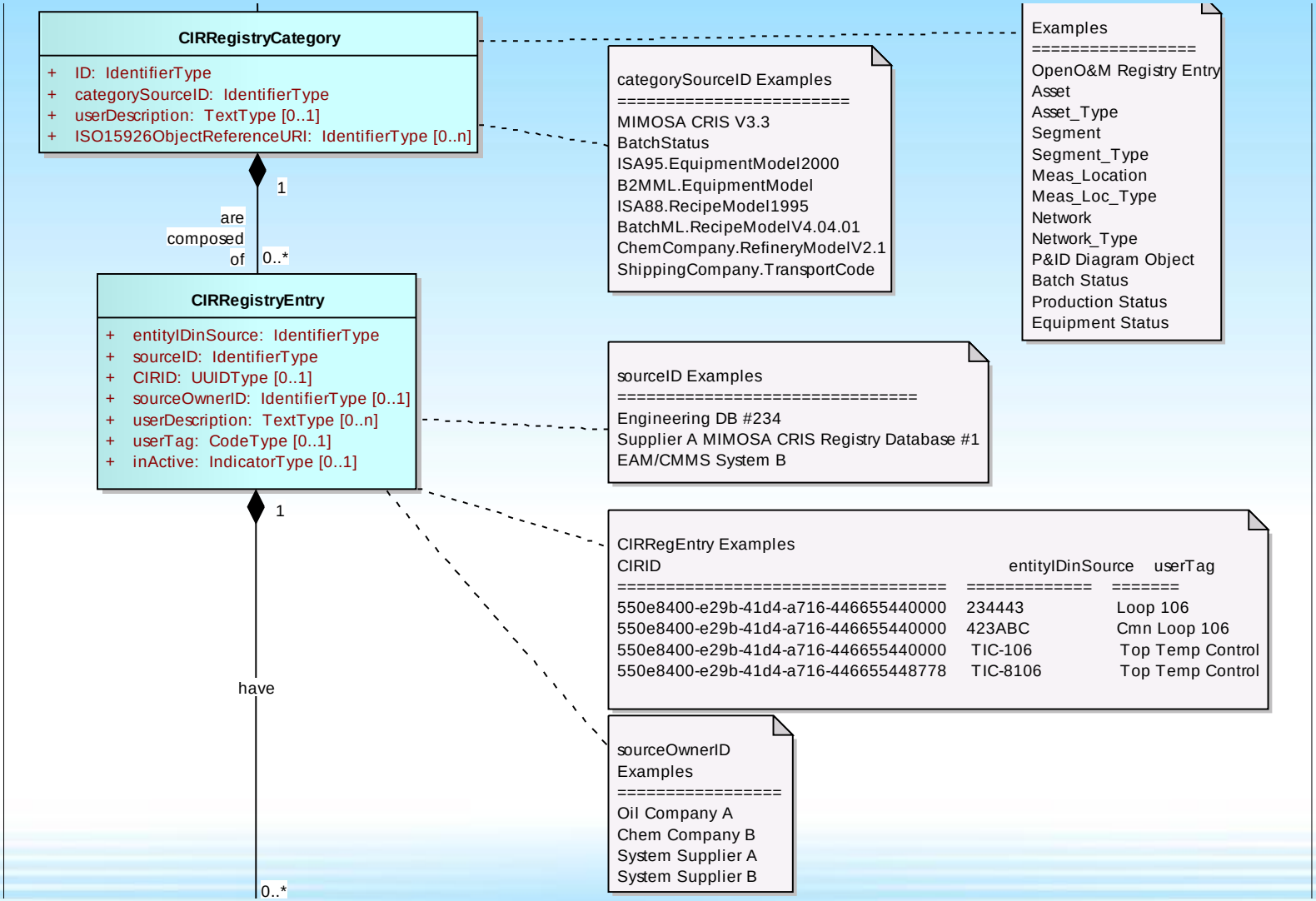
OpenO&M Common Interoperability Registry UML Model

CIRCategory

A CIRCategory object is the container object for a set of registry entries. Registry categories define sets of related, or potentially related registry entries. For example, a registry category may be defined for equipment hierarchy level names (Enterprise, Site, Area, Work Center, Work Unit), which have alternate names on different systems. The combination of ID and categorySourceID must be unique.

ATTRIBUTES		
Attribute	**Description**	**Restrictions**
ID	User supplied ID of the category	Required
categorySourceID	Identification of the category. May define the organization and specification name for the category, for example: • MIMOSA OSA-EAI V3 • ISA 88 BatchStatus • ISA 95-2000 EquipmentModel • B2MML.EquipmentModel • ISA88.RecipeModel1995 • BatchML.RecipeModelV4.04.01 • ChemCompany.RefineryModelV2.1 • ShippingCompany.TransportCode	Required
userDescription	User description of the category and expected use of the category	Multiple values allowed for multiple languages or alternate descriptions
ISO15926ObjectReferenceURI	Defines the associated part of the ISO 15926 that defines the registry category.	Optional

OpenO&M Common Interoperability Registry UML Model



OpenO&M Common Interoperability Registry UML Model

CIRRegistryEntry

A CIRRegistryEntry object defines a registry entry. Registry entries define named element and properties with an identifier local to the owning application and a possible global ID (CIRID) that defined equivalent entries in other applications.

For example the tag TC101 in system A may be the equivalent of tag UNIT101.TOP_TEMP in system B.

The assumption is that the combination of entityIDinSource and sourceID form a unique composite key within a registry category.

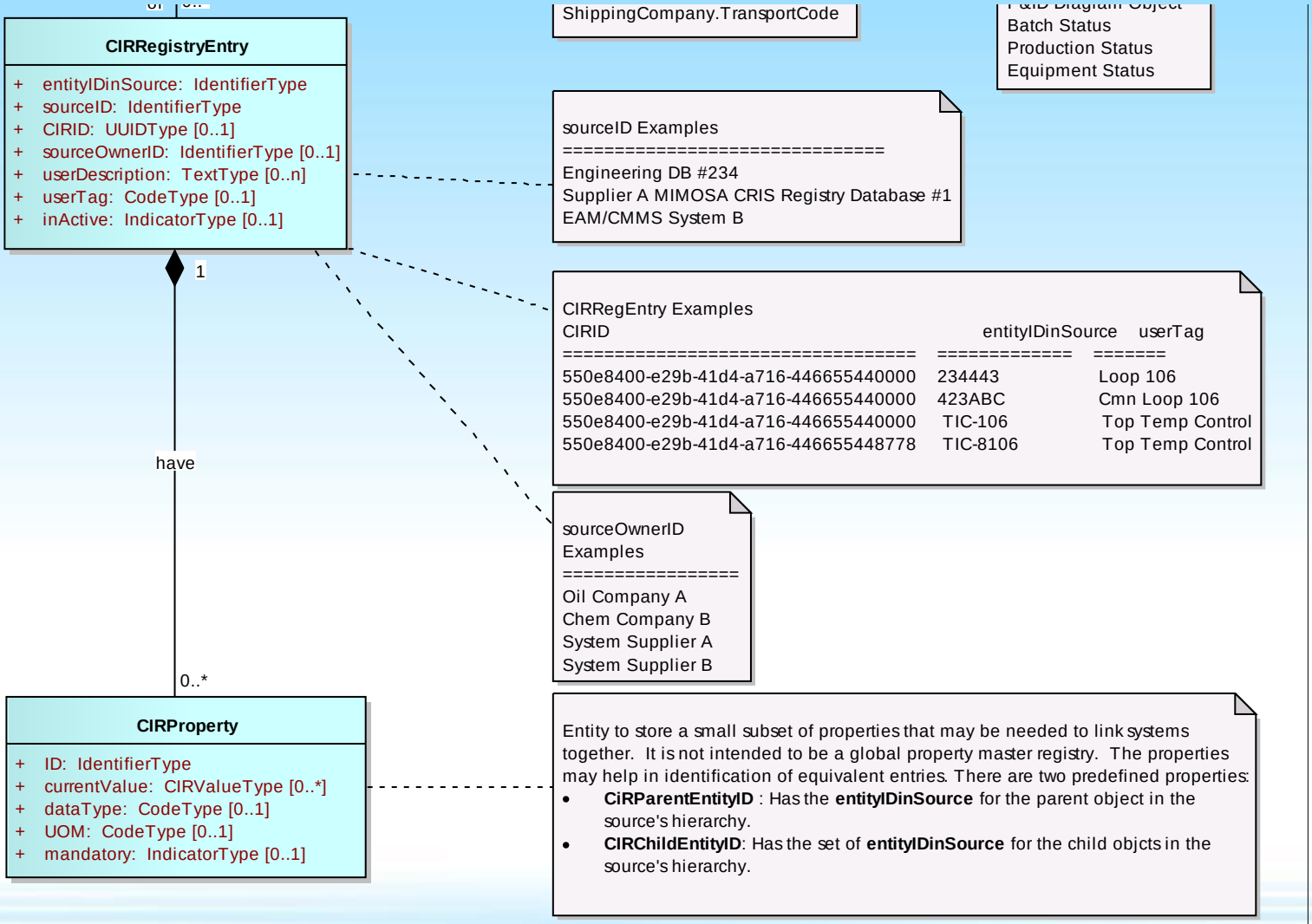
ATTRIBUTES		
Attribute	**Description**	**Restrictions**
entityIDinSource	User defined identification of the entry in the source system	Required Unique within the source system
sourceID	Identification of the source system	Required
CIRID	System assigned globally unique ID for the entry	Optional
sourceOwnerID	Organization that has responsibility for the source system or entity name space	Optional
userDescription	User description of the entry	Multiple values allowed for multiple languages or alternate descriptions
userTag	Shortcut identification of the entry, may not be unique within the source system.	Optional
inActive	Flag, if FALSE or missing indicates the entry is active and available for use. Examples of inactive entries may be data that is entered but the source system is not yet available or in use.	Optional

OpenO&M CIR“ID”

- The OpenO&M Common Interoperability Registry ID (CIRID) must be generated in compliance with the Universal Unique IDentifier (UUID) definition found in ISO/IEC 11578:1996 "Information technology – Open Systems Interconnection – Remote Procedure Call (RPC)"
- A UUID is a 16-byte (128-bit) number. The number of theoretically possible UUIDs is therefore 216*8 = 2128 = 25616 or about 3.4 × 1038. To understand the quantity which this represents, 1 trillion UUIDs would have to be created every nanosecond for slightly more than 10 billion years to exhaust the number of UUIDs.
- In its canonical form, a UUID consists of 32 hexadecimal digits, displayed in 5 groups separated by hyphens, in the form 8-4-4-4-12 for a total of 36 characters(32 digits and 4 '-'). For example:

550e8400-e29b-41d4-a716-446655440000

OpenO&M Common Interoperability Registry UML Model



OpenO&M Common Interoperability Registry UML Model

CIRProperty

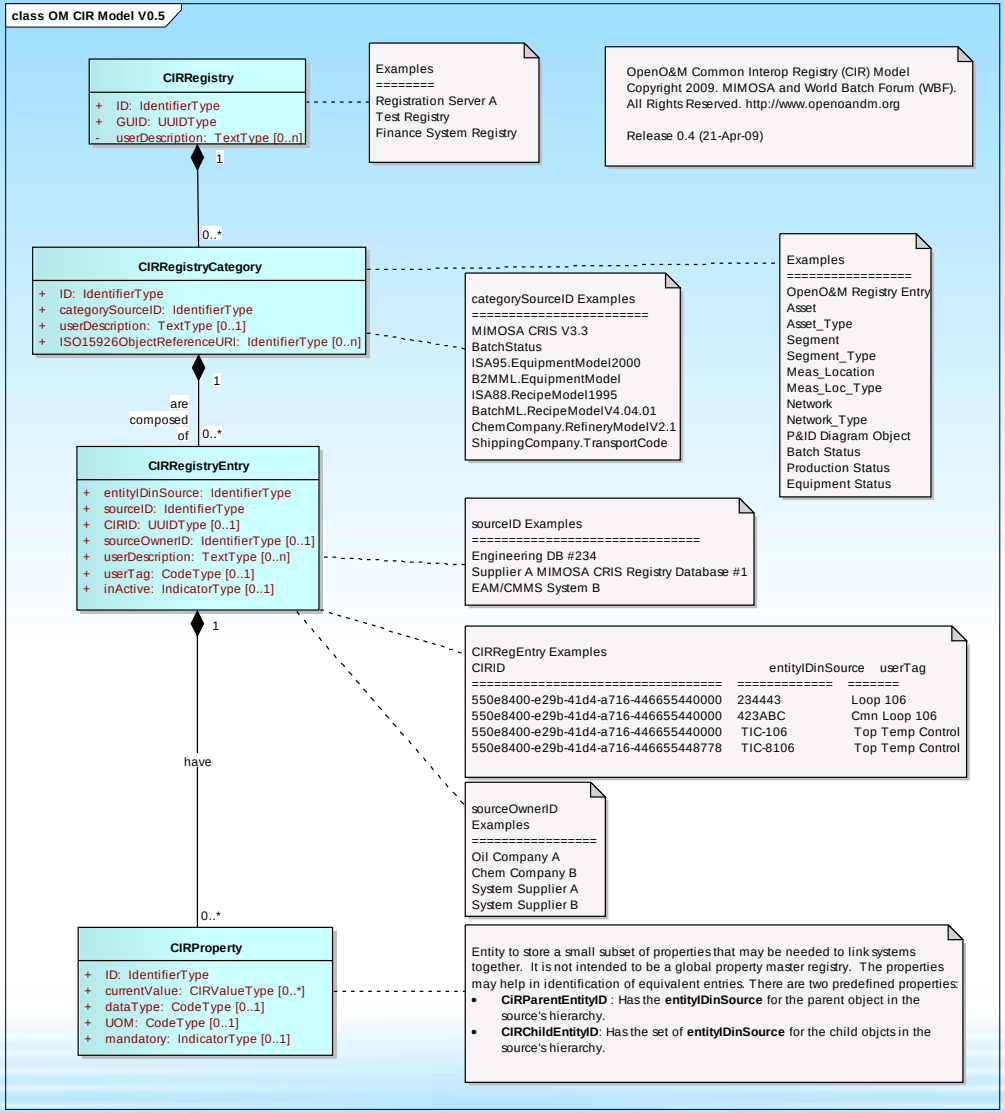
A CIRProperty object defines a property of a registry entry. Properties may be used to help identify equivalent registry entries. The properties should be a small set of properties that may be needed to link systems together, and not intended to be a global property master registry.

There are two predefined properties that should be used to identify an entry's position in a source's hierarchy:

1. **CIRParentEntityID**: Has the entityIDinSource for the parent object in the source's hierarchy.
2. **CIRChildEntityID**: Has the set of entityIDinSource for the child objects in the source's hierarchy.

ATTRIBUTES		
Attribute	**Description**	**Restrictions**
ID	User defined identification of the property	Required Unique within the list of entry properties
currentValue	Current value of the property	Optional Multiple values with value key to provide for alternate values for identification
dataType	Data type of the current value	Optional
UOM	Unit of measure of the current value	Optional
mandatory	Flag that indicates if a value is required	Optional

OpenO&M Common Interoperability Registry UML Model



UNCEFACT Core Components

- **UN/CEFACT Core Component Types**
- **The base types for most OpenO&M and MIMOSA XML Schema elements are derived from core component types that are compatible with the UN/CEFACT core component types. The UN/CEFACT core component types are a common set of types that define specific terms with semantic meaning (e.g. the meaning of a quantity, currency, amount, identifier,…). The UN/CEFACT core components were defined in a Core Components Technical Specification (CCTS) developed by the ebXML project now organized by UN/CEFACT and ISO TC 154.**
- **The core components use several international standards for the representation of semantic and standardized information:**

Name	Standard
Country Code	ISO 3166.1
Region Code	ISO 3166.2
Language Code	ISO 639: 1988
Currency Code	ISO 4217
Date and Time Representation	ISO 8601
Unit Of Measure Code	UN/ECE Recommendation 20
Unit of Transport or Packaging Code	UN/ECE Recommendation 21

UNCEFACT Core Components

AmountType is used to define a number of monetary units specified in a currency where the unit of currency is explicit or implied. It is derived from a **decimal**.

Optional Attribute	Base XML Type	Description
currencyID	normalizedString	An identifier specifying the identification of a currency code. Reference UN/ECE Rec 9, using 3-letter alphabetic codes, also available as ISO 4217.
currencyCodeListVersionID	normalizedString	An identifier specifying the version of the currency code. The version of the UN/ECE Rec.9 code list.

UNCEFACT Core Components

BinaryObjectType is used to define a data types representing graphics, pictures, sound, video, or other forms of data that can be represented as a finite length sequence of binary octets. It is derived from base64Binary.

Optional Attribute	Base XML Type	Description
format	string	The format of the binary content. No identifiers for standard formats are defined.
mimeCode	normalizedString	The mine type of the binary object. See IETF RFC 2045, 2046, and 2047.
encodingCode	normalizedString	Specifies the decoding algorithm of the binary object. See IETF RFC 2045, 2046, and 2047.
characterSetCode	normalizedString	The character set of the binary object if the mime type is text. See IETF RFC 2045, 2046, and 2047.
uri	anyURI	The Uniform Resource Identifier that identifies where the binary object is located.
filename	string	The filename of the binary object. See IETF RFC 2045, 2046, and 2047.

UNCEFACT Core Components

CodeType is used to define a character string that is used to represent a entry from a fixed set of enumerations. It is derived from the type **normalizedString**.

Optional Attribute	Base XML Type	Description
listID	normalizedString	An Identifier specifying the identification of a code list that this is registered with at an agency. For example: UN/EDIFACT data element 3055 code list
listAgencyID	normalizedString	An Identifier specifying the agency that maintains one or more lists of codes. For example: UN/EDIFACT.
listAgencyName	string	Text that contains the name of the agency that maintains the list of codes.
listName	string	Text that contains the name of a code list that this is registered with at an agency.
listVersionID	normalizedString	An Identifier specifying the version of the code list.
name	string	Text equivalent of the code content component.
languageID	language	An Identifier specifying the language used in the code name.
listURI	anyURI	The Uniform Resource Identifier (URI) that identifies where the code list is located.
listSchemaURI	anyURI	The Uniform Resource Identifier (URI) that identifies where the code list scheme is located.

UNCEFACT Core Components

DateTimeType is used to define a particular point in time together with the relevant supplementary information to identify the timezone information. It is derived from the type **dateTime**. This is a specific instance on time using the ISO 8601 CE (Common Era) calendar extended format and abbreviated versions. For example:

yyyy-mm-ddThh:mm:ssZ for UTC as “2002-09-22T13:15:23Z”

Optional Attribute	Base XML Type	Description
format	string	A string specifying the format of the date time content, however the format of the format attribute is not defined in UN/CEFACT specification.

UNCEFACT Core Components

IdentifierType is used to define a character string to identify and distinguish uniquely, one instance of an object in an identification scheme from all other objects in the same scheme. It is derived from the type **normalizedString**.

Optional Attribute	Base XML Type	Description
schemaID	normalizedString	An Identifier specifying the identification of the identification schema.
schemaName	string	Text that contains the name of the identification scheme.
schemaAgencyID	normalizedString	An Identifier specifying the identification of the agency that maintains the schema.
schemaAgencyName	string	Text containing the identification of the agency that maintains the schema.
schemaVersionID	normalizedString	The version (as an Identifier) of the schema.
schemaDataURI	anyURI	The Uniform Resource Identifier (URI) that identifies where schema data is located.
schemaURI	anyURI	The Uniform Resource Identifier (URI) that identifies where schema is located.

UNCEFACT Core Components

IndicatorType is used to define a list of two mutually exclusive Boolean values that express the only possible states of a Property. For example "**True**" or "**False**". It is derived from the type **string**.

Optional Attribute	Base XML Type	Description
format	string	A string specifying whether the indicator is numeric, textual or binary; however the format of the format attribute is not defined in UN/CEFACT specification.

UNCEFACT Core Components

MeasureType is used to define a numeric value determined by measuring an object along with the specified unit of measure. It is derived form type **decimal**.

Optional Attribute	Base XML Type	Description
unitCode	normalizedString	The type of unit of measure. See UN/ECE Rec 20. and X12 355.
unitCodeListVersionID	normalizedString	The version of the unit of measure code list.

UNCEFACT Core Components

NumericType is used to define a numeric value determined by measuring an object along with the specified unit of measure. It is derived from the type **decimal**.

Optional Attribute	Base XML Type	Description
format	string	Specifies if the number is an integer, decimal, real number, or percentage. No standard identifiers defined.

UNCEFACT Core Components

QuantityType is used to define a counted number of non-monetary units, possibly including fractions. It is derived from the type **decimal**.

Optional Attribute	Base XML Type	Description
unitCode	normalizedString	The unit of the quantity. May use UN/ECE Rec. 20.
unitCodeListID	normalizedString	The identification of the code list for the quantity unit of measure.
unitCodeListAgencyID	normalizedString	The identification of the agency that maintains the quantity unit code list.
unitCodeListAgencyName	string	The name of the agency that maintains the quantity unit code list.

UNCEFACT Core Components

TextType is used to define a character string (i.e. a finite set of characters) generally in the form of words of a language. It is derived from the type **string**.

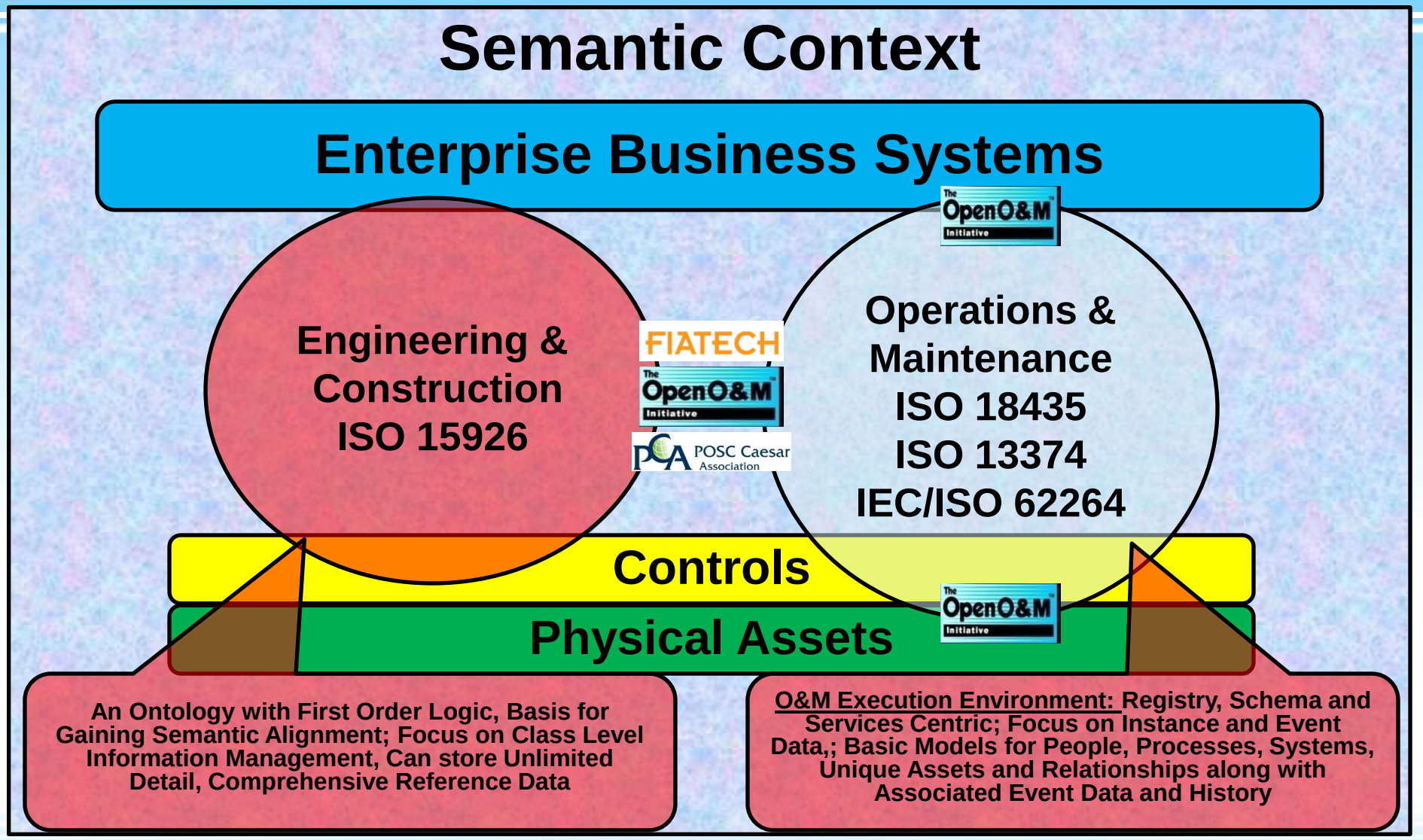
Optional Attribute	Base XML Type	Description
languageID	language	An Identifier specifying the the language used in the content component.
languageLocaleID	normalizedString	An Identifier specifying the locale of the language

OpenO&M Common Interoperability Registry

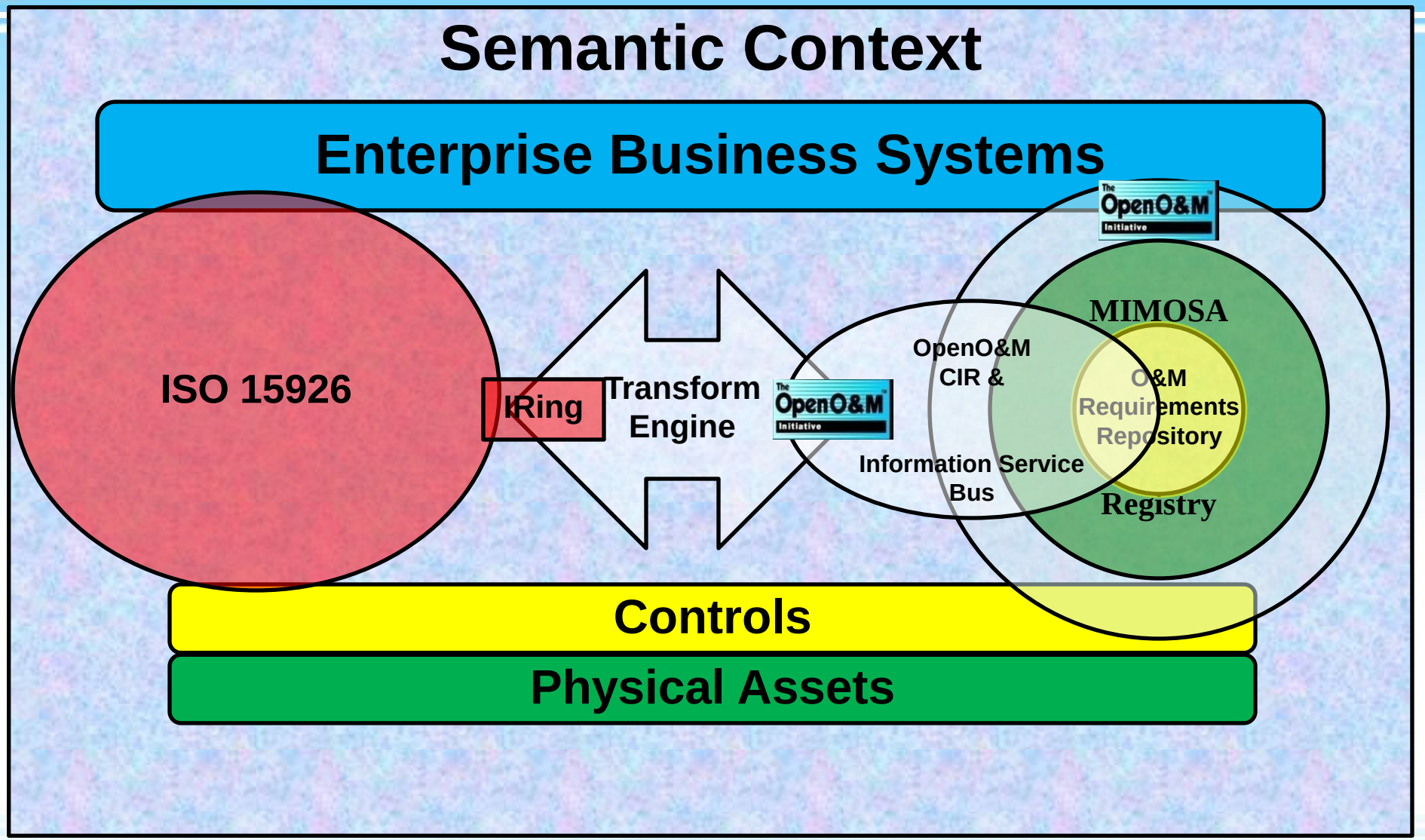
CIRML-Registry-V0.6.xsd

XML Schema File

Context for Collaboration: Bringing Enterprise Business Systems Together with Engineering and O&M Systems – Oil and Gas Upstream Model



Context for Collaboration: Bringing Enterprise Business Systems Together with Engineering and O&M Systems – Oil and Gas Upstream Model



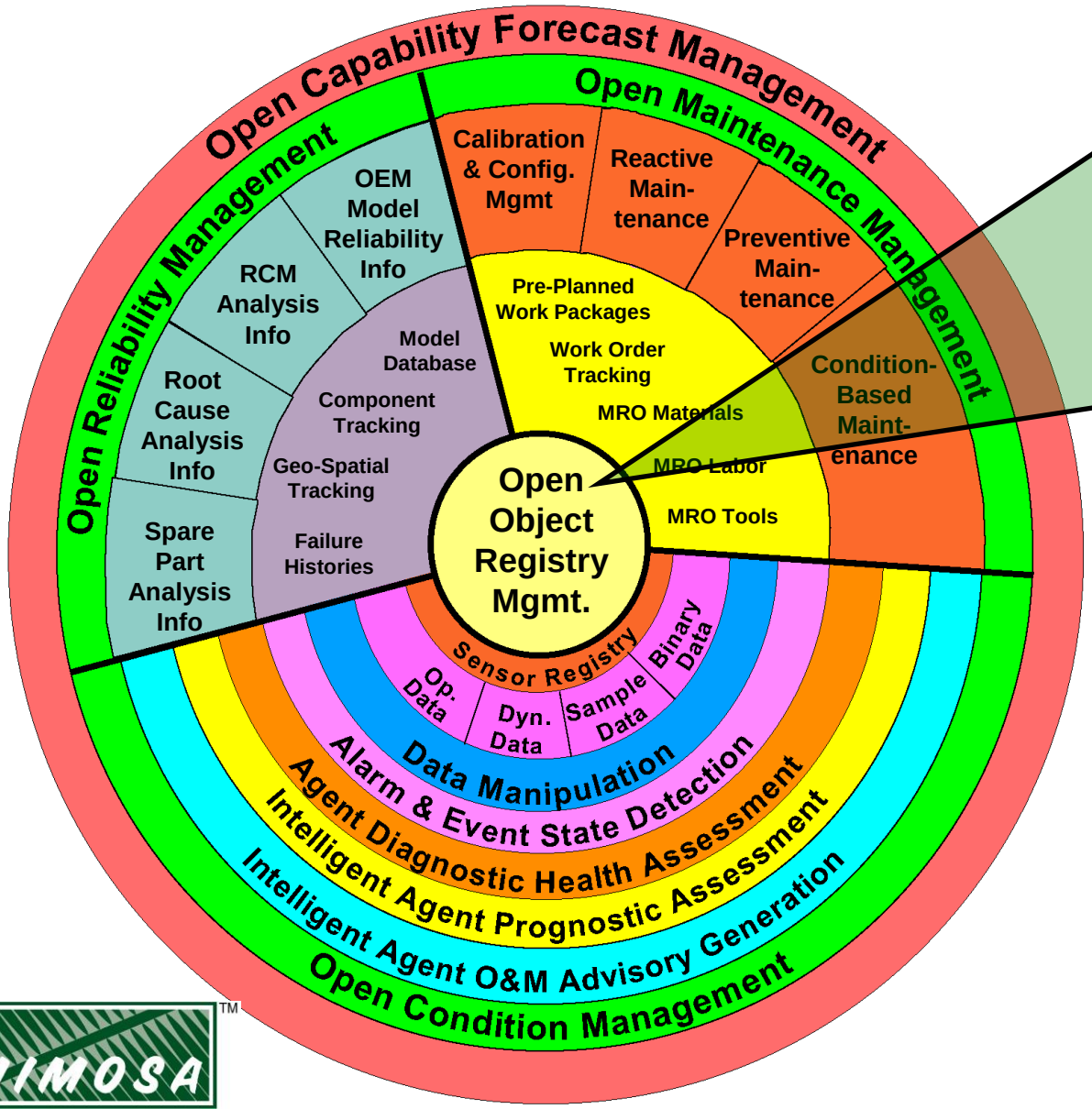
ISO 15926

- **ISO-15926:** Integration of life-cycle data for process plants, including oil and gas production facilities
  - A standard for interoperability of Engineering Design Information
- Provides specifications for:
  - Terminology – common set of names
  - Meaning – vital for correctly interpreting information
  - Implementations – how software systems connect to each other
- Implemented using standards from the World Wide Web Consortium (W3C)
- Is a thorough and rigorous approach to solving interoperability – a one stop shop!

ISO 15926 Benefits

- Standardized approach to interoperability
  - Enables the reusability of your interoperability investments; cost avoidance
  - Higher accuracy of information exchange and interpretation
  - Faster setup time
  - Leverage growing knowledge and expertise
  - Extensible – agile approach that will adopt to business changes
  - Sets the path for true integration and interoperability “plug and play” between application systems
  - Leverages internet protocols and technologies
  - An interoperability solution that will scale within project, enterprise, and joint venture deployments
  - Growing support from our key software suppliers

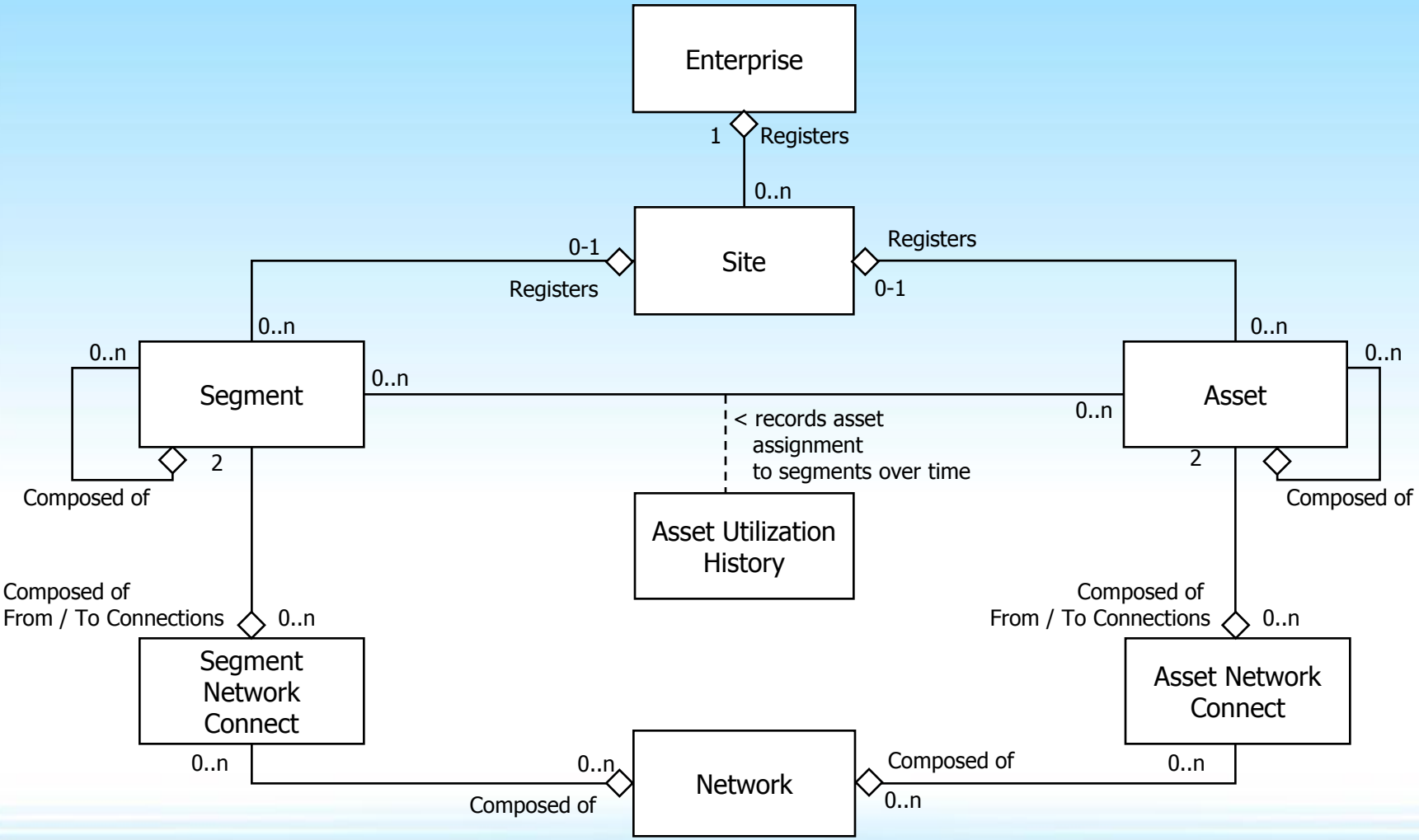
MIMOSA Open Systems Architecture for Enterprise Application Integration (OSA-EAI)



The MIMOSA Open Object Registry Is a Core O&M Interoperability Enabler for Asset Intensive Industries.

- **It provides a full mesh network for maintaining interrelationships between people, processes and systems in a Services Oriented Architecture.**
- **Unlike traditional Master Data Management (MDM), it is designed to support the highly dynamic requirements of physical asset management such as configuration management.**

MIMOSA OSA-EAI Objects



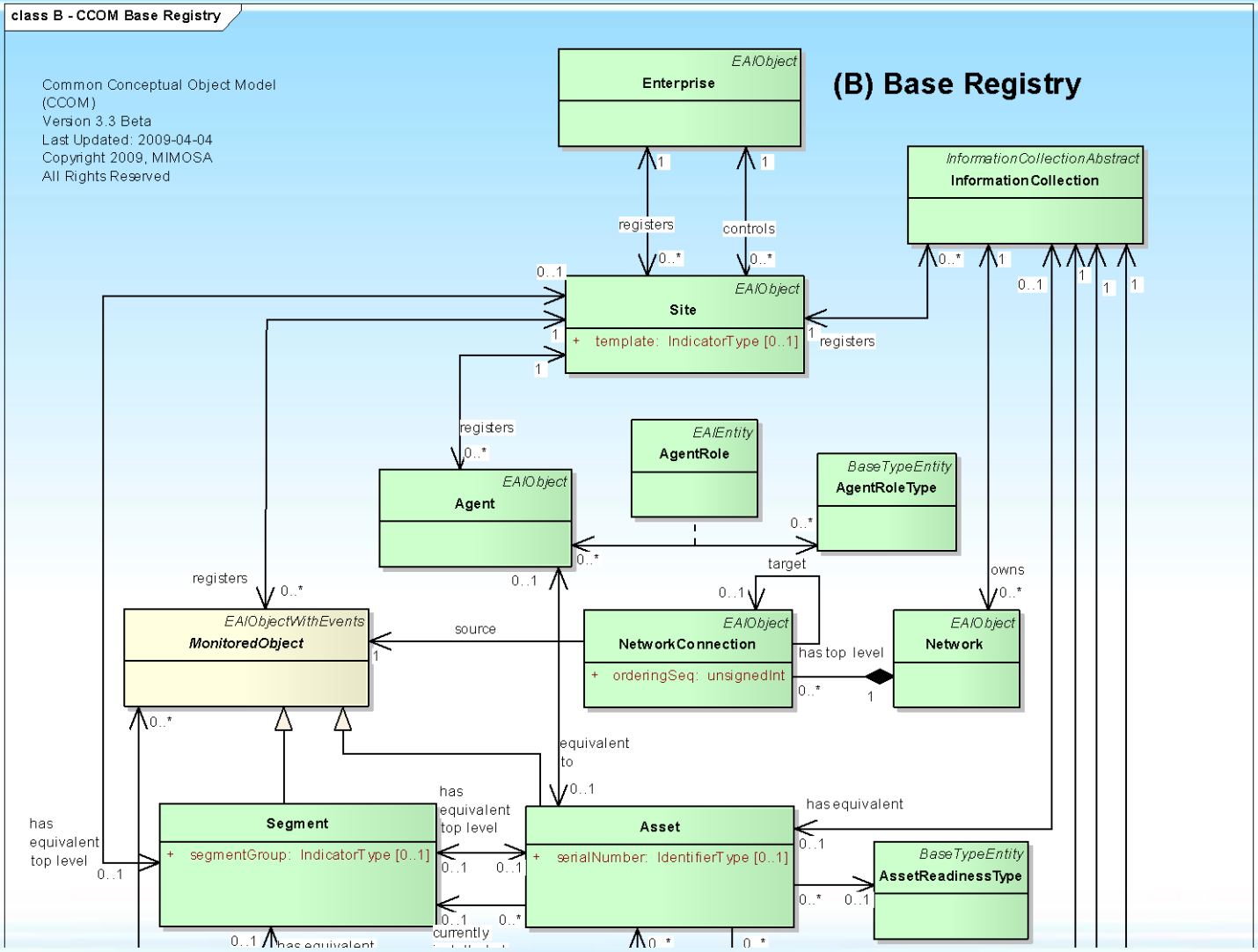
MIMOSA OSA-EAI Objects

- Is it an Asset?
  - An object is an Asset if it meets one of these criteria:
    - Could be depreciated in a financial system
    - Could be tracked by serial number
    - Could be transferred/sold and utilized/installed at a different Segment possibly associated with another Site at another Enterprise

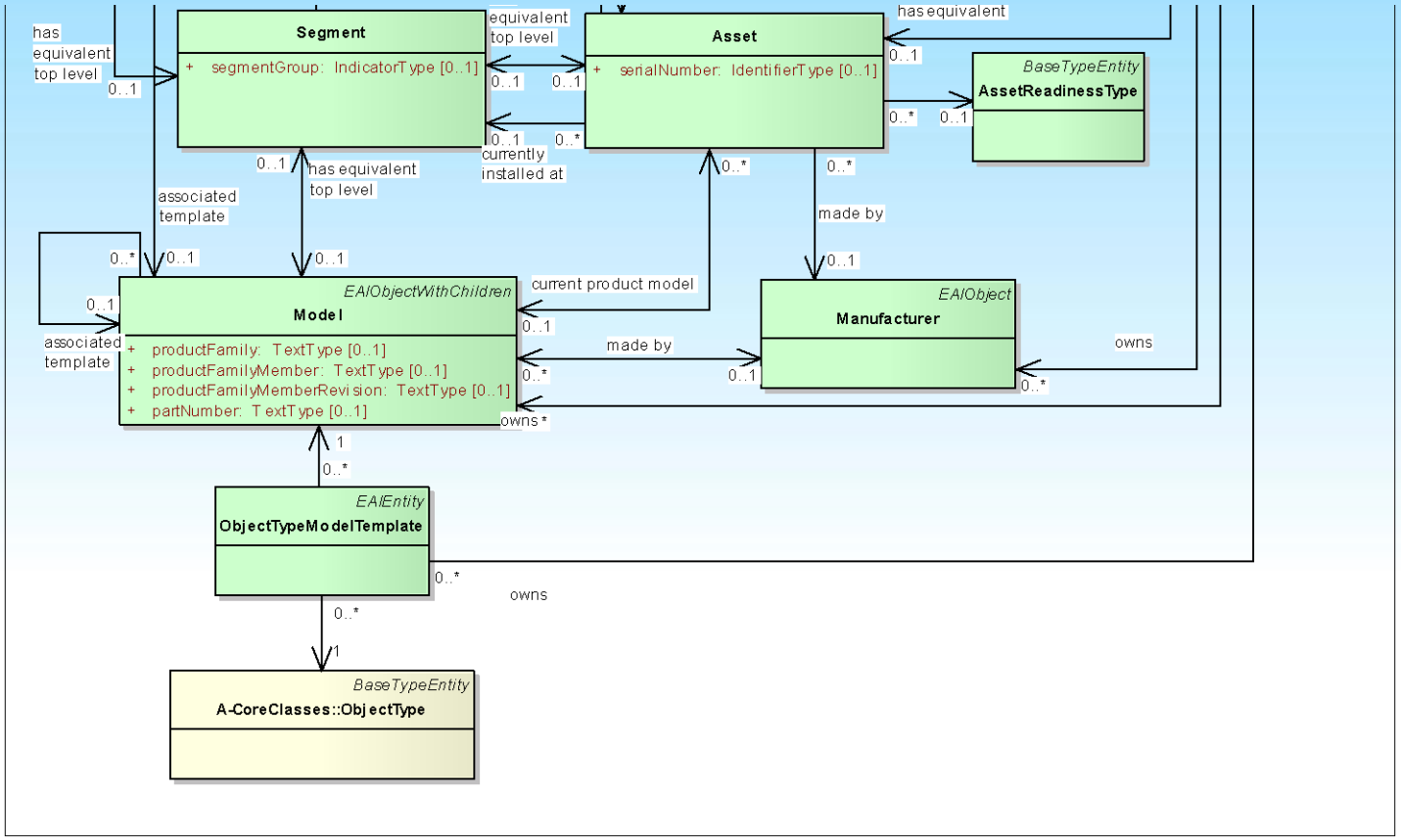
MIMOSA OSA-EAI Objects

- Is it a Segment?
  - A functional location where various Assets can be installed over time

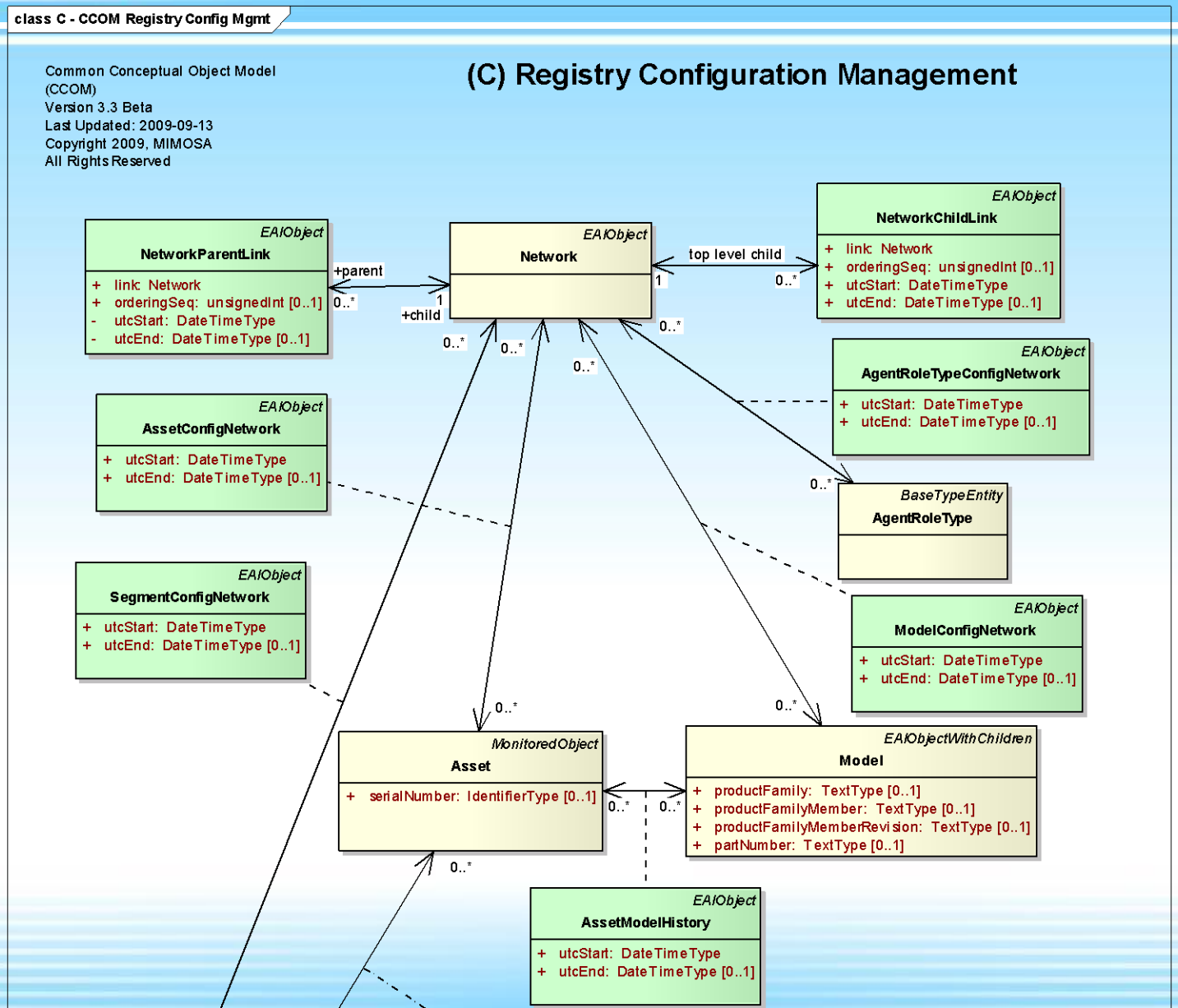
OSA-EAI CCOM Representation



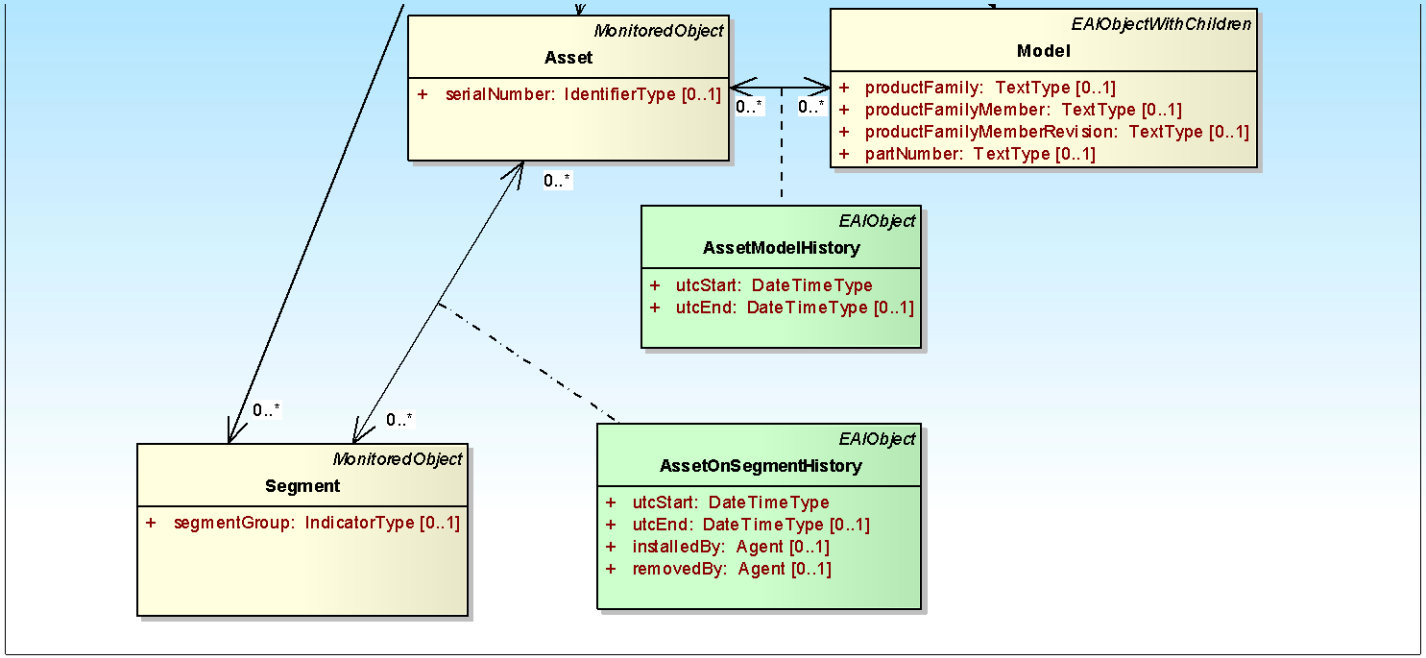
OSA-EAI CCOM Representation



OSA-EAI CCOM Representation



OSA-EAI CCOM Representation



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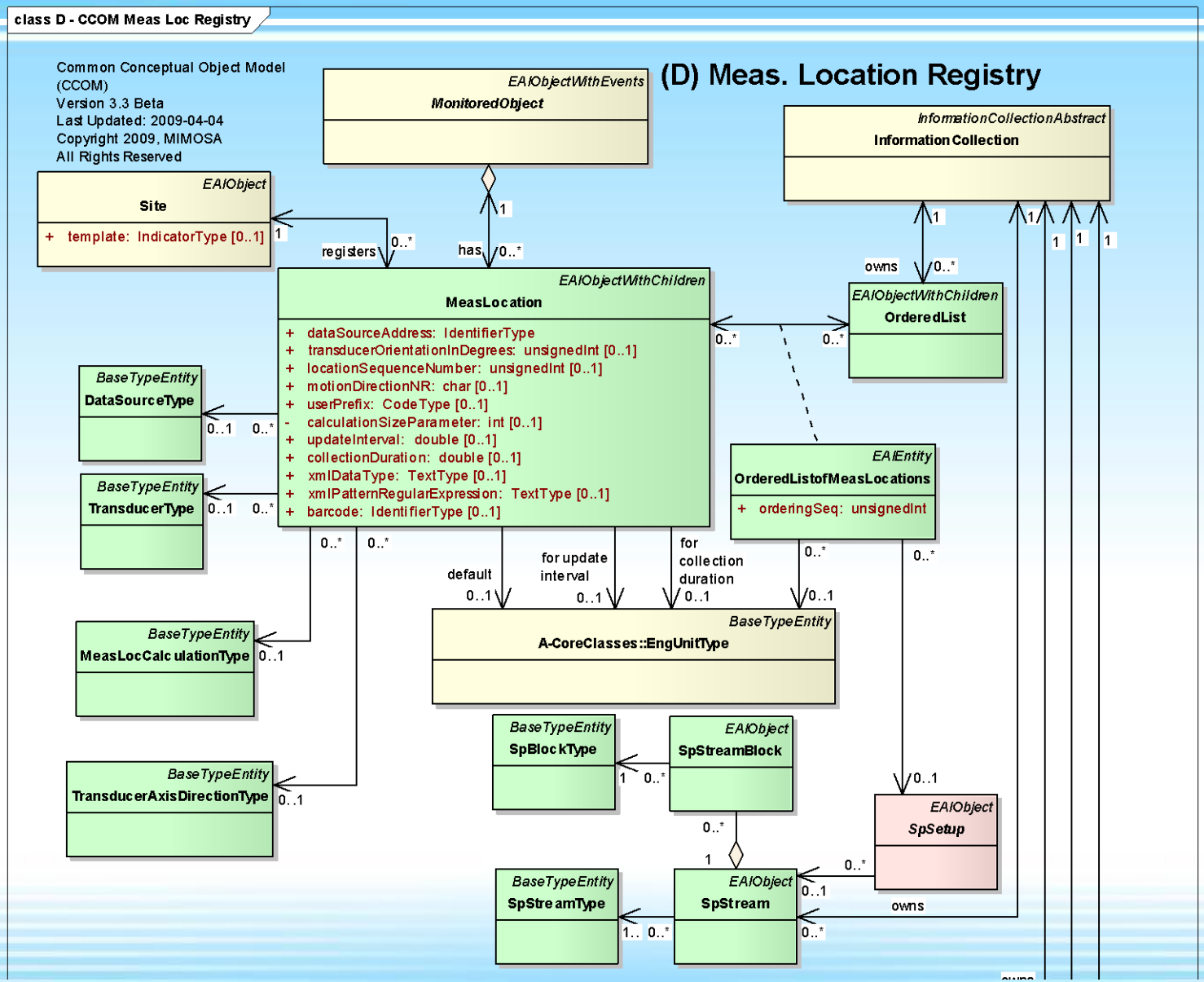

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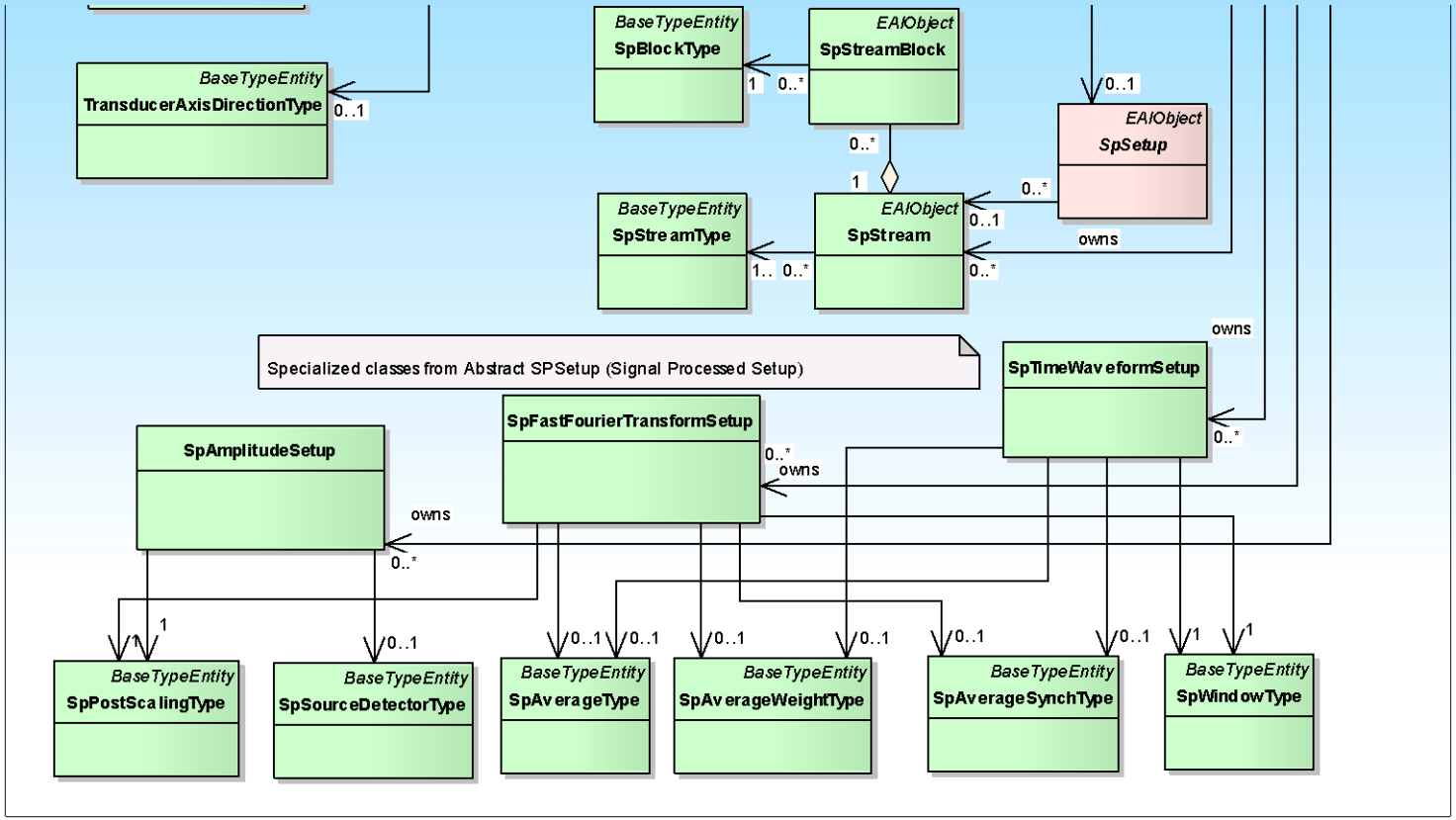
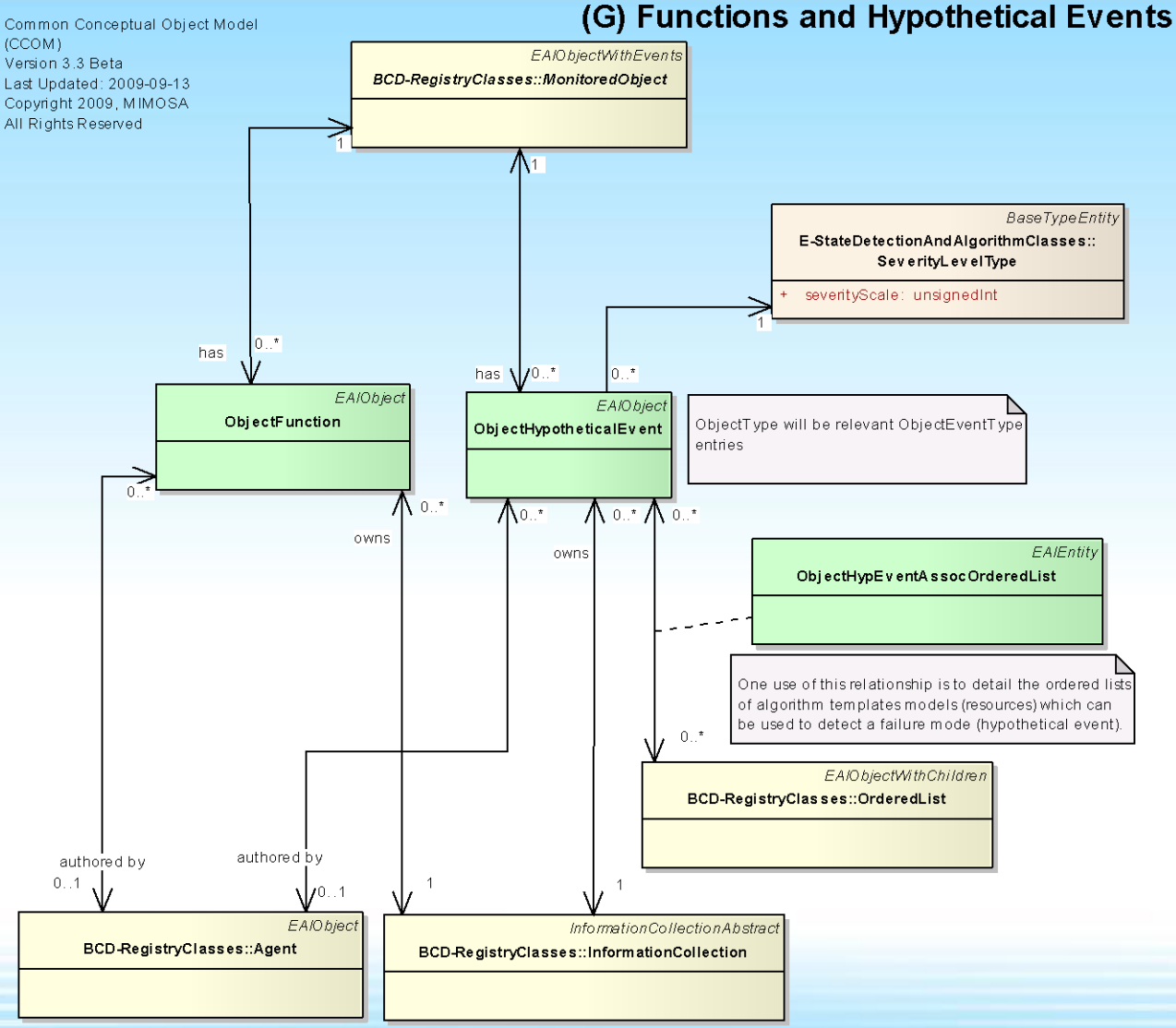


OSA-EAI CCOM Representation

class G - CCOM Functions and Hyp Event

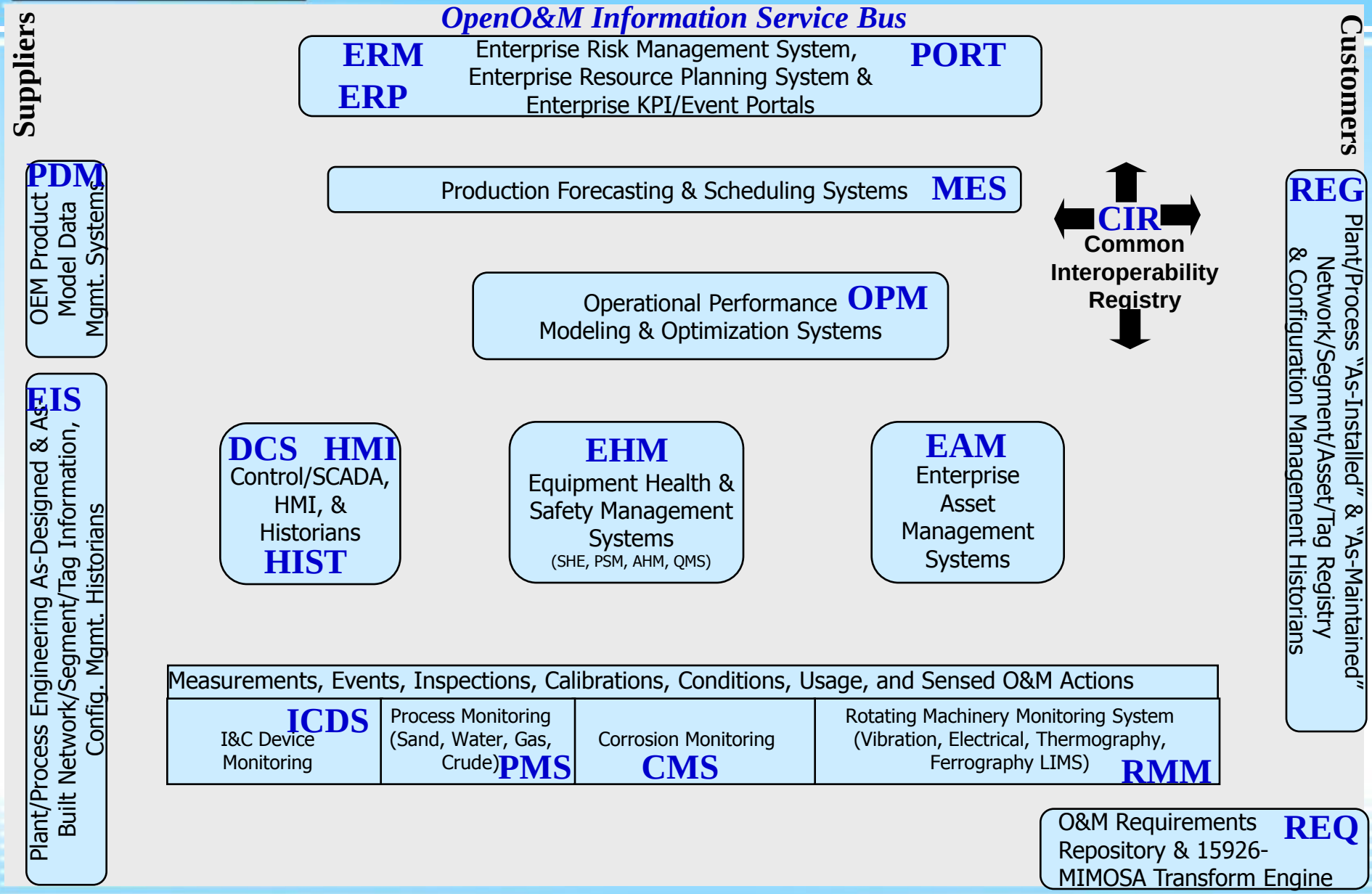


Use Cases Associated with Open Interoperability Scenarios With Standards Utilized

Systems Requiring Interoperability With Abbreviations

- **CMS:** Condition Monitoring System
- **DCS:** Distributed Control System
- **DEV:** Instrumentation & Control Device Monitoring System
- **EAM:** Enterprise Asset Management (Maintenance Management) System
- **EHM:** Equipment Health & Safety Management Systems
- **EIS:** Engineering Information System (Plant/Process Engineering As-Designed & As-Built Network/Segment/Tag Information, Configuration Management Historian)
- **ERM:** Enterprise Risk Management System
- **ERP:** Enterprise Resource Planning System
- **HIST:** Process/Asset Data Historian System
- **HMI:** Human-Machine Interface (Operator Console) System
- **ICDS:** Instrumentation & Control Device Monitoring System
- **ISB:** Information Service Bus
- **LIMS:** Lab Information Management System
- **MES:** Manufacturing Execution System / Production Forecasting & Scheduling System
- **OPM:** Operational Performance Modeling & Optimization System
- **ORM:** Operational Risk Management System such as EH&S, PSM, AHM, QMS
- **PDM:** Product Data Management (As-Designed Product/Part Model Identification and Data Sheets, As-Built Asset identification and Data Sheets)
- **PORT:** Enterprise KPI/Event Portal
- **PSM:** Process Safety Management System
- **QMS:** Quality Management System
- **REG:** As-Installed & Maintained Plant/Process Nework/Segment/Asset/Tag Registry & Configuration Management Historian System
- **REQ:** O&M Requirements Repository and 15926-MIMOSA Transform Engine System
- **RMM:** Rotating Machinery Monitoring & Analysis System (Vibration, Electrical, Thermography, Ferrography LIMS)
- **SHE:** Safety, Health, and Environmental System

Oil & Gas/PetroChem Industry OpenO&M Interoperability Scenarios



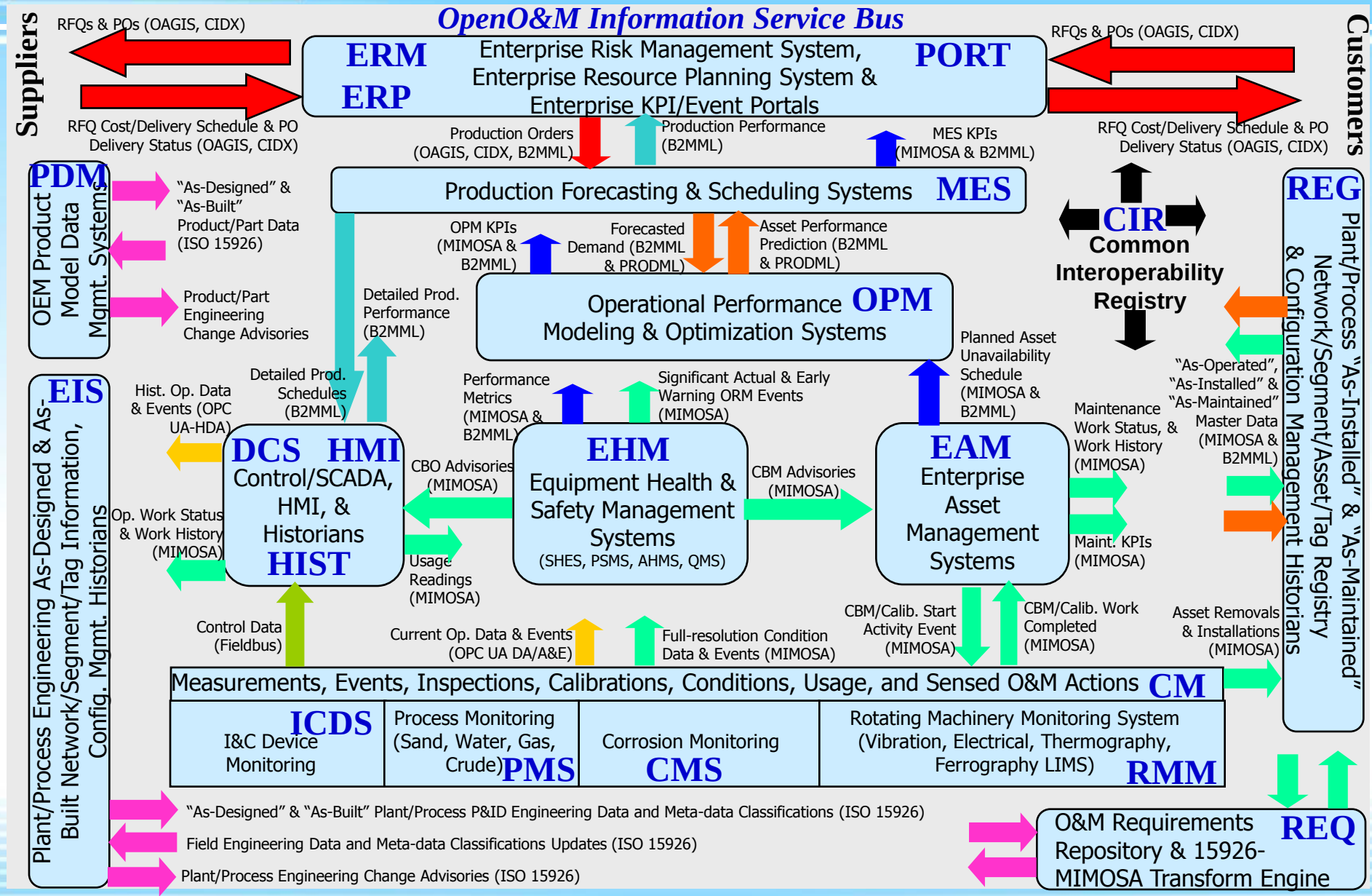
Oil & Gas/PetroChem Industry OpenO&M Interoperability Scenarios

NOTE: Arrows with Do Not Connect Directly to Another System Publish Information Which Can Be Subscribed to By Multiple Systems

Open Standards Which Define Data Content for Information Exchange:

- **OAGIS, CIDX**
- **OpenO&M Common Interop. Registry**
- **ISO 15926 / IRING**
- **B2MML**
- **B2MML & PRODML**
- **MIMOSA & B2MML**
- **MIMOSA**
- **OPC**
- **Fieldbus (Foundation, Profibus, etc.)**

Oil & Gas/PetroChem Industry OpenO&M Interoperability Scenarios (Complete)



What's Needed Now … ??

- An Open Architecture Solution to Integrate process/operational, maintenance, and business systems, applications and processes - to be used by *EVERYBODY*
- NOT more research.
- The Design is logical, thorough, demonstrable, and can be implemented with current technology.
- All software vendors to write Adapters to 'talk' OpenO&M
- Owner/Operators to demand compliance to OpenO&M standards in their specifications, RFPs, RFQs
- Concerted/Dedicated Effort to drive OpenO&M solution to cross-industry implementations – multiple coodinated ***Pilot Projects***
- An Organization to promote, manage, and steward the implementation process and, eventually, compliance to the standard
- **Get Involved – *Lead, Follow, Support … !!***