Enterprise Data Validation Architecture (EDVA):

Fixing Data Quality for Enterprise Interoperability

Cambridge, Massachusetts, USA

July 18-19, 2007

Bill McMullen

Outline

- Purpose
- Nature of the Problem
- Elements of a Solution
- Business Case Considerations
- Q&A

Business Enterprise Architecture (BEA) & Enterprise Transition Plan (ETP)
September 2006

An Objective – "Transform the Department's supply chain information environment by: 1) improving data integrity and visibility by defining, managing, and utilizing item, customer, and vendor master data; and 2) reducing complexity and minimizing variability on the supply chain business transactions by adopting standardized transaction and business rules."

Department of Defense

Enterprise Architecture Federation Strategy

Draft Version 1.0

18 September 2006

Prepared by the DoD CIO

DoD 8320.02-G

Guidance for Implementing Net-Centric Data Sharing

April 12, 2006
Assistant Secretary of Defense for Networks and Information Integration/ Department of Defense Chief Information Officer

CHAPTER 4 - DATA SHARING IMPLEMENTATION

C4.1. CHAPTER OVERVIEW
C4.2. MAKING DATA VISIBLE
C4.3. MAKING DATA ACCESSIBLE
C4.4. MAKING DATA UNDERSTANDABLE
C4.5. PROMOTING TRUST

Purpose

- Purpose of Briefing

  Provides an overview of an Enterprise Data Validation Engine

  (This may be an important management option for certain business cases.)

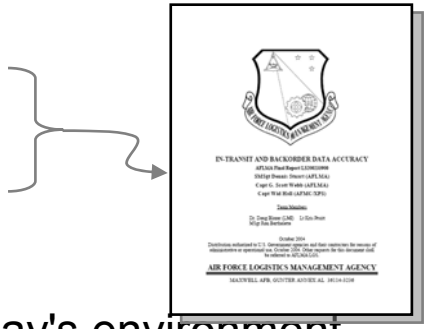
- Purpose of an Enterprise Data Validation Engine
  - Aligns data across previously independent legacy system sources
  - Eliminates routine manual reconciliation efforts previously needed to coordinate legacy data sources
  - Improves decision making at the domain and/or enterprise levels through enhanced legacy data quality
  - Can be applied in many ways across the enterprise

Decision Making Capability for the Next Decade

- ERP promises highly accurate data and superior decision making ability, but a wait is involved
  - ECSS is expected to be deployed about 2011+
- It is not necessary to wait to increase data and decision integrity
  - Selected “legacy” systems, with minimal effort, can provide more integrity in the meantime
  - Global Logistics Support Capability (GLSC) requires reengineering both the business processes and their supporting systems
- It is possible to make improvements without distracting from ECSS-ERP
  - The proposed approach will actually facilitate the migration of valid data to ECSS

Nature of the Problem Regarding Enterprise Data Validation

- The Business Problem
  - Data from separate legacy systems frequently can not reliably be combined at domain or enterprise levels
  - When combined, may not yield trustworthy results for quality enterprise decision making
  - Examples
    - **Case #1: 29% mismatch among two requisition systems (re GLSC)**
      - **"Almost 30 percent of Air Force backorder data is inaccurate."**
      - **"Forty-two percent of in-transit records … were invalid. This equates to 4,627 transactions, valued at $325M."**
    - **Case #2: 98% failure to integrate databases across domain**
    - **Case #3: 25% mismatch (est.) among several vehicle systems**


IN-TRANSIT AND BACKORDER DATA ACCURACY

AIR FORCE LOGISTICS MANAGEMENT AGENCY

  - Manual reconciliation to compensate is not satisfactory in today's environment (AFSO21)
    - **Airman resources no longer will be available to "fix" data (re GLSC)**

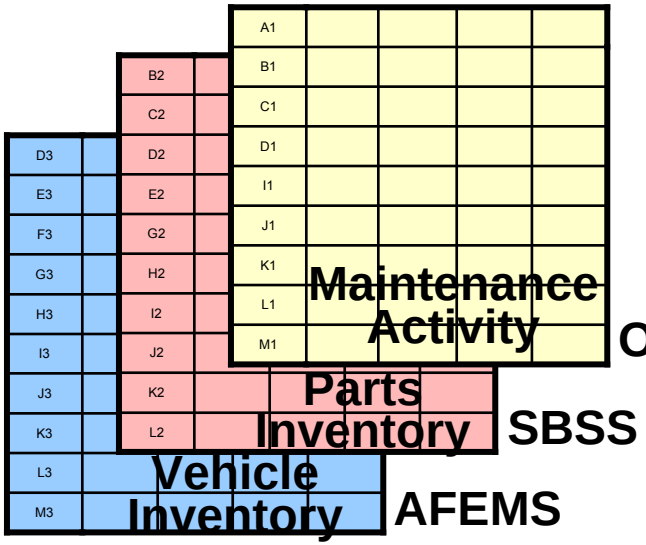
- The Technical Issues
  - Synchronization of multiple source system data
  - Association of multiple source data

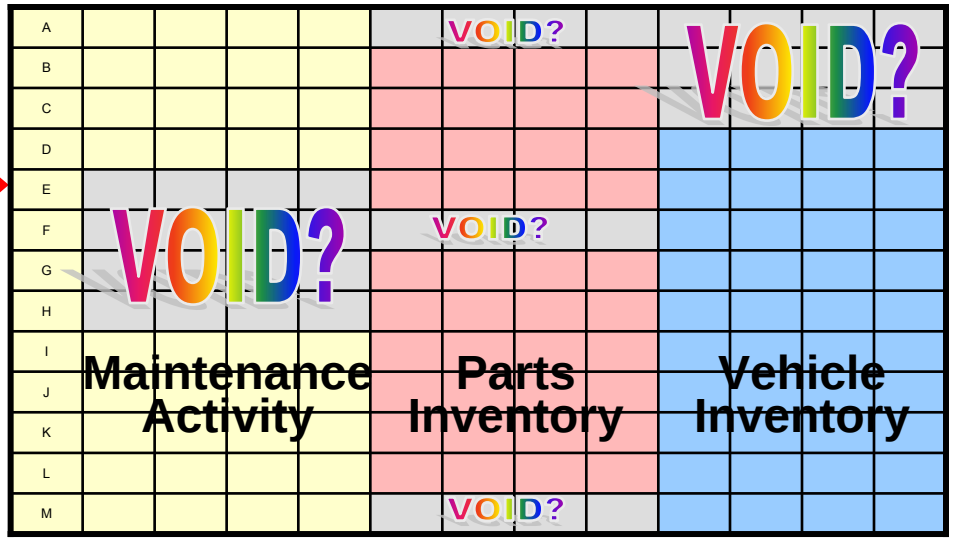
The Systems Gap: Misaligned Data Leads to Questions

Source systems often describe different aspects of the same asset.

Integration blends the data from the multiple source systems into a global "mismatched" view.

Data for Vehicles Within 3 Systems





Issue – Time and Instance Integrity Across Systems

Problem – Reporting Produces Inconsistencies

(Q: How much can we trust this?)

Note: The Synchronization Issue shows up in a database when data from multiple source systems does not correspond across the sources in a logical manner, or as expected, given the business rules.

Enforce Business Rules & Link Records

Equipment Information
(SBSS & AFEMS)

A1
B1
C1
D1
I1
J1
K1
L1
M1

Are the Voids in Gray Valid?

Organizational Information
(MPES)

B2
C2
D2
E2
G2
H2
I2
J2
K2
L2

A1		
B1	B2	
C1	C2	
D1	D2	D3
	E2	E3
		F3
	G2	G3
	H2	H3
I1	I2	I3
J1	J2	J3
K1	K2	K3
L1	L2	L3
M1		M3

Cross-Reference Information (GFM-DI)

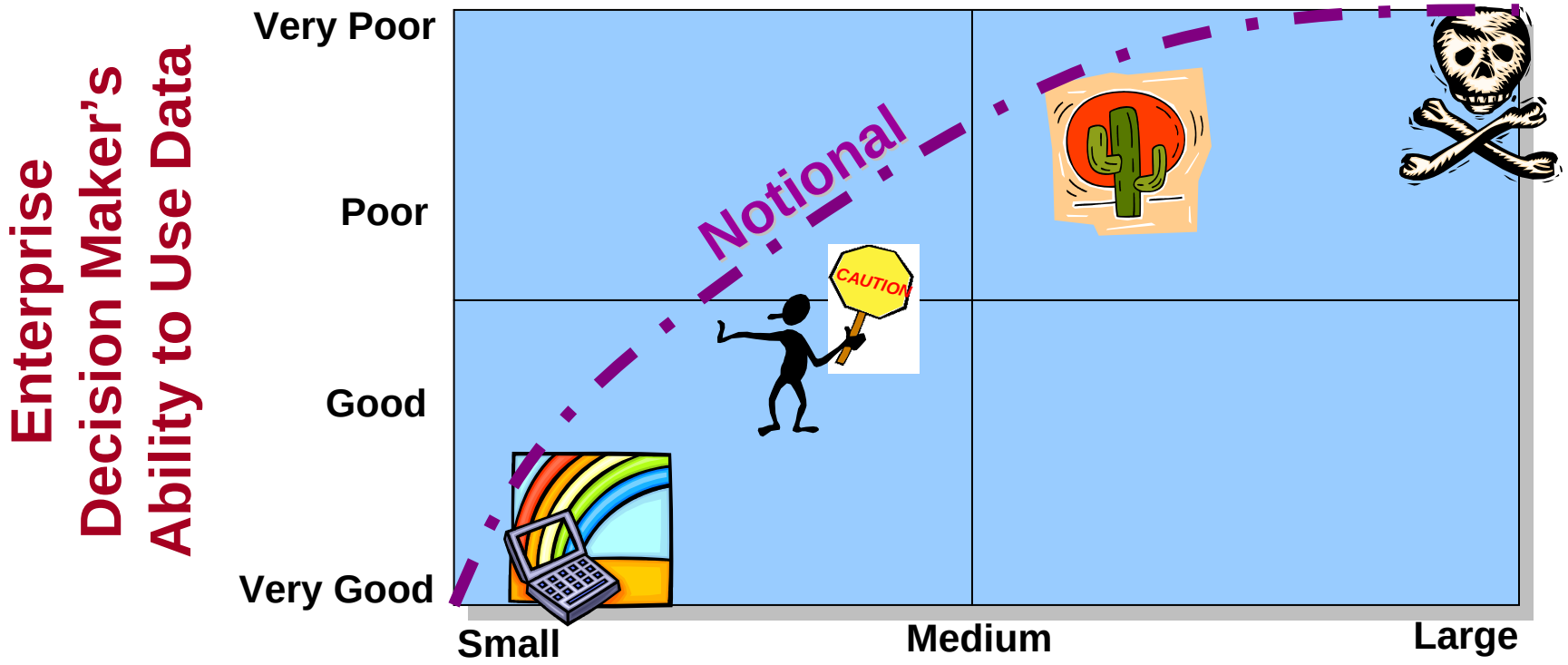
Aircraft Information
(ForceTab)

D3
E3
F3
G3
H3
I3
J3
K3
L3
M3

- **Check against enterprise business rules**
- **Make corrections at this point or they usually won't (can't) get done later**

Note: The Association Issue shows up in a federated database when invalid associations among object is erroneously permitted. Validation against business rules must be performed prior to a source system allowing such a transaction to update its own database.

Problems Compound as More Systems Are Considered



*** Only the topic of Object Association is addressed hereafter, because the solution to this single problem facilitates the solution of Attribute Synchronization (even though its solution can be attempted separately).**

Compounding of Missing, Mismatched, or Unsynchronized Data

(Due to improperly associated and serialized enterprise-wide data and enforcement of enterprise-wide business rules)

Some Elements of a Solution for Using an Enterprise Data Validation Engine

Associations Across Systems

Determine how different objects of two systems are associated.

Validation Engine

Associative Cross-Reference

System A

Object X

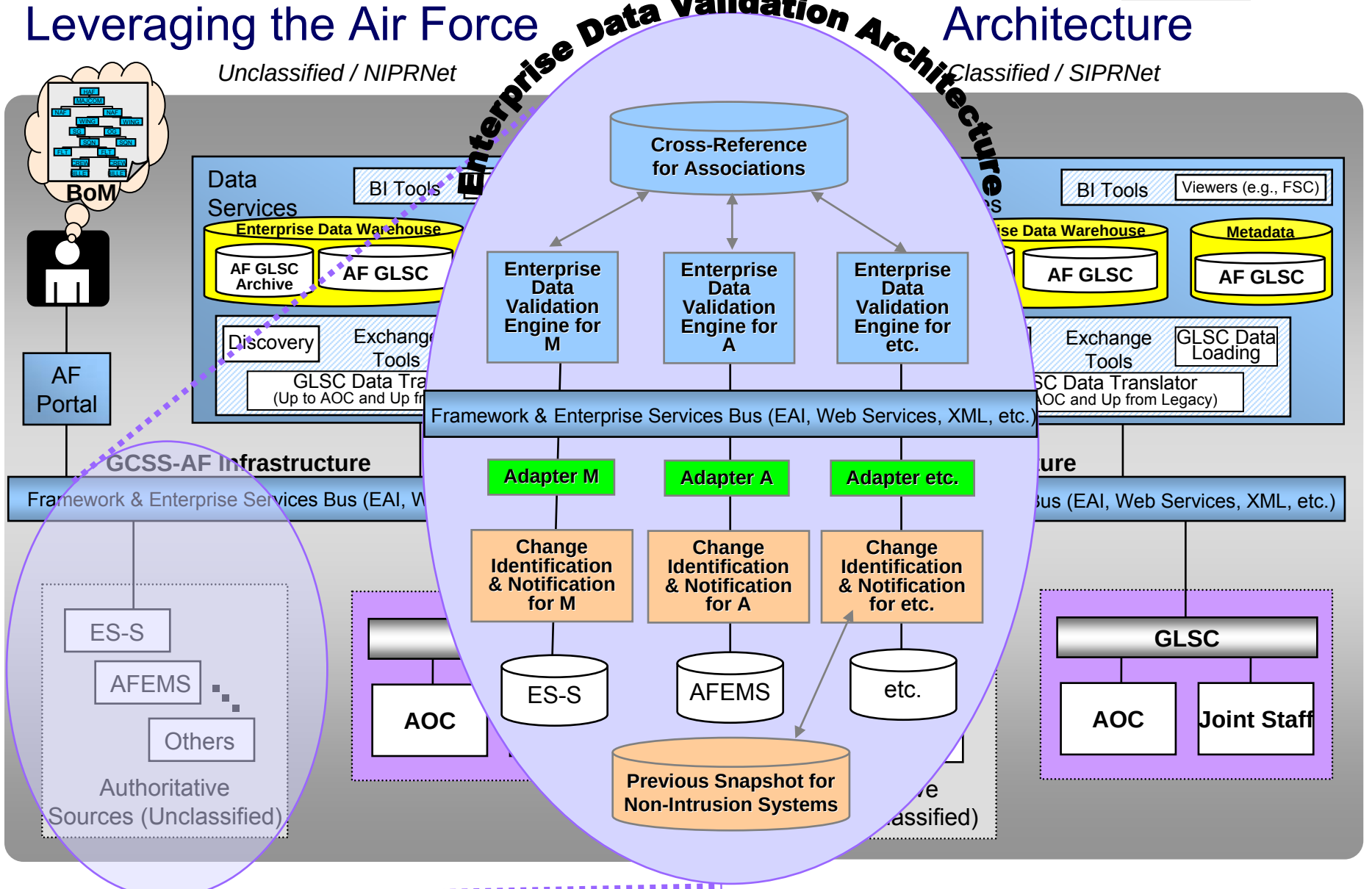
System B

Object Y

New **business rules must be enforced by Systems A and B.**

Note: EII usually requires that objects in separate database (i.e., Objects X and Y above) be logically related according to certain enterprise business rules.

Leveraging the Air Force Enterprise Data Validation Architecture

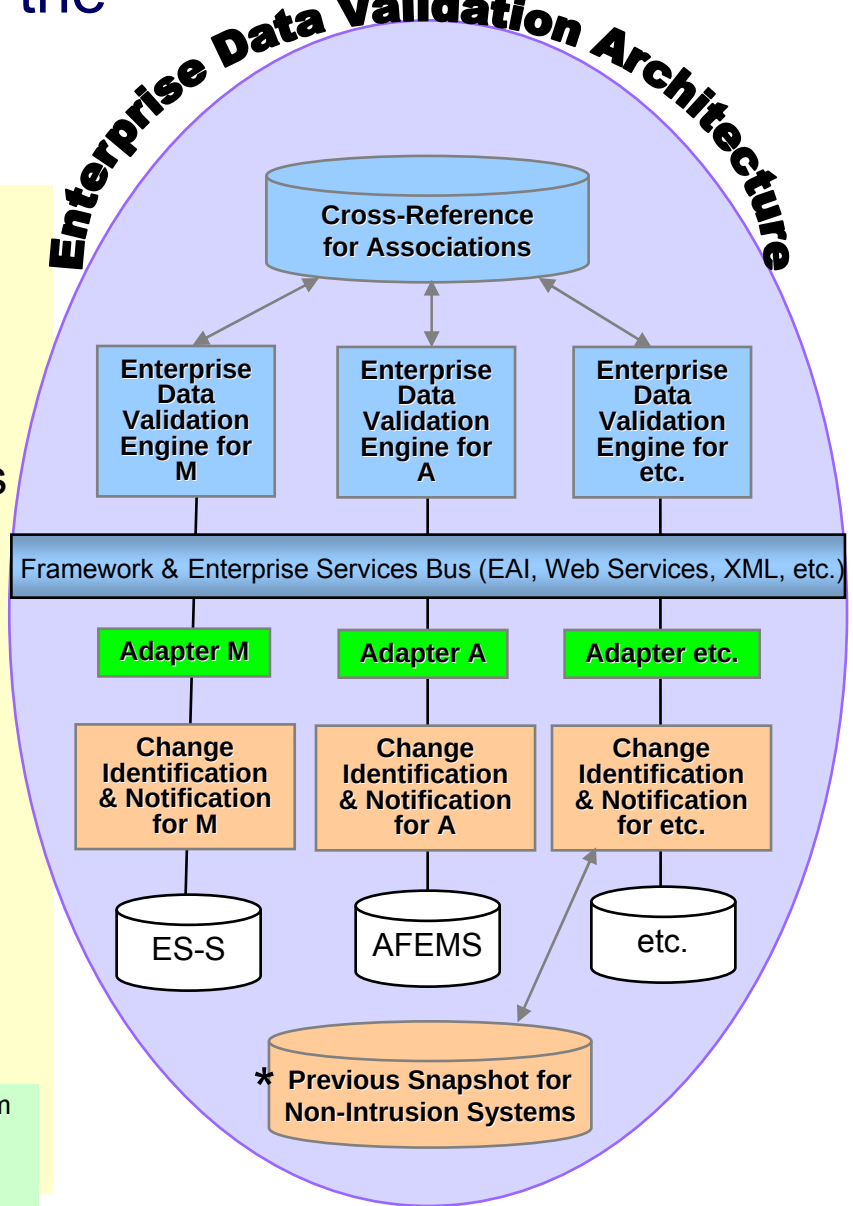


Source System Architecture Using the Enterprise Data Validation Engine

- Leads to greatly enhanced data agreement across systems that currently lack common standards or interoperability
- Enterprise Data Validation Engine ensures data integrity as it trickles in from the various systems
- Enterprise Data Validation Architecture
  - Components include
    - **Cross-Reference for Associations**
    - **Enterprise Data Validation Engine**
    - **Change Identifier and Notifying**
    - **Interoperability Protocols (7 possible choices)**

[Database Snapshot for Non-Intrusion*]

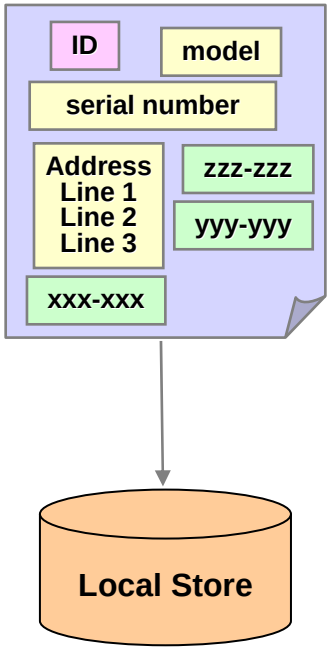
* Can be non-intrusive to source system, but with critical tradeoffs
  - Performance
  - Data Quality



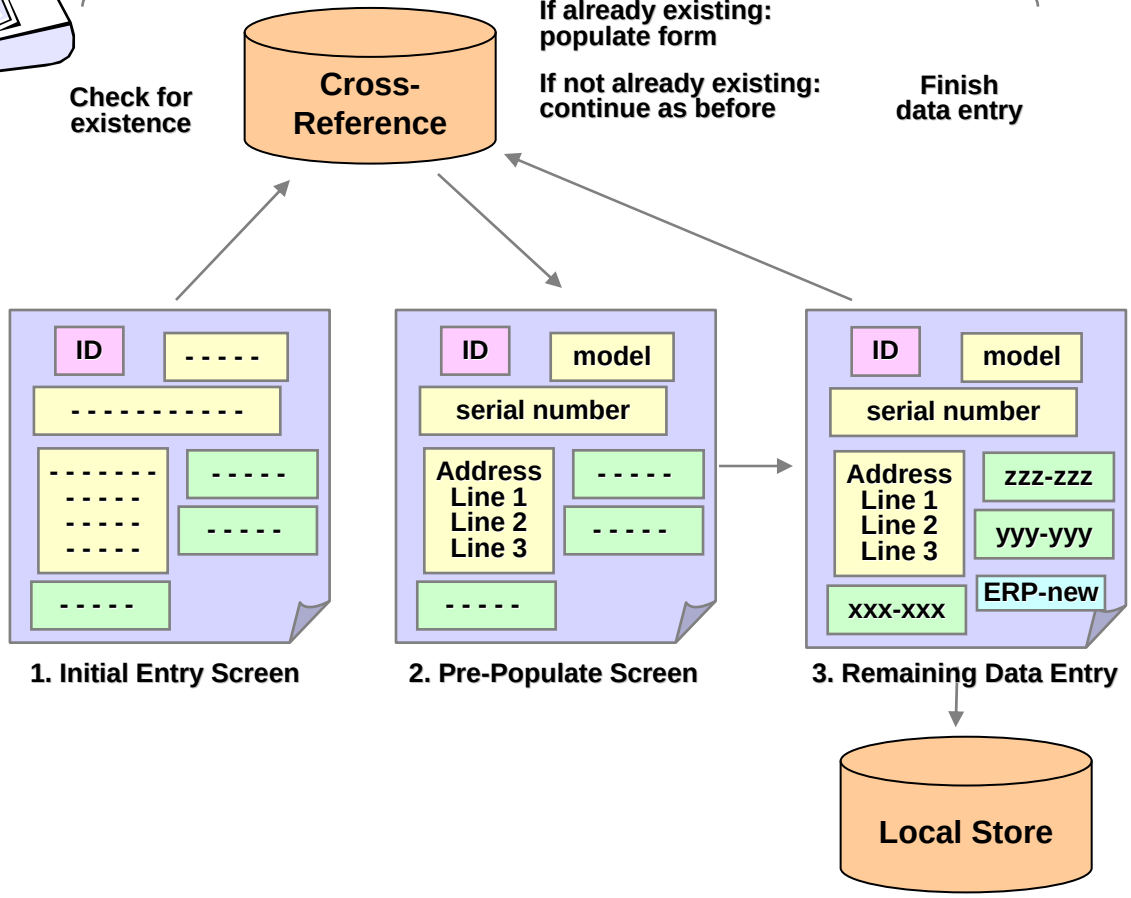
This architecture is an adaptation from "Protocols for Integrity Constraint Checking in Federated Databases", P. Grefen and J. Widom, 1997

Data Entry Scenario Where Legacy Modifications Allowed

Current Legacy Data Entry Process



Improved Legacy Data Entry Process



Business Case Considerations

- Program-Centric Aspects
  - Development Effort and Time [Investment]
    - **Added Effort**
      - **Systems Aspects (enhanced data integrity capabilities vs. system revisions)**
      - **Operational Aspects (elimination of reconciliation activities vs. data entry revisions)**
    - **Coordination Among Other Stakeholders (via a COI?)**
  - Lifecycle Benefits (may accrue over time) [Return]
    - **Improved Data Integrity**
    - **Improved Data Timeliness**
    - **Eliminate Redundant Data Entry**
    - **Eliminate Reconciliation Effort**
- Enterprise-Centric Aspects (in addition to above)
  - Generic Solution Template
  - Prerequisite to ERPs (DEAMS, ECSS, DIMHRS) Migration
  - Improved Integrity of Enterprise-Level Decision Making

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Considerations for Use of Enterprise Data Validation

Where would the Enterprise Data Validation Engine be considered for use?

After conducting Enterprise-Level Cross-System Data Quality assessments for given products, then perform the following Data Fixing Strategy as applicable.

Rule / Situation	1	2	3	4	5	6	7	8
Can Data Be "Abandoned"?	Yes	No	No	No	No	No	No	
Is Current Quality OK?	-	Yes	No	No	No	No	No	
Feasibly to Re-Entered?	-	-	Yes	No	No	No	No	
Feasible to Reconcile?	-	-	-	Manually	Auto-matically	Auto- matically	Auto-matically	
Can Apply Fix at Migration Time?	-	-	-	-	Yes	No	No	
Fixing Sources Cost Acceptable?	-	-	-	-	-	Yes*	No	
Data Fixing Strategy	Do Nothing	Do Nothing	Manually Re-Entry	Manually Reconcile	Do Data Cleansing	Enforce Enterprise Data Validation	???	

Note: The term "data" herein includes any data aggregation (element, record, file, cross-system composite, etc.).

This issue is similar to the Y2K problem in that you can't wait until the last minute to think about or act upon. It has the additional characteristic that the sooner it is addressed the better the data quality gets over time.

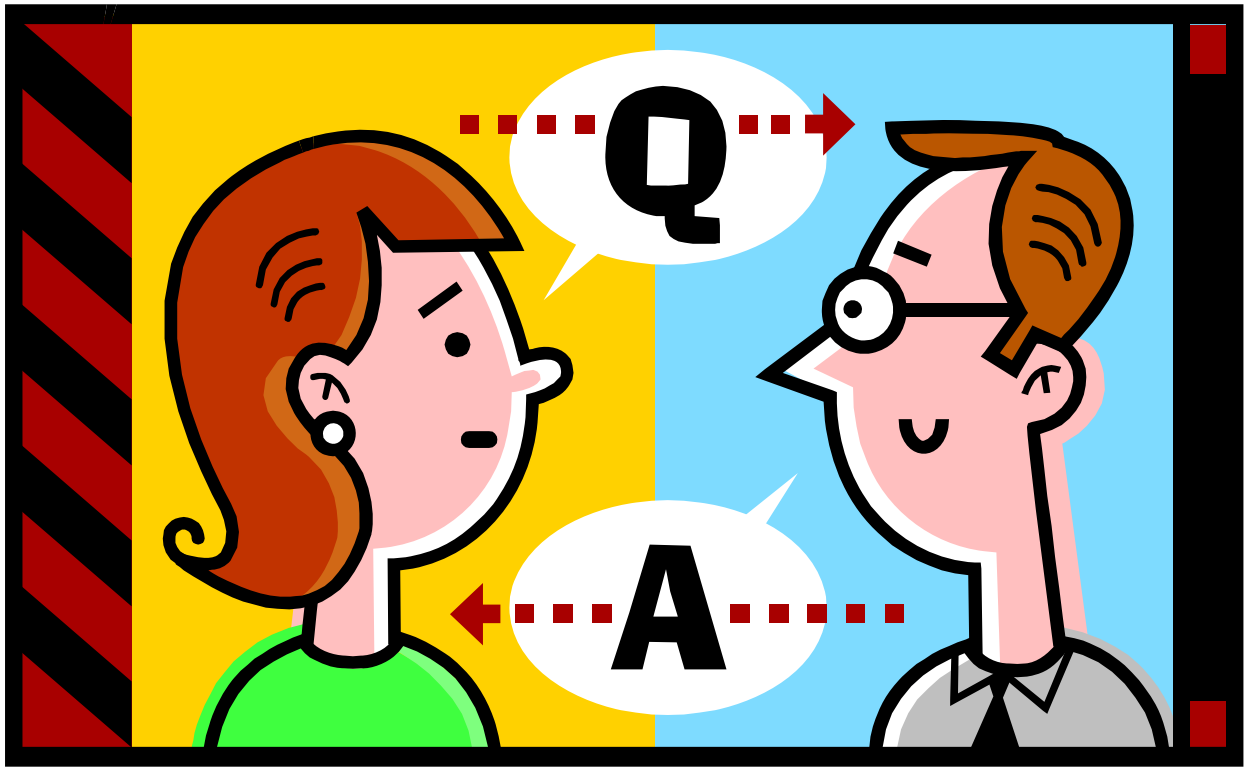
*** If interfaces are being changed anyway, then these costs may be negligible to use EDVA template.**

Data Quality Improvements

Indicates Inherent Government Responsibilities

PG 811

Questions and Answers

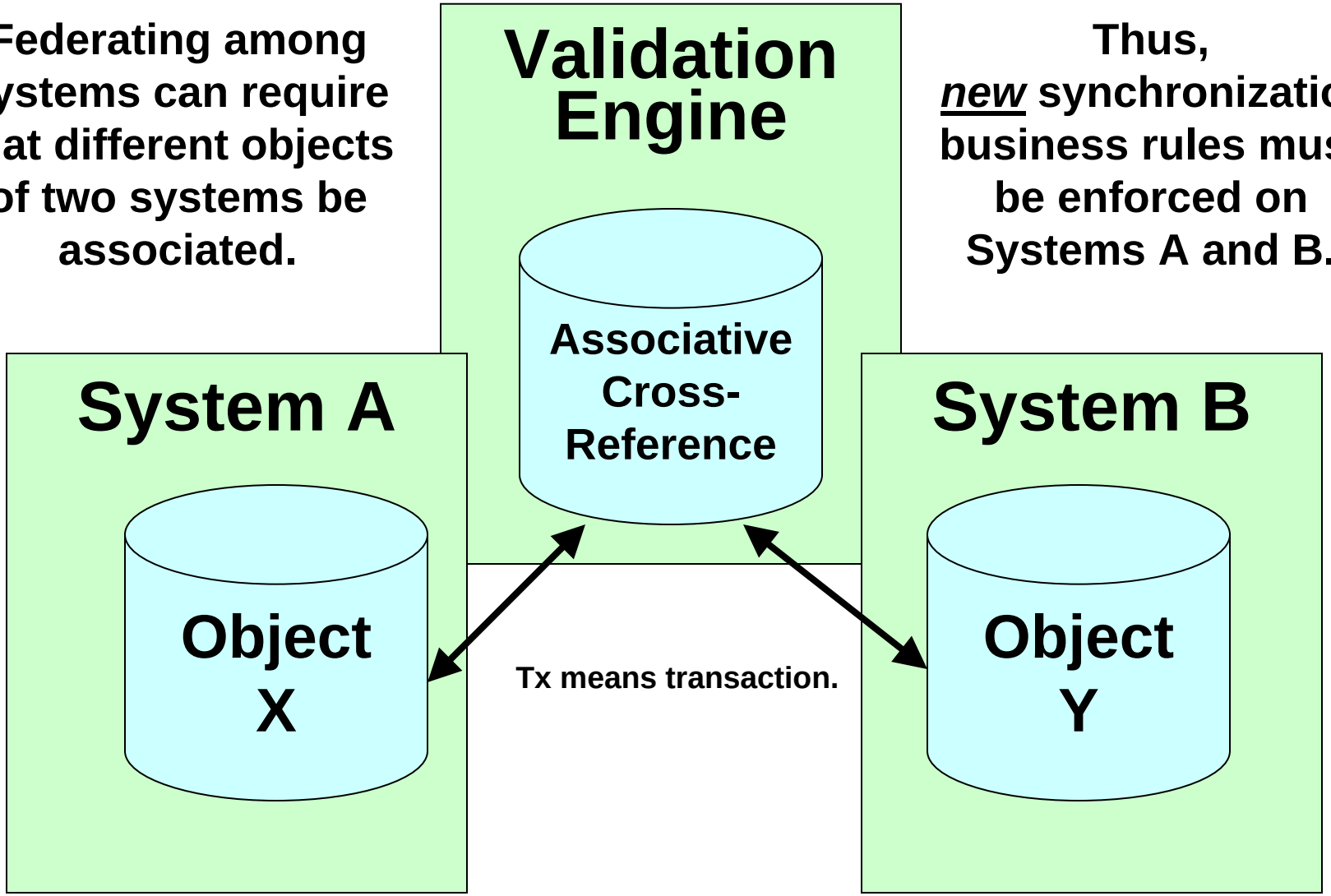


Backup Slides

Associations Between Objects

Federating among systems can require that different objects of two systems be associated.

Thus, *new* synchronization business rules must be enforced on Systems A and B.



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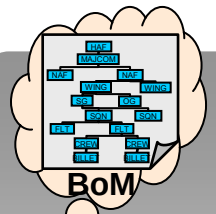
Vision Architecture (using GLSC example)

Unclassified / NIPRNet



AF Portal

Data Services

BI Tools

Viewers (e.g., FSC)

Enterprise Data Warehouse

AF GLSC Archive

AF GLSC

Metadata

AF GLSC

Discovery

Exchange Tools

GLSC Data Loading

GLSC Data Translator (Up to AOC and Up from Legacy)

GCSS-AF Infrastructure

Framework & Enterprise Services Bus (EAI, Web Services, XML, etc.)

Guard

ES-S

AFEMS

Oth

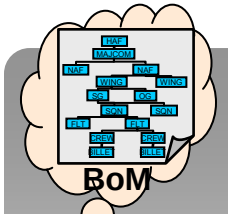
Authorita

Sources (Unclassified)

GLSC

AF GLSC Data Adaptors connect the authoritative sources to the ESB and provide various mediation services including format and protocol translation, mapping and translation.

Classified / SIPRNet



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GCSS-AF Infrastructure

Framework & Enterprise Services Bus (EAI, Web Services, XML, etc.)

ES-S

AFEMS

Others

Authoritative Sources (Classified)

GLSC

AOC

Joint Staff

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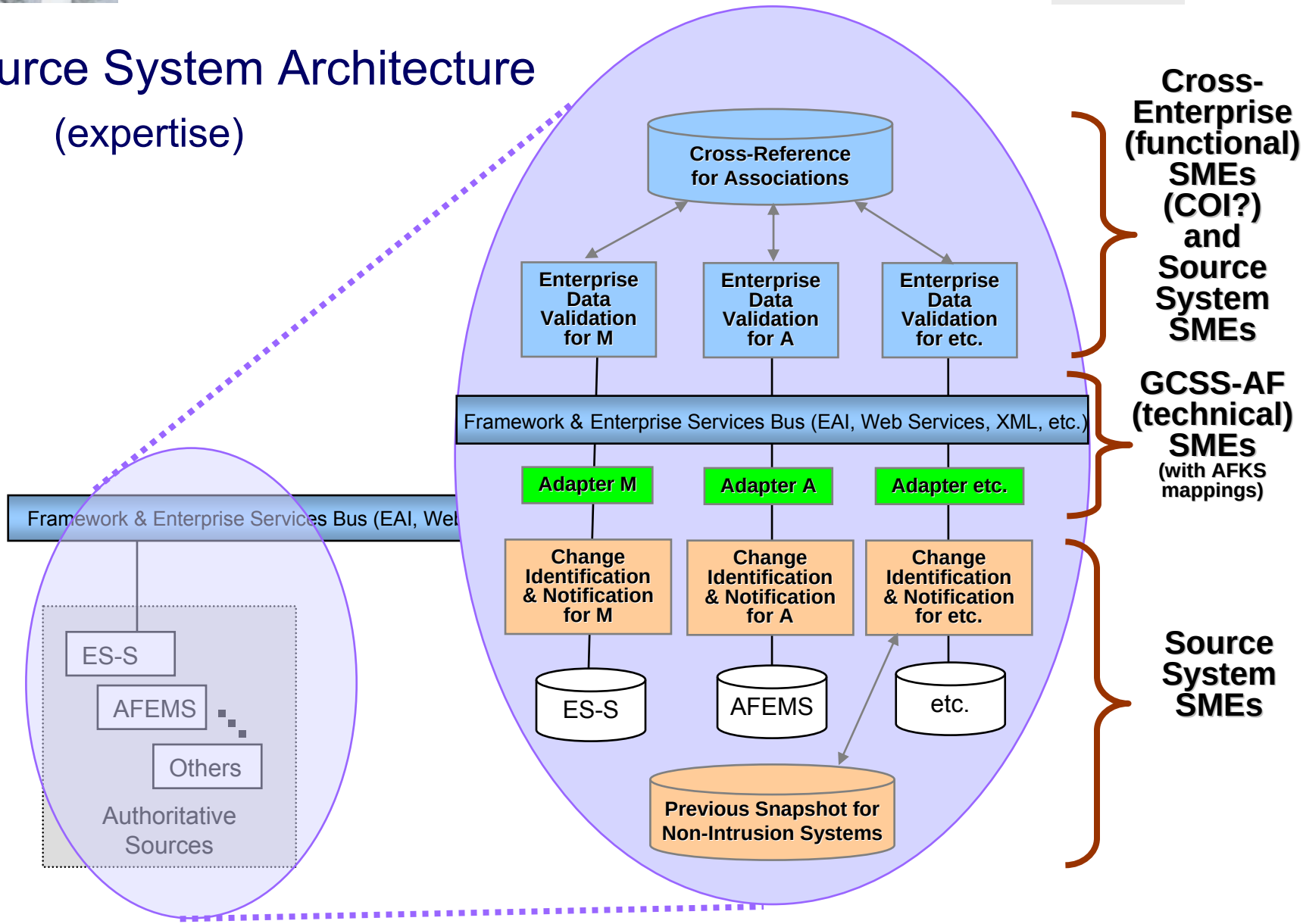
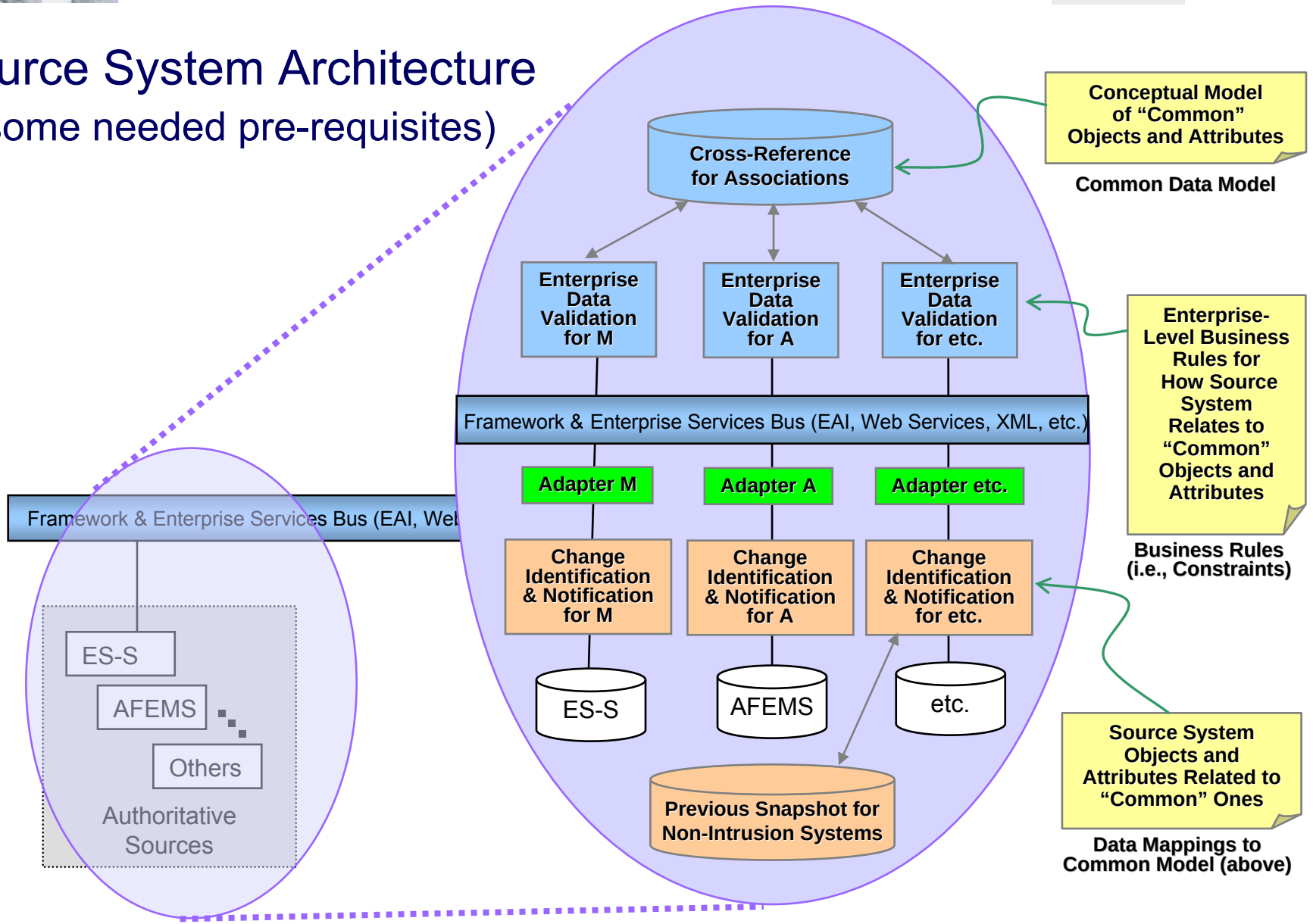
Source System Architecture

(expertise)

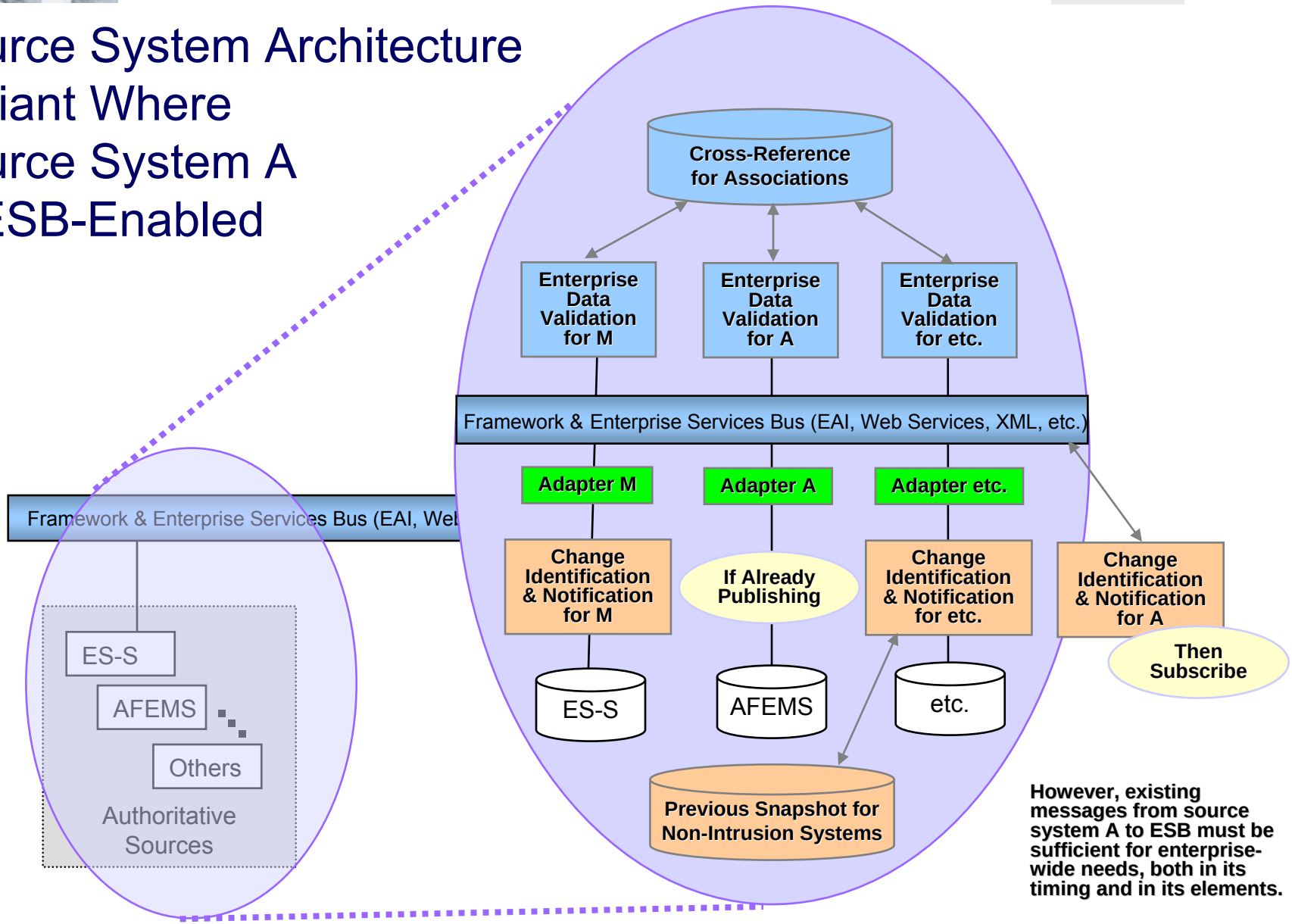


Source System Architecture

(some needed pre-requisites)

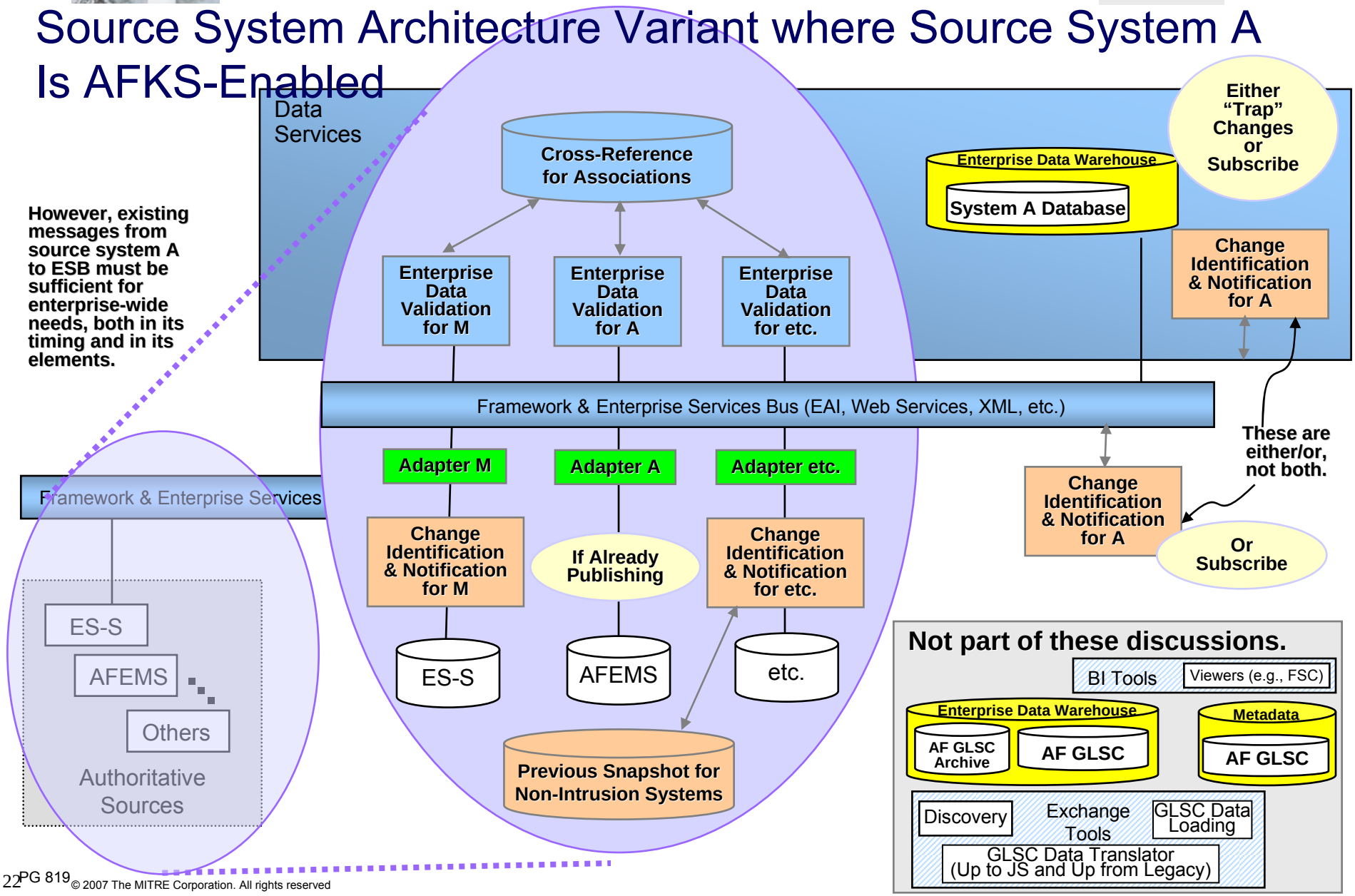


Source System Architecture Variant Where Source System A Is ESB-Enabled



However, existing messages from source system A to ESB must be sufficient for enterprise-wide needs, both in its timing and in its elements.

Source System Architecture Variant where Source System A Is AFKS-Enabled



AS-IS Data Sharing Example from Vehicle Domain

	Core vehicle data copies with additional domain data
→	Interfaces with limited automation; mostly abandoned in favor of dual data entry
	Rejected tx have limited notification processes and must each be cleared by workers
1	Tx are edited for syntax by SBSS
2	Tx are edited for syntax and semantics by AFEMS
3	Some tx are simply forwarded after syntax check (no other processing done by SBSS)

System of Record for Equipment Management

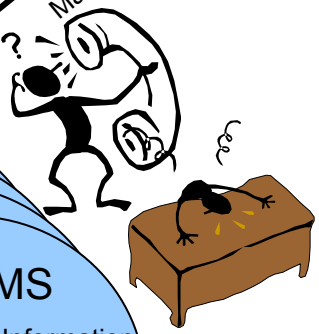
AFEMS
Air Force Equipment Management System
Vehicle Records

Rejected Transactions Require Human Intervention

Rejected Transactions Require Human Intervention

Tx Types of Equipment Management Interest

2



Tx Types of Financial Interest and Equipment Management Interest

3

System of Record for Inventory Financial Data

OLVIMS
On-Line Vehicle Information Management System
Vehicle Records

- About 200 Sites
- Distributed Data
- Stand Alone Operations

Vehicle Operations Management Data

Tx Types of Financial Interest and Equipment Management Interest

1

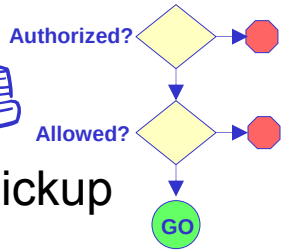
SBSS
Standard Base Supply System
Vehicle Records

Summary Financial Reporting

$$$ Systems

Rejected Transactions Require Human Intervention

Vehicle Life Cycle



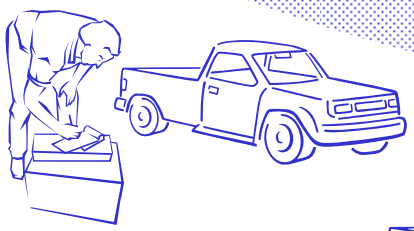
- Need: One Pickup
- Acquire
- Wait for

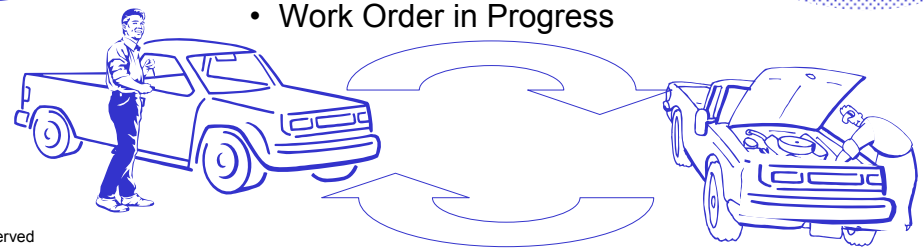
Priority Buy List
$ APPROVED $

- Receive

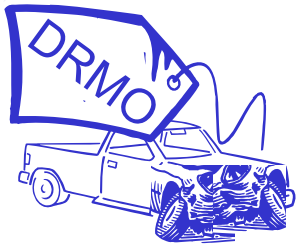
Change Highlights	Generating Parties	Interested Parties	Participating Systems
Wait for (SPR)	Acquisition	Vehicle Management, Equipment Management, Inventory Management	OLVIMS, AFEMS, SBSS
Receive (REC)	Vehicle Management	Vehicle Management, Equipment Management, Inventory Management	OLVIMS, AFEMS, SBSS
Operate (mission capable)	Vehicle Operations	Vehicle Management, Equipment Management	OLVIMS, AFEMS
Maintain (non-mission capable)	Vehicle Maintenance	Vehicle Management, Equipment Management	OLVIMS, AFEMS
Maintain (awaiting parts)	Vehicle Maintenance	Vehicle Management	OLVIMS
Turn-In (salvage)	Vehicle Management	Vehicle Management, Equipment Management	OLVIMS, AFEMS, SBSS

- Operate and Maintain
  - Mission Capable
  - Mission in Progress
  - Needs Preventive Maintenance
  - Work Order in Progress





- Turn - In



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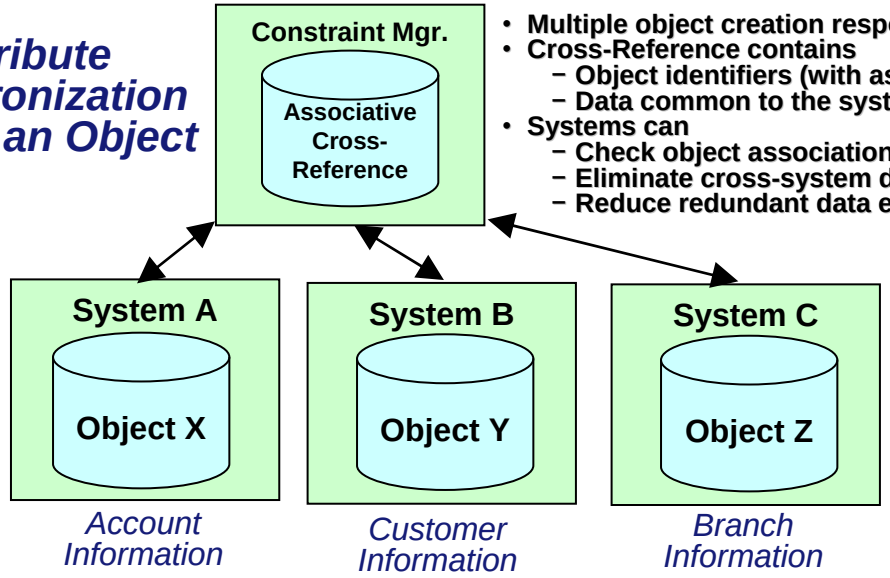
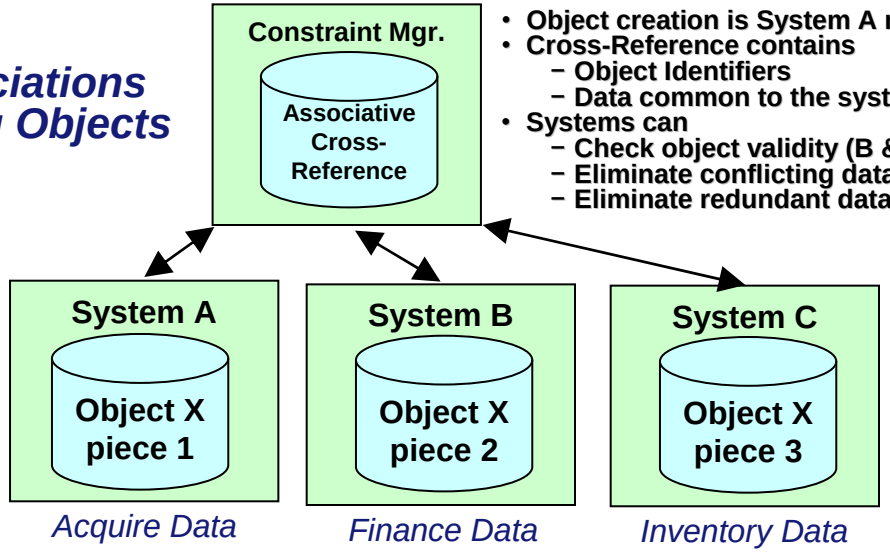
Characteristics of The Situations

Attribute Synchronization Across an Object



- Multiple object creation responsibility
- Cross-Reference contains
  - Object identifiers (with association rules)
  - Data common to the systems
- Systems can
  - Check object association validity
  - Eliminate cross-system data conflicts
  - Reduce redundant data entry

Associations Among Objects



- Object creation is System A responsibility
- Cross-Reference contains
  - Object Identifiers
  - Data common to the systems
- Systems can
  - Check object validity (B & C)
  - Eliminate conflicting data
  - Eliminate redundant data entry