Solving Large Scale Integration with Software Architecture: Payment Object Framework, an example

Abstract

How do you solve large scale integration which includes disparate systems, global in scope and is cross industry, cross business, and cross movement? Example such as the US Government mandate that all Healthcare claims be settled by electronic commerce by the year 2000. This means every doctor, every hospital, every diagnostic center, every HMO, every insurance company, every state government, and several US Government agencies must be able to electronically interoperate and exchange data in a secure and reliable way.

One approach taken by the submitters to OMG Electronic Commerce Domain Task Force RFP1, Electronic Commerce Payment Facility was to develop a specification for a common;

1. business model
2. set of requirement
3. appropriate technology
4. framework and services

and which supports customization for each industry specific domain with plugins.

The technology described in the Payment Object Framework (POF) submission provides a common payment model and a set of industry standard interfaces for the **exchange of value** (PAYMENTS) for goods and services which can accommodate a wide range of industry specific payment schemes while providing payment selection, security services, transaction protection and process flow management. The model address the needs of the current monetary systems which regulates behavior of participants and the model provides the necessary security technology for authentication, authorization, privacy, data integrity, confidentiality, and non-repudiation to establish trust between participants.

The technology specification is just the first step. Socialization of the model and concepts through industry forum presentations, education, and accepting feedback are essential to a successful deployment.

The Problem

The world is recognizing the Internet for what it is; a new paradigm for global communication and global interaction between people. As such the Internet is a new paradigm for commerce; commerce between consumer and provider and commerce between business and their trading partners.

Before the Internet can fulfill its destiny, however, needed infrastructure must be put in place. The biggest inhibitor to business on the Internet today is the lack of a trusted means for exchanging value for goods and services; that is a *trusted payment system*. A payment system which;

- Is open and interoperable
- Utilize existing payment infrastructure and monetary systems as appropriate
- Allows for selection of payment type
- Supports common monetary mediums including
    - **Credit Cards** for medium to large purchases
    - **Coins** for small ticket purchases
    - **Checks** (debit cards) for peer-to-peer payments
    - **Financial EDI** for business to business invoice and payments
    - **Electronic Fund Transfer** for large monetary payments internationally
    - **Purchase order** between businesses
- Supports non-monetary payments such as bartering systems, scripts, and frequent flyer miles
    - Enables expansion of Electronic Commerce through
    - support of legacy applications moving to the Internet
    - expansion of traditional business services on the Internet
    - introduction of new type and style of services on the Internet

OMG Payment Object Framework Submitters Approach, an example

Step 1. Research

Research into every major payment system was first conducted, the results are shown in the following matrix

Role & Regs. / Industry / Technology	Buyer	Seller	Payer	Rules of engagement	Industry Standard
Credit Cards SET	Cardholder	Merchant	Acquiring & Issuing Bank	Credit Card/ Merchant agreement	Secure Electronic Transaction
Credit cards Other	Consumer	Merchant using POS	Acquiring & Issuing Bank	Credit Card/ Merchant agreement	ISO 8583
Financial	Trading Partner	Seller	Merchant Bank	Invoice/ Purchase order	X12N 820 X12N 821 X12N 824, 827
ACH (US only)	Originator	Depositor	Originator/ Depositor Bank`	NACHA	X12N 820
Healthcare	Patient	Healthcare Provider	Government /Insurance	Policy and Government Mandates	X12N 837
EFT	Corporate Buyer	Corporate Seller	Buyer Bank	Reg. E Reg. C, D, F	ISO 8583
Electronic Cash	Consumer	Merchant	Acquiring Bank	Wallet Appl./ Smart Card	evolving
Electronic Check	Consumer	Goods or Services Provider	Consumer ‘s Bank	Evolving example: FSTC Proposal	evolving
Bill Payment	Consumer	Goods or Services Provider	Consumer ‘s Bank	Evolving example: OFX Proposal	evolving

Figure 1 Summary of electronic commerce payment systems listed by payment business/technolog

Step 2 Constructed a Common Business Model

Common **Elements of a Payment System**

The Matrix in figure 1 show payment systems listed by industry/ payment technology. This summary demonstrates that while the requirements for payments vary by industry and regulatory guidelines the players who participate in these industry payment systems can be generalized into four elementary roles;

Buyer - *consumer* of the good and or services
Seller - *provider* of the goods and or services
Payer -*manages the rules* of value exchange, e.g. an acquiring/issuing bank acting as a monetary authority or American Airline exchange of “frequent flyer” miles as a non-monetary authority
Trusty - provides services for assuring *trust amongst participants.*

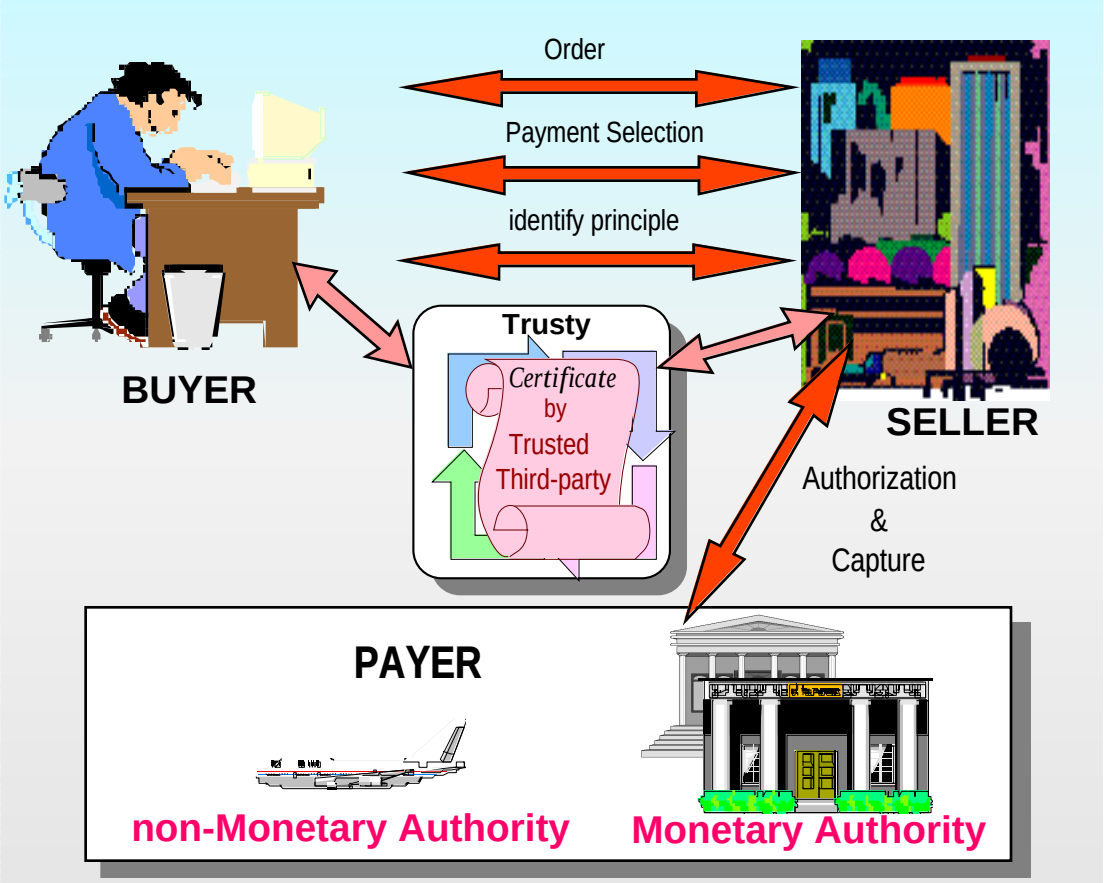

figure 2 A simple payment transaction model illustration interactions between participants.

Step 3 Establish Requirements

An Electronic Commerce Payment Facility must

1. Support payments between;
   - Consumer and Business
   - Consumer and Institution
   - Business and Business
   - Business and Institution.
2. Provide security services which meet the needs of current and emerging payment systems.
3. Have as it's center of design the requirements of the important value exchange systems.
4. Provide the underlying support for implementation of payment systems which conforms to or enhances adherence to the established guidelines for that industry.
5. provide the underlying support for implementation of payment systems which conforms to or enhances adherence to the established guidelines for that industry.

Step 4 Establish Architecture Goals and Framework

POF Goals

Flexibility in implementation - allows a range of implementations from a very simple payment system to a very complex payment system supporting multiple industry payment technologies to be implemented under a single architecture

Easy migration of existing payment systems - allows implementation of bits and pieces of an industry payment system, over time, by segmenting the activities by facilities, services, and domain. Not all elements are required for every implementations.

Use of shared code - A Payment Object Framework implementation may be shared with other implementation of Facilities, Application and Services. Differences in implementations should be limited to the Industry Payment Domain and Control Object subclasses.
Architectural expansion - As requirements evolve, and more industry payment systems move to the Internet, the architecture can be expanded to handle new requirements through new classes and subclasses. The interchanges between the Role Objects are messages of a REQUEST / RESPONSE style and are managed at multiple levels as defined by the architecture.

POF Framework

The Payment Object Framework Constituents consist of;

Payment Object Framework: Role Objects

POF Role Objects are instatiations of the logical equivalent roles played by participants in non-electronic commerce payment interaction or electronic commerce payment interchanges in a non CORBA environment. The Payment Object Framework entities Objects include:

- BUYER
- SELLER
- PAYER
- TRUSTY

All interactions between these member objects take place via the ORB independent of location, platform or implementation.

Payment Object Framework: Control Objects

POF-Control Objects are provided as input by the client of the POF. Control Objects allow the POF to execute independent of other processes in the broader electronic commerce commercial transaction.

Payment Object Framework: Audit Objects

POF Audit Objects are accessed through the ORB with object references provided during return from object invocation. Audit Objects allow the POF to execute independent of other processes in the broader electronic commerce commercial transaction.

Payment Object Framework: Payment Support Facility

Payment Support Facility is a set of POF companion services which support interchanges between Control Object classes and provide access control to Control Object classes and Audit Object classes. The class of services implemented will be set by the technology adopted by an OMG vertical domain task force specific to the needs of their industry payment protocol.. The spectrum of services include;

- Security Association
- Message Protection
- Transaction Protection
- Transaction Auditing
- Non-repudiation
- Persistence
- Security Auditing
- Interoperability
- Public Key Infrastructure (PKI) Facilities

These services are applied to the interchanges between Role Objects and access to Control Object classes or Audit Object classes. Since Role Objects, Audit Objects and Control Objects are known only within the CORBA environment, these services can utilize the existing CORBAServices or CommonFacilities in providing implementations of these services.

Architectural Spheres-of-Ascendancy

The POF architecture establishes “spheres-of-ascendancy” on the behavior of Role Objects and the interchanges between them. The architecture defines the, scope, boundaries and order of control of each of these *spheres*, while implementation determines their specific interface behavior. A given spheres-of-ascendancy enforces a set of object class specific rules. A specific implementation of the POF is customized through sub-setting of the Industry Payment Domain Class. and the Security Management Services Class.

In the architecture model (see figure 3) The “spheres-of-ascendancy” are shown and are labeled with the name of the Object class who’s rules they reflect. Role Objects interchanges are messages of REQUEST / RESPONSE style and are managed via interceptors by “spheres-of-ascendancy”.

The architecture model in figure 3 shows the EC application and three Role Objects deployed in a CORBA environment. The interchanges between Role Objects are controlled by each of three “spheres-of-ascendancy” label with the object class name.

Note The TRUSTY is not shown in this model for reasons of simplicity

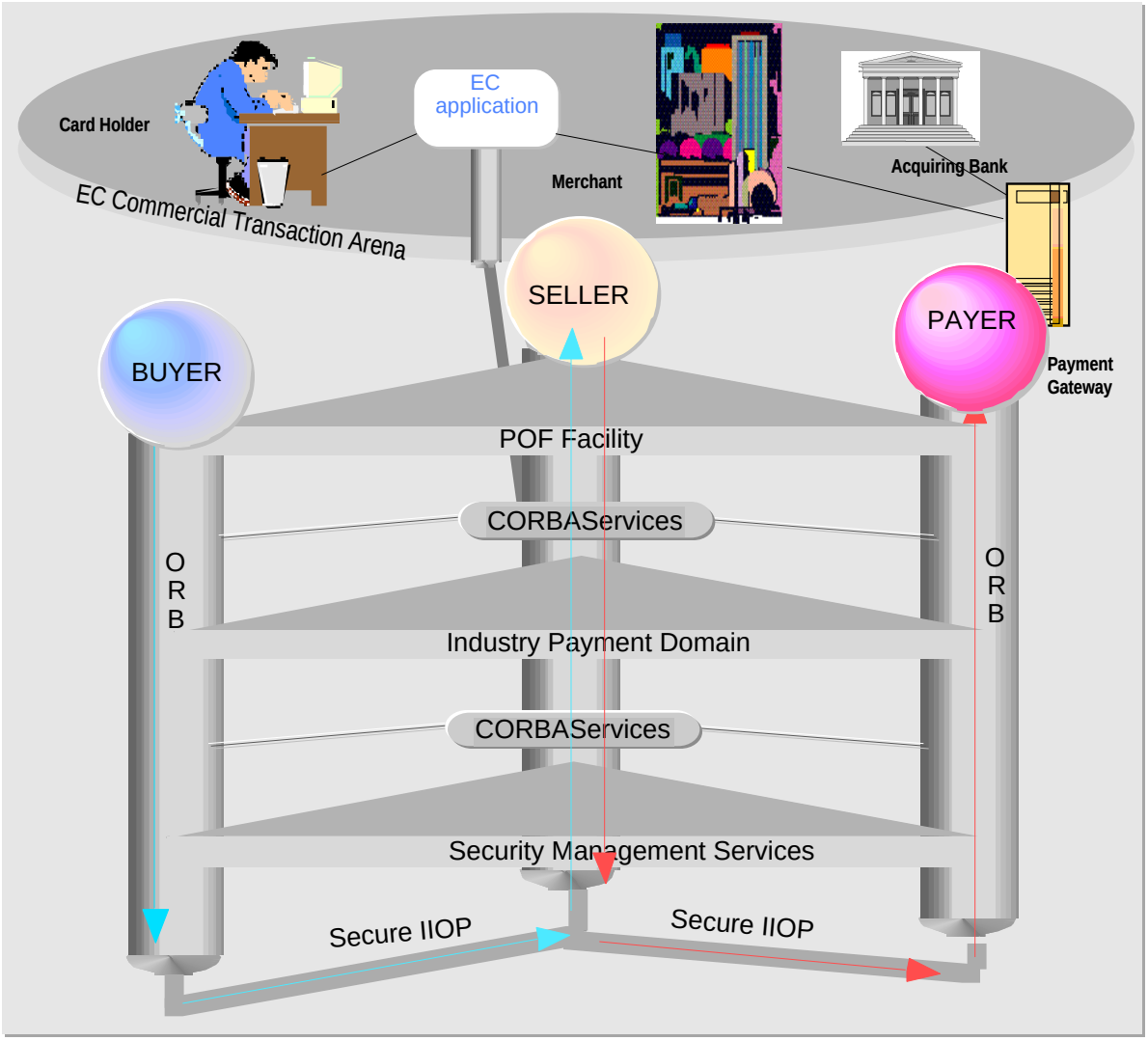

Figure 3 Illustrates the components of the POF architecture model and the level at which the interchange messages between Role Objects are managed. In this example the BUYER reflects the Cardholder’s role, the SELLER reflects the Merchant’s role, and PAYER reflects the gateway to the Acquiring Bank.