Service Oriented Architecture
Electronic Data Interchange (EDI)

Next class: Anderson chapter 1, 2. Exercise due before class
Solution - case study

- XSLT used by customer or manufacturer/distributor to alter XML being sent or received
- XSD and/or DTD used by customer or manufacturer/distributor to validate XML being sent or rec’d
- Web services package the HTTP, XML, XSD, request/response and URL used in “raw” XML transfers
- Web services described in WSDL documents in registry. E.g.,
  - Manufacturer/distributor registers Web service in UDDI registry
  - Customer discovers Web service and invokes it on mfr/distrib Web server
- Visual tool: CSS for XHTML, XSLT for XML
Challenges of system integration

- Companies use multiple systems that must increasingly cooperate
  - Systems often are in different business groups
  - Or in different companies (vendors, channel partners…)
  - Run on different platforms (operating system, hardware)
  - Written in different languages
  - Use different communication protocols
    - File transfer, EDI, XML, RPC, MQ, CORBA, COM, sockets…
    - Have different databases, data definitions
    - Have different objectives, run at different times/periods
- Solution is desired that allows integration in spite of different languages, protocols, hardware…
Service oriented architecture (SOA)

- Web services are basis for integration in SOA
- A core of standard open technologies are used
  - XML, XML Schema (XSD), XSLT, SOAP, WSDL
  - Operating system-, hardware-, software-, database-neutral
- A registry (database) is used to store WSDL for service discovery
- Security, reliability, performance, transactions must be added to ‘primitive’ Web services to have SOA
- SOA supports composition (assembling) of services, reusability of services, extensibility
- SOA is based on a service-focused business model
  - UML business process models can be implemented in SOA
Service oriented architecture 2

- SOA is based on loose coupling between systems
- Asynchronous, or message-oriented (MOM) integration
  - Document is sent from system A to system B
  - Response generally not guaranteed in any given time
    - A process may not complete for a long time
    - Example: Shipment tracking service (success)
    - Example: Async telecom service orders system (failed)
Example of current SOA implementation

An Early Incarnation of SOA

Service registry

Discover and retrieve WSDL

Publish WSDL

Exchange SOAP messages

Service requestor

Service provider

Image by MIT OpenCourseWare.

Service is Web service
SOA architecture (between Web servers)

Company 1 and 2 swap roles via exchanges of messages.

Image by MIT OpenCourseWare.
SOA use of WSDL

Company 1

- Invoice submission service
- Order fulfillment service

Message is compliant with
Accounts payable service WSDL

Ensures message will be successfully interpreted by
Order fulfillment service WSDL

Company 2

- Accounts payable service
- Purchase order service

Message is compliant with
Accounts payable service WSDL

Image by MIT OpenCourseWare.
SOA service composition

Company 2

Accounts payable composition

Accounts payable service

Vendor profile service

Ledger service

Image by MIT OpenCourseWare.
Web services and existing systems

Integrated system built using Web services/SOA to existing systems

Service Interface Layer

Service interface representation

Application Layer

Physical service encapsulation

Application (.NET) Application (J2EE) Application (Legacy)

(A) (B) (C)

Image by MIT OpenCourseWare.
Exercise

• Draw an SOA diagram for your homework system
• Decide how you would structure your catalog browsing and ordering systems
• Draw your Web services
• Draw the Web services your customers would use to communicate with you
• Use Figure 5.4 and/or Figure 5.15 on the previous slides as a template
Web 2.0

• First generation Web services: SOAP, WSDL, UDDI (WSDL registry)
  – Met functional requirements for businesses, but not the supporting requirements: security, reliability, availability, quality of service, choreography

• Web 2.0: WS-* specifications:
  – WS-Addressing: references to Web service endpoint
  – WS-Atomic Transaction
  – WS-Business Process Execution Language
  – WS-Choreography Language
  – WS-Coordination and WS-Eventing
  – WS-Metadata Exchange Language
  – WS-Notification
  – WS-Reliable Messaging
  – WS-Security: end to end, not just point to point
A Typical Strategy Using Electronic Data Interchange (EDI) for Business Process Definition Implementation

Image by MIT OpenCourseWare.
EDI (Electronic Data Interchange)

- EDI is a mainframe-based standard for electronic exchange of information. Developed in 1980s.
  - EDI is expensive, complex and has limited usage, but enough that new technologies must interoperate with it
  - Typically, large companies use EDI and require it of their smaller partners/vendors, who are not always eager to use it
  - Two EDI standards: ANSI X12 and EDIFACT (UN)
- XML documents follow EDI standards in many cases
  - EDI documents are called Transaction Sets (TS)
  - EDI to XML mapping established using DTDs
- New users of Internet ecommerce may skip EDI and use XML
  - Less than 80,000 of 6-10 million US businesses use EDI
  - 125,000 businesses world-wide use EDI
  - EDI cost and complexity are large obstacle for medium size businesses
EDI

• EDI communications:
  – Binary, not text (difficult to change or troubleshoot)
    • EDI transaction sets are static
    • EDI designed for expensive and scarce communications
      – Much optimization of message size, etc.
      – Intended to replace letters, phone calls, faxes
      – Not self-describing, cannot be validated, can’t be extended…
  – Done through third party value-added networks (VANs)
  – Companies generally use file transfer to send file to VAN
    • VAN handles EDI exchange with trading partners
    • Geared to once-a-day, batch exchanges of data
  – Example (over a period of days): A purchaser:
    • Sends EDI 840 document (Request for Quote)
    • Receives EDI 843 (Quote)
    • Sends EDI 850 (Purchase Order)
    • Receives EDI 856 (Shipment Notice)
    • Receives EDI 810 (Invoice)
    • Sends EDI 820 (Payment)
EDI and XML

EDI and XML translation

Image by MIT OpenCourseWare.
### ISA - Interchange Control Header

**Purpose:** To start and identify an interchange of one or more functional groups, interchange related control segments.

<table>
<thead>
<tr>
<th>Field</th>
<th>Element</th>
<th>Field Name</th>
<th>Req</th>
<th>Type</th>
<th>Size</th>
<th>Seagate Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISA01</td>
<td>101</td>
<td>Authorization Information Qualifier</td>
<td>M</td>
<td>ID</td>
<td>2</td>
<td>00</td>
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<tr>
<td>ISA02</td>
<td>102</td>
<td>Authorization Information</td>
<td>M</td>
<td>AN</td>
<td>10</td>
<td>Not used by Seagate</td>
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<tr>
<td>ISA03</td>
<td>103</td>
<td>Security Authorization Information</td>
<td>M</td>
<td>ID</td>
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<td>00</td>
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<tr>
<td>ISA04</td>
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<td>AN</td>
<td>10</td>
<td>Not used by Seagate</td>
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<tr>
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<td>105</td>
<td>Interchange ID Qualifier</td>
<td>M</td>
<td>ID</td>
<td>2</td>
<td>Trading partner qualifier</td>
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<tr>
<td>ISA06</td>
<td>106</td>
<td>Interchange Sender ID</td>
<td>M</td>
<td>ID</td>
<td>15</td>
<td>095333326 = Seagate production ID 98533326TST = Seagate test ID</td>
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<td>M</td>
<td>ID</td>
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<td>Trading partner qualifier</td>
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<td>M</td>
<td>ID</td>
<td>15</td>
<td>Trading partner receiver ID</td>
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<td>ISA09</td>
<td>108</td>
<td>Date</td>
<td>M</td>
<td>DT</td>
<td>6</td>
<td>Current date: YYMMDD</td>
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<tr>
<td>ISA10</td>
<td>109</td>
<td>Time</td>
<td>M</td>
<td>TM</td>
<td>4</td>
<td>Current time: HHMM</td>
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<tr>
<td>ISA11</td>
<td>110</td>
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<td>ID</td>
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<td>U =ANSI x12</td>
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<td>1</td>
<td>0 = no acknowledgment 1 = interchange acknowledged requested (always use 0)</td>
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<tr>
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<td>M</td>
<td>AN</td>
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<td>P = production data T = test data</td>
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<td>Sub-Element Separator</td>
<td>M</td>
<td>AN</td>
<td>1</td>
<td>Defined by sender</td>
</tr>
</tbody>
</table>

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Image by MIT OpenCourseWare.
Distributor information flow

- **SUPPLIER**
  - Purchase order
  - Open purchase order information
  - Account balances & Payment remittance information

- **Purchasing**
  - Receiving information
  - Freight bill
  - Payment remittance & Notification to pay

- **Distribution/Receiving**
  - Invoice
  - Order status inquiry - response
  - Account balances & Payment remittance information

- **Accounts Payable**
  - Invoice
  - Payment remittance & Notification to pay

- **SUPPLIER BANK**
  - Accounts payable

- **BUYER BANK**
  - Receipt

- **SALES/Marketing**
  - Internal order
  - Incoming order information

- **CARRIER**
  - Shipping information
  - Bill of lading

- **SELLER BANK**
  - Payment remittance & Notification to pay

- **CUSTOMER**
  - Purchase order
  - Invoice
  - Purchase order - acknowledgment
  - Payment remittance & Notification to pay

- **CUSTOMER BANK**
  - Currency exchange

Image by MIT OpenCourseWare.
Financial information flow

BUYER BANK
- Customer
- Notification to transfer funds & Payment remittance
- Transfer funds
- Pass EDI data
- Purchasing
- Accounts payable
- Invoice

SELLER BANK
- Customer
- Account balances & Payment remittance information
- Transfer funds & Payment remittance information

BUYER BANK
- Transfer funds & Payment remittance information

CENTRAL BANK
- Transfer funds & Payment remittance information

SELLER BANK
- Supplier of Product for Bank

SUPPLIER OF PRODUCT FOR BANK
- Purchase order
- Invoice

Image by MIT OpenCourseWare.
Manufacturing/engineering information flow

- **SUPPLIER**
  - Request for quote - Quote
  - Purchase order
  - Purchase order - acknowledgment
  - Open purchase order information
- **ENGINEERING**
  - Request for quote - Quote
- **PURCHASING**
  - Purchase requisitions
  - Receiving information
  - Invoice
- **DISTRIBUTION**
  - Invoice
  - Open purchase order information
  - Accounts payable
  - Payment remittance & Notification to pay
  - Freight bills
  - Bill of lading
  - Order status inquiry - responses
- **CARRIER**
  - Bill of lading
  - Payment remittance & Notification to pay
- **ACCOUNTS PAYABLE**
  - Invoice
- **CUSTOMER**
  - Customer bank
  - Supplier bank
  - Buyer bank
  - Outside warehouse
  - Seller bank
  - Customer bank
  - Supplier bank
  - Buyer bank
  - Outside warehouse
  - Seller bank
  - Customer bank

Image by MIT OpenCourseWare.
Manufacturer information flow: detail

- **Request for quote - Quote**
  - **Evaluate request for quote**
  - **Develop Manufacturing spec**

- **MANUFACTURING LOCATION**
  - **Internal order**
  - **Manufacturing Requirements Planning**
  - **Order entry, Order process**
  - **Internal staging order**
  - **Purchase order information**
  - **Invoice**
  - **Payment remittance & Notification to pay**

- **Purchasing**
  - **Purchase order**
  - **Purchase order information**
  - **Authorize payment, Invoice reconciliation**
  - **Account balances & Payment remittance information**
  - **Bill of lading**
  - **Freight bills**

- **Receiving information**
  - **Payment remittance & Notification to pay**
  - **Freight bill information**

- **Shipment staging, Develop bill of lading, Receive product**
  - **Freight bill information**
  - **Warehouse status inquiry - messages**
  - **Shipment information**

- **CARRIER**
  - **develop freight bill**
  - **order status**
  - **Bill of lading**
  - **Freight bills**

- **WAREHOUSE**
  - **shipment staging**
  - **Account balances & Payment remittance information**

- **CUSTOMER BANK**
  - **transfer funds**
  - **pass account balances**

- **CUSTOMER**
  - **purchasing**
  - **invoice reconciliation**
  - **Invoice**

- **SELLER BANK**
  - **transfer funds**
  - **pass account balances**

- **SUPPLIER BANK**
  - **transfer funds**
  - **pass account balances**

- **SUPPLIER**
  - **order processing**
  - **invoicing**
  - **order processing invoicing**

- **BUYER BANK**
  - **transfer funds**
  - **pass account balances**

Image by MIT OpenCourseWare.
ERP and EDI/XML standards

• The previous slides define the core of an ERP system
  – Many have very substantial additions for human resources, planning, etc.
  – You can buy a full ERP or mix and match best of breed systems. Web service/SOA integration is common.

• Almost every interface on the previous slides has a defined EDI or XML transaction set or message set, typically defined by industry
  – TDCC (1968), EDX, CDIX, TALC, UCS/VICS, WINS, BVAI and others