Lesson 17 – Advanced Web Services

Service Oriented Architectures Security

Module 3 - Resource-oriented services

Unit 3 – Advances

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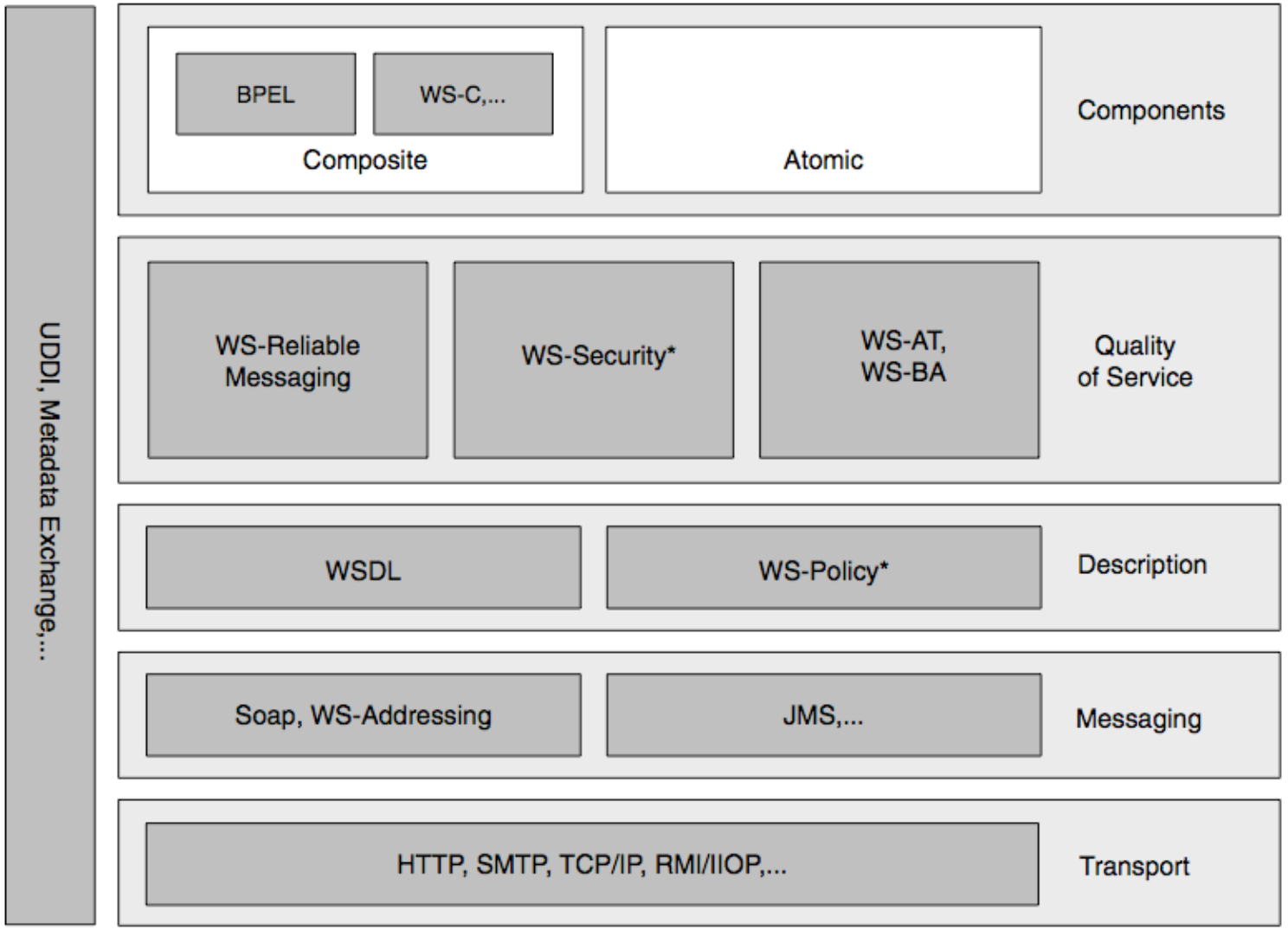
WS Architecture

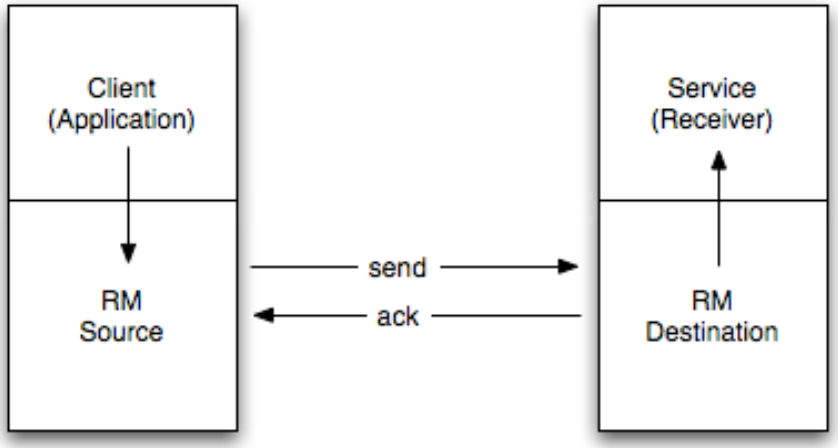


Advanced Topics for WS

- Quality of Service Layer
  - Transactions
  - Security
- Component Layer
  - WS-BPEL (and BPMN) WS-CDL

Other Aspects

- WS-Addressing and WS-Resources
  - standards to express end-points and state (references instead of values)
  - REST concepts
- Reliable Messaging - Add-on for Services/Clients
  - uses layer with message sequencing (acks and resends…)
  - best effort, at least once, at most once, exactly once



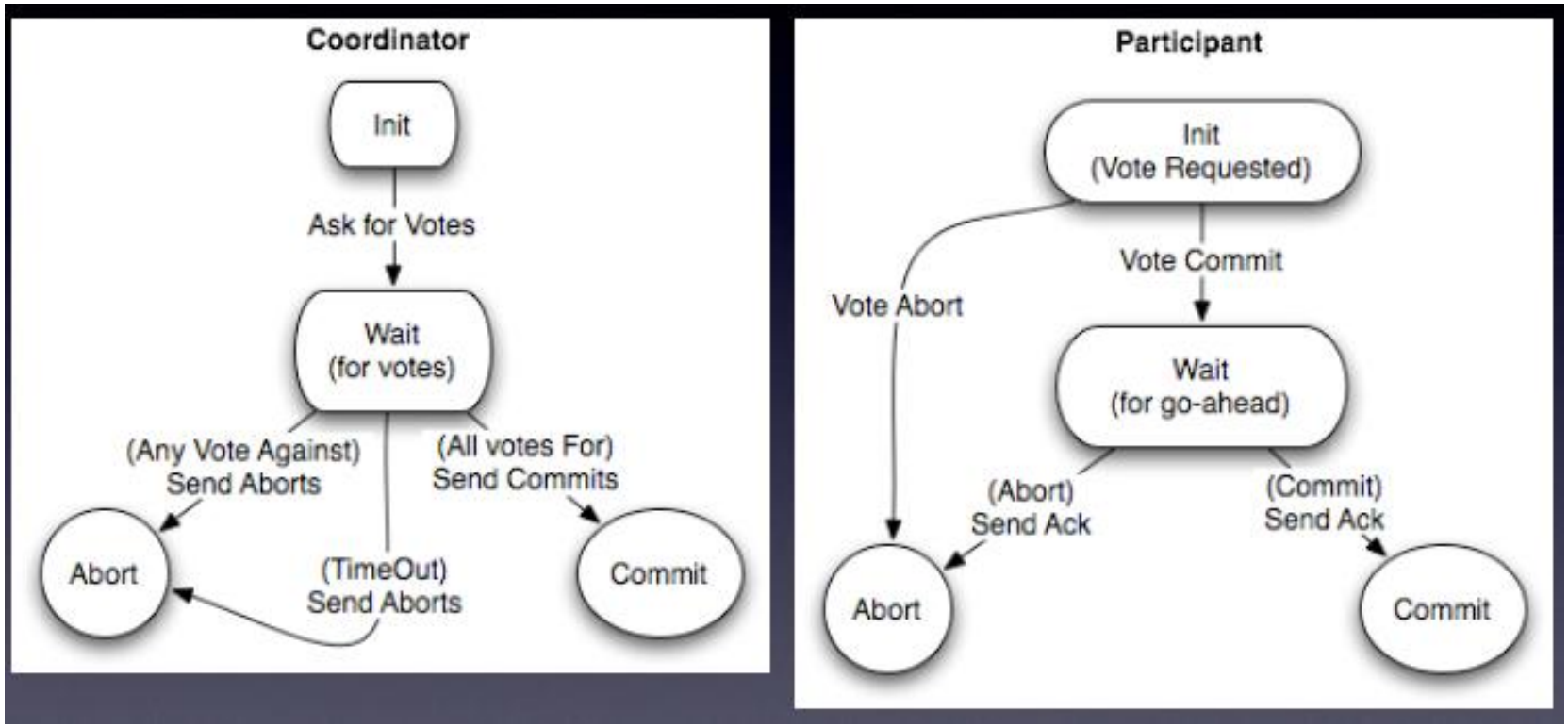
WS Transactions

Traditional transactions

- The problem
  - e.g. in programming: x = x+1 and x = x+y

    in sequence/in parallel
- Databases, Distributed Networking
- ACID
  - Atomic
  - Consistent
  - Isolated
  - Durable

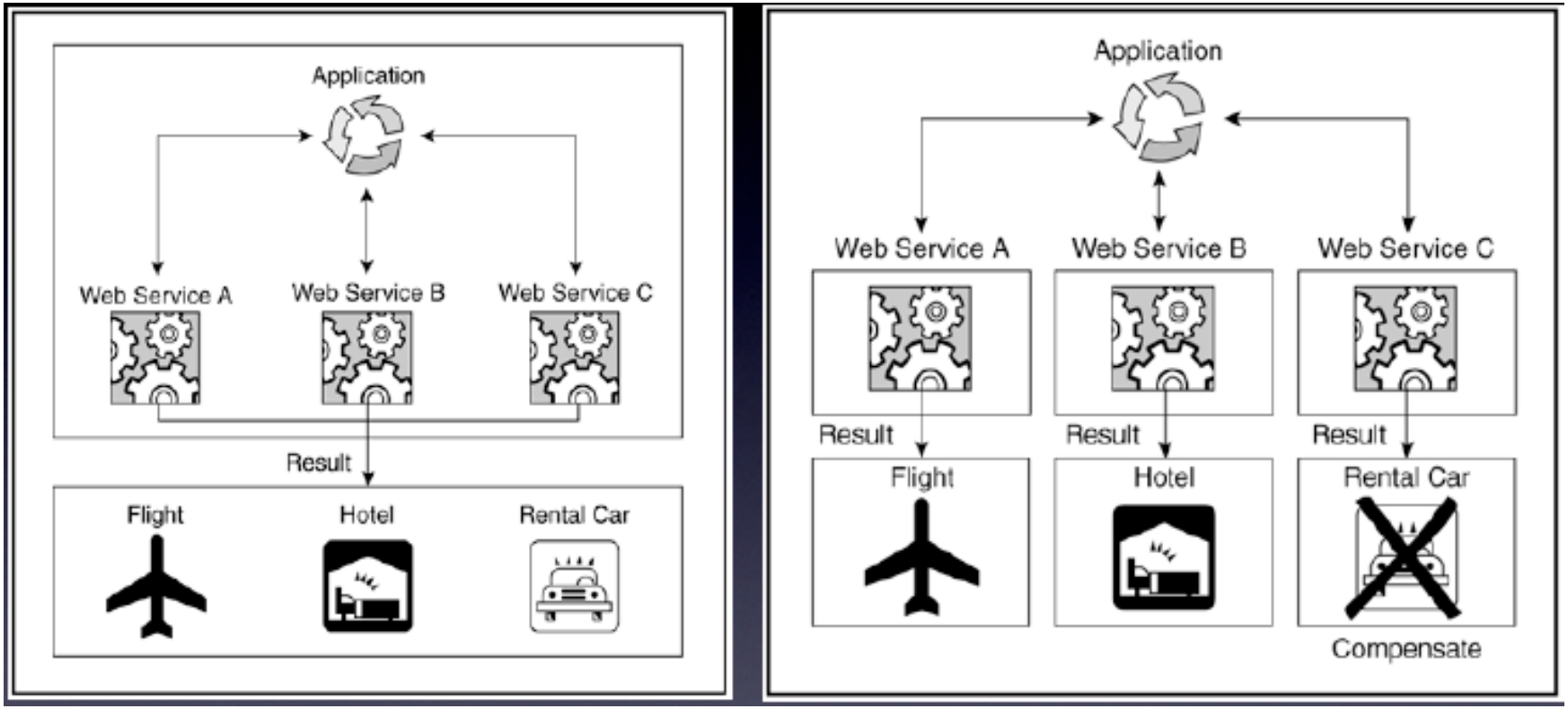
Phase Commit Protocol



Extended Transactions

- Need for Extended Transactions in Web Services
  - rationale for Non-ACID requirements
  - long duration, alternate failure handling, selected outcome inclusion, non-blocking across enterprises
  - (travel booking example)
- Web Services Protocols and Framework Standards
  - WS-Coordination
  - WS-Atomic Transaction
  - WS-Business Activity

Classic and Business Transactions

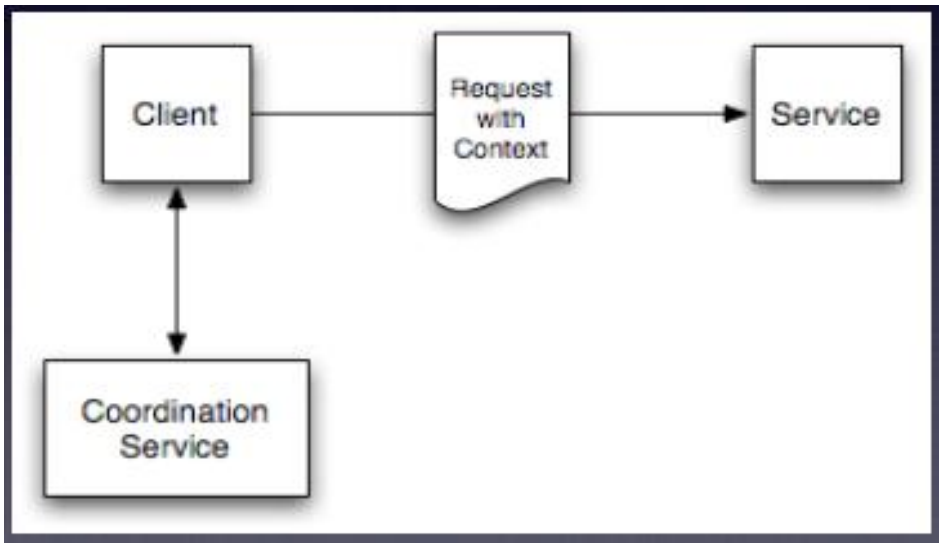


Framework for Transactions

- Need standard way to extend existing services
- Make use of additional services!

WS-Coordination

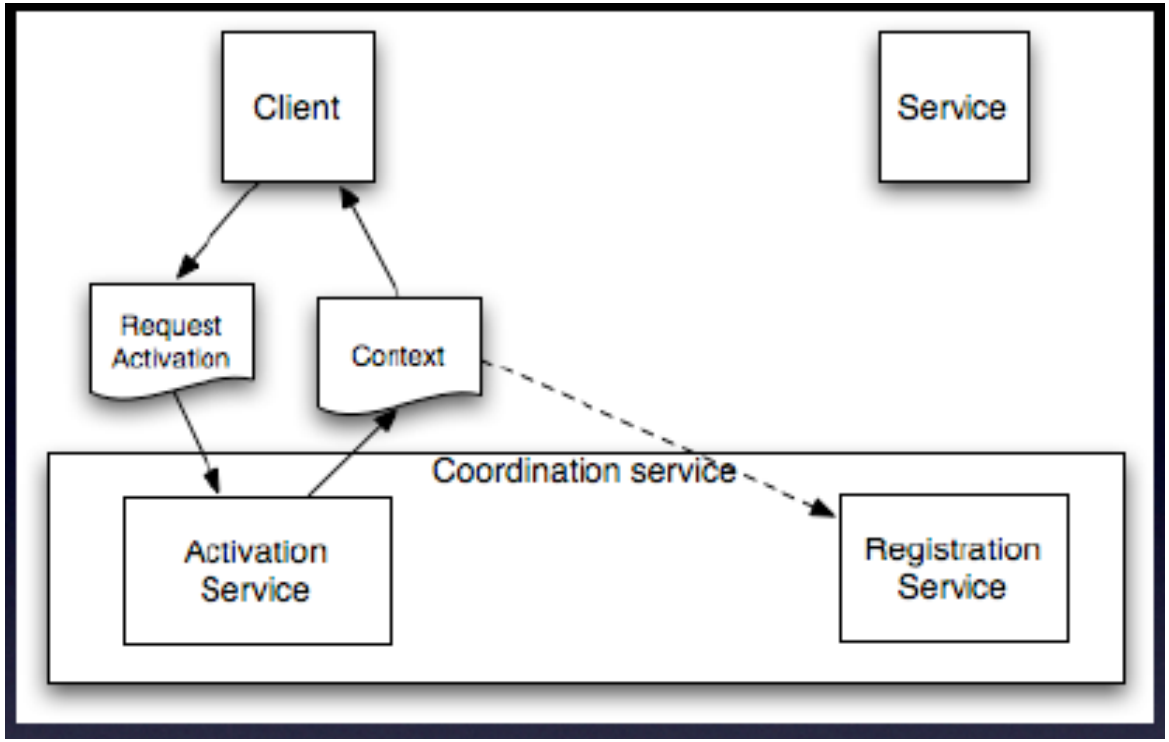
- ‘Coordination’ rather than ‘Transaction’ because the framework can be used for more than just transactions
- Plugable coordination protocols - separate from framework



Coordination Activation 1 (Part I)

- Create (coordinated) activity, supplying
  - choice of coordinator
  - options and info for choices of coordination (completion) protocol
- Context created, recording
  - Unique Identifier for the activity
  - address of registration service with completion protocol options

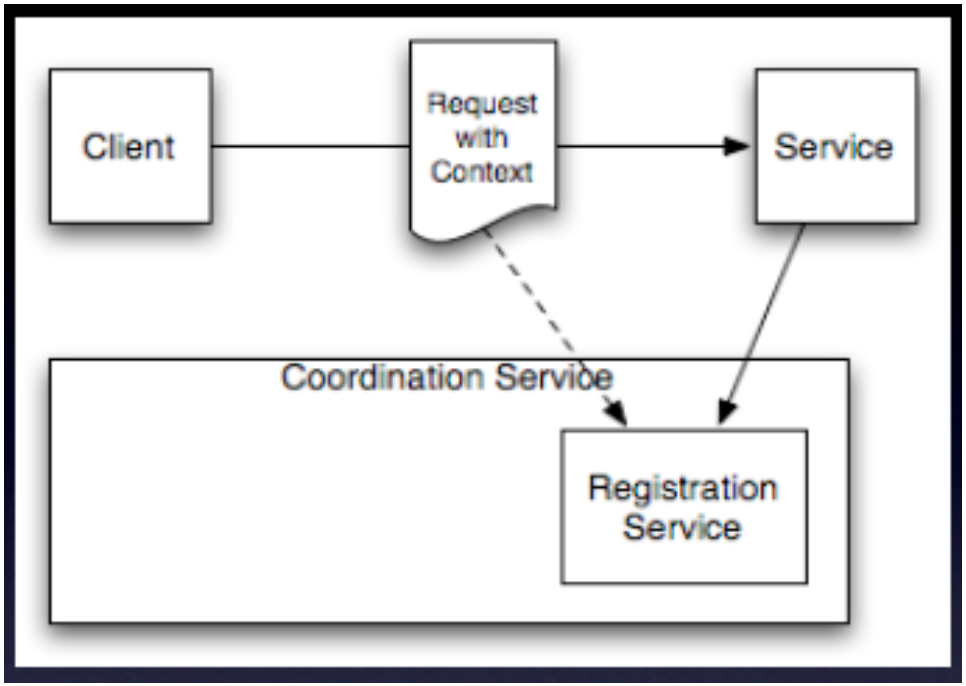
Coordination Activation 1 (Part II)



Coordination Activation 2 (Part I)

- Context is sent with web service request
- Service registers (to be involved in completion protocol) and can choose protocol to be used
- Depending on protocol, client or service can identify who is coordinator (endpoint responsible for running completion protocol)
- At completion, messages sent between coordinator and registered participants

Coordination Activation 2 (Part II)



Completion Protocols

- Examples
  - WS-Atomic Transaction
  - WS-Business Activity
- Exercises:
  1. Go through sequence of steps to understand the examples and use of coordination services and protocols
  2. Consider other examples (e.g. car parts case study)

Security and WS

- Fundamental to development of real web services (controlling access, simple authentication for range of distributed services, confidentially passing on security information, non-repudiation,..)
- Need for WS specific security support
  - Problems with SSL/TLS and IPSec alone
  - Generic protocols to leverage existing security concepts (Certificates, Kerberos tickets, CAs,...)
  - Example illustrating hiding, revealing, authenticating with multiple parties and federated security (policies)

WS-Security (Part I)

- Claims -> Security Tokens
  - (e.g. Kerberos Ticket, X509 certificate)
- Presenting Tokens in messages and service requests. Leveraging standards for XML:
  - Encryption and Signing using XML Encryption and XML Signature standards
  - SAML - security assertion markup language
  - Ways to include in SOAP (keys and encrypt info in headers, possibly partly encrypted/signed body) for intermediary access

WS-Security (Part II)

- Generating and Distributing Tokens (Security Token Supplier as a Service)
- Describing Policies (e.g. to put in WSDL)
- Verification activities (policy checking/managing)

Advanced Security (in Development) (Part I)

- WS-Trust
  - specifies models for Security Token Supplier Service
- WS-SecurityPolicy
  - how to express security policy for WS-Policy framework
- WS-SecureConversation
  - avoiding PKI for all messages
  - analogous to SSL/TLS as a layer between HTTP and TCP
  - exchange session keys (using PKI only at end points to set up)

Advanced Security (in Development) (Part II)

- WS-Privacy
  - expressing policies to be processed by clients and services as part of WS-Policy framework
  - constraining how data may be used
- WS-Federation
  - multiple enterprises sharing trust of authenticated identity
  - allows single sign-on
- WS-Authorization
  - add on to WS-Trust - standards for use of authorization tokens

Composing Web Services

- Problem:
  - how should we describe the combining (composing) of web services to create new services?
- Requirements:
  - descriptions should be relatively easy (test of SOA as good architectural approach) and completely platform independent
  - need a notation/language which is formal enough (executable!)
  - need to take account of both abstract and concrete services
  - need to orchestrate or choreograph the interactions (process description and collaborations)
  - should be linked to theory of processes e.g. Pi Calculus to understand completeness/properties/analysis

Look at Three Languages

- Business Process Execution Language WS-BPEL (Formerly BPEL4WS)
- Business Process Modelling Notation BPMN
- Choreography Description Language WS-CDL

Orchestration (1)

- Implementing a simple service (e.g. Java to match existing WSDL with SOAP conversion wrapper for IO)
- In practice, the other way round! (Take some Jave, use auto tools to expose it as a service, generating wrapper s/w and also WSDL file)
- What about a more complex service using other services...? (DIAGRAM)

Orchestration (2)

• A description language could be used to describe how the service works (is executed) however it is to be implemented. WSDL only says how to interact with a service. Using the new language we should be able to write an implementation of a new service and also describe how to make use of existing services in a combination. A standardised new language would allow for complete platform independence and possibilities for direct execution (i.e. no need for translation).

BPEL design

- Describing processes
  - flow (sequence, branching, parallel)
  - message exchanges
  - nested/recursive structure (processes within processes)
- Abstract or Executable
  - same notations (abstract can include hidden/unspecified detail)
  - executable means description can be implemented
    - locally (in some other PL), OR
    - with a BPEL engine (i.e. notation is a portable executable language)
- Programming in the Large
  - piecing together existing services, rather than locally implementing atomic services in a conventional PL.

BPEL is closely linked with WSDL

Recall WSDL docs - collection of definitions of

- Abstract Interface
  - types
  - message types
  - portTypes (with op names and message types)
- Deployment Information
  - bindings (to concrete transport protocols..)
  - ports (endpoint addresses for ops)
  - service (collection of ports)
    - Note separation of concerns (interface and deployment)
- BPEL also makes use of WS-Addressing, XPath, XML Schema

BPEL elements (1)

- Partner Links and Partner Link Types (abstraction of connections between 2 processes)
- Variables
  - message types
  - XML Schema types
  - XML elements
- Fault handlers

BPEL elements (2)

- Process (activity) description
  - <sequence> <if> <invoke> <receive> <reply> <assign> <flow> <pick> <wait>

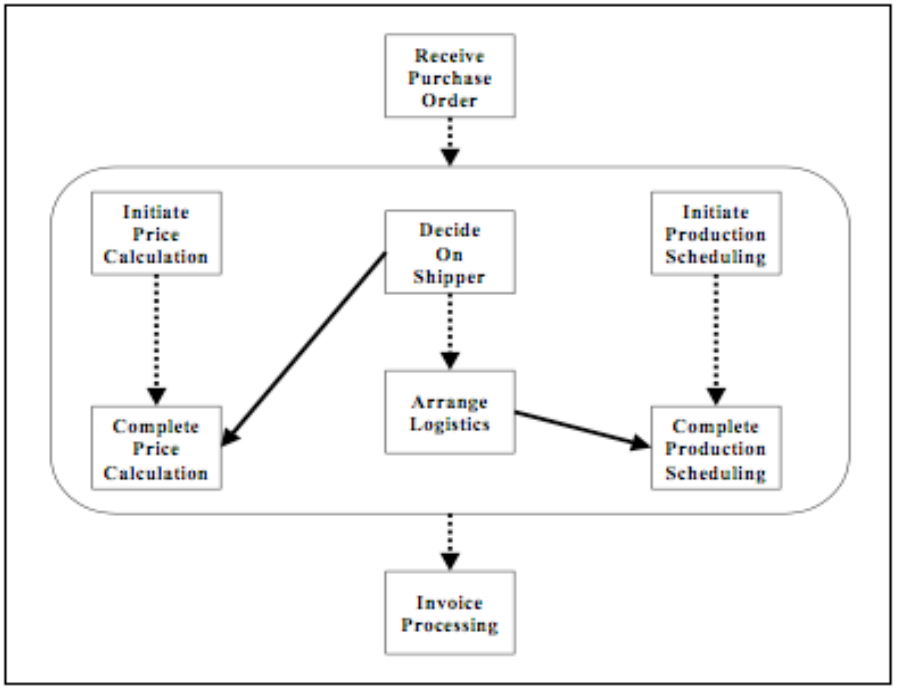
    iteration (<while> <for> <repeatUntil> <forEach>)

    <scope>
- BPEL only refers to abstract interface parts of WSDL for services
- Deployment of BPEL (e.g. endpoint addresses for services) kept separate
  - not part of the language

Advanced BPEL aspects

- Correlation Sets
- Fault Handling (including compensation handlers)
- Event Handlers
- Abstract and Executable details

An example from the standard (BPEL 1.1)



A picture of some business processing to be described in BPEL.

N.B: BPEL 2.0 is now referred to as WS-BPEL 2.0 (finalized 31/1/2007)

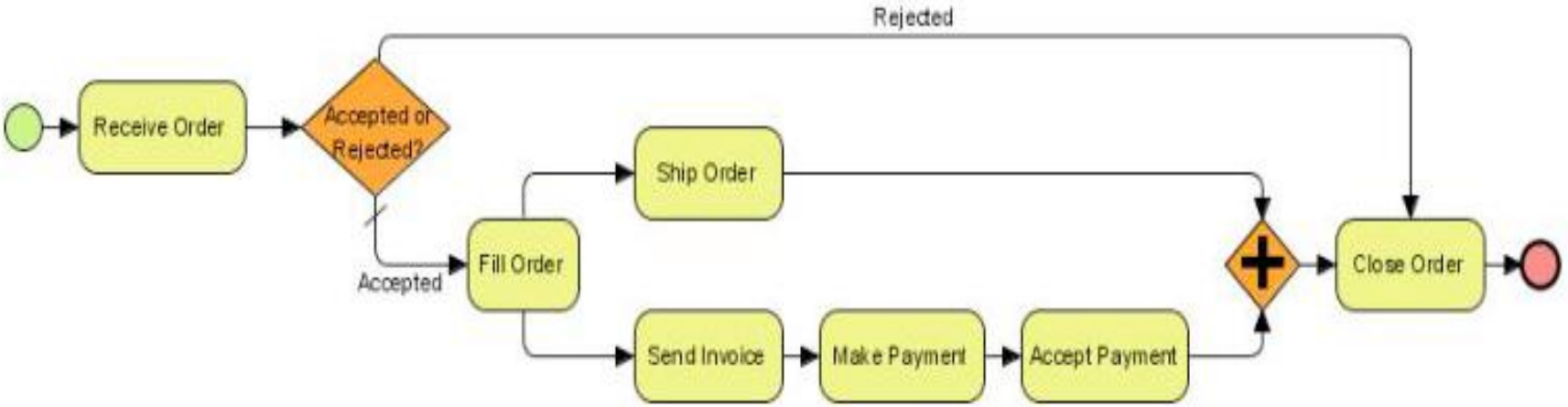
BPEL Examples

- See the Standard (s)
  - WS-BPEL 2.0 (31/1/2007)
    - http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=wsbpel
- and a tutorial
  - http://www.eclipse.org/tptp/platform/documents/design/choreography_html/tutorials/wsbpel_tut.html

BPMN (Business Process Modelling Notation)

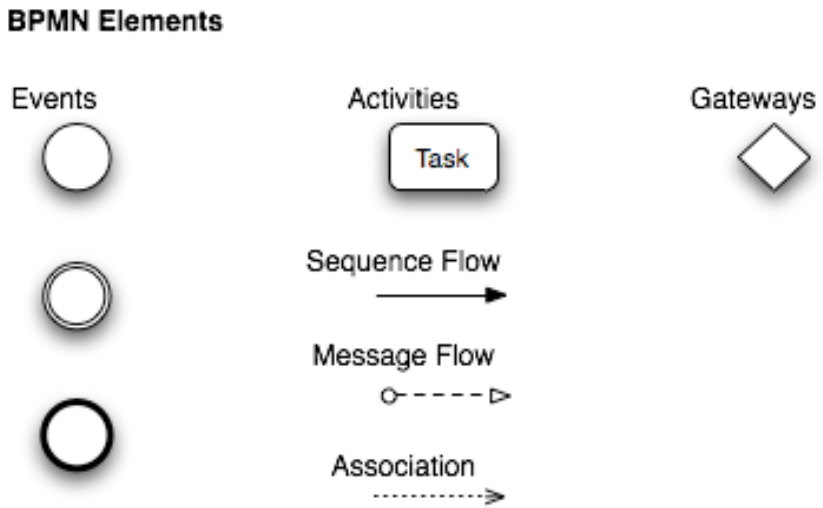
- Draft produced by BPMN-I in 2004 in an attempt to standardise from the multiple process notations being used at the time and designed to link to BPEL 1.1 standard (BPEL4WS at the time)
- Wide industry support
- OMG Standard BPMN 1.0 published Feb. 2006

BPMN example



BPMN Graphical Elements

- DEMOs
  - Wikipedia entry for a good introduction
    - http://en.wikipedia.org/wiki/BPMN
  - Links to demos and tools (on module page)
  - BP-VA (Flash demo 2006)



Orchestration and Choreography

- Orchestration is about describing and executing a single view point model
- Choreography is about describing and guiding a global model
- You can derive the single view point model from the global model by projecting based on participant

Too many languages?

- Still some issues on relationship between BPEL and BPMN
- CDL is NOT a competitor. There are good reasons for needing a global (choreography) view with no centralised control as well as the centralised control glue (orchestration)
- Especially for governance issues