Service Oriented Architectures and the JBoss SOA Platform

Dr Mark Little

Technical Development Manager, Red Hat

Overview

- **SOA in a nutshell**
  - Degrees of coupling
  - The component triad
- **Relationship to WS-***
- **The JBoss SOA Platform**
  - Registries and repositories
    - BRMS
  - Message delivery and transformation
  - Service orchestration
- **Futures**
  - Transaction processing in a SOA

What is SOA?

- *An SOA is a specific type of distributed system in which the agents are "services" (http://www.w3.org/TR/2003/WD-ws-arch-20030808/#id2617708*
- Adopting SOA is essential to delivering the business agility and IT flexibility promised by Web Services.
- But SOA is not a technology and does not come in a shrink-wrapped box
  - **It takes a different development methodology**
  - **It's not about exposing individual objects on the "bus"**

Services

- **Services represent building blocks for applications**
  - Allowing developers to organize their capabilities in ways that are natural to the application and the environment in which they operate.
- **A Service provides information as well as behaviour and it does not expose implementation (back-end) choices to the user.**
  - Furthermore a service presents a relatively simple interface to other services/users.

Tightly coupled

- A distributed application consists of several distinct components
- Traditional client and server technologies based on RPC
  - **Hide distribution**
  - **Make remote service invocation look the same as local component invocation**
- Unfortunately this *tightly coupled* applications
  - **Such applications can be brittle**

Loosely coupled

- SOA is an architectural style to achieve *loose coupling*
  - **A service is a unit of work done by a service provider to achieve desired end results for a consumer.**
- SOA is deliberately not prescriptive about what happens behind service endpoints
  - **We are only concerned with the transfer of structured data between parties**
- SOA turns business functions into services that can be reused and accessed through standard interfaces.
  - **Should be accessible through different applications over a variety of channels.**

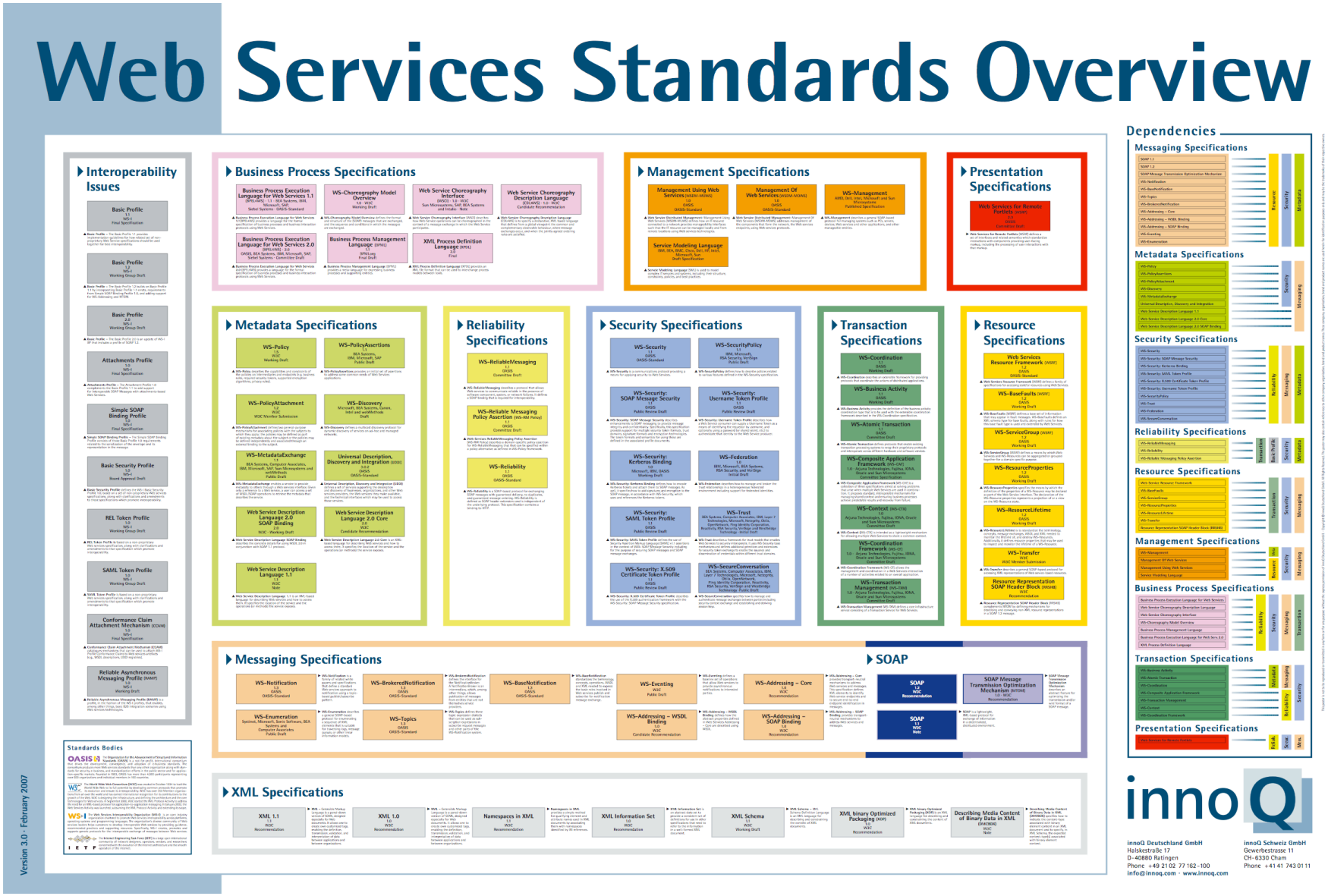
But …

- **There are degrees of coupling and you should choose the level that is right for you**
- **At the one extreme**
  - Defining specific service interfaces, akin to IDL
    - Easier to reason about the service
    - Limits the amount of freedom in changing the implementation
- **At the other extreme**
  - Single operation (e.g., doWork)
    - More flexibility is changing the implementation
      - Well, almost …
    - More difficult to determine service functionality a priori
      - Need more service metadata

What about Web Services?

- **Popular integration approach**
  - XML
  - HTTP
  - Pretty much universal acceptance (see bullets above!)
- **Not specific to SOA**
  - Web Services began life as CORBA-over-HTTP
  - XML-RPC
- **Web Services+SOA gives benefits**
  - Loose coupling
  - Interoperability
  - Enterprise capabilities, e.g., security and transactions

Relationship to WS-*



Fortunately …

- **SOA is technology agnostic**
- **WS-* offers the potential for interoperable SOA**
- **But it is just as easy to develop closely-coupled applications in WS-***
- **Most vendor WS-* tools are direct mappings of distributed object tools**
  - SOA != distributed objects with angle brackets
- **A SOA infrastructure should support and encourage SOA principles**
  - Sometimes it is easier said than done

The JBoss SOA Platform

- **A Service Oriented Infrastructure**
  - Based on JBossESB, Drools, JBossWS, JBossTS, JBoss Messaging and jBPM
  - Can run stand-alone or be deployed into JBossAS
- **JBossESB acts as the glue**
  - Supported protocols and capabilities make it more of an Internet Service Bus
  - Currently uses the “doWork” service definition approach
- **Encourages an incremental approach to SOA**
  - You don’t need to be a domain expert to benefit from it
  - Build up your knowledge in step with your requirements

Relationship to JBossESB

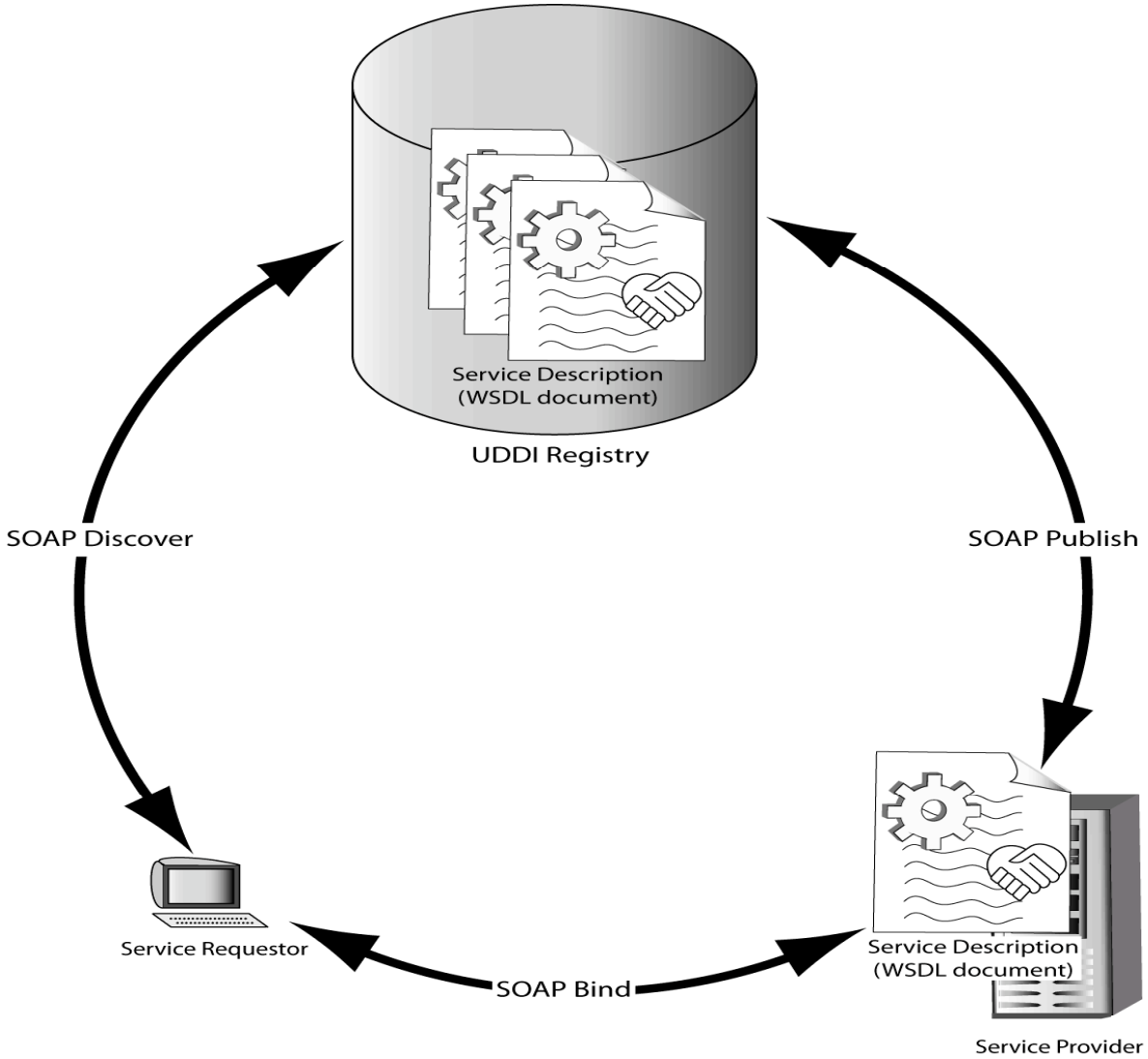
- **Messages and services are key to architecture**
- **Inherently asynchronous**
  - Correlated one-way messages for RPC
- **Support for Web Services**
- **Support for task management**
- **Adapters**
  - JCA
  - Gateways
- **Flexible architecture**
  - Multi-implementation approach

Where does it fit?

SOA components

- The key components of a Service Oriented Architecture are
  - **The messages that are exchanged**
  - **The agents that act as service requesters and service providers**
  - **The shared transport mechanisms that allow the flow of messages**
- A description of a service that exists within an SOA is essentially just a description of the message exchange pattern between itself and its users

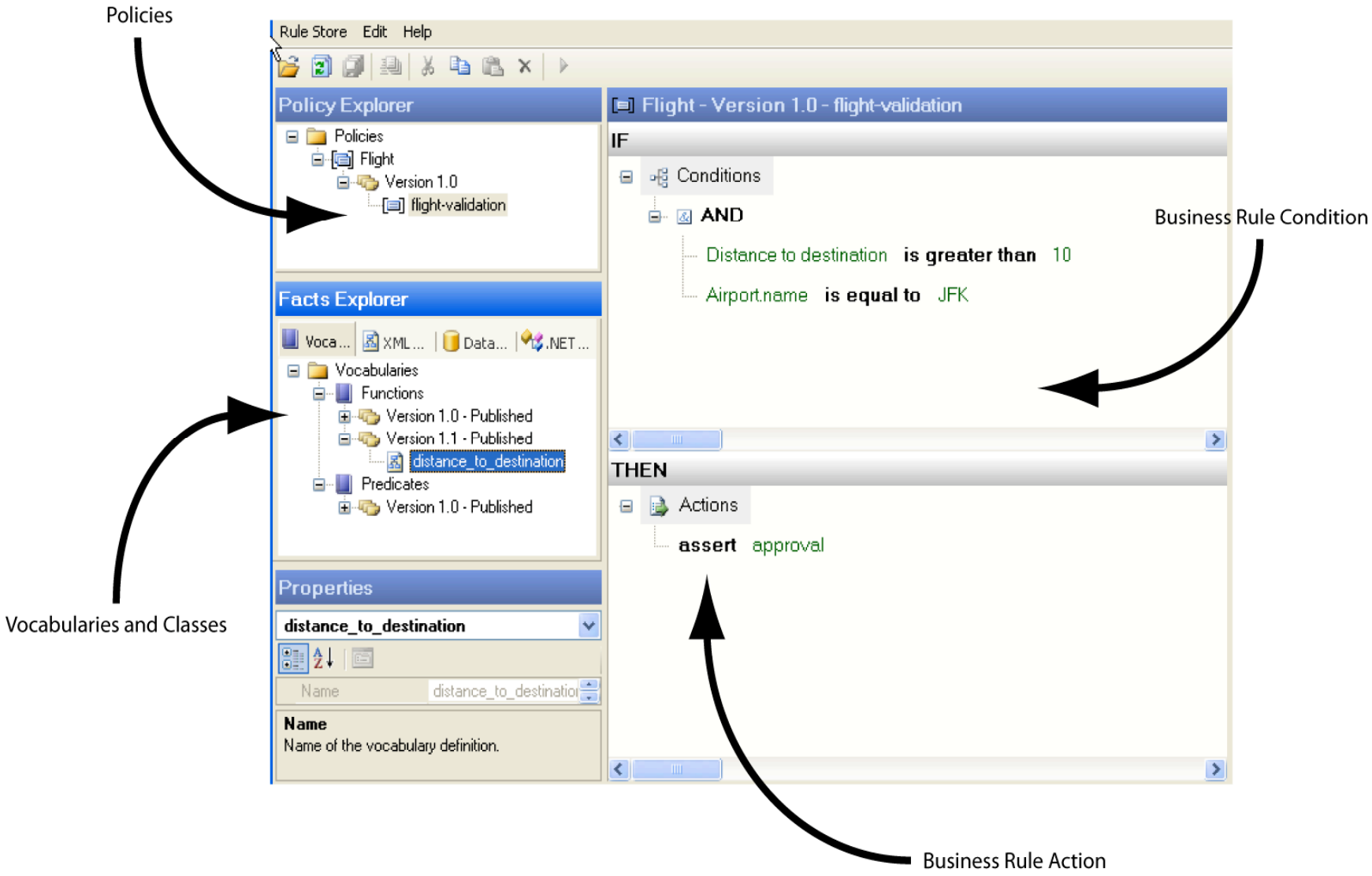
Component triad



Repository

- **Service metadata, which is important for contract definitions**
  - Functional and non-functional aspects
    - Transactional, secure, QoS, …
    - Policies
  - MEPs
    - One-way
    - Request-response
  - Message structure
    - Where data resides
  - Governance
- **Service binaries**
- **Business rules**
- **Workflow tasks or process control information**

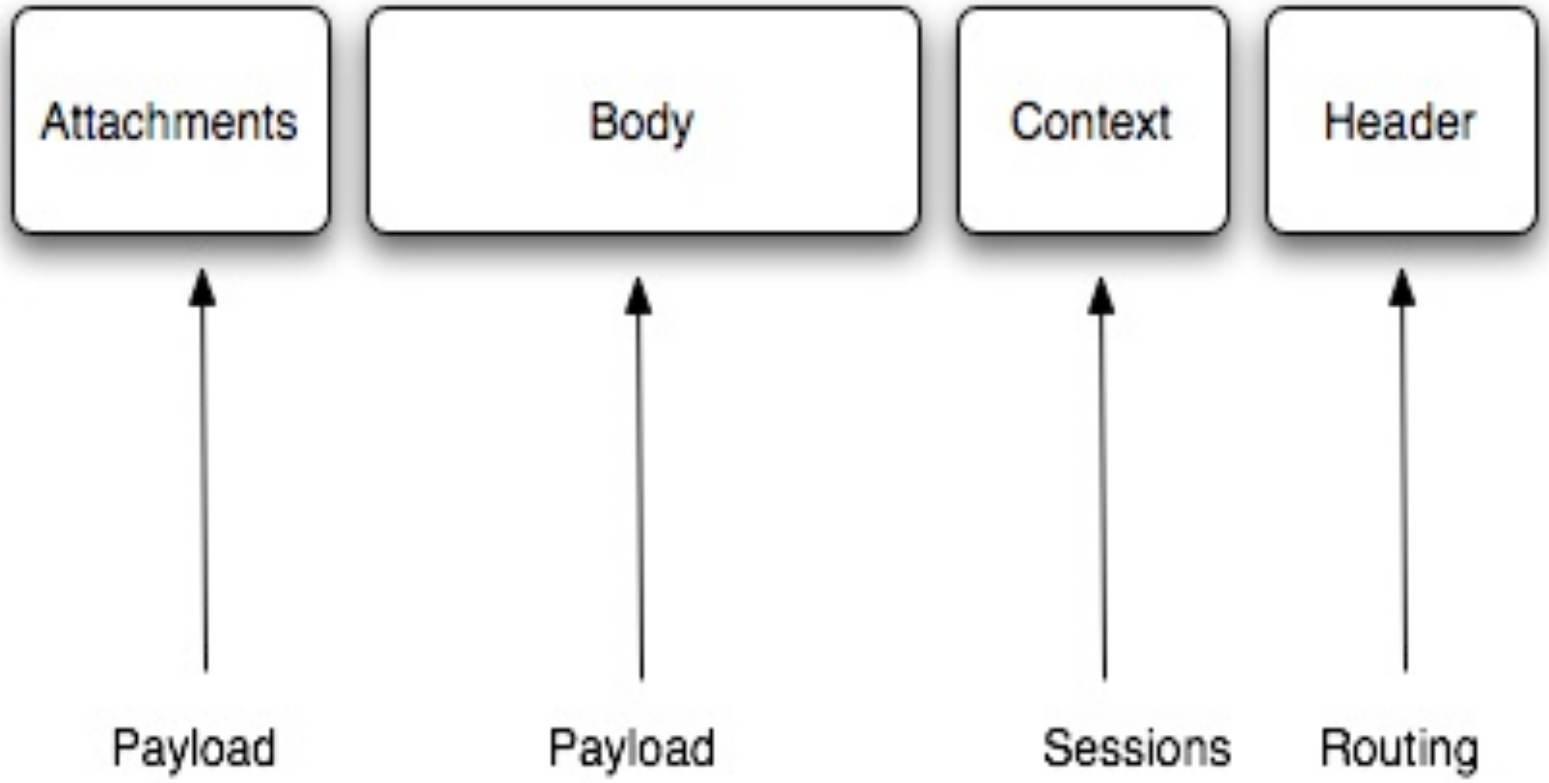
The BRMS


Policies
Rule Store Edit Help
Policy Explorer
Policies
Flight
Version 1.0
flight-validation
Facts Explorer
Voca... XML... Data... .NET...
Vocabularies
Functions
Version 1.0 - Published
Version 1.1 - Published
distance_to_destination
Predicates
Version 1.0 - Published
Properties
distance_to_destination
Name
distance_to_destinatio
Name
Name of the vocabulary definition.
Flight - Version 1.0 - flight-validation
IF
Conditions
AND
Distance to destination is greater than 10
Airport.name is equal to JFK
THEN
Actions
assert approval
Business Rule Condition
Vocabularies and Classes
Business Rule Action

Services and messages

- **Within the SOA-P everything is a service**
- **All services are interacted with via messages**
  - Messages are part of the contract between client and service
- **Messages do not imply specific implementations of carrier-protocol**
- **Services do not need to be bound to specific implementations of carrier-protocol**
  - Email, S-FTP, JMS, File, etc.
  - More can be added as required

The Message envelope



Message implementations

- **On-the-wire representation may be tailored for environment**
  - E.g., binary versus text
- **Only the structure of the Message is mandated**
- **Two wire-formats provided**
  - Java Serialized
  - XML
- **Others can be added statically or dynamically**

Message delivery in the SOA-P

- **Addressed via WS-Addressing Endpoint References**
  - Transport agnostic
- **Supports request-response as well as one-way MEP**
- **Mandatory to define the recipient address**
- **Optional**
  - Reply address
  - Message relationship information
  - Fault address

Gateway Services

- **Need to allow legacy services to plug-in to the bus**
- **Need to allow legacy clients to plug-in to the bus**
- **Neither have concept of Message or EPR**
- **Must bridge from ESB-aware to ESB-unaware domains**
  - Gateways perform this role
- **This allows the bus to be extended across the enterprise without perturbing existing infrastructure**

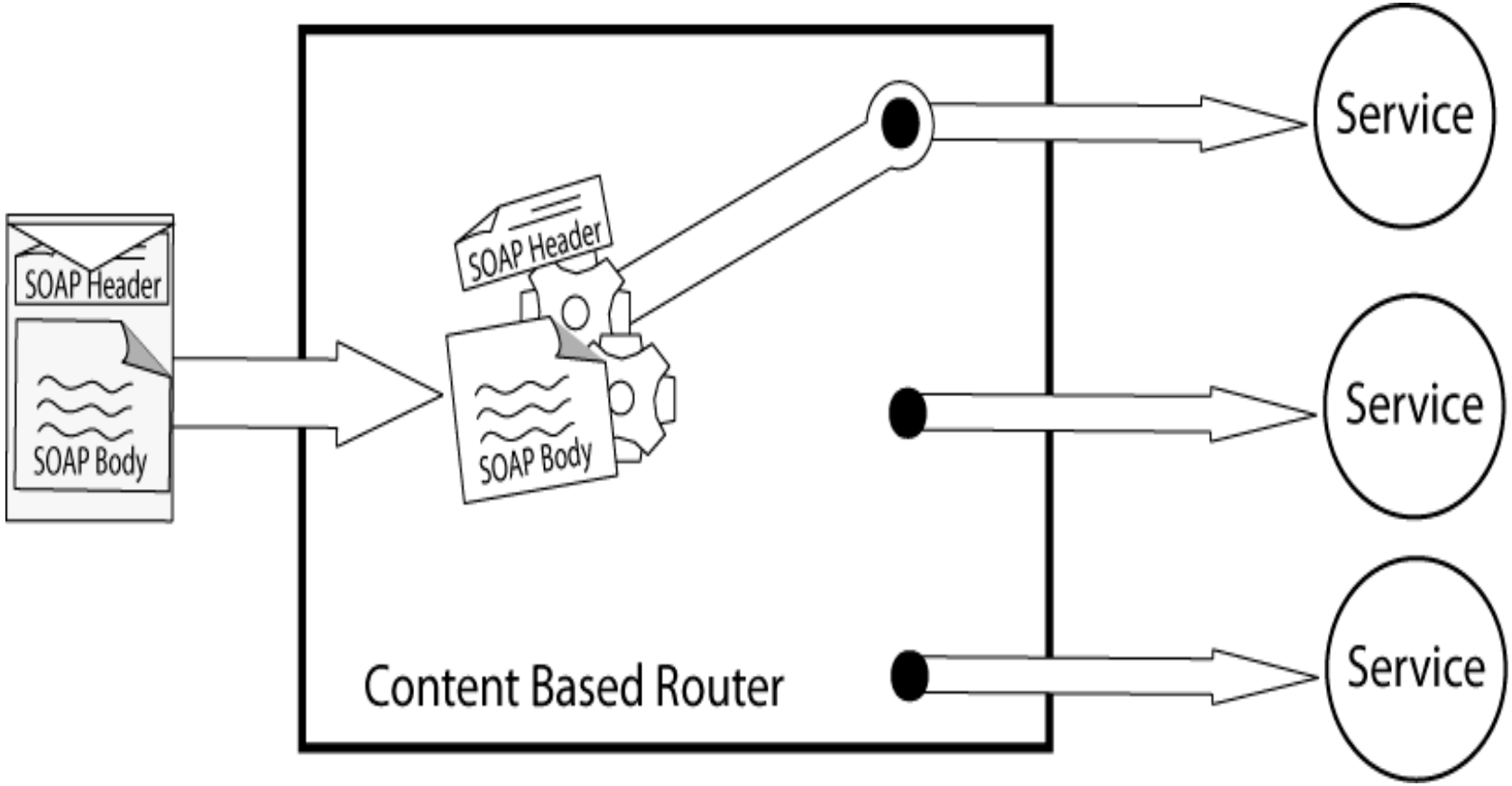
Service registration

- **Services are identified by Service Name but addressed by EPR**
  - Can be clustered for high availability and load balancing
- **Registry associates <Service Name, EPRs>**
- **Service may be available on more than one EPR**
  - E.g., different qualities of service
- **Services are expected to store EPR when activated**
- **Senders look up EPR(s) using Service Name**
  - May select on other criteria

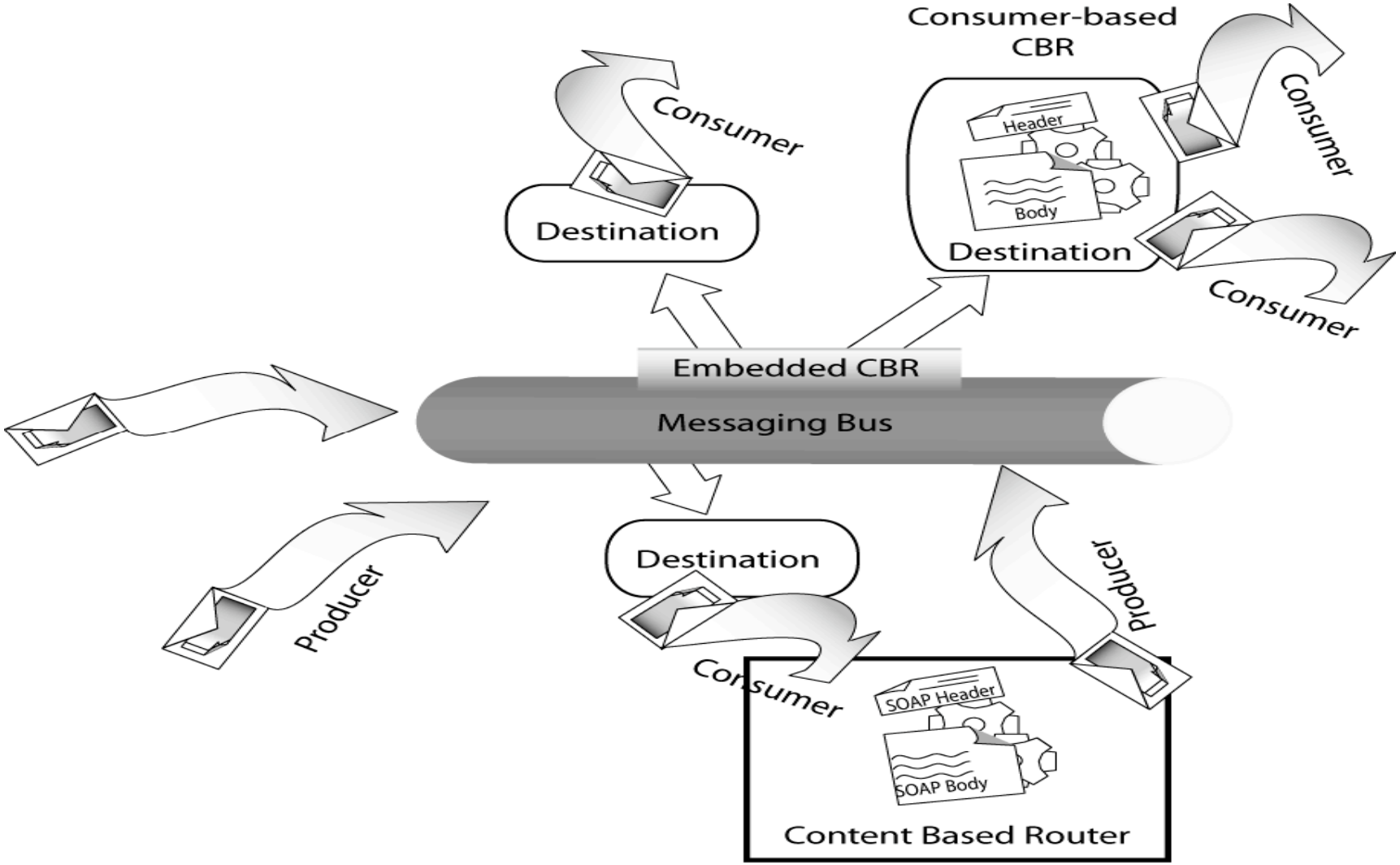
Content based routing

- **Intermediary services can redirect messages based on content**
  - Hiding federating service implementations
  - Business logic choices
  - Fault tolerance
- **Not a requirement for SOA**
  - But does help loose coupling and legacy integration
- **SOA-P has a CBR Service**
  - Supports JBoss Rules and XPath expressions

Web Service example



SOA Platform example



JBoss Rules

```
rule "Routing Rule - Serialized based message"

    when
        Message( type == MessageType.JAVA_SERIALIZED)
    then
        System.out.println("Serialized");
        destinationServices.add("test_category:Serialized_ServiceDestination");

end

rule "Routing Rule - XML based message"

    when
        Message( type == MessageType.JBOSS_XML)
    then
        System.out.println("JBoss_XML");
        destinationServices.add("test_category:JBOSS_XMLDestination");
end
```

Message transformation

- **Different services may communicate in different vocabularies**
  - Particularly with dynamic service registration/updates
- **Data may need to be restructured based on recipient, time of day, etc.**
- **Several ways to do transformation**
- **Transformation Service**
  - Smooks
  - XSLT
  - Others can be plugged in

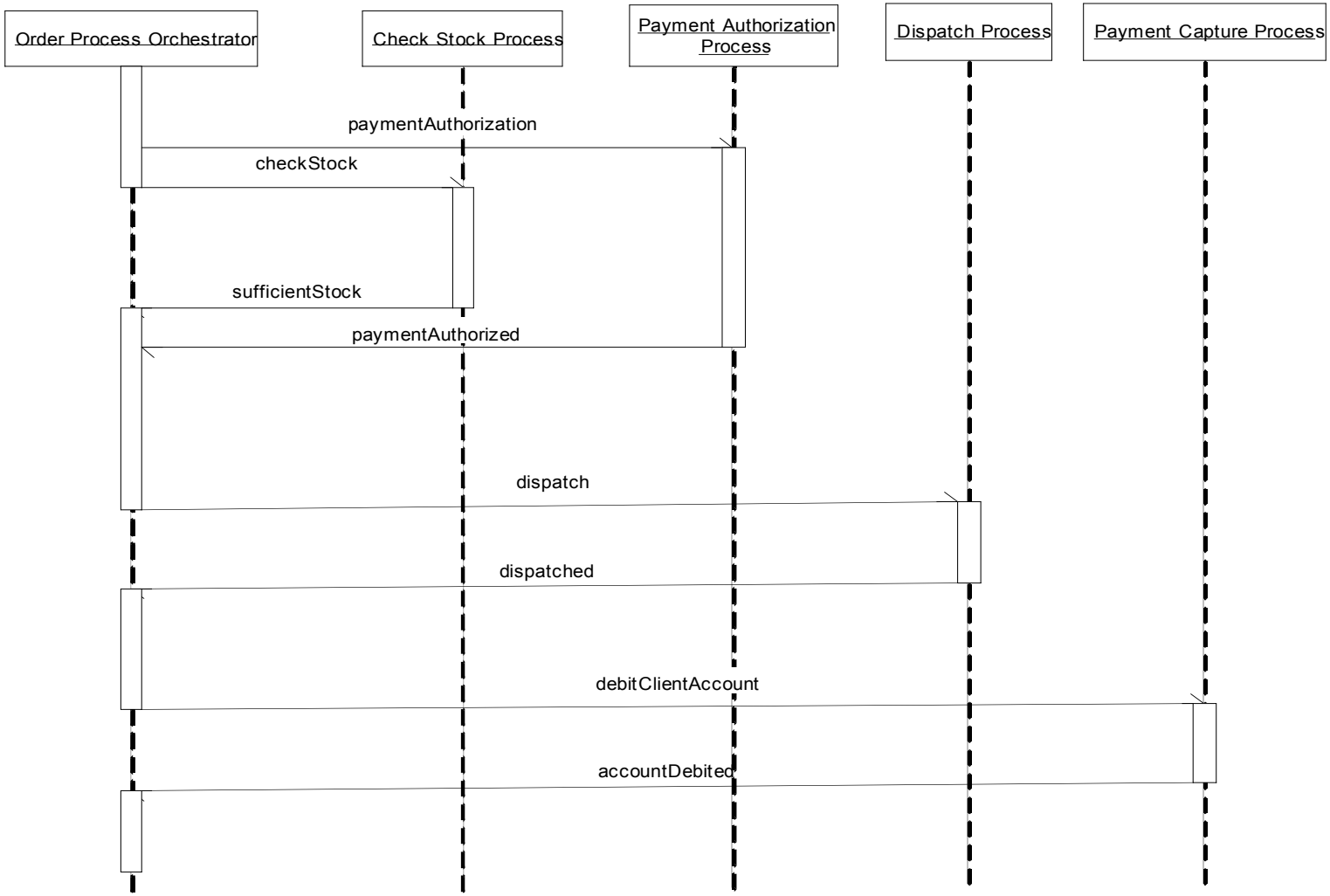
Message store

- **Messages can be durable recorded**
- **Useful for audit trail, debugging, replay etc.**
  - Sometimes mandated by local laws
- **Separate service**
- **Flexible implementations possible**
  - Service API does not impose implementation restrictions
  - Out-of-the-box uses JDBC

Service orchestration

- **Orchestration (e.g., BPM or workflow) is important in many distributed environments**
  - More so as the scale and complexity increases
- **Need to have intra service task orchestration**
  - Control the transition of the state of a service as it executes tasks
- **Need to have inter service orchestration**
  - Control the invocations of services as messages flow through the infrastructure
- **SOA-P supports both approaches**
  - jBPM
  - WS-BPEL

Orchestrating message flows



Fault tolerance

- **Machines and software fail**
  - Fundamental universal law (entropy increases)
  - Things get better with each generation, but still statistically significant
- **Failures of centralized systems difficult to handle**
- **Failures of distributed systems are much more difficult**

Fault tolerance techniques

- **Replication of resources**
  - Increase availability
    - Probability is that a critical number of resources remain operational
    - “Guarantee” forward progress
  - Tolerate programmer errors by heterogeneous implementations
- **Spheres of control**
  - “Guarantee” no partial completion of work in the presence of failures

What is a transaction?

- **Mechanistic aid to achieving correctness**
- **Provides an "all-or-nothing" property to work that is conducted within its scope**
  - Even in the presence of failures
- **Ensures that shared resources are protected from multiple users**
- **"Guarantees" the notion of shared global consensus**
  - Different parties in different locales have the same view of the transaction outcome

SOA characteristics

- **Business-to-business interactions may be complex**
  - involving many parties
  - spanning many different organisations
  - potentially lasting for hours or days
- **Cannot afford to lock resources on behalf of an individual indefinitely**
- **May need to undo only a subset of work**
- **Need to relax ACID properties**

Transaction interoperability

- **Web Services are as much about interoperability as they are about the Web**
- **In the short term will be about interoperability between existing TP systems**
  - Achievable with JBossTS

Transactions for SOA

- **Relax isolation**
  - Internal isolation or resources should be a decision for the service provider
    - E.g., commit early and define compensation activities
    - However, it does impact applications
      - Some users may want to know a priori what isolation policies are used
  - Undo can be whatever is required
- **Relax atomicity**
  - Sometimes it may be desirable to cancel some work without affecting the remainder
    - E.g., prefer to get airline seat now even without travel insurance
  - Similar to nested transactions
    - Work performed within scope of a nested transaction is provisional
    - Failure does not affect enclosing transaction

Heisenberg's Uncertainty Principle

- **Cannot accurately measure both position and momentum of sub-atomic particles**
  - Can know one with certainty, but not the other
  - Non-deterministic measurements
- **Large-scale/loosely-coupled transactional applications suffer the same effect**
  - Can know that all services will eventually see same state, just not when
  - Or at known time can determine state within model/application specific degree of uncertainty
- **Or another way of thinking about it …**
  - No such thing as simultaneity in data space as there isn't in space-time
    - *"Data on the Outside vs. Data on the Inside", by Pat Helland*

Conclusions

- **SOA is an important design-time and use-time approach**
  - SOA is NOT a product
  - Requires changes to organizational view of software components (services)
- **Web Services are important**
  - Interoperability
  - Internet-scale computing
  - But SOA applications are not inherent in WS-*
- **JBoss SOA-P can bridge the divide**
  - A single infrastructure that provides SOA support
- **Get involved**
  - Start by downloading JBossESB and give it a try (http://labs.jboss.com/jbossesb)
  - Lots of examples
  - Contribute

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