IBM WebSphere

Real World Uses of Transactions in SOA

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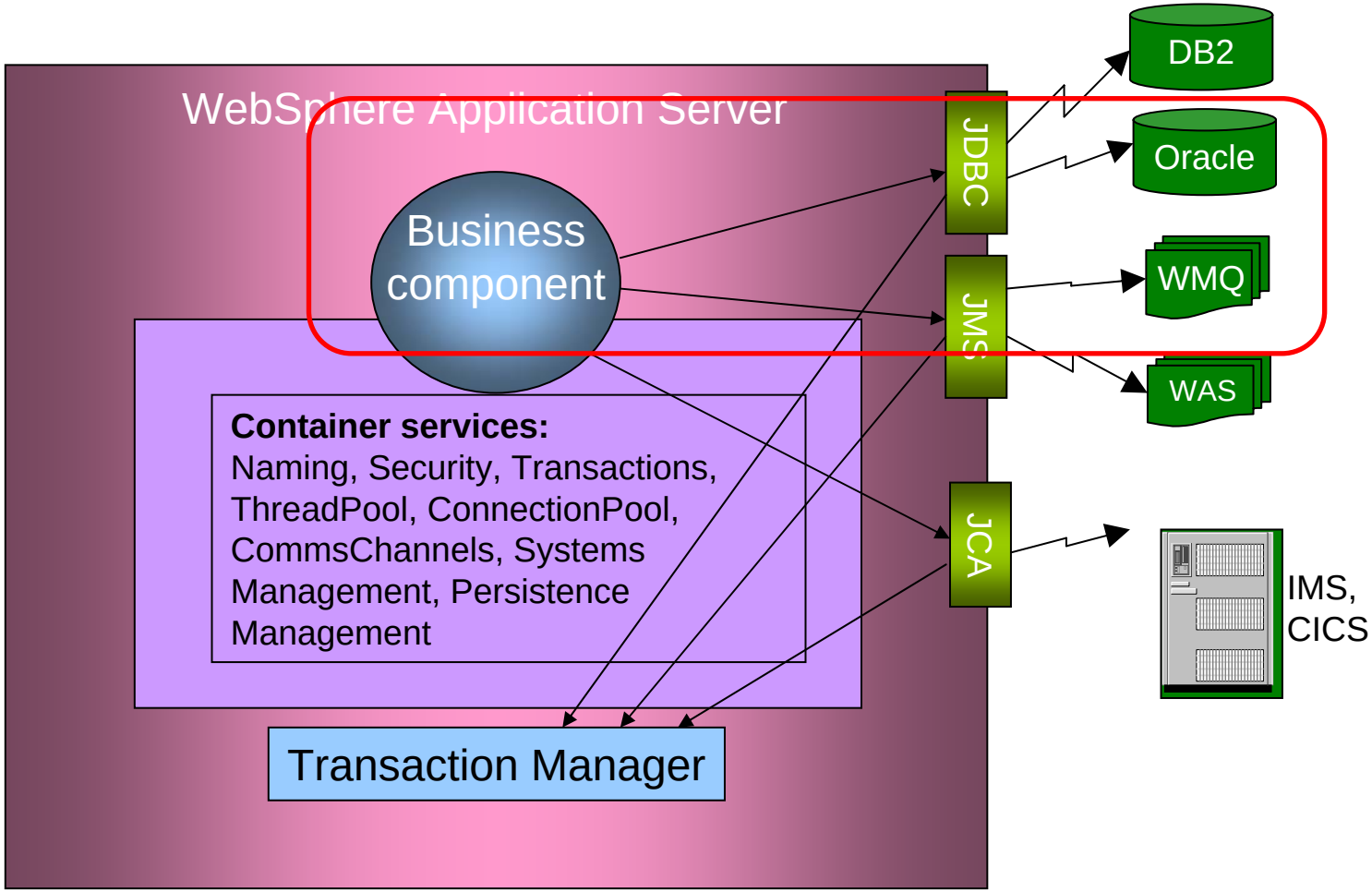
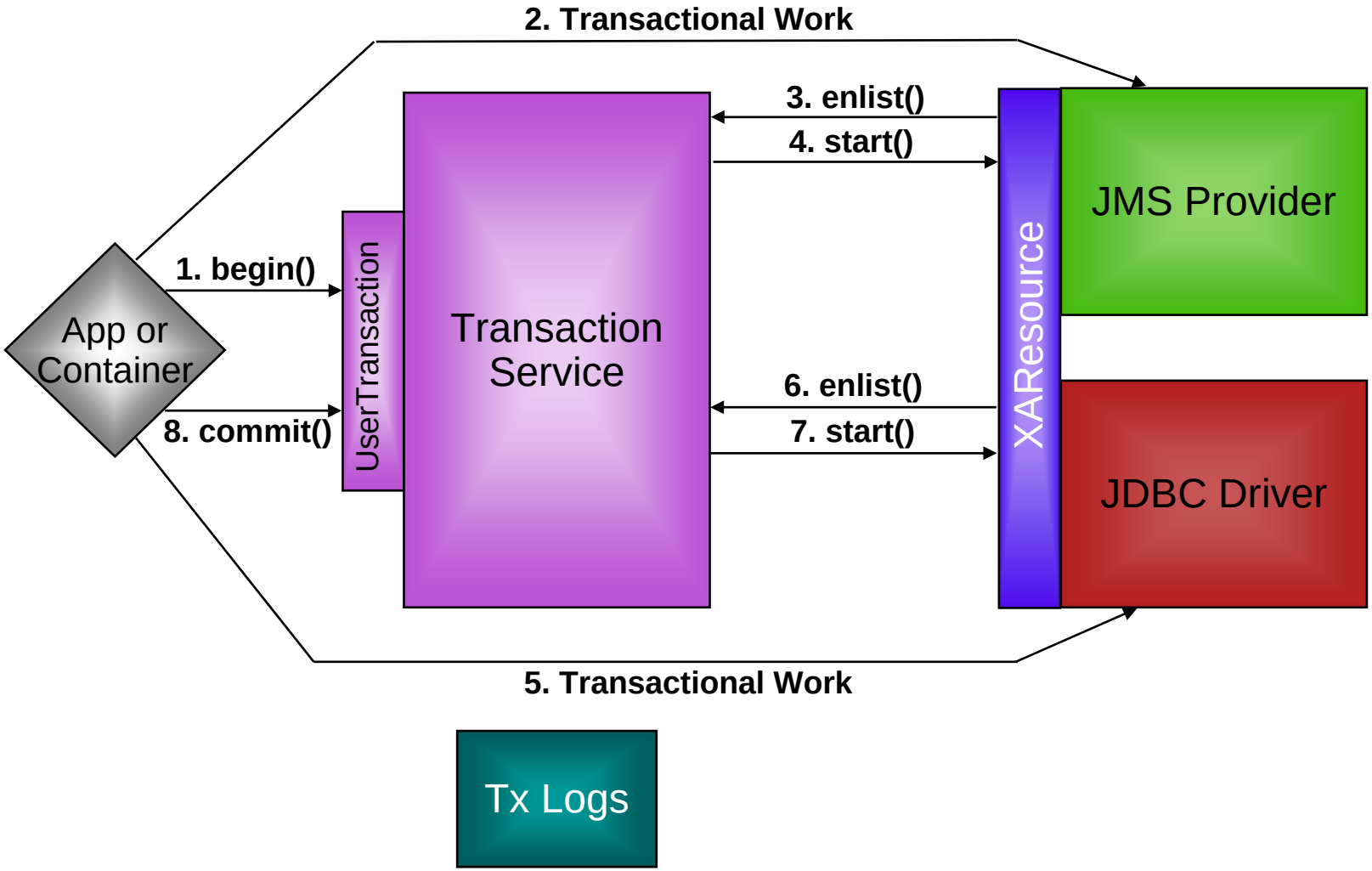
Agenda

- Transactions in Java EE and SOA
  - What is WS-Tx and how does it relate to Java EE?
- WAS support for WS-AT and WS-BA
  - How and when to use these in WAS.
- Qualities of service
  - What about the “NFRs” the specs don’t mention?
- Real world examples
  - Some real examples currently in use

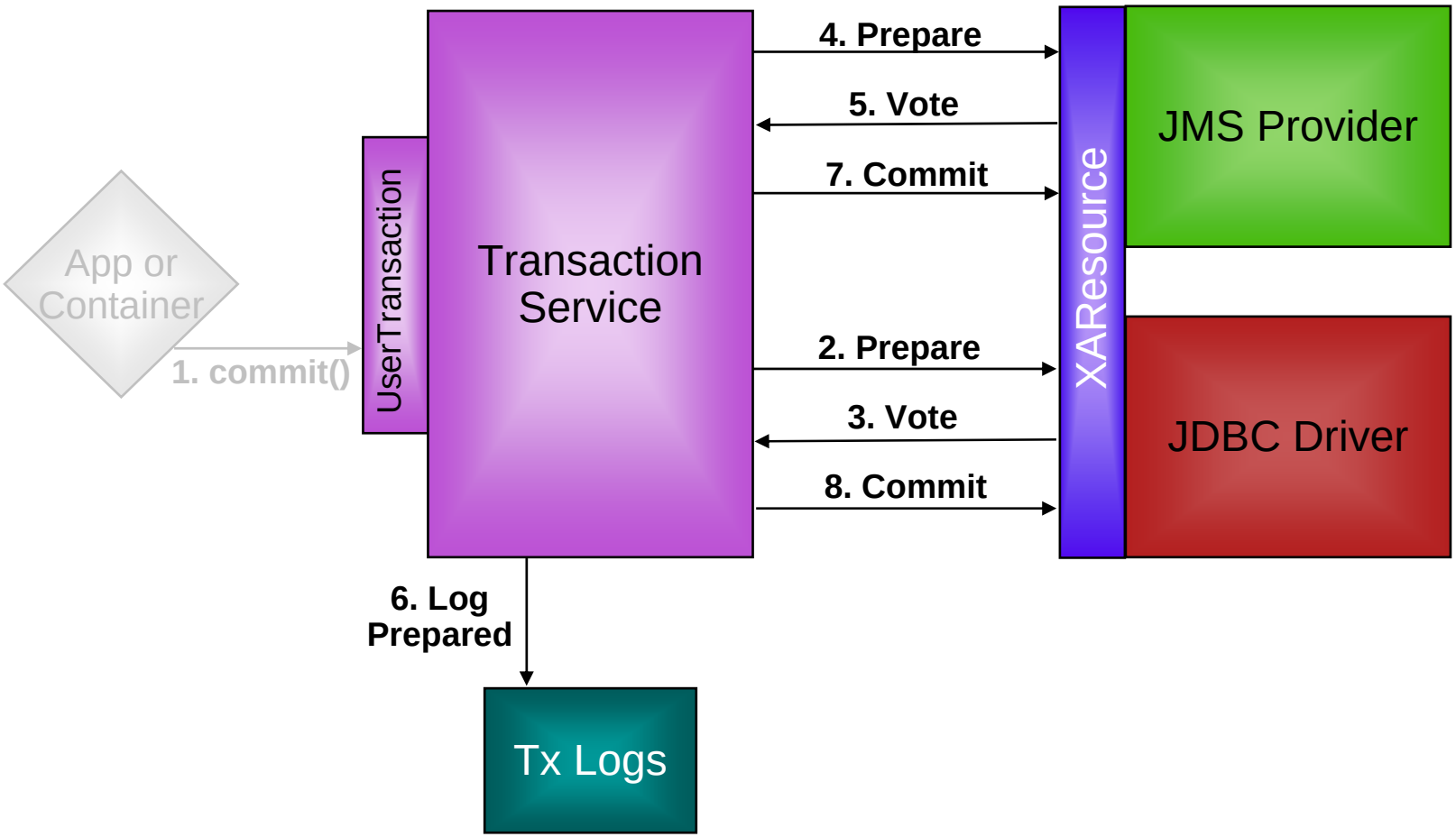
Local and Global transactions



Separation of concerns – interactions with RMs



Separation of concerns – 2-phase commit (2PC)

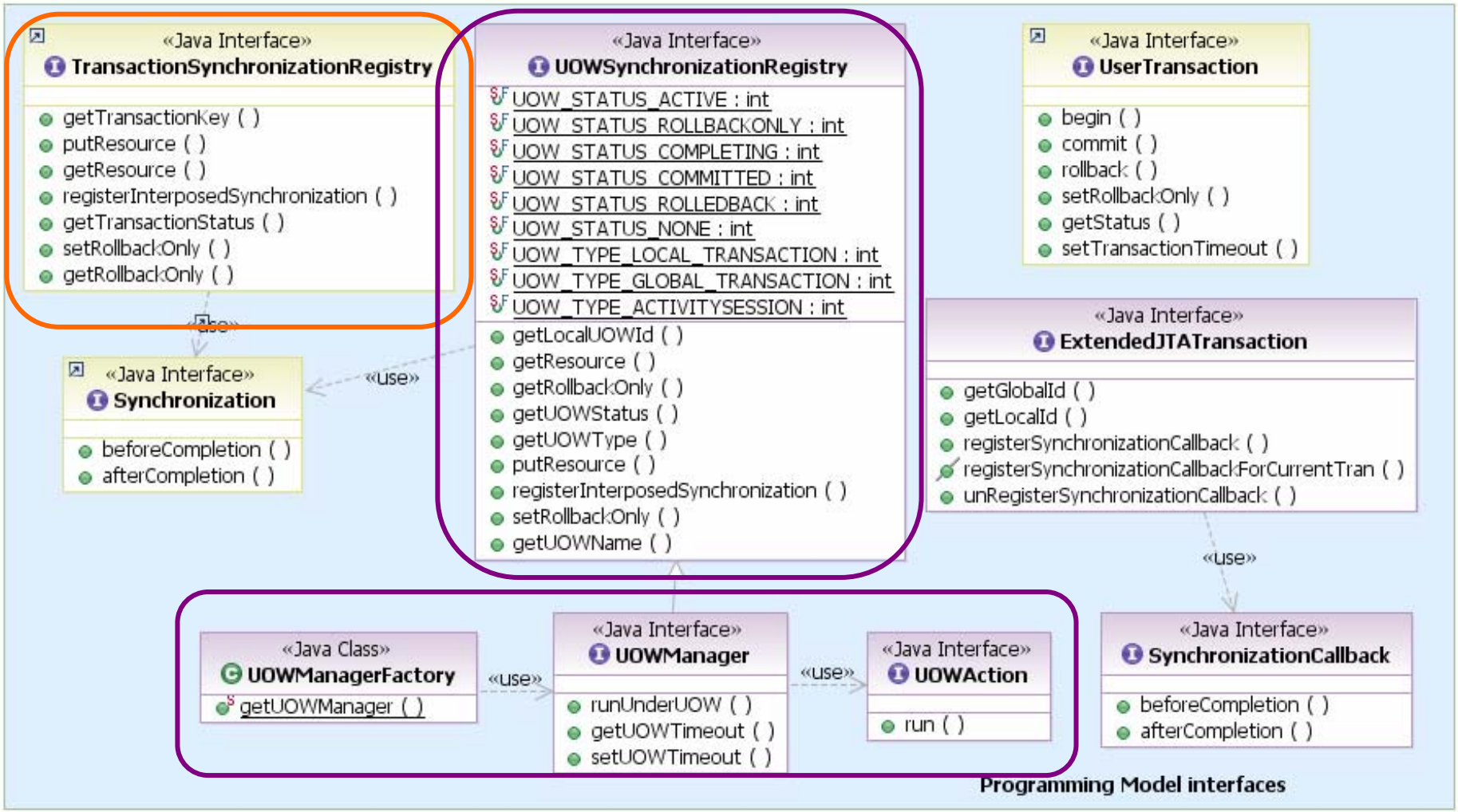


Bean or Container Managed Transactions?

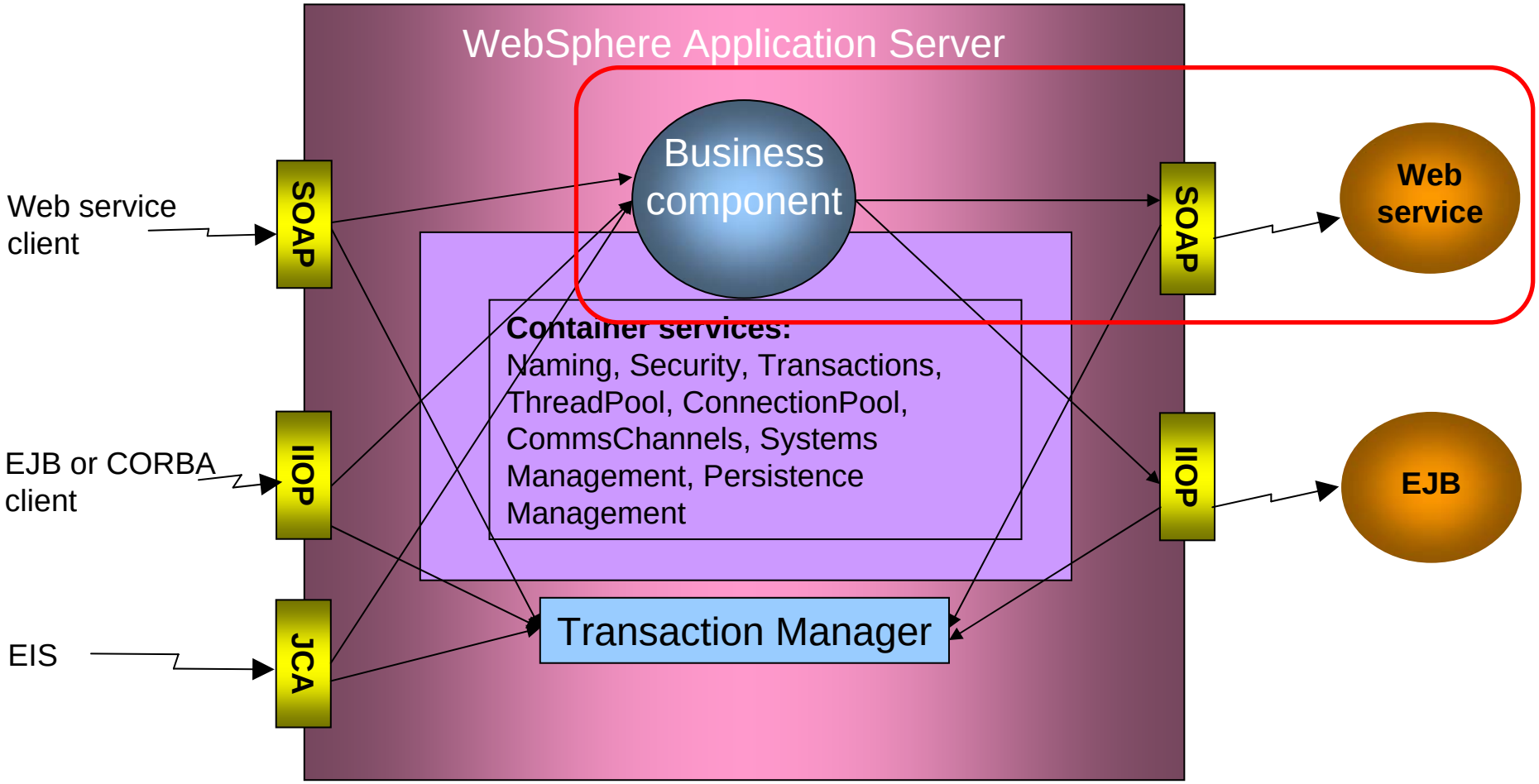
- Container managed (CMT)
  - Container manages transaction demarcation
  - Specified via application assembly tooling
    - Stored in deployment descriptors - No application code is required
  - Generally considered to be best practice
    - Easier to implement

- Bean managed (BMT)
  - Application code is responsible for demarcation of transactions
    - Via JTA UserTransaction API
      - begin(), commit(), rollback()
  - Complete set of APIs follow…

Java Transaction APIs (for Bean Managed Tx)



Distributed transactions



WS-Transaction: federating transactions across disparate systems

- WS-Tx defines the following concepts:
  - **An XML CoordinationContext** that identifies a transaction and which is passed implicitly in Web service messages without this context having to be declared as an explicit message parameter.
    - in the SOAP header for a SOAP binding
  - A generic **Coordination message set**
  - Protocol-specific messages sets that define the **AT and BA protocols**
- This XML context and XML messages are designed for simple transformation within different runtimes to map down to underlying transaction processing technologies.
  - For example, the J2EE WebSphere platform transforms WS-AT ← (JTA-based impl) → XA

Brief history of the WS-Transaction standard

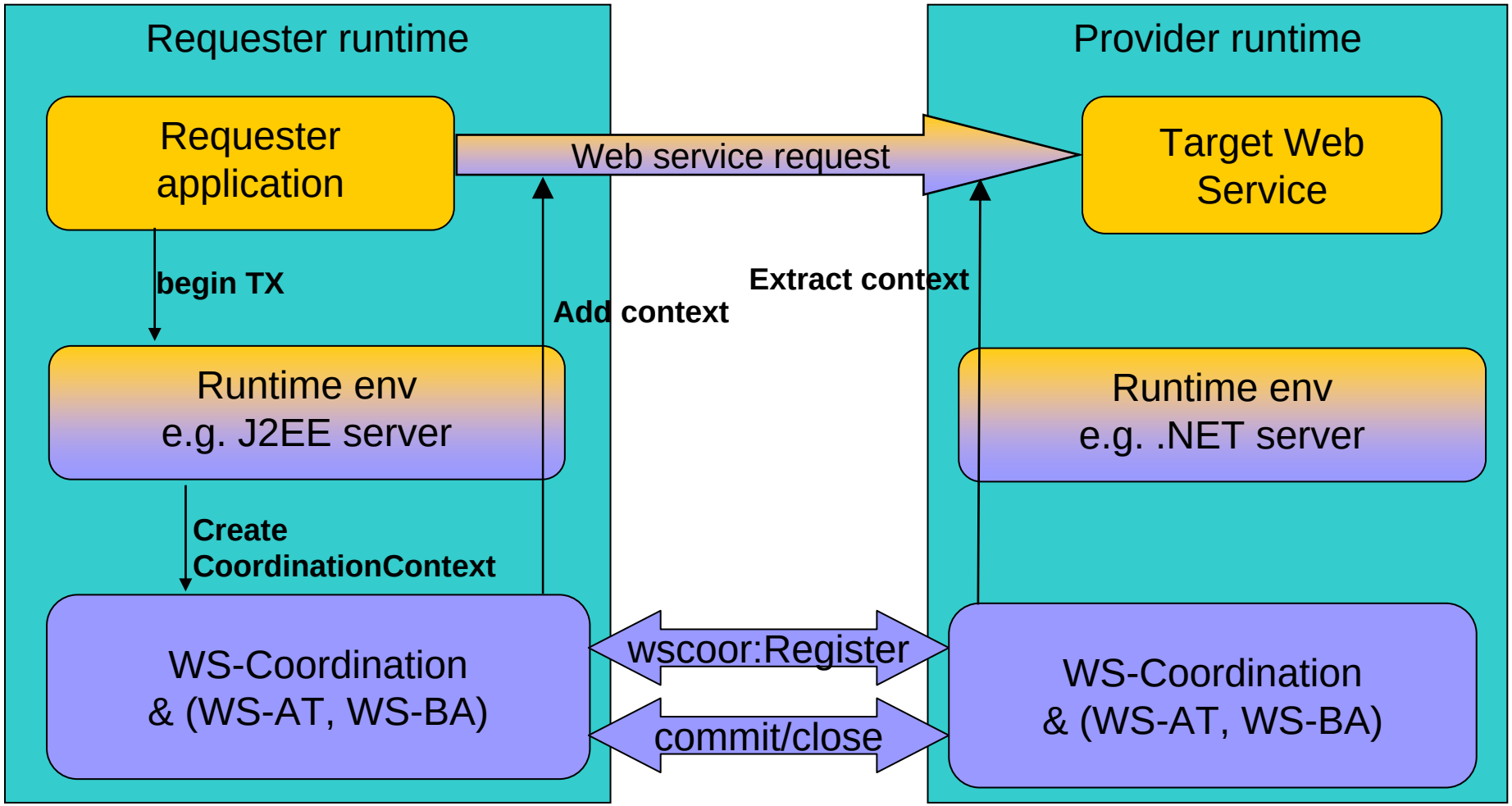
- Motivation: To provide a means to federate a variety of transaction models across different, existing systems
- WS-Tx = **WS-Coordination** +…
  - **WS-AtomicTransaction**
    - Atomic commit or rollback; 2PC
  - **WS-BusinessActivity**
    - Overall outcome atomic; business compensation
- IBM, Microsoft, BEA – first published draft Aug 2002.
- “Version 1.0” specs published Aug 2005
  - Input for OASIS WS-Tx Technical Committee
- OASIS WS-Tx TC V1.1 standard published April 2007

Status of WS-Transaction in IBM Products

- WS-C, WS-AT 1.0 available since:
  - WAS v6.0 (Dec 2004) and later
  - CICS TS v3.1 (March 2005)
- All interoperate with MS WCF (.NET v3) WS-AT support using SOAP/HTTPS.
- WS-BA 1.0 available since:
  - WAS v6.1 (May 2006)

- OASIS Standards (V1.1) of all the above in WAS V7 (additive).
- WS-Policy support for WS-Transaction

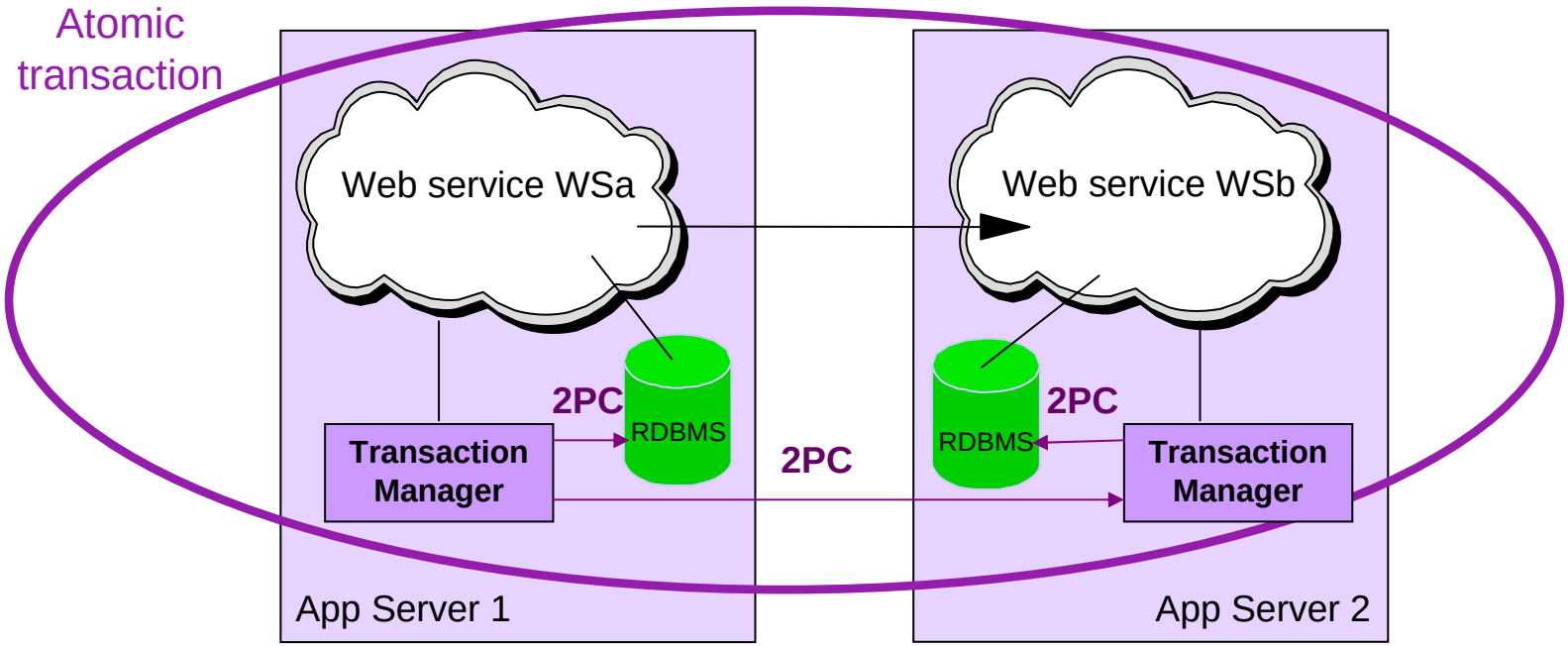
WS-Transaction architecture



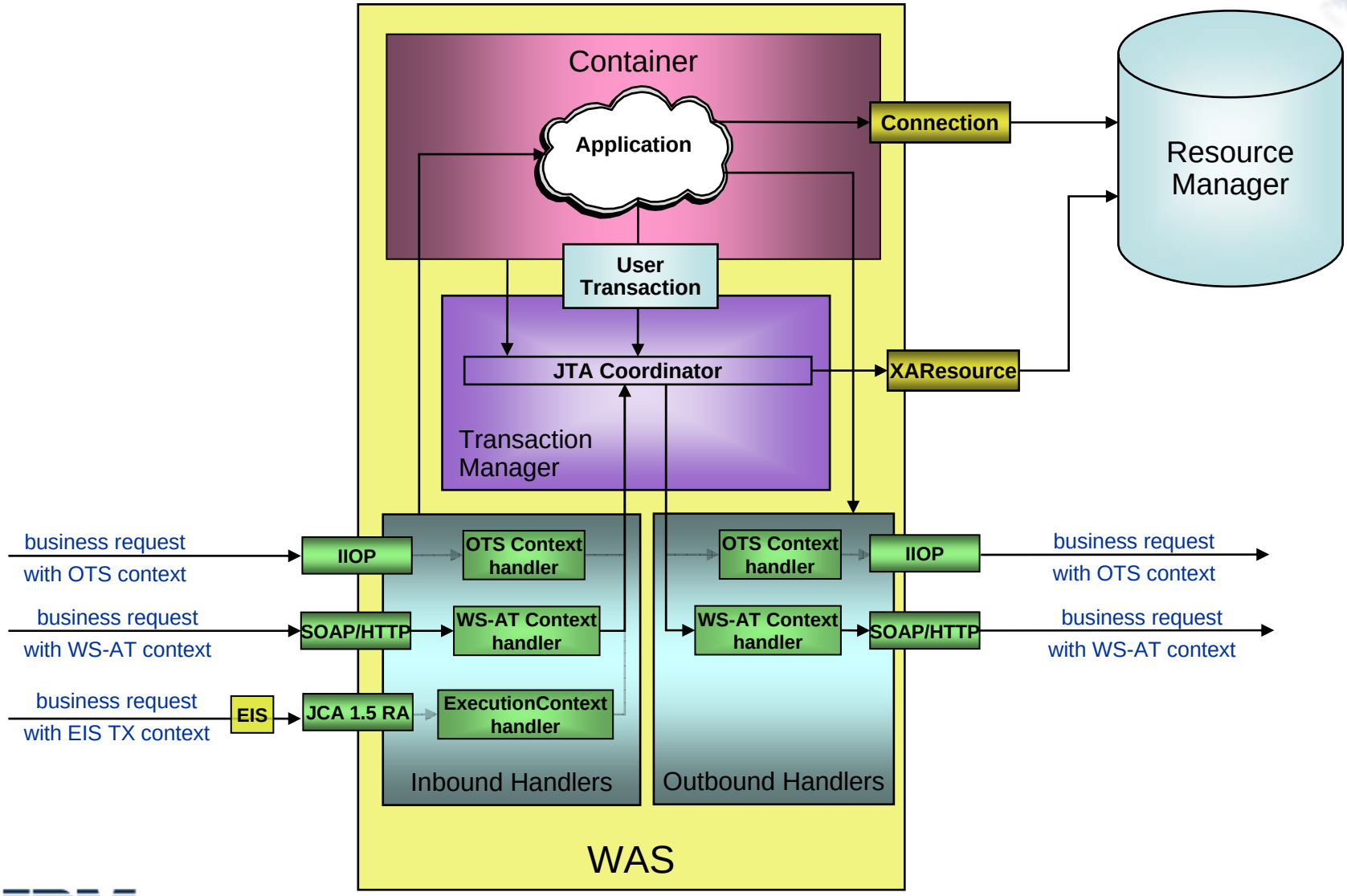
When is WS-AT useful?

- WS-AT enables the scope of ACID behaviour to be distributed between Web service components.
- BUT…
  - Resource locks are held throughout the transaction
  - Services that share an ACID transaction are not loosely coupled
- Primary uses:
  - transactions between services within a single organization domain
  - sometimes the *only* way to distribute an ACID transaction across different software stacks.

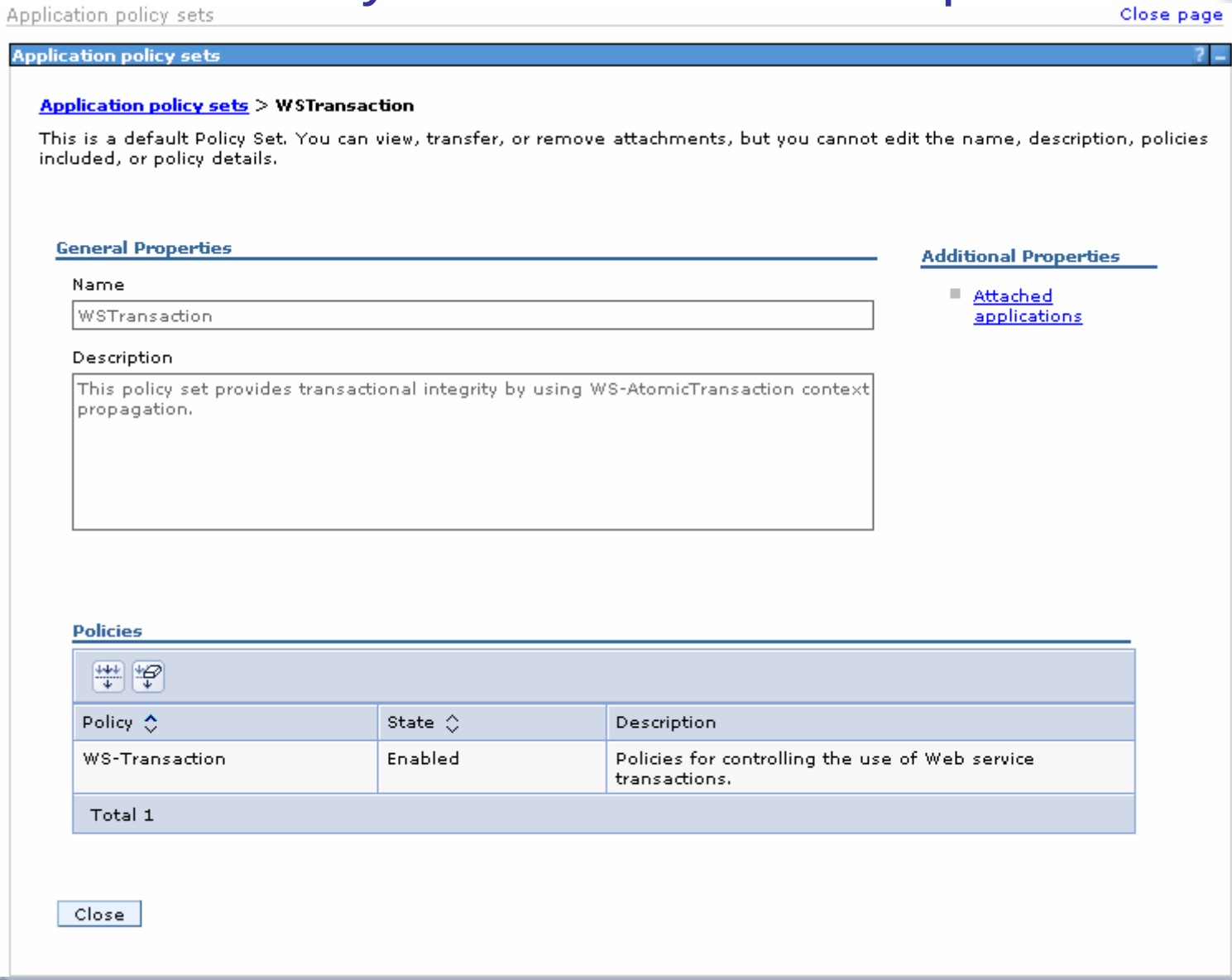
When is WS-AT useful?



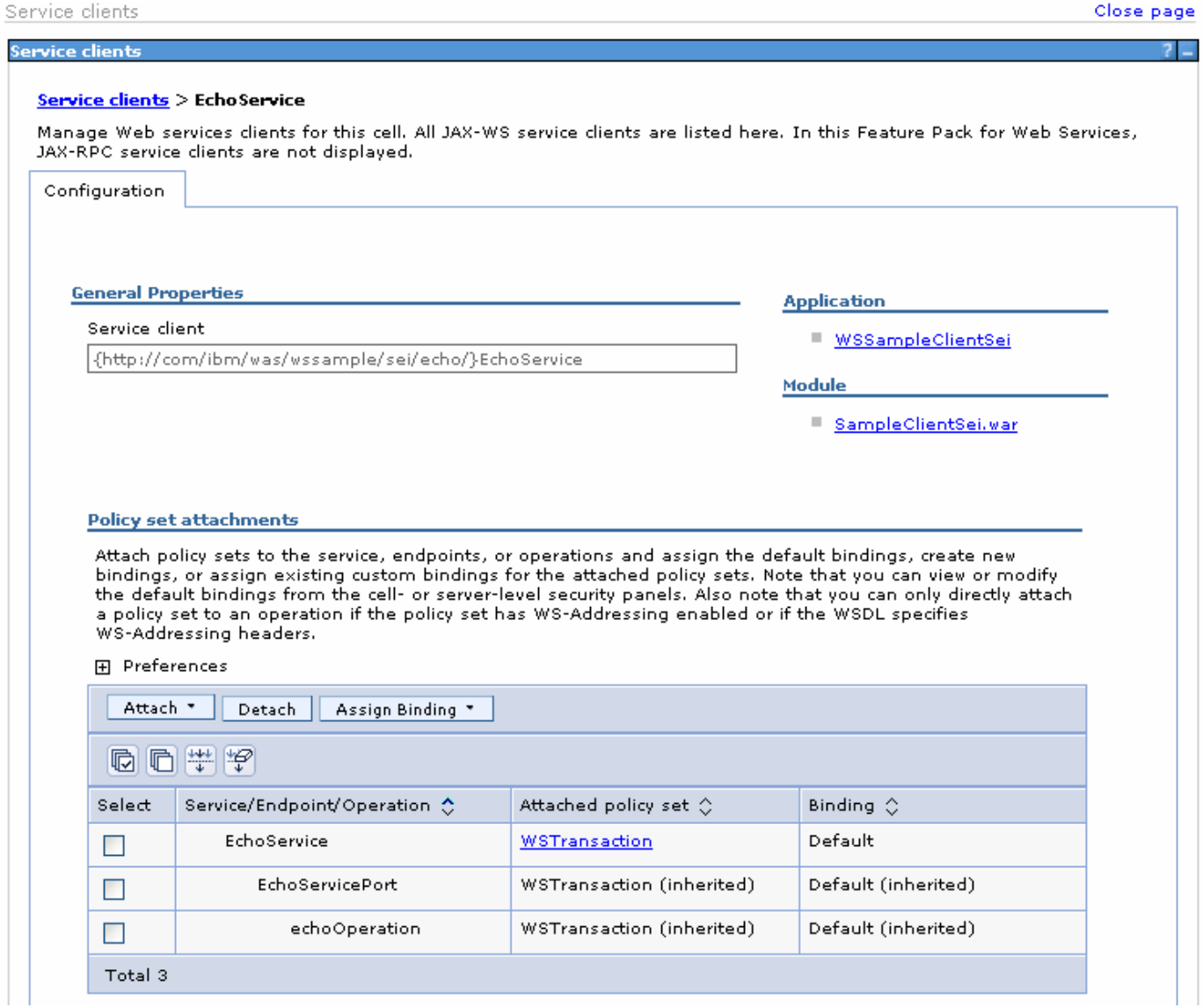
WS-AT in WAS: No coding to engage WS-AT



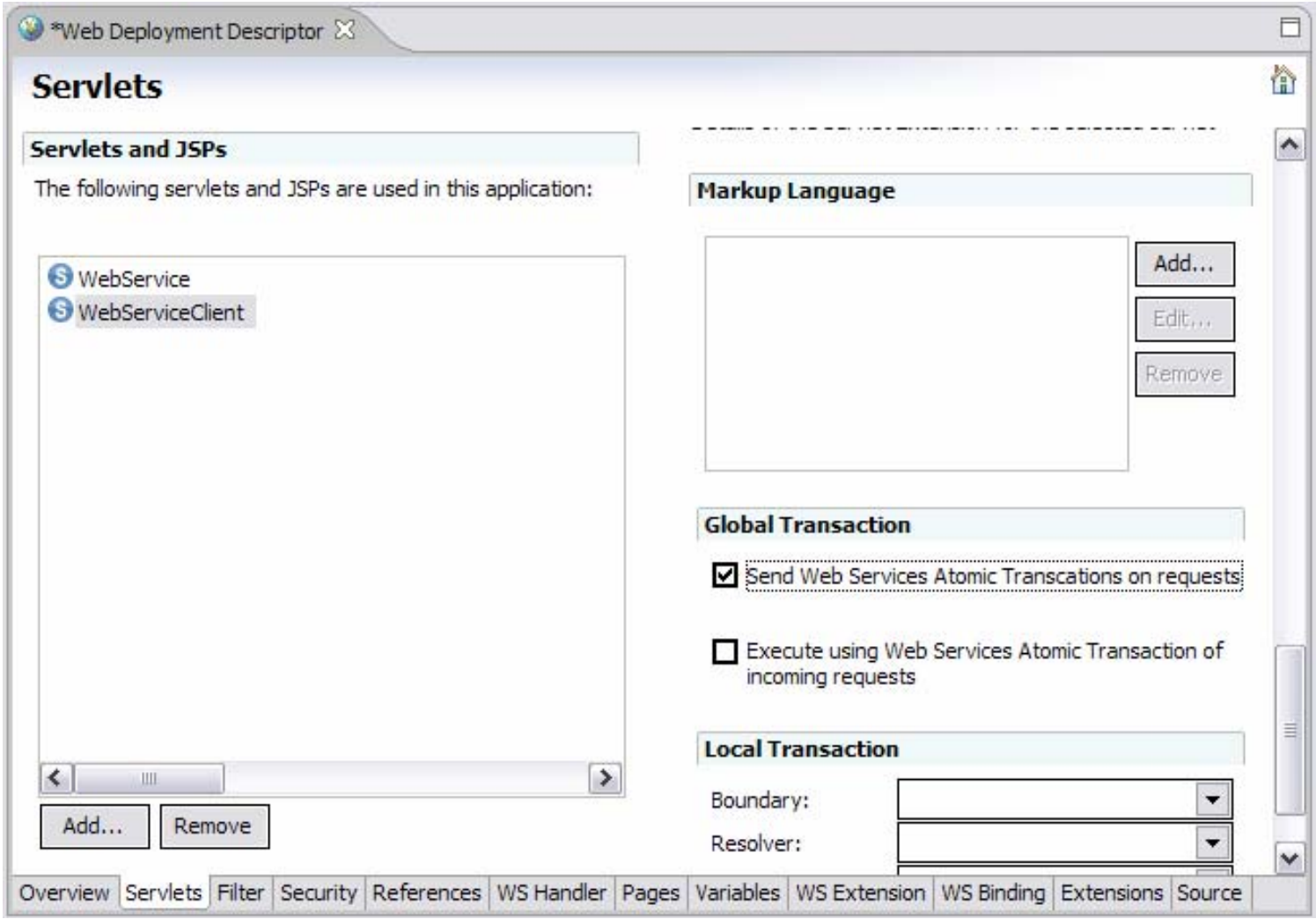
WS-AT assembly for JAX-WS clients/providers



WS-AT assembly for JAX-WS clients/providers



WS-AT assembly for JAX-RPC clients/providers

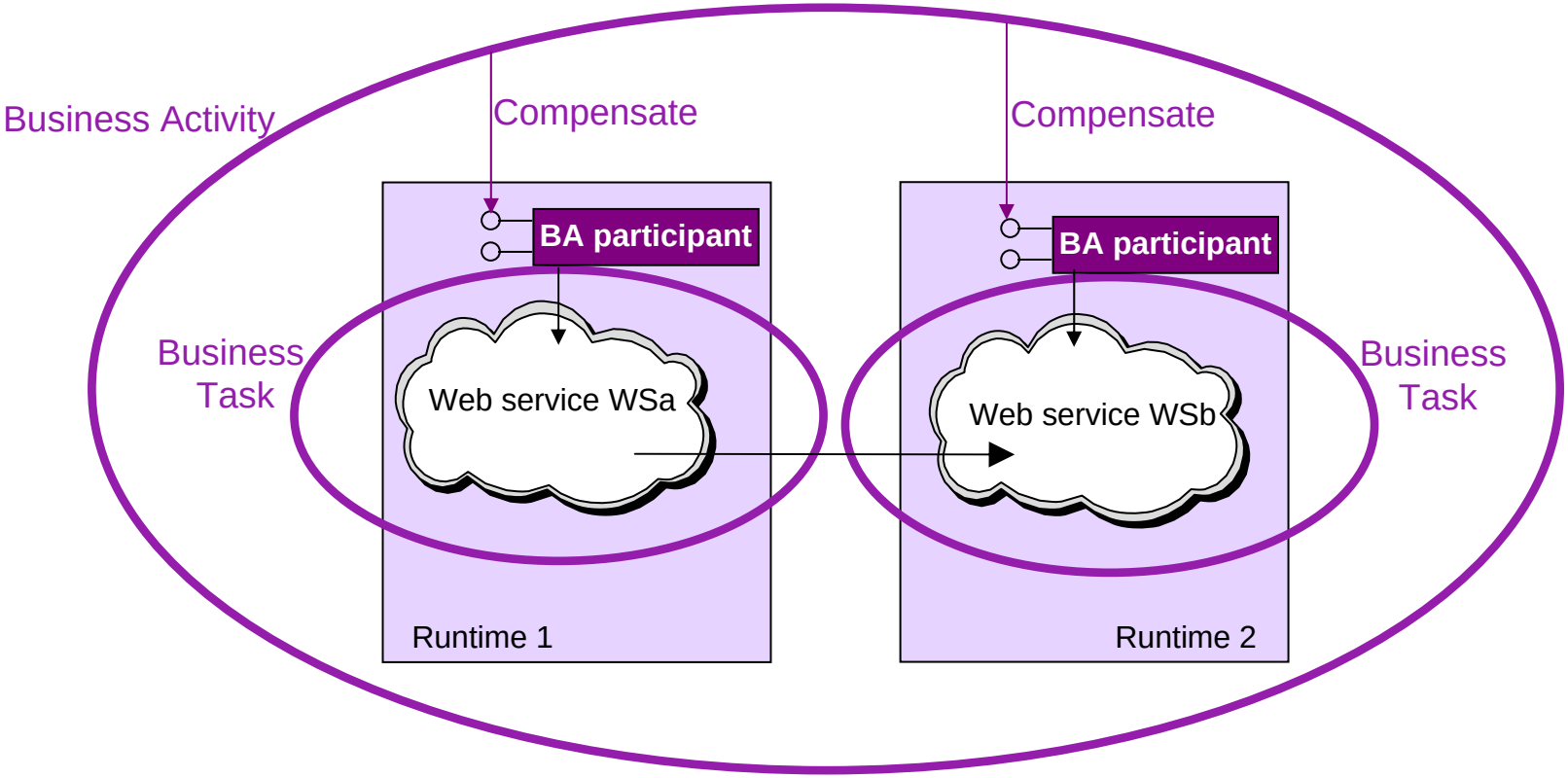


When is WS-BA useful?

- WS-BA provides a different form of atomicity from WS-AT. Participant are still brought to an atomic outcome but:
  - there is no isolation of resources
  - application-level compensation is required instead of resource manager rollback
- Also appropriate for longer-running and more loosely-coupled interactions.
  - but don't equate compensation with "looser coupling".
- A non-process-oriented approach *c.f.* WS-BPEL
- Primary uses:
  - business transactions that span organizational boundaries
  - distributed processes that use non-transactional resources

When is WS-BA useful?

- Business Tasks execute within the scope of a Business Activity
- Updates are exposed before Business Activity completes
- Completed participants receive common outcome



WAS *"BAScopes"*

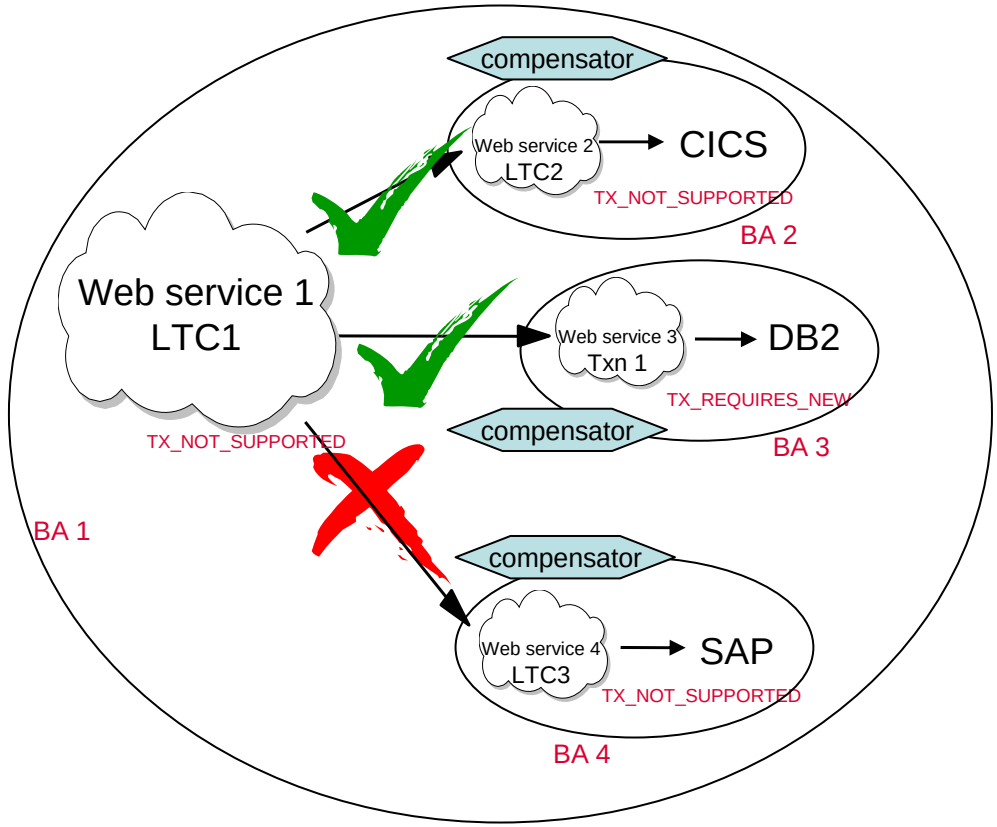
- …provides a compensating transaction model for **EJBs** that may (but do not have to) be exposed as Web services
  - *Uses WS-BA across Web service protocols*
- …enables 1PC or 2PC work to be committed as part of a larger activity and later compensated if the overall activity fails
  - *Activation of the CompensationHandler can be transacted as part of the forward transaction that it compensates.*
- …follows the BPEL compensation model for nested scope activities.

More on BAScopes

- The scope of a business activity, a BAScope, is that of a core WebSphere Application Server unit of work (UOW).
  - JTA Transaction
  - ActivitySession
  - Local Transaction Containment (LTC)
- A BAScope is *not* a new UOW; it is an attribute of an existing core UOW, therefore there is a one-to-one relationship between a BAScope and a UOW.
  - The outcome of a BAScope mirrors the outcome of its associated core UOW.
- A *child* BAScope is implicitly created if an EJB running under core UOW *A* calls an EJB running under core UOW *B*.
  - CompensationHandlers are implicitly promoted from a child to a parent BAScope.

Nested BAScopes

- An activity is a scope within which a single consistent outcome is provided.
- Successful work has compensators promoted
- Compensators are closed or compensated according to direction of top-level scope.



Using WS-BA functionality in WAS

1. Enable the application server.
   - By default the WS-BA functionality is disabled. This needs to be enabled on each application server planning to exploit the WS-BA function.
2. Create a CompensationHandler class.
   - An implementation of the CompensationHandler interface needs to be created for the WS-BA application component to reference and use at runtime.
3. Enable the application components.
   - Each application component needs to be configured using the RAD/AST tooling to enable WS-BA on the component and by setting a CompensationHandler class for that component.

Programming Model: WS-BA APIs

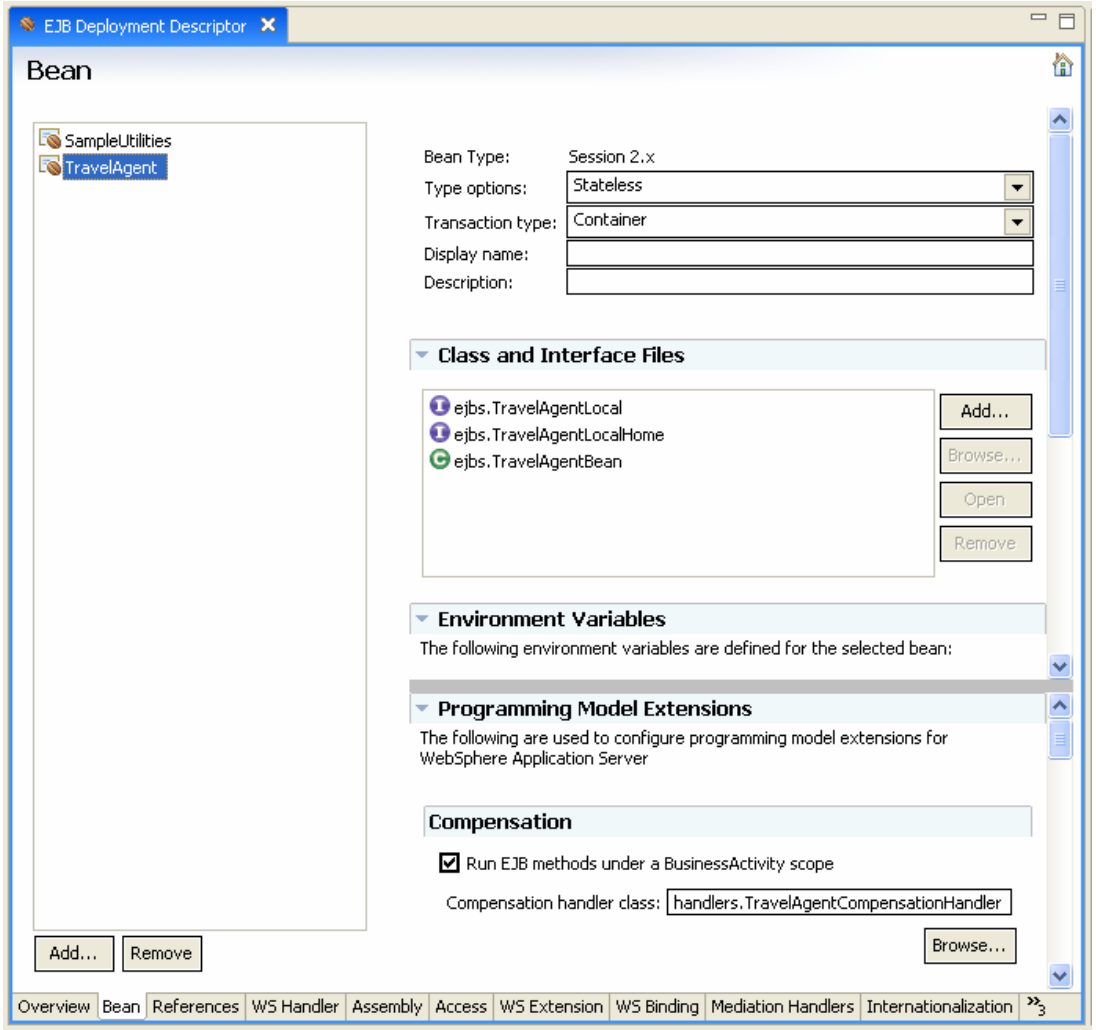
```
package com.ibm.websphere.wsba;
public interface UserBusinessActivity
{
  boolean isCompensateOnly() throws java.lang.IllegalStateException
  void setCompensateOnly() throws java.lang.IllegalStateException
  void setCompensationDataAtCommit(Serializable compensationData)
                  throws java.lang.IllegalStateException, java.io.NotSerializableException
  void setCompensationDataImmediate(Serializable compensationData)
                  throws java.lang.IllegalStateException, java.io.NotSerializableException
}
```

JNDI location: java:comp/websphere/UserBusinessActivity

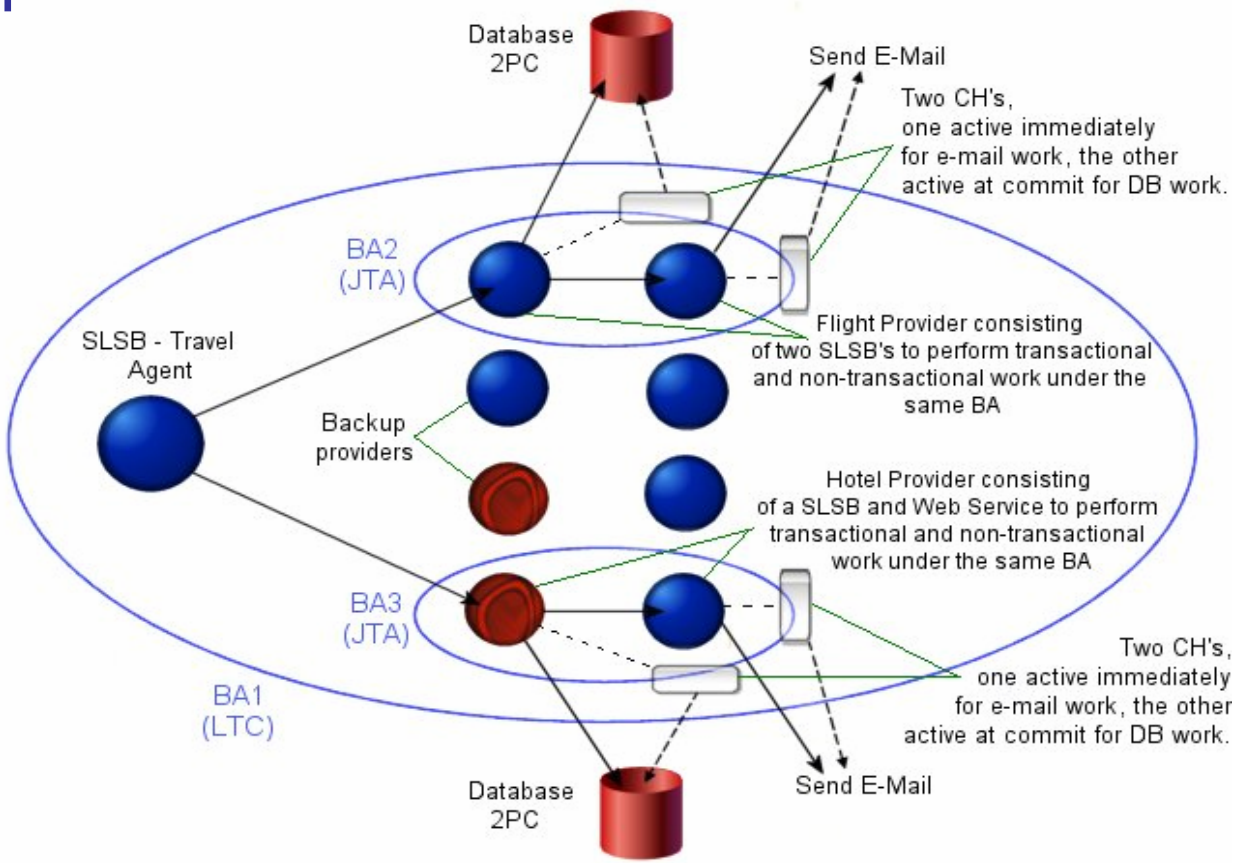
```
package com.ibm.websphere.wsba;
public interface CompensationHandler
{
  public void close(Serializable compensationData) throws
          RetryCompensationHandlerException, CompensationHandlerFailedException
  public void compensate(Serializable compensationData) throws
          RetryCompensationHandlerException, CompensationHandlerFailedException

}
```

WS-BA Step 3: Enable the application components



WS-BA Sample: Compensation and forward progress with multiple resources



http://www.ibm.com/developerworks/websphere/library/samples/wsba.html

What about the “NFRs”?

The TX specs define interoperable Web service transaction protocols. They don’t define “non-functional requirements” such as:

- Proxies and firewalls
- High availability and failover of TX endpoints
- Transaction-based workload management affinity

These are outside the scope of the specification. But any enterprise-level SOA runtime needs to accommodate these.

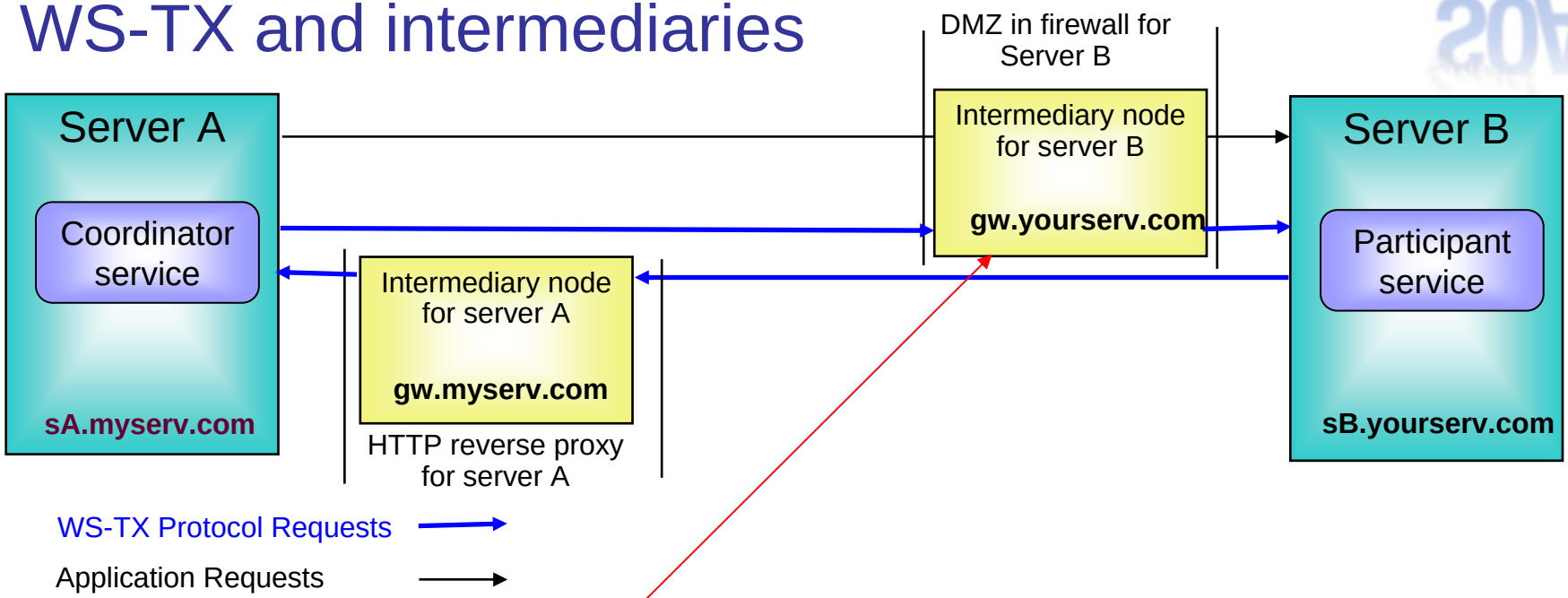
Where are these considerations factored and do they affect interoperability?

WS-Addressing EndpointReferences

- The TX endpoints exchanged are WS-Addressing EndpointReferences:
  - A “++” XML pointer.
  - Contains an address URI for the endpoint service
  - Contains a set of ***opaque*** “ReferenceParameter” tokens that augment the address with anything required by the target service or its runtime environment.

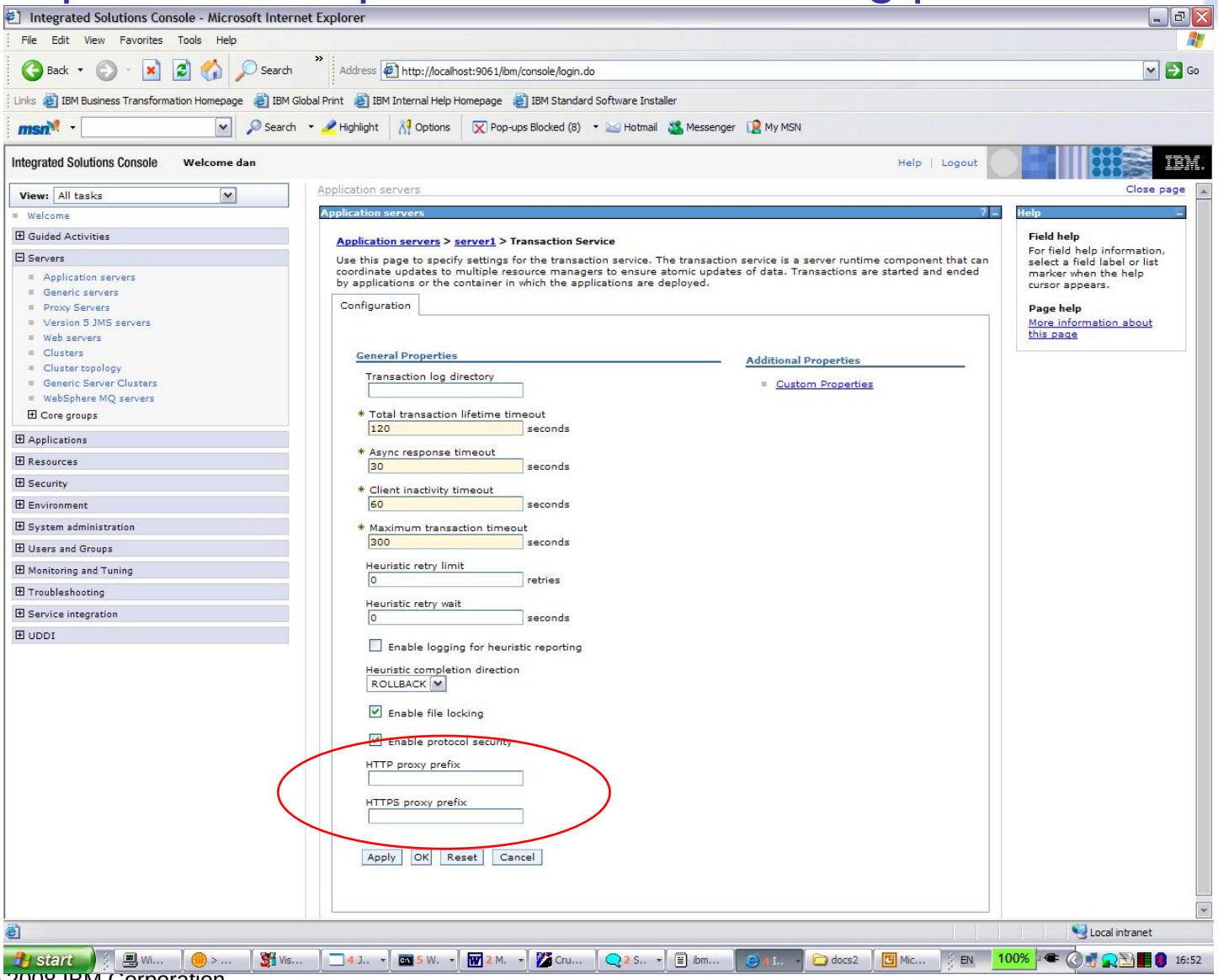
```
<wsa:EndpointReference>
    <wsa:Address>http://wsgw.fabrikam.com/_IBMSYSAPP/wsat/services/Participant</wsa:Address>
    <wsa:ReferenceParameters>
        <someNS:txID>111-222-333</someNS:txID>
        <was:HAclusterId>47563940008426597832759 3</was:HAclusterId>
     </wsa:ReferenceParameters>
</wsa:EndpointReference>
```

WS-TX and intermediaries




```
<wsa:To>
   <wsa:Address>http://gw.yourserv.com/_IBMSYSAPP/wsat/services/Participant</wsa:Address>
</wsa:To>
<someNS:txID wsa:IsReferenceParameter='true'>111-222-333</someNS:txID>
<was:HAclusterId wsa:IsReferenceParameter='true'>475639400084265978327593</was:HAclusterId>
<wsa:From>
   <wsa:Address>http://gw.myserv.com/_IBMSYSAPP/wsat/services/Coordinator</wsa:Address>
   …
</wsa:From>
```

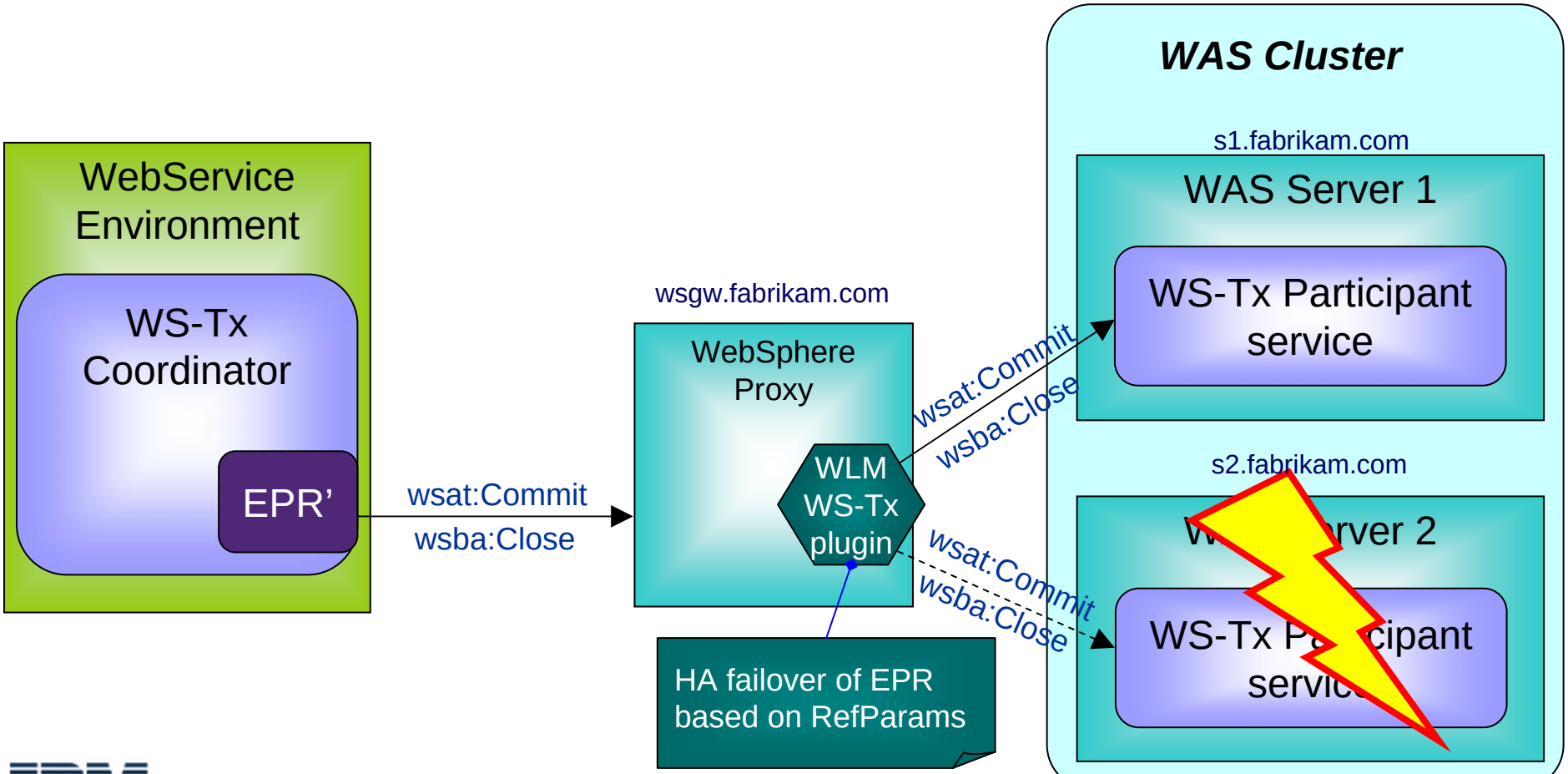
WS-TX protocol endpoints accommodating proxies



High availability failover of protocol endpoints

EPRs from each server contain a virtual host address mapped by the proxy.

RefParams in the EPR are used by WLM plug-in to “follow” HA failover.



High availability failover of protocol endpoints

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<wsa:EndpointReference>
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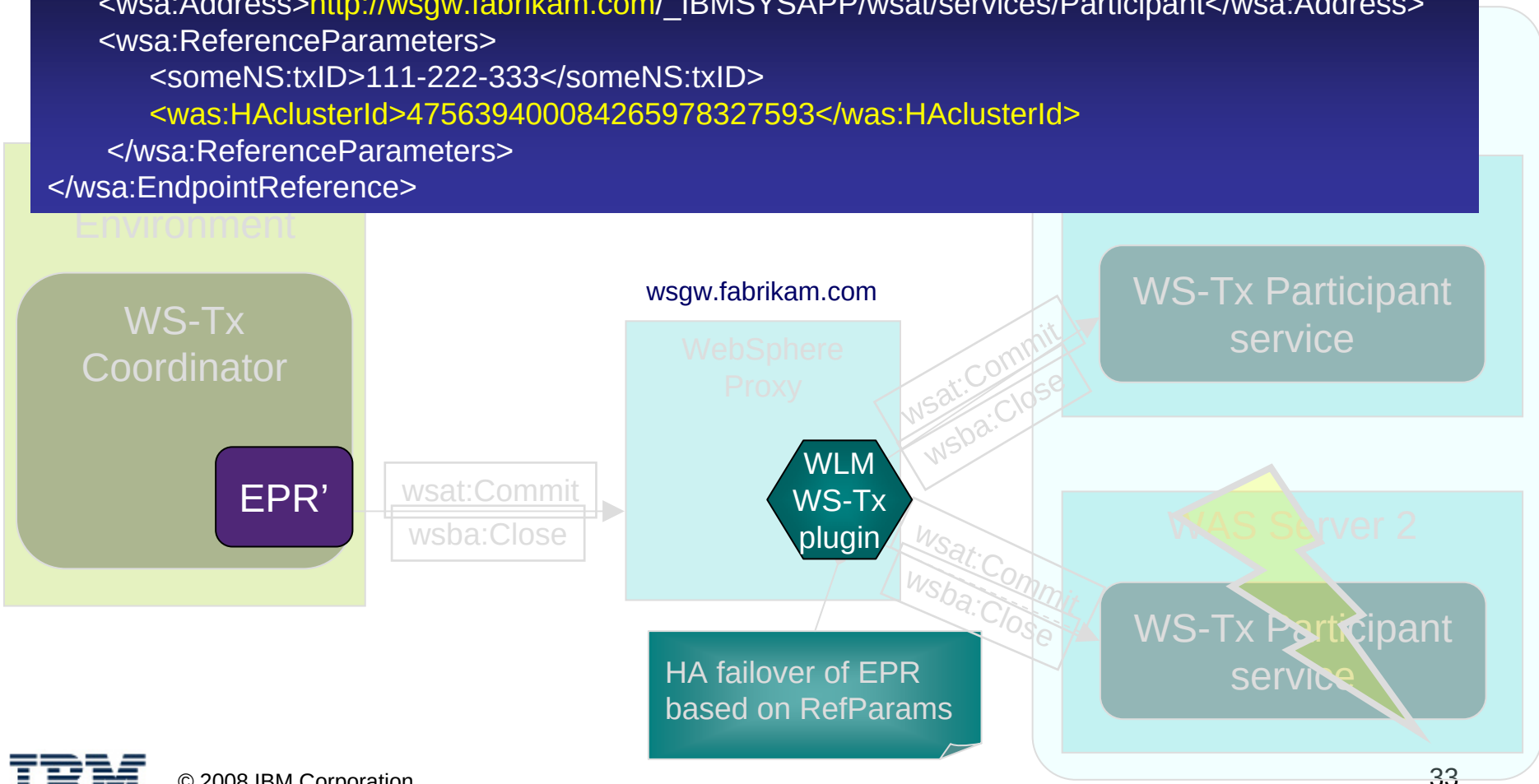
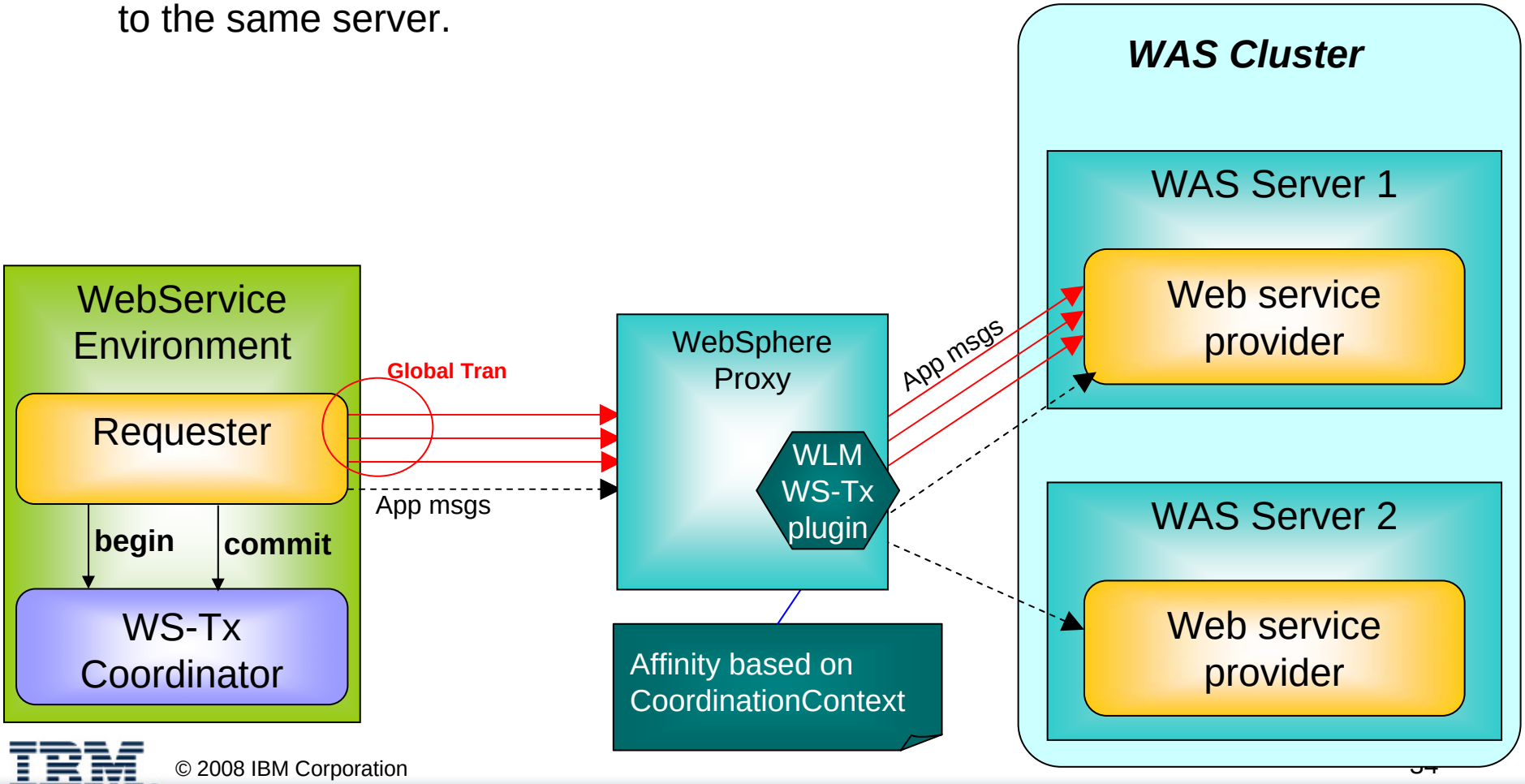
    <wsa:ReferenceParameters>
        <someNS:txID>111-222-333</someNS:txID>
        <was:HAclusterId>47563940008426597832759 3</was:HAclusterId>
     </wsa:ReferenceParameters>
</wsa:EndpointReference>
```



Transaction-based affinity routing

WLM transaction affinity constraints.

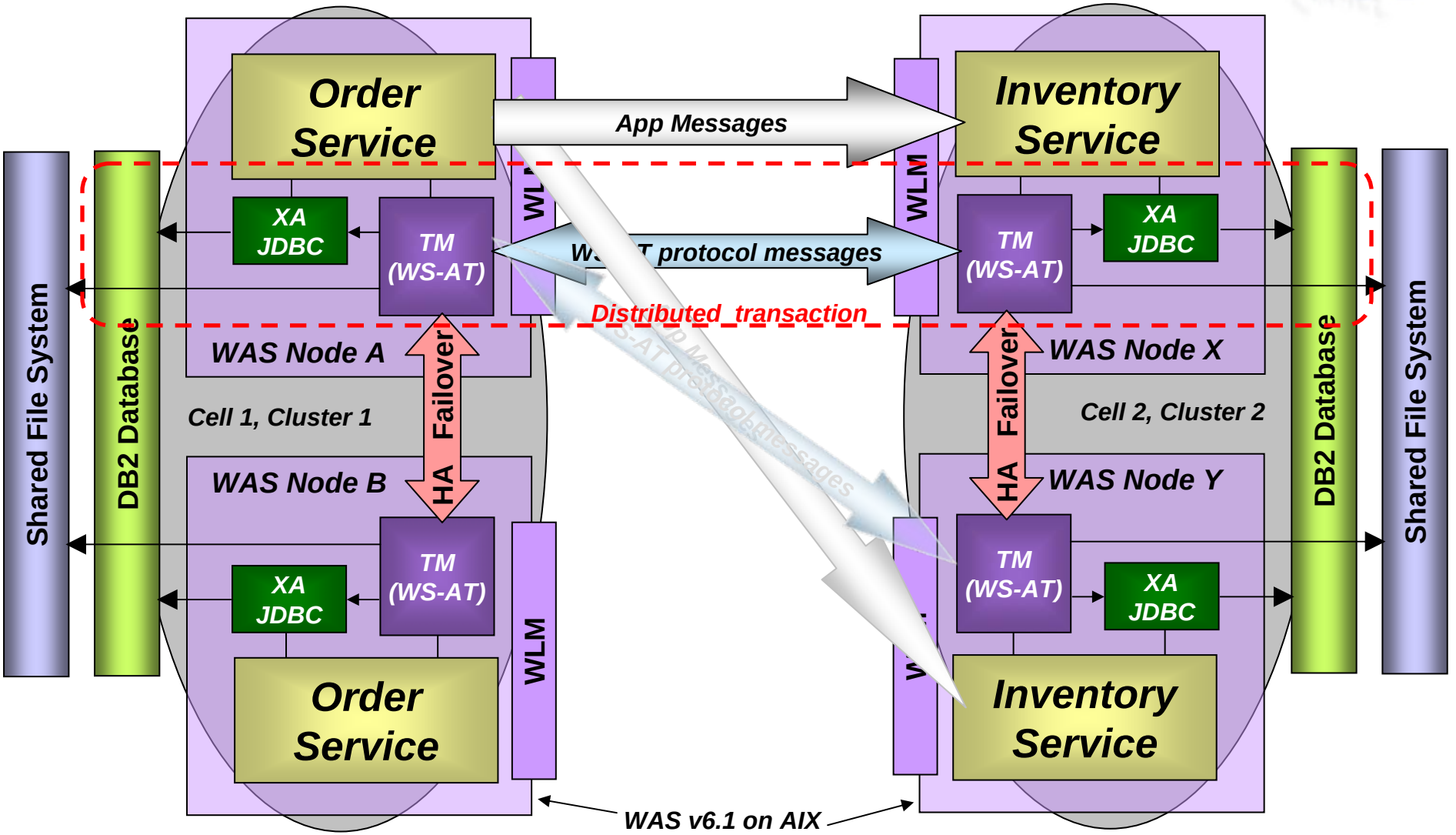
All requests to WLM-able EPRs within the same WS-Tx context targeted to the same server.



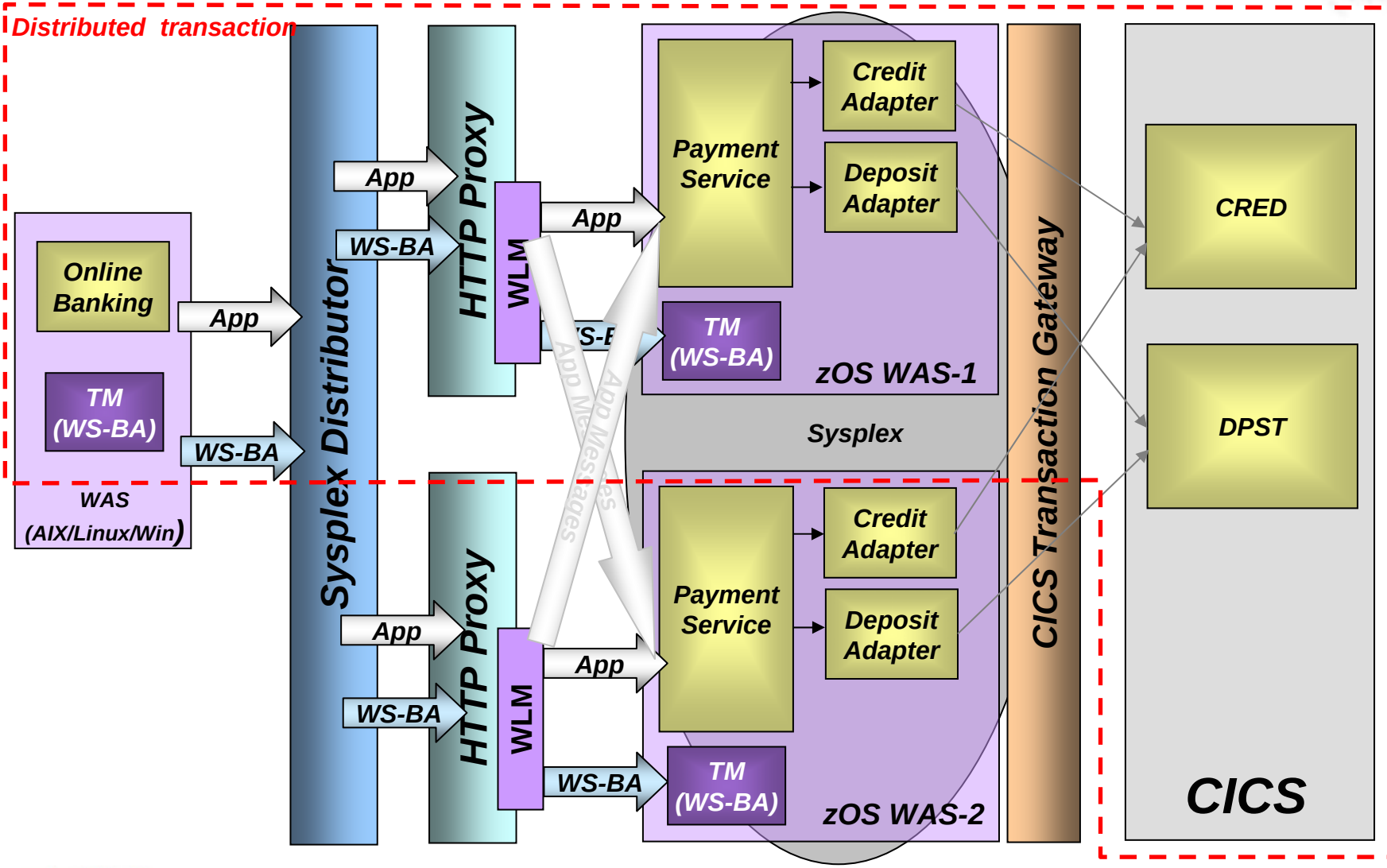
Transaction-based affinity routing

```
<soap:Header>
  <wscoor:CoordinationContext>
     <wscoor:Identifier>
              uuid:33ca57d4-eaab-4939-8177-77351e6e63c7
     </wscoor:Identifier>
     <wscoor:CoordinationType>
              http://docs.oasis-open.org/ws-tx/wsat/2006/06
     </wscoor:CoordinationType>
     …
  </wscoor:CoordinationContext>
  …
</soap:Header>
```

Order Management Application: HA WS-AT deployment



Online Banking: Proxied/WLM'd WS-BA deployment



Summary

- WS-Transaction defines a generic framework for Web service coordination protocols, as well as two concrete protocols for atomic and compensating transactions.
- The WAS support additionally provides for all the “non-functional requirements” typically necessary for enterprise deployments, in both a transparent and an interoperable fashion.
- Applications that use WS-AT and WS-BA and exploit these enterprise qualities of service have been successfully deployed and demonstrate the viability of these advanced technologies in the real world.

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Coordination Context (I)

```
<wscoor:CoordinationContext>
   <wscoor:Identifier>
         uuid:33ca57d4-eaab-4939-8177-77351e6e63c7
   </wscoor:Identifier>
   <wscoor:Expires>60000</wscoor:Expires>
   <wscoor:CoordinationType>
         http://schemas.xmlsoap.org/ws/2004/10/wsat
   </wscoor:CoordinationType>
   <wscoor:RegistrationService>
      <wsa:Address>http://wsatserver/wscoor/Registration</wsa:Address>
      <wsa:ReferenceParameters>
         <tm:txId>246</tm:txId>
      </wsa:ReferenceParameters>
   </wscoor:RegistrationService>
   …
</wscoor:CoordinationContext>
```

Note: Applications don’t see or care about this

Coordination Context (II)

Flows as a SOAP header on application requests

```
<s:Envelope>
   <s:Header>
      <wsa:Action>http://tempuri.org/application/action</wsa:Action>
      <wsa:To>http://server/service/</wsa:To>
      <wscoor:CoordinationContext s:mustUnderstand="true">
          ...
      </wscoor:CoordinationContext>
   </s:Header>
   <s:Body>
      <!-- Application body content -->
   </s:Body>
</s:Envelope>
```

Note: Applications don't see or care about this