



IBM WebSphere

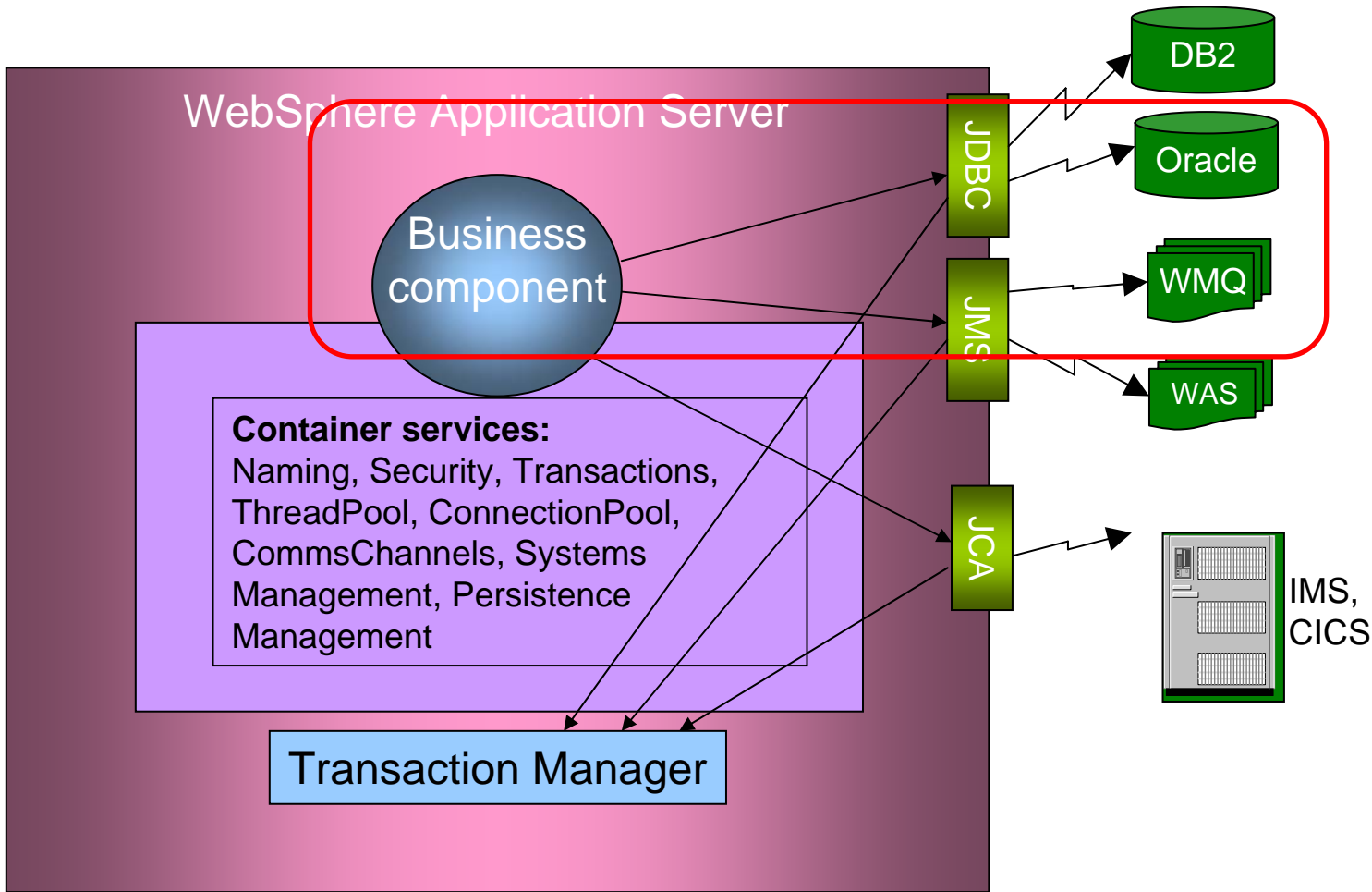
Real World Uses of Transactions in SOA

Ian Robinson, IBM Distinguished Engineer
WebSphere Transactions Architect, Chair OASIS WS-Tx TC

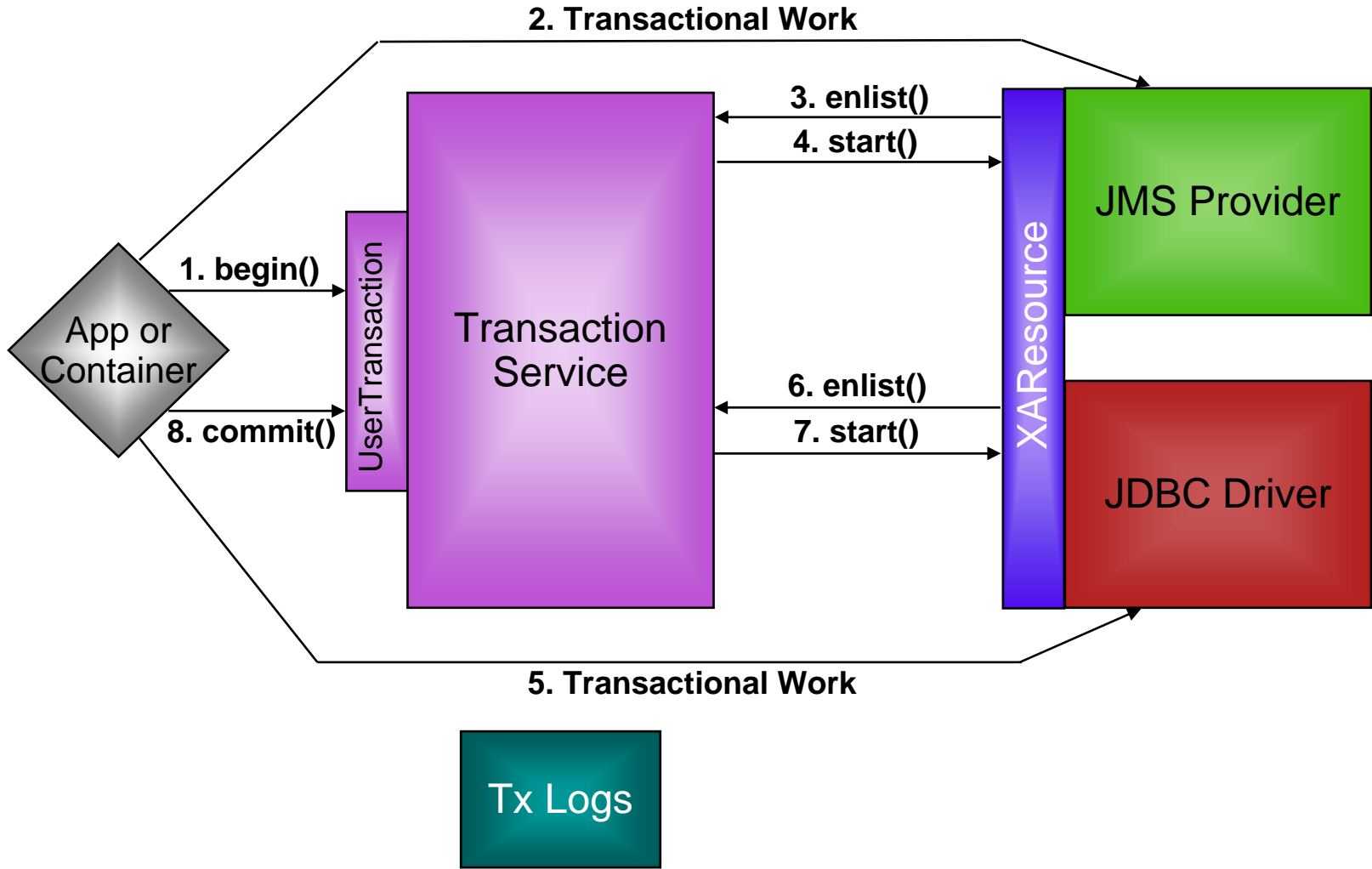
Agenda

- 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

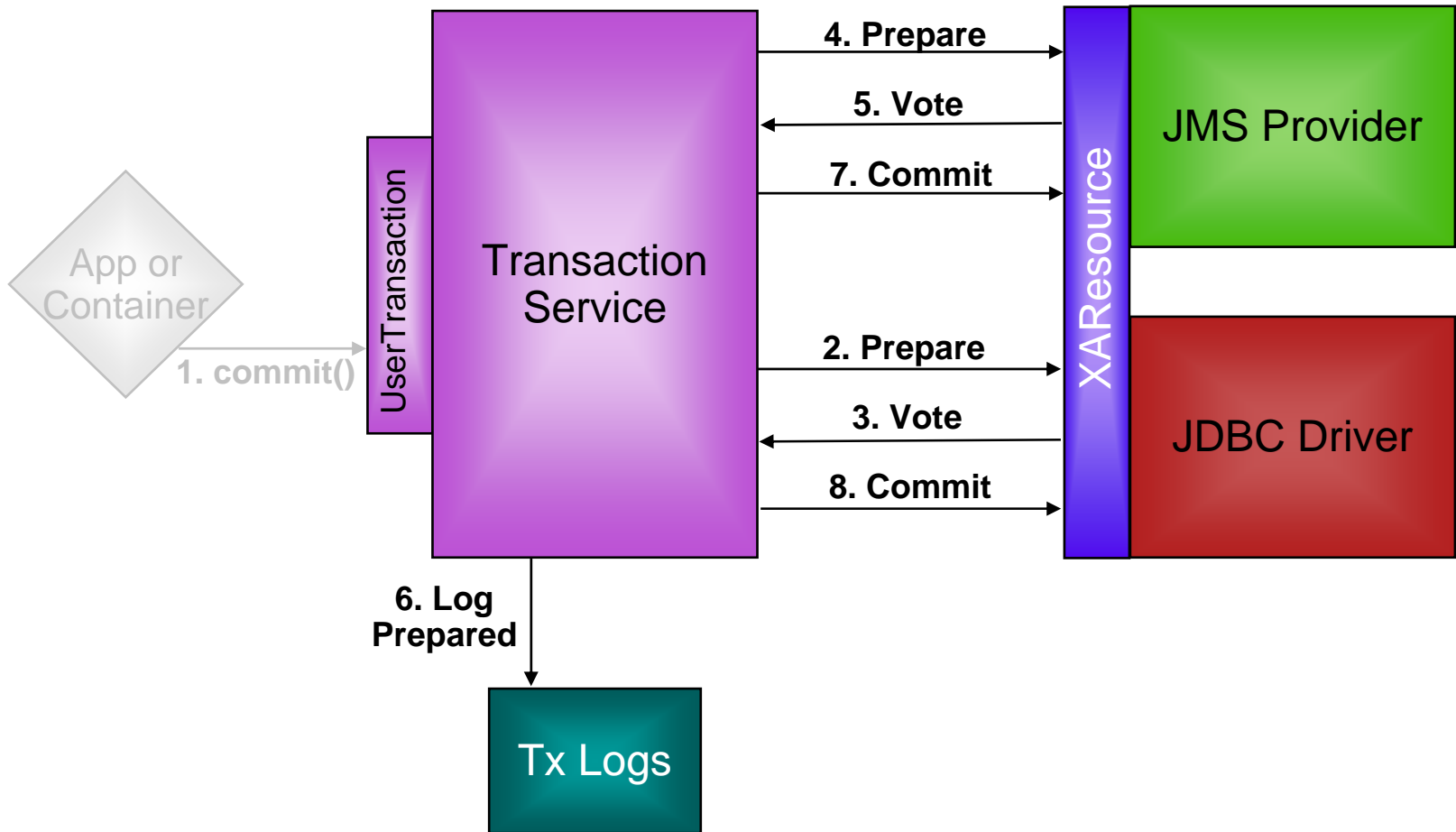
Local and Global transactions



Separation of concerns – interactions with RMs



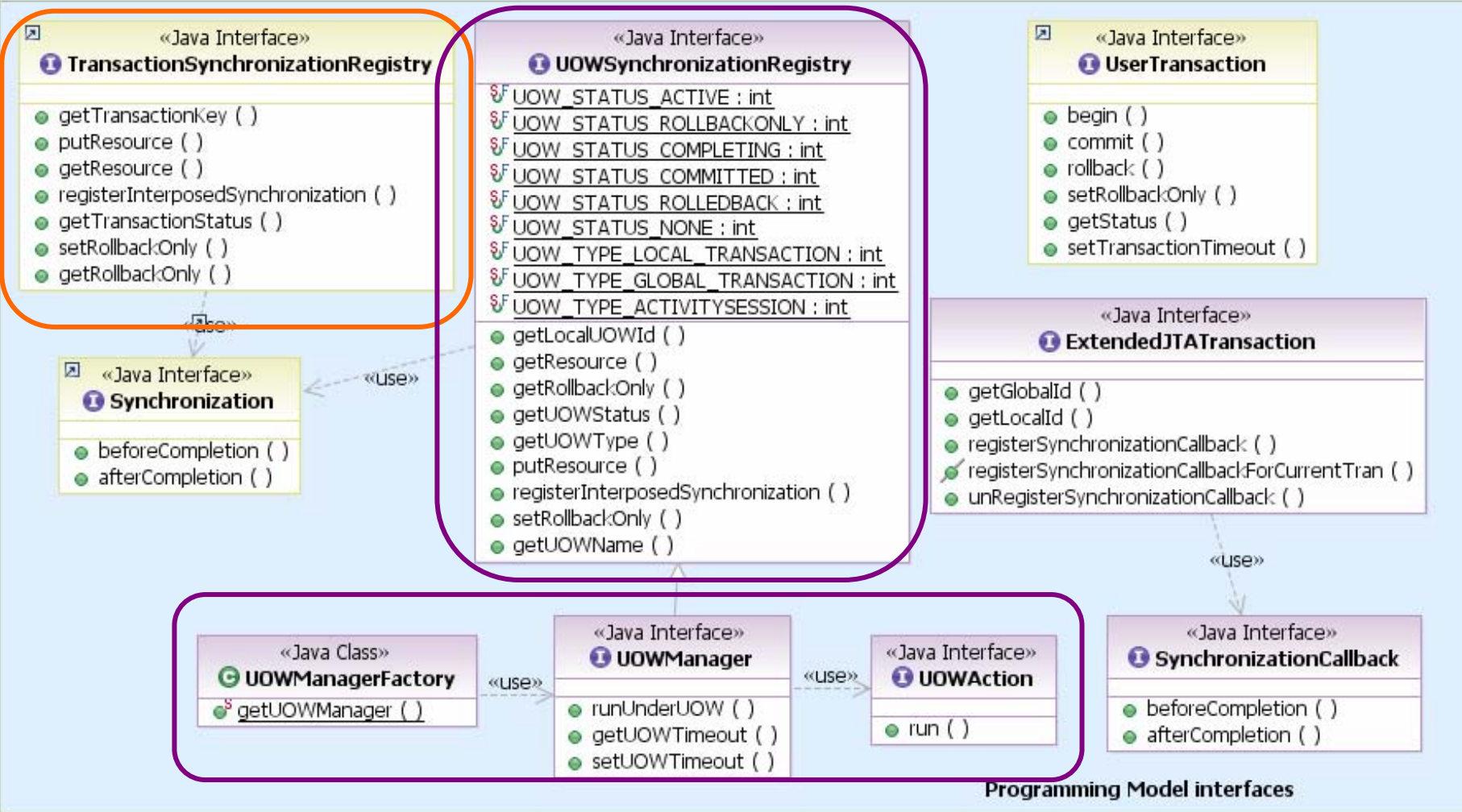
Separation of concerns – 2-phase commit (2PC)



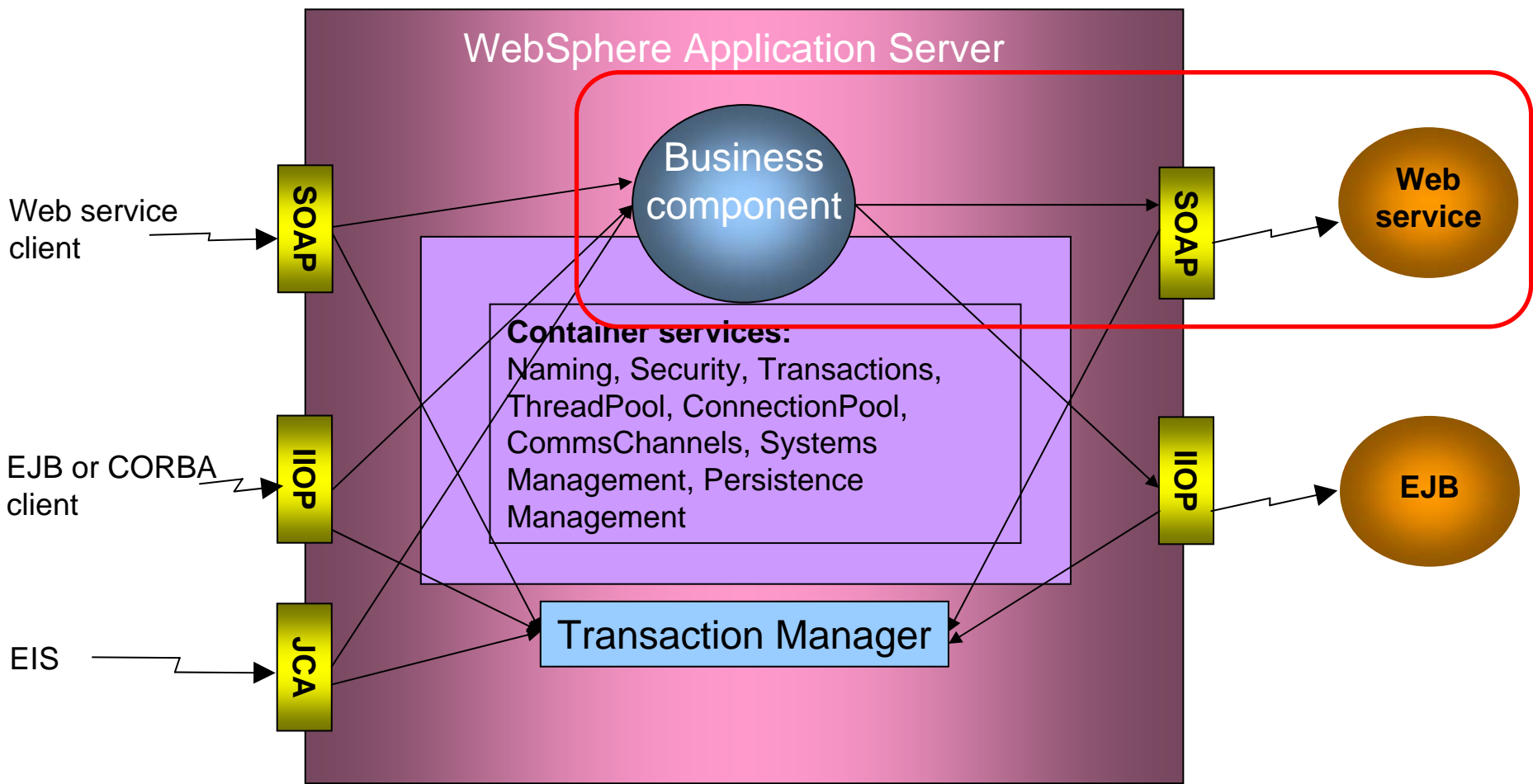
Bean or Container Managed Transactions?

- 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 \leftarrow (JTA-based impl) \rightarrow 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

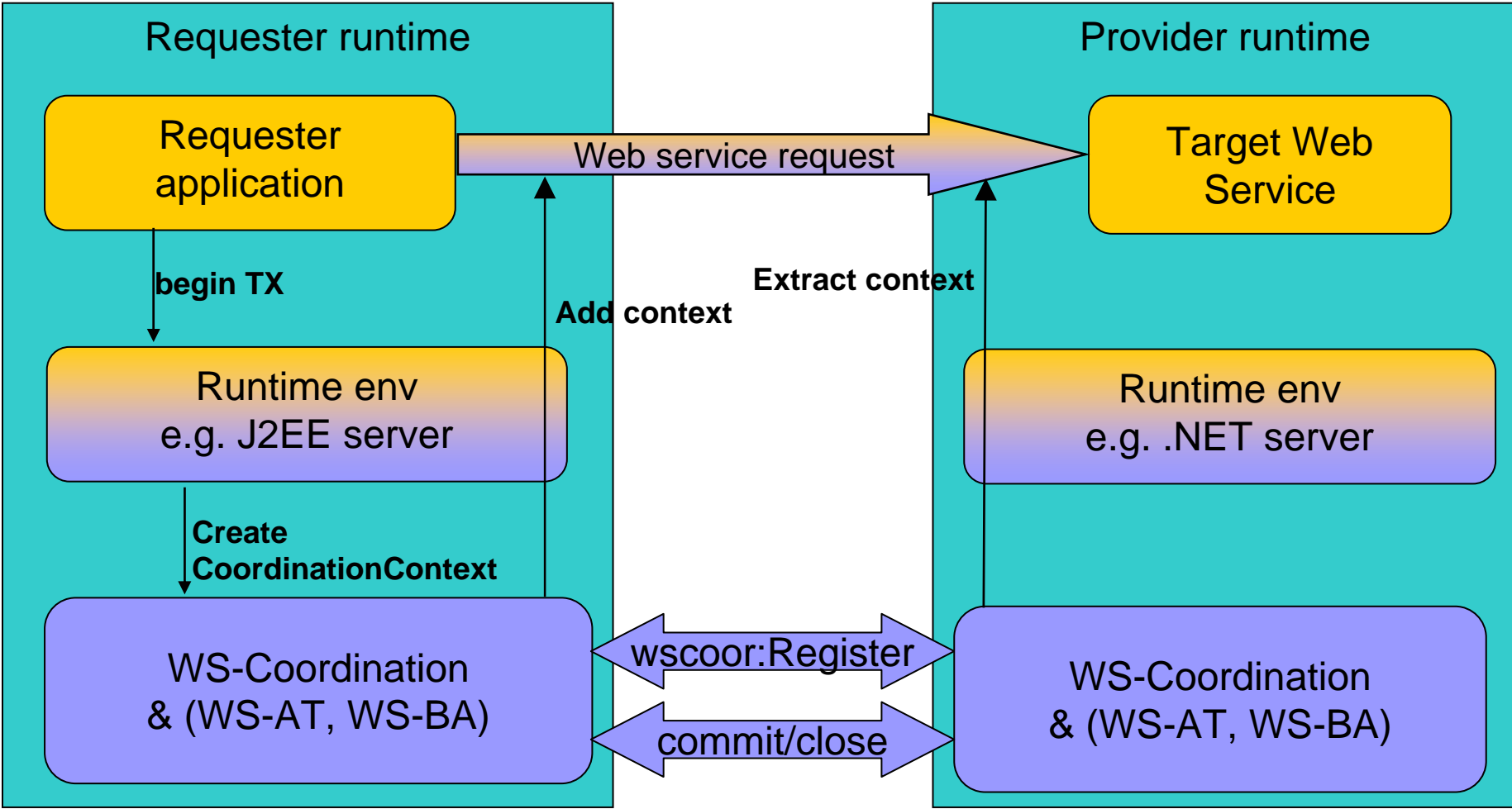
- WS-C, WS-AT 1.0 available since:
 - WAS v6.0 (Dec 2004) and later
 - CICS TS v3.1 (March 2005)
- All interoperate with MS WCF (.NET v3) WS-AT support using SOAP/HTTPS.
- WS-BA 1.0 available since:
 - WAS v6.1 (May 2006)



New in WAS V7

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

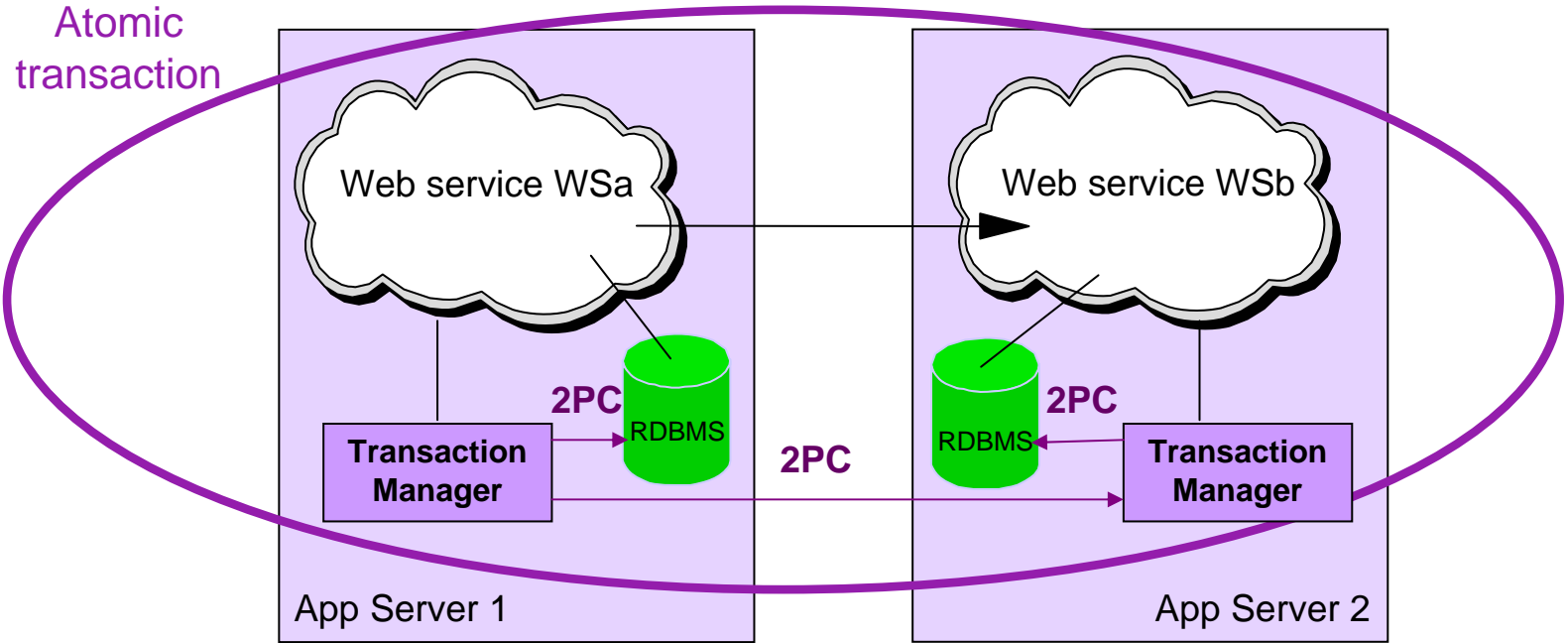
WS-Transaction architecture



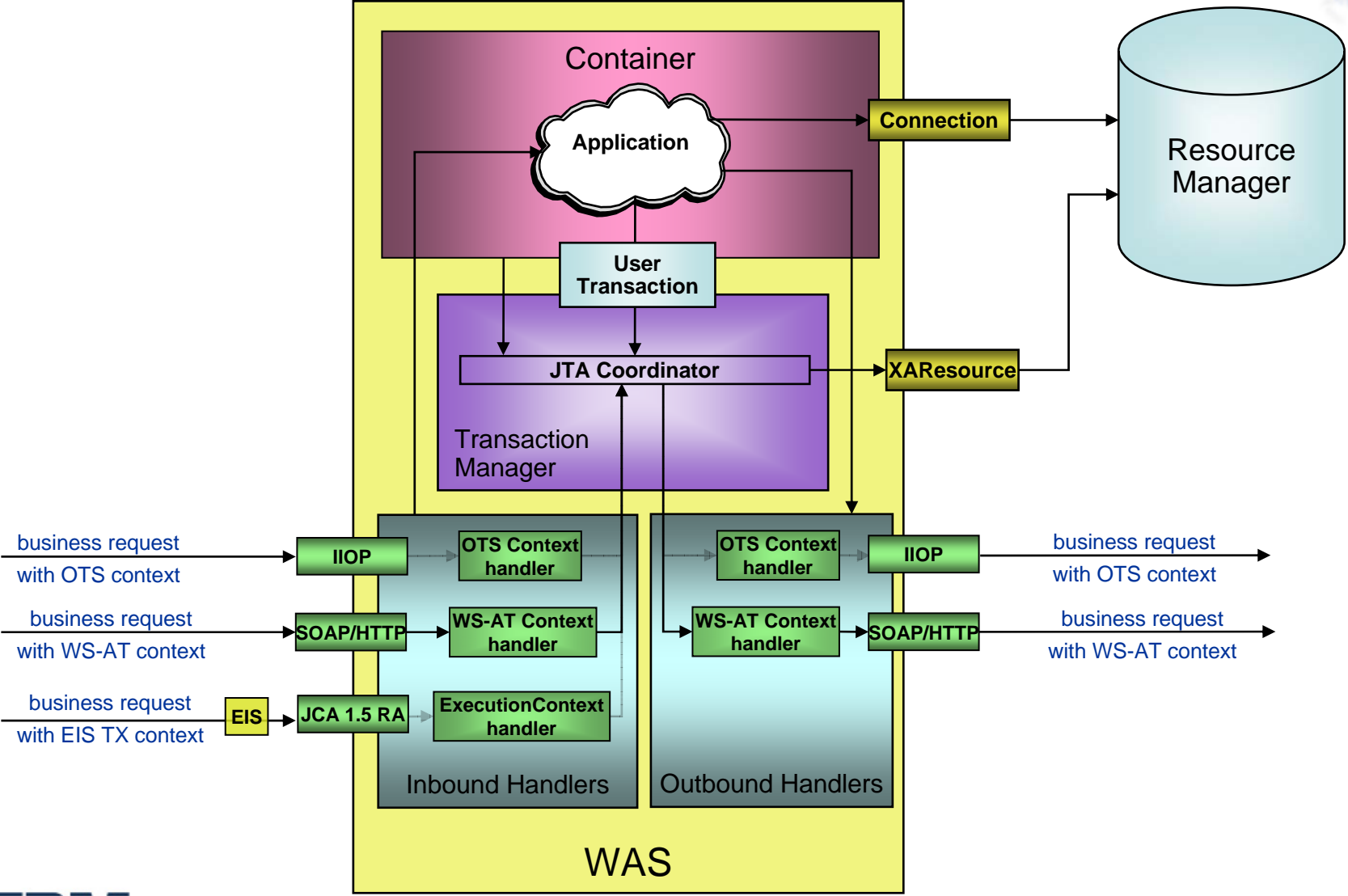
When is WS-AT useful?

- 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

Application policy sets

[Close page](#)

Application policy sets
?

[Application policy sets](#) > **WSTransaction**

This is a default Policy Set. You can view, transfer, or remove attachments, but you cannot edit the name, description, policies included, or policy details.

General Properties

Name

Description

This policy set provides transactional integrity by using WS-AtomicTransaction context propagation.

Additional Properties

- [Attached applications](#)

Policies

↑↓
↻

Policy ▾	State ▾	Description
WS-Transaction	Enabled	Policies for controlling the use of Web service transactions.
Total 1		

WS-AT assembly for JAX-WS clients/providers

Service clients

[Close page](#)

? -
Service clients

[Service clients](#) > **EchoService**

Manage Web services clients for this cell. All JAX-WS service clients are listed here. In this Feature Pack for Web Services, JAX-RPC service clients are not displayed.

Configuration

General Properties

Service client

Application

- [WSSampleClientSei](#)

Module

- [SampleClientSei.war](#)

Policy set attachments

Attach policy sets to the service, endpoints, or operations and assign the default bindings, create new bindings, or assign existing custom bindings for the attached policy sets. Note that you can view or modify the default bindings from the cell- or server-level security panels. Also note that you can only directly attach a policy set to an operation if the policy set has WS-Addressing enabled or if the WSDL specifies WS-Addressing headers.

Preferences

Attach ▾
Detach
Assign Binding ▾

Select	Service/Endpoint/Operation ▾	Attached policy set ▾	Binding ▾
<input type="checkbox"/>	EchoService	WSTransaction	Default
<input type="checkbox"/>	EchoServicePort	WSTransaction (inherited)	Default (inherited)
<input type="checkbox"/>	echoOperation	WSTransaction (inherited)	Default (inherited)
Total 3			



WS-AT assembly for JAX-RPC clients/providers

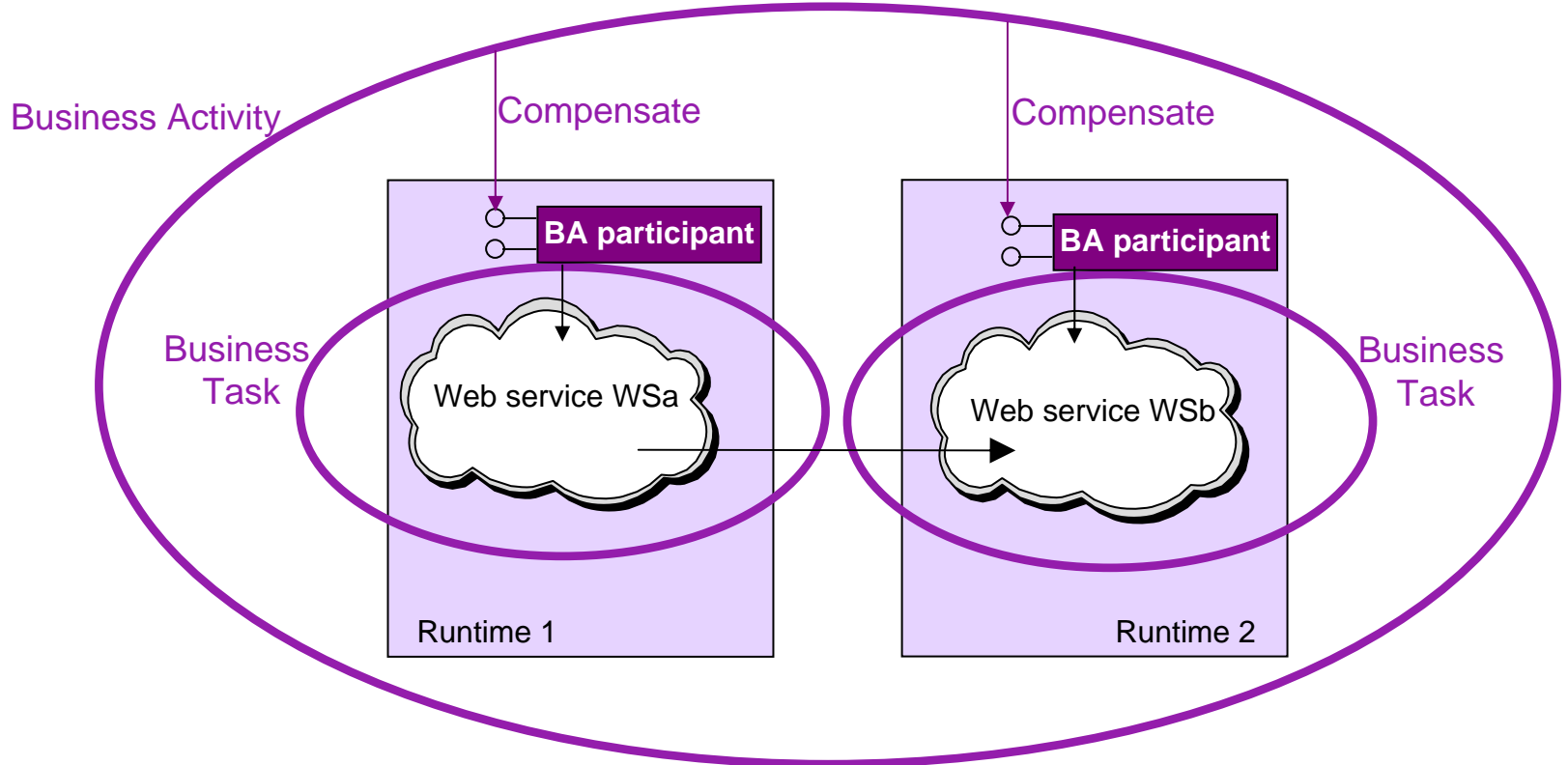
The screenshot shows the 'Web Deployment Descriptor' configuration window. The 'Servlets' tab is active, displaying a list of 'Servlets and JSPs' used in the application: 'WebService' and 'WebServiceClient'. Below this list are 'Add...' and 'Remove' buttons. To the right, the 'Markup Language' section is empty with 'Add...', 'Edit...', and 'Remove' buttons. The 'Global Transaction' section has a checked checkbox for 'Send Web Services Atomic Transactions on requests' and an unchecked checkbox for 'Execute using Web Services Atomic Transaction of incoming requests'. The 'Local Transaction' section has dropdown menus for 'Boundary:' and 'Resolver:'. At the bottom, a navigation bar includes tabs for Overview, Servlets, Filter, Security, References, WS Handler, Pages, Variables, WS Extension, WS Binding, Extensions, and Source.

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”

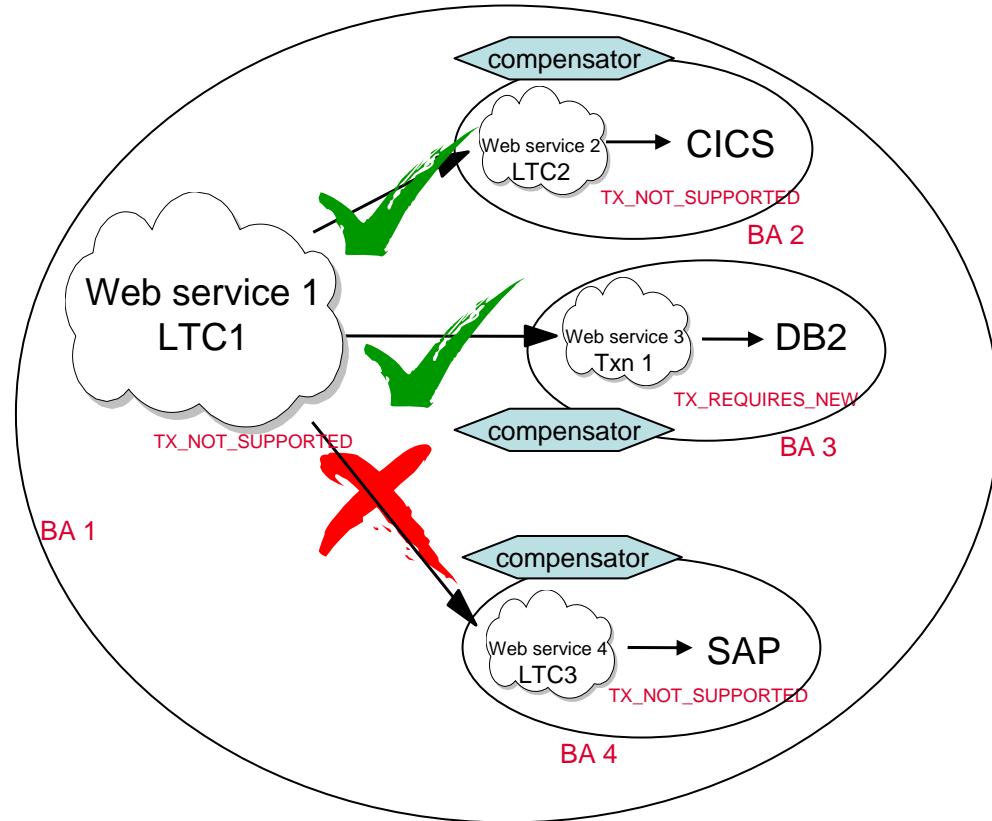
- ...provides a compensating transaction model for **EJBs** that may (but do not have to) be exposed as Web services
 - *Uses WS-BA across Web service protocols*
- ...enables 1PC or 2PC work to be committed as part of a larger activity and later compensated if the overall activity fails
 - *Activation 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

The screenshot shows the 'EJB Deployment Descriptor' window for a bean named 'TravelAgent'. The left pane shows a tree view with 'SampleUtilities' and 'TravelAgent' (selected). The right pane contains the following configuration details:

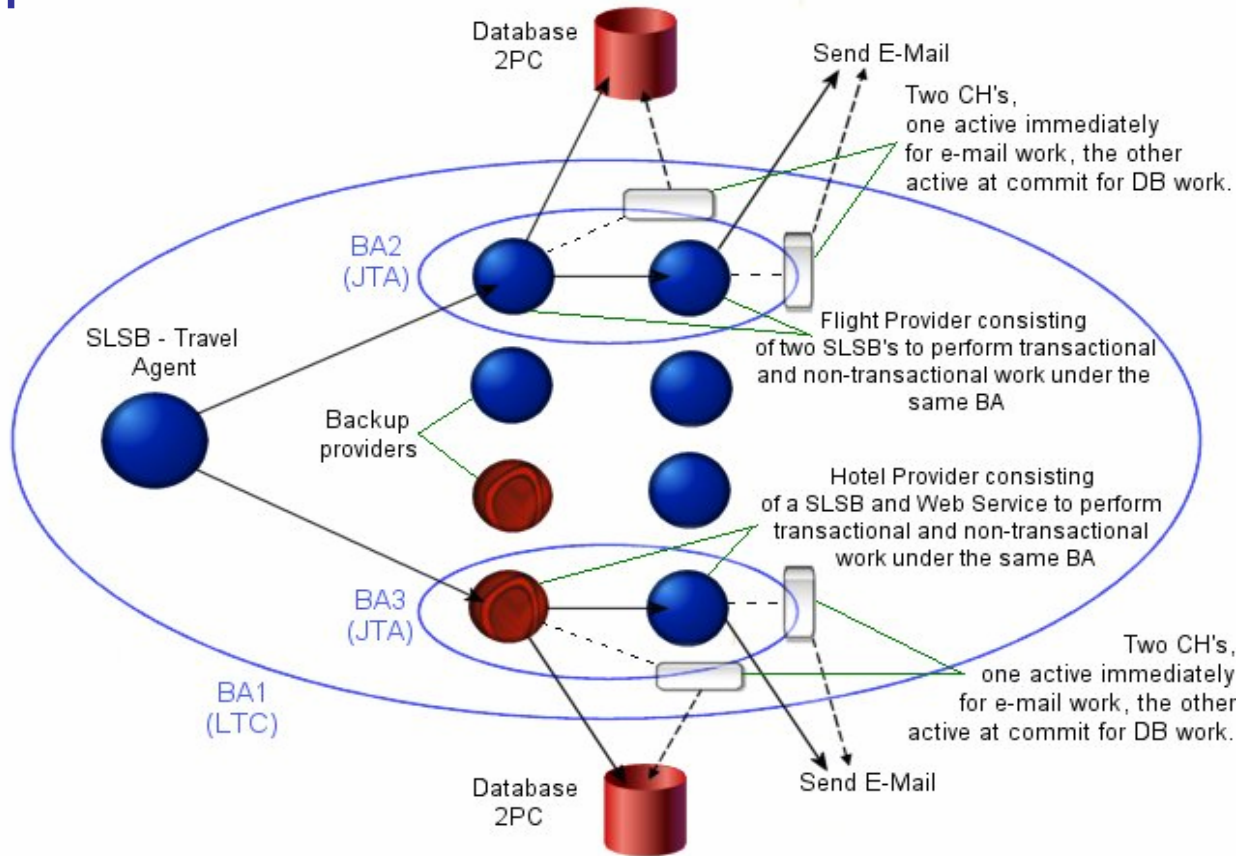
- Bean Type:** Session 2.x
- Type options:** Stateless
- Transaction type:** Container
- Display name:** (empty)
- Description:** (empty)

Below these fields are several expandable sections:

- Class and Interface Files:** Contains a list of files:
 - ejbs.TravelAgentLocal
 - ejbs.TravelAgentLocalHome
 - ejbs.TravelAgentBean
 Action buttons: Add..., Browse..., Open, Remove.
- Environment Variables:** The following environment variables are defined for the selected bean: (empty list)
- Programming Model Extensions:** The following are used to configure programming model extensions for WebSphere Application Server: (empty list)
- Compensation:**
 - Run EJB methods under a BusinessActivity scope
 - Compensation handler class: `handlers.TravelAgentCompensationHandler`
 - Action button: Browse...

At the bottom left of the main configuration area are 'Add...' and 'Remove' buttons. At the bottom of the window is a tabbed interface with the following tabs: Overview, Bean, References, WS Handler, Assembly, Access, WS Extension, WS Binding, Mediation Handlers, Internationalization, and a '»»' button.

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.

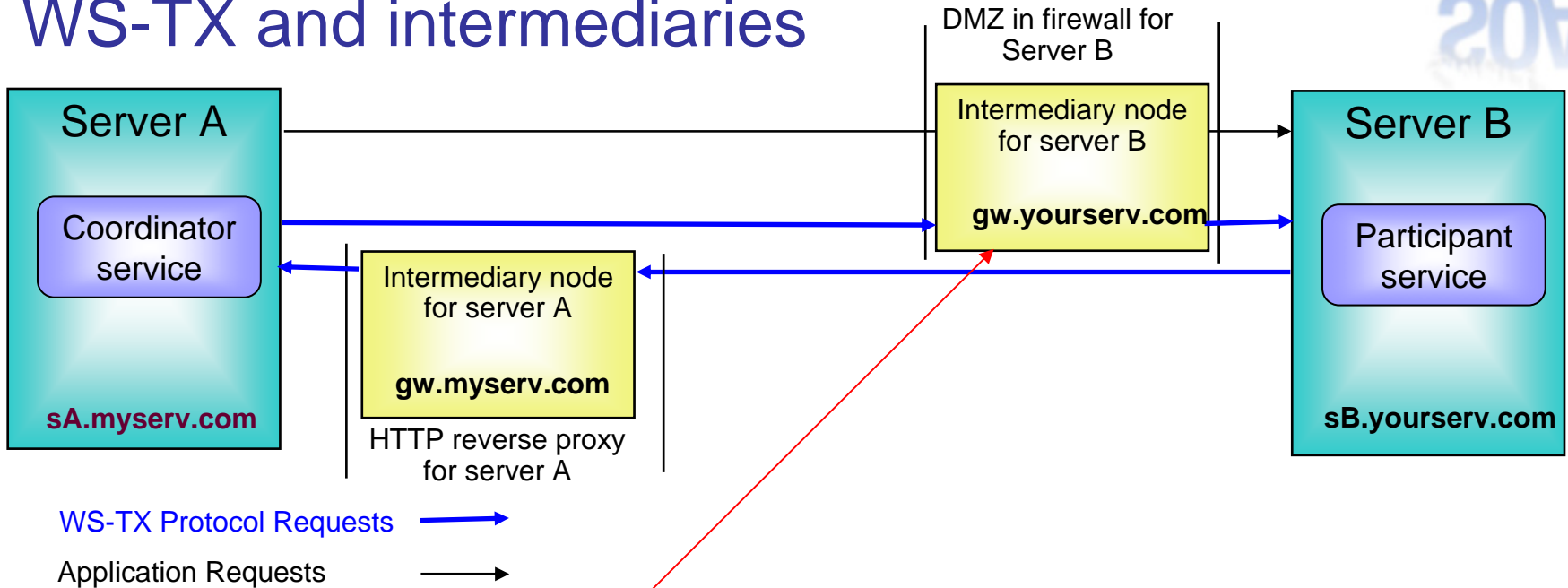
Where are these considerations factored and do they affect interoperability?

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>475639400084265978327593</was:HAclusterId>  
  </wsa:ReferenceParameters>  
</wsa:EndpointReference>
```

WS-TX and intermediaries



```

<wsa:To>
  <wsa:Address>http://gw.yoursevr.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.mysevr.com/_IBMSYSAPP/wsat/services/Coordinator</wsa:Address>
  ...
</wsa:From>
  
```

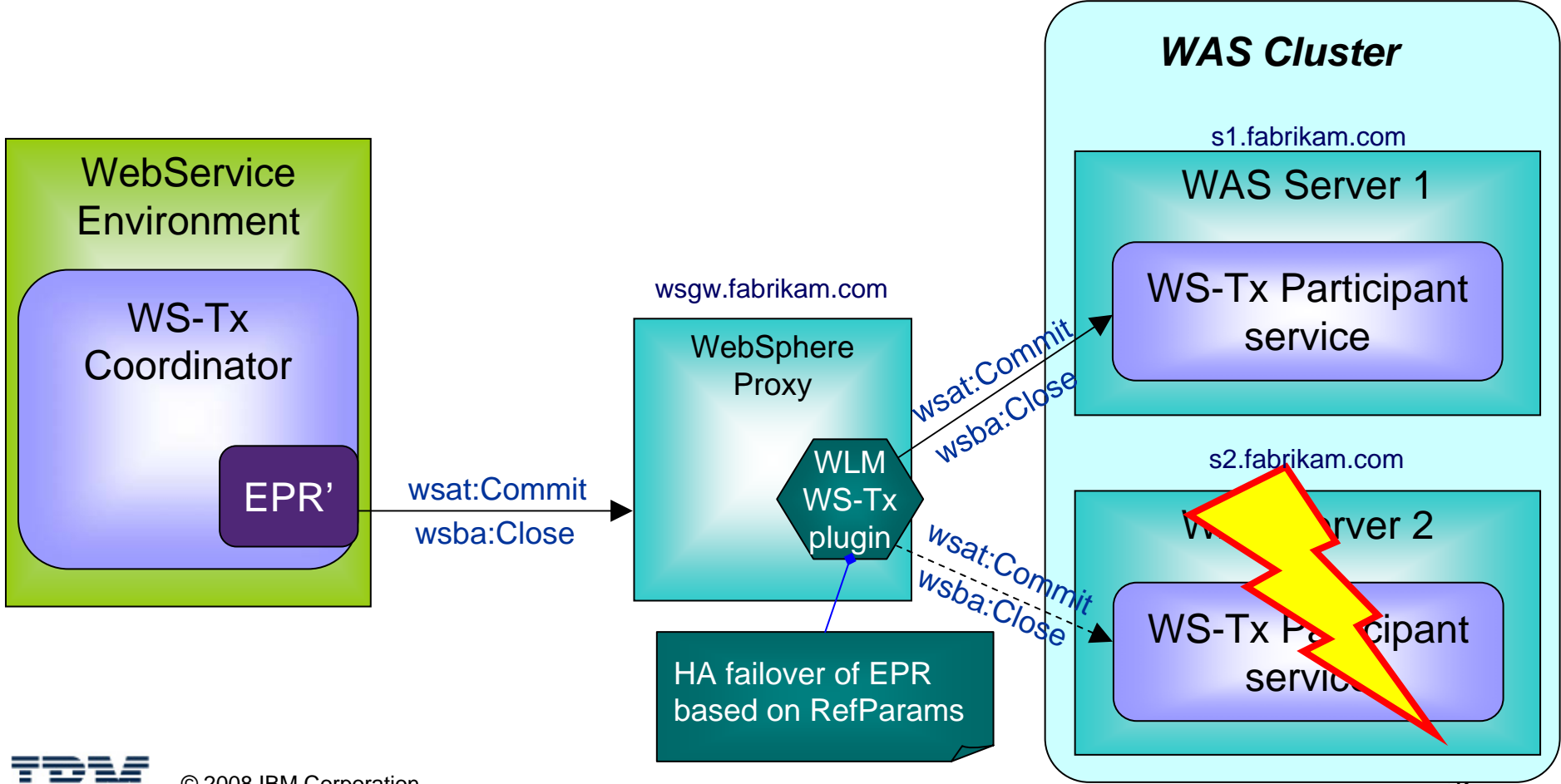
WS-TX protocol endpoints accommodating proxies

The screenshot shows the IBM Integrated Solutions Console interface. The left sidebar contains a navigation tree with categories like Servers, Applications, Resources, Security, Environment, System administration, Users and Groups, Monitoring and Tuning, Troubleshooting, Service integration, and UDDI. The main content area is titled 'Application servers' and shows the configuration for a 'Transaction Service'. The 'Configuration' tab is active, displaying 'General Properties' and 'Additional Properties'. Under 'General Properties', there are several settings: 'Transaction log directory' (text field), '* Total transaction lifetime timeout' (120 seconds), '* Async response timeout' (30 seconds), '* Client inactivity timeout' (60 seconds), '* Maximum transaction timeout' (300 seconds), 'Heuristic retry limit' (0 retries), 'Heuristic retry wait' (0 seconds), 'Enable logging for heuristic reporting' (checkbox), 'Heuristic completion direction' (ROLLBACK dropdown), 'Enable file locking' (checked checkbox), and 'Enable protocol security' (checked checkbox, circled in red). Below these are 'HTTP proxy prefix' and 'HTTPS proxy prefix' text fields. At the bottom of the configuration area are 'Apply', 'OK', 'Reset', and 'Cancel' buttons. A 'Help' sidebar on the right provides field help information.

High availability failover of protocol endpoints

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

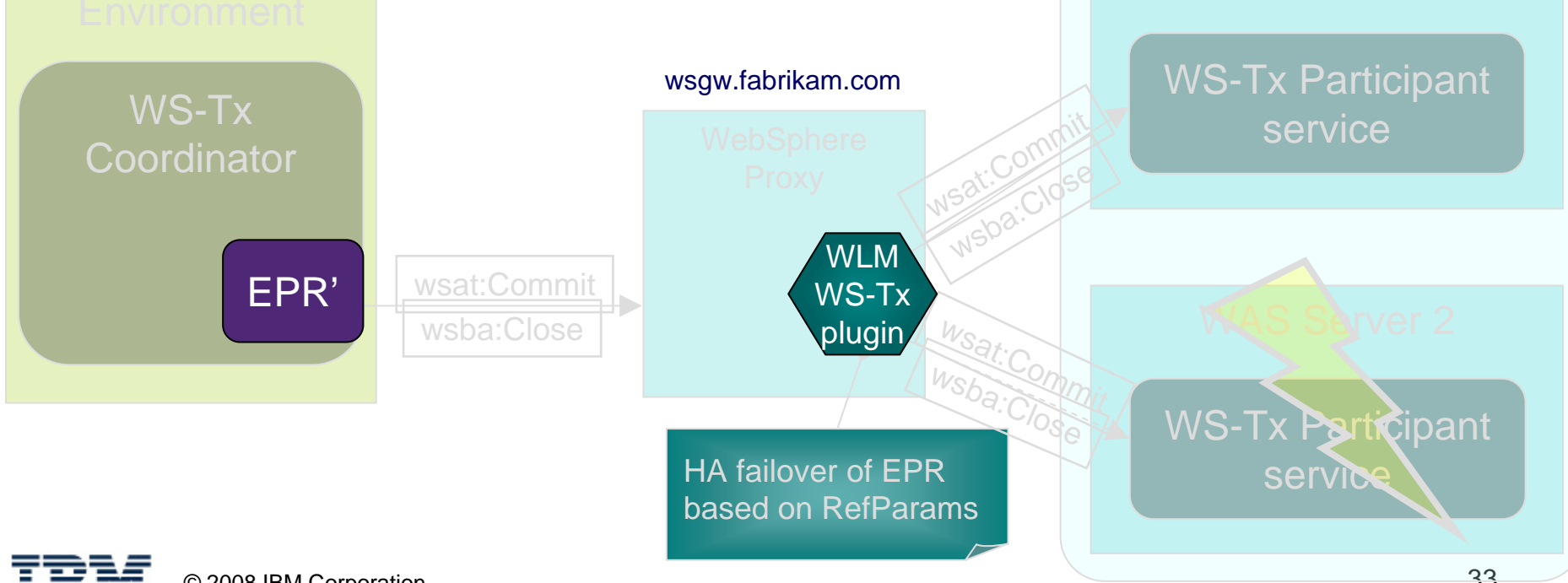
RefParams in the EPR are used by WLM plug-in to “follow” HA failover.



High availability failover of protocol endpoints

```

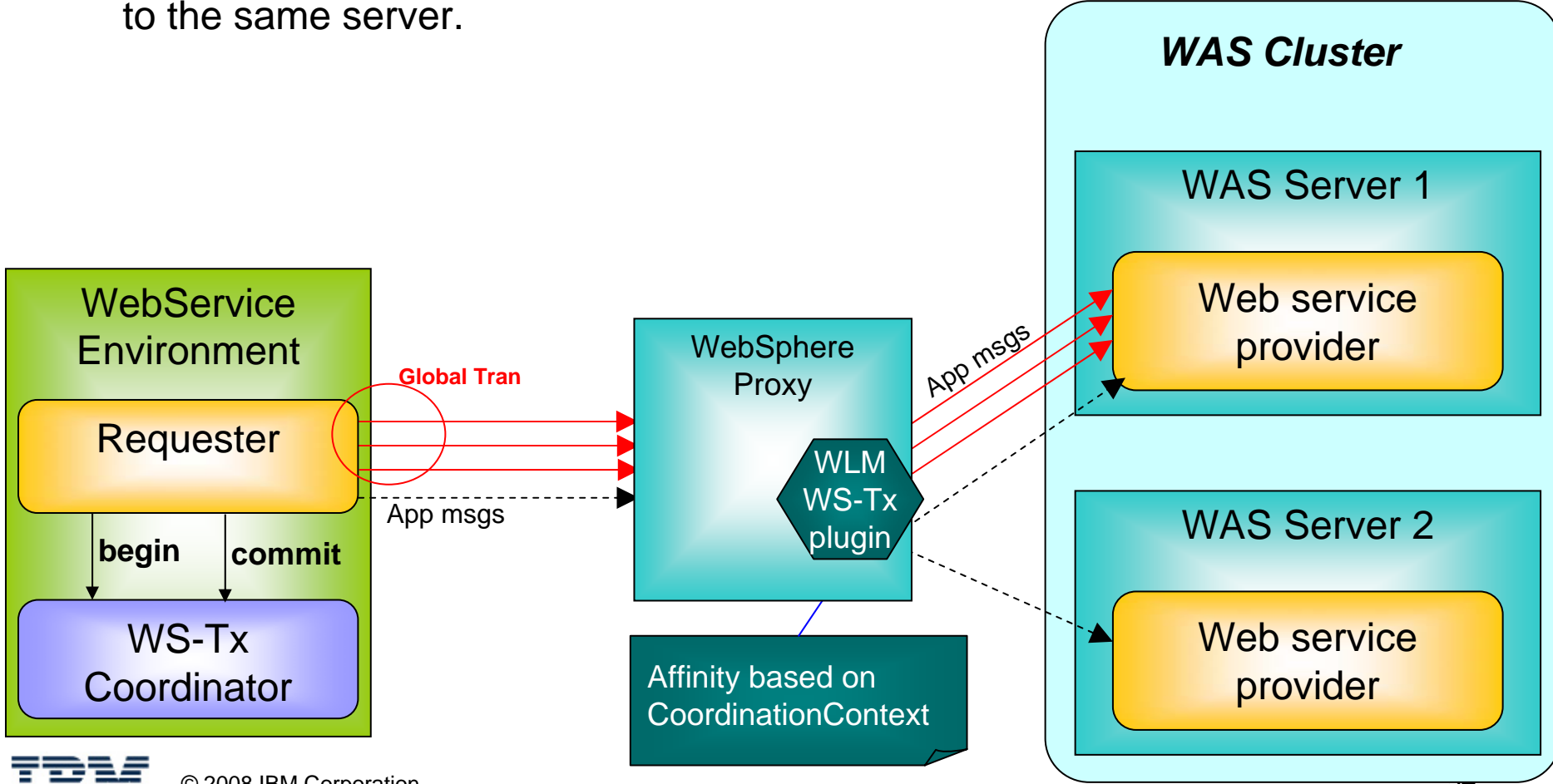
<wsa:EndpointReference>
  <wsa:Address>http://wsgw.fabrikam.com/_IBMSYSAPP/wsat/services/Participant</wsa:Address>
  <wsa:ReferenceParameters>
    <someNS:txID>111-222-333</someNS:txID>
    <was:HAclusterId>475639400084265978327593</was:HAclusterId>
  </wsa:ReferenceParameters>
</wsa:EndpointReference>
  
```



Transaction-based affinity routing

WLM transaction affinity constraints.

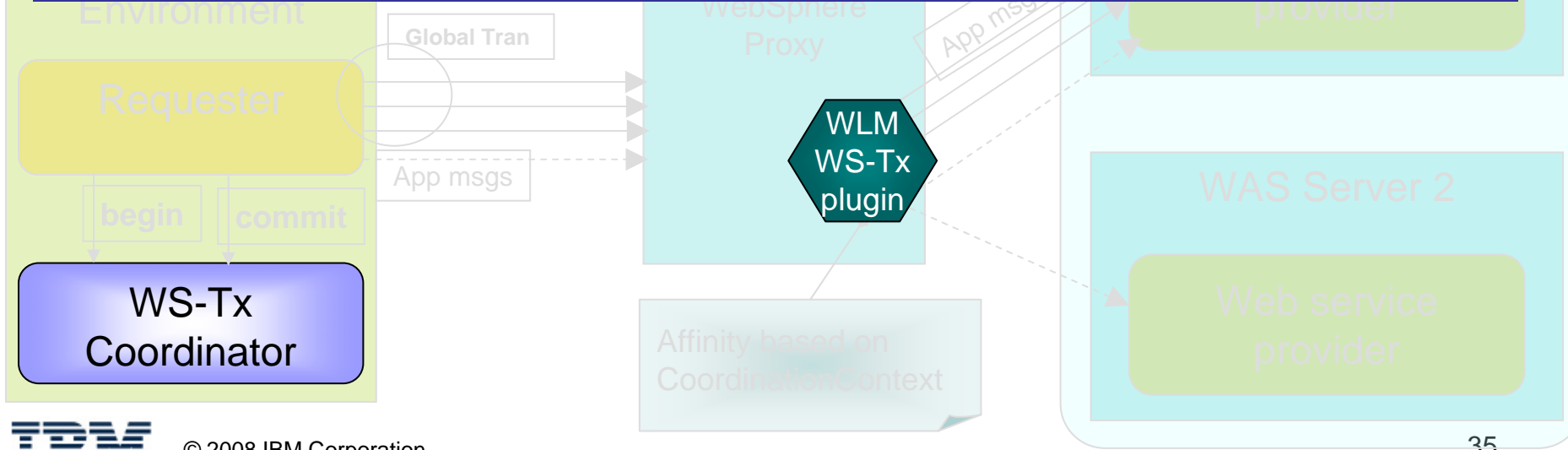
All requests to WLM-able EPRs within the same WS-Tx context targeted to the same server.



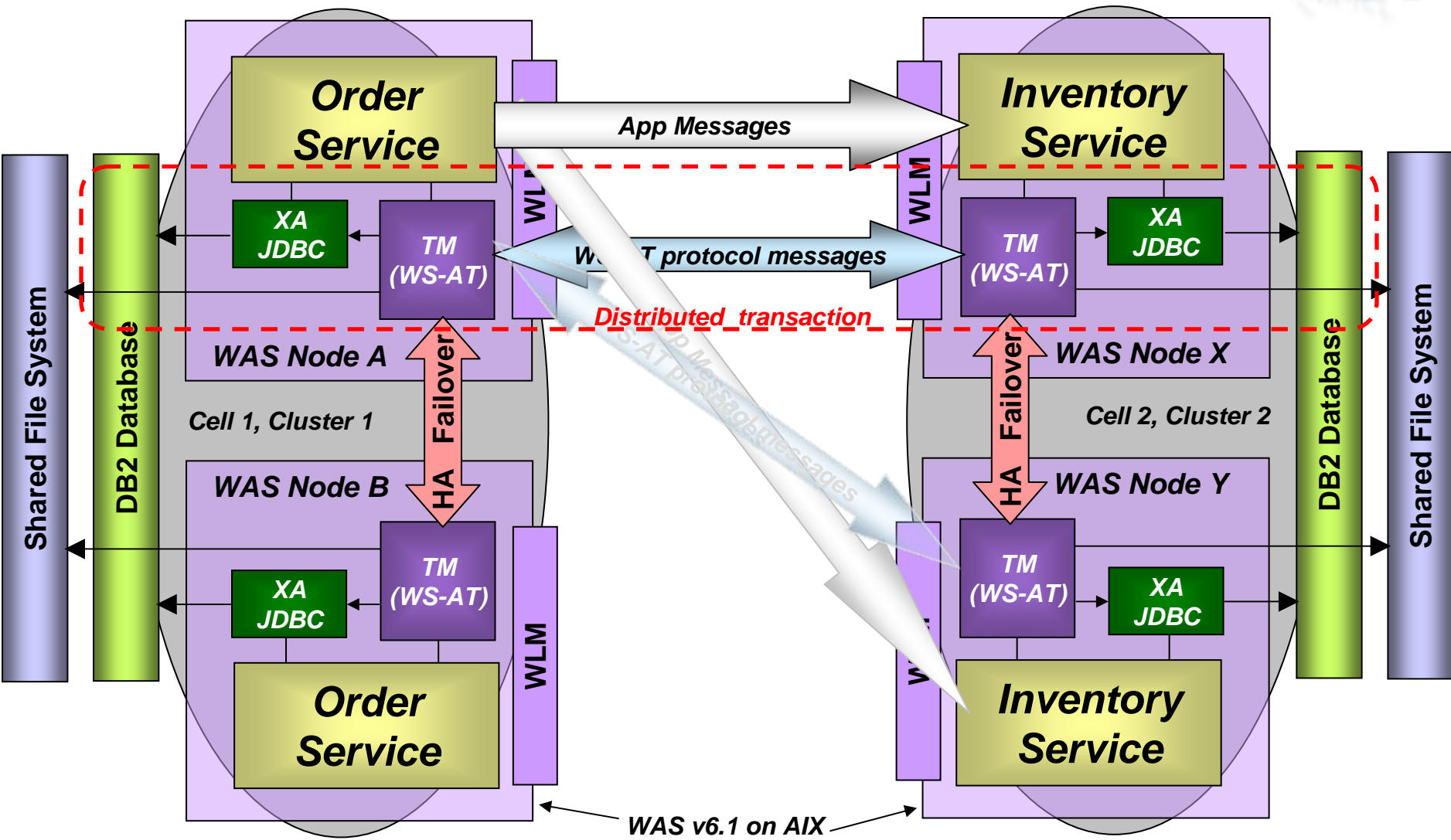
Transaction-based affinity routing

```

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



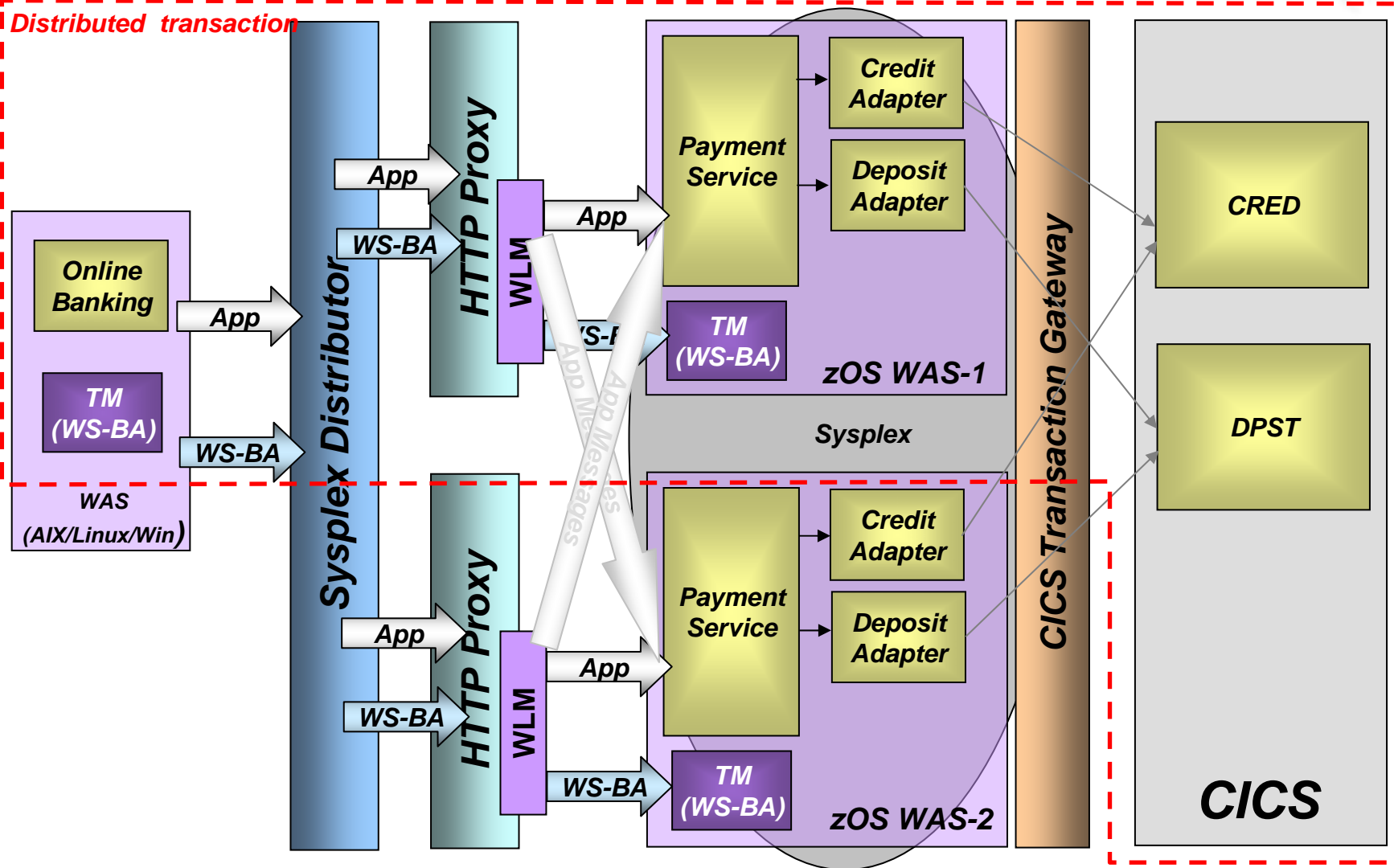
Order Management Application: HA WS-AT deployment



WAS v6.1 on AIX



Online Banking: Proxied/WLM'd WS-BAs 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>
    <wscor:CoordinationContext s:mustUnderstand="true">
      ...
    </wscor:CoordinationContext>
  </s:Header>
  <s:Body>
    <!-- Application body content -->
  </s:Body>
</s:Envelope>
```

Note: Applications don't see or care about this