Web Services and Transactions

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Agenda

• Web Services and Transactions
  – Long-running Transactions
  – Web Services

• Specifications and Standards

• Compare
  – WS-Transaction and WS-Coordination
  – Business Transaction Processing

• Driving Convergence

• Conclusions

• References
Why do Web Services Need Transactions?

- Loosely-coupled
- Distributed
- Coordination is an issue except for single sequence
  - Make error-prone complex transactions easier to program
- New requirements for independent participants
  - One coordinator can’t demand all participants follow the coordinator’s business rules
  - Isolation hard to maintain—one transaction affects another
- XML-based transaction protocols for interoperability
The Case for Long-running Transactions

- Existing businesses do them often
- Travel agent scenario
  - Multiple resources
  - Variable cost to change/cancel
  - Business rules vary
  - Need some consistent set of tickets/reservations
  - Need a deterministic agreed outcome
- Compensation rather than rollback (usually)—cancel reservation
Transactions Support
Workflow and Choreography

- BPEL4WS
- Web Services Choreography Interface (W3C Note)
- ebXML Business Process interactions
- Details BTP support for workflows in Potts, Temel paper (see References)
  - WSFL
  - XLANG
  - BPML
Web Services and Transactions

• To integrate transactions and Web services need to carry one or more of
  – Correlation ID
  – Conversation ID (for long-running conversations, not necessarily transactional—viz. WLStudio)
  – Transaction context ID (integer, for atomic single-site)
  – Additional context information

• Placed in SOAP Header

• Potential for conflicts as SOAP Header is used more and more
Specifications and Standards

• When is a specification not a standard?
• Is the protocol or API over-specified? Under-specified?
• How interoperable is the protocol?
• Automatic or manual configuration?
• Optimized for common cases?
• Consistent architecture and programming model?
The Landscape Today

- WS-Transaction + WS-Coordination (WS-T/WS-C)
- OASIS Business Transaction Processing (BTP)
- Others (see references)
WS-Transaction and WS-Coordination

- Published August 2002 by BEA, IBM, and Microsoft
- Factors out transaction context management and propagation into WS-Coordination
- XML with Web services binding
- Two sub-protocols in WS-T
  - Atomic Transactions (AT)
  - Business Activities (BA)
WS-T and WS-C (continued)

• WS-T/AT (atomic) transactions are essentially traditional and tightly-coupled (ACID) — Atomic, Consistent, Isolated, Durable

• Business Activities are richer and allow for looser coupling, relaxation of Isolation and Atomicity

• Both provide Web service/SOAP bindings
OASIS Business Transaction Protocol

- Technical Committee created March 2001 by BEA, Interwoven, and Sun, soon joined by others
- Committee Specification 1.0 May 2002
- XML, with SOAP binding
- Two sub-protocols relax ACID properties
  - Atoms—Isolation is relaxed
  - Cohesions—Isolation and Atomicity are relaxed
• Atoms do (mostly) what atomic transactions do

• Cohesions do (mostly) what business processes do, and are similar to WS-T Business Activities

• Most messages are the same across the two protocols (it’s really two kinds of coordinators)
Compare

- Superficial Similarities
- Real Similarities
- Messages
- State Diagrams
Superficial Similarities

• At a high level one might hope that the models align:
  – WS-T/AT =?= BTP-Atoms
  – WS-T/BA =?= BTP-Cohesions
  – WC-Coordination manages contexts as BTP does
  – Both use XML and Web Services

• But they don’t.

• The protocols seem similar

• And they are, but optimizations and scalability are needed for WS-C/WS-T
## A Clearer Comparison

<table>
<thead>
<tr>
<th>WS-T/WS-C</th>
<th>BTP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Activity</td>
<td>Cohesions</td>
</tr>
<tr>
<td>*</td>
<td>Atoms</td>
</tr>
<tr>
<td>Atomic Transaction</td>
<td>**</td>
</tr>
<tr>
<td>Web Services</td>
<td>XML with SOAP binding</td>
</tr>
</tbody>
</table>

- * WS-Transaction doesn’t address this except as a special case of Business Activity

- **BTP doesn’t address this as loosely coupled implementation of tightly-coupled transactions were explicitly ruled out early on
A Clearer Comparison (continued)

- **Isolation**
  - WS-T/AT mandates strict isolation, while BTP relaxes isolation—BTP is more loosely coupled

- **Binding**
  - WS-T/WS-C tightly bound to Web Services. BTP is an XML message protocol with a SOAP binding

- **Optimizations**
  - BTP “One Shot” optimization should be used in loosely-coupled interactions with high latency
  - BTP allows participants to resign without waiting for coordinator, and allows timeouts for commitments

- **WS-T/AT can work well in a tightly-coupled environment**
Real Similarities

• Both WS-T/WS-C and BTP can be used to support business process execution environments, e.g. BPEL4WS, WSFL, WSCI, BPMI, and others

• WS-T Business Activities are similar to BTP Cohesions
Real Similarities (continued)

- Compensating actions are a problem if too common (the protocol should prevent errors and aid recovery)
- Both are useful as an *implementing* technology, e.g. for workflows
- Both are relatively low level and complex
- Neither is the only solution in its problem domain
Real Differences
(see references)

- WS-T/AT is not loosely-coupled
- BTP incorporates optimizations
  - One-Shot
  - Participant resignation
  - Timeouts
- WS-C/WS-T is under specified—there’s not enough to build interoperable implementations from the specs
- WS-T/AT and WS-T/BA are similar but use different messages
- Factoring out of WS-C complicates the transaction protocol
- BTP is an OASIS Committee Specification
Messages—Normal Case

- Normal case: WS-T/AT 1PC or 2PC

<table>
<thead>
<tr>
<th>Role: Coordinator</th>
<th>Role: Participant</th>
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</thead>
<tbody>
<tr>
<td>Prepare</td>
<td>Prepared</td>
</tr>
<tr>
<td>Commit</td>
<td></td>
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</table>

- Normal case: WS-T/BA with Completion

<table>
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<tr>
<th>Role: Coordinator</th>
<th>Role: Participant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepare</td>
<td>Prepared</td>
</tr>
<tr>
<td>Close</td>
<td></td>
</tr>
</tbody>
</table>

- Normal case: BTP

<table>
<thead>
<tr>
<th>Role: Superior</th>
<th>Role: Inferior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepare</td>
<td>Prepared</td>
</tr>
<tr>
<td>Confirm</td>
<td></td>
</tr>
</tbody>
</table>
Figure 2: BusinessAgreement Protocol State Diagram

WS-C/WS-T State Diagram
BTP State Diagram Without Optimizations

Superior (coordinator) generated

Inferior (participant) generated

Courtesy Sazi Temel
Specifications and Standards (again)

• When is a specification not a standard?
• Is the protocol or API over-specified? Under-specified?
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Driving Convergence

• BTP and WS-Transaction/WS-Coordination overlap in significant areas
• Similar goals, different details
• Industry would be well-served by convergence in this space
• Standards submission of WS-Transaction and WS-Coordination would be the next step in driving convergence
Conclusions

• Both technologies approach broad and complex issues

• Both technologies can support aggregations including composition, workflows, and choreography

• Convergence is going to be important—the industry needs one standard, not two similar-but-different ones

• Either can simplify distributed agreement without making you “roll your own”
References

• On BEA, IBM, and Microsoft web sites (only BEA URL listed)
  – WS-Transaction
    • http://dev2dev.bea.com/techtrack/ws-transaction.jsp
  – WS-Coordination
    • http://dev2dev.bea.com/techtrack/ws-coordination.jsp
  – BPEL4WS
    • http://dev2dev.bea.com/techtrack/BPEL4WS.jsp
• OASIS Business Transaction Processing Web site
  – http://www.oasis-open.org/business-transactions/
References (continued)

• Choreology Ltd detailed analysis of BTP and WS-Transaction
  – Technical discussion
    • Link from http://www.choreology.com near bottom left
    – Peter Furniss and Alastair Green, *BTP: WS-T Message sequence comparisons*

• Papers
  – Mark Potts & Sazi Temel, *Business Transactions in Workflow and Business Process Management* on BTP Web site
    • Available on web to IEEE members at http://www.computer.org/internet/ic2003/w1030abs.htm
References (continued)

• WSCI
  – http://www.w3.org/TR/wsci/

• BPML
  – http://www.bpmi.org/

• XLANG (superseded by BPEL4WS)
  – http://www.gotdotnet.com/team/xml_wsspecs/xlang-c/

• Web Services Flow Language (superseded by BPEL4WS)