A Standard for Web Services Transactions

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Overview

• Transactions and why they are important
• Web services and the problems they present
• WS-Coordination, WS-AT and WS-BA
• Example scenario
  – WS-AT and WS-BA
Atomic transactions

- Scoping mechanism that provides “all-or-nothing” semantics
- Enables shared resources to be protected from concurrent users
- ACID properties
  - Atomic
  - Consistent
  - Isolated
  - Durable
Two-phase commit

Phase 1

1. Commit? A
2. Yes
3. Commit? B
4. Yes
5. Commit

Phase 2

1. Commit B
2. Commit C
3. Commit A
Environmental impact

• ACID transactions implicitly assume
  – Closely coupled environment
    • All entities involved in a transaction span a LAN, for example.
  – Short-duration activities
    • Must be able to cope with resources being locked for periods
• Therefore, do not work well in
  – Loosely coupled environments!
  – Long duration activities!
However …

• Web Services are as much about interoperability as they are about the Web
• In the short term Web Services transactions will be about interoperability between existing TP systems rather than running transactions over the Web
B2B interactions

- 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
Relaxing 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 need to know a priori what isolation policies are being used

- **Undo can be whatever is required**
  - Before and after image
  - Entirely new business processes
Relaxing 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

• However, nested transactions may be too restrictive
  – Relaxing isolation
WS-AT/WS-BA

• Specifications released by Arjuna, BEA, IBM, IONA and Microsoft
  – Now OASIS standard

• Separate coordination from transactions
  – WS-Coordination

• Define two transaction models
  – AtomicTransaction
    • Closely coupled, interoperability
  – Business Activities
    • Compensation based, for long duration activities
Web Services Coordination

• Coordination is more fundamental than transactions
  – Transactions, security, workflow, replication, …
  – But each use may require different protocol
    • Two-phase, three-phase, QoS specific, …
• Define separate coordination service
  – Allow customisation for different protocols
WS-Coordination

• Defines typical roles of coordinator and participant
  – Coordinator split into two roles
    • Activation service
      – Context
    • Registration service
  – Participant interface is implied by specific protocol
Coordination service

- Client
- Coordinator
- Participant
- Service
- Coordination Service
- Registration Service
- Protocol Definition (WSDL)
- Coordination Protocol Messages

Key:
- Application Level
- Web Service Infrastructure
- Coordination Framework
- Protocol-Specific Entities
WS-TX protocols

• Coordinator protocols
  – Atomic Transaction
    • Completion, DurableTwoPhase, VolatileTwoPhase
  – Business Activity
    • BusinessAgreementWithCoordinatorCompletion, BusinessAgreementWithParticipantCompletion
WS-AtomicTransaction

- Assume ACID transactions
  - High degree of trust
  - Isolation for duration of transaction
  - Backward compensation techniques
  - Does not allow heuristic outcomes
- Integration with existing transaction systems
  - Important to leverage investments
- Interoperability between transaction systems
  - Something of a holy grail to date
Services, participants and context

- Control Relation
- Client Application
- Transaction Context
- Application Message
- Transaction-Aware Web Service
- SQL
- Back-End Database
- Transaction Coordinator
- Participant
- API
- Transaction Protocol Messages
- Commit/rollback
- Transaction Messages
- API
WS-BusinessActivity

- Workflow-like coordination and management
- Business activity can be partitioned into tasks
  - Parent and child relationships
    - Select subset of children to complete
    - Parent can deal with child failures without compromising forward progress
- Tasks can dynamically exit a business activity
- Tasks can indicate outcome earlier than termination
  - Up-calls rather than just down-calls
WS-BA example

Customer Application

Supplier 1
Buy Suit

Supplier 2
Buy Tie

Supplier 3
Buy Shoes

Shopping Portal
Buy Outfit

Coordinator

Child BA 1

Child BA 2

Child BA 3
Compensating BA

Diagram: A compensating business activity (BA) flowchart showing the interactions between different suppliers and a customer. The flowchart includes nodes for Child BA 1, Child BA 2, Child BA 3, Child BA 4, Supplier 1, Supplier 2, Supplier 3, and Supplier 4. The nodes are connected by arrows indicating the flow of the compensating BA process.
Conclusions

- **Transactions are important in mission critical environments**
  - Definition of “transaction” needs to be re-thought for Web Services
  - But ACID transactions still important

- **OASIS WS-TX defines the standard for Web Services Transactions**
  - Multiple protocols for different use cases
  - Demonstrated interoperability between
    - Red Hat/Jboss
    - IBM
    - Microsoft
    - IONA Technologies