From JAX to Database

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Speaker’s Qualifications

- Decade of experience in OO Persistence
- Presented at Java One, Oracle World, OOPSLA, JAOO, Sun Tech Days, TheServerSide Symposium, etc.
- Author of numerous articles on persistence challenges
About the Audience…

- Who considers themselves first and foremost to be a DBA or “Database expert”?
- Who considers themselves first and foremost to be a Java and/or Web Services developer?
- Who considers themselves first and foremost to be an Architect?
- Who considers themselves first and foremost to be a manager, and will you admit it?
Purpose of This Session

Discuss persistence within J2EE Web Services.
Call to Action

Persistence related issues are often seriously underestimated when architecting Web Service applications – in terms of complexity, effort and maintenance.
Persistence in Web Services

- Typical Web Service Conceptual Diagram

Client

Web Service

SOAP

SOAP

Small Miracle Occurs
Agenda

- Four Views of WS Persistence
- Web Services Architectures – Review
- Web Service Persistence Options
  - Persistence from J2EE
  - Database as consumer and producer of WS
- Importance of O-X Mapping
  - 3 Levels of XML Representation in J2EE
  - Mapping, Caching, Querying, Transactions
Four Views of WS Persistence

- Just a classic O-R problem
- Database as a consumer or producer
- Database as an XDB
- Persistence as client on a wire
Just a Classic OR Problem

“I have some object I just built out of a SOAP message or XML document – how do I persist it?”

- Built explicitly through a parser
- Returned from some tool
- Classic O-R issues apply
Database as a Consumer or Producer of Web Services

“I’m a DBA, I write Stored Procs, we have lots of business logic on our database. How can I produce or consume Web Services on the database?”

- Need to examine what features and functionality exist from your DB vendor
Database as an XDB

“I want an XDB that simply acts like a classic RDB.”

This implies needing either

- Good O-X support if using Objects
- Good native XML manipulation and persistence support if not
Persistence as Client on a Wire

“I don’t really think of ‘persistence’, but I have related issues with all the constant work I do with XML.”

- O-X Mapping
- Caching
- Transactions
- Querying
Persistence and Web Services

- Consume a JAX-RPC message, need to perform some task with the database – how do you manage this?

Updates? Deletes? Queries?
Transactions? Caching?
Locking? Sequencing?
Web Service Persistence

- Persistence from J2EE Implementation
  - POJO / Entity Beans
  - Ad Hoc SQL
  - XML Manipulation and Storage

- Database Web Services
  - Database as a producer
  - Database as a consumer
J2EE Persistence – Objects

One possible use case where a developer has Java Objects from JAXB and needs to manage their persistence.
J2EE Persistence – Objects

- JAXB or other techniques to build Java objects or beans from SOAP / XML
- See Session “Persisting Java Objects and EJBs in Relational Databases” for issues
- Specific challenges for Web Services
  - How to merge/update changes from remote
  - How to handle workflows and “mid term persistence”
J2EE Persistence – Ad Hoc SQL

- If there is minimal business logic in Java tier, may consider using Ad Hoc SQL to interact with database
- Java becomes nothing more than presentation layer or database liaison...
J2EE Persistence – XML Storage

- Not all applications need business model in Web Services implementation
- Need tools and features for handling persistence of XML documents
  - XML Capabilities and extensions to RDB like Oracle or DB2
    - Full XDB
    - Data type for XML docs in columns in tables
  - XML Storage Vendors like X-Hive and XPEERION
Motivations for the Database as a Web Services Provider

Web Service Client  SOAP  J2EE Server  JDBC

- Streams
- SQL/Query
- SQL/DML
- XML
- Java
- Procs

Trump}

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Database as Service Provider

- Database Capabilities
  - Stored procedures
  - Java classes
  - SQL Queries and DML
  - XML capabilities
  - Queuing and Streams
- Traditionally accessible through JDBC/JMS
- Vendors making accessible through Web services
Service Provider Architecture

Endpoint implicitly specifies the type of service provided by the server.

J2EE

Decoding

OC4J
Web Services
Servlet

Encoding

Generated Java Classes

SOAP Libraries

XML Parser

SOAP

JDBC
Motivations the Database as Web Services Consumer

- Oracle9iAS Web Services Framework
- Batch Jobs
- SQL
- Procs

SOAP Message
XML

WSDL

Web Service Provider
Service
Database as Service Consumer

- Database
  - Database Module as a Web Service Requestor
  - Stored Procs
    - Java Client-Proxy
    - SOAP Client Runtime
    - JVM
  - WSDL

- Service Provider
  - SOAP

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Importance of O-X

- Just discussed various persistence strategies which can be used depending on situation...

- Two major paths likely:
  - Databases ⇔ XML Storage
    - Relational Schemas ⇔ XSD
    - Rows ⇔ Documents
    - XQUERY ⇔ SQL
  - Regardless of Storage format, clients exposed to XML Documents with need to map to Objects...
3 Levels of XML Representation

- **DOM**
  - File
  - Web Service
  - BPM
  - JMS

- **O-X Data Converter**
  - XML Document

- **O-X Persistence Manager**
  - Managed Object/EJB

- **XML Parser**
  - JDBC
  - J2C
  - XDB
  - EIS

Unmanaged Object
XML Parser

- JAXP – Java API for XML Parsing
  - DOM
  - SAX

- Very low level
- Akin to straight using straight JDBC for database interactions
- Useful for simple and raw GUI based apps where a business model is overkill
- See Neil Graham’s talks:
  - Parsing and processing XML documents
XML Parser Limitations

- Not working with object model
  - Although some may see this as an advantage to minimizing overhead
- Java persistence options less “main stream”
  - Persistent DOM
    - XHive
    - jXTransformer
- My gut feeling is this is more used in non-Java environments...
O-X Data Converter

- Converts XML data to Java objects and vice-versa
- Accessed by applications through Marshal/Unmarshal interface
- Usually for non-transactional data sources
- JAXB implementations
O-X Data Converter Limitations

- Generates Java classes from XML Schema – static, inflexible
  - No control over the mappings
  - Can’t use your own Java classes
  - Application code is tightly coupled to a specific XSD
- Usually no GUI tools to do mappings
- Conversion only, no run-time manager available for transactional data sources
- Homogeneous data support
  - Specific interfaces and generation for XML
O-X Persistence Manager

- Flexible mapping, developers control how objects are mapped to XML – “meet in the middle”
  - Can use developer-defined Java classes
  - Independence between object model and XML schema
  - Business logic can be safely added into Java model
  - Classes can be mapped to multiple schemas – vice versa
  - Support JAXB-based object model generation capabilities
O-X Persistence Manager

- Support complex XML mappings
  - Positional, path information
  - Examples coming...
- May provide visual mapping interface
- May support other data sources – relational and EIS
O-X Persistence Manager

- Persistence manager functionality may be required for transactional XML data sources such as EIS systems, XML databases.
- Provides additional capabilities on top of data conversion such as:
  - Caching
  - Querying
  - Transactions
  - Concurrency
- Castor, Zeus, Quick, Jbind, XML Beans, TopLink, XTAS, ...

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O-X Mapping

- Map Object Model to XSD
- Either code gen XSD from Object Model, *vice versa*, or “meet in the middle”
Example Object Model

Order
- id: long
- orderedBy: String

* lineItems

Address
- addressee: String
- city: String
- street1: String
- street2: String
- state: String
- country: String
- zipCode: String

LineItem
- lineNumber: long
- itemName: String
- quantity: long
- itemPrice: BigDecimal
Direct Mapping

: Address

: Order

id = 1234
orderedBy = “Jane Doe”

: Lineltem

: Lineltem

<ORDER ORDER_ID="1234">
  <ORDERED_BY>Jane Doe</ORDERED_BY>
  <ADDRESS>
    ...
    </ADDRESS>
  <LINES>
    ...
    </LINES>
  <LINES>
    ...
    </LINES>
</ORDER>
Composite Object Mapping

: Address

: Order
  id = 1234
  orderedBy = “Jane Doe”

: Lineltem : Lineltem

<ORDER ORDER_ID="1234">
  <ORDERED_BY>Jane Doe</ORDERED_BY>
  <ADDRESS>
    ...
  </ADDRESS>
  <LINES>
    ...
  </LINES>
</ORDER>
Composite Collection Mapping

: Address

: Order
  id = 1234
  orderedBy = “Jane Doe”

: LineItem
  : LineItem

  <ORDER ORDER_ID="1234">
    <ORDERED_BY>Jane Doe</ORDERED_BY>
    <ADDRESS>
      ...
    </ADDRESS>
    <LINES>
      ...
    </LINES>
  </ORDER>

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### Positional Information

#### Good O-X Support

**Address**

```java
addressee = "Jane Doe"
street1 = "Apt. #123"
street2 = "123 Some St."
...
```

```xml
<ADDRESS>
    <ADDRESSEE>Jane Doe</ADDRESSEE>
    <STREET>Apt. #123</STREET>
    <STREET>123 Some St.</STREET>
    ...
</ADDRESS>
```

#### JAXB/Class Generation Today...

**Address**

```java
addressee = "Jane Doe"
street = [{"Apt. #123"},
          "123 Some St."}]
...
```

```xml
<ADDRESS>
    <ADDRESSEE>Jane Doe</ADDRESSEE>
    <STREET>Apt. #123</STREET>
    <STREET>123 Some St.</STREET>
    ...
</ADDRESS>
```
Path Information

Good O-X Mapping

: Lineltem

lineNumber = 1
itemName = “Pens”
itemPrice = 2.50
quantity = 50

<LINES LINE_NO="1">
  <ITEM>
    <NAME>Pens</NAME>
    <PRICE>2.50</PRICE>
  </ITEM>
  <QUANTITY>50</QUANTITY>
</LINES>

JAXB/Class Generation Today…

: Lines

lineNumber = 1
quantity = 50

<LINES LINE_NO="1">
  <ITEM>
    <NAME>Pens</NAME>
    <PRICE>2.50</PRICE>
  </ITEM>
  <QUANTITY>50</QUANTITY>
</LINES>

: Item

name = “Pens”
price = 2.50
Caching

- Caching objects built from XML database no different than O-R caching

- Caching objects from XML documents is different!

  ➢ Benefits
  - Minimize parsing
  - Reuse/share objects in read intensive apps
  - Potential for in-memory queries

  ➢ Issues
  - PK, Versioning, Refreshing
Caching in an XDB

**OO Query**

**XQUERY**

**XML/XQUERY**

**Results(s)**

Does PK for result exist in cache?

NO – Build bean/object from results

YES – Get from Cache

Return object results
Caching without XDB

**Diagram**

1. **XML Doc**
2. **Does PK for doc exist in cache?**
   - **NO** – Build bean/object from results
   - **YES** – Get from Cache

- **Return object results**
Querying

- SQL For Querying RDB...
- EJBQL and other Java Query Languages for OR Frameworks...
- What about XML Data sources?
- See Jonathan Robie’s talks:
  - Java, Databases and XML Query Languages
  - Querying with XML XQuery
XQUERY

- W3C
- Consider when all your data is XML
- Returns results as XML
- JSR 225 – XQJ submitted June 2003
- Read Only – No updates
- No group/distinct support
XQUERY Example

```xml
<bib>
  {
    FOR $b IN document("bib.xml")/bib/book
    WHERE $b/publisher = "Addison-Wesley" AND $b/@year > 1991
    RETURN
      <book year={ $b/@year }>
        { $b/title }
      </book>
  }
</bib>
```
Querying Panacea

- Developers need choice
- If using XML Extensions to RDB, need to be able query with SQL
- Should be able to choose XQUERY regardless of datasource
- Should be able to choose EJBQL if using O-X Persistence Manager
  - Compile to SQL or XQUERY
Transactions

- What does a transaction mean in Web Services?
- Workflow and Choreography are higher level than this discussion and being addressed in their own rights...
- Let’s discuss –
  - Transactions when interacting with RDB seems obvious to me
  - What about transactions when working with objects built from docs?
Transactions

- Need Java support for ACID transactions
- Atomic
  - Many changes, all or nothing
- Concurrent
  - Many threads making modifications in parallel
- Isolation
  - Uncommitted changes not visible to others
- Durable
  - A successful commit means work is done
Transaction Management

- Java based APIs for modifying business objects
- At commit doc created for updated objects
Summary

- **Four views of XML Persistence**
  - Just an O-R Problem
  - Database as a producer or consumer
  - Database as an XDB
  - Persistence as a client on a wire

- **Three levels of XML representation**
  - XML Parser
  - O-X Data Converter
  - O-X Persistence Manager

- **O-X**
  - Mapping
  - Caching, Querying, Transactions