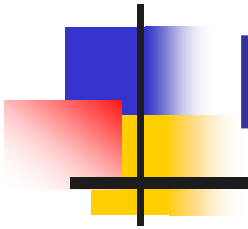
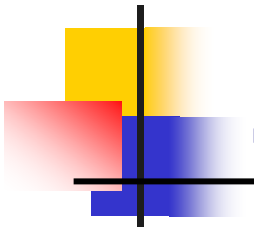


From JAX to Database

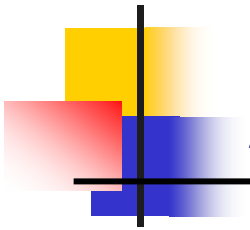
Donald Smith

Oracle Corporation



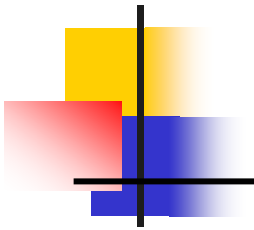
Speaker's Qualifications

- 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



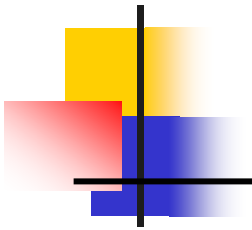
About the Audience…

- 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.

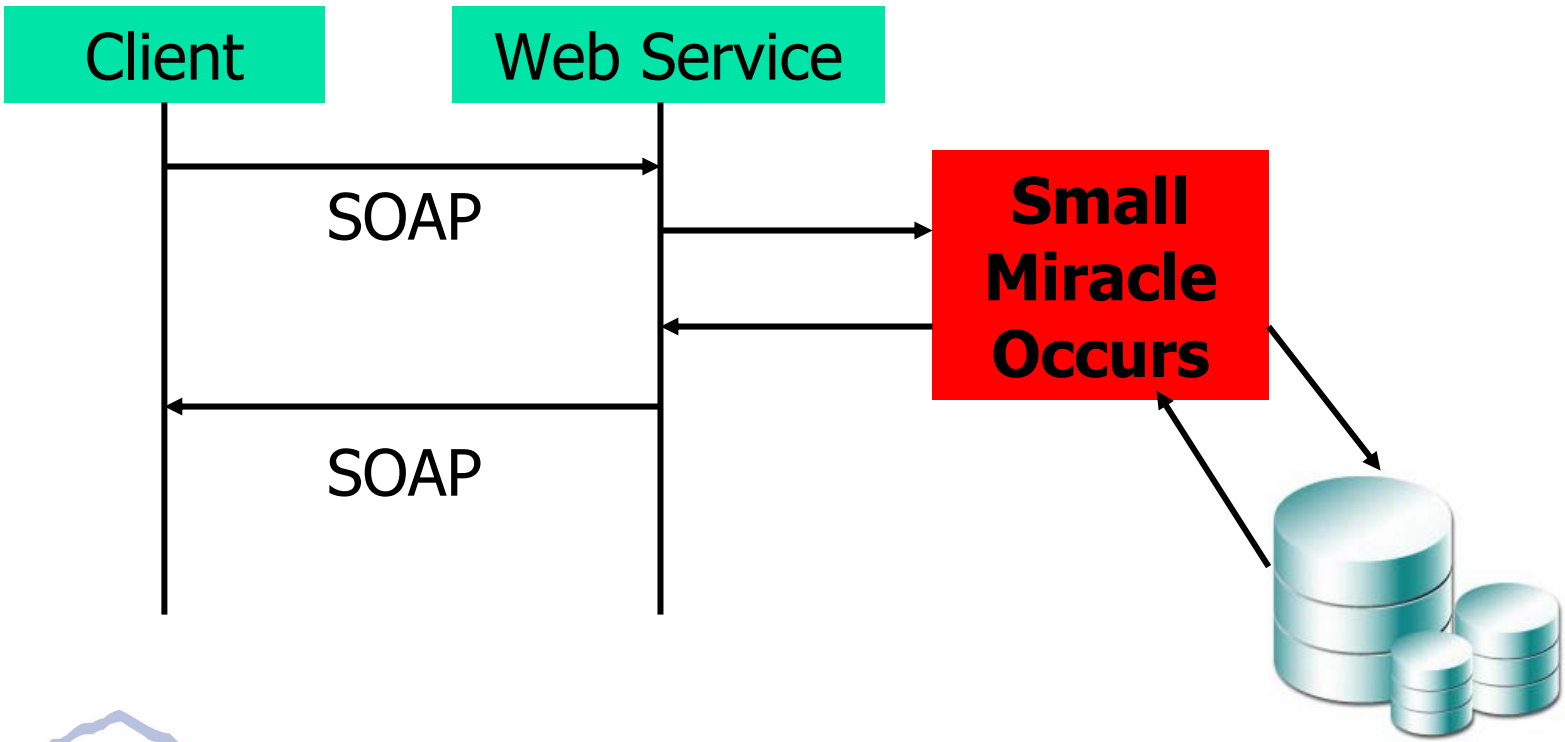


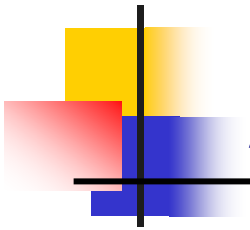
Call to Action

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

Persistence in Web Services

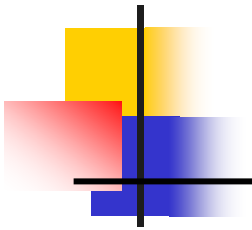
- Typical Web Service Conceptual Diagram





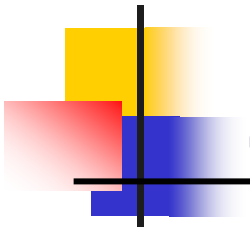
Agenda

- 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

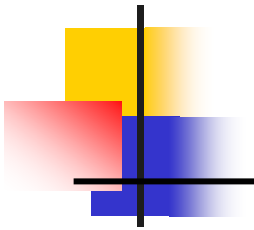
- Just a classic O-R problem
- Database as a consumer or producer
- Database as an XDB
- Persistence as client on a wire



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?"

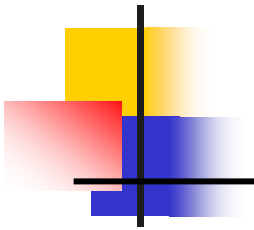
- Built explicitly through a parser
- Returned from some tool
- Classic O-R issues apply



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?"

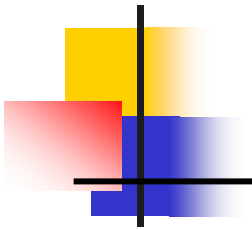
- Need to examine what features and functionality exist from your DB vendor



Database as an XDB

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

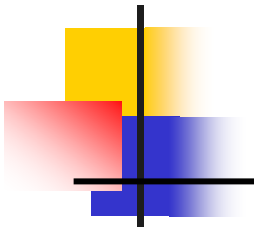
- This implies needing either
  - Good O-X support if using Objects
  - Good native XML manipulation and persistence support if not



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

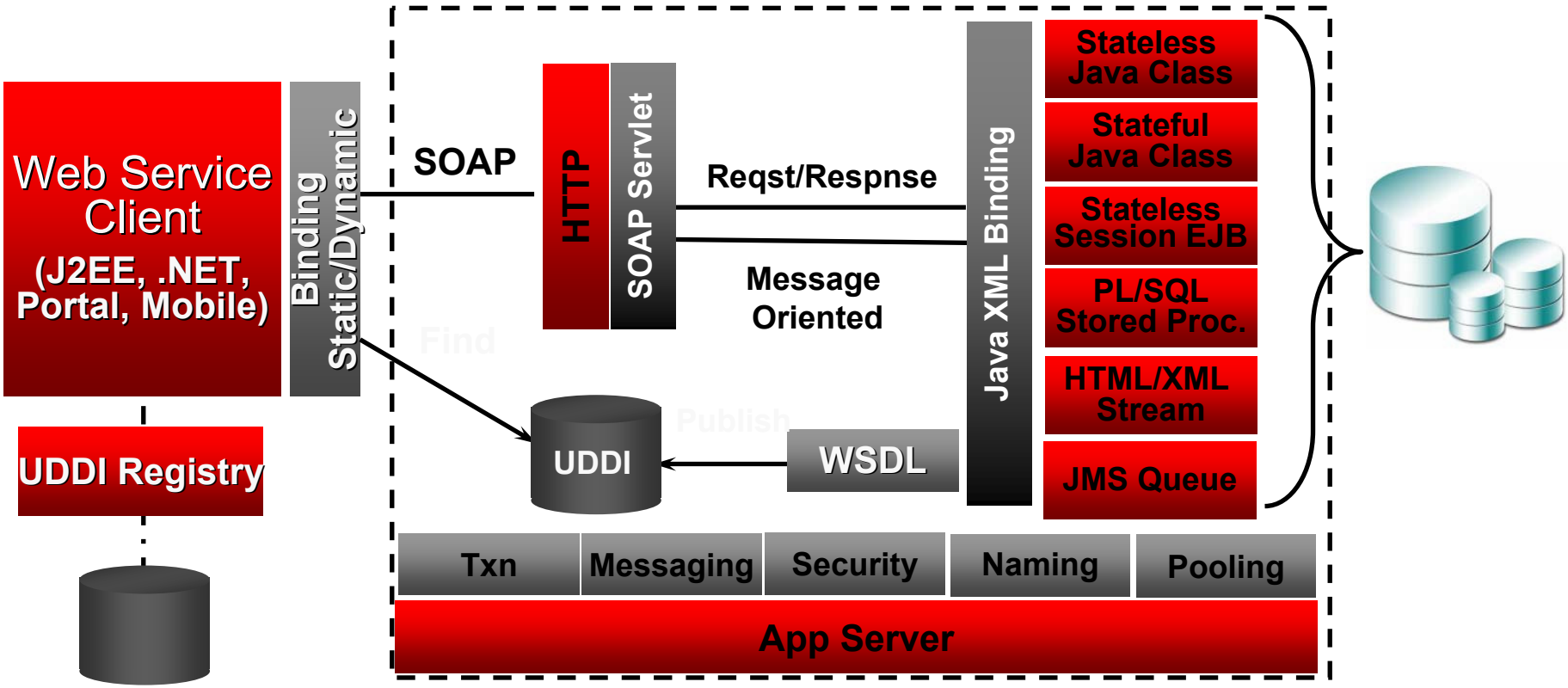


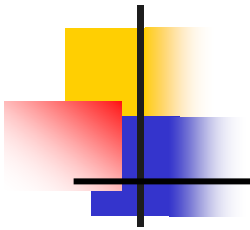
Persistence and Web Services

- Consume a JAX-RPC message, need to perform some task with the database – how do you manage this?
  - JDBC? JAXB? Entity EJB? POJO? Session EJB? Stored Proc?

Updates? Deletes? Queries?
Transactions? Caching?
Locking? Sequencing?

Persistence in Web Services

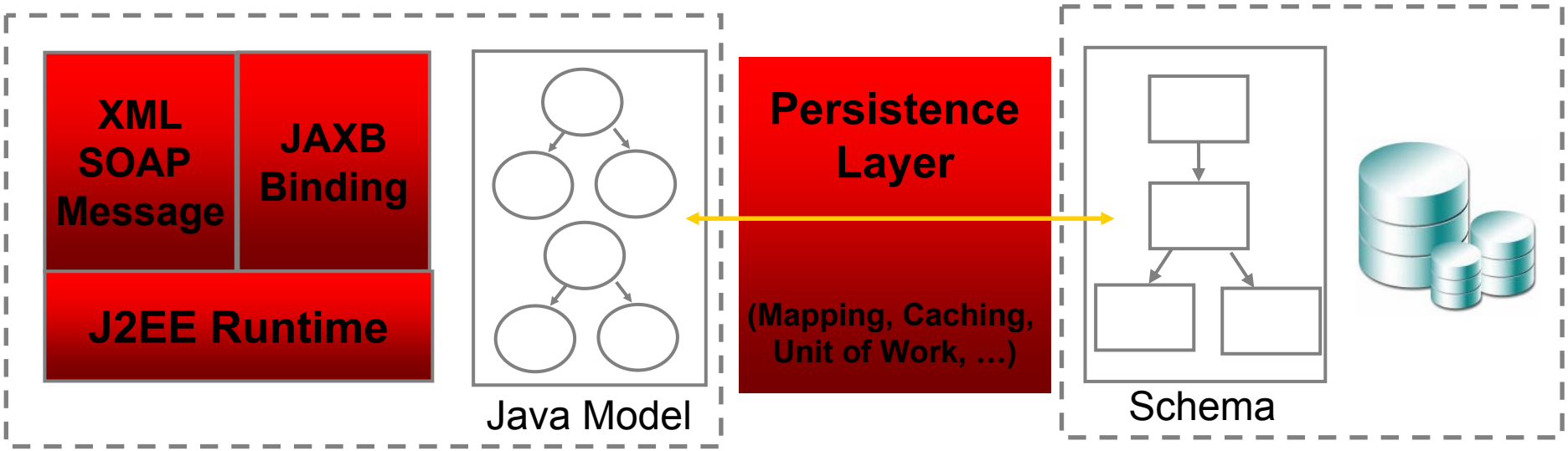




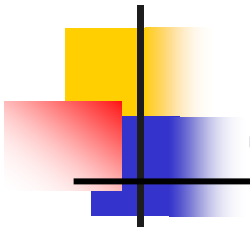
Web Service Persistence

- 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

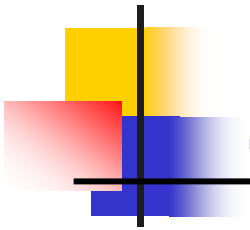


One possible use case where a developer has Java Objects from JAXB and needs to manage their persistence



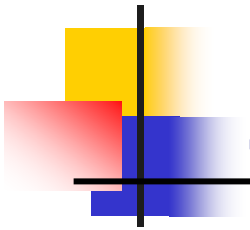
J2EE Persistence – Objects

- 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

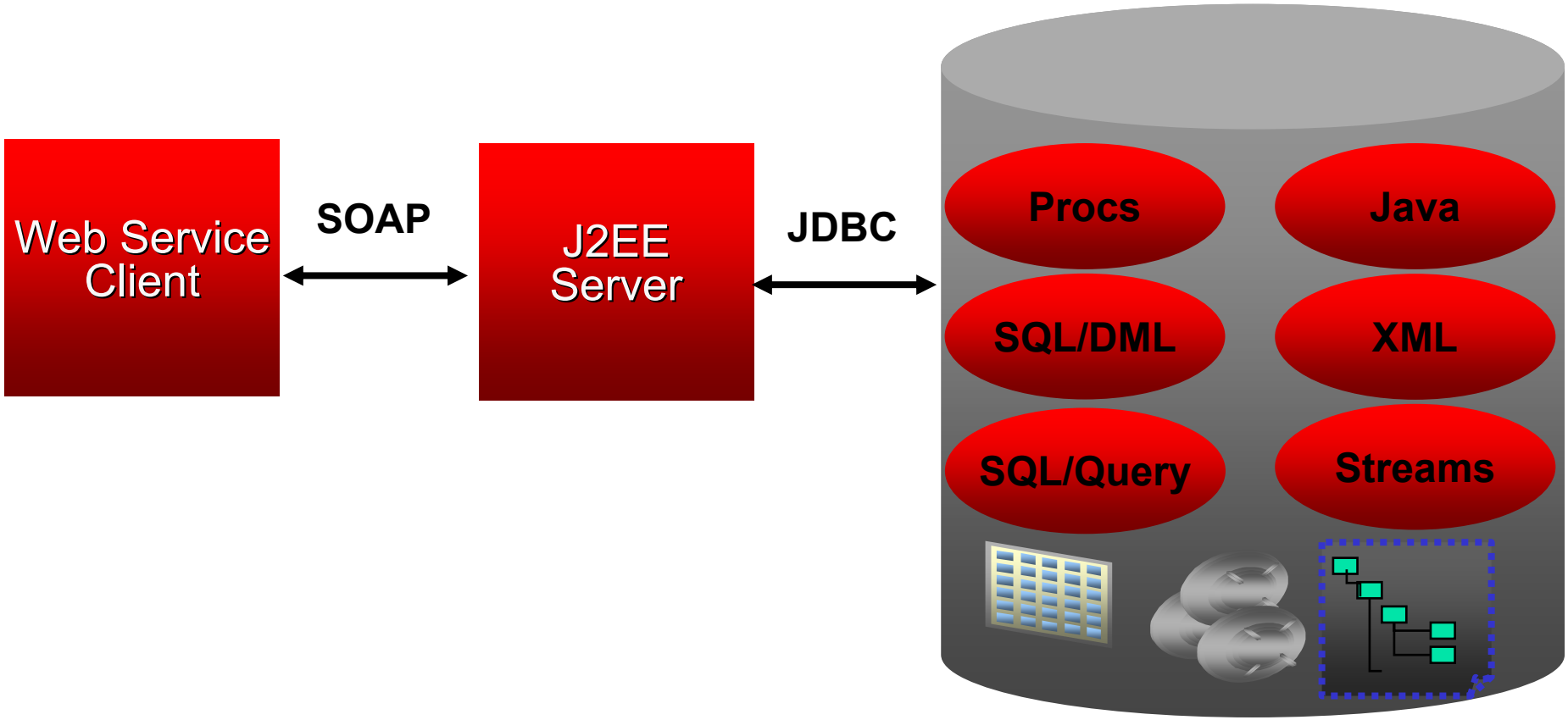
- If there is minimal business logic in Java tier, may consider using Ad Hoc SQL to interact with database
- Java becomes nothing more than presentation layer or database liaison…

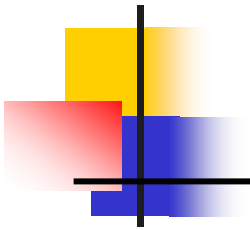


J2EE Persistence – XML Storage

- 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

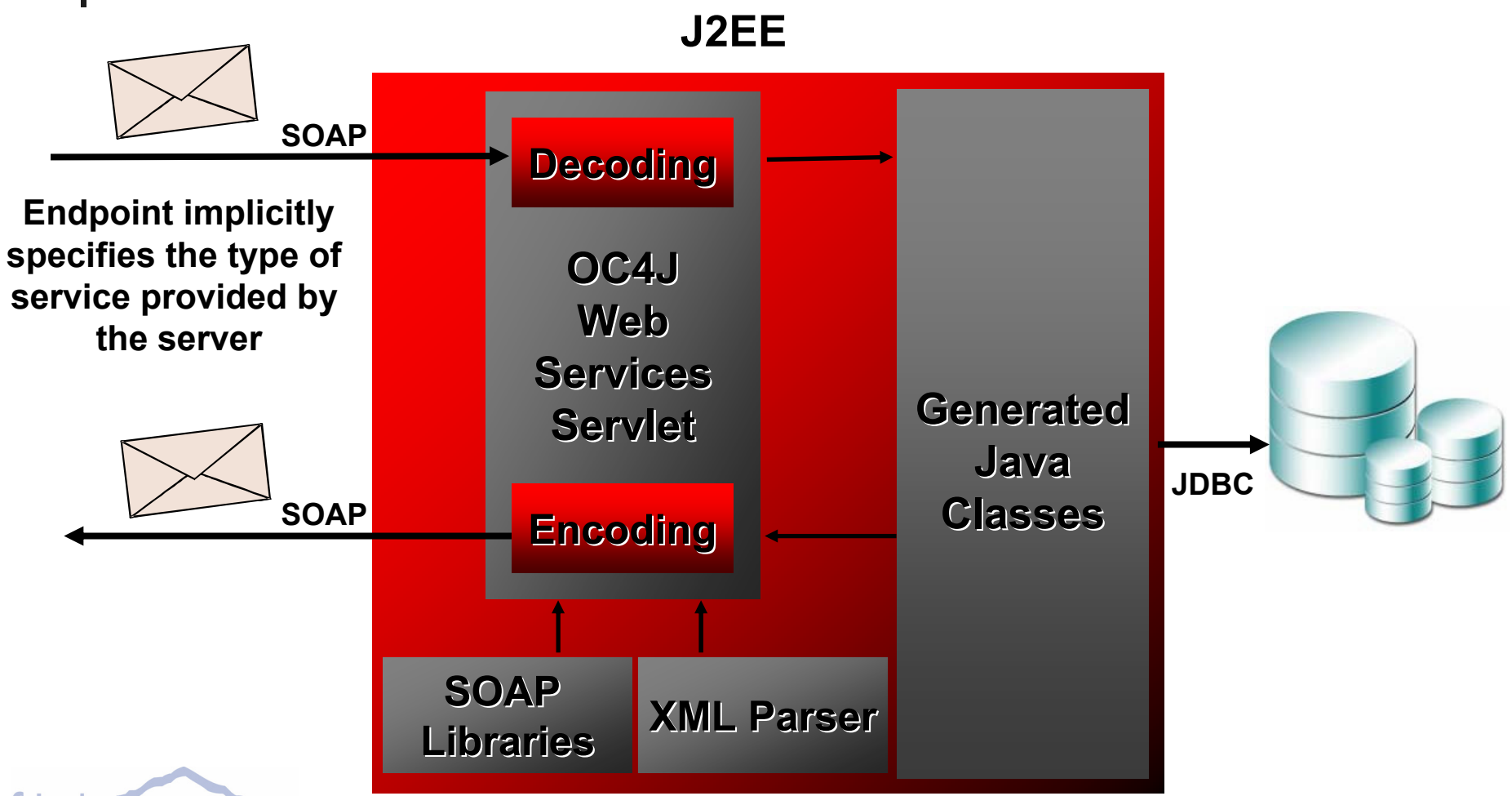




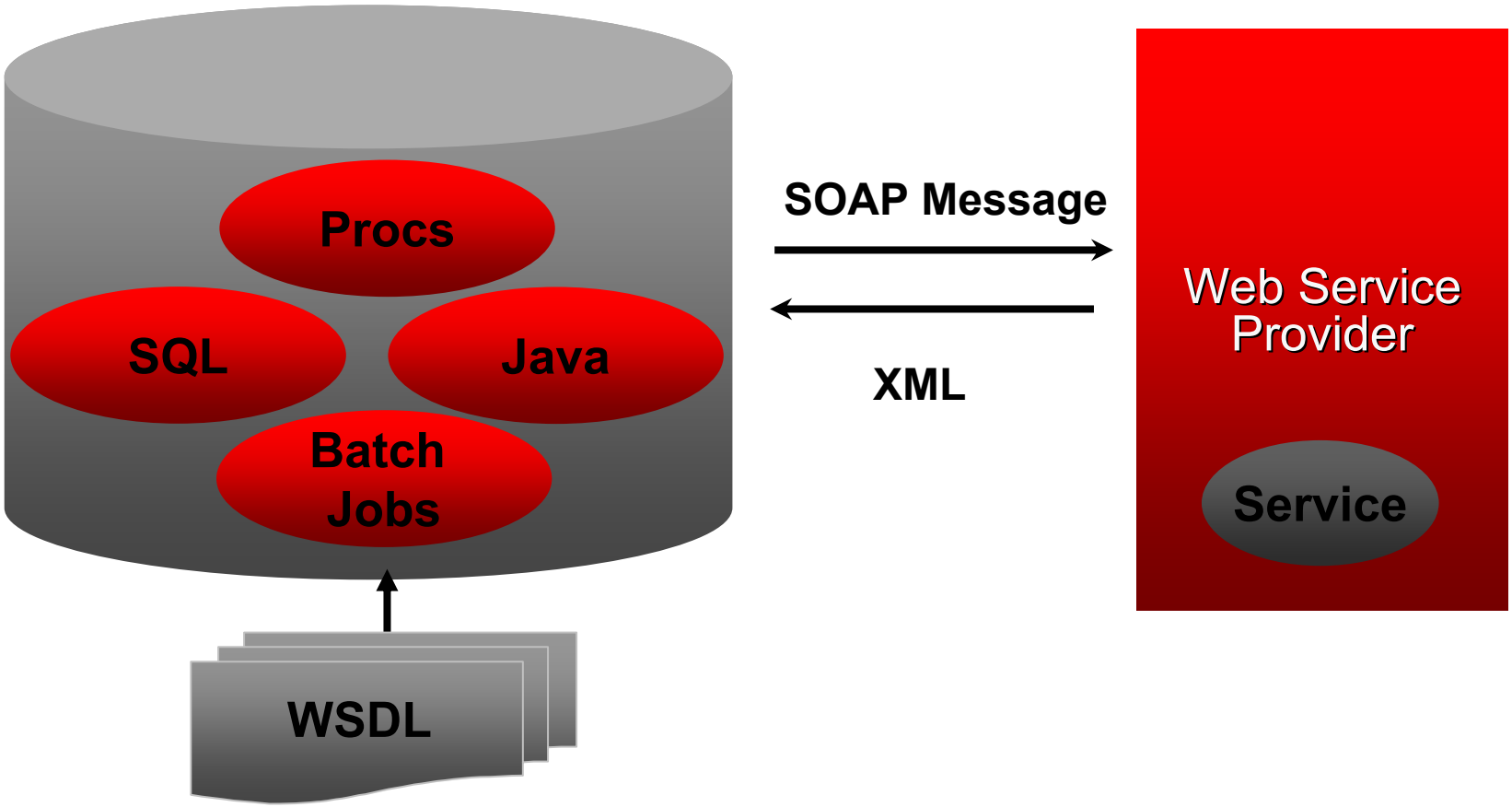
Database as Service Provider

- 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

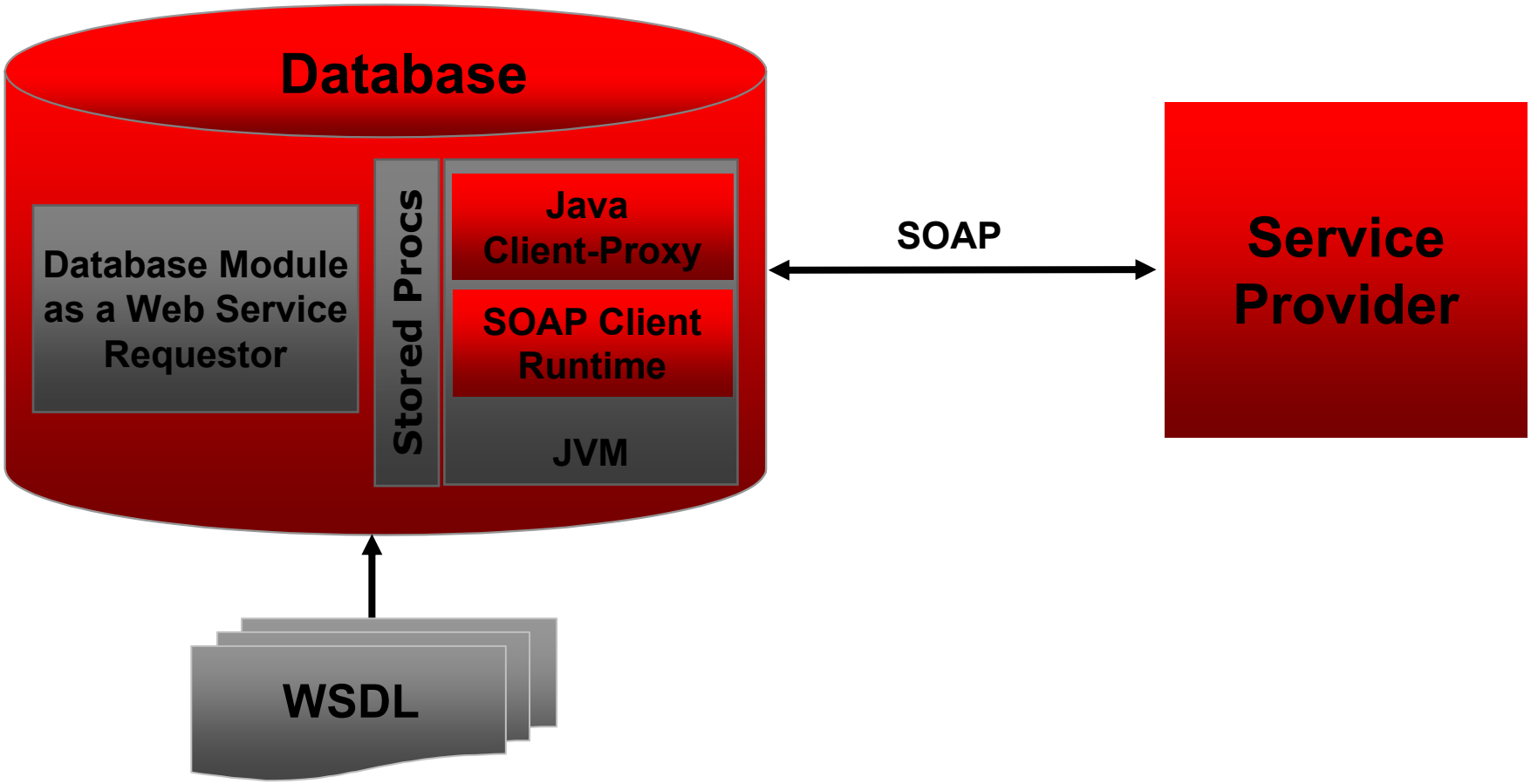
Service Provider Architecture

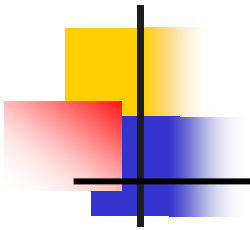


Motivations the Database as Web Services Consumer



Database as Service Consumer

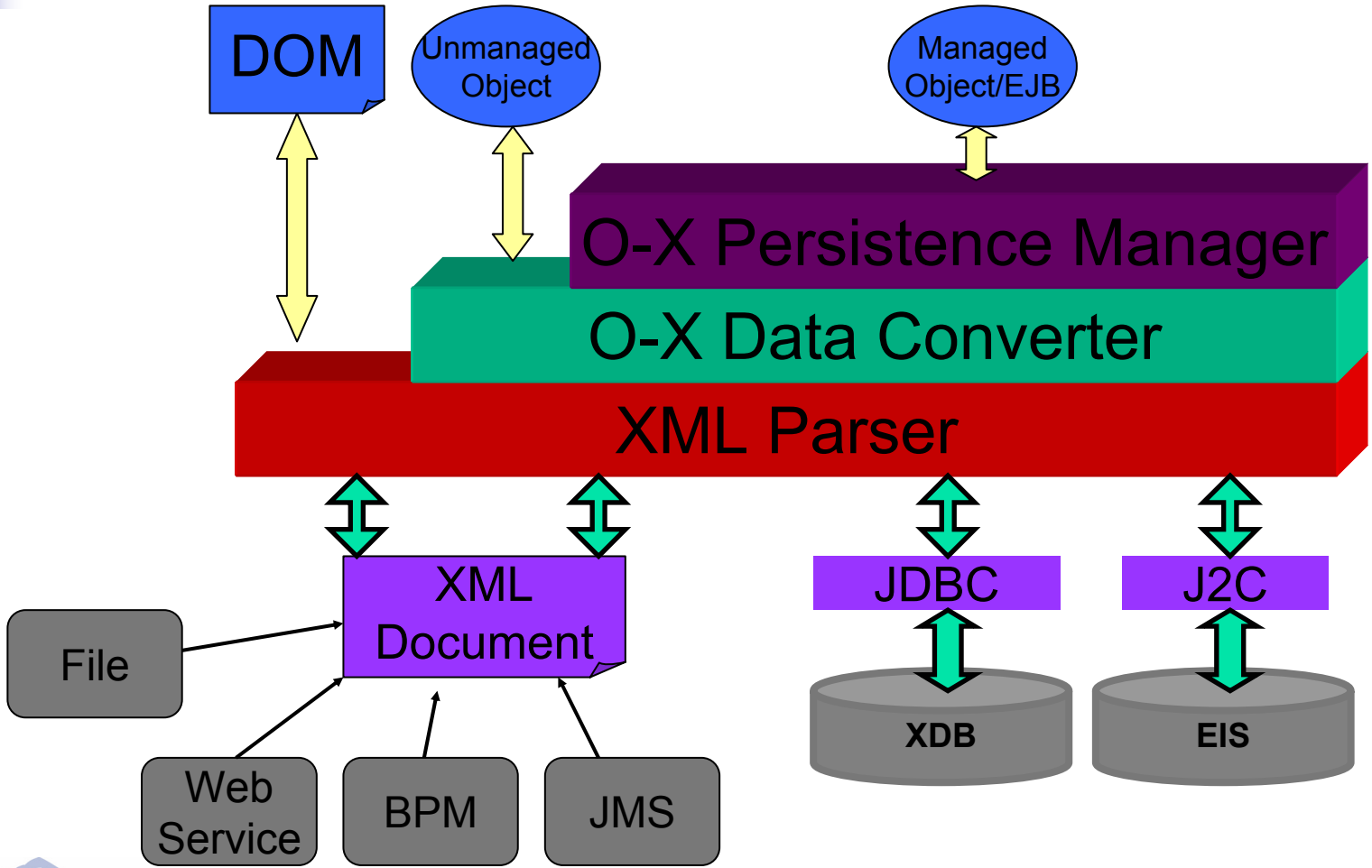




Importance of O-X

- 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…

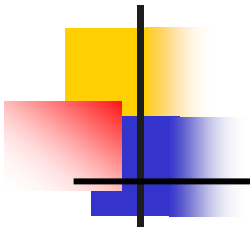
3 Levels of XML Representation



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

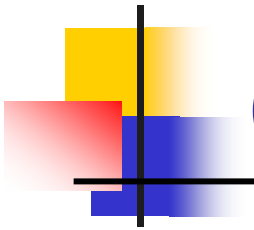


XML Parser Limitations

- 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

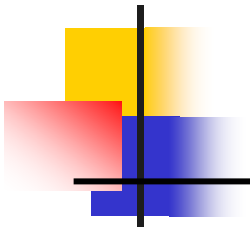


O-X Data Converter Limitations

- 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

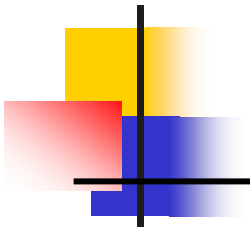
O-X Persistence Manager

- 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

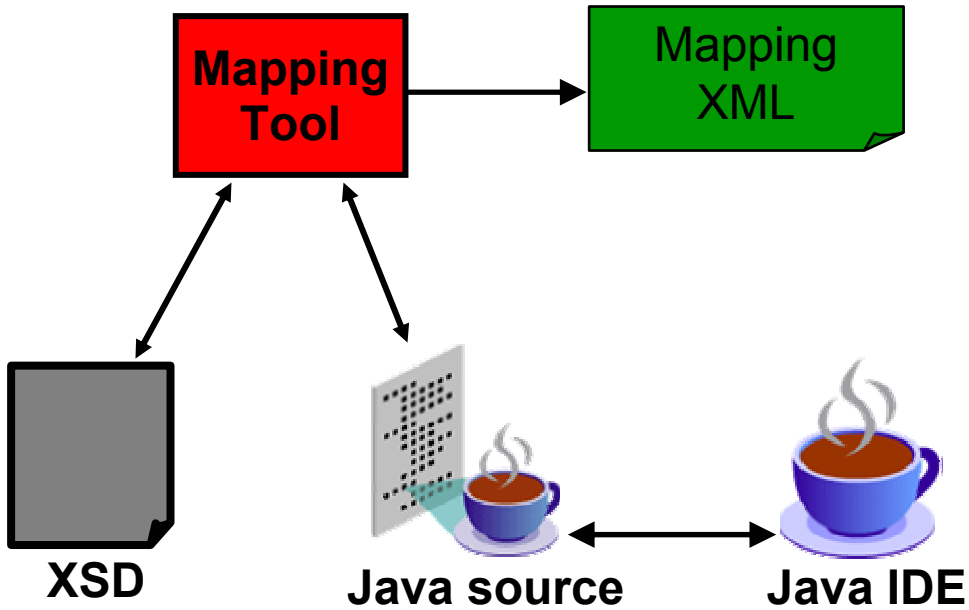


O-X Persistence Manager

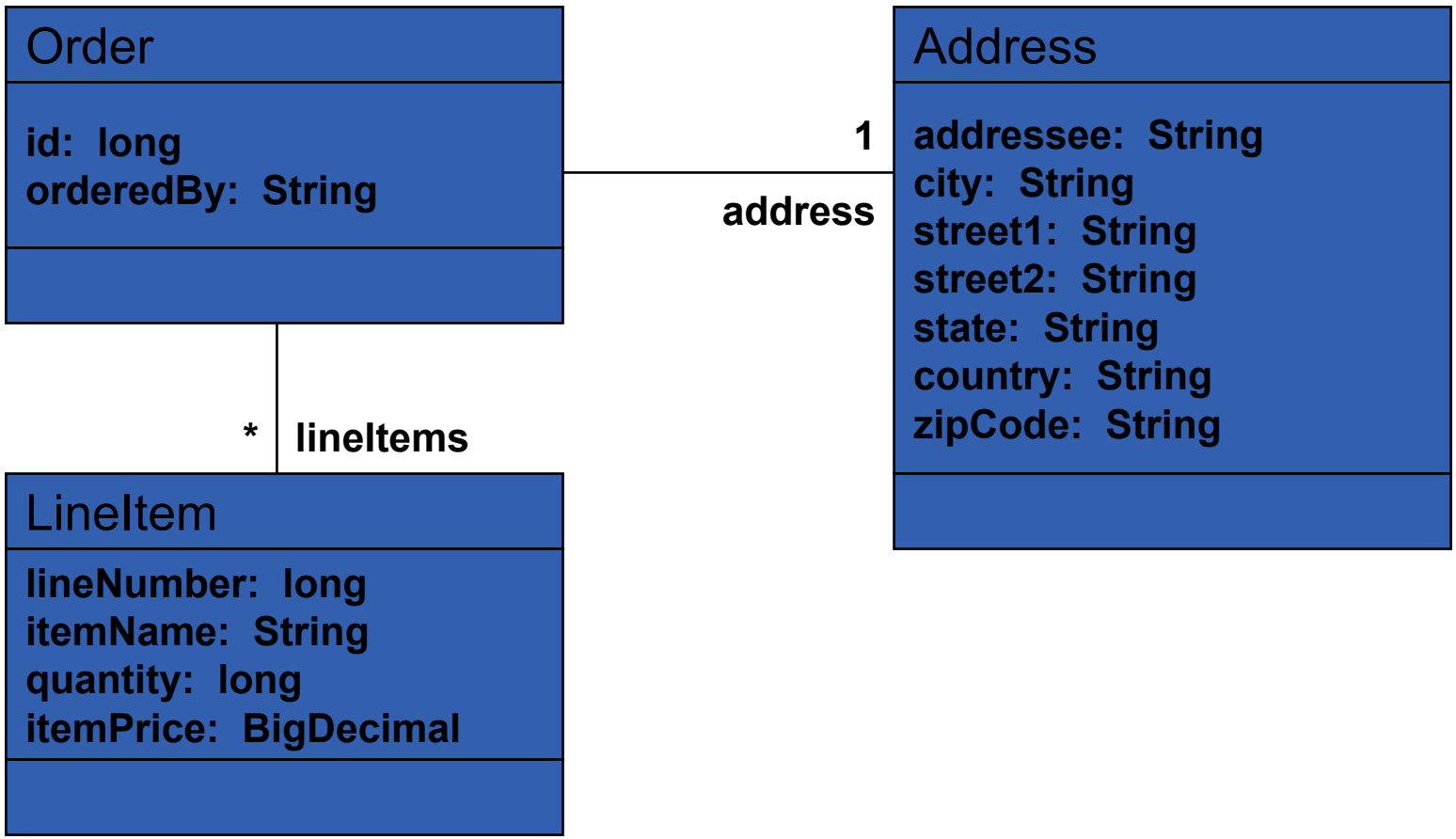
- Persistence manager functionality may be required for transactional XML data sources such as EIS systems, XML databases.
- Provides additional capabilities on top of data conversion such as:
  - Caching
  - Querying
  - Transactions
  - Concurrency
- Castor, Zeus, Quick, Jbind, XML Beans, TopLink,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

O-X Mapping

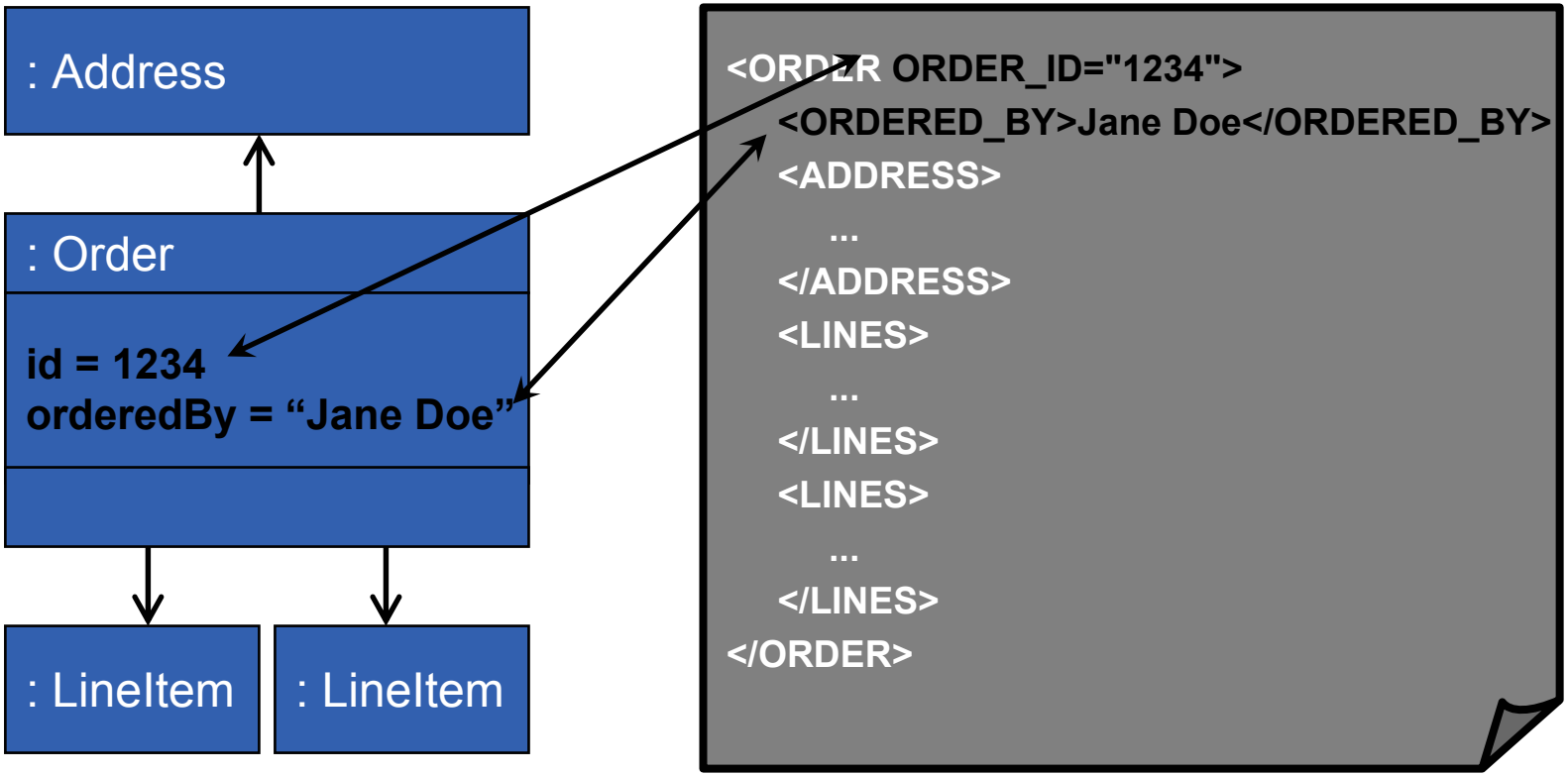
- Map Object Model to XSD
- Either code gen XSD from Object Model, *vice versa*, or "meet in the middle"



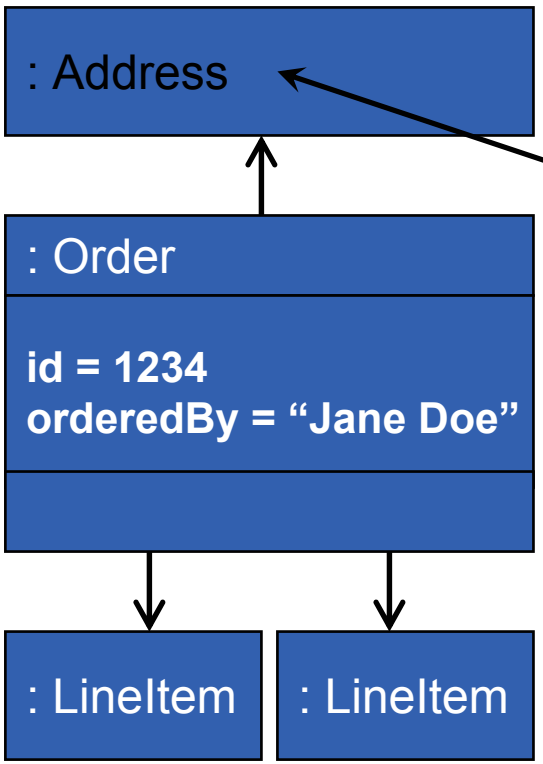
Example Object Model



Direct Mapping

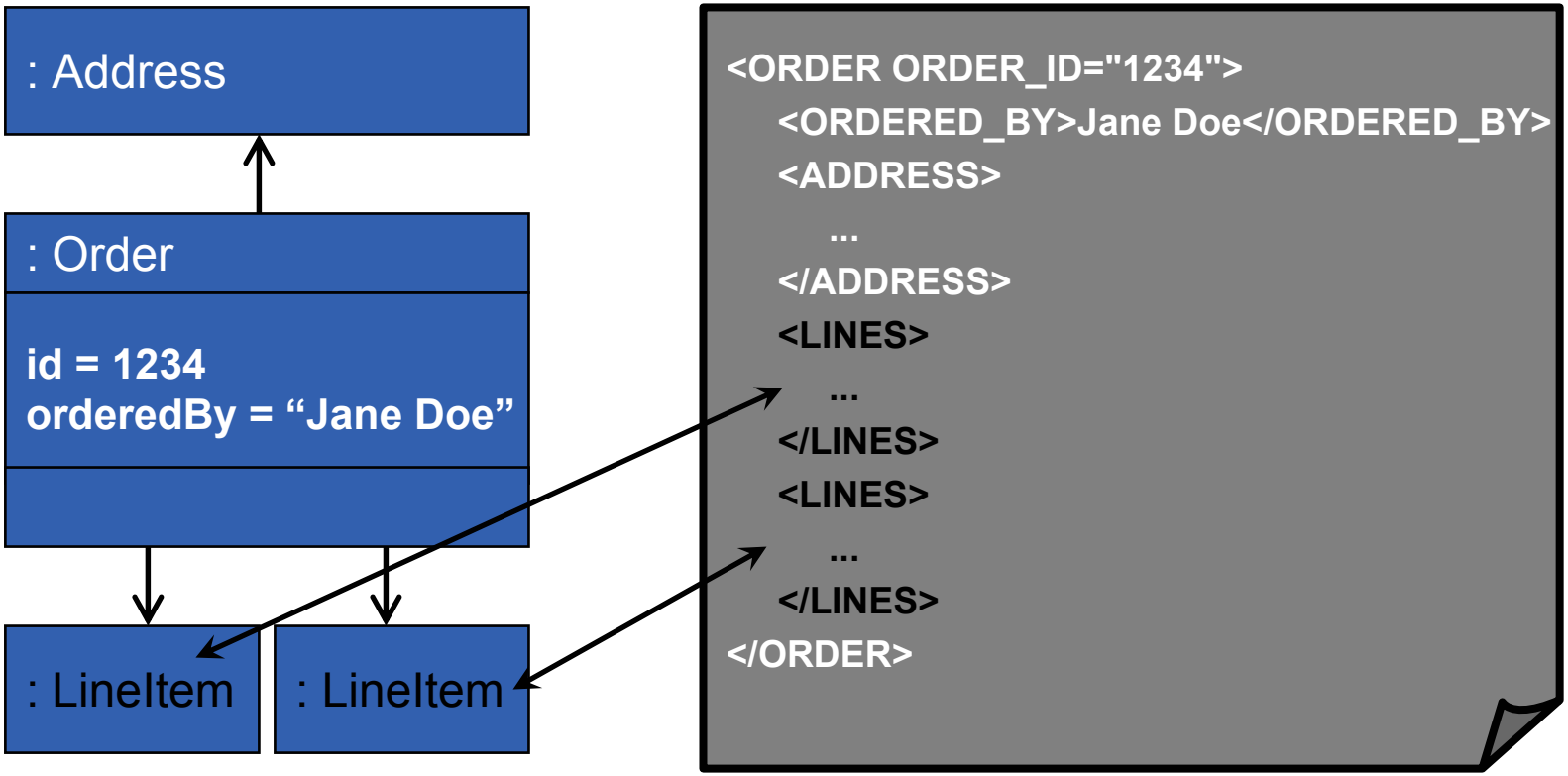


Composite Object Mapping



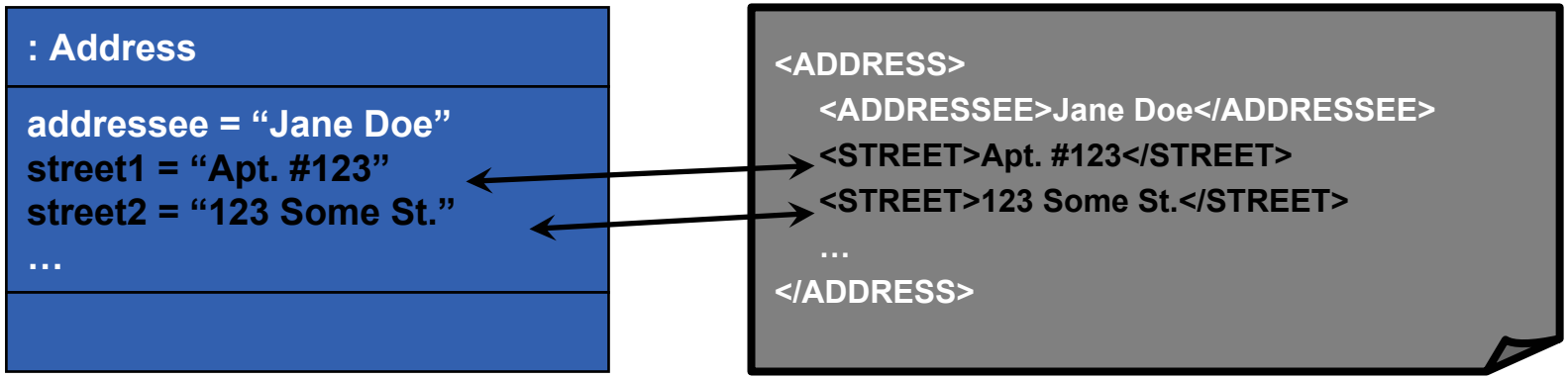

```
<ORDER ORDER_ID="1234">
    <ORDERED_BY>Jane Doe</ORDERED_BY>
    <ADDRESS>
        ...
    </ADDRESS>
    <LINES>
        ...
    </LINES>
    <LINES>
        ...
    </LINES>
</ORDER>
```

Composite Collection Mapping

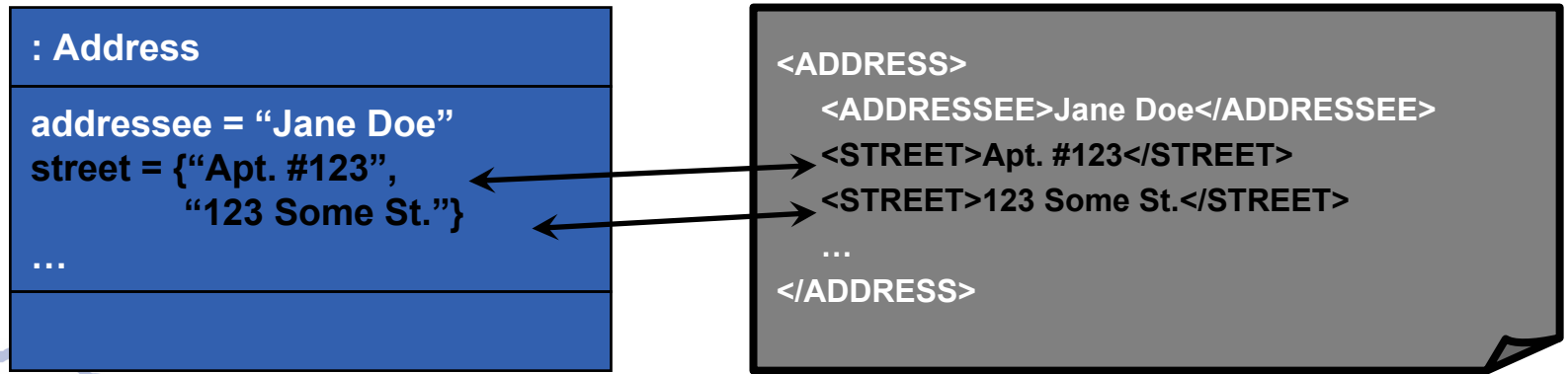


Positional Information

Good O-X Support

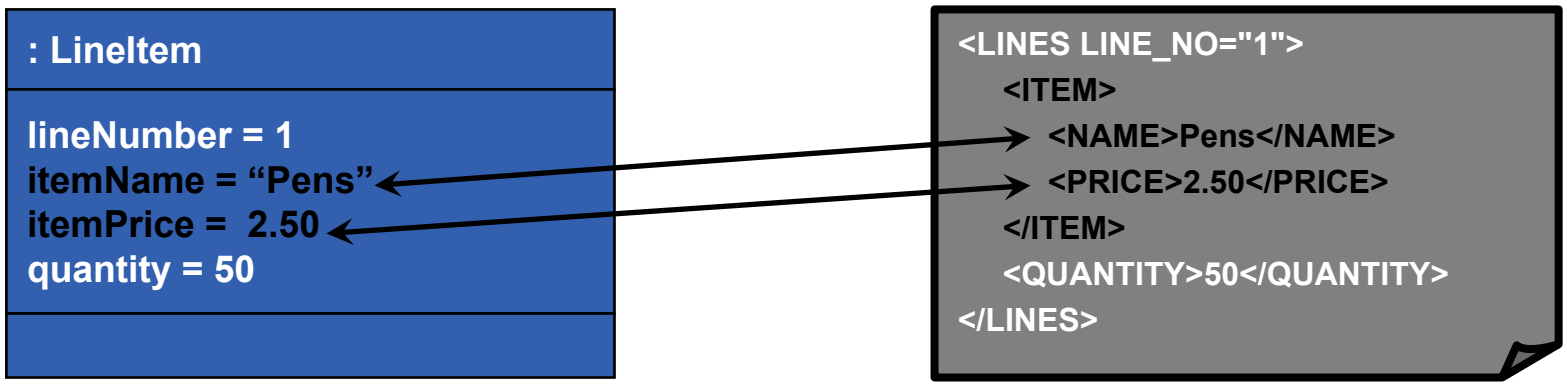


JAXB/Class Generation Today…

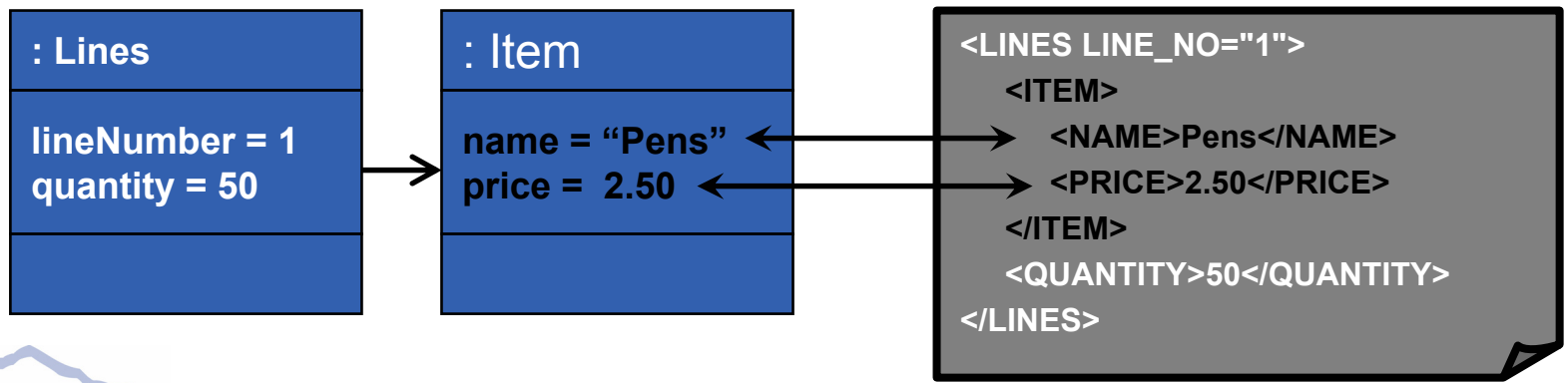


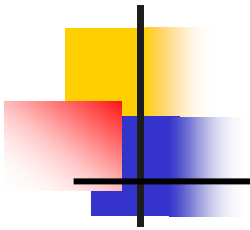
Path Information

Good O-X Mapping



JAXB/Class Generation Today…

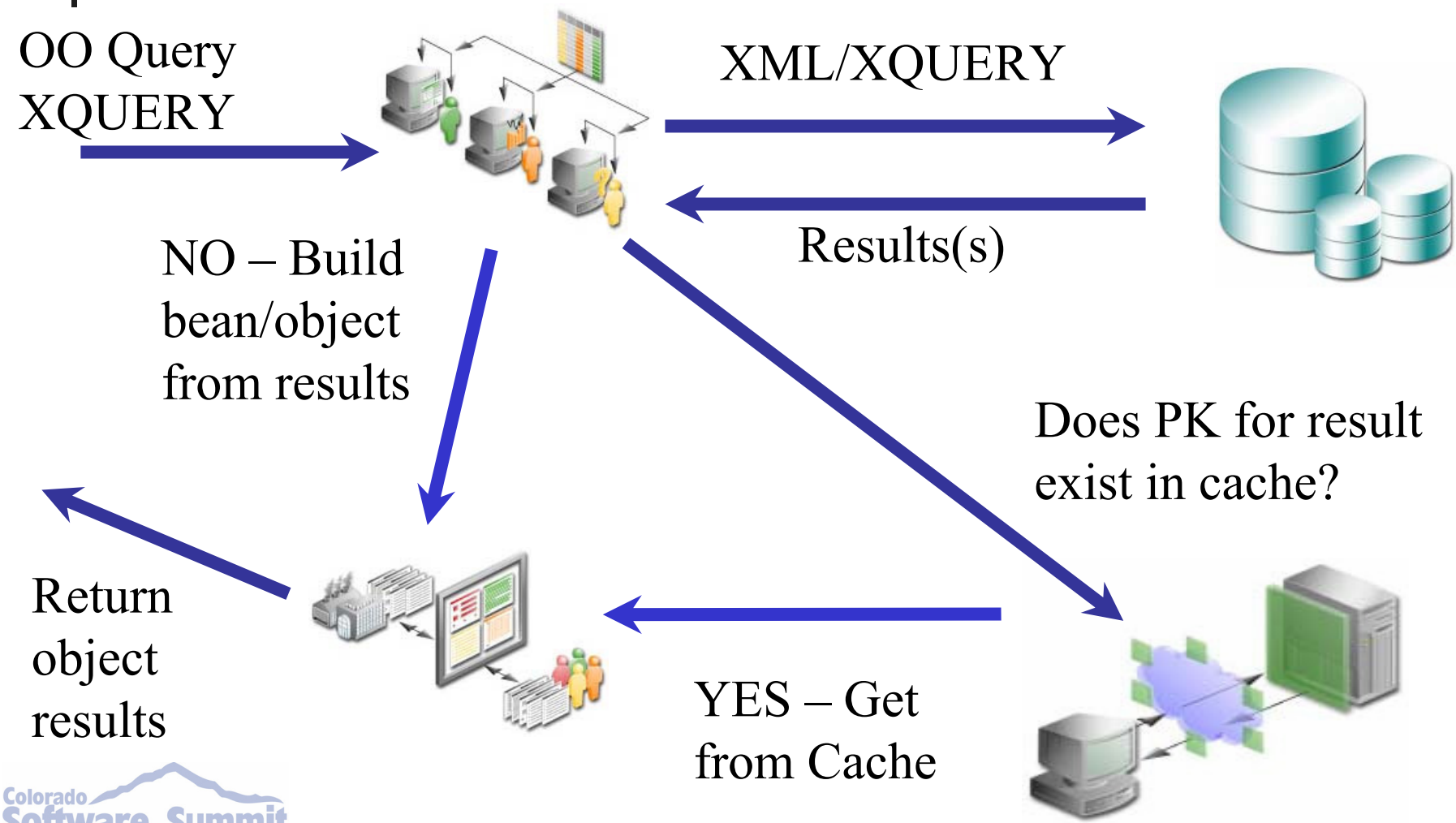




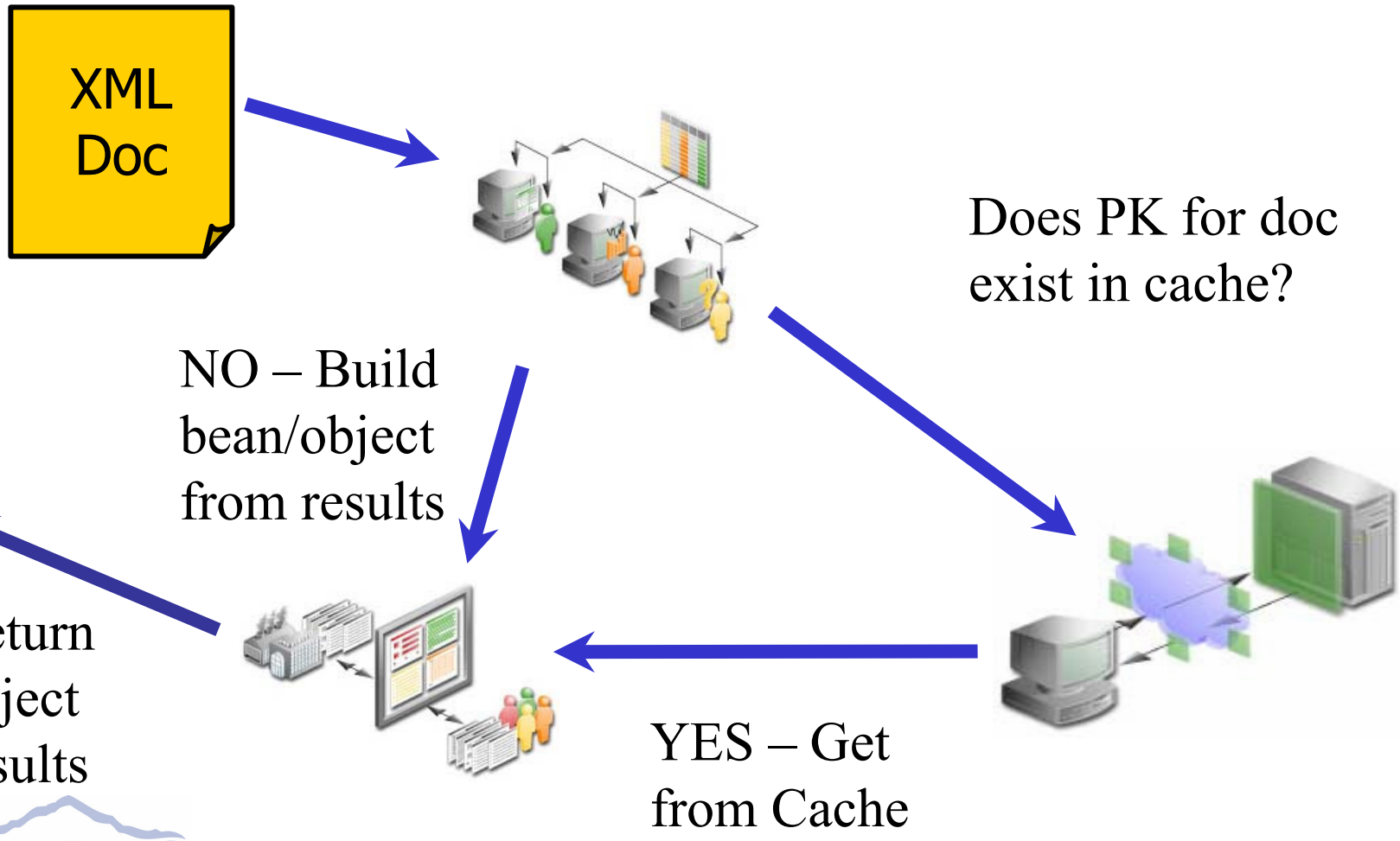
Caching

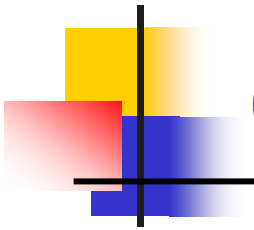
- Caching objects built from XML database no different than O-R caching
- Caching objects from XML documents is different!
  - Benefits
    - Minimize parsing
    - Reuse/share objects in read intensive apps
    - Potential for in-memory queries
  - Issues
    - PK, Versioning, Refreshing

Caching in an XDB



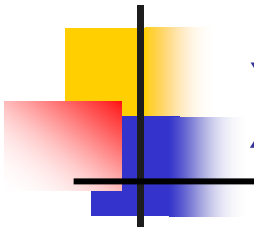
Caching without XDB





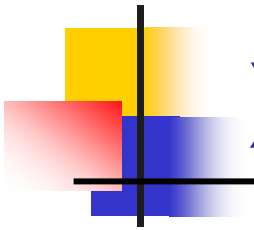
Querying

- 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



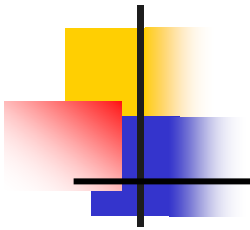
XQUERY

- 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



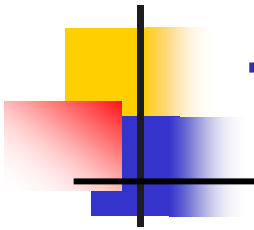
XQUERY Example

```
<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>
```



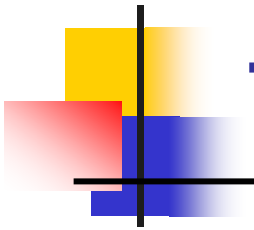
Querying Panacea

- 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?

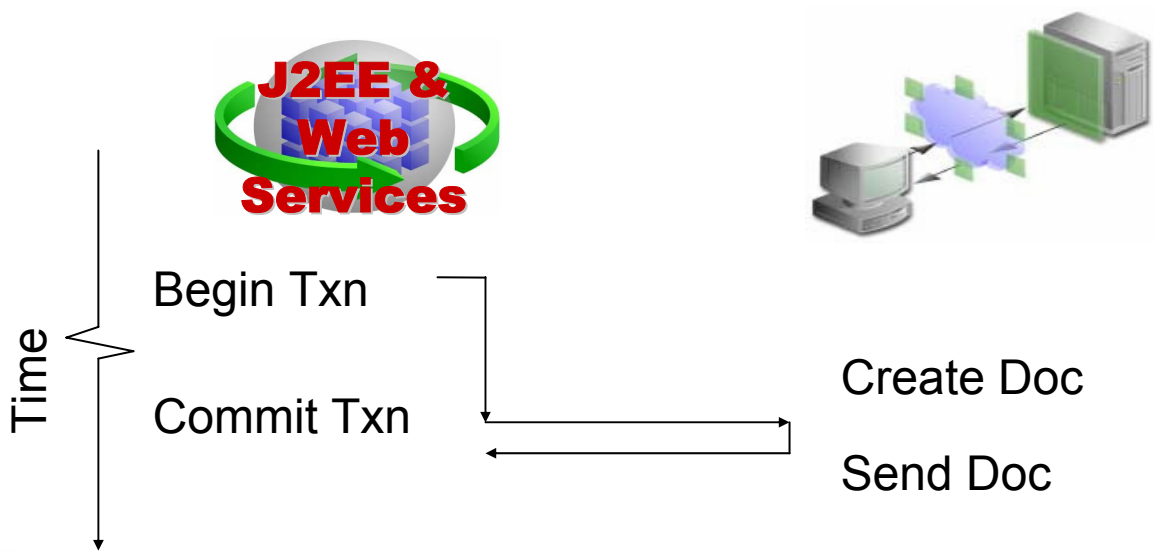


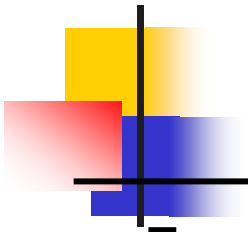
Transactions

- 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