Java Persistence: From NoSQL to HTML5

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About Me

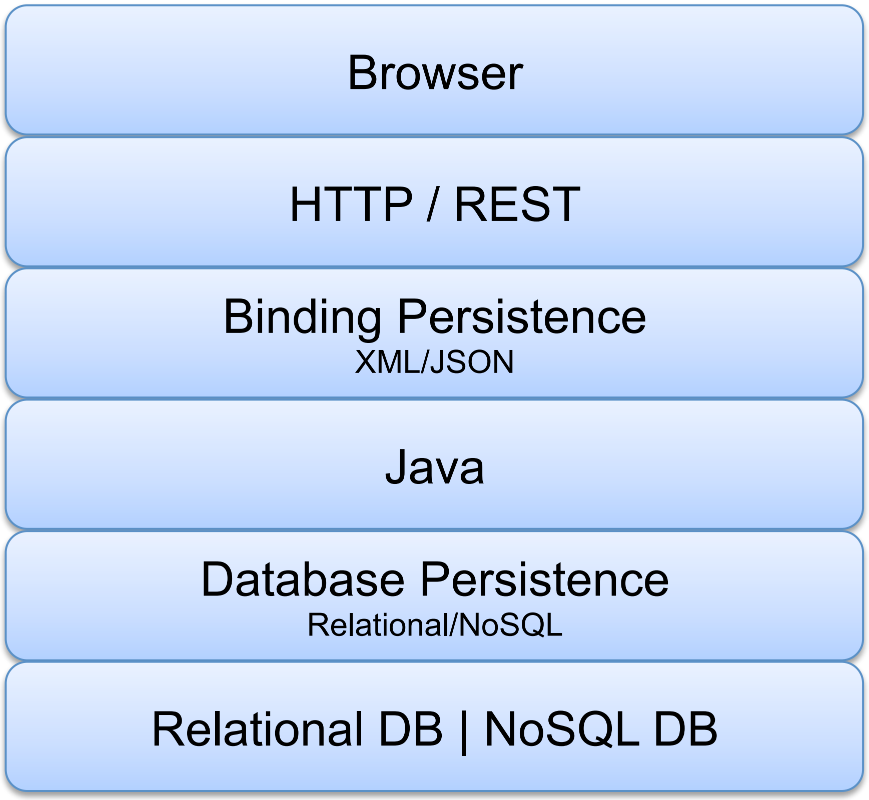
- Shaun Smith
  - Eclipse committer on EclipseLink and related projects
  - Oracle TopLink Product Manager
  - OO developer since 1987
    - “Old guy who knows Smalltalk” ;-)

EclipseLink Project

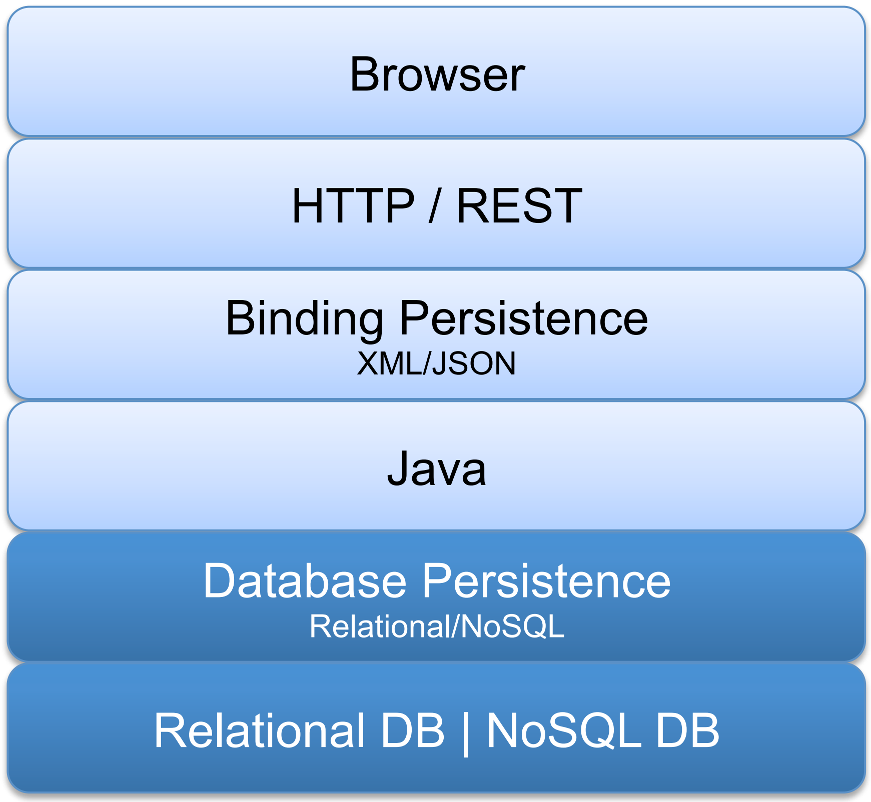
www.eclipse.org/eclipselink

- Object-Relational: Java Persistence API (JPA)
  - JPA 1.0 part of EJB 3.0 standard (JSR 220)
  - JPA 2.0 standardized in JSR 317
  - EclipseLink is *JPA 2.0 & 2.1 Reference Implementation*
- Object-XML/JSON: Java Architecture for XML Binding (JAXB)
  - JAXB 2.2 Certified Implementation

Agenda—Database to Browser (and back again)



Agenda


Browser
HTTP / REST
Binding Persistence
XML/JSON
Java
Database Persistence
Relational/NoSQL
Relational DB | NoSQL DB

NoSQL Databases

- EclipseLink is best known for relational persistence but…
- NoSQL databases are increasingly popular
- No common definition (document, graph, columnar)
  - Differing feature sets
  - Some offer query language/API—some not
- No standards
- Every database offers a unique API
  - Cost in terms of learning each database
  - Zero portability across databases

EclipseLink NoSQL

- Support JPA-style access to NoSQL databases
  - Leverage non-relational database support for JCA (and JDBC when available)
- Define annotations and XML to identify NoSQL stored entities (e.g., @NoSQL)
- Support JPQL subset for each
  - Key principal: leverage what’s available
- Initial support for MongoDB and Oracle NoSQL

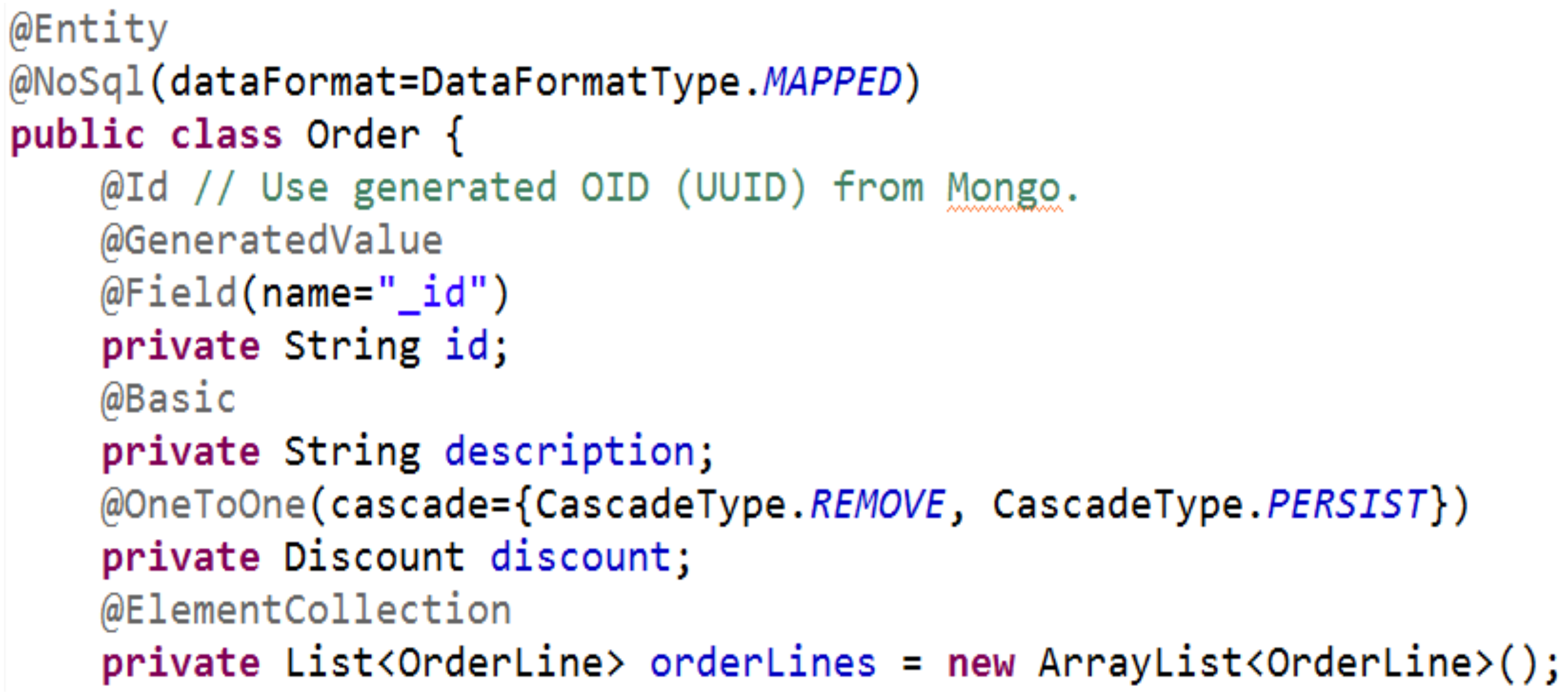
Applicability of JPA to NoSQL

- Core JPA concepts apply to NoSQL:
  - Persistent Entities, Embeddables, ElementCollection, OneToOne, OneToMany, ManyToOne, Version, etc.
- Some concepts apply with some databases:
  - JPQL, NamedNativeQuery
- Pure relational concepts don’t apply:
  - CollectionTable, Column, SecondaryTable, SequenceGenerator, TableGenerator, etc.

Querying NoSQL with JPA

- Two kinds of queries
  - JQPL—portable query language defined by the spec
  - Native query—lets you leverage database specific features
  - Dynamic or static @NamedQuery
- JPQL translated to underlying database query framework.

Example MongoDB Mapped Entity



```java
@Entity
@NoSql(dataFormat=DataFormatType.MAPPED)
public class Order {
    @Id // Use generated OID (UUID) from Mongo.
    @GeneratedValue
    @Field(name="_id")
    private String id;
    @Basic
    private String description;
    @OneToOne(cascade={CascadeType.REMOVE, CascadeType.PERSIST})
    private Discount discount;
    @ElementCollection
    private List<OrderLine> orderLines = new ArrayList<OrderLine>();
```

MongoDB Query Examples

- JPQL

```
Select o from Order o
  where o.totalCost > 1000
```

```
Select o from Order o
  join o.orderLines l where l.cost > :cost
```

- Native Queries

```
query = em.createNativeQuery(
  "db.ORDER.findOne({\"_id\":\"" +
  oid + "\"})", Order.class);
```

```
Order order =
  (Order) query.getSingleResult();
```

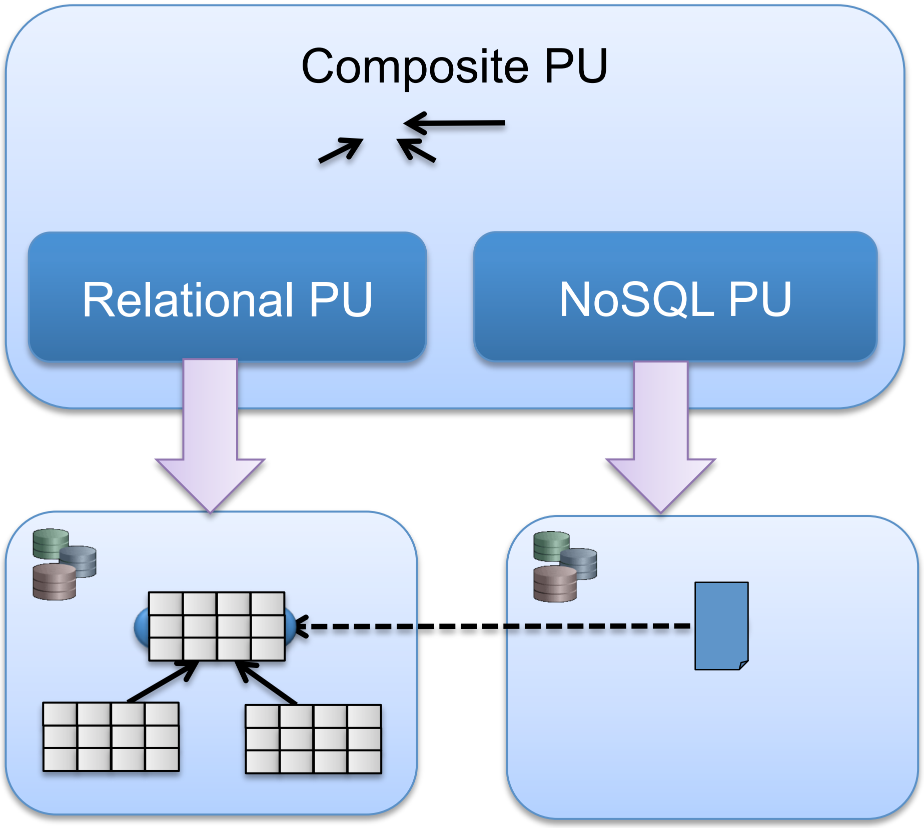
Demo EclipseLink NoSQL

"…we are gearing up for a shift to *polyglot persistence* - where any decent sized enterprise will have a variety of different data storage technologies for different kinds of data…we'll be first asking how we want to manipulate the data and only then figuring out what technology is the best bet for it.."

Martin Fowler

ThoughtWorks

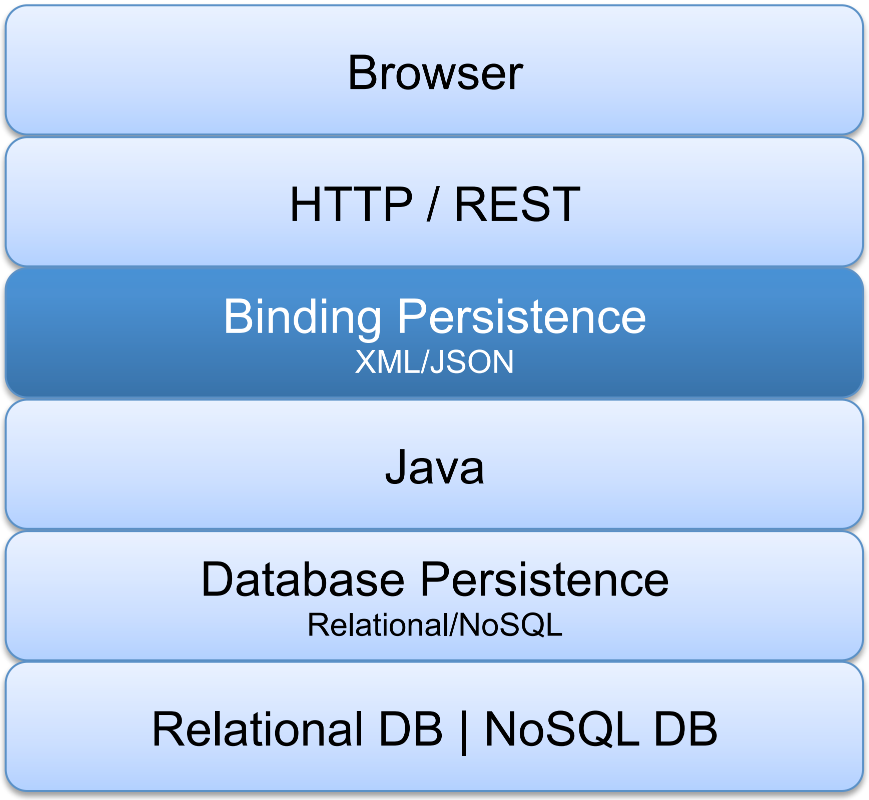
Composite Persistence Unit



Demo Polyglot Persistence

http:/git.eclipse.org/gitroot/eclipselink/examples.git/jpa/polyglot

Agenda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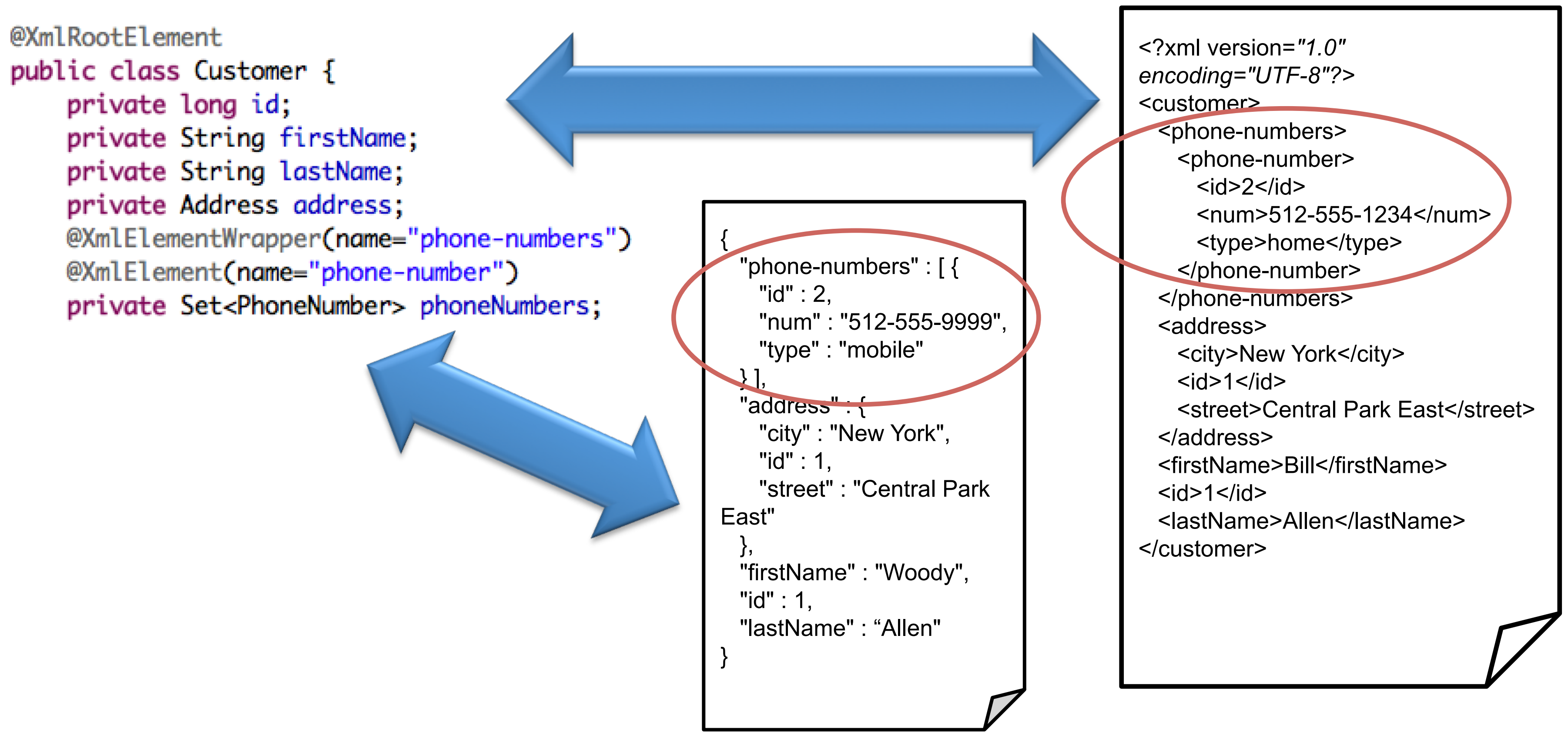
Binding Persistence

XML and JSON Binding

- EclipseLink implements
  - JAXB for Java/XML binding—covert Java to/from XML
  - Java/JSON binding—convert Java to/from JSON
- Currently no Java/JSON binding standard
  - Java API for JSON Processing (JSR 535) is parsing, not binding
- EclipseLink interprets JAXB XML bindings for JSON
  - Content-type selectable by setting property on Marshaller/Unmarshaller

XML and JSON from JAXB Mappings

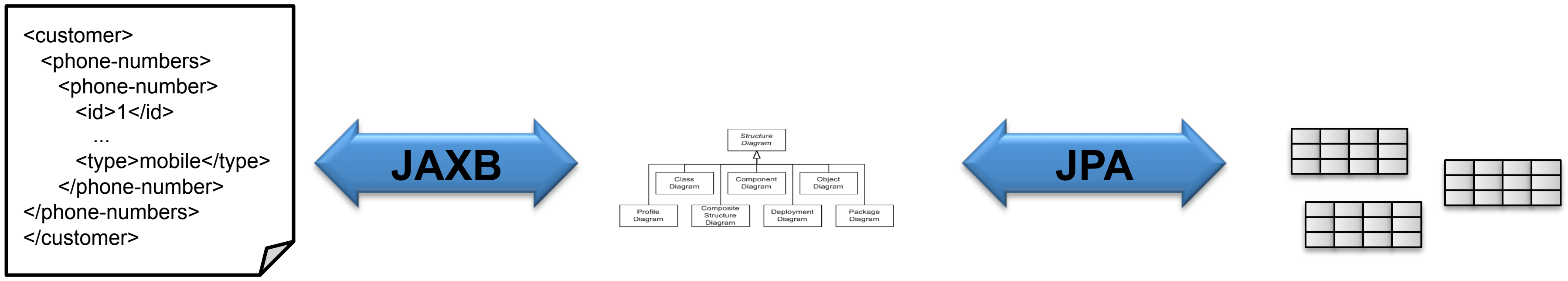


```java
@XmlRootElement
public class Customer {
    private long id;
    private String firstName;
    private String lastName;
    private Address address;
    @XmlElementWrapper(name="phone-numbers")
    @XmlElement(name="phone-number")
    private Set<PhoneNumber> phoneNumbers;
```

```
{
  "phone-numbers" : [ {
    "id" : 2,
    "num" : "512-555-9999",
    "type" : "mobile"
  } ],
  "address" : {
    "city" : "New York",
    "id" : 1,
    "street" : "Central Park
East"
  },
  "firstName" : "Woody",
  "id" : 1,
  "lastName" : “Allen"
}
```

```
<?xml version="1.0"
encoding="UTF-8"?>
<customer>
  <phone-numbers>
    <phone-number>
      <id>2</id>
      <num>512-555-1234</num>
      <type>home</type>
    </phone-number>
  </phone-numbers>
  <address>
    <city>New York</city>
    <id>1</id>
    <street>Central Park East</street>
  </address>
  <firstName>Bill</firstName>
  <id>1</id>
  <lastName>Allen</lastName>
</customer>
```

Challenges – Binding JPA Entities to XML/JSON



```
<customer>
  <phone-numbers>
    <phone-number>
      <id>1</id>
        ...
      <type>mobile</type>
    </phone-number>
</phone-numbers>
</customer>
```

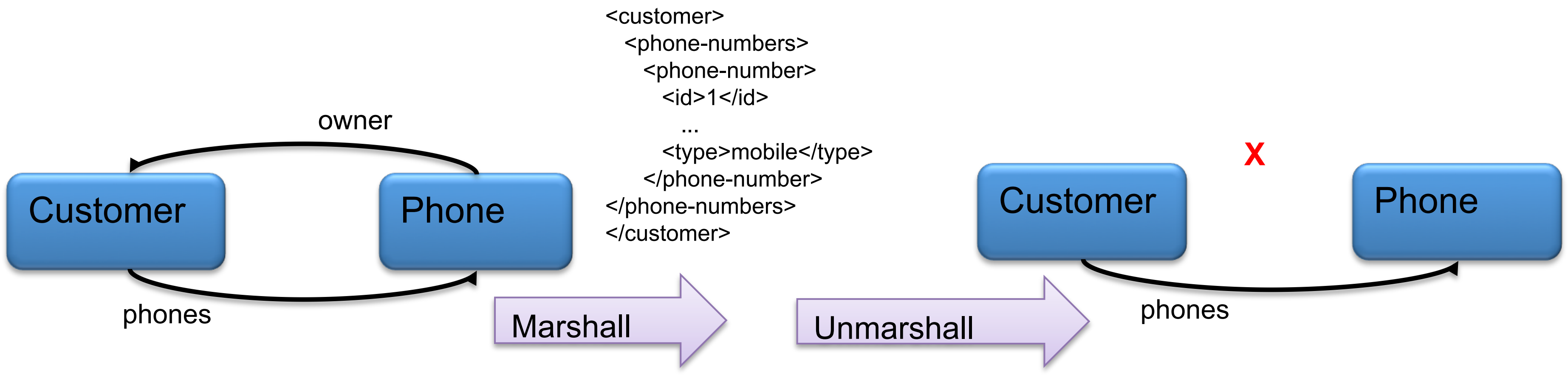
- Bidirectional/Cyclical Relationships
- Composite Keys/Embedded Key Classes
- Byte Code Weaving

Bidirectional Relationship

```
@Entity
public class Customer{
   ...
   @OneToMany(mappedBy="owner")
   private List<Phone> phones;
}
@Entity
public class Phone{
   ...
   @ManyToOne
   private Customer owner;
}
```

Bidirectional Relationships in JAXB

- JAXB specification does not support bidirectional relationships. One side must be marked `@XmlTransient`.
- But that loses the relationship!



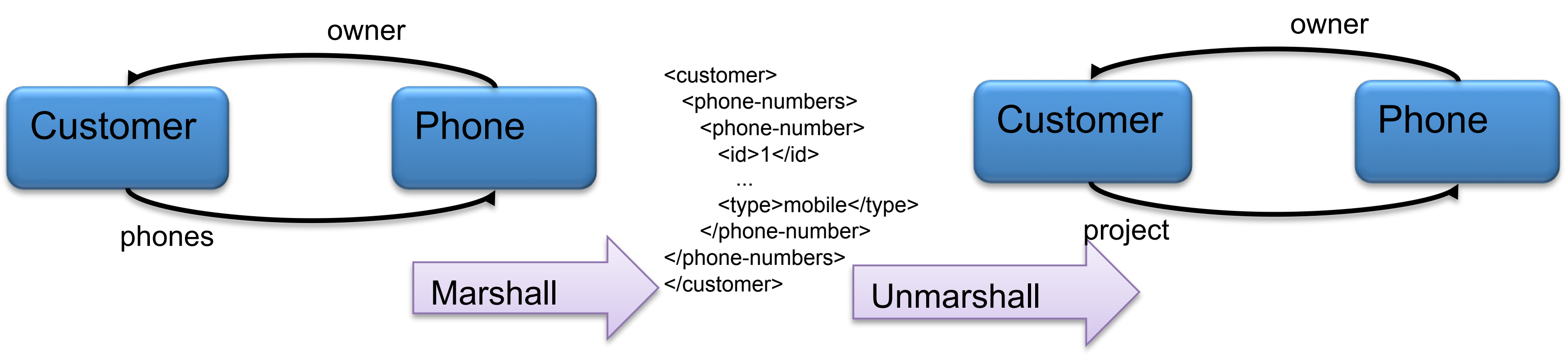
```
<customer>
  <phone-numbers>
    <phone-number>
      <id>1</id>
        ...
      <type>mobile</type>
    </phone-number>
</phone-numbers>
</customer>
```

EclipseLink XmlInverseReference

```
@Entity
public class Customer{
   ...
   @OneToMany(mappedBy="owner")
   private List<Phone> phones;
}
@Entity
public class Phone{
   ...
   @ManyToOne
   @XmlInverseReference(mappedBy="phones")
   private Customer owner;
}
```

EclipseLink XmlInverseReference

- EclipseLink restores relationships on unmarshall!



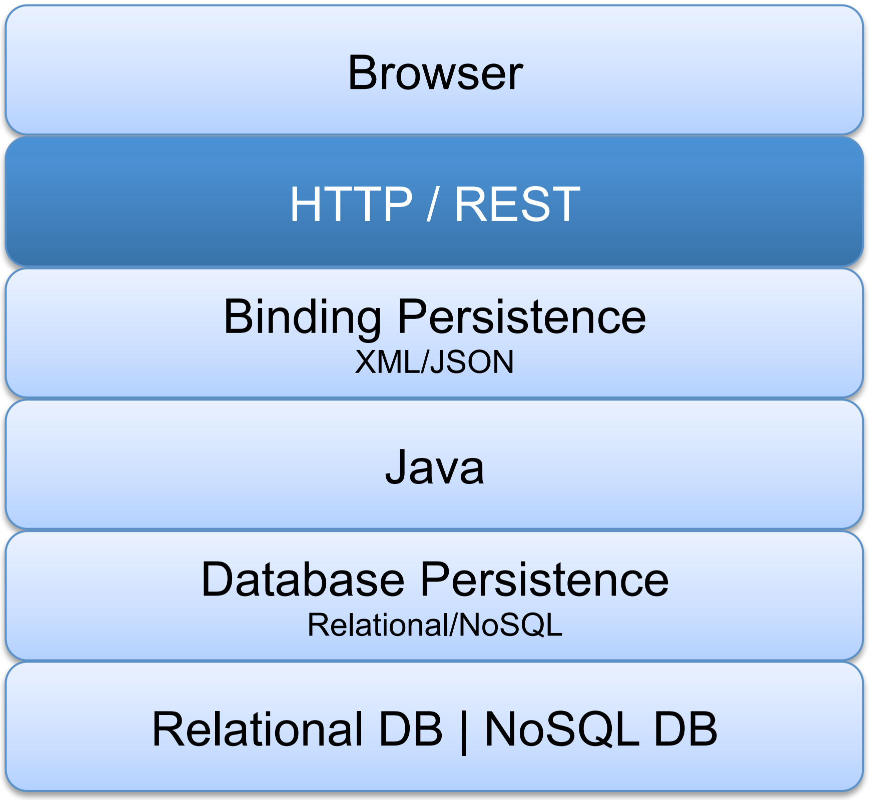
```xml
<customer>
  <phone-numbers>
    <phone-number>
      <id>1</id>
        ...
      <type>mobile</type>
    </phone-number>
</phone-numbers>
</customer>
```

Demo

JAXB/JPA Fidelity
JSON Binding

http:/git.eclipse.org/gitroot/eclipselink/examples.git/jpa-moxy/jpa-moxy.simple

Agenda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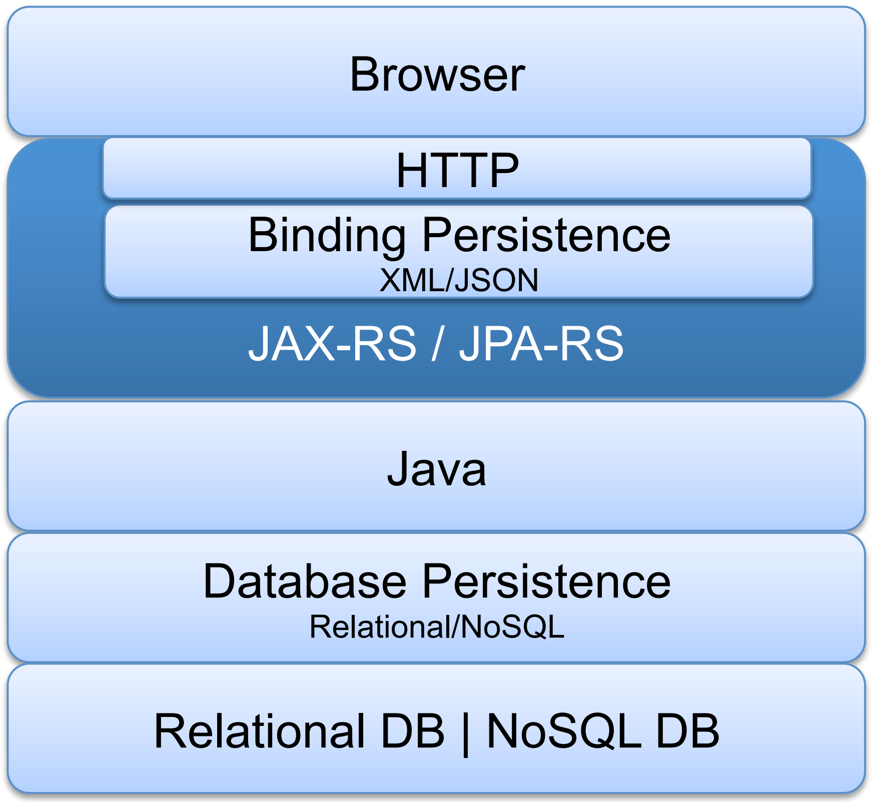
JPA-RS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XML/JSON
JAX-RS / JPA-RS
Java
Database Persistence
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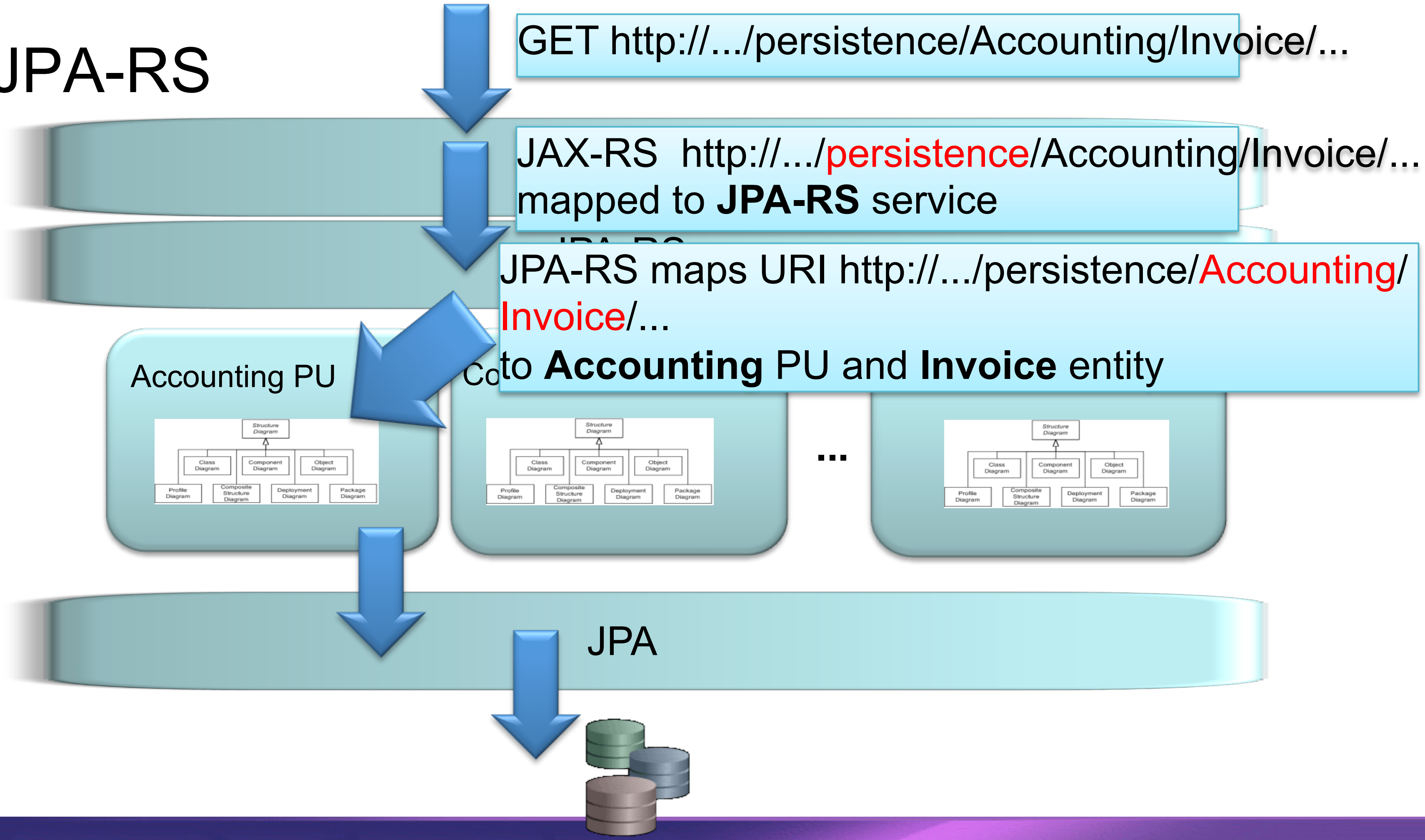
Relational DB | NoSQL DB

Example: GET Entity with JAX-RS

```
@Path("/invoice")
@Stateless
public class InvoiceService {...
  @GET
  @Path("{id}")
  @Produces({"application/xml", "application/json"})
  public Invoice read(@PathParam("id") int id) {
     return entityManager.find(Invoice.class, id);
  }
...
```

GET http://[*machine*]:[*port*]/[*web-context*]/invoice/4

JPA-RS


GET http://.../persistence/Accounting/Invoice/...

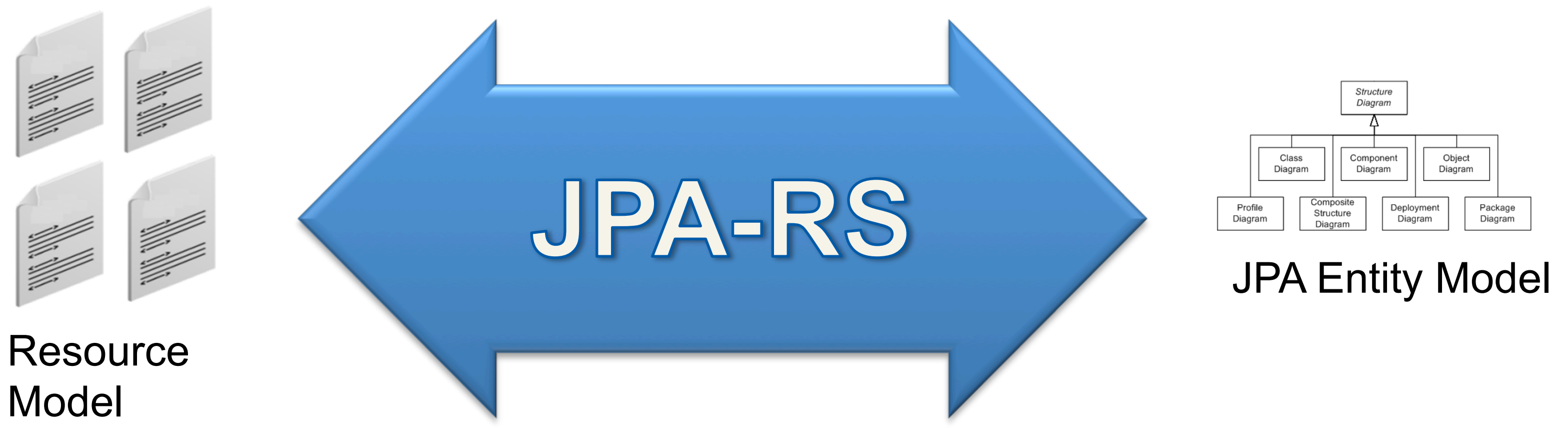
JAX-RS http://.../persistence/Accounting/Invoice/...
mapped to **JPA-RS** service

JPA-RS maps URI http://.../persistence/Accounting/Invoice/...
to **Accounting** PU and **Invoice** entity

JPA-RS Features

- Access relational data through REST with JSON or XML
- Provides REST operations for entities in persistence unit (GET, PUT, POST, DELETE)
- Automatic generation of XML and JSON bindings
- Supports invocation of named queries via HTTP
- Server Caching—EclipseLink clustered cache
- Dynamic Persistence also supported
  - **Entities defined via metadata—no Java classes required**
  - Enables persistence services for HTML 5/JavaScript applications

Resource Model



Resource Model & Links

```
{
   "firstName": "Frank",
   "gender": "Male",
   "id": 1,
   "lastName": "Smith",
   "responsibilities": [],
   "salary": 1,
   "version": 13,
   "address": {
      "_link": {
         "href": "http://localhost:7001/employee.web-js/persistence/employee/entity/Address/18",
         "method": "GET",
         "rel": "self"
      }
   },
…
```

Demo EclipseLink JPA-RS

http:/git.eclipse.org/gitroot/eclipselink/examples.git/jpa/employee

TopLink Data Services

Adding Push Notification to JPA-RS

- Provides Data Change Notification API
  - Supports use of
    - WebSockets
    - Server Sent Events
    - JMS
    - …
- Leverages Oracle QCN/DCN (Query/Data Change Notification)

Demo TopLink Data Services

Summary

- Java application needs are changing—and EclipseLink is evolving too!
- Support for NoSQL and Polyglot Persistence
- Support for building apps that go from ***Database to Browser***
  - JSON Binding
  - JAXB/JPA Fidelity
  - JPA-RS automating RESTful persistence service
- EclipseLink JPA-RS simplifies Java EE 7 HTML5/Thin Server Architecture applications
- TopLink Data Services adds push notification to JPA-RS