Data Binding Unleashed for Composite Applications

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Agenda

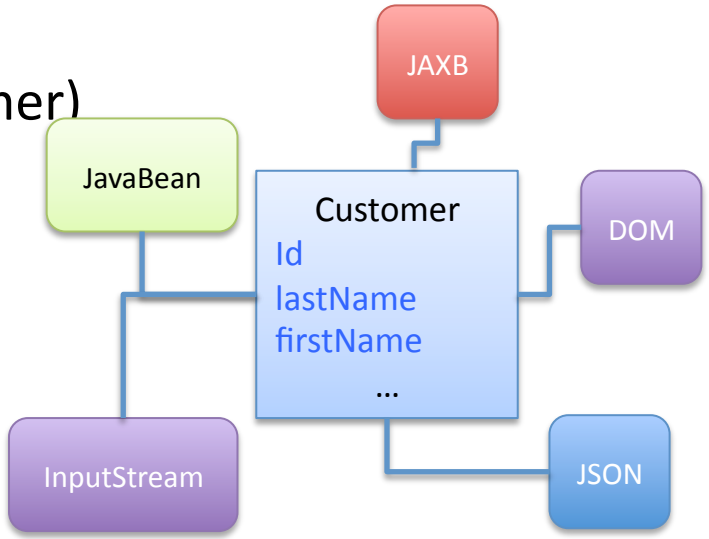
- Introduction
  - Data binding
  - SCA Composite application
  - Apache Tuscany project
- Data bindings in a composite application
- Tuscany data binding framework
- Extending Tuscany data binding framework

Introduction

Understanding the concepts: Data binding and SCA composite application

What's a data binding?

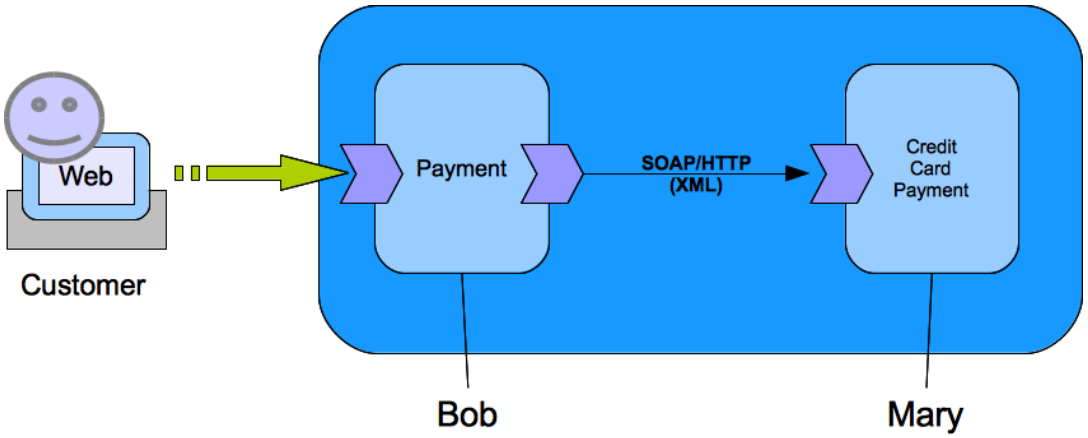
- A data binding (in this talk) denotes how business data are represented in memory as Java objects.
- For example, we can represent a customer as:
  - JavaBean (customer.Customer)
  - JAXB (customer.Customer)
  - SDO (DataObject or customer.Customer)
  - StAX XMLStreamReader
  - DOM Node (org.w3c.dom.Node)
  - XML String/byte[]/InputStream
  - JSON String/byte[]/InputStream
  - org.json.JSONObject
  - …



- The same information with different representations

SCA composite application

- SCA (Service Component Architecture, being standardized at OASIS)
  - Composite (a collection of collaborating components)
    - Component (encapsulation of reusable business logic)
      - Implementation (the code/script)
      - Service (the function it provides)
        - » Interface
        - » Binding (how is the service exposed)
      - Reference (the function it consumes)
        - » Interface
        - » Binding (how is the service accessed)



What is Apache Tuscany?

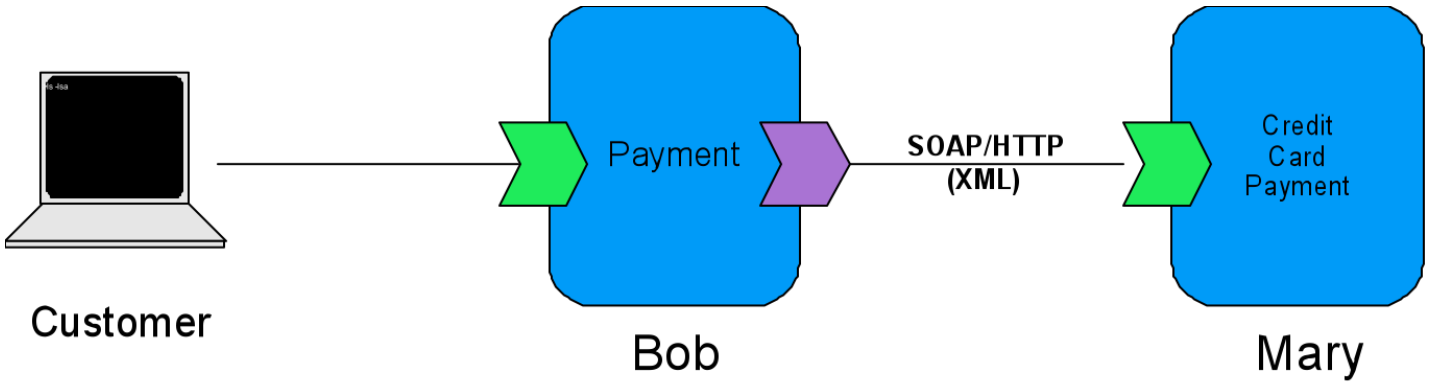
- Apache Tuscany (http://tuscany.apache.org) implements Service Component Architecture (SCA) standard. With SCA as it's foundation, Tuscany offers solution developers the following advantages:
  - Provides a model for creating composite applications by defining the services in the fabric and their relationships with one another. The services can be implemented in any technology.
  - Enables service developers to create reusable services that only contain business logic. Protocols are pushed out of business logic and are handled through pluggable bindings. This lowers development cost.
  - Applications can easily adapt to infrastructure changes without recoding since protocols are handled via pluggable bindings and quality of services (transaction, security) are handled declaratively.
  - Existing applications can work with new SCA compositions. This allows for incremental growth towards a more flexible architecture, outsourcing or providing services to others.

Data bindings in a composite application

Modeling, representing and flowing data across components and protocols

A simple scenario

- Two SCA components: Payment and CreditCardPayment (Payment calls CreditCardPayment to authorize credit card charges)
- Two developers: Bob and Mary
- Payment communicates with CreditCardPayment using SOAP/HTTP web service
- The Payment component will be exposed as a JSON-RPC service



The SCA composite file

```
<composite xmlns="http://docs.oasis-open.org/ns/opencsa/sca/200912"
        xmlns:tuscany="http://tuscany.apache.org/xmlns/sca/1.1"
        targetNamespace="http://tuscanyscatours.com/" name="Store">

   <component name="Payment">
      <implementation.java class="com.tuscanyscatours.payment.impl.PaymentImpl" />
      <service name="Payment">
         <tuscany:binding.jsonrpc uri="http://localhost:8080/Payment" />
      </service>
        <reference name="creditCardPayment">
         <binding.ws uri="http://localhost:8080/CreditCardPayment" />
      </reference>
</component>

   <component name="CreditCardPayment">
      <implementation.java class="com.tuscanyscatours.payment.creditcard.impl.CreditCardPaymentImpl" />
      <service name="CreditCardPayment">
        <binding.ws uri="http://localhost:8080/CreditCardPayment" />
      </service>
   </component>

</composite>
```

Interface and data modeling

- Bob and Mary first agree on what data needs to be exchanged between the two components
- The agreement is then described as an interface (which in turn references the data types)
  - The interface becomes the key contract between the SCA reference and service that are wired together
  - The interfaces can be described using different IDLs such as WSDL (w/ XSD) or Java interface
  - Interface compatibility
- Things to consider: efficiency, simplicity, remotablity and interoperability.

Sample interfaces

JAX-WS w/ JAXB (annotations omitted…):

```
public interface CreditCardPayment {
    String authorize(JAXBCreditCardDetailsType creditCard,  float amount);
}
```

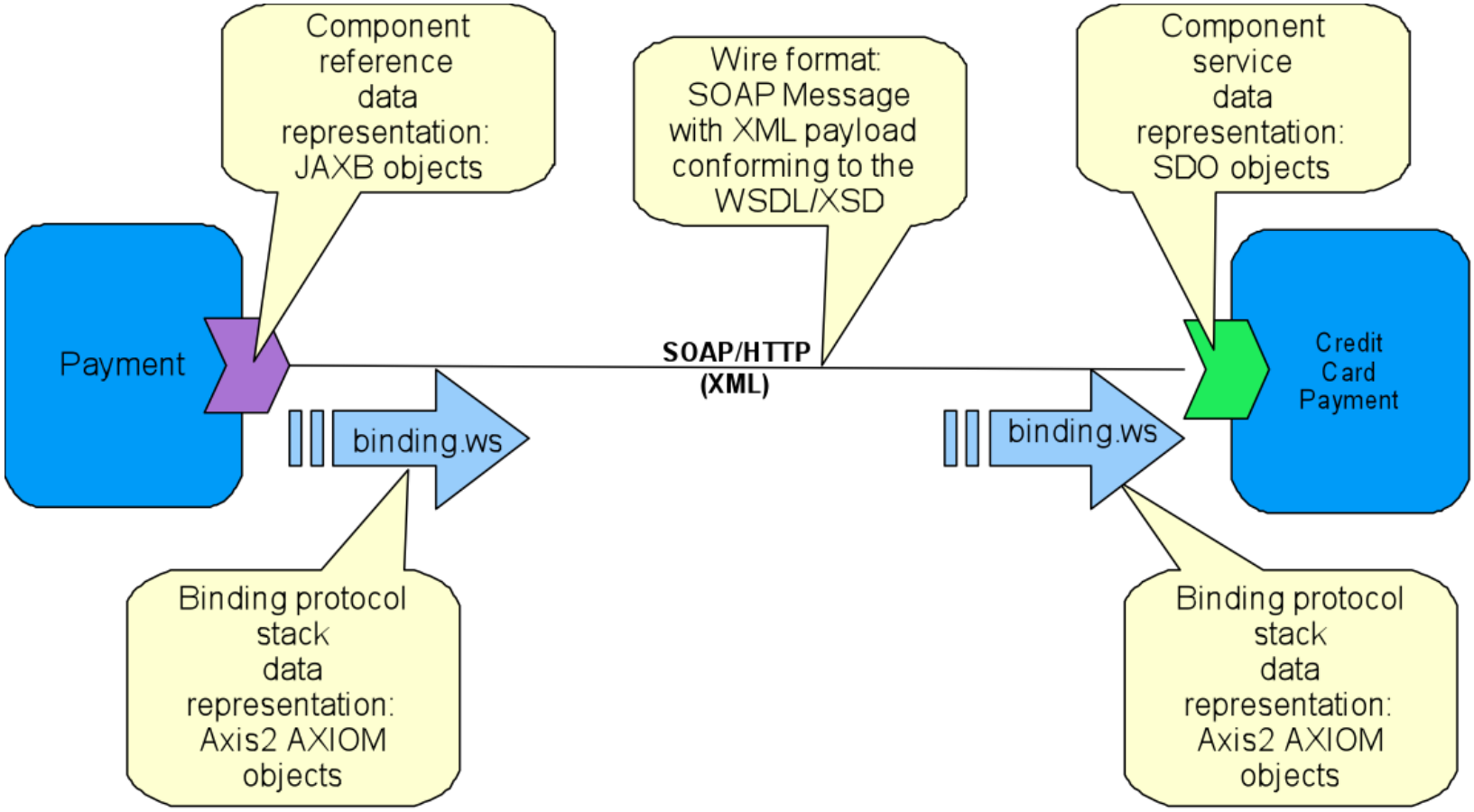
SDO:

```
public interface CreditCardPayment {
    String authorize(SDOCreditCardDetailsType creditCard,  float amount);
}
```

How are data represented in a composite application?

- Component implementations
  - Business logic needs to consume/produce data in a representation it supports
    - Handling incoming service calls
    - Calling other services
    - Receiving property values
  - Certain implementation containers impose the data representations (such as DOM for Apache ODE BPEL)
- Protocol stacks behind the bindings
  - Protocol stacks need to marshal/unmarshal data
    - Internal data representation
    - Wire format (XML, JSON, binary, etc)

Data representations between two components at runtime

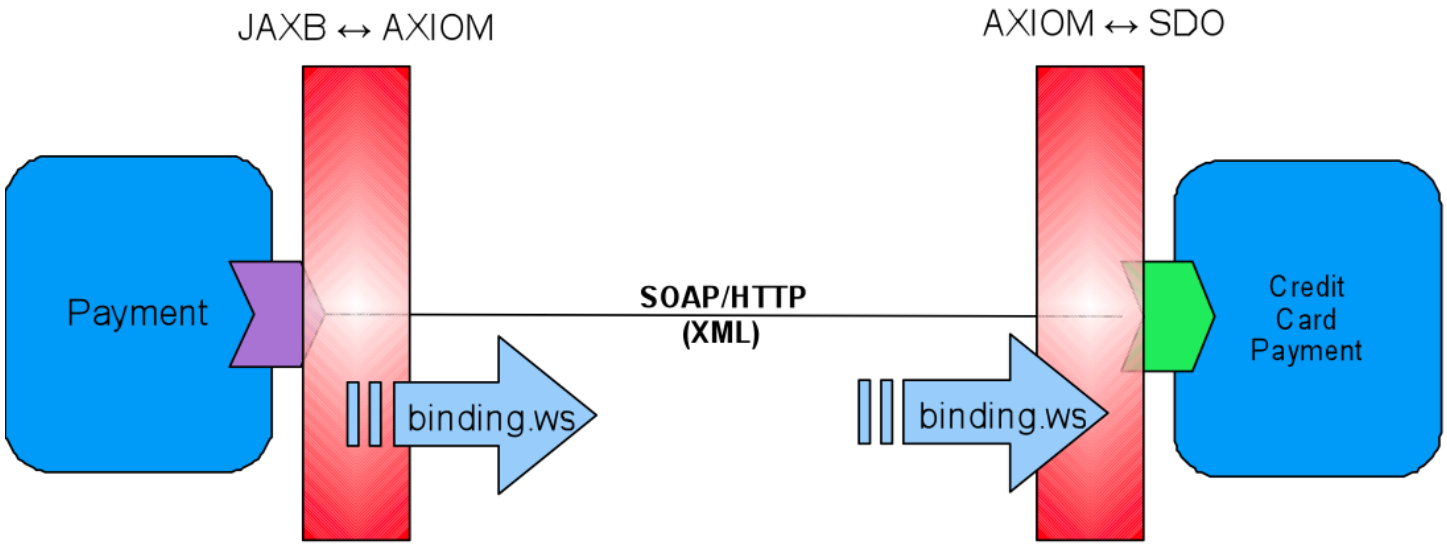


The reality check

- Enforcing one data binding is not flexible or even not feasible
  - Components can be implemented using different technologies which could impose the data binding requirements, for example, a BEPL engine may require DOM
  - Components may choose to use different data bindings to represent the business data (input/output/fault), for example, JAXB vs. SDO for the XML manipulations.
- Service providers or consumers are decoupled and it is impossible to have a fixed data binding
  - A service can serve different consumers that can only handle certain data bindings natively
  - The service providers for a given consumer can be replaced
- The same service can be accessed over different protocols with different data bindings

Data transformation

- Data transformations are required to get two components talk to each other
- Having application code to deal with technological data transformation is a nightmare and it will defeat the whole purpose and promise of SCA



Tuscany's data binding framework

Introspect/transform data without application coding

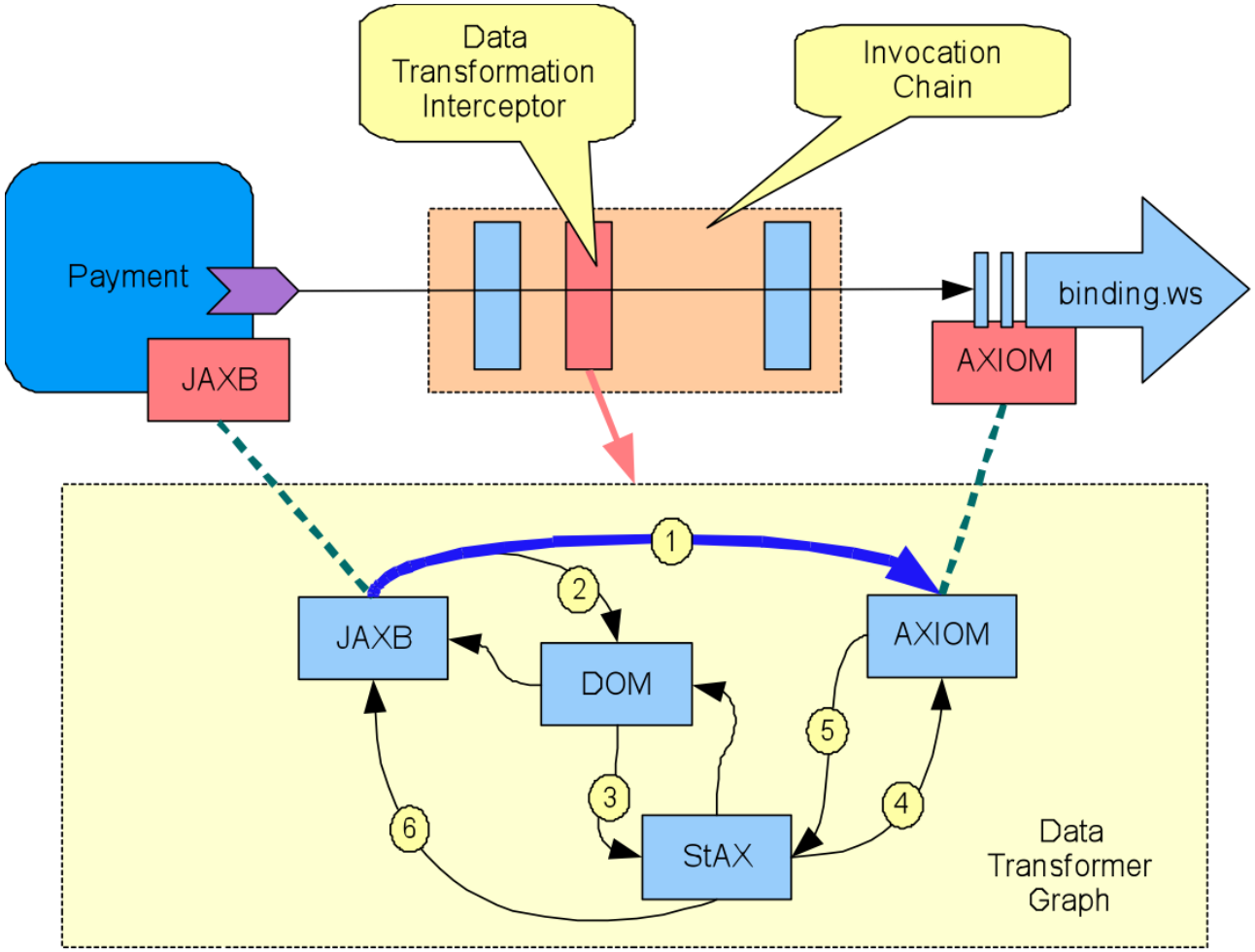
What does the framework need to figure out?

- Understand the data binding requirements at different places for the data flow
- Transform the data from one data binding to the other transparently without the interventions from the application developers
- Separate the data transformation/marshaling/ unmarshaling from the business logic

Data type introspection

- Marker interface
  - commonj.sdo.DataObject, org.w3c.dom.Node
- Annotations
  - JAXB annotations
- What information is captured?
  - Java class
  - Java generic type
  - Logic type (XML element/type, Mime types, etc)

The magic behind the scenes

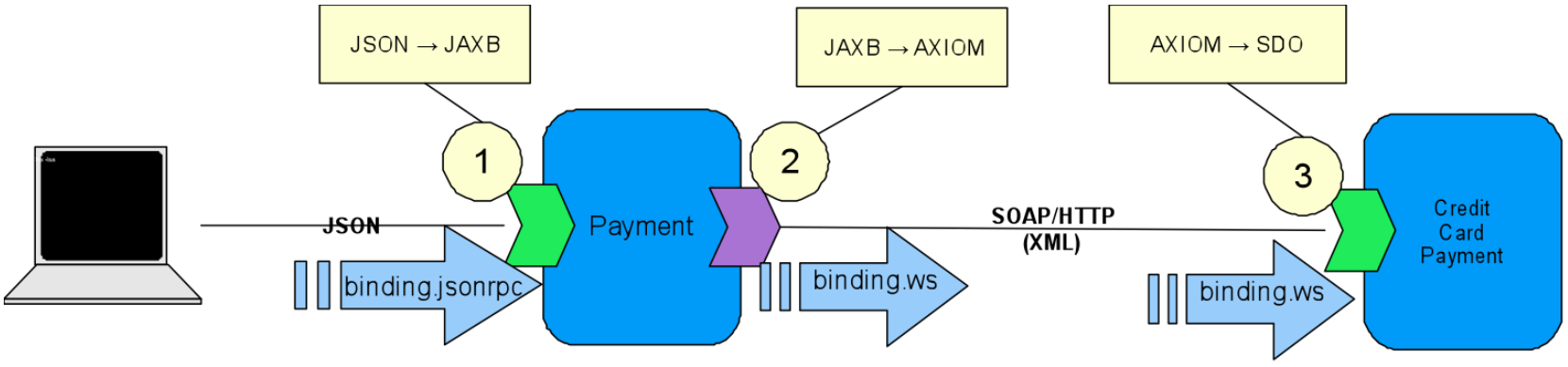


Transformation paths

- Types of transformations
  - Unmarshal/Deserialize (InputStream → Object)
  - Marshal/Serialize (Object → OutputStream)
  - Convert/Transform (Object → Object)
- Direct vs. Multi-hops
  - JAXB ←→ DOM
  - JAXB ←→ DOM ←→ SDO
  - Weight of a transformation
- Private vs. Public
  - Some data bindings are not good as intermediaries (data round-trip issues)

The complete data flow

- Customer data come in JSON from HTTP requests
- The JSON data is unmarshaled into JAXB for the Payment code to consume
- Payment passes CreditCard (JAXB) to the reference binding layer which in turn converts JAXB into AXIOM
- The service binding layer unmarshals the XML data into AXIOM and transform it into SDO for the CreditCardPayment
- The response path is reverse for the data transformations



Data bindings out of the box

- DOM
- JAXB (JavaBeans are treated as JAXB)
- SDO
- JSON
- StAX
- …

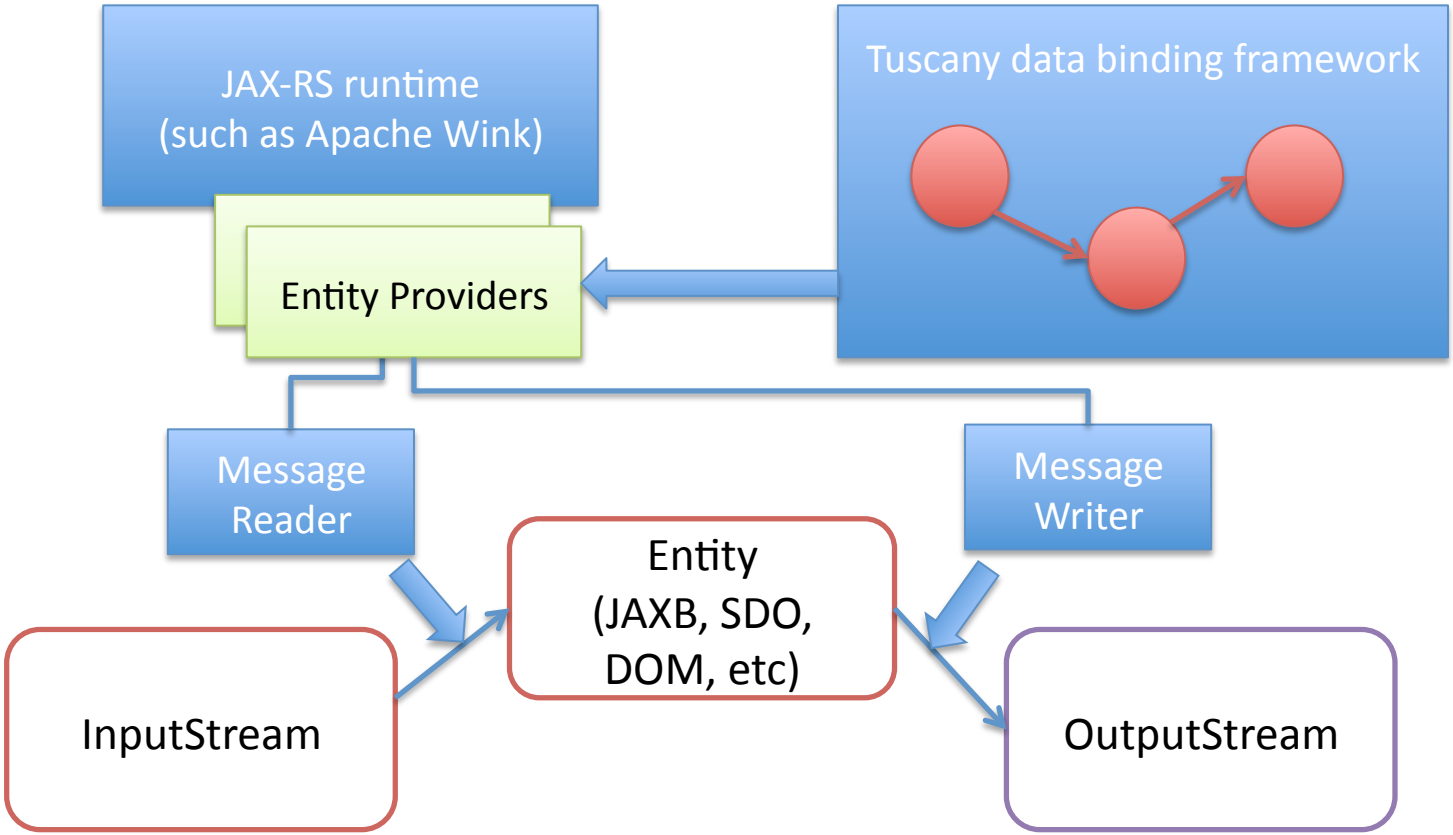
Data bindings for RESTful services

Integrating with JAX-RS entity providers

JAX-RS entity providers

- Entity providers supply mapping services between representations and their associated Java types.
- Entity providers come in two flavors:
  - MessageBodyReader
  - MessageBodyWriter

Tuscany's generic entity providers based on the data binding framework



Extending the data binding framework

Support your favorite data bindings

The DataBinding SPI

```
public interface DataBinding {
String getName();

boolean introspect(DataType dataType, Operation operation);

DataType introspect(Object value, Operation operation);

WrapperHandler getWrapperHandler();

Object copy(Object object, DataType sourceDataType, DataType targetDataType,
    Operation sourceOperation, Operation targetOperation);

XMLTypeHelper getXMLTypeHelper();

}
```

The Transformer SPI

```
public interface PullTransformer<S, R> extends
    Transformer {
R transform(S source, TransformationContext context);
}

public interface PushTransformer<S, R> extends
    Transformer {
void transform(S source, R sink, TransformationContext
    context);
}
```

Registering your data bindings/ transformers

- META-INF/services/ org.apache.tuscany.sca.databinding.DataBinding

  org.apache.tuscany.sca.databinding.xml.DOMDataBinding;name=org.w3c.dom.Node

- META-INF/services/ org.apache.tuscany.sca.databinding.PullTransformer

  org.apache.tuscany.sca.databinding.xml.Node2XMLStreamReader;source=org.w3c.dom.Node,target=javax.xml.stream.XMLStreamReader,weight=80

- META-INF/services/ org.apache.tuscany.sca.databinding.PushTransformer

  org.apache.tuscany.sca.databinding.xml.Node2OutputStream;source=org.w3c.dom.Node,target=java.io.OutputStream,weight=80

Q&A

Find more details from:

Chapter 9 of Tuscany In SCA Action
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