CONFLICT RESOLUTION IN WEB SERVICE FEDERATIONS

Veruska R. Aragão, Alvaro A. A. Fernandes

Department of Computer Science - University of Manchester

{v.aragao, a.fernandes}@cs.man.ac.uk



Information Management Group

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Agenda

- Motivation
- Application Scenario
- Web Service Heterogeneities
- Resolution of Web Services Heterogeneities
- Conclusion

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Web Service Features

- Independent, Autonomous, Heterogeneous
- Standardized
- Enable Federation

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Requirement for Web Service Federation

- Quick Delivery
- Stability

Requirement for Web Service Federation

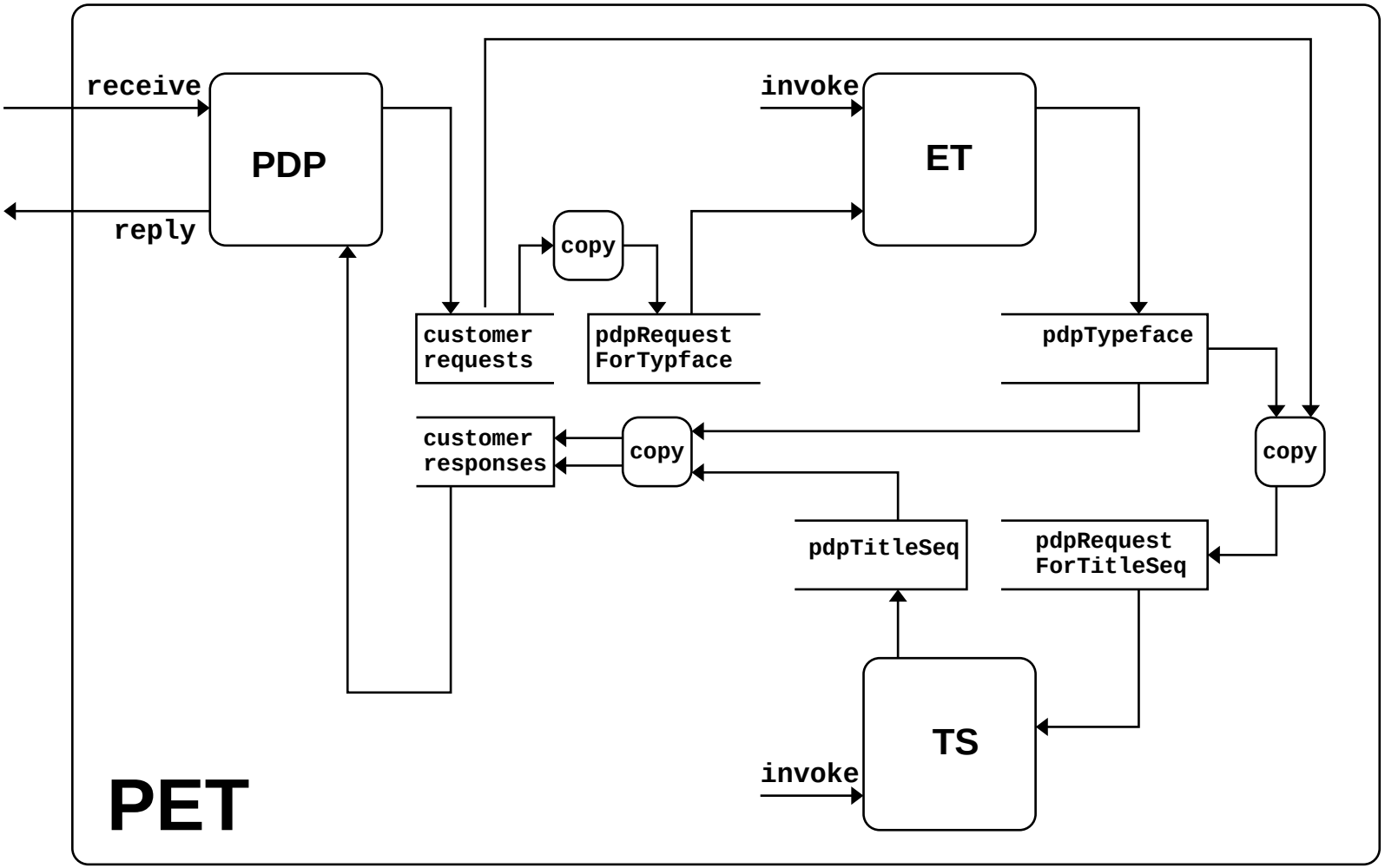
Requirements	Guaranteed by Standards
Quick Delivery	$\surd$
Stability	X

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Database Inspiration

- Database Standards do not prevent impediments to federation
- Which Impediments ?
  - Schematic and Data Heterogeneities
- Web Services presents the same heterogeneities

Application Scenario



```
<definitions...> <!-- PDP Web Service Description/1 -->
  <types><xsd:schema>
      <xsd:element name="typeface"      type="xsd:string"/>
      <xsd:element name="titleSeqSpecs" type="xsd:titleSeqSpec"/>
      <xsd:element name="titleSeq"      type="xsd:string"/>
      <xsd:element name="prodSpecs">
        <xsd:complexType>
          <xsd:sequence>
            <xsd:element name="typefaceSpecs" type="typefaceSpecs"/>
            <xsd:element ref="titleSeqSpecs"/>
          </xsd:sequence>
        </xsd:complexType>
      </xsd:element>
      <xsd:element name="prodDesign">
        <xsd:complexType>
          <xsd:sequence>
            <xsd:element ref="typeface"/>
            <xsd:element ref="titleSeq"/>...
          </xsd:sequence>
        </xsd:complexType>
      </xsd:element>
```

```
  <!-- PDP Web Service Description/2 -->
  <xsd:complexType name="typefaceSpecs">
    <xsd:sequence>
      <xsd:element name="varieties" type="typefaceStyle" />
      <xsd:element name="serif"    type="xsd:boolean" default="true"/>
      ...
    </xsd:sequence>
  </xsd:complexType>
  <xsd:complexType name="titleSeqSpecs">
    <xsd:sequence>
      <xsd:element ref="typeface" />
      <xsd:element ref="titleSeq" />
    </xsd:sequence>
  </xsd:complexType>
  <xsd:simpleType base="xsd:string" name="typefaceStyle">
    <xsd:enumeration value="bold"/>
    <xsd:enumeration value="italic"/>
    <xsd:enumeration value="slanted"/>
  </xsd:simpleType>
</xsd:schema></types> ...
```

```
  <!-- PDP Web Service Description/3 -->
  <message name="customerRequest">  <part name="prodSpecs"       element="prodSpecs"/>
  </message>
  <message name="customerResponse"> <part name="prodDesign"      element="prodDesign"/>
  </message>
  <message name="requestToET">      <part name="requestTypeface" type="typefaceSpecs"/>
  </message>
  <message name="responseFromET">   <part name="typeface"        element="typeface"/>
  </message>
  <message name="requestToTS">      <part name="requestTitleSeq" type="titleSeqSpecs"/>"
  </message>
  <message name="responseFromTS">   <part name="titleSeq"        element="titleSeq"/>
  </message>...
</definitions>
```

```
 <!-- ET Web Service Description/1 -->
<definitions ...>
  <types><xsd:schema>
      <xsd:complexType name="typeface">
        <sequence>
          <xsd:element name="serif"     type="choices"/>
          <xsd:element name="styles"    type="typefaceStyle"/>
          <xsd:element name="lowerCase" type="xsd:boolean" default="false"/>
        </sequence>
      </xsd:complexType>
      <xsd:simpleType base="xsd:string" name="choices">
        <xsd:enumeration value="yes"/>
        <xsd:enumeration value="no"/>
      </xsd:simpleType>
      <xsd:simpleType base="xsd:string" name="typefaceStyle">
        <xsd:enumeration value="bd"/>
        <xsd:enumeration value="it"/>
        <xsd:enumeration value="slt"/>
      </xsd:simpleType>
    </xsd:schema></types>
    ...
```

```
  <!-- ET Web Service Description/2 -->
  <message name="propertiesTypeface"> <part name="designSpecs" type="typeface"/>
  </message>
  <message name="typeface">           <part name="characters" type="xsd:string"/>
  </message>
  ...
</definitions>
```

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Web Services Heterogeneities

Description-level Heterogeneity two web services describe differently one or more of the elements in the message they exchange

- Name Heterogeneity
- Type Heterogeneity
- Cardinality Heterogeneity

Value-level Heterogeneity two web services describe differently one or more of the values in the message they exchange assuming they are homogeneous at the description level

- Representational Heterogeneity
- Interpretational Heterogeneity

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Description Level Heterogeneities

Name Heterogeneity occurs when two elements with the same semantics are assigned different concrete names or when the same concrete name is given to two elements with different semantics.

```
<!-- PDP Web Service Description -->...
<xsd:complexType name="typefaceSpecs">
  <xsd:sequence>...
    <xsd:element name="varieties" type="typefaceStyle" />
    ...
  </xsd:sequence>...

<!-- ET Web Service Description -->...
<xsd:complexType name="typeface">
  <sequence>...
    <xsd:element name="styles"    type="typefaceStyle"/>
    ...
  </sequence>...
```

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Description Level Heterogeneities

Type Heterogeneity occurs when two elements with the same semantics are assigned different concrete (built-in or used-defined) types or when the same concrete type is assigned to two elements with different semantics.

```
<!-- PDP Web Service Description -->...
<xsd:complexType name="typefaceSpecs">
  <xsd:sequence>...
    <xsd:element name="serif" type="xsd:boolean" default="true"/>
    ...
  </xsd:sequence>...

<!-- ET Web Service Description -->...
<xsd:complexType name="typeface">
  <sequence>...
    <xsd:element name="serif" type="choices"/> ...
  </sequence>...
```

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Description Level Heterogeneities

Cardinality Heterogeneity occurs when different numbers of elements are used to describe what is, semantically, the same information.

```
<!-- PDP Web Service Description -->...
  <xsd:complexType name="typefaceSpecs">
  <xsd:sequence>
    <xsd:element name="varieties" type="typefaceStyle" />
    <xsd:element name="serif"    type="xsd:boolean" default="true"/>
  </xsd:sequence>...

<!-- ET Web Service Description -->...
  <xsd:complexType name="typeface">
    <sequence>
      <xsd:element name="serif"     type="choices"/>
      <xsd:element name="styles"    type="typefaceStyle"/>
      <xsd:element name="lowerCase" type="xsd:boolean" default="false"/>
    </sequence>
  </xsd:complexType>...
```

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Value Level Heterogeneities

Representational Heterogeneity occurs when the same datum is concretely represented differently.

```
<!-- PDP Web Service Description -->...
  <xsd:simpleType base="xsd:string" name="typefaceStyle">
    <xsd:enumeration value="bold"/>
    ...

<!-- ET Web Service Description -->...
  <xsd:simpleType base="xsd:string" name="typefaceStyle">
    <xsd:enumeration value="bd"/>
    ...
```

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Value Level Heterogeneities

Interpretational Heterogeneity occurs when different interpretation is given to the same concretely represented value.

```
<!-- PDP -->
    PDP may interpret size to be in pica

<!-- ET -->
    ET may interpret size to be in points
```

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Resolution of Heterogeneities - Personalization Framework

- Mediates interaction between web services
- Analogous to the concept of view in database settings
- Personalization process make the use of rules (personalization rules)
- Implemented as a component in a SOAP Engine (Apache Axis)

Resolution of Heterogeneities - Personalization Rule

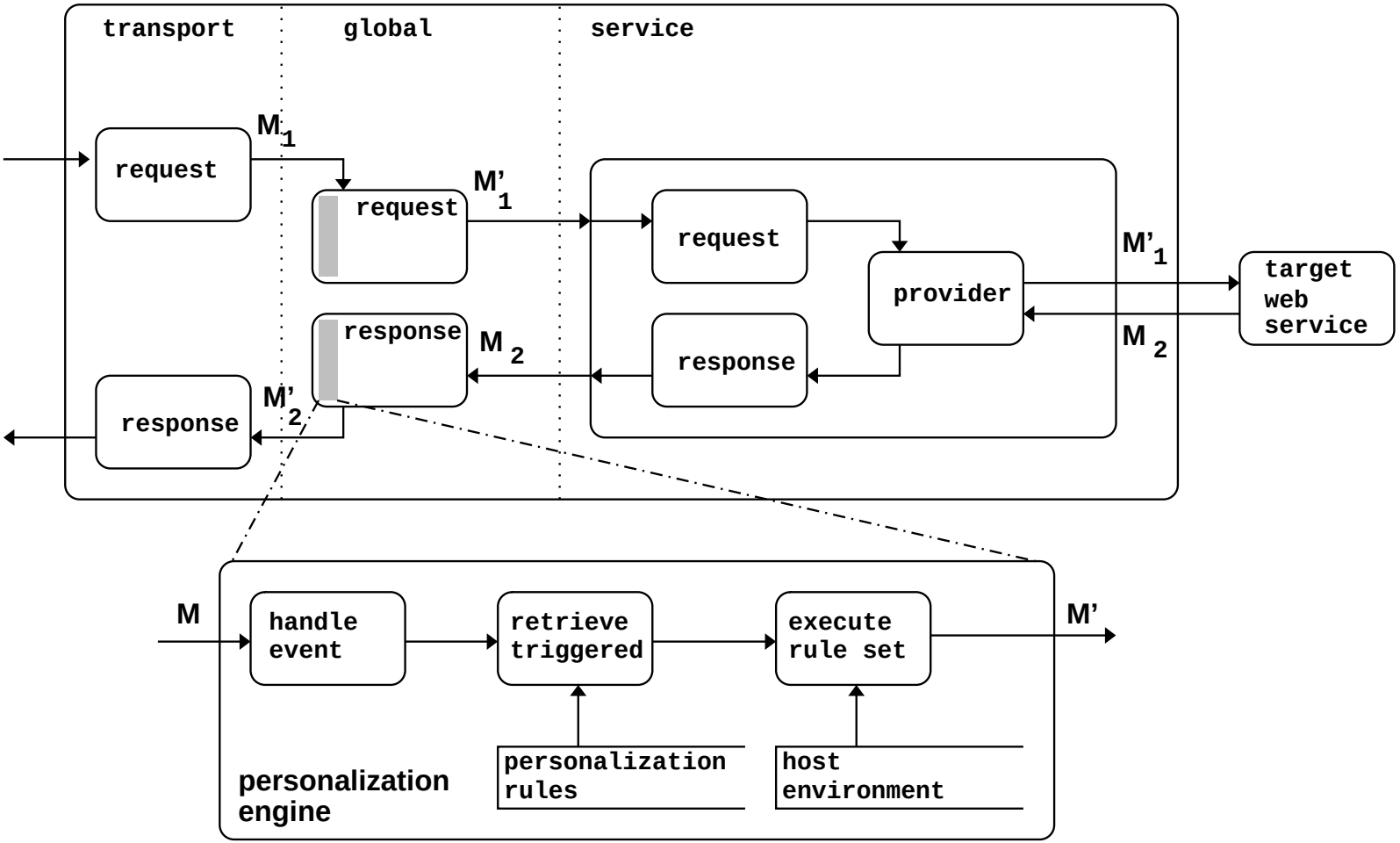
- on <event> if <condition> do <action>
- Event
  - Occurs when a SOAP message is received
  - Either a constant TRUE or
  - XPath expression that queries the header of a SOAP message
  - If True causes a rule to trigger

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Resolution of Heterogeneities - Personalization Rule

- Condition
  - Once a rule is triggered its condition is evaluated
  - Either a constant TRUE or
  - XPath expression that queries the body of a SOAP message
  - If True causes a rule to fire
- Action
  - Once a rule is fired its action is executed
  - An action is an XSLT program that changes the body of a SOAP message

Resolution of Heterogeneities - Personalization Engine



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Resolution of Heterogeneities - Personalization Rules Examples

```
<personalizationRule> <!-- - - reconciling name heterogeneity -->
  <on> //interaction[sender="http://www.productionDesigns.com"]  </on>
  <if> //varieties  </if>
  <do>
    <xsl:stylesheet version="1.0"
                    xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
      <xsl:output indent="yes" method="xml"/>
      ...
      <xsl:template match="varieties">
        <xsl:element name="styles">
          <xsl:value-of select="."/>
        </xsl:element>
      </xsl:template>
    </xsl:stylesheet>
  </do>
</personalizationRule>
```

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Resolution of Heterogeneities - Personalization Rules Examples

```
<personalizationRule> <!-- - - reconciling cardinality heterogeneity -->
  <on>   //interaction[sender="http://www.productionDesigns.com"]  </on>
  <if>   not(//lowercase) </if>
  <do>
    <xsl:stylesheet version="1.0"
                    xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
      <xsl:output indent="yes" method="xml"/>
      ...
      <xsl:template match="serif">
        <xsl:copy-of select="."/>
        <xsl:element name="lowercase">false</xsl:element>
      </xsl:template>
    </xsl:stylesheet>
  </do>
</personalizationRule>
```

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Conclusion

- Web service federation presents heterogeneities
- Web service federation need a mediation mechanism
- A lightweight, no-obtrusive and flexible mediation mechanism was presented
- Further Work: Evaluate the properties of this mechanism driven by an e-procurement case study.