

# Semi-automatic generation of Web services and BPEL processes - A Model-Driven approach

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## Appendix A: Message Classification - XML scheme definition

```
<?xml version="1.0" encoding="utf-8" ?>
<xs:schema targetNamespace="..." elementFormDefault="qualified" xmlns="..."
xmlns:xs="http://www.w3.org/2001/XMLSchema">
  <xs:complexType name="message">
    <xs:attribute name="name" type="xs:string" />
    <xs:element name="binding">
      <xs:complexType>
        <xs:sequence>
          <xs:element name="module">
            <xs:complexType>
              <xs:attribute name="name" type="xs:string" />
              <xs:sequence>
                <xs:element name="attribute">
                  <xs:complexType>
                    <xs:attribute name="id" type="xs:string" />
                    <xs:attribute name="name" type="xs:string" />
                  </xs:complexType>
                </xs:element>
              </xs:sequence>
            </xs:complexType>
          </xs:element>
        </xs:sequence>
      </xs:complexType>
    </xs:element>
  </xs:complexType>
</xs:element>

  <xs:element name="partner">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="module">
          <xs:complexType>
            <xs:attribute name="name" type="xs:string" />
            <xs:sequence>
              <xs:element name="attribute">
                <xs:complexType>
                  <xs:attribute name="id" type="xs:string" />
                  <xs:attribute name="name" type="xs:string" />
                </xs:complexType>
              </xs:element>
            </xs:sequence>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
    </xs:complexType>
  </xs:element>
</xs:schema>
```

```

        </xs:element>
      </xs:sequence>
    </xs:complexType>
  </xs:element>

  <xs:element name="complexactivities">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="module">
          <xs:complexType>
            <xs:attribute name="name" type="xs:string" />
            <xs:sequence>
              <xs:element name="attribute">
                <xs:complexType>
                  <xs:attribute name="id" type="xs:string" />
                  <xs:attribute name="name" type="xs:string" />
                </xs:complexType>
              </xs:element>
            </xs:sequence>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
    </xs:complexType>
  </xs:element>

  <xs:element name="correlationset">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="module">
          <xs:complexType>
            <xs:attribute name="name" type="xs:string" />
            <xs:sequence>
              <xs:element name="attribute">
                <xs:complexType>
                  <xs:attribute name="id" type="xs:string" />
                  <xs:attribute name="name" type="xs:string" />
                </xs:complexType>
              </xs:element>
            </xs:sequence>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
    </xs:complexType>
  </xs:element>
</xs:complexType>
</xs:schema>

```

## Appendix B: BPEL, WSDL and WS-policy definition

### IHE patient registration process - BPEL process definition

#### *PARTNERS AND PARTNERLINKS*

```
<partners>
  <partner name="IHEActorADTPartner"> <!-- generic name, instance bound
at run-time -->
    <partnerlink
name="IHETransactionPatientRegistrationIHEActorADTPartnerLink"/>
    </partner>
  <partner name="IHEActorDepartmentSystemSchedulerPartner">
    <partnerlink
name="IHETransactionPatientRegistrationIHEActorDepartmentSystemScheduler
PartnerPartnerLink"/>
    </partner>
</partners>

<partnerlinks> <!-- symmetrical definition -->
  <partnerLink
name="IHETransactionPatientRegistrationIHEActorADTPartnerLink"
  partnerLinkType="IHETransactionPatientRegistrationPartnerLinkType"
  myRole="IHEActorADTRole"
  partnerRole="IHEActorDepartmentSystemSchedulerPartnerRole"/>

  <partnerLink
name="IHETransactionPatientRegistrationIHEActorDepartmentSystemScheduler
PartnerPartnerLink"
  partnerLinkType="IHETransactionPatientRegistrationPartnerLinkType"
  myRole="IHEActorDepartmentSystemSchedulerPartnerRole"
  partnerRole="IHEActorADTRole"/>
</partnerlinks>
```

#### *MESSAGE PROPERTY TYPE DEFINITIONS*

```
<definitions name="properties"
  <bpws:property name="PID-105" type="xsd:string"/> <!-- Patient ID -->
  <bpws:property name="MSH-010" type="xsd:string"/> <!-- Message
Control ID -->
  <bpws:property name="PV1-132" type="xsd:string"/> <!-- Patient Class
-->
</definitions>
...

<types>
  <xsd:schema>
    <xsd:complexType name="HL7_A01_TYPE">
      <xsd:element name="PID-105" type="xsd:string"/>
      <xsd:element name="MSH-010" type="xsd:string"/>
      <xsd:element name="PV1-132" type="xsd:string"/>
      <xsd:element name="attachment" type="xsd:string"/> <!-- not
included, use DIME -->
```

#### *VARIABLE+MESSAGES*

```
<variables>
```

```

    <variable name="HL7_A01_VAR" messageType="HL7_A01_MSG">
    <variable name="HL7_A01_ACK_VAR" messageType="HL7_A01_ACK_MSG">
    ...

<messages>
<message name="HL7_A01_MSG">
  <part name="HL7_A01_PART" type="HL7_A01_TYPE"/>

```

### ***CORRELATION SET***

```

<correlationSets>
  <correlationSet name="HL7_A01_CS" properties="MSH-010"/> <!-- is
reflected by acknowledge message -->

```

### ***FLOW***

```

<flow>                                     <!-- patient registration
flow -->
  <switch>                                   <!-- switching PatientClass
attribute -->
  <!-- in-patient -->
  <case condition="bpws:getVariableData('HL7_A01_MSG', 'HL7_A01_PART',
'HL7_A01_TYPE/PV1-132') = 'in-patient'">
  ...
  <switch>                                   <!-- switching PatientClass
attribute -->
  <!-- registration -->
  <case condition="bpws:getVariableData('HL7_A01_MSG',
'HL7_A01_PART', 'HL7_A01_TYPE/PV1-132') = 'registration'">
    <invoke partner="IHEActorDepartmentSystemSchedulerPartner"
portType="IHETransactionPatientRegistrationCallbackPort"
operation="HL7_A01" inputvariable="HL7_A01_MSG">
      <correlations>
        <correlation set="HL7_A01_CS">
      </correlations>

```

### ***FLOW (using transactions)***

```

<scope>
  <compensationHandlers>
    <invoke partner="IHEActorDepartmentSystemSchedulerPartner"
portType="IHETransactionPatientRegistrationCallbackPort"
operation="HL7_A11" inputvariable="HL7_A11_MSG">
      <correlations>
        <correlation set="HL7_A11_CS">
      </correlations>
    </invoke>
    <receive partner="IHEActorDepartmentSystemSchedulerPartner"
portType="IHETransactionPatientRegistrationPort"
operation="HL7_A11_ACK" inputvariable="HL7_A11_ACK_MSG">
      <correlations>
        <correlation set="HL7_A11_CS">
      </correlations>
    </receive>
  </compensationHandlers>

  <invoke partner="IHEActorDepartmentSystemSchedulerPartner"
portType="IHETransactionPatientRegistrationCallbackPort"
operation="HL7_A01" inputvariable="HL7_A01_MSG">
    <correlations>

```

```

        <correlation set="HL7_A01_CS">
    </correlations>
</invoke>
<receive partner="IHEActorDepartmentSystemSchedulerPartner"
portType="IHETransactionPatientRegistrationPort"
operation="HL7_A01_ACK" inputvariable="HL7_A01_ACK_MSG">
    <correlations>
        <correlation set="HL7_A01_CS">
    </correlations>
</receive>
</scope>

```

## **IHE patient registration process - WSDL process definition**

### ***PORTTYPE***

```

<portType name="IHETransactionPatientRegistrationPortType">
    <operation name="HL7_A01">
        <input message="HL7_A01_MSG">
    </operation>
...

```

### ***PARTNERLINKTYPE***

```

<partnerLinkType name=
    "IHETransactionPatientRegistrationPartnerLinkType">
    <role name="IHEActorADTRole">
        <portType name="IHETransactionPatientRegistrationPortType">
    </role>
    <role name="IHEActorDepartmentSystemSchedulerPartnerRole">
        <portType name="IHETransactionPatientRegistrationCallbackPortType">
    </role>
</partnerLinkType>

```

### ***BINDING***

```

<binding name="IHEPatientRegistrationBinding"
    type="IHETransactionPatientRegistrationPortType">
    <soap:binding style="document" transport=
        "http://schemas.xmlsoap.org/soap/http"/>
    <operation name="HL7_A01">
        <soap:operation soapAction=
            "http://genericContent/iheserviceoperation"/>
        <input>
            <soap:body use="literal"/>
        </input>
        <output>
            <soap:body use="literal"/>
        </output>
    </operation>
</binding>

```

### ***SERVICE***

```

<service name="IHEServicePatientRegistration">
    <documentation>My IHE service</documentation>
    <port name="IHEPatientRegistrationPort"
        binding="IHEPatientRegistrationBinding">
        <soap:address location="http://genericContent/iheserviceport"/>
    </port>
</service>

```

```
</port>
...
</service>
```

## **IHE patient registration process - WS-policy definition**

### *SECURITY*

```
<wsp:Policy xmlns:wss="..." xmlns:wsp="...">
  <wsp:ExactlyOne>
    <wsse:SecurityToken wsp:Usage="wsp:Required" wsp:Preference="1">
      <wsse:TokenType>wsse:X509v3</wsse:TokenType>
    </wsse:SecurityToken>
  </wsp:ExactlyOne>
</wsp:Policy>

<xenc:EncryptedData MimeType="Application/Dicom">
  <xenc:EncryptionMethod
Algorithm="http://www.w3.org/2000/09/xmldsig#rsa-sha1"/>
  <ds:KeyInfo>
    <ds:KeyName>CN=ADT_TEST, C=AT</ds:KeyName>
  </ds:KeyInfo>
  <xenc:CipherData>
    <xenc:CipherReference URI="dicom:image"/>
  </xenc:CipherData>
</xenc:EncryptedData>
```

### *ATTACHMENTS*

```
<wsp:Policy>
  <wsa:AttachmentMethod wsp:Usage="wsp:Required">
    <wsa:Protocol Type="wsa:DIME"
  </wsa:AttachmentMethod>
</wsp:Policy>
```

## Appendix C

**Table 1.** Relationship of IHE concepts and BPEL constructs

IHE concept	BPEL construct
IHE actor	BPEL partner
IHE flow	BPEL process
IHE transaction	BPEL service link, 2 BPEL ports
HL7 message/DICOM service	1 BPEL invoke+receive activity, 1 SOAP message
HL7 message/DICOM service	1 BPEL compensation activity

**Table 2.** Mapping of an activity diagram and HL7 message attributes to BPEL constructs

activity diagram artefact	BPEL construct in <flow> section
<invoke> + <receive> activity	element: invoke and receive activity
scope start and end	element: scope (also defines the enclosed activities)
compensation activities	element: compensationhandler (also defines activities)
branch, branch condition	element: switch
branch condition	element: case (values have to be annotated in the diagram)
branch variable	statement: getVariableData(message, part, attribute-xpath-expression)
message attributes	defined BPEL element and attribute
IHE actor name	element: partner, attribute: name
IHE transaction name + IHE actor name + “partnerlink”	element: partnerlink, attribute: name
IHE transaction name + “partnerlinktype”	element: partnerlinktype, attribute: name
IHE actor name + “role”	element: myRole+partnerRole, attribute: name
IHE (HL7) message + “_MSG”	element: message, attribute: name
IHE (HL7) message + “_VAR”	element: variable, attribute: name
HL7 message + “_TYPE”	element: type, attribute: name
HL7 module name + “-“ + HL7 element name	element: property, attribute: name, type=”xsd:string” (also used as elements in BPEL type definition)
IHE (HL7) message + and “_VAR”	element: invoke, receive, attribute: operation and inputvariable
IHE (HL7) message + “_VAR”	element: variable, attribute: name
IHE (HL7) message + “_CS”	element: correlationset, attribute: name
HL7 module name + “-“ + HL7 element name (see classification)	element: correlationset, attribute: properties



**Table 3.** Mapping of HL7 message attributes to static WSDL element content.

message attributes	WSDL elements and attributes
IHE transaction name + "partnerlinktype"	element: partnerlinktype
IHE actor name + "role"	element: role
IHE transaction name + „porttype“	element: porttype
IHE (HL7) message	element: operation
IHE (HL7) message + “_MSG”	element: inputmessage

**Table 4.** Mapping of HL7 message attributes to WS-policy element content.

message attributes	WS-policy (WS-Security, etc.) elements and attributes
<i>always present</i>	element: wsp:ExactlyOne
constant: "wsp:Required"	element: wsse:SecurityToken attribute: wsp:Usage
constant: "1"	element: wsse:SecurityToken attribute: wsp:Preference
constant: "wsse:X509v3"	element: wsse:TokenType
constant: "DIME"	element: xenc:EncryptedData attribute: MimeType
constant: "http://www.w3.org/2000/09/xmlsimg#rsa-sha1"	element: xenc:EncryptionMethod attribute: Algorithm
dynamically inserted at run-time	ds:keyinfo, ds:KeyName
relative URI to DIME attachment	element: xenc:EncryptedData, xenc:CipherReference, attribute: URI
constant: "wsp:Required"	element: wsa:AttachmentMethod attribute: wsp:Usage
constant: "DIME"	element: wsa:Protocol attribute: Name

Note: "constant" means "defined for all process at design-time", of course it is possible to configure these value.