@enterprise 8.0

Application Development Guide

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Contents

1 Overview

This guide explains how to write workflow applications with @enterprise. **@enterprise** offers a set of demos combined in the file *demos.zip* of *doc* folder. Within this compressed file a text-file called *README.txt* is available which gives a short description about the demo programs.

This guide contains following chapters:

- Chapter 2 describes how servlet methods can be written.
- Chapter 3 describes the layer for persistent objects.
- Data structures and some useful utilities are described in chapter 4.
- Chapter 5 describes the structure of @enterprise applications.
- Chapter 6 describes the organizational data.
- In chapter 7 components for writing HTML interfaces are described.
- The workflow engine and its API is described in chapter 8.
- The usage of the workflow API is shown in chapter 9.
- Chapter 10 describes the configuration of the HTML-Client and the implementation of a customized worklist.
- Chapters 11 introduce the document management component and its API.
- Chapter 12 describes the usage of various communication mechanisms like email, RMI, Wf-XML and LDAP in @enterprise.
- The process definition representation XWDL is described in Chapter 13.
- The way how Web services can be used in @enterprise is described in Chapter 14.
- Chapter 15 describes how to handle with the intergrated DOJO component.
- The adaption of Mobile GUI Client is described in Chapter 16.

2 Servlet Methods

In this chapter we describe how to write methods for Web applications - receiving input from the browser and writing out to it. Moreover the authorization mechanism is discussed and some utilities for building HTML components are presented.
@enterprise is a Web-based system with an integrated Web-server. The interface between the Web server and the rest of the system is a set of servlets.
For the application programmer there exists a convenient interface to write "servlet methods". These methods must have one of the two following signatures:

```
public void methodX (HttpServletRequest req, HttpServletResponse res)
   throws Exception;

public Page methodY (HttpServletRequest req) throws Exception;
```

`HttpServletRequest` and `HttpServletResponse` are interfaces from the package `javax.servlet.http` (see the Documentation of the Java2 Enterprise Edition [1]). The return value `Page` represents a page sent to the browser and is described below.
The methods are called from the dispatcher servlet of @enterprise via reflection. The URL schema is as follows:

```
http://host:port/wf/servlet.method/appclass.appmethod?params
```

`appclass` is the fully qualified name of the class containing the method `appmethod`.
`appmethod` is a method having one of the two above signatures.
Why have we defined two interfaces for writing servlet methods? The first interface is the more general, because you can write directly onto the output stream of the response. It is the same as writing a `doGet` or `doPost` method of a servlet. However, the second method signature has some advantages:

- It is explicit, that a return value (the page sent to the browser) is necessary.
- The page is sent to the browser, after the method has been completed, and a commit has been performed (This prevents sending half pages when an error occurs.).
- `Page` is an interface, which can have several implementations with extended functionality, read below about `HTMLPage`, `ActionPage`, and `XHTMLPage`.

The limitation of this approach is that you cannot set Header-Fields of the HTTP-Response, for example Cookies. Now, let us look a little deeper into how the Dispatcher works:

2.1 *The Dispatcher Servlet*

The Dispatcher servlet handles all requests starting with "/<context-root>/servlet.method/", <context-root> is the context where you have installed @enterprise when using an application server, in standalone mode it is the constant `wf`. The Dispatcher performs the following steps:

1. Load the session of this request.
2. If there is no session and the method is not public, call the `sendLoginRequest` method of the authorization class.
3. Call the method specified in the URL by loading the class and calling the method using reflection.
4. If the method terminates normal (without exception) the user transaction associated with this thread is committed and the page together with a HTTP header is sent to the browser.

   If the method terminates with an exception, a rollback is performed on the user transaction and an error page is sent to the browser.

The distinction of public and non public methods works via the interface `com.groiss.servlet.Public`. If your class implements this interface, no authorization is needed. Public is an empty interface, therefore all you have to do when implementing the interface is to write `implements Public` in the class declaration. When using public methods the internationalization is done with the settings of user *guest*.

2.2 *Demo Package*

With the @enterprise kit comes a demonstration file `demos.zip` containing some examples for writing servlet methods. Load the demos using the "Install Application" link in the @enterprise system administration. You can go to the index page by pointing your browser to `http://host:port/wf/demo/index.html`.
The first of the four examples of the Java class `HttpDemo` simply writes out the current date to the browser:

File **classes/com/groiss/demo/HttpDemo.java**

```
public void showDate(HttpServletRequest req, HttpServletResponse res)
     throws IOException {
   res.getWriter().println("<html>"+ new Date()+"</html>");
}
```

The second example uses a form to give some values to the servlet method. The form looks as follows:

File **classes/alllangs/demo/dateform.html**

```
<html><form action="/wf/servlet.method/com.groiss.demo.HttpDemo.showNLSDate1">
Language:
<select name=language>
    <option value=de>German
    <option value=en>English
    <option value=es>Spanish
    <option value=fr>French
</select><br>

Format
long: <input type=radio name=format value=long>
short: <input type=radio name=format value=short>
<br>
<input type=submit>
</form>
</html>
```

The form contains two form fields. The `language` field to select one of four languages, the `format` field to select either a long or short date format. The form action is the method `showNLSDate1` of the class `HttpDemo`:

File **classes/com/groiss/demo/HttpDemo.java**

```
public void showNLSDate1(HttpServletRequest req, HttpServletResponse res)
      throws Exception {
   String language = req.getParameter("language");
   String format = req.getParameter("format");
   Locale l = new Locale(language,language);
   SimpleDateFormat df = new SimpleDateFormat(
      ("long".equals(format) ? "EEEE, MMMM dd, yyyy" : "EEE, MMM dd, yyyy"),l);
   res.getWriter().println("<html>Date in "+ format + " format in "+ language +
      ":<br>" + df.format(new Date())+"</html>");
}
```

The values from the form fields are retrieved with the method `getParameter()` of the request object. The result is written to the writer of the response object.

2.3 Page

The interface `Page` describes a page sent to the browser, it has the following methods defined:

```
public String show() throws ApplicationException;

public String getContentType();
```

The method `show` returns a String representation of the page and is normally called by the Dispatcher. The method `getContentType()` returns the mime-type of the page, for example "text/html". The interface is implemented by three classes:

HTMLPage: Used for HTML pages, where a fixed template is loaded and the dynamic parts are substituted from a Java method. See section 2.4 for details.

ActionPage: The action page is used for HTML pages containing JavaScript code only, for example a command for closing the browser window.

XHTMLPage: The XHTMLPage is used for XHTML and XForm pages. XHTML is a reformulation of HTML in XML. The advantage of using XML is that substitutions of XML structures are possible, see section 2.5. An example how an XHTMLPage is used in XForms is shown in section 9.4.1.

VelocityPage: Implementation which can handle Velocity-templates. See section 2.7 for details.

Of course, application programmers can define their own implementations of the Page interface. If any page should use the JavaScript methods of **@enterprise**, following import must be available within the HEAD-tags:

```
<script src="../servlet.method/
 com.groiss.gui.JavascriptLoader.getScripts"></script>
```

2.4 HTMLPage

When showing HTML pages with dynamically generated content it is useful to separate the fixed HTML code and the parts generated by the program.
Different approaches exist here. Most popular are Active Server Pages (ASP) from Microsoft and Java Server Pages, part of the Java 2 Enterprise Edition. In both frameworks you have to write the code into the HTML pages. Whereas this mechanism is nice for prototyping it has some drawbacks:

- Long HTML/code pages are developed, where the design of the page is hard to see and maintain.
- The placement of utility methods, constants or static variables is unclear.
- Development in an IDE.
- Internationalization of code and HTML text.

In @enterprise we use a different approach. The HTML pages contain placeholders, which are replaces with actual data at run-time.
Replacements are done with the class `HTMLPage`, which provides the following constructors and methods:
Constructors:

- `public HTMLPage()`

  No parameters: An empty page is generated, set the content of the page with `setPage(String)`.

- `public HTMLPage(String resource)`

  The parameter is the name of a resource, normally a file in the class path.

Methods:

- `substitute(String s1, String s2)`: The placeholder s1 is substituted by the string s2.
- `showPage()` returns the page as string.

The class `HTMLPage` is normally used in the following steps:

1. Use the constructor to load the mask,
2. make multiple calls of `substitute` to replace the placeholders,
3. return the page to the Dispatcher.

Example: The method `showNLSDate` can be rewritten using HTMLPage.
HTML-mask:

File **classes/com/groiss/demo/date.html**

```
<html><body>
Date in %format% format in %language%:<br>
%date%
</body>
</html>
```

Placeholders start and end with a "%" character. The Java-method now looks like:

File **classes/com/groiss/demo/HttpDemo.java**

```
public Page showNLSDate2(HttpServletResponse res) throws Exception {
  String language = req.getParameter("language");
  String format = req.getParameter("format");
  Locale l = new Locale(language,language);
  HTMLPage p = new HTMLPage("/com/groiss/demo/Date.html");
  SimpleDateFormat df = new SimpleDateFormat(
     ("long".equals(format) ?
        "EEEE, MMMM dd, yyyy" : "EEE, MMM dd, yyyy"), l);
  p.substitute("format", format );
  p.substitute("language", language );
  p.substitute("date", df.format(new Date()));
  return p;
}
```

2.5 XHTML

XHTML is a reformulation of HTML in XML, it has been defined and published by the W3C (World Wide Web Consortium), see their Web page [2] for details.
Analogous to the `HTMLPage` we have defined a class `XHTMLPage` based on XHTML with extended functionality:

- Every XML element with an "id" can be substituted. Therefore, whole parts of the page can be substituted, for example a table element. Making an element invisible is performed by substituting with `null`.

- It is possible to change elements by setting attributes, for example the background color or the value in an input field.
- It is possible to make the substitutions more than once or not at all. In the page there is a default value (element). A substitution is done when necessary. Multiple substitutions can be performed, because the result of the substitution is again a XML tree.

However, the usage of the XML components has some drawbacks. Only XML elements can be substituted or changed: It is not possible to substitute a part of an URL (for example to fill in an object's oid). Note, that the templates must be syntactically correct XML. For example, a "<" (less) character in a JavaScript must be written as &lt;.

Hint: Since @enterprise 8.0 it is not possible anymore to write HTML code directly on a page, but sometimes it is necessary that html code should be interpreted. For this purpose the class *ProcessingInstruction* can be used like in following example:

XHTML-mask snippet:

```
<table class="simple" width="100%">
 <tr><td width="120px">Name: </td><td><span id="name"/></td></tr>
 <tr><td valign="top">Description: </td><td><span id="descr"/></td></tr>
</table>
```

Java method snippet:

```
XHTMLPage page = new XHTMLPage("mask/MyXHTMLPage.xhtml");
page.get("name").setContent("MyText");
ArrayList l = new ArrayList();
l.add(new org.jdom.ProcessingInstruction(
                      Result.PI_DISABLE_OUTPUT_ESCAPING,""));
l.add("<b>This text</b> should be displayed in bold letters");
l.add(new org.jdom.ProcessingInstruction(
                      Result.PI_ENABLE_OUTPUT_ESCAPING,""));
page.get("descr").setContent(l);
```

Forms with Subtables

@enterprise allows the definition of master-detail relations between forms. Master-detail (or 1:n) relations are common in many application areas. Consider the relation of an "order" and the order items as an example.
To model such an relation using **@enterprise** forms you define first the "detail" form (the "order item" in the previous example) and load it into **@enterprise** . Next, you define the master-form with a reference to the detail-form.
This reference is defined with the HTML-Tag `tablefield`, which has the following attributes:

- **class** or **formtype:** The name of the Java class of the subform.

- **id** or **subformid:** An integer value as identification of the subform. There can be more than one subform in a form and they must have different numbers.
- **mode:** The mode defines how the subforms are edited, two modes are available:
  - subform: The main form contains a table where each line contains a link to a detail mask. An "Add" button is placed under the table. This mode is the default.
  - editable: The main form contains the button "Edit Table". It opens a new window, which allows to edit all lines of the table. You can add and delete lines in this window, too. This mode is useful to edit small tables with only a few columns. This mode is not applicable for:
    - subforms in subforms
    - XForms
    - Forms with object-select fields, e.g. user selection
- **buttonlabel:** This attribute is optional and is for changing the name of the subform–button (default *New Table Entry*)

Example for a tablefield entry:

```
<tablefield class="com.dec.avw.appl.shoppingitem_1" id="1" mode="editable">
```

The subform is a form with the id `shoppingitem` and version 1, mode is `editable`.

The parameter *epblock* in XHTML-Forms

Beside *input* and *textarea* fields, it is possible to hide *div* blocks with the parameter *epblock*. All *div* tags, which have a special attribute, will be displayed in the mask *Visibility of Forms*. If a *div* tag contains some fields, which have the attribute rw/ro, and the *div* tag visibility attribute is *invisible*, the whole *div* (including all fields) will not be displayed. The visibility attribute rw/ro affects fields only, but not the *div* tag.

The ID of the *div* tag is necessary for unique identification. The attribute *epblock* indicates the *div* tag for field-management (Visibility of forms) and appears at the allocation of access-rights. It is important that IDs are unique, i.e. a *div* tag cannot have the same ID as a *input* tag.

Example:

```
<div id="thefield_div" epblock="true">
 <table>
  <tr>
   <td class="tdb"><label for="thefield">FieldName:</label></td>
   <td><input type="text" id="thefield" name="thefield" dbtype="VARCHAR"
       maxlength="30" size="20" /></td>
  </tr>
 </table>
</div>
```

2.6 XForm

XForm is a standard defined by the W3C consortium for the definition of web forms. In **@enterprise** XForms can be used as an alternative to HTML forms. The advantages of XForms make this technology an excellent choice for all further web form implementations. This section describes how XForms can be used in **@enterprise**.

Following the functional principle for displaying a XForm is described:

- The XForm template is loaded and parsed
- Within the *model* element an *instance* element with instance- and context-data is added. The form fields are accessible via the path *data/form/fieldname*
- The *bind* element with visibilities is added to the *model*
- Depending on the kind of representation the appropriate submit-buttons and their actions are added
- The XForm is converted to a HTML page: Each XForm control is converted to a HTML equivalent which is filled with the data of the *model* and displayed with the appropriate visibility.

The following example shows the *model* of a form with the form fields *name*, *country* and *amount*:

```
<xf:model>
 <xf:instance>
  <data xmlns="">
   <form object="com.dec.avw.appl.wiztest_1:1000074412" task="1000074417">
    <transactionId>73</transactionId>
    <avwcreatedby>roland eisenberg</avwcreatedby>
    <avwcreatedat>2009-04-06T07:05:22Z</avwcreatedat>
    <avwchangedby>roland eisenberg</avwchangedby>
    <avwchangedat>2009-04-07T08:28:22Z</avwchangedat>
    <name>a</name>
    <country>GB</country>
    <amount>40011</amount>
   </form>
   <context>
    <viewmode>view_text</viewmode>
    <activityinstance oid="1000042420">Process 158</activityinstance>
    <processinstance oid="1000042417">158</processinstance>
    <task oid="1000000185" id="businesstrip_request">Request</task>
    <processdefinition oid="1000000090" id="hr_businesstrip">Business trip
    </processdefinition>
    ...
   </context>
  </data>
 </xf:instance>
 <xf:bind nodeset="/data/form/name" required="false()" type="string" />
 <xf:bind nodeset="/data/form/country" required="false()" type="string" />
 <xf:bind nodeset="/data/form/amount" required="false()" type="decimal" />
 <xf:submission action="com.groiss.storegui.FormWrapper.updateNoAction"
      replace="instance" validate="false" id="submit0" method="post" />
 <xf:submission action="com.groiss.storegui.FormWrapper.updateAndAction?
      javaAction=finish&amp;afterSubmit=top.right.location=comingFrom"
      method="post" id="submit1" />
 <xf:submission action="com.groiss.storegui.FormWrapper.updateAndAction?
      afterSubmit=parent.parent.changeTab()" validate="false"
      method="post" id="submit2" />
</xf:model>
```

In addition to the form fields the following context data are included:

- `activityinstance`: The oid and toString of the current activity
- `processinstance`: The oid and Id of the process instance
- `task`: The oid, Id and the name of the task
- `processdefinition`: The oid, Id and the name of the process definition
- `viewmode`: The view mode with one of the following values: update, insert, search, view, view_version, view_text

Hint: On loglevel 3 the whole XForm is written into log (before converting into HTML).

In the following some examples should illustrate the usage of XForms.

Example 1: Setting a field to read-only: The fields curefrom and cureto are editable only, if the field reason is set to value *cure*.

```
<xf:bind nodeset="/data/form/curefrom"
         readonly="/data/form/reason != 'cure'"/>
<xf:bind nodeset="/data/form/cureto"
         readonly="/data/form/reason != 'cure'"/>
```

Example 2: Usage of value lists: The different types of a vacation are stored in a value list. XForms use an own model element for value lists.

```
<xf:model id="valuelist">
 <xf:instance src="com.groiss.wf.html.ValueList.show?id=holidaytype"/>
</xf:model>
```

For the *src* attribute the represented URL must be entered. The attribute *id* references the Id of the value list. If more than one value list should be used, the id's must be separated by commas. The body of a XForm contains an element with reference to the value list:

```
<xf:select1 ref="/data/form/type"><xf:label>Vacation type</xf:label>
 <xf:itemset model="valuelist"
     nodeset="/valuelists/list[@id='holidaytype']/item">
  <xf:label ref="label"/>
  <xf:value ref="value"/>
 </xf:itemset>
</xf:select1>
```

Example 3: Configuration data: The form should use the currency symbol defined in the configuration (of an application). If configuration parameter should be used within the XForm, the *configuration* element is needed which defines all parameters as *property* element with their names. The name consists of the application-id as prefix and the parameter-name. **@enterprise** parameters do not need a prefix. The values are inserted at runtime:

```
<xf:instance>
 <data xmlns="">
  <configuration>
   <property name="myappl:currency.symbol" />
  </configuration>
 </data>
</xf:instance>
...
<xf:bind id="currency"
         nodeset="//property[@name='myappl:currency.symbol']"/>
```

Example 4: Usage of subtable (subform): The element *xf:repeat* is needed. Within this element the *formtype* of subform and a *subformid* must be specified:

```
<xf:repeat formtype="com.dec.avw.appl.subform_1" subformid="1">
  <xf:label class="label100">Subtable</xf:label>
</xf:repeat>
```

Example 5: Calculate sum from subforms: A billing form contains a subform which represents the items. The main form should display the sum of the items. For this purpose a *bind* element can be used which computes the sum with the attribute *calculate*:

```
<xf:bind nodeset="/data/form/totalamount"
         calculate="sum(/data/form/subform/form/total)"/>
```

Example 6: Embedded subtable: With XForms it is possible to embed subtables with the element *repeat* or the attribute *repeat-nodeset* (for any element). The attribute value (called *nodeset* for element *repeat*) is a XPath expression which selects the subforms. The content of the *repeat* element is repeated for each subform. The buttons *Delete* and *Insert* are XForm triggers which resolve the XForm actions "delete" and "insert". It is necessary for **@enterprise** to add a *subformid* and *formtype* to the *repeat* element:

```
<div class="group">

<table class="simple" style="width:90%">
 <colgroup>
   <col style="width:125px"/>
   <col style="width:80px"/>
   <col style="width:80px"/>
   <col style="width:80px"/>
   <col style="width:*" />
   <col style="width:80px;text-align:right" />
 </colgroup>
 <colgroup align="right"></colgroup>
 <tr>
   <th>@@@itemdate@@</th>
   <th>@@@timefrom@@</th>
   <th>@@@timeto@@</th>
   <th>@@@lunchbreak@@</th>
   <th>@@@description@@</th>
   <th>@@@costcenter@@</th>
   <th>@@@time@@</th>
  </tr>
  <tbody subformid="1" formtype="hr_timeitem_1"
    xf:repeat-nodeset="/data/form/subform[@id='1']/form[position()!=last()]">
     <tr>
      <td>
       <xf:input ref="itemdate" />
      </td>
      <td>
       <xf:input style="width:60px" ref="timefrom"></xf:input>
      </td>
      <td>
       <xf:input style="width:60px" ref="timeto"></xf:input>
      </td>
      <td>
       <xf:select ref="lunchbreak" appearance="full">
        <xf:item><xf:label></xf:label><xf:value>true</xf:value></xf:item>
       </xf:select>
      </td>
      <td>
       <xf:input ref="description" style="width:100%"/>
      </td>
      <td>
       <xf:input ref="costcenter"
           url="com.groiss.hrproc.TimeReport.selectCostCenter"/>
      </td>
      <td><xf:output ref="timehours" /></td>
     </tr>
  </tbody>
 </table>
 <xf:trigger ref="/data/form/subform[@id='1']/form">
   <xf:label>@@@ep:new_line@@</xf:label>
   <xf:insert ev:event="DOMActivate" position="after"
      nodeset="/data/form/subform[@id='1']/form" at="index('subform_1')"/>
 </xf:trigger>
 <xf:trigger ref="/data/form/subform[@id='1']/form">
   <xf:label>@@@ep:delete@@</xf:label>
   <xf:delete ev:event="DOMActivate"
      nodeset="/data/form/subform[@id='1']/form" at="index('subform_1')"/>
 </xf:trigger>

</div>
```

2.7 *Velocity Page*

Velocity is a Java-based template engine. It permits web page designers to reference methods defined in Java code. Web designers can work in parallel with Java programmers to develop web sites according to the Model-View-Controller (MVC) model, meaning that web page designers can focus solely on creating a well-designed site, and programmers can focus solely on writing top-notch code. For more details take a look on page
`http://velocity.apache.org/engine/releases/velocity-1.5/user-guide.html`

For this purpose **@enterprise** provides a class *com.groiss.gui.VelocityPage*. More details about the usage of VelocityPage can be found in **@enterprise** JavaDoc.

Example:
This example shows how to use and set variables in a velocity page.

First a html-page (template) should be created (it is also possible to use ordinary text-files):

```
...
<h4>Current Threaduser of reserved variable and set by JAVA</h4>
Threaduser: $user / $username_by_java

<p/>
```

```
<h4>List all users of @enterprise</h4>
#foreach($u in $users)
   $u<br/>
#end

<p/>

<h4>Simple IF-selection for variable str</h4>
#if($str != 'str')
   $str
#end

<p/>

<h4>Read request parameter</h4>
$request.getParameter('vpparam')

<p/>

<h4>Read configuration parameter</h4>
$Configuration.get().getProperty('avw.license')
...
```

After creating a template, a JAVA method must be written to fill template variables:

```
public Page getVelocityPage(HttpServletRequest req) throws Exception {
   VelocityPage vp = new VelocityPage("masks/velocitypage.html");
   //set current thread user
   vp.set("username_by_java", ThreadContext.getThreadPrincipal());
   //list all @enterprise users
   vp.set("users",ServiceLocator.getStore().list(User.class));
   //set variable
   vp.set("str","MyString");
   return vp;
}
```

Finally call the JAVA method by entering following URL:

```
http://'host':'port'/'ctx'/servlet.method/
 'class'.getVelocityPage?vpparm=myreqparam
```

2.8 File Upload

On the client side, the client's browser must support form-based upload (Most modern browsers do). The form looks like:

```
<form enctype="multipart/form-data"
```

```
method="POST" action="/wf/servlet.method/com.groiss.demo.HttpDemo.viewFile">
<input type="file" name="mptest">
<input type="submit" value="upload">
</form>
```

The input type "file" brings up a button for a file select box on the browser together with a text field that takes the file name once selected.
When the user clicks the "Upload" button, the client browser locates the local file and sends it using HTTP POST, encoded using the MIME-type multipart/form-data. When it reaches your servlet, your servlet must process the POST data in order to extract the encoded file. You can learn all about this format in RFC 1867, [3].
There is no method in the Servlet API to do this. The @enterprise API provides the class `MultipartRequest` to handle multipart/form-data requests.
The file(s) are stored in temporary files in the file system of the server. The following method shows how to access to these files:

File **demo/com/groiss/demo/HttpDemo.java**

```
public void viewFile(HttpServletRequest req, HttpServletResponse res)
 throws Exception {
   MultipartRequest r = MultipartRequest.createInstance(req);
   File tmpfile = r.getFile("mptest");
   String str = FileUtil.getContent(tmpfile);
   int i = 1;
   PrintWriter w = res.getWriter();
   w.println("<html><pre>");
   for (StringTokenizer st = new StringTokenizer(str,"\r\n"); st.hasMoreTokens();)
      w.println(Integer.toString(i++) + st.nextToken());
   w.println("</pre></html>");
}
```

The method writes the content of the file to the browser together with a line number.
The class `MultipartRequest` is a wrapper around the `HttpServletRequest` and provides some other useful methods:

```
public abstract void addParameter(String name, String value);
public abstract void removeParameter(String name);
public abstract Cookie getCookie(String id);
```

`addParameter` adds a parameter name-value pair to the request; this can be used when calling servlet methods from other servlet methods. `removeParameter` removes a parameter.
`getCookie` allows direct access to a cookie without iterating over the cookie array.
Note, that you must call the `createInstance` method of `MultipartRequest` before you call any method of the ServletRequest that reads the parameters or content of the request.

2.9 Authorization

@enterprise allows the implementation of customer defined authorization schemes. The authorization class must implement the following interface:

```
public interface HttpAuth {
    public void sendLoginRequest(HttpServletRequest req,
        HttpServletResponse res) throws Exception;
    public Principal checkUser(String user, String passwd,
        String clientAddr) throws Exception;
}
```

Fig. 2.1 shows the interaction during the authorization phase.

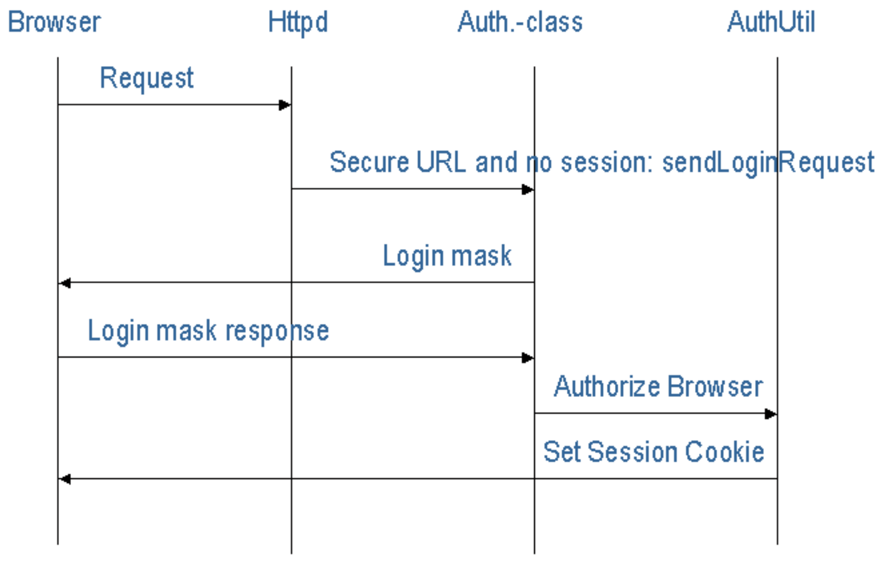


Figure 2.1: **Authorization**

As described in Section 2.1, the Dispatcher calls the `sendLoginRequest` method of the authorization class. This class either sends a login page to the browser or performs another action for finding out the user of the client. After it found out the user it should call the method `authorizeBrowser` of `AuthUtil` which sends the session cookie to the browser. The following examples show two implementations of the interface. The first one - `BasicPasswdAuth` - uses the basic Authorization of the HTTP protocol:

File **com/groiss/demo/BasicPasswdAuth.java**

```
package com.groiss.demo;

import java.security.Principal;
import javax.servlet.http.*;
import com.groiss.org.*;
import com.groiss.servlet.HttpAuth;
import com.groiss.util.Base64;

/** Check the password using BasicPasswdAuth
*/
public class BasicPasswdAuth implements HttpAuth {
    public void sendLoginRequest(HttpServletRequest req, HttpServletResponse res)
     throws Exception {
        String auth= req.getHeader("Authorization");
        if (auth != null && auth.startsWith("Basic ")) {
            auth = auth.substring(6);
            auth = new String(Base64.decode(auth));
            String userId = auth.substring(0,auth.indexOf(':'));
            String passwd = auth.substring(auth.indexOf(':')+1);
            try  {
                User u = (User)checkUser(userId,passwd,req.getRemoteAddr());
                AuthUtil.authorizeBrowser(req, res, u, req.getRequestURI() +"?"+
                    req.getQueryString());
                return;
            } catch (Exception e) {
                com.groiss.util.Settings.logError(e);
            }
        }
        res.setStatus(401);
        res.addHeader("WWW-Authenticate", "Basic realm=\"@enterprise\"" );
        res.getWriter().println();
   }


    public Principal checkUser(String userId, String passwd, String clientAddr)
            throws Exception {
        return AuthUtil.checkUser(userId,passwd, clientAddr);
    }
}
```

The method sendLoginRequest sends the status 401 (Not Authorized) to the client, which will open a login window and sends the login information to the server (base64 encoded user name and password). This information is used for checking the user and generating the session cookie.
The second example uses the login mask from the default `PasswdAuth` class but rewrites the user checking mechanism. The method `checkWinPassword` connects to a host with a FTP server and tries to login there. If it succeeds, the user is also authorized in @enterprise.
The class is a subclass of the default Authorization class `com.groiss.org.PasswdAuth`.
File **com/groiss/demo/WinPasswdAuth.java**

```
package com.groiss.demo;

import java.io.InputStream;
import java.net.URL;
import java.net.URLConnection;
import java.security.Principal;

import com.groiss.component.Configuration;
import com.groiss.org.AuthUtil;
import com.groiss.org.PasswdAuth;
import com.groiss.org.User;
import com.groiss.util.ApplicationException;
import com.groiss.wf.ServiceLocator;
```

```
/** Check the password against windows domain controller using the
* ftp service.
*/
public class WinPasswdAuth extends PasswdAuth {
    static String winhost = "cuzco";

    public Principal checkUser(String userId, String passwd, String clientAddr)
            throws Exception {
        User user;
        // don't connect to the database when sysadm
        if (userId.equals("sysadm")) {
            return AuthUtil.checkUser(userId, passwd, clientAddr);
        } else {
            user = (User)ServiceLocator.getOrgData().getById(
                com.groiss.org.User.class, userId);
            if (user == null) {
                throw new ApplicationException(null,56);
            }
            checkWinPassword(userId, passwd);
        }
        return user;
    }


    /** Try to make a ftp connection to auth host
    */
    private void checkWinPassword(String userId, String passwd) throws Exception {
        try {
            URL url = new URL("ftp://"+userId+":"+passwd+"@"+winhost+"/");
            URLConnection urlc = url.openConnection();
            InputStream is = urlc.getInputStream();
            is.close();
        } catch (Exception e) {
            throw new ApplicationException(
               "Authentification on host "+winhost+" failed for user "+userId);
        }
    }
}
```

3 Persistence Layer

The persistence layer of @enterprise has been defined to hide the complexities of reading and updating objects in a relational database. The underlying mechanism uses the Java Database Connection, the standard interface between Java and Relational Database Management Systems.
The classes and interfaces described in this chapter belong to the package `com.groiss.store`.

3.1 Database Connection Pool

The management of the database connections is done by the class `DBConnPool`. On startup the system initializes a pool of connections to the relational database. The number of connections and some other settings are specified in the system configuration.
Normally you don't have to deal explicitly with database connections. When an API call needs a database connection, it reserves one for the thread. As long as the transaction lasts, this connection is used.
If you want to get a database connection to perform JDBC operations directly, you get one with the method call `DBConnPool.getConnection()`. Multiple calls of this method in the same transaction will return the same connection.
Some words about transactions: Every servlet method in @enterprise is executed in a transaction context. Before the method is called a transaction is started and after the method has completed, the transaction is committed - on error a rollback is performed. When methods perform database operations, operations in the same thread use the same transaction and the same database connection.

3.2 Persistent Objects

For making Java objects persistent we have defined the interface `Persistent` and the corresponding abstract class `PersistentObject` implementing the interface. A member of a class implementing this interface has a corresponding tuple in a database table. The fields of the class have a corresponding column value in the database tuple. For reading objects from and writing to the database the service `Store` is used. This is an interface, with the call `ServiceLocator.getStore()` you get an instance of it.
Let's first take a closer look at the `Persistent` interface:

```
public interface Persistent {

    public long getOid();
    public void setOid(long oid);

    public void setFilled(boolean f);
    public boolean isFilled();

    public Store getStore();
    public void setStore(Store s);

    public String getTableName();

    public List<Field> dbFields();

    public void onInsert();
    public void onUpdate();
    public void onDelete();
    public void onRead();
}
```

Every object has a unique object id (`oid`), the getter `getOid()` retrieves this oid. The setter `setOid` should be used by the persistence mechanism only.
The object is filled, when the field values are set to the corresponding values in the database.
Each object knows its store and the store can be set. This is not necessary, if your program uses one database.
The method `getTableName` returns the name of the database table. This is the only method not implemented by `PersistentObject`, therefore you have to implement it in your class.
The method `dbFields` returns a list of Field objects, containing the class' fields which have corresponding fields in the database. The default implementation returns all fields which are neither static, volatile, nor transient.
The columns of the database table must have the same names as the fields of the Java class and the types must be compatible. The column oid is used for the object identifier. Its type is decimal(20) and it should be defined as primary key.
Compatible types are shown in the following table:

SQL Type	Java Type
char	String
varchar	String
decimal(x)	int,long
decimal(x,y)	float,double
longvarchar	String, char[]
longvarbinary	byte[]
date	Date
time	Date
timestamp	Date
decimal(20)	Persistent

The entry in the last row shows that you can define fields which refer to other persistent objects. The type of the field must be a class or interface implementing (or extending) the Persistent interface. If the objects for this field are not all from the same class, you must add a database field for the name of the objects class. This field is named like the Java class field with "_class" appended.
The store uses the following rule to decide whether a "_class" field is present: If the type is an interface or is an abstract class or implements the interface `HasSubclasses`, a "_class" field is expected.
The methods `onInsert, onUpdate, onDelete`, and `onRead` are called when the respective database operations are performed. They allow to add custom code to these operations.
The store interface provides, among others, the following methods for manipulation of persistent objects:

- `void insert(Persistent o)`: inserts the object into the database, assigns a unique oid,
- `void update(Persistent o)`: stores the (changed) object in the database,
- `void delete(Persistent o)`: deletes the object from the database,
- `Persistent get(Class c, long oid)`: reads an object from the database, where the oid is known.
- `Persistent get(Class c, String cond)`: The cond String is an SQL expression, the method returns the object matching the query where the cond argument is used as *where* clause.
- `Persistent fill(Persistent o)`: fills the object with the values from the database, the oid must be already set.
- `List<P> list(Class c)`: return all members of the class stored in the database.
- `List<P> list(Class c, String cond)`: cond is again a where clause, the method returns all matching objects.
- `List<P> list(Class c, String cond, String order)`: like above, the second argument contains one or more order attributes (separated by commas).
- `List<P> list(Class c, String cond, String order, Object[] bindVars)`: The additional object array contains bind variables, each question mark in the condition string is substituted by a value from this array.

Example: For a reservation system we define the class `Item`, which contains some information about reservable items:

```
public class Item extends PersistentObject {
    private String name;
    private String description;
    private int maxuse;

    public String getTableName() { return "res_item"; }
```

The class contains some fields for storing details about the item and the method `getTableName`, which returns the name of the database table.
The table must be generated using an SQL statement like this (in Oracle syntax):

```
create table demo_address (
  oid decimal(20) primary key,
  name varchar(100),
  description varchar(100),
  maxuse decimal(10)
);
```

A second class, `ItemRelation`, describes the user-reserves-item relation:

```
public class ItemRelation extends PersistentObject {
    private Item item;
    private User userid;
    private Date fromDate;
    private Date toDate;

    public ItemRelation() {}

    public ItemRelation(Item res, User user, Date from, Date to) {
        this.item = res;
        this.userid = user;
        this.fromDate = from;
        this.toDate = to;
    }

    public Item getItem() { return item; }

    public User getUser() { return userid; }

    public Date getFromDate()  { return fromDate; }

    public Date getToDate()  { return toDate; }

    public String getTableName() { return "res_itemrel";}
}
```

The database table for this class:

```
create table res_itemrel (
    oid decimal(20) primary key,
    item decimal(20),
    userid decimal(20),
    userid_class varchar(100),
    fromDate date,
    toDate date
);
```

Note that the fields item and userid hold the oids of an item object and a user object respectively. Because the field userid is of type `com.groiss.org.User` and this is an interface, we need the additional table column `userid_class`.

3.3 Lazy filling

When reading an object from the database, using one of the `get` or `list` methods of the store, the fields of the objects are filled with the values from the database. For fields containing persistent objects, the objects are created with the given `oid`, but the other fields have default values and the method `isFilled()` will return false.
If, for example, we read an object of the class ItemRelation from the database, the method `getItem()` applied to this object would return an object containing the oid but other fields will have their default values (0 or null). Calling `fill` on this object will set the values.
This behavior is important if you have nested object hierarchies. If you navigate through the objects you have to fill them after calling getter methods. However, it belongs to the developer to insert the fill methods into the getters, like in the following example:

```
public String toString() {
    try {
        ServiceLocator.getStore().fill(this);
    } catch(ApplicationException e) {
        throw new ApplicationRtException(e);
    }
    return name;
}
```

The `toString` method returns the name and ensures that the object is filled.

3.4 Optimistic Locking

If two threads want to change an object at the same time, one thread will overwrite the change the other thread made. To prevent these "lost updates", we implemented the optimistic locking mechanism: With each object a transactionid is stored, every update increases this transactionid and checks if it has the correct transactionid. If it does not have the correct id, an update occurred since it read the object from the database. In this case an error is thrown.
For using optimistic locking with your objects you must do two things: First, your class must implement the interface `OptimisticLocking`, secondly your database table must contain the decimal field `transactionid`.

3.5 PersistentEventHandler

This interface provides a hook for some action when an object is inserted, updated or deleted. The methods onInsert, onUpdate, and onDelete are called before the database operation is performed but after the corresponding methods of Persistent are called. Register your event handler using `StoreUtil.addEventHandler`.

4 Utilities and Data Structures

@enterprise provides some utility classes for working with files, strings or date objects as well as some data structures.

4.1 Data Structures

The data structures belong to the package `com.groiss.ds`.

4.1.1 KeyValuePair

The interface `KeyValuePair` is implemented by some classes like `PersistantObject`, which have a unique key (object id) and a value - the object itself or a string representation. We use it, for example, for representing objects in select lists.

4.1.2 Pair

The `Pair` is a simple class containing two objects. The class also implements the interface `KeyValuePair`, where the first object is returned with `getKey`, the second with `getValue`.

4.1.3 MultiMap

MultiMap is like a HashMap but can map a key to more than one value.

4.1.4 KeyedList

This class implements an ordered map. A list of keys is mapped to a list of values. The values can be accessed by the key or the position in the list. A small example should demonstrate the usage:

```
List l1 = Arrays.asList(new String[]{"a","b","c"});
List l2 = Arrays.asList(new String[]{"v1","v2","v3"});
KeyedList kl = new KeyedList(l1,l2);
// get the second value v2
Object x = kl.get(1);
// or get v2 by its key
Object y = kl.get("b");
```

4.1.5 CountedSemaphore

A counted Semaphore is used for controlling the number of threads entering a critical section. When constructing the semaphore object you specify two bounds: The first value defines how many threads can enter the critical section concurrently, the second value defines how many threads will wait for the resource until an exception is thrown (`QueueFullException`).
The clients call two methods: the method `P` for entering the critical section and the method `V` for leaving it. The waiting threads are handled in FIFO order.
Example:

```
// create a semaphore for two concurrent threads and three waiting threads.
static CountedSemaphore s = new CountedSemaphore(2,3);

public void foo() throws Exception {
   s.P();
   try {
     // make some complicated computations
   } finally {
      s.V(); // call V in finally guarantees that it is called
   }
}
```

4.2 StringUtil and FileUtil

The class `StringUtil` provides some convenient methods for Strings and the class `FileUtil` for files. See the API for details.

4.3 Date/Time Handling

4.3.1 CalUtil

Whenever the system reads and writes a date, the class *com.groiss.cal.CalUtil* is used. The format for conversions is defined in the system administration. Two formats exist: one for date only, one for date and time. The method `parse` converts a String to a Date object, trying both formats. The method `showDate` shows the date, `showDateTime` the date and time of the given `Date` object.
The class CalUtil allows you to get instances of *SimpleDateFormat* or the class defined in @enterprise configuration (*Configuration* → *Localization* → *Dateformat Class*). These instances are cached per Thread, are localized and adapted to ThreadContext-timezone (excepting some default patterns, e.g. ISO, RFC, etc.). For further information about patterns see *http://www.icu-project.org/apiref/icu4j/com/ibm/icu/text/SimpleDateFormat.html*

4.3.2 Holidays

In the system administration a class specifying the holidays can be defined. It must implement the following interface:

```
public interface com.groiss.cal.Holidays {
    public String isHoliday(GregorianCalendar d);
}
```

The method isHoliday returns null when the day represented by the Calendar object is a holiday, otherwise it returns the name of the holiday, for example "Easter Sunday".
The implementing class is used in the `CalUtil` methods `addWorkdays, isHoliday`, and `workdaysBetween`. Additionally, it is used in calendar used for entering dates, for example when setting a deadline.
The distribution contains the class `com.groiss.cal.impl.AustrianHolidays` with the following implementation of `isHoliday`:

```
public String isHoliday(GregorianCalendar d) {
    int day = d.get(d.DAY_OF_YEAR);
    int year = d.get(d.YEAR);
    switch ( d.isLeapYear(year) ? day - 1 : day ) {
        case 121: return "Staatsfeiertag";
        case 227: return "Maria Himmelfahrt";
        case 299: return "Nationalfeiertag";
        case 305: return "Allerheiligen";
        case 306: return "Allerseelen";
        case 342: return "Maria Empfängnis";
        case 359: return "Christtag";
        case 360: return "Stephanitag";
    }
    int easter = CalUtil.easterDay(year);
    if (day == easter) return "Ostersonntag";
    else if (day == easter + 1) return "Ostermontag";
    else if (day == easter + 39) return "Ch. Himmelfahrt";
    else if (day == easter + 49) return "Pfingsten";
    else if (day == easter + 50) return "Pfingsmontag";
    else if (day == easter + 60) return "Fronleichnam";
    else if (day == 1) return "Neujahr";
    else if (day == 6) return "Hl. 3 Könige";
    return null;
}
```

The floating holidays depend on the date of Easter, the method `easterDay` in `CalUtil` can be used here. We use the formula from Gauss, note that the result doesn't match the Greek-orthodox Easter.
For Germany use the implementation `com.groiss.cal.impl.GermanHolidays`.

4.3.3 Application dependent calendar-events

The @enterprise calendar-component can be extended to fetch events from custom sources. To specify your own calendar source, provide the configuration-parameter *cal.applications* in your system-configuration file. This property contains a comma separated list of classes

implementing the *com.groiss.cal.CalInfo*-interface. Please note that it's recommended to extend *com.groiss.cal.CalInfoAdapter*.
The following default implementations are shipped with @enterprise:

- *com.groiss.calendar.CalendarAppl*: returns custom events inserted by a user
- *com.groiss.calendar.wf.DueTasks*: returns all tasks which have to be finished at the given date
- *com.groiss.calendar.wf.FinishedTasks*: returns all finished workflow tasks

If you want to register your CalInfo-implementations programmatically, use com.groiss.cal.CalRegistry.

4.4 *ThreadContext*

The `ThreadContext` class contains some ThreadLocal variables, which are set by the `Dispatcher` servlet and can be retrieved from any method:

- `getThreadPrincipal()` returns the user of this thread. The method returns a `java.security.Principal` object, which can be casted to a `com.groiss.org.User` object.
- `getThreadLocale()` returns the locale of the thread: This is either the locale of the user, or if the thread is not assigned to a user, the default locale defined in the system configuration.
- `getSessionId()` returns the id of the user session.
- `isPrivileged()` returns true if the session is privileged. Privileged sessions are allowed to open additional database connections, if all connections are used. A thread belonging to the user `sysadm` is privileged.
- `getThreadRequest()` returns the `HttpServletRequest` object from the thread.
- The methods `setAttribute`, `getAttribute`, `removeAttribute`, and `getAttributeKeys` can be used to add arbitrary attributes to the ThreadContext object.
- The method `getSessionType` returns the type of the session, either HTTP, RMI, or internal.
- Client Certificates: The ThreadContext holds the client certificates, if the RMI communication requires a client authentication. The certificates of the client are set automatically and can be read from the attributes with the key `java.security.cert.X509Certificate` (returns an array of X509Certificates).

The following method from `HttpDemo` can be called to check the environment:

File **classes/com/groiss/demo/HttpDemo.java**

```
public void showThreadContext(HttpServletRequest req, HttpServletResponse res)
        throws Exception {
    PrintWriter w = res.getWriter();
    w.println("<html><pre>"+
        "\nUser: " + ThreadContext.getThreadPrincipal() +
        "\nLocale: " + ThreadContext.getThreadLocale() +
        "\nSession: " + ThreadContext.getSessionId() +
        "\nPrivileged: " + ThreadContext.isPrivileged() +
        "\nRequest: " + ThreadContext.getThreadRequest() +
        "</pre></html>");
    }
```

4.5 Logging

@enterprise writes logging output to a log file. An interface `com.groiss.log.ILogger` defines the methods of the logging mechanism and allows you to write your own logging mechanism. The default implementation is `com.groiss.log.Logger`.
Most important is the following method:

```
log(String message,int level)
```

It writes the message string to the log file, if the given level is equal or less than the log level of the Logger. In the system configuration you can define the logger class and the logging properties.
It is inconvenient to first get the logger object and then call the log method on it, therefore we defined the static log method in the `Settings` class (package `com.groiss.util`). It has the same signature than the log method above.
The format of each output line is as follows:

- log level
- thread name
- date
- time
- your message

Example:

```
1 http-5 2000-08-04 14:15:19.962 10.205.112.10 - GET /pr/images/d.gif
```

4.6 Timer

One of the services @enterprise provides is the timer service. You can schedule your tasks and specify the interval, thread, etc.

Your timer task must implement the `TimerTask` interface. It contains the two methods `run` and `abort`. The `run` method is called when the timer task should be executed, `abort` is never called and for future use.
The following example shows a timer which restarts the log-file periodically and zips the old files.

```
import java.io.*;
import java.util.zip.*;
import javax.servlet.http.*;

import com.groiss.timer.*;
import com.groiss.util.*;
import com.groiss.log.*;

/** A timer for restarting the logger.
*/
public class LogTimer implements TimerTask  {

    public void run(TimerEntry te, String args) {
        try {
            Settings.getLogger().restart();
        } catch (Exception e) {
            Settings.logError(e);
        }
    }

    public void abort () {}

}
```

A logger which zips the old entries:

```
import java.io.*;
import java.util.*;
import java.text.*;
import java.util.zip.*;
import javax.servlet.http.*;

import com.groiss.timer.*;
import com.groiss.util.*;
import com.groiss.log.*;

/** A logger class which zips the old log files
*/
public class ZipLogger extends Logger {
    SimpleDateFormat fm = new SimpleDateFormat("yyyyMMddHHmm");
    public void restart() {
        try {
            // restart the parent
            super.restart();
            // the current and previous log file
            File f = getLogFile();
            File f2 = new File(f +".1");
            if (!f2.exists())
                return;
            // Create a buffer for reading the file
            byte[] buf = new byte[1024];

            // Create the ZIP file
            String outFilename = f + fm.format(new Date()) + ".zip";
            ZipOutputStream out = new ZipOutputStream(
              new FileOutputStream(outFilename));
            FileInputStream in = new FileInputStream(f2);

            // Add ZIP entry to output stream.
            out.putNextEntry(new ZipEntry(f+".1"));

            // Transfer bytes from the file to the ZIP file
            int len;
            while ((len = in.read(buf)) > 0) {
                out.write(buf, 0, len);
            }

            // Complete the entry
            out.closeEntry();
            in.close();
            // Complete the ZIP file
            out.close();
            f2.delete();
        } catch (Exception e) {
            Settings.logError(e);
        }
    }
}
```

We extend the standard Logger and rewrite the restart method. The restart method of the parent is called and will copy the old log to a file named *logfilename*.1. We zip this file, add a timestamp to the filename and delete the unzipped file.

4.7 Beans

In @enterprise it is possible to implement Beans which are handled by *com.groiss.component.BeanManager*. The Bean must implement the interface *javax.ejb.SessionSynchronization*. Following 3 steps are necessary for the integration and usage in @enterprise:

1. `Write your own Bean`: Following *DemoBean* has a method to store DMS documents in a temporary folder. At the end of transaction (could be initiated by the call *BeanManager.commit()*) the methods *beforeCompletion()* and *afterCompletion()* are called. In our *DemoBean* we delete all files created in temporary folder after successful transaction.

```
import java.io.File;
import java.io.FileOutputStream;
import java.rmi.RemoteException;

import javax.ejb.EJBException;
import javax.ejb.SessionSynchronization;

import com.groiss.dms.DMSDocForm;
import com.groiss.util.ApplicationException;
import com.groiss.util.Settings;

public class DemoBean implements SessionSynchronization{

    private String TMP_FOLDER_PATH = Settings.getBaseDir() + "/files";

    /**
     * Method to store document in temporary folder
     * @param doc the DMS document to store
     * @throws Exception
     */
    public void storeDocument(DMSDocForm doc) throws Exception {
        File folder = new File(TMP_FOLDER_PATH);
        if(!folder.exists()) {
            folder.mkdir();
        }

        String filename = doc.getName() + "." + doc.getExtension();
        Settings.log("DemoBean.storeDocument: " + filename , 0);

        File f = new File(TMP_FOLDER_PATH, filename);
        if(!f.createNewFile()) {
            throw new ApplicationException("File " +
             filename + " could not be created!");
        }
        FileOutputStream out = new FileOutputStream(f);
        out.write(doc.getContent());
        out.close();
    }
    @Override
    public void beforeCompletion()
            throws EJBException, RemoteException { /* empty */ }


    @Override
    public void afterBegin()
            throws EJBException, RemoteException { /* empty */ }


    /**
     * Delete all files which were created in temporary folder
     */
    @Override
    public void afterCompletion(boolean arg0)
            throws EJBException,RemoteException {
          Settings.log("DemoBean.afterCompletion", 0);
          File folder = new File(TMP_FOLDER_PATH);
          File [] files = folder.listFiles();
          for(int i = 0; i < files.length; i++) {
              files[i].delete();
          }
    }

}
```

2. `Register the Bean`: This could be done e.g. at application startup (see section 9.3 for more details) by using following call:

   ```
   BeanManager.addBean("DemoBean", DemoBean.class);
   ```

3. `Use the Bean`: Our *DemoBean* has the method *storeDocument()* which allows to store a DMS document on file system. Before we could call this method we have to get the Bean with the BeanManager like in following way. A possibility to finish a transcation is the usage of *BeanManager.commit()*:

   ```
   DemoBean db = (DemoBean)BeanManager.getBean("DemoBean");

   //code to get DMS document(s)
   ...
   db.storeDocument(doc); //store document on file system
   ...

   try {
   ```

```
    //code to handle file(s)
    ...
    BeanManager.commit(); //calls beforeCompletion() and afterCompletion()
  } catch (Exception ex) {
    BeanManager.rollback();
  }
```

More details about the *BeanManager* could be found in the @enterprise API!

4.8 Resource Files

It is possible to change the labels and messages of @enterprise by writing your own resource files. @enterprise uses the mechanism of "ResourceBundles" of Java for translating language-dependent texts. See the Java documentation of java.util.ResourceBundle for details on how this works.
@enterprise uses two ResourceBundles

`<ephome>/classes/com/dec/avw/resource/Errors` for error messages and
`<ephome>/classes/com/dec/avw/resource/Strings` for label, messages and other texts.

The default versions contain the texts in English, the german versions, with the suffix "_de" contain the german texts. Other language dependent resource files may follow.
You can define resource files for country dependent locales, for example a file Strings_de_AT and overwrite selectively the labels you want to change.
Example:

```
finish=Senden
take=Übernehmen
```

This file overwrites the labels for finish and take, it has an effect for all users with Locale de_AT. You have to put the file in the class path of @enterprise, for example:

```
<ephome>/classes/com/dec/avw/resource/Strings_de_AT.properties
```

4.9 Error Handling

If your servlet code throws an Exception or Error, an error page will be displayed. This page contains the following message:

- the message from the exception itself, if the exception is an instance of `com.groiss.util.TopLevelException`.
- The standard message "An internal error occurred. Please contact the system administrator!" is shown otherwise.

Two classes implement the TopLevelException interface. The first, ApplicationException, is a subclass of Exception, the second, ApplicationRtException, is a subclass of RuntimeException.
All @enterprise errors have an error number as key, the key for the standard message is "unknown". You can change the text by defining a resource file for the Errors bundle for your Locale (see section above).
If you want to change the error page as a whole, you can implement an `ErrorFormatter` (package `com.groiss.gui`):

```
public interface ErrorFormatter {
   public Page format(java.lang.Throwable e);
}
```

This interface defines how to format the exceptions. The default implementation is the `DefaultErrorFormatter` in the same package. You can set the ErrorFormatter in the configuration (Classes page), default is the `DefaultErrorFormatter`. The class ApplicationException has a the method `setErrorFormatter` where you can set your own formatter class for a single exception.

5 Structure of Applications in @enterprise

The integration of applications is one of the main tasks of workflow systems. In this chapter we show how @enterprise applications should be structured to make installation and maintenance easy.
Our design goals were:

- Simple installation/un-installation of applications
- Support for upgrade of applications
- Independence of applications and @enterprise versions
- Support of startup and shutdown functions

5.1 Organization of Files

Application programs should not reside in the same directory as the @enterprise installation. A typical structure can be as follows:

```
/app/ep_Vx
/app/ep_Vy
/app/ep-appl1
/app/ep-appl2
```

Under the directory `app` there are two versions of @enterprise (ep_Vx and ep61_Vy) and two directories containing applications (ep-appl1, ep-appl2).
Equally important is the internal structure of application files. Typically, an application contains:

- jar files for application classes and additional libraries,
- static HTML pages, probably language dependent,
- HTML masks, loaded from the code,
- configuration file(s),

- other: export files, documentation, database scripts.

We suggest the following internal structure for applications:

appli/lib/	jar files
appli/classes/	Java-classes
appli/classes/alllangs/	language independent files (HTML, ..)
appli/classes/lang/<language>/	language dependent files and images
appli/classes/appli/properties.xml	property-file for application- and user-parameter
appli/classes/appli/import.xml	import-definition for file importer (see *System Administration Guide* - section *File Import*)
appli/classes/appli/reporting.xml	reporting definition containing needed information about the pool of data which can be used in reports (see *Reporting* manual - section *Schema* in chapter *Developers Guide*)
appli/classes/appli/styles.css	The **@enterprise** styleloader loads the file (depending on startup sequence of the application) and appends it to *avwbasic.css*
appli/appl.prop	configuration file

HTML masks used in servlet functions are loaded from the classpath and are located either in the `lib` or the `classes` directory. In the classloader the jar-files are sorted alphabetically for each path.
When you specify the application path in the corresponding field of the application entry in the system configuration, the `classes` directory and the jar files in the `lib` directory are added to the classpath. The `classes` directory is in the classpath before the jar files, so you can shadow classes in the jar files.
We recommend to build a jar file containing application classes and HTML masks and putting this jar file in the `lib` directory of your application. Thus, future application updates can be done by simply exchanging one single file. The `classes` directory is useful during application development, because you don't need to build and replace a jar file every time you compile your code.

5.2 *The Configuration File*

The configuration file `appl.prop` contains key-value pairs in the syntax of a Java property file. The configuration file contains two kinds of parameters: First, @enterprise reads some parameters when an application is installed. The second group of parameters is only used within the application. The first group of parameters contains:

avw.application.id: The id of the application,

avw.application.name: A name for the application,

avw.application.docu: Location of application documentation (see section 5.4 for details).

avw.export.file: The name of the export file (e.g. export.xml).

On startup, @enterprise reads the configuration file and keeps it in memory. With the configuration API the parameters can be read and set (package `com.groiss.component`). A `Configuration` object holds the parameter values of an application. To get this object call:

```
Configuration conf = Configuration.get("appl-id");
```

The parameter values are then retrieved and set with the following calls:

```
conf.getProperty(name);

conf.setProperty(name, value);
```

If parameter values have been changed in file *appl.prop* without using the GUI, the function *Reload Configuration* (can be found under *Administration* → *Admin-Tasks* → *Server* → *Server Control*) allows to load the changes and transfer the changed values into the `Configuration` object. After loading the method *reconfigure()* is called for each service (and each application where application class implements the interface `com.groiss.component.Service`). The name of the changed properties can be retrieved by using the method ThreadContext.getAttribute("changedParams") which returns a list of strings.

For further information of the methods of `Configuration` class see the API description.

The second group of parameters can be pre-defined in a XML-file called *properties.xml*. This file contains the properties, which are displayed in *Configuration* or (User-)*Settings* of @enterprise. The values of *Configuration* are stored in *appl.prop*, the user-settings in database-table *avw_userprops*.

Hint: For editing the file *properties.xml* please use the property-editor of @enterprise. This editor can be found as own tab of the application-object (see *System Administration Guide* - section *Applications*).

Example for *properties.xml*:

```
<application>
  <parametergroup name="ITSM">
    <property label="Start Org.unit" type="String"
     name="start.dept" needsrestart="true">
    </property>
    <property label="Start process" type="String"
     name="mail.start_process" defaultvalue="incident_management"
     needsrestart="true">
    </property>
    <property label="Mail sender" type="String"
     name="mail.sender" needsrestart="true">
    </property>
    <property label="Mail subject prefix"
     type="String" name="mail.subject.prefix"
     needsrestart="true">
    </property>
    <property label="BCC recipient" type="String"
     name="bcc.recipient" needsrestart="true">
    </property>
    <property label="Mail notification text"
     name="mail.notification.text" needsrestart="true">
      <components type="textarea" />
    </property>
    <property label="Mail receipt text"
     name="mail.receipt.text" needsrestart="true">
      <components type="textarea" />
    </property>
    <property label="Release info text"
     name="release.info.text" needsrestart="true">
      <components type="textarea" />
    </property>
    <property label="Auto receipt"
     name="auto.receipt" type="Boolean"
     needsrestart="true">
    </property>
    <property label="Trusted domains"
     name="trusted.domains" needsrestart="true">
      <components type="textarea" />
    </property>
  </parametergroup>
  <userprops>
    <property label="Signature" name="signature" needsrestart="false">
     <components type="textarea" />
    </property>
  </userprops>
  <resource strings="" errors=""></resource>
</application>
```

The property-file starts and ends with an *application*-tag. Between this tags you can define

- parametergroup (displayed as section in *Administration* → *Configuration*)
- userprops (displayed as group in *Worklist* → *Extras* → *Settings*)
- resources (plus error-resources)

A parametergroup should contain a *name*-attribute which represents the link in the navigation-tree of *Configuration*. Within the parametergroup and userprops the *property*-tags can be set, which symbolizes the property. The keywords *name* and *type* must be defined, *label* is optional (only for representation in GUI). Additionally a *defaultvalue* can be set within the *property*-tag. The keyword *needrestart* defines, if the server has to be restarted or not when property is set via GUI. The *components*-tag allows to define other html-elements like password-fields, select-lists, textareas, links, etc. @enterprise uses also a default property-file (stored in *conf*-folder), where you can see the definition of all @enterprise properties (values stored in *avw.conf*), but **DO NOT CHANGE THIS FILE!**

Following example shows, how to define different html-elements (snippet of *parametergroup*-tag):

```
<property label="Textfield name="example.textfield">
<components type="textfield" size="40" />
</property>
<property label="Password" name="example.password">
<components type="password" />
</property>
<property label="Textarea" name="example.textarea">
<components type="textarea" />
</property>
<property label="Checkbox"
name="example.checkbox" type="Boolean">
</property>
<property label="Dropdown-List"
name="example.dropdownlist" type="Integer"
defaultvalue="0">
 <restriction>
<enumeration value="0" name="v1" />
<enumeration value="1" name="v2" />
<enumeration value="2" name="v3" />
 </restriction>
</property>
<property lable="Select-List" name="example.selectlist">
<components type="selectlist" multiselect="true" />
<restriction>
<enumeration value="1" name="sunday" />
<enumeration value="2" name="monday" />
<enumeration value="3" name="tuesday" />
<enumeration value="4" name="wednesday" />
<enumeration value="5" name="thursday" />
<enumeration value="6" name="friday" />
<enumeration value="7" name="saturday" />
</restriction>
</property>
<property label="Class Checker" name="example.classchecker">
<components>
<a href="javascript:ep.admin.checkClass('example.classchecker',
'aimg','instanceof java.lang.Object')">
<img id="aimg" src="../images/cpcheck.gif" />
</a>
</components>
</property>
```

5.3 The Application Class

The application class contains methods for startup, shutdown, and other control operations of the application. The interface `com.groiss.component.Service` (a sub-interface of `Service`) contains the following methods:

```
public void startup() throws ApplicationException;

public void shutdown() throws ApplicationException;

public boolean isRunning() throws ApplicationException;

public void reconfigure() throws ApplicationException;
```

The first two methods are called on startup respective shutdown of the server. The method `isRunning` can be called to find out whether the application is running or not (whatever this means in the context of the application).
There is a default implementation of the application interface, the `ServiceAdapter` class. It contains empty method bodies. We strongly recommend to extend the adapter instead of implementing the interface: Future extensions of the interface (addition of methods) can make your implementation incomplete whereas the Adapter class will always implement the necessary methods.
Another class, `DefaultApplicationAdapter` provides a default implementation of the `ApplicationAdapter` interface, which contains some methods to tailor the behavior of an application. You can define such a class and register it in the application administration (field application class).

5.4 Documentation of Applications

You can add a documentation page to your application by specifying a property with the key `avw.application.docu` in the application's `appl.prop` file. @enterprise will search for the documentation in the classpath, so you must add it either to the `classes` directory or to the application jar file in the `lib` directory. Here comes an example for the property:

```
  avw.application.docu=demodoc/index.html
```

When a user clicks on `Help` and `Content`, the system searches for @enterprise and application documentation. If at least one application documentation is found, a selection page will be shown, where the user can choose either the system documentation or an application documentation. The application documentation links to the location specified in the above mentioned property. There you can provide HTML help pages or links to pdf-files or whatever you prefer.

5.5 Internationalization of Applications

@enterprise offers the possibility to add your own resource bundles to your applications. For internationalizing your application following steps are necessary:

1. **Definition:** A resource bundle for the strings (and error) messages of the application must be defined (see section 4.8).
2. **Configuration:** The resource bundle must be added to the application (see *System Administration Guide* - section *Applications*).
3. **Usage:** There are different ways to use the resource bundle:
   - `Resources loaded by @enterprise`: Use the placeholders "@@@" e.g. in forms or gui-configuration (see section 10.2.5 for using placeholders in gui-configuration). All strings beginning with "@@@" and ending with "@@" are interpreted as translation labels. They are substituted using the resource bundle (using the labels of the template as keys in the resource bundle).

     Example for forms:

     ```
     <input type="button" value="@@@close@@">
     in locale en_US: <input type=button value="Close">
     in locale de_AT: <input type=button value="Schließen">
     ```
   - `Resources loaded by FileServlet (images, scripts, HTML pages)`: This resources are loaded from alllangs directory in classpath or loaded from language specific directory (see section 5.9). Use the placeholders "@@@" as described above.
   - `Java Code`: In code resources can get by using the ApplicationAdapter to get the Resource object (see section 9.3 for more details). If the keys of a HTML-page should be translated, load the HTMLPage object like in following example (see section 2.4 for more details).

     Example:

     ```
     ApplicationAdapter applclass =
       (ApplicationAdapter)ServiceLocator.getOrgData().getById(
       Application.class,"staffprocs").getApplicationClass();
     Resource res = applclass.getResource();
     String key = res.getString("key"); //translation key without @@@
     HTMLPage p = new HTMLPage("hrmasks/info_vacation_added.html", res);
     ...
     ```

5.6 *Startup and Shutdown*

On startup of an application the system performs the following steps:

- Add the jar files to the lib directory and the classes directory to the classpath.
- Load the configuration file.
- Execute the startup method of the application class.

5.7 *Installation*

The installation of an application is done in two steps:

- First, copy the files to the destination directory.
- Secondly, create an application object, specify the id, name and installation directory of the application.

On insert of the application object, the classpath is altered, the application loaded and the application is started.
A second possibility to add an application is to pack the application into a jar or zip file and load it onto the server. This is done via the "Install Application" function in the administration task list.

5.8 *Upgrading/Patching*

Detailed information on how to apply a patch to an application can be found in the system installation manual.

5.8.1 Creating patch archives

A custom patch file has to meet following standards: The technical format of a patch archive is a ZIP-archive. It incorporates the individual new build numbers of the files to be patched, along with two additional files (version,changes) which describe the patch and the needed actions.

version

This file describes the build number of the patch and can also be used to specify a minimum required application build number to be installed before the patch can be applied.
The following parameters are supported:

new: Describes the build after applying the patch. This parameter is required.

base: Describes the minimum required build number. This parameter can be used if you want to release service-packs.

base-file: You can specify a pattern for a jar-file, which is used to determine the currently installed version of an application. Wildcards (*) can be used.

Example for file *version*:

```
new:4.7.1.1
base:4.7
base-file:lib/itsm-*.jar
```

Because not every patch may be applicable for each installation, the mechanism compares the currently installed build to the build number of the patch and the minimum required build.
The installed build is retrieved from the file you specified with the *base-file* parameter. E.g. if you set the parameter to lib/itsm-*.jar, a file is searched in the application-directory matching that pattern. So if you have a file named itsm-1.0.jar in your lib folder, this file is used.
The patch mechanism can use two mechanisms to determine the version of the file.

Manifest: A parameter named *Implementation-Version* is expected to be in your reference-file's manifest file.

Filename: The build number is determined using the reference-file's name. The part between the last '-' sign and the file-ending (.jar) is considered to be the version identifier.

Regardless where you prefer to store your build information, the build has to consist of several numbers separated by a dot (e.g. *4.7.1.1*).
Please note: If the currently installed build cannot be determined, the patch will not be applied.

changes

This file describes the required actions. Following actions are supported:

Copy Copies the file from the patch-archive to the given location. If the file doesn't exist, it will be created. If the file exists but is the same as the file in the patch (checksum comparison) , no action will be performed.

Delete Deletes the specified file (if present).

One file has to be specified per action. Each action has to be in a separate line.

Example for file *changes*:

```
Copy:lib/docu_it.jar
Delete:classes/MyForm.html
Copy:lib/itsm-1.0.2.jar
...
```

5.9 Mapping of URLs to files or methods

In this section we explain how a HTTP request URL is interpreted by @enterprise.
But let us first briefly step over the components of an URL:

```
<protocol>://<host>:<port><path>?<query>
```

e.g.:

```
http://www.groiss.com:80/wf/servlet.method/a.b.c?oid=24323&time=3254777
```

The protocol (http) states the set of rules which govern the communication between client and server place. The host is the name or ip-address of the machine (www.groiss.com). The port (80) is a specific transport endpoint within the machine. Together these three components specify a service, which is an @enterprise installation in our case.
The path (`/wf/servlet.method/a.b.c`) refers to a resource within the service. By interpreting this path, the service searches for resources internal to the service. Typical resources are static files and dynamic content generated by program code. The parameters (`oid=24323&time=3254777`) can be used by the service to customize the resource.

Using and referencing URLs

We do not deal with the protocol, host and port components of an URL, since we should never reference to them within the same @enterprise installation. Further, in @enterprise as well as in application servers, all URL paths start with the context root. In a standalone installation this is always "/wf". When @enterprise runs within in an application server the context root is specified during deployment.
When specifying URLs, adhere to the following rule:
Do not use an absolute URL when you are referring to resources within the same engine (deployment context). In other words:

- do not include the protocol (`http://`)
- do not include the host name
- do not include the port
- do not include the context root
- do not include the slash following the context root

in your URLs.
By obeying to this rule, we gain deployment transparency within the server. The browsers are responsible for constructing the absolute URL from the relative ones. In case of doubt, use the status line of the browser to determine the constructed path.

Mapping of the URL path to a resource within @enterprise

When the part of the path after the context root is `/servlet.method`, then the Dispatcher servlet is responsible for dealing with the URL. This is described in section 2.1.
Any string different from `/servlet.method` is handled by the FileServlet, which is responsible for locating the file specified in the URL path and for proper internationalization of those files.
Since there may be files which are independent of the language, the FileServlet distinguished two cases:

a) language independent files

For addressing language independent files, the string `/alllangs` follows the context root. The files are searched in the classpath including the `alllangs` prefix.

Example: The classpath consists of two components:

- a directory `/home/firstappl/classes`
- followed by a jar file `lib/secondappl.jar`

When resolving the URL

`http://myhost:8000/wf/alllangs/dir/text.html`

the FileServlet first tries to locate the file by accessing `alllangs/dir/text.html` starting from the directory `/home/firstappl/classes`. If successful, the file is returned. If the file could not be found in the first component of the class path, then the next component is searched, and so on. In the example the FileServlet tries to locate the file by searching for `alllangs/dir/text.html` within the jar file `lib/secondappl.jar`.

Hint: Since @enterprise version 8.0 images are stored in `lang` instead of `alllangs` folder.

b) language dependent files

When a string different from "/alllangs" follows the context root, the FileServlet interprets the file as language dependent, for which the FileServlet supports two mechanisms:

1. The file has already been translated for the different locales, and the translations have been stored in separate directories.
2. There is just one file (a template containing special labels) which is translated on-the-fly when the file is loaded.

Because a locale can contain language, country and variant, the search path is implicitly extended by
1. lang/<language>/<country>/<variant>/
2. lang/<language>/<country>/
3. lang/<language>/
4. lang/default

in this order.
If the file could not be found, an untranslated template is searched by extending the path with
5. alllangs/
If the file is found in steps 1,2,3 or 4 it is sent to the browser unchanged, if found in during step 5 it is translated on-the-fly (see following subsection).
Note that each of the steps means to search within all the components of the classpath.

Example: The classpath consists of two components:

- a directory `/home/firstappl/classes`
- followed by a jar file `lib/secondappl.jar`

When resolving the URL

`http://myhost:8000/wf/dir/text.html`

and the locale is en_US, the file is searched in the following locations (since the locale has no variant, the search starts at step 2):

```
2. /home/firstappl/classes/lang/en/US/dir/text.html
  lib/secondappl.jar!lang/en/US/dir/text.html

3. /home/firstappl/classes/lang/en/dir/text.html
  lib/secondappl.jar!lang/en/dir/text.html

4. /home/firstappl/classes/lang/default/dir/text.html
  lib/secondappl.jar!lang/default/dir/text.html

5. /home/firstappl/classes/alllangs/dir/text.html
  lib/secondappl.jar!alllangs/dir/text.html
```

Because the files are searched in all the components of the classpath, it is highly advisable to use different prefixes for the files of different applications.

6 Organizational Data

The package `com.groiss.org` contains the API for the organizational data in @enterprise. See the @enterprise Administration Guide for a description of the objects for representing organizational data.
The interfaces `Application, OrgUnit, Role, Right`, and `User` have been defined to access information abort the organization.
The interface `OrgData` is a service-interface for retrieving objects and make changes in the organizational database.
The methods `get` and `list` wrap the corresponding methods in the Store interface.
Example: the following piece of code returns the list of active organizational units, ordered by name:

```
List l = ServiceLocator.getOrgData().list(
   OrgUnit.class,"active=1","name");
```

If you have the id of one of the objects of the organizational data, you get the object with the method `getById`.

6.1 Users, their Roles and Rights

The interface `User` represents a person known to the system. The `toString` methods returns the title, first name and surname, separated with spaces.
The toListString method return the same in another order: the surname, the first name and then the title. It is more suitable for showing lists of users sorted by surname.

Use the methods `getRoles` and `hasRole` for finding out whether a user has a role.
Example: The following example shows the roles a selected user has in the - optionally - selected department.

```
public Page showUserSelection(HttpServletRequest req) throws Exception {
    HTMLPage p = new HTMLPage();
    p.setPage(
        "<html><form action=\"com.groiss.demo.OrgDemo.showUserRoles\">"+
        "%user% %org% <input type=submit></form></html>");
    OrgData od = ServiceLocator.getOrgData();
    p.substitute("user", new DropdownList("user",
        od.list(User.class,null,null)).show());
    p.substitute("org", new DropdownList("dept",
        od.list(OrgUnit.class, null,null), true).show());
    return p;
}

public Page showUserRoles(HttpServletRequest req) throws Exception {
    HTMLPage p = new HTMLPage();
    p.setPage("<html>%roles%</html>");
    OrgData od = ServiceLocator.getOrgData();
    User u = (User)od.get(User.class,
        Long.parseLong(req.getParameter("user")));
    OrgUnit ou = null;
    String d = req.getParameter("dept");
    if (!StringUtil.isEmpty(d)) {
        ou = (OrgUnit)od.get(OrgUnit.class, Long.parseLong(d));
    }
    p.substitute("roles", od.getRoles(u,ou));
    return p;
}
```

The first method shows a HTML page with two select lists for selecting a user and an organizational unit. The second method reads the corresponding User and OrgUnit objects and shows the roles of the user (optionally in the OrgUnit).

The home department - the department where the user has the `home` role can be retrieved with the method `getDefaultDept`.

For checking whether a user has a right, use the method `hasRight(User, Right, Object)` of interface `OrgData`.

You can overwrite the right checks for an object when implementing interface `RightCheck`. Implementing this interface is especially useful for classes which permissions are dependent on permissions on other objects (e.g. to edit object A the user must have edit right on some related object B). When implementing `RightCheck` you can use the right-related methods of interface `OrgData` (e.g. `hasRight` or its `may`-methods) for checking the rights of related objects or the methods of utility class `DefaultRightCheck`. The difference between those two alternative ways is that `OrgData` will check if the passed object implements `RightCheck` and therefore will take the `hasRight`-implementation of that object whereas `DefaultRightCheck` will check the standard permission system.
But note: you MUST NOT call the mentioned methods of `OrgData` with the current object (i.e. 'this' in Java) in its `hasRight`-implementation. This would lead to an infinite loop.

6.2 Dababase operations

The `OrgData` methods `insert`, `update`, `delete` perform the corresponding actions of the Store service with the following additional functions:

- checking permissions: The methods insert, update, and delete call the corresponding may* methods before performing the operation. As user argument the thread user is used. If the object implements the RightCheck interface the methods of the interface are called instead of the standard methods.
- making log entries: If the class implements the interface `HasLog` a log entry is written to the database.

You can get the log entries for an object with the method `getLogEntries`, `getVersion(Date)` returns the version of the object at a given date.

6.3 *Password Policies*

To write a special password checker, you have to implement the interface `com.groiss.passwd.Checker` (and configure it in the password policy configuration).

interface Checker A Checker has a method which checks the password if it is compliant to the specific policy. The method getReasons returns a list of Strings representing the reasons, why the password is not compliant.

```
public interface Checker {
    public List<String> getReasons();
    public boolean isCompliant(String password);
}
```

6.4 *Adding tab* ***Additional Info***

In @enterprise it is possible to attach forms to master data objects, for example users, org-units, process definitions. For maintaining these objects there is an API and a user interface. It is necessary to define the relation in one of your GUI configurations files: Add a node of class *com.dec.avw.lclient.AddInfoNode* to the *Actions* section of the file, for example:

```
<Config>
 <TreeConfig>
  ...
 </TreeConfig>
 <Actions>
  .....
  <Node id="your_id" name="a_label" class="com.dec.avw.lclient.AddInfoNode">
    <Attrib key="form" value="com.dec.avw.appl.Jobform_5"/>
    <Attrib key="attachedto" value="com.groiss.org.User" />
  </Node>
  .....
 </Actions>
</Config>
```

The configuration file must be referenced in a GUI configuration object. On startup, @enterprise reads these files and registers the object-extension nodes. In the above example you will now get an additional tab in the user detail mask, where you can edit the attached form. The OrgData interface has the method getObjectExtension for accessing the attached object:

```
OrgData org = ServiceLocator.getOrgData();
User u =  org.getById(User.class, "testuser_id");
DMSForm f = (DMSForm)org.getObjectExtension(u,
                     "com.dec.avw.appl.addform_1",true);
//further handling with DMSForm
....
```

The method *getObjectExtension()* has following parameters:

- Persistent obj: The object, where the extension is added (e.g. User)
- String formclass: The form-class of the additional form
- boolean create: create the extension, if it does not exist
- Return value: the form

6.5 Deleting master data with references

If a master data object with references should be deleted, errors occurs with the property *isWarning=true*. These errors are intercepted and a message in a confirm-dialog is displayed. If the user accepts the deletion, the parameter *ignoreError=<errnum>* will be added to the request and deletion will be tried again, whereas the deletion-operations using this parameter. Following objects support this behavior/Exceptions which are marked as warning:

- Application - Exception 232
- Dept - Exceptions 88 and 232
- Role - Exceptions 966 and 210
- All objects - Exception 150

For each run new errors could be thrown. The accepted errors are available in ThreadContext and can be used in onDelete().

7 HTML Components

The following section describes the API to build HTML components with Java. We have defined Java Classes for most HTML elements, like forms, input fields, etc. You find the classes in the package com.groiss.gui.component.
The use of them is simple: call the constructor with the necessary arguments. The method `show` returns a string representation of the component.
The internal representation of the elements is a JDOM tree representing the XML structure of the element. The method `getRoot` returns this tree.
The following method contains three examples for using the components:

File **com/groiss/demo/HTMLComponents.java**

```
package com.groiss.demo;

import java.util.*;
import javax.servlet.http.*;
import javax.swing.table.*;
import com.groiss.org.*;
import com.groiss.ds.*;
import com.groiss.wf.*;
import com.groiss.gui.*;
import com.groiss.gui.component.*;

/** Some examples of HTML components
*/
public class HTMLComponents {
  static String[][] arr = {{ "a11", "a12", "a13"}, {"a21", "a22", "a23"}};
  static String[] headers =  {"col1","col2","col3"};


  /** Show a select list of users.*/
  public Page showMask(HttpServletRequest req) throws Exception {
    HTMLPage result = new HTMLPage();
    List<User> l = ServiceLocator.getOrgData().list(
       User.class, null, "surname",null);

    SelectList sl = new SelectList("user", l, 10);
    DropdownList dl = new DropdownList("user", l);
    TableContainer tc1 = new TableContainer(new DefaultTableModel(arr,headers));
    tc1.setRowAttribute(1,"bgcolor","red");
    List style = new ArrayList();
    style.add(new Pair("bgcolor","grey"));

    TableContainer tc2 = new TableContainer();
    tc2.setAttribute("border","1");
    for (User u: l) {
      List row = new ArrayList();
      row.add(u.getSurname());
      row.add(u.getFirstName());
      if (u.isActive())
          tc2.addRow(row);
      else
          tc2.addRow(row,style,null);
    }

    result.setPage("<html>"+
        "\n<br>" + sl.show() +
        "\n<br>" + dl.show() +
        "\n<br>" + tc1.show() +
        "\n<br>" + tc2.show() +
        "</html>");
    return result;
  }
}
```

First, a select list of length 10 with name `user` containing a list of users is constructed. This works, because a User object implements the interface KeyValuePair: The value of the select list option is the toString method, the key is the oid (as String). A DropdownList with the same content is the next element.
A HTML table is build using the `TableContainer` class. One constructor takes a TableModel object, we use the `DefaultTableModel` from swing to generate such a model.
Another table is build using the TableContainer by adding rows in a loop. When adding rows one can set additional attributes of the row and the row columns.

8 The Workflow Engine

In this chapter we first present the function of the @enterprise workflow engine. After this, the API of the engine is explained. Examples will show the possibilities of the API.

8.1 Process definition and execution

The definition of a process can be represented as graph. The activities are the nodes, the edges represent the flow of control. The graph of the process definition is either generated from a WDL script or graphically defined using the process editor.
The nodes of the graph can belong to the following types:

- *task*: interactive task (done by the user)
- *system*: automatic step, call of a program
- *process*: call of a sub process
- *condition*: labeled as *if*, *while*, *exit_when*: branch with condition
- *andjoin* and *orjoin*: join node after a split to parallel branches
- *nop*: structural nodes labeled as *par*, *begin*, *end*, and *goto*

The edges are directed and can have one of the following types:

- *normal*
- *then*: The edge is followed, when the condition in the previous node evaluates to true.
- *else*: The edge is followed, when the condition in the previous node evaluates to false.

Fig. 8.1 shows the same process in WDL notation and as graph produced from the process editor. This graph is structurally equivalent to the internal structure of the process definition.

```
process iftest()
  version 1;
  name "iftest";
  forms f Jobform;
  application default;
  begin
    if (f.recipient = null) then
      all right();
    else
      r1 left();
    end;
    while (f.subj = "1") do
      r2 while1();
      r3 while2();
    end;
end;
```

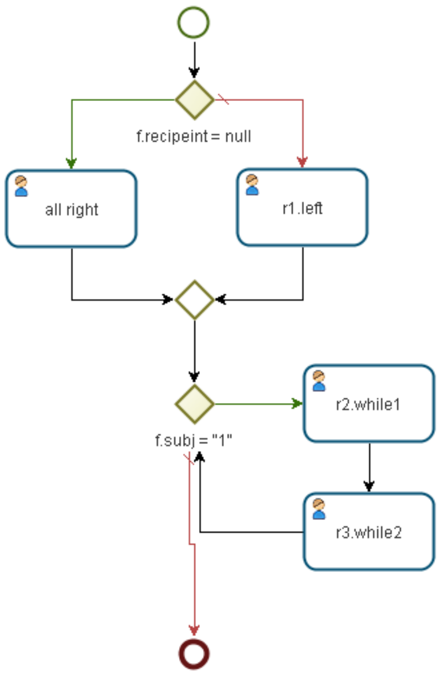


Figure 8.1: **Process graph**

The workflow engine is an interpreter for the process definition graph. Its responsibility is to change the state of the process instances according to the process definition graph.
The behavior of this interpreter can be described with the two procedures `start_activity` and `finish_activity` shown in Fig. 8.2.
When a workflow is initiated, the procedure start_activity is called, it selects the initial activity of the process and calls the procedure recursively. The behavior of this procedure depends on the type of the node currently processed. If the type is *nop* (*par, loop, endif*, or *end*) no action is performed and the execution proceeds with the successor nodes. If the type of the node is *condition* (*if, while*, or *exit_when*) the expression defined with the node is executed and depending on the result the branch marked with *then* or the branch marked with *else* is followed. The two node types closing a parallel execution - andjoin and orjoin - are handled in the following way: When processing an *orjoin* node, the successor is started when the first branch reaches the orjoin node. When processing andjoin nodes, the successor is started when the last branch reaches the node. If the node is a *task* node, the following steps are performed: the (optional) procedure defined for this activity is executed, then the agent is assigned. At this point the procedure terminates.
When the user finishes an activity, the procedure finish_activity is invoked (the button complete in the worklist client) with the activity. In the procedure finish_activity the successors of the node are started. The second argument defines the type of edge to follow. States of process instances and activity instances are shown in Fig. 8.3 and Fig. 8.4.
The process is either running (state *started*) or not running - when it has been finished normally (state *finished*) or when it has been aborted (state *aborted*).

```
procedure start_activity(act)
   if type_of(act) = condition then
      if execute_expression(act)
         then finish_activity(act,"then");
         else finish_activity(act,"else");
      end if;

   elsif type_of(act) = nop then
      finish_activity(act,"normal");

   elsif type_of(act) = orjoin then
      if this is the first finished branch then
         finish_activity(act,"normal");
      end if;

   elsif type_of(act) = andjoin then
      if this is the last finished branch then
         finish_activity(act,"normal");
      end if;

   elsif type_of(act) = process then
      start_activity(init_activity(act));

   elsif type_of(act) = activity then
      execute_procedure(act);
      assign_agent(act);

   elsif type_of(act) = system then
      execute_procedure(act);
      finish_activity(act,"normal");
   end if;
end;

procedure finish_activity(act, b)
    if no successors of act then
         finish_activity(parent(act));
    else
        for all successors succ of act in branch b do
           start_activity(act);
        end do;
      end if;
end;
```

Figure 8.2: Interpreting the process definition

When an interactive activity is started, it is assigned to a role (state *started*) or to a user (state *active*). Taking the activity from the role-worklist to the personal worklist changes the state to *active*. Putting it in the suspension list changes the state to *suspended*. When the process is aborted, the active activities afterwards have the state *aborted*. Finishing an activity normally leads to state *finished*. When the agent of the following task or a choice path have to be selected, the state of the activity is *waiting*, until this action has been done.

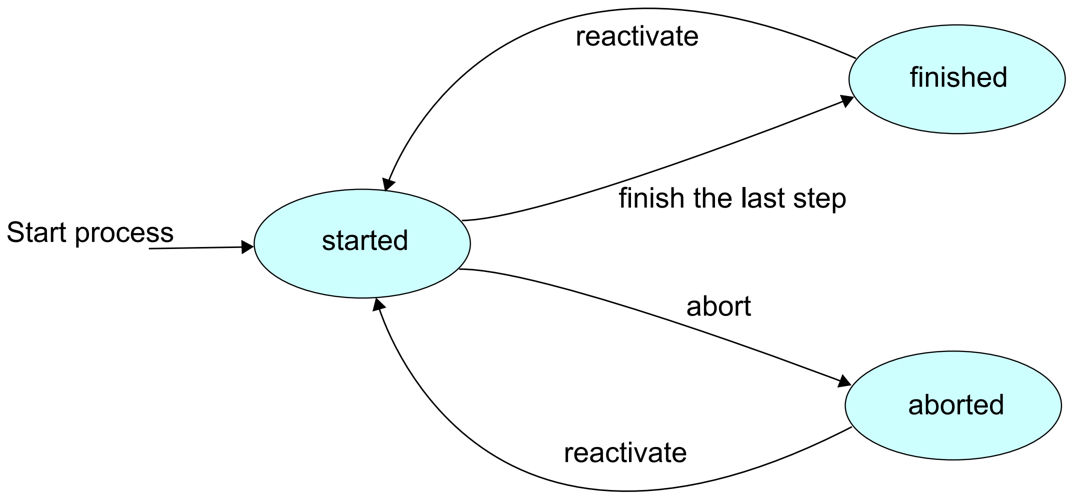


Figure 8.3: **Process States**

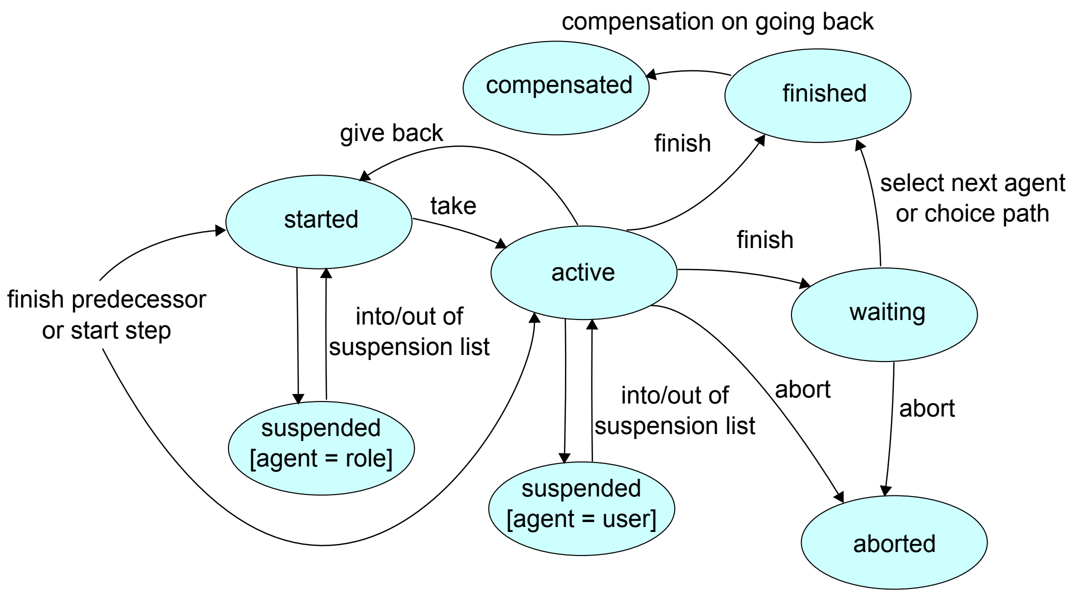

compensation on going back
compensated
finished
give back
finish
started
take
select next agent or choice path
finish
active
finish predecessor or start step
into/out of suspension list
waiting
into/out of suspension list
abort
abort
suspended [agent = role]
suspended [agent = user]
aborted

Figure 8.4: **Activity States**

The action "go back" compensates the activities lying on the path to the previous activity, this activities have then the state *compensated*.
The constants for this states are defined in the interface `ActivityInstance`.

8.1.1 Structure of run-time data

Whenever a process or activity is started, some objects are created and stored in the database. We call these objects run-time data, because they are created at run-time (of the engine) in opposition to the build-time data (for example the process definition).

Fig. 8.5 shows the relationship between the process graph and the run-time data. The process structure shown in the left part of the figure is composed of nodes and edges. Nodes of type *task* have a reference to a Task object. When the process is started, for each node the engine processes an ActivityInstance object is created. These objects have references to the corresponding node of the process graph. More than one ActivityInstance can be generated for one node in the process graph in one process instance: The functions "set agent" or "give back" create additional ActivityInstance objects, so that the history of the process instance can be seen when listing the ActivityInstance objects.

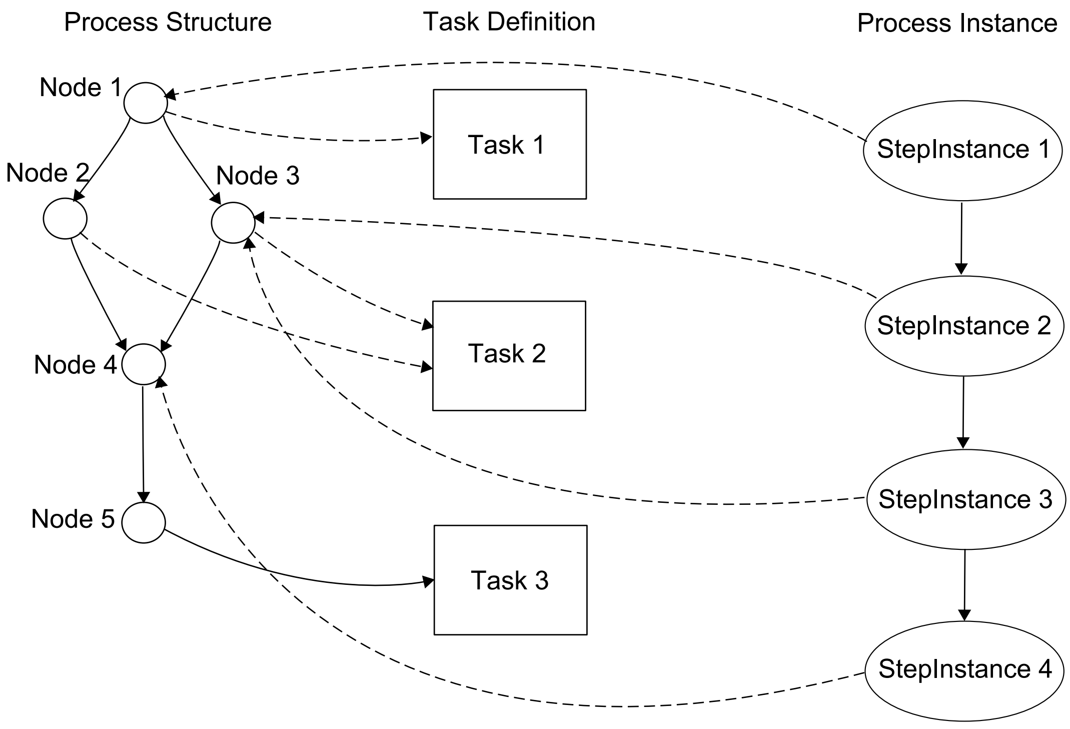


Figure 8.5: **Process graph and run-time data**

If the node in the process graph is of type *process* the corresponding ActivityInstance object represents the execution of a subprocess and also implements the interface ProcessInstance. The ActivityInstance objects representing the execution of the subprocess are children of this object. Fig. 8.6 shows such a graph of ActivityInstance objects. The object $p0$ represents the execution of a process instance $p0$ In this process instance four steps have been executed, the tasks $t1$,$t2$, $t3$, and the process $p1$. The execution of $p1$ contained the steps $t4$, $t5$, and $t6$. The API provides the methods `getParent()` of ActivityInstance and `getAtivityIntsance()` (of WfEngine), for navigating through this hierarchy. A process instance has always at least one root node (ProcessInstance object) and one or more leaf nodes.

8.2 Forms

Forms hold the local data of process instances. When loading a form, @enterprise creates two Java classes and a database table per form. All classes are in the package

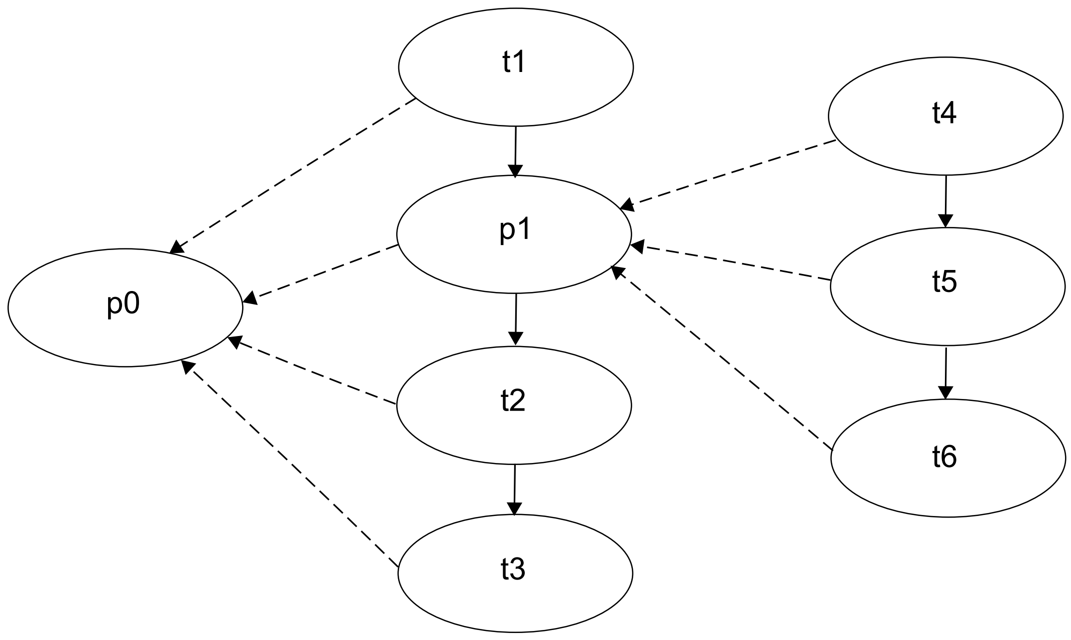


Figure 8.6: **Graph of ActivityInstance objects**

`com.dec.avw.appl`.

1. The name of the first class is the form id followed by "_" and the version of the form. It is a subclass of PersistentObject and provides the methods for access of the database table.

   The form fields are public fields of this class.

2. The name of the second class is composed of the string "HTML", the form id, an underscore ("_"), and the form version.

   It is a subclass of `com.dec.avw.html.HTMLForm` and contains the methods for viewing the HTML representation of the form.

For the form with the id `Jobform` and version 1 the Java Class looks like:

```
package com.dec.avw.appl;

import com.dec.avw.core.*;

public class Jobform_1 extends Form {
public String subj;
public String recipient;
public String description;
public String type;
public String finished;
public String getTabledef() {
  return "create table form_Jobform_1(\n"+
    " oid integer primary key,\n"+
    " task integer,\n"+
    " transactionId integer,\n"+
    " subj varchar(55),\n"+
    " recipient varchar(55),\n"+
    " description varchar(55),\n"+
    " type varchar(3),\n"+
    " finished varchar(3)\n"+
    ")";
  }

  public String getTableName() { return "form_Jobform_1"; }
}
```

The Class HTMLJobform_1 is a subclass of HTMLForm and is responsible for the HTML representation of the form.

```
package com.dec.avw.appl;

import com.dec.avw.html.*;

public class HTMLJobform_1 extends HTMLForm {

  public Class getSQLClass() {
    return com.dec.avw.appl.Jobform_1.class;
  }

}
```

See the method `setDate` on page 75 as example for the usage of the form classes.

8.3 The @enterprise workflow API

The classes and interfaces for accessing the workflow engine are located in the package `com.grois.wf`. The objects of the process definition and the run-time data can be accessed with the following interfaces:

- `ProcessDefiniton` representing the definition of a process
- `Task` the interactive steps of a process definition
- `ProcessInstance` the instance of a process
- `ActivityInstance` the instance of a step of a process

The methods for manipulating process instances are executed using the interface `WfEngine`. The method `getWfEngine` of class `ServiceLocator` returns an `WfEngine` object.
The methods are arranged in four groups:

- Create a process instance,
- find process instances,
- get information about process instances,
- change the state of process instances.

8.3.1 Create a process instance

To create a process instance we must specify the following data:

- the process definition,
- the user who starts the process,
- the organizational unit, where the process is started,
- the date, when the process should be finished (optional).

See the chapter 6 for information how to get users and org. units. The process definition can be retrieved with one of the methods of WfEngine:

```
ProcessDefinition getProcessDefinition(String id);
ProcessDefinition getProcessDefinition(String id, int version);
```

Additionally, `listProcessDefinitions` returns the process definitions of an application, `getStartableProcesses` the processes a user can start.
When the arguments are collected, the process can be started using:

```
ProcessInstance startProcess(ProcessDefinition p, User u, OrgUnit d,
   Date duedate, String id)
```

The last argument is the process instance id. If you leave it null, the system assigns an id.

8.3.2 Find process instances

The following methods are used to find a process instance:

```
public List<ActivityInstance> getWorklist(Application a, boolean withRepr);
public List<ActivityInstance> getRoleWorklist(Application a);
public List<ActivityInstance> getSuspensionList(Application a);
public ProcessInstance getProcess(String id) throws WfException;
public ProcessInstance getProcess(long oid) throws WfException;
public ProcessInstance getProcess(DMSForm f) throws WfException;
```

The first three methods retrieve the worklist, role-worklist, and suspension list of the current user. You can call the methods with application null, for getting the items for all applications.
If you know the id or the oid of a process, call one of the `getProcess` methods.

8.3.3 Get information about a process instance

The interface `ActivityInstance` has getter methods for all the information stored in the underlying object: the agent, start time, end time, status, organizational unit, process definition, process instance, type, and task.
The interface `ProcessInstance` has additional methods for getting the subject and the id.
In the `WfEngine` interface the following methods are available:

- `public List<ActivityInstance> getActiveTasks(ProcessInstance process)`
  returns all active (state started, active, or suspended) tasks of a process
- `public List<ActivityInstance> getActiveTasks(ProcessInstance process, User u)`
  like above, restricted to a user.
- `public List<? extends ActivityInstance> getAllInteractiveTasks(ProcessInstance pi)`
  returns all interactive tasks of a ProcessInstance, even if they are children of a parfor, par or scope.
- `public List<ActivityInstance> getActivityInstances(ProcessInstance process)`
  all activity instances of a process instance (all children).
- `public DMSForm getForm(ProcessInstance pi, String id)`
  a form of the process, identified by the id
- `public List<DMSForm> getForms(ProcessInstance process)`
  all forms of the process
- `public ProcessInstance getMainProcess(ActivityInstance ai)`
  the root of the tree of activity instances.
- `public ProcessInstance getParent(ActivityInstance ai)`
  the parent of an activity instance.
- `public List<DMSObject> getDocuments(ProcessInstance process)`
  a list of documents attached to the process
- `public List<DMSNote> getNotes(ProcessInstance process)`
  the notes attached to a process instance.

8.3.4 Manipulation of process instances

The API provides methods for all actions you can do from the worklist client: finish, take, untake, goBack, seeLater, seeAgain, setAgent, gotoTask, copyTo, makeBranch, setOrgUnit, setDescription. See there for details.
The following methods apply to process instances:

```
public void abort(ProcessInstance process) throws WfException;
public void reactivate(ProcessInstance process) throws WfException;
public void archive(ProcessInstance process) throws WfException;
public void setSubject(ProcessInstance process) throws WfException;
public void setSubjectToString(ProcessInstance process, String str)
   throws WfException;
```

8.3.5 Getting the context

In conditions and system steps the method defined by the application can retrieve the current activity instance with the following code:

```
WfEngine e = ServiceLocator.getWfEngine();
ActivityInstance ai = e.getContext();
```

8.3.6 Methods for process instances

There are several methods with process instance as arguments and how they perform needs some clarification.
The structure of a process instance is as follows:

```
activityInstance -> [ parfor_1 .. -> [subprocess_1 ...->]] main_process
```

The relation shown as arrow is a parent relation between activity instances. The *getParent()* method returns the target of this relation. If we start at a leaf node (activity instance) the first call returns the parfor node if existing. After other nested parfors the node of the current subprocess will be found and finally, after other possible parfor and process nodes, the main process. Any of these nodes except the first implements the process instance interface. The method *getProcessInstance()* returns the next activity instance with type *PROCESS* (not parfor) that can be found when calling *getParent()* repeatedly.

The methods on process instances behave as following:

- `archive`: This is the only method applicable only on the main process.
- `abort, reactivate`: Normally applicated on the main process, but it is possible to perform this operations on intermediate nodes.
- `getDocuments, getNotes, hasDocuments, hasNotes, setPriority`: These methods first navigate to the main process, then perform like called with it.
- `makeBranch, setSubject, getForms, getActivities, getActiveTasks`: The result depends on the argument. For example, to get the local forms inside a parfor, the method *getForms()* must be called with the parent of the activity instance

9 Using the Workflow API

The programming of a workflow application contains several different tasks, which we will describe in this chapter:

- Methods that are part of workflow execution: expressions, postconditions, preprocessing, system steps.
- Interactive functions: called on user request as extension to the standard worklist functions.
- Enhancing the functionality of forms.
- Setting the default behavior of some actions in the application class
- Internationalization of applications.
- Appearance of the client: configuration of the main screen and the worklists. Programming of application specific worklists.

9.1 Application Methods Called by the Engine

The application programmer can define several types of methods which are executed by the workflow engine:

- system step in the process definition,
- preprocessing: executed before the StepInstance is visible in the worklist,
- compensation: executed when compensating this step (function go back),
- postcondition: executed when user completes the task,
- take- and untake-hook: executed when the user takes the activity instance or gives it back.
- condition: condition evaluation in if, while, exit when, choice.

In each case a Java method can be specified. In the first and last case the name of the method is specified in the process definition, the other method names are specified in the task declaration. The methods can have zero to n String parameters. The return value must be `boolean` for conditions and postconditions and is ignored otherwise.
The following example shows two methods, `foo` and `fee`. The method foo can be used as system step or postcondition, the second for all above cases.

```
class Test {
    public void foo(String a, String b) {
        ...
    }

    public boolean fee() {
        ...
        return true;
    }

}
```

The value of the string parameters are constants, in the process definition and task declaration the method call must be specified with the parameters, for example:

```
Test.foo("first", "second")
```

Note, that you also have to specify the package together with the class name if the class belongs to a package. The class file must be in the class path of the server or the `classes` directory of an application.
The following example shows a method which is called, when an activity instance is taken:

```
public void setFieldsApproval() throws Exception {
    WfEngine e = ServiceLocator.getWfEngine();
    ActivityInstance ai = e.getContext();
    ProcessInstance pi = ai.getProcessInstance();
    DMSForm f = e.getForm(pi, REQUESTFORM);
    User u = (User)ai.getAgent();

    //set the fields in the form
    f.setField("approvedBy", u);
    e.updateForm(f);
}
```

The methods first gets the activity instance, the process instance, and then a form of this process. The field `approvedBy` of this form is set to the agent of this activity instance.

9.1.1 Usage of script-language GROOVY

@enterprise also offers the possibility to enter a GROOVY-script instead of a method-call (preprocessing, compensation, etc.) in tasks and task-functions. For this purpose you have to enter the keyword *groovy:* with a following groovy-script in one of the method-fields. How to implement the method above (*setFieldsApproval()*) in groovy is shown in following example:

```
groovy:
form_fmREQUESTFORM.setField("approvedBy",(User)ai.getAgent());
engine.updateForm(form_fmREQUESTFORM);
```

Hint: Groovy must be activated via the hidden parameter *ep.scripts.enable* in configuration-file (see *Installation and Configuration Guide* - section *Parameters without GUI*)!

The context for tasks is:

- *engine* is the WfEngine object
- *ai* is the ActivityInstance
- *pi* is the ProcessInstance
- *store* is the Store object
- *dms* is the DMS object
- *orgdata* is the OrgData object
- *user* is the User object
- *form_<formid>* is the corresponding form

The context for task-functions is:

- *request* is the HttpServletRequest
- *response* is the HttpServletResponse
- *context* is the ServletContext object
- *session* is convenient for request.getSession(false) - can be null
- *params* is a map of all form parameters - can be empty
- *headers* is a map of all request header fields
- *out* is equal to response.getWriter()
- *sout* is equal to response.getOutputStream()

These context-variables are defined in *com.groiss.groovy.WFBinding*, but can be configured via the hidden parameter *ep.groovy.binding.class* in configuration-file.

The following example shows a groovy-script which is called before activity instance is visible in worklist (preprocessing):

```
groovy:
form = engine.getForm(pi, "inputform");
form.description = form.description + "Method call activated by task2. ";
engine.updateForm(form);
```

In this example the field "description" of the "inputform" is extended by the string "Method call activated by task2". The form-fields are accessible directly without getField() and setField() calls.

In the next example a groovy-script is entered in a task-function which is assigned to all tasks:

```
groovy:
u = com.groiss.util.ThreadContext.getThreadPrincipal();
out.println("Logged on User: " + u.getFirstName() + " " +
       u.getSurname() + "<BR/>");
out.println("Instance Details: " + request.getParameterMap());
```

If this task-function is called via worklist, the current user and information about the selected instance will be displayed.

9.1.2 XPath-Conditions

The XML Path Langauge (XPath) is developed by the W3-consortium for addressing parts of an XML-document (considered as tree). The access on **@enterprise** process data is done with following variables:

- `Forms`: The access on a form and its elements is possible with variable $form_<fid>. The several fields are subelements, e.g.:

  ```
  <transactionId>2</transactionId>
  <avwcreatedby>Frank Mansdorf</avwcreatedby>
  <avwcreatedat>2010-01-29T09:34:29Z</avwcreatedat>
  ```

  The task-field, OID and the class are defined as attributes at the form-element:

  ```
  <form object="com.dec.avw.appl.hr_recruiting_1:1000002101"
        task="1000098715">
  ```

  Objects are defined as follows:

  ```
  <selectagent object="com.dec.avw.core.User:12345">
    ...object attributes...
  </selectagent>
  ```

  The access to subforms is done via the:

```
<subform id="1">
  <form object="com.dec.avw.appl.hr_evaluation_1:1000099042"
        task="1000098715">
    <transactionId>0</transactionId>
    ....
   </form>
</subform>
```

- `Current process instance`: The access is possible by using the variable $pi. The XML-structure of a process instance is defined as follows:

```
<pi object="com.dec.avw.core.StepInstance:12345">
  <agent object="com.dec.avw.core.User:12345">
    <firstName>Frank</firstName>
    ...
  </agent>
</pi>
```

- `Current activity instance (engine.getContext())`: The access is possible by using the variable $ai. The behaviour is analog to process instance.
- `User of current step`: The access is possible by using the variable $user. In process conditions this user is always the ThreadUser. The XML-structure of a user object is defined as follows:

```
<user object="com.dec.avw.core.User:12345">
    <firstName>Frank</firstName>
    ...
</user>
```

- `Java method`: XPathCheckClass.echo('arg') = 'arg'
  Any JAVA methods can be called, whereas String parameter are allowed only. The API programmer is responsible for the RETURN value, but *String* is recommended.
- `Configuration`: There are 2 different kinds of configuration and their access possibilities:
  - Application: $configuration_<appl_id>/property[@name='km']/text()
  - System: $configuration/property[@name='avw.servername']/text()

An other possibility to define XPath conditions is the usage of method *com.groiss.wf.SystemAction.evaluateXPath(xpathexpression).*

Examples for XPath-Conditions:

```
xpath:$form_f/recipient = $user
xpath:$form_f/recipient/firstName = 'Frank'
xpath:$form_f/subform[@id='1']/form/status = 'ok'
xpath:com.groiss.wf.SystemAction.evaluateXPath("$form_f/finished = '1'")
xpath:$configuration/property[@name='avw.servername']/text() = 'ep_oracle'
```

9.2 Interactive Functions

The set of standard functions applicable in the worklist client can be extended with the so called Task-Functions. The functions can be used for arbitrary application specific tasks, for example sending mails, filling forms with some initial data, or anything else.
We differentiate between four types of functions:

- Functions applicable in the worklist in certain tasks. These functions can be attached to task definitions in the system administration.
- Functions applicable in the worklist with every task of an application,
- task-independent functions,
- functions for viewing additional information for users, organizational units, and process instance history.

In the user interface only these tasks are shown, where the user has the execute right. Task-independent functions are reached with the link "Functions" in the navigation tree of the client.
The signature of the Java methods is as follows:

```
public void foo(HttpServletRequest req, HttpServletResponse resp)
public Page foo(HttpServletRequest req)
```

See chapter 2 for a discussion of these two method signatures.
After you wrote the Java method you have to define a Task-Function object with the name of your method in the system administration.

Example: Set a form field to the current date.

```
public Page setToDate(HttpServletRequest req) {
   WfEngine e = ServiceLocator.getWfEngine();
   ActivityInstance ai = e.getActivityInstance(Long.parseLong(
      req.getParameter("functionTask")));
   DMSForm f = e.getForm(ai.getProcessInstance(), "applform");
   f.setField("datum", new Date());
   e.updateForm(f);
   return HTMLUtils.refreshWorklist(req, ai.getApplication());
}
```

The method contains the following steps:

- Get the process context: The request contains the parameter "functionTask" with the object oid of the current activity.
- Get the form: the method `getForm` needs the id of the form and the process instance object.
- Set the field: The fields of the form can be set with the method `setField`.

- Save the changes in the database with the `updateForm()` method of the engine.
- View the worklist: The function has been invoked with a mouse click on a link, this must result in the presentation of an HTML page on the browser. Here, we show the worklist of the current user.

9.3 Application Adapter

For each application you can define a Java class where some characteristics of the application can be defined. This class must implement the interface `ApplicationAdapter`.
There exists a default implementation `DefaultApplicationAdapter` which is used when no application specific class is defined. You can either write a subclass of `DefaultApplication` or implement the interface `ApplicationInterface`. The first alternative is preferred, because it is more stable against changes of the default implementation or enhancements of the interface.
See the API for details.
Example: Generate process ids:

```
public String getNewProcessId(ProcessInstance pi) throws Exception {
    Connection conn = DBConnectionPool.getConnection();
    Statement stmt = conn.createStatement();
    int num = 1;
    synchronized (this.getClass()) {
     try  {
      int cnt = stmt.executeUpdate(
         "update avw_processIds set num = num+1");
      if (cnt == 0)
        stmt.executeUpdate(
          "insert into avw_processIds(num) values ("+num+")");
      ResultSet rs = stmt.executeQuery(
        "select max(num) from avw_processIds");
      if (rs.next())
        num = rs.getInt(1);
      rs.close();
     } finally {
       stmt.close();
     }
    }
    String id  = Integer.toString(num);
    return id;
}
```

This method generates new process ids.

9.4 The Form Event Handler

The behavior of forms can be modified using the `com.groiss.dms.FormEventHandler` interface. It contains the following methods:

```
public void onInsert(DMSForm f) throws Exception;
public void onUpdate(DMSForm f) throws Exception;
public void onDelete(DMSForm f) throws Exception;
public void onShow(DMSForm f, ActivityInstance ai, HTMLPage p,
                  HttpServletRequest req)) throws Exception;
public String getName(DMSForm f) throws Exception;
```

The first three methods are called before the respective database actions are performed. The `onShow` method is called after the HTML text of the form is built, you can change the form or make additional replacements. The `getName` method allows to set the name of the form. The form event handler for a form is defined in the administration mask of the form type. One event handler can be used for several form types.

Hint: If a form event handler is specified for a form and this form will be imported by @enterprise import-function, the form event handler(s) will be called. If the code of the event handlers should not be processed during import, you can check it by using ThreadContext attribute *ep.import.running* (returns TRUE, if import is running).
Example: In the following example the `onShow` method and the `onUpdate` method are used:

```
public void onShow(DMSForm f, ActivityInstance ai, HTMLPage p,
        HttpServletRequest req) {
    if (ai != null) {
        Task t = ai.getTask();
        if (t != null)
            p.substitute("task", t.getId());
    }
}

public void onUpdate(DMSForm f) throws Exception {
  try  {
    double total = 0;
    DMS dms = ServiceLocator.getDMS();
    DMSForm mf = dms.getMainForm(f);
    List l = dms.listForms(SampleProcesses.TRAVEL_SUBFORM,
      "oid in (select dest from avw_formrelation where id='1' and src=" +
      mf.getOid() + ")", null, null);
    for (Iterator e = l.iterator(); e.hasNext();)  {
      DMSForm next = (DMSForm)e.next();
        total += Double.parseDouble((String)next.getField("amount"));
    }
    mf.setField("spesenbrutto", ""+total);
    dms.update(mf);
  } catch (Exception e) {
    e.printStackTrace();
  }
}
```

The `onShow` method replaces the tag "%task%" with the id of the actual task, we have used this to show different images:

```
<img src="%task%_photo.jpg">
```

The `onUpdate` method selects the subforms of the current form, sums up the amount values and updates the main form.

9.4.1 Using Form Event Handler with XHTML forms and XForms

When using XHTML forms or XForms, the form event handler *XHTMLFormEventHandler* should be used. The *onShow()* method contains the parameter *XHTMLPage p*, which includes the whole HTML page with its html components. If the (HTML) components of a XForm page should be accessed or edited, *XPath* is needed.

Example:

```
public void onShow(
 DMSForm form, FormContext ctx, XHTMLPage p, HttpServletRequest req) {
 try {
   Element root = p.getRoot();
   XPath xp = XPath.newInstance("//xf:textarea[@ref='/data/form/texti']");
   xp.addNamespace(XForm.xformNS);
   Element f = (Element)xp.selectSingleNode(root);
   f.setAttribute("style","color:red");
 } catch (Exception e) {
   throw new ApplicationException(e);
 }
}
```

In this example we get a *textarea* with the identification *[@ref='/data/form/texti']* and set a new textcolor whereas *texti* is the name of the formfield. The following code shows the textarea within the XForm:

```
....
<xf:textarea ref="/data/form/texti" rows="" cols="">
   <xf:label class="label100">MyTextarea</xf:label>
</xf:textarea>
...
```

9.5 *The Form Table Handler*

A subform table can be customized using a tablehandler. The class must implement the interface `com.groiss.dms.FormTableHandler`. It is *registered* in the tablefield tag as attribute *tablehandler*. The interface contains the following methods:

```
public void init(HttpServletRequest req, User u);
public List getList(List list);
public void modifyTableHeader(List header);
public void modifyTableLine(DMSForm f, KeyedList line);
public String lineStyle(DMSForm f, String style);
```

The first method is useful to initialize your class with the request. With the second method you have the possibility to modify the delivered list and return it. The third method allows to modify the table header of a subform. With the fourth method you can modify each table line. The last method is for changing the style of the table lines.

9.6 *Utilities for building an HTML interface*

In this section some utility methods of the class `com.groiss.wf.html.HTMLUtils` are described that you will need for showing the worklist or showing a form, etc.

9.6.1 Show the worklist

The following methods returns a HTML page containing the worklist for the given application.

```
public static Page refreshWorklist(HttpServletRequest req,
  Application appl)
```

9.6.2 Show the form

Two methods can be used for showing a process form:

```
public static Page showForm(HttpServletRequest req) throws Exception;
public static Page showForm(HttpServletRequest req, ActivityInstance ai,
    String formid, int mode) throws Exception;
```

The first method calls the second, where the additional parameters ai, formid, and mode are taken from the equally named ServletRequest parameters. The mode is one of the following:

0	update mode
9	view mode without buttons

9.7 Object Selection

The class `com.groiss.wf.html.HTMLUtils` provides the method `selectList` for selecting objects from a list. The method is useful when you want to select an object and get the selected object in the opener document. The ServletRequest can have the following parameters:

Parameter	
classname	Java class of objects
title	The title of the window
field	The name of the field in the caller form: The classname and oid of the object is written to the field. The string representation of the object is written to the field with the specified name followed by "_display".
searchid	If a condition (where clause) is needed, the attributes *searchid* and *parameters* must be used and an action node must be created in the appropriate xml-file. An example how to define parameterized conditions (it is always the same procedure) can be found in chapter 15.
noClass	instead of $< classname >:< oid >$ only the oid is written to the field
attribs	Normally the toString() method is used to display the objects. With the attribs parameter you can specify a comma-separated list of attributes you want to see.
searchAttrs	If the list is very long a search can be used to restrict the number of elements shown. Specify a list of attributes where you want to search. An input field will appear on the mask. If the given string is a prefix of one of the attributes of an object, the object will appear in the list.

The entries are sorted alphabetically.
When selecting an object, two values are written to the opener form. The object classname and oid, concatenated with a colon (:) is written to the given field. The objects String representation is written to the field named `field_display`.

Example: The following url is used to show a window for user selection:
The HTML code shows a button opening a window for selecting users:

```
<script>
function selectUser(){
  window.open("../servlet.method/com.groiss.wf.html.HTMLUtils.selectList?"+
    "classname=com.dec.avw.core.User&title=User&field=customer"+
    "&attribs=surname,firstName,id&searchAttrs=surname,id",
    "search",'width=500,height=500,directories=0,toolbar=0,scrollbars=1');
}
</script>
...

<input type="hidden" name="customer" value=""/>
<input type="text" name="customer_display" value="" style="width:180"/>
<input type=button class="ep_button" value=" ? " onclick="selectUser()">
<input type=button class="ep_button" value=" X "
    onclick="form.customer.value='';form.customer_display.value='';"></td>
```

9.8 Task-Functions in forms

It is possible to place buttons for task-functions in forms. You must write the following placeholder in the HTML form: "%%taskfunction:*functionid%%*", functionid is the id of a task-function.
To sum up, there are several possibilities to place task-functions:

1. in the submenu appearing when you click on the cog-wheel in the worklist. the "show in worklist" checkbox must be clicked.

2. in the toolbar: add the key "taskfunction:*functionid*" to the list of actions.

3. in the form: add the key "%%taskfunction:*functionid%%*" in the html form.
   add the line *<script id="toolbarfunctions">fid1,..,fidn</script>* in the xhtml form

4. in the toolbar when the form is shown in the frame of the worklist. Add the key "%%toolbarfunctions:fid_1,..,fid_n%%" into the HTML form and the key *<script id="toolbarfunctions">fid1,..,fidn</script>* into xhtml forms. fid_1 and fid_n are ids of task-functions. If you write "all" instead of a list of function ids, all applicable task-functions are visible. It you specify no task-function at all, only the standard buttons (save, back, save and back, and save and submit) are shown.

   Hint: The necessary task functions have to be assigned to the corresponding tasks in administration, otherwise no functions are visible.

In any case the parameter `functionTask` contains the oid of the activity instance where the task function was invoked. In case 2, if more than one worklist entries have been selected, this parameter appears for every selected entry.
In the target field of the task-function, you can specify the target window. You can also add window properties if you want to create a new window. Add the properties after the target name and a "," (comma), for example: `_blank,toolbars=0,width=300,height=200`

Hint: If a target window is specified, the form will not be saved when activating the save button.

9.9 Batch Processing

In @enterprise two types of automated steps exist:

- synchronous: this is specified in WDL by the keyword `system` followed by a method call. The method is executed in the same thread and within the transaction context of the operation which started the step. After method execution the step is finished.

- asynchronous: specified by the keyword `batch` followed by a class name. Some methods of this class are executed after the step has been started - in their own transaction and thread.

Use the first method (synchronous) whenever possible, i.e. if the execution time of the method is not too long (it executes in the same transaction as the finish action of the previous interactive step) and if you don't need to wait for an external event to finish the step.
The class you specify for a batch job must implement the interface `com.groiss.batch.BatchAdapter`:

```
public interface BatchAdapter {
  void startup() throws ApplicationException;
  void afterCreation(BatchJob job) throws ApplicationException;
  void doStart(BatchJob job) throws ApplicationException;
  void beforeCompletion(BatchJob job) throws ApplicationException;
  void afterCompletion(BatchJob job, boolean commit) throws
    ApplicationException;
  void doCompensate(BatchJob job);
}
```

When the workflow engine reaches a batch step it creates a BatchJob object and writes it to the database, this BatchJob contains state information.
The timer `BatchManager` is responsible for starting batch jobs and for finishing the steps after the batch job has completed. The flow of control is as follows:

1. When the batch job is created, the `startup` method of the specified BatchAdapter class is called. Then the BatchJob state is set to CREATED and the `afterCreation` method is called.

2. The BatchManager timer starts the batch job by calling the `doStart` method. After successful completion the state of the BatchJob is STARTED. If an exception is thrown in `doStart`, the state of the BatchJob changes to STARTERROR. No further action is taken by the batch system.

3. Next the batch job must be finished. This can be triggered from an internal or external event (for example reception of an email). Call the method `BatchManager.markJobFinished`, and the state of the BatchJob object will be FINISHED.

4. When the BatchManager detects finished jobs during its next timer controlled run, it completes them. First it calls `beforeCompletion`. If there is an exception, the job is placed in state FINISHERROR. No further action is taken by the batch system.

5. On going back via the batch job step the method `doCompensate` is called.

   If `beforeCompletion` was executed successfully, `afterCompletion` is called with a boolean parameter which indicates if the job is now in state COMPLETED (commit = true) or in state FINISHERROR (commit = false).

It should also be noted, that the life cycle of a batchjob can be modified by appropriate flagging with respect to three areas, which can be combined arbitrarily in a fully orthogonal way.

- `newthread`: By specifying newthread, the start of the job takes place in a newly created thread. The original thread creates the batch job and calls afterCreation, but the start of the job is done in the new thread. This feature could be used when the start of the batch job itself takes significant time.
- `autofinish`: Setting autofinish means that immediately after the doStart Method has terminated, the job is marked as finished and then completed by the system itself. Could be used for "fire and forget" BatchJobs.
- `startnow`: A batch job where startnow is set is started immediately after the end of the current transaction not during the next timer triggered run of the BatchManager.
- `gobackonerror`: Setting gobackonerror to true means that in case of an unhandled exception during execution of the doStart method, the engine tries to goBack to the last interactive step.

Add the flags after the class name in the WDL call, for example:

```
batch com.groiss.demo.DemoBatchAdapter() autofinish;
```

The defaults for the life cycle modifications are newthread=false, autofinish = false, startnow=false, gobackonerror=false.
The following example illustrates the usage of this framework.

File **wdl/batchproc.wdl**

```
process batchproc()
application default;
version 1;

forms f Jobform;
subject f.subj;
begin
   <a1> all order(f);
   repeat
      f.recipient a_task(f);
      batch com.groiss.demo.DemoBatchAdapter("aparameter");
   until f.finished = "1";
end;
```

The process is a slight variation of the well-known jobproc example. We introduce an additional batch step, the processing logic is implemented in the class `DemoBatchAdapter`. The parameter (just one parameter is allowed) can be accessed in the methods of `DemoBatchAdapter` via `bj.getParameters()`. It is not used in the example, but could serve as a discriminator when the same BatchAdapter is refered to in several different locations in one process definition.
The general notion of the batch job we want realize is to write a file with some process data to a process specific location in the filesystem. Then we trigger some external entity to process the file. The external entity will place a second file in the same directory (the result of its processing). The batch job will be finished through invocation of an URL and some of the contents of the result file are transferred into the form.

The DemoBatchAdapter implements the BatchAdapter interface, imports the needed things and defines two utility methods, which state the location of the directories where the files will be placed. Under a subdirectory batchdemo in the servers temporary directory, we will place one directory for each process, named after the process id.

File **classes/com/groiss/demo/DemoBatchAdapter**

```
package com.groiss.demo;

import java.io.*;
import javax.servlet.http.*;
import com.groiss.util.Settings;
import com.groiss.wf.batch.*;
import com.groiss.wf.*;
import com.groiss.dms.*;
import com.groiss.util.ApplicationException;

public class DemoBatchAdapter implements BatchAdapter {

private String getMainDirName() {
  return Settings.getTempDir()+File.separator+"batchdemo";
}

private String getProcDirName(ActivityInstance si) {
  return si.getProcessInstance().getId();
}
```

The startup method creates the batchdemo directory. It is called by the BatchManager the first time the DemoBatchAdapter is used. We could establish a communications channel with some external entity here (e.g. a connection to a database or a JMS system).

```
public void startup() throws ApplicationException {
  Settings.log("DemoBatchAdapter: startup ",2);
  File mainDir = new File(getMainDirName());
  mainDir.mkdir();
}
```

The afterCreation method creates the appropriate subdirectory for the process. We use the getContext method of the BatchJob to retrieve the current ActivityInstance (StepInstance object).

```
public void afterCreation(BatchJob job) throws ApplicationException {
  Settings.log("DemoBatchAdapter: afterCreation "+job,2);
  File procDir = new File(getMainDirName(),getProcDirName(job.getContext()));
  procDir.mkdir();
}
```

The doStart method creates the first file (<processid>.out) and writes some process specific data into it. The "real" start would take place instead of the comment.

```
public void doStart(BatchJob job)  {
  Settings.log("DemoBatchAdapter: doStart in Thread"+
    Thread.currentThread().getName()+" for job "+job,2);
  try {
    String procId = job.getContext().getProcessInstance().getId();
    File procDir = new File(getMainDirName(),getProcDirName(
      job.getContext()));
    File outFile = new File(procDir,procId+".out");
    PrintWriter  out = new PrintWriter(new FileWriter(outFile));
    out.println("Output File "+ new java.util.Date());
    DMSForm f = ServiceLocator.getWfEngine().
     getForm(job.getContext().getProcessInstance(),"f");
    out.println(f.getField("description"));
    out.println("../servlet.method/com.groiss.demo."+
     DemoBatchAdapter.notifyFinish?bjOid="+job.getOid());
    out.close();
  } catch (Exception ex) {
      throw new ApplicationException("doStart",ex);
  }
}
```

The beforeCompletion method checks for the result file (<processid>.in) and transfers the first line of this file into the description field of the form attached to the process.

```
public void beforeCompletion(BatchJob job) throws ApplicationException {
  Settings.log("DemoBatchAdapter: beforeCompletion "+job,2);
  try {
    String procId = job.getContext().getProcessInstance().getId();
    File procDir = new File(getMainDirName(),getProcDirName(
       job.getContext()));
    File inFile = new File(procDir,procId+".in");
    BufferedReader in = new BufferedReader(new FileReader(inFile));
    String line = in.readLine();
    in.close();
    DMSForm f = ServiceLocator.getWfEngine().
      getForm(job.getContext().getProcessInstance(),"f");
    f.setField("description",line);
    ServiceLocator.getStore().update(f);
  } catch (Exception ex) {
      throw new ApplicationException("beforeCompletion",ex);
  }
}
```

After successful completion, we delete the files and directories.

```
public void afterCompletion(BatchJob job, boolean commit)
        throws ApplicationException {
  Settings.log("DemoBatchAdapter: afterCompletion("+commit+" "+job,2);
  if (commit) {
    String procId = job.getContext().getProcessInstance().getId();
    File procDir = new File(getMainDirName(),getProcDirName(
       job.getContext()));
    File inFile = new File(procDir,procId+".in");
    File outFile = new File(procDir,procId+".out");
    inFile.delete();
    outFile.delete();
    procDir.delete();
  }
}
```

For the sake of finishing, we provide a servlet method which expects the oid of the batch job as parameter bjOid (you can find the value in the <processid.out> file).

```
public void notifyFinish(HttpServletRequest req, HttpServletResponse res)
        throws Exception {
  long bjOid = Long.parseLong(req.getParameter("bjOid"));
  BatchJob bj = (BatchJob) new BatchJob().get(bjOid);
  BatchManager.markJobFinished(bj);
  res.getWriter().println("Done");
}
```

The compensation method does nothing in this simple example.

```
public void doCompensate(BatchJob job){}

}
```

This completes the example. The state of the batch job can be supervised via the communication section of the admin tasks in the system administration.

9.10 Event Mechanism

The event mechanism is used for raising and handling events inside the workflow engine. An event can be raised from the process execution or via API from another program. The event will be received from all process instances which have registered for the event and the event handler, specified by the receiver, will be called.
The event is identified by a name and an optional context object. If the raiser specifies such an object, a handler registration matches only when the same context object is given or when the handler registered without a context object. The context object itself is either a com.groiss.store.PersistentObject or a String.

9.10.1 WDL extensions

The following extensions have been made to our process definition language WDL to define the event mechanism:

```
raiseEvent =
    "raiseEvent" "(" eventname "," "current_tx" [ "," form ] ")".

registerForEvent =
    "registerForEvent" "(" eventname "," eventhandler [ "," form ]")".

sync =
    "sync" "(" eventname "," eventhandler  [ "," form ] ")".

unregister =
    "unregister" "(" eventname ")".
```

raiseEvent The first argument is the name of the event. The next argument must be `current_tx` at the moment. The third argument defines either a form or a form field as context object. A further possibility is to enter the keyword *process*, which represents the process instance oid (not the process instance itself).

registerForEvent The process registers for receiving events with the given name (first parameter) and the given context object (same as *raiseEvent*) which is an optional third parameter. The eventhandler defines a Java class implementing the interface com.groiss.event.EventHandler.

unregister Removes the registration of this process instance for all events of the given name.

sync waits for receiving an event. The parameters have the same meaning as in registerForEvent.

9.10.2 The Event API

All operations (except sync) defined in WDL can be performed from the API. The interface Event defines the methods an event must have:

```
public interface Event {
  public String getName();
  public ActivityInstance getRaiser();
  public Object getContext();
  public Date getRaiseDate();
}
```

The methods return the name, the raiser of the event, the context object and the raise date. The implementation BasicEvent can be used as implementation (and is used for events raised from the WDL statements above).
The EventHandler is a class containing the following methods:

```
  public boolean handle(Event e, ProcessInstance registrant,
    EventRegistry reg)
  public void onRegister(ProcessInstance handlerProc)
```

When the event handler is registered, the method onRegister is called. When the registration matches a raised event the handle method is called. You will make subclasses of this class for doing some actions in the handle method. The EventHandler class itself writes a log file entry when handle is called and does nothing in onRegister.
The utility class EventManager is used to raise events and register for events:

```
public class EventManager {
  public static void raiseEvent(Event e) throws Exception;
  public static long register(String name, Class eh, Object context)
     throws ApplicationException;
  public static void unregister(long oid) throws ApplicationException;
  public static void unregister(String name, ProcessInstance registrant)
     throws ApplicationException;
  public static void unregisterAll(ProcessInstance registrant)
     throws ApplicationException;
}
```

Events are submitted using raiseEvent. With register you can register an event handler, the method returns the oid for the registration. Use this oid for the method unregister. Alternatively, there is a unregister method for deleting registrations for a given event name and process instance.
unregisterAll removes all registrations made by a process instance.

9.10.3 Event Processing

The WDL statement registerForEvent or the API call EventManager.register writes the event name, event handler, the registrant, and the context object into the registration table.
When raiseEvent is called, all "matching" event handlers are executed (in undefined order). For each event handler a new instance is created and the handle method is called. Matching is defined as: same event name, and when a context object has been defined on register, the context object of the event must be the same (means equal for String, same oid for PersistentObject). The following table subsumes this behaviour (Y means handler is fired, N means handler is not fired, = means firing depends on object or string equality).

		register		
		null	object	string
	null	Y	N	N
raise	object	Y	=	N
	string	Y	N	=

The handling of raised events is performed synchronous in the same thread as the raising. The event raiser does not know how many handlers have been invoked. If the handling of an event throws an (uncatched) exception, the transaction is rolled back.
In log level 2 or higher raising and handling of events is logged.
After an event for a sync is executed, the sync-step is finished if the handle method returns true.
If unregister is not called explicitly, the handlers are removed at the end of the process (the outermost main process in case of subprocesses).
Example:

```
process p1
forms f Jobform;

begin
    all task1(f);
    registerForEvent("personChange", PersonEventHandler, f.agent);
    ...
end;

process p2
forms f Person;
begin
    all changeData(f);
    raiseEvent("personChange", current_tx, f.pers);
    ...
end;
```

It an instance of process p1, we call it pi1, reaches the line registerForEvent, the following record is added to the event registry:

client	eventname	context	eventclass
pi1	personChange	hugo	PersonEventHandler

Process instance pi1 waits for personChange events, which apply to the object "hugo" ("hugo" is the value of f.agent). When an instance of process p2 - pi2 - reaches the line raiseEvent and f.pers has the value "hugo", then an event is raised with the following properties:

```
getName: personChange
getRaiser: pi2
getContext: hugo
```

The event manager looks in the registry after matching registrations and finds the above entry, because event name and context object matches. An instance of PersonEventHandler is created and the handle method is called with the events and process instance pi2 as arguments.

9.10.4 Cluster

Event handlers are executed on the node where the event has been raised.

9.10.5 Administration

In the administration you can view the list of registrations and you can add and remove registrations.
Processes waiting in a sync can be finished manually from the process history.

9.11 Examples

9.11.1 Start a Process

The first example in this section starts a process using the API. This is an often needed task: Either you have to start processes from a program or want to fill the forms with initial values. In this example the process `jobproc` is started and the form of the process in initialized. The start form is static and resides in the serverarea directory:

File **classes/alllangs/demo/StartJob.html**

```
<HTML>
<HEAD>
   <TITLE>StartJob</TITLE>
</HEAD>
<BODY>
Start a process:

<P><form action="../servlet.method/com.groiss.demo.StartJob.start">
<TABLE>
<TR><TD>Subject:</TD>
  <TD><input name="subj"></TD>
</TR>

<TR>
  <TD>Next Agent:</TD>
  <TD><input name="agent"></TD>
</TR>

<TR>
  <TD>Description:</TD>
  <TD><textarea name="description"></textarea></TD>
</TR>

<TR>
  <TD>finished due to:</TD>
  <TD><input name="duedate"></TD>
</TR>
</TABLE>
<input type="submit" value="Start Process">
</form>
```

```
</BODY>
</HTML>
```

The method `start` in the class `StartJob`:

File **com/groiss/demo/StartJob.java**

```
package com.groiss.demo;

import java.util.Date;

import javax.servlet.http.HttpServletRequest;

import com.groiss.dms.DMSForm;
import com.groiss.gui.HTMLPage;
import com.groiss.gui.Page;
import com.groiss.org.OrgData;
import com.groiss.org.OrgUnit;
import com.groiss.org.User;
import com.groiss.util.ThreadContext;
import com.groiss.wf.ProcessDefinition;
import com.groiss.wf.ProcessInstance;
import com.groiss.wf.ServiceLocator;
import com.groiss.wf.WfEngine;


/* Start the process 'jobproc' using the information from the
* StartJob form.
*/
public class StartJob {

    public Page start(HttpServletRequest req) throws Exception {
        // get parameters
        String subj = req.getParameter("subj");
        String agent = req.getParameter("agent");
        String description = req.getParameter("description");
        String duedatestr = req.getParameter("duedate");
        Date duedate = com.groiss.cal.CalUtil.parseDate(duedatestr);

        User user = (User)ThreadContext.getThreadPrincipal();
        WfEngine e = ServiceLocator.getWfEngine();
        OrgData od = ServiceLocator.getOrgData();
        OrgUnit dept = od.getHomeOrg(user);

        ProcessDefinition pd = e.getProcessDefinition("jobproc");
        ProcessInstance pi = e.startProcess(pd, user, dept, duedate, null);

        DMSForm form = e.getForm(pi, "f");
        form.setField("recipient", agent);
        form.setField("subj", subj);
        form.setField("description", description);
        e.updateForm(form);
        HTMLPage p = new HTMLPage();
        p.setPage("<html><body>Process " + pi.getId() + "started.</body></html>");
        return p;
    }
}
```

9.11.2 Find running Processes

The following example, a simple process instance monitor, shows the work items assigned to a selected user.
A dynamically created form lets you select a user, on submit the list of work items belonging to this user is shown.

```
import java.util.*;
import javax.servlet.http.*;
import com.groiss.org.*;
import com.groiss.wf.*;
import com.groiss.gui.component.*;
import com.groiss.util.*;
import com.groiss.gui.*;


/** Show the worklist of a user
*/
public class Monitor {

/** Show a select list of users.
*/
public Page showMask(HttpServletRequest req) throws Exception {
    HTMLPage result = new HTMLPage();
    List l = ServiceLocator.getOrgData().list(
       User.class, "active=1", "surname");
    result.setPage(
      "<form action='com.groiss.demo.Monitor.showList'>Benutzer:"+
       new SelectList("user", l, 10).show() +
       "<br><input type=submit>" +
       "</form>");
    return result;
}

/** Show the worklist of a selected user.
*/
public Page showList(HttpServletRequest req) throws Exception {
    HTMLPage result = new HTMLPage();
    long user = Long.parseLong(req.getParameter("user"));
    StringBuffer p = new StringBuffer("<html>");
    WfEngine e = ServiceLocator.getWfEngine();
    e.setUser((User)ServiceLocator.getOrgData().get(User.class, user));
    List <ActivityInstance> l = e.getWorklist(null, false);
    for (ActivityInstance ai:l) {
        p.append(ai.getProcessInstance().getId() +", " + ai.getStarted()
           + ", " + ai.getProcessDefinition().getId() + "<br>");
    }
    result.setPage(p.toString());
    return result;
}

}
```

10 Configuring the Worklist Client

10.1 Introduction

The appearance of the Worklist Client of @enterprise is fully configurable. Use the *GUI Configuration* editor described in *System Administration* manual. Different clients can be built by defining configuration files.
The next sections describe the syntax of the configuration file. In the following section the implementation of a worklist class is described.

10.2 The Elements of the Configuration File

The configuration file contains the structure of the navigation tree. The tree consists of nodes of different types. Depending on the type, different attributes or child nodes are available.
The standard configuration file resides in the file *ep.jar* in `classes/standard.xml`. If you modify this file the standard appearance of the client is changed.
More often you want to create application or user group specific clients. In such a case you define your own configuration file and put it into the classpath. The URL for a client based on such a configuration file is:

```
http://host:port/wf/servlet.method/
   com.dec.avw.html.HTMLGui.showFrames?id=<the_id>
```

<the_id> stands for the name of the configuration file, (without the ".xml" suffix).
The configuration is described in XML format, the DTD (Document Type Definition) is in the file `Config.dtd` in the `conf` directory of the file *ep.jar*.
The DTD is used for the HTML client and for the Java client, so not every element makes sense for the HTML client. In this section, we describe only the elements for the HTML client. The structure of the navigation tree looks as follows:

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<!DOCTYPE Config SYSTEM "conf/Config.dtd">
<Config>
  <TreeConfig>
    <Main_Tree name="Desktop">
      <Node ... />
    </Main_Tree>
  </TreeConfig>
</Config>
```

The root element `Config` contains the whole tree configuration in the element `TreeConfig` (no other child elements of `Config` is applicable for the HTML client). This element contains the `Main_Tree`, which can contain `Node` elements.
When a user logs in, the navigation tree is built using the following rules: For the structure of nodes in the `Main_Tree` a corresponding tree of HTML labels and links is built.
The tree is then composed of elements of type `Node`. Before we look at the possible types of nodes we present the possibilities to customize the main tree:

10.2.1 Replacing the HTML templates

The main page of the client uses three HTML templates. All of them can be replaced with the configuration using `Attrib` elements with the following keys:

framepage: The frame page, default is `com/dec/avw/lclient/ClientIndex.html`

framepageRTL: The same as *framepage*, but for right-to-left mode (e.g. for Arabic symbols)

treeRenderer: A method which manipulates the tree rendering. This method must consist of a return value *Page* and a parameter *com.groiss.ds.Pair* which contains the whole tree.

The following example shows a treeRenderer method:

```
    public Page createTree(Pair pair) {
        HTMLPage p = new HTMLPage();
        p.setPage("<html>" + createRek(pair) + "</html>");
        return p;
    }

    private String createRek(Pair tree){
        String result = ((Link)tree.first).show()+"<br>";
        if (tree.second instanceof List)
            for (Pair child: (List<Pair>)tree.second){
                result += createRek(child);
            }
        return result;
    }
```

10.2.2 Restricting access to clients

With the attribute `right` you can restrict access to a client configuration. You specify the right the user must have to access the configuration. Other users receive an error, the message can be specified with the attribute `rightmessage`.

Example:

```
<Main_Tree name="Desktop">
    <Attrib key="right" value="client1"/>
    <Attrib key="rightmessage" value="You are not allowed to do this!"/>
    ..
```

10.2.3 Tree Nodes

The tree is described using nested `Node` elements. A Node can have the following attributes:

name: this name is visible in the tree.

class: specifies the type of the node - a fully qualified Java class name. The possible types are described in this section

Instead of *name* the tag <*name*> can be used. This tag allows to define e.g. images or include Java scripts (see example 10.2.3).
Every Node element can contain one or more `Attrib` elements, all having two attributes, `key` and `value`. The following Attrib names can appear in every Node element:

target: The target of the link, `right` is the default.

id: The id of the link.

cssclass: A style sheet can be entered here.

roles: Access restricted to users having one of the roles in the list.

default: If this attribute is present and its value is true, the node is the default node. The web page represented by this node will be shown when the user navigates to this client the first time.

In the following sections the node types are described.

Label

class: `com.dec.avw.lclient.LabelNode`
Defines a simple label.

Node

class: `com.dec.avw.lclient.Node`
Defines a hyperlink; `href` defines the link.

Worklist Description

class: `com.dec.avw.lclient.WorklistDescription`
Represents a link to the worklist. With the attribute `appl` you can restrict the worklist items to a given application. If this attribute is not present and the node is not inside an application node, the worklist for all applications is retrieved.

`USER`	the personal worklist: agent is the user
`ROLE`	the role worklist plus the role worklists of the substituted users
`SUSP`	the suspension list of the user plus the suspension list of the substituted users
`ROLESUSP`	the suspended item where the agent is a role the user has or substitutes.
`SUBST_USER`	the personal worklists of the substituted users.
`ROLE_NO_SUBST`	like ROLE without the substitutions
`SUSP_NO_SUBST`	like SUSP without the substitutions
`ROLESUSP_NO_SUBST`	like ROLESUSP without the substitutions

Table 10.1: **Worklist Types**

The type of the worklist (user worklist, role worklist, etc.) is specified in the attribute `type`, table 10.1 shows the possible values. You may specify any combinations of these types. The id attribute is used to refer to this worklist description from the API.
The attribute `worklist` defines the class implementing the worklist (implementing the interface `com.groiss.wf.html.Worklist`).
The attribute `actions` defines the applicable functions from the table 10.2.

Name	Description
`finish`	complete one or more tasks
`untake`	put item back into role worklist
`finishAndSelect`	finish and select next agent
`finishAndComment`	finish and comment for next agent (+ select next agent)
`goBack`	go back to one of previous steps
`seeLater`	put work item into suspension list
`makeVersion`	make a version of the process instance
`take`	take an item from the role worklist
`recall`	recall an item from the suspension list
`recallAndTake`	take an item form the role suspension list
`setAgent`	set a new agent
`newFolder`	new userfolder
`editFolder`	edit userfolder
`cut`	cut selected item and put it into clipboard
`insert`	insert item from clipboard
`adHoc`	adhoc-functionality for worklist
`loadDoc`	load a DMS object and attach it to process instance
`taskfunction:functionid`	functionid is the id of a task-function
`space`	separator

Table 10.2: **Actions**

Additional actions can be defined like in following example:

```
<Actions>
  <Node id="print">
    <name>@@@print@@</name>
    <Attrib key="iconpath" value="../images/print.gif" />
    <Attrib key="href" value="javascript:window.print()" />
  </Node>
</Actions>
```

This action is referenced in the worklist description, e.g.:

```
<Attrib key="actions" value="finish,xmlfilename.print" />
```

Name	Description
`role`	role the work-item belongs to
`id`	process id
`dept`	department name
`process`	process name
`task`	task name
`task-form0`	task name with a link to the first form in tab view
`process-form0`	process name with a link to the first form in tab view
`subject`	process subject
`documents`	links to the forms and documents
`functions`	link to the functions (icon)
`received`	when the work item has been received
`finish_till`	the due date of the task
`process_duedate`	the due date of the main process
`put_back_until`	in the suspension list till ...
`currentEditor`	the current editor (only displayed, if AUTO-TAKE)
`priority`	priority of the process instance
`origin`	symbolizes, if user sees the instance via substitution or not
`application`	the application where the process belongs to

Table 10.3: **Columns of Worklist**

The following attributes exist for defining columns:

- `links`: Defines the presentation of forms in worklist, when activating the forms-icon. Following values can be defined:
  - tabs: The default behavior of @enterprise. The form is opened in the tab-view. For displaying the worklist-toolbar above the tab-view, you have to set the value `detail` for attribute `formTarget`.
  - compatibility: This mode opens the form in an own window/frame, depending on attribute `formTarget`. The presentation of the form is the same like in @enterprise versions equal to or less than 6.4
  - tabsWithoutForms: With this value the form is displayed in an own frame without detail-tabs. The toolbar contains the functions *Save*, *Save and Complete* and *Back* only.

- `columns:` a set of <column> can be defined with following attributes:
  - id: from table 10.3 or self defined id, the worklist implementation must provide the value. The definition of a form field in the following syntax:

    ```
    id ":" process-definition-id ":" process-version ":" form-id ":"
            columnname
     { ";" process-definition-id ":" process-version ":" form-id ":"
            columnname }
    ```

    This syntax defines for every process instance which form field is shown. If the worklist contains an instance of a process not listed in the field specification the column will remain empty.
  - name: the name of the column
  - visible: when set to true, the column is displayed automatically without using the columnpicker.
  - icon: path to an icon; it is displayed instead of the name
- `defaultSortColumn` and `defaultSortDirection:` These 2 parameters allow to define a column which is sorted by default. If a user is changing the order in table, the new order is stored in the user properties table (and read from there). The attribute *defaultSortColumn* must contain the column-id as value (see example below). The attribute *defaultSortDirection* contains the values *asc* for ascending sorting or *desc* for descending sorting. If one attribute is missing, the first (or given) column will be sorted (by default in ascending order).
- `selection`: checkboxes on the left side of worklist-entries can be modified.
  - none: no checkboxes will be displayed in the worklist
  - one: radio-buttons will be displayed instead of checkboxes
  - multiple: checkboxes will be displayed (default, if the attribute selection is not set)
  - rowsingle: one row can selected only (no checkboxes or radio-buttons)
  - rowmultiple: multiple rows can be selected (no checkboxes or radio-buttons)

The following attributes allows to increase the performance of the worklist table:

- <Attrib key="avoidDocsAndNotes" value="true" /> avoids selection of documents and notes; should only be set if neither documents nor notes are needed in the application!
- <Attrib key="avoidUserFolderFilter" value="true" /> avoids filtering by userfolder contents; should only be set if user folders are not used in the application!

Example:

```
<Node name="MyWorklist" id="id_4"
      class="com.dec.avw.lclient.WorklistDescription">
 <Attrib key="type" value="USER" />
 <Attrib key="actions" value="untake,finish,finishAndSelect,goBack,
                              seeLater,setAgent" />
   <columns>
    <column id="id" name="@@@id@@" visible="true" />
    <column id="dept" name="@@@deptshort@@" visible="false" />
    <column id="process" name="@@@process@@" visible="true" />
    <column id="task" name="@@@task@@" visible="true" />
    <column id="subject" name="@@@subject@@" visible="true" />
    <column id="documents" name="@@@documents@@" visible="true" />
    <column id="received" name="@@@received@@" visible="true" />
    <column id="finish_till" name="@@@finish_till@@" visible="false" />
    <column id="rb:xhtml_proc:1:f:radiobutton" name="rb" visible="true"/>
   </columns>
  <Attrib key="defaultSortColumn" value="rb:xhtml_proc:1:f:radiobutton" />
  <Attrib key="defaultSortDirection" value="desc" />
</Node>
```

This node describes a link to the user worklist (type=USER) with 8 columns defined, six of them are visible, the others can be selected using the column selection menu on the right edge of the table header. The column with name *rb* is sorted by default in descending order.

UserFolder

class: `com.dec.avw.lclient.UserFolder`
Represents a link to the userfolder. In *standard.xml* the attribute `filterwl` with value `wl` means, that all stored filters are inherited from the standard-worklist depending on attribute `id` in worklist description node.

The attribute `treePerUser` is especially for displaying the worklist and user folders of substituted users in separated trees. If this attribute is not set/activated, the user folders of the substituted user are not displayed in the role worklist. The following example shows the personal worklist (with user folders) of substituted users in the role worklist.

Example:

```
<Node name="@@@role_worklist@@"
      class="com.dec.avw.lclient.WorklistDescription">
   <Attrib key="type" value="ROLE+SUBST_USER" />
   <Attrib key="functions" value="take+seeLater" />
   <Node name="user folder" class="com.dec.avw.lclient.UserFolder">
     <Attrib key="type" value="SUBST_USER" />
     <Attrib key="treePerUser" value="true" />
     <Attrib key="filterwl" value="wl"/>
     <Attrib key="actions" value="take+seeLater" />
     <columns>
```

```
      <column id="agent" name="@@@role@@" visible="true" />
      <column id="id" name="@@@id@@" visible="true" />
      <column id="dept" name="@@@deptshort@@" visible="true" />
      <column id="process" name="@@@process@@" visible="true" />
      <column id="task" name="@@@task@@" visible="true" />
      <column id="subject" name="@@@subject@@" visible="true" />
      <column id="priority" name="@@@priority@@" visible="true" />
      <column id="functions" name="@@@functions@@" visible="true" />
      <column id="documents" name="@@@documents@@" visible="true" />
      <column id="received" name="@@@received@@" visible="true" />
      <column id="finish_till" name="@@@finish_till@@" visible="true" />
    </columns>
  </Node>
  <columns>
    <column id="agent" name="@@@role@@" visible="true" />
    <column id="id" name="@@@id@@" visible="true" />
    <column id="dept" name="@@@deptshort@@" visible="true" />
    <column id="process" name="@@@process@@" visible="true" />
    <column id="task" name="@@@task@@" visible="true" />
    <column id="subject" name="@@@subject@@" visible="true" />
    <column id="priority" name="@@@priority@@" visible="true" />
    <column id="functions" name="@@@functions@@" visible="true" />
    <column id="documents" name="@@@documents@@" visible="true" />
    <column id="received" name="@@@received@@" visible="true" />
    <column id="finish_till" name="@@@finish_till@@" visible="true" />
  </columns>
</Node>
```

Process Start Node

class: `com.dec.avw.lclient.ProcessStartDescription`
Defines a link for starting processes. Four modes are available, the mode is specified via the attribute `mode`:

`FORM`: A form of the process is opened, after filling the form the process can be started. The definition of an interface form is necessary (see System Administration Guide).

`DUEDATE`: On click on the link a form is shown where the due date and the start department can be entered.

`DIRECT`: On click on the link the process is started immediately.

`ALL`: The list of startable processes of the application is shown.

The Attribute `procid` denotes the id of the process. The system uses the active process with this id and the highest version number. In mode `ALL` (default-mode) the attribute *application* can contain a list of application ids. The attribute *wlid* is an id of a worklist which is shown after a process start.

Functions

class: `com.dec.avw.lclient.TaskFunctionNode`
Shows a link to a global task function, parameters can be specified.
Example: A link to the function `note_global` will appear for all users with the role `r1`. The function will be called with the arguments $x = 1$ and $y = 2$. Left of the function name the specified icon is shown.

```
<Node class="com.dec.avw.lclient.TaskFunctionNode">
  <name><img src="../images/note.gif"/> f1 </name>
  <Attrib key="function value="note_global" />
  <Attrib key="roles" value="r1"/>
  <Attrib key="params" value="x=1&amp;y=2"/>
</Node>
```

Function List

class: `com.dec.avw.lclient.FunctionListDescription`
Shows a link to all global task functions of an application.
The attribute *application* can contain a list of application ids.

Reports

class: `com.dec.avw.lclient.ReportNode`
A node can be configured to link to a stored query.

```
<Node id="id_23" class="com.dec.avw.lclient.ReportNode">
 <name>MyReport</name>
  <Attrib key="report" value="bsp_03" />
</Node>
```

The attribute *report* contains the id of the report (see *Reporting* manual).

DMS

class: `com.groiss.dms.html.DMSNode`
Shows the DMS of @enterprise. Following attributes can be defined:

- `actions`: Analog to node type worklist description.
  Examples:
  - folderForm: The form of the current folder can be displayed by activating this function in toolbar.
  - taskfunction:formtemplate: The function *Mark as processform-template* is displayed in toolbar.
- `columns`. Analog to node type worklist description.
- `formtypes`: This attribute can contain a list of forms, which are allowed or denied depending on attribute *listtype*.

- `listtype`: Value *whitelist* means, that the entered *formtypes* are allowed only (can be created). Value *blacklist* means, that the entered *formtypes* are not allowed. All other formtypes of @enterprise can be used.
- `paging`: If set to true, the paging mechanism of **@enterprise** for DMS tables is used.

Example:

```
<Node id="id_5" class="com.groiss.dms.html.DMSNode">
 <name>DMS</name>
 <Attrib key="actions" value="new,space,cut,copy,link,paste,delete,
           refresh,space,folderProps,webfolder,upward,clipboard" />
  <columns>
   <column id="name" name="@@@name@@" visible="true" icon="" />
   <column id="form" name="@@@additional_data@@" visible="true"
    icon="images/form.gif" />
   <column id="type" name="@@@docType@@" visible="true" icon="" />
   <column id="size" name="@@@docSize@@" visible="true" icon="" />
   <column id="changed" name="@@@changed_at@@" visible="true" icon="" />
   <column id="status" name="@@@locked_by@@" visible="true" icon="" />
   <column id="info" name="@@@properties@@" visible="true"
    icon="images/info.gif" />
   <column id="versions" name="@@@versions@@" visible="true"
    icon="images/version.gif" />
   <column id="attachedNotes" name="@@@notes@@" visible="true"
    icon="images/dms/attachednotes.gif" />
   </columns>
 <Attrib key="formtypes" value=",f_mainform(1)" />
 <Attrib key="listtype" value="blacklist" />
</Node>
```

It is also possible to create a link in the navigation tree which refers to a simple DMS folder. The following example shows a possibility for this case:

```
<Node class="com.dec.avw.lclient.Node">
 <name>News of the day</name>
 <Attrib key="href" value="../servlet.method/
         com.groiss.dms.html.HTMLDMSObject.showDocs?path={COMMON}/News" />
</Node>
```

More information about the method HTMLDMSObject.showDocs() can be found in section 11.5.1.

Table

class: `com.dec.avw.lclient.TableRendererNode`
A table can be created whereas the table should be a form-class. Following most needed attributes are:

- `classname`: The classname of the object (form-class).

- `tablehandler`: The tablehandler to manipulate the table (see section 9.5).
- `model`: Here you can define the table model (default: *com.groiss.storegui.FormTable*).
- `columns`: Analog to node type worklist description.
- `actions`: Analog to node type worklist description.
- `size`: The window properties can set here by adding several parameters separated by semicolon. The syntax is the same as using the javascript method *window.open()*.
- `columnPicker`: If set to true, the column picker is displayed.
- `useFilter`: If set to true, the filter mechanism of **@enterprise** for tables is provided.
- `paging`: If set to true, the paging mechanism of **@enterprise** for tables is used.
- `pagesize`: Individual paging size for this table. If not set, the user parameter is used and as default the configuration parameter.
- `toolbarShape`: The value *text* indicates that toolbar functions are displayed as text instead of icon. The value *both* allows to display icon and text.

Example:

```
<Node id="id_25" class="com.dec.avw.lclient.TableRendererNode">
 <name>MyTable</name>
 <Attrib key="size" value="width=800,height=600" />
 <Attrib key="classname" value="com.dec.avw.appl.Jobform_5" />
  <columns>
   <column id="subj" name="Subject" visible="true" icon="" />
  </columns>
 <Attrib key="actions" value="new,edit,delete" />
 <Attrib key="columnPicker" value="true" />
</Node>
```

It also possible to define tabbed views shown in the following example. The master-view must contain the attribute *tabs*. The slash at the first position indicates that the master-view is shown as tab *Common*. The second position indicates the detail page (= second tab) which is defined as own node - named *detail* in this example - in the xml named *myxml* within the *Actions* block. A further necessary attribute in master-view is *detail* to get a tabbed window view. In our example the detail-view is a table (displayed in *page*) with columns *Id* and *Name* wich represents the history of the master-view. If an entry is double-clicked (= attribute *defaction*) or selected and the toolbarfunction *view* is activated, the detail-view of the selected entry is opened. The attribute *tb* indicates that a toolbar (frame with id *tbframe*) is displayed as vertical toolbar (= attribute *tbalign*).

```
<Node id="master" class="com.dec.avw.lclient.TableRendererNode">^
 <name>Master</name>
 <Attrib key="model" value="com.groiss.storegui.FormTable"/>
 <Attrib key="formclass" value="com.dec.avw.appl.master_1" />
 <Attrib key="columnPicker" value="true" />
 <Attrib key="actions" value="new,edit,delete,space,
              searchfield,search,allsearch"/>
 <Attrib key="searchAttrs" value="master_id"/>
 <Attrib key="detail"
    value="com.groiss.storegui.TabbedWindow.showDialog" />
 <Attrib key="tabs" value="/,myxml.detail" />
 <Attrib key="paging" value="true"/>
 <Attrib key="useFilter" value="true"/>
 <Attrib key="size" value="width=850,height=500" />
</Node>

<Actions>
<Node id="detail" class="com.dec.avw.lclient.TableRendererNode">
 <name>Detail</name>
 <Attrib key="model" value="com.groiss.storegui.FormTable"/>
 <Attrib key="tablehandler" value="com.groiss.test.DetailTableHandler"/>
 <Attrib key="formclass" value="com.dec.avw.appl.detail_1" />
 <Attrib key="actions" value="view" />
 <Attrib key="defaction" value="view"/>
 <Attrib key="tb" value="tbframe" />
 <Attrib key="tbalign" value="v" />
 <Attrib key="page" value="mask/TabTB.html" />
 <Attrib key="mf" value="parent" />
 <Attrib key="columnPicker" value="true" />
  <columns>
   <column id="detail_id" name="Id" visible="true" />,
   <column id="detail_name" name="Name" visible="false" />
  </columns>
  <Attrib key="size" value="width=800,height=500" />
</Node>
</Actions>
```

10.2.4 Default-page

One of the links in the tree can be the default-Link. This page is then loaded in the right frame when the frameset is initially loaded (after login). The default page is specified with the attribute `default` in the following manner:

```
<Attrib key="default" value="true" />
```

10.2.5 Internationalization

Use @@@key@@ like in HTMLPage. The resource must reside in classpath of the application. If standard @enterprise resources should be used, the key must contain a leading *ep:*, e.g. @@@ep:role@@. It is also possible to use resources of other applications. In this case the application-id is the prefix instead of *ep:*, e.g. @@@*itsm:abortandarchive*@@.

10.2.6 Adding HTML Code Between the Links

Arbitrary HTML Code can be put between the links in the navigation tree, for example a horizontal rule (<hr>). You specify a node with the HTML code as name and no other attributes. Example:

```
<Node class="com.dec.avw.lclient.LabelNode">
 <name><hr/></name>
</Node>
```

10.2.7 Configure user parameters

The node *settings* in the configuration file contains an attribute with following value, where you can add parameters in form of a list to show or hide options on the settings page of the users:

```
<Node name="@@@settings@@" class="com.dec.avw.lclient.Node" >
 <Attrib key="href"
  value="../servlet.method/com.dec.avw.html.HTMLUserProps.showProps" />
</Node>
```

The properties descend from the parameter `for` in the `label`-tag of *UserProps.html*. A summary of these properties is given in the following table:

Parameter	**Meaning**
avw.email.notification	E-Mail-Notification (New Entry in Worklist, New Entry in Role-Worklist)
locale	Language
avw.timezone	Time Zone
avw.table.pagesize	Items per Page
mail.protocol	Mail protocol
mail.communicationtype	Type of Communication
mail.server	Mail Server (IMAP)
mail.user	Mail User
mail.password	Mail Password
mail.foldername	Mail Folder
avw.gui.right.url	Home Page

The properties in the list are separated by a comma shown in the following example.

Example:

```
com.dec.avw.html.HTMLUserProps.showProps?list=locale,avw.timezone
```

In this example the options *Language* and *Time Zone* are visible on the settings page of the users only. If you want to show no options, you have to keep the list of properties empty. If you want to show all options, do not use a parameter list after *showProps*.

10.2.8 Change style and logos

@enterprise uses a property-file where the style-information are stored. This file is within the *ep.jar*. If you want to use your own style, you have to unzip the file *ep.jar*, put *style.prop* in the *classes* directory of @enterprise and change the properties within the file.
If you want to change the @enterprise-logos, you have to do following steps:

1. Create the directory *lang/default/images* in *classes* directory
2. Create a file named *enterprise.gif* in the *images* folder to replace the logo at the login-page
3. Create a file named *enterprise_medium.gif* to replace the logo in the top left corner above the navigation frame

Icons are referenced with the path */<ctx>/images/subdir/filename*. They reside in the classpath under the path *lang/default/images* and *lang/fa/images* for some right-to-left icons. If you want to you use your own icons, you have to put your icon in the classpath like in following examples:

```
classes/lang/default/images/kugerl.gif
classes/lang/default/images/smartclient/status-busy.png
```

The first example overwrites the icon for the old representation of @enterprise, the second one for shiny representation. The representation of @enterprise could be changed under *Configuration → Localization → Use shiny GUI.*

10.3 Customizing the Worklist

For achieving full flexibility in worklist layouts, it is possible to write a Java class defining the appearance of the worklist. You can mix information from @enterprise (user, task name) with application specific data from forms or other database tables.
Define your class as implementor of `com.groiss.wf.html.Worklist` or as subclass of `WorklistAdapter` and specify the class in the xml configuration file as additional attribute of the worklist description:

```
<Attrib key="worklist" value="com.groiss.demo.DemoWL" />
```

The Worklist interface contains the following methods:

```
public void init(HttpServletRequest req, WorklistDescription wl, User u);
public HTMLPage getHTMLPage();
public Object getTitle();
public List<ActivityInstance> getList();
public void getAdditionalData(List instances, List<String> splitResult);
public void modifyColumns(List<ColumnDescription> colDescs);
public void modifyTableLine(ActivityInstance ai,
  KeyedList<String,Object> line);
public String lineStyle(ActivityInstance ai, String style);
public List<Pair<String,String>> listFilters(List lines);
```

The interface `WorklistDescription` used in the init method:

```
public interface WorklistDescription {
  public int getType();
  public String getId();
  public Application getApplication();
  public List<ColumnDescription> getColumns();
  public void needForm(String processid, int version, String formid);
  public DMSForm getForm(ProcessInstance pi, String formid);
}
```

The WorklistDescription contains getters for the definitions from the XML file. The list retrieved from the method `getColumns` can be modified to change the displayed columns. The method `needForm` is used to define which forms will be needed in the worklist construction. You must call this method in the init method of your worklist implementation. The system will then retrieve the forms in an efficient manner. The method `getForm` retrieves these forms from the temporary cache.
The methods of the Worklist interface are called in the written order and do the following:

- `init`: You can init your class with the request. For you convenience, we give you the type of the worklist, the application, and the user. The init method is called once for the creation of a worklist.
- `getHTMLPage`: Replace the standard page or return null. Note that your page contains at least the tag `%tab%` where the table will appear and `%title%` where the title is inserted.
- `getTitle`: non null overwrites the title.
- `getList`: non null overwrites the list, should return list of ActivityInstances,
- `getAdditionalData`: Your chance to collect data. See the next section for details.
- `modifyTableHeader`: You get the header as we suggest it (i.e. the default), a list Pairs of reserved keywords and the labels. The keywords can be find in table 10.3.

  You can change this header as you like. The resulting header is used to build the table lines: for the keywords the system adds the corresponding column, for other names we add "null" elements.
- `modifyTableLine`: Your chance to modify the line, called for each table line. Returning null filters out this line.
- `lineStyle`: Finally you can change the style of the line, return the name of a table-row style class.
- `listFilters`: Define a list of customized filters. See below.

The worklist implementation can be used to define filters, two steps are necessary: First, the method `listFilters` defines the available filters:

```
public List<Pair<String,String>> listFilters(List<ActivityInstance> lines){
  List<Pair<String,String>> result = new List<Pair<String,String>>();
  // filter processes jobproc
  result.add(new Pair("jobproc","Process job"));
  // filter tasks a_task
  result.add(new Pair("a_task","Task a_task"));
  return result;
}
```

Next, you must remember the selected filter in a local variable:

```
String filter;
public void init(HttpServletRequest req, WorklistDescription wld,
    User u) {
  filter = req.getParameter("filter_s");
}
```

In the method modifyTableLine you can filter out lines with the method `clear()`:

```
public void modifyTableLine(ActivityInstance ai,
     KeyedList<String,Object> line) {
  if ("jobproc".equals(filter) && !(ai.getProcessDefinition().getId()).
        equals("jobproc") ||
     "a_task".equals(filter) && !(ai.getTask().getId()).equals("a_task")){
     line.clear();
     return;
  }
}
```

10.3.1 Link to forms and documents

For customizing the links to forms and documents the class com.groiss.wf.html.HTMLUtils contains the following methods:

- getDocumentsLink(ActivityInstance si): returns a link to the documents of the process,
- getNotesLink(ActivityInstance si): returns a link to the notes of the process,
- getFormLinks(ActivityInstance ai, int mode, String comingFrom, String target): returns the links to the process forms concatenated to a string. The mode is either UPDATE or VIEW, comingFrom is the url shown after a form submit and target is the target frame of the submit action.

10.4 Displaying Additional Data

The previous example showed how to display additional data in the worklist.
While this works in principle, the performance of such an approach may suffer. Consider a scenario where a database table `user_data` may hold additional data about a process.

The simplest approach to display this data in the worklist would be to define a method `getUserData`, which gets the ActivityInstance as a parameter and returns an appropriate display string (or link), and to call this method in `modifyTableLine`.

```
  ...
  line.set(i, getUserData(ai) );
  ...
```

As an example, we define a class `AdditionalProcessData` which contains some arbitrary data.

File **classes/com/groiss/demo/AdditionalProcessData.java**

```
package com.groiss.demo;

public class AdditionalProcessData extends com.groiss.store.PersistentObject {
  public com.groiss.wf.ProcessInstance process;
  public String data;
  public String getTableName() { return "demo_addprocdata";}
}
```

The class contains some fields for data storage and the method getTableName, which returns the name of the database table. The table must be generated using an SQL statement like this:

File **sql/addprocdataschema.sql**

```
create table demo_addprocdata (
  oid decimal(20) primary key,
  process decimal(20),
  process_class varchar(100),
  data varchar(100)
);

create index demo_addpdata_proc on demo_addprocdata(process);
```

A straightforward implementation of `getUserData` might look like this:

```
  String getUserData_V1(ActivityInstance ai) {
    AdditionalProcessData ad = (AdditionalProcessData)
      ServiceLocator.getStore().get(AdditionalProcessData.class,
          "process="+si.getProcessInstance().getOid());
    if (ad !=null) {
      return "<b>"+ad.data+"</b>";
    } else {
      return "&nbsp;";
    }
  }
```

While this implementation works nicely, it should be noted that it makes a single point query in the database for each item in the worklist. This could have quite a negative impact on performance for longer worklists and on server throughput in general.

A better solution is often to batch together a number of those single selects. This means to reformulate the query as `where value IN (...)` and then to collect the results in a Java method and to use this data later on in `getUserData`.
To accomplish this, we provide an extra method `getAdditionalData` in `Worklist` which should be implemented in your worklist class. The method is called with the parameter `list` containing the items of this worklist.
The `splitResult` parameter is a Vector of strings. Each of those strings is a comma separated list of oids of the main processes of the worklist items. The reason that we provide a Vector of such oid lists is that most database systems pose a limit on the number of elements of an IN-list. The length of the list is set in database specific way. Now our example looks like this:

```
protected Hashtable additionalDataTable;

public void getAdditionalData(List list, Vector splitResult) {
  additionalDataTable = new Hashtable();
  for (Iterator i = splitResult.iterator(); i.hasNext();)  {
    String inlist = (String)i.next();
    Iterator i2 = new AdditionalProcessData().list(
       "process in ("+inlist+")").iterator();
    while (e2.hasNext()) {
      AdditionalProcessData ad = (AdditionalProcessData) i2.next();
      additionalDataTable.put(new Long(ad.process.getOid()),ad);
    }
  }
}

String getUserData_V2(ActivityInstance si) {
  AdditionalProcessData ad =
    (AdditionalProcessData)additionalDataTable.get(
       new Long(ai.getProcessInstance().getOid()));
  if (ad != null) {
    return "<b>"+ad.data+"</b>";
  } else {
    return "&nbsp;";
  }
}
```

The Hashtable `additionalDataTable` is an instance variable which stores the additional user data. It is filled by the `getAdditionalData` method by iteration over the elements of the splitResult Vector and using a query of the form "where process in..." instead of the former "where process =". Later the `getUserData_V2` method is called once for each item in the worklist via `getTableLine` (change the call from `getUserData_V1` method to the `getUserData_V2` method). It looks up the data in the Hashtable and not in the database.
To test this functionality you may use the following task function:

File **classes/com/groiss/demo/HTMLAddProcData.java**

```
package com.groiss.demo;

import java.util.Date;

import javax.servlet.http.HttpServletRequest;

import com.groiss.gui.HTMLPage;
import com.groiss.gui.Page;
import com.groiss.store.Store;
import com.groiss.wf.ActivityInstance;
import com.groiss.wf.ProcessInstance;
import com.groiss.wf.ServiceLocator;
import com.groiss.wf.WfEngine;

public class HTMLAddProcData {

    public Page addData(HttpServletRequest req) throws Exception {
        WfEngine e = ServiceLocator.getWfEngine();
        Store store = ServiceLocator.getStore();
        ActivityInstance ai = e.getActivityInstance(
            Long.parseLong(req.getParameter("functionTask")));
        ProcessInstance pi = ai.getProcessInstance();
        AdditionalProcessData ad = new AdditionalProcessData();
        String msg;
        if (store.get(ad.getClass(), "process="+pi.getOid()) != null) {
            ad.data = new Date().toString();
            store.update(ad);
            msg = "Updated";
        } else {
            ad.process = pi;
            ad.data = new Date().toString();
            store.insert(ad);
            msg = "Inserted";
        }
        HTMLPage p = new HTMLPage();
        p.setPage("<html><head></head><body>"+msg+": "+ad.data+"<br>"+
        "<form><input type=\"button\" value=\"OK\" onclick=\"history.back()\">"+
        "</input></form></body></html>");
        return p;
    }
}
```

To sum up, this approach might be somewhat more intensive implementation wise, but in general it does pay off well in terms of increased performance and diminished server load.

11 Document Management

@enterprise offers powerful mechanisms for managing documents, either attached to processes or located within a document tree. The key features of this component are:

- **typed documents and folders:** each document or folder belongs to a type which may have its own set of meta data
- **flexible storage of document content:** storage of document content is independent from storage of meta data and can be changed via interface implementation (standard implementation: content will be stored in the database)
- **storage of meta data:** meta data are stored in the database (as known from process forms)
- **permission control:** individual permissions or permission lists (if activated) may be attached to documents and folders
- **adaptability:** own documents or folders may be integrated and the mechanisms for storing the document content and archiving documents may be changed

In the following sections we will see which classes and interfaces exist in @enterprise Document Management System (DMS) and how they are related and we will see some examples using the DMS API.

11.1 Objects of the DMS

The most important interface in the DMS is the interface `DMSObject`. The DMS can manage all objects that implement this interface. `DMSObject` provides methods for retrieving and setting information of an object in the DMS, like the name of an object or when it was lastly changed. But because we have various types of objects in the DMS which differ in their characteristics one interface would not be sufficient. Fig. 11.1 shows the schema of all the various types of objects (all represented by their own specific interface) which can be used within the Document Management System of @enterprise.

In a DMS usually thousands of objects will exists which have to be organized in some way so that users can handle their set of DMS objects. Therefore interface `DMSFolder` exists. The concept should be well known from file systems where each file is located within a folder.

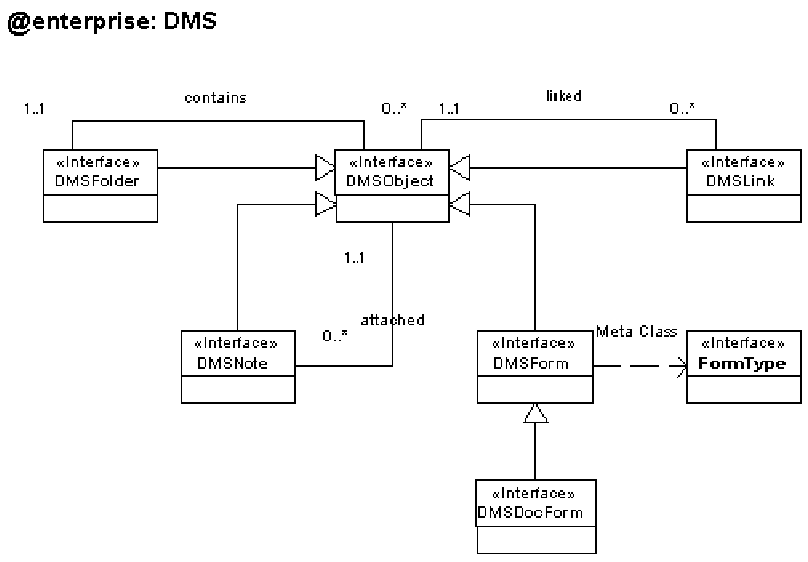


Figure 11.1: **Schema of DMS**

`DMSFolder` defines such a folder. You can add DMS objects to it, retrieve them later and you can remove them again. Because any object implementing `DMSObject` can be added to a DMSFolder you can build hierarchic folder structures by adding one folder to another folder. Although `DMSObject` provides already a set of properties these are all system defined and of limited use. So we need objects which can hold additional, user defined data. This can be achieved using `DMSForm`. `DMSForm` is an interface which provides access to structured data, i.e. data with a specific key and value. Related to a DMSForm is the interface `FormType` which provides more information about forms.
Beside structured data we also want to manage unstructured data like a text file or something else. Therefore the DMS provides the interface `DMSDocForm`, which can handle structured data (because it extends `DMSForm`) and unstructured data. Another different type of object in the DMS is defined by the interface `DMSLink`. A DMSLink holds a reference to another DMSObject of any type (except a DMSLink again).
At last we have the interface `DMSNote` which is special kind of DMSForm in the way that it has two predefined fields (a subject and a content) and it is used to annotate other DMSObjects. Therefore you can attach one ore more DMSNotes to any type of a DMSObject (you can think about it as a kind of an electronic Post-it ®).

11.2 *Life Cycle of a DMSObject*

The life cycle of a DMSObject is quite simple and straight forward as you can see in Fig. 11.2. When a DMSObject is created it already exists within the DMS but it is in an inconsistent state (from the DMS point of view) because it is not added to a folder.

The DMS requires all DMSObjects to be assigned to a folder (accept DMSNotes, they can be attached to a DMSObject). Only after adding the object to a folder the whole functionality of the DMS is available to manage and edit this object. Moving it from one folder to another folder is possible, but deleting the assignment is not.
As expected the life cycle of a DMSObject ends with its deletion. In the case of deletion interface `DMSArchiver` is invoked which can be used to archive some relevant data. The default implementation does nothing but the implementation of this interface can be replaced by the system administration in section *DMS*).

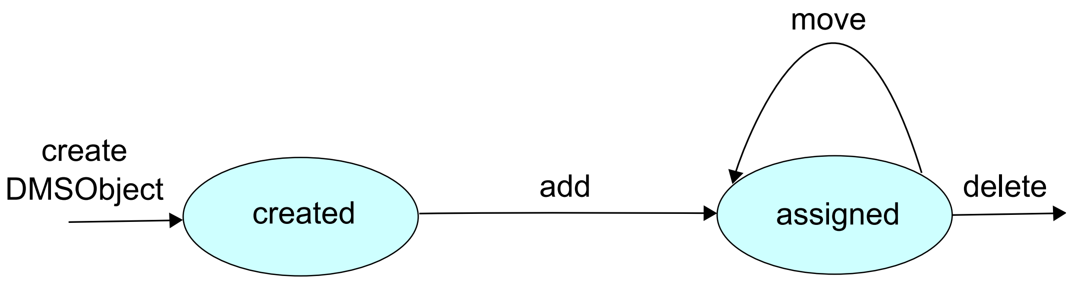


Figure 11.2: **DMSObject Life Cycle**

11.3 Storage and Versioning

For managing the data of the various DMS objects we need to store these data in a persistent storage. The DMS handles the storage of structured and unstructured data in different ways. Making the structured data persistent lies in the responsibility of the DMS objects themselves. But for storing the unstructured data the DMS uses the interface `IStore`. This interface provides a small set of simple methods for storing and retrieving these data.
The concrete implementation of this interface can be specified via the system administration of the @enterprise sever (in section *DMS*). The default implementation stores these data in the data base[1].

Although we mentioned that the structured data have to be handled by the DMS objects themselves they store their data also in the database, but they do not use the `IStore` interface for doing that.

In the DMS beside managing the actual data of DMSObjects we have also the possibility to make versions of DMSObjects. These versions must be managed too which lies in the responsibility of interface `PersistentVersion`. `PersistentVersion` holds information about the version itself (i.e. when it was created and by whom) and it manages the versioned content of the various DMSObjects. Here we have the same strategy as in managing the actual data: versions of structured data are stored in the database, versions of unstructured data are stored via `IStore`.

[1]An exemplary implementation of a store which stores the data as files in a file system can be found in the demo package of @enterprise (classes `com.groiss.demo.dms.FileStore` and `com.groiss.demo.dms.FileStoreBean`).

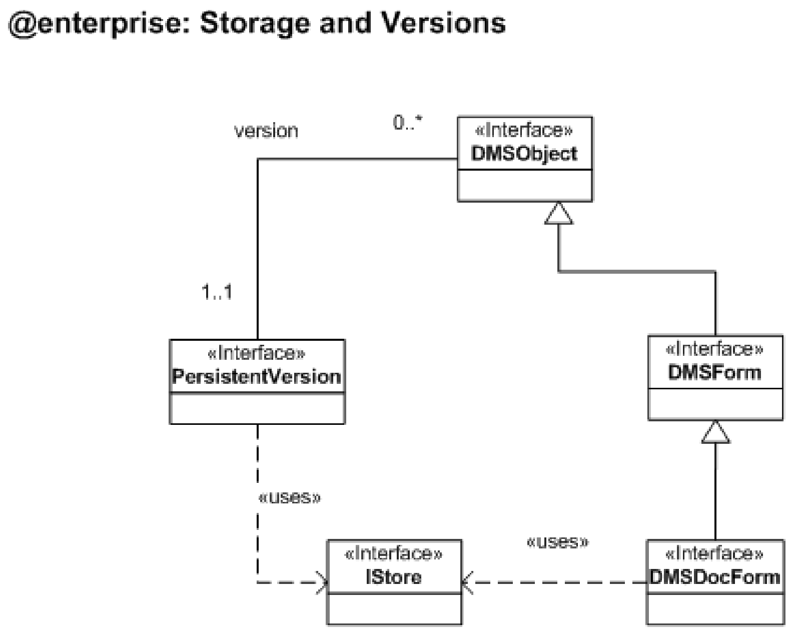


Figure 11.3: **Storage and Versions**

11.4 *The @enterprise DMS API*

All the interfaces of the DMS API are located in the package `com.groiss.dms`. Apart from the interfaces already mentioned in the above sections this package contains another important interface called `DMS`. This interface offers a powerful set of methods for creating and manipulating DMSObjects and provides also some other useful utility methods for programmers working with the DMS. You can retrieve an implementation of this interface by calling `ServiceLocator.getDMS()`.

The methods of interface DMS are arranged in the following groups:

- Create DMS related objects
- Manage the relations between these objects
- Manipulate the objects
- Navigate within the DMS
- Permissions on the objects
- other utility methods

Each group will be explained in the following section, but for a more detailed description of the mentioned methods see the @enterprise API Documentation.

11.4.1 Create DMS objects

Each kind of DMS object has its own creation method in interface **DMS**. For most of them you need the following data:

- the type of the object which should be created
- the name of the object
- a template if the new object should be a copy of this template
- the user who wants to create the object
- a permission list if wanted

The type can be retrieved with one of the following methods of DMS:

- `FormType getFormType(String id, int version)`
- `FormType getFormType(long oid)`

Or you can get all the types a user may create via method `listCreateableFormTypes`. If you want to use a template you have to specify one which is of the same type as the passed one.
When all arguments are available you can use one of these creation methods:

- `DMSFolder createFolder(FormType ft, String name, DMSFolder template, User u,`
  `PermissionList acl)`
- `DMSDocForm createDocForm(FormType ft, String name, String extension, DMSDocForm template, User u,`
  `PermissionList acl)`
- `DMSForm createForm(FormType ft, DMSForm template, User u,`
  `PermissionList acl)`
- `DMSNote createNote(String subject, String content, User u,`
  `PermissionList acl)`

As you can see we don't have a creation method for DMSLink. This is because links are created by method `move` which will be explained in section 11.4.2.

11.4.2 Managing Relations

There are three groups of relationship in DMS and for each group `DMS` offers a set of methods for managing those relationships. The first group is for managing the relations between a DMSFolder and its contents:

- `DMSObject add(DMSFolder f, DMSObject o, User u) throws Exception`
  adds the object to the folder
- `void remove(DMSFolder f, DMSObject o, User u)`
  removes the object from the folder

- `void delete(DMSFolder f, DMSObject o, User u)`
  removes the object from the folder and then deletes the object

- `DMSObject move(DMSFolder src, DMSFolder dest, DMSObject doc, short type, User u)`
  depending on the value of parameter `type` you can achieve the following goals:
  - `DMS.MOVE`: move the object from one folder to another
  - `DMS.COPY`: add a copy of the object to another folder
  - `DMS.LINK`: add a link to the object to another folder

The second group of methods is provided for managing the relationship between a DMSObject and its attached notes:

- `void attachNote(DMSObject target, DMSNote note, User user)`
  attaches the note to the target

- `void removeNote(DMSObject target, DMSNote note, User user)`
  removes the note from the target and deletes the note

- `List<DMSNote> listNotes(DMSObject target, User user)`
  returns the list of notes which are attached to the target and for which the user has at least view right

And last but not least we have methods for managing the relationship between a DMSObject and its versions:

- `PersistentVersion makeVersion(DMSObject obj, User user, String description)`
  makes a version of the passed object

- `void deleteVersion(PersistentVersion dv, User user)`
  delete the passed version

- `List<PersistentVersion> listVersions(DMSObject obj, User user)` returns a list of the versions of the passed object

11.4.3 Manipulate DMS Objects

Beside the manipulation methods offered already by `DMSObject` and their sub-interfaces, interface `DMS` provides the following methods:

- `DMSObject renameDocument(DMSFolder folder, DMSObject obj, String newName,String newExtension, User u)`
  renames the passed DMSObject

- `DMSDocForm reloadDocument(DMSFolder folder, DMSDocForm document, String newExtension, InputStream is, User user)`
  replaces the content of the passed DMSDocForm with the content held by the passed InputStream

- `DMSForm changeType(DMSForm obj, FormType newType, DMSFolder folder, User user)`
  changes the FormType of the passed DMSForm
- `void update(DMSObject o)`
  updates the DMSObject

11.4.4 Navigate within the DMS

Because objects in DMS are hierarchically organized we need some methods to navigate in this hierarchy. Therefore the following methods are available:

- `DMSFolder getRootFolder(User user)`
  returns the root of the DMS tree of the specified user
- `DMSFolder getFolder(DMSObject obj)`
  returns the folder the passed object belongs to
- `List<DMSFolder> listSubfolders(DMSFolder startFolder)`
  returns a list of all the folders within the tree of which startFolder is the root (inclusive the root itself)
- `DMSForm getMainForm(DMSForm f)`
  returns the main from if there is one
- `List<DMSForm> listSubforms(DMSForm f, int id)`
  returns the subforms with the passed id (if there are some)
- `List<DMSForm> listSubforms(DMSForm f, int id, String cond, String order, Object[] vals)`
  returns the subforms with the passed id which match the passed condition
- `List<DMSForm> listForms(FormType ft, String cond, String order, Object[] vals)`
  returns a list of objects of the specified type which match the passed condition
- `List<DMSObject> listContents(DMSFolder folder, FormType ft, String cond, String order, Object[] vals, boolean recursive)`
  returns a list of objects of the specified type which belong to the passed folder and match the passed condition

11.4.5 Permissions in DMS

The interface `DMS` offers some methods to check if a specific user may view or edit a DMSObject. Although interface `OrgData` defines method `hasRight`, these additional methods are necessary because the DMS performs the checks a little bit different.
The differences are:

- DMSObjects which are attached to a process are bound to the rights the user has for this process (i.e. their own right relations are ignored)

- DMSNotes which are attached to a DMSObject are bound to the rights of their DMSObject, and it is also interpreted if they are private (visible only to their creator) or public (visible to all that may view the DMSObject)

Therefore the following methods are defined in DMS:

- `boolean mayView(User user, DMSObject obj)`
  returns true if the user may view the passed DMSObject
- `boolean mayEdit(User user, DMSObject obj)`
  returns true if the user may edit the passed DMSObject
- `boolean mayDelete(User user, DMSObject obj)`
  returns true if the user may delete the passed DMSObject
- `void checkView(User user, DMSObject obj)`
  throws an Exception the user may not view the passed DMSObject
- `void checkEdit(User user, DMSObject obj)`
  throws an Exception the user may not edit the passed DMSObject
- `void checkDelete(User user, DMSObject obj)`
  throws an Exception the user may not delete the passed DMSObject
- `void disableRightChecks()`
  disables all DMS related right checks (i.e. the mayXXX methods always return true and the checkXXX methods never throw an exception)
- `void enableRightChecks()`
  enables the right checks again

ATTENTION: be careful with using `DMS.disableRightChecks()` because it disables them until `DMS.enableRightChecks()` is called or the transaction is finished.

11.4.6 Utility Methods

Last but not least interface `DMS` provides some utility methods, e.g.:

- `DMSObject getDMSObject(String classname, long oid)`
  returns the DMS object with the passed oid which is an instance of the passed class
- `String getIcon(String extension)`
  returns the path to the icon for the passed extension
- `void checkValidName(DMSObject target, String name, String extension)`
  throws an exception if the passed name or extension contain an invalid character. Invalid characters are all characters which are considered as invalid by the Windows® file system. By now these are the following characters: `/ \ : * ? " < > |`
- `void checkDuplicateNames(DMSFolder targetFolder, DMSObject targetObject, String name, String extension)`
  throws an Exception if the target folder already contains an object with the passed name and extension

- `boolean isDuplicateName(DMSFolder targetFolder, DMSObject targetObject, String name, String extension)`
  returns true it the target folder already contains an object with the passed name and extension

11.5 Using the DMS API

Knowing now all relevant interfaces and classes of the @enterprise DMS this chapter will show you some examples for the usage of the DMS API, especially for cases which we assume being most likely to be implemented by application programmers. But before describing those examples we will get to know a few additional utility classes of the DMS.

11.5.1 Utilities for DMS related HTML Interface

Additionally to the classes and interfaces mentioned in the sections above the DMS provides other classes and interfaces which should simplify the life of an API programmer building a specific HTML interface to the DMS. These are:

- `HTMLDMSObject`
- `DMSTableHandler`
- `XHTMLFolderFormEventHandler`

HTMLDMSObject

`HTMLDMSObject` contains a set of HTML specific utility methods, the most important are:

- `static Pair getTree(DMSFolder root)`
  Returns the tree of which the passed folder is the root of. The returned tree is a pair holding a structure which is designed to be used for class `HTMLTree`
- `static Page showDocs(DMSFolder f)`
  Returns a page showing the content of the passed folder.
- `static Page showDocs(HttpServletRequest req)`
  Returns a page showing the content of a folder. To specify the desired folder you can pass it by oid or by a path of names (as known by file systems).
- `static String getDocsUrl(DMSFolder folder, ActivityInstance task, String actions, String pathToRoot)`
  Returns the url for getting the list of documents of a specific folder.
- `static String getEditUrl(DMSObject object, DMSFolder folder, boolean readOnly)`
  Returns the url for editing (if `readOnly` is false) or viewing (if `readOnly` is true) the passed DMSObject.

A more detailed description can be found in the API documentation

DMSTableHandler

This interface gives the application programmer the possibility to change the table view and toolbar used to represent the contents of a folder in the HTML client. An implementation of that interface may be set globally (i.e. for all folders) via System Configuration (section DMS) or for each form type representing a folder via administration for form types.
The methods provided by this interface are:

- `void init(HttpServletRequest req, DMSFolder folder, User u, int mode)`
  Gives you the possibility to initialize the implementation class.
- `HTMLPage getHTMLPage()`
  Returns the html page into which the table should be integrated (e.g. for some placeholder substitutions).
- `String getTitle()`
  The title for the table can be changed by this method.
- `List<DMSObject> getList(List<DMSObject> objects)`
  Your chance to modify the list of the table entries and to collect additional data for them.
- `void modifyColumns(List<ColumnDescription> colDescs)`
  The descriptions (i.e. column header) for the table columns may be changed here.
- `void modifyTableLine(DMSObject obj, Map<String, Object> line)`
  The table line representing on folder entry can also be modified.
- `void modifyActions(List<Pair<String, Object» actions)`
  This is your chance to modify the set of provided actions for the folder and its entries.
- `String lineStyle(DMSObject obj, String style)`
  By implementing this method you change the style of the line for the specified folder item by returning the name of the style class which should be used.

Additional information about this interface and its methods can be found in the API documentation. There you will also find class `DMSTableAdapter` which is an empty implementation of this interface and can be used if you do not want to implement all methods of that interface (e.g. when only the title should be changed).
In section 11.5.3 we will see an example for an implementation of `DMSTableHandler`.

XHTMLFolderFormEventHandler

This interface is an extension of interface `XHTMLFormEventHandler` which is only useful for form types representing folders because it provides methods which will be called when an item will be added or removed from a folder.

- `void onAdd(DMSFolder f, DMSObject o) throws Exception`
  This method will be called immediately before a new item will be added to a folder.
- `void onRemove(DMSFolder f, DMSObject o) throws Exception`
  This method will be called immediately before a item will be removed from its folder.

You can register an implementation of this interface as you would register any other type of form event handler. It is also possible to register it for non-folder form types, in that case methods `onAdd` and `onRemove` will never be called.
As it is for interface `DMSTableHandler` there is also an empty implementation of this interface available which is `XHTMLFolderFormEventAdapter`.

11.5.2 Adding a Document to a Process

Although adding a document to a process is a default functionality of the @enterprise worklist it may sometimes be necessary to perform this action automatically within some program code. Or imagine the case that some external user which may not see the @enterprise worklist should be able to add documents to processes. The following example will show how to create a HTML mask which allows you to select a process and add a document to this process. Method `showMask` creates a simple HTML page in which a process can be selected and a file can be specified. As form action method `addDoc` is defined, which takes the users input (without checking the input for correctness) and makes a new document which is added to the specified process.

File **com/groiss/demo/dms/DMSDemo.java**

```
public Page showAddDocMask(HttpServletRequest req) throws Exception {
    List<ActivityInstance> ais =
       ServiceLocator.getWfEngine().getWorklist(null,false);
    DropdownList l = new DropdownList("process");
    for (ActivityInstance ai : ais) {
        ProcessInstance pi = ai.getProcessInstance();
        l.addOption("" + pi.getOid(), pi.toString());
    }
    HTMLPage page = new HTMLPage();
    page.setPage(
        "<form method=\"post\" enctype=\"multipart/form-data\" "+
        "action=\"com.groiss.demo.dms.DMSDemo.addDoc\">" +
        "Process:" + l.show() +
        "<br>File: <input type=\"file\" name=\"file\">" +
        "<br>Name: <input type=\"text\" name=\"name\">" +
        "<br><input type=\"submit\">" +
        "</form>");
    return page;
}


public Page addDoc(HttpServletRequest re) throws Exception {
    //transform the req. because we need a MultipartRequest when handling files
    MultipartRequest req = MultipartRequest.createInstance(re);
    //get the current user
    User user = (User)ThreadContext.getThreadPrincipal();
    //get the selected process
    WfEngine e = ServiceLocator.getWfEngine();
    ProcessInstance process = e.getProcess(Long.parseLong(
        req.getParameter("process")));

    //get the specified name and divide it into the name and the extension
    //(e.g. doc for Word files)
    String tmpName = req.getParameter("name");
    int idx = tmpName.lastIndexOf(".");
    String name = tmpName.substring(0, idx);
    String extension = tmpName.substring(idx+1);

    //get the file
    File file = req.getFile("file");

    //create a new standard document and add it to the process
    DMS dms = ServiceLocator.getDMS();
    DMSDocForm newDoc = dms.createDocForm(dms.getFormType(
       FormType.STANDARD_DOCUMENT), name, extension, null, user, null);
    dms.add(process.getDMSFolder(), newDoc, user);

    //check in the content of the file
    newDoc.checkIn(user, new FileInputStream(file));

    //return an answer
    HTMLPage page = new HTMLPage();
    page.setPage("<html>Upload done.</html>");
    return page;
}
```

Creating the document and adding it to the process is done using the utility class `DMS` from package `com.groiss.dms` which contains a set of DMS related utility methods (for more details see @enterprise API documentation).

This example works also for adding a document to a folder. The only difference is that you have to find the correct folder instead of the correct process. As you can see in the class diagram `StepInstance` and `FolderForm` (the base class for all folder implementations) implement the same interface `DMSFolder`, so all folder related API methods may be applied to processes and folders.

Adding other DMSObjects to a folder or process works quite similar as in the example above. You only have to choose the corresponding creation method in class `DMS` and collect the necessary parameters. After that again call method `add` to add it to the process or folder.

11.5.3 Adapting Folder and Table View

In this example we will implement a table handler and an event handler for a folder to solve the following tasks:

1. add an additional column determining if a bill has already been paid or not
2. at the bottom of the table we want to display the total amount of bills within the current folder
3. change the folders behavior so that it allows only bills or bill folders in its content
4. define a function 'paid' which marks a bill as paid

Adding a Column

If we want to add a column to the table of contents of a folder there are two different ways for doing that:

1. If the additional column is a meta data field of the objects within the content you can add this column via configuration of the folders table representation (either for one specific folder or for all folders of a specific folder type). How this can be done is explained in the *User manual*.
2. If the additional column is not a column of the contained objects or we don't want to configure it (or cannot because of format problems) we must implement a table handler.

In our case here we could just only configure the additional column but this would not be sufficient because it would display the values `0` for unpaid and `1` for paid (because the meta data field `paid` is a checkbox with these values in the meta data form) which is not very useful. Instead we want the text `No` for unpaid and `Yes` for paid.
So what we will do here is to implement a table handler by creating a class named `BillFolderTableHandler` which inherits from `DMSTableAdapter`.

File **com/groiss/demo/dms/BillFolderTableHandler.java**

```
private DMSFolder folder;
private Resource applResource;

public void init(HttpServletRequest reqP, DMSFolder folderP, User userP,
      int modeP){
    folder = folderP;
}

public void modifyColumns(List<ColumnDescription> colDescs){
    for(ColumnDescription cd : colDescs){
        if("form.paid".equals(cd.getId())){
            //in this case no additional column must be added because
            //it has already been added via configuration
            return;
        }
    }
    //here we know that the column has not already been added via configuration
    //so we do it now
    colDescs.add(new ColumnDescription("form.paid",
      new Image("../images/check.gif")));
    colDescs.add(new ColumnDescription("form.paid",
      new Image("../images/paid.gif")));
}

public void modifyTableLine(DMSObject obj, Map<String, Object> line) {
    String value = "";
    try {
        if(1 == ((DMSForm)obj).<Long>getField("paid").longValue()){
            value = getResource().getString("yes");
        }
        else {
            value = getResource().getString("no");
        }
    }
    catch(Exception ex){
        Settings.logError(ex);
    }
    line.put("form.paid", value);
}

private Resource getResource(){
  if(applResource == null){
    OrgData od = ServiceLocator.getOrgData();
    Application aa = od.getById(Application.class, "demo");
    applResource=((ApplicationAdapter)aa.getApplicationClass()).getResource();
  }
  return applResource;
}
```

The first method is used to initialize our handler so that we know for what folder it should be used.
The next step is to override method `modifyColumns(List<ColumnDescription>)` to add an additional column for the field `paid` if not already done via configuration. This is only done here to show the programmatically way of adding a column, normally the column should be added via configuration.
Then we must override method `modifyTableLine(DMSObject, Map<String, Object>)` which will add the value that should be displayed in column "form.paid". The white-list configuration of our demo folder (see formtype with id `demo_billfolder`) will guarantee that our folder only contains forms of type `demo_bill` in which field `paid` is available. Otherwise we could use method `hasField(String)` of interface `DMSForm` to check the availability of such a field.
At last we have a private helper method which will return the correct resource for I18N support of our demo application (see the configuration of application 'demo').

When we have finished our implementation we must register our new table handler for our new folder type via administration.

Display Total Amount of Bills

The next step in our bill example is to display the total amount of all the bills within a folder. This can be achieved by implementing method `getHTMLPage()` in the following way:

File **com/groiss/demo/dms/BillFolderTableHandler.java**

```
public HTMLPage getHTMLPage() {
    HTMLPage p = null;
    try {
        p = new HTMLPage("mask/Tab.html");
        Store store = ServiceLocator.getStore();
        //calculate the sum of all bills in the current folder
        Object sum = store.getValue("select sum(amount) from form_bill_1 " +
            "where oid in (select item from avw_dmsfldritemrel " +
                "where folder="+folder.getOid()+")");
        //add the calculated sum at the end of the table (by
        //replacing the table's placeholder with the placeholder
        //again and the calculated sum)
        p.substitute("tab", "%tab%<br><b>" +
            DefaultResource.getString("sum") + ": " +
                (sum == null ? "0" : sum) + "</b>");
    }
    catch (Exception ex){
        Settings.logError(ex);
    }
    return p;
}
```

Changing Folder Behavior

In this section we will see how we can change the default behavior of a folder. In our example we will:

1. set field 'account_year' of a bill to the account year of the folder
2. deny adding bills which account year is different to that of the folder

File **com/groiss/demo/dms/BillFolderEventHandler.java**

```
public void onAdd(DMSFolder f, DMSObject o) throws Exception {
  String folderAY = ((DMSForm) f).getField("accounting_year");
  if(!StringUtil.isEmpty(folderAY)){
    String billAY = ((DMSForm) o).getField("accounting_year");
    if(StringUtil.isEmpty(billAY)){
      //in this case set the accounting year of the bill to that of the folder
      ((DMSForm) o).setField("accounting_year", folderAY);
      ServiceLocator.getDMS().update(o);
    } else {
      //in this case accept o only if it belongs to the same accounting year
      if(!folderAY.equals(billAY)){
        throw new ApplicationException("Only bills belonging to accounting" +
         " year " + folderAY + " may be added to this folder.");
      }
    }
  }
}
```

Function 'paid'

Now we have reached the last step in our bill example. We will write a function with which we can mark a bill as paid without editing the bills meta data by hand. To achieve this goal we have to:

1. write this function
2. make this function available to the user

The next code snippet will show the method for writing this function. First we get the bills and manipulate their meta data programmatically. After doing that we must assure that the user gets according feedback by reloading the contents table which then displays `Yes` in the column `paid` for these bills.

File **com/groiss/demo/dms/DMSDemo.java**

```
public Page billPaid(HttpServletRequest req) throws Exception {
    //get the form
    for(String object : req.getParameterValues("object")){
        DMSForm bill = (DMSForm) HTMLDMSObject.getDMSObject(object);
        //set it to be paid
        bill.setField("paid", "1");
        ServiceLocator.getDMS().update(bill);
    }
    //reload the table
    return HTMLDMSObject.showDocs(req);
}
```

Now we must make this function available to the user. This can again be done in two different ways: via configuration in the folder properties of formtype `demo_billfolder` or by overriding method `modifyActions(List<Pair<String, Object»)` in our table handler.

File **com/groiss/demo/dms/BillFolderTableHandler.java**

```
public void modifyActions(List<Pair<String, Object>> actions){
    for(Pair<String, Object> action : actions){
        if("demo.billPaid".equals(action.first)){
            //in this case no additional action is needed
            return;
        }
    }
    //here we know that the action has not already been added via configuration
    //so we do it now
    actions.add(new Pair<String, Object>("space", "space"));
    actions.add(new Pair<String, Object>("demo.billPaid", "demo.billPaid"));
}
```

The concrete method for that action must be defined in an xml file which must be loadable via the class path. As an example here is our snippet of our demo file:

File **demos/classes/demo.xml**

```
...
<Actions>
    ...
    <Node id="billPaid" name="@@@paid@@">
         <Attrib key="href" value="com.groiss.demo.dms.DMSDemo.billPaid" />
```

```
        <Attrib key="iconpath" value="../images/paid.gif"/>
        <Attrib key="apply" value="MULTI"/>
    </Node>
</Actions>
...
```

As you can see the name of our action has three leading and two trailing '@' signs. This is used when the name of the function should be translated into different languages at runtime (needed in a multi-language environment). The system will interpret this markup and will use the application's resource for translation (see the application's configuration for the defined resource).

11.5.4 Build your own DMS Pages

In the last section of our examples we will see how we can integrate the various graphical elements of the DMS (tree, content table, toolbar) into our own HTML pages. This would allow us e.g. to open a browser window in which only the content of a folder and its toolbar is shown, or in which only the dms functionality of @enterprise is available.

Tree Page

First of all the following example will show how we can build a page only containing the dms tree and send it to the browser.

File **com/groiss/demo/dms/DMSDemo.java**

```
public Page showTree(HttpServletRequest req) throws Exception {
    User user = (User) ThreadContext.getThreadPrincipal();
    DMSFolder root = DMS.getRootFolder(user);
    Pair tree = HTMLDMSObject.getTree(root);
    return new HTMLTree(tree);
}
```

After getting the current user we get his DMS root folder by calling the corresponding method of utility class `DMS`. Then we must create the tree structure by using another utility method of class `HTMLDMSObject`. This will return a pair containing the whole tree of the root tree which can now be used to create a default HTMLTree.
It is possible to configure the returned tree, e.g. the page into which the tree is integrated, or the resource bundle which should be used for internationalizing the tree. For more possible configuration see the API documentation of HTMLTree. If the tree's page should be replaced two things must be elements of this page:

- the placeholder %tree% in the body which will be replaced by the generated tree
- the import of various javascript files:

```
<script src="../servlet.method/
        com.groiss.gui.JavascriptLoader.getScripts"></script>
<script src="../scripts/prototype.js"></script>
```

Content Page

The next example will return the page holding the content table of the root folder of the current user.

File **com/groiss/demo/dms/DMSDemo.java**

```
public Page showFolderContent(HttpServletRequest req) throws Exception {
    User user = (User) ThreadContext.getThreadPrincipal();
    DMSFolder root = DMS.getRootFolder(user);
    return HTMLDMSObject.showDocs(root);
}
```

Again we get the current user and his root folder. But now we use the utility class `HTMLDMSObject` and call its method `showDoc` with the root folder as parameter. This is all we have to do if we only want to display a folders content. We can also call this method for any other folder, but therefore we would have to pass the folders class and oid and then get the corresponding folder using method `getDMSObject(String, long)` of class `DMS`.

Content Page with Toolbar

But showing only the content of a folder may not be enough for our application programmers. It's likely that we also want the toolbar so we can add new objects or manipulate the existing ones. To do so we must create a new method and a new HTML page template which will consist of two frames, one for the toolbar and one for the table.
First take a look at the HTML page template:

File **demos/classes/alllangs/demo/dms/twoframes.html**

```
<html>
<head>
  <meta http-equiv="Pragma" content="no-cache">
  <frameset rows="35,*" border=1>
    <frame src="../servlet.method/com.groiss.avw.html.HTMLToolbar.show?actions="
      frameborder="no" name="toolbarframe" marginwidth=1 marginheight=1
      scrolling=no noresize>
    <frame src="\%contentUrl\%" name="right" frameborder="yes">
  </frameset>
</head>
</html>
```

This is only an example for such a template but note, the following conditions must be met by any other template:

- it must contain at least two frames (which can also be `iframes`)
- the frame for the toolbar must be named "buttons"
- the frame for the table must be named "right"

As you can see the first frame source is method `HTMLToolbar.show` which will return the toolbar. The second frame source is not fixed in the template instead a placeholder `contentUrl` is defined. So this frame source will be calculated at runtime and the placeholder will be substituted by the calculated url. The next code will perform this replacement in the template and will return the finished page to the browser.

File **com/groiss/demo/dms/DMSDemo.java**

```
public Page showContentAndToolbar(HttpServletRequest req) throws Exception {
    User user = (User) ThreadContext.getThreadPrincipal();
    DMSFolder root = DMS.getRootFolder(user);
    HTMLPage page = new HTMLPage("alllangs/demo/dms/twoframes.html");
    String ref = HTMLDMSObject.getDocsUrl(root, null, null,
        root.getClass().getName() + ":" + root.getOid());
    page.substitute("contentUrl", ref);
    return page;
}
```

The most important line of code is the call of `HTMLDMSObject.getDocsUrl`. This will return an url which will show the contents table of the passed folder when it is clicked. For more details see the API documentation of class `HTMLDMSObject`.

Putting it All Together

At last we will see an example containing all mentioned elements (tree, table, toolbar). Therefore we need also a HTML page template which uses already described methods for their frame sources. The complete page will be returned to the browser by method `DMSDemo.showAll()`.

File **demos/classes/alllangs/demo/dms/threeframes.html**

```
<html>
<head>
<meta http-equiv="Pragma" content="no-cache">
<frameset rows="35,*" border=1>
  <frame src="../servlet.method/com.groiss.avw.html.HTMLToolbar.show?actions="
    frameborder="no" name="toolbarframe" marginwidth=1 marginheight=1
    scrolling=no noresize>
 <frameset cols="200,*" frameborder="yes">
    <frame src="../servlet.method/com.groiss.demo.dms.DMSDemo.showTree"
       name="tree" frameborder="yes">
    <frame src="../servlet.method/com.groiss.demo.dms.DMSDemo.showFolderContent"
       name="right" frameborder="yes">
  </frameset>
</frameset>
</head>
</html>
```

File **com/groiss/demo/dms/DMSDemo.java**

```
public Page showAll(HttpServletRequest req) throws Exception {
    return new HTMLPage("alllangs/demo/dms/threeframes.html");
}
```

12 Communication with other Systems

12.1 E-Mail

@enterprise can receive and send emails in a simple way. For sending emails use the methods in `com.groiss.util.MailSender`, for example:

```
public static boolean send(String to, String from, String host,
   String subject, String msgText);
```

The following piece of code is an example of sending a message:

```
MailSender.send("recipient@yourdomain.com",
    "sender@mydomain.com",
    null,
    "subject text",
    "the mail text...");
```

The second argument, the mail sender, is usually left null, the system default is used in this case. The method returns true when sending was successful.

Receiving mails is a more complicated task. @enterprise contains a mail handler which is able to read mails from an IMAP mail box. In the system administration you can define such a mail box and a handler class for processing the incoming mails.
The mail handler class must implement the following interface:

```
package com.groiss.mail;

public interface MailHandler {
    public boolean receive(javax.mail.Message msg);
}
```

The following example takes the incoming mails and starts the process `jobproc` for each mail. It is assumed that the subject field contains a workflow user or role (the id of it). In the subj field of the form we write the email address of the sender, the message body is written to the description field.

File **com/groiss/demo/MailGetter.java**

```
package com.groiss.demo;

import java.io.InputStream;

import javax.mail.Message;
import javax.mail.Multipart;
import javax.mail.Part;

import com.groiss.component.Configuration;
import com.groiss.dms.DMSForm;
import com.groiss.mail.MailHandler;
import com.groiss.org.OrgData;
import com.groiss.org.OrgUnit;
import com.groiss.util.FileUtil;
import com.groiss.util.Settings;
import com.groiss.wf.ProcessDefinition;
import com.groiss.wf.ProcessInstance;
import com.groiss.wf.ServiceLocator;
import com.groiss.wf.WfEngine;

public class MailGetter implements MailHandler {

    public boolean receive(Message msg) throws Exception {
        // get the content
        Object content = msg.getContent();
        String contentstr;
        if (content instanceof Multipart || content instanceof InputStream) {
            InputStream is;
            if (content instanceof Multipart) {
                Part part = ((Multipart)content).getBodyPart(0);
                is = part.getInputStream();
            } else {
                is = (InputStream)content;
            }
            contentstr = new String(FileUtil.getBytesFromStream(is));
        } else
            contentstr = content.toString();
        String subject = msg.getSubject();
        String from = msg.getFrom()[0].toString();
        WfEngine e = ServiceLocator.getWfEngine();
        OrgData od = ServiceLocator.getOrgData();
        ProcessDefinition pd = e.getProcessDefinition("jobproc");
        OrgUnit startou = od.getById(OrgUnit.class,
            Configuration.get("demo").getProperty("start.ou"));
        ProcessInstance pi = e.startProcess(pd, null, startou, null, null);
        DMSForm form = e.getForms(pi).get(0);
        form.setField("subj", from + ","+ subject);
        form.setField("description", contentstr);
        e.updateForm(form);
        Settings.log("Process started, id:"+pi.getId(),2);
        return true;
    }
}
```

12.2 Remote Method Invocation

You can connect to @enterprise from other Java programs using Remote Method Invocation (RMI). The class `com.groiss.wf.SessionFactory` is used as root object to get a session from a client to the @enterprise server. Write the following lines to connect to a server:

```
DefaultResource.init("com.dec.avw.resource.Strings",
  "com.dec.avw.resource.Errors");
Properties props = new Properties();
props.put("url", url); // host:port
props.put("userid", userid);
props.put("password", password);
Session ss  = SessionFactory.createSession(
  "com.groiss.avw.RMISessionFactory", props);
Store s  = ss.getStore();
WfEngine e  = ss.getWfEngine();
OrgData od  = ss.getOrgData();
DMS dms  = ss.getDMS();
...
```

The interfaces `Store`, `WfEngine`, `OrgData`, and `DMS` provide you the necessary API calls of @enterprise. See the EPClient example in the demo files (`com.groiss.demo.client` package).

12.3 Wf-XML 2.0

Wf-XML is a protocol for process engines that makes it easy to link engines together for interoperability. Wf-XML 2.0 is an updated version of this protocol, built on top of the Asynchronous Service Access Protocol (ASAP), which is in turn built on Simple Object Access Protocol (SOAP).
@enterprise contains an implementation of the standard. @enterprise can receive Wf-XML messages to start a process, get the current state of a process and change a process' state; and the system can also send all types of messages.

12.3.1 ASAP Overview

ASAP is a protocol that is needed for integration of asynchronous services across the Internet and their interaction defined by Oasis ASAP Committee. The integration and interactions consist of control and monitoring of the services. *Control* means creating the service, setting up the service, starting the service, stopping the service, being informed of exceptions, being informed of the completion of the service and getting the results of the service. *Monitoring* means checking on the current status of the service and getting an execution history of the service.

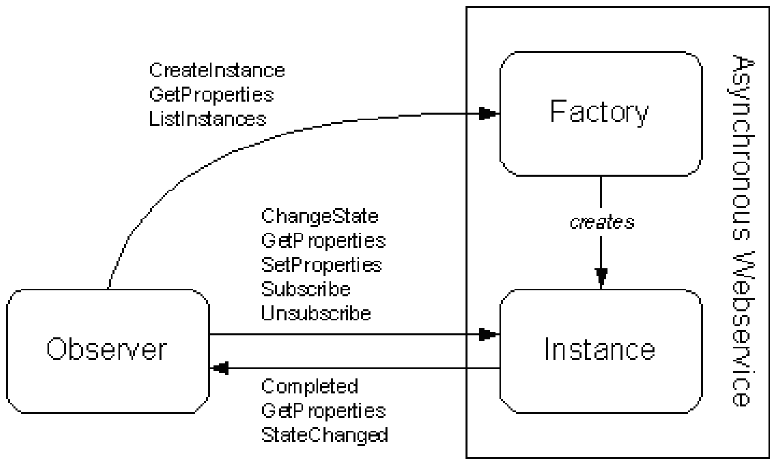


Figure 12.1: **Resource types of an asynchronous web service and the methods they use.**

For the support of an asynchronous web service, three types of endpoints are defined to match the three roles of the interaction: Instance, Factory, and Observer. An endpoint type is distinguished by the group of operations it supports, and so there are three groups of operations (see Fig. 12.1).

Typical use of this protocol would be as follows:

- A Factory endpoint receives a CreateInstanceRq message that contains ContextData and an EPR of an Observer
- The Factory service creates an Instance service (with associated Instance endpoint).
- The Factory responds with a CreateInstanceRs message that contains an EPR for the Instance
- The Instance service eventually completes its task and sends a CompletedRq message that contains the ResultsData to the Observer endpoint

12.3.2 Wf-XML Overview

ASAP offers a way to start an instance of an asynchronous web service (AWS), monitor it, control it, and be notified when it is complete. This service instance can perform just about anything for any purpose. Wf-XML extends this in the special case that the asynchronous service is being invoked on a process engine.
The Service Factory maps to a Process Definition; the Service Instance maps to a Process Instance. Process engines provide some additional capabilities for monitoring the process. First of all, because it is a process, and not simply an opaque service, there is a process diagram. This diagram can be retrieved for introspection. Second, since the process is composed of activities, one can ask the activities for their current values. An activity may

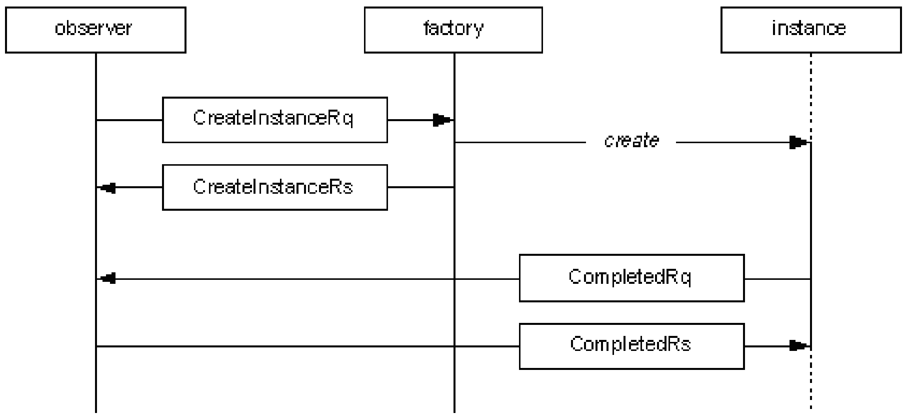


Figure 12.2: **Typical usage scenario of ASAP.**

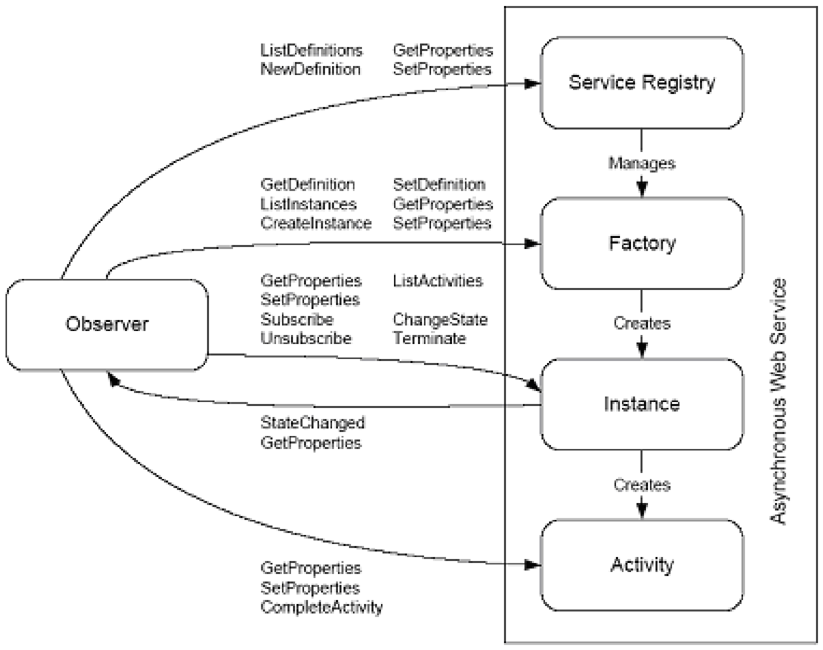


Figure 12.3: **Resource types of a process engine web service and the methods they use.**

itself represent an invocation of a yet another remote service, and the address of that service instance may be retrieved. Thirdly, the process definitions can be edited, removed, or added. Service registry resource is workflow system itself, or some application within this system, it manages factory resources, that are kind of process definitions, that can create in turn an operation instances, each of such instances can have one or more running activities.
Each resource has common properties like name, description, and few specific properties, that will be returned back to *GetProperties* call. Some of this properties read-only, other can be modified with *SetProperties* call.
Container resources like Service registry, Factory, Instance have additionally methods for container introspection (see corresponding *listXXX* calls).
Typical use of this protocol would be as follows:

- A Service registry resource receives ListDefintionsRq message, and returns list of process definitions
- A Client pick up required Factory resource from list and send CreateInstanceRq
- A Factory endpoint receives a CreateInstanceRq message that contains ContextData and an EPR of an Observer
- The Factory service creates an Instance service (with associated Instance endpoint).
- The Factory responds with a CreateInstanceRs message that contains an EPR for the Instance
- The Instance service eventually completes its task and sends a CompletedRq message that contains the ResultsData to the Observer endpoint

Context/Result data

As defined in ASAP specification the service factory should provide a schema for the ContextData element and ResultData elements. The schema may be XML Schema or Relax NG.
@enterprise WfXML implementation defines common XML Schema for both Context and Result data, the only difference between them is that Context data may contain additionally start parameter with optional start-up options (see Fig. 12.4).
Context and result data elements contains zero or more *Parameter* elements, each parameter has name and value. Value of Name could be one of the following:

- StartParameter (considered only for createInstance request)
- ProcessForms
- DMSFolder
- Notes

Content of Value element is dependent from value of Name element.

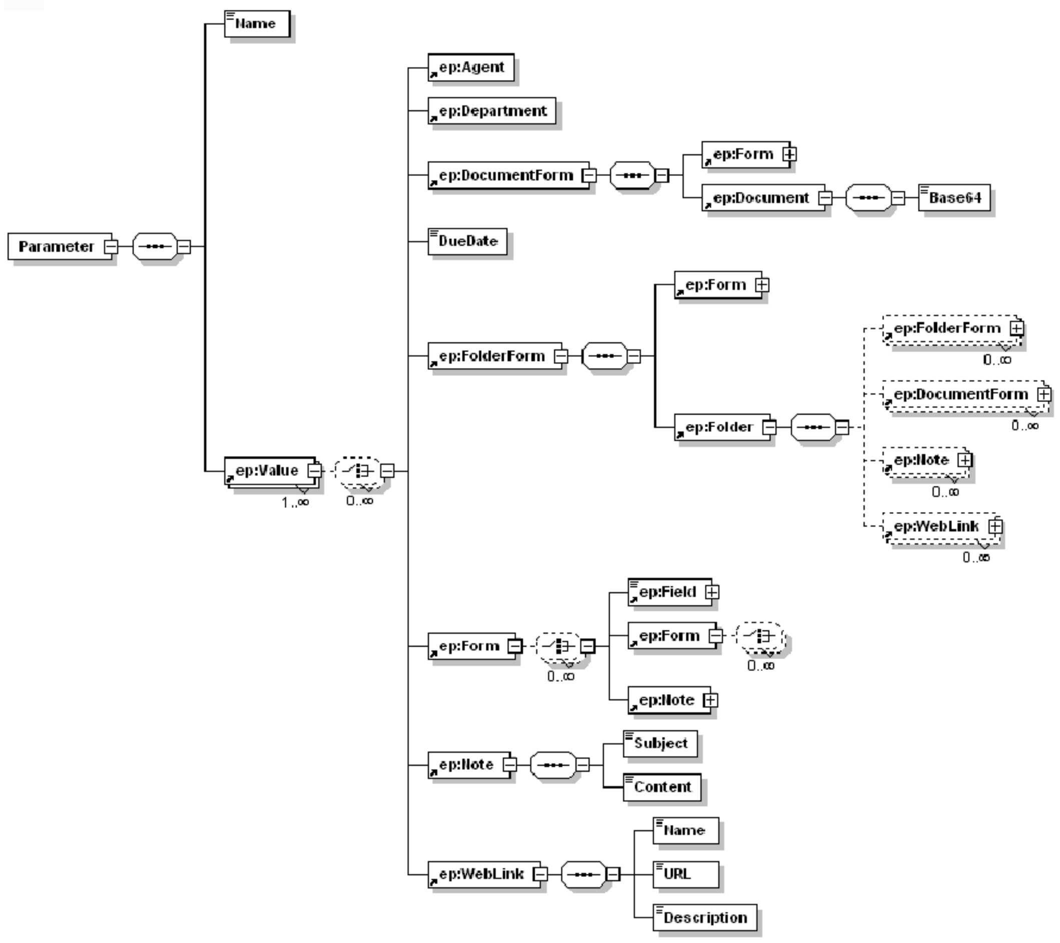


Figure 12.4: **Schema of process Context/Result data.**

StartParameter

Value element contains start-up properties for createInstance call, inside it can be *Agent*, *Department* and *DueDate* elements.
Value of Agent element is an agent id, that will be assigned with a new process. Agent Id should be known for @enterprise.
The *Department* element will contain id of organization unit, that will be assigned with new process. If department element is missing, then WfXML Engine will take default WfXML organization unit. This value will be taken from configuration properties of @enterprise
The date value in *DueDate* element will affect corresponding property of process. If no DueDate element is specified, then process will be started without this restriction. Format of date should be in following format: yyyy-MM-dd´T´HH:mm:ss´Z´.

ProcessForms

Value element contains zero or more *Form* elements. Each Form has a name that is unique for the process, this value will be encoded in content of Field element with attribute name='name'. Form contains also one or more Field elements and zero or more Form and attached Notes elements.

DMSFolder

Value element of DMSFolder parameter could contain zero or more of following elements:

- Form
- FolderForm
- DocumentForm
- Note
- WebLink

FolderForm is a folder object, that could contain some additional fields with meta information. Content elements allowed in FolderForm are the same as for the Value element of DMSFolder parameter.
DocumentForm is a file document, that could contain some additional fields with meta information. Content of file is encoded in *base64*.

Notes

This parameter contains zero or more Note elements.

WfXML2Timer

WfXML2Timer component is an @enterprise timer that will track status of observed processes, once status change detected appropriate method of IWfXMLEngine will be called. Engine will then lookup all remote observers and send them notifications. WfXMLTimer will also check expiration of local observers and once expired observer detected timeout method of corresponding handler class will be called.

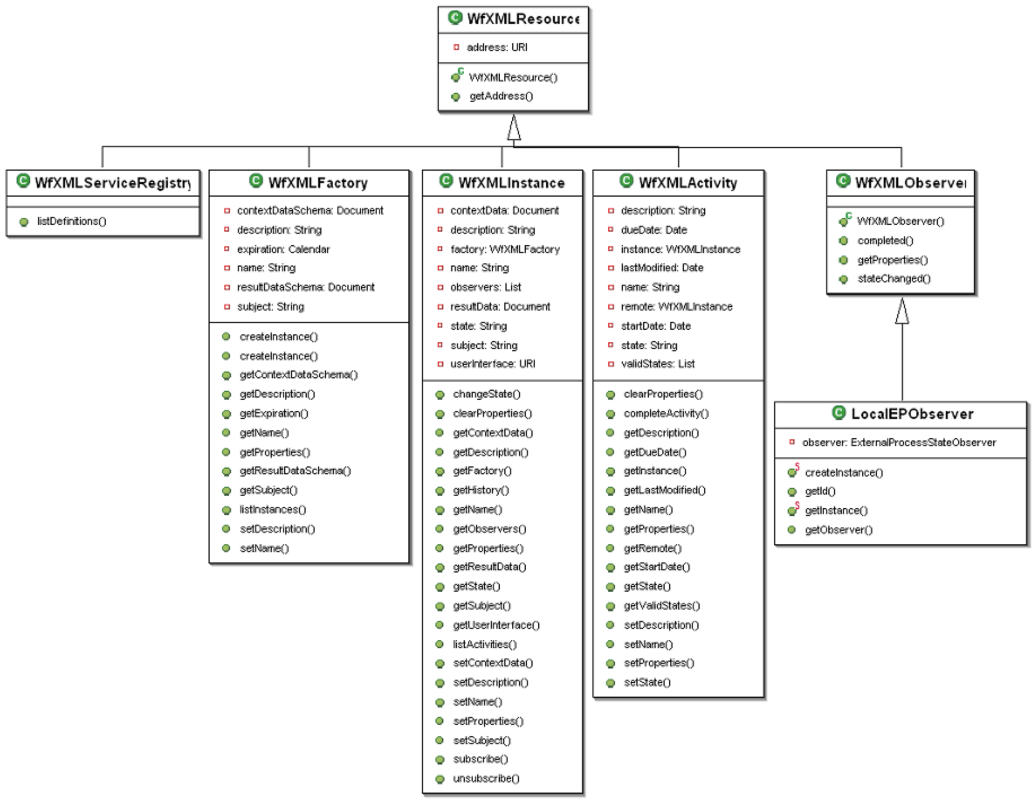


Figure 12.5: **Overview of WfXML client classes.**

Partner communication

WfXML itself does not require explicit partnership between communicating parts, but in some situation there is need to define it. These are advantages of communication on partnership basis:

- Accept only authenticated incoming requests from trusted partners
- Support one-way communications (e.g. through firewall)
- Configurable communication settings
- Automatic and reliable initiation of remote processes through application configuration

Wf-XML Client API

This layer provide easy to use API for communication with external part and dealing with Wf-XML/ASAP resource properties. This API will be used by @enterprise application classes and WfXMLEngine layer (see Fig. 12.5).

Example

Lets take a look how these classes can be used on short example.

```
WfXMLFactory factory;
WfXMLInstance instance;
WfXMLActivity activity;

factory = new WfXMLFactory(
   new URI("http://myserver.com/factory/jobproc")));
instance = factory.createInstance();

List activities = instance.listActivities();
activity = activities.get(0);
activity.completeActivity();

instance.getProperties();
if(instance.getStatus().equals("open.running")) {
instance.setName("job process 1");
instance.setProperties();
}
instance.changeState("closed.abnormalCompleted.aborted");
```

First of all we get access to factory resource with WfXMLFactory, this can be done either:

- through use of service registry method listDefinitions,
- or simply by call to constructor of WfXMLFactory with exact URL to external factory resource.

After that we get access to instance resource. This can be done in following ways:

- By call to factory method listInstances if we want to get existing instance
- By call to factory method createInstance if we want to start new process
- By call to constructor of WfXMLInstance object with exact URL to existing instance resource, and reference to factory object

Once we got instance object we can list activities, get and set properties, and also change instance state.

Access to activity resource can be gained from:

- instance resource object, by calling listActivities method
- or by call to constructor of WfXMLActivity class, with exact URL to external activity resource.

Activity object can be used by clients to get/set properties and to complete activity.

Observer resource can be used if client wants to subscribe/unsubscribe itself for process instance state notifications. The following short example show us how this could be done:

```
LocalEPObserver observer = LocalEPObserver.createInstance(null,
MyObserver.class, null, null);

instance.subscribe(observer);
observer.getObserver().setProcess_url(
instance.getAddress().toString());
observer.getObserver().update();
```

LocalEPObserver is special kind of WfXMLObserver, that will use @enterprise ObserverService for accepting of incoming notifications. Alternatively client can specify any other observer resource by call to instance subscribe with URL parameter.

To unsubscribe itself from notifications, client should call instance method unsubscribe with reference to WfXMLObserver object that should be taken off subscription. Access to existing observer object can be gained from:

- instance observers property
- or simply by call to constructor of WfXMLObserver class with exact URL that points to observer resource.

Local observers should be first taken from database, and only after that they can be passed to call to unsubscribe method. Client should remember value of observer id property, if sooner unsubscribe is possible.

```
long observerId = observer.getId();

...

LocalEPObserver observer = LocalEPObserver.getInstance(observerId);

instance.unsubscribe(observer);
```

12.3.3 Administration

Installation

There are few steps required before Wf-XML interface of @enterprise can be used. First of all Axis2 Web-service container should be installed either as part of @enterprise, or as standalone web-app inside @enterprise web-server. Implementation classes are dependent from runtime context of @enterprise, and cannot be launched out of it.

Once Axis distribution is installed and verified, we can overwrite generic axis configuration file (server-config.wsdd) located in WEB-INF directory with prepared configuration from *com/groiss/wfxml/server/impl*.

Configuration

Wf-XML components relies on few configuration properties, that should be configured by administrator, before it can be used. The following properties can be set via the GUI under

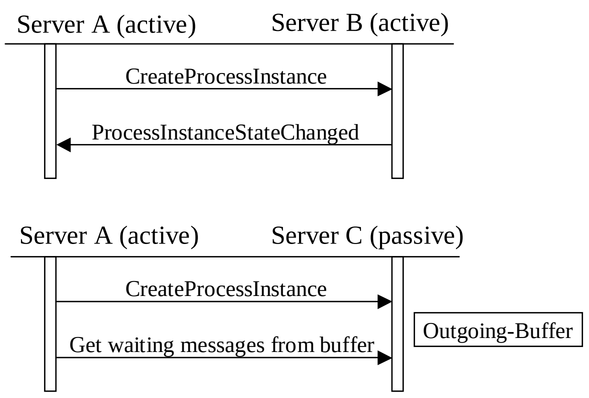


Figure 12.6: **Active-active and active-passive Wf-XML communication.**

Administration → *Configuration* → *Communication*.

First of all we have to specify relative location of Web-service classes on @enterprise web-server:

```
wfxml2.serviceregistry.path=/services.axis2/WfXML2ServiceRegistryService
wfxml2.factory.path=/services.axis2/WfXML2FactoryService
wfxml2.instance.path=/services.axis2/WfXML2InstanceService
wfxml2.activity.path=/services.axis2/WfXML2ActivityService
wfxml2.observer.path=/services.axis2/WfXML2ObserverService
```

Also default organization unit and user id for default agent should be configured:

```
wfxml2.orgunit=gi
wfxml2.user=wfxml_user
```

An @enterprise server can be configured to run with three different operating modes:

- **off**: Wf-XML is turned off. The server does not send messages and it also does not accept incoming messages.
- **active**: An active server sends messages to other servers and accepts messages. This is the 'normal' operating mode, like it is used in the specification.
- **passive**: A passive server does not send messages itself, it only receives incoming messages. Active servers can request outgoing messages from passive servers, but a passive server never sends messages itself. The passive server stores outgoing message in a buffer and keeps them until the target server requests them. This might be useful for security reasons where you want to allow connections to be established just in one direction. Figure 12.6 shows a diagram with active-active and active-passive server communication. The direction of the arrows always indicates the direction in which the connection is established. Responses are sent back through the same connections.

For proper work of WfXML Engine layer in @enterprise timer task should be registered under *Administration* → *Admin-Tasks* → *Server* → *Timer* :

- **Timer class name:** com.groiss.wfxml2.engine.timertask.WfXMLTimer
- **Period:** By default 60 seconds. Lower value will decrease status notification delays, higher will save system time resources.

The following additional settings must be applied to an @enterprise server in order to use Wf-XML:

You have to define communication partners in *Admin-Tasks* → *Communication* → *WfXML* → *Partner List*. You must set the following data for each Wf-XML partner server:

- Server: The ID of the server. In case of @enterprise servers, this must be the server id of the partner.
- Operating Mode: Operating mode of the partner server. If you set it to 'passive', the local server will try to request messages from this server, because it doesn't expect the partner server to send any messages. Mind: this works only, if the local server is active! Two passive servers cannot communicate with each other.
- Host Name: The host name of the partner server.
- Port: The port on which the partner server is listening for HTTP requests.
- Path: The context path

Here you can also get a quick overview of your local server with the *Local status* link. If you click on *Partner status*, your server sends a test message to the other server and displays information about the partner server. Mind that this works only if both servers are @enterprise servers.

12.3.4 Wf-XML Web client

For quick test of functional state of Wf-XML @enterprise, or any other Wf-XML implementations - administrator has possibility to use web client interface, that can be reached with following URL or find under *Administration* → *Admin-Tasks* → *Communication* → *WfXML* → *Web Client*.

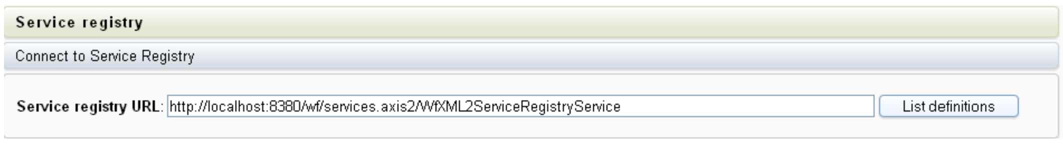
On first page location of ServiceRegistry Service should be specified, and list of definitions managed by ServiceRegistry can be obtained (see Fig. 12.7) by using following URL:

```
http://servername:port/wf/services.axis2/WfXML2ServiceRegistryService
```

It is also possible to restrict the definition list by adding an application id with parameter *?application_id=<applid>*.
After successful connection to ServiceRegistry service user will be able to browse list of definitions managed there (see Fig. 12.8).

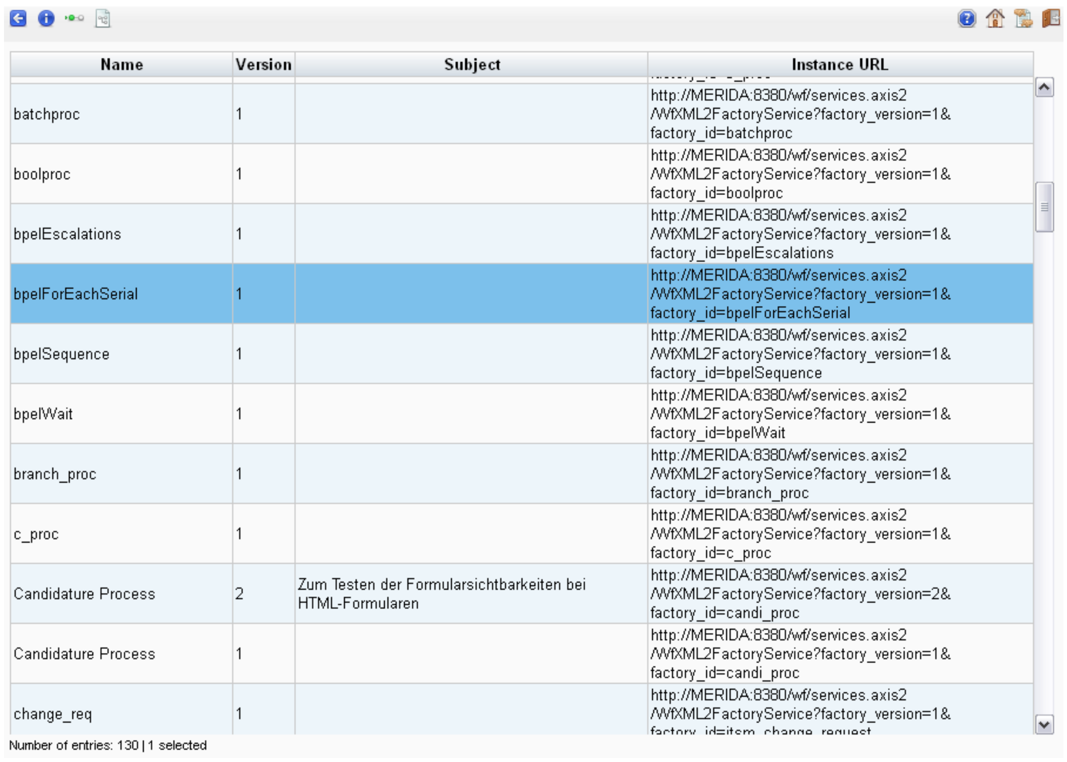
After selection one of definitions, which are Factory resources following actions are possible:

- **Show properties** will display available properties of Factory resource



Service registry URL: http://localhost:8380/wf/services.axis2/WfXML2ServiceRegistryService

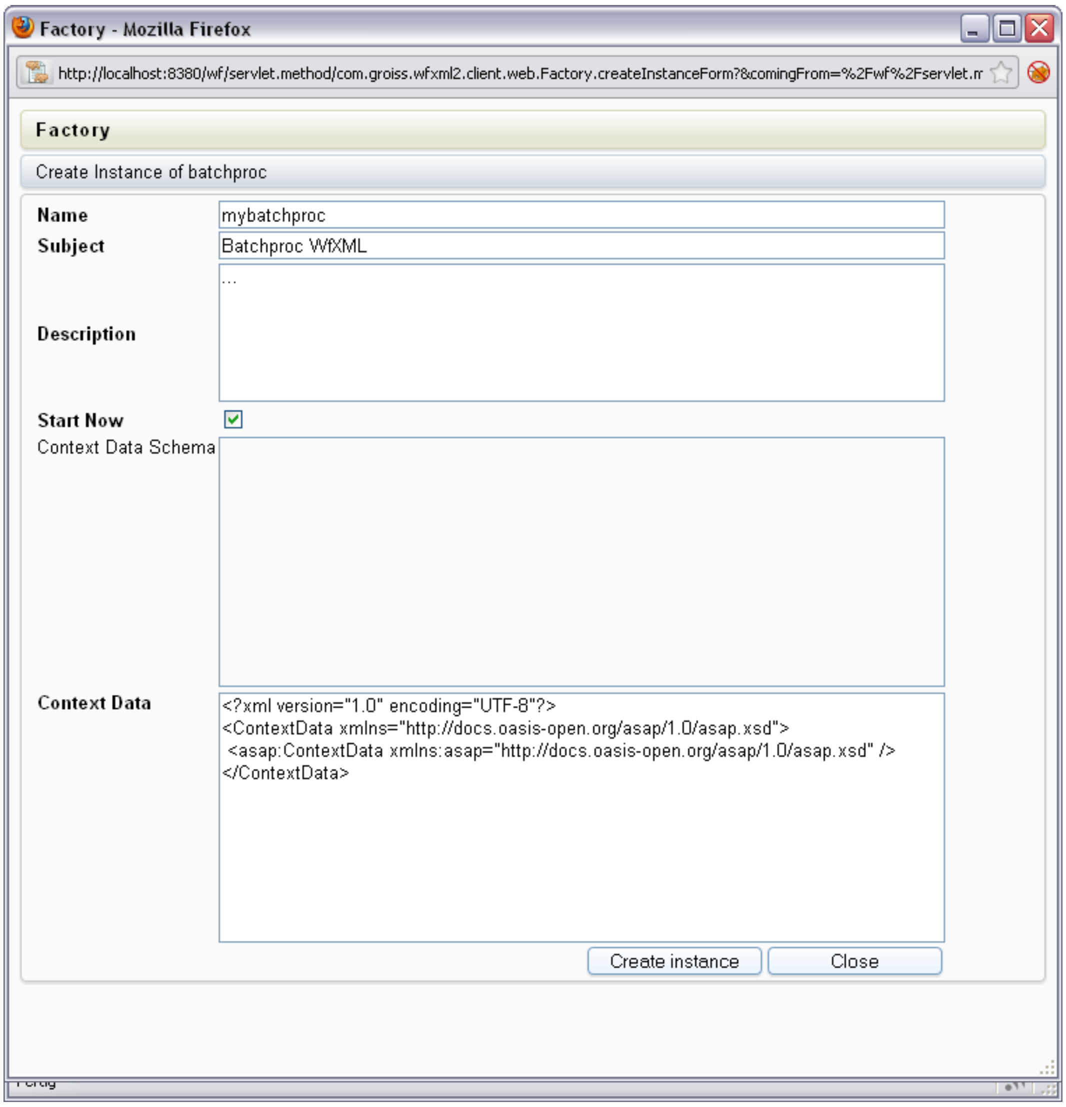
Figure 12.7: **Connect to service registry screen.**



Name	Version	Subject	Instance URL
batchproc	1		http://MERIDA:8380/wf/services.axis2 /WfXML2FactoryService?factory_version=1& factory_id=batchproc
boolproc	1		http://MERIDA:8380/wf/services.axis2 /WfXML2FactoryService?factory_version=1& factory_id=boolproc
bpelEscalations	1		http://MERIDA:8380/wf/services.axis2 /WfXML2FactoryService?factory_version=1& factory_id=bpelEscalations
bpelForEachSerial	1		http://MERIDA:8380/wf/services.axis2 /WfXML2FactoryService?factory_version=1& factory_id=bpelForEachSerial
bpelSequence	1		http://MERIDA:8380/wf/services.axis2 /WfXML2FactoryService?factory_version=1& factory_id=bpelSequence
bpelWait	1		http://MERIDA:8380/wf/services.axis2 /WfXML2FactoryService?factory_version=1& factory_id=bpelWait
branch_proc	1		http://MERIDA:8380/wf/services.axis2 /WfXML2FactoryService?factory_version=1& factory_id=branch_proc
c_proc	1		http://MERIDA:8380/wf/services.axis2 /WfXML2FactoryService?factory_version=1& factory_id=c_proc
Candidature Process	2	Zum Testen der Formularsichtbarkeiten bei HTML-Formularen	http://MERIDA:8380/wf/services.axis2 /WfXML2FactoryService?factory_version=2& factory_id=candi_proc
Candidature Process	1		http://MERIDA:8380/wf/services.axis2 /WfXML2FactoryService?factory_version=1& factory_id=candi_proc
change_req	1		http://MERIDA:8380/wf/services.axis2 /WfXML2FactoryService?factory_version=1&

Number of entries: 130 | 1 selected

Figure 12.8: **List of definitions screen.**


Factory - Mozilla Firefox
http://localhost:8380/wf/servlet.method/com.groiss.wfxml2.client.web.Factory.createInstanceForm?&comingFrom=%2Fwf%2Fservlet.m
Factory
Create Instance of batchproc
Create instance
Close

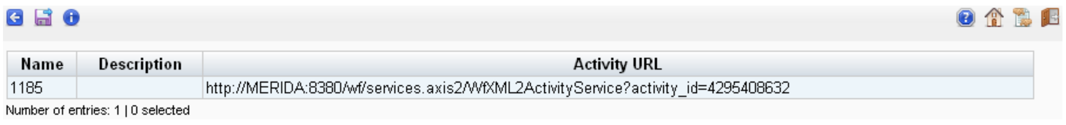
Name	mybatchproc
Subject	Batchproc WfXML
Description	...
Start Now	✓
Context Data Schema	
Context Data	<?xml version="1.0" encoding="UTF-8"?> <ContextData xmlns="http://docs.oasis-open.org/asap/1.0/asap.xsd"> <asap:ContextData xmlns:asap="http://docs.oasis-open.org/asap/1.0/asap.xsd" /> </ContextData>

Figure 12.9: **Create instance screen.**

- **List instances** action will show the list of running processes that belong to the selected Factory resource
- **Create instance** action will provide form where initial process properties can be specified (see Fig. 12.9). In this form name, subject, description fields can be specified. Additionally context data can be specified in XML format. Schema specified for factory is also displayed to make easy for client XML validation. After *Create* action successfully processed new screen with short information about created instance will be presented.

From this point we can operate on instance resource level. On this level we have following actions available for use:

- **Show properties** action will display form with available properties, observers and



Name	Description	Activity URL
1185		http://MERIDA:8380/wf/services.axis2/WfXML2ActivityService?activity_id=4295408632

Number of entries: 1 | 0 selected

Figure 12.10: **Activity list screen.**

context/result data for selected instance. This form allows to perform modifications on some instance properties.

- **List activities** action allows to browse list of active activities for this process instance. From this point we can operate on activity resource level.
- **Change state** action will display a form where required state can be specified. After successful change of instance state the instance properties page will be displayed.
- **Subscribe** action will display a form observer URL can be specified. After successful observer subscription the page with instance properties will be displayed.

On the activity resource level we have following actions available for use (see Fig. 12.10):

- **Complete activity** action will provide form where option path can be specified. After successful completion of activity user will be redirected back on instance level (instance properties screen).
- **Show properties** action will display form with available properties for selected activity, this form also can be used to perform modification of instance properties or context data.

12.4 LDAP

The organizational data of @enterprise can be synchronized with directory services (LDAP-servers). With the administrative interface, one can define a set of LDAP-servers for the purposes of either importing (part of) their directory data and incorporate it in the @enterprise organizational data or to export this organizational data into an LDAP server.
In most cases, an installation wanting to synchronize with directory services will define exactly one LDAP server and employ a unidirectional synchronization. Technically it is possible to have a single LDAP server and to bidirectionally import from this server as well as export to this server. But on an administrative level it is strongly recommended to use either @enterprise as the source and the LDAP server as the target or vice versa, but not at the same time.
Please note that LDAPv3 must be supported by the LDAP-Servers.

12.4.1 Basic Aspects of the Synchronization Mechanism

The synchronization can be characterized by the following aspects:

- **Directory Service:** Comprises the technical aspects of the directory server. Needed are the hostname or IP-address, the port, the path in the directory tree to use as a searchroot, a filter which can be applied to the entires in this tree, and credentials in the form of a user name and a password.
- **Direction:** Each LDAP-Server can act as source of imported data or as destination of exported data.
- **Timer Involvement:** The synchronization can be carried out manually or executed by the *LDAPDirSyncTask* timer (the system takes care that at most one LDAP synchronization operation takes place at at one point of time).
- **Scope:** The following organizational entities of @enterprise are subject to LDAP synchronization:
  - Rights
  - Organizational Units
  - Organizational Hierarchies
  - Roles with associated permissions
  - Users with associated roles and permissions

  While all of these entities can be synchronized by a default mechanism, most installations will probably restrict themselves to a subset, e.g. basic user data.
- **Schema Mapping** The default synchronization mechanism uses a fixed directory schema at this moment. But since each organization employs its specific schema to structure the information in the directory, the default mapping mechanisms can be replaced by a customer specific one in the form of a Java class.

12.4.2 Default Schema Mapping

Since we strive for a possibly complete mapping of all the @enterprise organizational data, we defined a specific LDAP schema. It can be found in the conf/schma.ldap file in the @enterprise installations. This schema comprises appropriate definitions for LDAP attributetypes and objectclasses and uses an officially registered enterprise number (see http://www.iana.org/assignments/enterprise-numbers).
The schema must be deployed onto the LDAP server using the proprietary means of the product. In OpenLDAP, the file must be included in the master schema file (which can usually be found in /etc/openldap/slapd.conf). For other products, your mileage will vary.
Since the schema is not trivial, it might be advisable to export some organizational data using the default mechanism and to browse the resulting LDAP directory to gain a better understanding of the following description.
Under the searchroot, there are the five subdivisions (People, Departments, DeptTree, Roles, Rights), each implemented as organizational unit:

- **Rights:** Each right is of objectClass entRight, it is identified (RDN) by the attribute entId which contains the @enterprise id of the right. For the other attributes, the mapping is as follows:

  - entName: name (mandatory)
  - entApplication: application (id of application the right is associated with, mandatory)
  - entOid: oid
  - entXid: transactionid
  - description: description
  - entActive: active

- **Departments:** Each department is of objectClass entDepartment which is a subclass of class organizationalUnit. It is identified (RDN) by the attribute ou which contains the @enterprise id of the department. Other attibutes are:
  - entName: name
  - entOid: oid
  - entXid: transactionid
  - description: description
  - entActive: active
  - entOrderAttr: orderattr
  - mail: email
  - entOrgType: orgtype
  - entOrgClass: orgclass (id of the departments orgclass)
  - telephoneNumber: telnr
  - postalAddress: address
- **Department Trees:** Each department tree is of objectClass entDeptTree. It is identified (RDN) by the attribute entId which contains the @enterprise id of the depttree. Other attributes are:
  - entName: name (mandatory)
  - entOid: oid
  - entXid: transactionid
  - Under each department tree node, there is a flat collection of directory entries which represent the edges of the department tree (Java class DeptHierarchy). Each depthierarchy object is mapped to one LDAP entry of objectClass entDeptHierarchy. It is identified by attribute cn. The value of cn is the id of the subDepartment of the edge, optionally concatenated with the id of the superDepartment of the edge. In concatenated RDNs, we use the # as a component separator. The other attributes are:
    - entOid: oid
    - entXid: transactionid
    - entSubDept: subdepartment (full LDAP DN of the subdepartment, mandatory)

    * entSuperDept: superdepartment (full LDAP DN of the superdepartment)

  By using DNs as the value for the subdepartment and superdepartments entries, we enable quick navigation in the LDAP-directory.

- **Roles:** Each role is of objectClass entRole which is a subclass of organizationalRole. It is identified (RDN) by the attribute cn which contains the @enterprise id of the role. Other attributes are:
  - entName: name
  - entOid: oid
  - entXid: transactionid
  - description: description
  - entActive: active
  - entRoleType: type
  - entReferenceRole: reference role (full LDAP DN of the referred role)
  - entApplication: application (id of application the role is associated with)
  - Below each role node, there is an organizationalUnit with ou=ACLEntries which contains a flat collection of directory entries which represent the permissions given to the role (Java class ACLEntry). Each ACLEntry object is mapped to one LDAP entry of objectClass entACLEntry. It is identified by attribute cn. The value of cn is concatenation of the following fields: id of the right, id of the department, name of the object class, oid of the object. The other attributes are:
    * entOid: oid
    * entXid: transactionid
    * entRight: avwright (full LDAP DN of the right, mandatory)
    * entDept: dept (full LDAP DN of the department)
    * entTargetClass: target_class
    * entTarget: oid of the object to which this permission applies
    * entOrgScope: orgscope (mandatory)
    * entObjScope: objscope (mandatory)
    * entPositive: positive (mandatory)
- **People:** Each user object is of objectClass entPerson which is a subclass of inetOrganizationalPerson. It is identified (RDN) by the attribute uid which contains the @enterprise id of the user object. Other attributes are:
  - title: title
  - givenName: firstName
  - sn: surname
  - description: description
  - mail: email
  - telephoneNumber: telnr
  - userPassword: password

  - entOid: oid
  - entXid: transactionid
  - entServer: server (id of the users server)
  - entActive: active
  - entOrderAttr: orderattr
  - entLocale: locale
  - entPWneverExpires: pwdneverexpires
  - entPWmustChange: changepwdnext
  - entPWunchangeable: cantchangepwd
  - Below each user node, there is organizationalUnit with ou=ACLEntries exactly like in the case of Roles.
  - Under each user node, there is als an organizationalUnit with ou=UserRoles which contains a flat collection of directory entries which represent the roles given to the user(Java class UserRole). Each UserRole object is mapped to one LDAP entry of objectClass entUserRole. It is identified by attribute cn.The value of cn is a concatenation of the id of the role, optionally followed by the id of the department. The other attributes are:
    - entOid: oid
    - entXid: transactionid
    - entActive: active
    - entDept: department (full LDAP DN of the department)
    - entRole: role (full LDAP DN of the role, mandatory)

Exporting to LDAP

Exporting an @enterprise object to the LDAP directory is done like this:

1. Lookup the LDAP entry by its RDN
2. If not found, search it via the entOid Attribute
3. if still not found, create the LDAP entry and export all its subobjects
4. else if the RDN changed (attributes which form the RDN in @enterprise were updated), delete the entire LDAP-subtree below the entry and export the object
5. else if RDN unchanged but Xid changed, then update the LDAP entry

Importing from LDAP

The import algorithm for one LDAP entry can be sketched as follows:

1. If the entry has an entOid attribute, then search in the database based on this oid
2. If not found, search by its RDN
3. If still not found, create a new database object with the attributes of the LDAP entry
4. else check if an update is needed (Xid changed), and update the SQL object as needed

12.4.3 Customizing the Synchronization

The default schema is clearly much more complicated than needed in typical installations which usually just want to import user data from the directory service.
As already mentioned, one installation can use its own schema mapping semantics by providing a Java Class which implements `com.groiss.ldap.DirectorySyncer`. The interface consists of just one method `synchronize()` which receives two parameters. The first one is the `com.groiss.ldap.DirectoryServer` entry as entered in the administrative interface. It can be used to parametrize the synchronization process or can be ignored altogether. The second parameter of `snynchronize()` is a `DirContext` (found in the `javax.naming.directory` package). The DirContext represents an established connection to the LDAP-server and serves as a main entry point for all following operations in the LDAP server (using the the LDAP-Provider of JNDI).
The following class realizes a simple mapping and can be used as a starting point for ones one implementations:

File **com/groiss/demo/SimpleDirectorySyncher.java**

```
package com.groiss.demo;

import java.lang.reflect.Field;
import javax.naming.Binding;
import javax.naming.NamingEnumeration;
import javax.naming.directory.Attribute;
import javax.naming.directory.Attributes;
import javax.naming.directory.DirContext;
import com.groiss.ldap.DirectoryServer;
import com.groiss.ldap.DirectorySyncer;
import com.groiss.ldap.LDAPUtils;
import com.groiss.org.OrgData;
import com.groiss.org.User;
import com.groiss.store.StoreUtil;
import com.groiss.wf.ServiceLocator;

public class SimpleDirectorySyncer implements DirectorySyncer {

   private static final String LDAPKEYATTNAME = "uid";

   public void synchronize(DirectoryServer ds, DirContext baseContext)
         throws Exception {

      NamingEnumeration<Binding> ne = baseContext.listBindings("");
      while (ne.hasMore()) {
         Binding b = ne.next();
         String rdn = b.getName();
         DirContext objectCtx = (DirContext) b.getObject();
         syncObject(rdn,ds,baseContext,objectCtx);
      }
   }

   private void syncObject(String rdn, DirectoryServer ds,
            DirContext baseContext,DirContext objectCtx)
         throws Exception {
      Attributes attribs = objectCtx.getAttributes("");
      Object ldapKey = attribs.get(LDAPKEYATTNAME).get();
      OrgData od = ServiceLocator.getOrgData();
      User u = od.getById(User.class,(String)ldapKey);
      if (u !=null) { // object exists in @enterprise
         //Settings.log("SimpleDirectorySyncer: "+ldapKey+"already present",1);
         // do nothing
         // od.update(u);
      } else { // create user object
         //Settings.log("SimpleDirectorySyncer: Creating User "+ldapKey,1);
         u = od.createUser();
         setFields(u,attribs);
         u.setActive(true);
         od.insert(u);
      }
   }

   private static String[][] attMap =  {
      {"sn","surname"},
      {"givenName","firstName"},
      {"uid","id"},
      {"title","title"},
      {"givenName","firstName"},
      {"description","description"},
      {"mail","email"},
      {"telephoneNumber","telNr"}
   };

   private void setFields(User u, Attributes attribs) throws Exception {
      for (int i = 0; i< attMap.length;i++) {
         Attribute att=attribs.get(attMap[i][0]);
         if (att==null) {
            continue;
         }
         Object attVal = att.get();
         if (attVal == null) {
            continue;
         }
         Field ff =  StoreUtil.getField(u,attMap[i][1]);
         //Settings.log("******"+attMap[i][0]+" "+attMap[i][1]+" "+attVal,1);
         LDAPUtils.setField(ff,u,attVal);
      }
   }


}
```

13 XWDL

13.1 Introduction

This chapter presents the XWDL, an extensible XML based dialect of WDL.
The classic approach to define process types in @enterprise was to use the Workflow Description Language (WDL) or to draw the process with the process editor applet.
WDL is designed as a kind of structured, human-readable process programming language. It is not mainly targeted for the exchange of process type information with other systems. In order to semantically analyze the WDL-scripts, those third-party systems would have to make use of conventional parsing techniques.
The export/import format of @enterprise allows one to transfer application definitions (which contain process definitions) between @enterprise systems. While this format is XML based, the process information is still sent along as a WDL-Script.
The formulation of WDL in a structure-rich XML has the following aims / benefits:

- third-party applications can generate XWDL-Scripts on the grounds of a well understood formalism
- use a plain DTD-driven XML editor to write XWDL-Scripts with automatic syntactical correctness
- verification of the syntax using solely an out of the box XMl-parser.
- third party extensions could be accommodated using an extension approach for the DTD

13.2 Usage

13.2.1 HTML-Client

XWDL-Processes can be loaded into the system exactly like WDL Processes. There are two new links on the Process / Script page for viewing (IE6 needed) or downloading the XWDL-Code of a process.

13.3 API

A simple API is provided to insert XWDL-Processes into the system.

```
package com.groiss.wf.xwdl;
  public class ProcessParser implements IProcessParser{

    public ProcessDefinition loadProcess(InputStream is, boolean genRoles,
        boolean genTasks) throws Exception;

    public ProcessDefinition loadProcess(String fileName, boolean genRoles,
        boolean genTasks) throws Exception;

    public String getErrors();
```

A XWDL-Process can be loaded from an InputStream or from a File which is specified via its filename. The booleans genRoles and genTasks state whether roles and tasks should be generated. When the process could be loaded without errors, no Exception is thrown and the getErrors method will return the empty string.
A typical usage would be like this:

```
    ProcessParser pp = new com.groiss.wf.xwdl.ProcessParser;
    try {
        ProcessDefinition pd  = pp.loadProcess(fileName, true, true);
    } catch (Exception ex) {
        //rollback;
    }
    if (pp.getErrors().length() != 0) {
        // error occured;
        // rollback;
    } else {
        // commit;
    }
```

13.4 The basic DTD

The dtd uses ENTITY definitions for the content of each element. This allows for extensions of the DTD in a modular manner. The extension mechanism is described in the next section. The DTD resides in the file conf/xwdl.dtd which is part of the distribution.

13.5 An Example

We will now present a rendering of WDL in XWDL by means of an example.

13.5.1 WDL

The example in WDL is:

```
process all_things_x()
version 1;
name "all control structures";
description "Test the control structures";
maxtime 10 minutes;
forms form Jobform;
timeoutaction none;
timeouttask
all,r adm_task(form);
application default;
startfunction ;
begin
   <first>
   all start_task(form);
   loop
      choice
      "first choice: an if":
         if (form.type = "hw") then
            all hw_task(form);
         elsif (form.type = "sw") then
            form.recipient swx_task(form);
         elsif (form.type = "adm") then
            first:user adm_task(form);
         else
            first:user none_task(form);
         end;
      "second choice: a while":
         while (form.type = "hw") do
            form.recipient while_task1(form);
            <in_while>
            form.recipient while_task2(form);
            form.recipient while_task3(form);
         end;
      "third choice: a loop":
         loop
            form.recipient loop_task(form);
            exit when (form.type = "hw");
         end;
      "fourth choice: system steps":
         system com.groiss.demo.SystemSteps.emptyMethod();
         form.recipient between_task(form);
         system com.groiss.demo.SystemSteps.emptyMethod();
         system com.groiss.demo.SystemSteps.emptyMethod();
         form.recipient aftersys_task(form);
      "fifth choice: andpar":
         andpar
            form.recipient andpar1_task(form);
            |
            all andpar2_task(form);
            |
            form.recipient andpar3_task(form);
         end;
      "sixth choice: orpar":
         orpar
            form.recipient orpar1_task(form);
            |
            form.recipient orpar2_task(form);
            |
            form.recipient orpar3_task(form);
         end;
      "eight choice: subprocesses":
         call subflow1(form);
      "nineth choice: goto (into the while)":
         goto in_while;
      end;
      exit when (form.finished = 1);
   end;
end
```

13.5.2 XDWL

The corresponding formulation in XWDL would look like this:

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<!DOCTYPE process SYSTEM "./conf/xwdl.dtd">
<process id="all_things_x" version="1"
name="all control structures" description="Test the control structures"
application="default">
  <forms>
    <formdecl id="form" typ="Jobform" />
  </forms>
  <timing timeoutaction="none" maxtime="10" maxtimeunit="minutes">
    <activity id="adm_task">
      <agent string="all" />
      <agent string="r" />
      <form name="form" />
    </activity>
  </timing>
  <label id="first" />
```

```
<activity id="start_task">
  <agent string="all" />
  <form name="form" />
</activity>
<loop>
  <choice>
    <case name="first choice: an if">
      <if condition="(form.type = &quot;hw&quot;)">
        <then>
          <activity id="hw_task">
            <agent string="all" />
            <form name="form" />
          </activity>
        </then>
        <elsif condition="(form.type = &quot;sw&quot;)">
          <then>
            <activity id="swx_task">
              <agent string="form.recipient" />
              <form name="form" />
            </activity>
          </then>
        </elsif>
        <elsif condition="(form.type = &quot;adm&quot;)">
          <then>
            <activity id="adm_task">
              <agent string="first:user" />
              <form name="form" />
            </activity>
          </then>
        </elsif>
        <else>
          <activity id="none_task">
            <agent string="first:user" />
            <form name="form" />
          </activity>
        </else>
      </if>
    </case>
    <case name="second choice: a while">
      <while condition="(form.type = &quot;hw&quot;)">
        <activity id="while_task1">
          <agent string="form.recipient" />
          <form name="form" />
        </activity>
        <label id="in_while" />
        <activity id="while_task2">
          <agent string="form.recipient" />
          <form name="form" />
        </activity>
        <activity id="while_task3">
          <agent string="form.recipient" />
          <form name="form" />
        </activity>
      </while>
    </case>
    <case name="third choice: a loop">
      <loop>
        <activity id="loop_task">
          <agent string="form.recipient" />
          <form name="form" />
        </activity>
        <exit condition="(form.type = &quot;hw&quot;)" />
      </loop>
    </case>
    <case name="fourth choice: system steps">
      <system methodcall="com.groiss.demo.SystemSteps.emptyMethod()" />
      <activity id="between_task">
        <agent string="form.recipient" />
        <form name="form" />
      </activity>
      <system methodcall="com.groiss.demo.SystemSteps.emptyMethod()" />
      <system methodcall="com.groiss.demo.SystemSteps.emptyMethod()" />
      <activity id="aftersys_task">
        <agent string="form.recipient" />
        <form name="form" />
      </activity>
    </case>
    <case name="fifth choice: andpar">
      <andpar>
        <parallel>
          <activity id="andpar1_task">
            <agent string="form.recipient" />
            <form name="form" />
          </activity>
        </parallel>
        <parallel>
          <activity id="andpar2_task">
            <agent string="all" />
            <form name="form" />
          </activity>
        </parallel>
        <parallel>
          <activity id="andpar3_task">
            <agent string="form.recipient" />
```

```
              <form name="form" />
            </activity>
          </parallel>
        </andpar>
      </case>
      <case name="sixth choice: orpar">
        <orpar>
          <parallel>
            <activity id="orpar1_task">
              <agent string="form.recipient" />
              <form name="form" />
            </activity>
          </parallel>
          <parallel>
            <activity id="orpar2_task">
              <agent string="form.recipient" />
              <form name="form" />
            </activity>
          </parallel>
          <parallel>
            <activity id="orpar3_task">
              <agent string="form.recipient" />
              <form name="form" />
            </activity>
          </parallel>
        </orpar>
      </case>
      <case name="eight choice: subprocesses">
        <call id="subflow1">
          <form name="form" />
        </call>
      </case>
      <case name="nineth choice: goto (into the while)">
        <goto label="in_while" />
      </case>
    </choice>
    <exit condition="(form.finished = 1)" />
  </loop>
</process>
```

Versioning: If -1 is specified as the version of the process, it gets a new version number. If there are already process definitions with this id in the system, the new process gets the highest version number of those processes plus one. If there are no processes with this id, version number 1 is assigned.

13.6 The extension model

13.6.1 The extension DTD

The extension mechanism follows the spirit of the formulation of Modular XHTML [5] without introducing any unneeded complexity.
The main idea is to leave the basic XWDL DTD untouched and to define a specific extension DTD which would include the original DTD like this:

```
<![ INCLUDE [
<!ENTITY % xwdl.mod SYSTEM "./xwdl.dtd">
%xwdl.mod;]]>
```

Before the inclusion, one would define a name for the extension like this:

```
<!ENTITY % adonis.name "adonis">
<!ENTITY % adonis.pfx "%adonis.name;:">
```

Further a namespace for the extension is to be defined:

```
<!ENTITY  % xwdl.process.xmlns.extra 'xmlns:%adonis.name;
CDATA #FIXED "http://www.woanders.com"'>
```

The xwdl.process.xmlns.extra entity was included in the attributes for the process element in the main xwdl.dtd file. By defining the namespace here, we can annotate the specific elements with the name prefix (adonis in this case).
Additional attributes would be declared via stand alone attribute lists like in the following example. We add an extra attribute to the element `if` with an attribute name which is prefixed by the namespace in the extension DTD. It is defined as implied, so it is not mandatory

```
<!ENTITY % adonis.if.condition.qname "%adonis.pfx;condition">
<!ATTLIST if
    %adonis.if.condition.qname;        CDATA        #IMPLIED
>
```

Changes in the element structure are implemented by defining the new elements in the extension DTD and then by defining the corresponding . . . content entity from the xwdl.dtd file. The example declares a new element adonis:followingProcess with four attributes and states the new content model for the activity. Thereby we can use the new element within activity elements after the original content (agents and forms).
It is a requirement, that the original content of the elements like described in the xwdl.dtd file is not altered but merely augmented.

```
<!ENTITY % adonis.followingProcess.qname "%adonis.pfx;followingProcess">
<!ELEMENT %adonis.followingProcess.qname; EMPTY>
<!ATTLIST %adonis.followingProcess.qname;
    id CDATA #REQUIRED
    name CDATA #IMPLIED
    version CDATA #IMPLIED
    gs CDATA #IMPLIED
 >

<!ENTITY % xwdl.activity.content
   "(agent*,form*,%adonis.followingProcess.qname;*)" >
```

System steps can be extended as follows:

```
<!ENTITY % adonis.varout.qname "%adonis.pfx;varout">
<!ELEMENT %adonis.varout.qname; EMPTY>
<!ATTLIST %adonis.varout.qname;
    task CDATA #REQUIRED
>
<!ENTITY % xwdl.system.content "(%adonis.varout.qname;)?">
```

The whole extension dtd looks like this:

```
<!ENTITY % adonis.name "adonis">
<!ENTITY % adonis.pfx "%adonis.name;:">
<!ENTITY  % xwdl.process.xmlns.extra 'xmlns:%adonis.name;
  CDATA #FIXED "http://www.woanders.com"'>

<!ENTITY % adonis.if.condition.qname "%adonis.pfx;condition">
<!ATTLIST if
    %adonis.if.condition.qname;        CDATA        #IMPLIED
 >

<!ENTITY % adonis.followingProcess.qname "%adonis.pfx;followingProcess">
<!ELEMENT %adonis.followingProcess.qname; EMPTY>
<!ATTLIST %adonis.followingProcess.qname;
    id CDATA #REQUIRED
    name CDATA #IMPLIED
    version CDATA #IMPLIED
    gs CDATA #IMPLIED
 >

<!ENTITY % adonis.varout.qname "%adonis.pfx;varout">
<!ELEMENT %adonis.varout.qname; EMPTY>
<!ATTLIST %adonis.varout.qname;
    task CDATA #REQUIRED
>

<!ENTITY % xwdl.activity.content
    "(agent*,form*,%adonis.followingProcess.qname;*)" >

<!ENTITY % xwdl.system.content "(%adonis.varout.qname;)?">
```

```
<![ INCLUDE [
<!ENTITY % xwdl.mod SYSTEM "./xwdl.dtd">
%xwdl.mod;]]>
```

13.6.2 An Example

An extended XDWL file using the above extension dtd could look like this:

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<?xwdl extensionHandler="com.groiss.wf.xwdl.NullExtensionHandler"?>
<!DOCTYPE process SYSTEM "./conf/adonis.dtd">
<process xmlns:xdwl='http://www.groiss.com'
 xmlns:adonis="http://www.woanders.com" id="all_things_x" version="1"
 name="all control structures" description="Test the control structures"
 application="default">
  <forms>
    <formdecl id="form" typ="Jobform" />
  </forms>
  <timing timeoutaction="none" maxtime="10" maxtimeunit="minutes">
    <activity id="adm_task">
      <agent string="all" />
      <agent string="r" rolename="anewnamedifferentfromr"/>
      <form name="form" />
    </activity>
  </timing>
  <label id="first" />
  <activity id="start_task">
    <agent string="all" />
    <form name="form" />
  </activity>
  <loop>
    <choice>
      <case name="first choice: an if">
        <if condition="(form.type = &quot;hw&quot;)" adonis:condition="cc">
          <then>
            <activity id="hw_task">
              <agent string="all" />
              <form name="form" />
              <adonis:followingProcess id="idid" gs="gsgsgs"/>
              <adonis:followingProcess id="ididid2" gs="gsgsgs2"/>
            </activity>
          </then>
          <elsif condition="(form.type = &quot;sw&quot;)">
            <then>
              <activity id="swx_task" name="the name of this task">
                <agent string="form.recipient" />
                <form name="form" />
              </activity>
            </then>
          </elsif>
          <elsif condition="(form.type = &quot;adm&quot;)">
            <then>
              <activity id="adm_task">
                <agent string="first:user" />
                <form name="form" />
              </activity>
            </then>
          </elsif>
          <else>
            <activity id="none_task">
              <agent string="first:user" />
              <form name="form" />
            </activity>
          </else>
        </if>
      </case>
      <case name="second choice: a while">
        <while condition="(form.type = &quot;hw&quot;)">
          <activity id="while_task1">
            <agent string="form.recipient" />
            <form name="form" />
          </activity>
          <label id="in_while" />
          <activity id="while_task2">
            <agent string="form.recipient" />
            <form name="form" />
          </activity>
          <activity id="while_task3">
            <agent string="form.recipient" />
            <form name="form" />
          </activity>
        </while>
      </case>
      <case name="third choice: a loop">
        <loop>
          <activity id="loop_task">
            <agent string="form.recipient" />
            <form name="form" />
          </activity>
          <exit condition="(form.type = &quot;hw&quot;)" />
        </loop>
      </case>
      <case name="fourth choice: system steps">
```

```
      <system methodcall="com.groiss.demo.SystemSteps.emptyMethod()">
         <adonis:varout task="something"/>
      </system>
      <activity id="between_task">
        <agent string="form.recipient" />
        <form name="form" />
      </activity>
      <system methodcall="com.groiss.demo.SystemSteps.emptyMethod()" />
      <system methodcall="com.groiss.demo.SystemSteps.emptyMethod()" />
      <activity id="aftersys_task">
        <agent string="form.recipient" />
        <form name="form" />
      </activity>
    </case>
    <case name="fifth choice: andpar">
      <andpar>
        <parallel>
          <activity id="andpar1_task">
            <agent string="form.recipient" />
            <form name="form" />
          </activity>
        </parallel>
        <parallel>
          <activity id="andpar2_task">
            <agent string="all" />
            <form name="form" />
          </activity>
        </parallel>
        <parallel>
          <activity id="andpar3_task">
            <agent string="form.recipient" />
            <form name="form" />
          </activity>
        </parallel>
      </andpar>
    </case>
    <case name="sixth choice: orpar">
      <orpar>
        <parallel>
          <activity id="orpar1_task">
            <agent string="form.recipient" />
            <form name="form" />
          </activity>
        </parallel>
        <parallel>
          <activity id="orpar2_task">
            <agent string="form.recipient" />
```

```
              <form name="form" />
            </activity>
          </parallel>
          <parallel>
            <activity id="orpar3_task">
              <agent string="form.recipient" />
              <form name="form" />
            </activity>
          </parallel>
        </orpar>
      </case>
      <case name="eight choice: subprocesses">
        <call id="subflow1">
          <form name="form" />
        </call>
      </case>
      <case name="nineth choice: goto (into the while)">
        <goto label="in_while" />
      </case>
    </choice>
    <exit condition="(form.finished = 1)" />
  </loop>
</process>
```

13.7 Extension API

Parsing a standard XWDL-file without extensions is done by @enterprise itself.
For the proper treatment of extension attributes and extension elements, we define a callback-interface. We will use the JDOM-API [6] for processing.

```
package com.groiss.wf.xwdl;
import org.jdom.Element;
import com.dec.avw.core.ProcessDefinition;
import com.dec.avw.core.Step;

public interface IExtensionHandler {
   public void init();
   public void handle(Element e, Step s, ProcessDefinition pd);
}
```

Call details:

- for extended elements: when the element is recognized, processing of the JDOM-tree of the element is done by the handler. The tree walker in @enterprise will never step "into" such a subtree.
- for extended attributes: when the containing element is recognized. The handler is expected to process the extended attributes and nothing else.

- oids for the process and the steps are already set when the handler is called, but the objects themselves have not yet been written to the database.

The extensionHandler is specified via a processing-instruction in the XWDL-file:

```
<?xwdl extensionHandler="at.adonis.xwdl.ExtensionHandler"?>
```

The processing instruction must be included at the outermost document level (before the root XML element).
For debugging purposes, a NullExtensionHandler can be specified. This handler logs its calls to the system log at log level 0.

```
<?xwdl extensionHandler="com.groiss.wf.xwdl.NullExtensionHandler"?>
```

14 Web services

@enterprise application classes can use external web services, and provide own web service interfaces for external use. Administration console provides easy management of own web services, and allows generation of client classes for external web service from corresponding WSDL.
@enterprise provides support for web service oriented development in a broad variety of use cases.

14.1 Components

14.1.1 WS-Framework

@enterprise uses the Apache Axis2 Web service engine [7] (v.1.5). It also ships with support for several WS-standards like WS-Security, WS-Policy, WS-Trust etc. Axis2 provides code generation capabilities to generate client and service stubs and implementations from or into WSDL-files. (see: [8]).

14.1.2 EP-Context

This component provides an invocation context for local service implementations, in way similar as the Dispatcher class for servlet methods.
The component is implemented as an Axis2 module. The module defines handlers for InFlow, OutFlow, InFaultFlow, and OutFaultFlow. If a service wants to use this functionality, it must engage this module in the *services.xml* file:

```
<service>
...
<module ref="epcontext" />
...
</service>
```

When a service specifies the use of this module, a transaction handling mechanism takes place (cf. Dispatcher):

- If the web service throws no exception, a commit is performed automatically.
- If the web service signals an error by throwing an exception, a rollback is performed.

If a different behavior is desired, then the web service implementation must take care of it.

14.1.3 Partner Links

Partner links provide a mechanism to obtain location transparency for the addressing of remote service links.
A partner link maps a logical id of a remote web service to a specific physical transport address. Changes in the address do not require any changes in the clients, because they reference just the partner IDs. The mapping of partner IDs to addresses can be accomplished via the administrative GUI of @enterprise.

14.2 Providing web services

To provide a web service via @enterprise, the Axis2 standard ways of creating webservices should be used.

Code-first write your service-implementation first and generate the WSDL

Contract-first write your WSDL to specify the service, generate the service skeletons and add your business logic

We recommend you to use the "contract-first" approach, because of better interoperability to other systems.

14.2.1 Contract-first with Axis2

1. Specify the WSDL
2. Generate your service skeletons with the Axis2 CLI or Ant-Task [9]
3. Compile the generated sources
4. Package the generated sources
5. Add the new library to your application classpath
6. Subclass the service-skeleton and implement your business logic
7. Modify the services.xml to change the implementation class. This step is required, because it's not recommended to modify the generated source files.
8. Package your services.xml and your WSDL as an Web service archive (.aar)
9. Upload the archive to the server
10. Deploy the service

An example contract-first-service can be found in the @enterprise demos at *demos/webservices*. Instructions on how to run the demo can be found in the readme.txt file.

14.3 Web service security

Several standards like WS-Security, WS-Trust, WS-Policy, WS-Secure Conversation can be used to get the desired level of security for local services. The WS-Framework component provides an implementation of those standards.
A policy following the WS-Policy standard should be used to describe any type of service requirements (policies). One particular type of such requirements are security aspects. They are specified via a policy descriptor which is usually embedded inside a WSDL or a service deployment descriptor.
Local Web services deployed on an @enterprise server can use one of the following predefined security profiles:

UserNameToken provides authentication for a single-call scenario

SAMLToken provides authentication for a repeated-call scenario

Both profiles enable to inject the user principal information into the EP-context and to access the UserPrincical via the ThreadContext from within the web service implementation classes where fine grained access control can be provided via the well known @enterprise rights system.
Please note that sending the credentials like username and password in plain text over HTTP is not secure. It is strongly recommended to use HTTPS as encrypted transport mechanism.

14.3.1 WS-security with UserNameToken

This is a basic form of security scenario; it can be used to the access to a provided web service. Is specifies, that a username and a password must be sent inside the SOAP header together with the request as proper credentials to use the service. On the server side the authentication will be performed on the basis of the provided credentials against the @enterprise user base. A positive authentication will result in the call of the service method; a negative result will deny the access and send an appropriate error back to the client.

14.3.2 WS-security with SAMLToken

This security scenario provides some kind of session context for repeated communication between the client and the service (cf. fig. 14.1).
Instead of providing the username/password credentials directly to the service, calls to the actual services in this scenario are preceded by an explicit authentication step.
In this "login" phase, @enterprise issues a special access token in the form of a SAMLToken. Proper credentials like username and password must be provided in order to get such a token. When the client possesses such a token, it can issue multiple calls of services without any need to repeated re-authentication. A SAMLToken can either expire or be explicitly invalidated/canceled by the client ("logout").

14.4 Demos

Examples for the various scenarios can be found in the demo package *demos.zip*.

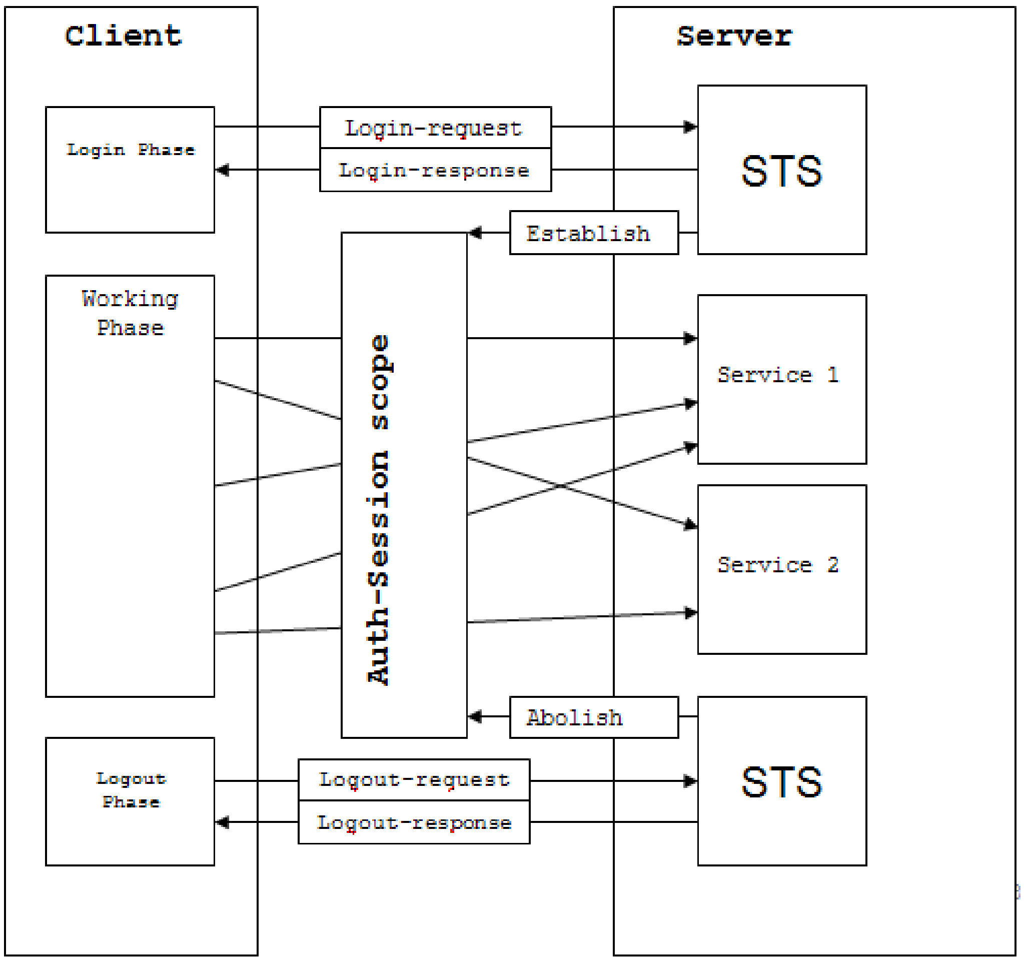


Figure 14.1: SAMLToken: Communication between server and client

After extraction of the archive, the *classes/com/groiss/demo/ws/security* directory contains two examples for web services with authentication:

- **WorklistService_UT** calls the username/password authentication.
- **WorklistService_SAML** implements a communication using a SAMLToken.

To run the examples do the following:

- Upload the two WorklistService*.aar files using the Local services wizard
- set up your server to use SSL
- browse to `servlet.method/com.groiss.demo.ws.Client.showPage`
- fill the required fields and perform the call, e.g. SAML-Token:
  - Client: SAML-token

- URL: https://'host':'sslport'/wf/services.axis2/WorklistService_SAML/
- User: <user_id>
- Password: <user_pwd>
- UT-Service-Policy: policy/ut/policy.xml
- SAML-Service-Policy: policy/saml/policy.xml
- STS-URL: https://'host':'sslport'/wf/services.axis2/SecureTokenService/
- STS-Policy: policy/saml/policy_sts.xml

15 AJAX and JavaScript in HTML pages

This chapter describes the handling of the @enterprise JavaScript library, the AJAX components (DOJO) and how to use customized DOJO controls.

15.1 The @enterprise JavaScript library

This section describes how to embed the @enterprise JavaScript library and how the files are organized in packages. Furthermore some useful methods are explained.

Each page which should use JavaScript must contain following import within the *head*-tag. The files are taken from the JavaScript source directory, packaged into the page and cached on the server:

```
<script src="../servlet.method/com.groiss.gui.JavascriptLoader.getScripts">
</script>
```

All @enterprise JavaScript methods are structured in packages (e.g. ep.util.js for utility methods) and are stored in alllangs/scripts/source within the ep.jar. Some useful methods are described below:

- `ep.util.isFF`: Check, if the current browser is Firefox.
- `ep.util.isIE`: Check, if the current browser is Internet Explorer.
- `ep.util.isIE6`: Same as *ep.util.isIE*, but especially for Internet Explorer 6.
- `ep.util.isSafari`: Check, if the current browser is Safari. Example:

```
if(ep.util.isFF) {
 //handling for Firefox
 ...
}
else if(ep.util.isIE) {
 //handling for Internet Explorer
 ...
}
else if(ep.util.isSafari) {
 //handling for Safari
 ...
}
else {
 //handling for all other browsers
 ...
}
```

- `ep.util.getParam(name,query_string)`: This method gets the parameter value from the query_string of the URL (= everything behind the question mark). The parameter *query_string* is optionally and if not used, *document.location.search* is the default search string.

- `ep.util.moveEntries(sourceid,targetid,sorted,indexarray)`: Moves the selected entries from selectlist *sourceid* (= id of the source selectlist) to selectlist *targetid* (= id of the target selectlist). The parameter *sorted* is a boolean parameter and indicates, if the moved entries should be sorted in target selectlist. The parameter *indexarray* contains the indices of the entries in source selectlist, which should be moved. If the parameter *indexarray* is null, all entries are moved.

- `ep.util.moveAllEntries(sourceid,targetid,sorted,indexarray)`: Moves all entries from selectlist *sourceid* (= id of the source selectlist) to selectlist *targetid* (= id of the target selectlist) analogous to *ep.util.moveEntries()*.

- `ep.util.showToolbar(actions,target,toolbar,orientation)`: By calling this method the servlet method *com.groiss.avw.html.HTMLToolbar.show* will be invoked. The parameter *actions* contains all actions, which should be displayed in toolbar. The *actions* parameter is a whitespace separated string containing the id's of the actions (from a XML-configuration). The *target* parameter indicates the location, where the toolbar should be displayed. If the parameter is empty, *parent.right* is used. With the optional parameter *toolbar* you can define the toolbar frame. If not defined, the *parent.toolbarframe* is default. The parameter *orientation* can be used to set the alignment of the toolbar. The character **v** symbolizes, that a vertical toolbar should be used; **h** or empty *orientation* parameter means that horizontal toolbar should be used.

  Example:

  ```
  <body onload="ep.util.showToolbar('admin.refreshControl myxml.save',
   'parent.right')">
  ...
  </body>
  ```

- `ep.util.clearToolbar(toolbar)`: This method removes all functions from the toolbar. With the optional parameter *toolbar* you can define the toolbar frame. If not defined, *parent.toolbarframe* is default.

- `ep.util.urlEncode(val,doc)`: This method encodes a string (= parameter *val*) and returns the encoded value for URL's. The optional parameter *doc* contains a reference to a document object; if the parameter is not used, the current document is used.
- `ep.util.urlDecode(val)`: This method is the direct opposite to *ep.util.urlEncode()*.
- `ep.util.refreshOpener()`: Method to refresh the opener window, e.g. if data are changed in a popup and the opener should be refreshed with this data.

15.2 Using DOJO in @enterprise

The DOJO toolkit is an open source modular JavaScript library designed to ease the rapid development of cross platform, JavaScript/Ajax based applications and web sites. One important feature of Ajax applications is asynchronous communication of the browser with the server: information is exchanged and the page's presentation is updated without a need for reloading the whole page.
@enterprise uses the latest DOJO version from http://dojotoolkit.org/

15.2.1 Add DOJO to a page

This section describes which components are necessary to use DOJO in your forms (xhtml, xforms) with the standard @enterprise style:

1. Import following script beneath the *JavaScriptLoader* call:

   ```
   <script type="text/javascript" src="../scripts/dojo/dojo.js"
    djConfig="parseOnLoad: true">
   </script>
   ```

   Depending on the used DOJO control (see section 15.3) it is recommended to use DOJO layers for reducing server requests and increasing performance (see http://www.qc4blog.com/?p=1001). Following layers are available in **@enterprise**:

   - objectselect
   - datefield
   - tooltip

   A layer can be imported in following way, e.g. for DateField:

   ```
   <script type="text/javascript" src="../scripts/dojo/dojo-datefield.js">
   </script>
   ```

2. Import style definition:

```
<link href="../html/avw.css" rel="stylesheet" type="text/css"></link>
<style type="text/css">
  @import "../scripts/dijit/themes/tundra/tundra.css";
  @import "../scripts/dojo/resources/dojo.css";
  @import "../scripts/jscalendar/calendar-system.css";
</style>
```

3. Import used widgets, for example:

   ```
   dojo.require("ep.widget.DateField"); //necessary for date fields
   dojo.require("ep.widget.ObjectSelect");//necessary for object select
   ```

   DODJO widgets are prepackaged components of JavaScript code, HTML markup and CSS style declarations that can be used to enrich websites with various interactive features that work across browsers.

4. Add the following css-class to the body tag:

   ```
   <body class="tundra">
   ```

Hint: If your page is dojo-enabled, it's recommended to use dojo.addOnLoad(foo) instead of <body onLoad="foo()"> (see: http://docs.dojocampus.org/dojo/addOnLoad)

15.3 *Usage of customized DOJO controls*

This section describes how the components *DateField* and *ObjectSelect* can be added to the form.

15.3.1 Date control - ep.widget.DateField

For adding a datefield an input-field must be created of dojoType *ep.widget.DateField* like in following example:

```
<input type="text" name="changeTime" id="changeTime" showTime="false"
value="" dojoType="ep.widget.DateField"/>
```

The attribute *showTime* means, that the time is displayed, if set to true. If the value of a datefield should be changed, the method *setValue()* should be used like in following example. The method *getValue()* reads the value of the datefield.

```
dijit.byId('changeTime').setValue('01-01-2009'); //set to value 01-01-2009
dijit.byId('changeTime').getValue(); //read value of datefield
```

15.3.2 Object selection - ep.widget.ObjectSelect

For adding a object selection an select-field must be created of dojoType *ep.widget.ObjectSelect* like in following example:

```
<select name="substitute" id="substitute" class="ep_select"
  style="width:400px" dojoType="ep.widget.ObjectSelect"
  classname="com.groiss.org.User" searchAttributes="surname,id"
  value="['','']">
</select>
```

The attribute *classname* is required and must contain a java class of type *Persistent*. Following optional attributes can be entered:

- *searchAttributes:* A comma separated list of attributes can be entered for searching the input string.
- *searchid:* This parameter must be used, if a WHERE-clause with parameter should be used. The searchid consists of the xml-id (created by the **@enterprise** *GUI-Configuration*) and the node-id, i.e. *<xmlid>.<nodeid>* and executes the appropriate action node of the xml.
- *parameters:* The parameters for the attribute *condition* in xml-file, if the WHERE-clause contains parameter.
- *displayAttributes:* Attributes to display; if empty: toString
- *noClass:* If set to true, the selected value will be in form <oid> instead of <classname>:<oid> (default: false)
- *value:* Initial value in form ['label','classname:oid']

If the selection needs a condition with parameter, it must be defined in following way:

Write an *action* node in application's xml which has been created by the **@enterprise** *GUI-Configuration*. In our example we need all departments with sub-departments:

```
<Actions>
 ...
 <Node id="DeptsWithSubdeptsSelect">
  <Attrib key="classname" value="com.groiss.org.Dept"/>
  <Attrib key="attribs" value="name"/>
  <Attrib key="searchAttrs" value="name,id"/>
  <Attrib key="title" value="@ep:dept@"/>
  <Attrib key="condition" value=
    "oid in (select superdept from avw_flatdepttree
     where application=?)"/>
  <Attrib key="types" value="Long"/>
 </Node>
 ...
</Actions>
```

The attribute *condition* defines the SQL WHERE-clause. The parameters are represented by question marks (?). The attribute *types* is necessary to define the datatypes of the given *parameters*. For each parameter in condition, a type is needed, e.g. <Attrib key="types" value="Long,Persistent,Date"/>. Possible values are:

- Persistent
- Date
- Integer
- Long
- Double
- Integer
- String

After creating an action node we have to set the attributes *searchid* and *parameters* in the appropriate HTML-file. In our example the parameter is the oid of the default-application:

```
<select name="dept" id="dept" class="ep_select" style="width:400"
   tabindex="2" dojoType="ep.widget.ObjectSelect" autoComplete="true"
   searchid="<xmlid>.DeptsWithSubdeptsSelect" parameters="1"
</select>
```

The attributes *searchid* and *parameters* can be set via JavaScript by using the functions dijit.setParameters(String) and dijit.setSearchid(String). Following an example how to use these functions:

```
var appl = dijit.byId("application");
var proc = dijit.byId("proctype");
if(appl.value && appl.value!='') {
  proc.setSearchid("ProcDefOfApplicationSelect");
  proc.setParameters(''+appl.value);
}
```

The methods *getValue()* and *setValue()* should be used in the same way described in section *Date control - ep.widget.DateField*. In object selection the method *getValue()* returns the **key** only! If the displayed value of the current selection is needed, the method *getDisplayedValue()* has to be used.

16 Mobile GUI Client

This chapter describes the possibilities to adapt the Mobile GUI client. The description how to use the mobile client can be found in the *User Manual*.

The mobile login window offers the checkbox *mobile* which is checked automatically on a mobile device only. After activating the button *Logon* the appropriate configuration file (XML) in the default urls are searched with the suffix *_mobile* only. The default XML for the mobile client is *standard_mobile.xml*.

The XML for the mobile version allows the node types worklist and link only. The default page displays the children of the first level. The html mask and the method for rendering the tree are interpreted only. The links always open the same window (attribute *target* is ignored). The worklist is displayed as list not as table. The html text for a list element can be declared in element *template*. This template contains the placeholder %name% which represents the id of a worklist column.

It is also possible to define a WorklistAdapter (see @enterprise API), but following methods are not relevant:

- getHTMLPage()
- listFilters()

The detail page of a worklist entry can be modified by adapting the link within the template.

16.1 WorklistAdapter Example

This example shows how to use an own WorklistAdapter. First we need a WorklistAdapter class like in following example:

```
public class MobileWLAdapter extends WorklistAdapter {

 @Override
 /* If subject of a task is empty, show <No subject> */
 public void modifyTableLine(ActivityInstance ai, KeyedList line) {
   Object o = line.get("subject");
```

```
    if(o instanceof String) {
      if(StringUtil.isEmpty((String)o))
       line.set("subject", "<No subject>"); //the placeholder %subject%
    }
  }


  @Override
  /* Get title of worklist */
  public String getTitle() {
    return "My Mobile Worklist";
  }

  @Override
  /* Get list of all ais which are in itsm-application. If no itsm
   * application is installed, show default worklist*/
  public List<ActivityInstance> getList() {
    WfEngine wfe = ServiceLocator.getWfEngine();
    OrgData org = ServiceLocator.getOrgData();
    Application appl = org.getById(Application.class, "itsm");
    if(appl != null)
      return wfe.getWorklist(appl, true);
     else
      return null;
  }


  @Override
  /* Set new line style for RM processes - placeholder %linestyle% */
  public String lineStyle(ActivityInstance ai, String style) {
    WfEngine wfe = ServiceLocator.getWfEngine();
    ProcessInstance pi = wfe.getMainProcess(ai);
    if(pi.getProcessDefinition().getName().equalsIgnoreCase("RM")) {
      return "rm_linestyle";
    }
    return null;
  }
}
```

This class replaces the subject placeholder defined in the configuration file (XML) below by an own defined string <*No subject*>, if no subject is available. The getList()-method operates like a worklist-filter which displays tasks of a particular application only. Furthermore the line-style of a worklist-entry is changed, if a task of a particular process is displayed in the worklist.

After creating a WorklistAdapter the configuration file (XML) must be prepared like in following example. For this purpose open the GUI configuration in Administration of @enterprise and make a copy of the entry with id *standard_mobile*. Rename it and edit the entry by adding the WorklistAdapter class *MobileWLAdapter* to the worklist-node. For more information about GUI Configuration please take a look into *System Administration Guide* - chapter *GUI Configuration*.

Snippet of configuration file:

```
...
<Node id="wl" class="com.dec.avw.lclient.WorklistDescription">
  <name><img src="../images/mobile/worklist.png"/><br/>@@@worklist@@
  </name>
  <Attrib key="type" value="USER" />
  <Attrib key="actions" value="untake,finish,finishAndSelect,
                               goBack,seeLater,setAgent" />
  <Attrib key="worklist" value="MobileWLAdapter" />
    <columns>
      <column id="id" />
      <column id="process" />
      <column id="task"/>
      <column id="subject"/>
      <column id="started" />
      <column id="seen"/>
      <column id="forms"/>
    </columns>
    <template><div class="%lineStyle%">
     <table width="100%">
      <tr><td style="width:15px">%seen%</td>
          <td><a href="javascript:document.location='%detaillink%'">
              <b>%id%: %subject%</b><br/>%process% / %task%</a>
          </td>
          <td valign="middle" align="right">%forms%</td></tr>
     </table></div>
    </template>
</Node>
...
```

Bibliography

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