BPEL4People: Modeling Business Processes Involving People

Claudia Iacob

Department of Computer Science and Communication

University of Milan

iacob@dico.unimi.it

Abstract

Modeling complex process control flows is made possible by the definition of the Web Services Business Process Execution Language (BPEL). This language, however, does not support the modeling of processes which involve human user interactions. For answering this need, an extension of BPEL has been developed, i.e. BPEL4People. The report presents the background and motivation for the development of this extension. The goals of BPEL4People are defined together with the overall definition of the language and some examples of its use.

Introduction

Modeling complex process control flows is made possible by the definition of the Web Services Business Process Execution Language (BPEL). This language focuses on two aspects:

    a.   The specification of "automated business processes that orchestrate activities of multiple Web services, and which may be interpreted and executed by compliant engines" [1].

    b.   The observation of the Web services' behavior.

BPEL is a powerful tool for building complex processes, "which can be executed by underlying software" [1]. However, the language does not provide means to specify human user interactions as processes. Nowadays, the activities that are subject to business process modeling is every day broader, hence the need to cover the modeling of processes in which humans are active participants who may influence the execution of the process. As examples of such possible activities [1], one could consider:

    a.   Being able to exclude users from performing an activity

    b.   Allowing a supervisor to manually and, possibly, collaboratively assign tasks to colleagues

    c.   People activities, defined as tasks that are assigned to a user and require the user to perform some action

    d.   Defining which people are eligible to start a certain business process

This raises the questions: "How should one model a business process in which the human is an actor who decides the execution flow of the process?" and, moreover, "How to model people's interaction with business processes?". As an answer to this problem, Adobe, IBM, SAP and a group of technology vendors (including Active Endpoints, BEA Systems, Oracle) have developed an extension of BPEL, i.e. BPEL4People. This extension was approved by Organization for the Advancement of Structured Information Standards (OASIS) in April 2007.

BPEL4People includes the following specifications [4]:

    a.   WS-BPEL Extension for People which is a layer on top of WS-BPEL and describes human tasks as "activities that may be incorporated as first class components in WS-BPEL process definitions" [4]

    b.   WS-HumanTasks which defines standalone human tasks, together with their properties, behavior, and the operations used to manipulate them.

The present report focuses on BPEL4People, describing the background and the motivation of this extension, its goals and its overall definition. Moreover, some examples of use are illustrated together with further conclusions on the matter.

Background, Motivation and Goals

Business processes consist of activities which "are assumed to be interactions with Web services with no additional prerequisite behavior" [1]. For this goal, BPEL provides a formalized way of modeling executable processes which are bound to the orchestration of Web services. BPEL does not take into consideration the human user and its possible interaction with the business process. However, more than often, people participate in the execution of business processes. The modeling of business processes is, therefore, influenced by the challenges brought by the interaction between the process and the user interface and taking into account human behavior [2].

BPEL4People has been developed as an answer to the problem of modeling the human behavior and the aspects introduced by his participation in the execution of business processes. The extension enables the modeling of human interactions which may vary from simple approval of tasks to more complex scenarios like distribution of duties. BPEL4People is developed on the top of BPEL, making it possible to compose its features with the BPEL core features without any compatibility hurdles. Moreover, BPEL4People allows the development of further extensions on top of itself, providing a flexible framework for future developments.

BPEL4People introduces the specification of a particular type of basic activity – the people activity. A people activity is used to specify human interactions in business processes. The implementation of a people activity may be either as an inline task or as a standalone human task defined based on the specification of WS-HumanTask. {The task is the implementation of an activity.}

> The *WS-HumanTask* specification enables the definition of *human tasks* and *notifications*, providing means for describing their properties, behavior and the operations used to manipulate human tasks. Moreover, the WS-HumanTask specification provides ways to define "a coordination protocol that allows interaction with human tasks in a more service-oriented fashion and at the same time controls tasks' autonomy" [3].
>
> A *human task* is a service "implemented" by people which allows the integration of humans in service-oriented applications. There may be two interfaces for a human task:
> 1. One which makes available the service offered by the task
> 2. One which allows people to deal with the task
>
> A *notification* is a particular case of human task which allows sending to people information about a business event. Notifications imply sending a one way message, in a fire-and-forget manner.

The goals of the BPEL4People include, but are limited to:

a. Supporting role based interaction of people
b. Providing means of assigning users to generic human roles
c. Assuring the delegation of the ownership of a task to a person only
d. Supporting scenarios involving people in business processes like: four eyes scenario, nomination, escalation and chained execution (described later on in the section Scenarios of Use)

Scenarios of Use

In what follows, the present report describes a set of patterns in the way humans interact with process instances, patterns which can be handled by BPEL4People.

1. **4-Eyes Principle**.
   The 4-eyes principle is a scenario that implies the fact that a decision is made by two or more people independently of one another. This scenario is common for domains like the medical or banking domains and it is also known as the "separation of duties" principle. The particularities of this principle are two-fold. On one hand, it may happen that for security reasons, the users may not be allowed to know who else is involved in the process. On the other hand, it may happen that a second opinion is desirable. In both of these cases, BPEL4People supports the exclusion of users from performing an activity.

2. **Escalations**.
   Escalations occur whenever "a task does not meet its modeled time constraints" [1]. For example, if a person working on a task suddenly cannot work on this anymore, then an escalation mechanism is required. When an escalation occurs, a notification is sent (by e-mail or SMS) to the people specified as escalation recipients

using a people assignment definition (described later on in the report). It is the escalation recipients who decide in the matter of getting the task back on the scheduled track.

3. **Nominations**.
   Nominations occur in the cases when there is no person assigned to the task at hand. This may be the case when a supervisor must manually assign tasks to colleagues based on their expertise on the matter. Moreover, this kind of task delegations may be performed collaboratively among a larger number of users.

4. **Chained Execution**.
   Chained execution is a process which requires a user to perform a sequence of inter-related steps. The sequence of steps may not be known in advance, but may be only determined during its execution. It is desirable that the person working on the sequence "performs subsequent actions of the form "complete and claim next task" within the scope of one and the same process instance" [1]. In case a single user is involved in the chained execution process, the user is given the illusion of a wizard-style interaction, similar with the typical Web-based order processes. When more users are involved in the process, it executes using the task list interaction instead of the wizard illusion [1].

BPEL4People Definition

Concepts

The section below describes the concepts used within BPEL4People. To be noted that many of the concepts of BPEL4People extension are inherited form WS-HumanTask.

Generic Human Roles

Process-related generic human roles define "what a person or a group of people resulting from a people assignment can do with the process instance" [2]. There are 3 types of process-related generic human roles:

1. **Process initiator**.
   The process initiator is a person in charge of "triggering the process instance at its creation time" [2]. At any time, this role can be assign to a person through a people assignment operation. Any implementation compliant to the BPEL4People rules, must ensure that at least one person is associate to the role of process initiator, at the runtime of the process.

2. **Process stakeholders**.
   The process stakeholders are people involved in a process and who influence the progress of a process instances. They may, for example, forward tasks or observe the progress of a process instance. A process stakeholder is associated to a particular process instance. In case there is no process stakeholder specified for a particular process instance, then the process initiator becomes the process stakeholder. Any implementation compliant to the BPEL4People rules, must ensure that at least one person is associate to the role of process stakeholder, at the runtime of the process.

3. **Business administrators**.
   Business administrators are people who are allowed to perform administrative actions on a business process. As example of administrative action, one may consider resolving missed deadlines. As opposed to a process stakeholder who is involved in one particular instance of a process, a business administrator has an interest in all the instances of a process type. In the case in which no business administrators are specified for a process, the process stakeholders become business administrators. Any implementation compliant to the BPEL4People rules, must ensure that at least one person is associate to the role of business administrator, at the runtime of the process.

Assigning People

Assigning people is an operation which determines who is responsible for "acting on a process, a human task or a notification in a certain generic human role" [2]. There are several ways in this can be achieved:

1. **Via logical people groups**.
   Logical people groups define which person or set of people may interact with a human task or a notification of a people activity [2]. An example is presented below; it is showing the assignment of the results of the evaluation of a logical people group to a process variable.

```
<bpel:assign name="getVoters">
    <bpel:copy>
        <bpel:from b4p:logicalPeopleGroup="voters">
            <b4p:argument name="region">
                    $electionRequest/region
            </b4p:argument>
        </bpel:from>
        <bpel:to variable="voters" />
    </bpel:copy>
</bpel:assign>
```

2. **Via literals**.
   An example of assignments of a set of literals to a logical people group is represented below:

```
<bpel:assign>
    <bpel:copy>
        <bpel:from>
            <bpel:literal>
                <myns:entity xsi:type="htd:tOrganizationalEntity">
                <htd:users>
                    <htd:user>Alan</htd:user>
                    <htd:user>Dieter</htd:user>
                    <htd:user>Frank</htd:user>
                </htd:users>
                </myns:entity>
            </bpel:literal>
        </bpel:from>
        <bpel:to b4p:logicalPeopleGroup="bpel4peopleAuthors" />
    </bpel:copy>
</bpel:assign>
```

3. **Via expressions**.
   Alternatively, people can be assigned using expressions returning instances of data types for organizational entities [3]. Data types for organizational entities describe "the format of the data that is returns at runtime when evaluating a logical people group" [3]. The result of such an evaluation may contain either a list of users or a list of groups.

People Activity

The people activity is a basic activity used to integrate human interactions within BPEL processes [2]. There are several ways in which human interactions (human tasks and notifications) can be integrated. Figure 1 illustrates possible ways for such integrations.
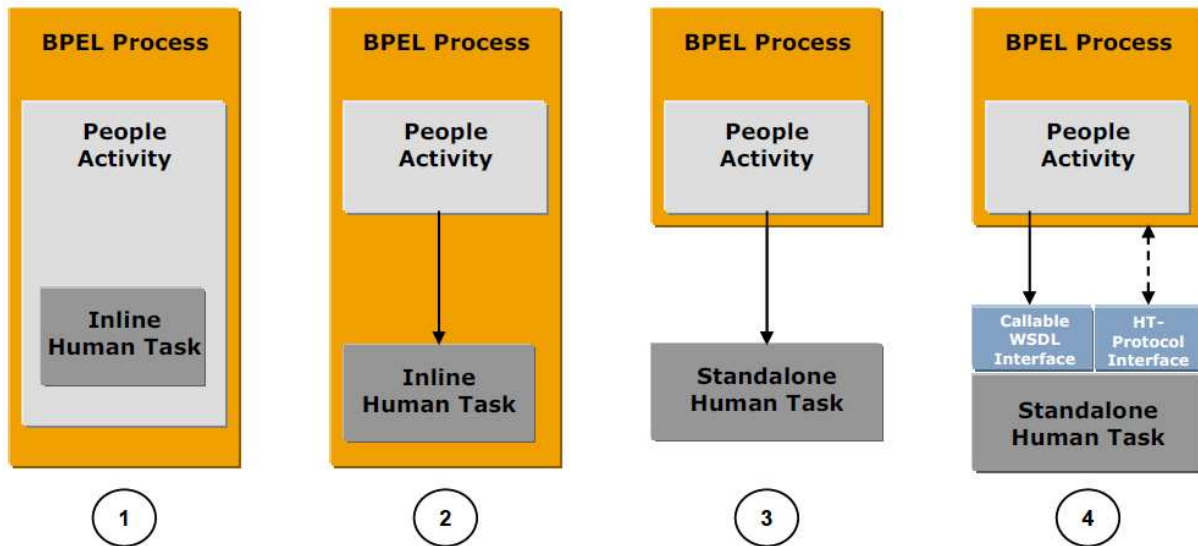
Figure 1 – Integrating people activities in BPEL Processes [2]

1. The first model of integration defines a human task as an inline task, part of a BPEL process. Moreover, the human task is defined as part of a people activity; hence its use is limited to the people activity encompassing it.

2. The second model in Figure 2 defines a human task as an inline task, part of a BPEL process, but as a top-level construct of the BPEL process. In this case, the same task can be used within multiple people activities, which brings a great advantage in terms of reusability. "BPEL4People processes that use tasks in this way are portable among BPEL engines that implement BPEL4People" [2].

3. The third model describes the use of a standalone human task within the same environment. Moreover, the task invocation is implementation-specific and the definition of the task is done independently of any process. Therefore, the task itself can not directly access the context of the process.

4. Lastly, model 4 describes the use of a standalone human task from a different environment. In this case, the human task has a Web service callable interface which may be invoked using standard Web services protocols. Moreover, the communication between the process and the human task is facilitated by the WS-HumanTask coordination protocol. This mechanism supports the propagation of the state changes between the human task and the process. In this way, the process can perform life cycle operations on the task, such as terminating it. "BPEL4People processes that use tasks in this way are portable across different BPEL engines that implement BPEL4People" [2]. Moreover, the process and the human task are interoperable providing that both of their infrastructures implement the coordination protocol.

The above descriptions hold true for notifications, as well as for human tasks.

Syntax

The template of the informal syntax of a BPEL process and scope containing logical people groups, inline human tasks and people activity is depicted below:

```
<bpel:process ...
...
                   xmlns:b4p="http://www.example.org/BPEL4People"
                   xmlns:htd="http://www.example.org/WS-HT">
...
<bpel:extensions>
      <bpel:extension
                   namespace="http://www.example.org/BPEL4People"
                   mustUnderstand="yes"/>
       <bpel:extension
                   namespace="http://www.example.org/WS-HT"
                   mustUnderstand="yes"/>
```

```
            </bpel:extensions>
<bpel:import importType="http://www.example.org/WS-HT" .../>
...
<b4p:humanInteractions>?
            <htd:logicalPeopleGroups/>?
                <htd:logicalPeopleGroup name="NCName">+
                    ...
                </htd:logicalPeopleGroup>
            </htd:logicalPeopleGroups>
            <htd:tasks>?
                <htd:task name="NCName">+
                        ...
                </htd:task>
            </htd:tasks>

            <htd:notifications>?
                <htd:notification name="NCName">+
                    ...
                </htd:notification>
            </htd:notifications>

</b4p:humanInteractions>

<b4p:peopleAssignments>
            <htd:genericHumanRole>+
                    <htd:from>...</htd:from>
             </htd:genericHumanRole>
                ...
</b4p:peopleAssignments>
...
<bpel:extensionActivity>
                <b4p:peopleActivity name="NCName" ...>
                 ...
                </b4p:peopleActivity>
</bpel:extensionActivity>
...
</bpel:process>
```

The description of each of the elements in the template above is presented in Table 1.

Element	Description
<b4p:humanInteractions>	Contains declarations of elements from WS-HumanTask namespace, i.e. <htd:logicalPeopleGroups>, <htd:tasks>, <htd:notifications>
<htd:logicalPeopleGroup>	Specifies a logical people group used in an inline human task or a people activity
<htd:task>	Provides the definition of an inline human task, respecting the syntax and the semantics defined by the WS-HumanTask
<htd:notification>	Provides the definition of an inline notification, respecting the syntax and the semantics defined by the WS-HumanTask
<b4p:peopleAssignments>	Used to assign people to process-related generic human roles (as described in Section BPEL4People Definition, Concepts)
<b4p:peopleActivity>	Used to model human interactions within BPEL processes (as described in Section BPEL4People Definition, Concepts)

Table 1 – BPEL4People Elements' Description

Examples

Let us focus on two concrete examples of use for BPEL4People.

1. **An approval task**.
   Consider a mortgage process. This requires that a set of data related to the mortgage is collected. In case the value of the mortgage exceeds some admissible amount, there is the need of a manual approval step. An approval service implemented by the approval task may be invoked. An instance of the approval task is, then, created through the invocation of the service by the business process. As result, this task lists down, on the

task, the list of the approvers. After one of the approvers claims the task and evaluates the mortgage, s/he completes the task by either approving or rejecting it. Therefore, the output of the process will consists of the approval decision (approve or reject).

2. **Opening a bank account**.
   Consider a process for opening a bank account. A human user must provide all the necessary details like name, address, initial deposit etc. After the process is initialized, the user may want to track the status of the operation and to answer to any additional query from the bank. This process requires the user's participation. Moreover, the process monitoring must be enabled so that the user is able to track the status of her/his request.

Conclusions: Capabilities and Limitations

BPEL4People provides "a consistent way for developers to describe interactive people processes in heterogeneous environments and SOA implementations that involve multiple organizations" [5]. BPEL4People "is often seen as the fix to add workflow capabilities to BPEL", which is not really the case [7]. This is because BPEL still imposes the fact that the communication among the activities of a processes are done through XML based process variables. BPEL4People answers the need of standardization of human interactions. Even if it does not provide an overall standardization, it is a solid base for future extensions.

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