Description and Composition of Services towards the Web-Telecom Convergence

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Abstract. Current research trends within a Next Generation Networks (NGN) are investigating the benefits and feasibility of developing integrated services in order to converge the Telco and Web worlds. These trends responds to the need to integrate features offered by heterogeneous subjects to provide new innovative value added services to end users on any device equipped with a web browser. This PhD work focuses on the study of service description models and mechanisms that facilitate and automate the interoperation and composition of heterogeneous services (Web and Telecom) within a NGN. The objectives of this research work are: first, creating a model for abstract and concrete service interface specifications for each service type and interaction model, second, defining a service creation environment (SCE) using a orchestration language to compose heterogeneous services, and third, developing a convergent platform for the orchestration and composition of heterogeneous services from different domains environments.

Keywords: Next Generation Network, Web-Telecom Convergence, Service Composition, BPMN, JSLEE.

1 Introduction

The providers of Telecom services are researching the development of value-added services leveraging on internet and telephony networks, i.e. the integration and composition of services offered by IT providers with Telecom operators towards the Web-Telecom convergence.

The major technical difficulty to achieve the convergence is that each service environment relies on specific protocols and architectures that are not natively interoperable. The web services are typically exposed with a synchronous interaction model (request-reply) and use Hyper Text Transfer Protocol (HTTP) [1] and Web Service Description Language (WSDL) [2], respectively, for message exchange between client and provider, and service description. The Telecom services, instead, are typically asynchronous and event-driven. In this case, international level specifications have been defined, e.g., applications based on the Session Initiation Protocol (SIP) [3] (e.g., call forwarding service) in IP Multimedia Subsystem (IMS) [4] and Java API for Integrated Networks Service Logic Execution Environment (JSLEE) [5], and

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Parlay X specifications [6], which define a set of Web service interfaces for the invocation of communication functionality.

This work aims at investigating the study of service description models and mechanisms that facilitate and automate the interoperation and composition of heterogeneous services towards the Web-Telecom convergence. The objectives of this research work are: i) to create a model for abstract and concrete service interface specifications for different service types, such as Simple Object Access Protocol, (SOAP) [7], Representational state transfer (REST) [8], and SIP services, and interaction models (i.e., input and output parameters, events and action related to an event), ii) to define a service creation environment that uses a orchestration language to compose Web and Telecom services, and iii) to develop a service orchestration platform based on the adoption of a standalone workflow engine to orchestrate heterogeneous services from different domain environments (e.g., SOAP and REST services, IMS-based and JSLEE-based SIP services).

I chose to adopt Business Process Model and Notation (BPMN) 2.0 [9] as orchestration language because it allows non-expert users to describe in intuitive and easy way any service type (Web or Telecom) by graphical notation.

Finally, to validate the proposed approach, my work includes also the implementation of a proof-of-concept of the above-mentioned Service Orchestration Platform. This prototype composes heterogeneous services provided by JAIN SLEE-compliant platform and simple IT web services developed by SOAP. This prototype leverages the Java Business Process Management (JBPM) [10] as workflow engine and Mobicents [19] as open source platform certified for JSLEE compliance.

2 Related Work

In literature there are different approaches for the realization of a convergent platform that provides an orchestration of heterogeneous services within the NGN.

TeamCom [11] project permits to define a service creation environment (SCE) in which each service is composed from one or more reusable service components. This approach employs BPEL to specify the composition and control flow of these service components. The BPEL scripts are analyzed and translated by a code generator into java code modules that can be deployed on a JSLEE execution environment. This approach permits to abstract the communication services, but is limited to compose and integrate only Telecom services on a JSLEE environment. Analogously, SewNet [12] platform proposes a solution that permits to abstract the communication services defining, in this case, an abstraction model for the Telecom functionalities.

Femminella et al. [13] propose to integrate a JBPM workflow engine inside the development environment of the JSLEE platform. This approach permits that service business logic can be separated by implementation issues and designed by non JSLEE experts. This solution is thus bounded to the JSLEE environment and supports the orchestration of services invoked through a variety of JSLEE Resource Adaptors. Analogously, Bessler et al. [14] integrate a BPEL orchestration engine into a JSLEE environment. This approach permits to create a service orchestration environment that uses deployable BPEL scripts to control and invoke service building blocks (SBB)

or external entities via different protocols as SIP , Intelligent Network Application Protocol (INAP) [15] or SOAP.

OPUCE [16] implements a solution that uses a standalone BPEL orchestration engine. This approach permits to define, for the communication services, base services identified by three sets of elements: properties, actions and events. With respect to previous approaches, this solution allows developers to choose their preferred environment to develop and deploy the base services. However, base service exposure should adopt the Web service stack specification and a WS-proxy is needed for interfacing components that offers different APIs.

Among the above mentioned works, this PhD work shows some similarities with OPUCE, since I chose to adopt a standalone workflow engine. Therefore, I do not specify any constraint on the implementation and execution environment of the base services. In addition my original contribution permits that base services APIs shall not be necessarily exposed as SOAP web services. Services can be invoked through different protocols (e.g., SIP, HTTP) and message formats.

3 Service Orchestration Platform

In this section, first I describe the objectives of this research work, and second, I present the proposed solution for the orchestration of heterogeneous services.

The first aim is to create a model for abstract and concrete service interface specifications for different service types (e.g., SOAP, REST and SIP services) and interaction models [17] (i.e., input and output parameters, events and action related to an event).

The second aim is to define a service creation environment (SCE) that uses a business process orchestration language to orchestrate heterogeneous Web and Telecom services. In the most widely used current approaches [16], [14] and [11], BPEL is been used as orchestration language, although it is conceived to orchestrate only web services. In our solution, I chose to adopt Business Process Model and Notation (BPMN) 2.0 [9] because it allows non-expert users to describe any service type (Web and Telecom) in very intuitive and easy way by a graphical notation.

The third aim is to design and develop a service orchestration platform that is able to invoke heterogeneous services from different domain environments (e.g., IMS-based and Mobicents JSLEE-based SIP services, SOAP and REST services).

To this end, the proposed solution is based on the adoption of workflow engine that can be deployed as a standalone solution. The workflow engine interacts with heterogeneous services provisioned by different external service provider platforms, according to the interaction paradigm (synchronous/asynchronous), protocol (e.g., SOAP, HTTP, SIP) and message format, such as Extensible Markup Language (XML) [18] and Session Description Protocol (SDP) [3], specified in the service interface description. Fig. 1 shows the functional architecture of the service orchestration platform proposed in this PhD work. This platform provides three components:

- The Service Creation Environment (SCE) includes BPMN 2.0 as orchestration language to compose base services for offering composite services.

- The Service Execution Engine (SEE) includes a workflow engine that invokes the heterogeneous services provisioned by different external service provider platforms, and a component to select the provider services that optimize the overall Quality of Service (QoS) [19] [20], according to network requirements.
- The Service Repository holds the information about each the service instance including the service URI and capabilities description.

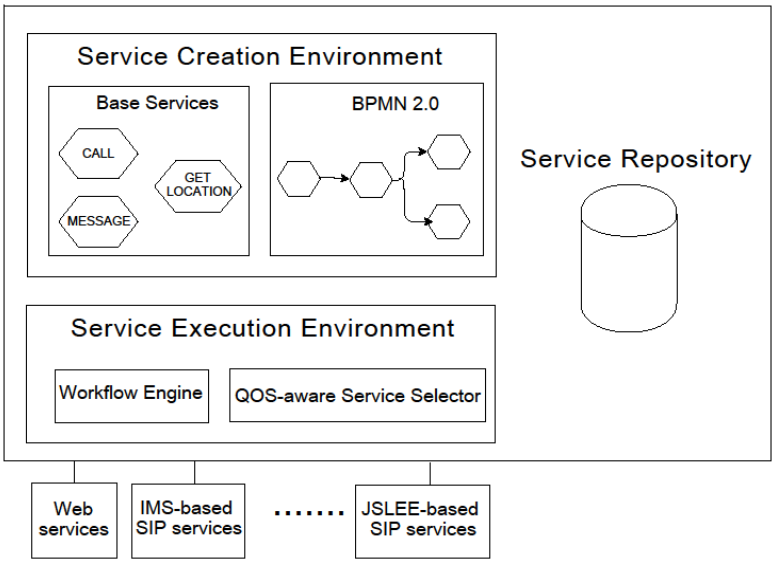

Fig. 1. Functional architecture of a Service Orchestration Platform

3.1 Proof of Concept

To validate the proposed approach, this PhD work includes the implementation of a proof-of-concept of the above-mentioned Service Orchestration Platform. Fig. 2 shows the prototype of this platform at the current state of development.

As orchestration engine I chose to adopt JBPM because it is open source, offers a strong interaction in Java environments and has a very simple graphical design tool. Moreover, JBPM allows to extend a default process constructs with domain-specific extensions that simplify development in a particular application domain. This permits also non-expert users to define domain-specific work items [10] for each type of service (also called service nodes), which represent atomic units of work that need to be executed. I embedded the JBPM workflow engine in a servlet container (Apache Tomcat [21]). In this way, an end user accessing a web application can trigger a composite service execution through a HTTP request.

As an example, I show the implementation of an “Expert on Call” service. In this scenario, a user having noticed a malfunction or failure of the business device, can contact a technician for assistance. The invocation flow is structured as follows:

first the user's personal data and location are retrieved, respectively by invoking a GetMember and GetLocation services. Then a GetCredit service is invoked to perform a check on the available user's credit. If the user's credit is enough to call, a GetLocation service is invoked to search the expert nearby and are retrieved the expert's personal data by invoking a GetMember service. Finally, a third party call service is invoked to establish a call between the user and the expert. Otherwise, if the user's credit is not enough to call, a message service is invoked to inform the user that the call can be not established. These service nodes can be combined as shown in Fig. 2. The base services have been implemented in two different environments. The third party call service is implemented as a JSLEE service that sends appropriate SIP signaling messages for the call setup between the two peers.

As JSLEE platform we chose to adopt Mobicents [22]. The Mobicents platform is built on top of the open source JBoss Application Server. The other services have been implemented as JAVA web services hosted on a JBoss Application Server.

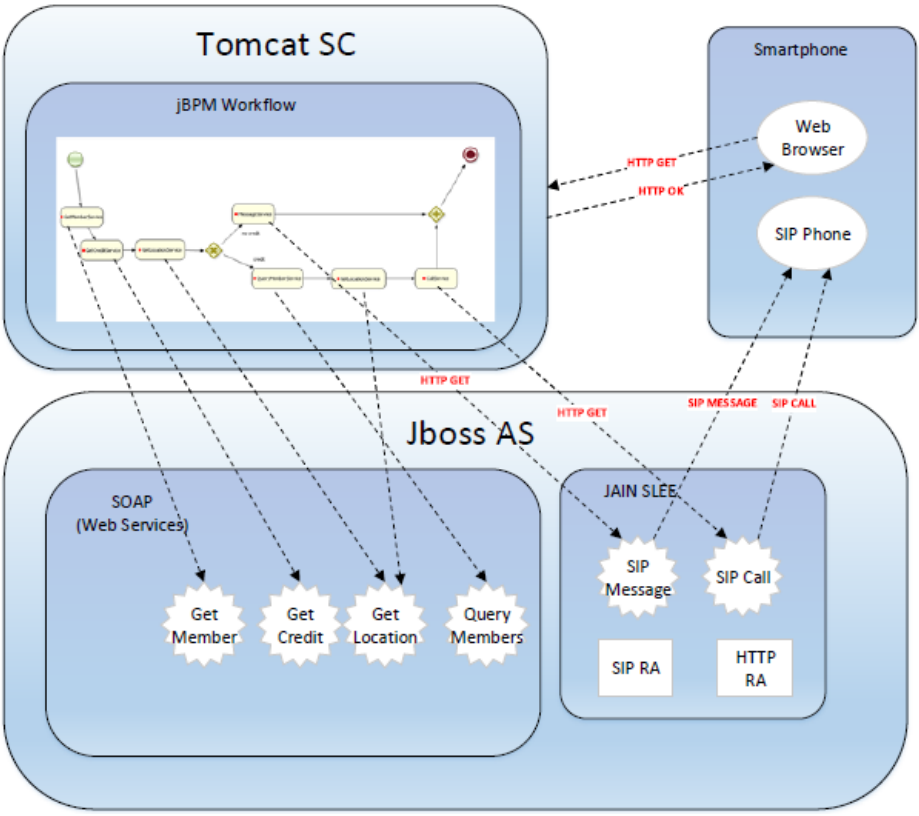

Fig. 2. Prototype of a Service Orchestration Platform

4 Conclusions

This PhD work focuses on the study of service description models and mechanisms that facilitate and automate the interoperation and composition of heterogeneous services (Web and Telecom) within a NGN. The objectives of this work are: i) to create a model for abstract and concrete service interface specifications for each service type and interaction model, ii) to define a service creation environment that uses BPMN 2.0 as orchestration language to compose Web and Telecom services, and iii) to develop a service orchestration platform based on the adoption of a standalone workflow engine to orchestrate heterogeneous services from different domain environments (e.g., SOAP and REST services, IMS-based and JSLEE-based SIP services).

At the current state of development, I implemented a prototype of Service Orchestration Platform which is able to compose heterogeneous services provided by JAIN SLEE-compliant platform and simple IT web services developed by SOAP. This prototype employs JBPM as workflow engine that permits to implement custom work items to define abstract service interfaces, and Mobicents as open source platform for the JSLEE services. I took into account a scenario for a "Expert on Call" service between a user and a expert, and I embedded JBPM in a servlet container (Apache Tomcat) so that an end user accessing a web application can trigger a composite service execution through a HTTP request.

Future work includes the study and development of a orchestration environment implementing dynamic binding techniques that comply with the binding information contained in the base service description, and the creation of a component to select the provider services that optimize the overall QoS, according to network requirements.

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