Workflow Description for Open Hypermedia Systems

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ABSTRACT
In this paper, we identify research issues in the development of system infrastructure support for introducing workflow support into Open Hypermedia Systems. We explore the suitability and applicability of having hypermedia services in a Web Services architecture, and integrating Web Services Flow Language for the coordination and interoperability of services. We identify and discuss some important problems and research issues related to this approach.

1. INTRODUCTION
We take the position that introducing workflow support into Open Hypermedia Systems (OHS) would enable coordination and integration of services. We suggest that a service-oriented architecture, such as that offered by Web Services, readily enables hypermedia services to be published, deployed, and invoked by other services on a global scale on the Internet. To enable integration and coordination between services, we suggest that workflow service components, such as IBM's MQSeries Workflow[7] and Web Services Flow Language (WSFL)[5], provide the levels of interoperability required to meet this agenda.

This position paper introduces these concepts from this perspective and identifies the research issues in the development of system infrastructure support for the composition of multiple OHS services.

Workflow deals with the management, specification, and execution of operations (*business processes*) in organizations. It addresses the concerns of coordination of geographical and organizational distribution within distributed organizations.

Distributed service-oriented architectures help create a distributed environment in which any number of services, regardless of physical location, can interoperate seamlessly in a platform– and language neutral manner. The goal of the Web Services architecture is to simplify the development and integration of distributed services over the network, and one of the key aspects of this goal is to enable inter and intra enterprise business processes and workflows to seamlessly integrate new and existing services.

In recent years, the Open Hypermedia Systems Working Group (OHSWG) has been working on a series of open hypermedia protocols to achieve interoperability between Open Hypermedia Systems[3]. The original Open Hypermedia Protocol (OHP)[6] effort was followed by the Fundamental Open Hypermedia Model (FOHM)[8], the latter concentrating on the link data model rather than an on-the-wire protocol. In the OHS approach an open hypermedia system consists of three types of components: the client, a link or structure service, and a hyperbase or a linkbase. In the OHS architecture the interfaces between these components are clearly defined, and this allows each interface to be clearly defined as a Web Service. Any application or hypermedia system conforming to the respective interface definition can integrate with other OHS conformant systems. For example, any hypermedia system implementing the OHS client interface can use OHS linking and navigation services provided by any OHS conformant link server. A Web Service architecture would allow these OHS services to be published, deployed, and invoked by other like- minded services on a global scale.

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2. Service-Oriented Architectures and Web Services
Service-oriented architectures (SOA) support a programming model that allows service components residing on a network to be published, discovered, and invoked by each other. Typically these services components interoperate with each other in a platform– and language independent manner.

The primary differences between a distributed service architecture and a distributed Web Service architecture is the size of the network being used and the underlying technologies involved. Web Services extend the SOA programming model into a vast networking platform that allows the publication, deployment, and discovery of service applications on Internet scale using Web technologies including SOAP[1] for inter-service communication, WSDL[4] for service description, UDDI[9] for service directories, and WSFL for multi-service orchestration.

The Web Services standard of primary interest in this paper is WSFL. WSFL is the Web Services Flow Language, and is an XML language for the description of Web Services compositions as part of a business process definition. It was developed by IBM to be part of the Web Services framework, and to complement existing standards and protocols. The WSFL specification considers two types of Web Services compositions:

- *Flow Model*: The Flow model describes how to choreograph the functionality provided by a collection of Web services to complete a particular transaction.
- *Global Model*: The Global model describes the interaction of a collection of Web Services with each other.

3. Workflow

3.1 Workflow Concepts

Workflow deals with the management, specification, and execution of operations (*business processes*) in organizations. In this section, we describe the basic workflow concepts that are used in the rest of this paper, and explain how these concepts are described in WSFL.

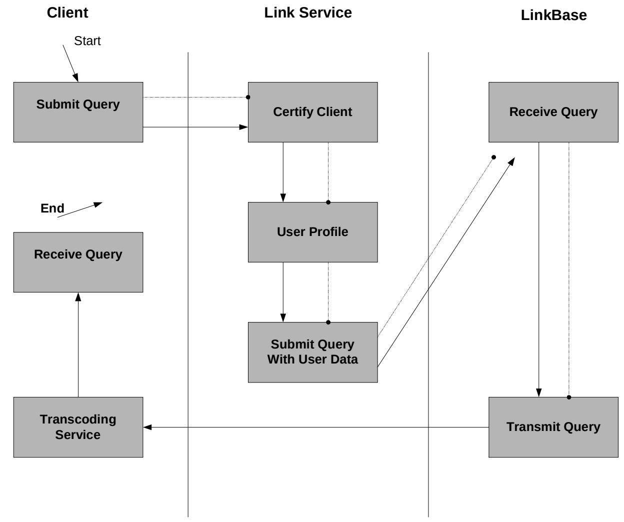

Figure 1. A Workflow Process

Workflow specifications usually describe the actions that are required to take place during the execution of business processes, and the overall flow of process. Figure 1 shows a workflow process modelled using a directed-edge graph. Each box is an activity (a transaction to be completed), and each activity is an individual Web Service, described by a WSDL document. All of the activities are linked together using arrows; called directed edges, that describes the flow of processing control from one activity to the next. Decisions are made at various control points to decide whether certain conditions have been met before the next activity is processed. The dotted-lines indicate the flow of information between activities. WSFL is essentially a tool to create an XML representation of the directed-edge graph that is both human and machine readable. By consuming WSFL, a workflow engine like IBM's MQSeries Workflow, can invoke and manage the entire business process.

3.2 Roles and Discovery

Every activity within a WSFL flow model is implemented in the form of a Web service offered by a Web service provider and represents the significant roles that must be filled to complete that process. Each service provider is expected to provide and implement the Web Service, or a composition of Web Services that would complete that transaction. From Figure 1, any Web Service provider that properly implements the Client, LinkService, and LinkBase Services may fill these roles. The fact that any OHS application adhering to the respective interface definition can interact with other OHS conformant systems allows service providers to fulfill these roles provided its compatible with the WSFL flow model for that process. The OHS Flow Model that corresponds with the graphical representation of Figure 1 is defined by the following WSDL specification:

```
<serviceProvider name =”Client”  type=”client”/>
<seriviceProvider name=”Linkservice” type=”linkservice”/>
<serviceProvider name=”Linkbase” type=”linkbase”/>
```

There are four different ways that the Web Services can be located: statically, locally, via UDDI, or dynamically while the transaction is being executed.

With a static location, the global model identifies a specific Web Service or composition of Web Services as the service provider for a given role. Local services are Web Services that are local to workflow engine processing the request. Locating a Web Service via UDDI essentially requires the global model to search the UDDI registry and retrieve a list of suitable Web Services. The global model decides on the Web Service by referencing a selection policy that may select the first service in the list, selecting a service at random from the list, or some user-defined algorithm. The use of UDDI allows multiple service providers to compete for the right to implement a role within a process. The ability to dynamically locate, and bind to service providers based on user defined selection policies adds a new dimension to conducting transactions on the Web that did not exist prior -- dynamic federation and integration of loosely coupled application components.

3.3 Recursive Composition

Recursive composition allows various service providers to combine services into a single solution. For example, a service provider may offer a LinkService Web Service that is actually a composition of Web Services provided from a number of different service providers (notification services, transcoding services, link resolver services). The end user only invokes the LinkService service, not the individual services that make up the LinkService service.

4. Discussion

In this paper we propose an approach to introduce workflow support for OHS systems. The goal of the infrastructure is to automate some of the services, making it simpler to maintain and integrate. We have also begun to explore the deployment of hypermedia services within a Web Services architecture, and integrating WSFL for the coordination and interoperability of these services.

To conclude, we suggest three areas of research relating to workflow support for OHS:

1. Application Interaction

   For example, how does a Web Service advertise its ability and willingness, to participate in a workflow process.

2. Reliability of Services

   For example, how do service providers guarantee the reliability of its services, and should there be a service-level agreement to guarantee reliability during a workflow process?

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