Grimoires: Grid Registry with Metadata Oriented Interface: Robustness, Efficiency, Security — Work-in-Progress

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Abstract

Grid registries allow users to discover resources made available by Grid resource providers. In this paper, we present our on-going work on a next-generation registry, initially desgined as part of the myGrid project and to be part of the OMII Grid software release. Specifically, we discuss the support of semantic service descriptions and task/user-specific metadata, along with related performance and security considerations.

Keywords: grid registry, semantic descriptions, metadata, signature-based authentication

1 Introduction

The Grid is a large scale, open distributed system that brings together heterogeneous computing resources across administrative domains. Grid registries allow service providers to expose information about their services. Users and applications can then use the registry to quickly, easily and dynamically find these available resources. However, existing service registry technologies such as UDDI (the de facto standard for Web Services registry) provide only a partial solution. First, they have very limited support for publication of semantic information. In particular, services are not the only entities that need to be classified. For instance, classifications can also be defined for individual operations or their argument types. Second, only service operators can provide information about services. However, in a large and disparate environment, it is impossible for operators to foresee all information users would use for finding resources. Third, existing implementations of UDDI utilise authentication techniques for security that are not particularly suited for the large scale nature of Grid systems.

To address these problems, we are designing and developing a registry called GRIMOIRES[1] for the myGrid project [6] and the OMII Grid software release (www.omii.ac.uk). Its features will be described in the next section.

2 Registry features

Registration of semantic descriptions Our registry has the ability to publish and inquire over metadata. Metadata are extra pieces of data giving information about existing entities in the registry. Currently, entities to which metadata can be attached are UDDI BusinessEntity, BusinessService, tModel and BindingTemplate; and WSDL operation and message part. Thus, BusinessEntities can be annotated with service ratings; functionality profiles can be added to BusinessServices; and semantic types of operation arguments can be attached to WSDL message parts.

A piece of metadata is in the form of an RDF [9] triple — the subject is the entity to be annotated, the predicate is the type of the annotation, and the object is the value. The metadata value can be a string, a URI, or structured data in RDF. For example, to describe the service ratings of an operation, the pair (mygrid:NumericRating, 8.5) can be used for the type and value of the metadata attachment.

A unique key is assigned to every piece of metadata published. Therefore, metadata attachments can be updated without republishing the service. This presents an efficient way of capturing ephemeral information about services that changes often, such as current load of a service.

Multiple metadata attachments There is no limit to the number of attachments each entity can have. Since each piece of metadata has its own unique key, it can be updated

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without republishing other metadata attached to the same entity.

Third party annotations The ability to publish metadata is available to both service operators and third parties. This provides the flexibility of allowing users with expert knowledge to enrich service descriptions in ways that might not be conceivable to the original publishers. For instance, users can provide their personal ratings on services.

Generic metadata interface The mechanism we used for attaching metadata is generic and can also be applied to service descriptions supported OWL-S and BioMOBY [7].

Inquiry with metadata Multiple search patterns are supported in GRIMOIRES. The simplest form of query returns a list of all metadata attached to the specified entity. A more complex search pattern is supported using the operation `find_entityByMetadata`, which takes a sequence of metadata (type, value) pairs or an RDQL statement. The operation returns a list of entities annotated by metadata matching the query. To support queries over both metadata and non-metadata (such as the name of a service), we have extended the UDDI `find_service` with similar metadata query facility.

Signature based authentication UDDIv2 and v3 specifications rely primarily on the use of authentication tokens to authenticate users for publisher API calls. In implementations such as jUDDI [3], this is generally achieved through a username/password credential scheme. However, this authentication method does not scale well for most Grid environments, which typically use certificate-based authentication schemes (e.g. Globus [1]). GRIMOIRES is currently deployed within the OMII framework [2], which is based on Apache Axis and Tomcat. The OMII framework provides an implementation of SOAP message signing and verification in accordance with WS-Security standards [5]. When deployed within the OMII container, our registry can extract the Distinguished Name (DN) from the submitted X509 client certificate for authentication purposes. Incorporating signature usage in this way makes it easier to integrate GRIMOIRES into existing Grid security infrastructures, as well as providing an important building block for single sign-on capabilities, an important requirement for many Grid applications.

A simplified view of the secure architecture is shown in Figure 1.

Access control Access control to registry entries on the basis of authenticated identity is achieved at the operation level. The inclusion of metadata also mandates accompanying access control, and this is achieved in a similar manner at the operation level.

Performance We have also conducted some prelim-
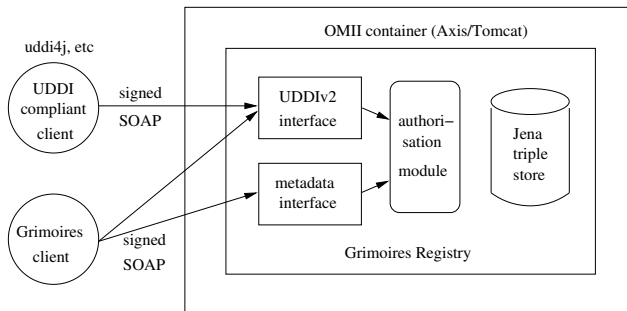
Figure 1. Simplified view of secure GRIMOIRES **architecture.**

inary performance tests for publishing and querying services with different memory backends (PostgreSQL, Berkeley DB and in-memory). Results are available at `http://twiki.grimoires.org/bin/view/Grimoires/TestingProcedure`. For an in-memory registry populated with 5000 services, the average times for publishing and querying are 11.5 and 100 milliseconds respectively.

3 Future work

We are examining the following issues for future work:

- Extending the registry to support RDFS [9] and OWL [8] reasoning. This allows users to publish domain specific ontology, and then query services using that ontology.

- Testing and fine-tuning performance.

- Extending access control on the basis of metadata attachments. This would be useful since third parties can annotate entries, and entry owners might wish to restrict such capabilities to certain parties only.

- Exploring standards such as XACML [4] for access control expression in the authorisation component of Grimoires.

4 Acknowledgements

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