

Towards a Semantic Grid Architecture

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The Semantic Grid is an extension of the current Grid in which information and services are given well defined and explicitly represented meaning, better enabling computers and people to work in cooperation [1]. Existing Grid Services deal with knowledge in the form of metadata and its associated semantics in an implicit fashion, providing no way to share this knowledge with other Grid components. Semantic Grids not only share computational and data resources, but also explicitly share and process metadata and knowledge.

In the last few years, several projects have embraced this vision and there are already successful pioneering applications that combine the strengths of the Grid and of semantic technologies [2]. However, the Semantic Grid currently lacks a reference architecture, or a systematic approach for designing Semantic Grid components or applications.

We need a Reference Semantic Grid Architecture that extends the Open Grid Services Architecture by explicitly defining the mechanisms that will allow for the explicit use of semantics and the associated knowledge to support a spectrum of service capabilities. An architecture would have (at least) three major components:

- (a) a definition of the **semantic entities** that are passed amongst the services, as an extension of the model of a Virtual Organisation. Grid entities are anything that carries an identity on the Grid, including resources and services [3]. These will acquire and discard associations with knowledge entities. We identify common forms of knowledge entities and discuss the life cycle and consequences of a Grid entity being tagged and stripped of its associations with knowledge entities;
- (b) **services that provision semantic entities** by supporting the creation, storage and access of different forms of knowledge entities and bidding Grid entities with knowledge. For example: ontology services; metadata services, for accessing and storing *bindings* of Grid entities with knowledge entities; and annotation services for generating metadata from different types of information sources, like databases, files or provenance logs
- (c) a **framework for evolving existing Grid entities** (services and resources) to become semantically aware, able to consume and produce semantic entities and process them to add value to their functionality. Two evolutionary mechanisms include: (i) semantically annotating existing entities that could facilitate dynamic discovery, dynamic composition or in general the development of “smarter” clients; and (ii) re-factoring existing services to become (*Semantic Grid*) Services capable of dealing with knowledge explicitly.

A Semantic Grid is a Grid, and thus must be able to host a *mixed economy* of semantic and non-semantic entities. Grid Services should be able to take advantage of knowledge on a best effort basis, in order to facilitate incremental acquisition of knowledge in a Grid, and to minimize the impact on Grid services that are not, and do not need to be, Semantic Grid Services.

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References

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- [2] David De Roure, Yolanda Gil, James A Hendler *Guest Editors' Introduction: E-Science*. IEEE Intelligent Systems 19(1), January/February 2004: 24-25

- [3] GGF Open Grid Services Architecture Glossary of Terms
<http://www.gridforum.org/documents/GFD.44.pdf>