Using semantic technologies to improve Grid resource management

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Effective management and use of complex heterogeneous systems such as Grids is entirely dependent on the availability, accuracy and relevance of information on all available resources, their characteristics and state. Mechanism to access this information should be as clear as possible for a wide range of users and at the same time sufficiently flexible and adaptive for a wide range of tasks. At this stage traditional technologies are widely used for this task, showing some weaknesses and constraints with its roots stretching back to the first Grid systems, the continuity with which they still support.

Our hypothesis is that semantic technologies, developing under the concept of the Semantic Web, can be effectively applied to Grid systems. With their help we plan to create a *semantic information service*, which will be based on intelligent knowledge management technologies.

Grid *resource ontology* is a keystone in our vision of semantic grid information services. The ontology we developed is based on *Grid Laboratory Uniform Environment* scheme [1] used by modern information services such as *MDS* [2] and *BDII*. However, to be of any use to us ontology needs to be filled with a set of assertions about individuals - *ABox* (*A*). Together they constitute the *knowledge base* which can be used for logical analysis. For the purpose of generating an ABox we have developed a program to import data from any Grid system that has *BDII*- or *MDS*-based information service.

Fig. 1 shows the basic system architecture of Semantic information service as we see it. We decided to design it as a complementary information service to traditional MDS and BDII. *OWL reasoner* executes all processing and query subroutines. We implemented this component using *Pellet* [3] tableaux OWL reasoner with SWRL [4] rules support. Some modifications were made to optimize it for the task at hand and modern multicore hardware. Ontology development is carried out by *Protégé* [4] editor with an extension that will interface it with *Domain ontology repository*.

We plan that multiple users that work in the same field of study will extend core resource ontology with new constructs helpful to them. Such constructs could describe some specific resources and configurations or user's personal aliases, etc. For example, user can define a set of programs and their resource requirements and make search query such as "find all Grid resources that satisfy the requirements of the program X". Or go ahead and identify resources necessary to perform some specific tasks (i.e. "what resources on the Grid capable of solving my problem X? ").

We set a goal for "intellectualization" of key Grid systems to promote it to a larger audience of users that sometimes have difficulties adjusting to way Grid is operated. We also think that semantic technologies will help us scale Grid systems more easily and allow us to integrate different Grid implementation under umbrella of interlinked ontologies.
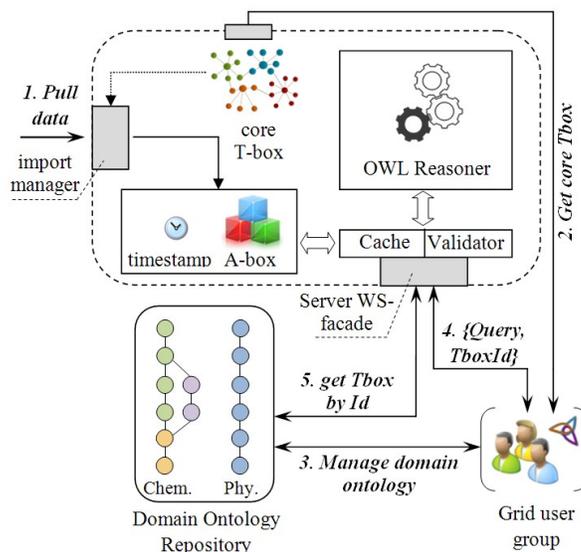
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