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Methodology for Virtual Organization Design and Management

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Introduction

Contemporary grid environment achieved high level of maturity. With still increasing number of various available resources, their optimal exploitation becomes a significant problem. One of solutions to the problem are Virtual Organizations (VO), which groups users and resources to solve a particular problem or a set of problems. Each problem has its own specific requirements in name of computational power, network bandwidth, storage capacity, resource availability etc. During VO design process, appropriate resources have to be selected from all available. This task can be vary difficult or time consuming, if done manually.

Current EGEE middleware (lcg 2.6 or glite 1.4.1) with VOMS or VOMRS systems address the problem of users management in existing VOs, offering web based interfaces for user registration and membership administration. However, creation of new VO is a heavy weight task, which is not automated. Existing EGEE procedures covers very well all administrative aspects, but in current form they are not feasible for automation of the VO creation task. There is no tool, which support design of new VO in EGEE environment.

In the presentation we propose a methodology of VO design. This methodology can be used to build a knowledge based system, which would support the process of VO creation by automating tasks, which do not need user interaction and support user, when the interaction is necessary. The methodology is general and can be adapted to EGEE grid environment. The knowledge based system can be used to support design of new VO without changing existing EGEE procedures.

Methodology

We propose the way of VO design which consists of three steps: definition of the VO, creation of abstract VO, creation of solid VO.

The first step of VO design is definition of the VO purpose with all requirements and constraints. This step has to be performed by an expert who knows the problem for which the VO is created. The definition of VO should be written in a form, which can be easily processed by machine, therefore we propose to use ontology for this task. The expert from the VO domain, does not have to be familiar with any ontology language. There is a need for a tool which will allow VO definition by fulfilling forms and questions. This tool can support the expert in the task, by providing hints and possible answers to questions.

The next step is creation of abstract VO. Abstract VO consists of resource types and their amount which is needed to fulfill VO requirements. Abstract VO is derived from VO definition (and available resources). Abstract VO has exact information about required computational resources, storage resources and all

other specific resources, like data sources (e.g. physical experiment), but does not aim to any specific instance of resource (site). However, the expert can state, that a specific site is required in VO, and this requirement will be fulfilled in the next step - creation of solid VO. For each resource type, there are functional and not functional requirements. The functional requirements are for example installed specific software on computational resources. Non functional requirements can be availability of resource or cost of usage.

The last step of VO design is creation of solid VO. During this step abstract resources are exchanged by real instances. This task can be performed automatically. Resources selection is based on specified requirements and knowledge about the grid environment. The knowledge consists of many kinds of facts and information about each resource, like computational power, storage capacity, bandwidth (network, storage), statistics about resource availability, etc. Because of a dynamic nature of the Grid, available resources can change in time. To support VO requirements, unavailable resources should be replaced with new ones during the VO lifetime. Therefore the last step of VO design should be repeated any time when needed.

During the first step of design, apart form getting the information on needed resources, a workflow, which defines the problem would be created. The workflow visualizes a process of VO usage, from data gathering, through each necessary step, like preprocessing, computations, postprocessing and visualisation. Using the workflow, one can easily generate a specific job description (can take advantage of DAG jobs) to solve the problem. This step can be done automatically.

Summary

Optimal resource utilization is a very important task for contemporary grid environments. With grid environments growth in size and complexity, this task becomes more and more complicated. We proposed the methodology, which can positively influence the process of optimal resource utilization by supporting design of a VO. Well designed VO hides size and complexity of the grid environments, reveling only parts, which are important for the specific problem (for which VO was created). Selection of appropriate resources for VO is time consuming task, therefore it's automation can significantly improve process of VO establishment.

References

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