Analyze Grid from the Perspective of a Computing System

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Abstract

This paper presents a service-based grid computing model which emphasizes that a grid is a special computing system. By comparing this model with the traditional computing system model, we analyze their similarities and differences, which is important for related grid study. The proposed model is very useful for future study in grid computing: it not only provides instructions for developing a grid system, but also provides a framework for the theoretical grid research.

1. Introduction and Background

There are many similarities and differences between the grid computing systems and the traditional computing systems. However, discussion on these similarities and differences is very limited in the open literature. Based on OGSA [1] [2] and OGSI [3], this paper proposes a service-based model and compares it with the traditional computing model. Due to the similarities, the existing technologies for the traditional computing system can be applied to the grid developing process. To address the differences, developers can focus on the special characteristics of grid.

2. The Service-Based Grid Computing Model

2.1. Outline of the Model

Figure 1 illustrates this service-based grid computing model, which contains five major layers: the *resources layer*, the *services pool layer*, the *workflow layer*, the *business layer* and the *user interface layer*.

The resources layer contains all the resources available in a grid. They have to be visited through services located in the services pool layer. Normally, request from a user needs several services collaboratively. Thus, the workflow layer is necessary to provide a collaborative environment [4]. The task of the business layer is to develop software based on business logic to generate the workflow description automatically.

2.2. Three Key Points of the Model

Access Resources through Services: In this model, the basic concept is that everything is unified under the realm of service. To enable other entities to visit various resources conveniently, the best solution is to hide the detailed information of these resources and to provide a universal interface for them. Service is a technology that achieves the interoperability by transferring XML document. No doubt, using service technology to implement the standard interfaces is the best choice to solve this problem.

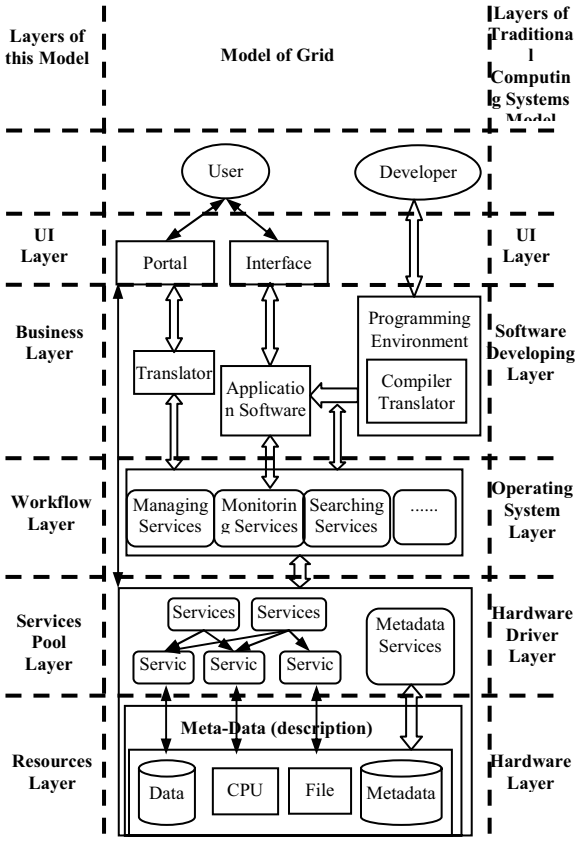

Figure 1. The service-based grid computing model.

Access Metadata through Services: Metadata is used to locate and query resources distributed in a wide range of computer network [5]. Metadata can be treated as one kind of resources though functionally it may be more important than other original resources. Treating metadata as one kind of resources makes the grid system simple and uniform because all operations of resources, including searching resources, querying resources, visiting resources and so on, are unified to the service visiting.

Workflow Realized by Services: The third challenge is how to implement the workflow mechanism in grid system. In order to make grid system simple and unified,

Proceedings of the International Conference on Information Technology: Coding and Computing (ITCC'05)
0-7695-2315-3/05 $ 20.00 **IEEE**

all functions related to workflow are all provided by services (high-level services). A workflow description is considered as a service; combining other services, calling them, monitoring their running state are all implemented by services.

2.3. Advantages of the Model

The three key concepts make service the primitive and unique unit in the model, which keeps grid extendible and unified. When several grids are connected, one grid is exposed to other grids through services, which makes grids can form a larger grid easily and naturally. This self-similar structure makes grid scalable naturally.

3. Compare with the Traditional Computing System Model

3.1. Resources vs. Hardware

Resources in grid are similar to hardware in a traditional computing system. In a traditional computing system, all functions have to be done ultimately by hardware. The resources in a grid computing system is scalable, distributed, heterogeneous, and dynamic, which is very different from the hardware typically seen in a traditional computer system. Different resources may have different kinds of metadata, they may have different contents, different formats, and even are stored in different places. Metadata are special resources in grid. In traditional computing system, there are similar data structures acting as metadata, such as the data describing the file, CPU, memory, and other devices.

3.2. Service vs. Hardware Driver

When resources are considered to be the hardware of a computing system, the services are considered to be the hardware driver. The hardware can only be accessed through hardware driver indirectly. Similarly, resources can not be accessed directly also and the service is considered to be the only entrance. Universal interfaces of various kinds of hardware hiding the details of the hardware make the system simple and unified. In UNIX, various devices are treated universally as files which are the only visiting entrances.

4.3. Workflow vs. Operating System

The work flow layer corresponds to the operating system layer in a traditional computing system. All the locating, scheduling, executing, and monitoring functions are provided in this layer. It provides supports for the software running in the upper layer. Lots of knowledge in parallel computing can be introduced to the study of this layer.

4.4. Business Logic vs. Software

Business layer provides the developer an environment to develop software to meet business needs. As the business expands, the application software can be revised or new software can be built to meet new requirements. As in a traditional computer system, this layer includes the compiler, SDK, and visual programming environment.

4.5 Advantages of the Comparison

Through the comparison with traditional computing systems, many components of grid system could be devised more reasonably. Almost all existing knowledge in computer architecture, operating system, software developing and software engineering can be useful in the development of a grid computing system. Also the grid is a special computing system and it is different from a traditional one. Besides the efforts introducing mature knowledge, more study is needed on the special characteristics which enable grid systems to fulfill more complex functions.

5. Conclusion

Although the concept of grid has been brought forward for several years, there is no available model describing this concept from the perspective of a computing system. A service-based model for grid computing is presented in this paper which is consistent with the OGSA and OGSI standards, recognizing the fact that grid is a special computing system. This model will be helpful in studying many research topics, both in engineering and theoretical sides, such as workflow, semantic description of resources, software developing environment, security, scalability, robustness, and self-management.

Acknowledgement

This work is supported by the National High Technology Research and Development Program of P. R. China (863 Program). Thank 863 experts for their instructions for this project. Thank Yongbo Zhang and other members involved in this project. Thank Professor Xiaodong Zhang from College of William and Mary for his wonderful instructions.

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