Deployment the testbed for Grid products testing on the base of Sun Grid Engine

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ABSTRACT

In this paper, we consider how to create a Polygon for testing Grid products on the base of the Sun Grid Engine. Now various realizations of GRID – systems are actively developed, the quantity of the users having access to systems of distributed calculations and data storage increases. we also focused on the description of the development of element of virtual testbed for marine technology virtual examination. Unit for sea environment (wind, waves, other factors) modelling is considered. Multi scale wave climate models are based upon development of distributed hardware – software complexes. Such complexes include a set of physical-mathematical models describing wave climate, including input meteorological data pre-processing and output data post-processing. The technology of distributed calculations and Grid technology provide simulation of the complex problems using remote heterogeneous computational resources, simultaneous visualization of the large amount of the scientific data. Distributed data processing and analysis provides interconnection of the scientific tools with remote computers and data bases.

Keywords

Testbed, Grid Technology, Sun Grid Engine, WRF (Weather Research and Forecast System). Problem solving environment.

1. INTRODUCTION

Development of virtual testbed for study of complex technical objects behavior requires application of many various models, describing different phenomena. We have such state because in reality there are many processes which are taking place simultaneously. Some of them are independent but some depends on each other. So in general we have joined different kinds of some mathematical models. Real time simulation of all processes which is influencing on final result of complex objects behavior (we can define virtual testbed by such a way too) could not be organized in one computer because adequate modeling requires different kinds of computer resources (for instance: high performance calculation, data processing, visualization, etc.). At the same time different algorithms in frameworks of virtual testbed require different ways of mapping on multiprocessor architecture [1]. If we consider one complete unit of virtual test bed for marine operations – environment simulation – we obtain complex multi layer application that requires mapping on distributed architecture.

The purpose of the given presentation was testing of Grid products as operative environment for the big computer centre. For that purpose the experimental test-bed was created with a help of middleware and other applications based on the UNIX type OS. For the deployment the polygon for testing Grid products, we consider the possible combinations of computing platforms and the middleware the following choice has been made –

1. The intermediate software as the manager - SGE (Sun Grid Engine).
2. For Storage and a data control - application DB 2.
3. Creation of the portal and gateway – UNICORE.
4. Monitoring of the weather conditions Model WRF (Weather Research and Forecast System)

We can consider this solution as a PSE for simulation of wave in virtual testbed.

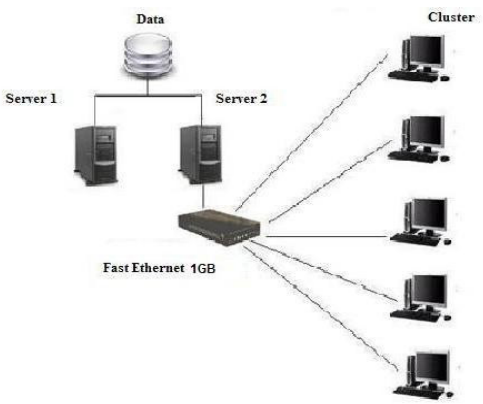

Fig 1. Architecture of testbed

2. THE CONCEPT OF VIRTUAL TESTBED

The proposed concept of virtual testbed defines process organization as complicated multilevel system consisting of the following core components:

- hierarchies of imitating models specifying considered problem areas;
- hierarchies of analytical models giving simplified description of various parties of modelled phenomena;
- information system including DB and KB based on methods and models of AI;

- control systems and interfaces providing interaction of all system component and interactive work with operator.

Virtual testbed development represents complex multistage iterative process. The basic feature of this process consists of necessity to carry out coordination (at conceptual, algorithmic, information and program levels) of heterogeneous models describing various parties of functioning of investigated objects. Choice of admissible alternatives is based on compression of assumed variants that are set by alternatives analysis in complex, especially in non-standard (supernumerary and extreme) situations. Concept of such analysis assumes that estimations of expenses for realization of achieving decisions (expenses for the charge of used resource) do not decrease virtual testbed and it become more and more exact in process of admissible alternatives set narrowing. Thus it is considered as control processes by structural dynamics of system have multilevel, multistage and multifunctional characters.

We can consider virtual testbed as a new generation of computer environment – problem solving environment (PSE) [6]. Main character of such PSE is complication of information processing algorithms, results in necessity of high performance application methods searching for new effective computer procedures and there parallel implementation [4].

Virtual testbed concept is formulated as generalization and development of information processing common methods utilizing high performance computer tools. Such models foresee complex virtual testbed using both complex ship dynamics modeling and software-hardware development. We can note that the following concepts and principles are adaptability, distribution, service orientation, virtualization and fault resistance.

Some complex problems can be solved on the basis of high-performance computing system in our polygon. For example, for monitoring of the weather conditions Model WRF (Weather Research and Forecast System) is used. The Weather Research and Forecasting (WRF) Model is a next-generation mesocale numerical weather prediction system designed to serve both operational forecasting and atmospheric research needs. It features multiple dynamical cores, a 3-dimensional variational (3DVAR) data assimilation system, and a software architecture allowing for computational parallelism and system extensibility. WRF is suitable for a broad spectrum of applications across scales ranging from meters to thousands of kilometers. WRF allows researchers the ability to conduct simulations reflecting either real data or idealized configurations. WRF provides operational forecasting a model that is flexible and efficient computationally, while offering the advances in physics, numeric, and data assimilation contributed by the research community. This program consists of several subsystems which are processed consistently with different requirements to resources. If these subsystems are processed on different computer complexes the organizational problem for the whole computing process becomes so difficult that for many users it will be unrealistic. In this connection it is offered to create the distributed computer complex in which problems of access and distribution of resources are taken care automatically. The scheme of such complex is shown in a Fig. 2.

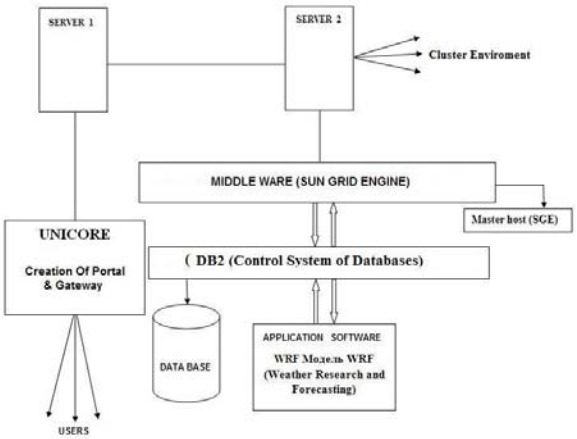

Fig 2. Data control and applications on the Sun Grid Engine platform

3. GRID SEGMENT

As the pre-production model of Grid segment for modeling of wave weather scenarios there exists some configurations. Each configuration for one site of Grid consists of 5 computer systems: a configuration server, a computing element (CE), a storage element (SE), the user interface (UI) and working node (WN).

1. The User interface (UI) provides access to resources of Grid segment. User registers in computer UI to choose Grid resources, to load a problem for processing, to obtain the necessary data and the storage space in case of need.
2. The configuration Server provides semi-automatic installation and a configuration (initial and secondary) of all basic elements of the control.
3. The Computing element is the main working point on a local site. CE provides the general interface for computing resources. Among its functions is a launch of a problem and jobs planning.
4. Working knots provide the processing of a problem. The site can contain some working
knots.
5. The Storage Element gives to the user universal access to accessible databases.

4. COMPLEX APPLICATIONS IN DISTRIBUTED ENVIRONMENT. PROBLEM TO SOLVE

The issue of running parallel applications in heterogeneous environment became more obvious after Grid technology was introduced. Observed is a problem-oriented environment for simulation of wave in virtual polygon. Large number of computational applications and problem solving environments (PSE) developed for traditional parallel systems which required modifications in order to enable efficient execution on distributed and heterogeneous environment such as Grid.

In this paper, different models of the natural environment of WRF (Weather Research Forecasting – (a regional model of atmospheric circulation), and Wave Watch (wind-wave model) examines the problem of constructing a virtual testbed in the form of PSE. These two models were chosen to illustrate the basic features of the implementation of virtual testbed, since each of them requires working with numerous

input data, significant computing resources, processing the output data (data assimilation, visualization and animation), and the output data of one of the models and after the treatment are baseline data for the other. This makes it to verify the information and computing solutions which are proposed for multi-applications in a distributed environment.The key point is to study the problem of run parallel applications in dynamic heterogeneous resources; it is because the requirement to meet the needs of the resource and the resource itself may change at running time.

The considered model (WRF, WW) were implemented, including in the form of parallel applications, traditional (i.e., static homogeneous) parallel systems. The real problem of such applications in a Grid environment is to maintain a high level of parallel efficiency. To ensure efficient use of network resources used special methods to distribute the workload.

Appropriate methods of optimizing the workload must be taken into account two aspects:

- characteristically applications (for example, the volume of data transferred between the processes, the number of floating point and memory);
- characteristics of resources (e.g., potential processors, network, memory, and the level of heterogeneity of dynamically allocated resources).

Collaborative work within the virtual testbed PSE is provided in two ways. Firstly, different users can start several instances of the PSE; PSE create different numerical experiments and run them independently on the testbed computational resources, replicating the simulation components and sharing access to databases, archives and other resources. Second, different users can connect to one common virtual display, thus having the same graphical output and interactive steering capabilities.

Generally the infrastructure of a site within a Grid testbed can be of one of the following types depending on the underlying resources:

1. Traditional homogeneous computer cluster architecture: homogeneous worker nodes and uniform interconnection links;
2. Homogeneous worker nodes with heterogeneous interconnections;
3. Heterogeneous worker nodes with uniform interconnections;
4. Heterogeneous nodes with heterogeneous interconnections.

5. CONCLUSION

A complete Grid infrastructure is always the Type IV, characterized by heterogeneity with a wide range of processors and network communication parameters Thus, for today such flexible system of the organization of grid-calculations on the basis of Sun Grid Engine appears optimum for creation of range for testing of any grid-applications. At the moment such testbed is created at Faculty of applied mathematics and control processes of St.-Petersburg state university.

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