# A Service-Based Grid Computing Model to Apply in the Universities and Institutes

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***ABSTRACT:*** *Development of science and technology in different fields followed by complicated calculations-based projects and studies, therefore, in recent years it has been attempted to find solutions for reducing the calculation and temporal costs in the area of such problems. Various distributed calculations method, each are seeking for reducing the costs by parallel implementation of calculation plans on non concentrated calculating nodes, among which grid computing, exploiting from unusable sources resulted in reduced costs for developing the calculation networks. In concurrent with developed countries, Iran Scientific Society tries to use such methods for reducing the temporal and resources costs by researching and defined some projects for providing service-based grid computing for being used in universities and researching house through the country and the one of the most important actions of such kind includes designing and introducing the grid of Institute for Studies in Theoretical Physics and Mathematics (IPM) where tries to aggregate universities and researching houses in the frame of a national grid and it has yet provided some of fundamental services of grid. This paper aims to provide a grid computing model for being used in universities and researching houses that implemented in Tarbiat Modares University by test.*

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## 1. Introduction

Man's knowledge has always developed and daily achievement of man is removing his past complications and drawbacks, on one side and also encounter him with new problems, on the other side. Therefore, man is always attempting to attain science and promote its knowledge and different societies paced to this way and such attempts could resulted in developed societies [1]. In our country, in recent years, scientists and technology and science specialists attempted hard and this resulted in considerable achievements in different scientific and technology fields such as stem cells, nuclear technology, Nano-technology, medical and engineering sciences. A glance to the past indicates that by appearance of computing services, there has occurred considerable bounce in the progress of man's knowledge followed by resolving the problems in greater size and more complicated but it was difficult to supply increased cost for providing needed infrastructures for such complicated calculations. Providing the methods for solving such complications using existing sources, forced authorities of computing to attend it and the result of numerous studies in recent years is the appearance of parallel computing and distributed computing methods with each are trying to reduce the temporal and computing costs of complicated scientific problems without increasing the cost of manufacturing and using hardware and software infrastructures, one of which is grid computing [2] [3].

Grid computing using existing unusable sources and distributed calculation of complicated scientific problems on such computing element tries to reduce the costs resulted from making and using advanced and expensive hardware and software in today world and most developed countries through the world try to make national grids and exploiting their whole potency of hardware and software infrastructures and universities and researching houses through the world inevitably need such bed for conducting their complicated calculations.

Disposing this subject and launching a researching project, called "Net of Grid Project", Institute for Studies in Technical Physics and Mathematics (IPM) tried to integrate universities and institute in the country to participate in national grid along with conducting distributed calculations in the field of modern sciences and technologies through the world. This paper provides a model of service-based grid computing for being applied in universities and institutes together with test conduction in Tarbiat Modares University.

The rest of this paper organized as follows. In Section 2, introduces the grid of IPM explaining its central services. Then, the service-based grid computing model for being applied in universities and institutes are presented in Section 3. In Section 4 reports the results of this test in Tarbiat Modares University. Finally, the concluding remarks are given in Section 5.

## 2. IPM Grid

Full-scale development of sciences through the world when people accessed to different scientific and informational sources by Worldwide Network saw an unassailable bounce like our country and intelligent action of IPM, one of the pioneer institute in Iran, along with communicating local networks of Iran to Internet is admirable. A glance to the history of this institute indicates that it always tried to invite different thoughts through the country to pace concurrently with scientific progress through the world and today, it tried to define and launch Grid Project in order for fulfilling it nationally and promoting the knowledge. This project aims to share calculating potency and data store between calculating and computing systems in the country, on one side, and joining to countries with such girds and using hardware and software infrastructures shared overseas, frankly speaking, drops that are collected to attain a sea on the other side, by which we can conduct complicated calculations. Continuously, we study the services of this grid and their role for communication [4][5].

### 2.1 Job Management Services

This service is responsible for distributing the jobs on grid computing elements and coordinating among them such that user can see all complications resulted from such distribution. On the other hand, this service provides the user with this possibility that anytime informed from the status of calculation distributed on the grid. The main factor of this service is workload manager responsible for managing the requests for conducting the jobs sent by users according to JAVA definition language (JDL). Another factor is logging and book keeping service that be storing the log files occurred when conducting a request on the grid, will provide the user with a complete history [6]. Job requested received from users will be sent to calculating elements and then to worker nodes for being conducted. The result of calculations will be returned back to the workload manager service and finally accessed by user.

### 2.2 Data management Services

Data management service is responsible for storing the data in storage element distributed on grid nodes [7]. One of the main factors of this service is Storage Resource Management responsible for hiding the method of launching and implementing the data storage system on grid as well as checking the licenses for accessing to data. Operation of reading and writing the stored data is possible using data management service for users [8].

### 2.3 Information and Monitoring Service

This service is responsible for discovering the existing and free sources in the grid. Such sources include computing and informational sources. After finishing the distributed calculations, computing elements make the monitoring and informing services aware of it. Making and presenting the indices related to data and services present in the grid is another duty of such service by which, user can be informed from the capacity and potency of grid for conducting the distributed calculations [9].

### 2.4 Access Services

Using this service, users, ignoring what platform is used,can connect to the grid and study their identity and it will be recorded by this service for meeting the requirements for authentication and authorization for next stages. On the other hand, this service

is a intermediate between users and grid and record and manage username and certificate authority of grid users. This service supervises on active requests using job management service and provides users with it [9].

**2.5 Security Services**

Because, physical situation of grid calculating elements will be hidden from user's view, therefore, users assure the grid when it enjoys high security. Security services of grid, as their name indicated, are responsible for making a secure bed for conducting the distribution calculations. On the other hand authenticating and authorization of users' identity that will access to information present in the grid will be possible by controlling their license for accessing the data and sources [10]. Any user must be provided with an identity registered internationally which will be authenticated by Certificate Authority Center. On the other hand, grid member organizations can also limit accessing to existing services and sources and their management and providing the accessing licenses will be possible using virtual organization management service (VOMS).

**3. Service-Base Grid Computing Model For Being Used in Universities And Institutes**

Conducting complicated calculations on the grid is successful when grid enjoys high potential. The more the level of sources accessed by grid, the more is its computing potential.Communicating between universities and institutes through the country for sharing the sources resulted in making a grid nationally and the more the number of member universities and institutes, the accessed sources will be increased and our national grid will be more potential. On the other hand, by connecting the national grid to Europe grid, it is possible to communicate with international grids as well resulting in our enjoyment from usable sources through the world. It is obvious that without a model for preparing how to communicate and describe the need of nodes comprising the grid, accessing to such network might be difficult. Model provided in "Figure 1." indicates the details of such relation together with services and sources necessary in each layer.

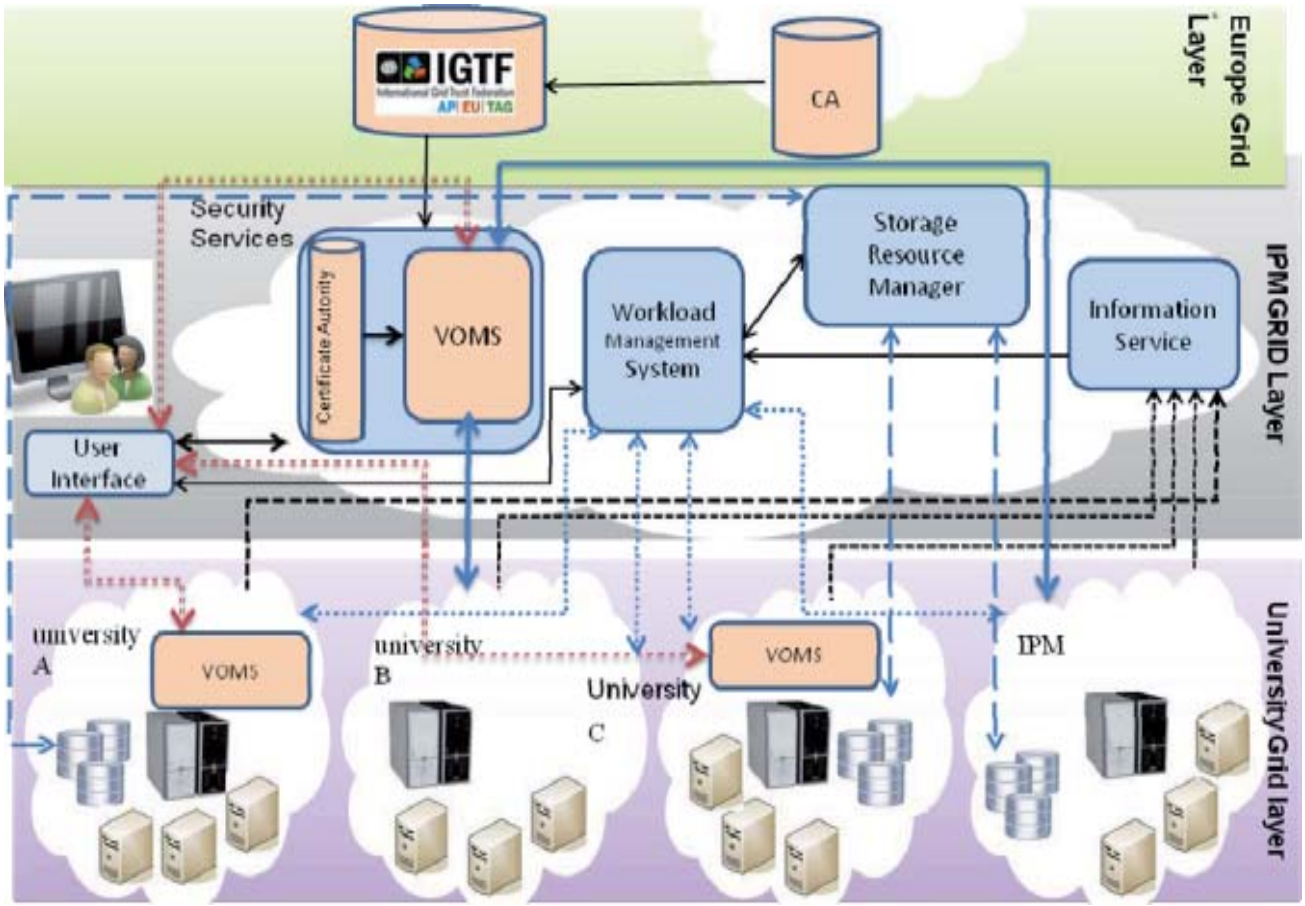


Figure1. Service-based grid computing for being applied in institutes and universities

As indicated in above figure, out national grid will be formed in two layers, and its managerial layer, providing the central services of grid, will be established in IPM and universities and institutes will be located in the lower layer. One of the services provided by IPM, is security service where authenticate the users' identity in the certificate authority center by communicating with International Grid Trust Federation (IGTF). It must be stressed that there will be only one certificate authority center through Iran located in IPM; on the other hand, authentication of our national users will be conducted concentrated and as indicated in the figure, universities lack such center. Because any organization can make decision about determining the licenses for accessing to its bridled sources, therefore, VOMS will be provided as a security service of this grid. IPM, as the central core of this grid, is obliged to provide this service but universities and related institutes, if will take security actions for allocating the accessing licenses to their sources, are obliged to provide this service. For making this clear, for example, Certificate Authority Center will issue a passport for any valid user in the grid internationally and only users who hold such passports can use the gird; on the other hand, any country (any grid member center) can also make limitations for accessing the users and this is like visa, therefore, a user with validated identity can used this organization when validated by VOMS.

Universities and centers can share sources such as computing elements and data storage in the grid and such sources must be accessed by Monitoring and Information Service conducted in IPM; on the other hand, IPM, as the Grid Management, will be informed from existing situation by monitoring and information service. Job management service that is responsible for dividing, distributing and implementing and concluding the jobs is communicating with monitoring and information service to conduct its duties properly. Another one of central services of grid provided by IPM is accessing service, by which users can request for entering to the grid and after authentication internationally and by VOMS, they can request for conducting the computing on the grid sources. Another service provided by IPM, is data management service that is responsible for storing, restoring, reading and writing the data on the grid and is another one of central services of the grid. Although, all of such services have not yet provided by IPM, but by providing them, universities and institutes can combine their sources by this model and clustering to the national grid and increase its computing potential.

**4. Applying The Provuded Model in Tarbiat Modares University**

Conducting complicated computing on systems with high software and hardware potential may not always be possible; on the other hand, although a unit system might possess high potency, but a big set of systems and sources can dominate based on their potential for high size calculation. Preparing a national grid structure, model provided in this paper comprises IPM as the grid manager, universities and institutes as its members, are trying to fulfill for sharing the sources present in the country to attain high computing potential. Tarbiat Modares University is applied as a test sample for applying this model. IPM has not yet provided the universities and institutes with needed services, so we forced to simulating IPM using the same software, Middleware and structure and this simulation conducted on one of the servers of university using WMWARE ESX software, version 4, a virtual simulation from an internal network with 6 servers for conducting the services such as access, job management, monitoring and information, data management, virtual organization management and certificate authority center. On the other hand, by making two clusters in the university, one of which possess a storage element and a computing element and another one possess two computing elements and a storage element as university grid there has been communicated between this grid and simulated IPM. Figure 2 indicates its details.

This test aims to determining the computing potential of grid on one hand and applying the provided model and its possibility on the other hand. In this sample, the calculations of multiplying two matrices N×N conducted on the grid as distributed and this has also been applied for comparing the grid potential on a unique system. Table 1 indicates time cost for calculation. Comparing the time cost, given in table 1, indicates that in some problems with high size calculation, it is necessary to use grid computing, as in calculations distributed on the gird, there are also side time costs such as network communications, central services communications of grid,.. when the dimensions of matrix is less than $10^4$, time cost for using a system for calculation is lower, but when there are increased size of calculations, in high sizes, this system may not be used and some calculations might take months and even years long and this is while using distribution calculation of gird will be lower despite increased cost of network.

It must be mentioned that in this test sample, services of IPM are used as simulated and in real samples, there will be considered the costs related to interconnection of universities and institutes with grid central services in IPM.

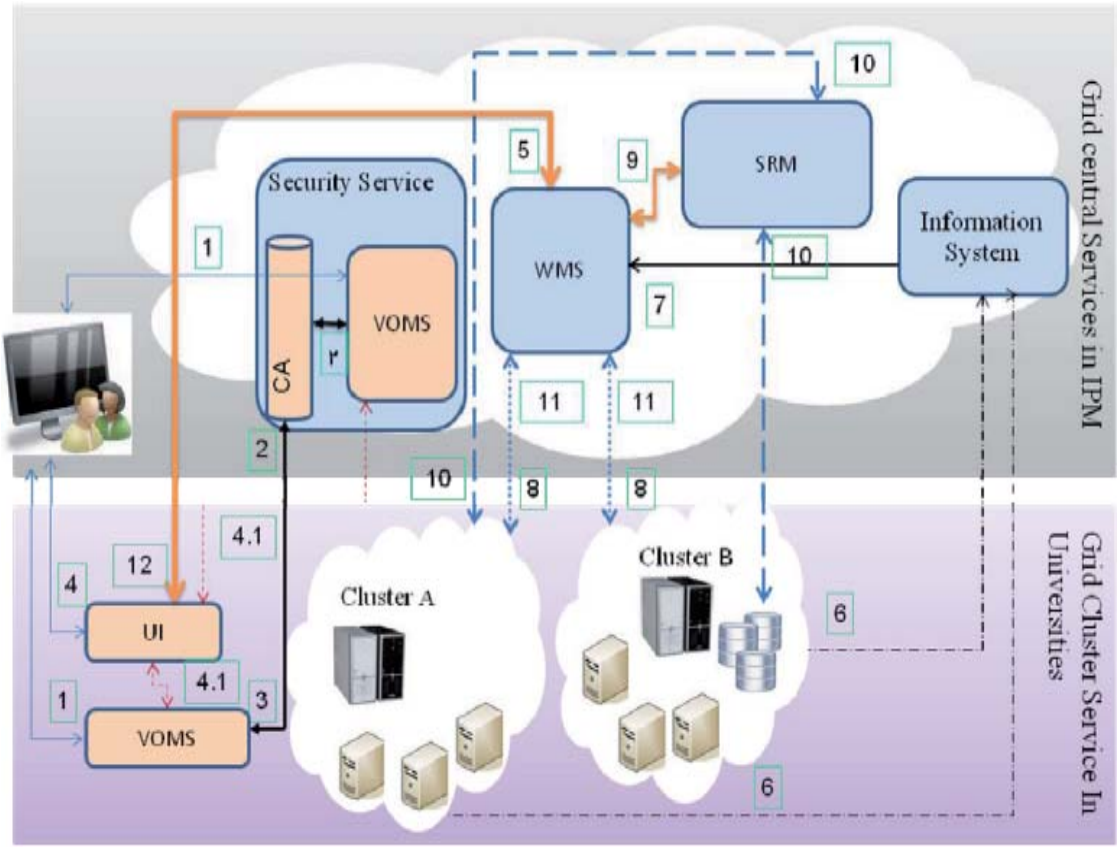


Figure 2. Schema of test sample conducted in Tarbiat Modares University

| Matrix dimensions | Time cost of calculations on a system (s) | Time cost of calculations on the grid (s) |
|---|---|---|
| 100 | 0.478 | 372.128 |
| 1000 | 460.203 | 699.704 |
| 104 | 453125.229 | 7023.442 |
| 10 | ? | 7264.045 |
| 10 | ? | 69385.42 |
| 10 | ? | 687039.208 |

Table 1. results of time cost of calculations for multiplying two matrices N×N using a system comparing with gird computing

## 5. Conclusion

Solving the complicated scientific problems need high size calculations and this may make impossible providing the software and hardware infrastructures needed for such costly calculations. Making a national grid for communicating among universities and institutes through the country for data sharing is an action managed by IPM. This paper provided a service-based applied model for preparing the connecting structure of this national grid and communication of universities and institutes with IPM grid and it has been tested in Tarbiat Modarres University. Results of such test indicated the advantages of using distributed calculations on the grid and it is a reason for its efficiency to being applied in universities and institutes through the country for data sharing in a national grid framework.

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