About Scientific and Technological Problems of the reconstruction of AzScienceNet Network based on Cloud-Oriented Architecture

Rashid Alakbarov[1], Mammad Hashimov[2]

[1,2]Institute of Information Technology of ANAS, Baku, Azerbaijan

[1]*rashid@iit.ab.az*, [2]*mhashimov@iit.ab.az*

Abstract— **The paper investigates establishment principles of distributed computing systems based on cloud computing technologies and some scientific and technological problems of computing clouds development in AzScienceNet network and their solution ways.**

Keywords— cloud computing; memory and computing resources; computing services; hybrid cloud computing; distributed systems

I. INTRODUCTION

At present, computing power of personal computers is not enough for the solution of complex issues requiring large computing and memory resources, which arise from the modeling physical-chemical processes in different fields of science, nuclear reactions, the global atmospheric processes, economic development in a real-time, in Cryptography, Geology, in the development of new medicines and etc. Supercomputers that have a high computational productivity and large memory are widely used in the solution of above-mentioned issues [1]. Supercomputers - which is a strategic product, are very expensive, thus, many countries cannot affort themselves to get and use them in scientific and technical researches. However, these states demand for large computing resources. On the other hand, computing and memory resources of hundred millions of computers connected to the network are not used properly. Conducted researches show that only 25-30% of personal computer capacity and 70-80% of data mining center resources are used. In this case, the remaining unused computing and memory resources of personal computers and data mining centers can be used to solve complex issues.

II. ANALYSIS AND SERVICE FIELDS OF DISTRIBUTED COMPUTING SYSTEMS BASED ON CLOUD COMPUTING TECHNOLOGY

Cloud computing technologies are widely used for the development of distributed computing systems to solve complex issues basing on computer networks. These types of systems with large computing and memory resources are developed on the basis of the computer networks with a high-speed communication channel. Using high-speed communication channels and benefiting from Cloud Computing system services is more economically advantageous for the users of different organizations and enterprises. Thus, Cloud Computing is a computing system which services to data processing and storage of the users by implementing clustering and virtualization of computing and memory resources of multiple computers (servers, computers, data center, etc.) locating in large organizations with the help of communication technologies [2].

Cloud Computing technology enables the users to get powerful computing and large memory resources, and at the same time the user is not interested where these resources are located and installed. 3 types of Cloud Computing system are distinguished for its assignment (Figure 1) [3,4]:

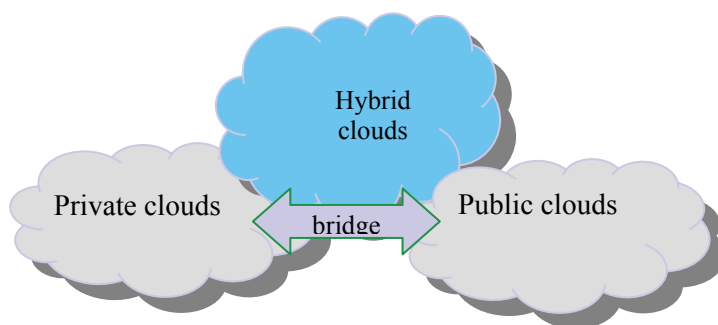- Public clouds;

- Private clouds;

- Hybrid clouds.

Figure 1. Cloud Computing System Architecture

Public clouds - any user and company may subscribe to these clouds. It offers problem solution which are impossible to be solved in other computing systems and

suitable for usage price, the development of web-sites or business-systems with large measurement features. For example, Google Apps/Docs, Microsoft Office Web.

Private clouds – are set within the corporative organizations, offices and departments. Set clouds are protected by means of brandmauers (displays) from the external interventions, and not going beyond the closed internal network, and provide a higher protection. The organization is able to control specific cloud independently or can assign this mission to the outside executor. The infrastructure can be located either at the place of the customer or outside executor, of at the place of the customer and the operator partially. Private clouds settle a number of serious problems, from which open (public) clouds are not ensured. These problems are as follows:

- safety;
- data confidentiality;
- waiting time;
- complying with the requirements of state and regional regulations.

Hybrid clouds combines advantageous features of Private and public clouds.

Cloud Computing offers the users a services close to them. The most frequently used services are as follows [5]:

- **Infrastructure-as-a-service (IaaS)** - IaaS (computing and storage system) provides the service of renting infrastructure. Apart from virtual servers providing secure computing and memory resources, these resources include communication channels, ensuring high speed access to the memory system. Briefly, at this level computer infrastructure is developed for the problem solution. Existing IaaS services are - Amazon S3, Amazon Elastic Computer (EC2), IBM Blue Cloud and others.
- **Platform-as-a-service (PaaS)** - PaaS enables the users to use operating systems and specialized software applications (Apache, My SQL, etc.) locating in the virtual servers (consisted of physical servers). PaaS services are - IBM IT Factory, Google App Engine, Microsoft.NET Azure Services Platform (Windows Azu-re), Force.com.
- **Software-as-a-service (SaaS)** - SaaS provides the users with software. The programs used at this level are - Microsoft "Software Services" (e-mail, video conference), Google Apps, Google Docs and etc. The user appeals the clouds through the network channels without downloading resident portion of the necessary software applications to the computer. Software applications run in the server providing SaaS service and send calculations results to the user. Thus, the user doesn't get the software, but uses it in case of problem solution, and pays for the use respectively.

- Cloud Computing companies are Google, Amazon, IBM, Microsoft, SAP and Oracle.

Gmail online mail service offered by Google company is based on Cloud Computing technology. Amazon S3 service provides each user or organization to receive 50-500 Tb memory to use computing resources. A monthly fee of 1 Gbayt memory fluctuates within 0,15-0.18 USD. An hourly fee for rent of virtual machines for UNIX-systems fluctuates within 0,085-0,68 USD. For Windows systems it is within 0,12-2,88 USD [6].

Processing of the users' calls in Cloud Computing system shall be carried out as follows [7]:

- The user query for service;

- Management system determines the necessary resources in accordance with the query;

- Resource allocation system determines the necessary resources;

- The query is processed after allocating necessary resources.

III. CREATION OF NEW AZSCIENCENET SERVICE FIELDS BASED ON CLOUD-ORIENTED ARCHITECTURE

The development of "AzScienceNet" formed in the direction of building information society in the country, enables Azerbaijani scientific research and educational environment to benefit from technologies and services in accordance with international standards, to function more efficiently this environment, being integrated into the European research and education space. This network system has created favorable conditions for the integration of the scientific institutions into the international scientific networks. "AzScienceNet" infrastructure was established on the basis of telecommunication and server equipments which are Cisco and HP company products. Global Internet access speed is 147 Mb/sec; it is providing Internet service and global network access to more than 2150 computer users. The main objective of AzScienceNet is providing high-speed, secure access to the global Internet within 24 hours a day.

AzScienceNet network is currently providing a large number of Internet services (for GRID, hosting, e-mail, electronic libraries, distance education, AZ-CERT, Training-Innovation center infrastructure, etc.). At the same time, in the near future, it will realize maintenance of mirror

reflection of well-known international electronic scientific bases, e-libraries and other resources in different scientific directions.

The problems to be solved in AzScienceNet have been systemized and listed below.

The complex issues arising in the scientific organizations of the Republic of Azerbaijan according to their characteristics can be divided into two major classes:

- Complex issues that require large memory resources;

- Complex issues that require large computing resources.

Complex issues that require large memory resources:

- Creation of biometric identification system based on the biometric technologies;

- Creation of the National Monitoring Bank for Environment and Natural Resources of AR;

- Creation of Fundamental Scientific Electronic library;

- Creation of cadastre system for real estate based on GIS technologies (orthophoto, digital cadastral, topographic maps);

- Creation of electronic database in the humanities.

Complex issues that require large computing resources:

- Analysis of prospective electronic signature algorithms;

- Transaction management in e-government portal;

- In the exploitation of oil and gas fields;

- Receiving, processing and archiving aerospace image of the territory of AR;

- Development of "Electronic science" project basing on world experience within the framework of "Electronic Government" program;

- Investigation and solution of mathematical models in the field of seismology and etc.

The main criteria in the problem solution at AzScienceNet are defined;

- Problem solution time;

- Problem solution expenditures;

- High-speed and reliable communication channel.

The three key factors of Cloud Computing technologies that attract users are as follows [8]:

- Extremely large computing resources, freeing the users from ordering beforehand and forecasting necessary resources;

- The absence of huge expenses in the early stages of the projects;

- Payment for the actual service (pay-as-you-go).

Data Center of AzScienceNet network was organized on the basis of the latest technologies. IBM company equipments have been used in building the Data center. It is in the same rate as the Data Centers of advanced countries for its technical. Its technical characteristics are as follows:

- The number of Blade servers - 10;

- Microprocessor type - Intel Xenon x5670 293GHz 6c;

- The number of Microprocessor - 20;

- The number of computing gateways - 20x6 Core = 120Core;

- Operation memory - 620 Gb;

- External memory - 20.4 Tb;

- Computing productivity - 1.4 Tflops.

At present, AzScienceNet network Data Center users are benefiting from computing and memory resources service. For this purpose, a special Vmware (Windows, Unix, Linux, etc.) software has been installed.

The users should load VMware Client (RDS - Remote Desktop Connection, SSH - Secure Shell, etc.) software to their computers to use Data center resources. After that, on the basis of data center resources the user is provided with the virtual machine to solve the complex issues, which can not be solved with PC. (Figure 2)
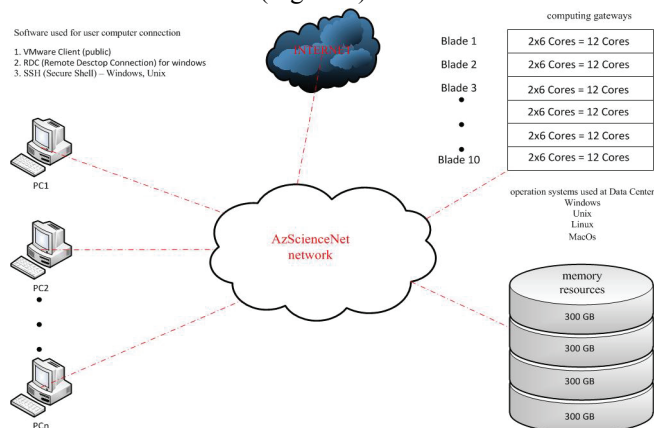

Figure 2. Virtualization scheme of computing and memory resources at Data Center.

Data Center has had implementations for file achieve for institutions and organizations of ANAS. Thus, special memory resources for each institution have been allocated at data center. These resources are divided according to the user name through which only the same user can access and are protected with password. Thus, both the loss and destruction of private organization files is prevented, and excessive expenditures as purchasing memory resources for each organization separately are reduced.

Currently, the infrastructure and software of AzScienceNet network enables to benefit from 1 (one) Blade server resources of the Data Center. Cloud Computing technology will be used to establish a number of virtual machines at multiple Blade servers.

Conducted research shows that a large memory and computing resources are required for institutes and organizations of ANAS to realize researches. Therefore, computing and memory resources of AzScienceNet Data Centre are required to be used more effectively. For this reason, we should assist the proper distribution and efficient use of resources within the academy users through this technology. Consequently, above mentioned 3 actual Cloud Computing services should be provided over AzScienceNet and ensure the users with large computing and memory resources, and software. The research work is carried out in this connection.

In order to use these resources interface programs should be used. At present, the work is carried out in this direction and those applications are downloaded on the user computer and the user gets required memory and computing resources in the windows opened in the computer. Licensed programs are also installed there so that if the computer is disabled to solve its package program the user could run this program in the virtual machine. After installing these programs we are going to distribute the resources among the users, then to generate 2, 4, 8, 16, 32 core virtual machines from 128 processor cores which are located in AzScienceNet. This would reduce the need to purchase computer equipment for organizations in the future.

These analysis show that we shall offer the development of Hybrid Cloud Computing systems particularly. Because, our computing and memory resources are not very vast, and the need for vast resources of our research organizations should also taken into account. With the help of hybrid systems, the users can use the services of other institutions whenever necessary.

IV. CONCLUSION

The paper analyzes Cloud Computing technology used for the development of distributed computing systems based on computer networks, and studies its technology services. The research shows that distributed computing systems based on cloud computing technology have a number of advantages. Establishing this service at AzScienceNet network, the demand for high parameter (computing and memory resources) personal computers connected to the network will be reduced, the users will be provided with unlimited computing and memory resources, software update and etc. The recommendations are given for the establishment of the services noted in the paper.

REFERENCES

[1] Voevodin V.V. Voevodin Vl.V., Parallel Computing. St. Petersburg. "Petersburg", 2002, 608 p.

[2] T.Jones, Cloud Computing and Linux (Platform and Applications for Cloud Computing), www.ibm.com/developezworks/ru/library/

[3] Debunking the myths of cloud computing, http://www.ibm.com/ru/clo-ud/pdf/

[4] Loridas P. Cloud applications. Open systems. 06/2010, www.osmag.ru

[5] Semenov Y.A. Telecommunication technologies. 2010, www.book.itep.ru

[6] Marios D. Dikaiakos, George Pallis, Dimitrios Katsaros, PankajMehra, Athena Vakali.Cloud Computing-Distributed Internet Computing for IT and Scientific Research //IEEE INTERNET COMPUTING .2009. № 9, pp.10-13

[7] Ferenz B. So what is "Cloud Computing", www.cio-world.ru/products/infrastructure

[8] Above the Clouds: A Berkeley View of Cloud Computing.Michael Armbrust, Armando Fox, Rean Griffith, Anthony D. Josep. www.eecs.berkeley.edu/Pubs/TechRpts/2009/EECS-2009-28.html