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ASPECTS OF CREATION OF THE SUPER COMPUTER CENTER FOR SOLUTION OF THE COMPLEX PROBLEMS DEMANDING GREAT CALCULATION RESOURCES IN AZERBAIJAN

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Building information society (IS) in our country has been accepted as one of basic priorities of the public policy. The ultimate goal of building information society includes some very urgent matters such as creation of the legal bases of this society, strengthening the economical, social and intellectual potential of the country, forming modern information communication infrastructure, providing information safety and integration into global information space etc. A number of complex information appears while dealing with these problems. Super computers having high computing productivity and great memory are widely utilized for processing information that demand complex calculation and voluminous memory more quickly and to deliver it to users. At the same time, calculation power of PCs does not suffice to solve complex problems requiring great calculation resources that arise in the different areas of the science, in modeling economical developments, physical and chemical processes, nucleus reactions, global atmosphere processes at a real time and in cryptography, geology and works on new types of medicine etc. [1,2].

Therefore, super computers are widely used in the solution of these complex problems.

First super komputer "CRAY-1" was invented by an American scientist Seymur Krey in 1976.

The super computer was able to do 160 million operations in a second, the capacity of RAM was equal to 8 Mbytes and the price was 8.8 million US dollars. Rating table of the strongest 500 super computers worldwide has been issued by computer experts yearly since 1993. (Two times a year recently – in June and November). According to the statistics printed in November (the 30th rating table), super computer "Blue Gene Solution" produced by İBM company takes the first place.

Super computer was assembled in Levermott national laboratory in Lorenz, USA and is used in modeling human brain and biomolecular processes. It was created on 212992 "PowerPC750" type microprocessors. Its real calculation power equals 480 Tflopsa (480 billions operations a second over *slippery comma numbers (?)*), capacity of RAM equals 32 Tbytes. It costs about 100 million US dollars [3].

In order for a supercomputer to be efficient, it is very important to define exactly the problems to be solved in supercomputers since its price is so high. Besides, it has to be noted that, expense of maintaining supercomputer's good working condition within a year comprises 10 % of its total value. [4].
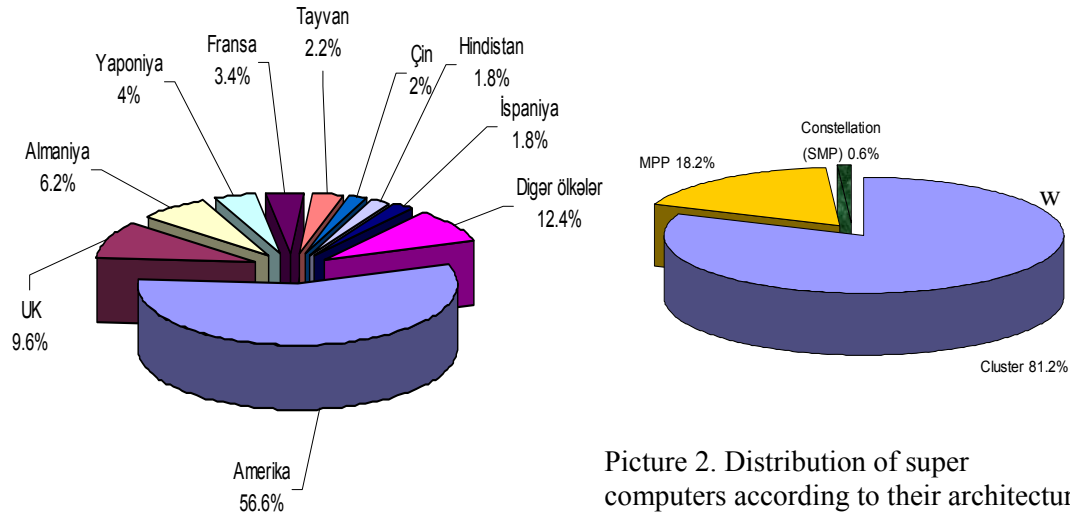
The calculation power of "Blue Gene Solution" is 1.7 times (280. 6s TFlopses) as high as the calculation power of the supercomputer which was announced to be first supercomputer in a 28th rating table that was issued in November 2006.

Super computer which stood in the last place in 30th rating table held 113th place in 28th rating table. Productivity of the super computers must be 5.93 Tflopses for participation in 30th rating table (500th place), whereas this indicator was 2.74 Tflopses in the 28th rating table. Within a year total productivity of the super computers printed in last table of rating has increased from 3.54 PFlops ($3.54*10^{15}$ operations a second over *slippery numbers with comma (?)*) up to 6.96 PFlopses.

Analysis of the distribution of super computers among countries shows that 56.6 % of super computers taking part in the rating table belong to USA. (picture 1). Wide range of changes has occurred in the architecture of the super computers produced recently. Super computers produced in the past were prepared based on MPP (Massively Parallel Processors)

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and SMP (Symmetric Multiprocessors) architecture. Super computers produced at present have cluster type (81.2%) architecture (picture 2)
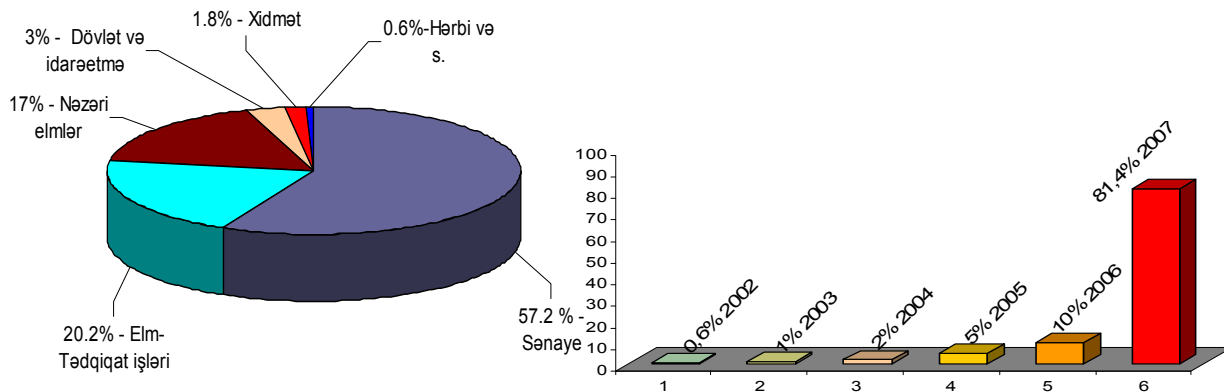
Cluster type architecture super computers are prepared based on modulus principle and it allows using them more efficiently.

Picture 1. Distribution of the super
computers among countries

Picture 2. Distribution of super
computers according to their architecture

Investigations show that super computers are mostly used in industry (57. 2%) and in scientific-research (20. 2%) (picture 3). Low cost of supercomputers with cluster type architecture has recently given a great impetus to mass production of the super computers. 81. 4% of super computers being assembled and produced within 2002-2007 were implemented in 2007 (picture 4).

Picture 3. Distribution of the
super computers according to
their application areas

Picture 4. Dstribution of the super computers
assembled in the years during 2002-2007

It is necessary to note that expedient work is carried out in the area of creation of the super computer center in our country. Intensive efforts are made in the direction of application

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corresponding scientific investigations for specifying and realizing applied problems of strategic importance to be solved in NSC (National Supercomputer Center).

State Program for development of communication and information technologies in the Republic of Azerbaijan for 2005-2008' (Electron Azerbaijan) affirmed by the order of the President of the Republic of Azerbaijan on October 21, 2005 includes establishment of National Supercomputer Center (NSC). Problems of creation of the centre have been entrusted to the Ministry of Communication and Information Technologies, and to the corresponding institute of the National Academy of Sciences of Azerbaijan.

NSC will enable to solve the problems occurring in the process of creation of the IS (information society) in the country more efficiently. In general, bringing super computers to Azerbaijan is favorable to state interests. Placing super computers in one unique centre will make it possible to solve the problems of different ministries demanding great calculations. That is, any country utilizing super computers is considered one of the developed countries.

Application of super computers in the fields of great calculations enables to increase the quality of scientific researches. Super computers are used to solve the problems of special complexity requiring great calculations in the fields of science, education, economy, ecological situation and to solve the problems in providing national security [3].

Creation of the super computer centers must be considered as one of the most important factors for preparing specialists of international standard in the country and for directing their potential of creative work to strategically fundamental and applied investigations.

The applied problems of strategic importance for our country intended to be solved in NSC have been specified in the result of investigations:

Evaluation of the algorithms of symmetric coding

Exploitation of oil and gas fields

Creation of biometric equation system on the basis of biometric technologies

Creation of the project of "Electronic science" based on the world experience within State Program of "Electronic government"

Application in the seismic area

Archiving processed information

In purchasing of the new chemical substances and medicinal preparations

In the ecological area

In identification of the descriptions and in the creation of the processing systems

In the solution of the problems with extremely high complexity (economy, space explorations, chemical (?), physics of high energy etc)

Intellectual analysis of the documents in corporative information space (Text mining)

Monitoring of the nets of state importance functioning in Azerbaijan Republic

■ In the population census.

A planned National Supercomputer Center will allow to implement a number of projects intended in the State Program of "Electronic Azerbaijan" and to solve a range of problems arising in the different fields of science. Let us have a look at a few problems that will be solved in the centre

Evaluation of the algorithms of symmetric coding - Algorithms of symmetric coding play an important and irreplaceable role in protection of information sent through communication channels from certain activities of malicious people. One of the main problems of providing information security for electron government in Azerbaijan Republic is acceptance of symmetric coding standard. This problem raises the problem of evaluation of such kind of algorithms. Investigations and experience of analogous projects in developed countries show that along with theoretical works it requires experiments of wide scale calculations as well. Spectrum of these works may include both practical verification of theoretical results, and implementation of cryptanalysis requiring great calculation resources.

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Creation of biometric equation system – Production and application of electron passport - visa and other identity cards and utilization of super computers in creation, processing and saving biometric information resources are advisable on the basis of biometric technologies required by A "State Program on creation of biometric equation system in Azerbaijan Republic for 2007-2017" affirmed by the order of the President of the Republic of Azerbaijan Ilham Aliyev on February 13, 2007.

In the area of oil and gas fields exploitation - It is obvious that a large sum of money is spent on drilling oil and gas wells and the result is not always positive.

With the help of a specially prepared algorithms and on the basis of calculations made on super computers, barren oil wells (layers) can be identified beforehand and prevent waste of capital.

Intellectual analysis of the documents in corporative information space (Text mining) - A great number of data gathers in corporative information spaces. Among this information, text type data, that is o say documents clearly prevails others. Methods of different intellectual analysis are offered to get (search) necessary information among collection of these documents and their solution necessitates computers having algorithms with great memory calculation power.

  Steps of establising and some proposals on national supercomputer center:
  - Investigation and analysis of the state organizations' demands for current and perspective information resources
  - Defining NSC's basic sphera of functioning problems to be solved in NSC.
  - Analysis of the present information infrastructure of the state organs of the Azerbaijan Republic.
  - For solution of the complex problems in NSC, calculation power should be specified and a suitable super computer must be elected.
  - Preparation of all projects the documents covering all activity periods of NSC.
  - Defining all requirements such as technical equipments and program software for establishing NSC and election of appropriate computer and software that will meet these requirements.
  - Super computer in NSC must have cluster type architecture and must be built on the basis of modulus principle.
  - Installing communication lines, providing continuous source of food, installing air conditioning system, providing security system, installing phone system, providing access to high speed net in NSC's building are some of essential projects to implement.
  - Ordering of necessary net and computer equipments and program software.
  - Perfection of technical opportunities and software as the complexity level of the problems which should be solved in NSC increase
  - Organizing a creative staff in NSC for the solution of the important problems in different areas of the science and engineering

     Thus creation of National Supercomputer Center will play an exceptional role in adapting Azerbaijani science and education to the level of world standard and contribute to realization af high-level reforms the field of economy, science and education.

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