Some Aspects of Research and Development in ICT in Bulgaria

Kiril Boyanov –Institute of ICT- Bulgarian Academy of Sciences (BAS), Stefan Dodunekov-Institute of Mathematics and Informatics, BAS

The development of science and economy is determined by a number of factors, among which:

- Large volumes of raw data increasing exponentially. The volume of the delivered information has increased from 5 exabytes to 280 exabytes in the last years, i.e. growth of 56 times [1]. This suggests searching of new methods for storing and processing of information.
- Scientific research has become more interdisciplinary. For example, the results obtained in biology, biochemistry, biophysics, are widely used in medicine. The computer image processing is widely applied in archeology, medicine, security, transport, etc. Mathematical models and the variety of mathematical instruments find application in almost every area of science and economy.
- ICT are used more and more for scientific research. There is almost no scientific field, that doesn't use the ICT possibilities. The development and application of new technologies and new products is impossible nowadays without ICT.
- The fast development of the economy, social, public and cultural life in the society requires higher level of education, new ways of thinking, new practices in research and new priorities.
- Building a society of knowledge demands ecological, energy and cultural changes and this is impossible to be achieved without the integration of efforts on international level both in research and in business processes formation in the economy.

The above factors suggest the creation of basic e-infrastructure in the particular countries, as well as in European and worldwide frame.

The necessity of creating, developing and maintaining the e-infrastructure in the EU countries increases steadily. The term e-Infrastructure is related to the ICT opportunities for integration of different economic, social, research and cultural activities. The prime goal of the e-Infrastructure is to build new platforms for supporting of e-science, e-education, e-health, e-culture, etc.

The general conclusion is that e-infrastructure is the backbone, which supports the development of science and economy.

Reporting on these trends, the main tasks to ICT in Bulgaria could be determined as follows:

- Building high-speed network connectivity within the country and with the European and world scientific community;
- Building and developing Grid technology platforms;
- Building and developing platforms, which can help business and innovation processes;
- Building and developing supercomputing platforms;
- Building virtual organizations, helping new ICT implementation;
- Participation in European and national projects, allowing extension of current applications and ICT possibilities in all fields of life.

The scientific activities keep structural arrangement till now, in gathering scientific data, processing it with the help of computer systems, connected in a network, making models and performing simulations, generalizing the obtained results with possible ideas for their application. Most of the scientific communities have separately followed this approach, which doesn't give great opportunities for direct access to data and results from other scientific communities. The present trends for scientific activity organization involve basic e-infrastructure of network connectivity, above which new computer platforms (Grid, Supercomputers, cloud) are build, as well as storage device for keeping

large data field. Similar structure, where different instruments are included for creating and performing of simulation models is given to all scientific communities (fig. 1).

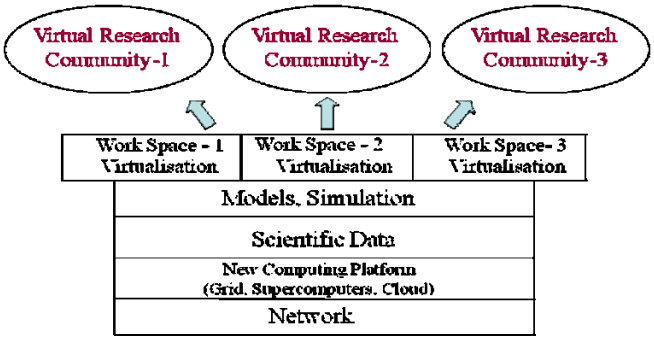


Fig. 1 Emerging of global virtual research communities

The European e-Infrastructure vision is based on the building of pan- European computer network (GEANT)[2], which enables access to different platforms (fig. 2).

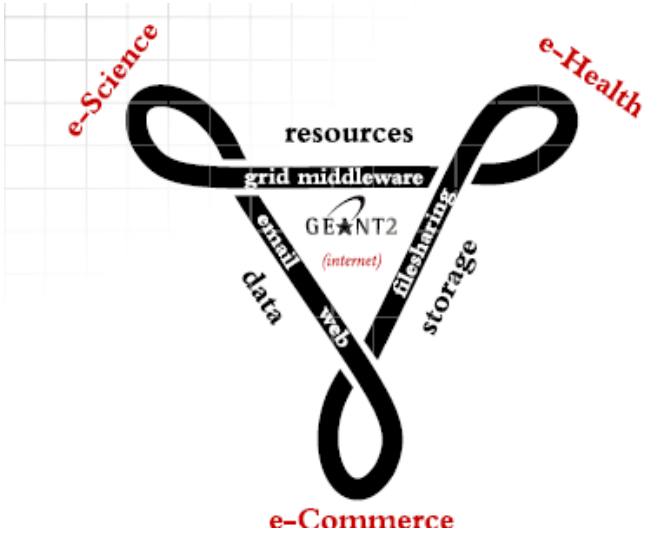


Fig. 2 E-infrastructure diagram

The usage of this e-infrastructure is accomplished through building of national research and educational networks, national Grid centers and national supercomputing centers. Bulgaria has adopted this scheme for scientific research activity development.

The coordination on European level is performed by e-Infrastructure Reflection Group (e-IRG) and EGI.eu [3].

The mission of e-IRG is to identify the fundamental needs from resources and services and to recommend policy guidelines for joint usage of distributed resources.

The European Grid Infrastructure (EGI.eu) is an organization established to coordinate and manage the infrastructure on behalf of its participants – National Grid Initiatives (NGIs) and European Intergovernmental Research Organizations (EIROs). The resources coordinated by EGI are free at point of use, and the individual users do not have to pay to use the Grid infrastructure and the resource providers (NGIs) fund and maintain the hardware in their own countries.

The supercomputing platforms are supported by the PRACE projects [4]. They enable access to the supercomputing systems and services for the users, regardless of the country they are situated.

Research and educational network (BREN)[11] is built in Bulgaria, which is connected to GEANT. Within the framework of the GÉANT project a backbone Point of Presence (PoP) is located in IICT. This PoP is connected by 10 Gbps communication lines with Athens, Bucharest and Budapest, by 2.5 Gbps line with Istanbul, and by 155 Mb/s line with Skopie.

BREN includes the BAS Institutes, the national and some private universities, the schools in Bulgaria and some scientific organisations. The speed to Bulgarian universities and BAS Institutes in BREN is 1 Gbps and is rather low.

Optical ring connects the main regional towns, where the local connections are wireless and optic-fibre. The implementation of the project SEE-Light has started, and it will provide additional high-speed connectivity through optic cables.

The new computer platforms are based on Grid and Supercomputing centers.

The National Grid Center is located in IICT. It is built with national funds and with funds from the European projects SEE-GRID, EGEE, EGI-InSPIRE [12]. The national Grid infrastructure includes 9 Grid clusters with a total of 1836 processor cores. Eight of them are located in the institutes of BAS, 1 cluster - in Sofia University, and 1 cluster is in the making in the Technical University. The Grid infrastructure supports 5 national, 5 regional and 13 international virtual organizations. The parameters of the National Grid infrastructure resources are given in Table 1. The clusters have free user access for the Bulgarian Research Community for applications demanding significant computing resource.

Organization	Cluster name	Number processor cores	Data storage [TB]
IICT-BAS	BG01-IPP	576	96
IM-BAS	BG02-IM	24	1
IICT-BAS	BG03-NGCC	200	10
IICT-BAS	BG04-ACAD	80	5
SU “Kl. Ohridsky”	BG05-SUGrid	24	1
NIGGG-BAS	BG06-GPHI	44	2
IICT-BAS	BG07-EDU	8	-
IOCCP-BAS	BG08-MADARA	800	24
INRNE-BAS	BG-INRNE	80	1
Total 6 organizations	Clusters - 9	1836 processors cores	Total 140 TB

Table 1

The European project EGI-InSPIRE is expected to create e-Infrastructure that can support researchers’ needs for large-scale data analysis and involves 50 partners from more than 40 countries.

The Supercomputing center is located in the Ministry of Transport, Information Technology and Communications, where an IBM Blue Gene/P supercomputer is installed. IBM Blue Gene/P is used for scientific research in the field of medicine, drug discovery, financial simulations, education etc. The performance of the supercomputer is 23 TFlop/s and it has 12 TB disk storage. It is linked to the BREN with a high-speed connection.

A joint team of assistants from the centre, universities and institutes of BAS take an active part in the project PRACE -2IP. One of the project's objective is the formation of integrated supercomputing system of equipments and services that enables the scientists to implement and extend the cooperation among the European Supercomputing Centers. This will greatly improve the partnership and will strengthen the European competitive power.

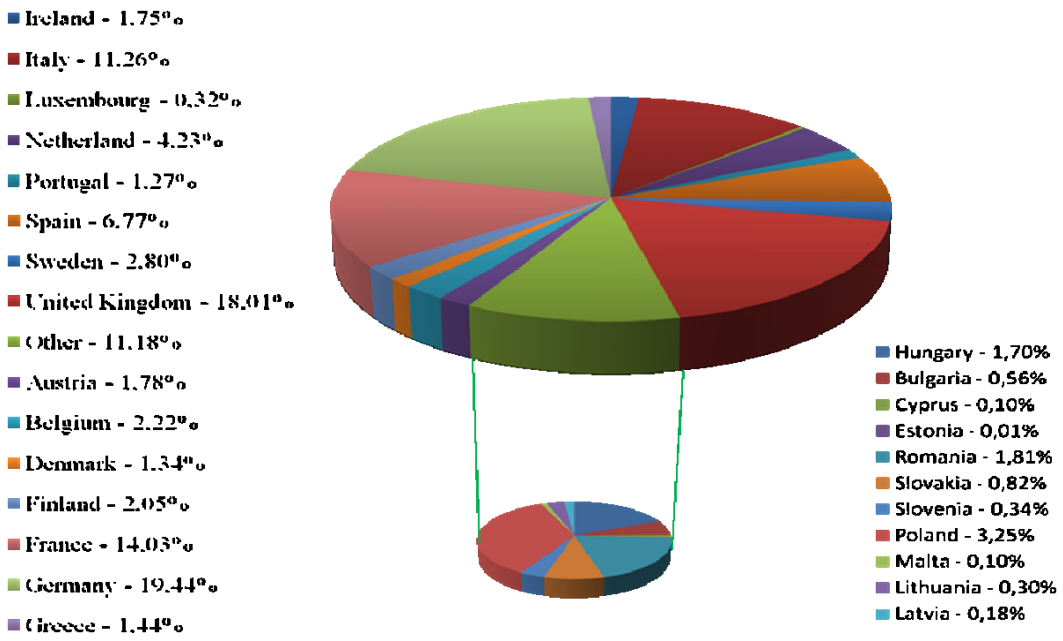
An ICT Cluster [5] is built to improve the competitive power of the Bulgarian ICT companies in 2005. The main aim of the Cluster is the widespread introduction of instruments and software applications in the economy and the social life. Its basic activity is to promote the Bulgarian organisations and companies in the implementation of new products, modernization and reformation of the educational system, in order to be up to the requirements of the global market.

Another important objective is to implement policies for increasing the part of the Bulgarian companies on the national and world market. The ICT cluster consolidates several associations: BASSCOM, BWA, BTCluster, and CMEES.

BASSCOM [6] consists of more than 60 companies, working in the area of software program systems. BWA [7] includes more than 34 WEB studious and more than 70 members for Web technologies development and quality web services. The Bulgarian Telecommunications Cluster [8] consists of 12 members and provides modern telecommunication equipment and services. CMEES [9] includes 12 design organizations in the area of microelectronics and embedded systems.

The ICT added value in Bulgaria is lower in comparison with the European countries (fig.3). According to the statistics 8000 people are employed in software companies with sales for 425 million leva. The associated companies in BASSCOM have sales for 163 million lv with staff of 2500 people.

Fig. 3 ICT value added produced by EU countries



The companies in the area of industrial electronics and microelectronics work mainly with foreign investments. Their sales are over 500 million lv. and staff of 5000 people.

The Bulgarian Association for Information Technologies (BAIT) [10] is another important structural unit. It was established in 1995 and 99 companies are its members at present. The Association includes companies from all ICT sectors – hardware, software, system integration, networks, telecommunications, Internet services providers, etc. Most of them offer their own solutions, products and services and work successfully on the international market. Most of the leading world manufacturer representatives in Bulgaria are members of the association.

The main scientific activities in the area of ICT are performed in BAS Institutes and the Departments on Computer and Communication Technologies at the Technical Universities in the country. Two institutes of BAS work in the area of ICT: Institute of Information and Communication Technologies and Institute of Mathematics and Informatics.

Besides the obtained theoretical results, published in a number of journals, proceedings and books, the above organizations take part in a number of European projects, which determine the development of directions with vital importance for the country.

The project, developed in IMI European Digital Mathematic Library has several main objectives:

- To create a common infrastructure for seamless navigation, searching and interacting within the deeply interlinked network of distributed validated multilingual digital mathematical content available throughout Europe, which will make mathematics readily available for all users of this resource;
- To provide a safe archival back-end so that publishers do not have to maintain their back catalogues indefinitely, and thus agreeing to transfer their content and license open access to it according to their policy;
- To satisfy the demand for reliable and long-term availability of mathematical research output.

Another project with great importance is OpenAIRE [14]. The main objectives of the project are:

- Support researchers in complying with the FP& Open Access Pilot through a European Helpdesk System;
- Support researchers in depositing their research publications in an institutional or disciplinary repository;
- Build up an OpenAIRE portal and e-infrastructure for repository networks;
- Explore scientific data management services.

The project Fibonacci [15] develops very well in the area of training of young mathematicians. The main project objective is to discover and train young talented students in mathematics, trained in mathematician schools in Bulgarian 12 towns. The significant achievements of the young Bulgarian mathematicians at world and international competitions are well-known.

IICT works on Supercomputing applications, financed by EU (PRACE-2IP) and the National scientific research fund [13]. Problems, related to computer modeling of microstructure of heterogeneous environment are developed, as well as evaluation of the wind potential and the air quality in Bulgaria, computer modeling of biological molecules and systems, in-silico medicine project.

A creation of critical mass of young scientists is expected as a result. The project consists of 11 work packets and partners from the BAS institutes and the universities are involved.

Conclusions

The development of ICT in Bulgaria is carried out by building an e-Infrastructure, containing the following basic components: National Research and Educational Network, Grid and Supercomputing center. The existing structures of the private business are an important component and are united in several associations ICT Cluster, BAIT, etc.

Building of techno parks, development of basic business models, new platform that allow active enterprising activity are expected in the future.

The active participation of the scientific organizations in the European framework programs determines the directions with great importance for the country.

A serious participation of the state at regular financing of the e-Infrastructure projects has not been noticed yet. The education has a great importance in the advanced society of knowledge, because a change of thinking is necessary. The education level in Bulgaria has decreased, the young people don't show ambitions in solving complex problems. The integration in the area of ICT among EU countries is expected undoubtedly to reflect in a positive way on the economy and science.

References:

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