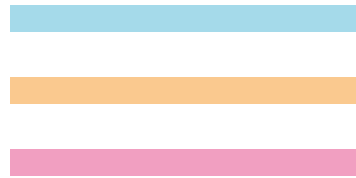




ANNUAL REPORT **CESNET** 2010



CHAPTER ASSOCIATION	4
CHAPTER RESEARCH PLAN	10
CHAPTER CESNET2 NETWORK	26
CHAPTER PUBLIC RELATIONS	30
CHAPTER ECONOMIC RESULTS	36

ANNUAL REPORT **CESNET 2010**

TABLE OF CONTENTS



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„2010 was the final year
of our seven-year research
plan *Optical National
Research Network and
Its New Applications.*“



A MESSAGE FROM THE **DIRECTOR**

You have got in your hands the CESNET Association Annual Report for 2010. It is unconventional compared to the previous Annual Reports. The reason is that 2010 was the final year of our seven-year research plan *Optical National Research Network and Its New Applications*. Therefore, whereas our previous Annual Reports only dealt with our achievements in the respective calendar years, we decided this time to look back at the entire seven-year period that we have spent working on the research plan. As you will see on the following pages - in the chapter *Research Plan* in particular - we have things to boast.

The objective of the research plan *Optical National Research Network and Its New Applications* was to develop and gradually transform the CESNET2 network into an integrated information and communication environment. It has included research into the issues of optical and IP networks, computing and access grids, mobility, multimedia services and the issues of End to End Performance. As part of the research plan, CESNET was involved in major international projects. Emphasis was placed on involvement in activities of the most sophisticated European network architecture, GÉANT, receiving support from the European Union.

I am pleased to say that we have made outstanding achievements virtually in every sphere that we have dealt with under this research plan. That was also recognised by a council of examiners composed of independent experts, who assessed the contribution of the research plan for the domestic academic community and the entire sphere of information and communication technologies after its accomplishment. According to the council of examiners, the results achieved within the research plan have significantly influenced the development of ICT in the Czech Republic. In addition, it stated that the research plan was characterized by the fact that the research and development outcomes were directly applied in the infrastructure and the portfolio of facilities offered, including in the form of patents, utility models, prototypes, and functional samples.

The chief outcome of the seven-year research plan is the CESNET2 optical infrastructure, thanks to which Czech scientists can be involved in today's most advanced projects. In addition to public universities and institutes of the Academy of Sciences of the Czech Republic, it is currently utilised by

more than 300 other institutions, such as research organisations, faculty hospitals, libraries, high schools, etc. Therefore, the CESNET2 infrastructure is essential for the national academic environment and its interconnection with European and global research and development.

We follow up on our *Optical National Research Network and Its New Applications* with another five-year strategic project, *CESNET Large Infrastructure*, the central objective of which is to elevate the CESNET2 national research network to a so-called large infrastructure. A large infrastructure means a wide range of devices, equipment, resources as well as services used by research teams for research activities. Its main task is to create the conditions for efficient collaboration of large scientific teams – both people and experimental equipment whose parts may even be located in different countries.

CESNET Large Infrastructure is one of the high-priority projects described in the *Large Research, Development and Innovation Infrastructure Roadmap of the Czech Republic*. The document was created in response to the European roadmap (*ESFRI Roadmap*) and discusses the inclusion of Czech large infrastructures in the European Research Area. It is therefore evident that CESNET is going to face big challenges in the upcoming years. I am convinced that we are going to tackle them successfully.

Allow me to conclude by saying thanks to everyone who has taken part in the research plan *Optical National Research Network and Its New Applications*, for their selfless devotion as well as high degree of erudition, which they continued to give in contribution to our common goals. I believe we can also rely on them in the project *CESNET Large Infrastructure*. Their abilities are irreplaceable to us. A great thank you for their excellent co-operation goes to all the Association members and, last but not least, to the Ministry of Education, Youth and Sports of the Czech Republic, without whose institutional and financial support we could not dream of accomplishing our projects. We appreciate it very much.

Ing. Jan Gruntorád, CSc.
Director and Member of the Board of Directors, CESNET

A handwritten signature in blue ink, appearing to be 'J. Gruntorád', written in a cursive style.

CESNET was the first
to make a native con-
nection with Google

CESNET was the first
to make a native
connection with
Google using IPv6

(February 2010)



CHAPTER **ASSOCIATION**

using IPv6



CESNET ASSOCIATION

HISTORY

The Association was founded in 1996 by universities in the Czech Republic, together with the Academy of Sciences of the Czech Republic (hereinafter referred to as ASCR). In the same year, when the Association received a grant for the *TEN-34 CZ Network Deployment* project from the Ministry of Youth, Education and Sports of the Czech Republic, the Association started building the academic backbone network of the Czech Republic at an entirely new level of quality. Along with it, the academic and the commercial sectors were separated, and all the members shifted for the academic network. From 1997, the Association operated two independent networks. The first network, TEN-34 CZ (later TEN-155 CZ), served the needs of science, research and education, to which members of the Association and some other institutions complying with the Acceptable Use Policy were connected. The second network was called CESNET, for historical reasons, and connected commercial customers. Both the networks were separated in technological, economic and largely also personnel aspects. After the commercial network was sold in 2000, the Association ceased to act as a commercial Internet provider. Since then, it has been engaged solely in the development and operation of the science, research and education backbone network (National Research and Education Network – NREN – of the Czech Republic) and other related activities. That network is called CESNET2. For the years 2004 to 2010 the Association was subsidized in the form of an institutional support for its *Optical National Research Network and Its New Applications* research plan, the draft of which was presented in 2003. 2010 was the seventh, final year of that research plan.

OBJECTIVES AND THE SCOPE OF ACTIVITIES OF THE ASSOCIATION

The main goals of the Association are the operation and development of the backbone network that interconnects the networks of the Association members, research and development of advanced network technologies and applications, and the dissemination of information about them.

The main scope of activities of the Association follows:

1. To do research and development in the area of information and communication technologies and their applications.
2. To provide, and arrange the provision of, education services within research and development, using the high-speed national research and education network.
3. To secure for its members and the allowance organizations they have established the development and operation of a computer network interconnecting their networks and metropolitan networks; the creation of collectively used technical, communication and software resources and information services; testing of new applications; cooperation and complementarity of the members' activities at a level comparable with leading education and research networks abroad (including Internet access).
4. To secure and provide, in cooperation with its members, the long-term development, acquisition and use of high quality communication and information technologies based on the Internet and similar later systems.
5. To support, against the reimbursement of related expenses, propagation of erudition, culture and knowledge, cooperation with members to broaden their experience, expansion of applications of the latest information technologies, and improvement of the quality of the network by recruiting additional participants, information sources and services.

The Association does and procures its activities within the scope of received subsidies and partial compensation of expenses related to these activities. It is not the Association's objective to generate any profit on these activities. In addition to its main activities, the Association also pursues economic/business activities; however, solely with the purpose of making more efficient use of its property and without any negative impact on research activities. The services are not provided on a publicly

available basis. The Association does not provide the academic backbone network services only to its members but also to selected entities complying with the *Access Policy of the Next Generation National Research and Education Network*. Any loss incurred in connection with the Association's economic/business activities is settled by the end of the fiscal year in question; otherwise, the Association will abandon the economic/business activities in question before the beginning of the following fiscal year. After settling the obligatory reserve fund contribution, the Association uses its entire profit to support the research and development.

MEMBERSHIP IN INTERNATIONAL AND NATIONAL ORGANIZATIONS

The CESNET Association is a member of important international and national organizations.

International Organizations

TERENA (Trans-European Research and Education Networking Association) – established in 1994 through the merger of EARN (European Academic and Research Network) and RARE (Réseaux Associés pour la Recherche Européenne). It is engaged in the development of the telecommunication infrastructure of academic and scientific sites across Europe.

CEENet (Central and Eastern European Networking Association) – organization coordinating international telecommunication activities of countries in Central and Eastern Europe.

GLIF (Global Lambda Integrated Facility) – global experimental network activities, focusing on the development support for most demanding scientific and research applications; the main objective is to create a network to serve applications with extreme transmission requirements.

DANTE (Delivery of Advanced Network Technology to Europe Ltd.) – non-profit organization aimed at the construction and quality improvement of the IP connectivity for academic institutions in European countries.

Internet2 – consortium led by American research and education institutions endeavouring to develop and deploy new types of network technologies, services and applications; CESNET has been an associate consortium member since 1999.

PlanetLab – consortium of academic, commercial and governmental organizations all around the world, collectively operating a global computer network designed for developing and testing new telecommunication applications; the network currently includes 780 nodes in 31 countries.

EGI.eu – organisation focusing on co-ordinating European computing grids used for scientific calculations and on supporting their sustainable development.

National Organizations

NIX.CZ – CESNET is one of the founding members of NIX.CZ Interest Association of Legal Entities (Neutral Internet Exchange), an association of Internet service providers in the Czech Republic, permitting mutual connectivity among its members' networks; the association had 82 members as of 31 December 2010.

CZ.NIC – the Association is also a founding member of CZ.NIC Interest Association of Legal Entities, dealing with domain registrations, support to Internet-related publicly beneficial projects and activities; the association had 77 members as of 31 December 2010.

ASSOCIATION MEMBERS

The following institutions were members of the Association in 2010:

Charles University in Prague
Palacký University in Olomouc
Czech Technical University in Prague
Technical University of Ostrava
Academy of Arts, Architecture and Design in Prague
Academy of Fine Arts in Prague
Technical University in Brno
University of Veterinary and Pharmaceutical Sciences Brno

Masaryk University
 Mendel University in Brno
 Academy of Performing Arts in Prague
 Janáček Academy of Musical and Dramatic Arts in Brno
 University of Pardubice
 The Institute of Chemical Technology in Prague
 Czech University of Agriculture in Prague
 Technical University in Liberec
 Institute of Economics in Prague
 University of Hradec Králové
 University of South Bohemia in České Budějovice
 University of Ostrava
 Silesian University in Opava
 University of Jan Evangelista Purkyně in Ústí nad Labem
 University of West Bohemia in Plzeň
 Academy of Sciences of the Czech Republic
 Tomáš Baťa University in Zlín
 Defence University
 During 2010, the Association accepted no new members.

INTERNAL ORGANIZATIONAL STRUCTURE

CESNET has the following bodies:

- General Assembly
- Board of Directors
- Supervisory Board

The **Board of Directors** operated with the following members until 8 July 2010:

Prof. Ing. Jiří BÍLA, DrSc.
 RNDr. Alexander ČERNÝ
 Ing. Jan GRUNTORÁD, CSc.
 Ing. Josef KUBÍČEK
 doc. RNDr. Václav RAČANSKÝ, CSc.
 doc. RNDr. Pavel SATRAPA, Ph.D.
 Prof. Ing. Miroslav TŮMA, CSc.
 Ing. Josef Kubiček held the office of the Chairman, and RNDr. Václav Račanský, CSc., and Prof. Ing. Miroslav Tůma, CSc., were Vice-Chairmen.

For the electoral term 2010-2012, the 29th General Assembly elected a Board of Directors with the following members during its meeting held on 8 July 2010:

Prof. Ing. Jiří BÍLA, DrSc.
 RNDr. Alexander ČERNÝ
 Ing. Jan GRUNTORÁD, CSc.
 Ing. Josef KUBÍČEK
 doc. RNDr. Václav RAČANSKÝ, CSc.
 doc. RNDr. Pavel SATRAPA, Ph.D.
 Prof. Ing. Miroslav TŮMA, CSc.
 Ing. Josef Kubiček was elected for the post of the Chairman of the Board of Directors, and RNDr. Václav Račanský, CSc., and Prof. Ing. Miroslav Tůma, CSc., were elected as Vice-Chairmen.

The **Supervisory Board** operated with the following structure in 2010:

RNDr. Pavel KRBEC, CSc.
 Ing. Jaromír MARUŠINEC, Ph. D., MBA
 Ing. Petr PĚTIOKÝ, MBA
 Prof. Ing. Ivo VONDRÁK, CSc.
 RNDr. František ZEDNÍK
 Ing. Jaromír Marušinec, Ph. D, MBA, was the Chairman of the Supervisory Board in 2010.
 Ing. Jan Gruntorád, CSc. was the **Director** of the Association again in 2010.

DEVELOPMENT FUND BOARD

The Development Fund Board operated with the following structure in 2010:

RNDr. Igor ČERMÁK, CSc.
 Ing. Miroslav INDRA, CSc.
 Ing. Olga KLÁPŠŤOVÁ
 Prof. Dr. Ing. Zdeněk KŮS
 Ing. Petr LAMPA
 Ing. Vladimír RUDOLF
 Prof. RNDr. Jan SLOVÁK, DrSc.
 RNDr. Igor Čermák, CSc., was the Chairman of the Development Fund Board.

ORGANISATIONAL CHART

The new organisational chart (see Fig. 1) was approved by the Director, following discussions with the Board of Directors, on 12 February 2008. In addition to employees included in the organisational chart, 185 workers of 28 universities, Academy of Sciences of the Czech Republic and other institutions were cooperating with the Association on the *Optical National Research Network and Its New Applications* research plan in 2010.

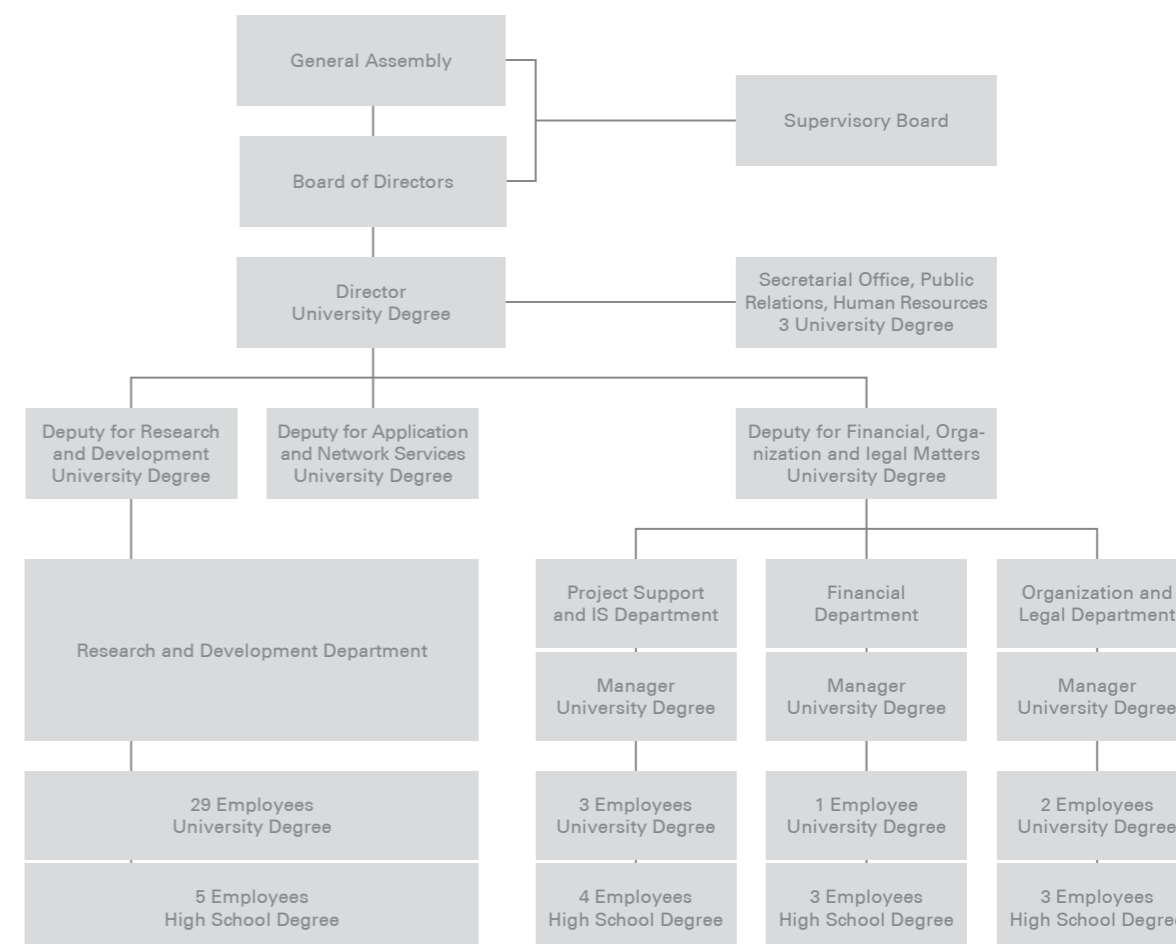


Fig. 1 – Organisational chart of the Association in 2010

Experts of CESNET
and Masaryk Hospital
in Ústí nad Labem
presented a real-time
stereo Internet

CHAPTER RESEARCH PLAN

transmission in
3D Full HD format
of a surgery
operation in Japan.

(November 2010)

RESEARCH PLAN

OPTICAL NATIONAL RESEARCH NETWORK AND ITS NEW APPLICATIONS RESEARCH PLAN

National Research and Education Networks, such as CESNET2 being built by the Association, are of a very specific nature. It is necessary to actively participate in the research and development of advanced network technologies and applications in order to ensure continual development of the networks. This applies both to the national and the international levels.

Research activities relating to the NREN CR development were performed mainly under works on the research plan *Optical National Research Network and Its New Applications*. The research plan, implemented in 2004 to 2010, was largely financed from the institutional support provided by the Ministry of Youth, Education and Sports of the Czech Republic. Experts in the Association, the ASCR and employees and students of the universities were actively involved in it.

The objective of the research plan was to design a prototype of a transparent integrated communication environment, meeting specific requirements of the academic community, and to test its characteristics and viability in practical operation. The need to design a next-generation National Research and Education Network is based on experience with the operation of NREN, indicating that the sufficient bandwidth, considered a priority until recently, is just one of the requirements for NREN. In order for the NREN to become a true (virtual) environment enabling cooperation of scientific teams, additional communication services need to be implemented as an extension of the high-speed infrastructure.

2010 was the final year of works on this research plan. The final examination of its progress and achievements took place on 8 March 2011. In addition to the 2010 achievements, the council of examiners assessed the entire research plan. It stated that the e-infrastructure built, which is the chief project outcome, ranks with its parameters among Europe's best academic networks and provides a good starting point for future development. The council also recognized the successful transfer of the research and development results into the practice, which made a significant contribution to the quality of the resulting infrastructure. According to the council, the provision of the infrastructure and services was very well combined with experimental activities.

The council of examiners recognised the high professional level of the solutions, which was also reflected in the fact that the researches were involved in numerous relevant international projects. In light of the accomplishment of the seven-year research plan, which has been an important stage within CESNET's fifteen years of existence, the following chapter takes the liberty of summarising the most important achievements and changes to the infrastructure over the past seven years.

RESEARCH PLAN RESULTS

With respect to the great extent of the research plan – both from the professional perspective and the financial/HR perspective – the research plan was divided into component activities:

National Research and Education Network Development

The CESNET2 backbone network is the most visible and most significant outcome of the research plan. The changes it underwent during the research plan are truly radical and are described in more detail in a separate chapter on the following pages.

Optical Networks

An optical network is the basis of CESNET2. It is based on an infrastructure of hired optical fibres fitted with the DWDM technology, permitting the construction of a sufficiently permeable (10 Gbps) and reliable IP network for standard Internet communication, as well as establishment of reserved channels (currently 32, extendable to 80) or networks for demanding data transfers. The infrastructure is ready for higher speeds, such as 40 Gbps.

CESNET built its development on its concepts. The most important of them is the building of user-controlled communications networks the physical layer of which consists of dark optical fibres - CEF (Customer Empowered Fibre). The concept, which the Association pioneers alongside others, has been adopted by numerous national research networks over time, and it is also the basis for the European research and network communications backbone, the *GÉANT*. The researchers under the research plan have promoted the concept in the international projects *SEEFIRE* and *Porta Optica Study*, thus significantly accelerating the development of NREN in less advanced regions. Another concept that brings new opportunities in building optical networks effectively connecting neighbouring countries is the so-called CBF (Cross Border Fibres). This is how the CESNET2 connects, beyond its connection to the *GÉANT*, to neighbouring countries' research and development networks SANET (Slovakia), AConet (Austria) and PIONIER (Poland).

Besides conceptual approaches, the Association also focused on the equipment necessary for implementing them. It has developed a number of original fully optical *CzechLight* transfer systems, currently including prototypes and functional samples of the *CLA* optical amplifier, *CLR* amplifier, *CLS* switch, *CLM* multicasting switch, *CLC* compensator, *CL-ROADM* reconfigurable optical add-drop multiplexer, *CL-VMUX* variable multiplexer, "colourless" multiplexer/demultiplexer, tunable source for multiple wavelengths, photon wavelength converter, and *CL-OCM* optical channel monitor. The *CzechLight* series elements have been deployed in practice: specialised companies have manufactured and offered them under licence from us.

Programmable Hardware

The *COMBO* family of cards, developed by the Association, is the basis for hardware-accelerated data packet processing; they combine into various adaptor configurations as needed, always consisting of a pair of interconnected cards: a base card and an interface card. The *COMBO* cards feature high-capacity FPGA circuits, permitting complex algorithms. Based on the experience gathered, CESNET designed the *COMBO version 2* family of cards in 2008, the parameters of which take it to transfer rates of 40 Gbps and above. The initial 40GbE testing of the cards was done in 2010, and it is being continued. CESNET has established the *NetCOPE* firmware platform for the *COMBO* cards, allowing the rapid development of hardware-accelerated applications. As part the research plan, the Association has developed the following main network applications for the *COMBO* cards and the *NetCOPE* platform:

- *FlowMon* is a probe for collecting information about IP traffic flows and exporting them in any of the *NetFlow5*, *NetFlow9* and *IPFIX* formats; the latest version of the probe using *COMBOv2* cards makes it possible to process two-way traffic on a fully loaded 10 GE line regardless of the packet size and ranks among the world's leaders in the area;
- *NIFIC* is a hardware-accelerated no-status firewall, the main purpose of which is to filter packets based on predefined rules; the current version of the application includes relatively broad possibilities of IPv6 traffic filtering and is also capable of operation on a fully loaded 10 GE line without any packet loss;
- *HAMOC* (Hardware accelerated monitoring centre) is a more general application allowing flexible arrangements of network monitoring depending on the needs and situation.

CESNET has made a successful transposition of its research results into practice. In 2007 and 2008, the Association signed contracts with INVEA-TECH, a. s., based on which the company obtained licences for commercial exploitation of the results, and it has marketed some of them (such as *FlowMon* and *NetCOPE*) in a modified form.



Fig. 2 – COMBO10G4TXT interface card with four 10 GE ports

Network Infrastructure and Traffic Monitoring

Information on the network load and the nature of the transmitted data is very important for the infrastructure operation as well as planning its development. In addition to the G3 and FTAS software systems, CESNET has developed several hardware elements as well during the research plan.

Above all, the G3 system serves the continuous and areal monitoring of large high-speed network infrastructure, but in general, it is applicable to monitoring any infrastructure at the network interface of its components. The system can be expanded to allow monitoring of specific equipment assemblies (in practice, e.g., video streaming within CESNET2, the *CzechLight* family equipment, *MTPP*, and others). The web-based user interface is fully interactive. The system includes a special module - electronic client, which simulates the user behaviour and can create periodic static outputs for specific purposes, such as infrastructure exploitation maps (see Fig. 3). Apart from CESNET2, the system has been successfully implemented in the *FEDERICA* research project under the 7th EU Framework Programme.

The purpose of the *FTAS* system is continuous areal monitoring of IP traffic based on distributed processing of information on network flows (NetFlow). The system accepts information from primary sources (routers or probes, such as *FlowMon*) and processes them for further uses. The basic form of processing is storage of records divided by the primary sources in preparation for subsequent general searches.

The system is fully compatible with IPv6: it can process (and does so routinely in the CESNET2 network) information on traffic transmitted by the IPv6 protocol as well as accept and redistribute operating records using IPv6. The system is equipped with an interactive web-based user interface with comprehensive search and visualisation facilities.

In addition to the CESNET2 backbone (about 13 nodes), the system is deployed in the internal networks of some of the connected organisations (such as the MU, TUL, WBU, Masaryk Hospital in Ústí nad Labem) as well as outside CESNET2 (e.g., Seznam.cz, a. s.).

Monitoring of Performance Characteristics of the Communication within Computer Networks and their Optimization

Part of our activities dealt with research into methods of monitoring network performance characteristics, development of related tools, and their network deployment. CESNET collaborated with partners in the international projects SCAMPI, LOBSTER, GN2 and GN3, the first two of which focused directly on designing and deploying scalable MAPI (Monitoring Application Programmable Interface) architecture for developing transferrable applications for passive network monitoring up to the transfer rate of 10 Gbps. Works under GN3 have been ongoing; we have been developing tools for classifying network traffic using computer learning methods.

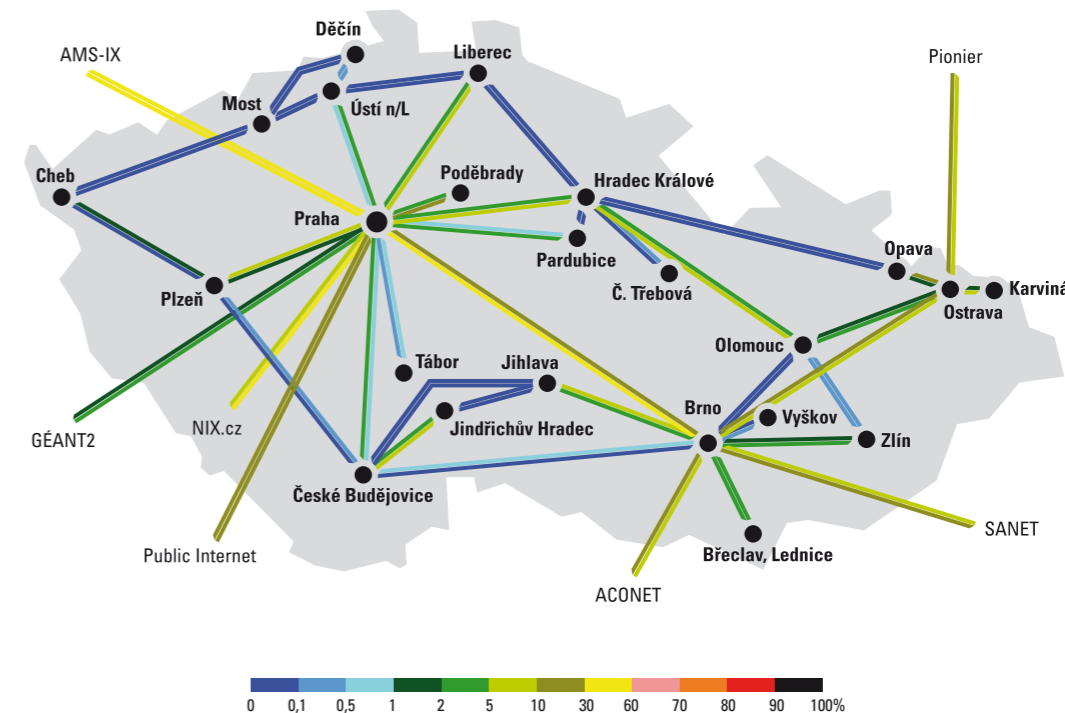


Fig. 3 – CESNET2 network load map (monitoring output)

The Association has developed the MTPP10 (Modular Traffic Processing Platform) platform for hardware acceleration. Its unique property is the option of user assembly of hardware-accelerated applications without programming and developer tools, based on the partial dynamic reconfiguration principle. All the modules created work at transfer rates up to 10 Gbps. The MTPP40 version uses fixed firmware, supporting rates up to 43 Gbps. A module for bit error testing (BERT) is available. The versatile concept of the MTPP platform, initially intended for monitoring, has made it possible to modify it for other types of applications too. The MVTP (Modular Video Transport Platform) has been the most successful: it allows the transmission of up to eight high-definition (HD) image channels via a packet network across any distance. The image channels can be used in combinations for stereophotographic (3D) transmissions or very high definitions up to 4K (4096x2160). During the research plan, CESNET also paid attention to building time services. Since 2009, we have dealt with accurate time transmission (in the metrological sense) in the full optical network environment. We have designed and built our own adaptors, capable of transmitting time at accuracies better than 1 ns over a distance of approx. 1000 km. We have authenticated the method in experimental operation between the Czech and Austrian national reference laboratories for time (IPE ASCR in Prague and BEV in Vienna). The research results are protected with utility models and patents.

AAI and Mobility

CESNET's key achievements include the establishment and rapid development of the *eduroam.cz* (www.eduroam.cz) project, promoting user mobility. Access to the network connectivity in over 460 sites in the Czech Republic is provided by 35 involved organisations. The participation of the *eduroam.cz* infrastructure in the international *eduroam* project makes it possible for Czech users to access the Internet via our partners' networks across Europe and in many other academic networks around the world.

The use of users' home identities for accessing services run by other institutions is made possible by the national academic federation of identities *eduID.cz* (www.eduID.cz), founded by the Association in 2008. During the project period, we built a full-fledged federation based on SAML standards. Users in 18 academic institutions can now make use of over 30 facilities offered by both academic and commercial providers (e.g., digital content providers such as EBSCO, Elsevier, IEEE, Ovid, Thomson Reuters, or licensed software providers such as Microsoft). The Association provides connection with federations outside the CR by means of the *eduGAIN* project, developed under *GN3*.

CESNET was an active co-creator of the *TERENA SCS* (Server Certificate Service) project and the successor *TCS* (TERENA Certificate Service), providing X.509 certificates for servers and users issued by recognised commercial certification authorities. Czech academic institutions were issued nearly two thousand *TCS* certificates in December 2010. During the research plan, we also provided our users with the services of the *CESNET CA* certification authority (pki.cesnet.cz). It issued nearly four thousand certificates largely for grid users and grid service administrators.

MetaCentrum

Throughout the duration of the research plan, the task of the *MetaCentrum* was to run and further develop the national distributed computing infrastructure - the national grid - and integrate it into the analogous European infrastructure. The total computing capacity consists of a combination of own sources and computing systems provided by partners, notably the SCB at the Masaryk University, Charles University CCC, and the CICT of the University of West Bohemia in Plzeň. However, other systems were successfully connected to the national grid during the project, such as the JČU, MZLU, UTB. The entire computing capacity and related storage space was available to the students, academic and other researchers of the universities, Academy of Sciences institutes and other research organisations free of any charges. The scientific results achieved using the *MetaCentrum* resources are summed up in its yearbooks.

Since 2006, the *MetaCentrum* has been promoting the concept of virtualising the computing and storage infrastructure as a tool for solving previously unmanageable problems, especially the capacity to satisfy users' contrary requirements. The *MetaCentrum* was among the pioneers of federalised accesses for authentication in a distributed environment. At the same time, it was a major partner to pan-European grid infrastructure projects throughout the research plan. In the *EGEE* project series (2004-2010), the *MetaCentrum* manager held the office of Member of the Project Management Board, representing all of Central Europe. He was also the Chairman of the Board for one term. The *MetaCentrum* was also involved in other projects under the 7th EU Framework Programme, such as the *EPIKH* and *EUAsiaGrid*, but co-ordinating the key project *EGI_DS* (European Grid Initiative Design Study) was its most important international activity. The latter project designed the organisational and functional structure of the future pan-European grid infrastructure, which is currently being implemented under *EGI InSPIRE*, in which the *MetaCentrum* is again involved as a partner. In 2009, CESNET Association was charged with acting at the international level as a representative of the National Grid Initiative (NGI); the representation is again effected by the *MetaCentrum*.

Multimedia Transfers and Collaborative Environments

In that sphere, CESNET pursued both research and development tasks and building of the relevant infrastructure for the connected institutions. The infrastructure includes an IP telephonic network covering almost all of the Association members, a video conferencing infrastructure with an element for multi-point conferences and over sixty registered hardware devices in the institutions, a web conferencing system, and a high-capacity multi-format storage/archive for audiovisual files along with a streaming farm and a search engine for audiovisual files on the Internet. The communications infrastructure is not limited to the Czech Republic; it is connected to partners abroad.

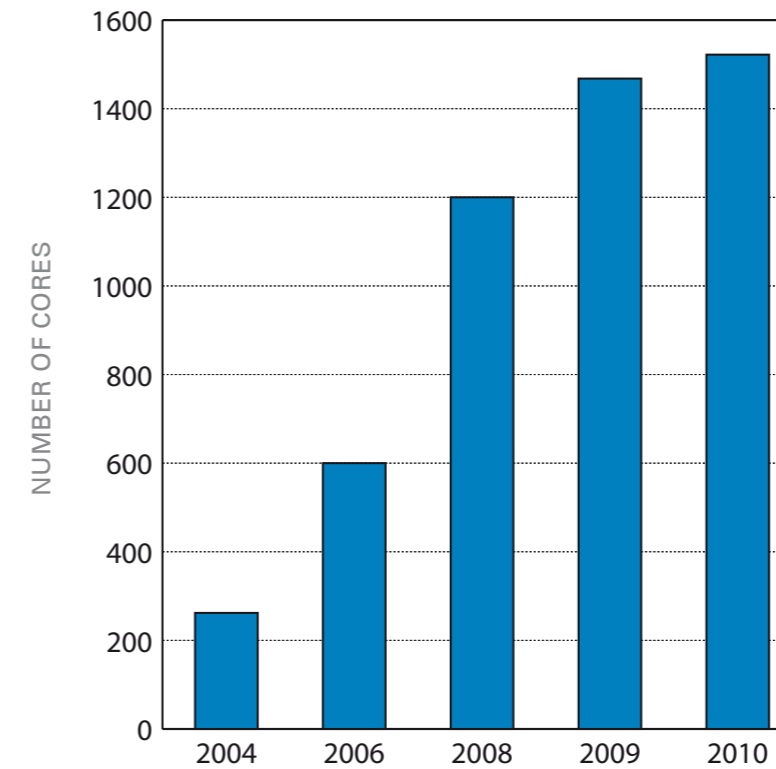


Fig. 4 – Number of cores available in the MetaCentrum

The research and development work in IP telephony resulted in an analytical model of delay behaviour in RTP flow routers and a description of the effect of network security on the quality of calls, proving the relationships between encoding and speech quality. Security is an important area; CESNET designed and implemented in the Asterisk open software exchange a method of antispam protection for IP telephony and an application for security analysis of IP telephony elements (penetration tests), which makes it possible to verify the degree of security of SIP elements. Our successes in special transmission systems include the development of parallel and distributed *RUM2* active elements allowing user-controlled network data distribution and processing, and the *UltraGrid* system for transmission of uncompressed HD and post-HD (2K, 4K) video. CESNET was able to execute transmissions of high-quality video in medical care (*Live Surgery* operating theatre transmissions), thus bringing new communication and education opportunities. The creation of several prototypes for distributed collaboration on film and television postproduction of multimedia content, the establishment of the *PragueMedia.Net* network and the involvement in the *CineGrid* intensified the Association's collaboration with the film industry and arts colleges on processing high-definition (4K, 3D HD), maximum-quality content.

CESNET CSIRT

CESNET did not ignore security aspects of network and service operation, notably the security incident area: incident resolution, detection and prevention. The Association set up an official CSIRT (Computer Security Incident Response Team) called the *CESNET-CERTS* (csirt.cesnet.cz), charged with resolving and co-ordinating the resolution of security incidents coming from CESNET2. The global community of CERT/CSIRT teams formally admitted the *CESNET-CERTS* in January 2004, and it was accredited by Trusted Introducer in January 2008, becoming a valid member of the global security community.

The *CESNET-CERTS* team is the first formally constituted CSIRT-type team in the Czech Republic. It receives reports of several thousand security incidents every year, and the trend of the successfully resolved ones has been improving thanks to the continuously improving work of network and service administrators.

Another success is the several de facto CSIRT teams established at large universities. One of them, the Masaryk University team, has also become involved in the global community collaboration and has been officially accredited.

Another aspect worth mentioning is the advanced team environment, which, in addition to rules, policies and recommendations, also includes tools for automatic detection of suspicious activities in the *CESNET2* network (such as IDS-based systems), tools for checking server and workstation security (*CESNET Audit System*), a system for monitoring the entire life cycle of a security incident, and more.

In 2007, the Association made use of its experience gained in building the *CESNET-CERTS* team and its collaboration with the global security infrastructure in building the *CSIRT.CZ* pilot workplace as part of the *Cybernetic Threat Issues from the Perspective of Czech Security Interests* grant project, funded by the Ministry of the Interior.

Application Support

Besides its own activities, the Association also provides direct support to projects run by *CESNET2* users, often as part of major projects in a pan-European or global context. Three large thematic areas from which the Association's leading partners have been recruited have profiled themselves over time: medicine, physics, and information technologies, with projects within the European scheme Future Internet play an important role. The supported groups share the need for specific network environment such as reserved connections at high speed, low latency, high degree of security, and so on.

In medicine, *CESNET* supported several projects throughout the research period: *POSN*, *MeDiMed/ReDiMed*, *Global Medicus*, *Cooperative 3D Model*, and *Video Surgery*. The transmission of 3D video of operations performed by the Da Vinci robot made a highly visible international appearance in 2010. It combines several prominent results of the research plan, high-speed transmissions with applied research in FPGA and latest medical imaging. The Association sees its practical application chiefly in the area of modern education for top surgeons.

In physics, the Association provided its support to the physicists' community as a whole. The greatest support was the provision of exclusive connectivity at the national and international levels. In addition to the high IP connectivity standard towards the *GÉANT* European academic backbone, *CESNET* provides the physicists' community with several reserved end-to-end (E2E) connections with data and computing centres around the world.

The information technology sphere included projects such as *PlanetLab*, *VINI*, *C2C* (Cave-to-Cave) and more. We also collaborated on new European projects such as *FEDERICA*.

INTERNATIONAL COOPERATION

GN3 Project

Since its establishment, the *CESNET* Association has been actively participating in the construction of a European infrastructure interconnecting research and education networks (NREN) of individual European countries with high-speed links. Between April 2009 and March 2013, it does so within the project *Multi-Gigabit European Research and Education Network and Associated Services*, also known under the acronym *GN3*. Unlike its predecessor *GN2*, focusing on building a hybrid network that is now the foundation for the *GÉANT* infrastructure (see Fig. 5), *GN3* focuses on provision of advanced communications services for NREN users. The project, part of the 7th EU Framework Programme, is run by a consortium of 34 partners: DANTE, TERENA and 32 European national research networks (NREN).

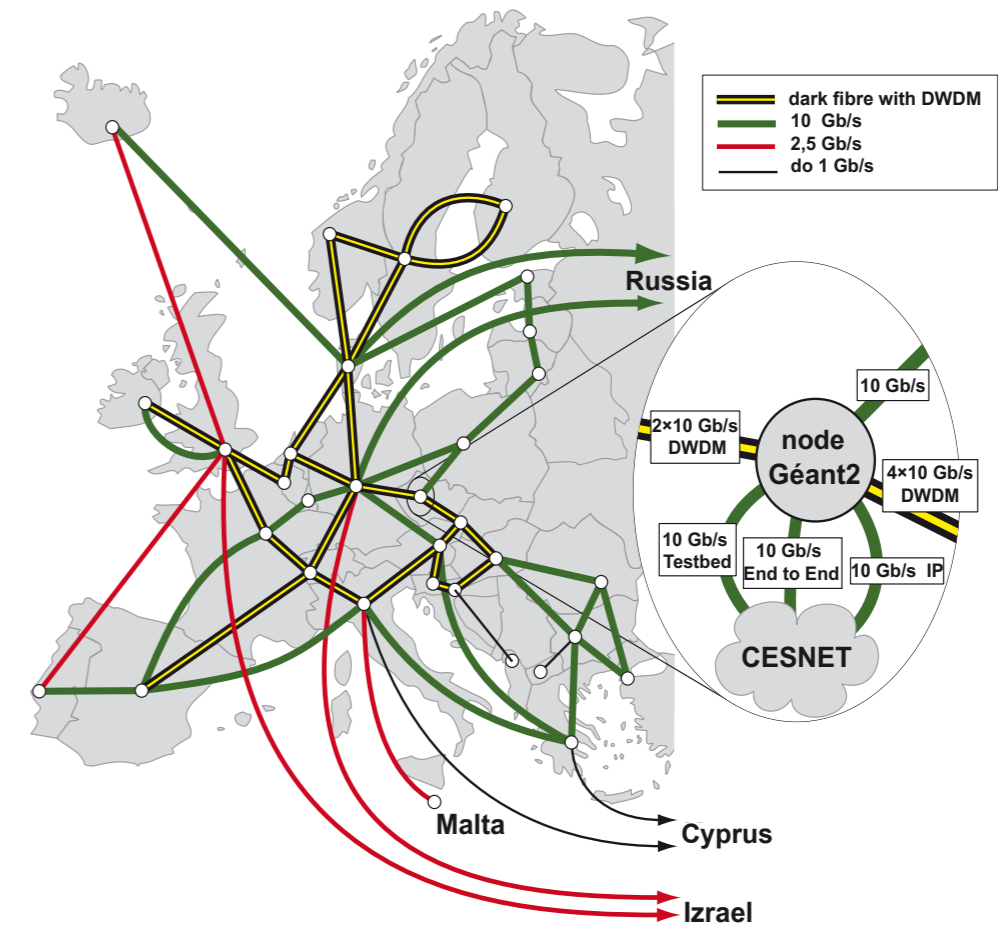


Fig. 5 – *GÉANT* network topology at the end of 2010

The *GÉANT* network currently makes its services available to about 40 million users in over 3500 institutions in 38 European countries. In addition to basic IP communications, the hybrid network also supports (for the needs of specific projects) guaranteed service quality transmissions, creation of temporary special-purpose infrastructures (grids) or point-to-point connections, based both on virtual private networks and reserved wavelengths (so-called lambda-services). Additional services available within the *GÉANT* network include the eduroam roaming system, a federalised PERT (Performance Enhancement Response Team), providing services in optimisation of network performance characteristics, as well as an identity provider facility, co-ordination of security incident resolution, and linking of European NREN with similar networks on other continents via the *GÉANT*.

CESNET is intensely involved in all the project components: we participate in the co-ordination activities as well as those dealing with research and development of services and applications in the sphere of advanced information and communications technologies, and activities dealing with practical implementation of those results.

The *CESNET* Association plays an important role in executing the project; apart from the intense involvement of its experts, this is attested by the fact that Ing. Jan Gruntorád, CSc., the Association Director, is one of the nine members of the project Executive Committee. See www.geant.net for more detailed information.

ORIENT

A project for implementing a connection of the GN2 network with Chinese research and education networks (CERNET and CSTNET), named *ORIENT*, was launched in October 2005. In addition to CESNET, the project involved six other European NREN and DANTE. CESNET's input in the project consists in its experience with monitoring large networks. The project was extended by a year at the end of 2009. In late 2010, CESNET was involved in preparation of another four-year project, *ORIENTPlus*, the objective of which should be to enhance the existing capacity and support demanding applications for scientific collaboration between Europe and China. See www.dante.net for more detailed information.

GLIF

Global Lambda Integrated Facility (GLIF) is an international research activity involving the most advanced institutions and consortiums engaged in the network research and application in Europe, North and South America, Asia and Australia. Individual *GLIF* participants enable other participants to use certain resources so that collective experiments can be carried out.

This environment differs from common infrastructures in that the participants' resources are used for constructing testbeds and performing experiments and demonstrations, which are not yet possible in the standard network, for example due to the risk of network destruction. This helps determine in which direction the research and commercial networks, their services and applications should be developed. See www.glif.is for more detailed information.

FEDERICA and other related projects

The *FEDERICA (Federated E-infrastructure Dedicated to European Researchers Innovating in Computing Network Architectures)* is the most momentous new-generation Internet project. The European project, involving 23 partners, was launched in January 2008 and concluded in October 2010. Although the project was not particularly big in financial terms, its importance grew a lot.

The project was included among the *FIRE (Future Internet Research and Experimentation)* group of projects, which are regarded as the European analogy of the American *GENI (Global Environment for Network Innovations)*, and responded to the current tendencies of virtualising information technologies. The project objective was to build an experimental network (see Fig. 6) at several levels, based on virtual principles, resting on the GÉANT physical infrastructure, existing national research and education networks and their newly created links. The *FEDERICA* environment has been operational since November 2008 and is designed for European researchers who need to test new computer network architectures, experiment with new drafts of communication protocols in these networks, including the option to verify destructive behaviour of some of their elements, and thus study means of avoiding such situations.

CESNET was one of the founders of the project and played an important role in it. It was involved in the design of the general network concept and development of resources for monitoring virtual infrastructures. See www.fp7-federica.eu for more detailed information.

Additional projects, linked to *FEDERICA* in some ways, were only developed in 2010 based on the users' needs. *PlanetLab* is the first laboratory that set changing the Internet as one of its objectives. It was set up in 2002 as a consortium of several American universities, and was joined by other universities from all around the world over time. Prominent research workplaces in IT companies have become its members. Today, it is a unique network with the status of a world-wide laboratory for network applications. It has over 1100 nodes distributed in more than 500 locations in every part of the world. CESNET joined the consortium in June 2006. At present, CESNET has four nodes in the *PlanetLab* network (two in the original planet-lab.org and two in the new planet-lab.eu). A fifth node in the Czech Republic is a computer at the Technical University in Brno, Faculty of Information Technologies. However, that computer too works under a licence awarded by CESNET. CESNET has the right to use ten virtual instances in planet-lab.org and five instances in planet-lab.eu.

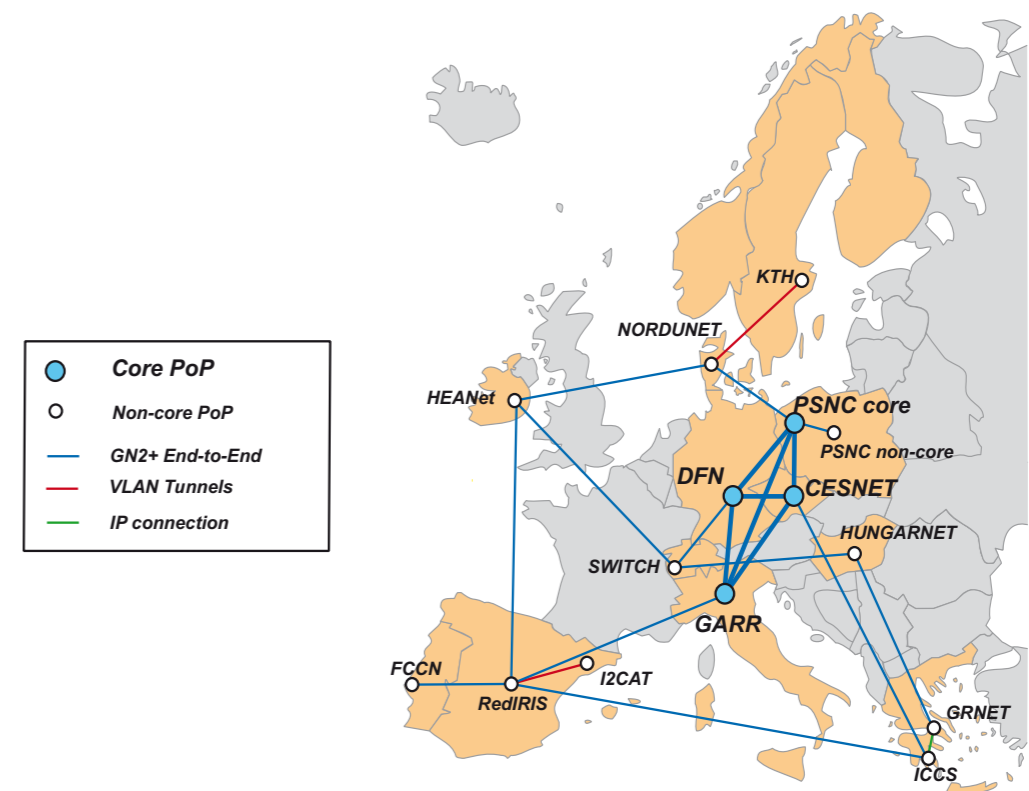


Fig. 6 – Diagram of the FEDERICA experimental network

A similar shared operation mode has been employed in the *VINI* project, a certain modification of the *PlanetLab* network using dedicated connections. In this respect, the project is analogous to *FEDERICA*. CESNET is the only foreign organisation involved in the purely American project. The Association's objective was to make a kind of bridge among European partners dealing with similar projects. It became evident, though, that the issue of connecting and federalising is not only a technical one but a political one as well. The Association will therefore probably have to cut down on the *VINI* project, as it was dependent on a link to the USA, which had to be cancelled temporarily. For more information, see www.planet-lab.org, www.planet-lab.eu, and www.vini-veritas.net.

INTERNATIONAL GRID PROJECTS

The year 2010 was a milestone in terms of the Association's involvement in international projects focusing on grids and middleware development. Until late April, we continued the *EGEE-III* project, crowning the series of projects under the first stage of building and operating the pan-European grid infrastructure, co-ordinated by CERN. Another project that concluded by the end of the first half was *EUAsiaGrid*, one of the accompanying projects of *EGEE*, focusing on the Asia Pacific region.

Two large international projects in direct follow-up on *EGEE III* were formally launched in May 2010. The responsibility for operating and further developing the pan-European grid infrastructure shifted to *EGI InSPIRE (Integrated Sustainable Pan-European Infrastructure for Researchers in Europe)*, whereas continuing development of grid middleware is the charge of *EMI (European Middleware Initiative)*. The *EGI InSPIRE* project is scheduled for four years; *EMI* for three years and a half.

EGI InSPIRE

The primary partners for *EGI-InSPIRE* are the national grid infrastructures. It involves practically all European countries, Russia, Southeast Asian countries and the US; the international organizations CERN and EMBO are also official partners. The project co-ordinator is *EGI.eu*, an organization established in Amsterdam in February 2010 and controlled by a consortium of NGI (national grid infrastructures). The Czech Republic, represented by CESNET, is part of the Central European group, which elected Prof. RNDr. Luděk Matyska, CSc., the Association representative, as a member of *EGI InSPIRE* Executive Committee.

EMI

Under the closely related *EMI* project, the Association continues developing grid middleware, specifically the *Logging and Bookkeeping* service, as well as certain components associated with operational security. The *EMI* project is co-ordinated by CERN; it associates representatives of three most important grid middleware systems being developed in Europe – *ARC*, *gLite* and *UNICORE*. The aim of the project is to make and further develop a consolidated set of middleware components designed for the *EGI* grid, *PRACE* and possibly also other DCI (*Distributed Computing Infrastructures*). See www.egi.eu and www.eu-emi.eu for more information.

CHAIN

Another related grid project in which CESNET is involved was launched in December 2010. The objective of the *CHAIN* (*Co-ordination and Harmonisation of Advanced e-Infrastructures*) project is to connect regional grid infrastructures with the *EGI* grid. Here, regions refer to areas outside Europe, such as Asia, Latin America and Africa. The EU has supported the development of *EGI*-compatible infrastructures in all those regions as separate projects (including the *EUAsiaGrid*, for instance). Under the *CHAIN* project, the activities will be integrated and co-ordinated at a higher level in order to ensure truly global, boundary-free co-operation of scientific teams making use of distributed computing infrastructure. See www.chain-project.eu for more information.

WORKGROUPS WITHIN THE TERENA ASSOCIATION

TERENA (*Trans-European Research and Education Networking Association*) associates 39 European NREN, the international organisations CERN and ESA and nine affiliated members (primarily manufacturers of network and computing equipment) with the aim of providing its members with a platform for collaboration and knowledge sharing in order to support the development of technologies, infrastructures and services designed for the European academic community.

Expert working groups (known as Task Forces, TF) are one of the most commonly used platforms for collaboration; they are set up based on current common needs of the European academic infrastructures and associate NREN experts interested in the issues in question. In 2010, CESNET was involved in the work of the following task forces:

TF-CSIRT (Computer Security Incident Response Team) – deals with co-ordinating network security incident resolution and prevention

TF-EMC2 (European Middleware Coordination and Collaboration) – a platform for co-ordination and co-operation in identity management and application and service middleware development

TF-Mobility and Network Middleware – the objective is to develop and deploy mobile technologies and utilise network middleware for supporting interoperable roaming services within academic networks; it has resulted in the *eduroam* roaming system

TF-CPR (Communications and Public Relations) – set up in order to exchange information and co-ordinate procedures associated with presenting national research network activities and results to the public

TF-Media (Media Management and Distribution) – the main aim is to collect and exchange ideas, knowledge and experience concerning technical, administrative as well as legal aspects of internet multimedia creation, its management as well as distribution of related work procedures in the European area

TF-Storage – working group comprehensively dealing with implementing data storage facilities in the academic network environment

TF-NOC (Network Operation Center) – this group deals with issues of supervision centres for national research and education networks

In addition, CESNET organized the 3rd *TERENA End-to-End Provisioning Workshop*, the last of the meetings of providers of so-called end-to-end services, in November 2010. The periodic meetings were a discussion forum for representatives of national research and education networks as well as administrators of metropolitan, college and local network infrastructures, who could share their experience with the generation and provision of end-to-end services, intended mostly for universities and research laboratories all over Europe.

NATIONAL RESEARCH PROJECTS

In addition to the research plan and international projects, the CESNET Association with its members also work on research tasks within the national research and education support.

Cybernetic Threat Issues from the Perspective of Czech Security Interests

Along with the Charles University Faculties of Mathematics and Physics, Philosophy and Science, the CTU Faculty of Electrical Engineering, the ASCR Institute of Social Sciences, and NESS Czech, s. r. o., the CESNET Association has been involved in the project *Cybernetic Threat Issues from the Perspective of Czech Security Interests*, financed by the Ministry of the Interior, since 2007. Under this grant project, CESNET is involved in solving the component task to “*design and implement a distributed hierarchy for systemic areal handling of security issues by means of CSIRT teams*”, which has resulted in the establishment and operation of the pilot workplace *CSIRT.CZ*. *CSIRT.CZ* was put into pilot operation on 3 April 2008 and is staffed by members of *CESNET-CERTS*. Although the grant project *Cybernetic Threat Issues from the Perspective of Czech Security Interests* ended on 31 December 2010, *CSIRT.CZ* is going to continue operation as the official, government-promulgated *National CSIRT of the Czech Republic*.

Processing signals in real time using parametric effects in fibres with high non-linear refraction index

In January 2010, CESNET and the Institute of Photonics and Electronics of the ASCR launched the two-years project *Processing signals in real time using parametric effects in fibres with high non-linear refraction index*, supported by the Czech Science Foundation. The project examines parametric effects in optical fibres with high non-linear refraction index, which may offer broad application opportunities in processing superfast optical signals. Examples may include parametric amplification in the area of wavelengths where amplifiers with fibres enhanced with precious earth elements cannot be used, multiple conversion of wavelengths of high-speed modulated signals with optical amplification, signal regeneration or demultiplexing of high-speed optical time division multiplexed (OTDM) signals (at bit rates of 100 Gbps and higher) to tributary flows of the 10 Gbps order. Project researchers focus primarily on amplification of wave multiplexed signals in double-pump (FOPA) amplifiers and examining transition effects in parametric amplifiers when changing the number of signals amplified.

DEVELOPMENT FUND

In 2010, the Development Fund Council announced a selection procedure for new projects in the following thematic areas:

- utilization of services of the CESNET2 network and modern information and communications technologies within the tuition and education process, creative and scientific research activities and management of public universities and the Academy of Sciences of the Czech Republic
- advanced applications utilizing the high-speed backbone network
- support to research into network services and applications

A total of 29 projects were registered; 22 were admitted for co-funding, including six that were admitted after being reworked. The allowance to one project from the Development Fund was lower than the requested sum.

In 2010 there were two rounds of examination procedures for completed projects: 28 projects were successfully completed in total, including two that were presented within the examination procedures. Completion of final documentation was requested for several projects. Final reports for projects implemented within the CESNET Development Fund are available on the Association's website.

The computerisation of activities related to project appraisal continued in 2010. A system for electronic processing of forms for initial and final project appraisal was implemented and put into routine operation. The system was drawn up for the purposes of informers and appraisal boards.

Attendees at workshops for CESNET research plan executors and attendees at meetings of the VIC Managers' Club were periodically informed about the work of the Development Fund and the projects executed under the Development Fund. Results of some projects were presented at workshops for entities working on the CESNET's research plan, at professional seminars for the Association members as well as at international conferences. Outcomes of the projects were also presented in the form of publications in professional journals.

Project Number	Project Executor	Project title
367/2010	Masaryk University	Equipment of basic network technology laboratory
368R1/2010	AS CR	Implementation of IPv6 protocol in networks of ASCR institutes in Brno
369/2010	University of West Bohemia in Plzeň	Improving the process of security incident resolution in WEBnet
370R1/2010	University of West Bohemia in Plzeň	Use of energy-efficient PCs in UWB academic environment
371R1/2010	University of West Bohemia in Plzeň	Presenting the IT service status to users
373/2010	University of West Bohemia in Plzeň	Opportunities for deployment of MacOS in the university environment
374/2010	University of West Bohemia in Plzeň	Integration of the IS/STAG study agenda and the Theses.cz system
375R1/2010	Technical University in Brno	Virtualisation of the network service centre servers
376/2010	VŠB-TUO	Development of an application for searching contacts in a corporate directory based on the CAP platform
377/2010	AS CR	Upgrading of ITAM ASCR data connection
379/2010	Technical University in Brno	Deployment of software for central management of network elements and a system for bulk installation of end stations
380R1/2010	University of Pardubice	Deploying PKI with safe carriers of personal electronic certificates
382/2010	Czech Technical University in Prague	Building PKI infrastructure for full-fledged deployment of IPv6 at CTU Faculty of Civil Engineering
383/2010	PU	Deployment of IPv6 protocol in the main backbone infrastructure at PU
384/2010	Academy of Performing Arts in Prague	Remote access to acoustic voice analysis, evaluation of high-speed optical methods
385R1/2010	Czech Technical University in Prague	SIP teleconferencing using a web browser
386/2010	Czech Technical University in Prague	Choosing a platform for application testing in 10 Gbps networks
387/2010	AS CR	System for efficient measurement and transfer of high-capacity multispectral image data
390/2010	Czech Technical University in Prague	Experimental computing grid for numeric linear algebra
392/2010	AS CR	Employment of DWDM network for time and frequency transmission
393/2010	DUNI	Implementing the Eduroam roaming system at the Defence University
394/2010	Mendel University of Agriculture and Forestry in Brno	Preparation for implementation of IPv6 protocol in the computer network infrastructure at Mendel University in Brno

CESNET and the
Austrian network
ACOnet performed
an experiment focusing
on comparing

CHAPTER **CESNET2 NETWORK**

the times of atomic
clocks in Prague
and Vienna using
an optical link

(April 2010)

CESNET2 NETWORK

The CESNET Association has been building and developing a national high-speed computer network for scientific, research and education purposes – CESNET2. Its purpose is twofold: it is used for testing components and systems developed by CESNET, but primarily it is utilised by connected organisations for data communications related to their own activities in research, development and education. It underwent radical evolution during the seven years of the research plan *Optical National Research Network and Its New Applications*. The figures below show a comparison of the CESNET2 network topology at the start and end of the research plan.

The increased transfer capacity as well as network „coverage“ compared to the initial state are obvious. However, quantitative parameters are by far not the only change in the communications backbone. It is worth mentioning that, concerning the lower layers, some of the routes to the smaller nodes were still wireless in early 2004. Seven years later, the overwhelming majority of the backbone infrastructure was optical, meaning higher transfer rates and error rates lower by an order of magnitude.

A gradual shift towards the DWDM technology also began in 2004: a principal change in the nature of the network and its services. When the research plan started, the key routes of the backbone network were using the PoS STM-16/OC-48 transfer technology or gigabit Ethernet. Their transfer rates of 2.5 Gbps and 1 Gbps respectively were sufficient to cover the needs, but the conflicts between the experimental and operational backbone elements were a problem. The effort to provide connected institutions with reliable transfer services was limiting the usability of the network for experimental purposes.

CESNET linked the major nodes - Prague and Brno - with the first DWDM route in late 2004. The DWDM ring Prague-Brno-Olomouc-Hradec Králové-Prague was completed the following year, and more and more cities followed to form the present-day richly branching DWDM network (see Fig. 3). In addition to the commercial Cisco ONS 15454 systems, situated at the core of the network on routes totalling 1410 km, the network features *CzechLight* components of our own design, covering 2660 km of routes. The total length of the DWDM infrastructure is thus over 4000 km.

Using DWDM, several totally independent signals can be transferred along a single optical fibre. That makes it possible to perfectly separate the experimental operation from the routine one, and the large number of separate (albeit virtual) connections offers new types of services - reserved routes on request, used for transmitting exceptional volumes of data in experiments, for example. Numerous changes also took place in the higher layers of the network architecture. From the user perspective, the most attractive advance was the backbone capacity for creating virtual private networks and providing services at a defined quality (QoS). CESNET substantially improved its support to the new Internet protocol IPv6. From the original software routing, it shifted to the 6PE technology, which provides the new protocol with services fully comparable to the current IPv4, and then added full support to group routing (IPv6 multicast).

The robustness and dependability of the services provided was given great care. The backbone nodes are linked with at least two independent circuits; the Association proceeded to separate them physically in two different locations in the major nodes in Prague and Brno. The crucial equipment elements are also internally redundant, and their key components (controlling processors, power supplies, etc.) are doubled. The years of efforts have resulted in a network with a unique supply of services, high reliability (the average accessibility of all its nodes exceeds 99.99%; it is 100% in the backbone nodes), and a potential for further development.

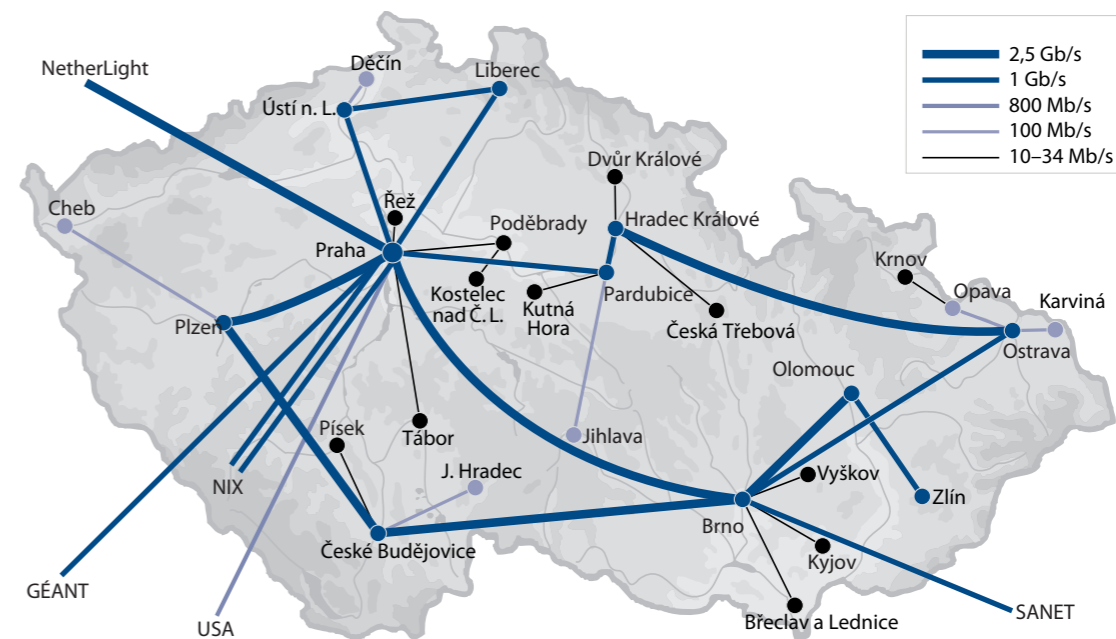


Fig. 7 – CESNET2 Network Topology in January 2004

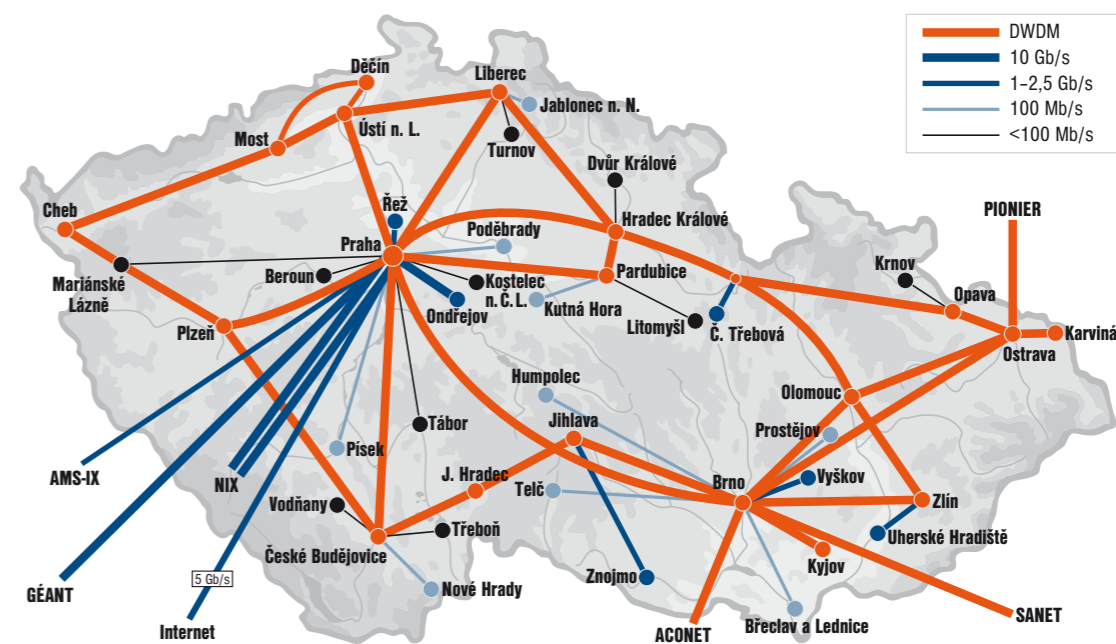


Fig. 8 – CESNET2 Network Topology in December 2010

CESNET hosted
the Fifth General
Assembly of the
international project
FEDERICA, dealing

CHAPTER **PUBLIC RELATIONS**

with experiments
focused on the future
of the Internet

(March 2010)

PUBLIC RELATIONS



Photo 1 – The sixth CEF Networks workshop



Photo 2 – Grid Computing Seminar



Photo 3 – Remote Network Collaboration seminar



Photo 3a – Remote Network Collaboration seminar

In 2010, the Association not only continued to highlight its research activities, confirming its position as an innovator in information and communications technologies, but also actively presented the openness of the CESNET2 network for research entities in the Czech Republic.

The Association organized eight national and international events in 2010, including the most prestigious sixth *CEF (Customer Empowered Fibre) Networks workshop* (see Photo 1). Sixty experts from Europe, North and South America, Africa and Australia met on 13 and 14 September to share their experience with designing and operating optical fibre networks built by users. Recordings of the speeches, including the presentations, are available on the Association's website.

The *Grid Computing Seminar* on 15 October (see Photo 2) was very popular; its primary objective was to inform existing as well as new potential users of high-performance computing on current options available for solving a wide range of research problems and challenges at the national and international levels. In co-operation with the Academy of Sciences of the Czech Republic, the Association held the *Federation of Identities* seminar on 13 October; it provided attendees with information on the principles of the federation of identities, functioning of the federation components, administrative processes associated with the federation of identities, and last but not least, services available in the federation. The *Remote Network Collaboration* seminar in December (see Photos 3 and 3a) for the scientific, research and education communities focused on the multimedia collaboration environment. The broadly defined area comprises mostly voice and image transmission using various techniques and devices, from IP telephony to uncompressed high-definition video. The seminar was a follow-up on successful events in previous years; it also dealt with the important network security issues. IP telephony was also the subject of the international *IPT Workshop* (see Photos 4 and 4a), held by the Association on 29 and 30 April under the auspices of the GÉANT project. The meeting focused on the migration processes within IP telephony, the effectiveness of the use of new IP telephony technologies, launching new applications, and security aspects.

The Association hosted three other international meetings in 2010. From 1 to 3 March, it hosted the *Fifth General Assembly of the European Project FEDERICA*, the aim of which is to develop an experimental testing environment for testing new network technologies. In the Ruzyně Airport Congress Hall on 16 March, the Association organized a meeting of the *NREN Policy Committee*, consisting of appointed representatives of all the GN3 project partners. The Committee makes strategic and conceptual decisions concerning the GN3 project, and elects an Executive Committee of five, charged with operative management of the project. On 29-30 November, the Association hosted the *3rd TERENA End-to-End Provisioning Workshop* (see Photo 5): a discussion forum for representatives of national networks for research and education, such as CESNET2 in the Czech Republic, as well as metropolitan, college and local network infrastructures, who can share their experience with the generation and provision of end-to-end services, intended mostly for universities and research laboratories all over Europe.

One of the important presentation forms of the Association is the provision of direct transmission of significant professional as well as popular educational events. As is the tradition in January, the Association was involved in producing the video conference for the ophthalmologists' meeting *Live a Video Surgery 2010*, where live video transmissions of several eye surgeries gave insight in the operating field and the surgeon's commentary. The Association produced the video transmission of a mini-invasive thyroid operation for the attendees of the international medical discussion forum *Střešovice Spring 2010*. A HD transmission between the ORL Clinic of CU 3MF and the Central Military Hospital in Prague was produced on 4 March. Our 3D Full HD transmissions of robotic operations are very attractive to the media. The first such transmission took place on 10 June last year; images from the surgery room at Masaryk Hospital in Ústí nad Labem travelled to the Prague CESNET headquarters. Another one was made on 19 October, when both image and sound from Masaryk Hospital in Ústí nad Labem were transmitted to the *5th International Congress on Mini-Invasive and Robotic Surgery in Brno* (see Photo 6).



Photo 4 – IPT Workshop



Photo 4a – IPT Workshop



Photo 5 – Third TERENA End-to-End Provisioning Workshop



Photo 6 – Fifth International Congress on Mini-Invasive and Robotic Surgery

The most demanding 3D Full HD transmission of a robotic operation was made in November, again from Masaryk Hospital in Ústí nad Labem; this time to the computing centre of KEK – High Energy Accelerator Research Organization in Tsukuba, Japan (see Photo 7). In November, the Association became one of the co-organisers of the tenth year of the *Science and Technology Week*, taking part in transmission of selected expert lectures. The lecture on *Safely through the Internet World* was given by Andrea Kropáčová (see Photo 8).

Results of the Association's research activities were published in conventional and electronic versions of professional journals. The Association issued 21 press releases in 2010, informing on events important from its perspective. The quality of the content of the press releases is confirmed by the fact that most of them were adopted by at least one conventional or electronic professional journal. Three issues of the *Datagram* journal were published during the year; one special issue was dedicated to announcing the request to submit projects for the *Development Fund of the CESNET Association*. The fourth year of the selected technical report anthology *Networking Studies 2010* was published. Both *Datagram* and the anthology were distributed in the print form, but are also downloadable in PDF from the Association's website.

It is gratifying that the Association again managed to penetrate the mass media - radio and television - in 2010. In connection to the 18th anniversary of introducing the Internet to the Czech Republic, TV Nova dealt with the history of the Internet in one of its reports in *Víkend* on 11 January; Jan Gruntorád appeared in it. The interview with Tomáš Košnar, broadcast by Czech Radio Leonardo in *Monitor* on 12 February, dealt with the same topic.

In the international sphere, the Association continued its active involvement in the TF-CPR group of TERENA and GÉANT2 PR Network group of DANTE.

The Association utilizes the feedback in the form of regular media monitoring and monthly analyses of these outputs. In 2010 there was another quantity increase in the activities representing the Association; however, the content of the messages communicated retains its high professional level and offers high information value despite the increasing quantity.



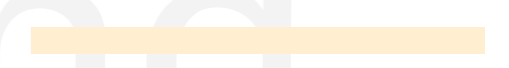
Photo 7 – 3D Full HD transmission from a robotic surgery



Photo 8 – Science and Technology Week

CESNET Association
experts involved in
a revolutionary simulation
of the Big Bang
(April 2010)

CHAPTER ECONOMIC RESULTS



ECONOMIC RESULTS

2010 Economic Results

Activities of the CESNET Association are divided into two categories in accordance with its statutes: main, and economic activities.

Main Activities

The seven-year research plan *Optical National Research Network and Its New Applications* was the most important component of our main activities in 2010; it had been launched on 1 January 2004. The Ministry of Education, Youth and Sports provided the research plan with institutional support (operating subsidy). The subsidy translated into 47% of the revenue from our main activities and was drawn in full.

Within its main activities, the Association continued developing the CESNET2 national research and education network, providing services for the Association members utilizing the CESNET2 network, and providing services for other entities meeting requirements for connection to the network. In addition, the Association was involved in execution of international research projects under the 7th EU Framework Programme, grant projects of the Academy of Sciences of the Czech Republic, Ministry of the Interior, and projects of the Development Fund Board, as referred to in the previous section of the Annual Report. Moreover, intense preparations for the *CESNET Large Infrastructure* and *eIGeR* projects were in progress.

The main activities of the Association ended in 2010 with a book loss of CZK 12,199,000. Revenues from the Association's main activities amounted to CZK 286,474,000; the expenditures were CZK 298,673,000. The basis of the income tax on the Association's main activities in 2010 was negative, amounting to CZK 747,000.

Economic Activity

The Association's economic activities in 2010 involved mainly management of the largely bond-based portfolio of the Development Fund comprising financial resources obtained by sale of the commercial part of the CESNET network in 2000 and management of financial resources in other funds.

The Association's economic activities ended in 2010 with a book profit of CZK 12,397,000. Revenues from the Association's economic activities in 2010 amounted to CZK 97,753,000; expenditures on the economic activities were CZK 85,356,000. The basis of the income tax on the Association's economic activities in 2010 was positive, amounting to CZK 12,815,000.

Total Book and Tax Economic Result

The total book economic result of the CESNET Association prior to taxation reported in 2010 was a profit amounting to CZK 198,000.

The total basis of income tax after deducting the items lowering the tax basis was CZK 11,815,000. The Association will pay the income tax of CZK 2,245,000 in 2010, resulting in a net loss of CZK 2,047,000.

Conclusion

The Association properly managed the entrusted resources in 2010, meeting all its obligations resulting from the legislation, decisions of the Ministry of Youth, Education and Sports of the Czech Republic, and concluded contracts. The financial statement for 2010 was verified by the auditor without any remarks.

BALANCE SHEET <i>in Thousands of CZK</i>	2010	2009	2008	2007
Assets total	649,539	754,621	753,947	734,438
Fixed Assets	459,849	524,013	525,680	535,043
Intangible fixed assets	3,623	3,064	4,369	3,949
Tangible fixed assets	137,150	206,780	208,788	220,715
Financial Investments	319,076	314,169	312,523	310,379
Current assets	189,690	230,608	228,267	199,395
Supplies	0	0	0	504
Receivables	19,042	25,879	36,086	35,139
Current liquid assets	144,003	160,692	158,078	128,070
Other assets	26,645	44,037	34,103	35,682

Liabilities total	649,539	754,621	753,947	734,438
Own resources	605,710	681,001	679,806	686,467
Funds	474,303	538,976	529,987	524,413
Economic result	-2,047	3,915	707	343
Undivided profit from last years	133,454	138,110	149,112	161,711
External resources	43,829	73,620	74,141	47,971
Obligations	41,321	70,980	70,923	46,315
Loans	0	0	0	0
Other liabilities	2,508	2,640	3,218	1,656

PROFIT AND LOSS STATEMENT <i>in Thousands of CZK</i>	2010	2009	2008	2007
Earnings for the sale of goods	20	23	44	23
Earnings of own product and services	102,050	105,437	100,946	99,567
Current liquid assets revenues	78,960	19,603	18,691	16,988
Other revenues	63,425	54,505	115,270	319,955
Received membership fees	0	0	0	0
Operation subsidies	139,771	186,688	193,720	182,828
Revenue total	384,226	366,256	428,671	619,361
Purchase price of sold goods	15	19	41	19
Material and energy consumption	15,274	17,416	23,006	15,244
Purchased services	149,385	191,555	178,318	171,417
Personnel costs	100,852	104,878	103,807	93,038
Depreciation and amortization of intangible and tangible fixed assets	24,926	30,902	40,262	46,065
Other costs	93,576	14,261	80,474	293,235
Income tax – assessment for the current year	2,245	3,310	2,056	0
Costs total	386,273	362,341	427,964	619,018

Economic result (revenue – costs)	-2,047	3,915	707	343
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R – audit, s. r. o.

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entered in the Commercial Register kept at the Municipal Court in Prague under Section C, Entry 20496 from 31 May 1993, auditor's certificate number 124

REPORT OF THE INDEPENDENT AUDITOR

Auditor's report for the members of the association of CESNET, Association of Legal Entities with its registered office at: Praha 6 – Dejvice, Zikova 4, Company Registration Number: 63 83 91 72

We have audited the accompanying financial statements of association CESNET, Association of Legal Entities which comprise the balance sheet as at 31 December 2010, a profit and loss statement and the appendix to these financial statements, including a description of the significant accounting policies used. Information about CESNET, Association of Legal Entities is specified in point 1 of the appendix to these financial statements.

The statutory body of CESNET, Association of Legal Entities is responsible for the presentation and the fair presentation of the financial statements in accordance with Czech accounting regulations. This responsibility includes: designing, implementing and maintaining internal control relevant to the preparation and fair presentation of financial statements that are free from material misstatement, whether due to fraud or error; selecting and applying appropriate accounting policies; and making accounting estimates that are reasonable in the circumstances.

Our responsibility is to express an opinion on these financial statements based on our audit.

We conducted our audit in accordance with Act No. 93/2009 Coll., the Act on Auditors, and International Standards on Auditing and the related application guidelines issued by the Chamber of Auditors of the Czech Republic. Those standards require that we comply with ethical requirements and plan and perform the audit to obtain reasonable assurance that the financial statements are free from material misstatement. An audit involves performing accounting procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The accounting procedures selected depend on the auditor's judgment, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of internal control. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion.

In our opinion, the financial statements give a true and fair view, in all material respects, of the assets, liabilities and financial position of CESNET, Association of Legal Entities as at 31 December 2010 and of its expenses, revenues, and income from operation for the accounting year that ended in accordance with Czech accounting regulations.

Date of issue of report:
In Prague on 2 June 2011

Auditing company: R – audit, s. r. o.
Chamber of Auditors of the Czech Republic certificate number 124
Company head office: Praha 5, Ostrovského 253/3

Responsible auditor: Ing. Radmila Špišková
Chamber of Auditors of the Czech Republic certificate number 1326

