2008 ANNUAL REPORT CESNET

2008 ANNUAL REPORT CESNET

*The photographs in the annual report that do not have individual descriptions were taken during the offsite seminar in which the CESNET research team for the project titled **International Optical Research Network and New Application**, participated and which was held on 6-8 April 2009 at the Skalský dvůr Hotel in Bystřice pod Pernštejnem.*
The photographs were taken by Pavel Satrapa and Martin Mašín.

C E S N E T
Association of Legal Entities
Zikova 4, 160 00 Prague 6

CONTENTS

CESNET is an association of 25 universities and the Academy of Sciences of the Czech Republic. The Association focuses on the **research and development** in the area of information and communication technologies, both on the national and the international level. 2008 was the **twelfth year** of the Association's continuous existence as well as the sixth year of works on the **research plan** named *The Optical National Research Network and Its New Applications*, which will be completed by CESNET in 2010.

History

The Association was founded in 1996 by all the universities in the Czech Republic, together with the Academy of Sciences of the Czech Republic ("Akademie věd České republiky" – hereinafter referred to as AV ČR). In 1996, when the Association received a grant for the *TEN-34 CZ Network Deployment* project from the Ministry of Youth, Education and Sport of the Czech Republic, the Association started building the academic backbone network of the Czech Republic at an entirely new level of quality.
The Association also operated as a commercial Internet provider, with the aim to gain sufficient resources from these activities for its main activity. From 1997, the Association operated two independent networks. The first one, *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. 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 operation of the science, research and education backbone network (National Research and Education Network – NREN – of the Czech Republic) and other related activities.
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. 2008 was therefore the fifth year of works on this 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 carry out the research and development in the area of information and communication technologies and their applications.
2. To secure the provision of education services within research and development, using the high-speed national research and education network.
3. To secure the following for its members and the 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 on a level comparable with prestigious education and research networks abroad (including Internet access).
4. To secure, 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 modern 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 most modern information technologies, and improvement of the quality of the network by gaining additional participants, information sources and services.

The Association ensures its activities within the scope of the institutional support gained, with subsidies and partial compensation of expenses related to these activities. The Association's objective is not to generate any profit.
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 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 ("Zásady pro přístup do sítě národního výzkumu a vzdělávání nové generace")*.
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. The key organization include:

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 goal of this project is to construct a network that will service applications with extreme transfer rate 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 endeavoring to develop and deploy new types of network technologies, services and applications. The CESNET Association has been an associate member of the consortium since 1999.

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

National Organizations

NIX.CZ – The Association CESNET is one of the founders of NIX.CZ, z.s.p.o. (Neutral Internet Exchange), an association of Internet service providers in the Czech Republic, offering the possibility of mutual interconnection of member networks. At the end of 2008, the association had 70 members.

CZ.NIC – The Association is also one of the founding members of CZ.NIC, z.s.p.o., an organization engaged in the domain registration, support of projects of general benefit and Internet-related activities. At the end of 2008, the association had 60 members.

Association Members

The following institutions were members of the Association in 2008:

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 in Brno
Masaryk University in Brno
Mendel University of Agriculture and Forestry in Brno
Academy of Performing Arts in Prague
Janáček Academy of Musical and Dramatic Arts in Brno
University of Pardubice
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 Ustí nad Labem
University of West Bohemia in Plzeň
Academy of Sciences of the Czech Republic
Tomáš Baťa University in Zlín
University of Defence

During 2008, the Association accepted no new members.

The professional members of the CESNET association met all of the key goals they set for 2008. They have provided confirmation of the fact that they are able to attain long-term results that meet acclaim on both the domestic as well as the international stage. The association's employees and partners organised several official expert meetings and participated in important research, development and awareness-raising projects. The results of their efforts have been praised even by independent experts.

Message from the Director

Over the course of 2008, i.e., the year that this Annual Report is looking back on, CESNET has attained all of the key goals that the association set for itself at the start of the year. Significant advances have been made in finding a solution with regard to the research objective titled *International Optical Research Network and New Applications*; several official professional conferences were organised successfully; and the association participated in important research, development and awareness-raising projects.

The results of the research objective achieved in 2008 were praised in the annual evaluation prepared by a peer review committee composed of independent experts. According to the peer review committee, we successfully maintained a high professional level for all of the individual tasks contained in our research objective. The independent experts praised several specific facts:

- According to them, the level of quality that has been attained for the CESNET2 national network is excellent and a number of the concepts that have been applied within its environment have been adopted by the international community;
- Research and development results are implemented in practice successfully;
- The problem-solving team is involved in relevant international projects within the specific area and, in addition, often plays an important role within these projects;
- The researchers present their results at numerous international fora and workshops;
- Systemic work with students within the framework of the research objective has brought a high level of success in the form of graduate theses that receive significant praise – in both national as well as international competitions.

At the start of 2008, the CESNET2 national research infrastructure that we are developing became one of the first wide-area optical networks in the world. In order to maximise transfer options, leading-edge dense wavelength division multiplexing (DWDM) technology was used. The implementation of Degree-4 ROADM equipment with three optical chassis makes it possible to use software to remotely switch individual wavelengths in the direction of the chassis that is connected without any manual intervention. Thanks to this solution, the CESNET2 network can support even "aggressive applications" that are characteristic of research projects, which are very demanding and require both a fast response time and high data transmission volumes whilst not limiting other standard applications. Last December saw yet another milestone in the history of the CESNET2 network, when we strengthened its backbone through the installation of a Cisco CRS-1 router – the highest performance router in the world. The new routing system ensures higher network stability and better access to network services; allows advanced network technologies to be used to a much higher degree; and will allow transfer speeds to be increased to as much as 40 to 100 Gb/s in the future.

The most prestigious professional meeting that we organised last year was the international Cesnet Conference 2008 that was held in September. Invitations were sent to leading experts from Europe, the United States and Taiwan. Within the framework of the two-day programme, we held a unique videoconference, during which we connected seven healthcare facilities located in various parts of the world all at once: three in Asia (two in Japan and one in Taiwan) and four in Europe (two in the Czech Republic, one in Italy and one in Spain).

The events of 2008 confirmed that we are able to attain results over the long-term, which receive acknowledgement on both the domestic as well as the international stage. Here is one example that can be used to speak for all: At the start of October, at the Eighth Annual Global LambdaGrid Workshop that was held in the United States city of Seattle, our experts presented a singular photonic multicast application. During the presentation, CESNET transmitted uncompressed HD video from the CESNET2 national network to the connecting node of the StarLight research network located in Chicago using a speed of more than 1Gb per second. In Chicago, this signal was split using CzechLight Multicast Switch (CLM) technology that was developed by our association's researchers and subsequently distributed to points in Seattle and San Diego as well as back to the CESNET2 network. This application consisted of the unique use of photonic multicast technology within extensive heterogeneous optical computer network (WAN) environments. This presentation, attended by approximately one hundred experts from around the entire world, was received with extraordinary acclaim.

At this point, I would like to thank all of my colleagues from the association and all those who work in partnership with us for their high level of dedication, the Ministry of Education, Youth and Sports of the Czech Republic, and all of the members of the association for their extremely high level of support, without which it would be impossible to attain our very demanding goals.

Jan Gruntorád
CESNET Director and member of the CESNET, z. s. p. o. Board of Directors

Internal Organizational Structure

CESNET, z. s. p. o., has the following **bodies:**
- General Assembly
- Board of Directors
- Supervisory Board

The **Board of Directors** operated with the following members until 10 July 2008:
prof. Ing. Jiří BÍLA, DrSc.
RNDr. Alexander ČERNÝ
Ing. Jan GRUNTORÁD, CSc.
Ing. Josef KUBÍČEK
doc. RNDr. Václav RAČANSKÝ, CSc.
RNDr. Pavel SATRAPA, Ph.D.
prof. Ing. Miroslav TŮMA, CSc.

Ing. Josef Kubíček performed the function of the Chairman, and Václav Račanský, CSc., and prof. Ing. Miroslav Tůma, CSc., were Vice-Chairmen.

For the electoral term 2008-2010, the 25th General Assembly elected a Board of Directors with the following members within its meeting held on 10 July 2008:
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.

Josef Kubíček was elected for the post of the Chairman of the Board of Directors, and Václav Račanský, CSc., and prof. Ing. Miroslav Tůma, CSc., were elected as Vice-Chairmen.

The **Supervisory Board** operated with the following structure in 2008:
RNDr. Pavel KRBEC, CSc.
Ing. Jaromír MARUŠINEC, Ph.D., MBA
Ing. Přemysl TICHÝ
doc. Ing. Zdeněk VOSPĚL, CSc.
RNDr. František ZEDNÍK

Ing. Zdeněk Vospěl, CSc. was the Chairman of the Supervisory Board in 2008.

In 2008 the member of the Supervisory Board Ing. Přemysl Tichý gave up his function. The Supervisory Board subsequently co-opted prof. Ing. Ivo Vondrák, CSc. as one of their members; the co-opting was approved by the 25th General Assembly, meeting on 10 July 2008.

Ing. Jan Gruntorád, CSc. was the **Director** of the Association in 2008.

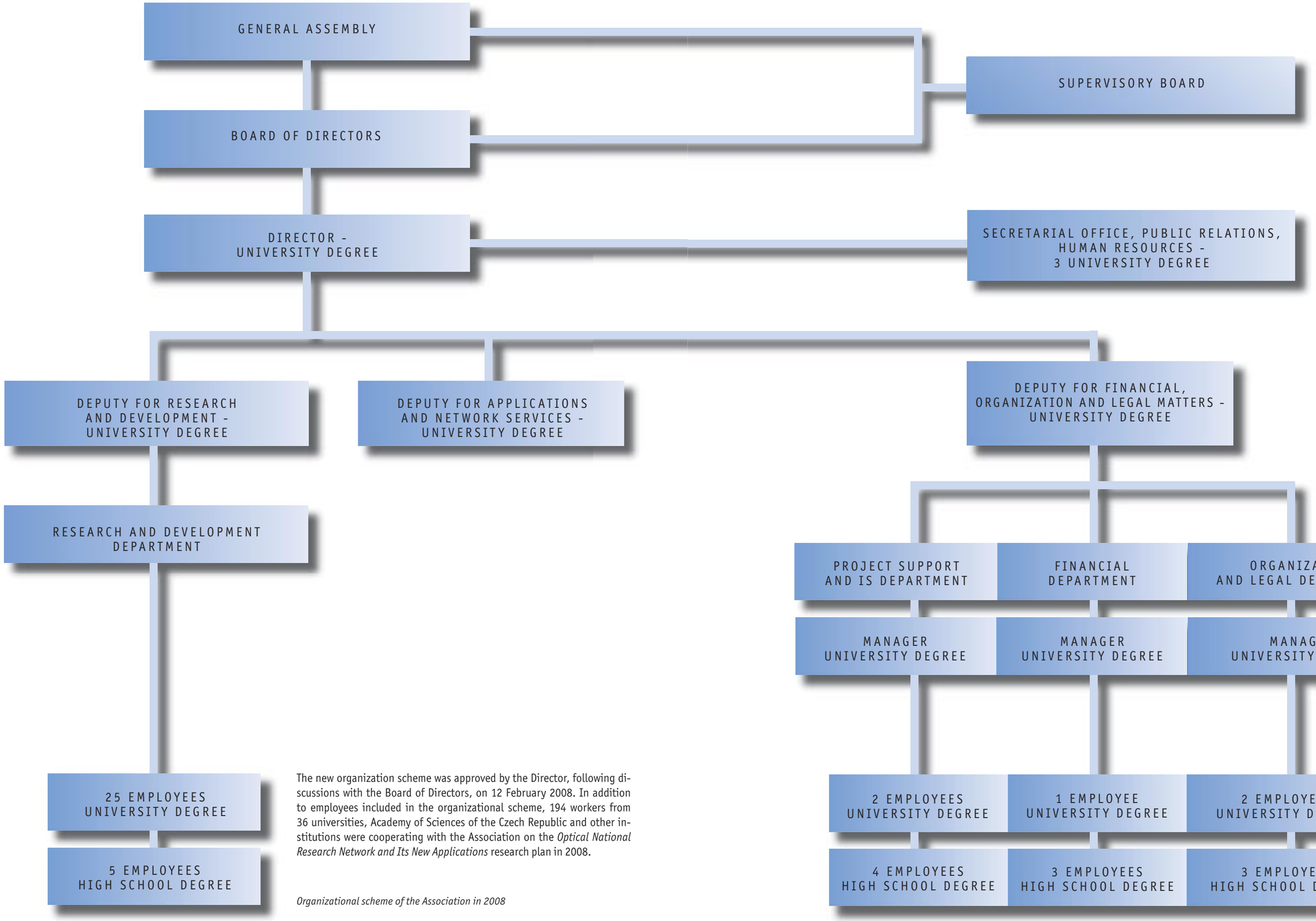
Development Fund Board

The Development Fund Board operated with the following structure in 2008:

RNDr. Igor ČERMÁK, CSc.
Ing. Miroslav INDRA, CSc.
Ing. Olga KLÁPŠŤOVÁ
doc. RNDr. Antonín KUČERA, CSc.
prof. Dr. Ing. Zdeněk KŮS
prof. RNDr. Jan SLOVÁK, DrSc.
prof. Ing. Pavel TVRDÍK, CSc.

Igor Čermák, CSc. was elected as the chairman of the Development Fund Board.

Organizational Scheme



The new organization scheme was approved by the Director, following discussions with the Board of Directors, on 12 February 2008. In addition to employees included in the organizational scheme, 194 workers from 36 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 2008.

Organizational scheme of the Association in 2008

The main objective of the CESNET Association is to build and develop the **national** multigigabit network designet for the science, research, development, and education – **CESNET2**. There is a transparent **integrated** communication **environment**, being created on this network, meeting specific requirements of the science and research community. In 2008 the Association focused on quality development of the **IP/MPLS layer** of the network.

The CESNET Association is building and developing a high-speed computer network for the science, research, development and education purposes – CESNET2. The backbone network interconnects the largest university cities of the Czech Republic with circuits featuring high transfer rates. Users of the network include universities and the Academy of Sciences of the Czech Republic as well as several high schools, hospitals, or libraries.

In addition to the standard Internet connection and high transfer rates for scientific and research purposes, the CESNET2 network offers to its users also some advanced and less common services.

In 2004 to 2007 the Association focused on building and developing the optical transfer layer, mainly in the DWDM network area. The optical infrastructure topology of the CESNET2 network at the end 2008 is shown in Fig. 1. This topology includes those CESNET2 nodes that are connected using optical fibers and fitted with equipment of the CESNET Association. Depending on the utilization mode of individual routes, the routes are fitted with two various technologies.

The first type of the DWDM system uses devices allowing transfers with speeds of up to 10 Gbps in up to 32 channels, at the maximum distance of 1000 km. This system enables software channel configuration, bringing significant flexibility in setting up circuits matching users' needs. The system has been implemented mainly in the core of the CESNET2 backbone.

Another system is based on our custom-built optical amplifiers, developed by the Association within the research plan works. Unlike the previous system, this system is configured statically, allowing to transfer up to 8 channels with the speed of 1 to 10 Gbps in a single fiber, depending on the device type used. The remaining optical transfer routes currently operate in the "gray optics" mode, meaning that only one transfer channel is implemented in one fiber.

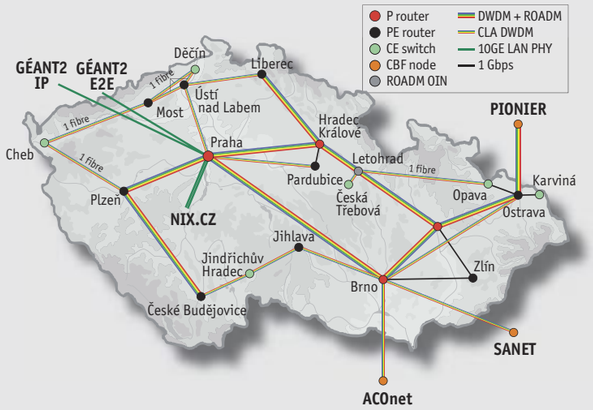


Fig. 1 Basic optical topology of the CESNET2 backbone network

The present level of the DWDM network meets needs of the CESNET2 network. Starting with 2008 the Association therefore focused on quality development of the IP/MPLS layer . Fig. 2 shows the IP/MPLS infrastructure topology from March 2009. In connection with increasing demands for the network features and functions and the rising data volume, there are many problems occurring, related in particular to main peering routers. The issues include mainly high processor loads, insufficient real throughput of routers and other HW restrictions related to the development of the backbone networks towards the transfer rate of 40 Gbps and above. This is why the Association decided to upgrade the network core by fitting new and more powerful and perspective routers, which will allow further development of the CESNET2 network. This process was launched in 2008 by selecting and installing the first terabit router in the backbone node in Prague. The public tender resulted in purchase of the Cisco CRS-1/16 router.

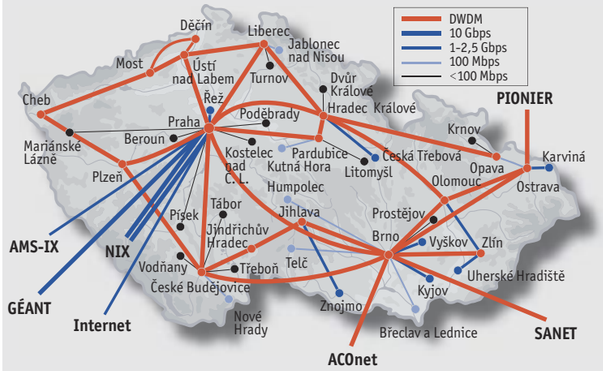


Fig. 2 CESNET2 IP infrastructure topology

When building the CESNET2 network the Association puts great emphasis on ensuring availability of network services and providing network redundancy. Interconnections of individual backbone nodes are backed up on the level of optical circuits. There are at least two independent lines leading to each of these nodes, which considerably boosts the resistance of the network to failures on individual lines or nodes. From the connectivity provision viewing, the weakest link became the node in Prague, because this is the only point where international connection to the GÉANT2 network and other foreign academic and non-academic network is established. To eliminate this weakness, the Association decided to double the Prague node and was selecting the locality for installation of this node in the second half of 2008. As a result of a public tender, the premises of the Housing Center of T-Systems Czech Republic, a. s., in the Congress Center building in Prague, Nusle, were selected to install the secondary node. Installation of technologies in this node started at the beginning of 2009. The Prague node distribution scheme is shown in Fig 3.

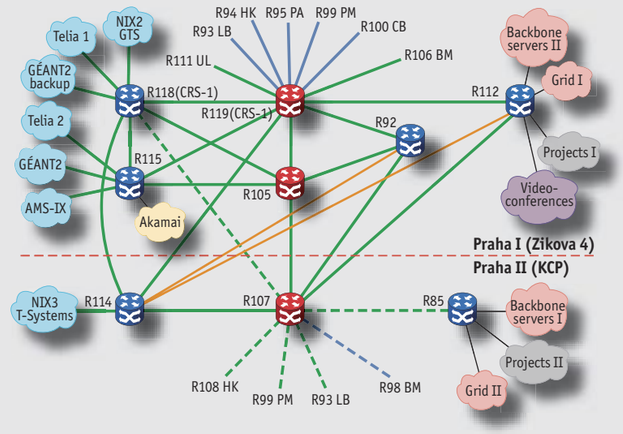


Fig. 3 Prague node distribution scheme

Since 2004 CESNET has been working on the seven-year *Optical National Research Network and Its New Applications* research plan. This plan is divided to **ten activities**, covering a wide scale of research topics. As indicated by the annual evaluation performed by independent experts, the research plan was implemented with a **high** professional level in 2008. Many concepts applied within the research plan in the CESNET2 national network is taken over by the **international** community.

Optical National Research Network and Its New Applications Research Plan

Considering the specific character of national research and education networks in general, 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 level.

Research activities relating to the Czech NREN development are performed mainly within works on the research plan *Optical National Research Network and Its New Applications*. This research plan, scheduled for 2004 to 2010, is to a large degree financed from the institutional support provided by the Ministry of Youth, Education and Sport of the Czech Republic.
The objective of the research plan is to design a prototype of a transparent integrated communication environment, meeting specific needs of the academic community, and to test its characteristics and viability within 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. 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.
With respect to the great extent of the research plan – both from the professional perspective and the financial/HR perspective – the research plan is divided into ten activities. These activities concentrate on specific areas that are strategic when attempting to complete the comprehensive objective of the research plan.

Research Plan Activities in 2008

National Research and Education Network Development

This key research plan activity is focused primarily on the development of the optical transfer infrastructure and its integration with the IP network layer, monitoring and provision of performance characteristics, and support for new functions and properties of this infrastructure, such as IPv6 unicast a multicast, creation of virtual private networks and private optical transfer channels.
An integral part of this activity is the cooperation with the GÉANT2 network as well as other European national research networks to ensure interoperability, essential for the provision of advanced services in the international scope. Encompassing more than just the research and implementation of new technologies in the national research environment, this activity includes also all supportive activities needed to provide quality and stable services for other activities and users.

Optical Networks

The Optical Networks activity deals mainly with the research in the CEF (Customer Empowered Fiber Networks) implementation area, particularly with data transfer methods and transfer devices development. Other areas of interest include cooperation on the development of new applications utilizing GLIF (Global Lambda Integrated Facility). Research results are tested both under laboratory conditions and within extensive experimental and subsequently also production networks. For this purpose an optical laboratory is available for this activity in the Association's premises and for needs of experiments on the lowest OSI model layers that could eventually lead to a network functionality loss, there is an experimental distributed laboratory being constructed within this activity (called CzechLight) that is connected to the worldwide experimental infrastructure GLIF. An important component of this activity is also the development of prototypes and functional samples of new optical devices, referred to collectively as the CzechLight family. These devices are protected by four utility models and one utility model is pending. Based on the licenses granted by the CESNET Association, these optical devices are offered by two commercial manufacturers.

Programmable Hardware

The objective of this activity is to develop specialized devices utilizing hardware acceleration and applications based on these devices, in particular for the network security area. The COMBO hardware platform allows processing of network traffic on 10-Gbps lines and in close future also 40--Gbps lines. The main network application is the FlowMon probe for monitoring IP data flows, exporting flow records in the NetFlow ver. 5 and 9 and IPFIX formats. COMBO cards represent the basis of the 10-Gbps version of the NetFPGA project, on which this activity works together with the Stanford university. The COMBO card and FlowMon probe technologies were successfully commercialized in 2007 and are available on the market. One of the first major accounts was the GÉANT2 project. An important part of this activity is the original research and education of university students in the area of the data processing and classification in high-speed networks, network security etc. There diploma theses created within the activity received outstanding awards in prestigious national and international contests in 2008.

Network Infrastructure and Traffic Monitoring

The network infrastructure monitoring focuses on processing and providing information obtained primarily from a set of technical means that constitute the network infrastructure, practically irrespective of the network layer where the given element is dominantly applied. The Association attempts to develop means that would be able to provide both detailed and summary information on specific parameters, capturing at least a certain degree of the network phenomena dynamics, and that could work with different logical structure of network elements as needed on the virtualization level, performing respective aggregation of the trends of desired quantities.
In the network traffic monitoring area the Association performs analysis of what is transferred through the network infrastructure. The focus is on the traffic transferred using the IP protocol (ver. 4 and 6) and processing of traffic logs based on the base of flows describing this traffic in an aggregated form. Our primary source of traffic information are the backbone routers of CESNET2 and FlowMon probes developed within the *Programmable Hardware activity*.

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

Within this activity, CESNET deals with the research the purpose of which is to find mechanisms to ensure the performance characteristics required for transferring data in large high-speed networks. We search for methods to monitor the performance characteristics of high-speed networks, aiming to acquire information on the network traffic character and the network behavior, used to identify problematic spots and bottlenecks. These activities are then followed by analyses of possibilities for ensuring the required performance parameters, including congestion management optimization proposals and testing of parallel communication options.
In 2008 the activity teamcompleted the development of a modular programmable platform for processing packets with the speed of 10 Gbps. The platform is capable of analyzing the packets for the purposes of monitoring as well as generating and modifying the packets, such as when processing video transfers. The key feature of the platform in comparison with other hardware-accelerated packet processing solutions is the possibility to change the firmware without having to install a bypass, simply by reordering the completed reconfigurable modules in slots. A significant result of 2008 is also the launch of the timestamp authority, which is a device that assigns timestamps to data in a trustworthy way.

AAI and Mobility

The goal of the activity is the development and implementation of an "inter--domain" distributed infrastructure, providing authentication and authorization services to support cooperation of users registered in various home institutions. The basic requirement for the constructed infrastructure is its compatibility with similar solutions developed in European NRENs (TERENA, GN2) and on the worldwide level (Internet2, in particular). This activity includes implementation of roaming in computer networks within the eduroam national initiative, enabling mobility of participants working also on the international level.
In 2008 there was a pilot mode testing in progress to verify the functionality of the national academic identity federation, eduID.cz. The federative identity management allows sharing information on users across various organizations in a standard and secure way based on agreed rules, enabling federation users to utilize services provided by other federation members. Following the pilot operation the federation was switched to the routine operation on 1 January 2009.
The association continued in providing SCS (Server Certificate Service), which is a result of a common project of several NREN operators under the auspices of TERENA, to CESNET association members.

MetaCentrum

The long-term objective of this activity is to build a distributed computing and storage environment, develop related services, and provide application support. The main current goal is to consistently virtualize the distributed grid environment that will allow more efficient work with available resources as well as deployment of new services, in particular support for parallel computations and interactive work with nodes. A specific area is the network infrastructure virtualization on the L2 level. In cooperation with the network management a unique environment interconnecting all resources of MetaCentrum with a de facto Ethernet network over the entire Czech Republic was created. This enables creating and running independent virtual clusters with a totally separated network infrastructure.
The access to the virtual environment is subject to strict authentication using Single Sign On principles and federation concepts. Even custom user clusters are successfully connected to the virtualized environment, which provides these users with access to more extensive resources without having to adapt to a new computing environment. MetaCentrum also offers extensive storage capacities (about 100 TB online) as well as backup service with the capacity of 400 TB.

Multimedia Transfers and Collaborative Environments

The objective of this activity is the research and development of communication technologies covering signaling protocols and relating infrastructures, transfer protocols for multimedia data, and sharing, storing and application utilization of this data. This involves development of rich communication services (including voice, video, text and presentations) using signaling protocols (SIP, H.323, SS7) and services (MCU, ENUM) and their linkage with the surrounding environment. The objective is the geographic integration (interconnection with other NRENs, academic institutions and non-academic institutions) as well as technological integration (capabilities of terminal devices, protocols etc.). One of the specific goals is to provide support for implementation of communication systems at CESNET members and/or other institutions. All this with increasing security considerations.
Another area is the research in the field of user-controlled elements to support multi-point synchronous communication. Development results are applied in the communication environment with Mbone tools; further development concentrates on elements supporting QoS. In the video transfer area we deal with multi-point transfer of uncompressed HD a 4K video over long distance. The last area relates to the operation of a streaming platform for needs of the academic community.

CESNET CSIRT

The objective of the CESNET CSIRT activity is to achieve a better internal organization level in the area of the security of the CESNET2 network and services running this network. Our goal is to have the users and administrators of the CESNET2 network prepared for potential network security violations, furnished with functional procedures, rules and technical means to remove the problems that occurred as fast as possible and minimize damage. This kind of background is best to create in the environment of CSIRT (Computer Security Incident Response Team). The primary objective of CESNET-CERTS is to handle and coordinate security incidents in the CESNET2 network, regardless whether CESNET2 is a victim or cause of the incident. Another task of comparably high importance is the cooperation with world's security platforms such as TF-CSIRT, FIRST, ENISA, which create and support collaborative environments for team meeting, discussions about security issues, and standardization of basic rules and procedures.

Application Support

The objective of this activity is to search for and support applications requiring above-standard communication with high demands for data transfer parameters, such as unusual volume, transfer rate, response time or reliability, and/or requiring special transfer modes that cannot be achieved in the shared IP mode. For these applications end-to-end routes and private and virtual networks on various levels are created, ensuring the required parameters and the transfer quality needed.
To provide an example, there are medical applications dealing with graphic data collected with modern scanning devices in hospitals (X-ray, MRI, CT) and applications from the field of physics processing data created in unique devices (electron microscopes, radiation detectors etc.). Data transfers connected with real-time 3D image modeling, virtual reality and high-resolution video are becoming more and more frequent in network applications.
Within this activity, there were several attractive events and demonstrations organized in 2008, including provision of a communication infrastructure for high quality video conferences that were a part of the medical conference Live and Video Surgery 2008, or a highly successful video conference demonstration within the program of the CESNET 2008 conference when footage from endoscopic and radiologic operations were transferred to Europe from medical facilities in Japan and Taiwan.

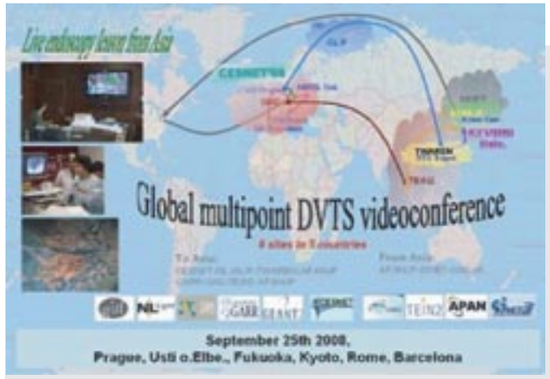


Fig. 4 DVTS multi-point video conference scheme

Evaluation of Research Plan Results Achieved in 2008

The assessment of results of the *Optical National Research Network and its New Applications* research plan achieved in 2008 was carried out within a regular opposition procedure, prescribed by the Ministry of Youth, Education and Sport of the Czech Republic as the institutional support provider, on 9 February 2009.

The board of opponents comprising independent experts stated that the search plan has been implemented with a high professional level in the evaluated period with the following reasons:

- The quality of the CESNET2 network achieved is excellent; many concepts applied in this environment are taken over by the international community.
- Research and development results are successfully transferred to practical applications.
- The implementation team participates in relevant international projects in the given area, often playing significant roles.
- Research plan implementers frequently present their results at many international seminars and workshops.
- Systematic work with students within the research plan brought considerable achievements in the form of award-winning diploma theses, presented in both national and international contests.

The board of opponents recommends continuing in practically applying results of individual research activities and providing legal protection of these results. The board of opponents also suggests exerting more effort in terms of provision of public information on the research plan and its results.

International Cooperation

GN2 Project

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 since 1996. From September 2004, this construction takes place within the *Multi-Gigabit European Academic Network project (GN2)*. 32 organizations engaged in the area of high-speed research and education networks will be involved in works on the project. The goal of the project is to provide European research and education institutions with a communication environment, capable of meeting their requirements from ensuring mobility in the European Research Area (ERA) to providing reserved high-capacity connections between specific terminal devices.

The basis for the aforementioned communication environment is the backbone network named GÉANT2 (see Fig. 5). This network has been designed as a hybrid network since the very beginning, meaning that it supports – in addition to the basic IP communication – also creation of temporary special-purpose infrastructures (grids) or point-to-point connections, based both on virtual private networks (VPN) and reserved wavelengths (so-called lambda-services).

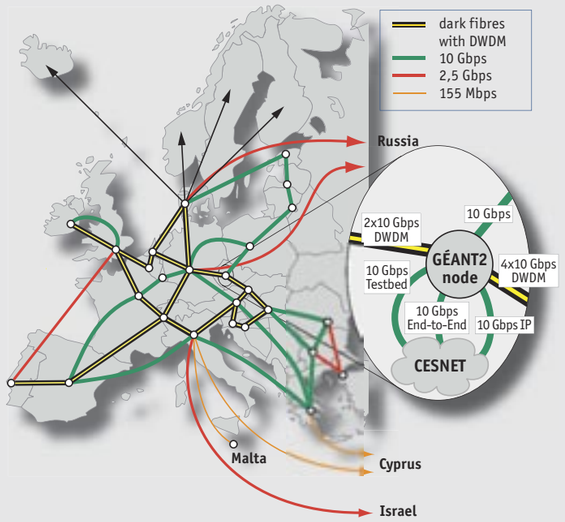


Fig. 5 GÉANT2 network topology at the end of 2008

Experts from the CESNET Association participate within this project in tasks from the following crucial areas:

- solution of QoS provision among end clients
- creation of tools for monitoring extensive high-capacity networks
- creation of tools and mechanisms needed to ensure security of the network
- creation of mechanisms for on-demand provision of reserved bandwidths or even reserved wavelengths (lambda services) for needs of short-term projects
- testing and application of the CBF (Cross-Border Fiber) model for border connections of neighboring NRENs via dark fibers
- development of a European video conferencing service
- development of an authentication and authorization infrastructure to support the user mobility

The GN2 project was originally scheduled for completion in August 2008. However, following an agreement with the European Commission, the project was extended to June 2009 with the condition of preserving the total budget. This ensures financing of the GÉANT2 network operation until the follow-up project is launched. This project was submitted within a request the closure of which was at the beginning of September 2008. In summer months the NREN consortium including CESNET was intensively preparing the draft for the new project named Multi-Gigabit European Research and Education Network and Associated Services (GN3). The main aspect of this project is orientation on creation and provision of advanced information and communication services for end users above the hybrid network infrastructure in a multi-domain environment.
More information: www.geant2.net.

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. Beside the CESNET Association, there are DANTE (Great Britain, coordinator), CERNET (China), GARR (Italy), RENATER (France), UKERNA (Great Britain) and GRNET (Greece) involved in the project. The CESNET Association is investing its experience in the project, gained within monitoring of extensive networks.
More information: www.dante.net/orient.

Phosphorus

Since October 2006 the Association has been actively participating in development of a global testbed (Europe-USA-Canada, see Fig. 6) for testing provision of on-demand network services in an extensive and heterogeneous (from the perspective of technologies in use and key element producers) network environment within an extensive international project named *Phosphorus*. The project includes development of middleware needed for smart allocation of network resources.
More information: www.ist-phosphorus.eu.

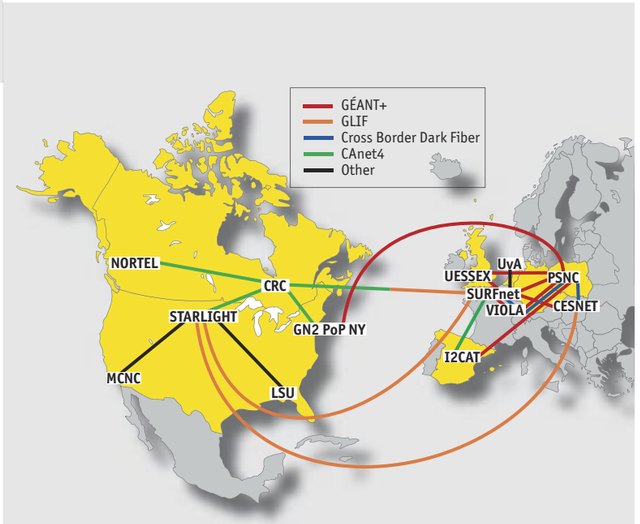


Fig. 6 Global testbed of the Phosphorus project

GLIF

Global Lambda Integrated Facility (GLIF) is an international research activity with participation of the most advanced institutions and consortia engaged in the network development and application in Europe, North and South America, Asia and Australia. Individual GLIF participants enable other participants to use specific resources so that collective experiments could be carried out.
This environment differs from common infrastructures in that the resources of participants are used for constructing testbeds and performing experiments and demonstrations, which are not 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.
More information: http://www.glif.is.

PlanetLab

The *PlanetLab* network is another project that plays an important role in the worldwide scope when testing new applications with a global character. The importance of PlanetLab has a permanent nature; its virtual principles affected the development in the entire IP area and continue to be reflected in other similar projects. CESNET entered this consortium in the middle of 2006, making the *PlanetLab* network available for use of all its members' workplaces. CESNET currently has three nodes in this worldwide network, which are intensively used within the international cooperation. The traffic on Association's servers can be monitored using references on the following website: „http://ngi.cesnet.cz/"ngi.cesnet.cz. Three professional workplaces became actively involved in the project (Czech Technical University in Prague, Technical University in Brno, and Masaryk University in Brno), implementing their own research projects here, related to the distribution of specific protocols in the global Internet environment.

FEDERICA

The *FEDERICA (Federated E-infrastructure Dedicated to European Researchers Innovating in Computing network Architectures)* project responds to the existing tendencies to virtualize information technologies. The objective of the project is to develop and experimental network (see Fig. 7) with several levels, based on virtual principles. This network should be based on the GÉANT2 physical infrastructure, existing national research and education networks and their newly created links. The *FEDERICA* environment has been operational from the 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 behavior of some of their elements, and study means to avoid these situations.
CESNET is one of the founders of the project and has an important role in it, participating in the design of the general network concept and development of resources for monitoring virtual infrastructures.
More information: www.fp7-federica.eu.

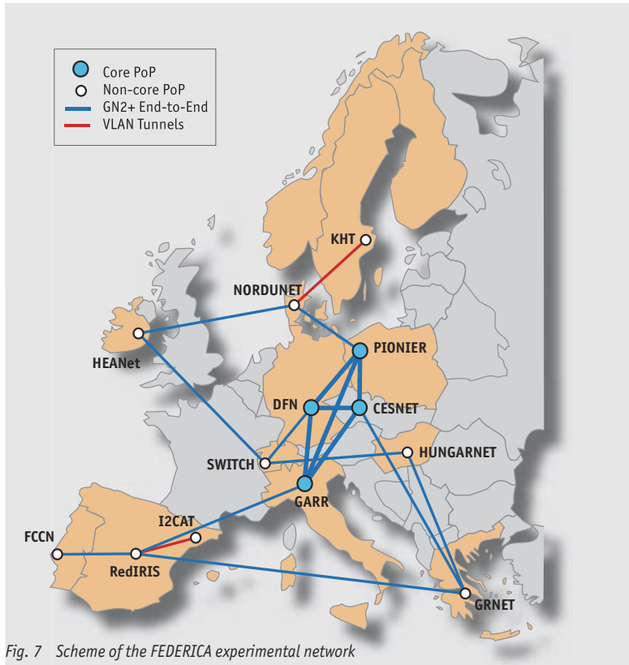


Fig. 7 Scheme of the FEDERICA experimental network

International Grid Projects

EGEE III

The international cooperation in the grid area is represented particularly by the Association's participation in the *EGEE III* project. The objective of this project that started in May 2008 as a follow-up to the *EGEE II* project is to extend the existing grid infrastructure, simplifying it from the user perspective. A vital goal is also to connect scientists from other branches (i.e. areas different from the high-energy physics, for which this environment was primarily constructed in connection with the LHC project preparation in CERN) to its use. A crucial change in the management of this infrastructure will the migration from the grid administration model based on specific research projects to a federative infrastructure comprising national grid initiatives.

EGI_DS

Another project in this area is the *EGI_DS (European Grid Initative Design Study)*. The objective here is to analyze options for creating a sustainable infrastructure on the European level, outlining a concept of mutual cooperation of grid initiatives from individual countries (both on the organizational and technological level), develop means for its implementation, and test these means in operation. The primary contribution of the study and the activity of the European grid initiative as such should be a maximally effective use of considerable resources invested in grid systems on the European and national level. In 2008 CESNET took over the role of the project coordinator from the University in Linz.
More information: http://www.eu-egi.org.

EUAsiaGrid

The interconnection of European and Asian grid infrastructures is the subject of the *EUAsiaGrid* project (Interconnection and Interoperability of Grids between Europe and Asia). The key Asian partner is the grid workplace from Academia Sinica; participants include also workplaces from Thailand, Malaysia, Singapore, Vietnam, and other countries. In EU the University of Manchester (Great Britain), HealthGrid (France), INFN (Italy) and CESNET are involved. CESNET is responsible for the Applications area.

International Projects in the Medical Field

The objective of the *Ithanet* and *MedGeNet* projects is to create a virtual environment for cooperation and coordination of medical research teams in an extensive geographic area (the basis of which is the Mediterranean region), using this environment to implement research related to thalassaemia and perform genetics tele-consulting. We offer for these projects our videoconferencing and multimedia data sharing experience.

Task Forces within the TERENA Association

In addition to international projects supported by EU, experts from the CESNET Association also actively participate in works of professional workgroups (Task Forces) organized by TERENA, an association of European NRENs where CESNET is also a member. The following groups are concerned:

- **TF-CSIRT:** coordination of network security incident handling
- **TF-EMC²:** platform for coordination and cooperation in the identity management and application and service middleware development area
- **TF-mobility and Network Middleware:** the objective is to develop and deploy mobile technologies and utilize network middleware for supporting interoperable roaming services within academic networks
- **TF-PR:** exchange of information relating to NREN presentation

National Research Projects

In addition to the research plan and international projects, the CESNET Association with its members work also on research tasks within the national research and development support. In 2008 the Association participated in four projects, the first three of which are supported by the Grant Agency of the Academy of Sciences of the Czech Republic within the Information Society program and the fourth by the Ministry of Interior of the Czech Republic.

MediGrid

The objective of the *MediGrid – Methods and Tools for Utilizing Grid Networks in the Biomedicine* project of the Information Society program, implemented collectively by the University Hospital in Motol, Masaryk Hospital in Ústí nad Labem and CESNET, is to create a pilot implementation of MediGrid – an environment and modular system of applications for distributed processing of data and computing tasks in the healthcare area.

Efficient Processing of Medical Image Information

Another project dealing within the Information Society program with medical data operations is the *Efficient Processing of Medical Image Information* project. The main objectives of this project included the design, development and implementation of resources for integration in the area of acquisition, storage and sharing of medical image information, proposal for handling legislation issues relating to the given topic and handling of issues of securing sensitive patient data. 2008 was the last year of works on the project collectively implemented by CESNET, Masaryk University in Brno, and Masaryk Institute of Oncology in Brno.

Raman Fiber Amplifiers

Raman Fiber Amplifiers with Time-Multiplex Pumping is the name of a collective project of the CESNET Association and Institute of Radio Engineering and Electronics of the Academy of Sciences of the Czech Republic. The objective of this project is the theoretical analysis and experimental verification of properties of wideband Raman fiber amplifiers with time multiplexing of pumping sources. This project the implementation of which was launched in 2006 was successfully completed in 2008. The board of the Information Society program stated, based on the evaluation of results, that the objectives of the project have been accomplished with outstanding results.

Cybernetic Threat Issues

The CESNET Association is also an important partner in the project supported by the Ministry of Interior of the Czech Republic – *Cybernetic Threat Issues from the Perspective of Czech Security Interests*. Works on this project were initiated in the middle of 2007. The CESNET Association is responsible for one of the project objectives – development of a model national CSIRT (Computer Security Incident Response Team) of the Czech Republic. Other partners of this project are the Faculty of Mathematics and Physics of the Charles University, Faculty of Philosophy of the Charles University and Faculty of Science of the Charles University, Faculty of Electrical Engineering of the Czech Technical University, Institute of Sociology of the Academy of Sciences of the Czech Republic and NESS Czech, s. r. o.

Development Fund

In 2008, the Fund Development Council announced two selection procedures for new projects. For the first round the following thematic circuit was announced: Completion of wireless networks in connection with the eduroam project.
Sixteen projects were submitted based on this announcement. All sixteen projects were accepted for co-financing; for two of them the allocated financial resources from the Development Fund were lower than the required amount.

Project Number	Project Executor	Project Name
260/2008	VUT	Deployment of the eduroam.cz mobile network in the premises of the Faculty of Chemistry of the Technical University in Brno
261/2008	JAMU	Extension of the wireless network in the Academy
262/2008	UHK	Completion of wireless networks in connection with the eduroam project in the University of Hradec Králové
263/2008	UPA	Completion of wireless networks in connection with the eduroam project of the CESNET Association
264/2008	AV ČR	Extension of the eduroam network in departments of the Academy
265/2008	MZLU	Extension of the eduroam wireless network in the University
266/2008	OU	Development of the wireless network of the Faculty of Natural Science of the University of Ostrava
267/2008	ČVUT	Extension of infrastructure and centralized administration of the eduroam network in the Czech Technical University
268/2008	UP	Extension of the wireless network in buildings of the Palacký University in Olomouc
269/2008	ZČU	Increase in coverage and speed of access points of the eduroam wireless network
270/2008	UTB	Extension of the WiFi network of the University to another locality and connection to eduroam
271/2008	ČZU	Completion o the WiFi network in the premises of the University
272/2008	UJEP	Extension of the University wireless network – 2008
273/2008	MU	Centralized administration of eduroam project access points
274/2008	AVU	Extension of the wireless network of the Academy in connection with the eduroam project
275/2008	UK	Centralized administration of eduroam network access points at the Faculty of Natural Science

Project Number	Project Executor	Project Name
214/2007	AV ČR	Oracle database training – Administrator Certified Associate
215/2007	VUT	Increase in professional qualification in the network security and IP telephony area
216/2007	ČVUT	Increase in qualification of workers of the Computing and Information Center of the University
217/2007	UK	Increase in qualification of workers of the CIT network department at the Faculty of Natural Science
218R1/2007	ZČU	Handling of security incidents in the computer network of the University of West Bohemia in Plzeň
219R1/2007	OU	Work stay focusing on efficient use of information and communication technologies in education

For the second round of the selection procedure, the following thematic groups were specified in 2008:

- Utilization of services of the CESNET2 network and modern information and communication technologies within the tuition and education pro cess, 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

7 of 13 projects submitted in this round were accepted for co-financing; 4 of them needed some revision before. No decision has been made yet regarding acceptance of one of the projects; the proposer was asked to present its goal to the Development Fund Board.

Project Number	Project Executor	Project Name
276/2008	ZČU	Group management optimization as a necessary condition of the federative authorization infrastructure
280/2008	VŠB-TUO	Optimization of the management of the distributed virtual computer network laboratory
281R1/2008	VŠB-TUO	New service implementation: HD video conferencing technology
283R1/2008	VUT	Monitoring of a 10-Gb link between the University network and the CESNET2 network
284R1/2008	AV ČR	Federative authentication and authorization infrastructure Shibboleth and parallel searching and linking in electronic information resources of the Academy
285R1/2008	AV ČR	Secure AV Outbound (SAVO)
288/2008	AMU	Connection of the Academy to the edulD.cz entity federation

In 2008 there were two rounds of opposition procedures for completed projects. 22 project were successfully completed in total; one was presented by its executor within an opposition procedure. Final reports for projects implemented within the CESNET Development Fund are available at the Association's website. After modifying the Development Fund website, we have also added the functionality for searching through final reports.

Results of some projects were presented within the seminars of entities working on the CESNET's research plan, at professional seminars for CESNET members as well as at international conferences. The presentation of results included publication is specialized press.

CESNET is a traditional organizer of professional meetings, regularly hosting **leading** world's and domestic **experts**. The most important even organized by the Association in 2008 was the two-day professional international

CESNET Conference 2008,

where top experts from Europe, United States and Taiwan gathered in Prague. In September one of the founders of the Internet visited CESNET, vice-president a Chief Internet Evangelist of Google –

Vint Cerf.

Public Relations

CESNET Conference 2008

The professionall *CESNET Conference 2008* ((Fig. 8), organized by the Association on 25 and 26 September in premises of the Faculty of Electrical Engineering of the Czech Technical University in Prague was the key event of 2008 prepared by the Association. Its importance was underlined during the ceremonial opening by the first ministry of the government's Research and Development Board, Miroslava Kopicová. The meeting with main topics such as security, middleware and virtualization hosted experts not only from Europe but also USA and Taiwan. One of the professional presentations related to the tele-medicine field included a unique video conference, interconnecting seven medical facilities in Japan, Taiwan, Italy, Spain and the Czech Republic. During the video conference footage of endoscopic and radiologic operations from medical facilities in Japan and Taiwan was transferred to Europe.

Fig. 8 CESNET Conference 2008

Live and Video Surgery 2008

One of the important presentation forms of the Association is the provision of direct transfers of significant professional and was as popular educational events. In January the Association took part in technical aspects of the unique ophthalmology video conference *Live and Video Surgery 2008* (Fig. 9), where live video transfers of several eye surgeries gave insight in the operating field and the ability to listen to surgeon's comments.

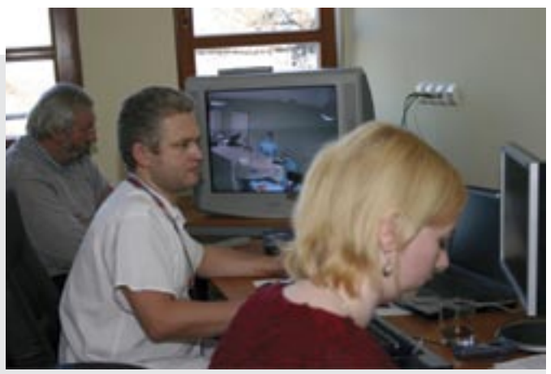


Fig. 9 Live a Video Surgery 2008

Pierre Auger Observatory Project Workshop

The Association traditionally hosted also other international meetings. In April it was the international workshop of scientists working on the *Pierre Auger Observatory* project, ensuring development of cosmic radiation detectors located in the Argentinean pampas. The Prague meeting (Fig. 10), organized by the Institute of Physics of the Academy of Sciences of the Czech Republic in cooperation with the Association dealt with options of utilizing the grid for demanding simulations of cosmic radiation showers in the atmosphere.

Fig. 10 Pierre Auger Observatory Workshop

EGEE II Project Meeting

At premises of the Czech University of Agriculture in Prague the Association organized a meeting of 70 experts involved in the *EGEE II* European grid project. These so-called JRA1 and SA3 all-hands meetings represent a regular opportunity for personal meetings and intensive direct communication of developers from various parts of Europe.

CSIRT.CZ Meeting

In May the Prague headquarters of the CESNET association served as the first meeting point of the *CSIRT.CZ* workgroup, consisting of representatives of key network operators, content providers, and risk service providers in the Czech Republic. Basic communication and cooperation rules were discussed within the meeting as well as operational aspects of the workgroup (Fig. 11).

Fig. 11 First CSIRT.CZ meeting

Vint Cerf in CESNET

From the perspective of the international awareness about the Association's activities it is very important that one of the founders of the Internet, vice-president a Chief Internet Evangelist of Google Vint Cerf visited the Association on 22 September 2008 (Fig. 12). In the headquarters of the association Vint Cerf met the Director of the Association Jan Gruntorád, Executive Director Ondřej Filip, and the Director of NIX.CZ Tomáš Maršálek.

Fig. 12 Vint Cerf with Jan Gruntorád in CESNET

Science and Technology Week

In November the Association became of the co-founders of the eight year of the *Science and Technology Week*, providing direct transfer and archiving of selected professional lectures.

TERENA Workgroups

In the international area, the Association continued in active participation in the TF-PR group of the TERENA organization and GÉANT2 PR Network group of the DANTE organization.

Media Relations

The Association utilizes the feedback in the form of regular press monitoring and monthly analyses of these outputs. In 2008 there was another quantity increase in the activities representing the Association. The content of the messages communicated retains its high professional level despite the increasing quantity, offering high information value.

Presentation of Research Plan Results

A crucial part of active steps of the Association in the public relations area is the presentation of its research plan results.

Datagram Magazine

Results of the research activities of the Association were published in classic and electronic versions of specialized magazines as well as internal university bulletins. Two Datagram issues were published during the year. One with a double extent was fully dedicated to the CESNET Conference 2008 event and two special issues were used to announce the request to submit projects for the Development Fund of the CESNET Association.

Networking Studies 2008 Publication

In 2008 CESNET continued in the tradition started in 2007 based on its positive response, issuing the second volume of the Networking Studies connection. 208 pages contain 13 selected and finally edited technical reports, divided into thematic areas: CESNET2 Network, Network Monitoring, Quality of Service, and Services and Applications.

Computer Network Security Seminars

The security of computer networks, protection against their misuse, and methods for revealing and handling security incidents become increasingly current topics. Since the CESNET association has been successfully dealing with these issues systematically and over a long term, our experience is highly valued in this field. Based on a request of the Czech Telecommunication Office and Czech Security Information Service, CESNET organized two one-day seminars for employees of these institutions in October and December, focusing on the computer network security issues.

Photonic Multicast Demonstration

Experts of the CESNET association demonstrated a unique photonic multicast application at the eighth annual LambdaGrid Workshop that took place in the beginning of October in Seattle, USA. This demonstration presented to about one hundred experts from the entire world received an exceptional response. Within the demonstration CESNET was transferring uncompressed HD video with the speed exceeding 1 Gbps from the CESNET2 national research and education network to an interconnection point of the StarLight research networks in Chicago, USA. In Chicago this signal was split using the CLM (CzechLight Multicast Switch) device developed by CESNET experts and further distributed to Seattle, San Diego, and back to CESNET2.

UltraGrid Technology Demonstration at the Internet2 Conference

Another highly successful demonstration of its results was performed by CESNET at the October meeting of the Internet2 consortium. Using the UltraGrid technology enabling high-speed video conferences and UDP reflectors developed by the CESNET Association a video conference was established between New Orleans, Baton Rouge, and Brno. International links were used to transfer the video, reaching to several circuit domains of the LONI (Louisiana Optical Networking Initiative), Internet2, or GÉANT2 networks. The event that showed capabilities of video conferencing tools for transferring HD video in connection with dynamic switching of optical lines provoked an exceptional response of the professional public.

Training of CERT/CSIRT Team Members

At the end of October CESNET cooperated with the TERENA Association and the CSIRT.CZ workplace on implementation of the TRANSISTS CSIRT Training, which is designed for newcomers in CERT/CSIRT teams or those who want to establish and operate such teams. The primary objective of the workshop was to train new members of CERT/CSIRT teams, providing them with knowledge and skills needed to further operate while mediating their first contact with the worldwide CERT/CSIRT team community. Activities of CERT/CSIRT are based mainly on cooperation, information exchange, and personal relations that represent a quality warranty in this area. The content of the training was developed by experts from the academic and commercial sector who work in CERT/CSIRT teams in various countries.

IP Telephony and Video Conferences Seminar

In November the Association organized a seminar in Prague, dedicated to the IP telephony and video conferences (Fig. 13). The event was a follow-up to successful seminars from previous years, aiming to introduce trends and technologies for remote cooperation mainly to administrators of academic networks, providing an in-depth look at solutions these administrators can apply at their workplaces. CESNET is preparing lectures with topics from the implementation area, for example a lecture on practical utilization of GSM/WiFi phones or communication security.

Fig. 13 IP Telephony Seminar

Grid Computing Seminar

In November the Association organized a grid computing seminar within the MetaCentrum project, named *Grid Future Ahead (Budoucnost Gridu na obzoru)* (Fig. 14). Seminar attendants got familiar with the MetaCentrum project, mainly with the current implementation of new services. The primary objective was to inform existing as well as new potential users of the high-performance computing on current options available for solving a wide range of research problems and challenges on the national and international level.

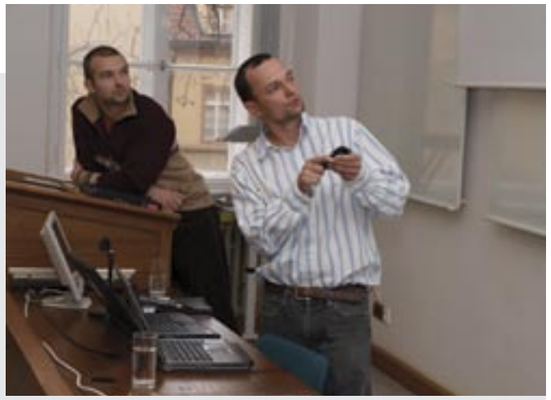


Fig. 14 Grid Future Ahead seminar

In 2008, CESNET administered the entrusted financial resources entrusted to the association in a due manner and met all its obligations as provided by law, decisions passed down by the Ministry of Education, Youth and Sports of the Czech Republic, and all contracts into which it entered. The association's financial statement for 2008 was verified by the auditor without any reservations.

2008 Economic Results

Activities of the CESNET Association are divided into two categories in accordance with its statutes: Main Activities and Economic Activities.

Main Activities

The most important share of the Main Activities in 2008 was the implementation of the *Optical National Research Network and Its New Applications* research plan, launched on 1 January 2004. The Ministry of Youth, Education and Sport of the Czech Republic provided its institutional support (operation subsidies) for this research plan, amounting to 57 % of all yields from the Main Activities in 2008. This support was fully utilized.
Within its Main Activities, the Association continued in developing the CESNET2 national research and education network, providing services to the Association members utilizing the CESNET2 network, and providing services to other entities meeting conditions required to be connected to this network. In addition the Association cooperated on implementation of international research projects of the 6th EU Framework Program and 7th EU Framework Program, grants of the Academy of Sciences of the Czech Republic, Ministry of Interior, and projects of the Development Fund Board.
The Main Activities of the Association ended in 2008 with a book loss of 9,045,000 CZK. Yields from the Main Activities of the Association in 2008 amounted to 337,087,000 CZK; costs for the Main Activities reached 346,132,000 CZK.
The basis of the income tax from the yields of Main Activities of the Association in 2008 was positive, amounting to 6,368,000 CZK.

Economic Activities

The Economic Activities of the Association in 2008 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 Economic Activities of the Association ended in 2008 with a book profit of 11,808,000 CZK. Yields from the Economic Activities of the Association in 2008 amounted to 91,583,000 CZK; costs for the Economic Activities reached 79,775,000 CZK
The basis of the income tax from the yields of Economic Activities of the Association in 2008 was positive, amounting to 13,732,000 CZK.

Total Book and Tax Economic Result

The total book economic result of the CESNET Association prior to taxation reported in 2008 was the profit amounting to 2,763,000 CZK.
The total basis of income tax after deducting the loss from previous years and other items lowering the tax basis is 9,792,000 CZK. The Association will pay the income tax of 2,056,000 CZK in 2008, resulting in the net profit of 707,000 CZK.

Conclusion

The Association properly managed the entrusted resources in 2008, meeting all its obligations resulting from the legislation, decisions of the Ministry of Youth, Education and Sport of the Czech Republic and concluded contracts. The financial statement for 2008 was verified by the auditor without any remarks.

BALANCE SHEET in Thousands of CZK

Index	2008	2007	2006	2005
Assets total	**753 947**	**734 438**	**741 539**	**711 008**
Fixed assets	525 680	535 043	410 531	386 821
Intangible fixed assets	4 369	3 949	4 952	6 045
Tangible fixed assets	208 788	220 715	217 591	200 907
Financial investments	312 523	310 379	187 988	179 869
Current assets	228 267	199 395	331 008	324 187
Supplies	0	504	0	0
Receivables	36 086	35 139	32 115	43 746
Current liquid assets	158 078	128 070	264 249	251 854
Other assets	34 103	35 682	34 644	28 587
Liabilities total	**753 947**	**734 438**	**741 539**	**711 008**
Own resources	679 806	686 467	699 578	665 219
Funds	529 987	524 413	660 115	587 091
Economic result	707	343	-25 704	13 982
Undivided profit from last years	149 112	161 711	65 167	64 146
External resources	74 141	47 971	41 961	45 789
Obligations	70 923	46 315	38 884	45 274
Loans	0	0	0	0
Other liabilities	3 218	1 656	3 077	515

PROFIT AND LOSS STATEMENT in Thousands of CZK

Index	2008	2007	2006	2005
Earnings for the sale of goods	44	23	730	36
Earnings of own products and services	100 946	99 567	101 611	104 568
Current liquid assets revenues	18 691	16 988	16 915	9 937
Other revenue	115 270	319 955	54 125	52 196
Received membership fees	0	0	0	0
Operation subsides	193 720	182 828	195 963	229 897
Revenue total	**428 671**	**619 361**	**369 344**	**396 634**
Purchase price of sold goods	41	19	711	38
Material and energy consumption	23 006	15 244	23 545	25 384
Purchased services	178 318	171 417	184 016	209 900
Personnel costs	103 807	93 038	89 016	74 950
Depreciation and amortization of intangible and tangible fixed assets	40 262	46 065	54 297	44 929
Other costs	80 474	293 235	43 463	27 451
Income tax – assessment for the current year	2 056	0	0	0
Costs total	**427 964**	**619 018**	**395 048**	**382 652**
Economic result (revenue – costs)	**707**	**343**	**-25 704**	**13 982**

R – audit, s. r. o.

150 00 Praha 5, Ostrovského 253/3

Tel.: 266 315 971, 604 824 760; fax: 257 003 291; e-mail: info@r-audit.cz

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 2008, 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. 254/2000 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 2008 and of its expenses, revenues, and income from operation for the accounting year then ended in accordance with Czech accounting regulations.

We therefore verify the annual financial statements without reservation.

Date of issue of report:
In Prague on 17 June 2009

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

R - audit, s.r.o. KA CR Osvědčení komory auditorů 124

R – audit, s. r. o.

150 00 Praha 5, Ostrovského 253/3

tel.: 266 315 971, 604 824 760; fax: 257 003 291; e-mail: info@r-audit.cz

zapsána v obchodním rejstříku MS Praha oddíl C, vložka 20496, od 31. května 1993, číslo auditorského osvědčení 124

ZPRÁVA NEZÁVISLÉHO AUDITORA

Auditorská zpráva pro členy sdružení CESNET, zájmové sdružení právnických osob, se sídlem Praha 6 – Dejvice, Zikova 4, IČ: 63 83 91 72

Ověřili jsme přiložené účetní závěrky sdružení CESNET, zájmové sdružení právnických osob, k 31. prosinci 2008, výkaz zisku a ztráty a přílohu této účetní závěrky.

Za sestavení a věrné zobrazení účetní závěrky v souladu s českými účetními předpisy odpovídá statutární orgán společnosti CESNET, zájmové sdružení právnických osob. Součástí této odpovědnosti je navrhování, zavedení a uplatňování vhodného systému vnitřní kontroly související se sestavením účetní závěrky tak, aby v účetní závěrce nebyly významné nesprávnosti způsobené podvodem nebo chybou, dále výběr a uplatňování vhodných účetních metod a provádění přiměřených účetních odhadů.

Naší odpovědností je na základě provedeného auditu vyjádřit k této účetní závěrce výrok.

Audit jsme provedli v souladu se zákonem č. 254/2000 Sb., o auditorech a Mezinárodními auditorskými standardy a souvisejícími Aplikačními doložkami Komory auditorů České republiky. V souladu s těmito předpisy jsme povinni dodržovat etické normy a naplánovat a provést audit tak, abychom získali přiměřenou jistotu, že účetní závěrka neobsahuje významné nesprávnosti. Audit zahrnuje provedení auditorských postupů, jejichž cílem je získat důkazní informace o částkách a skutečnostech uvedených v účetní závěrce. Výběr auditorských postupů závisí na úsudku auditora, včetně posouzení rizik, že účetní závěrka obsahuje významné nesprávnosti způsobené podvodem nebo chybou. Při posuzování těchto rizik auditor přihlédne k vnitřním kontrolám, které jsou relevantní pro sestavení a věrné zobrazení účetní závěrky. Cílem posouzení vnitřních kontrol je navrhnout vhodné auditorské postupy, nikoliv vyjádřit se k účinnosti vnitřních kontrol. Audit též zahrnuje posouzení vhodnosti použitých účetních metod, přiměřenosti účetních odhadů provedených vedením i posouzení celkové prezentace účetní závěrky.

Domníváme se, že získané důkazní informace tvoří dostatečný a vhodný základ pro vyjádření našeho výroku.

Podle našeho názoru účetní závěrka ve všech významných ohledech podává věrný a poctivý obraz aktiv, pasiv a finanční situace společnosti CESNET, zájmové sdružení právnických osob k 31. prosinci 2008 a nákladů, výnosů a výsledku jejího hospodaření za účetní rok 2008 v souladu s českými účetními předpisy.

Roční účetní závěrku proto ověřujeme bez výhrad.

Datum vydání zprávy:
V Praze, dne 17. června 2009

Auditorská firma: R – audit, s. r. o.
Osvědčení KA ČR č. 124
Sídlo společnosti: Praha 5, Ostrovského 253/3

Odpovědný auditor: Ing. Radmila Špišková
Osvědčení KA ČR č. 1326

R - audit, s.r.o. KA CR Osvědčení komory auditorů 124

2008 ANNUAL REPORT CESNET

www.cesnet.cz