ANNUAL REPORT 2006

CESNET

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CESNET

ASSOCIATION
OF LEGAL ENTITIES

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A MESSAGE FROM THE DIRECTOR

The last year was exceptional for the Association. We celebrated our 10th foundation anniversary in March 2006, reviewing our ten-year activities. On this occasion, we organized a professional international conference on 7 and 8 March. Over 100 leading professionals from the Internet research area from 15 European countries and the United States have participated in this event. The conference opening also hosted the Minister of Youth, Education and Sports of the Czech Republic, Petra Buzková. Concerning the professional branches, lectures at the two-day conference covered a very wide range of issues – from physical processes occurring within optical signal transfers and amplification up to highly-specialized network applications.

The most important activity of the Association in 2006 was traditionally the implementation of the research plan "Optical National Research and Education Network and its New Applications". The year 2006 was the third year of the research plan implementation, which is scheduled for the period of 7 years (2004-2010). The objective of the research plan is to design an integrated environment, meeting highly demanding requirements of the academic community, and to test its characteristics within practical operation. Our previous experience with the operation of a network for the science, research and education show that the sufficient free bandwidth is just one of the requirements of this very demanding user community – to provide a quality infrastructure, additional advanced services must be developed and offered.

With respect to the enormous extent of research and development activities and our large team of researchers involved in their implementation, the implementation has been divided in 2006 into twelve thematically specific activities. The issues dealt with belong to areas from the lowest transfer layers through middleware, grid technologies, authentication and authorization, and security up to development of new application services. Results achieved within these activities are internally evaluated within the CESNET Association twice a year. The evaluation results then help streamline the implementation of the given issues in the following period. We exert great efforts to enable cooperation and interaction of individual activities and obtain feedback from users provided with these results in the shortest time possible.

A very significant aspect of the research plan implementation was the completion of the next stage of the transformation converting the CESNET2 backbone network to the hybrid CESNET2+ network, capable of providing its users also with dedicated optical links between specific terminal locations, in addition to the classic IP connectivity.

An integral part of all research plan activities is the cooperation with the GN2 project as well as with other European national research networks (NREN) to ensure interoperability, essential for the provision of advanced network services in the international scope. In addition to implementation of the GN2 project, we have also taken part in other projects supported by the European Union – EGEE, EGEE II, Lobster, SEEFIRE, Porta Optica Study, ORIENT, Phosphorus, EuroCareCF, and Ithanet.

Activities of the Association Development Fund have undergone highly successful development, too. In total, 29 of 37 projects submitted in 2006 were co-financed based on recommendations of the Development Fund Council.

I would like to use this opportunity to thank the Ministry of Youth, Education and Sports of the Czech Republic (hereinafter referred to only as MŠMT ČR) as well as all Association members for their significant support provided to the research plan implementation.

Let me please thank all my colleagues, staff working on the research plan and international projects, for the work they have accomplished and the outstanding results they have achieved. I believe that we will be able to complete all objectives set not only in 2007 but also in the following periods.

Ing. Jan Gruntorád, CSc.
Director and Member of the Board of Directors, CESNET, z.s.p.o.

1 Introduction

1. INTRODUCTION

1.1. BASIC DATA ON THE ASSOCIATION AND THE GOALS BEHIND ITS ESTABLISHMENT

Name and Registered Office

Name: CESNET, Association of Legal Entities (the "Association")
Registered office: Zikova 4, 160 00 Prague 6

Subject of Activities

The main scope of activities of the Association follows:
To secure the research and development in the area of information and communication technologies and their applications.
To secure the provision of education services within research and development, using the high-speed national research and education network.
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).
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.
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.

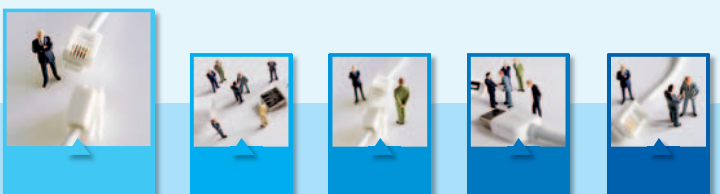
The Association does not provide the academic backbone network services only to its members but also to selected entities complying with the Access Policy of the Next Generation National Research and Education Network ("Zásady pro přístup do sítě národního výzkumu a vzdělávání nové generace").

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.

1.2. HISTORY OF THE ASSOCIATION AND ITS CURRENT STATE

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). 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.



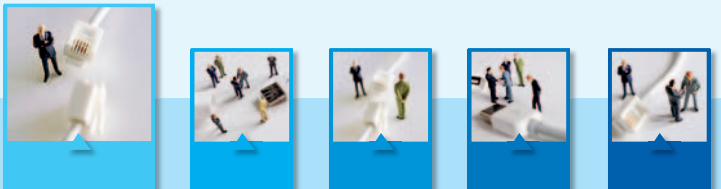
The Association also operated as a commercial Internet provider, with the aim to gain sufficient resources from these activities for its main activity. The Association became one of the main entities on the Internet connection market in the Czech Republic.

In 1996, when the Association received a grant for the "TEN-34 CZ Network Deployment" project from the MŠMT ČR, the Association started building the academic backbone network of the Czech Republic at an entirely new level of quality. Along with this process, the academic and commercial operation separated and all the members converted to the academic network.

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. Both networks were isolated technologically, economically and to a significant extent also in terms of personnel.

At the end of the 1990s, several financially very strong subjects entered the Internet connection market. The Association was unable to withstand the economic competition with these entities in the commercial Internet provision area. Therefore, a decision was taken to seek a strategic partner and to raise more capital by selling the commercial network. 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 NREN ČR and other related activities.

For the period of 2004 to 2010, the Association obtained subsidies in the form of an institutional support for its research plan titled "Optical National Research Network and Its New Applications", the draft of which was submitted in 2003. 2006 was therefore the third year of works on this research plan.



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Organizational Structure

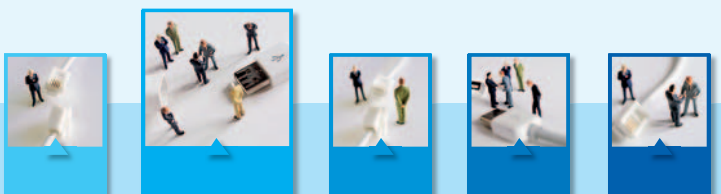
2. ORGANIZATIONAL STRUCTURE

2.1. EXTERNAL ORGANIZATIONAL STRUCTURE – ASSOCIATION MEMBERS

The following institutions were members of the Association in 2006:

1. Charles University in Prague, Prague 1, Ovocný trh 3-5, ZIP 116 36
2. Palacký University in Olomouc, Olomouc, Křížkovského 8, ZIP 771 47
3. Czech Technical University in Prague, Prague 6, Zikova 4, ZIP 166 36
4. Technical University of Ostrava, Ostrava-Poruba, 17.listopadu 15, ZIP 708 33
5. Academy of Arts, Architecture and Design in Prague, Prague 1, nám. Jana Palacha 80, ZIP 116 93
6. Academy of Fine Arts in Prague, Prague 7, U Akademie 4, ZIP 170 22
7. Technical University in Brno, Brno, Antonínská 1, ZIP 601 90
8. University of Veterinary and Pharmaceutical Sciences in Brno, Brno, Palackého 1-3, ZIP 612 42
9. Masaryk University , Brno, Žerotínovo nám. 9, ZIP 601 77
10. Mendel University of Agriculture and Forestry in Brno, Brno, Zemědělská 1, ZIP 613 00
11. Academy of Performing Arts in Prague, Prague 1, Malostranské nám. 12, ZIP 118 00
12. Janáček Academy of Musical and Dramatic Arts in Brno, Brno, Beethovenova 2, ZIP 662 15
13. University of Pardubice, Pardubice, Studentská 95, ZIP 532 10
14. Institute of Chemical Technology in Prague, Prague 6, Technická 5, ZIP 166 28
15. Czech University of Agriculture in Prague, Prague 6 – Suchdol, Kamýcká 129, ZIP 165 21
16. Technical University in Liberec, Liberec 1, Hálkova 6, ZIP 461 17
17. Institute of Economics in Prague, Prague 3, nám. Winstona Churchilla 4, ZIP 130 67
18. University of Hradec Králové, Hradec Králové, Rokitanského 62, ZIP 500 03
19. University of South Bohemia in České Budějovice, České Budějovice, Branišovská 31, ZIP 370 05
20. University of Ostrava, Ostrava 1, Dvořákova 7, ZIP 701 03
21. Silesian University in Opava, Opava, Na Rybníčku 1, ZIP 746 01
22. University of Jan Evangelista Purkyně in Ustí nad Labem, Ústí nad Labem, Hoření 13, ZIP 400 96
23. University of West Bohemia in Plzeň, Plzeň, Univerzitní 8, ZIP 306 14
24. Academy of Sciences of the Czech Republic, Prague 1, Národní 3, ZIP 117 20
25. Tomáš Baťa University in Zlín, Zlín, Mostní 5139, ZIP 760 01
26. University of Defence, Brno, Kounicova 65, ZIP 612 00

During 2006, the Association accepted no new members.



2.2. INTERNAL ORGANIZATIONAL STRUCTURE

CESNET, z.s.p.o. has the following bodies:

1. General Assembly
2. Board of Directors
3. Supervisory Board

The Board of Directors operated with the following members until 11 July 2006:

RNDr. Alexander ČERNÝ
Ing. Jan GRUNTORÁD, CSc.
Ing. Josef KUBÍČEK
Prof. Ing. Josef Macháček, DrSc.
Prof. RNDr. Milan MAREŠ, DrSc.
Doc. RNDr. Václav RAČANSKÝ, CSc.
RNDr. Pavel SATRAPA, Ph.D.

J. Kubíček performed the function of the Chairman, and M. Mareš and V. Račanský were Vice-Chairmen.

For the electoral term 2006-2008, the 21st General Assembly elected a Board of Directors with the following members within its meeting held on 11 July 2006:

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.

The Board of Directors elected J. Kubíček as Chairman, and V. Račanský and M. Tůma as Vice-Chairmen.

The Supervisory Board had the following structure in 2006:

Ing. Jiří Jirka
RNDr. Pavel Krbec, CSc.
Ing. Jaromír Marušinec, Ph.D., MBA
Ing. Přemysl Tichý
Doc. Ing. Zdeněk Vospěl, CSc.

Z. Vospěl was the Chairman of the Supervisory Board.

J. Gruntorád was the Director of the Association also in 2006.

2.3. ORGANIZATIONAL SCHEME OF THE ASSOCIATION

The organizational scheme (see Fig. 1) was approved by the Director, following discussions with the Board of Directors, on 1 June 2005, remaining valid for the entire year 2006. In addition to employees included in the organizational scheme, 191 workers from 32 universities, AV ČR and other institutions were cooperating with the Association on the "Optical National Research Network and Its New Applications" research plan in 2006.

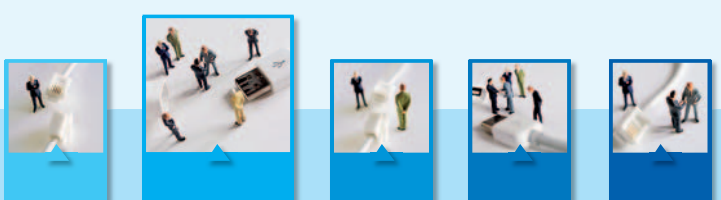
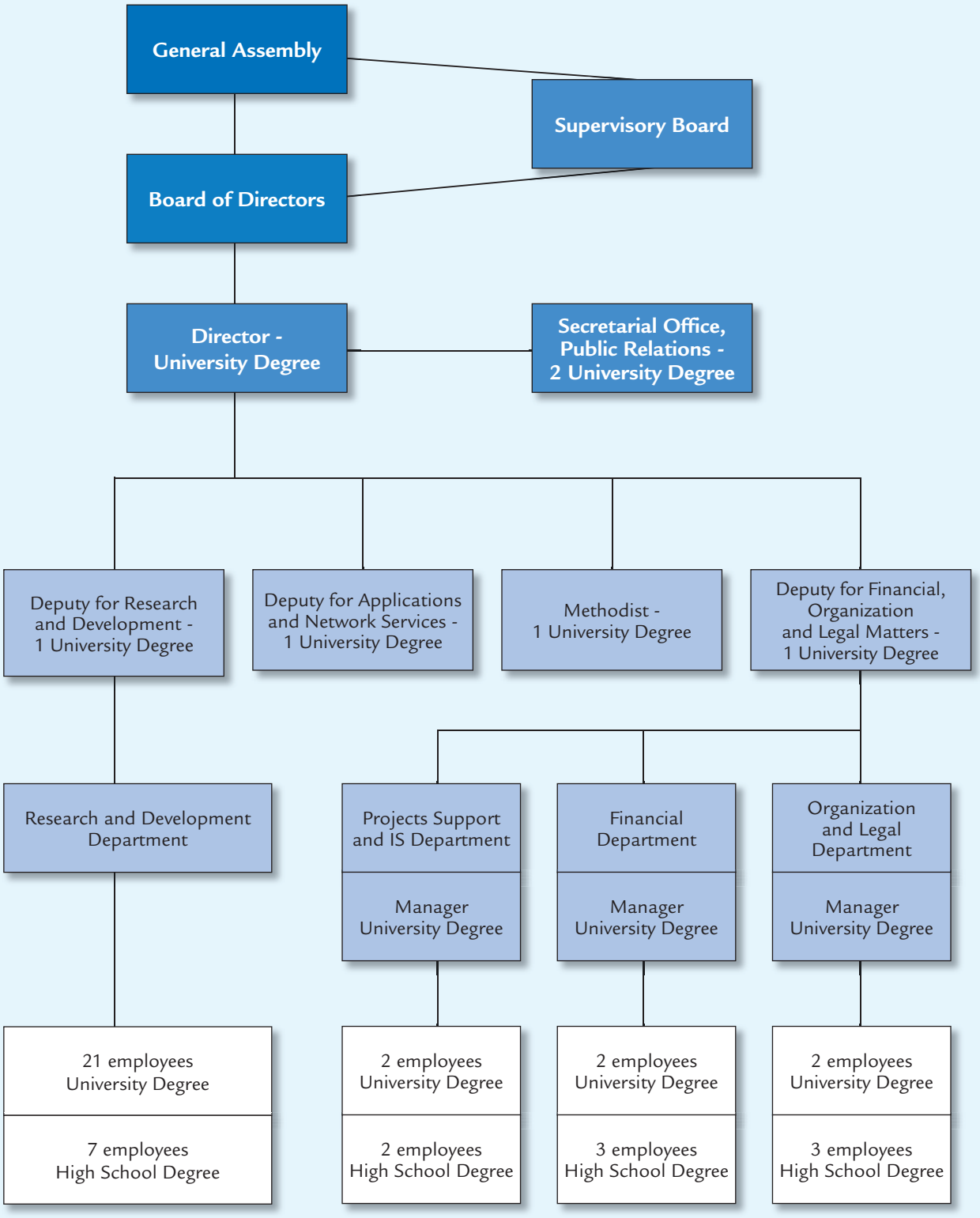
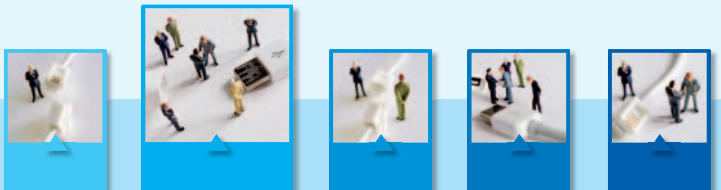


Fig. 1 ORGANIZATIONAL SCHEME OF THE ASSOCIATION IN 2006



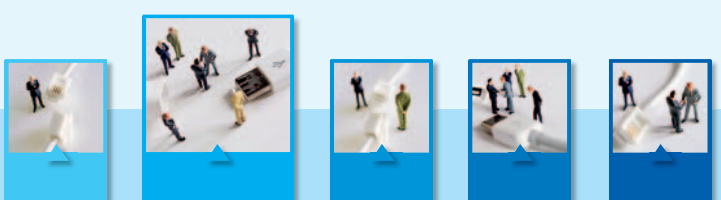


2.4. DEVELOPMENT FUND COUNCIL

The Development Fund Council operated with the following structure in 2006:

RNDr. Igor Čermák, CSc.
Ing. Miroslav Indra, CSc.
Doc. RNDr. Antonín Kučera, CSc.
Prof. Ing. Karel Rais, CSc., MBA
Ing. Vladimír Rudolf
Prof. RNDr. Jan Slovák, DrSc.
Prof. Ing. Ivo Vondrák, CSc.

I. Čermák was the Chairman of the Development Fund Council.



3

Membership in Organizations

Annual Report 2006 CESNET, z.s.p.o.

CESNET

3. MEMBERSHIP IN ORGANIZATIONS

3.1. MEMBERSHIP IN INTERNATIONAL ORGANIZATIONS

TERENA (Trans-European Research and Education Network 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 establish 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.

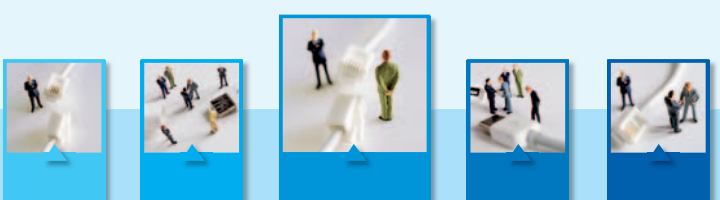
Internet2 – consortium led by American research and education institutions endeavoring to develop and deploy new types of network technologies, services and applications. The CESNET Association has been an associate member of the consortium since 1999.

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.

3.2. MEMBERSHIP IN NATIONAL ORGANIZATIONS

CESNET, z.s.p.o. 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 2006, the Association had 47 members.

CESNET, z.s.p.o. 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 2006, the Association had 46 members.



4

Activities of the Association

4. ACTIVITIES OF THE ASSOCIATION

4.1. "OPTICAL NATIONAL RESEARCH NETWORK AND ITS NEW APPLICATIONS" RESEARCH PLAN

4.1.1. Introduction

Implementation of the "Optical National Research Network and Its New Applications" research plan is the key activity of the CESNET Association for the period of 2004 – 2010. The research plan is financed to a considerable degree from the institutional support provided by the MŠMT ČR.

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 (hereinafter referred to only as NREN) 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 has been divided into activities corresponding to specific areas that are of high strategic importance to the Association. Each activity has its coordinator who is responsible for defining priorities and objectives and their accomplishment. In 2006, two meetings of all researchers involved in works on the research plan took place in order to give the geographically distributed teams a chance to mutually coordinate their progress, presenting results of their work.

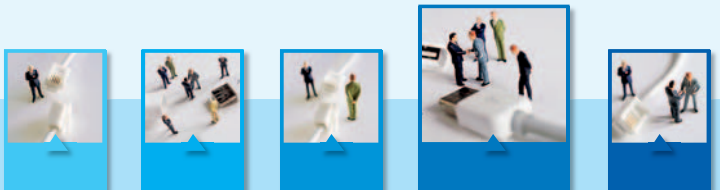
4.1.2. Research Plan Activities in 2006

National Research and Education Network Development

This basic research plan activity is focused primarily on the development of the optical transfer infrastructure and its integration with the IP network layer, monitoring of performance characteristics, and support for new functions and properties of this infrastructure, such as IPv6, ensuring of defined performance characteristic, creation of virtual private networks and private optical transfer channels.

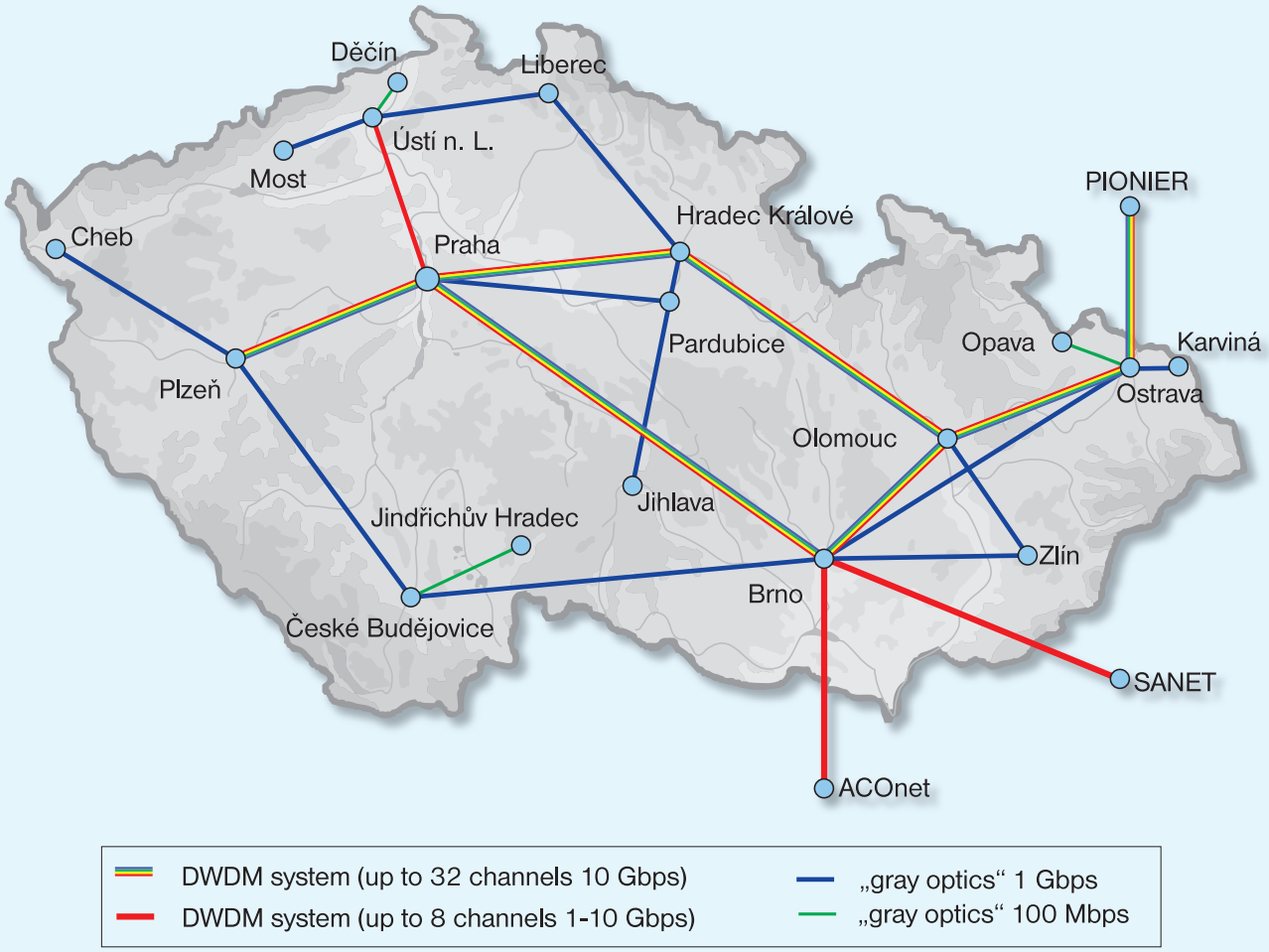
An integral part of this activity is the cooperation with the GÉANT2 network as well as with other European NRENs to ensure interoperability, essential for the provision of advanced services in the international scope. Encompassing more than just the research and implementation of new technologies, this activity includes also all supportive activities needed to provide quality and stable services for other activities and users.

In 2006, we have completed next phase of the backbone network transformation to a hybrid network, capable of providing its users also with dedicated optical links between specific terminal points, in addition to the classic IP connectivity. The optical infrastructure topology of the CESNET2 network at the end of 2006 is shown in Fig. 2. This topology includes those CESNET2 nodes that are connected using optical fibres and fitted with equipment of the CESNET Association. A transfer DWDM system, enabling transfers at 10 Gbps on up to 32 channels, is implemented in the circuit Prague – Hradec Králové – Olomouc – Brno – Prague and the routes Prague – Plzeň, Olomouc – Ostrava. This system is also installed on the route Ostrava – Těšín, where it was connected at the beginning of 2007 to the DWDM system of the Polish national research network, PIONIER, as the first Cross Border Fiber (CBF) circuit within the GN2 project. The transfer DWDM system is fitted with equipment enabling software channel configuration, making it possible to set up optical channels interconnecting nodes or terminal devices at distances of up to 1,000 km. Three additional circuits, Praha – Ústí nad Labem and routes to the SANET and ACOnet networks mentioned below, are equipped with a passive DWDM system. Unlike the previous setup, this system is configured statically, allowing transfers of at most 8 channels within the given optical fibre, with speeds ranging from 1 to 10 Gbps, depending on the device type in use. This system incorporates optical amplifiers developed by the Association as a part of the "Optical Networks" activity. The route Praha – Ústí nad Labem currently uses 2 channels with the transfer rate of 1 Gbps whereas channels



at the other two routes equipped with this technology transfer data at 10 Gbps. The remaining optical transfer routes operate in the "gray optics" mode for the time being, meaning that only a single transfer channel can be established in one fibre.

Fig. 2 CESNET2 OPTICAL INFRASTRUCTURE AND FIBRE FITTING METHODS AT THE END OF 2006



The international connectivity of CESNET2 was upgraded several times in the course of 2006.

- At the beginning of the year, we increased the speed of our connection with other European NRENs from 2,5 Gbps to 10 Gbps. This upgrade has been done while migrating our connection with these networks from the GÉANT network to the GÉANT2 network
- In February, we have increased the speed of our connection with the Slovak SANET network from 1 Gbps to 10 Gbps
- The 10 Gbps CBF circuit Brno – Vienna was put into service in October, interconnecting the CESNET2 network with the Austrian national research network, ACOnet. This route has been fitted with CLA PB02 amplifiers developed by the CESNET association within the "Optical Networks" activity. The route is a part of the triangle interconnecting the following research networks: CESNET2, SANET (Slovakia) and ACOnet (Austria). This topology and the configuration of active elements in use make the mutual interconnection of these three networks immune to a failure of one of the routes
- In November, we upgraded the speed of our direct connection to the Polish Pionier network from 1 Gbps to 10 Gbps

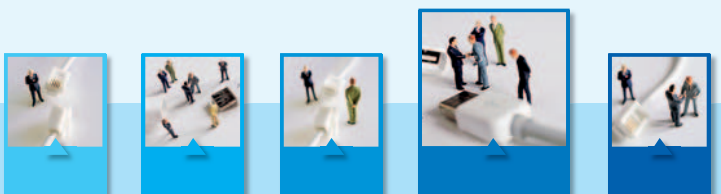
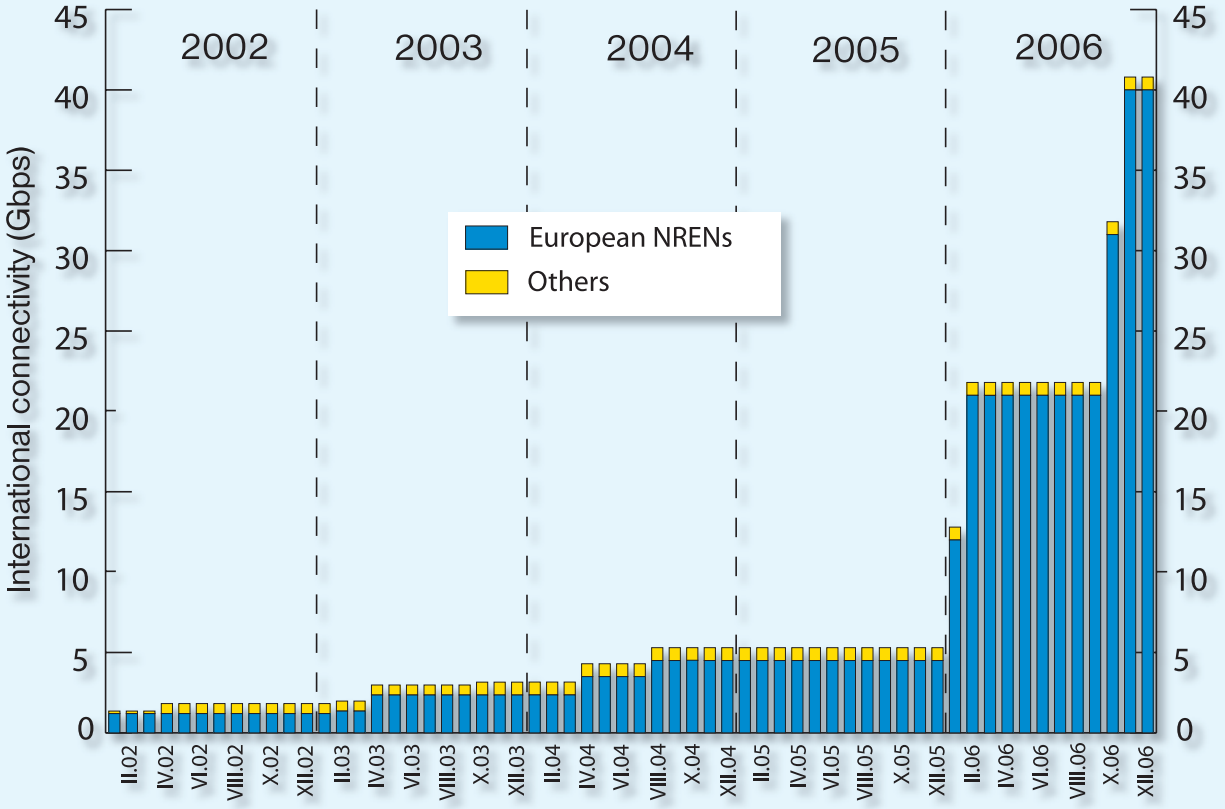


Fig. 3 INTERNATIONAL CONNECTIVITY DEVELOPMENT FROM 2002



The GÉANT2 environment does not provide only the IP connectivity. Subscribers of the GÉANT2+ service, including CESNET2, are also provided with dedicated optical links (so-called End-to-End or lambda services) for needs of research projects generating mutual exchange of high data volumes.

If such services are to be provided to a specific user, the CESNET Association of course needs to ensure a connection to a terminal point located in the terminal location of the connected user, with an appropriate technical level.

Fig. 4 shows a scheme illustrating the interconnection of CESNET2 and GÉANT2. The GÉANT2 node for the Czech Republic, located directly in the Association's premises in Prague, belongs to the highest category of GÉANT2 nodes, i.e. nodes providing connected NRENS – in addition to the "classic" IP connectivity interface – also with an interface for provision of lambda services. In the case of the Prague node, both interfaces have the type 10 GE LAN PHY.

In 2006, we have implemented the following lambda services:

- Direct connection of a workplace of the Institute of Physics of the AVČR, Na Slovance 2, Prague 8, with the Tier2 center of the LHC (Large Hadron Collider) project in Institut für Wisseschaftliches Rechnen (IWR) in Karlsruhe with a dedicated optical channel offering the transfer rate of 1 Gbps. This connection serves needs of our physicists when evaluating results of LHC project experiments
- Praha – Amsterdam connection maintained by an optical channel with the speed of 10 Gbps, reserved for interconnection with the global experimental infrastructure GLIF (Global Lambda Integrated Facility)

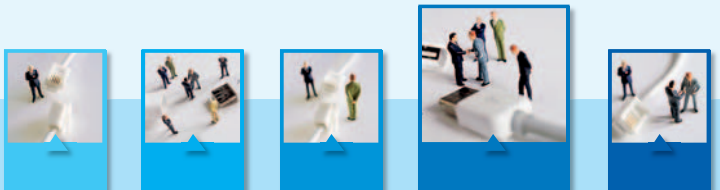
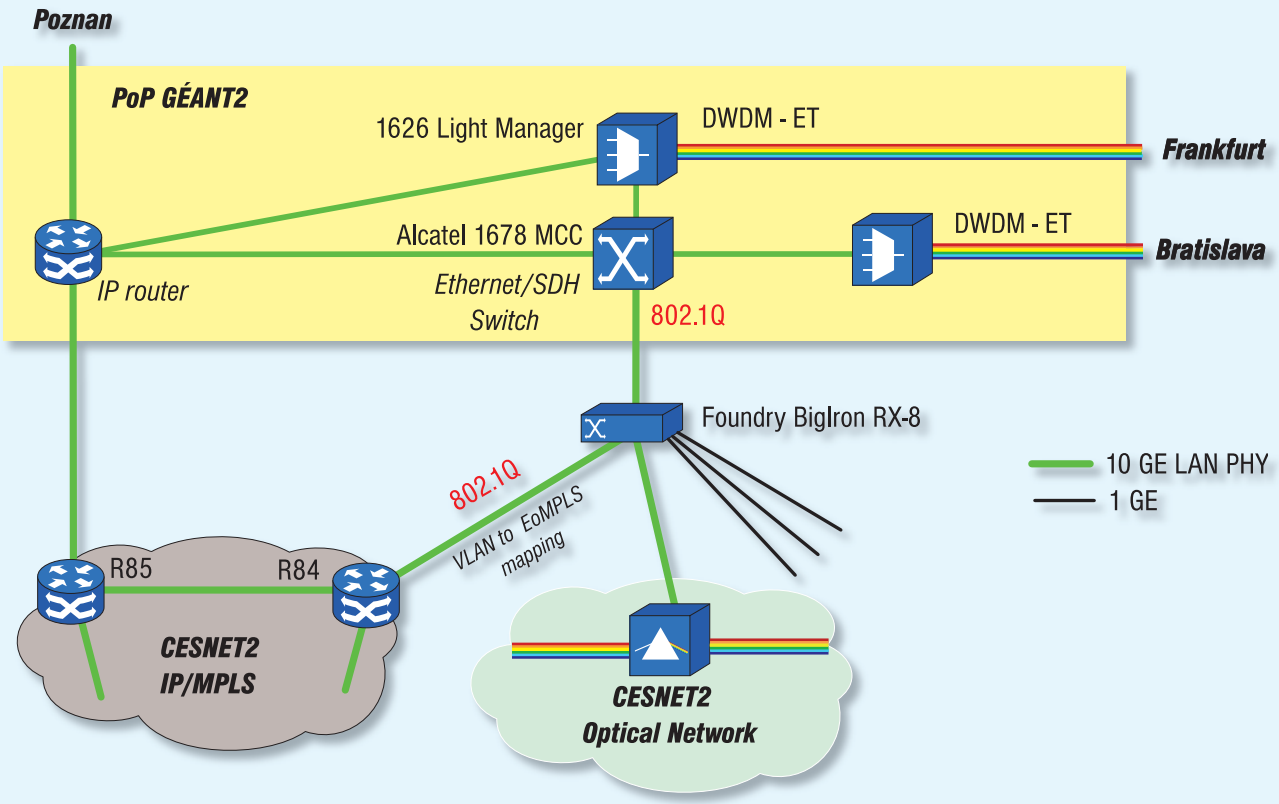


Fig. 4 GÉANT2+ NODE TOPOLOGY IN PRAGUE



Optical Networks

The Optical Networks activity deals mainly with the research in the CEF Networks (Customer Empowered Fiber Networks) implementation area, particularly with data transfer methods and transfer devices development. Other areas of interest include aerial optical transfer methods and cooperation on the development of new applications utilizing GLIF. Research results are tested both under laboratory conditions and within extensive experimental and subsequently also production networks. For this purpose, there is an optical laboratory available for this activity in the premises of the Association. 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.

Our achievements in the area of the development of customer optical devices include real-operation functionality testing of an optical amplifier we had developed (CLA – CzechLight Amplifier), performed at several routes. These devices are protected from November 2006 with the utility model no. 16952, "Modulární stavebnice zařízení pro optické zesilovaní signálů" ("Modular Construction Kit for Optical Signal Amplification Devices"). A licence contract has been signed with two entities for further production of these devices.

Programmable Hardware

The objective of this activity is to develop specialized network devices based on programmable hardware, especially gate arrays.

In 2006, the main priority within this activity was to develop a probe for passive monitoring, FlowMon, which would provide statistic data on IP flows, based on the Cisco Netflow protocol, in high-speed

networks. This probe awakened quite an interest especially in the international GN2 project.

Other applications of the programmable hardware developed within the research plan are as follows:

- Liberouter router – a multigigabit router for IPv6 and IPv4, based on the PC platform
- NIFIC – development of a network adaptor featuring hardware packet filtering, i.e. state-free firewall
- IDS probe – a device for detecting harmful network traffic (NIDS – Network Intrusion Detection System) that will allow timely response to attacks, preventing them in the initial stage

In 2006, development of the universal firmware platform NetCOPE (Network COMBO Pipe) started, too. The key motive behind this project was the need to create an infrastructure inside an FPGA chip that would allow for fast development of network applications.

Network Infrastructure and Traffic Monitoring

Within this activity, we are dealing with the design, development and utilization optimization of the means for systematic long-term and large-scale monitoring of network processes. We concentrate on two main fields of issues.

In the infrastructure monitoring area, we focus on development of monitoring systems that collect, process and present information obtained from active network elements (routers, switches etc.) and analysis of network infrastructure behavior trends from the long-term perspective. The main source of status information for all network infrastructure elements is *SNMP (Simple Network Management Protocol)*. The added value we provide results from our search for non-standard methods for processing and providing the information obtained in this way. At the same time, we endeavor to offer a comprehensive and mutually linked view of the network infrastructure elements, meaning that in addition to the traditional load characteristics and network utilization characteristics we implement also other groups of information – such as quite detailed error rate trends (including topology-dependent data) or signal quality and level trends in the optical part of the transfer infrastructure etc.

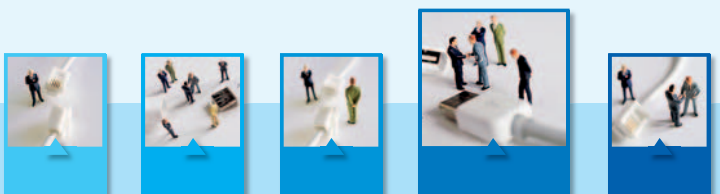
In the traffic monitoring area we perform analysis of what is transferred through the network infrastructure. Here we concentrate on the IP traffic (IPv4 as well as IPv6) and processing of NetFlow traffic logs, describing the traffic in an aggregated form. Our primary source of NetFlow information are the backbone routers of CESNET2 and FlowMon probes developed within the Programmable Hardware activity. Our goal is to gradually develop a flexible and scalable solution in a distributed architecture that would provide a wide range of IP traffic information. With this respect, we focus more and more on supporting the area of security issues and network incidents.

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

Within this activity, we deal with the research and development the purpose of which is to find mechanisms to ensure the performance characteristics required for transferring data in large high-speed networks. In particular, 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.

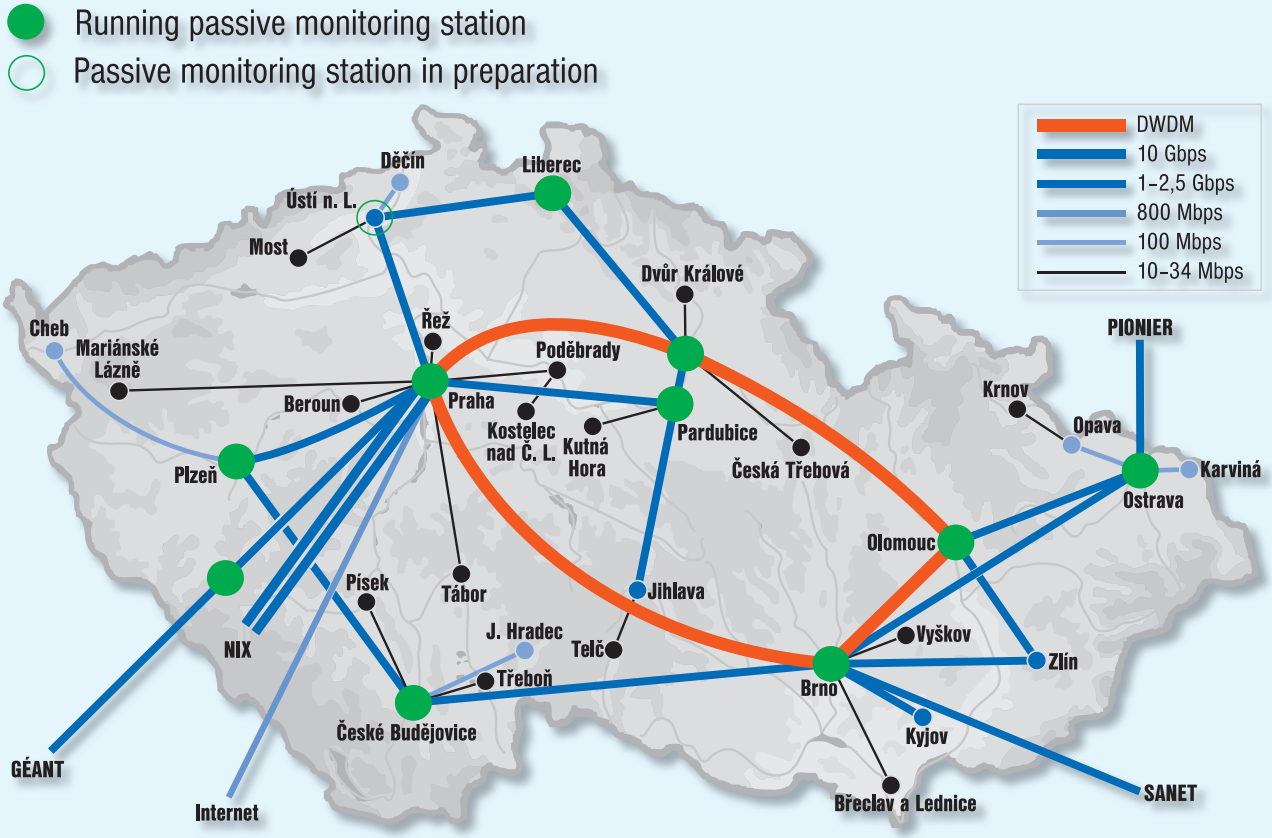
In the passive monitoring area, where no testing data is sent by monitoring devices to the network but user traffic characteristics are evaluated directly, we created the *ABW* (Available Bandwidth) application in 2006 in order to monitor line load details. In comparison with the traditional line load monitoring via the SNMP protocol, this application provides the following additional information:

- load distribution among protocols of different OSI model layers (L2, L3, L4 and application protocols), including protocols using dynamic ports
- load measurements performed in short time intervals (1 second or less) to detect peaks



This application was deployed at ten monitoring stations within the CESNET2 network, monitoring various points of access to this backbone network. One of the stations is reserved for monitoring the line to the GÉANT2 network. The location of stations is shown in Fig. 5.

Fig. 5 DEPLOYMENT OF THE *ABW* APPLICATION IN CESNET2

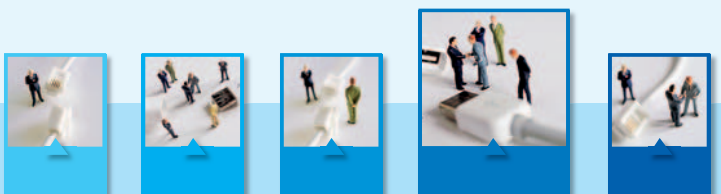


Accurate time synchronization needs to be ensured at each of the stations, which is crucial for some of the measurements. That is why we have installed GPS receivers at 8 of these nodes and also operate our own primary NTP servers. Since regular NTP service monitoring tools (e.g. Nagios) cannot provide the information to evaluate the time synchronization accuracy, we have created our own system for the NTP service monitoring.

In orded to optimize performance characteristics, we have developed an integrated toolkit with a shared user interface named *tbwtools*, which make it easier to fine-tune performance issues of TCP transfers. The user interface is implemented in Java as a web browser applet. Its use is divided into two stages. The user establishes a testing connection first, proceding by creating charts illustrating characteristics of this connection.

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. This infrastructure should be utilized mainly by web applications, connectivity provision services in host networks (roaming), and some IP telephony services (user registration, output of calls to the public telephone network). The basic requirement for the being 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* international initiative, enabling mobility of participants working also on the international level.



The CESNET CA certification authority is operated under this activity, maintaining about 700 active certificates at the end of 2006. Approximately 400 of these certificates are server certificates; the rest are personal certificates, belonging mostly to grid users and server administrators. In the server certificate issuing area, we have made SCS service (Server Certificate Service) available to our members, which originated as a result of a shared project of several NREN operators under the patronage of the TERENA association. CESNET Association members can thus obtain for their services server SSL/TLS certificates issued by GlobalSign, which are trusted by default by most of the internet browsers, e-mail clients and other application programs.

Significant efforts were put in continuing preparations of the Czech academic identity federation in 2006. A work group has been established to prepare the federation with participation of employees from nine Czech academic institutions (CESNET, Czech Technical University in Prague, Masaryk University, State Technical Library, Technical University in Liberec, University of Jan Evangelista Purkyně in Ústí nad Labem, Charles University in Prague, Institute of Chemical Technology in Prague, University of West Bohemia in Plzeň). The main areas of the group activities included development of local identity management systems (IdMS), deployment and development of local authentication and authorization systems, selection of the federation software, and unification of the attribute scheme.

One of the most successful recent implementations of the federated architecture is probably the *eduroam* project, providing connectivity to mobile users in over 30 countries. European coverage of the *eduroam* system is illustrated in Fig. 6.

Fig. 6 EUROPEAN *EDUROAM* COVERAGE

On the national level we concentrated in 2006 primarily on the technical infrastructure stabilization. Wider spread of the roaming system was also supported by subsidies from the Ministry of Informatics of the Czech Republic for the **Project for Supporting the Network Infrastructure within the eduroam Academic Roaming System** the CESNET Association received within the high-speed Internet deployment support program. This project allowed extending eduroam to 29 more localities of the Association members.

MetaCentrum

This activity deals with the development and management of the Czech academic grid environment and related research in selected areas. The task of MetaCentrum is to create a unified integrated environment for end-user applications using an intelligent interconnection of computing and data resources – a grid. Activities within MetaCentrum are closely coordinated with other activities within the research plan of the CESNET Association, mainly in the area of the security and management of access to resources, as well as with international grid construction and development activities, especially the Association's intensive participation in the implementation of the pan-European EGEE II project.

Research activities of MetaCentrum are focused on the distributed computing and data infrastructure monitoring area. Models, methods and tools for continuous and ad-hoc-initiated monitoring of the status of the grid and its individual components and services are developed within MetaCentrum. An important part is also the monitoring of the state of user jobs while these jobs proceed through the grid.

Operation-oriented activities then include mainly the user support, provided mainly in the form of the MetaCentrum portal and Charon system development, and further development of the user request management system including communication with users and handling of user requests. Another part of these activities is the security infrastructure development, especially the continuing support for use of hardware tokens, development of the certificate hadling, and creation of a Single Sign-On environment. The computing capacity of MetaCentrum has been increased by purchasing a new cluster and a multiprocessor server and integrating user clusters in the MetaCentrum environment.

Virtual Collaborative Environment

The area of interest of the CESNET Association within this activity are the issues bound to the transport and sharing of multimedia data in high-speed network environments, which can be dividied into two basic categories:

- synchronous interactive communication such as videoconferencing, telecoconsulting or interaction with remote applications
- unidirectional multimedia content spreading, i.e. streaming

The research in the interactive communication field focused in 2006 primarily on the area of network distribution elements allowing high-performance, robust and user-controlled synchronous processing and distribution of multimedia data.

Deeper integration of both signalling protocols supported (H.323 and SIP) was achieved in 2006 in the production videoconferencing infrastructure of the CESNET Association. Our current infrastructure makes it possible to perform mixed multi-point video conferences via MCU (Multipoint Conferencing Unit), using a shared numbering plan. Moreover, we have added two new types of stations to our portfolio of terminal videoconferencing equipment, capable of supporting video conferences in the HD resolution (1280x720p).

In the streaming area we dealt with issue of indexing and searching in multimedia files. We are currently indexing over 7 million unique multimedia file addresses. Our interests also cover HD video content streaming options and audio content spreading, including implementation of a multi-channel audio streaming system.

The CESNET Association regularly participates in projects of the multimedia group in Český rozhlas. In recent years, these projects involved live broadcasts from nesting localities of protected bird species or broadcast of the unique birth of a rare kind of the white rhinoceros. This year's multimedia project of Český rozhlas Leonardo Odhalení **(www.rozhlas.cz/odhaleni/portal/)**, was very successful as it won the

prestigious Wildscreen contest in the ARKive Interactive Awards category. Accepted as an analogy of the film Oscars, this largest and most prestigious show of nature films and projects takes place every two years in Bristol, UK.

IP Telephony

One of the applications that are currently getting more and more popular in the IP networks environment are voice services – the IP telephony. Since these services represent one of the integral components of a virtual cooperation environment, we pay due attention also to this application. On that account we deal with development in the following areas:

- implementation options of new protocols and services
- IP telephony support
- integration and NGN (SS7) technology
- monitoring and optimization of service quality parameters
- issues bound to the decentralized IP telephony architecture and its security
- ENUM

Research results from the area are automatically implemented in the IP telephony infrastructure owned by the CESNET Association. 1.25 million calls with the total duration of 3.9 million minutes (65,000 hours) were routed through elements of this IP telephony network in 2006.

Distance Learning Support

The basic objective of this activity was to raise the electronic education support quality at universities, making maximal use of existing options in the area of progressive network and local digital technologies. The activity concentrated on two critical missions in 2006. The first was to design and deploy a system for synchronizing video recording of lectures and seminars with accompanying text/audio materials. The second was to create an integration platform for national activities in the distance learning area. To be more specific, this meant development of the eLearning.cesnet.cz portal including the launch of an e-zin. At the close of 2006 we decided to terminate our activities in this area.

CESNET CSIRT

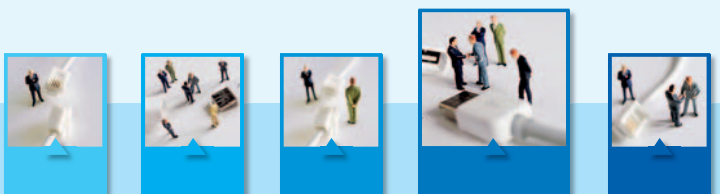
The objective of the CSIRT activity (Computer Security Incident Response Team) is to achieve a better internal organization level in the area of the security of the network and provided services, appoint a team of workers dealing with these issues, and reach certain coordination while handling security incidents and anticipating such incidents within organizations connected to CESNET2.

Administrators and users of networks and computers need to be ready for potential security compromising of these systems, having functioning structures, efficient procedures, rules and technical means at hand, leading to the fastest removal of all issues possible while minimizing the damage incurred. This is why we focused – concerning the development of a security strategy for CESNET2 in 2006 – on creation of formal rules and procedures to handle security incidents in the form of two documents: *Incident Response Policy and Incident Handling Policy.*

In the field of IDS system (Intrusion Detection System), we continued this year in developing programs to analyze data obtained from the LaBrea server in the Dejvice network of the CESNET Association. This machine records and blocks attacks directed to the yet unallocated address space of CESNET. Data on the attacks recorded are processed twice a day (only on workdays), followed by automatic distribution of notifications to administrators of those CESNET2 subnetworks where the attacks originated. In 2006, our system recorded 720,000 attack attempts from 320 IP addresses in the CESNET2 network, sending notifications to 269 network administrators.

Medical Applications

This activity aims to accelerate use of information and communication technologies in the medical area, as this area proves to be a source of interesting applications requiring a very high quality infrastructure and high transfer rates.



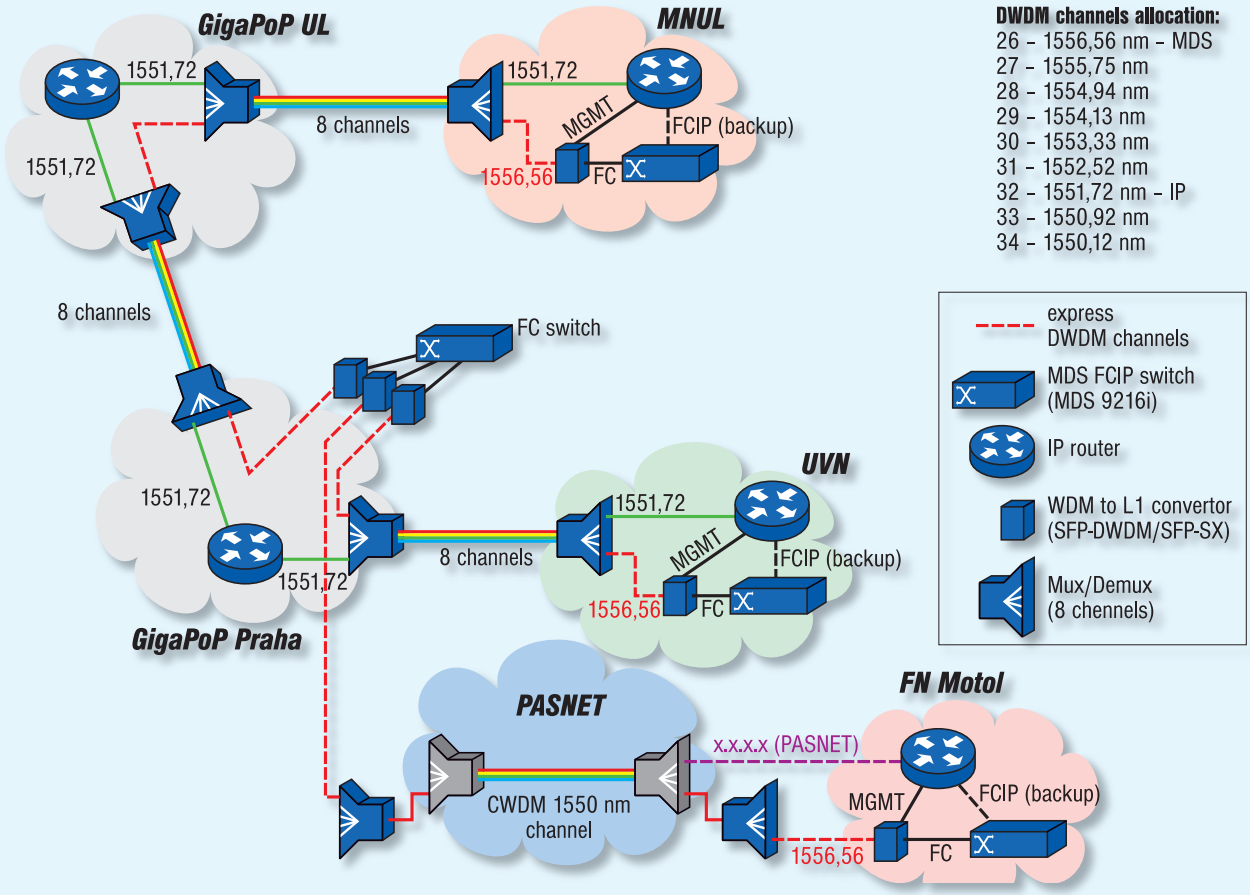
This activity involved in 2006 creation of a pilot private infrastructure among selected hospitals on the level of an optical interconnection for needs of secured transfers of medical image data between data centers of the participating hospitals. Schematics of this interconnection are provided in Fig. 7.

Another project in this area is the MediMed project dealing with authorization and authentication of access to medical image data stored in the regional PACS archive. Within this activity, an application is being developed in cooperation with the Masaryk University and Thomayer Hospital in Prague to enable tuition related to the medical data.

At the end of March, pilot operation was launched at the NETC@RDS workplace in hospitals in Znojmo and Hodonín. **The NETC@RDS** project concentrates on utilization of information and communication technologies for administrative procedures carried out in public health insurance companies and health care providers in connection with health care provision to citizens of EU countries travelling or temporarily living in an EU country different from their country of residence. Within the Medical Applications, the CESNET Association ensures operation of the NETC@RDS project national server and the respective communication infrastructure.

Another area of interest for those involved in this activity is the network utilization for visualization and processing of medical 3D models.

Fig. 7 POSN, PRIVATE OPTICAL NETWORK OF HOSPITALS



The above characteristics of individual research plan activities and the 2006 activity overview are merely informative. Detailed information on the progress of the research plan implementation, structured by these activities, is included in the publication titled "Optical National Research Network and Its New Applications" from 2006, the electronic version of which is available at **http://www.cesnet.cz/doc/2006/zprava/.**

4.1.3. Evaluation of Research Plan Results Achieved in 2006

The evaluation of results of the "Optical National Research Network and its New Applications" research plan achieved in 2006 was carried out within a regular opposition procedure, prescribed by MŠMT as the institutional support provider, on 5 February 2007. According to the conclusions of the board of opponents, comprising top experts from the area of information and communication technologies, the research plan in 2006 has been implemented with a very high professional level and the results achieved reach the world level. Important aspects include the considerable application impact of these results for research teams dealing in the Czech Republic with research in other areas, utilizing the high-speed network for communication and cooperation.

The board of opponents also stated that the objectives defined for 2006 have been met, with the exception of the OCSP (Online Certificate Status Protocol) service deployment. Concerning this objective, the technical solution for the CESNET2 network environment has been designed, tested and made ready. However, due to the continuity with other European national research and education networks, the researchers handling this solution have decided not to launch the service until the first half of 2007.

The board of opponents appreciated the fact that the research plan implementation team participates in relevant international projects in the given area, in particular the GN2 and EGEE II projects. In addition, representatives of the CESNET association – Ing. Jan Gruntorád, CSc., and Doc. RNDr. Luděk Matyska, CSc. – are members of management committees of these projects, which clearly indicates the level of the implementation team and its recognition abroad.

For the upcoming period, the board of opponents recommended the implementation team to continue transferring results of various activities into practice, as in the successful case of the CLA optical amplifier (see the Optical Networks activity), protecting these results with utility models and patents.

4.1.4. Research Plan Strategic Goals for 2007 - 2010

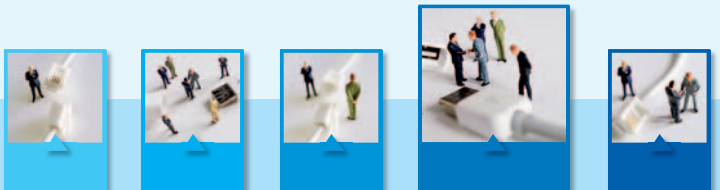
The proposal of the research plan "Optical National Research Network and Its New Applications" was created in 2003, for the period from 2004 to 2010. It was obvious even then that because of the rapid development in the network technology area it is impossible to predict the development for more than three or four years in advance, meaning that the generally defined research plan objectives for the period from 2007 to 2010 will have to be detailed as the works progresses. The leader of the research plan implementation, Ing. Jan Gruntorád, CSc., as well as key implementers therefore met between September and November at three professional meetings (2 two-day meetings and 1 one-day meeting) to set strategic objectives of the research plan for the period of 2007-2010 and plan activities for this period. Main outcomes of these meetings follow:

In the n**etwork area,** we will focus on:

- **applied research in the field of optical networks,** especially research and verification of theoretical principles and technological trends such as "All Optical Networking", network infrastructure virtualization principles, development of proven concepts such as "Customer Empowered Networks", "Nothing in Line" and "Cross Border Fiber", and prerequisites for provision of End-to-End services and on-demand bandwidth provision
- **network security and robustness,** representing verification and implementation of advanced solutions and network technologies, research in the area of adaptive systems for automatic detection of anomalies and problematic network conditions, and development of mechanisms to obtain network status information
- research of mechanisms for **managing large optical networks,** including methods for monitoring network and its performance characteristics or tools enabling network reconfiguration (with respect to Bandwidth on Demand and End-to-End services)

In the **network services area,** we plan to research mainly the following aspects:

- possibility of development of a **federative authentication and authorization infrastructure** for the academic community



- **End-to-End Performance,** i.e. development of tools to increase the network utilization efficiency for specific applications and users, including development of tools for monitoring performance characteristics of the network and revelation of weak points
- mechanisms to ensure **network security** from the end user perspective, concerning both prevention of security attacks and their detection with subsequent coordination of security incident handling

In the **application** area, we have the following plans:

- continue developing **METACentrum** including its connection to international computing grids
- develop the existing **remote cooperation infrastructure** and increase the convergence of data, voice and multimedia services
- analyze **high quality voice and video** transfer options, both in the synchronous (videoconferencing) and asynchronous (streaming) mode
- locate and support **applications with specific or non-trivial requirements for the network;** examples of such applications currently include some applications from the field of **medicine**

In the **programmable hardware** development area, we will keep on designing special network devices based on requirements of other research plan activities. This involves mainly development of the NetFlow monitoring probe, a detector for locating network security breaches, or HW accelerators for needs of variuous applications.

4.2. INTERNATIONAL COOPERATION

4.2.1. 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 are involved in works on the project. The goal of the project is to provide European research and education institutions with a communication environment until 2008, capable of meeting their requirements from ensuring mobility in the European Research Area (ERA) to providing reserved high-capacity connections between specific terminal devices.

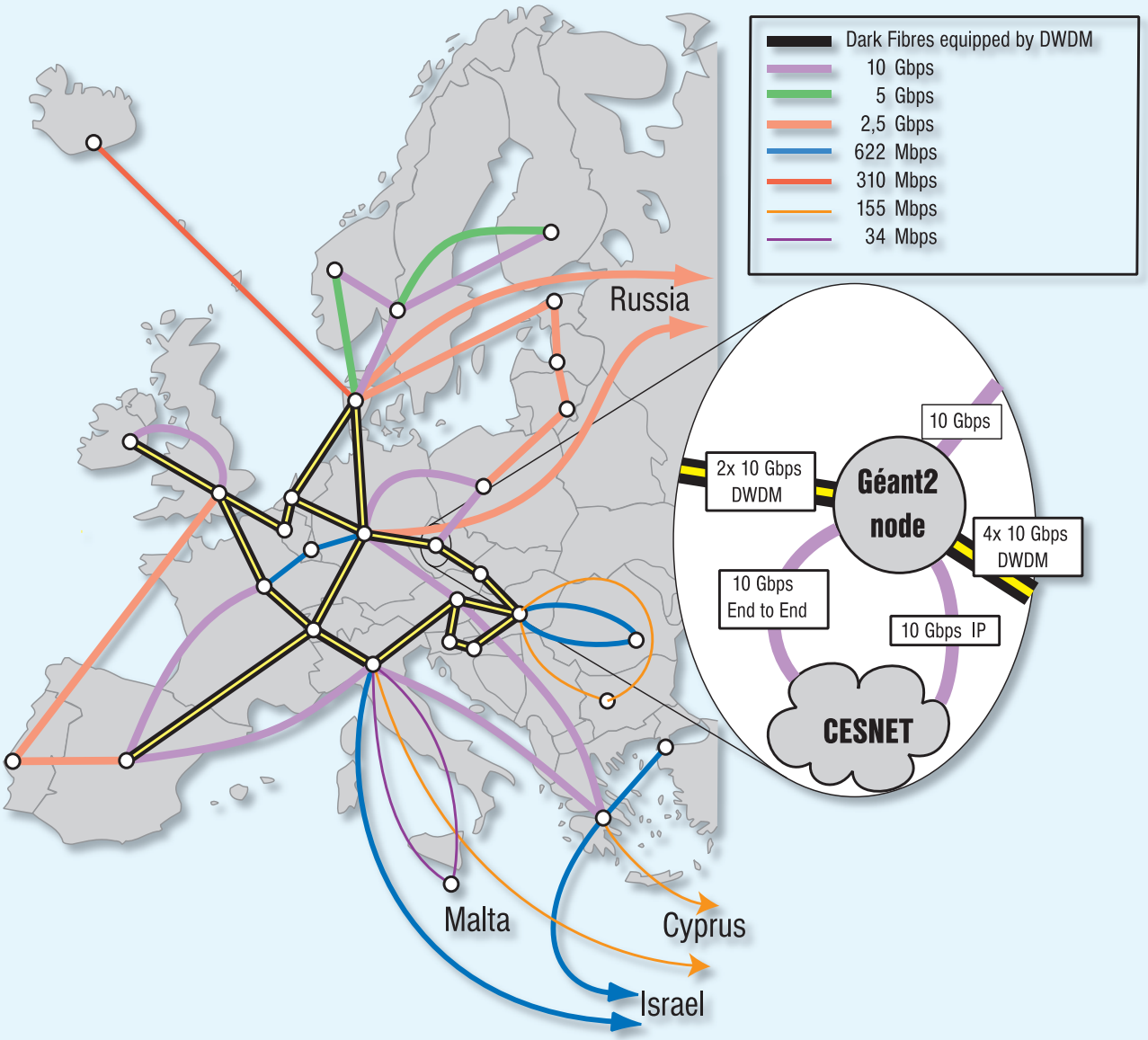
The basis for the aforementioned communication environment is the backbone network named GÉANT2 (see Fig. 8 for the network topology). This network has been designed as a hybrid network since the very beginning, meaning that it will support – in addition to the basic IP communication – also creation 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).

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 Fibre) model for border connections of neighboring NRENs via dark fibres
- development of an authentication and authorization infrastructure to support the user mobility

Detailed information on the project is available at **www.geant2.net.**

Fig. 8 GÉANT2 TOPOLOGY IN NOVEMBER 2006

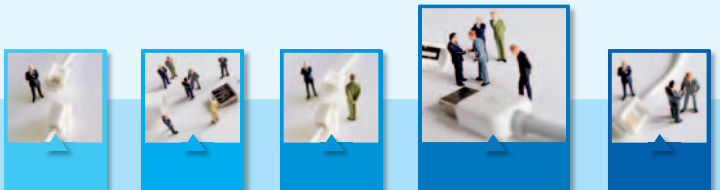


4.2.2. EGEE and EGEE II

Another project of the 6th EU Framework Program where the Association participated was the EGEE (Enabling Grids for E-Science and Industry in Europe) project, aiming to create and operate an extensive pan-European grid. The CESNET Association joined the efforts to develop middleware for this project. The project was successfully completed in March to be followed in April by the EGEE II project, with the objective to take the EGEE infrastructure development further. Our participation in this new project seamlessly connects to the work done within the EGEE project.

In the grid middleware development area, the Czech group continues to be responsible for the Logging and Bookkeeping (LB) service, the purpose of which is to monitor grid tasks, presenting their status to users. In 2006, we carried out regular maintenance activities (error corrections) in the appropriate extent. We have further optimized the service, reaching the total throughput of one million typical tasks per day (about 12 tasks per second) in a single service instance.

Our second service under development is the Job Provenance (JP) service. This service should enable long-term archiving of data on the tasks performed, searching through this data, and repeated task execution. JP is incorporated in the gLite middleware version 3.1, completed in December 2006.



CESNET has a significant share also in the grid operation, management and support. CESNET is responsible for the VOCE environment, which is a virtual organization gathering resources available in the Central European federation and making them accessible to users regardless of their application preferences.

CESNET is further responsible for the grid incident response team for the Central Europe. We take part also in a long range of additional operation activities, including management of a number of basic middleware services. Besides, we pay considerable attention to our participation in NA3 (training) and NA4 (application support). Within NA3, we organized further training session of EGEE users in December. We try to provide information about EGEE to the largest community possible with other articles and presentations, too. The application support is represented by our development of the Charon system as well as the care we provide to specific user communities. We are currently endeavoring to support communities dealing with particle physics, astronomy and computational chemistry.

More information on the project is available at **www.eu-egee.org.** Specific information about the participation of the CESNET Association can be found at **egee.cesnet.cz.**

4.2.3. LOBSTER

LOBSTER (Large Scale Monitoring of Broadband Internet Infrastructure) is focused on creation of European distributed infrastructure for traffic monitoring in high-speed networks.

Within this project, we take part mainly in works on the data anonymizing issue. We have designed an original method for hardware anonymizing of packets in both network and transport layer and implemented the method in FPGA on the COMBO card platform.

Also, we were charged with coordination of the goals of the Lobster project and the JRA1 activity of the GN2 project, the practical result of which is the ABW application, monitoring the line capacity utilization and distribution of data flows by protocols in the transport or application layer.

More information on the LOBSTER project is available at **www.ist-lobster.org.**

4.2.4. SEEFIRE

Mapping the availability of the optical infrastructure in countries of South-Eastern Europe, this project aims to outline potential strategies for further development of NRENs in this region. Participants of this project include NRENs of countries from South-Eastern Europe, the CESNET Association, DANTE and TERENA. Our task in this project is to coordinate the search for suitable transmission technologies for the region of South-Eastern Europe, processing descriptions and proposals for constructing selected optical lines.

More information is available at **www.seefire.org.**

4.2.5. Porta Optica Study

The aim of this project is to elaborate a study that will evaluate options for constructing networks based on dark fibres for needs of NRENs in the region of Eastern Europe, Baltic countries and South Kavkaz countries. CESNET participates in particular in evaluation of information on possibilities for obtaining dark fibres needed to establish international interconnection of the target countries and preparation of draft solutions for this region.

More information on the Porta Optica Study project is available at **www.porta-optica.org.**

4.2.6. 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. Besides CERNET, there are six more European NRENs involved in the project plus DANTE. The CESNET Association will invest its experience in the project, gained within monitoring of extensive networks.

More information is available at **www.dante.net.**

4.2.7. Phosphorus

Starting with October, we have been taking share in the construction of a global testbed (Europe-USA-Canada) for testing on-demand network services provision methods in a wide and heterogenous (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 is available at **http://www.ist-phosphorus.eu/.**

4.2.8. EuroCareCF and Ithanet

From April 2006, we are a part of a consortium of two projects from the human medicine area supported by EU – EuroCareCF and Ithanet. The goal of both projects is to create a virtual environment for cooperation and coordination of medical research teams within a large geographic area (the basis is the Mediterranean region), performing research in this area relating to the cystic fibrosis and thalassemia, respectively. We offer for these projects our videoconferencing and multimedia data sharing experience.

4.2.9. Workgroups 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-ECS: issues bound to deployment of advanced remote cooperation technologies, especially voice and video transfers

TF-EMC²: a middleware development platform

TF-LCPM: issues relating to management of the service portfolio provided by NRENs

TF- mobility: development of the *eduroam* roaming system

TF-PR: exchange of information relating to NREN presentation

TF-VSS: works on resolution of the question whether it is purposeful to create a unified European videoconferencing infrastructure

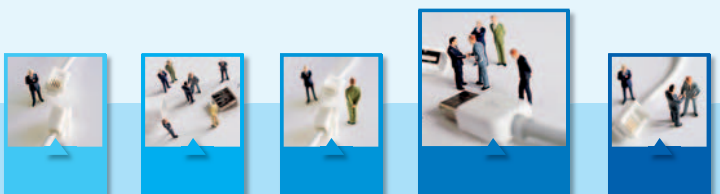
4.3. NATIONAL RESEARCH PROJECTS

In association with the Institute of Radio Engineering and Electronics of the AV ČR and the Faculty of Electrical Engineering of the Czech Technical University in Prague the CESNET Association participates in the project named **Optimization of 10Gbps Data Transfers via G.652 Fibers without Using Line EDFA to Maximize the Transfer Range.** The project is oriented at the analysis of options for increasing the transfer range on lines comprising G.652 and G.655 fibers with transfer rates of 10 Gbps, utilizing the Raman transfer fiber pumping and signal amplification through erbium-doped amplifiers at the terminal points of these lines.

Within the project **Efficient Processing of Medical Image Information,** the CESNET Association together with the Masaryk University and the Masaryk Institute for Oncology in Brno deal with:

- design, development and implementation of resources for integration in the area of acquisition, storage, transfers, and sharing of medical image information
- design of solutions to legislation issues relating to the topics in question
- security of sensitive patient data

The objective of the **MediGrid – Methods and Tools for Utilizing Grid Networks in the Biomedicine** project, 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.



The goal of the collective **Raman Fiber Amplifiers with Time-Multiplex Pumping** project of the CESNET Association and the Institute of Radio Engineering and Electronics of the AV ČR is the theoretical analysis and experimental verification of properties of wideband Raman fiber amplifiers with time multiplexing of pumping sources.

Project for Supporting the Network Infrastructure within the eduroam Academic Roaming System

The association received in 2006, within the support for high-speed Internet deployment, also a subsidy from the Ministry of Informatics of the Czech Republic to extend the eduroam system to the maximum number of academic institutions. The goal of the project was to connect at least 26 organizations to the eduroam project, providing mobile access to about 4,000 new users. In total, 29 organizations have been connected, increasing the number of registered users by about 37,000.

4.4. DEVELOPMENT FUND

In 2006, the Development Fund Council announced two calls for new projects. For the first call, the following thematic group was specified:

- Support of education of the Association member employees with the aim to obtain a world-recognized certificate

9 of 10 submitted projects were accepted for co-financing:

Project Number	Project Executor	Project Name
177/2006	Institute of Economics in Prague	Training provided to professional workers of the Institute, with the objective to obtain the CCNP certificate
178/2006	University of West Bohemia in Plzeň	Obtaining of the Oracle PL/SQL Developer Certified Associate certificate
179/2006	University of West Bohemia in Plzeň	Obtaining of the Oracle Database 10g Administrator Certified Associate certificate
180/2006	Technical University of Ostrava	Implementation of computer network security courses at the regional academy of the Cisco Networking Academy program associated with the University
181/2006	Academy of Sciences of the Czech Republic	Increase in qualification through participation in the Cisco Networking Academy program, with the objective to obtain the CCNA international certificate
182/2006	Academy of Sciences of the Czech Republic	Increase in qualification of an employee of the Biology Center of the AV ČR in the network technology area
183/2006	Technical University in Brno	Increase in professional qualification in the network security and wireless networks area
185/2006	Academy of Sciences of the Czech Republic	Increase in qualification in the network administration area – Cisco technologies
186/2006	Technical University in Brno	Education development in the technical project system management area

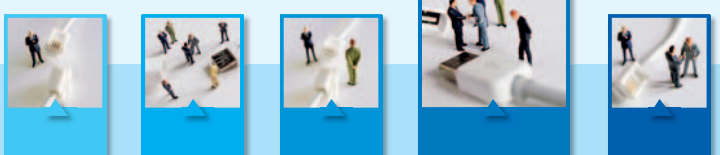
For the second call, the following thematic groups were specified in 2006:

- Utilization of services of the CESNET2 network and modern information and communication 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 using the high-speed backbone network; development of new network protocols.
- Interaction of university networks with public networks.
- Support for convergence of voice and data services
- Completion of wireless networks in connection with the eduroam project

The Association accepted 12 of 27 projects submitted in this call; 8 more projects were accepted after reworking:

Project Number	Project Executor	Project Name
187/2006	University of West Bohemia in Plzeň	Creation of a system to provide access to university qualification works at the University
188/2006	Technical University in Brno	Integration of mobile University networks to the eduroam project
190/2006	University of West Bohemia in Plzeň	Extension of the web-based Single Sign-On infrastructure
191/2006	University of West Bohemia in Plzeň	Deployment of the SIP IP telephony service and convergence of this service with the wireless connection
193/2006	University of Jan Evangelista Purkyně	Development of the University wireless network
194/2006	University of Jan Evangelista Purkyně	Establishment of the "Local Cisco Networking Academy" at the University
195/2006	Academy of Sciences of the Czech Republic	Pilot eduroam project for the Academy site – Mazanka
197/2006	University of Pardubice	Extension of the eduroam wireless infrastructure
200/2006	Technical University in Brno	Network application archive storing medical image data for a virtual technical/medical workplace
205/2006	Technical University of Ostrava	Electronic support for the tuition at the remote Šumperk site
207/2006	Academy of Sciences of the Czech Republic	Wireless network in the Academy Office with direct connection to the eduroam project
213/2006	Technical University of Ostrava	Distributed virtual laboratory of computer networks
189R1/2006	University of West Bohemia in Plzeň	Development of public information sites
192R1/2006	University of West Bohemia in Plzeň	Development of XEN virtual machines
196R1/2006	University of Pardubice	Security policy model solution
199R1/2006	Technical University in Liberec	Development of the University wireless network
201R1/2006	Technical University in Brno	Searching and access to large archives of audiovisual data
203R1/2006	Institute of Economics in Prague	Quality increase of the eduroam wireless network in Institute premises
209R1/2006	Czech Technical University in Prague	Connetion of the NMR laboratory to the hospital information system for educational purposes
212R1/2006	Czech University of Agriculture in Prague	OSPF protocol implementation in the University network

There were two successful rounds of oppositions for projects accomplished in 2006 – 15 projects were successfully completed in total. Final reports for projects implemented within the CESNET Development Fund are available at the Association's website. Results of some projects were also presented within seminars of the community of researchers implementing the research plan of CESNET, professional seminars for CESNET members, seminars of the EUNIS association, the EurOpen conference, and international conferences. The presentation of results included publication is specialized press.



4.5. PUBLIC RELATIONS

The first quarter of 2006 was fully in the spirit of the 10th Association Foundation Anniversary celebrations. The important day was 6 March 1996; the Association therefore organized a symbolic evening party on 6 March 2006 in Obecní dům, with participation of significant domestic and foreign guests (see Fig. 9). The invited included participants from the professional international conference CESNET Conference 2006, which took place from 7 to 8 March in the premises of the Conference Center of the Charles University in Prague. Over 100 professionals from 15 countries took part in the conference, which was opened by the Minister of Youth, Education and Sports of the Czech Republic, Petra Buzková (see Fig. 10 and 11). Concerning the professional branches, lectures at the two-day conference covered a very wide range of issues – from physical processes occuring within optical signal transfers and amplification up to highly-specialized distributed network applications. Records and presentations of lectures including photos are available at the Association's website at http://www.ces.net/conference06/prog/. Conference participants also received a printed version of proceedings titled "CESNET Conference 2006: First CESNET Conference on Advanced Communications and Grids". A unique video conference was carried out during the conference, using the high-definition (HD) video transfer. This was the first public demonstration of this type of a video conference in the Czech Republic ever and one of the first demonstrations within Europe. In connection with the conference, the CESNET Association published three press releases and a special issue of Datagram. Throughout 2006, the Association distributed its Czech/English publication titled "CESNET – 10 let/10 years of CESNET", the content as well as interesting graphic design of which is attractive also for the general public.

Fig. 9 CELEBRATORY EVENING ON THE OCCASION OF THE 10TH ASSOCIATION FOUNDATION ANNIVERSARY, 6 MARCH 2006

Fig. 10 CELEBRATORY OPENING OF THE CESNET CONFERENCE 2006, 7 TO 8 MARCH 2006

In May 2006, the Association hosted (for the third time now) representatives of research networks from Europe, United States and Canada at the CEF (Customer Empowered Fibre) Networks Workshop to let them exchange experience in the area

Fig. 11 CESNET Conference 2006, 7 to 8 March 2006

of design and operation of this type of optical networks and formulate main policies for their further research and development (see Fig. 12).

Fig. 12 CEF NETWORKS WORKSHOP, 29 TO 31 MAY 2006

As in the previous years, the Association organized also professional seminars intended mainly for domestic participants from the community of Association members and the professional public. The seminar topics follow: IP telephony (see Fig. 13), grids, ID card applications (see Fig. 14), e-learning, voice recognition, and automated processing of lecture video records.

Although the general public is not the target group of the Association's PR, it is undoubtedly positive that the Association managed to penetrate to the mainstream media, such as radio and TV in 2006. Česká televize (Czech TV) broadcasted on 13 February on the ČT24 channel in the program "Před polednem" an interview with the Association director. The topic of the program was the 14 years of Internet in the Czech Republic. On 2 October, two association representatives took part in a discussion with the topic "Vědecká komunikace včera a dnes" (Past and Presence of the Scientific Communication) within the program "Třetí dimenze" broadcasted by Český rozhlas (Czech radio) on the Leonardo channel. A large part of the discussion was dedicated to the Association's research activities. On 8 November, Česká televize broadcasted on the ČT1 channel in the program "České hlavy" the document "Přenos s vysokým rozlišením" (High-Definition Transfer), dedicated to one of the research activities of the Association relating to HD transfer options.

Results of the research activities of the Association were published in classic and electronic versions of specialized magazines as well as internal university bulletins. During the year, three new issues of the Datagram magazine were published, containing information relating to the CESNET2 network construction, research plan implementation, and other news concerning the activities of the CESNET association. Two special issues were dedicated to the announcement of the calls to submit draft projects for the Development Fund of the CESNET association. An electronic version of the magazine is available at: **http://www.cesnet.cz/doc/datagram/.** The Datagram is published and distributed in the printed form, too.

Fig. 13 IP TELEPHONY SEMINAR, 3 NOVEMBER 2006

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.

The Association makes use of the feedback represented by regular media monitoring. Monthly analyses of these outputs confirm the stable richness of the media outputs, which we managed to extend in 2006 also to the largest mass media such as radio and TV.

Fig. 14 ID CARD APPLICATIONS IN UNIVERSITY ENVIRONMENTS SEMINAR, 29 JUNE 2006

5

Economic Results

CESNET

5. ECONOMIC RESULTS

5.1. 2006 ECONOMIC RESULTS

Activities of the CESNET Association are divided into two categories – Main Activities and Economic Activities, in compliance with the Association's statues.

5.1.1. Main Activities

The most important share of the Main Activities in 2006 was the implementation of the "Optical National Research Network and Its New Applications" research plan, launched on 1 January 2004. The MŠMT ČR provided its institutional support (operation subsidies) for this research plan, amounting to 57 % of all yields from the Main Activities in 2006. 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, providing services to other entities meeting conditions required to be connected to this network, and cooperating on implementation of international research projects of the 6th EU Framework Program, grants of the AV ČR and projects of the Development Fund Council.

The Main Activities of the Association ended in 2006 with a book loss of 8,108,000 CZK. Yields from the Main Activities of the Association in 2006 amounted to 342,049,000 CZK; costs for the Main Activities reached 350,157,000 CZK.

The basis of the income tax from the yields of Main Activities of the Association in 2006 was positive, amouting to 13,157,000 CZK.

5.1.2. Economic Activities

The Economic Activities of the Association in 2006 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 2006 with a book loss of 17,596,000 CZK. The Economic Activities of the Association yielded 27,295,000 CZK in 2006; costs for the Economic Activities reached 44,891,000 CZK.

The basis of the income tax from the yields of Economic Activities of the Association in 2006 was negative, amouting to 16,903,000 CZK.

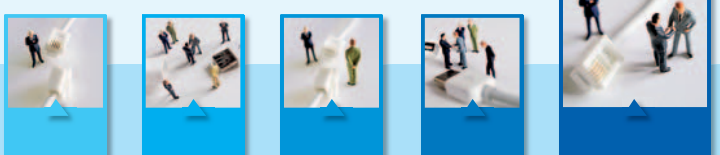
5.1.3. Total Book and Tax Economic Result

The total book economic result of the CESNET Association reported in 2006 was the loss amounting to 25,704,000 CZK.

The total tax economic result is the loss amounting to 3,746,000 CZK. The association does not pay income taxes in 2006.

5.2. CONCLUSION

The Association properly managed the entrusted resources in 2006, meeting all its obligations resulting from the legislation, decisions of the MŠMT ČR and concluded contracts. The financial statement for 2006 was verified by the auditor without any remarks.

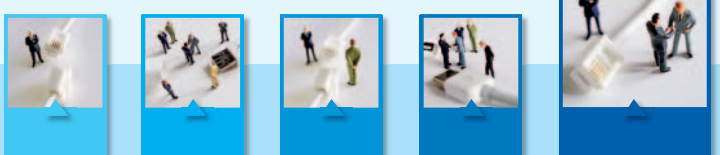


5.3. BALANCE SHEET IN THOUSANDS OF CZK

	2006	2005	2004	2003
Total assets	**741 539**	**711 008**	**683 135**	**646 776**
Fixed assets	410 531	386 821	370 877	359 428
Intangible fixed assets	4 952	6 045	6 613	4 218
Tangible fixed assets	217 591	200 907	170 529	150 722
Financial investments	187 988	179 869	193 735	204 488
Current assets	331 008	324 187	312 258	287 348
Supplies	0	0	0	0
Receivables	32 115	43 746	54 550	222 211
Current liquid assets	264 249	251 854	230 966	26 954
Other assets	34 644	28 587	26 742	38 183
Total liabilities	**741 539**	**711 008**	**683 135**	**646 776**
Own sources	699 578	665 219	652 920	599 032
Funds	660 115	587 091	574 006	484 508
Economic result	-25 704	13 982	-24 104	33 755
Undivided profit from last years	65 167	64 146	103 018	80 769
External sources	41 961	45 789	30 215	47 744
Obligations	38 884	45 274	30 109	39 517
Loans	0	0	0	0
Other liabilities	3 077	515	106	8 227

5.4. PROFIT AND LOSS STATEMENT IN THOUSANDS OF CZK

Index	2006	2005	2004	2003
Earnings for the sale of goods	730	36	113	68
Earnings of own products and services	101 611	104 568	106 585	328 414
Current liquid assets revenues	16 915	9 937	27 986	99 250
Other revenue	54 125	52 196	33 736	49 795
Received membership fees	0	0	0	0
Operational subsides	195 963	229 897	200 524	5 424
Total revenue	**369 344**	**396 634**	**368 944**	**482 951**
Purchase price of sold goods	711	38	104	85
Material and energy consumption	23 545	25 384	13 753	10 476
Purchased services	184 016	209 900	187 972	226 698
Personnel costs	89 016	74 950	61 567	52 100
Depreciation and amortization of intangible and tangible fixed assets	54 297	44 929	50 855	36 192
Other costs	43 463	27 451	78 797	119 384
Income tax – assessment for the current year	0	0	0	4 261
Total costs	**395 048**	**382 652**	**393 048**	**449 196**
Economic result	**-25 704**	**13 982**	**-24 104**	**33 755**
(Revenue – Costs)				



5.5. AUDITOR´S REPORT

R - audit, s. r. o.,
180 00 Praha 8, Na Hrázi 178/25,
Phone: 266 315 971, 604 824 760; fax: 266 315 972; e-mail: palmovka@r-audit.cz
Registered in the Commercial Register kept by the Municipal Court of Prague in Section C Insert 20496 as of 31 May 1993;
Auditor's Licence No. 124

Independent Audit Report
Regarding Annual Financial Statements for the Year 2006

I. Company Data:

1.1. Company name: CESNET, Association of Legal Entities
1.2. Registered office: Praha 6 – Dejvice, Zikova 4/1903
1.3. ID: 63839172
1.4. The report is intended for the members of the association.

2. 1. We have performed an audit of the annual financial statements for the year started 1 January 2006 and ended 31 December 2006, comprising long-form accounting statements (balance sheet and profit and loss statement) and the notes, including description of important accounting methods. Financial statements were drawn up on 24 May 2007 for the period ended 31 December 2006.

2. 2. It is the responsibility of the accounting unit's management to prepare a financial statement that is in compliance with the International Financial Reporting Standards as implemented in the Czech accounting regulations and to give a true and fair view of the reported disclosures. Such responsibility includes an obligation to plan, introduce and cause to perform internal control over the process of drawing up financial statements and reflecting fair view of the reported disclosures so that the financial statements did not contain any material misstatement whether caused by error or by fraud, to choose and implement appropriate accounting principles and to make accounting estimates that are reasonable with respect to the circumstances.

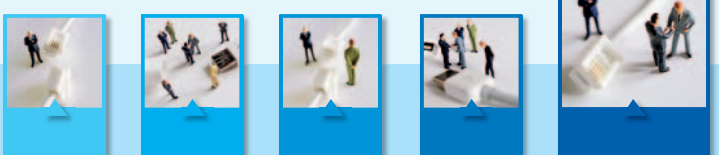
The financial statements reflect the opinion of the accounting unit's management. Auditor's responsibility is to form auditor's opinion on financial statements, basing on the completed audit.

2. 3. We conducted our audit in accordance with the International Standards on Auditing and the Application Guidelines issued by the Chamber of Auditors of the Czech Republic. The above audit standards require that the auditor observe ethical standards and plan and perform his audit so as to obtain reasonable confidence that the financial statements are free from material misstatement.

We have performed audit procedures the aim of which was to obtain evidence relevant to the amounts and disclosures in the financial statements; when choosing the audit procedures, we considered a risk of material misstatement of data provided in the financial statements whether caused by fraud or error. When evaluating the risks and selecting audit procedures, we have also assessed internal controls relevant for the drawing up of the financial statements and for giving a fair view of the reported facts, however, the purpose of the assessment was not that auditor expressed his opinion regarding effectiveness of the accounting unit's internal controls.

An audit further includes assessing of whether the accounting principles used are appropriate and accounting estimates made by the management reasonable as well as evaluating the overall financial statements presentation.

In our opinion, the evidence we have gathered is sufficient and appropriate to provide a basis for expressing auditor opinion.



- - - R – audit, s.r.o. - - -

III. Financial Statement Audit

The financial statements subject to our audit have been drawn up within the framework of the Czech accounting reporting in compliance with the Czech accounting regulations (Act on Accounting, Decree No. 504/2002 Coll., Czech Accounting Standards).
The accounting unit has not the statutory obligation of auditing its financial statements for the year 2006.

IV. Audit Opinion:

In our opinion, the annual financial statements give, in all material respects, a true and fair view of the assets, liabilities and the financial position of CESNET as at 31 December 2006 and of the result of its operations for the year 2006, in accordance with the International Financial Reporting Standards as implemented in the Czech accounting regulations.

Therefore, we hereby issue our unqualified opinion.

Prague, *11 June 2007*

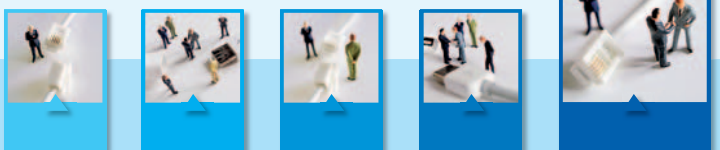
R - audit, s.r.o. VERIFIED number of licence 124

.....
for the Auditor – signature of responsible auditor

V. Auditor Data:

5.1. Auditor: R - audit s.r.o., 180 00 Praha 8, Na Hrázi 178/25, Licence No. 124
5.2. Responsible auditor: Jiří Randák, Certificate No. 521, Company Executive

2



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