CESNET

ANNUAL REPORT 2011

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CESNET

A MESSAGE FROM THE DIRECTOR

„WE LAUNCHED A NEW PHASE OF CESNET ACTIVITY IN 2011."

The Annual Report that you have just opened overviews the activities that the CESNET Association pursued in the milestone year 2011. Why was it a milestone year? In the course of the year, we received a positive decision of the Ministry of Education, Youth and Sports of the Czech Republic on funding two long-term strategic projects that will make up the core of our work in the coming years. The year 2011 was thus a landmark that started another era in the Association's work.

The first of the approved projects is called *CESNET Large Infrastructure*. It is scheduled until 2015 and aims at reconstructing and operating the CESNET2 national research network as a so-called large infrastructure: a broad range of devices, equipment, resources as well as services that are utilised by research teams. *CESNET Large Infrastructure* will comprise all the e-infrastructure components that are needed to link the Czech Republic to the European Research Area and to connect with other e-infrastructure described in the European ESFRI Roadmap. Its basic components will be a national communications infrastructure with a high throughput, national grid infrastructure (NGI), and data storage infrastructure, enhanced with tools and services for controlling access to e-infrastructure sources, tools for ensuring communication security and data protection, as well as tools for effective collaboration of distributed users and teams.

The other project is called *Extension of the National R&D Information Infrastructure in Regions* (abbreviated to *eIGeR*). Its purpose is to develop, based on the existing national research network CESNET2, a qualitatively new information e-infrastructure, which will boost and intensify the connection of a larger number of academic and scientific research workplaces across the Czech Republic, advancing them to a level necessary for them to get involved in European research and global scientific cooperation. The *eIGeR* project is complementary to *CESNET Large Infrastructure*, it is funded from the Operational Programme Research and Development for Innovation, Axis 3, Call 2.3, and should be completed in October 2013. Its specific tasks include increasing the capacity of the communications infrastructure and expanding its features, increasing the capacity of the access interfaces, expanding the NGI base, building three high-capacity repositories, and increasing the capacity and boosting infrastructure for executing video conferences.

Both core projects highlight the basic purpose of CESNET, which it has performed since its very foundation: to provide the Czech academic community with top-class infrastructure, thus creating conditions for its research and innovation work. When building the e-infrastructures in the Czech Republic, we proceed in close cooperation with entities included in the Roadmap for Large Research, Development and Innovation Infrastructures: the *CERIT-SC* and *IT4Innovations* projects.

Even this brief listing indicates that lots of challenging as well as exciting work lies ahead of us in the coming years. I believe that our results will continue to be capable of drawing attention of the professional public as they have been so far. After all, you will find an overview of our 2011 activities, including achievements on the global scene, on the following pages. There was no shortage of them.

We were also very vigorous in presenting our activities publicly. Our most prominent feat was the organisation of the *TERENA Networking Conference 2011*, which we hosted in Prague on the occasion of our 15th anniversary. It welcomed 525 guests from 36 countries on four continents, the biggest turn-out in the entire TERENA conference history.

Unfortunately, life brings woeful news too. Prof. RNDr. Milan Mareš, DrSc., a long-standing member of the CESNET Board of Directors, died on 25 July 2011. He conducted both primary and applied research in informatics and software systems at the AS CR Institute of Information Theory and Automation. Besides scientific and teaching work, he pursued the popularisation of mathematics, published in international journals and anthologies, and published two books in the USA and Germany. His influence on the successful progress of CESNET is indisputable, which is another reason why it is hard for us to cope with his departure. Our colleague Mareš also made a substantial contribution to the achievements that we are now able to boast.

In conclusion, allow me to express my cordial thanks to all those who have the most merit in the success of the CESNET Association: all its employees and fellow workers, who perform highly professional work. My sincere thanks also go to the Association members and, naturally, to the Ministry of Education, Youth and Sports of the Czech Republic for its institutional and funding support.

Ing. Jan Gruntorád, CSc.
CESNET Director and Member of the Board of Directors
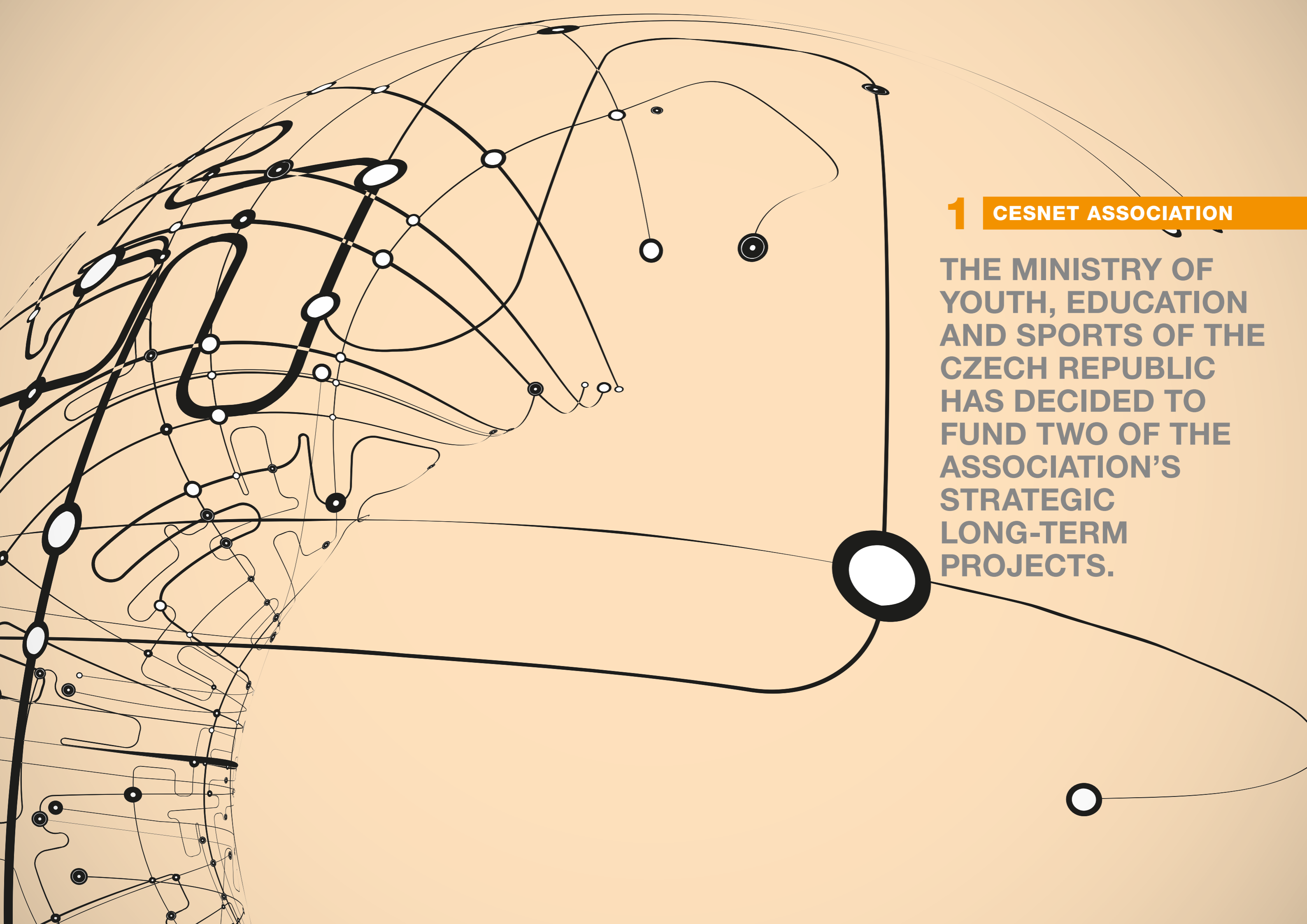
THE MINISTRY OF YOUTH, EDUCATION AND SPORTS OF THE CZECH REPUBLIC HAS DECIDED TO FUND TWO OF THE ASSOCIATION'S STRATEGIC LONG-TERM PROJECTS.

CESNET ASSOCIATION

History

The Association was founded in 1996 by universities in the Czech Republic, together with the Academy of Sciences of the Czech Republic (hereinafter referred to as ASCR). In the same year, thanks to the grant for the *TEN-34 CZ Network Deployment* project from the Ministry of Youth, Education and Sports of the Czech Republic, the Association started to develop the academic backbone network across the Czech Republic, with an entirely new quality level. At the same time, the academic and the commercial sectors became gradually separated, and all the members moved towards the academic network.

From 1997, the Association had operated two independent networks. The first network, TEN-34 CZ (later TEN-155 CZ), served the needs of science, research and education and members of the Association and some other institutions complying with the Acceptable Use Policy were connected to it. The second network was for historical reasons called CESNET, and served commercial customers. Both the networks were separated in technological, economic, and largely also personnel manners.

After the commercial network was sold in 2000, the Association ceased to act as a commercial Internet provider. Since then, the Association has been engaged exclusively in the development and operation of the science, research and education backbone network (NREN, National Research and Education Network of the Czech Republic) and related activities. The NREN is called CESNET2.

During the years 2004 to 2010 the Association was subsidised 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. The year 2010 was the seventh and final year of the research plan. The final expert review of the research plan took place in 2011, concluding that the objectives of the research plan were successfully achieved. The Association received two crucial decisions by the Ministry of Youth, Education and Sports of the Czech Republic in 2011, based on which it was promised funding for two large projects. The first of them is for *CESNET Large Infrastructure* with the implementation planned for 2011-2015. The other project, crucial for the Association's activities, is the *Extension of the National R&D Information Infrastructure in Regions* (abbreviated to *eIGeR*).

The Association Objectives and Scope of Activities

The main goals of the Association are the operation and development of the backbone network interconnecting the networks of the Association members, research and development of advanced network technologies and applications, and the dissemination of related information.

The main scope of activities of the Association is as follows:
1. to conduct research and development in the area of information and communication technologies and their applications;
2. to provide and arrange the provision of education services of research and development type, using the high-speed national research and education network;
3. to ensure for its members and the allowance organisations that 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; the testing of new applications; the cooperation and complementarity of the members' activities at a level comparable to leading education and research networks abroad (including Internet access);
4. to secure and provide, in cooperation with its members, the long-term development, acquisition and deployment of high quality communication and information technologies based on the Internet and other advanced systems;
5. to support, against the reimbursement of related expenses, propagation of erudition, culture and knowledge, cooperation of members with industry, expansion of the latest information technologies deployment, and quality improvement of the network by recruiting additional participants, information sources and services.

The Association performs and provides its activities within the scope of received subsidies and partial compensation of expenses related to these activities. It is not the Association's objective to generate any profit on these activities.

In addition to its main activities, the Association also pursues economic/business activities; however, solely with the purpose of making more efficient use of its property and without any negative impact on research activities. The services are not provided on a publicly available basis.

The Association provides the academic backbone network services not only to its members but also to selected entities complying with the *Access Policy of the Next-Generation National Research and Education Network*.

Any loss incurred in connection with the Association's economic/business activities is settled by the end of each fiscal year; 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 research and development.

Membership in International and National Organisations

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

International Organisations

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), is dedicated to the development of the telecommunication infrastructure of academic and scientific sites across Europe.

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

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

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

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

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

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

National Organisations

NIX.CZ – CESNET is one of the founding members of NIX.CZ, Interest Association of Legal Entities (Neutral Internet Exchange), an association of Internet service providers in the Czech Republic, permitting mutual connectivity among its members' networks; the association had 83 members as of 31 December 2011.

CZ.NIC – the Association is also a founding member of CZ.NIC, Interest Association of Legal Entities, dealing with domain registrations, support to Internet-related publicly beneficial projects and activities; the association had 94 members as of 31 December 2011.

Association Members

The following institutions were members of the Association in 2011:
Charles University in Prague / Palacký University in Olomouc / Czech Technical University in Prague / VŠB – Technical University of Ostrava / Academy of Arts, Architecture and Design in Prague /

Academy of Fine Arts in Prague / Brno University of Technology / University of Veterinary and Pharmaceutical Sciences Brno / Masaryk University / Mendel University in Brno / Academy of Performing Arts in Prague / Janáček Academy of Music and Performing Arts in Brno / University of Pardubice / The Institute of Chemical Technology in Prague / Czech University of Life Sciences in Prague / Technical University of Liberec / University of Economics, Prague / University of Hradec Králové / University of South Bohemia in České Budějovice / University of Ostrava / Silesian University in Opava / Jan Evangelista Purkyně University in Ústí nad Labem / University of West Bohemia in Plzeň / Academy of Sciences of the Czech Republic / Tomáš Baťa University in Zlín University of Defence During 2011, the Association did not admit any new members.

Internal Organisational Structure

CESNET has the following bodies:
– General Meeting   – Board of Directors   – Supervisory Board

The **Board of Directors** consisted of the following members in 2011:
Prof. Ing. Jiří BÍLA, DrSc.
RNDr. Alexander ČERNÝ
Ing. Jan GRUNTORÁD, CSc.
Ing. Josef KUBÍČEK
doc. RNDr. Václav RAČANSKÝ, CSc.
doc. RNDr. Pavel SATRAPA, PhD.
Prof. Ing. Miroslav TŮMA, CSc.
Ing. Josef Kubíček was elected to the post of **Chairman of the Board of Directors**, and RNDr. Václav Račanský, CSc., and Prof. Ing. Miroslav Tůma, CSc., were elected as **Vice-Chairmen**.

The **Supervisory Board** consisted of the following members until 30 June 2011:
RNDr. Pavel KRBEC, CSc.
Ing. Jaromír MARUŠINEC, Ph D, MBA
Ing. Petr PĚTIOKÝ, MBA
Prof. Ing. Ivo VONDRÁK, CSc.
RNDr. František ZEDNÍK
Ing. Jaromír Marušinec, PhD, MBA, was the **Chairman of the Supervisory Board**.

For the 2011-2013 term, the 31st General Meeting elected the following **Supervisory Board** at its session on 30 June 2011:
Ing. Jaromír MARUŠINEC, PhD., MBA
Mgr. František POTUŽNÍK
Mgr. Eva ŠMÍDOVÁ
Prof. Ing. Ivo VONDRÁK, CSc.
RNDr. František ZEDNÍK
Ing. Jaromír Marušinec, PhD, MBA, was elected as **Chairman of the Supervisory Board**.
Ing. Jan Gruntorád, CSc. was the **Director** of the Association in 2011.

Development Fund Board

The **Development Fund Board** operated with the following structure until 30 June 2011:
RNDr. Igor ČERMÁK, CSc.
Ing. Miroslav INDRA, CSc.
Ing. Olga KLÁPŠŤOVÁ
Prof. Dr. Ing. Zdeněk KŮS
Ing. Petr LAMPA
Ing. Vladimír RUDOLF
Prof. RNDr. Jan SLOVÁK, DrSc.
RNDr. Igor Čermák, CSc., was the **Chairman of the Development Fund Board**.

For the 2011-2013 term, the 31st General Meeting elected the following **Development Fund Board** at its session on 30 June 2011:
RNDr. Igor ČERMÁK, CSc.
Ing. Miroslav INDRA, CSc.
Prof. Ing. Pavel JURA, CSc.
Ing. Olga KLÁPŠŤOVÁ
doc. RNDr. Antonín KUČERA, CSc.
Prof. Dr. Ing. Zdeněk KŮS
Prof. RNDr. Jan SLOVÁK, DrSc.
RNDr. Igor Čermák, CSc., was elected as **Chairman of the Development Fund Board**.

Organisational Chart

Following negotiations with the Board of Directors, the Organisational Chart (see Figure 1) was approved by the Director of the Association on 18 February 2011 and came into force on 1 March 2011. The Association involved 132.8 converted full-time jobs in 2011. The Association's organisational structure comprises departments, which may be aggregated into sections. Management within this structure is performed by so-called line managers.

Figure 1: Organisational chart of the Association in 2011
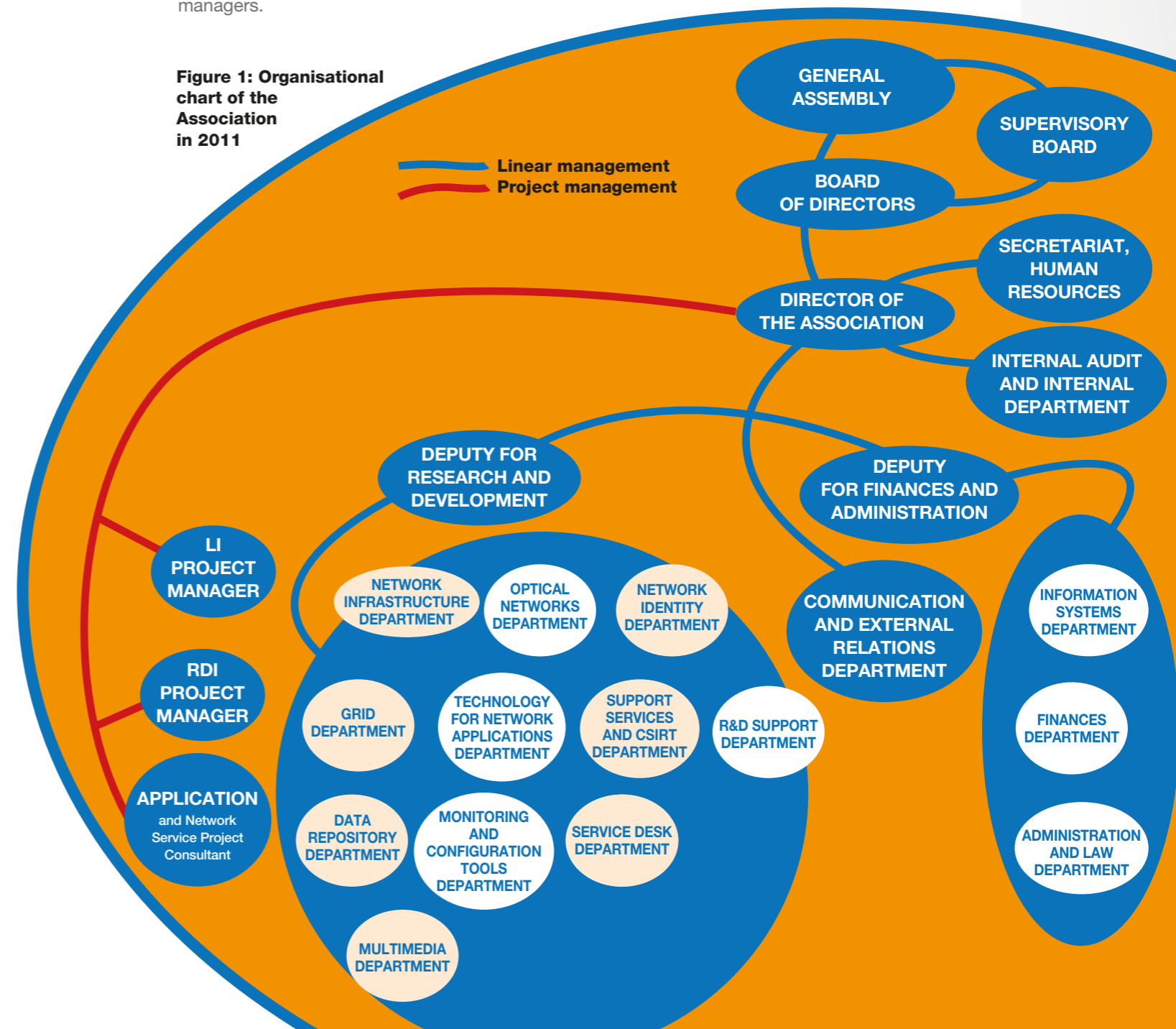
CESNET IS
DEVELOPING
A COMPLEX
ENVIRONMENT
COMPRISING
A NATIONAL
COMMUNICATION
AND GRID
INFRASTRUCTURE
AND A NETWORK OF
DATA REPOSITORIES.

CESNET E-INFRASTRUCTURE

CESNET's fundamental activity is the development, constructing and operation of the CESNET e-infrastructure, which is part of the *Roadmap for Large Research, Experimental Development and Innovation Infrastructures in the Czech Republic*, approved by Government Resolution no. 2072 of 15 March 2010. The purpose of the CESNET e-infrastructure within the national roadmap for large infrastructures is to provide a transparent common communication environment for the cooperation of entities dealing with research, experimental development and innovation across all sectors in the Czech Republic. Of course the e-infrastructure is integrated into the relevant international infrastructures, particularly those described in the *European Research Infrastructures Roadmap* (*ESFRI Roadmap*), on which the national roadmap is based. The CESNET e-infrastructure is also used as a testing and development environment for new technologies and applications in the area of information and communication technologies.

The CESNET e-infrastructure is a complex environment, comprising a high capacity national communications infrastructure, a national grid infrastructure (NGI) and a data repository infrastructure, complemented with tools and services for managing access to the e-infrastructure resources, tools for communication security and data protection, and tools for effective cooperation of the distributed users and teams.

The CESNET Association has been developing this infrastructure with substantial support from public budgets under two mutually complementary projects, *CESNET Large Infrastructure* and *Extension of the National R&D Information Infrastructure in Regions*.

Communications Infrastructure

The reconstruction of the CESNET2 backbone network started in 2011; it forms the necessary foundation for the other components of the national information e-infrastructure. The aim of the reconstruction is to create a multiple-layer national communications infrastructure whose layers will connect to research projects and user networks as well as research networks abroad, the European GÉANT network, and the global experimental GLIF infrastructure. The new communications infrastructure will offer concurrent support for the IPv4 and IPv6 protocols with optional advanced functionalities and features, provision of dedicated services at different network layers, especially lambda services and remote real-time access to user research equipment.

The core topology of the optical backbone network is based on leased optical fibres conforming to the ITU-T G.652 standard (see Figure 2). Some of the optical routes are single-fibre (Ostrava–Karviná, Ústí n. Labem–Most, Ústí n. Labem–Děčín, Plzeň–Cheb, Cheb–Most, Letohrad–Opava, Opava–Ostrava, and Karviná–Ostrava); nevertheless, most are double-fibre.

The current DWDM optical transport network deploys two basic types of DWDM technology:

- the main core of the optical transport network deploys *Cisco ONS 15454 MSTP* technology and allows flexible creation of optical transfer channels among ROADM nodes; the core of the DWDM network comprises a complete optical transport system with a common control system and allows creation of end-to-end optical transfer channels without the need for any interconnection or reconfiguration of intermediate ROADM nodes;
- the remaining DWDM routes deploy *CzechLight DWDM* technology, developed by the Association itself as part of its research activity: this technology is currently based on *CzechLight* optical amplifiers with passive Mux/Demux or ROADM installed; it is deployed on some of the double-fibre and all of the single-fibre routes.

In late 2011, the Association completed the reconstruction and upgrade of the primary transmission circuit Praha I–Brno I–Brno II–Olomouc I–Olomouc II–Hradec Králové–Praha II–Praha I to 80 channels spaced at 50 GHz and a designed transmission channel capacity of 1-100 Gbps. The single-fibre route Plzeň–Cheb–Most installations with the CL-DWDM system were modified, including upgrading the Plzeň–Cheb link to 10 GE, and the installation of the double-fibre routes Brno II–Vienna and Brno II–Ostrava in connection with moving their terminating points from the existing Brno I node to a new Brno II node.

In cooperation with Alcatel-Lucent, the Association successfully completed the first testing of the 100 Gbps transmission system under real CESNET2 operation in August 2011; it was tested alongside both ordinary and demanding transmission services. It verified the possibility to share optical fibres by transmission systems produced by various manufacturers, which improves flexibility and adaptability of the services provided by the network to the users, and the efficiency of utilisation of the fibres being the most costly network component. It substantially increases the competitive environment, and the operator is not as dependent on the development plans of a single manufacturer when developing the network.

In the course of 2011, the IP/MPLS layer of the communications infrastructure was boosted by deploying terabit routers in the Praha II, Hradec Králové and Olomouc nodes, and the DWDM system was reconstructed on the Praha–Hradec Králové, Brno–Olomouc, Hradec Králové–Olomouc, and Praha–Brno routes. In addition, technology allowing data transfer at a rate of 40 Gbps was deployed on the Hradec Králové–Olomouc route. The current topology of the communications infrastructure is shown in Figure 3.

Other major changes to the communications infrastructure:
- the back-up international connectivity upgraded from 3.5 to 5 Gbps;
- the connection for the ASCR site in Třešť upgraded to 1 Gbps via the Vysočina Region CWDM system;
- the IPv4 peering segment in NIX.CZ renumbered to 91.210.16.0/22 (existing 194.50.100.0/24 address range no longer sufficed);
- the second 1 Gbps circuit to AMS-IX made operational;
- IPv6 connectivity established for UTB Zlín;
- involved into GÉANT IX peerings project (GÉANT network launched pilot project for provision of European peerings for NRENs);
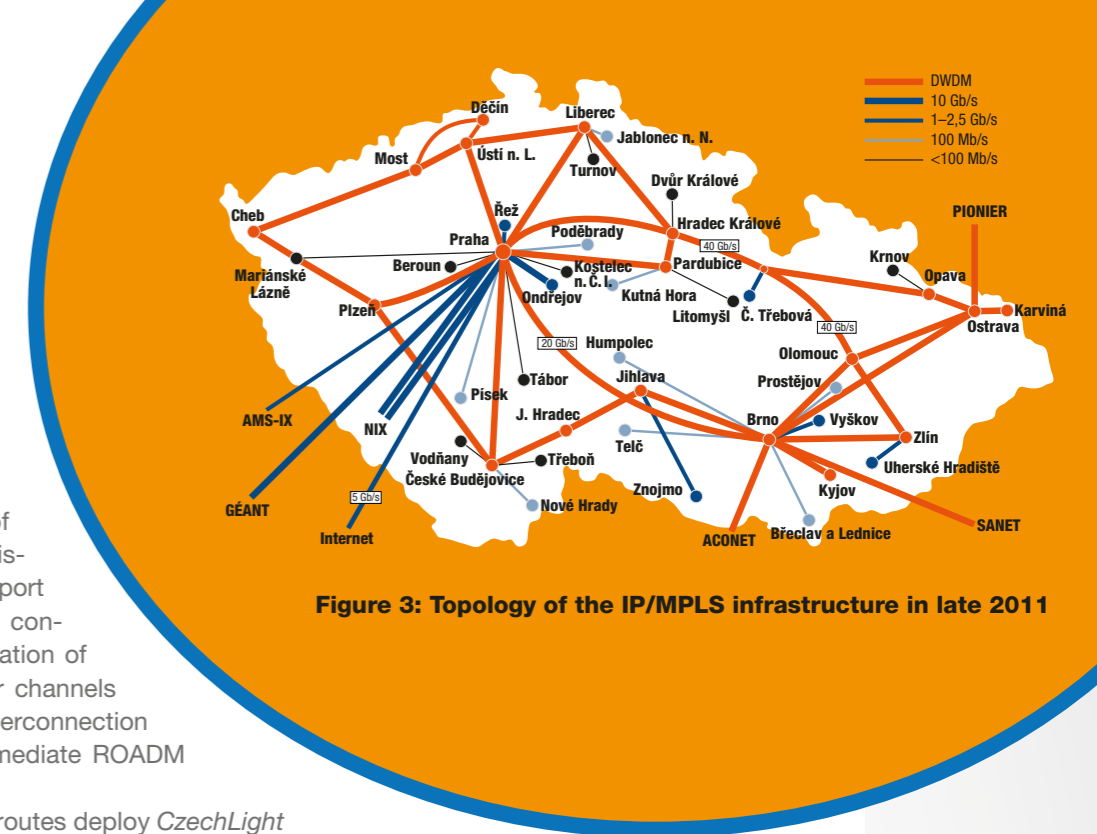- Praha-Brno backbone route upgraded to 20 Gbps (etherchannel 2×10 Gbps).

Figure 3: Topology of the IP/MPLS infrastructure in late 2011

Figure 2: Basic optical topology of the CESNET2 backbone network

The Association is intensely dealing with connecting emerging large research infrastructures to the CESNET2 network via optical fibres; first with the initial connection and in the second stage with provision of non-parallel back-up fibre connection. The first two large infrastructures dealt with have been IT4Innovations in Ostrava and FNUSA-ICRC in Brno. In addition, the connection of existing major CESNET2 network users' sites has been gradually improved by increasing the connection capacity, shifting to dark fibre connection, or providing an independent secondary route, especially supporting the participation in international research projects. The quality and reliability of the network is also improved by removing the first mile parallels on intercity routes to the CESNET2 network nodes.

Grids

The Association's long-term goal in the area of distributed computing is the operation and development of the *MetaCentrum National Grid Infrastructure (NGI)* and integration of its activities into the corresponding international projects and infrastructures. The National Grid comprises two basic types of computing clusters: conventional computing clusters with a lower number of high-performance processors, and high-performance SMP servers with more processors in shared memory. Along with these computing servers, the *MetaCentrum* also operates extensive data capacities, used for storing large experimental data processed in the grid. The grid infrastructure thus fits into the national e-infrastructure developed within the projects *CESNET Large Infrastructure*, *CERIT-SC* and *IT4Innovations*.

In 2011, the *MetaCentrum* computing clusters were substantially boosted thanks to both the Association's projects and the cooperating projects' resources. The *MetaCentrum* thus has fostered its coordination role and has transformed from a conventional computing power provider into a national coordinator.

At present, the *MetaCentrum* has its primary hubs at the Masaryk University in Brno (CERIT-SC Centre and Faculty of Sciences), Charles University in Prague (CU Supercomputer Centre), the West Bohemian University in Plzeň (Faculty of Applied Sciences), the South Bohemian University (Faculty of Sciences cluster), Brno University of Technology (Faculty of Electrical Engineering and Communication), Mendel University in Brno Department of Wood Science (Supercomputer Centre), the Academy of Sciences of the Czech Republic (Institute of Physics), and CESNET.

The Association's goals for 2011 in the area of grids also included steps necessary for creating a fully-fledged NGI and integrating it into the comprehensive infrastructure built under the *CESNET Large Infrastructure* project in the Czech Republic:

■ support of partner organisations resources (computing clusters) integration;
■ extension of the *MetaCentrum* application portfolio;
■ formal establishment of a national node in the European EGI infrastructure;
■ transformation of user account management tools and corresponding policies so that *MetaCentrum* tools can form the foundation for the Association's entire complex infrastructure;
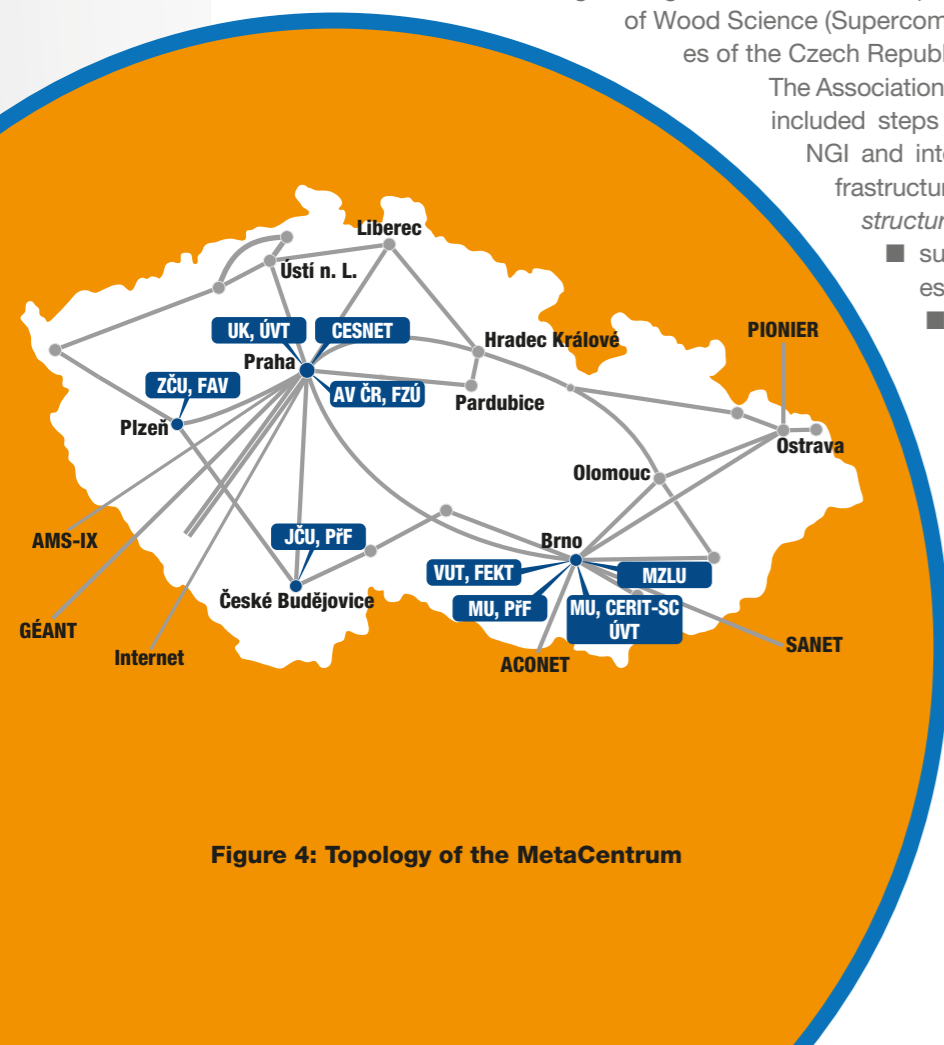■ launching the first pilot cloud interface installation, in cooperation with *CERIT-SC*.

Figure 4: Topology of the MetaCentrum

Data repositories

The main objective of the project in the area of data repository is to create an integrated data storage space infrastructure consisting of interconnected data centres distributed across the Czech Republic. The system will be based on CESNET's three own high-capacity data centres with a planned total capacity of 15-20 PB.

From a technical point of view, the repository is organised hierarchically (HSM – Hierarchical Storage Management). Its basic principle is that less frequently utilised data is shifted to cheaper and slower-access high-capacity media, typically tapes, which also considerably reduces the operating costs, and enables to achieve a much higher capacity with the given investment and operating costs compared to a disk-only repository. The only user limitation of this system is that the query will take longer to process once accessing long-unused data.

A data centre in each location will consist of the following main elements:
■ a disk array;
■ a tape library (or a similar system fully replacing the functionalities of a tape library, such as MAID);
■ servers for the control software (HSM and others);
■ servers for application support and virtualisation farm and a user interface (front-end);
■ local SAN and LAN network infrastructure.

In the future, the Association plans to interconnect all three data centres via dedicated SAN and IP lines, which will allow geographic back-up (replication) of data among the repository sites.

In 2011, the Association procured and installed 3.8 PB of equipment in the Plzeň node; the pilot operation was scheduled for the first half of 2012. The node has the following parameters:
■ high-speed FC disks with a usable capacity of 57 TB;
■ SATA disks with a usable capacity of 443 TB;
■ tape-based LTO5 media with a usable capacity of 3.3 PB, expandable to 5.5 PB.

Infrastructure for user cooperation and support

IP telephony, video and web conferencing and multimedia streaming

The IP telephony network connects 46 gateways connected to institution exchanges, several CCM IP telephone exchanges, and several SIP domains (complete SIP infrastructures within institutions). The Association cleared 900 thousand calls totalling 47.5 thousand hours during 2011.

Above all, the video conferencing infrastructure offers client registration options, use of virtual rooms on HD MCU, relation recording and streaming in the Windows Media and Flash formats. Registration of video conferencing devices brings easier availability of both units and services thanks to telephone numbers allocated by the Association. About seventy hardware units in eighteen institutions have made use of this option. The HD MCU itself hosted 2,000 hours of connections in dozens of virtual rooms in the course of the last year. Twenty hardware units were added in 2011, and the amount of connections increased by one quarter.

The Association operates a web conferencing system built on the Adobe Connect platform, employing Adobe Flash technology. The system registers 293 accessing users using authentication via the *eduID.cz* federation of identities, who together with visitors have 32 virtual rooms at a disposal. The Adobe Connect system users performed 1,390 hours of connections in 2011; an increase by about a quarter compared to the previous year.

In addition, the users can use an infrastructure for live and pre-recorded streaming, in the Windows Media, Adobe Flash and MPEG-4 formats, both via IPv4 and IPv6. The infrastructure is utilised by more than ten institutions, who store over 6 TB of video data in the repository.

The Association has supported a number of conferences and seminars by providing multi-point video conferencing and streaming, such as:
■ the international TERENA Networking Conference 2011;
■ the 11th Live Video Surgery at Prague Central Military Hospital;

- Science Week;
- several streamed events held at the National Theatre;
- the ORS2011, an Opensource solutions for networks conference.

Network identity

Providing comprehensive e-infrastructure services requires a new approach to user management. The Association envisages that the large infrastructure users will increasingly be distributed both geographically and organisationally. At the same time, the different large infrastructure services show different demands for the level of user authentication and the scope of information used for authorisation.

The user management is based on the *eduID.cz* distributed federation of identities, where the initial user registration and authentication services are provided by the home organisations while the authorisation information is managed at the level of the services and their administrative domains.

The Association joined the *eduGAIN* international interfederation in 2011. Thus its users can now use services operated by partner federations in Europe.

The Association has developed a special IdP *eduID.cz Hostel* for users who do not have an account with an IdP (identity provider) involved in *eduID.cz*. The *Hostel* enables normal self-service registration based on authenticating an e-mail address. Users registered in this way are provided with a limited scope of the large infrastructure services. For an unlimited use of the services, users need to perform full registration via an *eduID. cz Hostel* registration official based on furnishing their personal documents. A fully registered users' identity is equivalent to the identities provided by *eduID.cz* member IdPs.

The best-accepted federated service so far is probably *eduroam.cz* that enabled users from various involved institutions to connect to a (typically wireless) network of any other cooperating institution, thus gaining access to the Internet or certain other services operated by the host network (roaming). Users are always authenticated by the home institution. This academic roaming system was created as a European initiative, and has since spread to Australia, East Asia, Canada and the USA.

Security of the e-infrastructure

The CESNET-CERTS security team was the first CSIRT (Computer Security Incident Response Team) type team officially constituted in the Czech Republic in 2003. It has been part of the world infrastructure since January 2004, when Trusted Introducer awarded it "listed" status. At present, the team has seven members. Two members are also actively involved in the EGI CSIRT team, which is in charge of operational security of the European grid EGI.eu (European Grid Infrastructure).

The CESNET-CERTS team focuses on the following issues:
- receipt of security incidents notifications occurring in the CESNET2 network and incident handling;
- awareness raising: training sessions, presentations, publications;
- communication and cooperation with security teams abroad within TF-CSIRT activity, run by TERENA, and other organisations;
- operation and development of IDS systems, honeypots and network monitoring tools.

Great attention is paid to awareness raising among users and administrators of the connected computer networks. In 2011 the Association focused again on young users (university students) and organised several seminars in the series *Training for students in (not only) their first year*.

In 2007-2010, the Association managed the *Cybernetic Threats from the Perspective of the Security Interests of the Czech Republic* grant funded by the Ministry of the Interior of the Czech Republic. Within this grant project, a model workplace for CSIRT.CZ was built, which the Ministry of the Interior declared the National CSIRT of the Czech Republic in December 2010 and handed it to CZ.NIC for operation from 1 January 2011. The handover of CSIRT.CZ technologies and agenda from CESNET to CZ.NIC and training for its new members started on 1 January 2011. The process was successfully completed on 31 June 2011. The process of handing over the CSIRT.CZ workplace laid the foundation for further cooperation between CESNET and CZ.NIC.

User support

In 2011, user support focused on user groups that substantially use the e-infrastructure capacity or are expected to do so in the future. Other large research and development infrastructures are also an important group. In 2011, the most intense negotiations about needs and cooperation were held with the following infrastructures:

ELIXIR is a European infrastructure project for sustainable development in bioinformatics, established based on an analysis of the amount, flow and structure of biological data in Europe. The national ELIXIR node for the Czech Republic will provide coordination of projects within the national infrastructure for bioinformatics.

NDL – National Digital Library is a joint project of the National Library of the Czech Republic and the Moravian Library to digitise books and other publications within their own collections and subsequently to archive the digital copies. The project envisages both long-term storing of digital documents in a reliable data repository and making them publicly available over a common, user-friendly interface.

The objective of the *IT4Innovations* project is to build a national research centre of excellence for information technologies that will enable to strengthen the concentration of a number of scientific disciplines related to IT and develop them. The project will also include the procurement of a very powerful supercomputer, ranked among the hundred most powerful machines in the world.

The project *Extreme Light Infrastructure (ELI)* is part of a European plan to build a cutting-edge laser device and implement a number of research and application projects involving the interaction between matter and light pulse at an intensity about 1,000 times greater than what can be achieved today.

The Association has provided comprehensive consultations, mainly regarding video conferencing, for the International Clinical Research Centre, part of St. Anne's University Hospital in Brno (*FNUSA-ICRC*). This is a new generation scientific research centre and a public centre of first-class medical care focusing on preventing, early diagnosis and treatment of mostly cardiovascular and neurological diseases.

The objective of the project *CERIT-SC* is to offer computing and data capacities primarily available in real time, responding immediately to rapidly changing user requirements.

In addition, the Association has also long supported the Czech physics community involved in the *LHC (Large Hadron Collider)* project at CERN. We provide this group with a dedicated 1 Gbps link to the nearest Tier 1 data repository, located in Karlsruhe, Germany. The link is regularly saturated, which is why the Association is considering its upgrade. The amount of data analysis conducted in this project by Czech physicists has gradually increased. The Association expects the physics community to use the new resources to be deployed by CESNET as part of building the new data repositories and boosting the computing capacity at the *MetaCentrum*.

In the area of medicine, the Association mostly targets its support at applications that cannot do without high-speed routes and that it can provide thanks to its domestic infrastructure as well as involvement in international networks and consortia. We made great efforts in 2011 to support the implementation of stereoscopic high-definition streaming of robotic operations. Perhaps the most important event was the demonstration and lecture during Asia's biggest Internet conference last year, the *APRICOT/APAN* in Hong Kong. CESNET proved its ability to establish an ad hoc dedicated 10 Gbps link across seven administrative domains and run a 3D full HD stream and parallel video conference over it. The event made use of a 2.8 Gbps band.

THE ASSOCIATION PERFORMS NUMEROUS IMPORTANT ACTIVITIES FOCUSED ON ADVANCING SCIENCE AND RESEARCH IN THE CZECH REPUBLIC.

NATIONAL PROJECTS

The building, development and operation of the e-infrastructure entail non-trivial costs, which are covered, to a great extent, from public budgets under the *CESNET Large Infrastructure* and *eIGeR* projects.

CESNET Large Infrastructure

The *CESNET Large Infrastructure* project defines the basic orientation and goals of CESNET work for the period 2011-2015. The specific project funding is the most important source of funding for the operation and development of services in this e-infrastructure, as detailed in the previous section.

Since the different components of the e-infrastructure currently have their own user management tools, in 2011, the Association began work on unifying the user identification and authentication mechanisms for all of the pivotal e-infrastructure services that work with user access data. At the same time, the Association analysed the possible exploitation of mobile technologies for CESNET members' access to the e-infrastructure.

In the area of security, the architecture for two systems known as *Mentat* and *Warden* was designed. The *Mentat* system should serve the unified processing of security information from various sources (IDS, honeypots, log analysers, external sources such as ShadowServers, etc.), correlation of such data and, most importantly, as a support tool for CESNET-CERTS in handling security incidents. The *Warden* system is designed for efficient sharing of information about detected threats among CSIRT teams (security teams in general).

The reason is that in addition to their basic service, consisting in handling of security incidents and its coordination, many CERT/CSIRT teams develop useful tools and systems, for example in the area of network and service monitoring and detection of operation anomalies. The output of such detection systems is then utilised by the CSIRT team mostly for its own purposes and the network that it supervises. However, this data might be useful to other teams, working in other networks. *Warden* is a system that makes it possible for the teams to easily and efficiently share and utilise information about detected anomalies in network and service operation, generated by various types of systems.

In the area of high-definition multimedia data transmission and processing, the Association has completely reconstructed the *UltraGrid* platform, especially regarding the integration of all the features available in the various experimental versions and the production quality of the resulting software. The new version is enhanced with three new compression types and many other features, such as support to the new RTP format for flexible data transfer, native 4K (no tiles), support to channel alpha-composition (e.g., logo insertion), a simple GUI, support to transmission and rendering of stereoscopic video (including various rendering formats depending on the output rendering device), and support to transmission of complete HD-SDI and 3G-SDI signals on DELTACAST cards.

Extension of the National R&D Information Infrastructure in Regions (eIGeR Project)

The *eIGeR* project, funded from the EU structural funds under the operational programme *Research and Development for Innovation*, is designed as part of the building of the *CESNET Large Infrastructure*, and its main benefit is a substantial initial strengthening of installed technology in the regions outside Prague.

The main objective of the project is to build a regional foundation for the CESNET e-infrastructure in all its components. It particularly involves the following:
- increasing the communication infrastructure capacity by deploying more powerful network elements;
- increasing the capacity of access interfaces;
- boosting the computational capacity of the *MetaCentrum* as the foundation of the NGI;

- constructing three high-capacity data repositories enabling the storing and sharing of large amounts of data, including its medium-term and long-term archiving; and
- increasing the capacity and enhancing the infrastructure for videoconferences.

In doing so, it is imperative that the national infrastructure meet the anticipated requirements on the amount, content and nature of the data communication in the near future with a special focus on newly emerging research infrastructures in the regions and their connection to the European Research Area.

The project implementation phase commenced on 1 May 2011, and its completion is scheduled for 31 October 2013. The following activities were performed in this project in 2011:
- two terabit routers installed in the Olomouc and Hradec Králové nodes;
- primary Praha–Brno–Olomouc–Hradec Králové–Praha DWDM transfer circuit reconstructed and upgraded;
- computing cluster comprising 2000 cores installed in Plzeň;
- hierarchical data repository assembly of 3.8 PB installed in Plzeň;
- hardware procured and tender documentation drafted for the software part of the Adobe Connect web conferencing system.

POVROS

In 2011, the *Alfa* programme of the Technology Agency of the Czech Republic supported the Association's project *POVROS*, aimed at further development of the MVTP (Modular Video Transfer Platform) device for low-latency duplex streaming of high-definition video signals for specialised applications, its transformation into a product and its introduction to the market. The device is based on the application of an FPGA (Field Programmable Gate Array).

The project is scheduled for the period 2011-2013. In the first project year, the Association cooperated with its partners, KIT digital Czech, a.s., and ACE, a.s., and developed a function sample of the device, mapped the demand, designed the necessary changes, and began work on a prototype for future production. The Association employs the function samples of the MVTP device to realise streams for users of CESNET and connected networks in various areas: to support medical education, for remote work with 3D models in scientific and engineering work, and for cooperation in film production.

The major demonstrations and experimental application of the MVTP technology took place at the following events in 2011:
- streaming medical operations from the da Vinci robotic system in Masaryk Hospital in Ústí nad Labem to the medical section of the APAN workshop in Hong Kong;
- streaming medical operations from the da Vinci robotic system in Masaryk Hospital in Ústí nad Labem to the seminar Application of Information Technologies in Medicine in Banská Bystrica, Slovakia;
- three successful demonstrations at the TNC 2011 international conference in Prague: streaming of uncompressed video signal at 4K resolution from the Praha node; streaming of a 3D HD signal from a CAVE type device at the Intermedia Centre of the Czech Technical University Faculty of Electrical Engineering; and streaming of a medical operation from Masaryk Hospital in Ústí nad Labem;
- the MVTP device was demonstrated at the most prominent European trade fair with professional audiovisual technology, the IBC in Amsterdam, in cooperation with the *POVROS* project partner, KIT digital Czech, a.s., as well as at the CineGrid Day seminar held by the Waag Society;
- the MVTP device was also demonstrated during a local transfer of medical data at the Czech booth at the prestigious international ITU Telecom World 2011 conference in Geneva;
- the Association performed two successful demonstrations at the CineGrid 2011 workshop in San Diego: streaming of uncompressed video signal at 4K resolution accompanied with multi-channel audio, and streaming of a 3D HD signal from a CAVE type device at the Intermedia

Centre of the CTU Faculty of Electrical Engineering; both streams ran across a distance of more than 10,000 km without a single failure, which proved the high stability of the transfer system while keeping the latency low.

EF-TRANS

The *EF-TRANS* project under the operational programme Education for Competitiveness is organised at the level of the Ministry of Youth, Education and Sports of the Czech Republic. The main objective of the project is to propose and help realise efficient transfer of knowledge generated in research and development activities into practice.

The project was launched in August 2009 and is scheduled to conclude in May 2012. A set of seven methodologies was created in 2010; they were verified in the following year as part of pilot projects at fourteen institutions (universities and research institutes) throughout the Czech Republic that became project partners in 2011. One of them was CESNET, which based on its experience committed itself to evaluating the four following methodologies:

■ system for commercialisation;
■ intellectual property protection;
■ cooperation with the practice; and
■ licence use.

CESNET Development Fund

In 2011, the Development Fund Board announced a tender for new projects in the following thematic areas:

■ utilisation of services of the CESNET2 network and modern information and communications technologies within the tuition and education process, creative and scientific research activities and management of public universities and the Academy of Sciences of the Czech Republic;
■ advanced applications utilising the high-speed backbone network;
■ support of network services and applications research;
■ support to training for Association employees/members in order to obtain a globally recognised certificate in IS/IT.

A total of 41 project applications were made. Out of which 28 were admitted for co-funding, including eight that were admitted after being revised. A decision concerning one of the projects remains to be made.

Two rounds of expert review procedures on completed projects took place in 2011. A total of 31 projects were completed successfully, including three that were presented in expert review procedures. Completion or revision of final documentation was requested for several projects. Final project reports within the CESNET Development Fund are available on the Association's website.

In the course of 2011, the Development Fund Board also dealt with amending the Development Fund documents, the Economic Rules and the Recruitment Rules, based on recommendations by the Supervisory Board and its practical work experience.

Attendees at workshops for *Large Infrastructure* and *eIGeR* project executors and attendees at meetings of the VIC Managers' Club were periodically informed about the work of the Development Fund and the projects executed under the Development Fund. The results of some projects were presented within the seminars for project executors, seminars for CESNET members and the professional public, as well as international conferences. Project outcomes were also presented in the form of publications in professional journals.

PROJECT NUMBER	PROJECT EXECUTOR	PROJECT TITLE
396R1/2011	UEP	Developing professional qualifications of UEP staff in IT management
398/2011	TUL	Building and operation of a data repository for archiving and management of teaching recordings from TUL lecture rooms
399/2011	University of West Bohemia in Plzeň	Extension of the IS/STAG system with a student evaluation module
400/2011	University of West Bohemia in Plzeň	Acquisition of the Oracle Database 11g Administrator Certified Professional
401/2011	University of West Bohemia in Plzeň	Deployment of Windows 7 in the Orion environment at the University of West Bohemia in Plzeň
403/2011	University of West Bohemia in Plzeň	Secure availability of sensitive university resources to mobile device users
404R1/2011	University of West Bohemia in Plzeň	Support to IPv6 for external work sites
405/2011	University of West Bohemia in Plzeň	Acquisition of IBM WebSphere Application Server Network Deployment V6.1
406/2011	University of West Bohemia in Plzeň	Optimisation of a mobile platform portal
408/2011	Czech Technical University in Prague	Applied research into directional strategies in IP telephony
409/2011	AS CR	Visualisation of high-capacity multispectral visual measurements
411R1/2011	University of Pardubice	Increasing qualifications of teaching staff at the University of Pardubice Faculty of Electrical Engineering and Informatics concerning operating systems
412/2011	SBU	Acquisition of a server for the Moodle teaching system at the South Bohemian University Faculty of Sciences
413R1/2011	Czech Technical University in Prague	Application of video conferencing equipment to support teaching at external work sites of the CTU FEE in Prague
414/2011	Brno University of Technology	Deployment of IPv6 for end user services at the Brno University of Technology Faculty of Mechanical Engineering
415/2011	Czech Technical University in Prague	Implementation of IPv6 in the experimental and research network of the Department of Telecommunications Technology and its methodological generalisation
416R1/2011	AS CR	Institute of Physics computer centre and IPv6
418/2011	Czech Technical University in Prague	Increasing qualifications of staff of the CTU Computer and Information Centre concerning management of Linux servers
419/2011	Charles University	Increasing qualifications of staff of the CIT Network Department at the CU Faculty of Natural Science
421R1/2011	VŠB-TUO	Data centres in academic network environments
422R1/2011	Brno University of Technology	Study into advanced virtualisation and cluster solutions
423/2011	Academy of Performing Arts in Prague	Remote access to voice signal analysis
424/2011	Academy of Performing Arts in Prague	Analysis of high-speed video recordings
427R1/2011	University of Pardubice	Multi-platform access to university data and applications from mobile devices
429/2011	VŠB-TUO	Multimedia services in current optical access networks and new generation optical access networks
431/2011	Charles University	Interactive identification of physiological systems in a computer cloud and on cards with CUDA
432/2011	UP	Behavioural analysis of network operation (Internet Uplink) at the UP
433/2011	Brno University of Technology	ITIL V3 certification for BUT Faculty of Chemistry

CESNET HAS
BECOME INVOLVED
IN TODAY'S MOST
ADVANCED
INTERNATIONAL
RESEARCH
PROJECTS.
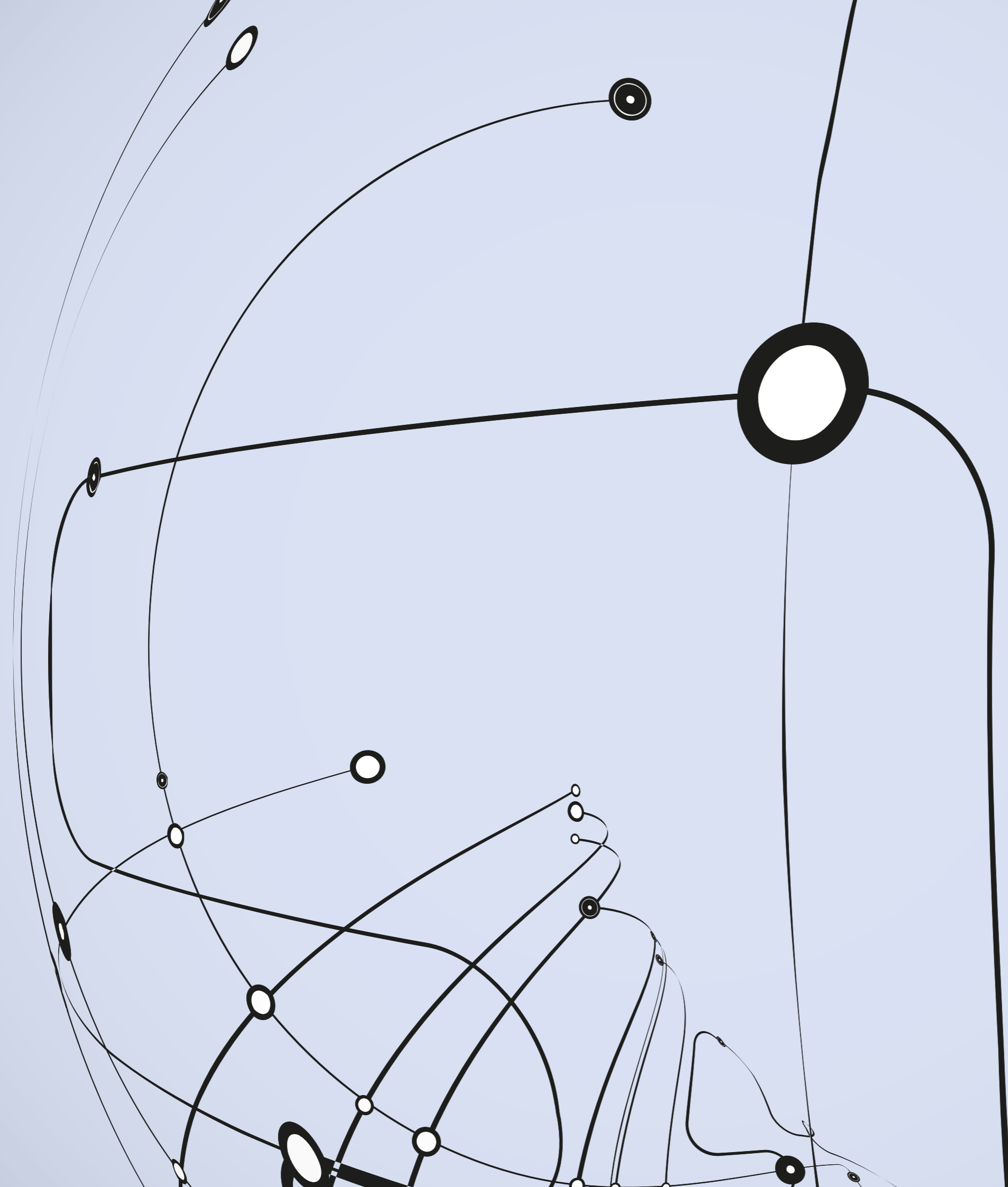
INTERNATIONAL PROJECTS AND COOPERATION

GÉANT

The GÉANT communications infrastructure currently makes network services available to approximately 40 million users at more than 3,500 institutions in 38 European countries. The connectivity provided includes connection of European National Research and Education Networks (NRENs) via GÉANT with similar networks such as the Internet2 and ESnet in the USA, the CANARIE in Canada and networks on other continents. The GÉANT network (its topology as of late 2011 shown in Figure 5) is being built and operated under the project *GN3* (*Multi-gigabit European Research and Education Network and Associated Services*). In addition to DANTE and the TERENA association, the project involved 34 NREN operators, including CESNET. Ing. Jan Gruntorád, CSc., Director of the CESNET Association, is one of the eight members of the project's Executive Committee.

CESNET staff apply their expertise in a number of project activities, primarily the following ones in 2011:

- examination of potential new transfer protocols and fully optical signal processing for new generation networks and, above all, for support to new applications, such as real-time signal processing;
- participation in designing the next generation of the pan-European GÉANT research network, especially concerning possible use of new photonic applications in a multi-domain environment;
- development of solutions for automated creation of virtual channels on a European scale for specialised applications;
  - transfer of the results of the *FEDERICA* project, the outcome of which is an infrastructure (see Figure 6) intended for European researchers who need to test new computer network architectures and new communication protocol designs on them;
    - development and operation of AAI mechanisms as part of the GÉANT network;
      - intense involvement in the task *Best Campus Practices*, whose outcomes are mostly documents describing recommended processes, focusing among others on IPv6, IP telephony and traffic monitoring in university networks.

ORIENTplus

Since July 2011, the Association has been involved in a project to connect the European (via the GÉANT) and Chinese national research networks (CSNET and CERNET), called *ORIENTplus*. Its basic objective is to maintain the existing connection and progressively increase its capacity up to 10 Gbps. The ideal goal is a hybrid link allowing both IP packet
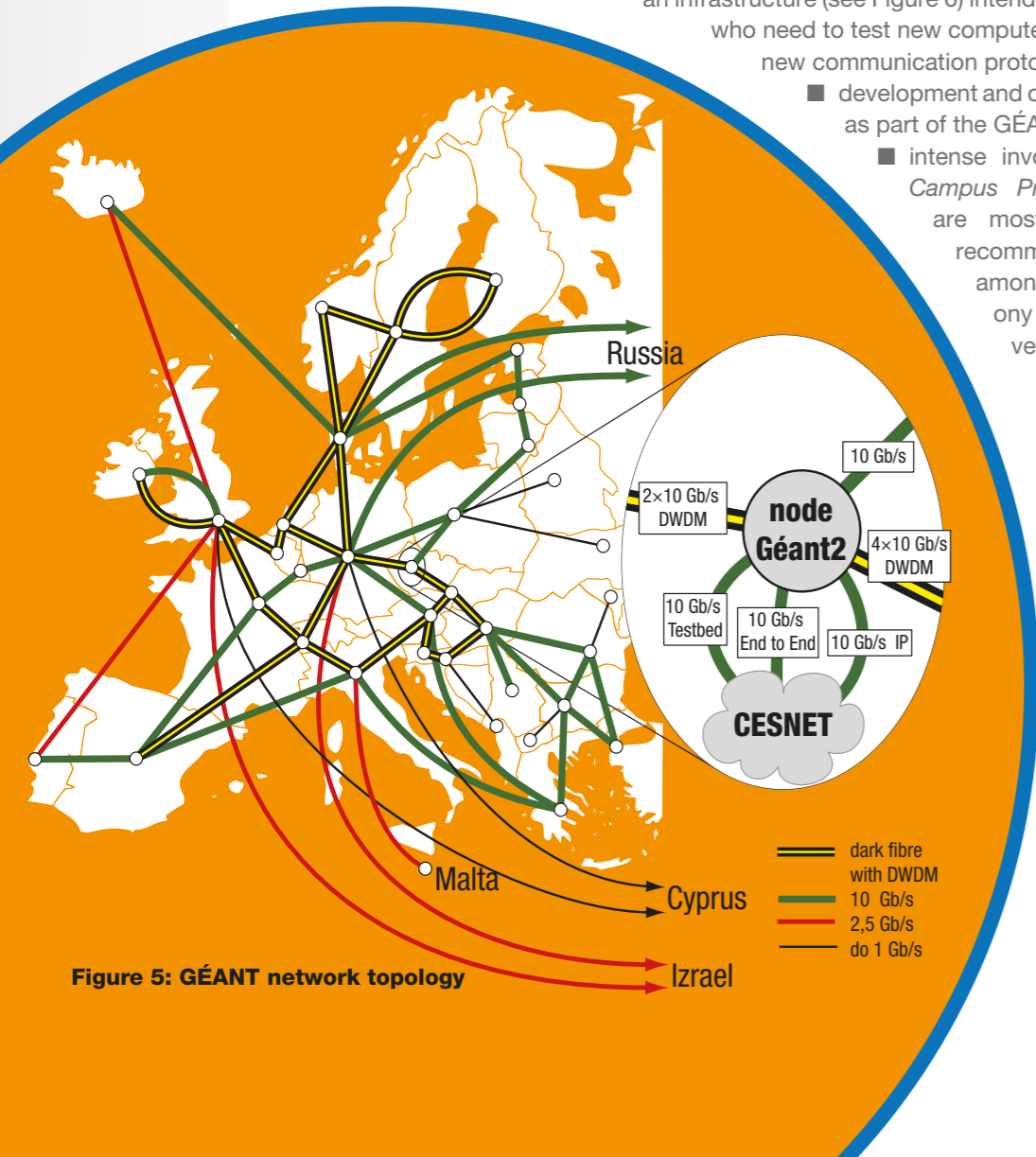
transfer and establishment of point-to-point connections. CESNET's activities focus on supporting users of such a link and demonstrating the possibilities that the new link is going to offer.

Global Lambda Integrated Facility – GLIF

Global Lambda Integrated Facility (GLIF) is a global research activity involving the most advanced institutions and consortia engaged in network research and application in Europe, North and South America, Asia and Australia. Individual *GLIF* participants enable other participants to use part of their resources so that collective experiments can be carried out. *GLIF* refers to a virtual organisation composed of involved institutions as well as a research environment (facility), consisting of lambdas and nodes known as GOLE (GLIF Open Lightpath Exchanges), set up by this organisation. Such an environment also enables experiments and demonstrations that pose a risk of interference and destruction.

The most prominent event of 2011 was the reopening of a direct 10 Gbps Chicago–Praha link using the GÉANT Praha–London route, which makes it possible to continue the work reduced or suspended in 2010 due to financial reasons (such as testing of high-speed video transfers). The cooperation with Chile for linking telescopes between the Academy of Sciences of the Czech Republic Astronomical Institute in Ondřejov and the La Silla Observatory was established. At the moment, a connection under the *GLIF* between Praha and São Paulo is currently being negotiated; there are problems with connectivity across Argentina and the last mile at the La Silla Observatory (high in the mountains).

PlanetLab and Related Projects

PlanetLab is the first laboratory that has changing the Internet as one of its objectives. It was set up in 2002 as a consortium of several American universities, and has been gradually joined by other universities from all over the world. Prominent research departments in IT companies have also become its members. Today, it is a unique network with the status of a world-wide laboratory for network applications. It has over 1,100 nodes distributed in more than 500 locations in every part of the world.

CESNET has been a member of this consortium since June 2006; it has four nodes in the network at present. The fifth node in the Czech Republic is a computer at the Brno University of Technology Faculty of Information Technology. However, that computer also works under a licence awarded to CESNET. The servers run special Linux-type software that supports virtualisation.

A shared operation mode has also been employed in the *VINI* project, which has become a certain modification of the *PlanetLab* network using dedicated connections. In this respect, the project is analogous to *FEDERICA*. CESNET is the only foreign organisation involved in this purely American project.
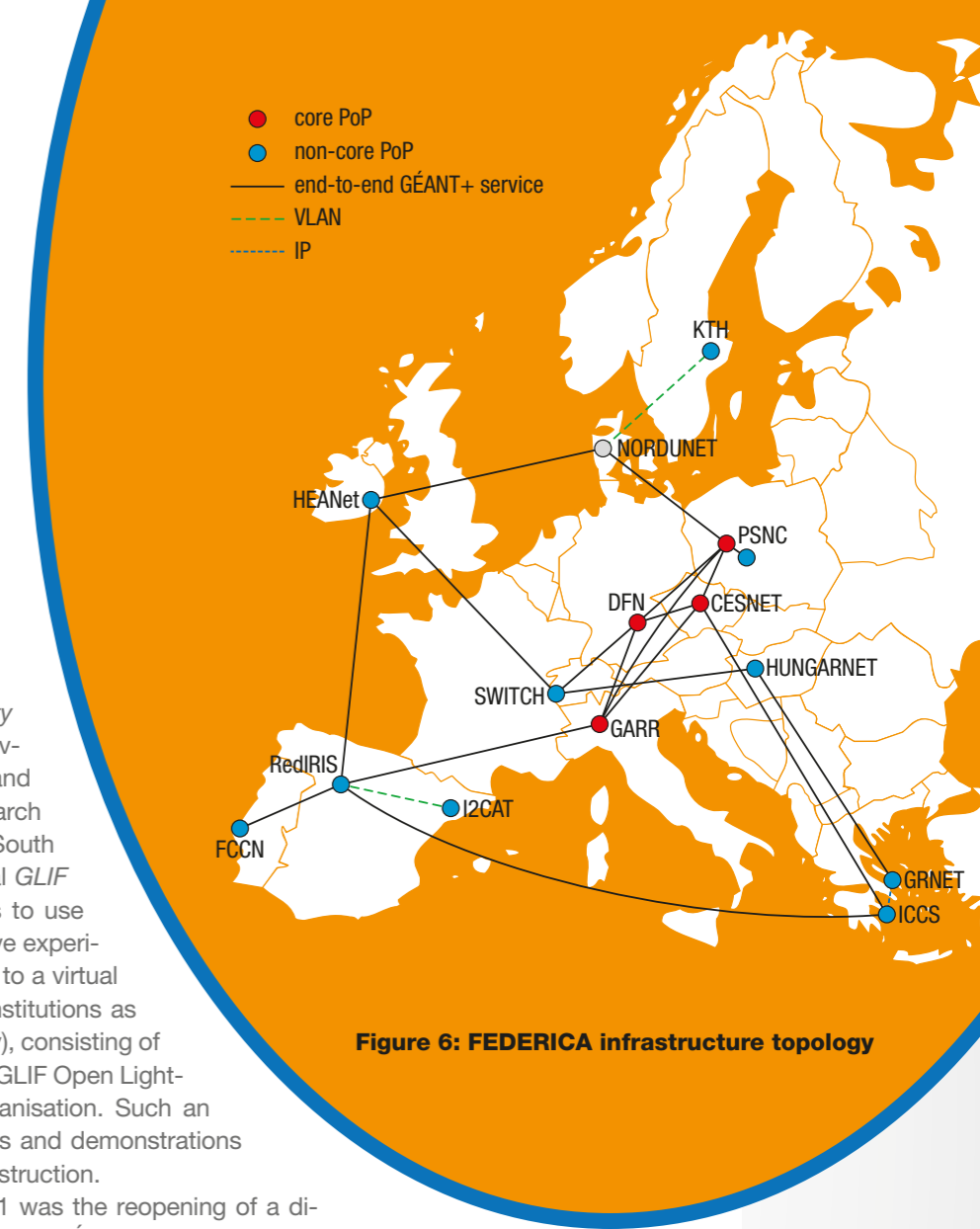

Figure 6: FEDERICA infrastructure topology

Figure 5: GÉANT network topology

EGI.eu and International Cooperation Projects on Grids

The *EGI.eu* initiative was founded in 2009 based on results and recommendations of an EU-supported project titled *EGI_DS* (*European Grid Initiative – Design Study*) with the objective to co-ordinate national activities in the area of implementation of grid technologies as an important e-infrastructure component at the European level. CESNET is one of the founding members of this initiative. The main objectives of *EGI.eu* include the following:

■ provision of long-term sustainability of the European grid infrastructure;

■ its operation, including interconnection of NGIs; and

■ coordination of middleware development.

In 2011, the cooperation under *EGI.eu* continued by conducting the *EGI-Inspire* project, which further develops the concept of a multi-discipline pan-European grid infrastructure. CESNET is involved in all the primary operational activities within the project, ensures the operation of the national EGI grid node, and provides computational resources, comprising both the association's own computing capacities and those of the Institute of Physics of the Academy of Sciences of the Czech Republic. The capacities involved are also part of *MetaCentrum* and use its virtualised infrastructure.

Providing the operation of the pan-European grid infrastructure also involves so-called global activities, common throughout the infrastructure. The project coordinator is in charge of their operation, but in fact more than half of them are performed by the partners. In this context, CESNET is in charge of operating the support services, and also continues to support the virtual organisations *Auger* and *VOCE*, as well as directly supporting user groups in the Czech Republic interested in utilising the pan-European grid. CESNET continues to focus groups involved in international cooperation.

As part of the closely related EMI project, CESNET also continues developing grid middleware, specifically the *Logging and Bookkeeping* service, and further advancing some components related to operational security. The purpose of this project is to create and further advance a consolidated set of middleware components designed for the EGI grid, *PRACE* and possibly other distributed computing infrastructures.

Moreover, CESNET is involved in the *CHAIN* project, focused on coordinating cooperation between European grid infrastructures with similar infrastructures in other regions.

OSIRIS

Together with the ASCR, the Association has become involved in the *OSIRIS* project, aimed at establishing a European platform for coordinating the development of research infrastructures in the area of information and communications technologies.
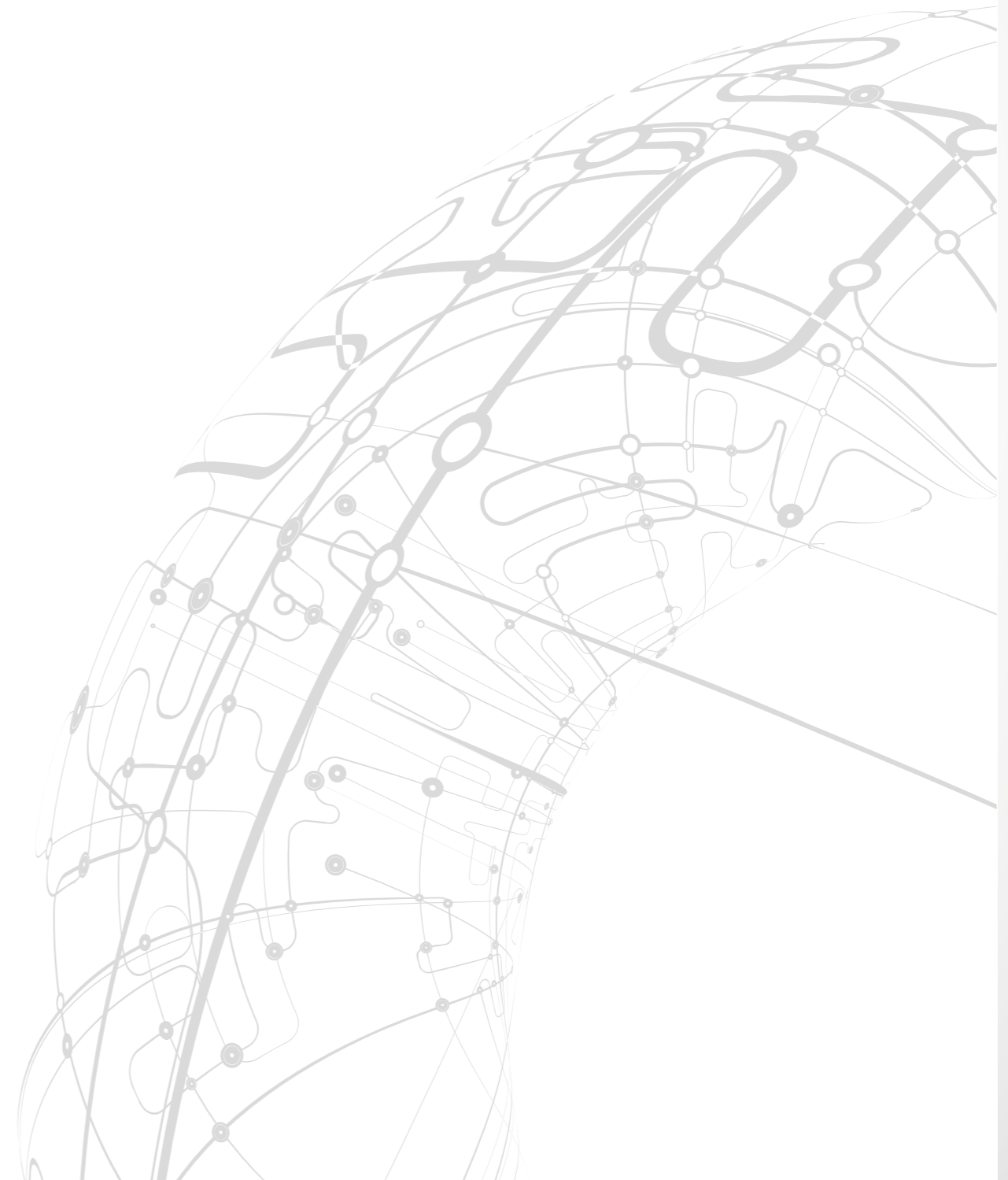
In 2011, the consortium was dedicated mostly to the collection of information on the legal forms, structures, funding and users of these research infrastructures and its analysis. CESNET's contribution to this work consisted chiefly in providing descriptions of two selected model e-infrastructures: CESNET and GÉANT.
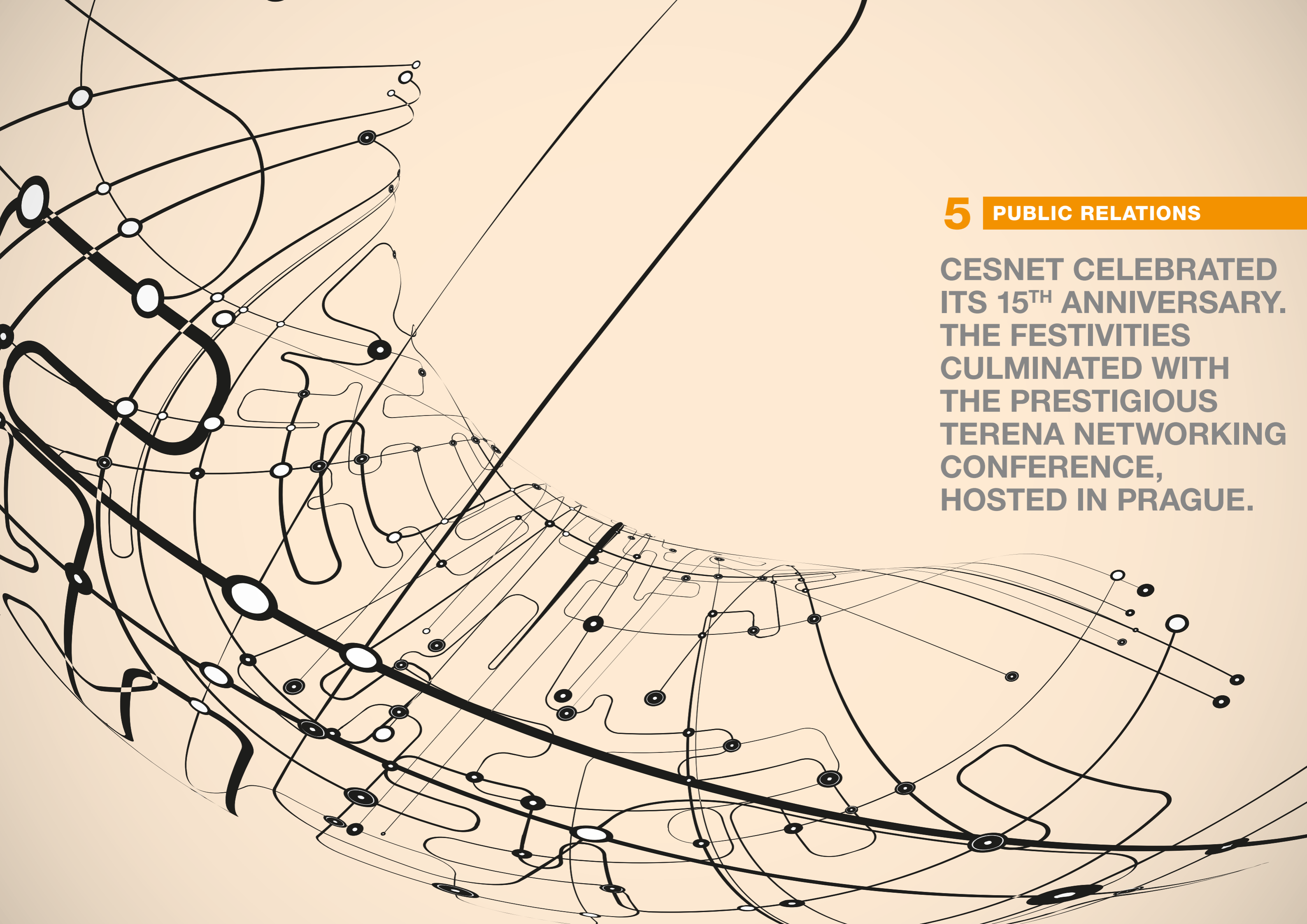
Cooperation Under the TERENA Association Activities

Task Forces (TFs) within the TERENA Association form a very important European platform for cooperation; they are set up based on current common needs of European academic infrastructures and bring together experts from NRENs interested in the issues. In 2011, CESNET was involved in the work of the following task forces:

■ **TF-CSIRT (Computer Security Incident Response Team)** – coordinating network security incident resolution and prevention;

■ **TF-EMC2 (European Middleware Coordination and Collaboration)** – coordination and collaboration in identity management and development of middleware for applications and services;

■ **TF-Mobility and Network Middleware** – development and deployment of mobile technologies and utilised network middleware for supporting interoperable roaming services within academic networks;

■ **TF-CPR (Communications and Public Relations)** – exchange of information and coordination of procedures associated with presenting national research network activities and results to the public;

■ **TF-Media (Media Management and Distribution)** – collection and exchange of ideas, knowledge and experience concerning technical, administrational as well as legal aspects of Internet multimedia creation, its management as well as distribution of related work procedures in the European area;

■ **TF-Storage** – issues of implementation of data repositories in the academic network environment;

■ **TF-NOC (Network Operation Centre)** – issues of supervision centres of National Research and Education Networks.

CESNET CELEBRATED ITS 15TH ANNIVERSARY. THE FESTIVITIES CULMINATED WITH THE PRESTIGIOUS TERENA NETWORKING CONFERENCE, HOSTED IN PRAGUE.

PUBLIC RELATIONS

The first half of 2011 was under the banner of the 15th anniversary of CESNET's foundation (6 March 1996). On 9 March, the Association organised the expert seminar *Research Projects and CESNET Large Infrastructure* (Photos 1, 2 and 3). The goal of the seminar was to outline the capacities of the *CESNET Large Infrastructure* with respect to research, development and innovation projects, and to present some of the demanding projects that are already using it. The seminar also included a roundtable on *CESNET comprehensive infrastructure as an integrating platform for research projects*, involving a discussion on which way to continue developing the e-infrastructure. The seminar participants were the first to receive copies of the book *15 Milestones in the CESNET Association History*, a Czech and English summary of the 15 most prominent successes and events in the Association's history.

In the 15th year since the Association's foundation, it was honoured with the task of hosting the greatest and most prominent European congress on network technologies, the *TERENA Networking Conference 2011 (TNC 2011*, Photos 4 and 5). Its four days (16 to 19 May) full of presentations by leading experts on networking technologies from all around the world attracted 525 participants from 36 countries on four continents to Prague; this was the biggest attendance in all of the TERENA conference history, which started in 1998. At the end of the conference, TERENA awarded CESNET a certificate of merit to acknowledge the professional organisation of the whole event. Prague hosted a unique forum attended by representatives of national research and education networks and key research institutions as well as leading network specialists, representatives of universities and other experts and students. Those who could not participate in person were able to watch all the lectures thanks to the live streaming provided by

CESNET via its network. The Full HD quality streaming allowed attendance by another 8.5 thousand users from 56 countries. All broadcasts and lectures, presentations and papers are now freely available to anyone interested in the archives on the conference website. The ceremonial lunch, held as part of the *TNC 2011* on 17 May, crowned the celebrations of the Association's 15th anniversary (Photo 6). Invitations by Ing. Josef Kubíček, Chairman of the CESNET Board of Directors, were accepted by leaders of global research in network technologies, representatives of state administration, domestic research institutions and leading ICT companies. The TNC 2011 smoothly transformed into the TERENA General Assembly session on 19 and 20 May. The CESNET Association was represented by Ing. Helmut Sverenyák, deputy director for research and development.

On the eve of TNC 2011 (11 to 13 May), the 22nd meeting of the *EUGridPMA*, the European component of the International Grid Trust Federation (IGTF), was held in Prague (Photos 7 and 8). It unites grid organisations in Asia, America and Europe in an effort to allow scientists to "introduce themselves" to any grid resource in the world using a single online identity. CESNET is one of the organisations involved in international grid projects.

In the autumn, the Association organised three expert seminars for the professional public. Over 60 mostly university experts attended the *Campus Network Monitoring Workshop* on 25 October (Photo 9), discussing issues related to operation monitoring and security provision in university and local institutional networks. The fourth *Grid Computing Seminar* took place in Brno on 7 November. The main objective of the session was to inform both existing and potential users of high-performance computing about the current capacities available for handling a broad range of

Photo 1: Seminar Research Projects and CESNET Large Infrastructure

Photo 2: Seminar Research Projects and CESNET Large Infrastructure (RNDr. Ing. Jiří Peterka, Ing. Naděžda Witzanyová)

Photo 3: Seminar Research Projects and CESNET Large Infrastructure (Prof. RNDr. Václav Pačes, DrSc.)

Photo 4: TERENA Networking Conference 2011 (Ing. Jan Gruntorád, CSc.)

Photo 5: TERENA Networking Conference 2011

research problems and challenges; it presented the previous year's most prominent milestones in HW, SW and development as well as future plans. The *Multimedia Seminar* dealt with HD and Post HD video streaming, security in IP telephony, video conferencing, and other multimedia services. Among other things, the aim of the session on 30 November was to introduce *CESNET Large Infrastructure* users to the broad range of transmission systems and their applications, and thus direct them towards the potentially appropriate technology to support their specific needs.

One of the important presentation forms of the Association is the provision of live streaming of significant professional as well as popular educational events. On 1 and 2 September, the Association was involved in an online streaming from the *International Congress of Trauma Surgery and Forensic Medicine*, held in Mikulov. An hour-long online broadcast of robotic surgery in 3D was done by the Association's experts led by Ing. Jiří Navrátil, CSc., at the international expert colloquium *Use of Information Technology in Health Care*, held on 20 October in Banská Bystrica, Slovakia. Exceptional attention was drawn to the stereoscopic low-latency broadcasts, presented by CESNET experts at the prestigious international *ITU Telecom World 2011* conference in Geneva on 24-27 October (Photo 10). In November, the Association again became one of the co-organisers of the eleventh year of the *Science and Technology Week* (Photo 11), taking part in broadcasting of selected expert lectures.

The Association published the results of its research activities in print and electronic professional journals. The Association made 29 press releases in 2011: a record-breaking number in all

15 YEARS OF CESNET

Photo 6: Ceremonial lunch on the occasion of the Association's 15th anniversary

Photo 7: 22nd session of the EUGridPMA

Photo 8: 22nd session of the EUGridPMA

its existence. The quality of the content of the press releases is confirmed by the fact that all of them were adopted by at least one print or electronic professional journal.

Three issues of the *Datagram* journal were published during the year; another special issue was dedicated to announcing the request to submit projects for the Development Fund of the CESNET Association. The fifth year of the selected technical report anthology *Networking Studies 2011* was published. The March extended issue of *Datagram* was dedicated to the completed research project *National Research Optical Network*, looking back at the most important results that were achieved. The June issue of *Datagram* was single-featured, dealing with TNC 2011 and the associated events. Both *Datagram* and the anthology were distributed in print form, and they are also downloadable in electronic form from the Association's website.

At least once every year since 2005, CESNET has made it into the biggest mass medium, being television. This tradition also continued in 2011; on the occasion of TNC 2011 being held in Prague, the Association's experts appeared in the *Milénium* show on the ČT24 news channel four days in a row.

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

The Association makes use of feedback in the form of regular media monitoring and its monthly analyses of these outputs have confirmed a steady increase in activities presenting the Association's work in a positive light.

Photo 9: Campus Network Monitoring

Photo 10: ITU Telecom World 2011 (Ing. Jiří Navrátil, CSc., Ing. Petr Žejdl)

Photo 11: Science and Technology Week

THE ASSOCIATION DULY MANAGED THE FUNDS ENTRUSTED. THE AUDITOR HAD NO RESERVATIONS TO THE FINANCIAL STATEMENT.

ECONOMIC RESULTS

2011 Economic Results

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

Principal Activity

Two new large projects were launched in 2011: the five-year project *CESNET Large Infrastructure*, with a primarily investment focus, and *Extension of the National R&D Information Infrastructure in Regions* (*eIGeR*), to run for 30 months, also with a major investment focus.

As part of its principal activity, the Association started building an e-infrastructure of a new quality to provide Association members and other entities eligible for connection to the CESNET2 network with a comprehensive set of services. In addition, the Association was involved in executing international research projects under the EU's 7th Framework Programme, a grant from the Technology Agency of the CR, and projects of the Development Fund Board.

The Association's principal activity ended 2011 with a book profit of CZK 653 thousand. Revenues from the Association's principal activity amounted to CZK 429,286 thousand; the expenditures were CZK 428,633 thousand.

The income tax base from the yields of the Association's principal activity in 2011 was positive, amounting to CZK 9,861 thousand.

Economic activity

The Association's economic activity in 2011 mainly involved management of the largely bond-based portfolio of the Development Fund comprising financial resources obtained by sale of the commercial part of the CESNET network in 2000 and management of financial resources in other funds.

The Association's economic activity ended 2011 with a book profit of CZK 12,838 thousand. Revenues from the Association's economic activity in 2011 amounted to CZK 35,157 thousand; expenditures on the economic activity were CZK 22,319 thousand.

The income tax base from the yields of the Association's economic activity in 2011 was positive, amounting to CZK 14,120 thousand.

Total Book and Tax Economic Result

The total book economic result of the CESNET Association prior to taxation reported in 2011 was a profit amounting to CZK 13,491 thousand.

The total income tax base after deducting the items lowering the tax base was CZK 22,981 thousand. The Association will pay income tax of CZK 4,366 thousand for 2011, resulting in a net profit of CZK 9,125 thousand.

Conclusion

The Association properly managed the entrusted resources in 2011, 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 2011 was verified by the auditor without any remarks.

BALANCE SHEET *in Thousands of CZK*	2011	2010	2009	2008
Assets total	973,454	649,539	754,621	753,947
Fixed Assets	627,664	459,849	524,013	525,680
Intangible fixed assets	3,615	3,623	3,064	4,369
Tangible fixed assets	306,765	137,150	206,780	208,788
Financial Investments	317,284	319,076	314,169	312,523
Current assets	345,790	189,690	230,608	228,267
Supplies	243	0	0	0
Receivables	70,176	19,042	25,879	36,086
Current liquid assets	252,428	144,003	160,692	158,078
Other assets	22,943	26,645	44,037	34,103
Liabilities total	973,454	649,539	754,621	753,947
Own resources	797,542	605,710	681,001	679,806
Funds	665,136	474,303	538,976	529,987
Economic result	9,125	-2,047	3,915	707
Undivided profit from last years	123,281	133,454	138,110	149,112
External resources	175,912	43,829	73,620	74,141
Obligations	173,658	41,321	70,980	70,923
Loans	0	0	0	0
Other liabilities	2,254	2,508	2,640	3,218

PROFIT AND LOSS STATEMENT *in Thousands of CZK*	2011	2010	2009	2008
Earnings for the sale of goods	21	20	23	44
Earnings of own product and services	100,933	102,050	105,437	100,946
Current liquid assets revenues	26,039	78,960	19,603	18,691
Other revenues	107,775	63,425	54,505	115,270
Received membership fees	0	0	0	0
Operation subsides	229,675	139,771	186,688	193,720
Revenue total	464,443	384,226	366,256	428,671
Purchase price of sold goods	16	15	19	41
Material and energy consumption	21,958	15,274	17,416	23,006
Purchased services	197,130	149,385	191,555	178,318
Personnel costs	129,133	100,852	104,878	103,807
Depreciation and amortization of intangible and tangible fixed assets	74,905	24,926	30,902	40,262
Other costs	27,810	93,576	14,261	80,474
Income tax – assesment for the current year	4,366	2,245	3,310	2,056
Costs total	455,318	386,273	362,341	427,964

	2011	2010	2009	2008
Economic result (revenue – costs)	9,125	-2,047	3,915	707

R – audit, s. r. o.

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

REPORT OF THE INDEPENDENT AUDITOR

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

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

The statutory body of CESNET, Association of Legal Entities is responsible for the preparation of financial statements that give a true and fair view in accordance with Czech accounting regulations and for such internal control as statutory body determines is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error.

Our responsibility is to express an opinion on these financial statements based on our audit. We conducted our audit in accordance with Act No. 93/2009 Coll., the Act on Auditors and International Standards on Auditing and the related application guidelines issued by the Chamber of Auditors of the Czech Republic. Those laws and regulations require that we comply with ethical requirements and plan and perform the audit to obtain reasonable assurance whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The 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 entity's preparation of the financial statements that give a true and fair view 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 the entity's 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 of the financial position of CESNET, Association of Legal Entities as of 31 December 2011, and of its financial performance for the year then ended in accordance with Czech accounting regulations.

Date of issue of report:
In Prague on 11 June 2012

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 Špíšková
Chamber of Auditors of the Czech Republic certificate number 1326