

annual report

2017

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A word from the Director

THE YEAR 2017 BROUGHT ONE IMPORTANT JUBILEE – THE 25TH ANNIVERSARY OF OUR COUNTRY'S FIRST CONNECTION TO THE INTERNET, WHICH FELL ON 13 FEBRUARY. CESNET ORGANIZED A REPRESENTATIVE MEETING ON THAT DAY.



You are reading CESNET's Annual Report in which we have recapped our achievements in 2017.

It was a very successful year from the Association's perspective. We made substantial progress in the implementation of our pivotal long-term CESNET e-Infrastructure project; we presented a number of innovative solutions resulting from our development activities, which aroused interest among both domestic and international audiences; we organized several meetings of networking technology experts as well as the broader professional public... We have summarized all of our principal activities on the following pages.

The year 2017 also brought one important jubilee – the 25th anniversary of our country's first connection to the Internet, which fell on 13 February. CESNET organized a representative event on that day, attended by dozens of professionals from among contemporary witnesses of the beginnings of the Internet and current leading experts in the field, as well as countless students representing the coming generation. It is hard to believe that today's university students that have decided to build their careers in our field had not been born when the first connection was made. We have made quite a lot of progress in the development of the Internet and, in the broader context, advanced information society since 13 February 1992. And CESNET has always been the one showing the directions to take.

The key tangible result of our efforts is CESNET's advanced national e-infrastructure.

It provides a universal environment for the transmission, processing, sharing and storage of scientific data and user collaboration that is independent of any specific field of research

and indispensable to contemporary research, development and innovation in any field of human activity. It is one of Europe's most advanced infrastructures of its kind.

As early as in 2014, the CESNET e-infrastructure was included in an assessment of research infrastructures made by the Ministry of Youth, Education and Sports (MYES). The assessment aimed to collect base data for updating the Czech Republic Roadmap for Large Infrastructures and, most importantly, making decisions on their future funding. The CESNET e-infrastructure got the highest score possible, becoming one of the infrastructures that would receive priority support. That is also why it is included in the new Czech Republic Roadmap for Large Research, Experimental Development and Innovation Infrastructures for 2016–2022.

The first interim assessment of large research infrastructures was carried out in early 2017 in order to obtain independent expert data for the Czech Government's decision on the provision of specific MYES aid to large research infrastructures in 2019 to 2022. Based on the assessment, our CESNET e infrastructure is included in the top category of research infrastructures with excellent quality comparable to that of similar infrastructures worldwide, which are highly relevant to the future development of the Czech Republic's research and innovation environment and necessary for the enhancement of its competitiveness. This was a crucial decision for our future activities, one that we see not only as a recognition of our work so far but also as a liability. It is obvious that society expects us to keep on undertaking demanding tasks in the future.

In fact, the international expert panel's assessment report includes several recommendations in addition to comments substantiating the overall assessment of the CESNET e-infrastructure. For example, we should prepare for the role of an umbrella organization for all national e-infrastructures, that is, CESNET, IT4Innovations and CERIT-SC. This is another acknowledgement of our unique position. I am sure that we will rise to this challenge as well as a number of other challenges we are facing.

I would like to thank all Association members, employees and collaborators for their commitment and erudition and the Ministry of Youth, Education and Sports for continued support, without which our successes would be inconceivable.



Ing. Jan Gruntorád, CSc.

Director and Member of the Board
of Directors, CESNET

IN 2017 CESNET PROGRESSED IN THE IMPLEMENTATION OF THE CESNET E-INFRASTRUCTURE PROJECT. PROJECT WAS LAUNCHED IN 2016 AND WILL LAST UNTIL 2019. ITS AIM IS TO ENHANCE THE NATIONAL E-INFRASTRUCTURE.





The Association's history and current tasks

THE CESNET ASSOCIATION WAS FOUNDED BY PUBLIC UNIVERSITIES AND COLLEGES AND THE ACADEMY OF SCIENCES OF THE CZECH REPUBLIC (ASCR) IN 1996.

ITS OBJECTIVES ARE TO:

- [1.] Independently conduct fundamental, industrial research and experimental development in information and communications technologies and their applications and disseminate the results of such activities by all available means including technology transfer
- [2.] Build, develop and operate the CESNET research infrastructure on a long-term basis and promote the development, adoption and utilization of state-of-the-art communications and information technologies
- [3.] Support, in return for the reimbursement of related expenses, the dissemination of erudition, culture and knowledge, its members' cooperation with industry, expansion of applications of the latest information technologies, and improvement of the CESNET research infrastructure by adding more subscribers, information sources and services

When founded, the Association also operated as a commercial Internet service provider in order to earn additional money from these activities for its principal activity. It managed to gain a leading position in the Internet connection market in the Czech Republic. The Association discontinued that activity in 2000, chiefly for economic and legislative reasons. Since then, it has been engaged exclusively in the development and operation of a backbone science, research and education network (Czech NREN – National Research and Education Network) and related activities. The NREN is called **CESNET2**. In 2011, the Association received two crucial decisions of the Ministry of Education, Youth and Sports of the Czech Republic on

funding for two large projects. One of them was **CESNET Large Infrastructure**, a project implemented in 2011–2015.

The purpose of the project was to rebuild the CESNET2 national research network as a large infrastructure, which would include all the information and communications e-infrastructures necessary for the Czech Republic's involvement in the European Research Area and enabling, for example, connection to the other e-infrastructures described in the ESFRI Roadmap.

The other project crucial for the Association's activities was the **Extension of the National R&D Information Infrastructure in Regions** (abbreviated as **elGeR**), the main objective of which was to build regional foundations for a comprehensive national research and development e infrastructure in the Czech Republic. The project was implemented between May 2011 and October 2013.

According to the grant decision, the Association is obligated to make the project sustainable at least until the end of 2018.

In line with its goals and as part of its main activities (see below), the Association began implementing the **CESNET e-Infrastructure** project (identification code LM2015042) in 2016. The project's objective is to develop the national e-infrastructure, which was built under the previous **CESNET Large Infrastructure** project, during 2016–2019.

The CESNET e-infrastructure is used to provide non-public services to support and serve Czech science, research, development and education. CESNET e-infrastructure services are described in the next sections of the Annual Report. The Association provides these services to not only its members but also other entities that meet the current **CESNET e-Infrastructure Access Policy**.

THE SCOPE OF THE ASSOCIATION'S MAIN ACTIVITIES IS AS FOLLOWS:

- [1.] Conducting independent research and development activities in information and communications technologies and providing research services in this field
- [2.] Supporting education in information and communications technologies
- [3.] Putting the results of in-house research and development into practice through technology transfer of internal nature
- [4.] Undertaking the following activities for the benefit of its members, their subsidiary organizations as well as other entities:
 - Developing and operating the national communications and information infrastructure to enable the interconnection of their infrastructures, provide access to the CESNET infrastructure and connect to similar third-party infrastructures (including Internet access)
 - Building shared hardware, communications and software and information services
 - Verifying new applications, collaboration and complementarity of member activities at a level comparable to that of leading academic and research infrastructures abroad

The Association performs and provides its activities within the scope of received subsidies and partial compensation for expenses associated with these activities. It is not the Association's objective to generate any profit on these activities. The Association pursues supplementary activities in addition to its main activities, but solely for 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.

Any loss incurred in connection with the Association's supplementary activities will always be settled by the end of the fiscal period in question or the supplementary activity in question will be discontinued before the beginning of the following fiscal period.

The Association uses all of its profits to promote research and development.

Membership in international and national organizations

CESNET WAS A MEMBER OF THESE RENOWNED INTERNATIONAL AND NATIONAL ORGANIZATIONS.

INTERNATIONAL ORGANIZATIONS

GÉANT Association – an association of European national research networks that is engaged in the operation and advancement of the GÉANT European communications infrastructure and coordination of related activities

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

Internet2 – a consortium led by US research and educational institutions endeavouring to develop and deploy new types of networking technologies, services and applications; CESNET has been an associate consortium member since 1999

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

EGL.eu – an organization aimed at coordinating European computing grids used for scientific computations and at supporting their sustainable development

Shibboleth – an international consortium for the coordination of the development of a service providing a single sign-on solution, meaning that a user can use multiple secured network resources using a single login; Shibboleth is the foundation for academic identity federations

NATIONAL ORGANIZATIONS

NIX.CZ – CESNET is one of the founders of NIX.CZ, z. s. p. o. (Neutral Internet Exchange), an association of Internet service providers in the Czech Republic providing interconnectivity for its members' networks; the association had 67 members as of 31 December 2017

CZ.NIC – the Association is also one of the founding members of CZ.NIC, z. s. p. o., which administers the .cz domain and supports publicly beneficial projects and activities relating to the Internet; the association had 114 members as of 31 December 2017

THE FOLLOWING INSTITUTIONS WERE MEMBERS OF THE ASSOCIATION IN 2017:

- Academy of Arts, Architecture and Design in Prague
- Academy of Fine Arts in Prague
- Academy of Performing Arts in Prague
- Brno University of Technology
- Charles University
- The Czech Academy of Sciences
- Czech Technical University in Prague
- Czech University of Life Sciences Prague
- University of Chemistry and Technology, Prague
- Janáček Academy of Music and Performing Arts in Brno
- Jan Evangelista Purkyně University in Ústí nad Labem
- Masaryk University
- Mendel University in Brno
- Palacký University Olomouc
- The Police Academy of the Czech Republic in Prague
- Silesian University in Opava
- Technical University of Liberec
- Tomas Bata University in Zlín
- University of Defence
- University of Economics, Prague
- University of Hradec Králové
- University of Ostrava
- University of Pardubice
- University of South Bohemia in České Budějovice
- University of Veterinary and Pharmaceutical Sciences Brno
- University of West Bohemia
- VŠB – Technical University of Ostrava

Internal organizational structure

CESNET HAS THE FOLLOWING BODIES:

- GENERAL ASSEMBLY
- BOARD OF DIRECTORS
- SUPERVISORY BOARD

GENERAL ASSEMBLY

Based on elections held at the 41st General Assembly on 30 June 2016, the Board of Directors had the following members in 2017:

- Mgr. Michal BULANT, Ph.D.
- RNDr. Igor ČERMÁK, CSc.
- RNDr. Alexander ČERNÝ
- Ing. Jan GRUNTORÁD, CSc.
- Mgr. František POTUŽNÍK
- Doc. RNDr. Pavel SATRAPA, Ph.D.
- Prof. Ing. Miroslav TŮMA, CSc.

The **Chairman** was Prof. Ing. Miroslav Tůma, CSc., and the **Vice-Chairmen** were doc. RNDr. Igor Čermák, CSc., and Mgr. František Potužník.

BOARD OF DIRECTORS

The Supervisory Board consisted of the following members until 29 June 2017:

- Mgr. Jan GAZDA, Ph.D.
- Ing. Jaromír MARUŠINEC, Ph.D., MBA
- Ing. Jakub PAPÍRNÍK
- RNDr. David SKOUPIL
- Ing. Michal SLÁMA

The **Chairman** of the Supervisory Board was Ing. Jaromír Marušinec, Ph.D., MBA.

The 43rd General Assembly held on 29 June 2017 elected the following Supervisory Board members for the term of 2017–2019:

- Doc. Ing. Vojtěch BARTOŠ, Ph.D.
- Mgr. Jan GAZDA, Ph.D.
- Ing. Jakub PAPÍRNÍK
- RNDr. David SKOUPIL
- Ing. Michal SLÁMA

Ing. Michal Sláma was elected **Chairman** of the Supervisory Board. Ing. Jan Gruntorád, CSc., was the **Director** of the Association in 2017.

DEVELOPMENT FUND BOARD

The Development Fund Board had the following members until 29 July 2017:

- Doc. Ing. Vojtěch BARTOŠ, Ph.D.
- Ing. Miroslav INDRA, CSc.
- Ing. Olga KLÁPŠTOVÁ
- Doc. RNDr. Antonín KUČERA, CSc.
- Prof. Dr. Ing. Zdeněk KŮS
- Ing. Michal SLÁMA – resigned from the Board on 29 November 2016
- Prof. Ing. Zbyněk ŠKVOR, CSc.

The **Chairwoman** of the Development Fund Board was Ing. Olga Klápštová.

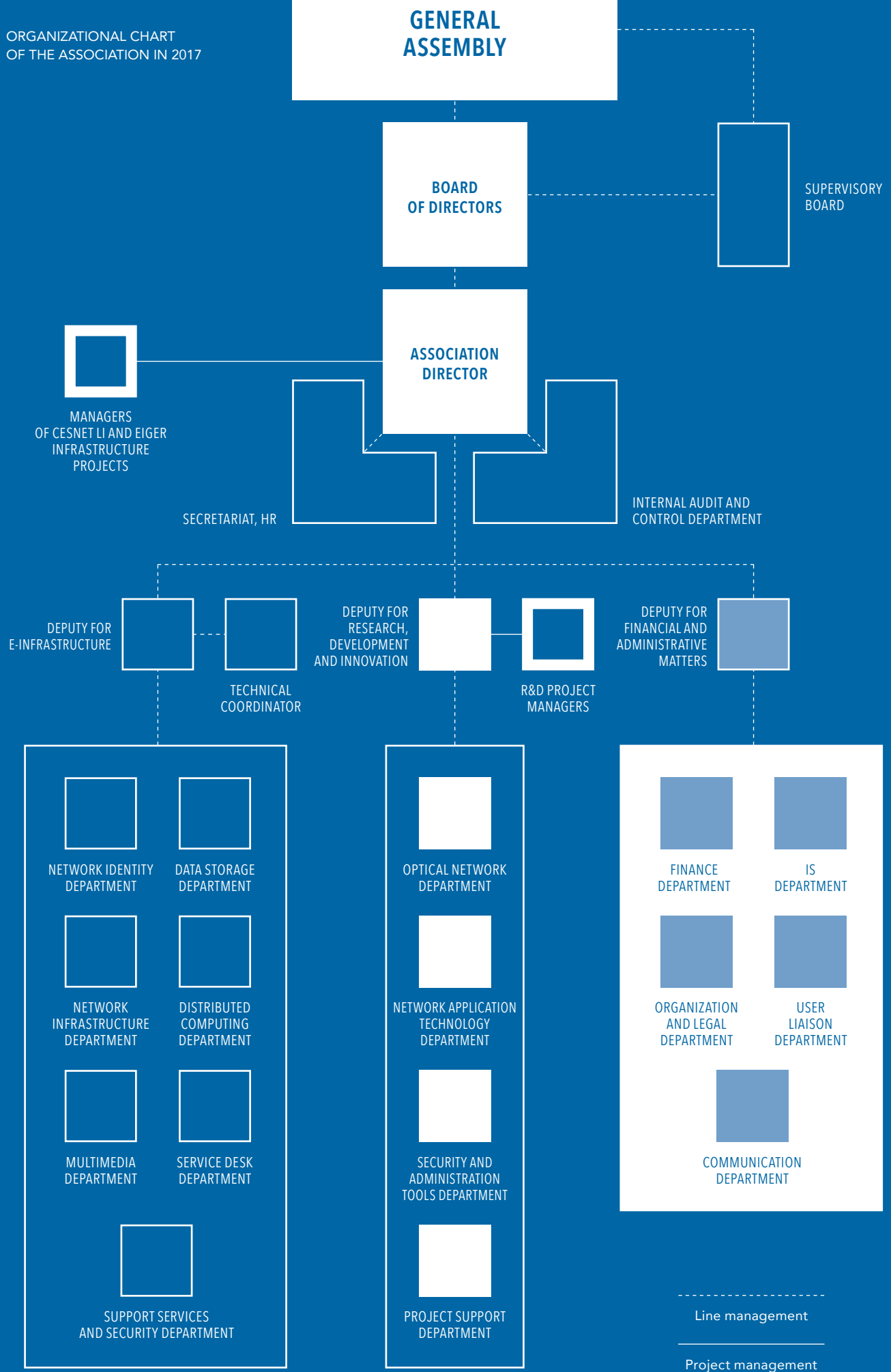
The 43rd General Assembly held on 29 June 2017 elected the following members of the Development Fund Board for the term of 2017–2019:

- Doc. RNDr. Eva HLADKÁ, Ph.D.
- Ing. Miroslav INDRA, CSc.
- Ing. Olga KLÁPŠTOVÁ
- Doc. RNDr. Antonín KUČERA, CSc.
- Prof. Dr. Ing. Zdeněk KŮS
- Ing. Jaromír MARUŠINEC, Ph.D., MBA
- Prof. Ing. Zbyněk ŠKVOR, CSc.

Ing. Olga Klápštová was elected **Chairwoman** of the Development Fund Board.

ORGANIZATIONAL CHART

Following discussion with the Board of Directors, the organizational chart was approved by the Association's Director on 4 January 2016 and entered into force on the same day. It was in force throughout 2017. The Association had 166.1 full-time equivalents in 2017. The Association's basic organizational structure comprises departments, which may be aggregated into sections. Management within this structure is performed by line managers.



IN THE PAST PERIOD, THE ASSOCIATION FOCUSED PRIMARILY ON ENSURING RELIABLE OPERATION, MAINTAINING ADEQUATE PERFORMANCE AS WELL AS SUPPORTING OTHER SERVICES OF THE CESNET E-INFRASTRUCTURE.





CESNET'S PRINCIPAL ACTIVITY IS DEVELOPING, BUILDING AND OPERATING THE CESNET E-INFRASTRUCTURE.

THE CESNET E-INFRASTRUCTURE IS A COMPLEX ENVIRONMENT COMPRISING A HIGH-THROUGHPUT NATIONAL COMMUNICATIONS INFRASTRUCTURE, A NATIONAL GRID INFRASTRUCTURE (NGI) AND A DATA STORAGE INFRASTRUCTURE, COMPLEMENTED WITH TOOLS AND SERVICES FOR MANAGING ACCESS TO RESOURCES, COMMUNICATION SECURITY AND DATA PROTECTION TOOLS AND TOOLS FOR EFFICIENT COLLABORATION BETWEEN DISTRIBUTED USERS AND TEAMS.

THE CESNET E-INFRASTRUCTURE IS INCLUDED IN THE CZECH REPUBLIC ROADMAP FOR LARGE RESEARCH, EXPERIMENTAL DEVELOPMENT AND INNOVATION INFRASTRUCTURES FOR 2016–2022.

NATURALLY, THIS E INFRASTRUCTURE IS INTEGRATED IN RELEVANT INTERNATIONAL INFRASTRUCTURES.

THE CESNET E-INFRASTRUCTURE IS ALSO USED AS A TESTING AND DEVELOPMENT ENVIRONMENT FOR NEW TECHNOLOGIES AND APPLICATIONS IN INFORMATION AND COMMUNICATIONS TECHNOLOGY.

Special-purpose support for developing and operating the CESNET e-infrastructure

THE DEVELOPMENT AND OPERATION OF THE CESNET E-INFRASTRUCTURE IS SUPPORTED FROM PUBLIC FUNDS, WITH THE MINISTRY OF EDUCATION, YOUTH AND SPORTS PROVIDING SPECIFIC SUBSIDIES FOR TWO PROJECTS:

THE CESNET E-INFRASTRUCTURE

The CESNET e-Infrastructure project (LM2015042, 2016–2019) funded under the R&D&I Large Infrastructure Projects programme (2010–2019). The subsidy is earmarked for covering a portion of operating costs associated with the operation of the CESNET e-infrastructure. The year 2017 was the second year of project implementation.

THE CESNET E-INFRASTRUCTURE – MODERNIZATION

A project funded under the Research, Development and Education Operational Programme (RDE OP) entitled **CESNET e-Infrastructure – Modernization** (reg. No: CZ.02.1.01/0.0/0.0/16_013/0001797, 2017–2020). Aid under this project is intended for investments in the network and grid infrastructures and especially renovation of the data storage infrastructure as well as for operating cost associated with in-house research on security, flexible infrastructures and the development of new technologies for network applications. Based on a positive project evaluation in the material assessment stage, the implementation stage of the project started on 1 January 2017.



Communications infrastructure

IN THE PAST PERIOD, CESNET FOCUSED PRIMARILY ON ASSURING RELIABLE OPERATION, MAINTAINING ADEQUATE PERFORMANCE CAPACITY, AND SUPPORTING OTHER SERVICES OF THE CESNET E-INFRASTRUCTURE, CONNECTED LARGE INFRASTRUCTURES AND OTHER NETWORK SUBSCRIBERS.

CESNET continually monitors traffic in order to identify and remove bottlenecks, such as insufficient capacities of some backbone transmission circuits, external connectivity or lack of connecting ports with sufficient capacity for the purposes of large infrastructures to which the CESNET e-infrastructure provides network services. Its activities inherently involve continual communication with other large infrastructures for which CESNET prepares and provides network-level services. Such services include, in particular, high-speed IPv4/IPv6 connectivity, L0 and L1 circuits or L2/L3 VPNs.

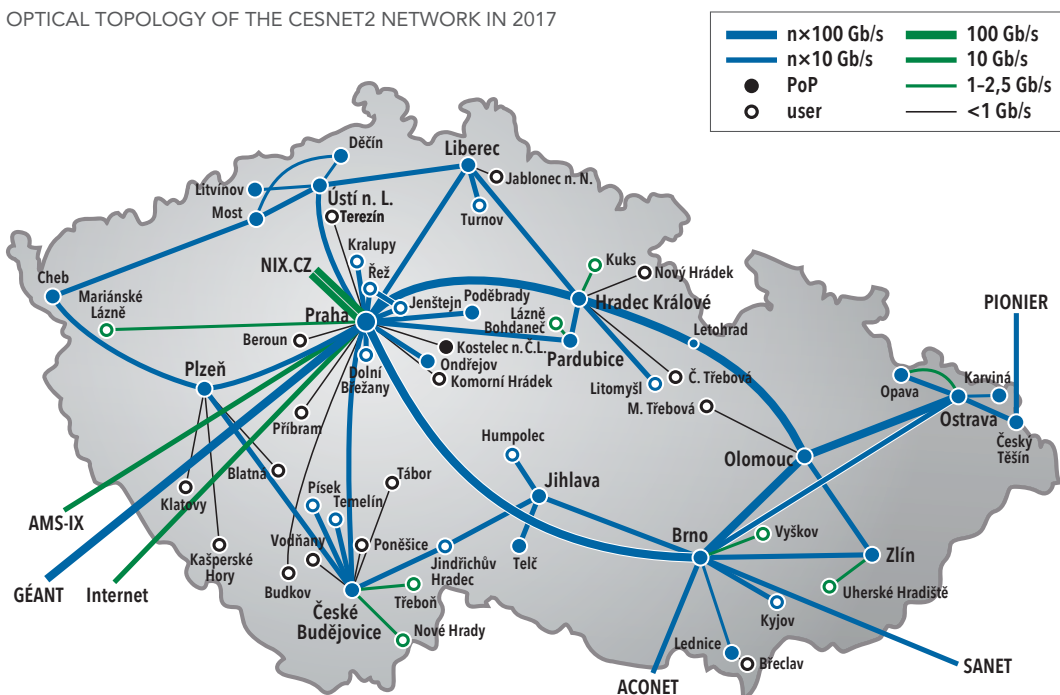
THE FOLLOWING FUNDAMENTAL CHANGES AND ACTIVITIES TOOK PLACE IN 2017:

- **Changing the provider of international connectivity** from Telia IC to Telecom Italia Sparkle. The costs of backed-up international connectivity were cut significantly in a tendering procedure. The tendering procedure included an option for 2x 10GE of backed-up connectivity, which allows for future upgrades if necessary. The main connection is to the Praha_2 node and the back-up connection is to the Brno_1 node (connected to Bratislava).
- **Upgrading the Jihlava node** from 10GE to 2x 10GE (Jihlava–České Budějovice and Jihlava–Brno CL DWDM lines).
- **Upgrading and enhancing the reliability of selected CL DWDM lines.** Due to aged technology, these lines faced frequent problems in case of failures of some optical transmission channels which resulted in a negative impact on other channels. These problems were eliminated by deploying the VMUX technology, which was used on the Brno–Ostrava, České Budějovice–Jihlava–Brno, Praha–Ústí nad Labem and Plzeň–Cheb–Ústí nad Labem CL DWDM lines.

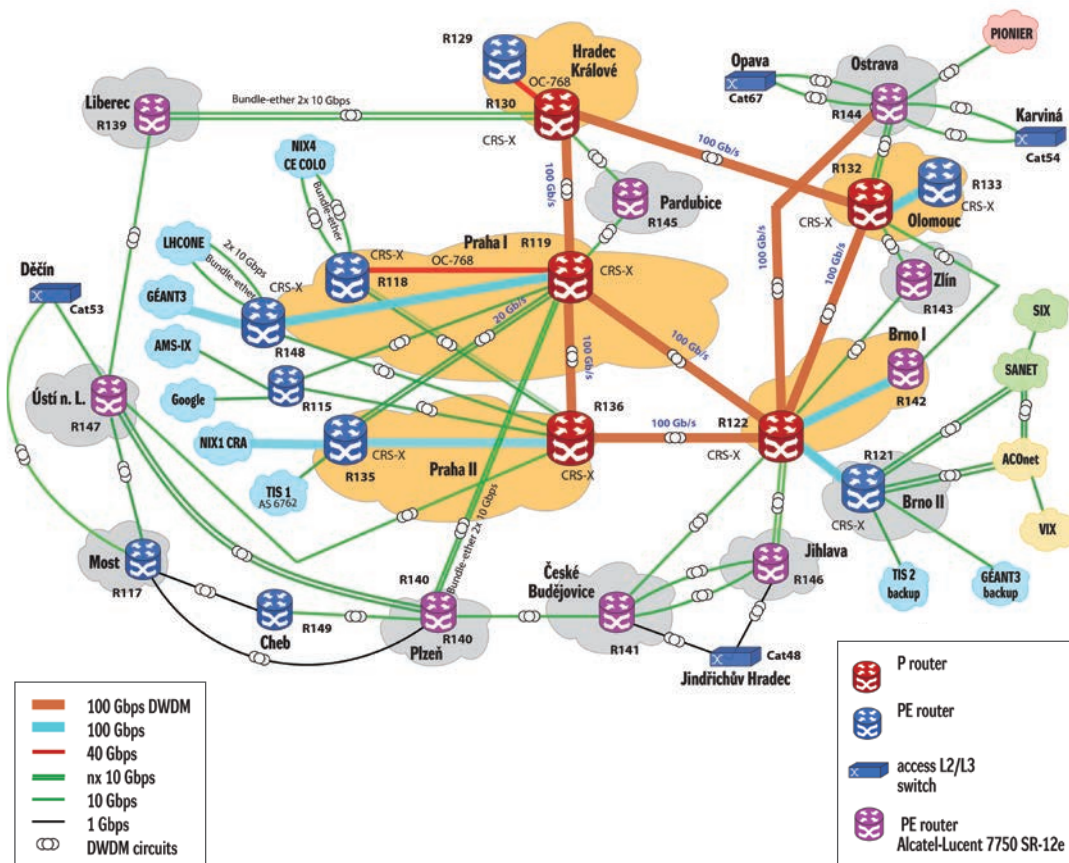
- **Adding 40GE/100GE interfaces to CRS-X access routers** at the Praha_1 and Praha_2 nodes (under an RDE OP project). These high-speed interfaces allowed connecting other parts of the e-infrastructure (a virtualization platform and others) with higher capacities to ensure their trouble-free operation. The purchased 40GE ports will also be used to upgrade subscribers' connections to higher capacities. The 100GE interfaces are used for connection to the backbone network and are prepared for upgrading the connection to NIX.CZ, which is planned for 2018.
- **Adding 100GE/40GE interfaces** to Alcatel-Lucent/Nokia equipment at the Brno_1 and Ostrava nodes. These high-speed interfaces allowed connecting other parts of the e-infrastructure (a virtualization platform and others) with higher capacities.
- **Creating an access CL DWDM node at the Institute of Molecular Genetics in Krč** (ASCR institutes) and incorporating it in the Zikova 4–Dolní Břežany–Vestec–Prague CL DWDM circuit. This node was created to provide services for ASCR institutes and the PASNET network.

Due to an increasing frequency and intensity of DDoS attacks, CESNET worked intensely on the protection of network communications infrastructures and connected subscribers. We made RTBH services available in the CESNET2 network environment for their needs. Ensuring reliable network operation inherently involves SW upgrades to resolve bugs and test and deploy new functionalities. In the area of specific network services, the Association continues building the national optical infrastructure for time and frequency transmission – the TF infrastructure.

OPTICAL TOPOLOGY OF THE CESNET2 NETWORK IN 2017



3 IP/MPLS TOPOLOGY OF THE CESNET2 NETWORK

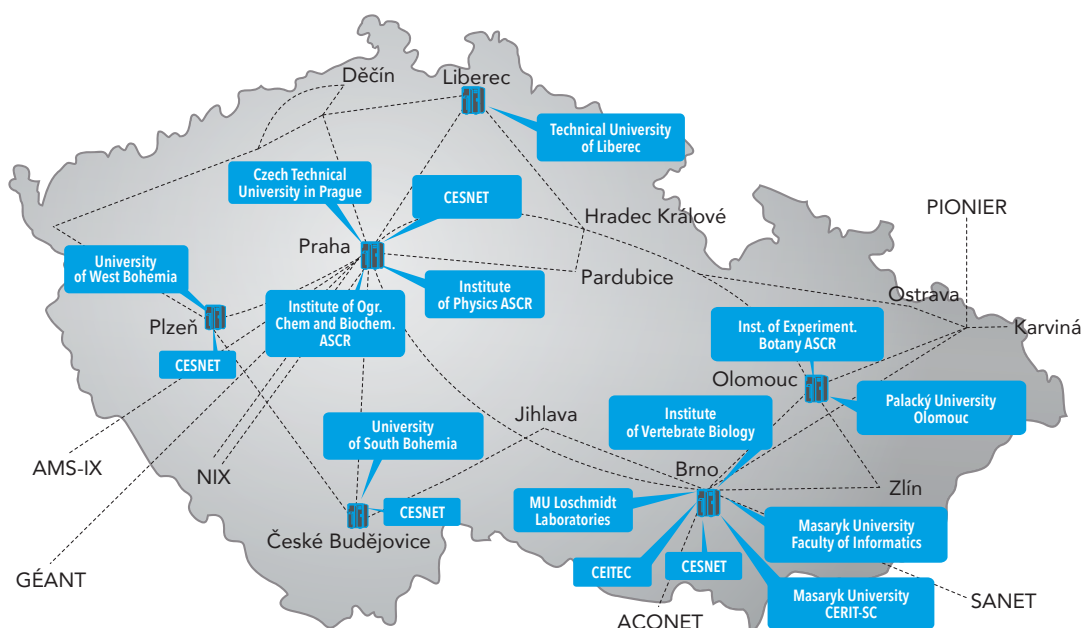


THE ASSOCIATION'S LONG-TERM OBJECTIVES IN THE AREA OF DISTRIBUTED COMPUTING ARE THE OPERATION AND GROWTH OF THE METACENTRUM NATIONAL GRID INFRASTRUCTURE (NGI) AND INTEGRATION OF THESE ACTIVITIES IN CORRESPONDING INTERNATIONAL INFRASTRUCTURES (ESPECIALLY EGI, EOSC AND ELIXIR) AND PROJECTS.

The NGI includes computing clusters of various types: conventional computing clusters with smaller numbers of more powerful processors, high-performance SMP servers with larger numbers of processors in a large shared memory, specialized SGI UV machines with up to 6 TB of memory, clusters with specialized GP-GPU cards as well as clusters prepared for MapReduce computations (Hadoop or Spark) with larger storage space in each cluster node. Along with these computing servers (about 15,000 CPU cores in late 2017), the MetaCentrum also operates extensive data storage capacities (4 PB at the end of 2017) used for temporary storage of processed data. **In the international** EGI environment, the NGI provides an additional approximately 3,200 CPU

cores and 3.8 PB of disk space for international projects, especially for the LHC. A cluster and a disk array in České Budějovice were renovated, a second set of SMP servers in Brno was replaced and Ceph object storage was built in 2017. CESNET functions as the national coordinator for the NGI, interconnecting individual clusters built by other organizations or projects into a single national grid and providing its resources primarily for balancing peak loads from individual groups and for a faster start-up of application projects that are only planning to acquire their own computational resources. The integration activities include the development and management of grid and cloud middleware, coordination of application software purchases and user support.

METACENTRUM INFRASTRUCTURE

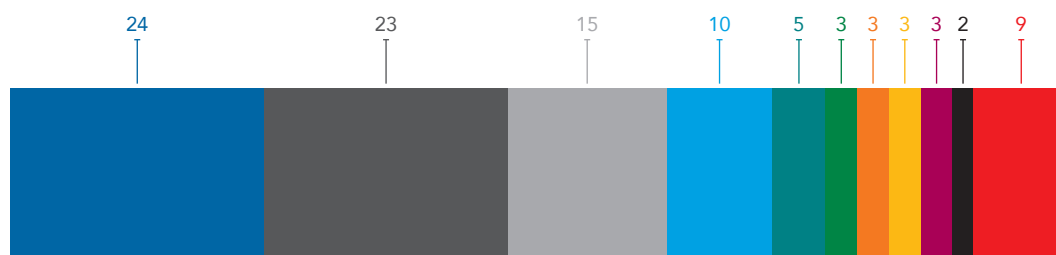


As part of its international activities, the Association continues to support LHC projects, the Pierre Auger Observatory experiment and the Belle, ELIXIR, ELI and CLARIN projects. At the national level, we focus on direct support of Czech user groups interested in using the pan-European EGI infrastructure. Specific examples are our involvement in the European ELIXIR project, in its EXCELERATE development project and in the construction of the ELIXIR research infrastructure in the Czech Republic. During 2017, the Association continued working on international H2020 projects that the NGI participates in. These included, in particular, the EGI-Engage and INDIGO-DataCloud projects, which dealt with the operation and development of the European EGI e-infrastructure and the development

of grid and cloud middleware. Both projects were completed successfully in 2017 and the work now continues under follow-up projects, namely EOSC-hub and DEEP. The AARC2 project discusses a future infrastructure for identity management and identity federations. Additionally, the Association has been developing its collaboration with ESFRI activities under the ELIXIR project; in particular, we are responsible for the preparation of cloud services under the EXCELERATE project. **At the national level**, we participated in the operation of the VI ELIXIR infrastructure and provided the first cluster dedicated to this group under the RDE OP ELIXIR project. We also managed to extend our support for the European Space Agency (ESA), where we participate in making Sentinel satellite data available to the Czech Republic.

SHARES OF INDIVIDUAL INSTITUTIONS IN METACENTRUM COMPUTATIONAL RESOURCES

Charles University [24%]
 Masaryk University [23%]
 Czech Technical University in Prague [15%]
 University of Chemistry and Technology, Prague [10%]
 Institute of Physics of the CAS, v. v. i. [5%]
 Brno University of Technology [3%]
 University of West Bohemia Pilsen [3%]
 Institute of Organic Chemistry and Biochemistry AS CR, v. v. i. [3%]
 Tomas Bata University in Zlín [3%]
 University of South Bohemia in České Budějovice [2%]
 Others [9 %]



ANOTHER FUNDAMENTAL COMPONENT OF THE E-INFRASTRUCTURE IS DISTRIBUTED DATA STORAGE, CONSISTING OF THREE INTERCONNECTED HIGH-CAPACITY DATA CENTRES SITUATED IN PLZEŇ, JIHLAVA AND BRNO, WITH A TOTAL INSTALLED MEDIA CAPACITY OF 21 PB. FROM A TECHNICAL POINT OF VIEW, THE STORAGE IS ORGANIZED HIERARCHICALLY (HSM – HIERARCHICAL STORAGE MANAGEMENT).

A tendering procedure for another HSM system took place in 2017. The system is located in Ostrava and was delivered at the end of the year. We carried out extensive tests of object storage technology, which should allow shifting the data storage paradigm towards a community-built shared infrastructure. This activity became one of the cornerstones of storage infrastructure development. As purchasing additional hierarchical storages is becoming technically and economically impractical within the financial scope planned for the RDE OP project, tendering procedures for a standard disk array and for a smaller cluster for object storage for Ceph pilot operation were prepared for 2018. The data storage infrastructure stored over **7,000 TB** of user data at the end of 2017. The storage was used via standard file-oriented interfaces by about 200 user groups (virtual organizations), which translates to more than

4,000 individual user accounts (people and service identities). Over 14,000 TB in total was occupied on available media. However, the total impact of data storage on the community is greater, as an individual user with a storage account often represents a group for which they perform backup or archiving operations, without all group members necessarily having physical access to the storage.

Data storage services include a very popular FileSender service for exchanging large files among users. The service had been used to exchange more than 80,000 files by the end of 2017, which represents approximately 170 TB of data.

The **ownCloud** cloud storage for data sharing and synchronization is directly accessible to members of the **eduID.cz** national identity federation. The service had 10,400 users at the end of 2017, who stored a total of 114 TB of data in 87 million files.



Infrastructure for collaboration and user support

25

- E-INFRASTRUCTURE SECURITY
- NETWORK IDENTITY
- USER COOPERATION AND MULTIMEDIA
- COLLABORATION WITH NATIONAL RESEARCH AND DEVELOPMENT INFRASTRUCTURES

E-INFRASTRUCTURE SECURITY

The internationally accredited **CESNET-CERTS** security team is the basic element ensuring e-infrastructure security. Its core activity is incident handling – receiving reports of security incidents occurring in the CESNET2 network and responding and coordinating response to such incidents in cooperation with network and service administrators at CESNET and connected organizations.

The team closely cooperates with other security teams and relevant organizations at the national and international levels, is a member of the CSIRT.CZ Working Group, organized by the Czech Republic's National CSIRT Team, and is also involved in the TF-CSIRT platform coordinated by GÉANT. Throughout the existence of the CESNET-CERTS security team, its members have handled more than 75,000 security incidents. The Association runs a number of its own detection systems. Network monitoring and detection of security events and anomalies play an important role; in the CESNET e-infrastructure, they are provided by **HW-accelerated network probes, FTAS and G3 systems and services and the Warden system**. They are operated to very high standards, enabling both CESNET administrators and administrators at connected institutions to improve the level of network, service and user security and eliminate identified problems quickly and efficiently.

Since 2013, the Association has operated **FLAB, a forensic laboratory** providing state-of-the-art services – analysis of security incidents, penetration and stress tests and,

since mid-2017, also a penetration test service using social engineering methods, which tests users' caution and ability to identify cyber threats such as fraudulent messages.

The laboratory's services are available to CESNET e-infrastructure subscribers as well as other clients. There is a growing demand for such services. In 2017, the Association carried out seven contracts for penetration and stress tests and one contract for penetration tests using social engineering methods and provided two Forensic Analysis training courses (training in the fundamental principles of forensic methods), several expert consultations and seven analyses of serious security incidents.

The Association is committed to raising awareness among users and administrators of connected computer networks. We hold expert workshops and training courses, give presentations at numerous events and publish papers focusing on security. For example, we organized the 3rd annual **Security Fest**, a public education workshop, during the European Cyber Security Month. We also prepared **The Catch**, a 'hacker' competition joined by 917 teams, including several teams from abroad.

CESNET also took part in several international security exercises in 2017. These included, for example, **the Cyber Coalition 2017** exercise but especially the prestigious and highly valued **Locked Shield 2017** exercise in which two members of the CESNET Forensic Lab took part for the Czech team. The Czech Republic's team was the overall winner.



NETWORK IDENTITY

An integral component of the comprehensive e-infrastructure is a system for user management and control of access to services. User management is based on the [eduid.cz](#) distributed identity federation, where initial user registration and authentication services are provided by the home organizations while authorization information is managed at the level of services and their administrative domains. At the end of 2017, the federation included 110 identity providers (IdPs) and more than 200 service providers (SPs). It also allows interconnection with the [eduGAIN](#) international federation of services.

A special [eduid.cz IdP, Hostel](#), is still available for minority user groups without their own IdP.

One highly used federated service is [eduroam.cz](#), which provides users with wireless connectivity at their home institution or any other cooperating institution. Secure user authentication is always provided by the home institution. This academic roaming system was created as a European initiative under the TERENA Association (now GÉANT Association) and has since spread all over the world. The Czech federation had a total of 87 member organizations in 2017, providing connectivity in more than 700 locations.

Up to 38,000 users take advantage of connectivity at an organization other than their home institution on a daily basis.

To ensure secure and trustworthy communication, the Association operates a public key infrastructure based on the CESNET CA certification authority, which issues various types of certificates for specifically defined application areas to

selected groups. This also includes providing a trusted certificate service (TCS). The service is used by 101 organizations.

For identity and access management, we continue developing the [Perun](#) system together with Masaryk University. The main instance of the system manages identities and access to services for almost 300 user communities (national and international) with about 27,000 users.

CESNET also addressed the impacts of the eIDAS regulation and the GDPR (General Data Protection Regulation) in 2017. We held workshops on these topics and also established a working group dealing with the impacts of GDPR legislation on CESNET's member organizations.

IP TELEPHONY, VIDEO AND WEB CONFERENCING AND MULTIMEDIA STREAMING

The videoconferencing environment, which offers custom client registration, use of virtual rooms and session recording and broadcast, was used for five thousand hours of meetings in dozens of virtual rooms over central multi-conferencing units (MCUs). More than a hundred and thirty hardware units were registered, with other users using their own software client or a software client provided by the Association. Users can also make use of an Adobe Connect–based web conferencing system, in which 6,239 hours of meeting took place in dozens of rooms. Users get access to these resources primarily through a **Meetings** reservation portal, which runs on a system named **Shongo**, created by CESNET. The environment includes live broadcasts (streaming) and recorded broadcasts. This component is used by about a dozen institutions, keeping 16.5 TB of multimedia data in dedicated storage. In addition, CESNET still interconnects dozens of exchanges operated by institutions (members) within the IP telephony infrastructure.

UltraGrid, a high-quality, low-latency transmission solution developed by the Association has been used for a number of live broadcasts of surgeries during medical events. The solution is also used for cultural events and teaching. Four technologies – LOLA by GARR, an Italian consortium; UltraGrid and MVTP made by CESNET; and Polycom videoconferences – are primarily used by the artist community today, which illustrates the Association’s cardinal contribution to advancement in this area.

COLLABORATION WITH NATIONAL RESEARCH AND DEVELOPMENT INFRASTRUCTURES

CESNET holds continuous discussions with representatives of other large infrastructures included in the Czech Republic Roadmap for Large Research, Experimental Development and Innovation Infrastructures and other infrastructure projects. We endeavour to identify their needs from the point of view of the services provided by our Association and establish collaboration in this area. CESNET e-infrastructure services are currently used by 55 out of the total of 57 (apart from CESNET) large infrastructures included in the Czech Republic Roadmap for 2016–2022.

An ex ante call to update and amend **the Czech Republic Roadmap for Large Research, Experimental Development and Innovation Infrastructures**, made as part of an assessment of large infrastructures in 2017, recommended including ten new infrastructures. All of them are users of CESNET e-infrastructure services.

An exceptional position, in terms of collaboration with CESNET, is held by the national node of the European ELIXIR bioinformatics infrastructure – the ELIXIR CZ research infrastructure.



International infrastructure projects

CESNET IS AN ACTIVE PARTICIPANT IN INTERNATIONAL EXPERT COLLABORATION, ESPECIALLY THROUGH MAJOR INFRASTRUCTURE PROJECTS.



International infrastructure projects

AN IMPORTANT TASK OF THE CESNET E-INFRASTRUCTURE IS INTERCONNECTING THE SERVICES IT PROVIDES AT NATIONAL LEVEL WITH THE SERVICES OF EUROPEAN E-INFRASTRUCTURES TO JOINTLY ESTABLISH AN INFORMATICS FOUNDATION FOR THE EUROPEAN RESEARCH AREA.

GÉANT

The interconnection of European national research and education networks (NRENs) and creation of a pan-European infrastructure for data transmissions is coordinated by GÉANT. It provides access to network services for approximately **40 million users** from more than 3,500 institutions in 38 European countries and ensures interconnection with similar networks such as Internet2 and ESnet in the USA, CANARIE in Canada as well as networks on other continents.

The operation of the GÉANT e-infrastructure and development of its services has been supported by the European Union since 2015 under a seven-year project named GÉANT2020, jointly implemented by most European NRENs including CESNET. The project is divided into three stages, with the second project stage of 32 months started in 2017.

CESNET'S INVOLVEMENT IN THIS STAGE INCLUDED, IN PARTICULAR:

- Leading a task focusing on developing a fibre infrastructure for the GÉANT network
- Coordinating the construction of the GTS (GÉANT Testbed Service) testing environment for networking technologies and applications
- Taking part in negotiating favourable terms with major commercial providers of cloud services
- Developing the AAI and guaranteeing security
- Communicating with large European research infrastructures

The Association's premises hosted a workshop focusing on the design of a new generation

of the **GÉANT** network, held as part of preparations for the next project stage on 12 June 2017. Preparations for the third project stage were led by the GÉANT Programme Planning Committee (GPPC), whose seven members include CESNET Director Ing. Jan Gruntorád, CSc.

EGI AND EOSC – EUROPEAN INFRASTRUCTURE FOR DISTRIBUTED COMPUTING

Another linchpin of the CESNET e-infrastructure is **MetaCentrum**, a distributed computing infrastructure that plays the role of the Czech National Grid Infrastructure (**NGI**), an officially recognized part of the European Grid Infrastructure (**EGI**). The objective of the EGI is coordinating national activities in the implementation of grid technologies as an important part of the European-level e-infrastructure. The operation and further development of the EGI is supported by the European Union under the **EOSC-hub** project, elaborating the concept of a multidisciplinary pan-European grid and cloud infrastructure. It is also one of fundamental projects building the **EOSC** (European Open Science Cloud) infrastructure. CESNET is involved in all the primary operational activities of the project, takes care of the operation of the national EGI node and provides computational resources comprising the Association's own computational capacities as well as those of the Institute of Physics of the Academy of Sciences of the Czech Republic and CERIT-SC. Another of the Association's tasks is to provide support for the Auger, Belle and ELI virtual organizations as well as direct support for Czech user groups interested in using the pan-European grid.

ELIXIR – EUROPEAN BIOINFORMATICS INFRASTRUCTURE

Since 2012, CESNET has been actively participating in building the national node of the European **ELIXIR** bioinformatics infrastructure, which provides an advanced computing environment, data resources and unique tools for the bioinformatics scientific community in the Czech Republic and Europe. Support provided to this user community includes a dedicated computing node for bioinformatics computations. CESNET participates in the development of the European infrastructure by its involvement in the European **ELIXIR-EXCELERATE** project under the Technical Services activity focusing on the establishment of a common framework for the provision of computational services and services related to data storage.

EUROPEAN SPACE AGENCY

CESNET, in coordination with the Ministry of Transport of the Czech Republic, submitted an offer to build a Data Hub Relay in the Czech Republic to the European Space Agency (**ESA**) in 2017. The offer was accepted, so one of the seven data hub nodes will be built in the Czech Republic with support from the ESA. These nodes will synchronize and redistribute large quantities of the latest imagery from Sentinel satellites in order to reduce the load of ESA lines. CESNET will set up new data storage for these purposes and offer specific data access mechanisms. Sentinel satellites observe the Earth in various spectral bands, which offers countless applications in science as well as everyday life.

GLIF

The role of a national research and education network such as CESNET is not only the

operation of an infrastructure but also research and development in information and communications technology. It is advisable to build a parallel testing infrastructure – a test bed – for demonstrations and experiments that could adversely affect routine infrastructure operations. Organizations involved in networking research and application in Europe, North and South America, Asia and Australia that have separate testing infrastructures have created the Global Lambda Integrated Facility (**GLIF**) to carry out joint experiments. It is a virtual organization composed of involved institutions as well as a research environment (facility) consisting of lambdas and nodes known as **GOLE** (GLIF Open Lightpath Exchange), set up by this organization. Such an environment also enables experiments and demonstrations that pose a risk of interference and destruction.

PLANETLAB AND RELATED PROJECTS

Planet-lab.org and **Planet-lab.eu** are research networks involved in global activities in the field of the **Next-Generation Internet**. The networks are used for testing new network applications, protocols, in simulation processes, etc., as well as for teaching master's programmes at computer and information technology departments. CESNET permanently maintains four servers in the infrastructure and is responsible for the operation of a local infrastructure. We have created and operate 20 active virtual networks with various configurations as specified by the users themselves. In total, all the virtual networks used by CESNET users contain about **400 nodes abroad**. This gives users an unusual opportunity to test their applications in a global context.

The Association's research activities

CESNET CARRIED OUT A NUMBER OF ACTIVITIES FOR ITS OWN RESEARCH AND DEVELOPMENT IN THE FIELD OF INFORMATION AND COMMUNICATIONS TECHNOLOGY.



The Association's research activities

E-INFRASTRUCTURE SECURITY

CESNET has long been committed to network security.

WE WERE INVOLVED IN THE FOLLOWING PROJECTS IN 2017:

- **Large-Scale Network Data Processing and Analysis Technology (Security Cloud)** is a project under TACR's ALFA 4 programme. The objective of the project is to develop an innovative technological solution that will enable both providers and users of network infrastructures and centralized services to detect operational and security issues.
- **High-Speed Network Protection Technology (DCPro)**. Part of TACR's EPSILON programme, the project aims to build equipment with a throughput of 400 Gbps for processing and filtering high-speed traffic in computer networks.
- **Network Feature Virtualization Acceleration Platform (NFV200)**. As part of TACR's EPSILON2 programme, the project aims to create a platform that will enable easy deployment of virtualized network features in the fastest network and data centre environments.
- **Network Diagnostics from Intercepted Communication (DISTANCE)**. The aim of the project under TACR's EPSILON2 programme is to create a software solution capable of intercepting traffic of interest based on various criteria and their combinations. The project result will be integrated into CESNET's existing network monitoring tools.
- **Detection of Infrastructure Security Threats (DOBI)**. The project is part of the Czech Republic Security Research 2015–2020 programme of the Ministry of the Interior of the Czech Republic. It aims to develop and test methods for preventive protection of fibre infrastructures, which are frequently threatened during various construction works as well as by line theft.
- **National Cyberspace Security Event Sharing and Analysis (SABU)**. The project is implemented under the Czech Republic Security Research 2015–2020 programme of the Ministry of the Interior of the Czech Republic. The aim of the project is to create a pilot system for timely submission and analysis of events relating to the national cyberspace. The system will enable information mining and sharing among involved security teams, including the national and governmental teams of the Czech Republic, with the aim of being able to predict the progress of an attack and warn involved infrastructures.
- **Adaptive Management of Data Collection and Analysis in High-Speed Networks (FOKUS)**. The project is implemented under the Czech Republic Security Research 2015–2020 programme of the Ministry of the Interior of the Czech Republic. It aims to create a system that will enable a higher threat detection rate and better data collection in networks. This will be achieved by implementing feedback from detection systems to probes. Based on analysis of measured data, detection systems will ask probes for more detailed analysis of selected parts of traffic. The project will involve the development of a probe for processing the 400 Gbps Ethernet protocol.
- **Secure Gate for Internet of Things (SIoT)**. This project under the Czech Republic Security Research 2015–2020 programme of the Ministry of the Interior of the Czech Republic aims to enhance security in ever-growing Internet of Things (IoT) networks,

which include hazardous and easy-to-attack elements today.

- **Building and Pilot Operation of a Cyber Threat Intelligence (CTI) System.** This project under the Security Research for State Needs 2016–2021 programme of the Ministry of the Interior of the Czech Republic aims to enhance the protection of critical information infrastructure and reduce damage caused by cybercrime by building an efficient system for the detection, identification and prediction of cyber threats and evaluation of cybersecurity incidents (Cyber Threat Intelligence).
- **Proactive Risk Management through Situation Awareness (PROTECTIVE)** is an international H2020 project that aims to create a pilot system for collecting and processing security-related data and information within an organization or network and sharing relevant data with stakeholders at national and international level.
- **BEhaviour-BASed forwarding (BEBA)** is an international H2020 project aimed at further advancing the OpenFlow technology in order to increase its flexibility and expand its capabilities (for example, monitoring). CESNET made use of its experience in hardware design and was involved in pilot testing under the project.

NETWORK IDENTITY

The Association continuously develops and implements an infrastructure for federalized sharing of services and resources.

WE WERE INVOLVED IN TWO INTERNATIONAL PROJECTS IN 2017:

- **Authentication and Authorisation for Research and Collaboration (AARC).** The objective is to design a general

authentication and authorization infrastructure for the broad user base of research infrastructures.

- The **Middleware for collaborative Applications and Global vrtual Communities (MAGIC)** project focuses on authorization and authentication mechanisms in grid and cloud environments.

GRID MIDDLEWARE, CLOUDS

As part of its activities associated with the operation of a grid environment, the Association participates intensely, mainly through EGI.eu, in the development of grid middleware relating to task scheduling as well as some components related to the security of grid infrastructure operation.

We also look into computing clouds, for example under an international H2020 project named **Designing and Enabling E-infrastructures for intensive Processing in a Hybrid DataCloud (DEEP-HybridDataCloud)**, which focuses on the development and subsequent implementation of cloud services to support demanding computations, use of GP-GPU cards and support for deep-learning applications in this environment.

OPTICAL TRANSMISSION SYSTEMS

CESNET develops a range of original, fully optical transmission systems, CzechLight, whose greatest advantage is openness: software modifications can be made by device owners or administrators themselves. CzechLight units have found practical application – they are manufactured and marketed by specialist companies under the Association's licence.

CESNET WAS INVOLVED IN THE FOLLOWING PROJECTS IN 2017:

- **Set of Elements for Photonic Communication (EPCOM II)** is a project under TACR's EPSILON programme. It aims to create a set of optical and electronic elements that will enable the operation of a photonic service on fibre and wireless communications links with a high degree of compensation for traffic delays in transmitted information.
- **COMmunication PLatform for tEnders of novels Transport nEtworks (COMPLETE)** is an international H2020 project that is expected to bring the benefit of more efficient tendering processes concerning the construction of communications infrastructures for research and education.
- **CLOck NETwork Services (CLONETS)** is an international H2020 project aiming to study and develop documentation for the construction of a pan-European optical network to provide high-quality services for the transmission and distribution of exact time and stable frequencies.

NEW APPLICATIONS

Innovative network applications usually require combining many technologies today. The benefits of such network applications include better e-infrastructure utilization in new fields and new options for collaboration in research, development and education in various fields such as medicine, culture or architecture.

CESNET PARTICIPATES IN THESE PROJECTS:

- **Digital Restoration of the Czech Film Heritage** is a project that combined digitization, transmissions of multimedia data and use of data storage. The project, under which CESNET as a national partner

provided data storage capacity and multimedia expertise, was successfully completed and the data is now being moved to the National Film Archive's storage.

- **Laterna magika. The Past and the Present, Documentation, Preservation and Accessibility**. The goal of this project under NAKI II – Support for Applied Research and Experimental Development for the National and Cultural Identity in 2016–2022, a programme supported by the Ministry of Culture of the Czech Republic, is to restore the archives of Laterna Magika films, create a storage methodology, build pilot storage and present the films.
- **8K Studio over IP Bridge (8KSVIP)** is a project under the European EUROSTARS2 programme which aims to design, implement and experimentally verify an architecture and components for scalable image transmission devices.

RESEARCH AND DEVELOPMENT OUTCOMES

CESNET's research activities resulted in eight articles in peer-reviewed scientific journals, 31 papers in conference proceedings, five functional specimens and two SW outcomes in 2017.

SIX PATENTS WERE GRANTED:

- CESNET, z. s. p. o. **Modular kit of the spectrally flexible device for bidirectional transmissions of optical signals sensitive to timing in the internet and other networks**. Inventors: Josef VOJTĚCH, Jan RADIL, Radan SLAVÍK, Stanislav ŠÍMA, Ondřej HAVLIŠ; no. US 20160329964 A1, granted by the United States Department of Commerce – United States Patent and

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- Trademark Office (USPTO), 16 May 2017.
 - CESNET, z. s. p. o. **System for hash table implementation**. Inventors: Sven UBIK, Matěj BARTÍK; no. 306787, granted by the Czech Industrial Property Office, 24 May 2017.
 - CESNET, z. s. p. o. **Modular kit for a spectrally flexible device for bidirectional transmissions of optical signals sensitive to timing in the Internet and other networks**. Inventors: Josef VOJTĚCH, Jan RADIL, Radan SLAVÍK, Stanislav ŠÍMA, Ondřej HAVLIŠ; no. 306846, granted by the Czech Industrial Property Office, 28 June 2017.
 - CESNET, z. s. p. o., and NETCOPE TECHNOLOGIES, a. s. **Connection for fast searching for regular expressions in data**. Inventors: Viktor PUŠ, Vlastimil KOŠAŘ, Jan KOŘENEK, Denis MATOUŠEK; no. 306871, granted by the Czech Industrial Property Office, 7 July 2017.
 - CESNET, z. s. p. o. **Modular kit of devices for variable distribution, mix and monitoring of optical signals in the Internet and other networks**. Inventors: Josef VOJTĚCH, Miloslav HŮLA, Miroslav KARÁSEK, Stanislav ŠÍMA, Jan RADIL; no. 2612507, granted by the European Patent Office, 25 August 2017.
 - CESNET, z. s. p. o. **Circuit for the fast analysis of packet headers transferred via a data bus**. Inventor: Viktor PUŠ; no. 2654261, granted by the European Patent Office, 22 December 2017.

CESNET DEVELOPMENT FUND

In late 2016, the Development Fund Board prepared and launched a new tendering process for projects for 2017. Its topics had been chosen in cooperation with the Association.

THE FOLLOWING TOPIC AREAS WERE ANNOUNCED FOR THE FIRST ROUND IN 2017:

- **Utilization and advancement of the CESNET e-infrastructure** services and modern information and communications technologies in teaching and education processes, creative and scientific research work and management of public universities and the Academy of Sciences of the Czech Republic
- **Advanced applications** utilizing the CESNET e-infrastructure
- **Support for training** of Association members' employees with the aim of acquiring a globally recognized IS/IT certificate

Out of the 28 project applications submitted in that round, 23 projects were admitted for co-funding, including six projects admitted after rewriting. The contributions requested by five projects were reduced compared to the amounts requested. An overview of accepted projects is shown in the table below.

Two rounds of opposition procedures for completed projects took place **in 2017** – a total of **23 projects were completed successfully**. Amendments to the final documents of several projects were requested while one project was not defended and was terminated. Final reports for projects carried out under the CESNET Development Fund are available on the Association's website.

Updated Financial Rules and Selection Rules of the CESNET Development Fund were approved with effect from 21 December 2017.

CESNET DEVELOPMENT FUND: OVERVIEW OF ACCEPTED PROJECTS

PROJECT NUMBER	PROJECT HOLDER	PROJECT TITLE
594/2017	ASCR	Upgrading the professional qualifications of an IT system administrator of the Institute of Molecular Genetics of the ASCR – RHCE certification
596/2017	VŠB – Technical University of Ostrava	Utilization of minicomputers in academic environments
597/2017	VŠB – Technical University of Ostrava	Computer network access logging
598/2017	Jan Evangelista Purkyně University	Development of the JEPU identity management system
599/2017	Masaryk University	Preparation and pilot testing of a methodology for GDPR implementation in public university IT environments
600/2017	VŠB – Technical University of Ostrava	Pilot project for CESNET infrastructure application in an Internet of Things (IoT) network
601/2017	University of West Bohemia	Implementation of new identity management in UWB information systems
602/2017	University of West Bohemia	Gaining an Oracle Database 12c: Advanced PL/SQL Developer Certified Professional certification
603/2017	University of West Bohemia	Gaining Oracle Certified Associate, Java SE 8 Programmer, Oracle Certified Professional, Java SE 8 Programmer and Google Associate Android Developer certifications
604R1/2017	University of West Bohemia	Incorporation of a long-range (LORA) wireless network into the CESNET network
605/2017	Czech Technical University	Upgrading the professional qualifications of CTU networking specialists in Ubiquiti and MikroTik technology
606/2017	Jan Evangelista Purkyně University	Extending the certification of Cisco Networking Academy staff at the Department of Informatics of the Faculty of Science, Jan Evangelista Purkyně University in Ústí nad Labem

PROJECT NUMBER	PROJECT HOLDER	PROJECT TITLE
607/2017	Jan Evangelista Purkyně University	Upgrading the professional qualifications and certification of a database specialist at the Department of Informatics of the Faculty of Science, Jan Evangelista Purkyně University in Ústí nad Labem (Oracle Database SQL Expert 1Z0-047)
608R1/2017	University of Pardubice	Management of the physical network layer, automation of active CISCO elements
610/2017	Masaryk University	Upgrading the qualifications of an employee in charge of virtualization infrastructure administration by taking an OpenStack Administration and COA Exam Prep. course (OST-104) in order to gain international certification as a Certified OpenStack Administrator (COA)
611R1/2017	Masaryk University	Advanced system for detecting and sharing information about security incidents from the Masaryk University network
613/2017	Technical University of Liberec	Simple IoT platform
614R1/2017	VŠB – Technical University of Ostrava	Development of photonic services in NGA networks with regard to new trends in the assessment of their qualitative parameters
616/2017	Czech Technical University	Creation of a lab and assignments for IT security training for medical staff
617/2017	University of Technology	DDoS protection in a CESNET member's network
618R1/2017	Silesian University	Creating nodes at Silesian University sites, interconnecting them with the CESNET infrastructure and building a platform to store collected data
619R1/2017	ASCR	Enhancing the security of the AS network infrastructure by integrating security tools detecting traffic anomalies and interconnecting them with Warden
620/2017	Czech Technical University	A system and methodology for photographing historic buildings using unmanned helicopters and transmitting collected big amounts of data for expert processing

AS FOR COMMUNICATION, THE YEAR 2017 WAS HIGHLY POSITIVE FOR CESNET. THERE WAS A UNIQUE EVENT TAKING PLACE IN ADDITION TO ANNUAL WORKSHOPS AND CONFERENCES – A MEETING ON THE OCCASION OF 25 YEARS OF THE INTERNET IN THE CZECH REPUBLIC.





THE ASSOCIATION CONTINUED WITH ITS ACTIVITIES UNDERLINING ITS UNIQUE ROLE AS A SCIENTIFIC AND RESEARCH INFRASTRUCTURE IN THE CZECH REPUBLIC IN 2017. IT ALSO ORGANIZED EVENTS AIMED TO SHARE EXPERIENCE WITH THE INTERNET COMMUNITY.

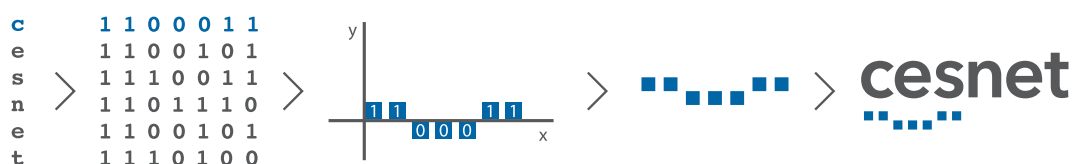
As for communication, the year 2017 was highly positive for CESNET. There was a unique event taking place in addition to annual workshops and conferences – a meeting on the occasion of twenty-five years of the Internet in the Czech Republic (Fig. 1).

On 13 February, CESNET had a celebration marking this important anniversary, attended by people that were there 25 years ago and held at the same place it all started. One of the promoters of connection to the Internet was Jan Gruntorád, today's director of CESNET, thanks to whom we became the 39th connected country in 1992. The meeting was held at the Faculty of Mechanical Engineering of the Czech Technical University in Prague and was attended by more than 200 guests. Speakers included leading figures of the Czech and foreign Internet and academia. Both the anniversary and the meeting received wide media coverage. Czech Television covered the topic throughout the day – there was a pre-recorded or live report every hour and everything was rounded off in the **Události** and **Události, komentáře** evening newscasts. Jan Gruntorád appeared not only in the live reports (Fig. 2) but also in the shows **Hyde Park Civilizace** and **@online24**. Reports were also broadcast by other television stations, namely Prima, Barrandov and Blesk TV. The CESNET Director gave interviews to a number of printed and electronic media, as well as Czech Radio. The beginning of December brought

a significant landmark in CESNET's history, as the Association's **new visual style and new logo including sub-brands** for individual services (see below) were presented at the CESNET e-Infrastructure Conference (Fig. 4 and 5). The graphic design of the logo is based on binary code. The new logo consists of the Association's name and seven blue squares which are a graphical representation of the letter 'c' in binary-coded ASCII. It makes CESNET 'smile'. New logos have been created in the same manner for each of the Association's services and activities. The designs of their graphic marks have also been determined by binary code, or more precisely the representation of the initial letter of the name of the service or activity in the code. The main point here was to create a visual link between CESNET and its services. CESNET also started to use a new typeface, Avenir, at the same time as the new logo; its name means 'future' in French.

There were also workshops, training courses and conferences held in 2017. In addition to the events mentioned above, there were another ten national and international events and nine non-public working group meetings or expert workshops. The first, already traditional workshop was the well-attended **Network and Service Security Workshop** (Fig. 3). The workshop included a **Forensic Show** – a demonstration of the analysis of a serious security incident inspired by the CESNET Forensic Lab's experience.

Diagrammatic illustration of the development of the new CESNET logo



- 1 Meeting marking 25 years of the Internet in the Czech Republic
- 2 Jan Gruntorád, CESNET Director, interviewed by Daniel Stach for Czech Television during the meeting marking 25 years of the Internet in the Czech Republic
- 3 Network and Service Security Workshop



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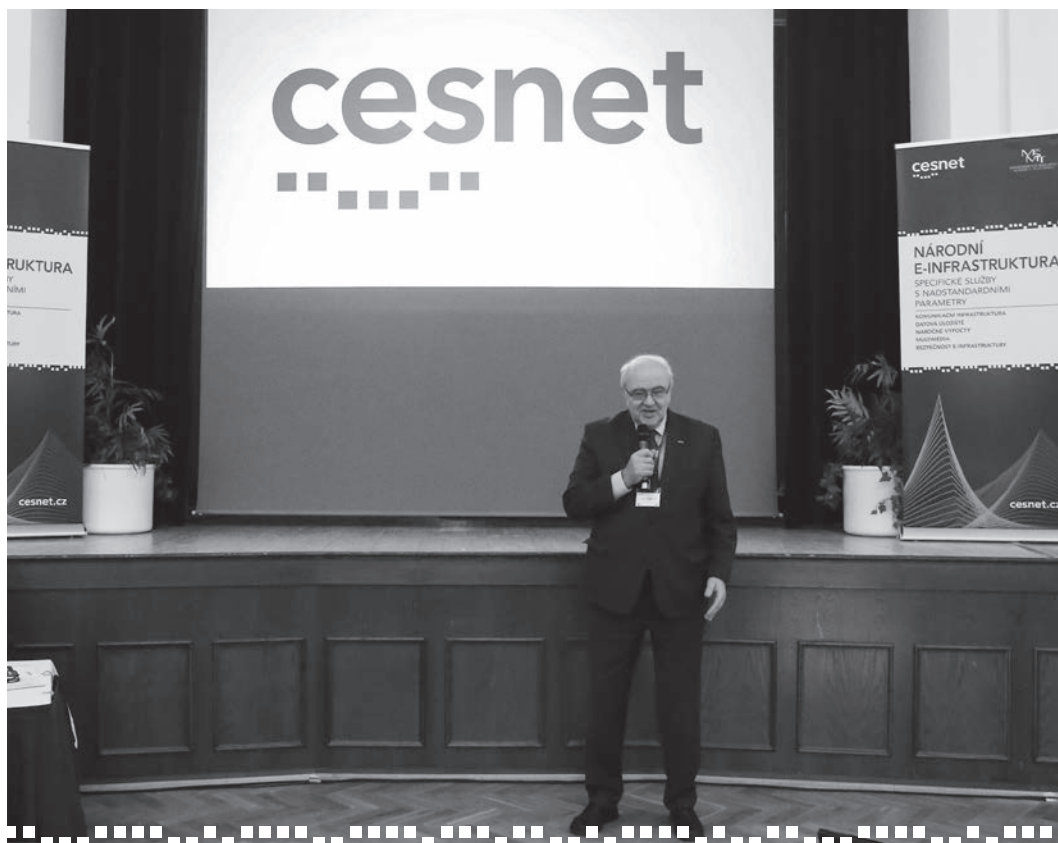


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- 4 CESNET e-Infrastructure Conference – demonstration of UltraGrid, high-quality video transmission on a commodity PC
- 5 CESNET e-Infrastructure Conference
- 6 IPv6 Workshop



6

The following events also took place in the first half of the year: Day with Perun, Grid Computing Workshop, GDPR Workshop or IPv6 Workshop (Fig. 6). There were also several working group meetings, especially for EGI projects, BEBA, GÉANT Network Evolution Meeting and ELIXIR Compute Platform.

In the second half of the year, there was the ninth annual international CEF Networks workshop (Fig. 7) dedicated to optical networks, as well as the University Identities, Security Fest and GDPR workshops. The NGI Workshop was held in collaboration with the European Commission. Prominent events in the second half of the year included the above-mentioned

CESNET e-Infrastructure Conference, which presented not only the new logo but also most of the Association's services and latest news from research and development. Another important event was the **CESNET Day** in Liberec, which was organized with a new format – inviting members of academia as well as research institutes, hospitals, libraries, representatives of the Liberec Region, and high-tech firms.

The Association became a partner for several events such as the Science and Technology Week, TSP 2017 conference, InstallFest or LinuxDays. We also participated in **the Science Research Innovation Fair in Brno** for the first time, setting up our own booth (Fig. 8).

- 7 9th CEF Networks Workshop 2017
- 8 CESNET's booth at the Science Research Innovation Fair in Brno
- 9 CESNET's booth at the international TNC17 conference in Linz

7



The Association also presented its activities on its website, which was kept updated throughout the year. The CESNET blog publishes posts by the Association's experts with information on interesting technologies and events or reflections on information and communications technology. The Association also used social media to present itself, sharing its latest news, its employee's achievements and information on conferences and other topics. The Association, in collaboration with the Ministry of Education, Youth and Sports of the Czech Republic, launched and continues to administer a website for large research infrastructures in the Czech Republic. The new

website at www.vyzkumne-infrastruktury.cz contains information about all infrastructures included in **the Czech Republic Roadmap for Large Research Infrastructures**.

The Association continued to make use of feedback in the form of regular media monitoring and monthly analyses of its outputs. We issued 15 press releases in 2017, informing about the Association's current activities. Considering the events held, the media storm concerning the **25th anniversary of the Internet in the Czech Republic** and the presentation of a new logo, the year 2017 was very successful in terms of public relations.

8



9



THE ASSOCIATION MANAGED THE FUNDS ENTRUSTED TO IT PROPERLY IN 2017. ITS FINANCIAL STATEMENTS WERE REVIEWED BY AN AUDITOR AND GIVEN AN UNQUALIFIED OPINION.





ECONOMIC RESULTS IN 2017

CESNET'S ACTIVITIES ARE DIVIDED INTO TWO CATEGORIES IN ACCORDANCE WITH ITS STATUTES: NON-ECONOMIC AND ECONOMIC.

NON-ECONOMIC ACTIVITIES

The four-year CESNET e-Infrastructure project was in its second year in 2017.

As part of its non-economic activities, the Association continued 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. The Association was also involved in the execution of international research projects under the EU Horizon 2020 programme, grants from the Technology Agency of the Czech Republic, Ministry of the Interior of the Czech Republic and Norway Grants and projects of the Development Fund Board, as already mentioned in the previous section of the Annual Report.

The Association's principal activities in 2017 were concluded with an accounting profit of CZK 949 thousand. Revenues from the Association's principal activities amounted to CZK 445,701 thousand; expenditures were CZK 444,752 thousand. The income tax base for the Association's principal activities in 2017 was positive, amounting to CZK 8,863 thousand.

amounted to CZK 114,726 thousand; expenditures on economic activities were CZK 113,882 thousand.

The income tax base for the Association's economic activities in 2017 was positive, amounting to CZK 722 thousand.

TOTAL ACCOUNTING AND TAXABLE PROFIT

CESNET had a total accounting profit of CZK 1,793 thousand before tax in 2017. Its total income tax base after deducting tax base-reducing items was CZK 8,585 thousand. The Association paid income tax of CZK 1,663 thousand for the year 2017, resulting in an after-tax profit of CZK 130 thousand.

CONCLUSION

The Association managed the entrusted funds properly in 2017, meeting all of its obligations resulting from legislation, decisions of the Ministry of Youth, Education and Sports of the Czech Republic and concluded contracts. Its financial statements for 2017 were reviewed by an auditor and given an unqualified opinion.

ECONOMIC ACTIVITIES

The Association's economic activities in 2017 consisted primarily in holding a prevalently bond-based portfolio of the Development Fund, comprising financial resources obtained by selling the commercial part of the CESNET network in 2000, and in managing financial resources in other funds.

The Association's economic activities in 2017 generated an accounting **profit of CZK 844 thousand**. Revenues from the Association's economic activities in 2017