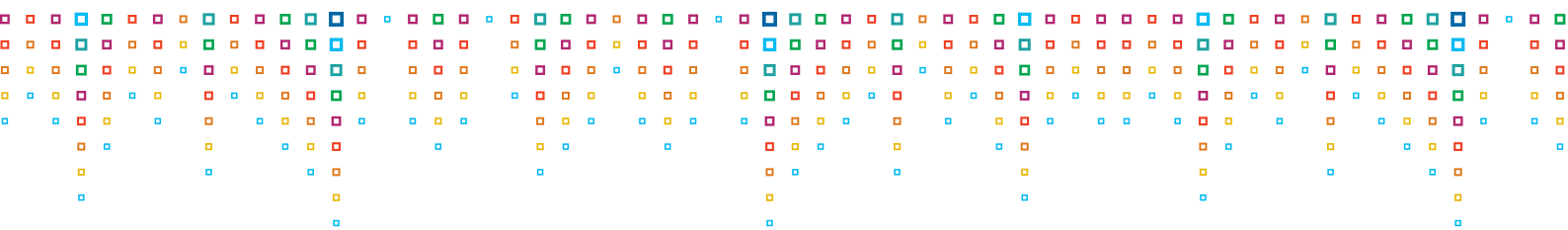


ANNUAL REPORT 2019










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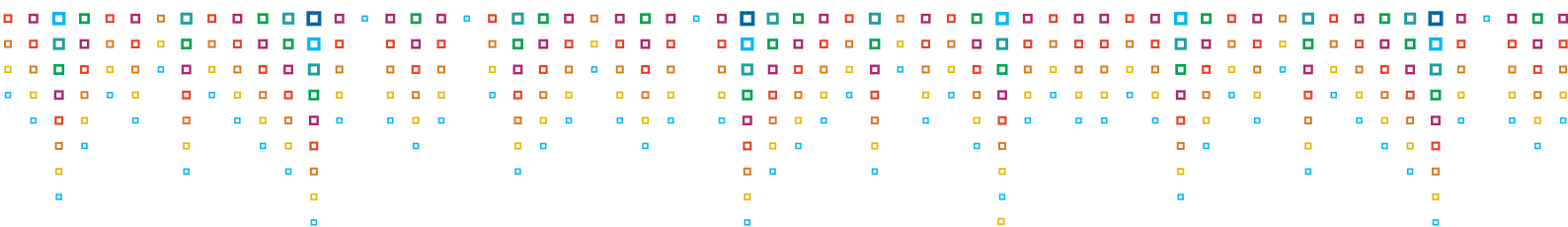
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A WORD FROM THE DIRECTOR

THE ANNUAL REPORT YOU HAVE JUST OPENED SUMMARIZES ALL ACTIVITIES OF THE CESNET ASSOCIATION IN 2019. AT THE VERY BEGINNING OF THE YEAR, THE MINISTRY OF EDUCATION ASSESSED THE CESNET ASSOCIATION AS AN EXCELLENT RESEARCH ORGANIZATION. THE ASSESSMENT STATED THE POTENTIAL FOR INNOVATION, EXCELLENT RESULTS OF THE APPLIED RESEARCH, AND THE SIGNIFICANT SOCIAL RELEVANCE OF THE ASSOCIATION. THIS POSITIVE ASSESSMENT IS ALSO PROOF THAT THE CESNET ASSOCIATION IS A TECHNOLOGICAL LEADER IN THE FIELD OF INFORMATION AND TELECOMMUNICATION TECHNOLOGIES.



15

The 15th anniversary of the foundation of the first Czech security team CESNET-CERTS

3D

The 3D specialists of the CESNET Association created 3D models of the collection articles that were presented within the scope of the exhibition Prague 1848 → 1918.



In 2019, we strengthened the **infrastructure for demanding calculations and data warehouses**. This year was significant to us in terms of cyber security management. We marked the 15th anniversary of the foundation of the first Czech security team **CESNET-CERTS**. Our protection solution against DDoS attacks called **DDoS Protector** was deployed experimentally in the connecting node NIX within the scope of the security project FENIX.

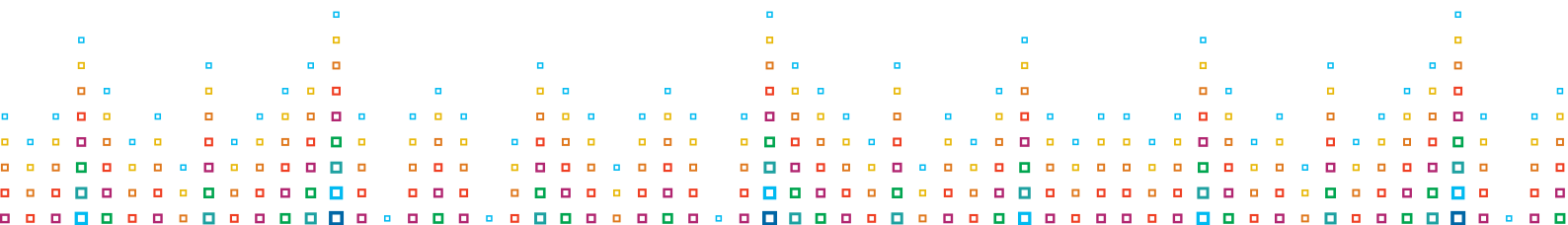
We entered into a **Memorandum on Cooperation in the field of information and communication technologies** with other research infrastructures CCP, CZ-OPENSOURCE, Czech-Bioimaging and ELIXIR-CZ; the common interest is a closer coordination of ICT planning and searching for solutions for efficient use of the planned resources.

The CESNET Association, Masaryk University and VŠB - Technical University of Ostrava have applied for a joint project for establishing an upgraded national large research e-infrastructure **e-INFRA CZ** under which they committed to mutual cooperation in operation, development and provision of a comprehensive service portfolio of this infrastructure.

On a long-term basis, the CESNET Association represents the possibility of use of modern technologies in the world of culture as well. This year, the CESNET Association significantly participated in a project which strives for preservation, protection and accessibility of the **Laterna magika** work. The specialists of the CESNET Association created 3D models of the collection articles that were presented at the web extension of the exhibition Prague 1848 → 1918 titled **Předměty Pražanů kolem roku 1900** (the Articles of Prague citizens from around 1900). The Association also participated in the implementation of the unique distributed performance within the scope of the Network Performing Arts Production Workshop 2019 and demonstrated the possibility of remote collaboration in live culture at the Supercomputing 2019 conference.

I hereby thank all employees and colleagues for their intensive work in completion of the set objectives. I also thank our members and partners for allowing the implementation of our mission. I am looking forward to the challenges that will be brought by the next year, as well as to the activities that we are going to perform.

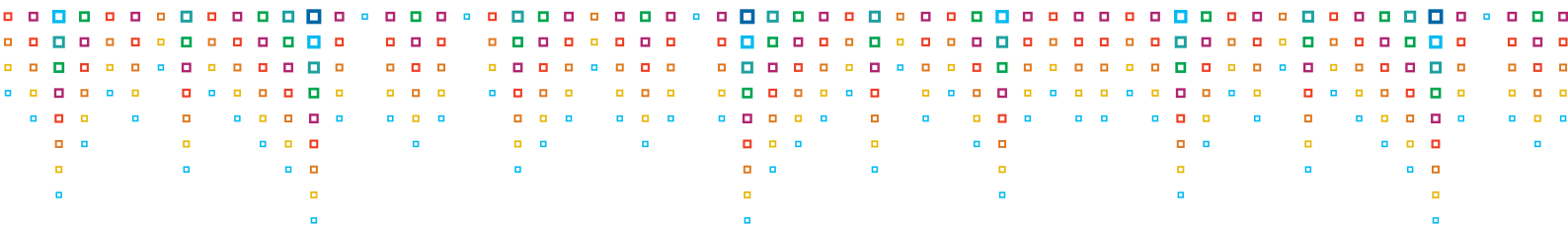
Ing. Jan Gruntorád, CSc.
Director and Member of the Board
of Directors, CESNET



THE CESNET ASSOCIATION

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 IN 1996.



The mission of the CESNET Association is:

- To provide unique and complex e-infrastructure services in a quality comparable to top world standards in the field to the science, research and education community and to support the Open Science concept;
- To offer stable services with high added value covering the widest possible spectrum of needs of our users;
- To contribute with our in-house research activities to development of information and communication technologies and practical applications of the outcomes of this development.

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. The Association discontinued that activity in 2000, chiefly for economic and legislative reasons. The Association continues to deal exclusively with **developing and operating e-infrastructure, designed for science, research and education** and with related activities.

The next milestone in the Association history is the year 2010 when the CESNET e-infrastructure became a **part of the Czech Republic Roadmap for Large Infrastructures for research, experimental development and innovations**¹. In 2014, the CESNET e-infrastructure received the highest score possible awarded to research infrastructures, and **was included in the updated Czech Republic Roadmap for Large Infrastructures**.

Based on the further assessment of the large research infrastructures in 2017, the CESNET e-infrastructure was included in the top category of research infrastructures with excellent quality comparable to that of similar infrastructures worldwide, highly relevant to the future development of the Czech Republic's research and innovation environment and necessary for the enhancement of the Czech Republic's competitiveness. Furthermore, the International Assessment Board recommended the e-infrastructures CESNET, CERIT-SC and IT4Innovations a closer cooperation in terms of the building of capacities and provision of services to users. The operators of the said infrastructures (CESNET, Masarykova Univerzita (Masaryk University) and VŠB – Technická univerzita Ostrava - the Mining University - Technical University of Ostrava) formed a consortium in 2019 and starting from 2020, they will provide services under unified brand **e-INFRA CZ**.

¹A large infrastructure for research, development and innovation shall mean "unique scientific facility – including its purchase, associated investments and organisation of its activities – that is necessary for research and development activity as a whole having high financial and technological demands and that is approved by the government and established by one research organisation to be also used by other research organisations (hereinafter referred to as the "Large Infrastructure"). Definitions of infrastructure. Ministry of Education, Youth and Sports [online]. [quote 2020-04-24]. Available from: <http://www.msmt.cz/vyzkum-a-vyvoj/definice-infrastruktury>



SCOPE OF ACTIVITIES

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.

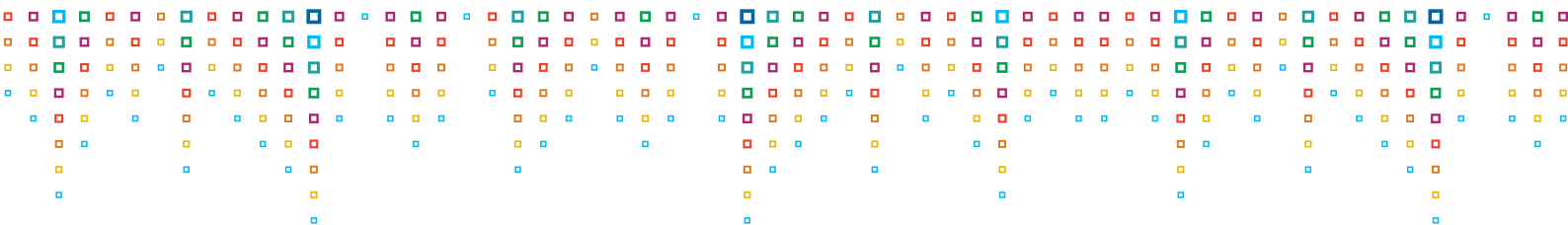
Any loss incurred in connection with the Association's supplementary activities will always be settled by the end of the fiscal period in question or the supplementary activity in question will be discontinued before the beginning of the following fiscal period.

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

THE CESNET ASSOCIATION

MEMBERSHIP OF INTERNATIONAL AND NATIONAL ORGANIZATIONS

CESNET WAS A MEMBER OF THE FOLLOWING RENOWNED INTERNATIONAL AND NATIONAL ORGANIZATIONS IN 2019:



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 (www.geant.org)



PlanetLab – a consortium of academic, commercial and governmental organizations from the entire world, collectively operating a global computer network designed for developing and testing new telecommunication applications (www.planet-lab.eu)



GLIF (Global Lambda Integrated Facility) – global experimental network activities focusing on the development support for most demanding scientific and research applications (www.glif.is). Since the end of 2019, the GLIF activities have been taken over by two initiatives, **GNA-G (Global Network Advancement Group)** and **GRP (Global Research Platform)** in which CESNET also participates.



Shibboleth – international consortium for the coordination of development of a service providing a solution for unified login, meaning that a user can use multiple protected network resources using a single login. Shibboleth is the foundation for academic federations of identities. Shibboleth is the basis of the academic federations of identities (shibboleth.net).





QUAPITAL – a Central European partnership for secure communication with security at the quantum level and quantum internet (www.quapital.eu)



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



Internet2 – a consortium led by American research and education institutions endeavouring to develop and deploy new types of network technologies, services and applications (www.internet2.edu)

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, offering the possibility of mutual interconnection of member networks (www.nix.cz).



CZ.NIC – The Association is also one of the founding members of CZ.NIC, z.s.p.o., an organization engaged in the operation of the domain .cz, support of projects of general benefit and Internet-related activities (www.nic.cz).

ASSOCIATION MEMBERS

The following institutions were members of the Association in 2019:

- Academy of Performing Arts, Prague
- Czech Academy of Sciences
- Academy of Fine Arts, Prague
- Czech University of Agriculture, Prague
- Czech Technical University, Prague
- Janáček Academy of Musical and Dramatic Arts
- University of South Bohemia, České Budějovice
- Masaryk University
- Mendel University, Brno
- University of Ostrava
- Police Academy of the Czech Republic in Prague
- Silesian University, Opava
- Technical University, Liberec
- University of Hradec Králové
- Jan Evangelista Purkyně University, Ústí nad Labem
- Charles University
- University of Defence
- Palacký University, Olomouc
- University of Pardubice
- Tomáš Baťa University, Zlín
- University of Veterinary and Pharmaceutical Sciences, Brno
- VSB - Technical University of Ostrava
- University of Economics, Prague
- University of Chemistry and Technology, Prague
- Academy of Arts, Architecture and Design, Prague
- University of Technology, Brno
- University of West Bohemia, Plzeň

THE CESNET ASSOCIATION

INTERNAL ORGANIZATIONAL STRUCTURE

CESNET, Z. S. P. O., HAS THE FOLLOWING BODIES:
GENERAL MEETING, BOARD OF DIRECTORS, SUPERVISORY BOARD

THE BOARD OF DIRECTORS

consisted of the following members in 2019:

- 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 position of the **CHAIRMAN** was held by prof. Ing. Miroslav Tůma, CSc., and the positions of **Vice-chairmen** were held by Igor Čermák, CSc., and Mgr. František Potužník.

THE SUPERVISORY BOARD

consisted of the following members **till June 2019**:

- doc. Ing. Vojtěch Bartoš, Ph.D.
- Mgr. Jan Gazda, Ph.D.
- Ing. Jakub Papírník
- RNDr. David Skoupil
- Ing. Michal Sláma.

THE SUPERVISORY BOARD

consisted of the following members **from June 2019**:

- Ing. Radek Holý, Ph.D.
- Ing. Jaromír Marušinec, Ph.D., MBA
- Ing. Jakub Papírník
- RNDr. David Skoupil
- Ing. Michal Sláma.

In 2019, the **CHAIRMAN** of the Supervisory Board was Ing. Michal Sláma.

In 2019, the office of the **DIRECTOR** of the Association was held by Ing. Jan Gruntorád, CSc.

THE DEVELOPMENT FUND BOARD

operated in the following structure **till June 2019**:

- doc. RNDr. Eva Hladká, Ph.D.
- Ing. Miroslav Indra, Csc.
- Ing. Olga Klápšťová
- doc. RNDr. Antonín Kučera, Csc.
- prof. Dr. Ing. Zdeněk Kůs
- Ing. Jaromír Marušinec, Ph.D., MBA
- prof. Ing. Zbyněk Škvor, CSc.

THE DEVELOPMENT FUND BOARD

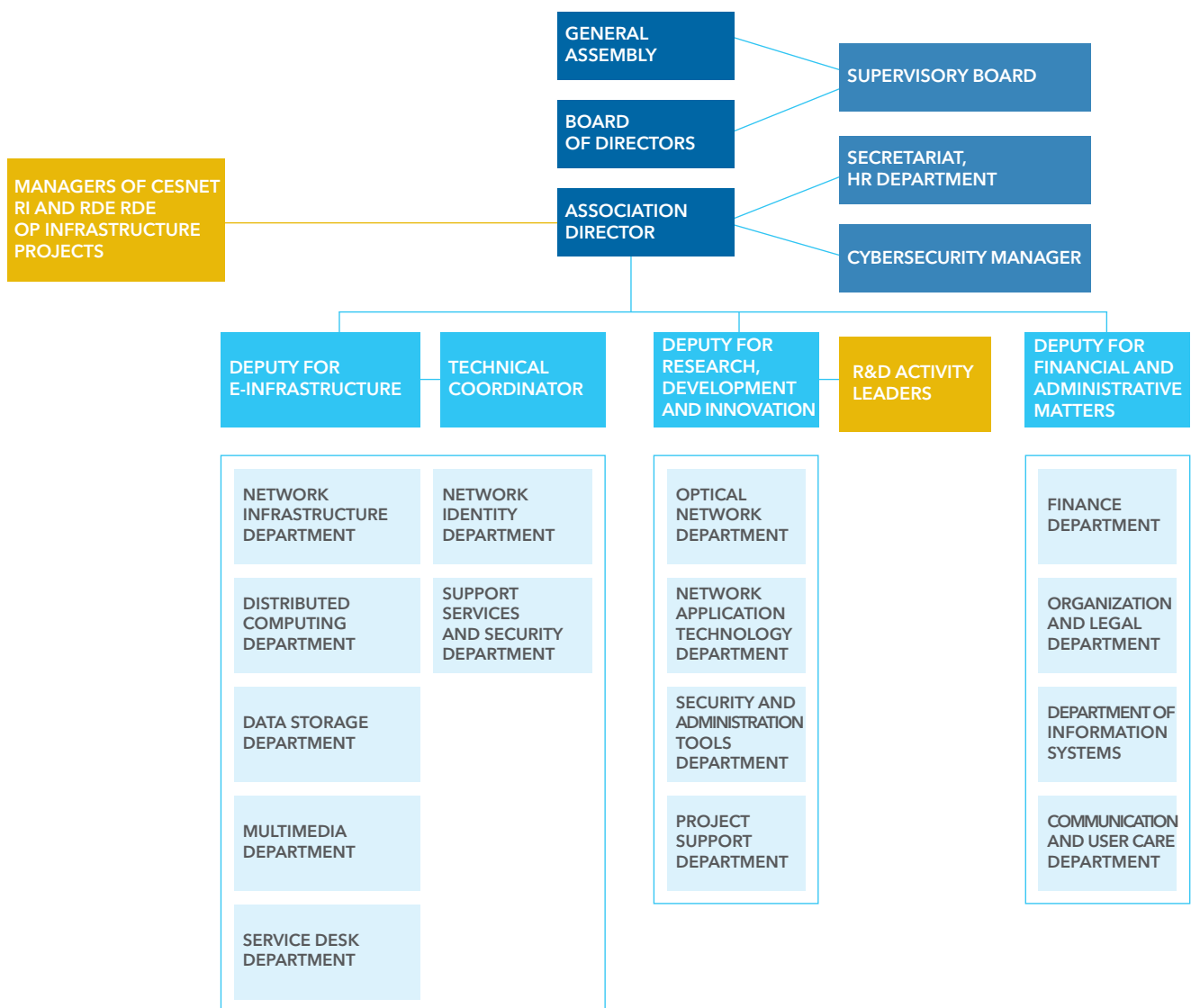
operated in the following structure **from June 2019**:

- doc. RNDr. Eva Hladká, Ph.D.
- Mgr. Monika Hrabáková
- Ing. Olga Klápšťová
- doc. RNDr. Antonín Kučera, Csc.
- Ing. Jan Pinta, MBA
- Ing. Tomáš Podermanski
- prof. Ing. Zbyněk Škvor, CSc.

The office of the **CHAIRWOMAN** of the Development Fund Board was held in 2019 by Ing. Olga Klápšťová.

ORGANIZATIONAL CHART

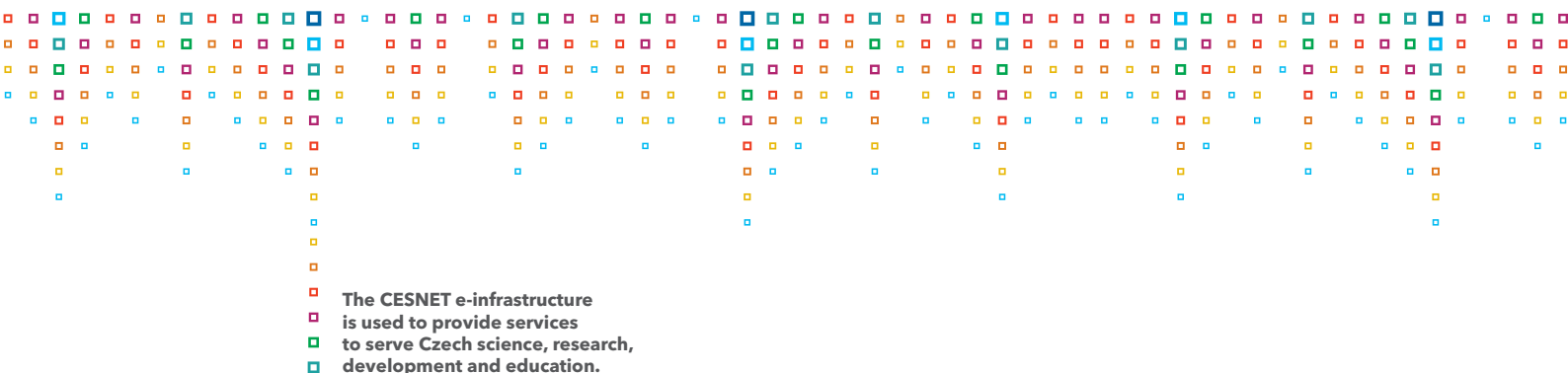
THE ASSOCIATION'S BASIC ORGANIZATIONAL STRUCTURE COMPRISES DEPARTMENTS, WHICH ARE AGGREGATED INTO SECTIONS. MANAGEMENT WITHIN THIS STRUCTURE IS PERFORMED BY LINE MANAGERS. THE ASSOCIATION HAD A TOTAL OF 176.5 FULL-TIME EQUIVALENTS IN 2019.



Line management Project management

CESNET E-INFRASTRUCTURE

THE CESNET E-INFRASTRUCTURE IS A LARGE RESEARCH INFRASTRUCTURE WHICH IS A SIGNIFICANT ELEMENT OF THE CZECH REPUBLIC ROADMAP FOR LARGE RESEARCH, EXPERIMENTAL DEVELOPMENT AND INNOVATION INFRASTRUCTURES FOR 2016 TO 2022. 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 NOWADAYS TO CONTEMPORARY RESEARCH, DEVELOPMENT AND INNOVATION IN ANY FIELD.



The development and operation of the CESNET e-infrastructure is supported from public funds, with the MYS providing specific support in the form of a subsidy for two complementary projects:

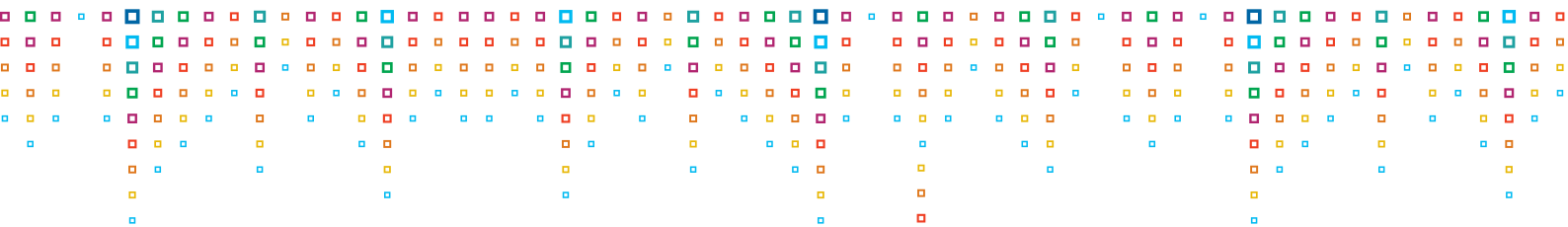
– **The CESNET e-Infrastructure** (LM2015042, 2016 – 2019) funded under the R&D&I Large Infrastructure Projects programme (2010–2019). The special-purpose support was earmarked for covering a portion of operating costs associated with the operation of the CESNET E-infrastructure. The year 2019 was the last year of the implementation of this project.

– **E-infrastructure CESNET – modernization** (EF16_013/0001797, 2017 – 2020) funded from the OP VVV programme. The special-purpose support in this project is intended for the renewal of the elements of e-infrastructure and own research in the field of safety, flexible infrastructures and new technologies for network applications.

The CESNET e-infrastructure is used to provide services to serve Czech science, research, development and education. The following chapters describe the development of this e-infrastructure, portfolio of the services offered and the associated research activities. The Association provides these services to not only its members but also other entities that meet the CESNET E-infrastructure Access Policy.

COMMUNICATIONS INFRASTRUCTURE

IN THE PAST PERIOD, CESNET FOCUSED PRIMARILY ON ASSURING RELIABLE OPERATION IN THE 24X7X365 MODE, MAINTAINING ADEQUATE PERFORMANCE OF THE NETWORK COMMUNICATION INFRASTRUCTURE, SUPPORTING OTHER SERVICES OF THE CESNET E-INFRASTRUCTURE, CONNECTED NETWORK SUBSCRIBERS AND LARGE RESEARCH INFRASTRUCTURES.



CESNET continuously 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 universities, institutes of the Academy of Sciences and other subscribers. Such network services include high-speed IPv4/IPv6 connectivity, L0 and L1 circuits or L2/L3 VPNs, including the necessary professional consultations.

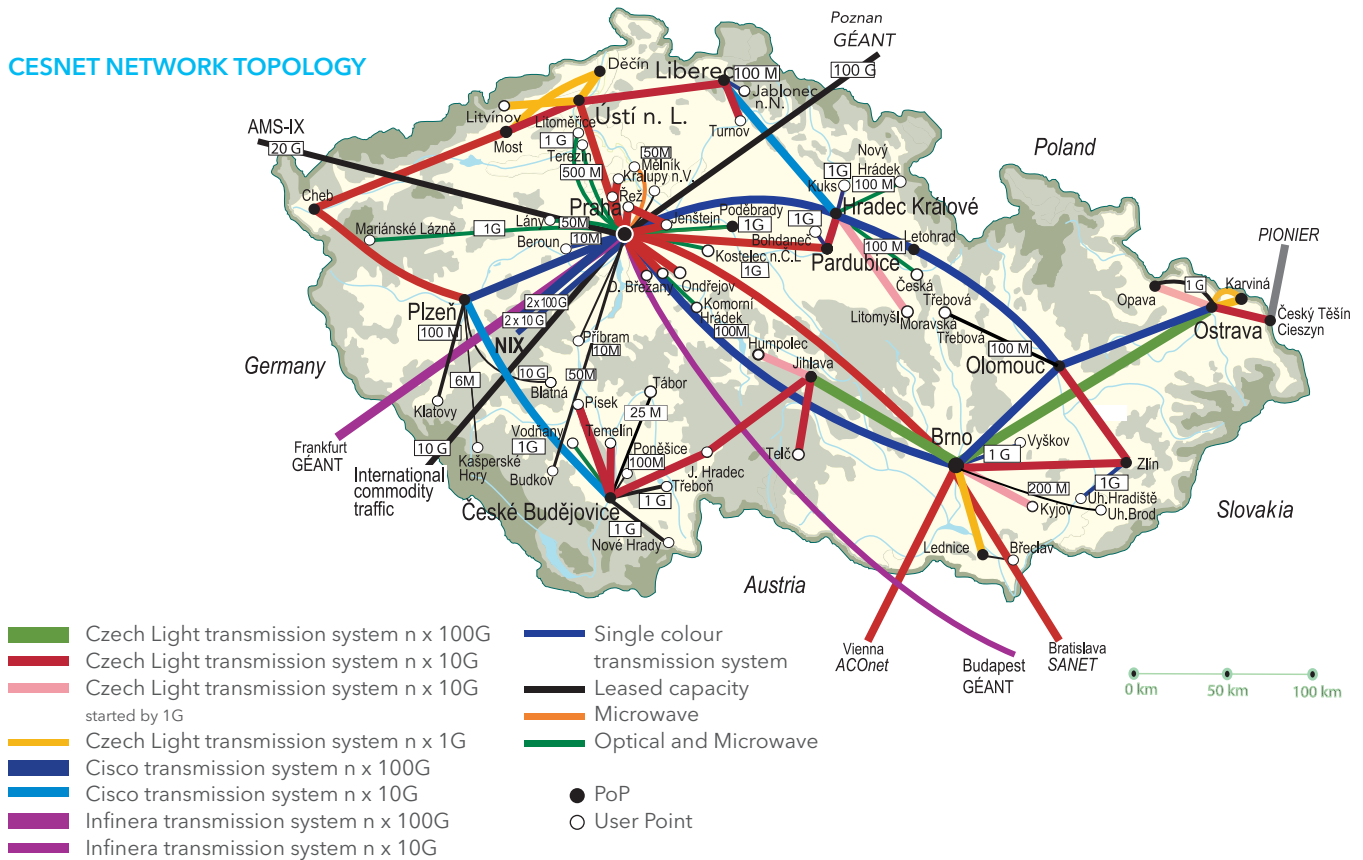
Overview of the most important changes and activities in 2019:

- upgrade of DWDM technology to upgrade the Prague - Plzeň route to 100 GE.
- upgrading the connection to the node of the national peering centre NIX4
- CE COLO to 100 GE, – upgrade of the DWDM node Olomouc_1 and Olomouc_2 that will serve at the same time as the upgrade for the route Olomouc_2 - Ostrava to 100 GE,
- modification of the transmitting DWDM system in the section Brno
- Olomouc to support the transmission of QKD signals (safety cryptographic mechanism based on the principle of transmission of quantum keys at the optical level),
- upgrade of the DWDM node Letohrad,
- connection upgrade of the work site CENEKVA (JČU) in Vodňany to 1 Gb/s,
- connection upgrade at FZÚ Slovanka (Academy of Sciences of the Czech Republic) to 100 Gb/s for the needs of CERN experiments CERN (Atlas, Alice) and Fermilab,
- connection of the work site RINGEN in Litoměřice (UK),
- arranging for connection of the polar station in Spitsbergen (JČU),
- reconnecting the Police Academy into the node at UMG AV ČR (Academy of Sciences) in Krč,
- establishing a new 10 Gb/s channel Opava - Karviná,
- connection of detached work sites of the Czech Agricultural University Lány, Mělník, Chuchle,
- change of the technology at the DC TOWER circuit
- ÚMG Krč (AV ČR) (The Molecular Genetics Institute Krč (Academy of Sciences of the Czech Republic))
- BIOCEV Vestec (AV ČR) (Academy of Sciences of the Czech Republic)
- ELI Beamlines Dolní Břežany (AV ČR) (Academy of Sciences of the Czech Republic) – Zikova.

24x7x365
CESNET focuses on arranging a reliable operation in the mode 24x7x365 on a long-term basis



CESNET NETWORK TOPOLOGY



Monitoring, detection of attacks **in the network and protection of the active elements and network participants** against such attacks are important activities. We therefore constantly search for and verify new ways and procedures for efficient protection of the network infrastructure.

We have implemented another version of the user API system **exa BGP** for the needs of the administrators of the connected research infrastructures and other subscribers. The system uses the RTBH and BGP Flowspec protocols to block/reroute the undesirable traffic (typically various attacks over the network), enabling hereby the protection of CESNET network subscribers using BGP. **DDoS protector** developed as a part of the investigation activities of CESNET constitutes an integral part of the system. The system has a number of protections, and the administrators may only act on their address ranges (not on networks of other subscribers).

The CESNET Forensic laboratory performed **penetration tests** to detect security issues of the entire network communications infrastructure. The critical problems were immediately removed and we continue working on elimination of less substantial problems. Regular technology audits constitute an integral part of the assurance of reliable operation. The output of these audits is the identification of issues in the network (problems in active elements, error rate of ports, and others). We keep eliminating these issues which increases the reliability of the entire infrastructure and accessibility of the services provided.

We also put into regular operation the **RPKI** system (validity verification of prefixes of autonomous systems based on the records in the RIPE and RaDB databases). This system serves as a protection against unauthorized distribution of our legal prefixes on the internet by foreign providers which would cause inaccessibility of certain target networks in the internet for our users.

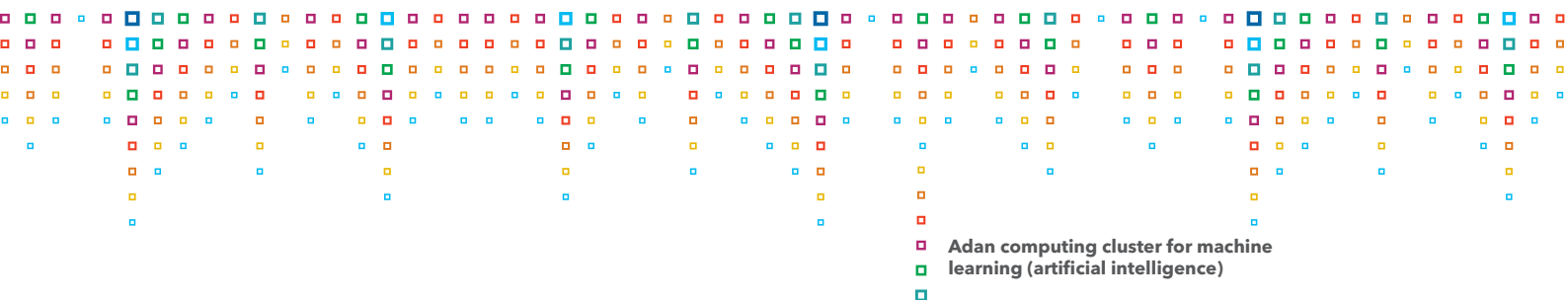
In the area of specific network services, the Association continues building the national optical infrastructure **for time and frequency transmission - the TF infrastructure**.

Preparatory works **for the upgrade of the CESNET2 network after 2020** also continued. The network infrastructure upgrade design is outlined with respect to the needs of the user community and research projects. A feasibility study was prepared, including the technical details, requirements for new technologies and expected financial costs. There was also a preliminary market consultation and preparation of the tender documentation for the public tender for upgrade of the main optical transmission system DWDM (layer FWDM0).

The upgraded CESNET network will be based on the latest technologies and will allow providing new services (such as QKD or transmission of accurate time and frequency). An important aspect of the plan for upgrade is naturally also the satisfaction of user requests for higher transmission capacities (400 GE and higher).

DEMANDING CALCULATIONS

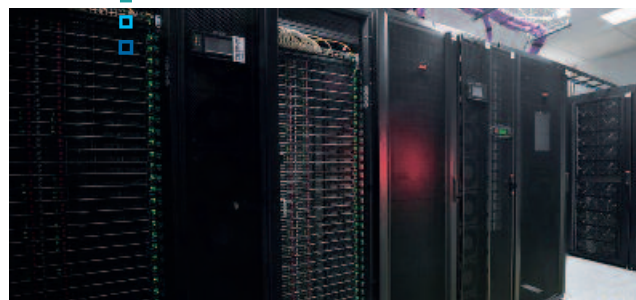
THE ASSOCIATION'S LONG-TERM OBJECTIVES IN THE AREA OF DISTRIBUTED COMPUTING ARE THE OPERATION AND GROWTH OF THE NATIONAL GRID AND CLOUD INFRASTRUCTURE - METACENTRUM AND INTEGRATION OF THESE ACTIVITIES WITH CORRESPONDING INTERNATIONAL INFRASTRUCTURES AND PROJECTS (ESPECIALLY EGI, EOSC AND ELIXIR).



CESNET acts as the national coordinator, interconnecting individual clusters built by other organizations or projects into a single national grid and providing its resources also for balancing peak demand by individual groups of users and for a faster start-up of application projects that are only planning to acquire their own computational resources. Its integration activities include the development and management of grid and cloud middleware, coordination of application software purchases and user support.

MetaCentrum 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 machines with up to 11 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. **MetaCentrum operates an output of about 22,334 CPU cores and has data capacities of 10.4 PB available which serve for temporary storing of the data being processed.**

In the international EGI environment, MetaCentrum provides approximately an additional 4268 CPU cores and 4 PB of disk space for international projects, especially for the LHC. As a part of the CESNET E-Infrastructure project - upgrade of the OP VVV programme, the planned restoration of about one third of the computing and storage capacities took place.



In 2019, a cluster was acquired that is located at the biotechnological centre BIOCEV - Biotechnological and biomedical centre of the Academy of Sciences and the Charles University in Vestec. It is a cluster intended for the support of the tasks of **artificial intelligence in the field of machine learning** (AI, Artificial Intelligence), equipped with a total of 122 computing graphic cards (GPGPU) NVIDIA T4, located in a total of 61 nodes interconnected with high-speed communication technology OmniPath. The cluster is an essential contribution to the availability of the corresponding computing capacity for artificial intelligence in the Czech Republic. In addition to GPGPU cards, it offers almost 2000 CPU cores and over 11 TB RAM.

The computing and storing resources of the Botanic Institute of the **Academy of Sciences of the Czech Republic, Průhonice**, were newly included in Meta Centrum (two clusters, a total of over 300 CPU).



METACENTRUM INFRASTRUCTURE

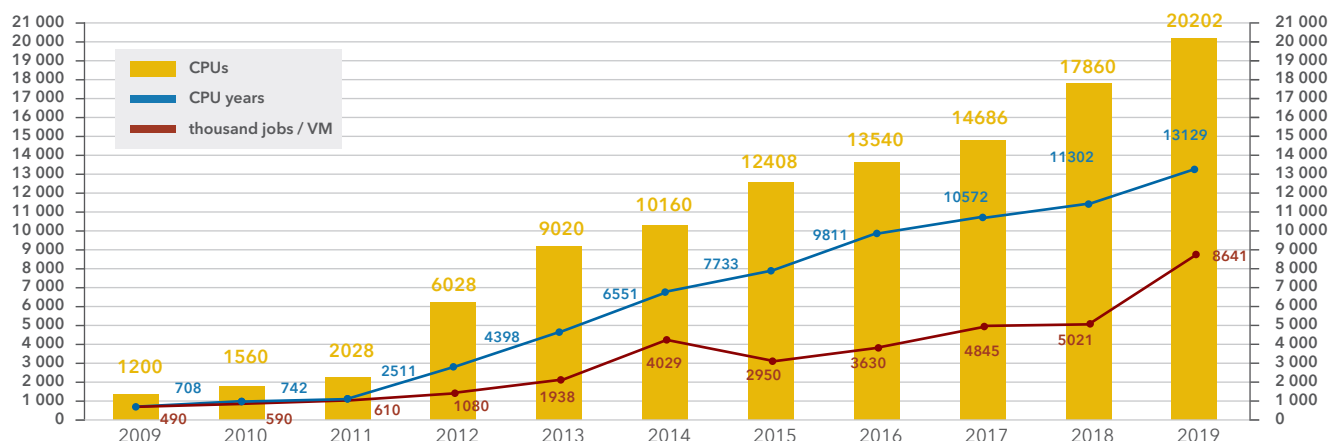


The MetaCentrum provides access to cloud-based services and environments for MapReduce computations. In the sphere of cloud infrastructure, the new cloud environment based on the OpenStack platform was put into full production operation. The cloud environment opens new opportunities both to users and to CESNET, in particular in the form of higher flexibility and extension of the potential for cooperation at the international scale. The operation from the old platform OpenNebula was completely transferred to the new environment, including the projects of international groups of the FedCloud (EGI) environment. The new infrastructure OpenStack currently uses, in the operating

mode, the Ceph technology administered by the Data Warehouse department as the primary data warehouse for all virtual machines.

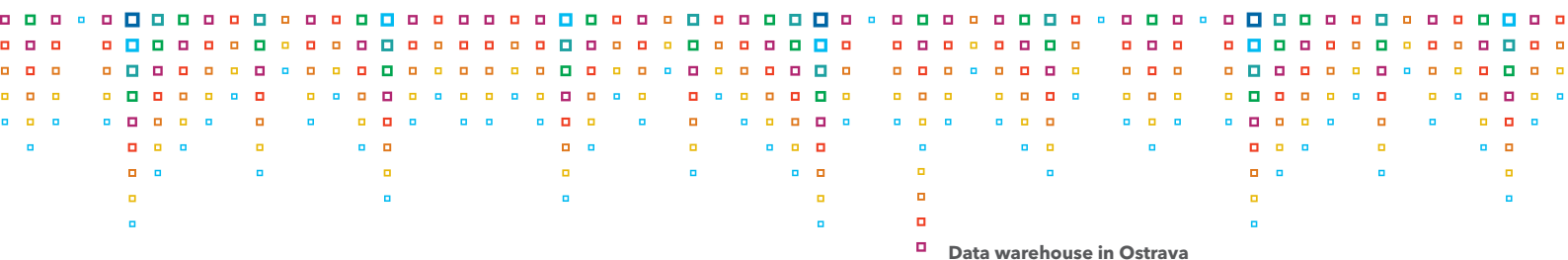
The virtualization platform built on the VMware technology was also strengthened with the computation nodes (blades) and a new disk array intended for the services provided as a part of cooperation with the European Space Agency (ESA) (satellite images of Earth surface). CESNET joined the pan-European GÉANT IaaS Framework tender to be able to resell the services of commercial cloud providers (Microsoft Azure, Amazon AWS and other Original Infrastructure Providers).

NUMBER OF CPU CORES, NUMBER OF TASKS AND CALCULATED TIME IN INDIVIDUAL YEARS (national resources MetaCloud, PBS, Hadoop)



DATA STORAGE

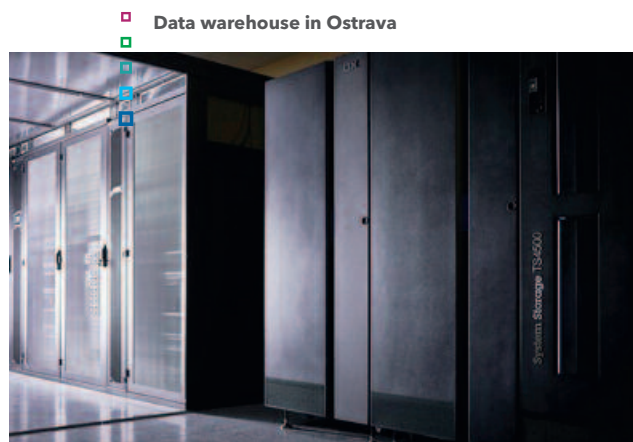
OTHER FUNDAMENTAL COMPONENTS OF THE CESNET E-INFRASTRUCTURE ARE THE DISTRIBUTED DATA WAREHOUSES. IN 2019, THERE WAS THE RENEWAL OF THE ORIGINAL WAREHOUSE INFRASTRUCTURE IN PLZEŇ, JIHLAVA AND BRNO WHICH WAS BUILT FROM THE RESOURCES OF THE EIGER PROGRAMME OP VAVPI IN THE YEARS 2011 TO 2013 WITH A TOTAL ORIGINAL CAPACITY OF 21 PB.



The oldest data warehouse in Plzeň was physically liquidated; in accordance with the requirements for data security, the memory media were crushed. The data warehouse in Jihlava was put out of operation and the user data were re-migrated to the data warehouse in Ostrava which has the tape library available of a gross capacity of 17 PB, with prepended 5PB disc cache. The operation of the data warehouse in Brno will end at the beginning of 2020.

On the basis of extensive tests of the object storage technologies and with regards to the investment aspects of the OP VV project, it ceased to have the economic and technical sense to acquire an additional hierarchical warehouse. The hierarchical data warehouse in Ostrava was supplemented with a standard disk array with the file system and Ceph object storage technologies in Jihlava. Before the end of 2019, hardware was supplied for the object storage to be located in Plzeň, and a small part to be also located in Jihlava. The data warehouse infrastructure stored over 7400 TB of user data at the end of 2019. Over 13,400 TB of available media were occupied in total (according to internal system redundancy settings).

In the course of the year, our cooperation focused on preservation of operation, development of service and international cooperation, as well as on support of application communities. We launched the service of long-term archives (LTP) with a high guarantee of binary preservation of data; a system for open data repository supplied with metadata is under development. The development activities focused on the building of object storages and principles of provision of the same to the user community, including the possibility to contribute to such infrastructure with own resources of the user groups. The



storages in the first stage of the pilot operation administer the object system for the cloud computing platform.

The FileSender system (a popular service for exchanging large files among users) and ownCloud system (cloud warehouse with about 13,000 registered users) were linked to proxyIDP and thus strongly integrated into a single user identity management system. They were also migrated to a cluster platform, which greatly improved the stability and scalability of their operation. A user data accounting application, including a user interface, is headed for the implementation of a system for controlling the amount of data. Its basic principles are:

- Maintaining a reserve for institutions that do not use warehouse services yet,
- Enforcing rotation of data having the nature of backup by administratively deleting files older than a defined limit (typically, a year).



CESNET E-INFRASTRUCTURE SECURITY

AN INTERNATIONALLY ACCREDITED CESNET-CERTS SECURITY TEAM IS THE BASIC ELEMENT ENSURING CESNET E-INFRASTRUCTURE SECURITY. ITS CORE ACTIVITY IS INCIDENT HANDLING - RECEIVING REPORTS OF SECURITY INCIDENTS CONCERNING THE CESNET E-INFRASTRUCTURE 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 level. It is a member of the working group CSIRT.CZ that is organized by the National CSIRT team of the Czech Republic, and also participates in the TF-CSIRT platform provided by the GÉANT association. At the end of June 2018, the CESNET Association obtained internationally recognized certification of its **Information Security Management System (ISMS)** to the ČSN EN ISO/IEC 27001:2014 standard, which specifies requirements for an information security management system within an organization's activities and provided services with the aim of eliminating the risks of data loss or corruption. At the end of June 2019, the 1st supervisory audit ISMS successfully took place. As part of its activities related to network security, CESNET runs a number of its own detection systems to obtain information about attacks in progress. An important role in security is played by network monitoring and security event and anomaly detection, which are provided in the CESNET e-infrastructure by **HW-accelerated network probes, FTAS and G3 systems and services and the Warden and Mentat systems**. These tools enable both the CESNET administrators and administrators at connected institutions to improve the level of network, service and user security and eliminate identified problems quickly and efficiently. All the systems are results of the Association's

own work and have been developed continually in accordance with trends, the Association's needs and users' needs.

The Association also provides the expert security services of a **Forensic laboratory FLAB** - analysis of security incidents, penetration and load tests, and social engineering method tests which test the attention and abilities of users to identify cybernetic threats. The laboratory's services are available to CESNET e-infrastructure subscribers as well as other clients. In 2019, the Forensic laboratory implemented two internal tests (network infrastructure and information systems), five external orders for penetration and load tests, three orders for phishing tests, a couple of professional consultations and one analysis of safety incident on a commercial basis. The Association is committed to the edification of users and network administrators. We hold expert workshops and training courses, give presentations at numerous events and publish papers focusing on security. We organized another annual security workshop, a workshop titled GDPR - one year later, and a traditional IPv6 workshop in 2019. We also organized several training sessions on DNS systems, and two sessions of Forensic Training. As a part of the cyber security month, CESNET in cooperation with the National Office for Cyber Security and CZ.NIC association held a professional conference as a part of the **Secure Internet Festival**, and prepared the next year of the "hacker" competition **The Catch** where the participants could test their analytical skills. In 2019, the professionals of the CESNET Association also participated in several international seminars, in particular in the prestigious and highly valued Locked Shield 2019 seminar. The Czech Republic team, consisting of the best specialists, placed second, following up on the successes of previous years.



NETWORK IDENTITY

AN INTEGRAL COMPONENT OF THE CESNET 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 OR THEIR ADMINISTRATIVE DOMAINS.



At the end of 2019, the federation eduID.cz included over 140 identity providers (IdPs) who use it to access more than 200 service providers (SPs). A number of other services are also available via the international interfederation eduGAIN. For minority user groups without their own IdP, it is possible to use the social networks identities and mojID.

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. The Czech federation had a total of about 400 member organizations in 2019, providing connectivity in more than 1000 locations. The roaming system also runs on an international basis, covering currently almost 27,000 localities in 104 countries of the world. More than 63,000 users use the 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 (PKI) 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 the GÉANT TCS (Trusted Certificate Service). The PKI service portfolio also includes the Time Stamp Authority.

In the area of identity and access management, we continue developing the **Perun** system along with the Masaryk University. On a long-term basis, the system has been an integral part of e-infrastructure, administers the users and accesses to various services connected with MetaCentrum, data warehouses and a lot of other fields of e-infrastructure. The main instance of the system manages identities and access to services for 352 user communities (national and international) with about 50,000 users. Its advantages include support for the entire user life cycle, ability to integrate with existing environments and capability to delegate access and user administration.

In 2019, we started working on the supporting services for **eIDAS** - RemSig system for remote signing of electronic documents and the validation service for authentication of signatures based on a qualified certificate.

COOPERATION OF USERS AND MULTIMEDIA

AS A PART OF THE BOOKING SYSTEM MEETINGS WHICH RUNS ON THE SHONGO SYSTEM BEING DEVELOPED BY THE CESNET ASSOCIATION, THE USERS MAY BOOK THE CAPACITIES OF A NUMBER OF TOOLS. THE VIDEOCONFERENCE ENVIRONMENT WAS REPLACED WITH THE PEXIP SYSTEM WHICH ENABLES INTERCONNECTION OF BOTH HW, SW UNITS, AND CONNECTION VIA THE WEB BROWSERS SUPPORTED BY WEBRTC, OR WITH THE POSSIBILITY OF CONNECTION TO SKYPE FOR BUSINESS/LYNC.



Low-latency transmission via the UltraGrid and 8K video technology.

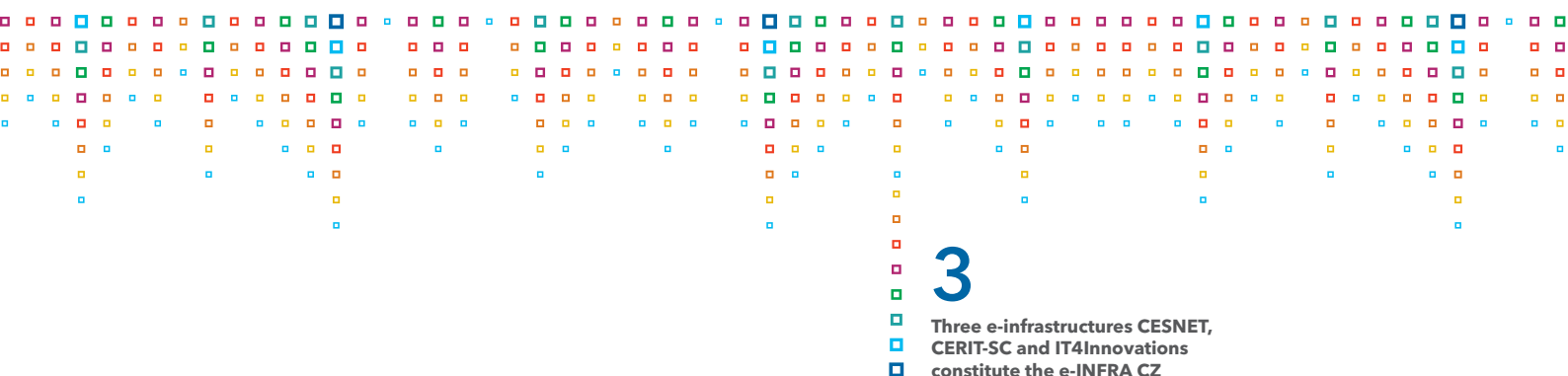
The Meetings environment is implemented as software running on the CESNET virtualization platform. This allows gradual capacity extension, as well as independent renewal of hardware (servers) of the system. The users also have the web conference system available on the **Adobe-Connect** platform. The tests of the **Zoom** solution took place in cooperation with the users at universities.

We continue running the **streaming platform, video archive** and interconnection of tens of exchanges of the institutions (members) within the scope of the IP phone infrastructure.

The **MVTP** and **UltraGrid** solutions developed by the Association for high-quality, low-latency transmission solution were used for a number of live broadcasts of surgeries during medical events. The solutions are also used for cultural events and teaching.

COOPERATION WITH LARGE RESEARCH INFRASTRUCTURES

E-INFRASTRUCTURE CESNET IS A PART OF THE EUROPEAN E-INFRASTRUCTURES AND FORMS THE COMMUNICATION AND INFORMATION ENVIRONMENT FOR LARGE NATIONAL RESEARCH INFRASTRUCTURES FROM OTHER SCIENCE FIELDS AND ALLOWS THEM COOPERATION WITH THEIR FOREIGN PARTNERS.



Currently, the building of the European Open Science Cloud - EOSC - takes place at the European level, with the aim of creating open space for storing, processing, sharing and making accessible the scientific data, and thereby making the European research more efficient.

The following chapters describe cooperation with other infrastructures and involvement into the building of EOSC ecosystem both nationally and internationally.

E-INFRASTRUCTURE CZ (e-INFRA CZ)

The Czech Republic Roadmap for Large Research, Experimental Development and Innovation Infrastructures for years 2016 to 2022 categorizes large research infrastructures into six areas based on their focus. One of the areas is e-infrastructures that provide information and communications services for research and development in the Czech Republic. This category includes three e-infrastructures: **CESNET**, **CERIT-SC** (operated by Masaryk University) and **IT4Innovations** (operated by VSB - Technical University of Ostrava).

These infrastructures consistently cooperate and coordinate their activities in order to efficiently provide services to users. Based on a recommendation made by an international panel during an interim assessment of large research infrastructures carried out in 2017, the provider of support - the MEYS of the Czech Republic - decided to support these e-infrastructures in 2020-2022 as a single national e-infrastructure, titled e-infrastructure CZ (abbreviated - **e-INFRA CZ**), specifically by means of two complementary shared projects. Operating costs will be covered under the **Support for Large Research Infrastructures programme and investments under the OP VVV**. During 2019, CESNET, Masaryk University and VŠB (Mining University) - Technical University Ostrava formed the e-INFRA.CZ consortium which prepared and submitted two complementary projects for years 2020 to 2022.

- **E-Infrastructure CZ CZ** (LM 2018140) from the Support of Large Research Infrastructures for R&D&I programme,
- **e-INFRA CZ: Modernization** (EF18_072/0015659) from the OP VVV programme.

ELIXIR CZ - CZECH NATIONAL INFRASTRUCTURE FOR BIOLOGICAL DATA



CESNET is directly involved in the national activities in the field of biomedicine - it is one of the founding members of the **ELIXIR CZ** infrastructure - it is one of the founding members of the ELIXIR CZ infrastructure which provides advanced computing environment, data resources and unique tools to the bioinformatics science community in the Czech Republic and in Europe and participates directly in two projects assuring the operation and development of this infrastructure: The Czech National Infrastructure for Biological Data (LM2015047) from the Large Infrastructure Projects for R&D&I and ELIXIR-CZ programme: Building the capacities (EF16_013/000 1777) from OP VVV. We contribute to the ELIXIR European infrastructure development under the activity Technical Services ELIXIR Compute Platform focused on the creation of a common framework for the provision of computing services and services associated with data storage and building of ELIXIR AAI.

OTHER NATIONAL LARGE RESEARCH AND DEVELOPMENT INFRASTRUCTURES

In addition to the above mentioned close cooperation with the national e-infrastructures and involvement in the large infrastructure ELIXIR CZ, we are also continuously negotiating with the representatives of other large infrastructures which are stated in the Czech Republic Roadmap of Large Infrastructures for the research, experimental development and innovations and other infrastructural projects for the years 2016 to 2022, we provide for their needs in the field of information and communication and technologies and offer cooperation in the solution of the same. Examples may include:

- cooperation between ÚMG AV ČR and CESNET on the building and subsequent operating of the chemical-biological database ECBD,
- memorandum on cooperation in the field of ICT with ÚOCHB AV ČR and ÚMG AV ČR, including the infrastructures:
 - Czech national infrastructure for biological data ELIXIR CZ,
 - National infrastructure of chemical biology CZ-OPENSOURCE,
 - the Czech centre for phenogenomics CCP,
 - the National infrastructure for biological and medical imaging Czech-Bioimaging.

- CESNET is directly involved
- in the national activities in the field
- of biomedicine - it is one of the founding
- members of the ELIXIR CZ infrastructure

GÉANT - EUROPEAN BACKBONE COMMUNICATIONS INFRASTRUCTURE



The Pan European GÉANT communications infrastructure ensures interconnection of the European national research and education networks and connection to similar infrastructures such as Internet2 and ESnet in the USA, CANARIE in Canada and academic networks on other continents. GÉANT is the basis of the European Digital Infrastructure (EDI), which constitutes the communications infrastructure of the developing European Open Science Cloud (EOSC) concept. The funding of this infrastructure and related activities at European level until the end of 2022 is ensured through framework support under the **GÉANT2020** project. CESNET is primarily involved in the project in activities related to the building of test environment, matters concerning network security, the provision of cloud services within the European infrastructure or the deployment of AAI. In addition, the GÉANT Association, coordinating the project, asked CESNET for a capacity of a particular worker, dedicated to the assessment of the public tender for infrastructure which was going on intensively in the period of July to October 2019.

EGI - EUROPEAN INFRASTRUCTURE FOR DISTRIBUTED COMPUTING



The EGI.eu initiative coordinates at the European level the national activities in the area of implementation of grid technologies as an important component of EOSC. Cooperation among the members of this infrastructure takes place in particular within the intention of the EOSC-Hub programme H2020. CESNET is involved in all the primary operational activities within this cooperation, 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 the MetaCentrum and use its virtualized infrastructure. We continue supporting the virtual organizations ELIXIR (bioinformatics), Auger (cosmic rays), Belle (particle physics) and CTA (gamma astronomy) as well as the direct supporting of the user groups from the Czech Republic, interested in the use of the Pan European grid. It is a priority to focus on specific needs of these groups and their international projects.

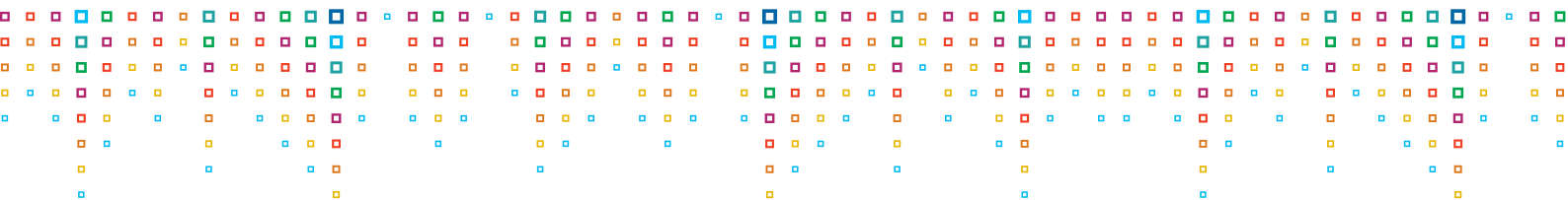
ESA - EUROPEAN SPACE AGENCY



CESNET, in coordination with the Ministry of Transport of the Czech Republic, concluded a contract for the construction of a Data Hub Relay with the European Space Agency (ESA) in early 2018. In the Czech Republic, one of the seven data hub nodes has been put into operation in the Czech Republic to synchronize and redistribute large quantities of the latest imagery from Sentinel satellites in order to reduce the load of the ESA infrastructure.

RESEARCH, DEVELOPMENT AND INNOVATION

THE DEVELOPMENT OF CESNET E-INFRASTRUCTURE REQUIRES AN INNOVATIVE APPROACH. THAT IS WHY CESNET, IN ADDITION TO BUILDING AND OPERATING ITS CESNET E-INFRASTRUCTURE, IS ALSO ENGAGED IN RESEARCH AND DEVELOPMENT IN THE FIELD OF INFORMATION AND COMMUNICATIONS TECHNOLOGY, MOST IMPORTANTLY IN THE AREAS MENTIONED BELOW. WE COLLABORATE ON RESEARCH AND DEVELOPMENT NOT ONLY WITH ASSOCIATION MEMBERS BUT ALSO WITH PARTNERS ABROAD OR WITH SPECIFIC COMPANIES.



OPTICAL TRANSMISSION SYSTEMS

CESNET has been researching and developing optical technologies for a long time. We have developed the CzechLight series of original fully optical transmission systems, whose greatest advantage is openness. This means that the owner or administrator of a device can make software modifications directly without asking CESNET or the manufacturer to do so. This makes them independent in terms of decisions on further network development. In the sphere of optical systems, we also deal with the issue of software management of optical networks, transmission of the exact time and stable frequency, quantum transfer of cryptographic keys and use of optical networks as sensors of physical quantities.

E-INFRASTRUCTURE SECURITY

CESNET CESNET has long been committed to e-infrastructure security. In addition to developing tools for ensuring user privacy and security of their data or tools for sharing information on security incidents, we have also been intensively developing tools for network monitoring and detection of operating anomalies as potential sources of attack. In 2019, we deployed among others our own developed system against DDoS (DDoS protector) in the peering centre NIX.cz, and/or verified in the pilot mode the system for automated sharing of information and analysis of information from the sphere of cyber security, developed as a part of the European project PROTECTIVE.

NETWORK IDENTITY

The mechanisms for the access control to individual services are an important component of the CESNET e-infra-

structure, and therefore the Association also deals with the development and implementation of infrastructure for federalized sharing of services and resources. Its main purpose is to allow users from various home institutions to use resources operated by partner institutions. These resources may be either various network applications or network connectivity as such. In the field of identity management and access control, we are developing together with the Masaryk University, the Perun system, for example, which allows to organize the users into virtual organizations and groups and allocate them resources and control the access to them.

NEW APPLICATIONS

To make use of our infrastructure from the beginning of the Association, we support the CESNET e-infrastructure utilization in new areas and we are searching for new possible ways of collaboration in research, development and education in various fields such as medicine, culture, architecture etc. Often, this involves combining premium network access, storage capacities, special transmission hardware and software and visualization and interaction resources, including a method of use in the field in question. As a part of this activity of ours, we are for example developing two platforms, a hardware one, called MVTP, and, together with the Masaryk University, a software Ultra-Grid one for the works with high-resolution video (up to 8K) while maintaining low latency, which are usable for example for video transmission in medicine and/or for implementation of distributed cultural events. Furthermore, we pay intensive attention to the sphere of digitalization and presentation of the cultural heritage articles, and the issue of the Internet of Things.



PROJECTS SOLVED IN 2019

- Adaptive protection against DDoS attacks (AdaptDDoS)
- Adaptive Management of Data Collection and Analysis in High-Speed Networks (FOKUS).
- Advanced time/frequency comparison and dissemination through optical telecommunication networks (TiFOON)
- Acceleration platform for virtual switches (ViSA)
- Asset Management AND Diagnostics (AMANDA)
- Authentication and Authorisation for Research and Collaboration (AARC2)
- Czech national infrastructure for biological data (ELIXIR-CZ)
- CLOck NETwork Services (CLONETS)
- Designing and Enabling E infrastructures for intensive Processing in a Hybrid DataCloud (DEEP-HybridDataCloud)
- Detection of Infrastructure Security Threats (DOBI)
- Network Diagnostics from Intercepted Communication (DISTANCE)
- Remote Collaboration in Artist Education Using Modern Transmission Technology– E-infrastructure CESNET
- E-infrastructure CESNET - modernization
- ELIXIR-CZ: Building the capacities (ELIXIR-CZ)
- ELIXIR-EXCELERATE: Fast-track ELIXIR implementation and drive early user exploitation across the life-sciences
- European Open Science Cloud
- Expanding Capacities by building Capabilities (EOSC-synergy) – GN4-3
- Integrating and managing services for the European Open Science Cloud (EOSC-hub)
- Laterna magika. The Past and the Present, Documentation, Preservation and Accessibility.
- Monitoring of Sensitive Objects over the Internet of Things (Mon-IoT)
- Photon and Neutron Open Science Cloud (PaNOSC)
- Network Feature Virtualization Acceleration Platform (NFV200)
- Proactive Risk Management through Situation Awareness (PROTECTIVE)
- Security Event Sharing and Analysis in the National Cyberspace (SABU)
- Sharing and Automation for Privacy Preserving Attack Neutralization (SAPPAN)
- Smart ADS
- Special Projects for Advanced Research and Technology in Europe (SPARTA)
- Building and Pilot Operation of a Cyber Threat Intelligence (CTI) System.
- Use of Digital Models for the National Infrastructure of Memory Institutions
- Secure Gate for Internet of Things (SioT)

RESEARCH AND DEVELOPMENT OUTCOMES

The CESNET Association's research activities in 2019 led to the creation of one chapter in a book, eight articles in the reviewed scientific magazines, thirty articles in the conference collections, one semi-operation, five functional samples and nine results of the software type. Two patents and a utility design were awarded.

Patents:

- CESNET, z. s. p. o. and Netcope Technologies, a.s. A connection for quick search of regular expressions in data. Inventors: Viktor PUŠ, Vlastimil KOŠAŘ, Jan KOŘENEK, Denis MATOUŠEK, no.: EP3258385B1 granted by the European Patent Office on 30th January 2019.
- CESNET, z. s. p. o. and FIT ČVUT (the Faculty of Information Technology of the Czech Technical University). System for Implementation of a Hash Table. Inventors: Matěj BARTÍK, Sven UBIK, number: US1026702 granted by the United States Department of Commerce - United States Patent and Trademark Office (USPTO) 16. April 2019,

Utility design:

- CESNET, z. s. p. o. Mobile Sensors for the Network of the Internet of Things. Inventors: Sven UBIK, Jiří POSPÍŠILÍK, number: 32911 granted by the Industrial Property Office on 04/ 06/ 2019.

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In 2019, CESNET
was granted two patents

DEVELOPMENT FUND OF THE ASSOCIATION

CESNET In late 2018 and during 2019, the Development Fund Board prepared and launched two rounds of tendering process for projects for 2019. At present, the Association has selected the following topics:

- Utilization and advancement of CESNET e-infrastructure services and modern information and communications technologies in teaching and learning processes, creative and scientific research work and management of public universities and the Czech Academy of Sciences
- Advanced applications utilizing the CESNET e-infrastructure

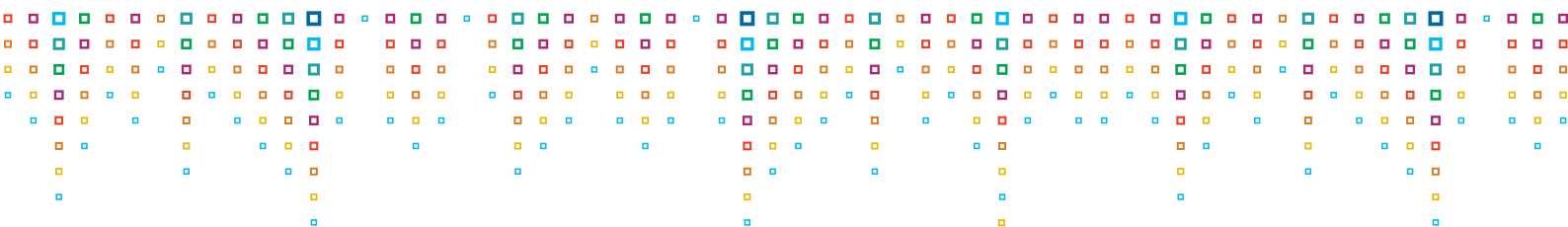
On the basis of tenders, 25 projects were submitted, seventeen of which were accepted for co-financing, of which seven were accepted after being reworked. An overview of accepted projects is shown in the table below.

Two rounds of opposition procedures for completed projects also took place over the course of 2019 – a total of 8 projects were completed successfully. When assessing the achieved results, one project was presented to public. In five completed projects, a broader presentation was recommended at the specialist forum so that also the other Association members could benefit from the results. Final reports for projects carried out under the CESNET Development Fund are available on the Association's website <https://fondrozvoje.cesnet.cz/zpravy.aspx>.

NUMBER	PROJECT HOLDER	PROJECT NAME
635R1/2019	ČVUT	Creation of access nodes of the IoT network LoRaWAN including pilot check-up and use in projects
636/2019	VŠB-TUO	Application and development of experimental IoT network at the LoRaWAN platform with the use of the CESNET infrastructure
637/2019	UPA	Implementation of the public service for protection against undesirable crypto-currency mining at the users' terminals with the use of RPZ in DNS
638/2019	ZČU	Pilot verification of connection of identification cards of ZČU (JIS cards) into European Student Card
640/2019	ZČU	Makerspace in the university environment
642/2019	MU	Enhancing the professional qualification of the cybersecurity team members at the Masaryk University - CISSP certification
644/2019	VŠB-TUO	IT security training session
645R1/2019	VŠB-TUO	Processing the events at IT infrastructure
646/2019	VŠB-TUO	Telemetry of IT infrastructure
649R1/2019	UP	Implementation of software components at the platform .NET for authentication of users as a part of the federation eduID.cz
650/2019	VŠB-TUO	Hybrid metallic-optical systems with corrected operation in higher layers
653/2019	JU	Creation and implementation of the client of the validator.cesnet.cz service
654R1/2019	MU	Portmanager - web application for delegated configuration of switches
655R1/2019	MU	Administration of firewall rules with the use of users' identities
656/2019	MU	Analysis of image data from digital pathology in the CESNET e-infrastructure environment
657R1/2019	MU	Transformation on-premise MS environment at MU and cloud environment O365 at MU into the integrated hybrid cloud environment M365 MU
659R1/2019	JU	DoH detection and suppression

PUBLIC RELATIONS

THE ASSOCIATION CONTINUED ITS ACTIVITIES UNDERLINING ITS UNIQUE ROLE AS A SCIENTIFIC AND RESEARCH E-INFRASTRUCTURE IN THE CZECH REPUBLIC IN 2019. IT ALSO HELD EVENTS AIMED AT THE TRANSFER OF EXPERIENCE TO THE USER COMMUNITY, PROFESSIONAL AND NON-PROFESSIONAL PUBLIC. THE ASSOCIATION WAS PREPARING THEMATIC SEMINARS, CONFERENCES AND WORKSHOPS FOR ACADEMIC AND PROFESSIONAL PUBLIC.



At the beginning of the year, the Association held a two-day **Conference on CESNET e-infrastructure** where over 500 participants presented the entire range of their services and the news of their own research and development. This conference was followed by the next year of the Network and Service Security Seminar.

In the first half of the year, the international workshop **Network Performing Arts Production Workshop 2019** was held where a unique distributed performance using the MVTP hardware and UltraGrid software, developed by the employees of the CESNET Association took place.

In 2019, the Association paid attention to the GDPR topic and held a conference titled **GDPR - a year later**. The jubilee 10th year of the **CEF Networks Workshop** took place where 46 leading world specialists in the field of optical networks gathered. As a part of the cybernetic security month, CESNET was a part of the Secure Internet Festival and prepared a conference dedicated to ICT and the legal matters. The third year of **The Catch competition** took place where 732 players conquered demanding tasks with the aim to save the world from hacker attacks.

Even this year, the workshops such as **IPv6, CESNET Day, Forensic Training** were held. The Association held various training sessions, meeting of working groups and professi-

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The Association organized thematic seminars, conferences and workshops. It organised a total of 14 events, including 10 national and 4 international.

onal workshops for the Czech and international communities. CESNET was a partner of a number of events, such as **Týden vědy a techniky (Science and Technology Week), Linux Days, Open Alt, Install Fest**, and others. The Association also co-organized the second year of the community network meeting **CSNOG 2019**.

The CESNET Association presents the news, activities and achievements of the employees, information on the events to be held and on other events via its web sites, social networks and blog. In cooperation with the Ministry of Education, Youth and Sports Education, the Association continues the web administration of the Large Research Infrastructures of the Czech Republic. In 2019, the CESNET Association issued 19 press releases and 239 press outputs in printed and/or online form were recorded.





→ CESNET e-infrastructure conference



→
**Conference IPv6
The Festival of Science
Presentation at the SPIE
Conference**



ECONOMIC RESULTS

ECONOMIC RESULTS IN 2019

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

NON-ECONOMIC ACTIVITIES

As part of its Non-economic activities, the Association continued building a CESNET e-infrastructure of a new quality to provide Association members and other entities eligible for connection to the CESNET network with a comprehensive set of services.

The Association was also involved in the execution of international research projects under the Horizon 2020 programme, national projects supported by the Ministry of Education, Youth and Sports, Technology Agency of the Czech Republic, Ministry of the Interior of the Czech Republic, Ministry of Industry and Trade of the Czech Republic, Ministry of Culture of the Czech Republic and projects of the Development Fund Board CESNET, as already mentioned in the previous section of the Annual Report.

The Association's non-economic activities in 2019 generated an accounting profit of CZK 7,340 thousand before tax. The Revenues of the non-economic activities of the Association amounted to CZK 479,769 thousand, the costs achieved CZK 472,429 thousand. The income tax base of the non-economic activities in 2019 was positive, amounting to CZK 15,263 thousand.

ECONOMIC ACTIVITIES

The Association's economic activities in 2019 involved mainly management of the largely bond-based portfolio of the Board of the Development Fund comprising financial resources obtained by sale of the commercial part of the CESNET network in 2000 and management of financial resources in other funds. The Association's economic activities in 2019

generated an accounting profit of CZK 14,091 thousand. The Revenues of the economic activities of the Association in 2019 amounted to CZK 29,662 thousand, the costs of the economic activities amounted to CZK 15,571 thousand. The income tax base of the Association's economic activities in 2019 was positive, amounting to CZK 13,553 thousand.

TOTAL ACCOUNTING AND TAXABLE PROFIT

The total book economic result of the CESNET Association before tax reported in 2019 was the profit amounting to CZK 21,431 thousand. The total income tax base of the Association was CZK 28,816 thousand. The total legal entity income tax of the Association for year 2019 amounts to CZK 5,605 thousand which gives a profit after tax of CZK 15,826 thousand.

CONCLUSION

In the previous year, the CESNET Association managed the entrusted funds responsibly and properly, meeting all of its obligations resulting from legislation, decisions of the Ministry of Education, Youth and Sports of the Czech Republic and concluded contracts. The auditing company BDO Audit s. r. o., registered office in Olbrachtova 1980/5, Prague 4, authorization by KA ČR number. 018, performed the auditor verification of the annual financial statements, giving the following statement: "In our opinion, the financial statements give a true and honest view of the assets and liabilities of the CESNET Association, the association of interest of legal entities as of 31/ 12/ 2019 and of costs and revenues and the economic result and cash flow for the period starting 1/ 1/ 2019 and ending 31/ 12/ 2019 in accordance with Czech accounting regulations".

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