



ANNUAL REPORT 2020

cesnet
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A word from the Director

CESNET'S 2020 ANNUAL REPORT SUMMARIZES ITS ACTIVITIES. IN SPITE OF THE FACT THAT MOST OF THE YEAR WAS AFFECTED BY MEASURES RELATING TO THE COVID-19 PANDEMIC, WE MANAGED TO CARRY OUT MOST OF OUR PLANNED PROJECTS AND MAKE SIGNIFICANT PROGRESS IN THE MODERNIZATION OF OUR SERVICES.

We provide the community with e-INFRA CZ, a unique infrastructure for research and development in the Czech Republic under the freshly established e-INFRA CZ consortium, in collaboration with Masaryk University (CERIT-SC) and the VSB – Technical University of Ostrava. The e-INFRA CZ consortium presented its new logo and put up a new website with information on offered services and research and development projects, which CESNET takes part in.

We provided computing capacity and expertise to the Czech academic and scientific community to measure, process and evaluate data in the fight against COVID-19. We reacted to the shift to online in our lives by reinforcing services relating to distance education and telecommuting, data sharing and synchronization and increased information on internet safety. We provided videoconferencing services to connect 1.8 million users, who debated for 2 million hours at 130,000 meetings. We successfully passed an information security management system (ISMS) certification audit and joined the **Hospital SOC** initiative to improve hospitals' cybersecurity.

As part of our partnership with the producers of **Caught in the Net**, we organized a series of screenings for college of education

students, followed by a debate with the film director Vít Klusák, in collaboration with Association members.

We continued to support the application of modern technology in culture throughout the year. We prepared an audiovisual broadcast of a memorial ceremony named A Candle for Toufar and broadcasts of concerts such as Music without Borders, Concert against Totalitarianism and Prague Clarinet Days. We presented digitized 3D models of the Old Town Madonna and R.U.R. Our sustained efforts in this field were rewarded in May with an **EUROPA NOSTRA cultural heritage award** for utilizing network transmissions for international cooperation in live culture.

CESNET actively supports the academic and research community and continually expands its activities to other areas. Our community was joined by two important cultural institutions: the National Museum and the Moravian Gallery in Brno.

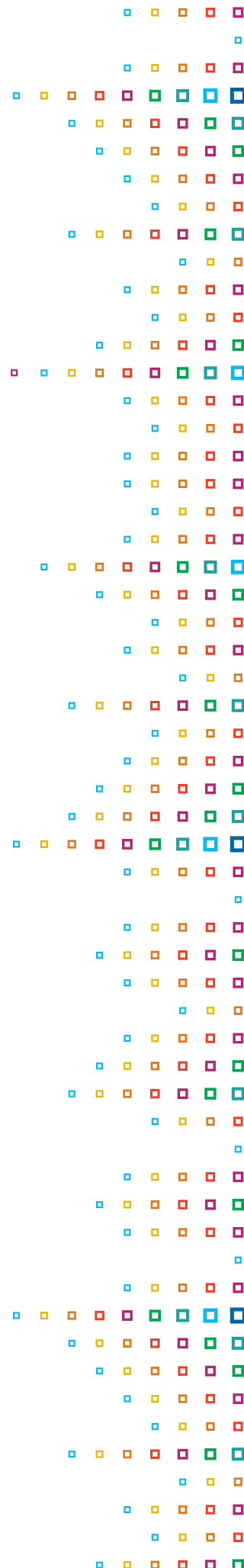
Our collaboration with industry resulted in two major business transactions. **Flowmon Networks**, a global leader in network traffic monitoring and analysis, which CESNET helped to start up, was acquired by Kemp Technologies, a major technology company.

The other transaction concerned the sale of our programmable HW know-how to another big U.S. company.

CESNET became a member of the EOSC (European Open Science Cloud) at the end of the year. By a decision of the Ministry of Education, Youth and Sports, CESNET assumed the role of the national mandated organization that represents official opinions of the Czech Republic, specifically the MEYS, in the newly established association. The objective of the EOSC is to provide scientists with free access to data and research results stemming from public funds and to support their practical application.

I would like to take this opportunity to thank all employees for their work in these difficult times. We achieved the goals we had set despite all obstacles and a changing environment. I would also like to thank our partners and community members for their support and cooperation and I am looking forward to the next year's challenges.

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





The CESNET Association

THE ASSOCIATION'S HISTORY AND CURRENT TASKS

CESNET was founded by public universities and colleges and the Czech Academy of Sciences (CAS) in 1996.

CESNET's mission is to:

- Provide the scientific, research and education community with unique and comprehensive e-infrastructure services with a quality comparable to the world's best and support the Open Science concept,
- Offer stable services with high added value covering the widest possible spectrum of needs of our users,
- Contribute our in-house research activities towards the development of information and communications technology and put their results into practice.

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 discontinued the activity in 2000, chiefly for legislative reasons. Since then, it has been engaged exclusively in the **development and operation of science, research and education e-infrastructure** and related activities.

A milestone in the Association's history is the year 2010 when the CESNET e-infrastructure became part of the **Czech Republic Roadmap for Large Research, Experimental Development and Innovation Infrastructures**. In 2014, the CESNET e-infrastructure received the highest research infrastructure rating possible and was included in the updated Czech Republic Roadmap for Large Infrastructures.

In 2019, CESNET, Masaryk University and VSB – Technical University of Ostrava decided to coordinate the activities of the CESNET, CERIT-SC and IT4Innovation e-infrastructures, create a consortium and establish closer cooperation in terms of capacity building and provision of services to users under a joint e-infrastructure, e-INFRA CZ.

Since 2020, e-INFRA CZ has been the sole national e-infrastructure included in the Czech Republic Roadmap for Large Research, Experimental Development and Innovation Infrastructures for 2016 to 2022.

CESNET accepted its first two **associate members, the National Museum and the Moravian Gallery in Brno**, in 2020.

¹ A large infrastructure for research, development and innovation means a unique research facility, including its acquisition, associated investments and operational arrangements, which is necessary for comprehensive research and development activities with high financial and technological demands and is approved by the government and established by a research organization to be also used by other research organizations ("large infrastructure").
Infrastructure definitions. Ministry of Education, Youth and Sports [online] [viewed 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:

- Conducting independent research and development activities in information and communications technologies and providing research services in this field
- Supporting education in information and communications technologies
- Putting the results of in-house research and development into practice through technology transfer of internal nature
- 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 2020:

International organizations



EOSC AISBL – an international association of institutions involved in the building of the European open science cloud concept (www.eosc-portal.eu).



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).



EGI.eu – an organization focusing on coordinating European computing grids used for scientific computations and supporting their sustainable development (www.egi.eu).



Shibboleth Consortium – 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 (www.shibboleth.net).



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

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 that provides interconnectivity for its members' networks (www.nix.cz).



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 (www.nic.cz).

Association members

The following institutions were regular members of the Association in 2020:

- Academy of Performing Arts, Prague,
- Czech Academy of Sciences,
- Academy of Fine Arts, Prague,
- Czech University of Life Sciences, Prague,
- Czech Technical University, Prague,
- Janáček Academy of Music and Performing Arts, Brno,
- University of South Bohemia, České Budějovice,
- Masaryk University,
- Mendel University, Brno,
- University of Ostrava,
- Police Academy of the Czech Republic, Prague,
- Silesian University, Opava,
- Technical University of 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,
- Brno University of Technology,
- University of West Bohemia, Plzeň.

The following institutions were associate members of the Association in 2020:

- Moravian Gallery in Brno,
- National Museum.



The CESNET Association

INTERNAL ORGANIZATIONAL STRUCTURE

CESNET has the following bodies:

- General Assembly
- Board of Directors
- Supervisory Board

The Board of Directors consisted of the following members in 2020:

- 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 RNDr. Igor Čermák, CSc., and Mgr. František Potužník.

The Supervisory Board consisted of the following members in 2020:

- Ing. Radek HOLÝ, 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. Michal Sláma.

Ing. Jan Gruntorád, CSc., was the **Director** of the Association in 2020.

Development Fund Board

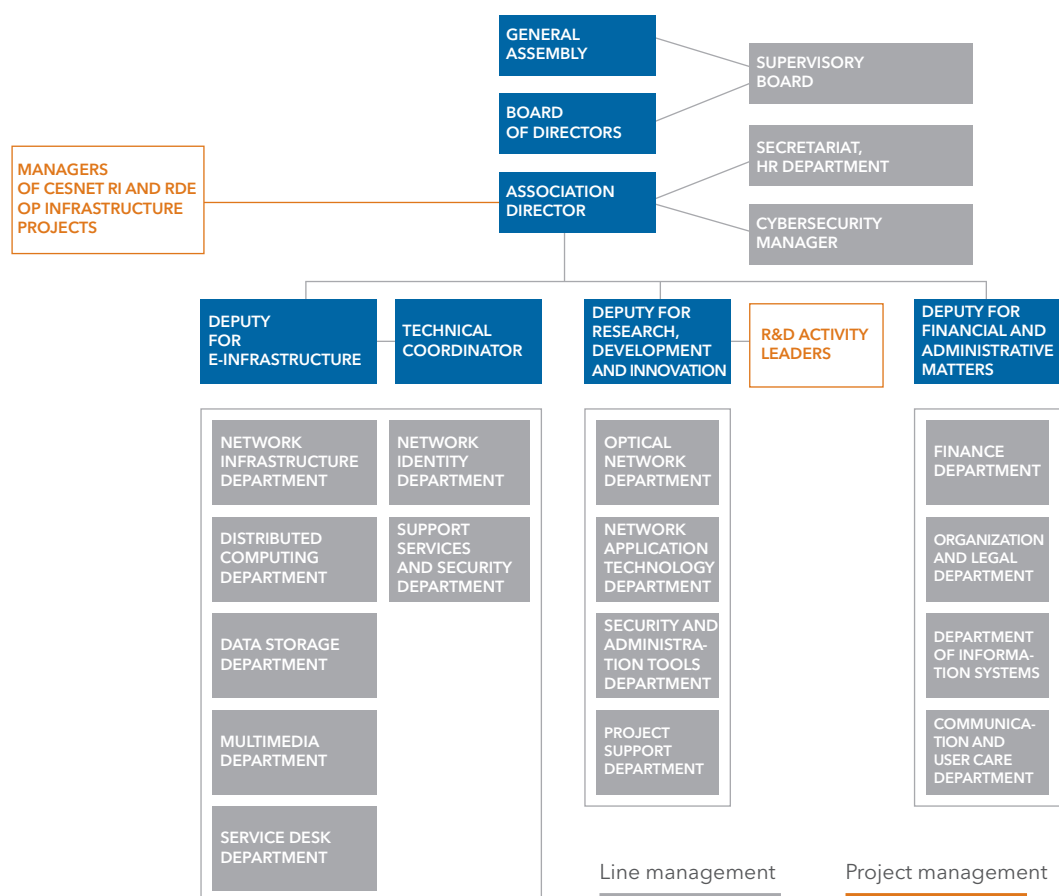
The Development Fund Board consisted of these members in 2020:

- 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 **Chairwoman** of the Development Fund Board was Ing. Olga Klápšťová in 2020.

ORGANIZATIONAL CHART

The Association's basic organizational structure comprises departments, which are aggregated into sections. The Association had a total of 183.7 full-time equivalents in 2020.





CESNET

e-infrastructure

450 000

active users
Services for Czech science

THE CESNET E-INFRASTRUCTURE IS PART OF E-INFRA CZ, A LARGE RESEARCH INFRASTRUCTURE THAT IS A MAJOR 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 TRANSFER, 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 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 comply with the CESNET e-Infrastructure Access Policy.

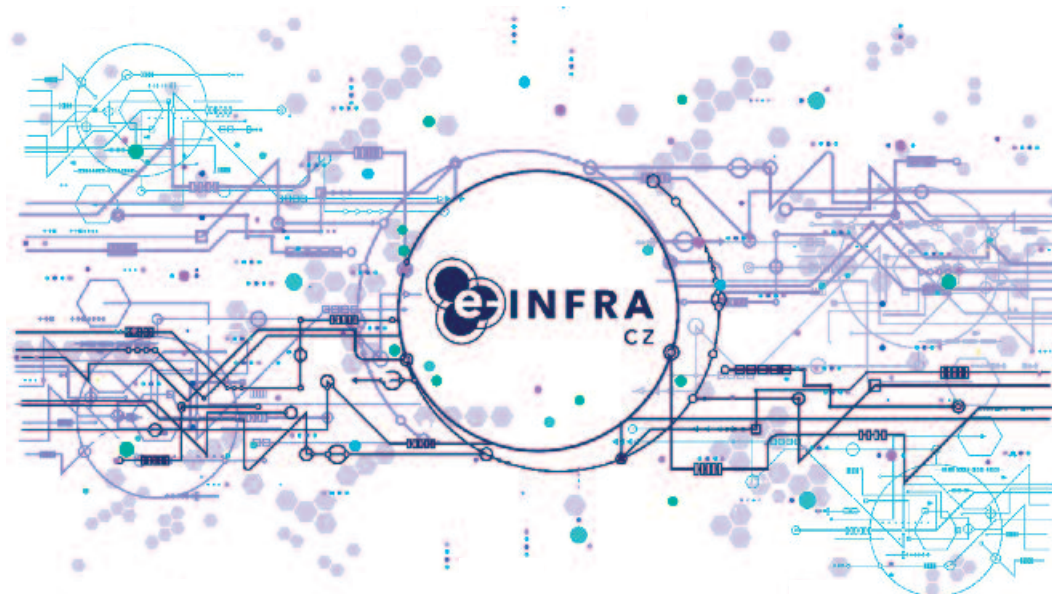
The year 2020 was a bridging one in terms of funding; CESNET e-infrastructure projects were finished while e-INFRA CZ projects and activities for the integration of three infrastructures were started.

- **CESNET e-Infrastructure - Modernization** (EF16_013/0001797, 2017-2020) funded from the Research, Development and Education operational programme. Aid under this project is intended for the renovation of e-infrastructure elements and in-house research on security, flexible infrastructures and new technologies for network applications.

CESNET is the host organization for e-INFRA CZ as well as the coordinator of two complementary projects for the development and operation of e-INFRA CZ, which were started by a consortium of CESNET, Masaryk University and VSB – Technical University of Ostrava in January 2020:

- **CZ e-Infrastructure** (LM 2019140, 2020-2022) funded under the Large R&D&I Infrastructure Projects programme (2010-2022). The special purpose aid in the form of subsidy is earmarked for covering a portion of operating costs associated with e-infrastructure operation.
- **e-INFRA CZ: Modernization** (EF18_072/0015659, 2020-2022) funded from the Research, Development and Education operational programme, which is the main source of investment funds for a major e-infrastructure upgrade.

e-INFRA CZ infrastructure



The objective is to modernize and ensure the operation of individual e-INFRA CZ components. The members of the consortium thus build on the previous operation of their e-infrastructures (CESNET, CERIT-SC, IT4Innovations) while striving to **align their approach to users** so that they perceive the e-INFRA CZ e-infrastructure as a coherent whole. A number of working groups have been established for this purpose, focusing on:

- Long-term orientation of e-INFRA CZ,
- Joint support for specific user groups,
- AAI unification,
- Computing and data service architecture,
- Cybersecurity,
- Single reactive user support (help desk),
- Joint edification, PR and training,
- Procurement coordination,
- Coordination in submitting projects,
- Identifying a common portfolio of e-INFRA CZ users.

The working groups' most significant outputs include the **definition of an e-INFRA CZ user, a draft acceptable use policy (AUP) and joint approach to GDPR**.

The following activities relating to e-INFRA CZ modernization took place in 2020:

- Completing a contract award procedure for modernizing the CESNET2 main optical transmission system (CESNET),
- Making a call for tenders and starting evaluation in a contract award procedure for an upgrade of the IP/MPLS layer of the CESNET2 network (CESNET),
- Completing a contract award procedure for an HD cluster (CESNET),
- Completing evaluation in a contract award procedure for a data storage facility; however, the procedure was cancelled due to external circumstances (CESNET),
- Completing a contract award procedure for an SMP and GPU cluster (CERIT-SC),
- Expanding the SW portfolio (IT4Innovations).



CESNET e-infrastructure development

ACTIVITIES RELATING TO THE DEVELOPMENT OF THE CESNET E-INFRASTRUCTURE FOCUSED MOSTLY ON CARRYING OUT CONTRACT AWARD PROCEDURES IN 2020.

Procedures were carried out for the **e-INFRA CZ: Modernization** project (modernizing the CESNET2 main optical transmission system, upgrading the IP/MPLS layer of the CESNET2 network, HD cluster and data storage) as well as for the **ELIXIR-CZ: Capacity Building** project:

- Acquiring a high-performance computing cluster intended for bioinformatics tasks within the ELIXIR CZ infrastructure,
- Procuring high-performance computer technology for the Institute of Molecular and Translational Medicine of the Faculty of Medicine and Dentistry of Palacký University in Olomouc (EATRIS infrastructure) to process data from testing for the SARS-CoV-2 coronavirus.

However, the exceptional situation related to the COVID-19 epidemic affected the course of those contract award procedures and caused significant delays from planned schedules. The delays resulted in lower drawdowns of related operating expenses in 2020 and postponement of planned capital expenditures until 2021.

The following was carried out in the development of e-infrastructure services:

- Commencing a contract award procedure for modernizing the CESNET2 main optical transmission system,
- Commencing a contract award procedure for modernizing the IP/MPLS network layer
- Integrating the Adan computing cluster into the MetaCentrum environment,
- Commencing a contract award procedure for an object storage facility in Ostrava,
- Considerably enhancing the capacity of videoconferencing and streaming services,
- Switching the GÉANT TCS (Trusted Certificate Service) to a new provider,
- Launching new MetaCentrum services: Jupyterhub and Kubernetes,
- Launching modernization projects aimed at optimizing MetaCentrum environment security,
- Making new-generation data storage facilities in Plzeň and Jihlava available to users,
- Joining the Hospital SOC (HSOC, Hospital Security Operation Centre) initiative with the aim of enhancing the cybersecurity of hospitals and health service providers.

Communications infrastructure

CESNET ENSURED STABLE OPERATION AND PROVIDED SUPPORT TO OTHER SERVICES OF THE CESNET E-INFRASTRUCTURE, CONNECTED NETWORK USERS AND LARGE RESEARCH INFRASTRUCTURES. IT ALSO FOCUSED ON PREPARING EXTENSIVE NETWORK MODERNIZATION UNDER THE E-INFRA CZ: MODERNIZATION PROJECT. THE CONTRACTOR WAS CHOSEN FOR THE MODERNIZATION OF THE CESNET2 MAIN OPTICAL TRANSMISSION SYSTEM (FWDM0). THE FIRST STAGE OF THE MODERNIZATION IS ALREADY UNDER WAY. THE DIFFICULT PROCESS, WHICH HAS BEEN TAKING PLACE WHILE THE SYSTEM IS IN OPERATION, IS PLANNED TO BE FINISHED IN LATE 2021. ANOTHER PUBLIC CONTRACT WAS PREPARED FOR THE MODERNIZATION OF THE IP/MPLS NETWORK LAYER.

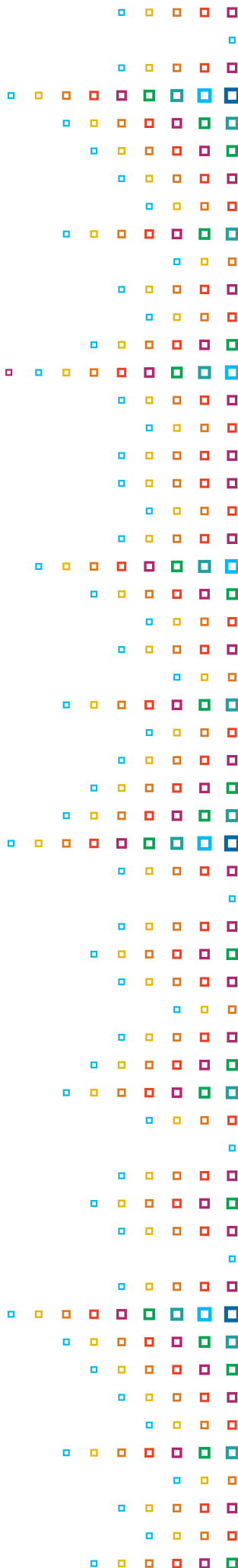
The modernized CESNET network will be based on the latest technologies allowing reaching a higher transmission capacity (400 GE and higher). This will also allow a wider range of applications such as connecting data-intensive user systems (clusters, repositories, specific systems) directly to backbone nodes to make the most of the higher transmission capacities.

Network infrastructure development was reflected in an upgrade of backup international connectivity to 2x 10GE, which serve to complement the primary 100GE connection. Additionally, the connection of the Jihlava region was upgraded to 100GE, which is related to further development of data storage facilities in the locality. The connection of the Plzeň data storage facility was also upgraded to 100GE, which allows faster user access and replication between facilities. High-speed dedicated circuits were built to interconnect BIOCEV data storage facilities in Krč and Vestec. Prepared infrastructure modernization also assumes new methods for the collection of operating data. A pilot telemetry deployment reflected the search for new options for infrastructure monitoring depending on options provided by the elements used.

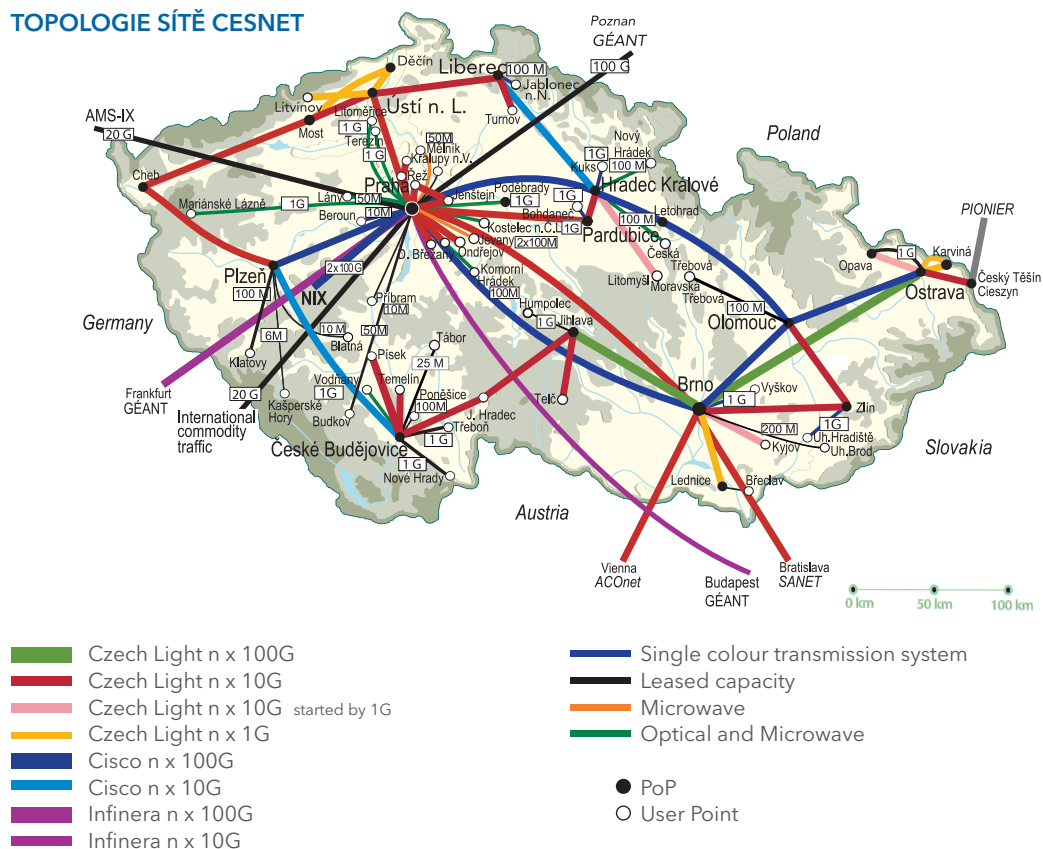
As concerns security, a dedicated, more secure network for hospitals and medical facilities (referred to as hSOC VRF, Virtual Routing and

Forwarding) was designed and implemented. This is a dedicated and specifically secured private network to protect hospitals from potential cyber attacks. A pilot project for anti-DDoS protection of the CESNET2 network against volumetric attacks was implemented in collaboration with an international connectivity provider. The system provides protection against the flooding of international links on the connectivity provider's side to extend protection implemented at the perimeter of CESNET2.

As part of the development of a high-precision time and frequency infrastructure (CITAF), an infrastructure for two-way time and radio frequency transfer between CESNET and the Institute of Photonics and Electronics of the Czech Academy of Sciences was put into operation, allowing multiple time transfers using different technologies. Its major benefit is the ability to evaluate and control the short-term and long-term stability of transfers. Time is transferred from atomic clocks at CESNET, VUGTK (Research Institute of Geodesy, Topography and Cartography) and the Faculty of Electrical Engineering of the Czech Technical University in Prague to the national time standard laboratory at the Institute of Photonics and Electronics of the Czech Academy of Sciences using the White Rabbit protocol. This allows creating a composite timescale from all connected caesium clocks.



TOPOLOGIE SÍTĚ CESNET



The first coherent two-way cross-border transfer of optical frequency was launched on a link to Austria in collaboration with the Institute of Scientific Instruments of the Czech Academy of Sciences and ACONET. Optical frequency is transferred from a sub-hertz laser located in Brno to the Austrian national metrology institute (BEV) in Vienna using active link stabilization. Cross-border optical transfer of precise time has also been carried out on the same link since 2011.

CESNET provides its members with connection to a backbone infrastructure with a capacity of 1 to 100 Gbps. **The backbone infrastructure is designed to provide sufficient capacity for data transmissions and be as resilient to link and technology outages as possible.**

The offered network access services include:

- Dedicated circuits and networks,
- Lambda services with physically reserved capacity and fixed delay,
- Photonic services for the most demanding applications with an all-optical pathway between points,
- Internet identifier administration (CESNET NIC), including a LIR Sponsoring service,
- Authoritative and secondary DNS services
- Stratum 1 primary time servers with an internal time source,

- Infrastructure monitoring and surveillance using tools such as FTAS, G3, Nagios/Icinga,
- Services of an internationally accredited CSIRT security team, CESNET-CERTS,
- Permanent network operability monitoring (NOC),
- 24 x 7 x 366 service desk - support contact point (monitoring centre and help desk).

CESNET also pays much attention to protecting the infrastructure against security incidents and dealing with security incidents as appropriate. The network has semi-automatic protection against DDoS attacks by restricting the data flows of certain network traffic. Additionally, an RTBH (Remotely Triggered Blackhole) filtering service is provided in production mode. A new service, ExaFS, has been deployed in operating mode, which allows administrators at connected institutions to use a BGP FlowSpec configuration in case of a massive DDoS attack to make unwanted traffic drop already at CESNET2 routers or reroute the traffic to further analysis or to the DDoS Protector (developed as part of CESNET's research activities), which filters out unwanted traffic. As part of its national activities, CESNET is also a trustworthy operator in the **FENIX** project. The whole defence ecosystem is developed continually because the protection of network communications infrastructure and subscribers must respond to new threats all the time.

Demanding computations

32 026

CPUs

cesnet
metacentrum

13 200 000

tasks/year

ADAN, A COMPUTING CLUSTER PURCHASED IN LATE 2019 UNDER THE CESNET E-INFRASTRUCTURE: MODERNIZATION PROJECT, WAS FULLY INTEGRATED INTO THE METACENTRUM ENVIRONMENT IN EARLY 2020. THE CLUSTER IS FITTED WITH A TOTAL OF 122 NVIDIA T4 COMPUTING GRAPHIC UNITS (GPGPU) LOCATED IN A TOTAL OF 61 NODES INTERCONNECTED WITH OMNIPATH HIGH-SPEED COMMUNICATIONS TECHNOLOGY. IN ADDITION TO THE GPGPUS, IT OFFERS ALMOST 2,000 CPUS AND OVER 11 TB RAM. THE CLUSTER IS PRIMARILY INTENDED FOR SUPPORTING ARTIFICIAL INTELLIGENCE TASKS IN THE FIELD OF MACHINE LEARNING.

An HD cluster was purchased and more computing capacity was added to the cloud-based environment under the e-INFRA CZ: Modernization project in 2020; at the same time, storage capacity located at the University of West Bohemia in Plzeň was expanded by more than 1 PB. The total capacity of new computing resources was increased by 3,800 cores and 20 GPGPUs were added to the cloud-based environment.

A high-performance computing cluster intended for natural science tasks, with a total capacity of 2,000 CPUs, including machines with 3 TB RAM, was purchased under the project ELIXIR-CZ: Capacity Building under the Research, Development and Education operational programme. Another purchase was two servers (a web server and a database server), which will be used for storing and processing data obtained from SARS-CoV-2 coronavirus testing on the basis of collaboration between the ELIXIR CZ and EATRIS research Infrastructures.

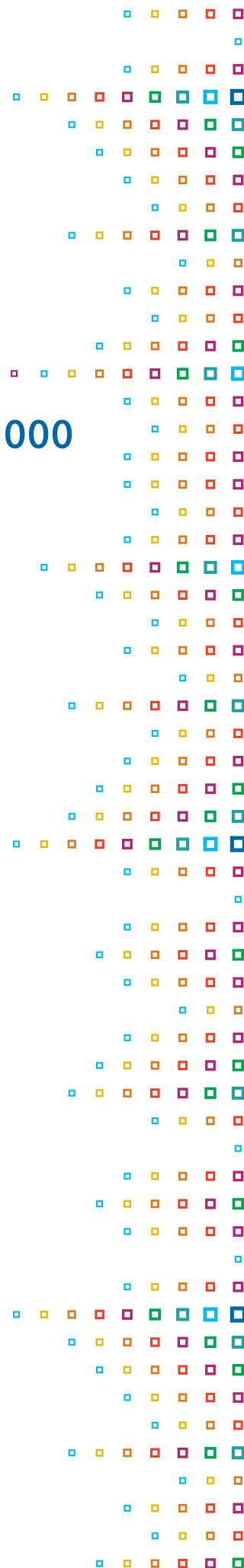
A switch to Debian 10 was completed at all clusters and a major upgrade was made to PBSPro, in which custom development concerning sup-

port for Kerberos authentication was merged with mainstream development. MetaCentrum file servers were upgraded to the latest version of IBM Spectrum Scale, which allows operating online storage with capacity exceeding 1 PB.

A new service, JupyterHub, was offered to users. It allows using computing infrastructure resources in the form of Jupyter notebooks. Using Singularity technology and the CVMFS file system, it is now easier to run computing tasks in MetaCentrum in a fine-tuned and completely portable environment, such as NVIDIA containers for efficient GPGPU support.

As concerns cloud-based infrastructure, a switch to OpenStack was completed for all virtual machines.

A new service, Kubernetes, was launched in collaboration with CERIT-SC. CERIT-SC also offered the OnDemand environment for test operation, which allows running grid tasks from a web client environment, and a new infrastructure for the collection of operating and statistical data based on Prometheus/Grafana.



METACENTRUM



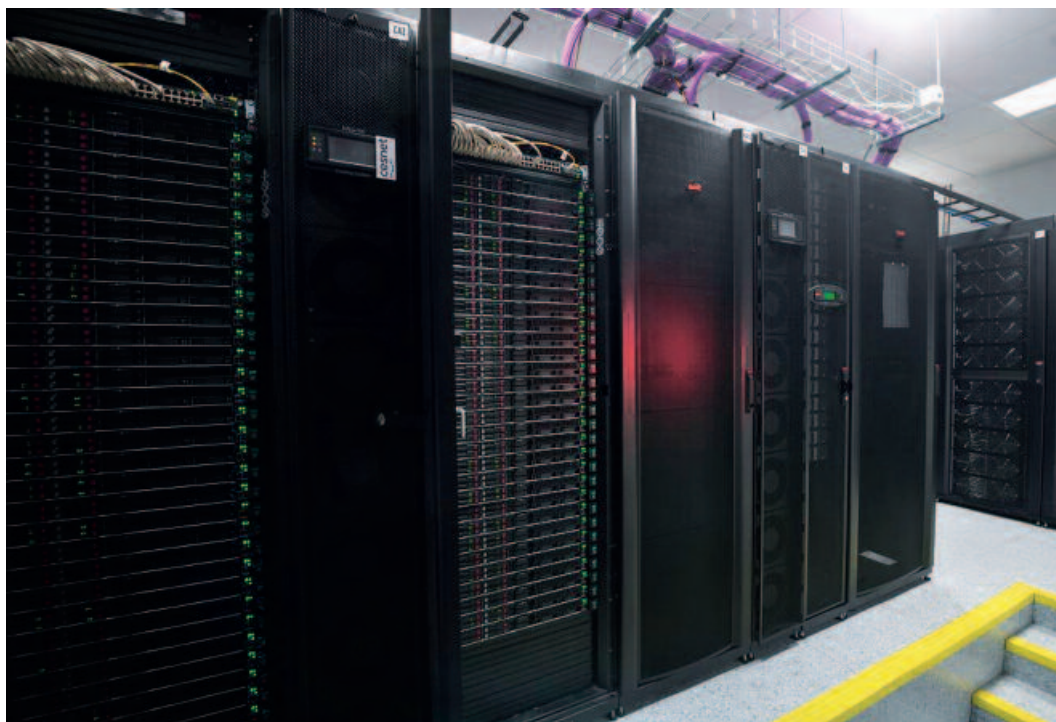
An ISMS surveillance audit focused on MetaCentrum in 2020. Risk analysis led to several modernization projects, which were aimed at creating an environment with enhanced security protection that would be available to all services running on the virtualization platform, optimizing security elements (fail2ban protection against SSH attacks, detection of anomalies in user behaviour) and monitoring MetaCentrum network security. Penetration tests were also carried out.

MetaCentrum is a national academic computing infrastructure designed to handle highly demanding computing tasks and data processing. Its fundamental concept is the interconnection of heterogeneous resources, be it computing systems, storage capacities, special instruments, an interconnecting network or software. Such interconnection also allows catering for the needs of both users and resource owners. Most importantly, it provides users with single and transparent access and resource owners with efficient and optimized allocation of resources. In summary, it is a single service of 'access to a distributed computing infrastructure', which can be broken down into the following components for the purposes of external view:

Actual computing environment – users can access the fundamental computing environment in several different ways. Today, there is

grid and cloud-based access as well as the Hadoop platform. This involves not only ensuring adequate operating parameters and basic user support but also installing application software and supporting users or scientific teams for efficient and advanced utilization of the available resources and application software (designing and optimizing a scientific workflow or specific data processing methods, choosing the most appropriate of available resources and algorithms).

Integration of capacities into an infrastructure – scientific teams and institutions have access to tools for contributing their resources to a shared pool, at several levels and in several modes matching their needs and objectives. The common denominator is integration into a higher whole in order to create a qualitatively new level of available services and options. The aim is not only to allow users and administrators to work more efficiently but also to share and disseminate appropriate know-how. Specific motivation as well as a specific tool can be participation in international infrastructures (such as the European Grid Infrastructure, EGI). Examples of participating centres and institutions include the Czech Academy of Sciences (Institute of Botany, Institute of Vertebrate Biology, Institute of Physics, Institute of Experimental Botany, Institute of Organic Chemistry and Biochemistry),



Cluster Adan (AI)

CERIT-SC, CEITEC, New Technologies for the Information Society research centre of the University of West Bohemia in Plzeň, Faculty of Science of the University of South Bohemia in České Budějovice, Technical University in Liberec or Palacký University in Olomouc.

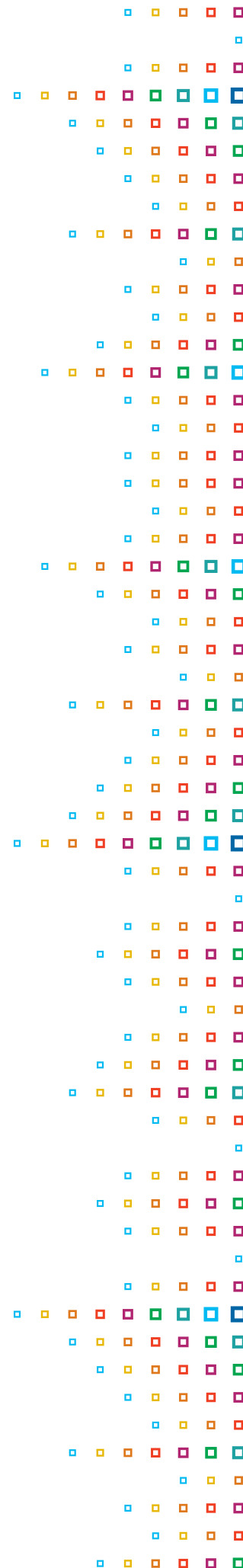
Support for specific needs – we provide custom-tailored solutions for scientific teams with specific or exceptional needs. This can involve adaptation to needs (development or joint development of new properties) or custom virtual infrastructures (including ‘platforms’, i.e., environments intended for specific communities or application fields, such as the current Galaxy and Chipster portals). It can also involve systematic collaboration in designing and building the infrastructural parts of a scientific experiment or application infrastructure – a current example is the ELIXIR infrastructure. The common denominator is emphasis on keeping a balance between specific needs and the benefits and conceptual principles of a unified and interconnected environment.

A standalone service is the provision of software application licences. This is a service linked to MetaCentrum computing resources; it is aimed at creating a new resource provided separately in a manner similar to in-house computing or storage capacities. The service is typically provided for licences that are costly

(their value is similar to or exceeds the value of other provided resources) and used very widely (across teams, fields and institutions). Examples include development environments and mathematical and simulation software. This service also incorporates the idea of integrating capacities into a shared environment but due to its specifics (licensing rights), it is rather about institutions’ long-term strategic cooperation in the operation of this service.

Free capacities are also used to provide services of the CESNET virtualization platform, which allows running private servers using VMware virtualization technology administered by CESNET. The virtualization platform is operated redundantly in two data centres (Prague, Brno). An added value is the ability to provide integration into the address range of a member network or guarantee high availability at the level of the CESNET network infrastructure (using BGP anycast routing). The virtualization platform also serves as a support service for some hosted services (e.g., eduroam-hosted Radius or the Koha library system). Migration of the Prague node of the virtualization platform to a new location, DC Tower, began in 2020.

CESNET started to procure commercial cloud services by means of GÉANT framework agreements under the OCRE international project.





Data storage

60 PB

of total gross
capacity

cesnet
datacare

THE ORIGINAL DATA STORAGE INFRASTRUCTURE IS BEING REPLACED WITH NEW FACILITIES OVER TIME. THE JIHLAVA STORAGE FACILITY WAS PHYSICALLY DISPOSED OF. THE HIERARCHICAL STORAGE FACILITY IN BRNO WAS ALSO RETIRED. DATA FROM RETIRED STORAGE FACILITIES WERE MOVED TO NEWER SYSTEMS IN COOPERATION WITH USERS.

A hierarchical storage facility in Ostrava, a standard disk array and a pilot object storage facility in Jihlava are in operation. The hierarchical storage facility in Ostrava was used to the limits of its throughput, which is determined mostly by its tape library. Its most active users were therefore migrated to other systems if possible. Hardware for an **object storage facility** located **in Plzeň** and to a small extent also **in Jihlava** was delivered at the beginning of the year. The system is being made accessible to users.

A tendering procedure for an object storage facility to be located in Ostrava was prepared and commenced. However, the procedure was cancelled due to external circumstances.

Activities focused on continuity of operations, development of services and international co-operation, as well as support of application communities. A long-term archives service with a high guarantee of binary data preservation is in pilot operation; a system for an open repository of data provided with metadata is under

development. Other development activities included the preparation of auxiliary mechanisms for object storage, which will enable delegation of the management of provided space, efficient administration of users and credentials and easy configurability of data sharing. This also involves changes in the operational metrics collection system and modifications to the accounting system.

Data storage facilities administer an object system for the cloud computing platform (Meta-Centrum/CERIT-SC) and the virtualization platform. Especially the cloud platform represents a community-based approach to the development of an infrastructure in which resources provided by Masaryk University are directly deployed. Additionally, several external user groups participated in its pilot operation.

In relation to coping with the pandemic situation, data storage facilities expanded especially their consulting activities for groups organizing the processing of biological material tests.

CESNET e-Infrastructure security



13
penetration tests
carried out



SINCE 2018, CESNET HAS HELD INTERNATIONALLY RECOGNIZED **CERTIFICATION OF ITS INFORMATION SECURITY MANAGEMENT SYSTEM (ISMS) TO ČSN EN ISO/IEC 27001:2014**, 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 LOSS OF DATA AVAILABILITY, CONFIDENTIALITY AND INTEGRITY. THE RESULT OF THE SECOND ISMS SURVEILLANCE AUDIT, WHICH TOOK PLACE IN JUNE 2020, CONFIRMS THAT THE IMPLEMENTED SYSTEM MEETS THE REQUIREMENTS OF THE STANDARD.

In the field of security incident prevention and facilities for efficient handling of identified security incidents, an important component is technology complexes for backbone network monitoring, security event and incident detection and sharing such information through the **FTAS, G3, Warden and Mentat** services. All of those systems are under continuous development, which reflects requirements made by both the Association as the operator of the e-infrastructure and users (members and subscribers). Warden continues to prove to be a stable and useful project. Several projects in which Warden was deployed as a platform (SABU, Protective) were successfully finished and defended; other projects (CTI) are still

under way. The platform's main benefit proves to be the successful growth of adjacent projects that use the shared data - the Mentat security event management system or the NERD reputation database.

The **CESNET Forensic Lab (FLAB)** did **thirteen penetration test jobs** (including two focusing on internally operated services) and one stress test job in 2020. It also organized **another annual competition for young hackers, The Catch 2020**. Together with the CESNET-CERTS security team, it was actively engaged in **Hospital SOC**, an initiative aiming to enhance cybersecurity at hospitals and healthcare organizations.



Network identity

147

identity
providers

cesnet
eduid.cz

THE PURPOSE OF AUTHENTICATION INFRASTRUCTURE SERVICES IS TO PROVIDE A TRUSTED ELECTRONIC IDENTITY AND EASY ACCESS TO E-INFRASTRUCTURE SERVICES.

The infrastructure is based on **eduid.cz, the Czech academic identity federation** whose members use shared information about the identity of their users to provide them with access to various network services. Every federation member can have either or both of the following roles:

- An **identity provider** (IdP) administers user names, passwords and other user data and makes selected information available to service providers.
- A **service provider** (SP) runs a web application or network service and uses information about users' identity and other properties, if applicable, to control access to it.

The IdP role was performed by 25 public colleges and universities (except the Academy of Fine Arts in Prague and the Police Academy of the Czech Republic in Prague), 48 institutes of the Czech Academy of Sciences, 54 libraries, 10 hospitals, 8 other research organizations, 2 international research groups and several museums, archives, and regional authorities in 2020. A number of other institutions were in the process of joining. Users were also able to authenticate by means of the MojID.cz service or social connectors (Apple, Facebook, GitHub, Google, LinkedIn, ORCID).

Service providers included CESNET and many Czech universities as well as most major providers of electronic information resources and services for universities in the Czech Republic: GRADA BookPort, GTS Alive – ISIC, Cheap Library, Single Information Gateway of the National Library of the Czech Republic, Mefanet, TECHEM.cz and others. There was also debate

about re-opening the Kramerius Digital Library while face-to-face instruction at universities was restricted. The eduid.cz federation participated in the **eduGAIN** international academic inter-federation, providing Czech universities with access to the services of ACM, Annual Review, BMJ, Cambridge Core, Elsevier, EBSCO, Emerald, IEEE, JSTOR, Karger, Microsoft Dream-Spark, Ovid, Proquest, Thomson Reuters, Wiley, Springer, Taylor & Francis, Oxford University Press, Proquest RefWorks, Web of Science.

Work on support services for **eIDAS** continued in the year. Thus services could use a new qualified repository infrastructure for signature certificates and software for certificate handling and remote document signing (RemSig) developed by a collaborating team from Masaryk University. Connection to the repository was available to five suppliers of university information systems.

The **switch of GÉANT TCS** (Trusted Certificate Service) **to a new provider, Sectigo** was completed on 1 May. As part of the change, the Association's support services had to be modified so as to minimize the impact of the change on end-use customers.

As part of measures relating to the COVID-19 epidemic, the National Library of the Czech Republic and the Moravian Library obtained consent from the copyright management organization, Dilia, to **make resources in the Kramerius digital library available to all college and university teachers and students, including employees of CAS institutes**. Access to the digital library is provided transparently **through the eduid.cz academic federation**.

User collaboration and multimedia

1,8

million
users

cesnet
meetings

IN 2020, THE ASSOCIATION CONTINUED TO OPERATE A VIDEO CONFERENCING AND WEB CONFERENCING INFRASTRUCTURE AND DEVELOP **CESNET MEETINGS**, A SERVICE THAT IS THE PRIMARY POINT FOR USER SELF-SERVICE IN THE VIDEO AND WEB CONFERENCING INFRASTRUCTURE. ZOOM, A WEB CONFERENCING TOOL AIMED AT SUPPORTING DISTANCE LEARNING, WHICH WAS TESTED LAST YEAR, RECEIVED A VERY POSITIVE RESPONSE FROM USERS.

The capacities of provided video conferencing services were considerably enhanced in the first quarter, as concerns hardware and licensing, in relation to a state of emergency resulting from the spread of the SARS-CoV-2 coronavirus. After successful testing of the Zoom web conferencing system, a decision had been made to retire the technically outdated Adobe Connect system. Based on the recent situation, it was decided to keep it operating in parallel with the Zoom web conferencing system. The streaming platform was reinforced due to increased interest in streaming services so as to be able to serve tens of thousands of users.

The state of emergency caused by the COVID-19 epidemic placed enormous demands on the use of the CESNET Meetings service as well as the video conferencing, web conferencing and streaming infrastructure operated by CESNET. Throughout 2020, 1.8 million users created approximately 130,000 meetings and conferences with a total of 2,000,000 man-hours on all operated platforms (Pexip, Adobe Connect and Zoom). This was associated with a substantial increase in the amount of provided support and consulting.

Cooperation with large research infrastructures

THE CESNET E-INFRASTRUCTURE IS PART OF RELEVANT EUROPEAN E-INFRASTRUCTURES, FORMING A COMMUNICATIONS AND INFORMATION ENVIRONMENT FOR NATIONAL LARGE INFRASTRUCTURES IN OTHER SCIENTIFIC FIELDS AND FACILITATING THEIR COOPERATION WITH FOREIGN PARTNERS.

EOSC



The European Commission's goal for scientific data is to lower the barriers to free access to data (while adhering to the principles of personal data protection) in order to support their practical application. The tool for achieving the accessibility, interoperability and reusability of data obtained from publicly funded research and development should be the European Open Science Cloud (EOSC).

Activities in the development of the EOSC environment resulted over time in the formation of the EOSC AISBL association. The association, which should be the European Commission's key partner in EOSC development, was founded in July 2020. CESNET, Masaryk University and VSB - Technical University of Ostrava became members of the EOSC (European Open Science Cloud) association at its inaugural general assembly in December 2020. By a decision of the Ministry of Education, Youth and Sports, CESNET became the national mandated organization that represents official opinions of the Czech Republic, specifically the MEYS, in the newly established association.

The EOSC is developed under multiple international projects; in the second half of the year, CESNET participated in:

- **EOSC-hub** (731107 - Integrating and managing services for the European Open Science Cloud; H2020 programme): CESNET's participation in the project concerns, most importantly, the development of services necessary for the operation of the European EGI e-infrastructure, in the operation of the EGI

FedCloud environment and in the CSIRT security group's work for the EGI. Additionally, it coordinates supervision over third-level support for individual software packages and back-office operations for EGI.eu itself.

- **PaNOSC** (823852 - Photon and Neutron Open Science Cloud; H2020 programme): The project is aimed at creating federated services for easy data accessibility, interoperability and reusability (FAIR) over existing metadata catalogues and data archives. It is also concerned with scientific data analysis with the aim of offering services that will help users work with primary data. All services should be fully integrated into the EOSC catalogue. CESNET participates in the project as a third party for EGI.eu.
- **EOSC-synergy** (857647 - European Open Science Cloud - Expanding Capacities by Building Capabilities; H2020 programme): The project aims to coordinate the establishment of a European open environment for scientific data and their processing, which should promote mutual collaboration between infrastructures at national and European level. The EOSC-synergy project is developed by the national EOSC centre.
- **CS3MESH4EOSC** (863353 - Interactive and agile/responsive sharing mesh of storage, data and applications for EOSC; H2020 programme): The aim of the project is to develop a platform for easy and user-friendly data sharing and transfers between sync'n'share systems. Another project focus is controlled access to applications integrated into sync'n'share systems. CESNET's participation in the project concerns, most significantly, the development and implementation of a federated authentication and authorization infrastructure.

Processes for the preparation of grant and consortium agreements were under way in the second half of 2020 for four H2020 projects that would address various EOSC aspects starting from January 2021:

- **EOSC FUTURE** (101017536) – a project under call INFRAEOSC-03, Integration and consolidation of the existing pan-European access mechanism to public research infrastructures and commercial services through the EOSC Portal
- **EGI-ACE** (101017567) – a project under call INFRAEOSC-07, Implementing the European Open Science Cloud, topic A1 – Distributed and cloud computing resources
- **DICE** (101017207 – Data resources and interoperable services for EOSC) – a project under call INFRAEOSC-07, Implementing the European Open Science Cloud, topic A2 – Data Services
- **C-SCALE** (101017529 – Copernicus – eoSC Analytics Engine) – a project under call INFRAEOSC-07, Implementing the European Open Science Cloud, topic A6 – Additional research enabling services

GÉANT European backbone communications infrastructure



The GÉANT pan-European communications infrastructure ensures interconnection of 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.

Funding for this infrastructure and related activities at European level is ensured through framework support under the GÉANT2020 project until the end of 2022. The framework project is currently in its third stage – GN4-3 (856726; H2020 programme), whose aim is to improve the quality of European research, support its scientific excellence, provide access to research data and make them reusable. This stage focuses on updating services to offer comfortable, fast and reliable access to European high-performance facilities, scientific data and publications.

CESNET is primarily involved in project activities relating to the building of specialized network environments (for example, for transfers of precise time and stable frequency or QKD), matters concerning network security, the provision of cloud services within the European infrastructure or the deployment of AAI.

EGI.eu European infrastructure for distributed computing



The EGI.eu initiative coordinates at European level national activities for the implementation of grid technologies as an important e-infrastructure component. Collaboration among members of this infrastructure takes place in particular within the intentions of the **EOSC-Hub** H2020 programme. As part of the collaboration, CESNET participates in all primary operational activities, ensures the operation of the national EGI grid node and provides computing resources comprising both its own computing capacities and those of the Institute of Physics of the Czech Academy of Sciences. The capacities involved are also part of MetaCentrum and use its virtualized infrastructure.

Support continued to be provided to the virtual organizations ELIXIR (bioinformatics), Auger (cosmic radiation), Belle (particle physics) and CTA (gamma astronomy) as well as directly to user groups from the Czech Republic wanting to utilize the pan-European grid. A priority was focus on specific needs of those groups and their international projects.

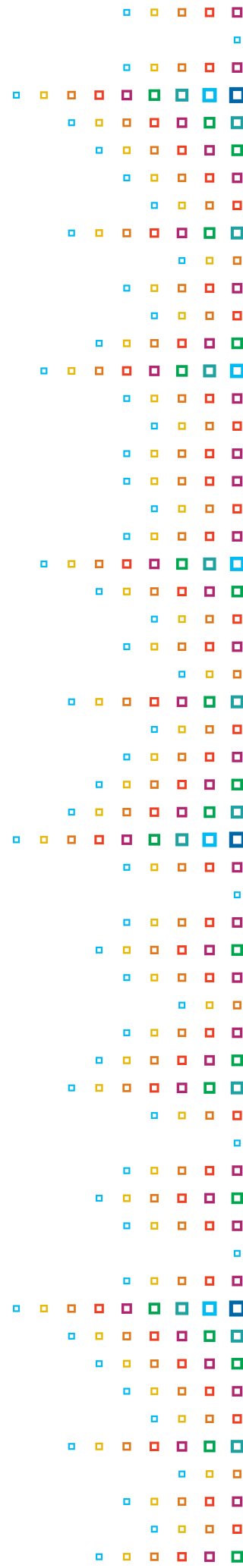
A new activity in 2020 was participation in the provision of computing resources to COVID-19 research projects (EGI COVID-19 support initiatives).



ELIXIR

The European ELIXIR bioinformatics infrastructure combines advanced computing environments, data resources and unique tools for the purposes of bioinformatics research across Europe. CESNET contributes to the development of the European infrastructure under the Technical Services activity of the ELIXIR Compute Platform, focusing on the establishment of a common framework for the provision of computing services and services related to data storage, and to the building of ELIXIR AAI. A major activity in 2020 was support for research focusing on COVID-19 (<https://elixir-europe.org/services/covid-19>).

CESNET is also directly involved in national activities in this field – it is one of the founding members of the ELIXIR CZ infrastructure, which provides an 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 for the operation and development of this infrastructure: Czech National Infrastructure for Biological Data (LM2018131) under the Large Infrastructure Projects for R&D&I programme and ELIXIR-CZ: Capacity Building (CZ.02.1.01/0.0/0.0/16_013/0001777) under the Research, Development and Education operational programme.





QUAPITAL

CESNET joined QUAPITAL, a Central European partnership for secure communications with quantum-level security and a quantum internet. The initiative's goal is to build a quantum-compatible infrastructure interconnecting quantum experiments between various research facilities throughout Central Europe.

National large research and development infrastructures

In addition to the above mentioned close collaboration with national e-infrastructures and participation in the ELIXIR CZ large infrastructure, CESNET also holds continuous debates with representatives of other large infrastructures included in the Czech Republic Roadmap for Large Research, Experimental Development and Innovation Infrastructures for 2016 to 2022, provides for their information

and communications technology needs and offers collaboration in addressing them. Examples include:

- Cooperation between the Institute of Molecular Genetics of the Czech Academy of Sciences and CESNET on the operation of the European Chemical Biology Database (ECBD)
- Organization of four seminars/consultations for research infrastructure representatives under e-INFRA CZ and in collaboration with the Technology Centre of the Czech Academy of Sciences on the topic of research data and their storage, accessibility and processing
- Collaboration between e-INFRA CZ, ELIXIR CZ and EATRIS on procuring high-performance computer technology for the Institute of Molecular and Translational Medicine of the Faculty of Medicine and Dentistry of Palacký University in Olomouc, which is put in charge of the national coordination and processing of data from SARS-CoV-2 testing

Research, development and innovation

THE DEVELOPMENT OF CESNET E-INFRASTRUCTURE REQUIRES AN INNOVATIVE APPROACH. THAT IS WHY THE ASSOCIATION, IN ADDITION TO BUILDING AND OPERATING ITS E-INFRASTRUCTURE, IS ALSO ENGAGED IN RESEARCH AND DEVELOPMENT IN THE FIELD OF INFORMATION AND COMMUNICATIONS TECHNOLOGY, MOST IMPORTANTLY IN THE AREAS MENTIONED BELOW.

Optical transmission systems

CESNET has long looked into the software management of optical networks, transfer of precise time and stable frequency, quantum transfer of cryptographic keys and use of optical networks as physical quantity sensors.

CESNET e-infrastructure security

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. The Association continues to develop its own **DDoS protector**.

Network identity

In the field of identity management and access control, CESNET and Masaryk University jointly develop **Perun**, a system that allows organizing users into virtual organizations and groups, allocating resources and controlling access to them.

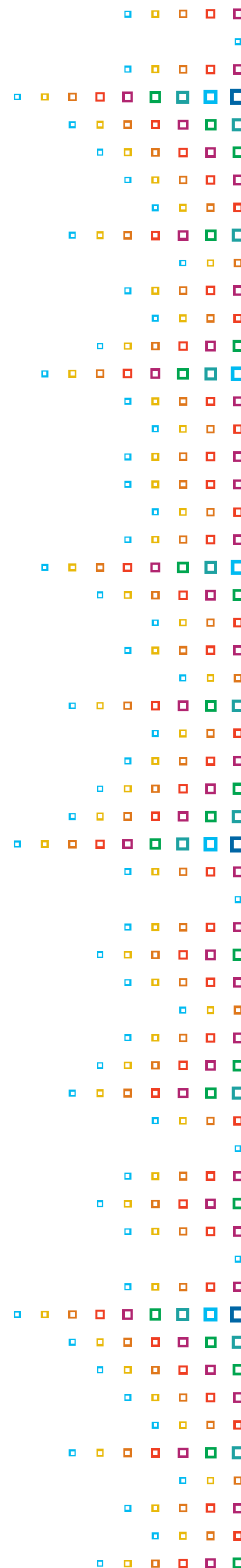
New applications

CESNET constantly looks at possible applications of its e-infrastructure in new fields such as medicine, culture or architecture. Research in the area includes the development of two platforms, a hardware platform named **MVTP** and a software platform named **UltraGrid** (in collaboration with Masaryk University), for working with high-definition video (up to 8K) while maintaining low latency. Furthermore, the Association is also heavily engaged in the digitalization and presentation of cultural heritage objects and the internet of things.

Projects undertaken in 2020

International projects

Project title	Subsidy provider	Programme
Adaptive Protection against DDoS Attacks	Mol CR	VI - Czech Republic Security Research 2015-2022
Adaptive Management of Data Collection and Analysis in High-Speed Networks (FOKUS)	Mol CR	VI - Czech Republic Security Research 2015-2022
Acceleration Platform for Virtual Switches	TA CR	TH - EPSILON Applied Research and Experimental Development Support Programme (2015-2025)
Asset Management ANd DiAgnostics	TA CR	National Cybersecurity Competence Centre
Czech National Infrastructure for Biological Data	MEYS	LM - Large Research Infrastructure Projects
Detection of Infrastructure Security Threats	Mol CR	VI - Czech Republic Security Research 2015-2022 (2015-2022)
Remote Collaboration in Artist Education Using Modern Transmission Technology	TA CR	TL - ÉTA Social Sciences and Arts Applied Research, Experimental Development and Innovation Support Programme (2018-2023)
e-INFRA CZ: Modernization	MEYS	EF - Operational Programme Research, Development and Education
CESNET e-Infrastructure - Modernization	MEYS	EF - Operational Programme Research, Development and Education
CZ e-Infrastructure	MEYS	LM - Large Research Infrastructure Projects
ELIXIR-CZ: Capacity Building	MEYS	EF - Operational Programme Research, Development and Education
Monitoring of Sensitive Objects over the Internet of Things	MIT	FV - TRIO
National Cybersecurity Competence Centres	TA CR	National Cybersecurity Competence Centre
Presentation and Protection of 3D Digital Objects in Museum Collections	MoC CR	DG - National and Cultural Identity Applied Research and Experimental Development Support Programme for 2016 to 2022 (NAKI II)
Smart ADS	TA CR	TH - EPSILON Applied Research and Experimental Development Support Programme (2015-2025)
Cyber Threat Intelligence System Development and Pilot Operation	Mol CR	VH - Security Research for State Needs Programme 2016-2021
Use of Digital Models for the National Infrastructure of Memory Institutions	TA CR	TL - ÉTA Social Sciences and Arts Applied Research, Experimental Development and Innovation Support Programme (2018-2023)
Secured Gateway for the Internet of Things	MV ČR	VI - Czech Republic Security Research 2015-2022
Equipment for Low-latency Transmissions of JPEG XS Video	TA CR	FW - TREND Industrial Research and Experimental Development Support Programme



Projects undertaken in 2020

International projects

Project title	Subsidy provider	Programme
Advanced time/frequency comparison and dissemination through optical telecommunication networks	EURAMET	EMPIR
Clock Network Services - Design Study	EU	H2020
Designing and Enabling E-infrastructures for intensive Processing in a Hybrid DataCloud	EU	H2020
European Open Science Cloud - SYmbiosis for New and Established Research Groups Yield	EU	H2020
European Chemical Biology Database		
GN4-2 Research and Education Networking - GÉANT	EU	H2020
GN4-3 Research and Education Networking - GÉANT	EU	H2020
Integrating and managing services for the European Open Science Cloud	EU	H2020
Interactive and agile/responsive sharing mesh of storage, data and applications for EOSC	EU	H2020
Photon and Neutron Open Science Cloud	EU- EGI.EU	H2020
PRIVacy and homomorphlc encryption for artificial intElliGencE	European Defence Agency	H2020-Future Disruptive Defence Technologies
Sharing and Automation for Privacy Preserving Attack Neutralization	EU	H2020
Special projects for advanced research and technology in Europe	EU	H2020

We would like to thank all subsidy providers for providing the funds for undertaking the projects.

Research and development outcomes

Research activities in 2020 resulted in thirteen articles in peer-reviewed scientific journals, twenty-nine papers in collections, seven functional specimens, two software outcomes and two datasets.

Additionally, one new patent was granted (CESNET & BUT. Distributed fibre optic sensory system. Inventors: Petr MÜNSTER, Josef VOJTĚCH, Tomáš HORVÁTH, No.: 34280 granted by CZ001 - Industrial Property Office, 11 August 2020).

CESNET Development Fund

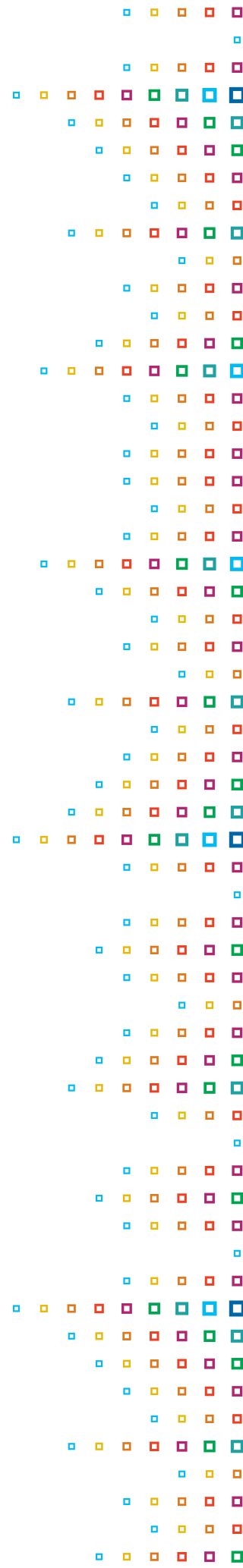
In late 2019, the Development Fund Board prepared and launched a tendering process for projects for 2020. The following topic areas were chosen in cooperation with the Association:

- 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

The tendering process resulted in the submission of 11 projects. Eight of those projects were accepted for co-funding, including four projects admitted after revision. An overview of accepted projects is shown in the table below.

Project number	Project holder	Project title
660/2020	VSB - Technical University of Ostrava	Optimizing the Coverage of an Experimental LoRaWAN Network
661R1/2020	University of West Bohemia	UWB Open Data 2
665/2020	Czech Technical University	Integrated Security of Unattended Entrance to Common Premises of CTU-FBME and CU FFM and their Spin-off Companies
666R1/2020	Czech Technical University	Advanced IDS for IoT Networks Using P2P Information Sharing and Collaborative Machine Learning
667/2020	Academy of Performing Arts	Communications Platform for Enhancing Voice Training and Research
668R1/2020	Czech Academy of Sciences	Data Formats and Standards for the Interoperability of Structural Biology, Bioinformatics and Biophysics Infrastructures
669R1/2020	Czech Technical University	Creation of Cybersecurity Guidelines and Documentation in Public University Environments
670/2020	University of South Bohemia	Transformation of a Data Repository to a Microsoft Azure Cloud Environment

Five rounds of opposition procedures for completed projects were carried out over the course of 2020 – a total of 18 projects were completed successfully. A public presentation took place for one project during the evaluation of achieved results. A broader presentation at an expert forum was recommended for five completed projects so as to allow other Association members to benefit from the results. Final reports for projects carried out under the CESNET Development Fund are available on the Association's website at <https://fondrozvoje.cesnet.cz/zpravy.aspx>.





Public relations

THE YEAR 2020 WAS AFFECTED BY THE COVID-19 PANDEMIC. MOST WORK, STUDY BUT ALSO CULTURAL ACTIVITIES WERE SHIFTED TO ONLINE, WHICH CESNET FLEXIBLY REACTED TO. IT MOVED EVENTS FOR ITS USER COMMUNITY AND THE EXPERT AND GENERAL PUBLIC TO AN ONLINE ENVIRONMENT.

In the first half of 2020, the **Network and Services Security Workshop**, focusing on the operation and security of networks, services and internet applications, was held as usual in February 2020. The workshop was attended by almost 360 people. Most attention focused on the topic of authentication and certificates.

A Candle for Toufar audiovisual broadcast took place in February. We used our unique technology to interconnect 4 churches and the Borůvka Sanatorium. The event received extensive media coverage. There were 3 reports broadcast by Czech Television and many articles published in the media (e.g., Lidovky.cz, Novinky.cz, E15.cz). In March, in relation to COVID-19 measures, events were moved to a virtual world. We became a partner of the **Music without Borders** project. Using our technology, we organized broadcasts of a series of online concerts of leading musicians playing classical music from the Bohuslav Martinů Foundation. Additionally, we arranged broadcasts of the **Concert against Totalitarianism** and **Prague Clarinet Days** during the year.

In June, we got together at an online IPv6 workshop entitled **The World without IPv4**. We organized an **EOSC Landscaping** webinar and met virtually at the annual **CSNOG 2020**, which we organized in collaboration with CZ.NIC and NIX.CZ in September.

Another annual run of **The Catch** competition took place as part of the Cybersecurity Month. Its 679 participants fought a dangerous virus, RANSOMVID-20. There was a **Security Fest - an online screening of the film Caught in the Net** followed by a debate with the film director Vít Klusák and our cybersecurity expert. The screening was primarily intended for students and teachers from colleges of education in Brno, Hradec Králové and Prague. The film and the debate were attended by more than 1,000 students and teachers.

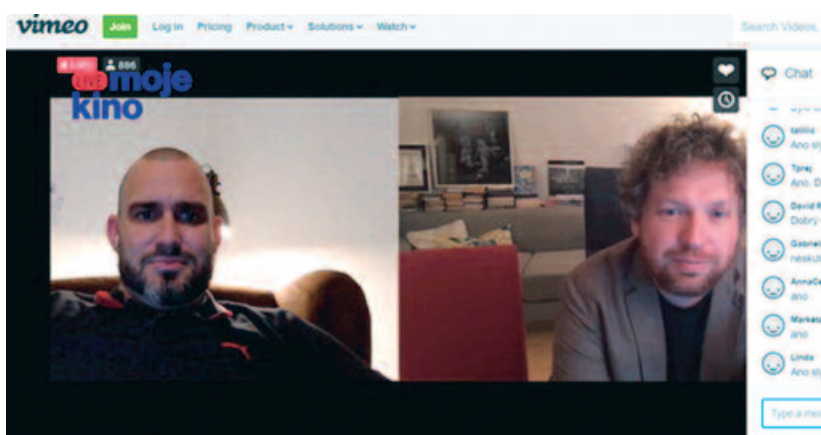
Traditionally, we were a technology partner of many events such as the Linux Day, OpenAlt, IS2 - Information Security Summit or Contemporary Libraries.

In cooperation with the Ministry of Education, Youth and Sports, the Association continues to administer the **website of Large Research Infrastructures of the Czech Republic**. In cooperation with its partners, CESNET prepared the **logo and website of the e-INFRA CZ consortium** in 2020.

CESNET published 12 press releases and registered 235 media outputs in 2020.



←
Seminar
on network
and service
security



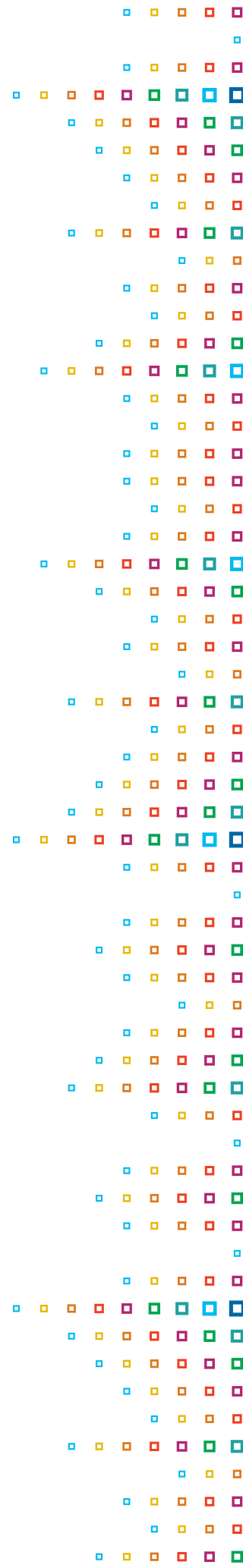
←
Security Fest



←
Audiovisual
transmission
Candle for Toufar



←
CESNET
at Czech
television





Financial performance

FINANCIAL PERFORMANCE IN 2020

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

Non-economic activities

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

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

The Association's non-economic activities in 2020 generated an accounting profit of approximately CZK 29,198,000 before tax. Revenues from the Association's non-economic activities amounted to approximately CZK 551,756,000; expenses were approximately CZK 522,558 before tax.

The income tax base for the Association's non-economic activities in 2020 was positive, amounting to approximately CZK 19,373,000.

Economic activities

The Association's economic activities in 2020 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 2020 generated an accounting profit of approximately CZK 2,759,000. Revenues from the Association's economic activities in 2020 amounted to approximately CZK 103,038,000; expenses on economic activities were approximately CZK 100,279,000 before tax.

The income tax base for the Association's economic activities in 2020 was positive, amounting to approximately CZK 2,347,000.

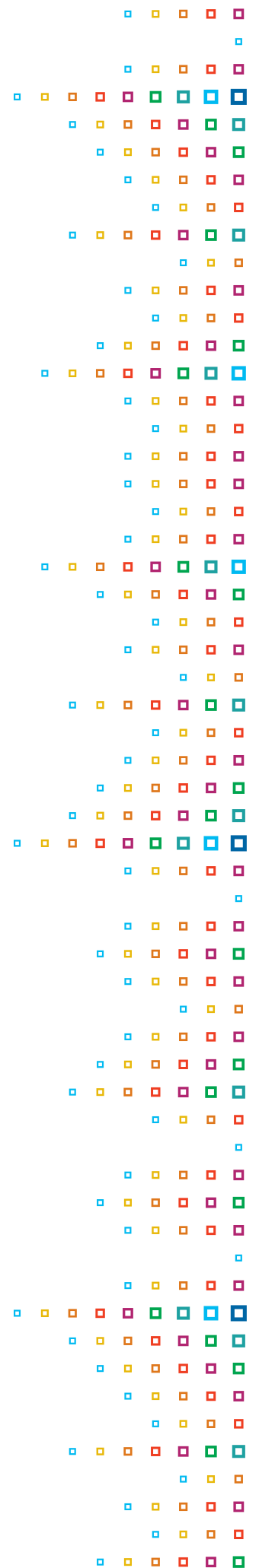
Total profit or loss

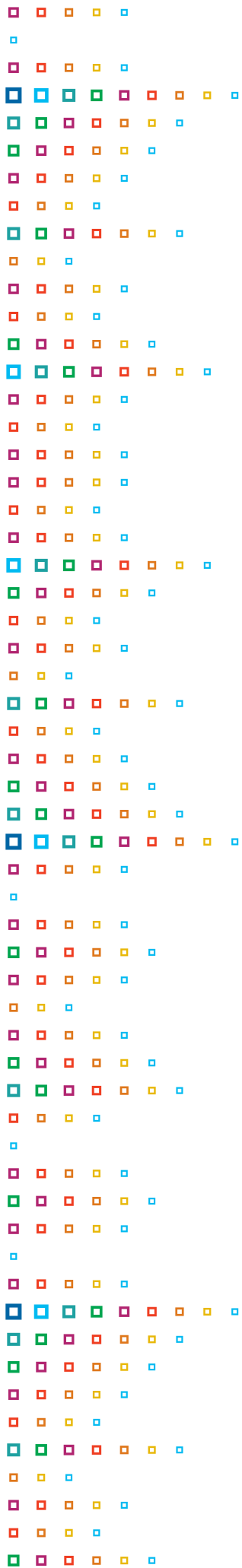
CESNET had a total accounting profit of approximately CZK 31,957,000 before tax in 2020.

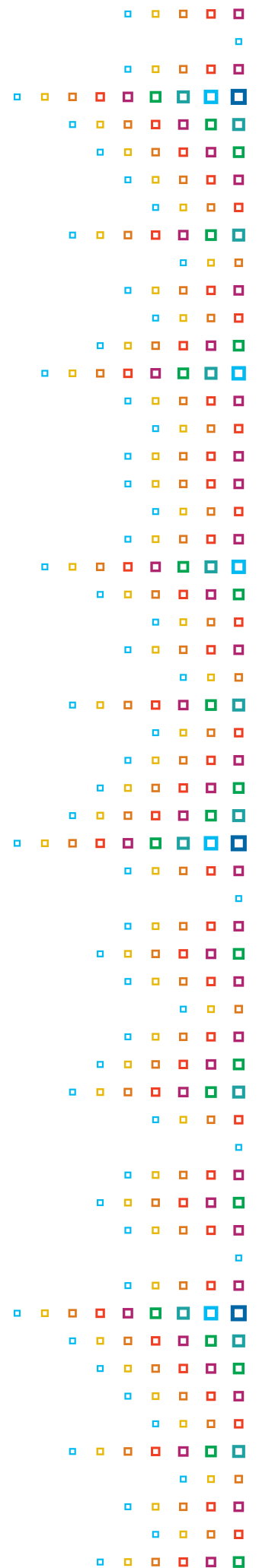
The Association's total income tax base was approximately CZK 21,720,000. The Association's total corporate income tax, including the withholding tax for 2020, is approximately CZK 4,290,000, resulting in a post-tax profit of approximately CZK 27,667,000.

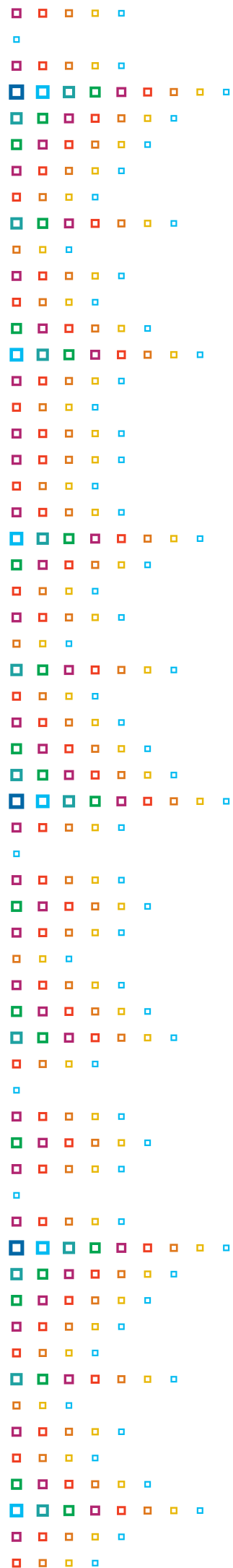
Conclusion

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.









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