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Networking with Eastern Europe

Research and academic networking in the Czech and Slovak Federal Republic

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Abstract

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The international computer networks are accessible only for a limited number of Czechoslovak users. The accessibility of these networks for a larger number of users remains a fundamental problem. This unsatisfactory state should be solved consistently by setting up a suitable distributed infrastructure which could access the international networks.

These facts led to the concept of the FESNet (Federal Educational and Scientific Network). The main goal of the FESNet project is to create a multiprotocol infrastructure to provide services of all available academic networks—Internet, EUnet, EARN, HEPNET, etc. The IP protocol was selected as the basic protocol of the FESNET backbone.

Keywords: computer networks; network infrastructure; EUnet; EARN; Internet; multiprotocol backbone.

Introduction

Although computer networking on the international level has rather a short history in the Czech and Slovak Federal Republic (CSFR), it has evolved very rapidly. The number of university professors, students and research workers who are using the network increases every month in spite of the fact that the technical conditions for using the network are far from satisfactory. An unreliable switched telephone network is still the most commonly used means to access the computer networks. In spite of that, most of the users cannot imagine their work without the network today. The services of three international networks are already in some form available in the CSFR: EARN, EUnet and Internet.

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EARN

EARN (European Academic and Research Network) connects the European academic and non-commercial research institutes. Czechoslovakia joined the EARN network in May 1990. Since June 1990, a dial-up connection to Austria has been used regularly. After establishing a 9600 bps leased line to the Austrian EARN national node in Linz (Johannes Kepler University), the Czechoslovak national node was set up in Prague at the Czech Technical University in October 1990.

Currently, there are 11 EARN nodes in Czechoslovakia (6 nodes at various institutions of higher education and 5 nodes at the Czechoslovak or Slovak Academy of Sciences). Most of

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these nodes are based on IBM hardware (including an IBM 3090 computer which IBM installed as a part of their Academic Initiative) or on IBM-compatible COMECON-made RJAD machines. The communications protocol on local lines is NJE/BSC; leased lines of 9600 or 4800 bps are used. The international line is shared with the Internet traffic. In addition to electronic mail, the most useful EARN services are interactive message transfer, file transfer and electronic conferences.

Our users work at the following EARN nodes:

CSBBYS51	Slovak Academy of Sciences, Banska Bystrica;
CSBRMU11	Masaryk University, Brno;
CSEARN	Czech Technical University, Prague;
CSPGAS11	Czechoslovak Acad. of Sciences, Prague;
CSPGCE11	Czech Technical University, Prague;
CSPGCS11	Czechoslovak Academy of Sciences, Prague;
CSPGEU11	University of Economics, Prague;
CSPGFU11	Czechoslovak Acad. of Sciences, Prague;
CSPGIG11	Czechoslovak Acad. of Sciences, Prague;
CSPGUK11	Charles University, Prague;
CSPUNI12	Czech Technical University, Prague.

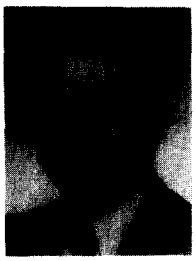
Moreover, research and academic workers from some 60 institutions located all over our country (Prague, Liberec, Plzen, Ceske Budejovice, Hradec Kralove, Pardubice, Ostrava, Olomouc, Brno, Bratislava, Zilina, Nitra, Banska Bystrica, Kosice) use the EARN services by means of dial-up connections. The numbers of (80-byte) records transferred on the international line and on national lines during each month is shown in Table 1.

Table 1

Month	Number of records	
	national	international
Oct 90	6,000	560,000
Nov 90	190,000	576,000
Dec 90	168,000	822,000
Jan 91	745,000	1,185,000
Feb 91	2,468,000	3,072,000
Mar 91	3,419,000	4,632,000
Apr 91	5,036,000	5,425,000
May 91	6,303,000	7,447,000
Jun 91	7,293,000	8,548,000
Jul 91	4,427,000	5,550,000
Aug 91	4,168,000	5,169,000
Sep 91	4,424,000	5,549,000
Oct 91	6,660,000	8,236,000
Nov 91	6,374,000	8,926,000
Dec 91	6,775,000	8,670,000
Jan 92	7,579,000	9,203,000
Feb 92	8,464,000	9,298,000
Mar 92	11,803,000	10,691,000

EUnet

The EUnet network is operated by the European association of the UNIX operating system users (EurOpen) and the corresponding national groups (in Czechoslovakia, the CSUUG). The Czechoslovak EUnet national node has been operated by the Faculty of Mathematics and Physics at the Comenius University in Bratislava since the beginning of 1990. All the EUnet communication in Czechoslovakia uses dial-up lines only (the



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international connection to the Technical University of Vienna uses a leased line). UUCP protocol and a limited number of 9600 bps "Telebit Trail Blazer" modems are used. Typical speed of data transfer between Czechoslovak EUnet nodes is 2400 or 1200 bps. Electronic mail and limited file transfer are the only services provided by EUnet; the present hardware does not allow any electronic conferences.

There are some 800 EUnet users in Czechoslovakia at the following nodes:

- Comenius University, Bratislava (National Node);
- Institute for Applied Cybernetics, Bratislava;
- Institute of Informatics & Statistics, Bratislava;
- Slovak Technical University, Bratislava (2 nodes);
- Slovak Academy of Sciences, Bratislava;
- School of Economics, Bratislava;
- SWH Ltd., Bratislava;
- Masaryk University, Brno;
- Technical University, Brno;
- P.J. Safarik University, Computing Centre, Kosice;
- Technical University at Liberec;
- Technical University, Ostrava;
- West Bohemian University, Plzen;
- APP Systems, Prague;
- Charles University Computer Centre, Prague;
- Czech National Assembly, Prague;
- Czech Technical University, Prague;
- Czechoslovak Road Transportation, Prague;
- Institute of Chemical Technology, Prague;
- Ministry of Economic Policy & Development, Prague;
- Prague School of Economics, Prague;
- Software Aplications & Systems, Prague;
- University of Transport and Communications, Zilina.

Internet

The first experimental connection to Internet was realized in the fall of 1991 after the international line Prague–Linz was equipped with 19.2 kbps multiplexing modems. Half of the line bandwidth was used for the EARN NJE/BSC protocol; the other half was used for the IP connection. PC-based routers with SLIP protocol were used. In January 1992 (8 months after ordering), the first and so far the only CISCO IGS-R router was delivered to Czechoslovakia. After the IGS-R was installed on the international line, our IP connection became much more reliable.

Just recently VMNET software was installed and NJE over TCP/IP communication is being utilized. The official opening of the Internet net-

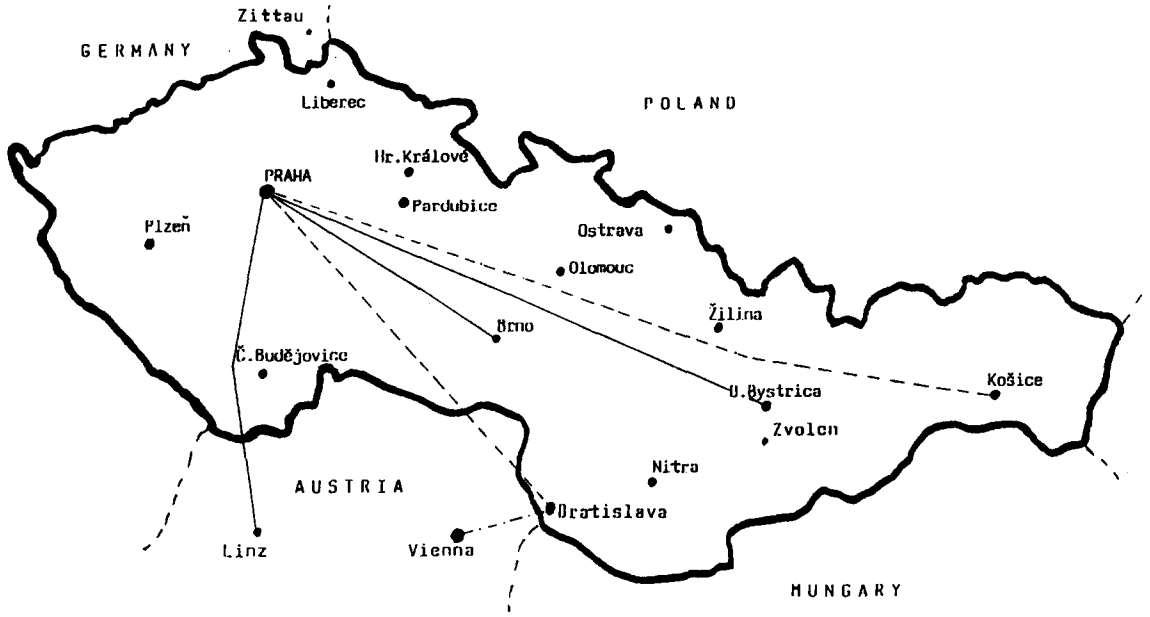

Fig. 1. Existing leased lines. Legend: ——— 19.2 kbps, – · – · – 14.4 kbps, – – – 9.6 kbps.

work services in Czechoslovakia took place on February 13, 1992 at the Czech Technical University in Prague. We had the pleasure of welcoming about 130 participants at the event including some guests from Austria, Bulgaria, France, Germany, Hungary, The Netherlands, Poland and the USA. So far, only the users of the CSEARN, CSPUNI12 and CSBBYS51 nodes can access the Internet services.

The FESNet Project

A missing internal networking infrastructure in our country led to the FESNet (Federal Educational and Scientific Network) project. The existing leased lines that are being used for connecting nodes and networks are shown in Fig. 1. In addition, there are leased lines Prague–Bratislava and Prague–Kosice to connect the terminals to the IBM 3090 mainframe which is installed at the Czech Technical University Prague as a part of the IBM Academic Initiative. One part of the 19.2 kbps Prague–Brno line is used to connect the terminals to the IBM 3090. The other part of the bandwidth is used to connect to the EARN node at the Masaryk University in Brno. There are more than 1000 users who use a very unreliable telephone network to dial in to the CSEARN computer. Twelve inputs to CSEARN are permanently overloaded (some users use an alarm clock to wake up at 2 a.m. in order to get to the network).

The main goal of the FESNet project is to create a multiprotocol infrastructure which might allow its users to use the services of all major R&D networks—EUnet, EARN, Internet, HEPNet, etc. This tendency to integrate the services in one multiprotocol network infrastructure corresponds with the present European integration plans. Just like in Europe, we do not expect this integration to be an easy process. The detailed technical FESNet project is not finished yet. A fundamental decision about the basic (bearer) protocol of the FESNet is already settled: after many discussions and evaluations of user requirements, the TCP/IP protocol suite was selected. The backbone of the FESNet network consists of medium speed (64 kbps) leased circuits which interconnect the three main FESNet nodes located at Prague, Brno and Bratislava (Fig. 2).

An extension of this backbone to Banska Bystrica where a large network node is being realized on the basis of the TEMPUS project, is being considered. Both the current (Linz, Vienna) and any future international links will be connected to these nodal points. Both the IP routers and X.25 switches will be used for distri-

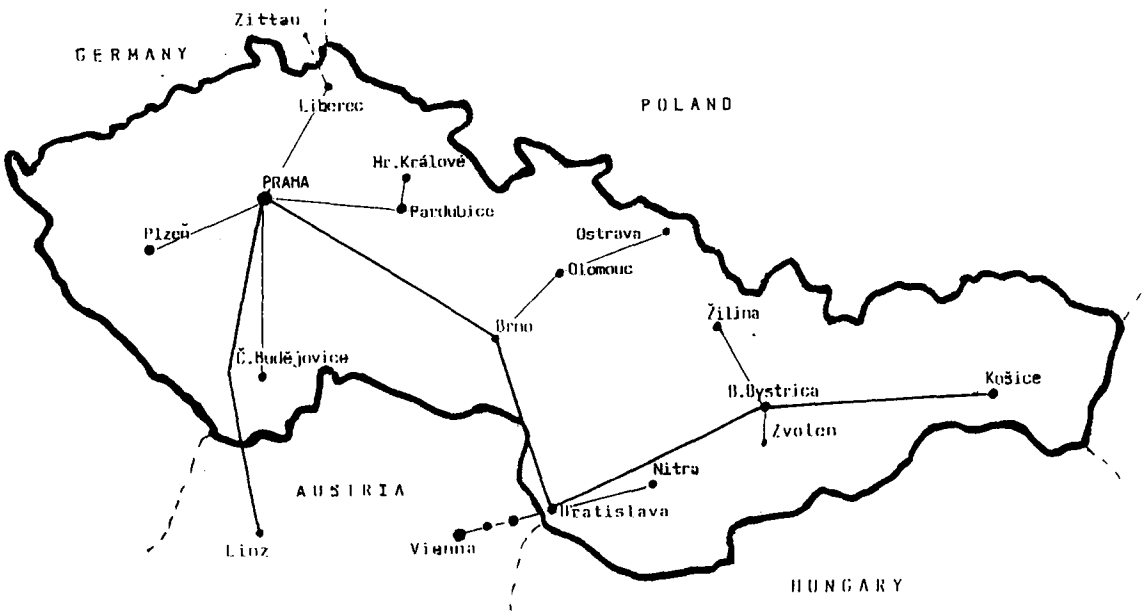

Fig. 2. Planned FESNet lines. Legend: ——— 64 kbps, –·–·– 19.2 kbps, – – – 9.6 kbps.

bution of the network services from the main nodes. Each of the main nodes will be equipped with:

(1) IP router with at least 4 serial ports and 2 Ethernet ports,
(2) X.25 switch with 8 serial ports,
(3) technical facilities for the implementation of 64 kbps connections,
(4) modems for data circuits with access to the IP routers and X.25 switches.

The existing nodes and local networks of individual user organizations will be connected according to the available hardware and software using some of the following variants:

(a) dedicated IP router with appropriate adapters and software (X.25 etc.),
(b) PC-router, i.e. a personal computer in an appropriate configuration including the X.25 and Ethernet adapters and suitable software,
(c) a UNIX-based computer with the appropriate adapters and software.

Negotiations with the Czechoslovak PTT about the possibilities of realizing the 64 kbps circuits started by the end of 1991. An analog telephone primary group solution was offered for the backbone links for 10 times the price of an analog telephone channel. That means that the 64 kbps Prague–Brno link would cost about 370 thousand CKR (Czechoslovak Crowns, presently, 1 US$ = 28 CKR) per month. Another possibility is to use microwave links. The monthly fee is quite reasonable (about 40 thousand CKR/month) but the initial investment required is rather high (several million CKR). Satellite links were also considered but most of the satellite companies use volume-dependent charging. With the volumes of data expected to flow over the FESNet backbone, the satellite solution would also be very expensive. Negotiations with the PTT about giving lower prices to the R&D community are going on. These include the international 64 kbps Prague–Linz link which is already needed. The implementation of the FESNet project is planned in two stages:

First stage: the creation of the multiprotocol Prague–Brno–Bratislava backbone was originally scheduled for completion in June 1992. Due to the above mentioned price problems with the leased lines providers, a certain delay is expected.

Second stage: connection of further locations and cities where the Universities and Czech and Slovak Academy of Sciences Institutes are located (Liberec, Plzen, Ceske Budejovice, Hradec Kralove, Pardubice, Ostrava, Olomouc, Zilina, Banska Bystrica, Nitra, Kosice, Zvolen) should be completed before the end of 1992. Analog telephone leased lines are considered (14.4–19.2 kbps).

Another candidate to provide services between the cities was the EUROTEL public X.25 data network which started operating in Czechoslovakia in November 1991. EUROTEL is so far using a strictly volume-dependent charging mechanism with a very high price level not acceptable to the Czechoslovak R&D community.

Networking organization and funding

In order to coordinate the network activities, a FESNet coordination team has been formed. Actually it consists of representatives of the two parts—Czech (CESNet) and Slovak (SANET). This is because all funding of R&D networking is done on the basis of the individual republics. The attempts to find some financial resources on a federal level have not been successful. Most of the funds are provided by the Czech and Slovak Ministries of Education. Although the Institutes of the Academies of Sciences are also using the network services, negotiations to establish regular contributions on a top-sliced basis are under way. Similar negotiations are taking place with the Ministries of the Health, Care and Culture. The absence of a Ministry of Science in the CSFR makes this situation rather complicated. A strong independent networking organization is very much needed. It has been agreed that before a networking organization is formed, the Czech Technical University in Prague will be responsible for the FESNet implementation and operation.

International and corporate support activities

The Commission of the European Communities introduced the PHARE project to extend the IXI network to Bulgaria, Czechoslovakia, Hungary, Poland and Romania. Governments of several countries have already expressed their willingness to help R&D networking in our country.

The Austrian goverment is funding a 14.4 kbps leased line between Bratislava and the Technical University of Vienna. This line is used for EUnet (SLIP) and IXI (X.25) connections. Plans for supporting an Austrian part of a 64 kbps line have been announced.

The German DFN has already started to realize the Dreiländereck project to connect Liberec in Czechoslovakia, Wroclaw in Poland and Zittau in Germany using leased 9.6 kbps links. Proposals for broader cooperation are being discussed.

The French government expressed its support by the introduction of the Copernicus project. The FESNet backbone design and implementation will be done in close cooperation with INRIA. Donation of some hardware and a very important know-how transfer will be a part of Copernicus.

The Dutch Ministry of Education helped especially those users in Czechoslovakia who use the network services by dial-up access, by its donation of an IBM 7171 communication controller which enables full screen services on the start/stop dial-up lines.

A very important contribution to the evolution of the network services is the project for "Value Added Services" coordinated by Professor S. Ruth from the USA and funded by the A.W. Mellon Foundation. Some much needed equipment (disks, multiplexing modems) has been obtained as a part of the project.

IBM is very cooperative in the R&D networking area in Czechoslovakia. Due to the delivery of the TCP/IP software, the IBM 3090 (CSPUNI12) node was one of the first mainframes connected to Internet. IBM in cooperation with the Czechoslovak PTT is building a digital 2 Mbps data network. Microwave links are being used with utilization of Data Over Voice technology. IBM 973X intelligent multiplexors divide the bandwith into $N \times 64$ kbps channels that are available to customers.

In the beginning of this year, DIGITAL announced its initiative aimed at supporting development of advanced information services in our country. A very significant contribution was offered to 20 leading Universities which enables them to integrate their existing workstations and personal computers into local area networks and to help them to connect to FESNet.

Conclusion

To conclude my contribution I would like to thank everyone who has contributed to the development of the R&D computer networks in the Czech and Slovak Federal Republic. We are really happy that after many years of isolation we have become a member of a large and very cooperative networking community. I believe that we shall overcome all the financial, organizational and technical problems and FESNet will become a reality in the near future.