# Research and Academic Networking in the Czech and Slovak Federal Republic

Jan Gruntorád, Ph.D.
Czech Technical University Prague
Zikova 4
CS–16635 Praha 6
ČSFR
<tkjg@earn.cvut.cs>

The international computer networks are accessible for a limited number of Czechoslovak users only. 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 a concept of the FESNet (Federal Educational and Scientific Network). The main goal of the FESNet project is to create a multiprotocol infrastructure for providing services of all available academic networks – Internet, EUnet, EARN, HEPNET, etc. The IP protocol was selected as a basic protocol of the FESNET backbone.

## Introduction

Although the computer networking on the international level has rather a short history in the Czech and Slovak Federal Republic, it evolves 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 for accessing the computer networks. In spite of that, most of the users can't imagine their work without the network today. The services of three international networks are already in some form available in the ČSFR: the EARN, EUnet and Internet.

## EARN

The EARN (European Academic and Research Network) connects the European Academic and non–commercial Research institutes.

Czechoslovakia has 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, 5 nodes at the Czechoslovak or Slovak Academy of Sciences). Most of these nodes are based on IBM hardware (including an IBM 3090 computer which the 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 the 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 - Slov. Acad. of Sci., Banska
        Bystrica
CSBRMU11 - Masaryk University, Brno
CSEARN - Czech Technical University, Prague
CSPGAS11 - Czechoslovak Acad. of Sciences,
        Prague
CSPGCE11 - Czech Technical University,
        Prague
CSPGCS11 - Czechoslovak Acad. 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 (Praha, 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 number of Czechoslovak EARN users (on the first day of each month) is shown in the following Tables:

| Node/Date | Dec90 | Jan91 | Feb91 | Mar91 |
|---|---|---|---|---|
| CSEARN | 180 | 310 | 490 | 570 |
| CSPGAS11 | | | 123 | 135 |
| CSPGCE11 | 13 | 16 | 22 | 48 |
| CSPGCS11 | | 2 | 62 | 62 |
| CSPGEU11 | | 5 | 15 | 20 |
| CSPGFU11 | | | | |
| CSPGIG11 | | | | |
| CSPUNI12 | | | 176 | 245 |
| Total | 193 | 333 | 888 | 1080 |

| Node/Date | Apr91 | May91 |
|---|---|---|
| CSEARN | 625 | 700 |
| CSPGAS11 | 151 | 169 |
| CSPGCE11 | 50 | 52 |
| CSPGCS11 | 65 | 73 |
| CSPGEU11 | 22 | 25 |
| CSPGFU11 | | |
| CSPGIG11 | | |
| CSPUNI12 | 272 | 310 |
| Total | 1185 | 1329 |

| Node/Date | Jun91 | Jul91 | Aug91 | Sep91 |
|---|---|---|---|---|
| CSEARN | 763 | 840 | 930 | 934 |
| CSPGAS11 | 170 | 190 | 199 | 213 |
| CSPGCE11 | 55 | 57 | 58 | 60 |
| CSPGCS11 | 78 | 93 | 104 | 105 |
| CSPGEU11 | 26 | 28 | 28 | 28 |
| CSPGFU11 | | | 33 | 52 |
| CSPGIG11 | 10 | 42 | 45 | 48 |
| CSPGUK11 | | | | |
| CSPUNI12 | 325 | 377 | 352 | 362 |
| Total | 427 | 1627 | 1749 | 1802 |

| Node/Date | Oct91 | Nov91 |
|---|---|---|
| CSEARN | 1086 | 1140 |
| CSPGAS11 | 225 | 258 |
| CSPGCE11 | 71 | 77 |
| CSPGCS11 | 110 | 113 |
| CSPGEU11 | 28 | 32 |
| CSPGFU11 | 70 | 77 |
| CSPGIG11 | 48 | 48 |
| CSPGUK11 | 3 | 70 |
| CSPUNI12 | 360 | 400 |
| Total | 2001 | 2215 |

| Node/Date | Dec91 | Jan92 | Feb92 | Mar92 |
|---|---|---|---|---|
| CSBBYS51 | | | | |
| CSBRMU11 | | 22 | 39 | 57 |
| CSEARN | 1240 | 1320 | 1329 | 1415 |
| CSPGAS11 | 275 | 309 | 314 | 319 |
| CSPGCE11 | 82 | 84 | 87 | 92 |
| CSPGCS11 | 114 | 115 | 121 | 136 |
| CSPGEU11 | 36 | 41 | 45 | 48 |
| CSPGFU11 | 99 | 79 | 79 | 87 |
| CSPGIG11 | 58 | 61 | 61 | 58 |
| CSPGUK11 | 169 | 205 | 249 | 335 |
| CSPUNI12 | 405 | 400 | 404 | 435 |
| Total | 2478 | 2636 | 2728 | 2982 |

| Node/Date | Apr92 |
|---|---|
| CSBBYS51 | 35 |
| CSBRMU11 | 64 |
| CSEARN | 1499 |
| CSPGAS11 | 341 |
| CSPGCE11 | 99 |
| CSPGCS11 | 140 |
| CSPGEU11 | 49 |
| CSPGFU11 | 95 |
| CSPGIG11 | 58 |
| CSPGUK11 | 335 |
| CSPUNI12 | 535 |
| Total | 3250 |

The numbers of (80–byte) records transferred on the international line and on national lines during

... month can be seen from the following Table:

| 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 |

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 Applications & Systems, Prague
University of Transport and Communications, Zilina

## 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 use dial-up lines only (the 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)

## Internet

The first experimental connection to the Internet has been 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 istalled and NJE over TCP/IP communication is being utilized. The official opening of the Internet network services in Czechoslovakia took place on February 13, 1992 at the Czech Technical University in Prague. We had the pleasure to welcome about 130 participants of the event including some guests from Austria, Bulgaria, France, Germany, Hungary, Netherlands, Poland and the U.S.A. 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 Praha–Bratislava and Praha–Košice for connecting the terminals to the IBM 3090 mainframe which is installed at the Czech Technical University Prague as a part of the IBM Academic Iniciative. One part of the 19,2 kbps line Praha–Brno is used for connecting the terminals to the IBM 3090. The other part of the bandwidth is used for connection of EARN node at the Masaryk University in Brno. There are more than 1000 users who use a very unreliable telephone network for dialing 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 mail 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 to one multiprotocol network infrastructure corresponds with the present Europe integration plans. Just like in Europe, we don't expect this integration to be an easy process. The detailed technical FESNet project is not finished yet. A fundamental decision was about the basic (bearer) protocol of the FESNet is already settled: after many disscussions 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 Banská Bystrica where a large network node is being realized on a basis of the TEMPUS project, is 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 distribution 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 have started already by the end of 1991. An analog telephone primary group solution was offered for the backbone links for 10 times the price of an analogue telephone channel. That means that the 64–kbps Praha–Brno link would cost about 370 thousand Czechoslovak Krowns–CKR (1 USD = 28 CKR) per month. Another possibility is to use microwave links. The monthly fee is quite reasonable (about 40 thousand CKR/month) but initial investment required is rather high (several millions CKR). Satellite links were also considered but most of the satellite companies use a volume dependent charging. With the volumes of data expected to flow over the FESNet backbone, the satellite solution would be very expensive as well. Negotiations with the PTT about giving lover prices to the R&D community are going on. These include the international 64–kbps Praha–Linz link which is already needed. The implementation of FESNet project is planned in two stages:

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

II. stage – connection of further locations and cities where the Universities and Czech and

Academy of Sciences Institutes are located (Liberec, Plzeň, České Budějovice, Hradec Králové, Pardubice, Ostrava, Olomouc, Žilina, Banská Bystrica, Nitra, Košice, Zvolen) should be done before the end of 1992. Analog telephone leased lines are considered (14,4 – 19,2 kbps). Another candidate for providing services between the cities was the EUROTEL – public 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 for the Czechoslovak R&D community.

## Networking Organization, 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). It is because that all funding of the R&D networking is so far done on a basis of 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 for establishing of regulary contributions on a top– sliced basis are under way. Similar negotiations take place with the Ministries of the Health Care and Culture. The absence of a Ministry of Science in CSFR makes this situation rather complicated. Strong independent networking organization is very 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 Commision of the European Communities introduced PHARE project for extending of the IXI network to Bulgaria, Czechoslovakia, Hungary, Poland and Romania. Governments of several countries has already expresed their willingness to help the R&D networking in our country.

The Austrian goverment is funding a 14,4–kbps leased line between Bratislava and Technical University of Vienna. This line is used for EUnet (SLIP) and IXI (X.25) connections. Plans for sup-
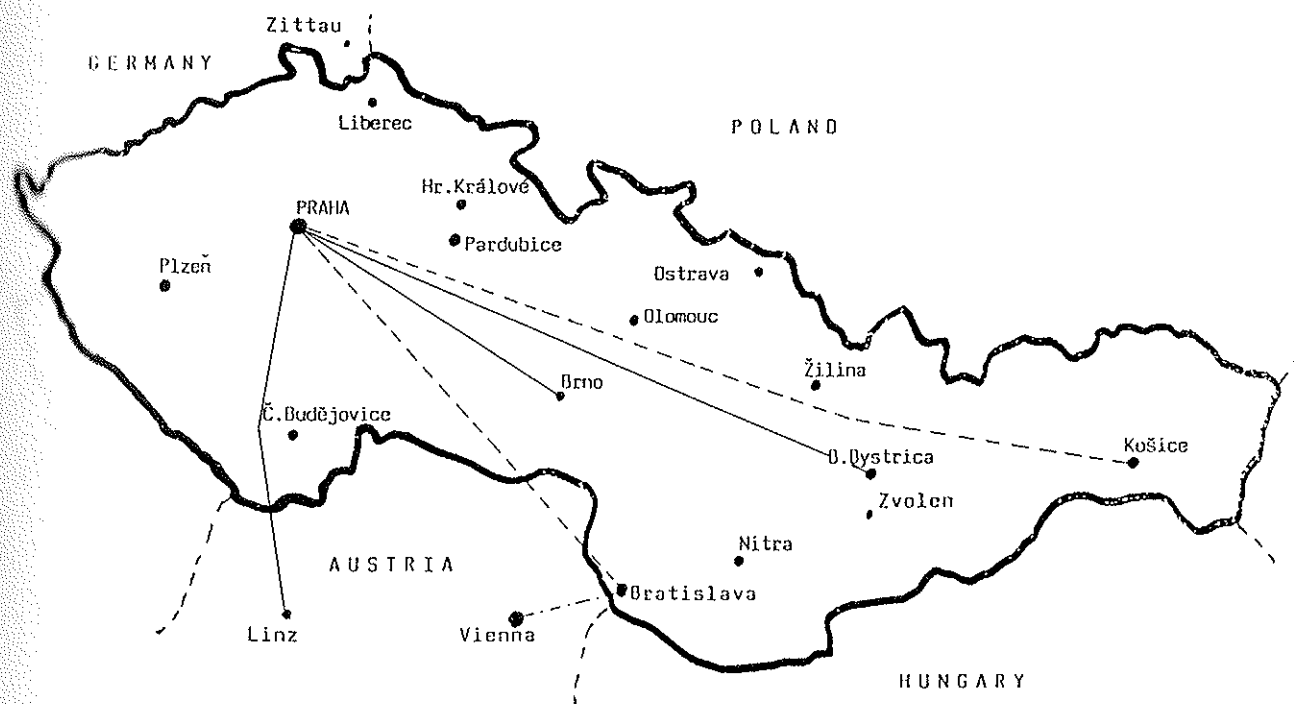


Fig. 1   Existing leased lines
(————— 19,2 kbps, —·—·— 14,4 kbps, — — — 9,6 kbps)

porting an Austrian part of a 64-kbps line were announced.

The German DFN has already started to realize the Dreilaendereck project for connecting Liberec in Czechoslovakia, Wroclaw in Poland and Zittau in Germany using leased 9,6-kbps links. Proposals for broader cooperation are being disscussed.

The French government expressed his 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 the Copernicus.

The Dutch Ministry of Education helped especially to those users in Czechoslovakia who use the network services by a 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 evolution of the network services is the project for "Value Added Services" coordinated by Professor S. Ruth from the U.S.A. and funded by the A.W. Mellon Foundation. Some very needed equipment (disks, multiplexing modems) has been obtained as a part of the project.

The 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 the Internet. IBM in cooperation with Czechoslovak PTT is building a digital 2 Mbps data network. Microwave links are being used with utilization of the Data Over Voice technology. IBM 973X inteligent multiplexors divide the bandwith to N x 64 kbps channels that are available to the customers.

In the beginning of this year, the DIGITAL announced its initiative aimed at supporting a development of advanced information services in our country. A very significant contribution was offered to 20 leading Universities which enables
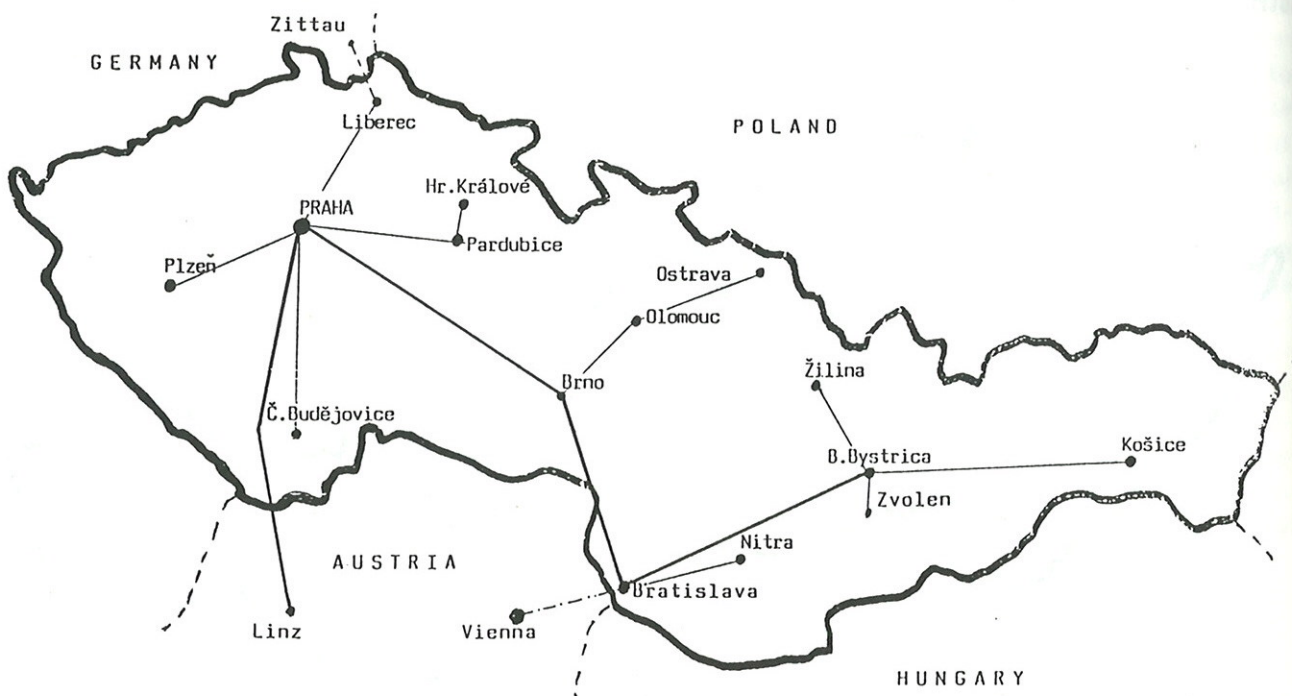


Fig. 2 Planned FESNet lines
(——— 64 kbps, ——— 19,2 kbps, —·—·—14,4 kbps, ————9,6 kbps)

S. Ruth
. Mellon
t (disks,
as a part

&D net-
the de-
3M 3090
inframes
peration
digital 2
re being
ice tech-
s divide
that are

IGITAL
orting a
rvices in
tion was
enables

them to integrate their existing workstations and personal computers to local area networks and to help them to connect to the 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 become a member of 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 a near future.