DATA COMMUNICATION IN CZECHOSLOVAKIA - THE TELECOMMUNICATION INFRASTRUCTURE AND RELEVANT ADMINISTRATIVE PROCEDURES

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PREFACE

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CONTENTS

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0. INTRODUCTION

As in many other countries, data communication is becoming increasingly important in Czechoslovakia. In what follows we will describe first the general status quo of information processing, which sets the increasing demands for data communication. Then the general status of data communication in the country is discussed, followed by some governmental and PTT policy considerations. In Chapter 2 a picture of the Czechoslovak telecommunication network is given, followed by a description of data communication services provided by the Czechoslovak PTT. A separate chapter is devoted to tariffs and other administrative procedures. Special emphasis is given to international data communication throughout the paper. The last chapter deals with some of the present transborder data flow applications in Czechoslovakia.

1. GENERAL STATUS OF DATA COMMUNICATION AND INFORMATION PROCESSING

Data communication is not a service and technique *per se* but is closely connected with computer applications and utilization. Therefore, some space should be devoted to a brief explanation of the computer application situation in the CSSR.

According to [1], there were 1810 digital computers (excluding microcomputers) in operation in the CSSR at the end of 1978. In fact, 2005 computers (including 432 analog, 211 punched-card, 161 process-controlled) were in operation at that time. The growth of the computer population between 1972 and 1978 is shown in Figure 1.

Most of the computers are East European products (CMEA) with nearly 30 percent belonging to the Ryad Series. In this figure for 1978, 54 computers of the ES-1010 series, 161 of the EC-1020 series, 107 of the EC-1030 series, and 41 of the EC-1040 series are hidden.

At the beginning of 1979, the total purchase price of CPUs (Central Processing Units) with necessary periphery equipment (but without data acquisition, collection, and transmission devices) was more than 13 billion crowns, whereas one year earlier it constituted 11 billion crowns; a growth rate of nearly 22 percent. At the same time, the purchase price of data communication equipment was 150 million crowns with a rate (index 1979/1978) of 36 percent.

Data communication in Czechoslovakia, strictly speaking the first steps of two point data transmission began in the late 1960s. Because second generation computers were installed and operated at that time,

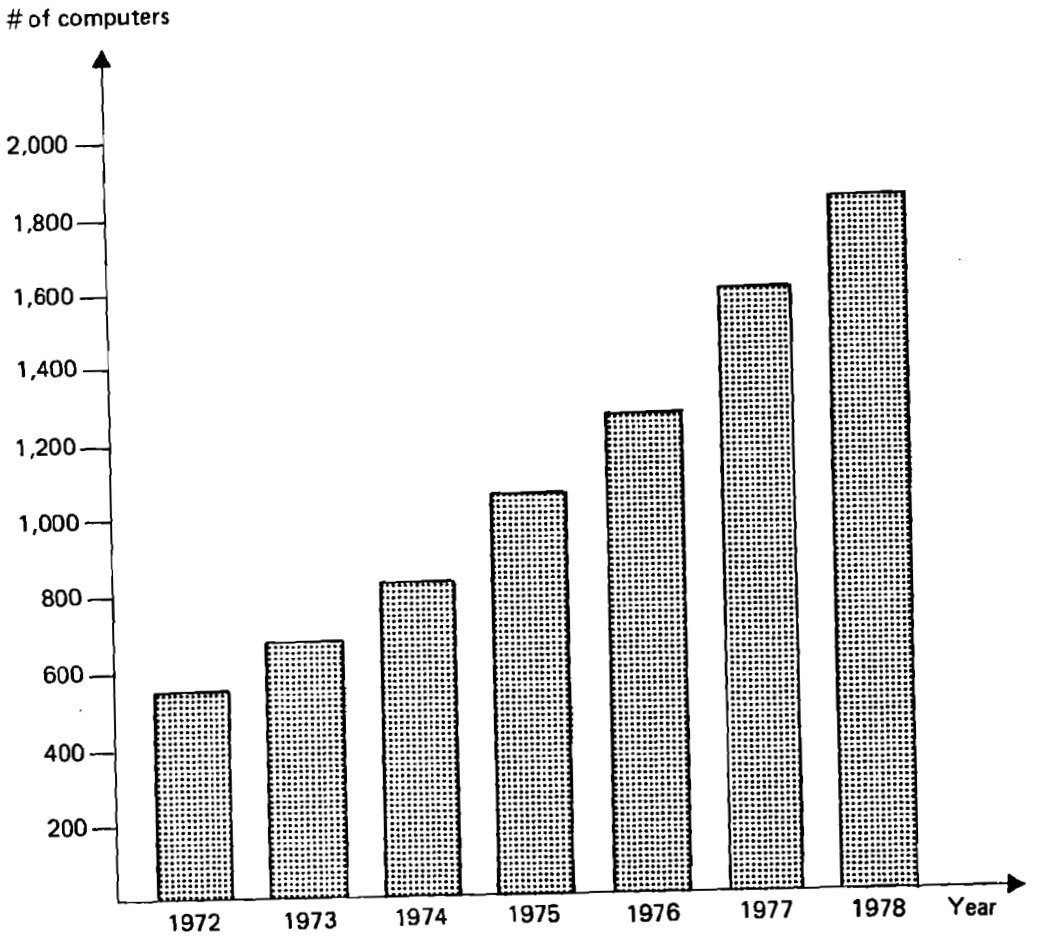
# of computers
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
1972
1973
1974
1975
1976
1977
1978
Year

Figure 1

only off-line data transmission could be provided. Nevertheless, some useful experiences have been gathered, in particular that Czechoslovak telex and telephone networks have proved feasible for data transmission at lower speeds.

Simultaneously with the above, the Czechoslovak industry with the support of the Research Institute of Post and Telecommunications developed a series of low-speed modems (up to 1200 bit/s, serial and parallel) and off-line batch terminals with paper tape readers and punchers, which were then manufactured by the Czechoslovak industry. After having checked the telecommunication network for use for data transmission, the Czechoslovak PTT prepared the first user guide for data communication purposes. This guide was issued in 1971 [2], accompanied by appropriate PTT regulations on how the Administration should collaborate with data transmission users.

Data transmission (and not just experimentally) started thus in the early 1970s and the number of terminals connected to the PTT telecommunication network has rapidly increased since then. For example, in 1980 there was a total of 1159 NTPs (Network Terminal Points), excluding telex devices used for data transmission, while in 1981 this figure had increased by more than 14 percent mainly due to the better utilization of switched telephone networks [3]. The population growth of NTPs during the last decade or so is shown in Figure 2 and on Table 1.

It is expected that this trend will continue in the 1980s due to the installation and operation of the third generation CPUs, in particular the Ryad 2 series, which possess the ability for on-line connection of a wide range of remote terminals with varying speeds. At the same time, the

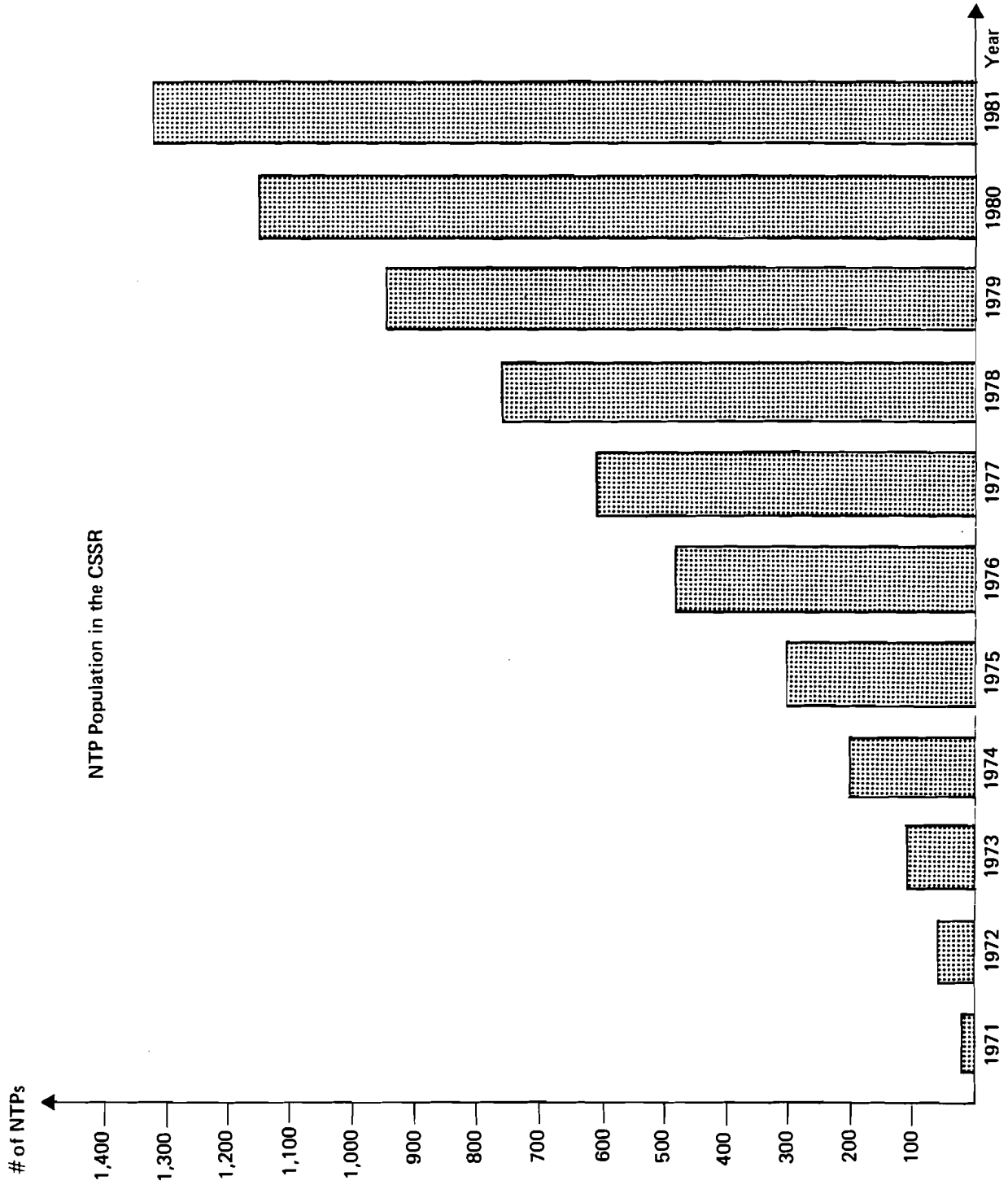
NTP Population in the CSSR
# of NTPs
1,400
1,300
1,200
1,100
1,000
900
800
700
600
500
400
300
200
100
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
Year

Figure 2

Table 1. NTP Statistics in Czechoslovakia (as of 30 December 1980)

Speed / Service type	up to 200 bit/s	up to 600/1200 bit/s	2400 bit/s	4800 bit/s	9600 bit/s	Total
Switched telegraph (excluding telex)	26					26
Leased telegraph	449					449
Switched telephone	219	223				442
Leased telephone	16	132	75	17	2	242
Total	710	355	75	17	2	1159

Ryad 2 peripheral equipment, including remote terminals, multiplexers, transmission facilities (data sets, modems), telecommunication control units, etc., are being manufactured and put into operation, so that smaller or larger user-oriented data transmission systems can be created.

Hand in hand with the above, the development of the unified minicomputer series (MES) has helped the progress of data transmission and data communication networking. Dedicated minicomputers of the MES series (SM 3-10 and SM 3-20) already serve as node computer switching centers with packet switching abilities according to ISO standards (IS 3309, 4335, 6159) in experimental computer networks; it is planned to extend their functions to the CCITT recommendations (X.25, X.3, X.28, X.29) [13].

The Czechoslovak PTT has strictly followed the CCITT recommendations from the outset, and data communication equipment that does not fulfill the CCITT recommendations is not permitted to be connected to the telecommunication network. Another source of standards close to each other and slightly overlapping the CCITT recommendations stems from the ISO and the CMEA, although these standards are aimed at data transmission manufacturers. There are a number of CMEA standards in force and most of them form the basis for the emerging national standards of CMEA countries. In spite of the fact that the Czechoslovak Office for Standardization and Measurements (UNM) up to now has only issued, standards concerning 7 and 8 bit coding (CSN 39 9100, 36 9102-9104), the manufacturers, as well as the PTT, already follow all CMEA standards.

2. CZECHOSLOVAK TELECOMMUNICATION NETWORK

All public services for information transfer, exchange, and distribution by means of electrical signals is provided by the Czechoslovak PTT (according to the Law No. 110/1964) within the framework of the so-called Unified Telecommunication Network (JTS). JTS includes the telephone network as the main means, supplemented by the telex and telegraph networks (at present the integrated telegraph network) and broadcasting and TV distribution networks.

The development of the telephone network is usually measured by the number of telephone stations per 100 population. In 1974 [4] the Czechoslovak telephone network had a density of 19.7 percent, with nearly 3000000 telephone stations in service, and held 18th place in the world (13th in Europe) with a growth index of approximately 1.05 (5

percent). In spite of this, the telephone network is not yet fully automated and a small part of trunk traffic is still connected manually.

The telephone network involves many different telecommunication facilities. Wire lines, as well as microwave radio-relay links for local and trunk connections, and satellite channels for long distance telephone calls, all service telephone signal transmissions. Line switching on a three-level arrangement serves to connect telephone calls. Telecommunication facilities are predominantly based on second generation technologies (analog transmission systems with frequency division multiplexing (FDM) techniques by cross-bar exchanges). However, because of the slow depreciation in telephony, some exchanges are still of the first generation type. All equipment has to be interconnectable, even with third and fourth generation exchanges, which are already being installed (such as digital transmission systems based on pulse code modulation (PCM) and time division multiplexing (TDM) techniques, semi-electronic exchanges with space switching, and fully electronic exchanges with time switching).

The telex network comprised nearly 8500 subscribers in 1978 [4], which represented 56 telex stations per 1000 population and places the CSSR in 18th place in the world (13th in Europe), with a growth rate of about 2 percent. With the intention of extending services, in particular for those telex subscribers who want to utilize the telex network for data and electronic message transfer, the Czechoslovak telex service provides within the framework of the so-called integrated telegraph network transmission at rates of up to 200 bit/s in any code format (not only for the standard ITA 2 code).

The telegraph network is equipped with telegraph exchanges in a two-level arrangement, with telegraph converters extending 4-wire connections to subscribers, and with VFT (Voice Frequency Telegraphy) transmission systems created on telephone lines.

All data transmission traffic can be handled over either the two networks or over leased lines on the transmission facilities of the networks. In special cases the Czechoslovak PTT provides other media for transmission users: radio channels (radio frequencies) to connect moving objects (cars, persons), or microwave frequencies for those situations when line connection is difficult or unexecutable. The emerging CATV (cable-television) networks do not belong to JTS and thus the corresponding services are not provided by the PTT. From the technical point of view, they only serve for television and broadcasting and are, therefore, one-way and unsuitable for two-way data exchange.

In many countries, public data networks are at present created on either the classical line-switching or the packet-switching basis. Such networks prove to be economical if the volume of data flow traffic is sufficiently large that sufficient revenues based on a appropriate tariff policy are able to balance the capital and operational costs in a reasonably short time. As can be seen from Figure 2, the terminal population, speed and volume of data traffic in Czechoslovakia does not yet justify the introduction of a new dedicated data network. Thus, for the time being, data transmission will use traditional telecommunication means as sketched out above and no special data network is being planned for the immediate future. However, to utilize better the present telecommunication means, namely the telephone network, multiplexers, multidrop lines, etc., will

need to be applied as an extension of PTT services.

3. PTT SERVICES FOR DATA COMMUNICATION USERS

As has been mentioned, the PTT services offered to data communication users still follow the guidelines of document in [2] although Data Communication Regulations [5] are under preparation and should be approved soon. Such an act will elevate data communication services in Czechoslovakia to the level of telephone and telegraph services, for which such regulations have been in existence for a long time. This section, therefore, will be based upon [2] with reference to [5], whenever necessary.

3.1. General Services and Contact Points

The PTT services offered for data communications (hereafter called services), are understood to be a set of technical and organizational arrangements, which enable the utilization of JTS as a technical means of data communication. The services include:

- leasing of lines on a permanent or temporary basis for local, trunk, and inter-state data communication
- provision for subscribers with appropriate facilities and equipment (e.g., data sets) to enable user DTEs (data terminal equipment) to be connected to the JTS
- licensing of the DTEs and DCEs (data circuit terminating equipment) to be connected to the JTS.

-- a consulting activity to aid with the problems of JTS utilization at the beginning and design stage of data communication systems.

The highest level contact point in Czechoslovakia, which is also an addressee of requests for the international flow of data, is the Federal Ministry of Post and Telecommunications (Olsanska street 5, 3 Prague 130 00, Tel.: 714 1111 (exch.)).

For Czechoslovak users the licenses are issued by the regional PTT Directorates throughout the country and by the International and Interurban Telephone and Telegraph Switching Center. The same authorities also provide a consultation activity free of charge.

3.2. Licensing Procedures

Every user-owned communication device to be directly connected to the JTS must be licensed by the Czechoslovak PTT. In general, the licensing procedure is initiated through a request from either the domestic manufacturer, or the distributor, or in special cases, by the user himself. The requests are accepted and processed by the Research Institute of Post and Telecommunications (Prague 5, Kobrova street 2) and appropriate fees are charged for the procedures involved.

There are two different types of licenses issued. The first, type of license is granted for manufactured devices freely available on the market. The second type are individual licenses, which can only be granted for predescribed and limited applications for a limited time, and applies in particular to "home-made" equipment, experimental operations, etc. Besides data sets manufactured in Czechoslovakia, however,

several licenses have been granted for imported communication devices, such as modems for speeds above 1200 bit/s (Videoton, Racal Milgo, SAT, IBM) and baseband modems (Videoton, Racal Milgo, SAT, Siemens).

Licenses for connecting a user DTE to a PTT DCE or user DCE to JTS are granted by the PTT on an individual basis upon receipt of a written request by the corresponding PTT authority. The user must fulfill the following conditions:

- his subscriber line must be equipped with the technical means for DTE and/or DCE connection
- the user DTE interface or the user DCE must already be licensed
- the user must assure the maintenance of his own equipment.

The same procedure applies for acoustic and electromagnetic couplers.

As precisely described in [2] and [5] the user has well-defined rights and duties. For example, if the user has the possibility of monitoring and measuring with his own equipment and locates a fault, a failure, or a decline in transmission quality, he can ask the PTT to repair it or to supply an appropriate hardware replacement as soon as possible. On the other hand, he is obviously obliged to pay for the service (see below), to allow access to his equipment by PTT staff, and has to obtain permission before making any changes in his hardware arrangements and operation.

3.3. Data Communications Services

Table 2 shows the data communication services presently provided by the Czechoslovak PTT [2, 6]. The services are divided into three groups according to the telecommunication facilities discussed in section 2:

Table 2. Data communication services provided by the Czechoslovak PTT

Service	Transmission media	Tranimission rate (bit/s)	Transmission mode	Operating mode	Subscriber line	Interface
Public telephone network	Switched telephone lines	up to 300	asynchronous	FDX	2-wire	V.24
		up to 600/ 1200	asynchronous synchronous	HDX	2-wire	V.24
Telex network	switched telegraph lines	50 (IA 5)	start-stop	HDX	2-wire	telex
		50 (arbitrary 5 unit code	start-stop/ synchronous	HDX	2-wire	as specified by PTT
		up to 200 (arbitrary code)	start-stop/ synchronous	HDX	2-wire	V.24
Leased lines	telegraph lines	up to 50 up to 100 up to 200	start-stop/ synchronous ibid ibid	HDX FDX ibid ibid	2-wire 4-wire ibid ibid	as specified by PTT
	telephone lines	up to 300 up to 600/ 1200	asynchronous asynchronous synchronous	FDX HDX FDX	2-wire 2-wire 4-wire	V.24 V.24
		above 1200	depends on modem	HDX FDX	2-wire 4-wire	as specified by PTT
	wideband lines	48,000-72,000	depends on modem	HDX FDX	2-wire 4-wire	as specified by PTT

- data communications over the telephone network
- data communications over the integrated telegraph network
- data communications over leased lines.

The data transmission quality is not specified in the service;, nevertheless, it follows the corresponding CCITT recommendations. Some figures of performance criteria (e.g., for the error rate) have been published [7 and 8] and help the users to plan and design their data communication system.

3.4. Services Over the Telephone Network

Services over the public telephone network usually involve the connection of user DTE to the PTT DCE so that the interface is digital (it must also be licensed) and constructed for data transmission up to 300 bit/s and 600-1200 bit/s. If the user wants to exchange data over the public switched telephone network at higher speeds (2400, 1200+1200 bit/s), or by means of acoustic or electromechanical couplers from portable DTEs, the corresponding DCE is the property of the user and must be licensed (the interface is obviously analog). Parallel transmission at a rate of 20/40 chrs is also permitted and will soon be the standard service (by means of parallel data sets EC-8025).

The data connection set-up is provided either manually from the user site (the user dials by means of a telephone set connection to the addressee and, after connection has been established he switches on to the data transmission mode), or may be automatic. In the latter case, the user device must be equipped with an ACU (Automatic Calling Unit)

and/or an AAU (Automatic Answering Unit).

3.4.1. Services over the Telegraph Network

There are three types of service offered over the integrated telegraph networks:

- data communications by means of the PTT teleprinter of 50 bit/s with the ITA 2 code (such a service does not require a special license)
- data communications by means of the user DTE (or of a supplementary PTT teleprinter) of 50 bit/s with an arbitrary 5 unit code
- data communications by means of the user DTE up to 200 bit/s with an arbitrary code

The last service comprises the termination of a telegraph circuit with the PTT telegraph data set (of type TMS 200 - EC 8032). The interface between the user DTE and the PTT DCE must fulfill the corresponding CCITT recommendations.

If teleprinters are used they serve not only to establish the connection but also as a means of data acquisition and buffering on paper tape. If the user DTE is used it can be equipped with the ACU and/or AAU.

3.4.2. Services over Leased Lines

The leased lines provided for data communications are of the following type:

- telegraph up to 50 bit/s
- telegraph up to 100 bit/s
- telegraph up to 200 bit/s
- data (telephone equipped with modems) up to 300 bit/s
- data (telephone equipped with modems) up to 600-1200 bit/s
- analog telephone for speeds above 1200 bit/s
- analog wideband (60-108 kHz) for speeds above 48 kbit/s.

The user may request either the 2-wire subscriber line for SX (simplex) and FDX (full duplex) operation (FDX operation is only possible with FDX modems) or the 4-wire subscriber line. Leased lines terminate at the user site with digital interfaces according to the corresponding CCITT recommendations or with an analog interface. Both point-to-point and multi-point lines can be leased from the PTT. Leased lines shared among several users are offered on a special tariff rate.

3.5. Data Communications Tariffs

For tariffs of data transmission services as well as of telephone and telex services the corresponding PTT rate tables are provided, the most up-to-date rate table is outlined in [9].

3.5.1. Tariffs for Switched Telephone Calls

Tariffs for data transmission over the public telephone network are based on the same principles and have the same rates as for ordinary telephone calls. The inland speech band connections esta-

blished manually are charged according to the distance, the duration and type of the call. The charges per 3-minute normal calls are listed in Table 3. For the zones between cities in Czechoslovakia see Table 4. "Urgent" and "Avia" telephone calls are possible options and in these cases the charges are multiplied by two and five; an additional charge of 2 crowns per call is added if data are transmitted over manually switched lines.

Table 3. Charges for inland normal telephone calls

Zone	1 (within the same group area)	2 (within the transit area and between adjacent transit areas)	3 inter-transit up to 250 km	4 intertransit above 250 km
Charges per 3 minutes (in crowns)	3.00	6.00	9.00	12.00

The international telephone call charges for automatically established telephone connections are shown in Table 5.

Installation and maintenance of telephone and data sets provided by the PTT and that of subscriber lines are billed monthly and the rental fee depends on the distance from the exchange and on the data transmission rate.

Table 4. Telephone tariff zones between transit areas

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Prague	1	2	2	3	2	3	2	2	2	2	2	3	3	4	4	3	4	4	4	4	4	4	4	4
Tabor	2	2	2	2	3	3	3	3	3	3	2	2	3	3	4	3	3	4	4	4	4	4	4	4
C. Budejovice	3	3	2	2	2	3	3	3	3	3	3	2	3	3	4	3	3	4	4	4	4	4	4	4
Plzen	4	2	3	2	2	2	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4
K. Vary	5	3	3	3	2	2	2	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4
Most	6	2	3	3	3	2	2	2	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4
Usti n/L	7	2	3	3	3	3	2	2	2	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4
Liberec	8	2	3	3	3	3	3	2	2	3	3	3	3	4	4	3	4	4	4	4	4	4	4	4
Hr. Kralove	9	2	3	3	3	3	3	3	2	2	2	3	3	3	3	3	3	3	4	4	4	4	4	4
Pardubice	10	2	2	3	3	3	3	3	3	2	2	2	2	3	3	2	3	3	3	4	4	4	4	4
Jihlava	11	3	2	2	3	3	3	3	3	3	2	2	2	3	3	3	3	3	3	4	4	3	4	4
Brno	12	3	3	3	3	4	4	3	3	3	2	2	2	2	3	2	2	3	3	3	3	4	4	4
Gottwaldov	13	4	4	3	4	4	4	4	4	3	3	3	2	2	2	2	2	2	3	3	3	4	3	4
Ostrava	14	4	4	4	4	4	4	4	4	3	3	3	3	2	2	2	3	3	3	3	3	3	3	3
Olomouc	15	3	3	3	4	4	4	4	3	3	2	3	2	2	2	2	3	3	3	3	3	4	3	4
Bratislava	16	4	4	3	4	4	4	4	4	3	3	3	2	2	3	3	2	2	2	3	3	4	4	4
Trencin	17	4	4	4	4	4	4	4	4	3	3	3	3	2	3	3	2	2	2	2	2	3	3	3
Nitra	18	4	4	4	4	4	4	4	4	3	3	3	3	2	3	3	2	2	2	2	2	3	3	3
Zilina	19	4	4	4	4	4	4	4	4	3	3	3	3	2	2	3	3	2	3	2	2	3	2	3
B. Bzstrica	20	4	4	4	4	4	4	4	4	4	4	4	3	3	3	3	3	2	2	2	2	3	2	2
Poprad	21	4	4	4	4	4	4	4	4	4	4	4	4	3	3	3	4	3	3	3	3	2	2	2
Presov	22	4	4	4	4	4	4	4	4	4	4	4	4	4	3	4	4	3	3	3	3	2	2	2
Kosice	23	4	4	4	4	4	4	4	4	4	4	4	4	4	3	4	4	3	3	2	2	2	2	2

Table 5. International telephone call charges

Country	No. of second for one crown	Charge per minute crowns
Austria	4	15.00
Belgium	3	20.00
Bulgaria (Sofia)	2	30.00
Denmark	3	20.00
Finland	2	30.00
France	3	20.00
Ireland	2	30.00
German Democratic Republic	4	15.00
German Federal Republic	3	20.00
Hungary	4	15.00
Italy	3	20.00
Liechtenstein	2.5	24.00
Luxembourg	3	20.00
Monaco	3	20.00
Netherlands	2.5	24.00
Norway	2	30.00
Poland - Warsaw	4	15
- others	2	30.00
Portugal	4	15.00
Rumania	3	20.00
Spain	2	30.00
Sweden	2.5	24.00
Switzerland	2.5	24.00
United Kingdom	2.5	24.00
USSR (Moscow)	2	30.00
Yugoslavia	3	20.00

3.5.2. Tariffs for Telegraph Calls

As the telegraph network in Czechoslovakia is fully automated the telegraph charges are concerned only with automatically established connections. The corresponding inland charges are shown in Table 6.

Installation and maintenance of teleprinters and telegraph subscriber lines are billed monthly. The rental depends on the distance

Table 6. Charges for inland telex calls

Zone	1 (within the local exchange area)	2 (within the transit exchange area)	3 (out of the transit exchange area)
Charges per 1 minute (in crowns)	1.00	2.00	4.00

from the nearest telegraph exchange and varies between 5,000 and 12,000 crowns per year. If a telegraph data set is required it is leased for an additional monthly rental.

3.5.3. Tariffs for Leased Lines

The charges for leased lines depend on the type of circuit (telegraph, telephone), the transmission rate, and the distance. For telegraph connections only two zones are distinguished: within the area of a transit (remote) exchange, and otherwise (outside of the transit exchange area). Table 7 contains monthly rentals for the three transmission rates. Of course, these rentals do not include the rentals for subscriber (local) lines.

The scheme for the speech band charge policy is different. The rentals depend on the distance (there are 4 zones described in Table 3), and if the line is used for data transmission the charge increases by 25 percent regardless of the data transmission rate (unless the line is conditioned). Table 8 shows the monthly rentals for leased

Table 7. Monthly rentals in crowns for inland leased telegraph circuits (in crowns)

Transmission rate (bit/s)	up to 50	up to 100	up to 200
Transit connection	6,000	7,200	9,600
Intertransit connection	12,000	14,400	19,200

speed band lines. If the modem is provided by the PTT a marginal additional charge applies; installation charges depend on the actual costs. When paying for lines one has to pay always for 4-wire lines, regardless of whether 2-wire lines are used in the connection.

Table 8. Monthly rentals for inland speech band circuits

Zone	1	2	3	4
Monthly rental (in crowns)	7,500	15,000	22,500	30,000

If leased telephone lines are used for the multi-user scheme the monthly rental is increased by 37.5 percent. Multi-point and conditioned (e.g., according to the CCITT recommendation M. 1020) speech band lines are specially charged.

Charges for wideband circuits as well as international lines are subject to the PTT and are calculated on a case-by-case basis. Appli-

cations for international lines have to be submitted to the Federal Ministry of Post and Telecommunication.

4. SOME TRANSBORDER DATA FLOW APPLICATIONS

4.1. Transborder Activity of the Regional Telecommunication Center of the Czech Hydrometeorological Institute [10]

The Regional Telecommunication Center (RTC) of the Czech Hydrometeorological Institute was established in 1972 and is responsible for data transmission within the WMO-GTS (World Meteorological Organization) and the ICAO (International Civil Aviation Organization) networks. It provides connection among the others with the World Meteorological Center in Moscow,with regional telecommunication centers in Vienna, Offenbach, and Sofia, and national meteorological centers in Potsdam, Warsaw, and Budapest. Within the ICAO network RTC is connected with centers in Budapest, Berlin, Moscow, Warsaw, and Vienna. For data communication,a wide range of transmission rates are used: 50-200 bit/s for national meteorological purposes, 100 bit/s for ICAO purposes, and 100-2400 bit/s for WMO purposes. Data are exchanged over FDX 4-wire leased telephone lines equipped with modems both in synchronous mode and asynchronous (start-stop) mode.

Subscribers to the telex network have access to the RTC via universal DTEs. The RTC provides many different services: message switching for WMO and ICAO, selecting, editing, and correcting of meteorological reports, subscriber dialogue with an average response time of 1 second, databases of original and selected

messages, code conversion (ITA 2, IA 5), transmission rate conversion, error control, etc. Most of the RTC hardware is duplicated for higher reliability. The RTC is in operation for 24 hours a day, and daily receives about 10 million characters and transmits 40 million characters.

4.2. Remote Access to SITA [11]

The Czechoslovak Airlines (CSA) is connected to the SITA (Societe Internationale de Telecommunications Aeronautiques) network to the Seat Reservation System GABRIEL run on UNIVAC computers, in Atlanta (USA) via the SITA Main Communication Processor in Frankfurt and Satellite Processors both in Zurich and Munich. Data are exchanged over two HDX trunk lines at a transmission rate of 4800 bit/s and over remote national lines that are controlled by the cluster controller in Prague, which assures high reliability and data flow flexibility.

The Czechoslovak domestic sub-network involves more than 60 VDUs and 15 matrix printers, which are placed in two reservation control centers, two airports, and five town offices. The inquiry system provides identical services to SITA's, e.g., storing and updating flight timetables, booking, changing or cancelling air tickets, avoiding duplications of reservations, reporting statistical data, informing about vacancies and connecting lines. The response time, in spite of the long distance to Atlanta, is very short--on average, approximately 3 seconds.

4.3. International Connection for Scientific, Technical, and Economic Information Exchange [12]

Within the Czechoslovak Scientific, Technical, and Economic Information (STEI) system, a Central Technical Base (CTB) was established, which enables inter-alia the direct access to databases of STEI. For the purposes of information exchange with databases in Eastern and Western European countries, the experimental data connection VNIISI (Moscow)-CTB (Prague)-IIASA (Laxenburg-Austria) was established in 1981. The connection is based on a leased 4-wire telephone line equipped with modem 4800 bit/s. The data flow is routed at CTB by means of time division multiplexers.

The CTB provides among others:

- access to Czechoslovak databases for Soviet organizations,
- STEI exchange between scientific institutes in the CSSR and in the USSR
- access to Soviet and Eastern European databases for Czechoslovak organizations
- centralized control of the orders of primary records (documents) on the basis of on-line Western European database systems.

It can be expected that the exchange of STI (Scientific Technical Information) in the future will grow and new connections will be established to promote this.

5. SUMMARY

As in other countries, the demand for data communication is increasing in Czechoslovakia. However, according to the PTT its demand has not yet required the establishment of a dedicated digital PTT data communication service. Thus data communication services by the PTT are provided through the existing telecommunication networks, through telephone, telex, and telegraph lines, which fully satisfy the present data communication requirements both in speed, quality, and volume. As to the technical characteristics of such services the Czechoslovak PTT strictly follows the appropriate recommendations of the CCITT. Similarly the telecommunication equipment industry follows the standards of ISO and CMEA.

The importance of transborder data flows for Czechoslovakia--a small country with an open economy--is not to be overlooked. The country plays an important role, for example, in the WMO-GTS network, actively participates in the networking activities of ICAO, and in the exchange of scientific and technological information over computer networks. It can be expected that the scope and volume of this transborder data fow traffic will further increase in the future.

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