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

I. Sebestyen

January 1983

WP-83-16

INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS
2361 Laxenburg, Austria

PREFACE

This Working Paper is part of the IIASA study "Telecommunication Equipment and Administrative Procedures Relevant to Experimental and Operational East-West Computer Connections". This work is supported both by the Control Data Corporation in Minneapolis and the Austrian Ministry for Science and Research in Vienna.

In the preparation of this paper invaluable contributions were made by Mrs. Zdravka Bralic and Director Miljenko Zuber from the Croatian PTT in Zagreb, by Mr. Anton Berisa from the University Computing Center in Zagreb and by Mr. Dusan Korunovic from the EDP Processing Center (Elekronska Industrija) in Nis.

Many thanks also to the staff of the Communities of the Yugoslavian PTT in Belgrade.

CONTENTS

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

I. Sebestyen

0. INTRODUCTION

In many countries, the increasing importance of new information technologies requires the development and use of an appropriate data communication infrastructure to enable remote use to and between computers. The development of this infrastructure in Yugoslavia is still in its infancy. In this paper an attempt is made to sum up the status quo of the Yugoslavian tele- and data- communication infrastructure, to give some illustrative statistical figures on the present data communication uses and future needs, and to describe the relevant administrative procedures linked to data communication. Finally some aspects of Yugoslavian transborder data flow applications will be outlined.

1. STATE OF THE TELECOMMUNICATION NETWORK

1.1. The Telephone

Telephony in Yugoslavia--as in other European countries--has a history of over one hundred years. In Zagreb, Croatia, for example, the first telephones were installed as early as 1881, about the same time as telephony in the other regions of the old Austro-Hungarian Monarchy started. In terms of telephones the Monarchy was one of the most advanced countries in the world, the first switched telephone exchanges of this federation being installed at about the same time as the first exchanges in the US, France, and the UK. At that time the Southern and Eastern parts of Yugoslavia were just about to finish the period of the Turkish occupation, which had lasted for about four hundred years and had certainly not been influenced too much by technology "hard-liners". Thus, when Yugoslavia, after long struggles, several wars and uprisings, finally became independent and unified after World War I, the country inherited a rather heterogeneous telephone infrastructure. Slovenia and Croatia, which were important parts of the old Austro-Hungarian Monarchy, were much better developed from the telephony point of view than the remote mountainous Monte Negro or Kosovo. Although the situation is now much better than in the past, there is still a difference in the level of development of the telecommunication infrastructure between West and East Yugoslavia.

In 1980 [1] Yugoslavia had about 1.9 million telephones in operation, out of which 46.7% were used in business and administration and 53.3% by residential users. The number of telephones per 100 population is 8.5, a

figure similar to countries such as the USSR, Poland or Venezuela, and with respect to some of its neighbors it is somewhat lower than Hungary (11.1) and considerably lower than Austria (36.6), Greece (28.2) or Italy (31.8). The difference is even more significant in comparison with the most leading countries in the world like the USA (79.1) and Canada (65.6). It is interesting to note that residential usage (the "number" of telephones per household) in Yugoslavia is 0.17, which means that only every fifth family has a telephone; in the US the average number of telephones per household is 1.67, i.e., most households have more than one telephone.

The telephone density in the major cities of Yugoslavia is somewhat better: Belgrade, Ljubljana, Novi Sad, Rijeka, Sarajevo, Skopje, and Zagreb account for 42.8% of the total telephones. On the other hand these cities only account for 16.4% of the total population, which means that the rural areas still represent a major problem in telephone coverage. Belgrade has 21 telephones per 100 population; the other cities, with the exception of Ljubljana with its 41.8 telephone stations are at about the same level. All in all, these figures are below the European average, and thus it is evident that the primary goal of the different PTT Administrations in Yugoslavia is to improve these figures by extending the present telephone network. The development figures are according to this policy high: between 1979 and 1980 the number of telephones increased by 10.4%, the number of telephones per 100 population by 14.1%.

For international telephony all stations are connected to the worldwide telephone network, the most frequently called countries from Yugoslavia being (in descending order) the FRG, Austria, Italy, Switzerland, and

France. From Austria, Yugoslavia is the fourth most frequently called country, while no other countries have reported [1] Yugoslavia as one of the five most frequently called countries from their territories.

The administrative organization of the PTT in Yugoslavia differs from that of most other countries. First of all, Yugoslavia, which is a federation of six republics and two autonomous provinces, has separate PTT administrations in each of its republics. These regional PTTs are loosely linked together on a federal level at the headquarters of the so-called Communities of Yugoslavian PTTs in Belgrade, which represents the country to the outside world (their address is: ZAJEDNICA JUGOSLAVENSKIH PTT, Palmoticeva 2, 11000 BEOGRAD). It is also this body that represents the country on the international level, such as in CEPT (in which Yugoslavia is the only member from the Eastern European socialist countries) and in ITU. At the federal level the general planning, technical development, and coordination of the work between the individual PTTs takes place. However, the individual PTTs are responsible for the provision of services and development of the network at the republic level. Strangely enough, the definition of PTT tariffs are also done at the regional level, which means that each republic has a slightly different tariff structure and level. There are even some republics in which separate data communication tariffs are not yet specified. For this reason we did not make an attempt to collect all tariff structures for each republic of Yugoslavia; for information purposes we have enclosed the tariffs for Croatia only, which is one of the largest republics and represents and excellent example for the general Yugoslavian conditions. Figure 1 shows a general scheme of the Yugoslav Federal Telephony Network. The network is built up of

seventeen main "transit" exchanges (TE's) of each to which are linked several "main" exchanges (69 in total). For example, eight main switching exchanges (e.g. Varazdin, Karlovac) are linked to the TE Zagreb in Croatia, which are major telephone centers in their region.

1.2. General Status of Data Communication

The present base of data communication in Yugoslavia is the standard telephone network. The quality of lines are in accordance with the CCITT recommendation M 1040; however, the line quality requirements for specially conditioned lines requested by the CCITT recommendation M 1020 cannot be fulfilled. For dedicated data lines, speeds up to 9600 baud are used; in baseband mode up to 19200. For the public switched telephone network (PSTN), speeds up to 2400 baud can be used in a reliable way. Higher speeds are obviously allowed, between telephone exchanges in the network, usually up to 48000 baud; between Belgrade and Zagreb, in the so-called basic group mode, this speed rises to 60000 - 108000 baud. The telephone network is still built basically on analog technology; in the process of digitalization, the main exchanges are being replaced first. The present main exchanges are mainly equipped with Ericsson-type crossbar exchanges, however, new, so-called fourth generation, switching centers will be produced in Yugoslavia by N. TESLA, based on Ericsson licenses. In the telephone network mechanical switching is still the dominant technology, systems based on time division multiplexing (TDM) not being in operation yet. An EDX digital system of Siemens has recently been installed in Belgrade for telex and telegraphy.

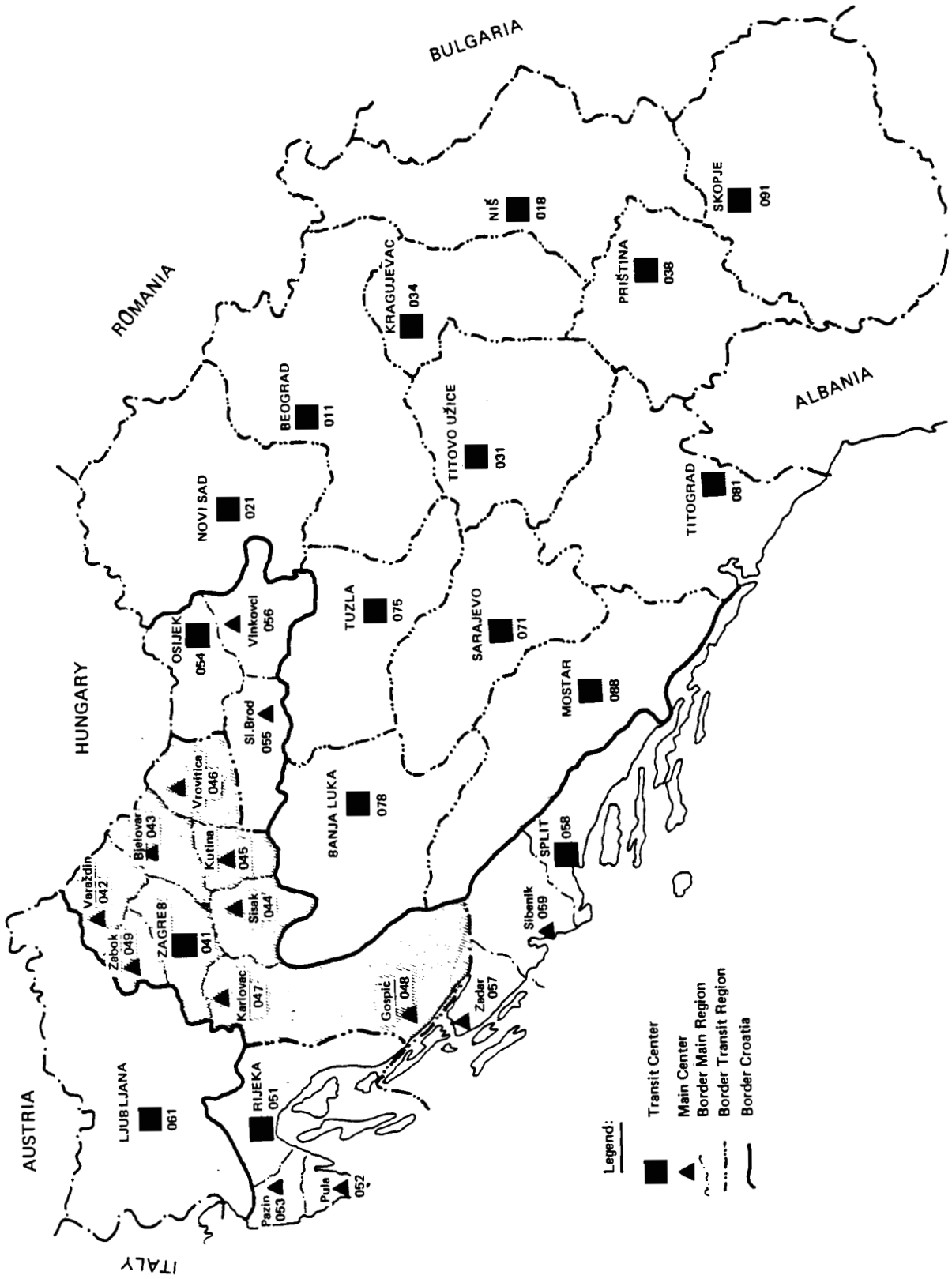

Figure 1. General scheme of the Yugoslav Federal Telephony Network

Separate digital data services are not yet offered by the PTTs in Yugoslavia, thus all data traffic is carried by the analog telephone network; to a lesser extent, the telex network is also used for data transmission.

For the long run the PTTs are planning to introduce digital data services, i.e., in the form of circuit and packet switching data networks. It seems as though the PTT packet switching network would be built first, with three initial network nodes at Ljubljana, Zagreb, and Belgrade. It is, however, not expected that this service would become available before 1985. Interconnection with other PTT networks is of utmost importance from the outset. The first connections are planned to the PTT networks of Austria, Italy, FRG, and Switzerland through X.75 protocols. As described in some length in the last part of this paper, there is a strong interest of some domestic users to locate nodes of dedicated data networks in Yugoslavia, for example, the banking network S.W.I.F.T. or a link to Euronet. The experimental connection to Euronet by Yugoslavia has already been decided: the University Computing Center in Zagreb will be responsible for establishing and operating an X.25 connection to the Euronet node in Rome.

The introduction of new data services, as in other countries, is not a question simply of technical capabilities. The analysis of present and future demands for data communication has to justify economically the introduction of such a service. Estimates are being made in Yugoslavia in order to predict this demand. The results of this activity--performed by all PTTs in Yugoslavia--are just about to take shape. At the time of writing this report, some preliminary results (for Croatia) were made available

[2] through the generosity of the Croatian PTT. The statistical figures for this republic--which, with an area of 56536 km^2 territory and a population of 4.25 million inhabitants, is the second largest in Yugoslavia--provide a typical example for a Yugoslavian republic.

The Yugoslavian PTTs, have made a major survey to map the present data communication situation in Yugoslavia, and as a part of it in Croatia, and to predict future demands. The Croatian PTT sent out a questionnaire to 25 major organizations in Zagreb asking for information on their data communication data usages and requirements. The Croatian PTT hope that through this survey they will actually cover 75-80% of all connections of the transit exchange Zagreb.

The cumulated results of the survey are given in Table 1. As can be seen the number of network terminating points (NTPs) and terminals will grow by a factor of approximately 2.5 over the three year period 1982 to 1985. It can also be seen that the trend is towards more distribution of computer traffic, going out from a more centralized type of status. In Table 2, the distribution of NTPs are given according to major application categories. It can be seen that in the region of TE Zagreb the most important application is banking, followed by data traffic of industrial enterprises and educational centers. The trend between 1982 and 1985 will not change significantly. Table 3 shows the line speeds used. At present, 2400 bit/sec is the most frequently used line speed. This is also expected to remain so for the future, at least until 1985, but in general a slight shift to higher line speeds can be observed. Table 4 gives an overview of the ratio between switched and direct telephone lines used for data communication. The change between 1982 and 1985 is negligible,

Table 1. Distribution of NTPs and terminals according to transit regions (for those 25 organizations based in Zagreb who sent answers to the survey on TE Zagreb).

Region	in 1982		in 1985	
	(NTP)	terminals	(NTP)	terminals
Zagreb	237	433	520	980
Rest of region of transit exchange Zagreb	58	93	169	316
Osijek	6	8	20	26
Rest of region of transit exchange Osijek	5	9	26	45
Rijeka	10	23	19	51
Rest of region of transit exchange Rijeka	4	4	9	31
Split	4	4	20	33
Rest of region of transit exchange Split	3	7	13	35
Other parts of Yugoslavia	6	18	44	89
Total	333	599	840	1516

roughly one-third of the NTPs using the public switched telephone network, while the rest using leased lines. Table 5 shows the present compositions of terminals according to terminal manufacturer.

Table 6 shows the number of terminals in 1982 and 1985 for the whole of Croatia. These data are based on information from 50 major organizations in Croatia (not only those that are based in Zagreb) and they expect to cover 75-80% of the total terminal population. As can be seen the number of terminals during this period is almost going to triple. The location of the majority of all terminals, which in 1982 was in the town

Table 2. Distribution of NTPs by application categories (Answers of 25 organizations based in Zagreb to the survey on TE Zagreb)

No.	Application category	in 1982 NTP (%)	in 1985 NTP (%)
1.	Banking	37.6	32.7
2.	Industrial	24.6	23.1
3.	Education	19.2	15.4
4.	Government	9.9	6.1
5.	Insurance	3.3	9.6
6.	Trade	1.8	2.5
7.	Mass media	1.5	3.5
8.	Communal services	1.5	2.0
9.	Health	0.6	5.1
	Total (%)	100%	100%
	Total (NTP)	333	840

Table 3. Distribution of speeds of lines of NTPs in % (for 25 major organizations based in Zagreb, who responded to the survey on TE Zagreb).

Line speeds (bit/sec)	in 1982 NTP (%)	in 1985 NTP (%)
300	3	1.8
1200	6.9	5.8
2400	79.9	70.6
4800	8.4	15.4
9600	1.2	3.8
19200	0.6	2.6
Total (NTP):	333	840

of Zagreb, will become more dispersed, and in general the share of terminals in rural areas will slowly increase.

It is interesting to observe that the number of terminals in the rest of Yugoslavia used for traffic to Croatia is relatively small, showing that the "transborder data flow" over data links even between republics of Yugoslavia is almost negligible at present.

Table 4. Distribution of NTPs according to type of lines used (for 25 major organizations based in Zagreb who responded to the survey on TE Zagreb).

Type of line	in 1982		in 1985	
	No. of lines	%	No. of lines	%
Switched	102	30.6	261	31.1
Direct	231	69.4	579	68.9
Total	333	100	840	100

Table 5. Distribution of terminals in 1982 by manufacturers (for 25 major organizations based in Zagreb who responded to the survey on TE Zagreb).

Terminals by manufacturer	Terminals	
	Number	%
UNIVAC	159	27
IBM	127	21
NCR	120	20
TRS 721	90	15
MDS	36	6
Honeywell	19	3
Others (Interscan, Videoton, Singer, HP, ICL, PDP, Delta, RIZ, ...)	48	8
Total	599	100

Finally, Table 7 shows a rough comparison between NTPs in some European countries. As can be seen values for the NTP per number of working population, which is one of the characteristic indicators for the development of data communications, is rather low for the Eastern European countries shown here. This explains the present policies of some of

Table 6. Distribution of terminals and NTPs linked to transit regions in Croatia (data based on response of 50 Croatian organizations to the survey of the Croatian PTT).

Region	in 1982		in 1985	
	Number	%	Number	%
Zagreb	435	60.7	895	43.8
Rest or region of TE Zagreb	93	13	327	16
Osijek	36	5	137	6.7
Rest of region of TE Osijek	27	3.7	171	8.37
Rijeka	75	10.5	124	6
Rest of region of TE Rijeka	6	0.8	66	3.2
Split	12	1.7	157	7.68
Rest of region of TE Split	7	0.97	65	3.18
Rest of Yugoslavia	23	3.2	101	4.94
Total terminals	714	100	2.043	100
Total NTPs	401	–	1.141	

the Eastern European PTTs not to install at this point a separate data network.

2. PTT SERVICES FOR DATA COMMUNICATION USERS

As has been mentioned, the different PTT services of the republics provide data services rather independently of each other. The Community of Yugoslavian PTT in Belgrade, provides mainly a coordinating function between them.

The general policy of the PTTs towards data communication is--as in other countries--to follow as closely as possible all recommendations made by CCITT within the framework of ITU.

Table 7. Numbers and penetrations of NTPs in some European countries, 1979 [2], [6], [7], [8]

Countries	1979	
	Number of NTPs	NTPs per 1000 working population
United Kingdom	117000	5.20
German FR	61700	2.87
France	54100	3.03
Italy	45500	3.16
Spain	25000	2.80
Sweden	20000	5.66
Netherlands	16500	4.06
Denmark	12100	4.56
Switzerland	10900	4.81
Belgium	9050	3.04
Finland	7090	3.22
Norway	6640	3.56
Austria	4480	1.60
Ireland	966	1.33
Portugal	794	0.32
Luxembourg	649	5.15
Greece	639	0.42
Yugoslavia (data for Croatia only) (1982)	401	0.19
Czechoslovakia	940	0.13
Hungary	≈ 600	0.12

For the purpose of data communication using the telephone network, the PTT only provides the communications channels required, guaranteeing M 1040 quality; however, the users must provide all the required telecommunication equipment, such as modems, multiplexers, and terminals.

Line ordering requests for leased telecommunication lines have to be sent to the respective republican PTTs. For example, the Croatian PTT is responsible for Croatia; its address is PTT Zagreb, Yu 41000 Zagreb, Jurisiceva 13, Telex 22-333. On average, lines are established by the PTTs

within one or two months after the order has been placed.

The Community of Yugoslavian PTT, is responsible for international connections. The tariffs and procedure for international lines follow the appropriate recommendation D2 of CCITT. To all European countries, for example, the costs for the Yugoslavian part of an international four-wire leased line are at present 5535 "gold franks"--the imaginary currency of the PTTs. Other PTTs are responsible for the non-Yugoslavian part of the line. They collect the revenues for their services, also according to a special well-defined tariff. Thus, if a Yugoslavian customer wants to establish an international leased line, say to Austria, he first orders the connection from the Yugoslavian PTT, which contacts the Austrian PTT on the request, and asks the Austrian user partner about its willingness to accept the computer line. If the answer is positive the two PTTs establish the physical line, and on both ends the appropriate--(PTT approved)--telecommunication equipment will be connected, in order that the data traffic may start. Yugoslavian customer is responsible for payment which is to make in local currency, i.e., in dinars, to its PTT. In this case, the Yugoslavian PTT transfers the predefined amount in "gold franks" to the Austrian PTT for the use of the Austrian part of the line. Since there are also lines ordered by Austrian customers to locations in Yugoslavia the usual practice between the PTTs is to "clear" their accounts at the end of each year.

The telecommunication equipment linked to the telecommunication lines has to be approved by the PTT, as in other countries. This equipment has to fulfill the appropriate V. or X. recommendations of CCITT. Usually it is the case that either the domestic manufacturer or the

importeur of the equipment requests the PTT to test and approve the equipment. The costs for such a procedure are billed to the domestic manufacturer, the importeur (or the end user, if the application was submitted by him). When specific telecommunication equipment has been approved by the PTT for use, all other similar types of equipment can be connected to the PTT network, without further complicated application procedures. The PTT maintains a list of approved telecommunication equipment, which is available publicly, and all equipment on this list can be connected to PTT lines without any delay after appropriate notification by the user to the PTT.

A list of the telecommunication equipment currently approved in Yugoslavia is provided in Table 8. Table 8 also shows that the domestic modem production of Yugoslavia covers, from the speed point of view, all categories that are of significance at present for data communication purposes. The factory of N. Tesla in Zagreb is manufacturing modems up to 9600 bit/sec under licenses from LM Ericsson in Sweden, and ISKRA in Kraj is producing modems under SRT licenses. From this point of view the domestic modem production is basically in a position to cover all domestic needs.

3. TARIFFS

3.1. International Tariffs

As mentioned in the previous chapter international data communication is done between Yugoslavia and the rest of the world almost completely through the telephone network. If the public switched telephone

Table 8. List of telecommunication equipment approved by the Communities of Yugoslavian PTTs.

Modem 200 Bd (300 Bd)

1. GH 1101	–	SRT
2. IBM 3976	–	IBM
Mod 102	–	
3. D 200 E	–	PYE TMC
4. MD 200	–	EI - IRI
5. ZAT 300	–	N. TESLA Lic. Ericsson
6. SRT 1161	–	ISKRA Lic. SRT

Table 8a. Modem 600/1200 Bd

1. 8 TR 652	–	Philips
2. GH 2002	–	SRT
3. IBM 3976	–	IBM
Model 3		
4. GH 2052	–	SRT
5. IBM mini 12	–	IBM
6. GH 2052	–	ISKRA Lic. SRT
7. ZAT 1200	–	N. TESLA Lic. Ericsson
8. PP 1200	–	INST. M. PUPIN
9. MD 6-12	–	RACAL-MILGO LTD
10. IBM 38 LS	–	IBM
11. ZAT 1200-5 LSI	–	N. TESLA Lic. Ericsson
12. SRT - 2082	–	SRT

Table 8b. Modem 2400/1200 bit/s

1. GH 2054	–	ISKRA Lic. SRT
2. 2200/24	–	RACAL MILGO LTD
3. 24 LSI	–	RACAL MILGO LTD
4. IBM 3872	–	IBM
5. IBM Mini 24	–	IBM
6. GH 2054	–	ISKRA - License SRT
7. ZAT 2400	–	N. TESLA - License Ericsson
8. 26 LSI	–	RACAL-MILGO LTD
9. PP 2400	–	Institut Mihailo Pupin - Belgrade
10. ZAT 2400-5 LSI	–	N. TESLA Lic. Ericsson
11. IBM 3863 model 1 and 2	–	IBM
12. SRT 2084	–	SRT

Table 8c. Modem 4800/2400 bit/s

1. MPS 48	–	RACAL-MILGO LTD
2. IBM 3874	–	IBM
3. ZAT 4800-5 microprocessor	–	N. TESLA Lic. Ericsson
4. IBM 3864 model 1 and 2	–	IBM
5. SRT - 2058	–	ISKRA Lic. SRT (4800 bit/s)

Table 8d. Modem 9600 bit/s

1. 96 MM/96	–	RACAL-MILGO LTD
2. MPS 9629	–	RACAL-MILGO LTD
3. IBM 3865	–	IBM
4. ZAT 9600 LSI microprocessor	–	N. TELSA Lic. Ericsson

Table 8e. Baseband modems

1. COM - LINK II 2,4 : 19,2 kbit/s	–	RACAL-MILGO LTD
2. COM - LINK IV 2,4 : 64 kbit/s	–	RACAL-MILGO LTD
3. ER BdB 19-12 2,4 : 19,2 kbit/s	–	CIT-ALCATEL
4. IBM 5979-L41 2,4 : 19,2 kbit/s	–	IBM
5. ZAT 12/96 2,4 : 9,6 kbit/s	–	N. TESLA Lic. Ericsson
6. DCB 19200 MK 2	–	ISKRA Lic. SRT

network is to be used for such connection, the usual telephone tariffs between Yugoslavia and the country in question applies. For neighboring countries, users of telephone lines have to pay for 1 IMPULSE every 2 seconds (1 IMPULSE = 1.08 dinars), and for other countries 1 IMPULSE every second. The quality and convenience for such types of data traffic is, however, somewhat limited, and although it is daily practice to use the PSTN for such purposes it is far from being ideal.

For leased telecommunication lines the line charges are defined by the PTT according to the rules and tariffs on a case-by-case basis, and customers in Yugoslavia have to pay their monthly telecommunication bills in local currency, i.e., in dinars.

3.2. Domestic Tariffs

As mentioned earlier domestic tariffs do differ from republic to republic. Croatia, Serbia, and Slovenia, for example, have basically the same tariff structure with minor differences in the impulse costs, but other less developed republics do not even distinguish between voice and data traffic. As an example of a tariff structure in a Yugoslavian republic, the tariff scheme for Croatia is given in Table 9.

4. TRANSBORDER DATA FLOW APPLICATIONS

One of the most important applications of transborder data flow is the access it provides to bibliographical and numerical databases. According to [9] at present in Yugoslavia some 38 mainly bibliographical public databases are in operation. Fifteen of them are of foreign origin and are imported from all parts of the world on a subscription basis, such

Table 9. Telephone line rental tariffs for data transmission in Croatia

A. Leased lines*		Price
1. In-town network		(based on number of impulses) current impulse price = 1.08 Din.
1.1. Line crossing 1 telephone exchange		1.500 IMP = 1.620 Din/month
1.2. Line crossing 2 telephone exchanges		3.000 IMP = 3.240 Din/month
1.3. Line crossing more than 2 telephone exchanges		5.000 IMP = 5.400 Din/month
1.4. In-town lines which are extensions of inter-urban connections		
1.4.1. Line crossing 1 telephone exchange		400 IMP = 432 Din/month
1.4.2. Line crossing 2 telephone exchanges		1000 IMP = 1080 Din/month
1.4.3. Line crossing more than 2 telephone exchanges		1600 IMP = 1728 Din/month
2.1. Inter-urban lines		
2.1.1. Line between telephone exchanges of the same node region**		11.666 Din/month
2.1.2. Line between telephone exchanges of different node regions of the same transit exchange		14.580 Din/month
2.1.3. Line between different transit exchanges		
	Zone I (100 km)	17.496 Din/month
	Zone II (200 km)	21.870 Din/month
	Zone III (400 km)	29.160 Din/month
	Zone IV (more than 400 km)	34.992 Din/month

B. Switched lines (in-town network only)

Line usage:	24 hours a day	5000 IMP = 5400 Din/month
	from 7 am - 3 pm	3000 IMP = 3240 Din/month
	from 3 pm - 7 am	1500 IMP = 1620 Din/month

* The term line means a 2-wire connection; 4-wire = 2 lines

** The term node region covers either one main exchange, e.g., in rural areas, or more main exchanges, e.g., in major towns such as Zagreb.

Note that all NTP's have to be declared to the PTT if they are going to use the switched telephone network for data transmission. In this case the above charges apply regardless of the actual use of the line.

as INSPEC, COMPENDEX, ISMEC, METADEX, CAS, and VINITI. There are 3 international databases to which Yugoslavia provides its own contribution and benefits from the whole, but the majority of the databases (more than 20) are national ones.

Some smaller national databases are "manually" operated in the form of catalogs and registers, but the vast majority of database operations are provided through computers, in both SDI (Selective Dissemination of Information) and retrospective type of service. The online, interactive type of information retrieval is still in an experimental phase, but there are a few information centers in the country (e.g., in Belgrade, Zagreb, Ljubljana, Nis, Sulootica and so on), which have all the facilities to introduce such services in the near future.

Concerning the organizational framework for scientific/technical information activities in Yugoslavia, since the beginning of the seventies much effort has been made to organize and coordinate work at the federal level. In 1976, for example, a so-called Interrepublic Self-management Agreement was signed to foster computer processing of scientific and technical information. A so-called Project Council for Coordination of Database Performance, Purchase and Processing was also introduced.

Direct cooperation between specialized information centers and between powerful computer centers largely promoted the emergence of effective database services. Examples for such bilateral cooperation are, for example, between the Public Library of Serbia (Narodna Biblioteka Srbije) and the Institute for Informatics in Vinca (Institut za Informatiku); between the Reference Center in Zagreb (Referalni centar) and the

University Computing Center in Zagreb (Sveucilisni racunski centar); and between the Institute for Occupational Safety and Health Documentation "Edvard Kardelj" in Nis (Institut za dokumentaciju zastite na radu "Edvard Kardelj") and the EDP center of Electronic Industry in Nis (Electronski racunski centar Elektronske industrije).

The general policy for scientific/technical information services in Yugoslavia is to provide all domestic users with national and worldwide information and to provide foreign users with the possibility of access to Yugoslavian information sources. In order to achieve this broader goal, several projects and experiments were launched and are being conducted.

One of the first computer networking projects in which Yugoslavia participated was the so-called EC COST Project 11--or as it is better known--the European Informatics Network (EIN) [3]. This experimental packet switched computer network, which in a sense can be regarded as a forerunner of the present EURONET network, was initiated in 1971 by nine European Governments--including Yugoslavia--which signed together with Euroatom an international agreement for the creation of a European pilot informatics network. The main goals of the project were to create a model for future networks for commercial and other purposes, to promote the agreement of standards and networks, and to coordinate and exchange ideas for national networks.

As a result of this activity, in May 1976 the so-called EIN sub-network was completed and put into operation. In 1978, when the network had already been operational for two years, some signatories nominated so-called Associated Centers, not connected permanently to the network but

capable of access through the public switched telephone network to one of the network nodes (Figure 2). From the Yugoslavian side, RSS-Raziskovalna Skupnost Slovenije--participated in the project with the status of an Associated Center. The EIN project finally phased out in 1979 after it had successfully fulfilled its mission. EURONET, originally the network of the European Communities, can to a certain degree be regarded as the successor to EIN.

Yugoslavia's plans for interconnection with EURONET are in a sense a logical consequence of Yugoslavia's special relation to the European Communities. EURONET, which became fully operational in February 1980, linked some 25 host computers to the network at its opening date, with some 150 databases and databanks. At the time of writing the number of EURONET hosts were above 40 and the number of databases more than 250. Also, other applications such as message sending and scientific computing are being supported on EURONET in an increased way. Originally the network used four packet-switched exchange nodes located in London, Paris, Frankfurt, and Rome. Remote access facilities were available in Amsterdam, Brussels, Copenhagen, Dublin, and Luxembourg. In 1980, Switzerland, the first non-Community country joined EURONET, setting up a fifth packet-switching exchange in Zurich. Sweden joint EURONET in 1982, and it is expected that Portugal and Yugoslavia will follow [4].

Yugoslavia's connection to EURONET is expected around the beginning of 1984, when EURONET becomes a public data network. The technical solution of the EURONET link will be similar to the original Austrian approach which was finally dropped by Austria when no agreement between the state of Austria and the European Communities could be

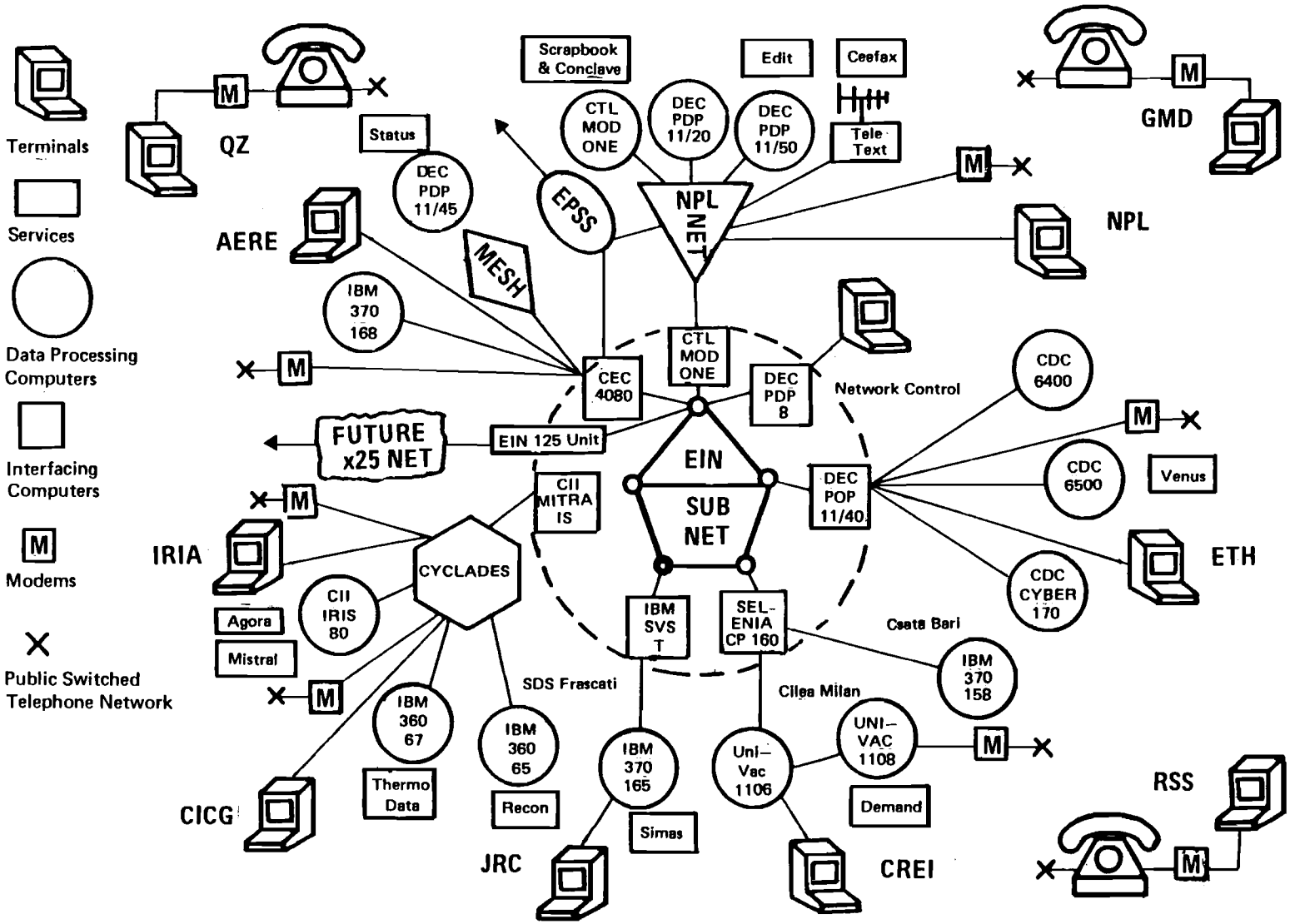

Figure 2. General scheme of the EIN network

reached. The Austrian PTT, which did not operate its own packet switching network in 1981 when the technical work started, subcontracted the Technical University of Vienna to interlink its PDP 11/34 to the Frankfurt node of EURONET through an X.25 high speed line. In the same way the University Computing Center of Zagreb will be responsible for the link to the EURONET node in Rome. In 1981 Yugoslavia joined the COST 11 BIS project and participated actively in the work of the file transfer protocol development group, together with Norway and Sweden. To realize that project, connection to EURONET is necessary. The University Computing Center will establish, for the experimental purposes, an X.25 high speed line by means of a 3705 IBM front-end processor of an IBM 4341 computer. This EURONET experimental connection is planned to become permanent, and to act as a EURONET node for all the present University Computing Center user community (which means all the Croatian university community: Split, Rijeka, Osijek, Varazdin) and even wider. Through the EURONET connection first of all a number of publicly available databases would be accessed easily by Yugoslavian users. At present access to foreign database hosts are made exclusively through the public switched telephone network, which is not only expensive, but also most inconvenient for such applications.

Plans also exist to link Yugoslavian computers into an international computer network with its neighbors. Within the framework of UNESCO project, supported by UNDP, a regional South-East European would link together computers of scientific institutions in Hungary, Yugoslavia, Bulgaria, and perhaps Greece, Turkey, and Rumania. Through the current Hungarian Academic Network, or the CISTI node at the Central Institute

of Scientific and Technical Information in Sofia links to Austrian scientific institutions are planned to promote exchange of scientific technical information and joint research.

With regard to the classical dedicated international networks, such as the WMO-GTS for meteorology, the SITA network for aviation information, and the news agencies networks, Yugoslavia is naturally linked through dedicated computer lines to these networks.

In the field of meteorological networks Yugoslavia is the only East European socialist country that is a member of the European Center of Medium Term Forecasts (ECMWF) in Reading, United Kingdom. Their own dedicated network called ECNET, which became operational in 1980, is linked or will be linked to all member countries with medium speed lines (2400 or 4800 bit/s) [5]. Through these links, medium range (4-10 days) forecast results produced on large CDC and Cray mainframes are transmitted to the member countries; approximately 8-16 million pieces of information per night. In addition, member countries use the super computers of the Reading Center in its free time for their own purposes by means of remote job entries.

S.W.I.F.T., the "Society for Worldwide Interbank Financial Telecommunication", founded in 1973 and fully operational since 1977, is presently operational throughout Western Europe and North America and the Far East and is being extended to Latin America and slowly, most probably, to some Eastern European countries. Along these lines Yugoslavia is one of the first candidates to be connected to this interbanking network.

5. SUMMARY

With regard to its tele- and data communication infrastructure Yugoslavia is at the beginning of its potential. At present, all datacommunication is carried out through the telephone network. Dedicated data PTT networks are not expected to be operational until the middle of this decade. Both domestic and international data communication applications have only recently started but their growth rates predict high prospects and importance in the future.

REFERENCES

[1] AT&T Long Lines, 1981. The World's Telephones as of January 1980. AT&T, Morris Plains, New Jersey, USA.

[2] Zuber, M., Z. Bralic, 1982. Personal Communication at the Croatian PTT Headquarters in Zagreb.

[3] Barber, D.L.A., 1979. The End is Nigh for EIN, in Proceedings of the IIASA Meeting "Evolution of Computer Networks: Theory and Experience". CP-81-27, IIASA, Laxenburg, Austria.

[4] Kelly, P.T.F., 1982. The Euronet Diane Network, Proceedings of the COMNET '81 Conference held in Budapest, May 1981. North-Holland Publishing, Amsterdam, The Netherlands.

[5] Haag, A., F. Königshofer, P. Quailin, 1982. Review and Reassessment of ECNET - A Private Network with Open Architecture, ECMWF Technical Report No. 30, Reading, England.

[6] Savezin Zavod Za Statistiku, 1982. Statisticki Kalendar Yugoslavije 1982, Belgrade, Yugoslavia.

[7] Johnson, T., 1981. The Data Comms Market in Western Europe 1981-1987. Logica Ltd., UK. Online Publications Ltd., Northwood Hills, UK.

[8] Puzman, J., 1982. Data Communication in Czechoslovakia - The Telecommunication Infrastructure and relevant Administrative Procedures. IIASA, WP-82-104, Laxenburg, Austria.

[9] Korunovic, D., 1982. Scientific/Technical Informatics in Yugoslavia - Experiences and Possibilities in Computerized connecting into the International Information Exchange in the Field of Occupational Safety and Health. Proceedings of the International Symposium on Occupational Safety and health held in Nis (Yugoslavia) in June 1982. Institute for Occupational Safety and Health Documentation "Edvard Kardelj".