WORKING PAPER

THE IIASA TPA/70 - X.25 GATEWAY-NETWORK PROMOTES INTERNATIONAL FLOW OF SCIENTIFIC INFORMATION

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IIASA
International Institute for Applied Systems Analysis

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ABSTRACT

This paper describes the "TPA/70 - X.25 gateway-network" of the International Institute for Applied Systems Analysis (IIASA) in Austria, and of the Institute for Computerization and Automation of the Hungarian Academy of Sciences (SZTAKI) in Hungary, and its promoting role in the on-line exchange of scientific information among national and international institutes and organizations. It presents a short overview of the major categories of transborder data flows relevant to IIASA's work, and how the gateway-network handles them. Finally, some operational and technical aspects of this East-West network of gateways are discussed.

Keywords

computer network/international cooperation/packet switching/ network services/transborder data flow.

PREFACE

This working paper is part of the IIASA study "Telecommunication Equipment and Administrative Procedures relevant to Experimental and Operational East-West Computer Connections".

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INTRODUCTION

There is no single definition of the term "Transborder Data Flow". This phenomenon is described in many documents, in very broad terms, as the movement of information across national borders for subsequent processing and storage in automated data systems. [1] This paper follows a considerably narrower definition. The authors regard only on-line computerized informaton flow over national borders as transborder data flow; basically the flow of computerized data as handled by the TPA/70-X.25 gateway-network, which is run by the Computer Communications Services Group of the International Institute for Applied Systems Analysis (IIASA) and by the Computer Center of the Institute for Computerization and Automation of the Hungarian Academy of Sciences (SZTAKI).

There are many different categories of transborder data flow: the Electronic Fund Transfer of the SWIFT network; the air passenger reservation data of the SITA network; observed meteorological data on the network of national meteorological institutes; news on the network of news agencies such as Reuter's; corporate data on the private networks of multinationals such as IBM, Philips or Unilever; technical and economic data on private time-sharing networks such as CYBERNET or the IP Sharp Network; scientific, technical, economical, and legal information on Euronet, Tymnet, and Telenet. Through the international links of IIASA in

*This paper is an updated and extended version of the article "IIASA TPA-70 Gateway-network promotes international flow of scientific information" which appeared in Vol V No 1 (1982) of Transnational Data Report, North-Holland, 1982.

Laxenburg, Austria, information relating primarily to the Institute and its research activities are transmitted between collaborating parties. The major categories of IIASA's transborder data flow activities are shown in Table 1.

STATUS OF IIASA'S EXTERNAL COMPUTER COMMUNICATION LINKS

The Computer Communicatons Services department of IIASA is responsible for providing the telecommunication infrastructure necessary for the above transborder data flow. The basic philosophy of the services provided by this department is described in length in earlier papers ([2] and [3]); the activities of the Institute with regard to the transborder dataflow category of electronic message sending and computerized teleconferencing are described in [4]. The present status of IIASA's external computer links through dedicated lines is shown in Figure 1. The rather complicated mesh of connections represent the links of some significance to IIASA, however it does neither mean that all these connections are owned and operated by the Institute nor that they represent all computer communication links, which physically could be used by the Institute, if desired. Compared with figures on the same subject as shown in papers [3] and [4], a major step forward has been the installation of the second TPA/70 node (based on the Hungarian made minicomputer TPA/70) at the Institute for Computerization and Automation of the Hungarian Academy of Sciences (SZTAKI) in Budapest. This node is also linked to the computer network of the Hungarian Academy of Sciences, and to the IBM 3031 computer of the Academy where work is being carried out, for example on the water quality models of IIASA's Resources and Environment Area. In addition, on this IBM 3031 computer, the online bibliographical data base being installed under STAIRS on "Mass Communication Research"--compiled by the Central European Mass Communication Research Documentation Center (CECOM) in Krakow, Poland might be of considerable interest to IIASA. Also our Systems and Decision Sciences Area started to use for econometrical modelling the SZTAKI computer in an increased way. According to the latest statistics the monthly usage of this computer by IIASA staff is at present about 25 hours.

The next important step forward at the TPA/70 node in Budapest was the connection of the node to the Hungarian Circuit Switching PTT-network NEDIX, which was brought into operation early in 1981. Through NEDIX it is possible to establish direct computer connections with IIASA's cooperating scientific institutions in Hungary.

In addition all third party traffic from Hungary previously routed through IIASA from Academic Institutions in Hungary are now connected through this network, since NEDIX has been interconnected to the network node of Radio Austria since July 1982.

It should be mentioned that the HAS network is also linked to the Leningrad Research Computer Center of the USSR Academy of Sciences (CYBER and BESM6 systems) for collaborative research purposes and through this connection IIASA is also able to access that computer center in Leningrad, and actually during the past couple of months several connections were established. Also the direct connection to Czechoslovakia

Table 1. Major Categories of IIASA's Transborder Data Flow Activities

Name of category	**Example**
Service of scientific time-sharing centers.	Computational services of, e.g., CNUCE (Italy) or SZTAKI (Hungary) for IIASA; or services of the IIASA VAX 11/780 and PDP 11/70 computers to external collaborators.
Service of data base centres (mainly in the field of science and technology).	Data Bank Services of, e.g. Data Star (Switzerland), ESA (Italy),IAEA (UN), SZTAKI (Hungary), VINITI (USSR), for IIASA; or usage of IIASA private data bases by external collaborators.
Electronic message sending and computerized teleconferencing.	For writing joint manuscripts, preparing joint conferences, management of joint projects on, e.g., the EIES system (US) or on the PDP 11/70 of IIASA by the TELECTR System.
Bulk (file) transfer of scientific data for remote handling.	e.g., IIASA's large global energy models were partly installed at the IBM computers of CNUCE (ITALY) and SZTAKI (Hungary), or scientific data files loaded from Moscow to IIASA for batch processing on the internal IIASA computers.

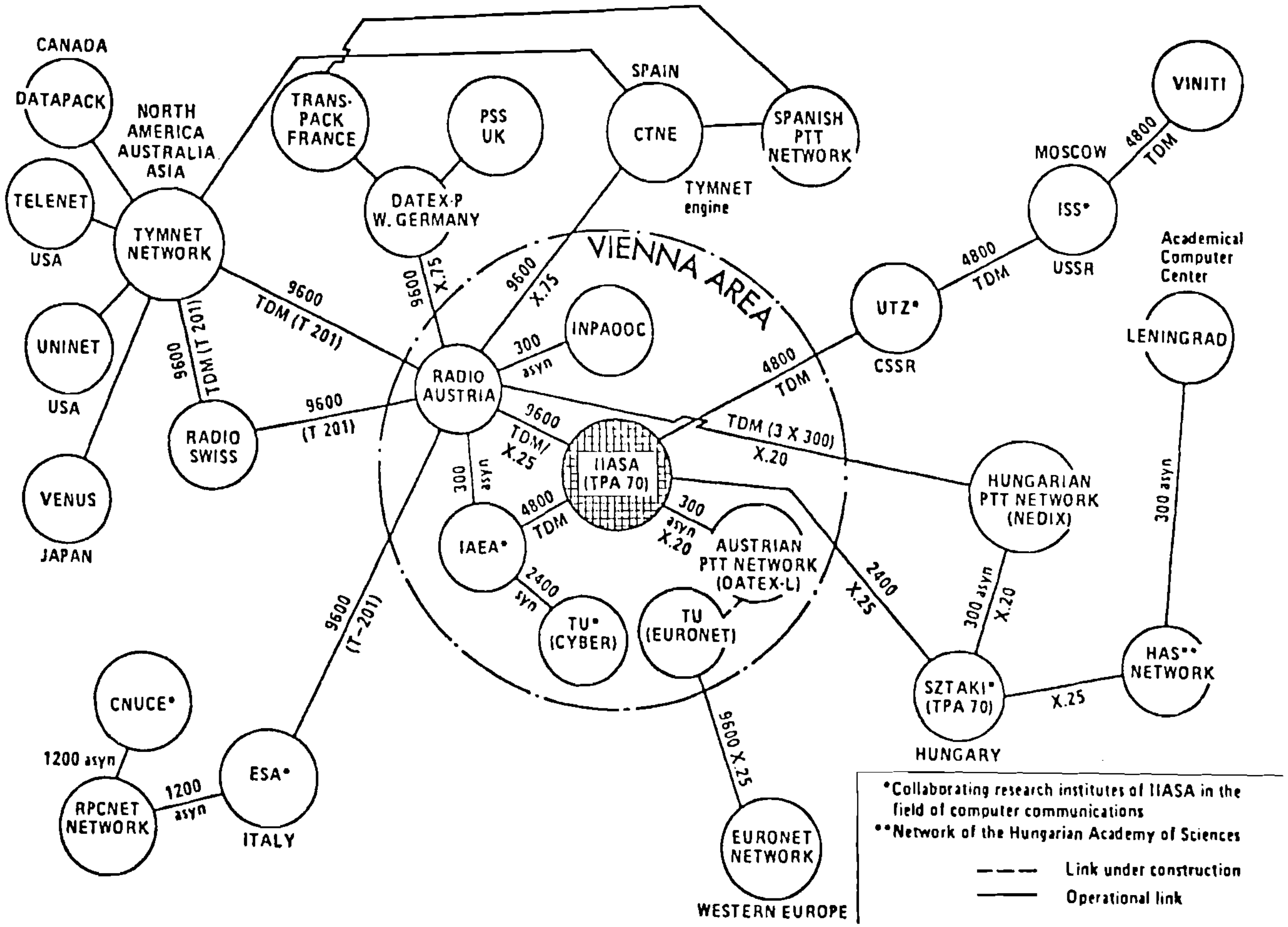


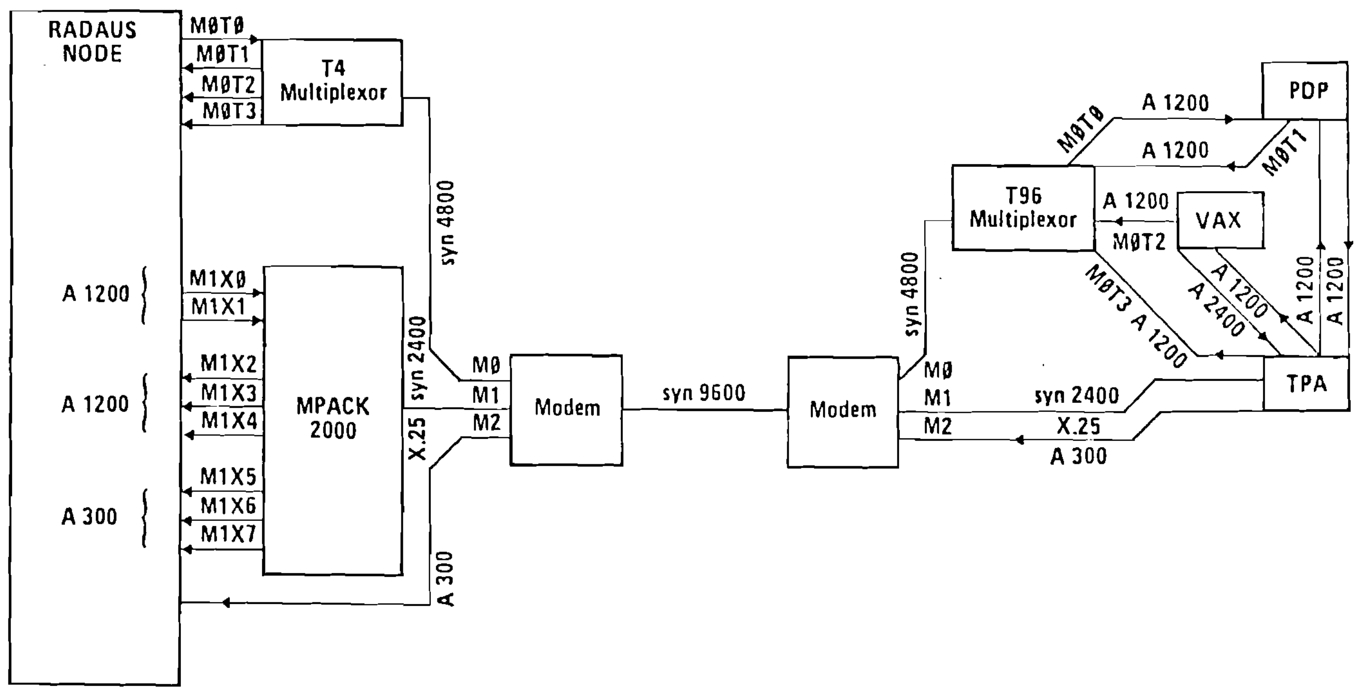
Figure 1. IIASA's external communication connections through dedicated lines (Status August 1982)

and the USSR was extended by new services. In Moscow the data base center of VINITI with its multidisciplinary bibliographical databases became available to IIASA users through the ISS-node in Moscow. ISS--the All Union Institute for Systems Studies --which also represents the Soviet National Member Organization of IIASA is one of our major partners in the Soviet Union for carrying out and coordination of joint research with our Institute. Negotiations with other Eastern European countries concerning computer link to IIASA (such as to Bulgaria, and the GDR) are in progress. The Western european computer links from Austria have been considerably improved during the last year or so although the connection through Euronet--allowing access to some specifically Western European data bases relevant to IIASA's research-- could still not be put into operation because of contractual difficulties between the Commission of European Communities and the State of Austria. The solution to this problem of IIASA is being gradually brought about; *i.e.*, the individual national PTT networks are being interconnected. In Austria itself we see two coordinated developments along this line. First Radio Austria--originally operator of oversees data communication services--has received from the PTT a temporary licence to provide Intereuropean connections as well--as long as the PTT does not make similar services available itself. By this decision much time was saved--all to the benefit of Austrian customers, who are now able to access most European national PTT networks, and *vice versa* Austrian hosts--such as IIASA--can now be accessed through Radio Austria not only from oversees but also from many countries in Europe. Through this service new connections are opened literally month by month and we expect that in the next two years or so our data communicaton infrastructure with Western Europe will be perfectly developed.

THE MAIN FUNCTIONS OF THE TPA/70-X.25 GATEWAY-NETWORK

The principal technical description of IIASA's computer communication infrastructure is described in more detail in [3] and [5].

It is basically a mixed system built on node computers performing the usual network functions (switching, routing, multplexing, flow control, code conversion, etc.) and on Time Division Multiplexers (TDMs). As an example of the present network on Figure 2 the present configuration between IIASA and Radio Austria is shown. The actual implementation is very much dependent on the technical and financial capability of our partners and of course of IIASA itself. Therefore, the original link to the International Atomic Energy Agency (IAEA) and European Space Agency (ESA) was practically conceived as the extension of the private network of the European space agency the same TDM-based technology. A similar case was that of the Radio Austria (Tymnet/Telenet) and the Prague-Moscow line. It is, however, planned to replace the TDM technology gradually; the connection to ESA and Radio Austria through packet-switching has been completed, and the control of the Prague-Moscow line will be taken over by a Czechoslovak-made minicomputer SM 4, which was donated to IIASA by its Czechoslovak NMO in 1980 and is already under preparation by all parties. The connection to Hungary was planned from the beginning to be built on Hungarian-made TPA/70 node computers. It is worth drawing attention to the interesting fact that the present model



Multichannel modem (MØ – M3) set to:

MØ = 4800 bit/sec
M1 = 2400 bit/sec
M2 = 2400 bit/sec
M3 = –

Figure 2. Communication between IIASA and Radio Austria (VAX-PDP-TPA-RADAUS)

of the TPA/70 at IIASA was originally donated to the Institute by CDC and controlled a very early version of the Hungarian-made graphical display GD-71. In 1977 when the first plans were made to implement a gateway system for IIASA, it was decided, for reasons of economy, to upgrade the original TPA/70 hardware configuration. The enhancement of the systems was started in 1978 and is still continuing in accordance with the needs of the growing gateway traffic. At present this rather old TPA/70 hardware--which was built almost a decade ago--performs all major network functions of IIASA with reliability of over 97%. From the software point of view, which will be discussed later at length, the first node version described in [5] was basically one-node oriented. However, after the installation of a second TPA/70 node computer in Budapest, circuit-switching network software was put into operation which has eventually been superseded by packet-switching network software supporting X.25 (Figure 3).

The main system functions of the TPA/70 nodes are listed in Table 2. It mainly performs the usual network control functions plus some specific "value-added" functions which were required to improve the quality of the gateway service. Thus, additional features for remote training and monitoring, for control of authorizaton (who may access what), and for direct exchange of short messages between users of the TPA/70 gateway-network, had to be built in. From the 'semantics' point of view a short overview of the kind of services the TPA/70 gateway-network is actually used for is given in Table 3. It can be seen that the Institute's connections are primarily used for supporting the research work of IIASA. In addition to this, they allow a form of third party traffic between other international organizations and partner organizations of the Institute, in cases where no other way of connection is possible. Thus, for example, the Czechoslovak Liaison Office of INIS/AGRIS to the International Atomic Energy Agency can be switched from their terminal in Prague through the gateway-network to the IAEA center in Vienna. This switching function will be discontinued as soon as the appropriate national PTT networks are interconnected, since it is not the function of IIASA to take over the role of national PTTs in international networking. This already happened in the case of third party access of Hungarian Academic research Institutions through IIASA, whereby the Hungarian PTT insisted that all such kind of connections have to go through them, which is actually the case now. Another aspect of the provisional 'switching-through function' is its close user group nature. IIASA only grants switching facilities to those organizations, such as UN organizations, collaborating research institutes *etc.*, which are in close relation to the Institute. Thus it may be claimed that IIASA, and its partners were the first organizations which operate international computer links carrying transborder data traffic in the field of science and research between East and West, but it represents a closed user group; thus it will not and cannot compete with present and future interconnected national data networks, which carry transborder data traffic for a considerably broader audience.

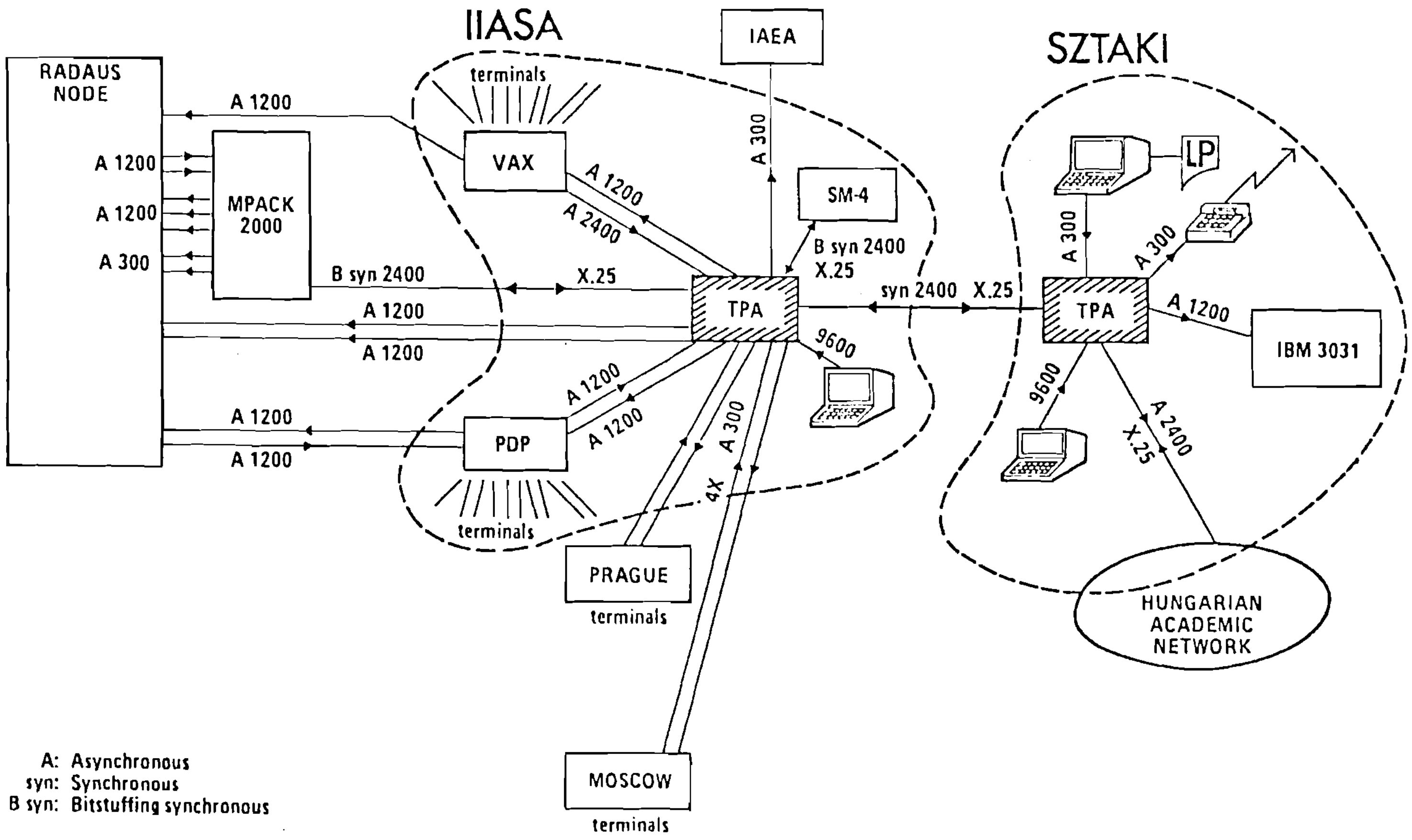


Figure 3. IIASA TPA/70 - X.25 Gateway Network (August 1982)

Table 2. The main functions of a TPA/70 node

--Provision of concurrent terminal-host communications
--User-user communication
--User-node-operator communication
--Monitoring
--Remote training
--Saving of the traffic of any terminal
--Authorization control
--Maintaining of a day-file (statistics)
--Status reports

Table 3. Switching function of the gateway-network according to major categories of scientific application between users and providers of information services

Source of service / Consumer of service	IIASA	International organizations	IIASA partner organization West	IIASA partner organization East	Scientific service centres (data bases, time-sharing)
IIASA	–	– access to data bases – scientific computing	– access to private data bases – scientific computing – message-sending	– scientific computing – access to private data bases (experimental)	– scientific computing – public data bases – message-sending
International organizations	– IIASA data bases – scientific computing – message-sending	–	–	–	–
IIASA partner organization West	– IIASA data bases – scientific computing – message-sending	–	–	– scientific computing – access to private data bases (experimental)	–
IIASA partner organization East	– access to IIASA data bases – scientific computing – message-sending	– access to data bases of international organizations	– scientific computing – access to private data bases – message-sending	–	– scientific computing – public data bases (experimental)
Liaison offices of international organizations	–	– access to data bases of international organizations (experimental)	–	–	–

SOME TECHNICAL AND OPERATIONAL ASPECTS

The TPA/70-X.25 gateway supports different types of lines. To make the interconnections easier a common language is used between those processes which are logical entities representing either physical lines or local gateway services. These processes can be called from any location in the network and in return they can establish calls to any location in the network. The processes using the common language are called "INTERFACE"s, the common language used is the third level of the X.25. Since the INTERFACEs are expected to work as "ideal" X.25 level 3 automats, time-outs and error recovery procedures are not included in the internal common language. Each data communication line is handled by an INTERFACE. Network callable functions (*e.g.*, "echo") are also implemented by an INTERFACE. A given connection between two INTERFACEs is labelled by an internal "association number" which is established at call-time and released at clear-time. The method of association numbering is similar to the channel numbering of the X.25. An INTERFACE process may be part of any number of associations at a given time.

All address-like information concerning requested destination is handled by the "LOGON" process. The LOGON is responsible for security check, association establishment and the selection of the destination INTERFACE. After having established a particular association, the data flow is maintained by the "ROUTE" which recognizes partner INTERFACEs by their association number.

The "X.25 INTERFACE" process is to connect network lines. It can work either as a DCE or a DTE. Essentially it follows the CCITT X.25 Recommendation (1980). Only virtual calls are supported. Any number of groups, any number of channels in each group and any range of (channel) numbering in each group can be defined. Two versions of LAPB can be used. One conforms to the CCITT recommendation, the other is slightly modified according to the standard used in the Hungarian Academic Network. On the physical level usually bit stuffing synchronous interface is used running with block input-output hardware. It is also possible to utilize conventional synchronous or asynchronous interfaces. In that case the framing is done by software and similar to the IBM BSC transparent format.

The "PAD INTERFACE" process is responsible for interfacing TTY like terminals to the packet switching network. It follows the CCITT X.3 and X.28 Recommendations (1978), all 12 PAD parameters are implemented. The speed of the lines can vary from 50 to 9600 baud. Upper case only terminals are also supported. Special, character filtering masks can be applied on input and output or both. Any kind of parity check or generation can be used. Since the PAD INTERFACE can be called by any other-process, terminal to terminal communication is also allowed.

The "AHPAD INTERFACE" process is responsible for connecting computers using ASCII code set to the packet switching network through asynchronous channels. Speed may be up to 9600 baud. When several channels are used to connect a specific computer, then the channels are dynamically assigned to the incoming calls. Explicit channel selection can also be made by the so called CALL USER DATA FIELD. The handling of the physical lines (speed, conversion, parity, filtering) is similar to that mentioned in PAD. Input-output flow-control can be made by means of CTRL Q and CTRL S characters.

The network callable "MONITOR" process is to supervise the Gateway. It provides information such as connections going through the Gateway, status of the lines and so on. Certain operational parameters can be changed; INTERFACEs, can be stopped or started, short messages can be sent to terminals connected directly to the Gateway, independently of their possible existing connections. Any traffic going through the Gateway can be copied to any other terminal and to a disc file to help fault investigation as well as user training. The MONITOR-- with a limited command set--is available to the users to gain status-like information as well as to send messages to other terminals or to the Gateway operator.

A day-file is maintained in the Gateway containing information about each major event which has happened, such as changes in the status of the lines, messages to the operator, call establishment, accounting information, and so on.

STATISTICS

The upgraded configuration of the TPA/70 was installed at IIASA in December 1978. The development of the first version of the node (character switching for asynchronous lines only) was finished by May 1980. The regular experimental service of the TPA/70 node at IIASA started in July 1980 and since then the node has been in daily operation. With the other TPA/70 in Budapest the circuit chamber switching version of the Gateway-network was put into operation in August 1981. The packet switching based Gateway-network was introduced in February 1982. The aggregated statistics of the IIASA TPA/70 Gateway from December 1980 (when the accounting system was installed) are given in Figures 4, 5 and 6.

FUTURE

By the end of 1982 a line to the experimental Austrian PTT packet switching network (DATEX-P) is going to be established. The present connection to the low-speed circuit switching network of the Austrian PTT (DATEX-L) allows incoming calls only. It is to be replaced by a real X.20 connection to provide automatic outgoing calls also.

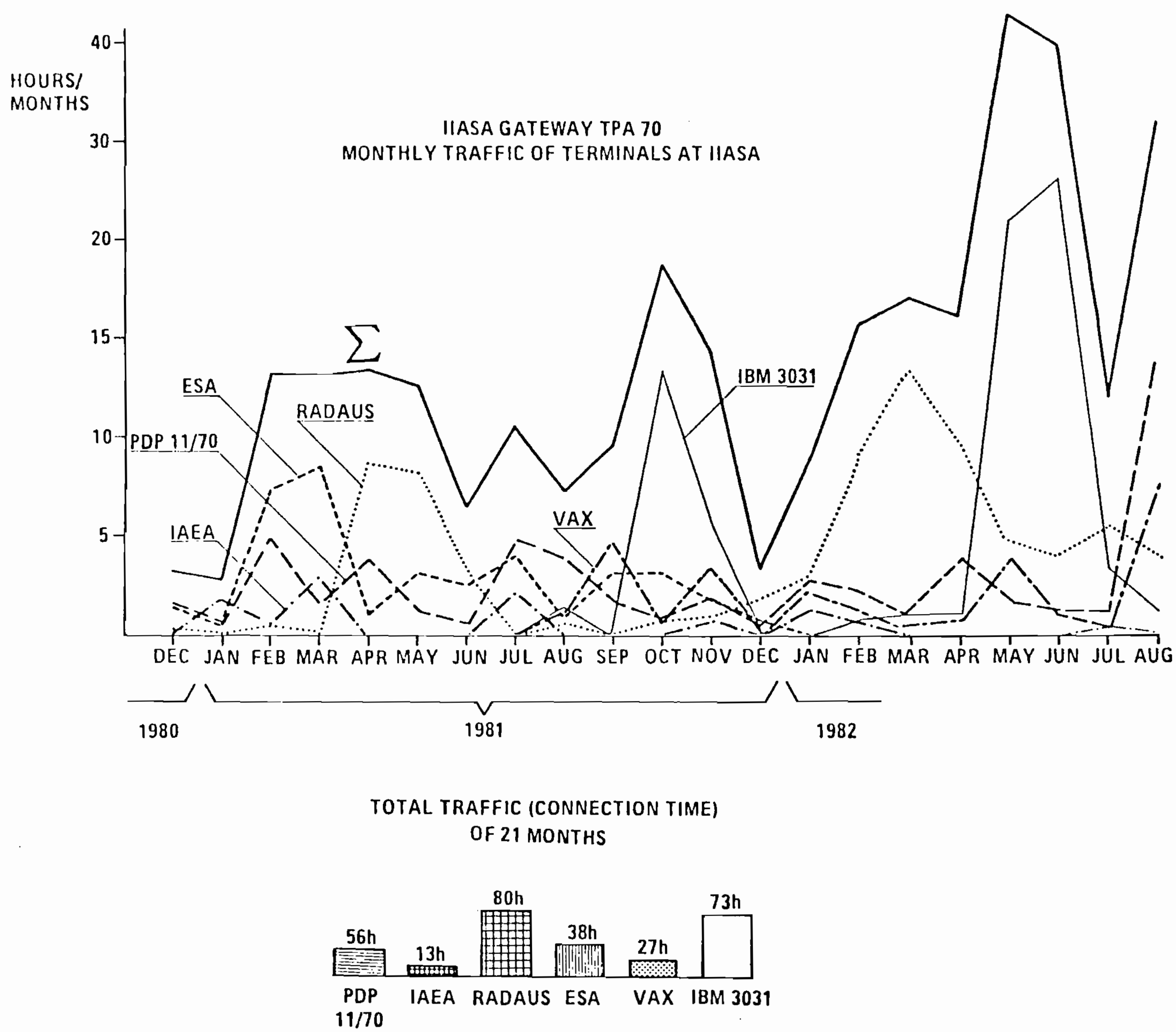

IIASA GATEWAY TPA 70
MONTHLY TRAFFIC OF TERMINALS AT IIASA
HOURS/
MONTHS
40
30
20
15
10
5
Σ
ESA
RADAUS
PDP 11/70
IAEA
VAX
IBM 3031
DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG
1980
1981
1982
TOTAL TRAFFIC (CONNECTION TIME)
OF 21 MONTHS
56h
13h
80h
38h
27h
73h
PDP 11/70
IAEA
RADAUS
ESA
VAX
IBM 3031

Figure 4

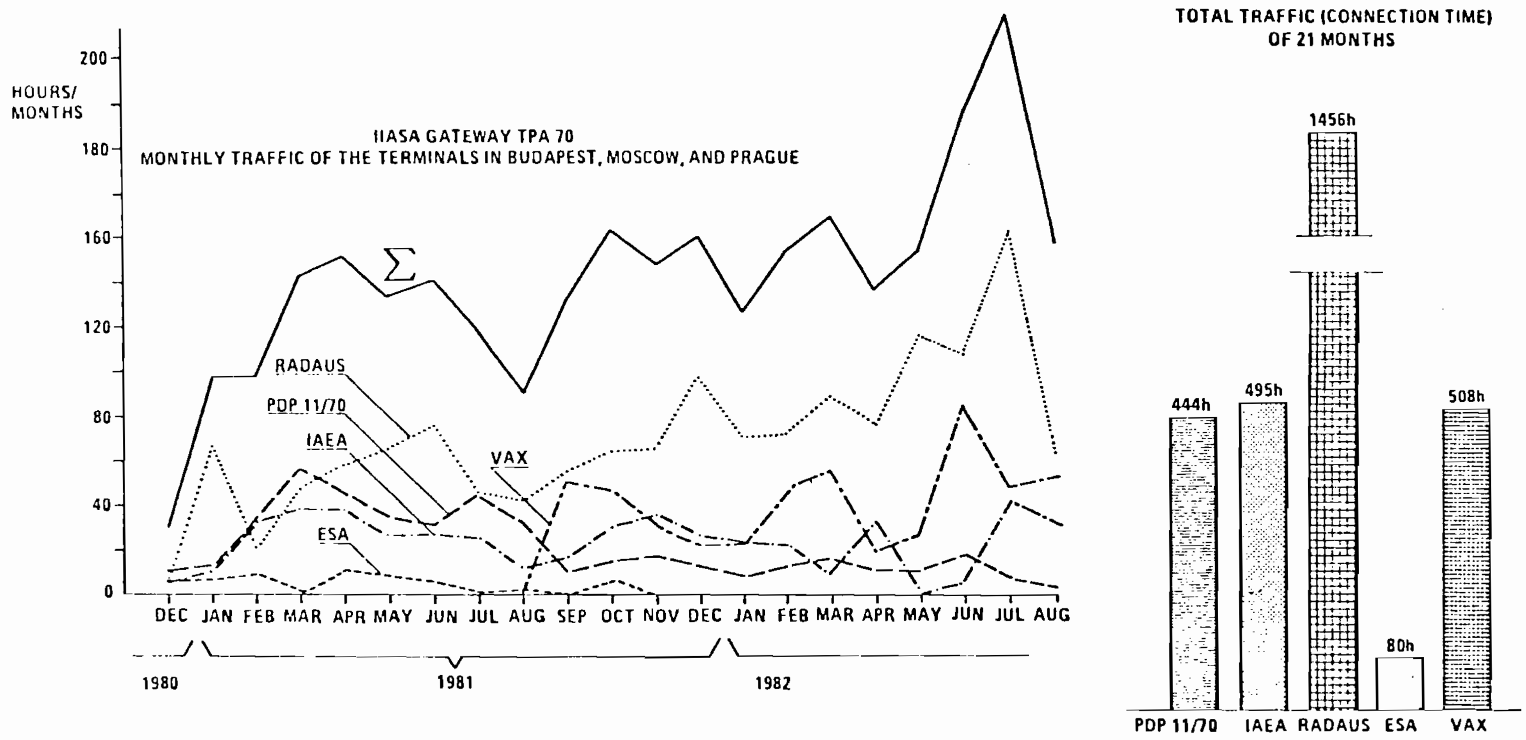

HOURS/
MONTHS
200
180
160
120
80
40
0
IIASA GATEWAY TPA 70
MONTHLY TRAFFIC OF THE TERMINALS IN BUDAPEST, MOSCOW, AND PRAGUE
Σ
RADAUS
PDP 11/70
IAEA
VAX
ESA
DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG
1980
1981
1982
TOTAL TRAFFIC (CONNECTION TIME)
OF 21 MONTHS
444h
495h
1456h
80h
508h
PDP 11/70
IAEA
RADAUS
ESA
VAX

Figure 5

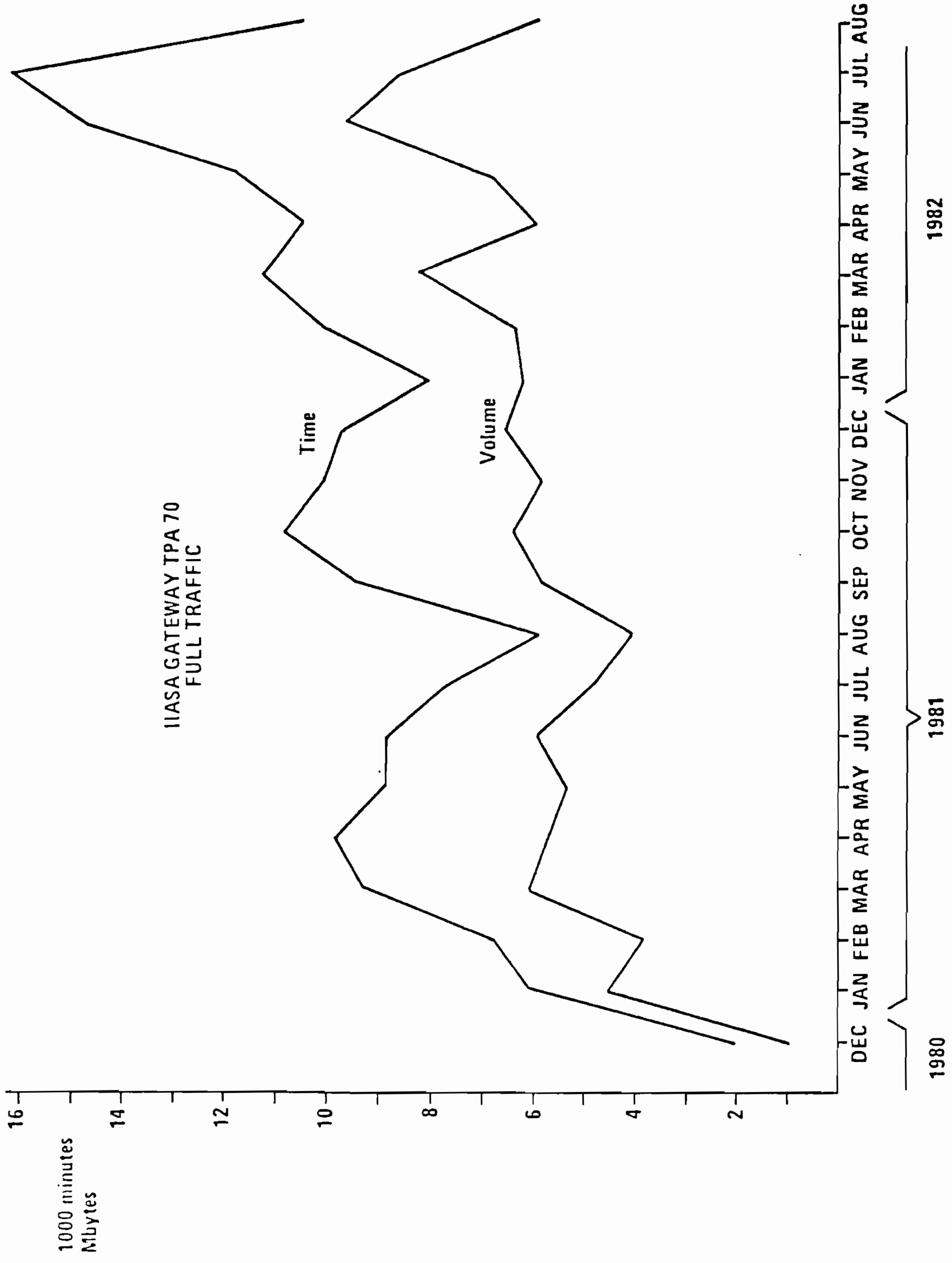

IIASA GATEWAY TPA 70
FULL TRAFFIC
1000 minutes
Mbytes
16
14
12
10
8
6
4
2
Time
Volume
DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG
1980
1981
1982

Figure 6

REFERENCES

[1] IBI-SPIN 231 Documents on Policies for Information, Transborder Data Flow: Its Environment and Consequences, June 1980, Rome, Intergovernmental Bureau for Informatics.

[2] Butrimenko, A., 1979 Computer Communication for Scienfitic Cooperation--the IIASA case. pp 383-388 Proceedings of the EURO-IFIP Conference 1979, London, 25-28 September, Amsterdam: North-Holland.

[3] Bakonyi, P., Kiss, I., Petrenko, A., Sebestyen, I., 1981 Promotion of East-West Computer Communication in IIASA's International Environment and the Hungarian Case Study; Proceedings of COMNET '81 Conference, Budapest, 11-15 May, Amsterdam: North-Holland.

[4] Sebestyen, I., 1981 Computerized Message-sending and Teleconferencing in an International Environment--Present and Future, Proceedings of the First International Conference on Computer Messaging Ottawa, Canada, 6-8 April 1981, Amsterdam: North-Holland.

[5] Labadi, A., 1981 IIASA Gateway System and Experiments in Daily Operation. Proceedings of COMNET '81 Conference, Budapest, 11-15 May, Amsterdam: North-Holland.