USING POWERFUL, LOW COST ACADEMIC NETWORKS TO ASSIST EASTERN EUROPE : EXAMPLES OF A VALUE ADDED PERSPECTIVE

DR. STEPHEN R. RUTH

PROFESSOR OF DECISION SCIENCES/MIS

DIRECTOR, INTERNATIONAL CENTER FOR APPLIED STUDIES IN MIS

GEORGE MASON UNIVERSITY

FAIRFAX, VA

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Dr. Stephen Ruth, Professor of Decision Sciences and Director, International Center for Applied Studies in Management Information Systems, George Mason University

Abstract

In spite of the major expense of improving the Eastern European telecommunications infrastructure--hundreds of billions of dollars over at least a decade--academic networks provide an interim capability for researchers that is quite promising. Since Western European nations have been successfully using these robust, low unit cost networks for over a decade, the major development and implementation expense can be considered amortized, allowing new network users the combined advantage of rapid connection and outstanding support service from the vast network of competent, experienced users. The perspective offered is one of examining the unit cost of such network services, rather than the more amorphous value structures frequently used in assessing progress of a new technology in a developing country.

With the unit cost criterion as a basis, the use of existing academic networks, especially the European Academic Research Network (EARN), is shown to be in the range of one tenth to one hundredth the cost per transmission of fax, telephone or cable and far below the cost per message of the mail system. Transmissions arrive at their destinations in minutes or less.

The favorable cost of these communications systems can be given greater leverage by the providing of value added services that provide users with a broad range of help, particularly in the context of training and integration with the hundreds of other networks beyond EARN, making it possible to link to hundreds of thousands of researchers in over sixty countries of the world for a few cents per transmission.

To operationalize the perspective offered, actual data from Czechoslovakia are included showing exponential rises in both the user population and the volume of message traffic in and outside the country. Finally, a test case is suggested, that of Romania, a country that has not entered the international network process yet, but which could quickly achieve the described benefits after a short period of using value added services.

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The state of telecommunications in Eastern Europe can be characterized as far below desirable levels, lacking in equipment, expertise and infrastructure, and improving at a very slow rate. A critical requirement for national growth, telecommunications has been neglected for decades but as national policies become more open, the need to overhaul the data communications infrastructure is becoming an obvious priority for national legislatures. Unfortunately, the cost of bringing this neglected resource up to the standards of the developed nations is astronomical. An estimate by the Institute for Electrical and Electronic Engineers (IEEE) for the revitalization of the communications infrastructure in Eastern Europe was over $400 billion covering a period of several decades. (Blau, 1990) Even comparatively modest plans in the fragmented efforts of individual countries are measured in increments that are in the range of nearly $10 billion each. For example, in Hungary a telecommunications plan aimed at raising the country's saturation to 30 lines per 100 population--still below Western European standards--will require investments of $7-8 billion over the decade (Tilley, 1990). Hungary is, after Czechoslovakia, in the best beginning position for such improvements (Crawford, 1991), so the overall case in Eastern Europe is, and will continue to be, grim for many years.

Gaining Leverage in Spite of Communications Challenges

In this environment of poor infrastructure for data communications, there is an interesting and positive development in academic networking that is quietly making it possible to gain great leverage for each small step that improves the opportunities for communications generally. The vast academic networking systems that connect nearly half the countries in the world have become robust, dependable and easily expandable. For example, the European Academic Research Network (EARN) currently sends millions of messages per month for academic users in over thirty countries and makes it possible for researchers to be connected to dozens of other powerful networks. The net effect of this well rationalized EARN system as well as dozens of others like BITNET, JNET, INTERNET, SWIFT, etc., is that even the most poorly endowed university or research institution can be connected to gateways that enable users to be communicating with each other as frequently as they wish.(Lawrence et al 1986, Quarterman and Hoskins, 1986) The writer had a typical experience recently that involved a manuscript for a scholarly journal that required the joint participation of three persons, one in the US, another in Egypt and the third in Chile. The manuscript was floated to the three and by an iterative process that required no more than ten days, was

successfully completed. Each author was able to review and make changes to various parts of the manuscript as many as ten times, approximately one cycle per day. The result was a useful article that has since been accepted by an academic journal. Without using international networks, this kind of collaboration would have been hard to attain and would have required about a year to complete instead of less than two weeks.

Other Examples of Successful Connections

Dr. Charles Bronfman, a Columbia-trained astronomer at the University of Chile, connects frequently to colleagues viewing the northern skies in Europe, the US, Canada and Israel. One of the new Czech subscribers to the academic networks, Dr. Josef Jarab, rector of the Palacky University in Olomouc, Czechoslovakia, began to send messages in mid-January, 1991, by using a simple modem connected to an old personal computer in the computing center. The first message cost about a dollar (30 crowns), the cost of a long distance call to Prague node, but if ten messages had been sent at the same time, the unit cost would have been reduced by almost an order of magnitude . Rector Jarab and his staff now use the network routinely and it was instrumental in his recent reception of a large grant from a US foundation. Soon Czechoslovakia as a national policy will have a node in Brno (as well as Bratislava) and the rector's unit cost of a message will be reduced to the level of one half to one tenth that of mailing an international letter.

Most professors and researchers in Eastern Europe do not yet have access to the powerful, low cost, high yield networks like EARN, BITNET and INTERNET. Unit cost of a message of any size to any colleague in the world is a few cents or less, after normal country-specific annual fees are accounted for. Once on the network, a professor anywhere in the world has the ability to be connected to several hundred thousand colleagues in over 40 countries. For example, Dr. Milan Jira, an epidemiologist at the Charles University in Prague, is in contact with about a dozen colleagues in Europe and the US every day. His messages run the gamut from specific research inquiries in his specialty area to interrogation of on line data bases. In spite of the generally poor state of telephony and data communications infrastructure in Eastern Europe, this unique and valuable capability can still be provided amid such conditions.

Unit Costs--Some Specifics

Table 1 gives a simple view of the unit cost issues involved in the use of academic networks. It is clear that the availability of stable, fully operational systems and the relative simplicity of joining the nets gives them a unit cost advantage in the range of one to two orders of magnitude

over cable and fax transmission.

Table 1 about here

Problems of Initial Connections

The speed and reliability, and especially the attractive unit cost of academic networks does not mean that they are a substitute for the major improvements that are in progress in improving the infrastructure in Eastern Europe. What they do provide is a level of service that would only be expected much later in the current decade as a result of structural improvements being phased in by each nation's Postal, Telephone and Telegraph (PTT) organization. This is possible because all the network development costs and the necessary system enhancement expenses have been previously paid in the 20 year evolution of the international academic networks and their successful implementation at tens of thousands of locations around the world. (Puliatti, 1990) Stated in business terms, the fixed costs are almost fully amortized and the resulting variable costs are very low on a per unit (message) basis.

It should be stressed that using these international networks is still not a matter of simply turning on a personal computer in a professor's office. In most universities or research institutions in Eastern Europe, access to a network means either a visit to the computer center or, as in the case of Cloumots cited above, making innovative use of the equipment at hand. It is true though, that in most university cities in Czechoslovakia, Poland and Hungary it is possible to link up to the academic networks by the use of a PC and a modem attached to the phone line. In Czechoslovakia the country wide "backbone" for academic networking installed in mid 1991 (Gronterad, 1991) will make the transmission much more reliable and eliminate many of the errors that are inherent in the current telephony arrangements.

Measuring Progress: An Example from Czechoslovakia

Perhaps the best method of describing the progress in Czechoslovakia in spite of the problems just mentioned is to show the actual results in terms of records transmitted and users. Table 2 summarizes the data from Czechoslovakia for the EARN network for the seven month period that the capability has been in existence. The amount of users as

Table 1-Rough Comparison of Unit Costs and Delivery Interval for Facsimile, Cable and Typical Academic Networks for Two Message Sizes (US East Coast to Prague)

	Cost per Message	Delivery Interval
Three page fax message	$5.00	Minutes
Thirty page fax message	$30-$50	Minutes
Three page cable	$15	Minutes
Thirty page cable	$100	Minutes
Academic network three page message	$.01-$.50	Minutes
Academic network thirty page message (Typical manuscript)	$.01-$1.00	Minutes

Note: Costs are based on sending messages during the normal working hours in the US from one research institution on the East Coast and a partner institution located in Prague. Unit costs for academic networks vary because each participating institution has fixed costs that are relatively similar with respect to this service and usage rates that vary widely. For an institution that sends 10,000 or more messages per day the low cost would apply while one that sends 100 per day would represent the higher unit cost. Several thousand messages per day on the network per institution is not uncommon.

well as message traffic is still increasing exponentially, most of the growth taking place under conditions of extreme difficulty in connecting to as well as utilizing the networks.

Table 2 about here

Facilitating the Entry of Countries into the Network: the Role of Value Added Services

To facilitate the entry into these networks, certain value added services can give major impetus to national as well as regional planning. Value added services are aimed at two vital, attainable goals: increasing the number of potential active users and improving the capabilities of these users to extract maximum value and opportunity from the net. Most of the investment is in the country itself and the results can be rapid, measurable and enormously cost-effective. In Czechoslovakia, for example, with the help of a Mellon Foundation grant, several value added investments in January 1991 will add hundreds of users to the network who would not normally have had the opportunity for a year or more. These users will be registered and operating in a few months. Many more such strategic investments in Czechoslovakia will add thousands of other users, and make them more productive much more quickly.

In Eastern Europe the poor state of their informatics infrastructure makes the region a particularly good candidate for this approach. By facilitating the use of existing hardware and software and making strategic enabling investments in nodal facilities (network servers, modems, some terminals) it will be possible to offer a leverage to the country's research community that would normally not be expected for several years. While a country gradually improves its informatics infrastructure, it will still be possible to offer this very modern service to researchers.

Using the Value Added Services Approach in Romania: a Proposed Plan to Operationalize the Concept

Despite the problems in the infrastructure and training in Romania--far worse than Poland, Hungary, or Czechoslovakia, connecting to the EARN-like networks is relatively straightforward . The crucial risk of BITNET/EARN is not scientific or technological. These international systems work superbly and have for over a decade. (Gurbazani, 1990) The real challenges concern facilitating entry of the vast numbers of the uninitiated into full partnership. A

Table 2. EARN Network Usage Summary for Czechoslovakia for the period December 1990 to June 1991

Month	Number of Users	Records * Sent/Received	
		National	International
December 1990	193	168,000	822,000
January 1991	333	745,000	1,185,000
February	888	2,468,000	3,072,000
March	1,080	3,419,000	4,632,000
April	1,185	5,036,000	5,425,000
May	1,329	6,303,000	7,447,000
June	1,427	7,293,000	8,548,000

Source: Monthly network statistics provided by EARN as well as summary data by Czechoslovakia EARN director, Dr. Jan Gruntorad and EARN statistician for Czechoslovakia, Mr. Pavel Vachek.

* A record represents the transmission of about 80 alphabetic or numeric characters.

recent study of effective implementation in Chile, eventually to twenty universities, (Ruth, Utreras and Brescia, 1990) makes it clear that rapid fan-out of the capacity to all the academic community--arts, language, social sciences, law, and literature along with traditional users like sciences and engineering--is not automatic. Implementation across a broad range of academic users depends on the provision of a broad range of services, services that add value to the connection. The premise of this concept is that these value added services are capable of giving great leverage to the installation of BITNET/EARN, far out of proportion to their cost.

Examples of Value Added Services

Once the first link to BITNET/EARN/INTERNET/UUNET (only one of these networks is really needed to connect to the others) is established, it becomes possible to provide a wide variety of services to users, potential users and network administrators. Most of these services could be considered technology transfer--since the technology already exists and is in use by scores of countries. The following list is indicative, not exhaustive, but gives a sense of the types of help that can be offered.

- Strategic, focused investments in capacitating node services and connections, especially powerful super microcomputers or minicomputers to act as "servers" for the network. (One node can eventually be responsible for tens of thousands of users)

- Continuing updates on new affiliated networks and their operating procedures. Examples are ECONET, PEACENET, INTERNET, etc.

- On line trouble-shooting services with capability of checking with BITNET in Washington, IBM or VAX hardware or software services as needed to maintain confidence in the robustness and dependability of the net.

- More detailed training on basic issues in newer informatics technologies. Because most journals and scientific trips were prohibited in Romania, it will require a more careful "warming up" for them to be able to take full advantage of emerging technologies. IEEE Computer Society and Association for Computing Machinery have already agreed in principle to assisting in this training as part of their Eastern European initiatives.

- Direct "hand-holding" links with users and prospective users. Includes planning and delivering training that has proven useful in other data communications environments.

- Hands on classes in logging on and off and off the system

as well as the full range of network services. Target audience : professors, administrators and students who represent disciplines that are often ignored in early stages of electronic messaging implementation.

- Connecting individual disciplines with colleagues and counterparts in the network throughout the world ("Yellow pages" for academic community)

- Aiding in human engineering of screens and other dialog services. It is relatively easy now to customize screens and local software to make the system's use less threatening.

- Establishing links between BITNET/ EARN connections and other value added services, especially CD ROM and microimaging. It is frequently possible to combine the ease of BITNET communication with the simplicity of CDROM at the same personal computer at unit costs that are so low as to be almost trivial. Such services could be described and pilot installations implemented using a typical academic work station--a 286 or less IBM system.

- Working with BITNET/EARN officials to enhance network connections.

- Performing ombudsman services with respect to proposed new linkages.

- Aiding in the formation of direct connection to on line search services. While BITNET/EARN are not research services they can be used successfully to link to a full range of such services, particularly at volumes and times that are most cost-advantageous. Example: Chemical Abstract Services on line system.

- Devising small focused expert systems to broaden the base of potential users Some online systems have small expert systems imbedded in them to facilitate the transmission and reception of network services. An example is a small expert system that makes identification of an addressee easier by knowing that SIMTH is probably SMITH.

- Help in importing or exporting files including text files, graphics and other digitized data. It is still difficult to send graphics files on BITNET but instructions on successful transmission techniques could greatly assist the process.

- Advice on use of current technology in training, including auto-didact materials. Hundreds of these materials exist and can be of direct help in user training.

- Advice or guidance on "best practice" in networking,

message management, selection of data communications equipment.

- Assistance in maintaining existing bulletin boards and starting new ones. As part of the value added services in Czechoslovakia it has been possible to facilitate the development of a LIST SERVER network centered in Prague, instead of the more typical case where an American university becomes the central point of a list server for an Eastern European nation. For example, a formal listserver for Hungary is operated from the University of California, Santa Barbara, nine time zones from Hungary.

A hidden advantage accompanies the provision of these services, one that does not normally attend technology transfer to developing nations. Since many of the countries that are the longest standing users of BITNET/EARN do not have a proportionately large number of fully informed users either, it is quite likely that this service might empower more Romanian academics than has been the case for American or European, on a unit basis. Certainly it will empower the Romanians to do their own value added services within a few years and to perform the same services for other countries in later years.

Time Line and Opportunity Loss Assessment for Value Added Services in Romania: A Five Year Plan

The timeline for BITNET/EARN/Internet implementation in Romania can be separated into three phases. Each of these phases can be described in terms of results expected with and without Value Added Services. This opportunity loss perspective offers conservative estimates of expected gains attributable to the availability of Value Added Services. The basis of these estimates is the recently available data on Chile's three years of implementation (Utreras,1991) and the first seven months of Czechoslovakia's implementation (Gronterad, 1991), together with extensive data on implementation cycles in other networking contexts--data that are just beginning to emerge in the academic and popular publications (Gurbazani,1991; Biorci and Trumpy, 1990; Crockett, 1990; Mc Carthy, et al, 1989; Llana, 1990; Sevsic, 1988). Chile and Czechoslovakia have roughly similar populations, some comparability in academic infrastructure, about the same number and size of universities and several other characteristics that make the extrapolations valid. While Romania is behind both countries in its readiness, infrastructure, quality of data communications lines, and other characteristics, it is a larger country, with a potential user base at least thirty percent greater than Czechoslovakia's. The data described below is based on a recent trip by the author to Romania and was supplied with the help of Dr. George Pascovich, director of the Atomic

Physics Institute and Dr. Dan Matudianu, research director of ICI.

Phase 1: Bucharest Region Implementation (September 1991-September 1992)

With the aid of supermicrocomputer systems as nodes (example: Microvax 3100 model 20e) connect Research Institute for Informatics-Bucharest, Institute for Atomic Physics and the Polytechnic University (Polytechnic Institute-Bucharest) in the Bucharest area as shown in Figure 1. This architecture makes use of several existing capabilities in the Bucharest area:

Figure 1 about here

Research Institute for Informatics-Bucharest: Existing Capabilities

- Switched dial-up lines to the Romanian Academy, Research Institute for Computer Technology, LAN (Novell) within Research Institute for Informatics-Bucharest and the link to EARN from Research Institute for Informatics-Bucharest to Linz, Austria

Polytechnic Institute-Bucharest: Existing Capabilities

- Existing LAN (Novell) from node to Computer Science Department and Electrical Engineering Department, ten work stations with a direct connection that would allow EARN/BITNET access, switched line to the Ministry of Education and Science plus switched lines to Cluj, Timisoara and Iasi

Institute for Atomic Physics: Existing Capabilities

- Existing LAN (Novell) with ten work stations
- Connection to satellite link for external transmission

Results After One Year--Without Value Added Services (Estimate): Up to a year or more delay in beginning services. Less than 100 active users and monthly message volumes of 500 totalling about 70,000 records per month. A record is a unit used by EARN management and is equal to eighty characters or bytes. (EARN Traffic Report) Few sites on line and no viable plans for Phase 2 inclusion of new users. Relatively sparse representation of arts, economics, literature, law and other faculties frequently omitted in

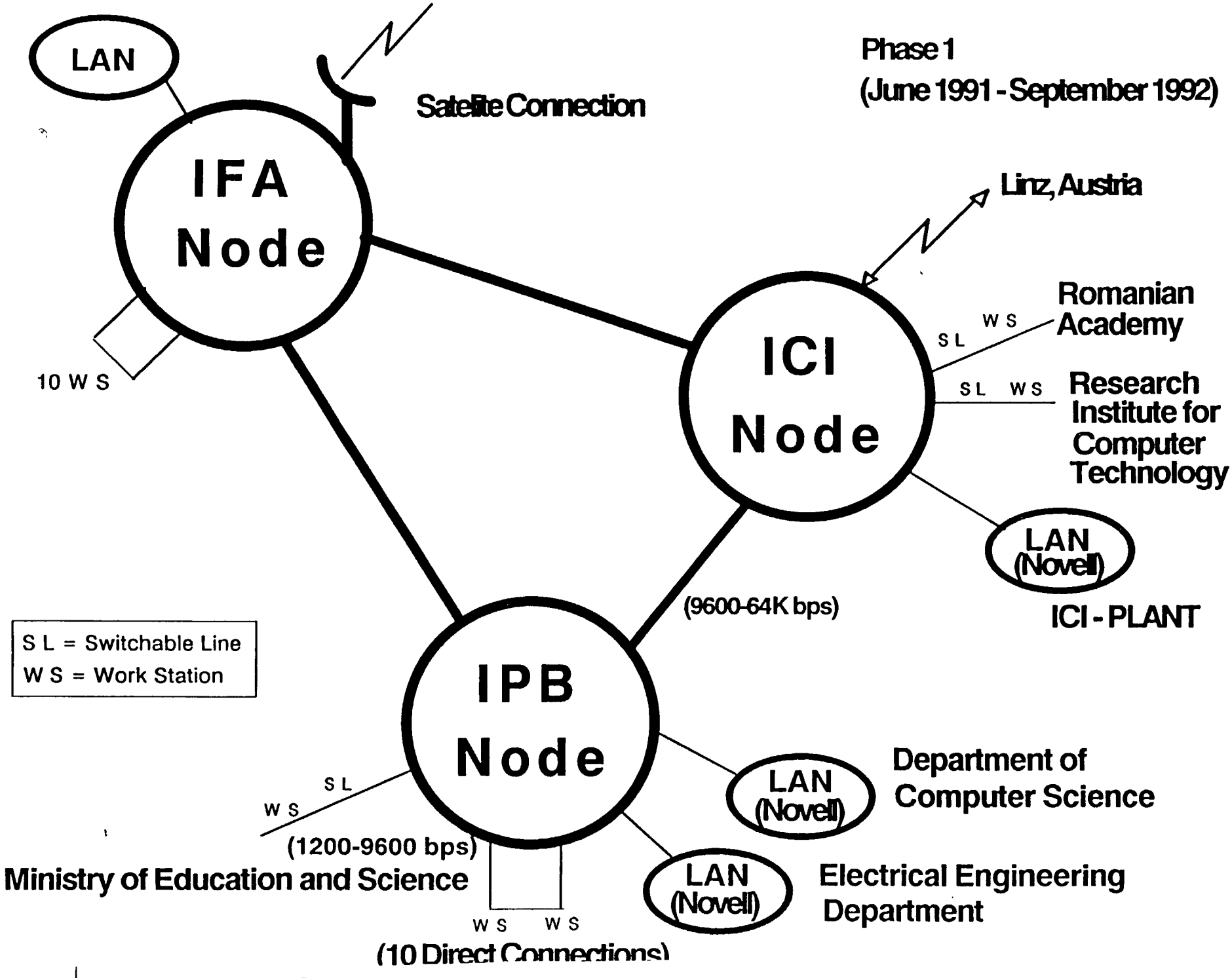

FIGURE 1 : SCHEMATIC OF THE FIRST PHASE--CONNECTION TO THREE NODES IN BUCHAREST AREA

such plans.

Results After One Year--With Value Added Services (Estimate): Over 500 users (Czechoslovakia attained twice that number by its sixth month so this is a conservative estimate), monthly message volumes of 4,000 totalling about 400,000 records per month.(Czechoslovakia's totalled twice that after four months), 8-10 sites on line with plans for Phase 2 inclusion of 20 more. Relatively high representation of arts, economics, literature, law and other faculties frequently omitted in such plans

Phase 2: Major University Implementation Outside Bucharest plus Added Connections in Bucharest (October 1992-October 1994)

Extension of the connections to Cluj, Timosoara and Iasi. These switched dial up connections would be of moderate quality depending on the arrangements with the PTT, and would assure a dedicated use of the increasingly active "triangle" (Research Institute for Informatics-Bucharest, Polytechnic Institute-Bucharest, Institute for Atomic Physics) in Bucharest. See figure 2.

Figure 2 about here

Additional Bucharest Links In Bucharest the Academy of Economics, the Research Institute of Research Institute for Informatics-Bucharest and Bucharest University would also be added.

Results without Value Added Services: After delays, Bucharest volume rises only slightly, to 250 active users and Phase 2 implementers add 50-150 to this total at a few sites in each of the three cities. Volumes : Bucharest 700 messages per month totalling 150,000 records per month, and outside Bucharest about 200 messages per month totalling 50,000 records. Non-scientific users still not well represented in the mix, and only about ten percent of the potential users are connected.

Results with Value Added Services: Bucharest rises to 1000 users logged in and Phase 2 implementers add 200-350 to this total at about ten sites in each of the three cities. Volumes : Bucharest 5,000 messages per month with message volumes of approaching a million records in Bucharest and about 800 messages per month totalling over 150,000 records outside Bucharest. About one fourth of the potential users are connected. Non-scientific users becoming better

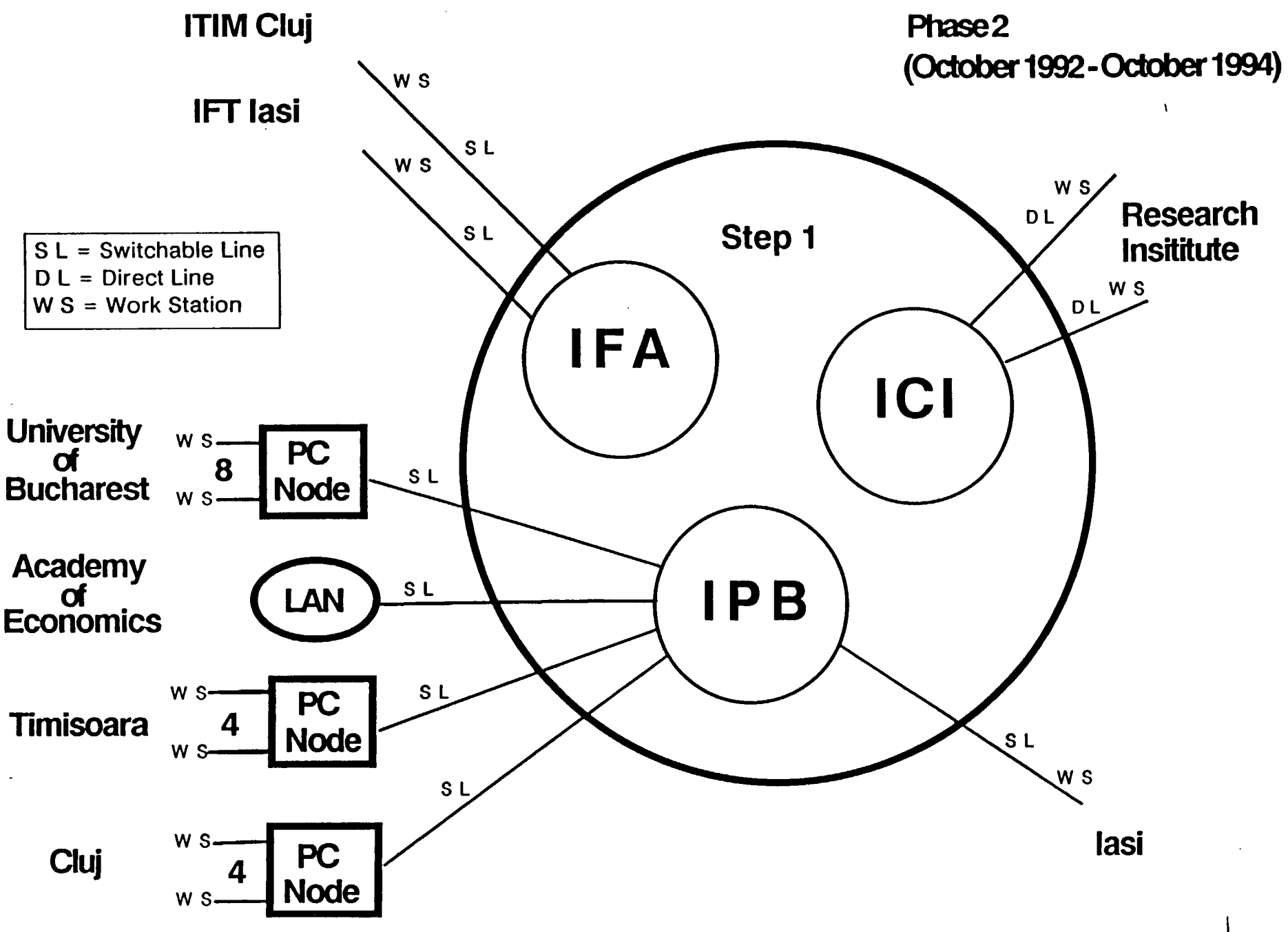

FIGURE 2: SCHEMATIC OF THE SECOND PHASE--ADDITIONAL CONNECTIONS IN BUCHAREST AND LINKS TO TIMISOARA, CLUJ AND

represented and most Value Added Services are being offered by Bucharest-based specialists.

Phase 3 Consolidation and Addition of Other Universities (November 1994-October 1996)

Craiova, Tirgu-Mures, Brasov, Contranta, Suceava, Oradea and other smaller universities are added to the net using either phone lines or other low volume connection technologies. See Figure 3

Figure 3 about here

Results without Value Added Services Added service of this type would be unlikely, since other services would lag significantly and these outlying institutions would probably not be connected until Romania's major backbone network were completed, late in the decade. Phase 2 universities rise to steady state about 10% above previous level. Some Value Added Services being offered by Bucharest specialists.

Results with Value Added Services Bucharest users rise to steady state of about 1,500 users with 15,000 monthly messages and about 2.5 million records. Phase 2 universities rise to steady state about 20% above previous level. Phase 3 users constitute relatively low volumes initially but rise steeply as training and better communications lines become available. Nearly all Value Added Services being offered by Bucharest specialists as well as an increasing number of specialists from Phase 2 implementation.

Timing of Value Added Services

Table 3 describes the Value Added Services listed in terms of the three phase implementation schedule.

Table 3 about here

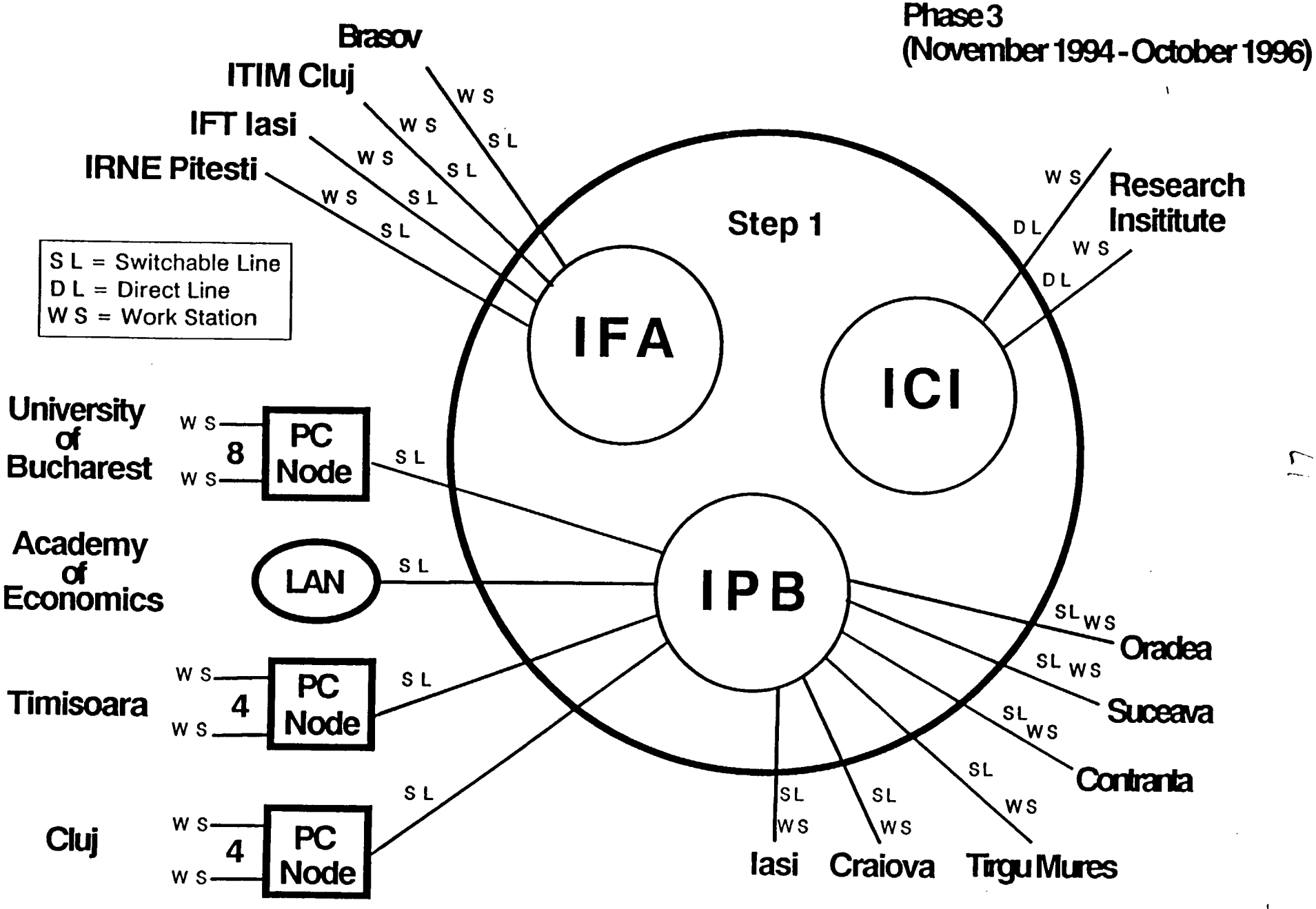

FIGURE 3: SCHEMATIC OF THE THIRD PHASE--EXTENSION OF NETWORK TO OTHER CITIES

Table 3
Applicability of Various Value Added Services to Developing Nations' Implementation Planning: Romania Example

	Phase		
	I	II	III
Assisting in the purchase of specific machines as specialized BITNET/EARN nodes (three systems)	x		
Assisting in the purchase of dedicated software for network management	x		
Short courses for Romanian specialists with EARN specialists in France, Germany and Austria			
Establishing links between BITNET/ EARN connections and other value added services, especially CD ROM and microimaging	x		
Hands-on classes for advanced users	x	x	x
Direct "hand-holding" links with users and prospective users.	x	x	
Hands-on classes in logging on and off and other basic skills	x	x	
Continuing updates and training on new affiliated networks and their operating procedures.	x	x	
On line trouble-shooting services with capability of checking with BITNET, IBM VAX, etc.	x	x	
Services that enhance productivity of BITNET connection, like monthly network updates	x		x
Connecting individual disciplines with colleagues and counterparts in the network	x		

Table 3 (Continued)

Applicability of Various Value Added Services to Developing Nations' Implementation Planning: Romania Example

	Phase		
	I	II	III
Working with BITNET/EARN officials to enhance network connections	x	x	
Performing ombudsman services with respect to proposed new linkages	x	x	x
Aiding in the formation of direct connection to on line search services	x	x	
Devising knowledge based systems to broaden the base of potential users (Small, focused Expert Systems)	x	x	
Help in importing or exporting files including text files, graphics and other digitized data;	x		
Advice on use of current technology in training, including auto-didact materials;	x	x	
Advice or guidance on "best practice" in networking, message management, selection of data communications equipment	x	x	
Assistance in maintaining existing bulletin boards and starting new ones	x	x	x
Assistance in connecting to hundreds of other existing, linked networks,; e.g. ECONET, PEACENET, UNET, etc.	x	x	

Summary

The approach outlined in this paper, using existing international networks and providing strategic value added services to give leverage to specific activities, may appear to be a temporizing one, since it does not insist on the availability of the full infrastructure that will be required for needed network services. Yet such an infrastructure may require a decade or more and vast expenditures. Academic networks may be in the van of the revolution that will allow users to be connected at the earliest possible time to their colleagues all over the world with stable service of a quality expected in developed nations. And the unit costs of this approach, at least one tenth of those for more conventional solutions, argue persuasively that until the full infrastructure is available, academic networks may in fact be the highest level of service--at the lowest unit cost --available to a broad range of users.

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