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MERRY CHRISTMAS

and a Happy New Year
Happenings at Duke University Tel-Com

—Jim Dronsfield

I am sure that many members of ACUTA are finding themselves in the dilemma of now having to evaluate and utilize new station and background equipment that was formerly provided and maintained by the local operating company. If you are fortunate (or unfortunate depending on your viewpoint) enough to replace your switch and station equipment you may have already experienced a major change for your University users. However, many of us are in a transitional stage between a complete replacement and the upgrading of current equipment. The old reliable 1A2 key systems have served well over the years, but new equipment and replacement parts are becoming difficult to obtain.

As your own "telephone company" the responsibility for upgrading and replacement now falls under your jurisdiction. I would strongly recommend that you do not try to become another "phone nut" where a wide variety of selection of types of equipment are offered. I would also be cautious of the many vendors offering the newest electronic key systems at rock bottom prices. Concentrate on one or two proven lines of equipment with a good company track record and prospects of staying in business to support your purchases for many years to come. Training of your own installation and maintenance personnel should be a definite consideration and the fewer variations and diversity of equipment means less expensive training sessions required.

Our experience at Duke covers many years in providing end to end services and we have served as a beta test site for several types of equipment. We have utilized ITT electromechanical equipment for many years and presently are migrating our medium to large hybrid key system customers into the ITT 3100 series. The 288 port 3100L has proven to be a very reliable and feature-rich system and is utilized in many of our new building telecommunications requirements. We have served as the beta test site for the new 3100D data switch in our Computation Center which provides simultaneous voice and data transmission on a modem-less intra-departmental basis. It also provides for modem pooling access to the outside world for data communications. ITT has also recently released the Orion 902 system with a 24/48 line-port configuration for smaller applications.

In order not to give the impression that we are a subsidiary of ITT, I would also like to indicate our use of another fine product - the Iwatsu Omega IV electronic key system. We have been installing this system for over two years and have yet to experience any major trouble calls. It has been used in several applications to replace and expand out-moded 1A2 key systems. It has two cabinets with expansion from 8 lines/24 stations to 16 lines/48 stations. The sets are very attractive and contain 16 prime line buttons as standard features. The non-blocking station line occupies button 16 and all other buttons can be programmed for prime line pickup or special features. A unique feature button pad is mounted above the standard touchtone key pad to allow easy visual prompts to the features. A system speed dialing repertoire of 89 numbers plus 10 speed number unique to each station is built into the background equipment. An LED crystal indicates date, time of day, and length of call is featured on the display sets. The background cabinet is very compact and will fit in a smaller area than comparable KSU units. So far we have had no problem with placing these units in non-air-conditioned areas or areas of relatively high humidity.

Customer training has proven to be a very pleasant surprise. Because the Omega IV emulates closely the operation of a standard key set the user has little difficulty utilizing the set immediately. With follow-up training the expanded availability of the features enhances telephone usage. The Omega IV utilizes just 3 pair of wires so most of our existing cable can be utilized in a replacement project which keeps cost down. The costs for the Omega IV system also compares very favorably with the costs of a 1A2 or 36A key system when labor for installation is considered.

Duke is in the process of bidding a new digital Central office which will provide us much needed capacity and data enhancements for the future. Our planning at the station level will be to gradually migrate our personnel into newer and more feature-rich equipment. Nothing that we improve presently should prove to be incompatible with our new Central Office. We will continue to constantly monitor and evaluate new equipment to keep abreast of the changing technologies in telecommunications.

James B. Dronsfield is at Duke University and Region 2 Director of ACUTA Board.
COMMUNICATIONS, BITNET AND YOU
OR
ACUTA MEETS THE ELECTRONIC AGE

—Neil Sachnoff

The meetings, seminars and newsletters that ACUTA sponsors are more useful then many of us suspect. The wide press coverage they get attests to this fact. Aside from the topics at the meetings, how many useful tidbits of information have you picked up from hallway conversations or get togethers after the meetings? I know that I have picked up quite a few.

There are hundreds of us who are members of ACUTA who can attend only a limited number of functions. This may be because of financial constraints or just lack of available time to attend. Herein lies part of the problem, because of these facts, many of us have a limited opportunity to interact and share information at ACUTA conferences. Yes, Yes, I know there is the telephone, but that requires calling and recalling and speaking to perhaps dozens of members until you reach the one or several that can perhaps help you with a particular problem.

Recent articles by Ruth Michalecki and John Sleasman on the importance of continued education and the help ACUTA sponsored seminars have been to this end, reminded me of another very important medium available to us for continued education and communications. I am referring to electronic mail systems.

Most of us are somewhat familiar with electronic mail systems that service a particular department or school. For example, I use electronic mail quite extensively to communicate with my managers and other administrators around Columbia University. We utilize a DEC 2065 which we have ID’s on. We use the DEC’s particular mail handling system called Mail Manager. Most computer systems have a mail handling capability similar to the one we use. If I need to query or instruct any of my staff on a particular item, all I need do is have the item typed up on the DEC system, or any system for that matter, and mail it to the correct ID of the staff I want to reach.

One very important electronic file/mail system, mom, if not all of us have available is BITNET. BITNET is a nation-wide network of several hundred universities composed primarily of IBM computers running the VM/CMS operating system, but also includes various other systems that can communicate with IBM’s BSCS networking system. BITNET uses a store and forward method of transferring data from one location to another. Most BITNET sites use leased telephone lines operating at 9600 baud between themselves and the next node on the BITNET network. BITNET was initiated in 1981 by the City University of New York (CUNY), and has grown by leaps and bounds since then.

To send a message to someone on the BITNET network you need to know both their computer ID and BITNET node network name. For example, my local ID is NSFPCU, the particular computer I use to receive my electronic mail on is known as CVMA. When I receive mail from other institutions they mail to NSFPCU CVMA. The message is then sent through the BITNET network until it reaches Columbia University and my ID mailbox.

The BITNET network may not seem very important at first, however, after a little thought and practice, the possibilities are endless. Let me give you an idea of what I mean. Columbia University has recently released an RFP for a telecommunications systems. We have raised more questions then we can possibly have the answers too. However, there is a wealth of information available within the ACUTA network of Schools and Universities. One item we have asked ourselves is whether or not we should plan on a backup HVAC system in case of power failure. I could spend several hours calling and recalling dozens of ACUTA members that have recently installed systems to see what their experiences have been. What I would rather do is make a general mailing to a special electronic mailing list I can develop on my computer system and ask the same question of 10;20;50 or as many ACUTA members as I think may be helpful with such a question. Their will be dozens of questions like this that other ACUTA members have already experienced or other questions that have already been answered. BITNET makes this kind of give and take, question and reply very simple.

Perhaps we may consider publishing the "ACUTA NEWS" electronically and distributing it via BITNET, or, if not publishing the newsletter via BITNET, at least using it for the transmission of submission of articles to the editing staff.

Many of your institutions already belong to this fast and easy way of communicating with our large educational audience. I was originally going to do an article on BITNET for ACUTA, however, there is more than ample information available from EDUCOM. If your institution does not already belong to BITNET you can get information about becoming a member from:

EDUCOM
Network Information Center
P.O. Box 364
Princeton, New Jersey 08540
(609) 734-1878
BITNET ID INFOSITE

Remember, BITNET allows you to easily communicate with other persons at other BITNET sites merely by using your local computer systems mailer facilities. If you are not the primary party responsible for these systems at your University, it would be well worth your while to discuss the implications of BITNET to your University.

Getting together several times a year is great, but imagine the power we could share if we were all on the BITNET network. I urge as many of you as possible, if you are not now members of BITNET, join, if you are, use it. My personal BITNET ID is as follows; NSFPCU/CVMA or CU.NSS/CU2OB. Eugene F. Locke, Director of Telecommunications ID is CU.EL/CU2OB.

I have lots of questions and I hope, much to share. The new Member Roster should include many BITNET and other electronic mail/file transfer ID’s, the more we use this communications instrument, the wiser we all can be;)

Neil Sachnoff is Director of Support Operations at Columbia University Center for Computing Activities at Columbia University in the City of New York.

"Have you decided which telephone service we're going to use, dear?"
**DATA COMM FOCUS**

Michael F. Finneran

Packet Switching

One of the most exciting technologies in data communications today is packet switching. It is being implemented in a number of new products including AT&T's Information Systems Network and Northern Telecom's Meridian. Also, a number of Regional Bell Operating Companies (RBOCs) have announced plans to offer packet switching services in competition with the established packet carriers like GTE's Telenet, McDonnell Douglas' Tymnet and United Telecom's Uninet. What's more, the possibility of using packet switching techniques for carrying voice traffic has reemerged.

The column is divided into two sections. The first deals with the development of packet switching in the public network area and its unique applicability to data communications. The second section deals with the subject of a private packet network planning.

How Packet Switching Works

The public packet switching networks that we have today were developed by Value Added Common Carriers (VACCs). A Value Added Carrier leases basic communications services from another carrier (typically private line services) and then adds some processing intelligence and resells what the FCC terms an "Enhanced Communications Service" to end users. In the case of the packet carriers, the added intelligence takes the form of minicomputer based communication controllers called "packet switching nodes" or simply "nodes." Nodes are connected together by the leased private line facilities to form a network through which the carrier can provide service to end users. (See Figure 1.) The nodes provide the capability to allocate the communication capacity in a very efficient fashion and can also provide protocol conversion and billing features.

The easiest way to understand the principles of packet switching is to go back to its inception in Arpanet. The Advanced Research Projects Agency is a government agency which does basic research. Some of that research is conducted in government laboratories, and some in university or private research laboratories.

The researchers needed access to computer resources to support their projects. Most often, those resources were minicomputer systems that were accessed by low speed (110 or 1200 bps), teletypewriter compatible terminals through dial-up (DDD or NATS) facilities. Those facilities, which were billed solely on the basis of connect time, were used very inefficiently with terminals that were transmitting at keyboard speed. A person typing 50 words per minute continuously can produce only 50 bits per second of data for transmission while a voice grade, dial-up channel can carry about 4800 bits per second--about 100 times as much! The network designers thus had to look for a more efficient way to provide that communications capability. The constraint was that the user required interactive access to the host and so batch communications or message switching were automatically ruled out.

Packet switching was selected because it could provide interactive access and at the same time allocate expensive communication resources efficiently. In a packet network, the user is attached to it through one of the nodes, typically over a local dial connection using a 300 or 1200 bps asynchronous terminal (the larger packet carriers can be accessed with a local call in about 400 cities in the U. S. and 50 countries overseas). The user's connection through the node by typing the address of the computer system he wishes to access. In order for a computer system to be accessed, it must be connected to the network through a dedicated port (or ports) on one of the nodes. The nodes establish a connection between the terminal and the host by writing a packet in software that will cause the user's data to be routed correctly over the network. When the connection is established, the user transmits data to the node which briefly stores it. (Usually one line of data is stored.) The node then wraps the data in special error detecting and correcting network protocol and attaches the address that it has stored for that connection. (See Figure 2.) The addressed data is called a "packet" and is transmitted over one of the trunk facilities attached to that node. The packet may be routed directly to the destination node (i.e., the node to which the other packet network the user is attached) or it may be handled by several other nodes before reaching its destination. When the packet arrives at the destination node, it is checked for transmission errors -- if an error is detected the node automatically requests a retransmission. The node then strips the protocol information from the packet and passes the data on to the terminal.

While a delay is introduced into the transmission by the packeting and unpacketing process, the connection approximates DDD network service. As in telephony, the network must be engineered to provide an adequate grade of service for the terminal users. If there is not sufficient carrying capacity available in the network, the amount of time it takes to send a packet through the network might increase from a quarter of a second to two or three seconds. This connection is called a "virtual connection" because while it acts like a "real" connection between the two terminals, there is no unique physical path linking the two. The "connection" exists because of the routing instructions that are written in the software; when the terminals disconnect, the routing entry is erased.
The Cost Argument for Packet Switching

While packet switching technology is interesting, the issue of whether to use the packet network to serve a particular application comes down to cost. The process of breaking the data into addressed packets, usually up to 128 characters in length, allows the carrier to support hundreds of simultaneous terminal connections over a single high speed communication path. Part of that savings can be passed on to the customer in lower prices. However, since the communication facility can be shared efficiently, the packet carrier can provide a cost effective alternative to the switched telephone network for certain types of data communication applications.

The pricing structure for a packet network breaks the connection charge into two parts:

- **Connect Time** -- based on the amount of time the user is connected to a node;
- **Usage Charge** -- based on the amount of data that is transmitted during the connection.

Given this pricing structure the packet network is most appropriate for communication sessions that are long distance -- because the charges are not distance sensitive; and have long holding times and relatively low data volume -- connect time and usage are billed independently, where in other dial services you pay solely for connect time regardless of how much data is actually transmitted.

![Figure 2: Simplified Packet Format](image)

**Other Features of Packet Switching**

Aside from the factor of cost, the packet network can also provide other benefits for the data communications user. The packet switching nodes utilize a protocol that can detect and correct transmission errors. It should be noted that if no error protection is provided on the link between the user's terminal and the node and an error occurs there, that error will be transported through the network.

The other major feature of a packet network is protocol conversion. Regardless of the protocol that is used between the user's terminal and the node, the node always translates the data into a standard protocol that is used between the nodes. The destination node then translates the data from the "inter-node" protocol to the protocol that the destination terminal requires. There is no reason that the terminal protocol used at one end of the connection has to look anything like the protocol used at the other end. The user's terminal might be a teletypewriter compatible device that communicates at 1200 bps asynchronously using ASCII transmission code, while the computer interface at the other end of that virtual connection might operate at 4800 bps using a Bi Sync 3270 protocol. As the packet network uses its own transmission speed and protocol between the nodes, it must translate to and from terminal protocols. In fact, each time the user requests a connection, the network can provide speed, code and protocol conversions that make his terminal compatible with the communication requirements of the host systems, thus allowing a user to access a number of dissimilar host systems from a single terminal. The host systems can also use the packet network for file transfers, again using the network to correct for incompatibilities.

Packet networks support a number of standard terminal protocols including:

- Asynchronous teletypewriter
- Bi Sync 2780/3780 (Batch)
- Bi Sync 3270 (Interactive)

The network also supports a CCITT protocol that was developed specifically for packet network access called X.25. The X.25 protocol has certain unique features that are geared toward the packet switching environment.

**CCITT Recommendation X.25**

The CCITT X.25 Recommendation is entitled "Interface Between Data Terminal Equipment (DTE) and Data Circuit Terminating Equipment (DCE) For Terminals Operating in the Packet Mode and Connected to Public Data Networks By Dedicated Circuit." While the CCITT might be a bit long-winded in their titles they are quite precise. The X.25 protocol is used primarily for access from user devices to packet nodes, normally on connections from host computer systems. In that environment, X.25 provides a particular advantage: a single X.25 connection can simultaneously support multiple user sessions. Under its current implementation, X.25 does require a private line connection between the host system and the node (a dial-up operation is defined in the 1984 version of the Recommendation). X.25 defines its own packeting format so that user data is formed into addressed packets and transported over a single link between host and node. This operation has proved to be cost effective over the earlier implementations where a unique port on the node and a dedicated facility of some form was required for each terminal connection. (See Figure 3.) The X.25 protocol sequence also provides for error detection and correction between the node and the host. An X.25 interface could be supported between a user terminal and the node, but economics usually stands in the way:

- The terminal would have to be connected by private line to the node (i.e., no dial-in access is being supported as yet);
- The terminal would require some significant processing capability to generate the protocol sequences (i.e., that intelligence is not found in the $500 to $1000 terminals that are normally used for these applications);
- A user terminal having only one keyboard and one printer would have no requirement for multiple simultaneous sessions.

This situation may change with personal computers which are being used as terminals today. Currently the PCs emulate asynchronous teletypewriters, but they have the intelligence to support more complex communication procedures. Tymnet, which operates one of the largest packet networks, has developed a PC access protocol for their network called "X.PC" that works like a simplified version of X.25 and operates in a dial-up mode. One of the advantages of X.PC is that the packeting feature of the protocol allows data to be routed to or from different "windows" on the PC.
The CCITT has also defined the procedures for converting asynchronous data into an X.25 stream using a type of protocol converter called a "Packet Assembler/Disassembler" or PAD. The CCITT Recommendation covering the PAD procedure is X.3, and there are a number of these devices on the market. The PBX suppliers are getting into the act as well, and Rolm Corp, ATTIS, Northern Telecom, NEC and others have either developed PAD functions for their products or announced their intention to do so.

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Packet Switching Applications

While much of the traffic that is carried on packet networks today is virtually identical to what we saw with magstripe in the late 1960s (i.e., asynchronous terminals accessing time sharing systems), the unique features of the network make it appropriate for other types of communications as well.

Personal Computer Communications: Packet switching has already been discovered by the personal computer industry as a vehicle for low volume interactive communication. With the networks supporting asynchronous error-correcting PC protocols such as "Xmodem" and "X.PC," we can only expect this use to grow. PC file transfer in the packet medium may not prove to be there is access to the packet network. The same characteristics as a batch communication session, and packet communication has not proven itself to be a suitable vehicle for high volume batch sessions due to the number of packets generated and hence, the usage charge.

Credit Authorization: With the advent of low cost credit authorization terminals, packet networks can be used as an economical transport mechanism. The terminal can read a customer's account number from the magnetic stripe on the back of a credit card and transmit it through the network to a computer system that verifies the credit and approves the transaction. This verification provides security to the merchant and the credit card company and eliminates the need for manual look-up so the customer is served more quickly.

Message Communications/Electronic Mail: Packet networks have been used to access message switching systems since the mid-1970s. In this application packet switching can provide cost effective communication and allows a user access to the message switch whenever there is access to the packet network. This capability has been used almost exclusively with teletypewriter terminals, additional features have been added to support communicating word processors. One of the major obstacles with word processor communications has been the inability for formatting codes generated by one vendor's equipment to be interpreted by another's. This meant that complete documents (i.e., including all the formatting commands) could be exchanged only between word processors from the same vendor. The electronic mail systems offered by the carriers now provide that format conversion as well as the basic message switching service. Documents can be exchanged between word processors, teletypewriter terminals and even telex locations with the message system providing the necessary conversions.

The Future of Packet Switching

The packet switching applications discussed this far have dealt almost exclusively with long distance communications. The reason is simply that in the long distance area, the technology has been most cost effective. Many of the newer implementations of packet switching address local communications. A number of the 950s are implementing local packet networks within LATA's and plan to provide service to end users. As the tariff rates for these services are not yet available we cannot readily predict if they will meet with any success. Traditionally the cost of the nodes has been justified by an off-setting reduction in the number of long distance communication facilities required. We will have to see if the market finds a value in these services, or if we will have the opportunity to subsidize them with our local phone rates.

The ATTIS Information Systems Network (ISN) and the Northern Telecom Meridian data switching add-on both use what is essentially packet switching techniques internally. The advantage is that switching capacity can be allocated more efficiently than channel capacity.

However, it may be some time before we see packet switching used in the voice area. The possibility of using packet switching techniques to carry digitized voice has been discussed for a number of years, but the processing power required to packetize the high bit rate data streams produced by digitized voice channels goes far beyond the capacity of our existing packet switching nodes.

Even if none of these applications turns out to be viable (a prospect that does not seem likely), packet switching techniques have been shown to provide cost effective long distance communication and protocol conversion services.

Private Packet-Switching Networks

The following section was written by Lou Piazza, director of product marketing for BBN Communications Corporation of Cambridge, MA.

A growing number of users are examining the option of a private packet switching network. With a public net, you buy service. With a private network, you buy a system. There are more responsibilities involved in buying a system such as selecting components and managing operations -- but there are also many potential advantages. The main reason companies elect to go the private network route can ultimately all be viewed under the heading of control.

A private network can provide control over such factors as:

- availability, quality and reliability of service
DATA COMM FOCUS. Continued:

- cost: particularly through reducing or slowing growth of line costs
- geographic coverage
- security
- planning and growth

-specific technical features and capabilities: can use technologies which have features not available in public networks, e.g., routing algorithms, protocol support, higher trunking speeds; use/restrict specific media.

There are also several "in-between" approaches, such as virtual private networks configured within a larger private or public network; third-party private networks where a complete network and its control are provided through a separate organization; and hybrid networks which combine private and public portions. However, these can all be viewed as special cases of virtual networks, as the customer is able to make choices and control and the quality of network service.

Defining the needs in any of the control factors listed above translates into specific criteria which become part of the vendor evaluation and selection process. Other user concerns include vendor experience, customer referrals, current and planned product offerings, geographic availability, ability to deploy the network to meet the required schedule, design, operations and management support, and custom product and services engineering capabilities.

The Network Design Process

Although the major components can easily be standard, off-the-shelf hardware and software products, each network must be a uniquely designed system. The submission of one or more network designs is usually a major portion of a vendor's response to a network RFP.

The information needed to design a network includes the intended locations of network sites, hosts, terminals and other facilities; user transactions (data entities, by application), and anticipated average/peak traffic; costs of components and lines; performance criteria such as delays, reliability, availability, survivability, growth and security, and restrictions such as where equipment cannot be installed and what lines are already in place and still required.

The resulting network design includes configuration and topology for the access and sub-rings -- i.e., a list of the packet switching nodes (PSNs) and Packet Assembler/Disassemblers (PADs), the locations this equipment goes and the transmission services needed to connect it -- plus itemization of any access, management, control and service costs. The solution usually includes itemized lists plus physical and logical maps.

The standard approach to network design is to "build" mathematical models of possible network topologies, plug in traffic, performance, cost and other data, and run a series of simulations of network performance until the optimum solution is found. In theory, this sounds straightforward. In reality, the model-solving process is complex, time-consuming and required design experts to investigate alternative topologies. While the model calculation can be speeded up, and some degree of the model selections automated, the heuristic experience and intuition of network designers cannot be totally replaced by automated tools.

Once a basic design has been arrived at which meets requirements for performance and cost, other tests are needed such as reliability analysis and analyzing the connectivity of the topology to determine how many link or node failures can occur before the network partitions (i.e., breaks into two or more sub-networks, each still capable of independent service, but unable to intercommunicate).

Bringing in the Network

Integration is the challenge of producing a network from its component parts. Network integration activities include logistics, software configuration, software distribution, system engineering, staging and troubleshooting.

Like designing a network "bringing it in" is no small task and may well span two years or more, and there is some follow-through that continues for the life of the network. The size, scope and importance of a private network is such that the primary vendor often assigns a project team to manage the initial installation and integration activities, and to provide long-term coordination for network operational quality and capacity management and growth.

Bringing in the network involves many parallel activities. New sites and facilities for equipment and network control centers must be planned, surveyed and prepared. New staff may need to be hired and trained. Transmission lines must be ordered and installed. Concurrent with this are activities relating to the actual component manufacturing, staging, integration and network test/acceptance.

The network itself is usually brought up in a series of steps, each carefully staged and monitored. These steps include (not necessarily in this order):

- Test network configuration: running test traffic
- Initial operational network: running test traffic
- Operational network configuration: running initial real traffic
- Geographical expansion and new applications
- Interfacing to other operational networks
- Transfer of the operational network procedures to customer operations personnel

Once the network is operational, one very important aspect of post-installation support is network performance analysis. Ongoing evaluation of network performance based on operational and traffic statistics generated by the network is performed by network designers using the same method that led to the initial network design. Through this activity, the network topology and configuration can be examined against actual traffic and performance data and recommendations can be made to add, drop, or move network resources to maintain optimum price-performance and to guide network growth.

Network Management and Control

Like any sophisticated computer-based system, a packet-switching network requires management and control. The design and "intelligence" of the network components may allow the overall network to automatically detect, compensate for and automatically correct the bulk of routine problems and stuggles. This capability will ensure minimal or no disruption to service.

However, certain central activities are essential to daily and long-term network operations. These central activities can be divided into five major areas:

- Configuration Management: addresses the inherent
Hard to realize another year is coming to a close. I wonder if deregulation and divestiture activities are settling down, or if we are still struggling with knowing who's on first. This year saw a lot of our members installing their own switches and a lot of them electing to retain central office services. Increased need for data communications and the need for higher speeds are finally coming into play, after talking about this for years. I was reading the results of a recent survey in the magazine On Communications where the question was "What are your most pressing data communications needs?" The overall, prevailing response was for standardization of equipment so it would become simple to hook this up to that. Another response that was given by many was for a LAN that really worked! Communication links that connect minis and mainframes and minis and printers, etc., was also high on the priority list. Several respondents called for a return of Ma Bell as sole source supplier, while faster and better installation also rated a high priority. I felt I could readily identify with all the answers. Our annual conference next summer will respond to the need for further education for our members in the data communications field.

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I see where Harris has announced their new 'fourth generation' PBX, called the 20-20 PBX. It ranges in price from $400 to $900 per line, attendant workstation is priced at $2500 and the telephone sets from $350 to $700.

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Some additional info about switch activity at Lehigh. Lehigh will spend about $20 million on their telecommunications project that includes equipping every student residence, faculty and staff office with simultaneous voice/data links. Intecom of Dallas will be installing the Zenith 10 and Zenith Data Systems will supply 350 Model-158 Personal Computers to faculty members plus 250 slated for public sites around the campus. No modems will be used in the residence hall system. The University has opened a computer store to give students the opportunity to purchase a Zenith 168 PC, with a single floppy disc drive, 128-K RAM, software and monochrome monitor for about $1275.00. Databases will include library card catalog system for locating books, articles and other documents and the new computer center will offer online services including electronic mail. Printers will be located at various strategic points on campus. Lehigh has 6300 students.

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The University of Illinois has a pilot project underway to determine the best way to accomplish full computerization of the residence hall system. About 261 students in a co-ed dorm will have IBM PCs installed in their rooms. IBM will provide $700,000 in equipment and software, while the university will spend about $75,000 in contain service. The objective of the pilot project is to determine what's being used, how it's being used and how it affects the student's personal and academic lives, according to Howard Diamond, Assistant Vice Chancellor for Student Affairs.

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Best wishes to all of you for a Happy Holiday and for a New Year full of good health, good friends and effective, economical solutions to all your telecommunications problems! Merry Christmas from all of us at The University of Nebraska.