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ABSTRACT

Written for the information technology manager who is about to enter the telephone communications system business, this paper takes a "primer" approach, outlining the major issues in telecommunications which face all higher education campuses today. An introduction which places the issues into perspective is followed by a quick look at the history of deregulation and the effects of divestiture. The basic components of the telephone business are then described, i.e., switch options, financing considerations, management systems, telephones, Integral Services Digital Network (ISDN), and wiring. Finally, some of the management issues of a telecommunications organization are considered. Information is drawn from publications listed in the 34-item bibliography, experiences at Florida State University, and a 1988 survey of 22 universities. (DB)

CAUSE

The Association for the Management of Information Technology in Higher Education

An Information Technology Manager's Guide to Campus Phone Operations

by Gene T. Sherron

Professional Paper Series, #3

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Preface

We are liberated! We are deregulated! Gone are the days of the Bell monopoly. But what does this really mean? We now have more options and many more responsibilities—and we can no longer look to someone else to do it for us. Like it or not, we are all now involved in telecommunications.

This guide is written for the information technology manager who is about to get into the phone business. The paper takes a "primer" approach, outlining the major issues in telecommunications which face all of our campuses today. An introduction, putting the issues in perspective, is followed by a quick look at the history of deregulation and effects of divestiture, then a description of the basic components of the phone business—switch options, financing considerations, management systems, telephones, wiring, ISDN, and, finally, a brief consideration of some of the management issues of a telecommunications organization.

Throughout this guide, the choices are illustrated by real-people experience and data. Besides the information drawn from publications listed in the bibliography and our experiences at Florida State University, actual campus experience is presented from a December 1988 survey providing data collected from twenty-two universities. Miscellaneous surveys conducted by the Datapro Research Corporation are also referenced.

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Gene T. Sherron
January 1990

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About the Author

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INTRODUCTION

The most significant judicial ruling of the past decade with regard to technology has given information technology managers challenges and opportunities that never seem to cease. That 1984 ruling was handed down by U. S. District Court Judge Harold H. Greene, who was responsible for the AT&T divestiture agreement and the settlement of the federal antitrust suit against AT&T. The effects of divestiture are widespread, and they continue to evolve as follow-on rulings and adjustments take place.

Are we better off today, with regard to telecommunications, than we were five years ago? We were warned that there would be a period of "adjustment" after deregulation. Judge Greene promised that deregulation would increase competition *and* lower costs to the consumer. Over the past four years, competition in long-distance service has resulted in lower costs to the user, but we have found that local service rates have gone up.

So, how are we doing? Some costs are up, others are down, and we seem to have a lot more work to do. Indeed, the work has to do with choices we were never faced with before. Now we have difficult judgments to make in the telecommunications area. What would a wise old man tell us?

> Life is short,
> the art long,
> opportunity fleeting,
> experience treacherous,
> judgment difficult.
> — Hippocrates, 460-400 B.C.

Prior to 1984, the *judgment* on campus was not as difficult. Our local telephone company provided *all* of our telecommunications services. It was regulated, and it was the law. Remember those simple times when the telephone coordinator at the physical plant office took care of phone service, and the computer center ordered data circuits? A lot has changed since then. The deregulation of 1984 opened a Pandora's Box of decisions for us to make. Now the judgments in telecommunications are difficult.

I was motivated to develop this *Information Technology Manager's Guide to Campus Phone Operations* as a result of my past two years of immersion in this area. For the prior twenty years, most of my experience had been in computing and information systems. Sure, most of us in computing understand data, and some of us have even been involved in microwave signaling. But few computer managers have experience in the voice communications side of information technology management.

All of this is changing. Why? It is not solely because of deregulation; we have moved to a point in computing where networking is the real challenge of the 90s. Thus, we need to be a part of the planning, developing, and decision making about all three of the facets of communications—not just data, but the voice and image components, too.

Given this premise, this paper addresses some of the important aspects of planning for telecommunications because these decisions will affect the computing scene. To make a contribution, we need to know something about the telecommunications industry to appreciate why companies do things the way they do. As in computing, there is a unique vocabulary and jargon for the trade. We all have a lot to learn.

The heart of this paper lies in the second section, *Getting into the Phone Business*. It is here that some of the key issues are identified and discussed:

- Should a campus buy a switch or procure the service from the local telephone company? What are the differences in costs?
- What are the financial considerations? How can the endeavor be financed? What are some of the potential revenue streams?
- Do you need a telephone management system?
- Now that the local phone company has passed along the problem to you, do you need to replace those old rotary dial phones? rewire campus buildings? dig up campus to lay fiber optic cable?
- What is ISDN, and do you need to consider it?

It would be naive to represent that these considerations make up the totality of telecommunications. One of the more difficult judgments that the university will have to make concerns people issues. So this discussion includes a few observations about the newest technology position on campus, the Director of Telecommunications, and concludes with advice from more than a dozen individuals who make their living in campus telecommunications.

As most of us know, decision making can be a very lonely job. The recommendations that we pass on to top management represent our best professional judgment. But these difficult judgments can be less lonely if the road we take is one that has been traveled by others.

1 DEREGULATION

Over the past decade, our government has deregulated trucking, airlines, banking, and, most recently, telecommunications. Since Judge Greene's ruling in 1984, the monopoly is gone; we can now go to the marketplace and select from dozens of vendors. But before we settle down to reviewing our choices under this new freedom, let's take a brief look at history.

A Brief History

Did you know that 1984 was not the first time the Bell monopoly was dissolved? Almost a century ago, in 1894, the Bell System patents ran out and competitors began to nibble at Bell business. Within three years, 6,000 telephone companies were established to manage 240,000 phones—that's forty phones for each company.

These pioneering telecommunications entrepreneurs provide some interesting stories. An undertaker invented a circuit switch that led to today's switched network. A medical doctor came up with the idea of telephone numbers. In an era that lacked indoor plumbing, interstate highways, and McDonald's, parts of the country that were ignored by the original monopoly were tended to by the independents. In fact, the independent telephone industry of today grew out of those early sharing and resale cooperatives. My home state of Florida stands as living example of this heritage, with its thirteen independent companies operating as islands in the ocean of Southern Bell. But even the independents could not serve rural America completely. Farmers were inclined to take matters into their own hands by using their barbed wire fences as telephone lines. Today, we call that "bypass."

At the turn of the century, the flourishing telephone business brought on advertising slogans like, "We have two ears, why not two phones?" But several states began a piecemeal end to deregulation by setting up rate-regulating bodies, and then Congress placed long-distance telephone operations under the jurisdiction of the Interstate Commerce Commission. Even before World War I, England and France had nationalized their phone systems. Woodrow Wilson was running on a platform that would have the Postmaster General operate a nationalized phone company. This actually happened several years later in 1918. Within a year, service had deteriorated so badly that Congress reversed itself and returned the phone company to private ownership.

For the next sixty-five years, the Bell system monopoly grew as rapidly as technology itself. The installed base of phones grew from 10 to 150 million, industry assets grew from $4 to $180 billion, and AT&T revenues grew from $3 to $60 billion.

This period of regulation was one in which both the government and the phone company raised barriers to competition when it was senseless to do so. Microwave radio transmission that was honed during World War II was a growth business, but private companies were not allowed to use it. Regulation moved from the sublime to the ridiculous when the Federal Communications Commission (FCC) ruled against plastic covers on public phone books as "harmful to the network and posing a safety hazard" to society.[1] Yet the force of technological advance was relentless. The Bell monopoly began to erode in the same piecemeal fashion as that in which it was created. The key steps in this chronology were:[2]

- 1957- Hush-a-phone is allowed to attach its rubber ear piece to a Bell instrument.
- 1959- FCC allocates spectrum for private microwave systems.
- 1968- Carter Electronics allows limited interconnection to the public (AT&T) telephone network.

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[1] Lynn A. DeNoia, *Data Communication: Fundamentals and Applications* (Columbus, Ohio: Merrill Publishing Company, 1987), p. 101.

[2] "A History of the Telecommunications Regulatory Environment," *Datapro Management of Telecommunications*, January 1985, p. 105. Copyright McGraw-Hill Incorporated, Datapro Research, Delran, N.J.

1971- Computer Inquiry I stops common carriers from offering data services.
1972- FCC opens domestic satellite communications to competition.
1976- FCC permits sharing and resale of private line services.
1978- Courts allow MCI to offer switched services.
1980- Computer Inquiry II de-tariffs new residential and business telephones, Private Branch Exchanges (PBXs), modems, and other end-user devices.
1982- AT&T and the Federal government agree on divestiture plan.
1984- Divestiture!

Divestiture

Seven years after filing its antitrust suit against AT&T, the Justice Department made an agreement with the company to drop the suit if AT&T would give up its twenty-two local operating companies of the Bell System. The settlement included the following points:[3]

- AT&T would divest itself of all exchange access and local exchange services. This created the twenty-two separate operating companies that could even compete with each other.

- No relationship could exist between AT&T and the divested companies. This was intended to keep customer rates from skyrocketing after divestiture.

- The divested companies would have to provide equal access to all interchange carriers. This allowed consumers to use an alternative carrier by just dialing the area code and seven-digit telephone number, eliminating the need to dial multiple strings of numbers associated with such fledgling alternative companies as MCI.

- The twenty-two new companies would not be permitted to discriminate in favor of AT&T for procurement of products and services. This ended the practice of buying from Western Electric.

- The divested companies would be able to provide basic services only. This prohibited them from providing interchange services, information services, or any type of non-tariffed services.

- Finally, AT&T was prohibited from being involved in the information services and electronic publishing industries until August 25, 1989. (Watch for this "sleeper"!)

The Baby Bells and Access

The twenty-two Bell Operating Companies (BOCs) that existed prior to divestiture are now grouped into seven Regional Bell Holding Companies (RBHC). They are completely disassociated from AT&T and are free to deal with any equipment and facilities vendor they choose. The RBHCs and BOCs can sell but not manufacture terminal equipment (customer premises equipment or CPE).[4]

As part of the judgment, all of the BOCs must offer equal access to all common carriers. This ruling allows customers to choose a primary common carrier—AT&T, MCI, US Sprint, etc., also called Interexchange Companies or IXCs—for their long-distance calls and reach their carrier simply by dialing "1" plus the area code and telephone number. Equal access means that customers can now use the services of as many long-distance carriers as they wish. Access to these alternate carriers is achieved by dialing only five extra digits.

The charge to connect the customer to the local telephone company and thus to access the long-distance carrier has been implemented after considerable controversy. Current monthly charges for the connection to the outside world are about two to three dollars for residences and slightly more for businesses.

The Bypass Business

Bypass is defined as the use of communications facilities or services to go around, avoid, or bypass the local telephone exchanges of the public switched network. With the threat of large rate increases in local telephone service and the fact that advances in technology make it more attractive, bypass has become more of a viable alternative to many large organizations. Some of the more popular bypass technologies:[5]

- Microwave is the direct, line-of-sight transmission of radio waves. FCC-regulated, affected by weather, and in need of retransmission towers every twenty-five miles or so, it is still the most popular means of bypass today.

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[3] "AT&T: Straightforward Answers You Need Now," *Datapro Management of Telecommunications*, April 1988, pp. 105-106. Copyright McGraw-Hill Incorporated, Datapro Research, Delran, N.J.

[4] "A History of the Telecommunications Regulatory Environment," pp. 115-117.

[5] George W. Reynolds and Donald Riecks, *Introduction to Business Telecommunications*, 2nd ed. (Columbus, Ohio: Merrill Publishing Company, 1988), pp. 25-27.

- Fiber optic cable transmits by means of light that transforms the signals into light pulses. Despite high system cost, the need for right-of-way, and costly interconnections to copper, the technology is becoming more attractive as costs come down— primarily because of its high bandwidth.
- Coaxial cable is a popular local area network medium for buildings and between buildings. Between buildings, it can be used as bypass.
- Cellular radio has stirred up quite a bit of interest recently as cellular phones have appeared in most metropolitan areas. Usage costs are coming down as vendors find alternative pricing and renting plans. The cost per minute of using a cellular phone is still high, compared to conventional phone lines. As a bypass technology, cellular phones are suited only for special purpose applications today, such as backup of other phone circuits. The cost per minute will drop in the next few years, making cellular a more attractive bypass option.

These alternative technologies seem so appealing for bypass because bypass technologies frequently offer greater bandwidth than copper-wire pairs, faster service than the local telephone company, greater reliability and flexibility, and greater cost control because of customer-owner equipment. As these areas of technology expand, the pricing structure will eventually come down, encouraging more and more companies to consider bypass and causing the local telephone company to price its services more attractively or provide services with higher capacity.

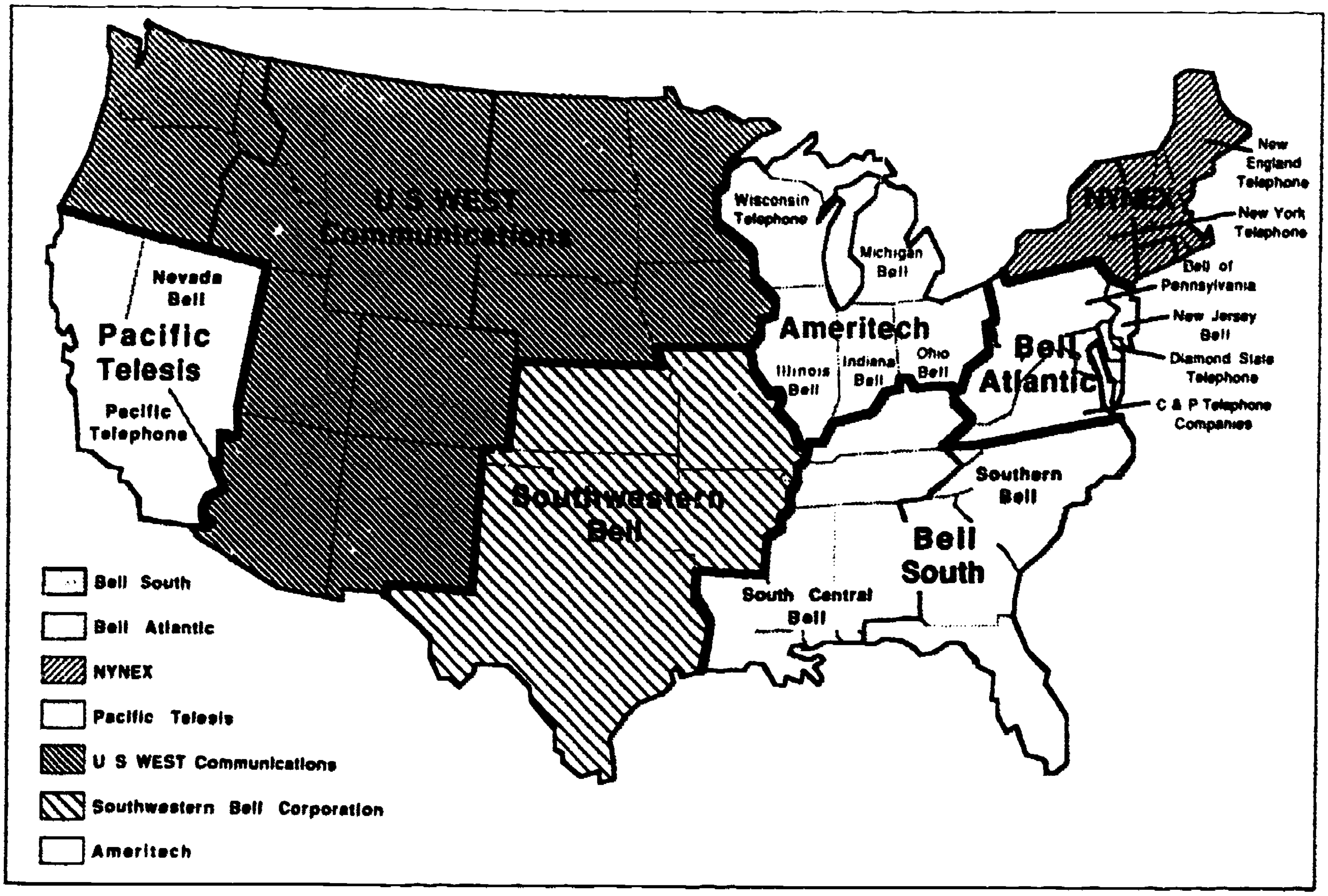

Figure 1. The Seven Regional Bell Holding Companies

From "The United States: The Commercial and Regulatory Environment," *Datapro Management of Telecommunications*, May 1989, p. 402. Copyright McGraw-Hill Incorporated, Datapro Research, Delran, N.J.

2
GETTING INTO THE PHONE BUSINESS

As in any planning endeavor, approaching the question of whether or how to get into the phone business requires several steps before a recommendation can be made: (1) identifying the problem, (2) gathering the facts, and (3) developing and analyzing the alternatives.

Often the problem identification is easy. At Florida State University (FSU), for example, the phone switch was thirteen years old, and the regulated company threatened not to maintain it any longer. In many cases, the basic problem is usually one of economics or cost-effectiveness. In our 1988 survey (to which twenty-two of thirty-five well known universities responded, identified in Table 2 on page 7), we found that of the ten respondents that had bought their own switches, six did so seeking a more cost-effective system.

The remainder of this section is designed to help you with the second and third aspects of deciding whether and/or how you will get into the phone business: gathering the facts and developing and analyzing the alternatives.

The switch industry is big business, and the switch is only one part of the system. The wiring, both in the buildings and underground, is an expensive capital investment. If new phones are installed, as was the case at FSU, the total system cost goes up another million or so. Keep in mind that, because these are multimillion-dollar acquisitions, the process will generate great interest on campus, and among a dozen or more vendors wanting your business.

Let's begin with a look at the fundamental decision that you will need to make.

Centrex vs. PBX

The freedom of choice resulting from deregulation gives a college or university one of the biggest dilemmas it will ever face: whether to (1) subscribe, or continue to subscribe, to Centrex service or (2) acquire a private branch exchange (PBX), or switch, for the campus telecommunications services. In the first instance, the switch will be located in the local telephone company office. If it is campus-owned, it will be in one of the campus buildings.

Centrex

Centrex is a business telephone service offered by a local telephone company (telco) from a local central office. It is basic telephone service delivered to individual desks, the same as you get at your home, but it is offered to businesses with more "bells and whistles," or features.

Centrex service was first introduced in the early 19[illegible]0s and targeted small and large users with enhanced features available to all, for a price. It has been marketed by the BOCs under a variety of names over the years, including Centron, ESSX, and Plexar. The independent telephone companies also use the "Centrex" term in its generic sense. Western Electric produced these central office switches for the BOCs up through divestiture. Now the renamed manufacturing arm is AT&T Technology Systems. Both before and after divestiture, the AT&T switches have been called ESS (Electronic Switching System) and the model number is now up to five, or "Number 5 ESS."

Centrex is designed for the organization that does not want to run its own telecommunications utility. The Bell companies are aggressively positioning Centrex to compete with the PBXs, and new digital central office switches are giving them the power to compete. The emerging standards of the Integrated Services Digital Network (ISDN) are allowing these companies to offer Centrex customers multiline and feature phones just like PBX manufacturers' proprietary phones—more on all of this on pages 20-21.

The modernization of central office switches from analog to digital reflects the war that is going on in the U.S. among two giants, Northern Telecom and AT&T, along with GTE, Stromberg-Carlson, Ericsson, NEC, and Siemens (and, worldwide, with Alcatel). Both Northern Telecom and AT&T offer all state-of-the-art Centrex services including slow-scan video, packet switching, graphics, and central-office-based local area networks and. In the future, they will accommodate electronic mail and ISDN.

Private Branch Exchange

A PBX, or switch, is the other horn of the dilemma. A PBX is a business telephone system that provides inside calling among users within an organization, and makes efficient use of lines that tie the PBX to the outside or the local telephone companies and long-distance carriers. It is private in the sense that it is in your building, run by your people, and serves your organization. The "branch" comes from predivestiture days when a PBX was like a branch of a Bell System central office but located on a customer's premises. (This gives rise to the phrase "premise-based equipment," which is commonly used in the industry.) "Exchange" refers to electronic equipment that controls the connection of incoming and outgoing calls—in other words, a switch. The term "switch" usually means something that central telephone offices have. But the PBXs that campuses are buying today are like those of the central office, so the words are often used interchangeably.

Like the computer mainframe business, the number of manufacturers of PBXs has grown since deregulation—more than thirty companies now offer over eighty models. Three vendors dominate the U.S. market: AT&T, Northern Telecom, and Rolm. Mitel, Intecom, NEC, and Ericsson also share the market. And like buying a very large mainframe, the purchase of a PBX system is a multimillion dollar capital project. The number of lines basically dictates the size, and thus the cost, of the switch. From that general sizing, other factors specific to the individual campus will also affect the cost of the switch. Prices of some of the more popular switches are illustrated in Table 1.[6]

As mentioned earlier, freedom of choice came as a result of the Computer Inquiry II of 1980. From that date, new residential and business telephones, PBXs, modems, and other end-user (premise-based) devices were de-tariffed. When I was at the University of Maryland in the early 1980s, I remember moving into a new central administration building and buying all new phones and a PBX for the building. The low bid was ITT's, and we experienced our first "freedom" from the Bell System. What were the ramifications? For the first time in any of our experiences, we realized we were on our own in making the system work when it needed maintenance or when training was needed because our users thought the system was broken. But it was not until the 1984 deregulation that breaking away from the local telephone company became popular.

Let's take a look at some data from our 1988 survey in Table 2. Note that ten of the thirteen universities that bought their own switches did so after deregulation. But the real pioneers were the three who bought before deregulation, as a result of the Computer Inquiry II ruling. The table also offers an idea of the different PBXs in use. It is interesting that this somewhat random sample produced a group of thirteen universities that now own their switch and nine that have stayed "regulated," or subscribe to tariffed offerings.

Each year Datapro Research Corporation surveys thousands of PBX users in industry and higher education to determine the market and provide normative data for its subscribers. Highlights of the 1989 Datapro survey are presented in Table 3. The survey represented 300 PBX users of twenty different vendors' equipment.

Table 1: Popular PBX Systems

Manufacturer/Model	Introduced	Installations	Line Capacity	Pricing/Line
AT&T System 25	1986	n/a	150	$550-750
AT&T System 85	1983	*	300-32,000	$750-1,000
IBM 9751 (was Rolm CBX II)	1987	24,000	600-20,000	$800-1,200
NEC NEAX 2400	1983	5,000+	32-23,000	$100-1,000
Northern Telecom SL-1	1975	22,000+	32-7,000	$550-650

**Total number not reported, but AT&T and others report it is "the MOST popular PBX in America."*

[6] "PBX Systems," *Datapro Reports on Telecommunications*, April 1989, pp. 101-122, 301-333. Copyright McGraw-Hill Incorporated, Datapro Research, Delran, N.J.

Table 2: University Switches and their Environment

University	Manufacturer/Model	Year in Service	Owned/ Regulated	Number of Lines
Emory University	Northern Telecom SL-100	1985	Owned	9,000
Florida Atlantic University	Rolm CBX 9000	1986	Owned	2,000
Florida State University	Northern Telecom SL-100	1988	Regulated	7,300
Georgia Tech	Northern Telecom DMS-100	1984	Regulated	6,000
Georgia State University	Northern Telecom DMS-100	1987	Regulated	2,000
Iowa State University	AT&T System 85	1985	Owned	12,500
Mississippi State University	Northern Telecom DMS100	1985	Regulated	6,700
Northern Illinois University	Northern Telecom SL-100	1985	Owned	8,000
Northwestern University	Northern Telecom SL-100	1984	Owned	16,000
Oregon State University	Bell System Centrex	1976	Regulated	4,000
Ohio State University	Northern Telecom SL-100	1985	Owned	17,000
Stanford University	Northern Telecom SL-100	1986	Owned	15,000
University of Alabama	Northern Telecom SL-100	1985	Owned	7,500
University of California/LA	Northern Telecom SL-100	1983	Owned	18,760
University of Central Florida	Rolm CBX	1981	Owned	2,300
University of Florida	Bell System Centrex 5ESS	1982	Regulated	10,700
University of Maryland	Bell System Centrex 1AESS	1986	Regulated	8,000
University of Miami	AT&T System 85	1984	Owned	8,900
University of Michigan	Northern Telecom SL-100	1985	Owned	29,000
University of Nebraska	Northern Telecom DMS100	1988	Regulated	14,000
University of North Florida	Bell System Centrex 5ESS	1986	Regulated	800
University of Tennessee	NEC NEAX 22	1982	Owned	10,000

Table 3: Highlights of 1989 Datapro Survey[7]

- 93% of the companies have been operating a PBX over one year.
- 54% of the systems were purchased.
- 71% are installed by the equipment vendor.
- 56% are maintained by the equipment vendor.
- 44% are using the PBX to switch data
- 33% have medium-sized PBXs (100 to 500 lines)
- 55% have large system PBXs (500 plus lines)
- The most popular vendors and their best-selling models are:
  - AT&T: System 85, System 75, Dimension
  - Northern Telecom: SL 1
  - Rolm: CBX II
  - NEC America: NEAX 2400
- Mitel leads in overall user satisfaction followed by:
  - AT&T
  - Siemens
  - Northern Telecom

[7] "User Ratings of PBX Systems," *Datapro Reports on Telecommunications*, October 1989, pp. 501-508. Copyright Mc-Graw Hill Incorporated, Datapro Research, Delran, N.J.

Cost-Comparison Study

As part of any good analysis, it is necessary to make a cost comparison among the alternatives. This is a complex piece of work and unique to each organization. However, the fundamentals are the same. Table 4 indicates the factors that go into such a study and provides an idea of the return on investment (ROI) or break-even points (please recognize that this is a highly simplified model).

Using the data in this illustration, the break-even point on buying your own switch versus subscribing to Centrex service is 2.5 years. However, for a complete telecommunications system, one must include phones, trunks, wiring, and people. (The biggest obstacle might be the development of an entirely new organization to manage the campus telephone company.) When these are considered, the break-even point can be as long as five to ten years. Beyond two or three years, proper financial planning involves building a formal life-cycle cost model that takes into account the cost of money and inflation factors. The point to be made is that this ROI number (in years) is a critical factor for financial planning. But more on this below.

Let's use this set of calculations as a spring board to several other issues that need to be considered so that taking a giant step to a switch does not become a Titanic experience.

Some Financing Concepts

Consider some financial issues concerning these multimillion dollar decisions from our university survey data. One of the early decisions that needs to be made is how the switch will be financed. In response to that question, the thirteen switch-owning universities provided the following answers:

- 62% were financed through a bond issue, repayable through telecommunications income;
- 22% used the normal university capital budget;
- 8% used joint-venture capital; and
- 8% used state financing.

Another issue is the amortization period for these capital investments. This might become a real stumbling block, as it did with Florida State. Recall the earlier model of assessing the return on investment or break-even point for "owned" versus "regulated" switch service. It was revealed that it could take a number of years to pay for a switch. At Florida State, our model revealed that it would take at least seven years. Many people expect that a switch, being a type of special-purpose computer, should have a life comparable to a mainframe computer which is generally five years. However, the amortization period industry normally uses for switches is seven to ten years. Note that data from the university survey (below) confirm the norm of a longer amortization period than that for computer mainframes.

LENGTH OF SWITCH AMORTIZATION

Frequency	Amortization Period
8%	15 years
61%	10 years
8%	9 years
23%	5 years

Table 4: A Cost Comparison of PBX versus Centrex

The Campus Situation

1,000 Telephone Lines
80% Plain Old Telephones *or* 800 analog station lines
20% Voice/Data Phones *or* 200 digital lines

Options

1. *PBX Hardware Costs*

800	Analog Lines @ $750/station	$600,000
200	Data Lines @ $1,250/station	250,000
	Total PBX Hardware Costs (Excludes station equipment and trunk costs; Centrex is automatically trunked)	$850,000

2. *Centrex Hardware Expense*

800 Station Lines @ $25/month each (Includes amortization of all Centrex equipment and features, but excludes on-premise station equipment) $20,000/mo *or*	$240,000	annually
200 Data Lines @ $40/month each (Includes 1200 bps modems and amortization of all Centrex equipment and features, but excludes on-premise equipment) $8,000/month *or*	$96,000	annually
Total Centrex Hardware Expense (Excluding Station Equipment)	$336,000	annually

Whether you own a PBX or "rent" switch service through Centrex, there is need for revenue streams. In the case of subscribing to local telephone company service, it may be important to supplement the rate structure fees with other sources of income for the overall telecommunications services. These other revenue sources can help provide income streams for rewiring the campus, developing networks, or expanding the infrastructure of the campus telephone company organization. They include such things as features, long-distance resale, voice mail, and telephone registration systems.

Rate Structure

Whether the campus needs to pay the monthly telephone company bill, pay off a bond, and/or keep the telecommunications office solvent, the university will need a rate structure for telecommunications services. This structure has at least two components. The major portion of the rate is to cover the cost of the switch, regardless of whether it is your cost or your mortgage payment for the telephone company's switch. The other portion is what you might call telecommunications overhead, which is heavily skewed by salaries for the telecommunications staff.

Three years ago, the rates at Florida State were extremely low: the thirteen-year-old switch had already been amortized to a point that it was embarrassing to the local telephone company to charge us very much. Consequently, the basic service rate was $11, extensions were $8, and student phones were $6. In this same time frame, the rate for telephones at the State of Florida offices downtown was $30. From day one, we knew we had the problem of creating an adequate "basic rate" income stream to offset the cost of new technology. You may have the same problem on your campus. Please bear in mind that the people who pay the telephone bill on your campus are your source of revenue for basic phone service. If the departmental budgets are modest in the category that is used to pay phone bills, you are limited in options.

We knew we had to get the rate structure up if we were ever going to afford new technology. So we sold the administration on a three-year plan to raise rates in three steps to $21 across the board. We made this apply to all phones because we were planning on the single-line concept where each phone has its own unique number. You don't win popularity contests by doubling the cost of phone service. But in such unusual circumstances, and with top-management backing, you must make such rate decisions to generate the funding necessary to move a campus into the 21st century in telecommunications.

Sample university rates from our campus survey are presented in Table 5 in detail to give you a basis for comparison. These data come from the twenty-two respondents but without campus identification. For readers with only a casual interest, rate averages are shown first.

It was somewhat surprising to find that the prices of "regulated" offerings were close to those of "owned" systems in the basic services category. Note what one university telecommunications director responding to our survey had to say on this point:

> Know all the requirements to manage and maintain a telephone company (BEFORE you decide to buy a switch). Establish procedures, departmental organization, staff requirements, and data base systems ahead of time. *While savings are possible*, it is not the primary criterion for this decision. More important is the ability to respond quickly to service needs and to introduce advanced technology more quickly than the telephone company.

The other thing this points out is that the regulated telephone companies are learning how to be more competitive in their pricing. Just within the past two years, the State of Florida has been able to push the competition concept to a point that regulated service has been cheaper than buying in two major acquisitions. By and large, the rates reflect a surprising homogeneity although you will probably notice some higher-than-average rates which typically indicate that the university is located in a metropolitan area. You and your telecommunications chief should find these numbers quite interesting because they are real and comparable.

Features

One difference between residential central office service and business service that occurred in the early 1960s was the announcement of Centrex Service with all of its bells and whistles. These bells and whistles are actually tariffed features to provide better productivity in the office, and they can promote more revenue for the telephone companies. Over the past two decades we have become accustomed to features. Even on the home front, we save the cost of another line and put in "call waiting," especially if there is a teenager in the house. These are really cost effective since the direct cost to the telephone company—yours or theirs—is quite low. More and more features are being developed by the switch manufacturers. With each new software revision for a switch, the manufacturer announces a handful of new features. For example, the latest software version offered in our switch at FSU provides more than a gross of features. Yes, over 144! The only higher number I've heard of is a 181-channel-capable TV. Who can deal with all of those choices?

On a practical basis, it is interesting to note what features sell best on a campus. The revenue earned from the sale of features on a campus-owned switch comes with modest cost. When asked to list their "best selling" features, respondents to our university survey produced this list:

Table 5: Average Monthly Line Charges at Universities

Basic Service Own	vs. Reg	Data Line	Extension	Campus Only	Maint. Fee	Instr. Rental
$22.54	$24.77	$26.09	$8.54	$15.00	$2.50	$4.03 to $8.54

MONTHLY UNIVERSITY LINE CHARGES

Basic Service Own	vs. Reg	Data Line	Extension	Campus Only	Maint. Fee	Instr. Rental
$33	—	$12	$7.50	—	—	—
$21	—	$25	$14	—	$3	$7 - $23
—	$21	$21	$18	$18	—	$2 - $10
—	$23	$56	—	$23	—	$1.50
—	$27	$58	—	$25.60	$1.10	—
$18	—	—	$10	—	—	$1
—	$17	$17	$17	$17	—	$3
$18	—	$18	—	—	—	$1 - $3
$25	—	$15	—	—	—	$14
—	$40	—	$3.25	$18	—	$3.25
$27	—	$25	$8	$14	—	—
—	$36	—	—	—	—	$2
$16	—	—	$3	$12	—	$2 sl - $6 key
$20	—	$20	$2	—	—	$2 sl - $16 P
$24	—	$22.40	—	$21.70	—	$3.30 - $22
$28	—	—	—	—	—	—
—	$18	$.90/mile	$.30	$2.25/10th mile	—	—
—	$23	$20	$17	$4.50	—	—
$31	—	$31	—	—	$4.35	$4.35
$22	—	—	—	—	—	$10 electronic
—	$18	$25 @ 56 kbps	$4	$4	—	$4 - $9 PP
$27	—	$26 @ 9.6 kbps	$7	$20	$4 P - $5 D	—

Key to abbreviations:

D = digital phone
electronic = electronic key phone
kbps = kilobits per second
key = key system phone
P = plain old telephone
PP = proprietary phone
sl = single line phone
— = no data provided

The 10 Most Popular Features at Universities

1. Call Pickup
2. Ring Again/Camp On
3. Call Transfer
4. Call Forward—Immediate
5. Three-Way Calling
6. Call Forward Busy
7. Call Forward Don't Answer
8. Speed Dialing
9. Call Forward Variable (Programmable)
10. Call Forward Universal

Features offer convenience and increase productivity. A little like the operating system on a mainframe, they come with the software that runs on the switch. As with any computational activity, there is a slight load placed on memory or cycles to generate a feature for a "customer." Yet, except for things like long speed-dial lists, most features have a negligible impact on the switch and are, therefore, high-margin money makers.

The flip side of a feature is that it is nothing unless it is used. You will want to budget for a customer service representative (CSR) to train users on the features. By the way, it is the busy administrators who can best profit from these time-saving features, but the will not take the time to learn them. "Features illiterate" bosses can give the campus telephone company a bad reputation just because they have not taken the time to learn how to use the system. For good will, plan on having a CSR make an appointment and give key managers one-on-one instruction.

It is reasonable to establish a modest charge for features. CPU-intensive features may need to be priced higher than others. Rest assured that your local telephone company will charge its "regulated" customers for features. These "tariffed" feature prices vary by state and telephone company, but the range is from 90¢ to $1.50 on the Bell ESSX systems.

The university survey did not produce enough data to even present an average. Yet the following individual responses may be helpful in demonstrating some of the pricing strategies that are in use today.

A Sample of University Features Pricing

$ .55 per feature
$3.00 per feature
$1.40 for three features; $2.05 for the next four
$5.00 per feature for installation; free thereafter

Long-Distance Resale

The phrase "equal access" mentioned earlier in the divestiture agreement makes it possible for universities to get into the long-distance resale business. As a practical matter, it could be an arrangement to reduce the cost of long distance service to the faculty and staff—in other words, to lower administrative costs. Yet long-distance resale also has the potential of generating revenue. Many universities have installed or developed systems to provide this resale service to dorm students as a savings to the students while generating a reserve for the university which can be applied to faster amortization or reduced station costs.[8]

There are three basic approaches to long-distance resale that universities currently follow:

- Bring in a third party to install and manage the entire operation and give the university a percentage of the "profit." This is the format used by AT&T in its College & University Systems or ACUS. The major expense to the university would be the interface hardware and, if desired, the writing of code to interface the AT&T system with the university accounting system. The ball-park cost would be $10,000 to $25,000.
- Acquire the hardware and write your own system to operate and manage the system. Some have done this for as little as $25,000 but an average might be in the $100,000 area.
- Buy a vendor turn-key system that includes the hardware, software to make the interconnection to long-distance carriers, and application software to manage the system. This option has the greatest "profit" potential but with the proportionally greatest headaches.

You do not have to have your own switch to take advantage of equal access and make some margin for the university. A good example of this is Mississippi State, which is on a regulated switch but through offering students long-distance resale provides a source of revenue for the university.

The following real-life university example will give you a feel for the numbers associated with an option like AT&T's serving as a third-party provider of long-distance services.

An Example of the "Margin" from Long-Distance Resale

Given 4,400 students in residence halls

Assume 75 percent of the students subscribe to the long-distance service

An *annual revenue* is estimated to be $600,000

The university's *net margin* would be $100,000

As competition continues to develop in this area, it is fair to say that the margins (or "profits") are shrinking. The 16 percent margin shown above may be too aggressive. Loyola University of Chicago plans on a 5 percent margin.

When asked about long-distance resale, the universities in our surveys responded as follows:

University Long-Distance Resale

Do you offer long-distance resale?

Yes	14
No	8

[8]You should be aware that Congress and some state legislatures are considering restrictive legislation that could affect revenue-generating operations for colleges and universities. This issue involves the tax status of business activities by nonprofit organizations (including colleges and universities) that are unrelated to the organization's primary purpose—the Unrelated Business Income Tax (UBIT). The tax is usually discussed in terms of equity between nonprofits and for-profit businesses. Legislative changes are likely within the next year, so you will want to be aware of the issues as you frame your resale policies.

A follow-up question asked about the savings that occurred when long-distance resale was used over the former regulated offering. Not surprisingly, universities DO save money in this venture. Responses included the following reported percent of savings: three reported 0 percent, one 5 percent, two 10 percent; one each 13 percent, 15 percent, 16 percent, and 25 percent; two 50 percent, one 70 percent, and one unknown.

A report at a recent ACUTA (Association of College and University Telecommunications Administrators) seminar indicates that, by charging students 10 percent less than the regular long-distance rates, the university should be saving the students money, and still generating some income for the institution. But the cost to administer the system, including salaries and processing costs, must be subtracted from that gross figure to reach the net margin/profit.[9]

From the fourteen responses described above, if the "zero" and "unknown" responses are removed, the average savings is 26 percent. With all the responses included, the average savings is 19 percent. In either case, it is clear that long-distance resale can be a viable money-saver for the campus.

Voice Mail

Another popular feature that is being offered by colleges and universities is voice mail or a voice mail box which is like a telephone answering machine. For less than 50¢ a message, calls can be routed to a personal "voice mail box" in the switch where a user's own voice asks callers to leave a message when he or she is not in. Subscribers can then retrieve their messages by dialing a special number.

The local telephone companies are gearing up to offer this service as part of their regulated offerings—which is to say that you might not be able to offer the service to your campus yet, even if you wanted to do so, unless you buy your own system. Yet the pressure is building and, if price is not terribly important, your local telephone company can bring up this service fairly rapidly.

As with long-distance resale, universities have a do-it-yourself option for voice mail, thanks to Judge Greene. The "system" consists of hardware and software. The third-party vendors that might be calling on you include: AT&T, Centigram, Digital Sound Corporation, Octel, Rolm, and VMX, to name the top six. The cost of these systems varies widely, from $35,000 to $500,000 depending on the number of "mail boxes" and the sophistication of the service.

Because these systems are costly, some fee must be charged against their use. Forty percent of the universities offer voice mail and the number will be growing. To recover the cost of the operation, the average rate was $6.40 a month. The individual responses below illustrate the range of charges.

University Voice Mail Box Pricing per Month

$ 0
$ 1.00
$ 3.50
$ 5.00
$ 8.50
$10.00
$11.00
$12.00

Only nine of the twenty-two universities were currently offering voice mail, but two were planning to add it within the next year. It is clear that this is a coming attraction at most universities.

On a national basis, the Datapro survey reported that 29 percent plan to add voice messaging equipment during the next year.[10]

Telephone Registration Systems

The concept of registering students for classes via a touch tone telephone and a scripted, voice response system is becoming quite popular and is a labor saver for students, faculty, and staff. It is not a "revenue producer" in the usual sense; however, some universities are looking at ways of using it for that purpose. The rationale is that a telephone registration system is only used a few months each registration cycle. What do you do with it between cycles? The option is to have it available for students to inquire about a number of things, such as the status of their admission, financial aid information, current balance in fee payments, housing waiting list, etc. In each of these cases, the unit that currently has to respond to phone calls or written inquiries might be willing to pay for a telephone response unit to reduce labor costs or provide a better service to the students. An otherwise-idle telephone registration system could be used to generate some income and cover its cost, and expanded use could help accomplish the university's mission.

Six of the universities that were a part of the survey indicated that they used the touch-tone telephone registration system, and two indicated that they would be adding it this year.

[9]David Douglass, "Student Resale," A report presented at the Spring Seminar on Student Services of the Association of College and University Telecommunications Administrators (ACUTA), April 1989.

[10]"User Ratings of PBX Systems," October 1989, p. 508.

Telephone Management Systems

In the past, many telephone users had no accurate way to manage telecommunications costs. Whether at home or in the office, the monthly phone bill was simply something you paid. Over the years, that has changed. Now we not only look at the bill but study it for errors and abuse, and try to figure out ways to reduce it. What has changed is the introduction of telephone management systems (TMS) products that are available for almost any type of business environment to provide valuable information for controlling telephone expenses, curbing abuse, and optimizing network facilities.

These TMS products are software packages that run on micro, mini, or mainframe computers. The sixty-plus vendors offering this software design them for almost any type of telephone system you might be using, from a PBX to a central office Centrex.[11]

How a TMS Works

A stand-alone (micro-based) system is the simplest in design and use. It is linked to the telephone system, a PBX for example, and records data about every call. (Technically, it is connected to the SMDR output port—Station Message Detail Recording—via an RS-232-C interface.) Every time a call is made, it starts collecting details about the call, such as:

- extension number generating the call,
- date and time of the call,
- number dialed,
- length of the call, and
- outside line used to complete the call.

These call records are processed into detailed management reports and can generate daily, weekly, or monthly management reports. The three basic categories of reports are call accounting, system management, and traffic analysis.

Call accounting is the heart of the TMS product. It generates the detailed accounting-type information for billing customers like those you experience in most hotels and motels. Call accounting systems make up over 75 percent of the TMS market.[12] This system is used to feed the next level of reports, **system management**, and provides summarized reports by unit such as excessive calling, frequently-dialed numbers, and the number of operator-assisted calls. In addition to identifying telephone expenses and charging them back to the appropriate user, a TMS can serve as an effective tool for **traffic engineering** to assist in the development and maintenance of a cost-effective telephone network.

Some of the Options

One easy path to a TMS is through a turnkey system provided by a vendor who will deliver the hardware (usually a micro- or mini-computer) with proprietary software and customize the software to suit your particular situation. This type of system ranges in cost from $500 to $100,000 or more.

Another popular approach is to acquire software from a vendor and run it on your PC or one included by the vendor. These commercial software packages running on a micro system handle call records and generate reports for a price that ranges from a few hundred dollars to less than $90,000.

The very large scale TMSs run on a mainframe computer. This mainframe-compatible TMS software is used in a multinode network with a price tag that ranges from $15,000 to over $100, 000.[13] At Florida State, we took this mainframe approach because another university in the State of Florida System took the lead and bought the initial copy of the license. Buying a "second copy" of the software allowed us to come in under $75,000. And, as suggested earlier, some customization was necessary, which makes the software distinct for each of our campuses.

What the Users Have to Say

To provide a user's perspective, we turn to a survey conducted by Datapro Research Corporation which shows that, of over 260 businesses using TMS, 20 percent of them bought the "proprietary turnkey" approach. This was followed by 18 percent who bought the vendor's software and micro to run commercial software. The next major group, also at 18 percent, used commercial software running on a mainframe. The final large group, at 16 percent, used commercial software bought to run on an existing PC. The remaining 28 percent used "homegrown software" running on all types of processors, with a small group using the service bureau approach.[14]

Since there are many approaches and dozens of vendors offering TMS, it is difficult to provide a listing of the "top five"

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[11] "Telephone Management Systems and Software," *Datapro Reports on Telecommunications*, May 1988, p. 101. Copyright McGraw-Hill Incorporated, Datapro Research, Delran, N.J.

[12] Ibid., p. 104.

[13] "Communications Management Capabilities of Telephone Systems," *Datapro Reports on Telecommunications*, December 1988, p. 302. Copyright McGraw-Hill Incorporated, Datapro Research, Delran, N.J.

[14] "User Ratings of Telephone Management Systems and Software," *Datapro Reports on Telecommunications*, October 1988, p. 401. Copyright McGraw-Hill Incorporated, Datapro Research, Delran, N.J.

vendors in the TMS market. A few of the more popular vendors, in alphabetical order, are Account-A-Call, Control Key, Moscom, NEC-America, and Telco Research.

If you are thinking about owning or operating a switch, you will need a TMS. It is critical to billing your customers and provides a means to examine the various costs of telecommunications and manage the network.

Phones

Now that we appreciate what a switch or a PBX does for us, we turn to "station equipment." That comprehensive phrase covers everything from the old black single-line rotary-dial phone to the most complex electronic units that can handle simultaneous transmissions of voice or data, with programmable special features.

Ever since Alexander Graham Bell called Watson in the late 1800s, Americans have been "reaching out to touch someone." Today, there is a greater than 90-percent penetration of telephones in our society—nine out of ten homes in America have a phone. That makes it the top selling gadget, trailed by television sets and automobiles which are at the 70-percent level. So, what do we need to know about them? For starters, we must appreciate that replacing ALL the phones on a campus is a costly decision. At a large campus, it can involve millions of dollars. So let's discuss the basic types of phones and some associated costs.

That Plain Old Telephone

The most recognizable piece of station equipment is the plain old telephone or POT as it is called in the trade. The old rotary-dial (analog) phone is referred to as the "500 telephone" and in the touch-tone form is called a "2500 phone." The "2500" sets can be envisioned as phones that have a physical wire connection to a circuit in the central office switch. Whether at home or in the office, one phone equals one pair of wires and a unique 7-digit telephone number. These durable and reliable old phones last decades and are still the most popular category of phones on campuses today. What are they worth on a trade-in? From our experience, you might get a few dollars apiece if you have them available for bid in lots of a hundred. But think about the cost of their replacements!

Electromechanical Key Systems

Because many of our campus systems date back decades, it is appropriate to describe one of the old mainstays called key systems. The "electromechanical" part of the name comes from the electronic and mechanical components between the phone and the central office switch. To allow a work group to share fewer lines than there are phones or people in the group, the Bell system introduced a 1A Key Telephone System shortly before World War II. Featuring six- or ten-button (-key) desk telephones, these phones had advanced to the popular 1A2 key phones by 1963. (Actually, these phones have either five or nine line buttons and one red "hold" button.) Although GTE, ITT, and others manufacture look-alike phones, the industry gives them all the generic name "1A2." Behind these desk phones, rather expensive components are needed. Typically found in telephone closets, there is a key service unit (KSU), the key telephone unit (KTU), and the power supply (needed for the blinking buttons).

Key phones pose cabling and maintenance problems. Instead of the two-pair wiring used in single-wire phones, a large 25-pair cable is connected to every key phone. This wire supports the various buttons, blinking lights, intercom, music-on-hold, and the like. Any estimate of the 1A2 per-station price is complicated by the cost of those 25-pair cables. One estimate is that the use of 25-pair instead of the newer 3-pair cable not only increases the station cable cost by $10, but increases the station installation labor cost by $45.[15]

Electronic Systems

In the mid 1970s, microelectronics found its way into the telephone industry in the form of electronic key systems.

Types of "Signaling" Phones

There are two types of "signaling devices" used in our phones today—rotary dial and pushbutton. The purists refer to these as "dial pulsing" and "tone pulsing." Tone pulsing is most formally known as Dual-Tone Multi-Frequency or DTMF. But we don't call these phones by any of those names, do we? Like Kleenex, we refer to these phones by the Bell trade name Touch Tone ®.

Note that some touch tone phones come with a switch that allows them to be used in one of two modes—tone or pulse. The tone mode sets the electronics to instant "beep" dialing through a modern digital switch. In the other case, pulse mode is necessary for the older-type analog switches that electromechanically "click" their way through the dialing pattern.

[15]William J. Bahr, "Alternatives for PBX and Key System Integration," *Telecommunications*, February 1987, p. 109.

These electronic key systems feature electronic phones and, as the name implies, are made with integrated circuit and chip electronics. Such systems offer lighter, less bulky equipment with high reliability. They have become so popular that the 1A2 is no longer manufactured. An electronic system generally reduces the cable requirements from 25-pair cable systems down to 2-, 3- or 4-pair wiring. As mentioned above, the "typical" 3-pair wiring of electronic key systems will cut down on system costs and maintenance.

There are dozens of manufacturers of these types of electronic systems. As is true in the computer industry, data books, like Datapro's, are invaluable in saving time in the evaluation process. Yet the prices of these systems can be difficult to compare. The common statement is: "Pricing depends heavily upon configuration and installation requirements."[16] Typical electronic key systems cost between $500 and $1,000 per line.

Proprietary Phones

After the electronic phones, the most common type of station equipment is the proprietary electronic telephone. Northern Telecom (NTI) calls its proprietary phones "P-phones." Most PBX vendors, even Centrex providers, offer feature phones that use proprietary signalling that conform to the manufacturer's specifications so that the PBX/switch and phone work as a system.

The attraction of this type of phone is that the features offered by the switch are activated by the touch of a single button on the phone. By contrast, feature activation on most PBXs using "2500"-type phones will require the user to key in a two-digit code. This presumes that you can remember which two-button codes gets you to which feature.

Another popular capability of these electronic phones is the speakerphone, which is a transistorized, voice-switched, microphone-speaker system to permit hands-free conversation. It is a useful, inexpensive way to hold a conference between two or more groups of people in different offices. A combination of these features creates one of the most popular administrator's phones at Florida State: eight programmable buttons for features or frequently-dialed numbers, at a cost of under $150 per unit.

Integrated Voice/Data Phones

More recently, with the advent of digital transmission and the popularity of PCs on the desk, integrated voice-data phones or IVD phones are becoming increasingly popular as a way to combine a phone and a modem into a single unit. (A modem is a device that converts the computer's digital signals to analog signals that can be sent over telephone lines and vice versa.[17]) With these data phones, the "codec," or coder-decoder, is located in the phone itself and transforms the analog voice (speech pattern) into digital signals right at the set. When data interfaces are added to these telephones, digital voice and data can be carried over the same pair(s) of wire simultaneously. By the way, most of these phones do use fewer pairs than the old key systems. The normal is two pairs, the number found in household wiring. Contrast this with the electronic phones that require a separate set (two pairs) of wires for data transmission.

Because these proprietary digital phones are not produced in large numbers like the "2500" sets sold at discount stores across America, the costs are higher. At Florida State, the digital phone is in the $350 price range and jumps up to $450 with the data interface unit (a built-in modem).

What Are Others Doing?

To get an idea of what others are doing when it comes to instruments, we will look at nationwide data, then present the campus survey data, and wrap up our discussion of phones with a manufacturer's rule of thumb.

First, a national perspective. In a survey conducted by Datapro Research in 1988, it was reported that most station equipment still used today consists of "2500"-type sets. Interestingly, the next most common type phone was the proprietary digital phone. Proprietary analog phones accounted for the next largest group, while integrated voice/data phones rounded out the top four.[18]

In the campus survey, we included questions about the different types of instruments. The resulting table below shows the total number of lines/stations on campus as well as the five basic categories of phones service—data through the switch, "2500" types, electromechanical (1A2) key system phones, electronic system phones, proprietary phones, and integrated voice/data (IVD) phones. Please understand that these are very broad groupings of phones.

These data confirm the national data that the "2500"-type phones are the most popular unless the university bought a PBX that required it to use the proprietary-phone approach. Note also that the electronic phones are still used quite frequently—one might consider them to be transition phones from 1A2 to the more modern PBXs.

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[16] "Key and Hybrid Systems," *Datapro Reports on Telecommunications*, June 1989, p. 110. Copyright McGraw-Hill Incorporated, Datapro Research, Delran, N.J.

[17] "Robert E. Marotta, ed., *The Digital Dictionary*, 2nd ed. (Bedford, Mass.: Digital Equipment Corporation, 1986), p. 282.

[18] "User Ratings of PBX Systems," *Datapro Reports on Telecommunications*, September 1988, p. 506. Copyright McGraw-Hill Incorporated, Datapro Research, Delran, N.J.

Total University Phones by Category

Phones	Data Lines	"2500" Phones	1A2 Key	Electronic	Proprietary	IVD Phones
9,000	5	7,500	0	400	1,100	0
2,000	150	70	0	0	1,800	130
7,300	660	660	4,840	1,600	100	100
6,000	7	5,993	0	7	0	0
2,000	200	0	1,890	110	0	0
12,500	30	12,250	0	220	30	0
6,700	350	3,500	0	2,200	1,000	0
8,000	100	7,200	0	0	800	0
16,000	0	0	0	12,750	3,000	250
4,000	0	4,000	0	0	0	0
17,000	600	15,300	1,700	0	0	0
7,500	1,500	6,865	0	0	635	0
18,760	0	9,930	8,830	0	0	0
2,300	2	2,200	0	0	0	100
10,700	unknown	3,200	7,300	0	100	100
8,000	0	800	6,500	700	0	0
8,900	0	4,400	4,500	0	0	0
29,000	2,900	26,300	0	0	2,700	0
14,000	4,000	10,400	1,500	2,000	100	0
800	16	792	0	0	8	0
15,000	1,000	12,000	0	0	3,000	0
10,000	0	9,000	0	1,000	0	0

Average Number of Phones by Category (rounded)

Phones	Data Lines	"2500" Phones	1A2 Key	Electronic	Proprietary	IVD Phones
9,800	500	6,470	1,685	954	653	30

The Old 80/20 Rule

While trying to get a handle on the proportion of different types of phones that Florida State would need to acquire to go along with its new switch, I learned about a new application of the 80/20 rule. Northern Telecom said that their customers used 80 percent "2500"-type telephones and 20 percent proprietary phones. When pressed about the use of data through the switch, they conceded that 2 percent of the proprietary phones were of the IVD variety. Northern Telecom has national sales data to demonstrate this rule of thumb:

THE 80/20 RULE OF TYPES OF PHONES

- 80% Plain Old Telephones
- 18% Proprietary Phones
- 2% Integrated Voice/Data Phones

The data in the table above tend to confirm this rule of thumb. The reason they do not correlate more closely is that so many universities in the survey population are still on regulated switches. For these universities, the norm is the versatile "2500"-type phones with electronic sets when features are desired. Thus the university averages give us the following percentages:

TYPES OF PHONES FROM THE UNIVERSITY SURVEY

- 66% Plain Old Telephones
- 17% 1A2 Key System Phones
- 10% Electronic Phones
- 6% Proprietary Phones
- 1% Proprietary Voice/Data Phones

Wiring

Until recently, computer managers, systems analysts, and administrators, in general, thought little about wires, cables, and conduits. Like plumbing and lighting, we appreciated them but did not spend too much time thinking about them.

Several events in the past few years have moved the technology of wire and cables out of the background and into a more prominent position, where they frequently account for 30 percent of the cost of installing a new telecommunications system. With new technological capabilities and demands for the seamless interconnection of all kinds of information, wiring that used to serve phone systems or computer linkage can now serve both simultaneously. The cabling for a new building or telecommunications project is a primary budget and design priority for both voice and data communications. Consider the following aspects that have given rise to this situation.

With the AT&T divestiture, we have more choices than before, and probably more questions. The wiring in the buildings, like your home wiring, has become the user's responsibility. Campuses found that telephone companies were responsible for the copper in the ground but the university had to lay the new conduit in the ground.

After a decade of exploding personal computer growth, users are placing greater demands on the linking of PCs to one another and to the host computer. In the late 70s and early 80s, coax and twin coax cabling were popular. But as the number of communicating PCs grew, so did the need for additional building wiring. This raised questions of whether existing copper telephone wire could be used for the PCs; whether there were ways to interface the existing low-cost, twisted-pair copper wiring to higher speed, higher cost coaxial cable; or whether to install wiring management systems.

Campus renovations and new construction are taking advantage of the "smart building" concepts which feature a variety of local and remote communications services for both data and voice built into the wiring of the building. New users need only plug in their hardware and make suitable adjustments on a central control facility to configure the desired network.

For decades, standards in the computer industry have been embraced only after IBM announces its product. With no generally-accepted building wiring system, a trend might have been started in telecommunications when the IBM Cabling System was announced to a hesitant market in 1987. Now, almost two years later, although users are not beating a path to it, it has generated interest and validated the importance of fiber optic cable because IBM has embraced it.

There has been an increased maturity of PBX and Local Area Network (LAN) offerings. PBXs or small telephone switches are now available in all sizes and capabilities and from vendors who have become household names. In a similar way, LANs have evolved from the homegrown variety to sophisticated systems bearing trade names of respected vendors. In fact, IBM's explanation for its decision to introduce its Cabling System is that the cabling product was necessary to support the LANs it introduced afterward.

Some Basic Definitions

Baseband—A signal transmitted in its original frequency without being changed by modulation.

Broadband—A channel with a bandwidth greater than that of voice band, and therefore capable of higher data communications rates.

Channel Bandwidth—The difference between the highest and lowest frequencies that a medium such as wire, fiber, or cable can produce with reasonable fidelity.

Hertz (Hz)—The measurement of frequency as expressed in waves per second. It can be applied to light waves, sound waves, and electromagnetic waves.

Voiceband—As defined by the telephone industry, about 300 to 3,000 Hz frequency.

Wire and Cables

The data side of telecommunications has, for the most part, been piggybacked onto the voice side of the telephone companies' systems. By so doing, the companies have taken advantage of the existing cable plant, networks, and maintenance organization for the system. Because the voice side was originally designed around analog signals, and most computers use digital technology, this has required the constant use of MOdulation/DEModulation (modem) devices. This force fit has meant that the computer industry has had to make wide use of twisted-pair wire technology since its earliest days.

Twisted-Pair Wiring

The oldest type of wiring in widespread use today is twisted-pair wiring that consists of 24-gauge copper strands covered with colorful plastic coating. It is still popular because of its low cost and flexibility. And because there is such a huge installed base of twisted pair, there is an ongoing development effort to increase its speed and quality for data use.

Referred to as half-duplex mode, two-wire circuits allow data to flow in only one direction at a time. Four-wire circuits or double twisted-pair wiring are needed to send and receive simultaneously (called full duplex data communications).

Today, whether in your home or in the office, each of the copper wires is surrounded by its own color-coded polyethylene or polyvinylchloride (PVC) insulating layer. There may also be a coating of Teflon for fire resistance if the wire is passing through a plenum or false ceiling. This usually meets fire code and avoids the cost of installing wiring and conduit. Anywhere from 2 to 4,000 twisted-pairs are bound together into cables for transmission between floors of a building, between buildings, and between cities.

Prior to the 1950s, copper wiring was insulated with a wood-pulp-based, paper-like material. It was effective if kept dry. Today, many of our campuses suffer with the paper-insulated twisted pairs that make up our underground cabling system. When rains flood the underground conduit network, it is normal to have static on the lines until the moisture dries out.

Another problem with copper wiring is "cross talk" which can play havoc with data systems. To deal with this problem, each wire, one being positive and the other negative, is insulated. But it is actually the twisting of the two wires that has the effect of balancing the signal that usually eliminates the crosstalk problem in copper wiring. Furthermore, the drive to use existing twisted-pair wire has been fueled by competition among local area network hardware vendors. The result is improved electronics that can transmit data as fast as 16 megabits per second on twisted-pair cable.

Coaxial and Twinaxial Cables

Coaxial cables, like those used on IBM 3270 terminals, involve a pair of conducting elements. In this case, one of the elements is a flexible, hollow, pipe-like shape and the other is a flexible, circular, positively-charged rod strung through the center of this much larger negatively-charged conducting pipe. Polyethylene disks every inch or so center the rod in the pipe while other insulating material fills out the remaining space. This produces well-insulated cabling capable of much higher data speeds and higher frequencies of broad-band data communications.

Two variations of coax cable deserve mention. First, Wang uses a type of dual-balanced coaxial cable which uses two center conductors. Since it is balanced relative to grounding, it does not have the grounding and security problems of standard coax. Second, IBM's twinaxial cable runs a twisted-pair as the rod through the center of the pipe.

Coaxial cable, in its various forms, cannot be spliced by the manual strip-twist-and-insulate method. Like twisted-pair wiring, press-fit connectors that clamp over the end of the wires can be used. Then these ready-made connectors are screwed together. However, due to the heavier nature of coax, and the importance of alignment of the rods, it is much more difficult to handle splicing.

Optical Fiber Cabling

In the electromagnetic or metallic cabling discussed thus far, the type of wire, amount of insulation, and number of strands have to be evaluated against cost and environmental risk. Water and lightning are natural enemies of copper cabling. And electromagnetic fields become an issue as the quantity and quality of data transmissions rise.

Fiber optics offer a carrying capacity that is at least 1,000 times greater than that of copper. Optical fiber cabling is made possible by the development of especially transparent fibers with low light loss, and ultra-small, concentrated, reliable light sources such as laser diodes that are capable of trillions of bits per second, or the cheaper, slower technology of the light-emitting diode (LED). A typical transparent fiber, thinner than angel hair on a Christmas tree, is measured in millionths of a meter, or mic:ons, and is surrounded by a refraction boundary—a layer of light-bending cladding made of glass or quartz—which is in turn surrounded by a protective coating. A light source, such as a laser, sends analog waves or digital pulses of light down the fiber to a receiving unit that may be either a repeater that renews the signal or the receiver where the light signal is transformed back into a electromagnetic signal for input to the computer.

These fibers are so tiny that is is impractical to have a single fiber, even though one can carry as many as 64,000 simultaneous voice transmissions. So individual fibers are usually bundled by twos, sixes, twelves, twenty-fours, thirty-sixes, or forty-eights. Although no standard has developed, most cabling plans call for at least four fibers into a floor or building, with eight and twelve fibers becoming quite popular. As with copper, it makes sense to go heavy on the medium rather than pay for the labor twice. Normally, six or more layers of insulation and strengthening materials surround these fibers to produce a finger-sized cable, which for outside plant cabling is usually specified at 600 pounds of tensile strength.

Like twisted-pair wiring and coaxial cable, fiber has a tendency toward signal loss over time and with the length of the run until the form of the "wave" is lost. A repeater is needed about every thirty miles for the best quality fiber to reliably detect and retransmit the waveforms. As one would expect, there is a delicate balance between fewer repeaters to keep costs down and more repeaters to keep fidelity up.

Over the past several years, the MCIs and Sprints of the long-distance carrier industry have been constructing networks using fiber-optic cable. These light-wave lines, which transmit a signal faster than ordinary cables and produce clearer sound than satellite communications, form less than half of AT&T's telephone grid. For this reason, AT&T is replacing two billion miles of telephone connections with higher-capacity fiber-optic lines.

No fiber design has emerged as the industry standard as yet. However, three basic designs are accepted as responsive to users' needs—single-mode fiber; multi-mode, stepped-index fiber; and multi-mode, graded-index fiber. They vary as to the nature of the input light source, size of the core fiber, and the complexity of the refraction boundary (cladding).[19]

Single-mode Fiber
The simplest and most expensive concept is single-mode fiber, because of the critical tolerances in its manufacture and because it is usually coupled with a costly laser input device that drives the signal about thirty-five miles before regeneration is required. It features a small core fiber about eight microns wide and cladding carefully designed to create the right kind of refractive index.

Multi-mode, Stepped-index Fiber
Stepped, multi-mode fiber has a thick core but only a single index of refraction that bends back the light. This is a relatively cheap fiber and is sometimes manufactured in plastic rather than glass. Since there is no gradation of refraction, the waveforms deteriorate rapidly giving it a ceiling of about 20 megabits per second for one kilometer. This problem worsens as transmission speed increases so this fiber is most useful over short distances.

Multi-mode, Graded-index Fiber
When people speak of multi-mode fiber, this is what they are usually referring to. Graded, multi-mode fiber is the most widely used because it supplies adequate speed benefits at more reasonable prices. This fiber has a larger core than single-mode—over 50 microns in diameter—and thus can accept light rays at a variety of angles. The 62.5 micron size is becoming a very popular fiber.

Multi-mode is the only fiber that can work effectively with the cheaper light-emitting diode (LED) light source. While this design is not as fast as single-mode fiber, it is fifty times faster than stepped-mode fiber.

All of these fibers can accept laser diodes (LDs) or LEDs as light sources. The LED approach is more economical, but the lasers offer eighteen times the speed of LEDs.

Connecting Wire, Cable, and Fiber

It is common practice to combine several low-speed data lines into a single higher-speed line and thence to a computer. This is called multiplexing. This can be accomplished with several twisted-pair wires being multiplexed together into a single coax cable. In a time when more and more terminals and PCs are in use, this type of multiplexing tends to occur with those lines leaving a floor or building to travel to a computer on the same floor or even across the campus. Twisted-pair or coax wiring can also be multiplexed on fiber lines.

It is also becoming quite common to use coax and twinax to connect twisted-pair wiring. The primary device used to make such connections is a "BALUN." A balun connects an electrically BALanced element (such as a twisted pair wire) with an UNbalanced element (such as a coax cable). It is a simple device which may do some filtering and impedance matching but is otherwise a low-cost ($50) connector. When several coax cables are being converted into a multitwisted-pair trunk, a balun patch panel is frequently used to control and centralize the wiring connections.

Interconnecting fibers and copper wire has not yet become popular. In order to make this link, the electromagnetic signal has to be converted into an optical signal and vice versa—not an easy or inexpensive conversion.

So where are we going with these different wiring technologies? There is a growing tendency to reduce coax cabling in favor of the older, slower, and less reliable twisted-pair wiring. Twisted-pair is much less expensive than coax, and for the majority of terminals and PCs it is adequate in speed. And, if local fire codes require it, the wire can be coated with Teflon when routed through the ceiling. Such twisted-pair wire is about 10¢ to 15¢ per foot, whereas coax costs anywhere from 50¢ to $1 per foot for the same coating.

Despite recent advances in today's twisted-pair technology, there are situations where it just won't do. Computer-to-computer communications and other high-speed transmissions require a faster medium. The traditional approach for these applications has been coax. Now it is likely that users will consider fiber for even greater speed and significant room for expansion.

The rapid drop in cost for fiber cabling and end equipment will make it increasingly likely that it will be used for underground cabling, computer-to-computer connections and vertical building wiring. Why use fiber in a campus backbone today? By using fiber in the campus backbone network system, you can serve the point-to-poir.. or specialized needs of today and, at the same time, develop the framework to build the networking systems of the future.

Some Emerging Patterns of Wiring

The very nature of wiring is such that nearly any topological pattern could be used because it is usually hidden behind wall, ceiling, and floor panels. Yet, certain patterns have been developing in recent years as a result of "smart building" concepts, the need to renovate, and the demands of PBXs, LANs, and PCs.

The horizontal wiring of a building on a particular floor tends to be twisted-pair due to low cost and flexibility. LANs will more and more be using twisted-pair wiring, phasing out the more costly and cumbersome coax cabling. The floor wires

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[19]Dan Davila, "Fiber Optics Installation, Maintenance, and Troubleshooting." Paper presented at ACUTA Conference, July 1988.

connect in a wire frame to riser or vertical cables which are typically multiplexed to coax or fiber optic cable, although twisted-pair trunks can be used.

The amount and type of centralized control provided for a building's wiring and cabling varies widely. An organized cabling system frequently provides a patch panel in the wiring closet for identifying each wall outlet so that it can easily be connected or re-connected to another specific device. This control facility can expedite the installation of LANs and switches (PBXs). Systems like this can pay for themselves in five years due to the cost saved in labor of rewiring when terminals or phones are moved and equipment is added. So important is this concept that vendors such as AT&T and IBM have developed, published, and distributed these specifications to their customers. Additionally, state communications offices, such as ours in Florida, have developed standardized wiring specifications for all new construction and renovation.[20]

Integrated Services Digital Network

Several major trends are apparent today which accompany the growing need to integrate the technologies of computing and communications. These trends include ever-more-sophisticated voice communication capabilities, the increasing use of PCs in networks and LANs, and the growing importance of distributed computing. One trend getting a lot of press is Integrated Services Digital Network, or ISDN.

Born of This Decade

Talk about ISDN has been under way since 1980 when an international standards committee (International Telegraph and Telephone Consultative Committee, commonly referred to by the acronym CCITT) was commissioned to define the way of standardizing high-speed digital service. As a result of the committee's style of publishing standards in four-year cycles, the first definition of ISDN standards describing a system that would provide simultaneous voice and high-speed data transmission through a single channel was not published until 1984. It is this standard that has caused all of the discussion and action about ISDN over the past five years. As we look to next steps, we can expect that ISDN services will connect most major cities by 1995. By the year 2010, complete domestic coverage and international connections will become possible.[21]

Few people give much thought to the fact that progress toward this utopian integration is hampered by the maze of telephone wiring all over America that we have been constructing over the past century.[22] How old is the wiring in the buildings on your campus? Twenty years old? Or is it more like fifty years old? Every phone in every room on every floor of every building has at least a few pairs of copper wires leading to a central switching center. The bandwidth of copper that we use for these voice transmissions is very narrow, expensive, and inefficient. Within this decade we seem to have dropped the analog standard and everything is going digital. Yet we have tended to develop separate networks for voice and data. The integration suggested by ISDN is the only technology on the immediate horizon that promises to bind the various communications and computing technologies into a coherent whole. The development of ISDN stems from this worldwide need to modernize switching and transmission equipment, to extend the availability of public networks, and to take full advantage of technological progress, particularly in digital, satellite, and fiber-optic techniques.

What Is It?

The first two words—Integrated Services—define the goals of the entire concept: to combine all communication services currently offered over separate networks into a single network to which any subscriber has access over common facilities, through a single plug in the wall.

ISDN is not a single piece of equipment. It is a modest set of broad technical recommendations for a common user interface to digital networks. By using a multiplexer-concentrator in each office or building, we could take advantage of the fact that individual lines are used only a small fraction of the time. We would then connect to a common access loop operating at T1 speeds (1.54Mbps) and thence to an ISDN compatible switch (a local campus PBX or a central office switch). By installing these T1 systems, campuses will be able to avoid the cost of installing expensive copper pairs for each individual trunk line that goes to the "central office-type" switch.

With a pair of wires and a phone, you can make a single call to another phone. With ISDN, you get three paths. Two are bearer ("B") digital channels of 64 kilobits per second that can be used for all types of transmission from voice to slow-

[20]Patricia Cuocco and Thomas Darragh, "The Case for Campus Wiring Standards," *CAUSE/EFFECT*, Fall 1989, pp. 5-6, 49. Two documents in the CAUSE Exchange Library available to CAUSE members relate to campus wiring standards: *Systemwide Cable Plan*, California State University (CSD-0263, 168 pages, $25.20) and *Wiring Standards*, Indiana University (CSD-0314, 26 pages, $3.90).

[21]David M. Rappaport and Cory Van Wolvelaere, "ISDN: Two Key Points to Remember," *The Office*, September 1986, p. 88.

[22]Lee Alley and Stephen D. Willits, "ISDN—What It Means to Information Technology Administrators on Campus," *CAUSE/EFFECT*, Fall 1988, p. 10.

scan television. The other signal path, referred to as the "D" (for digital) channel of 16 kilobits per second is used to control how the two bearer paths are used. (This is called "2B+D" service.) Using this approach, a single T1 digital carrier can be multiplexed to support twenty-four simultaneous conversations.[23]

So what are the benefits? Digitization and integration should lead to greater efficiency and lower costs. This "motherhood" statement points to two categories of benefits. First, we should have voice communications enhancements, service center improvements, and better security and privacy features. Yet many feel that the most important advantage of the evolving ISDN system will be its accommodation to other nonvoice message services such as videotext, teleconferencing, and high-speed data exchange. The second category might be even more exciting. ISDN should give us new instructional applications from its integrated voice, data, and video capabilities. In turn, this could lead to an enhancement of our public service functions and other campus service center capabilities to better serve the students.

Getting Ready

To start preparing for ISDN, campuses should consider ISDN compatibility in the acquisition of all major telecommunications system components, including cabling system design. Even if you are considering a bid for Centrex service from your BOC, you should demand ISDN compatibility. Access to the full capabilities allowed by ISDN will require the acquisition of certain special equipment, or add-on equipment, on the campus. It must link to your central office equipment and the other regulated carriers, all of which are rapidly installing ISDN-compatible equipment. From a technical standpoint, ISDN is undoubtedly attractive and on the horizon. Yet it cannot be an end in itself—only a means to satisfy users' present and future needs.[24]

Management Considerations

There's more to making telecommunications happen on campus than switches, phones, and wiring. We need *good people* to plan and manage the effort. As mentioned earlier, it is difficult to make the transition from a handful of people in the physical plant whose primary responsibility has been to order phones to a university telecommunications department with a wide variety of responsibilities—including both voice and data communications. Naturally there will be organizational issues to resolve, and new positions will have to be created. Gaining approval for the new positions may be a problem, but even if it is not, a universal challenge will be developing new position classifications that will allow us to get and retain good people. Deregulation came on the campus scene so fast that the personnel department bureaucracy has yet to catch up. In the State of Florida, only three existing classifications are appropriate to our fledgling Office of Telecommunications. Try putting together a new organization of twenty-five-plus positions with such a limitation!

Staff Size

As part of our campus survey, we included a question to determine the size of the different offices of telecommunications. Since all of the universities came from a regulated background, it is interesting to look at those that are still using regulated service and those that have begun to develop their own telephone company. As a means of correlating the size of the operation with the number of people in the organization, the table below shows the staff size in relationship to number of lines/phones on campus. (Lines are the number of stations with direct inward dialing numbers; phones, in this case, represent the actual instrument. Therefore, lines could represent the physical connection to multiple line units or from a PBX to the phone.)

STAFFING OF TELECOMMUNICATIONS ORGANIZATIONS

"Regulated" Switch

Number of Lines/Phones	Staff Size
800	2
2,000	3
4,000	12
6,000	2
6,700	19
7,300	27
8,000	15
10,700	18
14,000	25

Average Number of Lines: 6,600; Average Staff Size: 14 people

"Owned" Switch

Number of Lines/Phones	Staff Size
2,000	5
2,300	6
7,500	17
8,000	15
8,900	14
9,000	24
10,000	16
12,500	19
15,000	84
16,000	123
17,000	74
18,760	86
29,000	100

Average Number of Lines: 12,000; Average Staff Size: 45 People

[23]Thomas B. Cross, "ISDN—What Is It and Do I Really Need It?" *The Office*, July 1987, p. 84.

[24]Alley and Willits, p. 10.

In the case of regulated service, the average ratio of staff to lines/phones is approximately one person for each 500 lines. For the owned-switch situation, the ratio changes markedly to one person for each 250 lines. This could be related to the fact that the average owned operation is twice the size of the regulated university examples—and with size comes complexity of operation.

Admittedly, this is a small sample, but you might use the ratios to get an idea of the size your campus telecommunications office should be in relation to the number of lines. At Florida State we have 7,300 lines/phones, so the telecommunications office staff should be about thirty people. That is close to where we'll be before the year is out.

The Director

The next issue is finding the manager to lead these new campus telephone companies. This is a new breed on campus: managers who know the technical side of telephony. When you also ask for some data capability, central office knowledge, and familiarity with video and satellite technology, you really narrow the field.

Where can you find these directors? The university survey told us the following:

PREVIOUS JOB OF DIRECTOR OF TELECOMMUNICATIONS

- 12 within the university
- 4 telecommunications industry
- 3 another university
- 3 other (medical center, retired military, and business)

Considering all twenty-two of the directors at responding institutions, the average tenure was 6.5 years. When the two real "old timers" with 18 and 30 years in the same job are taken out of the group, the average time as director comes down to a little under 5 years. The newness of this position is dramatized when the 10-, 16-, 18-, and 30-year veterans are excluded: the average tenure of the remaining eighteen directors is 3.8 years. This does not mean that telecommunications directors don't last very long on the job—we have only been deregulated for about that period of time.

Professional Resources

In addition to the resources available through CAUSE, another source of information for the emerging profession of telecommunications management in higher education is the Association of College and University Telecommunications Administrators (ACUTA). ACUTA is a professional organization that offers publications, conferences, and seminars that cover a range of topics, from basic voice services to video and data communications. For further information: ACUTA, Lexington Financial Center, Suite 1810, Lexington, KY 40507; 606-252-2882; e-mail ACUTA@UKCC.BITNET.

Parting Thoughts

This move so many of us are making into voice communications is just one more example of the increasing interconnection of information-support units across our campuses. As we become more involved with phone systems, library and networking technologies, supercomputing, and other developing areas, a major part of our job is learning new jobs—and what better way than through the experience of others? An appropriate conclusion to this *Guide* are some recommendations from people who have already been there. If you are just moving into the phone business, here is some advice from the trenches.

The final question of our survey was, "If you could give one word (or sentence) of advice to someone contemplating the acquisition of a switch and moving toward the setting up of their telephone company, what would it be?" As you can see, most of the comments boil down to a single word: "Plan!"

- "Don't rush. Get all the facts."
- "Define the goals of the proposed telecom organization as it relates to the mission of the university."
- "Hire people who understand telephony and central office operations. Whether you realize it at the outset, you will become a university telephone company."
- "Be sure that your upper management understands and supports the change and do not underestimate the resources needed to both manage the project and the ongoing activities after the cutover."
- "Decide what the university wants or needs. If your data will go through the switch (most don't), then consider combining voice and data. If not switched, don't combine them."
- "Look for proven, widely used hardware. Dependability and, more importantly, proven documentable, support-reliability from the vendor."
- "Make certain top administrators fully understand the size and complexities of the tasks and are willing to support the staffing, space, and financial needs of being your own 'telco.'"

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northern telecom

Company Overview

Northern Telecom is the leading global supplier of fully digital telecommunications systems. The company provides products and services to the telecommunications industry, businesses, universities, governments, and other institutions worldwide The second largest domestic manufacturer of telecommunications equipment in the United States, Northern Telecom is among the top five in the world.

Northern Telecom employs more than 48,000 people throughout the world and has research and development facilities and forty-eight manufacturing plants in the United States, Canada, the United Kingdom, the Republic of Ireland, Malaysia, and Brazil. The largest component of Northern Telecom's international operations is in the United States, which accounts for some 70 percent of the corporation's total sales and more than 65 percent of its investment. Northern manufacturing employs more than 22,000 people in the U. S. in the manufacturing facilities, fifteen research and development centers, and numerous marketing, sales, and service offices across the country.

Northern Telecom has a sizable and increasing research and development program in the United States. Annual investment in research and development runs about 12 percent of Northern Telecom sales. Research and development is conducted in fifteen Northern Telecom locations in association with manufacturing operations and in five laboratories run by BNR, Northern Telecom's research affiliate. BNR labs, with more than 5,000 employees, are located in Atlanta, Georgia; Dallas, Texas; Ann Arbor, Michigan; Mountain View, California; and Research Triangle Park, North Carolina.

Northern Telecom pioneered the full-scale application of digital technology to telecommunications when it announced the Digital World in 1976. Today Northern Telecom designs, manufactures, and supplies the industry's only complete line of fully digital switching and transmission systems.

Products, Services, and Programs

Northern Telecom has one of the broadest product portfolios of any manufacturer in the industry. Northern Telecom's product portfolio falls into two broad categories:

- equipment designed for public telecommunications networks, sold to local and long distance communications carriers, and

- office communications systems, sold to business, universities, governments, and other public and private users.

Northern Telecom makes virtually everything that goes into a telecommunications system: telephones and terminals, the wire and cable connecting them to the network, switching systems that route information, transmission systems that transport it through the network, and operational and maintenance systems needed to manage the network. The product lines include the Meridian 1 line of office system products.

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For more information about Northern Telecom, its products, services, and programs, contact:

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