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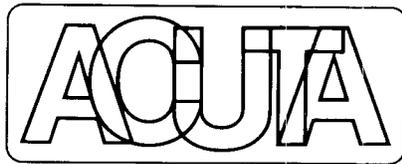
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# NEWS

Association of College & University Telecommunication Administrators  
THE VOICE OF TELECOMMUNICATIONS IN HIGHER EDUCATION

VOLUME 17, NUMBER 3

MARCH, 1988

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## President's Message

—Kia Malott, Southern Illinois University

Every time I attend an ACUTA seminar or conference, I wonder how the next event could possibly measure up to the one just finishing. I can attest I have never been disappointed and that was certainly the case in Charleston, South Carolina. The exhibits were the largest ever for a seminar. The seminar topic was very timely, the social activities better than ever, the hotel accommodations were excellent and even the weather was very cooperative. All in all the seminar was well accepted by the 140 plus in attendance.

Elizabeth Bullock and Tina Whitehead of the College of Charleston are to be commended for their assistance in making the Spring Seminar the huge success it was. The oyster roast at the southern plantation could only be described as a commercial testifies "It doesn't get any better than this." For those in attendance, thanks for coming and those who missed Charleston can look forward to the annual ACUTA conference this July in beautiful San Diego.

The selection committee has been working extremely hard evaluating the large number of applicants for the position of Administrative Director. There are a number of highly qualified applicants, and the process has been difficult. I am confident, however, that the position will be filled before the July conference.

The ACUTA Board of Directors has contracted with GKA to conduct a survey of member educational institutions. The survey results will be presented at the San Diego conference. All institutions participating in the survey will also receive a synopsis of the results. We urge everyone to complete and return the survey, in a timely fashion, so there is a representative sampling of the ACUTA membership.

The brochure on the annual ACUTA conference will be in the mail shortly. Please make your hotel arrangements early. We are expecting a very large turnout and want to insure everyone has the accommodation they need.

## ACUTA

### 17th Annual Summer Conference

San Diego, CA

July 17 - 21, 1988

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## PARTY LINE

—Ruth Michalecki, University of Nebraska

I have received many calls concerning a growing "problem" for university telecom administrators. It is called Alternative Operator Services (AOS).

Operator services represents a \$6 billion industry. The market is lucrative because operator-assisted calls are priced at a premium; AT&T adds fixed charges of 80 cents for calling card calls, \$1.55 for collect and third number calls and \$3.00 for person-to-person calls on top of the applicable time and distance MTS charges. I read that nearly 20 percent of all interLATA MTS calls are operator-assisted and that 45% of all operator-assisted calls originate from pay phones that serve high transient markets such as airports, truck stops, hotel lobbies. The remaining 55% originate from hotels, motels, hospitals, convention centers, university dorms, etc. It is the aggregation of large volumes of operator-assisted traffic and the revenue enhancement potential associated with value-added services, that make the operator services market attractive. Is there any wonder that competition has entered this market in a big way!

AOS (Alternative Operator Services) has a variety of service offerings: long distance services thru reselling major carriers' services; operators for handling operator-assisted calls such as third number billing, and collect calls; placing credit card/calling card calls made on other carriers' cards and calls can be charged to major credit cards as well. AOS companies are not required to follow AT&T's operator-assisted rates and some have allowed their customers (hotels, private pay phone holders, universities) to add their own surcharges for operator-assisted calling. Value-added services (voice messaging, information services, electronic yellow pages, etc.), may be billed at a further premium. Problems or headaches for the telecom manager arise when the AOS charges far exceed the normal operator-assisted charges and the customer has no idea their call is being processed by an AOS provider.

Motels, hotels, airports, hospitals, private payphone owners and some universities contract with AOS for their services because the commission they receive is pretty hefty. At the Spring Seminar in Charleston, one of the exhibitors was an AOS company. The first line

PARTY LINE. Continued:

of their literature telling about their service was: 15% commission paid to their customers. There are nearly 40 AOS firms in the United States and most of them have billing arrangements with the local phone company. AOS charges appear on your phonebill---causing another headache for university telecom managers.

Right after semester break, my accounting supervisor brought me a copy of our telephone bill. She pointed out several calls charged to student telephone numbers, pretty hefty charges for fairly short-duration calls. These were third number charges, all placed from locations outside Lincoln and terminating outside Lincoln, and for the most part, placed several months previously. Well, I don't have to tell you the difficulties we have getting bills several months old and billed to student telephone numbers. Who knows who placed the calls in the first place and who was living in the dorm room at that time? We have the dorm numbers listed in the AT&T-owned and controlled database called the "billing validation application" or BVA, as restricted-billing lines, and of course, we have never issued calling cards to student telephones. AOS providers do not have access to AT&T's BVA, and I'm sure the lack of validation services must be frustrating to these vendors. The BVA relies upon daily updates and information from the BOC-owned database administration systems. The BOCs' network sharing contracts with AT&T permit the BOCs to query AT&T's BVA for validation purposes but prohibit the BOCs from providing access to AT&T's BVA to any third party.

Another problem, the calls were billed to the university, but they were NOT on the mag tape copy of the bill, only on the paper copy. This presented another problem---manual billing for calls, if we accepted the charges. Our decision was to deny the calls and refuse payment of these charges. Since our experience was with the student numbers, it was fairly simple to handle. However, what happens when a department using their legitimate calling card from a payphone or a hotel room, has their call processed by an AOS and we receive a bill amounting to 4 or 5 times the normal rate for such calls?

There is usually no indication a call is going to an AOS provider and seldom, if ever, is there any posting of the higher rate. The Virginia State Corporation Commission says AOS charges can be up to 10 times AT&T or local phone company charges. It is not unusual for calls to be routed via an AOS provider's switch located far from the call origination point, with the caller paying the mileage. They cited an example of a call placed from Suffolk, VA to Richmond, VA, a distance of about 70 miles. The call went by way of Georgia, at four times the AT&T MTS cost. One Florida caller made a three-minute calling card call from Miami to Fort Lauderdale on a private pay phone. The AOS charged 200% more than the Southern Bell rate: \$3.45 as compared to \$1.71.

We have had several ACUTA members contract with AOS companies to handle their operator-assisted calls. I have talked to at least 15 members during this past week to see what their experiences have been. Everyone I talked to has had some serious problems, although not everyone solved them in the same

manner. I am going to discuss briefly some of the problems experienced by our members, but I will not use their names or the name of the AOS firm.

One member said that although their contract called for AOS charging applicable AT&T MTS rates, they received charges far in excess of those rates. Callers were being charged operator-assisted rates when the AT&T DDD rates should have applied. Even though their contract specifically covered not placing unauthorized third number calls, the AOS firm ignored the agreement and accepted all such calls. This university had contracted with the AOS to handle all of their hospital and dorm traffic, including DDD. The AOS company's billing system was a nightmare according to our ACUTA member, who also said the complaints from the university community were numerous and even reached the top administrators. At the end of their one-year contract, this university terminated their contract and refuses to have anything more to do with AOS.

Another member cited many of the same problems. The AOS raised their rates with no advance warning. All at once, the university bills were 3 times more than the agreed upon AT&T applicable MTS rates. Bills were several months late and once again, the number of complaints received by the telecom office were enormous and angry users also called the top administration. Our ACUTA member said it certainly caused many problems for their office for several months. This university and the AOS worked together and reached an agreement that was satisfactory for both. Rates were lowered, per the original contract, and in fact, they are now about one penny lower than applicable AT&T MTS rates. The AOS pays for the access lines and hardware required to reroute the operator-assisted calls. This university contracts with the AOS to handle only operator-assisted calls for both the students and faculty/staff. A concerted effort has been made by the AOS to correct their billing problems, which was proven to be partly the fault of the local operating company. The AOS is refunding the overcharges, IF they are requested to by the caller. They have not made any blanket refunds, only upon request. When I asked why the university would consider retaining the services of the AOS, I was told it was a matter of money. The university made a hefty commission on the calls plus avoiding the cost of approximately 28 access trunks. They simply felt the profit and reduced costs were too significant to give up. However, the advice we received from this ACUTA member was to carefully watch the activity and make certain your contract covers all the bases!

Another university didn't have a contract that protected the university and they purchased their new switch depending upon the AOS commissions to make some of the switch payments. They are really hurting now---experiencing all the same problems as the other universities, but without recourse.

All of the ACUTA members I spoke to had similar experiences. Those members not contracting for AOS, were having problems with receiving bills from their local telco for AOS services. Without a doubt, this is a problem for all of us. These firms are growing by leaps and bounds which means our problems will grow right along with them. We

## POTPOURRI

### -Connie Gentry, Emory University

I don't know about "y'all," but this past winter has been . . . well, not exactly "THE PITTS!", but not far from it, as far as I'm concerned. I feel as if I've been in one of those avant garde films where you don't have the foggiest notion what in the world's going on, and if you did you wouldn't understand it anyway!

Five year budget projections and the 88-89 Emory telecommunications budget have been contributing factors to my on going confusion. I've made so many revisions now that every time I call up the budget spreadsheet on my PC the prompt reads, "here is the file you asked for. . . any resemblance to actual income and expense is purely coincidental!"

On the brighter side, I finished putting together an RFP for a new system at our junior college and we've just been given the go-ahead to release it. And I'm actually making progress with creating a disaster backup and recovery plan. By the way, in one of my previous columns I asked that you wonderful folks help your struggling colleague by sharing your disaster plans. Only Linda Bogden-Stubbs of SUNY Health Sciences Center at Syracuse took pity on me and sent me a copy of their disaster plan. The rest of you either don't have one or deserve a resounding "Phtttt!", (commonly known as a razzzzzberry) for being so tacky and not sharing. I'm going to share ours with you in an upcoming ACUTA NEWS just to make you feel guilty.

Speaking of feeling guilty. . . I'm afraid I have to take a few lumps on that account. Last year, in one of my columns, I told you about an AOS (alternative operator services) company which would take your 0+ traffic and give you a tidy little commission on the calls. We were using the service and quite happy with it at the time. Unfortunately, we found out that what you see is not always what you get and as of January of this year are no longer using this company. To say that the repercussions of our experience have been a headache is a VAST understatement. However, dreamer that I am, I still think the concept is sound; one just needs to be more careful in making sure one knows who one is dealing with, if you get my meaning.

The most unusual thing that happened this winter was being asked to install a phone in a 12 story construction crane on campus. It seems that the crane operator had to report to his parole officer every day at a set time and rather than stop work while he climbed down, made the fall, then climbed back up, the construction foreman just gave him a phone of his own. . . and we installed it. As Alf says, "No Problem".

We also ended up having to remove patient room phones from the hospital psychiatric unit. It seems that the inhabitants were creating havoc by calling out for pizza's. . . and taxis.

Well, I don't think I have any more exciting news or experiences to pass along right now. I kept looking for Mal Reader during the Olympics but I guess he was too busy to give Jim McKay an interview. I've heard rumors that in addition to his telecommunications duties he was coaching Eddie the Eagle.

Sounds like Mal, doesn't it?

Our words of wisdom this month come from the late Samuel Goldwyn, the G of MGM, who said, "A verbal contract isn't worth the paper it's written on." Let that be a lesson to you all.

See you soon. . . .

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### FROM THE BOARD

- Coleman Burton, University of Missouri

The annual dues notices will be sent out around May 1, 1988. The dues will be the same as last year, \$75 for Full and Associate members and \$150 for Industry members. The dues should be paid by July 1, 1988 in order to qualify for member registration rates at the Annual Conference in San Diego on July 17 through 21.

This year's dues notice will include a data update form for entering name, title and address corrections. The form will also include space for entering your BITNET address and facsimile number. The coming year's roster will be generated directly from our ACUTA membership list, which is used to send out the Newsletter and dues notices. If your entry in last year's roster has any errors, or if you have a BITNET address or FAX number that was not listed, please be sure to indicate the changes on the data update form when you send your dues in.

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### PLAN NOW FOR SAN DIEGO

- Bill Morris, University of Central Florida

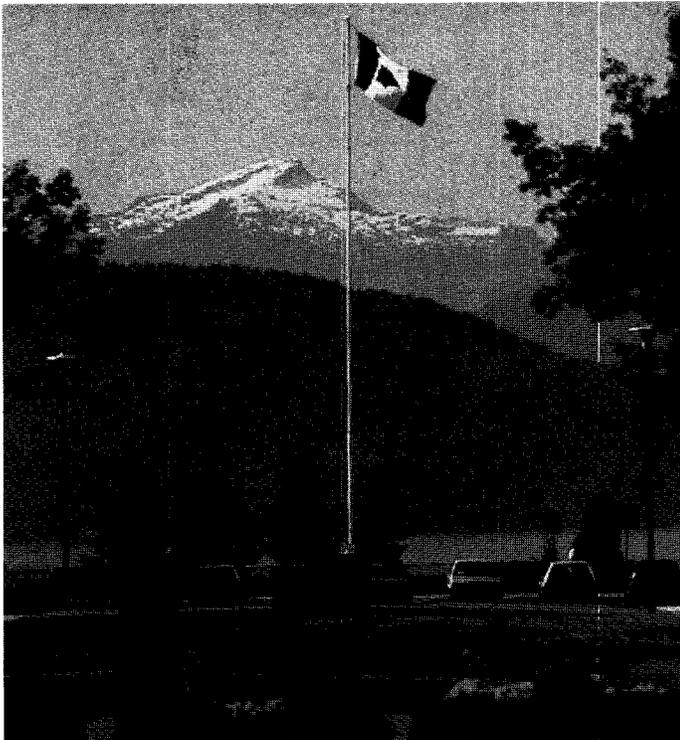
The program for our 17th annual conference is being finalized and the speakers are being re-confirmed. As always, the program committee has selected diverse, current topics and the best speakers available. The presentation of papers by peer ACUTA members will provide real life experiences. The Regional meetings give you the opportunity to know your neighbors and the User Groups provide the opportunity to hear the latest information from your equipment vendor and to ask your questions directly to their representatives. The exhibits will be the biggest and best yet. Over 50 vendors are expected to display their products and services at our conference. Our sponsors are also providing unique learning experiences. This conference should be your priority education experience for the summer.

In addition, San Diego is one of the country's premier vacation destinations. Our hotel, the Sheraton on Harbor Island, a four star facility, will provide us beautiful harbor views, superior rooms and the excellent service that will make our conference an enjoyable trip. Many of us will take this opportunity for personal vacation time. You may choose a cruise, sport fishing, harbor sightseeing or a stroll on the beach. San Diego's zoo with over 3,000 animals is world famous. The Wild Animal Park with 1,800 acres of natural habitat is a one-of-a kind nature experience. A visit to Sea World, the missions, Old Town, Gaslamp Quarter, Coronado, Balboa Park and bargain shopping in Tijuana will give you a wide option for using your leisure time.

We hope to see every member on July 17th in San Diego. Make your reservations early!

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# THE UNIVERSITY OF BRITISH COLUMBIA



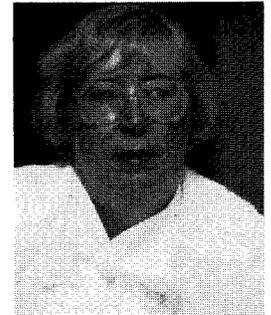
There are few university campuses in Canada that compare to the University of British Columbia (UBC) in terms of sheer natural beauty. Its location on 1000 acres of provincial endowment land, on a peninsula in English Bay, offers students a panorama of visual wonders, including a mountain range with snowy peaks that loom only a few miles across the water.

The second largest university in Canada, UBC offers many of the amenities of a self-sufficient urban community. In fact, the university might better be described as a small city rather than a campus. It's estimated that 60,000 students, professors, administrators, and support staff have daily business at UBC.

Since the endowment lands are outside the jurisdiction of Vancouver's municipal government, UBC is responsible for providing its own essential services--health care, security, fire department, garbage disposal. Self-sufficiency also includes buying hydro power in bulk and distributing it to various faculties, residences, and several provincial government agencies located nearby.

UBC administrators have taken great strides recently with the cutover to a 6000 line Meridian SL-1XT, representing the third upgrade in a smooth and steady evolution of Meridian SL-1 systems that dates back to 1980. For the first time, UBC's 400 buildings, 12 faculties, and 91 academic departments are connected through one main switch. By bringing the entire campus under one communications umbrella, UBC is now realizing the advantages of centralization, including vastly superior network management capabilities, and an estimated 15-to-25 percent reduction in annual long distance bills.

"Technology has come a long way since we installed our first on-site switch over 20 years ago," says Dr. Krishan Srivastava, Vice President, Student and Academic Services, who came to UBC after a 17-year career at the University of Waterloo, where he headed the electrical engineering faculty. "The transition to digital technology was inevitable. We needed to satisfy our short-term needs and still allow for future growth. We had to improve the internal channels of communication, and provide better access for outside callers."



**Olga Duncan -  
Communications Supervisor,  
"Expectations are high and  
we need a reliable network  
to get the job done".**

Priorities are centered on voice communications. The day-to-day management of the network is largely the responsibility of UBC's Communications Supervisor, Olga Duncan: "When people walk into an office, any office, they automatically expect to find a working telephone. Expectations are high and we need a reliable network to get the job done. I believe we made the right choice with Meridian SL-1 products."

Duncan has been at UBC since 1973 after spending over a decade in the marketing department of British Columbia's provincial telephone company. On arrival she found a series of key systems and a collection of rotary phones that were hardwired, inefficient, and costly to operate by today's standards. All WATS calls had to be channelled through UBC's two console attendants--who, as a result, were inevitably overworked, and often too busy to provide other services such as internal directory assistance.

The key systems in this environment were obviously outdated. "All people could really do with their phones was place or receive a call," Duncan says. "There was no capability for someone to take messages unless your phone was hardwired to someone else's phone. The system was bulky, slow, and expensive."

Dramatic changes started to take place in 1980 when a new teaching hospital was erected on campus. The first step was to install a 900 line SL-1VLE at the hospital. Five years later, to accommodate rapid expansion, the hospital's switch was upgraded to a 1300-line Meridian SL-1XN. But the primary challenge remained: How to prepare for the anticipated growth that would bring the total number of telephones on campus to over 7000 by 1990.

The answer was another upgrade. Because of the continual evolution of Meridian SL-1 systems, which had already seen UBC through two significant growth periods, a decision was made in 1986 to go one step further: the Meridian SL-1XN was converted to a Meridian SL-1XT, which offers four times faster call

(Continued, next page)

#### UNIV. OF BRITISH COLUMBIA, Continued:

processing ability and 10 times the memory storage. With enrollments showing no sign of declining, and education budgets getting tighter, the move to a campus-wide network couldn't have come at a better time.

Today, the network offers significant savings because Electronic Switched Network (ESN) software automatically chooses the least expensive long distance service, regardless of where the call originates on campus. Programmable capabilities such as call forwarding, call restriction, conferencing, ring again, and direct-in-dialing have given UBC a flexibility in its communications that it had lacked.

Call forwarding is an excellent example. "Faculty advisors can now hold a meeting and no one has to worry whether their telephone will be answered," says Duncan. "Now it's simply a matter of forwarding everybody's calls to one secretary."

An added benefit of a network built around one centralized switch is that future software enhancements need only be programmed at the main source, rather than at a collection of independent systems across campus.

Duncan is developing a PC-based telephone management system to allocate back to each faculty its share of the communication costs. In addition, when telephones have to be installed or moved, the program will be used to simultaneously notify the maintenance department of the request, update cable and inventory records, and transmit the software change to the Meridian SL-1XT as required. "Because the Meridian SL-1XT is the main network control point, campus-wide software changes can be made quickly and easily," she says.



For the first time UBC's 400 buildings, 12 faculties and 91 academic departments are connected through one main switch.

More advanced data applications are still a few years in the future. As a co-director of the UBC Centre for Integrated Computer Systems, Dr. Srivastava is naturally intrigued by the data transmission possibilities offered by a digital switch such as the Meridian SL-1XT. "The common link for the next generation of services is our Meridian SL-1." he says.

He envisages the day when faculty, staff, and students will be able to tap each other's PCs, and the university mainframes, for any number of reasons; a professor adds final grades to his student's files; a student scans a computerized course syllabus; an administrator uses electronic mail to pass memos along to other staff, or contact alumni during fundraising campaigns.

University administrators have come to realize their operating budgets aren't growing at a rate fast enough to meet all their needs. UBC's network has evolved from clusters of archaic key systems into a centralized digital switch that offers innumerable productivity and financial benefits. Along the way, three successful Meridian SL-1 upgrades have helped UBC adapt to its internal growth in an orderly, flexible manner . . . it's an excellent reason for learning with Meridian SL-1.Ⓢ

This article is from Northern Telecom, January 1988 issue.

#### PARTY LINE, Continued:

need to look at how local telcos' can profit by providing billing services to these vendors, creating billing nightmares for all of us for services we neither requested or want.

I have been told there are ways you can avoid using pay phones that use AOS. First look for a sign indicating who owns the pay phone, but watch out for sound-a-like names. If it is owned by the local telco, dialing "0" will get a telco operator for local calls and an AT&T operator for long distance. If it is a private pay phone, dialing "0" will get the telco operator for local calls and dialing "00" (in most states) gets a long distance operator. Easier way; simply ask the operator who they work for.

In many states the Public Service Commission is taking action to prevent wholesale rip-offs. In Florida the PSC wants the AOS to get a certificate as an interexchange carrier, disclose all rates in a tariff, and not charge more than \$1 over the AT&T day rate for pay phone calls. In California, the Consumer Action Group is asking the PUC to rule that private pay phones can't charge more than 10 cents over AT&T's operator-assisted rates. However, the major problem seems to be that users have absolutely no idea which service they are using; they often cannot place 800 calling card calls; they are billed for incomplete calls; calls are placed via a carrier other than the one on their calling card; they receive no time-of-day discounts.

During the annual ACUTA conference in San Diego this July, we will have a panel of ACUTA members discussing Alternative Operator Services. We want to hear from you on this subject, both good and bad experiences. Please let me know what your experiences have been and let me know if you are willing to participate in a user panel on this subject.

(Continued, Page 8)

# The Other Side of T-1

The highly touted digital networking technology has a dark side. Failure to recognize T - 1's problems can result in data transmission glitches and high debugging costs.

—George Pfister

Overly positive expectations inevitably lead to crushing disappointments, and T - 1 networking is no exception. A growing number of brave users and consultants have found that 2T-1 carrier is far from the panacea that some members of the vendor and press communities would lead us to believe. Indeed, the evolution of this technology over the past two decades has led to problems in loop synchronization, data transmission accuracy and start-up costs.

The major problems are most attributable to a lack of understanding of how T - 1 was first justified and how it evolved---from a voice-only technology designed for internal telco use to a non-telephone company private networking alternative. To shed some light on the problem it's important to examine T - 1 technology from a historical perspective and from the vantage point of users' real-world requirements. The consultant may then adjust his or her expectations to fit a more realistic view of T - 1's current strengths and weaknesses, and to make arrangements with the telco to boost T - 1 network performance once services to the client are kicked in.

## First 'N,' Then 'T'

The first implementation of a carrier system in the telco environment was the "N" carrier, which was installed when toll links between telco central offices became saturated in the late 1940s. The typical N carrier system supported 12 links derived from a single twisted pair. The N carrier was analog and difficult to engineer, resulting in higher support costs.

The "T" carrier, in contrast, was born a generation later. First proposed and installed about 1964, it provided major benefits. Among them, the carrier accommodated 24 voice-frequency (VF) channels on two twisted pairs. Reliable end-to-end digital connection was achieved over a single T - 1 pipe, and at lower costs than "N" carrier.

The T - 1 carrier operated then, as it does now, over existing 24-gauge wires at distances of one mile. Repeaters regenerate the transmitted signal for greater distances. Digital regenerators offer advantages over analog amplifiers in that they do not amplify the accumulated noise and distortion along with the signal.

The early implementation of T - 1 carrier were made in the telcos' "toll plant," where their performance was strictly an internal concern of the telcos since subscribers were not directly connected to T - 1 facilities. Beginning in the 1970s, however, digital carrier began to enter the subscriber side of the network with the introduction of the Subscriber Loop Carrier, or SLC-96. This facility let the telco utilize four pairs of

wire to derive four T - 1 spans, or 96 voice channels in all. The system was ideal for those areas where the plant had become saturated.

## T - 1 Transmission Formats

The original T - 1 carrier introduced the first widely installed digital encoding technique: Pulse Code Modulation (PCM), figure 1 illustrates how PCM encoding is accomplished. Each PCM sample is eight bits and the same samples are transmitted 8,000 times per second, yielding an aggregate bit rate of 64,000 bps. The original T - 1 transmission scheme, called "D1" framing, encoded voice in seven bits and retained one bit in each channel for signaling.

Twenty-four channels today are multiplexed into the T - 1 carrier and thus produce an aggregate rate of 1,536 Mbps. An additional bit is reserved to synchronize 24 channel T-1 frames; this accounts for the additional 8,000 bits per second in the published T - 1 rate of 1,544 Mbps (Note:  $1,536,000 + 8,000 = 1,544,000$  bps.)

The signaling bits in the original D1 frame have since been revised to conform to a more efficient framing format, termed D3 and D4. Both D3 and D4 have come to dominate digital encoding schemes, with signaling bits inserted into every sixth frame.

A still more recent and more meaningful development has been the introduction of the "Extended Superframe Format." Just as the inclusion of signaling bits in each channel in D1 format was deemed excessive so to 2 have framing signals at 8,000 bps---in part because digital repeaters have become more reliable. The Extended Superframe convention calls for framing bits to occupy only 2,000 bps, with the remaining bandwidth used for a Facility Data Link (FDL), which allows for diagnostics and control of remote transmission equipment and the Cyclical Redundancy Check (CRC), which monitors the performance of the link.

Obviously, the kind of digital technology available in 1965 is far from today's state-of-the-art. As a result, the original specifications for T - 1 carrier were forced to deal with the primitive digital signal processing and synchronization capabilities of the 1960s technology. In the area of signal processing, however, a relatively robust technique was developed early on. Termed Bipolar Return to Zero (BRZ), the technique employed zero bits, represented by zero voltages on the circuit and "one" bits by alternating positive and negative voltages. With this robust signaling scheme, even the primitive 1960s style of signal process technology could function reliably.

## T - 1's Dark Side

The reader should remember three underlying characteristics of T carrier from the foregoing discussions:

- T Carrier is intended to operate on the telcos' installed twisted wire plant;
- T Carrier is oriented toward voice, not data transmission;
- T Carrier was originally a technology used internally by the telco.

These conditions have had far-reaching effects

## The Other Side of T-1, Continued:

on the quality of T - 1 transmission. Quality is dependent on the exact condition of T - 1 transmission. Quality is dependent on the exact condition of the telco outside plant. Any given piece of telco outside plant can vary from one operating company to another---and to a great degree within a specific operating company with respect to the quality of the circuit design and maintenance documentation.

Perhaps the most outlandish problem the author has encountered has been loop "desynchronization" with a long distance carrier servicing one of its large accounts. After weeks of attempting to synchronize with a local loop, we discovered the telco had installed a relatively unconventional T - 1C link (two DS - 1 channels) over the same twisted pair route that the carrier was now trying to use. Because this link introduced a multiplex-demultiplex conversion, a synchronization problem resulted. The fact that no one knew about this T - 1C span at the telco and that the presence of this Mux/Demux was discovered almost by accident suggests that the T - 1 implementation process can be more "artistic" than many telcos would lead customers to believe.

### **Voice Orientation**

The T Carrier systems were developed because the telcos were experiencing congestion in their plant during the mid-1960s. At that time data transmission was not a priority.

The Bipolar signaling technique that is part of T Carrier spans allowed the relatively primitive repeaters to maintain their synchronization as well as sample and regenerate digital signals over reasonable distances. However, the repeaters had significant problems in maintaining synchronization with each other and would lose synchrony if they received a large number of zeros. No transmitter was therefore "allowed" to send more than eight consecutive zeros. This limitation worked for voice, since it's impossible to violate the rule (known as "ones density"), but when data came along almost as an afterthought, the rules had to change, since more than eight zeros could be generated for data.

The resolution of the problem took the form of violating the bipolar scheme, creating a specific pattern such that the receiver would interpret the violations as a secret way of sending zeros. The problem was that the telco's intermediate equipment has to be let in on this little secret or else its equipment would automatically make a "correction," resulting in faulty transmission. The new scheme was called Bipolar 8 Zero Substitution (B8ZS).

An additional problem arises in the area of T - 1 data transmission at speeds exceeding 56 Kbps. This transmission limitation is exaggerated by data communications users; it is nearly impossible to fathom how an extra 8 Kbps could make or break a data network capable of justifying 56 Kbps transmission in the first place.

The 56 Kbps limitation is also one of the multiple "non-problems" that Integrated

Services Digital Networks (ISDN) should solve by the year 1997, but in the interim consultants are advised to live with the high speed data transmission maximum of 56 Kbps.

### **For Internal Use Only**

Because T - 1 was installed principally in the toll environment without direct subscriber access, the maintenance and operating procedures created a natural susceptibility to problems that consultants and telcos are now facing.

In general, telco T - 1 spans were maintained on a "management by exception" basis, meaning synchronization and transmission quality problems were isolated with relatively primitive "red and blue" network alarms. Because the toll plant was totally within the telco's domain, outage or marginal performance of a T - 1 span would result in the trunk group being taken out of service until technicians had resolved the problem. They could perform disruptive testing and maintenance without experiencing heat from irate customers.

It should be noted that the B 1 and B 3/4 transmission formats allowed no provision for non-disruptive testing or continuous performance monitoring. Only recently has the Extended Superframe format allowed for the calculation of bit error rates on a continuous basis and the ability to retrieve this performance data remotely. The author has received a few too many questions from customers about the need for Extended Superframe; they feel they are being unreasonably pressured by their carriers to implement this format. The fact is that the Extended Superframe is absolutely necessary. It's the best thing that could have ever happened to the customer requiring high reliability.

### **Conclusions and Recommendations**

The biggest problem the author has encountered is that users overestimate the performance of the T - 1 Carrier network and are unpleasantly surprised when they encounter some of the "mystery" problems once the network has become operational. When users understand that many problems are endemic to T - 1's "voice" and "internal use only" orientations, expectations are reduced.

When utilizing telco-provided T - 1 Carrier, the customer and consultant should anticipate significant start-up problems and allow for an extended pilot period. You will be wise to procure the required test equipment and train technicians to debug the pilot installation.

While bit error rates may ultimately provide for superior transmission quality, the client should not expect perfect transmission performance. T - 1-based networks for the foreseeable future will be very good 99.5 percent of the time and an atrocity the rest. Back-up facilities and contingency plans are a good idea, such as retaining existing analog circuitry for an interrupt period.

The Extended Superframe format, which many users appear to be apprehensive about, should be embraced and incorporated into the network at every possible point. The carrier

### The Other Side of T-1, Continued:

representative who insists on this interface might appear to act paternally, but in the long run is doing you a favor.

Multi-carrier networks can be a nightmare. The local telco and your interexchange carrier may use different network clocks, have incompatible network management procedures and techniques as well as other problems that can make the digital networking endeavor difficult.

Further, expectations for T - 1 must be factored against the economics associated with the channels that will be supported. Because of the way many telcos tariff Dataphone Digital Service, several DDS links may justify the T - 1 alternative by themselves. Moreover, the performance of T - 1 will not be appreciably worse than DDS once the network has burned in. Many of the problems encountered by early T - 1 users have been related to data---not voice. As a result, the discounts offered by the telco over traditional analog facilities will be sufficient to push the consumer into the T - 1 camp with uniformly acceptable service levels.

Finally, both consultants and users must pay attention to standards for digital networking. In no area is this violation as rampant as with the T - 1 multiplexer or T - 1 resource manager. These devices have been designed to optimize data transmission functions at the expense of adherence to published and pervasive digital networking standards.

In fact, there is a defined set of data transmission standards that should be implemented for T - 1. They observe the following conventions:

- The maximum data channel transmission rate is 56 Kbps;
- Transmission below 56 Kbps is supported within each PCM frame with five 9.6, 10 4.8 and 20 2.4 Kbps channels;
- If subrate transmission is supported, the maximum number of subchannels is the same as the number of the highest speed subchannels (i.e., if 9.6 is mixed with lower speeds, only five total channels can be supported).

T - 1 mux vendors statistically multiplex data in a fashion violating not only subrate data conventions but also the D 3/4 and Extended Superframe formats.

Despite that, consultants should be aware that there are always strategic advantages to standards. Digital links should be installed and maintained without complicating an already difficult process; this can be achieved by adhering to commonly accepted framing, channelization and data transmission conventions. The local telcos and interexchange carriers are having a difficult enough time dealing with standard interfaces to introduce further complications associated with vendors' esoteric, proprietary protocols.

I've maintained for some time that costs for raw digital bandwidth, at both the local and long-haul levels, will diminish at such a rapid rate that it will no longer make sense to optimize bandwidth, but instead to buy more lines. Declining bandwidth costs are already obvious in all the tariffs. Deviation from de facto and published standards will have negative consequences in terms of operations,

manageability, service costs and equipment life cycles.

One of the most important technical trends at all levels of the telecommunications network is the implementation of the Digital Access Crossconnect System (DACS). DACS lets the telco terminate DS-1 streams in an effective fashion with a small number of standard time division interfaces replacing complex space division techniques. The economic and functional benefits of DACS will serve as the cornerstone of enhances, low-cost digital services of the future. It is only through the implementation of digital links, which are compatible with DACS at the frame, channel and subrate levels, that the user can reap the full set of economic and functional benefits of digital networking. ⊕

The above article is from Communications Consultant, October, 1987. George Pfister is president of the Greenwood Group (West Milford, NJ), a consulting organization specializing in strategic planning for voice/data telecommunications systems for major corporations.

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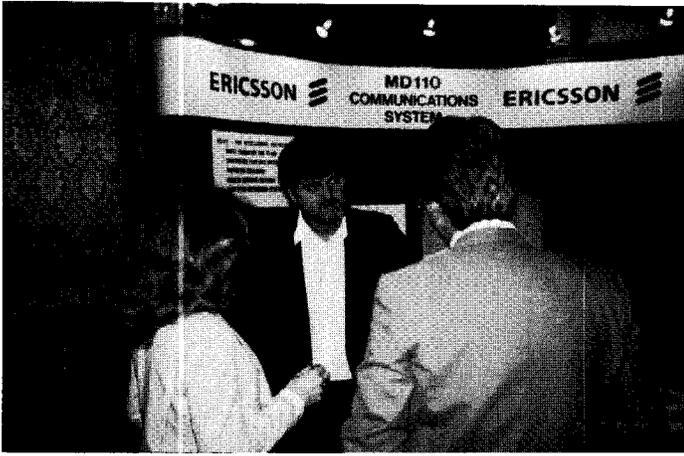
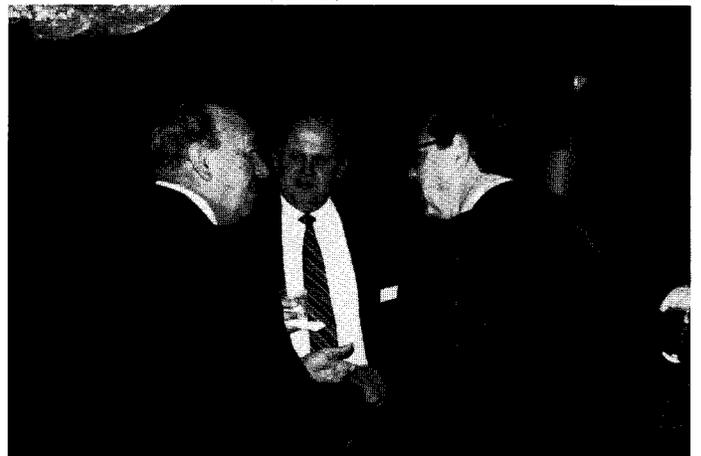
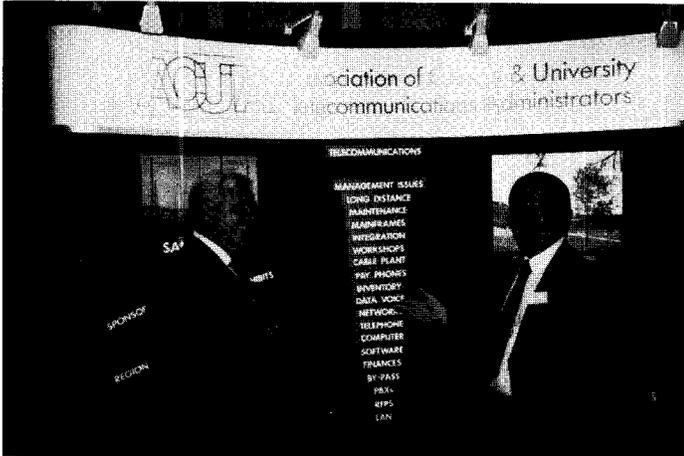
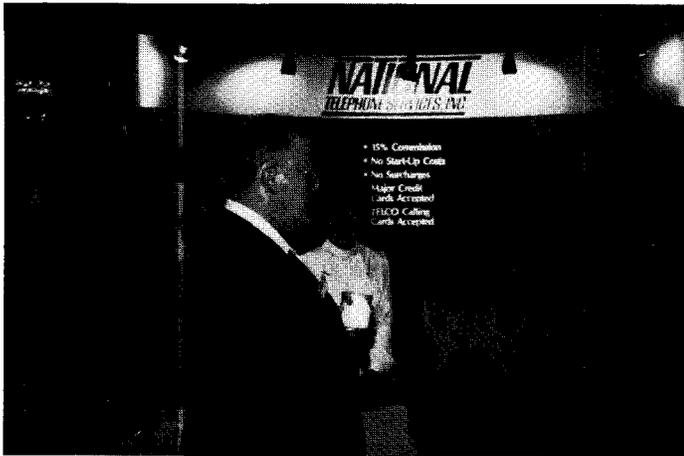
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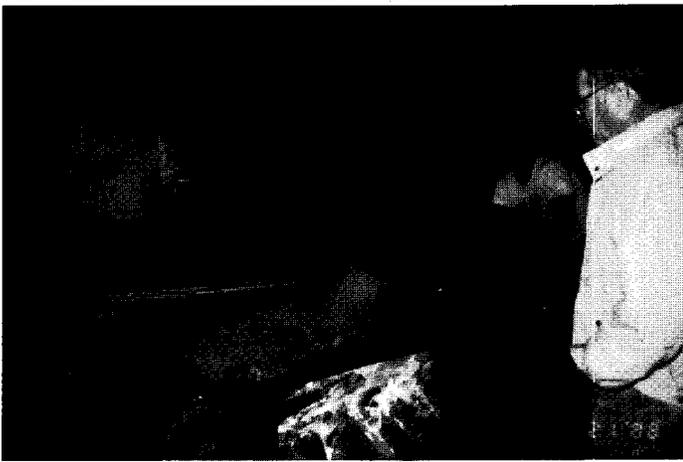
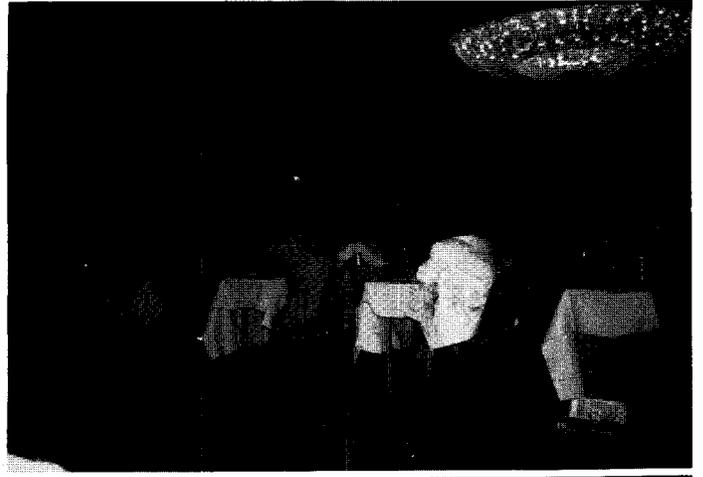
The Charleston Seminar on Telecommunications Facilities Management Systems was very good. John Powers and Geoffrey Tritsch did their homework on this subject---material was interesting and informative. Vendors offering management systems have increased tremendously over the past 5 years. I can remember when we were trying so hard to automate our billing, inventory, order system starting about 10 or 12 years ago. It was very hard to find anyone in the business back then. I struggled with our university computing staff and the state computing staff, trying to get them to understand what we wanted to accomplish and it seemed that every time I thought we were finally making some headway, we actually fell backwards and had to start again.

During the ACUTA Annual Conference held in Lincoln, Nebraska in 1980, I was introduced to our very first Telecom Software vendor sponsoring an event at an ACUTA Conference. It was Randall Manuel of Telecommunications Software, Inc. He talked about his product during the breakfast and before the conference was over, he had a new customer, the University of Nebraska. We were so happy to finally find someone who understood what we wanted, even better than we did. Needless to say, we are still customers of TSI, and Randy still sponsors events and is a regular exhibitor at ACUTA functions. However the number of telecom software vendors has grown and we now have a great many of them sponsoring events and participating as exhibitors during our seminars and conferences. They certainly enhance the learning process at the seminars covering management systems since during breaks and after the sessions, one can actually view the various systems in operation. There are a good many fine systems on the market and one needs to determine which product best suits your application. A good way to do this is to see them at the ACUTA seminars, get hands-on experience with all of them, talk to users of the various systems and to the vendors.

See you next month . . . . ⊕

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