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US Army Information Systems Engineering Command
Fort Huachuca, AZ 85613-5300

U.S. ARMY INSTITUTE FOR RESEARCH
IN MANAGEMENT INFORMATION,
COMMUNICATIONS, AND COMPUTER SCIENCES

ISDN Applications in the Army Environment

February 1992

ASQB-GC-92-011

AIRMICS
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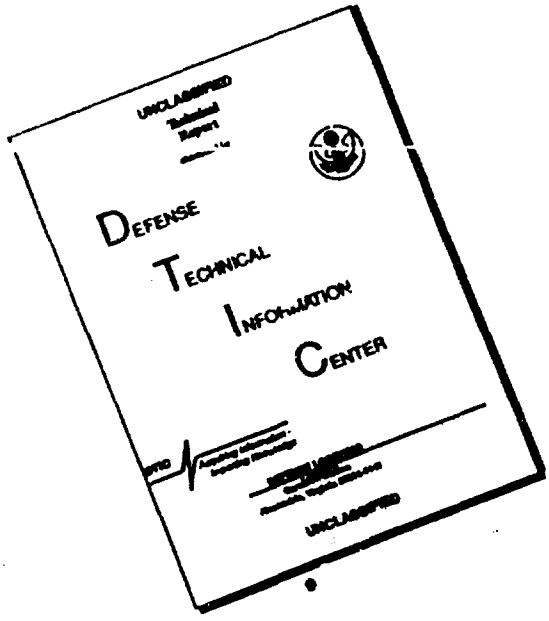

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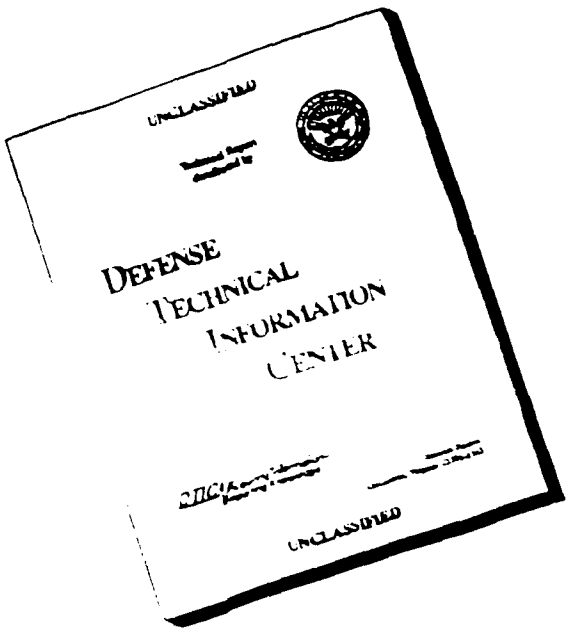

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SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188
Exp. Date: Jun 30, 1986

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b. RESTRICTIVE MARKINGS NONE
2a. SECURITY CLASSIFICAION AUTHORITY N/A	3. DISTRIBUTION/AVAILIBILTY OF REPORT N/A
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE N/A	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) ASQB-GC-92-011	5. MONITORING ORGANIZATION REPORT NUMBER(S) N/A
6a. NAME OF PERFORMING ORGANIZATION AIRMICS 6b. OFFICE SYMBOL (If applicable) ASQB-GCN	7a. NAME OF MONITORING ORGANIZATION N/A
6c. ADDRESS (City, State, and Zip Code) 115 O'Keefe Bldg. Georgia Institute of Technology Atlanta, GA 30332-0800	7b. ADDRESS (City, State, and ZIP Code) N/A
8b. NAME OF FUNDING/SPONSORING ORGANIZATION AIRMICS 8b. OFFICE SYMBOL (If applicable) ASQB-GCN	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code) 115 O'Keefe Bldg. Georgia Institute of Technology Atlanta, GA 30332-0800	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. 62783A; PROJECT NO. DY10; TASK NO. 03-06-91; WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification)
ISDN Applications in the Army Environment (UNCLASSIFIED)

12. PERSONAL AUTHOR(S)
Richard Schaphorst

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
	FROM 6/91 TO 2/92	Feb 1992	268

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUBGROUP	ISDN, B-channel, D-channel, LAPD protocol, Terminal Equipment

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The Army has identified Integrated Services Digital Network (ISDN) as a major component of the future Army communications architecture to support the Information Area (IMA). This report identifies those applications in the Army environment which would benefit from use of the ISDN.

20. DISTRIBUTIONN/AVAILIBILTY OF ABSTRACT	21. ABSTRACT SECURITY CLASSIFICATION
[X] UNCLASSIFIED/UNLIMITED [ ] SAME AS RPT. [ ] DTIC USERS	UNCLASSIFIED

22a. NAME OF RESPONSIBLE INDIVIDUAL	22b. TELEPHONE (Include Area Code)	22c. OFFICE SYMBOL
Winfred Y. Fong	(404) 894-3136	ASQB-GCN

DD FORM 1473, 84 MAR 83 APR edition may be used until exhausted.
All other editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE

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THIS REPORT HAS BEEN REVIEWED AND IS APPROVED

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ISDN APPLICATIONS IN THE ARMY ENVIRONMENT

February, 1992

FINAL REPORT
DAKF11-91-C-0033

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1.0 INTRODUCTION

The U.S. Army Institute for Research in Management Information, Communications, and Computer Science (AIRMICS) located in Atlanta, GA awarded Contract No. DAKF11-91-C-0033 to Delta Information Systems (Delta) to determine those applications in the Army environment which would benefit from the Integrated Services Data Network (ISDN). This project is a Phase I SBIR program responding to Topic Number A91-019. This document is a final report summarizing all the work performed on this project.

Work on the project was divided into the six tasks listed below. The report is structured to summarize the work accomplished on each task.

- Task 1 - Status of Commercial ISDN

  This task reviewed the technical capability of the ISDN, general applications of ISDN, and the status of its introduction into the commercial telecommunications environment.

- Task 2 - ISDN Activity in the U.S. Government

  This section reviews the ISDN activity in the U.S. Government as outlined below.

  - ISDN in the Army Information Mission Area (An Overview of the Role of ISDN)
  - Army Plans and Programs
  - Plans and Programs of Other Organizations

- Task 3 - Review of ISDN Terminal Equipment

  This section reviews the range of terminal equipment which is available for operation over the ISDN. Types of equipment which are analyzed are listed below.

  - Telephone systems
  - Personal Computer/Workstations
    - + Services
    - + Software and hardware products

- Facsimile
- Audiographics terminals
- Videophone

- Task 4 - Application Analysis

  This task is divided into two parts. In the first part, a tradeoff analysis is performed comparing the advantages/disadvantages of LANS and ISDN technology. In the second part, high payoff ISDN applications are identified. It is concluded that multimedia, multipoint desktop teleconferencing systems are the primary high payoff application.

- Task 5 - Phase I Demonstrations

  ISDN demonstrations, provided to AIRMICS personnel on this task, are described along with the test bed used for the demonstrations.

- Task 6 - Phase II Program Plan

  In this section, the plan for a Phase II SBIR project is described. The proposed program calls for the development, installation, and demonstration of a multimedia, multipoint, desktop teleconferencing system in the Army environment.

STATUS OF COMMERCIAL ISDN
EXECUTIVE SUMMARY

ISDN is an emerging world-wide standard endorsed by the International Telephone and Telegraph consultative Committee (CCITT), the American National Standards Institute (ANSI), and virtually every other national telecommunications authority. An objective of ISDN is to provide the user with access to a variety of network services through a limited number of user-network interfaces. In most cases, this means access to voice, data and image via a single network connection. Inter-operability of switches and terminal equipment, another ISDN objective, will be assured by conformance to standards. Standardization will lead to significant reductions in equipment cost. ISDN will also contribute to reduced operating costs through its capability of continuously monitoring loop performance over an embedded maintenance channel.

In the information era of the 1990s, local telephone companies will provide a wide range of voice, data and image services. The demand for facsimile and emerging services such as electronic mail are prime examples of the need for faster, more efficient communications services that will shape the telephone network of the 1990s. The major obstacle to providing these services by the present analog system is the local loop itself - it cannot accommodate improved service, such as Group IV facsimile, or adequately handle image and video transmission. The data service provided by the current public telephone network is limited to 9.6 kbps by its analog architecture -- far too low for today's rapidly expanding information requirements. The Integrated Services Digital Network (ISDN) will transform the present telephone network into an end-to-end switched digital network providing 64 kbps, 128 kbps or higher bit rates instead of the current 9.6 kbps digital service.

The Regional Bell Holding/Operating Companies (RBOCs) project that by the end of 1994, they will have almost 65 million ISDN-capable access lines (57%) and 1832 ISDN-capable switches (19%). Independent Local Exchange carriers (LEC) are also deploying ISDN. LEC data is not available.

RBOCs are in the process of putting ISDN basic rate interface tariffs into place. For example, PACTEL recently issued basic rate ISDN tariffs of $17.50 per month for B+D and $29.50 per month for 2B+D. The federal Government strongly endorsed ISDN by awarding a 10-year, multibillion-dollar contract for FTS-

2000 to AT&T and Sprint. Both proposals were based on ISDN architecture. Since August 1990, compliance with the Government Open Systems Interconnection Profile (GOSIP), the Federal Government's adaptation of the OSI model has been mandatory for all government procurement. Many Federal Government requests for proposals included requirements for ISDN Private Branch Exchange or Centrex services.

Broadband ISDN implementation depends on the development of Asynchronous Transfer Mode (ATM) switch capable of terabit throughput. However, while two or three manufacturers have demonstrated ATM switching on a laboratory scale, it is unlikely that a production grade switch will be commercially available in the near future.

2.0 TASK 1 - STATUS OF COMMERCIAL ISDN

2.1 Introduction

The Integrated Services Digital Network (ISDN) will transform today's public switched telephone network into an end-to-end digital network with out-of-band signalling and the capability of supporting voice, data and image/video simultaneously. In addition to plain old telephone service (POTS), many services available with the current phone system will be provided more efficiently and cost effectively, and new services such as Calling Line Identification (CLID) and call-by-call routing can be offered.

2.1.1 Evolution of ISDN

In 1962, the telecommunications community saw the advent of digital telecommunications with the T1 carrier. In 1976, the IEEE Communications Society (IEEE COMSEC) initiated a biennial ISDN Symposium. To date, there have been seven such symposia discussing issues from analog-to-digital conversion and switching to world-wide application of ISDN. Most of the early symposia focused on Narrowband ISDN, but more recently Broadband ISDN (B-ISDN) has been the subject of interest.

Today's ISDN focus is on the development of services with acceptable tariffs. Although many standards exist, new standards are under formulation in order to promote new application ideas and a larger variety of customer premise equipment (CPE). ISDN also has the advantage of being implementable on existing copper pairs.

B-ISDN is still in the infancy stage. Standards need to be developed as well as an extensive deployment of fiber to the premise before B-ISDN will have the same applications impact as narrowband ISDN. The other obstacle in the path of B-ISDN is the need for Asynchronous Transfer Mode (ATM) which must be a resident function in the digital switches.

ISDN is an emerging world-wide standard, endorsed by the International Telephone and Telegraph Consultative Committee (CCITT), the American National Standards Institute (ANSI), and virtually every other national telecommunications authority. An objective of ISDN is to provide the user with access to a variety of

network services through a limited number of user-network interfaces. In most cases, this means access to voice, data and image via a single network connection. Inter-operability of switches and terminal equipment, another ISDN objective, will be assured by conformance to standards. Standardization will lead to significant reductions in equipment costs. ISDN also will contribute to reduced operating costs through its capability to continuously monitor loop performance over and imbedded maintenance channel.

2.1.2 Benefits of ISDN

Digital telecommunications via the public telephone systems is opening a new world of information exchange. ISDN will provide the standard interface and medium for taking full advantage of digital communications. The modem will become obsolete.

Some of the benefits to be reaped by ISDN are:

a. Decreased costs from dynamic bandwidth allocation which will replace trunk lines and T1;

b. Faster data rates over the ISDN D-channel (i.e., packet switching);

c. Improved access to corporate information from remote access;

d. LAN-to-LAN applications operating at higher speeds without the requirement for dedicated lines;

e. Call-by-call service selection which will enable lower long distance charges;

f. Call center ISDN applications that improve customer service through increased queuing efficiency and inventory control and superior network management due to call source/destination information.

Narrowband ISDN uses existing network facilities, typified by the twisted

pair local loop and 64 kbps digital switch. Basic rate service (2B+D) can be provided to a customer by replacing an analog telephone with an ISDN telephone and a network termination. The B channels (64 kbps) provide circuit-switched voice and data; the D channel (16 kbps) provides out-of-band signalling plus packet data. Primary rate ISDN consists of 23 B channels and one 64 kbps D channel for signalling. The PRI may also be allocated as high speed (H) channels at 384, 1472 or 1536 kbps.

Ubiquitous ISDN depends on the implementation of Common Channel Interoffice Signalling System Number 7 (SS7). SS7 is a packet switched signalling network operating in parallel with the traffic bearing network. The current, in-band, inter-switch signalling system (SS6) cannot preserve ISDN signalling between switches. Out-of-band signalling is necessary to connect ISDN switches and is essential to any service provided from a network database such as CLID and call-by-call routing. Custom Local Area Signalling Services (CLASS) for example, require SS7.

Further into the future, broadband ISDN (B-ISDN) is expected to provide high-quality, full-motion video, High Definition Television (HDTV) and similar services. B-ISDN is based on fiber optic technology and fast packet switching using Asynchronous Transfer Mode (ATM), a technique for interleaving and routing calls that vary greatly in bandwidth and duration. Narrowband ISDN (N-ISDN) cannot satisfy the bandwidth requirements of high resolution video transmission and other emerging services.

2.1.3 Opportunities

Benefits are there to be claimed. ISDN represents an evolutionary change to our communications system which offers opportunities to make revolutionary changes in the way we do business.

ISDN basic rate can provide a number of new services with promising revenue potential using the existing telephone plant. Examples include Group IV facsimile (fast facsimile service with laser printer quality), videotext (high-quality graphics), PC screen sharing, telemetry,image transfer, telewriting (electronic sketch pad) and limited-motion video teleconferencing.

Exploitation of ISDN will be dependent on the development of customer premise equipment (CPE) for the many applications that have been theorized.

An existing application which is compatible with ISDN is facsimile services. Group IV facsimile will be made feasible by ISDN. The emergence and explosive growth of facsimile services in just a few years illustrates the potential of services which fill a timely need. Facsimile revenues have grown from $2.6 billion in 1987 to $4.8 billion in 1989 and are projected to reach $9.3 billion in 1991. While today's facsimile is a significant and growing source of revenue for the telephone industry, it is based on rudimentary imaging and transmission technology. ISDN facsimile offers resolution approaching letter quality with shades of gray, rather than just black and white, at several times the transmission rate of analog facsimile. These improvements could lead to another growth spurt in facsimile revenues. High resolution color image transmission, the next stage in the natural progression from black and white facsimile will be almost impossible without ISDN.

For geographically dispersed, smaller business offices, ISDN could be a viable alternative to private networks, especially when switches are connected through SS7. ISDN, in combination with enhanced Centrex Services, could allow local exchange carriers to compete effectively with PBX services. The high-speed access made possible by ISDN technology will encourage personal-computer-based communications between offices and homes (telecommuting).

2.2 ISDN Capabilities/Applications

2.2.1 Digital vs. Analog

Advances in recent years resulting in widespread implementation of stored-program, digital switching and digital trunking systems laid the foundation for digital access by the average telephone user.

The second necessary step in the process is the implementation of out-of-band common-channel signalling. This step is now rapidly transpiring with the deployment of SS7.

The third and final step in this path is the full implementation of ISDN. With the implementation of ISDN, every business and every home will become capable of rapid, efficient and practical access to a new world of information transfer and access.

Computers now have a "natural" interface to the public communications networks.

2.2.2 Basic Rate ISDN (BRI)

BRI provides a composite bandwidth of 144 kbps (2 x 64 kbps B channels + 1 x 16 kbps D channel) and full duplex transmission with time division multiplexing (TDM) into a single stream containing both user and signalling information.

Two interfaces are available with BRI, the S/T interface and the U interface. The 4-wire S/T interface, CCITT I.430 and ANSI T1.605/1989 standards, is wired inside the premise and is manifested as a standard wall plug to link telephones, facsimiles and computers with the ISDN network. Each S/T interface can accommodate a maximum of eight devices.

The 2-wire U interface connects local telephone lines to the customer premise (network termination) telephone lines with the central office (line termination) or 2-wire ISDN telephone, bypassing the S interface.

Basic rate ISDN uses existing network facilities, typified by the twisted pair local loop and 64-kbps digital switch. Basic rate service (2B+D) can be provided to the customer by replacing an analog telephone with an ISDN telephone and a network termination. The B channels (64 kbps) provide circuit-switched voice and data and packet-switched data; the D channel (16 kbps) provides out-of-band signalling plus packet data. Basic rate ISDN allows applications such as Group IV facsimile, PC screen sharing, image transfer and limited motion videophone. (Primary rate (2B+D) provides up to 1.536 Mbps.)

ISDN basic rate can provide a number of new services with promising revenue potential, using the existing telephone plant. Examples include Group IV facsimile (fast facsimile service with laser printer quality), videotext (high-quality graphics), image transfer, telewriting (an electronic sketchpad) and video teleconferencing.

For geographically-dispersed, smaller business offices, ISDN could be an available alternative to private networks, especially when switches are connected through SS7. ISDN in combination with enhanced centrex services could allow local exchange carriers to compete effectively with PBX services and LANs.

An innovative new application capability is that of telemetry. The D channel packet switch capability can be used to transmit low-data-rate information while the phone is "on hook".

2.2.3 Primary Rate ISDN (PRI)

Primary rate ISDN (PRI) consists of 23 64-kbps B channels (30B channels in Europe) and one 64-kbps D channel for signalling. The PRI may also be allocated as high-speed (H) channels at 384, 1472 or 1536 kbps. The H channels are currently viewed as wideband circuits and could possibly be used to meet most demands of data communications users.

Primary rate channels can be used to multiplex lower data rate channels, provide high-data-rate wide area network connectivity and implement private branch exchange (PBX) connectivity.

PRI can also be used for LAN-to-LAN connectivity.

2.2.4 Broadband ISDN

Further into the future, broadband ISDN (B-ISDN) is expected to provide high-quality, full-motion video, HDTV and similar services. B-ISDN is based on fiber optic technology and fast packet switching using asynchronous transfer mode (ATM), a technique for interleaving and routing calls that vary greatly in bandwidth and duration. Narrowband ISDN (N-ISDN) cannot satisfy the bandwidth requirements of high resolution video transmission and other emerging services.

CCITT Study Group XVIII prepared a list of potential B-ISDN services which are divided into two major categories:

a. Interactive Services: conversational services, massaging services and retrieval services

b. Distribution Services: broadcast services and distribution services

2.2.5 Line Multiplication

One twisted pair, copper line can supply three, full-duplex communications channels. Multiple, separately addressed terminals (telephone, PC, facsimile, etc.) can be connected to each line. Up to eight terminal devices can be connected to one U interface twisted pair.

2.2.6 Standardization

The digital telecommunications network which has been rapidly implemented in the United States has had significant benefit to the efficiency of the public telephone systems and to the public. However, the implementation of ISDN will prove much more significant in that it will provide the standardized interface for the many hundreds of applications that will service millions of customers directly. ISDN as a standard for implementation for this new generation of applications will have a major impact on the future of telecommunications worldwide. Benefits will most likely come in the area of increased productivity as opposed to reduction of communications costs. Increased productivity will result in cost reduction at the system or function level. Utilization of the public telecommunications network will increase substantially.

2.2.7 Local Area Networking

X.25-like packet switching is available on both the signalling (D) channel and on the bearer (B) channels. PRI packet switching is also feasible. The standard LAP-D protocols are used. It is possible to implement LAN-LAN connectivity via switch-based packet routers or via gateways and circuit switched ISDN.

ISDN's major competition is from LANs and PBX-based virtual private networks. LANs are intended for applications at a much higher speed than ISDN can handle. Nevertheless, ISDN could provide LAN-to-LAN gateways throughout the public switched network. An ISDN PBX with a basic rate interface, such as the AT&T Definity 85, could become a major network bypass threat. Currently primary rate applications marketed by AT&T are aimed at large-volume telemarketing organizations.

2.2.8 Wide Area Networking

Private networks are used to link major corporate and government entities which a high volume of communications is required. These networks have proven cost effective for the users. ISDN (BRI and PRI) both offer capacity on demand which will be able to provide "virtual" private networks on a much more cost effective basis. Private networks will primarily be used for computer networking.

Government applications will also include distributed simulation and interactive training.

Other wide area network applications will include video, audio and audiographic teleconferencing.

2.2.9 Private Branch Exchange

ISDN PBX technology seems to be in a developmental stage; hence, customers are uncertain of the direction the technology will take or whether a manufacturer will continue to support his product (currently, at least nine PBX vendors are developing primary rate interfaces). This situation should persist for a few years or until one manufacturer emerges as the technical and marketing leader. Thus, the customer perceives ISDN Centrex as offering a wider selection of compatible equipment, easier upgrades to new voice and data features and lower maintenance costs than primary rate ISDN.

2.2.10 Special Switch Features

Exchange switches soon will have the capability of continuously monitoring access lines for quality of service and initiating maintenance procedures, such as loopback to the customer termination. Subscriber-initiated maintenance may be provided as well. Equipment for monitoring higher level functions at the switch, such as the exchange of link level frames, is available. Taken together, these capabilities will improve Quality of Service significantly while producing a substantial decrease in maintenance costs.

2.3 ISDN Status

Three elements are required to implement ISDN: infrastructure (public ISDN), user application equipment (customer premise equipment) and defined user needs.

2.3.1 Infrastructure

ANSI standards for ISDN basic and primary rate transmission services are largely in place, and standards covering internetworking of ISDN and SS7, terminal adapters for non-ISDN equipment and supplementary services are nearing completion. At the same time, groups of the North American ISDN User's Forum are working to increase the effectiveness of these standards by resolving ambiguities that could lead to incompatibility among implementations. Major central office switch manufacturers (AT&T, Ericsson, Northern Telecom and Siemans) are now working to resolve incompatibility problems and expect to offer ANSI-Conformant N-ISDN switches by the end of 1991.

2.3.1.1 Local Exchange Carriers

Presently, the majority of ISDN switch installations consist of a single switching node providing basic rate service within a local exchange area. A nationwide ISDN network will be possible only after the deployment of SS7, now under construction and partially deployed by the RBOCs and Inter-Exchange Carriers (IECs). So far, the IECs are further ahead, with the three largest (AT&T, MCI and US Sprint) already functional with SS7, and in the process of developing ISDN primary rate applications. MCI filed a PRI tariff that became effective on October 1, 1990. Service offerings include calling number identification and call-by-call service selection.

The RBOCs expect to have SS7 installed by 1992. (See description of National ISDN-1 below). Bellcore is coordinating nationwide SS7 interconnection which was targeted for completion by the end of 1992. Also, AT&T has announced plans for a "virtual SS7", scheduled to become available in 1991, that will give independent telephone companies full access to AT&T's SS7 network.

2.3.1.1.1 Growth of ISDN Access Lines and Switches, 1990

Table 2-1 depicts the status of ISDN deployment by the Regional Bell Operating Companies in the United States as of 1990. Generally, the independent local exchange carriers have implemented a lesser number of ISDN lines and switches. About 4% of all RBOC switches were ISDN capable. About 0.5% of

line connections were ISDN capable.

2.3.1.1.2 Growth of ISDN Access Lines and Switches, 1991

Table 2-2 depicts the status for ISDN deployment by the Regional Bell Operating Companies in the United States as of 1991. Note that some data is derived by interpolation from data in earlier and later years. About 8.4% of all RBOC switches were ISDN capable. About 21% of line connections were ISDN capable. This data indicates the rapid deployment of ISDN has begun.

2.3.1.1.3 Growth of ISDN Access Lines and Switches, 1992

Table 2-3 depicts a forecast of ISDN deployment by the Regional Bell Operating Companies in the United States as of 1992. Note that some data is derived by interpolation from data in earlier and later years. About 13% of all RBOC switches will be ISDN capable. About 39% of line connections will be ISDN capable. The higher rate of increase in ISDN lines versus ISDN switches is due to the RBOCs concentration of ISDN deployment in more populated regions. This deployment strategy is based upon user demand.

2.3.1.1.4 Growth of ISDN Access Lines and Switches, 1993

Table 2-4 depicts a forecast of ISDN deployment by the Regional Bell Operating Companies in the United States as of 1993. Note that some data is derived by interpolation from data in earlier and later years. About 16% of all RBOC switches will be ISDN capable. About 49% of line connections will be ISDN capable.

2.3.1.1.5 Growth of ISDN Access Lines and Switches, 1994

Table 2-5 depicts the status of ISDN deployment by the Regional Bell Operating Companies in the United States as of 1994. Note that some data is derived by interpolation from data in earlier and later years. About 19% of all RBOC switches will be ISDN capable. About 57% of line connections will be ISDN capable.

2.3.1.1.6 Composite Growth of ISDN Access Lines, 1990 - 1994

Table 2-6 depicts the composite forecast of ISDN line deployment by the Regional Bell Operating Companies in the United States encountered in 1990 and projected through 1994. This table shows a rapid deployment in the first years with a general flattening out with steady deployment in the later years.

2.3.1.1.7 Composite Growth of ISDN Equipped Switches, 1990 - 1994

Table 2-7 depicts the forecast of ISDN Switch deployment by the Regional Bell Operating Companies in the United States for the period 1990 - 1994. This data indicates a steady deployment of switches over the entire period.

Table 2-1
RBOC Access Lines & Switches -- 1990

1990 GROWTH OF ISDN LINE & SWITCH POPULATIONS

	CENTRAL	OFFICES	ACCESS	LINES	PERCENT
	TOTAL	ISDN EQPD	TOTAL	ISDN EQPD	ISDN EQPD
AMERITECH	1,156	69	16,247,000	43,700	0.27%
BELL ATLANTIC	1,336	102	17,819,000	14,500	0.08%
BELLSOUTH	1,654	35	17,574,000	335,000	1.91%
NYNEX	1,320	34	15,515,000	22,500	0.15%
PACTEL	826	35	14,176,000	5,500	0.04%
SW BELL	1,342	45	11,970,000	29,000	0.24%
US WEST	1,772	86	12,564,000	46,100	0.37%
TOTAL	9,406	406	105,865,000	496,300	0.47%

Table 2-2
RBOC Access Lines & Switches -- 1991

1991 GROWTH OF ISDN LINE & SWITCH POPULATIONS

	CENTRAL OFFICES		ACCESS	LINES	PERCENT
	TOTAL	ISDN EQPD	TOTAL	ISDN EQPD	ISDN EQPD
AMERITECH	1,156	90	15,100,000	2,200,000	14.57%
BELL ATLANTIC	1,395	293	18,157,895	6,900,000	38.00%
BELLSOUTH	1,729	121	18,235,294	3,100,000	17.00%
NYNEX	1,316	29	15,578,558	1,900,000	12.20%
PACTEL	828	88	13,666,667	4,100,000	30.00%
SW BELL	1,341	51	12,806,818	1,127,000	8.80%
US WEST	1,770	130	13,043,478	3,000,000	23.00%
TOTAL	9,532	802	106,588,710	22,327,000	20.95%

Table 2-3
RBOC Access Lines & Switches -- 1992

1992 GROWTH OF ISDN LINE & SWITCH POPULATIONS

	CENTRAL OFFICES		ACCESS	LINES	PERCENT
	TOTAL	ISDN EQPD	TOTAL	ISDN EQPD	ISDN EQPD
AMERITECH	1,155	111	15,400,000	9,700,000	62.99%
BELL ATLANTIC	1,389	500	18,734,177	14,800,000	79.00%
BELLSOUTH	1,593	223	18,666,667	5,600,000	30.00%
NYNEX	1,311	57	15,642,115	2,061,250	13.18%
PACTEL	829	100	14,242,424	4,700,000	33.00%
SW BELL	1,339	112	12,817,298	2,214,500	17.28%
US WEST	1,767	145	13,438,863	3,673,050	27.33%
TOTAL	9,383	1,248	108,941,544	42,748,800	39.24%

Table 2-4
RBOC Access Lines & Switches -- 1993

1993 GROWTH OF ISDN LINE & SWITCH POPULATIONS

	CENTRAL	OFFICES	ACCESS	LINES	PERCENT
	TOTAL	ISDN EQPD	TOTAL	ISDN EQPD	ISDN EQPD
AMERITECH	1,155	132	15,700,000	13,500,000	85.99%
BELL ATLANTIC	1,395	600	19,506,173	15,800,000	81.00%
BELLSOUTH	1,676	285	19,512,195	8,000,000	41.00%
NYNEX	1,307	69	15,705,673	3,080,625	19.61%
PACTEL	831	125	14,871,795	5,800,000	39.00%
SW BELL	1,338	146	13,240,947	3,307,250	24.98%
US WEST	1,765	174	13,876,294	5,486,525	39.54%
TOTAL	9,465	1,530	112,413,077	54,974,400	48.90%

Table 2-5
RBOC Access Lines & Switches -- 1994

1994 GROWTH OF ISDN LINE & SWITCH POPULATIONS

	CENTRAL	OFFICES	ACCESS	LINES	PERCENT
	TOTAL	ISDN EQPD	TOTAL	ISDN EQPD	ISDN EQPD
AMERITECH	1,154	153	16,100,000	14,000,000	86.96%
BELL ATLANTIC	1,400	700	19,000,000	17,100,000	90.00%
BELLSOUTH	1,609	354	20,192,308	10,500,000	52.00%
NYNEX	1,302	80	15,769,231	4,100,000	26.00%
PACTEL	832	175	15,000,000	7,500,000	50.00%
SW BELL	1,336	167	13,664,596	4,400,000	32.20%
US WEST	1,762	203	14,313,725	7,300,000	51.00%
TOTAL	9,395	1,832	114,039,860	64,900,000	56.91%

Table 2-6
RBOC Access Lines -- 1990 - 1994

TOTALS BY YEAR -- ISDN ACCESS LINES

	1990	1991	1992	1993	1994
AMERITECH	43,700	2,200,000	9,700,000	13,500,000	14,000,000
BELL ATLANTIC	14,500	6,900,000	6,900,000	15,800,000	17,100,000
BELLSOUTH	335,000	3,100,000	5,600,000	8,000,000	10,500,000
NYNEX	22,500	1,900,000	2,061,250	3,080,625	4,100,000
PACTEL	5,500	4,100,000	4,700,000	5,800,000	7,500,000
SW BELL	29,000	1,127,000	4,700,000	3,307,250	4,400,000
US WEST	46,100	3,000,000	3,673,050	5,486,525	7,300,000
TOTAL	496,300	22,327,000	37,334,300	54,974,400	64,900,000

Table 2-7
RBOC ISDN Capable Switches -- 1990 - 1994

TOTALS BY YEAR -- ISDN EQUIPPED SWITCHES

	1990	1991	1992	1993	1994
AMERITECH	69	90	111	132	153
BELL ATLANTIC	102	293	500	600	700
BELLSOUTH	35	121	223	285	354
NYNEX	34	29	57	69	80
PACTEL	35	88	100	125	175
SW BELL	45	51	100	146	167
US WEST	86	130	145	174	203
TOTAL	406	802	1,236	1,530	1,832

2.3.1.1.8 Comparison of RBOC ISDN and Non-ISDN Switches

Figure 2.1 depicts the status of ISDN switch deployment by the Regional Bell Operating Companies in the United States for the period 1990 - 1994. When considering the RBOC strategy of deployment to metropolitan areas first and rural areas later, it can be seen from this graph that the majority of the access lines in the United States will be ISDN capable by 1994.

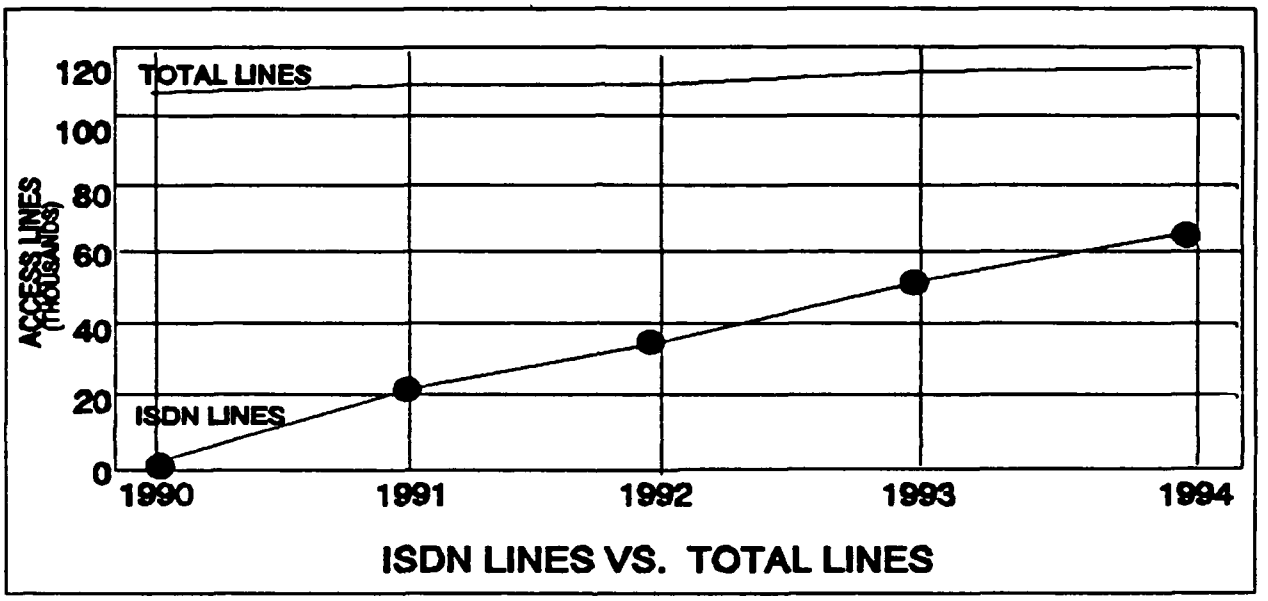

Figure 2.1. RBOC Total Access Lines vs. ISDN Access Lines

2.3.1.1.9 Comparison of Total Access Lines and ISDN Access Lines

Figure 2.2 depicts the status of ISDN line deployment by the Regional Bell Operating Companies in the United States for the period 1990 - 1994. When considering the RBOC strategy of deployment to metropolitan areas first and rural areas later, it can be seen from this graph that the majority of the United States will be ISDN capable by 1994.

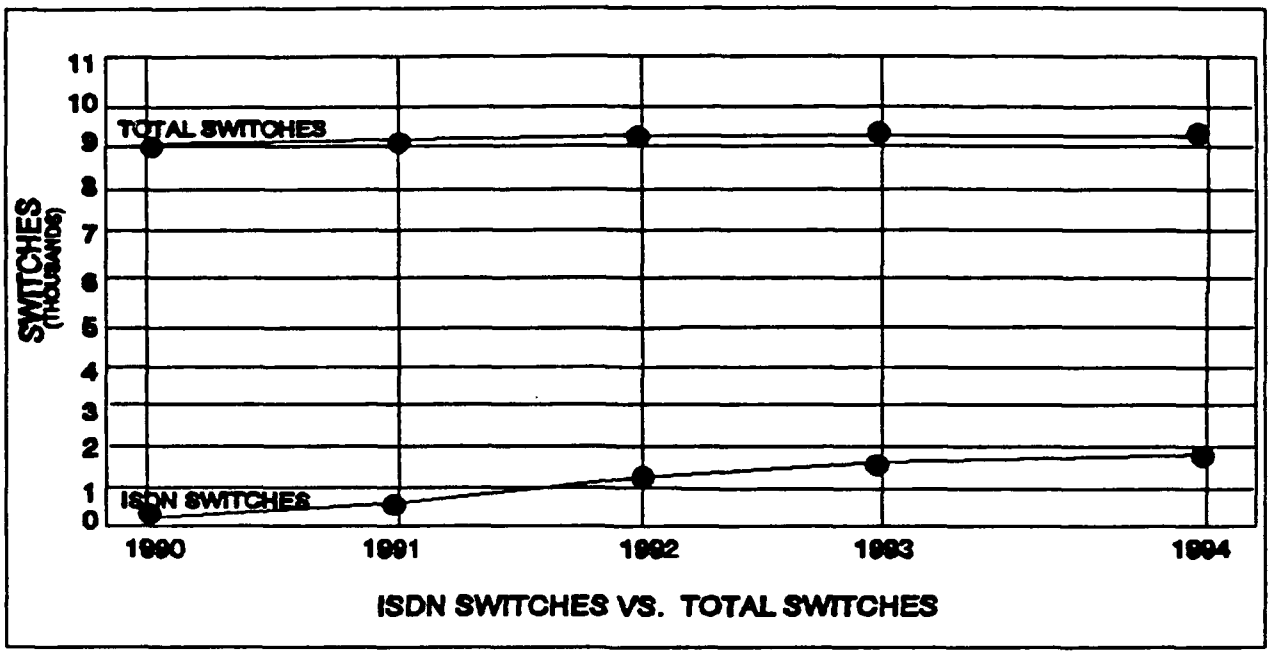

Figure 2.2. RBOC ISDN and non-ISDN Switches

2.3.1.2 Interexchange Carriers

So far, the IECs are further ahead, with the three largest, AT&T, MCI and US Sprint, already functional with SS7 and in the process of developing ISDN primary rate applications. MCI filed a PRI tariff that became effective on October 1, 1990. Service offerings include calling number identification and call-by-call service selection.

2.3.1.3 B-ISDN

The main obstacle to implementation of B-ISDN is the deployment of the fiber optic network to end user premises. Many large companies have fiber networks in place, but the deployment of fiber to small business and homes render a sizeable economic and technical challenge. Some assertive RBOCs are planning to upgrade their entire loop distribution network to fiber by the year 2010.

The standard mode of transmission for B-ISDN will most likely be fast packet switching, also known as "frame relay" or "cell relay". A cell is currently defined as a 53-byte packet of which 48 bytes are information and 5 bytes are overhead.

Since bandwidth can be varied on demand, different services can be allocated specific cell quantities. This mechanism supports Asynchronous Transfer Mode (ATM) or demand multiplexing utilizing labels.

B-ISDN will require ATM on a large scale capacity in digital switches in order to satisfy the need for virtual circuit switching, as opposed to continuously occupied circuits which currently exist.

2.3.1.4 Terminal Equipment

ANSI standards should be available now that the basic technology has been standardized, the next step appears to be the development of personal-computer-based application platforms. These will consist of expansion boards with a software-defined interface which will allow developers to tailor applications directly to ISDN. Expansion boards are offered by a number of suppliers.

Strong interest in ISDN is now being shown in the terminal development community. For example, an estimated 400 personnel attended the 1991 ISDN user's forum who identified themselves as applications developers. This was reportedly an order of magnitude increase over attendance at the previous forum meeting.

2.3.1.5 ISDN Transmission Media

CCITT Recommendation I.121 specifies Asynchronous Transfer Mode (ATM) as the major element of the B-ISDN architecture, and ANSI has adopted I.121 with minor modifications to the cell structure to suit the U.S. environment. In the U.S., ATM cells will be mapped into a SONET-based frame (STS-3, 155.52 Mb/s) with cell header information carried in the frame overhead. Thus B-ISDN implementation depends on the development of an ATM switch. However, while at least one company has demonstrated ATM switching on a laboratory scale, it is unlikely that a commercial, production grade switch capable of terabit throughput will be available during this century. Critical issues in need of further resolution include mitigating the effect of variations in transmission delay and cell loss (especially for video), interworking with circuit-switched networks, and scaling network parameters from 150 Mb/s to higher levels (600 Mb/s, STS-12).

2.3.1.6 Defined User Need for ISDN

ISDN penetration will be influenced by four main factors - retirement of existing analog switches, upgrading digital switches to ISDN, deployment of SS7, and tariff structures. ISDN switches must be interconnected for ISDN to make sense; hence, SS7 deployment will be the major catalyst for market growth. Nevertheless, SS7 must await the widespread introduction of digital switching, which regulatory agencies will resist until depreciation has run its course. Tariffs will be necessary for all but the largest users.

Ultimately, ISDN success will depend on the availability of applications and services that fulfill customer needs.

2.3.1.7 Regulatory Issues/Political

Inter-LATA connectivity issues related to SS7 could have far-reaching business and regulatory implications. At this time, the RBOCs do not permit interexchange carriers (IXC) to make SS7 connections with their central office switches. The IXCs claim that this prevents them from designing the network for greatest reliability and gives the RBOCs greater business control of the network. In replay, the RBOCs claim that indiscriminate access to their switches would be detrimental and, furthermore, that such connections are unnecessary.

SS7 raises serious issues under the Modified Final Judgement (MFJ). While it is clear that network control functions (e.g., call setup, call routing via Signal Transfer Points, call clearing) fall within the "official services" exemption of the MFJ, (i.e., may be provided by the RBOC), inter-LATA RBOC delivery of customer services from remote (Service Control Point or SCP) data bases is considered an inter-exchange service and is barred by the MFJ. As for Calling Line Identification (CLID, also known as Calling Number Identification or CLI), privacy claims of callers who wish to remain anonymous are competing against the desire of call recipients to screen unwanted calls. The state PUCs are split on how to resolve this, and definitive resolution will not occur anytime soon. (It should be noted that ISDN standards allow CLID to be blocked at the switch.)

2.3.2 Offerings

2.3.2.1 BRI Offerings

All seven Regional Bell Operating companies planned to file ISDN Basic Rate Interface (BRI) tariffs by the end of 1990.

The past two to three years have seen a number of ISDN trials and commercial offerings. This year will see an expansion in the number of ISDN lines and service offerings as general tariffs are formalized to replace special service contracts. PACTEL, for example, recently issued basic rate ISDN tariffs of $17.50 per month for 1B+D and $29.50 per month for 2B+D. As inter-switch SS7 connectivity becomes pervasive and equipment for applications becomes less expensive, ISDN will become more acceptable to the small business user.

2.3.2.2 PRI Offerings

RBOCs have begun to offer PRI access. Users are implementing and testing PBX access to support data transfer and special applications such as video conferencing and multi-media applications. Costs vary widely between exchange areas. Prices from $300 to $800 per month for PRI access have been found. Usage charges for long distance are additional.

2.3.3 ISDN Users Groups

Any major change to a very large, communications systems infrastructure such as the United States public telephone systems must overcome a tremendous inertia at rest. Further , a "catch 22" situation exists regarding the local and interexchange carriers making the financial investment to develop the necessary infrastructure prior to the availability of the market, the applications developers' investment prior to the availability and standardization of the infrastructure, and the development of the market (public need) without knowing the uses and services that the new system can provide.

ISDN User Groups are performing a significant service to the public. These groups are promoting user interest, informing application developers, and prodding the local exchange and interexchange carries to install the infrastructure.

2.3.3.1 ISDN Forum (NIU/Bellcore)

Working Together to Make National ISDN Happen. Organized by: Ameritech, Bell Atlantic, Bellcore, BellSouth, NYNEX, Pacific Bell and US West Communications. The ISDN Forum has been highly instrumental in providing ISDN implementation standardization within the RBOCs, the Independants, and the inter-exchange carriers. Bellcore has published several technical reports and special reports to support the standard implementation of ISDN in the United States. These reports are based on international and national standards and, in effect, provide specific guidance on subsets of the major standards for early, phased implementation. The objective is to get all carriers to implement common ISDN capabilities in step with each other in order to advance the pace of overall ISDN implementation. The ISDN Forum is the primary sponsor, along with NIU, of National ISDN-1 (described below).

2.3.3.2 North American ISDN Users Forum.

The NIU Forum is sponsored by the United States National Institute of Standards and Technology (NIST). The precise relationship of the NIU Forum, NIST, and other business concerns is defined by the "cooperative Research and Development Agreement: The Consortium on ISDN Based Systems" which is available from the NIU Forum Secretariat. Although this forum focuses on the requirements of the ISDN users in North America, participation and membership is open to anyone.

The NIU Forum was established to achieve three principle objectives:

a. promote an ISDN forum committed to providing users the opportunity to influence the developing ISDNs to reflect their needs;

b. identify ISDN applications, develop implementation requirements, and facilitate their timely, harmonized, and interoperable introduction; and

c. solicit user, product provider, and service provider participation in this process.

The NIU Forum creates common North American functional and operational standards. A functional standard is limited to those functions that are executed to achieve a capability that fulfills the applications requirements. An operational standard describes how this capability is provided to the application. Compliance with functional and operational standards enables applications to interwork and interoperate across communications links with conformant capability and behavior.

2.3.4 National ISDN

National ISDN-X is a program to describe an ISDN implementation plan over several years which will help harmonize service provider, application developer, systems integrators, and user initiatives.

2.3.4.1 National ISDN-1

National ISDN-1 is a set of service capabilities that have been developed for implementation in 1992 which will demonstrate the national connectivity of ISDN. ISDN-1 will enable the simultaneous voice and data service over the same telephone line. It is based on technical references (TRs) specified by Bellcore that will lay the groundwork for a national ISDN infrastructure. Bellcore issued the National ISDN-1 document SR-NWT-0001937, Issue 1, in February 1991 which describes the describes the capabilities expected to be deployed on multiple vendor switches in 1992. Bellcore issued National ISDN-1 document SR-NWT-001953, issue 1, in June 1991, which provides Generic Guidelines for ISDN Terminal Equipment on Basic Access Interfaces.

2.3.4.2 Significance of National ISDN

National ISDN represents an effort by the telecommunications industry (primarily the RBOCs and Bellcore) and government agencies to implement a national network to demonstrate coast to coast ISDN connectivity. This demonstration would support various user tests of their ISDN systems on a national basis. The purpose is to publicize ISDN and to promote the development and implementation of user applications.

2.4 Conclusions

2.4.1 Narrowband ISDN

ISDN is being deployed rapidly. By the mid nineties N-ISDN will be ubiquitous in the more populated areas in North America. N-ISDN offers many opportunities for implementation of improved performance in communications systems, many new productivity enhancements, new applications and, in some cases, cost reductions.

2.4.2 Business Opportunities

ISDN deployment, which is now a virtual certainty, will result in new information technology applications with millions of customers. This market represents an immense opportunity for modernization and productivity enhancements that will affect the way we do business in this country.

However, user unfamiliarity together with a lack of applications software could stifle business opportunities in the short term. Personnel training and user familiarization on ISDN will be necessary.

2.4.3 Broadband ISDN

Broadband ISDN is a developing technology without a clearly charted course of evolution. Although many applications have been proposed a solid user requirement for broad-based applications has not been documented.

2.4.4 Economic and Regulatory Restrictions

Economic and regulatory restrictions make it unlikely that the local telephone plant will be replaced with fiber or that broadband ISDN services will become available to a significant degree during the next several years.

2.4.5 ISDN Deployment Strategy

We should not delay the introduction of narrowband ISDN in anticipation of broadband ISDN. Narrowband ISDN requires a strong effort in applications development, but does not require any major advances in network technology. The strategy must be to implement an N-ISDN capability into the network that can be migrated to B-ISDN when the switching and transmission technology become available.

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3.0 TASK 2 - ISDN ACTIVITY IN THE U.S. GOVERNMENT

3.1 ISDN in the Army Information Mission Area

ISDN is a prominent component of the planned Army Information Mission Area (IMA) architecture and operational functionality. It will directly or indirectly support specific objectives of the Army IMA Long Range Plan and IMA Architecture. It is envisioned as a key technological capability that will support major functional improvements in the Army's daily operations and readiness. A discussion of this future role and the status of the realization of that role is a underlying basis for following discussions of specific programs and developments.

3.1.1 The Future Environment

The IMA Long Range Plan[1] defines the Army's Focus and direction for the IMA for the next 30 years. An underlying objective, and challenge, for the IMA environment is illustrated in Figure 3.1. The IMA Long Range Plan clearly identifies the need to evolve to an environment in which the 5 IMA disciplines of Automation, Telecommunications, Records Management, Printing and Publishing, and Audio-Visual are technologically and functionally integrated to achieve more cost-effective integrated information management systems serving Army managers and users at all levels. Several major programs and activities are underway which are keyed to achieving this integration of IMA disciplines.

ISDN is viewed as affording the inherent capabilities, capacities, flexibilities and long term adaptability to support these objectives. The IMA Long Range Plan identified several specific guidelines for the evolution of the IMA architecture. Key principals in these guidelines included:

- o Elimination of dedicated systems in the IMA backbone structure.
- o Maximizing reliance on common user services.
- o Providing access to all needed common user services from user's workstations.

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[1] "The Army Long Range Plan for the Information Mission Area", Office of the Director of Information systems for command, Control, Communications and Computers, 11 January 1991

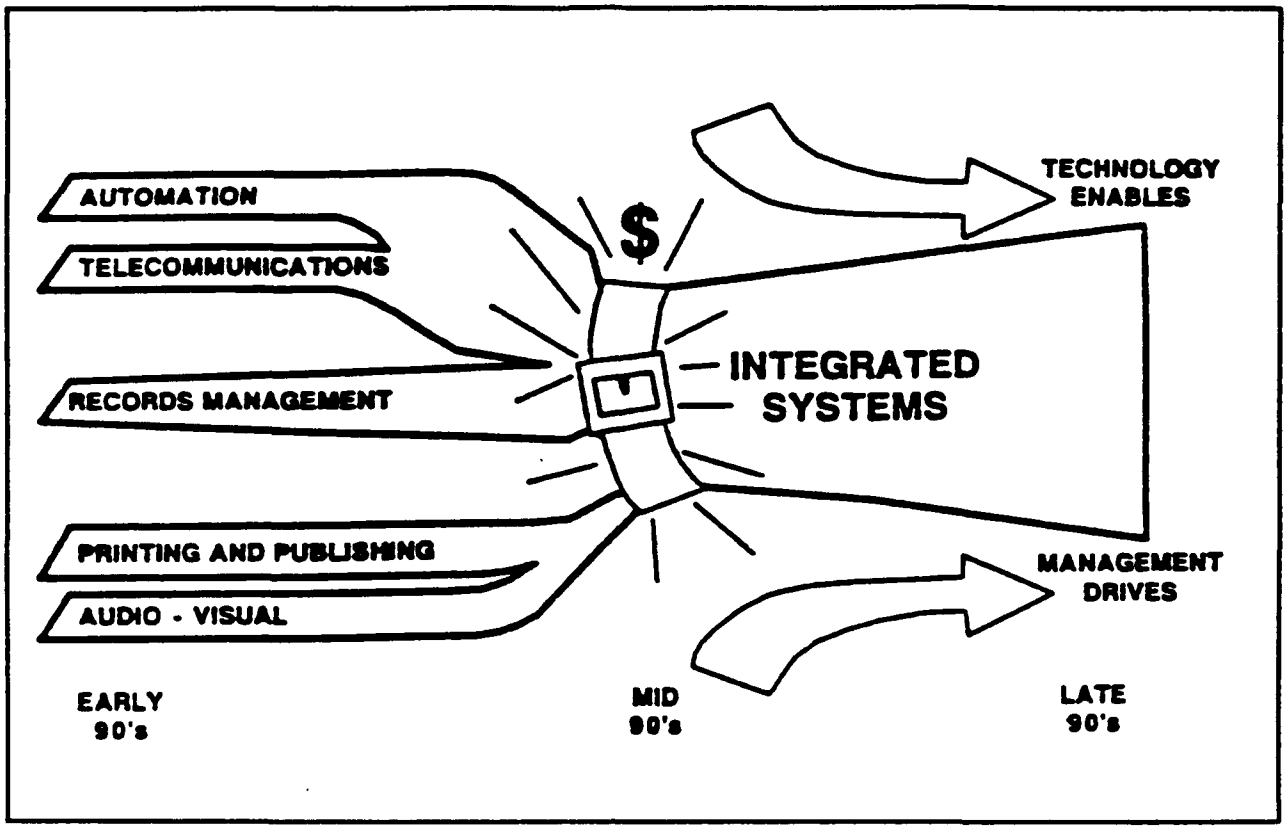


Figure 3.1. Long Range Integration of IMA Disciplines

ISDN represents a means of providing common user services that are anticipated to afford both increased information services connectivity and enhanced information services performance. The anticipation is also that these benefits will come at a lower cost as well.

The particular position for ISDN envisioned in the IMA architecture is illustrated in Figure 3.2.[2] The installation level ISDN Circuit/Packet Switching System will support both intra-installation and inter-installation (i.e., long haul) requirements. It will support intra-installation voice, data and other information (e.g., visual information) services requirements. The data and other information services requirements will be supported in conjunction with the installation wide backbone FDDI network and organizational/user level IEEE 802.X LANs. The ISDN switching system will also serve as a multi-functional and/or end-user interface to the Defense Communications Network and Public Switched Network for

[2] From "Information Systems Architecture Circa 1997", US Army Information Systems Engineering Command, 29 August 1989.

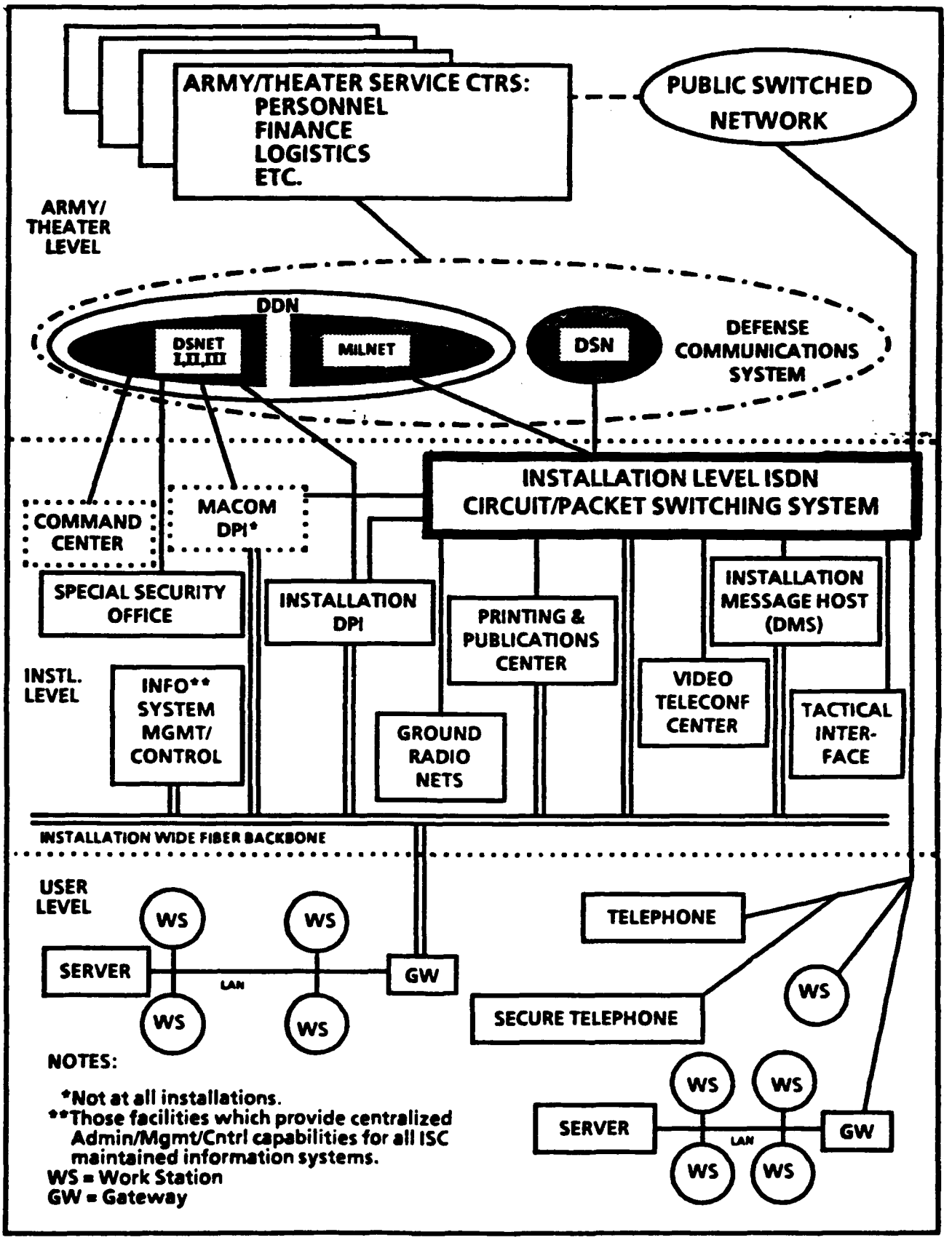


Figure 3.2. Systematic and Network View of Installation Level Information System Architecture

inter-installation information services.

Two significant evolutions will impact the significance of this architecture and the particular role of ISDN. One will be evolution of the external long haul networks, including the DCS, public switched network and special use network services such as FTS-2000, to incorporate ISDN or ISDN-like capabilities. This is likely to facilitate the application of inter-installation information services that can benefit from or take special advantage of ISDN services capabilities. For example, the Computer-Aided Acquisition and Logistics System (CALS) will involve large scale distribution, processing and coordination of engineering and logistical data, technical drawings and programmatic, engineering and logistics documentation on weapons systems programs among widely geographically distribute Army activities. The CALS Communications Plan envisions the use of ISDN capabilities that will be available through FTS-2000 to meet elements of CALS requirements.

The second, and more profound, evolution will be in applications and extensions of ISDN capabilities that more effectively support integrated voice, data and other information services. Two factors come into play here. There is a continuing increase in availability (and deployment in the Army) of more cost-effective workstations (i.e., lower cost per MIP) with multi-media capabilities. There will be a continuing, if not increasing, trend toward development and availability of workstation applications devices and software by independent ADP industry suppliers. As in other aspects of the automation/telecommunications marketplace, the growth and evolution of ISDN availability will spur developments specifically oriented toward ISDN applications. The Long range IMA objectives of (1) eliminating multiple terminal deployments to support user-level requirements by providing multi-functional workstations as the user-level device and (2) providing access to all required common-user services from the users' multi-functional workstations are another factor. In conjunction, these factors may be reasonably expected to lead to greater user-level interface with and support from ISDN resources. Studies and demonstrations are underway that are looking at the application of ISDN capabilities to achieve the functional alternative to LANs, where applicable and cost effective, and to achieve integrated functional information services capabilities at the installation level through use of ISDN capabilities.

Examination of the efforts in this area has been a particular focus of this investigation. Examples include:

- o Mitre Corporation study of installation-level information transfer alternatives (i.e., ISDN vs LANs) for USAISEC.
- o Jet Propulsion Laboratory (JPL) Advanced Communications Laboratories (i.e., ISDN) project,including implement a Ethernet LAN functionality through a remote ISDN switch.
- o USAPERSINSCOM's Personnel Information System providing integrated voice, data, record, image record services and desk-top conferencing services at high workstation data rates via ISDN capabilities.
- o USAMICOM ISDN Demonstration Program
- o Installation Support Module (ISM) Program, particularly its use of the USAMICOM ISDN facilities as its demonstration test-bed.

These projects are described in subsequent paragraphs.

3.1.2 Current Environment

While the concepts and developments referenced above represent the near term and future environments, the current situation casts somewhat of a shadow on the picture. On the whole, the installed installation switch and cable plant are far from supportive of near term wide scale implementation of ISDN-based functionality. The situation varies in the CONUS and OCONUS environments.

In the CONUS environment, Army operations are installation specific with requirements for reporting to higher command installations in the same MACOM structure and some coordinations across installations within the same MACOM structure. Future information systems may require more information services across installations in different MACOM structures with common interests in the particular IMA functional area. Most of the switches in place at CONUS installations are older analog systems. Less than 40% of the switches in place or planned for installation are newer digital switches capable of ISDN interfaces or of being upgraded to ISDN capabilities. The analog switches in place use key systems which enable one line to serve several telephone instruments. This was done to reduce the size of the cable plant when they were installed. The same cable plant structure exists at most of the installations at which more modern digital switches have been or are being installed as replacements. This conflicts with the

requirements of modern digital ISDN capable/upgradeable switches which need single line services to implement many ISDN features. Thus, the cable plant at most Army installations would require substantial modernization to support ISDN installation and full use of ISDN features.

The OCONUS situation is mixed. In Europe, there is less of the installation-specific environment seen in CONUS. Army communities with similar interests or in the same major organizational entity may be located near to one another or dispersed over a large geographic area. Some elements of the community may be in an installation supported by installation communications facilities and switches. Area communication networks may be needed to extend the information services to elements not within the installation service area. In addition, long haul communications between installations and supporting dispersed communities of interest depend to a large degree on the host country for services; approximately 50% of these services depend on leased circuits. While all of the installation switches in Europe are newer digital voice switches capable of being upgraded to ISDN interfaces, they still use key systems and cannot meet the single line service of ISDN without substantial upgrades to the cable plants.

The situation in the Pacific is similar to that in CONUS with respect to being installation oriented. All installation switches are newer digital voice switches capable of being upgraded to ISDN interfaces. Because of a number of recent telecommunications upgrade programs in the Pacific Theater, the cable plant at these installations is adequate to support realization of ISDN features.

3.1.3 Technological Adaptation

Current and future budgetary limitations will inhibit or delay full deployment of ISDN capable switches, upgrades to in place switches and/or necessary upgrades to in place cable plants. Technological approaches and developments that will evolve from industry interest in ISDN may provide the means for adapting available resources to provide ISDN-like services until the actual deployments/upgrades are accomplished. Some of the potential approaches are being looked at in the projects referenced in subsequent paragraphs. For example, one of the applications demonstrated and evaluated at USAMICOM was sharing of resources in which a processor was employed as a server to a number of user devices. Server based architecture and technology is a reality today and is rapidly

advancing. This is discussed in Section 4.0.

3.2 Plans and Programs

3.2.1 USA Personnel Information Systems Command (USAPERSINSCOM)

3.2.1.1 Background

The only specific functional application in the US Army committed to the application of ISDN services is the development and implementation of the Personnel Information System by USAPERSINSCOM. ISDN services will provide key functional capabilities within the US Army Personnel Network (PERnet) which implements the system.

The Army Personnel Information System/PERnet will be an integrated system intended to support the total Army requirements to man, manage, sustain, mobilize and transition the force in peacetime and war. The system will replace current manual, fiche, tape and automated records systems and the cumbersome means of transmission of personnel records throughout the various organizations concerned with personnel matters, accessing the records, and servicing both Army and local force management and individual personnel information needs.

The basic networking objectives established for the Personnel Information System/PERnet were:

- Electronic files transfer (Reduce current tape handling).
- Interactive user access to and from all major personnel systems (Create multi-functional workstations).
- Establish inter-network electronic mail service (Use of E-Mail for official mail).
- Minimize hardware,software and/or configuration changes at the users' end of existing network systems.
- Facilitate early transition to Government Open System Interconnection Profile (GOSIP) standards.

ISDN services were viewed as a significant means for addressing these objectives in conjunction with other data processing and communications

networking technologies. ISDN services were also viewed as a key factor in the design and development of the Personnel Information System/PERnet because of the basic nature of the system database. The individual personnel record, which is the base data for the system, is an image record from which the necessary textual, data and pictorial information is derived. This played heavily in the definition and design of the manner in which ISDN services are employed. This will be discussed further in subsequent paragraphs.

3.2.1.2 PERnet Configuration

The geographical distribution of major Army personnel centers which will be connected by PERnet is shown in Figure 3.3. Personnel information services also exist at individual installation levels which will interface with the Personnel Information System/PERnet on a limited basis.

The baseline PERnet environment consists of various host processors, user terminals and LANs at User Level, Direct Support (i.e., personnel center, installation) Level and General Support (i.e., ASIMS) Level with little direct interoperation. Personnel information in the form of computer records (e.g., tapes) are transferred between the various levels for integration into local files and processing.

The PERnet objective architecture is fully compliant with Army IMA guidelines on standardization on a minimal set of standards based systems technology and multi-functional workstations. POSIX will be the standard operating system for all user workstations, host and communications processors. GOSIP will be the standard interconnect protocol. Interconnectivity at and between the User and Direct Support Levels is envisioned as accomplished via IEEE 802.X and ISDN based LAN. Connectivity between the User/ Direct Support Levels and the General Support Level will via WAN or MAN (Metropolitan Area Network), as applicable, through DDN and ISDN Services.

Current efforts, applicable to this investigation, are directed toward the evolution of the existing baseline to the Target Architecture illustrated in Figure 3.4. This figure indicates that ISDN will play a role in support of processing and communications connectivity. Eventually, the CO-LAN (data over voice) capabilities will be replaced by ISDN supported capabilities. Since GOSIP is not anticipated to be realizable as the network standard for the Target Architecture, SNA and TCP/IP

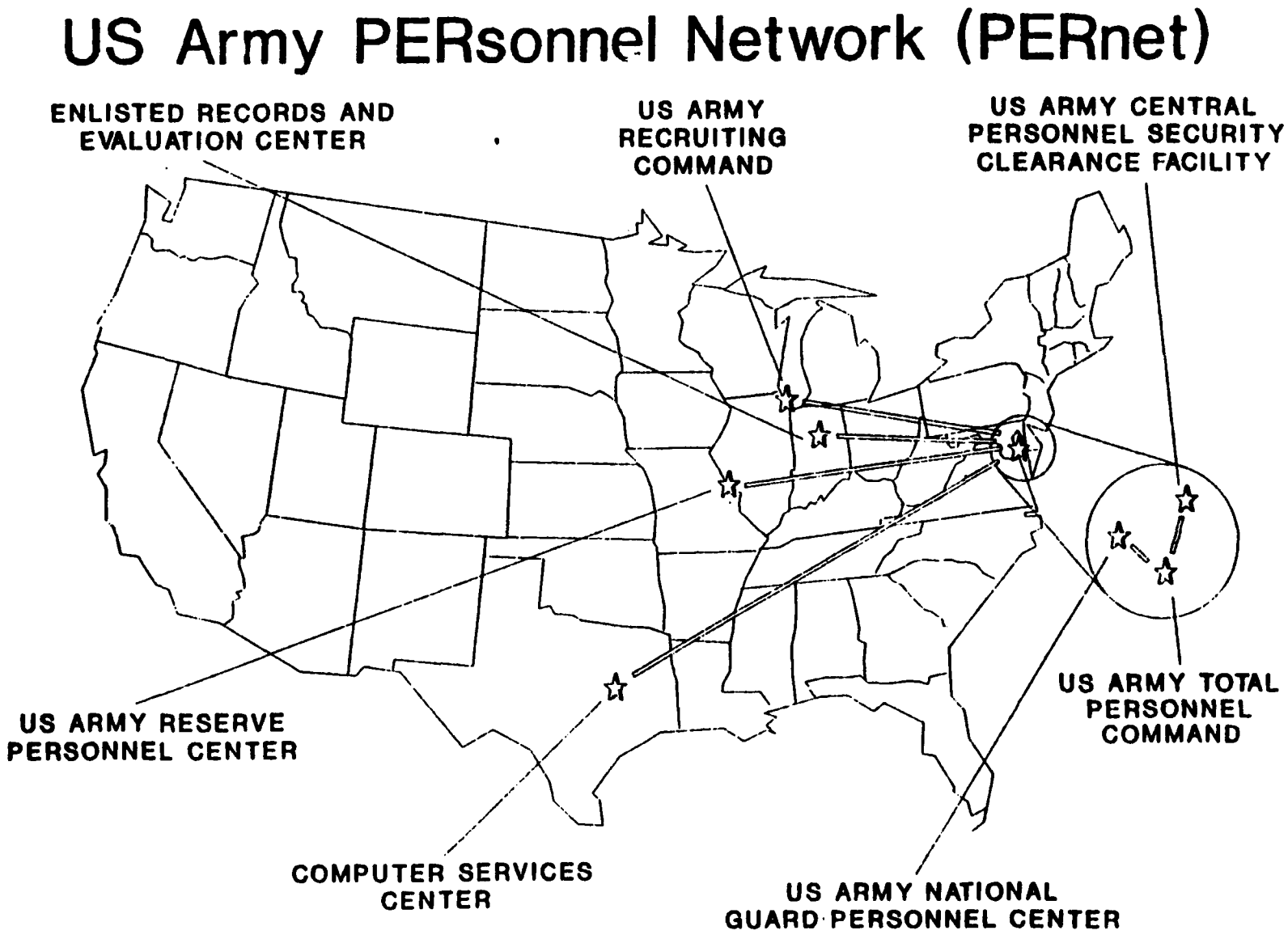
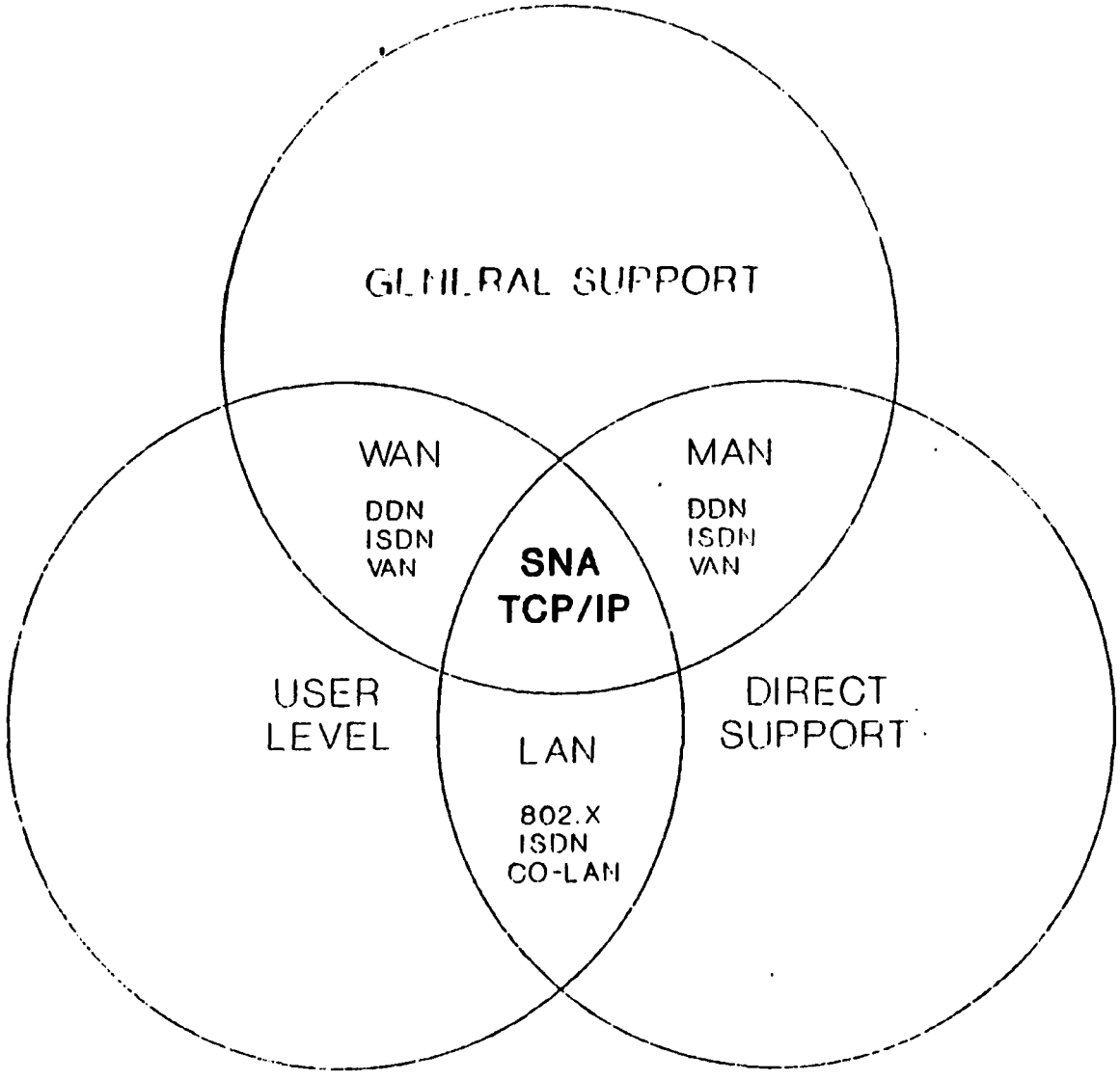


Figure 3.3. Army Personnel Information System/PERnet User Activities

PERSINSCOM TARGET ARCHITECTURE



ASQNI-DOO-N (Jul 91)

Figure 3.4. Army Personnel Information System/PERnet Target Architecture

will be employed as the network protocols. However, the SNA protocols will be achieved over ISDN.

The multiplicity of data processing and communications interfaces to be achieved in the Personnel Information System/ PERnet are illustrated in Figure 3.5. To achieve the various interfaces a Gateway Utility System (GUS) will be implemented at the PERSINSCOM facility. The functional objectives of the GUS are illustrated in Figure 3.6. The technical architecture is illustrated in Figure 3.7. Both figures indicate the connectivity of ISDN services within the total network.

3.2.1.3 ISDN Installation and Support

The ISDN services for the Personnel Information System/ PERnet program efforts by USAPERSCOM and USAPERSINSCOM HQ at the Hoffman Building Complex in Alexandria VA are supported by an off-site switch installation. The AT&T 5ESS 5E5 switch is located at the C&P Bell Burgundy Road Central Office. Several PRI lines to the Host processors are brought into the Hoffman facility by dedicated T-1 carriers on fiber optic cable. BRI service is via copper wire.

The system implementation is being supported by Army Information System Command activity (ISC-Hoffman) collocated at the complex.

The initial application of the ISDN services afforded by this switch will be devoted to the implementation of the Personnel Information System/PERnet. Subsequently, the ISDN services will be extended to other Army tenant activities located in the Hoffman buildings with the support of the ISC-Hoffman activity.

3.2.1.4 ISDN Services Applications in Personnel Information System/PERnet

Two primary objectives for the application of ISDN within the Personnel Information System/PERnet were:

- To maximize the interface with and use of Plain Old Telephone System (POTS) and instruments that represent the bulk of the services/instruments available at most system user sites for voice services. In addition, to minimize the requirements for newer ISDN specific individual user instruments within the local system configuration at the Hoffman complex.

PERnet Hosts & Gateways

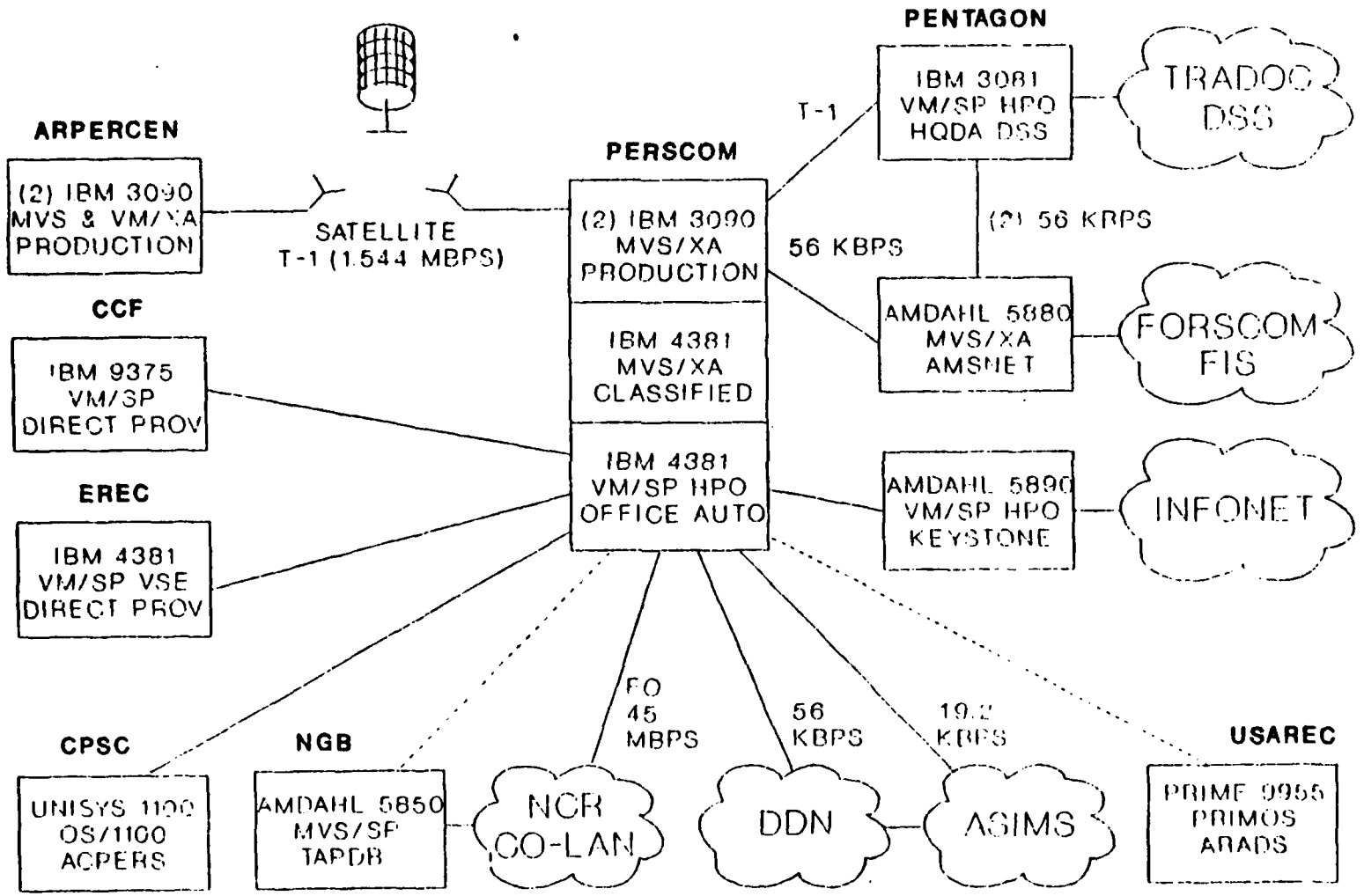


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Figure 3.5. Army Personnel Information System/PERnet Hosts and Gateways

FUNCTIONS OF GUS

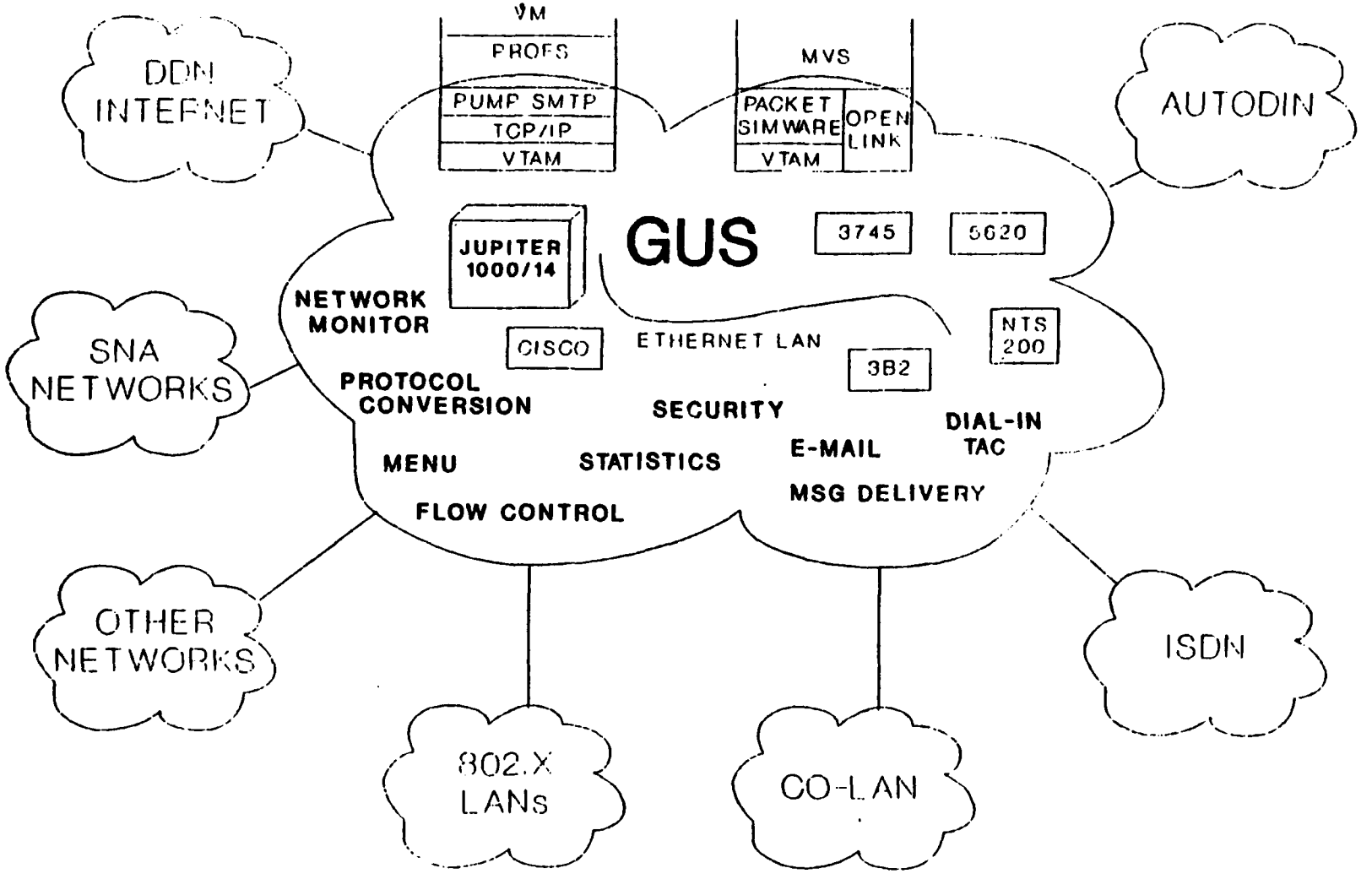


Figure 3.6. Army Personnel Information System/PERnet Gateway Utility System Functions

ASQNI-DOO-N (Jul 91)

Gateway Utility System (GUS)

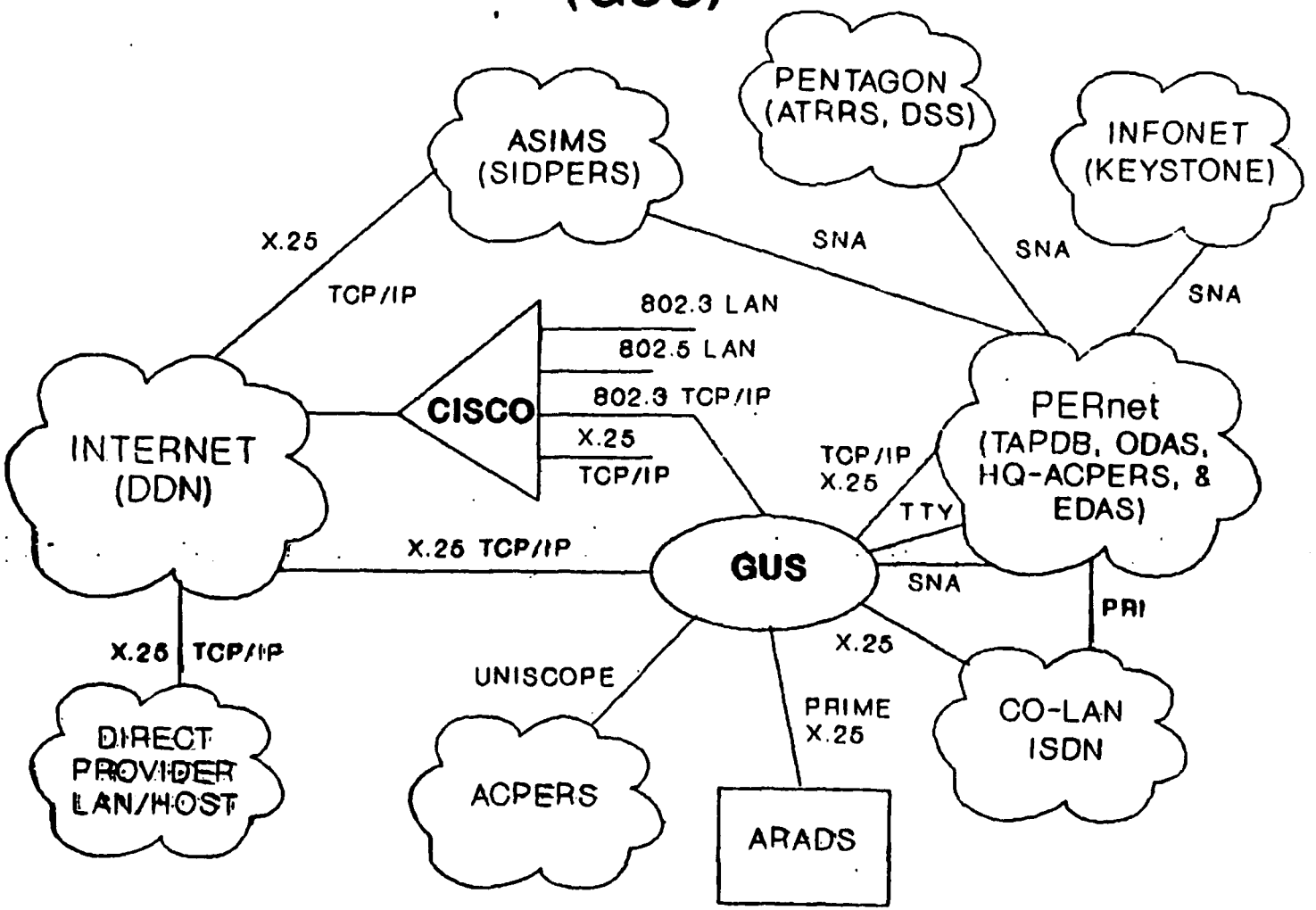


Figure 3.7. Gateway Utility System Architecture

- To achieve all other text, data, graphics, image and video interchange services on a digital basis through ISDN.

An additional objective was to employ the user workstations as true multi-functional workstations to provide interface to all system operational capabilities and features and interface to other system users and customers.

Specific functional service multipliers to be achieved through the use of ISDN services include:

- Ubiquitous access availability.
- Caller identification.
- Control over all incoming calls.
- Record of all communications and system accesses.
- Fast/economical dial-up services.
- High speed FAX at the user workstation, with laser printer quality.
- Video teleconferencing.
- Groupware/desktop conferencing.

A few specialized requirements for the system include:

- Graceful migration from DOV CO-LAN to BRI ISDN.
- PRI channel interface to PERnet Host computers.
- In-band capturing of callers' personnel ID number for automatic record retrieval.
- Dynamic allocation of both BRI B channels to data calls.
- SNA gateway to PERnet Hosts.

The application of Caller ID and dynamic B channel allocation features are discussed in the next paragraph.

3.2.1.5 Primary System Functional Performance Example

Figure 3.8 illustrates a primary functional performance application of ISDN service within the Personnel Information System/PERnet.

A soldier interested in discussions or obtaining information pertaining to his service career situation would call the system through the ordinary installation or public telephone system. The Voice Processing System (VPS) would receive (and log/record) the call and request the caller's Personnel ID Number (specifically his/her Social Security Number). The PIN would be used to access the system data base to identify the caller's name, Active/ Reserve/National Guard duty status, branch, rank and other data to initiate subsequent system action. The caller's duty status, branch and rank are used to identify, from the data base, the specific action officer desk to which the call should be routed.

As the call is being routed to the action desk, the caller's records are retrieved from the system data base. The caller's ID and other basic data are displayed on the action officer's workstation along with a message that the caller's record is being retrieved. The design goal is that the routed call and record data will be available to the action officer nearly simultaneously in order that he can begin to respond immediately to the caller's purpose.

3.2.1.6 Interface to ISDN Services

Figure 3.8 depicts the service center user interface to the ISDN switch as employing BRI channels. It may also be noted that it indicates the use of either ISDN or POTS instruments in conjunction with what is identified as an ISDN board within the user workstation.

The ISDN Board is a prominent feature of the Personnel Information System/PERnet adaptation of ISDN capabilities to the system's unique requirements. The primary function of the ISDN Board is to achieve a cost-effective means for handling voice, data, image and video access within the system at the high rates consistent with rapid caller service and other system user site interchanges. The salient features of the ISDN Board are summarized here.

The ISDN Board is in actuality two boards, a PC/Workstation Interface Board as shown in the figure and a Host Computer Interface Board not explicitly shown in the figure. The Workstation Interface Board is designed to be physically and electrically compatible with IBM AT-type insertion boards and bus interface. The Host side board integrates the capabilities of 12 workstation side boards.

There are two primary functional capabilities of the Workstation ISDN Board. The first is to provide dynamic allocation of the two BRI-B channels. When the

telephone instrument is off-hook the user has a B-channel for voice communications and the second channel for data to/from the workstation at 64 Kb/s. When the instrument is on-hook the board provides a combined 128 Kbps data service channel to/from the workstation. The on-/off-hook sensing and allocation is performed automatically by the Board.

The second is associated with the image record, including color photo image, nature of the basic system data. The Board provides Group 3 and Group 4 facsimile compression capabilities to support the handling of the image data. As a result, when in the full data mode with the compression feature employed, the Board enables an effective data rate of over 500 Kbps to the workstation.

The Board also incorporates the NT-1 interface capability, thus eliminating the need for a separate device. It also will support the necessary OSI protocols for the system.

Other characteristics and planned enhancements to the ISDN Board are discussed further in Section 4.0.

Deliveries of the Board for system installation are scheduled to begin in October 1991.

3.2.1.7 Current Status

The USAPERSINSCOM is currently in the status of demonstrating the ISDN based features of the system. The following figures and discussions summarize the current demonstration efforts.

Figure 3.9 illustrates a simple PC workstation data interface demonstration configuration. The Aristacom devices and AT&T PC/ISDN card indicated in the figure are being used in lieu of the ISDN Board for network connectivity. The Aristacom devices provide the protocol interfaces from the Application through Transport layers. The AT&T PC/ISDN card provides the protocol interfaces at Transport through Physical layers. The PC unit is an IBM compatible 386 class terminal. This configuration was used to demonstrate the caller ID capture (from the telephones depicted) and data retrieval functionality as well as other data services.

Figure 3.10 illustrates a simple image retrieval demonstration configuration. The image terminal as shown was employed to present a black & white display of the service record image. A VGA monitor is used to display the color photo image

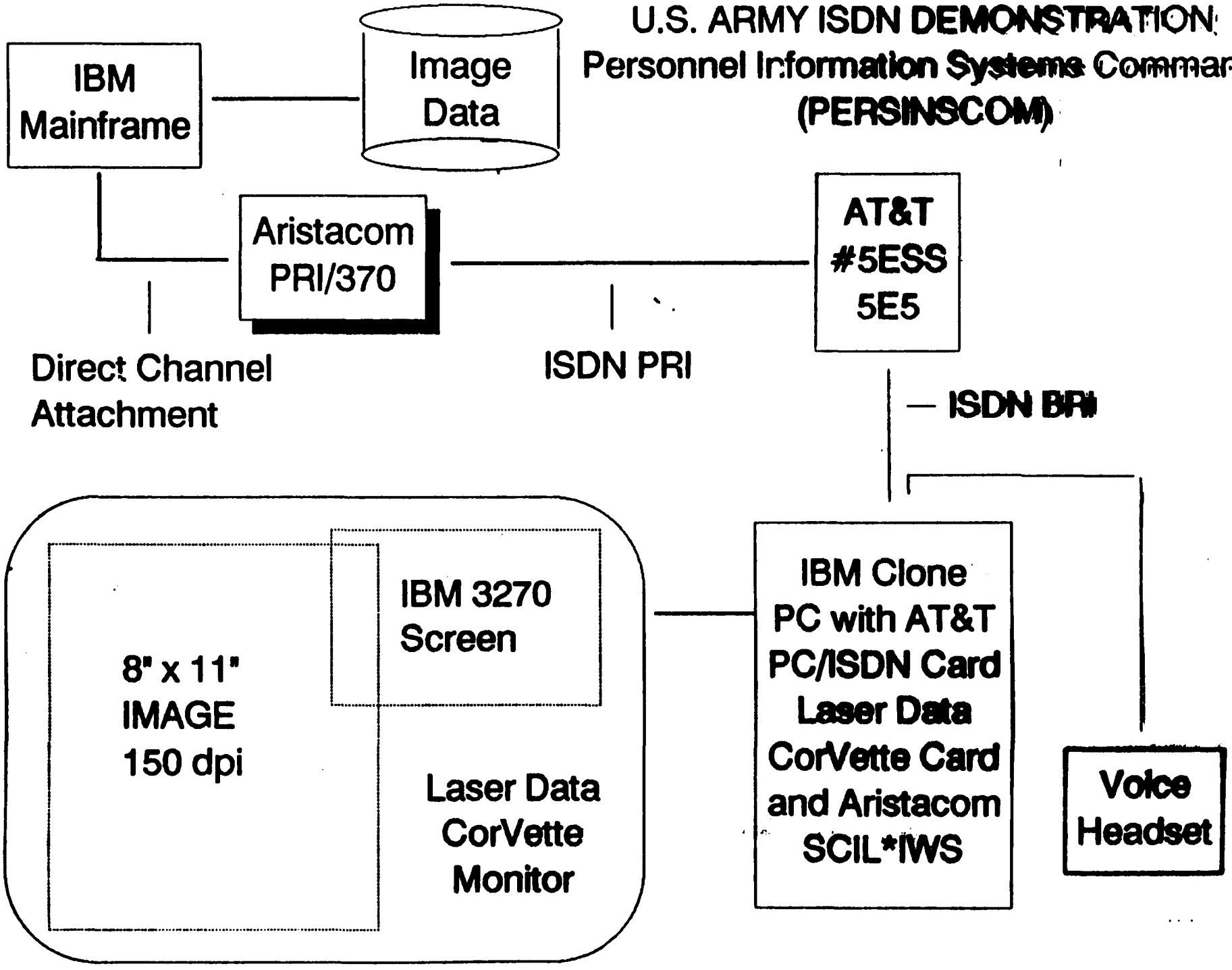


Figure 3.9. PC Data Retrieval Demonstation Configuration

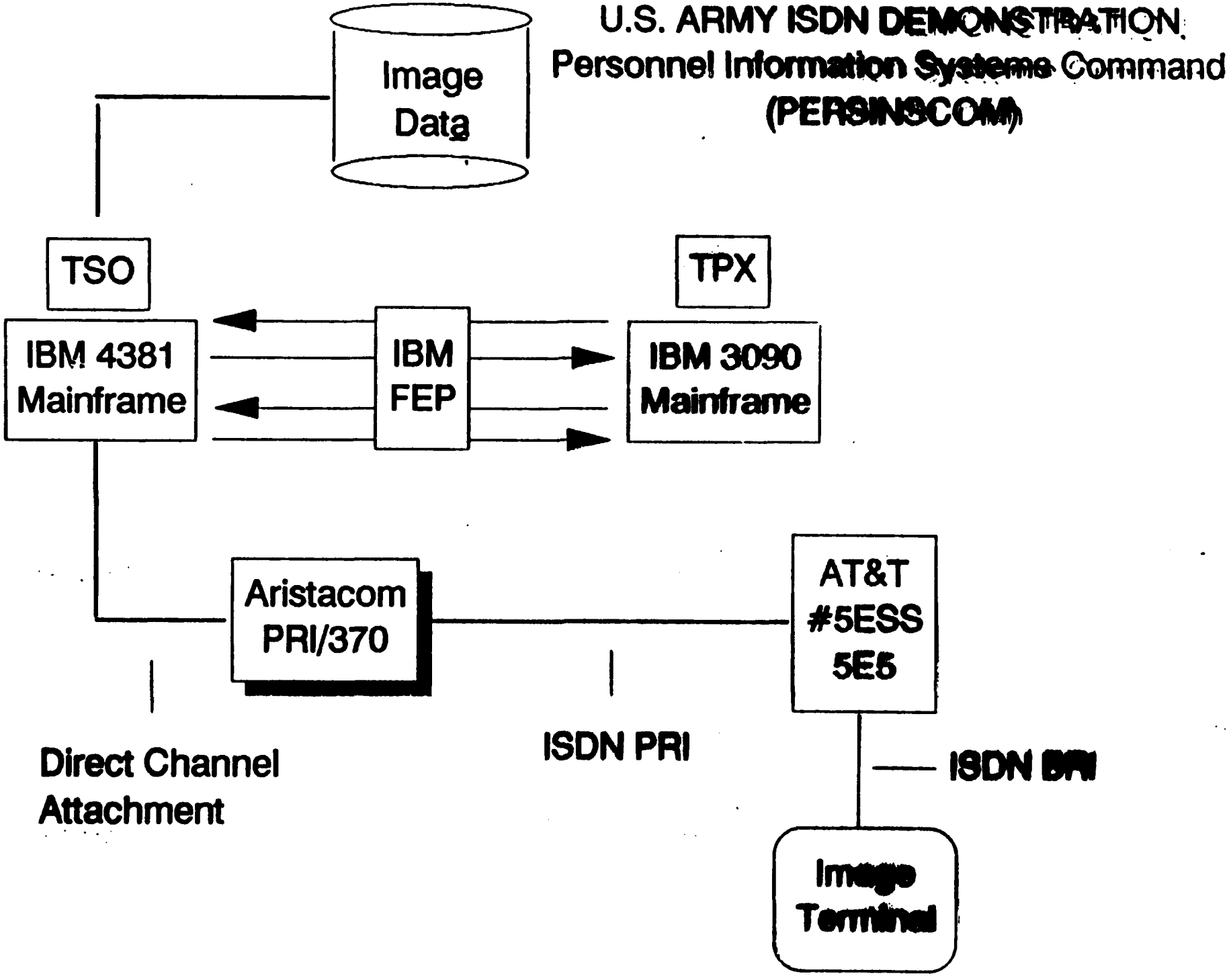


Figure 3.10. Image Data Retrieval Demonstration Configuration

of the service record.

Figure 3.11 illustrates a test configuration for a potential display format and monitor equipment. As shown the display format includes both textual and data information and a record image or photo image in the screen format shown.

Further demonstrations are planned in October 1991 with expected deliveries of the ISDN Board. A preliminary vendor plant demonstration of image record retrieval through the Board features was conducted. This demonstration involved side by side comparisons of image record retrieval from the system data base with retrieval of the same image record previously stored in a workstation hard disk. Operators and observers reported noting no perceptible difference in the retrieval to the screen image. This demonstration will be repeated at the system site after the Boards are installed in system equipment.

Table 3-1. Data and Image Sets for Army Personnel Information System/PERnet ISDN Demonstrations

U.S. ARMY ISDN DEMONSTRATION		
CASE #	IMAGE TYPE	SIZE IN BYTES
A1	Text	76,802
A2	Text	83,180
A3	Text	44,354
A4	Text	59,518
A5	Text	85,106
A6	Certificate	29,238
A7	B/W Picture	61,496
A8	B/W Picture	88,822
A9	Color Picture	186,114
A10	Color Picture	134,264

Table 3-1 lists the image sizes for various retrieval function tests employed in the system demonstrations. Table 3-2 by comparison indicates the image

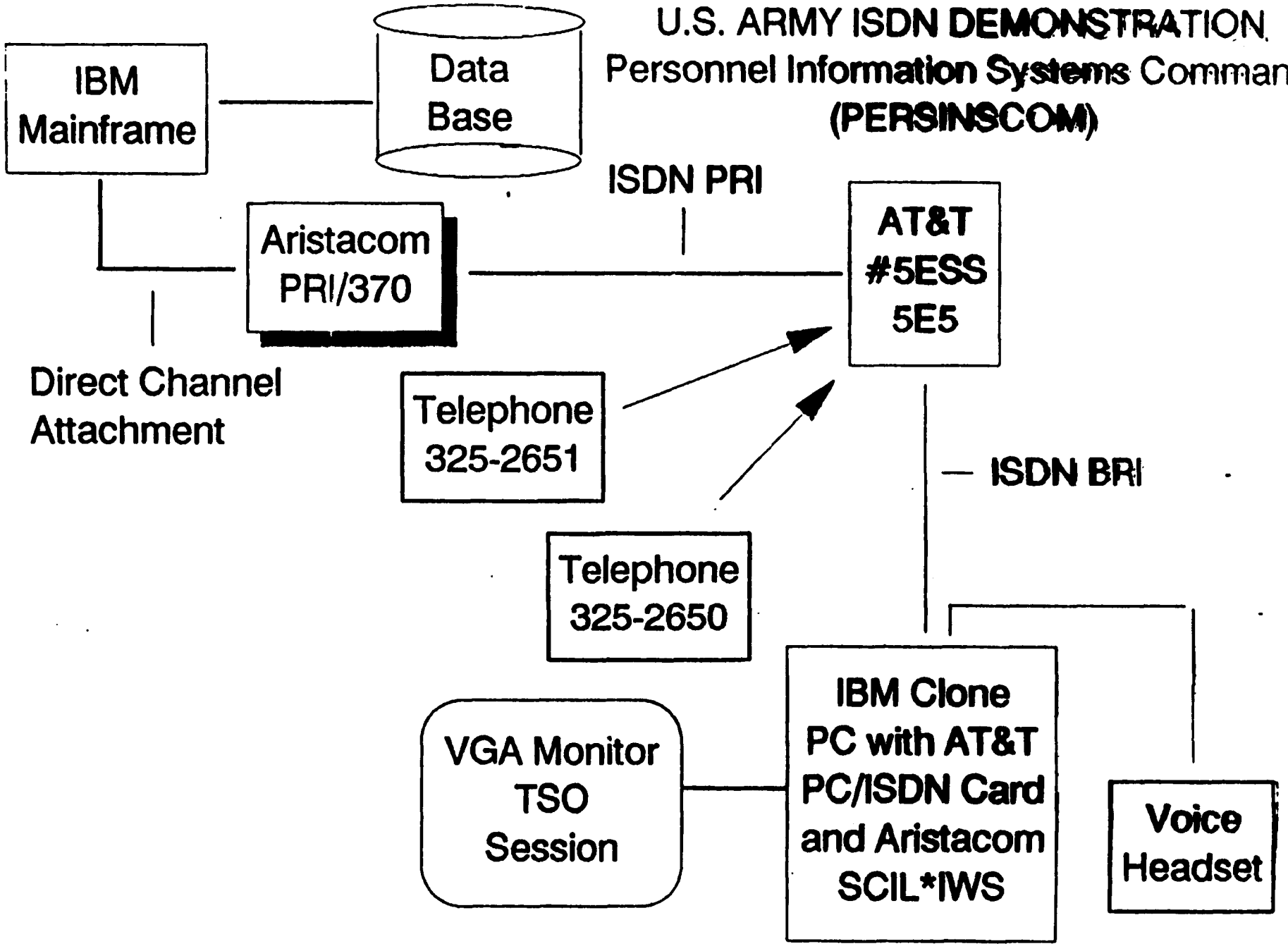


Figure 3.11. Data and Image Retrieval Demonstration Configuration

Table 3-2. Image Data Retrieval Reductions With ISDN Board

U.S. ARMY ISDN DEMONSTRATION	
Further Image Reduction Via Compression	
o A7 B/W Picture 61K to 38K Reduction	37%
o A8 B/W Picture 89K to 54K Reduction	39%
o A9 Color Picture 186K to 127K Reduction	32%
o A10 Color Picture 134K to 100K Reduction	25%

compressions expected to be achieved by the ISDN Board.

The Personnel Information/PERnet is currently scheduled to enter operational service in October 1991 following the completion of system demonstrations.

3.2.2 USA Missile Command (USAMICOM)

3.2.2.1 Background

Redstone Arsenal is the site of an Army Pilot Project for telecommunications services through ISDN. USAMICOM is the host command at Redstone and the central activity in the project.

Redstone Arsenal is a major US Government installation. It covers 100 square miles, encompasses more than 600 buildings and test ranges utilized by more than 20,000 personnel. Its occupants include eight Army Commands/Activities, several Army (and Joint) Project Offices, and the NASA Marshal Space Center. The bulk of the activities in which these organizations are engaged involves advanced technology R&D and systems development and acquisition. In this environment, data processing and communications represent massive and critical elements of daily and special requirements of on-going programs and facilities management.

In early 1989 USAMICOM, in conjunction with the US Army Information Systems Command activity and other tenant Activities, began investigating

methods through which it could achieve more cost-effective data communications throughout the installation. In addition to the desire for enhanced data communications, the investigation was intended to determine means for more effective use of the extensive twisted pair cable plant at the Arsenal. As South Central Bell already had an ISDN capable central office switch located on the Arsenal, the effort focused on the determination of where and how ISDN services could help achieve these objectives. Agreement was reached between the Army and SCB on a mutual effort to examine, implement and evaluate how ISDN could improve the efficiency of operations at the Arsenal.

3.2.2.2 ISDN Pilot Project Facilities

The cornerstone of the project was the ISDN capable switch. It was an AT&T 5ESS with 5E6 software.

In June 1989 funding authorization was provided to equip up to 512 lines for ISDN services. At that time deployment of new AT&T ISDN telephones, data communications adapters and enabling applications software was begun. By September 1990 over 300 lines were in service. The deployment of the lines and associated equipment provided a basis for an evaluation effort discussed below. By the time of this report the number of lines in service will be well over 400.

The AT&T digital telephones installed are 20-button models enabling access to several system features. They are equipped with built-in terminal adapters which provide RS-232C linkage to user computer terminals, workstations and personal computers.

Telephone access to the ISDN switch is via digital ESSX lines utilizing BRI protocol.

The SCB ISDN service at Redstone includes the passive bus feature, allowing up to eight devices to be served by a single BRI line. Contention for service among the devices and addressing to the devices is controlled by a single NT-1 terminating the BRI line.

The ISDN services were employed to provide voice services and data and video connectivity between data processing equipment utilized at Redstone. The computing environment consists of a wide variety of mainframe, minicomputer and user workstations and PCs. This includes Amdahl Es, IBM 3270s, Unisys 5000s, AT&T 3B2s, many different vendor workstations and virtually every type of

MacIntosh or IBM compatible PC on the market.

In addition, SCB installed an ISDN Laboratory facility at Redstone. This laboratory was employed in several ways to support the effort. ISDN vendors were provided a vehicle to test and demonstrate their applications products for consideration. It was used by SCB and Arsenal participants to test and integrate various vendor products involved in given project applications before actual application installation. It was also used as a means for intended applications users to learn how to operate their ISDN equipment configuration prior to actual installation.

3.2.2.3 Pilot Project

The ISDN Pilot Project was conducted between June 1989 and December 1990. Four of the eight Army Commands/Activities located at the Arsenal participated in the pilot implementations and evaluations. These included:

- US Army Missile Command
- US Army Information Systems Command
- US Army Ordnance Missile and Munitions Center and School
- US Army Test, Measurement and Diagnostic Equipment Support Group

Ten pilot applications were defined, developed and installed for the project. These included:

- Key System Replacement and Intercom
- Electronic Directory
- Electronic Messaging
- Pair Gain
- File Transfer
- Modem, Printer and Terminal Sharing
- SNA 3270 Access
- ISDN Teleconferencing via MacIntosh Executive Network
- Military Police Security
- ISDN Attendant Console.

JRH Associates, Inc., an independent market research firm, was contracted by SCB to conduct an evaluation of the Pilot Project. The evaluation was to include determination of productivity gains and related economic benefits which resulted from the ten pilot applications. During September and October 1990, JRH conducted interviews of thirty of the ISDN users and evaluated the pilot applications. Their report in November 1990 indicated wide spread satisfaction, and even enthusiasm, for the ISDN services and specific productivity and economic gains for the pilot applications.

The ten pilot applications are briefly summarized in the following paragraphs. The benefits noted in the JRH report are included.

3.2.2.4 Key System Replacement and Intercom

Figure 3.12 illustrates this application. It supplanted multi-button key system service and intercom capabilities currently available to non-ISDN ESSX users.

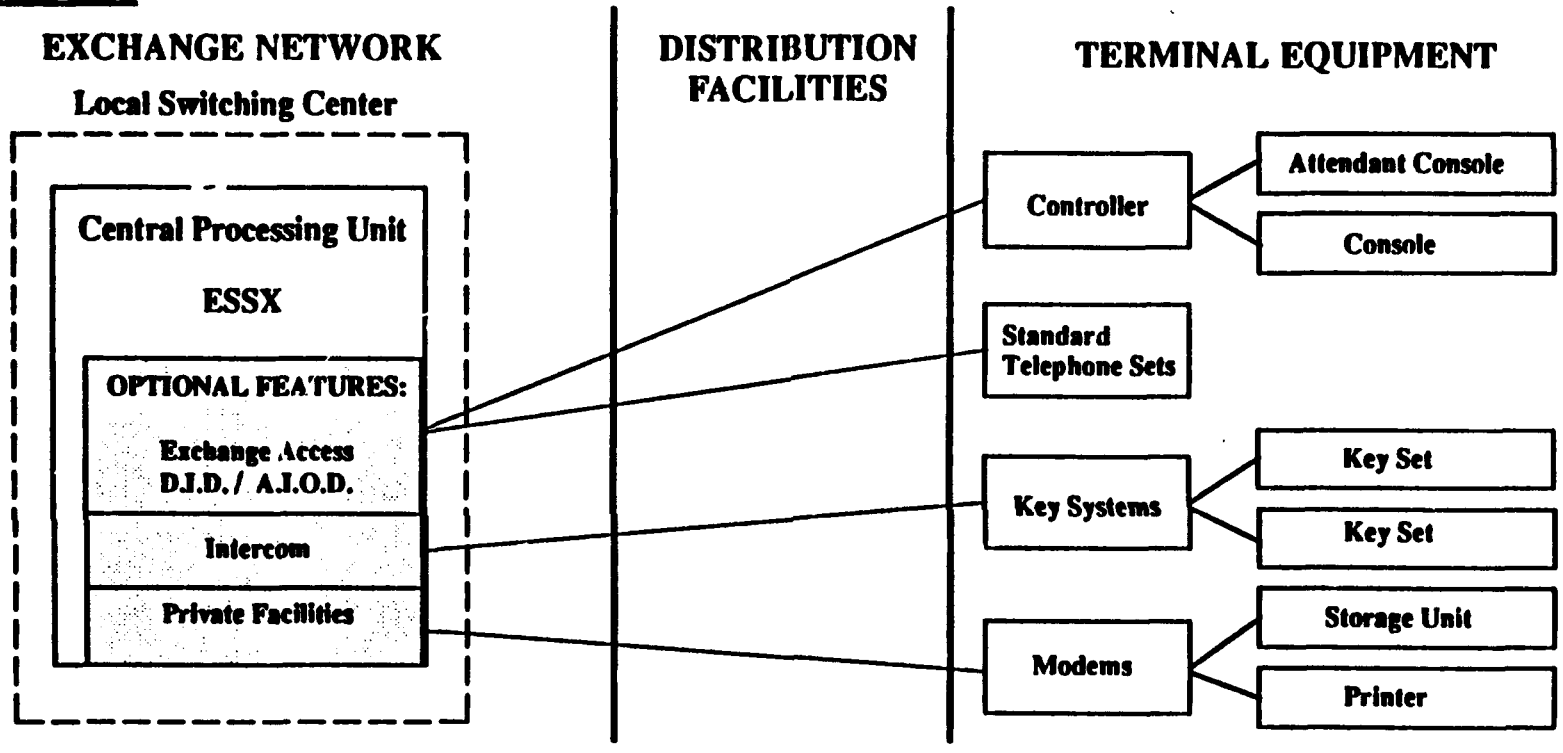
Call pickup groups had pre-defined and programmable buttons for one-touch feature activation and multi-line pickups. Single button access to over thirty features was provided. Most commonly used features included intercom, conference calling, call holding and call transfer.

This application represents a streamlined , user friendly replacement for systems requiring a greater number of individual devices to achieve the same functional services, more extensive wiring to provide the multi-line pickup capability and more extensive wiring rearrangements when implementing a new feature.

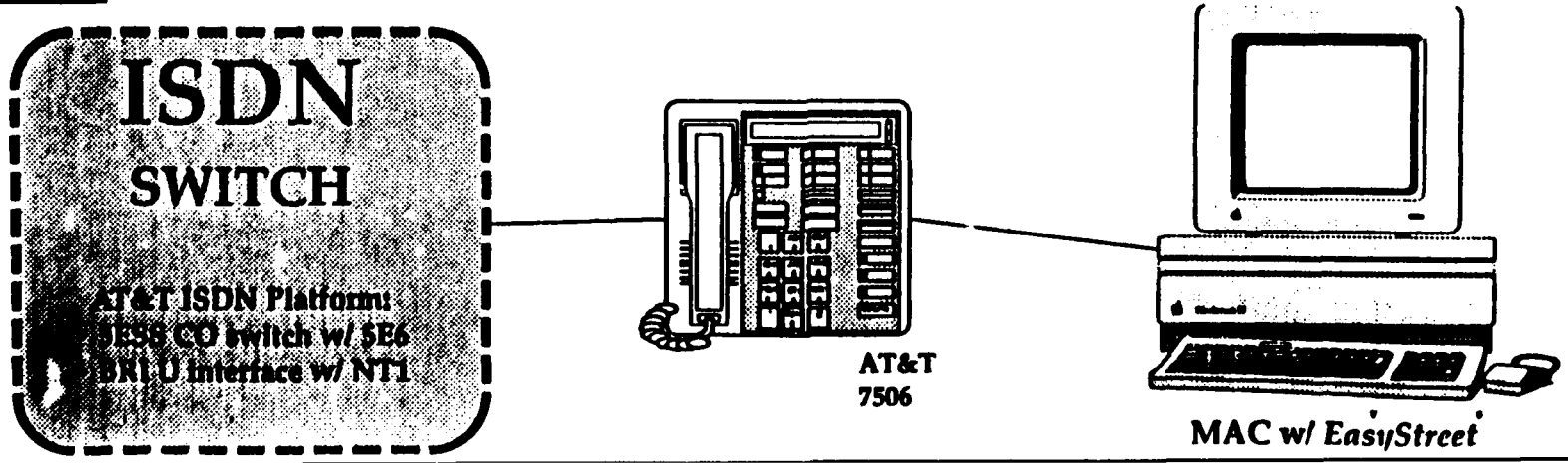
JRH estimated the benefits of this application in relation to what its experience indicated to be a common conventional system configuration, which included 6-button desk sets (5) and a secretarial 18-button Call Director. First, the use of the new instrument eliminates the need for 25 pair cabling associated for each 6-button conventional instrument. Second, their assessment indicated that the cost of $600 per 20-button ISDN telephone versus the allocated cost of $958 per instrument in the common configuration represented a cost savings of 37%.

Figure 3.12. # Key System Replacement and Intercom

BEFORE:



AFTER:



3.2.2.5 Electronic Directory

This application is illustrated in Figure 3.13. It provides the user with the capabilities to obtain personnel directory information from an automated central file. The telephone sought is presented on the telephone instrument display. The user can place the call to that number with a single Autodial button action. This capability also facilitates look-up and call transfer to other individuals.

If, in addition, the user instrument was interfaced with a computer terminal, a customized listing could be printed out for reference.

JRH interviews determined that it takes an average of 10 seconds to enter a name, obtain the individual's telephone number and Auto-dial the call. This compares to their estimate of 70 seconds to accomplish the same task by referencing a manual directory, assuming a directory copy was readily available to the user and was up to date. These conditions, especially the latter, are frequently not the case at Redstone or most other installations.

JRH estimated, based on an average of two look-ups per day (for either originating calls or transfers), a productivity gain (savings) of 400 minutes per worker per year. For an installation such as Redstone with 20,000 employees this represents a gain of over 83 person-years per year.

3.2.2.6 Electronic Messaging

This application is illustrated in Figure 3.14. The application addressed several services designed to direct and control network traffic not answered by a called party. This included message desk, voice store and forward and electronic directory features in an integrated voice and text messaging system.

All voice and text messages not answered were stored with a postmark of the date, time and originator telephone number and/or address. The message waiting light on the telephone instrument alerted users to retrieve stored messages. As each message is retrieved, the user could call the originator using the Auto-dial feature.

Although not part of this application, the electronic messaging could be linked to Voicemail equipment to afford more extensive voice messaging capability. At least one user ordered this service after the evaluation was completed.

JRH's evaluation indicated high user satisfaction with this application.

Figure 3.13

Electronic Directory

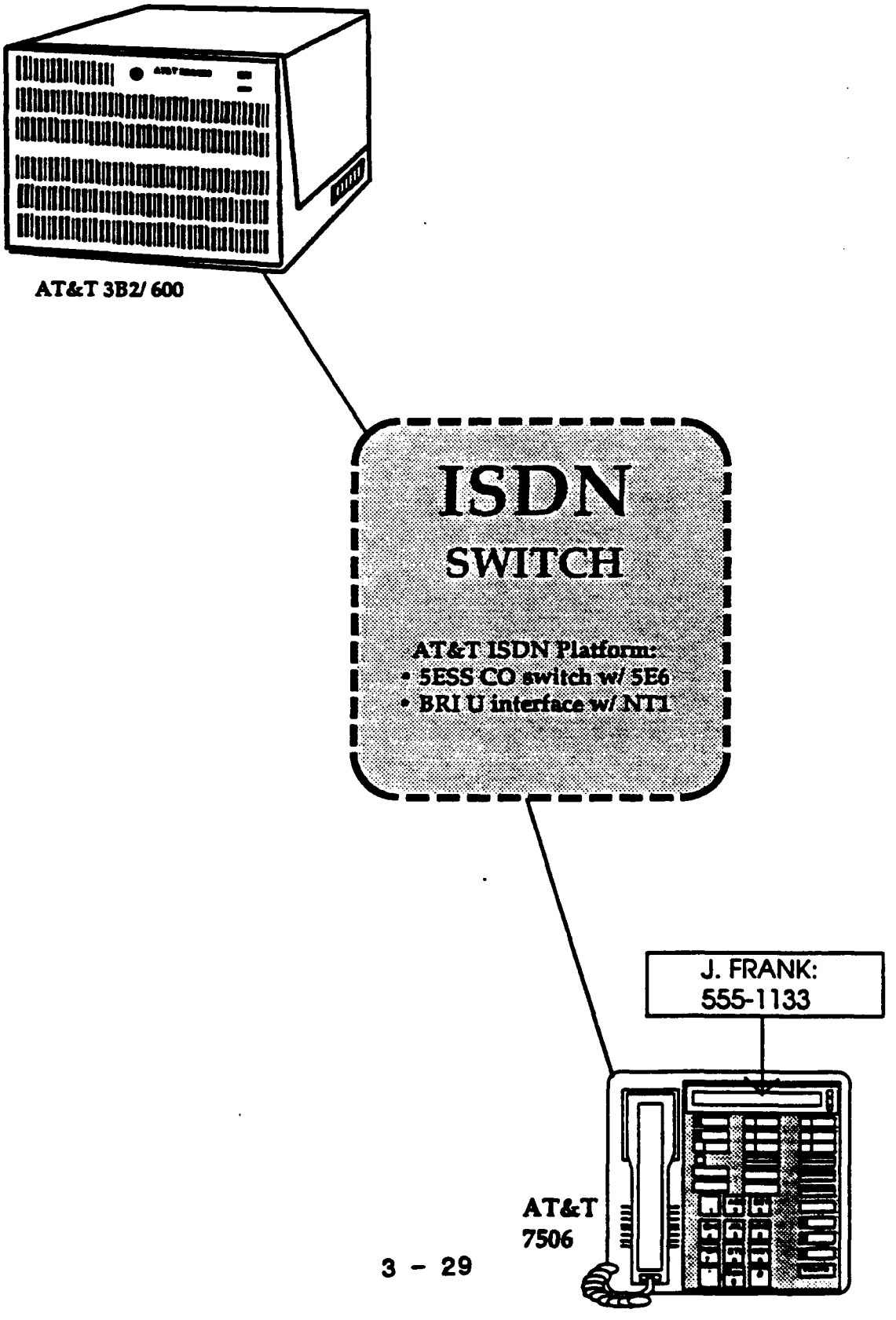
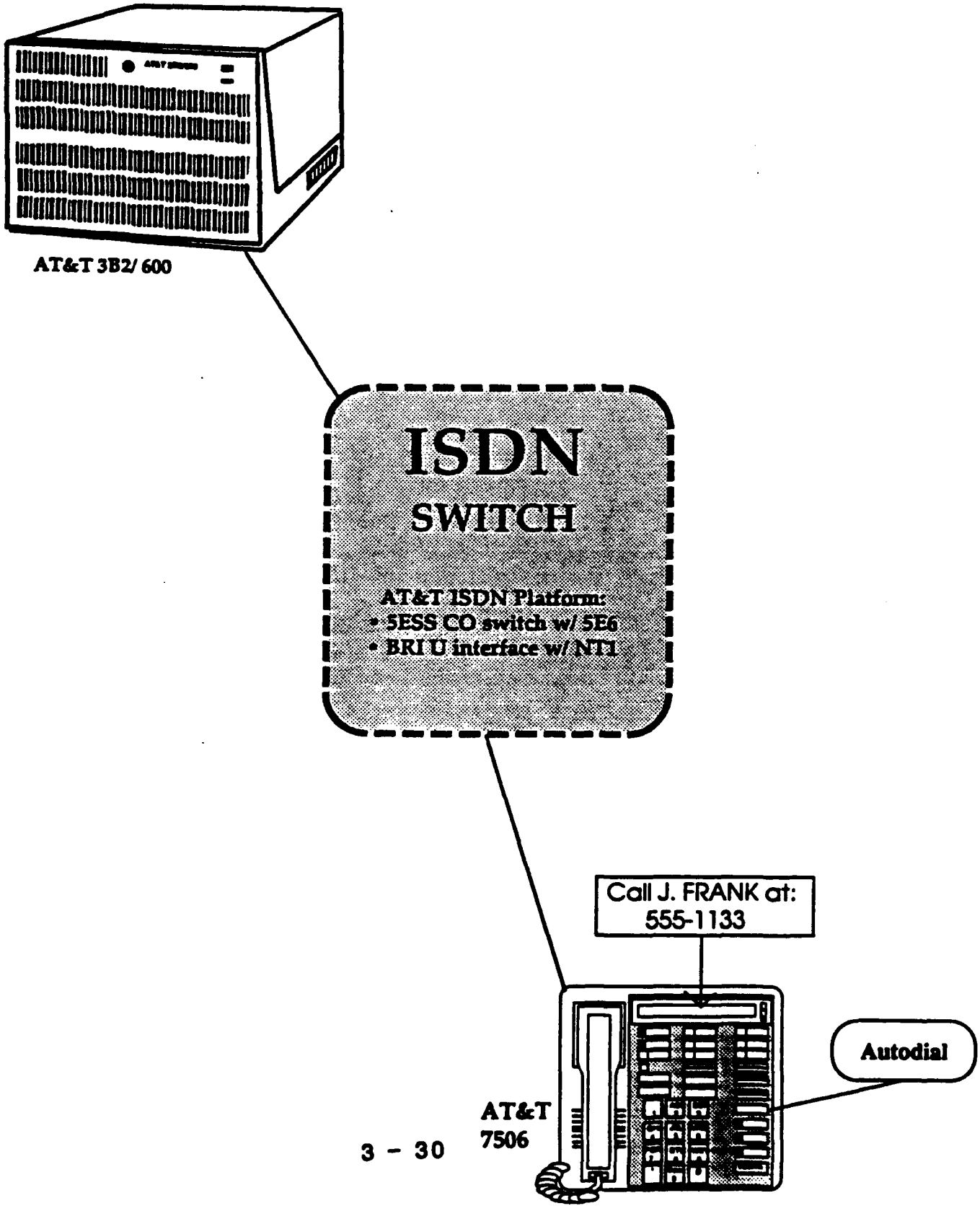


Figure 3.14. # Electronic Messaging



Qualitatively, it was noted as significantly reducing "telephone tag" between users. Quantitatively, users indicated a reduction in incorrect numbers or illegible writing on message slips from over 20% to less than 2%. There was no estimate made of the time saved in follow-up efforts to correctly identify the callers or their numbers.

3.2.2.7 Pair Gain

The object of this application was to investigate the capability afforded by ISDN to achieve more effective use of existing twisted pair copper wire cabling resources. It employed the passive bus feature of the ISDN services at Redstone to enable up to eight users to be served by a single BRI line.

Several organizations at Redstone operate out of trailers for extended periods of time. JRH evaluation of this application focused on one such group consisting of 25 persons. It required 50 pairs to meet their communications needs; 25 for telephone service and 25 for 9.6 Kbps Synchronet data communications service.

JRH's evaluation of this situation indicated that the application of the ISDN passive bus feature reduced the number of lines required, reduced the amount of equipment needed to effect the voice and data connectivity at the user site and reduced the cost (over a projected three years in which the facility would be employed) from over $52,000 to just over $40,000, for a 23% saving.

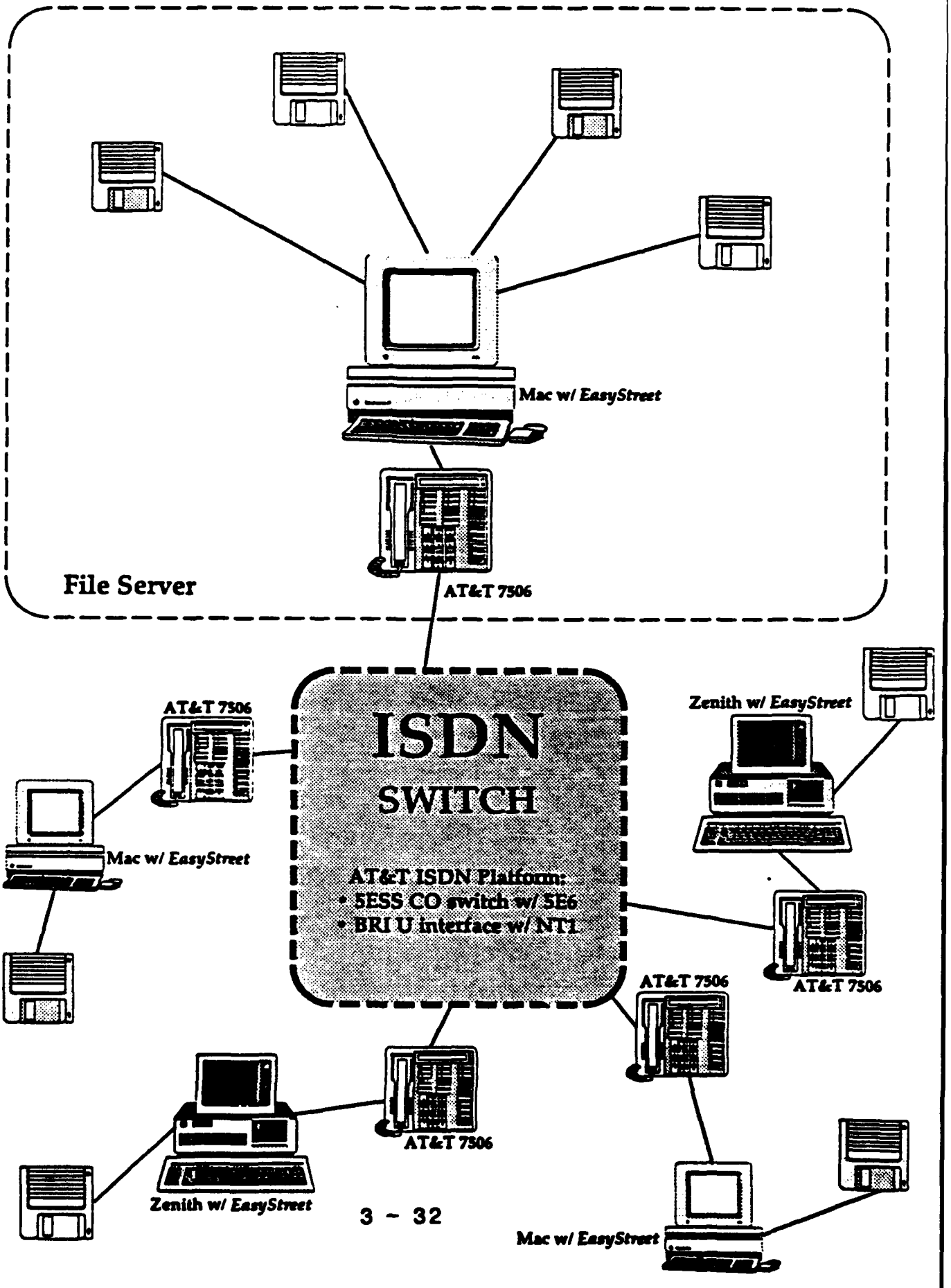
3.2.2.8 File Transfer

This application is illustrated in Figure 3.15. The application provided the users with a LAN-like connectivity for file transfer, document transfer and data exchange. In addition, the users were able to simultaneously interact by voice to discuss, view and revise the information presented on their PC screens.

The EasyStreet software indicated in the figure was adopted as an office communications software product for the ISDN Pilot Project. In this application it enabled the ISDN platform to recognize each of the multi-vendor PCs and terminals being used. It also administered each of the files the users might wish to transfer.

JRH's assessment of this application indicated that it was well received by the users. This was particularly true for the desktop conferencing afforded to the users. Qualitatively, this conferencing capability was reported to have facilitated

Figure 3.15. File Transfer



and enhanced the coordination among users. A quantitative assessment of this application was made in relation to its use by the USAMICOM Contract Management Branch. Its use in coordination, review and approval of contractor vouchers for payment indicated an estimated 15-20% productivity improvement over the courier process normally employed to expedite voucher processing on contracts with substantial discounts for prompt payment.

3.2.2.9 Modem, Printer and Terminal Sharing

The purpose of these applications was to investigate and evaluate the degree to which ISDN services afforded capabilities for sharing of data system resources among users.

Figure 3.16 illustrates the printer, facsimile and terminal sharing application. The ISDN switch provides the interface from several user PCs to another PC functioning as a Printer/FAX server to allow multiple users to share these terminal devices. This application was implemented in several departments within the four participating Activities. In one instance 15 users served by ISDN lines shared one printer. In this instance the alternative would have been a LAN or the provision of 9 additional printers, one for each of the heavy users.

The modem sharing application is illustrated in Figure 3.17. In this application, the 16 Kbps capacity of the BRI D- channel was employed beyond its basic signalling function. Packetized 16 Kbps data from user terminals were routed as a combined packetized B channel to the devices shown to provide X.25 LAN interfaces to other non-ISDN users.

JRH's assessment of the printer/fax sharing application was based upon the number of approximately 2,500 PCs at Redstone. It estimated that users would require 1,657 printers without ISDN supported sharing and only 357 with ISDN. At an average of $500 per printer the elimination of 1,318 printers would save $659,000.

The JRH assessment did not examine the quantitative cost savings that could be achieved by the modem sharing application.

Figure 3.16. # Printer, FAX & Terminal Sharing

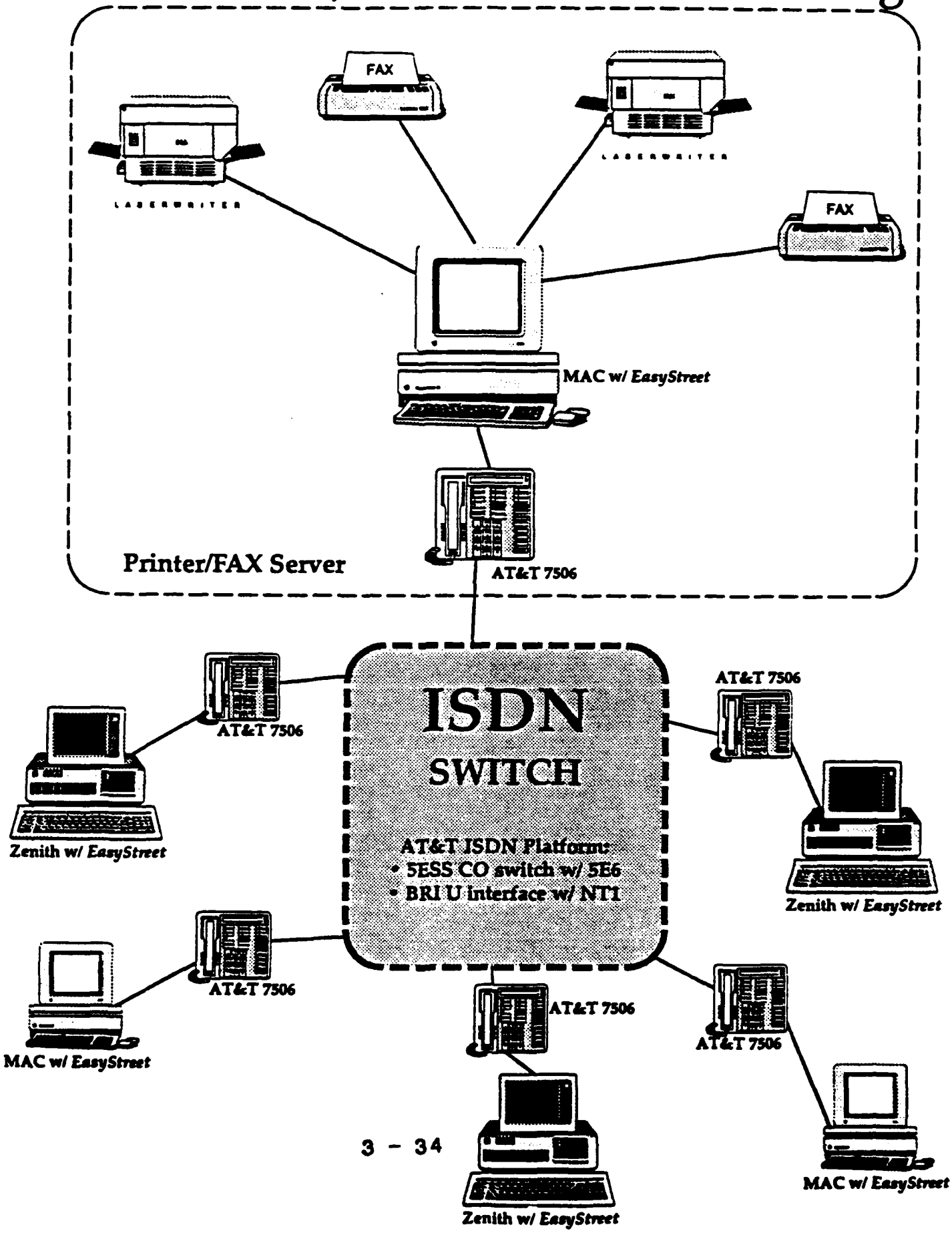
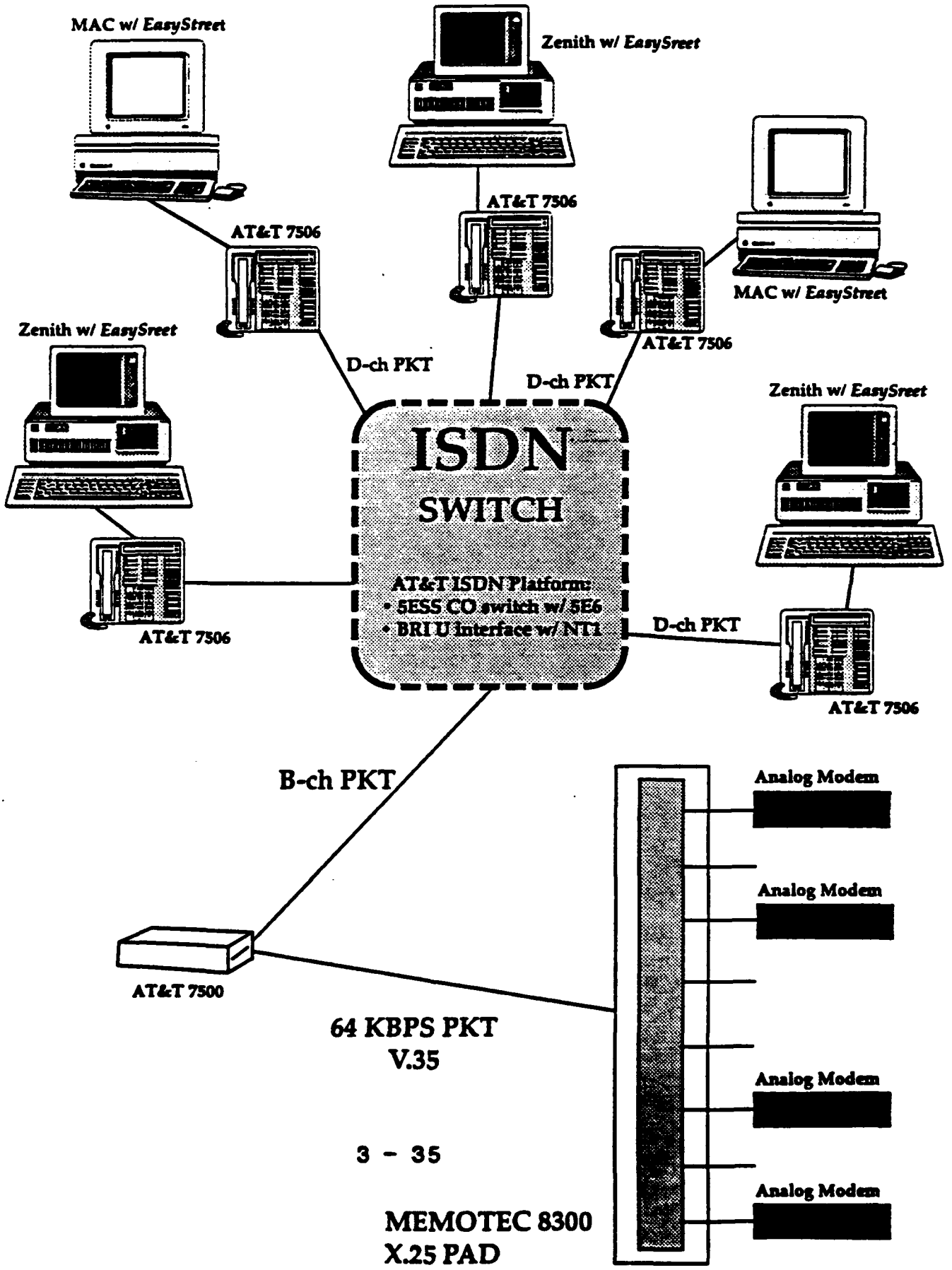


Figure 3.17. Modem Sharing



3.2.2.10 SNA 3270 Access

This application is illustrated in Figure 3.18. The application was intended to demonstrate SNA LAN functionality through ISDN. It would make use of a recent IBM enhancement of its 3714 cluster controller microcode with Advanced Peer-to-Peer Networking (APPN). The normal 3714 controller-host link can be implemented using various data link protocols, including X.25 and SLDC, or using a front-end processor which acts as a gateway to the host. APPN permits the controller to handle the intermediate routing of Logical Unit 6.2 sessions. This makes it possible to use IBM's Convergent Data Stream for 3270 terminals. In this application an ISDN compatible terminal emulation package would be able to directly access both a System/370-type mainframe and an AS/400 minicomputer (not shown in the figure) to achieve a Token Ring LAN functionality without having to implement a Token Ring LAN.

This application was still being developed at the time of JRH's assessment. However, they estimated that it would permit users to implement a Token Ring LAN functionality at $187 per PC, including the allocated cost of $2,000 for the upgrade to the cluster controller and new device drivers for each PC at $125 per PC. This compared to their estimated cost of $5,500 per PC for a Token Ring LAN installation.

3.2.2.11 ISDN Video Conferencing via MacIntosh Executive Network

This application is illustrated in Figure 3.19. It was intended to provide on-demand desk-top video-conferencing among system users.

At the time of the JRH effort there were over 70 users of the MacIntosh Executive Network. Another 250 users were scheduled to be connected to the network in FY91. This application would link the Network with the ISDN user network to permit desk-top video-conferencing. MacIntosh IIC users would receive digital video transmissions over the B-Channels of a BRI line for presentation in a window on their PCs.

This application was still in pilot test at the time of the JRH assessment. However, they reported that the pilot-testing was successful.

JRH's qualitative assessment of the application indicated three points. First, switched bandwidth video-conferencing may be implemented on a demand basis as

Figure 3.18. SNA 3270 Access

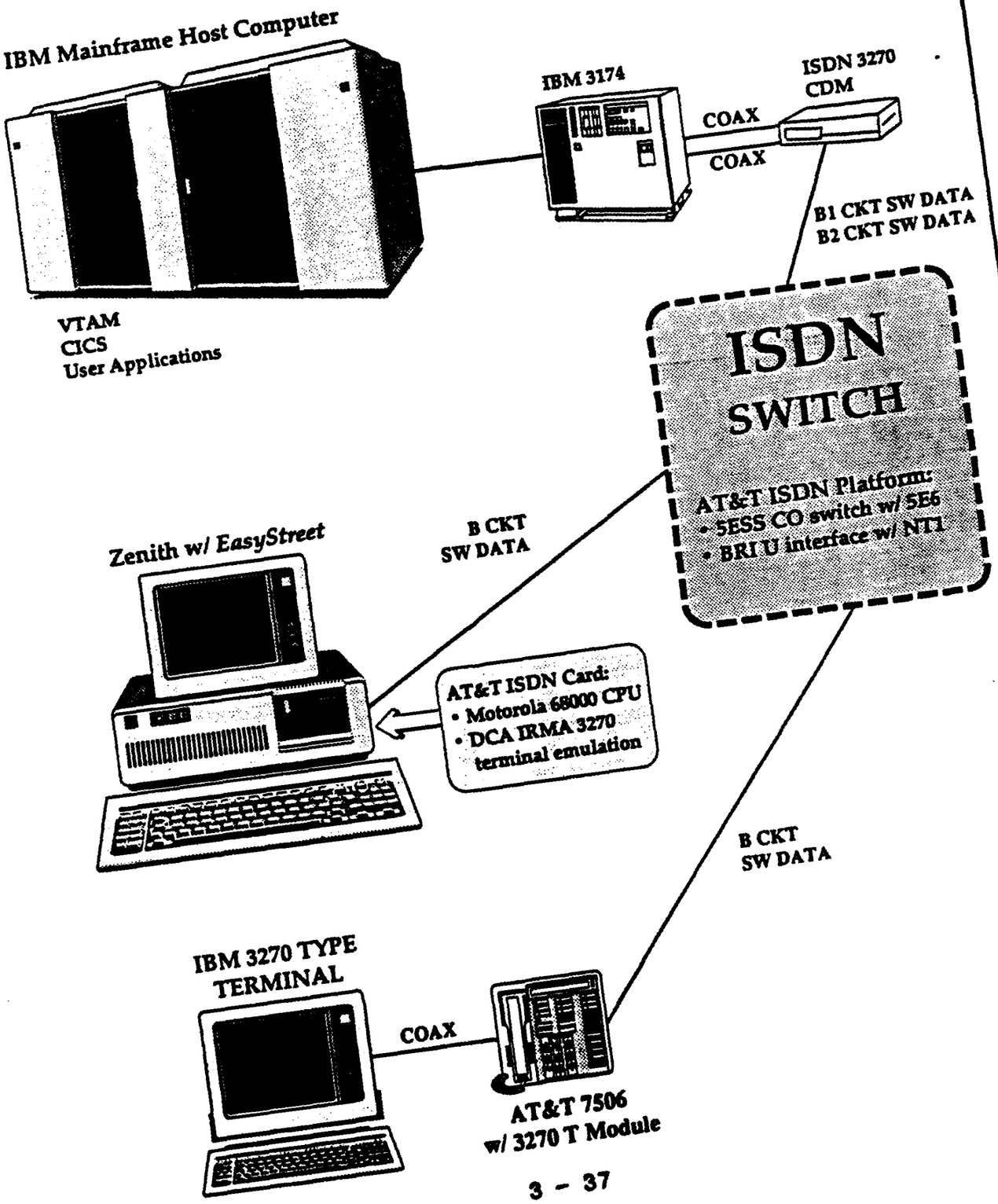
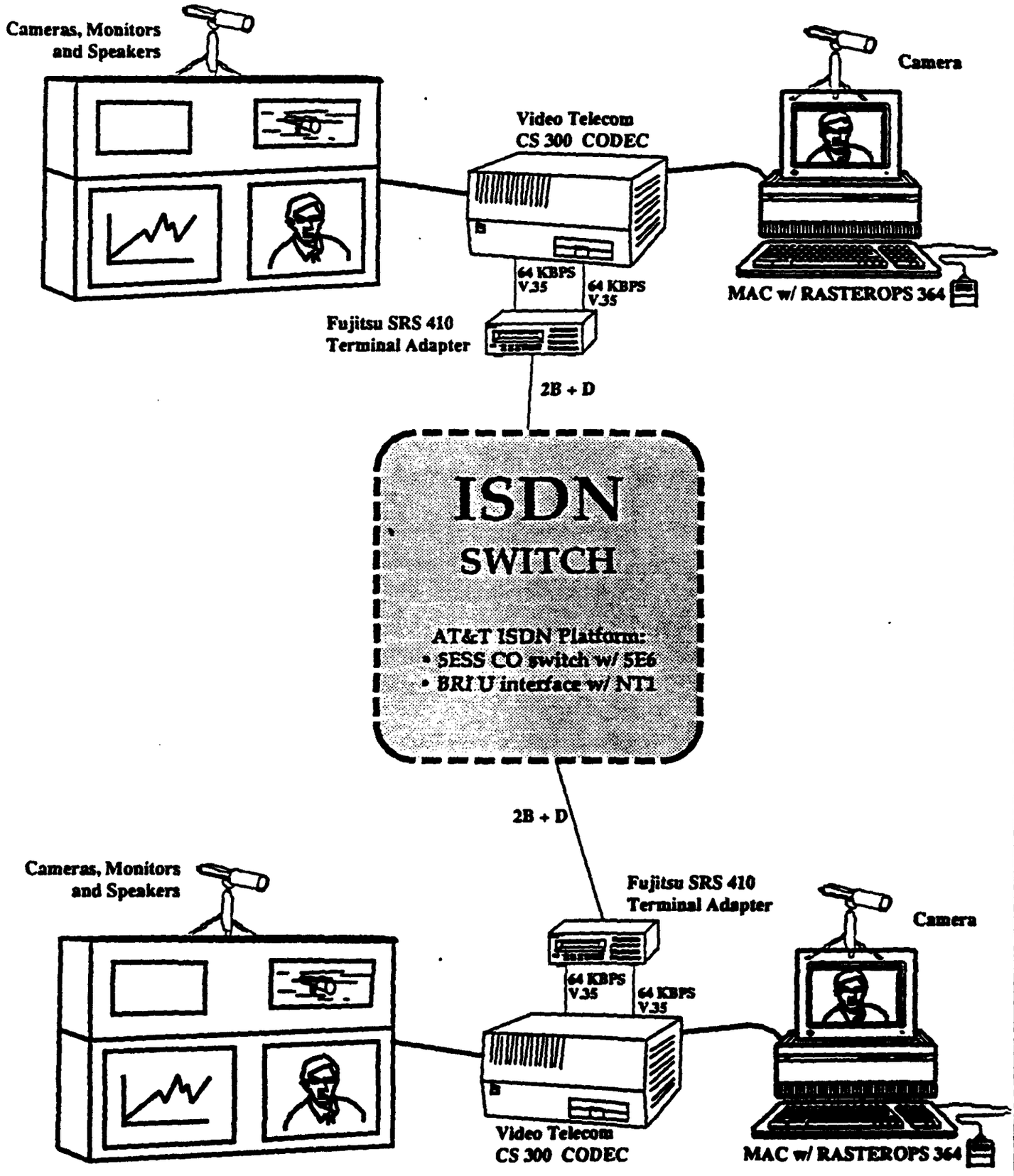


Figure 3.19. Video Conferencing via Macintosh Executive Network



easily as making an ordinary telephone call. Its ability to be implemented on short notice would avoid the special scheduling arrangements for use of teleconferencing centers and for the participants to convene at the centers, potentially from widely dispersed locations on the installation. Second, it will become more economical to implement video-conferencing over ISDN rather than over leased facilities. They noted that under ISDN only the amount of bandwidth used would be charged for, according to a time- and distance-sensitive rate schedule. With leased facilities, a distance sensitive fixed monthly rate would be charged no matter how much or how little the bandwidth was utilized. They noted this as a significant factor since teleconferencing was not a continuous or frequent requirement like voice or data services. Third, they noted that ISDN offered greater connectivity potential for video-conferencing. Parties external to the installation with ISDN links and a compatible video-conferencing system could be participants. This could include other military activities as well as contractors. JRH asserted that the Px64 (or H.261) international standard compatible with ISDN would be an important factor in the future broad ISDN video-conferencing connectivity

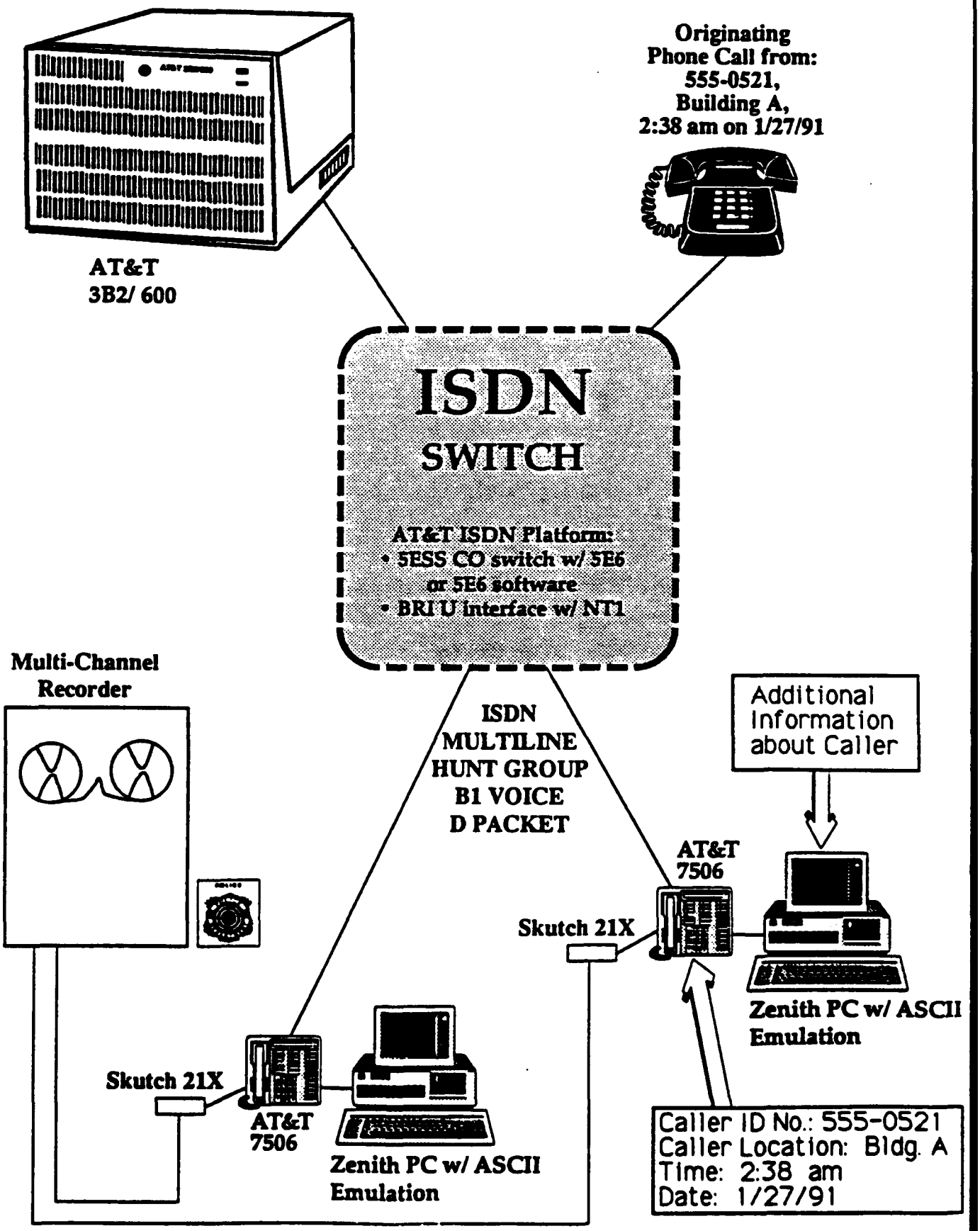
In a quantitative assessment, JRH indicated that Apple computers such as those used in the MacIntosh executive Network can display video using an adapter card costing over $1000. They estimated that new less-expensive computer chips now being pilot tested will wholesale for as little as $85 and allow adapter cards to be built for a wide range of PCs that will cost $300 or less in 1992. They estimated that the costs of video-conferencing through ISDN would be less than $15,000 per PC unit as compared to over $100,000 per conferencing center.

3.2.2.12 Military Police Security

This application is illustrated in Figure 3.20. The application was intended to provide capabilities similar to Enhanced 911 type service, including Automatic Number Identification (ANI) and Automatic Location Identification (ALI), to military police at Redstone. The application employs D channel signalling data to identify the telephone from which a call is received. The number is matched with the electronic directory file to identify the location of the telephone on the installation. Other information pertaining to the caller or the location would be retrieved from computer files and displayed on the PC screen as the call is being answered.

JRH's assessment indicated that the application had been of benefit to the

Figure 3.20. # Military Police Security



military police in handling several incidents.

3.2.2.13 ISDN Attendant Console

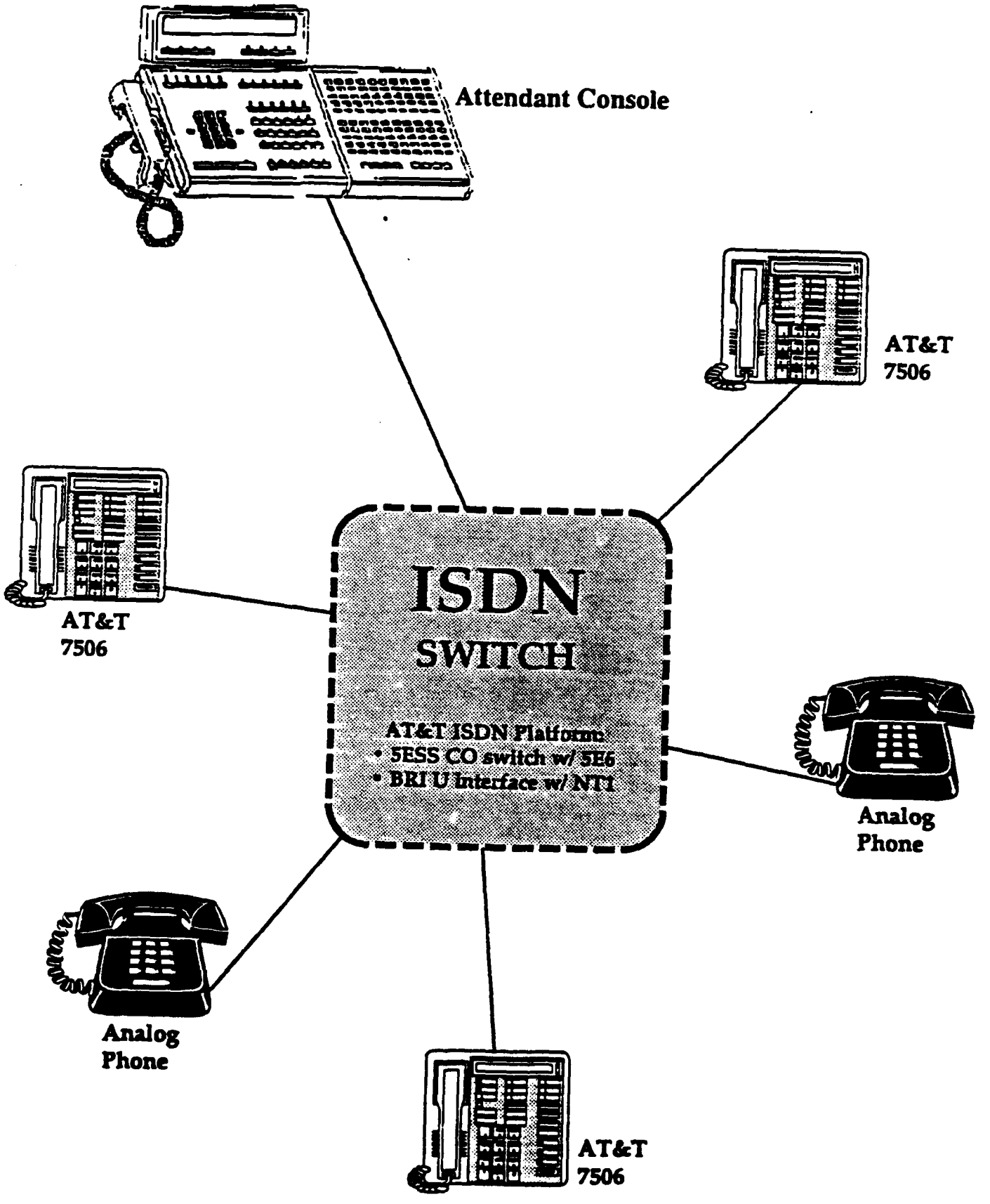
In this application, illustrated in Figure 3.21, the ISDN attendant console replaced the existing 50-B consoles used by the Redstone operators. The application included use of electronic directory and the Auto-dial feature, automated placement of calls in a queue when all operators were busy, and ISDN Station Message Detail Recording (SMDR).

The telephone operators at Redstone hand: over 70,000 calls per month. This includes over 10,000 calls placed to overseas destinations and setting up over 200 conference calls per month. They prepare charge back tickets on some 19,000 (27%) of the 70,000 calls handled. They maintain a directory of all Redstone personnel and almost 5,000 organizational entities. This is accomplished with seven operators.

JRH's assessment indicated very favorable response from the operators. They estimated that the ISDN consoles was several times faster than the 50-B consoles (The operators estimated ten times faster). It permitted the operators to set up conference calls in 2-3 minutes rather than 30-40 minutes under the previous system. The display of the originating telephone number facilitated preparation of charge back tickets and reduced errors in the recording of the numbers.

JRH reported that the ISDN system was also useful in reducing telephone abuse and unauthorized usage. Previously Autovon had been used for calls from various non-office locations such as the post exchange, swimming pool, commissary and mess hall. The ability of the system to display the originating call number enabled such calls to be blocked. Unauthorized use of WATS, at $.14 per minute, was frequent prior to ISDN services because there was no way to charge the calls back to the originators. The ISDN SMDR capability provided a means for detecting and correcting the problem. It saved over $30,000 per month for the first three months after cutover.

Figure 3.21. Attendant Console



3.2.2.14 Current Status

Following the completion of the pilot effort, ISDN services have been deployed on a wider basis. Development and deployment of applications has continued and is still underway. These applications have not been documented as yet. However, the documentation effort is in progress. A copy of the documentation has been requested.

One application of particular interest involves another use of the D-channel to meet military police requirements. Security access sensors and control devices and other sensing devices will be linked via ISDN to military police monitoring stations. This application will employ the D channel packet operation to poll the status of these security indicators with minimal use of the 16 Kbps capacity of the channel. The identity and location of any indicator responding out of its normal status would be displayed at the monitor stations. This application is one of those currently being developed in the ISDN laboratory at Redstone. Further information will be available in the forthcoming documentation.

The ISDN services at Redstone were also being extended to the Strategic Defense Command (SDC) facilities located off the Arsenal premises. There is no information available relating to applications supporting SDC, if any.

3.2.3 Installation Support Modules (ISM) Project

3.2.3.1 Background

The ISM project is an outgrowth of Army efforts from 1978 to 1986 to apply automation to the requirements of installation-level commanders, and their tenants, for management of the numerous operations and functions of an installation. ISM are standard, automated procedures packaged into functional modules which integrate day-to-day installation processes. ISM will be applicable to all Army installations and will support the sustaining base.

ISM has been designated as a major Automation Information System (AIS), although it will not be implemented in the common sense of a system acquisition program. ISM is intended to provide a software versus a hardware solution to installation requirements. ISM applications will utilize and be adaptable to the information systems infrastructures at Army installations.

The ISM Mission Needs Statement (MNS) was approved by the Director of Management, Office of the Chief of Staff, Army (DM, OSCA). The ISM Project was approved to continue the concept development phase at a January 1989 Army Major Automated Information Systems Review Council (MAISRC) Milestone Review. A Project Manager was appointed and PM Charter adopted in February 1989. The ISM Project is under the cognizance of the Program Executive Office for Standard Management Information Systems (PEO STAMIS).

ISM is a very important Army Program with high visibility up to the Office of the Director of Information Systems for Command, Control, Communications and Computers (DISC4) and wide organizational support. DM OSCA is the overall ISM functional proponent. HQDA level organizations (e.g., DCSPER, DCSLOG) provide subject area functional area proponency. USAISC through USA Information Systems Engineering Command (ISEC) Headquarters elements, Information System Software Center (ISSC) and Software Development Centers (SDCS) provide systems engineering, telecommunications engineering, database engineering and software engineering support. ISEC Information Systems Management Activity (ISMA) will also support ISM objectives through IMA programs to modernize LAN, telephone switch, cable plant, and Defense Communications System interface resources. Support is also received from other STAMIS PMOs and USAIRMICS.

3.2.3.2 ISM Functional Description

ISM represents a distributed, shared information system environment.

The heart of ISM is an Installation Level Integrated Data Base (ILIDB). The ILIDB is a shared data base supporting all installation users functional needs in accordance with the standard Army Data Dictionary. Data required for user specific functional applications is accessed through the information processing and communications resources of the installation.

ISM information processing resources include the installation level host processors, including mainframe and minicomputer systems, user workstations and output devices. ISM communications resources include installation level telephone switches and backbone LAN, departmental LANs, dedicated lines and interconnect devices (e.g., bridges, routers, terminal adapters) to support intra-installation data transfer. The ISM communications resources will also support external data transfer to Sustaining Base Information System (SBIS) regional centers to support

other Army STAMIS requirements. Aspects of the ISM information system infrastructure pertinent to this investigation are discussed in further detailing in succeeding paragraphs.

ISM applications software will support all areas of installation management and operation. ISM specifically supports requirements of Process No. 19, Manage Installations, of the HQDA Information Model. The ISM Information Model (IIM) incorporates seven (7) process areas.

- o Plan Requirements (19.1)
- o Direct Resources (19.2)
- o Acquire Personnel (19.3)
- o Acquire Property and Services (19.4)
- o Support Personnel Services (19.5)
- o Support Property (19.6)
- o Monitor Activities (19.7)

The functional requirements of these processes involve thirty-eight (ISMs) covering various functional areas as shown in Table 3-3. These ISMs are further subdivided into a number of specific applications modules. As of December 1990, 45 candidate ISM applications module had been identified and 16 approved for implementation. Half of those approved applications fall under the Personnel ISM (PERS, ISM).

ISM deployment to the large number of individual Army installations worldwide will be a complex process. It will involve deployment of various applications over time at these numerous locations employing varying installation information systems infrastructures, and probably with enhancements of previous deployed ISM overlapping new ISM deployments. Conventional material fielding software installation, and personnel training methods will not be particularly appropriate. Therefore, the ISM Project envisions application of automation techniques for:

- o Remote distribution of ISM applications software
- o Remote software installation Help-Desk support
- o Embedded user training with remote Help-Desk Support

Table 3-3. The ISM Objective Set Functional Classification of ISM

ISM	Functional Area	Installation Manager
CMD.ISM	1. Command Group Functions	Commander and Staff
INSPECT.ISM	2. Inspector General Functions	Inspector General
JAGAID.ISM	3. Legal Support	Staff Judge Advocate
CHAPLAIN.ISM	4. Religious Support	Chaplain
PUBAFF.ISM	5. Public Affairs Functions	Public Affairs Office
INTREV.ISM	6. Internal Review	Internal Review Office
HEALTH.ISM	7. Health, Fitness & Wellness	Health Services
SAFER.ISM	8. Environmental Safety & Service	Safety Office
EQUALOP.ISM	9. Equal Employment Functions	Equal Employment Office
CMDSPT.ISM	10. Command Support	HQ Commander
CPO.ISM	11. Civilian Personnel	Director, Personnel and Community Affairs
CO.ISM	12. Counseling	Director, Personnel and Community Affairs
FAMILY.ISM	13. Family Matters	Director, Personnel and Community Affairs
ED.ISM	14. Education	Director, Personnel and Community Affairs
VOLS.ISM	15. Volunteer Services	Director, Personnel and Community Affairs
AER.ISM	16. Army Emergency Relief	Director, Personnel and Community Affairs
PER.ISM	17. Personnel Management	Director, Personnel and Community Affairs
SECURIT.ISM	18. Information Security	Director of Security
MOB.ISM	19. Mobilization	Director, Plans, Training and Mobilization
TRAIN.ISM	20. Training	Director, Plans, Training and Mobilization
TRAINSPT.ISM	21. Training Support	Director, Plans, Training and Mobilization
PLANS.ISM	22. Plans & Operations	Director, Plans, Training and Mobilization
AVN.ISM	23. Aviation	Director, Plans, Training and Mobilization
RES.ISM	24. Resource Management, Budget	Director, Resource Management
MAN.ISM	25. Manpower	Director, Resource Management
LOGGER.ISM	26. Logistics & Maintenance	Director of Logistics
TRANS.ISM	27. Transportation	Director of Logistics
POLICER.ISM	28. Law Enforcement	Provost Marshal
PHYSEC.ISM	29. Physical Security	Provost Marshal
INFOMGR.ISM	30. Automation and Communications	Director, Information Management
VISUAL.ISM	31. Records, Printing & Publication	Director, Information Management
RESCOMP.ISM	32. Support to Reserve Components	Director, Reserve Component Support
PURC.ISM	33. Purchases & Requisitions	Director of Contracts
CONTR.ISM	34. Contracts Management	Director of Contracts
NONAPP.ISM	35. Non-Appropriated Fund Management	Director of Contracts
FAC.ISM	36. Facilities management	Director, Engineering and Housing
HOUSE.ISM	37. Housing management	Director, Engineering and Housing
ENVIRO.ISM	38. Environmental Support	Director, Engineering and Housing

The information system network to support these processes will be installed, operated and supported at Redstone Arsenal by agreement with PM ISM. This network is discussed further in a later paragraph.

3.2.3.3 ISM Telecommunication Infrastructure

The objective installation information system infrastructure for ISM shown in Figure 3.22 conforms to the objective installation information system architecture previously discussed in paragraph 3.2.1.[3] The ILIDB which supports ISM may be a physically independent data base system or a functionally independent component of other installation level data base systems.

The previous discussion in Paragraph 3.2.1 noted that not all Army installations are now or may in the future be equipped with ISDN capable switches. Telecommunications architecture evaluations for ISM reflect the diversity of the infrastructures within CONUS, European and Pacific installations. The "System Design Plan for the Installation Level Integrated Data Base and Installation Support Modules", dated 28 December 1990, prepared by USAISEC discusses several different telecommunications alternatives that might be employed in various installation Infrastructure configurations.

Installations supported by an ISDN capable switch will employ the capabilities of the switch in conjunction with backbone and local LAN and other communications connectivity resources. Figure 3.23 illustrates a representative installation configuration in support of the ISM application Personnel Locator.[4] Telecommunications support configurations for other ISM applications are comparable.

Current ISM project plans involve deployment of a number of applications modules to eight selected installations. It appears that these installations were selected as being representative of various telecommunications infrastructures within CONUS installations, as well as being representative of various installation missions. Redstone Arsenal was selected as representative of an installation

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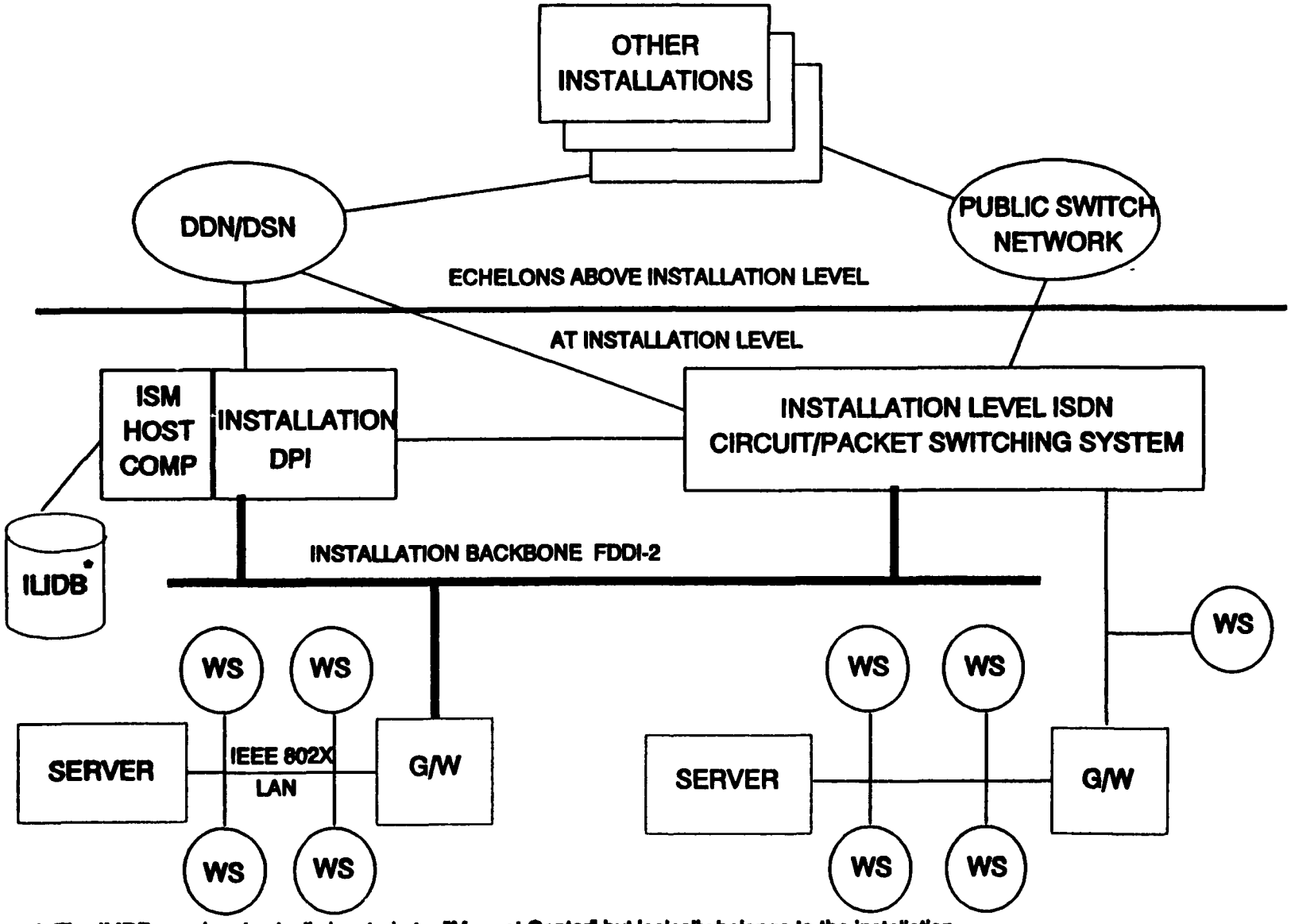
[3] Figure taken from USAISEC Report No. ASQB 90048, "Installation Support Modules (ISM), Attachment J, ISM Telecommunications", February 1991.

[4] Figure taken from USAISEC Report No. ASQ 90048, Installation Support Modules (ISM), Attachment J-A9.20, Personnel Locator, Telecommunications, 31 July 1991. Similar documentation will be prepared for each ISM application.



* The ILIDB may be physically located at a "Magnet Center" but logically belongs to the installation.

Figure 3.22. INSTALLATION NETWORK OBJECTIVE CONFIGURATION

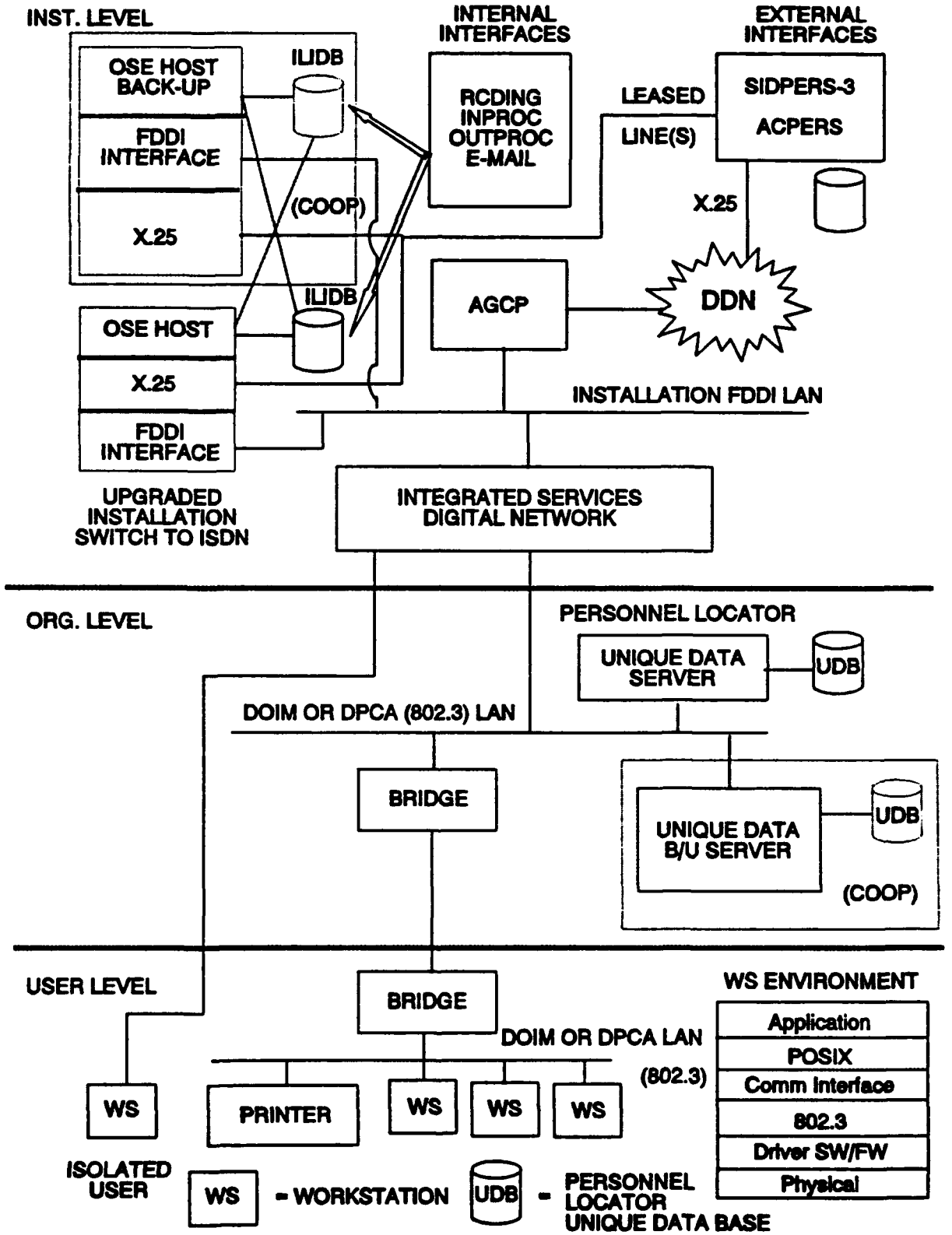


Figure 3.23 TELECOMMUNICATIONS CONFIGURATION FOR PERSONNEL LOCATOR ISM

conforming to the infrastructure shown in the figure.

3.2.3.4 ISDN Employment in ISDN Project

Figure 3.23 indicates that telecommunications support for the Personnel Locator ISM application emphasizes utilization of user level, organizational level and installation backbone LANS. The ISDN switch is envisioned as providing a gateway between incompatible LAN formats and connectivity for isolated users. This is noted for other ISM applications as well. These concepts do not appear to utilize the capabilities afforded by ISDN as noted in the preceeding discussions of PERSINSCOM and Redstone Arsenal/MICOM activities.

It is particularly noteworthy in view of the fact the Personnel Locator ISM implementation in an ISDN capable installation differs very significantly from the implementation of this functionally at Redstone Arsenal, the ISDN capable site chosen for the project. As described in Paragraph 3.2.2.3, Redstone's own implementation is based upon direct user line connectivity to the switch, additionally affording employment of ISDN switch features such as Auto-dial to facilitate the call to the party sought.

The point is that employment of ISDN capabilities in ISM implementation were not noted to be well defined during this investigation. As indicated above, they did not treat the uniqueness functional configurations or performance enhancements that would be possible in an ISDN environment. It is believed that this reflects rather recent consideration of ISDN based environments within the Project. Project documentation up through the December 1990 System Design Plan barely referenced or treated an ISDN-based ISM implementation. However, specific references to ISM implementations in an ISDN environment were noted in the previously referenced ISM Telecommunications Attachment (J) to the ISM Program Management Plan and subsequent first sub-attachments for particular ISM applications published in July 1991.

It would be valuable to follow the ISM deployment at Redstone Arsenal to determine if, and how, the current concepts of ISM implementation in an ISDN capable installation are modified by the deployment. USAISC Redstone personnel (and probably others) who have been involved in Redstone's own ISDN deployment efforts will be supporting the planned ISM deployment at Redstone. Their experience may be influential in any changes to/adaptations of ISM

telecommunications in an ISDN environment.

3.2.3.5 Other Pertinent Aspects of ISM Project

There are a few other pertinent aspects of the ISM Project that merit some discussion here.

a. Group Development Activities - As noted above, the ISM Project involves a number of participant activities throughout the Army. The ISM Functional Description discusses the involvement of a team of representatives from the various activities in the development of Functional Requirements documents for ISM applications modules. It identifies a group activity at a single conference site with support for up to 12 persons and equipped with 6 PCs, a laser printer, telephone, copier and facsimile facilities. It is noted that AIRMICS has provided some assistance through its Group Support Research Program to the ISM Project in the context of the Project's group dynamics aspect. This has included specific linking of AIRMICS, PM ISM, HQDA and USAISEC activities. The addition of Redstone activities as a key participant in the Project would expand this group dynamic. It is an area in which ISDN supported capabilities could prove highly cost effective.

b. ISM Modules Deployment and Training - Through an agreement with PM ISM, activities at Redstone Arsenal will become a significant component of the Project beyond the Arsenal's selection as a prototype ISDN capable installation. Redstone personnel will provide sustained support in the deployment of ISM modules and in the training of ISM users. A CDCnet facility, employing a CDC 830, tied into the Redstone Campus network, will provide a means for distribution of ISM application module software, development and distribution of training packages, and storage and distribution of manuals and all other ISM reference documentation. Training packages will include specific elements for each ISM application screen format. The network will provide a Hot-Line for assistance in

user implementation and employment problems. It will also include Bulletin Board for inputs from the field and information dissemination to the field.

Discussions were held with Redstone personnel responsible for this ISM support during a visit in September 1991. The discussions included explorations of alternatives by which ISDN capabilities at Redstone and linkage to other Army locations through future ISDN capable Government public networks could enhance the ISM distribution and training activity. The primary alternative included connectivity to a Help Desk and a desk-top conferencing and screen-sharing application through which applications installers and/or users could receive specific assistance in a particular problem. This concept was very favorably received.

c. Physical Environment for ISM at Redstone Arsenal

During the September visit, a meeting was held with Redstone information systems personnel who will be directly supporting the ISM deployment there. The specific physical telecommunications support configuration has not been defined. An ISM team survey at Redstone was being conducted the week of the visit. It will provide the basis for the configuration definition. One significant point determined by this visit was that AT&T 3B2 equipment will be utilized for the ISM ILIDB. Another is that the user terminal environment at Redstone is approximately 50% PC and 50% "dumb" terminals supported by UNISYS 5000/95 host equipment. This indicates a mixed environment in which some ISM applications may be employed directly in PC user workstations and others via Unisys host processing.

Discussions included explorations of alternatives by which ISDN capabilities at Redstone and linkage to other Army locations through future ISDN capable Government and public networks could enhance ISM applications. The view was offered by the Redstone personnel that demonstrating ISDN based voice and data desktop-to-desktop interchange including windows applications would tend to accelerate a desirable migration to PCs employment for ISM at Redstone.

3.2.4 Computer-Aided Acquisition and Logistics System (CALS) Project

3.2.4.1 Background

CALS is a major DoD initiative to enhance the system acquisition process through the application of automation technology. CALS is intended to provide the means for improved communication, sharing and processing of system acquisition data between Government activities and industry contractors and between Government activities in a paperless environment. It represents a massively distributed information system environment. The heart of CALS will be a distributed Integrated Weapons Systems Data Base which will incorporate the operational, functional and design data for weapons (and non-weapons) systems. Contractors and Government activities will provide system data (e.g., specifications, designs and drawings, technical documentation) inputs, retrieve data for specific design and acquisition logistics functional applications, and update the system data based on the results of these applications.

Overall oversight of CALS is provided by a DoD management office. The individual Services and DoD agencies have implemented specific programs intended to develop and implement CALS capabilities in particular functional areas (e.g., electronic drawings storage and distribution, publications) or in a complete system framework. The U.S. Army CALS (ACALS) project is the prime example of the latter approach.

Recent decisions have tended to move the CALS Program toward the system level development and deployment represented by ACALS. At a February 1991 MAISRC Milestone 1 Review, the ACALS Project Management Office was directed to begin evaluation and planning to transition the ACALS to meet Joint Service Requirements. A Joint CALS Management office was established to coordinate the integration of Services requirements. In September 1991, a decision was made to consolidate the ACALS and Air Force managed Joint Uniformed Services Technical Information System (JUSTIS) projects. JUSTIS was specifically intended to provide an automated capability for development, distribution, and maintenance of Manuals/Technical Orders.

The distributed architecture of CALS necessitates reliance on telecommunications to support data transport between the Government and

industry contractors and both intra-installation and inter-installation data transport for Government activities. Communications planning and implementation for CALS represents an area of particular significance in this investigation.

3.2.4.2 ACALS

ACALS is presently completing competitive demonstrations between two contractor teams leading to the down-selection to a single contractor for the Basic Capability Module (BCM) deployment phase. This phase included deployment of an initial CALS capability at 5 sites: USA AVSCOM, St. Louis, MO.; Corpus Christi Army Depot, Corpus Christi, TX; USA Aviation Center and School, Ft. Rucker, AL; USA Aviation Logistics School, Ft. Eustis, VA.; and Project Manager, TRADE, Orlando, FL. The deployment will directly support the RAH-66 Commanche/Light Helicopter (LH) Project, the Army's designated CALS pilot project. Following the completion of the BCM validation, CALS will be deployed to the remaining 51 designated Army sites and one (or more) System Operational Support Center (SOSC) sites. These sites will include AMC acquisition centers, TRADOC centers, depots, TECOM sites and other locations of which the Army activities engaged in R&D, acquisition, testing and logistic support of Army systems are located.

Portions of the IWSDB will be located at a number of the system sites. The portions will be functional system and component related (e.g., aircraft systems/subsystems/components, combat vehicle systems/subsystems/components) and located at organizational activities responsible for such functional entities. There will be some overlap in IWSDB data among the sites to minimize the extent of intersite communications necessary for CALS functional performance.

ACALS will employ standard functional software modules that will permit users at various locations to retrieve and process data from IWSDB locations, store new and processed data in the IWSDB, and communicate data to other users within their own or other sites to achieve/support numerous system acquisition processes.

The status of JCALS (i.e., CALS configurations at Air Force, Navy, Marine Corps, Defense Logistics Agency and other defense organizations) is only formative at this time. However, these configurations will be physically functionally similar to ACALS with some differences that will be minor in relation

to the total system architecture. It is estimated that the total number of CALS functional sites will exceed 200 when deployment is completed within all Services/Agencies.

The status of JUSTIS is also undefined at this time as the details of the consolidation with ACALS/JCALS are not yet fully defined. However, the functional processes of preparation, storage, distribution and maintenance of Manuals/Technical Orders are finally resolved between ACALS/JCALS and a redefined JUSTIS project, the result will still be a system operationally/technology similar to ACALS/JCALS in terms of involving a distributed data storage and processing architecture with many, if not most, storage/processing sites in common with ACALS/JCALS.

One of the key operational/functional requirements in both system concepts is the ability to permit communication and sharing of data between users performing related functional processes or in coordinating and approving the results of their functional processing.

3.2.4.3 ACALS Communications and ISDN

The distributed architecture of ACALS (as well as JCALS and JUSTIS) involves a heavy dependence on intra- and inter-site communications. Currently, the ACALS Communications Plan emphasizes the employment of LANS and LAN bridging for intra-site data communications. Inter-site data communications will employ various long-haul Government data networks. This will include DDN and FTS-2000.

With respect to utilization of ISDN services, the current CALS Communication Plans indicates that ACALS will employ ISDN services afforded by FTS-2000. However, it specifically indicates that it will employ only those ISDN services that are generally available from FTS-2000. This portion of the CALS Communications Plan has recently been designated to be upgraded. Subsequent examination of the revisions to the CALS Communications Plan in this area may be worthwhile.

A point worth noting is that ACALS will face the same situation as ISM with regard to the diversity of Communications environments at the sites at which it will be deployed. Specific planning and definition of the employment of the capabilities afforded by ISDN-capable switches at sites where they exist was noted to be

absent from ACALS efforts as it was in ISM communications planning and definitions.

3.2.5 USA Institute for Research in Management Information, Communications and Computer Sciences (USAIRMICS)

3.2.5.1 Background

USAIRMICS instituted an ISDN Experimental facility in conjunction with Georgia Technical Institute. The facility was intended to provide a research testbed for implementation and evaluation of ISDN customer premise equipment (CPE) that may be employed in ISDN applications.

The experimental facility was planned around three separate sites on the Georgia Tech campus to provide a generic connectivity and a variety of equipments that would permit test scenarios simulating many normal user installation environments. The three sites included the AIRMICS office area in the O'Keefe Building, Georgia Tech School of Electrical Engineering Communications and Computer Engineering area, and the College of Computing Networking Laboratory.

The experimental facility was supported by South Central Bell ISDN services.

3.2.5.2 ISDN Research Testbed

The AIRMICS ISDN Research Testbed configuration is illustrated in Figure 3.24. The configuration provides capabilities to investigate ISDN applications and connectivity interoperability issues in varying environments emulating those that may be expected in Army installations.

The testbed is supported by BRI lines from the Bell South Central Office. Six lines are provided from the CO to the College of Computing Networking Laboratory. Two lines are provided to each of the School of Engineering computer cluster and AIRMICS computer room. Three of the lines provide B channel packet switched capabilities, the remainder only provide B channel circuit switched capabilities. The CO switch is an NTI DMS-100.

The AIRMICS and College Computing sites are equipped with Teleos ASK200 Central Office Simulators. These simulate the ISDN services provided by AT&T 5ESS switches. These installations offset the lack of fiber cable between

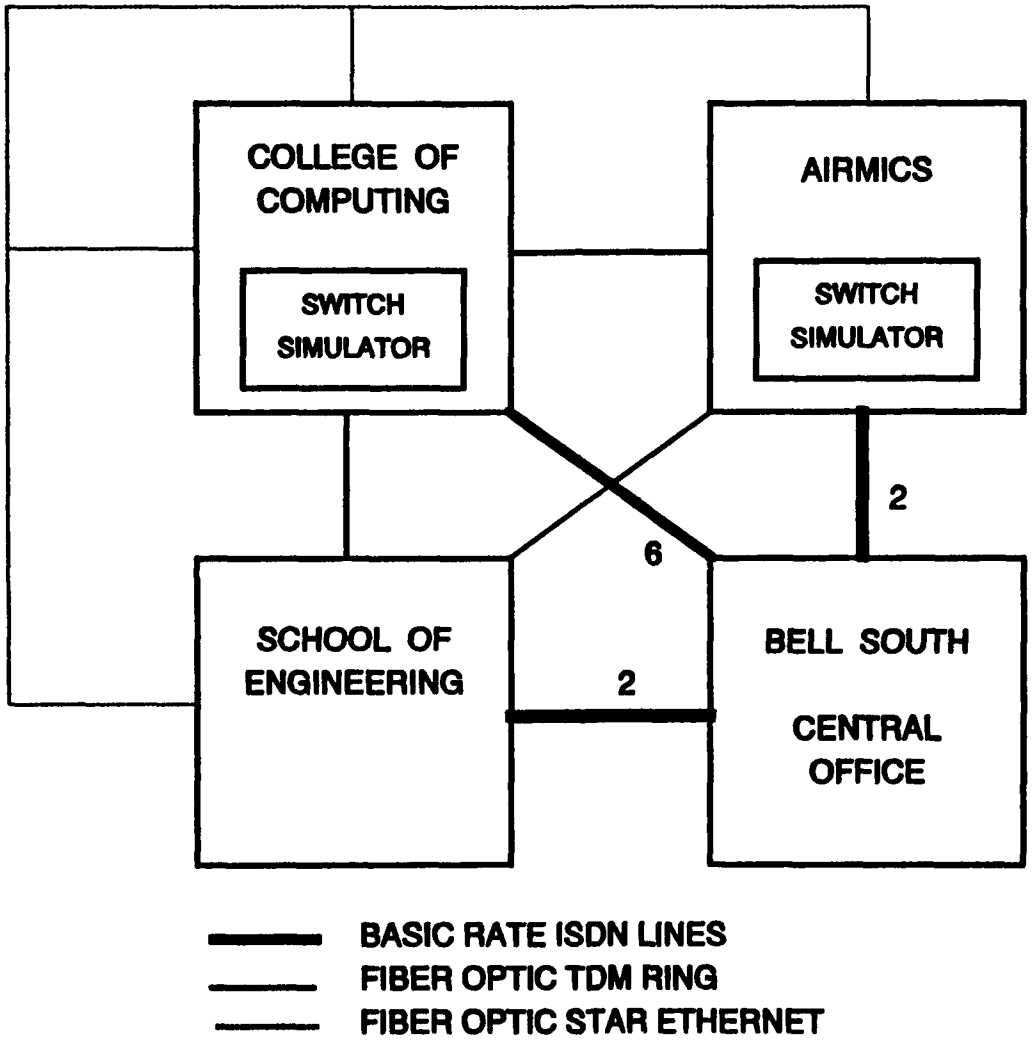


Figure 3.24. AIRMICS ISDN APPLICATIONS RESEARCH TESTBED

the CO and Georgia Tech that could provide a PRI line capability. This capability is provided by optical fiber T-1 carrier line between the switch simulators.

The three sites are also connected via by Ethernet LAN.

The combined configuration of real CO ISDN switch service and simulated ISDN switch services provides capabilities for development and testing of operations and applications in varying ISDN services environments. This includes CO and/or site deployed switches environments that may be found at any installation. In addition, the configuration provides two different ISDN signaling methods as represented by the NTI DMS-100 CO switch and simulated AT&T 5ESS switches. This provides a capability for hook up of any ISDN terminal equipment, terminal adapters or other CPE regardless of switch signaling formats and to test interoperability between the different operations.

This capability was utilized in the hook-up of terminal equipment. Each site included a variety of IBM, IBM compatible and MacIntosh PCs as well as workstation terminal equipment. Several different vendor terminal adapter cards are employed in the IBM compatible PCs. AT&T 7506 telephone sets, with built in terminal adapters, are employed with the MacIntosh terminals.

Various vendor software packages providing phone call logging, directory and automated call placement, and electronic mail delivery were incorporated into terminal equipment.

The AIRMICS terminal environment is shown in Figure 3.25. This testbed configuration is employed to investigate information system architecture issues and alternatives for Army installation level environment.

3.2.5.3 ISDN Application and Environment

The AIRMICS ISDN Research Testbed provides unique capabilities for development, testing and evaluation of ISDN networking issues and applications. As noted above, the incorporation of real CO and simulated switch capabilities permits evaluations of ISDN services in environments including either or both CO and site located services environments. The testbed readily permits configuration to a range of switch support or switch and LAN supported ISDN services environments that will exist at different Army installations.

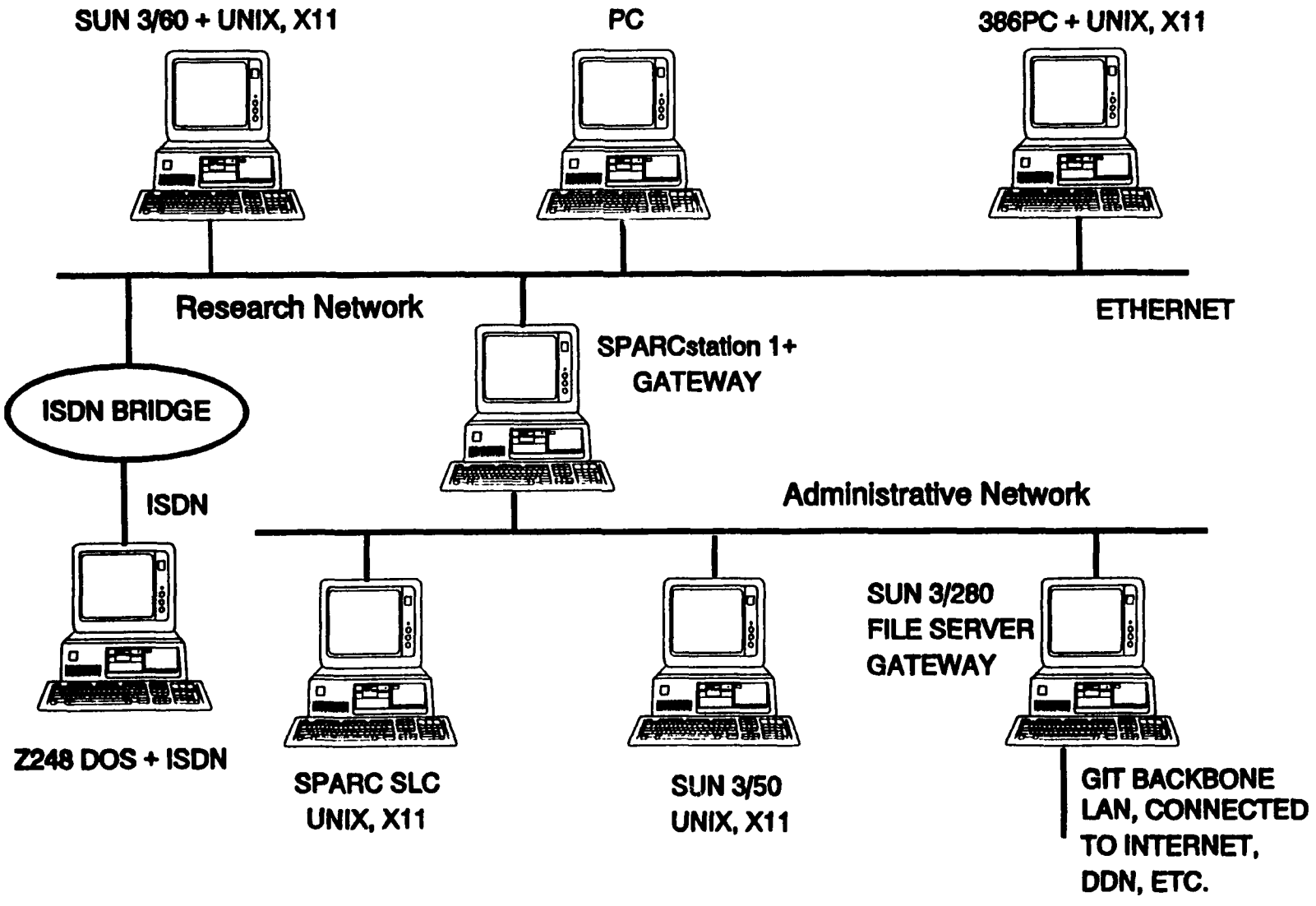


Figure 3.25. AIRMICS ARCHITECTURE TESTBED

3.3 Plans and Programs of Organizations

3.3.1 Jet Propulsion Laboratory (JPL) Advanced Communications Laboratories (ACL) Project

3.3.1.1 Background

The JPL ACL Project was conceived in response to the perceived need for more effective capabilities to support NASA's continuing growing data processing and telecommunications requirements. NASA's total annual data accumulation under its various aeronautics and space programs is expected to exceed 4,200 terabits per year by the end of the decade. A major portion of NASA programs involve extensive intra-Center, inter-Center and Center-Headquarters data sharing, processing and communications. Thus, a corresponding continuing increase in bandwidth requirements for NASA networks was projected. The ACL Project was initiated as an approach to meeting these increasing bandwidth requirements cost-effectively through advanced telecommunications technologies.

ISDN was the first major advanced communications technology to appear on the horizon that offered the basis for initiation and realization of the project objectives as well as a basis for expansion into future technologies. The future technologies of interest include frame relay, Switched Multi-Megabit Data Services (SMDS) and Broadband ISDN (BISDN), all progressing toward an ability to route data traffic at speeds of gigabits per second.

3.3.1.2 ISDN Test Bed

JPL implemented a test bed configuration for deploying Basic Rate ISDN services in October 1990. The test bed lines were provisioned by Pacific Bell (PacBell) through a Northern Telecom DMS 100 switch dedicated to the JPL campus. The ISDN capability was interfaced to the JPL Institutional Local Area Network (ILAN) and existing telecommunications structure.

The test bed was initially configured to demonstrate functionality and compatibility with the existing JPL telecommunications infrastructure. The elementary test suite was employed to demonstrate:

- o ISDN to ISDN voice via NT 5317 telephone instruments.
- o ISDN to Plain Old Telephone System (POTS) voice via NT 5317 to existing phones.
- o ISDN to ISDN 19.2 Kbps synchronous data.
- o ISDN to ILAN Harris Terminal Adapter 19.2 Kbps synchronous data and vice versa.
- o Synchronous 64 Kbps Cisco router to Cisco router - TCP/IP
- o Synchronous 64 Kb/s Ungerman Bass bridge to UB bridge - Ethernet XNS
- o ISDN to switched 56 Kbps and vice versa.

The results of these tests have formed the basis for planning for development, demonstration and evaluation of ISDN services applications.

3.3.1.3 ACL Project Laboratories

Experience gained, both procedurally and technically, about implementing and evaluating ISDN applications led to the implementation of three different laboratories to support continuing ACL project efforts. These include:

- o Configuration Analysis Laboratory
- o Prototype Laboratory
- o Demonstration Laboratory.

3.3.1.3.1 Configuration Analysis Laboratory

The Configuration Analysis Laboratory is intended to provide a means to test, evaluate and document ISDN related products loaned to JPL by vendors for this purpose. The laboratory functions both as a means of increasing JPL's knowledge base on advanced telecommunications technology and products and as a vehicle for assessing products that might be deployed in its own networking infrastructure.

The laboratory consists of 6 work areas. Each provides various communications media including twisted pair digital, twisted pair Ethernet, thin net coaxial BNC Ethernet, broadband RF and fiber optic cable. Bridge devices also

connect the laboratory to existing telecommunications infrastructure.

Under an agreement with PacBell, JPL will be provided information on advanced communications technologies and products that may be evaluated in the laboratory. Product evaluation data will be provided to PacBell in the same manner as to other vendors which submit products for test and evaluation. One of the particular arrangement will focus on use of the laboratory as a formal test site for frame relay and to evaluate SMDS.

3.3.1.3.2 Prototype Laboratory

The Prototype Laboratory is intended to provide an environment to beta test ISDN related products and applications. The laboratory efforts will examine issues related to implementation and employment of the products and applications in operational configurations.

The laboratory contains 4 work areas with communications media and bridges to the JPL network similar to that in the Configuration Analysis Laboratory. The work areas support operational configurations of applications being prototyped for implementation in the JPL environment. Typically the configurations included both send and receive sides of the prototyped applications.

3.3.1.3.3 Demonstration Laboratory

The Demonstration Laboratory is intended to serve as a self-teaching facility to "assist" potential advanced communications applications in gaining user understanding and acceptance prior to their deployment within the JPL operating environment. The intent is to develop user understanding and acceptance of the applications and, thereby facilitate their introduction.

The laboratory contains contemporary and permanent exhibits pertaining to selected advanced communications applications planned for implementation. It is designed for unguided movement of visitors through the laboratory. There are two types of exhibits. The primary exhibits consist of real-time operational configurations of applications which have been implemented and scheduled for deployment and applications which have been prototyped. These exhibits include story board formats and "press to play" video and digitized recordings operating over the technology/application being demonstrated. The second type of exhibits

are story boards explaining the next planned prototype implementation. The laboratory is organized so that visitors flow from the impending to future technology applications demonstrations.

Configurations in the laboratory may also provide an operational functionality to an adjacent lecture hall and teleconference center. This supports the internal introduction of applications within JPL and its commitment to a continuing involvement with other elements of academia, government and industry to the development and promotion of advanced communications networks technology.

3.3.1.4 Major Developments and Demonstrations

An ACL Project management and staff analyses of potential technology applications determined that the most significant step that should be undertaken was implementation of office or networking functionality at a remote location.

JPL is now developing and demonstrating this application. It is intended to provide the identical functionality of an Ethernet LAN through the ISDN switch. This application is being implemented within the normal geographical service limitations of the ISDN switch at the JPL campus. Although it is not planned for the subject demonstration, JPL analysts have determined that the capability could be extended to remote locations outside normal switch service area limits through the use of Brite technology. Brite provides for extended loop lengths over copper wire media up to miles from the local office. PacBell offers this capability under existing tariffs at $100 per month per line with a minimum of 8 lines service.

A case study of this application is being prepared for presentation at the upcoming Telecommunications Society of America conference. It will include a cost comparison of the application vs a conventional Ethernet LAN configuration. A copy of the case study will be provided for reference in this investigation.

One of the reasons given for the high value placed on this application is purely subjective. The position is that it is viewed as a very basic functionality that users have come to understand and accept in conventional LAN functionality. Thus, it is viewed as being very basic in facilitating user migration to other ISDN based functionalities.

A successor to this application will involve implementation and demonstration of other remoted services normally associated with LAN based

configurations and host processor support. These will include remote servers for sharing of automation resources and applications. Remote E-Mail services are also planned. It is also planned that these functionalities will be demonstrated to Australian telecommunications authorities. Further information on these applications will be requested from JPL.

JPL is also investigating acquisition and development of applications based upon an ISDN interface board developed for the Army's Personnel Information System Program. This board will be discussed in connection with that program.

JPL plans include a major participation in the Transcontinental ISDN Project '92. The director of the ACL project will be the co-chairman for this endeavor. The project is planned to provide a national exhibition of transcontinental ISDN uses in November 1992. The ACL will be used to develop applications for the exhibition.

3.3.2 Base Information Digital Distribution (BIDDS) Project

3.3.2.1 Background

BIDDS is a major component of the Air Force Model Base Program. The Model Base Program is intended to provide operational evaluation and validation of communications-computer systems concepts, systems, procedures and applications. It emphasizes real-world testing in an operational base environment to determine factual cost versus operational mission benefit information. This information is to be used as initial decision support for potential new Air Force standard systems/ requirements, proposed modifications to standard systems/ requirements contracts and current/new Air Force communications-computer systems initiatives.

The program was initiated in 1984 at Mather AFB to foster creative communications-computer systems technology usage. In 1986 the focus changed to one of validating Air Force communications-computer systems architectures. In 1990 the program was moved to Barksdale AFB with its current focus.

BIDDS is one of 20 projects under the Model Base Program. It is a key project in that it provides the telecommunications architecture to support and implement other project objectives. One of these other projects is Fee-for-Service; that is, direct user fees for communications and computer services as utilized. This is comparable to similar objectives of the Army Automated Information

Management Environment (AIME) Project.

BIDDS provides one or more ISDN capable switches as one of the primary means of intra-base and external communications. Other communications network components include standard ULANA and non-ULANA LANS, Land Mobile Radio (LMR) systems, and interfaces to Air Force and DoD networks.

A key factor in the Model Base Programs and BIDDS project is an Air Force decision to consolidate data processing capabilities into a number of regional processing centers. (This would be comparable to the Army limiting its major data processing capabilities to SBIS.) Thus, BIDDS switches become the major interface between base information systems users and regional processing centers.

3.3.2.2 Existing Basewide Information Transfer Infrastructure

The existing base-wide information transfer architecture is comprised of analog, digital, and radio frequency transmission media. Each media was installed, and later upgraded or modified, to satisfy stated requirements in support of a program. Since the funding for each program was independent, it was extremely difficult to coordinate base-level information connectivity requirements with other programs such that resource conservation could have been achieved.

The basewide architecture was further fragmented by the delineation of switched and nonswitched services. Switched services include transmission, switching, processing, systems, control and network management equipment, systems, and facilities supporting the general base population. Non-switched services meet the same description as switched services however they generally support the command and control function on base and are segregated from switched services within the infrastructure.

A standard base is supported by a telecommunications distribution facility comprised of at least one PBX, with possibly several RST's. These switching facilities provide support through copper cable plants and are interconnected to one another through high speed fiber optic or copper cable circuits. Even when the main exchange on base is digital, it, like many of the RST's, supports an analog user base with plain old telephones (POTS) and circuit switched services. The base populous generally receives modem-to-modem, dial-up modem, analog, and limited digital voice services, all of which do little to harness the capabilities of that switching hardware.

A typical base has several LANs which support specific areas of interest. Each area of interest is often confined to a building, or building cluster, and user terminals on the LAN are interconnected through fiber optics or coaxial cables. LAN's often support remote users through dial-up or dedicated ports configured with modems. In many instances, LANs have been interconnected through bridges and routers over the telecommunications distribution facilities. In general, user applications generate slow rate, burst data that is well suited to the packet transfer methods used within the LAN information transfer architecture.

Every base is supported by many networks of portable and mobile radios which comprise the Land Mobile Radio (LMR) system. LMR users are separated into well defined user groups called networks, through radio frequency allocations. Only a few networks have telephone interconnect features which allow dial-in or dial-out access. At this time only voice services are supported over the RF portion of the information distribution architecture.

The existing copper cable plant which presently supports the telecommunications system is old and, on many bases, in need of upgrades. Transition to the single line concept will be costly in terms of black cable (intra-base) and gray cable (intra-building). The zonal concept, with increased use of RSTs, will offset some of that cost. Most of the uses of the telecommunications assets are those of analog, circuit switched voice calls, as well as modem-to-modem, and dial-up modem data applications. As a result of BIDDS a limited ISDN capability will exists for digital voice and data applications. Intra-base use of fiber optics is limited due to the cost of burial and conduit projects. Its most widespread use is that of organizational LANs used to connect computers on a floor, or within a building. LANs are often bridged or tied together through high speed analog circuits such as T-1 spans. Fiber optics are also used to connect the main telephone exchange with each RST or PBX on base.

The number of frequencies in the electromagnetic spectrum for each base to use for LMR nets is limited. The number of LMR nets on a base often approaches twenty and expansion is difficult due to the limited quantity of frequencies available. The predominant use for these networks is voice calls. New, trunked radio systems are available and implemented at some bases. These trunked radios time-share the available frequencies and networks are established through software as common user groups.

3.3.2.3 Model Base/BIDDS Information Transfer Infrastructure

The existing Model Base/BIDDS information transfer infrastructure is illustrated in Figure 3.26. It makes use of the existing telecommunication distribution, including zonal RSTs and PBXs and copper cabling plant, and incorporates the capabilities afforded by the BIDDS ISDN switches. Current BIDDS switches allow circuit switched ISDN voice and data. Actions are currently in progress to upgrade the switches with X.25 packet handler capabilities. This is intended to provide the means for evaluation and verification of performance enhancements and cost savings that are expected with this capability.

The Model Base/BIDDS infrastructure after the packet handler capabilities are implemented will evolve to the configuration illustrated in Figure 3.27.

Distribution of voice/data service at the base-level will be via BIDDS. Utilization of existing POTS, RSTs and PBXs under the zonal concept will be phased out as progress is made toward the single line concept. All future RST and PBX systems upgrades will be fully ISDN capable. ISDN capabilities at the base level will be implemented in accordance with the ISDN Operational Concept (ISDN OPSCON) formulated by the Air Force Model Base. ISDN dual voice/data capable customer premise equipment will be used at locations where modem requirements exist. Common users will receive D-channel access (16 Kbps) and high data rate subscribers will receive B-channel rates (64 Kbps). Bridging of LANs to the ISDN will be accomplished through B-channel access (64 Kbps) ISDN packet services. All End Office, RST, and PB exchanges will be interconnected via primary rate (1.544 Mbps) ISDN links.

Standard networking hardware within the Air Force includes the AT&T 3B2 600G running a TCP/IP based application. X.25 packet transport throughout the LAN is accomplished via ULANA cables, bridges, and routers. The gateway to external networks is through the 3B2 host computer on an 802.3 LAN interface, or through a 64 Kbps synchronous or an 802.3 LAN interface, or through a 64 Kbps synchronous or 38.4 Kbps synchronous ports. To interface 3B2 based networks to the ISDN, the 3B2 will convert the IP address to E.164 (X.121) addressing schemes.

The radio frequency portion of the base communications-computer infrastructure will be integrated through directed basic rate ISDN services or modem pool access to the ISDN. Data capable radios will extend data networking

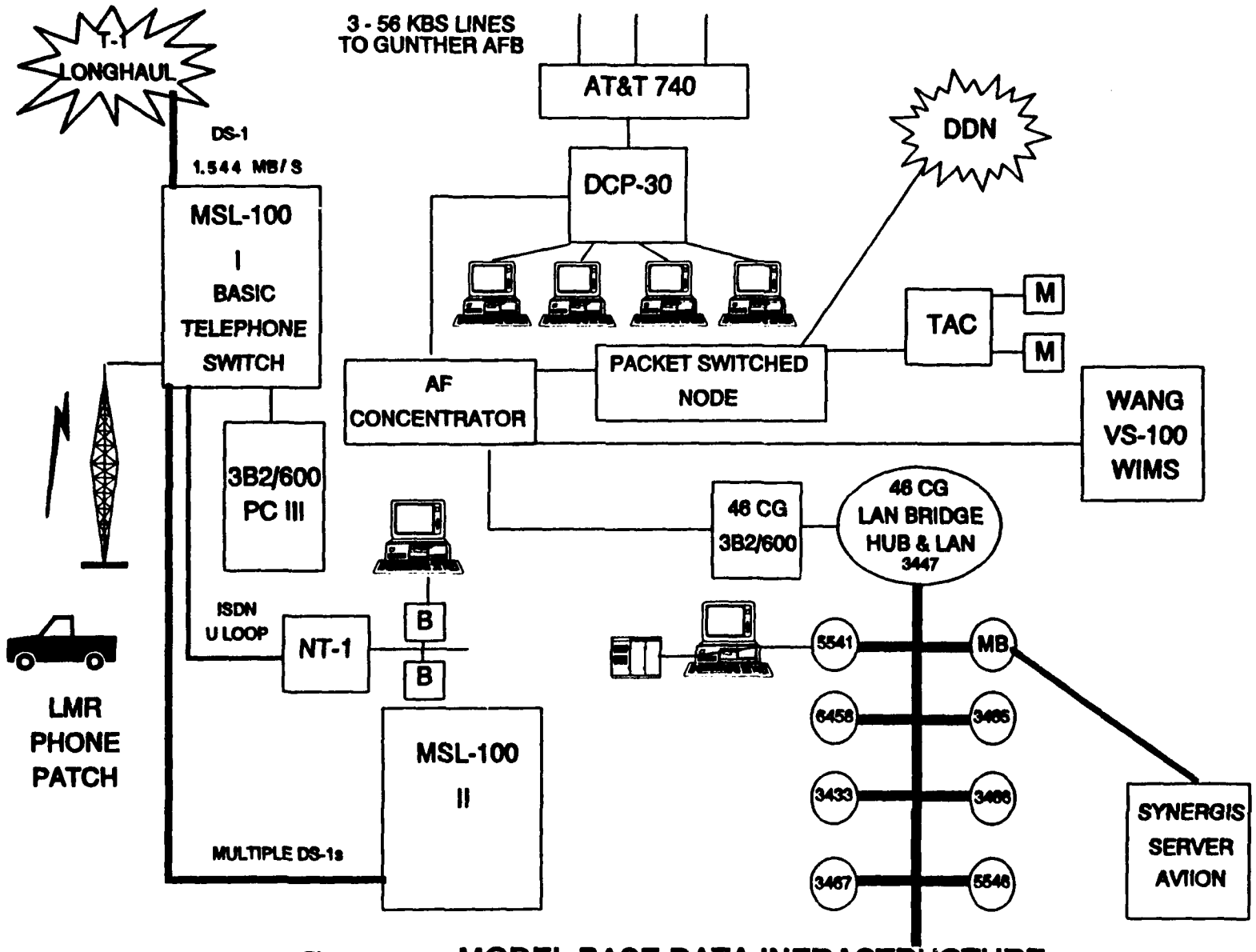


Figure 3.26 MODEL BASE DATA INFRASTRUCTURE

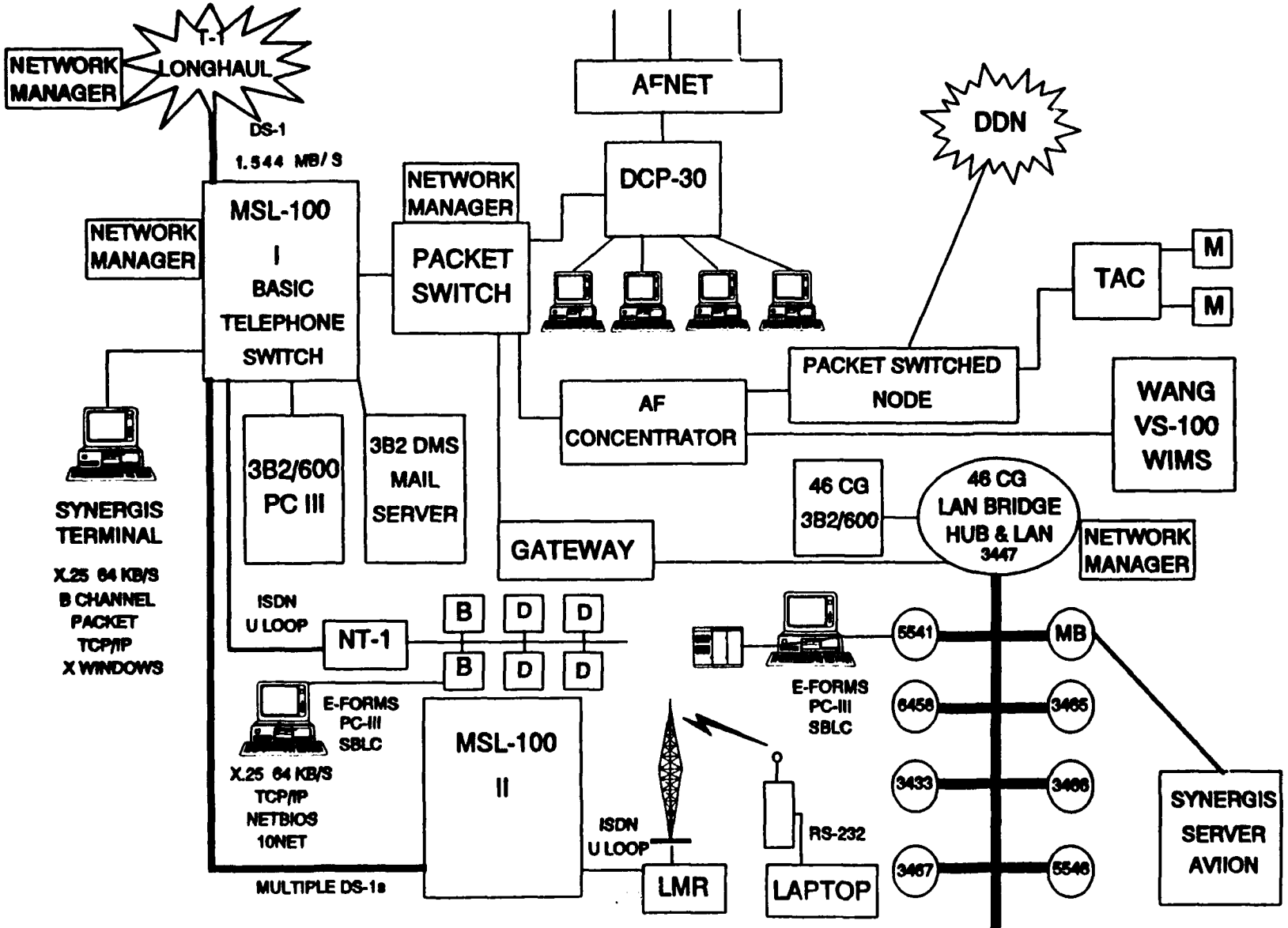


Figure 3.27. MODEL BASE DATA INFRASTRUCTURE FUTURE

capability to existing Land Mobile Radio (LMR) users.

LAN users will have the available bandwidth associated with their LAN distribution method. Data rates starting at 64 Kbps, and up to 1.544 Mbps will be possible over the intrabase telecommunication backbone. Stand alone users will be able to transfer information beginning at 9.6 Kbps up to 1.544 Mbps depending on their terminal and application.

As a result of post independent information system program procurements, users have been forced to pirate separate computer systems for each program. Under a packet environment, implemented using an Open Systems Architecture approach, there will be an evaluation toward a single terminal to be used for all applications.

3.3.2.4 Model Base/BIDDS ISDN Capabilities Applications

The Model Base/BIDDS configuration at Barksdale AFB includes the two BIDDS ISDN switches shown in Figure 3.27. The central BIDDS switch was initially implemented with 52 installed BRI lines. An additional 750 BRI lines will be installed over the next year. The second BIDDS switch with 150 BRI lines will be installed during the year. The ISDN packet handler to be implemented will be capable of interface with NTI and AT&T ISDN (LAPB and LAPD), commercial X.25 and DoD TCP/IP and ULANA 802.3 protocols.

As previously noted, a major factor in the Model Base/BIDDS program is the current Air Force direction in restructuring its operations, under Defense Management Review (DMR)/Corporate Information Management (CIM) initiatives, to consolidate base level processing to regional processing centers. This places a major emphasis in Model Base/BIDDS activities to offset the limitations caused by the loss of local processing installations. Major thrusts are directed at implementing Server based applications directly interfaced to the central BIDDS switch. Three current server applications planned include:

- o Forms/Publications Server
- o Mail Server
- o File Server

These applications will employ 3B2 equipment.

The Forms/Publications server application will be used to evaluate ISDN as an alternative to dedicated lines and modems for distribution of print material generated at regional processing centers to printers throughout the base. The switch to server interconnect will be over a BRI line with server to printer interconnect at X.25 rates.

The Mail Server application will evaluate ISDN as a means of supporting Defense Messaging System objectives. This will include X.400 functionality and use of ISDN X.25 packet as a distribution approach for writer-to-reader E-Mail.

The File server application will evaluate ISDN as an alternate to dedicated lines and modems for user access to regional processing centers for base processing support requirements.

Other applications of the capabilities of the BIDDS switches are planned or in initial planning for intra-base employment. These include:

- o ISDN as an alternative to X.25 LANS
- o Automation of base level audio-visual functions and teleconferencing.
- o Utilization of ISDN Caller ID features to extend current fee-for-service for data processing services to all communications-computer system services.

3.3.2.5 Model Base/BIDDS Evaluations

Model Base Program evaluations are normally conducted within a 6-12 month window. Results of the evaluations are intended for immediate reporting, export to other Air Force employment, and use in validating requirements and/or preparing specifications for new Air Force communications-computer systems standards and standard components.

The results of the Model Base/BIDDS evaluations should be monitored for reference by the Army in defining and implementing ISDN-supported Army installation level applications.

3.3.3 FTS-2000

3.3.3.1 Background

The FTS-2000 Project was initiated by the General Services Administration in the mid-1980's to provide standard common carrier telephone network services to Government agencies that would satisfy other than specialized information resources needs. Contracts were awarded in 1988 to two common carriers, AT&T and SPRINT for FTS-2000 services. The networks operated by these carriers are referred to as Network A and Network B, respectively. Individual agencies are assigned to either network in accordance with a plan to maintain a specific percentage traffic distribution between the networks at the time of the 1988 award.

The Army is assigned to AT&T Network A.

3.3.3.2 FTS-2000 Services

FTS-2000 was initially intended to provide switched voice services.

The services provided to users have been expanded. Currently Switched Data Services (SDS) and Dedicated Transmission Services (DTS) are available. Compressed Video Transmission Services (CVTS) are planned but are not yet provided on the networks. Its inclusion would require specific requests for the service from user agencies.

3.3.3.3 FTS-2000 ISDN Services

Earlier this year ISDN Services were introduced in FTS-2000. It is currently available on Network A and should be available on Network B shortly. Currently only Circuit switched voice and data services are available. ISDN Packet Service is not available on either network yet. It will be incorporated when user agencies request it.

ISDN PRI service can be provided to any user agency with an ISDN compatible PBX via a T-1 carrier to the PBX. Currently approved PBXs include AT&T Definity 75 and 85 models, NTI SL-1 and SL-100 models. The NEC 2400 PBX was expected to be approved in October 1991.

FTS-2000 does not provide ISDN BRI services. In addition, the full scope of ISDN services are not available through FTS-2000 even to users with fully capable ISDN PBX/switch facilities. Since Caller ID data is not passed along in FTS-2000, those inter-site capabilities that utilize this data will not be possible.

At this time, it is impossible to predict the extent to which future modification/expansion to the FTS-2000 ISDN services offered may be required to remove the limitations noted above. Further, no information was available regarding any objectives or plans for FTS-2000 to conform to specific National ISDN-1 standards which are evolving at this time.

3.3.4 National Institute of Science and Technology (NIST)

3.3.4.1 Background

NIST maintains an active program related to the furtherance of ISDN technology and applications development and deployment. This is accomplished through sponsorship and management of the North American ISDN Users' Forum, maintenance of an ISDN test-bed environment and sponsorship and participation of the Transcontinental ISDN Deployment Project (TRIP) for the Fall of 1992.

3.3.4.2 North American ISDN Users' Forum (NIU-F)

The NIU-F provides a national level forum and clearinghouse for ISDN technical issues, conformance standards, implementation agreements and applications approaches for the spectrum of ISDN services suppliers, ISDN services equipment and CPE vendors, and Government and industry users. It maintains a number of standing work groups in each of these areas. It provides periodic national meetings to present the work and recommendations of these groups and individual NIU-F participants to the ISDN-interest community.

A major effort of the NIU-F is joint sponsorship and participation with the Corporation for Open Systems (COS) in developing, implementing and demonstrating nationwide ISDN capabilities. A primary example is its involvement in the definition of National ISDN-1 service capability which is expected to be completed by October 1991. It will continue its joint involvement with the COS in the sponsorship of the TRIP which will implement nationwide National ISDN-1

capabilities by October 1992 and begin demonstrating these capabilities in November 1992. NIST/NIU-F will coordinate the technical aspects of TRIP while COS will carry out the administrative functions.

NIST plans for TRIP participation are discussed in a later paragraph.

3.3.4.3 NIST ISDN Test Bed

NIST maintains an ISDN Test Bed employed for analysis, demonstration and evaluation of ISDN services, vendor products and system applications of ISDN services.

The NIST testbed is supported by eight Centrex BRI lines from a Central Office. The lines are provided to separate buildings in the NIST Campus, and two locations within one of the buildings. Figure 3.28 is illustrative of the configuration at NIST. The ISDN services provide terminal-host, terminal-terminal, and LAN bridging capabilities for various product and applications tests.

3.3.4.4 Transcontinental ISDN Deployment Project (TRIP)

A major effort is now underway to plan, design and implement a NIST technical system as a participation activity in TRIP. This NIST participation in the TRIP is intended to demonstrate:

- o A node which conforms to ANSI T1 ISDN definitions and other related NIU-Forum Agreements, including selected Application Profiles from the NIU-Forum suite of Application Profiles and conformance tests defined by the NIU-Forum.
- o A general information access capability, with universal, transparent multi-media information access across a geographically distributed system, possibly supporting several different user application domains.
- o OSI communications in ISDN environment.
- o Security and protected operations, including secure voice and data conferencing and secure facsimile and network security services.
- o Network management, including display of managed object alarms and monitoring, and definition of managed objects for secure network

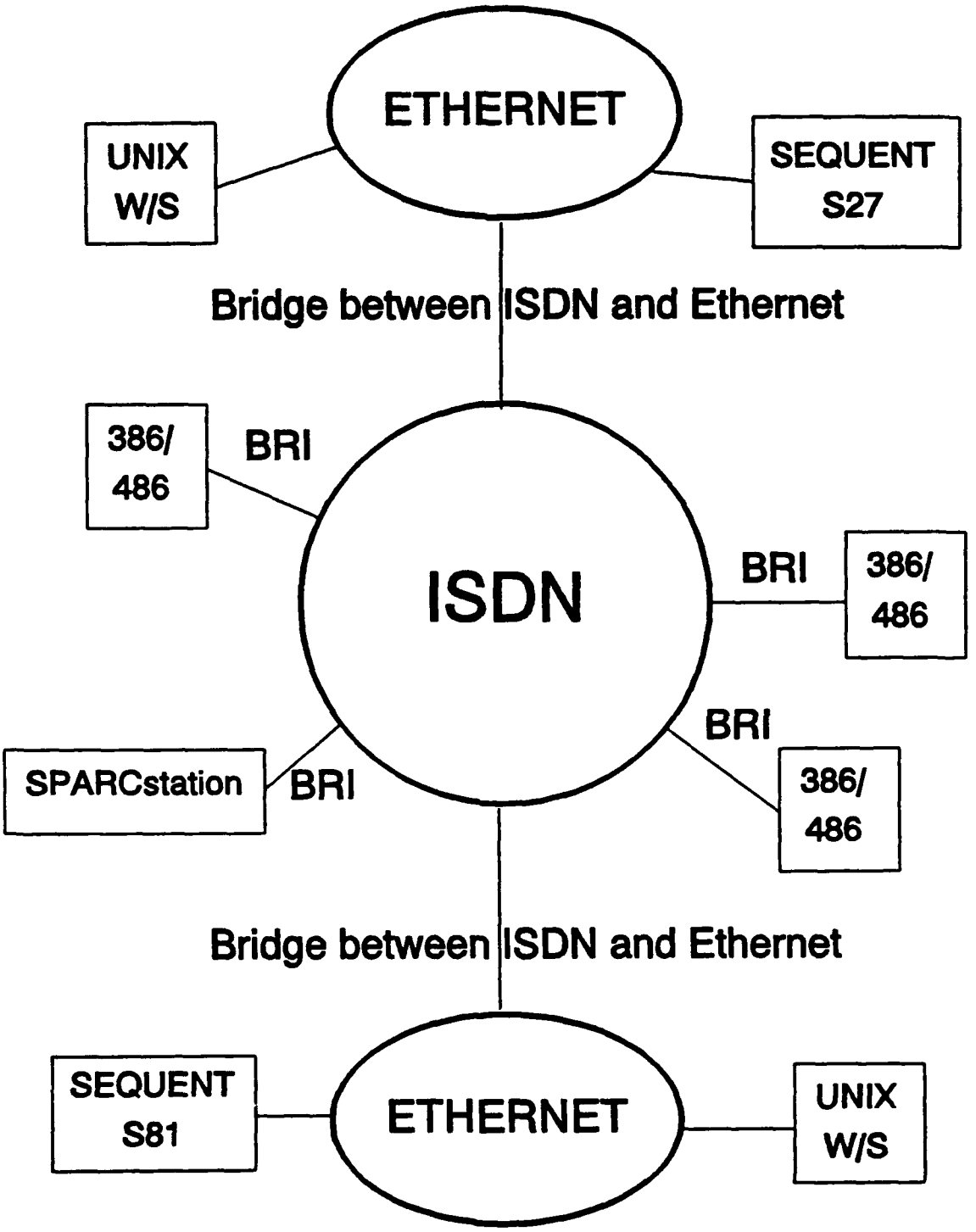


Figure 3.28. ILLUSTRATIVE NIST ISDN TEST BED CONNECTIVITY

management.

- o ISDN over satellite.

NIST planning is still formative at this time. However, it is divided into two aspects. Systems/Infrastructure and Applications. The former is focused on providing expanded NIST ISDN resources and access with sufficient functional capability for PRI and BRI services, including circuit switched and packet services, to support a broad range of network management and technical applications in the applications aspect.

The desired physical system infrastructure is illustrated in Figure 3.29. It would add a remote switch capability at the NIST Campus with PRI and BRI services. CPE would be included to provide dynamic service configuration on B-channels (similar to that described previously for USAPERSINCOM/PERnet) and network management features. The remote switch would maintain its connectivity to the CO switch currently serving the testbed to provide the exterior nationwide network connectivity objectives of TRIP. PRI service would be extended to ISDN capable PBX(s) of NIST TRIP collaborators (e.g., Government agencies, commercial corporations, universities). Lastly, it would include an interconnect of the NIST remote switch with a satellite communications system with capability for BRI (and PRI) services.

The system infrastructure and applications will conform to OSI data communications protocols.

NIST plans include implementation and demonstration of numerous applications. All will represent User Application Profiles coordinated through the NIU-F processes. A listing of currently envisioned applications is provided below. For those which have gone through the NIU-F User Application Profile process, the reference Profile number is included. Whether particular applications are implemented will be contingent upon the availability of commercial CPE/software products compatible with NIST TRIP equipment.

a. Stable NIU-Forum User Application Profiles

- o 810004.0 Data Conferencing (Point-to-Point)
- o 810005.0/840023/-24/-25 Incoming Call Mgmt.
- o 960029.0 ISDN Station Event Recording

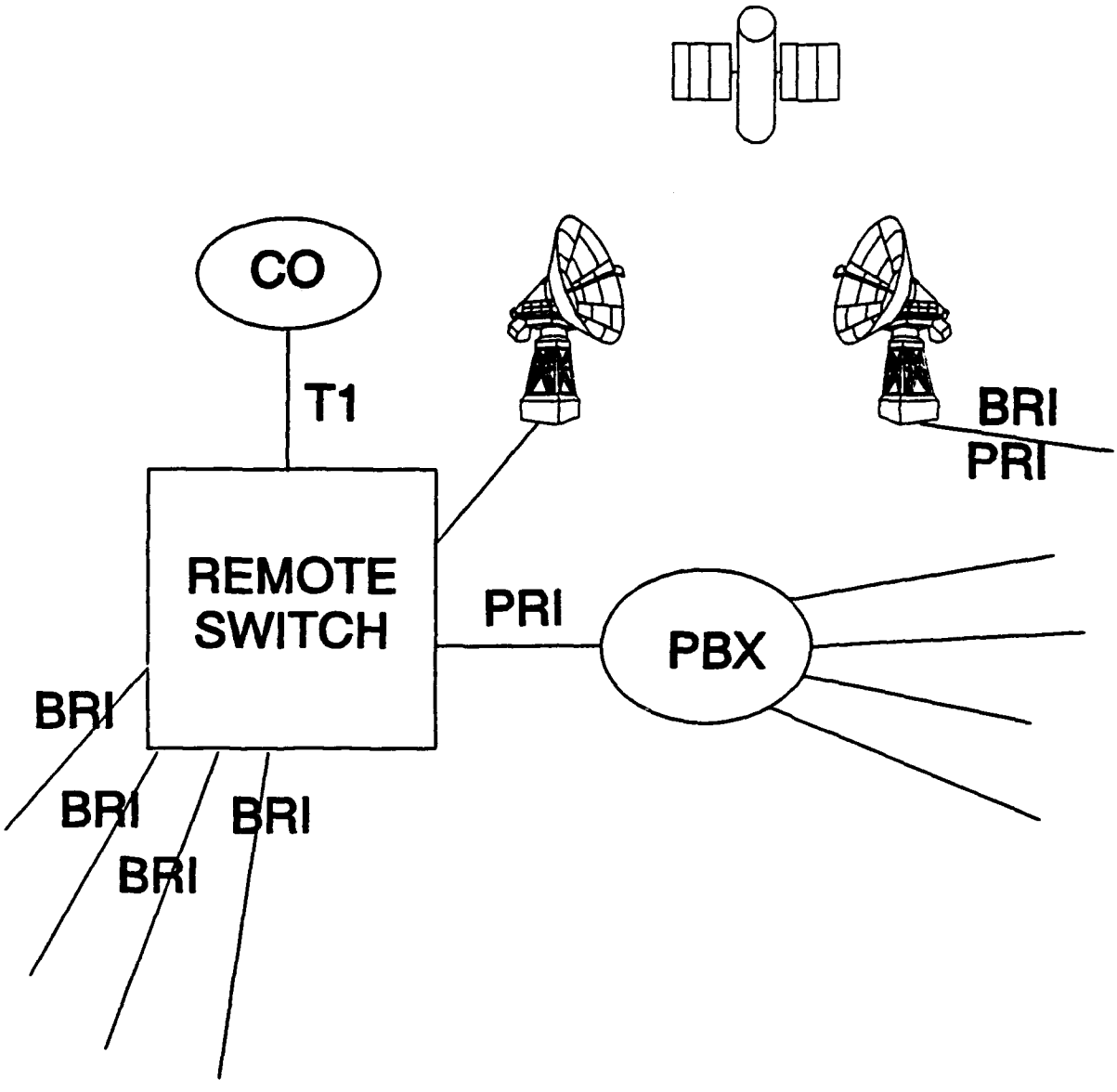


Figure 3.29. POTENTIAL EXPENDED NIST ISDN SYSTEM INFRASTRUCTURE FOR TRIP PARTICIPATION

b. Other NIU-Forum User Applications

- o 030001.0 Centralized FAX Server with ISDN
- o 050018.0 Multidocument Image Storage and Retrieval
- o 810002.0 Engineering Workstation Interface to ISDN
- o 860021.0 High Speed File Exchange
- o 860022.0 Multipoint Screen Sharing
- o 940007.0 Video Conferencing
- o 940030.0 Small Business EDI Access
- o 950001.0 End-User Addressing
- o 950028.0 Data Conferencing/EDI

c. Security-related NIU-Forum User Application Profiles

- o 050009.0 Secure Data Conferencing
- o 050010.0 Network Security Services - Key Management
- o 050011.0 Definition of Managed Objects for Secure NM
- o 050013.0 Secure Voice Conferencing
- o 050016.0 Secure Facsimile Transmission Through ISDN
- o 850027.0 Use of Existing Secure Terminal over ISDN
- o 950023.0 Secure ISDN Terminals
- o 950024.1 Secure Video Conferencing
- o 960042.0 BRI Encryption Device

d. Information Server

- o Distributed set of information resources
- o Multimedia, as available
- o Not all resources necessarily located directly on ISDN; common access point for all resources

e. Application Domain Interests

- o EDI--coupling EDI with transaction processing (X.12 based EDI); secure EDI transactions; also consider EDI concept as an "Information Service Presentation Facility', using standardized formats for graphical presentation of transactions, for data base

interchange format, and for system resources "contracting" and auditing;

- o medical imaging--transport, storage, retrieval and display of medical images in multimedia environment;
- o manufacturing--CAD conferencing, graphics transport, storage, retrieval and display;
- o logistics--CALS multimedia information environment, secure CALS transactions;
- o aircraft maintenance--interactive maintenance information environment, multimedia presentation;
- o network management--integrated management of ISDN and other communications resources; higher-level network resources management (directories, e.g.);
- o authoring--author conferencing, multimedia document creation/maintenance;
- o training/education--multimedia courseware;
- o library/research--test retrieval, hypermedia;
- o Group 3/4 FAX.XFC

3.3.5 Defense Information Systems Agency (DISA)

3.3.5.1 Background

The DISA, formerly the Defense Communications Agency (DCA), is responsible for overview, engineering and management of Defense communications systems and networks supporting National Command Authority (NCA) and Defense Services and Agencies requirements. Over the years, the Agency has provided management of telecommunications systems/networks for voice and data transmission over terrestrial and satellite systems and overview of their interfaces and interoperability with the specific communications systems/networks of the Defense Services/Agencies. Recently, its mission has been expanded to incorporate overview, engineering and management of Defense information systems.

In its earlier status, the Agency was involved in efforts to investigate, plan and incorporate ISDN capabilities into the Defense Communication System (DCS)

environments. This was a significant element of its Integrated Defense Communications System (IDCS) program. Its interest and efforts related to ISDN capabilities are reinforced and expanded by its expanded mission. This reinforcement and expansion now extends to the information services, rather than just information transport, that are cost-effectively supported by ISDN. This involves specific information services applications of ISDN, which are the subject of DoD ISDN Demonstration Programs discussed in a subsequent paragraph.

3.3.5.2 ISDN Test Bed

The Defense Communications Engineering Center (DCEC) maintains an ISDN test bed to investigate and evaluate the general characteristics of ISDN services and various CPE that provide interfaces and capabilities for employment of ISDN services at the user level.

The DCEC ISDN Test Bed incorporates a Teleos ASK200 ISDN switch simulator. It provides capabilities to simulate AT&T 4ESS and 5ESS switches, with generic 4E11 and 5E5 software respectively, and NTI DMS-100 and DMS-250 switches, with BCE-29 software. The switch simulator is interfaced with an external ISDN-capable Central Office. The interface is a PRI line. The simulator provides BRI lines to test bed equipment. The simulator-CO interface permits experimental evaluation of ISDN in intra-facility and simulated inter-facility application.

3.3.5.3 DoD ISDN Demonstration Program

DISA is currently in the planning stages of a DoD ISDN Demonstration Program. The program is intended to demonstrate and evaluate long distance ISDN applications in the broad DoD environment. DISA is working with various Defense Services and Agency organizations to formulate and develop the demonstration program.

Interfaces with various organizations have been conducted to identify:

- o Telephone equipment currently installed
- o Other equipment and ISDN interfaces installed
- o System upgrades needed for long distance ISDN

- o ISDN demonstrations or tests planned
- o ISDN applications of interest

Many of the respondents to DISA's information requests include activities discussed in previous paragraphs. The information received from other respondents is summarized below.

- o USAF Gunther AFB - NTI MSL-100 switch with BCS-33 software currently installed. No communications equipment with operational ISDN interfaces installed for local applications.
- o USN Pensacola NCTS - Two AT&T System 85s and one System 75 PBX suites, with Release 2, Version 4 software. Interfaces available via NAVNET to any NAVNET mode. No local BRI services.
- o USN Naval Weapons Center China Lake - NTI MSL-100 cutover planned for January 1992. NTI Meridian telephone instruments ordered will support local ISDN services.

The applications of interest noted by the respondents are presented in Table 3-4. These applications will be considered in the Demonstration Program Planning.

The projected schedule for the Demonstration Program as of October 1, 1991 is shown in Table 3-5.

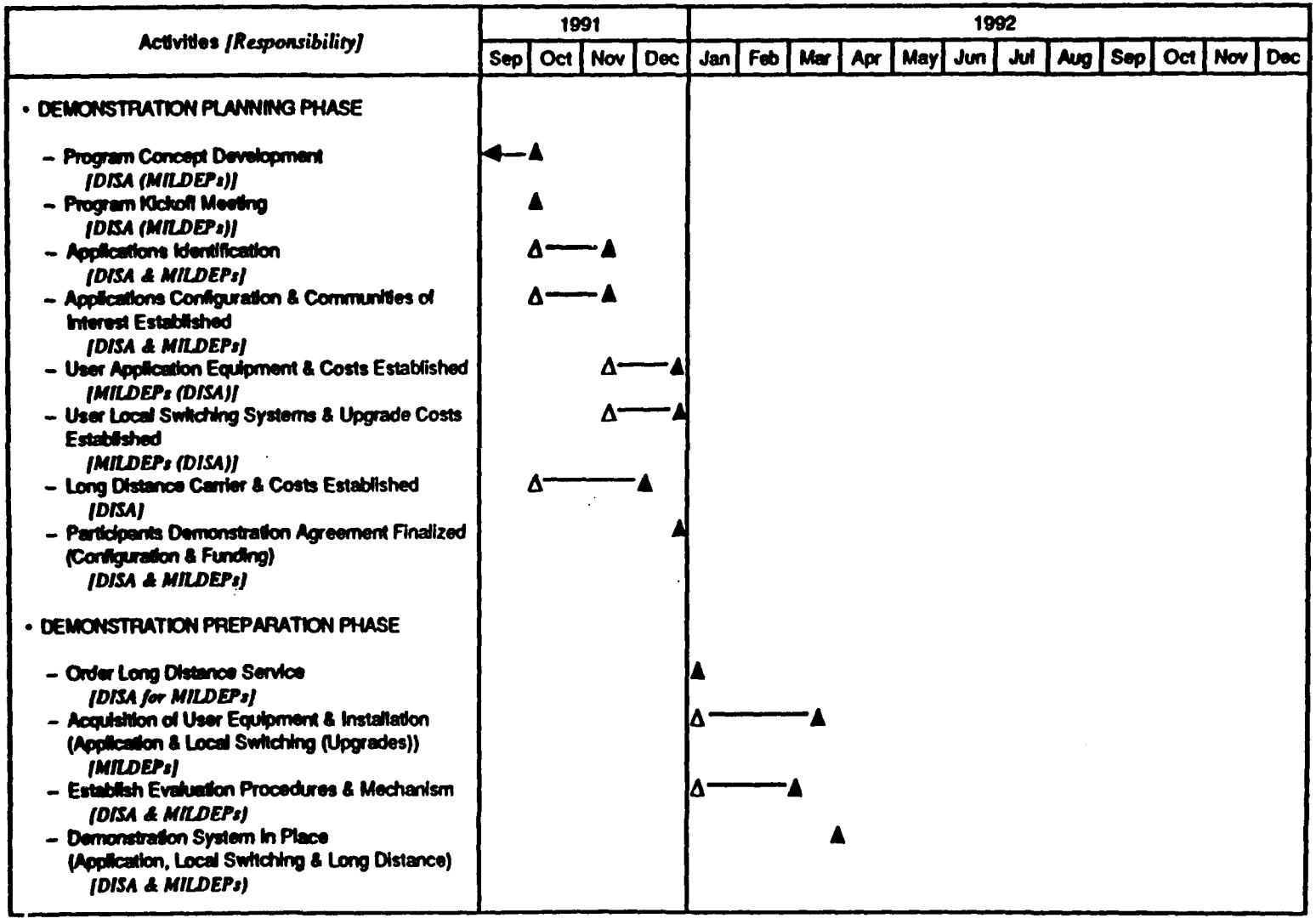
Preliminary planning has identified the ISDN services objectives for the long distance ISDN demonstration. These include:

- o PRI and BRI interfaces
- o Voice and Packet Data Services
- o Switched data at 56/64, 384 and 1472 Kbps

The network currently is under investigation for the required long-haul services including the DCTN, with upgrades, and FTS-2000 Network A (AT&T). The technical applicability, timeliness of availability and cost of desired capabilities are the key evaluation criteria. As indicated in Table 3-3, these evaluations are expected to be completed by December 1, 1991.

Table 3-4. Applications of Interest

APPLICATIONS	LOCATIONS INTERESTED
Desktop Conference	
-Simultaneous document Processing and voice	AIRMICS, Barksdale, Redstone, Pensacola, PERSINSCOM, DCEC
-File transfer	Pensacola, PERSINSCOM, DCEC
Network Access	
-LAN interconnection	AIRMICS, Barksdale, Redstone, Pensacola, China Lake, DCEC
-X.25 Packet (DDN)	Barksdale, Gunter, DCEC
-Network Management	Barksdale, Gunter, China Lake, DCEC
Image Transfer	
-Medical	AIRMICS, PERSINSCOM, DCEC
-Image database access	AIRMICS, Gunter, China Lake, PERSINSCOM, DCEC
-Group IV FAX	AIRMICS, DCEC
Video Teleconference	
-Desktop	AIRMICS, Barksdale, Redstone, PERSINSCOM, DCEC
-Limited Motion	AIRMICS, DCEC



DOD ISDN Demonstration Program
Major Activities and Schedule

Table 3-5

Activities *[Responsibility]*	1991				1992											
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
• DEMONSTRATION CONFIGURATION VERIFICATION PHASE																
– Test Applications In Local Environment *[MILDEPs (DISA)]*								Δ–▲								
– Test Applications In Long Distance Environment *[MILDEPs (DISA)]*								Δ–▲								
• DEMONSTRATION & EVALUATION PHASE																
– Perform Demonstrations & Record Results *[MILDEPs (DISA)]*									Δ––	––	––	––	––▲			
– Perform Comparative Tests *[MILDEPs (DISA)]*									Δ––	––	––	––	––▲			
– Evaluate Results *[DISA & MILDEPs]*										Δ––	––	––	––▲			
– Document Final Report *[DISA (MILDEPs)]*												Δ––	––▲			
– Document Recommended FY93 Activities *[DISA (MILDEPs)]*												Δ––	––▲			
• ADVANCED EVALUATION PHASE																
– Technology Assessment • Communications • DOD Applications *[DISA]*									Δ––	––	––	––	▲			
– FY93 Plans Established (Including TRIP '92) *[DISA & MILDEPs]*												Δ––	––▲			
– FY93 Activities *[DISA & MILDEPs]*														Δ––	––	▶

DOD ISDN Demonstration Program
Major Activities and Schedule (Concluded)

Table 3-5

4.0 TASK 3 - REVIEW OF ISDN TERMINAL EQUIPMENT

In this section of the report, we introduce the subject of ISDN terminal equipment, describe the classes of phone features, provide some terminal equipment standards, and discuss different manufacturers' offerings. Table 4-1 provides a description of about 22 terminal equipment sets.

4.1 Telephone Systems

ISDN Telephone Systems replace and expand on features available on the Public Switched Telephone Network. Capabilities similar to those available on key systems, automatic call distributors (ACDs), private branch exchanges (PBXs), and Centrex services are also offered. A wide range of telephone sets are available.

Simple voice terminals provide conventional telephone operation. The switchhook, keypad, ringer, and audio tones and announcements allow the user and the network to interact.

Feature phones support added services and allow for greater user and network interaction (See Figure 4.1). Feature activators (e.g. buttons and keys) provide a means for the phone to invoke an ISDN feature and feature indicators provide a means for the switch to provide status information regarding that feature. Soft Keys offer another means for the user to access and interact with an ISDN service. Unlike feature activators, which have a fixed association between activator and feature, soft keys are associated with features on a real time basis by the switch. In addition, displays allow the terminal or network to communicate with the user.

4.1.1 Framework

The basic format of ISDN Telephone Systems is derived from the I-series of CCITT recommendations.

The CCITT I.200-Series recommendations describe the service aspects of ISDN. Three ISDN service types are described: bearer services, teleservices, and supplementary services. Bearer services provide for the transfer of information. Teleservices offer value-added information processing in addition to information transfer. Supplementary services supplement bearer or teleservices and cannot be

Table 4-1. ISDN Voice Terminal Offerings

VENDOR	MODEL	COMPATIBILITY	DISPLAYS & KEYS	FEATURES
AT&T	ISDN 6504T Terminal	AT&T ESS	keypad 11 fixed function keys 10 user option keys 14 LEDs	hold, conference, drop, transfer, redial, select ring, self-test, message indication, volume control, speakerphone, 10 telephone number memory
AT&T	ISDN 6508T Display Terminal	AT&T 5ESS	keypad 2 line x 24 character LCD display 12 fixed function keys 29 user option keys 63 LEDs	hold, conference, drop, transfer, redial, select ring, self-test, message indication, volume control, speakerphone, 29 telephone number memory, clock, call timer
AT&T	ISDN 7505 Modular Terminal	AT&T 5ESS	keypad 11 fixed function keys 12 user option keys 24 LEDs	hold, conference, drop, transfer, redial, select ring, self-test, initiate data calls, data option settings, message indication, volume control, speakerphone
AT&T	ISDN 7506 Display Terminal	AT&T 5ESS	keypad 2 line x 24 character LCD display 11 fixed function keys 12 user option keys 24 LEDs	hold, conference, drop, transfer, redial, select ring, self-test, initiate data calls, data option settings, message indication, volume control, speakerphone, clock, call timer
AT&T	ISDN 7507 Display Terminal	AT&T 5ESS	keypad 2 line x 40 character LCD display 11 fixed function keys 39 user option keys 75 LEDs	hold, conference, drop, transfer, redial, select ring, self-test, initiate data calls, data option settings, message indication, volume control, speakerphone
AT&T	ISDN Attendant Console	AT&T 5ESS	keypad 1 line x 40 character display 26 fixed function keys 27 user option keys 79 LEDs	display area, trunk group select, call processing area (cancel, start, release), programmable feature area (split, hold, forced release, night service, position busy), call appearance area, three tone signal volume controls, lamp test switch, receiver/headset jacks, optional selector console
Cortelco	ITT Millennium Standard Digital Model	Cortelco-proprietary ISDN	keypad 18 user option keys 18 LCDs	ITT Millennium PBX-based Programmable Functions

Table 4-1. ISDN Voice Terminal Offerings

VENDOR	MODEL	COMPATIBILITY	DISPLAYS & KEYS	FEATURES
Cortelco	ITT Cortelco Enhanced Digital Model	Cortelco-proprietary ISDN	keypad 2 line x 24 character LCD display 8 fixed function keys 30 user option keys 30 LCDs	ITT Millennium PBX-based Programmable Functions
Cortelco	ITT Cortelco Enhanced Digital Model with DSS/BLF	Cortelco-proprietary ISDN	keypad 2 line x 24 character LCD display 8 fixed function keys 78 user option keys 78 LCDs	ITT Millennium PBX-based programmable functions
Fujitsu	SRS-1050	AT&T 5ESS	keypad 2 lines x 24 character LCD display 10 fixed function keys 21 user option keys 27 LEDs	hold, conference, drop, transfer, redial, speed dialing, 8 call unanswered call logging, message indication, volume control, speakerphone, call duration display, intercom voice announce, access to advanced centrex features, optional data support
Fujitsu	SRS-2000	AT&T 5ESS or NT DMS-100	keypad 4 lines x 40 character LCD display 12 fixed function keys 31 user option keys 44 LEDs	hold, conference, drop, transfer, redial, speed dialing, 8 call unanswered call logging, message indication, volume control, speakerphone, call duration display, intercom voice announce, access to advanced centrex features, calendar and clock, personal schedule/memo, optional data support
NEC	ISD term 3020	AT&T 5ESS/5E5	keypad 2 lines x 20 character LCD display 16 fixed function keys 28 user option keys 34 LEDs	hold, conference, drop, transfer, redial, speed dialing, message indication, volume control, speakerphone, programmable ringer sounds, flexible call offering (call appearances), key system service (shared call acceptance, multiple directory number), recall, time and date display, optional data support

Table 4-1. ISDN Voice Terminal Offerings

VENDOR	MODEL	COMPATIBILITY	DISPLAYS & KEYS	FEATURES
Northern Telecom	Centrex ISDN Set M5317T	Meridian Digital Centrex	keypad 2 line x 40 character LCD display 6 fixed function keys 10 user option keys	hold, release, handsfree, mute, volume control, programmable lines or features (directory number appearances, speed call, ring again, call forwarding, auto answer back), predial, save numbers, call timer, caller list, edit, 4 distinct alert tones, optional data support
Siemens	ISDN set 777	Siemens EWSD	keypad 2 lines x 24 characters display 12 fixed function keys 15 user option keys 23 LEDs	program, data, key control, mute, clear, do no disturb, redial, handsfree, distinctive ringing, speakerphone
Telrad	IDS 284 and 285	AT&T 5ESS or NT DMS-100	keypad 2 lines x 24 character LCD display 11 fixed function keys 6 user option keys 6 LCDs	hold, drop, transfer, conference, volume, mute, speakerphone, call duration timer, date and time, speed dialing, optional data support
Telrad	IDS 286	AT&T 5ESS or NT DMS-100	keypad 2 lines x 24 character LCD display 11 fixed function keys 14 user option keys 14 LCDs	hold, drop, transfer, conference, volume, mute, speakerphone, call duration timer, date and time, speed dialing, optional data support
Telrad	IDS 287	AT&T 5ESS (functional/ stimulus) or NT DMS-100 (stimulus)	keypad 2 line x 40 character LCD display 14 fixed function keys 30 user option keys 30 LCDs	hold, drop, transfer, conference, volume, mute, speakerphone, call duration time, date and time, speed dialing, optional data support
TIE	Onyx Single Line Phone	Onyx-proprietary	keypad 4 fixed function keys 1 LED	hold, transfer, volume control, message waiting indication
TIE	Onyx Thirty-Button Phone	Onyx-Proprietary	keypad 4 fixed function keys 36 user option keys 36 LEDs	hold, conference, intercom, message indication, volume control, speed dial, redial, automatic privacy, do no disturb, handsfree

Table 4-1. ISDN Voice Terminal Offerings

VENDOR	MODEL	COMPATIBILITY	DISPLAYS & KEYS	FEATURES
TIE	Onyx Executive Display Phone	Onyx-proprietary	keypad LCD display 4 fixed function keys 36 user option keys 36 LEDs	hold, conference, intercom, message indication, volume control, speed dial, redial, automatic privacy, do not disturb, handsfree
Tone Commander	Centracom 1030 Answering Console	AT&T 5ESS (with ISDN option package)	keypad 20 character display 10 fixed function keys 40 user option keys 53 LEDs	hold, release, transfer, answer, connect, pick up, ring delay, message, volume control, distinctive ringing, line privacy, time of day, conference, intercom
Tone Commander	Centracom 1560 Answering Console	AT&T 5ESS (with ISDN option)	keypad 20 character display 11 fixed function keys 45 user option keys 93 LEDs	hold, release, transfer, answer, connect, pick up, ring delay, message, volume control, distinctive ringing, line privacy, time of day, conference, intercom

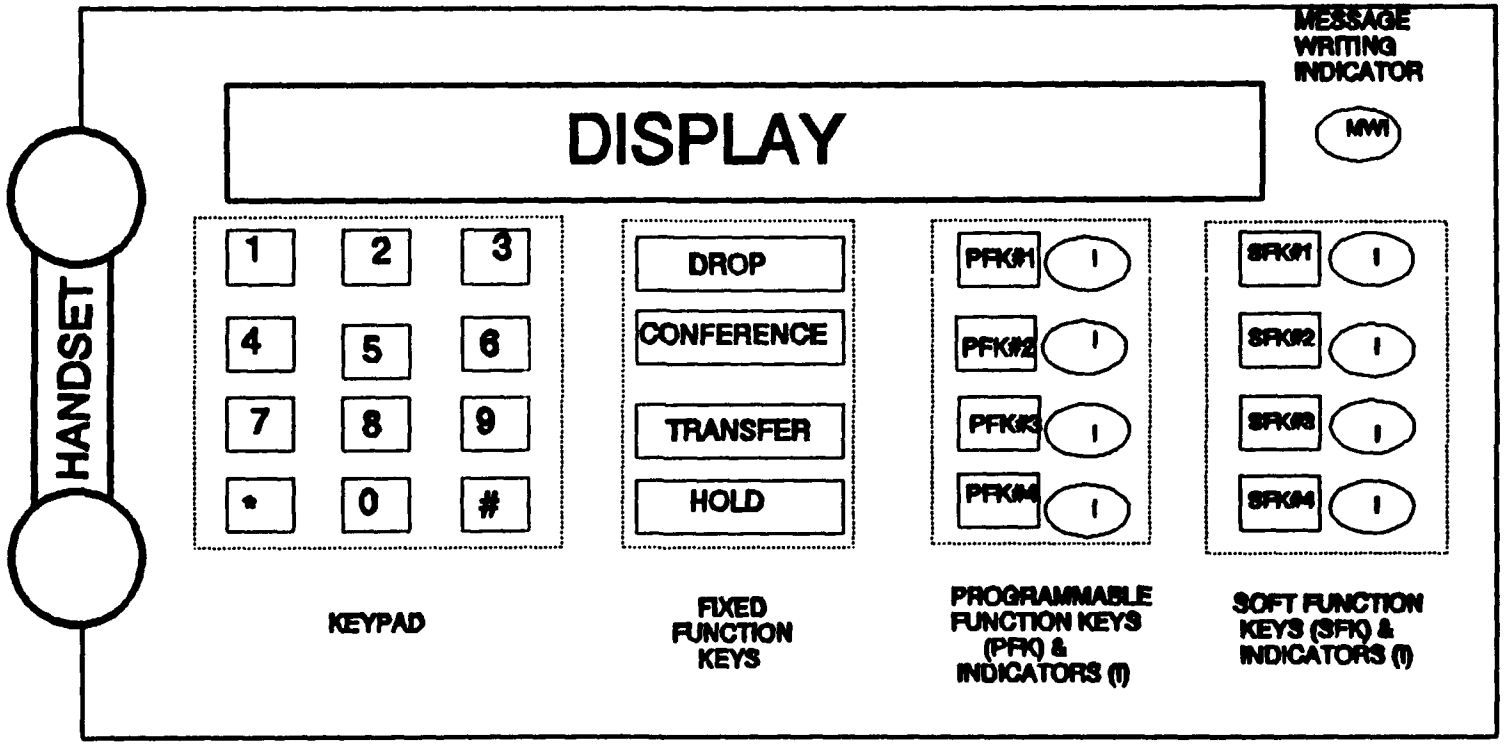


Figure 4.1. Generic Voice Terminal

offered independently.

The following seven classes of supplementary services are defined in CCITT Recommendations I.251-257:

1. Number Identification
2. Call Offering
3. Call Completion
4. Multiparty
5. Community of Interest
6. Charging
7. Additional Information Transfer

The CCITT I.300-Series recommendations describe the network aspects of ISDN. Network functional principles; reference models; numbering, addressing and routing; connection types; and performance objectives are described.

Terminal selection, defined as the process by which a network exchange queries a called terminal and receives either an acceptance or a rejection to its request, is described in CCITT Recommendation I.333.

The I.400-Series Recommendations describe the different versions of the interface between users and the ISDN network.

Reference configurations of ISDN user-network interfaces are described in CCITT Recommendation I.411. Reference configurations are described in terms of functional groups and reference points. Functional groups (e.g., TE1, TE2, TA, NT2, NT1) organize the communications functions between the network interface and the user into more manageable, logical and physical groupings. Reference points (e.g., R, S, T, U, V) describe the conceptual interfaces between the functional groupings.

CCITT Recommendation I.412 addresses ISDN user-network interfaces and describes channels and their use, interface structures and also gives some interface structure samples. Voice transmission is provided over the B-channel.

The physical characteristics of the ISDN S and T interfaces are described in CCITT Recommendation I.430.

CCITT Recommendations I.440 and I.441 reference CCITT Recommendations Q.920 and Q.921 which describe the general aspects and specifications of the data link layer of the ISDN user-network interface.

CCITT Recommendations I.450 and I.451 reference CCITT Recommendations Q.930 and Q.931 which describe the general aspects and basic call control specifications of the network layer of the ISDN user-network interface.

CCITT Recommendation I.452 references CCITT Recommendation Q.932 which describes the generic procedures for controlling ISDN supplementary services.

CCITT Recommendation I.470 describes the relationship of terminal functions to ISDN. The relationship between terminals and ISDN services is given along with the mandatory physical, link and network functions that a terminal must support.

Standard implementations of ISDN Telephone Systems evolved further through the work of Bellcore -- the jointly owned research, testing, and standards organization of the seven regional Bell holding companies. Bellcore has issued a large number of documents covering ISDN-related topics.

In order to align ISDN and industry, Bellcore undertook the National ISDN initiative. To that end, Bellcore developed a family of requirements (FR) that described a common implementation target, called National ISDN-1 or NI-1. The FR comprise:

1. TR-INS-000776, Network Interface Description for ISDN Customer Access
2. TR-NWT-000393, Generic Requirements for ISDN Basic Access Digital Subscriber Lines
3. TR-NWT-000397, ISDN Basic Access Transport System Requirements
4. SR-NWT-001953, Generic Guidelines for ISDN Terminal Equipment on Basic Access Interfaces

Bellcore sponsored several forums educating industry on NI-1. AT&T, Northern Telecom, and Siemens got behind NI-1 by agreeing to implement the NI-1 generic guidelines for ISDN terminal equipment in their central office switches by 1992. Supported by the large switch manufacturers, NI-1 will provide ISDN terminal vendors a large customer base supporting a common set of ISDN specifications. More recently, Bellcore along with the seven regional Bell holding companies, AT&T, Northern Telecom, Siemens Stromberg Carlson, the Corporation for Open Systems, and the North American ISDN Users Forum started sponsoring

National ISDN-1 Customer Premise Equipment (CPE) Guidelines Workshops to further clarify ISDN CPE specifications and to present details of the central office switch vendors' implementation plans.

At present, Bellcore is documenting National ISDN-2 in SR-NWT-002006. The developing specification will incorporate newly developing ISDN services while remaining backward compatible with previous National ISDN releases.

4.1.2 Terminal Types and Modes (Voice)

ISDN supports two terminal types: stimulus and functional. Stimulus terminals are the more simplistic. Signals are sent one key or event at a time (overlap sending) to the ISDN exchange switch. The exchange takes responsibility for providing control functions. Functional terminals, on the other hand, are more advanced and interact with the ISDN switch by exchanging I.451-based messages (en bloc sending).

A terminal mode describes a configuration of terminal features which enable a terminal to establish and clear calls and use supplementary services. Bellcore in SR-NWT-001953, Generic Guidelines for ISDN Terminal Equipment on Basic Access Interface[1] defined several types of voice terminal modes. They are:

1. Voice
2. MultiLine Hunt Group (MLHG)
3. Basic Electronic Key Telephone Service (EKTS)
4. Call Appearance Call Handling (CACH) EKTS

4.1.3 Supplementary Services

Seven classes with multiple supplementary service types have been defined in CCITT Recommendations I.251-257. They are:

I.251 Number Identification Supplementary Services
- Direct Dialing In
- Multiple Subscriber Number

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[1] SR-NWT-001953, Generic Guidelines for ISDN Terminal Equipment on Basic Access Interfaces, Bellcore, Issue 1, June 1991.

Calling Line Indentification Presentation
Calling Line Identification Restriction
Connected Line Identification Presentation
Connected Line Identification Restriction
Malicious Call Identification
Sub-addressing

I.252 Call Offering Supplementary Services
Call Transfer
Call Forwarding Busy
Call Forwarding No Reply
Call Forwarding Unconditional
Call Deflection
Line Hunting

I.253 Call Completion Supplementary Services
Call Waiting
Call Hold
Completion of Calls to Busy Subscribers

I.254 Multiparty Supplementary Services
Conference Calling
Three-Party Service

I.255 Community of Interest Supplementary Services
Closed User Group
Private Number Plan

I.256 Charging Supplementary Services
Credit Card Calling
Advice of Charge
Reverse Charging

I.257 Additional Information Transfer Supplementary Services
User-to-User Signaling

Bellcore publication SR-NWT-001953 expands on some of the CCITT I-Series Recommendations' supplementary service descriptions and defines some additional supplementary services. Bellcore describes the following supplementary services:

1. ISDN Basic Business Group Structure
2. ISDN Business Group Dialing Plan
3. ISDN Calling Number Identification Services
4. ISDN Message Service
5. ISDN Hold Capability
6. Flexible Calling
7. ISDN Call Forwarding
8. ISDN Call Pickup
9. Additional Call Offering
10. ISDN Automatic Callback
11. ISDN Multiline Hunt Group
12. User-User Signaling with Call Control

4.1.4 Market Offerings

Up to now, most ISDN voice terminal vendors built instruments that operated only with one specific switch. Many PBX vendors had digital switches and telephone sets using proprietary communications schemes. PBX vendors first started offering Primary Rate Interfaces (PRI) tailored to specific central office (CO) switches (e.g. AT&T's 5ESS, NT DMS-100, Siemens EWSD) and later started offering Basic Rate Interfaces (BRI) designed around a proprietary scheme or a specific central office switch.

In a sense, each CO switch manufacturer offered its own version of ISDN and ISDN voice terminals were developed accordingly. With Bellcore's National ISDN-1 initiative specifying a baseline offering of ISDN capabilities and services and AT&T, Northern Telecom, and Siemens agreeing to make their products conform to this specification by 1992, a common implementation of ISDN will exist, allowing ISDN voice terminal vendors to offer universal ISDN instruments.

Existing ISDN voice terminals offer a range of features based on the specific features of the switch that they were designed to work with. Table 4-1 lists vendors, models, compatibility, keys and displays, and features of many of today's ISDN voice terminals. Descriptions of various vendors' ISDN Voice Terminal offerings follow the table.

AT&T

AT&T, the dominant interexchange carrier, has long been a proponent of ISDN. AT&T's 5ESS central office switch supports both the Primary Rate and Basic Rate ISDN Interfaces (PRI and BRI) as well as other ISDN features implemented in the 5ESS software. The 5E7 version of 5ESS software is currently fielded. Version 5E8, scheduled for first office testing in July 1992, will conform to National ISDN-1 requirements. GTE's Marina Del Rey central office will start testing in August 1992. AT&T's Definity Generic 2 PBX also supports PRI and BRI ISDN interfaces. AT&T offers two voice-only ISDN key telephones, the ISDN 6504 and 6508, with a T or U interface. AT&T also offers three ISDN voice (with data optional) telephones, the ISDN 7505, 7506, and 7507, with T interfaces. AT&T's ISDN telephones currently run feature pack 2.7 which supports the 5E6 version of 5ESS software. Feature pack 3 will support the 5E8 version of 5ESS software and National ISDN-1. The AT&T sets act as functional terminals in supporting the hold, transfer, conference, and drop features and as stimulus terminals otherwise. The AT&T 7505, 7506, and 7507 sets support voice and optionally data. The data connection is an RS-232C/D interface supporting 19.2 Kbps. It can be used for transferring data over the second B-channel in circuit-switched mode or over the D-channel as packetized data. The asynchronous data is packetized by an internal PAD (Packet Assembler Disassembler). An AT&T ISDN 7506 Display Terminal is part of GTE's ISDN Testbed in Chantilly, VA.

Cortelco

Cortelco manufactures PBXs and station instruments. Its basic offering, the System 3100, is not an ISDN system. Its new system, the ITT Millennium, is being designed to ISDN standards. Three proprietary Millennium station instruments are described in its literature: an 18 button standard digital telephone, a 30 button enhanced digital model, and another 30 button enhanced digital model telephone with DSS/BLF. Cortelco is delivering an ISDN switch by February 1992 that will be marketed as "The Answer". Cortelco provides two instruments that will work with the switch and it is developing an ISDN telephone that will configure itself according to the type of switch it is connected to.

Ericsson

In the states, Ericsson makes its own digital sets that work with its switches. It is a proprietary implementation and does not satisfy the BRI requirement. Ericsson is considering developing an S interface (4 or 6 wire BRI with ISDN link and network protocols). Ericsson does support a PRI in its switch which supports connections to AT&T 5ESS and Northern Telecom DMS-100. Ericsson does not have any generic ISDN telephone but supports adapters to provide the 2B+D interface and has just added some new software to its switch that supports more ISDN capabilities. Ericsson's European offerings are different. Ericsson's T Division in Sweden is evaluating S and U interface telephones. In Europe, Ericsson has already made ISDN telephone sets and is in the process of making new ones.

Fujitsu

The SRS-2000 was designed to work with AT&T 5ESS 5E6 and NT DMS-100 BCS-31 software. The SRS-1050 was designed to work with AT&T 5ESS 5E6 software and is being developed for NT DMS-100 BCS-31 software. All ISDN telephones supporting the AT&T 5ESS switch are stimulus terminals. The SRS-2000 for the NT switch is a functional terminal. The SRS-1050 and 2000 support voice only or voice and data. No B-channel packet is supported. D-channel packet is supported with a built-in PAD on both sets. The only difference between the sets that support AT&T or NT are which PROM is installed. Fujitsu is working on its NI-1 terminals. Existing sets will support it with only a PROM change. The Fijitsu SRS-2000 ISDN Digital Telephone is part of GTE's ISDN Testbed in Chantilly, VA.

Hitachi

Hitachi's ISDN digital telephones are connected to their PBXs in a proprietary manner, not ISDN.

ICL

ICL does not make standalone ISDN telephone. All of ICL's "ISDN" telephones must plug into the PC card that they manufacture.

Intecom

Intecom currently makes telephones that are strictly geared to their PBXs.

Mitel

Mitel does not currently make ISDN telephones.

NEC

NEC has ISDTerm 3010 and 3020. The ISDTerm 3020 supports the 5E5 version of AT&T's 5ESS central office switch software. The data option is scheduled for future release. B-channel circuit-switched and D-channel packet-switch are planned.

Northern Telecom

Northern Telecom's INS group makes a 5000 series ISDN Telephone. GTE Government Systems and Northern Telecom have just been awarded the Major-Command Telephone Modernization Program (MTMP) contract for providing up to 39 SL-100 switches in the CONUS with options for full ISDN support to the U.S. Army.

Rolm Company, Rolm Systems

Rolm currently supports station's on its switches using Rolm Link, a proprietary protocol. Rolm Systems is developing an ISDN NI-1 telephone, the ISDN Set 787, to be distributed by Siemens Tel Plus. It should be available by September 1992 at the same time that most major switch vendors will be offering general NI-1 capabilities on their switches. Rolm Systems does the engineering and manufacturing for Siemens Tel Plus and does most of the manufacturing for Rolm Company.

Siemens

Siemens markets its own ISDN-proprietary telephone, the ISDN 777, built by Rolm Systems. Rolm Systems is currently developing an ISDN NI-1 telephone, the ISDN Set 787, to be distributed by Siemens Tel Plus. It should be available by September 1992 at the same time that most major switch vendors will be offering general NI-1 capabilities on their switches. Rolm Systems does the engineering and manufacturing for Siemens Tel Plus and does most of the manufacturing for Rolm Company. The ISDN Set 787 is similar in form to the ISDN 777.

Telrad

Telrad provides four different types of ISDN Voice/Data Telephones: the IDS 284, 285, 286, and 287. The AT&T 5ESS and Northern Telecom DMS-100 central office switches are both supported. D-channel packet-switched and B-channel circuit-switched data are both supported. A Telrad IDS 287 Voice/Data Telephone is part of GTE's ISDN Testbed in Chantilly, VA.

TIE

TIE/Communications markets the ONYX family of PBXs. The ONYX IV Digital PABX is to provide the migration path to ISDN. The ONYX IV product is expected for release in February 1992 and will support the 2B+D interface to various manufacturers' central office switches. ONYX offers a selection of telephone instruments to suit various communications and budgetary requirements. These include the Single Line Phone, the Thirty-Button Phone, and the Executive Display Phone.

Tonecommander

Tonecommander markets two attendant consoles: the Centracom 1030D and the 1560D. They both support ISDN through the Tonecommander ISDN interface. Both the AT&T 5ESS and the Northern Telecom DMS-100 central office switches are supported. Versions BCS 29 and 31 of Northern Telecom's DMS-100 software supporting stimulus and functional terminal, respectively, are supported.

A 4-wire T-interface (2B+D) is provided.

Unifi

Unifi makes three ISDN network interface products: a micro-channel interface, an EISA channel interface, and a phone; a PC-based "virtual" phone product; and two software products: Phone server and a distributed call center. The software is Unix System V-based currently running on Intel 386/486 platforms.

4.1.5 Conclusion

In choosing an ISDN telephone, compatibility and features are the key issues. Generally, digital sets are built around the switch that they connect to. Each switch vendor offers various features in its switch and usually several choices of telephones that support some subset of those features. ISDN switches and telephone sets are no different, though the National ISDN initiative is evolving to offer an common core of ISDN features and services from all vendors. Each switch vendor is still offering its set options which extend beyond the common core. So one aspect of choosing a telephone system revolves around what features a user needs and the features available on different vendors switches and telephone sets.

The other key issue is compatibility. A set bought today might not connect tomorrow. In fact, each vendor today provides ISDN based on a specific central office switch implementation. An ISDN telephone bought today for an AT&T 5ESS switch will not work with a Northern Telecom switch. As vendors move to NI-1, that will change. But a phone bought today might need to be replaced tomorrow to offer that compatibility. Some vendors (such as Fujitsu) will be able to upgrade to support NI-1 through the simple replacement of a PROM (Programmable Read Only Memory).

Most of today's ISDN telephones offer data as an option, supporting B-channel circuit-switched or D-channel packet-switched data transfer at up to 19.2 Kbps. To support both simultaneously with 64Kbps B-channel and 16Kbps D-channel is yet to come and would require an instrument replacement.

The U.S. Army's current and future requirements have a great impact on

which ISDN features should be provided and on minimizing total lifecycle costs. Compatibility and upgrade economy could mean the difference of replacing ISDN telephone sets in five years or fifteen years. Telephone sets that can easily be upgraded in parallel with the upgrade of the National ISDN network and also support those features most needed by the U.S. Army are best.

4.2 Personal Computer/Workstation

The ubiquitous PC provides an excellent platform for creating an inexpensive, multipoint, multimedia teleconferencing terminal. The following sections discuss some teleconferencing services that could be available to PCs. They also discuss a few hardware and software choices for making those services a reality on ISDN.

4.2.1 Services

ISDN makes possible the simultaneous use of multiple telecommunication services in a multipoint environment. Some of these services are electronic mail, fax, data transfers, and database accesses. Plus, ISDN makes it possible for PCs to offer high data rate services like video. Potential services fall into five categories: audio, data, graphics, video, and teleconferencing.

4.2.1.1 Audio

Audio plays an important role in ISDN applications, and, in some cases, is crucial to their successful operation. Most communications between humans are through the spoken word. Thus, a loss of audio can jeopardize a successful conclusion. In addition, audio can sometimes provide communications when its users' other senses are engaged. This is likely to occur in cases like conferences and database inquiries. For teleconferencing, audio is important enough that 57% or more of all teleconferences are audio only. (See Table 4-2).

When used by PCs, audio has at least two main uses: to carry live sounds or to carry canned sounds. Live sounds can enhance conferences and interactive sessions. Canned sounds like narrative and background sounds can enhance documents and video imagery. For conferences involving two or more individuals,

Table 4-2. Teleconferencing Use Breakdown

Type of System	Percent of Total
Audio teleconferencing	57.14
Meet-me bridging	14.97
Dial-up conferencing	22.45
Dedicated network	12.93
Meet-me and dedicated	2.72
Dial-up and dedicated	3.40
Audio and graphics	11.56
Facsimile	5.44
Electronic blackboard	2.72
Electronic blackboard and facsimile	0.68
Electronic tablet and facsimile	0.68
Typewriter or computer	2.04
Audio and freeze-frame/slow-scan video	8.16
Audio, freeze-frame and graphics	7.48
With facsimile	4.76
With electronic blackboard	0.68
With electronic blackboard and facsimile	1.36
With electronic blackboard, facsimile and computer	0.68
Audio and full-motion videoconferencing	12.24
Audio, full-motion video and other	3.40
With facsimile	0.68
With freeze-frame	1.36
With freeze-frame and facsimile	0.68
With freeze-frame and computer	0.68

audio permits all to participate. This includes even those in the remotest outposts where only audio is available.

An example of a canned audiovisual application is the case of an automotive mechanic who needs factory advice to repair an engine. The mechanic could query a factory database to observe techniques and hear tips on troubleshooting, servicing, and repairing the engine. He might do this using a PC that operates over an ISDN.

Having audio is no guarantee of success, however. A clear and intelligible audio link is crucial. For example, a teleconference will probably fail if participants have difficulty hearing one another. The clearness and intelligibility of an audio link depends on at least three items: the transmission line, room acoustics, and the terminal equipment (microphones and speakers).[1],[2],[3] The last two are important because participants will hear what the microphones hear. Poor room acoustics or poorly working microphones can (and often do) result in the

transmission of unintelligible sounds.

Room Acoustics

A room's acoustical properties belong to at least three main categories: echoes, reverberation, and background (ambient) noise. The first two categories describe a room's reaction to sounds. The third one describes sounds that are always present in the room. Echoes are exact repetitions of original sounds. A good example is the sound of your own voice returning in a large cavern. Reverberations are multiple echoes with very short times in between. People usually perceive them as sounds that "bounce around." They are also perceived as a hollowness in voices. Excessive reverberation usually makes it difficult for listeners to understand a speaker. It also usually makes a room unsuitable for audio conferencing. Background or "ambient" noises are sounds a room contains even when unoccupied. They have many sources: air-conditioning, heating and ventilation equipment, office equipment, lighting fixtures, outside noises, etc.

Reducing a room's echoes, reverberations, and ambient noises, may require modifying the room. For instance, sound absorbent material placed on room surfaces can limit the reflection of sound. Multi-angled walls and ceiling can also limit the reflection of sound. Nevertheless, their application must be done judiciously and must account for all sound frequencies. A common mistake is to assume that placing general purpose acoustic absorption materials directly on a surface will absorb lower frequency sounds. (Materials like carpeting, acoustic tiles, and thin fiberglass panels.) They might not, and may result in a "boomy" or "hollow" sounding room.

Transmission Lines

Transmission line electrical noise and distortion also hampers audio. Fortunately, one of ISDN's advantages is that it is "digital." Digital transmissions naturally separate desired sounds from unwanted electrical noise. With digital, sounds are modeled as a time series of discrete numbers expressed in binary form. Since just ones and zeros are transmitted, noise is not amplified. Other advantages are that computers can process digital transmissions economically, can compress the signals to achieve better bandwidth, and, can encrypt the signals for security purposes.

How the transmission line operates also has an effect on the clarity and

intelligibility of a teleconference. For instance, the most natural sounding audio gives users the ability to talk and listen simultaneously. Providing this capacity for simultaneous two-way conversation is normally accomplished by using a "full-duplex" channel. Full-duplex uses two channels or paths. One channel allows a user to listen and the second channel allows the user to speak. In addition, the separate channels eliminate unwanted feedback signals. ISDN uses full-duplex channels.

Another method uses just one channel for both talking and listening (half-duplex); unfortunately, it is less natural sounding. With half-duplex, a message is sent and received in one direction at a time. To accommodate messages from more than one speaker, the channel must switch from one message to another. Typically, switching is based upon sound levels. So, on a half-duplex line, the user with the loudest voice is usually the one who is heard.

Microphones

In addition to telephone hand-sets and speakerphones, there are several options for speaker-microphone equipment. These options include both their type and operation. The most frequently used microphones are omnidirectional microphones placed or mounted on conference tables, and lavaliere microphones that are hung around necks. In large conference settings, highly directional shotgun microphones are invaluable. They avoid forcing participants to line up at microphones and eliminate pauses while participants make their way to a microphone. Microphones are useable in three ways: voice-switched, press-to-talk, and open audio.

Voice-switched permits only the speaker's microphone to transmit. This reduces ambient noise and prevents sound from a loudspeaker from reentering the transmission circuit. When another participant speaks louder than the incoming sound, their microphone is automatically turned on. Nevertheless, loud ambient noise or other noises, such as a cough, can activate the microphone and keep it on, blocking all other locations. Voice-switched microphones need a quiet environment to operate properly. Also, since voice-switched microphones allow only one person to talk at a time, it can be difficult to interrupt a speaker. Some voice-switched microphones have a softer switching mechanism that mutes but does not completely block simultaneous messages; thereby accommodating the more natural flow of human conversation.

Press-to-talk microphones are not active until a user depresses a button. This keeps ambient noise out of the audio link when a participant is listening and prevents accidental activation from loud noises in the room. Press-to-talk microphones are very useful in noisy rooms and on large teleconferencing networks where the number of on-line sites may compound noise.

Open audio microphones transmit sound continuously. They are usually omnidirectional and pick up sound from all directions in a room. Therefore, it is crucial to eliminate excess noise. Nevertheless, these microphones are preferred because people find them easy and natural to use.

4.2.1.2 Data

Data transfers include items like electronic mail, facsimiles, and binary file transfers.

Electronic Mail

There are many ways to deliver packages and information to their proper destinations. Historically, these deliveries were done mainly by postal mail and courier services. Today, electronic mailing and delivery is an economic and speedy substitute for some information transfers.

Electronic mail comes in many guises. A few are teletype, telex, telephone, television, facsimile, and computer-based mail systems (CBMS). CBMSs are of particular importance because their flexibility make interconnecting different types of terminal equipments possible, at economic prices (e.g., PCs to facsimile equipments). Currently, CBMSs dominate the electronic mail arena. As a result, their service is what people think of when they encounter the term "electronic mail."

To interconnect different types of terminal equipments using CBMSs, the International Telegraph and Telephone Consultative Committee (CCITT) is defining a set of Recommendations concerning Message Handling Systems (MHS). They are incomplete, however. For example, for fax, they do not, as yet, describe how facsimile equipments will access, use, and work on computer-based MHSs. Although much work remains, the MHS Recommendations do have sufficient detail to allow CBMS manufacturers to begin making interoperable systems.

Facsimile

Adding facsimile capabilities to most PCs is as simple as adding a fax card and software, and connecting a phone line. Typically, the fax card is a modem capable of talking to both fax machines and regular data communications modems. The driving software usually controls fax operations and is capable of transforming documents into faxable images. For example, the software might provide background send and receive capabilities. With this capability, users may send and receive faxes as they work, without their work being interrupted. The division between hardware and software functionality is blurry, however. Some cards are more capable than others. Some may perform functions like compression and decompression. In addition, most fax card and software packages can convert a variety of file formats into faxable images. At a minimum, this includes text files and popular wordprocessor file formats (e.g., Wordperfect, Wordstar). Some even permit overlaying the document with graphics like company logos, or signatures.

Group 3's modems can work on ISDN. Thus, all of the aforementioned fax functions can work on ISDN. This approach fails to exploit ISDN's higher data rates, however. The data rates are limited to the modem's data rates (i.e., 14.4 kb/s). At present, the CCITT Recommendations for modemless ISDN fax connections are incomplete. As a result, manufacturers are currently unable to offer true ISDN fax connectivity (See Section 4.3). A pseudo-fax or proprietary-fax transmission capability is possible, however. It can take full advantage of ISDN's data rates. A few manufacturers offer this capability (See Section 4.2.2).

4.2.1.3 Graphics

Graphical capabilities on PCs during conferences include drawing and annotating. This is usually done with a mouse. Graphical capabilities enhance a conference by permitting participants to stress important points visually. The setup, control, and positional information for these capabilities usually require only low data rates.

4.2.1.4 Video

Video demands large amounts of transmission bandwidth. How much usually depends on three main factors: picture size, pixel depth, and frame rate. Picture size may vary. For example, the National Television System Committee (NTSC) defines a 525 by 360 screen size. Of this, only 360 by 240 is considered the "safe" region on a television. Recommendation 601 of the International Radio Consultative Committee (CCIR) specifies at least two digital screen sizes. One is 720 by 625 (European). The other is 720 by 480 (U.S.). The CCITT uses a Common Intermediate Format (CIF) and a QCIF (quarter CIF). It serves as a bridge between the others.

Pixel depth includes monochrome (1 bit), gray scale (often 8 bits for 256 levels), and color (usually 8,9,16 or 24 bits). It also includes the chosen color space. For example, cameras or scanners often separate and quantize images into their red, green, and blue (RGB) components. For example, RGB 8:8:8 denotes a 24 bit color image.

The human visual system is more sensitive to color intensities (luminance) than it is to color (chrominance). To take advantage of this, color spaces that separate luminance from chrominance are often used. Examples of such color spaces are XYZ, YUV, LAB, and YCrBr. Mapping between color spaces is often done using linear transformations. Plus, the ratio of luminance to chrominance can vary depending on which standard is used. For example, CCIR Recommendation 601 uses a ratio of 4:2:2. In this case, luminance has twice as many samples as chrominance.

Smooth motion video requires at least 25 to 30 frames/s. If the standard TV signal is encoded using conventional 8-bit PCM, it requires a transmission bit rate of approximately 90 Mb/s. Video compression technology can reduce this bit rate to the basic rates (64 kb/s and multiples). The compression function is often performed by a codec, usually according to CCITT Recommendation H.261.

H.261 reconciles the incompatibility between European TV standards (PAL, SECAM) and those in most other areas of the world (NTSC). PAL and SECAM employ 625 lines and a 50 Hz field rate while NTSC has 525 lines and a 60 Hz field rate. This conflict was solved by adopting CIF and QCIF. These picture structures must be used for any transmission adhering to H.261. (See Table 4-3).

The QCIF format is the mandatory H.261 format. The full CIF is optional.

Table 4-3. CIF and QCIF Parameters

	CIF	QCIF
Coded Pictures per Second	29.97	(or integral submultiples)
Coded Luminance pixels per line	352	176
Coded Luminance lines per picture	288	144
Coded Color pixels per line	176	88
Coded Color lines per picture	144	72

QCIF employs half the CIF spatial resolution in both horizontal and vertical directions. It is expected to be used for videophone and desktop applications where head-and-shoulders pictures are sent from desk to desk. CIF is expected to be used for teleconferencing where several people must be viewed in a conference room. At 29.97 frames/s, QCIF requires approximately a 950 kb/s bandwidth, uncompressed.

4.2.1.5 Teleconferencing

Teleconferencing services provide the tools for multiple users to communicate effectively. The larger the conference the more important these tools become. This usually includes services like speaker and pointer control. Conference controls should be capable of both formal and informal control. In the formal setting, a chairperson might decide issues like who may speak, who may annotate, and who may edit. In the informal setting, the terminals (or MCU) in the conference might decide those issues. At present, there are no multipoint teleconferencing standards. They are being developed, however. (See Section 4.4, "Audiographic Terminals.")

4.2.2 Software and Hardware Products

The key areas of interest for providing a multipoint, multimedia, teleconferencing terminal are video, network interface, and multipoint service. The following sections discuss the software and hardware products that are available to provide these services.

4.2.2.1 Network Interface and Multipoint Service

Several vendors offer ISDN-related PC compatible products. (See Appendix A.) Most permit the simultaneous transfer of data with voice communications between two users. A few provide tools for transforming PCs into multipoint multimedia teleconferencing terminals.

4.2.2.1.1 AT&T

AT&T sells a BRI interface card (PC/ISDN) with support software for DOS PCs. It supports applications for communications with SNA hosts, asynchronous hosts, and other PCs. Supporting B-channel circuit-switched data and D-channel signalling, the PC/ISDN card may be connected to AT&T's 5ESS switch. The applications program interface (API) supports synchronous and asynchronous data transmissions and voice transmissions.

4.2.2.1.2 DGM&S

DGM&S offers a ISDN PC Adapter and development software for a variety of platforms. It supports NTI's DMS-100, AT&T's 5ESS, and Siemen's EWSD switches. Data may be sent using V.120 or X.25 protocols. The development kit permits developers to use the API using C source code.

4.2.2.1.3 Hayes

Hayes sells a ISDN PC Adapter with voice and data capabilities for IBM PC XTs, ATs, and compatibles. It supports NTI's DMS-100 and AT&T's 5ESS central office switches. Data may be sent using V.120, or X.25 protocols. Two APIs are available: ISDNBIOS and Hayes Standard AT Command Set Enhanced for ISDN. ISDNBIOS supports point-to-point or networked applications, allows current data communications packages to perform in an ISDN environment, and provides a path for adding voice call control and management. The enhanced Hayes command set provides backward compatibility with asynchronous communications packages (like Hayes Smartcom III) and operates at rates up to 38.4 kb/s. Both interfaces permit control and monitoring of voice and data calls.

4.2.2.1.4 ICL

ICL offers ISDN hardware and desktop conferencing software. The hardware is compatible with AT&T's 5ESS, NTI's DMS-100, and Siemens EWSD switches. The B channels may use the V.120 rate adaption protocol and the B, and D channels may use the X.25 packet switching protocol. With the V.120 protocol, speeds may vary from 300 b/s to 64 kb/s.

The desktop conferencing software can permit up to eight conference participants to see the same information and make changes to it:

- The person running the application makes changes as normal.
- Control of the application may pass to another conference participant.
- Participants may use a mouse or light pen to write on the screen. This is independent of the application; the application does not need to support any type of drawing facilities.

The multipoint capability is no longer included as part of desktop conferencing. Insufficient interest caused ICL to stop supporting it. Nevertheless, ICL appears to be willing to reinstitute it for interested parties.

This software also provides various data transfer modes, screen logging, and conference management. For example, the Transfer Mode automatically sends a selected application's imagery or text to all conference participants. Plus, the Background File Transfer sends files without disrupting already running applications. A Flipchart mode freezes an application so participants may annotate and discuss its output. Flipcharts are automatically saved, and up to 99 may be active simultaneously. Control of the conference keyboard and screen is easily changed to any participant, and a nominated "Chair" has the tools necessary to control the conference.

ICL also offers an applications programming interface. The API permits applications to initiate and terminate voice and data calls, use X.25 and V.120, selectively accept incoming calls, process a caller's telephone number, incorporate call logging of incoming and outgoing calls, and can send DTMF tones.

ICL incorporated these capabilities into two 386-based workstations. These workstations include additional features and capabilities:

- ISDN Voice and Data Call Management Software
- Switch Interface Software
- ISDN Phonebook Software
- Integrated Featurephone
- Accelerator feature for fast image transfers by DeskTop Conferencing and Group 3 and 4 fax systems

4.2.2.1.5 NCR

NCR offers a ISDN PC terminal adapter and software. The adapter works with AT&T's 5ESS switch and provides Circuit switching, X.25 packet switching and V.120 rate adaption on the B channels. DOS applications may use serial port emulation to transmit data at rates up to 38.4 kb/s. OS/2 applications may transmit data at rates up to 19.2 kb/s. NCR's Voice/Data Manager supports file and screen transfers at 64 kb/s over the B channel.

4.2.2.1.6 Teleos

Teleos sells the B101PC terminal adapter (PCTA) which provides access to basic rate ISDN services. Its intended primary applications are PC-to-LAN telecommuting, LAN-to-LAN routing, and PC-to-mainframe communications. The adapter works with AT&T's 5ESS and NTI's DMS100 switches and provides X.25 packet switching and V.120 rate adaption on the D channel. The API emulates NetBIOS, and a time division multiplexed bus permits integration of image compression, video graphics, and voice/digital processing. The PCTA supports a variety of communications software like Procomm, Crosstalk, and Carbon Copy. This enables data calls such as file transfers, terminal emulation and screen sharing. For these packages, D channel transfers support rates up to 9.6 kb/s and B channel transfers support rates up to 19.2 kb/s. Other capabilities support V.120 rate adaption to 56 or 64 kb/s and support of an abbreviated AT command set. The command set permits setting up and tearing down B-channel V.120 circuit-switched data calls and D-channel X.25 packet-switched calls.

The PCTA also supports a voice features interface that emulates the voice features of a ISDN phone. Features like call conferencing, hold, drop, and transfer, all while using an analog phone for voice conversations.

4.2.2.1.7 Comparison of ISDN Products

Most of the products provide data transfers during voice conversations between two terminal equipments. In some cases, enhancements to better manage the phone are available. (e.g., call conferencing, hold, drop, and transfer) A few offer multipoint teleconferencing capabilities. Most offer APIs that allow developers to create applications that incorporate capabilities like multipoint teleconferencing.

Of the reviewed products (See Table 4-4), Hayes ISDN PC Adapter and ICL's I^3 product appear to offer the most multipoint multimedia capabilities. Of these two, ICL's product offers more multipoint functions. These functions include mechanisms for controlling conferences having up to 8 conference members, include porting and viewing of documents (e.g., like facsimiles or application windows) by all conference members, and include screen annotation coupled with screen logging.

4.2.2.2 Video

There are several hardware and software products that provide full-motion video on PC monitors. Some are established products. Others are soon to be released. Most of these products provide a video compression capability. None currently offer H.261 compliance. At least one full-motion H.261 compliant board does exist that could be adapted to a PC bus.

4.2.2.2.1 IBM

IBM offers a series of hardware options that can turn a PC into a multimedia terminal. Their full-motion video product uses a proprietary compression and decompression algorithm called Digital Video Interactive (DVI). It can compress video by a factor of at least 100 to one. Their product is available on both the Industry Standard Architecture (ISA) bus and the Micro Channel Architecture

Table 4-4. Comparison of PC ISDN Adapters

	AT&T PC/ISDN Platform	ICL i²	NCR ISDN/PCTA	Hayes ISDN PC Adapter	DGM&S	Telesis B101PC Adapter
GENERAL						
List price	$1,995	$1,695	$1,695	$1,599		$1,695
Compatible with AT&T 5ESS	■	■	■	■	■	■
Compatible with NTI DMS-100	□	■	□	■	■	■
Compatible with Siemens EWSD	□	■	□		■	■
DATA TRANSFER ON B CHANNEL						
Circuit-switched	■	■	■	■		■
X.25-packet-switched	□	■	■	■	■	□
V.120-packet-switched	□	■	■	■	■	■
Maximum transfer rate (kb/s)	64	64	64	64	64	64
DATA TRANSFER ON D CHANNEL						
X.25-packet-switched	■	■	■	■	■	■
HARDWARE						
Emulates COM ports	None	COM1, COM2 (with V.120)	COM1, COM2 COM3, COM4	COM1, COM2		None
Maximum COM speed (kb/s)	N/A	64	38.4	?		N/A
Uses Hayes AT command set	□	□	■	■		□
Detects remote DTMF	■	□	■	■		□
Integrated voice mail	□	□	■	N/A	■	□
SOFTWARE						
TSR (RAM required)	□	□	□	N/A		■ (50K)
With EMS 3.2	N/A	N/A	N/A	N/A		□
With EMS 4.0	N/A	N/A	N/A	N/A		□
Phone directory	□	■	■	N/A		■
Terminal emulation included	■	Optional	□	N/A		Optional
Uses ICLID for database lookup	■	■	■	N/A		□
Has API for developers	■	■	■	■	■	■
Has NetBIOS interface	□	□	□	-		□
Multipoint Operation		■ (Up to 8 users)		■(8 data, 2 voice)		
Operating System	DOS	OS/2	OS/2, DOS	DOS	DOS	DOS
PHONE FEATURES						
Uses normal phone	□	□(Package includes ISDN-like phone)	■	■ (Includes external P.S.)	■	■
Phone rings generated on	Phone (card speaker with hand/headset)	Phone	PC speaker (with optional power supply)			Card Speaker
Uses ISDN phone	■	□	■			□
On passive bus	□	N/A	■			N/A
Terminal adapter card between phone and CO	■	N/A	□			N/A

■ - Yes □ - No N/A - Not applicable; product does not have this feature

(MCA) bus. Two cards are needed, the ActionMedia II Display Adapter and the ActionMedia II Capture Option. The display adapter provides up to 30 frames/s motion video and high-quality audio. Video sources may be storage devices, digital networks or analog video. The capture board is used for the analog sources. The video can be displayed within Microsoft's Windows environment within a window. The boards are being beta tested. They are expected to be released during March or April of 1992.

4.2.2.2.2 New Media Graphics

New Media Graphics offers a full-motion video board called Super VideoWindows. It can operate within Microsoft's Windows environment within a window. It works on the ISA bus. Three NTSC/PAL video sources may be used. In addition, New Media Graphics offers a Super Motion Compression board that performs JPEG motion video compression and decompression. It does not comply with H.261, at present. Compression ranges from 12:1 to 80:1. Storage rates are approximately 12 MB/minute. The compression board connects directly to the Super VideoWindows board. The compression board has a target release date of February 1992.

4.2.2.2.3 Integrated Information Technologies

Integrated Information Technologies (IIT) provides an integrated vision module (IVM). It is a plug-in circuit card that provides still image and motion video compression and decompression. The module can execute JPEG, CCITT H.261 (Px64), and MPEG algorithms. The card is desiged to be used in a number of systems. The user is expected to provide the interface to the target system's bus. The board is expected to be released in April of 1992.

4.2.2.2.4 Comparison of Video Compression Products

Of the reviewed products, only IIT's IVM offers H.261 compliance. (See Table 4-5.) Nevertheless, to use it in a IBM PC or compatible, an interface to the PC busses is needed. The IVM is not directly compatible with ISA or MCA busses. The other two, DVI and Super Motion Compression, are compatible with ISA or MCA busses. Plus, although neither currently adhere to H.261, they might do so in the future.

Table 4-5. Comparison of Video Compression Products

Product	Bus		Compression Algorithms			
	ISA	MCA	JPEG	MPEG	H.261	Proprietary
Digital Video Interactive	✓	✓	✓			✓
Integrated Vision Module (IVM)			✓	✓	✓	
Super Motion Compression	✓		✓			

4.3 Facsimile

At present, the CCITT is developing Recommendations to interface facsimile equipments to ISDN. This includes Group 3 and Group 4 facsimile equipments. For Group 4 (and Teletex and Videotex), the CCITT is seeking approval of Recommendation T.90, "Characteristics and Protocols for Terminals for Telematic Services in ISDN." To accelerate T.90's approval, the CCITT is applying its resolution 2 procedures. For Group 3, no Recommendations currently address interfacing Group 3 to ISDN (i.e., a modemless Group 3 interface). There is, however, strong U.S. support to do so.

Some vendors provide Group 3 and Group 4 fax on ISDN (e.g., Canon and Ricoh, See Appendix B). Nevertheless, until appropriate Recommendations are approved, few guidelines exist for ensuring facsimile equipment interoperation on ISDN.

4.3.1 Group III Facsimile

Today, the majority of facsimile equipments used by the U.S. Government and the private sector are Group 3 compliant equipments. These equipments were, in general, designed to operate over the PSTN in point-to-point configurations. They couple short document transmissions (e.g., less than 1 minute per page) with automatic equipment operation. For compressing documents, Group 3 equipments use both one-dimensional and two-dimensional coding schemes. The one-dimensional coding scheme uses fixed codes to represent run-lengths of white and black pixels in the horizontal direction. The two-dimensional coding scheme takes advantage of vertical pixel color correlation to achieve even greater compression. Group 3 equipments now provide 98x204

and 196x204 pixel/inch resolution, and may soon offer 300 and 400 pixel/inch resolutions. Of these resolutions, the first is the baseline resolution with the remainder being optional.

Because of the popularity of Group 3 equipments, the CCITT has been enhancing Group 3's capabilities. For example, they have added features like higher speeds (14.4 kb/s) and improved compression. Plus, they are adding features like higher resolutions (300 and 400 pixels/inch), binary file transfer, and gray scale and color imagery. Some of these features (e.g., higher resolutions and improved compression), are capabilities previously enjoyed only by Group 4 equipments.

On the PSTN, Group 3 equipments may transmit documents at rates of 2.4, 4.8, 7.2, 9.6, and 14.4 kb/s. On ISDN, these same equipments can transmit documents using the same rates. Doing so does not take advantage of ISDN's 64 kb/s B channel transfer rates, however. Within the U.S., there is strong support to allow Group 3 equipments to take advantage of ISDN's higher transmission rates. One possible approach is a Group 3 ISDN protocol that builds on the existing Group 3 protocol. It could take advantage of the higher rates while permitting interoperation with older, non-ISDN Group 3 equipments. When a ISDN Group 3 equipment is connected to a similar machine, it could use the higher ISDN rates (i.e., 64 kb/s). When the equipment is connected to a non-ISDN Group 3 equipment, it would use the slower rates (i.e., less than or equal to 14.4 kb/s).

On ISDN, Group 3 may have a few advantages as compared to Group 4. Group 3's protocol is simpler than Group 4's, which might make for quicker document exchanges. Second, Group 3 ISDN equipments could interoperate more easily with the existing base of Group 3 equipments. At present, Group 4 equipments are unable to interoperate with Group 3 equipments.

4.3.2 Group IV Facsimile

Group 4 is the latest set of CCITT facsimile Recommendations, and was primarily designed for point-to-point operation on digital, error-free, high-speed networks. These networks include public data networks, packet-switched networks, and the ISDN. Group 4 operates at transmission rates up to 64 kb/s. There are three types of Group 4 equipments with characteristics as shown in Table 4-6:

Class 1: A terminal able to *send* and *receive* facsimile documents.

Class 2: A terminal, in addition to having Class 1 capabilities, able to *receive* teletext and mixed-mode[2] documents.

Class 3: A terminal, in addition to having Class 1 and Class 2 capabilities, able to *generate* and *send* teletext and mixed-mode documents.

Table 4-6. Group 4 Class Characteristics

	Class		
	1	2	3
Pel-density of scanner-printer (pels/25.4mm)	200	300	300
Pel transmission density (pels/25.4mm)	200	200/300	200/300
Pel transmission conversion capability	not required	required	required
Mixed-mode capability	not required	not required	required
Optional pel density of scanner-printer	300/400	400	400
Combined with pel transmission density (pel/25.4mm)	200/300/400	200/300/400	200/300/400
Storage	not required	not required	required

These three classes provide a wide range of capability. For example, Group 4 Class 1 is similar to Group 3 (low capability). Classes 2 and 3 permit

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2 Mixed-mode documents contain a mixture of teletext and facsimile data on the same page. For example, a page consisting of line art and text could be sent as a mixed-mode document; the line art could be sent as facsimile data, and the text could be sent as teletext data.

interoperation with Teletex and mixed-mode equipments (higher capability). Being Group 4 compliant, however, does not guarantee interoperation between the different Group 4 equipment classes. A careful examination of Group 4's communication protocols (See Figure 4.2) reveals slight protocol differences that prevent communication between Class 1 and Class 3 equipments (T.521 versus

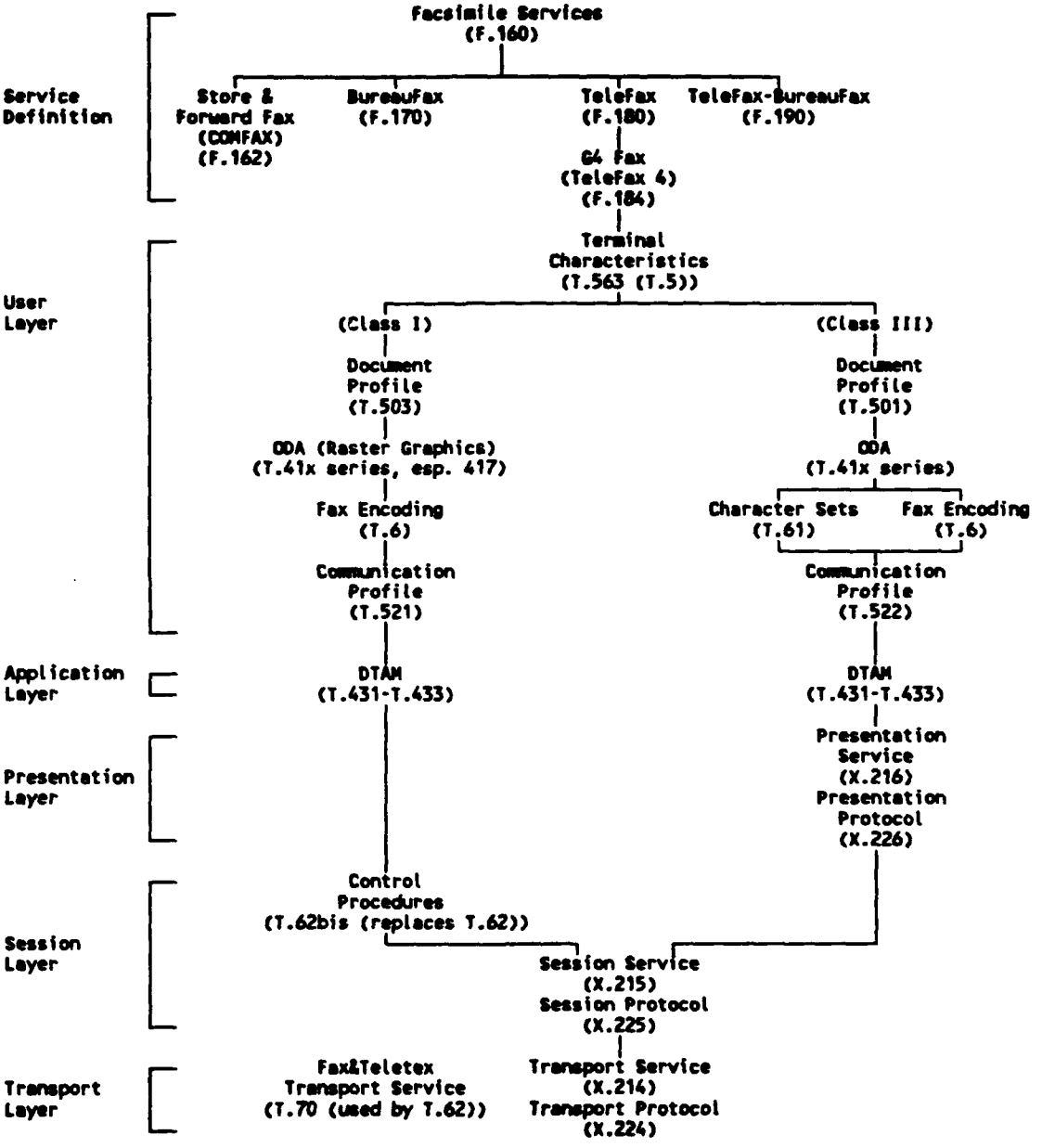

Figure 4.2. Hierarchy of CCITT Recommendations for Group 4 Facsimile

T.522, etc.). Group 4 Class 1 uses a protocol tailored to facsimile (formerly T.73). Group 4 Classes 2 and 3 use a general-purpose protocol designed to connect terminals to many different types of systems and equipments (computer systems, facsimile equipments, etc.).

This fracture exists for two main reasons: 1) T.73 was published prematurely, 2) Group 4 Class 1 was not required to be compatible with the general-purpose protocol. The general-purpose protocol adheres to the Open Document Architecture (ODA) and Document Transfer and Manipulation (DTAM) Recommendations (T.400 series). This series replaced T.73. Nevertheless, the premature publishing of T.73 allowed several manufacturers to build Group 4 equipments (especially Class 1) with the underlying assumption that the CCITT Group 4 Recommendations were stable. Unfortunately, this was not true.

At the time, the CCITT was considering incorporating into Group 4 the Open Systems Interconnection (OSI) concepts. OSI was developed by the International Organization for Standardization (ISO).[3],[4] It is designed to permit many different types of systems to communicate with one another (especially computer systems). The CCITT decided to make Group 4 OSI compliant. As a result, they replaced T.73 with the T.400 series Recommendations. This created a dilemma. The equipments made according to the original Recommendations (e.g., T.73) would no longer be Group 4 compliant. Manufacturers who had already made equipments requested that Group 4 Class 1 equipments keep their original protocol. They were accommodated. As a result, the CCITT excluded Group 4 Class 1 equipments from using the newer, OSI compliant protocol.

Since then several attempts have been made to bring Group 4 Class 1 equipments in line with the T.400 series Recommendations and the OSI standards (e.g., change from T.62 to T.62bis and change from T.70 to X.215, See Figure 4.2). Nevertheless, Group 4 Class 1 equipments are still unable to communicate with Group 4 Class 2 or Class 3 equipments, or vice versa.

4.4 Audiographic Terminals

According to the CCITT, an audiographic terminal (AGT) is meant to imply all equipment used in association with an audiographic service. This includes equipment to input, output, and process both audio and graphics. Some examples are scanners, cameras, electronic tablets and keyboards, computer systems,

printers, video displays, facsimile equipments, conference control equipment, microphones, and speakers. (See Table 4-7). Depending on user needs, this equipment may be in one device or several separate devices. An AGT should allow simultaneous viewing, manipulation, and oral discussion of an image on multiple AGTs. Some AGT systems are discussed in Section 4.2, "Personal Computer/Workstation." ICL's product is one example.

Table 4-7. Audiographic Options

Device	Capability	Examples
Facsimile	Paper reproductions, Delayed transmission, Permanent paper copies	Typewritten pages, Documents, Prepared graphics, Pictures
Telewriters	Hand-drawn graphics, Shown on TV monitors/ projection screens Instant transmission	Writing, Drawings, Outlines, Equations, Graphs
Computer Systems	Text and computer-drawn graphics, Instant transmission, Shown on TV monitors, Permanent paper copies	Alphanumerics, Diagrams, Graphs, Schematics, Charts
Random access microfiche and slide projectors	Microfiche images Slides	
Slow-scan television		

For AGTs, the intent is to use soft copy imagery as the primary conveyor of graphical information. This allows all participants to view the same documents simultaneously. Furthermore, they may discuss the documents using audio, pointers, and annotation devices.

At present, the standards defining how audiographic terminals interoperate are being developed by the CCITT. The emphasis is on optimizing the service for ISDN with integrated audio and graphics. So far, the standards include service requirements, operational procedures, quality of service, and terminal and network requirements. They do not yet include terminal interoperability.

In addition, the CCITT has decided that the higher levels of the teleconferencing protocols will consist of two parts. The first is a Conference

Control Protocol/Service (CCS). The second is a Multipoint Communication Protocol/Service (MCS)). They haven't decided how functions are divided between the two. Plus, adherence to OSI is a consideration.

Currently, five different proposals are under consideration. (See Figure 4.3.) Normally, a fully implemented OSI structure might have been implemented without

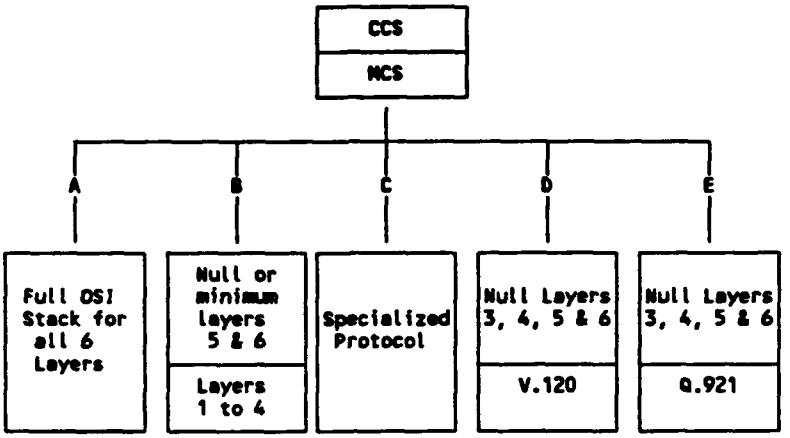

Figure 4.3. OSI Implementation in Teleconferencing

much discussion. A full implementation of OSI, however, may be unable to support real-time teleconferencing applications. For example, assume a presenter annotates a document during his presentation. Also assume that these annotations can be seen by the other conference participants via their AGTs. With a full OSI implementation, protocol delays might slow annotation transmissions. As a result, the annotations might not coincide with the oral presentation. This could cause confusion about the point the presenter is trying to make. Some of the proposals suggest ways the OSI overhead might be reduced to eliminate loss of synchronization. For example, some contain null OSI layers.

Although the roles of the CCS and the MCS are incomplete, broad guidelines for them are emerging. The CCS will probably provide all control aspects of a teleconference. This includes capabilities like establishing or de-establishing the conference, controlling who joins the conference, controlling who is the presenter, and controlling network resources. The MCS will probably provide the underlying mechanism to accomplish the CCS functions. For example, the CCS might specify that a particular AGT will transmit a facsimile while all other AGTs must receive the facsimile. The MCS would then negotiate common facsimile capabilities.

4.5 VIDEO TELECONFERENCING

The primary use of video teleconferencing is for point-to-point and multipoint meetings that require motion images of participants or activities (e.g., videotapes). They typically emphasize personal interaction and facial expressions. The main benefits of video teleconferencing is that it helps organizations strategically place themselves and their products in the marketplace. For instance, a product might get to market sooner. Or, students might get to interact with experts in a particular field. These benefits usually overshadow the most often cited justification for teleconferencing: cost reductions realized by avoiding travel.

Video teleconferencing has three basic installation categories.

- Custom rooms
- Rollabouts
- Desktop systems

Many organizations choose to implement fully installed custom video teleconferencing rooms. At each location, a particular room is designated for video teleconferencing. The room is constructed or modified around certain requirements. This may include acoustical treatment and proper lighting arrangement. Typically display screens or monitors are built into the front wall, and cameras are placed unobtrusively. In general, the custom room is the most expensive approach. It can cost more than $200,000.00, depending on equipment and construction options.

Rollabouts are self-contained systems that may be moved from room to room. Although most manufacturers do not encourage buyers to think of them as truly portable. They are usually less expensive than custom rooms. Their starting price is typically around $14,000.

Desktop units reflect the concept of picture phones with options. These typically range in price from a few thousand dollars and up. They are usually meant for three or fewer participants at a particular unit.

4.5.1 Basic Elements

The basic elements of a video teleconferencing system are video, audio, graphics (e.g., fax, annotation devices, pointers), and conference control subsystems. (See Figure 4.4). In general, a camera can comfortably frame three seated participants and capture enough detail to communicate facial expressions or subtle body motions. There are two ways of framing more than three people at a location: continuous presentation and camera switching. With continuous presentation split screens are used to display up to six people on a display. This stacked configuration is known as the "Hollywood Squares" view. Sometimes separate monitors are used for each group to provide a panoramic view. The participants appear just as they do in the distant conference room. A disadvantage of this approach is that the design is usually limited to six active participants.

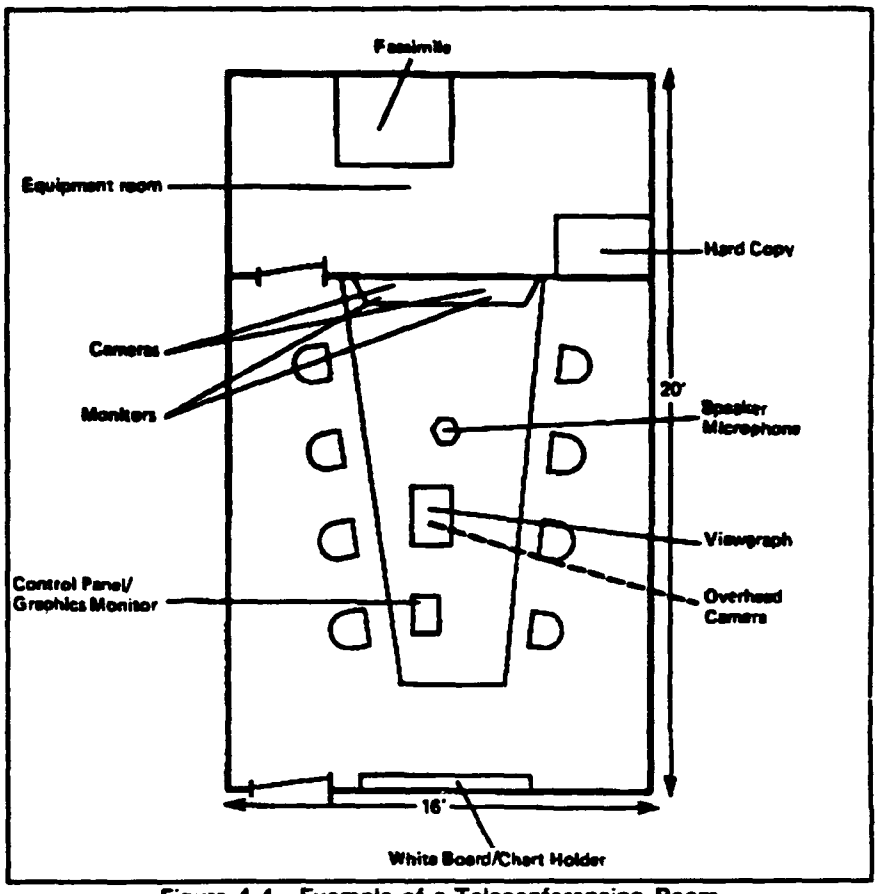

Figure 4.4. Example of a Teleconferencing Room

Another way to accommodate more than three people is by using camera switching. Camera switching is usually voice-activated or manually controlled. Of the two, voice-activated is usually more user friendly. The sound system determines who is speaking, then it enables the camera associated with the speaker and transmits his image to distant locations. This type of system works for a large number of participants. For lively discussions where excessive switching may occur, most systems offer a manual override that allows a

chairperson to take control.

Audio, as noted before, is the most important element of a teleconference. (See Section 4.2.1.1, "Audio.") Without audio, or with poor audio, a video teleconference is likely to fail. Humans are more likely to accept poor video than they are poor audio. If a picture is fuzzy, important details are usually still discernable. If audio is poor, however, participants may be unable to understand one another.

Conference control is usually provided by a room controller. Room controllers typically come in two flavors: wired and remote. They provide the means to control both the conference and conference room assets. Typically, wired controllers are custom-designed arrays of buttons, switches, potentiometers, and joy sticks. Newer systems use keyboards and touch sensitive matrix boards. Some are built into the conference table. All are connected by cable to the conference equipment. Remote controllers often use infra-red light to connect them to the conference equipment. Their advantage is that participants may easily share the controller. Their disadvantages are that they often have limited buttons and operate on batteries. If the batteries fail during a conference, the conference could be disrupted. Another disadvantage is that the remotes can be misplaced.

4.5.2 Data Transmission

To make video teleconferencing economically feasible, the video portion of the data stream must be reduced. A single video signal uses the equivalent communications capacity of over 3,500 simultaneous telephone calls. To reduce this bandwidth, digital compression by video coder/decoders (codecs) is often used.

Typically, video images occur at a frame rate of thirty frames/s. From one frame to the next, the video image usually remains fairly constant. Video codecs take advantage of redundant frame-to-frame information to reduce the video bandwidth. Only the video information that changes from one frame to the next is usually sent. A set of five Recommendations (H.261, H.242, H. 230, and H. 320) collectively define an audiovisual terminal for providing video teleconferencing (VTC) and video telephony (VT) services over the ISDN and Videophone (VP) services. These Recommendations are commonly referred to as P x 64 since they define systems operating at multiples of 64 Kbps.

Recommendation H.261, "*Video codec for audiovisual services at P x 64 kbit/s*," specifices the video coding algorithms, the picture format, and forward error correction techniques for the audiovisual terminal.

Figure 4.5 is a functional block diagram of the video codec as defined in Recommendation H.261. The heart of the system is the source coder which compresses the incoming video signal by reducing redundancy inherent in the TV signal. The multiplexer combines the compressed data with various side information which indicates alternative modes of operation. A transmission buffer is employed to smooth the varying bit rate from the source encoder to adapt it for the fixed bit rate communication channel. A transmission coder includes functions such as forward error control to prepare the signal for the data link.

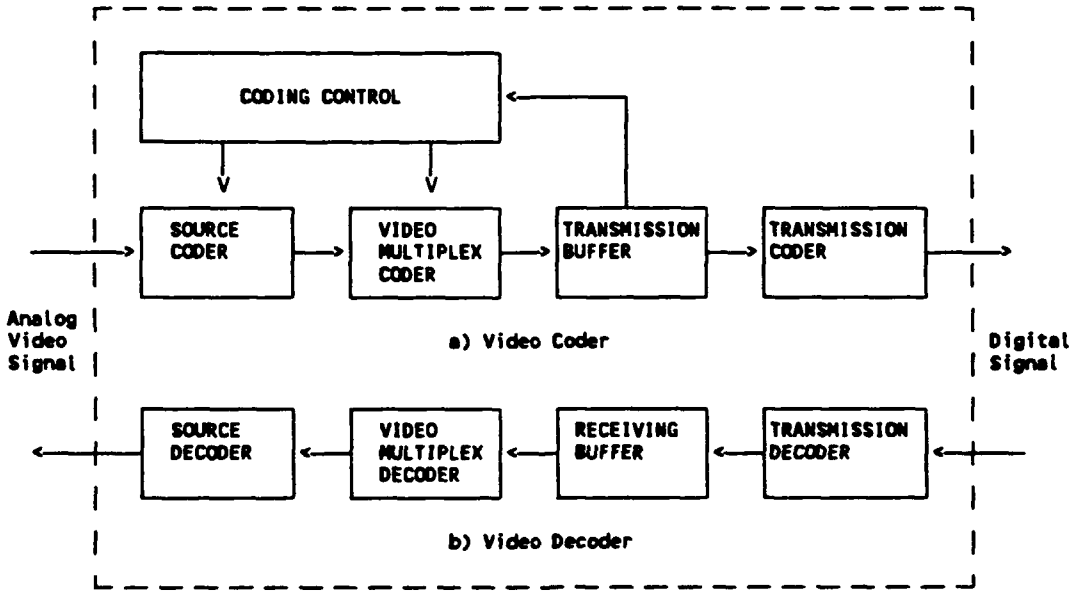

Figure 4.5. Block Diagram of the Video Codec

One of the most challenging problems to be solved by the codec was the reconciliation of the incompatibility between European TV standards (PAL, SECAM) and those in most other areas of the world (NTSC). This conflict was resolved by adopting CIF and QCIF as the picture structure that must be used for any transmission adhering to H.261. See Section 4.2.1.4, "Video," for a discussion about CIF and QCIF picture formats. It is expected that the full CIF format will be used for teleconferencing where several people must be viewed in a conference room.

Although P x 64 systems manufactured by different vendors will be interoperable, they will not provide the same picture quality. The H.261 standard does not define (1) the strategy to be employed by the encoder, (2) which blocks will be transmitted, (3) what type of code, and (4) the coding precision. The picture quality for VTC/VP systems to ensure a specifiable quality of service can be delivered to the user community. Since the basic building block of the ISDN is the B channel operating at 64 Kbps, the generic term "P x 64 Kbps" referes to operation of this terminial at integral values of P up to a maximum of 30. Values of P that are of greatest interest are 1,2,6,12,24, and 30.

Recommendation H.230, "*Frame synchronous control and indication signals for audiovisual systems*," defines the C&I symbols related to video, audio, maintenance, and multipoint. Second, it contains a table of escape codes that clarify the circumstances under which some C&I functions are mandatory and others optional. Presently, standards do not exist for multipoint operation of H.320/P x 64 terminals. Nevertheless, work is underway on three CCITT Recommendations to fill this void. The three proposed recommendations are listed below.

AV.231	Multipoint control unit for audiovisual services
AV.243	System for establishing communication between three or more audiovisual terminals using digital channels up to 2mbit/s
AV.440	Call-control procedures for real-time audiovisual conference calls

4.5.3 Video Conferencing Products

Motion Video codecs are at the core of digital videoconferencing networks. Table 4-8 shows some of the manufacturers whose codecs adhere to H.261. MCUs are needed for multipoint operation. Due to the lack of multipoint standards, most MCUs are product specific. They usually do not work with other vendors' codecs. Some MCU manufacturers are shown in Table 4-9.

Table 4-8. Motion Video Codec Products

Manufacturer	Product	Price	Data rates	Comments
BT North America	VC2200 VC2100	43,000 45,000	56 to 112 kb/s 56 kb/s to 1.544 Mb/s	Full motion compensation
GPT Video Systems	System 261 System 261 Twin Channel	51,000 49,500	56/64 kb/s to 2.048 Mb/s 56/64 kb/s to 112/128 kb/s	
Mitsubishi Electronics	MVC-8000	29,000	56 to 384 kb/s	
Video Telecom Corporation	MM386 MediaConferencing	40,000	56 to 384 kb/s	Built in 80386 PC

Table 4-9. MCU Products

Manufacturer	Product	Price
BT North America	VC4100	150,000
GPT Video Systems	System 261 MCU	140,000
Video Telecom Corporation	MultiMax MCU	70,000

4.6 Video Phone

AT&T displayed the first video phone (PICTUREPHONE) more than 28 years ago at the 1963 World's Fair. The phone used black-and-white video and was never really sold commercially. PICTUREPHONE was intended for face-to-face communications and included a means for transmitting low resolution graphics. PICTUREPHONE used a picture size of 5½ by 5 inches. It could display a head and shoulders view of the user while allowing for some side to side movement. As in broadcast television, two-to-one interlace was used with a frame rate of 30 frames/s. Each frame consists of approximately 250 lines. To transmit the signal, approximately 1 MHz of bandwidth was required.

Transmission of the PICTUREPHONE signals was envisioned as consisting of three cable pairs. (See Figure 4.6). One pair for each direction of video transmission, and a third pair for two-way voice. Dialing was to be accomplished over the voice pair. The video was to be switched at local offices by a video switch that was slaved to the voice switch.

Today, AT&T is again offering a video phone. (See Figure 4.7). This one uses a regular telephone line. The video phone sends audio and color video by

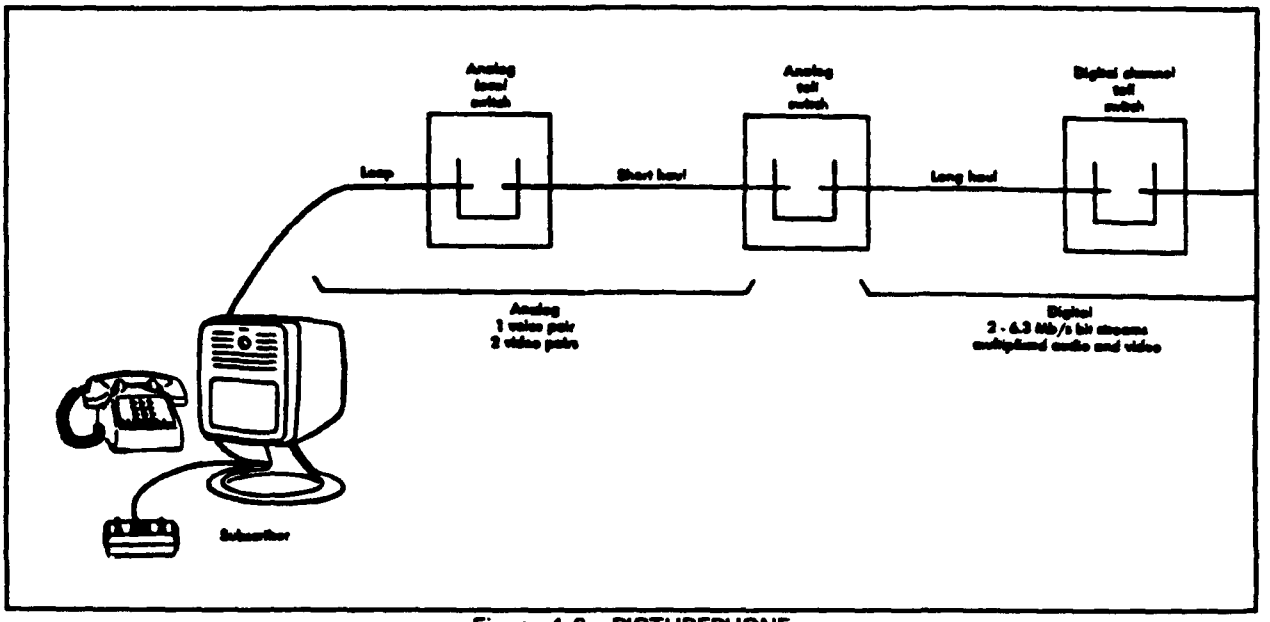

Figure 4.6. PICTUREPHONE

using a 19.2 kb/s modem. Of which, 6.8 kb/s is used for audio and between 9.6 kb/s and 11 kb/s is used for video. The remaining 1.4 to 2.8 kb/s is for system overhead. The phone delivers up to 10 frames/s depending on the amount of motion in the picture.

This is fast enough to capture changing facial expressions. Maximum picture resolution is 128 by 112 pixels on a 3.3-inch-square LCD. It does not adhere to the H.261 standard. It uses IIT's vision processor chip. The chip is also at the heart of IIT's IVM. (See Section 4.2.2.2.3.) The IVM can adhere to H.261. The proprietary compression algorithm for AT&T's video phone was defined by Compression Labs, Inc. ISDN and recent teleconferencing efforts may make the widespread use of full-motion video phones a reality. AT&T's video phone is not a ISDN equipment. Nevertheless, it does demonstrate the ability of compression algorithms to expand

Figure 4.7. AT&T Videophone

the effective bandwidth of a transmission channel.

Some manufacturers (e.g., Fujitsu, Mitsubishi, OKI and Toshiba) do make video phones for ISDN. These video phones are similar to AT&T's. They send color video at rates starting at 5 frames/s to 15 frames/s. Video phones using QCIF will probably achieve, or come close to achieving, full-motion. Some, like Mitsubishi's, conform to H.261.

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5.0 TASK 4 - APPLICATION ANALYSIS

5.1 Tradeoff Analysis

The U.S. Army has stated an intention to implement high-speed, digital communications systems to support its sustaining base information systems. ISDN and FDDI have been cited as selected media.

A MITRE study, Army Installation-Level Information Transfer System Assessment (Draft), 3 July 1991 describes 120 Army installations which are being considered for upgrade to digital/ISDN capability under the Macom Telephone Modernization Program (MTMP). Various alternative implementation plans are under study. Integrated Services Digital Networks (ISDN) provide an infrastructure networking capability to support enumerable user applications. Application categories generally include voice, data, text, imagery, and video.

The number of alternatives facing Army decision makers regarding MTMP implementation strategies, intra-installation networking architectures, and functional application selections is immense. In this era of constrained budgets the right choices have to be made. Choices that will not only be cost effective but will actually result in O & M cost reductions are highly desirable.

5.1.1 Purpcse of this Section

The purpose of this section is to define an approach to tradeoff analysis model development which will lay the groundwork for development of a decision support tool in the future.

5.1.2 Scope

This phase 1 SBIR study is very restricted in resources and time. This tradeoff analysis will be restricted to the most important aspects of the decision problem. An abbreviated, non-computerized analysis will be completed to demonstrated the method and to provide preliminary results. Discussion will consider sustaining base communications and information transfer and will not cover the tactical mission area.

5.1.3 Assumptions

It is assumed that the Army will proceed with the MTMP and that most bases will be ISDN capable by the mid 1990s. Further, it is assumed that FTS-2000 will proceed with implementation of ISDN. Based on Section 2 of this report it is highly probable that commercial ISDN will be available at most Army installations if it has not developed its own infrastructure. Therefore, cost benefit tradeoff discussions below will be based on cost of using the ISDN infrastructure and not consider the cost of acquiring that infrastructure.

5.1.4 Cost/Benefit Discussion and Definitions

Although decreased cost could be considered as a benefit, in this discussion, costs are considered separately from benefits. Further, benefits which can be quantified and evaluated at the functional level may have an additional indirect benefit at the organizational level which is of even greater importance.

5.1.4.1 Benefits

Benefits are sometimes difficult to quantify. Benefits accrue when the operational mission performance is improved through higher quality or faster response time.

5.1.4.1.1 Quality

Certain benefits may accrue that are separate from the computer, or data communications implementations benefits. These indirect benefits could be reflected in the quality of the function being supported by the applications programs. For example, improved training will result in a more effective soldier in the field.

5.1.4.1.2 Response Time

The time required to implement a multimedia call setup with ISDN may be greatly reduced when compared with setting up sessions via such media as T1 leased lines for video conferencing.

5.1.4.1.3 Modernized Infrastructure

The implementation of an ISDN infrastructure and implementation of ISDN applications represent a "chicken and egg" situation. The infrastructure is not cost effective unless it is used. As it is used it becomes more widespread and available and it enables more applications which further increase its effectiveness. Benefits are thus derived that are greater than from the specific application itself.

5.1.4.1.4 Organizational Benefits

Benefits may accrue to a military organization in abstract ways such as improved morale of troops derived from working with modern, efficient, high tech equipment.

5.1.4.2 Costs

Dollar values can be assigned where manhours are saved, travel costs are obviated, equipment does not need to be bought, etc.

5.1.4.2.1 ISDN Access Costs

ISDN access costs will vary depending on the number and type of channels used. Local D channel and at least one B channel are sunk costs. Additional B channels, H channels, or Primary Rate Access will carry additional costs. The underlying feature of lower costs from ISDN usage comes from the capacity on demand attribute. In other words, you pay for only what you use. Present systems usually involve leasing high data rate lines for blocks of time.

5.1.4.2.2 Off-The-Shelf (OTS) Software and Hardware Costs

ISDN is envisioned to become widely available and used throughout the United States and the World during the 1990s. This will apply to the Department of Defense (DoD) as well as the commercial world. As the market for ISDN applications proliferate, software and hardware will become widely available on the open market. All but unique presentation and applications content will be available as OTS purchases.

5.1.4.2.3 Unique Applications and Presentation Software Development

A distinct advantage of ISDN implemented applications will be in the reduced software development costs. In terms of the OSI 7-level architecture, the lower three levels of communications software become a part of the ISDN infrastructure itself. The mid level software should be available as OTS products. Only the Presentation and Applications levels of software should need to be developed by the user.

5.1.4.2.4 Training Costs

Initial implementation of ISDN and ISDN applications will require significant user training. However, training costs should decline over time due to the standardization afforded by ISDN. The system will be somewhat analogous to the graphical user interfaces (GUI) impact on using PCs and Mackintosh computers.

5.1.4.2.5 Operations Costs

This class of costs includes all service personnel, facilities, travel, communications, and logistics support for the functional area which the application being evaluated supports. Reduction of operations costs is considered to be the primary opportunity of implementing many ISDN supported applications. Functions such a group-work document development, remote training, and distributed simulation and war gaming offer significant opportunities for reduction of operations costs. (The future tradeoff model would contain page-segment spreadsheet quantification for each of these subcategories of costs.)

5.1.4.2.6 Maintenance Costs

This class of costs includes data administration, software maintenance, and applications hardware maintenance and upgrade costs. Although significant, these costs should be reasonably stable over time and possibly decline in later years as ISDN applications proliferate.

5.1.4.2.7 Hardware Costs

Hardware for a great number of ISDN applications are becoming common commodities. Prices are dropping as sales build up. Hardware to provide ISDN interfaces are becoming commonplace. PC cards to support image transfer, video compression, file transfer management, etc, are also commonly available. Prices are dropping steadily. With the exception of video codecs, prices for most cards are in the hundreds of dollars range.

5.1.5 Modeling Approach

A general model is required that can be adapted and modified. A methodology for quantifying and summing a variety of parameters will be necessary. Precision of the model should be suited to the accuracy of the available data and the ability of the decision maker to use and fully comprehend the results of the model.

5.1.5.1 General Methodology

The model will run on a Personal Computer (IBM or compatible) with OTS software such as Lotus 123.

5.1.5.1.1 Enterprise Model

Reference Information Engineering (IE) Concepts. In this report we are postulating an enterprise for a limited set of applications. In the future, it will be necessary to develop a set of generic enterprise models for the user applications to be covered.

5.1.5.2 Costs Accumulation

Costs are accumulated from the many sources and as a function of time, usually several years.

5.1.5.3 Benefits Accumulation

Benefits are accumulated from many sources and as a function of time using the same time period as costs.

5.1.5.4 Model Structure

A spreadsheet model which uses a standard layout page segments for each category of costs and benefits is needed. Various roll-up page segments will accumulate the costs and benefits in appropriate subcategories and top level categories. A net present value (NPV) top level figure of merit would be calculated and presented in graphical form. Options would be provided to the user which allow playing "what if?" with the applications definitions, deployment start and completion times, network topologies, and operational scenarios.

The segmented-page spreadsheets support decomposition of the problem to enable the user to better understand the discrete elements of the analysis. A user can review a particular cost element such as cost of software maintenance as a function of time and analyze its impact on the overall result. This approach supports model sensitivity analysis.

5.1.5.4.1 Net Present Value

Beginning year dollars as the standard for assessment. Future models will be based on NPV. NPV models allow accurate analysis of scenarios which involve significant cost investments in lump sums or with front end loading with benefits accruing over an extended time. Positive "cash flow" occurrences can be found, NPV ($) at the end of the evaluation period can be calculated , or internal rates of return (IRR) can be calculated for the entire program.

5.1.5.4.2 Applications Categories

Voice, data, text, image, and video. Intermediate roll up of specific applications data would be made to these applications categories. This will support analysis of the viability of these types of functional applications for further research and deployment. Such analyses would support strategic planning.

5.1.5.4.3 Scenarios

Evaluation of ISDN applications for the Army environment is very dependent on the operational scenario selected. A particular applications might be very expensive to implement and provide no cost reductions if implemented in 1994 but might be very cost effective if implemented in 1996 after a significant cost reduction in equipment. Similarly, early implementation of an application before a the appropriate installation switches are all upgraded to ISDN might result in a very ineffective system operationally. A thorough trade off analysis will consider several operational scenarios including various deployment dates, deployment rates, network configurations, etc.

5.1.6 Analysis of Selected Applications Areas

Within the limited scope of this report we will discuss costs and benefits of those areas demonstrated in our test bed.

5.1.6.1 Distributed Access to Multi-media Database

As described in Section 6 of this report, we conducted experiments using B-channel packet switching between three PCs via an AT&T 5ESS switch.

5.1.6.1.1 Benefits

Quality - A common database accessed by multiple, remote installations will provide more current and accurate data. (Or at least all will be using the same data.)

Response Time - Response time for our experiment was very fast (seconds) and one was given the feeling that you were accessing a local database.

Organizational - The common database system has potential for increasing confidence in the decision making process based on such data and as such might improve troop morale and performance.

Operational - The ability to remotely update and access a common database in a rapid and efficient manner could increase the operational effectiveness of military units.

5.1.6.1.2 Costs

Access (communications) - B-channel packet switching will involve minimal monthly costs in the local switch area and will probably have minimal charges per packet on a long distance network.

OTS Hardware & Software - PC-based ISDN cards,image compression cards and packet networking cards with their associated software are available OTS in the one-thousand dollar per card range. Prices in quantities should be lower. Prices will fall in the future. Common database software can be used.

Software Development (Unique applications and presentation) - Minimal software was required. A few hundred lines of code to obtain user friendly interfaces is recommended.

Training - A few hours of training is all that will be required. A skilled PC user could operate this system with no training.

Operations - Operations costs should decline compared with present database operations costs in that file transfer database updates will be eliminated, the common database will be easier to validate, and data can be continually updated versus block updated. Workload at the remote site should be reduced.

Maintenance - Maintenance costs for the hardware and software should be minimal in that all equipment is standard and built into the PC. Maintenance of the database should be reduced as it is a single, common database versus numerous, distributed copies of a database.

Hardware (Unique) - Unique hardware could run up to $3000 at today's prices. Some common usage of this hardware is envisioned where other ISDN applications will be included in the same PC.

5.1.6.2 Image Transfer Systems

Also described in Section 6.0 is a demonstration experiment involving transfer of a high resolution image using B-channel packets. This demo involved transmitting an NTSC generated image between two PC work stations via the AT&T 5ESS switch.

5.1.6.2.1 Benefits

Quality - This rapidly acquired and transmitted image is of high quality,and full color. Quality can be improved further at the expense of time. The quality is much greater than that available from facsimile transmission.

Response Time - Transmission of a full screen, NTSC image took about 8 seconds. ISDN would permit this kind of response in a common access environment at low cost.

Organizational - The common availability of quality images to support organizational functions could improve the way of doing business and result in positive organizational changes.

Operational - The common availability of these images could add a new dimension to the decision making process and support more accurate decisions.

5.1.6.2.2 Costs

Access (communications) - Same arguments as for central database applications. This is a low cost item. Overall costs should be lower than the database as transmission sessions should be much shorter.

OTS Hardware & Software - The test bed demonstration was built up from all OTS hardware and software. Costs involved purchase of image capture and compression cards and the ISDN interface cards. A standard NTSC video camera was used to obtain the image. Costs are estimated at the $4000 per location at today's prices.

Software Development (Unique applications and presentation) - None. Some user interface development to improve user friendliness is recommended.

Training - Little or no training is required for operational use. Some training for equipment maintenance would be required.

Operations - Although adding this new capability to the facility will involve added operational functions an overall reduction in operational costs should result if high resolution images are germane to the operations.

Maintenance - Maintenance for the hardware and software should be minimal in that all equipment is standard and built into the PC with the exception of the image acquisition equipment (camera).

Hardware (Unique) - No user developed hardware was required.

5.1.6.3 Video Conferencing

Although it was not demonstrated to the government visitors, the GTE test bed previously contained a video conferencing system. We therefore will discuss the system based on our prior experience. Our system involved use of a basic rate access (BRI) using 2 B channels and the D channel. Voice was included in the

video transmission. PictureTel codecs were used. The circuit switched mode was used.

5.1.6.3.1 Benefits

Quality - The wide availability of video conferencing should support better decision making and provide a quality improvement in communications between widely separated personnel.

Response Time - Under an ISDN environment, this capability is available as dial up, on demand. Picture transmission was virtually instantaneous depending on the amount of motion in the images.

Organizational - The wide availability of video conferencing should result in reduced travel and a more efficient operation. Manpower reductions can be anticipated. The elimination of the present, high-quality, high-cost, dedicated video conferencing centers could result.

Operational - The ability to expeditiously convene conferences and obtain rapid communications, understanding, and decision making should improve operational effectiveness.

5.1.6.3.2 Costs

Access (Communications) - Video conferencing will usually involve long distance calling. This application operates in the circuit switch mode and therefore takes a BRI connection for the period of the conference. The costs will be comparable with the present long distance call. ISDN allows adding and dropping conferees dynamically. Costs should be substantially lower than present day methods of leasing T1 lines for video conferencing.

OTS Hardware & Software - All equipment and software was available OTS. Costs are driven by the codecs which run in the $20,000 plus range. Recent announcements indicate that comparable quality codecs built on PC cards will be

available shortly in the $5000 range. These costs compare favorably with the cost of the dedicated, high quality video conferencing systems being used by the Army.

Software Development (Unique applications and presentation) - None was required.

Training - Operational training should be minimal. Maintenance training will be required.

Operations - Operations costs should be substantially reduced by elimination of TDY costs and lost man hours consumed by travel.

Maintenance - Maintenance costs for the hardware systems will be nominal. There should be no software maintenance costs. Maintenance costs will increase over the life time of the equipment.

Hardware (Unique) - No unique hardware should be required.

5.1.7 Conclusions and Recommendations

In evaluating ISDN Applications in the Army Environment it is not possible at this time to make an accurate, quantitative analysis that really nails down the specific applications to select. However, it is possible to identify those areas which are most promising. Further investigation will be necessary. Enterprise models as well as trade off analysis models need to be completed.

5.2 Identification of High Payoff Applications

Of the six application areas for terminal equipments, the personal computer/ workstation is the one that could provide the highest payoff. It provides the most functionality per dollar. The other categories do not provide high payoffs or are expensive to implement. For example, ISDN telephone and fax are unlikely to affect significantly how the ARMY accomplishes its mission. (ISDN telephone includes video phone.) Most of their capabilities are already provided by the non-ISDN telephone services. Video teleconferencing can, but is usually expensive to implement. Of the categories investigated, personal computer/workstation and

audiographic terminals might be the preferred candidates. (Note, they are basically the same.) They can provide several services that are synergistic, inexpensively.

The ARMY's mission can be significantly affected by a multipoint, multimedia PC-based terminal that incorporates video. Plus, these additional capabilities could be added inexpensively. Table 5-1 compares the various application categories.

Table 5-1. Application Payoff Comparison

Terminal Category	Number of Existing Applications	Implementation Cost	Application Payoff
Telephone	High	Medium	Low
Personal Computer/Workstation	Low	Low	High
Facsimile	Low	High	Low
Audiographic Terminals	Low	Medium	High
Video Teleconferencing	High	High	High
Video Phone	High	High	Low

The table indicates that the personal computer terminal couples high payoff with low cost. These terminals could permit users to converse easily, discuss documents, and share files. Users could be at different geographically remote locations. Such teleconferences emulate in-person meetings. Using these terminals could not only reduce or eliminate travel costs, but could dramatically shorten project efforts. This is possible because delays are eliminated. Delays like waiting for mailed documents or travel time to meetings. Plus, the terminals can provide a simple, user-friendly teleconferencing mechanism. By doing so, the conferencing mechanisms become almost transparent. In addition, the sense of an in-person meeting is heightened by the terminals' capability to provide a head-and-shoulders view of the speaker.

The terminals could take advantage of IBM PCs or compatibles that the ARMY already owns. The multipoint multimedia capabilities could be added by

upgrading the PCs. The upgrades might include a few peripherals, PC cards and software. This approach helps reduce implementation costs. These terminals could be used in several applications. A few applications are desktop conferencing, helpdesks, and information retrieval systems.

6.0 TASK 5 - PHASE 1 DEMONSTRATIONS

Demonstrations of ISDN capabilities were performed in GTE's ISDN Test Bed Laboratory, located in the Wohlstetter Technology Park in Chantilly, VA. The ISDN test bed is currently configured for ISDN Basic Rate (BR) and X.25 packet switching over Bearer (B) channels. The flexible design of the test bed allows for multifunctional applications which can easily be added or deleted from the base configuration. Provided below are descriptions of the three major applications demonstrated along with detailed procedures and results.

6.1 ISDN Test Bed

Three applications were demonstrated: 1) ISDN Telephone Sets with Protocol Monitoring; 2) Image Transfer System, and; 3) centralized ISDN Image/Text Retrieval System via an X.25 WAN (Wide Area Network). The ISDN signals are routed through a dedicated line card on an AT&T 5ESS switch at GTE's Dulles facility. Figure 6.1 shows a conceptual block diagram of the end-to-end system. Figure 6.2 shows the current equipment layout of the ISDN test bed in the laboratory. The GTE ISDN test bed includes an outstanding suite of test equipment.

6.1.1 ISDN Telephone Sets with Protocol Monitoring

GTE's ISDN Test Bed includes telephone sets of several manufacturers. The application demonstration constituted the connection of two of these phone sets through an NT-1 interface unit to the 5ESS switch. The demonstration, which not only exhibited the clarity of the B-channel call revealed the ability to trap D-channel protocol transmission and display the information on a Tekelec Chameleon 32 Protocol Analyzer. The call transits an FMT-150 T1 multiplexer and a fiber optic link to the switch for a 1-way distance of approximately 10 kilometers.

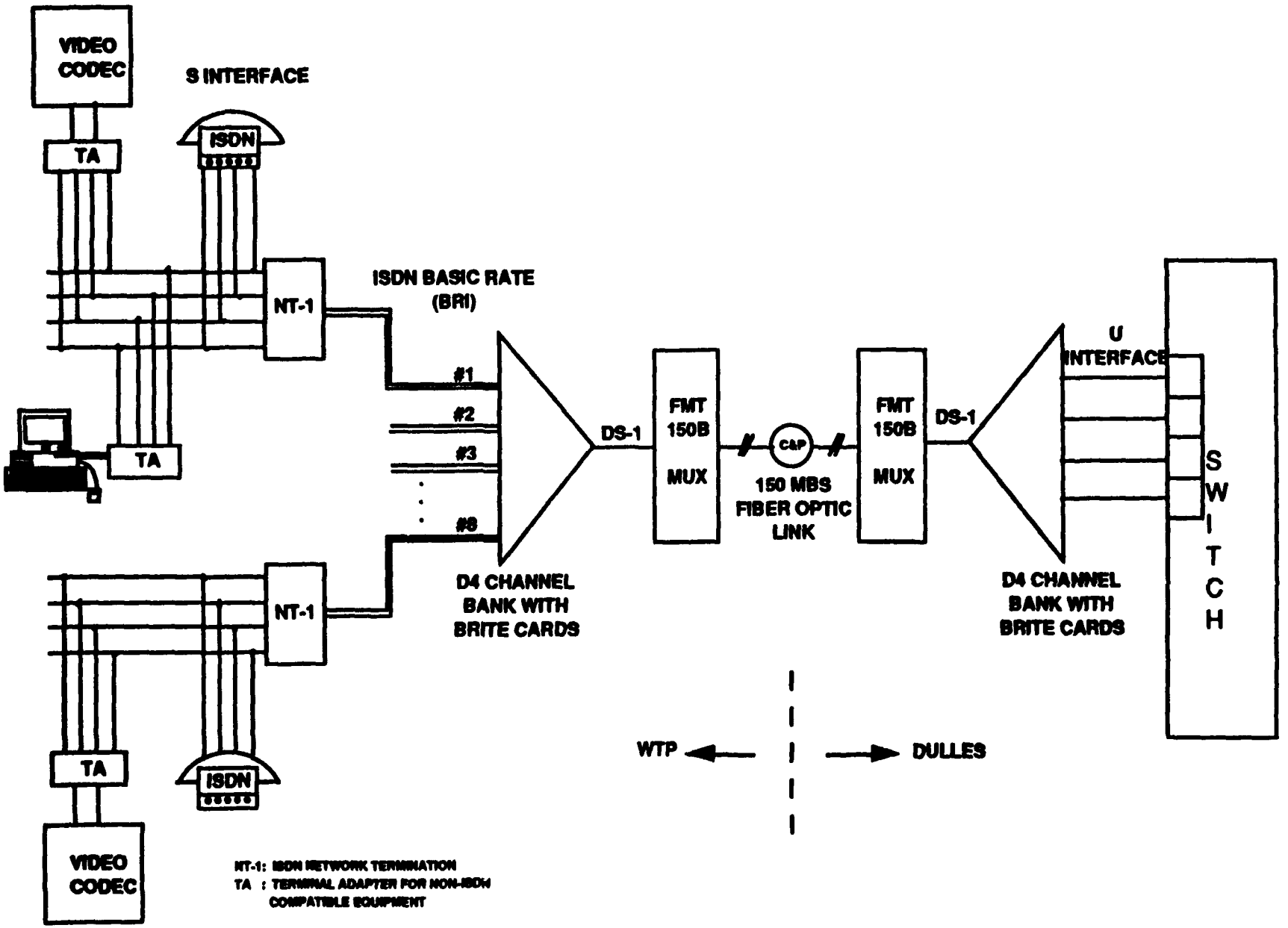

Figure 6.1 ISDN BASIC RATE SERVICE BLOCK DIAGRAM OVERVIEW

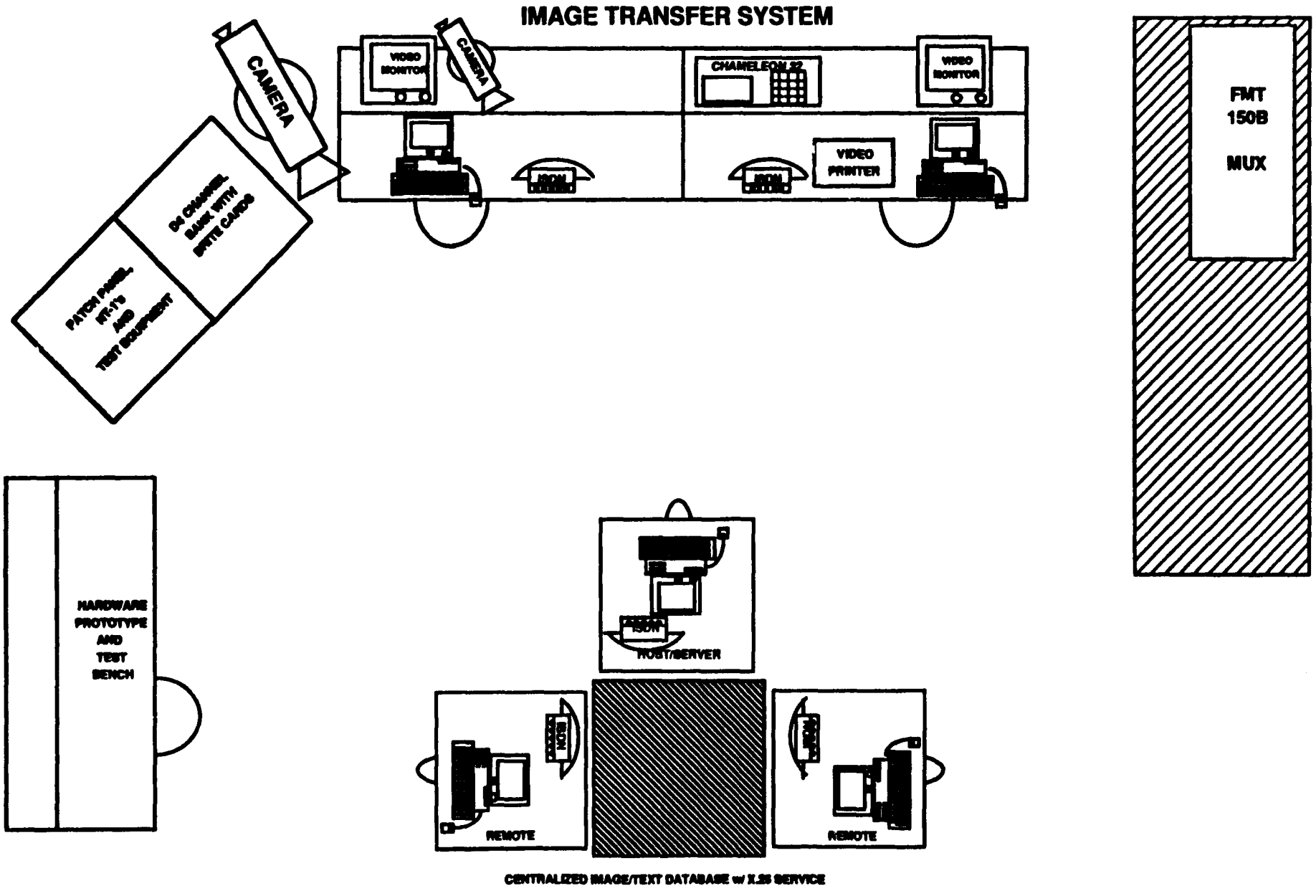

Figure 6.2 WTP ENGINEERING LAB ISDN TEST BED CONFIGURATION

6.1.2 Image Transfer System

The Image Transfer System can capture, compress and transmit a high resolution color image over 64 Kbps ISDN B-channel in approximately 8 seconds utilizing CCITT JPEG compression algorithm. This system architecture can be implemented at a relatively low cost.

The functional block diagram of the Image Transfer System is shown in Figure 6.3. At the transmit end, an image is captured by a video or still-image camera. The image signal in the form of NTSC (National Television Systems Committee) composite or analog RGB (Red, Green, Blue) video is sent to the frame grabber to be digitized. A digitized frame of approximately 500 Kbytes is then compressed utilizing the ISO/CCITT JPEG standard compression algorithm. The compressed image, 50-70 Kbytes, is then sent to the ISDN adapter which builds the frames for transmission over the ISDN B-channel. This procedure is reversed at the receive end.

The IBM PC/AT compatible host provides a development platform that is low cost and flexible. The frame grabber unit is a Truevision TARGA T16I board; the JPEG compression unit is a C-Cube IMPC/A board, and; the ISDN adaptor is a Digiboard tel/adapter board. Figure 6.4 depicts a simplified layout of this configuration.

The Image Transfer System has the capability to transmit video, audio and text over twisted pair copper local loops. It uses dial up circuits - not leased lines. The system is capable of editing, cropping, enlarging/reducing, and text or audio overlay. Figure 6.5 shows the physical layout of the Image Transfer System in the laboratory.

6.1.3 ISDN Image/Text Retrieval System

The second implemented application which the ISDN test bed provides is that of interconnection of three IBM PC/ATs distributed over an ISDN WAN. This network demonstrates the capability of interconnecting remote branch offices with headquarter's data processing center for resource sharing over a wide area environment. Although the speed offered by the IBM PC/AT network is slower than a conventional Ethernet network, its throughput more than suffices for the applications capable of being supported such as office E-mail, images of defective

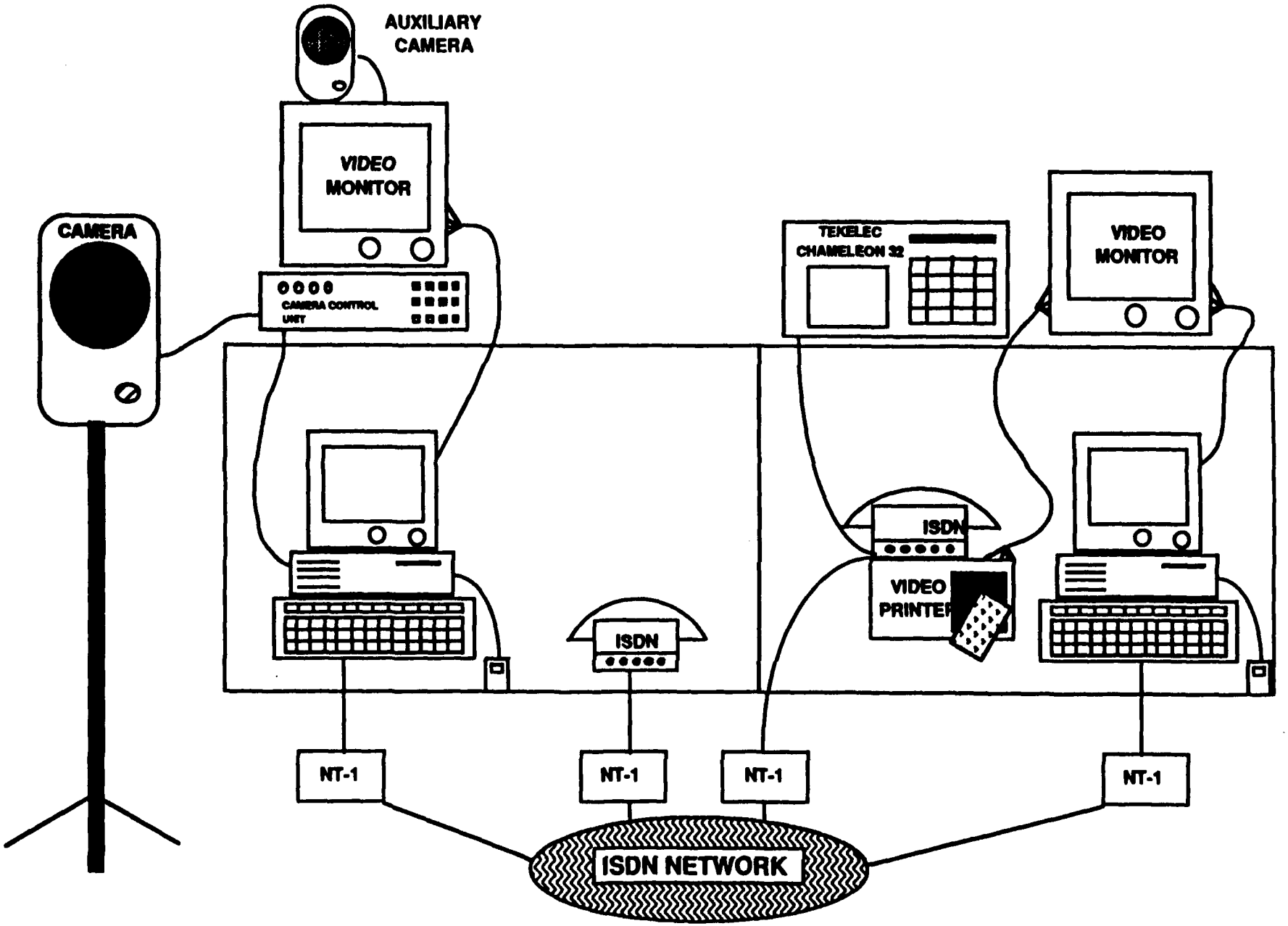

Figure 6.5 **ISDN IMAGE TRANSFER TEST BED**

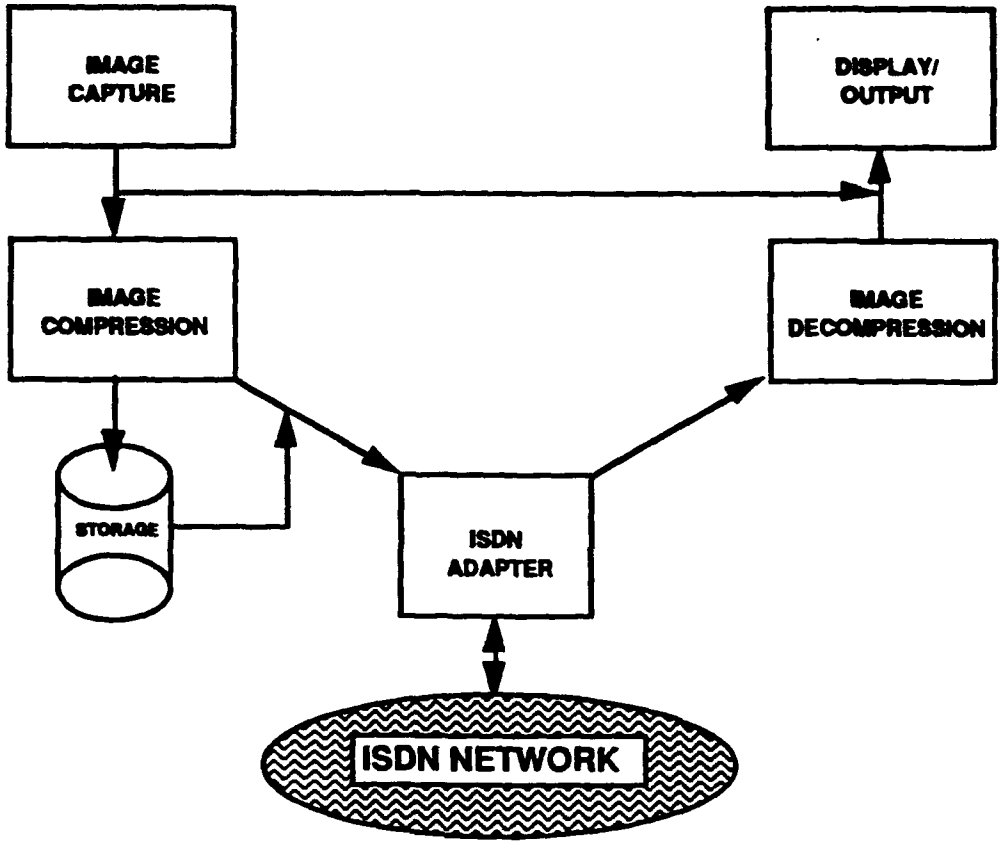

Figure 6.3
IMAGE TRANSFER SYSTEM
FUNCTIONAL DIAGRAM

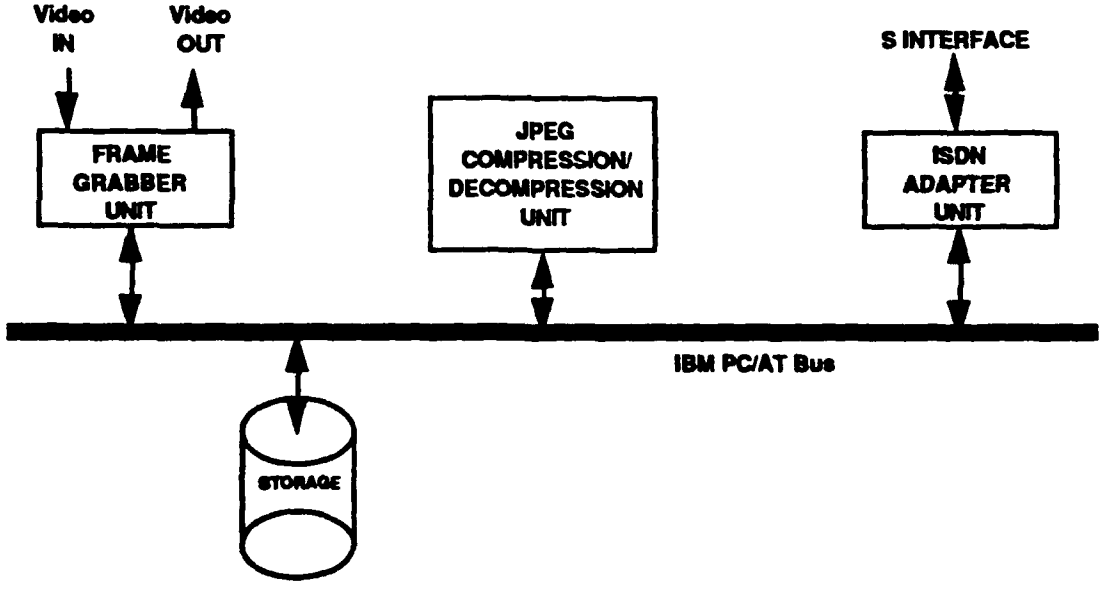

Figure 6.4
HARDWARE COMPONENTS FOR IMAGE TRANSFER SYSTEM

parts sent to central diagnostic center, medical images, and security monitoring.

This WAN has a star topology as depicted in Figure 6.6. The server is the network hub or host. The remote stations are interconnected to the hub via the ISDN network in the test bed. Figure 6.6 shows the conceptual layout of the WAN. Each PC has an on-board Digiboard tel/adapter board which is used to transmit or send image files via B-channel, X.25 packet-switched virtual circuit set up by the 5ESS switch. The server must be able to handle connections for each active node on the network, simultaneously. Due to required high data throughput, the server utilizes permanent B-channel packet service to handle large file transfers and multiple user access.

Image acquisition and compression boards are used to grab an image and compress the resulting image file to up to 1/15 of its original size. Various image/text data bases can easily be created for custom applications using *PC ALBUM®* software. A 4 Kbyte image file can be retrieved from a central database and displayed in approximately 5 seconds using a single ISDN B-channel.

6.1.4 Test Equipment

The ISDN test bed is supported by a large complement of test equipment:

TEKELEC CHAMELEON 32 (2 each)
FIREBERD 6000
FIREBERD MC6000
TTC 2100 SERIES LOOP EMULATOR
TTC 1020B DIGITAL ERROR SIMULATOR
TTC 101B DIGITAL DELAY SIMULATOR
TEKTRONICS 2225 50MHz OSCILLOSCOPE
MARCONI 2382/1 SPECTRUM ANALYZER w/ 2380 DISPLAY
HP 1651B LOGIC ANALYZER

6.2 Demonstrations

The test bed is currently configured to handle three demonstrations: 1) Telephone system; 2) Image Retrieval Network, and; 3) Image Transfer System.

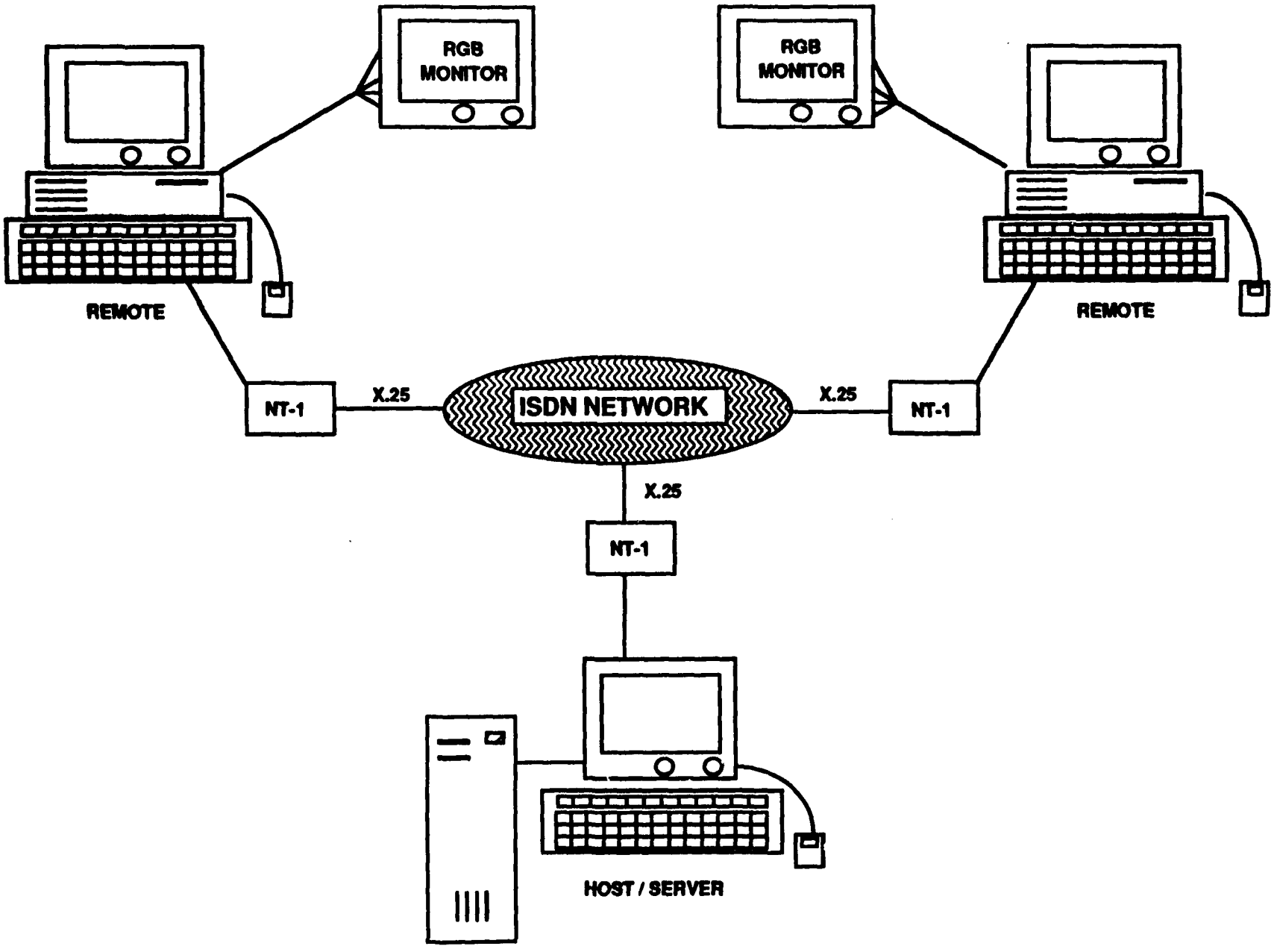

Figure 6.6 CENTRALIZED ISDN IMAGE/TEST RETRIEVAL SYSTEM TEST BED

6.2.1 ISDN Telephone Sets with Protocol Monitoring

This demonstration illustrates the call connection protocol between two ISDN compatible phone sets, monitored by a Chameleon 32.

6.2.1.1 Procedure

1. Power-on Chameleon 32

   - set up Chameleon 32 to monitor ISDN B-channel
   - choose to monitor:
     a. physical link only
     b. Q.921 protocol
     c. Q.931 protocol
     d. combinations of a, b & c

2. Take Call Originating Station Off-hook

   - either physically or utilizing the speaker phone function

3. Dial Phone Number to Destination Station

4. Monitor Activity on Chameleon 32

6.2.2 Image Transfer System

The Image Transfer System consists of two IBM PC/AT compatible 80286 machines, two SONY PVM-1344Q color video monitors, a SONY DXC-M7 video camera and CCU-M7 camera control unit, and a SONY UP-5000 color video printer.

6.2.2.1 Procedure

1. Power-on All Equipment for Image Transfer System

   - ~20 - 30 seconds for boot-up

2. Transmit End (A) Setup

   - type >**RGBIMG Listen *filename*** <CR>
   - watch for image on video monitor (A) and adjust camera if necessary (~10 seconds for setup + any time for adjustment)

3. Receive End (B) Setup

   - type >**RGBIMG phone # (A) *filename*** <CR>
   - screen on video monitor (B) should be snowy with no image visible (~10 seconds for setup)

4. Transmit Image from (A) to (B)

   - press F3
   - image on monitor (A) freezes and appears as still image on monitor (B). (~8 seconds)

5. Print Image (optional)

   Using keypad to color video printer:

   - press Memory In
   - press PRINT
   - process takes ~70 - 75 seconds

6. Transmit New Image

From Station (A)

- press F2
- repeat from step 4

6.2.3 Image Retrieval Network

The current network configuration employs three IBM PC/AT compatibles, one 80386 system as system host and two 80286 systems as remote users. The system utilizes B-channel, X.25 packet-switched service from the 5ESS switch at GTE's Dulles facility. Future plans include the incorporation of voice compression for multimedia transmission and the use of the D-channel.

The total response time is given by equation (1). This shows that the approximate overall system response time is approximately 5 seconds.

(1) $t_{response} = t_{proc} + t_{ISDN} + t_{search} + t_{access}$

$t_{response}$ = Overall System Response Time
(~5 seconds for a 4K image file)
t_{proc} = Image Decompression and Display Time
(< 3 seconds)
t_{ISDN} = Time Required to Transmit Request and
Image, Packet Overhead time and
Packet Switch Delay (~1 second)
t_{search} = Time Required to Search Database
(~1 second)
t_{access} = Disk Access Time (~65 milliseconds)

Three database files currently exist (Table 6-1) which can be demonstrated:

TABLE 6-1

DATABASE DIRECTORY	IMAGE FILE SIZE	RESPONSE TIME
MLS	6 - 14 Kbytes	3 - 5 seconds
PRSNL	~75 Kbytes	~22 seconds
TSL	3 - 9 Kbytes	2 - 4 seconds

6.2.3.1 Procedure

1. Power-on Host and All Active Nodes

   - ~20 - 30 seconds to power-on and boot-up

2. Host Setup

   - type **>start** <CR>

   Main Function Menu

   - down arrow key (↓) to **Login Logout** line
   - <CR> <CR>

   Activate Users

   - type **>Server name** <CR>
   - type **>User name** <CR>
   - type **>Password** <CR>
   - type **>Time & Date** <CR> (optional)

   Verify Setup (optional)

   - <ESC> back to Main Function Menu

- (↓) to Display system activity on server
- <CR> <CR>
- ID list should show host user name and each active node

3. Remote Setup

- type >start <CR>

PC Screen should show: C:\PCA

- type >pca <CR>

PC Screen should only show title information; PC Album MasterMenu and calendar should appear on RGB video monitor. (~2-3 seconds)

- (↓) to Select New Database or type S <CR>
- type ***Database name*** (if known) <CR>
- if database name not known:
  press F1 for listing and select database <CR>
- screen returns to PC Album Master Menu (upper left hand corner depicts selected database)
- Database Access/Reporting should be highlighted in PC Album Master Menu, if not select this choice
- <CR> <CR>

- Database Reporting Menu appears on video screen

- (↓) to View Data or type V <CR>

- to select records, locate data field you wish to key on and type in the desired attribute (more than one field may be chosen); to chose data fields:

- TAB go to next field
- shift TAB go to previous field
- (↑) go to field directly above current field
- (↓) go to field directly below current field

(NOTE: On-line help is available - press F1)

- press F2 to show first record (continuing to press F2 will step you through the records which are indexed by the chosen attributes
- press ESC ESC to return to Database Reporting Menu
- press ESC to return to PC Album Master Menu

- (↓) to Exit PC Album or type E to exit
- control is now returned to the PC monitor

6.3 Summary

In summary, three basic operations were demonstrated on the ISDN Test Bed. The above detailed procedures illustrates the ease of implementation and rapid response that can be accomplished over ISDN. Table 6-2 provides a timing summary which supports these conclusions.

To compare ISDN performance with other means of accomplishing these same tasks, one would simply scale the performance bases on transmission speeds. For example, a good modem operating over good public switched network (PSN) transmission lines can achieve a throughput of 9.6 Kbps. Basic rate ISDN can operate at 9.6, 64 or 128 Kbps. Primary rate ISDN can operate at NX 64 Kbps up to 1,472 Mbps. An ethernet LAN can operate at a maximum of 10 Mbps but usually provides an individual user about 1-3 Mbps of throughput. It can be seen that basic rate ISDN can provide service 7 to 15 times faster than the PSN. However, BRI ISDN is 7 to 15 times slower than an ethernet LAN. PRI ISDN will approximately equal the performance of an ethernet LAN.

The end result indicates that basic rate ISDN will prove to be a very effective

medium for these applications where wide area or metropolitan area transmission is required. LANs will prove more effective for both cost and performance if the LAN already exists. However, it may be more cost effective to use ISDN for local transmission if no LAN exists.

TABLE 6-2

DEMONSTRATION	SETUP TIME	TRANSMISSION TIME
Telephone System	1-2 minutes *	Virtual Real Time
Image Transfer System	40-90 seconds	~8 seconds
Image Retrieval Network	2-3 minutes †	
MLS (6-14 Mbyte files)		3-5 seconds
PRSNL (75 Kbyte files)		~22 seconds
TSL (3-9) Kbyte files)		2-4 seconds

* Majority of setup time is for Chameleon 32.

† Assumes entire system starts out cold. If all active nodes are up, then setup time reduces to 2-3 seconds.

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7.0 TASK 6 - PHASE II PROGRAM PLAN

7.1 Overview

Work on the Phase II program will be organized into six tasks. They are listed below.

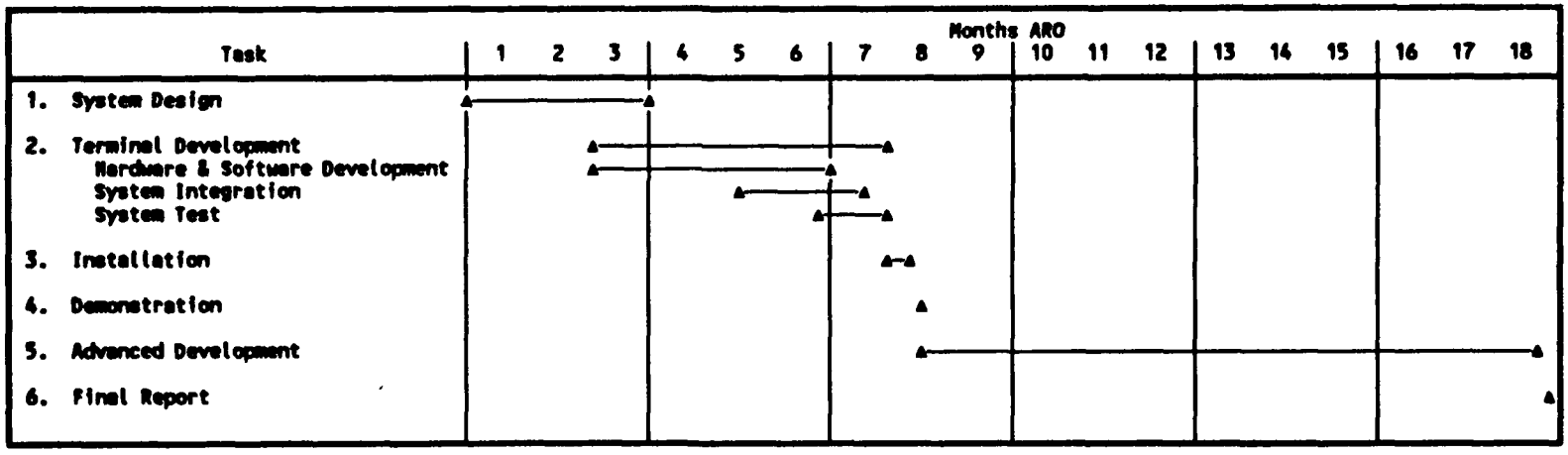
Task Number	Title
1	System Design
2	Terminal Development
3	Installation
4	Demonstration
5	Advanced Development
6	Final Report

Table 7-1 is a schedule illustrating the time relationship of the tasks. The system design task will perform a detailed functional design of the proposed multipoint multimedia teleconferencing system. System parameters will be defined. A preliminary system design by Delta indicates that the system will probably consist of three terminals connected to a MCU via ISDN. (One terminal for each test site.)

The terminal development task will develop the terminal according to the system design parameters. Since building an MCU may also be necessary, its development is included. The need for building a MCU is dependent upon the design approach selected and the availability of suitable commercially available MCUs.

The installation task installs the terminals at their demonstration sites. Plus, it ensures that the terminals (and MCU) survived shipping, are working as designed, and are properly installed.

Table 7-1. Project Schedule



The demonstration task demonstrates the system configuration implemented in the preceding tasks. The demonstrations and evaluations could be initiated as part of the Army's participation in the DoD ISDN Demonstration Project during the April - September 1992 time period. They could provide inputs for continued demonstrations and evaluations in conjunction with the TRIP '92 National demonstration beginning in October - November 1992.

The advanced development task will enhance the terminals. These enhancements could incorporate technologies not used in the initial applications. This might include expanding the demonstration network to include additional users. The additional users could be located at the initial sites. Or, the additional users could be at other sites. Adding users demonstrates the ability of the terminals to work in larger multi-point environments.

At the conclusion of the phase II project, Delta will write a detailed final report. The report will include a description of the work performed on all tasks, a summary of the conclusions drawn, and a list of recommendations made based on those conclusions.

The following sections discuss how the terminals will connect to one another. They also discuss terminal functionality, and possible demonstrations.

7.2 Network Configuration

In general, most multipoint conferences use Multipoint Control Units (MCUs) to connect individual terminals. The terminals usually connect to the MCU and form a star network pattern. (See Figure 7.1.) Doing so, permits individual terminals to join or leave the conference without disruption. In the future, the switches themselves may offer a MCU capability. In general, the terminals will probably connect to the ISDN using one 2B+D link each. Sites hosting the terminals are expected to supply ISDN to the terminals. Plus, the connections between sites are expected to support ISDN. Terminals will be

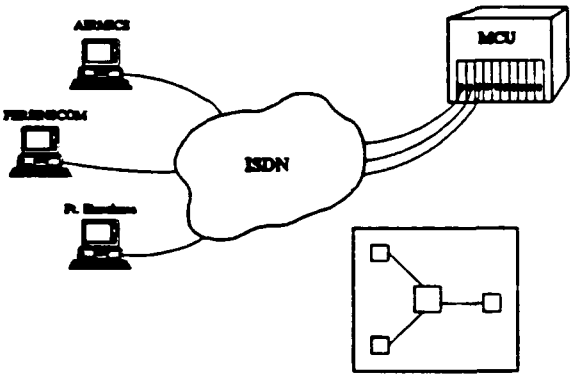


Figure 7.1. Terminals Joined by MCU

installed at three demonstration sites. Candidate sites are AIRMICS, PERSINSCOM, and Ft. Huachuca.

7.3 Terminal Functionality

A multipoint, multimedia terminal could allow participants at several locations to interact and exchange ideas and information. These may range from formal presentations to informal meetings. The terminal could permit participants to do the following items.

- The participants might see a live or canned presentation that includes both visual and aural material.
- The participants might exchange, discuss, modify, and annotate documents. (The term document includes text, graphics, photographs, motion imagery, etc.)
- The participants might view motion imagery from a variety of sources (e.g., commercial broadcasts, VCR tapes).
- The participants might see a head and shoulders motion image of the speaker. This could provide the feeling of a face-to-face meeting.

Such a terminal could have the following capabilities.

- The terminal uses a multitasking windows environment to unify all terminal services (e.g., Microsoft's Windows).
- The terminal is, or is based upon, an IBM PC or compatible.
- The terminal is capable of displaying a head and shoulders image of the current speaker.
- Participants can converse easily with one another.
- Participants can see, annotate, modify, and make copies of working documents. Reference documents may also be seen and copied.

- Documents may include text, graphics, still imagery (e.g., photos) and may be output from active programs (e.g., spreadsheets, wordprocessors, image editors).
- Documents may include audio.
- Participants may transfer files between terminals without noticeably disrupting a conference.
- The conference may be controlled on a formal or informal basis.
- To provide interoperability with other teleconferencing systems, all provided functions should adhere to existing teleconferencing standards. Or, a defined migratory path should exist to permit adherence later. (Note, teleconferencing standards are currently incomplete. For example, work is now underway on the multipoint aspects of teleconferencing.)

7.4 Proposed Demonstration

Three major desk-top conferencing applications are envisioned for the demonstration. These are representative daily activities in the Army environment that could benefit from using ISDN. They are document coordination, project review, and help desk.

Desk-top conferencing represents one way document coordination could be done. It could reduce personnel time and travel costs associated with coordination meetings. A document originator could electronically transmit a document to the reviewing activities. This is essentially a file transfer function. The reviewing activities could printout or directly review the document on their terminal. As they do so, they could note the revisions they deem necessary. The originator could then connect to each reviewing activity on an ad-hoc basis. Or, the originator could connect to all reviewing activities simultaneously. This is similar to setting up a conference call. Once connected, the participants could discuss, annotate, and edit the documents being reviewed.

Desk-top conferencing represents one way program reviews could be done. The participants needn't convene at a single conference site or in separate

teleconferencing facilities. In particular, the requirements for travel coordination or for scheduling teleconferencing facilities would be reduced.

Desk-top conferencing represents one way to implement a Help Desk capability. A user call to the Help Desk number would establish a link between the terminals of the user and the Help Desk Operator. The user would verbally describe his problem as in conventional Help Desk situations. However, the user can show the Help Desk what is wrong. The actions of the user and the results (or lack of) would appear on the Help Desk Operator's terminal. The operator could then provide the user with verbal instructions. Or, the operator could perform the corrective actions. The user could view these corrective actions as they occur.

For the demonstration, terminals will be installed at three demonstration sites. Candidate sites are AIRMICS, PERSINSCOM, and Ft. Huachuca. If an MCU is needed, it will probably be installed at one of these sites.

APPENDIX A

CANON FAX-L3100

GENERAL INFORMATION

Suggested Retail Price:	$6,995
Data... Segment:	6
Sales Stat... :	Current
U.S. Introduction Date:	March 1998
Manufacturer:	Canon
Country of Manufacture:	Japan
Also Distributed As:	None
Distributed Through:	Dealers
Machine Type:	Digital desktop transceiver
Compatibility:	CCITT Group 4 (Class 1)

TRANSMISSION CAPABILITIES

Modem Speed:	64,000 bps
Transmission Speed:	3 seconds
Line Connection:	PSTN, CSDN, ISDN, DDS
Coding:	MMR
Scanning Method:	Contact image sensor
Transmit Terminal Id:	Standard
Remote Terminal Id:	Standard
Auto. Document Feeder:	Standard; 30 pages
Autodialing Functions:	Standard
Capacity:	120 locations
One Touch:	20 locations
Coded:	100 locations
Automatic Redial:	2 times; 2 minute intervals
Groups:	20 groups
Program Keys:	No
Broadcasting:	Standard; 20 stations
Relay Broadcast Request:	No
Relay Broadcast:	No
Auto Page Count:	Simple
Confidential Transmission:	No
Transmission Reservation:	No
Message Headers:	No
Automatic Cover Sheet:	No
Verification Stamp:	No

RECEPTION CAPABILITIES

Print Method:	Laser
Automatic Paper Cutter:	–
Auto FAX-TEL Switching:	No
Confidential:	
Mailbox(es):	No
Password:	No
Card Access:	No
Substitute Memory Reception:	Standard
Answering Machine Interface:	No

IMAGE CONTROL

Resolution:	
Standard:	N/A
Fine:	200 X 200 lpi
Superfine:	400 X 400 lpi
Other:	None
Contrast:	Automatic and manual
Halftone:	16 levels
CCITT Error Correction Mode:	N/A
Other:	G4 Error Correction Mode

MEMORY

Standard	
Available Pages:	20 pages
Capacity:	2 (MB)

GENERAL FEATURES

Monitor Speaker:	No
Built-in Phone Handset:	No
LCD Size:	Standard; 16 characters
Voice Request:	N/A
Local Copy Function:	Standard; 99 copies
Restricted Access:	No
Closed Network:	No receptions No transmissions
RS-232-C Interface:	No
Remote Diagnostics:	No
Status/Error Indicators:	Standard
Timer:	Standard; 1 timer
Other Features:	Manual 10-key dialing, 20 stations per calling group

POLLING FUNCTIONS

Simple:	Standard
Sequential:	Standard; 20 locations
Memory:	Standard
Secure:	No
Secure FAX Numbers:	No
Turnaround:	No

ORIGINAL/COPY CAPACITIES

Min. Original Size (WxL):	4.1" x 11"
Max. Original Size (WxL):	11.7" x 14"
Effective Scanning Width:	9.9"
Automatic Reduction:	92%
Max. Copy Size (WxL):	8.5" x 14"
Effective Print Width:	7.8"

PAPER

Roll (WxL):	–
Sheet (WxL):	8.5" x 11" or 14"
Quantity:	400 sheets

MANAGEMENT REPORTS

Confirmation Reports:	Transmit and Receive
Activity Reports:	Standard
Other Reports:	System data list, CPU and broadcast logs

PHYSICAL DESCRIPTION

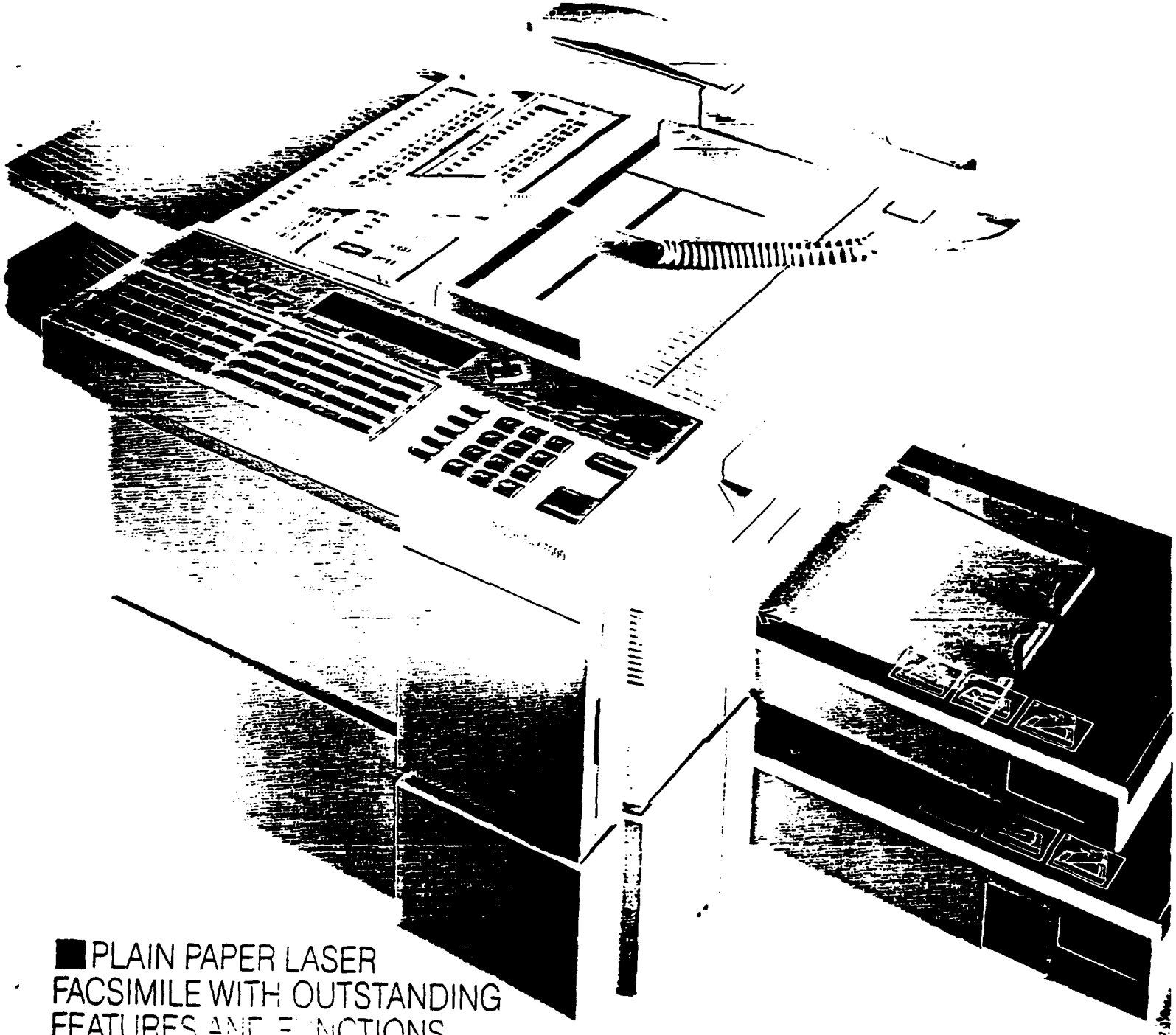
Dimensions (HxWxD):	35.5" x 18.9" x 22.9"
Weight:	187.4 lbs
Power Requirements:	1200W

COMMENTS

The vastly increased availability of digital switched services, as well as falling costs, make the FAX-L3100 a logical step for all serious facsimile users, in terms of high speed, high volume, or specialized graphic requirements. Target market also includes private network and leased line applications. The optional pedestal is priced at $500.

RICOH FAX7000

WITH DIGITAL G4 OPTION AVAILABLE NOW

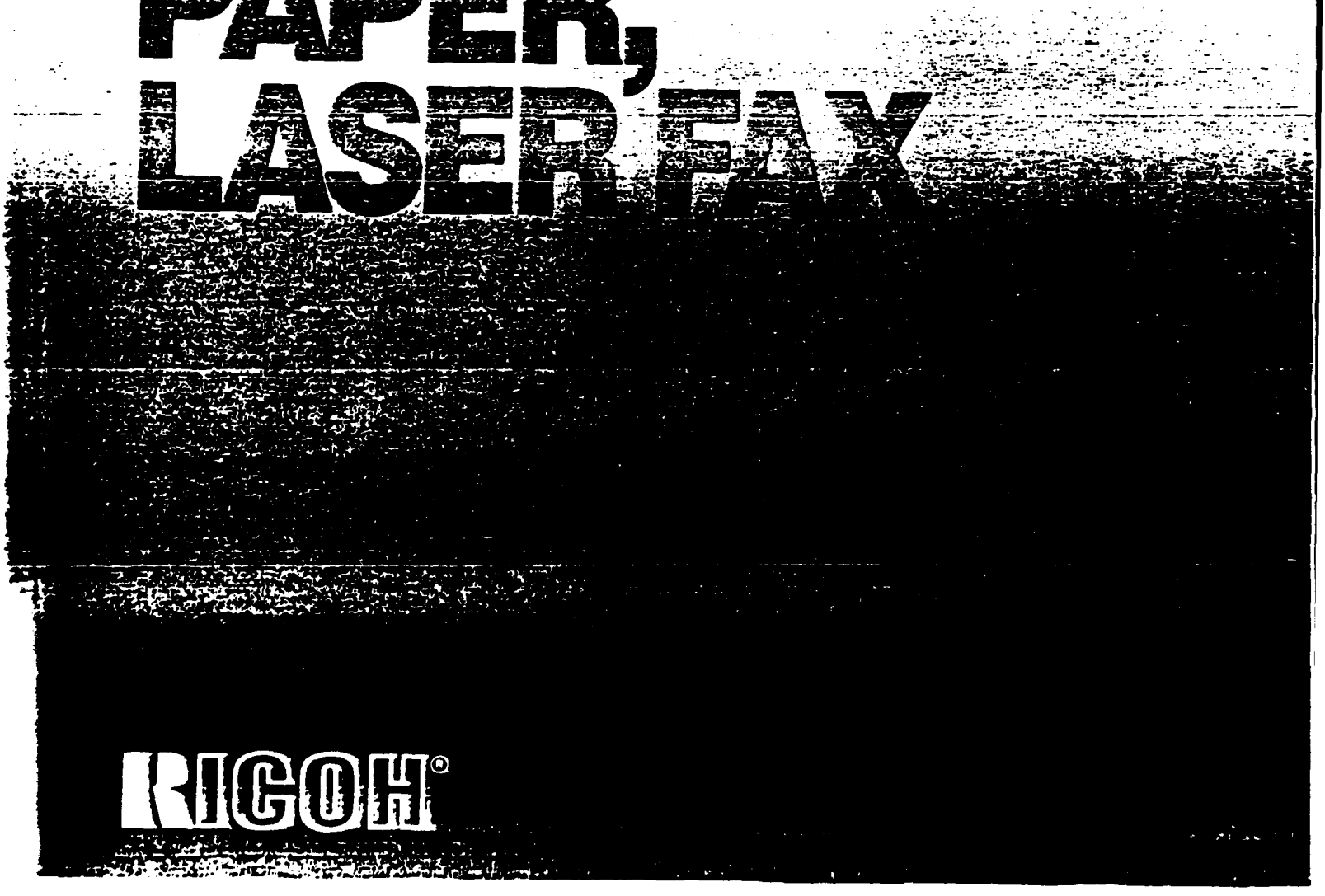


■ PLAIN PAPER LASER
FACSIMILE WITH OUTSTANDING
FEATURES AND FUNCTIONS

RICOH®

Where Imagination Becomes Reality

POWER AND INNOVATION IN A PLAIN PAPER, LASER FAX



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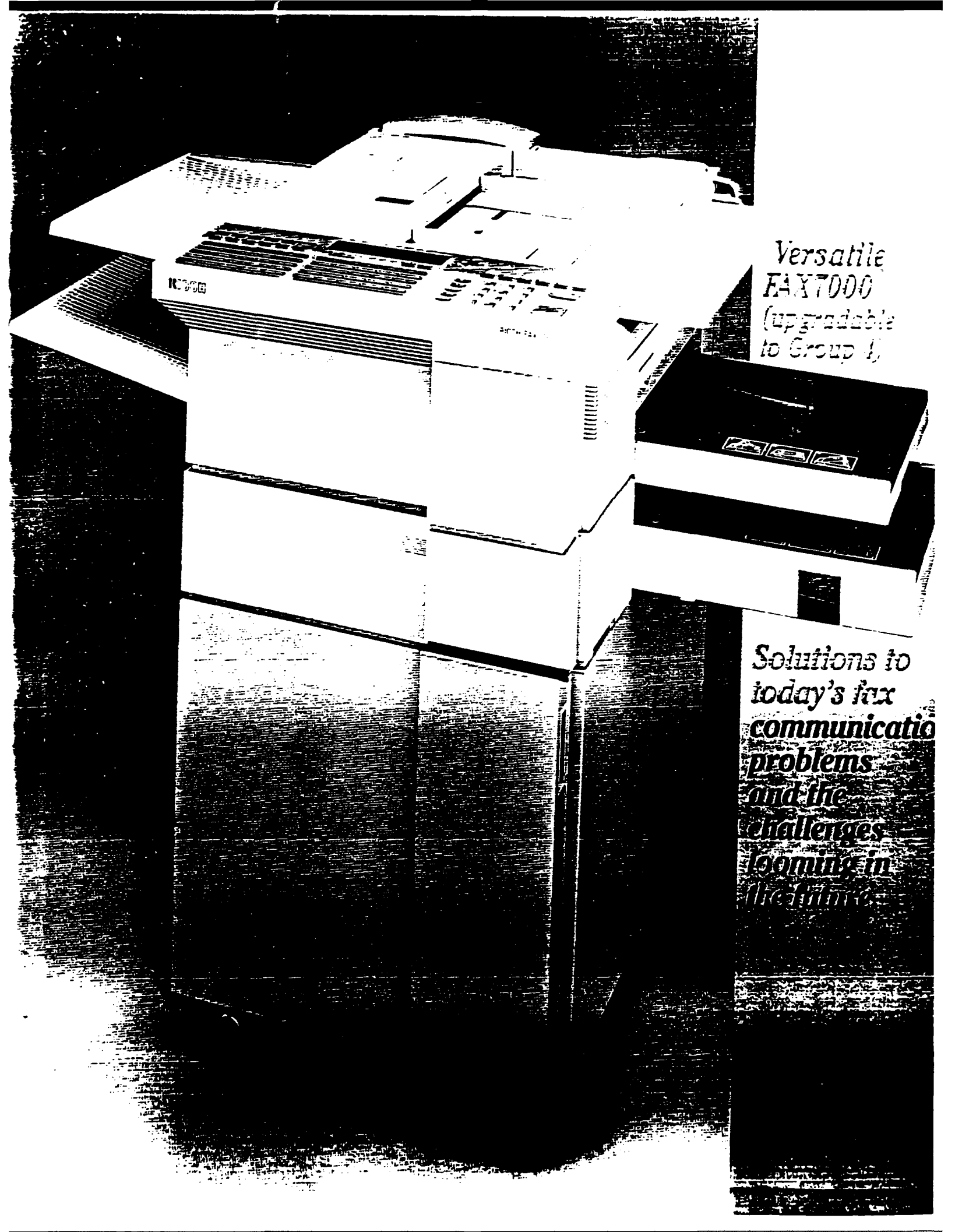
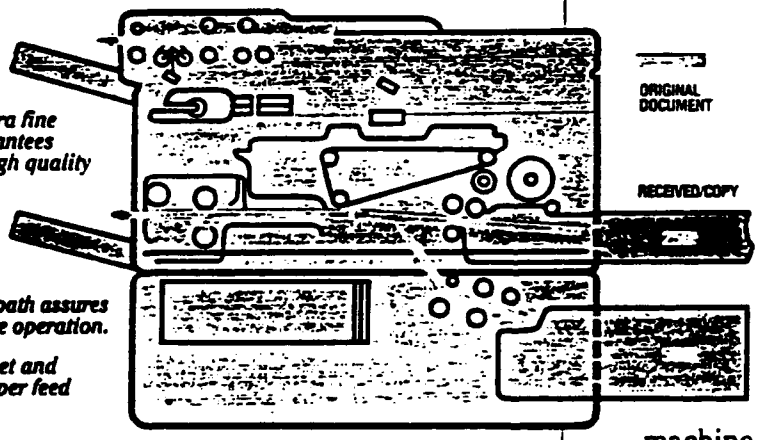

Versatile
FAX7000
(upgradable
to Group 4)
Solutions to
today's fax
communicatio
problems
and the
challenges
looming in
the future

RICOH LASER TECHNOLOGY RE-DEFINES QUALITY PRINTING ON PLAIN PAPER

The Ricoh laser system printing on plain bond paper is simply the finest. Documents are clearer, sharper, long lasting, easily annotated and ready to be faxed again. Immediately. Independent 250-sheet and 500-sheet paper feed units combine to maximize reception efficiency. Each can accommodate Letter or Legal or B-4 (10.1" x 14.3") plain bond papers. Every document is enhanced by Ricoh's Super Smoothing (392 x 406 lpi) which guarantees remarkably clear reproduction especially for curves and fines lines. In this mode, no time is compromised. If your business depends on having clear, highly readable documents, you will appreciate this unique Ricoh innovation.

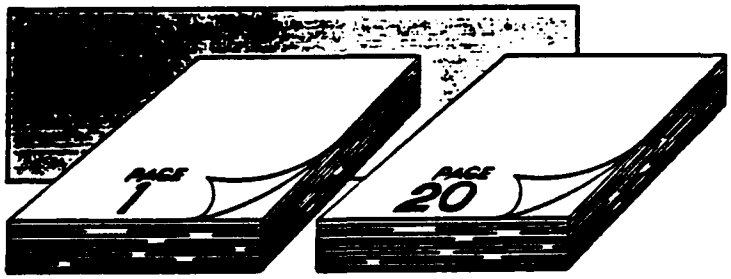
6 Second Scanning and 11 Second Transmission – About the quickest analog line standard* performance you'll find.



392 x 406 lpi ultra fine resolution guarantees exceptionally high quality printing.

A straight paper path assures efficient, jam-free operation.

Both the 250-sheet and the 500-sheet paper feed are standard.



Choose document reception in either last page first or first page last sequence.

CONVENIENCES YOU JUST CAN'T FIND EVERYWHERE ELSE

Full Dual Access allows you to store documents into memory for transmission during reception and memory transmission. This greatly aids communication flow and convenience and greatly increases productivity.

The five User Function Keys can each store a frequently used function request allowing instantaneous access to those functions.

The One-Touch Key Stroke Program let's you program an entire task for one-touch execution. Just set the document in the feeder and press the button.

The One-Touch Group Transmission let's you organize document recipients into groups for one-touch transmission to each member of the group. Input up to 32 groups of up to 200 numbers each.

The Manual Document Feed accommodates large or thick documents without re-sizing. Simply fold the document in half. scan it twice, and it will be sent as two pages.

By programming Alternate Destination to offices with more than one facsimile, the FAX7000 can automatically send to another pre-designated machine in the same office if the first machine is busy. Especially helpful when handling urgent documents.

The Message Attachment automatically inserts a header message when desired. Up to 2,050 different header messages can be input, with quick and speed dialing. Each can contain up to 4 lines of 130 characters total.

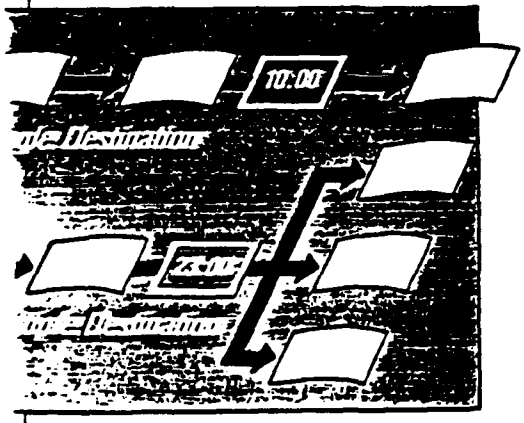
When in the Auto Receive mode, Automatic Voice Messaging will greet incoming callers with your personalized message, notifying a telephone caller that they have reached a facsimile, giving them the chance to hang up before having to hear the modem tone.

The Auto Note imprints any of four messages (Urgent, Confidential, Please Call, Please Distribute) at the top of outgoing documents so the receiving party can immediately tell what class of document has been received.

The Verification Stamp imprints documents to indicate successful scanning (memory mode) or transmission (non-memory mode) so you can always be sure a document has been scanned successfully or sent. And it's on/off selectable.

Both TTI (Transmitter Terminal Identifications) **and RTI** (Remote Terminal Identification) are incorporated in the FAX7000 repertoire of convenience features.

And the Transaction Confirmation Report keeps a record of all essential facsimile transactions – time, destination, number of pages, etc. – and prints it all out for you automatically at set intervals or as requested.



The Ricoh FAX7000 Memory lets you store now and "send later" when phone rates are most economical.

THE MEMORY OF A GENIUS – 20MB HARD DISK

A strong memory is synonymous with strong facsimile performance. The FAX7000 memory is 20MB strong, providing a full array of resource-saving functions:

■ Unparalleled Capacity – The 20MBs of memory means the FAX7000 can hold up to 1,200 pages (CCITT Test Chart #1).

■ Batch Transmission – If two or more fax messages are stored on the hard disk addressed to the same number, they will be transmitted in a single call, cutting transmission costs, especially beneficial when used in international networks.

■ Transmission Deadline – Assures that the machine will continue to try to send a specific document until a pre-set time. It can also generate a report at a pre-set time to confirm transmission. This helps you meet deadlines.

■ Substitute Reception: You're never "out" of paper – If the FAX7000 runs out of paper or jams during reception, it stores the incoming document into memory and then prints it after the paper supply has been replenished. If you want, the FAX7000 can also forward the reception to another facsimile.

■ Volatile Memory is a Thing of the Past – The hard disk protects your stored files from power outages or human error.

■ Send Broadcasting – Once to 200 times out. A single scanning into memory and the document can be sent to up to 200 locations, then automatically erases the file.

■ Transfer Broadcasting – Enables a more economical international or intercontinental network. By using two or more FAX7000s as broadcast machines, you reduce the number of long distance calls necessary to send a document to several long-distance locations.

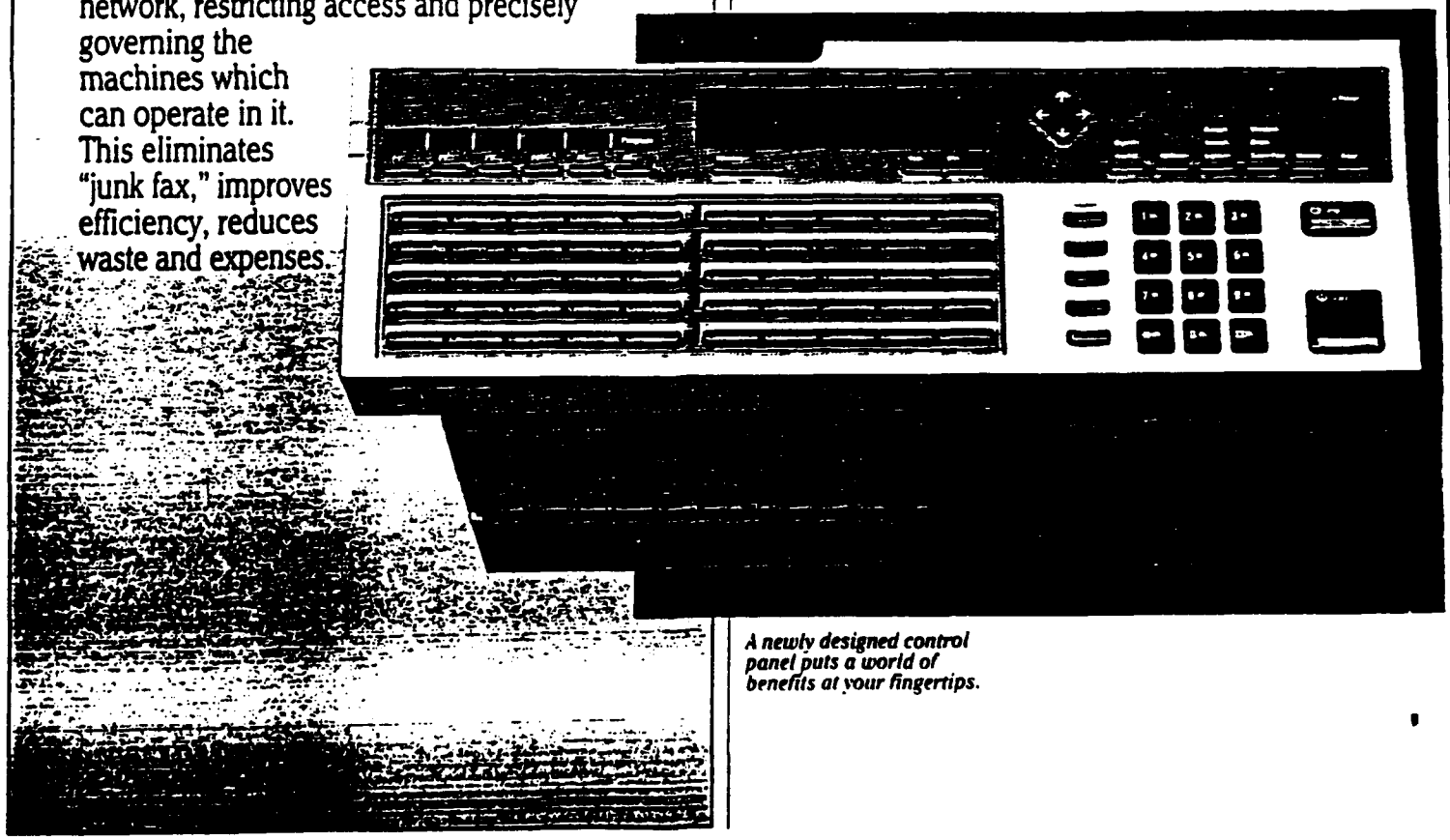
■ Confidential Transmission/Reception keeps it secret – The use of confidential ID codes allows you to send and receive documents with absolute security. Simply send a file under this function with the access ID. It will be stored into memory and can then only be accessed by entering the correct ID.

■ Secured Polling – ID codes can also be used to set up a private facsimile network. so you can safely send or poll documents to or from private groups.

■ Closed Network – Let's you control your network, restricting access and precisely governing the machines which can operate in it. This eliminates "junk fax," improves efficiency, reduces waste and expenses.

WHEN IT COMES TO PRODUCTIVITY AND EFFICIENCY, THE FAX7000 SETS THE STANDARD.

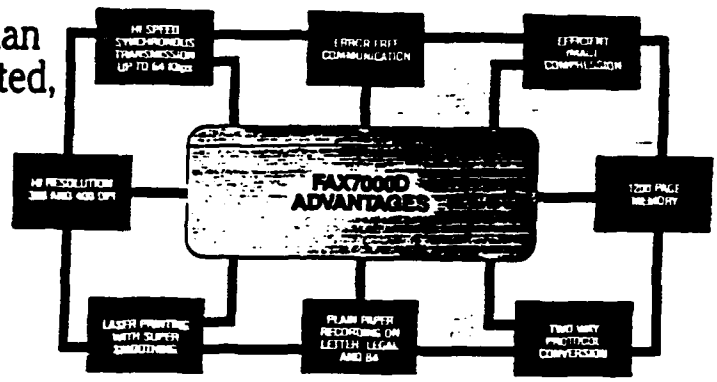
You can enter up to 50 destinations for Quick (one-touch) Dialing and up to 2000 for Speed (two-touch) Dialing. If you need to receive more than one copy of an incoming document, Multi-Copy Reception lets you pre-set the machine to print the desired number of copies in the page order you need. ECM, (Error Correction Mode) automatically monitors transmissions. Should any portion of the transmissions be damaged by "noisy" phone lines, the FAX7000 will resend the damaged portion. This saves you from having to send the whole page again. If the phone lines are of unacceptable quality, the FAX7000 Page Re-transmission feature will hang-up and redial automatically.



A newly designed control panel puts a world of benefits at your fingertips.

THE FAX7000D GROUP 4 AND MORE, IT'S ALL YOU COULD EVER ASK FOR!

The all new FAX7000D DIGITAL G4 is more than just a laser facsimile. It's the most sophisticated, innovative collection of facsimile functions available in a single machine. And the FAX7000D easily accepts data encryption, for ultra-confidential applications. It's the facsimile for which the world of business communications has been waiting.



YOUR OPTION...NOW OR LATER

The FAX7000 is a G3 facsimile and can be easily upgraded to a G4 facsimile with the addition of an optional upgrade to become the FAX7000D. This makes the FAX7000 a wise investment today anticipating a changing communications world *tomorrow*.

THE FAX7000D DEFINES "FAST" TRANSMISSION

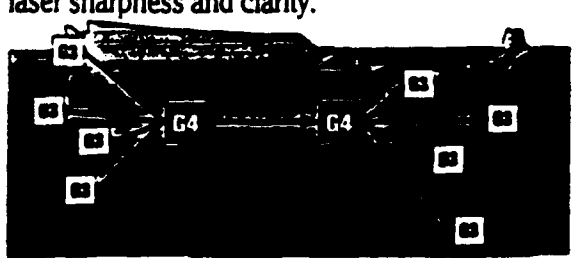
The FAX7000D transmits with astonishing quickness – like sending a page* in just 1.5 seconds (through digital lines). This outstanding feature alone can increase throughput and reduce line costs.

ERRORS BECOME A THING OF THE PAST

Digital communication lines are reliable and virtually free from transmission errors.

A RESOLUTION: TO MAKE THINGS CRYSTAL CLEAR

The ultra-fine 400dpi resolution of the FAX7000D delivers documents with unsurpassed laser sharpness and clarity.



***Master of economics!** With the Ricoh FAX7000D (with G4 option) you can go from multiple G3 locations to the FAX7000D to another remote FAX7000D which will then distribute to other multiple G3 locations.*

MAKES ALL THE RIGHT CONNECTIONS

The FAX7000D can be connected to either an ISDN (Integrated Services Digital Network), CSDN (Circuit Switched Data Network), PSDN (Packet Switched Data Network) or Leased Digital Lines. Benefits include the ability to utilize your existing digital lines. The result: flexibility that assures maximum versatility today, tomorrow and beyond.

COST-CUTTING FEATURES LIKE MULTI-STEP TRANSFER ARE FAST AND SIMPLE

If you have two or more FAX7000D's at the heart of your communications network, you can send a document from your local FAX7000D to a remote FAX7000D which will automatically forward the document to other machines in the network.

Two-step Transfer lets you send a document from your local G3 to your local G4, which will then transmit to the remote G4 which will then complete the mission by sending it to the final G3 or G2 destination fax. Benefit: gives non-G4 machines the economy of transmitting through the digital network.

DUAL PORT RECEPTION DOUBLES CONVENIENCE

Connect the FAX7000D to both a digital and analog circuit, and it will transmit and receive in the G3 mode even while receiving in the G4 mode. Benefit: another breakthrough in facsimile versatility.

■ *CCITT Group 4 standard fea*

■ *Ricoh value added G4 featu*

The Ricoh FAX7000D with G4 digital upgrade adds fi distinct advantages to the required CCITT Group 4 Standard Features.

DIGITAL G4

*(CCITT Test Chart #1)

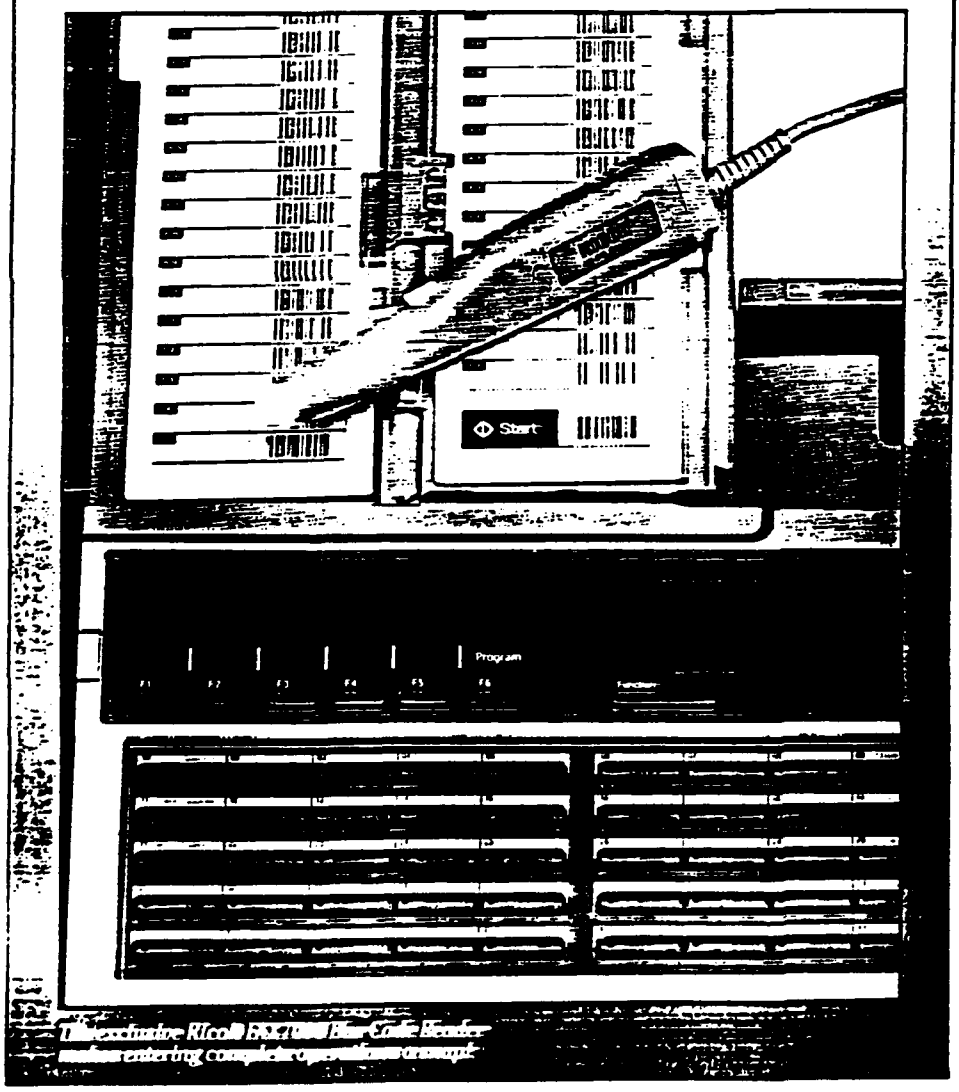
THE RICOH FAX7000 IS INNOVATION AT ITS VERY FINEST.

At Ricoh, Imagination Becomes Reality, and proving this are the many exclusive innovations on the FAX7000. Enhancements that simplify and improve the interaction and communications between man and machine.

An optional Bar Code Reader offers the unprecedented convenience of enacting complete functions simply by "scanning" them, tremendously enhancing efficiency.

If an error should occur during memory transmission, the FAX7000's Page Re-transmission will automatically resend the page even if the other machine does not have ECM.

Collated Printing allows for outprinting multi-page documents in correct page order or reversed page order, placing and noting the first page of the document either at the top or bottom of the stack.



RICOH FAX7000 SPECIFICATIONS:

Type: Console-type transceiver

Line Interface: (G3) PSTN connection with RJ11C RJ45S
(G4) CSDN, PSDN, ISDN V.35, RS232 (V.24) X.21, RS366 (V24-200)

Compatibility: CCITT G4, G3 and G2 machines

Resolution: 98 x 203 (3.85 x 7.7 MM), 196 x 203 (7.7 X 7.9 MM), 392 X 406 (15.4 X 15.9 MM)

Transmission Speed:
1) G3 11 Sec/A4 (CCITT Test Chart #1)
2) G4 1.5 Sec/A4 (CCITT Test Chart #1)

Data Transmission Speed:
1) G3 9600, 7200, 4800, 2400 bps. automatic shift down
2) G4 Maximum 64 kbps

Data Compression Method: MH, MR, EFC, MMR

Scanning Method: Flatbed Solid State Scanner

Scanning Width: 1. 8.5" (A4) (216 MM)
2. 10.1" (B4) (256 MM)
3. 11.7" (A3) (304 MM)

Input Document Size: Width: 4.1" to 11.7" (105 – 304 MM)
Length: 4.1" to 47.2" (105 – 1200 MM)

Document Feed: Automatic feed, face down

Paper Feed: Automatic feed

Recording Method: Laser printing

Recording Paper: Plain cut bond paper sheets
Letter: 8.5" X 11" (A4) (210 x 297 MM)
Legal: 8.5" X 14" (A4) (216 x 336 MM)
10.1" X 14.3" (B4) (257 x 364 MM)

Effective Recording Width: 8.3" w/letter or legal (A4) (210 MM)
9.8" (B4) (250 MM)

Power Supply: AC 115 (±) 15v, 60Hz

Dimensions: 18.9" (W) X 20.1" (D) X 35.5" (H) (480 MM (W) x 510 MM (D) x 900 MM (H)) (without tray)

Weight: Approx. 170 lbs. (without tray)

Specifications, configurations and dimensions subject to change without notice.

RP-1 L07000/D 01901

RICOH®

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Canadian Main Office: Ricoh Canada Ltd., 2245 St. Laurent Blvd., Ottawa, Ontario K1G 4K3 • 613-739-9900

APPENDIX B

DGM&S

IDC BRI

ISDN DSP Basic Rate Adapter

PRODUCT BULLETIN

The DGM&S ISDN Basic Rate DSP Adapter Card (IDC BRI) offers a greater degree of performance and flexibility than any other ISDN implementation on the market. Based on the Texas Instruments TMS320C30 32 bit Digital Signal Processor and high performance Siemens ISDN components, the IDC BRI can fully utilize the ISDN Basic Rate Interface. The 33 Mflop performance of the DSP has ample reserve horsepower to perform such additional tasks as Video Compression, Voice/Data Encryption, Modem and FAX emulation, Speech Recognition, and Speech Synthesis.

The IDC BRI is the first ISDN product to offer the ideal combination of TI DSP performance, Siemens Advanced ISDN Components, and DGM&S QSource™ Enabling Technology software. Residing in an AT compatible PC chassis, the IDC BRI is the most powerful, full featured ISDN platform available on the market today. So great is the power of this card that full duplex data transfers can be performed on both B-Channels simultaneously, at network speed, with more than 90% of the DSP horsepower available for user applications.

The architecture of the IDC makes full use of the formidable processing power of the DSP. A new dynamic RAM controller developed by DGM&S provides zero wait state operation for up to 2 Mbyte of memory. An 8 Kbyte dual-ported static RAM shared memory area, bus master operation, and DMA access combine to allow data transfers across the PC bus at up to 8 Mbps.

IDC resident applications have unrestricted use of the DSP Primary and Expansion buses. An IOM™2 TDM Highway interconnects the CPU and the high performance Siemens ISDN components to an RJ-45 connector. Other features of the IDC BRI that help to facilitate ISDN product development are an RS-232 port which can be attached to a debug terminal and an RJ-11 jack that allows the attachment of handset or external speaker. Easily configured to operate in back to back mode, the IDC offers the user the opportunity to develop and test applications with confidence that network compatibility will be met when connected to an ISDN switch or switch simulator.

The IDC BRI adapter may be coupled with the DGM&S QSource™BRI ISDN Basic Rate Interface Software. This robust software product provides a powerful protocol engine for voice, circuit switched and packet switched data in a clean, conformance tested architecture. The multi-processing capabilities of the DGM&S Kernel operating system, mated with the power of the DSP CPU, provides a unique platform for DSP resident ISDN applications.

FEATURES

- Texas Instruments 32 Bit TMS320C30 Digital Signal Processor.
- A complete development environment available with an ANSI C compiler, assembler, linker, and source level debugger.
- 512 K 32 bit words of zero wait state 60 to 80 ns high speed DRAM.
- 16 K 32 bit words of high speed SRAM.
- 8 K byte dual ported high speed SRAM shared memory interface to the host system.
- Bus master operation.
- DMA access to all PC address space.
- Supports multiple user provided IDC resident DSP applications.
- IDC resident applications have direct access to all IDC hardware through a high speed IOM™2 TDM bus.
- Siemens Advanced ISDN Chip Set.
- RJ-45 connector for BRI S-Bus.
- RS-232 serial port for connection of external DTE.
- RJ-11 modular connector for telephone handset/headset.
- Supports QSource™ Enabling Technology software.
- Supports CCITT V.110 and V.120 Rate Adaption.
- Conformance tested with AT&T and Northern Telecom switches.
- Additional connectors on board for expansion of DSP Primary/Expansion Bus, IOM™2 Bus, optional Debug board, TI XDS500 Emulator, and External Speaker

Technical Specifications

Operating Temp: 0 to 50 degrees C
Storage Temp: -10 to 60 degrees C

Humidity: 20% to 80% non condensing.

Clock Speed: 26 MHz.

Memory: 16 K Words 20 ns SRAM 512 K Words 80 ns DRAM Proprietary DRAM Controller allows subsequent accesses to the same page with 0 wait states.

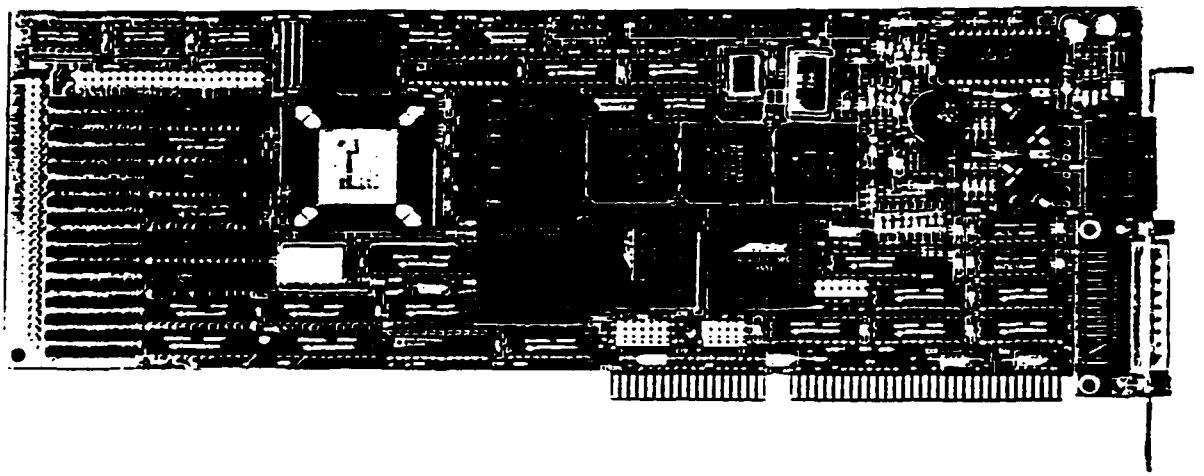
PC Interface: IDC appears as 8 read/write I/O locations starting at address 388H, 390H, or 398H as selected by jumpers on the IDC. The IDC also appears as two blocks of memory in the C0000H - EFFFFH range.

PC Interrupt Level: IRQ3,4,5,6,7,9,10,12, or 15 jumper selectable. Board shipped with IRQ10 enabled.

DMA Request: DMA Request 0,1,3,5,6,or 7 jumper selectable.

ISDN Interface: Standard RJ-45 connector, point to point and passive bus.

Power Requirements: +5 VDC at 1.5 amp (typical), 2.2 amp (max) +12 VDC at 30 ma (typical), 60 ma (max), -12 VDC at 30 ma (typical), 60 ma (max), -5 VDC at 30 ma (typical), 60 ma (max).



Information

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Telex: 46-7851

DGM&S provides the tools and expertise to achieve a turning point in your development effort.

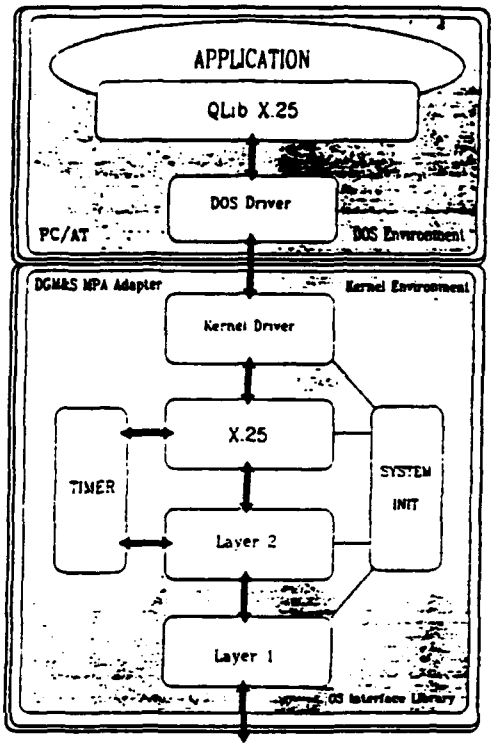
DGM&S

QSource™X.25

CCITT X.25 Protocol Software

X.25 APPLICATION DEVELOPMENT KIT

- CCITT compatible X.25 software providing X.25 Layers 2 and 3 services in binary form.
- Library functions written in ANSI C provided in source and binary form to support the rapid development of X.25 applications
- MPA 909-1 Multi-Protocol Adapter provides synchronous communications at data rates up to 1.5 Mbps.
- Supports application and configuration verification using a private X.25 integrated network.
- Compliance tested with the AT&T #5ESS and Northern Telecom DMS100 switches.
- Can be bundled with QSource™ ISDN software packages for packet transmission on the ISDN B and D channels.
- Provides 64 logical channels and PVCs.



The DGM&S QSource™ family of software products exists to provide the system integrator and telecommunications product developer with the means to build a product in the minimum time and with minimum cost. The QSource™X.25 Application Development Kit addresses this need in the packet switch environment.

Through the incorporation of the QSource™X.25 code, you can easily bundle X.25 functionality into your application. The QLib X.25 application interface library is provided in both ANSI C and binary form and easily melds into your product. These library subroutines provide the necessary interface to the X.25 software residing on the DGM&S MPA 909-1 Multi-Protocol Adapter.

QSource™X.25 is the software which provides 1984 compliant CCITT X.25 Layer 3, Layer 2, and Layer 1 functionality on the co-processor card. This software provides 64 logical channels and PVC capability. QSource™X.25 operates under an optimized version of the DGM&S Kernel multi-tasking operating system which adds trace and debug capabilities to the wide range of features available.

Through the integration of the supplied DGM&S MPA Co-processor board and QLib X.25 library subroutines, the developer can easily create high layer communication applications that utilize the robust processing ability of QSource™X.25.

The QSource™X.25 Application Development Kit consists of binary software images for X.25 layers 2 and 3, the DGM&S Kernel operating system and the device drivers and support software necessary to operate the MPA 909-1 Multi-Protocol Adapter board which forms the hardware portion of the kit.

The QLib X.25 Application Interface library is supplied in both ANSI C source and binary form. The documentation package included with the kit contains an installation guide and a user's guide for application development. An intensive one day training class augments the documentation with hands-on exposure to both the software and the hardware.

The QSource™X.25 software is also available in conjunction with the QSource™ ISDN family of Enabling Technology packages. These include System and Application Development Kits for use on a variety of hardware platforms.

QSource™X.25 Protocol Software Overview

QSource™X.25 Application Development Kit Includes:

- QSource™X.25 software for X.25 Levels 2 and 3 in binary form.
- QLib X.25 application program interface to the embedded X.25 software.
- MPA 909-1 Multi-Protocol Adapter card with device drivers and support software in binary form.
- Cables for back-to-back, terminal-to-terminal configurations.
- Installation and user manuals.
- One day hardware and software training seminar.

X.25 FACILITIES

Packet layer facilities supported by QSource™X.25 include:

Throughput class
Flow control parameters
Network user ID
RPOA
Closed User Group (CUG)
CUG outgoing
Fast selection
Reverse charging

X.25 APPLICATION LIBRARY

The applications interface library includes the following functions:

X.25 connect request
X.25 connect response
X.25 disconnect request
X.25 reset request
X.25 reset response
X.25 data transfer request
X.25 expedited data request
X.25 read request
X.25 Read any request
X.25 user restart request
Link status request

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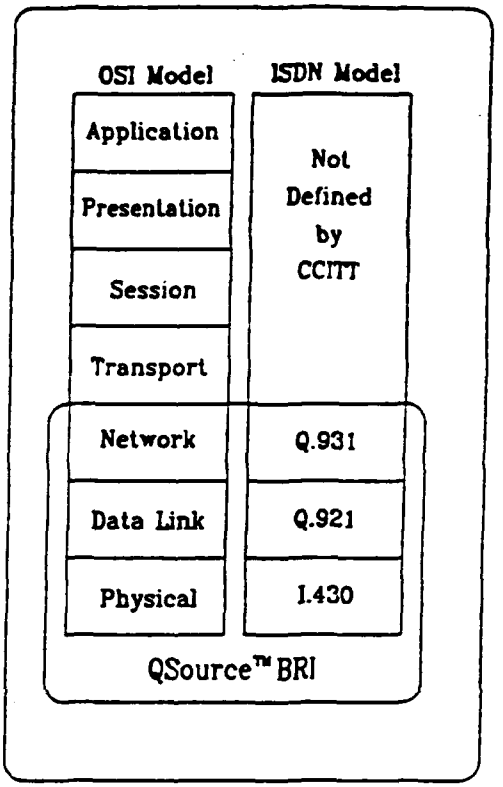
QSource™BRI

ISDN Basic Rate Application Development Kit

BINARY SOFTWARE on a PC53 HARDWARE PLATFORM

- CCITT Q.931/Q.921/I.430 compatible ISDN Basic Rate protocol software for Layers 1 through 3 in binary form.
- Two PC53 adapter cards and support software facilitating a "back to back" switch simulation environment.
- QLib BRI message oriented application interface library supplied in both ANSI C source and binary.
- Debug facilities at levels 1, 2 and 3 and the application interface facilitate development and testing of your ISDN application.
- PC53 adapter card features the Intel iAPX188 microprocessor and offers rate and data adaption.
- DGM&S Kernel high performance multi-tasking operating system.



QSource™BRI covers all your Basic Rate ISDN needs.

Today's telecom product developer faces the most aggressive marketplace ever. This constant market flux necessitates a rapid product development cycle. DGM&S provides the developer and system integrator with the means to minimize costs and maximize productivity through the use of the QSource™ family of Enabling Technology products. The QSource™BRI Application Development Kit gives you, the developer, every advantage in attacking the Basic Rate market.

Incorporating the QSource™BRI Application Development Kit into your system provides you with state of the art communications capabilities with a minimum of effort. QSource™BRI flexibility eases system integration, minimizes development time and reduces development costs. QSource™BRI does not require previous experience with ISDN. The level of technology independence provided by QSource™BRI frees you to concentrate your efforts where they really count: on your application.

QSource™BRI supplies you with CCITT compliant Basic Rate signalling and call control software in a modular binary form which can be easily integrated with host application software. Library subroutines provide the user applications with easy access to ISDN call control functions through a message oriented interface. The Kernel operating system on the adapters provides full multi-tasking and debug capabilities.

The QSource™BRI Application Development Kit consists of binary software images for ISDN Layers 1 through 3, the Kernel operating system and PC53 support software. The application interface library is supplied in both ANSI C source and binary form. The two DGM&S PC53 Basic Rate adapter cards provide the platform upon which the QSource™BRI software operates. An extensive documentation package is also supplied.

The QSource™BRI Application Development Kit can form the core of a user application or ISDN test equipment, or be used as a means of evaluating the QSource™BRI software prior to upgrading to the QSource™BRI System Development Kit.

Software Overview

The software provided in the QSource™BRI Application Development Kit contains the DGM&S QSource™BRI software and represents over *30 man-years* of ongoing development. Features of the software include a runtime option for operation with either the AT&T #5ESS, Northern Telecom DMS100, or Siemens EWSD switch and support for protocols such as X.25, V.120 and HDLC. The developer can take advantage of these features through the QLib BRI Applications Interface library subroutines provided in ANSI C and binary.

Debug Facilities

Debugging and trace facilities in the Application Interface, Layer 3, Layer 2, and Layer 1 allow the developer to monitor every aspect of application operation. The Layer 3 filter can be used to validate and debug user defined messages. The exhaustive testing and extensive deployment of QSource™BRI ensures the user a robust protocol engine which frees the developer from low level concerns.

PC53 BRI Basic Rate Adapter

The DGM&S PC53 BRI Basic Rate adapter card utilizes an Intel iAPX188 microprocessor and iATC 29C53 DLC for D channel control. The board offers an RS-232 interface for a debug terminal and RJ-11 connector for an optional handset. The PC53 provides fundamental rate and data adaption for ISDN BRI communications.

Layer 3 Process

The QSource™BRI Layer 3 is a CCITT Q.931 compliant subsystem which provides all Network Layer functions needed for ISDN D channel signalling. This process is preceded by a pre-processor which validates the structure of the Q.931 Layer 3 primitives.

Layer 2 Process

The QSource™BRI Layer 2 process is a CCITT Q.921 compliant subsystem which provides all Link Layer functions required for the ISDN D channel and two B channels (LAPD/LAPB).

Layer 1 Process

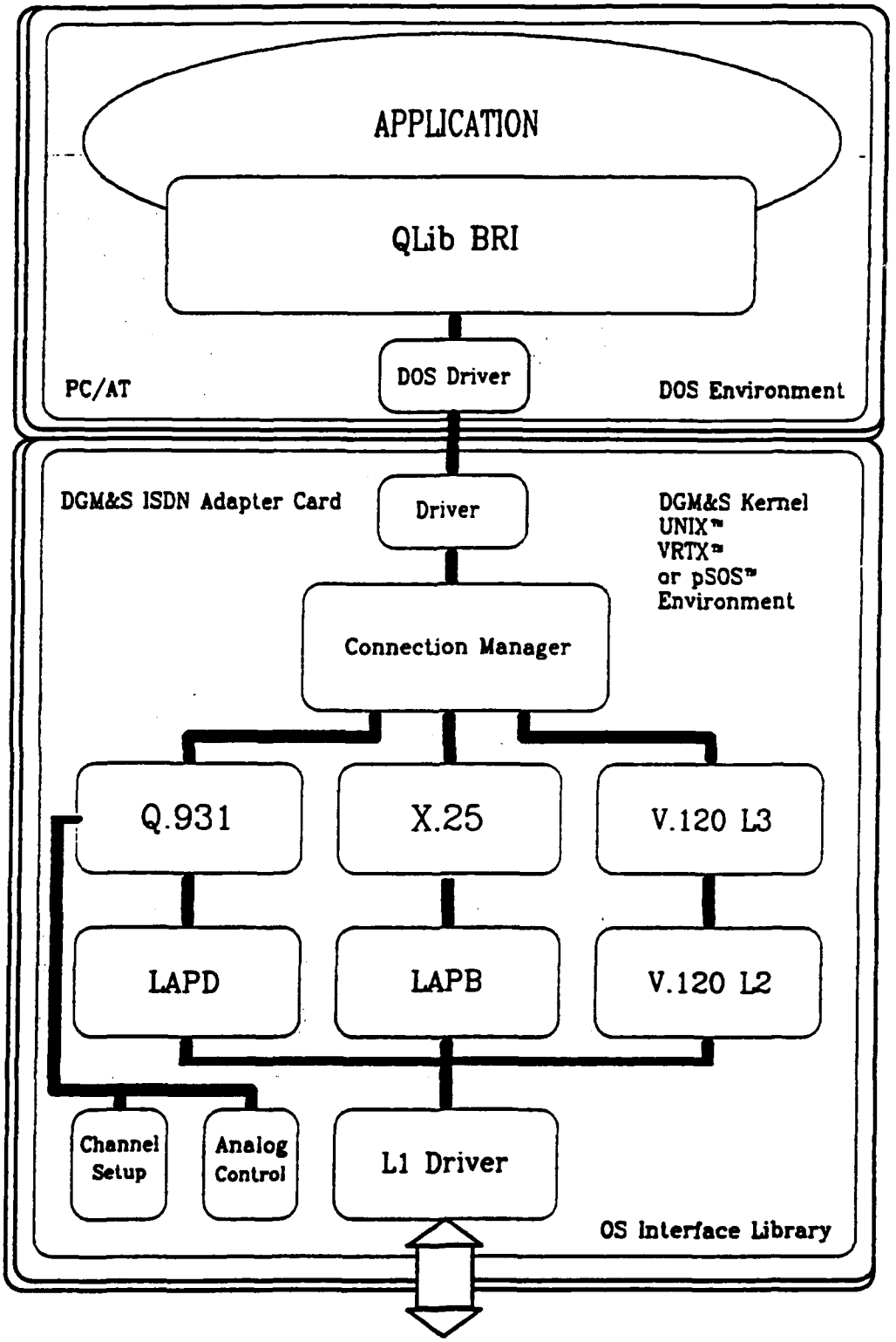
A CCITT I.430 compliant Layer 1 process is supplied for operation with the PC53 adapter.

Support Software

BIOS, shared memory drivers, loaders and utility software are provided for the DGM&S PC53 adapter. Together with the QSource™BRI process they form an extensively tested, extremely resilient set of software tools.

Sample Application

The QSource™BRI Application Development Kit includes the QTalk sample application. QTalk performs simple call setup and teardown of voice and data calls illustrating the simplicity of access to the layer 3 application interface.



A typical QSource™BRI application utilizing the DGM&S PC53 adapter on the IBM PC.

QSource™BRI ISDN Protocol Software for the Developer and Systems Integrator

QSource™BRI Application Development Kit Includes:

- Source and object code for the QLib BRI Application Interface.
- Two DGM&S PC53 Basic Rate adapter cards featuring:
  - Intel iAPX188 Microprocessor CPU.
  - RJ-11 and RJ-45 interfaces for Basic Rate and a telephone handset.
  - RS-232 interface for a debug terminal.
  - Configurable back-to-back.
- CCITT Q.931 Layer 3 Binary code providing:
  - Support for the AT&T #5ESS, Northern Telecom DMS100 and Siemens EWSD switches.
  - Multiple X.25 connections using B and D channels at full network capacity.
  - V.120 rate adaption.
- CCITT Q.921 Layer 2 Binary code providing:
  - Support for 2B+D Basic Rate access (LAPB/LAPD).
- CCITT I.430 Layer 1 Binary code for the PC53 Basic Rate Adapter Card.
- Binary code for the QSource™ Initialization process.
- Binary code for the QSource™ Timer process.
- Binary code for the OS Services Library.
- Binary code for the DGM&S Kernel Operating System.
- Binary code for the QNet Simulator.
- Binary code for the QTest Stress tester.
- Source code for the QTalk prototype application.
- QSource™BRI Documentation Library, including:
  - QSource™BRI Application Development Kit Installation Guide
  - QSource™BRI Application Development Kit User's Guide
  - QTalk User's Guide
  - QTest User's Guide
  - PC53 Technical Reference

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QSource™BRI

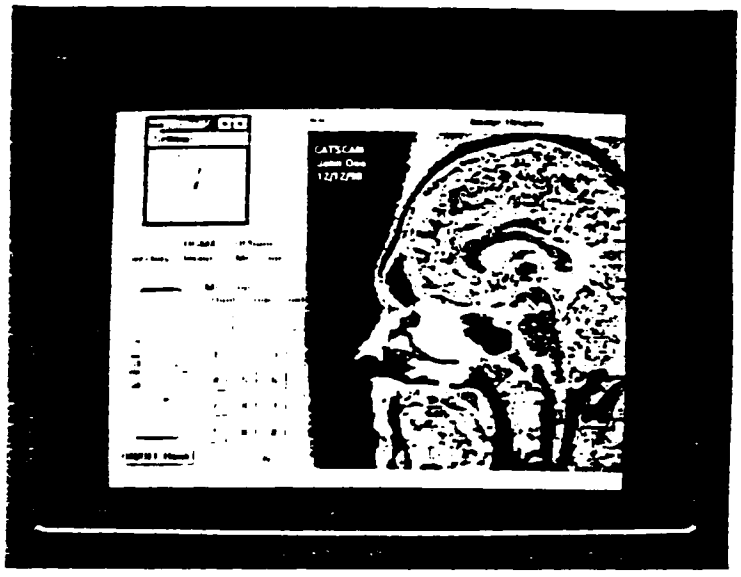
ISDN Basic Rate
Extended Application Development Kit

BINARY SOFTWARE on a DSP HARDWARE PLATFORM

- CCITT compatible ISDN Basic Rate protocol software for Layers 1 through 3 in binary form.
- Two powerful IDC BRI adapter cards and the support software required for a "back to back" switch simulation environment.
- Message oriented application interface accessed through library subroutines supplied in both ANSI C source and binary.
- Fully rated ISDN BRI 144 Kbps data transmission with CPU processing bandwidth to spare.
- The development of sophisticated multi-media applications is facilitated by:
  - 33 Mflop Digital Signal Processor CPU performance.
  - No ROM or firmware: applications are soft loaded to the co-processor.
  - Multi-tasking Kernel operating system permits multiple co-resident DSP applications.
  - Sophisticated debug facilities for layers 1 through 3 and the applications interface.

Today's telecom product developer faces the most aggressive marketplace ever. This constant market flux necessitates a rapid product development cycle. DGM&S provides the developer and system integrator with the means to minimize costs and maximize productivity through the use of the QSource™ family of Enabling Technology products. The QSource™BRI Extended Application Development Kit gives you, the developer, every advantage in attacking the Basic Rate market.

Incorporating the QSource™BRI Extended Application Development Kit into your system provides you with state of the art communications capabilities with a minimum of effort. QSource™BRI flexibility eases system integration, minimizes development time and reduces development costs. QSource™BRI does not require previous experience with ISDN. The level of technology independence provided by QSource™BRI frees you to



QSource™BRI covers all your Basic Rate ISDN needs.

concentrate your efforts where they really count: on your application. QSource™BRI supplies you with CCITT compliant Basic Rate signalling and call control software in a modular binary form which can be easily integrated with host and DSP resident user application software. Library subroutines provide the user applications with easy access to ISDN call control functions through a message oriented interface. The Kernel operating system on the IDC adapters provides full multi-tasking capabilities to any number of IDC resident user programs.

The QSource™BRI Extended Application Development Kit consists of binary software images for ISDN Layers 1 through 3, the Kernel operating system and IDC support software. The application interface library is supplied in both ANSI C source and binary form. The two DGM&S IDC BRI Basic Rate adapter cards provide the platform upon which the QSource™BRI software operates. An extensive documentation package is also supplied.

The QSource™BRI Extended Application Development Kit can form the core of a user application or ISDN test equipment, or be used as a means of evaluating the QSource™BRI software prior to upgrading to the QSource™BRI System Development Kit.

Software Overview

The software provided in the QSource™BRI Extended Application Development Kit contains the DGM&S QSource™BRI software which represents over 30 man-years of ongoing development. Features of the software include a runtime option for operation with either the AT&T #5ESS, Northern Telecom DMS100, or Siemens EWSD switch and support for protocols such as X.25, V.120, V.110, and HDLC. The developer can take advantage of these features through the QLib BRI Application Interface library subroutines provided in ANSI C and binary.

Debug Facilities

Debugging and trace facilities in the Application Interface, Layer 3, Layer 2 and Layer 1 allow the developer to monitor every aspect of application operation. The Layer 3 filter can be used to validate and debug user defined messages. Exhaustive testing of QSource™BRI ensures the user a robust protocol engine which frees the developer from low level concerns.

IDC BRI Basic Rate Adapter

The DGM&S IDC BRI Basic Rate adapter card utilizes a Texas Instruments TMS320C30 Digital Signal Processor and the Siemens HSCX High Level Serial Controller to provide the highest performance of any communications adapter on the market. Bus master operation allows the PC/AT resident card to directly access data in video and LAN card memory. The ultra high performance of this board allows data to be transferred from the PC at the speed of the AT bus and provides full network speed on dual B channels.

Layer 3 Process

The QSource™BRI Layer 3 is a CCITT Q.931 compliant subsystem which provides all Network Layer functions needed for ISDN D channel signalling. This process is preceded by a pre-processor which validates the structure of the Q.931 Layer 3 primitives.

Layer 2 Process

The QSource™BRI Layer 2 process is a CCITT Q.921 compliant subsystem which provides all Link Layer functions required for the ISDN D channel and two B channels (LAPD/LAPB).

Layer 1 Process

DGM&S provides the QSource™BRI user with a CCITT I.430 compliant Layer 1 process for the IDC BRI adapter as part of the QSource™BRI Extended Application Development Kit.

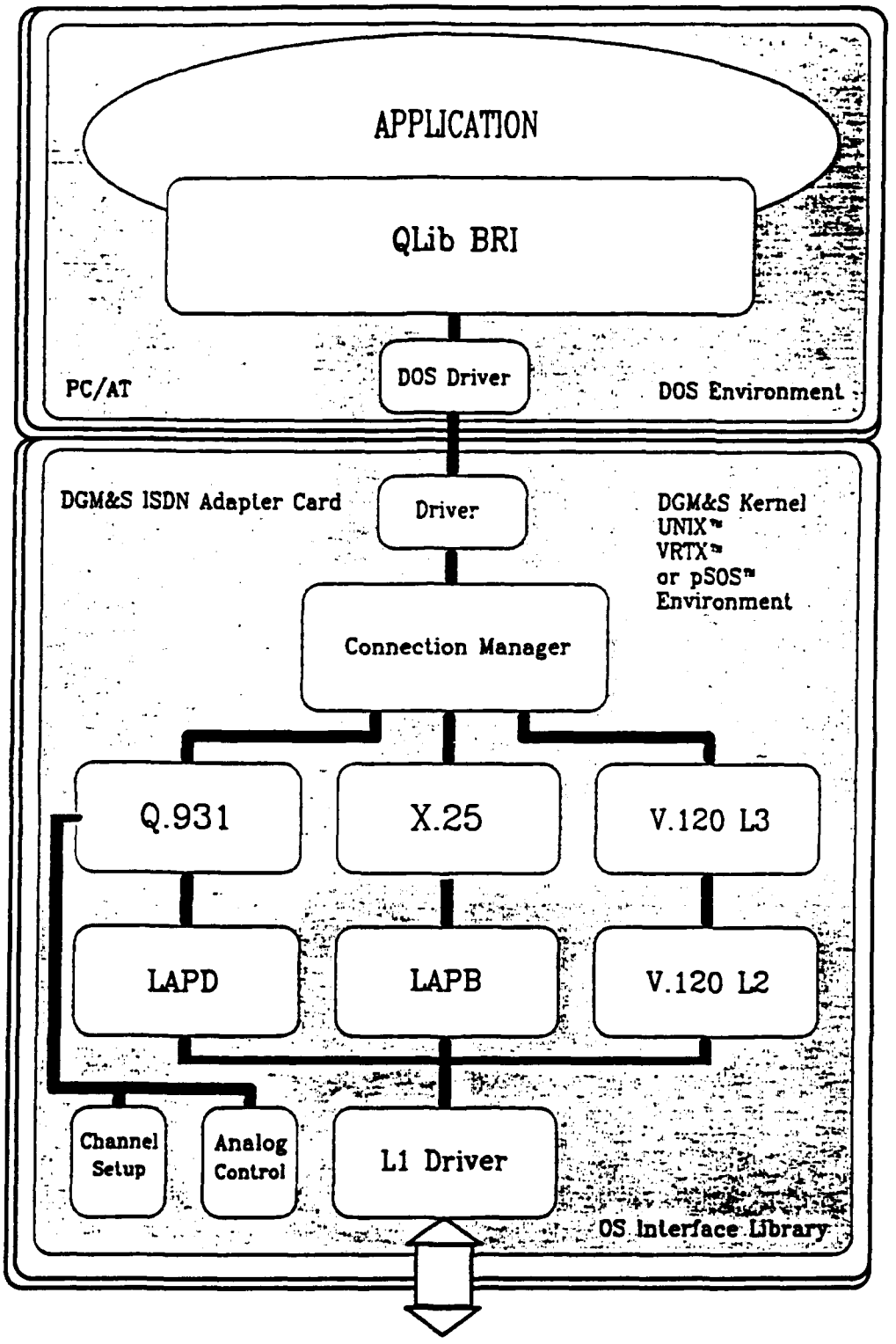
Support Software

BIOS, shared memory drivers, loaders and utility software are provided for the DGM&S IDC BRI adapter. Together with the QSource™BRI process they form an extensively tested, extremely resilient set of software tools.

Sample Applications

Two sample applications are provided with the QSource™BRI Extended Application Development Kit. One of these is a Medical Imaging application that performs video image compression, DMA data transfers across the PC/AT bus directly to the video card, and transmission of mouse positioning information between the two image screens. The other is a voice messaging application that can perform voice storage and playback on two simultaneous voice calls.

The QSource™BRI Extended Application Development Kit includes source code to rebuild these sample applications. This allows the developer to customize the applications creating extremely powerful multi-media applications.



A typical QSource™BRI application utilizing the DGM&S IDC BRI adapter on the IBM PC.

QSource™BRI Extended Application Development Kit Includes:

- Source and object code for the QLib BRI Application Interface.
- Two DGM&S IDC BRI Basic Rate adapter cards.
  - Texas Instruments TMS320C30 33 Mflop Digital Signal Processor CPU.
  - Siemens HSCX High Level Serial Controller.
  - Full network speed on both B channels.
  - Configurable back-to-back.
- CCITT Q.931 Layer 3 Binary code providing:
  - Support for the AT&T #5ESS, Northern Telecom DMS100 and Siemens EWSD switches.
  - Multiple X.25 connections using B and D channels at full network capacity.
  - V.110 and V.120 rate adaption.
- CCITT Q.921 Layer 2 Binary code providing:
  - Support for 2B+D Basic Rate access (LAPB/LAPD).
- CCITT I.430 Layer 1 Binary code for the DGM&S IDC BRI adapter.
- Source and binary code for the QSource™ Initialization process.
- Binary code for the QSource™ Timer process.
- Binary code for the OS Services Library.
- Binary code for the DGM&S Kernel Operating System and documentation.
- Source and Object code for QTalk prototype application.
- Binary code for the QTest Stress tester.
- Source code for two prototype applications (video transmission and voice storage).
- An optional daughter card is available for debugging.
- QSource™BRI Documentation Library, including:
  - QSource™BRI Extended Application Developer's Guide
  - QSource™BRI Architecture Overview
  - QSource™BRI Detailed Module Descriptions
  - QSource™BRI Installation Guide
  - QSource™BRI User's Guide
  - QTalk User's Guide
  - IDC BRI Technical Reference

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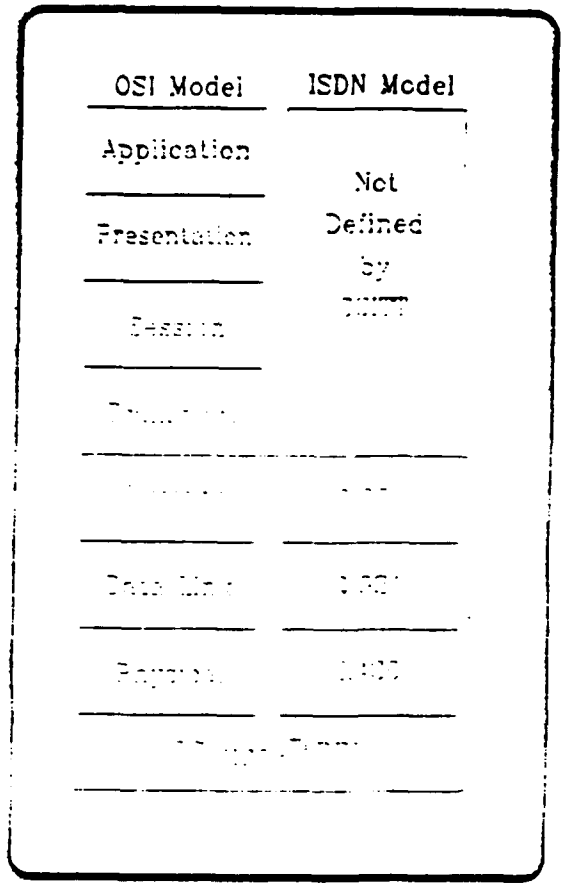
QSource™BRI

ISDN Basic Rate System Development Kit

SOURCE SOFTWARE with a DSP or PC53 HARDWARE PLATFORM

- CCITT compatible Q.921/Q.931 ISDN Basic Rate protocol source code written in ANSI C.
- Two powerful IDC BRI adapter cards and support software required for a "back to back" switch simulation environment.
- Message oriented application interface library supplied in both ANSI C source and binary.
- Debugging and trace capabilities for ISDN Layers 1 through 3 and the applications interface.
- Choice of hardware platforms provided as part of the kit:
  - The Digital Signal Processor (DSP) platform includes two 33 Mflop IDC BRI adapter cards with sufficient power to support multiple board resident multi-media applications.
  - The PC53 platform includes two Intel based adapter cards providing full 2B+D Basic Rate ISDN functionally.



QSource™BRI covers all your Basic Rate ISDN needs.

Today's telecommunications marketplace is more dynamic and competitive than ever. A telecom product developer must constantly search for the means to improve productivity, reduce costs, and shorten the development cycle. DGM&S addresses these needs for both product developer and system integrator with the QSource™ family of Enabling Technology products. QSource™BRI is the product of choice for applications utilizing ISDN Basic Rate.

Incorporating QSource™BRI into your system provides you with state of the art communications capabilities with a minimum of effort. QSource™BRI reduces development time and development costs. QSource™BRI flexibility eases system integration. QSource™BRI places no constraints upon your system architecture. QSource™BRI does not require prior experience with ISDN. The level of technology independence provided by QSource™BRI frees you to concentrate your efforts where they really count: on your final product.

QSource™BRI supplies you with CCITT compliant Basic Rate signalling and call control functionality, compliance tested against the AT&T #5ESS, Northern Telecom DMS100 and the Siemens EWSD switches. QSource™BRI is written in carefully structured modular ANSI C source code to facilitate customization. Library subroutines are used to provide easy access to ISDN call control functions. A filter ensures that the Q.931 primitives received by Layer 3 are CCITT compliant.

QSource™BRI is supplied in the form of an ISDN System Development Kit. This kit includes ANSI C source code for Layers 1 through 3, the application interface, two BRI adapter boards and support software, and the DGM&S Kernel operating system. Documentation and a training course ease familiarization. Optional Layer 1 software for other hardware platforms is also available.

System Independence

The QSource™BRI source code provides a level of system independence unheard of with other products. The code itself is written in ANSI Standard C, thus ensuring compatibility with a wide range of compilers. The heart of QSource™BRI, Layers 2 and 3 and the applications interface, are system independent and the code can be rapidly deployed on any hardware platform. OS interface libraries are available for a number of popular operating systems. No changes to the source code are required. This level of system independence frees the applications developer to concentrate his efforts where they really count: on the final product.

Applications Interface

QLib BRI provides the application with a message oriented interface to the QSource™BRI software. This interface is invoked by library subroutines which are linked into the application. Through the use of these subroutines, the application generates a QSource™BRI message which is then sent to the Layer 3 process. These routines are written in ANSI C and can be easily modified to suit the needs of the application.

Layer 3 Process

The QSource™BRI Layer 3 process is a CCITT Q.931 compliant subsystem which provides all Network Layer functions needed for ISDN D channel signalling. This process is preceded by a pre-processor which validates the structure of the Q.931 Layer 3 primitives.

Layer 2 Process

The QSource™BRI Layer 2 process is a CCITT Q.921 compliant subsystem which provides all Link Layer functions required for the channel and two B channels (LAPD/LAPB).

Layer 1 Process

DGM&S provides the QSource™BRI user with a Layer 1 process for the BRI adapters supplied as part of the QSource™BRI System Development Kit. Additionally, Layer 1 processes are available for use with other DGM&S communication adapters. These processes are I.430 compliant and intended for use with the DGM&S ISDN adapter cards.

Debug Facilities

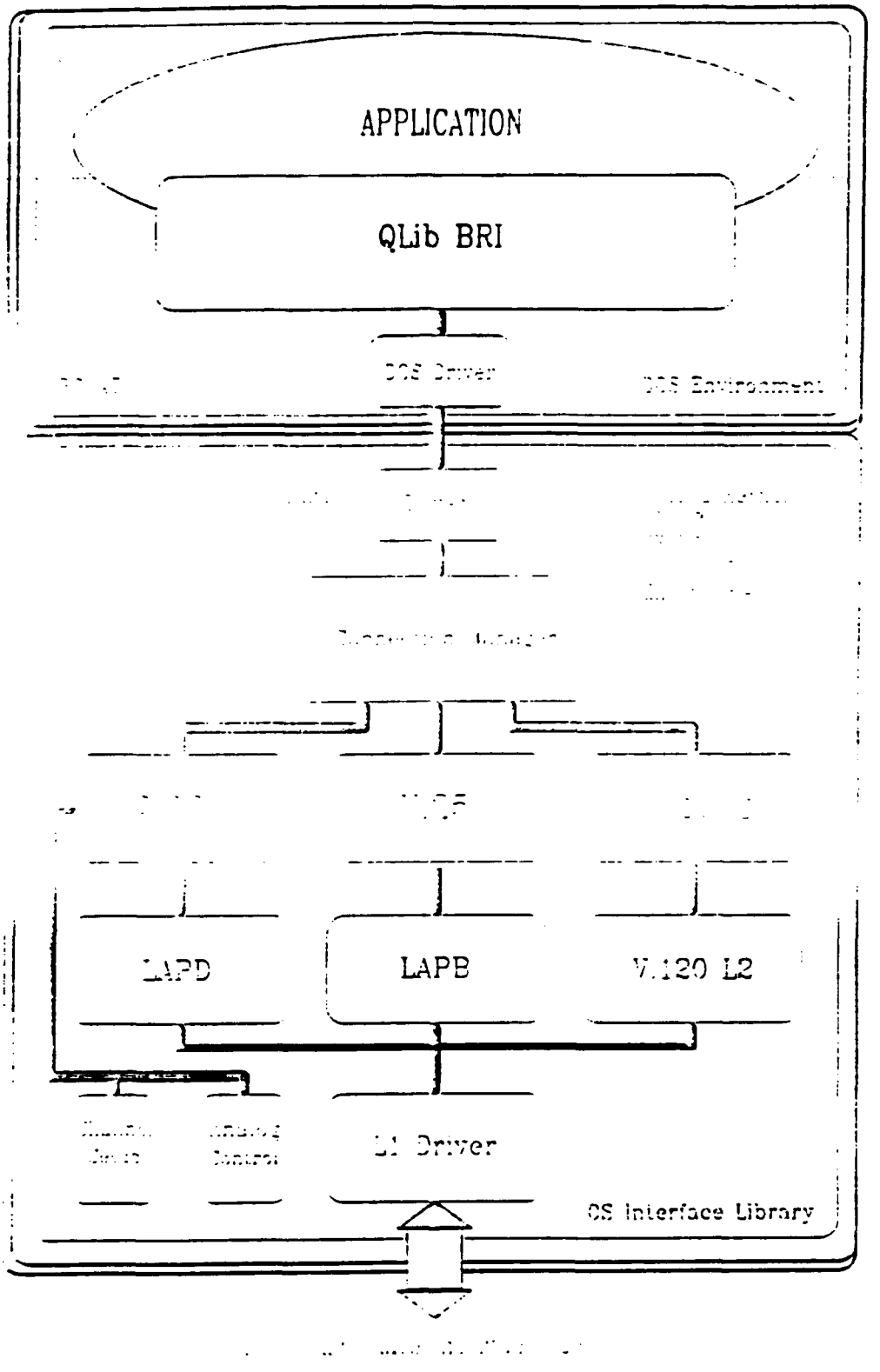
Debugging and trace facilities in the Applications Interface, Layer 3, Layer 2 and Layer 1 allow the developer to monitor every aspect of application operation. The Layer 3 filter can be used to validate and debug user defined messages. Our exhaustive testing of QSource™BRI ensures the user a robust protocol engine which frees him from low level concerns.

Support Software

BIOS, shared memory drivers, loaders and utility software are provided for the DGM&S BRI adapter cards and are optionally available for other environments. This software can be customized to suit special applications and unique requirements. Together with the QSource™BRI process they form an extensively tested, extremely resilient set of software tools.

Sample Applications

Sample applications are provided with the QSource™BRI System Development Kit. The PC53 platform includes an application that connects and disconnects voice and data calls. The IDC BRI platform includes two applications, the first of which is a Medical Imaging program that performs video image compression, DMA data transfers across the PC/AT bus directly to the video card, and transmission of mouse positioning information between the two image screens. The second application supplied with the IDC BRI platform is a voice messaging system that can perform voice storage and playback on two simultaneous voice calls.



A typical QSource™BRI application utilizing the DGM&S IDC BRI adapter on the IBM PC.

QSource™BRI System Development Kit Includes:

- CCITT Q.931 Layer 3 Source and Object code providing:
  - Support for the AT&T #5ESS, Northern Telecom DMS100 and Siemens EWSD switches.
  - Multiple X.25 connections using B and D channels at full network capacity.
  - V.110 and V.120 rate adaption. (V.110 rate adaption only available with the IDC platform.)
- CCITT Q.921 Layer 2 Source and Object code providing:
  - Support for 2B+D Basic Rate access (LAPB/LAPD).
- CCITT I.430 Layer 1 Source and Object code providing support for the DGM&S ISDN IDC Basic Rate Adapter Card or the PC53 ISDN Basic Rate Adapter card.
  - Please refer to the QSource™BRI Extended Application and Application Development Kit Brochures.
- Two DGM&S IDC BRI Basic Rate adapter cards or two PC53 ISDN Basic Rate adapter cards.
- A built-in debug port is supplied with the PC53 adapter card. An optional debug daughter is available for the IDC adapter card.
- Source and object code for the QLib BRI Applications Interface.
- Source and Object code for the QSource™ Initialization and Timer processes.
- Source and Object code for QTalk prototype application.
- Object code for the DGM&S Kernel Operating System and documentation.
- Binary code for the QNet Simulator (for the PC53 platform only).
- Binary code for the QTest Stress tester.
- Prototype applications.
- QSource™BRI Documentation Library, including:
  - QSource™BRI Developer's Guide
  - QSource™BRI Architecture Overview
  - QSource™BRI Detailed Module Descriptions
  - QSource™BRI Installation Guide
  - QSource™BRI User's Guide
  - QTalk User's Guide
  - Platform Technical Reference Manual

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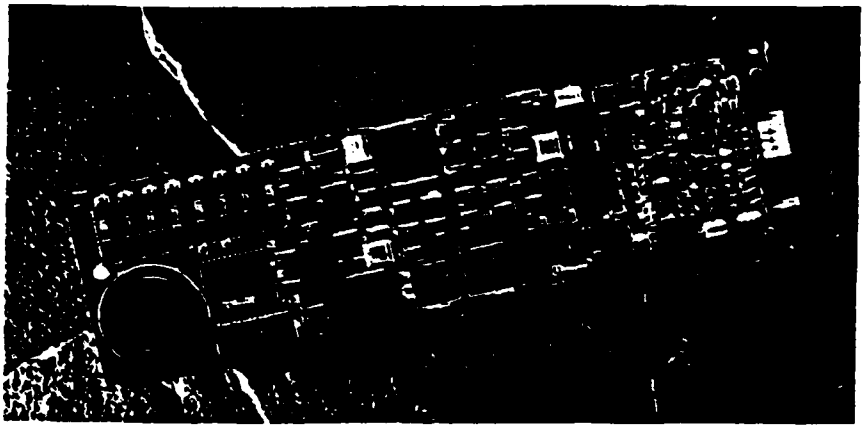
Hayes ISDN PC Adapter

Next Generation Voice/Data Capabilities with Today's Equipment

Hayes



With successful field trials underway around the world and tariffed commercial usage in place in a growing number of areas, ISDN has progressed through its initial stages and is rapidly moving toward large scale implementation.

The Hayes ISDN PC Adapter implements the CCITT ISDN Basic Rate Interface (2B+D) supporting simultaneous voice and data communications. This internal terminal adapter is designed for the installed base of IBM PC XT/AT and compatible personal computers. Specific ISDN features include support of Northern Telecom DMS-100 and AT&T 5ESS central office switches, CCITT X.25, ANSI V.120, high speed data rates for circuit switched and packet switched data, as well as comprehensive ISDN voice services.

General availability of ISDN offers tremendous benefits in flexibility, cost effectiveness, and increased efficiency.

The introduction of Hayes ISDN PC Technology provides a direct path to the integration of voice and data using existing PCs and communications software. This capability of providing next-generation communications capabilities through the use of existing, installed equipment provides enormous cost savings.

Hayes ISDN interfaces offer a growth path for users which starts with today's PC data applications and extends to full voice and data integration in networked environments. Designed for extensive multisession activities and ISDN data rates, the Hayes ISDNBIOS Interface supports either point-to-point or networked applications environments. The ISDNBIOS Interface is an Application Programming Interface (API) that is particularly useful for developing applications designed for local and wide area networking via ISDN. Designed for flexibility and expansion, the interface supports a broad spectrum of ISDN features and services.

The Hayes ISDNBIOS Interface complements the Hayes Standard AT Command Set Enhanced for ISDN which allows current data communications packages to perform in an ISDN environment and provides a clear path for adding voice call control and management.

The backward compatibility provided through the Hayes Standard AT Command Set Enhanced for ISDN is designed into Hayes ISDN Technology to enable our ISDN products to operate with current asynchronous communications packages such as Hayes Smartcom III™ and Smartcom Exec™. In addition, software developers are now shipping packages that offer the Hayes ISDN PC Adapter as a setup choice in their start-up menus.

Technical Specifications

ISDN SERVICES (Basic Rate Access)

Data Capabilities

- Circuit switched data connection on a B-Channel can transmit at high speeds using either X.25 or V.120 protocols for rate adaption, flow control, and error control
- Packet switched data (which uses X.25) can be provisioned on a B-Channel with up to 8 sessions
- Packet switched data provisioned on the D-Channel can also support up to 8 sessions
- Actual total number of data sessions is dependent on the PC system memory available

Voice Capabilities

- Circuit switched voice communications is available on one B-Channel using an analog phone attached to the RJ-11 connector on the adapter's back bracket
- External power supply provides voice communications when the PC is powered off
- ISDN voice services supported include: Basic Call Control; Flexible Call Offering - Conference, Drop, Transfer, Hold, Retrieve; Incoming and Outgoing Calling Line Identification; Feature Button Support for Supplementary Services; two call appearances, and in-band B-Channel Dual Tone Multiple Frequency (DTMF) signalling
- Supplementary Services the ISDN PC Adapter supports include: Speed calling, call forwarding, call park, call pickup, and others
- Exact options of the Feature Buttons supported are switch dependent

SUPPORTED SERVICE OPTIONS

Combinations of these services are dependent on the switch's line provisioning. The Hayes ISDN PC Adapter will support the options listed below.

Service Options				Switch Support	
Voice	*BCSD*	*BPSD*	*DPSD*	*NT DMS-100*	*ATT 5ESS*
			✓	Yes	Yes
		✓		Yes	Yes
		✓	✓	Yes	No
	✓			Yes	Yes
	✓		✓	Yes	Yes
✓				Yes	Yes
✓			✓	Yes	Yes
✓	✓			Yes	Yes
✓	✓		✓	Yes	Yes
✓		✓		Yes	Yes
✓		✓	✓	Yes	No

SWITCH/NETWORK COMPATIBILITY

Switch Support

- The Hayes ISDN PC Adapter System Software is the executable code that is uploaded to the adapter's on-board RAM by the PC at initialization
- This flexibility provides an easy product upgrade path to address changes in standards and future enhancements
- The ISDN PC Adapter system will be certified with the AT&T 5ESS Generic 5E5 and the Northern Telecom DMS-100 BCS-29
- Hayes will continue to develop System Software that will support additional switches and switch enhancements as the markets develop and these features become widely available to the general public

Network Support

- Supports 64K Unrestricted or 64K rate adapted from 56K network transmission bearer capabilities

ISDN STANDARDS SUPPORT

Signalling and Call Control
- Hayes supports Northern Telecom DMS 100 and AT&T 5ESS implementations of CCITT Q.931/I.451 which provides signaling and call control, and CCITT Q.921/I.441 which implements the Data Link Layer and provides error-control

Network Support
- The Hayes ISDN PC Adapter also supports the CCITT I.430 network interface, and ANSI V.120 and CCITT X.25 for rate adaption and flow control
- CCITT X.3 and X.29 are implemented for X.25 packet switched data on the B- or D-Channel
- X.25 functionality is provided through the Hayes Standard AT Command Set Enhanced for ISDN and ISDNBIOS

INTERFACES

PC Host Interface
- Two separate software interfaces to the Hayes ISDN PC Adapter:
  - The adapter supports a serial data interface, like a modem, accessed via a COM port
  - High speed data transfers are performed via shared PC memory using the Hayes ISDNBIOS Interface
- Voice and data calls can be monitored and controlled through either interface

Hayes Standard AT Command Set Enhanced for ISDN
- The Hayes Standard AT Command Set Enhanced for ISDN provides an Application Programming Interface (API)
- This API provides autobauding at up to 38.4Kbps and allows the adapter to provide high speed data services while emulating a Hayes Smartmodem™ product
- Voice call control and monitoring as well as multiple data calls on the two B-Channels and the D-Channel are available through this API
- Available call types include PSD-D X.25, PSD-B X.25, V.120, and voice

Hayes ISDNBIOS Interface
- The Hayes ISDNBIOS Interface supports the high data rates and accesses the multi-session capabilities of ISDN and provides an enhanced mode of operation
- Through the Hayes ISDNBIOS Interface, the ISDN PC Adapter supports actual data transfers of over 50,000 bps
- This interface allows multiple applications operating in foreground or background to use the Hayes ISDN PC Adapter simultaneously, and is well suited for access by Terminate and Stay Resident (TSR) programs
- The Hayes ISDNBIOS Interface is also the preferred interface for development of wide area networking (WAN) applications

Analog Telephone Interface
- Analog telephone interface is provided via an RJ-11 connector on the ISDN PC Adapter's back bracket
- The adapter provides ring equivalence to support up to three 2500-type compatible analog devices such as telephones, modems, and Group III facsimile machines through the single RJ-11 connector

ISDN Line Interface
- An RJ-45 connector on the back bracket is the physical interface for the ISDN Basic Rate S/T interface

Flow Control
- When using the serial port, flow control between the terminal and terminal adapter is determined via AT commands
- Flow control is inherent in the Hayes ISDNBIOS Interface and is handled automatically

TRANSMISSION MODES

Asynchronous Character Formats
- When using the Hayes Standard AT Command Set Enhanced for ISDN, the following asynchronous character formats are supported in the adapter:
  - Data Formats: 7 data bits and 1 parity bit (even, odd, mark, or space); 8 data bits with no parity; 1, 1.5, or 2 stop bits in the DTE-to-DCE direction; 1 stop bit in the DCE-to-DTE direction)
  - DTE Serial Interface Speeds supported: 300, 1200, 2400, 4800, 9600, 19200, 38400 bits per second
- Rate adaption protocols are used to guarantee flow-control, in-sequence, unduplicated, and error-control delivery of data

CONFIGURATION AND DIAGNOSTICS

Installation and Configuration Programs
- Installation Program helps the user identify their PC system configuration and install the Hayes ISDN PC Adapter with the appropriate System Software
- Configuration of the PC Adapter is made easy by the user-friendly Configuration Program and thorough documentation included with the card

Non-Volatile Memory
- Non-volatile memory is provided to store configuration parameters
- Once the Hayes ISDN PC Adapter has been configured for the line, it will remember this custom configuration even if the adapter is powered off or reset

OPERATING ENVIRONMENT

System Requirements
- The Hayes ISDN PC Adapter is for use with IBM® PC XT/AT, PS/2® Model 30, or 100% compatible personal computers
- DOS 3.1, 3.2, or 3.3 version required
- Hard disk with at least 1.5M bytes available, and 640K bytes of system memory is recommended

Software Compatibility
- Supports existing communications software using the Hayes Standard AT Command Set Enhanced for ISDN.
- Supports Hayes AutoStream protocol
- Supports applications programs designed for the Hayes ISDNBIOS.

ISDN Interface
- ISDN S/T Basic Rate Interface (BRI)
- AT&T 5ESS switch support
- Northern Telecom DMS-100 switch support

Telephone Interface
- Supports up to three standard 2500-type analog telephone sets
- Compatible with existing modems, Group III faxes, and answering machines

Data Services
- B-Channel circuit switched data (CSD)
- B-Channel packet switched data (PSD)
- D-Channel packet switched data (PSD)

Data Transmission Protocols
- X.25 and V.120 CSD
- X.25 PSD D- and B-channels, up to 16 simultaneous sessions (8 each on the D- and B-Channel)

Voice Services
- Voice on one B-Channel
- Basic voice call control through the telephone and full voice supplementary services support through the Hayes Standard AT Command Set Enhanced for ISDN and ISDNBIOS APIs.

Application Interfaces
- Hayes Standard AT Command Set Enhanced for ISDN
- Hayes ISDNBIOS
- Complete technical documentation

Installation
- Installation Options:

Installation/Configuration Program	Evaluates PC environment to ease installation
Com Port Selection	1, 2, or None
Base I/O Address	208, 288, 308, 388 (hex) switch selectable
Shared Memory Address	Programmable
Shared Memory Enable	Programmable
Interrupt usage	Int 2, 3, or 4 programmable
Configuration Storage	Non-Volatile Memory on-board
	Installation/Configuration Program provided
Documentation	User's Guide Technical Reference

PHYSICAL SPECIFICATIONS

Dimensions
- One full-card, 3.9x13.5 inches
- Power Supply, 4.8x2.7x2.7 inches

Weight
- Less than 4 lb

Power Consumption (maximum)
- From external supply
  - +5 volts DC, 1.0 Amps
  - +15 volts DC, 100 Milliamps
  - -15 volts DC, 100 Milliamps
  - +130 volts DC, 75 Milliamps
- From host PC (if external power supply not used)
  - +5 volts DC, 1.0 Amps

Operating Temperature
- 0 to 50 degrees Centigrade

Relative Operating Humidity
- 10% to 90 % non-condensing

Warranty
- Two year limited hardware warranty

Hayes®

Hayes Microcomputer Products, Inc.
P.O. Box 105203
Atlanta, Georgia U.S.A. 30348

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Hayes ISDN Technologies
Development Center
501 Second Street, Suite 300
San Francisco, California 94107

Hayes Microcomputer Products
(Asia) Limited
21/F Caxton House
1 Duddell Street
Central, Hong Kong

Hayes Microcomputer Products, Inc.
1 Roundwood Avenue
Stockley Park
Uxbridge, Middlesex UB11 1AE
United Kingdom

00-00273 AA A21

Hayes®

Hayes Microcomputer Products, Inc.

Feature Overview

Hayes ISDN PC Adapter

The Hayes ISDN PC Adapter implements the CCITT ISDN Basic Rate Interface (2B+D) supporting simultaneous voice and data communications. This internal terminal adapter is designed for the installed base of IBM PC XT, AT and compatible personal computers. Specific ISDN features include support of Northern Telecom DMS 100 and AT&T 5ESS central office switches, CCITT X.25, ANSI V.120, high speed data rates for circuit switched and packet switched data, as well as comprehensive ISDN voice services.

ISDN SERVICES (Basic Rate Access)

Data Capabilities - Circuit switched data connection on a B channel can transmit at high speeds using either X.25 or V.120 protocols for rate adaption flow control, and error control. Packet switched data (which uses X.25) can be provisioned on a B Channel with up to 8 sessions. Packet switched data provisioned on the D Channel can also support up to 8 sessions. The actual total number of data sessions is dependent on the PC system memory available.

Voice Capabilities - Circuit switched voice communications is available on one of the B channels using an analog phone attached to the RJ-11 connector on the adapter's back bracket. An external power supply is also included to provide voice communications even when the PC is powered off.

The supported ISDN voice services include Basic Call Control; Flexible Call Offering - Conference, Drop, Transfer, Hold, Retrieve; Incoming and Outgoing Calling Line Identification; Feature Button Support for Supplementary Services; two call appearances, and in-band B channel Dual Tone Multiple Frequency (DTMF) signalling. Speed calling, call forwarding, call park, call pickup are examples of the Supplementary Services the ISDN PC Adapter supports. The exact options of the Feature Buttons supported are switch dependent.

P.O. Box 105203. Atlanta, Georgia 30348 (404) 449-8791 / Fax (404) 441-1238

SUPPORTED SERVICE OPTIONS

Combinations of these services are dependent on the switch's line provisioning. The Hayes ISDN PC Adapter will support the options listed below.

Service Options				Switch Support	
B Voice	B CSD	B PSD	D PSD	NT DMS 100	ATT 5ESS
			√	Yes	Yes
		√		Yes	Yes
		√	√	Yes	No
	√			Yes	Yes
	√		√	Yes	Yes
√				Yes	Yes
√			√	Yes	Yes
√	√			Yes	Yes
√	√		√	Yes	Yes
√		√		Yes	Yes
√		√	√	Yes	No

SWITCH/NETWORK COMPATIBILITY

Switch Support - The Hayes ISDN PC Adapter System Software is the executable code that is uploaded to the adapter's on-board RAM by the PC at initialization. This flexibility provides an easy product upgrade path to address changes in standards and future enhancements.

The ISDN PC Adapter system will be certified with the AT&T 5ESS Generic SE5, and the Northern Telecom DMS 100 BCS 29.

Hayes will continue to develop System Software that will support additional switches and switch enhancements as the markets develop and these features become widely available to the general public.

Network Support - Supports 64K Unrestricted or 64K rate adapted from 56K network transmission.

ISDN STANDARDS SUPPORT

Hayes supports Northern Telecom DMS 100 and AT&T 5ESS implementations of CCITT Q.931/I.451 which provides signaling and call control, and CCITT Q.921/I.441 which implements the specified Data Link Layer and provides error control. The Hayes ISDN PC Adapter also supports the CCITT I.430 network interface, and ANSI V.120 and CCITT X.25 for rate adaption and flow control. CCITT X.3 and X.29 are implemented for X.25 packet switched data on the B or D channel. X.28 functionality is provided through the Hayes Standard AT Command Set Enhanced for ISDN and ISDNBIOS.

INTERFACES

Analog Telephone Interface - Analog telephone interface is provided via an RJ-11 connector on the ISDN PC Adapter's back bracket. The adapter provides ring equivalence to support up to three 2500-type compatible analog devices such as telephones, modems, and Group III facsimile machines through the single RJ-11 connector.

ISDN Line Interface - An RJ-45 connector on the back bracket is the physical interface for the ISDN Basic Rate S/T interface.

PC Host Interface - There are two separate software interfaces to the Hayes PC Adapter. The adapter supports a serial data interface, like a modem, accessed via a COM port; and high speed data transfers are performed via shared PC memory using the Hayes ISDNBIOS Interface. Voice and data calls can be monitored and controlled through either of these interfaces.

TRANSMISSION MODES

When using the Hayes Standard AT Command Set Enhanced for ISDN, the following asynchronous character formats are supported in the adapter according to the following speeds and protocols:

Data Formats:
- 7 data bits and 1 parity bit (even, odd, mark, or space),
- 8 data bits with no parity, and
- 1, 1.5, or 2 stop bits in the DTE-to-DCE direction, or
- 1 stop bit in the DCE-to-DTE direction.

DTE Serial Interface Speeds supported:
- 300, 1200, 2400, 4800, 9600, 19200, 38400 bits per second.

Through the Hayes ISDNBIOS Interface, the ISDN PC Adapter supports actual data transfers of over 50,000 bps. Rate adaption protocols are used to guarantee flow-controlled, in-sequence, unduplicated, and error controlled delivery of data.

TA CONTROL AND OPERATION

Hayes Standard AT Command Set Enhanced for ISDN - One of the PCA's Application Programming Interfaces (APIs) is the Hayes Standard AT Command Set Enhanced for ISDN. This API provides autobauding at up to 38.4Kbps and allows the PCA to provide high speed data services while emulating a Hayes Smartmodem. Voice call control and monitoring as well as multiple data calls on the 2B and D channels are available through this API. The available call types include PSD-D X.25, PSD-B X.25, V.120, and voice.

Hayes ISDNBIOS Interface - To support the high data rates and access the multi-session capabilities of ISDN, Hayes has developed the Hayes ISDNBIOS Interface which provides an enhanced mode of operation. Through this interface, based architecturally on IBM NETBIOS, users can achieve actual data transfer rates of over 50,000 bps. This interface allows multiple applications operating in foreground or background to use the Hayes ISDN PC Adapter simultaneously, and is well suited for access by Terminate and Stay Resident (TSR) programs. The Hayes ISDNBIOS Interface is also the preferred interface for development of wide area networking (WAN) applications.

Flow Control - When using the serial port, flow control between the terminal and terminal adapter is determined via AT commands.

Flow control is inherent in the Hayes ISDNBIOS Interface and is handled automatically.

Non-Volatile Memory - Non-volatile memory is provided to store configuration parameters. Once the Hayes ISDN PC Adapter has been configured for the line, it will remember this custom configuration even if the adapter is powered off or reset.

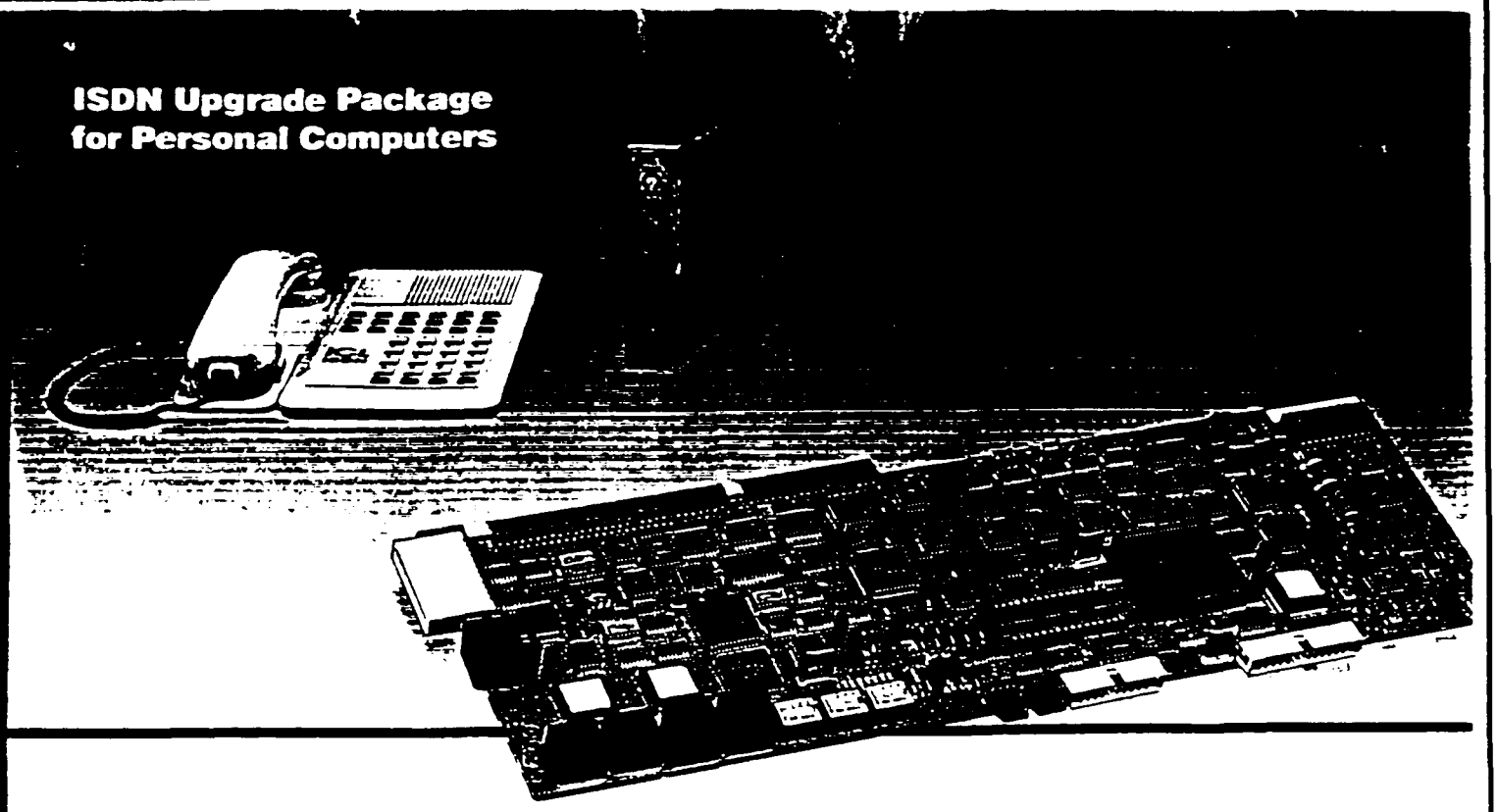
CONFIGURATION AND DIAGNOSTICS

An installation program helps the user identify their PC system configuration and install the Hayes ISDN PC Adapter with the appropriate System Software. Configuration of the PCA is made easy by the user-friendly Configuration Program and thorough documentation included with the PCA.

OPERATING ENVIRONMENT

The Hayes ISDN PC Adapter is for use with IBM PC XT, AT or 100% compatible personal computers. The system needs DOS 3.1, 3.2, or 3.3 version, a hard disk with at least 1.5M bytes available, and 640K bytes of system memory is recommended.

ISDN Upgrade Package for Personal Computers



ICL/ISDN

ICL's I³ (I-Cubed) is a plug-in-and-go hardware, software, and applications package that connects PC's to the ISDN Basic Rate Interface (2B+D). It includes an ISDN plug-in card (PC expansion board), an ISDN telephone, software, applications, and a voice and data Applications Programming Interface.

2B+D for Almost Any PC, No Matter What the Family Tree

The I³ is available for OS/2-based computers including:

- **Micro Channel™ architecture** (MCA) based computers from IBM and compatibles.
- **PC-AT's and compatibles.**
- **EISA-based computers and compatibles** (Extended Industry Standard Architecture).

Installation is simple. The ISDN board plugs into an expansion slot and an easy-to-use utility sets everything up.

The ISDN Connection Makes PC Stand for Powerful Communications

Putting 2B+D on a PC transforms it into a desktop communications center. Some of the PC's newfound power includes:

- *The ability to integrate voice and data applications*, such as Automatic Number Identification (ANI or incoming caller identification) combined with personalized Phonebook facilities.
- *The ability for an application to activate a communications session*: such as when an incoming call, using ANI, initiates the retrieval of a customer file from a host computer.
- *The ability to customize most of the 38-button telephone keypad and computer screen layouts* on the telephone.
- *The ability to integrate user-designed applications, both existing and newly created*, with the system's voice and data communications facilities via an Applications Programming Interface.
- *The ability to easily conduct multiple mainframe data sessions*, each in its own window, while running OS/2 applications.
- *The ability to interactively share applications with other users in real time*, via DeskTop Conferencing software.

Software Makes the PC and Phone Mutually Supportive

The I³ comes with software that fully integrates the computer and the ISDN telephone.

- ISDN Voice and Data Call Management software
- Switch interface software for connection to AT&T's 5ESS, Siemens EWSD, and Northern Telecom's DMS-100 using functional signaling.
- V.120 Rate Adaption Protocol Software

Built-In ISDN Applications Make New Things Possible

Also included with the I³ are:

- A fully integrated Phonebook
- An Applications Programming Interface (API)

DeskTop Conferencing™ (ICL's real time, interactive screen sharing software) is optional.

Screen Calls–Right from the Screen

The I³'s Phonebook is like having an electronic rolodex and file folder all in one package. Details about all contacts can be stored to create a personalized "directory" database, which includes names, addresses, telephone numbers, and notes.

The I³'s Phonebook quickly becomes invaluable because making a data call is as easy as making a voice call. There aren't any special codes or long strings of information to enter. A data call is as simple as a key depression.

ANI Tells Who's Calling

Automatic Number Identification (ANI) is another powerful I³ feature. When a call comes in, a caller's number, name, address, and any associated notes appear on the screen. RECENT CALLS is a feature that displays a list of the most recent incoming and outgoing calls. Even unanswered calls are listed.

Communications Across the ISDN Network

The I³ comes with V.120 rate adaption protocols built into it. In addition, ICL has a complete range of products by which users manage their communications across the ISDN network, including multiple, multi-host sessions. These products include support of IBM's SNA communications, asynchronous systems, including DEC and UNIX hosts, and OSI products, such as X.25 and FTAM.

Multiple Mainframe Data Sessions and Multi-Tasking Meet at the Desktop

Connection to a remote computer host is as simple as pressing the "LINK" button on the telephone keypad and selecting a menu item. The menu lists available remote data services as well as data call applications. A specific caller's identity causes an application to be loaded or a communications session to start, such as the retrieval of a customer's invoice from a corporate host computer. Up to 16 simultaneous data sessions can be conducted, each in its own window. An OS/2 application, such as Lotus, can be run concurrently with mainframe information retrieval.

A Programmers Dream: The Built-In API

ICL's telephony subsystem was built with an interface so user-designed applications can interact with the system's voice and data communications facilities. The I³'s built-in Applications Programming Interface (API) includes both a voice *and* data API. The API adds communications power to applications because they can be programmed to initiate or manage calls, process ANI, or begin synchronous or asynchronous data sessions. **For more information, please see the ICL data sheet entitled "API".**

Specifications

ICL's I³ Includes:

- ISDN PC plug-in interface card
- ISDN Telephone
- ISDN RJ-45 cable for connection to an NT1
- ISDN Telephone Manager Application Software
- ISDN Phonebook Application Software
- ISDN Central Office Switch Interface Software
- V.120 Rate Adaption Software
- Applications Programming Interface (API) Toolbox
- Complete documentation

ISDN PC Plug-In Interface Card with Software

Physical Connections
- RJ-45 jack for S/T interface
- 16-bit bus PC edge connector

On-board Processor
- NEC V25 (80188 based)

On-board RAM
- 1 MB (MCA card)
- 256 Kb (AT card)

Operating System
- OS/2

Switch Types Supported
- AT&T 5ESS
- Siemens EWSD
- Northern Telecom DMS-100

Data
- Up to 64 Kbps on any B-Channel connection.
- Circuit-switched connections on B-Channels.
- "Nailed" X.25 Packet-switched connections on B Channels (up to 16 sessions).
- "On Demand" X.25 Packet-switched connections on B Channels (up to 16 sessions).
- LAPB Link Layer Protocol on B Channels.
- SDLC Protocol on B Channels.
- V.120 Rate Adaption (up to 16 sessions).
- X.25 Packet-Switched Connections on D Channel (up to 16 sessions).
- LAPD Link Layer Protocol on D Channel.
- Asynchronous terminal emulation support.
- IBM SNA communications.

Voice
- Voice calls on B Channels.
- Up to 64 call appearances.
- Key systems support.
- Supplementary services support; e.g., Hold, Conference, Call Forwarding.

ISDN Telephone

Keys
- 12 Standard dialing keys (0-9, *, #).
- 22 soft keys each with its own red LED to invoke voice, data, phone, and switch features
- 4 keys for applications.

Integration
- Feature keys may automatically "pop up" windows or menus on the workstation monitor to display information (e.g., a list of phone numbers of parties who called while the system was unattended).

Speakerphone
- Standard
- Volume Up/Down Controls
- Mute (microphone button)

Connecting Cable
- A 6'6" cable connects the ISDN phone to the ISDN workstation

Ringing
- The phone itself rings, not a speaker inside the PC

Dimensions
- Width 8.5"
- Depth 10.5"
- Height 2.5"

Operating Environment

IBM PC-AT, IBM PS/2 Model 30-286, IBM PS/2 with MCA bus (Model 50 or above) or compatible with Operating System/2 Version 1.1 or higher installed. A hard disk with 1.5 Mb available, 4 Mb RAM, and a VGA or EGA monitor.

ISDN Power for Your Business Applications

ICL

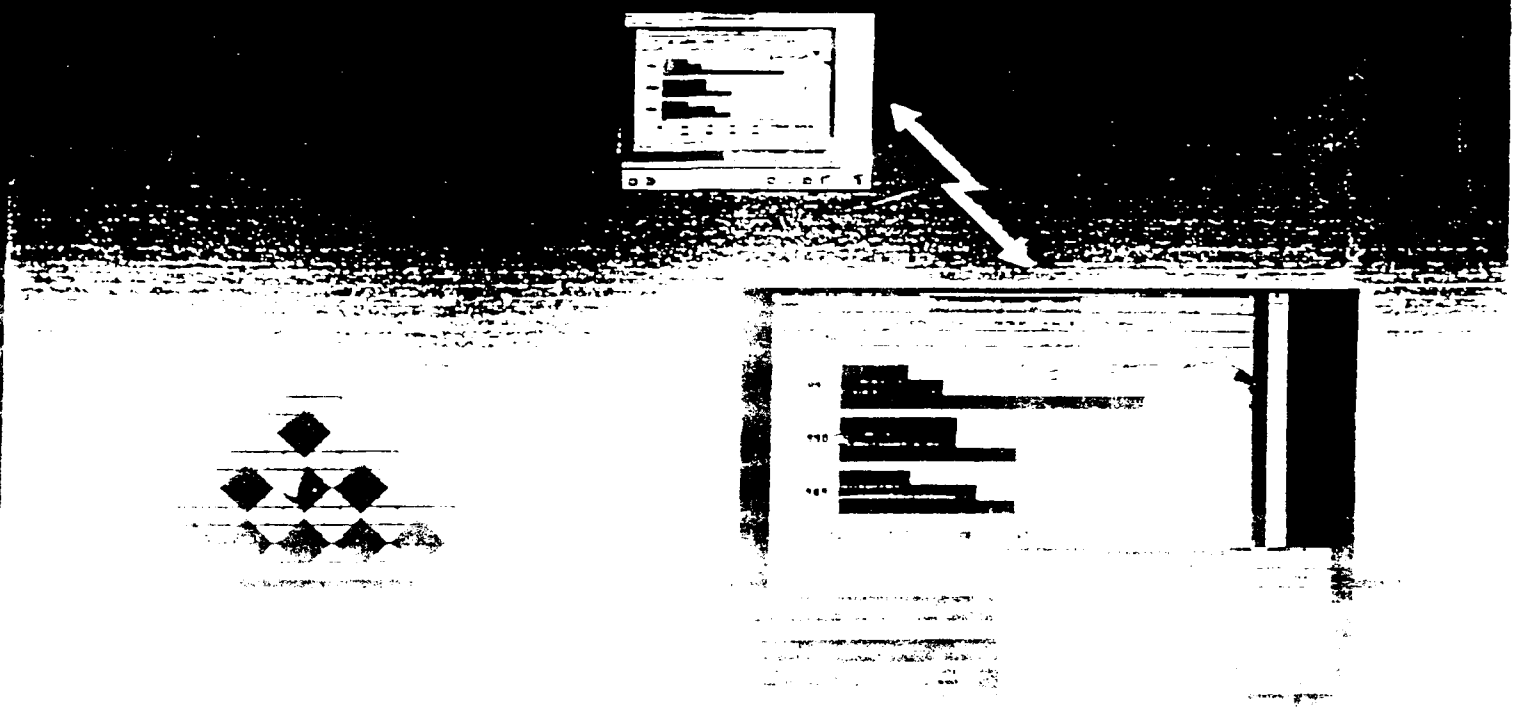
[illegible] works Industry
ISDN Systems Group

77 [illegible]ong Ridge Road
Sta[illegible]ford, CT 06902
203-968-7222 (Within CT)

1-800-446-ISDN (4736)

For further information contact:

Transforming the Desk Top Into a Communications Center



and displayed within the DeskTop Conferencing "Status" window.

Send a Portion or a Partition

Portions of a screen may be conferenced, such as columns, defined areas, and specific windows. This gives the conference "Chair" more control because it is possible to send only the data that is relevant to the conversation. For example, from a full spreadsheet, the Chair may choose to transfer only the screen area with prices and not the costs. By using an option called "Transfer Area," the conference Chair positions and sizes a window on the screen and specifies the area of the screen to be transferred.

A "Full Screen" mode is available to view individual images or to view any screen in which a full screen view versus a window is preferred.

A Thermometer Registers File Transfers

The File Transfer facility includes a thermometer style gauge that displays file transfer progress. Files may be sent in two directions at once–and *during* screen transfers.

Create Flexible and Focused Communities of Interest by Linking Employees-to-Employees and Employees-to-Customers

The combination of ISDN and DeskTop Conferencing offers a world without walls because it extends the ability to create workgroups. ISDN and DeskTop Conferencing open workgroup computing beyond LANs to Wide Area Networking. DeskTop Conferencing is a powerful tool to flexibly create and expand "communities" of interest, both inside a company, and outside of it. People can be easily linked, in real time connectivity, within a company, and beyond its walls, to the larger world of global networks.

DeskTop Conferencing opens up a world of opportunities to create flexible communities that include everyone with whom your company does business:

- Workgroups gain improved flexibility.
- Decisions are made much faster because of the ability to see what is being discussed. The majority of time-consuming, face-to-face meetings required today can be eliminated.
- DeskTop Conferencing makes it possible to derive ISDN benefits today without waiting for the network to be fully deployed. DeskTop Conferencing benefits can be derived today by using ISDN locally; X.25 can be used to connect outside the ISDN network and meet Wide Area Networking requirements

The "community" no longer needs to be limited to a company's locations With DeskTop Conferencing, customers, vendors, and other contacts who comprise a company's communications lifeblood can become part of a flexible, networked community. The public network offers the advantage of equal access to all companies, no matter what their size. As a shared communications application, DeskTop Conferencing is a powerful tool to link them today.

- DeskTop Conferencing reduces the need for travel. This saves human wear and tear, and keeps the decision makers where they best make decisions–in their offices and at their desks, instead of in transit.

Primary Features

If you spend a great deal of time discussing information over the phone, you will never want to be without DeskTop Conferencing

Transfer Mode
Screens automatically transfer the selected OS/2 or DOS application, image, or text to all conference participants.

Flipchart
Flipchart freezes the current application, without interrupting normal activities, so conference participants can highlight it, draw, make changes, and point to it. Each flipchart page is automatically saved. Up to 99 flipchart screens can be active, including blank white screens for conference participants to use as a "whiteboard." A mouse or light pen may be used to point and draw in any color, and documents may be signed in real time.

Background File Transfer
Files may be transferred between users as a background task. Screens transparently transfer without any interruption to an already running OS/2 or DOS application.

Keyboard Control
Keyboard operation of the conferenced application is easily transferred between workstations. Applications can be operated remotely.

Screen Control
The source of the screen transfer is easily changed to any conference participant.

Screen Saving
Text or graphics images can be saved into bit formats (PCX). These files can be used by other applications for editing and printing, or included in other documents. Retrieval of previously saved files or images produced by other applications is simple.

Conference Management
A nominated "Chair" has the necessary tools to flexibly yet securely control sessions. Conferences may be informal or formal in nature, depending upon the sensitivity of the information being discussed, and the working relationship among the participants.

ISDN Power for Your Business Applications

ICL

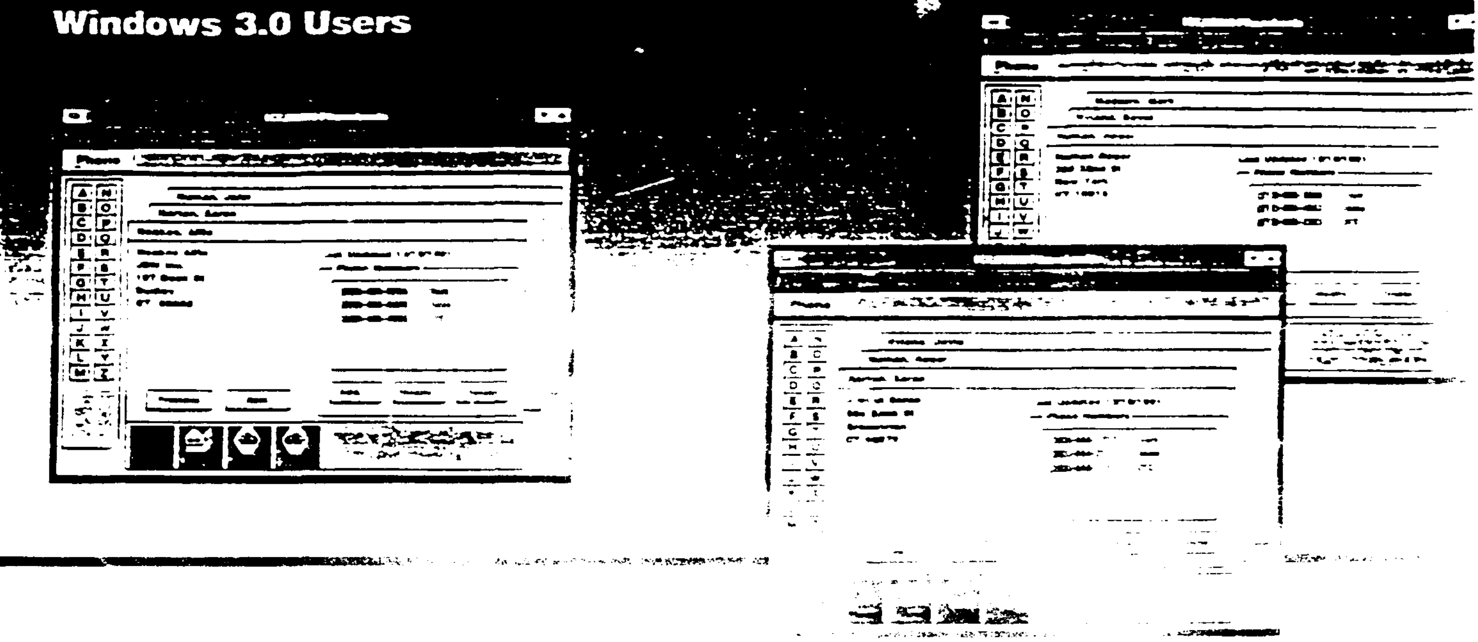
Networks Industry
ISS Systems Group

[illegible] Long Ridge Road
[illegible]mford, CT 06902
[illegible]968-7222 (Within CT)

[illegible]0-446-ISDN (4736)

For further information contact:

ICL's I³, Telephony, and DeskTop Conferencing for Windows 3.0 Users



ICL / ISDN

ICL has taken Microsoft's phenomenally successful Windows™ Version 3.0 software and combined it with DeskTop Conferencing™ and ISDN.

Personal computer users ... allows their Windows 3.0 environment to communicate ...

All the Windows 3.0 advantages are there—the ability to run multiple DOS and Windows applications with a friendly Graphical User Interface—but adding DeskTop Conferencing means ... annotate any Windows 3.0 or DOS application with other users who are in remote locations.

At the touch of a button ... Windows or DOS screen instantly and invisibly transfers to another PC connected to ISDN. Users not only *see* the same information at once, they may make changes to it or interactively annotate it *in real time*.

Decisions are made on the spot.

Compatible With All Compatibles

The ... software which ... integrates the computer and the ISDN telephone ... includes ... Voice and Data Call Management software ... software for connection to AT&T 5ESS or Northern Telecom DMS-100 using functional signaling ... Rate ...

ICL's ISDN products for Windows 3.0 ... processors ... AT, EISA and Micro Channel bus architecture based machines.

Windows 3.0 Improves Your Memory

Better memory management is a much-heralded Windows 3.0 feature ...

DeskTop Conferencing Adds a Voice/Data Dimension to Windows

... Windows application ... text or graphics ... mouse ... information ...

... with other applications ... are connected by a conference ... DeskTop Conferencing ... ISDN B channel ... information sharing, the other ... is used for voice communication. ... DeskTop Conferencing ... the first ISDN application for Windows 3.0. This new application ...

... saved material may be displayed ... by another graphics package independent of DeskTop Conferencing. If desired, portions of ... may be conferenced. By using the ... Area option, a window may be positioned and sized, and the area ...

Telephony Applications: Feature Rich with Full Facilities

An advanced featurephone and integrated telephony applications are built into all ICL ISDN systems.

A major benefit of ICL's voice/data integration is the ability to map features to dedicated telephone keypad buttons and display full screens of information. ISDN switch features and computer application features are mapped to the telephone's keypad buttons. The telephony features below are designed as an integral part of ICL's ISDN telephone, and as part of ICL's package for Windows 3.0.

- Multiple call appearances and directory numbers
- Speed dial
- Redial
  - Recent Calls
  - Hold
  - Conference
- Transfer
- Drop
- Call Forward
- Call Pickup
- Speakerphone (hands free calling)
- Distinctive ringing
- Time and date display

Menu-driven access to ISDN supplementary features not assigned to a single key is available: e.g., Call Park.

The Phonebook: An Invaluable Electronic Rolodex and Personalized Database without Par and without Limitations

ICL's *Phonebook* is an easy-to-use Windows 3.0 application. *Phonebook* is like having a personalized database at your fingertips that includes an electronic rolodex, a telephone directory of contacts, a notebook, and a file folder. Because of the excellent memory management facilities inherent in Windows 3.0, much larger databases may be created.

Each voice or data entry may include name, address, and telephone numbers. Notes may be attached to any entry and may be displayed and edited at any time.

Fast Text Facilities Simplify Searches

To truly take advantage of the larger database facilities Windows 3.0 makes possible without compromising speed, ICL developed a fast text searching system. The entire database may be quickly searched for strings of characters.

Data Calls and DeskTop Conferencing are a One-Button Operation

Making a data call or a DeskTop Conference is as easy as making a telephone call. They both begin at the touch of a single button. All data communications or telephony activities proceed uninterrupted using your preferred tool: the telephone keypad, computer keyboard, or mouse.

Standard Interfaces Come Standard with ICL Systems

All ICL ISDN systems include built-in standard interfaces to the network. ICL's package for Windows 3.0 supports connections to AT&T's 5ESS and Northern Telecom's DMS-100 switches and supports the V.120 protocol for rate adaption.

Primary Features

File Transfer
Files may be transferred between users without any interruption to an already running Windows or DOS application.

Transfer Mode
Windows or DOS screens automatically transfer to all conference participants, whether image or text.

Flipchart
Flipchart freezes the current application, without interrupting normal activities, so conference participants may highlight it, draw, make changes, and point to it. Each flipchart page is automatically saved. Up to 99 flipchart screens can be active, including blank white screens for conference participants to use as a "whiteboard." A mouse or light pen may be used to point and draw in any color, and documents may be signed in real time.

Keyboard Control
Keyboard operation of the conferenced application is easily transferred between workstations. Applications can be operated remotely.

Screen Control
The source of the screen transfer is easily changed to any conference participant.

Screen Saving
Text or graphics images can be saved into bit formats (PCX). These files can be used by other applications for editing and printing, or included in other documents. Retrieval of previously saved files or images produced by other applications is simple.

Conference Management
A nominated "Chair" has the necessary tools to flexibly yet securely control sessions. Conferences may be informal or formal in nature, depending upon the sensitivity of the information being discussed, and the working relationship among the participants.

Operating Environment
IBM PC-AT, IBM PS/2 Model 30-286, IBM PS/2 with MCA bus (Model 50 or above) or compatible with Microsoft Windows 3.0 installed. A hard disk with 1.5 Mb available, 3 Mb RAM, and a VGA or EGA monitor.

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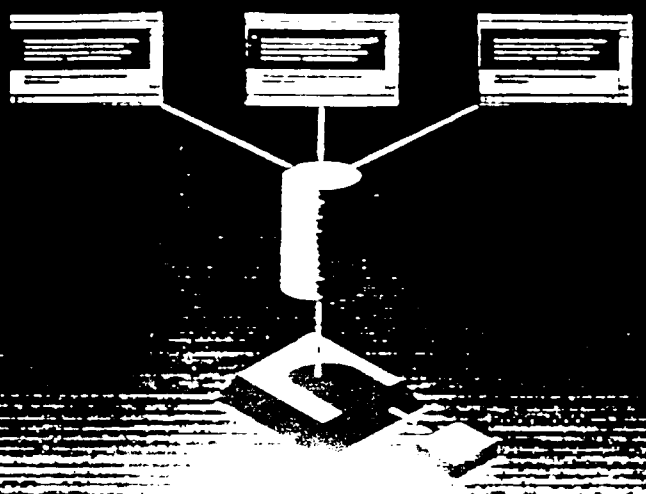
For further information contact:

A Toolbox That Puts Applications in Touch with ICL's ISDN Technology



Telephone API Functions

Simple programming commands enable applications to:

- Make outgoing calls to an ISDN number.
- Auto-Answer incoming calls.
- Determine Call Status. Call Status indicates type of call (voice or data) as well as its state: connected, ringing, on hold.
- Request Call Logging. Notification of when a call is terminated and why.
- Reject Incoming Call. Application rejects an incoming call without tying up a B-Channel. Calling party hears ringing.
- Send DTMF tones. User application sends DTMF tones over the B-Channel.

V.120 API

The V.120 API uses the Hayes AT (Attention) command set for communication control.

ICL's V.120 conforms to the CCITT's Rec. V.120 (i.465) rate adaption. V.120 enables devices that transmit data at different speeds to communicate by managing their transmission rates. It supports computers and data communications equipment that communicate asynchronous or synchronous data at speeds from 300 bps to 64 kbps.

V.120 API applications address DOS device names to open and close the communications device; send and receive data, and to send control commands to the device.

X.25 Applications Interface

The X/Open Transport Interface (XTI) includes a transparent interface between higher layer applications and X.25. The application operates independently of the X.25 implementation; i.e., the application must know how to access the XTI functions. XTI is an industry accepted standard among companies such as ICL, AT&T, Hewlett-Packard, Siemens, Nixdorf, UNISYS, and Fujitsu. It is pending adoption as a CCITT standard. It offers the advantages of ease of application portability and protects the application base.

Function Calls Make It Functionally Simple

An application interacts with ICL's system via simple instructions called Function Calls. An API Function Call is as simple as this:

This function notifies an application of an incoming call to the ISDN system. In addition, several parameters can be passed, such as the calling number and a text message from the calling station.

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Industry Standard, Comprehensive ISDN Connectivity Solutions

... the Right ISDN ...tions

...switched ...

... channels ... up to 16 ... circuits.

... channel, leased ... on the B channel ... virtual circuits.

... and B-Channel pack... AT&T's 5ESS sw...

... adaption. Support ... asynchronous ...

... terminal emulation ... transparent packet ...

... terminal emulation.

Modem Pool connections.

... transfer using X-Modem, ... Z-Modem, and ... protocols.

... data communications ...

... enterprise-wide ...

... new communications

multiple mainframes ...

information from ... company ...

Higher Layer Protocols

ICL ISDN

SNA Communications

IBM 3270 terminal emulation (SNA) solutions are available using transparent packet-switched X.25 transport services.

An SNA 3278 emulation package runs in ICL's ISDN workstations and I³ upgrade package. The 3278 emulation uses X.25 which may or may not interconnect with the ISDN network. From there, it is connected to an ICL 3x74™ cluster controller, which supplies standard RS232 or V.35 SNA into the host. Up to 32 concurrent workstations may be supported. NPSI and QLLC implementations are unnecessary at the host.

The ICL/ISDN solution has two components:

ICL/ISDN 3x74™ Controller:

- RS232 or V.35 host connection.
- Up to 32 LUs.
- Terminal and printer LU support.
- Speeds from 4800 to 64000
- CUT and DFT modes.
- IND$FILE support for TSO, CICS, and VM/SP.
- Data Link Address Configuration.
- Optional NRZI support.
- B or D Channel packet support.

ICL/ISDN SNA Terminal:

Emulates a 3278 Model 2 CRT and supports 3287 SCS and DSC type printers.

IBM 3278 Keyboard functions include:

- Erase EOF
- Erase Input
- Field Mark
- RESET
- PF1-PF24
- ATTN
- CLEAR
- PA1-PA3

IBM 3278 Extended Attributes:

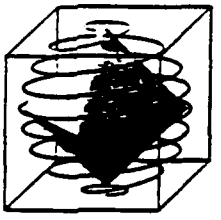
- Extended Color
- Extended Highlighting
- Local Print
- EDS (Extended Data Stream)

ICL's 3270 products have key advantages:

- No need for NPSI/QLLC.
- Multi-session display.
- Screen to disk copy.
- Printer to disk copy.
- PC to MF file transfer.
- ISDN support (2B+D).
- High speed (to 64kbps).
- CCITT X.25 (1984).
- AT&T, NTI and Siemens switch support.
- OS/2 applications.
- EISA and MCA versions.

ICL Access™

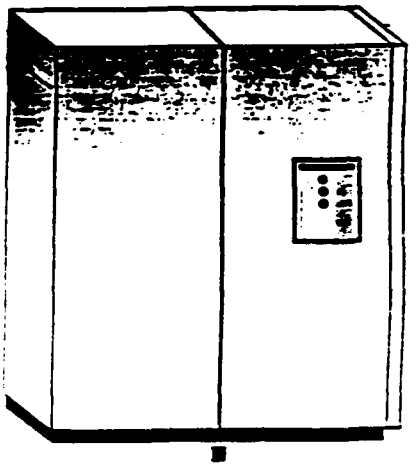
ICL's Presentation Manager based Asynchronous communications package, called Access™, has asynchronous terminal emulations and file transfer protocols that operate over ISDN circuit-switched and Modem Pool connections. ICL's package enables easy access to an almost unlimited number of async-based services, such as DEC hosts and bulletin boards. Not only are multiple connections simple, they can run concurrently with synchronously connected services.

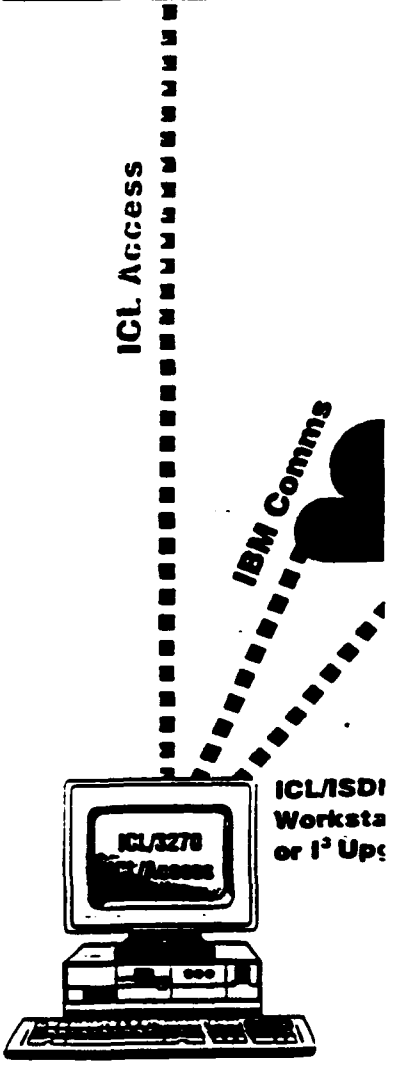


Access™ Features:

- Emulation of DEC VT220, VT102, and VT52 terminals.
- 132-column mode support.
- Local printer support.
- Auto-dial and repeat dial for Hayes-compatible modems.
- Support for ISDN X.25 Modem Pools (Two-stage dialing).
- Log-In script compatibility.
- Text and binary file transfer using the Kermit, X-Modem, Y-Modem, and Z-Modem protocols.
- Ability to capture screen images and session logs to disk.
- Clipboard cut and paste.
- Screen colors may be customized
- Programmable function keys.
- Baud rates from 50 to 64,000.
- Programmable flow control characters.
- Flow control options include X-On/X-Off, DTR, DSR, DCD, RTS, CTS.

ASYNC Host





DeskTop Conferencing

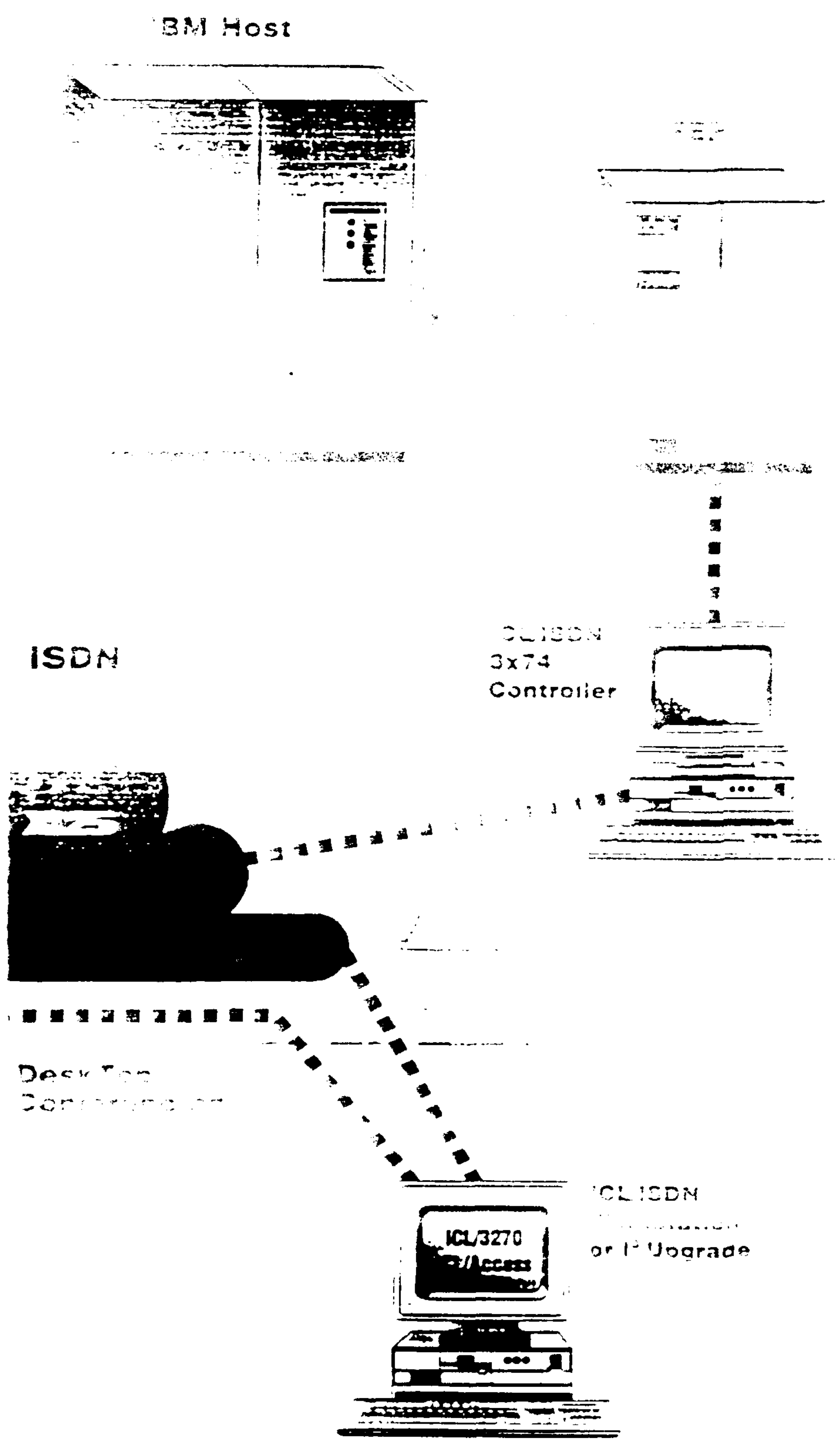
[illegible] DeskTop Conferencing software [illegible] the desk top into a communi[illegible] center. It incorporates the best [illegible] technology and multi[illegible] facilities to add a whole new [illegible] to desk top work. DeskTop [illegible] is like an "interactive fax," [illegible] better because it eliminates the need to [illegible] hard copies, make changes to them, and fax them back again.

While discussing information over the telephone, any OS/2 or MS-DOS application may be interactively shared in real time with another ICL ISDN workstation or personal computer equipped with [illegible] upgrade package.

It all begins at the touch of a button. Screen transfers are automatic – there's no waiting – and the process is completely transparent. Participants may use a mouse or light pen to draw or write on the screen. These activities are independent of the application – the application does not need to support any type of drawing facilities.

DeskTop Conferencing supports the following features:

- [illegible] transparently with any DOS [illegible]
- [illegible] File Transfer [illegible]
- Supports light pen and mouse annotation
- Transfer of [illegible] (e.g. screen, keyboard, pen and mouse)
- [illegible]
- [illegible] free form
- [illegible]
- [illegible]
- [illegible] may conference [illegible] data bridge



Transport Layer Protocols

V.120

[illegible] the industry standard [illegible] in 1988 and [illegible] Committee, is included with all ICL ISDN products. V.120 is flexible, has superior facilities, and is an international standard [illegible] transmission [illegible] communications between ICL ISDN systems and terminal adapters attached to different manufactur[illegible] devices.

Devices that communicate at different speeds can successfully run communicating applications that transfer files, [illegible] information, and have remote access to computing systems.

ICL's V.120 implementation supports the following features:

- Asynchronous Protocol Sensitive Mode.
- TE1 to TE2 operations.
- TE1 to TE1 operations.
- Multiple Logical Link support (Up to 10 links).
- Device Names COM2 and ASYN1-ASYN 9.
- Full Hayes Command Set support.
- Multiple Frame Acknowledge Transfer Mode.
- Data speeds from 300 to 64kbps.

X.25

Users can gain from ISDN benefits available locally and use X.25 to meet Wide Area Networking requirements.

Public and private X.25 communications networks are the most common vehicles for cost effectively transmitting data around the world. ICL's X.25 software is based on the CCITT's 1984 standard and supports the X/OPEN Transport Interface (XTI). This opens the door to thousands of UNIX applications.

On-Demand B Channel Packet Switching

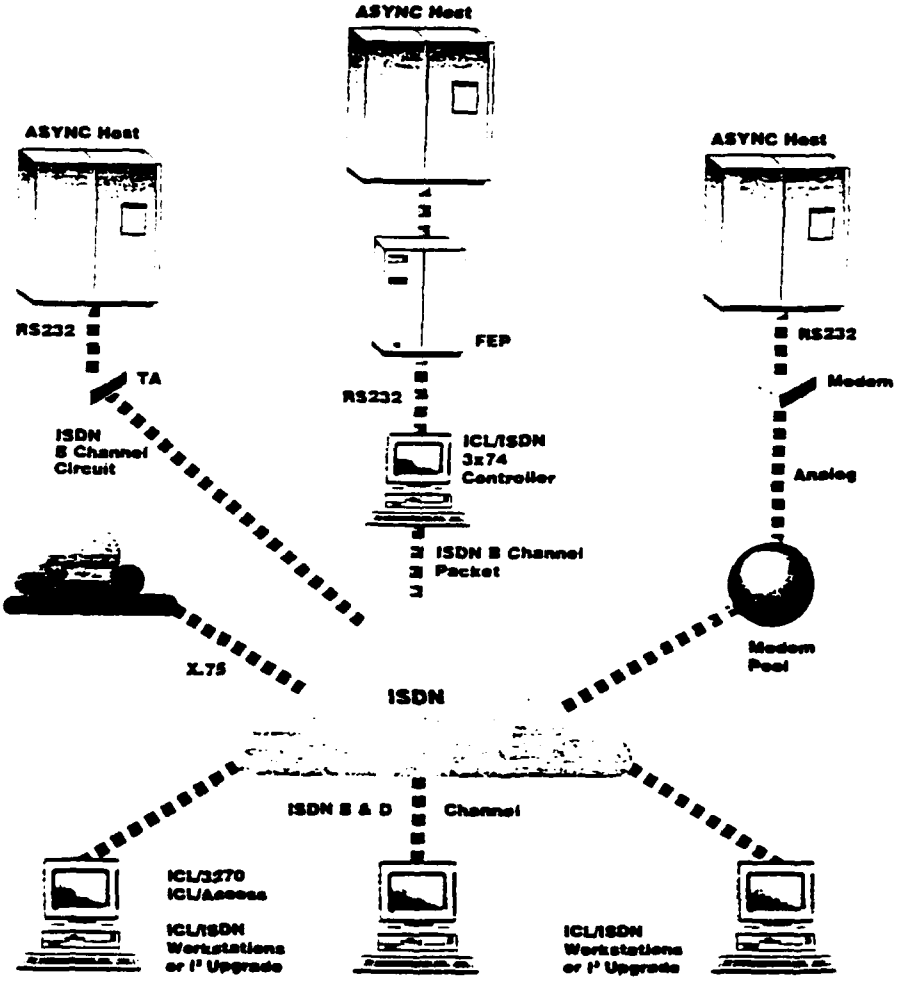
ICL is the first company to support AT&T's newly available on-demand B channel packet switching capability. Packet-switched channels may be used "on demand" or on a call-by-call basis to transmit voice, data, image, or text.

Bearer Services Supported

- ISDN B Channel Circuit-switched (Point-to-Point)
- ISDN B Channel "Nailed Up" or Permanent Connection
- ISDN B Channel "On Demand" or Call-By-Call Connection
- ISDN D Channel

Features and Facilities

- RS232 or ISDN Connection.
- 1984 Standard.
- X/OPEN Transport Interface (XTI) for program access.
- Transport layer support for Class 0, 2, 3 or Null.
- PVC and SVC support.
- Reverse Charge and Closed User Group operation.
- Negotiable parameters for packet size, throughput, and window size.
- Call User Data up to 32 digits.
- Initiator or Responder Modes.
- Variable TPDU size (128-2048) with fragmentation and reassembly.
- Configurable timers. (Reset Timer, Local Timers, Call Timer, Connect Request Timer, Disconnect Request Timer, Connection Retry Timer, Frame Acknowledge Timer, Connection Re-Use Timer, Retransmit Frame Timer).
- Address Configuration. (NSAP, TSAP, PVC channel numbers, LINK address).



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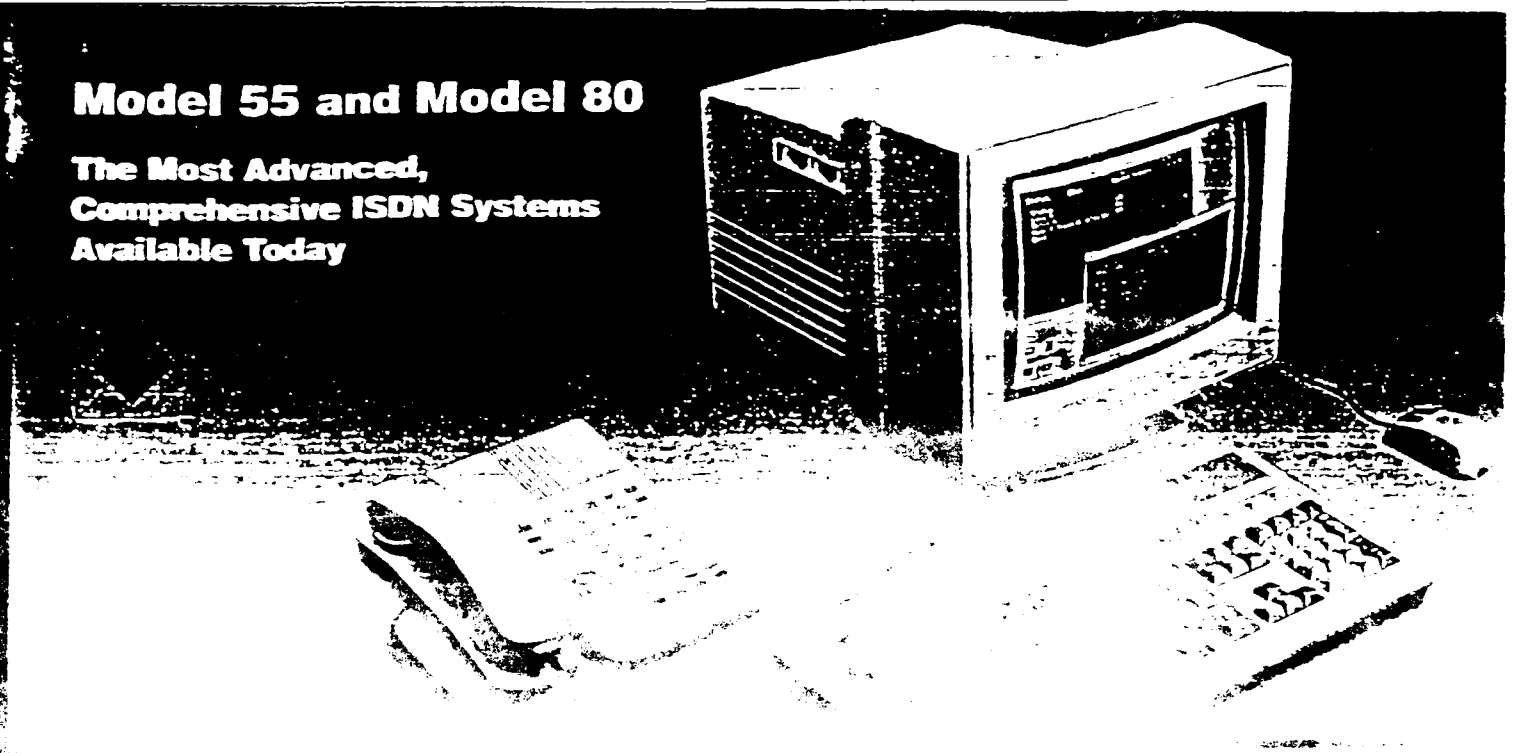
Model 55 and Model 80

The Most Advanced, Comprehensive ISDN Systems Available Today



Communications Across the SDN Network

CL has a complete range of products y which users manage their communi-ations across the ISDN network, cluding multiple, multi-host sessions. ese products include support of M's SNA communications, asynchro-ous systems, including DEC and UNIX sts, and OSI products, such as X.25 d FTAM. For more information, ease see the ICL data sheet entitled — ommunications.

CL's ISDN Workstations: a New World of Possibilities at the DeskTop

The ICL ISDN workstations have features that are possible for the first time due to heir voice/data integration and OS/2's dvanced multi-tasking facilities:

- A caller's number automatically appears on the workstation screen (ANI or Automatic Number Identification). If the caller is part of a personalized "Phone-book," a name also appears. Expanded notes may be instantly displayed from a database.
- A specific caller's identity causes an application to be loaded or a communications session to automatically start, such as the retrieval of a customer's record from a corporate mainframe computer.
- All calls are listed, both incoming and outgoing, answered and unanswered.
- Up to 16 simultaneous data sessions can be conducted, each in its own window, while running OS/2 applications. Making a data connection is as simple as making a telephone call.
- Applications can be interactively shared with other users in real time, using ICL's DeskTop Conferencing software.
- A built-in Applications Programming Interface makes it easy to incorporate existing and newly created user-designed applications with the system's voice and data communications facilities.

All ICL Workstations Include:

- Workstation Base Unit
- Image Accelerator Feature
- VGA Monitor
- Keyboard
- Mouse
- Keylock
- ISDN Interface
- ISDN Telephone
- ISDN RJ-45 cable for connection to an NT1
- MS-OS/2
- DeskTop Conferencing Software
- ISDN Telephone Manager Application Software
- ISDN Phonebook Application Software
- ISDN Central Office Switch Interface Software
- V.120 Rate Adaption Software
- Applications Programming Interface (API) Toolbox
- Complete documentation

ICL/ISDN Workstation Specifications

Model 80

Microprocessor: Intel 80386, 32 bit, 20 Mhz

Ram: 4 Mbytes expandable to 16

Fixed Disk Drive: 80Mb (28ms average seek time)

Floppy Drive: 3 1/2" 1.44 Mb

VGA: Register and Bios compatible with the IBM VGA standard

Slots: 4 dedicated for memory; 4 expansion slots

Ports: 1 serial I/O port; 1 parallel port, 25 pin D type connector; Dedicated port for mouse

Dimensions: 22.6" wide, 16.6" deep, 7" high

Weight: 38.8 lbs / 17.6Kg

Operating Environment: 50-95 F / 10-35 C

Relative Humidity: 20 to 80%

Power: 120v, 50-60Hz, 192 watts

Model 55

Microprocessor: Intel 80386X, 32 bit, 16 Mhz

Ram: 5 Mbytes expandable to 16; (8Mb on the motherboard)

Fixed Disk Drive: 42Mb or 104Mb (28ms average seek time)

Floppy Drive: 3 1/2" 1.44 Mb

VGA: VGA Graphics on the motherboard

Expansion Slots: 1 AT type 16 bit slot; 1 XT type 8 bit slot

Ports: 2 serial I/O ports, 9 pin and 25 pin D type connectors; 1 parallel port, 25 pin D type connector; Dedicated port for mouse

Dimensions: 16" wide, 16.5" deep, 4" high

Weight: 33 lbs / 15Kg

Operating Environment: 50-95 F / 10-35 C

Relative Humidity: 30 to 80%

Power: 120v, 47-63Hz, 145 watts

VGA Color Monitor

Resolution: Up to 720 x 400 Pixels
Screen: 14" diagonal, anti-glare
Base: Tilt and Swivel
Dimension: 14.3" wide, 15.9" deep, 12.4" high
Weight: 33 lbs / 15Kg

Keyboard

101 key, AT enhanced keyboard layout. LEDs for Number lock, Caps lock, Scroll lock keys

ISDN Interface

Switch Types Supported

- AT&T 5ESS
- Siemens EWSD
- Northern Telecom DMS-100

Data Features

- Up to 64 Kbps on any B-Channel connection.
- Circuit-switched connections on B-Channels.
- "Nailed" X.25 Packet-switched connections on B Channels (up to 16 sessions).
- "On Demand" X.25 Packet-switched connections on B Channels (up to 16 sessions).
- LAPB Link Layer Protocol on B Channels.
- SDLC Protocol on B Channels.
- V.120 Rate Adaption (up to 16 sessions).
- X.25 Packet-Switched Connections on D Channel (up to 16 sessions).
- LAPD Link Layer Protocol on D Channel.
- Asynchronous terminal emulation support.
- IBM SNA communications.

Voice Capabilities

- Voice calls on B Channels.
- Up to 64 call appearances.
- Key systems support.
- Supplementary services support: e.g., Hold, Conference, Call Forwarding.

ISDN Telephone

- 12 Standard dialing keys (0-9, *, #).
- 22 soft keys each with its own red LED to invoke voice, data, phone, and switch features.
- 4 keys for applications.
- Speakerphone with mute and volume control

Connecting Cable

- A 6'6" cable connects the ISDN phone to the ISDN workstation

Ringing

- The phone itself rings, not a speaker inside the PC workstation

Dimensions

- Width 8.5" • Depth 10.5" • Height 2.5"

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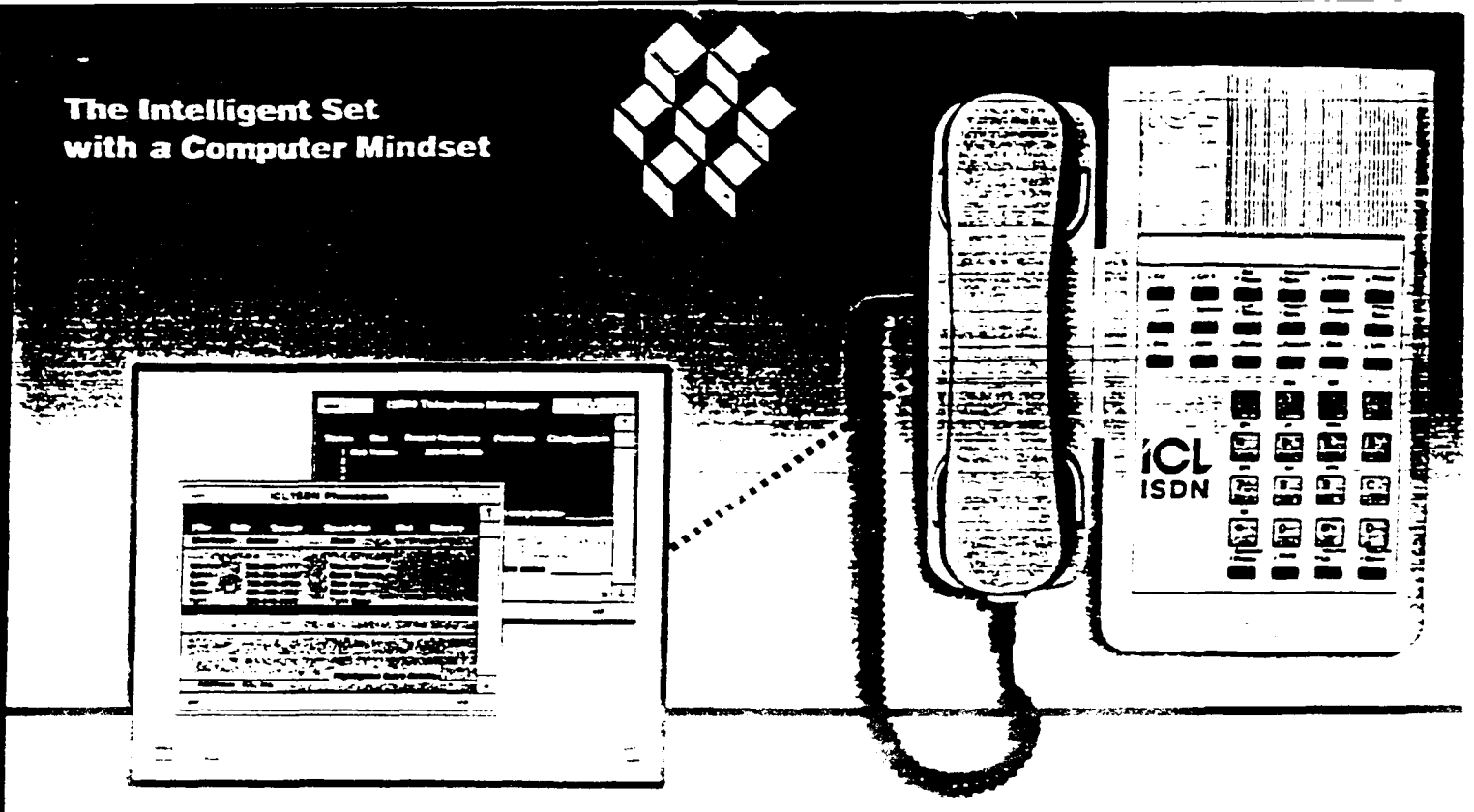
The Intelligent Set with a Computer Mindset



ICL ISDN

An advanced featurephone and integrated telephony applications are built into all ICL ISDN systems. Because ICL's ISDN telephone has the benefit of a computer mindset, it performs in ways other "super" phones and systems cannot.

- ICL's Telephony system puts an electronic rolodex and file folders at your fingertips.
- Full-screen workstation displays offer distinct advantages over LEDs.
- Making a data call is as simple as making a voice call. All it takes is the touch of a single button.

The System that Mirrors Your Mindset

The system's intuitively designed features lead you seamlessly between computer applications and telephony functions without demanding time out for a tool change in the middle of an activity. All data communications or telephony applications proceed unimpeded using the tool of your choice: the telephone keypad, computer keyboard, or mouse.

The phone works like you would expect a phone to work: its standard features are familiar, and using the advanced ones soon becomes second nature. There aren't any magic sequences or difficult strings of commands to [illegible].

Functionality at the Desk Top from using Standard Interfaces

All ICL ISDN systems include built-in standard interfaces to the network and support connections to AT&T's 5ESS switch, Northern Telecom's DMS-100 and Siemens EWSD.

Special Software for Special Facilities

Two built-in software packages, Phonebook and Telephone Manager, make it easy to incorporate special facilities and features on your ICL ISDN system.

Phonebook

ICL's Phonebook is an easy to use, OS/2 Presentation Manager application. Details about contacts may be stored in a personalized "database," and include data call listings such as remote services and host computers.

Each voice entry may include name, address and telephone numbers. Notes may be attached to any entry and may be displayed and edited at any time.

Data Call entries have fields for the following information:

- Session names
- Application type
- Application command string
- Telephone number
- Protocol
- Rate adaption scheme

[illegible] deleted, displayed in abbreviated or expanded formats and dialed.

A Selection of Dialing Modes

Entries may be dialed by:

- Using the mouse to select an entry and then double clicking on it.
- Using the keyboard's cursor keys to highlight an entry and then pressing the Return key.
- [illegible] shortcode using the keypad.
- Selecting the "Dial" option from the pop-up menu.

Telephone Manager

Sophisticated and Customized Features at Your Fingertips

Most features and functions are easily customized, either by the user or by a system administrator, if consistency throughout an organization is desired.

[illegible] OS/2 Presentation Manager configuration utilities make it simple to:

- Map features to the telephone pad keys
- Set distinctive ringing tones
- Select criteria for pop up messages
- Designate central office switch selection
- Interact with applications processors

A Special Window Shows Who's Calling

Messages automatically pop up in a special window on the workstation or personal computer screen, including:

- Incoming call notification, complete with the caller's phone number, name, and address.
- Help and error messages.
- Telephony status.

Telephony messages appear independent of what else is going on; activities such as spreadsheet applications or mainframe data sessions are totally unaffected.

Up to the Second, Full-Screen Status Reports Show It All:

Who's Calling, Who Called, Who Was Reached, Who Wasn't, Who's on Hold, Who's a Priority

A major benefit of ICL's voice/data integration is the ability to map features to dedicated telephone keypad keys and display full screens of information.

ISDN switch features and computer application features may be mapped to any of the 22 soft keys. Mapping may be predefined in an installation file or easily configured using a friendly utility. Features not mapped to dedicated keys may be used via screen menus and prompts. Call appearances and directory numbers (DNs) not mapped to a dedicated key may be used via the Call Status screen.

Some of Telephone Manager's customized features and full-screen displays include:

Speed Dial and Redial

A list of speed dial names and numbers may be displayed. Dialing is as simple as touching a number on the telephone keypad that corresponds to the name.

The last number dialed may be redialed by pressing the REDIAL button.

Recent Calls

Touching the RECENT CALLS button will display the telephone numbers of the most recent outgoing *and* incoming calls, both answered *and* unanswered, and the date and time called.

Key Systems Functionality

Key Systems Functionality is a configurable option on all ICL ISDN systems.

Call Status

ICL's ISDN telephone supports multiple call appearances and key system features, including *Call Status*. All calls and their status are displayed, making it much easier to manage multiple incoming calls and conference calls.

Some status messages include:

- Handset or speakerphone in use.
- Voice and/or data call activity.
- Outgoing *and* incoming telephone numbers.
- Help and error messages.
- Call duration (call timing).
- Telephony status messages. (On Hold, Conferenced, Ringing)

Link

The LINK telephone keypad button is used to instantly connect to a remote computer or terminal. A menu shows all available remote data services and applications that use a data call. Simply select an entry and the data connection is made. A DeskTop Conference begins with the LINK facility.

Reject Call

You have the option of rejecting any incoming call. The caller simply hears a ringing tone.

Features

Menu-driven access to ISDN supplementary features not assigned to a single key is available: e.g., Call Forwarding.

Call Appearances and Directory Number Mapping

Up to 6 call appearances and up to 18 directory numbers may be mapped to dedicated keys.

Telephone Manager

Telephone Manager was designed as an integral part of ICL's ISDN telephone, and takes advantage of 22 soft keys and LEDs to invoke features. The telephone LED display indicates when a feature is activated. Telephone Manager supports the following features; most may be assigned to any of the 22 dedicated keys:

- Multiple call appearances and directory numbers.
- Speed dial
- Redial
- Recent Calls
- Incoming Caller Identification
- Call rejection
- Information retrieval based on Automatic Number Identification(ANI)
- Call Status
- Hold
- Conference
- Transfer
- Drop
- Call Forward
- Automatic Call Back
- Call Pickup
- Priority Calling
- Speakerphone (hands free calling; action invocation turns speaker phone on automatically; volume and mute controls)
- Call duration timing
- Dial pad feedback
- Distinctive ringing (for individual sets)
- Link (single button data call setup)
- Time and date display
- User programmable phone feature keys.
- Key Systems Functionality.

Applications Processor Supported Features

- Message waiting indicator
- Leave word calling
- Message retrieval
- Calling name display
- Directory queries

ISDN Power for Your Business Applications

ICL

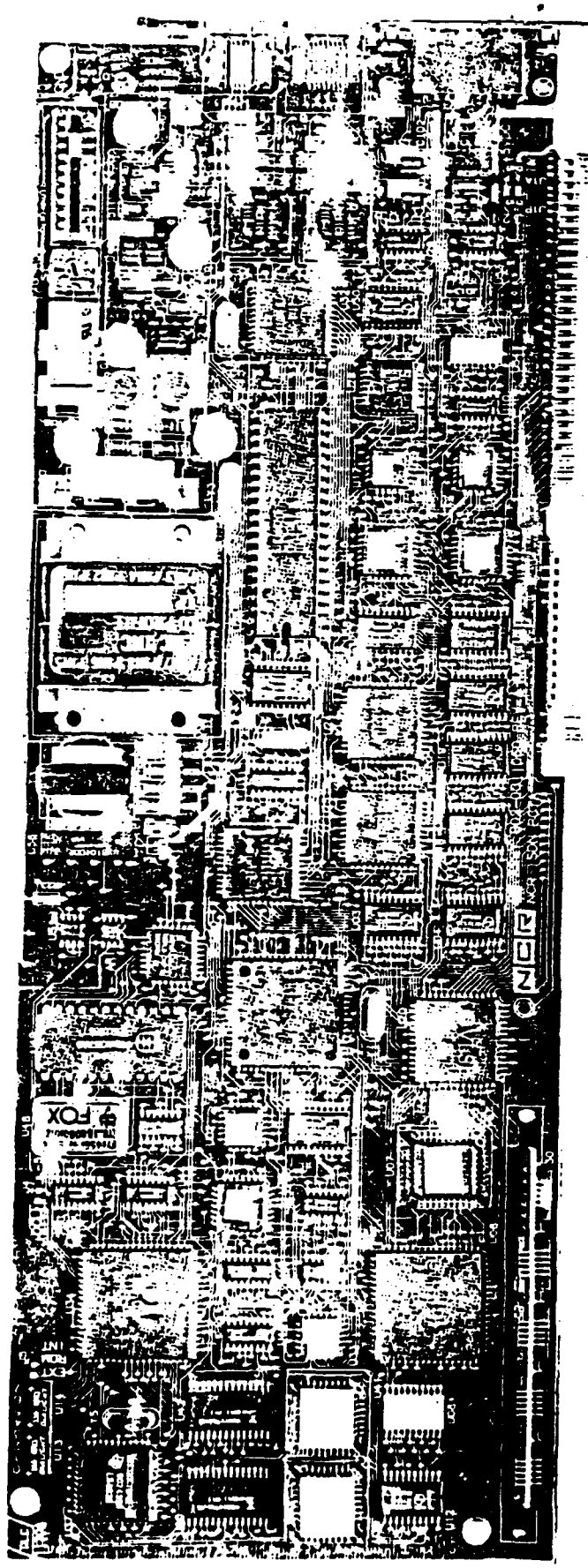
Networks Industry
ISDN Systems Group

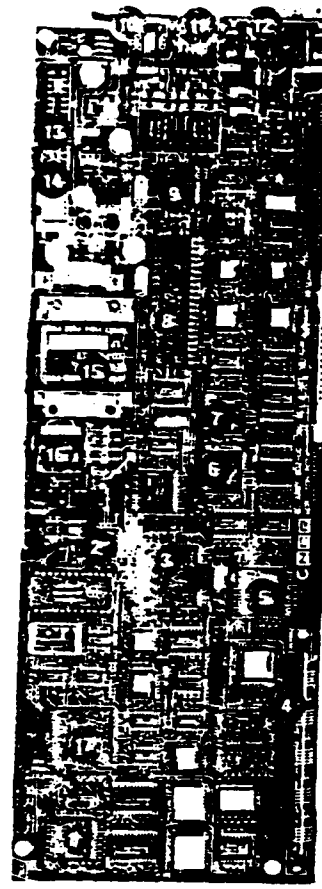
777 Long Ridge Road
Stamford, CT 06902

1-800-446-ISDN (4736)

For further information contact:

...minal Adapter





1. Digital Signal Processor (for speech digitization and telephone/modem control)
2. Programmable CODEC (for digital-to-analog and analog-to-digital conversion)
3. Intel 8 MHz 80188 CPU
4. 256 KB DRAM (for high-speed efficiency)
5. 2 K Dual Port RAM (for fast voice/data transfers across the PC bus)
6. Two-Port HDLC Controller
7. UART (for serial emulation)
8. V.110 Rate Adaption Controller
9. ISDN Interface Controller
10. Telephone/Modem Interface
11. ISDN Interface
12. RS-232/Power Supply Interface
13. Interrupt Selection Switch
14. I/O Address Switch
15. Power Transformer
16. Analog Telephone Isolation Transformer
17. Voice ASIC (Application Specific Integrated Circuit)

NCR ISDN PC Terminal Adapter (PCTA)

In a *PC Magazine* article analyzing the relative merits of ISDN (Integrated Services Digital Network) adapters for personal computers, the NCR ISDN PC Terminal Adapter received the Editor's Choice award. It is the PCTA that connects NCR PCs and other personal computers with AT bus architectures to ISDN.

ISDN provides a single point of access to multiple services, such as telephone service, data transmission, and voice mail. ISDN carries digital voice and data signals simultaneously over telephone lines.

By simply connecting your telephone to the PCTA, and the PCTA to the ISDN service, you bring the advantages of ISDN to your desktop.

NCR ISDN PCTA AT A GLANCE

ISDN Basic Rate Interface	AT&T 5ESS 5E4 Generic Supports Full Supplementary Voice Services Compatible with CCITT S/T interface V.110 or V.120 rate adaption
Circuit-Switched Data Support	Dual channel HDLC connections at either 64 Kbps or 56 Kbps
Interfaces	ISDN interface (RJ45) for ISDN service Telephone/Modem interface (RJ11) for 2500 phone set or analog modem Serial port emulation (COM1–COM4), maximum speed 38.4 Kbps RS-232/External Power Supply interface for RS-232 device or external power supply AT Bus interface for 16-bit bus
Typical System Components	A personal computer with a 16- bit AT bus and an installed PCTA. ISDN service and NT1 Standard analog telephone (2500 phone set) Telephone or modem adapter cable External Power Supply (an optional add-on product that provides phone operation and ringing when the PC is powered off)

HIGHLIGHTS

- QUALITY FOR REDUCED COSTS

  ISDN brings end-to-end digital connectivity, resulting in better voice quality and more reliable data transmission.

  ISDN eliminates the need for modems, since there is no need for analog/digital conversion.

  ISDN's speed and reliability result in less connect time per transmission, not to mention overall improved productivity.

  And because the PCTA supports existing applications and equipment, system start up costs are minimized.

- IMPROVED PRODUCTIVITY

  When used with NCR's Voice/Data Manager application, the PCTA provides the features and benefits of a sophisticated telephone management system. Simultaneously, users can take advantage of OS/2 multitasking capabilities and ISDN multiuser capabilities.

EASY TO INSTALL

You can install the PCTA on a PC with either MS®-DOS, OS/2, or both. Setting up the PCTA board is simple and the installation and diagnostics programs are friendly.

- HIGH-SPEED TRANSMISSION

  Through its Basic Rate Interface (BRI), ISDN provides two 64 Kbps channels (B-channels) for transmitting files at high speeds. A third channel (D-channel) transmits information at 16 Kbps.

  MS-DOS applications can use serial port emulation to transmit data at rates up to 38.4 Kbps. OS/2 applications can transmit data at rates up to 19.2 Kbps. The NCR Voice/Data Manager (VDM) application supports file and screen transfers at 64 Kbps over the B-channel.

  File transfers which normally take several minutes using traditional analog (2400- or 9600-baud) modems now take seconds.

- OS/2 SUPPORT

  The PCTA supports OS/2 Presentation Manager, noted for its easy-to-use graphical interface. OS/2 also lets the user run multiple applications at the same time. OS/2 Application Program Interface (API) also provides a standard development interface.

- PRESERVED INVESTMENTS

  The PCTA provides serial port emulation that allows you to use MS-DOS communication applications you already own. HyperACCESS®, Crosstalk,® or Carbon Copy Plus, can transmit data on the ISDN line.

  Complementing the serial port emulation, the PCTA supports the Hayes® AT command set. The PCTA adapts standard RS-232 devices and standard analog telephones to ISDN.

- FLEXIBLE ARCHITECTURE

  A wide array of features, such as COM port emulation, dual HDLC controller, Digital Signal Processor, external RS-232, and V.110 and V.120 rate adaption, make the NCR ISDN PCTA an excellent platform for applications development.

  Available through NCR Corporate Publications Services are:

  The *NCR ISDN PCTA Device Driver (OS/2) Programmer's Reference* (ST-2113-46)

  NCR ISDN PCTA Data Interface Technical Reference (ST-2113-44)

- SWITCH SUPPORT

  The NCR ISDN PCTA is certified for operation with the AT&T® 5ESS.

4/90
SP-3921

NCR

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NCR CORPORATION
Public Relations
Dayton, Ohio 45479

FOR IMMEDIATE RELEASE

Contact: Kim Warnock
(513) 445-4732

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(212) 213-7065

NCR INTRODUCES NEW ISDN WORKSTATION PRODUCTS

- OS/2-Based Application Integrates Voice and Data -

DAYTON, OH, April 25, 1990 -- NCR Corporation today became the first major personal computer vendor to introduce an Integrated Services Digital Network (ISDN)-compatible workstation that can simultaneously handle voice and data.

As part of this announcement, NCR released an ISDN voice/data manager application software package that provides voice mail features with simultaneous data transfer of files and screens.

NCR also introduced an adapter card that allows users to upgrade existing NCR or other AT™-compatible personal computers to ISDN workstations. Each NCR product announced today can be purchased separately.

The NCR ISDN Workstation™ -- based on the 16MHz Intel 386SX™ microprocessor -- features Microsoft's

- more -

OS/2 1.1 operating environment and Presentation Manager graphical interface.

Both the power of the 386 processor and the multitasking/multi-threading capabilities of OS/2 are required to support the sophisticated features of ISDN. The graphical user interface of OS/2 provides an easy to use way of interacting with ISDN.

"With ISDN, users need only one phone line, instead of separate lines, to transmit voice and data," said Alok Mohan, vice president of NCR's Workstation Products Division. "Another benefit is that users can send files over an ISDN line two to six times faster than traditional analog modem communications. Of course, less online time also means reduced communications cost."

In essence, ISDN workstation technology provides enhanced communications and productivity. For example, two users can now simultaneously work on a document while concurrently talking on the same phone line.

THE NCR ISDN WORKSTATION

NCR's new ISDN Workstation includes an NCR ISDN Personal Computer Terminal Adapter™ (PCTA) card, which works with the ISDN Basic Rate Interface. The Basic Rate

Interface supports two 64-kilobit/second B signalling channels for voice/data transmission and one 16-kilobit/second D signalling channel.

The NCR ISDN Workstation is currently compatible with ISDN services supported by AT&T's 5ESS central office telephone switch. By fourth quarter 1990, it will be compatible with services supported by Northern Telecom's DMS-100 central office switch, and others.

The NCR ISDN Workstation features Microsoft's OS/2-based Presentation Manager interface. OS/2's multitasking capabilities take full advantage of ISDN's multiple communications channels, allowing the user to run different applications over one ISDN telephone line.

"This workstation is 'plug and play,' meaning it is preconfigured and is ready to operate," said Mohan. "All a customer needs is a standard push-button telephone and the ISDN link to a commercial carrier." An optional power supply is available for phone operation when the PC is powered off.

Available in June, the workstation is U.S. list priced at $7,795.

NCR PCTA CARD

The heart of the NCR ISDN Workstation is the AT™-compatible NCR PC Terminal Adapter Card which links a standard telephone and personal computer to ISDN.

The NCR ISDN PCTA, in addition to the Basic Rate Interface facility, has an onboard 80188 CPU running at 8MHz with a 256Kb random access memory. It also contains a 25MHz 32010 Texas Instruments digital signal processor that provides voice compression for recording and playback of messages left on the PC hard drive.

The NCR ISDN PCTA also features a two-channel HDLC controller, which connects into SNA networks; supports the standard 2500 phone set; supports DTMF or pulse dialing and standard DOS async communications applications such as Crosstalk™, Hyper Access™ and Carbon Copy™.

The PCTA card is U.S. list priced at $1,695.

ISDN VOICE DATA MANAGER APPLICATION SOFTWARE

The OS/2 1.1-based NCR ISDN Voice Data Manager (VDM) application software package is preconfigured on the NCR ISDN workstation, and contains features that:

-- Allow the identification of an incoming telephone caller via a display window;

-- Record incoming messages from callers;

-- Call preselected numbers, and;

-- Keep directories of numbers.

VDM also allows the workstation to be used to:

-- Merge calls into a conference call;

-- Record special messages for selected callers;

-- Transfer or receive files and screens with simultaneous phone conversation;

-- Use feature buttons such as hold, transfer and conference calling;

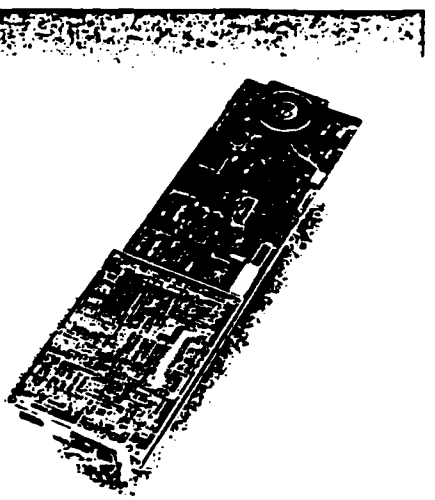
-- And have the appearances of multiple telephone calls over a single line.

The software is U.S. list priced at $195 and will be available in May. The NCR ISDN Voice Data Manager application was developed by NCR and Natural Microsystems, a leading provider of DSP-based voice processing technology. The data portion of the ISDN Voice Data Manager draws significantly from NCR's data communications and ISDN technology. The voice portion and API software draws significantly from Natural Microsystems' telephony and voice technology and is compatible with Natural Microsystems' VBX voice processing product line.

With headquarters in Dayton, Ohio, NCR Corporation develops, manufactures, markets and supports business information systems for worldwide markets.

# # #

B101PC Terminal Adapter: Enabling Comprehensive PC-Based Solutions



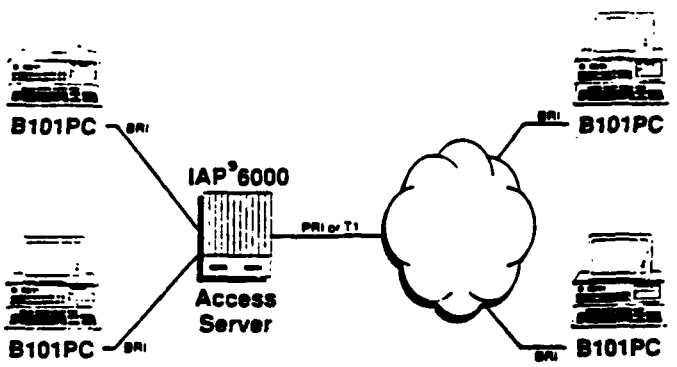
Combine your application with the added values of Switched Digital Networking

The B101PC Terminal Adapter (TA) from Teleos® allows you to quickly provide your market with turnkey solutions. The B101 is *the* open platform you need for all your networked applications. Paired with your applications, the B101 enables IBM® PC®/XT®/AT® or compatibles to communicate with the speed and accuracy of Basic Rate Switched Digital Networking (56/64/112/128 Kbps). And because the B101 handles all signaling and electrical interfaces to the network, it enables the PC to run its applications ***without performance or PC memory bottlenecks***.

A HOST OF FEATURES...

With the B101, you can combine the advantages of Switched Digital Networking, standard network access, and vendor interoperability for a truly complete solution. The B101 provides:

- A 16 bit *internal* bus for high-performance processing power.
- Signaling procedures that allow users to access any Switched Digital Network.
- Soft-loaded signaling and data protocols, making field upgrades easy.
- Support for V.120 ANSI standard protocol—the accepted rate adaptation.
- A high level of interoperability with other TA products.
- An open Application Programming Interface (API) that emulates NetBIOS.
- A Time Division Multiplexed (TDM) bus, which can be used to integrate image compression, video graphics, voice/digital processing, or other third-party boards.



The B101PC TA provides an open platform to develop a wide variety of innovative and practical Switched Digital Network applications.

APPLICATIONS

- PC-Based LAN Bridges & Routers
- Telecommuting
- Group 3/Group 4 Facsimile
- Medical Imaging
- Videoconferencing
- EDI

- Analog telephone support with continued voice service—even when the PC is off.
- COM Port emulation that supports leading modem communications software—protecting your customer's training investment.

Only Teleos—the company that introduced the first PC adapter for Switched Digital Networking—offers you the choice of two B101 versions. The B101 S/T Version accommodates users who already have an external NT1. The B101 U Version features an 2B1Q (National ISDN-1) integrated U interface, allowing users to *directly connect* their PCs into the Switched Digital Network without an external NT1—a significant cost savings.

APPLICATIONS

Some sample applications for the B101 include:

Novell LAN Router	Workgroup Voice/Data Conferencing
TCP/IP Gateway	Attendant Console
Medical Imaging	COM Port TTY Emulation/ File Transfer
Distributed ACD	Others to be announced
Telecommuting	
IBM SNA	

...AND APPLICATIONS ENVIRONMENTS

The B101 makes it easy to incorporate Switched Digital Networking into your applications. It's particularly suited for bursty or bandwidth-intensive applications such as PC-based LAN bridges, routers, electronic document interchange, medical imaging, videoconferencing, or Group 3/Group 4 facsimile. You can use both B channels simultaneously, either for voice, data, or a combination of both.

The B101 can make your application a total solution. Let Teleos show you how to include the added values of Switched Digital Networking and Bandwidth-on-Demand into your PC solutions. Just call (908) 389-5767.

SIGNALING INTERFACES

- Switch Compatibility: *AT&T 5ESS™, NTI DMS100™, IAP™ 6000 Access Server*

OPTIONS

- Wall-Mounted External Power Module

SPECIFICATIONS

- Integrated 2B1Q U or S/T Interface
- Analog (2500) Telephone Interface
- PC ISA (8 bit) Bus Interface
  - —Three User-Selectable Interrupt Levels
  - —32 KB PC-B101 Shared Memory Interface
- Network Layer (Q.931) Signaling Software
- Link Layer (Q.921) Signaling Software
- Soft-Loaded Signaling and Data Protocols

Compliance

- CCITT I.430, I.440, I.441, I.450, I.451, FCC Part 15

Protocol Support

- V.120, X.25 D Channel

Host PC Operating System

- MS-DOS®/PC DOS 2.X, 3.X

Technical descriptions and specifications are subject to change without notice.

Teleos Communications, Inc.
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Voice: (908) 389-5767
Fax: (908) 544-9890

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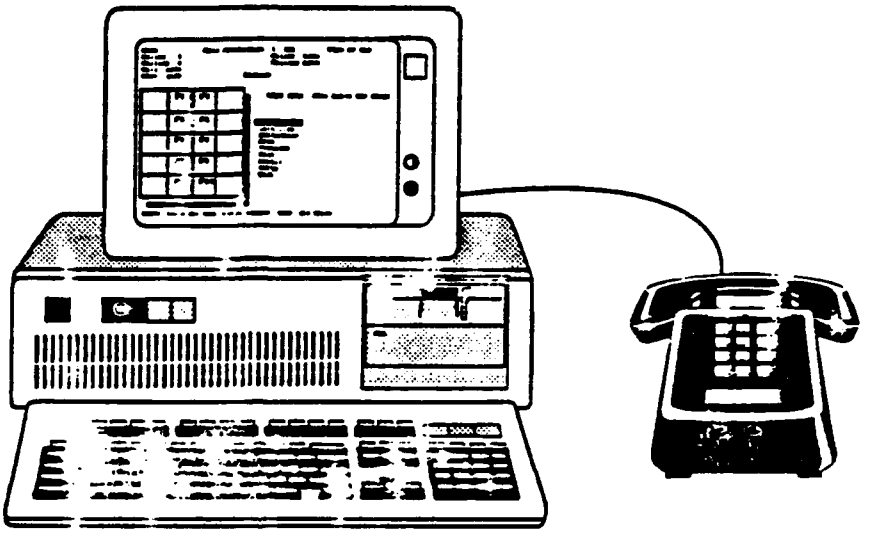
Application Briefs

Voice Features Interface



DESCRIPTION:

The Voice Features Interface (VFI) is a terminate and stay resident (TSR) program. Once executed, it remains in the background when you execute other applications and can be easily accessed via a hot key. VFI, a DOS executable program, operates on IBM PC/XT™, AT® and compatible machines and will run with compatible PC application software such as wordprocessing, spreadsheets, and integrated desktop publishing.

An application that runs on top of Teleos' B101PC™ Terminal Adapter (TA), VFI enables you to emulate the voice features of an ISDN phone. You can take advantage of features such as call conferencing, hold, drop, and transfer through your PC while using an analog phone for voice.

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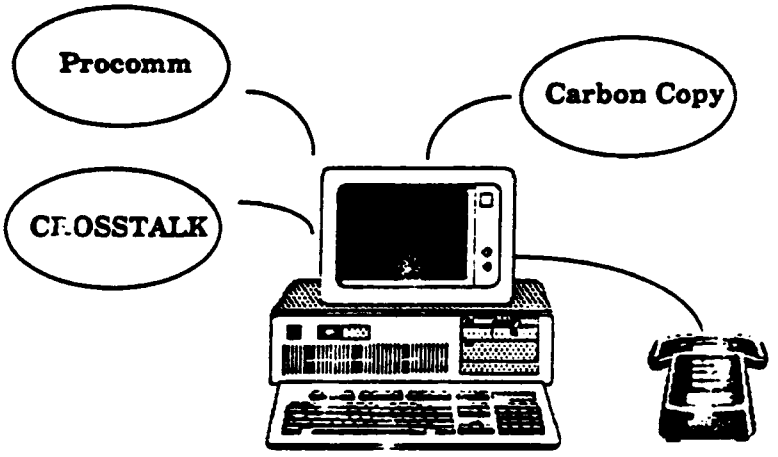
Application Briefs

Communications Port Applications



DESCRIPTION:

Teleos' B101PC™ supports a variety of communications software which enables data calls such as file transfers, terminal emulation, and screen sharing while you continue to speak on the phone. Communications port applications such as Procomm®, CROSSTALK™, or Carbon Copy™ run above the B101PC board and can access either D channel X.25 services or B-channel V.120 services.

The D-channel supports data transmission speeds of up to 9.6 Kbps. Other capabilities include configurability of frame and window sizes and support of an abbreviated AT Command set which allows you to set up and tear down D-channel X.25 packet-switched calls.

Data transmission speeds for the B-channel are up to 19.2 Kbps. Other capabilities include configurability of frame and window sizes, V.120 rate adaption, ISDN channel rate adjustability to 56 or 64 Kbps and support of an abbreviated AT Command set which allows you to set up and tear down B-channel V.120 circuit-switched data calls.

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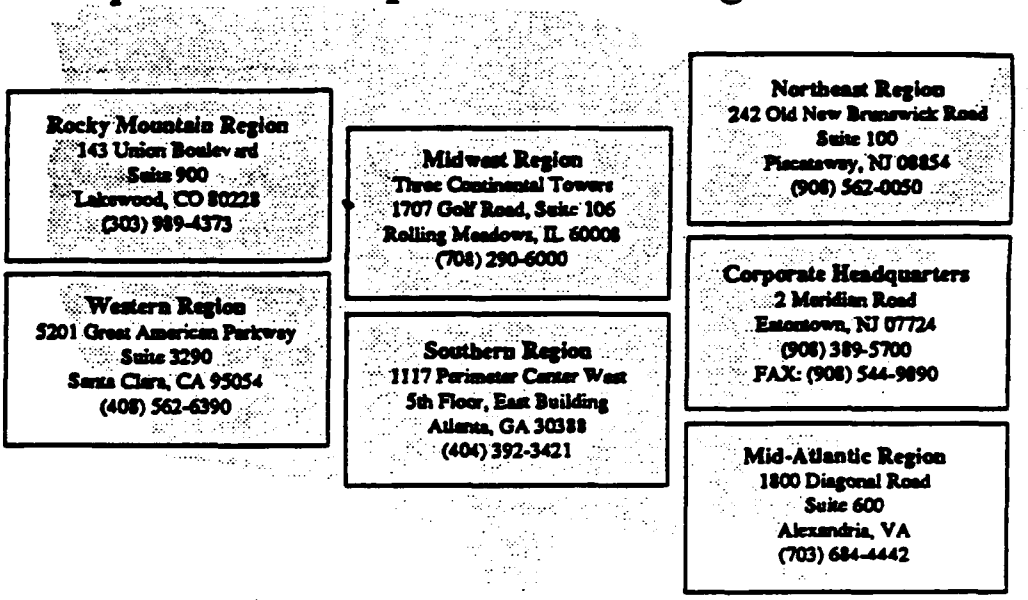
Corporate Headquarters and Regional Offices



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