BELL CANADA AND FEDERAL GOVERNMENT

ISDN TECHNOLOGY TRIAL

COMPLETION REPORT

Bell Canada
Corporate Business Development
Product Management - ISDN

Department of Communications
Government Telecommunications Agency
Division of Development and Engineering

Ottawa
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BELL CANADA AND FEDERAL GOVERNMENT ISDN TECHNOLOGY TRIAL

Completion Report

This document reports on the Bell Canada and Federal Government ISDN Technology Trial at the completion of the project. It has been reviewed by the Project Management Committee for the Bell Canada and Federal Government ISDN Technology Trial.

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ACKNOWLEDGEMENT

The Project Management Committee for the Bell Canada and Federal Government ISDN Technology Trial wishes to recognize that the success of this trial has been made possible due to the endeavours of many individuals at Bell Canada and within the Government of Canada. While they are too numerous to mention here, their individual and collective contribution to the trial has been enormous. Therefore, to all who were involved in the many facets of the trial - planning, implementation, operation and evaluation - either as users or as providers of the service, we say, "Thank you!".

We would also like to express our appreciation for the efforts of those individuals who have either prepared portions of this report or reviewed and commented on drafts during its preparation. A special mention is due Douglas T. MacGillivray of Bell Canada and Jatinder Bhullar of GTA who shouldered the major effort in compiling and editing this document.

EXECUTIVE SUMMARY

The Federal Government ISDN Technology Trial was a collaborative endeavour championed jointly by Bell Canada and the Government Telecommunications Agency, a branch of the Department of Communications, Government of Canada. The trial started in November 1987, with a gradual introduction of users and applications onto the trial and was completed in November 1989. Three key federal government departments participated in the trial: the Department of National Defence; Industry, Science, and Technology Canada; and the Department of Communications. Specific applications were chosen for each of these departments based on technical feasibility, user need and the user environment.

The key objectives targetted by Bell Canada were to prove-in technology; assess user acceptance; and adapt the operation, administration and maintenance processes for the commercial introduction of ISDN. Significant inroads were made into all these areas. In addition, Bell Canada availed itself of the opportunity to expose one of its key customers to the new and upcoming ISDN technology.

The Federal Government's participation was focused on how ISDN technology could be applied to meet specific user needs. The trial allowed GTA and the user departments to evaluate ISDN features and performance in an operational environment. An area of major interest to the government was the interworking of ISDN with existing networks and services and, in particular, with the government's own internal networks. Moreover, the trial provided valuable insights into the strategic, technical, policy, and economic issues pertaining to ISDN introduction in Canada. The Federal Government's leadership role in this trial was intended to assist Canadian industry to position itself at the forefront of commercial use and exploitation of ISDN.

The key applications under exploration in this trial included enhanced digital business telephony; desk-to-desk data communications; access to wide area data networking including shared data screens; and high speed access to GEMS/Envoy 100 messaging. User acceptance surveys were conducted by Bell Northern Research. Digital telephone with PC-coupled Call Management functions was very well received. High speed efficient access to GEMS/Envoy 100 was also very well accepted and used. Other data applications were used at various activity and satisfaction levels based on specific user environments and needs.

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1. INTRODUCTION

This document, a joint effort by the Government of Canada (GOC) and Bell Canada reports on the completed Bell Canada and Federal Government Integrated Services Digital Network (ISDN) Technology Trial. The trial began in November 1987 and was originally scheduled to end one year later in November 1988. However, it was later extended for an additional year and divided into two phases. Phase I ended in March 1989 and Phase II ran from March to November 1989.

ISDN is a fundamental evolving networking capability based on world standards. It provides a foundation for the synergistic integration of voice, data and image services. ISDN derives its strength from technological innovations in digital signal processing, digital access transmission technologies, and enhanced signalling and switching systems. An efficient integrated voice and data operations, administration and maintenance system support structure is being developed by Bell Canada for ISDN introduction. In the GOC, the Government Telecommunications Agency (GTA) is also addressing the ISDN common service implementation issues for the deployment of ISDN in the federal government.

1.1 PURPOSE

This report is being issued to achieve the following;

- Develop a common resource document for Bell Canada and the GOC on the trial activity
- Document the key achievements and findings of the trial
- Document the trial completion
- Document final assessments against trial objectives
- Document additional key findings since the Phase I completion report

This report will also provide a common platform for understanding the technology trial results.

1.2 SCOPE

The prime focus of this document is the trial activities and in particular the technical aspects of the trial. These encompass the following:

- Final assessment of the trial objectives against the trial results
- User assessments of the offered technology solutions
- Analysis of common technology related problems as encountered by end users
- Technical evaluations of the evolving ISDN technology by the GOC and Bell Canada
- Recommendations for the future

However, issues such as the following are outside the scope of this report:

- Policy assessments relating to ISDN in Canada
- Business case analysis of ISDN introduction in the GOC
- Conformance testing and standardization of technologies or applications

1.3 APPROACH

This report is a joint Bell Canada and GOC effort. Inputs from a variety of users and organizations have been received and incorporated in this report.

The ISDN technology trial objectives as they pertain to the provider (Bell Canada) and the User (GOC) are stated in section 2. Measurement of results against these objectives is included in section 4 of this report.

The deployment of communications capabilities and applications is discussed in section 3. The trial users are also identified. This represents an overall snapshot of the trial deployment.

The results are summarized in section 4. The appropriate supporting material is included in the appendices. These consist of excerpts from original analysis and documentation issued during the trial.

1.4 TRIAL OVERVIEW

The Bell Canada and Government of Canada ISDN Technology Trial (the "Trial") was conducted over a two year period from 02 November 1987 to 02 November 1989. This endeavour - the first ISDN customer trial in Canada - was jointly sponsored by Bell Canada and the Government Telecommunications Agency (GTA), a branch of Communications Canada responsible for providing telecommunications services to the departments and agencies of the Government of Canada. User groups from the Department of Communications, the Department of National Defence, and Industry, Science and Technology Canada (formerly the Department of Regional Industrial Expansion) participated in the project.

The start of the Trial marked the culmination of many months of planning and preparation by Bell Canada and the federal departments and agencies participating in it. Bell Canada's intention to undertake an ISDN trial programme was first made public in the fall of 1985. Formal planning between Bell and GTA began in the summer of 1986, leading to an agreement in December of that year for the Government of Canada to participate in this programme. Although the Trial was originally planned to continue for a period of only one year, it was later extended for an additional year.

The Trial was the first of several phases in Bell's overall ISDN customer programme. While the federal government was the sole customer during the first phases, other customers were added in subsequent phases which incorporated Primary Rate Access, extended the trial programme to other cities and introduced networking between ISDN nodes.

The Trial was held in Ottawa using an ISDN node consisting of a Northern Telecom DMS-100 digital switch and DPN-50 packet handler. It was decided to dedicate a switch to the Trial to eliminate the possibility of the Trial adversely affecting service to the more than 100,000 government telephone lines in the

National Capital Region. The node, located at the Bell Canada O'Connor Street Central Office, provided coverage to the downtown core of Ottawa.

As the Trial constituted an ISDN island, ISDN features and functionality were limited to calls between users on the Trial node. However, users had access to other services such as the government's local and intercity networks, the public switched telephone network and the Bell Canada Datapac network.

All ISDN telephones and terminal adapters (TAs) used in the Trial were provided by Bell Canada or by suppliers who were participants in the Bell Canada ISDN Vendor Programme (TAs are devices which enable non-ISDN terminals to access the ISDN service). These ISDN devices include Meridian T2317 ISDN digital telephones and ISDN Personal Computer Terminal Adapters (PCTAs) from Northern Telecom and Packet Assembler/Disassember (PAD) TAs and T-Link TAs from Harris Corporation. In addition, Apple Canada Inc. supplied a number of Macintosh computers.

The Trial for the most part was based on prototype equipment and applications software. However, a number of steps were taken to ensure the serviceability of Trial components before they were deployed to Trial users. The federal government trial was preceded by technology testing and an internal Bell Canada ISDN trial. Also all products from third party vendors were conformance tested.

A multi-tiered organization was put in place to plan and implement the Trial. A Steering Committee, comprised representatives of Bell Canada, GTA and each of the user departments, provided overall direction to the conduct of the Trial and was responsible for approving and reviewing the execution of Trial plans developed by the Project Management Committee.

The Project Management Committee (PMC), also with representation from Bell Canada, GTA and the user departments, was responsible for developing and co-ordinating the execution of plans for all aspects of the Trial, including the selection and definition of applications to be included in the Trial; implementation; operations, administration and maintenance issues; training and user support; evaluation; and internal and external communications.

As the need arose, the PMC set up special working groups to address specific issues. These working groups were made up of one or more PMC members together with appropriate members drawn from the organizations participating in the Trial.

The final layer in the hierarchy, and one of the most important elements in the success of the Trial, consisted of the user coordinators. These were specifically selected individuals from within each group of users who were responsible for providing ongoing support to the other members of their group. Their role was to reinforce the initial training provided to users, to help users resolve any problems that they might be experiencing and to serve as the first point of contact in the trouble reporting process.

As the end of 1988 approached, it was mutually agreed that the technology trial should be extended and continue for an additional year to test the X.25 TA and Station Message Detail Recording (SMDR), as well as to gain further experience with the Harris PAD TA and the Harris T-Link TA which were delivered late in the first year of the Trial.

Upon completion of the Trial, a gradual removal of the ISDN access lines, equipment and service was coordinated starting with DND followed by DOC, ISTC and lastly GTA during January of 1990. Care was taken to ensure that the users' Centrex III/EEWD tariffed services and features were restored to the original configuration.

2. TECHNOLOGY TRIAL OBJECTIVES

2.1 BELL CANADA OBJECTIVES

From the Bell Canada perspective, the purpose of the Ottawa Technology Trial was to obtain maximum knowledge of the ISDN technology, operational capabilities, technical and administrative procedures, applications, and service implications in preparation for commercial service.

The Basic Rate Access (BRA) technology included a Northern Telecom ISDN Node (DMS-100 + DPN-50), Centrex terminals, and other standard hardware and software required to support the Trial. However, the Trial objectives were focused on the ISDN specific components. Reference to other components included in the Trial is from the viewpoint of their interaction or interworking with ISDN. The intent of the technology trial was to test the technical design, operational characteristics, and general capabilities of an innovative technology employed in typical user configurations.

The ISDN technology trial was designed to:

- provide a testbed for the development and refinement of operational procedures, support systems and organizational arrangements
- allow systematic evaluation and adjustment of ISDN network and terminal equipment as it evolved from prototype components to commercial product(s)
- provide a proving ground for consideration of a wide range of potential ISDN service capabilities and user applications under "in-service" conditions

The Bell Canada Basic Rate Access technology trial programme in Ottawa consisted of an In-House trial and a Customer trial with the Government of Canada. The In-House trial participants were Bell users located at 78 O'Connor St., 410 Laurier Ave. W., 220 Laurier Ave. W. and 160 Elgin St. The Customer trial included four departmental user groups within the Government of Canada in downtown Ottawa. Each trial was administered separately. However,

common practices and procedures were utilized. Furthermore, operational performance was recorded over the total base of ISDN access lines and terminations.

2.2 FEDERAL GOVERNMENT OBJECTIVES

From the early planning stages, the federal government was determined to avoid simply repeating trials that were already underway elsewhere. Previous trials, such as those of Mountain Bell and Pacific Northwest Bell, had proven the underlying technology. The focus of the federal government in the Ottawa Trial, therefore, was directed toward the goal of trialling the latest ISDN technological advances and determining how this technology could be applied to meet specific user needs.

Towards this overall goal, the federal government established the following objectives for the trial:

- To evaluate ISDN features and performance

  GTA and its client departments wished to evaluate the features and performance of the ISDN technology in as close to an operational environment as possible.

- To explore new or enhanced user applications

  Users wanted to see how the new ISDN capabilities could be used to develop new applications or to enhance existing applications in order to improve their operations.

- To study operational and administrative issues

  The introduction of ISDN services will require changes in operational and administrative policies and procedures by both users and service providers. In particular, the advent of an integrated infrastructure for voice and data telecommunications is bound to have an impact on many organizations since these services have traditionally been planned and administered by separate groups.

- To verify interworking with existing networks and services

  Since ISDN is to be phased in over a period of several years, there will be a lengthy transition period during which ISDN and non-ISDN networks and services must co-exist.

- To gain insight into technical, policy and economic issues

  The federal government recognized that participation in the Trial would allow it to take a leadership role in the process of introducing ISDN in Canada, thereby gaining valuable strategic insight into technical, policy, and economic issues pertaining to ISDN. The knowledge gained would enhance the contribution of the Department of Communications to international standards activities and assist GTA in planning the evolution of government telecommunications services.

- To support the Canadian telecommunications industry

  By providing a test-bed on which to evaluate and refine products at an early stage in the evolution of this new technology, it was intended that the Trial would help Canadian industry maintain a position at the forefront of the development and application of telecommunications technology.

  In addition, it was expected that the Trial would increase the general awareness in Canada of the importance of ISDN in the future world marketplace and encourage Canadian firms to position their products in this market.

3. TRIAL APPLICATIONS

3.1 INTRODUCTION

The ISDN circuit and packet switching functions in the trial were provided by Bell Canada through a Northern Telecom DMS-100 switch (designated DS-9) located at 78 O'Connor Street, Ottawa. The switch supported both circuit and packet data communications capabilities and enhanced telephony using Centrex III business features. The maximum reach for the selected trial users was approximately 3.5 kilometers cable route distance from the switch. Approximately 50 "U" loops were installed for the Trial to serve approximately 170 terminations.

The end user capabilities in the Trial were derived from the DMS-100 Centrex III/EEWD telephony features, circuit and packet switching terminal equipment and associated software applications. Most of the Personal Computers (PCs) were IBM or compatibles with DOS environments without multi-tasking or multi-processing features.

3.2 APPLICATIONS DEVELOPMENT

A significant portion of setting up the technology trial was devoted to the development of ISDN applications and the impact they would have on the user community. Rather than simply implement a technology, a rationale was developed to implement ISDN as if it were a service. This involved new routines for the processing of orders, operations support, and applications integration. To facilitate this, Bell Canada delivered ISDN integrated voice and data applications plus the software which were supported for the duration of the technology trial.

3.2.1 APPLICATIONS IMPLEMENTATION

The first activity in implementing the developed applications was to identify prospective participants. Contacts were established at GTA and DOC, ISTC and DND. These contacts led to the identification of the ISDN Trial User Co-ordinators. Information about the customers, their general business functions, needs and primary locations was established. The principle criteria used in selecting users and applications for the Trial were:

- The geographic coverage of the Trial. This was constrained by the location of the node and the loop technology to a cable distance of 3.5 km from the O'Connor Central Office.
- The willingness of the department to commit the resources necessary for planning, implementing, conducting and evaluating the trial.
- The applications proposed by the potential participant. An effort was made to select applications that would demonstratably benefit from the enhanced capabilities of ISDN; e.g., applications which were in some respect constrained by limitations of existing telecommunications services.
- The level of experience of the user. An attempt was made to select users who were familiar with the use of personal computers and the application packages they would be expected to use. Not only would this minimize the training burden, but these users were more likely to have experienced the limitations of present services and be more likely to appreciate the added capabilities of ISDN.

Final selection of the end-users was at the discretion of the manager of the particular end-user group and the User Co-ordinator. Components requiring development work were identified and time frames estimated. Feasibility was based on the availability of the ISDN components. Alternate technical solutions were examined and one recommended solution was put forward. Engineering designs were subsequently completed prior to trial implementation.

A detailed checklist was established for each user group. ISDN lines, equipment and resources were forecast. Customer equipment was verified which included a certain amount of hardware and software testing.

The required ISDN lines and equipment were ordered by Bell Canada. Other tariffed services required were ordered by the customer. ISDN facilities were provisioned 2 weeks in advance of customer cut-over to allow for system testing and integration.

The ISDN equipment was set-up and tested to ensure all features were installed as ordered and that it functioned as intended. Systems integration testing included the setting up of software parameters such as those found in the PCTA, establishment where necessary of user/machine interfaces like the Automenu or Fixed Disk Organizer, individual user requirements, and a review of back-up procedures. End-User training was subsequently provided (refer Appendix A-4).

At the completion of the first year of the trial it was agreed that the onus for further applications development would be on the the participating Government of Canada departments. This was based on the success of the technology implementation and the reality that future ISDN based service would see the applications development or "off-the-shelf" application program purchases as a customer responsibility. This would be no different than the existing practices of PC users in the GOC and/or private industry. However, the GOC groups experienced limited success with internal development and/or encouraging of third party vendor participation in such a program at this early stage of ISDN development. One of the factors was the limited amount of time remaining in the trial at this point to develop an application quickly enough and to test it before the end of the trial. The other basic reason being that the market has not yet reached a critical mass for immediate commercial exploitation.

3.3 TRIAL COMMUNICATIONS CAPABILITIES

The ISDN capabilities made available in the Technology Trial were as follows:

- ISDN Telephony
- Call Manager
- Wide Area Networking
- Shared Screen

- 3270 Emulation
- ASCII Connectivity (Packet Switched and Circuit Switched)
- X.25 Networking (for X.25 terminal devices and ports)

The individual user's applications were composed of one or several of the above capabilities. The applications integration and ongoing support was provided jointly by Bell Canada and the GOC.

3.3.1 ISDN TELEPHONY

The Northern Telecom Meridian T2317 ISDN digital telephone was used. This hands-free instrument provided access to features via twelve programmable hard keys and five context-sensitive soft keys. It also had a two line LCD display used to display call status information and labels for the softkeys. The set's features included:

- Superior voice quality
- Hands Free (built into the telephone)
- Programmable hard keys
- Context specific soft keys
- Access to Centrex III features
- Calling Line Identification (CLID)
- Interface to PC Call Manager
- Headset (optional)
- LCD information display

The set required AC power to function. The T2317 supported various capabilities in a stand-alone mode as well, such as:

- User selectable ringing tones, speaker volume, time and date
- Programmable hard keys for storing frequently called numbers, etc.
- Ability to store and display the calling number and to call-back unanswered calls.

The voice interworking capability permitted the user of an ISDN T2317 phone to communicate with users on both the government's private network and the public telephone network. If both users were on the serving ISDN switch (DS-9), the full range of capabilities was available, for example Ring Again and CLID.

3.3.2 CALL MANAGER

The Call Manager capability was provided through the Northern Telecom PC Terminal Adapter (PCTA) and associated software which is compatible with IBM DOS based PCs. This software package enabled a T2317 telephone and a PC equipped with a Northern Telecom PC Terminal Adapter (PCTA) card to function as an integrated system, allowing the telephone to be controlled by the user from the PC. It used the D-channel on the T-Bus to interwork with the Northern Telecom T2317 to provide functionality in:

- managing a large personal directory of names and telephone numbers
- logging incoming and outgoing calls
- controlling the telephone
- monitoring telephone line status

Call logs were also automatically stored on the PC for later access if required. This application had the following features:

- Call logging (start time/duration, incoming/outgoing marks and answered/unanswered status)

- Call origination/termination/answering from the PC
- Personal directory of up to 750 entries
- Calling number identification if the caller was part of the ISDN Trial and calling party identification if the caller's ID was in the Personal Directory.
- Call origination from the application, personal directory, call log, or phone lines window

3.3.3 WIDE AREA NETWORKING

The ISDN Wide Area Networking (WAN) capability was provided through the Northern Telecom PCTA and associated Networks software developed by Northern Telecom under license from Microsoft.

In an ISDN environment, WAN permitted the networking of PCs and file/print servers for communications at speeds of up to 64 kbps. Using a shared server(s), files could be read, edited, or shared with others as if they were on the end-user's own PC. A printer associated with the File Server could also be shared by authorized WAN users. WAN communities of interest were defined by inputting the server addresses into the terminal's "network directory". Workstations and servers could be located in the same or different buildings provided that they were located within the range of the trial switch (DS-9). The ISDN packet network access was set-up to allow up to 15 users to simultaneously access a server. Users could employ a wide variety of commercially available applications software on the ISDN WAN.

The WAN Server could be used for file storage, as a print server, as a multi-user software storage vehicle and for other user-developed applications such as message desk. The server was primarily accessed via B channel packet. Users could originate sessions to the server either via B or D channel packet switched access according to their configurations.

3.3.4 SHARED SCREEN

The shared screen capability was provided by a Northern Telecom prototype software package called Mu-share which used the Northern Telecom PCTA D or B packet access to permit two PC users to share the same PC screen. The screen could be shared in either of two modes. In show mode, the screen was controlled exclusively from the keyboard of the end user who initiated the session. In dual mode, both end users could control the screen from their respective keyboards. Shared Screen was intended to be used as an adjunct to enhance a telephone conversation. As such, for example, it could be used to provide remote technical support or training. It was a memory resident package which could be invoked at any time via a hot key sequence.

3.3.5 3270 EMULATION

This capability, provided by the Northern Telecom PCTA, enabled a PC to function as a 3278 terminal, allowing access to a remote host without the use of coaxial cable or a controller. In addition, advanced features were supported which are not available on a 3278 terminal such as screen to disk copying, disk to host file transfer, escape to DOS and others.

3.3.6 ASCII CONNECTIVITY

This capability permitted personal computers or asynchronous terminals attached to an ISDN switch to communicate with appropriate devices throughout the network using the ASCII character set.

There were two modes of ASCII connectivity:

- Circuit Switched
- Packet Access

Circuit switched permitted dial access to (i) Datapac or other ISDN terminals/hosts, (ii) Centrex III/EEWD Data, or (iii) any ASCII device on the

public switched network through a Data Unit (DU) and modem combination. Circuit Switched required a T-LINK Terminal Adapter. T-Link TA units were used to demonstrate TA to TA connections at asynchronous speeds up to 19.2 kbps and TA to DU connections at speeds of 9.6 kbps & 19.2 kbps (asynchronous).

Packet Access in ISDN allowed a PC or ASCII terminal to access other terminals/hosts on Datapac/ISDN. In the packet-switched version, analogous to the existing Bell Canada Datapac 3101 service, an ISDN terminal (e.g., an ASCII terminal or PC equipped with a PAD TA) could communicate with an another ISDN terminal or with devices on the Datapac Network.

Note: Synchronous circuit switched support was tested on the Bell Canada In-House trial using Racal-Milgo Terminal Adapters at 64 kbps (V.35 Interface) between Group IV facsimile machines.

3.3.7 X.25 NETWORKING

This capability was to involve the use of an X.25 TA to permit Hosts, PCs, or LANs to communicate via the B or D packet switched access. An X.25 application was identified which was scheduled to be implemented in Phase II of the trial. However, when the selected X.25 TA was tested it was discovered that the interface to the Data Terminal Equipment was not compatible with the standard Datapac X.25 protocol implementation. Consequently, this capability could not be trialled in the field due to late availability.

3.4 APPLICATIONS

The generic service capabilities were combined in various ways to address specific user needs. Some of the applications used on the Trial are the following:

- **Enhanced ISDN Telephony**

  This application was based on the Northern Telecom T2317 ISDN digital telephone which was the basic device for voice communications. The features and capabilities are described in item 3.3.1 of this section.

- **Integrated Workstation**

  This application was used by almost all of the user groups on the Trial. It integrated the functionality of an ISDN telephone with a PC through the use of ISDN Terminal Adapter(s). By using a single telephone line and terminal, the user could quickly switch between a variety of applications such as stand-alone PC functions (such as working on a spreadsheet), integrated telephony functions (such as Call Manager), 3270 emulation, Wide Area Networking, Shared Screen, and ASCII terminal emulation for access to electronic messaging services such as Envoy 100.

- **Office Networking**

  Using Wide Area Networking capabilities, this application demonstrated the ability of ISDN to provide connectivity to a number of resources both within their own user group as well as the outside world. Users were able to share printers and file servers and access both internal and external databases.

- **File Transfer**

  A large database, maintained at a local service bureau, was required to be frequently downloaded to a server on a Local Area Network. The increased data rate and lower error rate of the ISDN access, as compared to the dial up modems previously used, significantly reduced the time required to accomplish this process, thus reducing congestion at the host end.

- **Telecommuting**

  This was undoubtedly the most glamorous of the Trial applications, judging from the degree of media attention afforded to it. An ISDN workstation installed in an employee's home provided the same telecommunication capabilities and access to the same databases as the employee had access to at the office. The employee worked from home a few days each week to evaluate this concept.

A number of other planned applications were not fully deployed.

- **Message Desk**

  The development of this application would have been quite complex, since the lack of an application programming interface on the PCTA put the task beyond the capabilities of the average user. There was an initial delay while a non-disclosure agreement was negotiated with Northern Telecom for information regarding the internal architecture of the PCTA. The work was subsequently deferred in anticipation of a new version of PCTA (which in fact never actually materialized) having an applications programming interface. The application was eventually dropped completely as the user group discontinued use of the PCTA when the cards were found to be incompatible with the interface cards for the Banyan LAN which they introduced midway through the trial.

- **Centralized Answering Position**

  An innovative use of the Call Manager package was developed for ISTC. In this application, a telephone operator was required to answer incoming general inquiries calls and transfer them to the appropriate destination within the department. Despite the fact that its designers had not envisaged it being used in this situation, the Call Manager package provided the needed functionality although the maximum capacity of the directory at 750 entries was not sufficient for this application which required approximately 3500 entries. However, by using Call Manager in conjunction with Lotus Metro, it was found that multiple directories (one for each letter of the alphabet) could be easily and quickly called up.

This application was developed and proven to work to the satisfaction of the client. However, it was not deployed in operational use because the large amount of RAM required by Call Manager caused conflicts with other memory intensive applications.

- **Help Desk**

The concept of the Help Desk was evaluated to a limited extent within a controlled environment but was not deployed to a general user group due to limitations of the shared screen capability. The prototype Mu-Share program from BNR was not sufficiently robust and the PCTA did not permit the use of third party shared screen programs.

3.5 USER APPLICATIONS DEPLOYMENT

Seven customer groups within the Government of Canada participated in the Ottawa BRA Trial. These were from the Department of National Defence (DND), Department of Communications (DOC), and Industry, Science and Technology Canada (ISTC) (formerly the Department of Regional Industrial Expansion, DRIE). They are as follows:

- DND DCSEM at 219 Laurier Ave. W. on the 11th Floor
- DND DPS at 360 Laurier Ave. W. on the 8th Floor (subsequently moved to 305 Rideau St. on the 9th Floor)
- DND DMAS at 101 Colonel By Drive on the 9th and 11th Floors and at 219 Laurier Ave. W.
- DND SCPO at 101 Colonel By Drive on the 7th Floor
- DOC DGIM at 300 Slater St. on the 14th, 8th and 7th Floors
- DOC GTA at 300 Slater St. on the 7th and 10th Floors
- ISTC at 235 Queen St. on the 3rd Floor.

Each of these groups is profiled in terms of their business function and ISDN "solutions" below. Some overlapping Community of Interest (C.O.I.) existed between:

– DCSEM and DPS

– DMAS and SCPO

– DGIM and GTA

Note: A wider COI was fostered by the User Forum activities in the trial. The main areas being telephony and GEMS/Envoy 100 messaging.

3.5.1 DND DCSEM (refer Figure 3.5.1.1)

User Group Overview

The Directorate of Computer Systems Engineering and Maintenance (DCSEM) trial group consisted of three users located on the 11th floor of the Canadian Building at 219 Laurier Avenue West.

These users required voice access and data connectivity to the DCO host at Tunney's Pasture, to a Develnet switch and to the DPS Project Management server, the latter two also being located on the 11th floor of the Canadian Building. The Develnet switch, in turn, provided access to Telecom Canada's Envoy 100 electronic messaging service via Datapac and to an ALTOS minicomputer located on the 11th floor of the Canadian Building.

Trial Configuration

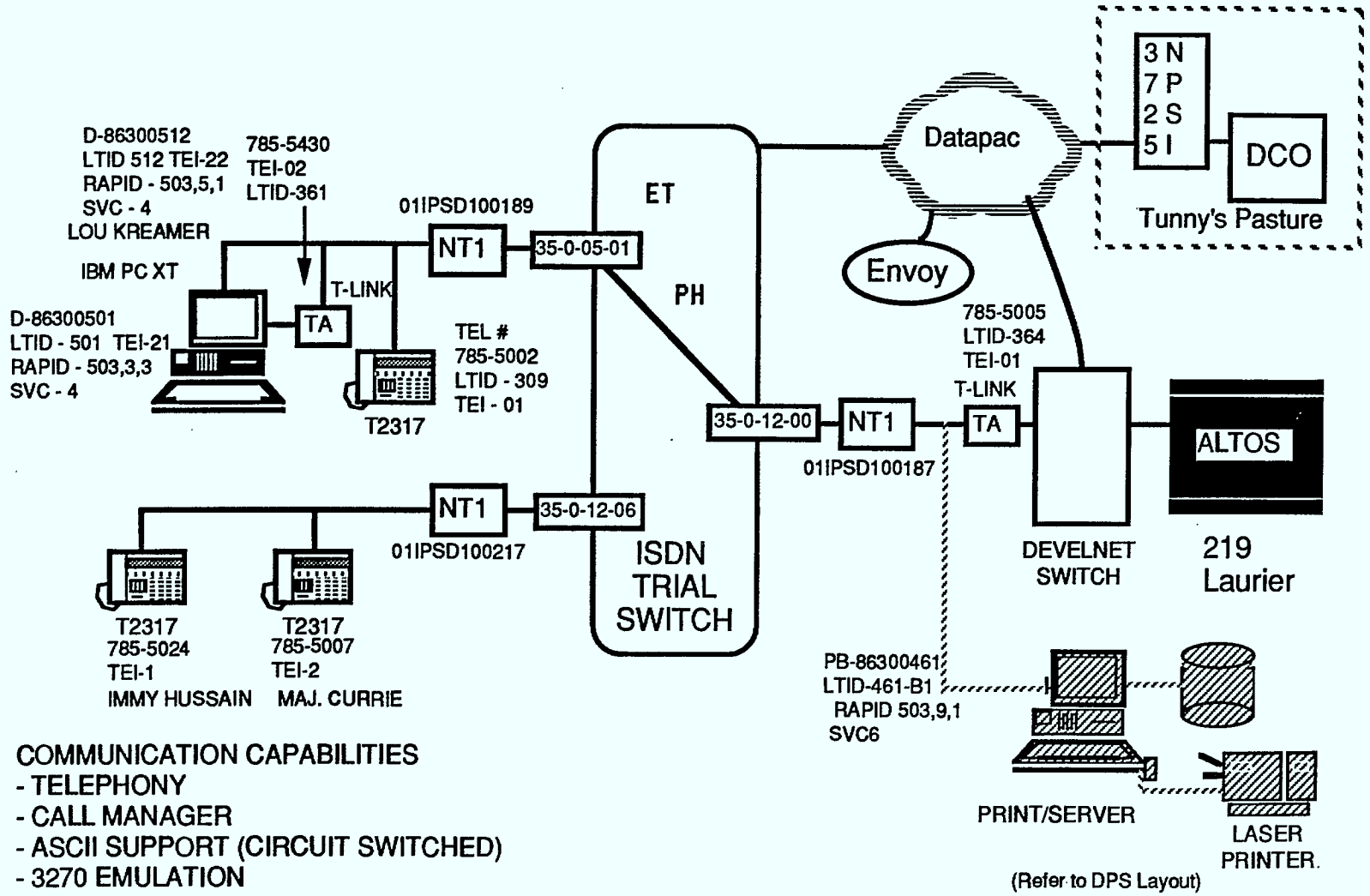
Two users had T2317 telephones while the third was provided with an integrated workstation setup consisting of a T2317 telephone and a PC equipped with both the Northern Telecom PCTA (for D-channel circuit switched access) and a Harris T-Link TA (for B-channel circuit switched access). The Develnet switch was connected to a circuit switched B-channel by means of a Harris T-Link TA. The DPS Project Management server was connected to a B-channel packet switched access using a PCTA.

Applications

The following applications were trialled:

- Enhanced ISDN Telephony
- Integrated Workstation
- Office Networking

DCSEM
INTEGRATED WORKSTATION
(219 Laurier Ave.. W., Floor 11)



COMMUNICATION CAPABILITIES
- TELEPHONY
- CALL MANAGER
- ASCII SUPPORT (CIRCUIT SWITCHED)
- 3270 EMULATION

Figure 3.5.1.1

3.5.2 DND DPS (refer Figure 3.5.2.1)

User Group Overview

The Directorate of Pay Systems (DPS) was responsible for managing the development of a new civilian pay system. Six members of the group are located on the 9th Floor of the Constitution Building at 305 Rideau Street with a seventh member and a server located in the Centennial Building at 219 Laurier W. on the 11th Floor.

These users required enhanced voice access and data connectivity to share project management files with DCSEM. They also required 3270 access to an IBM Host in Tunney's Pasture. The Develnet switch connection was also available for access to the ALTOS minicomputer and to GEMS/Envoy 100 electronic messaging.

Trial Configuration

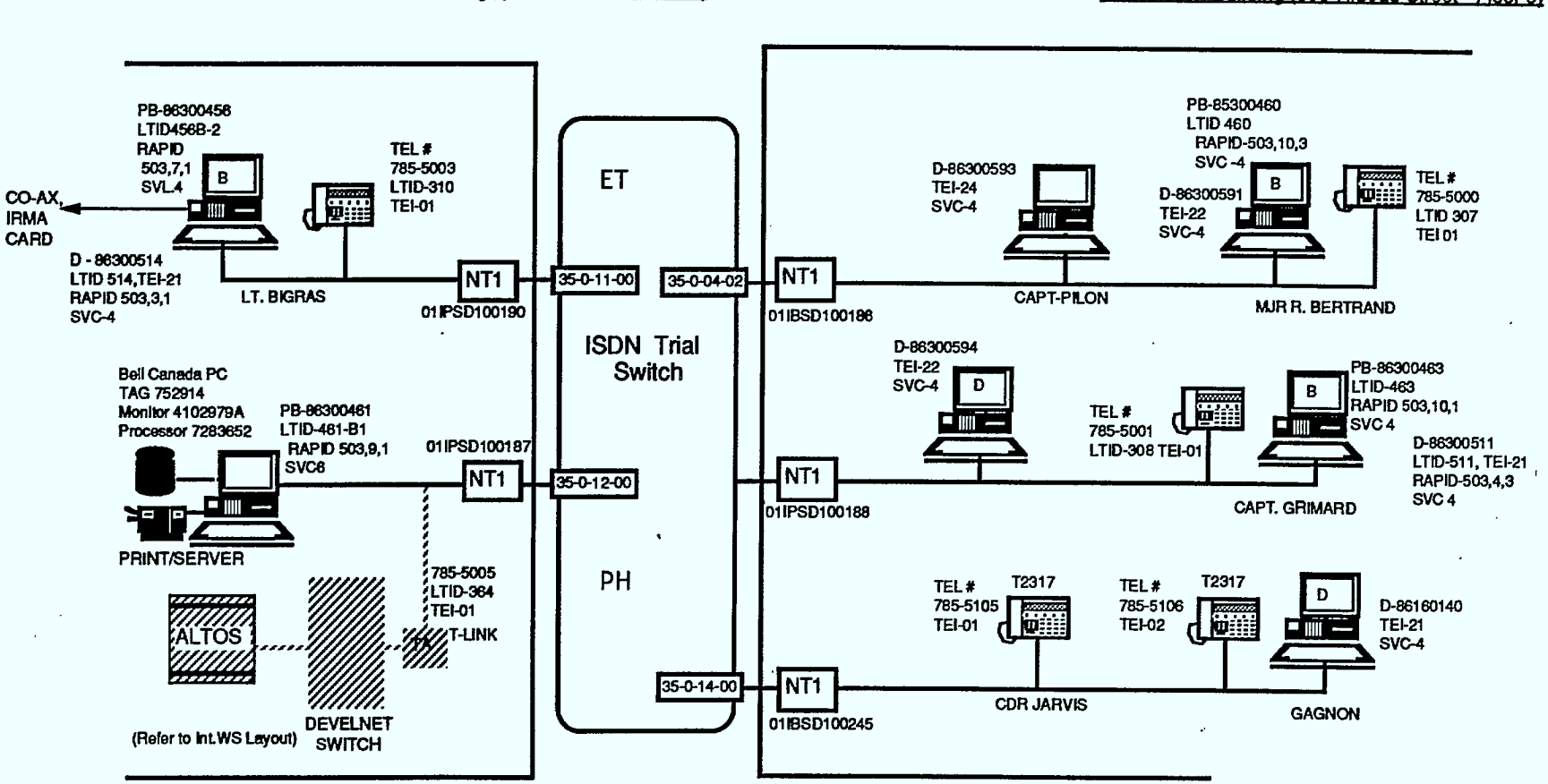
Four integrated work stations were deployed, two standalone PCs provided Wide Area Networking and one user had a requirement for enhanced ISDN telephony. Switched access to a common printer/server was available to this group as well as a connection to the Develnet Switch.

Applications

The following applications were trialled:

- Enhanced ISDN Telephony
- Integrated Workstation
- Office Networking

DCSEM / DPS
APPLICATION - DISTRIBUTED PAY SYSTEM
PROJECT MANAGEMENT



COMMUNICATION CAPABILITIES
- TELEPHONY
- CALL MANAGER
- WIDE AREA NETWORKING
- 3270 EMULATION

Figure 3.5.2.1

3.5.3 DND DMAS (refer Figure 3.5.3.1)

User Group Overview

Two groups within the Directorate of Materiel, Administration and Services were involved in the trial. DMAS 4 was located on the 9th floor at 101 Colonel By Drive and DMAS 2 was located on the 11th floor in the same building.

The DMAS 4 group provides administrative support. ISDN was employed to improve the connectivity between administrators and supervisors using a shared file server and printer.

DMAS 4 was to use ISDN WAN as the sole means of connectivity between PCs in a primarily Database-oriented applications environment. This proved to be inappropriate due to the disk intensive nature of the PC application. Consequently, users were slowed relative to their stand-alone PC configuration and discontinued the ISDN WAN concept. DMAS 4 also configured a UNIX operating system to permit remote users to access the system via ISDN. This server arrangement was deployed as an alternative to the initial design and was acceptable to the users.

The DMAS 2 group is primarily concerned with staffing and budgeting for the Assistant Deputy Minister (Materiel) (ADM(MAT)) organization which has 4500 employees in 28 locations in Ottawa. To do this job, DMAS 2 staff required access to Corporate Financial Information Systems (on the IBM Host in Tunney's Pasture), access to civilian personnel resource files (SCPO), and the use of spreadsheets for staff budgeting.

Trial Configuration

Twelve users were provided with enhanced ISDN telephony. Two PC Work Stations were equipped with Harris T-link TAs for circuit switched ASCII access to a T-link configured server.

The original intent was to permit DMAS 2, through a standard workstation (PCTA) to allow access to the F.I.S. Mark III system on the IBM Host. This part of the application was not implemented due to the substantial software

development costs for unique modifications to the PCTA 3270 emulation software for its use in the DND environment.

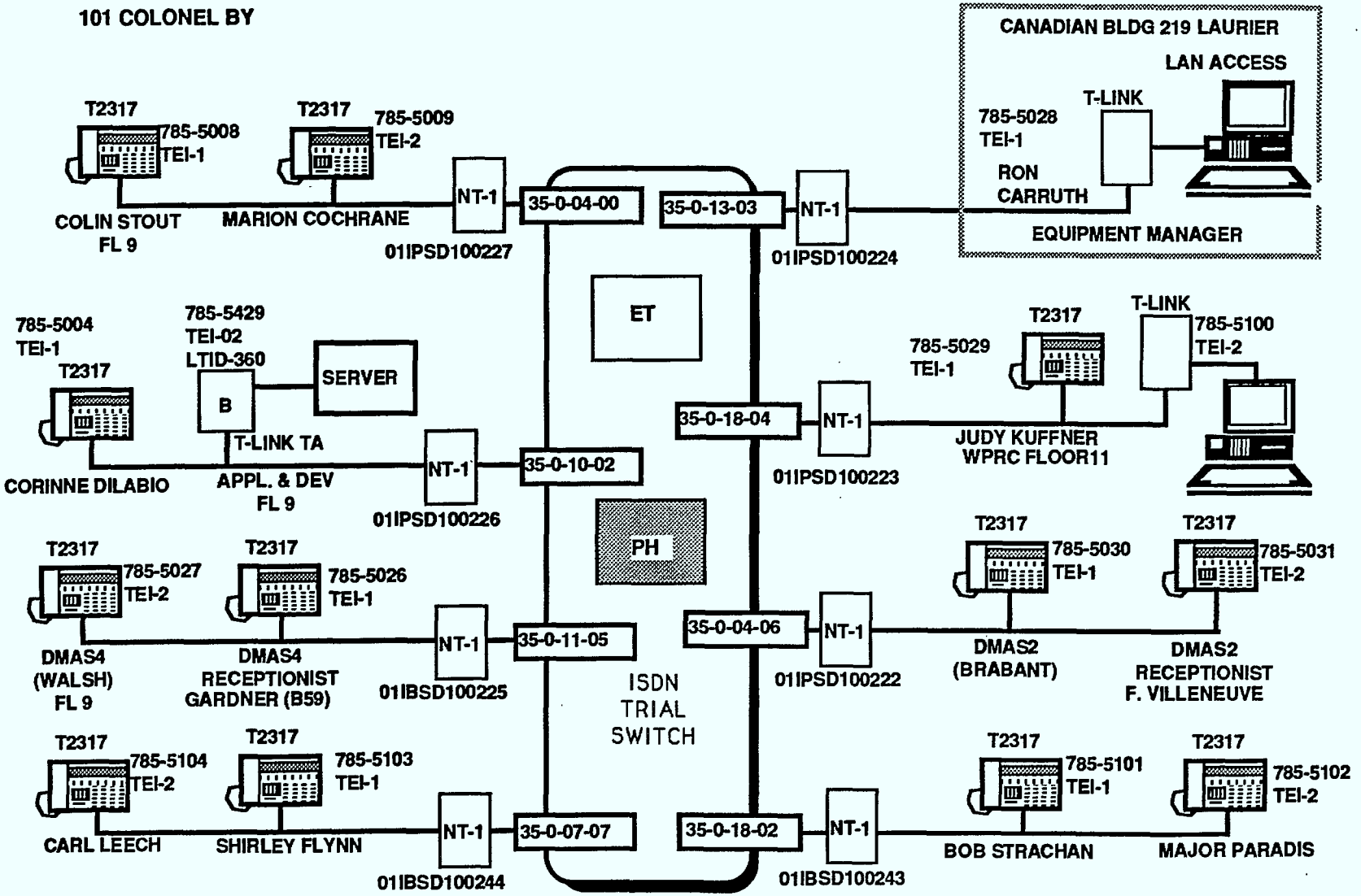
Connectivity to the SCPO LAN Database was provided via the Datapac Network.

Applications

The following applications were trialled:

- Enhanced ISDN Telephony
- Office Networking

DND-DMAS4
WORD PROCESSING TRACKING



COMMUNICATION CAPABILITIES
- **TELEPHONY**
- **ASCII SUPPORT (CIRCUIT SW.)**

Figure 3.5.3.1

3.5.4 DND SCPO (refer Figure 3.5.4.1)

User Group Overview

The Senior Civilian Personnel Officer (SCPO) group located on the 7th floor at 101 Colonel By Drive is responsible for maintaining all civilian personnel records for ADM(MAT). They mechanized their large paper filing system to better help other staff groups in planning resource and budget requirements. They used Apricot PC's on an Omninet LAN.

Trial Configuration

For the trial, Bell Northern Research developed the capability which permitted an Apricot PC to interwork with ISDN.

Two integrated ISDN workstations, one standalone PC and a server were configured.

This design permitted the ISDN implementation to support gateway access to SCPO's Local Area Network from remote terminals and other LANS (LAN/WAN interworking).

Applications

The following applications were trialled:

- Enhanced ISDN Telephony
- Office Networking

DND-SCPO
LAN/WAN GATEWAY

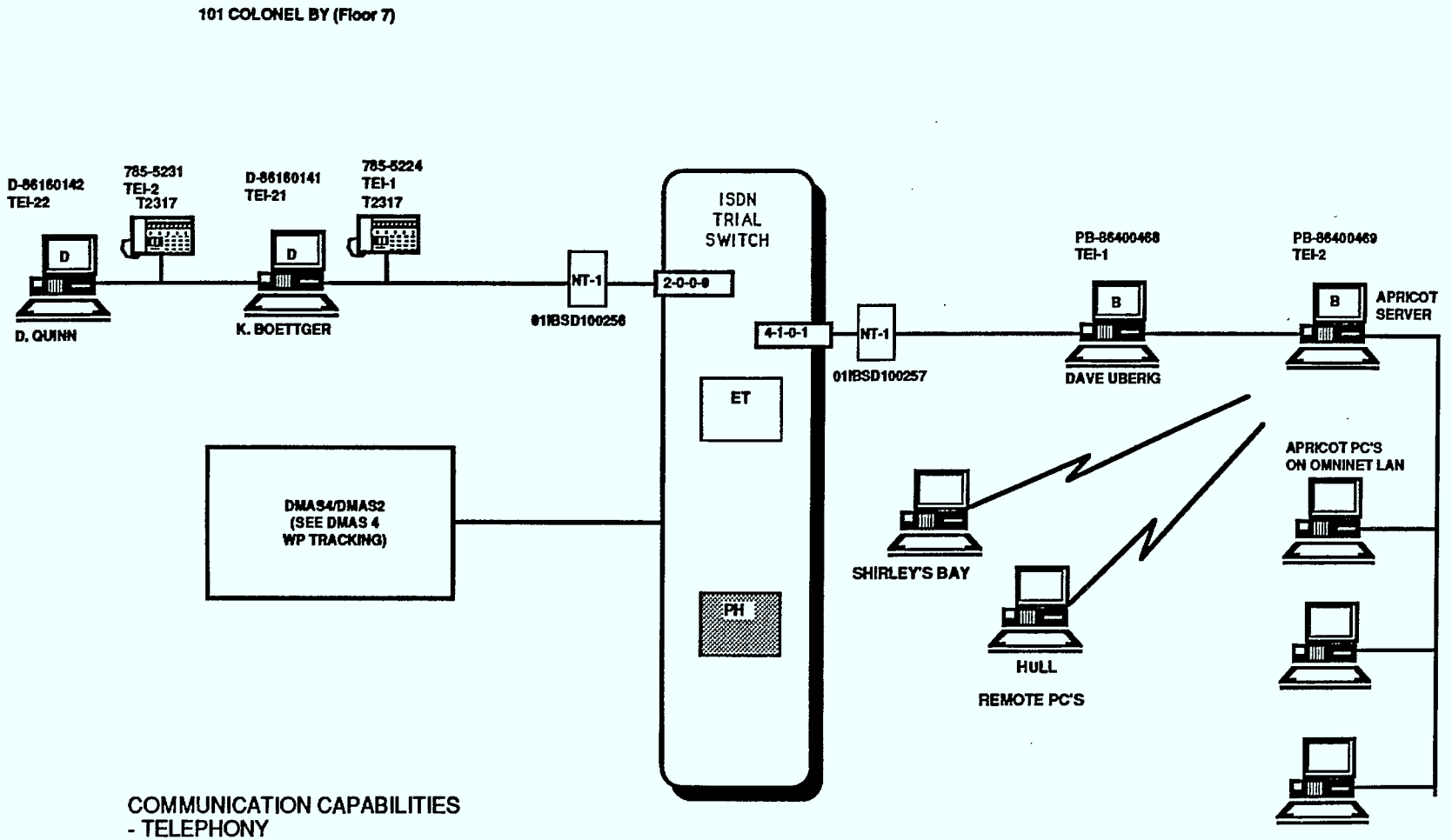


Figure 3.5.4.1

3.5.5 DOC DGIM (refer Figure 3.5.5.1 and Figure 3.5.5.2)

User Group Overview

The Director General Informatics Management (DGIM) group is located at 300 Slater Street on the 14th, 8th, and 7th floors and is responsible for providing and operating the information processing resources for the Department of Communications, monitoring of developments in communications technology and the assessment of associated policy implications. This group was divided into two sub groups from an ISDN perspective.

- Office Networking for knowledge workers (Fig 3.5.5.1), and
- Administrative Services Support for the Directorate (Fig 3.5.5.2).

Telecommuting as a sub-application of Office Networking was also implemented. See Appendix B4 for an analysis.

In DGIM, PC's were used for personal (stand-alone) applications as well as being networked using DOC's nationwide Develcon Network and a Banyan LAN to access Host systems, other PCs, and Envoy 100.

The ISDN technology replaced existing capabilities and provided better connectivity within the department through shared file servers, access to electronic mail systems e.g., GEMS/Envoy 100, and provided an integrated receptionist position referred to as the "Message Desk".

Trial Configuration

- **Office Networking**

  Six integrated work stations were provided out of which five were additionally equipped with Harris PAD TAs for GEMS/Envoy 100 access.

  A seventh integrated workstation was provided at an employee's home for telecommuting.

The receptionist position was configured as a message desk with an enhanced ISDN telephony position with a backup answering position. A server was configured in the group's Model Office.

- **Administration Services Support**

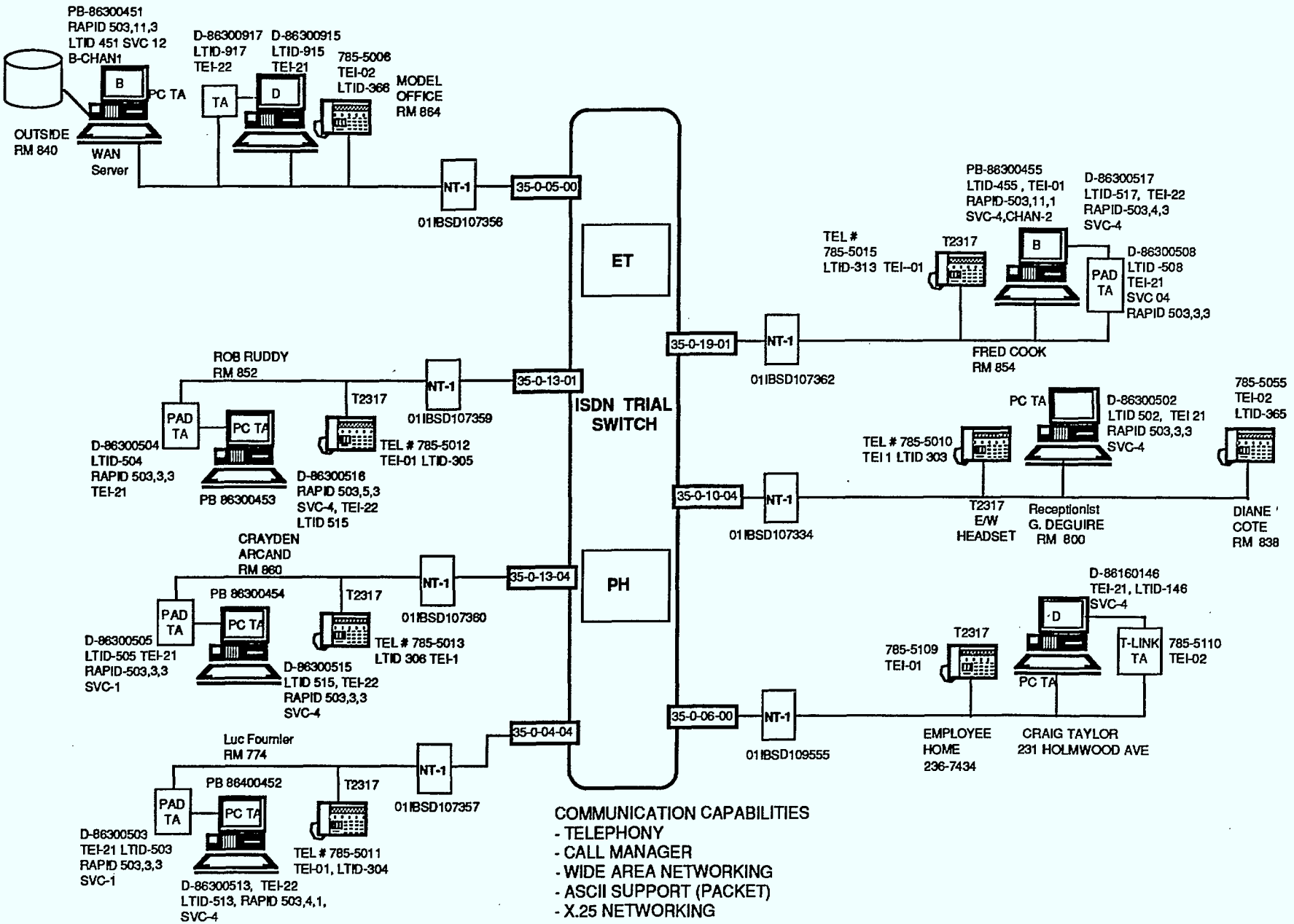
  Three integrated workstations, two PCs and a server for high quality printing were configured. All the PCs were configured for electronic messaging using GEMS/Envoy 100.

Applications

The following applications were trialled:

- Enhanced ISDN Telephony
- Integrated Workstation
- Office Networking
- Telecommuting
- Message Desk

DOC - DGIM
OFFICE NETWORKING



COMMUNICATION CAPABILITIES
- TELEPHONY
- CALL MANAGER
- WIDE AREA NETWORKING
- ASCII SUPPORT (PACKET)
- X.25 NETWORKING

Figure 3.5.5.1

DOC - DGIM
ADMIN SUPPORT

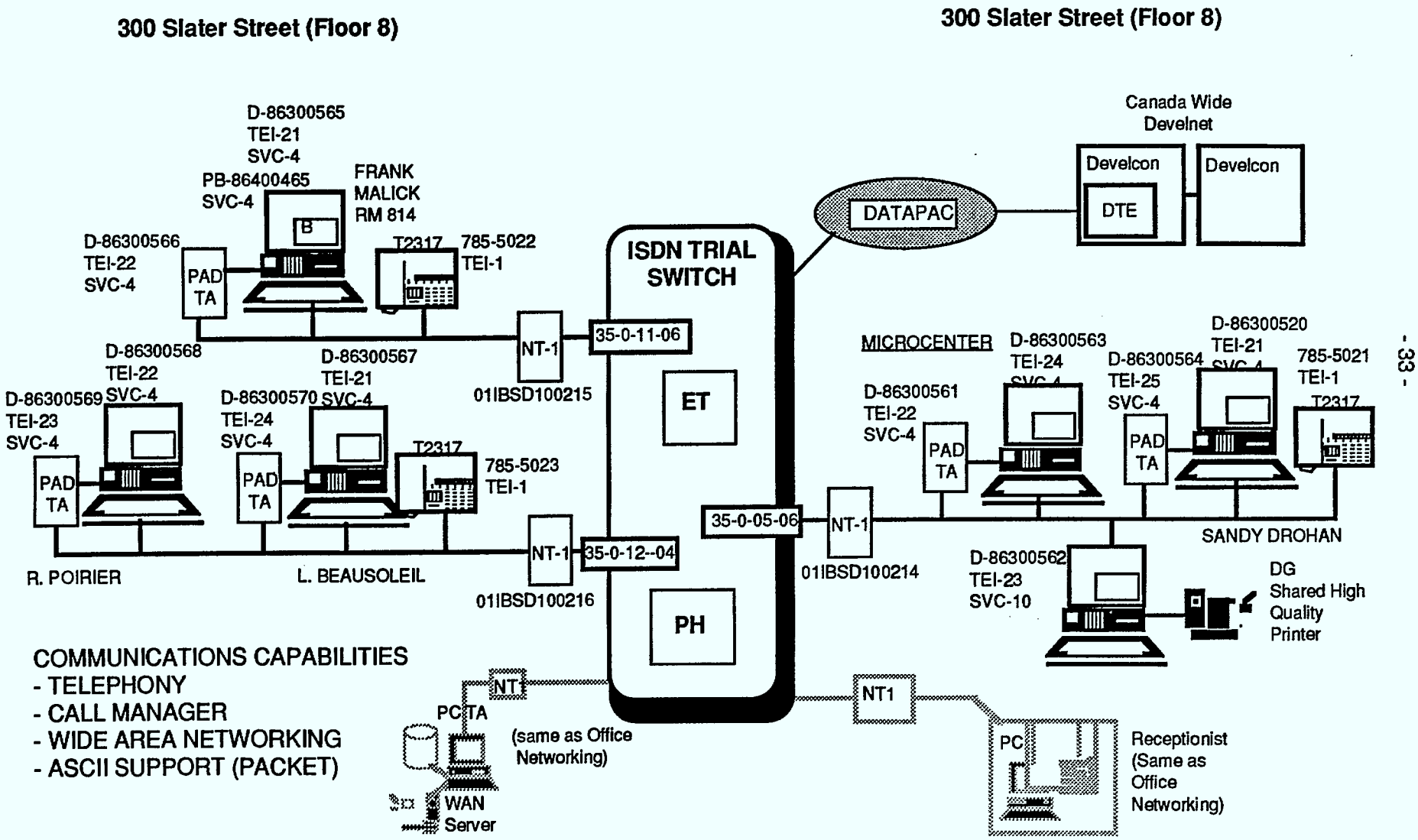


Figure 3.5.5.2

3.5.6 DOC GTA - Division of Development and Engineering (refer Figure 3.5.6.1 and Figure 3.5.6.2)

User Group Overview

Within GTA, one ISDN user group was the Division of Development and Engineering (DDE) located on the 7th floor at 300 Slater Street. In addition, the Director General, Government Telecommunications and his Secretary were provided with ISDN service.

The DDE group is responsible for planning and developing new common telecommunications services for the GOC user community. It also provided overall project management for the GOC participation in this Trial.

DDE also provided internal demonstrations to many GOC groups. Technical evaluation of ISDN was also a key responsibility of this group within the Trial. An analysis of D channel potential use is covered in Appendix B2. General assessment of the Trial against GOC objectives is carried out in Appendix B1.

Trial Configuration

The DDE Office System used ISDN to demonstrate easier access to both existing and new databases. They implemented a number of WAN applications (e.g., shared printing, bulletin board) and used PAD TAs for access to GEMS/Envoy 100. ISDN Telephony and Call Manager was used extensively within this group. A Group Teleconferencing System (GTCS) was also installed at GTA.

Most of the DDE staff were equipped with integrated work stations. The secretaries and two staff members were equipped with enhanced ISDN telephony.

A WAN server, an integrated work station, and the GTCS system were configured in the DDE lab.

Applications

The following applications were trialled:

- Enhanced ISDN Telephony
- Integrated Workstation
- Office Networking

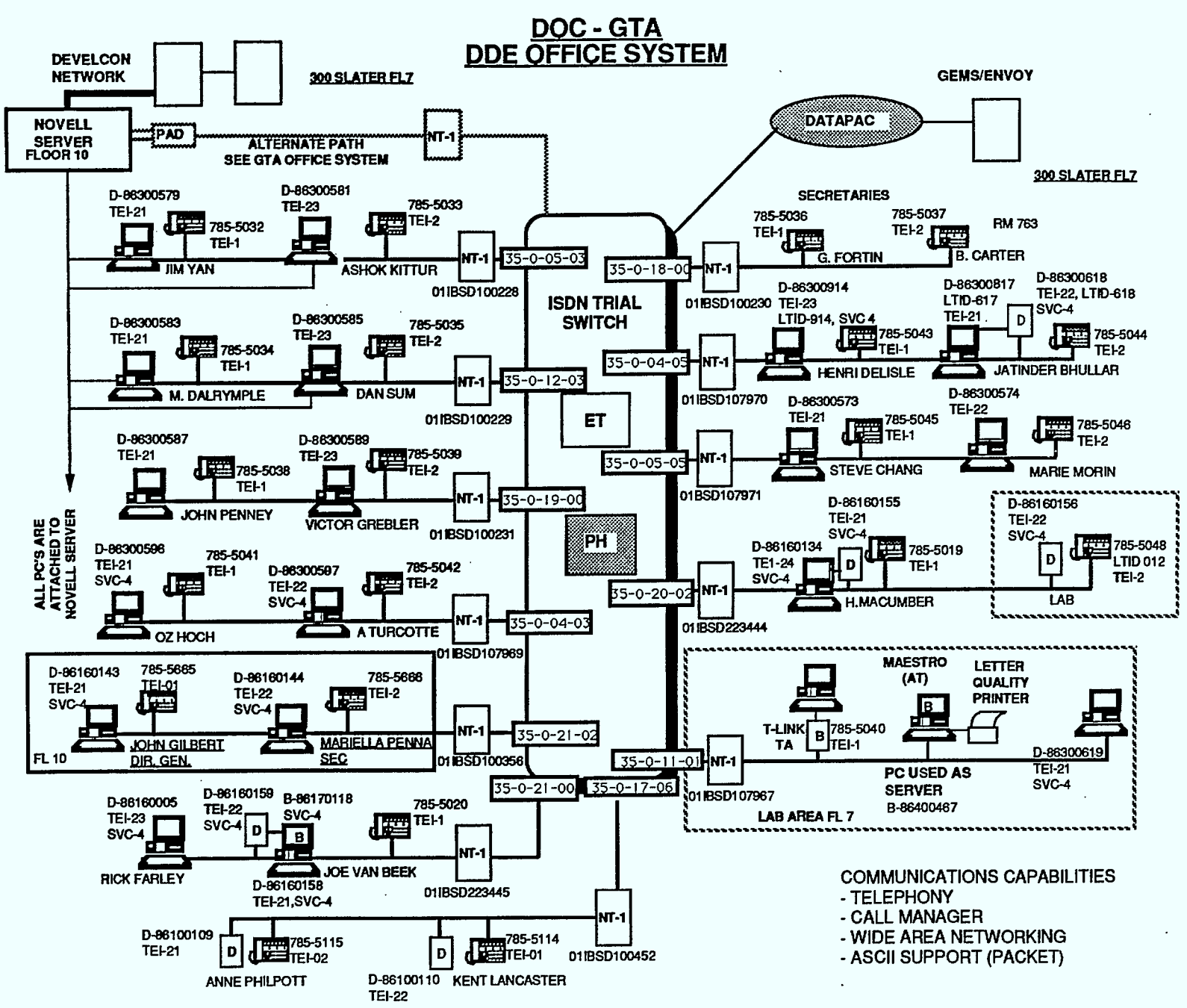

DOC - GTA
DDE OFFICE SYSTEM
DEVELCON NETWORK
300 SLATER FLZ
GEMS/ENVOY
DATAPAC
NOVELL SERVER FLOOR 10
PAD
ALTERNATE PATH
SEE GTA OFFICE SYSTEM
NT-1
300 SLATER FLZ
SECRETARIES
D-86300579 TEI-21
785-5032 TEI-1
JIM YAN
D-86300581 TEI-23
785-5033 TEI-2
ASHOK KITTUR
35-0-05-03
01IBSD100228
ISDN TRIAL SWITCH
35-0-18-00
01IBSD100230
785-5036 TEI-1
G. FORTIN
785-5037 TEI-2
RM 763
B. CARTER
D-86300583 TEI-21
785-5034 TEI-1
M. DALRYMPLE
D-86300585 TEI-23
785-5035 TEI-2
DAN SUM
35-0-12-03
01IBSD100229
ET
35-0-04-05
01IBSD107970
D-86300914 TEI-23 LTID-914, SVC 4
785-5043 TEI-1
HENRI DELISLE
D-86300817 LTID-617 TEI-21
D-86300618 TEI-22, LTID-618 SVC-4
785-5044 TEI-2
JATINDER BHULLAR
D-86300587 TEI-21
785-5038 TEI-1
JOHN PENNEY
D-86300589 TEI-23
785-5039 TEI-2
VICTOR GREBLER
35-0-19-00
01IBSD100231
PH
35-0-05-05
01IBSD107971
D-86300573 TEI-21
785-5045 TEI-1
STEVE CHANG
D-86300574 TEI-22
785-5046 TEI-2
MARIE MORIN
ALL PC'S ARE ATTACHED TO NOVELL SERVER
D-86300596 TEI-21 SVC-4
785-5041 TEI-1
OZ HOCH
D-86300597 TEI-22 SVC-4
785-5042 TEI-2
A TURCOTTE
35-0-04-03
01IBSD107969
D-86160155 TEI-21 SVC-4
D-86160134 TE1-24 SVC-4
785-5019 TEI-1
H.MACUMBER
35-0-20-02
01IBSD223444
D-86160156 TEI-22 SVC-4
785-5048 LTID 012 TEI-2
LAB
D-86160143 TEI-21 SVC-4
785-5665 TEI-01
JOHN GILBERT
DIR. GEN.
FL 10
D-86160144 TEI-22 SVC-4
785-5666 TEI-2
MARIELLA PENNA
SEC
35-0-21-02
01IBSD100356
MAESTRO (AT)
LETTER QUALITY PRINTER
T-LINK TA
785-5040 TEI-1
D-86300619 TEI-21 SVC-4
PC USED AS SERVER
B-86400467
35-0-11-01
01IBSD107967
LAB AREA FL 7
35-0-21-00
35-0-17-06
D-86160005 TEI-23 SVC-4
D-86160159 TEI-22 SVC-4
B-86170118 SVC-4
785-5020 TEI-1
RICK FARLEY
JOE VAN BEEK
D-86160158 TEI-21,SVC-4
01IBSD223445
D-86100109 TEI-21
785-5115 TEI-02
ANNE PHILPOTT
D-86100110 TEI-22
785-5114 TEI-01
KENT LANCASTER
01IBSD100452
COMMUNICATIONS CAPABILITIES
- TELEPHONY
- CALL MANAGER
- WIDE AREA NETWORKING
- ASCII SUPPORT (PACKET)

Figure 3.5.6.1

GROUP TELECONFERENCING SYSTEM

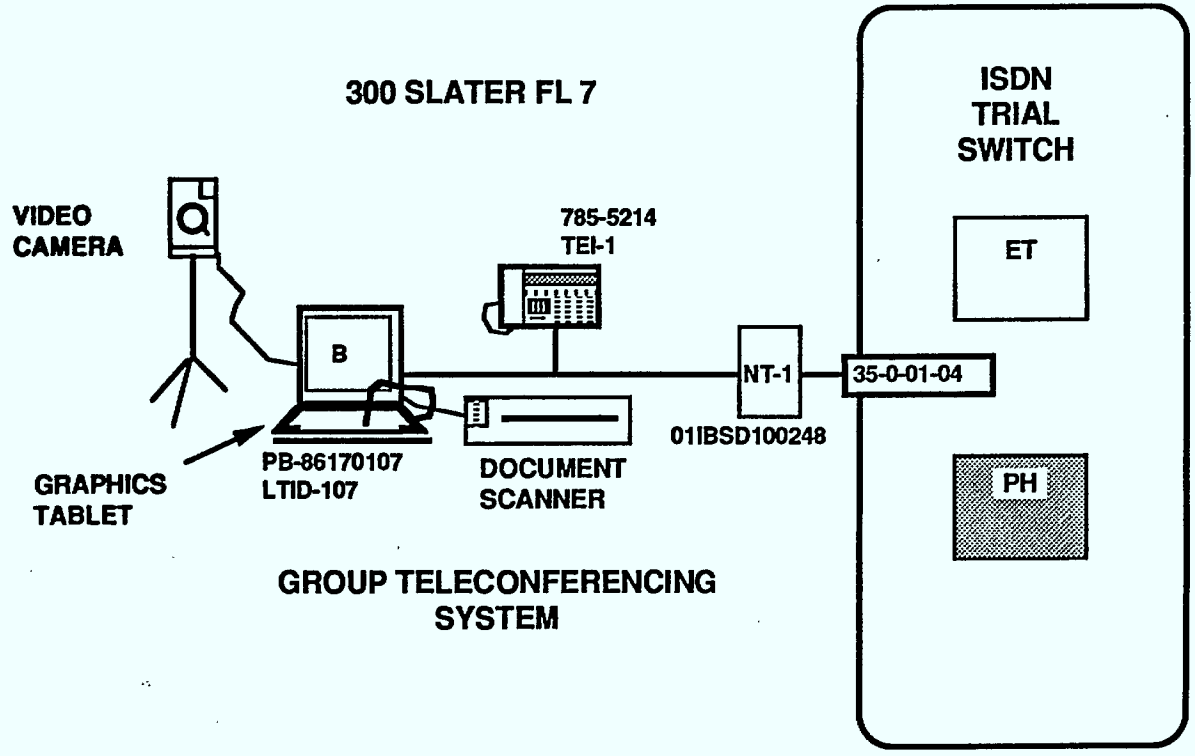


Figure 3.5.6.2

3.5.7 DOC GTA - Telecommunications Systems Management Division (refer Figure 3.5.7.1)

User Group Overview

The other GTA user group was in the Telecommunciations Systems Management Division (DST). The majority of users were with the Information Systems section (MOI). In addition, two unit chiefs with the Systems Planning and Development section (MSD) were provided with ISDN service.

The Information Systems section located on the 10th floor at 300 Slater Street is responsible for providing Electronic Data Processing and Office Automation services for the Agency. They manage three major EDP systems including the Circuit Inventory System, the Call Detail Processing system, and GTA's financial system. This group is also responsible for SMDR processing. See Appendix B5 for details on this aspect of ISDN. They also operate and maintain a Novell Local Area Network for GTA's internal use.

The Information Systems group used ISDN to provide 3270 Emulation access to an IBM Host located in Montreal via the Datapac Network. They also accessed Datapac based services (i.e., GEMS/Envoy 100) through PAD TAs on their Novell Server. The group had many of their PCs connected to the Novell LAN as well as ISDN. Telephony and Call Manager were also being used to enhance voice communications.

Trial Configuration

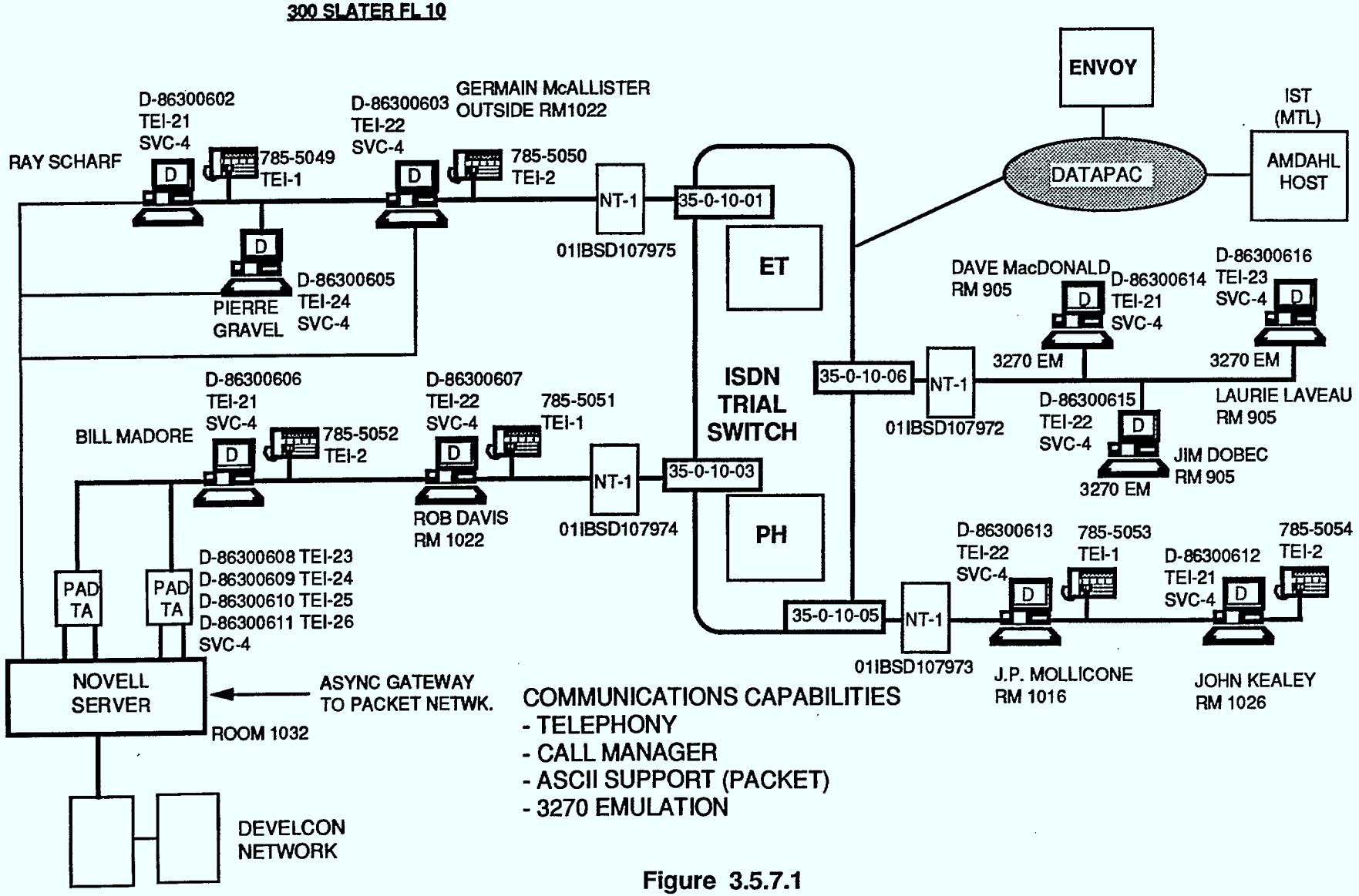
The Trial involved six integrated workstations, four standalone PCs and two PAD TAs attached to a NOVELL LAN for GEMS/Envoy 100 access.

Applications

The following applications were trialled:

- Enhanced ISDN Telephony
- Office Networking
- Integrated Workstation

DOC - GTA
DST INFORMATION SYSTEMS



COMMUNICATIONS CAPABILITIES
- TELEPHONY
- CALL MANAGER
- ASCII SUPPORT (PACKET)
- 3270 EMULATION

Figure 3.5.7.1

3.5.8 ISTC (refer Figure 3.5.8.1 and Figure 3.5.8.2)

User Group Overview

Two groups within Industry, Science and Technology Canada located on the 3rd floor at 235 Queen Street trialled the ISDN capabilities.

- Facilities Management Branch
- Information Management Branch

The Facilities Management Branch has a mandate to plan, design, select, and implement voice systems.

The Information Management Branch of ISTC is the Mainframe and PC Support subsection of Technical Support and Operations. The mandate of this branch is to support and help users with their PC-LAN, PC to mini, and PC to mainframe data processing needs and problems. They tested ISDN to provide remote LAN technical support and for mainframe to LAN file transfer via packet switched access and circuit switched access using a PCTA and T Link TA respectively. The Amdahl mainframe was equipped with a Datapac 3000 access at 9.6 kbps with a NPSI package and an asychronous 19.2 kbps Centrex III/EEWD circuit switched Data Unit to receive the data. See Appendix B3 for an analysis of this deployment.

Trial Configuration

Four integrated work stations were provided plus two non-integrated circuit switched arrangements were deployed. Two integrated workstations had associated Harris PAD TAs for Access to GEMS/Envoy 100.

Applications

The following applications were trialled:

- File Transfer
- Integrated Workstation

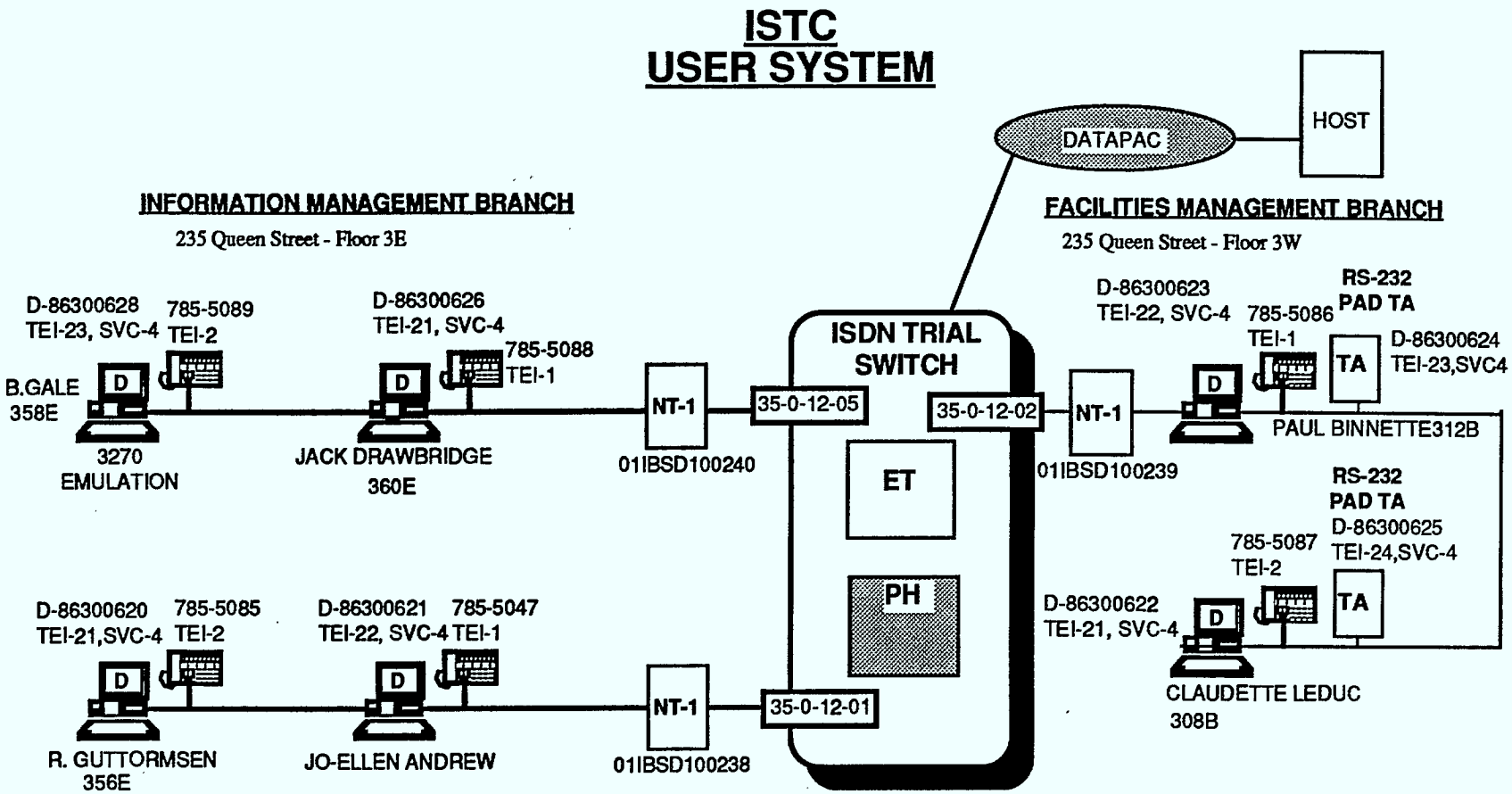
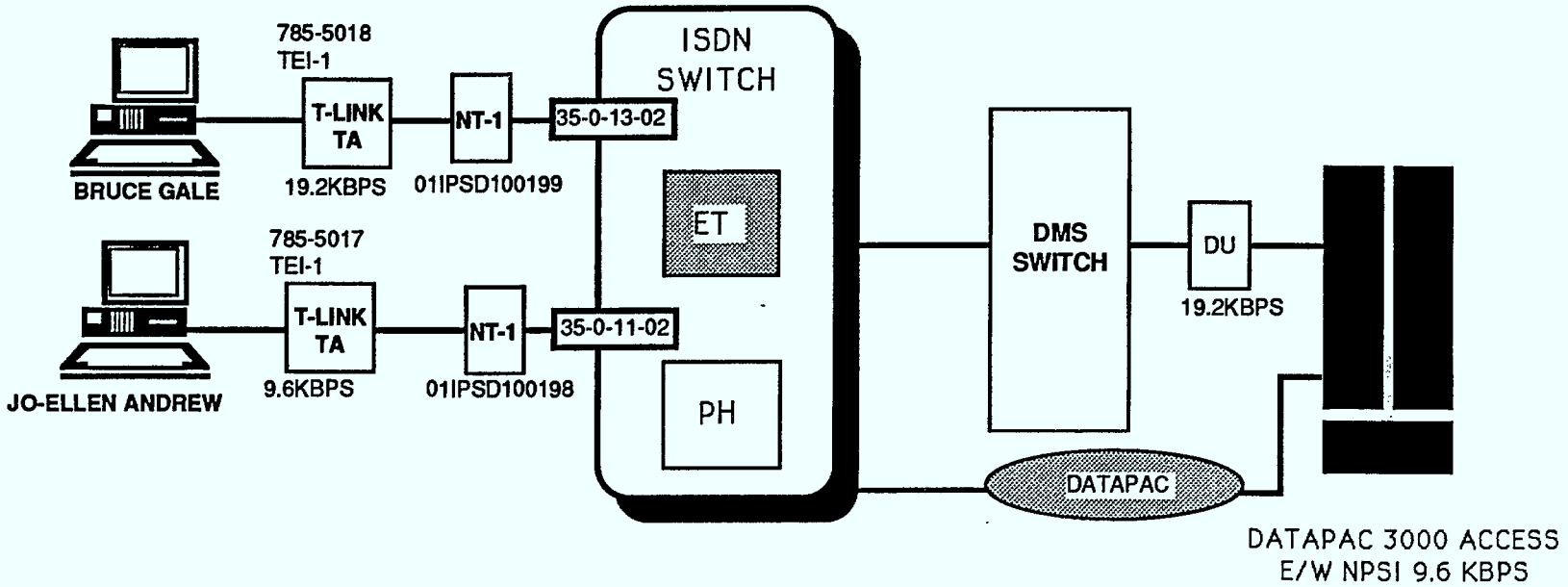

ISTC
USER SYSTEM
DATAPAC
HOST
INFORMATION MANAGEMENT BRANCH
235 Queen Street - Floor 3E
FACILITIES MANAGEMENT BRANCH
235 Queen Street - Floor 3W
D-86300628
TEI-23, SVC-4
785-5089
TEI-2
B.GALE
358E
3270
EMULATION
D-86300626
TEI-21, SVC-4
785-5088
TEI-1
JACK DRAWBRIDGE
360E
NT-1
01IBSD100240
35-0-12-05
ISDN TRIAL
SWITCH
ET
PH
35-0-12-02
NT-1
01IBSD100239
D-86300623
TEI-22, SVC-4
785-5086
TEI-1
RS-232
PAD TA
TA
D-86300624
TEI-23,SVC4
PAUL BINNETTE312B
RS-232
PAD TA
D-86300625
TEI-24,SVC-4
785-5087
TEI-2
TA
D-86300622
TEI-21, SVC-4
CLAUDETTE LEDUC
308B
D-86300620
TEI-21,SVC-4
785-5085
TEI-2
R. GUTTORMSEN
356E
D-86300621
TEI-22, SVC-4
785-5047
TEI-1
JO-ELLEN ANDREW
NT-1
01IBSD100238
35-0-12-01
COMMUNICATIONS CAPABILITIES
- TELEPHONY
- CALL MANAGER
- 3270 EMULATION - PACKET SWITCHED
- SHARED SCREEN
COMMUNICATIONS CAPABILITIES
- TELEPHONY
- ASCII SUPPORT (PACKET SWITCHED)
- CALL MANAGER

Figure 3.5.8.1

ISTC
HOST TO PC FILE TRANSFER



COMMUNICATION CAPABILITIES
- ASCII SUPPORT (CIRCUIT SWITCHED)

Figure 3.5.8.2

4. RESULTS

4.1 OVERALL APPLICATION-RELATED FINDINGS

Findings related to software capabilities include:

- The Northern Telecom PCTA was tested for compatibility with various IBM PCs, compatibles, and software. A list of the products tested is found in Appendix A-1.
- Of the software packages tested, only 4 were found to be incompatible with the Northern Telecom PCTA in some way. These were GEMdraw, BASIC, AESOP, and RAMLORD.
- Windows software worked well in the environment though it was not possible to properly position the data between the windows and Call Manager software.
- In general, the PC boot up procedure should load the ISDN software prior to any of the other memory-resident applications required.
- 640 Kbytes is insufficient RAM to load the ISDN base software, Call Manager, and large application programs such as Harvard Total Project Manager II, Harvard Graphics or WordPerfect 5.0. Suffice it to say that application software interworking with resident ISDN software will continue to be an issue for PC users to recognize (See Appendix B-2). The trial played an important role in identifying such interworking problems to manufacturers and future users.

Findings related to work station design include the following:

- The PC and the telephone must be close together if the Call Manager is to be at all useful. An obvious point but this was overlooked initially.
- PCs without hard disk drives are not well suited to use as ISDN workstations - unless they are connected to a LAN server from which they can download their ISDN software.
- The hands-free feature of the telephone is suitable for use primarily in a

closed-office environment. However, it could be used in other situations for hands-free dialing, waiting on hold, etc.

4.2 USER FEEDBACK

To achieve a reasonable level of confidence in the results, the GOC and Bell Canada In-House users provided feedback with emphasis placed on the GOC. The applications and respective distributions which were evaluated in the Ottawa trials include:

APPLICATION	% OF RESPONDENTS USING APPLICATION
– Telephony (Centrex III/EEWD based)	86%
– Call Manager	37%
– Wide Area Networking	23%
– Shared Screen	19%
– ASCII Support	51%
– 3270 Emulation	11%

– Deployment of one other Trial application, X.25 Networking, was cancelled when conformance testing for the Infotron TA, which was delivered near the end of the trial, determined that the manufacturer had implemented X.25 based on Modulo 128 rather than Modulo 8 frame numbering (which is required by the Datapac network).

Note: X.25 Networking was implemented successfully in early 1990 by Bell Canada on another ISDN trial using a TA from the same supplier (Infotron Canada Ltd.) with modified Data Terminal Equipment.

The comments include user feedback from questionnaires and interviews with managers from each of the participating government departments which were conducted in 1988 and 1989. The responses relate to Strengths and Weaknesses, which address ease of use and preference(s) over conventional service and equipment.

The overall results may be summarized as follows:

- Most of the respondents were pleased to have been selected to participate in the Ottawa BRA Trial and expected to derive future benefits from using ISDN.
- Telephony, Call Manager, Wide Area Networking, 3270 Emulation and ASCII Support were valued, whereas, Shared Screen was considered unreliable. Nevertheless, the ISDN technology was recognized as a means to bring integrated voice and data to market in the near future. (The comments on Shared Screen relate to the specific (prototype) software used and not to the concept.)
- Trial users consistently indicated the need for a "desk top" solution which would integrate the telephone and the PC and take advantage of CLID.
- Users' concern for a simplified wiring solution was of less concern than other issues. However, wiring issues are of significant importance and urgency to the operations groups within GTA.
- Over half of the users stated a willingness to develop their own applications if application development tools were available.
- Trial users expressed satisfaction with the level of support received during the trial.

Overall, the ISDN trial has been considered as a good learning experience, but ISDN technology when commercially available will be competing with a wide range of alternative technologies on the data side.

4.2.1 STRENGTHS AND WEAKNESSES

4.2.1.1 ISDN TELEPHONY

The T2317 was a popular set with almost all of the trial participants using it. Users reported that they would like to keep their T2317 and would recommend it to others.

In terms of what users liked most about ISDN Telephony, the single most popular capability was Hands-Free, followed by programmable Hard Keys, Soft Keys, Calling Number Display (wide 2 line display), and a host of specific Centrex III/EEWD and T2317 stand-alone features.

One problem area, garbled voice, stood out throughout the course of the trial. This was an intermittent problem on some lines. Users whose lines were affected could not be understood by the other party. It was found that service could be restored to normal by powering the telephone off and then powering it on again (See Appendix A-2 for additional details on this problem).

Improvements suggested by the users most typically focussed on the poor readability (i.e., restricted useful viewing angle) of the display. Others included:

- Better hands-free
- Better handset (lightness, shape, balance)
- Retain/Restore time display on power failure
- Ring Again outside of ISDN
- Smaller set size

In terms of preference over existing equipment, most users indicated that they would prefer to keep their ISDN T2317 telephone rather than go back to using their previous phone. In most cases, the ISDN T2317 replaced either a Unity set, a 2500 set, or an Electronic Business Set (EBS). Furthermore, it was indicated that the T2317 was preferred over the EBS.

4.2.1.2 CALL MANAGER

Initially, the Call Manager was a popular application but its popularity dropped as the trial progressed. Some of the comments received from users provide a hint to the rationale.

- With some applications introduced toward the middle of the trial, it was no longer possible to keep Call Manager up-and-running at the same time, either because of insufficient memory (e.g., WordPerfect 5.0) or PCTA incompatibility with LAN interface boards.
- Other applications have some of the same functionality (e.g., SideKick, Metro) and require less memory.
- Promised enhancements to the PCTA failed to materialize.

Nevertheless, the Call Manger was considered a viable application. The Directory capability was the unanimous favorite when coupled with the interface to the T2317 and the Call Log.

In terms of improvements, it was noted that the Call Manager would be more useful if it contained Larger Special Directories, the ability to quickly unload and load into memory, integrated voice/data call management, interworking (e.g., with "hooks" to existing databases, applications, etc.) and finally, improved reliability (e.g., eliminating the "link to phone down" problem).

The Call Manager was regarded as easy to learn and use. Experience gained with the Call Manager influenced the user's recognition of the integrated Voice/Data potential.

4.2.1.3 WIDE AREA NETWORKING

The three main uses of Wide Area Networking were for server access, file exchange, and printing.

In terms of overall popularity, Wide Area Networking ranked third.

Users liked the networking functionality of WAN. The idea of having a shared or "virtual" disk drive appealed to the Trial user. The WAN features which were therefore appreciated include:

- Easy access to centralized printers
- File transfer
- File sharing
- Sharing print facilities

An improvement was discovered to increase the speed of printing operations. It was found that if one were to print a document using Wordperfect, that by writing a document to a file in Wordperfect and then using "Copy" in DOS to send that file to a print server could improve throughput by a factor of 2.

The current version of WAN seems to be fairly well suited to word-processing, spreadsheet, and E-Mail applications. In general, the WAN works well in applications where the interaction between the WAN File Server and the WAN (PC) Terminal is limited (see Appendix B-2).

4.2.1.4 SHARED SCREEN

Shared Screen was the least popular of the applications trialled. Uses included a help desk, joint document review, spread sheet discussion, and graphics.

However, it was recognized by the users that the application had potential value for the sharing of information in the real-time, especially in a problem solving mode.

Suggested recommendations from the users included the need for increased reliability, better training of users, ability to share graphics, and a better user interface.

4.2.1.5 ASCII SUPPORT (Packet & Circuit)

ASCII Support from either a PAD TA or a T Link TA received the highest rating given to all of the applications. The positive features include:

- Reliability, Dependability
- Speed and ease of access to GEMS/Envoy 100
- Ease of use

Some of the frequently mentioned improvements included:

- Greater speed
- T-Link needs an interface to more devices
- Better error messages
- Integrate into the phone
- Better end-user training

4.2.1.6 3270 EMULATION

This was the least widely deployed application within the trial but worked very well once installed. The 3270 applications established terminal to host communications via the PCTA and T Link TA. Access to an IBM host was used almost daily without disruption.

4.3 STATION MESSAGE DETAIL RECORDING

Station Message Detail Recording (SMDR) provides details of the long distance and special services calls initiated from all Centrex III/EEWD stations including ISDN provisioned locals. The usage detail is recorded and collected on disk at the DMS 100 Central Office from which the Bell Canada Data Centre produces a magnetic tape each month for customers such as GTA who subscribe to the service. Therefore, it was essential that the ISDN technology should not impose any restrictions/compromises to the GTA billing routines associated with SMDR.

The Information Systems section in GTA received SMDR tapes for the ISDN trial usage from May 1989 until the end of the Trial in November 1989 inclusive. Their analysis verified that the tapes were in standard Centrex III/EEWD format and could be processed for internal billing using established GOC computer programs and procedures.

5. OVERALL ASSESSMENTS

5.1 BELL CANADA CONCLUSIONS & RECOMMENDATIONS

5.1.1 DESIGN

As a result of experience gained in the trial:

- A standardized T-bus configuration and design has been adopted which will eliminate the requirement to specially design and/or engineer each individual 2B + D ISDN installation.
- Terminating the D Channel at the desktop with a full X.25 16 kbps capability was determined to be uneconomical and in most cases the full 16 kbps capability was not required.

Northern Telecom will be designing and providing a throttling mechanism which will restrict the effective throughput of a specific address on the D channel to one of three speeds (2.4, 4.8, 9.6 kbps).

- The prototype NT1 (Network Terminator) and T2317 ISDN telephone will be redesigned for commercial service. The NT1 used on the trial will be improved to permit a more flexible deployment of the T-bus and permit improved testing capabilities. A new integrated Centrex III/EEWD ISDN telephone will be standardized for service to provide telephony, circuit switched data and packet switched data access capabilities.

5.1.2 ADMINISTRATION

- Ordering ISDN BRA service will require more efficient and cost effective procedures with reduced provisioning intervals. The Centrex III/EEWD order flow will be enhanced to meet these demands and will at the same time provide input to the trouble handling system database for the voice and data access privileges.

- Application type troubles were extremely difficult to resolve during the Trial. Bell Canada provided applications support during the Trial. The resolution of the variety of applications and application troubles would be costly to provide and universally standardize. Bell Canada will not distribute or support unique applications for ISDN.

5.1.3 TRIALS

As a result of the User Surveys, it was determined that the following must be considered when conducting future trials:

- User Selection. The individuals involved must be committed to actively participate in the trial and be prepared to contribute to evaluation needs.
- Stable Environment. User expertise with office PCs and related systems should be in place prior to user selection.
- User expectations. Trial deliverables and expectations must be clearly communicated and accepted by all levels of the organizations participating in the trial.

5.2 GOC ASSESSMENT

Most applications were sufficiently used by the trial participants. An exception being the shared screen service which was considered a good concept but the implementation was not sufficiently reliable for general use. It is noted that the suite of applications offered in the trial was in line with what the users needed to perform their jobs. Of particular note and usefulness were enhanced telephony, wide area networking in support of remote processing and file transfers, and text messaging using the PAD-TAs over the D-channel. The B-channel circuit switched data application was not widely deployed. It however was considered potentially very useful by the heavy remote processing users.

Various technical evaluations were also carried out by GTA. These were mainly directed at data transmission performance assessment and the synergistic co-existence of ISDN applications with other PC applications. It was

determined that the WAN application throughput suffered from excessive data integrity overheads built into the particular implementation deployed in this trial. This being the MS-Net WAN platform provided under license from Microsoft by Northern Telecom . In spite of this, it was concluded that some applications could still be provided at a suitable level of responsiveness. These being local shared text printing, bulletin board type uses, and small size file transfers (less than 50 KB). It was categorically determined that users with exposure to high speed LAN type connectivity would find the ISDN WAN too slow for use in large application program scenarios like Harvard Graphics, Wordperfect and other similar size applications and input/output scenarios. However, ISDN appears to be well suited for occasional access to LANs/WANs. The memory residency needs of the PCTA was unacceptable for efficient use of the PCs with 640 KB memory configurations.

The trial was particularly valuable to GTA. Being a common service agency for the GOC, the successful introduction of common telecommunications services depends to a large extent upon the attention paid to the operation, administration and maintenance aspects of services. This aspect of ISDN was of key importance and would pay dividends to the GOC as GTA plans, selects service capabilities and introduces ISDN into the GOC.

During the ISDN trial, the following network interworking scenarios were successfully established with reference to the ISDN user abilities to effect connectivity and communicate with people or systems in these networks.

- EEWD telephony
- PSTN telephony for local, national and international calls
- Messaging via the D-Channel
  - From user PAD-TA to GEMS/Envoy 100 and Datapac
  - From LAN PAD-TA to GEMS/Envoy on a shared basis
- Mainframe access

- PCTA with 3270 Emulation via the D-channel
- T-link TA via the circuit switched digital public network capability

Some areas where improvements were desirable include a larger array of applications and involvement of a larger group of vendors. This should be considered in any future activities in this area.

The evolution of ISDN applications would be limited if restricted to MS/DOS. Other forms of multi-tasking (e.g., on MAC II) or Unix or OS/2 will be important in exploiting the ISDN technology for the integrated Voice/Data strengths.

This trial was of particular value in the Canadian context. The trial provided a major telecommunications service provider (Bell Canada) with the opportunity to fine tune for the service development and introduction at a level competitive in the world. The trial allowed a major Canadian telecommunications company (Northern Telecom) to test their technology for global exploitation. Other vendors like Apple Canada, IDACOM Canada, Harris Corporation, etc., were given the opportunity to work and learn from the trial capabilities.

The trial excelled in allowing real user interactions with the service providers, researchers, equipment vendors and GTA. Valuable feedback and experiences were shared amongst this community. This experience should lead to ISDN being introduced in Canada in a manner which better meets the telecommunications needs of the future.

APPENDIX A: BELL CANADA ANALYSIS

APPENDIX A-1

COMPATIBLE PCs AND SOFTWARE

The following equipment and software was tested for compatibility with trial applications employing the Northern Telecom PCTA.

COMPATIBLE PCs

IBM PC

IBM XT

IBM AT

Northern Telecom M6000

Compaq Deskpro

Ericson XT

Olivetti M24

Lanpar XT

DEC Vaxmate

HP Vectra

Xerox 6065

AES

Titan

AES 286 (running at 6 Mhz)

Arvita SM 286 (running at 6 Mhz)

Comterm C2

Epson Equity 1+

Epson Equity 11+

Epson Equity 111+

Compaq 286 Deskpro

Zenith 151

Zenith 152

Maestro XT

Apricot XENi, XENi 45, VX 386 (in compatible mode)

COMPATIBLE SOFTWARE

Oracle

Lotus 1-2-3 (Note 5)

Dbase II

Dbase III

Framework (non-communication)

Wordstar

Multiplan

MS-Word

ZIM

PC-Write

Harvard Total Project Manager II (Note 7)

MS-Paintbrush

Sidekick (Note 1)

Superkey (Note 4)

WordPerfect

Multimate (Note 3, 6)

Fixed Disk Organizer

Sideways

X-Tree

Metro (Note 2)

Typing Tutor II

GW-BASIC

PC-Talk

Mirror (Note 8)

Crosstalk

ProComm

BASICA

Compaq Basic

Apricot LAN-Link Gateway

Notes:

1) Sidekick must be the last memory resident program loaded as specified in its manual.

2) Metro must be loaded before the ISDN software. When one of the Metro pop-up screens is present the Call Manager software cannot be invoked from the keyboard, only from the Call Manager key on the T2317 phone.

3) Multimate 3.3 with a creation date for WP.EXE of 10-24-84 is not supported. Multimate version 3.3 with a creation date for WP.EXE of 12-20-84 is supported.

4) The Superkey program and its macros must be loaded after the ISDN software. To invoke the Call Manager the first time after loading Superkey one must use the 3 control keys and hit return.

5) If printing over the WAN with LOTUS 1-2-3 select the default printer to be DOS device LPT1. To do this, input the following command /Worksheet Global Default Printer Interface 5.

6) Multimate will not work with Mu-Share.

7) The Harvard Total Project Manager II (HTPM II) program will not run with the Call Manager due to memory constraints unless the HTPM II program is loaded as HTPM 99 instead HTPM.

8) The Mirror program (memory resident) must be loaded after the ISDN software.

9) Printing over the Wide Area Network via a user interface program (e.g., Fixed Disk Organizer) still requires a CTRL-ALT-* to close the spool file unless the user interface program is also exitted and control given back to DOS.

NON-COMPATIBLE SOFTWARE

Gem

BASIC

AESOP

RAMLORD

Note: The users found problems operating GTCS with software release 24G or higher. Problems were also encountered in operating Banyan LAN with Ethernet implementation. Shared screen locked up PCs many times.

APPENDIX A-2

SUMMARY OF BNR CONCLUSIONS

The following conclusions are those expressed by Bell Northern Research and are based on the feedback obtained from users in the technology trial.

CONCLUSIONS

It is to the credit of Bell Canada and the Government of Canada that such a diverse set of user groups participated in the BRA ISDN technology trial. We know of no other single ISDN trial in North America that has encompassed such a wide range of applications and vendor technologies. While some problems are inevitable in any technology trial, the users welcomed the opportunity to express their views, and, in many cases, saw various improvements implemented in the operation and performance of their equipment as the Trial progressed.

The comprehensive nature of the technology trial evaluation programme also permitted some conclusions that may prove useful in future trials. Some of the prominent ones are as follows:

- User Selection - Although considerable attention was paid to identifying user groups which would benefit from using the ISDN technology, it would appear that little was done to ensure that the individuals involved were (a) willing to participate, (b) in a position where they could personally benefit from ISDN use, and (c) willing to contribute detailed feedback to the evaluation team. In many cases lack of need or user reluctance meant that the installed equipment was not used.

- Stable Environment - Several user groups' PCs and LANs were just being introduced as the technology trial began. This meant a steep learning curve for less sophisticated users and the danger of confusing ISDN problems with those more properly associated with other facilities which were being used. Some of the ISDN applications in the trial may not have received as much credit as they deserved since alternate technologies were also being introduced which often displaced ISDN.

- Expectations - It is very important to manage user expectations. For example, DND expected WAN performance to be as acceptable as LAN performance to the end users. Obviously, it was not, and some DND users clearly felt that they were misled. An up-front approach must be taken with all participants in a trial including the end users.

DESIGN ENHANCEMENTS

1. T2317

The phone needs a better display. None of the users interviewed felt that it was acceptable as is, although many commented that the concept of a display as part of the user interface was clearly preferable to a set without a display.

The "garbled voice" problem must be resolved. A related but frequently discussed problem is uneven volumes between the calling or called party and the person placing or answering a call. (This was remedied by replacing the set.)

The handset was considered to be unbalanced and the headset jack was in a very awkward position on the base of the phone.

2. PCTA

Generally it was felt that ISDN and Call Manager software took up too much memory on a standard 640K PC if any other application was to be run (e.g., there is insufficient memory left for Harvard Total Manager II or WordPerfect Version 5).

It is quite evident that it is impractical to use a PC without an associated hard disk (unless the machine is connected to a file server via a LAN and ISDN software is booted via an Autoexec).

a. Call Manager

The most frequent suggestions for Call Manager enhancements include:

- Larger directories.
- Links from CLID and numbers called from the screen or T2317 to records in an associated database.
- Better interworking with other memory-resident applications.
- Reduced PC memory requirements.
- Improved reliability and speed (boot time and file loading time).

b. Shared Screen

The two fundamental problems identified were:

- The software is unreliable.
- Users have been unable to generate applications for Shared-Screen which would produce tangible benefits (within the geographical constraints of the trial).

c. WAN

The biggest problem identified was that it is too slow to suit most current applications. Many users expected LAN-like performance and failed to receive it.

The equipment assigned to applications which are not likely to prove viable (e.g., DMAS's word processing tracking application) could probably be put to better use in other areas.

PERCEIVED VALUE

The voice based applications - T2317 and call Manager - were highly valued. Two implications may be drawn:

- The phone and Call Manager should be used to lever future acceptance of the ISDN Integrated Voice/Data strengths.
- The data services require much more attention.

APPENDIX A-3

ISDN TRIAL TROUBLE ANALYSIS SUMMARY

The information compiled in this report is for the Ottawa BRA technology trials. The report is a composite of the GOC and Bell Canada In-House trial results and analysis.

ISDN TROUBLE ANALYSIS

Circuit

Year	Month	Base	Reports	Report Rate %
1987	Nov	206	43	20.9
	Dec	242	30	12.4
1988	Jan	223	36	16.0
	Feb	223	46	14.0
	Mar	268	61	22.8
	Apr	287	56	19.5
	May	294	37	12.6
	June	316	41	13.0
	July	333	27	8.1
	Aug	333	24	7.2
	Sept	338	11	3.3
	Oct	352	3	0.9
	Nov	373	29	7.7
	Dec	380	43	10.0
1989	Jan	380	43	11.3
	Feb	380	25	6.3
	Mar	392	35	8.4
	Apr	396	47	9.3
	May	398	21	4.5
	June	453	60	11.5
	July	453	33	6.4
	Aug	478	40	8.5
	Sept	493	13	2.4
	Oct	492	22	4.3

Note: – Circuit Base includes the Basic Rate Access "U" Loop and assigned "T" Bus access privileges.

– Report Rate % is the reports per 100 circuits.

ISDN TROUBLE SUMMARY COMMENTS

1. The high report rate appears to be caused by three major problems which are garbled voice transmission, Call Manager link to phone dropping and other troubles which were cleared when diagnostic tests were run on the loop.

   The garbled transmission problem has been identified as a trouble with the firmware in the prototype T2317 ISDN telephones which will be rectified with the next generation of ISDN phones.

   The Call Manager link to phone problem has been isolated by NTL and a prom change in the T2317 was recommended.

   Many of the troubles cleared by diagnostics have resulted in a high repeat report rate. This problem has been identified as a T Chip in the NT1 which will be rectified in the later version of NT1s.

2. The average report rate has dropped from an average high of 16.6% in 1987 to an average low of 5.8% in the last year of the technology trial. This can be attributed to:

   a) User familiarization with the ISDN equipment and applications.

   b) Stability of the prototype ISDN equipment on the loop.

   c) Technology enhancements in the DMS 100 switch and the Packet Handler.

   d) Increased knowledge by all groups involved in the trial to self rectify repeat problems with known user correction procedures.

APPENDIX A-4

CUSTOMER TRAINING

User-Coordinator training was particularly important. Without on-premise User Co-ordinators who understood the ISDN applications and how to use them, the end-users would not have been as well served. The User Coordinators provided Bell with a window on the users, a focal point of contact, and helped to keep end-users using their ISDN solution rather than reverting to their backup mode due to temporary frustration or lack of motivation to learn a new way of doing things. However, the User-Co-ordinator role did not eliminate the need for direct contact with the end-users.

User Coordinator Training was conducted using a full day consisting of two half day sessions. The morning session focussed on the Telephony side (Phone, features, Call Manager, dialing plan), while the afternoon session concentrated on the data networking elements (Wide Area Networking, Shared Screen).

Training played a very critical role in preparing the end-users for the Trial. The training given to customer trial end-users was beneficial and allowed the end-user to overcome the technology barrier and move quickly to apply the technology for day-to-day business affairs.

End-User training was conducted (usually one on one) at the end-user's work station. In general, training began with the dialing plan, how to call forward to the ISDN set (and revert to the normal phone if required). The features installed were reviewed as well as the use of each one of them on the T2317 or EBS provided. Users were also instructed how to update autodial, volume, time, and ringing on the T2317. An opportunity was provided for the end-user to practice these functions while the trainer was there. T2317 training usually took about one hour and sometimes up to one and a half hours. Call Manager training was usually conducted at the same time as the Telephony Training. Customer feedback on end-user training was generally favourable.

Users felt that the one-on-one training provided by Bell was the single most useful source of information on ISDN capabilities. The T2317 User Guide was the second most useful reference. Other Users were the third most popular source.

End-user feedback stressed the need for timely training and more attention to the Wide Area Networking and Shared Screen applications which were often covered in less depth (and sometimes not at all). On a more positive note, end-users were pleased with the one-on-one hands-on approach at the user's desk which was generally used to deliver training.

While documentation provided with training was generally received positively, users stressed the need for reference material to be designed for quick reference rather than for reading from cover to cover. Therefore a good index and Table of Contents with short concise descriptions of how to use features and capabilities should be mandatory for future documentation along with quick reference summaries such as the one provided with the Call Manager. Some users noted that documentation was not necessarily complete (e.g., online Help Screens) and that it should be less technical and confusing. Feedback also confirmed findings from other NTL-based trials that there is no substantial need for the PCTA User Guide. Finally, some users pointed out the need for better documentation for (generic) applications of ISDN capabilities.

APPENDIX A-5

"U" LOOP ASSIGNMENT DISTRIBUTION

Application	ISDN "U" Loops	ISDN "T" Bus Assignments
DND		
DCSEM - Integrated Workstn.	2	6
DCSEM - DPS Proj. Mgmnt.	5	16
DMAS4 - WProc., Tracking	8	15
SCPO - LAN/WAN Access	2	6
DOC		
DGIM - Office Networking	7	26
DGIM - Admin. Support	3	15
GTA - Office System	12	46
SCPO - Information System	4	20
GTA - GTCS System	1	2
Teleforum '89*		
ISTC		
Host File Transfer	2	2
User Systems	3	14
	49	168

* Two (2) ISDN "U" Loops with six (6) ISDN "T" Bus assignments were provisioned for the annual Government Study Session, **Teleforum** '89, which was held at the Government Conference Centre, 2 Rideau St. on June 12 & 13, 1989 (see Appendix A-6).

APPENDIX A-6

TELEFORUM '89

Teleforum '89 was the Government of Canada annual telecommunications study session which was sponsored by the Telecommunications Advisory Committee. Approximately 200 Government personnel attended the two day programme (12 & 13 June 1989) which was represented by the theme "Making Connections" with the fundamental objective of getting together to encourage communication and make contacts. The keynote address was delivered by the Chairman of the Advisory Committee on ISDN, Mr. John Lawrence. The session was highlighted by a panel discussion on Competition between Frank Degenstein, President of Telecom Canada and George Harvey, President of CNCP Telecommunications.

Demonstrations were provided by suppliers/vendors throughout the sessions to illustrate state-of-the-art technology at work within the GOC.

The Bell Canada and Federal Government ISDN Technology Trial was represented. Two ISDN access line facilities were provisioned to demonstrate the Group teleconferencing System (GTCS) application plus Enhanced Telephony, Data Access to Wide Area Networking and Data Access to GEMS/Envoy 100. IIS Technologies arranged the provisioning and staffing of the GTCS demo while the office applications were demonstrated by GTA personnel using GOC PCs with Bell Canada PCTAs, T2317s and PAD TAs. Bell Canada ISDN representation was present throughout the conference to answer Service and Technical questions as well as to provide the co-ordination of any OA&M issues.

APPENDIX B: GTA BACKGROUND ANALYSIS

APPENDIX B-1

ASSESSMENT OF THE TRIAL AGAINST GOC OBJECTIVES

1. INTRODUCTION

The key GOC objectives are reiterated below,

To evaluate the features and performance of the ISDN service

To explore opportunities to use the expanded range of capabilities provided by ISDN through

- the introduction of enhancements to existing user applications
- the implementation of new user applications which have previously not been feasible due to the limitations of the existing telecommunication technology and services

To gain insight into the operational and administrative impacts of the introduction of ISDN

To evaluate the interworking of ISDN with existing public and private telecommunications networks and services

To gain insight into the economic aspects of ISDN

To support the Canadian telecommunications industry by providing a testbed for the development of applications for this new technology

The approach in the assessments in section 2 is to provide a summarized perspective on the global achievement of an objective. The details on many of the underlying aspects are captured in the main report, other appendices to this report, and additionally the Phase I Completion Report which was issued in July 1989.

2. ASSESSMENTS

2.1 Evaluate Features and Performance

The ISDN applications available in the trial were evaluated for the following two aspects as appropriate,

Suitability of the application user interface and the usefulness of the application

Technical performance evaluation of the constituent elements of the application

Most applications were sufficiently used by the trial participants. An exception being the shared screen service which was considered a good concept but not a reliable implementation for general use. Detailed assessments on the human factors aspects of the applications was carried out by Bell Northern Research. The results are captured in Appendix A. It is noted that the suite of applications offered in the trial was in line with what the users needed to perform their jobs. Of particular note and usefulness were enhanced telephony, wide area networking in support of remote processing and file transfers, and text messaging using the PAD-TAs over the D-channel. The B-channel circuit switched data application was not widely deployed. It however was considered potentially very useful by the heavy remote processing users if the reliability of the service could be improved.

Various technical evaluations were also carried out by GTA. These were mainly directed at data transmission performance assessment and the synergistic co-existence of ISDN applications with other PC applications. It was determined that the WAN application throughput suffered from excessive data integrity overheads built into the particular implementation deployed in this trial; this being the MS-Net WAN platform provided under license from Microsoft by Northern Telecom. In spite of this, it was concluded that some applications could still be provided at a suitable level of responsiveness; these being local shared text printing, bulletin board type uses, and small size file transfers (less than 50 KB). It was categorically determined that users with exposure to high speed LAN type connectivity would find the ISDN WAN too slow for use in large

application program scenarios like Harvard Graphics, WordPerfect and other similar size applications and input/output scenarios. The memory residency needs of most ISDN applications was unacceptable for efficient use of the PCs with 640 KB memory configurations.

2.2 ISDN Use to Enhance Existing and Support New Applications

ISDN applications were useful in enhancing user capabilities in the following areas,

Enhanced Telephony

Enhanced GEMS access

The enhanced telephony supported by the ISDN trial was multifaceted. It provided enhanced local features like calling log, customized ringing, context sensitive soft keys, and programmable feature keys. The coupling of the telephone with the user PC in a unified synergistic operation in support of call management functions was found to be very useful. The enhanced telephony allowed for more efficient and more responsive delivery of telephone services, an integral and important aspect of every job.

Enhanced GEMS access was impressive and very noticeable compared to the alternatives. Of the D-channel services, this was the most used. The PAD-TAs worked reliably and the service improved user responsiveness where now people would check their messages more frequently and respond expeditiously.

The support of new applications was linked in large part to the D-channel connectivity attributes. Customer access to the D-channel can be equated to the immediate delivery of a digital modem to the desk operating at almost 16 kbps. This compares favourably with the expensive state of the art 9.6 kbps modems justified only under special circumstances like facsimile machines, dedicated host links, etc. The D-channel was successfully exploited for mainframe and terminal interactions. It essentially took the distance element out of SNA networks and other implementations where any user could become part of such a network on a remote basis.

2.3 Insight into ISDN Operations and Administration

The trial was particularly valuable to GTA. Being a common service agency for the GOC, the successful introduction of common telecommunications services depends to a large extent upon the attention paid to the operation, administration and maintenance aspects of services. Some of the key areas where agency sensitivities and capabilities were enhanced vis-a-vis ISDN are,

Operations

Implications of ISDN circuit and equipment deployment

User training and support to keep voice and data capabilities operational

Powering considerations in introducing ISDN including various elements like NT1s, terminal adapters, locally powered telephones and other associated/integrated data equipment.

User support and service maintenance including handling software and hardware upgrades.

Service provider interfacing

Performance measurements and testing.

Administration

Determination of user needs

Intricacies of service ordering and service order processing.

Billing and service design impacts.

Organizational impacts

This aspect of ISDN was of key importance and will pay dividends to the GOC as GTA plans, selects service capabilities and introduces ISDN into the GOC.

2.4 ISDN Interworking with Other Networks

During the ISDN trial, the following network interworking scenarios were successfully established with reference to the ISDN user abilities to effect connectivity and communicate with people or systems in these networks,

- government local (EEWD) and intercity private networks
- PSTN telephony for local calls (for administrative reasons, national and international calling was prohibited)
- Messaging via the D-channel
  - From user PAD-TA to GEMDES and Datapac
  - From LAN PAD-TA to GEMDES on a shared basis
- Mainframe access
  - PC-TA with 3270 Emulation via the D-channel
  - T-link TA via the circuit switched digital public network capability

The above is a substantial group of scenarios. However some of the remaining untested important networks and services include the GPN, Dialcom, the GVMS enhanced SMDI based service, and non-SNA host systems.

2.5 Insights into ISDN Economics

This trial was a technology trial where many applications were introduced. Under such circumstances, financial and economic factors are difficult to promulgate or define. Based on Bell Canada's stated plans and a comparison with current trends in other countries we observe the following,

1B+1D(shared) would be an ideal deployment package if the D-channel packet data is suitably priced.

Commercial Powering of basic ISDN telephony is an issue. Users expect telephone service to be maintained during a power failure. Furthermore, power outlets at the desk are expensive to provision.

A basic WAN service for terminal-to-terminal applications which does not go into a packet switched network would be desirable if economically provided.

The above are at best first order of magnitude indicators based on the limited economies component associated with technology trials. Future market trials, field trials or service proposals could shed more light on the subject. Economic and business analyses could than be carried out.

2.6 Support Canadian Telecommunications Industry

This trial was of particular value in the Canadian context. The trial provided a major telecommunications service provider (Bell Canada) with the opportunity to fine tune for the service development and introduction at a level competitive in the world. The trial allowed a major Canadian telecommunications company (Northern Telecom) to test their technology for global exploitation. Other vendors like Apple Canada, IDACOM Canada, Harris Corporation, etc., were given the opportunity to work and learn from the trial capabilities. The trial was also used in Technical Marketing Operations (GOC) to showcase Canadian capabilities to many different country delegations. The trial was demonstrated to members of the Technical Advisory Committee on ISDN chaired by Mr. John Lawrence. This committee delivered a report on the policy and public aspects of ISDN introduction in Canada.

It can be stated that the trial was a significant value to Canadians in various enterprise situations.

3. THE BOTTOM LINE

The trial excelled in allowing real user interactions with the service providers, researchers, equipment vendors and GTA. Valuable feedback and experience were shared amongst this community. This experience should lead to the introduction of ISDN in Canada which better meets telecommunications needs into the future.

Some areas where improvements were desirable include a larger array of applications and involvement of a larger group of vendors. This should be considered in any future activities in this area.

APPENDIX B-2

PACKET DATA CHARGES IN ISDN TRIAL: ANALYSIS

1. INTRODUCTION

Data is a very important part of ISDN capabilities. In particular packet data communication could find large numbers of PC based applications. Like most other goods and services, the cost of the data services would have an impact on the success of these capabilities. The basic setup used in this exercise included WAN transfer of data. There were two servers present in the experiment. Namely, the Bell Canada server at 160 Elgin Street and the GOC server at 300 Slater Street.

Various data files were exchanged between the servers and the B-channel packet configured station. These statistics are noted in Table 1.

2. THE MEASUREMENTS AND THE CHARGING REGIME

All the circuits in the measurements were configured as B-channel packet data. The Directory Control program was used in the movement of data between the PC and either one of the servers at any given time. The connectivity had the following environment and treatment,

- each leg in a connection was classed a Datapac 3000 entity
- loop and access charges were not considered as these were not available for the ISDN service concept
- The throughput class subscribed to was class A. This carried a 20% premium over the 35 cent per kilopac local Datapac charge.
- There is one cent per call setup charge for regular call setups or resets
- the transmit and receive packets are aggregated and the charges calculated to the next higher cent
- calls are charged to the calling party

The measurements and the charges are captured in Table 1.

3. ANALYSIS AND RESULTS

3.1 Verification of Billing Records

The detailed usage statements received from Bell Canada were analyzed and the following was determined,

- There was a direct correspondence between a log of the packet data calls kept by Joe Van Beek (Joe made all the data calls) and the detailed usage statement.
- There was a four hour difference in the actual timing of the calls versus what the usage records showed. Bell determined that it was caused by incompatible assumptions made by different Bell groups. It related to making adjustments for GMT versus EST. The timing of calls is an issue for future action as well (see section 3.4).
- The billing formula was verified and found to be correctly applied. Each call was individually billed and the results rounded off to the next full cent. This way the fifteen calls were charged 75 cents. If there was non rounding-off, the charges would have been approximately 72 cents or 4% lower. This is not very significant in our test case but can add up in a large scale deployment and usage scenario.

3.2 Use of WAN versus LAN: An Analysis

An investigation was carried out to assess various user activity levels and the associated costs. The objective was to assess how much typical applications supported on our LAN would cost for transmission if carried over the ISDN WAN. We realize that there could be other significant differences as well. For example the difference in transmission speed of kb/s for the WAN versus Mb/s for the LAN. The results are tabulated in Table 3. We have made the following assumptions in these calculations,

- The impact of call setup/reset charges of one cent per event are ignored. This results in slightly lower charges versus the actual.

- The total data throughput is assumed to be just one call which would also result in slightly lower charges versus the actual where many calls would have been made and charges calculated on individual calls and each call rounded to the next cent.
- The results from Table 2 were used to convert the data transferred in kB to the approximate number of billable packets.
- The throughput class was assumed to be A resulting in 20% surcharge over the 35 cents per kilopac charge; the service type was assumed to be ST=1 which is Datapac 3000 connections with a local transport charge of 35 cents per kilopac.
- The charges are for transmission only, any other charges like subscription or detailed usage statements are not accounted for and if applicable in the future would add to the total costs.
- We assume there to be 20 business days/month for monthly charges calculation.

Based on our results in Table 3 we conclude that substantial charges would be incurred by users trying to achieve levels of throughput commonly available on the LAN. These could range from $4.20 per month to greater than $420 per month depending upon the user level of activity.

Given the current billing regime the ISDN packet data seems most suitable for low throughput applications requiring say less than 250 kB of data transfer per day.

3.3 GTA Opportunities in ISDN Packet Data

We believe that in spite of the above limitations, ISDN packet data would see substantial use as ISDN is introduced. This would apply to users remote from their data processing resources, occasional users with needs to access data over a wide area, etc. If this is the case, then substantial revenue generating opportunities would become available. GTA should plan to carry this traffic over GOC shared networks like the GPN.

3.4 Issues

There are a variety of service development and operational issues involved in the overall introduction of ISDN, but in particular for the packet data component of ISDN. Investigation should be carried out in terms of developing GOC shared packet data and D-channel handling services.

The development of billing for such services could be quite complex and as such would require substantial lead times before implementation. The time synchronization of circuit switching and packet switching components would be necessary. For example a person making a circuit switched call for making a packet switching connection would like to consider such a situation to be one call occurring at relatively same instant in time.

There is a need to assess the most suitable combinations of throughput class versus user needs to best fit the packet data capabilities with user needs. The charging aspects as well as other needs like closed user groups, permanent virtual connections, etc., should be looked into.

TABLE 1

RECORD OF DATA TRANSFER AND CHARGES

Date & Time mm.dd hh:mm	Approximate Data .. kB	Data Activity	Server	Billable Packets Rx	Billable Packets Tx	Charges in cents
10.20 @ 10:58	17.4	Read	GTA/DDE	93	20	6
10.20 @ 11:03	--	Browse	Bell	18	20	3
10.20 @ 13:28	--	Browse	GTA/DDE	20	14	3
10.23 @ 09:17	17.2	Read	GTA/DDE	90	17	6
10.23 @ 09:19	13.8	Write	Bell	29	83	6
10.26 @ 14:42	--	Browse	GTA/DDE	20	14	3
10.26 @ 14:48	23.8	Write	GTA/DDE	13	106	6
10.26 @ 14:50	--	Browse	GTA/DDE	33	21	4
10.26 @ 14:52	23.8	Read	GTA/DDE	118	19	7
10.27 @ 10:13	--	Browse	GTA/DDE	23	17	3
10.30 @ 15:05	23.8	Read	GTA/DDE	118	19	7
10.31 @ 10:38	--	Read	Bell	86	32	6
10.31 @ 10:41	--	Browse	GTA/DDE	20	14	3
10.31 @ 11:01	--	Read	Bell	72	18	5

Note:

- The throughput class was "A" for all transactions which meant a 20% surcharge over the local 3000 service charge of 35 cents per kilopac of Rx plus Tx.
- Call setup/reset charge of 1 cent per call was applied. However, there were no call resets in the calls recorded above.
- No holding charges applied to this service
- The browsing activity in general related to logging on to the server and doing a basic directory control or directory listing

TABLE 2

BILLABLE PACKETS VERSUS DATA TRANSACTION RELATIONSHIP

Approximate Data Transaction .. kB	Billable Packets	Billable Packets per kB of Data
17 (read)	107	6.3
14 (write)	112	8.0
24 (write)	119	4.9
24 (read)	137	5.7

Note:

- We conclude that for first order calculations and data transactions of say 25 kB or more, each kB of data would generate approximate 5 billable packets.
- For smaller transactions of less than 15 kB, approximately 8 packets per kB of data can be assumed.

TABLE 3

TYPICAL ACTIVITY LEVELS AND ASSOCIATED COSTS

This table estimates the packet data costs for two classes of users - standalone users and LAN users, based on their existing typical activity levels.

Standalone User

- Basic communication, for example electronic messaging, etc.
  - 5 - 10 kB/day
  - Charges of 2 - 4 cents/day or $0.40 - $0.80/month
- Active PC to PC Communicator
  - 100 - 250 kB/day
  - Charges of 21 - 53 cents/day or $4.20 - $10.60/month
- Heavy user with mainframe and/or database accessing
  - 1 MB/day
  - Charges of $2.10/day or $42.00/ month

LAN User

- Basic software, communication on the LAN
  - 100 - 250 kB/day
  - Charges of 21 - 53 cents/day or $4.20 - $10.60/month
- Active Word processing user
  - 1 MB/day
  - Charges of $2.10/day or $42.00/ month
- Active spread sheet and graphics user
  - 5 - 10 MB/day
  - charges of $10.50 - $21.00/day or $210.00 - $420.00/month
- Very active user on the LAN
  - greater than 10 MB/day
  - Charges greater than $21/day or greater than $420.00/month

APPENDIX B-3

ISDN DATA APPLICATIONS AT ISTC

1. INTRODUCTION

The Information Management Branch at ISTC was one of the groups trialling a data application in the ISDN trial. The group had available to it enhanced ISDN telephony as well. The focus of this analysis is however the data applications.

1.1 Situation Analysis

In the existing configuration, a typical data user was connected to a mainframe host in the following fashion,

The PCs were connected via Gandalf limited distance data sets to the Gandalf data controller/concentrator. This would have the following terminal cost elements,

Monthly Bell charge of $6.90 per termination for the loop from the desk to the controller

One time installation charge of $100 per loop

Approximately $150 one time charge per LDDS which is the cost to purchase the sets by ISTC

The controller was connected to Datapac for connection to the host.

The STM host connected to Datapac with a suitable Datapac access arrangement at 9.6 kb/s providing the termination point for the terminal to host connection. The actual implementation of the loop could employ technologies like Synts, etc., which are used in the Dataroute service.

In this arrangement the Gandalf controller provided packetized concentration of the incoming traffic from all the users. The packetized data would then be transported via Datapac to the destination STM host over a collection of suitably traffic engineered access arrangements. Under these circumstances the maximum throughput speed experienced by an end user was 9.6 kb/s minus any local emulation and packet transport overheads. The maximum true data throughput experienced by any applications would be less than 9.6 kb/s. The actual throughput at any time during link up with the host would also depend

upon the total engineering of the configuration vis-a-vis total user activity levels and the various data transport handling functions.

1.2 The ISDN Alternative

The ISDN configuration is shown in Figure 1. It allowed for two data access alternatives to the users for connecting to the STM host.

In the first alternative, the PCTAs in conjunction with 3270 emulation software allowed for D-channel packet access to the STM host. The traffic was carried on Datapac after it left the ISDN node. The Datapac access arrangement between the STM host and the Datapac network was setup for a transmission speed of 9.6 kb/s. The STM host was equipped with NPSI interworking capabilities.

In the second alternative, T-link TAs were used and the communication was set up at a data speed of 19.2 kb/s in the asynchronous mode. The T-link traffic from the ISDN node was transferred and carried across another DMS switch. From this switch a Datalink circuit switched connection was established terminating on a DU at the STM host location. The PC and the host were configured with SIMWARE application software to facilitate the communications between the terminals and the remote host.

This ISDN setup was enabled early in the second quarter of 1989. The use continued until the end of the trial in November 1989.

2. RESULTS

2.1 Speed of Communication

In terms of data connectivity over the D-channel, the users did not experience much difference in data throughput between this mode of operation and their non-ISDN service using the Gandalf data system. This is as expected as the two implementations are virtually identical with respect to data transport. The maximum throughput is determined in each case by the smallest capacity link in the terminal to host connection. This in both scenarios was a 9.6 kb/s data link from the Datapac network to the STM host. Both scenarios also employed terminal emulation packages for establishing a remote terminal operation. It was the 3270 emulation software for the ISDN implementation and SIMWARE package for the Gandalf scenario.

The T-link TA arrangement provided for enhanced speed. The connections were established at 19.2 kb/s. This was double the maximum speed of 9.6 kb/s available in the D-channel implementation or the Gandalf scenario. In the user community, this mode was used for large file transfers (say 1 MB size file). This could effectively reduce the transmission time in half. SIMWARE terminal emulation and interworking software was employed to allow for the remote terminal operation in this configuration.

2.2 Reliability of Communication

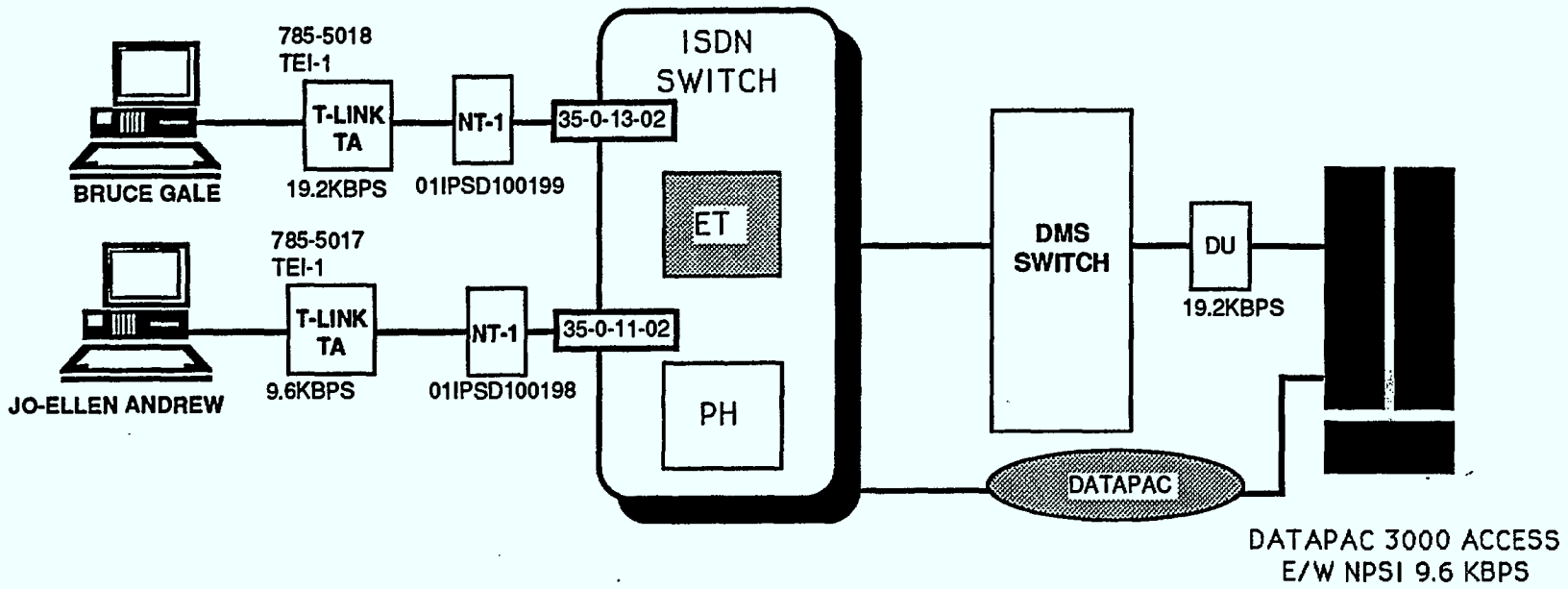
The D-channel mode of connectivity provided levels of reliability comparable to or slightly lower than the Gandalf implementation. This was considered a reasonable mode of operation by the users.

The T-link TA configuration experienced problems with call drops during large file transfers. A new circuit switched connection would have to be established after each call drop.

2.3 General Conclusions

It is concluded that the technology worked as it was implemented. The users would like to continue using it if it would become available. However, improvements in reliability of transmission would be required. This is true in particular for the circuit switched T-link access.

ISTC
HOST TO PC FILE TRANSFER



COMMUNICATION CAPABILITIES
- ASCII SUPPORT (CIRCUIT SWITCHED)

Figure 1

APPENDIX B-4

TELECOMMUTING EXPERIMENT IN THE ISDN TRIAL

1. INTRODUCTION

The basic premise in telecommuting is that the "commuting" needs of one's job are replaced by a telecommunications alternative. The actual commuting needs can arise under many scenarios or in the elements of one's work. For example,

commuting to and from work

commuting between more than one work location

travelling to other job activities like meetings, etc.

In any of the above situations, telecommuting can be used as a complement to commuting or as its replacement. Telecommuting was tested in the GOC ISDN trial on a limited basis.

An employee at DOC was provided with ISDN technology capabilities to connect his home to the office systems at the normal work location at 300 Slater Street, Ottawa. The employee also maintained his normal office at 300 Slater Street in Ottawa. The key objective of this activity was the following,

"Assess the feasibility and suitability of ISDN in support of telecommuting."

2. THE EXPERIMENT

2.1 Configuration

The user was provided with a BRA at his home. The following hardware and associated software plus communications capabilities were provided,

One circuit switched B-channel for enhanced ISDN telephony along with the NT T2317 digital ISDN telephone

An IBM XT PC with a PCTA connected for wide area networking (WAN) capabilities

A PAD-TA configured over the D-channel for GEMS/Envoy 100 communications

A local printer was attached to the PC

The primary WAN connectivity was for communication with the DGIM ISDN server located at 300 Slater Street for file server and high quality laser printing capabilities

2.2 Operation

The experiment was carried out over a period of one year. The user was also a user coordinator with the trial and could be considered an expert user in the trial. The home was used as the office from one to three days a week by the user. Normal voice telephony and data connectivity was maintained during the office hours including secretarial telephone backup.

3. CONCLUSIONS

3.1 User Observations

It was observed that non-technical and non-ISDN factors had considerable impact on the user's experiences in this experiment. The telecommuter essentially had two considerations impacting his work as follows,

Functionally he had to appear as though he was in the office even when away from his normal office.

The telecommuter had to operate at his home (telecommuting office) with less than the in-office levels of support and physical contact.

The user observed that because of the physical separation from the other members in the office group, he felt as though he was forgotten by the group. Since it was not a quantitative piecework type operation, the measurement of employee effectiveness and productivity was considered difficult. An employee had to face inaccurate though genuinely held perceptions of people in terms of "really working at home". If one steps out of the office and does not answer a phone call versus not answering a call coming into your home for whatever reason carry different but more negative perceptions for telecommuting.

The office of today is still a paper driven engine. It may be in the form of routing lists for documents, memos, forms and other paper derived documents. Whereas there would be a scheduled routine to handle these in the office, it would be more difficult to provide a transparent level of service at home. For example, when you are reading a document and you want to immediately consult with someone, one can just walk across to their office in a traditional office setting. It would not be equally possible in telecommuting.

The question of reduced access to office supplies from the telecommuting location, even though a minor consideration can make operation at home less efficient. There is also the question of operating office equipment at home. There would be demands in terms of office space at home, powering of equipment, insurance considerations, security, etc.

We can summarize the above observations by saying that telecommuting has significant human factors issues associated with it rather than being just a technical equipment connectivity enterprise.

3.2 Other Observations

The following are some general observations and considerations vis-a-vis telecommuting,

To use telecommuting for eliminating short distance travel may not be the most suitable application.

Telecommuting may succeed where there is a good trade-off between the time to commute modified by the facilities for commuting versus the time to be spent on the job. For example a highly efficient commuting facility coupled with moderate commuting time (say 30 minutes each way) may make telecommuting less attractive.

Certain job functions would be more suited to telecommuting than others. For example telecommuting may find use in the telephone operator services, telemarketing, etc.

Certain people may be more suited to telecommuting versus others. For example the physically challenged people with low mobility levels.

Success in telecommuting deployment may depend largely upon telecommuting organization design, telecommuting job function design, telecommuting technology availability (tested in part in this ISDN trial), telecommuting operation and support design, and the availability of suitable performance measurement tools.

3.3 Results

The following outcomes were observed,

The data speed over the D-channel was considered adequate for connectivity between the telecommuting location and the main office.

The technical feasibility of the ISDN implementation was successfully proven in terms of functionality and reliability.

3.4 Conclusions

It was noted that the results of the telecommuting experiment cannot be generalized due to minimum deployment size of only one user participating in the experiment.

Technical and even more important the non-technical organizational and human factors were significant determinants in the user's overall experience.

The second pair coming into the home was found to be readily available for quick deployment of ISDN BRA into the home.

There is a need to address the question of telecommuting in the GOC on a more global basis. It may find suitable use under specific environments like job function ideally suited for telecommuting, long commuting times, economic factors vis-a-vis the cost of operating at a downtown location versus via remote satellite offices as a hybrid between telecommuting and traditional approach to work locations.

APPENDIX B-5

SMDR PROCESSING AND ASSESSMENT

1. INTRODUCTION

Station message detail recording (SMDR) is an application which is used in the collection of telephone call data for chargeable calls made by the GOC. The information for the EEWD is collected on magnetic tape medium. These tapes are subsequently processed by GTA to allocate the charges to the various user departments. The processing is carried out every month and at the moment twenty five tapes per month are processed for the EEWD traffic. The SMDR activity was established on the ISDN node in the trial starting for the month of May, 1989. The GOC user group tapes were processed for the period of May, 1989 to the completion of the trial in November, 1989. This work was carried out by the MOI group in GTA.

2. CONCLUSIONS

In processing the tapes from May 1989 to the end of the trial, the tapes were found to be compatible with the EEWD tape format. Hence there were no problems detected in terms of the GTA ability to process ISDN circuit switched long distance calls.

3. OTHER OBSERVATIONS

The SMDR testing carried out in this exercise was for the circuit switched B-channel type traffic only. Hence the conclusions in Section 2 would hold if the ISDN billing regime would be identical to the EEWD type telephony service. Any modifications required for whatever reason in ISDN billing processing of such data would introduce an implementation and processing delay in terms of GTA capability to handle the same.

It is also important to note that the current SMDR facility for processing in-house databases is operating close to its processing limit. This is in terms of the processing power required to process the current load of SMDR tapes. Substantial implementation effort and enhancement of the bill processing engine would be required under any of the following scenarios,

If feature usage charges were introduced and would need to be equitably recovered through feature usage allocations, it would be a major effort.

Data type traffic billing would require substantial billing systems development. This would be true for D-channel packet data as well as the packet B-channel data scenarios. The complexity of the processing job would also increase if various traffic quality/class type modulators were introduced on top of the basic charges.

These are some of the elements which must be planned for and considered prior to the introduction of such ISDN services in the GOC.

DATE DUE

JAN 13 1992			
NOV 10 1994			