Department of Communications
Ministère des Communications

THE CHARACTERISTICS OF DATA COMMUNICATIONS TARIFFS

ECONOMIC POLICY AND STATISTICS BRANCH

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Economic Policy & Statistics Branch
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June, 1976

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INTRODUCTION

This study presents the characteristics of data communications products, services and facilities offered by two major, federally regulated common carriers - Bell Canada and CN/CP Telecommunications (CN/CPT).

The study sets out the framework within which the two carriers introduce data communications tariffs and provides a general background of data communications concepts and hardware. In presenting data communications tariffs in this form, logically divided by class of service and described in non-technical terms, it is intended that the importance and complexity of the material will be appreciated more widely. Too often it is assumed that data services are of less importance than other telecommunications services. The carriers' revenue share from data communications operations, although small compared to the monopoly services*, is steadily rising.

Data communications is a relatively new field for the two carriers evolving from two traditional types of service, telephone and telegraph. From these two monopolistic bases the telephone and telegraph companies have expanded into new service areas such as teletypewriter, video, and data, and thereby into more direct competition with one another.

To market the new services and to present customers with a distinctive corporate focus for data communications the carriers established separate organizational groups. In 1967 the major railways formed a partnership called CN/CPT and in 1971 the major Canadian telephone companies formed the Computer Communications Group (CCG), comprising data communications personnel from each member company. Bell Canada, the largest of the telephone companies, is the planning

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*CN/CPT monopoly operations include Telex and Public Message Service.

and organizational leader of the CCG.

In the last five years technological changes began to revolutionize the computing and communications business and user demand shifted dramatically from low speed teletypewriter systems to higher speed, computer-to-computer and terminal-to-computer applications. The carriers were quick to capitalize on this trend with specialized data facilities and equipment. Recently, intercarrier competition was extended with the respective introduction of digital communications networks.

Data communications tariffs are subject to the jurisdiction of the Government of Canada and the carriers must file their tariffs with the Canadian Radio-television and Telecommunications Commission (CRTC). Such filings, upon approval by the CRTC, are open to inspection by the public. The General Tariffs contain the rules and regulations governing the leasing of carrier network facilities and equipment, restrictions on service availability, and the rate schedules consisting of fixed, variable, and service charges. Extensive use has been made of the material in the General Tariffs although (as previous researchers have noted and it still holds true) this information tends to be neither clearly nor efficiently organized, especially from a user's perspective. Also the tariff books require one to be familiar with the general structure of a telecommunications system and the technology employed. In order to achieve a balanced study it was necessary to supplement the General Tariffs with material obtained from the carriers and other researchers.

The focus of the study is on the standard data communications tariffs of the two carriers, beginning with the older teletypewriter

services and ending with the newest digital network services. Both carriers market additional equipment called special assembly devices which are usually made up for specific customer demands and the assigned rates vary with the intended scale of use. Special assembly devices are not included in the General Tariffs and are outside the scope of this report.

A characteristic of data communications tariffs filed by the two carriers is their marked similarity of rate levels and other specifications. This leads many to the conclusion that price competition does not exist. In fact, parallel tariffs may be the end-product of the duopoly structure of the carrier sector, and a good deal of price rivalry prior to specific tariff filings may have taken place. Sometimes this rivalry leads one carrier to follow a tariff initiative of the other, despite the erosion of price-cost margins to levels judged to be inappropriate by the carrier itself. Nevertheless, the study is primarily concerned with a description of services and this pricing process is not discussed in any great depth at this time.

Finally, a distinction between the terms, tariffs and rates, must be noted. Data communication rates are one important element in a data communications tariff. A tariff as filed with the CRTC often includes terms and conditions of service in addition to the actual rates to be charged. These non-rate features of current data communication tariffs have been highlighted in this study wherever it has seemed appropriate.

1 MARKET SHARE

This section identifies the market share as measured by data communications revenue for the two carrier systems, CN/CPT and the Trans-Canada Telephone System (TCTS). The market share for Bell Canada, a member of TCTS is also shown, however it should be kept in mind that the Company operates only in Ontario, Quebec and the eastern part of the Northwest Territories, while CN/CPT operates on a trans-Canada basis.

The actual acquisition of reasonably accurate and comparable statistics is the initial and major obstacle. The data communications revenues of TCTS and Bell Canada are not made public and this necessitates their development from various Departmental sources. Nevertheless, the resultant figures fall within admissable ranges and can be accepted as representative and instructive.

Table 1 - Data Communications Revenue Comparison (1974)

Carrier	Revenue ($ Million)	% of Total
CNT*	102	65%
CPT	55	35%
CN/CPT (Total)	157	100%
Bell Canada	70	49%
Remaining Carriers	73	51%
TCTS (Total)	143	100%

*Revenue from telephone operations is included.

Table 1 shows the revenue breakdown for the major data communications carriers in Canada. The CNT revenue figures, however, include revenue from telephone operations in parts of Newfoundland, the Yukon and the Northwest Territories. Excluding the telephone revenues the remaining CNT revenue is approximately equal to that of CPT.

In order to compare CN/CPT and Bell Canada with respect to competitive data communications offerings, revenues from Telex (in 1974 totaled about $50 million) which is usually viewed as a monopoly service should be excluded from the total in Table 1 as well as CNT telephone revenues. On this basis, the CN/CPT revenues from competitive offerings are roughly equivalent with those of Bell Canada but represent about 50 per cent of total TCTS data communications revenues.

Table 2 - Contribution of Data Communications Revenues to Total Revenues for TCTS and Bell Canada (1974)

Carrier	Revenue ($ Million)
TCTS Total Operations	2,267
TCTS Data Communications	143
% Data/Total	6%
Bell Canada Total Operations	1,440
Bell Canada Data Communications	70
% Data/Total	5%

Table 2 shows that TCTS revenue from data communications is now six per cent of total operations. In 1972, Branching Out* estimated that TCTS data communications revenues accounted for between three to four per cent of their total operations. There are no accurate

*Branching Out, Volume I, page 111. May 1972.

historical figures available to indicate the changing share of data communications revenues in Bell Canada's total operations, although at the time of Branching Out it was considered to be around three per cent.

In absolute terms Bell Canada is certainly the largest data communications revenue producer in TCTS. However, the fact that data communications represents six per cent of the TCTS total revenue indicates that there are some other member companies with data communications revenue representing a larger relative share of their total operations compared with Bell.

2 INTERCONNECTION

During the course of this study various interconnection regulations, covering situations allowed and not allowed, were encountered in the General Tariffs of Bell Canada and CN/CPT. These are of two types, either between carriers, or between a carrier and a customer. Interconnection is a major example of what is embodied in a tariff apart from specified rate levels.

It appears that the interconnection regulations serve the carriers a twofold purpose. The first is that of the preservation of the integrity of the system whereby the carriers' facilities are protected from unauthorized and technically dangerous equipment, and the second is the protection of a carrier's particular market advantage.

Of the two carriers, Bell Canada is the more conservative, stemming from the carrier's policy to protect its telephone monopoly. Bell Canada sees any relaxation of the regulations as a threat to its telephone network.

CN/CPT, on the other hand, is far more liberal in its position and sees a need for an eventual relaxation of the regulations. Moreover, CN/CPT often argues that a more liberal interconnection policy is a prerequisite for their long term survival.*

The following figures illustrate the current data communications interconnection policies of Bell Canada and CN/CPT. Exceptions to these are in the form of special terms and agreements negotiated in the public interest or in circumstances involving public safety, national security or the provision of service to remote areas not

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*On 14 June 1976 Canadian Pacific Ltd. filed with the Canadian Radio-television and Telecommunications Commission (CRTC) an application to order Bell Canada to permit connection of CPT's lines to the local telephone network of Bell Canada.

normally served by telecommunications carriers. Interconnection between Bell Canada, other Trans-Canada Telephone System (TCTS) companies and independent companies is covered by formal agreements filed with the appropriate regulatory authorities.

The figures are grouped under three headings, Facility Regulations, Equipment Regulations and Network Regulations.

FACILITY REGULATIONS

Figure 1 Interconnection of Facilities

Figure 2 Interconnection of Facilities on a Computer

EQUIPMENT REGULATIONS

Figure 3 Connection of Customer Provided Equipment to Bell Canada Switched Network

Figure 4 Connection of Equipment to Facilities

Figure 5 Connection of Customer Provided Multiplexors or Concentrators to Analogue Facilities

Figure 6 Connection of Customer Provided Multiplexors or Concentrators to Dataroute/Infodat Facilities

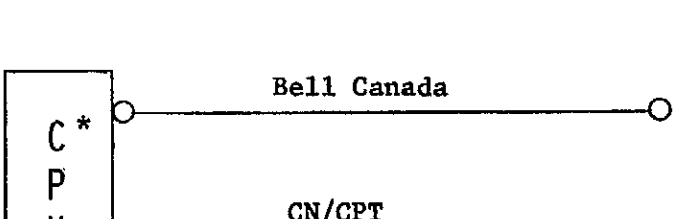
NETWORK REGULATIONS

Figure 7 Interconnection of TWX and Telex

Figure 1 - Interconnection of Facilities

The carriers do not allow the interconnection of their facilities (analogue or digital) either permanently, through multiplexors, or other switching equipment.

Figure 2 - Interconnection of Facilities on a Computer



The carriers allow the termination of competitive facilities on a CPU, together with their own, if the CPU is used for normal data processing and storage and not as a multiplexor, concentrator or switcher.

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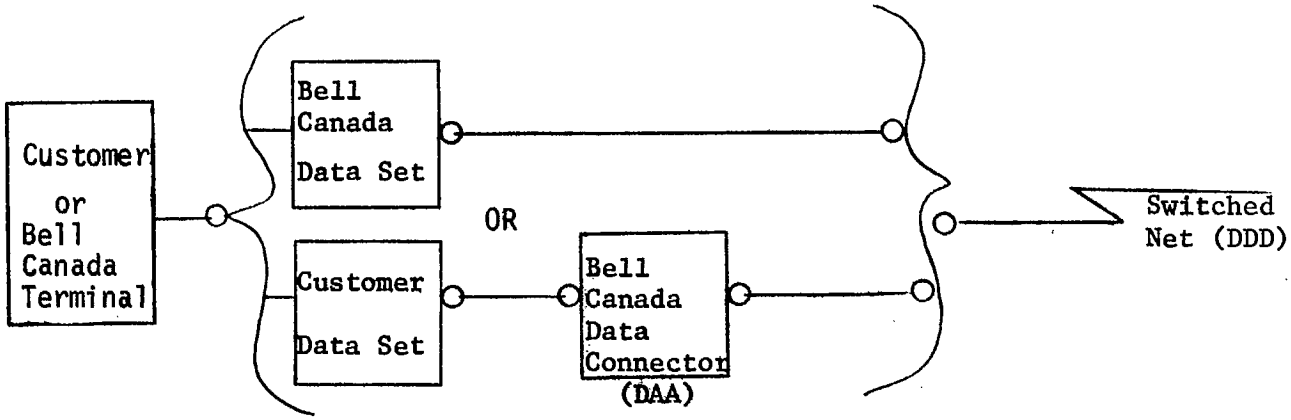
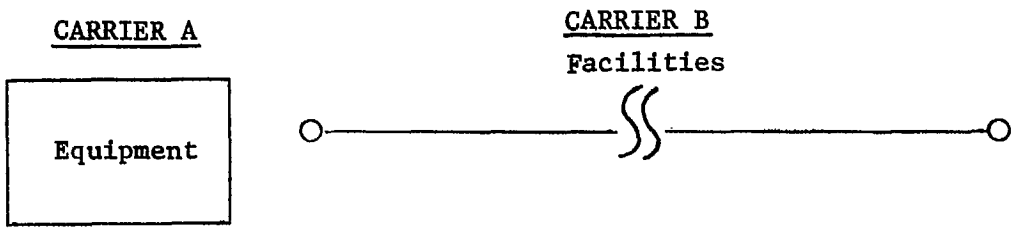
*Central Processing Unit.

Figure 3 - Connection of Customer Provided Equipment to Bell Canada Switched Network



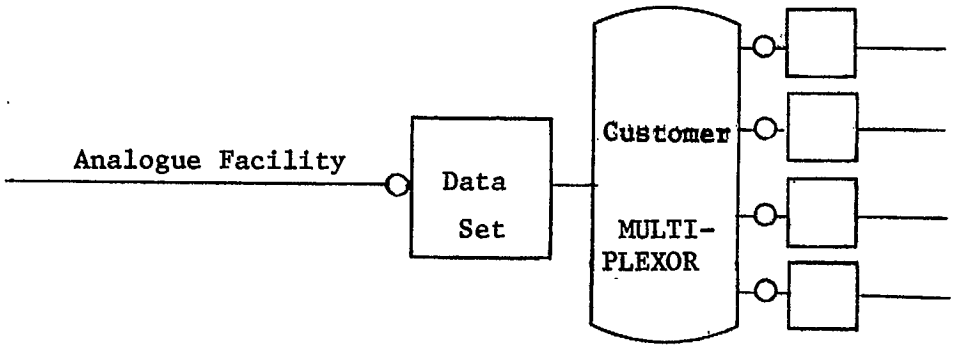
Bell Canada must provide the data set or data connector when customer provided equipment is connected to the switched network.

Figure 4 - Connection of Equipment to Facilities



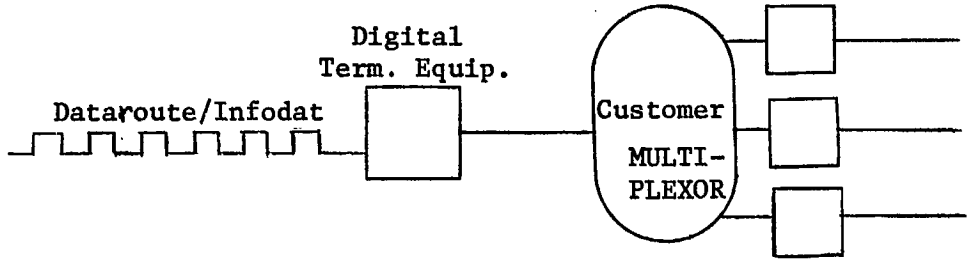
The carriers do not allow the connection of competitive (other carrier) equipment to their facilities (analogue or digital). However; customer provided equipment can be connected to either one or the other of the carrier systems.

Figure 5 - Connection of Customer Provided Multiplexors or Concentrators to Analogue Facilities



Customer provided multiplexors can be connected to a carrier's analogue facilities using either customer or carrier provided data sets.

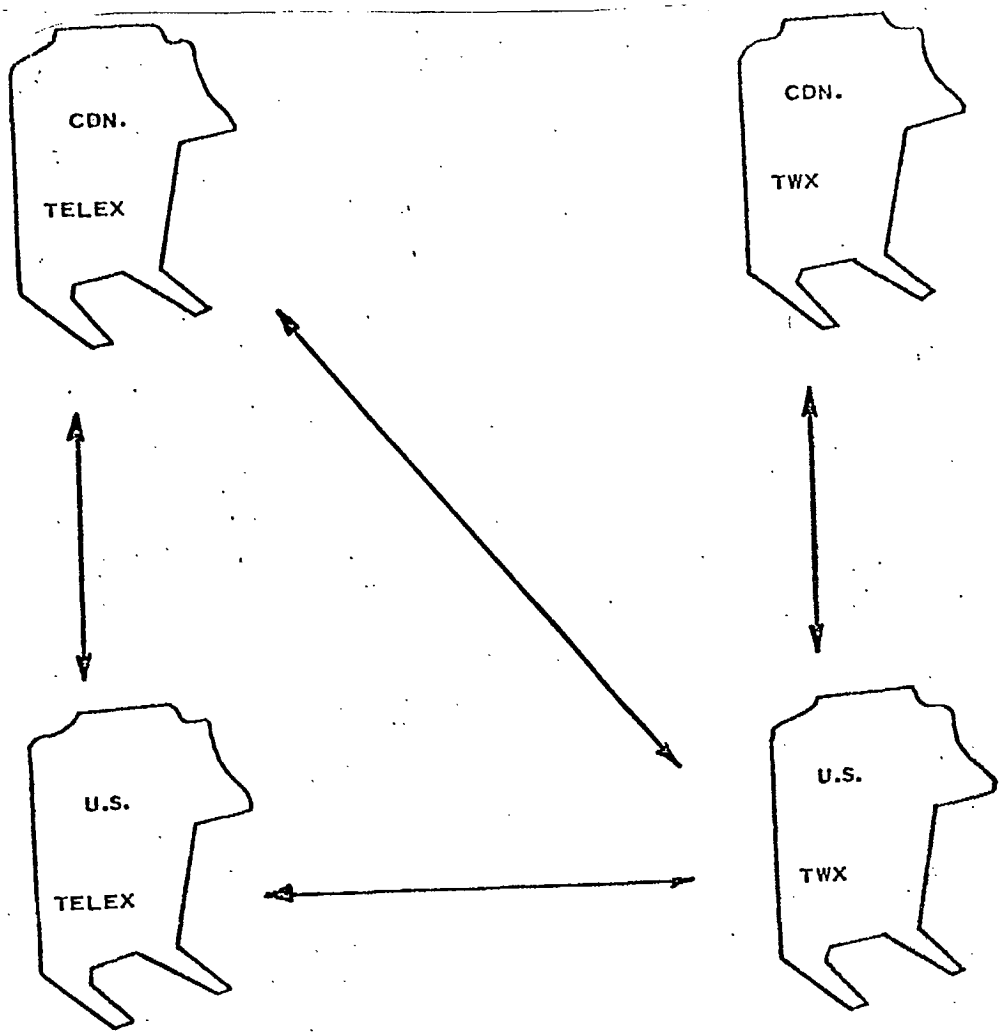
Figure 6 - Connection of Customer Provided Multiplexors or Concentrators to Dataroute/Infodat Facilities



Customer provided multiplexors or concentrators can be connected to the digital facilities of Dataroute or Infodat. However, the digital terminating equipment must be carrier provided.

Figure 7 - Interconnection of TWX and Telex

Canadian and U.S. TWX and Telex can communicate as shown below.



3 ORGANIZATION AND METHODOLOGY

This section describes the manner in which the study has been organized and how the characteristics of each tariff are presented. The tariffed services have been assigned to one of three broad groups and each tariff is described using a common format with several headings.

SERVICE GROUPS

The products and services of Bell Canada and CN/CPT are grouped under the headings Networks, Equipment, and Facilities. Each service group is preceded by a table showing pertinent information such as trade name, transmission speed range, and carrier.

(1) Networks

A network is considered to be a number of communication channels operating on a switched or non-switched basis, and interconnecting various locations.

The networks are described with the switched networks first, beginning with the lower speeds, and proceeding to the higher speeds.

(2) Equipment

Equipment services consist of standard hardware offerings such as terminals and datasets. Special assembly equipment, which is marketed for limited customer requirements, is not included. It could, however, be the topic of a separate study.

Most of the services and especially terminal devices listed in this section are provided by Bell Canada. This reflects the current situation in which the market for dial-up data equipment used on the telephone network is not open to CN/CPT. The telephone network is a Bell Canada monopoly service used primarily for voice transmission. Data transmission is made possible through the use of interface equipment which adapts business machine output for use on the network. This allows for conversations between teletypewriters, computers, video terminals and other business machines. At present, Bell Canada does not allow competing carriers to interconnect to the switched network. On the other hand, CN/CPT is expected to introduce a family of private line terminals to compete with Bell Canada's private line services.

(3) Facilities

The facilities included in this section are private line services and special service arrangements. Private line services provide for the transmission of data on a point-to-point or multi-point basis. Special service arrangements provide customers with services designed for a specific market (e.g. time sharing) and with bulk circuit discounting due to a customer's large scale of operations.

DESCRIPTIVE FORMAT

Each service description is preceded by appropriate headings: "Name of Service", "Provided By", "Competitive Service", etc. "Provided By" refers to either Bell Canada or CN/CPT. "Competitive Service" identifies, where applicable, the competing carrier's service offering. This heading was not included in the Equipment Group because CN/CPT does not compete in the hardware market outside of teletypewriters and data sets. Bell Canada competes with the terminal industry at large but it would be impractical to include every competing terminal on the market.

The characteristics of each service are described under the following headings:

(a) General Description: The features of a service, both operational and technical (from a non-technical user's viewpoint).

(b) Tariff-Non-Rating Features: Supplementary information from the General Tariffs relating to the service's availability, limitations on use and other rules and regulations of the carriers.

(c) Tariff-Rating Features: The rating approach is described. Actual costs were not used so that the study will not become dated with each new general rate increase. Rates are described from a conceptual point of view and, if applicable, a comparison was made with competing services and competing carrier services.

(d) Service Applications: Customer applications for the service are identified. It is intended that the material in this section will help to make the rather faceless collection of general tariffs less abstract to the reader.

4 NETWORKS

Table 3 - Current Networks

SERVICE[1]	SWITCHED or NON-SWITCHED	SPEED RANGE			CARRIER
		SUB-VOICE 300 bits per second	VOICE 300 - 9600 bits per second	ABOVE VOICE 9600 bits per second	
Direct Distance Dialing Network (DDD)	Cct Switched	Note 2	up to 1200 async up to 2400 sync		Bell
TWX	Cct Switched	up to 110 bps			Bell
Telex	Cct Switched	50 bps			CN/CPT
DataTelex	Cct Switched	180 bps			CN/CPT
Multicom 1	Cct Switched		up to 1200 async		Bell
Multicom 2	Cct Switched		up to 4.8 kbps		Bell
Multicom 3	Cct Switched			up to 50 kbps	Bell
Broadband Exchange Service	Cct Switched		Note 2	up to 48 kbps	CN/CPT
MSDS	Message Switched	up to 110 bps			Bell
Telenet	Message Switched	up to 300 bps			CN/CPT
Dataroute	Non-Switched Digital	Note 2	Note 2	up to 50 kbps	Bell
Infodat	Non-Switched Digital	Note 2	Note 2	up to 50 kbps	CN/CPT
Datapac/Infoswitch:	See pp. 43 and 44 for a brief discussion and appendices A and B for current carrier positions.				

Note 1: Where applicable networks are grouped to reflect competitive carrier services

Note 2: A full range of speeds available

DIRECT DISTANCE DIALING NETWORK (DDD)

PROVIDED BY: Bell Canada

GENERAL DESCRIPTION

The long distance network connects the many local central offices by means of facilities called toll trunks enabling any telephone subscriber to be connected to any telephone on the network. Calls may be placed by dialing directly (DDD) or with the assistance of an operator.

Direct Distance Dialing service, although primarily a voice offering, is capable of transmitting data from a business machine at speeds up to 2400 bps. To connect a business machine to the network a data set must be used to convert the digital output of the business machine into tones compatible with the transmission capabilities of the telephone network. Data sets can be either permanently connected to the network (hard wire) or acoustically coupled, and provided by Bell Canada or the customer. When a data set is provided by the carrier the service is known as DATA-PHONE service.* The local distribution portion of the DDD network is also ideal for local data communications because local calling is toll free and universally available.

TARIFF-NON-RATING FEATURES

The connection of customer provided terminals and data sets is permitted provided that the data set is used along with a telephone company data connector (coupler). Bell Canada's tariffs state that the data connector performs supervisory control functions and prevents signals of too high an intensity from reaching the network.

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*DATA-PHONE service is described in greater detail at p. 66, Data Sets.

TARIFF-RATING FEATURES

A telephone terminal provided by the telephone company must be used to access the DDD network. The telephone terminal is billed monthly and its fixed charge is related to the user's intended use, either residence, business or trunk service. All data communications users are billed for either business or trunk rates. Acoustically coupled devices prove to be an exception because they can be used with any available handset and thereby can transmit undetected from any class of service.

When the network is used for toll calls the user incurs variable charges based on call duration and distance. Rate schedules generally reflect the telephone company's desire to distribute the long distance calls more or less uniformly throughout the day and week. Thus, long distance rates are lower in the evenings, at night and on weekends.

The network is toll free when used for local calling with the result that intense usage of the local network for data communications is not reflected in the user's monthly bill.

SERVICE APPLICATION

The network is attractive to many types of user because of its relatively low cost and universal access. Most users operate in the range of 300 bps asynchronously and for the most part take advantage of toll free local calling.

It is especially attractive for accessing time sharing firms and in-house computing centres. The limiting factors of DDD are its inherent low speed and marginal error performance as a result of adapting to a network intended for voice rather than for data transmission.

TELETYPEWRITER EXCHANGE SERVICE (TWX)

PROVIDED BY: Bell Canada

COMPETITIVE SERVICE: Telex (CN/CPT)

TWX is a dedicated public switched telecommunications service employing teletypewriters operating at a speed of 110 bps and using the 8-level* ASCII code (American Standard Code for Information Interchange). The service is used for data communications on a two-point or conference call basis. Connection to 45,000 Western Union TWX stations in the USA is provided; however, connection to Western Union Telex stations is not. Connection to the international Telex network is made through Teleglobe Canada.

TWX service can also be combined with Datacom 100 service (alternate use TWX/Datacom) which allows the same terminal to access both the TWX network and the DDD network to reach other compatible business machines.**

TARIFF-NON-RATING FEATURES

Connection of subscriber owned teletypewriter and associated equipment to the TWX network is not permitted although the Company does allow connection of receive-only terminals which are not capable of originating a call.

TARIFF-RATING FEATURES

There is great similarity between the rates charged for TWX and the CN/CPT competing Telex service. (See following service.) Total monthly charges for both consist of fixed and variable "pay as you use" charges.

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*Level, refers to the bit pattern which makes up a transmission code, i.e. 5, 6, 7 or 8 bits. Bit patterns correspond to predetermined alpha-numerics.

**Datacom 100 is further described at p. 48.

The Bell Canada basis for calculating usage charges differs slightly from CN/CPT. Rather than divide the country into 23 rate centres, as was done for Telex, it was more natural for a telephone oriented company to utilize existing area code divisions. TWX usage rates are also generally higher than Telex, but this difference is nullified when taking into account the difference in transmission speed (Telex - 66 wpm vs. TWX - 100 wpm). In fact, the edge in transmission speed makes TWX more economical than Telex when sending identical message lengths.

As with Telex, charges per minute increase with distance whereas charges per mile decline. Comparison of rates for TWX with ordinary long distance service for equipment distances reveals that TWX is consistently less expensive. Nevertheless, a customer must be sustaining long distance charges in excess of the fixed monthly charge for the teletypewriter terminal to benefit from the lower usage tariffs.

SERVICE APPLICATION

TWX service attracts a different market mix than Telex because of its limited Canadian user penetration. A prospective user would naturally opt for Telex if the businesses it wishes to communicate with are Telex subscribers. Notwithstanding this liability, TWX does fill a need for users with intra-company operations. Alternate use TWX/Datacom service is also attractive to some users. The higher speed and ASCII operation of the service makes TWX attractive for low cost access to computer communications services. TWX can also be used for the transmission of administrative type messages, purchase orders, payroll data, shipping or sales information.

TELEX

PROVIDED BY: CN/CPT

COMPETITIVE SERVICE: TWX (Bell Canada)

GENERAL DESCRIPTION

Telex is a dedicated public switched telecommunications service employing teletypewriters operating at a speed of 50 bps and using the 5-level international (Baudot) code. Telex customers have direct access to over 30,000 domestic and 500,000 international subscribers. In addition, interconnection is possible with 45,000 US TWX stations by means of a speed and code conversion process through Western Union. (TWX service operates at 110 bps or 100 wpm in an 8-level ASCII code.)

Telex is the major business of CN/CPT and as such the service is used as the basis of various complementary services, e.g. TEL-TEX and Telepost service are two methods whereby Telex customers can communicate with non-Telex customers. TEL-TEX allows customers to Telex messages to a CN/CPT office in the destination city, whereupon the carrier telephones the message locally. The service is useful in the event of postal interruptions. Telepost service is a computer switched service which directs the customer's message to a Canada Post Office at the destination city. From there the message is sent to the addressee in the next mail delivery.

TARIFF-NON-RATING FEATURES

Connection of subscriber owned teletypewriter and associated equipment to the Telex network is not generally permitted.

TARIFF-RATING FEATURES

Total monthly charges for Telex service consist of two factors:

1) monthly rental of Company provided teletypewriter equipment
2) "pay-as-you-use" charges.

The Company's usage charges are based on call duration in minutes and on distance measured by the 23 trans-Canada rate centres. The Company rate tables show that although charges per minute increase with distance, charges per mile decline. A user, therefore, pays proportionately less for a call sent a greater distance. When comparing Telex to long distance rates for equivalent distances, Telex was found to be consistently less expensive. However, a customer's calling volume and respective long distance charges must exceed the fixed monthly charge for the teletypewriter terminal before the lower Telex usage charges become attractive.

SERVICE APPLICATION

Telex is directed to users who require a capability to send and receive written messages such as purchase orders, shipping information, payroll data, sales information, etc. The fact that Telex rates are cheaper than long distance is a bonus. The service appeals to users with both small and large operations and the Telex subscriber list of around 30,000 Canadian customers is testimony to its popularity.

DATATELEX

PROVIDED BY: CN/CPT

COMPETITIVE SERVICE: TWX (Bell Canada)

GENERAL DESCRIPTION

DataTelex is a low-speed data exchange service. It is a network which can accommodate a variety of transmission codes of 5, 6, 7, or 8-level and speeds up to 180 bps. Subscribers communicate with each other on a dial-up basis.

TARIFF-NON-RATING FEATURES

The DataTelex network is accessible by either carrier or customer provided terminals. If carrier provided, the terminals are usually Teletype Models 28, 32, 33 or 35.

TARIFF-RATING FEATURES

The DataTelex usage rates are identical to Telex rates. However, since the network can accomodate various speeds, a subscriber charge per mile is inversely proportional to the speed of the equipment, but as speed increases greater volumes of data can be delivered and the net result can be a lower cost per message to the user.

SERVICE APPLICATION

DataTelex offers a customer the capability to transmit at higher speeds and (with the appropriate equipment) to transmit directly to a computer without any code conversion which is usually necessary when using a Telex terminal. This capability is a direct response to the Bell Canada TWX network and an attempt to share in the low speed data, dial-up teletypewriter market. DataTelex has applications for intra-company message systems, purchase orders, payroll data and shipping or sales information.

MULTICOM 1,2, and 3

PROVIDED BY: Bell Canada

COMPETITIVE SERVICE: Broadband Exchange Service (CN/CPT)

GENERAL DESCRIPTION

Multicom 1, 2 and 3 are pay-as-you-use switched network services providing alternate voice/data communications between customer designated locations at speeds up to 50,000 bps.

Multicom 1 speeds are constrained by the capability of the regular telephone network (upper limit 2400 bps) using a telephone company provided data set. The service utilizes pre-programmed automatic dialers to establish connections to other Multicom 1 stations via the DDD network.

Multicom 2 is functionally separate from the regular telephone system providing for full duplex transmission (simultaneous transmission in both directions) at speeds up to 4800 bps. Call set-up times are faster than with Multicom 1 due to the use of touch-tone equipment.

Multicom 3 is a high speed, full duplex, data transmission network at 19.2, 40.8 and 50 kbps. Like Multicom 2, the service uses switching equipment functionally separate from the regular telephone system.

TARIFF-NON-RATING FEATURES

The connection of customer owned and maintained data sets is permitted for Multicom 1 and 2, provided the data set is used along with a telephone company data connector (coupler). Customer

owned data sets are not permitted on Multicom 3.

On the other hand, all three services allow the connection of customer owned terminals. Although the Multicom exchanges are accessible in all major cities, the general tariff specifies that the telephone company has the sole right to determine the exchanges between which it will provide the service.

TARIFF-RATING FEATURES

A subscriber's monthly charge for Multicom service is the sum of the fixed charges (network access lines and data sets or station arrangements) and the variable charges (network utilization). As stated previously, the subscriber can provide carrier approved data set equipment for Multicom 1 and 2 service.

The Company basis for calculating usage charges is the subscriber's choice of distance, speed and duration of call. For low speed subscribers, the Multicom 1 rate schedule is divided into seven mileage bands with each band allocated a rate per minute. Although rates per minute increase with distance, the cost per mile is relatively constant however the third mileage band between 650 and 1000 miles has the lowest cost per mile. Multicom 1 usage rates are generally less expensive than DDD rates but the service is only economical when a subscriber has monthly long distance charges in excess of the initial Multicom 1 access line charges. From that point the rate per minute becomes advantageous.

The Multicom 2 rate schedule is configured on the same basis as Multicom 1, except that a distinction is made for transmission speeds at 2400 bps and under, and over 2400 bps to the limit

of the voice bandwidth. For speeds at 2400 bps and under, the rates per minute are identical to those of Multicom 1. For speeds over 2400 bps the rates per minute are slightly higher reflecting, in part, the Company's increased cost in providing higher capacity bandwidth equipment. Offsetting this increase, the cost per mile declines as distance increases. The rates per minute charged for Multicom 2 at speeds over 2400 bps are identical to CN/CPT Broadband at equivalent speeds.

For high speed service applications the Multicom 3 rate schedule follows the same pattern as Multicom 2. The rate schedule is divided by speed, showing rates per minute for transmission at 19.2 kbps and under, and for transmission at either 40.8 or 50 Kbps. The cost per minute by mileage band for transmission at either 40.8 or 50 kbps is double the rate for 19.2 kbps. Both rate schedules show cost per mile declining as distance increases.

SERVICE APPLICATION

The basic appeal for Multicom is that many transmission speeds are available to a subscriber on a pay-as-you-use basis. Multicom 1 is an economical step up from expensive DDD rates but with the sacrifice of universal calling capability because all Multicom 1 stations on a system must be pre-designated. The service is ideal for users with applications for voice and medium speed data communications equipment, and whose scale of operation does not yet require a private line or more sophisticated alternative services. A common use for Multicom 1 is as a private communications network for a company with many branch operations. Multicom 1 can also be used to access computing centres or as a connection to other services e.g. Dataroute. Since the Multicom 2 network was designed for data and low error rates the service is suited for applications where accuracy is a key factor.

Multicom 3 appeals to a very limited number of subscribers with its very high data transfer rates. For speeds at the top end, the service could be used for computer-to-computer transmission and at the low end for remote job entry applications. The service does meet a demand for dial-up, high speed, data and facsimile transmission where the volume of messages is not large enough to warrant a full-time wideband private line.

BROADBAND EXCHANGE SERVICE

PROVIDED BY: CN/CPT

COMPETITIVE SERVICE: Multicom 1, 2, 3, (Bell Canada)

GENERAL DESCRIPTION

Broadband is a pay-as-you-use switched network providing alternate voice/data communications between designated locations at speeds up to 48 kbps. The user establishes connections with pre-designated subscribers through use of a two-digit push button number.

Broadband Exchange Service is also available between Canada and the USA through subscriber stations of the Western Union Telegraph Company.

TARIFF-NON-RATING FEATURES

The carrier allows the use of all approved customer owned equipment, with the stipulation that the subscriber is not allowed to create additional channels from the furnished facilities (multiplexing).

TARIFF-RATING FEATURES

The basis for a subscriber's monthly Broadband charge is similar to that of Multicom. The monthly charge is the sum of the network access line charges and usage charges . Access line charges, however, are at a fixed rate and do not vary upward as speed increases, as does Multicom service. Data sets and terminals can be leased from CN/CPT at fixed rates but the customer has the option to provide the equipment.

The Company's basis for calculating usage charges is by the distance and duration of a subscriber's call. There are two rate schedules for Broadband, up to 2400 bps, and over 2400 bps to the limit of the voice bandwidth. These two rate schedules cover the same services provided by Bell Canada Multicom 1, 2 and 3. In fact, the rate schedules for Multicom 2 and Broadband, at transmission speeds over 2400 bps to the limit of the voice bandwidth, are identical. The distance factor for Broadband service is built up from eight mileage bands and the time factor from corresponding rates per minute.

Transmission rates for 2400 bps and lower are relatively constant on a per mile basis throughout the mileage bands. This is unusual because it is conventional to establish rates that reflect the inverse relationship between most transmission costs and increases in distance. When looking at transmission rates over 2400 bps to the limit of the voice bandwidth, the cost per mile decreases with distance, to the benefit of subscribers.

SERVICE APPLICATION

Low speed Broadband competes directly with Bell Canada Multicom 1, and service applications are similar. Subscribers are drawn to the service to reduce long distance voice and data charges coupled with the advantage of using a private intra-company network either on a two-point or multi-point basis.

High speed Broadband fills the requirement for pay-as-you-use switched data communications at speeds and with features not available with low speed Broadband and the switched telephone network. The higher speed of the service is useful for bulk data transfers, remote job entry terminals, etc.

MESSAGE SWITCHING DATA SERVICE (MSDS)

PROVIDED BY: Bell Canada

COMPETITIVE SERVICE: Telenet (CN/CPT)

GENERAL DESCRIPTION

MSDS is a store-and-forward message switching service in which the pick-up and delivery of messages is under the control of a computer.

MSDS allows messages to be transmitted to and from TWX stations using the switched TWX network, to and from private line teletypewriter stations using dedicated circuits, and between TWX and private line stations. A central computer is supplied by the carrier and is programmed for speed and code conversions to allow communications between differing terminals. The computer controls many separate customer networks simultaneously and ensures privacy between each. In addition, the system embodies various features, some of which are polling, broadcast messages, selected group messages, message retrieval, priority message designation, and traffic statistics.

MSDS is equally adaptable to message or data communications.

TARIFF-NON-RATING FEATURES

MSDS is a service which requires a complex system design and traffic simulation studies prior to supplying equipment to the customer. Because customer requirements are unique it is offered on the basis of each individual case. Therefore, MSDS is not a regular tariff item, but a special assembly available on an intra-Canada basis only.

TARIFF-RATING FEATURES

Since MSDS is only offered as a special assembly the charges depend on the particular system configuration, although some of the following rating principles are common to any system. Fixed monthly charges consist of the charge for equipment (teletypewriters, TWX), access arrangements (CPU connections, individual terminal accreditation charges), and circuits (private line access to MSDS network nodes). Variable charges depend on the degree of customer use of the network. Unlike previous Company services, MSDS usage charges are not based on distance and time but on volume. Messages sent to and from the computer are broken down into blocks of characters and charged per block. Usage in excess of certain amounts receive a discount.

There are additional charges for computer operations such as polling, traffic statistics, code and speed conversion and other features.

SERVICE APPLICATION

MSDS is ideal where there is a need for large scale, multi-terminal applications, such as order entry and inter-office communications. Existing customer operations which use many TWX terminals or private line teletypewriters can benefit from effective control by MSDS over the many networks and a resultant lowering of their total communications costs.

TELENET

PROVIDED BY: CN/CPT

COMPETITIVE SERVICES: MSDS (Bell Canada)

GENERAL DESCRIPTION

Telenet is a computerized store-and-forward message switching service. It is designed to act as a common interface for private line and switched teletypewriter networks requiring speed or code conversion. It also provides for the dispersal of large volumes of message or data traffic, validation and error checking as that traffic is relayed to its final destination, and collection and storage of data from a number of originating points until required by the customer.

Access to and from the computer is provided via dedicated transmission facilities to dedicated ports and through the Telex network. Telenet computers, which are Company owned, are located in Montreal and Toronto, and provide the capability to exchange traffic between dedicated (Class A stations) and switched (Class B and C stations) using different codes and speeds. Data transmission speeds up to 300 bps are available between Class A stations and the switched (Telex) stations on the network. Access to any Telex subscriber from a dedicated Class A station is also available through the computer.

These three classes of station are determined by traffic volume. A Class A station with heavy traffic volume is assigned a dedicated computer connection and traffic is transmitted and received over dedicated facilities. Each customer network is required to have at least one Class A station to perform the functions of network control.

A Class B Station with medium traffic volume can handle messages to and from the general Telex network as well as messages transmitted via the computer. A receive-only unit, dedicated to the receiving of traffic from the computer via the DataTelex network is also required.

Finally, a Class C Station with light traffic uses a Telex terminal with access to both Telenet and the general Telex network. Class A stations may be located anywhere in the world, Class B and Class C stations are permitted in Canada and continental USA.

Telenet, in addition to providing complete privacy between subscribers, provides many features among which are polling, group messages, priority message retrieval, traffic statistics, etc.

TARIFF-RATING FEATURES

Telenet is considered by CN/CPT to be a Special Tariff because of specialized and limited applications. Although monthly charges can vary due to the complexity of customer applications, the same rating principles as previously described for MSDS (Bell Canada) apply.

SERVICE APPLICATION

Telenet incorporates the features of private (dedicated) communications networks and switched services such as Telex and DataTelex, allowing for communications between terminals with different speeds and codes. The service is especially applicable for customers who already have existing but separate networks and require interconnection to increase efficiency. Various company services, such as data entry, order writing, and inter-office communications can be run simultaneously.

DATAROUTE

PROVIDED BY: Bell Canada

COMPETITIVE SERVICE: INFODAT (CN/CPT)

GENERAL DESCRIPTION

Dataroute is a private line, digital data service, capable of a range of speeds up to 50 kbps. Customer access to Dataroute is available at designated Dataroute Serving Areas (DSA) and service can be provided outside the DSAs by means of standard private line or dial-up (switched) services. Dataroute service is provided via a specially designed digital data network which results in improved data transmission performance over analogue networks. Analogue transmission means that a signal with continuously variable characteristics (amplitude, frequency, or phase) is transmitted. Sound and light consist of such a continuous range. Digital transmission means that a stream of on/off pulses is sent in the same way that data travels in computer circuits. The major advantage in using digital techniques for transmission is that each repeater station completely regenerates the pulses whereas transmission by analogue techniques only amplifies the signal at the repeater station along with noise and distortion, resulting in errors. Another advantage is that computers and terminals, which operate in a digital mode, are directly compatible with a digital network. A lower speed service-deriving arrangement is available with Dataroute, to enable a customer with a high speed, two-point, Dataroute service to obtain from the circuit two or more lower speed services.

Private line Dataroute channels can be multi-point as well as two-point, and if multi-point the circuit will consist of points in at least three DSAs. Multi-drop, another feature, allows for more than one location within a given building or within the same continuous

property (e.g. a university campus). And finally, combinations of multi-point and multi-drop arrangements are possible on the same channel.

Dial access to the Dataroute network is available by conventional modems on the switched network. This arrangement allows for dial connection to the Dataroute at one end of a two-point system. Dial pulses, however, can be one-way originating only, from the customer location within or beyond the DSA.

TARIFF-NON-RATING FEATURES

The areas between which Dataroute is provided are datermined by the carrier. The carrier's prime criterion for adding a DSA is determined by the minimum amount of data traffic for the network. Two-point Dataroute service is furnished with carrier provided digital data sets at both the DSA central offices and the customer location. Customer provided modems are permitted at a customer's terminal location with dial or private line analogue access to Dataroute. The customer may provide the channel deriving equipment but only if it is located on the customer's premises.

TARIFF-RATING FEATURES

The monthly charge for Dataroute service is the total for Dataroute Access Arrangement (DAA) charges and inter-DSA line charges.

The DAA consists of digital data sets and local channels which allow the customer to access the Dataroute. As higher speeds are chosen more expensive equipment with a greater capacity is used and this is reflected in higher DAA charges.

Inter-DSA line charges are speed, distance and time sensitive. The cost per bit-mile decreases with distance but increases with higher speeds. The cost per bit-mile is also sensitive to time of day. Dataroute is offered on a 24 hour, business day and night basis, with 24 hour service the most expensive and night service the least expensive.

The sensitivity of rates to time is due to the use of Time Division Multiplexing (TDM) equipment which allow the carrier to obtain more effective use of Dataroute facilities. Users' transmissions are interwoven and sent through the TDM onto network trunks operating at 56 kbps. The three time-of-day tariff categories aim to encourage a more even distribution of network load over a 24 hour period. Also service periods are responsive to some customer needs for a private line service on a limited time basis only.

Another rate feature of Dataroute is its relatively low cost, particularly at lower speeds, when compared to standard analogue private line services. In some cases rate reductions are dramatic and the service has attracted users who previously could not afford private line services.

SERVICE APPLICATIONS

The Dataroute, because of its low cost relative to private line analogue service, its dial-up network capability, improved error performance due to digital transmission techniques, and its wide range of speeds has appealed to a broad range of customers since its introduction in March, 1973.

Dataroute is extensively used in time sharing, inquiry response and information retrieval applications, where users interact via low speed keyboard printers or CRT-type stations.

Another segment of the market uses Dataroute for bulk data transfers and remote job entry for medium and high-speed, computer-to-computer and high-speed, terminal-to-computer applications.

Other user applications are for data collection, such as sales reports, updates from outlying points, message transmission and text retrieval (e.g. retrieval of legal or medical journals).

INFODAT

PROVIDED BY: CN/CPT

COMPETITIVE SERVICE: Dataroute (Bell/Canada)

GENERAL DESCRIPTION

Infodat is a private line, digital data service capable of a range of speeds up to 50 kbps. Customer access to Infodat is available in designated serving areas, and access to stations located outside of service areas can be furnished by means of other standard carrier services. The service is provided via a specially designed, digital data network which results in improved data transmission performance.

Infodat is identical to Dataroute in features, such as lower speed service-deriving arrangements, and multi-drop and multi-point capability. The one major difference between the two services is that Infodat cannot be used on a switched telephone dial-up basis because the carrier has no access to the DDD network. However, the CN/CPT dial-up services such as Telex, DataTelex, Broadband, and Telex Computer Inquiry Service can be used.

TARIFF-NON-RATING FEATURES

The General Tariff states that the locations between which Infodat is provided is determined by the carrier.

Another tariff requirement is that the carrier must supply the digital data set at the serving area central office and at the customer's premises. When other carrier services are interfacing with Infodat, customer supplied modems are permitted subject to the restrictions of the particular service.

TARIFF-RATING FEATURES

Infodat rates are identical to those of Dataroute, and therefore exhibit the same sensitivity to distance, speed and time. (See Tariff-Rating Features for Dataroute.) The only difference between the two services is that Dataroute has access to the DDD network. This feature gives Dataroute an advantage for time sharing services, the bulk of which operate in a dial-up mode.

SERVICE APPLICATIONS

Infodat and Dataroute applications are identical except for the Dataroute DDD network capability. (See Service Applications for Dataroute.) CN/CPT can substitute some carrier-provided dial-up services such as Broadband but cannot match the convenience and versatility of the switched telephone network.

DATAPAC/INFOSWITCH

Datapac, offered by Bell Canada, and Infoswitch by CN/CPT are publically announced services scheduled to be operational in the latter part of 1976.

The effect of these two services on the data communications market is expected to be great. Instead of looking at networks as sets of communications lines and separate pieces of equipment, Datapac and Infoswitch are specifically designed for data communications and can be viewed as more or less homogeneous structures to which computers and terminals attach.

Both services represent advanced technological improvements over existing networks and facilities. The services will provide the Canadian data communications user with universally available packet and circuit-switched networks.

In packet switching there is no direct physical link between the sender and the receiver. Instead small packets of information are shunted through the switching system using special address codes to arrive at their destination.

Circuit switching is the traditional method by which a physical connection is established between two terminals by means of electrical connections in switching machines. That connection is held open for the exclusive use of that communication, as in a telephone call. The networks operate on a message oriented basis, receiving and sending data over a shared user network. In this way many of the problems and shortcomings associated with conventional dedicated networks such as polling, errors, and high costs are overcome.

Essential to any message oriented network is the protocol which forms the basis of network access standards. Protocols are used to define the physical link between the device and the network, how the terminals communicate over the network, how messages are identified to the network for routing, and how terminals and application programs talk to each other.

At present negotiations are being undertaken to standardize the various network protocols to allow users the freedom to use competitive products and networks. Since both Bell Canada and CN/CPT have developed their own separate protocols and since their respective positions are anything but final it makes it difficult for the purposes of this study to present the definitive characteristics of the services. For this reason the respective positions of each carrier on the proposed configuration of their networks have been included in Appendices A and B, expressed in recent speeches by S. Erskine, General Manager, Data Network Planning, Bell Canada and by G.F. Carleton, Manager, Strategic Planning, CP Telecommunications.

5 EQUIPMENT

Table 4 - Types of Equipment

TERMINAL SERVICE	CARRIER	SERVICE DESCRIPTION	SPEED
Teletypewriter Service	Bell Canada CN/CPT	Teletypewriters used on PL* facilities	45, 150 bps
Datacom 100	Bell Canada	Teletypewriter using DDD network	110 bps
Datacom 300	Bell Canada	Teletypewriter using DDD network	110, 150, 300 bps
Datacom 400	Bell Canada	Teletypewriter using DDD network or PL facilities	110, 150, 300 bps
Datacom 600	Bell Canada	Buffered teletypewriter used on PL facilities	1200 bps
VUcom I	Bell Canada	CRT, Printer, Tape Cassette. Used on DDD network or PL facilities	Up to 300 bps Switched up to 9600 bps PL
VUcom 2	Bell Canada	Programmable CRT, Tape Cassette, Printer used on PL facilities.	2400, 4800, 7200 bps
VUcom 3	Bell Canada	CRT, Printer, Tape Cassette used on DDD network or PL facilities	up to 1200 bps switched up to 9600 PL
Faxcom	Bell Canada	Facsmile used on DDD network or PL facilities	3&6 minutes per page
Datasets	Bell Canada CN/CPT	Data Sets for use on DDD network or PL facilities	Full Range
Channel Deriving Arrangement	CN/CPT	Low Speed channels from medium speed conditioned private lines.	Variable

*Private Line.

TELETYPEWRITER SERVICE

PROVIDED BY: Bell Canada and CN/CPT

GENERAL DESCRIPTION

Teletypewriter Service consists of a series of electromechanical teletypewriter terminals for switched or private line systems.

The following Teletype Corporation Models are available from both carriers; however, Models 33 and 35 are available from Bell Canada as special assemblies only.

TELETYPE CORPORATION MODEL 28
- Light, Medium or Heavy duty equipment
- 5-level operation at speeds of 45 baud, 49.5 baud, 56.3 baud, 75 baud.
- Keyboard Send and Receive Unit (KSR) or Automatic Send and Receive Unit (ASR)

TELETYPE CORPORATION MODEL 32
- Light to Medium duty equipment
- 5-level operation at speeds of 45 baud, 49.5 baud, 75 baud.
- Keyboard Send and Receive Unit (KSR) or Automatic Send and Receive Unit (ASR)

TELETYPE CORPORATION MODEL 33
- Light to Medium duty equipment
- 8-level operation at 66 baud, 74 baud, 82.5 baud, 110 baud.
- Keyboard Send and Receive Unit (KSR) or Automatic Send and Receive Unit (ASR)

TELETYPE CORPORATION MODEL 35

- Heavy duty equipment
- 8-level operation at 66 baud, 74 baud, 82.5 baud, 110 baud.
- Keyboard Send and Receive Unit (KSR) or Automatic Send and Receive Unit (ASR)

Teletypewriter Service is one of the carriers' oldest data offerings and many options and features have evolved to enhance the service. Notwithstanding the low speed capability, some large systems have reached a high degree of sophistication and utility.

TARIFF-RATING FEATURES

Fixed monthly rates are charged for both teletypewriter terminals and options. The total charge for an operating service is the sum of the mileage rental for the channels and the charge for the teletypewriters and other equipment located at the service points.

SERVICE APPLICATIONS

The equipment provided for Teletypewriter Service has a reputation for ruggedness and is used in many adverse locations such as mines, factories, etc. However, the terminals are noisy and therefore are usually relegated to segregated areas. The service is often on dedicated facilities and terminals can be polled and controlled by a carrier-provided switching option. This versatility makes the service ideal for large, dispersed company applications, for order entry, stock control and pay processing. Teletypewriters can also be used on a two-point basis for dispatching trucks or sending company messages.

The Model 33 and 35 machines operate in 8-level ASCII code and can be used for transmissions to a computer without the code conversion needed with other models.

DATACOM 100

PROVIDED BY: Bell Canada

GENERAL DESCRIPTION

Datacom 100 provides for the transmission of data at 110 bps over the switched telephone network with a carrier supplied, switched network, access line; a telephone set; and a teletypewriter terminal. (The data set is an integral part of the terminal.) Using the DDD network, both local and long distance calls are a standard feature. Datacom 100 has the capability for alternate data/voice communications to allow for voice co-ordination of data transmission and optional use of the same access line for both voice and data requirements. The terminal transmits data in ASCII code.

The terminal equipment can be either Teletype Corporation Model 33 designed for light to medium use or the Model 35 designed for heavier use and multi-copy forms. Information is transmitted manually through the keyboard or by punched paper tape for automatic sending and receiving at 110 bps. The service can also be adapted by a selector switch for alternate Datacom/TWX use. This feature permits access to either the DDD or TWX network from the same terminal.

TARIFF-NON-RATING FEATURES

Datacom 100 is an integral service package and the carrier must provide all the individual components.

TARIFF-RATING FEATURES

The monthly fixed charges for Datacom 100 service is the sum of the terminal and access line charges. The terminal charge

depends on the Model (33 or 35 depending on light or heavy use) and the features (paper tape, friction or sprocket feed). The access line is charged at business rates and is dependent on the rate group in which the subscriber is located.

The transmission component of the charge is variable when long distance is used. Local calling is at no charge. Other carrier services, such as Multicom I, can be used to minimize long distance usage.

SERVICE APPLICATION

Datacom 100, because of its low cost (relative to other terminal offerings) and simple operation is ideal for low speed terminal-to-terminal or terminal-to-computer applications. It can be used for individual applications such as time sharing, as an integral part of a communications network, for management information systems, or order entry systems.

DATACOM 300

PROVIDED BY: Bell Canada

GENERAL DESCRIPTION

Datacom 300 provides data transmission at switch-selectable speeds of 110, 150 and 300 bps using the switched telephone network. The service consists of Datacom 300 asynchronous, electronically operating terminals, a 103 type data set, and an access line to the switched network. Terminal operation is in ASCII code. Datacom 300 is available in either a friction feed or sprocket feed paper handling mode and with or without paper tape send and receive capability. A magnetic tape cassette recorder option can be used as an alternative to paper tape operation. Alternate voice/data capability is a standard feature and allows for voice co-ordination of data transmission and optional use of the same access line for both voice and data requirements.

TARIFF-NON-RATING FEATURES

Datacom 300 is no longer available for new installations and the service will soon be superseded by Datacom 400. The carrier will continue to support the service until there are no units left in the field.

TARIFF-RATING FEATURES

The monthly fixed charges for Datcom 300 service are the sum of the terminal and access line charges. The terminal charge is dependent on the options required (paper tape, friction or sprocket feed, wide or narrow platen). The access line is charged at the monthly business rate and is dependent on the rate group location of the subscriber.

When long distance is used, the transmission component of the charge is variable, and is determined by the distance and duration of a call. Local calling is at no charge. Datacom 300 higher speed capability (300 bps) makes for more efficient utilization of long distance rates than do slower speed terminals. Other carrier services, such as Multicom 1, can provide economies over long distance rates if usage becomes very high.

SERVICE APPLICATION

Datacom 300 has many advantages over Datacom 100 and one of them is speed. The higher speed capability of the terminal makes it more cost effective in relation to usage sensitive services (e.g. DDD, Multicom) and through a reduction in computer holding times. Another advantage is its quiet electronic operation. The terminal competes in the market as an imput-output device to access a time sharing computer and this market is experiencing a substantial growth. Other applications include management information and order entry systems, and point-to-point data exchange.

DATACOM 400

PROVIDED BY: Bell Canada

GENERAL DESCRIPTION

Datacom 400 is a teletypewriter service which has the capability of transmitting data at 110, 150 and 300 bps asynchronously in the ASCII code over the switched telephone network, private line point-to-point or multi-drop, and in-house facilities. The basic service is the page, send and receive (PSR) terminal. Automatic send and receive capabilities are achieved by combining the operations of the PSR terminal with a magnetic tape cassette recorder.

The terminal can be equipped with either a regular or APL* character set. Unlike previous carrier teletypewriter terminals the Datacom 400 has 132 character line print positions, especially useful for compatibility with computer output.

Although polling is not a standard option, Bell Canada will meet this requirement as a special assembly.

TARIFF-NON-RATING FEATURES

Datacom 400 is available for outright purchase through a Customer Purchase Plan (CPP). Bulk discount rates are available which vary with the quantity purchased. A purchase agreement between the carrier and the customer covers quantity, price and warranty. The equipment can also be maintained through a carrier maintenance program option.**

An Extended Term Plan (ETP) is available providing for slightly lower monthly rates for the terminal and options. The ETP is based on a two-year contract with rates established at the start of each year.

*APL, A Programming Language, is used in computer time sharing systems.
**The Maintenance program is covered in Tariff-Non-Rating Features for Datacom 600 at p. 55.

Any rate change granted by the Canadian Transport Commission (CTC) makes the contract null and void.

Bell Canada states that Datacom 400 is not marketed as a replacement offering for Datacom 300. The terminal is expected to compete for applications which require APL, the 132 character print position, and when private line operation is needed. In this way the existing stock of Datacom 300 terminals will remain functional.

TARIFF-RATING FEATURES

Datacom 400 is available on a monthly rate, with ETP options and Customer Purchase Plan (CPP). The only usage charges are those of the associated DDD, private line of other exchange service.

SERVICE APPLICATION

Datacom 400 can be used in a dial-up or private line mode for time sharing or message traffic, or as a receive-only printer associated with a CRT device for hard copy or forms printing. The primary application is time sharing where APL or 132 character print positions are required. Other terminal applications are management information, order entry systems, point-to-point data exchange, information retrieval, and message communications.

DATACOM 600

PROVIDED BY: Bell Canada

GENERAL DESCRIPTION

The Datacom 600 offering is a buffered typewriter style terminal which consists of a keyboard, printing mechanism and a panel-mounted control unit. The terminal is designed to operate in a multi-point, polled, private line environment under the control of an IBM host computer at a transmission speed of 1200 bps. The transmission code is BCD (Binary Coded Decimal) and the terminal operates under IBM 2740, Model 2, line control procedures.

All data is blocked in the 440 character buffer of the terminal prior to transmission, and characters within a block are transmitted asynchronously at 1200 bps.

The operation of the terminal is similar to other teletypewriter terminals except that as a buffered device, data keyed in by the operator does not go out on the line immediately. Transmission occurs when the operator depresses a bid key and the host computer polls the terminal.

Datacom 600 is compatible with Dataroute service and Schedule 4* analogue channels.

TARIFF-NON-RATING FEATURES

Along with some of the newer terminal offerings the carrier will accept requests for outright purchase of Datacom 600 terminals. Installation and maintenance of the equipment is also available provided that all of the facilities are carrier provided.

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*Schedule and channels are described in the Facility Section, on Voice-grade channels at pp. 73 and 76.

Three maintenance options are open to customers:

1) Hourly rate plus customer provided parts;
2) Hourly maintenance rate plus Bell Canada provided parts, and
3) All labour and parts included in a monthly maintenance fee.

TARIFF-RATING FEATURES

Datacom 600 is leased on a monthly basis. When used on analogue facilities the terminal is equipped with an integral data set at no extra charge.

SERVICE APPLICATION

Datacom 600 is a simple-to-operate, teletypewriter-like terminal for on-line, real-time interaction with a host computer in a multipoint, multi-drop, private line environment.

The system operation is primarily inquiry response in nature, but it can be used for the majority of data applications such as accounting, order entry or invoicing.

The terminal is designed for markets with the following characteristics:

1) Head office function with many branch locations,
2) centralized computer processing,
3) real-time, on-line interaction with a host computer, and
4) an easily operated input/output device (terminal).

The marketing approach of Bell Canada is to offer a complete communications package consisting of terminals and multi-point private lines. Datacom 600 competes directly and at a lower rate with the IBM 2740 Model 2 and the IBM 3767 Model 1. The lower user cost, together with the opportunity for a customer to lease both terminals and facilities from one supplier appears to be a strategy designed to capture the multi-point, multi-drop, private line facility and terminal market from IBM and CN/CPT. Very few applications for terminal-only leasing are permitted by the carrier although examples of such arrangements include in-house configurations and self-contained establishments such as university campuses.

VUCOM I

PROVIDED BY: Bell Canada

GENERAL DESCRIPTION

VUcom I is a video terminal with a cathode ray tube (CRT) display and alpha-numeric keyboard. It is designed for data communications to a central processor or to other compatible terminals. The terminal is capable of transmitting and receiving asynchronous ASCII data on either the switched network or private line facilities*. Options are available to expand the display format from 8 lines of 80 characters to 16 lines of 80 characters and to allow for the bulk transfer of screen data. Also available with the service is a magnetic tape cassette recorder and an impact or non-impact printer. Essentially, the terminal is an advancement over the conventional teletypewriter, offering the user more composition versatility and quieter operation.

TARIFF-NON-RATING FEATURES

VUcom I is no longer manufactured and is only provided from returns to stock. VUcom III, its replacement, has more features and capabilities and is expected to have a greater share of the market.

TARIFF-RATING FEATURES

The pricing of VUcom I is a departure from the usual carrier policy of bundled services. The CRT display unit is independently priced and this may be an indication that profitability does not depend upon the sale of associated devices or facilities. This means that a customer can lease the terminal on a stand-alone basis for use with an acoustic coupler, or hard wired as a slave to a central processor.

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*VUcom I operates at switch selectable speeds of 75, 110, 150, 200 and 300 bps on the switched network and can also operate at 600, 1200, 1800, 2400, 4800 and 9600 bps on private line facilities.

The fixed monthly charge for the terminal is competitive with Datacom 100 and 300, although when an application requires hard copy operation the VUcom I configuration is more expensive due to the added printer cost.

SERVICE APPLICATIONS

The number of time sharing and large computer users has grown spectacularly in recent years creating a high demand for CRT display terminals. VUcom I was introduced by Bell Canada to meet part of this demand and also to underline the carrier's intention to compete in the data communications market, both as a provider of traditional facilities and more recently of data transmission equipment.

Major applications for VUcom I are in the time sharing and remote computing fields. The terminal is well equipped for management information systems, legal services, retail credit checks, order entry, library retrieval, etc. These applications are equally suitable for dial-up or private line services. In some cases VUcom I can replace existing private line teletypewriter systems; however the fact that the terminal is not addressable limits it to more basic system applications.

VUCOM 2

PROVIDED BY: Bell Canada

GENERAL DESCRIPTION

VUcom 2 is a programmable CRT terminal system in which the individual terminals are clustered around a mini-computer based control unit. The controller is fully programmable and gives VUcom 2 the operational features and on-line characteristics of a fully buffered CRT system. The terminal is capable of speeds of 2400, 4800 or 7200 bps over multi-point, multi-drop dedicated facilities.

In contrast with the IBM 2260 and 3270 terminals, which are strictly hardware devices, VUcom 2 performs the functions of these terminals under the control of an operating system known as an emulator. This permits the use of essentially the same hardware for emulation of the two terminal devices; however minor hardware changes are required for keyboard layouts, etc.

Functions which are not available with the emulated devices may be implemented in VUcom 2 through software modifications, called enhancements.

Peripheral equipment, such as a magnetic tape cassette recorder, and either a 30 cps or 165 cps printer is available.

The terminals can be configured as single, stand-alone stations or clustered, and are polled by the remote computer employing IBM Binary Synchronous Communications (BSC) or IBM 2260 Asychronous Line Protocols. In general terms, the only component of VUcom 2 which varies with the configuration is the controller itself. The controller

is a mini-computer made up of the following modules which gives the system its intelligence:

1) Processor
2) Memory
3) Display adaptor
4) Display controller
5) Multiplex channel controller
6) Input/output device adaptor.

For a stand-alone configuration a Model 1005 controller is used. Although a stand-alone configuration could exist with its own communications link back to the front end of the central processor it is usually configured as part of a multi-point facility. With a remote mini-concentrator the stand-alone configuration could be expanded to a maximum of five CRT displays and one printer.

If a medium sized cluster is required, a Model 1016 controller is used with a maximum capacity of eight CRT displays and one printer. Very large clusters of CRT displays and peripherals require the use of a Model 1021 controller with a maximum capacity of 23 CRT displays and two printers.

TARIFF-NON-RATING FEATURES

VUcom 2 is programmable by the carrier and not by the user in order that all software modifications can be universally documented for the benefit of all users.

The VUcom 2 controllers are designed for a terminal communications environment and not as mini-computers for stand-alone processing. VUcom 2 cannot be connected to another carrier's facilities or used with customer-owned equipment.

TARIFF-RATING FEATURES

Due to the complexity and unique combinations of hardware and software a fixed over-all rate for VUcom 2 is impossible. Therefore the service is provided only as a special assembly.

SERVICE APPLICATION

VUcom 2 is the Bell Canada competitive entry in the buffered CRT market. The terminal was designed initially to gain a foothold in the market defined by the IBM 2260 and 3270 terminal systems. Although VUcom 2 is competitive in price with IBM, some users may not wish to have a terminal system supplied by someone other than the vendor of their mainframe.

VUcom 2 can be used for reservation systems, library retrieval services, order writing, text editing and inquiry response.

A purchase agreement covers quantity, prices, warranty, and a penalty clause of 10 per cent of quoted price if the customer does not accept delivery or installation.

An Extended Term Plan (ETP) is available providing for slightly lower monthly rates for the terminal and options. The ETP is based on a two-year contract with rates established at the start of each year. The contract is subject to any rate change granted by the Canadian Transport Commission (CTC) which makes the contract null and void.

TARIFF-RATING FEATURES

The monthly rate for VUcom 3 is the sum of the charges for the terminal and options. Similar to VUcom 1 policy, the terminal is independently priced and this may be an indication that its profitability does not presume the sale of associated devices and facilities. As described in the preceding section the customer may choose to purchase the terminal outright or reduce his monthly rates by Extended Term Plan contract. Usage charges are extra and dependent on the associated DDD, Multicom, Dataroute or other exchange service.

SERVICE APPLICATIONS

The VUcom 3 terminal is line-compatible with the VUcom 1 terminal and applications are similar for time sharing, inquiry response, information and text retrieval, message switching, and data collection.

The area of greatest strength for VUcom 3 is in a polled multi-point system. In a multi-point terminal configuration a user benefits from economies of line sharing. Applications parallel those of VUcom 2 in text retrieval, reservation systems, etc.

FAXCOM

PROVIDED BY: Bell Canada

GENERAL DESCRIPTION

The Faxcom transceiver converts graphics or documents into electronic signals by means of an integrated acoustical coupler and transmits them over the regular telephone network to a receiving station where a facsimile of the original document is produced. The originating copy can be in written, drawn, typed, or half-tone copy form of any color and up to 9" X 14" in size. In all cases the facsimile received will be in varying shades of grey.

The terminal can be considered to be portable because of its light weight (47 lbs), and acoustic capability. The data set is built into the transceiver and, because the terminal is not hard-wired, it can be connected to a variety of private line or switched network, voice grade services such as Multicom I or DDD.

Faxcom operates in a three minute or six minute mode, with sharper contrast being achieved in the latter because of the slower transmitting speed. An unattended receive-only unit can be provided on a hard-wired individual case basis. With this device incoming calls are automatically answered, received, and the unit is disconnected if 45 seconds elapse without a transmission.

TARIFF-NON-RATING FEATURES

Bell Canada has cut down on the promotion of Faxcom and the terminal is now available only from returns to stock.

Since the terminal is portable and subject to damage and loss the carrier has the right to request the customer to pay the cost of restoring the unit to its original condition or replacing it.

TARIFF-RATING FEATURES

A fixed monthly rate is charged for the Faxcom transceiver and this includes the integrated acoustic coupler. Charges for voice facility and transmission time are additional, if applicable.

SERVICE APPLICATIONS

Facsimile service has the potential to displace some of the message market now shared by TWX, Telex and private line teletypewriter. Nevertheless, Faxcom is currently priced above competing Xerox units and Bell Canada has not experienced the sales volume it had expected. Faxcom is also an analogue unit and therefore not compatible with digital services like Dataroute.

The business applications for Faxcom service are unlimited since it can replace most current methods of sending or receiving business documents, drawings, inter-office correspondence, etc. The terminal can be used for PERT or CPM schedules, time logs, charts and graphs, waybills, bills of lading, and geological surveys.

Although the demand for Faxcom as a service offering of Bell Canada has not been as great as expected, the adoption of facsimile services generally has probably stimulated greater use of the DDD network. In particular, each sale of the low-cost, market-dominant Xerox Telecopier induces an increase in carrier long distance revenues.

DATA SETS

PROVIDED BY: Bell Canada and CN/CPT

GENERAL DESCRIPTION

The terms *data set* and *modem* are often used interchangeably when in fact, there is a distinction. A modem is a contraction of the term *modulator-demodulator*. In data transmission a modem changes the digital (DC) signal of a business machine to an analogue (AC) signal by impressing the DC signal on a carrier wave of a voice facility. This process is called modulation and the result is called a modulated carrier wave. The reverse process, whereby the signal is retrieved from the modulated carrier wave is called demodulation.

In contrast, data sets do not necessarily perform the functions of modulation-demodulation. Rather, data set is a generic term for any equipment that interfaces a business machine to a transmission facility.

There are three basic types of data set:

1) analogue input/analogue output as in facsimile or electrocardiogram transmission
2) digital input/analogue output as TWX or Telex
3) digital input/digital output as a terminal using Dataroute or Infodat.

The data sets described in this service section and included in the following table are of the digital input/analogue output type. The table contains the most commonly used of these available on lease from carriers, although CN/CPT customers can lease only private line data sets because that carrier does not have access to the switched telephone network. Both carriers can supply additional data sets capable of speeds of 9.6, 19.2, 40.8 and 50 kbps but only as special assemblies.

Table 5 - Current Data Sets

DATA SET*	MAX. SPEED bps	TRANS. MODE ASYNCHRONOUS (A) SYNCHRONOUS (S)	SERVICE: DIAL NETWORK (DDD) PRIVATE LINE (PL)
100 SERIES			
103A or 113A	300	A	DDD
113BR	300	A	DDD
108 type	300	A	PL
200 SERIES			
201A	2000	S	DDD
201B	2400	S	PL
201LSI	2400	S	DDD
202C	1200	A	DDD
202D	1800	A	PL
4800 SERIES			
4800 series	4800	S	PL

The data sets used on the switched network are commonly referred to as Data-Phone service. This implies that a telephone is associated with the data set and it can be used for voice co-ordination before subsequent data transmission.

Data sets and terminals operate either in asynchronous or synchronous mode. With asynchronous transmission one character at

*The Data Sets are grouped into three series based on transmission speeds: low, medium and high.

a time is sent and synchronizing bits are unnecessary since each character is initialized and terminated by a signal to indicate that transmission is about to take place or has taken place. With synchronous transmission, characters are sent in a continuous stream requiring that the data sets and terminals at each end are exactly in phase with each other. The synchronizing bits are used to distinguish the beginning and the end of a character or a block of characters. Equipment designed for synchronous transmission is generally more complex and expensive because of the addition of the timing mechanisms. Synchronous transmission is more suited for medium and high speed transmission where exact timing is required to minimize errors in large bursts of information. In low speed transmission, the error potential is not as great and less sophisticated equipment can be used.

TARIFF-NON-RATING FEATURES

The maximum transmission speed available for Data-Phone service on the public switched network is 2400 bps. This is not necessarily a limitation of the facilities but a self-imposed limitation by Bell Canada to stimulate Multicom II services above 2400 bps. For instance, in the United States, data sets are available from AT&T for data transmission at 4800 bps.

TARIFF-RATING FEATURES

The monthly rate for data sets generally increases in some proportion to increased speed of transmission, increased sophistication of the data set, optional features, and adaptability for use with the switched network.

The tariffs charged by both carriers for private line data sets are similar, although not identical. This can be attributed to the use of products from different suppliers and to data sets with different operating characteristics. For example, some data sets

have a reverse channel capability used for error control purposes, others are used for receive-only applications.

In addition to the fixed monthly rate for the data set, the customer is charged for the associated DDD or Multicom exchange service, or for private line facilities.

SERVICE APPLICATIONS

The 100 series of data sets are low cost, low-speed asynchronous devices used primarily for teletypewriter terminals. The 103A or 113A data sets are used for interactive communications on the dial network with terminals such as VUcom III and Datacom 300.

The 113BR is a terminate-only data set (can receive but not send data) used for dial-up access to a time sharing computer. It is of modular design allowing it to be plugged into a prewired cabinet. The data set cabinet or "nest" permits varying the number of 113BR sets at one location. Different cabinet sizes are available to accommodate 14, 42 or 112 units. The data sets can be wired for line equivalency so that calls are placed exclusively on the main telephone number and in the event of a busy indication calls are automatically passed on to the next free data set.

The 108 type data set is used for private line application only. It is suitable for point-to-point or multi-point transmission.

Data sets within the 200 series accept medium-speed (maximum 2400 bps) digital signals from a customer's business machine and convert these signals into modulated tones for transmission over voice grade facilities. Depending on the data set, data transmission can be over dial-up or private line facilities.

The 4800 series data set is a high-speed unit designed primarily for private line facilities although both carriers use it for switched network service on Multicom and Broadband as well.

CHANNEL-DERIVING ARRANGEMENTS

PROVIDED BY: CN/CPT

COMPETITIVE SERVICE: Low Speed Multiplexing Service (LSMS) although this service is no longer a standard Bell Canada offering.

GENERAL DESCRIPTION

Channel-Deriving Arrangements permit an interexchange voice-grade data channel to be sub-divided into two or more private line or dial-up narrowband channels from a remote exchange to a central processing unit. Access to the remote exchange is provided by Telex or DataTelex, or by narrowband channel facilities. Channels are provided in channel termination groups of four and can accommodate speeds up to 180 bps.

When the multiplexing equipment is carrier provided, two services are offered:

a) Circuits providing access to a computer, and

b) Circuits connecting subscriber service points for teletypewriter service.

When the multiplexing equipment is subscriber provided the carrier provides circuits to connect the subscriber's service point.

TARIFF-NON RATING FEATURES

The standard multiplexing supplied by the Company is frequency division equipment. Time division equipment is available for larger quantities of channels but only provided on a special assembly basis.

The service can be integrated into the switched network (Telex/DataTelex) but only at the discretion of the carrier.

Subscriber provided equipment must be compatible with the carrier's facilities and the carrier, upon notice, may make tests to determine the equipment performance.

TARIFF-RATING FEATURES

The monthly charge for the service is the sum of the rates for inter-city channels and access charges at each end of the derived channels. Also, charges are applicable for any station equipment supplied.

SERVICE APPLICATION

The Channel Deriving Arrangements provide a very efficient method of handling communications from many terminals. However, the service is challenged by the lower-speed deriving arrangements offered by Infodat with the accompanying low channel rates. For instance, Bell Canada's channel deriving services have already been de-standardized and some customer channels converted to Dätaroute.

Table 6 - Current Facilities

SERVICE[1]	DESCRIPTION	CARRIER
Dataroute[2]	Digital Facilities up to 50 kbps	Bell Canada
Infodat[2]	Digital Facilities up to 50 kbps	CN/CPT
Sub-Voice Channels	Leased Facilities up to 180 baud[3]	Bell Canada CN/CPT
Voicegrade Channels	Leased Facilities up to 9.6 kbps	Bell Canada, CN/CPT
Telpak	Bulk rate facilities service	Bell Canada
Dataline II, III	Rating service for terminal-to-computer systems	Bell Canada
Telex Computer Inquiry Service	Rating service for terminal-to-computer systems	CN/CPT

Note 1: Services have been grouped to reflect inter-carrier competition.

Note 2: The information for Dataroute and Infodat has been included in the Networks section at p. 19.

Note 3: A baud is defined in the section on Sub-Voice Channels.

SUB-VOICE CHANNELS

PROVIDED BY: Bell Canada and CN/CPT

GENERAL DESCRIPTION

Sub-voice channels are private line facilities designed for transmission of data or textual material between two or more points at speeds ranging from 45 baud to 180 baud. They provide for transmission in half or full duplex, two-point or multi-point configurations. This service is generally used for private line teletypewriter usage although not restricted to this alone.

The following table shows the transmission speeds available for each schedule by carrier:

Table 7 - Sub-voice Channel Schedule

CARRIER	SCHEDULE #1		SCHEDULE #2	SCHEDULE #3		SCHEDULE #3A	
	Up To 45 baud	Up To 50 baud	Up To 55 baud	Up To 75 baud	Up To 82.5 baud	Up To 150 baud	Up To 180 baud
CN/CPT		X	X	X		X	X
BELL CANADA	X		X		X	X	

Sub-voice channels can be leased on a local basis between service points within a building, on a local basis between points in a city, or on an interexchange basis between points in two or more different cities.

Note: A baud is a unit of signalling speed (i.e. number of signal events per second). If each signal event represents only one bit condition, (as in the above table) a baud is the same as bits per second. Transmission rates for sub-voice channels are usually given in bauds.

Alternate data/voice is not available with sub-voice channels because the channels do not operate in an analogue mode but allow for ON/OFF pulse transmission. If a customer wishes to interface data processing or teletypewriter equipment using binary voltage signals on a sub-voice channel, a data loop converter or station arrangement is need to convert the binary voltage signals to DC current signals (e.g. on/off pulse transmission).

TARIFF-NON-RATING FEATURES

Bell Canada actually has two service offerings which fall under the sub-voice heading, Narrowband Data Channels and Private Line Teletypewriter Channels. Both services are operationally identical; however, the former is for use with customer provided equipment whereas the latter is used with carrier provided equipment. CN/CPT makes no such distinction.

TARIFF-RATING FEATURES

Bell Canada has two rate schedules. One is used for circuits or channels between exchanges or rate centres in Company territory; the other for circuits or channels originating in, but terminating outside, Company territory (Trans-Canada). The rates charged for non-Trans-Canada traffic are higher. CN/CPT has one rate schedule, with rates similar to Bell Canada Trans-Canada rates but at a slightly lower cost per mile.

The rates for both carriers consist of a flat monthly charge for the interexchange mileage, plus flat rate local loops. Rates are based on the service period (day, night, 24-hour) and distance (first 300, next 300, next 400, next 500 and over 1500) with the cost declining with distance. The intra-company Bell Canada distances reflect the Company's smaller operating territory by dividing the distance into smaller units (first 100, next 200, next 300, next 400 and over

1000). Charges per mile also increase with schedules capable of higher transmission speeds. For full duplex operation the charge or rental of the circuit is 125 per cent of that of the basic rate.

SERVICE APPLICATIONS

Sub-voice channels are used for private line, low-speed applications. When configured for multi-point use the circuits are used to link head offices to factories, for assembly line data, and inventory control. The channels can also be used effectively for in-house systems, scheduling, and order information dispatching.

VOICE-GRADE CHANNELS

PROVIDED BY: Bell Canada and CN/CPT

GENERAL DESCRIPTION

Voice-grade or medium speed data channels are private line facilities having bandwidths equivalent to those provided on normal voice telephone services (about 3000 Hz). Data channels are available for two-point, multi-point, multi-drop, half or full duplex, 2-wire or 4-wire configurations. The channels can be used on a local or interexchange basis. Various grades of conditioning arrangements, called 4A, 4B, 4C, are available to improve the channel characteristics in order to allow higher speeds over the standard Schedule 4 Type 4 channel. The type of conditioning required is a function of the characteristics of the data set used. Conditioning is required for the local loops only because the interexchange circuits are already conditioned for maximum data transmission rates.

The following table illustrates the type of conditioned channels required with Bell Canada data sets. CN/CPT has similar requirements.

Table 8 - DATA SETS AND CORRESPONDING GRADES OF CHANNEL

SPEED	DATA SET	GRADE OF CHANNEL REQ'D
over 150 up to 300 bps	108 type	Sched. 4 type 4
1200 bps	202D	Sched. 4 type 4
over 1200 up to 1400 bps	202D	Sched. 4 type 4A
over 1400 up to 1800 bps	202D	Sched. 4 type 4B
2000 bps	201A	Sched. 4 type 4A
2400 bps	201B	Sched. 4 type 4A
4800 bps	4800 series	Sched. 4 type 4B
over 4800 bps	special assembly	Sched. 4 type 4C

Voice-grade channels operate in an analogue mode and they can be used for alternate voice/data applications except when connected to a digital facility, such as Dataroute or Infodat.

Wideband data channels can be provided on an individual case basis (special assembly) for data transmission speeds greater than those available at voice-grade levels (i.e. 9600 bps). The service is used to transmit data at speeds of 19.2, 40.8 or 50.0 kilobits per second or higher. It is composed of a communications channel, 300 series data set, and a wideband station arrangement.

TARIFF-NON-RATING FEATURES

Customer provided equipment can be attached to voice-grade facilities. However, it is the responsibility of the customer to specify the grade of conditioning required.

Additional channels may be derived from a voice-grade data channel either by customer provided equipment or special assembly, carrier equipment.

TARIFF RATING FEATURES

In the same fashion as narrowband data channels, Bell Canada has two rate schedules, one for Bell Canada territory and another for communications originating but terminating outside of Bell Canada territory (Trans-Canada). In both cases, especially for intra-Bell Canada transmission, the rates are slightly higher than those of CN/CPT.

The rates for both carriers consist of a flat monthly charge for the interexchange mileage based on distance, with the cost declining with distance. Local loops are included in the

inter-exchange rate.

Conditioning charges are extra and the customer is billed on a flat monthly basis for a conditioning arrangement at each end of the circuit.

Full duplex or two-way simultaneous transmission is charged at 125 percent of the standard half duplex rate. Full duplex, two-way simultaneous transmission is defined as that mode of operation in which customer data signals are transmitted simultaneously in both directions over the 4-wire Schedule 4 data channel. Subscriber data signals consist of subscriber intelligence data only and do not include the flow of control tones, block acknowledgements or signals required to maintain synchronization. Therefore, alternate transmission of subscriber data signals, one-way at a time, over 2-wire or 4-wire constitutes non-simultaneous data transmission. When a customer requires a 4-wire facility for non-simultaneous data transmission, the 2-wire half duplex rate is charged. The additional 2-wire local loop is an extra charge.

SERVICE APPLICATIONS

Before the introduction of digital facilities such as Dataroute and Infodat, private line data communication was accomplished with voice-grade channels. Voice-grade circuits are still used in situations where digital services are not available and to connect a customer location to a digital serving area. The facilities are used for time sharing, data retrieval, accounting, payroll or any application which requires the use of a private line facility.

TELPAK

PROVIDED BY: Bell Canada

GENERAL DESCRIPTION

Telpak service provides bulk rate discounts of multi-channel circuits on a two-point or multi-point basis. The service may be used for most forms of communications, such as voice, facsimile, and data transmission. The basic notion underlying the provision of Telpak implies that economies of scale are evidenced as the volume of channels needed by a particular user increases. This view is reflected in lower unit charges for high volume users.

Telpak consists of a number of intercity voice-grade circuits in multiples of 12, offered between certain locations which have sufficient volumes of information flow. The following table indicates the base capacities of Telpak circuits.

Table 9 - TELPAK BASE CAPACITIES

Classification	Maximum Equivalent Telephone - Grade Channels
Telpak A	12
Telpak B	24
Telpak C	60
Telpak S*	120

TARIFF-NON RATING FEATURES

A subscriber may derive additional channels from a Telpak channel. Access to the switched network can be gained through a switchboard.

*Telpak S is available only between Bell Canada exchanges. It was developed primarily for the large circuit requirements of the Federal Government.

TARIFF-RATING FEATURES

There are two rate schedules for Telpak; one for traffic between Bell Canada exchanges and another for traffic originating within but terminating outside of Bell Canada exchanges. The latter schedule has slightly lower rates per mile.

A subscriber pays flat, monthly charges per mile for the base capacity of a selected Telpak size whether it is used or not. This differs somewhat from the decreasing incremental mile charges associated with individual private line circuits. Once a subscriber uses a Telpak at full capacity additional circuits can be added, with charges that approximate the average cost per circuit. As a subscriber moves to a Telpak with a larger base capacity the average cost per circuit decreases. The rate structure is so arranged that a user is given an incentive to lease the next largest Telpak when the number of circuits required is over 50% of the base capacity of that Telpak.

In addition to the interexchange charges, a subscriber is charged for channel terminations at flat monthly rates for each circuit used in a Telpak. The initial circuit is charged at a higher rate than each succeeding circuit. Channel termination charges vary according to whether it is used for telephone, data transmission, etc.

For full duplex operation the interexchange circuits are charged at 125 per cent of the regular rate. Channel termination charges are also increased moderately for each class of service for full duplex operation.

SERVICE APPLICATIONS

Telpak service is utilized primarily for high volume inter-city voice traffic. Large corporations, eductional institutions and governments are the main customers for the service. Telpak can

also be connected to a US Telpak circuit at certain designated border crossings. Branch offices and factories can then be linked in a cost-effective way to their parent firms.

DATA-LINE II & III

PROVIDED BY: Bell Canada

COMPETITIVE SERVICE: Telex Computer Inquiry Service (CN/CPT)

GENERAL DESCRIPTION

Data-Line II and III provides for the transmission of data from remote originating data stations (users) to a centralized data terminal (provider) such as a time sharing computer. The service is available wherever DDD is provided. A Data-Line II system is designed for the transmission of data at speeds up to 300 bps and a Dataline III system for transmission of data at speeds up to the capability of the voice network (2400 bps). The Data-Line services are one-way originating from the user only. Automatic dialers, located in either the remote central office or the users premises, originate calls to the provider access lines and are activated by placing the telephone in an off-hook condition at the users station. A customer can access more than one computer port using a terminal with a Multi-Number Dialer. Alternate data/voice is not available. Full duplex transmission is available with Data-Line II but not with Data-Line III.

TARIFF-NON RATING FEATURES

At the user location carrier or customer provided data sets are allowed. The data sets at the provider end (CPU) must be provided by the carrier.

A Data-Line system is furnished subject to the availability of suitable facilities. All points in the system must be located in Canada.

TARIFF-RATING FEATURES

Rates consist of the monthly rate for each access line at the CPU end and the monthly rate for each originating user station. User station rates are determined by the mileage between the user and the provider, with the mileage applied to a corresponding rate on one of thirteen mileage bands. Charges per mile per station decrease with increasing distances and numbers of stations. Because the speed capability of Data-Line III is greater, rates for both the access lines and originating user stations are higher, reflecting the increased cost to the carrier to provide the service. Data-Line II however, offers a reduced rate for any additional user stations in excess of 10 in any one mileage band.

In addition to the monthly rates, the customer has a period of up to six months to develop the system to a minimum of five access lines and 10 users with a minimum of two users in any mileage band. At the end of the six month period the charge for the minimum system is applied, with any missing stations considered to be located in the first mileage band.

SERVICE APPLICATION

Data-Line II in particular, and Data-Line III were designed to serve the needs of the computer time sharing industry to enable a time share firm to supply customers of users a total package including software, hardware and communications. In addition these services may be used for other applications such as information retrieval, private time sharing systems for large businesses or institutions, and for information collection systems.

TELEX COMPUTER INQUIRY SERVICE

PROVIDED BY: CN/CPT

COMPETITIVE SERVICE: Data Line II and III (Bell Canada)

GENERAL DESCRIPTION

Telex Computer Inquiry Service provides for flat rate charges, in lieu of tolls, for communications originated by Telex or DataTelex outstations (users) to a centralized computer (provider). The service is only available in Canada and is designed for the transmission of data at signalling speeds up to 180 bps.

The service consists of two separate offerings, flat rate calling for outstations located in the same city service area as the centralized computer, and flat rate calling for outstations located in cities other than the same city service area as the centralized computer.

TARIFF-NON-RATING FEATURES

Service is furnished subject to the availability of facilities and only in Canada.

Terminal equipment at the outstations may be either standard carrier offerings or customer provided.

TARIFF-RATING FEATURES

The flat rate, in lieu of tolls, is a summation of two charges. First, there are port charges depending on the number of Telex lines required to the centralized computer to handle the total communications from the outstations, with the exception of the outstations located in the same city service area as the centralized computer.

Outstations in the same city area will normally be served by separate groups of Telex lines. Second, Outstation Charges are applicable to each outstation. The distance from the city in which the centralized computer is located to the rest of Canada is divided into 13 mileage bands, each mileage band having a different outstation rate. The appropriate mileage band and rate for each station is determined by the inter-city mileage between the city in which the outstation is located and the city of the centralized computer. Outstations in the same city service area as the centralized computer are charged a flat monthly rate and are not included in the mileage band rates. A reduced monthly rate applies to each additional outstation in excess of the first 10 stations in the same city or local service area and accessing the same number. This does not apply to those outstations which are in the same city serving area as the centralized computer.

SERVICE APPLICATIONS

Telex Computer Inquiry Service was developed as a total service offering for the transmission of data communications from many users to a centralized computer. The concept behind the service is essentially the same as that of the Dataline service of Bell Canada except that the rates are lower both for port and outstation charges and the service does not have any minimum configuration requirements. With a maximum speed of 180 bps the service appeals more to low speed teletypewriter services than higher speed (300 bps and 2000 bps) interactive terminals which Bell Canada Dataline services can better service. Telex Computer Inquiry Service is applicable, however, for time sharing and can be used for information retrieval and collection systems.

APPENDIX A

Speech given by S. Erskine, General Manager, Data Network Planning, Bell Canada on 30 March 1976 at the DPI Conference in Ottawa

A year ago, I addressed this conference on the subject of Packet Switching and how we were using this technique in our new Network "DATAPAC". This network is now one year closer to reality, and as I think many of you are aware, will be operational this year. So what has happened during the last 12 months and how will this impact our Datapac services?

Perhaps the most significant achievement over the past year has been the consensus between carriers as to how Packet Switching would be used to provide Data Communications services: and of much more practical importance is international agreement to a Standard User to Network Protocol for Packet Mode Operation.

But before I talk about the international standard, and how it relates to Datapac, I would like to first review some of the issues that have led us to build such a Network.

In order to set the stage, I would first like to address two words which are very commonly used in our business, These two words are monopoly and competition.

Monopoly

In Canada, the telecommunications industry is a semi monopolistic one because there is a controlled number of carriers providing communications service. Traditionally, a monopolistic environment brings to mind such phrases as non-innovative, too expensive, non-market or consumer oriented. The monopoly is often regarded as "an organization" that is out to control the industry it serves.

Fortunately, most people will agree, that such monopolies do have some redeeming features... In the case of Telephone Companies these include making services commonly available to all, taking a total systems approach and establishing clear interface arrangements.

Competition

On the other side of the coin, there is the computer industry, particularly the terminal part, which operates in a very competitive market. Here you are bombarded by such phrases as "the choice is phenomenal", "the offerings are user oriented" and "the product is most cost competitive". Now this probably seems like the better situation of the two because the user has simply to sit back and take the best offer. But is this the best alternative? What about adherence to some long term standard or set of standards? Certainly we have learned through experience with the telephone network, that there must be a common standard in communicating devices so that individuals can talk with other individuals within the country or even the world.

In looking back the short 15 years that mark the life of the computer communications industry, we see that there has been little regard for standards in Computer Networks, except for the very rudimentary standard necessary to interconnect with common carriers.

Now we will be the first to admit that for stand-alone products where system integration with existing and future products, is not a necessity, competition is the only way to go. But this cannot be the case for computer networks. You, the users and manufacturers know it, when you find yourselves unable to access other terminals and networks, and we, the common carriers, know it when we find ourselves faced with the problem of interconnecting to many different devices all operating in different modes and at different speeds.

Users want integrated systems designs for their on-line computer systems and they want freedom of choice between manufacturers. It is our premise that common carriers can fill the function where competition is weak. A common user communications system holds out the promise to meet both of these needs and still allow most of the benefits that can be derived from competition.

As we see it, if many private systems are put together by large corporations or groups of large corporations, the result will be the extension of what is now happening. Each large corporation is building its own private system into its own standard. Each large manufacturer is coming up with his own standard system design parameters in order to be able to provide total systems in a logical manner.

This proliferation of private systems is certainly unacceptable to us, TCTS and we think, in the long term, will be unacceptable to our users.

The question is: "How will these systems be integrated in the 1980s if nothing is done now?" And just as important "Who will take the responsibility to provide this integration?".

All of our Activities over the past 10 years,

- M.S.D.S.
- Multicom II
- Communication Controllers
- Dataroute
- Terminals

with their varying degrees of success and failures, interaction with manufacturers and users, have led us to one conclusion:

A more flexible, shared, common user network, designed with on line computer communications in mind is required on a national basis if Canada is going to enjoy the benefits of universally available Data communications over the long term. This is what our Datapac project is all about.

It will not be easy to superimpose a new concept into an environment basically designed to expect only transparent wires from carriers. But the benefits we feel are well worth the effort.

What is Datapac?

Basically, it is the application of packet switching techniques to our backbone digital data network to provide a universal usage sensitive service designed specifically for the computer communications environment.

In 1976 TCTS will have Digital facilities coast to coast in the P.D.U.V. system (Vancouver to Halifax). The LD-4 system (274 mb/s on 2 Co-ax tubes) will be in service in the Golden Triangle (Ottawa - Montreal - Toronto) and our short haul LD-1 and T-1 systems provide local inter-office service to numerous locations. Already, plans are being developed for Digital Radio systems for service before the end of the decade.

The development of this Backbone Digital structure is fundamental to the evolution of shared Data networks.

First lets review the overall objective of Datapac, Unlike the telephone network the characteristics of the information to be transferred over a network is varied and most application oriented. The primary objective of Datapac is to efficiently carry this myriad of data through one physical connection to customer equipment. In other words the network must be Multi Application, meeting the needs of such diverse requirements as inquire/response and remote job entry.

How does the network accomplish this? In a non technical way, service can be broken down into two basic types:

- Permanent Virtual Circuits
- Switched Virtual Circuits

Packet switching allows these circuits to be established, yet the network is only used when Data Transfer takes place, and the two D.T.E.'s can be speed independent.

Terminals with logical capabilities, and S.N.A.P. implementation may have several switched and/or permanent virtual circuits at the same time over one physical link to the network. These Virtual Circuits may all be terminating at different terminals.

This is accomplished by the network independently administering the network-user path through the establishment of logical channels. The two logical channels that form part of a virtual circuit are quite independent from each other.

What types of terminals can support S.N.A.P.?

- Computers
- Intelligent Terminals
- Terminal Controllers
- Carrier Provided Non-Snap Terminal Interfaces (N.I.M.)

What's in the Gray Mass?

The Datapac Network has been very carefully structured to keep the evolution and enhancement of the internal network independent from the user. Unfortunately, I can say very little technically about the Back-Bone Network at this time. Those interested should plan on attending I.C.C.C. in Toronto in August, where we will first release technical information.

Briefly all nodes are doubly connected using high speed digital facilities, and the entire T.C.T.S. network is centrally monitored from the Network Control Centre located in Ottawa.

With such a novel and flexible approach to Data Networking, the important thing is to get started, While the initial services may seem limited, we expect that by the end of 1977 an integrated family of services will be available on Datapac which will go a long way to meet the total needs of on-line Computer Communications systems. We expect that dialogue with customers during the next six months will enable us to set priorities for our service development program.

I promised at the beginning that I would discuss S.N.A.P. and how it relates to the recently adopted X-25 international recommendation.

First, I would like to point out that Datapac will be providing two types of interface

1) Device-dependent
2) Device-independent

I will not dwell on Device dependent interfaces at this time, except to say that they are required to support terminals with hard wired or fixed logic. These include teletypewriters, point of sale terminals, remote job entry terminals, etc. and a family of device dependent specifications will be required.

On the other hand, only a single specification of a device independent interface is required. Since no significant vested interest was apparent, over the last two years we have worked long and hard for international agreement, we are most happy to report that this agreement has been achieved.

S.N.A.P. is totally compatible with the international standard recommendation X-25.

What is SNAP

SNAP is a 3 component protocol consisting of the Physical Interface, the Frame Level Logical Interface and the Packet Level Logical Interface.

The Physical Level of SNAP specifies the characteristics of the physical media by which a user device is linked to the network.

The Frame Level Logical Interface is responsible for administering the access line over which the user is linked to the network. Basically, it ensures that user data enters and leaves the network in an error free condition.

The Packet Level Logical Interface specifies the manner in which users establish, maintain, and clear calls through the network. It also specifies the manner in which control information and user data are structured into packets.

We will now look at the three components of SNAP in some detail. The first component of SNAP we will examine is the Physical Interface.

DTE's adhering to SNAP are connected to the Network by digital or analogue, four-wire, point to point, synchronous circuits.

Data sets or modems are required to terminate these circuits. The physical electrical and functional characteristics of the DTE to data set (or modem) interface are those of the RS-232-C standard. Since this is an existing standard, no changes to the interface hardware of the DTE are required. Initially, synchronous transmission speeds of 1200, 2400, 4800 and 9600 bps over the network access link will be supported. It is anticipated that 19.2 kbps and 56 kbps will be supported in the future.

A DTE requires only one access link into the network regardless of the number of Datapac Service offerings subscribed to. Access link capacity is governed by the total throughput, and the degree of back up, required by the user.

The second level is the Frame Level Interface, The Frame level specifies the use of data link control procedure which is compatible with the High-Level Data Link Control (HDLC) procedures being standardized by ISO. An HDLC class of procedure for a point-to-point balanced system is used, whereby the terminal and the network node each have a primary and a secondary function.

The functions performed at the Frame Level are:

- synchronizing the link to ensure that the receiver is in step with the transmitter,
- detecting transmission errors and correcting them by retransmission,
- identifying and reporting procedural errors to higher levels for recovery.

In essence the Frame Level provides the Packet Level with an error-free, variable delay link between the terminal and the network.

Frames crossing the DTE/network interface are structured as shown:

Where F - Is a one octet flag sequence found at the start and end of each frame, This flag is used to achieve synchronization between the transmitter and receiver and to delimit the frame. Transparency is achieved through a zero bit insertion technique which prevents this unique flag sequence from occurring within the frame boundaries.

A - Is the one octet address of the network node.

C - Is a one octet control field. This is the main vehicle for user/network communication at the frame level. It is in this control field that instructions for requesting retransmission of frames, controlling the flow of frames and for logically initiating and closing the link are housed. Under these HDLC compatible procedures, a device on the link may have up to 7 information frames unacknowledged by the receiver at any given time. This capability serves to increase attainable throughput while minimizing overhead transmissions.

Packet Level - This is an optional variable length field structured according to the Packet Level Logical Interface.

FCS - Is a two octet frame check sequence used for error detection purposes. The contents of the Address, Control, and Packet Level fields are subject to error checking in this manner.

We will now turn to the third component of SNAP, the Packet Level Logical Interface. This interface specifies the manner in which calls between DTE's are set up; maintained and cleared through the network. As well, it specifies how user data and control information are structured into packets.

Virtual Circuit Operation provides a DTE with the ability to have multiple calls to multiple remote DTE's in session at any given time. Because of this facility, a DTE must have a mechanism to indicate to which virtual circuit or call a given packet relates.

This is accomplished through the use of logical channels. Each packet crossing the access link has a logical channel number, which relates to a specific virtual circuit, indicated in its header. Here we see a DTE transmitting three packets across the access link, each specifying a different logical channel number. Packets to multiple destinations are interleaved over the single network access line using a dynamic multiplexing scheme. Under this scheme, access line bandwidth is assigned to a given call on a dynamic, as required basis. If bandwidth is not required by a call at any given moment, it is available to other calls operating over the access line.

Inside the Datapac node, a mapping process occurs, whereby Logical Channel Numbers are associated with destination DTE addresses. All packets, in transit across the network, are identified as to source and destination. For Switched Virtual Circuits the association between logical channel numbers and source-destination pairs is made at call set-up time. It should be emphasized that virtual circuits are an end-to-end or DTE-to-DTE concept, whereas logical channels are local and exist between the DTE and the network. Logical channels form each end of a virtual circuit and are used to identify that virtual circuit.

Let's examine a data packet in some detail. A data packet consists of two parts: Header and Data Field. In this representation, we see a variable length data field containing the desired communication content or text. Initially, Datapac will operate at a maximum data field length of 256 octets for normal class of service and 128 octets for priority service.

Coding structures used within the packet's data field are not specified under SNAP. That is, any code such as ASCII, BCD, EBCDIC, or BAUDOT can be used. In addition, SNAP does not preclude the use of encryption techniques on the contents of the packet's data field.

The three octet header of a data packet contains supervisory control information as shown where,

N(S), the send sequence number of the packet, is a sequential number (modulo 8) associated with each data packet, and is required to maintain the integrity of the transfer of data packets on a virtual circuit. It allows both the network and the DTE to detect the loss of data packets as well as to control the flow of data packets.

N(R), the receive sequence count, is used to confirm the receipt of all data packets numbered up to, but not including, N(R). This confirmation is local between the DTE and the network. N(R) also serves as a local authorization to transmit up to 7 additional data packets.

L, the level indicator, allows a receiving DTE to distinguish between two levels of data transfer. For example, it may be used to distinguish between data which is destined for a terminal or data which is destined for the controller handling that terminal.

M, the more data mark, is used in a full data packet to indicate whether there is a logical continuation of this data in the next data packet on this virtual circuit. The use of the More Data mark ensures that DTE's can operate at their locally selected maximum packet sizes.

LCN, the logical channel number, is used to identify the virtual circuit and thus the source-destination pair for this transfer.

TYPE - indicates that this is a data packet.

In addition to the Data packet, there are a total of 14 special packet formats associated with Call Set up and Control. Unfortunately, time does not allow me to go into these packets in detail.

In SUMMARY, I would like to say a few words about the expected benefits of the Datapac Network.

1) Universality: resource sharing inherent in the network enables small as well as large organizations to participate in a nationwide system.

2) Communication interconnection flexibility: the specification of a standard network access protocol facilitates communications between user systems.

3) Low cost: economics of sharing transmission facilities and switching and control equipment enable low communications costs to be offered to a large segment of Canadian data users on a usage-sensitive (by volume of data transmitted) basis.

4) Accuracy: powerful error detection and correction facilities incorporated into the Datapac Network provide users with virtually error free end-to-end data transfer.

5) Reliability: sharing of stand-by facilities, the provision of alternate routes through the network as well as network monitoring and control by a Network Control Center (NCC) result in high network availability.

APPENDIX B

Speech given by G.F. Carleton, Manager,
Strategic Planning, CP Telecommunications
on 19 February 1976 at a Data Communications
Conference in Baden-Baden Germany

February 19, 1976

INFOSWITCH

A PUBLIC NATIONWIDE DATA NETWORK IN CANADA

PROVIDED BY CNCP TELECOMMUNICATIONS

By: G. F. Carleton
Manager, Strategic Planning
CP Telecommunications

1. INTRODUCTION

The data communications industry in Canada is serviced primarily by two nationwide competing common carriers. CNCP Telecommunications is a cooperative arrangement between the telecommunications departments of the two major railways in Canada, Canadian National Railways and Canadian Pacific Limited. CNCP jointly supply data services throughout the country. In addition CN Telecommunications (which is a federally owned Crown corporation) provides telephone service in exclusive areas of the country, specifically the Northwest Territories.

CNCP's competition for the data-communications market is provided by the Trans-Canada Telephone System (TCTS) which is an association of telephone companies providing public telephone service in Canada. The association is a unique combination of private and provincially owned carriers. Bell Canada and BC Telephone are federally regulated. The predominant remaining companies belong to the provincial governments and as such are not subject to federal government regulation.

CNCP and TCTS compete on a service by service basis for the domestic data-communications market. The recently formed Canadian Telecommunications Carrier Association (CTCA) is a non-profit organization operated by all the carriers in Canada through which mutual problems and areas of common concern are discussed and resolved. The Canadian Carriers position on Network Access Standards, a subject currently in the forefront of the CCITT study group VII activities is developed within the CTCA, for example.

2. NEW CARRIER SERVICES

In 1974, CNCP and TCTS announced several new services which have had a major impact on the evolution of the data communications market in Canada.

The first of these new offerings was a point to point digital service called Infodat and Dataroute by CNCP and TCTS respectively. This service is primarily provided through a heirarchy of Time Division Multiplexors riding on high speed (56 kbps) trunks which derive "digital" circuits from the very low speeds of 50 baud through to 56 kbps.

Both systems are synchronized to clocks on a nationwide basis, and are designed to provide end-to-end digital point-to-point circuits.

The tariff structure of these two services has had a major impact in the communications market in Canada.

For example at 300 baud, a Montreal/Vancouver circuit (5000 km) decreased from approximately $3000./month to $300./month.

As stated above these services are only point-to-point in nature and therefore to expand to their capabilities CNCP and TCTS announced Infoswitch and Datapac respectively. Datapac, according to the publicly available information, is a nationwide packet-switching network to be implemented around July 1976.

Infoswitch on the other hand is a nation-wide hybrid circuit/packet switching network which will be available in the latter part of 1976.

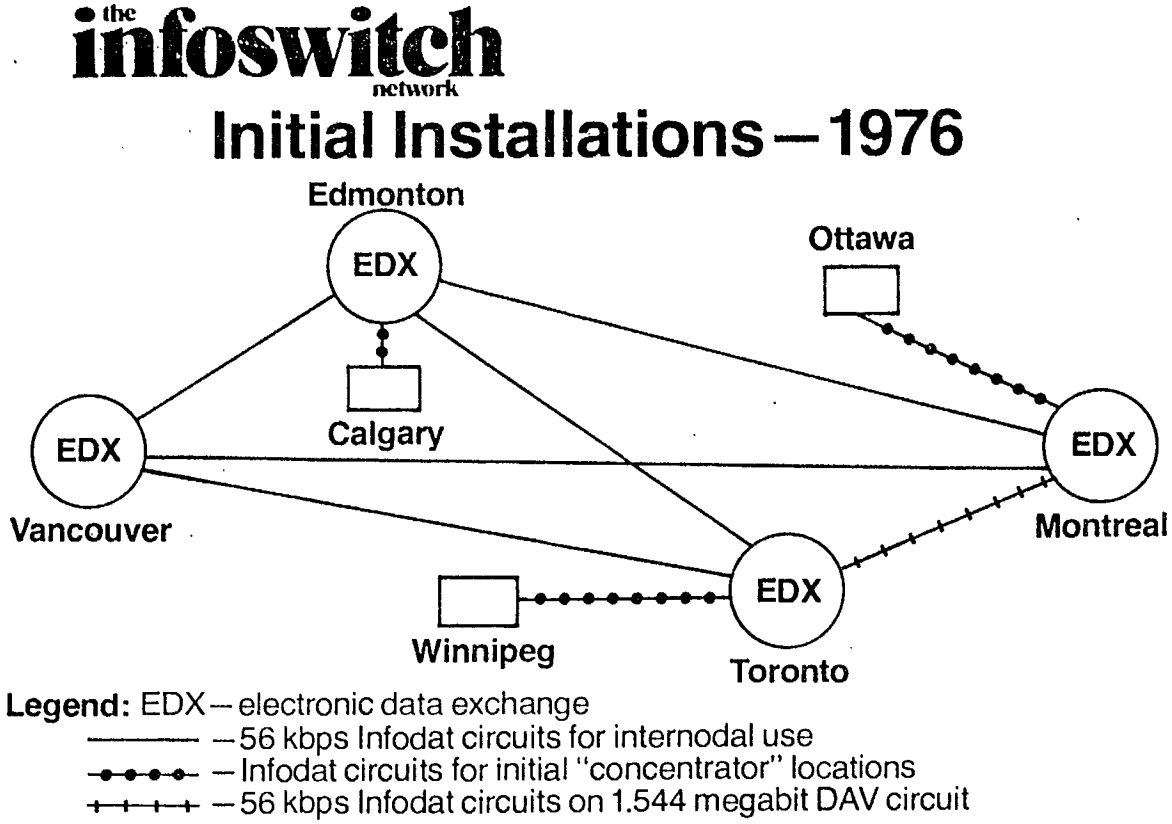
As can be seen by the scheduled implementation dates, the current time is a very active one in terms of the finalization of the network characteristics, specifically those aspects which relate to the so-called standard packet-mode interface (X.25). These issues are discussed later on in this paper.

3. INFOSWITCH

3.1 General

The Infoswitch network is a hybrid circuit packet mode network in which the major characteristics of both operational switching modes are evident. Four switching nodes (EDX) are being implemented in the first phase of operation. These nodes will be located at Vancouver, Edmonton, Toronto and Montreal. The nodes will be interconnected utilizing digital "Infodat" facilities for all modes of operation. Initially the circuit mode, called Infoexchange will utilize individually derived circuits dedicated to the speed of the customer. However, as the base of users grows, it is planned to implement a dynamic multiplexing technique which will enable the selection of

the required bandwidth from, say a 56 kbps trunk, at the time of call establishment. Needless to say the intelligent multiplexors will communicate with the switching nodes to achieve this end. The virtual call modes of operation, Infocall and Infogram will utilize inter-nodal packet mode trunking up to 56 kbps. The Toronto-Montreal trunks will be carried on a 1.544 Megabit/sec DOV path currently being implemented on the CNCP microwave network. The switching nodes themselves which are being provided by Siemens, utilize standard commercially available mini-computers coupled with sophisticated communications controllers and line-terminating equipment designed to accommodate the Infoswitch requirements. Infoswitch, in addition will be locked into the nationwide clocking system which is used for the provisioning of CNCP's Infodat digital transmission network.



3.2 Infoswitch Features and/or Characteristics

There are several overiding mandatory characteristics that CNCP insist a public data network must have. Some of the major features will be discussed in the following few pages.

Any digital network adds delays to the transmission of the data. In addition any service which operates in the packet mode,... which we equate to a simplified form of store and forward message switching... adds additional store and forward delays.

Therefore, a prime design objective in the Infoswitch network is the minimization of these delays. The delay caused by the network for the circuit mode will be one octet per switch and the delay for the packet mode will be approximateley 150 milliseconds per switch.

Additionally, a fast call set-up is required to meet the future market needs and therefore an average call transitting three (3) Infoswitch nodes will be set up in less than 1 second. This criteria will be met in both modes of operation, that is circuit or packet, since all network signalling will utilize the packet mode for simplicity and efficiency. This means that even the lower speed operation in the circuit mode will not be restricted to the slower transmission rates for the network signalling data along its trunk routes. In effect a true common-channel signalling approach will be implemented, utilizing the packet mode trunks.

The Infoswitch network will utilize a predetermined alternate routing technique only. In this regard, it will differ from the classical design approaches of packet networks, however, CNCP in analyzing the geography of our country, and in weighing the additional costs and complexities to both the network and the user which are introduced with dynamic adaptive alternate routing, felt that the predetermined alternate routing was the optimum solution. A side benefit of this decision, and a mandatory requirement of any network offered by CNCP is that data will be delivered in the same sequence as it is received. This is a feature which networks utilizing the dynamic adaptive routine approach cannot guarantee on a broadly implemented unrestricted public basis without significant expense and complexity.

The Infoswitch network will be capable of providing for both synchronous and asynchronous speeds up to 9600 bps and will be capable of supporting any 5, 6, 7 or 8 level code although initially only ASCII, EBCDIC and BCD will be offered to the public. Similarly, the initial speeds which will be offered are 134.5, 300, 600 and 1200 baud asynchronous along with 1200, 2400, 4800 and 9600 bps synchronous.

The network will operate on a closed numbering scheme utilizing a three digit area code and a four digit subscriber number. In addition, essentially total flexibility is available to interface with other networks utilizing different schemes since the network will be able to accommodate up to 16 digits of addressing information both for routing and administrative purposes.

One hundred area codes will be reserved initially for the network special services, which may include anything from test and maintenance, to specialized store-and-forward services which may be offered. These have not yet been assigned.

There will be no dial-plate operation in the network. All addressing will take place in the code and speed of the connected DTE. Therefore, it is anticipated that the majority of connections will utilize keyboard addressing, and the connected computers will be able to utilize a very simple interface procedure which will allow them with ease to both accept and establish calls.

Users of the services in the network will be able to subscribe for abbreviated dialing which will feature 1 or 2 alpha/numeric octet operation with no limitation (design) on the flexibility and no escape digits required as is the case in the more traditional abbreviated dialing services.

Hot-line service will also be available to all users. Collective numbering groups will be offered in the traditional fashion. A master number will give access to the collective group. However, to facilitate testing, all other connections in the group may be addressed individually without the free-hunting action being initiated by the network.

In order that some customer groups may be able to operate essentially in a private network fashion, the Infoswitch network will offer intially the possibility of up to 128 closed user groups in the network.

Camp-on and Retry will both be provided. In the case of the circuit mode of operation, a customer who has subscribed to the service may initiate a retry option in which the originating node of the call will attempt to reach the called number up to 5 times with call attempts being made, say every 30 seconds. The retry procedure will be terminated if the calling party attempts to set-up another call.

In the case of the virtual-call subscriber, however, a true camp-on feature will be offered. In this case if the called party has subscribed to the service, the calling party will receive a coded signal indicating he has camped-on to the called party and is awaiting connection. Camp-on may be terminated if the calling party disconnects, or goes on hook, or attempts to set-up another call.

From the foregoing, it is obvious that an array of signals which will provide call-status notification to the calling party will be provided. In the event that a user's DTE is unable to recognize, or print the signals, or address the network, CNCP will be providing a network addressing unit for the customer.

High reliability and network availability will be achieved through the provisioning of alternate routing, full hot standby mode of operation in the switches, error detection and retransmission in packet mode, on-line diagnostics of hardware, uninterrupted power supply.

3.3 Infoswitch Initial Services

3.3.1 Initially, the network will provide three basic services. The first one, Infoexchange service is a pure circuit switching operations which operates in the traditional circuit switching fashion and provides all of the capabilites listed in the above text.

The second two services, Infocall and Infogram service are virtual call services and are basically the same in that logical connections are established through the network. However, in the Infocall service the network carries out the packetizing functions, whereas the DTE on the Infogram service is responsible for the packetizing function.

This means, by definition, that all DTE's utilizing Infogram service must be intelligent enough to implement a virtual call packet mode standard. This is currently being discussed in great detail within the SGVII activities of CCITT.

3.3.2 Infocall Service

Infocall service is available to all terminals "dumb" and "intelligent" alike, but is primarily intended for the low speed inter-active user. In this case the network will packetize the user's data into packets suitable in size to allow an acceptable response time in the network. The network will determine the packet size which will vary depending on the nature of the call which has been established. The subscriber will essentially be unaware of the packetizing nature of the network. He will realize and accept however, that he is being charged in accordance with how many ocetets or characters he transmits and receives and not in accordance with the connect time.

All of the network offered codes and speeds may be implemented in the Infocall service, although in spite of the store and forward nature of the service, code and speed conversion will not be provided initially.

As was the case with the Infoexchange service, all of the features mentioned in paragraph 3.2 are available to the Infocall DTE. In addition, however, a special option will be provided, called the computer concentration option.

3.3.3 The Concentration Option

The computer concentration option is designed to allow host computers, who have a large number of low speed ports operating on a collective number group basis, to communicate to a host computer via medium speed lines on which multiple simultaneously Infocalls may be established. It is anticipated that this option will be attractive due to potential host computer hardware savings. Over this connection, the computer host will be able to originate and receive calls with equal ease without any additional hardware utilizing very simple interface procedures.

Traditionally, in Canada, a host computer would be required to have individual port groups to service every city to which the host requires access. With the Infoswitch network, he will require only one group of ports to service the complete country. In the normal case, therefore, the host operator would lease sufficient ports between his computer and our network to provide an adequate grade of service to his users, taking into account, in the Canadian situation, the 4.5 hour time zone differentials between the east and west coasts which effectively causes a peak hour distribution on a regionalized basis.

It will be possible for the operator to lease a medium speed interconnect to the network over which the low speed data from the terminals will be effectively multiplexed in a efficiently formatted fashion. The link itself would operate under the normal case, using a subset of HDLC.

Because the network/host link is now operating at a higher speed than previously the network will packetize the low speed DTE's data in larger packets, thereby increasing network efficiency without reducing end to end response time.

3.3.4 Synchronous Infocall

The Infocall service will also provide for point-to-point synchronous transmission on the basis that the framing data utilized in the standard protocols will be switched through the network and utilized by the user on an end-to-end basis. Therefore, synchronous Infocall users will not have the ability to utilize the concentration option.

3.3.5 The Infogram Service

The Infogram service is an other virtual call packet-mode type of service in which the user will transmit and receive standard packets to and from the network. As was the case in Infocall, logical connections will be established by the network to accommodate the routing of the Infogram packets.

In this case, however, the DTE's will be inherently intelligent and, therefore, they will be able to establish multiple simultaneous virtual calls in the network. In a sense they will establish a uniquely dimensioned community

of interest for transmission and reception of packetized data in accordance with their requirements. Typically, therefore, the DTE's will be computers or an intelligent controllers for a cluster of interactive inquiry response type devices. A flow control procedure will operate to administer the flow of packets to and from the network. The address portion of the packet will be utilized by the network to associate the packet with the appropriate virtual call. All of the previously mentioned network features will be available to the Infogram DTE.

The synchronous frame in which the packets are carried will not be transmitted on an end-to-end basis in the network. Rather it will be stripped off at the originating node and the packet will be carried throughout the network as a block of data. Therefore, it is possible to accomplish several objectives:

- protocol conversion, for example data could be received under a subset of HDLC and delivered under a subset of BSC.

- intermingling of asynchronous Infocall data and synchronous Infogram data over the same network host interface trunk.

This means that a host computer could simultaneously establish multiple calls over one link (9600 bps) and communicate both to asynchronous low speed Infocall DTE's and to Infogram packet mode DTS's. This enables the integration of both high volume and low volume users into the same host connection.

4. Infoswitch Hardware/Software

Infoswitch represents an exciting application of Siemens system EDX to meet the present and future needs of the data communications world. The EDX Hardware/Software offers a unique flexibility which is attractive in this Infoswitch application. The switches may be reconfigured readily in accordance with market growth of the particular services in any given region.

4.1 Infoswitch Hardware

The Infoswitch Hardware is comprised of three major components:

1) Communications hardware
2) Central processor hardware
3) Peripheral equipment.

Items 2 and 3 above are standard commercially available items, with the Central Processing equipment being in the PDP-11 family of hardware.

The communications hardware is primarily comprised of Line Terminators (LT's), and a Communications Controller (CC) specifically developed by Siemens to meet these data communications requirements.

More specifically the communications hardware connects the Line Terminating equipment with the CPU in the call establishment and packet mode call connected phases while enabling a through connection from LT to LT in the circuit mode of operation.

This means that the Infoexchange users can communicate in the call connected mode without any load on the central processing unit. This operation is possible based on a character oriented time division multiplexing method utilized in the Communications Controller.

In the store and forward mode (Infocall and Infogram) the CC also provides for autonomous two-way transfer of data to and from the CPU where the packet mode software is implemented.

In addition the CC provides for the scanning of all LT's as well as other specialized functions such as the recognition of system specific significant characters or character sequences.

The line terminators will provide a substantial degree of flexibility in the initial implementation of Infoswitch. All terminations will be equipped with an EIA 423 interface. In addition all terminations will be able to handle any 5, 6, 7 or 8 level code at speeds of up to 4800 bps asynchronous and 9600 bps synchronous. Of course the LT's utilized on internodal trunks will accommodate speeds up to 56 kbps.

In addition to providing the Input/Output functions of serial/parallel conversion the terminators contain control logic to enable interworking with the CC and the CPU.

A significant degree of flexibility enabling line specific significant character detection is also built into the LT's. Many special features required for the handling of specialized protocols such as HDLC (bit insertion deletion) are also included in the terminators.

4.2 Infoswitch Software

The operating capabilities and the high degree of flexibility of the Siemens System EDX are essentially determined by the EDX system software support. The EDX software consists of:

- the Operating System and
- the Maintenance System.

The main tasks of the software are:

- internal coordination and task dispatching
- System safeguarding and ensuring cooperation between the two computer systems in exchanges with hot-standby capability
- Control of the computer peripherals
- Control of the switching-oriented operations
- Support for changing operational parameters such as mode of operation or class of service
- Support of hardware check-out and maintenance.

Each EDX exchange operates under the control of a Site Program comprising program modules of the Operating System and, if necessary, of customer specific programs.

The EDX software is organized in an optimized modular structure. This is achieved by separating program functions, assigning each unique function to a separate program module, clearly defining the input to, and the output from and the processing to be done by each module, and designing clearcut demarcation between functional modules.

The Operating System comprises the Control Systems and the Switching Programs designed for the operation of the system as well as the Language Processors and Utility Programs required for Site Program preparation and modification.

The Control Systems and Switching Programs perform the computer and switching-oriented control functions which occur in the operation of an exchange. The exchange-specific Site Program consists of a subset of these programs. The number and the size of these programs are dependent on the particular system configuration and the performance characteristics required.

The Language Processors and the Utility Programs are used off-line and are run in EDX itself without requiring the support of external computer systems.

The Maintenance System supports the commissioning and maintenance of an EDX exchange. It comprises Test and Diagnostic Programs for all the hardware facilities of the system.

The hardware and software of the EDX system permits exchanges with the aforementioned features to be implemented economically.

5. Interfacing Principles of the Infoswitch Network

CNCP have developed the requirements for Infoswitch with a number of major goals and principles in mind. These goals

and principles apply to both the circuit and packet mode services. It is our viewpoint that:

A properly implemented network interface will:

1) enable existing terminals of all classes to utilize the network.
2) enable single terminations of Infoswitch to operate in circuit and/or packet mode.
3) enable Infoswitch to interconnect any of its services with other national networks regardless of the fact they may be specifically circuit of packet mode oriented.

To achieve this, Infoswitch will implement procedures which:

1) maintain traditional protocols which have been used in digital data networks for years. (There is a logical consistency in all procedures laid out for Infoswitch DTE's. A voltage reversal may be replaced by the raising of a control lead, or the transmission of a specialized packet type, or character but the function will be the same.)

2) maintain a strict differentiation between the call establishment requirements of public data networks and the data transmission mode of operation.

3) maintain a clear DTE/DCE interface with minimum penetration into the customers Data Terminal Equipment.

In Canada, thousands of man hours have been spent analyzing the report of the Rapporteur on packet switching, Mr. Bother-by. This analysis has resulted in the preparation by CNCP and TCTS under the Carrier Association of two documents approved by the highest authorities of TCTS and CNCP as well as the Federal Department of Communications. These documents support the fundamental position of the rapporteur. Canada recommends the elements of the details of call establishment among others in Annex 13 and Annex 14 in the category of requiring further study.

At time of writing a new submission from France/UK regarding X.25 had just been received in Canada. However, since basically the areas of concern remain unchanged the recommendation of the Canadian Carriers to the government will not be revised.

It is the CNCP viewpoint, furthermore, that these items mentioned above require clearly more time to evolve and reach a clearly definitive stage. Hopefully, CCITT SGVII will forward a preliminary recommendation X.25 in which the details of the implementation of these principles can evolve taking into account their total relationship to public data networks whether they be circuit or packet mode - or as in the case of CNCP - both.

GLOSSARY OF TERMS

ACOUSTIC COUPLER - A device that permits the transmission of data over telephone circuits without making an electrical connection to the line.

ANALOGUE-The representation of numerical quantities by means of physical variables, eg. voltage, rotation.

ASCII - American Standard Code for Information Interchange. A seven bit code accepted as a communication standard in North America. ANSI Standard X3.4 - 1968.

ASR - Automatic Send-receive. A teletypewriter equipped with a paper tape reader and a paper tape.

ASYNCHRONOUS - The speed of transmission is not a fixed rate, however, the circuitry is designed to operate within given speed limits. Timing bits must be added to the data to maintain synchronization. Also referred to as start-stop transmission, ie. Data Set 103A operates asynchronously up to 300 Baud.

BAUD - A unit of signalling speed. Defined in two ways: 1) The number of signal elements per second where all such elements are of equal length and represent one or more information bits, 2) The reciprocal of the time duration of the shortest signal element being transmitted, ie. If the shortest signal element is .02 seconds the signalling speed would be 50 baud.

BAUDOT CODE - The standard 5-unit code used in older teletypewriter systems. Also referred to as the Murray Code. Machines utilizing this code are identified by their 3 row keyboards. ie. Models 14, 15, 19 and 28 teletypewriters use the Baudot Code.

BIT - A contraction of the term binary digit. A bit can be either 0 or 1 and is the smallest possible unit of information.

BIT RATE - The rateoof information transfer in a communications system. Normally measured in bits per second (bps). The bit rate is either equal to or some multiple of the baud rate (signalling speed) depending on the type of modulation being employed.

BPS - bits per second.

BYTE - A sequence of binary bits operated on as a unit. A byte usually contains 8 bits and can represent either one alphanumeric character or two numerics.

CENTRAL OFFICE - The location of telephone switching equipment where customers' lines are terminated and interconnected.

CHANNEL - An electrical transmission path between two or more stations or channel terminations. Channels may be furnished by wire, radio or a combination of both.

CHANNEL, FULL DUPLEX - A channel providing simultaneous transmission in both directions.

CHANNEL, HALF DUPLEX - A channel capable of transmitting and receiving signals, but in only one direction at a time.

CHANNEL, VOICE GRADE - A channel which permits transmission of voice frequencies normally in the pass band between 300 and 3000 Hz.

CHANNEL, WIDEBAND - A channel whose bandwidth is greater than that of a voice grade channel. Such channels are normally 6, 12, or 60 times the bandwidth of telephone channels.

CPS - Characters per second.

DATA COMMUNICATIONS - The movement of encoded information by means of electrical transmission systems. The transfer of data between points of origin and reception including all manual and machine operations necessary to transfer such data.

DATA SIGNALLING RATE - It is given by

$$\sum_{i=1}^{i=m} \frac{1}{Ti} \log_2 ni$$

where m is the number of parallel channels, Ti is the minimum interval for the i^{th} channel expressed in seconds, ni is the number of significant conditions of the modulation in the i^{th} channel.

Data signalling rate is expressed in bits per second.

DIGITAL - A device or technique using binary one or zero signals to represent data. Digital circuits can represent quantities to any precision required and can calculate or perform logic operations on the data.

FACILITY - A transmission path between two or more locations without terminating or signalling equipment.

The addition of terminating equipment would produce either a channel, central office line or a trunk. Various types of signalling would also be used depending on the application.

FACSIMILE - Transmission of pictures, maps, diagrams etc. The image is scanned at the transmitter, reconstructed at the receiving station and duplicated on some form of paper or film.

FLAT RATE SERVICE - A service which is provided at a fixed monthly charge regardless of usage.

FULL DUPLEX - See Channel, Full Duplex.

GROUP, CHANNEL - A unit of organization on telephone carrier (multiplex) systems. A full group is a channel of equivalent bandwidth to 12 voice grade channels (48 KHz). A half-group has the equivalent bandwidth of 6 voice grade channels (24 KHz). When not subdivided into voice facilities, group channels can be used for high speed data communications.

HALF DUPLEX - See Channel, Half Duplex.

KSR - Keyboard Send-Receive teletypewriters having a keyboard and page printer. Synonymous with PSR and Page-Send Receive.

KBPS - Kilobits (1000) per second.

MESSAGE SWITCHING - The switching technique of receiving a message, storing it until the proper outgoing circuit and station are available and then retransmitting it toward its destination. Also known as store and forward switching.

MULTI-POINT, MULTI-DROP - Line or channel interconnecting more than two stations.

NETWORK - A network is considered to be a number of communication channels, operating on a switched or non-switched basis, and interconnecting various locations.

PARITY CHECK - The process of checking received data to determine if the correct parity has been received. If the total of "one" or "marking" bits is not odd or even depending on the system being used an error has occurred

POLLING - The process of "calling out" to remote stations from a central point on a sequential, systematic basis. The polling operation may be to request, collect or distribute data. Polling may be manual or under the control of a business machine which is programmed with the "addresses" or telephone numbers of the remote stations.

REVERSE CHANNEL - An optional feature provided on some data sets. Provides simultaneous communication from the receiver to the transmitter on a two wire channel. This feature is intended as a means of sending low speed control signals back to the transmitter. It may be used for circuit assurance, break, and to facilitate certain forms of error control.

START/STOP - A system in which each code combination is preceded by a start signal which serves to prepare the receiving mechanism for the reception and registration of a character and is followed by a stop signal which serves to bring the receiving mechanism to rest in preparation for the reception of the next character. The start and stop signals are referred to as "machine information" or synchronizing.

SYNCHRONOUS - Speed of transmission is at a fixed rate. Operations which are performed in step with each other i.e. Common timing and co-ordination.

TELECOMMUNICATIONS - Any transmission or reception of signals, writing, sounds or intelligence of any nature by wire, radio, visual or electromagnetic systems.

TELETYPEWRITER - A typewriter capable of sending and receiving over communications channels. Often used in connection with terminals manufactured by Teletype Corp. and offered to customers by the common carriers.

TIME DIVISION MULTIPLEXING - A technique for deriving several channels from one facility or transmission path. Each derived channel, in turn, is allotted a unit of time on the main channel. Thus, the information on derived channels is interleaved, at higher speed on the main or multiplexed channel. At the receiving end the signals are separated to reconstruct the individual

derived channels. The number of channels obtained in this manner is dependent on the speed and bandwidth of the channels to be multiplexed and the speed and bandwidth of the channel used to carry the multiplexed signals.

WPM - Words Per Minute. Used to express the rated speed of teletypewriter equipment.