90 per cent and compete vigorously for traffic with TCTS.

Even with time-division multiplexing, these early digital systems had their flaws. When one terminal in a multipoint system is using the system, the others are effectively closed down. Neither the computer nor the terminals nor the people operating them are used to their full capacity. Only about 10 per cent capacity is used in a multipoint system. In addition, when the circuit is not being used by one of the original users, it is unavailable to a new user because the system only permits private-line arrangements.

Such networks pose other difficulties too. For example, what do you do when several terminals are trying simultaneously to communicate with a data base? The only solution is to install communications control programs which will organize the traffic flow. But such programs take up valuable mainframe and front-end capacity on the computer and add to the overhead of data base operations.

Large businesses and institutions could absorb these added costs. But many smaller businesses and organizations could not and were unable to take advantage of the digital revolution until 1977.

In that year, TCTS (TransCanada Telephone System) introduced its Datapac network, which employs packet switching technology. CNCP Telecommunications introduced its Infoswitch service, which uses both packet switching and circuit switching. Packet switching technology has radically cut the cost of data communications by improving the efficiency with which existing digital networks are used.

The new technology enables many users to employ the same circuit simultaneously, with no loss of privacy or confusion of messages. A computer breaks every message down into packets—short bursts of information representing a fraction of the entire message. Each packet has appended to it a "header" containing a variety of control functions and an address indicating its destination, as well as a Frame Check Sequence which checks for errors on the local access line.

The packet then travels to a packet-switching node which is a specialized computer. This computer decodes the header, checks the packet for accuracy and routes it to its destination by the best route, taking into account the volumes of traffic, the possibility of trouble and other factors on the different routes available.

How does packet-switching permit different users to send messages over the same route simultaneously? Each packet — or fraction of a message — is sent on separately from the switching node. If there are two messages from different terminals, the packets composing one message will be mixed together with the packets composing the other as they travel along the high-capacity digital line between switching nodes. Both messages will travel along the line at the same time. At the end of the line, another switching node will separate the packets composing each message and send each group in the proper sequence to the appropriate destination where a computer terminal reassembles the message.

Because many users can simultaneously use the same line, its capacity is not wasted and the cost of using it declines sharply. Users are charged for the amount of information sent, not for connection time or bandwidth leased. Even distance is less a factor than in the past.

In the TCTS Datapac system, the packets are automatically checked for accuracy at each switching node. If errors are found, the packet is automatically retransmitted from its last correct location. Estimated accuracy is one undetected packet error for every 10 billion packets transmitted.

Both CNCP and TCTS offer a wide range of terminals — the users' windows into the digital world. The simplest is the basic teletypewriter terminal. The trend, however, is not only towards terminals capable of displaying information on a cathode ray tube (CRT), but also towards intelligent and programmable terminals containing mini computers with memories or the capability of formatting information, checking its accuracy and a host of other communications functions.

The mini computers inside the intelligent terminals are of course becoming progressively cheaper. New applications are becoming possible. For example, it is no longer necessary to be wholly dependent on a group of programmers huddled around a central computer. In the new "distributed networks", a person can use his smart terminal to perform sophisticated manipulations on the central computer himself or to carry out complicated data transactions with the operator of another smart terminal.

With many different types of terminals and computers sending packets of information into Canadian digital networks, there was obviously a need for standards. Without them, the packet-switching nodes in the networks might not understand the coded instructions for handling packets, while terminals and computers might not be able to figure out what to do with packets received from the network.

TCTS has come up with such a standard and calls it "SNAP" (Standard Network Access Protocol) or "X.25". It has been ratified by the CCITT (Consultative Committee on International Telegraphy and Telephony) as the agreed international standard for packet mode operations. It is also the first step towards eventual world wide communications on a packet basis without costly interface arrangements between nations. In 1980, Teleglobe Canada, the government-owned corporation which links Canadian telecommunications carriers with other countries, expects the completion of a packet-switching link with such networks in the United Kingdom, France and Japan.

The computer economy

The improved efficiency, falling rates and growing reach of the Canadian digital networks have caused many smaller firms to take advantage of data communications. Other factors include the increased processing power and declining cost of computers themselves. There has been a rapid increase in the number of computers used by Canadians — from about 1,000 in 1965 to an estimated 37,000 in 1979. The greatest increase has been in computers with a monthly rental less than $5,000.

With the advent of packet switching, a small data-processing firm in southwestern Ontario, Cableshare Ltd., was able to expand dramatically its traditional services to cable TV companies and move into new markets. Not only does it provide computerized general ledger, subscriber accounting and other similar services to Canadian cable TV companies across more than half the continent, it also provides software for such two-way TV services as remote