HANDBOOK OF INTERACTIVE COMPUTER TERMINALS

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Dedicated to my family, Myrna, Heidi, Brett, and Dana

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PREFACE

The burgeoning technology surrounding interactive computer terminals has produced a multitude of devices with a diversity of applications and a consequent complexity of choice for the user.

It is fair to say that the computer has become a much more useful tool as the power of remote data communications has increased and the development of interactive devices has progressed. The capability of using a computer from a remote location to perform a variety of data processing operations has opened new horizons. All of these developments have involved the use of electronic technology and computer techniques to arrive at terminal designs with an increasingly sophisticated capability.

In addition to the refinement of basic terminal performance characteristics to provide additional data communications features, the concept of programmability has been one of the key attributes of the most recent developments in terminal technology. The aim of programmability is to make the terminal more self-sufficient, enabling it to pre-process data prior to that data being transmitted to a host computer.

This handbook presents a detailed analysis of interactive terminals: the technology used, performance characteristics, and some guidelines for evaluating pertinent characteristics for these applications. Evaluation guidelines include an extensive series of specification pages for interactive terminals offered by manufacturers. All models for which information could be obtained have been included.

Providing this information has involved compilation of manufacturer's information, research, and discussion with users. This task would have been even more formidable without the cooperation of the many suppliers whose products are presented in this handbook. To all suppliers who have contributed, the author expresses appreciation.

The author also wishes to acknowledge the valuable contribution of Glen Farrell, a long-time colleague with considerable data-processing experience, for the information on evaluating intelligent terminals, and other advice and counsel.

It is appropriate that the author extend special acknowledgement to the Communications Research Centre (CRC) of the Federal Department

of Communications in Ottawa, Ontario, Canada. Besides the specific references in this handbook, CRC research reports on interactive terminals have provided much of the background material for this handbook.

Duane E. Sharp, P.Eng.

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PART I

Technology and Performance

INTRODUCTION TO DATA COMMUNICATIONS AND INTERACTIVE COMPUTER TERMINALS

1

It has been estimated that in the year 1980 computers in the United States alone will transmit or receive 250 *billion* data transactions over telecommunication lines. Interactive computer terminals will play a major role in this communications volume.[1]

Communicating effectively with computers has been a challenge to man ever since the computer was invented. Early computers used simple keyboard-to-printer terminals as *consoles* which allowed an operator to control computer operation and to perform functions such as monitoring program run times, doing housekeeping operations, and running diagnostic routines. The computer console was the earliest man/computer interactive device—the forerunner of today's sophisticated terminal technology. Figure 1-1 illustrates a data communications network, showing the various elements which make up a typical teleprocessing system.

Teleprocessing is one of the most rapidly growing areas in the application of data processing for the improvement of business efficiency. In the future, the power and versatility offered by interlinking terminals and computers will be felt in diverse areas, in industry, in our homes, and literally throughout society.

These reflections of our expanding technology undoubtedly will change our lives as a new type of interaction with computers develops. The human user will interact with the tremendous logic power of the computer and its vast stores of data; an interaction which will yield results that neither man nor computer alone could achieve.

Networks of telecommunications facilities are expanding at an in-

[1]James Martin. *Introduction to Teleprocessing*. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1972, p. 2.

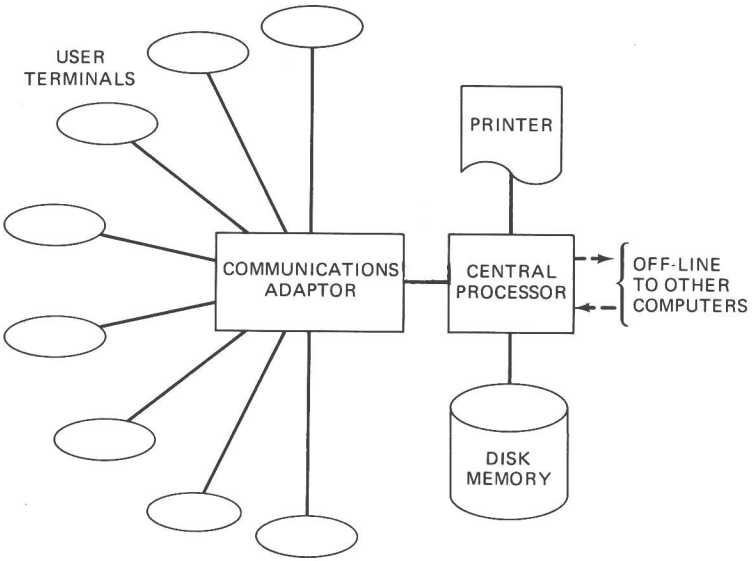

Figure 1–1. Typical data communications network. (Courtesy, Datashare Corporation, San Antonio, Texas.)

creasing rate. New equipment enables these networks to use data communications more efficiently and more economically than ever before. Computers are able to "dial up" other computers, terminals can communicate with each other, and information is transmitted at high data rates between machines and from user to machine.

The numerous applications of data communications have resulted in an estimated 4 to 5 million computer terminals being used in teleprocessing networks. Continuing development of new communication facilities, both networks and hardware, will expand the whole field of data communications, and will become the major aspect in meeting the challenge of efficient business communication.

Offices, factories, and even homes will use data communications equipment and networks to access computers at locations remote from the computing system. There will be many tasks which will be performed by this combination of technology, and large data banks will be capable of access, interrogation, and response.

Information placed in computer storage may be transmitted immediately to the computer from a terminal or it may be stored for later transmission. Data can be prepared on-line or off-line and may be punched out on a paper tape, or prepared in some other form, prior to transmission to a computer.

Data transmission costs will continue to decrease as more efficient use

is made of technology. Recent years have seen a virtual explosion in areas related to interactive computer terminals, a key element in improving the efficiency and economy of aceessing a host computer.

One view of an interactive terminal as an interface between an application (*task environment*) and remote data processing and storage resources is shown in Figure 1-2. This graphic representation of a terminal relates input and output modes, the active elements in a terminal which control input and output operation, and the processing features of a remote computer. Input may be data or instructions, and the computer can respond with either data or instructional output.

1.1 INTERACTIVE TERMINALS

A wide variety of different devices can be used to communicate with a computer. Some are devices into which data are entered by human operators, while others collect data automatically. Terminals that allow an operator to have two-way communication with a computer, to *interact* with a program, are referred to as *interactive terminals.* This communication may be at a relatively low or high level of sophistication. For example, a terminal which accepts a credit card and provides a simple verification message is at the low end of the interactive spectrum. On the other hand, a terminal which provides the facility for a user to perform a number of editing, formatting, and preprocessing functions is defined as having a degree of *intelligence.* In Chapter 4, an intelligent terminal is defined as one which is capable of being *programmed* by the user, a definition of intelligent terminals which is used throughout this handbook.

Most interactive terminals consist of a keyboard and printer or a keyboard and some type of display. Figure 1-3 is a pictorial representation of the various components and functions of the peripheral devices in a typical interactive terminal, showing both input and output operations. Some interactive terminals can be used for off-line data preparation, or as elements of a cluster of manual-input devices in a data collection system. Options to enhance the capabilities of interactive terminals include tape cassettes and cartridges, small disks, logic circuitry, and additional core memory. Microprogramming and stored-program minicomputers also are incorporated in some terminals.

Included in the definition of interactive terminals are both simple keyboards (with and without displays) and sophisticated intelligent terminals capable of performing front-end preprocessing of data and of being programmed by the user. The extent of coverage of the different technologies in Chapter 2 is directly related to the current level of interest in the user marketplace. Some devices have been used for a number

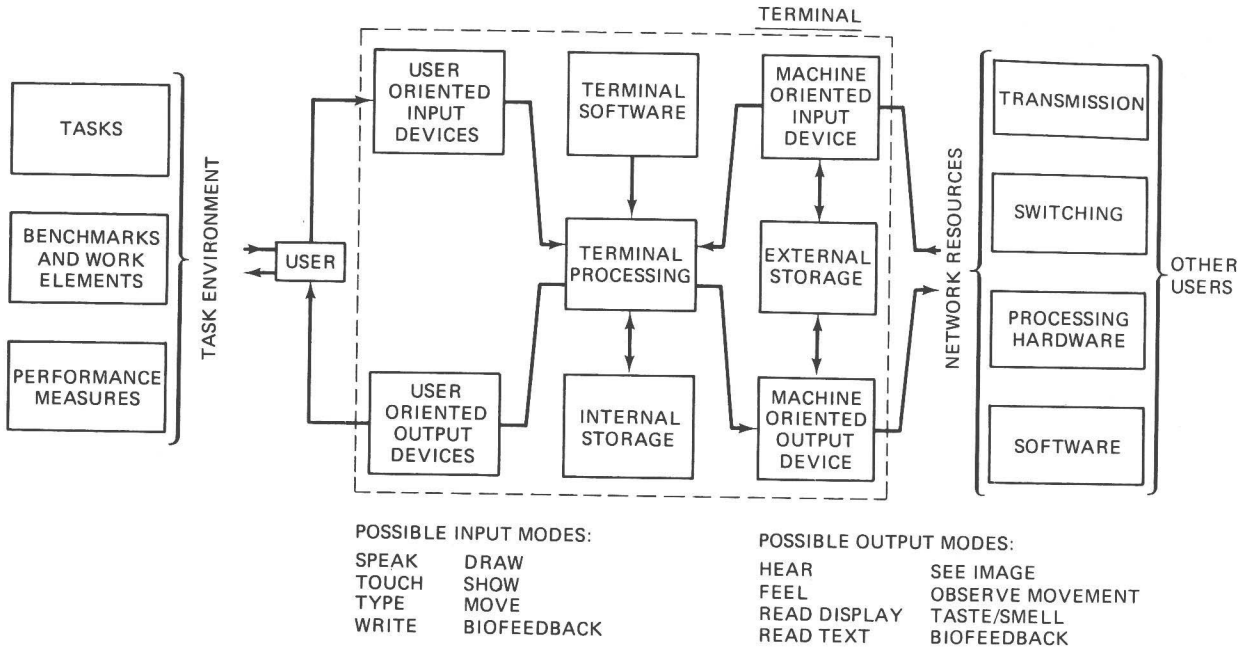

Figure 1–2. An interactive computer terminal as it interfaces a task environment to remote data processing and storage resources. (Source: CRC Report No. 1276–2, "Data Terminal Technology—Present and Future. Vol. II, Technology Forecasting and Assessment." Communications Research Centre, Department of Communications, Ottawa, Ontario, April, 1975.)

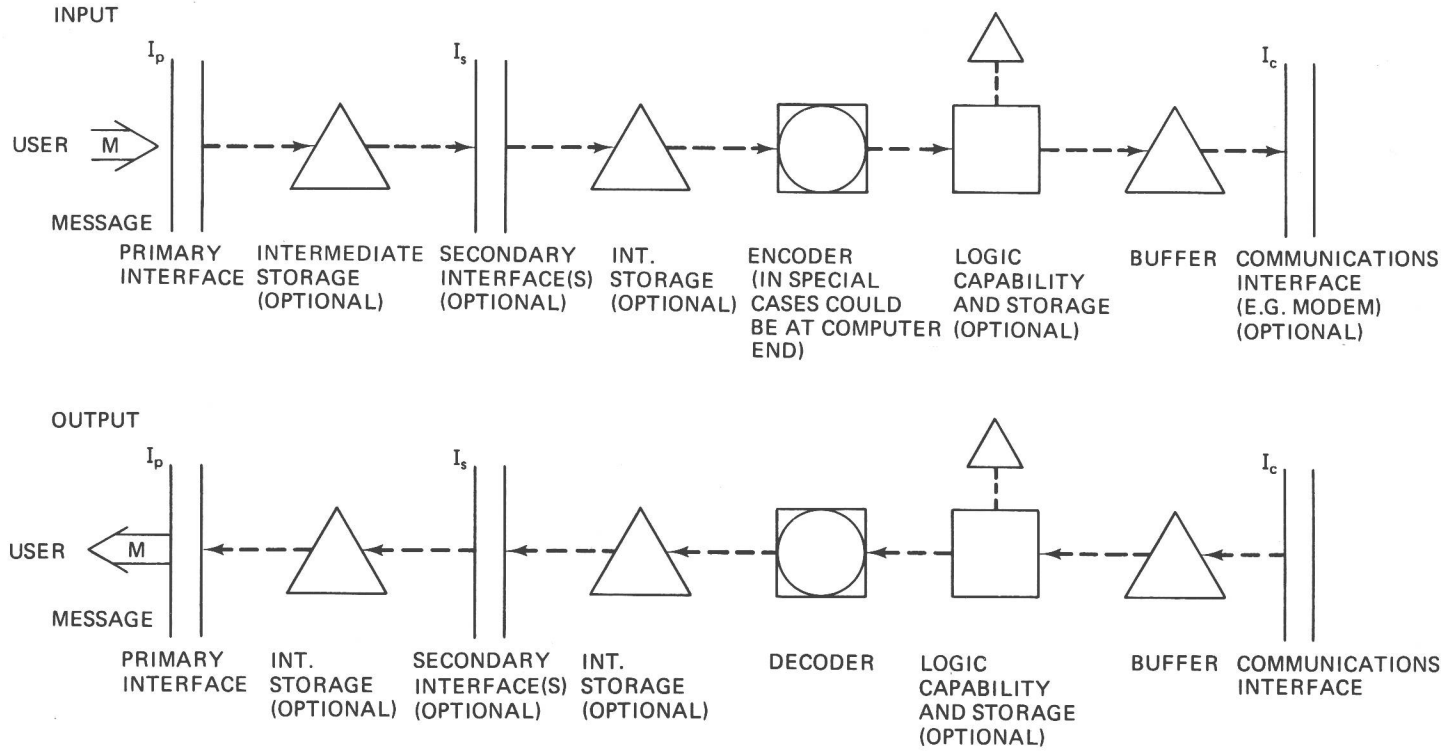

Figure 1–3. Functional representation of an interactive terminal. (Source: CRC Report No. 1276–2, "Data Terminal Technology—Present and Future. Vol. II, Technology Forecasting and Assessment." Communications Research Centre, Department of Communications, Ottawa, Ontario, April, 1975.)

of years, others are in the early stages of development, and some are just appearing on the market.

The cathode ray tube (CRT), the most commonly used display device, added a new dimension to terminal technology. Little did Heinrich Geissler realize when he first placed electrodes in a glass tube filled with gas to produce pretty colors that his *cathode rays* would form the basis for a modern-day device which would revolutionize data communications. The CRT is the display device used in most display terminals, although other technologies discussed in this handbook are gaining acceptance rapidly.

As previously noted, an interactive terminal is one which enables an operator to interact with the computer; that is, to provide input to and receive output from the computer. This handbook describes interactive terminals where both input and output capabilities are provided, and does not discuss *limited* interactive devices such as card-reading or optical character recognition (OCR) devices.

In succeeding chapters, evaluation characteristics are provided to enable users to evaluate terminals for various data communication requirements and to select suitable devices to meet specified performance criteria.

In the following paragraphs, terminals are briefly categorized and described according to general physical and functional characteristics. These characteristics indicate how data are input into the terminal and the form of the output. In subsequent chapters, details of the technologies used for each terminal category are examined. This input may be data or instructions, and the computer can respond with either data or instructional output.

1.1.1 Keyboard with Printer

The standard teletypewriter device is the best example of this type of terminal. It finds its greatest application as a simple terminal in the interactive time-sharing environment, and has been in use for a number of years. The capability of producing "hard (printed) copy" makes this terminal type distinct from others which use display devices as an output medium, and offer hard copy as an option.

1.1.2 Keyboard with Display

This is one of the most common types of simple interactive terminals because of its intrinsic capability to enhance user/machine communications. It usually incorporates an alphanumeric keyboard with some form of electronic display, but provides no hard copy to the user, except as an

option. Alphanumeric and graphic displays are included in this classification as the technology used is similar. These units are employed in a wide variety of data processing applications, and are used in almost all intelligent terminals.

Graphic Entry

The primary characteristic of this keyboard with display type is the use of a coordinate reference to initiate an enquiry, in addition to keyboard input. This class includes terminals which use light pens, a finger touch, or input drawn on a tablet with either hard or soft copy display for response. These terminals are used extensively in design applications to display three-dimensional shapes, and enable a designer to rotate, modify, and otherwise manipulate design characteristics.

1.1.3 Keyboard with Printer-Plotter

This classification is a variation of the keyboard with printer where printing capability is not limited to normal type, but may include hard copy, graphic display, diagrams, and other forms of printed material. The printer-plotter is generally a refined version of one of a limited number of printer technologies incorporating an optional plotting capability using ink and a plotting device driven by keyboard input.

1.2 APPLICATIONS OF INTERACTIVE TERMINALS

1.2.1 Basic Applications

There are an increasing number of applications of interactive systems. Some of these applications fall into the category of exchanging information, for example, information acquisition and retrieval, editing, and instruction.

Information Acquisition and Retrieval. This involves entering data into a computer using interactive methods to check the data on entry, an immediate error feedback, and the use of a host computer to provide explicit information. Redundant transcription and transmission of data is reduced by using this technique. Retrieval concerns the recovery of stored information using conversational techniques to ensure that all requested information is identified, and that the user has access to it. Retrieval and data entry are often cofunctions, since originators of information may have to ask questions before deciding what to enter into stored files. Library cataloging is one specific application area for information acquisition and retrieval. (See Figure 1-4.)

Editing. This is the storing of textual material to enable an opera-

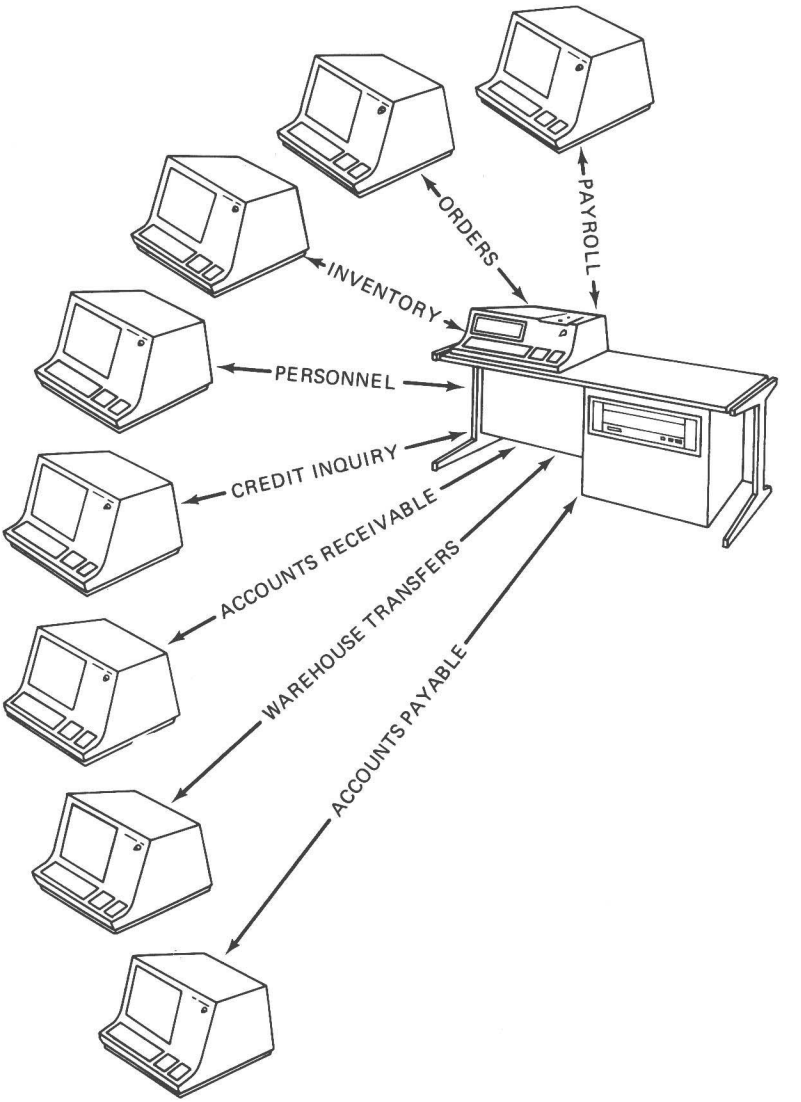

Figure 1–4. Some typical business applications of a multi-user, multi-task data communications system. (Courtesy, Datapoint Corp.)

tor (who may be the author) to prepare it for publication using an interactive terminal. Most of this activity consists of entering information in the same manner as typing it out on a typewriter, and then allowing the author to make changes—adding or deleting material, and moving portions of it around. This application also extends to the editing of highly structured material.