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**AN AUTOMATED SYSTEM FOR ACCUMULATING COUNT RECORDER (ACR)
FIELD DATA COLLECTION**

by

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Zhanmin Zhang
Terry Dossey

Research Report 2040-1F

Research Project 1-2040

Automated System for ACR Field Data Collection

conducted for the

Texas Department of Transportation

by the

CENTER FOR TRANSPORTATION RESEARCH

Bureau of Engineering Research

THE UNIVERSITY OF TEXAS AT AUSTIN

October 1994

IMPLEMENTATION STATEMENT

Field trials of the ACR data acquisition system are now being conducted by the Texas Department of Transportation (TxDOT). Thirty complete hardware systems, each loaded with the final version of the software, have been furnished to TxDOT, along with the base station software and ancillary equipment needed for transferring files. It is expected that these thirty systems will eventually be deployed in the field, replacing the current manual, paper-based system.

ACKNOWLEDGMENTS

This report describes the work performed under Project 2040, "Development of Automated System for ACR Field Data Collection." The study was conducted at the Center for Transportation Research (CTR), The University of Texas at Austin, as a research program sponsored by the Texas Department of Transportation. This report presents the rationale for developing an automated system for ACR field data collection, the market survey conducted to select the system hardware, the development of the system software, and a guide for using the system.

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Prepared in cooperation with the Texas Department of Transportation.

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SUMMARY

The Texas Department of Transportation (TxDOT) records traffic counts at tens of thousands of locations throughout the state. Such traffic information is crucial to statewide planning, forecasting, and roadway design programs. Moreover, this information is reviewed by the federal government in determining the amount of highway funds to be allocated to a state.

This report describes the development of an automated system for collecting state traffic count data, specifically accumulative count recorder (ACR) field data. As part of this effort, the researchers carried out a market survey of available computer hardware appropriate for field operations, and then developed, tested, and refined a system software capable of improving the speed, efficiency, and accuracy of data transmission. This system, when fully implemented by TxDOT, will replace an operation that, at the present time, is carried out manually. Included in the report is a user's guide that describes all operations pertaining to the collection of ACR field data and the two-way transmission of schedule files and ACR data files between the field operating computers and TxDOT's base computer.

CHAPTER 1. NEED FOR AUTOMATING ACR FIELD DATA COLLECTING

1.1 INTRODUCTION

The measurement of traffic volume is one of the most basic functions of highway planning and management. For many years, the traditional approach to the development of annual average daily traffic (AADT) has consisted of three different but complementary types of traffic counts: continuous, control, and coverage (Ref 1). Continuous counts are taken 365 days a year at a small number of locations. These counts provide the most useful information and are the backbone of contemporary state traffic counting programs. Control (or seasonal) counts are much more difficult to characterize because of the many alternatives in use by the state planning organizations. These counts are usually taken from 2 to 12 times a year, for periods of time ranging from 24 hours to 2 weeks. The main purpose of control counts is to provide a seasonal assignment linkage for factoring short counts to AADT.

Coverage counts are short duration counts, ranging from 6 hours to 7 days, distributed throughout the system to provide point-specific information. In some states, the coverage programs are implemented as system tools, and as such they have a limited number of counts, lengthy count cycles, and efficient computerized analysis capability. Other states, conversely, emphasize complete and detailed coverage of their highway systems, the result of which is a very large number of counts taken over short cycles and stored manually.

1.2 RECORDING TRAFFIC DATA IN TEXAS

The Texas Department of Transportation (TxDOT) counts traffic at tens of thousands of locations throughout the state. The traffic information is crucial to TxDOT's planning, forecasting, and roadway design programs. It is also a factor considered by the federal government in determining the amount of highway funds to be allocated to Texas.

Presently, traffic counts in Texas are performed on a given roadway over a 24-hour period once a year. TxDOT maintains permanent traffic counters at around 140 locations in the state to count traffic on different classes of roadway 24 hours per day, 365 days per year. These automatic traffic recorders (ATR) provide TxDOT with an effective check of seasonal traffic variations on different types of roads in different areas of the state.

The ATR and accumulative-count recorder (ACR) data, including the axle factor, are combined, by analysis, into a number expressed as the annual average daily traffic, or AADT, for a specific road section. The AADT is posted to a traffic map known as an annual average map. The ACR counting program, taken at over 75,000 sites annually, is the central, critical part of the TxDOT traffic data program. Because reliable ACR data are extremely important, TxDOT analysts take great care in ensuring that the data collected and reported are accurate. With historical, ATR, and classification data at their disposal, the analysts can determine quite well the accuracy and validity of ACR data.

To obtain accurate data, the traffic counter operator must set up the equipment at the correct location, in the prescribed manner, and must allow the machine to count for a period no longer or no shorter than 24 hours. While the precision regarding the counting period is especially crucial in high-traffic areas, it is also very important in medium- and low-traffic areas. Currently, Texas uses 3,500 ACR devices to sample traffic counts at 75,000 sites. The major tasks involved in this effort include (1) scheduling the movement of these devices by the 30 field operators, and (2) processing the recovered data.

1.3 OBJECTIVE

Currently, the tasks of scheduling the movement of the ACR units and transferring ACR field data to TxDOT central facilities are accomplished manually. Two ACR schedules per week (along with maps and special instructions) are prepared for each field operator. These schedules include instructions for an average of 37 setups. Traffic counts collected from the ACR units are recorded manually on paper sheets, which are maintained in the TxDOT planning section after being entered manually into the Department's mainframe computer.

In an effort to upgrade the existing manual system, Project 2040 developed ACR field data collection software that automates the scheduling and data transfer procedures. Using this software, the Department can save the time and expense involved in key-entering ACR data from paper file records. Moreover, the transfer of the data files from the field microcomputers to the Departmental computer will ensure greater speed and accuracy (for example, the field data will be checked at the point-of-entry for reasonable values, and then transferred via phoneline to central facilities, permitting a very timely assessment of the data). Such speed and accuracy will ultimately assist in the supervision of the field crews.

The automated ACR system developed under this project is expected to greatly improve scheduling and data transfer. A detailed market survey was conducted to determine the best computer hardware currently available for the ACR system. This hardware included a small, portable PC-compatible microcomputer for field data acquisition and all necessary modem and I/O port hardware and software for telecommunications. In addition, new field and base software will be developed to meet the general outline specified in the TxDOT document entitled "Project 2031: Task 2. Development of ACR Software" (see Appendix 2).

CHAPTER 2. OVERVIEW OF AUTOMATED ACR FIELD DATA COLLECTION SYSTEM

2.1 SYSTEM OVERVIEW

The ACR data collection computer system includes the following steps:

- Step 1 TxDOT planners use a desktop PC to generate the instruction schedule files.
- Step 2 Field operators use the data communication software running on palmtop microcomputers to receive the instruction schedule files from TxDOT via phone line.
- Step 3 Based on the received instruction files, the palmtop computers will generate the instructions guiding the field operators to go to the traffic stations to set up the ACR counters on a specific date.
- Step 4 After a period of time specified by the instruction files, the palmtop computer will prompt the field operators to go back to the specific traffic stations to collect the removal traffic counts.
- Step 5 Once all the traffic data from the traffic stations listed in the instruction files have been collected, the field operators will use the palmtop computers to send back to TxDOT the resulting data files containing traffic counts.

2.2 SOFTWARE SPECIFICATIONS FOR THE ACR FIELD DATA COLLECTION SOFTWARE AND THE DATA COMMUNICATION SOFTWARE

The general outline of the ACR system field data collection software and the data communication software is described in the TxDOT document entitled “Project 2031: Task 2. Development of ACR Software” attached in Appendix 3. A very detailed specification for the ACR system software is provided in this attached document. However, during the regular meetings between project and TxDOT personnel, some modifications of the software specification were made and new features were added. The final software application features are described in Chapter 6 and Chapter 7 (these chapters also serve as the manual for using ACR software).

CHAPTER 3. CHOOSING SYSTEM HARDWARE

3.1 MARKET SURVEY OF SYSTEM HARDWARE

Presently, there are six small, palmtop PC-compatible computers that would be suitable for the ACR system. These include the Hewlett Packard 95LX, 95LX1MB, 100LX, 200LX, and Palmbooks 286 and 386. Additionally, several smaller computers termed “personal digital assistants” (PDA), an example of which is Apple’s Newton, have just now reached the market. The palmbook was eliminated as a choice because of its high risk of obsolescence (i.e., servicing this computer could become problematic in the near future). However, Hewlett Packard (HP) is a reputable company that has an abundance of services available.

HP 95LX, HP 100LX and HP 200LX

With its monochrome display and MS-DOS, the HP 95LX is fully PC-compatible. While its calculator-style keys are too small and too close together to type rapidly, it is suitable for a two-finger exercise. The HP 95LX is available with 512K or 1MB of RAM. Since MS-DOS and Lotus are built into ROM, most of the built-in RAM can be used for work space and data storage. For expansion, there is a PCMCIA slot for storing data or for running a program on removable cards. For transferring stored data to a PC, the HP 95LX includes a modified three-pin serial port for connecting modems and printers.

The HP 100LX is the successor to the HP 95LX. It has a CGA-compatible display, an upgraded 9-pin serial port, and a bigger menu selection that now includes cc:Mail Remote. The 80-column-by-25-row CGA display uses advanced liquid crystal technology capable of producing a higher density of pixels. The new display is 480 by 200, compared with 240 by 120 on the HP 95LX’s MDA (Monochrome Display Adapter) screen. The HP 100LX also has a zoom feature that allows the viewing of text in three different sizes. An upgraded serial port allows the HP 100LX to be used with standard modems, an improvement over the earlier HP 95LX, whose 3-pin port works only with modems specifically designed for palmtops.

Inspired by the success of the HP 100LX, Hewlett Packard developed the HP 200LX, which has 2 MB RAM and is faster than the HP 100LX. Because the HP 100LX has only 1 MB RAM, the installation of the ACR software leaves very little memory left on the HP 100LX for storing the maximum required extra ACR schedule files and data files. The HP 200LX eliminates this problem: Since, on average, a schedule file takes up 1924 bytes and a result data file takes up 1591 bytes, the one extra MB of RAM gained by using the HP 200LX could be used to store about 90 schedule files and data files (plus have temporary memory space left over for processing these files).

Table 3.1, a comparison of the HP 95LX, HP 100LX, and the HP 200LX, shows some of the important features of each. The detailed specifications for the HP 95LX, HP 100LX, and HP 200LX are included in Appendix 1.

Table 3.1 Important features of the HP palmtops.

Features	HP 95LX	HP 100LX	HP 200LX
Operating system	DOS 3.22	DOS 5.0	DOS 5.0
CPU Run Time	5.37 MHz	7.91 MHz	7.91 MHz
Display	Monochrome	CGA	CGA
Screen	40 columns x 16 rows	80 columns x 25 rows	Same as 100 LX
RAM	1MB	1MB	2MB
Communications	3-pin serial port using special modem	9-pin serial port using standard modem	Same as 100 LX

Table 3.2 compares the retail prices for the HPs. These prices, based on EduCALC's 1994 catalog #65, are likely to vary for different dealers.

Table 3.2. Prices for the HP palmtops and other ACR system hardware

Palmtop Models	Price
HP95LX-512K	\$399.00
HP95LX-1MB	\$589.00
HP100LX	\$600.00
HP200LX	\$621.00

Accessories	Price
U.S. Robotics 2400 Modem	\$185.00
Connecting cable	\$18.95
Gender Changer	\$24.95
Connectivity Pack	\$109.95
Cigarette Lighter	\$39.95

Based on the comparison, the HP 200LX has obvious advantages over the HP 95LX and the HP 100LX.

Apple Newton

As requested by TxDOT, information was also obtained on the Apple Newton, an artificial intelligence communications tool that makes use of a messagepad and a pen. The cost of a Newton at the MicroCenter at The University of Texas at Austin is \$858 (this includes an external fax modem and a connection pro kit).

After testing the Apple Newton, we concluded that the product was unreliable and lacked sufficient software for effective use in an ACR system. Currently, the Newton is primarily used as a personal organizer for appointments, telephone numbers, and small memorandums. Software

included for handwriting recognition is interesting but unreliable. As software is developed and artificial intelligence is improved, the Newton may become more applicable for the ACR system. Specifications for the Apple Newton can be found in Appendix 2.

3.2 RECOMMENDATIONS

Based on the above considerations, the HP 100LX was selected as the platform for running the ACR software. During the course of the project, however, the HP 100LX was phased out and replaced by the more powerful (though comparably priced) HP 200LX, which became the ultimate platform of choice.

CHAPTER 4. OVERVIEW OF SOFTWARE DEVELOPMENT

4.1 FIELD COMPUTER SOFTWARE

Both the ACR field data collection/data communication software and the base computer data communication software are written in the Turbo Pascal programming language. The compiler used for this project is Borland Turbo Pascal Version 6.0.

Figure 4.1 shows the structure of the field software, based on the general system functional outline provided by TxDOT (Appendix 3).

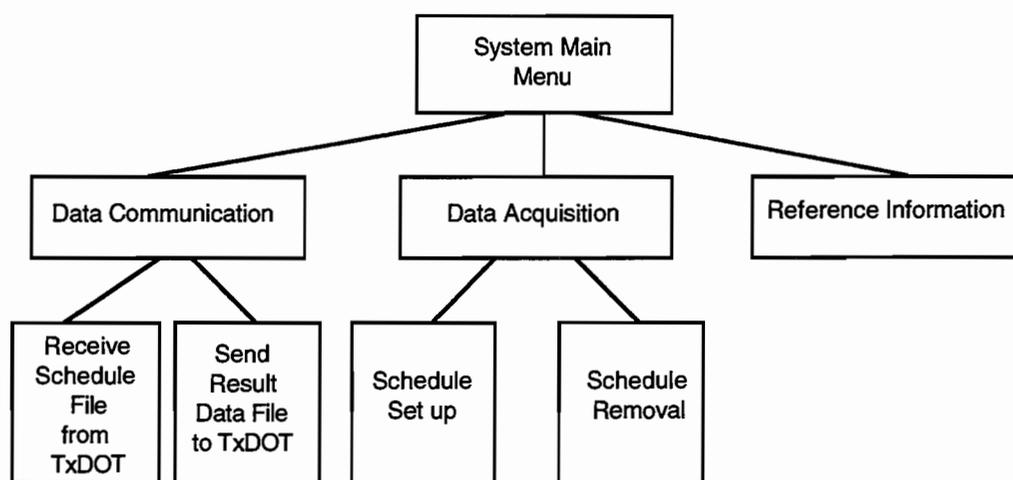


Figure 4.1 Basic functional structure of ACR field software

As shown in the above figure, this system contains a main menu that allows the user to select from three main functions: (1) data communication, which includes receiving the schedule files from TxDOT and transferring completed traffic data files back to TxDOT; (2) data acquisition, which is used in the field to record starting and ending counts for the ACR data; and (3) reference information, which is used to clarify and inform the operators about various codes and procedures used in the program.

The ACR field computer software program consists of one main program and 14 units. Some standard Pascal subroutines are also used in the ACR program and its units.

The data input activities in the ACR field software include the validation checking features. The data communication subroutine includes user ID and password-level security features. In the program, a circular/loop structure is used for the main data input operations so that the data input can be modified until the user confirms that the job has been finished, or until the user chooses the quit option.

4.2 BASE COMPUTER SOFTWARE

Base computer data communication software was developed for sending schedule instruction files to the field computers and for receiving result data files from the field computers.

Functioning as a base station, the base computer data communication software runs continuously, waiting for incoming calls requesting a download (base to field) of the schedule files, or an upload (field to base) of the collected ACR station counts. This software runs continuously until terminated by pressing the ESC key.

The base software also includes an important function that logs all transmissions to a separate file. The file includes a time and date stamp as well as the file name for the data transfer. In this way, TxDOT personnel can keep track of data collection progress, while receiving timely information that can be used to correct software or hardware problems before any data are lost.

CHAPTER 5. INTRODUCTION TO ACR SYSTEM HARDWARE

The ACR computer network consists of a host computer at TxDOT headquarters, 30 HP 200LX Palmtop personal computers in the field, 31 data communication external modems (1 for the host computer and 30 for field HP 200LX palmtop PCs), and some other accessory equipment. In this chapter, the system hardware and its use will be introduced.

5.1 HOST COMPUTER IN TXDOT

The host computer at TxDOT, illustrated in Figure 5.1, is an IBM-compatible personal computer. Its job is to send schedule files to the field palmtop PCs and to receive data files from the field palmtop PCs. It will run the base computer communication software to accomplish this task.

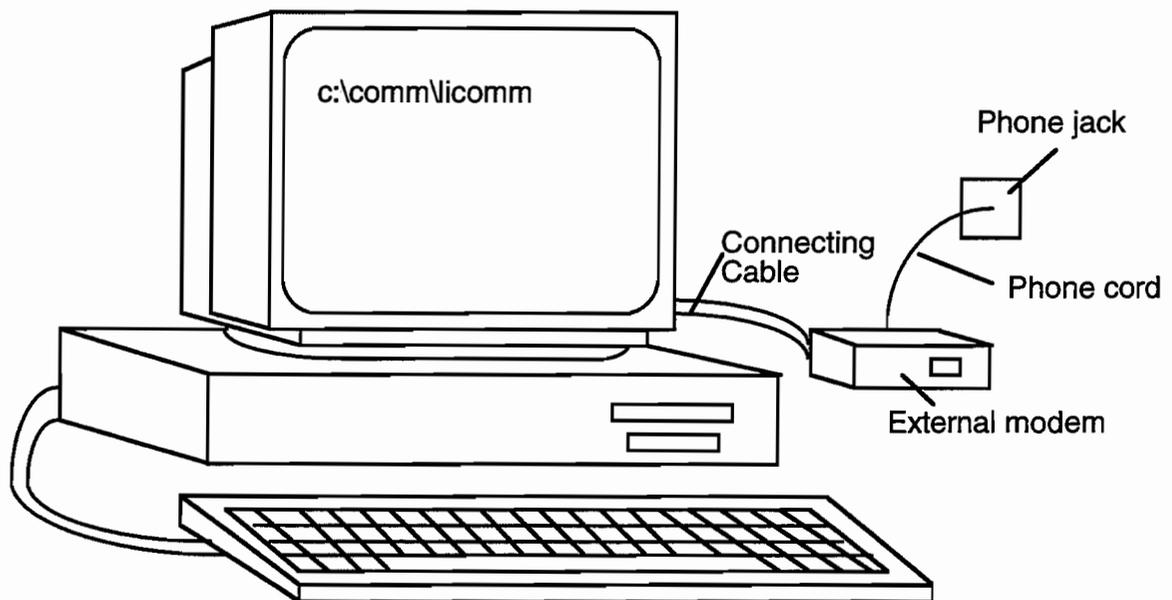


Figure 5.1 Host computer setup

To set up the host computer, connect the external modem to the host computer by using a connecting cable (see Fig 5.1 above). Make certain that one end of the cable connects to the host computer communication serial port COM1, and that the other end connects to the serial port on the modem. Next, connect the modem to the phone jack using a phone cord. Then plug in the AC power adapter for the modem to provide AC power. Finally, turning on the modem's power switch completes the hardware setup for the host computer.

5.2 HP 200LX PALMTOP PERSONAL COMPUTER

5.2.1 Main Battery

The HP 200LX palmtop computer, shown in Figure 5.2, uses two size AA batteries as its power source. On average, two AA batteries will last 1 month before they need replacement. To extend battery life, we highly recommended that the AC power adapter be used whenever AC power is available.

To replace the batteries in the HP 200LX, open the battery compartment at the back of the computer and place the new batteries in correct “+” and “-” positions. If the main batteries are low on power, the whole computer screen will blink and will be difficult to read; so please remember to change batteries every month and use the AC power adapter whenever possible.

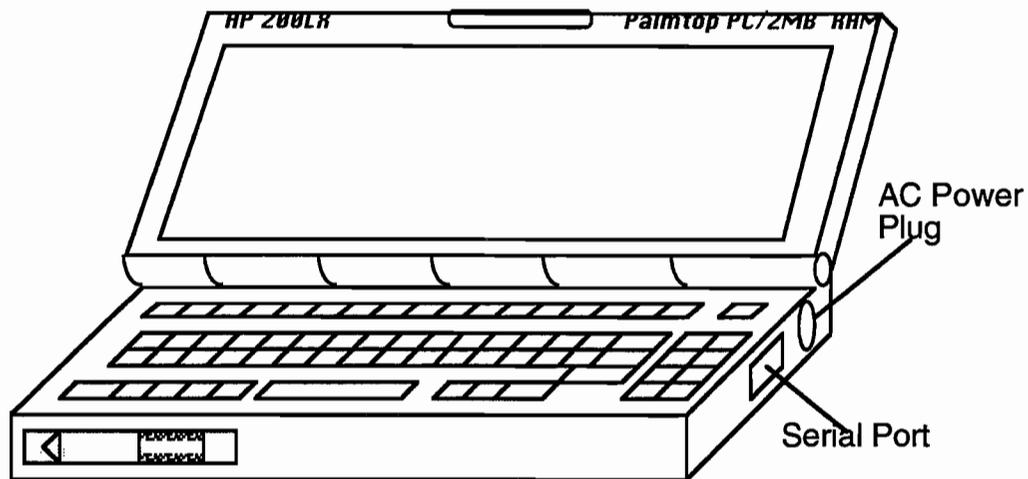


Figure 5.2 The HP 200LX palmtop computer

CHAPTER 6. USING THE HOST COMPUTER AT TXDOT

This chapter describes the installation and operation of the host computer communication software. All preparations described in section 5.1 of Chapter 5 must be completed before installing and operating the host computer communication software.

6.1 INSTALLING THE HOST COMPUTER COMMUNICATION SOFTWARE

Insert the communication software floppy disk in either the A:\ drive or the B:\ drive of the host computer; then copy the program *licommii.exe* to the C:\ drive.

```
A:\ copy licommii.exe C:\licommii.exe
```

6.2 SETTING A SCHEDULE FILE DIRECTORY ON THE HOST COMPUTER

You need to make a specific directory on the host computer. This directory will store schedule files, returned data files, and the log file. To create a directory, use the following DOS commands:

```
C:\mkdir sche  
C:\cd sche
```

In the example here, all schedule files, as well as all data files received from field, will be saved in the directory *c:\sche*. In case you need to look at the communication history, there is a *record.log* file in this directory (created by the communication software) that allows you to view what schedule files have been sent out and what data files have been received.

6.3 SET UP COMMUNICATION SOFTWARE PARAMETERS

To run the host computer communication software, use the following command:

```
C:\licommii
```

This will bring up the screen shown in Figure 6.1. You will be prompted to type a directory name. Based on the example used in section 6.2, you need to type *C:\sche* after the prompt message and hit the return key. Then you will see a message "Waiting for a call.... Hit ESC to quit this program." This means that the host computer communication software is waiting for a call from a field HP 200LX palmtop computer. You can terminate this program at any time by hitting the ESC key.

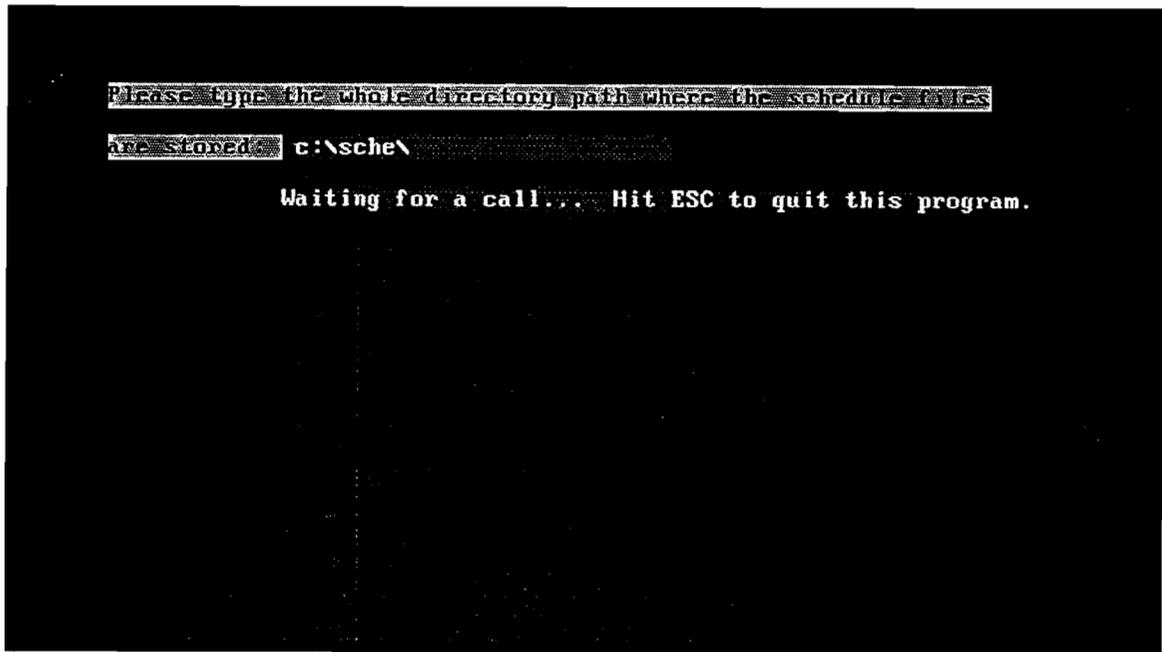


Figure 6.1 Base computer communication setup screen

6.4 DATA COMMUNICATION MESSAGES

During operations of the host computer communication software, data communication messages will be displayed on the screen to inform users of communication activities. Figure 6.2 shows a sample message indicating that the host computer is sending out a schedule file *sample2.out* to a HP 200LX computer in the field.

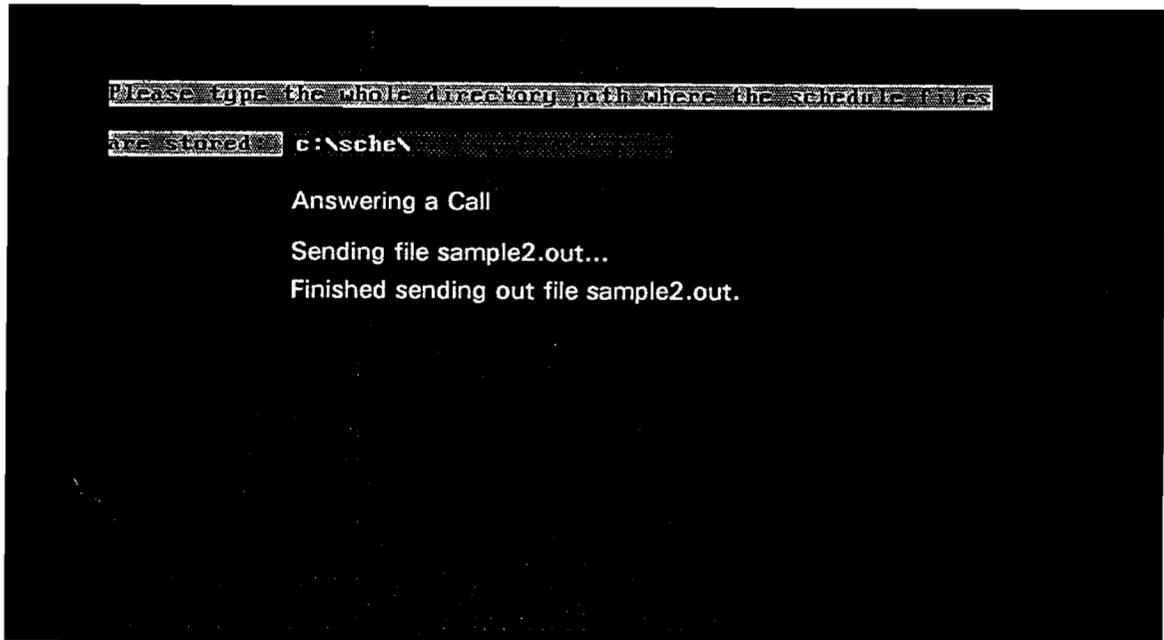


Figure 6.2 Base computer sending out file screen

Similarly, Figure 6.3 shows a sample screen indicating that the host computer is receiving a data file *sample2.in* from a field computer.

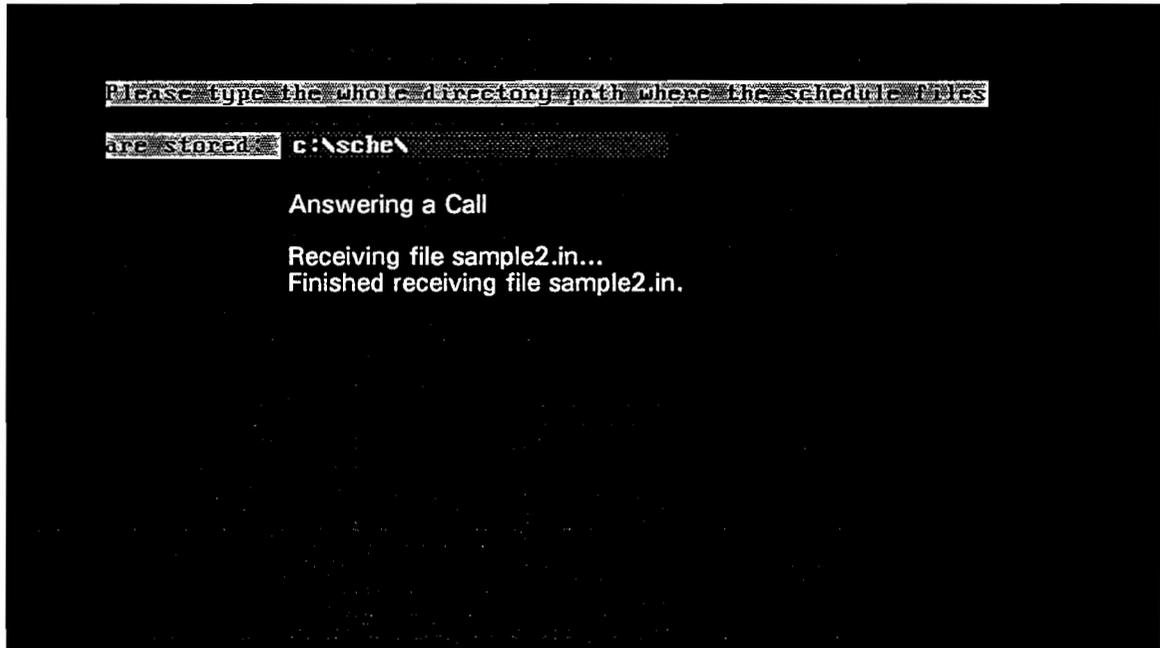


Figure 6.3 Base computer communication receiving file screen

If you need to check the file transfer history record, first press the ESC key to stop the communication program, and then go to the directory *C:\sche* you have just used to look at the log file *LOGFILE*. This file records the file name, send/receive, date, and time of the file transfer.

CHAPTER 7. FIELD OPERATION OF THE HP 200LX PALMTOP PC

Chapter 6 introduced the host computer communication software. This chapter provides instructions for using the field ACR software on an HP 200LX palmtop PC.

7.1 INTRODUCTION TO ACR SOFTWARE

When you start the ACR program on the HP 200LX for the first time, you will see the message screen shown in Figure 7.1. This figure also gives a view of the system menu screen of the ACR software. The menu bar at the top of the screen includes Communication, Traffic Counter Work, Reference Info, the current date, and a running clock. At the bottom of the screen, you can use the F1 function key to get instructions on how to use this software, or you can use F10 to activate the top menu bar. You can also use F5 to zoom within a window (enlarge the text), or press the ESC key to close an open window.

When you want to do any work related to communication, hit F10 to activate the top menu bar, choose *Communication*, and hit the ENTER key to get the communication menu items. Similarly, choose *Traffic Counter Work* to perform counter setup and counter removal work, or choose *Reference Info* to get reference information.

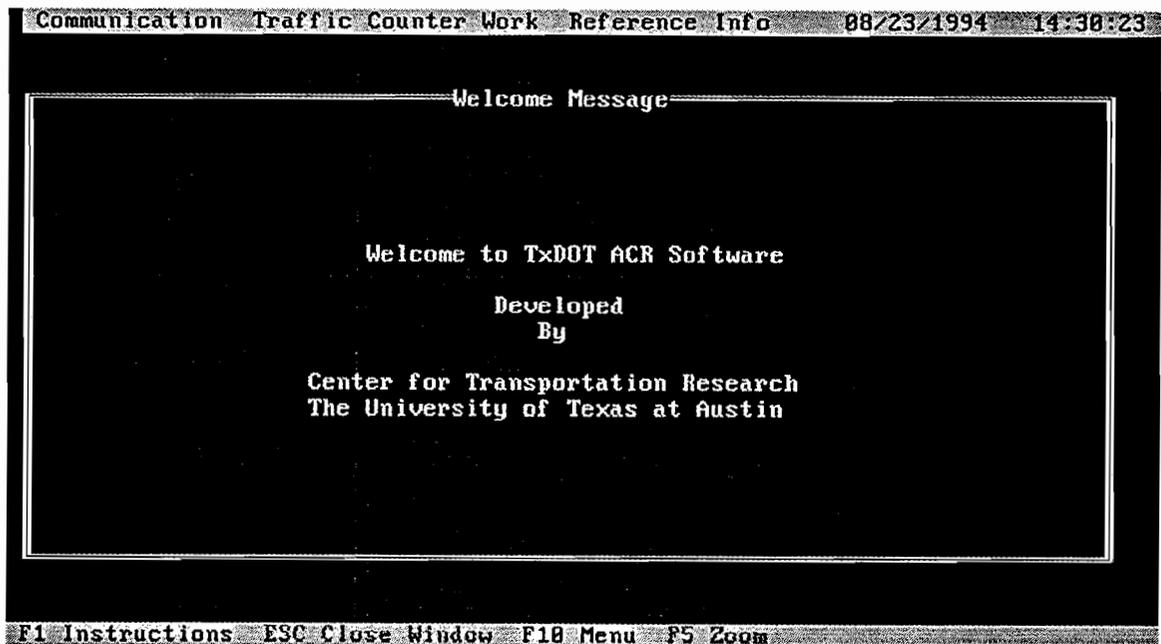


Figure 7.1 ACR main menu screen

7.2 USING DATA COMMUNICATION IN ACR SOFTWARE

7.2.1 Assigning a User ID and Password

Using ACR software to transfer files requires the correct combination of user ID and password input. TxDOT supervisors can assign to operators their user IDs and passwords for the HP 200LX computers before the computers go out with the field operators.

To assign the user ID and password, TxDOT supervisors should first login to the system. After pressing the F10 function key, move the shaded area to *communication* on the top menu bar and hit the ENTER key. You will see the communication menu shown in Figure 7.2.

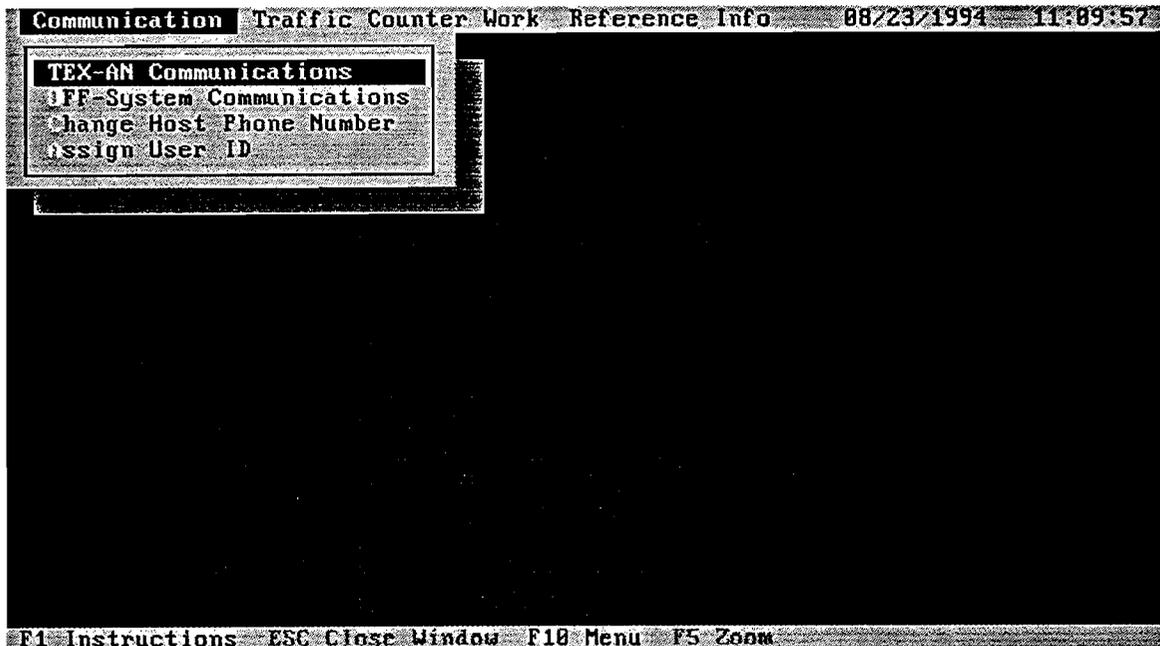


Figure 7.2 Communication menu screen

Use the arrow key to move the cursor down to the last item "Assign User ID;" then, hitting the ENTER key, you will get the screen shown in Figure 7.3.

```

Communication Traffic Counter Work Reference Info 08/29/1994 16:54:42
-----
Assign User ID to a Field Operator
-----
To assign a user id, please type your supervisor id first.
Your Identification Name:  hello
Please enter your password: 
Good, you are logged in and ready to assign User ID.
-----
F1 Instructions ESC Close Window F10 Menu F5 Zoom

```

Figure 7.3 Login screen for assigning user ID and password

Before assigning a user ID and password, you must first input the correct TxDOT supervisor ID and password, as shown in Figure 7.3. After a successful login, you can assign a user ID and password, as shown in Figure 7.4.

```

Communication Traffic Counter Work Reference Info 08/24/1994 21:39:3
-----
Assign Operator a User ID
-----
Assign a User ID here:  acr
Assign a password to this user:  user
-----
F1 Instructions ESC Close Window F10 Menu F5 Zoom

```

Figure 7.4 Assign user ID and password

7.2.2 Changing the Host Computer Telephone Number

To change the host computer telephone number, the operator must input the correct user ID and password for the computer he/she is assigned to use. After the operator logs in, he/she can choose a phone system to change the phone number. The two-step procedure involves (1) moving the cursor to the choice and hitting the return key, and (2) typing in the phone number and then hitting the ENTER key (see Fig 7.5).

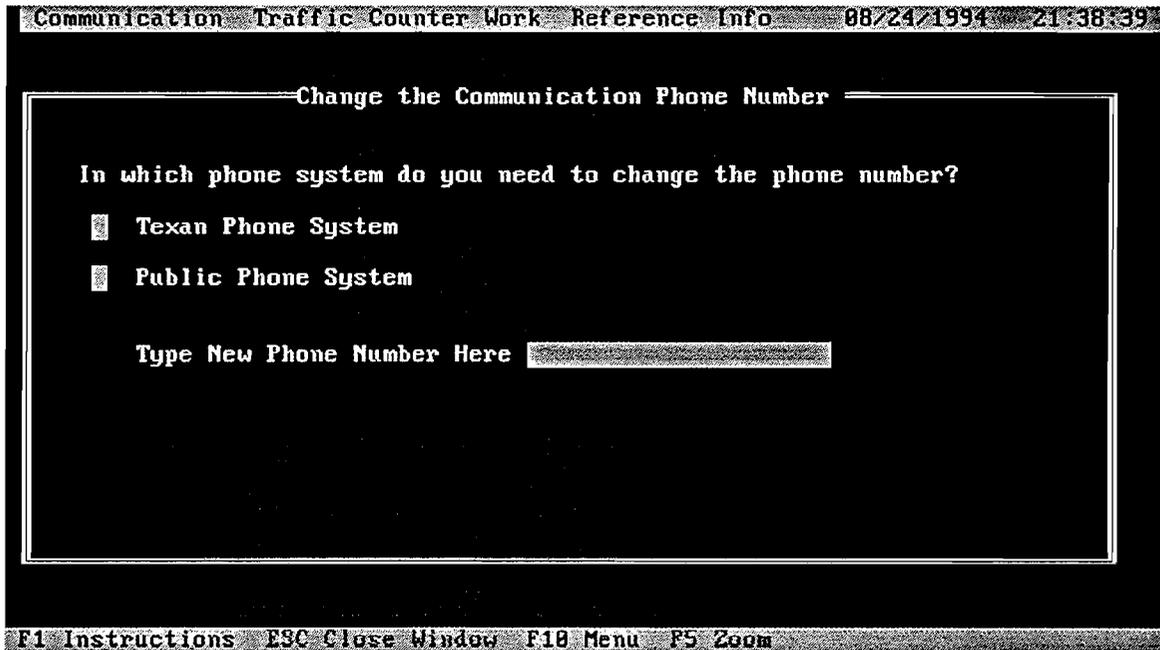


Figure 7.5: Changing the host computer telephone number

7.2.3 Communication through the Public Phone System

7.2.3.1 Login for Communication. To use the public phone system for data communication work, the operators must prepare the hardware for the HP 200LX as described in sections 5.2 and 5.3. Then operators log in by typing the correct user ID and password combination. Incorrectly entering the user ID and password combination more than three times will result in the screen shown in Figure 7.6; the program sounds an alarm and then locks for a brief period.

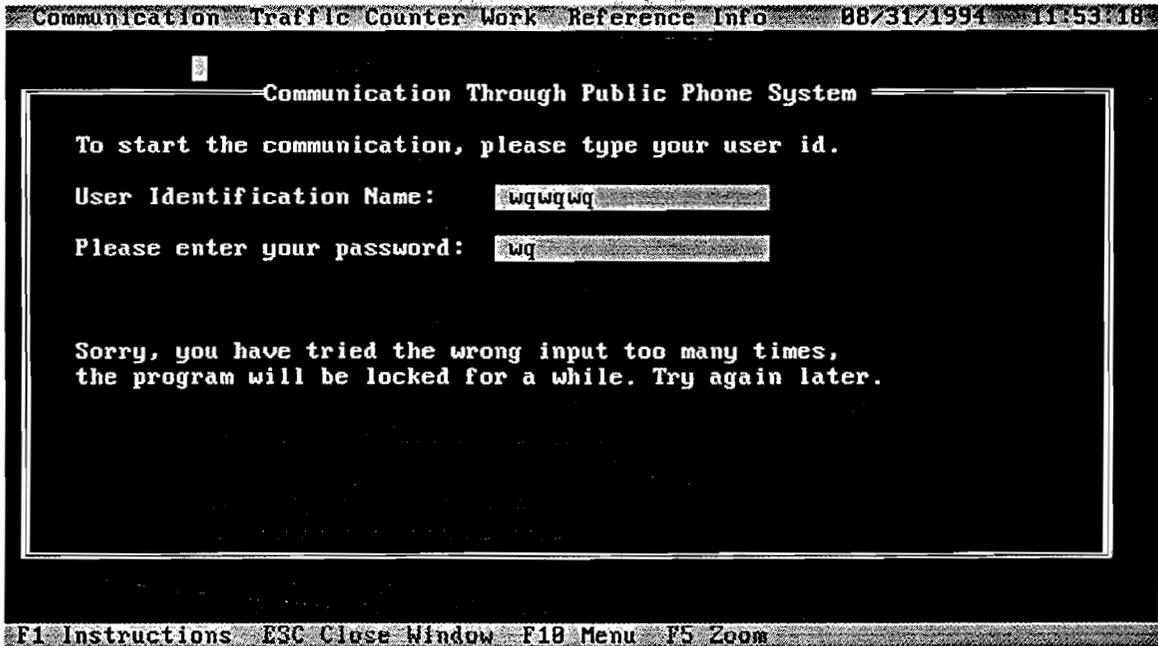


Figure 7.6 Error message display for communication login

Entering the correct user ID and password yields the message screen shown in Figure 7.7; at this point the operator can begin the communication.

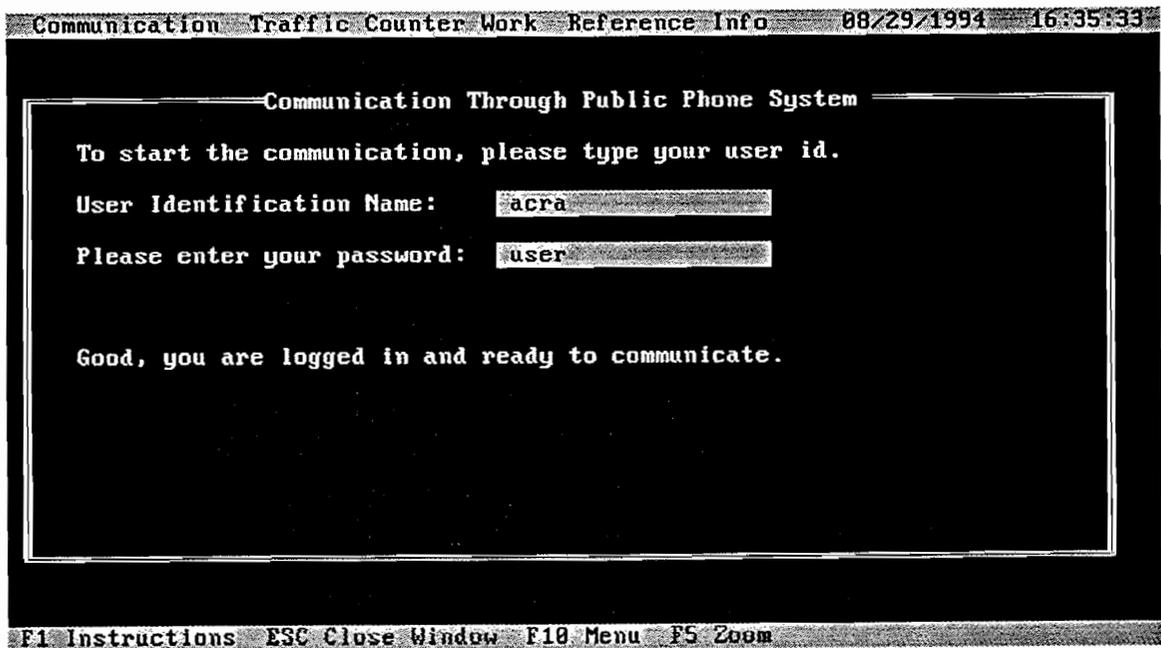


Figure 7.7 Successful message screen for communication login

7.2.3.2 Building a Communication Connection. After a successful login, it is time to begin communication. As shown in Figure 7.8, you can choose either "t" for touch-tone phone, or "p" for pulse phone, based on the telephone you are using for data communication. After typing "t" or "p," the cursor will automatically (don't hit the ENTER key) move to the next line, prompting you to type the TxDOT host computer telephone number. If you are in the Austin area, just type the phone number in the format as "XXX-XXXX." If you are making a long-distance call to the TxDOT host computer, use the phone number format "1-512-465-7940." If you are using a business's internal phone system and must dial "9" to reach an outside line, then use the format "9,465-7940" or "9,1-512-465-7940."

After typing the phone number, hit the ENTER key; the computer will dial the number and set up the communication connection. You can press ESC to quit. If you do not press the ESC key, you will hear the modem dialing and see the message on the screen. After a while, you will hear the continuous tone and noise; the connection has been made. If the connection cannot be made, the program will automatically log off from communication.

```

Communication Traffic Counter Work Reference Info 08/23/1994 13:59:56
-----Communication Through Public Phone System-----
Choose "t" for touch tone, "p" for pulse, for your phone: t
Please type remote TxDOT host computer phone number: 465-7940
Begin to build communication connection...
"Esc" to quit.

No Carrier

O K
F1 Instructions ESC Close Window F10 Menu F5 Zoom

```

Figure 7.8 Build up communication connection screen

7.2.3.3 Receiving a Schedule File from TxDOT. When the communication connection has been made, you will see the screen shown in Figure 7.9. At this stage, you can either receive a schedule file from TxDOT, or you can send a data file back to TxDOT. Figure 7.9 indicates that a schedule file has been received from TxDOT. Type "r" for receiving file and "sample2.out" for the file name of the schedule file you wish to receive from TxDOT. After typing the file name (remember to type the ".out" file name extension for all schedule files from TxDOT), hit the ENTER key. You will see the receiving file communication begin. A screen message will then

tell you whether the file is correctly received. If you don't see this message, or if you see an "incomplete file received" message, or if you see a "wrong file name" message (meaning you typed the wrong file name), you need to go through the communication procedure again to make sure the schedule file has been successfully received.

```

Communication Traffic Counter Work Reference Info 08/24/1994 23:03:22
-----
Communication Through Public Phone System
-----
Communication Connection has been built.
Type "r" for receiving file; "s" for sending file:
Type receiving file name: sample2.out

Start to Receive File...

File received correctly

F1 Instructions ESC Close Window F10 Menu F5 Zoom

```

Figure 7.9 Receiving schedule file from TxDOT

7.2.3.4 Sending a Data File to TxDOT. Similarly, if you choose "s" for sending a data file back to TxDOT, you will see the screen shown in Figure 7.10. Remember to type a file name with an ".in" extension for the data file you need to send back to TxDOT. If errors are made during this file transfer, the screen will display messages similar to those displayed for errors made in receiving schedule files.

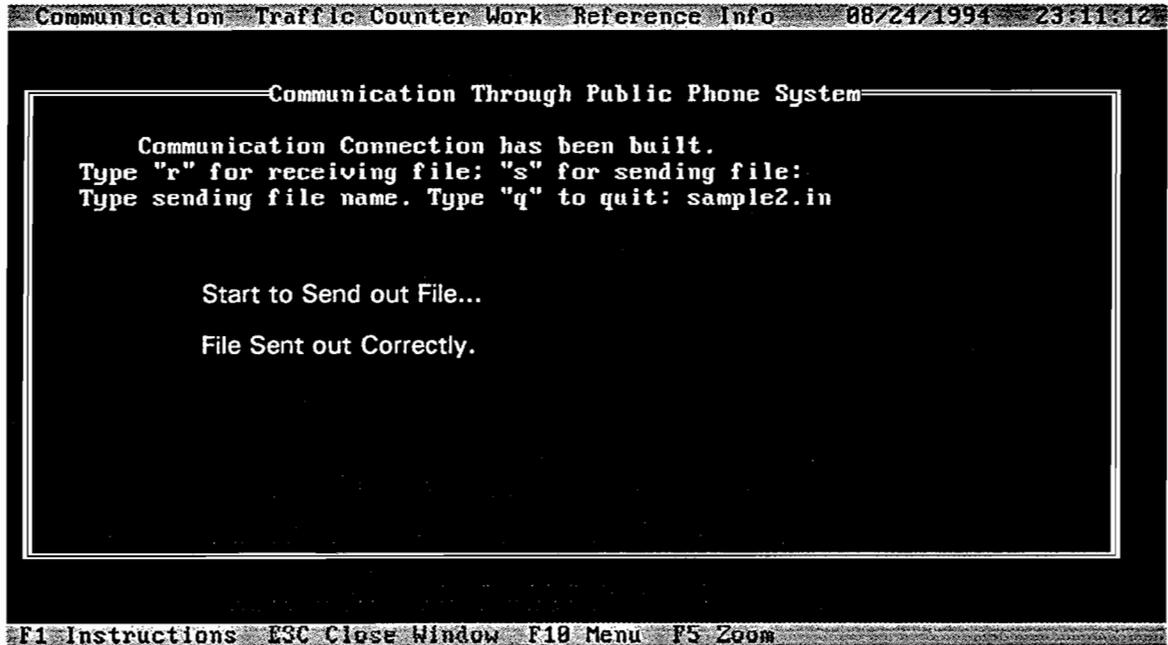


Figure 7.10 Sending a data file to TxDOT

7.2.4 Communication through TEX-AN Phone System

Finally, it is necessary to mention that, while the procedure used for communicating through a TEX-AN phone system is basically the same as that used for a public phone system, the TEX-AN phone system does require its own phone number formats. Thus, to access a TEX-AN phone system use 8,241-465-7940 if calling long distance; 9,241-465-7940 if in Austin.

7.3 USING INFORMATION TOOLS IN ACR SOFTWARE

7.3.1 Browsing a Schedule File

If you need to browse a schedule file you have received, press the F10 function key and move the cursor to the Traffic Counter Work area in the top menu bar. Then, pressing the ENTER key, you will get the menu for traffic counter work, shown in Figure 7.11. By choosing the first item in this menu, you can browse the schedule screen shown in Figure 7.12. Then use the TAB and arrow keys to select the schedule file you want to review (see Fig 7.13).

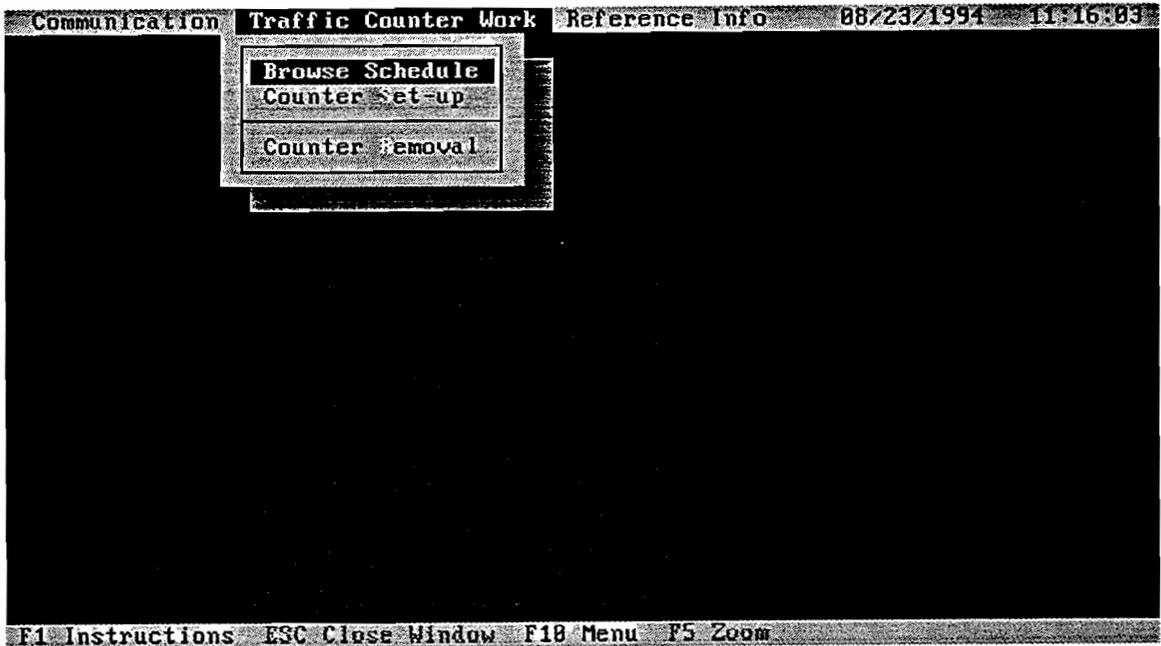


Figure 7.11 Traffic counter menu screen

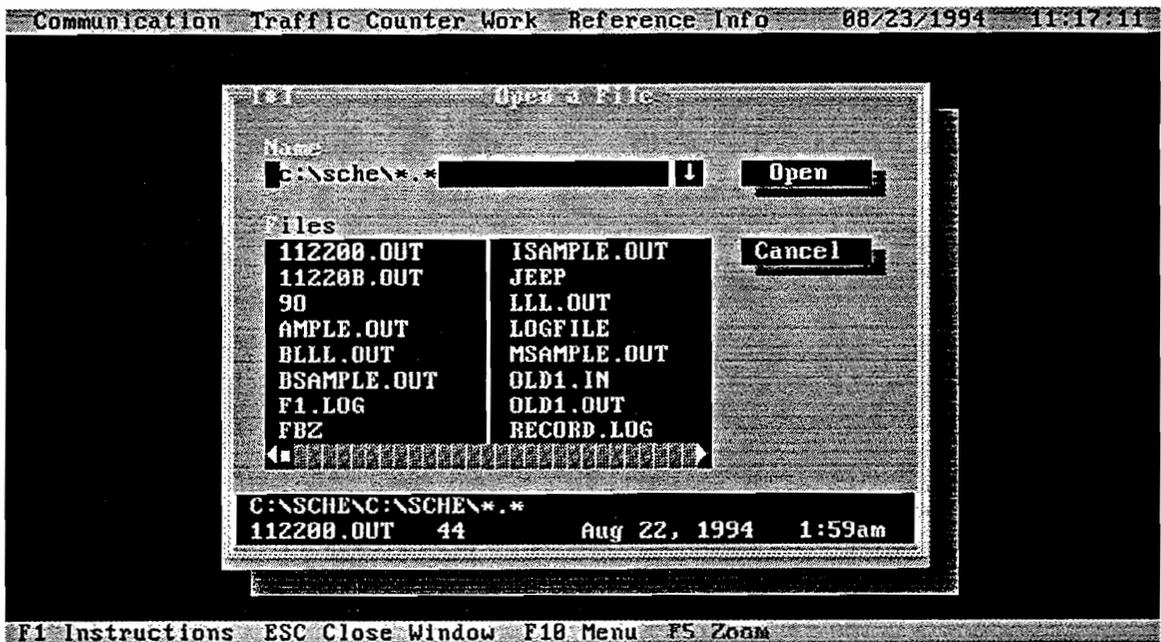


Figure 7.12 Browsing a schedule file (screen 1)

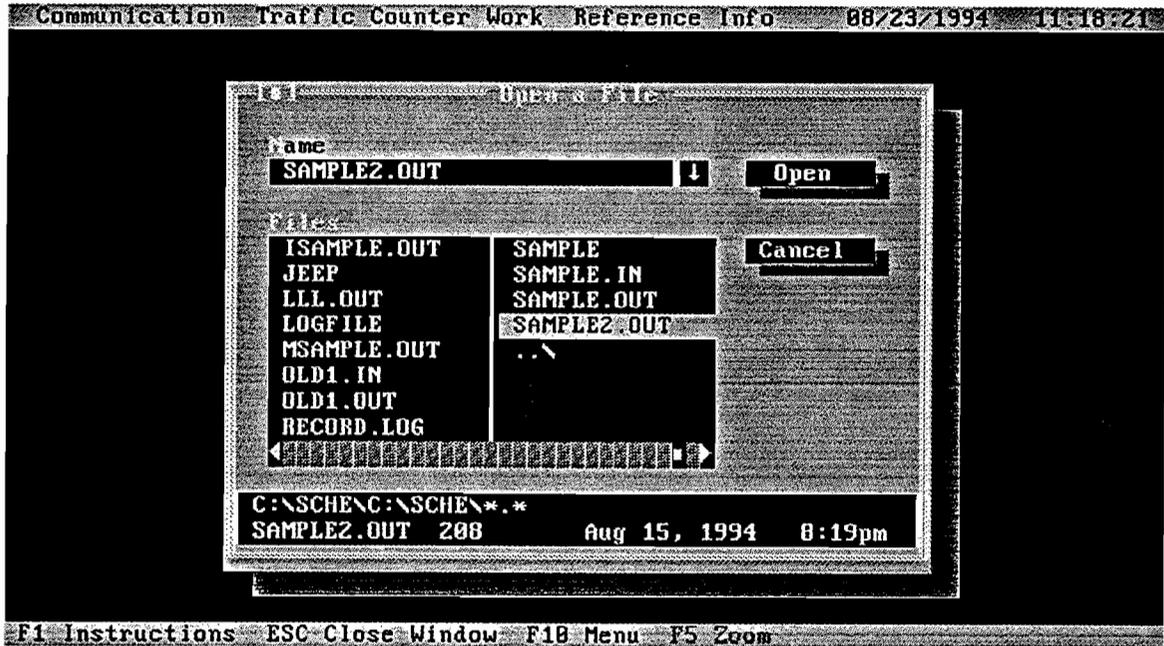


Figure 7.13 Browsing a schedule file (screen 2)

Suppose you want to browse the schedule file *sample2.out*. Press the ENTER key and you will get a new screen, as shown in Figure 7.14. You can use the arrow keys to move up and down, left and right. You can also use the F5 function key to zoom into the screen, and the ESC key to quit.

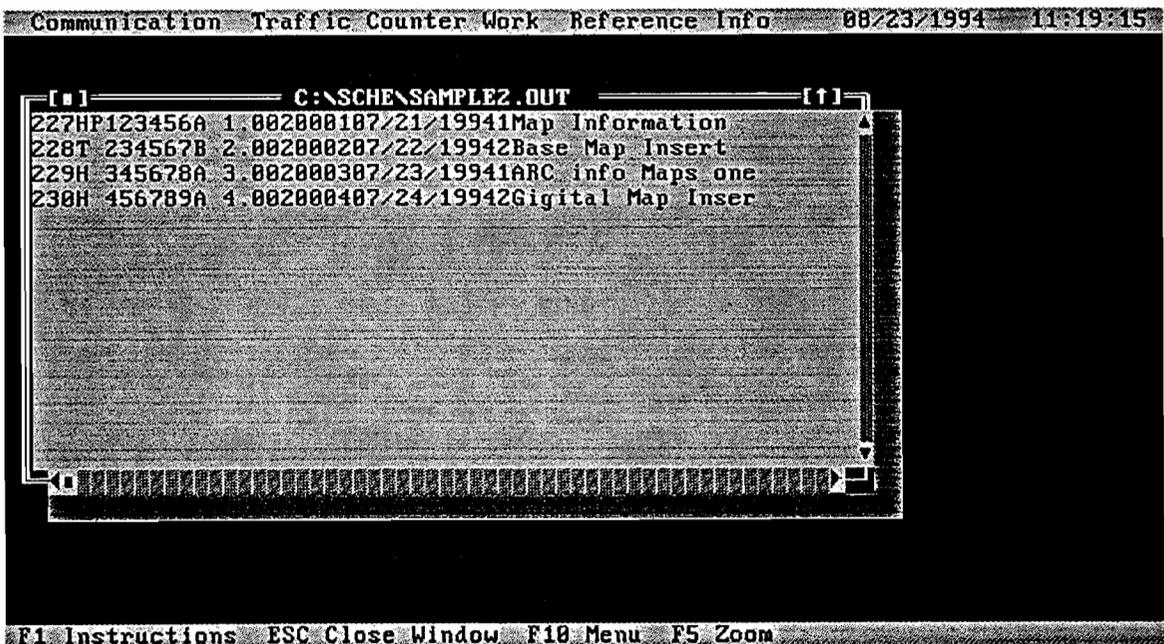


Figure 7.14 Browsing a schedule file (screen 3)

7.3.2 Reference Information

When you need reference information for schedule setup and removal, or when you need a quick reference on how to use the ACR program, you can choose *Reference Info* from the top of the menu and select the *Instruction* from the bottom of the menu. Press F10 to activate the top menu bar and choose *Reference Info*; you will get the menu shown in Figure 7.15.

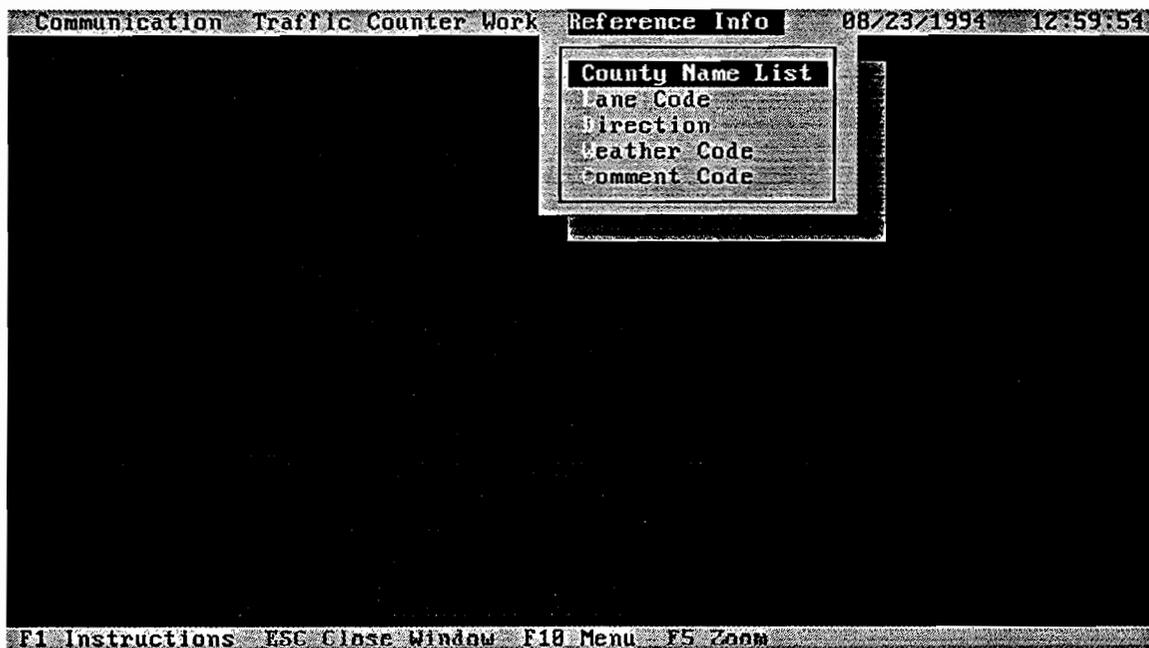


Figure 7.15 Reference information menu

7.3.2.1 County Name List. You can read the county name list, as shown in Figure 7.16. Use the arrow keys to scroll the file, and use F5 to zoom into the screen. Use the ESC key to quit.

Communication Traffic Counter Work Reference Info 08/23/1994 13:00:57

County Name List

The following is the county name list
in the state of Texas

County Name	County Code	County Name	County Code
Anderson	001	Karnes	129
Andrews	002	Kaufman	130
Angelina	003	Kendall	131
Aransas	004	Kenedy	066
Archer	005	Kent	132
Armstrong	006	Kerr	133
Atascosa	007	Kimble	134
Austin	008	King	135
Bailey	009	Kinney	136
Bandera	010	Kleberg	137
Bastrop	011	Knox	138
Baylor	012	Lamar	139
Bee	013	Lamb	140
Bell	014	Lampasas	141
Bexar	015	La Salle	142
Blanco	016	Lavaca	143

F1 Instructions ESC Close Window F10 Menu F5 Zoom

Figure 7.16 County name list

7.3.2.2 Lane Code List. Similarly, you can access lane code information from the screen shown in Figure 7.17.

Communication Traffic Counter Work Reference Info 08/23/1994 13:02:03

Lane Code List

The lane code consists of two parts:
"Lane Type" + "Lane Number".

For example : Lane code could be "M1" or "S2".
 where "M" is Lane Type part,
 "1" is Lane Number part.

Part (1) Lane Type

- o "M" for main lane.
- o "S" for service road.

Part (2) Lane Number

- o If a station has only one set-up, let Lane Number part be blank.
- o For multiple set-ups, put "1" in the Lane Number part for the original (first) lane. Then for each additional lane, keep the part one lane type unchanged, and increment part two lane number by one.

F1 Instructions ESC Close Window F10 Menu F5 Zoom

Figure 7.17 Lane code list

7.3.2.3 *Direction List.* There are four travel directions, as shown in Figure 7.18.

Code	Direction
N	North
E	East
S	South
W	West

Figure 7.18 Direction code list

7.3.2.4 *Weather Code List.* Figure 7.19 shows the codes for various weather conditions.

Code	Condition
0	Clear
1	Cloudy
2	Showers
3	Rain
4	Fog
5	Snow
6	Sleet
7	Ice
8	Hail
9	Dust

Figure 7.19 Weather code list

7.3.2.5 *Comment Code List.* Figure 7.20 shows the codes for the various comments.

Code	Comment
01	New Traffic Generator
02	Abandoned Traffic Generator
04	Gravel Hauling
05	Farming Activity
06	Crop Harvests
07	Oil Field Activity
08	New Housing in Area
09	Vacated Housed in Area
10	Recreational area
11	No Farming Activity
12	Weather/Road condition affect
13	Livestock Auction
14	Road Construction
15	Business Construction
16	Logging Activity
17	Strip Mining
18	Test Vehicles
19	Setup Tampered with

F1 Instructions ESC Close Window F10 Menu F5 Zoom

Figure 7.20 Comment code list

7.3.2.6 *Instruction on How to Use ACR Program.* By pressing the F1 function key, you can get instructions on how to use the ACR software (Figure 7.21). You can use the F5 function to zoom into the screen, or use the arrow keys to move, or the ESC key to quit.

Communication Traffic Counter Work Reference Info 09/29/1994 15:25:39

How to use ACR software

Welcome to TxDOT
ACR Software

ACR software package consists two parts: communication and traffic counter work. Their work procedures are described in the following two sections.

*****PART ONE: REMOTE COMMUNICATION WITH TXDOT*****

You can use the communication package in ACR to receive the work schedule file from the TxDOT and to send the traffic count data file back to TxDOT via the telephone line. You may use either TEX-AM phone system or the general public telephone system. In the following you will find instructions for the communication work.

1. GET THE HARDWARE READY

(1) Connect Palmtop PC and External Modem
Use the connecting cable to connect the HP 200LX PalmTop PC and the U.S. Robotics 2400 external pocket size modem. One end of

F1 Instructions ESC Close Window F10 Menu F5 Zoom

Figure 7.21 Instruction for using ACR software

7.4 SCHEDULE SETUP

7.4.1 Choosing a Schedule File for Schedule Setup

In this section, we describe how to use the ACR software for traffic count recording in traffic stations. First, access the screen shown in Figure 7.11 by using the same method described in the beginning of section 7.3.1. Then choose the item *Counter Set-up* and press the ENTER key. You will then be prompted to input a schedule file name. Just type the schedule file name *without* its ".out" extension (see Fig 7.22).

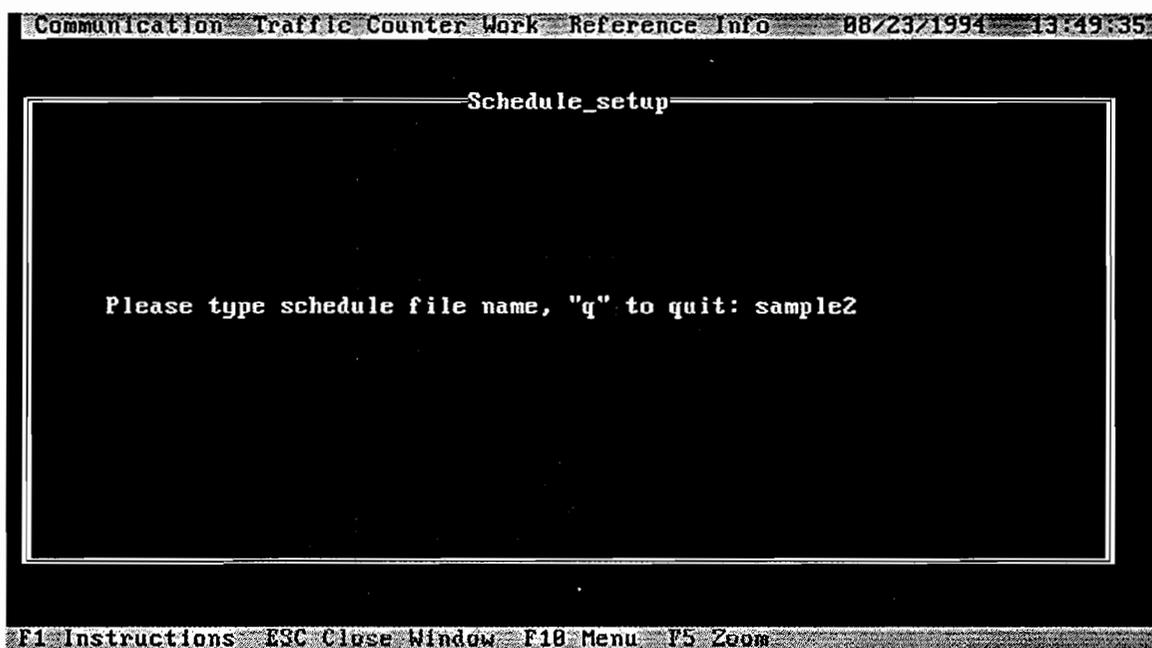


Figure 7.22 Choosing a schedule file for setup

If you input the wrong file name for a schedule file, you will see the error message screen shown in Figure 7.23.

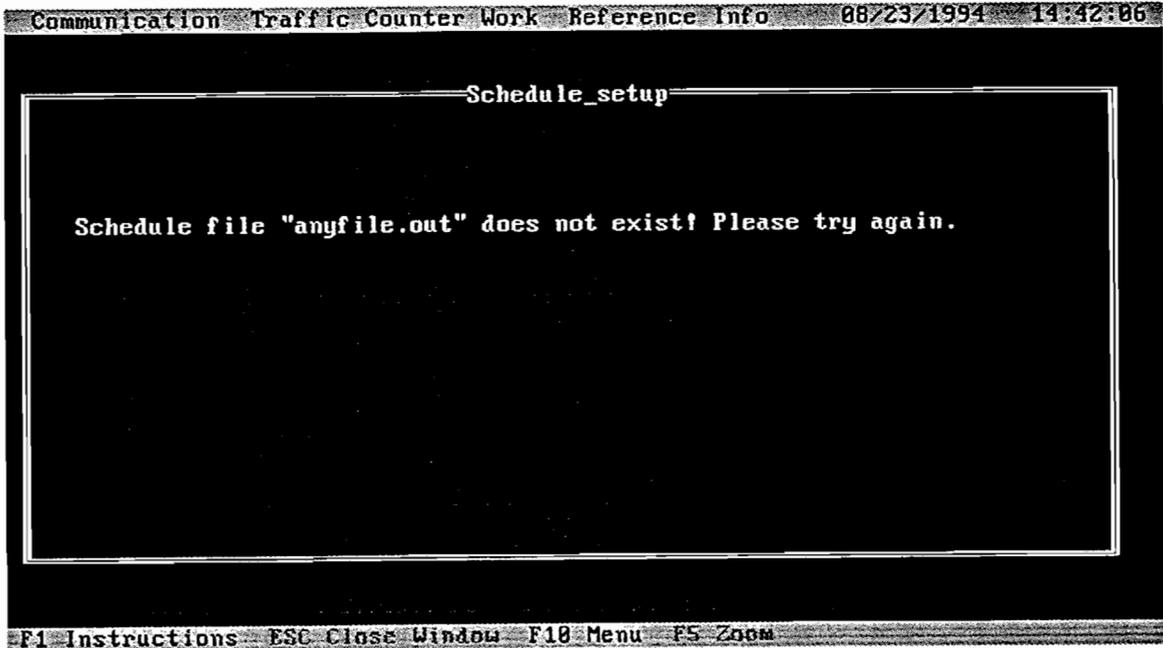


Figure 7.23 Error message for invalid setup schedule file

7.4.2 Choosing a Station from the Schedule File for Schedule Setup

Once you input a valid schedule file name, you will get the screen shown in Figure 7.24. This screen tells you which schedule file you are using, what the station is, and other information that you will need in schedule setup for a station. If you decide to begin the schedule setup at the current station shown on the screen, just press "y" to start; if you want to skip to the next station, press "s;" if you want to delete an invalid station, press "d." You will then get a warning message asking you to confirm; if you need to add a new station, press "i;" if you want to quit, press the ESC key.

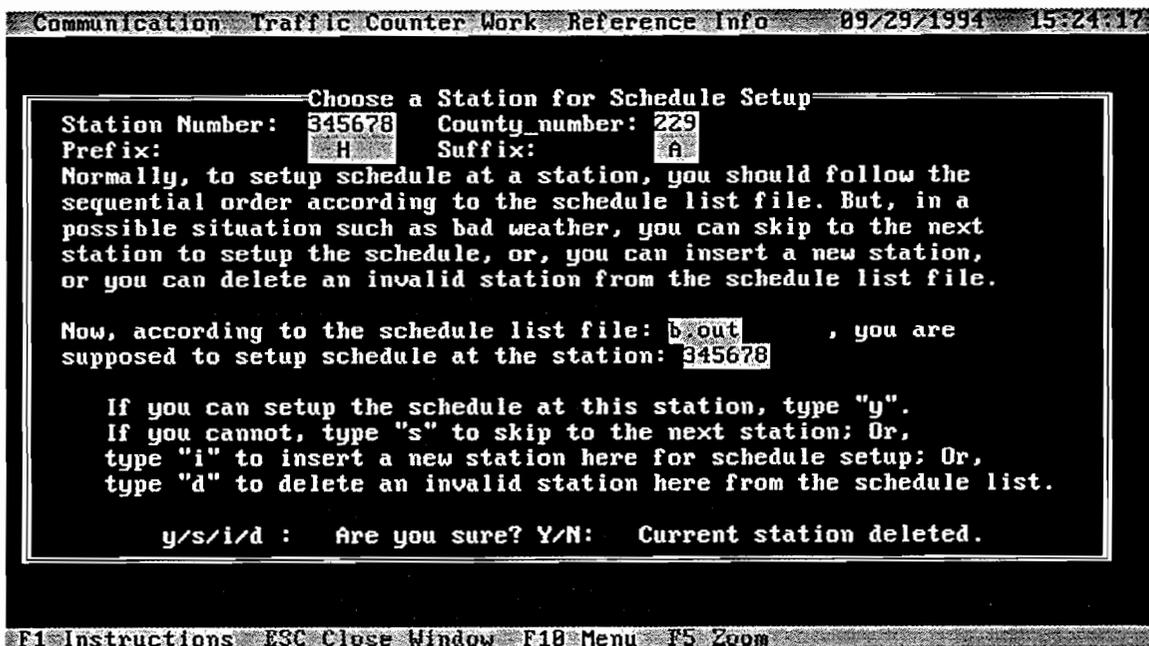


Figure 7.24 Choosing a station from the schedule file to setup

7.4.3 Performing a Schedule Setup at a Station

Figure 7.25 shows the standard screen used for schedule setup work at a station. You should: (1) input either "1" or "2" for duration; (2) input a four-digit number for Counter Machine serial Number; (3) input a five-digit number for setup reading; (4) input either "S" or "M" plus a one-digit number between 1 to 4 for the lane code; and (5) input either "W" or "S" or "E" or "N" as direction. When you have finished, you can type "y" to confirm the setup data input, or press "n" to change your input, or press ESC to quit at anytime.

Once the setup data input has been confirmed, you will see the screen displaying the time and date of your schedule setup at this station.

```

Communication Traffic Counter Work Reference Info 08/23/1994 13:49:35
-----
                Setup schedule sample2.out
Schedule Number: sample2.out Set-up date: 07/21/1994 Current Date: 8/23/1994
County Number: 227 Prefix: HP Station No.: 123456
Suffix: A Sequence No.: 1.00 Last Count: 20001
Map Info.: Map Information Number of Setups: 1
-----
Choose a duration, 1 or 2: 1 Set-up Time: 8/23/1994 13:52
Machine Serial Number 1324 Set-up Reading 53245
Lane Code S1 Direction W
-----
Ready to setup? Hit "n" key to go back to update the inputs,
Hit "y" key to finish inputting the data for schedule setup.
Ready to setup? y/n Y
-----
F1 Instructions ESC Close Window F10 Menu F5 Zoom

```

Figure 7.25 Data input for a station setup

7.4.4 Adding a New Station

As mentioned, new stations may be added. If you pressed "i" in the screen shown in Figure 7.24 to add a new station, you will see the screen shown in Figure 7.26. In this screen, make sure you type a three-digit county number; then hit the ENTER key. In the same procedure, enter two characters for the prefix. If the prefix is one character, you will need to add a space and then hit the ENTER key, as shown in Figure 7.26. Input a six-digit number for station number, one character for the suffix, and either "1" or "2" for number of setups.

```

Communication Traffic Counter Work Reference Info 08/23/1994 13:52:44
----- Insert a New Station -----
To insert a new station, please enter the following information.
Hit "esc" key to quit inserting new station.

County Number: 123 prefix: H
Station Number: 345122 Suffix: A
Number of Setups: 1

To accept input, type "y". To quit, type "q".

y/q :
-----
F1 Instructions ESC Close Window F10 Menu F5 Zoom

```

Figure 7.26 Insert a new station

7.4.5 Message of Finishing Schedule Setup

After you have finished all schedule setup work on a schedule file, the message screen in Figure 7.27 will confirm that the schedule file has been completed for all the stations in this schedule.

```

Communication Traffic Counter Work Reference Info 08/23/1994 13:55:08
----- Message Window -----
You have finished the setup work for schedule sample2.out
CONGRATULATIONS!
-----
F1 Instructions ESC Close Window F10 Menu F5 Zoom

```

Figure 7.27 Message screen when schedule setup is finished

7.5 SCHEDULE REMOVAL

This section describes schedule removal. The procedure used for schedule removal is similar to that used for schedule setup.

7.5.1 Choosing a Schedule File for Schedule Removal

In Figures 7.28 and 7.29, you can follow the same procedure described in section 7.4.1 to remove a schedule.

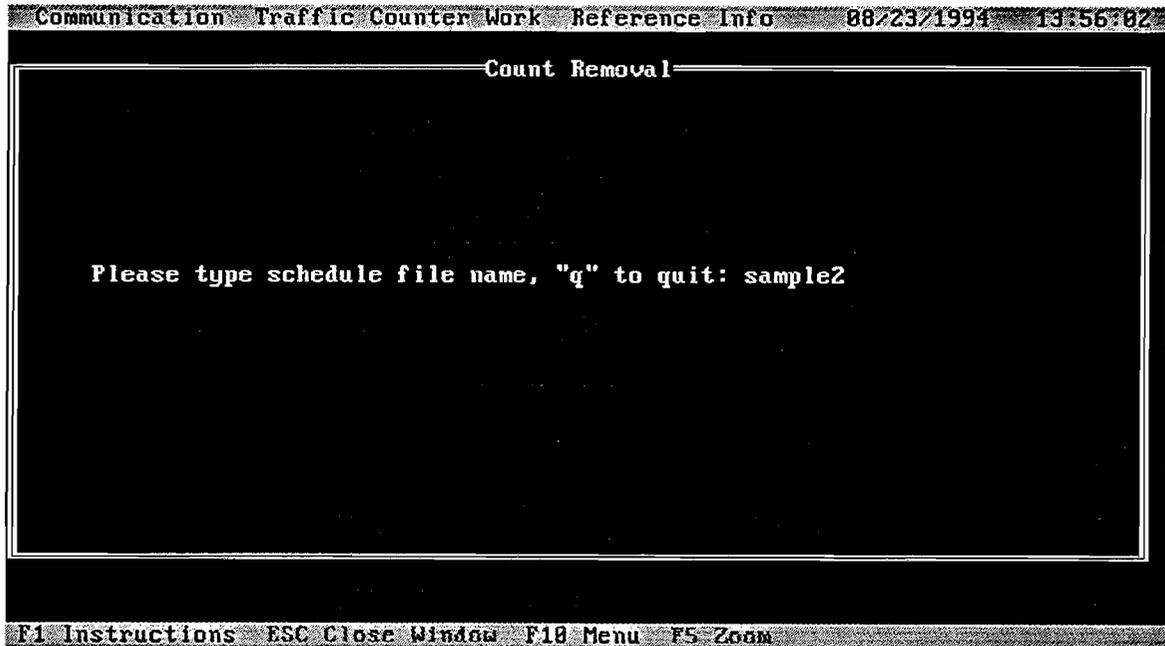


Figure 7.28 Choosing a schedule file for removal

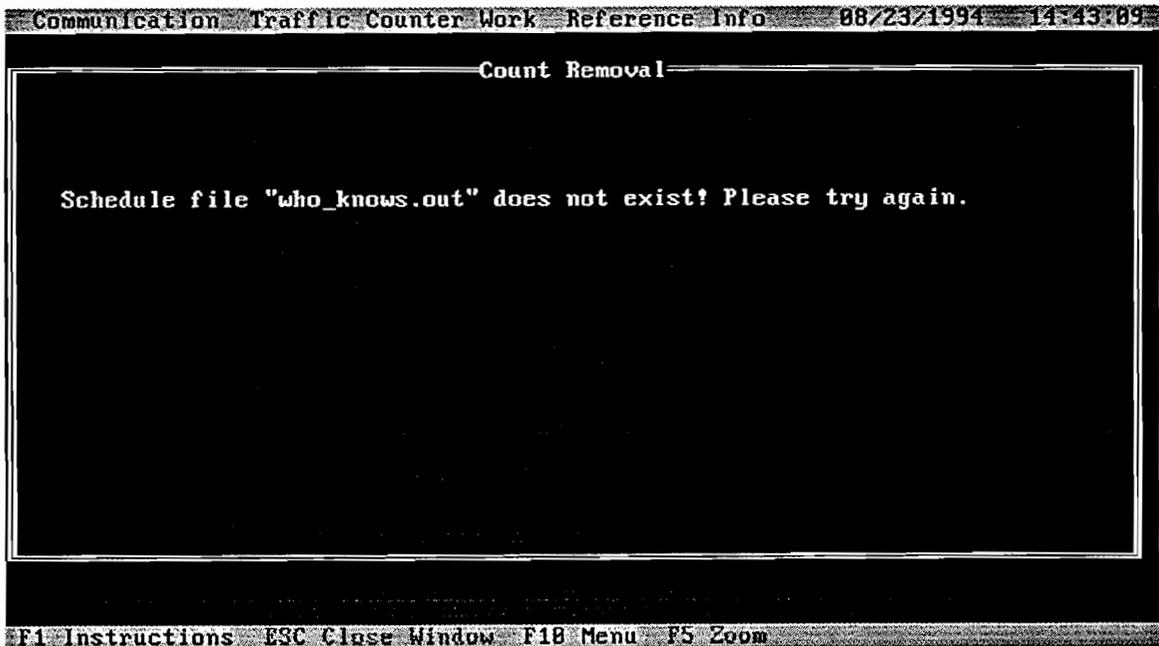


Figure 7.29 Error message for invalid removal

Counter removal for each schedule can be done **only after** the same schedule file has been previously set up. Obviously, you cannot remove a counter that has not been set up (see Fig 7.30).

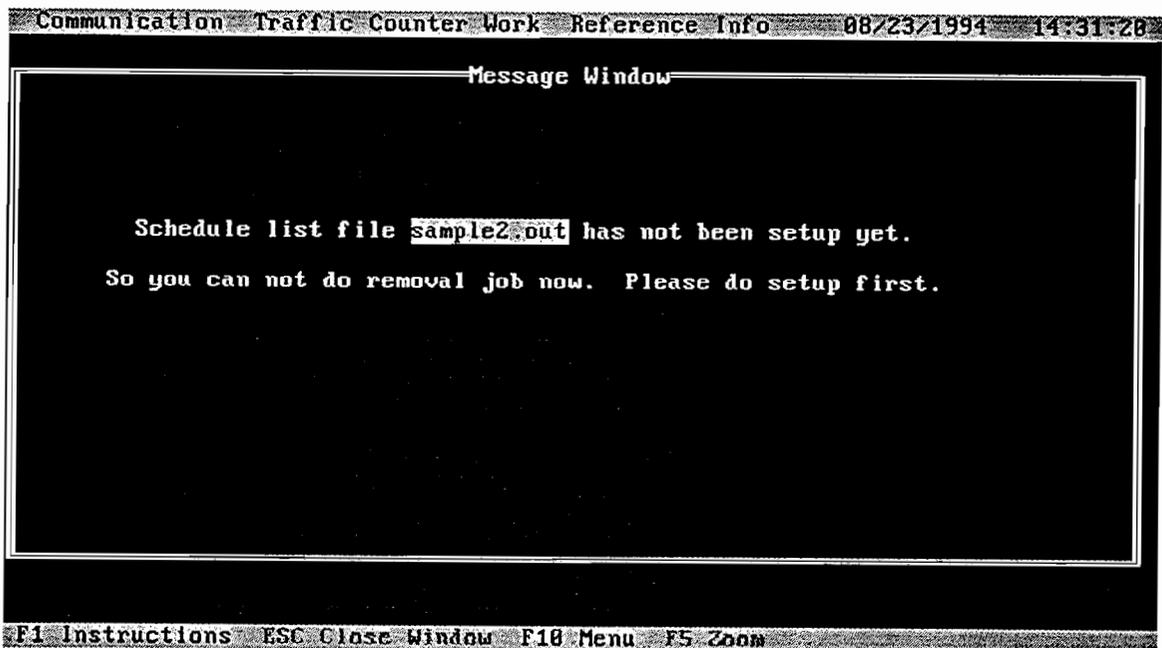


Figure 7.30 Error message when trying to remove a non-setup schedule

7.5.2 Choosing a Station for Counter Removal

The procedure here is similar to the procedure described in section 7.4.2, except that stations can not be deleted or added (see Fig 7.31).

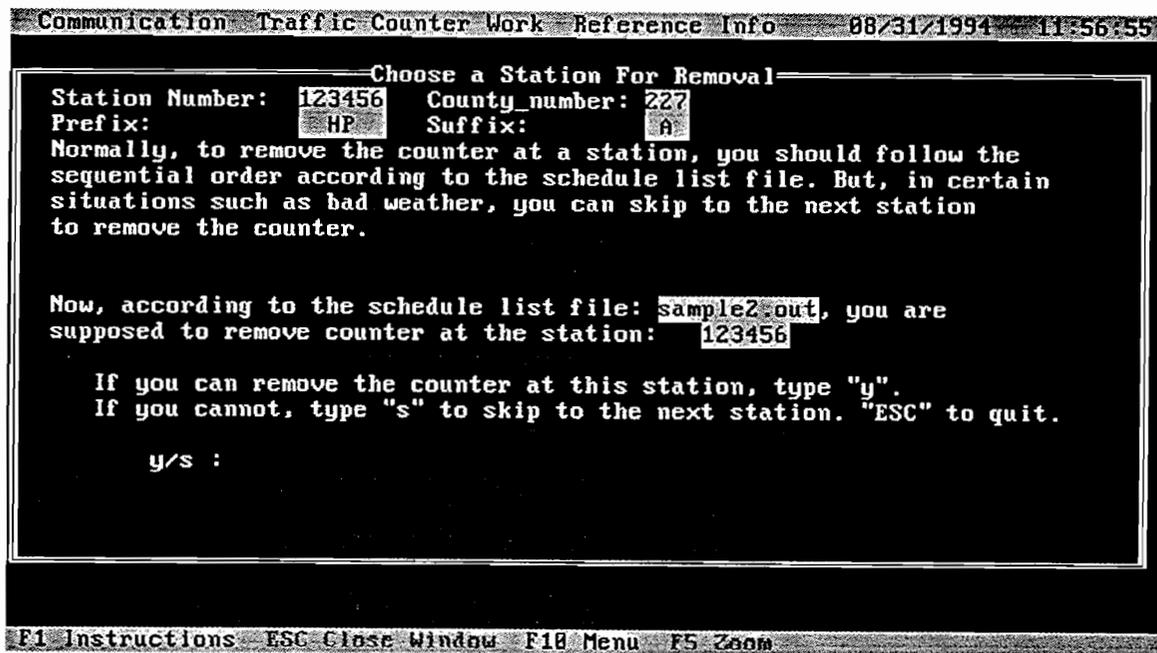


Figure 7.31 Choosing a station for removal

7.5.3 Scheduled Removal at a Station

As in the counter setup standard screen, the counter removal screen shown in Figure 7.32 asks you to input certain data. If you chose duration "1" in schedule setup work at a station, you need to come back to that station 24 hours later to do the schedule removal work, or "2" for 48 hours later. If you return to the schedule removal work more than 3 minutes too early, you will see the message shown in Figure 7.32, telling you that you are too early. In this situation, you can either quit by pressing "n," or continue by pressing the "y."

```

Communication Traffic Counter Work Reference Info 08/23/1994 13:56:02
-----
Removal schedule sample2.out
Schedule File: sample2.out Set-up date: 07/21/1994 Current Date: 8/23/1994
County Number: 227 Prefix: HP Station No.: 123456
Suffix: A Sequence No.: 1.00 Last Count: 20001
Map Info.: Map Information # of Setups: 1
-----
Choose a duration, 1 or 2: 1 Set-up Time: 13:52, 8/23/1994

This Count: 12121 Machine Serial Number 1324
Set-up Reading 53245 Removal Reading: 21212
Comment Code: 12 Weather Code: 1
Lane Code: 31 Direction W
-----
Ready to removal? If "n", you can update the input data, if "y", hit
the return key to finish the removal.
Ready to removal? y/n
-----
F1 Instructions ESC Close Window F10 Menu F5 Zoom

```

Figure 7.32 Data input for counter removal at a station

When you finish all counter removal work for a schedule file, you will get the message screen shown in Figure 7.33, telling you that you are done and that you can now send the data back to TxDOT. To send back a data file, see the instructions in section 7.2.3. If you want to review the data file before sending it back to TxDOT, use the method described in section 7.3.1. A sample data file is shown in Figure 7.35.

```

Communication Traffic Counter Work Reference Info 08/23/1994 13:58:47
-----
Removal schedule sample2.out
Message Window
-----
You have finished setup and removal job for the
schedule file sample2.out.

Congratulations!

Now you can send result file sample2.in back to TxDOT.
-----
F1 Instructions ESC Close Window F10 Menu F5 Zoom

```

Figure 7.33 Message screen when all removal work is finished

During schedule removal, you may finish the work for all previously setup stations, but not for all stations in the schedule file. In this situation, you will see the message shown in Figure 7.34. This screen reminds you to first finish setting up the rest of the stations, and to then come back to do the removal work at these stations; when this is completed, you will see the “all done” message screen shown in Figure 7.33.

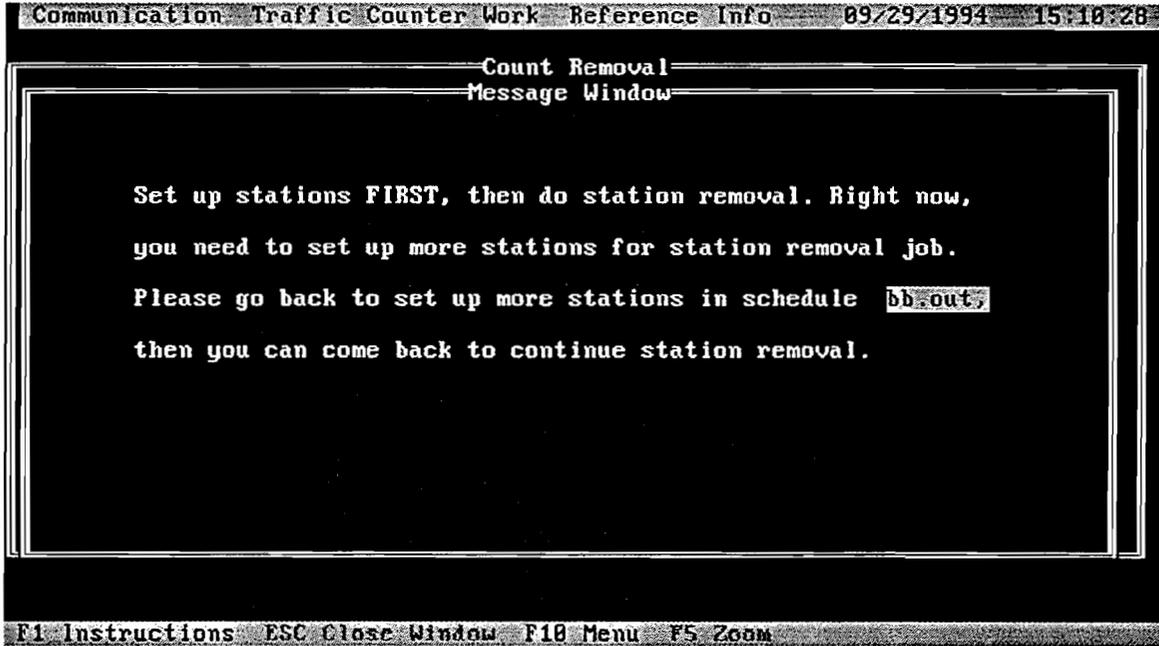


Figure 7.34 Reminder message to check if all removals are finished

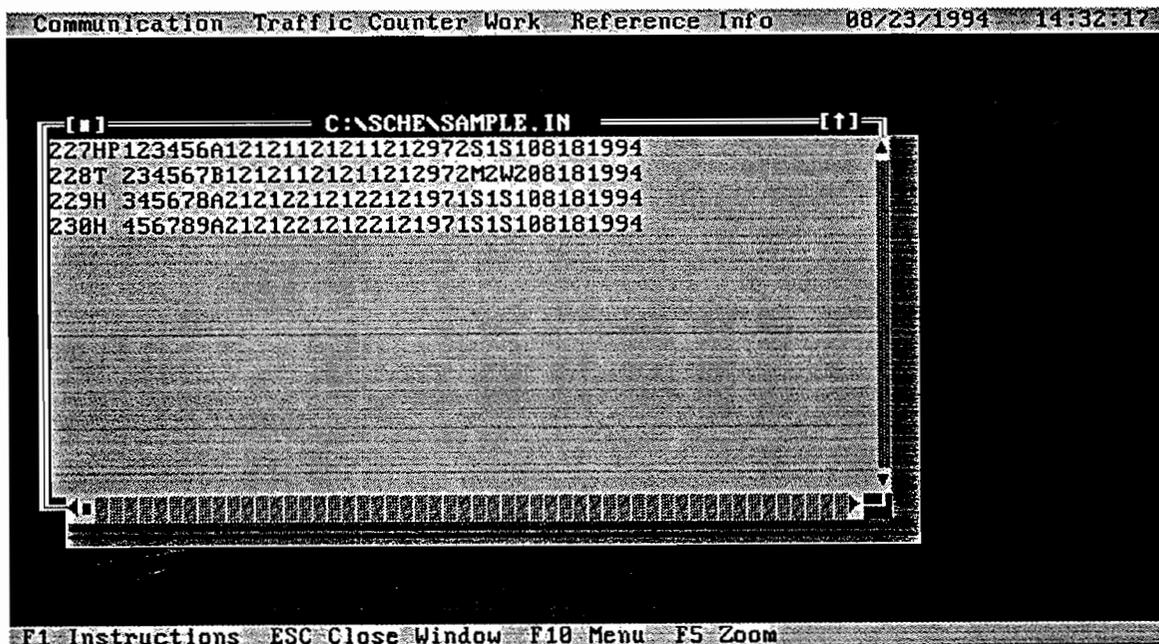


Figure 7.35 Browsing a data file

CHAPTER 8. CONCLUSIONS AND RECOMMENDATIONS

The automated ACR field data collection and data file transfer system described in this report will improve the speed, efficiency, and accuracy of TxDOT's data transfer efforts. However, there remain aspects of the process that require further improvement. For example, even with an automated ACR system, field operators are still obligated to reference paper maps when identifying traffic stations. These paper maps not only consume resources in terms of materials, money, and labor; they also represent cumbersome burdens to the field operators.

As an alternative, we recommend that Geographic Information System (GIS) technology be employed to create computerized maps. The advantages of GIS applications in transportation have been previously investigated at The University of Texas at Austin (Refs 8, 9). At present, two approaches are possible for integrating computerized maps within the ACR system:

1. The separate-maps approach: In this approach, the current inventory of paper maps used by TxDOT (about 700)would be stored as separate maps in electronic format; a match table could be developed to connect the maps with their corresponding traffic stations.
2. The GIS approach: This approach would make use of one master map to automatically generate a map of a specific area. Using GIS technology, operators could zoom in on the master map when searching for specific stations of interest. We believe this approach would require less effort than the separate-maps approach.

Considering the space required to store maps, and the time required to develop the match table in the separate-map approach, we recommend the GIS approach as the most favorable solution. In fact, a simple "Intelligent Maps" system has already been developed (under project 2040) to demonstrate the benefits of combining computerized maps with the ACR system. The program runs under MS-Windows. Major features in this Intelligent Maps system include:

- 1) Concept of GIS-based maps: Entire maps of all Texas counties can be integrated as one master map.
- 2) The power of zooming: While the entire state of Texas can be put on one map, the zoom function associated with GIS allows close-up views of detailed portions, such as a single road segment.
- 3) Spatial query: With spatial query, one can interactively query or identify a specific feature (e.g., a station or a section of highway).
- 4) Two-way selection: Stations selected from the station list can be seen on the map, and stations selected from the map can be seen on the station list simultaneously. This feature will assist the contractor in locating stations.
- 5) District information: District information can be easily accessed using the maps.
- 6) Desktop mapping: Traffic volume and other information can be easily displayed to generate corresponding maps.

Since the tasks in the initial proposal did not consider computerized map function, the HP 200LX was selected as the platform. While the HP 200LX can perform all the tasks described in the original proposal, it may not be adequate for computerized map function, owing to its monochrome display and small screen. Accordingly, laptop computers with color displays are recommended for developing the computerized map display system.

In summary, we recommend an ACR system that combines a laptop computer with a GIS-based electronic map system. The GIS-based electronic map system can also be integrated with the Global Positioning System (GPS) technology.

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9. Zhang, Z., *GIS Application in Urban Roadway management Systems*, Master's thesis, The University of Texas at Austin, 1993.

APPENDIX 1

95LX, HP 100LX, AND HP 200LX SPECIFICATIONS

HP 95LX

- Execute MS-DOS commands available in the HP 95LX
- Transfer files between one HP 95LX and another via infrared interface
- Transfer files between an HP 95LX and an IBM-compatible PC, either through direct serial connection or via an optional modem, using the optional HP F1001A Connectivity Pack
- Simplify file management tasks, especially file transfer, using the split-screen feature; lets you see two directories at once, making it easy to copy a file from one to the other
- Print a file, set of files, or directory listing to a printer
- Play TigerFox, a chase game with 45 different mazes

Setup Utility

- Adjust display contrast, memory allocation, and beeper volume
- View battery level
- Set date and time formats
- Specify punctuation, language, keyboard, and currency settings
- Select or modify printer configuration
- Create customized user keys that let you quickly recall a string of text or automatically execute a series of keystrokes to perform a specific task
- Format a plug-in RAM card
- Personalize the HP 95LX by filling in a business card display or adding your own customized graphics image

That's what the 7 wonderful keys do, each by itself. But that's not all — these applications fit together. This means that you can jump from one to another at will, and even take data along with you. It means that you won't have to learn different schemes of commands for each piece of software, because these are consistent, as alike as Lotus programming could make them.

Look at these consistency features:

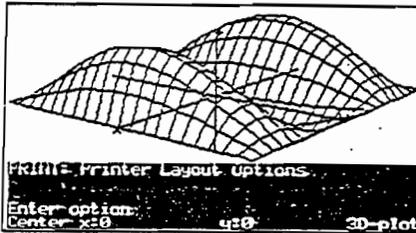
- Press a single key to access any of the 7 built-in applications
- Press a single key to switch to another application without having to close the first one
- Find your way around an application easily, guided by menu keys and softkeys
- Access **Help** from any application by pressing **F1**
- Move information among applications by copying it to a clipboard and pasting it where you need it
- Save time by creating custom user keys to recall specific sequences of keystrokes that you use often

"This handheld hybrid may change financial organization as we know it."

Portable Office

"HP's 95LX is an engineering triumph, incorporating amazing advances in miniaturization and connectivity."

BYTE

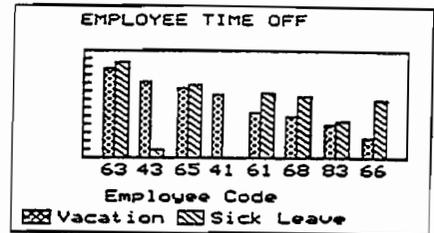


Time Value of Money - Case 1

Number of periods... N	=	360.00
Annual interest... I/YR	=	11.50
Present Value... PV	=	189,000.00
Payment... PMT	=	-1,871.65
Future value... FV	=	0.00
Payments per year... P/YR	=	12
Begin/End mode... B/E	=	END

PMT = -1,871.65

Print F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 F11 F12



Melbourne: 10/16/92 4:55 pm
Press ENTER to select highlighted City

City	Country	GMT Offset
Melbourne	Australia	+10:00
Hawaii	USA	-10:00
Hawaii Island	Spain	-11:00
Memphis	United States	-06:00
Mexico City	Mexico	-06:00
Miqueav Island	United States	-11:00
Milan	Italy	-01:00
Milwaukee	United States	-06:00
Minneapolis	United States	-06:00
Headshu	Switzerland	+01:00
London	UK	+01:00

Help Delete Copy Find

the specs

HP 95LX and HP 95 LX1MB Palmtop PCs Include

- Owner's Manual
- Quick Start Guide
- Two AA and one CR2032 batteries
- Engravable personal nameplate

Physical Specifications

- Dimensions:
 - 16 x 8.64 x 2.54 cm (6.3 x 3.4 x 1 in) closed
 - 16 x 16 cm (6.3 x 6.3 in) open
- Weight (with batteries): 312g (11 oz)

Memory

- Built-in ROM size: 1 Megabyte
- Software built into ROM:
 - MS-DOS 3.22
 - HP financial calculator
 - Appointment book
 - Data communications
 - Lotus 1-2-3 2.2
 - Memo editor
 - Phone book
 - File
- Built-in RAM size: 512K or 1M bytes with adjustable partitioning between system RAM and electronic RAM disk
- Built-in RAM availability: Because the built-in software executes from ROM and uses minimal RAM, most of the RAM is available for file creation and file storage
- Expansion capability: PCMCIA 1.0 Industry-standard plug-in card slot lets you increase electronic RAM disk, for file storage, or add ROM-based software applications.

Industry-standard PC Architecture and Central Processing Unit (CPU)

- IBM PC-XT architecture
- NEC V20H CPU (80C88-compatible) running at 5.37 MHz

Display

- Type: Supertwist liquid crystal
- Size: 40 columns x 16 rows
- Graphics resolution: 240 x 128 dots
- MDA compatible
- Character size: 5 x 7 dots

Beeper

- Alarm feature in appointment book
- Adjustable volume
- Audible warning of operator error



Keyboard Layout

- Familiar typewriter-like QWERTY layout
- Separate numeric keypad
- 10 function keys (softkeys)
- 7 application keys providing one-key access to built-in software applications

Input/Output

- Built-in 3-wire serial interface for connection to RS-232 devices
- Built-in infrared transmitter/receiver for wireless HP 95LX to HP 95LX communication at 2400 bps with a separation distance up to 20.3 cm (8 in)
- Built-in data communication software:
 - VT-100, ANSI and tty terminal emulation
 - Kermit and XMODEM protocol
- Built-in printer driver sets supporting:
 - HP LaserJet, Epson FX-80, IBM Proprinter
- Plug-in card slot, PCMCIA Type I

Power

- Two 1.5 v AA main batteries
- One 3 v CR2032 coin cell backup battery
- Battery life for main batteries is 1 to 2 months of typical use, depending upon type.
- Optional ac adapter

Operating Requirements

- Operating temperature:
 - 0° to 45° C (32° to 113° F)
- Storage temperature:
 - 20° to 60° (-4° to 140° F)
- Data retention temperature (operating or storage):
 - 0° to 45° C (32° to 113° F)
- Humidity:
 - 90% relative humidity at 40° C (104° F) maximum

Free Technical Support

Week days, 5:AM to 5:PM Pacific time call (503)757-2004. Limited automated support services are available 24 hours a day, 7 days a week toll-free at (800)443-1254





HP 100LX Palmtop PC Technical Data

Put the world's most portable workplace in your pocket. Bring along Quicken, Microsoft Project, or hundreds of other off-the-shelf PC applications. Connect with your electronic mail. Track your calendar and assignments. And manage your information with the most productive and well-integrated system of organizer software and core business tools available anywhere.

HP F1020A

HP 100LX Palmtop PC includes:

- User's Guide
- Quick Start Guide
- Two AA and one CR2032 batteries
- Engraving personal nameplate

Software Built into ROM

- cc:Mail® Remote for the HP 100LX
- Data communications
- Lotus® 1-2-3® Release 2.4
- MS-DOS®5.0
- Appointment book
- Phone book
- HP financial calculator
- Memo editor with outliner
- Notetaker
- Database
- Filer
- World time and stopwatch
- Application manager
- System macros
- Setup utility

Optional PC-compatible Software

- The HP 100LX will run a wide variety of DOS software. (Software must be DOS-based, CGA screen-compatible, and fit available memory.) The following examples have been tested for compatibility by Ingram Laboratories:
- Flight Simulator 4.0
- Harvard Project Manager 3.02
- Microsoft Project 4.0
- Norton Commander 3.0
- Quicken 5.0

cc:Mail and Data Communications

- cc:Mail® Remote for the HP 100LX built in
- With a modem:
 - Write text messages
 - Batch or interactively transfer messages
- VT-100, ANSI, and tty terminal emulation
- Kermit, ASCII text, and X, Y, & Z MODEM file transfer capability
- Capture file capability to save data received from information services

Lotus 1-2-3 Release 2.4

- Large worksheets – cells available from 1 to 256 columns and 1 to 8,192 rows
- Graphics
- Database commands
- Macro creation and execution
- File linkage
- @ functions from @ABS to @YEAR

Appointment Book

- Week-at-a-glance, month-at-a-glance, and six-month calendar
- Daily schedule with appointment alarms
- Daily, weekly, monthly, and yearly repeating appointments and events
- To-do list with automatic carryover of past-due items
- Archive feature for appointments and lists

Phone Book and Database

- Alphabetical list of names and numbers
- Contact information cards
- Search and sort on any field
- Custom database capability

Memo Editor with Outliner

- Text entry and editing including block cut/copy/paste, search and replace, bold, and underline
- ASCII file format for reading and editing
- Basic outliner with promote and demote

HP Financial Calculator

- General and technical math functions
- Time-value-of-money calculations
- HP Solve equation-writing capability plus equation plotting
- Links to Lotus 1-2-3 including:
 - Backsolve to a desired result
 - Store/recall numbers to a worksheet
 - Send amortization schedule to a worksheet
- Currency and other unit conversions
- Choice of algebraic or RPN data entry
- Cash flow analyses (IRR, NPV) and statistics functions, both with plotting

Notetaker

- Database of notes, indexed by title
- Title, categorize, search, and edit capabilities

World Time and Watch

- Local and worldwide time for over 450 cities
- World map and custom city list
- Timer and stopwatch

Physical Specifications

- 16 x 8.64 x 2.54 cm (6.3 x 3.4 x 1 in)
- 312 g (11 oz) with batteries

Memory

- 2-MB ROM
- 1-MB RAM
- PCMCIA version 2.0 industry-standard plug-in card slot allows memory capacity to expand up to 32 megabytes
- Read and write to flash disk cards

Industry-standard PC Architecture and Central Processing Unit (CPU)

- IBM PC-XT architecture
- Intel 80C186 CPU running at 29.1 MHz

Display

- CGA-compatible FTN liquid crystal
- 80 columns by 25 rows; 640 x 200 pixels
- Zoom feature

Keyboard Layout

- Familiar typewriter-like QWERTY layout
- Separate numeric keypad
- 10 function keys
- 8 application access keys

Input/Output

- Built-in 9-wire serial interface for connection to RS-232 devices
- Built-in infrared transmitter/receiver up to 115K bps for HP 100LX to HP 100LX and other wireless communication
- Built-in printer drivers supporting these printer types: HP LaserJet, Epson FX-80, IBM ProPrinter
- PCMCIA version 2.0 plug-in card slot for running PC software and expanding I/O memory; optional HP 5-MB and 10-MB flash disk cards available
- Optional HP F1021A Connectivity Pack for file transfer between an HP 100LX and a DOS-compatible PC

Power

- Two 1.5-V AA main batteries
- One 3-V CR2032 coin cell backup battery
- Optional 1.5-V AA rechargeable batteries
- Optional adapter: HP F1021A available in worldwide configurations for powering unit and recharging NiCd batteries

Lotus and 1-2-3 are U.S. registered trademarks of Lotus Development Corporation. cc:Mail is a U.S. registered trademark of cc:Mail, a wholly owned subsidiary of Lotus Development Corporation. MS-DOS is U.S. registered trademark of Microsoft Corporation.

Technical information and product availability are subject to change without notice.

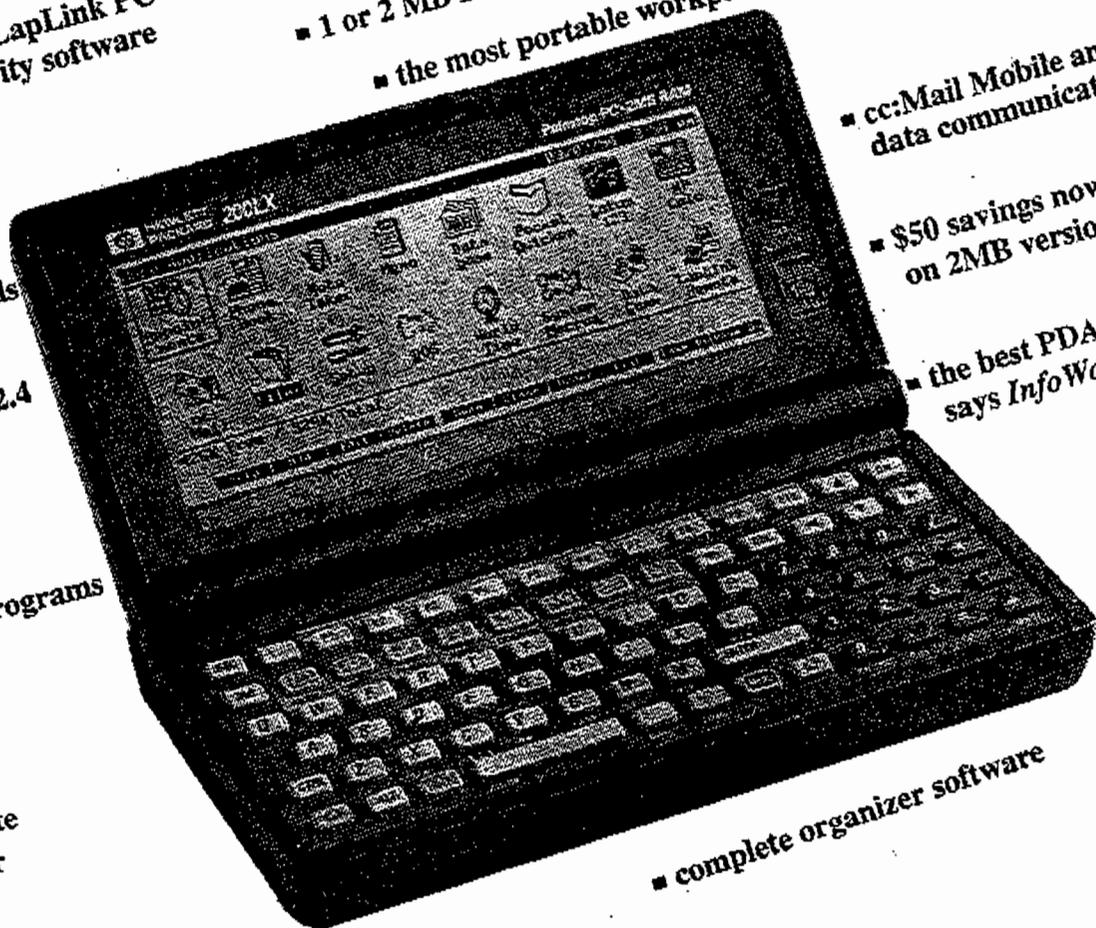
Hewlett-Packard Company
Corvallis Division
1000 NE Circle Boulevard
Corvallis, OR 97330 USA

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Printed in USA 4/93
5091-6267E BTP/323.0

HP 200LX

- now with LapLink PC connectivity software
- 1 or 2 MB RAM and expandable memory
- the most portable workplace
- cc:Mail Mobile and data communications
- \$50 savings now on 2MB version
- the best PDA, says *Info World*
- new tilted keys
- global passwords
- Lotus 1-2-3 rel 2.4
- runs your PC programs with DOS 5.0
- up-to-the-minute rich green color
- complete organizer software



Now with Pocket Quicken

 **HEWLETT
PACKARD**

HP 200LX—the specs

HP 200LX Palmtop PC includes:

- User's Guide
- Quick Start Guide
- Two AA and one CR2032 batteries
- Engravable personal nameplate

Software built into ROM

- Pocket Quicken
- cc:Mail Mobile
- Data Communications
- Lotus 1-2-3 Release 2.4
- MS-DOS 5.0 • LapLink
- Appointment Book • Phone Book
- HP financial calculator
- Memo editor with outliner
- Notetaker • Database • Filer
- World time and Stopwatch
- Application manager
- System macros
- Setup utility

Physical Specifications

- 16 x 8.64 x 2.54 cm (6.3 x 3.4 x 1 in)
- 312 g (11 oz) with batteries

Optional PC-compatible Software

- The HP 200LX will run a wide variety of DOS software. (Software must be DOS-based, CGA screen compatible, and fit available memory.)

Memory

- 3-MB ROM • 1 or 2 MB RAM
- PCMCIA version 2.0, Type II

Industry-standard PC Architecture and Central Processing Unit (CPU)

- IBM PC architecture
- Intel 80C186 CPU running at 7.91 MHz

Display

- CGA-compatible FTN liquid crystal
- 80 columns by 25 rows; 640 x 200 pixels
- Zoom feature

Keyboard Layout

- Familiar typewriter-like QWERTY layout
- Separate numeric keypad
- 10 function keys
- 8 application access keys

Input/Output

- Built-in 9-wire serial interface for connection to RS-232 devices
- Built-in infrared transmitter/receiver up to 115K bps for HP 200LX to HP 200LX and other wireless communication
- Built-in printer drivers supporting these serial printer types: HP LaserJet, Epson FX-80, IBM ProPrinter
- PCMCIA version 2.0, Type II plug-in card slot for running PC software and expanding I/O memory; optional HP 5 MB, 10 MB and 20 MB flash disk cards available
- Optional HP F1021B Connectivity Pack for file transfer between an HP 200LX and a DOS-compatible PC

Power

- Two 1.5-V AA main batteries
- One 3-V CR2032 coin cell backup battery
- Optional 1.5-V AA rechargeable batteries
- Optional adapter: HP F1011A available in worldwide configurations for powering unit and recharging NiCd batteries

 **HEWLETT
PACKARD**

HP 200LX

Manage your world with the world's most powerful palmtop PC! Carry your critical business and personal information as easily as you carry your wallet. The software you already know comes built-in with the only pocket PC that's fully DOS compatible.

Use PC power to organize your personal and business expenses on the go. Check your calendar, or let the appointment book keep you on schedule. Graph your latest sales figures or edit a quick memo. Open built-in DOS applications with a single keystroke, or add your favorite DOS programs from your desktop PC.

Advanced communication features keep you in touch everywhere. Plug in your HP StarLink card to pick up notification of phone and fax messages from home or the office.

You'll stay in charge with the most complete personal information management software on the market.

You simply touch one of 8 special keys to access this software—then switch to another program with one key-touch. *These 8 special keys will make the HP 200LX your favorite computer at any size! at any price!*



Stay in control of personal and business finances anywhere with Pocket Quicken. Enter transactions from checking, savings, credit card, and cash accounts using convenient on-screen forms. Keep on top of current balances and reconcile accounts with your bank statements. You can even organize expenses by category and create summaries for business reimbursements or tax records.

Manage your finances with Quicken all these ways:

- Enter and edit transactions in checking, savings, credit card, and cash accounts
- Review account balances and registers
- Create and print financial reports
- Share data with desktop versions of Quicken



It's a portable electronic mailbox. You'll keep in touch with a built-in cc:Mail Mobile for the HP 200LX. With a modem, check your cc:Mail post office and exchange messages with any cc:Mail user in the world. Handle messages with cc:Mail Remote Inbox, Outbox and Saved Message folders.

Receive news, weather, and stock reports automatically. Using HP 200LX terminal emulation, built-in data communications software, and a modem, access e-mail and information services such as CompuServe.

With HP 200LX communications accessories, connect with devices like the Skystream wireless messaging receiver, modems, and global positioning systems.

Here's how you'll use built-in cc:Mail and Data Communications:

- Transfer messages or files via a modem
- VT-100, ANSI and tty terminal emulation
- Kermit, ASCII text, and X, Y, & Z MODEM file transfer capability
- File capture capability saves data from information services

Don't leave the office without it! Now you can download spreadsheets from the big PC to your HP 200LX. Because this is real Lotus 1-2-3.

Take that sales report, budget or investment portfolio right along with you in your pocket. Update as

you talk. See the results instantly. Zoom them. Show them around. Transfer them back to your PC when you are in the office again.

If you need to leave Lotus, perhaps to check your appointments or to find a phone number, just press another blue key. When you're ready to use Lotus again, touch the blue 1-2-3 key and you'll be back in your spreadsheet, exactly where you left off. You can also copy part of a worksheet and move it to where ever you want it, maybe into a memo.

Here are some other things you can do with this powerful version 2.4 of Lotus:

- Large worksheets—cells available from 1 to 256 columns and 1 to 8,192 rows
- Graphics • Database commands
- Macro creation and execution
- File linkage
- @ functions from @ABS to @YEAR



Sure, your HP 200LX will do the same timely chores that a Wizard or a BOSS will... to help you with appointments, schedules and priorities.

But the HP 200LX is itself a PC, so it has a big Appointment Book program, with all the frills of an office machine—plus the big memory to match.

You can set your alarms to go off, say, 15 minutes in advance. Set repeating appointments once and they'll show up as specified, weekly, monthly, or yearly.

Can't remember details from a note you saved? No problem. Enter a word or short phrase; search for it.

Here's how you use your appointment book:

- Week-at-a-glance, month-at-a-glance, and six-month calendar
- Daily schedule with appointment alarms
- Daily, weekly, monthly, and yearly repeating appointments and events
- To-do list with automatic carryover of past-due items
- Archive feature for appointments and lists
- Local and worldwide time for over 450 cities
- World map and custom city list
- Timer and stopwatch



Your HP 200LX will have all the goodies that go with a big PC Phone Book and Database program done by Lotus, plus its giant RAM memory

- capacity. Here's what you can do with it:
- Alphabetical list of names and numbers
 - Contact information cards
 - Search and sort on any field
 - Custom database capability
 - Create multiple or subset phone books



You won't want to type a book into your HP 200LX—that's what desk PCs and secretaries are for. But you could edit a book on your 200, by using its Memo Editor, which is a small word-

processor. Or store reference information. Or take a quick note on the spot. Here's how:

- Text entry and editing including block cut/copy/paste, search and replace, bold, and underline
- ASCII file format for reading and editing
- Basic outliner with promote and demote



Do simple arithmetic simply—either Algebraic or RPN style—you decide.

But your HP 200LX will have the latest, most sophisticated Financial Calculator, one that only HP

could give you. Time Value of Money answers and "what-if" recalculations. Backsolving for any variable in your equation—and you can use this feature to compute values in worksheet cells, automatically!

Note the currency conversions and the quick plotting and root-finding in this list of powerful features:

- General and technical math functions
- Time-value-of-money calculations
- HP Solve equation-writing capability plus equation plotting
- Links to Lotus 1-2-3 including: Backsolve to a desired result Store/recall numbers to a worksheet Send amortization schedule to a worksheet
- Currency and unit conversions
- Choice of algebraic or RPN data entry
- Cash flow analyzers (IRR, NPV) and statistics functions, both with plotting capability



Here's the quick power that touching the Filer button gets you:

- Create, rename, copy, view, and move files and directories
- RAM-disk backup
- Plug-in RAM card formatting
- DOS program execution
- Split-screen file transfer feature

That's what the 8 wonderful keys do, each by itself. But that's not all—these applications fit together. This means that you can jump from one to another at will, and even take data along with you. It means that you won't have to learn different schemes of commands for each piece of software, because these are consistent, as alike as Lotus programming could make them.

Look at these consistency features:

- Press a single key to access any of the 8 built-in applications
- Press a single key to switch to another application without having to close the first one
- Find your way around an application easily, guided by menu keys and softkeys
- Access Help from any application by pressing F1
- Move information among applications by copying it to a clipboard and pasting it where you need it.
- Save time by creating custom user keys to recall specific sequences of keystrokes that you use often
- Read and write to flash disk cards

There's more powerful, built-in software, and it's easy to access with a single keystroke:

Notetaker

- Create, save and edit short notes
- Database of notes, indexed by title
- Title, categorize, and search capabilities

Database

- Create and modify database templates
- Add, delete, and edit records
- Search by field or text

World Time and Stopwatch

- Local and worldwide time for over 450 cities
- World map custom city list
- Timer and stopwatch

Application Manager

- Manage all HP 200LX system applications, whether built-in, plug-in, or RAM-based
- Application-key assignment, application RAM use, status, current drive, and files

Setup Utility

- Display contrast, memory allocation, and beeper volume
- Printer and comm port configuration
- Battery status and NiCd recharging

palmtops



When being on the move is part of being on the job, carry all your critical information with you as conveniently as you carry your wallet.

still undecided?

Let's recap the facts—this little gem has Hewlett-Packard design excellence in its logical architecture and in its calculations. It has MS-DOS, so it's fully PC-compatible. Quicken will manage your finances. cc:Mail Mobile is built-in, so you can carry your electronic mailbox wherever you go. And it has Lotus 1-2-3 and Lotus Development's programming of its applications, so they all have similar, consistent command structures, and so you can transfer data and results back and forth between them.

- Lotus 1-2-3
- Phone book
- Memo editor
- Appointment book
- 3.7 times faster than an XT
- HP financial calculator
- Quicken
- Datacomm
- Filer
- 1 or 2 MB RAM
- MS-DOS 5.0

Is that reason enough to buy it now?

You can see the excellence of its HP machine design in its keyboard, its Input/Output capabilities, and its case (not to mention its robust reliability).

- Crisp 80 column x 25-row display
- Serial and infrared interfaces
- Familiar QWERTY keyboard
- Industry-standard card slot
- Separate numeric keypad
- Protective clamshell design
- One-key access to applications
- Easy-to-carry size and weight

Is that why you have decided to get yourself an HP 200LX, now? This is exactly the way you've always known computers should be. So it's no wonder that the HP 200LX will be your favorite computer, at any size, at any weight, at any price!

It's an always-with-you extension of your desk-bound computers, so anywhere, anytime, you can

- find important phone numbers
- calculate loan payments
- convert currencies
- check the time around the globe
- edit your letters and reports
- dial up information services

- explore "what-ifs" with your spreadsheets
- track your appointments and assignments

This computer is personal and exciting — your power tool for the '90s. Best of all, it weighs just 11 ounces, fits into a pocket and costs only a fraction of what a laptop or desktop PC does.

which model fits your needs?

You get your choice of two models, the HP 200LX and the HP 200LX2MB. There's just one difference, but it's a big one—one has 1MB of RAM memory, while the other has a full 2 Megabytes of internal RAM. Having the extra memory is like having a second card slot with a 1MB RAM card permanently installed in it (and everyone seems to want more memory).

You'll have EduCALC's 30-day warranty, for a no-questions credit or refund. You can try out your HP 200 for a month, put it through its paces and make sure it is exactly what you need—there is no risk, because we want you to be delighted.

Live technical support is available 5 am - 5 pm (Pacific time) Monday - Friday. You pay only for the call. (503)757-2004.

Express Exchange Coverage for 1 year—so if your 200 fails you merely call for a replacement, which arrives next day! Then just send back the old unit (full 3-year coverage optional).

Offer includes PC, Quick Start Guide, User's Guide, nameplate and alkaline batteries; 1 yr Express Exchange warranty.

Stock #HP200LX1MB [Palmtop PC] . \$499
 Stock #HP200LX2MB [Palmtop PC] . \$679
 Stock #H5465A [Expr Exch - 3 yr] . . \$85

We still have a few new HP 100s in stock.
 Stock #100LX1MB [Palmtop] \$479

your name engraved - free

We will personalize your name or initials free on a small plate that you can neatly adhere in a countersunk space on the back of your new 100. Just include Stock #95CNP and we will include everything you need to get your FREE engraved name plate. You'll be limited to 16 characters and your imagination.
 Stock #95CNP [Nameplate]Free

TIP program

Save even more—

TRADE IN your used HP 100LX 1MB or 2MB. Just send it to us, insured, in working order, with all its Manuals. Take CREDIT on your order—\$170 for a 100LX 1MB and \$250 CREDIT for an HP 100LX 2MB. Put the order and your check right in the box.

If you prefer to keep your old instrument until your new HP 200 arrives, just send it to us up to 45 days later, along with its Owner's Manual and a copy of the sales receipt for your new machine—We'll send you your refund right away.

Subscribe now to
The HP Palmtop Paper
 for HP 95/100/200

Thaddeus
 Computing



- Be an insider
- Be an expert
- Be fully up-to-date

You'll find out about the hidden features of your 95/100/200—how to access secret utilities—even hidden games!

You'll have how-to tips and tricks that make your work easier—solve your problems—even give you impressive new powers!

You'll read comparative brand-by-brand surveys of the software and programming languages that work best in your 95/100/200—plus consumer's advice on peripherals like RAM cards and drives.

Think of it as a giant (50 pages average) supplement to your EduCALC catalog—a new issue will come every other month, packed with the latest information—focussed right where you want it, on your HP 95/100/200.

Extra BONUS . . . each year's subscription comes with a copy of the Subscriber Disk for that year—the 1992 disk contains 34 free programs (no shareware), fully documented and easy to use utilities, games, templates and programmer's aids (8 of these are system-compliant).

FREE Issue . . . this subscription starts with the current issue, and you'll also get an extra back-issue—that makes 7 issues in all, plus your bonus Subscriber's Disk of programs.

(Allow 4 to 6 weeks for your subscription to start.)
 Stock #2676, 1 year to U.S. address . . \$39
 Stock #2839, 1 yr air to Canada/Mexico \$45
 Stock #2840, 1 yr air, foreign \$57

here's where you find	
accessories	10
cables / interfaces	13
peripherals	15
software	19
programming aids	23

APPENDIX 2

APPLE NEWTON SPECIFICATIONS

Newton MessagePad

Technical Specifications

Newton Intelligence

- Newton Recognition Architecture
 - Recognizes handwriting: printed, cursive, or mixed word recognition
 - Recognizes graphics and the inherent symmetry in objects
- Newton Information Architecture
 - Object-oriented data storage optimized for storing, finding, and linking small pieces of information
 - Easy creation of custom forms applications via the flexible graphical view toolbox
 - Easy data sharing using standard tags
 - Object-oriented database provides flexible view of data
- Newton Communications Architecture
 - Provides single interface for all communication services
 - Integrated to support easy communications with minimum setup requirements
 - Designed in modules to support new communications capabilities
- Intelligent Assistance Architecture
 - Assists users in completing repetitive tasks done in multiple categories, including communications, scheduling, finding, and reminding functions
 - Contains smart defaults to reduce complexity
 - Functions across applications transparently
 - Allows extensions by third-party developers
- Newton Hardware Architecture
 - ARM 610 processor at 20 MHz
 - Apple custom system ASIC
 - Low-power, reflective LCD display (336 x 240 pixels)
 - Transparent tablet with passive pen
 - 4MB of ROM
 - 640K of RAM
 - One PCMCIA type 2 card slot
 - LocalTalk compatible serial port
 - Low-power, half-duplex, infrared transceiver (9600 baud at 1 meter)

Communications capabilities

- Print to Apple LaserWriters and StyleWriters with serial cable and to popular parallel printers using Newton Print Pack
- Fax with optional fax modem (9600 baud fax send, automatic cover-page generation, post-formatting)
- "Beam" via infrared technology (send notes, name cards, appointments at 9600 baud with 1-meter range)
- Handle telephony needs with assistance for intelligent auto dialing (DTMF or modem dialing)
- Receive and store wireless messages using optional Messaging Card
- Send and receive NewtonMail to other Newtons, PC's and Macintosh computers with optional modem

**This service will be available in the fall of 1993.*

Size and weight

- Height: 7.25 in. (184.75 mm)
- Width: 4.50 in. (114.3 mm)
- Depth: 0.75 in. (19.05 mm)
- Weight: 0.9 lb. (0.4 kg)

Operating environment

- Temperature: +0° to +40° C
- Storage temperature: -20° to +60° C
- Humidity range: 20% to 95% RH noncondensing

Power requirements

- Power adapter:
 - Universal, 100 to 240 VAC, 50/60 Hz
 - Four plug configurations: U.S., U.K., Europe, and Australia
- Battery type: alkaline or nickel-cadmium
 - Alkaline output: 6.0V DC, 1.1 WH (nominal)
 - Nickel-cadmium output: 4.8V DC, 200 mAh (nominal)
- Lithium cell: CR2032
 - Operating range: 3 V (nominal)
- Power source: AC adapter (included) or four AAA batteries (included) and optional Rechargeable Battery Pack

System requirements

- Works with personal computers running Microsoft Windows; requires connector cable and version 3.0 or later
- Works with Macintosh personal computers; requires connector cable and system 7.01 or later

Printer support

- Built-in printer support for the Apple StyleWriter and StyleWriter II
- All Apple PostScript laser printers from the LaserWriter Plus and up
- The Apple Personal LaserWriter printer
- Works with most popular PC printers, including the Hewlett-Packard LaserJet, Hewlett-Packard DeskJet, Canon BubbleJet, and Epson LQ and FX using the Print Pack option

Fax machine support

- Supports Group 3 fax machines



Ordering Information

Newton Connection Kit for Macintosh

—Order No. H0006LL/A

Newton Connection Pro Kit for Macintosh

—Order No. H0030LL/A

Newton Connection Kit for Windows

—Order No. H0004LL/A

Newton Connection Pro Kit for Windows

—Order No. H0029LL/A

Messaging Card

—Order No. H0016LL/A

Fax Modem

—Order No. H0005Z/A (U.S., Canada, and Japan)

—Order No. H0039Z/A (Europe)

Print Pack

—Order No. H0015LL/A

Power Adapter

—Order No. H0003Z/A (U.S., Canada, and Japan)

—Order No. H0011Z/A (international)

—Order No. H0011B/A (Great Britain)

—Order No. H0011X/A (Australia)

Battery Booster Pack

—Order No. H0010LL/A

Rechargeable Battery Pack

—Order No. H0007LL/A

Battery Pack Recharger

—Order No. H0002LL/A (U.S., Canada, and Japan)

—Order No. H0023Z/A (international)

—Order No. H0023B/A (Great Britain)

—Order No. H0023X/A (Australia)

1MB Storage Card

—Order No. H0028LL/A

2MB Flash Storage Card

—Order No. H0008LL/A

Carrying Case

—Order No. H00009LL/A

Leather Carrying Case

—Order No. H0012LL/A

Communications System Carrying Case

—Order No. H0053LL/A

Technical Specifications

Connection Kits

- Newton Connection Kit for Macintosh and Newton Connection Pro Kit for Macintosh require:
 - System software version 7.0 or later
 - A Macintosh SE/30 or later computer with at least 4MB of RAM
 - An Apple SuperDrive floppy disk drive
 - A hard disk drive
 - A serial port connection
- Newton Connection Kit for Windows and Newton Connection Pro Kit for Windows require:
 - Microsoft Windows 3.1 or later
 - Serial port connection

Messaging Card

- Consists of a PCMCIA card that receives and displays pages
- Receives one-way messaging of alphanumeric pages
- Works with PCMCIA 2.0 interface
- Supports POCSAG 512/1200/2400 baud coding, including both 7- and 8-bit messaging formats
- Provides 512 address capability
- 929- to 932-MHz single-frequency receiver
- Operates with one AAA alkaline battery cell

Fax Modem

- Transmission speeds of 2400 bps (data mode) and 9600 (fax mode) bps
- Data communications standards
 - CCITT V.22bis
 - CCITT V.22
 - Bell 212A
 - Bell 103
 - MNP Class 2 and 4 error correction
 - MNP Class 5 data compression
- CCITT V.42bis data compression
- Fax communications standards
 - CCITT V.29
 - CCITT V.27ter
 - CCITT V.21

Print Pack

- Works with parallel printers: dot matrix (80 or 120 column), multiform printers, portable printers, and HP DeskJet and LaserJet printers
- Includes embedded, serial-to-parallel converter

Power Adapter

- Provides 7 V at .5 amp output, universal 100 to 240 V
- Comes in four configurations:
 - In-Line Adapter for U.S., Canada, and Japan
 - Right Angle Adapter for international use
 - Right Angle Adapter for Australia
 - Right Angle Adapter for Great Britain

Battery Booster Pack

- Consists of unit which holds eight AA alkaline batteries for extended mobile use (batteries not included)
- Connects to Newton MessagePad through AC port with flexible cable

Rechargeable Battery Pack

- Includes one nickel-cadmium battery pack
- Fully recharges in three to four hours when used with the Battery Pack Recharger, or charged overnight in the Newton MessagePad when connected to the Power Adapter

Battery Pack Recharger

- Includes one nickel-cadmium battery pack and recharger
- Automatic built-in timer prevents overcharging

1MB Storage Card

- Consists of 1MB SRAM card that fits in PCMCIA slot
- Holds 1,250 name cards (name, title, company, address, and three phone numbers), 1,000 notes of up to 50 characters, 2,500 calendar appointments at 20 characters, or as many as 400 screens of uninterpreted text and drawings

2MB Flash Storage Card

- Consists of a 2MB Flash Storage Memory Card that fits in the Newton MessagePad PCMCIA slot
- Holds 2,500 name cards (name, title, company, address, and three phone numbers), 2,000 notes of up to 50 characters, and 5,000 calendar appointments at 20 characters or up to 800 screens of uninterpreted text and drawings

Leather Carrying Case

- Consists of zippered case made of high-quality leather
- Includes rigid, built-in screen protector

Carrying Case

- Consists of clasp-style, filofax-like case made of synthetic leather
- Includes rigid, built-in screen protector
- IR and PCMCIA slot can be accessed while the case is closed

Communications System Carrying Case

- Consists of zippered case made of fine leather
- Can hold Newton MessagePad, Fax Modem, Messaging Card, and PCMCIA storage cards

NEWTON ACCESSORIES

Accessorize one of your most valuable possessions—your personal digital assistant—and you can work faster and even more efficiently. With the Newton MessagePad communications assistant from Apple, you can choose from a broad range of accessory products—from connectivity devices to battery enhancements to storage options.

With the optional accessories, you can print letters, send a fax or receive paging messages, connect to your personal computer, or access information on the network. You can also work for hours without having to change batteries. Then carry your Newton MessagePad in its fine leather case wherever you go.

Accessories

Communications Products

Newton Connection Kit

This kit comes with a serial cable and software that allows you to connect your Newton MessagePad communications assistant to your personal computer. Then you can view and edit on your computer all the notes, name cards, and appointments you created on your Newton MessagePad. Press a button, and files between your personal computer and the Newton MessagePad are updated and synchronized automatically. You can also back up information you keep in your Newton MessagePad.

One version of the kit works with personal computers running Microsoft Windows, and the other works with Apple Macintosh computers.

Newton Connection Pro Kit

This kit gives you everything the Newton Connection Kit provides—and more. You can translate your appointments, name cards, and notes from your Newton MessagePad directly into popular PC and Macintosh applications—and vice versa. One version works with personal computers running Microsoft Windows, and the other works with Apple Macintosh computers.

Messaging Card

Turn your Newton MessagePad into a mobile pager. The Messaging Card receives and stores wireless messages—even when it's not plugged into your Newton MessagePad. It is for use with regional and nationwide paging systems and news services.

Fax Modem

This lightweight, portable fax modem allows you to send and receive electronic mail, connect to on-line services, and send faxes anywhere. It weighs only 7 ounces and uses either two AA alkaline batteries (included) or a Newton Power Adapter.

Print Pack

The Print Pack comes with all the software and hardware you need to use your parallel printer with your Newton MessagePad. It works with the most popular laser printers, dot-matrix printers, portable ink-jet and thermal printers, and other printers that are compatible with MS-DOS and Windows-based computers.

Power accessories

Power Adapter

The Power Adapter lets you run your Newton MessagePad or fax modem with AC power. It comes in multiple versions to meet international outlet requirements.

Battery Booster Pack

Plug this portable pack's cable into your Newton MessagePad, and its eight AA alkaline batteries add hours of running time. Batteries are not included.

Rechargeable Battery Pack

To keep your most valuable possession running, get this rechargeable nickel-cadmium battery pack before you need it.

Battery Pack Recharger

Charge one battery pack in this recharger while using another in your Newton MessagePad. One rechargeable nickel-cadmium battery pack is included.

Storage products

1MB Storage Card

Use the 1MB Storage Card to increase the storage capacity of your Newton MessagePad and to back up your information. This card holds up to four times as much information as your Newton MessagePad.

2MB Flash Storage Card

Use the 2MB Flash Storage Card to increase the storage capacity of your Newton MessagePad even more. It holds up to eight times as much information as your Newton MessagePad.

Carrying cases

Carrying Case

This protects your Newton MessagePad and your add-in cards when you take them on the road. It is made of durable synthetic material and snaps closed.

Leather Carrying Case

This leather carrying case has room for three add-in cards and lots of business cards, and has a zipper to keep everything where it belongs.

Communications System Carrying Case

Use this fine leather carrying case for your Newton MessagePad and accessories—from the Fax Modem to the Messaging Card and PCMCIA storage cards. The case also provides convenient access to telephone lines for easy faxing or connection to on-line services.

Features

Built-in applications

- Let you capture, organize, and communicate all kinds of information
- Allow free-form notetaking—mixing ink handwriting, printed text, and graphics all on the same page
- Turn printed or cursive handwriting into typed text or leave it as ink
- Track tasks via a to-do list that helps you assign priorities, lets you check off completed tasks, and then updates the next day's list for you
- Let you create name files with a familiar, business-card look and feel that help you store information on hundreds of colleagues and friends
- Help you plan monthly, weekly, and daily calendars
- Include an assortment of information and productivity tools (such as time-zone maps, calculator, and currency-exchange formulas)

Communications capabilities

- Send notes or messages, schedule appointments, or exchange business cards with other nearby Newton users via built-in, infrared beaming technology
- Print formatted letters and notes to serial and parallel printers
- Send faxes anywhere with an optional compact fax modem
- Receive and store wireless paging messages with the optional Newton Messaging Card
- Share information and keep files synchronized and updated with personal computers running Microsoft Windows or with Macintosh computers (requires Newton Connection Kit)
- Tap into electronic mail and on-line services with an optional compact fax modem

Intelligent assistance

- Knows how you work and actively assists you in completing tasks
- Assists you in making phone calls, faxing, finding information, sending electronic mail, printing, scheduling meetings, and completing to-do lists

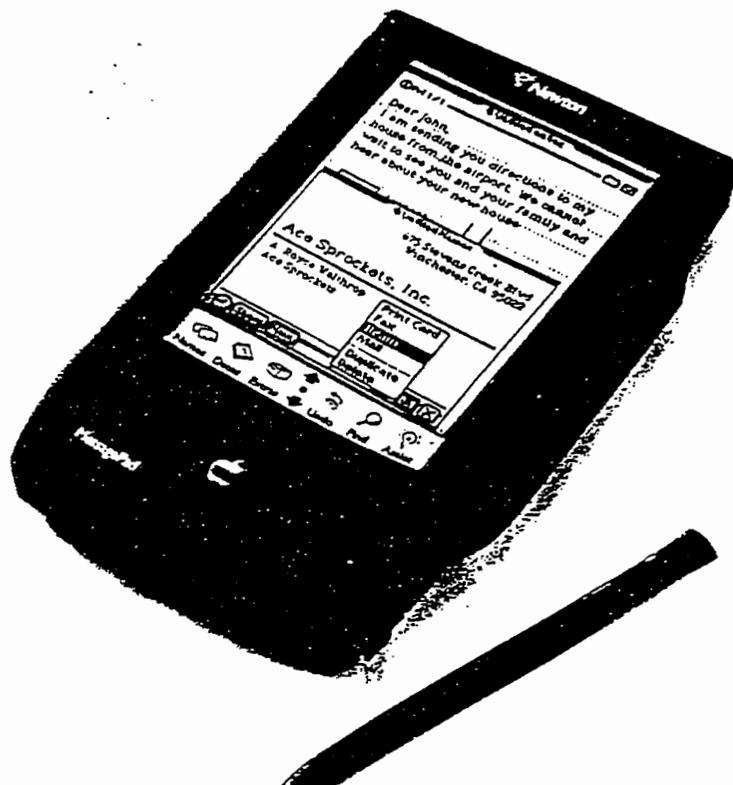
The Newton MessagePad is the first in a family of communications assistants from Apple. By combining Newton Intelligence technology with sophisticated communications capabilities, the Newton MessagePad helps you stay in touch with friends and colleagues, organize your life, and keep track of your ideas. You can take notes. Make a quick sketch. Format and print letters. Share and synchronize information with your personal computer. Send a fax. Receive pages and messages. Tap into on-line services or electronic mail. Even exchange business cards with a colleague via built-in infrared technology. And wherever you go, the powerful, under-one-pound personal digital assistant goes too, tucked in your pocket or briefcase.

As easy to use as pencil and paper, the Newton MessagePad lets you leave

your notes handwritten or reads your handwriting and transforms it into typed text. If you prefer, you can type words using an on-screen keyboard. It even cleans up your rough sketches. And as time goes by, it learns about you, your handwriting, and the way you work.

Because the Newton MessagePad is designed to know how you work, it can help you work smarter. For example, the Newton MessagePad can find a phone number and dial the phone for you, fax a note, format a letter, and even set up a lunch appointment.

The Newton MessagePad comes with built-in applications that include a notepad, to-do list, datebook, and name file to get you started. When you're ready, you can customize your Newton MessagePad to include Apple and third-party software and hardware additions as well.



MicroCenter Individual Price List

Apple Newton and Newton Accessories

Newton Hardware		
	Stock#	Price
Apple Newton MessagePad..... Includes: 4-AAA Alkaline Batteries 2-Stylus Getting Started Card and Intro Video Tape Protective Slip Case	# H0001Z/A	\$657.00
Apple Newton Communications System..... Includes: Newton MessagePad External Fax Modem	# H0050Z/A	\$766.00
Apple Newton Pro Communications System Mac..... Includes: Newton MessagePad External Fax Modem Connection Pro Kit for Mac	# H0031Z/A	\$858.00
Newton Accessories		
	Stock#	Price
Apple Newton 1MB Storage Card.....	# H0028LL/A	\$188.00
Apple Newton 2MB Flash Storage Card.....	# H0008LL/A	\$245.00
Apple Newton Messaging Card.....	# H0016LL/A	\$237.00
Apple Newton Rechargeable Battery Pack (4 AAA NiCad Batteries).....	# H0007LL/A	\$16.00
Apple Newton External Battery Booster Pack.....	# H0010LL/A	\$20.00
Apple Newton Battery Recharger (w/ 4 AAA NiCad Batteries).....	# H0002LL/A	\$40.00
Apple Newton Carrying Case.....	# H0009LL/A	\$24.00
Apple Newton Leather Carrying Case.....	# H0012LL/A	\$65.00
Apple Newton Communications Carrying Case.....	# H0053LL/A	\$48.00
Newton Software		
	Stock#	Price
Apple Newton Print Pack.....	# H0015LL/A	\$82.00

The MicroCenter will be unable to service any Newton product until further notice.

APPENDIX 3

**TXDOT DOCUMENT “PROJECT 2031: TASK 2.
DEVELOPMENT OF ACR SOFTWARE”**

TEXAS DEPARTMENT OF TRANSPORTATION

PROJECT 2031

TASK 2. DEVELOPMENT OF ACR SOFTWARE

SUBTASK 2.2 SYSTEMS ANALYSIS AND DEVELOPMENT OF SOFTWARE

1.0 INTRODUCTION

The following is not a specification. It is intended to be used as a starting point for systems analysis, and is only an outline of our anticipated requirements.

We intend to assign a two digit ID number to each operator. That number combined with the six character schedule number could be used to build file names. This combination would tell us; 1) to whom the schedule is assigned, and 2) the schedule number. This could eliminate the need to put these items in the records.

It is necessary to send maps to field personnel for all schedules. Therefore, a printed schedule will be sent with the maps to be used as a fail-safe in case telecommunications cannot be established.

Eventually, there will be more than twenty computers in operation. The time available for telecommunications on the host computer will be limited. Simplicity is important because personnel with varying levels of training and technical skill will operate the system. So, the system must be as automated as possible and not require a high degree of specialized technical knowledge for operation.

An "OUT" file will be created by our Foxbase ACR scheduling program to meet your specification.

2.0 FUNCTIONAL REQUIREMENTS

- 2.1 Transmit an "OUT" file, generated from the ACR Station Location database (ACR1), to a computer being operated in the field.
- 2.2 Create, from the "OUT" file, a working file to be used for schedule set-up and removal.
- 2.3 Create an "IN" file, from the working file, to be transmitted to a host computer.
- 2.4 Transmit the "IN" file to the host computer.
- 2.5 Programming for the field computer and host computer to handle telecommunications from the field.
- 2.6 The programs should allow for a 24-hour or a 48-hour schedule set-up and removal cycle. Selection of duration time should be made at the beginning of the set-up operation for each schedule, but the operator must have the option to change each duration time during the removal operation.

- 2.7 All movement within the schedule should be navigation-key type movement. Some coded field entries should be done using text file or programmed lists and "hot-key" or "check-off" type selection. The only operator "written" entries should be:
 - 2.7.1 the machine serial number.
 - 2.7.2 the set-up counter reading.
 - 2.7.3 the removal counter reading.
 - 2.7.4 a comment code.
- 2.8 The programs should automatically download "OUT" files to the field computer and upload "IN" files to the host computer.
- 2.9 Communications should be initiated from the field, and be accomplished by menu selection.
- 2.10 Written instructions manuals for operation and host computer communications program.
- 2.11 Operator access to the command line in the field computer should be denied. We specifically don't want operators to be able to reset the system clock.
- 2.12 Temporarily save the "OUT" file for disaster recovery.
- 2.13 Dial-in on the TEX-AN phone system, or from a phone in a motel (off system). A menu selected operation.
- 2.14 A view screen which shows every field in all records.
- 2.15 A routine to insert, and hand write, added or omitted stations to schedules.

3.0 TELECOMMUNICATIONS PROGRAM REQUIREMENTS

- 3.1 General Communications: Always initiated in the field.
 - 3.1.1 The computer will dial only one number. A method to change that number is required.
 - 3.1.2 Initiation of communications should be accomplished by attaching the modem to the phone system and selecting the communications option from a menu. The program should handle everything from there.
 - 3.1.3 Communications errors should be shown on the screen.
 - 3.1.4 If communications cannot be established after three attempts, the program should abort. If communications cannot be established at a later time, the technician will use the manual process to complete the schedule.

3.1.5 When communication is established, the program should:

3.1.5.1 Automatically upload any completed schedules to the host computer.

3.1.5.2 Automatically download any new schedules addressed to the Operator ID Number.

3.1.5.3 Synchronize the field computer clock with the host computer. Time Zones aren't necessarily important because we are mainly interested in the elapsed time between set-up and removal.

Note: The program which controls up and down loading can reside in the host computer. It isn't important to us where it runs.

3.1.5.4 All transmissions should be error checked.

3.1.5.5 While communication is in progress, the program should show the operator what is going on—how many blocks are expected—how many have been received. Something like that.

4.0 FILES: of course, you can do this any way you think is best, but here is a way we thought it might work.

4.1 "OUT" File: (Host to field)

4.1.1 The file title could be the Operator ID Number plus the Schedule Number with "OUT" used for the extension.

4.2.2 "OUT" file description:

Field	Data Type	Len.	Dec.
a. County no.	a/n	3	
b. Prefix	c	2	
c. Station no.	a/n	6	
d. Suffix	c	1	
e. Sequence no.	n	5	2
f. Map information	c	20	
g. Last Count	a/n	6	
h. Set-up Date	d	8	
i. Number of setups	n	1	

NOTE: The sequence number is used to order the schedule.

EXAMPLE: The file can be in any order you need.

a	b	c	d	e	f	g	h	i
227	H	000001		1.00	Base Map Inset	002000	05/01/1990	2

227H 000001	1.00	Base Map Inset	00200005/01/19902
227HP005000A	2.00	Sheet A	00010005/01/19901
114T 000023	2.50	Inset b	00100005/01/19901

4.3 WORKING File: Created in the field computer for schedule set-up and removal. To contain everything in paragraph ~~3.2.2~~ plus:

4.2.2

4.3.1	Field	Data Type	Len.	Dec.
	Set-up time (hhmm)	n	4	
	Removal time (hhmm)	n	4	
	This count	a/n	5	
	Last count	a/n	5	
	Machine sn	n	4	
	Set-up reading	a/n	5	
	Removal reading	a/n	5	
	Comment code	n	2	
	Weather code	n	2	
	Lane code	c	2	
	Direction	c	1	
	Duration (1=24; 2=48)	n	1	

4.4 RETURN File: From the field to host computer. Some of the information in the working file doesn't need to be transmitted back to the host. The following items are needed:

4.4.1 The File name with the "IN" extension.

4.4.2	Field	Data type	Len.	Dec.
	a. County no.	a/n	3	
	b. Prefix	c	2	
	c. Station	a/n	6	
	d. Suffix	c	1	
	e. Set-up reading	a/n	5	
	f. Removal reading	a/n	5	
	g. Machine sn	n	4	
	h. Comment code	n	2	
	i. Weather code	n	1	
	j. Lane code	c	2	
	k. Direction	c	1	
	l. Duration	n	1	
	m. Set-up date	d	6	

EXAMPLE:

aaabbcccccd	e	f	g	h	i	j	k	l	m
227H 000001	01000	02000	1111	1	01	M1	1	N	050190

227H 000001 01000020001111101M11N050190

227H 000001 01000010502222101M22S050190 ← Dup. rec. for 2 sets

- 4.5 Working file fields: The working file will require more information than is transmitted in the "OUT" file. All the extra fields will be standard for every record.
 - 4.5.1 Set-up time: The hour and minute the set-up was completed. Automatically placed in the record by the program when confirmation is entered indicating that the set-up is ready. The set-up time should be displayed.
 - 4.5.2 Removal time: The hour and minute the pick-up was completed. Automatically placed in the record after the Removal reading has been entered and confirmed. Not shown on the screen.
 - 4.5.3 This count: The difference between the Set-up reading and Removal reading. See "Special Considerations" para. 8.9.
 - 4.5.4 Machine sn: The serial number of the ACR machine used. This number must be written in and confirmed. Shown on the Screen.
 - 4.5.5 Set-up reading: The accumulated count in the ACR counter at set-up time. This number must be written in and confirmed.
 - 4.5.6 Removal reading: the accumulated count in the ACR counter at removal time. This number must be written in. Not shown on the screen after confirmation.
 - 4.5.7 Comment Code: The operator will have to write this code to the record, but we'd like a "Help" list available for viewing. Most set-ups will not require a comment, so the program should be made to skip entry of this item unless it is specifically requested by the operator.

4.5.7.1 Operator Comment Code list:
(Unnecessary comment codes skipped)

Code	Comment
01	.....New Traffic Generator
02	..... Abandoned Traffic Generator
04	..... Gravel Hauling
05	..... Farming Activity
06	..... Crop Harvests
07	..... Oil Field Activity
08	..... New Housing in area
09	..... Vacated Houses in area
10	..... Recreational area
11	..... No Farming Activity
12	..... Weather/Road Condition Affect
13	..... Livestock Auction
14	..... Road Construction
15	..... Business Construction
16	..... Logging Activity
17	..... Strip Mining
18	..... Test Vehicles
19	..... Setup Tampered with
20	..... School out/in

Code	Comment
21	..... Holiday Traffic
22	..... Sporting Event/Season
23	.....(High Count) Funeral or Convoy
24	.....Special Comments
25	....Bad Count (Machine, tubing, etc.)
26	..... Tube or Machine damage
27	.....New Business
28	.....:No Oil Activity
29	.....No Gravel Hauling
30	.....No Logging Activity
31	..... ? Increase
32	.....? Decrease
50	..... Accumulator Rollover
69	..... Not Scheduled
77	.....Elective Pulloff
95	.....Late Removal (bad count)
99	.....Ramp or SR count

NOTE: Operators will be furnished with paper copies of this list, but we'd like to be able to get the list from the computer if the paper is lost or is not handy.

NOTE: If the operator has a comment that isn't covered in the list, or has multiple comments, the operator should select code 24 and send in the comments on an ACR slip.

4.5.7.2 Early Removal code: If the machine is removed more than three (3) minutes early (based on the duration and the difference between the set-up time and the removal time), and the operator doesn't enter a comment code, place 97 in the comment code field. Not shown on the screen.

NOTE: The program should display a warning when the operator is going to remove the machine early, but the operator needs the option to override the warning.

4.5.7.3 Late Removal Time: If the machine is removed more than 3 minutes late (based on the same parameters as in early removal), and no comment is selected by the operator, place 98 in the comment code. This code should not be shown on the screen.

4.5.8 Weather Code: the Weather Code should be entered only during the removal operation. Once a code has been selected by the operator, that code should be automatically placed in each record as the site is removed. The operator needs the ability to change the code in each record.

4.5.8.1 Weather Code List:

Code	Condition
0	..... Clear
1	.....Cloudy
2	.....Showers

Code	Condition
3	.....Rain
4	.....Fog
5	.....Snow
6	.....Sleet
7	.....Ice
8	.....Hail
9	.....Dust

4.5.9 Lane Code: Each set-up will have a lane code. Lane codes consist of two parts. Part 1 is the lane type. There are two lane types. Lane type 1 is "M" for the Main lane. Lane type 2 is "S" for Service Road.

4.5.9.1 If a station has only one set-up, put blanks in the lane code field.

4.5.9.2 If a station has multiple set-ups, put M1 in the lane code field in the original record, and add a new record (by duplicating the original record) for each additional set-up (based on the setups field). Part 1 of the lane code field for each new record should be "M" with Part 2 being incremented by 1 for each new record.

4.5.9.3 When new records have been added, allow the operator to change the lane code by paging through a list and selecting a different code. The code list should have M1-M4 and S1-S4.

4.5.10 Direction Code: Each record should have a Direction Code which is used in conjunction with the Lane Code to identify a set-up. For initial added records the codes "N" and "S" can be used. The operator can correct these codes later.

4.5.10.1 If there are 2 set-ups, one is going North and the other is going South. Both records should show "M1" in the Lane Code and "N" and "S" in the direction codes. For stations with more set-ups, half are going one direction and the rest going the other.

Direction codes:

N = North
E = East
S = South
W = West

4.5.11 Duration Code: ACR schedules are usually set-up on a 24-hour cycle. Some schedules are set-up on 48-hour cycle. When the working file records are crated a "1" should be placed in this field. The program should allow a change in this field prior to the first set-up on a schedule. that variable should be carried forward to each subsequent record so the operator will not have to make an entry if there is no change. However, weather could force early removal. Therefore, the operator should have the ability to change this code during the removal operation.

NOTE: The duration code can be a two digit field with 24 or 48 entered, it doesn't matter to us.

70

5.0 SCREENS

- 5.1 In the original request for this project we'd requested the Schedule Form be displayed. We've since come to realize that that isn't absolutely necessary. We would like the operator to get a sense of where he is within a schedule by looking at the schedule screen, but it doesn't have to look like a printed schedule.
- 5.2 A "Header Bar" at the top of the screen should show:
 - 5.2.1 Schedule Number
 - 5.2.2 Set-up Date
 - 5.2.3 Current Date
 - 5.2.4 A real-time clock
 - 5.2.5 Schedule Duration time (24 or 48-hour cycle)
- 5.3 During the set-up operation, the only fields which need to be shown are:
 - 5.3.1 Record Inserter: If stations have to be added to a schedule after it has been transmitted to the field, we need a method to insert records for those stations into the schedule, and we need to be able to tell the program whether to insert the new record(s) before or after the current record. This is only necessary during the Set-up operation or prior to it. See "Special Considerations", para. 8.4.
 - 5.3.2 Station Location number consisting of: County number, prefix, station number, and suffix *
 - Examples: 227 H-1
227 HP-501 A
 - 5.3.3 Map information *
 - 5.3.4 Number of setups (i.e. 1 of 1, 1 of 4, etc.)
 - 5.3.5 Entry field for set-up time
 - 5.3.6 Entry field for set-up recorder reading
 - 5.3.7 Entry field for Lane code
 - 5.3.8 Entry field for Direction code
 - 5.3.9 Entry field for machine serial number

NOTE: We'd like some way to optionally display the county name somewhere on the screen.

5.3.10 Before a schedule set-up is begun, we'd like the operator to be prompted for the Duration Code. That code should automatically be put in each record until the schedule is completed. The operator needs the option to change this item, in each record, during the removal operation.

* No operator changes allowed in these fields.

5.4 During the Removal operation, the fields that need to be shown are:

5.4.1 The Header Bar *

5.4.2 Station Location Number (same as above) *

5.4.3 Map information *

5.4.4 Set-up time *

5.4.5 Last Count * (shown on the last record of each station set of records)

5.4.6 Machine Serial Number *

5.4.7 Lane Code

5.4.8 Direction Code

5.4.9 Entry field for Weather Code

5.4.10 Computed Current Count

5.4.11 Set-up Reading *

5.4.12 Entry Field for Removal Reading

5.4.13 Entry Field for Comment Code

NOTE: Records that have been completed don't have to be displayed during the removal operation.

* No operator changes allowed in these fields.

5.5 SYSTEM MENU: All operations should be initiated from one menu. The program should be so complete that the operator will NEVER have to do ANYTHING from the command line.

5.5.1 The minimum menu functions should be:

5.5.1.1 TEX-AN Communications

5.5.1.2 OFF-SYSTEM Communications

5.5.1.3 Reload Programs

- 5.5.1.4 Backup Schedules
- 5.5.1.5 Select Set-up Schedule
- 5.5.1.6 Select Pick-up Schedule
- 5.5.1.7 Change Host Computer Phone Number
- 5.5.1.8 Change Operator ID number
- 5.5.1.9 Erase Completed Schedules
- 5.3.1.10 View Schedules
- 5.3.1.11 Battery Check
- 5.3.1.12 Quit

5.6 HELP SCREENS: We'll need the following Help screens:

- 5.6.1 County Names List
- 5.6.2 Direction Codes List
- 5.6.3 Lane Codes List
- 5.6.4 Weather Codes List
- 5.6.5 Comment Codes List
- 5.6.6 Schedule Directory

✓
5.7 VIEW SCREEN: The operator needs a method to look at all fields of all records on a schedule so that the information can be copied to paper in case of a communications failure. The only data that shouldn't be shown to the operator are Comment Codes 97 and 98.

6.0 SCHEDULE SET-UP

- 6.1 Due to some special circumstances, the operator may not be able to set the schedule up in strict sequential order. Therefore, the operator needs the freedom to move up and down the schedule and select the appropriate station. The schedule program should start out at the top of the file (in sequence number order). The operator should have the option to move to a different record. If the operator does move out of sequence number order the program should go to the top and find the first station (in sequence number order) which has not been set-up. Something like this needs to be in place so that no stations can inadvertently be omitted from a schedule during the set-up operation.
- 6.2 The Set-up time should automatically be entered by the program after the operator enters and confirms the Set-up counter reading.

- 6.3 After the Set-up reading has been confirmed, the operator should be queried as to whether the counter is working properly. If the answer is "NO", the program should allow the record to be set-up again. When the answer is "YES", no further changes to the set-up data should be allowed (except in the Lane and Direction Codes).
- 6.4 We'd like "Window" type entry for the fields which have to be "written in".
- 6.5 We'd like to page through choice lists for the other fields which require entry (which we don't want to hand write) and have a "check-off" selection method.
- 6.6 When the last record for a schedule has been set up, the program should prompt the operator to confirm that the set-up process is complete. If the process is complete, the program should return to a menu. If the process is not complete, a new record may need to be added, or the operator may want to double-check the Lane, Direction, and Comment codes. Changes in the Lane, Direction, and Comment codes should be allowed at any time.

7.0 SCHEDULE REMOVAL

- 7.1 When the removal process begins, the schedule should be reordered in Set-up Time order. The operator still needs the freedom to move up and down in the schedule to select a specific station.
- 7.2 When the operator has entered and confirmed the Removal Reading, the program should automatically calculate and display the current count next to the Last Count. See "Special Considerations" parA. 8.9.
 - 7.2.1 Each record needs to have an individual Total Count based on the difference between the set-up reading and the removal reading for that station set-up record.
 - 7.2.2 The removal time should not be displayed, but if removal is not done at the proper time and the operator doesn't enter a comment code, the program should put an early (97) or late (98) code in the Comment Code field. These codes should never be displayed.

8.0 SPECIAL CONSIDERATIONS:

- 8.1 The operator should be able to browse a schedule without making changes.
- 8.2 The operator should be able to change the Lane, Direction, and Comment codes at any time prior to transmitting the schedule to Austin.
- 8.3 The operator needs a running clock displayed on the screen.
- 8.4 The operator needs to be able to add or insert records.
 - 8.4.1 Change the number of set-ups required at a station. This might call for adding records, and it could mean deleting a record if the actual number of set-ups is less than the number transmitted.

- 8.4.2 Add reset stations or stations which were accidentally omitted from the original schedule. this would require totally new records to be added and hand-written. The hand-written fields would be:

Field	Description
8.4.2.1 County No.	Numeric, three digits. We'd like the operator to have the option to search the county lists for the number.
8.4.2.3 Prefix	Alpha, two characters. Left justified with a trailing blank if the field is not completely filled in.
8.4.2.4 Station No.	Numeric, six digits. Leading zeros added by the program. (Leading zeros not displayed)
8.4.2.5 Suffix	Alpha, one character. If not filled in, a blank inserted in the record.
8.4.2.6 No. of set-ups	Numeric, one digit. Use to add set-up records.

NOTE: We'd like "Window" type entry fields, and we'd like the operator prompted to confirm all entries.

- 8.5 The operator should be able to delete, or somehow mark, invalid records. The Station Location database is often wrong about the number of set-ups required. The operator needs to be able to change the number of set-ups required. Records which have been added to accommodate multiple set-ups, but which are not needed should be deleted, or skipped, or marked in some way as not applicable.
- 8.6 Operators must have free movement within the schedule. Weather and other causes can affect the set up and removal routine.
- 8.7 Program operation must be as simple as possible. The operators should be able to use the program with a minimum of technical training.
- 8.8 Operators must be able to select a schedule out-of-sequence. Due to weather and other causes, a schedule may have to be skipped and done later. When an operator sets up a schedule on a date other than the scheduled set up date, the program should replace that field with the system date.

- 8.9 The Total Current Count is used by the operator for comparison with the Last Count to determine:
- A. If there was a problem with the set-up.
 - B. If the traffic pattern has changed requiring an operator comment.
- 8.9.1 ~~The Last Count which is transmitted to the field is the total for all set-ups. The Total Current Count should not be shown to the operator until the last set-up for a particular station has been removed, but the total count for each set-up should be placed in the record for each set-up.~~
- 8.9.2 The total count should be the rounded-off integer obtained by subtracting the Set-up Recorder Reading from the Removal Recorder Reading divided by 2 (for 24-hour duration), or by 4 (for 48-hour duration). This number should be rounded to the nearest 10th.
- i.e. 15 should be rounded to 20, 21 should be rounded to 20. The Unit digit should always be "0".
- NOTE: This number is not transmitted to the host computer.
- 8.9.3 If the Removal Recorder Reading is less than the Set-up Recorder Reading, add 100,000 to a variable to be used for obtaining the Total Current Count, but put the actual Removal Recorder Reading in the record.
- 8.9.4 Operators should be denied access to:
- 8.9.4.1 The command line.
 - 8.9.4.2 Resetting the system clock.
 - 8.9.4.3 Changing the Set-up Time once the set-up has been confirmed as ready to go.
 - 8.9.4.4 Changing the removal time.
 - 8.9.4.5 Changing the Set-up Recorder Count after the set-up has been confirmed as ready to go.
 - 8.9.4.6 Changing the Removal Recorder Reading after it has been finalized.
 - 8.9.4.7 Changing a Station Location Number.
- 8.10 TEX-AN DIAL-IN: From a district office. The program will include a subroutine to handle telephone protocol. This program will be easily modified in case the telephone system changes.

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9.0 SECURITY:

- 9.1 There should be a hard coded password exchanged between the host and the field computer. If the field computer doesn't receive the proper response , it should put the modem on-hook. We don't want operators using the computer to call a BB.
- 9.2 Operators should be prevented from changing or listing the programs.
- 9.3 The field computer should have password protection. After three unsuccessful attempts to enter the password, the computer should display "Access Denied" and go into an endless loop. The date and time should be placed in a file which is checked on boot up. If the file contains the current date and a time that is less than five (5) minutes earlier than the system time, the program should go back to the Access Denied loop and continue to loop until five minutes have passed based on the file time, then return to the password screen.
- 9.4 The computer should run the program on boot up.
- 9.5 The only way to exit the program should be to turn off the computer. We want operators to be able to run the program and nothing else.
- 9.6 Back up copies of the programs, related files, and recently completed schedules should be kept on disk for disaster recovery.
 - 9.6.1 Back up copies of schedules should be automatically deleted from Storage when the files are older than two weeks.
- 9.7 If possible, the modem should be configured so that it can only originate calls.