NOAA Technical Memorandum NWS SR-116

THE AUTOMATED TONE DIAL DATA COLLECTION SYSTEM

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January, 1986

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National Oceanic and Atmospheric Administration
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National Weather Service
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An AUTOMATED TONE DIAL DATA COLLECTION SYSTEM (ATDDCS) has been designed, developed, and has been installed, tested, and put into operation in Alabama at WSFO Birmingham. A similar system is being installed in Mississippi at WSFO Jackson in early calendar year 1986. The system was developed by the Southern Region Computer Management Group (RCMG). The system is used to collect observations of several meteorological, hydrological, and agricultural parameters that are taken by NWS cooperative observers throughout the state. The observations are entered into the system via tone dial phone, processed by the host computer into the Standard Hydrometeorological Exchange Format (SHEF), sent to an Automation of Field Operations and Services (AFOS) computer for distribution to NWS offices throughout the state and to neighboring offices in other states that have a need for the information. The use of this system replaces a manual, labor intensive system to allow a more efficient use of NWS manpower resources.

SYSTEM OPERATION

After recording the various meteorological parameters, the cooperative observer dials an In-WATS (Wide Area Telephone Service) to access the ATDDCS computer. An example of the instructions used by the cooperative observer is presented in Figure 1. The ATDDCS computer answers the telephone call and sends a distinctive audible tone back to the observer to let them know they are connected to the computer. The observation is then entered via the cooperative observers tone dial telephone. If a tone dial telephone isn't available, one is furnished to the observer. The code used to report the various meteorological/hydrological/agricultural elements is presented in Figure 2. As each group is entered, the computer sends another distinctive audible tone to indicate to the observer that the correct number of digits has been entered. Then the observer proceeds to enter the other groups repeating the same process. As can be seen from Figure 2 the code allows up to 19 separate groups to be sent and could be easily expanded to 99 groups, although most observations consist of only two or three groups, the station identification, amount of rainfall, and river stage. A group is even available to request the NWS office to contact the cooperative observer. When the observer finishes entering the last group, two ## are entered to signal the computer that the observation is finished. The computer again sends another distinctive audible tone to signify that the observation has been received and disconnects the telephone line.

The ATTDCS system can host two incoming telephone lines. The information is stored in a buffer until the computer isn't processing an incoming call or during the time it takes one call to disconnect and another to connect. Then the information is processed and converted to SHEF code. The observation is sent to the printer for immediate use by the WSFO and to a disk file for further use. At the end of a thirty minute period, all observations that have been collected during that period are formatted into a message as shown in Figure 3 and sent to the AFOS computer. The message has AFOS State Distribution Circuit (SDC) routing and is sent to all NWS offices in the state. The thirty minute collection cycle is resumed and once the end time is reached, another properly formatted and addressed AFOS message is sent to the AFOS computer. This message contains all the previous observations plus those collected for this thirty minute period. This process continues until all the rainfall observations are collected. After collection is finished, the office retrieves the product, quality controls and edits it if needed, and then transmits the product on the Regional Distribution Circuit (RDC) for use by NWS offices in neighboring states.

Although the primary rainfall collection period is from 7 AM til 10 AM, there are two other periods during the day when observations can be called to the NWS office. This system makes provision for the other collection periods, beginning a new one at 1 PM and another at 7 PM utilizing the same methodology as presented above.

HARDWARE

The system is a standard IBM Personal Computer with 256k memory, dual 360k byte diskette drives, monochrome monitor, and two asynchronous communication adapters. An Epson FX-80 printer is used with the system. Two Tuck Company modems, Model 1842 Dataset, are used to receive the incoming calls and convert the analog signal to a digital signal used by the computer. A Giltronix Automatic Switching Unit allows one of the two IBM PC asynchronous ports to service both a Tuck modem and the AFOS computer. A Giltronix Peripheral Share Device allows the ATDDCS to be interfaced into an AFOS computer using the same asynchronous port as the Auxiliary Backup Terminal (ABT). A diagram of the system is presented in Figure 4.

SOFTWARE

The system software was written in Turbo Pascal by L. Minton, RCMG. The IBM PC utilizes the Disk Operating System (DOS) Version 3.0. The software is very flexible. Collection periods can be changed easily and stations can be added or deleted by editing a text file.

SYSTEM COSTS

The ATDDCS is relatively inexpensive when compared to other data collection systems of similar type especially since it makes use of a tone dial telephone as an entry device. More and more of the cooperative observers will be getting tone dial telephones as this service spreads through the country. However, in Alabama, as of the date of writing this paper, approximately $2,000 has been spent to buy 51 telephones for the cooperative observers to use. A sturdy, memory telephone costing approximately $45 each is being used.

Hardware cost for the ATTDCS is approximately $4,000. This includes the microcomputer, printer, Tuck modems, and the Automatic Switching Unit. To interface into the AFOS asynchronous port utilized by the ABT costs another $500.

The ATDDCS will utilize two existing In-WATS lines in the state, one at Birmingham WSFO and the other at Montgomery WSO. At the beginning of the changeover to this system, a second line was installed at Birmingham. After all the reports that were previously manually collected by Montgomery are automated, that line will be discontinued.

BENEFITS

The installation of the ATDDCS in Alabama has allowed the automation of the collection of 74 observations from cooperative observers throughout the state. Previously, the observations were collected manually, typed into a message, and transmitted on AFOS. The 74 observations were collected in varying numbers by 7 NWS offices with the heaviest collection burden at WSFO Birmingham and WSO Montgomery. The ATDDCS to be installed at WSFO Jackson will collect, process, and transmit up to 115 reports being called into that office and 20 reports being called into WSO's Meridian and Mobile.

]

MONTEVALLO ALABAMA

STATION NUMBER 00020

1) ENTER YOUR RAINFALL IN THE FOUR BLANKS IN THE NEXT LINE.

00020* 01 _ _ _ _ *##

2) SWITCH THE TELEPHONE TO PULSE DIAL

3) DIAL 1-800-325-8248

4) SWITCH THE TELEPHONE TO TONE.

5) WAIT FOR THE COMPUTER TO ANSWER (A SHORT TONE).

6) USING THE TOUCH TONE NUMBERS ON YOUR TELEPHONE...
ENTER YOUR STATION NUMBER 00020 FOLLOWED BY A STAR (*).

7) AFTER EACH STAR (*) YOU WILL HEAR A SHORT BEEP. THIS INDICATES YOU HAVE ENTERED THE CORRECT AMOUNT OF NUMBERS.

8) IF YOU DO NOT HEAR THE SHORT BEEP AFTER PRESSING THE STAR (*).
-YOU WILL NEED TO ENTER THAT SECTION AGAIN.

9) NOW PRESS 01 AND ENTER YOUR RAINFALL AMOUNT (USING 4 NUMBERS) FOLLOWED BY A STAR (*).

10) THE END OF THE MESSAGE IS TWO POUND SYMBOLS (##). YOU WILL HEAR A SHORT BEEP IF ALL FIELDS HAD THE CORRECT AMOUNT OF NUMBERS.

11) IF YOU DO NOT HEAR THE SHORT BEEP AFTER THE THE TWO POUND SYMBOLS
-PLEASE RE-DIAL AND TRY AGAIN.

...EXAMPLES....

A) PRECIPITATION AMOUNT OF 0.51 OF AN INCH
YOUR REPORT WOULD BE 00020*010051*##

B) PRECIPITATION AMOUNT 3.51 INCHES
YOUR REPORT WOULD BE 00020*010351*##

C) PRECIPITATION AMOUNT 10.21 INCHES
YOUR REPORT WOULD BE 00020*011021*##

Figure 1

7/16/85

Final Message Coding (SHEF) for AFOS

The following is the format for the fields of data to be sent in to the IBM-PC via the two tone receive modems.

Field #	Length	Coded	Actual	
00	3	072	VRNA1	Station
01	4	0124	01.24	Rainfall in inches
02	4	0678	06.78	River Stage in feet
03	6	087068	087/068	Temperature Max/Min deg F
04	3	078	078	Temperature Current deg F
05	4	0987	0987	Solar Energy watts/meter sq.
06	6	072064	072/064	Soil Temp. Max/Min deg F
07	3	087	0.87	Evaporation in inches
08	2	05	05	Vegetative Wetting hours
09..18	future			
19	0	n/a	n/a	Call the Observer

As entered by phone this message in raw form would look like this:
00072*010124*020678*03087068*04078*050987*06072064*07087*0805*19*##

Notes:

The station codes are 3 digit numbers which the computer uses to look up the 5 character station identifier from a look-up table. Temperatures that are below 0 (minus) are preceded by a 9 (i.e. -6 degrees would be 906). A single # separates more than one observation sent by a station. A double ## signals end of the message. Answer back tones indicate a properly entered field. The 00 field must be acknowledged properly before any other fields are recognized. A warble tone is given at the end of the message if the 00 field was recognized and the message ended with ##.

As an AGO report the above message would appear in SHEF code as:

.B BHM 0715 C DH07/TX/TN/TA/PP/TS/TT/ER/AW/RI
VRNA1 087/068/078/01.24/072/064/0.87/05/0987

As an RR2 report it might appear as:
.B BHM 0715 C DH07/HG/PP/TX/TN/TA
VRNA1 06.78/01.24/087/068/078

The difference between RR2 and RR3 reports is determined by the time of day the message is received.

If an error is made in a field (even if length was proper and a positive beep returned) the field can be reentered and the last good field is the one used in the coded SHEF message. If an observer re-sends an observation during a later call for an accumulative report such as the RR2 or AGO reports, the latest data in the fields sent will overwrite the earlier data.

Figure 2

```
ZCZC BHMRR2BHM
TTAA00 KBHM 101347
:
: 24 HOUR PRECIPITATION (PP) REPORTS
:
.B BHM 0110 C DH07/PP
ADDA1 00.05, ALCA1       , BOZA1       ,  CHTA1       , CRHA1
CLNA1       , CORA1       , ELRA1       ,  FLKA1       , FOPA1
HVLA1       , HAMA1       , HNCA1 00.04,  HGHA1       , HGDA1
JAXA1       , LEDA1       , LVNA1       ,  MARA1       , MLPA1
MTVA1       , MDVA1 00.12, OMPA1       ,  ONEA1       , PLDA1
PNNA1       , PRYA1       , RFMA1       ,  RKMA1       , SULA1
SCGA1       , UNTA1       , WBLA1       ,  ABBA1       , ALBA1
ALXA1       , ALUA1       , AUTA1       ,  BLLA1       , CLYA1
EWRA1       , GRGA1       , GVLA1       ,  HIHA1       , KGNA1
LOUA1       , MATA1       , PINA1       ,  PLNA1       , ROKA1
TOIA1       , UNSA1 00.16, WETA1       ,  ATMA1       , BEAA1
EVRA1       , FRCA1       , TOMA1       ,  WLCA1 00.45, MVNA1
CTNA1 00.27, HRTA1       , WHTA1       ,
END.
:
:RIVER STAGE (HG) PRECIP (PP) MAX TEMP (TX) MIN TEMP (TN) CUR TEMP (TA)
.B BHM 0110 C DH07/HG/PP/TX/TN/TA
RVFA1       /      /    /    /
BWTA1       /      /    /    /
ELBA1 08.60/01.07/    /    /
MGYA1       /      /    /    /
GNVA1 05.83/       /    /    /
ALDA1       /      /    /    /
BRPA1       /      /    /    /
JPRA1       /00.03/044/040/040
PNSA1       /      /    /    /
SELA1       /      /    /    /
VRNA1       /00.23/044/023/038
VYHA1       /      /    /    /
SUTA1       /      /    /    /
END.
```

```
ZCZC BHMRR3BHM
TTAA00 KBHM 012143
:
RIVER STAGE (HG)   PRECIPITATION AMOUNT SINCE 7AM (PPP)
.B BHM 0101 C DH19/HG/PPP
BWTA1 07.33/03.20
.END
```

Figure 3

The Automated Tone Dial Data Collection System

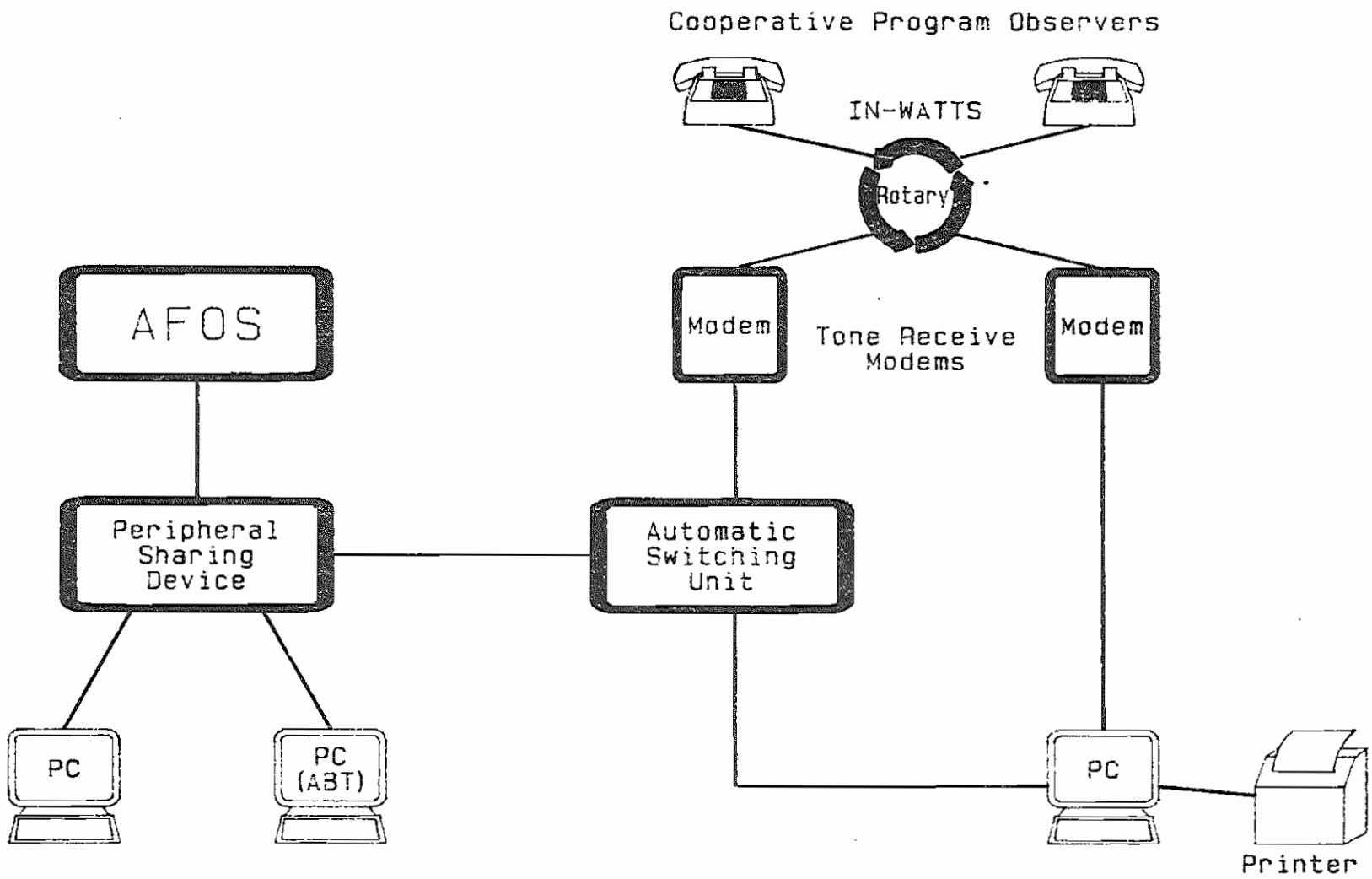

Figure 4