A Techniques Development
Laboratory Computer Program
NWS TDL CP 85-2

AFOS TERMINAL FORECAST DECODING

Silver Spring, Md.
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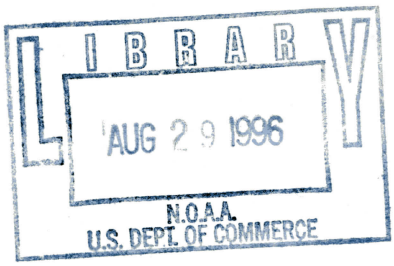

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1. INTRODUCTION

Terminal forecasts (FT's) are issued by Weather Service Forecast Offices (WSFO's) for approximately 500 airports nationwide. These forecasts are issued both on a scheduled and non-scheduled basis to "... serve the pre-flight and in-flight meteorological service requirements of domestic aviation operations by providing ... definitive weather information about cloud heights and amounts, visibility, weather, obstructions to visibility, and wind" (NWS, 1984).

A regularly scheduled FT is valid for the 24-h period following its issuance. This period is broken down into two distinct parts--specific forecasts for the first 18 hours and categorical forecasts for the last 6 hours. Each part may be subdivided into one or more forecast groups depending on expected weather changes. Additionally, the forecast groups are divided into two segments--the prevailing conditions and the remarks.

The FT's are prepared manually each day at WSFO's which have FT responsibilities. Once prepared, they are then stored in the local Automation of Field Operations and Services (AFOS) database and transmitted over the AFOS communications circuits. The information in the forecasts can also be used by various applications programs at the local office (e.g., Vercelli and Norman, 1985). To do this, however, the forecasts must first be decoded. This paper describes two FORmula TRANslation (FORTRAN) subroutine programs which together with their subordinate subroutines can be used to decode FT's. The first subroutine, DCDFT, will decode the prevailing conditions of each forecast group in an FT. It will also store the undecoded remarks for each group for use by the second subroutine, REMDEC, which will decode the remarks for one user-selected forecast group at a time.

2. SUBROUTINE CALLING PROCEDURES

Data flow and program relationships are illustrated in Fig. 1. Software structures and the load lines are shown in Fig. 2. Before subroutine DCDFT can be called, the user must retrieve and unpack[1] an FT from the AFOS database. This can be done by using the AFOS.LB subroutines KSRCF, RDBKF, and NXBKF for retrieval and the UTIL.LB subroutine UNPACK for unpacking the product. DCDFT limits the size of the packed FT to two AFOS blocks (128 words per block).

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[1]The FT products are stored in the AFOS database in packed ASCII format, i.e., two ASCII characters per 16-bit word. An unpacked FT will have one ASCII character per word stored in the right-hand 8 bits (= 1 byte) and a null (Ø) in the left-hand byte.

The call for subroutine DCDFT is as follows:

CALL DCDFT (IFT, IDATA, IRC),

where IFT is the unpacked FT which is to be decoded, IDATA is the decoded FT array returned by DCDFT, and IRC is the return code. The dimensions for IFT and IDATA are 512 and 558, respectively. The IFT dimension is based on the two AFOS block size limit (256 packed words = 512 unpacked words). The IDATA dimension consists of 8 words for the header record and 55 words for each of a maximum of 10 groups. Table 1 shows the format of the IDATA array, Table 2 provides the definitions of the weather codes referred to in Table 1, and Table 3 shows the return codes for IRC.

Records 2 through N, as shown in Table 1, contain the decoded prevailing conditions in words 1 through 13, inclusive, and the undecoded remarks in words 14 through 55, inclusive. If the remark for a particular group exceeds 42 characters (including blanks and the period) it will be truncated to 42. The effect of truncation on the remarks decoder will be explained later. DCDFT will decode up to the maximum of 10 FT groups but will not decode the categorical outlook group(s).

The primary assumption made in the development of the remarks decoder, REMDEC, was that each phrase within a particular remark can be considered as another forecast with the same basic structure as the prevailing conditions. If a particular element is not specifically stated in a phrase, then it is assigned the value of the corresponding element in the prevailing conditions. For example, let's say that an FT group is written as follows:

15Z 30 SCT C50 BKN 5RW- 0912 OCNL C30 BKN 50 OVC CHC 2RW+.

Here, the prevailing conditions are: 30 SCT C50 BKN 5RW- 0912, and there are two remark phrases: 1) OCNL C30 BKN 50 OVC
2) CHC 2RW+.

Subroutine DCDFT interprets the prevailing conditions as: two cloud decks, 30 SCT and C50 BKN; 5 mi visibility; light rain showers; and an east wind at 12 kt. REMDEC interprets the first remark phrase to be two cloud decks, C30 BKN and 50 OVC; 5 mi visibility; light rain showers; and an east wind at 12 kt. The second remark is interpreted to be two cloud decks, 30 SCT and C50 BKN; 2 mi visibility; heavy rain showers; and an east wind at 12 kt. One can see that, for each remark phrase, REMDEC looks to the prevailing conditions to fill in the missing elements.

To access REMDEC, the following call is used:

CALL REMDEC (IDATA (IPTR), ITIME, IREM, NSENT, IREMRC),

where IDATA is the array returned by DCDFT, IPTR points to the first word of the group for which remarks are to be decoded, ITIME is a time used to evaluate time qualifiers in the remarks such as AFT (after) or TIL (until), IREM is the array containing the decoded FT remarks, NSENT is the number of remark phrases decoded, and IREMRC is an input/output status code.

REMDEC will only decode the remarks for one selected FT group at a time. Therefore, IPTR must point to the first word in that group, which can be computed for any group starting location with the following formula:

IPTR = (NWORDS x NGRP) - (NWORDS - 1) + NCNST

where NWORDS = 55, NCNST = 8, and NGRP is the group to be decoded, which simplifies the formula to:

IPTR = 55 x NGRP - 46.

As with the variable IPTR, the user must define ITIME in the calling program. An example of where ITIME would be used is:

14Z 30 SCT C50 BKN 3015G20 G30 18Z-21Z. 04Z VFR WND ..

If ITIME is defined to be a time between 18Z and 21Z, inclusive, then the G30 would be treated as a remark phrase. Otherwise, the G30 would not be used and the information would be lost.

The decoded remark array, IREM, is dimensioned 48. This consists of a maximum of four 12-word records as shown in Table 4. The format is very similar to that of IDATA (see Table 1, record 2, words 1 through 12, inclusive). The only difference is that the first word is the phrase type rather than the group time.

At present, REMDEC will allow a maximum of four remark phrases to be decoded from one FT group. Therefore, NSENT will not exceed four. For example, the following FT group has three remark phrases (beginning with the underlined characters) so that NSENT = 3:

00Z C30 OVC 4F 2415G20 G28 02Z-04Z OCNL C12 OVC 3RW-F
CHC C4 X 1/2TRWF G35.

The last argument, IREMRC, must be defined by the user prior to calling REMDEC. On input, this variable tells REMDEC if the undecoded remarks were truncated because they exceeded the maximum length of 42 characters. If the remarks were truncated, the last word for that particular group is set by DCDFT to a decimal 33 which is an ASCII exclamation point (!). The user will need to check the last word of the particular FT group for which the remarks are to be decoded to see if it is equal to 33. If it is, then the user must set IREMRC to a number less than zero. Otherwise, IREMRC is set equal to zero. Also, the character itself must be changed from an ASCII exclamation point to an ASCII period (decimal 46) for use by REMDEC. To compute the location of the last word for any particular group, use the following equation:

IFLAG = NWORDS x NGRP + NCNST.

With NCNST, NWORDS, and NGRP defined as before, this becomes:

IFLAG = 55 x NGRP + 8.

IREMRC returns to the calling program a code number to indicate the success level of the decoding process. These code numbers are defined in Table 5.

3. CAUTIONS

a. The FT decoder expects to find variables in a specific order: cloud group(s), visibility, weather/obstructions to vision, and wind (direction, speed, gust). Typographical errors or positioning variables in the wrong order can result in misinterpretation of the information by the decoder. The user should adhere to the prescribed rules for writing an FT (NWS, 1984; NWS, 1985) to avoid or limit such misinterpretations. For example, a time qualifier such as "10Z-12Z" cannot be written "10-12Z." Also, there are occasions when typographical errors (misspellings, illegal blanks, etc.) can cause an error message for an element after the element which actually contains the error. One of the most frequent typographical errors which can cause decoding errors is the use of the number zero for the letter "O" and vice versa.

b. An FT remark, for the FT group being monitored, should not exceed 42 characters in length. If it does, the FT decoder will truncate it. The truncated phrase and any phrases after it will not be decoded.

c. REMDEC was written for use in the AFOS applications program MONITR (Vercelli and Norman, 1985). MONITR does not use information on low-level wind shear (LLWS) or weather in the vicinity of the terminal (e.g. TRW VCNTY). Therefore, although REMDEC will look for this information, it will not be decoded.

d. Misspelling of official abbreviations which are legal for use in an FT (NWS, 1984) can result in decoding errors. For example, the use of the abbreviation "VSBYS" instead of the legal abbreviation "VSBY" can result in the interpretation of the last "S" as snow.

4. REFERENCES

National Weather Service, 1984: Aviation terminal forecasts. NWS Operations Manual, Chapter D-21, Manual Issuance 84-14, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, 44 pp.

____, 1985: Aviation terminal forecasts. NWS Operations Manual, Chapter D-21, Manual Issuance 85-1 (Rev.1), National Oceanic and Atmospheric Administration, U.S. Department of Commerce, 10 pp.

Vercelli, D. J. and G. A. Norman, Jr., 1985: AFOS monitoring of terminal forecasts. NOAA Techniques Development Laboratory Computer Program NWS TDL CP 85-1, National Weather Service, NOAA, U.S. Department of Commerce, 23 pp.

5. TERMINAL FORECAST DECODER

Subprogram Information and Initiation

Program Name: DCDFT

AAL ID: LBS016
Revision No.: 02.00

Purpose: Decodes and returns the prevailing conditions portion of an aviation terminal forecast (FT) along with undecoded remarks portion of the FT in an array. The array can then be passed to subroutine REMDEC (LBS016.LB) to decode the remarks. DCDFT assumes the input data is an unpacked FT which is no longer than 2 AFOS blocks--the input array must be dimensioned at least 512 in the calling program. It also expects the FT to follow the format defined in NWS (1984, 1985). The program will not decode the outlook group of the FT.

Program Initiation:

FORTRAN Call Statement:

```
CALL DCDFT(IFT,IDATA,IRC)
```

IFT( ) - Input array containing unpacked FT which is dimensioned at least 512 in the calling program.

IDATA( ) - Output which consists of decoded FT plus undecoded remarks for a maximum of 10 groups. Array is dimensioned 558 in calling program. See Table 1 for definition of contents. See text for method of computing location of first word in Records 2 through N, inclusive ($N \leq 10$).

IRC - Return code

0 - Successful return
1 - Routine delayed FT
2 - Unable to find issue date/time field
3 - More time groups than allowed
4 - Unable to find valid time of forecast group
5 - Unknown number field of length greater than 4
6 - Invalid wind field
7 - Invalid gust field
8 - End of FT buffer before end of FT

Note: IRC = 1 or 2 will result is IDATA being returned undefined. For IRC = 3 through 8, inclusive, IDATA will be defined up to the occurrence of the error.

COMMON BLOCKS:

/CFTA/ ITIMPT(10)

/CFTB/ LHDR, NFCSTG, LFCSTG

/CDCDFT/ ICOMMENT(3,2), ICCVR(3,4), ITYPE(3,3), IDCVR(4)

/CFT/ IPERIOD, ILNFD, ICRTN, ININE, IZERO, IBLANK, IFP(3,3)

These common blocks are used internally by DCDFT and should not be defined in the calling program.

DISK FILES: NONE

Load Line

RLDR ... LBS016.LB ...

Programmer(s):

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Subprogram Information and Initiation

Program Name: REMDEC

AAL ID: LBS016
Revision No.: 02.00

Purpose: Decodes the terminal forecast (FT) remarks for a specified group in a decoded FT. Input is the output array (IDATA) from subroutine DCDFT (LBS016.LB).

Program Initiation:

FORTRAN Call Statement:

```
CALL REMDEC (IDATA(IPTR),ITIME,IREM,NSENT,IREMRC)
```

IDATA( )	-	Input array containing FT decoded by DCDFT (also available from LBS016.LB).
IPTR	-	First word of the decoded FT group in IDATA for which remarks are to be decoded. See text for method of computing this location.
ITIME	-	User supplied time for evaluation of time qualifiers in remarks such as "AFT" or "TIL." (See text for usage.)
IREM( )	-	Output array containing the decoded FT remarks. Must be dimensioned 48. See Table 4 for definitions.
NSENT	-	Number of remark phrases decoded (maximum of 4).
IREMRC	-	Input/output status code.

Input: (See text for definition and method of computing IFLAG.)

IREMRC		IFLAG
<0	if	=33*
=0	if	≠33

Output:

IREMRC	MEANING
0	No errors found, all phrases in remark were decoded.
1	At least one error found in at least one phrase.
2	Same as 1, plus the remark was truncated. Actual number of phrases stored will be one less than total found (the last phrase is dropped).

*If IFLAG = 33, it must be changed by user to 46 for use by REMDEC.

3	At least one error found in each phrase. All phrases rejected, remarks not decoded.
4	Same as 3, plus the remark was truncated.
5	Remark was truncated so last phrase was dropped. Remaining phrases successfully decoded.

COMMON BLOCKS:

/IDESCR/IADJ(28),IADV(8),MCHAR(11),JCHAR(11)

/POSN/ IPOS(5)

These common blocks are used internally by REMDEC and should not be defined in the calling program.

DISK FILES: None

Load Line

RLDR ... LBS016.LB ...

Programmers:

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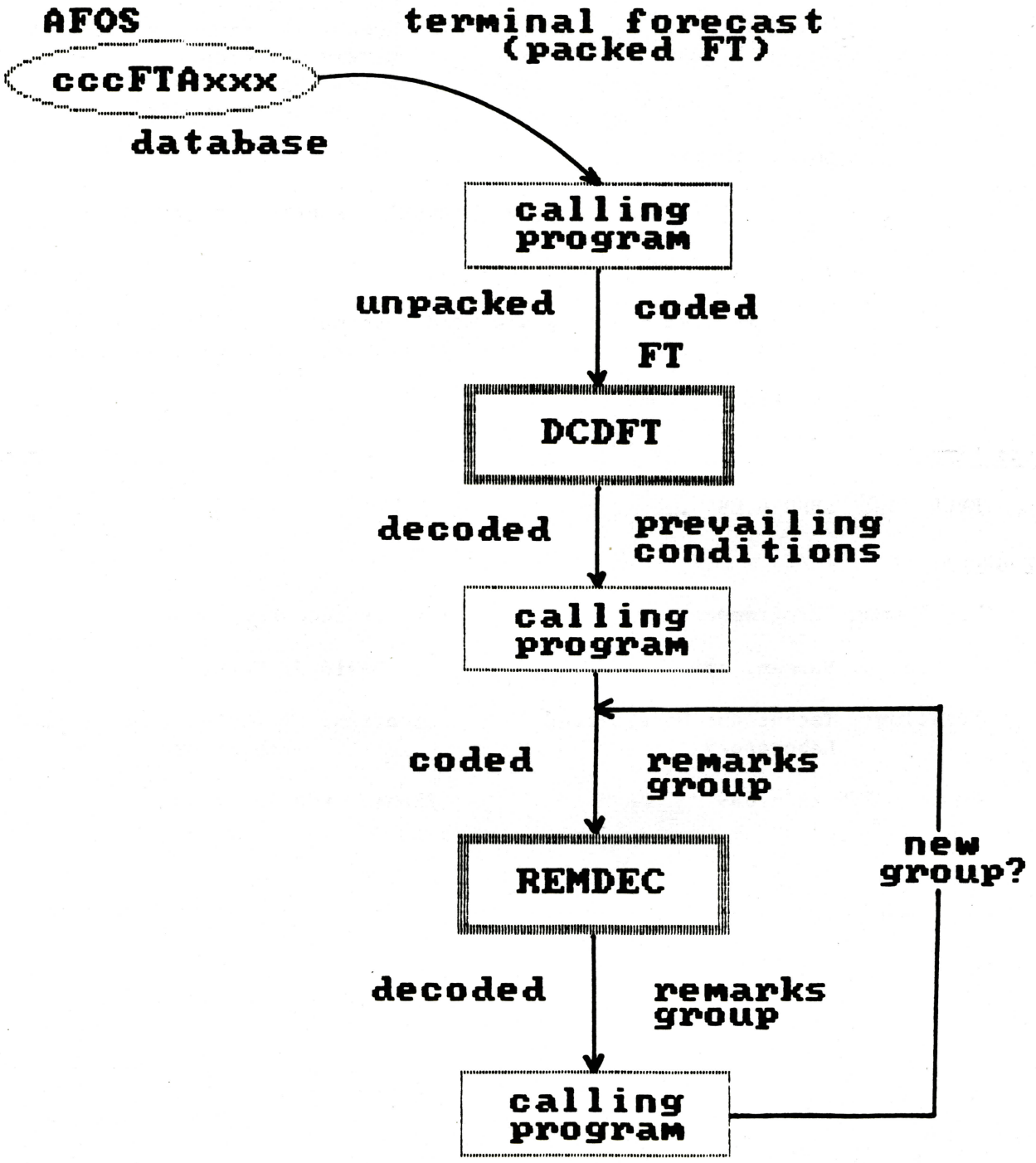

Figure 1. Data flow and program relationships for the FT decoder system. The main subroutines are designated by heavy boxes, user defined code by light boxes, and the AFOS disk file by the oval.

DCDFT

MAIN SUBROUTINE

DCDFT

SUBORDINATE SUBROUTINES

SSEARCH
COUNT
CLD → COUNT, SSEARCH

VSBLTY → SSEARCH
WTHR → CHEKR → SSEARCH
GETRMK

LOAD LINE

RLDR ... LBS016.LB ...

REMDEC

MAIN SUBROUTINE

REMDEC

SUBORDINATE SUBROUTINES

IZOUT
SSEARCH

GETCLD → BAKUP, SSEARCH, CLD → COUNT, SSEARCH

SORT
COUNT
RSATIM
CLD → COUNT, SSEARCH

SSEARCH
BAKUP

CLDCHK → LOHT → IZOUT, GETHT, SORT

GETHT
GETYPE

WTHR → CHEKR → SSEARCH
VSBLTY → SSEARCH

LOAD LINE

RLDR ... LBS016.LB ...

Figure 2. Software structure and load lines for subroutines DCDFT and REMDEC.

Table 1. Format of the IDATA array returned by DCDFT.

Words	Contents	Type
Record 1		
1-2	Station call letters	ASCII
3	Type of forecast -2 correction -1 routine delayed 0 routine > 0 amendment number > 10 corrected amendment where the amendment number = IDATA(3)-10	Integer
4	Date of FT issuance	Integer
5	Starting and ending time of FT in form: start X 100 + end	Integer
6	Number of forecast groups	Integer
7-8	Not used	
	The following 55 words are repeated for each forecast group (maximum N = 10). Words 1 through 13, inclusive, contain decoded prevailing conditions and words 14 through 55, inclusive, contain the undecoded remarks for that group (may be truncated--see text for more information)	
Records 2-N		
1	Time of forecast group	Integer
2	First cloud layer (Bit 15 is left most bit) Bit 15: ceiling if = 1 Bit 14: thin/variable flag if = 1 Bits 12-13: not used Bits 9-11: amount of layer 0 = clear 1 = scattered 2 = broken 3 = overcast 4 = obscured Bits 0-8: cloud height in 100's of feet	Integer
3-5	Second, third, and fourth cloud layers as defined above	Integer
6	Visibility (mi)	Integer
7-10	Weather code (see Table 3) (maximum of 4 weather codes)	Integer
11	Wind direction (dd) and speed (ff) in form ddff (deg and kt)	Integer
12	Gusts (kt)	Integer
13	Frontal passage indicator 0 = no passage 1 = cold front 2 = warm front 3 = occluded front	Integer
14-55	Undecoded remarks	ASCII

Table 2. Weather code definitions. These codes will be modified to reflect intensity where applicable by adding 100 for "very light," 200 for "light," and 300 for "heavy." The values shown are for "moderate" intensity where applicable.

Weather Type	Abbreviation	Code Number
Hail	A	1
Blowing dust	BD	2
Blowing sand	BN	4
Blowing snow	BS	6
Blowing spray	BY	8
Dust	D	10
Fog	F	11
Ground fog	GF	12
Haze	H	14
Ice pellet showers	IPW	15
Ice pellets	IP	18
Ice fog	IF	20
Ice crystals	IC	22
Smoke	K	24
Drizzle	L	25
Rain showers	RW	26
Rain	R	28
Snow showers	SW	29
Snow pellets	SP	31
Snow grains	SG	33
Snow	S	35
Thunder	T	36
Freezing drizzle	ZL	37
Freezing rain	ZR	39

Table 3. Definitions of return codes from subroutine DCDFT.

IRC	Meaning
0	Succesful return
1	Routine delayed FT
2	Unable to find issue date/time field
3	More time groups than allowed
4	Unable to find valid time of forecast group
5	Unknown number field of length greater than 4
6	Invalid wind field
7	Invalid gust field
8	End of FT buffer before end of FT