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NETWORK: A User-Oriented, Interactive, Station-Siting Program for NOAA VHF Weather Radio

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PREFACE

Certain commercial equipment and software products are identified in this report to adequately describe the design and conduct of the research or experiment. In no case does such identification imply recommendation or endorsement by the National Telecommunications and Information Administration, nor does it imply that the material or equipment identified is necessarily the best available for the purpose.

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NETWORK: A User-Oriented, Interactive, Station-Siting Program for NOAA VHF Weather Radio

G. R. Hand and J. E. Adams*

NETWORK is an interactive computer program designed to help the National Weather Service expand the NOAA Weather Radio Network to obtain the desired coverage at minimum spectrum usage. For each active station, areas of predicted service and co-channel interference are calculated by NETWORK.

This manual describes how to use the NETWORK program as well as the propagation prediction methods that it uses.

Key words: co-channel interference; computer program; desired station; interactive graphics; network; service

1. INTRODUCTION

The NOAA Weather Radio Network administered by the National Weather Service (NWS) broadcasts current weather conditions and forecasts on a 24-hour-a-day basis. This broadcast network is also the primary element in the national disaster warning system. In order to effectively reach a majority of the population of the contiguous United States with these broadcasts, NWS must expand the network by adding new stations. Current NWS antenna locations are shown in Figure 1. The network must be carefully designed to minimize the co-channel and adjacent channel self interference that will result from operating closely spaced stations. To assist NWS in siting new weather broadcast stations and selecting the optimum channels to meet their objectives, the Institute for Telecommunication Sciences (ITS) has developed an interactive computer model called NETWORK.

NETWORK is designed to help NWS plan the expansion of the broadcast network by predicting the coverage that results when stations are added to or deleted from the network or have their location or characteristics (i.e., frequency assignment, transmitter power, antenna height, etc.) changed. The NETWORK data base contains the required information about each station in the network to determine service and interference areas. NETWORK's editing capability allows the user to easily modify any of this station data, and the resulting changes in service and interference areas are then calculated and

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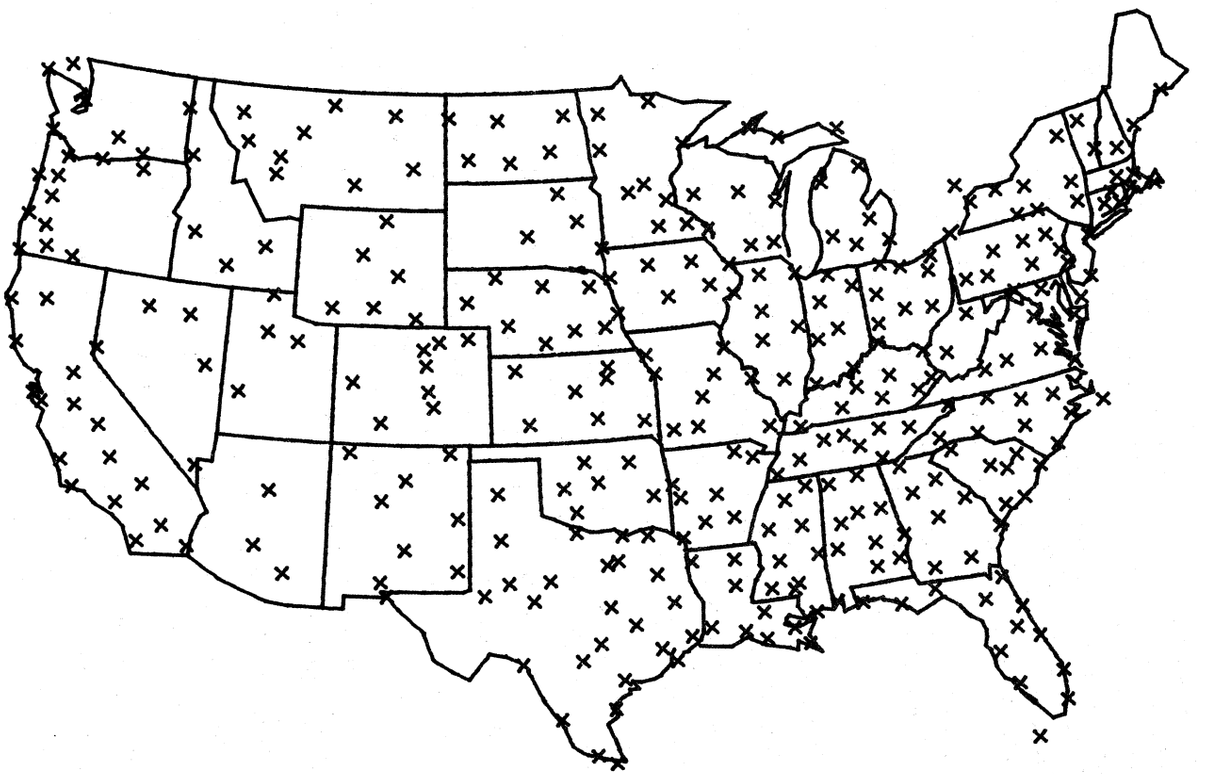

Figure 1. NWS example of transmitter locations in NETWORK data base.

added to the data bases used to display coverage. Thus, the service and interference areas plotted on the interactive terminal will always reflect the current station parameters contained in the data base.

This capability allows the user to select the combination of station location and technical characteristics that will maximize service and minimize interference for the network. By revising the station data and comparing the resulting coverage predictions, the user can effectively plan the expansion of the network to obtain the desired coverage at minimum spectrum usage.

2. PREDICTION METHOD

Radio signal strengths do not have a single deterministic value, but vary randomly with time and space. If an observation point is set up near the fringe of the service area of a broadcasting transmitter and the signal is monitored for a period of time, part of that time the signal will be entirely adequate, but the rest of the time it will have faded out below the receiver sensitivity. If interference is present, the interfering signal level will also vary with time. Part of the time it will be imperceptible, but the rest of the time it will be strong enough to add an annoying amount of noise to the signal, or to superimpose a beat frequency (a "whistle") on the signal, or even to "capture" the receiver. The average listener should be able to tolerate an occasional fadeout or burst of interference, but if it happens too often he will find the situation intolerable and will abandon the signal as unusable.

In addition to variations in the signal over time, the received signal level also varies from location to location, even within the same "neighborhood." For instance, if the observation point is moved to a new location within a few hundred meters of the old location and the signal is monitored again for a period of time, the measurements may show that the signal fades out or suffers from interference for a different fraction of time than at the previous location. The new location may be better or worse than the old location, depending on whether the amount of time during which the signal is usable is larger or not. Sometimes the change will be quite significant--from a totally useless location to an entirely adequate one.

NETWORK's predictions of service or interference for an area are based on how much of the time and in how many locations an adequate signal level is available. These calculations are performed by utilizing the ITS Irregular

Terrain Model (ITM) in the Area Prediction Mode (Hufford et al., 1982). The model covers all frequencies from 20 MHz to 20 GHz and nearly all ground-based antenna heights. It is particularly good for predicting land mobile radio and broadcast situations such as those found in the NOAA Weather Radio Network.

As developed in the ITM, the notation $E(Q_T, Q_L, Q_C)$ is used to represent the field strength in dBμ (decibels above a microvolt per meter) that will be exceeded for at least the percentage of time Q_T in at least the percentage of locations Q_L with a prediction confidence of Q_C percent. In other words, when many predictions of the statistics of field strength are made Q_C percent of the actual statistics will provide greater service than predicted. Greater service means, in turn, that if one visits many locations in some small region, then more than Q_L percent of them will have greater reliability than predicted. Finally, greater reliability means in turn that if one measures the field strength over a period of time then for more than Q_T percent of that time those measurements will be greater than the value of E. In NETWORK the value of Q_C is always set to 50 so that the median prediction is obtained. This has three consequences: (1) to each transmitter is ascribed a "best estimate" for its service area and a "best estimate" for its possibly interfering fields; (2) taken as a whole a network of transmitters will have a total service area that is estimated fairly accurately since prediction errors will tend to cancel against each other; and (3) there are immediately available to the computations those values that theory says should be used to find desired-to-undesired signal ratios.

The statistics that are specified for time availability and location variability for a desired signal should be high so that the value of E obtained will be a lower bound. NETWORK uses E(95,95,50) for service predictions. On the other hand, an interfering signal does not need to be present much of the time or in many locations to make the desired signal unusable. Consequently, NETWORK uses E(10,50,50) for interference predictions. The same cumulative distributions may be used to determine the value of E that is not exceeded for at least $100-Q_T$ percent of the time and at least $100-Q_L$ percent of the locations.

3. SERVICE AND INTERFERENCE AREAS

NETWORK calculates areas where service and co-channel self-interference are predicted to occur for a specified portion of the broadcast network. To

store the data necessary for service and interference predictions in a uniform manner, a 4-minute arc grid has been superimposed on the contiguous United States extending from the southwest corner at (24°N, 125°W) to the northeast corner at (50°N, 66°W). For every grid point, the field strength values of E(95,95,50) and E(10,50,50) from every station within 200 km of the grid point are stored. This information is automatically updated with the ITM whenever a station is added, deleted, moved, or the technical characteristics are changed. Consequently, the service or interference coverage calculated always reflects the current station data.

To describe precisely what is meant by service and interference areas, we must first describe what quality of service we assume is to be delivered. Consider a "typical" receiver installation. The antenna is 6 ft (1.8 m) above ground and is not deliberately hidden behind or within buildings or trees. The antenna-receiver combination performs adequately if the received field strength is 18 dBμ or greater. This value corresponds to 8 μV/m and, if the antenna is good but unsophisticated, to a receiver sensitivity of about 2 μV. As for co-channel interference, we assume that FM capture takes full effect when the desired signal is 10 dB greater than all undesired signals.

As suggested before, it is not enough to specify the laboratory bench values such as given here. We must also specify what statistics we expect. In keeping with this concept we shall say that a given location is "served" if it receives an adequate field strength (18 dBμ at a point 1.8 m above ground) for at least 95 percent of the time.

For these system characteristics we can proceed to a definition of the service area of a desired station. By "desired station" we mean the station closest to the location of interest. From our definition, a station further away with a stronger signal is not considered adequate because its transmitted information is not the desired information. A neighborhood of locations is within the service area provided that 95 percent of the locations are served by the desired station. This means, in the notation of Section 2, that a neighborhood is within the service area provided that we compute E(95,95,50) to be greater than 18 dBμ. A neighborhood lies outside the service area if the calculated field strength is less than 18 dBμ. Note, however, that many of its locations, although less than 95 percent of them, may still be adequately served.

In the case of interference, imagine the situation of a given neighborhood where there is a "desired" NWS station and one or more "undesired" NWS stations, each of which might cause annoying or intolerable interference. To gauge the amount of interference we use the E(10,50,50) value. This is fairly conservative and accounts for the abnormally high fields that occur for 10 percent of the time. Then we say that a given neighborhood suffers from co-channel interference if there is at least one undesired station operating at the same frequency such that

$$E_D(95,95,50) - E_U(10,50,50) < 10 \text{ dB}$$

where the subscripts D and U refer to the desired and undesired stations, respectively.

The situation regarding co-channel interference is illustrated in Figure 2. In that figure we have assumed two typical co-channel stations separated by 160 km (100 mi) and have considered the neighborhoods that lie on the straight line connecting them. For the desired station on the left we have drawn the desired E(95,95,50) field strengths for successive distances from the station. Note that this curve crosses the threshold of 18 dBμ when the distance is about 68 km (42 mi). This distance, then, can be called the "service range limit" of our typical station. For the undesired station on the right we have drawn the E(10,50,50) curve which represents the undesired field strength. This curve lies higher than 10 dB below the desired E(95,95,50) curve unless the distance to the desired station is less than about 44 km (27 mi). This distance is therefore the "interference range limit." Of course, this is the worst case situation with the receivers located directly between the two stations. For other positions off the connecting line, the numbers would be somewhat more optimistic.

For the plots, service or interference for each 4-minute area centered at a grid point is determined by comparing the service level field strength from the desired station with the interference level field strength from each of the other stations within 200 km.

Co-channel interference is only calculated for grid points that would otherwise have service from their desired station. If the point has a service level field strength from its desired station of less than 18 dBμ, it will be

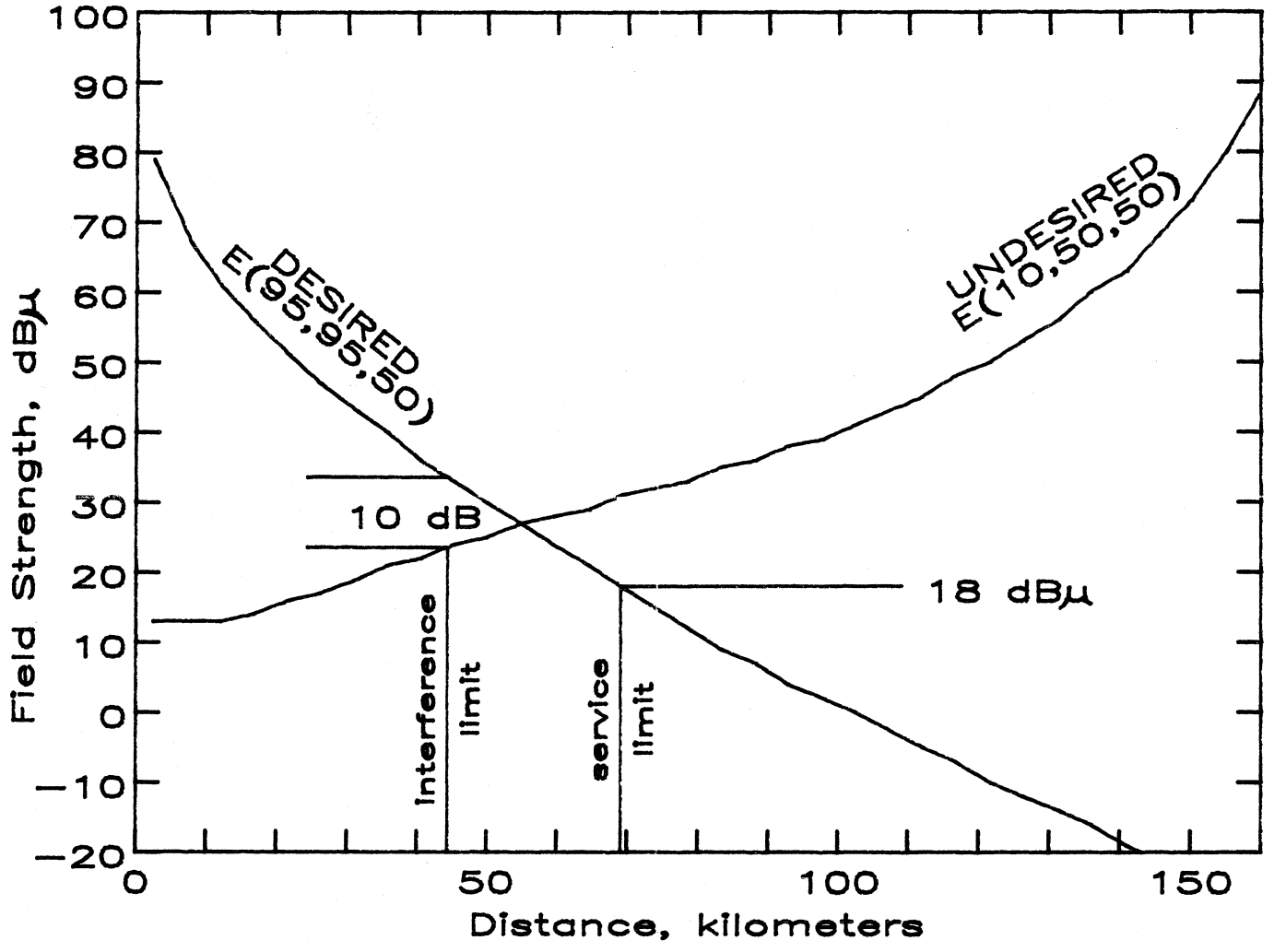

Figure 2. A plot of field strength values from two typical NWS transmitters. An undesired co-channel station is located 160 km away from the desired station.

considered not served even though it may have signal levels high enough to be considered served from a more distant station.

Based on comparisons of the predicted service signal levels and interference signal levels from the desired and undesired stations, a coverage code is assigned to each grid point and stored in the computer for plotting coverage areas. These codes are updated whenever the changes to the station data base require new signal predictions. The three types of coverage codes that are used are as follows:

0 -- not served by desired station

1 -- served by desired station

2 -- co-channel interference present.

4. OUTPUT OPTIONS

NETWORK may be run from either a CRT interactive graphics terminal or a nongraphics terminal. The output options available include listing stations and their characteristics, and plotting service and interference areas that may be superimposed on state or county boundaries for a selected area of the network. Plots may also be output to a color pen plotter. Figures 3 through 10 show examples of the output available from NETWORK. In the coverage plots, those stations showing no coverage have not been activated. The plotting capability is not available on a nongraphics terminal.

5. DATA BASES

NETWORK uses several large data bases to store all of the data values necessary to calculate coverage for the broadcast network. Some of these have read-only access while others may be modified as the user enters changes in the network. Each file is listed below with a brief explanation of its contents. (See Appendix B for a detailed description of the file structures and data values.)

(1) STATS - The station file that contains the location and characteristics of each station in the network.

(2) STATI - The "active" station file that contains a list of those stations from STATS that have been "inserted" into the network.

FILE=STATS::NT # ENTRIES=338

NETWORK DATA SUMMARY

#	LOC	ID	FREQ CODE	LATITUDE D	M	S	LONGITUDE D	M	S	POWER WATTS	HT FT	ELEV FEET	AZ DEG	GAIN DBI	LOSS DB
1	ALHUNTS	KIH20	1	34	44	16	86	32	2	250.0	200	1623	90	14.0	2.5
2	ALMOBIL	KEC61	7	30	36	22	88	11	28	330.0	70	500	-1	8.0	1.5
3	ALBRMNG	KIH54	7	33	29	22	86	47	58	1000.0	550	821	-1	11.0	5.0
4	ALANSTN	KIH58	4	33	29	7	85	48	33	100.0	215	2405	-1	11.0	3.0
5	ALDOZIR	KIH59	6	31	33	16	86	23	32	800.0	500	481	-1	11.0	5.0
6	ALFLRNC	KIH57	3	34	35	40	87	46	54	800.0	490	938	-1	11.0	5.0
7	ALLOUVL	KIH56	4	31	43	5	85	26	3	450.0	500	605	-1	11.0	5.0
8	ALMNTGM	KIH55	2	32	22	52	86	17	30	1000.0	200	260	-1	11.0	3.0
9	ALTUSCL	KIH60	1	33	12	33	87	32	57	1000.0	200	215	-1	11.0	3.0
10	AZPHNIX	KEC94	7	33	19	57	112	3	58	300.0	100	2779	45	9.0	2.0
11	ARFTSMT	WXJ50	1	35	17	40	94	18	25	1000.0	190	500	90	12.0	4.0
12	ARTXRNA	WXJ49	7	33	26	56	94	4	4	500.0	300	420	40	12.0	3.0
13	ARGURDN	WXJ48	4	33	54	26	93	6	46	1000.0	500	240	360	12.0	4.0
14	ARLTLRK	WXJ55	7	34	47	58	92	30	1	300.0	150	1030	-1	11.0	1.5
15	ARSTROY	WXJ54	1	33	57	13	91	52	42	500.0	180	401	230	12.0	2.0
16	COCLSPR	222	4	38	49	12	104	49	24	100.0	80	6000	-1	8.0	1.0
17	ARJNSBR	WXJ51	7	35	54	14	90	46	14	500.0	500	380	150	12.0	4.0
18	AZTUCSN	WXL30	1	32	26	25	110	47	13	100.0	20	9150	210	11.0	1.5
19	CACOCHL	KIG78	1	33	39	15	115	59	20	100.0	15	1700	270	11.0	1.0
20	CAEURKA	KEC82	1	40	25	3	124	7	9	330.0	70	3184	-1	11.0	1.5

MENU(SUMMARY) ?

Figure 3. Example list of station characteristics from SUMMARY command.

ID	LOCATION	FREQ
1	ALHUNTS	1
2	ALMOBIL	7
3	ALBRMNG	7
4	ALANSTN	4
5	ALDOZIR	7
6	ALFLRNC	4
7	ALLOUVL	4
8	ALMNTGM	1
9	ALTUSCL	1
39	FLPANMA	7
40	FLPNSCL	1
41	FLTALHS	1
49	GAALBNY	7
92	MSAKRMN	4
93	MSBONVL	7
100	MSMERDN	7
221	GACLMBS	1
300	ALDMPLS	4

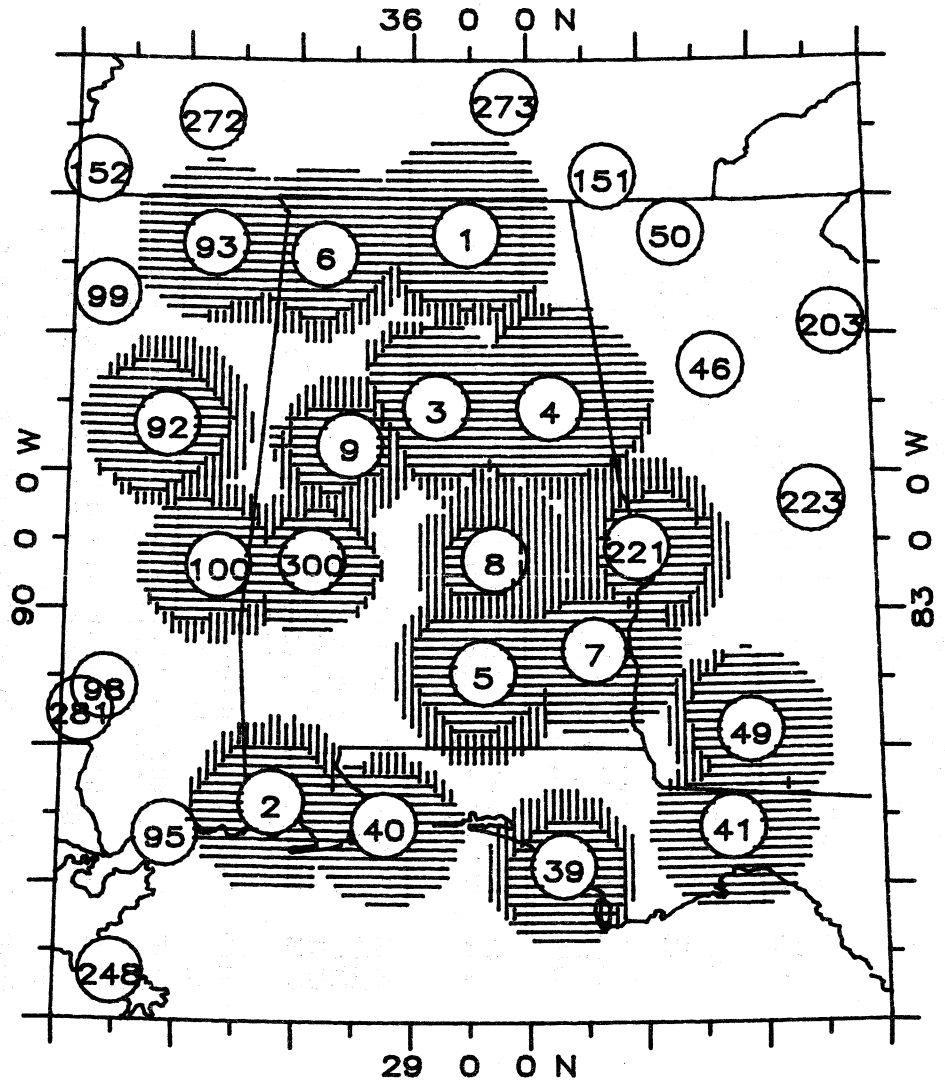

Figure 4. Plot (code 13) showing coverage (horizontal shade) and co-channel interference (vertical shade) for Alabama.

ID	LOCATION	FREQ
1	ALHUNTS	1
2	ALMOBIL	7
3	ALBRMNG	7
4	ALANSTN	4
5	ALDOZIR	7
6	ALFLRNC	4
7	ALLOUVL	4
8	ALMNTGM	1
9	ALTUSCL	1
39	FLPANMA	7
40	FLPNSCL	1
41	FLTALHS	1
49	GAALBNY	7
92	MSAKRMN	4
93	MSBONVL	7
100	MSMERDN	7
221	GACLMBS	1
300	ALDMPLS	4

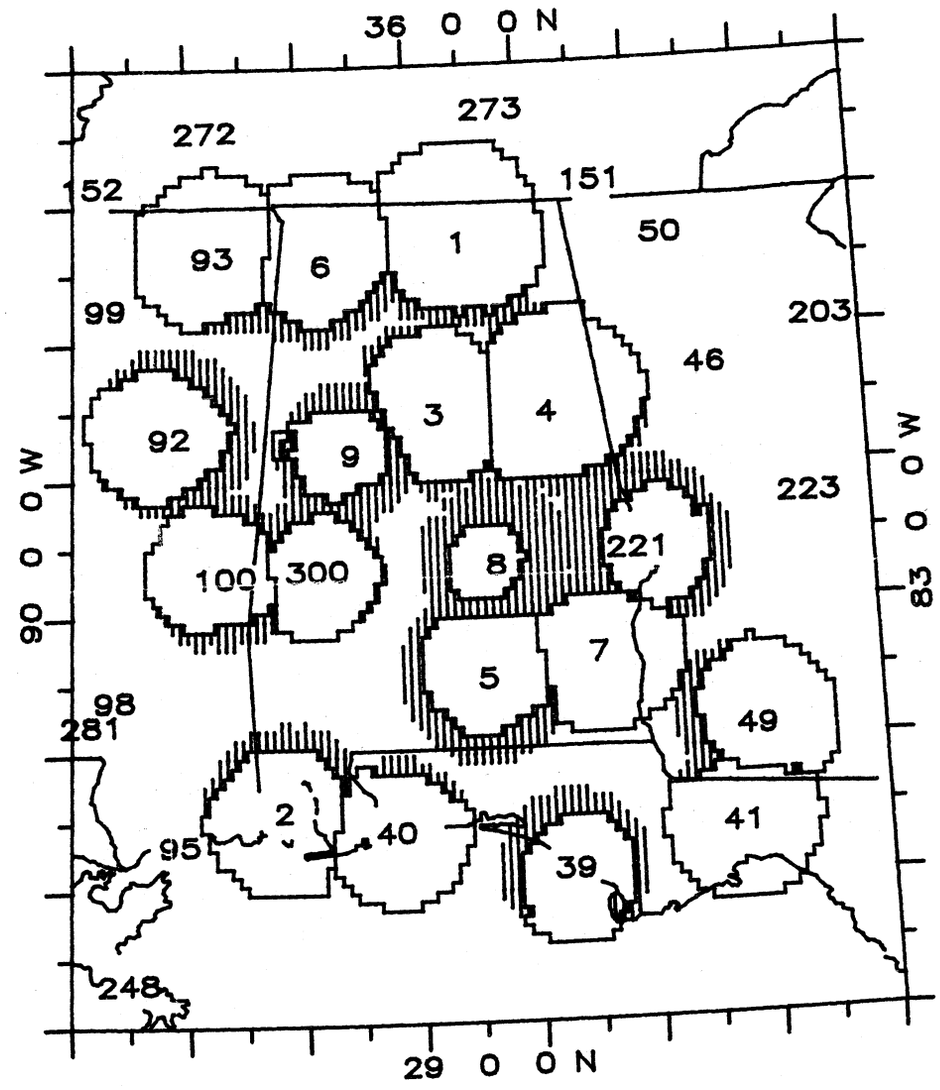

Figure 5. Plot (code 15) showing coverage (polygons) and co-channel interference (vertical shade) for Alabama.

ID	LOCATION	FREQ
1	ALHUNTS	1
2	ALMOBIL	7
3	ALBRMNG	7
4	ALANSTN	4
5	ALDOZIR	7
6	ALFLRNC	4
7	ALLOUVL	4
8	ALMNTGM	1
9	ALTUSCL	1
39	FLPANMA	7
40	FLPNSCL	1
41	FLTALHS	1
49	GAALBNY	7
92	MSAKRMN	4
93	MSBONVL	7
100	MSMERDN	7
221	GACLMBS	1
300	ALDMPLS	4

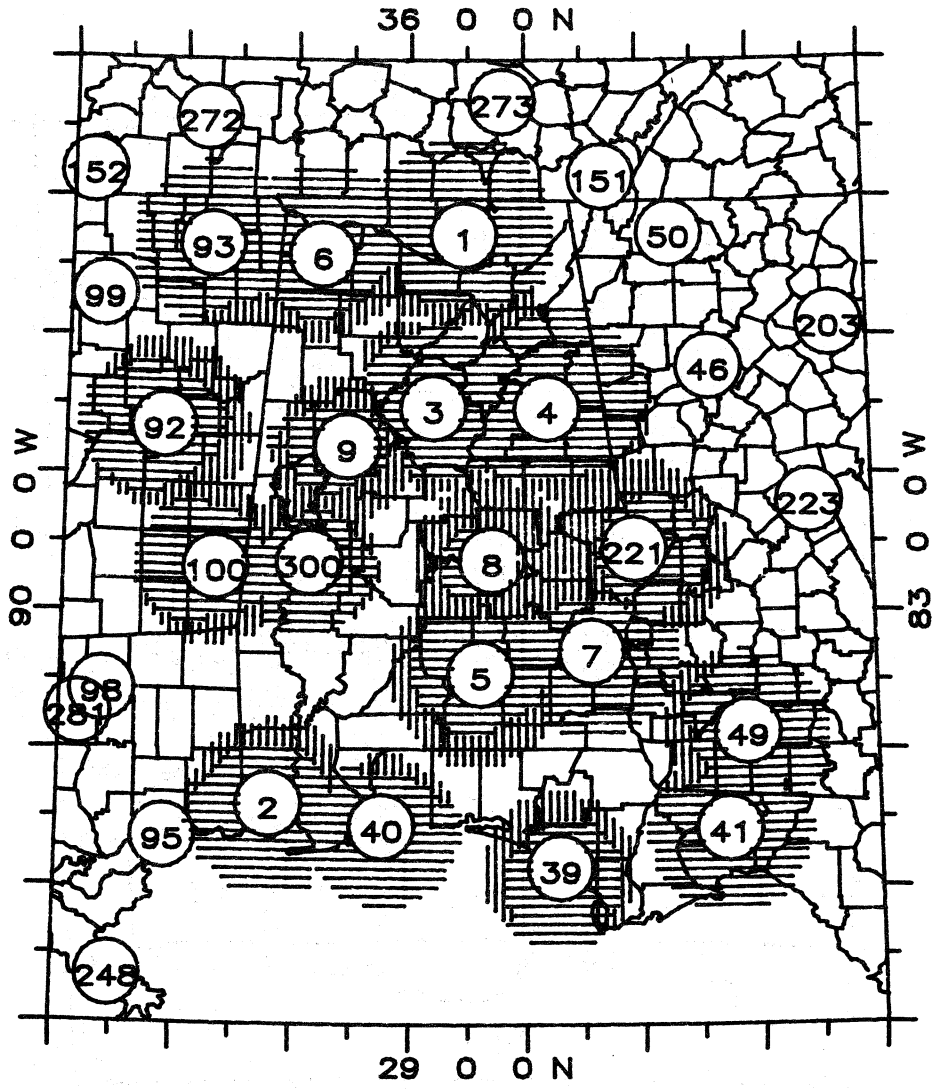

Figure 6. Plot (code 23) showing coverage and co-channel interference with county boundaries.

ID	LOCATION	FREQ
1	ALHUNTS	1
8	ALMNTGM	1
9	ALTUSCL	1
40	FLPNSCL	1
41	FLTALHS	1
221	GACLMBS	1

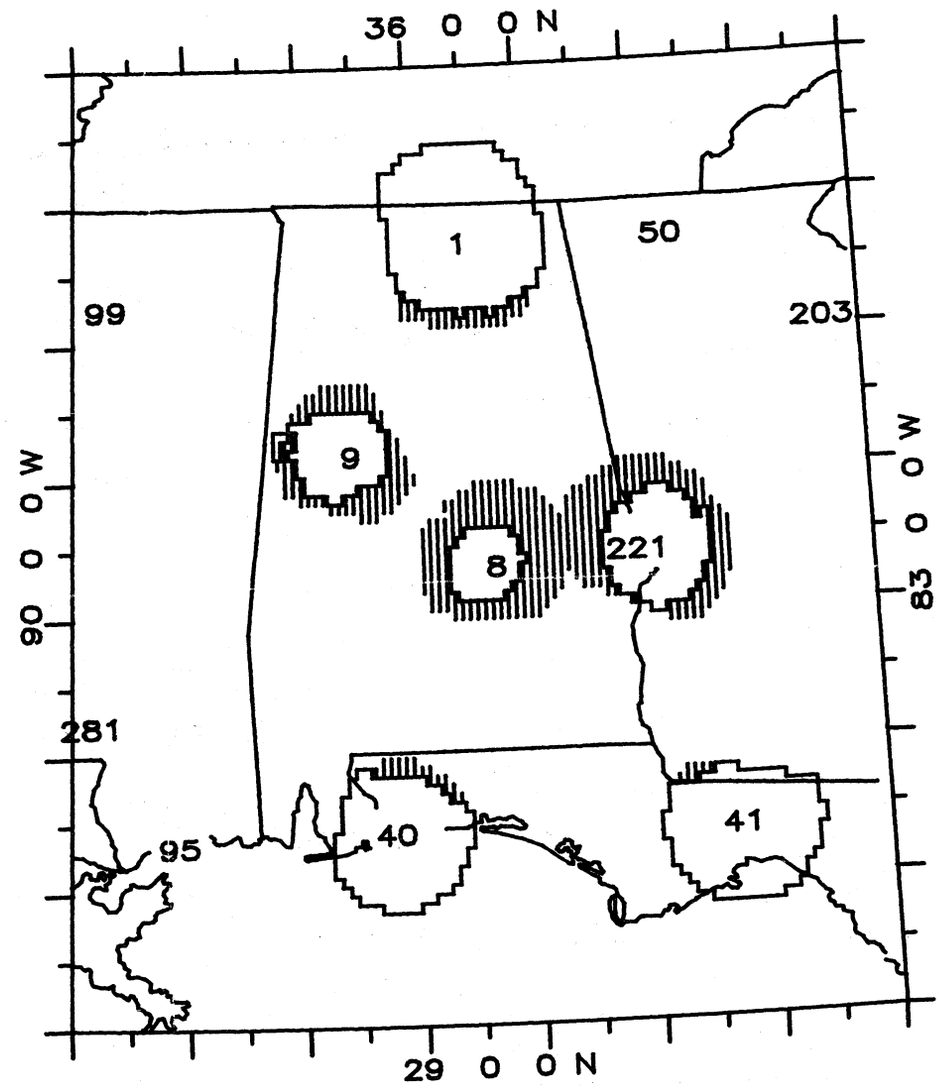

Figure 7. Plot of coverage and interference for frequence code 1.

ID	LOCATION	FREQ
4	ALANSTN	4
6	ALFLRNC	4
7	ALLOUVL	4
92	MSAKRMN	4
300	ALOMPLS	4

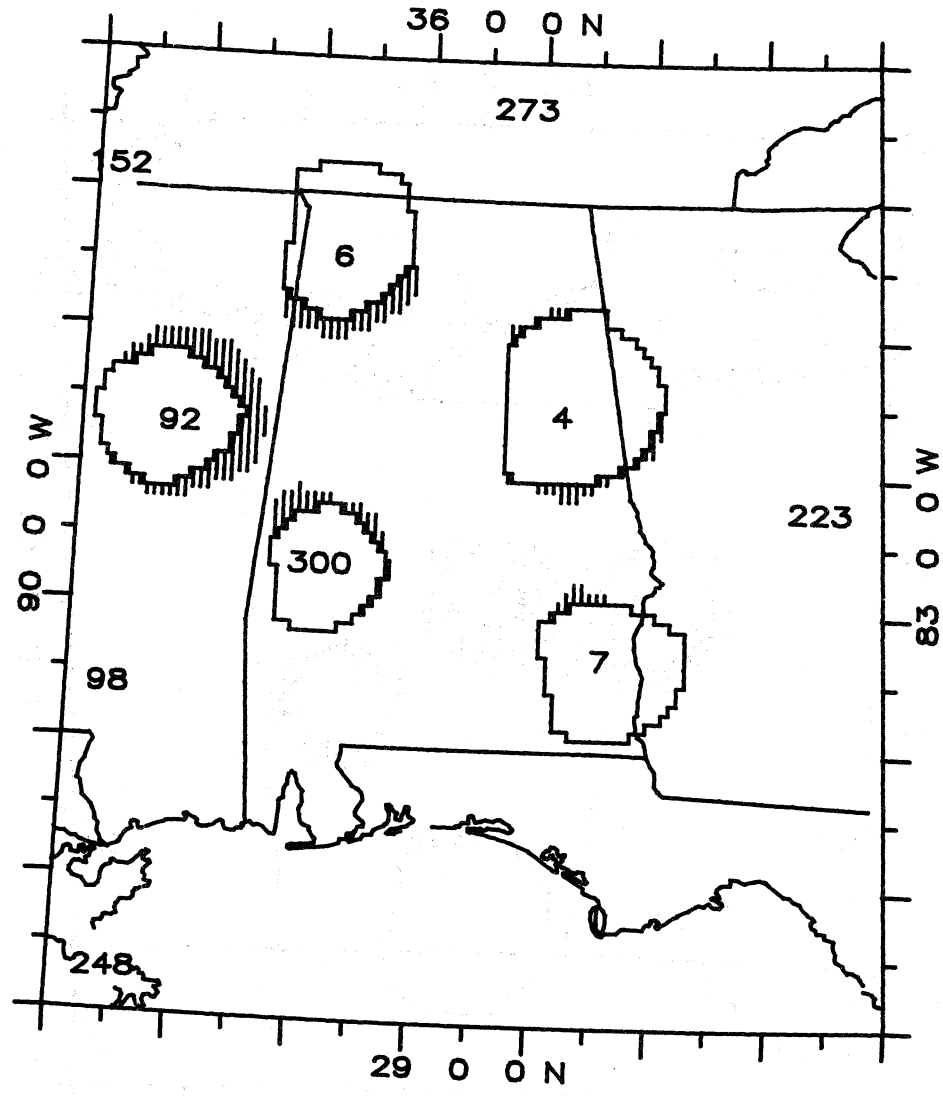

Figure 8. Plot of coverage and interference for frequence code 4.

ID	LOCATION	FREQ
2	ALMOBIL	7
3	ALBRMNG	7
5	ALDOZIR	7
39	FLPANMA	7
49	GAALBNY	7
93	MSBONVL	7
100	MSMERDN	7

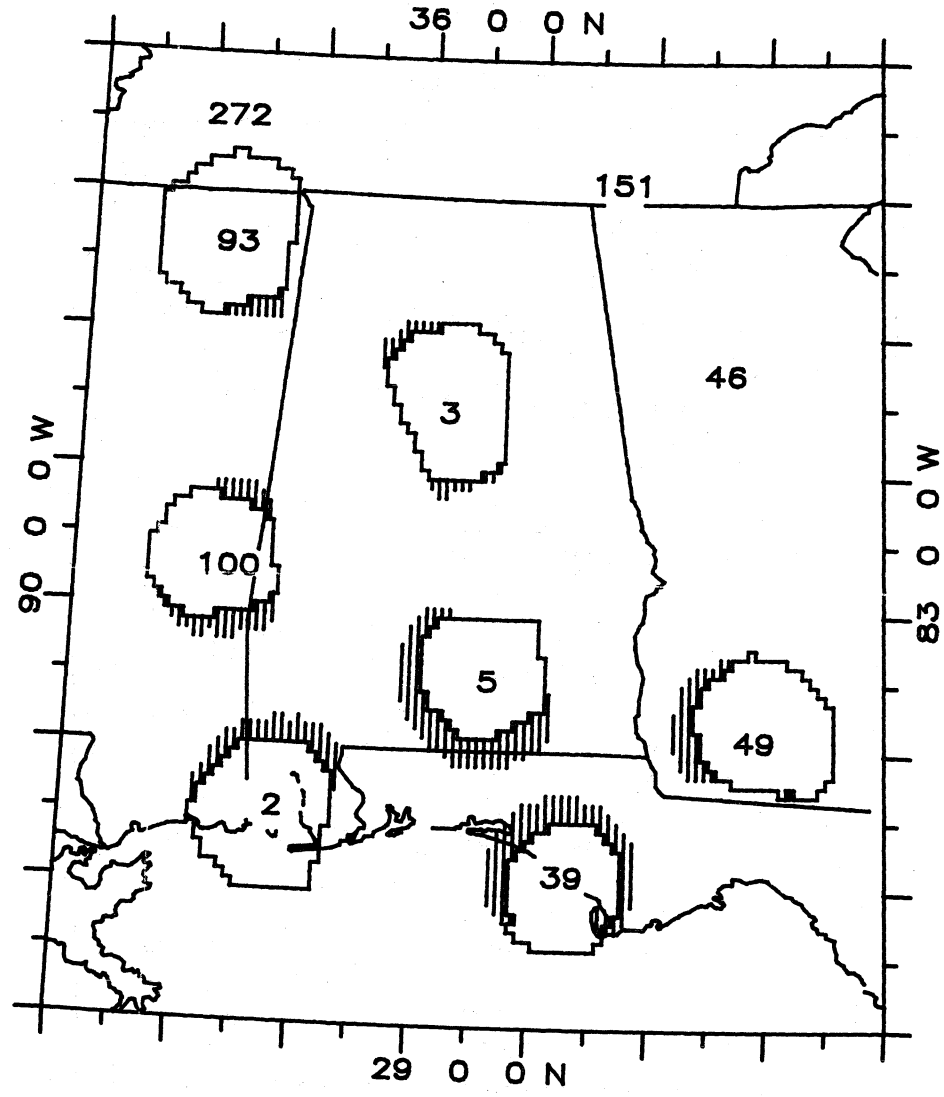

Figure 9. Plot of coverage and interference for frequence code 7.

ID	LOCATION	FREQ
1	ALHUNTS	1
2	ALMOBIL	7
3	ALBRMNG	7
4	ALANSTN	4
5	ALDOZIR	8
6	ALFLRNC	4
7	ALLOUVL	4
8	ALMNTGM	2
9	ALTUSCL	1
39	FLPANMA	2
40	FLPNSCL	1
41	FLTALHS	1
49	GAALBNY	7
92	MSAKRMN	3
93	MSBONVL	7
100	MSMERDN	7
221	GACLMBS	1
300	ALDMPLS	4

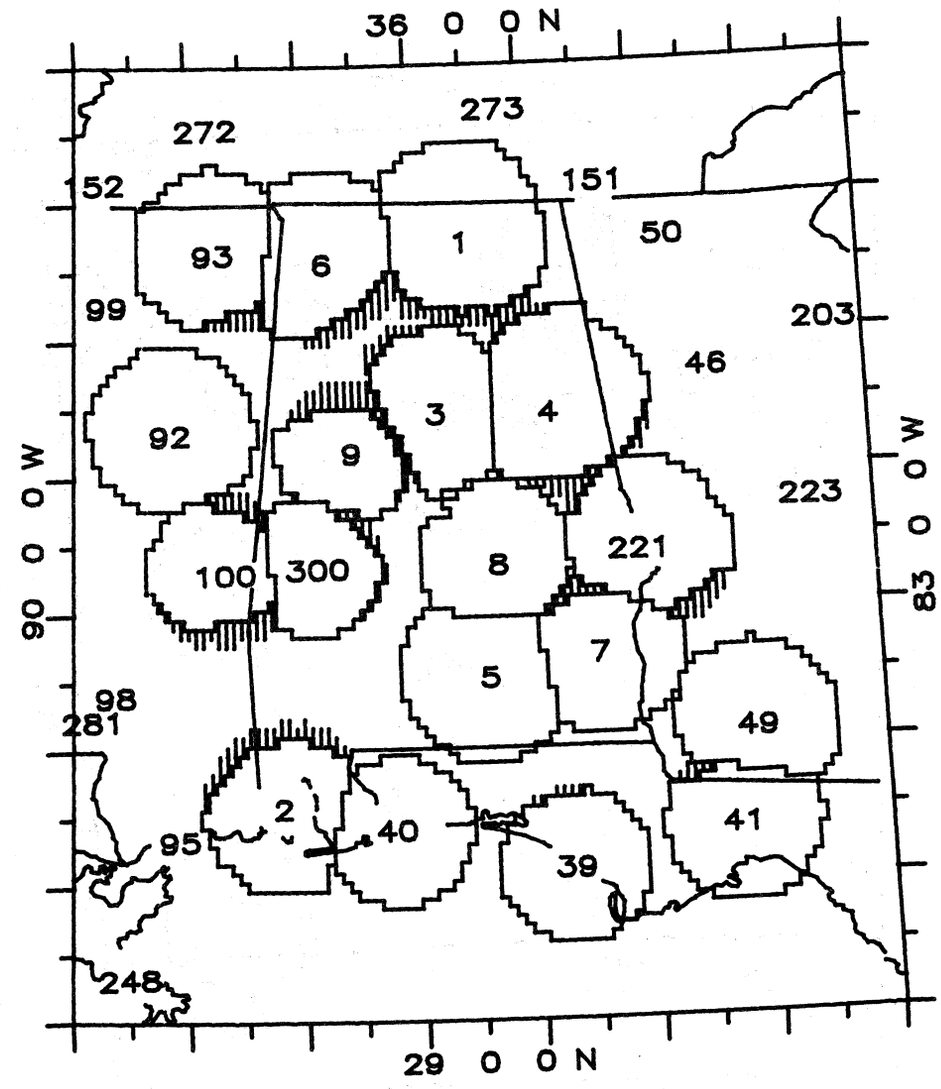

Figure 10. Plot of coverage and interference after altering frequency codes for stations #5, #8, #39 and #92 to reduce co-channel interference.

(3) STATD - The display file that contains a coverage code for each grid point: 0=not served by desired station
1=served by desired station
2=co-channel interference present.

(4) STATG1 - The grid index file that contains pointers as to where to find the grid coverage information in STATG2.

(5) STATG2 - The grid file that contains desired and undesired field intensity values at each grid point from every station within 200 km of that grid point. This information is used to determine whether the grid point has service or interference.

(6) HBARD - This contains the average elevation of each 4-minute square block comprising the display grid (read-access only). Provides a more responsive average elevation than PROPAR.

(7) PROPVM - This contains the propagation parameters terrain irregularity (delta H) and surface refractivity (N-sub-S) used by the ITM for points equally spaced every 30 minutes across the contiguous United States (read-only access).

(8) POLYMP - This contains the coordinate chains that are used to plot state and county boundaries for the contiguous United States (read-only access).

(9) STATES - This contains the coordinate chains that are used to plot only state boundaries for the contiguous United States read-only access). Used instead of POLYMP for state only plots for increased speed.

(10) NTHELP - This contains brief help information on how to run NETWORK.

(11) NTNEWS - This contains latest news about any revisions to NETWORK.

(12) H.xxxx - These files contain HELP information on how to run each NETWORK command. (xxxx = ADD, CONCise, DELEte, EDIT, HELP, NEWS, PLOT, QUIT, SUMMary, UPDAte, VERBose.)

6. HOW TO USE NETWORK

This chapter describes the use of NETWORK on the ITS HP-1000 computer system.

NETWORK consists of three main sections: editing the station data, updating the coverage data, and plotting service and interference areas for a specified portion of the network.

Initially, the user must enter the location and characteristics of each station into the data base (STATS). The coverage calculations are then performed for all grid points affected by this station. The

user may then use the PLOT command to display the coverage resulting from these stations. To see what coverage changes occur if stations are added, deleted, or have their location or characteristics revised, the EDIT command is used to modify the station parameters and then the PLOT command is used to display the resulting coverage.

The following syntax conventions are used in this section:

[CR] - means pressing only the carriage return in response to a question. This will choose the default response.

xxxx - underlined text identifies the user responses in the examples given.

? - responding to any question with ? will produce more detailed information about the question.

All responses must be in UPPER case letters.

After logging on to the computer system, the user must enter the command NETW to execute the NETWORK model. All necessary data files are attached and control is given to the model.

The initial display will be as follows:

```
You are executing  NETWORK.

To properly control INPUT/OUTPUT, you must specify your
output device from the list below:

 GRAPHIC WORK STATIONS AVAILABLE:
    1=TK4012           (Tektronix 4012)
    2=HP2648
    3=HP2623
    4=HP9872           (Pen plotter)
    5=TTY              (Any nongraphic terminal)
 TERMINAL TYPE = 1                          (User selects Tektronix 4012)
 Terminal BAUD rate ([CR]=4800) = 1200      (User specifies 1200 baud)
                                            (Baud rate is necessary to
                                             control Tektronix terminals.)

 (If graphics terminal, screen will erase at this point.)
```

```
          INSTITUTE FOR TELECOMMUNICATION SCIENCES
                NETWORK VERSION 2.0  8/12/83
             THU 25 AUG 1983  15:27:49

NETWORK MENU OPTIONS:
     A=ADD STATIONS
     E=EDIT DATA
     D=DELETE DATA
     S=SUMMARY OF DATA
     P=PLOT STATION COVERAGE
     U=UPDATE STATION INTO COVERAGE DATA BASE
     C=CONCISE DIALOG
     V=VERBOSE DIALOG
     H=HELP
     N=NEWS
     Q=QUIT

MENU(NEWS     ) ?
```

The prompt "MENU(xxxxxx) ?" requires that the user enter one of the menu options. A carriage return will process the function "xxxxxx", which is usually the last function requested. Only the first character is important.

6.1 ADD

To add a new station to the data base (STATS), the user types ADD or A. NETWORK will respond with the following questions:

```
ENTER INPUT DATA
(IF CARRIAGE RETURN IS TYPED THEN DATA SHOWN IN PARENS WILL BE INPUT)


ENTER STATION NAME (UP TO 7 CHARACTERS)
 1) STATION NAME (COTEST ) ? COBOLDR        (First 2 characters SHOULD
                                             be the state abbreviation.
                                             Duplicate station names are
                                             not allowed.)

ENTER STATION CALL SIGN (UP TO 5 CHARACTERS)
 2) CALL SIGN (KCALL) ? KTEST               (Duplicate call signs are
                                             not allowed.)

SYSTEM FREQUENCY CODE TABLE
            1= 162.400 MHz
            2= 162.425 MHz
            3= 162.450 MHz
            4= 162.475 MHz
            5= 162.500 MHz
            6= 162.525 MHz
            7= 162.550 MHz
```

```
 3) FREQ(  1) ? 2                          (User selects 162.425 MHz.)

ENTER STATION LATITUDE AND LONGITUDE
   LIMITS ARE-     24 <= LAT <=   50 DEG N
                   66 <= LON <=  125 DEG W
   INPUTS OF THE FORM X,Y,Z IMPLY DEGREES, MINUTES, AND SECONDS
   INPUTS OF THE FORM X.Y IMPLY DECIMAL DEGREES
 4) STATION LAT( 35.0000 DEG or  35, 0, 0 DMS)? 40,7,30
 4) STATION LON( 70.2000 DEG or  70,12, 0 DMS)? 105,15

XMTR POWER OUT OF THE FINAL AMPLIFIER(    1.0 TO   1000.0 W )
 5) XMTR PW(  1000.0 W ) ? [CR]           ([CR] selects default 1000 Watts)

XMTR ANTENNA HEIGHT ABOVE GROUND (  1.6 TO 9842.5 FT)
 6) XMTR HT(   50.0 FT)? 100               (100 feet selected.
                                            100M would select 100 meters)

ENTER XMTR ANTENNA ELEVATION OPTION
  U = USER-SUPPLIED
  D = DATA BASE (TOPO FILES BASED ON LAT/LON)
 7) ELEVATION OPTION (USER-SUPPLIED)? [CR]
ENTER XMTR ANTENNA BASE ELEVATION ABOVE MEAN
SEA LEVEL ELEVATION (BETWEEN -285. AND 14500. FT)
XMTR ELEVATION ( 5460. FT) ? 5400

ENTER DIRECTIONAL ANTENNA MAIN BEAM AZIMUTH
        -1 = OMNI-DIRECTIONAL ANTENNA
   0 TO 360 = ANTENNA'S MAIN BEAM AZIMUTH CLOCKWISE
              FROM TRUE NORTH DEG
 8) ANTENNA AZIMUTH (   -1 DEG) ? 90       (east)

ENTER ANTENNA POWER GAIN (BETWEEN 0 AND 22 DBI)
 9) ANTENNA POWER GAIN (10.0 DBI) ? 11


ENTER LINE LOSSES FROM TRANSMITTER OUTPUT TO
  ANTENNA INPUT (BETWEEN 0 AND 10 DB)
10) LINE LOSSES ( 2.0 DB) ? 1.5

                                  (Data will be summarized for this new
                                   station and allow you to save or reject
                                   it. If saved, you are then allowed to
                                   UPDATE the coverage into the network.)

   NETWORK DATA SUMMARY

   # LOC      ID    FREQ LATITUDE LONGITUDE POWER  HT   ELEV  AZ GAIN LOSS
                    CODE  D  M  S   D  M  S WATTS FEET  FEET DEG  DBI  DB
 339 COBOLDR KTEST  2   40  7 30 105 15  0  1000  100  5400  90 11.0  1.5
SAVE DATA (Y or N)? Y              (Save new station.)
                                   (Y means station is ADDed to the STATS
                                    data base. UPDATE question will be asked.
                                    N would not ADD this station and would
                                    return control back to the main menu.)
```

```
Do you want to UPDATE NETWORK with this station (Y or N) ? Y
                                (Y will perform coverage calculations.
                                 This will process the UPDATE command
                                 for the station just ADDed.
                                 N will skip calculations. Coverage
                                 will then not reflect latest station
                                 parameters. UPDATE command may be run
                                 at a later time.)
```

6.2 EDIT

EDIT allows the user to change any of the station parameters in the NETWORK data base and to calculate the resulting coverage. The station to be EDITed may be identified by either the LOCATION or ID field or by its index number. Below is a sample of the EDIT command:

```
     (The screen will erase)
ENTER STATION NAME, CALL SIGN, OR #NNN OF STATION TO EDIT
      (CR=IGNORE) ? #10            (wish to edit station #10)

   FILE=STATS::NT      # ENTRIES=338     (Total entries in data base)

   NETWORK DATA SUMMARY

   # LOC      ID    FREQ LATITUDE LONGITUDE POWER  HT    ELEV  AZ GAIN LOSS
                    CODE  D  M  S   D  M  S WATTS FEET  FEET DEG  DBI  DB
  10 AZPHNIX KEC94   7   33 19 57 112  3 58   300  100  2779  45  9.0  2.0

ITEM NUMBER ? ?                  (?=give more information)

ENTER THE NUMBER OF THE ITEM TO BE CHANGED.
ENTER A CARRIAGE RETURN WHEN FINISHED.
      1 = LOCATION
      2 = CALL SIGN
      3 = FREQUENCY INDEX
      4 = LAT/LONG
      5 = TRANSMITTER POWER
      6 = ANTENNA HEIGHT
      7 = ELEVATION
      8 = AZIMUTH
      9 = GAIN
     10 = LINE LOSSES

ITEM NUMBER ? 3                  (EDIT frequency index)
 3) FREQ(  7) ? 2                (Change frequency code from 7 to 2)
                                 (This assumes CONCISE mode, VERBOSE mode
                                  will display more information)

ITEM NUMBER ? [CR]               (Carriage return only to end EDIT)
                                 (Will summarize data for this station
                                  and allow you to save or reject the
                                  changes made. If changes are saved, you
```

```
                                    are then allowed to perform coverage
                                    calculations.)

   NETWORK DATA SUMMARY

   # LOC      ID    FREQ LATITUDE LONGITUDE POWER  HT   ELEV  AZ GAIN LOSS
                    CODE  D  M  S   D  M  S WATTS FEET  FEET DEG  DBI  DB
  10 AZPHNIX KEC94   2   33 19 57 112  3 58   300  100  2779  45  9.0  2.0
SAVE DATA (Y or N)? Y               (Save changes made)
                                    (Y means station parameters on STATS
                                     data base are replaced with most
                                     recently defined values.)
                                    (N would mean ignore changes made to
                                     this station being EDITed.)
Do you want to UPDATE NETWORK with this station (Y or N) ? Y
                                    (Y will perform coverage calculations.
                                     This will process the UPDATE command
                                     for the station just EDITed.
                                     N will skip calculations. Coverage
                                     will then not reflect latest station
                                     parameters. UPDATE command may be run
                                     at a later time.)
```

6.3 DELETE

Existing stations may be deleted from the data base with this command. As with EDIT, stations are identified by either STATION NAME, CALL SIGN, or index number. DELETE also removes any reference to the station in the coverage display and grid files. To temporarily remove a station, use EDIT and set POWER=0 or use UPDATE and REMOVE station.

```
     (Screen will erase)
Enter STATION NAME, CALL SIGN, or #nnn of STATION to DELETE
      (CR=ignore) ? AZPHNIX

   NETWORK DATA SUMMARY

    # LOC      ID    FREQ LATITUDE LONGITUDE POWER  HT   ELEV  AZ GAIN LOSS
                     CODE  D  M  S   D  M  S WATTS FEET  FEET DEG  DBI  DB
   10 AZPHNIX KEC94   7   33 19 57 112  3 58   300  100  2779  45  9.0  2.0

Do you want to DELETE the above station (Y or N) ? N
                                          (Y or N is required)
     DELETE ignored.                      (In this example, the station
                                           was not deleted).
```

6.4 SUMMARY

The SUMMARY command will list the current parameters for stations on the user's terminal. Options allow SUMMARY by state code or specified index numbers.

```
SUMMARY COMMAND OPTIONS:
  1 = by STATE                          (2 character state code)
  2 = by INDEX NUMBER RANGE             (specify lower, upper range)
  3 = by INDEX NUMBER VALUE             (specific index numbers)
? 1                                     (user selects option #1)
Input 2 character STATE code = CO       (user selects COlorado)
```

NETWORK DATA SUMMARY

#	LOC	ID	FREQ CODE	LATITUDE D	M	S	LONGITUDE D	M	S	POWER WATTS	HT FEET	ELEV FEET	AZ DEG	GAIN DBI	LOSS DB
16	COCLSPR	222	4	38	49	12	104	49	24	100	80	6000	-1	8.0	1.0
30	CODENVR	103	7	39	41	30	104	56	9	200	140	5450	180	8.0	1.5
307	COREIRD	310	1	40	36	3	103	1	55	300	300	4400	-1	8.0	2.5
308	COPUBLO	221	1	38	16	32	104	35	55	100	160	4750	270	8.0	2.0
*309	COGMESA	410	7	39	5	2	108	13	12	300	165	10000	-1	8.0	2.0
#310	COPOOLT	513	4	37	43	46	106	55	17	100	180	10872	155	11.0	1.5
311	COMEAD	308	7	40	14	24	105	3	19	100	120	5310	300	9.0	1.5
312	COROCKS	309	1	40	29	7	104	21	3	100	130	4975	270	8.0	1.5

↑
↑<<<< ← <<<<<< * = Station has never been UPDATEd into coverage. Station was ADDed but user bypassed coverage calculations.

= Station latitude/longitude or frequency not same in coverage data base. This means that the coverage calculations do not reflect the latest station parameters. User bypassed coverage calculations after EDITing the station parameters.

6.5 PLOT

The PLOT command allows the coverage and co-channel interference calculated by UPDATE to be displayed for a specified geographic area. All stations or only those with a desired frequency may be plotted. The plots may be superimposed on state or county borders. Any computer graphics terminal supported by the ITS HP-1000 system may be used to display NETWORK PLOT results.

Executing the PLOT command produces the following:

(Screen will erase and PLOT options will be displayed)

```
PLOT CODE DESCRIPTION
 0=STOP
   No geographic map
 1=SHADE COVERAGE
 2=SHADE INTERFERENCE
 3=SHADE BOTH
 4=POLYGON COVERAGE, SHADE INTERFERENCE
   State borders
```

```
10=STATION LOCATIONS ONLY
11=SHADE COVERAGE
12=SHADE INTERFERENCE
13=SHADE BOTH
14=POLYGON COVERAGE
15=POLYGON COVERAGE, SHADE INTERFERENCE
   State & county borders
20=STATION LOCATIONS ONLY
21=SHADE COVERAGE
22=SHADE INTERFERENCE
23=SHADE BOTH
24=POLYGON COVERAGE
25=POLYGON COVERAGE, SHADE INTERFERENCE

PLOT CODE (15) ? 25                    (State & county borders)
Which FREQUENCY [CR=all] ? [CR]        (Plot all frequencies)
VIEW WINDOW COORDINATES
WEST LONG( 90.0000 DEG)
        ( 90, 0, 0 DMS) ? 109,15       (For State of Colorado)
EAST LONG( 83.0000 DEG)
        ( 83, 0, 0 DMS) ? 101,45
SOUTH LAT( 29.0000 DEG)
        ( 29, 0, 0 DMS) ? 36,45
NORTH LAT( 36.0000 DEG)
        ( 36, 0, 0 DMS) ? 41,15

Screen will erase and plot will begin.
After plot is displayed, control will return to:

    PLOT CODE (__) ?

to allow you to make another plot.
```

6.6 UPDATE

The UPDATE command will insert/remove a specified station number into/from the coverage data base. UPDATE is usually run by the ADD or EDIT commands unless the user overrides it. This may be desired if many stations are being ADDed or EDITed. Then UPDATE can be run to perform the coverage calculations using the "-n" option described below.

Because a single station may affect about 2800 grid points, UPDATE requires about 2 to 5 minutes to calculate the coverage per station (varies with computer load). Further information concerning footnotes (a), (b), and (c) below is found in the DISCUSSION at the end of the UPDATE documentation.

Typical UPDATE sequence:

```
MENU(EDIT   ) ? UPDATE                 (select UPDATE command)
      (Screen will erase)
```

```
                NETWORK UPDATE PROGRAM

Input ID# from STATS data base (-n=MULTI, 0=END) = ?       (a)

NETWORK UPDATE PROGRAM VALID INPUT VALUES:
 0 = End UPDATE program, return to menu control.
-n = Allow user to input "n" stations to UPDATE.
     This allows multiple stations to run without further
     user input required.

Input ID# from STATS data base (-n=MULTI, 0=END) = 310     (b)

   NETWORK DATA SUMMARY

   # LOC      ID   FREQ LATITUDE LONGITUDE POWER  HT   ELEV  AZ GAIN LOSS
                   CODE  D  M  S   D  M  S WATTS FEET  FEET DEG  DBI  DB
 310 COPOOLT 513    4  37 43 46 106 55 17   100  180 10872 155 11.0  1.5

Exists and has not been moved. CHANGE may be used.
Operation code:
   -1=Ignore
    0=Remove
    2=Change (station values changed)
  CODE = 2
 CHANGE STATION   310 AT LAT,LON   37.72944 -106.92139
 PROCESSING GRID POINTS ... PLEASE STAND BY
 Processing BLOCK# 1 of 25
 Processing BLOCK# 2 of 25
   .      .
   .      .
 Processing BLOCK#25 of 25
   2889 GRID POINTS PROCESSED
  30198 GRID POINTS OCCUPIED OF   32000 ALLOWED.

Input ID# from STATS data base (-n=MULTI, 0=END) = 0       (c)
 # GRID CELLS OCCUPIED =  30198  MAX ALLOWED =  32000
UPDATE  complete. Select NETWORK menu option.
```

DISCUSSION:

a.) The "?" requests UPDATE to display more information about this question. The useful point here is the "-n" option. If you have 10 stations to UPDATE, the 2 to 5 minutes required for each station is too long to be interactive and too short to allow you to do something else. By telling UPDATE all the stations at the beginning, you could leave the terminal and return when the UPDATE is finished.

b.) Specifying a valid ID number (310 in this example) causes UPDATE to display a summary of the station's parameters and determine if it is already on the active list. You must then select one of the operation codes:

-1=Ignore	(Specify another ID#)
0=Remove	(Deactivate this station)
	(Required if Lat/Lon changed)
1=Insert	(New station into active list)
	(Not allowed if already active)
2=Change	(Already active, parameters changed)
	(Not allowed if not active)

Since the calculation process for one station may take about 2 to 5 minutes, information is displayed to keep you occupied. Each block number displayed contains 225 grid points. Generally there are 25-30 blocks within the 200 km radius used for coverage in NETWORK. When processing is completed, the number of grid points affected by this station (2889 in this case) is displayed.

c.) ID# = 0 terminates the UPDATE program and returns control back to the NETWORK menu selection. Upon exit, the current number of grid cells occupied is displayed.

6.7 CONCISE

The CONCISE command allows the more familiar user to input data without the more complete VERBOSE questions being asked. In the CONCISE mode, the user can still get the VERBOSE questions when needed by answering with a "?".

6.8 VERBOSE

The VERBOSE command will always display the most verbose questions for any input data. As the user becomes more familiar with NETWORK, the CONCISE command can be used to turn this off.

6.9 HELP

The HELP command will display a text file designed to assist the new user in using NETWORK.

HELP xxxx

Will display the help file for the command "xxxx".

e.g. HELP HELP displays this documentation.

HELP ADD will display information on how to use the ADD command.

HELP will display a general help file on using NETWORK.

6.10 NEWS

The NEWS command will display the latest NEWS file (NTNEWS) which contains information concerning changes made in the current version of NETWORK.

6.11 QUIT

The QUIT command is the proper way to exit from the NETWORK program. All opened data files are closed and control is returned to the File Management Program (FMGR) or TA SERVICE.

7. SAMPLE USE OF NETWORK

NETWORK can be used to analyze coverage and co-channel interference problems in a particular area of the existing network. To illustrate how this is done, we have chosen to look at the existing service in the Gulf Coast States centered around Alabama, from 29 to 36 degrees North and 90 to 83 degrees West. A plot of the service and co-channel interference for NOAA Weather Radio stations currently operating in this area is shown in Figure 5. As can be seen in this figure, large areas of interference are present, but it is difficult to determine which stations are causing the co-channel interference. Figures 7-9 show the same information but each plot is for a specific frequency code. From Figure 7 it is quite obvious that station #8 is causing the majority of the co-channel interference problems by being too close to stations #9 and #221 at the same transmission frequency. A simple solution would be to use the EDIT command and change the frequency code of station #8 from 1 to 2. Similarly, based on Figures 8 and 9, we will change the frequency code

of #92 (4 to 3), #5 (7 to 6), and #39 (7 to 2). Using the UPDATE command, we can then recalculate the coverage for stations #5, #8, #39, and #92. Figure 10 shows the result of this procedure, with a noticeable reduction in co-channel interference.

In like fashion, any of the other station characteristics can be EDITed and the station's resulting coverage pattern may be PLOTted. Using the ADD command, new stations can be inserted into the NETWORK data base to provide coverage to vacant areas.

8. CONCLUSIONS

1. An effective tool has been developed to aid NWS in the selection of (a) antenna locations, (b) antenna types, and (c) transmitter powers to effectively meet their coverage requirements. The tool provides options that allow some limited real-time trade-off analysis of installation alternatives, and the selection of system parameters can be made effectively and quickly.
2. The tool is a sophisticated, interactive computer program using the best available techniques for statistically predicting signal strength, and is coupled with several large computer data bases to provide data for the ITM prediction model and geographical data for plotting purposes.
3. The program has been designed to be used by a broad spectrum of users. That is, it is designed with both HELP instructions and simple question-answer input or it can be used in a higher level mode to play the trade-offs against existing parameters with little effort by more sophisticated engineers.

9. RECOMMENDATIONS

1. Measurements of signal strengths should be made around existing NWS stations to obtain some confidence in the reliability between the predictions and the contractor's installations.
2. Whenever significant man-made or natural obstacles exist in an area, a more detailed engineering analysis should be made in order to best site a station. In these cases, it is more appropriate to use a more detailed system model based on actual topographic data, such as COVERAGE (Hufford, 1977) or CSPM (Paulson, et al., 1977) rather than the statistical terrain data NETWORK uses.

10. REFERENCES

Hufford, G. A., A. G. Longley, and W. A. Kissick (1982), A guide to the use of the ITS irregular terrain model in the area prediction mode, NTIA Report 82-100 (NTIS Access. No. PB 82-217977).

Longley, A. G. (1976), Location variability of transmission loss--land mobile and broadcast systems, OT Report 76-87 (NTIS Access. No. PB 254-472).

Longley, A. G., and P. L. Rice (1968), Prediction of tropospheric radio transmission loss over irregular terrain, a computer method - 1968, ESSA Tech. Report ERL-79 ITS-67 (NTIS Access. No. AD 676-874).

Rice, P. L., A.G. Longley, K. A. Norton, and A. P. Barsis (1967), Transmission loss predictions for tropospheric communication circuits, NBS Tech. Note 101, Vols. 1 & 2, revised (NTIS Access. No. AD 687-820 and AD 687-821).

APPENDIX A. EXISTING NWS TRANSMITTER PARAMETERS

Locations of the current NWS transmitters are shown in Figure 1. The existing station parameters are listed in Table A-1. The definition of each parameter is given below:

= a unique index number by which each station can be referenced.

LOC = a unique 7-character location name of the form XXYYYYY.

XX represents the 2-character state code.

YYYYY is a 5-character abbreviation of the nearest map feature.

ID = a unique 5-character call sign assigned to the station.

FREQ CODE = a code identifying the transmission frequency of the station

1 = 162.400 MHz
2 = 162.425 MHz
3 = 162.450 MHz
4 = 162.475 MHz
5 = 162.500 MHz
6 = 162.525 MHz
7 = 162.550 MHz.

LATITUDE = latitude of the station (nearest second).

LONGITUDE = longitude of the station (nearest second).

POWER WATTS = transmitter power out of the final amplifier in watts.

HT FT = transmitter antenna height above ground in feet.

ELEV FEET = elevation above mean sea level at antenna base in feet.

AZ DEG = directional antenna main beam azimuth.

-1 = omni-directional antenna.

0 to 360 = antenna's main beam azimuth clockwise from true north in degrees.

GAIN DBI = antenna power gain in dBi.

LOSS DB = line losses from transmitter output to antenna input.

Table A-1. Station Parameters

# LOC	ID	FREQ CODE	LATITUDE D	M	S	LONGITUDE D	M	S	POWER WATTS	HT FEET	ELEV FEET	AZ DEG	GAIN DBI	LOSS DB
1=ALHUNTS	KIH20	1	34	44	16	86	32	2	250	200	1623	90	14.0	2.5
2=ALMOBIL	KEC61	7	30	36	22	88	11	28	330	70	500	-1	8.0	1.5
3=ALBRMNG	KIH54	7	33	29	22	86	47	58	1000	550	821	-1	11.0	5.0
4=ALANSTN	KIH58	4	33	29	7	85	48	33	100	215	2405	-1	11.0	3.0
5=ALDOZIR	KIH59	7	31	33	16	86	23	32	800	500	481	-1	11.0	5.0
6=ALFLRNC	KIH57	4	34	35	40	87	46	54	800	490	938	-1	11.0	5.0
7=ALLOUVL	KIH56	4	31	43	5	85	26	3	450	500	605	-1	11.0	5.0
8=ALMNTGM	KIH55	1	32	22	52	86	17	30	1000	200	260	-1	11.0	3.0
9=ALTUSCL	KIH60	1	33	12	33	87	32	57	1000	200	215	-1	11.0	3.0
10=AZPHNIX	KEC94	7	33	19	57	112	3	58	300	100	2779	45	9.0	2.0
11=ARFTSMT	WXJ50	1	35	17	40	94	18	25	1000	190	500	90	12.0	4.0
12=ARTXRNA	WXJ49	7	33	26	56	94	4	4	500	300	420	40	12.0	3.0
13=ARGURDN	WXJ48	4	33	54	26	93	6	46	1000	500	240	360	12.0	4.0
14=ARLTLRK	WXJ55	7	34	47	58	92	30	1	300	150	1030	-1	11.0	1.5
15=ARSTROY	WXJ54	1	33	57	13	91	52	42	500	180	401	230	12.0	2.0
16=COCLSPR	222	4	38	49	12	104	49	24	100	80	6000	-1	8.0	1.0
17=ARJNSBR	WXJ51	7	35	54	14	90	46	14	500	500	380	150	12.0	4.0
18=AZTUCSN	WXL30	1	32	26	25	110	47	13	100	20	9150	210	11.0	1.5
19=CACOCHL	KIG78	1	33	39	15	115	59	20	100	15	1700	270	11.0	1.0
20=CAEURKA	KEC82	1	40	25	3	124	7	9	330	70	3184	-1	11.0	1.5
21=CALSANG	KW037	7	34	13	27	118	3	41	330	55	5739	220	11.0	1.5
22=CAMNTRY	KEC49	1	37	11	55	121	54	55	330	35	3415	135	8.0	1.5
23=CAPTRNA	KIH30	1	39	1	20	123	31	17	1000	40	2783	250	12.0	1.5
24=CASCMTO	KEC57	1	38	20	24	120	43	13	330	70	2399	315	11.0	2.0
25=CASNDGO	KEC62	1	33	1	0	116	57	0	330	25	2870	-1	8.0	1.5
26=CASNFRN	KHB49	7	37	27	2	122	20	18	500	45	2038	75	12.0	1.5
27=CASNLBP	KIH31	7	35	21	28	120	39	21	330	20	2446	220	12.0	1.5
28=CASNBRB	KIH34	1	34	31	31	119	57	29	330	40	4028	200	12.0	1.5
29=CAFRSNO	KIH62	1	36	44	45	119	16	53	100	60	3396	60	12.0	1.5
30=CODENVR	103	7	39	41	30	104	56	9	200	140	5450	180	8.0	1.5
31=CTNWLON	KHB47	7	41	26	27	72	8	29	500	85	375	-1	8.0	2.0
32=CTHRTFD	WXJ41	4	41	53	14	72	22	40	500	115	960	-1	11.0	2.0
33=CTMERDN	WXJ42	1	41	33	47	72	50	42	500	40	1024	-1	8.0	1.0
34=DELEWES	WXJ94	7	38	47	17	75	9	42	500	175	11	-1	8.0	2.5
35=FLDAYTN	KIH26	1	29	12	6	81	0	56	330	200	30	-1	11.0	1.0
36=FLJCKSN	KHB39	7	30	19	55	81	32	30	500	174	60	-1	8.0	2.5
37=MTBLNGS	WXL27	7	45	48	8	108	32	27	1000	20	3575	-1	11.0	1.0
38=FLMIAMI	KHB34	7	25	41	8	80	9	27	1000	306	5	-1	11.0	1.5
39=FLPANMA	KGG67	7	30	8	42	85	42	50	1000	200	7	-1	11.0	2.5
40=FLPNSCL	KEC86	1	30	26	36	87	14	3	330	200	233	-1	8.0	2.5
41=FLTALHS	KIH24	1	30	25	49	84	16	16	1000	300	70	-1	11.0	3.0
42=FLTAMPA	KHB32	7	27	50	26	82	15	47	1000	500	35	-1	11.0	5.0
43=FLWPALM	KEC50	1	26	43	0	80	3	0	330	200	19	-1	8.0	2.5
44=FLORLND	KIH63	4	28	33	17	81	24	42	500	350	65	-1	8.0	3.0
45=FLKYWST	WXJ95	1	24	39	39	81	32	18	1000	250	4	270	12.0	2.5
46=GAATLNT	KEC80	7	33	47	20	84	23	10	330	473	1050	-1	8.0	1.5
47=GASAVAN	KEC85	1	32	4	12	81	6	41	330	225	42	-1	8.0	1.0
48=GAAGSTA	WXK54	7	33	15	33	82	17	9	500	500	435	-1	11.0	5.0
49=GAALBNY	WXK53	7	31	8	5	84	6	16	500	500	325	-1	11.0	5.0
50=GACHATS	WXK52	1	34	45	6	84	42	54	200	150	2716	-1	11.0	2.0

Table A-1. Station Parameters (Cont.)

# LOC	ID	FREQ CODE	LATITUDE D	M	S	LONGITUDE D	M	S	POWER WATTS	HT FEET	ELEV FEET	AZ DEG	GAIN DBI	LOSS DB
51=ILCHCGO	KW039	7	41	53	0	87	38	0	500	1482	575	-1	11.0	1.5
52=ILMTVRN	WXJ77	4	38	22	14	88	55	24	1000	280	560	-1	11.0	2.5
53=ILSPRNG	WXJ75	1	39	47	36	89	36	18	1000	210	590	-1	11.0	2.0
54=ILCHMPG	WXJ76	7	40	4	11	87	54	45	1000	380	661	-1	11.0	3.7
55=ILPEORA	WXJ71	4	40	46	20	89	26	32	1000	280	800	-1	11.0	2.5
56=ILRCKFD	WXJ74	4	42	1	1	89	18	41	1000	230	838	-1	11.0	2.5
57=ILRCKIS	WXJ73	7	41	30	36	90	34	28	1000	361	570	-1	11.0	3.0
58=INEVNSU	KIG76	7	38	2	0	87	32	0	1000	72	381	-1	11.0	1.5
59=ININDPL	WXK64	7	39	46	13	86	9	20	330	514	712	-1	7.6	3.9
60=INFTWYN	WXJ58	7	41	6	31	85	9	56	1000	215	785	-1	11.0	1.5
61=INSOBND	WXJ57	1	41	36	58	86	11	32	1000	250	875	-1	11.0	2.0
62=IADESMN	KEC75	7	41	40	5	93	37	5	1000	230	910	-1	11.0	2.0
63=KSWCHTA	KEC59	7	37	45	1	97	18	12	1000	340	1340	-1	11.0	3.5
64=KYASHLN	KIH39	7	38	27	43	82	37	12	1000	360	810	-1	11.0	4.0
65=KYBWLGR	KIH45	1	37	5	22	86	38	5	1000	543	556	-1	11.0	5.0
66=KYCOVNG	KIH42	7	39	1	50	84	30	23	1000	267	820	-1	11.0	2.5
67=KYHAZRD	KIH40	4	37	11	34	83	11	16	1000	530	2025	-1	11.0	5.0
68=KYLXNTN	KIH41	1	37	52	45	84	19	33	1000	775	880	-1	11.0	6.5
69=KYLOUVL	KIH43	4	38	22	2	85	49	53	1000	380	970	-1	11.0	3.0
70=KYMAYFL	KIH46	4	36	41	33	88	32	10	1000	570	530	-1	11.0	5.0
71=KYSOMRS	KIH44	7	37	10	0	84	49	28	1000	918	1530	-1	11.0	7.5
72=LABTNRG	KHB46	1	30	36	38	91	10	30	330	415	76	-1	11.0	4.0
73=LAMORGN	KIH23	4	29	42	5	91	11	35	1000	290	30	-1	11.0	3.0
74=LALKCHR	KHB42	1	30	18	43	93	20	14	500	490	20	120	14.0	4.0
75=LANWORL	KHB43	7	29	56	50	90	4	26	1000	503	8	-1	11.0	1.5
76=MELSWOR	KEC93	1	44	32	45	68	30	43	1000	150	537	145	11.0	2.0
77=MEPRTLN	KD095	7	43	45	45	70	19	30	500	337	420	-1	8.0	3.0
78=MDBLTMR	KEC83	1	39	27	0	76	47	0	250	400	656	-1	11.0	3.5
79=MDSLSBY	KEC92	4	38	17	50	75	39	30	1000	450	26	-1	11.0	4.0
80=MABOSTN	KHB35	4	42	12	44	71	6	52	200	40	600	30	11.0	1.5
81=MAHYANS	KEC73	7	41	41	19	70	20	49	330	320	150	-1	8.0	3.0
82=MIALPNA	KIG83	7	45	4	0	83	43	0	300	158	910	-1	11.0	1.5
83=MIFLINT	KIH29	1	43	13	1	83	43	17	1000	868	690	-1	11.0	7.5
84=MIDETRT	KEC63	7	42	24	22	83	0	6	330	360	633	-1	8.0	3.0
85=MIGRNRP	KIG63	7	42	52	34	85	35	45	1000	120	804	-1	11.0	1.5
86=MIMRQUT	KIG66	7	46	32	50	87	23	13	300	110	710	-1	11.0	1.5
87=MISSMRE	KIG74	7	46	28	42	84	21	34	300	40	724	-1	8.0	1.5
88=MITRVRS	KIH22	1	44	45	43	85	40	53	330	585	1071	-1	11.0	5.0
89=MNDLUTH	KIG64	7	46	50	30	92	4	43	1000	160	1390	-1	11.0	2.0
90=MNMINAP	KEC65	7	44	58	7	93	12	27	1000	403	910	-1	8.0	3.0
91=MNLACRS	WXJ86	7	43	48	17	91	22	6	1000	600	1200	-1	11.0	5.0
92=MSAKRMN	KIH51	4	33	21	7	89	8	56	300	850	678	-1	8.0	6.2
93=MSBONVL	KIH53	7	34	40	0	88	45	5	700	350	729	-1	8.0	3.2
94=MSBUDE	KIH48	7	31	22	19	90	45	5	400	850	480	-1	8.0	6.2
95=MSGLFPT	KIH21	1	30	22	5	89	5	10	330	400	42	-1	11.0	3.0
96=MSINVRS	KIH50	7	33	22	34	90	32	32	400	850	115	-1	8.0	6.2
97=MSJCKSN	KIH38	1	32	16	0	90	16	59	1000	460	410	-1	11.0	4.0
98=MSMCHNY	KIH47	4	31	25	46	89	38	14	1000	200	450	-1	11.0	2.5
99=MSOXFRD	KIH52	1	34	17	26	89	42	24	400	1080	460	-1	8.0	7.6
100=MSMERDN	KIH49	7	32	19	40	88	40	30	200	200	660	-1	11.0	2.0

Table A-1. Station Parameters (Cont.)

# LOC	ID	FREQ CODE	LATITUDE D	M	S	LONGITUDE D	M	S	POWER WATTS	HT FEET	ELEV FEET	AZ DEG	GAIN DBI	LOSS DB
101=MOKANCY	KID77	7	39	6	12	94	34	53	1000	269	1060	-1	11.0	1.5
102=MOSTLUS	KD089	7	38	34	49	90	19	45	1000	1080	494	-1	11.0	8.0
103=MOSTJOS	KEC77	1	39	46	0	94	55	0	330	40	858	-1	8.0	1.5
104=MOSPRNG	WXL46	1	37	10	11	92	56	30	250	500	1565	-1	11.0	3.5
105=MOCLMBA	WXL45	1	38	52	43	91	58	55	1000	330	851	-1	11.0	2.5
106=MOCMDNT	WXJ90	7	38	9	27	92	36	49	1000	340	920	-1	11.0	3.0
107=MTGRFLS	WXJ43	7	47	29	40	111	13	17	330	15	3480	-1	8.0	1.0
108=NENPLAT	WXL68	7	41	1	16	101	9	9	500	500	3210	300	14.0	3.5
109=AZFLGST	WXK76	1	35	14	25	111	36	2	100	15	9002	-1	11.0	1.6
110=NHCNCRD	WXJ40	1	43	13	10	71	26	25	330	60	1080	-1	8.0	1.5
111=NJATLCY	KHB38	1	39	22	42	74	26	53	500	250	95	-1	11.0	2.5
112=NMALBUQ	WXJ34	1	35	3	56	106	47	16	100	70	5700	-1	8.0	1.5
113=NMHOBBS	WXJ36	1	32	42	14	103	33	58	100	300	4302	-1	8.0	2.5
114=NMFRMNG	WXJ37	4	36	41	45	108	13	14	100	130	5840	-1	8.0	1.5
115=NMRUDSO	WXJ38	7	33	24	14	105	46	56	100	60	10775	-1	8.0	1.5
116=NMCLOVS	WXJ35	4	34	28	59	103	32	56	100	200	4750	-1	8.0	2.0
117=NMSANFE	WXJ33	7	35	47	8	105	46	55	100	50	12020	-1	8.0	1.5
118=NYBUFLO	KEB98	7	42	57	14	78	52	37	330	500	607	-1	8.0	1.5
119=NYNYCTY	KW035	7	40	45	32	73	58	47	500	860	80	230	11.0	1.5
120=NYRCHST	KHA53	1	43	8	0	77	35	0	500	350	743	-1	8.0	2.0
121=NCCPHAT	KIG77	7	35	16	0	75	33	0	1000	405	5	320	11.0	4.0
122=NCNWBRN	KEC84	1	35	8	3	77	3	0	1000	600	192	-1	8.0	5.0
123=NCWLMNG	KHB31	7	34	16	0	77	55	0	500	320	20	-1	8.0	3.0
124=OHAKRON	KD094	1	41	3	52	81	35	0	500	672	1088	-1	11.0	5.0
125=OHCLVND	KHB59	7	41	31	22	81	19	43	500	200	950	-1	11.0	2.5
126=OHCLMBS	KIG86	7	39	57	48	83	0	15	1000	721	760	-1	11.0	5.5
127=OHSNDSK	KHB97	1	41	24	11	82	49	5	1000	335	630	-1	11.0	3.0
128=OHLIMA	WXJ93	1	40	38	50	84	9	4	1000	200	988	-1	11.0	1.5
129=OHDAYTN	WXJ46	4	39	39	30	84	19	0	300	335	1167	90	12.0	2.5
130=OHCLDWL	WXJ47	4	39	50	13	81	46	15	500	118	1204	-1	8.0	1.5
131=OKTULSA	KIH27	7	36	11	27	96	5	33	500	330	1008	-1	11.0	2.5
132=ORASTOR	KEC91	1	46	22	0	123	48	0	330	30	1985	-1	11.0	1.0
133=ORBROKG	KIH37	7	42	7	36	124	12	34	1000	30	2074	220	12.0	1.5
134=ORCOSBY	KIH32	1	43	23	26	124	7	48	330	30	915	-1	11.0	1.5
135=OREUGNE	KEC42	1	44	7	16	123	12	42	80	50	440	-1	8.0	1.5
136=ORNWPRT	KIH33	7	44	45	24	124	2	47	1000	40	1050	-1	11.0	1.5
137=ORPRTLN	KEB97	7	45	34	24	122	47	24	330	39	1096	140	11.0	1.5
138=PAERIE	KEC58	1	42	5	0	80	11	0	330	731	299	-1	8.0	2.5
139=PAPHILA	KIH28	4	40	3	45	75	14	40	1000	300	123	-1	11.0	2.0
140=PAPITTS	KIH35	7	40	26	46	79	57	51	1000	360	1165	-1	11.0	2.5
141=RIPRVDN	WXJ39	1	41	48	18	71	28	24	500	191	292	300	18.0	2.5
142=SCCHRLS	KHB29	7	32	47	44	79	50	27	1000	505	0	120	8.0	4.0
143=SCMYRTL	KEC95	1	33	43	0	78	53	0	330	240	25	-1	11.0	2.0
144=SCFLRNC	WXJ22	7	34	16	45	79	44	36	1000	485	126	-1	11.0	3.0
145=SCCLMBA	WXJ20	1	34	7	7	80	56	12	1000	379	385	-1	11.0	2.5
146=SCBOFRT	WXJ23	4	32	42	44	80	40	49	350	900	16	-1	11.0	6.5
147=SCGRNVL	WXJ21	7	34	56	26	82	24	38	1000	33	2035	-1	11.0	1.5
148=TNNASHV	KIG79	7	36	9	30	86	47	5	1000	452	536	-1	8.0	1.5
149=TNKNXVL	WXK46	4	36	0	13	83	56	35	1000	150	1355	-1	11.0	3.0
150=TNBRSTL	WXK47	7	36	26	57	82	6	31	500	125	4300	-1	11.0	1.5

Table A-1. Station Parameters (Cont.)

# LOC	ID	FREQ CODE	LATITUDE D	M	S	LONGITUDE D	M	S	POWER WATTS	HT FEET	ELEV FEET	AZ DEG	GAIN DBI	LOSS DB
151=TNCHATT	WXK48	7	35	9	39	85	19	11	1000	100	2080	-1	11.0	1.5
152=TNMEMPH	WXK49	4	35	10	52	89	49	56	1000	300	275	240	12.0	2.5
153=TXAMRLO	WXK38	7	35	18	55	101	50	3	1000	350	3331	-1	11.0	0.0
154=TXPHARR	33KHB	1	26	12	36	98	11	18	330	120	300	-1	8.0	2.5
155=TXCRPUS	KHB41	7	27	47	44	97	23	41	500	290	37	-1	8.0	1.5
156=TXDALLS	KEC56	1	32	51	0	96	51	58	330	550	481	-1	8.0	1.5
157=TXLARDO	WXK26	4	27	31	14	99	31	19	1000	300	449	-1	11.0	2.5
158=TXGLVST	KHB40	7	29	18	0	94	49	0	500	354	7	-1	8.0	1.5
159=TXHUSTN	KGG68	1	29	45	32	95	22	3	330	690	41	-1	8.0	1.5
160=TXELPSO	WXK25	7	31	48	54	106	29	20	100	100	5748	-1	11.0	1.5
161=TXBRWNS	KHB33	7	25	54	10	97	30	13	500	185	21	-1	8.0	1.0
162=TXDLRIO	WXJ98	1	29	27	45	100	58	45	1000	170	1162	140	12.0	1.5
163=TXAUSTN	WXK27	1	30	3	33	97	48	42	1000	330	780	-1	11.0	2.0
164=TXABLNE	WXK29	1	32	17	13	99	44	20	100	210	2350	-1	11.0	1.5
165=TXBGSPR	WXK37	4	32	15	14	101	26	44	1000	370	2460	-1	11.0	2.0
166=TXTYLER	WXK36	4	32	17	30	95	18	16	1000	300	492	-1	11.0	2.0
167=TXPARIS	WXK20	7	33	38	7	95	33	14	1000	250	545	-1	11.0	1.5
168=TXSHRMN	WXK22	4	33	42	30	96	38	30	1000	165	840	-1	11.0	1.5
169=TXLUFKN	WXK23	7	31	17	58	94	42	54	1000	250	329	-1	11.0	1.5
170=TXVICTR	WXK34	1	28	46	41	96	57	38	1000	330	89	-1	11.0	2.0
171=TXWACO	WXK35	4	31	17	54	97	19	11	500	400	846	-1	11.0	3.0
172=TXMDLND	WXK32	1	31	50	42	102	28	10	1000	4000	2945	-1	11.0	3.0
173=TXSNANG	WXK33	7	31	37	22	100	26	14	1000	360	2250	-1	11.0	2.5
174=UTSLTLK	KEC78	7	40	37	0	112	12	0	330	25	9375	-1	8.0	1.5
175=VAMNSAS	KHB36	7	38	38	0	77	26	0	1000	525	981	-1	11.0	4.5
176=VANRFLK	KHB37	7	36	50	0	76	15	0	1000	479	23	-1	11.0	4.0
177=VTBURLN	KIG60	1	44	32	0	72	49	0	1000	185	4048	180	14.0	1.5
178=WANEHBY	KIH36	7	48	22	15	124	40	20	330	25	1300	195	12.0	1.5
179=WASEATT	KHB60	7	47	34	0	122	30	14	300	60	2210	135	12.0	1.5
180=WAYAKMA	KIG75	7	46	31	59	120	30	0	300	60	2210	-1	11.0	1.5
181=WVCHRLS	WXJ84	1	38	11	17	81	36	31	1000	160	1600	-1	11.0	1.5
182=WVCLRKS	WXJ85	7	39	19	0	80	20	52	1000	140	1200	-1	11.0	1.5
183=WIGRNBY	KIG65	7	44	24	35	88	0	5	1000	700	900	-1	11.0	5.5
184=WIMILWK	KEC60	1	43	1	56	88	23	31	1000	350	700	-1	11.0	2.5
185=WIMADSN	WXJ87	7	43	3	18	89	28	42	1000	800	900	-1	11.0	5.5
186=WIEAUCL	WXJ88	1	45	2	47	91	51	42	1000	900	1200	-1	11.0	6.0
187=WIWAUSA	WXJ89	4	44	55	14	89	41	31	100	300	1902	-1	11.0	2.0
188=WYCHYNE	WXM37	4	41	17	17	105	26	42	100	40	8821	-1	11.0	1.0
189=WYCASPR	KKEEE	7	42	44	40	106	18	0	1000	75	8200	-1	11.0	1.5
190=WYRCKSP	WXM35	7	41	34	43	109	19	12	500	200	7619	-1	11.0	2.0
191=WYRWLNS	WXM36	1	41	38	8	107	23	22	250	60	8442	-1	11.0	1.0
192=KYELZTN	KKXXX	7	37	40	55	85	50	32	10	135	795	315	12.0	1.5
193=KYPIKVL	KKZZZ	1	37	29	31	82	31	12	10	150	1340	45	16.0	1.5
194=SCSMPTR	KKYYY	4	33	53	0	80	16	0	10	325	1665	310	14.0	2.5
195=TXWCHTA	WXK31	4	33	53	23	98	33	30	1000	230	1000	-1	11.0	2.5
196=VARCHMD	WXK65	4	37	30	7	77	32	19	1000	225	280	-1	11.0	2.5
197=TXFTWTH	KEC55	7	32	44	30	97	20	5	1000	250	708	-1	8.0	2.5
198=MOJOPLN	WXJ61	7	37	9	1	94	0	18	500	360	1173	-1	11.0	2.5

Table A-1. Station Parameters (Cont.)

# LOC	ID	FREQ CODE	LATITUDE D	M	S	LONGITUDE D	M	S	POWER WATTS	HT FEET	ELEV FEET	AZ DEB	GAIN DBI	LOSS DB
199=IDLEWTN	WXK98	7	46	19	48	116	38	0	100	20	3670	-1	8.0	1.5
200=FLMLBRN	WXJ70	7	28	4	45	80	36	36	1000	192	20	250	12.0	1.5
201=FLFTMYR	WXK83	4	26	37	48	81	48	37	1000	260	19	310	12.0	2.0
202=FLGNSVL	WXJ60	4	29	42	34	82	23	34	1000	350	180	-1	11.0	2.0
203=GAATHNS	WXK56	1	34	5	2	83	19	18	600	450	860	180	14.0	3.5
204=LASHRVP	WXJ97	1	32	36	46	93	52	10	1000	400	320	-1	11.0	3.0
205=OKOKCTY	WXK85	1	35	34	7	97	29	20	1000	400	1146	-1	11.0	3.0
206=OKLAWTN	WXK86	7	34	35	32	98	29	28	1000	280	1200	-1	11.0	2.5
207=KSCHNUT	WXK95	1	37	34	0	95	14	30	1000	400	1000	-1	11.0	5.5
208=KSGDLND	WXK96	4	39	28	50	100	54	34	600	450	3044	-1	11.0	3.0
209=KSCNCRD	WXK94	7	39	28	15	96	40	45	1000	175	1578	-1	11.0	2.0
210=OKCLNTN	WXK87	4	35	25	16	98	58	30	1000	200	1595	-1	11.0	2.0
211=KSELSWR	WXK92	1	38	42	42	98	14	31	1000	330	1645	-1	11.0	3.0
212=KSTOPKA	WXK91	4	39	5	33	96	47	4	1000	500	900	-1	11.0	3.5
213=KSDODGE	WXK93	4	37	38	28	100	20	40	1000	400	2108	-1	11.0	3.0
214=BCMTUAM	CFA24	1	48	43	38	123	28	59	60	20	1980	-1	9.0	1.0
215=MNMNKTO	WXK40	1	44	5	20	93	42	0	1000	210	1130	-1	11.0	2.0
216=MNRCHST	WXK41	4	44	3	45	92	21	7	1000	200	1238	-1	11.0	2.0
217=MNTHFRV	WXK43	7	48	6	52	96	11	15	1000	200	1128	-1	11.0	2.0
218=MNWLMAR	WXK44	1	45	20	32	95	0	21	1000	250	1250	-1	11.0	2.5
219=MNLTFRK	WXK45	7	48	23	23	93	33	0	1000	200	1145	-1	11.0	2.0
220=NDFARGO	WXK42	1	46	52	36	96	14	40	500	200	1316	-1	11.0	2.0
221=GACLMBS	WXK55	1	32	27	58	85	3	23	1000	220	623	-1	11.0	2.5
222=GAWYCRS	WXK75	4	31	13	17	82	34	24	500	550	160	95	12.0	4.0
223=GAMACON	WXK71	4	32	48	19	83	32	20	1000	350	420	140	12.0	3.0
224=ARFYTVL	WXJ52	4	34	48	53	94	1	41	100	500	2310	40	12.0	3.5
225=INTERHT	WXK72	1	39	30	43	87	8	19	1000	250	646	-1	11.0	2.5
226=INLAFET	WXK74	4	40	45	40	86	45	50	1000	350	695	-1	11.0	2.5
227=LAMONRO	WXJ96	7	32	31	37	92	6	16	500	550	76	-1	11.0	4.0
228=LAALXND	WXK78	4	31	38	20	92	12	18	400	600	215	210	14.0	4.5
229=LALAFYT	WXJ80	7	30	2	54	91	59	49	300	500	20	200	12.0	3.5
230=MIHGHTN	WXK73	1	47	2	8	88	41	43	1000	300	1506	-1	11.0	2.5
231=MILNSNG	WXK81	1	42	26	33	84	34	21	500	450	963	-1	11.0	3.5
232=MTHELNA	WXK66	1	46	35	48	112	17	58	1000	20	7753	-1	8.0	1.0
233=NVRENO	WXK58	7	39	19	0	119	53	0	100	20	9693	-1	8.0	1.5
234=TXBOMNT	WXK28	4	30	4	45	94	7	58	1000	240	18	180	11.0	2.5
235=TXBRYAN	WKK30	7	30	37	48	96	20	33	1000	269	313	-1	11.0	2.5
236=TXLUBOK	WXK79	1	33	44	16	101	45	3	500	280	3260	200	12.0	2.5
237=TXSNANT	WXK67	7	29	30	25	98	34	29	1000	176	990	-1	11.0	2.0
238=IDTWNFL	WXL35	1	42	43	50	114	24	44	100	20	4303	-1	8.0	1.0
239=IDPCTLO	WXL33	7	43	30	3	112	39	48	100	10	6605	120	12.0	1.0
240=MTMISLA	WXL25	1	47	2	24	113	59	1	100	16	7943	-1	7.0	1.0
241=MTGLSGO	WXL32	7	48	12	54	106	37	6	1000	10	2279	160	12.0	1.0
242=OKMCALS	WXL49	4	34	58	36	95	8	43	1000	360	910	-1	11.0	3.5
243=OKENID	WXL48	4	36	17	13	98	2	13	200	340	1260	-1	11.0	3.0
244=NYBNGTN	WXL38	4	42	4	3	75	54	20	1000	200	1557	-1	11.0	1.5
245=NYALBNY	WXL34	7	42	38	13	74	0	6	1000	135	1550	-1	11.0	1.5
246=OHTOLDO	WXL51	7	41	37	32	83	42	41	100	250	900	-1	11.0	3.5
247=NVWINNE	WXL29	1	41	0	40	117	46	3	100	20	6650	-1	8.0	1.0
248=LABURAS	WXL41	4	29	21	11	89	31	16	1000	240	5	-1	11.0	2.0

Table A-1. Station Parameters (Cont.)

# LOC	ID	FREQ CODE	LATITUDE D	M	S	LONGITUDE D	M	S	POWER WATTS	HT FEET	ELEV FEET	AZ DEG	GAIN DBI	LOSS DB
249=NVELKO	WXL28	7	40	54	55	115	49	9	100	20	6620	-1	8.0	1.0
250=NYKINGS	WXL37	4	41	56	11	74	0	30	1000	305	223	-1	11.0	2.0
251=NYSYRCS	WXL31	7	42	58	0	76	12	1	1000	140	1310	30	12.0	1.5
252=PAALLEN	WXL39	1	40	34	2	75	26	5	250	280	1005	-1	11.0	2.0
253=PAHRSBG	WXL40	7	40	20	45	76	52	6	250	500	1300	60	14.0	3.5
254=MNSTCLD	WXL65	4	45	34	30	94	12	22	330	154	1040	-1	11.0	1.5
255=PAWILKS	WXL43	7	41	10	58	75	52	26	250	100	2248	60	14.0	1.5
256=NVLSVGS	WXL36	7	35	51	44	114	51	46	100	4	3789	-1	8.0	1.0
257=.ZZZZZ	XXXXX	4	30	0	0	70	0	0	1000	300	0	360	14.0	0.0
258=NCWNSLM	WXL42	1	36	22	31	80	22	27	100	150	3098	120	14.0	1.5
259=MTHAVRE	WXL53	1	48	29	36	109	43	40	300	15	3182	-1	11.0	1.0
260=MTMILES	WXL54	1	46	24	16	105	39	48	300	15	3180	-1	11.0	1.0
261=PACLEAR	WXL52	7	41	7	21	78	26	28	500	450	2625	-1	11.0	3.0
262=NCFYTVL	WXL50	4	35	8	24	79	5	4	250	100	486	-1	11.0	1.5
263=NCASHVL	WXL56	1	35	25	32	82	45	25	250	30	5721	30	11.0	1.5
264=MOHNBAL	WXK82	4	39	43	45	91	24	15	1000	270	715	-1	11.0	2.0
265=MOSIKES	WXL47	1	36	52	44	89	51	37	1000	240	425	-1	11.0	2.0
266=PAWMSPT	WXL55	1	41	11	21	76	58	53	250	140	1850	360	14.0	1.5
267=IADUBUQ	WXL64	1	42	31	43	90	36	50	1000	300	925	-1	11.0	1.5
268=IABDGTE	WXL63	1	42	49	3	94	24	41	100	20	2362	-1	8.0	2.0
269=IASIOUX	WXL62	4	42	28	56	96	15	30	1000	500	1260	-1	11.0	3.5
270=IACEDAR	WXL61	4	41	54	33	91	39	17	1000	302	837	-1	11.0	2.5
271=IAWTRLO	WXL94	7	42	46	42	92	22	42	1000	320	1045	-1	11.0	2.5
272=TNJCKSN	WKK60	7	35	34	46	88	48	25	1000	245	359	-1	11.0	2.0
273=TNSHLBY	WXK63	4	35	42	8	86	11	45	200	69	1369	-1	11.0	1.0
274=TNCAMDN	WXK62	1	36	6	37	87	40	2	1000	113	838	-1	11.0	1.0
275=TNCOOKE	WXK61	1	36	10	18	85	13	53	200	64	2000	-1	11.0	1.0
276=VARONOK	WXL60	4	37	18	33	80	9	36	200	30	3263	-1	8.0	1.0
277=NCCHARL	WXL70	4	35	17	50	81	6	53	200	250	1300	-1	8.0	2.0
278=NCDURHM	WXL58	7	36	2	21	78	57	34	1000	120	555	-1	11.0	1.0
279=NCROCKY	WXL59	4	35	55	40	77	34	15	1000	250	80	-1	11.0	2.0
280=ARHORSE	WXL66	1	36	9	44	91	32	20	1000	240	845	240	14.0	3.0
281=MSCLMBA	WXL21	1	31	15	2	89	50	7	30	80	156	-1	5.0	1.0
282=NEBASST	WXL73	4	42	20	17	99	29	17	630	535	2525	240	14.0	5.0
283=NEGRAND	WXL74	1	40	46	16	98	5	21	800	530	1811	270	14.0	5.0
284=NEHLDRG	WXL75	4	40	23	5	99	27	30	1000	500	2383	300	14.0	5.0
285=NEMERRI	WXL76	1	42	40	37	101	42	35	800	550	3538	270	14.0	5.0
286=NEOMAHA	KIH61	1	41	15	28	96	0	32	1000	275	1151	-1	11.0	2.0
287=NESCOTT	WXL67	7	41	50	24	103	3	18	1000	500	4250	270	14.0	3.5
288=NEWAYNE	WXL77	7	42	14	15	97	16	14	800	500	1780	270	14.0	5.0
289=NELNCLN	WXM20	4	40	49	23	96	39	28	1000	365	1195	-1	8.0	2.0
290=ONTRNTO	KK033	4	43	38	33	79	23	15	20	929	269	-1	5.0	0.0
291=IDBOISE	WXK68	7	43	45	16	116	5	42	100	35	7190	-1	8.0	1.0
292=NVELY	WXL69	1	39	16	3	114	53	36	100	20	7890	-1	8.0	1.0
293=NDBSMRK	WXL78	1	46	35	17	100	48	45	1000	500	2243	240	14.0	4.5
294=NDDCKSN	WXL80	1	46	43	29	102	54	53	800	400	2916	210	14.0	4.5
295=NDJMSTN	WXL81	1	46	55	22	98	46	21	1000	300	1505	-1	11.0	3.0
296=NDMINOT	WXL83	1	48	3	3	101	23	24	1000	500	2076	240	14.0	4.5
297=NDWLSTN	WXL84	1	48	8	22	103	53	24	1000	650	2300	90	14.0	5.0
298=PAJOHNS	WXL71	1	40	22	22	78	58	51	250	20	2700	-1	8.0	2.0

Table A-1. Station Parameters (Cont.)

# LOC	ID	FREQ CODE	LATITUDE D	M	S	LONGITUDE D	M	S	POWER WATTS	HT FEET	ELEV FEET	AZ DEG	GAIN DBI	LOSS DB
299=NMDESMN	WXL90	7	36	42	20	103	52	36	100	85	8720	-1	8.0	1.5
300=ALDMPLS	WXL72	4	32	22	1	87	52	3	330	400	264	-1	8.0	3.5
301=MTBUTTE	WXL79	7	46	0	27	112	26	30	100	15	8226	270	14.0	1.0
302=MTKALIS	WXL82	7	48	0	42	114	21	51	100	20	6757	-1	11.0	1.0
303=MAWRSTR	WXL93	7	42	18	14	71	53	51	200	200	1365	120	10.0	2.5
304=VTRTLND	KK062	4	43	26	28	72	27	30	100	100	3291	-1	11.0	2.0
305=NMLSCRC	WXL91	1	32	17	16	106	44	59	100	50	4915	-1	8.0	1.5
306=VALYNCH	WXL92	7	37	26	11	79	7	28	1000	81	820	-1	8.0	1.5
307=COREIRD	310	1	40	36	3	103	1	55	300	300	4400	-1	8.0	2.5
308=COPUBLO	221	1	38	16	32	104	35	55	100	160	4750	270	8.0	2.0
309=COGMESA	410	7	39	5	2	108	13	12	300	165	10000	-1	8.0	2.0
310=COPOOLT	513	4	37	43	46	106	55	17	100	180	10872	155	11.0	1.5
311=COMEAD	308	7	40	14	24	105	3	19	100	120	5210	300	9.0	1.5
312=COROCKS	309	1	40	29	7	104	21	3	100	130	4975	270	8.0	1.5
313=WARCHLD	WXM39	4	46	6	14	119	8	6	100	20	2150	-1	8.0	1.0
314=ORDALLS	WXM34	1	45	42	25	121	5	28	100	25	2905	-1	8.0	1.0
315=ORPNDTN	WXL95	7	45	35	19	118	59	45	300	30	2390	-1	8.0	1.0
316=UTLOGAN	WXM22	1	41	53	11	112	4	16	100	20	5970	-1	8.0	1.0
317=CAWTHVN	WXL87	7	33	3	18	114	49	37	100	20	2164	-1	11.0	1.0
318=CABKFLD	WXL89	7	35	42	27	118	33	34	100	20	7092	235	11.0	1.0
319=CABRSTW	WXM21	1	34	58	12	117	2	19	100	20	3365	-1	8.0	1.0
320=CAREDDG	WXL88	7	40	39	16	122	31	25	100	15	3450	155	11.0	1.0
321=CAMRCED	WXL99	7	37	17	20	120	27	13	1000	40	175	-1	8.0	1.0
322=ORSALEM	WXL96	4	44	50	50	123	6	34	1000	80	1000	-1	8.0	1.0
323=ORRSBRG	WXL98	7	43	7	9	123	14	34	100	20	3235	-1	8.0	1.0
324=ORKFALL	WXL97	7	42	14	35	121	42	18	100	15	6400	-1	11.0	1.0
325=UTRSVLT	WXM23	1	40	21	2	110	47	52	100	10	9880	95	14.0	1.0
326=UTMLFRD	WXM24	1	38	30	30	113	17	21	100	10	9660	150	14.0	1.0
327=SDPIERE	WXM26	1	44	3	7	100	5	3	700	500	2040	-1	11.0	3.5
328=SDSFALL	WXM28	1	43	31	41	96	30	28	1000	500	1400	-1	11.0	3.5
329=SDHURON	WXM27	7	44	29	44	97	38	56	250	275	1800	-1	11.0	2.5
330=WASPKNE	WXL86	1	47	55	18	117	6	48	100	30	5862	-1	7.2	1.5
331=NYPLCID	810	4	44	15	30	73	59	0	100	50	2700	-1	8.0	1.5
332=SDABRDN	WXM25	4	45	28	29	98	31	35	1000	325	1310	-1	11.0	3.0
333=NDPTBRG	WXM38	1	48	8	24	97	59	38	250	600	1521	-1	11.0	5.0
334=NYELMRA	WXM31	7	42	6	20	76	52	17	100	250	1706	-1	11.0	3.0
335=MDHGTWN	WXM42	4	39	39	4	77	58	15	1000	400	1894	-1	11.0	3.5
336=ORMDFRD	WXL85	1	42	25	41	123	0	4	1000	20	2115	-1	11.0	1.0
337=WYLNDER	817	4	43	25	55	107	59	14	200	30	8520	-1	11.0	1.0
338=WYSHRDN	818	1	44	36	30	106	55	0	100	20	5836	-1	11.0	1.0

APPENDIX B. NETWORK SOFTWARE TECHNICAL DESCRIPTION

This technical description of the NETWORK program is intended to serve as a guide for program maintenance and modification. The sections included are:

Section	Description
B.1	General overview, file descriptions, COMMON blocks
B.2	Individual routine documentation
B.2.1	NTWRK - driver program for NETWORK
B.2.2	NTUPD - program for ITM coverage calculations
B.2.3	NTPLT - program for graphic plotting
B.2.4	DBINT - program to initialize data base files
B.2.5	DBMS - general library routines used by all programs in NETWORK
B.3	Installation procedure files for HP-1000 system

B.1 General Overview

The NETWORK program has been developed for the NWS as an aid in predicting the coverage in the NWS broadcast network. Coverage is calculated at grid points superimposed on the earth's surface. The grid chosen covers the area from 24 to 50 degrees north and 125 to 66 degrees west, at 4-minute intervals. Data files that reference these grid points are divided into 1560 1-degree-square blocks (1560=26 latitude x 60 longitude). Each block is identified by the latitude and longitude of its southwest corner. These blocks are arranged on the files in longitude-major order. If t is the latitude and n the longitude of a southwest corner, then the order of blocks is given by the following series of (t,n) pairs:

(24,-125), ... ,(49,-125),(24,-124), ... ,(49,-66).

The block at (t,n) is the (t-24+1) + (n+125)x(49-24+1)th block on the file. Within a block, the grid points form a 15x15 array, such that for block (t,n) the order of grid points is:

(t,n),(t+4',n), ... ,(t+56',n),(t,n+4'), ... ,(t+56',n+56').

The ITS Irregular Terrain Model is used in the area prediction mode to calculate the field intensity strength at each grid point within 200 km of a station. Each grid point is assigned a coverage code based upon the desired field intensity of the closest station and the undesired field intensity of all other stations operating within 200 km at the same frequency:

0 = no coverage

1 = coverage with no interference

2 = co-channel interference.

Plots showing the coverage or interference patterns for any geographical area may be made superimposing state or county borders.

The process diagram for NETWORK (Figure B-1) shows the organization and flow of the major parts of the program. NETWORK is divided into three subprograms with communication between them occurring through data files and program-to-program parameter passage. NTWRK is the primary program controlling user interaction. NTWRK opens all necessary data files and calls routine MENU which displays the NETWORK commands and requests the user response. Once a valid response occurs, NTWRK branches to the appropriate routine as outlined in Table B-1. Because of memory limitations, NTUPD (ITM calculations) and NTPLT (plotting) are performed with EXEC program swaps. These are separately loaded programs that communicate with NTWRK through EXEC parameter passage.

Figure B-2 shows the program organization for NTUPD and NTPLT. The ITS Irregular Terrain Model(ITM) routines used in NTUPD and the Advanced Graphics Package(AGP) routines used in NTPLT are not described in this manual.

File INPUT/OUTPUT in NETWORK is performed with associated COMMON blocks. These COMMON blocks and file structures are described in Tables B-3 through B-11. All other COMMON blocks are described in Table B-12.

The file STATS contains the parameters for each station in the data base. As stations are ADDed or EDITed, STATS is changed to reflect the latest values defined by the user. After each ADD/EDIT command, the user may recalculate the coverage affected by the current station. NTUPD calculates this coverage and updates the files STATG1, STATG2, STATD, and STATI. When plots are requested with NTPLT, plotting speed is

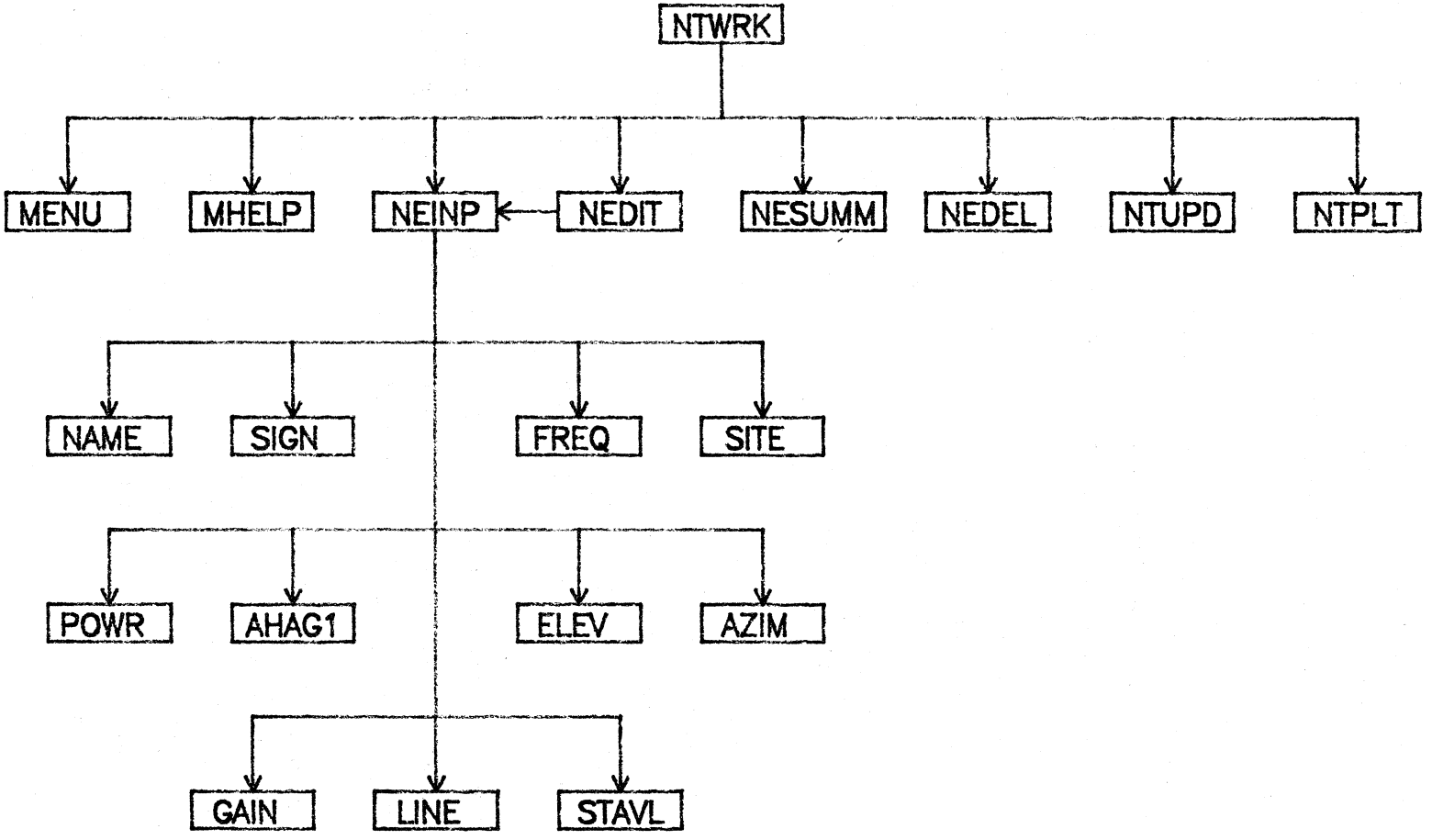

Figure B–1. NTWRK program organization.

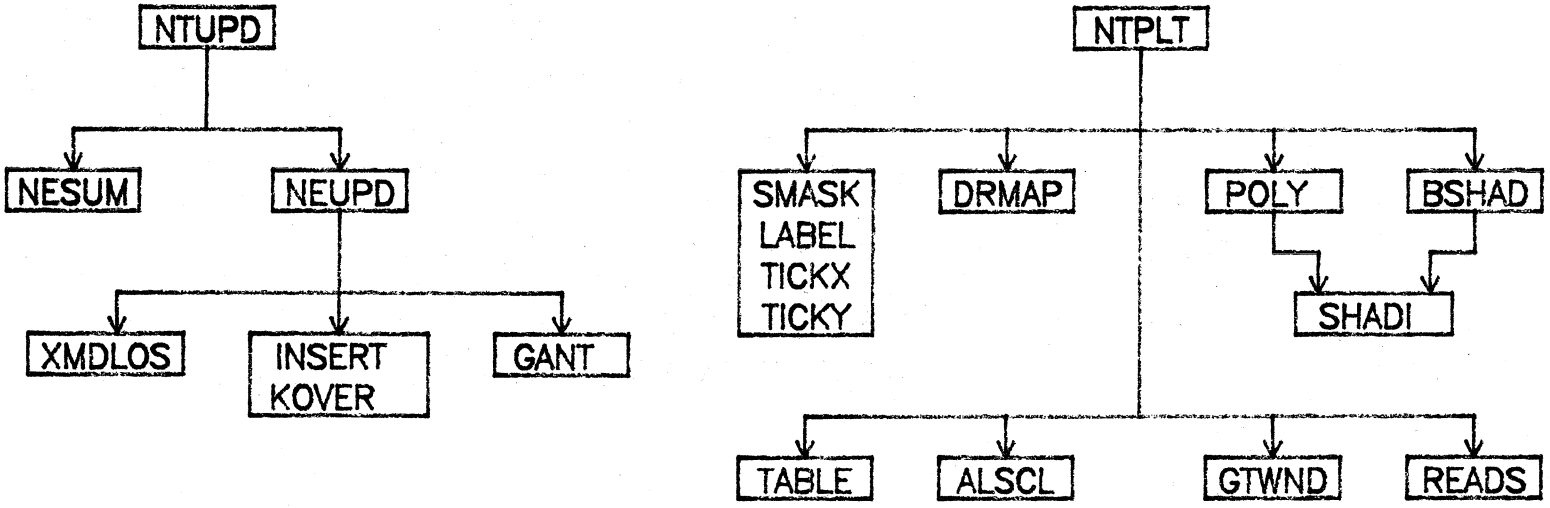

Figure B–2. NTUPD and NTPLT program organization.

Table B-1. Command-Process Routine Relationship

Command	Process Routine
ADD	NEINP - request new station parameters
EDIT	NEDIT - modify existing station parameters
DELETE	NEDEL - delete station
SUMMARY	NESUM - summary of station parameters
PLOT	NTPLT - plot coverage results (program swap)
UPDATE	NTUPD - update coverage calculations (program swap)
CONCISE	no routine invoked
VERBOSE	no routine invoked
HELP	MHELP - display help information
NEWS	MHELP - display latest news information
QUIT	no routine invoked Program termination

Table B-2. NETWORK Files

File Name	Table	Logical Unit Number or DCB Common Block	Description
INPUT		1	INPUT file from terminal
OUTPUT		1	OUTPUT file to terminal
PRINTER		6	Line printer output
STATS	B-3	60	FORTRAN binary file containing all station parameters
STATI	B-4	61	FORTRAN binary file containing which stations are "active"
STATD	B-5	/DCBD/	Block addressable file containing display information for each grid point
STATG1	B-6	/GSTAT/	Block addressable file containing indexes for grid point locations into STATG2
STATG2	B-7	/GRID2/	Grid point addressable file containing coverage information at each grid point
HBARD	B-8	/HBARC/	Block addressable file containing average elevation of each 4 minute grid point
PROPAR	B-9		Contains propagation parameters delta H and Ns for 30 minute geographic blocks in US
POLYMP	B-10	99	Contains county/state boundary coordinates
STATES	B-10	99	Contains state boundary coordinates
NTHELP	B-11	44	Text file which contains HELP information to run NETWORK
NTNEWS	B-11	44	Text file which contains latest NEWS information about current version of NETWORK
H.ADD	B-11	44	HELP file for ADD command
H.CONC	B-11	44	HELP file for CONCISE command

TABLE B-2. (Cont.)

H.DELE	B-11	44	HELP file for DELETE command
H.EDIT	B-11	44	HELP file for EDIT command
H.HELP	B-11	44	HELP file for HELP command
H.NEWS	B-11	44	HELP file for NEWS command
H.PLOT	B-11	44	HELP file for PLOT command
H.QUIT	B-11	44	HELP file for QUIT command
H.SUMM	B-11	44	HELP file for SUMMARY command
H.UPDA	B-11	44	HELP file for UPDATE command
H.VERB	B-11	44	HELP file for VERBOSE command

Table B-3. STATS file description and COMMON /SDATA/

STATS - Station Parameter File

I/O ROUTINES: STATS, NEOPN, NERD, NESUM, NEWR

COMMON block used for read/write:

```
COMMON /SDATA/ LOCS(4),IDS(3),LFREQ,SLAT,SLON,SPOW,SHGT,
               SLOSS,SGAIN,SAZIM,NPAT,SELEV,SDELTH(8)
```

LOCS	station location name in 3A2,A1 format
IDS	station call sign in 2A2,A1 format
LFREQ	transmitter frequency code of station 1=162.400 Mhz 2=162.425 Mhz 3=162.450 Mhz 4=162.475 Mhz 5=162.500 Mhz 6=162.525 Mhz 7=162.550 Mhz
SLAT	latitude in decimal degrees north
SLON	longitude in decimal degrees east
SPOW	transmitter power out of final amplifier (watts)
SHGT	transmitter antenna height above ground (meters)
SLOSS	transmitter line losses (dB)
SGAIN	antenna power gain (dB)
SAZIM	antenna main beam azimuth (degrees) = -1 = omni-directional antenna = 0 = north = 90 = east
NPAT	antenna pattern index for directional antennas (currently only one pattern available)
SELEV	antenna ground elevation above sea level (meters)
SDELTH	currently not used

File structure:

256 bytes per record (82 are used)
Random access index is the station number
One station per record
Maximum of 500 stations
Data stored is LOCS through SDELTH

Storage required:

500 stations * 256 bytes/station = 128000 bytes

Table B-4. STATI file description and COMMON /ISTATC/

STATI - Active Station Index File

I/O ROUTINES: STATI, SETI, GETI, DELI

COMMON block used for read/write:

```
COMMON /ISTATC/ LUIS,NSTATI,INCORE,
                KDNUM,KLOC(4),KDS(3),KFREQ,HLAT,HLON
```

LUIS	FORTRAN unit number (61)
NSTATI	number of stations active
INCORE	current record number in core
KDNUM	index number of in-core station (Index into file STATS)
KLOC	station location name (7 chars)
KDS	station call sign (5 chars)
KFREQ	station frequency code (1-7)
HLAT	station latitude location
HLON	station longitude location

File structure:

26 bytes per record
Record 1 word 1=NSTATI= the number of records in the file
Records are kept sorted by KDNUM ascending
Random access index is 2 through NSTATI+1
One station per record
Maximum of 500 stations
Data stored is KDNUM through HLON

Storage required:

501 records * 26 bytes/record = 13000 bytes

Table B-5. STATD file description and COMMON /DSTAT/ and /DCBD/
STATD is a Block Addressable FMP File Containing Display Information for each 4-minute Grid Point

I/O ROUTINES: STATD, GETD, ICOVRG, PUTDSP

COMMON blocks used for read/write:

```
COMMON /DSTAT/ IDWSA(2,225),ICHAN,NWDD
COMMON /DCBD/ INCORE,IDCB(466)
```

IDWSA(1,i) word 1 of the i'th grid point
= ID*32 + IDFREQ*4 + KOV
ID =ID number of desired station
IDFREQ=frequency code of station
KOV =calculated coverage code
=0=grid point not covered
=1=grid point covered
=2=co-channel interference

Table B-5. (Cont.)

```
       IDWSA(2,i)        word 2 of the i'th grid point
                         =DIST/10. + .5
                             DIST = distance to station (meters)
       ICHAN             flag indicating if in-core block has
                         been changed (=0=no change)
       NWDD              number of words in block (=450)
       INCORE            block number in core
       IDCB              Data Control Block used for FMP I/O

File structure:
       450 words per record(2 words per grid point)
       One block (255 grid points) per record
       1560 blocks in data file
       Data stored is IDWSA

Storage required:
       1560 blocks * 450 words/block * 2 bytes/word
             = 1.404 million bytes
```

Table B-6. STATG1 file description and COMMON /GSTAT/
STATG1 is a Block Addressable FMP File Containing
Indexes for Grid Point Locations into STATG2.

```
I/O ROUTINES: STATG, GET1, IPNTG

COMMON blocks used for read/write:

       INTEGER*4 IPNTA
       COMMON /GSTAT/ IDCB1(466),INCOR1,ICHAN1,IPNTA(225)

       IDCB1       Data Control Block used for FMP I/O
       INCOR1      block number in core (1-1560)
       ICHAN1      flag if incore block has been changed
                   (=0= no change)
       IPNTA       data array for 225 grid points in incore block
                   DOUBLE PRECISION INTEGER
                   IPNTA(i)=0=grid point not influenced by
                            any station
                   IPNTA(i)=IPNT=stations affecting the i'th grid
                            point are found on record IPNT in
                            the file STATG2

File structure:
       450 words per record(1 DOUBLE INTEGER per grid point)
       One block (255 grid points) per record
       1560 blocks in data file
       Data stored is IPNTA

Storage required:
       1560 blocks * 450 words/block * 2 bytes/word
             = 1.404 million bytes
```

Table B-7. STATG2 file description and COMMON /GRID2/ and /GRID/

STATG2 is a grid point addressable FMP file containing coverage information for each grid point. The number of grid points available is dependent on the size of the file (limited by available disk space).

I/O ROUTINES: STATG, GET2, SETG, DELG, GETG

COMMON blocks used for read/write:

```
      INTEGER*4 INCOR2,LINK,MX
      COMMON /GRID2/ IDCB2(529),INCOR2,ICHAN2,NWDS2
      COMMON /GRID/ LBLK,LNDEX,NSTAT,ICOV,LGRID(3,8),LINK,MX,
     +                                    IGRID(3,16)
```

IDCB2	Data Control Block used for FMP I/O
INCOR2	DOUBLE INTEGER pointer of current grid point in core
ICHAN2	flag if incore data has changed (=0= no change)
NWDS2	number of words per record (=32)
Grid Point data	
LBLK	block number containing this grid point (1-1560)
LNDEX	index number with block of this grid (1-225)
NSTAT	number of stations affecting this grid point (Only the closest 16 stations are saved)
ICOV	current coverage code =0= not covered =1= covered by desired station =2= co-channel interference
IGRID(1-3,i)	3 words of station information for the i'th closest station to this grid point (1,i)=ID*8 + IFREQ ID=station index number (1-500) IFREQ=frequency code (2,i)=DIST/10. + .5 DIST=distance (meters) from i'th station (3,i)=(EDES+100)*256 + (EUND+100) EDES=predicted field strength at grid point if desired station =E(95,95,50) EUND=predicted field strength at grid point if undesired station =E(10,50,50)
LINK	DOUBLE INTEGER link to additional stations =0 NSTAT <= 8 No link necessary >0 Record number to find additional stations <0 Backward link from 2nd record to 1st In record number 1, LINK=maximum number of records allowed
MX	DOUBLE INTEGER current number of grid points occupied Only stored in record number 1 for restart

Table B-7. (Cont.)

File structure:
32 words per record
8 stations per record
One link allowed yields maximum of 16 stations per grid point
Data stored is LBLK through MX

Storage required:
32 words/gridpoint * 2 bytes/word = 64 bytes/gridpoint
Total number of grid points possible in data base:
1560 blocks * 225 grid points/block
= 351000 grid points
Approximately 1/3 will be unused because of water
234000 grid points assumed needed
Total storage:
234000 grid points * 64 bytes/gridpoint =
14.976 million bytes

Table B-8. HBARD file description and COMMON /DHBAR/ and /HBARC/

HBARD is a block addressable FMP file containing average elevations of each of the 4-minute grid points. HBARD should be used to extract average elevation instead of PROPAR because it is based on a finer grid and is more responsive to terrain changes.

I/O ROUTINES: HBARD, HBARG

COMMON blocks used for read:

```
COMMON /DHBAR/ IHBARA(225)
COMMON /HBARC/ INCORE,NWDD,IDCBH(241)
```

IHBARA(i)	average elevation (meters) of the i'th grid point in the in-core block
INCORE	block number of in-core block
NWDD	number of words per block (=225)
IDCBH	Data Control Block for FMP I/O

File structure:
Read only file
225 words per record(1 word per grid point)
One block (255 grid points) per record
1560 blocks in data file
Data stored is IHBARA

Table B-9. PROPAR file description and COMMON /PRODC/

PROPAR is an FMP file containing data for the propagation parameters Delta-H, N-sub-S, and average terrain elevations (for average elevations use HBARD). The values are on a grid from 23.75 to 50.25 degrees north and -125.25 to -64.25 degrees east, at 0.5 degree intervals. The values are read by SUBROUTINE PRODG and stored into VMA (virtual memory) in:

Table B-9. (Cont.)

```
COMMON /PRODC/ IPRO(3,54,122)

IPRO(i,lat,lon)   lat=latitude grid point (1-54)
                  lon=longitude grid point (1-122)
                  i=1 = average elevation (meters)
                  i=2 = Delta-H (meters)
                  i=3 = N-sub-S (refractivity)
```

The value of any parameter is obtained by bilinear interpolation among the four data points windowing the location of interest (performed by PRODV).

I/O routines: PRODG, PRODV

Table B-10. POLYMP and STATES file description

POLYMP and STATES are binary-random access files containing the data points for state and county outlines within the limits 25.13 to 49.01 degrees north and -124.68 to -67.01 degrees east. STATES contains only state boundaries for faster plotting. The files are divided into 160 blocks. Each block contains map data for a 3-degree-square area. The southwest corner of the first block is located at 25.13,-124.68 with consecutive blocks in longitude-major order. Thus an array of 8 by 20 blocks covers the continental United States.

The first three 128 word records contain data for:

```
    INDX(8,20,2)   where:
         INDX(lat,lon,1) represents the record number of
                         the start of the (lat,lon) block
    and  INDX(lat,lon,2) represents the number of 128 word
                         records
```

Each record consists of a variable number of words and is structured as a chain. A chain is a series of points which, when connected in sequence, will define a part of a county or state line. The chain structure is:

```
NCF       county/state flag:  0=county line
                              1=state line
NP        number of points in this chain
ALN(1)    longitude in radians east of first outline point
ALT(1)    latitude in radians north of first outline point
LD(1)     detail level of first outline point
.
.
ALN(NP)   longitude in radians east of last outline point
ALT(NP)   latitude in radians north of last outline point
LD(NP)    detail level of last outline point
```

Chains are assigned to blocks on the basis of the coordinate of midpoint of the chain. Thus, a block, while representing data

Table B-10. (Cont.)

for a 3-degree square area, will not necessarily contain all the data points within that area. This deficiency is corrected by the method used to select blocks for the area to be displayed. A layer of blocks around the obviously necessary blocks is plotted to ensure that all needed chains within the plot area are provided. The graphics software "clips" the chains displayed to the desired plot area so that superfluous data is not evident to the user.

Table B-11. Information HELP files.

The following is a list of text files that contain information that is accessible through the HELP or NEWS commands:

File Name	Description
NTHELP	Contains basic HELP information to run NETWORK
NTNEWS	Contains latest NEWS about current NETWORK version
H.ADD	Contains HELP for ADD command
H.CONC	Contains HELP for CONCISE command
H.DELE	Contains HELP for DELETE command
H.EDIT	Contains HELP for EDIT command
H.HELP	Contains HELP for HELP command
H.NEWS	Contains HELP for NEWS command
H.PLOT	Contains HELP for PLOT command
H.QUIT	Contains HELP for QUIT command
H.SUMM	Contains HELP for SUMMARY command
H.UPDA	Contains HELP for UPDATE command
H.VERB	Contains HELP for VERBOSE command

Table B-12. COMMON blocks used in NETWORK

/ALSC/ XV1,XV2,YV1,YV2,XCEN,YCEN,DX,DY,SLIMIT,ARS
Window parameters filled by ALSCL
XV1=minimum X viewport coordinate (0 to 1)
XV2=maximum X viewport coordinate (0 to 1)
YV1=minimum Y viewport coordinate (0 to 1)
YV2=maximum Y viewport coordinate (0 to 1)
XCEN=X center of window in Albers units
YCEN=Y center of window in Albers units
DX=X length in Albers units from center to east border
DY=Y length in Albers units from center to north border
SLIMIT=AMAX1(DX,DY)/15.
Fraction of window size in Albers units used to determine text size and station masking distance
ARS=screen aspect ratio used to keep X and Y in same scale

/AZEL/ ZTLAT,ZTLON,ZTHT,ZRLAT,ZRLON,ZRHT,ZTAZ,ZRAZ,ZTELV,ZRELV, ZD,ZDGC,ZTAKOF,ZRAKOF
Communication to the TA Services routine DAZEL to calculate great circle distance between two points
(ZTLAT,ZTLON)=lat/lon of transmitter
ZTHT=elevation of transmitter
(ZRLAT,ZRLON)=lat/lon of receiver

Table B-12. (Cont.)

```
        ZRHT=elevation of receiver
        ZTAZ=bearing from transmitter to receiver (output of DAZEL)
        ZDGC=great circle distance (km) between two points(output)
        Other variables are not used by NETWORK

/BAUD/ IBAUD
        Terminal baud rate (Tektronix only)
        Required to determine delay for Tektronix erase
        IBAUD - baud rate (eg 1200, 4800)
                =0= not Tektronix

/COLOR/ ICOLOR(3)
        Color array for background, coverage, interference plotting
        Required only for terminals/plotters with multiple color
        capability
        ICOLOR(1)=color code to plot background (border & county/state)
        ICOLOR(2)=color code to plot service coverage
        ICOLOR(3)=color code to plot co-channel interference

/DFILE/ LUDATA,MAXREC,INCORD,IFILE(10)
        Data base information for STATS file filled by STATS
        LUDATA=unit number for I/O to STATS (=60)
        MAXREC=number of stations on STATS file
        INCORD=current station in COMMON block /SDATA/
        IFILE=STATS file name (=STATS::ND) (RTE-6/VM namr format)

/FREQA/ NFREQ,AFREQ(7)
        Defines frequency indexes in MHz
        NFREQA=number of frequency indexes (=7)
        AFREQ(1)=162.400 MHz
             (2)=162.425 MHz
             (3)=162.450 MHz
             (4)=162.475 MHz
             (5)=162.500 MHz
             (6)=162.525 MHz
             (7)=162.550 MHz

/GETIT/ IEOF,IQMARK,IERR,IBAIL,JEND,KNT,ICARD(80),XNUM
        Communication to GETVL routine
        JEND=total number of characters entered
        KNT =total number of leading numeric characters entered
        ICARD=array containg input string entered by user (80A1)
        XNUM=floating point number value of numeric characters entered
        Other variables are not used by NETWORK

/LOCAT/ SLAT(400),SLON(400),ISFREQ(400)
        Station latitude, longitude, and frequency
        VMA COMMON block
        SLAT(i)=latitude  of the i'th station
        SLON(i)=longitude of the i'th station
        ISFREQ(i)=frequency index of the i'th station
```

Table B-12. (Cont.)

```
/LU/ LUIN,LUT,LUP
        Terminal I/O unit numbers
        LUIN=terminal input  unit number (=1)
        LUT =terminal output unit number (=1)
        LUP =line printer unit number (=6)

/MAXG/ MAXSG2
        Maximum number of grid points available in STATG2 data base
        Determined by disk space allocated
        MAXSG2=(INTEGER*4)=maximum number of grid points available

/MINMAX/ XMIN,XMAX,YMIN,YMAX
        Min/max view window coordinates in lat/lon
        XMIN=longitude of west boundary of view window (negative)
        XMAX=longitude of east boundary of view window (negative)
        YMIN=latitude of south boundary of view window
        YMAX=latitude of north boundary of view window

/MMEVAL/ EMIN,EMAX
        Min/max of field strength values calculated (determines if
        min/max limits have been exceeded)
        EMIN=minimum of E(95,95,50) or E(10,50,50) for any grid point
        EMAX=maximum of E(95,95,50) or E(10,50,50) for any grid point

/PARAM/ IMENU,ILEN,IPWR
        Communication to the input routines for NEINP
        IMENU= 2HVE = display verbose input question
             = 2HCO = display concise input question
        ILEN = variables of length are input in the following units:
             = 1 = meters
             = 2 = feet (NETWORK default)
        IPWR = variables of power are input in the following units:
             = 1 = watts (NETWORK default)
             = 2 = kilowatts
             = 3 = dBm
             = 4 = dBw
             = 5 = dBk

/PASSIT/ FSL,ENO,HBAR,ZRLAT,ZRLON
        Communication between NEUPD and XMDLOS for debug printing
        FSL=free space loss
        ENO=surface refractivity reduced to sea level at (ZRLAT,ZRLON)
        HBAR=average elevation at (ZRLAT,ZRLON)
        (ZRLAT,ZRLON)=location where propagation parameters ENO,HBAR,
                      and DELTH are found (see XMDLOS for definition)


/PROP/ KWX,AREF,MDP,DISTP,HG(2),WN,DELTH,ENS,GME,ZGND,HE(2),DL(2),THE(2)
       COMPLEX ZGND
        Communication with ITM routines
        See ITM documentation for complete description of /PROP/
```

Table B-12. (Cont.)

```
/SCLIP/ MSTAT,XSTAT(400),YSTAT(400),SLIM2
        Station locations within view window in Albers coordinates
```

Table B-12. (Cont.)

```
        VMA COMMON block
        MSTAT=number of stations in view window
        XSTAT(i)=Albers X coordinate of the i'th station
        YSTAT(i)=Albers Y coordinate of the i'th station
        SLIM2=SLIMIT**2=square of mask distance (used in DRMAP clipping)

/STG/ MAX
        Number of grid points used in STATG2 data base
        MAX=(INTEGER*4)=current number of grid points active in STATG2

/SVMA/ LOCA(4,500),IDA(3,500)
        Station location names and call signs
        VMA COMMON block
        LOCA(1-4,i)=7-character location name of the i'th station
        IDA (1-3,i)=5-character call sign of the i'th station

/VERSION/ LVER(2)
        Current version of NETWORK
        LVER=current version of NETWORK used in HELLO printout
            ="2.0 " as of this documentation

/ZVALS/ Z95,Z50,Z10
        Standard normal deviates for use with ITM routine AVAR
        Z95=QERFI(.95)
        Z50=QERFI(.50)
        Z10=QERFI(.10)
```

optimized because the file STATD contains the coverage codes necessary to create the plots.

For more detailed description of the routines involved, refer to the documentation given in section B.2.

B.2 Introduction

Documentation for each routine used in NETWORK (except the ITM propagation and AGP plotting software) is included in this section. Each routine is described in the same order as it appears on the source program file. The information given for each routine includes:

(1) a short statement of purpose,

(2) a description of the input and output values,

(3) COMMON block referenced,

(4) a list of routines called,

(5) a list of calling routines, and

(6) a general discussion of algorithms used and execution flow.

The routine descriptions that follow have been grouped by main program to facilitate coordinating the information given here with that in section B.1. Besides NTWRK, NTUPD, and NTPLT, the section DBMS contains general data base routines that are used throughout NETWORK.

B.2.1 NTWRK Routines - source file &NTWRK::NT

B.2.1.1 NTWRK

PROGRAM DESCRIPTION

NTWRK is the main controlling routine for NETWORK. It requests commands from the user and calls the necessary routines and program swaps as they are needed. GETWSP is called to allow the user to specify what type of graphic terminal is being used (necessary for plotting). The routine TODAY retrieves the date for the hello message. All of the current station names and call signs are then read into VMA arrays to allow rapid determination for station existence or duplicate names. MENU is then called to display NETWORK commands and request user selection. NTWRK then branches with a computed GO TO to process the command. NTUPD and NTPLT are executed by calling SWAP which performs an EXEC call that schedules another program to execute while suspending NTWRK.

COMMON BLOCKS

/BAUD/ - terminal baud rate (Tektronix only)
/LU/ - terminal I/O unit numbers
/GETIT/ - communication with GETVL routine
/PARAM/ - parameter passage to input routines
/SDATA/ - in-core station parameters read from STATS file
/DFILE/ - data base information for STATS file
/SVMA/ - VMA arrays for all station names and call signs
/VERSION/-NETWORK version number

FILES

The files used by NTWRK include STATS, STATI, and all of the text HELP files listed in Table B-11.

ROUTINES CALLED

MENU - display legal commands and request user selection
MHELP - display contents of HELP file
NEINP - prompt user for station parameter data (ADD or EDIT command)
NESUMM- display summary of existing station parameters
NEDEL - delete a station from the STATS data base
GETWSP- prompt user for graphic terminal type
GETVL - prompt user for character or numeric input data
ERASE - erase screen
TODAY - retrieve current date
STATS - initial setup for I/O to file STATS
NEOPN - open STATS data file
BYTE - store a character in an array
LOOK - look up for CALL SIGN or NAME match on STATS data file
STATI - OPEN/CLOSE STATI data file
SWAP - schedule program execution through EXEC

B.2.1.2 MENU

SUBROUTINE DESCRIPTION

If VERBOSE dialog is in effect, MENU will display a list of commands and their one character abbreviation. Then, in either mode, the prompt:

MENU(xxxxxx) ?

is displayed. "xxxxxx" will be the previous command that was executed. The user must now respond in one of the following ways:

[CR] - Entering only a carriage return will cause MENU to assume the user wants to execute the command "xxxxxx".

? - A "?" will cause MENU to display the list of legal commands.

command - Enter the command you wish executed. Only the first character is required.

Any illegal command (first character not matching), will cause MENU to display the message:

INVALID MENU OPTION

You will be requested to try again.

COMMON BLOCKS
    /LU/   - terminal I/O unit numbers
    /GETIT/ - communication with GETVL routine

ARGUMENTS - SUBROUTINE MENU(MODE,NMENU)
    MODE - (input) - current dialog mode
           =2HVE = verbose = display list of all commands available
           =2HCO = concise = only display last command executed as
                             the default command option
    NMENU - (output) - command number [1-11] for computed GO TO in
                       NTWRK of the command selected by the user

ROUTINES CALLED
    GETVL - read user command response
    IBYTE - retrieve single characters for match check
    ERASE - erase screen

CALLED BY
    NTWRK - to display and request legal commands.

B.2.1.3 MHELP

SUBROUTINE DESCRIPTION

Whenever the HELP or NEWS command is requested, NTWRK packs the NAME parameter and calls MHELP to display the file contents. MHELP will pause after one screen of text and wait for a carriage return before erasing the screen and continuing. The user can halt the display by hitting any key to interrupt the program and responding with BR to break out. If HELP is requested for a command that does not exist (e.g. HELP XYZ), MHELP will respond with the message:

Could not OPEN (H.XYZ::NT). Error= 506

All HELP files are preceded with "H.". Error 506 means file not found.

COMMON BLOCKS
    /LU/   - terminal I/O unit numbers

ARGUMENTS - SUBROUTINE MHELP(NAME)
    NAME - (input) - 6-word array containing the file name to display
           Should be in standard HP RTE-6/VM NAMR format

ROUTINES CALLED
    IFBRK - determine if user interrupted with "BR" to halt
    ERASE - erase screen
    ITLOG - retrieve number of characters in last READ
    BELL - ring bell
    GETVL - request user carriage return

CALLED BY
    NTWRK - to display the contents of a HELP file

B.2.1.4 STAVL

SUBROUTINE DESCRIPTION

    STAVL will READ/WRITE the parameters for a specified station on file STATS into/from common block /SDATA/.

COMMON BLOCKS
    /DFILE/ - data base information for STATS file

ARGUMENTS - SUBROUTINE STAVL(MODE,NREC)
    MODE - (input) = 0 = READ station parameters from STATS into
                        common block /SDATA/
                   = 1 = WRITE station parameters from common block
                        /SDATA/ onto file STATS
    NREC - (input) - record number to access on file STATS

ROUTINES CALLED
    NEOPN - open STATS data file
    NERD - read data from STATS
    NEWR - write data onto STATS

CALLED BY
    NEINP - to READ/WRITE station parameters on file STATS

B.2.1.5 LOOK

SUBROUTINE DESCRIPTION

    LOOK will search through VMA arrays in COMMON /SVMA/ to find a match for station name or call sign. Since station name and call sign must be unique for every station, commands such as ADD, EDIT, and DELETE may be referenced by these parameters. The VMA common arrays are initialized at the beginning of NTWRK and are maintained whenever a new station is ADDed, EDITed, or DELETEd.

COMMON BLOCKS
    /SVMA/ - VMA arrays for all station names and call signs
    /DFILE/ - data base information for STATS file

```
ARGUMENTS - SUBROUTINE LOOK(IALF,NUM,IREC)
    IALF - (input) = text string to match
    NUM  - (input) = number of words in IALF
                   = 3 = CALL SIGN
                   = 4 = station NAME
    IREC - (output)= station number if match was found
                   = 0 = no match found

ROUTINES CALLED
    None

CALLED BY
    NTWRK - find first vacant spot to ADD new station in STATS
    NAME  - determine if new station name already exists
    SIGN  - determine if new call sign already exists
    NEDEL - return station number for given station name or call sign
            of station to DELETE
    NEDIT - return station number for given station name or call sign
            of station to EDIT
```

B.2.1.6 NEINP

SUBROUTINE DESCRIPTION

NEINP prompts the user to input station parameter data for a new station (ADD) or to modify an existing station (EDIT). For each of the 10 station parameters, a different subroutine is called to prompt the user and check for valid data. Once all data has been entered, a summary will be displayed. The user can then accept or reject the data. If accepted, the user can process the new or modified station and have its coverage calculated. This is performed with a SWAP to NTUPD.

```
COMMON BLOCKS
    /BAUD/  - terminal baud rate (Tektronix only)
    /LU/    - terminal I/O unit numbers
    /GETIT/ - communication with GETVL routine
    /PARAM/ - verbose/concise question flag
    /SDATA/ - in-core station parameters read from STATS file
    /DFILE/ - data base information for STATS file

ARGUMENTS - SUBROUTINE NEINP(MODE,*)
    MODE - 0 = new station from ADD command. All parameter questions
               will be asked.
           1 = modify existing station from EDIT command. Allow user
               to specify which parameters to change.
    *    - alternate return statement number if data input is not to
               be saved.

ROUTINES CALLED
    NAME  - to input station name
    SIGN  - to input station call sign
```

```
    FREQ  - to input station frequency index
    SITE  - to input station latitude/longitude location
    POWR  - to input transmitter output power
    AHAG1 - to input antenna height above ground
    ELEV  - to input antenna height above mean sea level
    AZIM  - to input antenna main beam azimuth
    GAIN  - to input antenna power gain
    LINE  - to input line losses from transmitter output to antenna
            input
    ERASE - erase screen before data summary
    DDMS  - convert decimal degrees to degrees, minutes, seconds
    STAVL - store data on STATS if accepted
    GETVL - request user response from terminal
    SWAP  - EXEC program swap to NTUPD

CALLED BY
    NTWRK - to ADD a new station to file STATS
    NEDIT - to EDIT an existing station's parameters
```

B.2.1.7 NAME

SUBROUTINE DESCRIPTION

NAME requests the station location name from the user. The location name can be a maximum of 7 characters with the first 2 characters being the state abbreviation. The name entered must also be unique in the STATS data base. If an existing name is entered, the user will be informed as to which other station has the same name.

```
COMMON BLOCKS
    /LU/    - terminal I/O unit numbers
    /GETIT/ - communication with GETVL routine
    /PARAM/ - verbose/concise question flag
    /DFILE/ - data base information for STATS file

ARGUMENTS - SUBROUTINE NAME(INUM,LOCS,*)
    INUM  - (input) - data parameter number (=1 for NAME)
    LOCS  - (output)- 7-character (3A2,A1) location name
    *     - alternate return statement number for "BAILOUT"
            If user inputs "::", control is sent to this statement

ROUTINES CALLED
    GETVL - request station name from user
    BYTE  - pack characters into LOCS
    IBYTE - extract characters from GETVL array ICARD
    LOOK  - check for duplicate station name

CALLED BY
    NEINP - to allow user input of station location name
```

B.2.1.8 SIGN

SUBROUTINE DESCRIPTION

SIGN requests the station call sign from the user. The call sign can be a maximum of 5 characters and must also be unique in the STATS data base. If an existing call sign is entered, the user will be informed as to which other station has the same call sign.

```
COMMON BLOCKS
    /LU/    - terminal I/O unit numbers
    /GETIT/ - communication with GETVL routine
    /PARAM/ - verbose/concise question flag
    /DFILE/ - data base information for STATS file

ARGUMENTS - SUBROUTINE SIGN(INUM,IDS,*)
    INUM  - (input) - data parameter number (=2 for SIGN)
    IDS   - (output)- 5-character (2A2,A1) call sign
    *     - alternate return statement number for "BAILOUT"
            If user inputs "::", control is sent to this statement

ROUTINES CALLED
    GETVL - request call sign from user
    BYTE  - pack characters into IDS
    IBYTE - extract characters from GETVL array ICARD
    LOOK  - check for duplicate call sign

CALLED BY
    NEINP - to allow user input of station call sign
```

B.2.1.9 FREQ

SUBROUTINE DESCRIPTION

FREQ requests the station transmission frequency from the user. COMMON block /FREQA/ must be initialized to define the number of frequencies and their values in MHz. Frequency index IFREQ must be in the range 1-NFREQ.

```
COMMON BLOCKS
    /LU/    - terminal I/O unit numbers
    /GETIT/ - communication with GETVL routine
    /PARAM/ - verbose/concise question flag
    /DFILE/ - data base information for STATS file
    /FREQA/ - frequency index definitions

ARGUMENTS - SUBROUTINE FREQ(INUM,IFREQ,*)
    INUM  - (input) - data parameter number (=3 for FREQ)
    IFREQ - (input) - default frequency index number
                      If user responds with [CR], IFREQ is unchanged.
    IFREQ - (output)- frequency index number
```

Must be in range 1-NFREQ
    *   - alternate return statement number for "BAILOUT"
            If user inputs "::", control is sent to this statement.

ROUTINES CALLED
    GETVL - request user input

CALLED BY
    NEINP - to allow user input of station frequency index

B.2.1.10 SITE

SUBROUTINE DESCRIPTION

SITE requests the station location in latitude/longitude from the user. Latitude/longitude may be input as either decimal degrees or degrees, minutes, seconds. Longitude is assumed to be west, so negative values are not allowed. Input values outside the min/max limits are considered illegal.

COMMON BLOCKS
    /LU/   - terminal I/O unit numbers
    /GETIT/ - communication with GETVL routine
    /PARAM/ - verbose/concise question flag

ARGUMENTS - SUBROUTINE SITE(INUM,XLAT,XLON,XLOLAT,XHILAT,
                            XLOLON,XHILON,*)
    INUM - (input) - data parameter number (=4 for SITE)
    XLAT,XLON - (input) - default station location
                 If user responds with [CR], XLAT,XLON are unchanged
    XLAT,XLON - (output)- station location - latitude,longitude
                          decimal degrees, west longitude is negative
    XLOLAT,XHILAT - (input) - latitude limits for XLAT
    XLOLON,XHILON - (input) - longitude limits for XLON
    *   - alternate return statement number for "BAILOUT"
            If user inputs "::", control is sent to this statement.

ROUTINES CALLED
    DDMS - convert decimal degrees to degrees, minutes, seconds
    GETVL - request user input

CALLED BY
    NEINP - to allow user input of station latitude and longitude

B.2.1.11 POWR

SUBROUTINE DESCRIPTION

POWR requests the transmitter output power from the user. Limits in NETWORK are .0001 <= POW1 <= 1000 watts. POW1=0 is not defined in the propagation equations (LOG(POW1)). POWR will set POW1=.0001 if

the user inputs a value of 0. This allows the user to temporarily remove a station by removing its power. This is preferred over DELETE because DELETE assumes you want it removed forever.

```
COMMON BLOCKS
    /LU/    - terminal I/O unit numbers
    /GETIT/ - communication with GETVL routine
    /PARAM/ - verbose/concise question flag and power units

ARGUMENTS - SUBROUTINE POWR(INUM,POW1,XLO,XHI,*)
    INUM  - (input) - data parameter number (=5 for POWR)
    POW1  - (input) - default transmitter output power in watts
                      If user responds with a [CR], POW1 is unchanged
    POW1  - (output)- transmitter output power in watts
                      XLO <= POW1 <= XHI
    XLO   - (input) - minimum power allowed in watts
    XHI   - (input) - maximum power allowed in watts
    *     - alternate return statement number for "BAILOUT"
            If user inputs "::", control is sent to this statement

ROUTINES CALLED
    GETVL - request user input

CALLED BY
    NEINP - to allow user input of transmitter output power
```

B.2.1.12 AHAG1

SUBROUTINE DESCRIPTION

AHAG1 requests the user to specify the antenna height above the ground. While internal units for HAG is meters, the user default for input is feet. To input meters, add the suffix "M" (e.g. 100M). Limits in NETWORK are:

```
                    .5 <= HAG(meters) <= 3000   or
                   1.6 <= HAG(feet)   <= 9842.5
```

```
COMMON BLOCKS
    /LU/    - terminal I/O unit numbers
    /GETIT/ - communication with GETVL routine
    /PARAM/ - verbose/concise question flag and length units

ARGUMENTS - SUBROUTINE AHAG1(INUM,HAG,XLO,XHI,*)
    INUM  - (input) - data parameter number (=6 for AHAG1)
    HAG   - (input) - default antenna height in meters
                      If user responds with a [CR], HAG is unchanged
    HAG   - (output)- antenna height in meters
                      User default specification in NETWORK is feet
                      AHAG1 converts units to meters for internal use
```

```
    XLO   - (input) - minimum value of HAG allowed in meters
    XHI   - (input) - maximum value of HAG allowed in meters
    *     - alternate return statement number for "BAILOUT"
            If user inputs "::", control is sent to this statement.

ROUTINES CALLED
    GETVL - request user input

CALLED BY
    NEINP - to allow user input of antenna height above ground
```

B.2.1.13 ELEV

SUBROUTINE DESCRIPTION

ELEV requests the station elevation above mean sea level from the user. Internal units for ELEVX are meters. User must input the data in feet. Limits are -285 <= ELEVX <= 14500 feet. User may either specify the elevation, or have ELEV retrieve the elevation for the given station latitude/longitude from topographic files.

```
COMMON BLOCKS
    /LU/    - terminal I/O unit numbers
    /GETIT/ - communication with GETVL routine
    /PARAM/ - verbose/concise question flag
    /DATA/  - arrays for PFLTP to read topographic data

ARGUMENTS - SUBROUTINE ELEV(INUM,ELEVX,XLAT,XLON,*)
    INUM  - (input) - data parameter number (=7 for ELEV)
    ELEVX - (input) - default station elevation in meters
                      If user responds with a [CR], ELEVX is unchanged
    ELEVX - (output)- station elevation in meters
    (XLAT,XLON) - (input) - station location in latitude,longitude
                      Longitude is negative for west Used to extract
                      elevation data from topographic files
    *     - alternate return statement number for "BAILOUT"
            If user inputs "::", control is sent to this statement.

ROUTINES CALLED
    GETVL - request user input
    PFLTP - to extract elevation from topographic data base

CALLED BY
    NEINP - to allow user input of station elevation above sea level
```

B.2.1.14 AZIM

SUBROUTINE DESCRIPTION

AZIM requests the antenna's main beam azimuth from the user.

```
COMMON BLOCKS
    /LU/    - terminal I/O unit numbers
    /GETIT/ - communication with GETVL routine
    /PARAM/ - verbose/concise question flag

ARGUMENTS - SUBROUTINE AZIM(INUM,SAZIM,*)
    INUM  - (input) - data parameter number (=8 for AZIM)
    SAZIM - (input) - default main beam azimuth clockwise
                      If user responds with [CR], SAZIM is unchanged
    SAZIM - (output)- 0<=SAZIM<=360 - main beam azimuth clockwise
                                      from true north
                      -1 = omni-directional antenna
    *     - alternate return statement number for "BAILOUT"
            If user inputs "::", control is sent to this statement.

ROUTINES CALLED
    GETVL - request user input

CALLED BY
    NEINP - to allow user input of antenna main beam azimuth
```

B.2.1.15 GAIN

SUBROUTINE DESCRIPTION

GAIN requests the antenna power gain from the user.

```
COMMON BLOCKS
    /LU/    - terminal I/O unit numbers
    /GETIT/ - communication with GETVL routine
    /PARAM/ - verbose/concise question flag

ARGUMENTS - SUBROUTINE GAIN(INUM,SGAIN,*)
    INUM  - (input) - data parameter number (=9 for GAIN)
    SGAIN - (input) - default antenna power gain
                      If user responds with [CR], SGAIN is unchanged.
    SGAIN - (output)- antenna power gain (must be between 0 and 22 dBi)
    *     - alternate return statement number for "BAILOUT"
            If user inputs "::", control is sent to this statement.

ROUTINES CALLED
    GETVL - request user input

CALLED BY
    NEINP - to allow user input of antenna power gain
```

B.2.1.16 LINE

SUBROUTINE DESCRIPTION

LINE requests the station line losses from transmitter output to antenna input.

COMMON BLOCKS
    /LU/   - terminal I/O unit numbers
    /GETIT/ - communication with GETVL routine
    /PARAM/ - verbose/concise question flag

ARGUMENTS - SUBROUTINE LINE(INUM,SLOSS,*)
    INUM - (input) - data parameter number (=10 for LINE)
    SLOSS - (input) - default line losses
                      If user responds with [CR], SLOSS is unchanged.
    SLOSS - (output)- line losses (must be between 0 and 10 dB)
    *   - alternate return statement number for "BAILOUT"
            If user inputs "::", control is sent to this statement.

ROUTINES CALLED
    GETVL - request user input

CALLED BY
    NEINP - to allow user input of line losses from transmitter
            output to antenna input

B.2.1.17 NEDEL

SUBROUTINE DESCRIPTION

NEDEL allows the user to delete a station from the STATS data base. This should only be used when the user wants to eliminate a station forever. To temporarily remove a station, EDIT the station and set its power=0. When a delete occurs, NEDEL sets the station name to ".ZZZZZ". This is a flag to allow ADD to reuse the location. Also, NTUPD is run to allow the coverage to be removed from the grid and display files.

The user may specify the station to delete with its location name, call sign, or station index number.

COMMON BLOCKS
    /BAUD/ - terminal baud rate (Tektronix only)
    /LU/   - terminal I/O unit numbers
    /GETIT/ - communication with GETVL routine
    /SDATA/ - in-core station parameters read from STATS file
    /DFILE/ - data base information for STATS file

ARGUMENTS - SUBROUTINE NEDEL(*)
    *   - alternate return statement number if user overrides delete

ROUTINES CALLED
    GETVL - request user input
    IBYTE - extract a character from an array
    BYTE - store a character into an array
    LOOK - search for name or call sign match
    NESUM - summarize the parameters for a single station

STAVL - store delete flag back onto the STATS file
SWAP - execute NTUPD to remove station from coverage data bases

CALLED BY
NTWRK - to delete a station from the STATS data base

B.2.1.18 NEDIT

SUBROUTINE DESCRIPTION

NEDIT allows the user to modify parameters for an existing station. The station to modify is specified by its station name, call sign, or its index number. Once selected, the current station parameters are displayed. NEINP is then called to allow values to be changed. The user must then accept the changes before the data is written to the STATS file.

COMMON BLOCKS
/LU/ - terminal I/O unit numbers
/GETIT/ - communication with GETVL routine
/SDATA/ - in-core station parameters read from STATS file
/DFILE/ - data base information for STATS file

ARGUMENTS - SUBROUTINE NEDIT(*)
* - alternate return statement number if user ignores EDIT changes made

ROUTINES CALLED
GETVL - request user input
IBYTE - extract a character from an array
BYTE - store a character into an array
LOOK - search for name or call sign match
NESUM - summarize the parameters for a single station
NEINP - request from user parameters to modify

CALLED BY
NTWRK - to allow user to modify parameters of an existing station

B.2.1.19 NESUMM

SUBROUTINE DESCRIPTION

NESUMM allows the user to display a summary of station parameters. Single stations or groups of stations may be summarized. NESUMM will display the following options:

SUMMARY COMMAND OPTIONS:

1 = by STATE

2 = by INDEX NUMBER RANGE

3 = by INDEX NUMBER VALUE

Since the station name SHOULD be coded with the first two characters as the state code, summary by state (1) becomes rather simple. Option (2) will request a low and high index number. All stations within this range will be summarized. Option (3) allows the user to input up to 10 random index numbers which will be summarized.

COMMON BLOCKS
    /LU/   - terminal I/O unit numbers
    /GETIT/ - communication with GETVL routine
    /SDATA/ - in-core station parameters read from STATS file
    /DFILE/ - data base information for STATS file

ARGUMENTS - SUBROUTINE NESUMM
    None

ROUTINES CALLED
    BELL - ring the bell
    ITLOG - determine number of characters in last read
    NEOPN - open STATS data base
    ERASE - erase screen
    NERD - read a station from STATS data base
    DDMS - convert decimal degrees to degrees, minutes, seconds
    IFBRK - determine if user "BREAK" occurred to stop listing

CALLED BY
    NTWRK - to display a summary of station parameter data

B.2.2 NTUPD Routines - source file &NTUPD::NT

B.2.2.1 NTUPD

PROGRAM DESCRIPTION

NTUPD is the driver program that performs the statistical propagation loss calculations on every grid point within 200 km of a transmitter station. The ITM routines are used in the area prediction mode. This simplifies the data required and greatly increases the speed. NTUPD can be executed in either the stand-alone mode where the user will be queried, or it can retrieve parameters with RMPAR and can process a station defined by NETWORK's main program NTWRK. Its general mode of operation is that it opens all data bases necessary (STATS, STATI, STATD, STATG1, STATG2, HBARD, PROPVM) and passes control to NEUPD to perform the calculations.

COMMON BLOCKS
    /STG/   - number of grid points used in STATG2 data base
    /MAXG/ - maximum number of grid points in STATG2 data base

/BAUD/ - terminal baud rate (Tektronix only)
/MMEVAL/- min/max field strength values
/ISTATC/- in-core data from STATI data base
/DFILE/ - data base information for STATS file
/SDATA/ - in-core station parameters read from STATS file
/LU/ - terminal I/O unit numbers

FILES

The files used by NTUPD include STATS, STATI, STATD, STATG1, STATG2, HBARD, and PROPVM.

ROUTINES CALLED

RMPAR - retrieve parameters passed from NTWRK
STATS - initiate setup for I/O to file STATS
STATD - OPEN/CLOSE STATD data base
STATI - OPEN/CLOSE STATI file
STATG - OPEN/CLOSE STATG1 and STATG2 data bases
HBARG - OPEN/CLOSE HBARD data base
PROVM - OPEN file PROPVM and fill VMA block /PRODC/
BELL - ring bell
NEOPN - OPEN the STATS data file
NESUM - summarize parameters for a single station
IFIND - see if station already exists on STATI file
NEUPD - direct the coverage calculations for a specified station
NEDEL - delete a station from the grid and display files
DELI - remove a station from the STATI file
SETI - add a station to the STATI file
GETI - get station information from STATI file
DDMS - convert decimal degrees to degrees, minutes, seconds

B.2.2.2 NEUPD

SUBROUTINE DESCRIPTION

NEUPD determines all grid points within 200 km of the transmitter being processed, calculates the desired E(95,95,50) and undesired E(10,50,50) field strengths for these points, and stores the results into the grid (STATG2) and display (STATD) data bases. Subroutine BOX is used to find all 1-degree blocks within 200 km of the station. Processing is rather straightforward after that. A special debug mode (KODE=3 or 4) allows the user to print out intermediate values at 4 bearings and 9 distances from the station. These results are not saved in the grid or display files.

COMMON BLOCKS

/STG/ - number of grid points used in STATG2 data base
/MAXG/ - maximum number of grid points in STATG2 data base
/MMEVAL/- min/max field strength values
/DFILE/ - data base information for STATS file
/SDATA/ - in-core station parameters read from STATS file

/LU/ - terminal I/O unit numbers
/PROP/ - communication with ITM routines
/ZVALS/ - standard normal deviates for AVAR
/PASSIT/- communication with NTUPD for debug printing

ARGUMENTS - SUBROUTINE NEUPD(KODE,IDNUM)
KODE - (input) - flag directing NEUPD operation
= 1 = ADD new station into coverage
= 2 = CHANGE - calculate coverage for an existing station
= 3 = debug mode. Print onto terminal coverage calculations at 9 distances and 4 bearings.
= 4 = debug mode. Print onto terminal and line printer coverage calculations at 9 distances and 4 bearings.
IDNUM-(input) - station index number to process

ROUTINES CALLED
GTBLK - convert lat/lon to block/index
QERFI - ITM routine to calculate standard normal deviates
BOX - calculate lat/lon limits 200 km around a station
XCLOS - find closest lat/lon
DESIC - calculate great circle distance between two points
INDBLK- calculate block number
HBARG - retrieve average elevation data for specified block
XMDLOS- calculate median basic transmission loss
GANT - antenna gain function for directional antennas
IPNTG - get grid pointer for specified block/index
DELGG - remove coverage from specified grid point
INSERT- insert coverage data into grid and display data bases

CALLED BY
NTUPD - to calculate coverage for a specified station

B.2.2.3 XMDLOS

SUBROUTINE DESCRIPTION

XMDLOS computes the basic transmission loss between the points (XLAT,XLON) and (ZRLAT,ZRLON) for both the desired E(95,95,50) and the undesired E(10,50,50) signal levels. The ITM routines QLRPS, QLRAR, LRPRP, and AVAR are used here in the area prediction mode. The unusual features of this routine are the definitions of the propagation parameters HBAR, N-sub-S, and DELTH. HBAR, the average elevation, is used in the calculation of effective antenna height:

HE(1)=HG(1)+ELEV-HBAR

where HG(1)=antenna height above the ground, and
ELEV =station elevation above mean sea level.

HBAR is chosen at a point 10 km from the transmitter on line with the

receiver. If the receiver is closer than 10 km, the receiver HBAR is used. HBAR is interpolated from the HBARG data base which is aligned with the grid points (4-minute separation). DELTH (terrain irregularity) and N-sub-S (surface refractivity) are interpolated from the PROPVM data base (30-minute separation). HBAR requires the finer grid size because it needs to be responsive to terrain changes. DELTH defines the terrain irregularity for an area. Its definition becomes confused as that area sie is decreased. For distances less than 60 km, DELTH and N-sub-S are chosen at the midpoint. For distances greater than 60 km, they are the average of the values 30 km from each point.

COMMON BLOCKS
    /DHBAR/ - average elevation in core buffer
    /PROP/   - communication with ITM routines
    /ZVALS/ - standard normal deviates for AVAR
    /PASSIT/ - communication with NEUPD for debug printing

ARGUMENTS - SUBROUTINE XMDLOS(FMHZ,ELEV,DIST,BEAR,XLAT,XLON,DESIR,UNDES)
    FMHZ - (input) - transmission frequency in MHz
    ELEV - (input) - station elevation above mean sea level (meters)
    DIST - (input) - distance from station to grid point (meters)
    BEAR - (input) - bearing from station to grid point (degrees)
    XLAT - (input) - station latitude coordinate decimal degrees
    XLON - (input) - station longitude coordinate decimal degrees
    DESIR- (output)-transmission loss for desired station (95,95,50)
    UNDES- (output)-transmission loss for undesired station (10,50,50)

ROUTINES CALLED
    DAZET - calculate lat/lon given lat/lon, bearing, distance
    PRODV - retrieve DELTA-H and N-sub-S parameters
    GTBLK - convert lat/lon to block/index
    HBARG - load 1 block of average elevation data into memory
    IHBARA- retrieve average elevation data of specific grid point
    QLRPS - ITM routine to initialize parameters
    LRPRP - ITM routine to compute the reference attenuation
    AVAR - ITM routine to compute statistical attenuation quantiles

CALLED BY
    NEUPD - to calculate the desired and undesired basic transmission
            loss

B.2.2.4 INSERT

SUBROUTINE DESCRIPTION

INSERT will insert the station service parameters for the specified grid point into the grid file data base (STATG2). The

station service parameters are packed into 3 words by routine PACK and are: station index number, frequency index, distance from grid point, and desired (E(95,95,50)) and undesired (E(10,50,50)) field intensity strengths. INSERT uses IPNTG to get the grid point index and GET2 to load the current service parameters into common block /GRID/. Then a determination is made if the station is new or if it already exists and needs to be replaced. PACK is used to pack the service parameters and SETG will merge them into the IGRID array maintaining the order sorted by distance. KOVER is then used to calculate the coverage code and the update for this grid point is complete.

COMMON BLOCKS
    /GRID/ - coverage information for specified grid point
    /LU/   - terminal I/O unit numbers

ARGUMENTS - SUBROUTINE INSERT(ID,DIST,IBLK,INDEX,ICODE,IFREQ,EDES,EUND)
    ID   - (input) - station index number to insert
    DIST - (input) - distance from station to grid point (meters)
    IBLK - (input) - block number (1-1560) containing grid point
    INDEX - (input) - index number (1-225) within IBLK of grid point
    ICODE - (input) - insert code (1=add a new station)
                                  (2=change an existing station)
    IFREQ - (input) - station frequency index (1 thru 7)
    EDES - (input) - E(95,95,50) - the desired field intensity
    EUND - (input) - E(10,50,50) - the undesired field intensity

ROUTINES CALLED
    IPNTG - retrieve grid pointer for specified block/index
    GET2 - load grid point information into memory
    PACK - pack grid coverage information
    SETG - store packed coverage information into STATG2 data base
    KOVER - calculate coverage code for specified grid point

CALLED BY
    NEUPD - to insert coverage information into grid and display files

B.2.2.5 KOVER

SUBROUTINE DESCRIPTION

KOVER calculates the coverage code for a specified grid point. Common block /GRID/ must contain the grid file information for the grid point in question. This is done with a call to GET2. Since the stations that affect this grid point are stored in order by closest station first, KOVER assumes the closest station is the desired

station. Using EVAL, it converts the packed desired field intensity into dBu and compares that with the service threshold of 18 dBu. If less that 18 dBu, service is not considered adequate, and KOV=0 is assigned. Now all other stations at the same frequency are examined. If any of those stations have an undesired field intensity greater than or equal to the desired-10, co-channel interference is assumed and KOV=2. Otherwise the grid point is in service and KOV=1. The coverage code, frequency, and distance are then stored into the display data base (STATD) with PUTDSP for use by the plotting program NTPLT.

COMMON BLOCKS
    /GRID/ - coverage information for specified grid point
    /GRID2/- DCB block + flags for STATG2 data base I/O

ARGUMENTS - SUBROUTINE KOVER(IBLK,INDEX,KOV)
    IBLK - (input) - block number (1-1560) for grid point of interest
    INDEX - (input) - index number (1-225) within block of grid point
    KOV   - (output)- calculated coverage code of grid point
                    =0= grid point not covered
                    =1= grid point covered
                    =2= grid point experiences co-channel interference

ROUTINES CALLED
    EVAL - convert packed data to field strength values
    PUTDSP- store coverage code into display data base

CALLED BY
    INSERT- to calculate coverage code for specified grid point and
            store coverage code into display data base

B.2.2.6 XCLOS

FUNCTION DESCRIPTION

XCLOS is used to calculate the closest grid point coordinate to a given latitude or longitude coordinate. Thus, XCLOS is used once for latitude and once for longitude. This is used by NEUPD to determine if any grid point within a specified 1-degree block is within 200 km of the station, thus reducing the number of computations that need to be made.

ARGUMENTS - FUNCTION XCLOS(X,K,BLKINC)
    X   - (input) - latitude or longitude coordinate
    K   - (input) - lat/lon coordinate of SW corner of 1-deg block
    BLKINC- (input) - distance along side of grid block (decimal
                      degrees). (For 4-minute grids = 56/60 = .933333)

XCLOS - (output)- closest grid point coordinate (lat or lon) to X

ROUTINES CALLED
None

CALLED BY
NEUPD - to calculate closest grid point to station location

B.2.2.7 DESIC

SUBROUTINE DESCRIPTION

DESIC is used to calculate the great circle distance between two points given in latitude/longitude pairs. DESIC previously performed all the calculations internally, but to standardize calculations, DESIC was modified to call DAZEL. DAZEL requires COMMON /AZEL/ to be filled with the values prior to being called. Thus, this version of DESIC returns the distance in meters and the bearing between the two specified points. DAZEL is part of the TA SERVICES support routines.

COMMON BLOCKS
/AZEL/ - communication to DAZEL subroutine which performs the distance calculations

ARGUMENTS - SUBROUTINE DESIC(DLAT0,DLON0,THT,DLAT1,DLON1,RHT,DIST,BEAR)
DLAT0,DLON0 - (input) - lat/lon of transmitter (decimal degrees)
THT - (input) - elevation of transmitter (meters)
DLAT1,DLON1 - (input) - lat/lon of receiver (decimal degrees)
RHT - (input) - elevation of receiver (meters)
DIST - (output) - great circle distance between points (meters)
BEAR - (output) - bearing from transmitter toward receiver (degrees clockwise from true north)

ROUTINES CALLED
DAZEL - perform distance calculations

CALLED BY
NEUPD - to calculate great circle distance between points

B.2.2.8 GANT

FUNCTION DESCRIPTION

GANT is used to calculate the antenna gain function for directional antennas. Directional antennas have gain functions that are not symmetrical about the antenna. GANT currently has data for only one antenna type. The array GFACT can be changed to allow for more antenna gain functions as the data becomes available.

ARGUMENTS - FUNCTION GANT(BEAR,ITYPE,AZIM)
    BEAR - (input) - [0-360 degrees]-bearing for which gain is desired
    ITYPE- (input) - index of particular antenna patter desired
                     (Only ITYPE=1 currently provided)
    AZIM - (input) - [0-360 degrees]-bearing of antenna in offset mode
                     =-1 = omni-directional, GANT=1. on output
    GANT - (output)- antenna gain for specified offset

ROUTINES CALLED
    None

CALLED BY
    NEUPD - to calculate the antenna gain function for directional
            antennas

B.2.3 NTPLT Routines - source file &NTPLT::NT.

B.2.3.1 NTPLT

PROGRAM DESCRIPTION

NTPLT is the driver program that performs the graphical plotting for the NETWORK model. NTPLT can be executed in either the stand-alone mode or it can be activated with the PLOT command from program NTWRK. NTPLT requires heavy use of the MLLDR multilevel loader because of the varied data base arrays required and the overhead associated with using the AGP routines.

NTPLT is rather straightforward in its code except for the use of the subroutine TABLE. Normally TABLE is used to display the list of stations at the end of the plot to allow use of FORTRAN WRITE statements (for more speed on the Tektronix). But when this was done on the HP9872 pen plotter (not using WRITE), the viewport was messed up. Therefore, for HP9872 plotter, TABLE is the first information plotted. This accounts for the IF branches with TABLE at the beginning and also at the end. It appeared to be a problem in AGP that could not be solved.

COMMON BLOCKS
    /BAUD/ - terminal baud rate (Tektronix only)
    /ALSC/ - window parameters filled by ALSCL
    /ISTATC/- in-core data from STATI data base
    /MINMAX/- min/max view window coordinates in lat/lon
    /LU/   - terminal I/O unit numbers
    /GETIT/ - communication with GETVL routine
    /COLOR/ - color array for background, coverage, interference

FILES

The files used by NTPLT include STATS, STATI, STATD, and the geographic boundary files POLYMP and STATES.

ROUTINES CALLED

RMPAR - retrieve parameters passed from NTWRK
LGBUF - define larger input buffer to read POLYMP and STATES files
ERASE - erase screen
GETWSP- prompt user for graphic terminal type
STATI - OPEN/CLOSE STATI file
STATS - initiate setup for I/O to file STATS
READS - read station locations into /LOCAT/ from STATS data base
STATD - OPEN/CLOSE STATD data base
BELL - ring bell
GETVL - prompt user for character or numeric input data
GTPEN - get pen colors to use for plotting
GTWND - get geographic view window from user
INITT - initialize AGP routines
ALSCL - convert window to Albers scale factors
JCOLR - AGP routine to set color
JVIEW - AGP routine to set viewport
TABLE - display list of stations in view window
JWIND - AGP routine to set view window
JCLPW - AGP routine to activate clipping
ERASA - erase alpha area of HP terminals
SMASK - draw border and display viewable stations
DRMAP - draw state or county boundaries
JMCUR - AGP routine to update display
GTBLK - convert lat/lon to block/index
POLY - plot coverage as polygons
BSHAD - plot coverage as horizontal shading
J2MOV - AGP routine to move pen
JWOFF,JWEND,JEND - AGP routines to end graphics

B.2.3.2 ALSCL

SUBROUTINE DESCRIPTION

ALSCL calculates the necessary parameters for the AGP window and viewport given the lat/lon display boundaries in /MINMAX/. The lat/lon coordinates are converted to Albers. The viewport and window parameters are calculated so as to have the same scale in X and Y. The aspect ratio of the screen is also taken into account. SLIMIT is calculated to be 1/15th of the screen size and is used to size the display characters.

COMMON BLOCKS

/ALSC/ - window parameters filled by ALSCL
/MINMAX/- min/max view window coordinates in lat/lon

```
ARGUMENTS - SUBROUTINE ALSCL(LUDSP,SCAL)
    LUDSP - (input) - unit number of graphics terminal
                      = 1 = interactive terminals
                      =62 = HP9872 pen plotter
    SCAL  - (input) - user specified scale factor

ROUTINES CALLED
    ALBER - convert lat/lon to Albers projection
    JIWS  - AGP routine to retrieve terminal aspect ratio
    JASPK - AGP routine to define aspect ratio

CALLED BY
    NTPLT - to calculate scale factor in Albers projection based
            on lat/lon limits of view window
```

B.2.3.3 TABLE

SUBROUTINE DESCRIPTION

TABLE is used to display the station number-location-frequency table associated with each plot. TABLE searches the "active" data base STATI and lists all stations that fall within the window coordinates and match the LDFREQ parameter.

```
COMMON BLOCKS
    /MINMAX/- min/max view window coordinates in lat/lon
    /ISTATC/- in-core data from STATI data base

ARGUMENTS - SUBROUTINE TABLE(LUDSP,ARS,LDFREQ)
    LUDSP - (input) - unit number of graphics terminal
                      = 1 = interactive terminals
                      =62 = HP9872 pen plotter
    ARS   - (input) - screen aspect ratio
    LDFREQ- (input) - frequency display flag
                       =0= display all stations
                           Otherwise display only stations with
                           frequency code LDFREQ

ROUTINES CALLED
    JWIND - AGP routine to set view window
    J2MOV - AGP routine to move pen
    JMCUR - AGP routine to update display
    JCSIZ - AGP routine to set the text height and width
    JTEXM - AGP routine to display medium quality text
    GETI  - get station information from STATI data file

CALLED BY
    NTPLT - to display a table of stations within view window.
```

B.2.3.4 SHADI

SUBROUTINE DESCRIPTION

SHADI is called to display the interference for the incore grid block as vertical shade lines. Only interference that matches the frequency display flag LDFREQ is displayed. (XLAT,XLON) is the lat/lon offset coordinates for the grid block.

COMMON BLOCKS
/DSTAT/ - current incore block from STATD data base

ARGUMENTS - SUBROUTINE SHADI(XLAT,XLON,LDFREQ)
XLAT - (input) - latitude offset of block being shaded
XLon - (input) - longitude offset of block being shaded
LDFREQ- (input) - frequency display flag
=0= display all stations
Otherwise display only stations with frequency code LDFREQ

ROUTINES CALLED
PLTAL - convert lat/lon to Albers and do move or draw
IYCHK - clip vertical shade lines at view window in lat/lon

CALLED BY
POLY - to shade interference areas vertically
BSHAD - to shade interference areas vertically

B.2.3.5 PLTAL

SUBROUTINE DESCRIPTION

PLTAL is used to move or draw to a lat/lon coordinate. PLTAL performs the Albers projection first.

ARGUMENTS - SUBROUTINE PLTAL(XLON,YLAT,IPEN)
XLON - (input) - longitude of coordinate
YLAT - (input) - latitude of coordinate
IPEN - (input) - pen up/down flag
=3= move to (XLON,YLAT)
=2= draw to (XLON,YLAT)

ROUTINES CALLED
ALBER - convert lat/lon to Albers coordinates
PLOTA - do graphics move or draw

CALLED BY
SHADI - to move or draw in Albers projection given lat/lon
POLY - to move or draw in Albers projection given lat/lon
BSHAD - to move or draw in Albers projection given lat/lon

B.2.3.6 ALBER

SUBROUTINE DESCRIPTION

ALBER is used to convert lat/lon coordinates to an Albers equiareal conical display projection to reduce distortion. The standard parallels are at 45.5 degrees and 29.5 degrees north latitude.

```
ARGUMENTS - SUBROUTINE ALBER(IFLAG,XLON,YLAT,XOUT,YOUT)
    IFLAG - (input) - flag
                      =0= initialization. (XLON,YLAT) is the center
                          of projection. (XOUT,YOUT) ignored.
                      =1= project (XLON,YLAT) in an Albers projection
                          to produce (XOUT,YOUT) in meters.
                      =2= inverse projection. (XOUT,YOUT) in Albers
                          and produce (XLON,YLAT) in lat/lon.
    XLON  - (input/output) - longitude in decimal degrees. See IFLAG.
                             Data type - REAL*6
    YLAT  - (input/output) - latitude  in decimal degrees. See IFLAG.
                             Data type - REAL*6
    XOUT  - (input/output) - X display coordinate(meters). See IFLAG.
    YOUT  - (input/output) - Y display coordinate(meters). See IFLAG.

ROUTINES CALLED
    None

CALLED BY
    ALSCL - to initialize projection center and convert lat/lon
    PLTAL - to convert lat/lon to Albers projection for plotting
    SMASK - to convert lat/lon to Albers projection for plotting
    LABEL - to convert lat/lon to Albers projection for plotting
    TICKY - to convert lat/lon to Albers projection for plotting
    TICKX - to convert lat/lon to Albers projection for plotting
```

B.2.3.7 GTWND

SUBROUTINE DESCRIPTION

GTWND requests the min/max view window from the user. Inputs are in latitude/longitude and may be specified in decimal degrees or degrees, minutes, seconds. Remember, since longitude is positive and assumed west, 126 < 65 (this states 126 is west of 65).

Limits are:

```
        126 <= longitude <= 65
         22 <= latitude  <= 51

COMMON BLOCKS
    /LU/     - terminal I/O unit numbers
    /GETIT/ - parameter passage to GETVL routine
    /MINMAX/- min/max view window coordinates in lat/lon
```

ARGUMENTS - SUBROUTINE GTWND
    None - parameters passed through common block /MINMAX/

ROUTINES CALLED
    DDMS - convert decimal degrees to degrees, minutes, seconds
    GETVL - request station name from user

CALLED BY
    NTPLT - to allow user input of view window

B.2.3.8 READS

SUBROUTINE DESCRIPTION

    READS is used to read all of the station locations and frequencies from the STATS data base. This information is saved in common block /LOCAT/ and is used to determine which stations are to be displayed and where the station masking should occur. (See SMASK.)

COMMON BLOCKS
    /LOCAT/ - station locations (degrees) and frequency index filled by READS
    /SDATA/ - in-core station parameters read from STATS file
    /DFILE/ - data base information for STATS file

ARGUMENTS - SUBROUTINE READS
    None

ROUTINES CALLED
    NEOPN - open STATS data file
    NERD - read station parameters from STATS data file

CALLED BY
    NTPLT - to read lat/lon coordinates of all stations

B.2.3.9 SMASK

SUBROUTINE DESCRIPTION

    SMASK is used to draw and label the geographical display window and to plot all stations within that window. All text labeling is done with FONT2 which is the Simplex Roman font. The /SCLIP/ VMA common is filled with the Albers coordinates of all stations visible and is used by DRMAP to "mask" out areas within SLIMIT of each station. This allows the station numbers to be readable because no graphics lines will go through them.

COMMON BLOCKS
    /MINMAX/- min/max view window in lat/lon

/SCLIP/ - station locations in Albers for DRMAP to clip around
/LOCAT/ - station locations (degrees) and frequency index filled by READS
/DFILE/ - data base information for STATS file

ARGUMENTS - SUBROUTINE SMASK(SLIMIT,MAJOR,ICODE,LDFREQ,*)

SLIMIT - (input) - distance (meters) away from center of station to mask. Is chosen large enough to allow a 3-digit station number to be displayed.

MAJOR - (input) - flag. MAJOR >= 3 and ICODE=0 means mark station locations with an "x".

ICODE - (input) - flag. See MAJOR for ICODE=0.
=1,2,3=label station with number and draw circle around it at distance SLIMIT
=4,5 =label station with number and no circle

LDFREQ - (input) - frequency display flag
=0= display all stations
Otherwise display only stations with frequency code LDFREQ

ROUTINES CALLED

JDFNT - AGP routine to open font file
JFONT - AGP routine to activate font file
JCSIZ - AGP routine to define text height and width
JJUST - AGP routine to define text positioning
ALBER - convert lat/lon to Albers projection
LABEL - label plot border with degrees, minutes, seconds
JCORI - AGP routine to define text angle
TICKY - draw vertical border line with tick marks
TICKX - draw horizontal border line with tick marks
IFBRK - halt plotting at user "BREAK" request
J2MOV - AGP routine to move pen
J2DRW - AGP routine to draw line
JTEXH - AGP routine to display high quality text
JMCUR - AGP routine to update display

CALLED BY

NTPLT - to display border and all stations within view window

B.2.3.10 LABEL

SUBROUTINE DESCRIPTION

LABEL is used by SMASK to label the view window border with degrees, minutes, seconds. Because LABEL assumes DEG<0 is west longitude and DEG>0 is north latitude, it will only work in that quarter of the earth. (X,Y)--the label position in degrees--is converted to meters with an Albers projection. (DX,DY) is then added to this position to move the label away from the border.

ARGUMENTS - SUBROUTINE LABEL(X,Y,DX,DY,ANG,DEG)

X - (input) - longitude of label (degrees)
Y - (input) - latitude of label (degrees)
DX - (input) - label X offset (meters)
DY - (input) - label Y offset (meters)
ANG - (input) - label angle (degrees)
DEG - (input) - label in decimal degrees Will be converted to degrees, minutes, seconds

ROUTINES CALLED
DDMS - convert decimal degrees to degrees, minutes, seconds
ALBER - convert lat/lon to Albers coordinates
J2MOV - AGP routine to position pen
JCORI - AGP routine to define text angle
JTEXH - AGP routine to display text

CALLED BY
SMASK - to label plot borders with degrees, minutes, seconds

B.2.3.11 TICKY

SUBROUTINE DESCRIPTION

TICKY is used to draw the vertical (east and west) borders of the view window. Tick marks are placed every 30 minutes (1/2 degree). Input parameters are in lat/lon degrees and are converted to an Albers projection before plotting. TICKH<0 will produce a tick mark left of the line; TICKH>0 will produce a tick mark right of the line.

ARGUMENTS - SUBROUTINE TICKY(YMIN,YMAX,X,TICKH)
YMIN - (input) - minimum latitude of view window (degrees)
YMAX - (input) - maximum latitude of view window (degrees)
X - (input) - longitude of border line (degrees)
= XMIN - western border, set TICKH>0
= XMAX - eastern border, set TICKH<0
TICKH - (input) - tick mark length in Albers projection meters

ROUTINES CALLED
ALBER - convert lat/lon to Albers coordinates
J2MOV - AGP routine to move pen
J2DRW - AGP routine to draw line

CALLED BY
SMASK - to draw vertical border lines with tick marks

B.2.3.12 TICKX

SUBROUTINE DESCRIPTION

TICKX is used to draw the horizontal (south and north) borders of the view window. Tick marks are placed every 30 minutes (1/2 degree). Input parameters are in lat/lon degrees and are converted to an Albers

projection before plotting. TICKH<0 will produce a tick mark below the line; TICKH>0 will produce a tick mark above the line.

```
ARGUMENTS - SUBROUTINE TICKX(XMIN,XMAX,Y,TICKH)
    XMIN  - (input) - minimum longitude of view window (degrees)
                      West longitude is negative
    XMAX  - (input) - maximum longitude of view window (degrees)
    Y     - (input) - latitude of border line (degrees)
                    = YMIN - southern border, set TICKH>0
                    = YMAX - northern border, set TICKH<0
    TICKH - (input) - tick mark length in Albers projection meters

ROUTINES CALLED
    ALBER - convert lat/lon to Albers coordinates
    J2MOV - AGP routine to move pen
    J2DRW - AGP routine to draw line

CALLED BY
    SMASK - to draw horizontal border lines with tick marks
```

B.2.3.13 POLY

SUBROUTINE DESCRIPTION

POLY is used to draw the coverage areas as polygons and then calls SHADI to shade interference areas if so desired. The technique used to draw polygons is that a vertical line is drawn wherever the coverage code changes along a horizontal set of grid points. Also, a horizontal line is drawn on the grid boundary where the coverage changes along a vertical set of grid points. Thus, POLY loops on all the grid blocks plotting little line segments where changes are detected. This will graphically produce polygons of coverage area around each station activated.

```
COMMON BLOCKS
    /COLOR/ - color array for background, coverage, interference
    /MINMAX/- min/max view window in lat/lon
    /DSTAT/ - current in-core block from STATD data base

ARGUMENTS - SUBROUTINE POLY(MINB,MAXB,IFLAG,LDFREQ,*)
    MINB  - (input) - minimum block number to shade (1-1560)
    MAXB  - (input) - maximum block number to shade (1-1560)
                      Must be >= MINB
    IFLAG - (input) - operation flag
                    =4= draw polygons for coverage only
                    =5= polygons for coverage and shade interference
                    =3= do both 1 and 2 above
```

```
    LDFREQ- (input) - frequency index of stations
                    =0= include all stations
                        Otherwise only draw polygon coverage for
                        stations with frequency=LDFREQ.
    *       - alternate return statement number if user causes
              a BREAK while POLY is processing. This allows the user
              to stop plotting and return to control of NTPLT.

ROUTINES CALLED
    JCOLR - AGP routine to set color
    IFBRK - halt plotting at user "BREAK" request
    GTBLK - convert block/index to lat/lon
    GETBD - get coverage display information bordering given block
    GETD  - get coverage display information of given 1-degree block
    IYCHK - clip vertical shade lines at view window in lat/lon
    IXCHK - clip horizontal shade lines at view window in lat/lon
    PLTAL - convert lat/lon to Albers and do move or draw
    JMCUR - AGP routine to update display
    SHADI - shade interference vertically

CALLED BY
    NTPLT - to plot coverage as polygons
```

B.2.3.14 GETBD

SUBROUTINE DESCRIPTION

GETBD will get the coverage code for the 15 border grid points along the north or east side of a specified block. This is required by POLY because for POLY to draw the line for different coverage codes, it must detect a change. Without these boundary points, it could not detect a change at each block border. POLY converts IBLK into NX and NY (IBLK=(NX-1)*26+NY). Then to get the northern boundary points, it requests with NY+1; for the eastern points, it requests NX+1.

```
COMMON BLOCKS
    /DSTAT/ - current in-core block from STATD data base

ARGUMENTS - SUBROUTINE GETBD(NX,NY,IXS,IXE,IYS,IYE,JCOV)
    NX    - (input) - east/west block coordinate
    NY    - (input) - north/south block coordinate
    IXS,IXE - (input) - x indexes to save
                      = (1,15) for north
                      = (1, 1) for east
    IYS,IYE - (input) - y indexes to save
                      = (1, 1) for north
                      = (1,15) for east
    JCOV - (output)- 15 word array to receive boundary coverage points

ROUTINES CALLED
    GETD  - get coverage display block into memory from STATD data base
```

CALLED BY
    POLY - to allow proper polygon drawing outside 1-degree block

B.2.3.15 BSHAD

SUBROUTINE DESCRIPTION

BSHAD is used to shade the coverage areas with vertical lines and then calls SHADI to shade interference areas horizontally if so desired. This is an alternative display option to the POLY subroutine described earlier. Only coverage that matches the frequency display flag LDFREQ is displayed.

COMMON BLOCKS
    /COLOR/ - color array for background, coverage, interference
    /MINMAX/- min/max view window in lat/lon
    /DSTAT/ - current in-core block from STATD data base

ARGUMENTS - SUBROUTINE BSHAD(MINB,MAXB,IFLAG,SLIMIT,LDFREQ,*)
    MINB - (input) - minimum block number to shade (1-1560)
    MAXB - (input) - maximum block number to shade (1-1560)
                      Must be >= MINB
    IFLAG - (input) - operation flag
                      =1= shade only coverage horizontal
                      =2= shade only interference vertical
                      =3= do both 1 and 2 above
    SLIMIT- (input) - distance(meters) from each station to ignore
    LDFREQ- (input) - frequency index of stations
                      =0= include all stations
                          Otherwise only draw polygon coverage for
                          stations with frequency=LDFREQ.
    *   - alternate return statement number if user causes
            a BREAK while BSHAD is processing. This allows the user
            to stop plotting and return to control of NTPLT.

ROUTINES CALLED
    JCOLR - AGP routine to set color
    IFBRK - halt plotting at user "BREAK" request
    GTBLK - convert block/index to lat/lon
    GETD - get coverage display information of given 1-degree block
    IXCHK - clip horizontal shade lines at view window in lat/lon
    PLTAL - convert lat/lon to Albers and do move or draw
    SHADI - shade interference vertically

CALLED BY
    NTPLT - to display coverage as horizontal shade lines

B.2.3.16 IXCHK

FUNCTION DESCRIPTION

IXCHK allows clipping of plot data at longitude border limits. Since the plotting is done in an Albers projection, lines cannot be clipped at the view window because the view window is curved in that projection. Therefore, clipping must occur in lat/lon coordinates. IXCHK checks to see if the horizontal line (XS,Y)-(XE,Y) is in the view window. IXCHK=0 if not in the view window. If XS or XE extend beyond the view window, they are set to the XMIN/XMAX limit, whichever they exceed.

COMMON BLOCKS
    /MINMAX/ - min/max view window in lat/lon

ARGUMENTS - FUNCTION IXCHK(XS,XE,Y)
    XS - (input) - starting longitude of line
         (output)- XS will lie within XMIN/XMAX defined in /MINMAX/
    XE - (input) - ending longitude of line
         (output)- XE will lie within XMIN/XMAX defined in /MINMAX/
    Y - (input) - latitude of horizontal line
    IXCHK-(output)-0=line not within view window
                   1=line is within view window

ROUTINES CALLED
    None

CALLED BY
    POLY - to clip coverage polygon lines
    BSHAD - to clip coverage shade lines

B.2.3.17 IYCHK

FUNCTION DESCRIPTION

IYCHK allows clipping of plot data at latitude border limits. Since the plotting is done in an Albers projection, lines cannot be clipped at the view window because the view window is curved in that projection. Therefore, clipping must occur in lat/lon coordinates. IYCHK checks to see if the vertical line (X,YS)-(X,YE) is in the view window. IYCHK=0 if not in the view window. If YS or YE extend beyond the view window, they are set to the YMIN/YMAX limit, whichever they exceed.

COMMON BLOCKS
    /MINMAX/ - min/max view window in lat/lon

ARGUMENTS - FUNCTION IYCHK(X,YS,YE)
    X - (input) - longitude of vertical line
    YS - (input) - starting latitude of line
         (output)- YE will lie within YMIN/YMAX defined in /MINMAX/
    YE - (input) - ending latitude of line
         (output)- YE will lie within YMIN/YMAX defined in /MINMAX/
    IYCHK-(output)-0=line not within view window
                   1=line is within view window

ROUTINES CALLED
    None

CALLED BY
    POLY - to clip coverage polygon lines
    SHADI - to clip interference shade lines

B.2.3.18 GTPEN

SUBROUTINE DESCRIPTION

    GTPEN is only called if the graphics terminal selected supports multiple colors. It allows the user to define what color code is used to plot the general background (border, state/county boundaries, stations), the coverage areas, and the interference areas.

COMMON BLOCKS
    /COLOR/ - color array for background, coverage, interference
    /LU/   - terminal I/O unit numbers

ARGUMENTS - SUBROUTINE GTPEN
    None

ROUTINES CALLED
    None

CALLED BY
    NTPLT - to get pen colors for background, coverage, and interference
            plotting for terminals that support color

B.2.4 DBINT - source file &DBINT::NT

PROGRAM DESCRIPTION

    DBINT is used to initialize some of the large data base files used in NETWORK if they do not exist. DBINT is therefore used only when the user wants to eliminate all coverage and start from scratch. DBINT was written to significantly reduce the time required to initialize STATD and STATG1. This is achieved because DBINT can use

a very large (10016 words) data control block. DBINT creates the file requested and sets all values to zero.

DBINT requires four parameters passed to it. Routines STATD and STATG use a swap to execute DBINT from NTUPD when they detect their files do not exist.

IPAR(1)=file code = 1 = STATD
= 2 = STATG1
IPAR(2)=number of records (1560 for both STATD and STATG1)
IPAR(3)=number of words per record (450 for both STATD and STATG1)
IPAR(4)=cartridge name (2HNT for STATD, 2HND for STATG1)

COMMON BLOCKS
/DCB/ - Data Control Block used in file I/O

FILES
DBINT may be used to initialize the files STATD and STATG1

ROUTINES CALLED
RMPAR - system routine to retrieve parameters passed from NTUPD
CREAT - system routine to create an FMP file
OPEN - system routine to open an FMP file
WRITF - system routine to write on an FMP file
CLOSE - system routine to close an FMP file

B.2.5 DBMS - source file &DBMS::NT

LIBRARY DESCRIPTION

DBMS is a library of routines developed to access the data base files used by the programs that form the NETWORK model. Because of the large number of routines involved, only a short description of each routine will be given here. Complete documentation for each routine exists as comment cards in the source file.

Routine	Description
STATL	Program to list STATS data base on line printer
NEOPN	Open and read number of stations in STATS data file
NERD	Read station parameters from STATS data file
NEWR	Write station parameters onto STATS data file
NESUM	Summary of the parameters for a single station
STATI	Open/close NETWORK index file STATI
HALT	Message routine to indicate a NETWORK file cannot be accessed because it is in use by another user
GETI	Reads a record from the STATI file
SETI	Writes a record to the STATI file
DELI	Deletes a record from the STATI file

IFIND	Searches STATI to find a given station
GET1	Reads a block (225 double integer) of grid point pointers from the STATG1 file
GET2	Reads information for the specified grid point from the STATG2 data file
IPNTG	Retrieves the double integer pointer for the specified grid point
STATG	Open/close/initialize the STATG1 and STATG2 data files
SETG	Stores station parameters into a specified grid point in the STATG2 data file. Order is sorted by distance.
DELG	Deletes a station from a specified grid point on the STATG2 data file
DELGG	Used by DELG to perform the delete and to recalculate the coverage for that grid point and store in STATD file
INDBLK	Calculates block number (1-1560) given lat/lon of corner
BOX	Calculates the min/max blocks within 200 km of a specified lat/lon coordinate
DAZET	Given lat/lon point, bearing, great circle distance, computes other lat/lon point
STATS	Initializes STATS data files
STATD	Open/close STATD data file
GETD	Retrieves the display information from the STATD file for a specified grid block (1-1560)
PUTDSP	Stores station ID, frequency, coverage code, and distance into STATD display file for specified grid point
PACK	Packs station ID, frequency, distance, E(95,95,50), and E(10,50,50) into 3 words for storage into STATG2 file
EVAL	Unpacks field strength values from 1 word
GTBLK	Given lat/lon, calculates block/index or given block/index, calculates lat/lon
HBARD	Open/close HBARD average elevation file
HBARG	Reads a 1-degree grid block (1-1560) of average elevations from HBARD file into memory
PRODG	Opens and reads the PROPAR propagation file and stores into COMMON block /PRODC/ for use by PRODV
PROVM	Opens and reads the PROPVM propagation file and stores into COMMON block /PRODC/ for use by PRODV. PROPVM was created from PROPAR by writing to the file PROPVM the contents of /PRODC/. Makes for faster access.
PRODV	Retrieves propagation parameters N-sub-S, DELTH, and HBAR from COMMON block /PRODC/ for specified lat/lon
BIVAR	Used by PRODV for bilinear interpolation of 4 grid points
DDMS	Converts decimal degrees to degrees, minutes, seconds

B.3 NETWORK Installation Procedures

This section describes the procedure used to load all of the programs of NETWORK on the ITS HP-1000 with RTE-6/VM Operating System. All source files (& suffix), procedure files (/ suffix), and loader command files (# suffix) are assumed to reside on cartridge NT. The procedure file /NTALL::NT will compile all source files and

transfer to procedure files to load all the programs. The following libraries are assumed to exist:

```
      $GHLIB - contains some general purpose graphics routines
      %TALIB - contains general purpose routines
      $PMODS - contains ITM and topographic routines
      $UPLIB - contains AGP graphics routines
```

Source files required for NETWORK:

```
      &DBINT::NT - program to initialize large data base files
      &DBMS::NT  - library routines to access data base files
      &DRMAP::NT - routines to plot state and county borders
      &NETW::NT  - driver program to begin NETWORK execution
      &NTPLT::NT - program to plot NETWORK coverage graphs
      &NTUPD::NT - program to perform ITM calculations
      &NTWRK::NT - program to control user interaction
```

Procedure files required for NETWORK:

```
      /NTALL::NT - compile and load all NETWORK programs and
                   libraries(uses procedure files below)
      /DBMS::NT  - compile &DBMS and create $DBMS library
      /DBINT::NT - load DBINT program Needs #DBINT
      /LDNTW::NT - load NTWRK program Needs #NTWRK
      /LDUPD::NT - load NTUPD program Needs #NTUPD
      /LDPLT::NT - load NTPLT program Needs #NTPLT
```

/NTALL contents:

```
:** EXECUTE WITH :/NTALL
:** Will compile all NETWORK source files on CR=NT
:** And will load all programs required by NETWORK.
:*************************************************
:** Requires libraries: $GHLIB, %TALIB, PMODLB, $UPLIB
:*************************************************
:** Compile and load NETW, the driver program.
:RU,FTN7X,&NETW::NT,,-
:PU,NETW:GH:NT
:OF,NETW
:RU,LOADR,,%NETW::NT
:SP,NETW:GH:NT
:PU,%NETW::NT
:*************************************************
:** Compile &NTWRK, &NTUPD, &NTPLT
:RU,FTN7X,&NTWRK::NT,,-
:RU,FTN7X,&NTUPD::NT,,-
:RU,FTN7X,&NTPLT::NT,,-
:*************************************************
:** Compile and create DBMS library
:TR,/DBMS::NT
:*************************************************
:** Load DBINT
:TR,/DBINT::NT
:*************************************************
:** Load NTWRK
```

```
:TR,/LDNTW::NT
:************************************************
:** Load NTUPD
:TR,/LDUPD::NT
:************************************************
:** Load NTPLT
:TR,/LDPLT::NT
:************************************************
:** NETWORK model has been loaded.
:************************************************
```

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15. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*

NETWORK is an interactive computer program designed to help NWS expand the NOAA Weather Radio Network to obtain the desired coverage at minimum spectrum usage. For each active station, areas of predicted service and co-channel interference are calculated by NETWORK.

This manual describes how to use the NETWORK program as well as the propagation prediction methods that it uses.

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