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IMPLEMENTATION PLANS FOR TDL'S LOCAL APPLICATIONS SYSTEM

Ward R. Seguin

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1. INTRODUCTION

The Techniques Development Laboratory (TDL) of the Office of Systems Development (OSD) has developed applications programs for Automation of Field Operations and Services (AFOS) for a number of years. These programs, such as the verification programs, the data decoders, and the weather monitoring programs, are designed to assist Weather Service Forecast Offices (WSFO's) and Weather Service Offices (WSO's) with current operational needs. TDL is now devoting development resources to applications designed to run on the next generation computers, the Advanced Weather Interactive Processing System for the 1990's (AWIPS-90), as well. As this development progresses, a system of applications is taking shape, all designed to interface with a common applications file system (or data base) and to run in concert with each other.

The system is referred to as the TDL Local Applications System (T-LAS). It is evolving into seven groups of applications shown in Fig. 1--the data and guidance decoders and unpackers, the Local AFOS MOS Program (LAMP) (Glahn and Unger, 1986) (MOS--Model Output Statistics, Glahn and Lowry, 1972), interactive graphics programs to enter and edit forecasts, official product formatters, product quality control programs, weather and forecast monitoring programs, and programs to support an applications file system. These programs, taken as a whole, are focussed on two goals: to improve the overall quality of forecast products, particularly the routine aviation and public forecasts, and to improve the overall efficiency of the forecast office.

The National Weather Service (NWS) is planning to restructure field offices in the 1990's and concurrently to implement AWIPS-90. The restructuring will place more emphasis on the warning functions of the offices. AWIPS-90 will dramatically increase the offices' ability to process, analyze, and display direct and remote sensed data. T-LAS is designed to take advantage of this increased power to achieve the above goals.

Prior to the restructuring and nationwide implementation of AWIPS-90, the NWS plans to demonstrate the new operational procedures and techniques in an operational experiment called the Modernization and Restructuring Demonstration (MARD). To carry out a smooth MARD and a transition to the operations of the 1990's, the NWS plans to test and integrate new operations concepts before MARD. For example, the NWS is working with the Program for the Regional Observing and Forecasting Services (PROFS) in Boulder, Colorado. PROFS is developing and experimenting with new forecaster work-stations and ways of displaying and processing the literally hundreds of new products the forecast offices will receive or have access to in the future.

It is with this backdrop that TDL is developing new applications for implementation on AWIPS-90. These applications will provide techniques that are not currently available and provide whole new ways of performing basic forecaster functions. For example, LAMP will provide improved numerical and statistical guidance products for the first 20 hours often data cut off. The product formatters will draft the official forecast products thus saving valuable forecaster time, and interactive graphics programs will improve the way forecasters construct and edit their forecasts. The operational concept for the 1990's is for the forecaster to build and maintain a forecast data base from which official forecasts are formatted automatically. This contrasts with the way things are done today, in that currently a forecaster composes his/her forecast at a word processor in code or plain language directly. These new techniques and applications will allow the forecaster to change forecast elements at points (stations) or areas.

Forecast data and information entered interactively will be used in a number of ways. It may be used as input to simple numerical models to allow the forecaster to perform simple "what if" scenarios; to set control constants to control the complexity of forecast wording, to force certain forecast periods or geographic zones to combine in a forecast product; and, as mentioned above, to provide the specific warning and forecast information the product is designed to convey.

Some of the development efforts are far enough along to show great promise. Other efforts are in the formative stages and will require close coordination with operational people, both at headquarters and at field offices, to ensure that the applications meet the needs of operations.

We can't wait until the first hardware prototypes of the 1990's appear in the forecast offices to begin developing and testing new software. We don't want the software to lag behind the hardware for years because that will prevent us from making greater use of these machines sooner. We must make maximum use of AFOS as it is currently installed, and, in some instances, we must increase the processing capability of these machines. System Z, the AFOS upgrade, will substantially improve communications and will eventually make more AFOS processing time available for applications. As applications are developed from specifications jointly prepared by the field and headquarters, they must be tested, modified, and re-tested. Much of this testing must occur in operational settings.

The remainder of this note describes T-LAS, starting with the hardware configurations, followed by a description of the individual software components. Finally, an implementation schedule is proposed, which is designed to merge with AWIPS-90 plans.

2. HARDWARE REQUIREMENTS

Some of the T-LAS applications can be run at any WSFO in the background normally used for applications, while others will require the processing power of an additional Eclipse S230 equipped with floating point hardware, hereafter in this paper designated as the S230F. Fig. 2 shows the hardware configuration and requirements. A special S230F will be installed in the test forecast office as a WSO spur. This applications S230F will communicate with the dual WSFO machines synchronously just as other WSO's communicate with their parent node. In fact, the operation of this machine for applications will be similar to the way many WSFO's are using their WSO's. These WSO'S run applications for the parent WSFO and then transmit the output back to the WSFO as an AFOS product.

The S230F will be equipped with a Dasher terminal and Winchester and Phoenix disk systems, but will not require an alphanumeric display module/graphic display module (ADM/GDM) console. The floating point hardware is essential because of the large number of computations the programs will perform. Applications will be run automatically on a scheduled basis using the applications program AEX (Opitz, 1987). AFOS products required by applications on the S230F will be routed to the machine in the normal manner. Products generated on the S230F will be routed to the WSFO machine for display or for use in other applications. In general, forecasters will not interact with either the applications run on the S230F or with the products they generate while they are on the S230F.

The S230F will require about 1200 surface airways observations (SAO's), which is the number of SAO's currently on the Central Region Loop where MARD will be held, about 19 National Meteorological Center (NMC) gridded fields, manually digitized radar (MDR) data reports for a large portion of the country, and the MOS guidance for the Central Region (the FPC and SMG products).

The WSFO S230 applications processor will be used for the interactive graphics work to enter and edit forecasts, to automatically format products, and to perform product quality control and weather and forecast monitoring. These applications, even when taken as an aggregate, are not resource intensive programs. All of these programs are written in FORTRAN IV and do not require floating point hardware. Thus, no modifications are required to run these programs, and, in fact, they can be run on any WSFO Eclipse computer.

The operational scenario for running these applications is as follows. Observations and guidance required by LAMP, which are available on the Central Region loop, will be captured by the WSFO machine and forwarded to the S230F. Applications will be scheduled to run automatically on the S230F to produce current analyses of surface fields and numerical and statistical guidance. The output of these programs will be graphic, gridded, and tabular products and addressed to the WSFO machine. These products will then be called up by the forecaster on either the GDM or ADM for review. Then, using interactive graphics techniques, the forecaster will enter and/or edit tabular, gridded, and graphic forecasts which will then be stored in the applications forecast data base both as gridded data and as station point forecasts. These forecasts will then serve as input to the product formatters, also run on the WSFO S230. Finally, using conventional word processing techniques, the forecaster, either on AFOS, AFOS Backup Terminal (ABT), or other word processing computers, will make final changes if necessary.

3. APPLICATIONS FILE SYSTEM

The AFOS data base system was designed to facilitate the retrieval and display of AFOS products, including observations, tabular guidance, forecasts, and graphics products. It was not designed to be used as an applications data base. For this reason, TDL has designed and assembled an applications program file system (Perrotti, 1987) to meet special needs. This is not a data base management system that would be implemented on AWIPS-90, but rather one that will facilitate the testing of the applications mentioned below.

There are a number of advantages of this file system over the AFOS data base. First, the data are stored in a computation-ready form; they do not need to be decoded. Second, data are grouped together so that multiple reads are not required to obtain a number of observations. The files also contain a set of attributes describing the data which have been stored. And a set of subprograms have been written to facilitate reading and writing the data files.

The whole system is set up so that products are periodically retrieved from the AFOS data base, decoded, and placed in the applications files. The data are rotated over a period of time, say 48 hours, so that the oldest data are periodically overwritten.

Data are stored in station, element, and grid point files. Data records in the station files consist of different elements such that an SAO would be one record in the station file. Element files, on the other hand, consist of records each of which has the same variable throughout. A temperature record of an element file would consist of temperatures for many stations at a given observation time.

These files will be used to store observations and numerical guidance and forecasts. Depending on the data and their use, some information will be stored in both a station and element file format. For example, the plotting of the data in the station model format is best accomplished from the station file. Using the data to objectively analyze a field is best accomplished from the element format. Some of the data will arrive in station format while other data will arrive in the gridded format. A good example of the latter are the gridded data that will be transferred from NMC for use in initializing local models and analysis schemes.

4. DATA DECODERS

T-LAS uses a number of data products including SAO's, MDR data, central MOS, and a number of NMC gridded fields which will require decoding or unpacking. For the initial implementation, all of the decoders will be slight modifications of those programs that are currently running on AFOS at field offices. The gridded data will be packed at NMC, and special unpacking routines have been written and implemented for this project.

5. LAMP

The LAMP system consists of objective analysis programs, three simple numerical models, and a statistical model. It is designed to produce analyzed fields and numerical and statistical guidance at any hour of the day or as required by the forecaster. The statistical guidance is for the following weather elements for projections from 1 to 20 hours:

ACRONYM	DESCRIPTION
TEMP	Hourly temperatures
DEWPT	Hourly dew points
MX/MN	Maximum/minimum temperatures
POPO	Probability of precipitation occurence on the hour
POPO6	Probability of precipitation, 6-h period
POP12	Probability of precipitation, 12-h period
CIG	Probability of ceiling height categories

VIS	Probability of visibility categories
OBVIS	Probability of obstructions to vision categories
C/V	Best category of ceiling and visibility
WINDS	Surface wind speed and direction

The guidance is being designed so that it can update central MOS guidance which is produced twice a day at the 0000 and 1200 GMT cycles. This LAMP statistical guidance will be produced for all locations for which the WSFO will make routine forecasts. Fig. 3 shows the aviation and public forecast valid periods starting with the 0000 GMT NMC model run as well as the valid period for the MOS guidance forecast. The LAMP statistical forecasts in this case are based on 0600 GMT observations. LAMP will provide improved guidance for both the public and aviation forecasts for the period shown.

The analyses programs are being set up to analyze 13 meteorological variables and parameters listed here:

Sea level pressure
Surface temperature and dewpoint
U- and V- wind speed components and total wind speed
Saturation deficit
Ceiling height
Visibility
Cloud amount
Categories of precipitation type (liquid, freezing, frozen).

The analyses are done over a grid with a spacing of one-quarter Bedient, or approximately 75 km in the central United States.

Two analysis techniques are employed. The Cressman (1959) method of successive corrections is used with the quasi-continuous fields of sea level pressure, temperature, dew point, U- and V-wind components, wind speed, and saturation deficit. The first guesses for the fields are obtained from NMC numerical forecasts. For saturation deficit analysis, areas of precipitation are defined by conventional observations and MDR data. In the AWIPS-90 era, the latter information will be supplied by NEXRAD-derived products.

The nearest neighbor technique is used for discontinuous fields. For ceiling height, visibility, cloud amount, and the three categories of precipitation type, a grid point is assigned the value of the nearest station. The three precipitation types are represented by binary numbers, that is 0 or 1 depending on whether precipitation is not occurring or occurring, respectively. These binary values are then assigned to the grid points.

The three numerical models of LAMP include a sea level pressure (or 1000-mb height) model (Unger, 1982) based on Reed's (1963) model, a moisture model (Unger, 1985) based on the SLYH model (Younkin et al., 1965), and a trajectory model called CLAM (Grayson and Bermowitz, 1974). These models are initialized by the 500-mb height forecasts of the NMC models and analyzed surface observations.

The statistical forecasts are made with multiple linear regression equations derived from surface observations, central MOS guidance, and the output of the simple numerical models described above. The regression coefficients are derived in the same way as are MOS equations used on the mainframe at NMC. Derivation is done on the mainframe computers from archived data. Equations will be transferred to the S230F for evaluation in real time.

The LAMP system will be implemented in phases as will be discussed in Section 10. The initial implementation will include the analyses programs, one or two of the models, and a statistical model based on the observations and central MOS guidance. Further, the statistical model will include equations for only a limited set of predictands and for only one start or initial time, 0600 GMT. Later, all three models will be provided and the statistical model will be updated so that it uses all three model inputs. Equations will then be provided for the 1300 and 2000 GMT start times or start times consistent with when a forecaster needs guidance for public and aviation forecasts. Recall that LAMP produces forecast for about 20 forecast projections for each start time.

Initially the statistical forecast model can be run only once a day at the one start time (0600 GMT). With the addition of the 1300 and 2000 GMT equations, it can be run three times per day. The analyses and numerical models, on the other hand, can be run any hour of the day.

6. FORECASTER-MACHINE INTERACTIVE GRAPHICS TECHNIQUES

TDL is actively developing techniques and applications to interactively edit and change forecasts graphically. Fig. 4 shows an AFOS GDM display of a local map background with the forecast zones for Fort Worth, Texas. The interactive program that displays this graphic allows the forcaster to select a forecast period (today, tonight, tomorrow, etc.) and the variable group he or she wishes to display (temperature, PoP, clouds, etc.), and then to change the displayed forecasts. Menu options and data entry/editing are accomplished with the cursor and the enter cursor control on the GDM.

This software was set up for the public station and zone forecasts. It allows the forecaster to change the forecasts at stations, at the centers of zones, or at the centers of combined zones. Forecasts at the centers of zones are derived by interpolating nearby station values. Forecasts at the centers of combined zones are derived by averaging forecasts from the zones that combine.

Because of the large set of numbers involved, due to both the large number of forecast projections and the forecasted variables, it is impossible to build the data base and, hence, the initial display from scratch. It would simply take the forecaster too long. Therefore, one option is to initialize the data files with statistical guidance. Ultimately it could be initialized with the the previous forecast or directly from numerical models. However, it seems reasonable that MOS or LAMP will be required to initialize some of the forecast fields.

Despite the fact that there will always be a need to initialize fields from previous forecasts or guidance, there will also always be a need to enter or edit a forecast over a forecast area quickly. To meet this need, TDL is developing interactive graphic techniques and applications to allow the forecaster to enter and edit data and forecasts displayed on grids over the forecast area of responsibility. Fig. 5 shows an example of a forecast of grid points. Specifically, these techniques will allow the forecaster to:

1. Enter data at grid points by drawing contours or by assigning values to areas,
2. Identify an area and increment or decrement values of the grid in the area,
3. Advect a field in any direction,
4. Contour continuous and discontinuous fields on the grid,
5. Redraw contours or portions of contours and have the machine adjust grid points to conform to new contours, and
6. Use modified or unmodified grid points to calculate zone averages.

These applications, combined with the programs to enter and edit forecasts at a point, will allow the forecaster to compose his or her forecast graphically and pictorially.

TDL is also working on a menu scheme that allows forecasters to initiate applications from the GDM rather than the ADM using the RUN: command. This display will allow the forecasters to initiate applications to format products (discussed in the next section) as well as set complexity constants of the programs. In fact, the AFOS display will allow a number of menus to be displayed by using the zoom feature, hence simplifying the initiation of applications. This is an area ripe for considerable future development. Fig. 6 shows the current interactive menu which accompanies the product formatting programs.

7. PRODUCT FORMATTERS

TDL has been involved in the development of product formatters for a number of years. A considerable amount of effort has been put into the Computer Worded Forecast (CWF) (Bermowitz et al., 1980) for the public station and zone forecasts and the aviation Computer Formatted Terminal Forecast (CFFT) (Vercelli et al., 1985a). Product formatters such as these offer the potential for a significant increase in the productivity of a forecast office, as well as for the individual forecaster. To appreciate this, one has only to realize that a forecaster may spend 30 to 45 minutes composing and typing a set of zone forecasts and probably a comparable amount of time preparing 10 to 12 terminal forecasts.

Automatic product formatting offers a number of other benefits as well. It can improve the consistency among forecasts if the products are all produced from a common data base of numerical forecast information. Forecasts can be made to be more consistent in structure and format from one forecast to another. Finally, it can mean the process of updating forecasts is much easier, thus encouraging forecast offices to better maintain credible forecasts issued to the public and the other users of NWS products.

Automatic product formatting does not necessarily mean more product rigidness or less flexibility. Forecasters will always have the ability to override the machine generated products. A forecaster will be able to edit the text of the forecast using conventional word processing software. In many instances, however, this may not be necessary because the forecaster may control the forecasts through control constants or phrases selected by the WSFO. Fig. 7 shows four forecasts all generated from the same digital forecast input but with different control constants specified. There is also the possibility that a forecaster will be able to adjust the forecast zones by season or even the meteorological event. Such flexibility would allow forecasts to be issued for counties or even smaller geographic areas, and such forecasts could be directly tied to geographical areas that the user can easily relate to.

TDL has developed the software for the computer worded station and zone forecasts (Bermowitz et al., 1980) and is currently developing the aviation terminal forecast (FT) (see Fig. 8) formatter code. We have also developed formatters for the coded cities forecast (CCF, see Fig. 9), the International Terminal Aerodrome Aviation Forecast (TAF, see Fig. 10) (Wantz and Eggers, 1987), and the National Verification Program product called the Manually Entered Forecast (MEF). TDL in now starting the development of the Agricultural Forecast (AGF) formatter. Other products under consideration include the state, fire weather, and travelers forecasts.

8. PRODUCT QUALITY CONTROL

The format and internal consistency of official NWS products is becoming ever more important because these products serve as input to other computer programs being run by other users. For example, header information must be correct to ensure the products are routed properly to the user. The format of the product must be correct so that user software can decode the product correctly. These programs are necessary even though we are planning to format products automatically because the forecaster will always have the ability to text edit the final product if he or she feels that there is a need.

TDL has developed a program to check the format and internal consistency of the FT's (Vercelli and Leaphart, 1987) and is considering developing others.

9. FORECAST AND OBSERVATION MONITORING

There are not a lot of programs designed to monitor the weather and alert the forecaster when conditions exceed forecaster-set thresholds. However, these are considered important applications because the machines will have to assist the forecaster in staying on top of all of the remote and conventional data that will be available.

TDL has developed two applications for AFOS to monitor incoming data, one of which is planned for implementation with T-LAS. The FT monitoring program, MONITR (Vercelli and Norman, 1985b), compares incoming SAO's with the valid FT and alerts the forecaster when the observations indicate that the FT is no longer valid due to one or more of the official amendment criteria having been met or exceeded. A second set of criteria has also been built into the program to advise the forecaster when conditions are approaching but have not met or exceeded the amendment criteria.

10. SCHEDULES

TDL plans to develop and test these applications on AFOS until such time as AWIPS-90 equipment becomes available. At that time, TDL in coordination with the AWIPS-90 Project Office and the Transition Program Office will work with the AWIPS-90 Prime Contractor (APC) to convert these applications to the new machines.

Currently, the schedule for the selection of the APC is mid-1989. This is the beginning of the development phase. The first MARD prototype machines are scheduled for delivery to the NWS 6 months after the beginning of the development phase. As these machines are installed in the field, TDL hopes to install T-LAS to allow each office to immediately become familiar with the techniques and outputs.

TDL plans to work with only one WSFO site until the AWIPS-90 MARD prototypes become available. As the MARD sites are brought up, TDL will install and train the offices in the use of these new applications.

Fig. 11 shows the proposed implementation schedule for T-LAS. During the spring of 1988, TDL will install the first load of T-LAS. This will include the file system, the analyses programs, the sea level pressure model, the statistical model using equations based on surface observations and MOS, the first version of the interactive programs, and public product formatters such as the local forecast product (LFP), zone forecast product (ZFP), CCF, and MEF. The second load will be installed in September 1988 in time for the beginning of the cool season. At that time, the other numerical models will be made available, the statistical model will be updated with the cool season equations, and the aviation FT and TAF product formatters will be added. Enhancements and extended capabilities of the interactive programs will be added as well.

For the spring of 1989, the statistical model will be enhanced by providing equations derived from the local model output. Equations to permit the running of the statistical model at 1300 GMT will also be provided, as well as product formatters for other products.

In September of 1989, TDL will provide the last major upgrade to the AFOS version of T-LAS. Equations for the cool season and for both model run times (0600 GMT and 1300 GMT) will be provided, as well as additional upgrades to the interactive programs and product formatters. TDL will then focus on converting the programs with the APC to the MARD prototypes and installing T-LAS at other sites.

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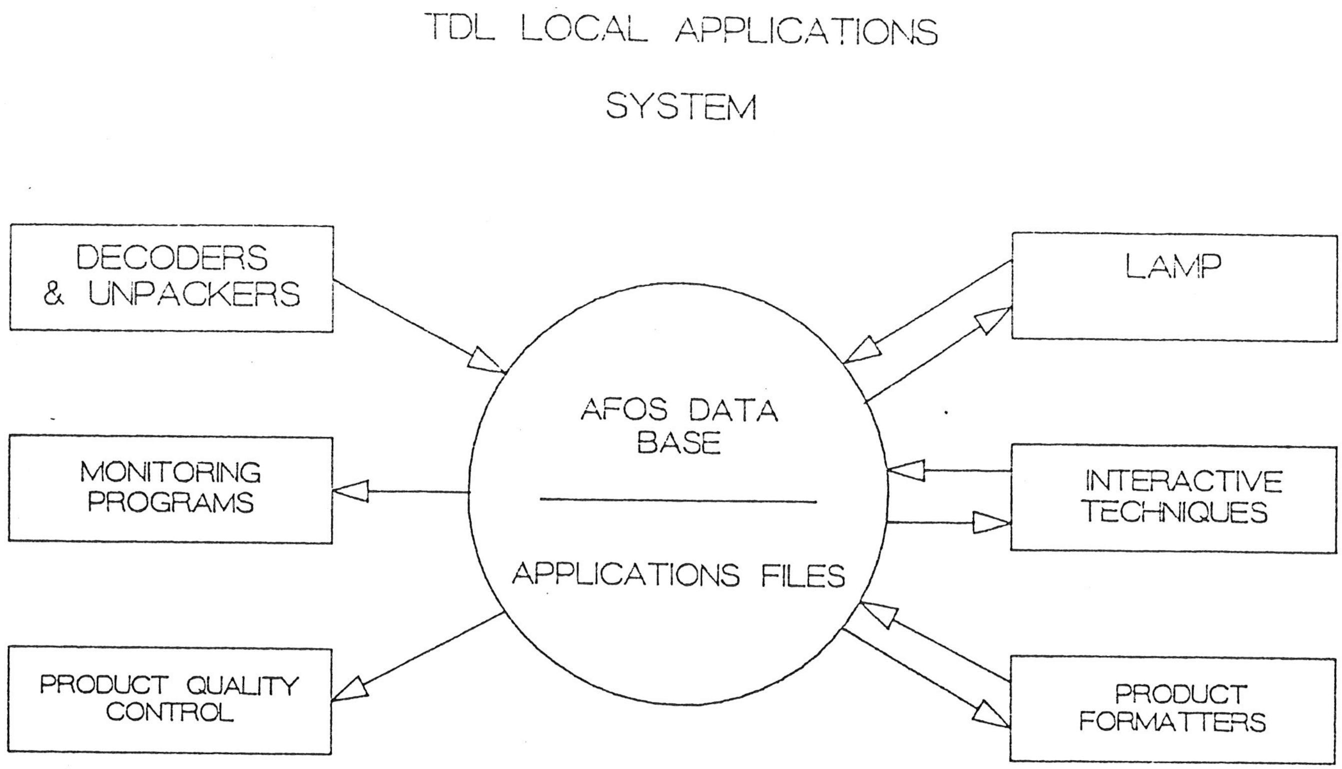

Figure 1. Components of the TDL Local Applications System.

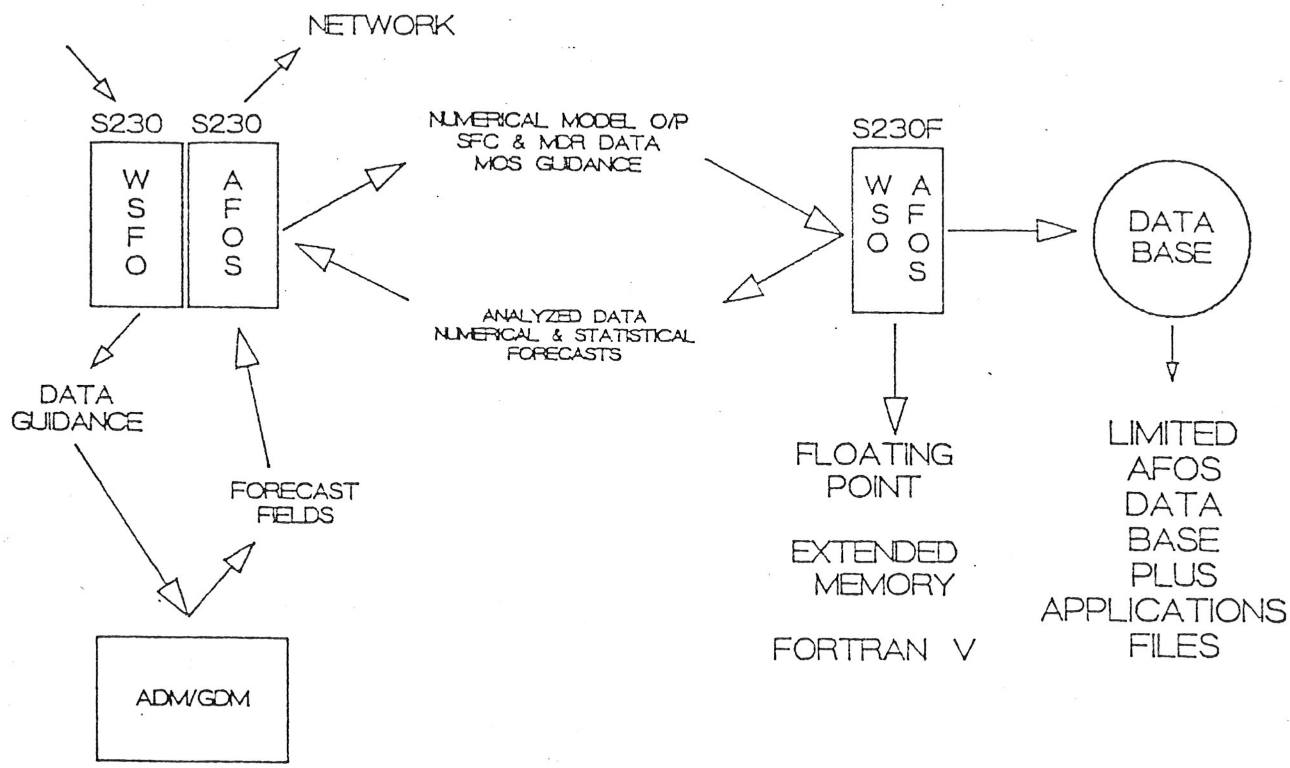

Figure 2. Proposed hardware configuration with the WSO floating point machine synchronously linked to the WSFO machines as a spir.

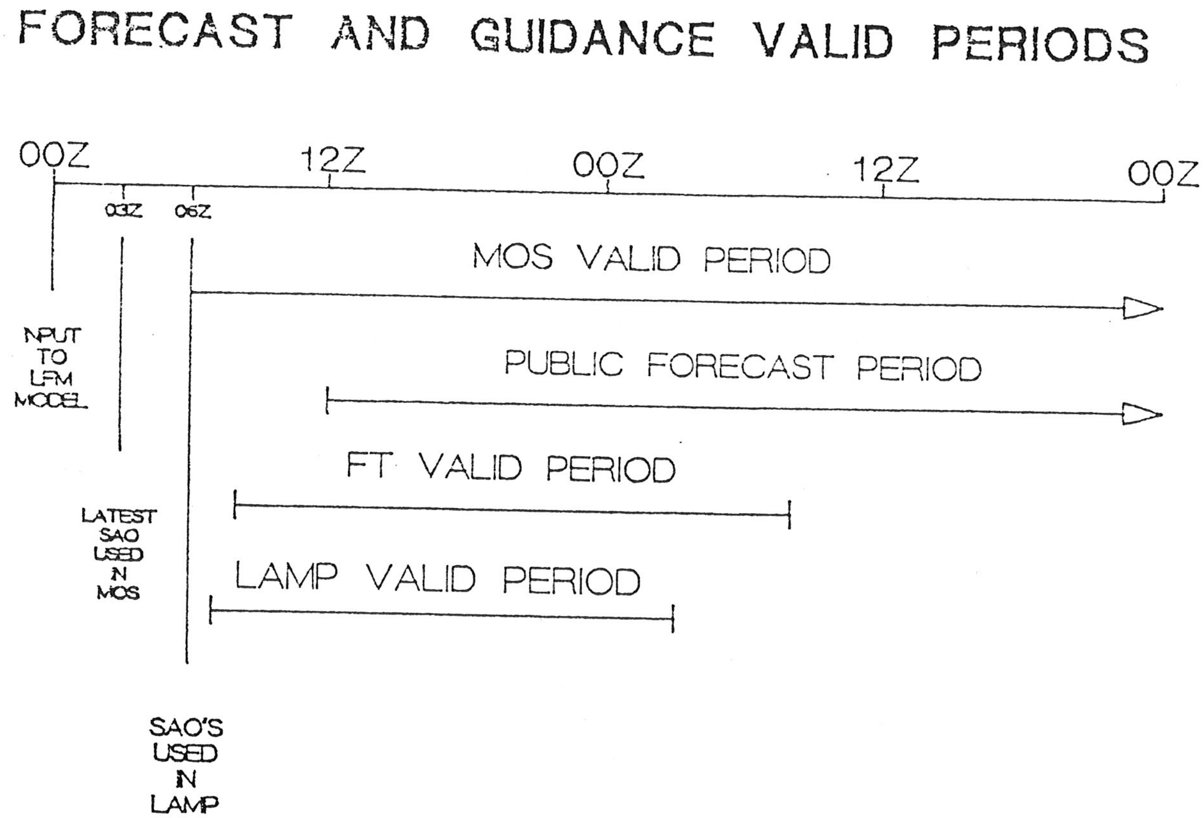

Figure 3. Valid periods for one of the public and aviation forecasts and the corresponding MOS and LAMP guidance.

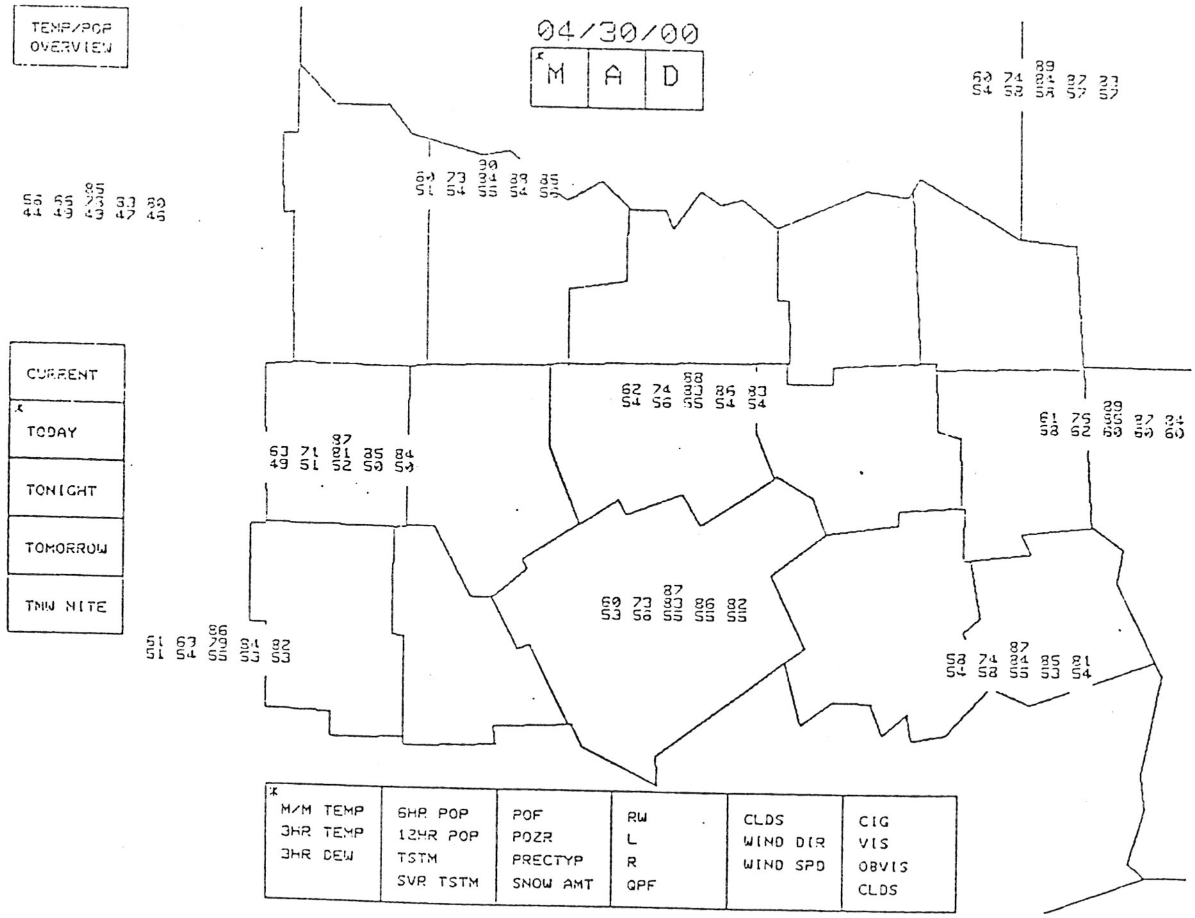

Figure 4. Local map background showing zone boundaries for Fort Worth, Tex. along with maximum temperature, 3-h temperatures, and dew points for the first period station forecast (today).

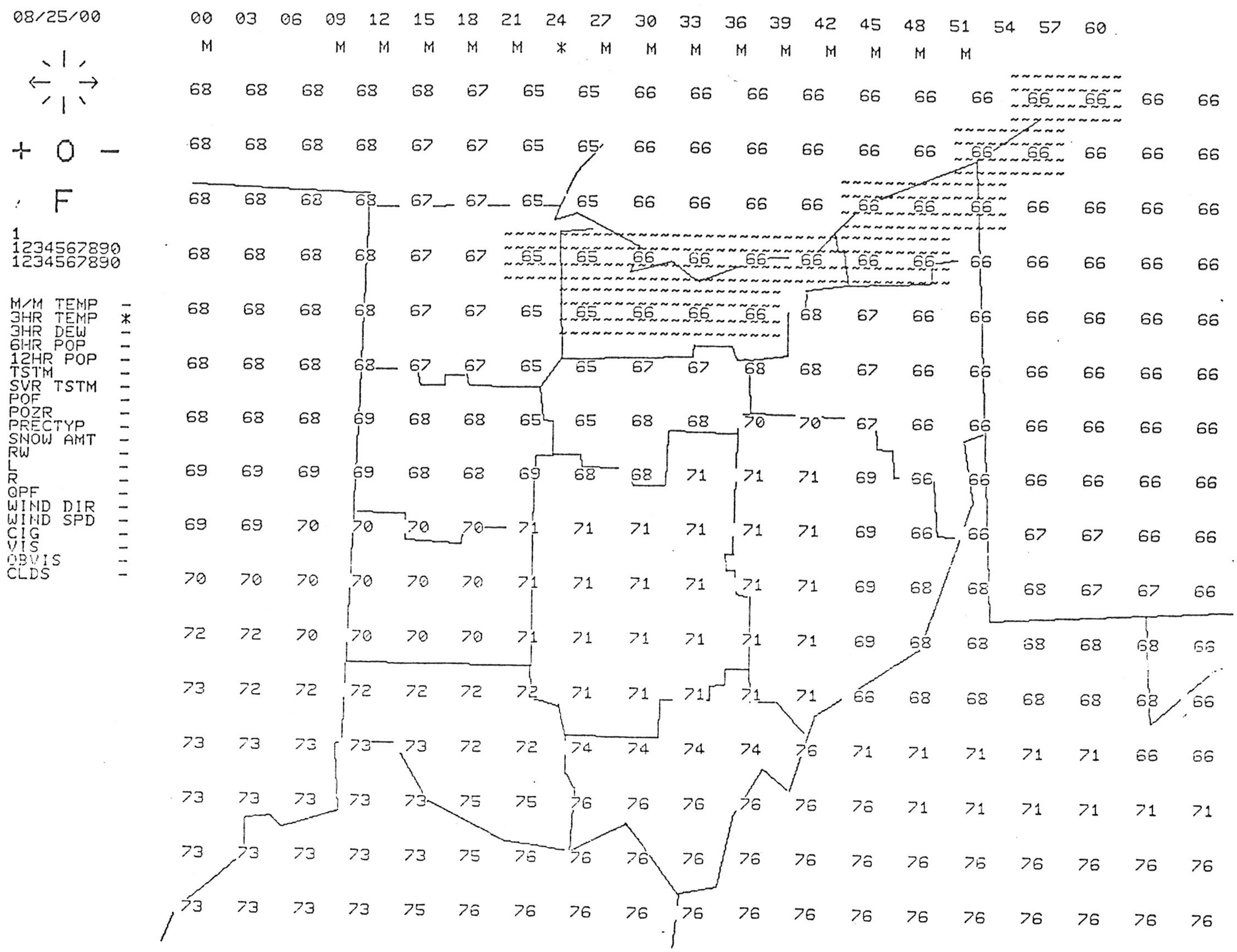

Figure 5. Grid Point temperature forecast field for hour 18. Using displayed menus, the forecaster will select projections and variables he or she wishes to enter and edit. Using the cursor, the forecaster will then identify those grid points to be changed and the screen will show areas to be changed by shading.

ICWF MASTER MENU

DIGITAL GUIDANCE - CURRENT STATUS	
STATION GUIDANCE	09/24/12
ZONE GUIDANCE	09/24/12
COMBINED ZONE GUIDANCE	09/24/12

FORECASTER NUMBERS	
AVIATION FORECASTER NUMBER	66
PUBLIC FORECASTER NUMBER	79

DIGITAL OPERATIONS

REVISE GUIDANCE:	
FOR STATIONS	[ ]
FOR ZONES	[ ]
FOR COMBINED ZONES	[ ]
INTERPOLATE GUIDANCE (STATIONS TO ZONES)	[X]
COMBINE ZONES: (ZONES TO COMBO'S)	
USING DIGITAL GUIDANCE	[ ]
WITHOUT GUIDANCE	[ ]
REARRANGE COMBINED ZONES (COMBO'S TO COMBO'S)	[ ]
ASSIGN STATIONS (COMBO'S TO STATIONS)	[ ]

PRODUCT GENERATION (0=NO, 1=YES)

CODED CITIES FORECAST (CCF)	1
MANUALLY ENTERED FORECAST (MEF)	1
STATION WORDED FORECAST (RWF)	0
ZONE WORDED FORECAST (RZF)	1

SUBMIT ICWF PRODUCT FORMATTER

[ ]

QUIT ICWF MASTER MENU

[ ]

FORMAT OPTIONS (0=NO, 1=YES)

COMBINED FORECAST PERIODS	1
WARNING CAPABILITY	1
POP'S AT END OF EACH PERIOD	1
ABBREVIATED ZONE HEADERS	0
POP THRESHOLD FOR PRECIP IN CCF	30

COMPLEXITY CONSTANTS:

PERIOD	1	2	3	4	RANGE
WIND	1	2	4	4	1-4
TEMP	1	2	2	2	1-3
CLOUD	1	1	3	3	1-3
PRECIP	1	1	2	2	1-3

Figure 6. Interactive Computer Worded Forecast (CWF) Menu as displayed on the GDM for use in initiating applications and setting control constants.

	WTCP
CLEAR THIS MORNING, BECOMING CLOUDY WITH A CHANCE OF RAIN IN THE AFTERNOON. STRONG NORTH WINDS 20 TO 30 MPH. HIGH IN THE LOWER 70'S.	2311
CLEAR THIS MORNING, BECOMING CLOUDY BY EVENING. CHANCE OF RAIN. STRONG NORTH WINDS 20 TO 30 MPH. HIGH IN THE LOWER 70'S.	2312
PARTLY CLOUDY TODAY WITH A CHANCE OF RAIN IN THE AFTERNOON. STRONG NORTH WINDS 20 TO 30 MPH. HIGH IN THE LOWER 70'S.	2312
PARTLY CLOUDY TODAY WITH A CHANCE OF RAIN. STRONG NORTH WINDS 20 TO 30 MPH. HIGH IN THE LOWER 70'S.	2322

Figure 7. Four local forecast products (LFP's) made with the same digital input forecast data but different control constants for clouds (C), and precipitation (P). The control constants specify the degree of detail to be used in the worded forecasts of each weather element. No changes were made in the wind (W) and temperature (T) control constants.

OFFICIAL FT	COMPUTER FORMATTED FT
JFK FT 071515 C25 OVC 0608. 17Z C25 BKN 0608 BKN OCNL SCT. 21Z C20 OVC 0908. 00Z C12 OVC 5H 0908. 032 C7 OVC 3RW-F 1210. 09Z LIFR CIG RW F..	JFK FT 071515 C23 OVC 5H. 22Z 3 SCT C11 BKN 3F. 00Z C3 BKN 2F OCNL 2L-. 06Z C2 BKN 11/2F OCNL 11/2L-. 09Z LIFR CIG R F. 14Z IFR R..
ATL FT 071515 10 SCT C30 OVC CHC C8 BKN 30 OVC 3R-F. 18Z 8 SCT C20 OVC 5F 0908 OCNL C6 OVC 2R-F. 00Z C15 OVC 5F 1108 CHC C5 OVC 2R-F. 09Z IFR CIG F..	ATL FT 071515 11 SCT C23 OVC 4F 1207 CHC 4R-. 21Z C13 BKN 1208 OCNL 6R-. 05Z 5 SCT C25 OVC 1209 OCNL 6R-. 09Z MVFR. 12Z IFR. 13Z LIFR CIG F. 14Z IFR..

Figure 8. Comparison of machine-generated aviation terminal forecasts (FT's) with the official FT's for New York, N.Y. and Atlanta, Ga.

CLECCFCLE	EXFCCFWRK
TTAA00 KCLE 300834	TTAA00 KEXF 300958
CVG UB 068/042 076/053 075 19002	CVG UU 068/042 075/053 075 88102
DAY UB 063/040 073/048 072 19003	DAY UU 063/040 072/050 071 88002
CMH UB 063/039 073/049 072 19003	CMH UB 062/039 071/048 072 88003
TOL UB 062/038 068/043 063 19003	TOL UU 067/037 064/040 061 88012
CLE UB 055/037 067/045 064 19003	CLE UU 056/037 065/045 060 88012
CAK UB 060/036 067/046 064 19003	CAK UB 060/036 067/046 060 88003
YNG UB 058/035 065/045 063 19003	YNG UB 057/037 065/044 062 88003

FTWCCFFTW	EXFCCFWRK
TTAA00 KFTW 300922	TTAA00 KEXF 300958
SPS UU 090/058 090/061 090 40111	SPS UU 090/061 090/064 086 88--1
ABI BB 087/060 090/062 090 40111	ABI UU 087/063 089/065 087 88111
DFW BB 090/058 090/063 089 40111	DFW UU 088/061 087/066 089 88010
ACT BB 090/060 090/064 090 40111	ACT UU 087/063 086/066 089 88011

Figure 9. Comparison of machine-generated coded cities forecasts (CCF) with the official CCF's for Cleveland, Ohio and Fort Worth, Tex.

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TTAA00 KMIA 240835
MIA FT 24909 25 SCT C80 BKN 1014 OCNL C25 BKN CHC C10 OVC 2RW/TRW.
     032 VFR.
TTAA00 KMIA 241700
TAF

KMIA 1212 10014 9999 2SC025 6AS080 INTER 1203 6SC025 PROB40 1203
     3200 95TS 8CB010 GRADU 0203 2ST015=
```

Figure 10. Comparison of an official FT for MIA with a machine generated TAF using the FT as input.

Implementation Schedule

	4/88	10/88	4/89	10/89
FIRST LOAD	+			
1. File system 2. 06Z Warm Season LAMP (MOS+OBS) 3. Analysis and Contouring Programs 4. Interactive Programs Version 1.0 5. Public Product Formatters				
SECOND LOAD		+		
1. 06Z Cool Season LAMP (MOS+OBS) 2. Models 3. Interactive Programs Version 2.0 4. Aviation Product Formatters				
THIRD LOAD			+	
1. 06Z and 13Z Warm Season LAMP (MOS+OBS+MODEL) 2. Interactive Programs Version 3.0 3. Additional Product Formatters.				
FOURTH LOAD				+
1. 06Z AND 13Z Cool Season LAMP (MOS+OBS+MODEL) 2. Interactive Programs Version 4.0 3. Additional Product Formatters.				

Figure 11. Proposed implementation schedule for T-LAS. MOS + OBS means that the input to the statistical model is based on MOS and SAO's. MOS + OBS + MODELS means that the statistical model uses MOS, SAO's and the simple advective models as input.