TEST DATA SET FORMULATION OF DATA TYPES AND SIZES FOR THE FEDERAL AVIATION ADMINISTRATION'S WEATHER MESSAGE SWITCHING CENTER REPLACEMENT

by

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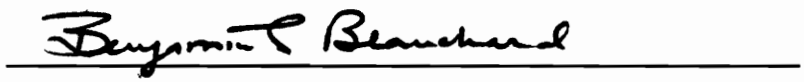
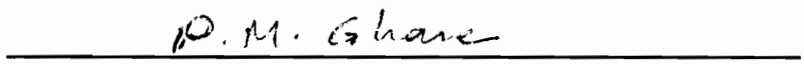


B. S. Blanchard, Chairman



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(ABSTRACT)

In order to ensure the successful demonstration that the Weather Message Switching Center Replacement (WMSCR) of the Federal Aviation Administration (FAA) can complete its primary mission of accepting and distributing various data formats in use today and those of future systems, including the expected message traffic, this study was initiated.

This Test Data Set Formulation will specify the various data formats, worst-case traffic load/size, and a distribution scenario for the WMSCR. From this Formulation, an actual Test Data Set can be constructed and used to test the WMSCR.

A description of the WMSCR, its operational environment, current users, future users, various message formats and associated sizing requirements per interface are detailed within.

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1.0 OVERVIEW.

The WMSCR must accommodate current and future data exchange requirements. To ensure the WMSCR will be capable of meeting these data exchange requirements, it will be tested accordingly. Testing of the WMSCR must take into account all possible data formats that can be encountered, expected traffic loading/sizing, WMSCR user data distribution needs, and specified growth requirements.

1.1 Brief description of the problem.

How can the Contractor chosen to produce the WMSCR (Harris Corporation of Melbourne, Florida) demonstrate to the FAA that its system is capable of meeting the data exchange requirements? The Contractor can demonstrate the feasibility of the system through testing with the Test Data Set specified by the Test Data Set Formulation addressed in this study. The Test Data Set Formulation will specify the data exchange formats to be encountered, a worst-case traffic loading/sizing estimate, expected distribution needs of users, and incorporate the growth requirements for the WMSCR.

1.2 Approach to test data set definition.

The compatibility and capacity requirements will be addressed by a test data set which consists of every type of

data the WMSCR will encounter in its role in the future NAS. The approach taken has been addressed to two concerns. First, the current types of data and associated traffic loading must be defined. Second, the future data types and respective loading must be defined.

Once the total data exchange scenario for the WMSCR is defined, growth requirements that have been applied to the WMSCR are factored into the test data set. It is, therefore, felt that by providing the designer of the WMSCR the kinds, quantity, and distribution requirements expected for the WMSCR, it can be designed in such a manner that a test data set representative of these characteristics may be constructed to be used to verify the data exchange aspect of the WMSCR, in addition to providing it with a data load that will be run as all of the WMSCR's internal functional and performance requirements are being tested.

Section 2.0 provides a background briefing for those readers not intimately familiar the FAA's WMSCR project. The Test Data Set Formulation is addressed in Section 3.0. Section 3.5 describes the Test Data Set specification. Verification for the Test Data Set is described in Section 4.0, and finally, the conclusion of the Formulation is presented in Section 5.0.

2.0 BACKGROUND.

The National Airspace System (NAS) Plan, affectionately referred to as the "Brown Book" due its cover's color, was prepared by the Federal Aviation Administration to present its approach to standardizing and updating a system that has evolved into a perplexing and complicated entity. It demonstrates a perfect example of individual components of an integrated system allowed a large share of autonomy and hence, a lack of a total Systems Engineering approach, which of course resulted in the components driving the system which has now become nearly obsolete and very inflexible in expandability in satisfying new NAS requirements. This Plan contains over 90 projects that the FAA is undertaking with the support of a Systems Engineering and Integration Contractor in hope of developing a system from the top-down which is both technically current, in some cases state-of-the-art, and amenable to incorporation of new requirements without junking what has been already implemented. The NAS Plan is the FAA's cornerstone in accepting and implementing the Systems Engineering approach so that the system can, with proper feedback, remain flexible so that it can be upgraded with minimal impact on the total system.

The following is a quote of the "Brown Book" that introduces the FAA's needs for modernization to Congress: "The

National Airspace System (NAS) is the busiest and most complex in the world. It is a mixture of equipment, techniques, and skills that have evolved over 40 years. Without question, it is the world's safest and most efficient-- yet at the outset of this Plan, its expansion capability was limited, and adaptability to changing requirements was difficult."

The present day NAS, including the procedures and equipment which comprise it, has evolved through a series of piecemeal adjustments and improvements. This is due to the situation that as technology changed, resulting improvements, attributed to science and engineering advancements were implemented at a localized level to solve immediate problems that had or were expected to occur in operational use. The present day NAS environment is made of components providing similar functions that are not strictly uniform let alone identical. Needless to say, the current NAS is very expensive to maintain and operate. It is also limited in flexibility as to adapting to changing demands in the operational arena.

One of these 90 NAS Plan projects is the Weather Message Switching Center Replacement (WMSCR). As the name of the project implies, it is the replacement for the current

Weather Message Switching Center (WMSC) located in Kansas City, Missouri. It is quite representative of a single component isolated from the rest of the system in which it operates a key function.

The WMSC is located in a facility known as the National Communications Center or NATCOM. It became operational in 1967. The system is implemented on a North American Phillips architecture that was designed in Holland. The architecture is based on transistor technology. Any reports required from the WMSC can only be printed on paper. The Phillips system's data can not be dumped in a universal format such as ASCII and requires a very time consuming data translation that is, more often than not, not worth waiting for. The WMSC occupies an entire floor of NATCOM with many rows of equipment.

The primary functions of the WMSC are to accept and distribute a variety of weather data and what is known as Notice to Airmen (NOTAM) data among FAA; Department of Defense (DoD); Department of Commerce (DoC) (primarily the National Weather Service (NWS) and National Severe Storms Forecasting Center (NSSFC)); private users, general aviation pilots; commercial airlines, air transports, and vendors of flight briefing information. The only data handled by the

current WMSC is alphanumeric.

The WMSCR will take over all of the current WMSC functions and also handle new data types and formats expected to be in use in the near future. The WMSCR will communicate with the majority of its users through a modern X.25 protocol packet switching network that will also be the FAA's primary means of communications between all of its internal subsystems and to DoD and DoC. As a part of the verification that the WMSCR can handle everything the WMSC could and all of the new expected formats and users of the future, the WMSCR must be tested accordingly.

A key point in WMSCR system testing will be directed toward its compatibility with current and "end-state" users. The end-state time-frame will occur when all of the 90 NAS Plan projects are implemented. This paper addresses researching current and end-state data formats in both contents and loading to ensure that the WMSCR can be tested to verify its ability to exchange the variety of data expected along with the demands associated with this message traffic.

2.1 Current user environment.

Currently, the WMSC exchanges alphanumeric data with a variety of users. These users amount to 6,000 nationwide. Of these 6,000 users, 500 are primary customers which employ a request/reply function in addition to the simple distribution requirements that are associated with all of the users.

The primary users consist of FAA and other Government Agencies such as the Automated Weather Network (KAWN) of the Department of Defense (DoD) at Carswell Air Force Base (AFB), Texas; from the Department of Commerce both (the National Weather Service (NWS) at Suitland, Maryland and the National Severe Storm Forecast Center (NSSFC) at Kansas City, Missouri); the Aeronautical Fixed Telecommunications Network (AFTN), which consists of international meteorological teletype users; Leased Service A Systems (LSAS) that are FAA systems; FAA Air Route Traffic Control Center (ARTCC) 9020/HOST computers; the FAA Consolidated NOTAM System (CNS) at Washington, DC; and FAA Flight Service Data Processing System (FSDPS-1) computers. All of these users are allowed to receive information from the WMSC and also can request information from the WMSC or input information.

The balance of the users fall into the category that receives information only. Some airlines and air carriers can request information from the WMSC. All of the rest receive the information collected from the WMSC's primary users described previously.

The WMSC is connected to all of these users via approximately 102 circuits consisting of low-speed, leased-lines. In some cases, the WMSC is attached to a message switching network known as the National Airspace System Data Interchange Network 1A (NADIN 1A). The current formats used are of an antiquated teletype format. Since the information stored in the WMSC is primarily used for planning flights, the bulk of the data exchanged by the WMSC is weather related; however; in addition to weather data, NOTAMs, which are also important to flight planning, that deal with the availability of aviation resources such as runways and navigational aides are also distributed and collected. The current WMSC system is depicted in Figure 2.1-1.

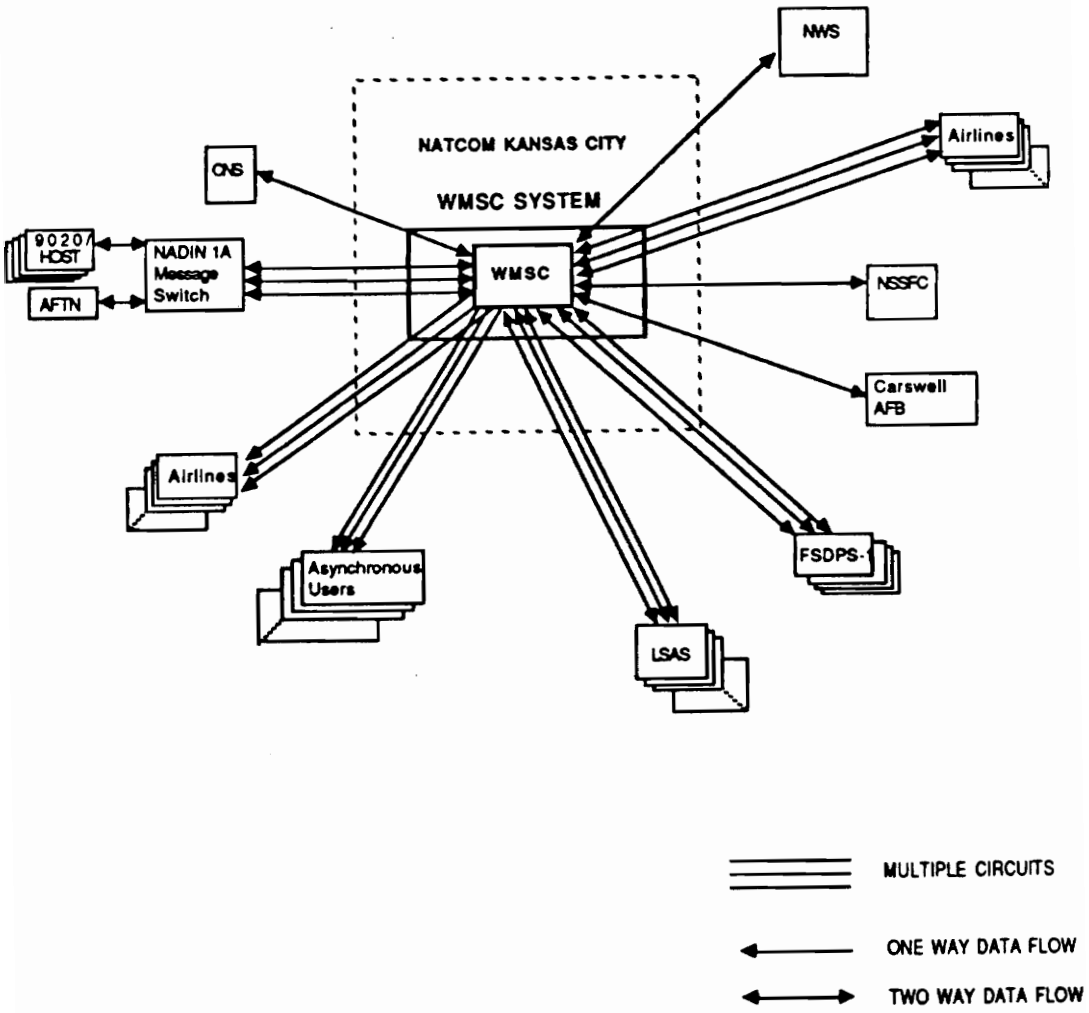

FIGURE 2.1-1. CURRENT WMSC FUNCTIONAL TOPOLOGY

2.2 Future User Environment.

In an effort to modernize the NAS, the FAA is procuring an X.25 packet switch network, known as the Nation Airspace Data Interchange Network Packet Switching Network (NADIN PSN), to handle the majority of its data communications needs and thereby disposing of the expense of leasing point-to-point lines that is the current scenario. The packet switch technology provides the FAA with the advantage of utilizing the International Standards Organization's (ISO) Open Systems Interconnect (OSI) model.

OSI allows otherwise incompatible equipment to exchange information at an applications level, and takes care of the data transmission at a lower level transparent to the computers. The other advantage of packet switch technology allows users to share data lines by only establishing connections when data exchange is required, and then releasing those lines to other users upon successful completion of the data exchange.

This has led to an agreement among the DoD, DoC, and some airlines to convert to the X.25 protocol for data exchange, and consequently a direct interface to the NADIN PSN. In time it is expected that the NADIN 1A function will be taken over by the NADIN PSN once the out-dated AFTN equipment and

the 9020/HOSTs are replaced. Among the users scheduled to convert to a direct connection to the NADIN PSN are NSSFC, Carswell AFB, some airlines, and the NWS via its NWS Telecommunications Gateway (NWSTG).

The other users will be connected to the NADIN PSN via various gateways. A NADIN 1A Gateway will be used for the 9020/HOSTs and AFTN. Those users which share a common X 3.28 protocol such as LSAS, some airlines, and FSDPS-1s, will access the NADIN PSN via a Service A Gateway that will contain both the X.25 and X 3.28 protocols. And finally, the balance of the users that are receive-only, will have data distributed to them from an Asynchronous Packet Assembler Disassembler (APAD) that will be an internal part of the NADIN PSN, as will the NADIN 1A Gateway.

As part of the NAS Plan, there are some future systems being designed that will have to receive data currently provided by the WMSC. These totally new systems are the Aviation Weather Processors (AWPs), Meteorological Weather Processors (MWPs), Real-time Weather Processors (RWPs), the Traffic Management Processor (TMP), and Weather Communications Processors (WCPs). Also as part of the NAS Plan, some of the current systems will be replaced because their equipment consists of old technology. These include replacing the

WMSC with the Weather Message Switching Center Replacement (WMSCR), which this study addresses in detail, and the Consolidated NOTAM System Processors (CNSPs) that replace CNS.

Two other systems will be implemented as part of the NAS Plan. The Maintenance Processor System (MPS) that collects equipment status related information, and the Automated Weather Observation System (AWOS) Data Acquisition System (ADAS) that acts as a concentrator for AWOS data that is forwarded to the WMSCR.

2.3 Weather Message Switching Center Replacement (WMSCR) Program.

The WMSCR will be the WMSC of the future. The WMSC has had a long and useful life, well over twenty years, and will be replaced with the state-of-the-art technology of the WMSCR. To address the FAA's concern for high reliability and avoidance of single-point catastrophic failures, the WMSCR will consist of two identical, remotely located nodes housed in the FAA National Aviation Weather Processing Facilities (NAWPFs) located in Salt Lake City, Utah and Atlanta, Georgia along with the AWPs and the CNSPs. A third component of the WMSCR is the NWSTG/WMSCR Interface Device (NWID) that acts as the WMSCR system interface to the NWS.

The NWID is needed because the NWS can provide only one port for the WMSCR.

The three components that make up the WMSCR system will be transparent to all of its users; therefore, as far as all of the users are concerned, they only interface to a WMSCR system and not to individual parts thereof. Each node is being designed to handle the entire system's data collection and distribution requirements in the event of a failure. Normally, each WMSCR node will handle approximately half of the NAS in the end-state or final configuration. The driving factor for the nodal responsibility assignment, is based on the support of FAA Area Control Facilities (ACFs) that replace the current ARTCCs. The ACFs house the majority of the WMSCR's future users and gateways such as the ADASs, APADs, MPSs, MWPs, NADIN 1A Gateways, RWPs, Service A Gateways, and WCPs. The ACFs are also the FAA's base unit for supporting a segment or regional division of the NAS based on air traffic capacity requirements. Therefore, since the majority of the WMSCR's data exchange requirements are based on ACF support, the WMSCR nodes were assigned responsibility to share an equal load, under normal operating conditions, of the ACF distribution accordingly. Figure 2.3-1 depicts the regions supported by WMSCR nodes on an ACF basis. The WMSCR Atlanta node is housed in the NAWPF

adjacent to the ZTL ACF, the WMSCR Salt Lake City node is similarly located with the ZLC ACF, and the WMSCR Leesburg NWID is contained in the ZDC ACF. The three components of the WMSCR system are indicated by the triangle in the figure.

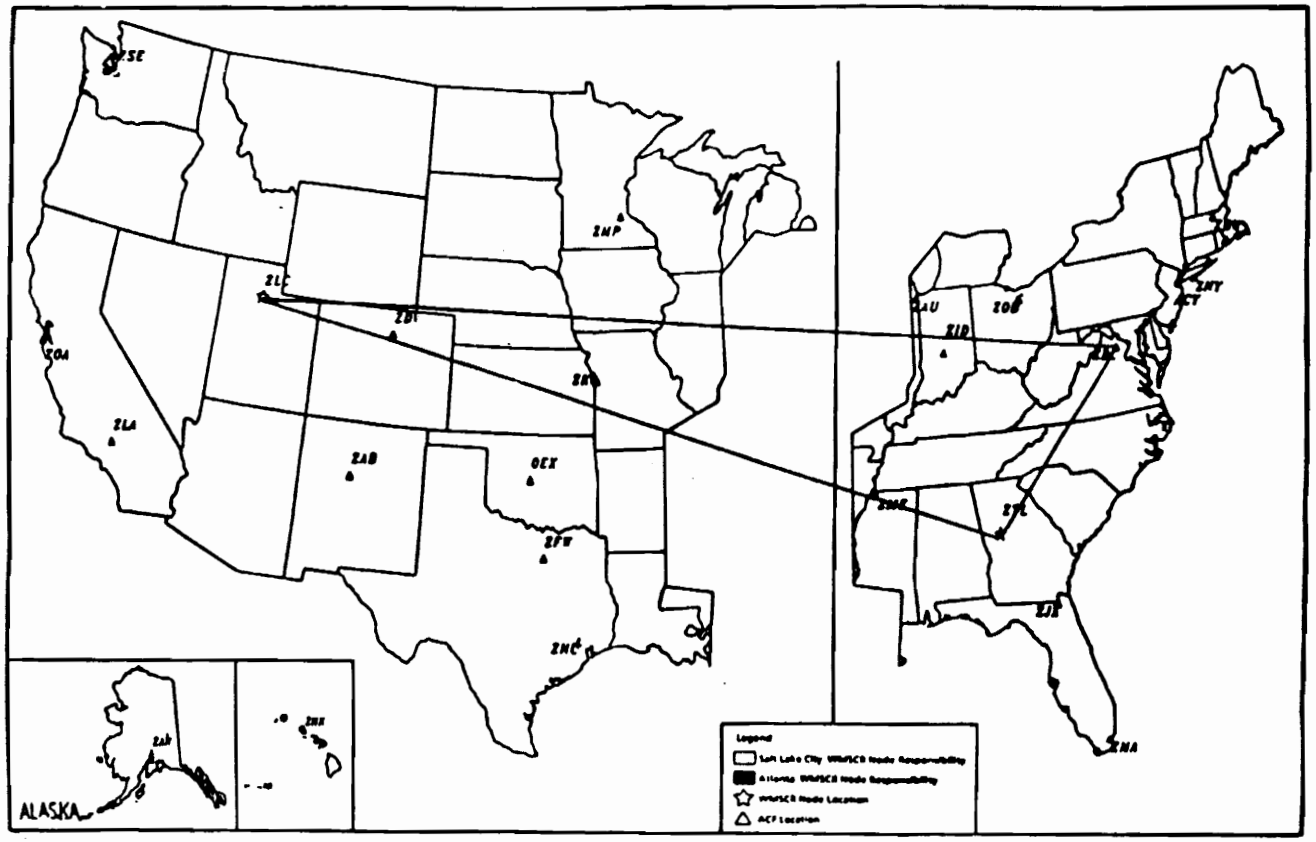

FIGURE 2.3-1. END-STATE WEATHER MESSAGE SWITCHING CENTER REPLACEMENT (WMSCR) NODAL AREAS OF RESPONSIBILITY

A major requirement of the WMSCR is to exchange the same type of information currently supported by the WMSC. In addition to the current data, the WMSCR is being designed to handle additional data requirements of the future users. Every interface to the WMSCR, except the AWP, will be via the X.25 protocol. The WMSCR/AWP interface will be via X 3.66 otherwise known as Advanced Data Communications Control Procedure (ADCCP). The reason for the ADCCP procedure, is that it is better suited than X.25 for a dedicated, intra-facility link. The remaining WMSCR interfaces are inter-facility and utilize X.25.

The WMSCR will support all current users of the WMSC as presented in Section 2.1 and modified and/or future users as presented in Section 2.2. The NADIN PSN basically acts as the WMSCR's data communications medium to the systems outside its facility, excluding the CNSPs which together act as a single system in the same manner as the WMSCR. The functional relationship of the WMSCR system, consisting of its components (WMSCR nodes and the NWID), and all its end-state users is depicted in Figure 2.3-2.

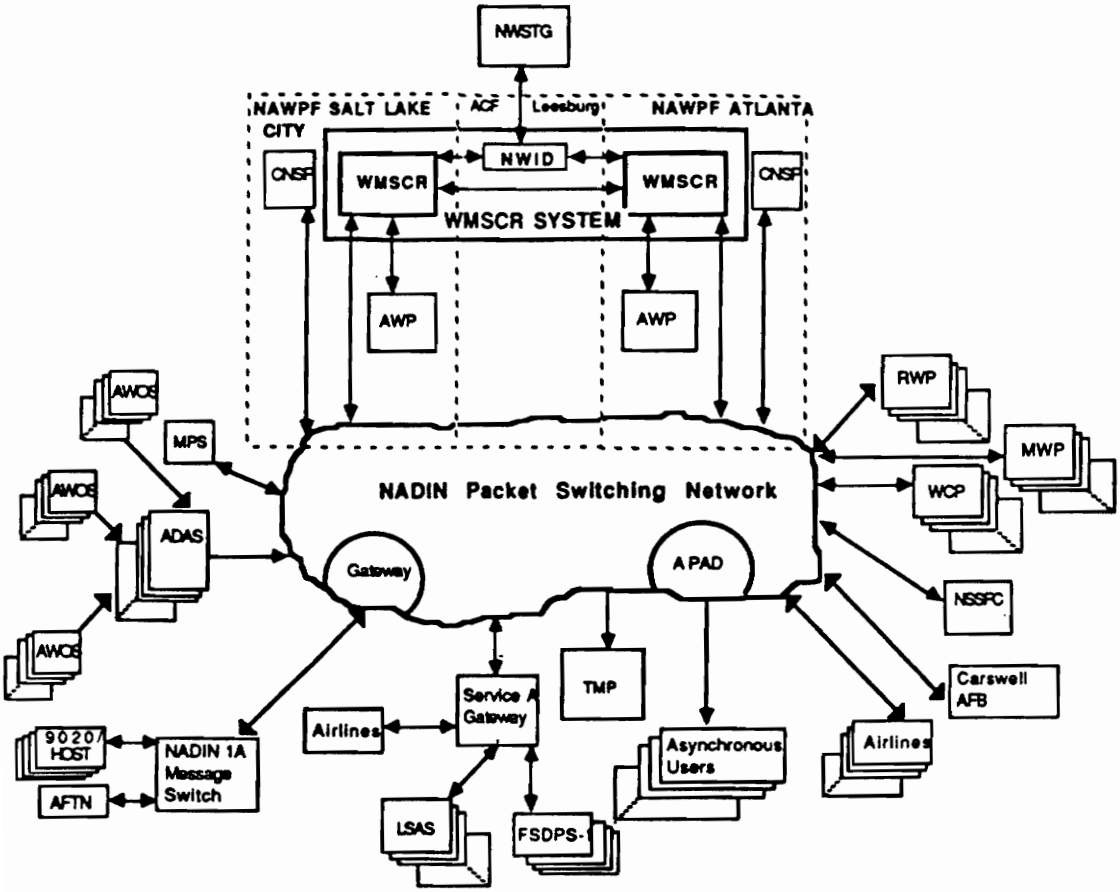

FIGURE 2.3-2. END-STATE WMSCR FUNCTIONAL TOPOLOGY

2.4 Data exchange scenario for the WMSCR.

The WMSCR will collect and disseminate a variety of weather data that includes radar summaries, weather observations, weather warnings/advisories, weather forecasts, and depictions of hazardous weather conditions. The non-weather data that the WMSCR collects and distributes is principally data associated with the availability of NAS airspace resources such as equipment outages, runway closings, and reserved airspace allocations that in effect close sections of the airspace to public use. The bulk of this data is alphanumeric; however, it is projected that since technology has allowed the production of graphical weather depictions in an efficient manner, these graphics will be desired by the users of the WMSCR and the WMSCR is being designed to handle graphic data with the same proficiency as alphanumerics.

Based on the current way observations are recorded and forecasts produced, the majority of data expected by the WMSCR is produced on a scheduled basis. For example, hourly surface observations are allotted a time window each hour in which the WMSCR anticipates this data. Other data such as weather forecasts are produced for a specific time period and are valid for a discrete time period, such as 6 hours. There is also a time window assigned for receiving new

forecasts in a given hour previous to the expiration of the forecast currently residing in the WMSCR. Since there is quite a bit of regularity involved in producing and collecting various forms of routine weather data with respect to discrete hours, the WMSCR uses the time period of an "hour" to address its data collection needs, and consequently the distribution of data to users is done respective to this standard hour.

The standard hour is divided into ten 6-minute time intervals. Certain types of data are expected to be collected and distributed during each six minute time interval. If certain data are not received, the provider of these data is queried for it.

Of course, everything is really not that predictable when the primary information is weather and aviation resource related. Common events that occur such as severe weather conditions, like tornadoes, hazardous icing, and significant precipitation, and other situations also critical to flight safety like runways being closed, direction finders under repair, and navigational outages can not be scheduled. These events are common, but are not frequent. Included in the unscheduled data received by the WMSCR are requests for data not usually allocated to a specific user. This occurs

because certain users are only concerned with their respective area of interest; however, in the case of Flight Services provided by the FAA, FAA Flight Service Specialists are occasionally required to brief a general aviation pilot whose destination or proposed flight route lies outside the specialist's area of immediate concern. When this happens, the specialist must request all pertinent information to that flight which lies outside that data normally scheduled to be automatically received by his or her Flight Service computer, i.e., the FSDPS-1. This is only one example of the many cases where the WMSCR has to supplement a user with information generally not requested to be received by that user in a service agreement.

That information considered critical to flight safety is marked as high priority, and interrupts the routine collection and dissemination function of the WMSCR so that this critical information is immediately forwarded to all affected users. Unscheduled data requirements aside, the busiest time intervals of the WMSCR's standard hour are the first three 6-minute intervals. Scheduled collection and distribution occur during these first intervals. Everything in between will consist of critical and noncritical unscheduled data, and data which is normally scheduled but has either been prepared early or transmitted late.

The other aspect to data exchange for the WMSCR is related to supporting current WMSC users and end state users. The end state users will adhere to a common data format that was designed to reduce associated overhead with data exchange. Current WMSC users transmit data according to a data format that supports teletype equipment which was standardized by the World Meteorological Organization in the 1960's and early 1970's. Since the FAA provides a government service to non-government users such as private pilots and commercial airlines, implementation of the WMSCR must remain transparent to those users unable to purchase new equipment or enhancements allowing them to convert to the end state data exchange format or the X.25 protocol utilized by the end state systems.

3.0 TEST DATA SET ANALYSIS.

The true Systems Engineering approach consists of system-life-cycle functions. These functions span the entire Systems Engineering effort from the identification of a need by the customer, in this case the FAA, through the system production and consumption, or use, functions.

One of the aspects of the Systems Engineering process is the evaluation of the system. It is with regard to this evaluation function that this paper is addressed. The evaluation of the data distribution requirements addresses one of the primary functions of the WMSCR system and is an integral component of the overall evaluation of the system.

Figure 3.0-1 provides the perspective of the WMSCR Test Data Set Analysis with respect to the total Systems Engineering Approach. This figure is based on the "generic system life cycle functions." (See chapter 2 of the first reference in Section 6.0, Other References.)

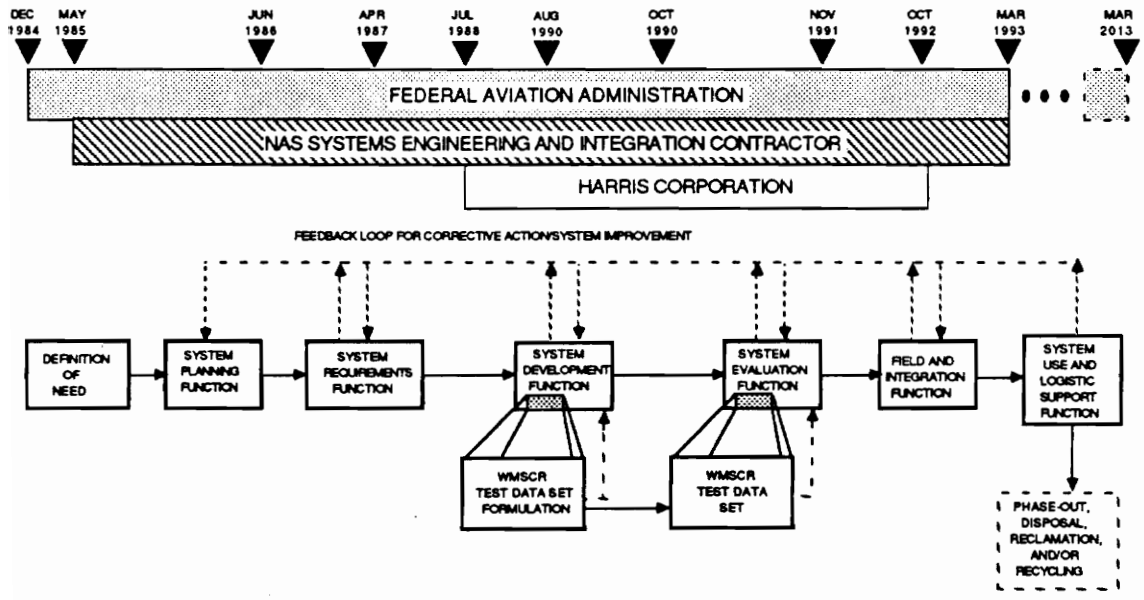

FIGURE 3.0-1. WMSCR SYSTEM LIFE CYCLE FUNCTIONS

More specifically, this Test Data Set Analysis is a follow on from the advanced product planning activities that occur during conceptual design of a system where the customer identifies its needs with respect to an intuitive consideration of system testing later on. If needs or requirements can't be realistically tested, then they can not be verified.

The system evaluation function, previously addressed, can be decomposed into several discrete steps. The Test Data Set Analysis is one of the sub-steps performed in system evaluation. The relation of this Test Data Set Analysis is depicted with respect to overall system requirements and evaluation in Figure 3.0-2. (See page 300 of the first reference in Section 6.0, Other References).

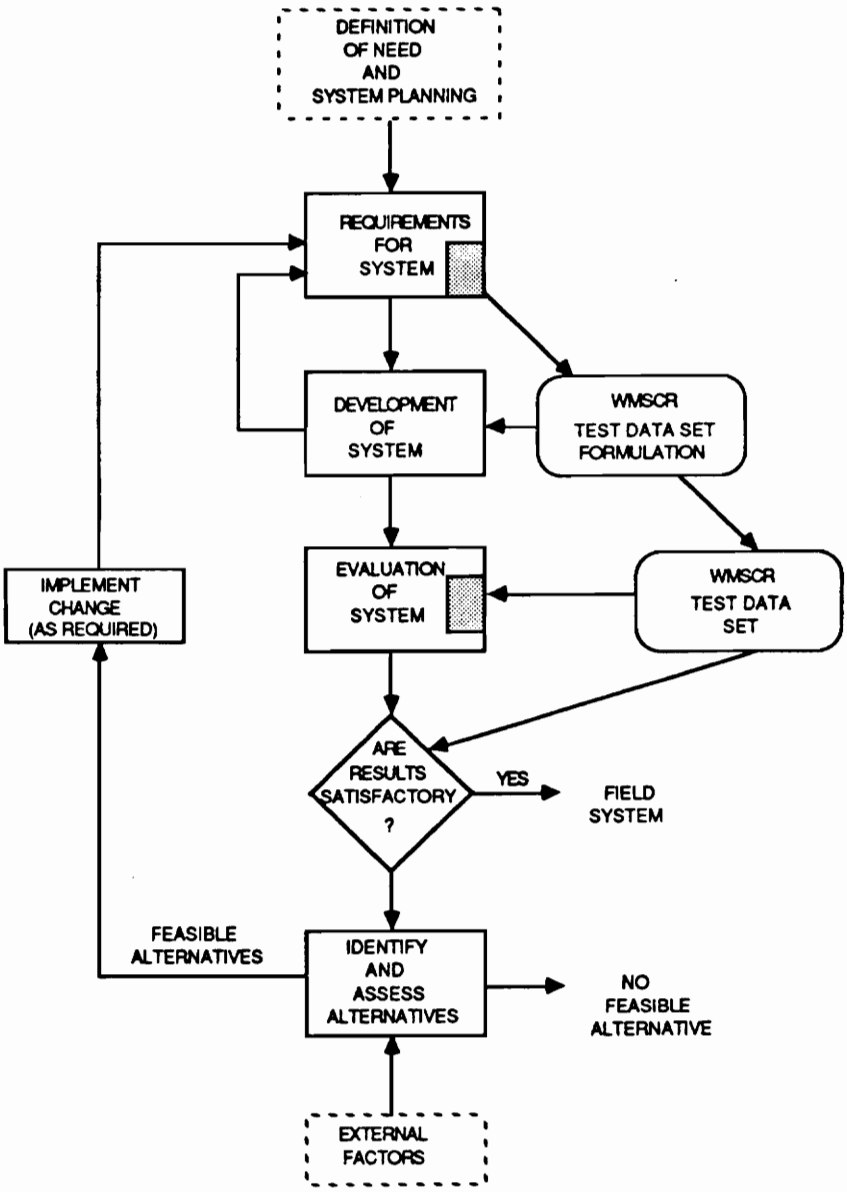

FIGURE 3.0-2. WMSCR SYSTEM REQUIREMENTS AND EVALUATION

The relationship between the Test Data Set Formulation and the Test Data Set with respect to the functions of the Systems Engineering Process is shown in the preceding figures. The Systems Engineering and Integration Contract (SEIC), who is responsible for project management of the WMSCR, based the Formulation on original FAA needs. The contractor is designing to the original requirements on which the Test Data Set is based. The Test Data Set Formulation is presented to the contractor in order define how a portion of the WMSCR requirements will be evaluated and verified. The contractor incorporates this information into the WMSCR design since it will be used in the evaluation of the WMSCR system by the FAA and the SEIC.

There are four basic phases associated with the Test Data Set Analysis. They are Definition, Analysis, Results, and Conclusion. Figure 3.0-3 provides the overall flow of the steps involved in each of the phases of the Test Data Set Analysis effort.

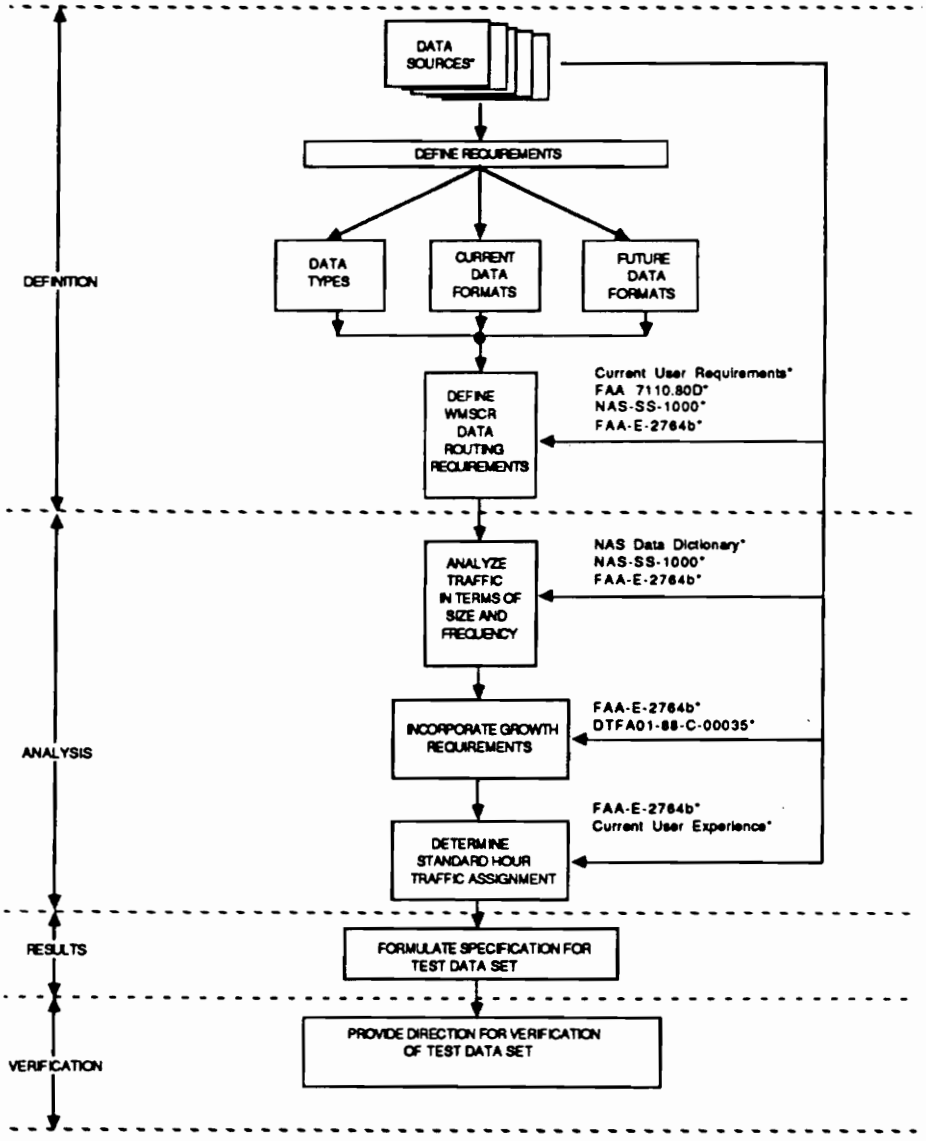

FIGURE 3.0-3. TEST DATA SET ANALYSIS PHASES

Data sources referenced in the WMSCR Contract are utilized in defining and analyzing the Test Data Set. The Test Data Set lays out all of the types of data that the WMSCR system will be expected to handle and all of the respective data formats to be supported for current and future users in the end state environment. The users are related as sources and sinks of data since the primary function of the WMSCR is to collect various types of data and distribute the data to the users allocated for the receipt of the data. (Note: the WMSCR is being designed so that after the system is operational, it can be easily modified by FAA WMSCR personnel to handle new users, new formats, and new distribution requirements as necessary.)

The source documentation is used in determining appropriate traffic sizing and frequency characteristics, along with the incorporation of those growth requirements anticipated for the WMSCR's future demand, and also in formulating the standard hour traffic. From this the Test Data Set is derived and the contractor is provided the information against which a portion of the WMSCR's requirements will be evaluated.

This Test Data Set is a key to the acceptance of the entire WMSCR system by the FAA. Once the WMSCR system meets the

Test Data Set requirements, all of the internal functional and performance requirements will be tested and evaluated as this standard hour of data is continuously run through the system. The philosophy behind this is that normal operating functions such as data editing, data base updating, adding new users, and so on will be performed operationally as the WMSCR is providing its normal data collection and distribution function in the NAS environment. Therefore; every operator command that the WMSCR must provide has to meet its timing requirements for execution as the WMSCR system is collecting and distributing data according to its user's needs.

3.1 Data type definitions.

The WMSCR will handle weather and NOTAM data. The FAA, the Military, and the NWS all follow the World Meteorological Organization's (WMO) format that utilizes conventions adopted by the International Civil Aviation Organization. For the most part, the data will be alphanumeric; however, graphic data will also be accepted and distributed by the WMSCR. The graphic data will be formatted according to an agreement between the FAA, Military, and NWS defined by the Federal Coordinator of Meteorological (FCM) data. Some data, such as NOTAMs, will be in a NAS domestic format that has evolved exclusively within the United States of America.

The NOTAM data will be exclusively alphanumeric. Weather data can be broken into three categories. First, the weather data is either a report, a collective, or a graphic depiction. For the purposes of the WMSCR, all data is categorized as either a report or product. All NOTAMs are considered reports and so are weather data that are not collectives. All weather collectives and graphic data are considered to be products.

Collectives, as the term implies, consist of multiple weather reports for a specific region, or of a specific type of report or reports. The collectives are either stand-alone products or allocated as break-down collectives. Break-down collectives are received by the WMSCR and the individual reports stripped out, distributed, and stored in the WMSCR's data base for future request/reply queries.

The kinds of collectives that the WMSCR can encounter will now be briefly identified and discussed. Hourly surface observations (SA) are received and stored from manual and automatic weather reporting sites that include the LSAS, ADAS, airlines, Carswell AFB (KAWN), and the NWS. They are either domestic, military, or international. The SAs will contain one or more reports and are considered to be break-

down collectives.

Terminal forecasts (FT); which can be domestic, military, or international; are received from NWS, KAWN, and AFTN. These forecasts are considered break-down collectives because they contain forecasts for multiple air terminals which are to be separated and stored with respect to each airport they are specific to. Other forecasts categorized for break-down by WMSCR include wind and temperature aloft forecasts (FD), area forecasts (FA), operational forecasts (FO), public forecasts (FP), and severe weather forecasts (WW) [that are received from NSSFC].

The remaining weather collectives that will be classified as break-down collectives are pilot weather reports (UA) of weather conditions noted during flight; flight advisories, AIRMETS (WA), that are issued by NSSFC and NWS for notice of potentially hazardous weather conditions; radar reports (SD) compiled by NWS; transcribed weather broadcasts (TWEB), for selected flight routes, and synopsis reports (SYNS), that are associated with one reporting station and transmitted with a group of TWEBs, from the NWS; WMO SYNOPTIC surface observations (SM, SI, and SN) and WMO upper air observations (TEMP and PILOT) from the NWS.

Weather collectives or products that will not be broken down include: flight advisories for selective distribution SIGMETS (WS) and Convective SIGMETS (WST) issued by NSSFC; meteorological impact statements (MIS) that are unscheduled forecasts for an ARTCC or ACF used for planning purposes regarding flow control; and finally, center weather advisories (CWA), which are also ARTCC/ACF based, used to indicate adverse weather conditions in terminal and enroute environments.

Examples of weather reports received, for the most part individually, are special surface observations (SP) provided automatically by ADAS if there are any drastic changes in current weather conditions noted, and urgent pilot weather reports (UUA) received from AWP or FSDPS-1.
The preceding information covers the majority of the data encountered by the WMSCR. A detailed listing of the weather data expected to and from the various users of the WMSCR is contained in Appendix E of this document.

The data the WMSCR handles is either routine or urgent. The majority of the routine data is of the scheduled nature, whereas all of the urgent data is unscheduled and requires immediate distribution. Some of the routine data like SAs are reported to the WMSCR hourly, and are replaced the next

hour when the updated SAs arrive. UAs, on the other hand, are weather reports from pilots that describe the weather encountered during a portion of a particular flight and are unscheduled. Most of the forecasts are provided once or multiple times daily and are valid for various time periods ranging from six to twenty four hours.

A basic summary of the WMSCR data types encountered can be said to be a routine of scheduled data acquisition and distribution with instances of critical data distribution requirements that must be accommodated in addition to the scheduled workload expected.

3.2 Data type formats.

Of course, since the WMSCR is dealing with multiple types of data from currently supported and future users both within and external to the FAA, the same data can arrive in multiple formats. These formats depend on all of the preceding conditions.

The approach used to define the various formats encountered by the WMSCR is based on what is called an application data unit (ADU). The ADU is meant to be that datum which is exchanged at the ISO Application Layer of the OSI seven layer model. It is really that datum the WMSCR's and WMSCR

User's applications software can recognize and process. All of the rest of the message header associated with the lower layers that are the Presentation, Session, Transport, Network, Data Link, and down to the Physical, are stripped off by the WMSCR's communications function before presented to the WMSCR applications and then included once again after the application has finished its processing. In fact, the WMSCR is only concerned with identifying the data received so that it can be distributed to appropriate users and whether or not it is a collective requiring break-down or a data request.

There are four basic ADUs used by the WMSCR. There is a data exchange ADU that will be utilized in the normal receipt and distribution of data. Another ADU is the data request ADU, which is used to obtain a specific type or types of data. Along with the data request ADU, are two other ADUs. A request response ADU is transmitted if the request was successful, and a request reject ADU is transmitted either if the request was in error or if the data requested was unavailable.

ADUs have been designed for end state systems in order to streamline the data exchange environment. However, ADUs have also been incorporated from the current WMSC

environment in an effort to make the transition to WMSCR transparent for those users who currently have no immediate plans for altering their data formats that they now handle.

Figure 3.2-1 gives an overview of the categories of users that will use which types of ADUs. Those users requiring the current ADU support can be listed as the 9020/HOSTs, AFTN, some airlines, LSAS, FSDPS-1s, Asynchronous Users, and the AWPs.

The AWPs are being fielded in the 1990 time frame, and were designed before the NAS Plan came into existence. Therefore; the AWPs will go into the field expecting the current ADUs and in some cases, modified current ADUs. The balance of the users/systems in Figure 3.2-1 will use the end state ADUs.

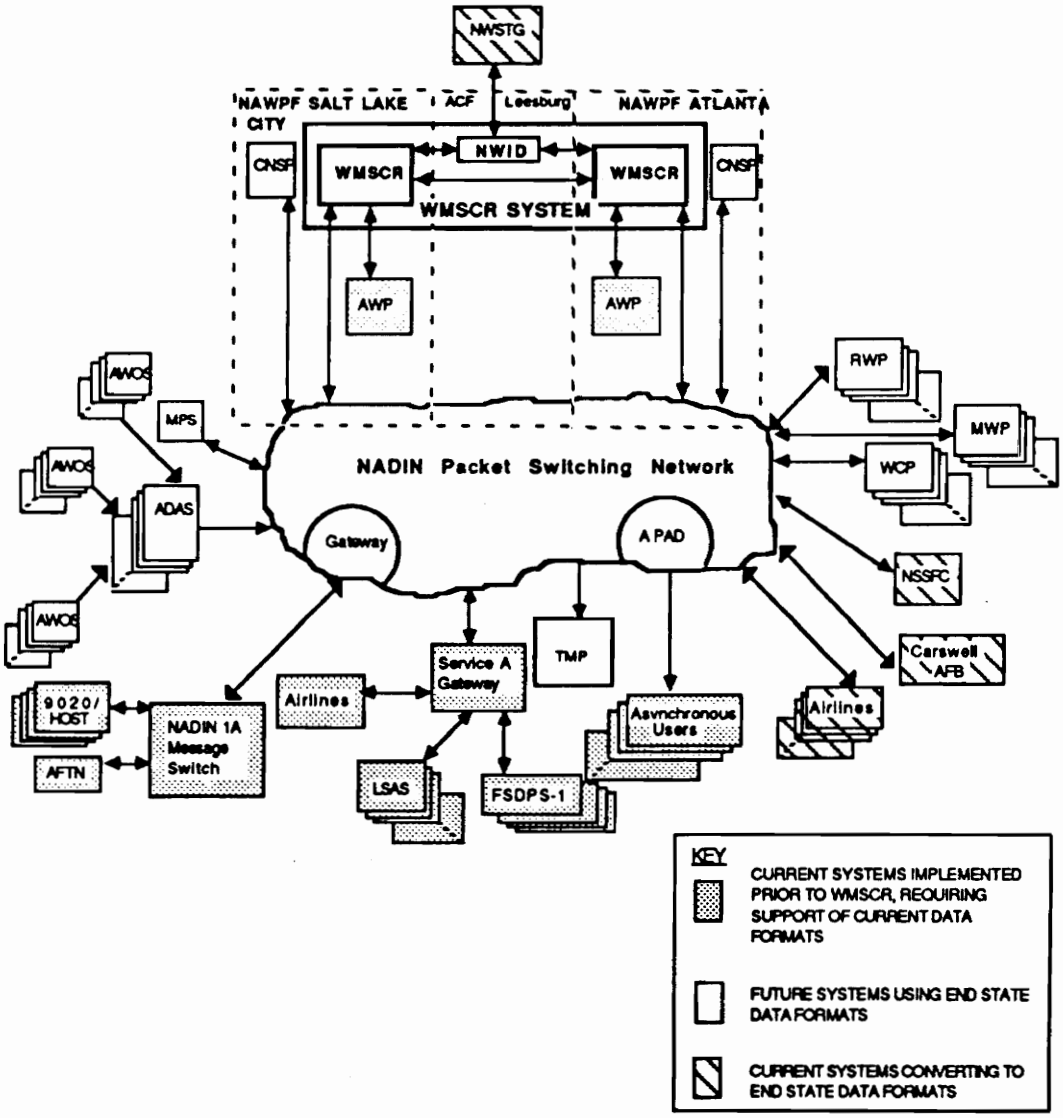

FIGURE 3.2-1. WMSCR DATA FORMAT SUPPORT SCENARIO

3.2.1 Current formats to be supported.

The current formats the WMSCR must support contain a lot of overhead, or unnecessary information. This is because the current users are either using older teletype equipment or their systems have replaced teletype equipment and were designed to receive the same information as the equipment they replaced.

There are basically four categories of current users that the WMSCR must communicate with. They are grouped as the Nadin 1A Gateway users, which include the 9020/HOSTs and AFTN, the AWPs, LSAS Gateway users which include LSAS, FSDPS-1s, and airlines, and finally APAD users.

The types of data these users expect are grouped according to WMO, NOTAM, Weather Report, Weather and NOTAM Report, and even WMO and Weather Report. For example, the NADIN 1A Gateway users have ADUs that address WMO data, and ADUs that address both Weather and NOTAM Report data. Similarly, there are specific ADUs associated with the APAD users, the AWPs, and LSAS Gateway users. Some of the users handle certain data with the same type of ADUs.

The final level of concern to the ADU is the format or function of the ADU itself. Each type of data grouped under

a user ADU can have up to four possible formats. The format varies depending on whether it is used for data exchange, data requests, request responses, or request rejects. In some cases, especially NOTAMs, there are two ADUs used for data exchange; one is strictly for input of a NOTAM into the WMSCR, the other is strictly for output of a NOTAM from the WMSCR.

In summary of the current ADUs, each of the categories of users have ADUs associated with the data communications requirements resident in their equipment. The NADIN 1A category of users has four ADU formats that are used for data exchange (one for input to WMSCR, one for output from the WMSCR, which also serves the function of being a request response), for data requests, and for request rejects for Weather and NOTAM Report type data. There are three ADUs used by the NADIN 1A Gateway category for data exchange, which also doubles as a request response, for data requests, and for request rejects for WMO type data. There are seven distinct ADUs corresponding to NADIN 1A Gateway users.

The AWP category of users has four associated ADUs that function similarly to the NOTAM type ADU formats of the NADIN 1A Gateway category of users. Both the AWP and the LSAS Gateway categories of users utilize the same ADU

formats with respect to data requests and request rejects associated with WMO type and Weather Report type data, and two distinct formats of data exchange ADUs for WMO type and Weather Report type data. In addition, the LSAS Gateway category of users has four ADUs corresponding to NOTAM type data. Three of these, for data requests, input to WMSCR, and request rejects are unique to LSAS Gateway users. The fourth, which addresses the output of NOTAM data from the WMSCR, is the same ADU utilized by the APAD category of users. The APAD category of users has only one other ADU format classified as data exchange for WMO type data. The APAD users in today's environment are receive only. Therefore, in essence, the data exchange ADU they employ may be considered only for output of WMO type data from the WMSCR.

The final tally of unique ADUs associated with current users amounts to twenty. Figure 3.2.1-1 summarizes the ADUs based on user, data type, and formats for the data types. A complete definition of the current ADUs down to the "byte" level is provided in Appendix A of this document. Appendix F is provided to present the binary coding of the control characters used.

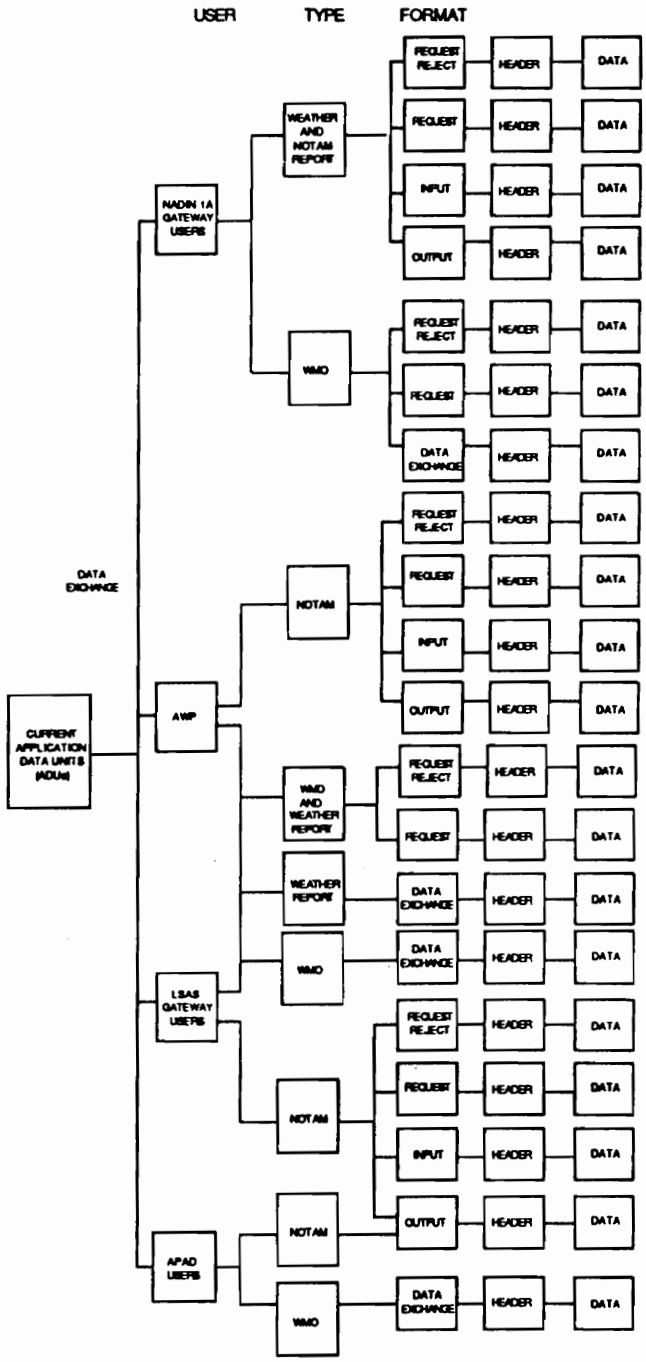

FIGURE 3.2.1-1. CURRENT USER APPLICATION DATA UNITS

3.2.2 Future formats to be supported.

Unlike the current user formats for ADUs, the future or end state ADUs are much more versatile. There is a slight difference in terminology used when addressing the end state ADUs. There are four formats of ADUs corresponding to data exchange, data request, request reply, and request reject functions. The data exchange and request response ADUs are further broken down into the four types of data encountered. The data types are WMO, Report (meaning weather report), NOTAM, and FCM or graphic. The two ADUs associated with data requests and request rejects are universal to any type of data.

The end state users basically have ten ADUs that will be encountered. The reason for the subdivision with respect to the data types is that the information which concerns data type and originator vary within the formats used. It has been proposed that all end state subsystems will convert to one data format, such as FCM, which can accommodate any type of alphanumeric or graphic data. In this case, the WMSCR would only be concerned with four ADUs, one for each format. This, however, is something that may be considered as a future upgrade to the NAS.

The end state ADUs, in an effort to remove any unwanted

overhead associated with the teletype controls contained in the current user ADUs, have not incorporated any of the antiquated control characters such as vertical tabs and line feeds which were actual control characters used in the earlier data communications environment. In addition to removing the teletype conventions resident in the older data, the end state ADUs employ a Format/Type code as the first byte of the ADU. From this byte, the WMSCR or the user can immediately discern appropriate application processing functions that the data contained in this ADU will require. For example, a "1110" as the first four bits of the Format/Type byte indicates that this ADU is a data exchange ADU. The second four bits, "1111," would indicate that this data exchange ADU contains NOTAM data.

Another convention incorporated into the end state ADUs is the "identifier." There is a universal product identifier (UPI) and also a universal report identifier (URI). The UPI is used for products, while the URI is used for reports. All necessary information required by the WMSCR is contained in this identifier. The identifier consists of the first sixteen bytes immediately following the Format/Type byte.

Between the Format/Type byte and the identifier, the WMSCR can readily identify the ADU format, the type of data

contained, and the pertinent information necessary for processing of the data for distribution and storage purposes. This eliminates the need to read the entire header of a current ADU while retaining each byte so that it can pass through an identification algorithm which will identify the data and then route it to the appropriate function that must understand the meaning of the teletype conventions employed by its source.

The overall organization of the end state ADUs which are to be utilized by the NWSTG, CNSP, MPS, ADASs, TMP, some airlines, KAWN, NSSFC, WCPs, MWPs, and RWPs is provided in Figure 3.2.2-1. Specifics of the ADUs to the "byte" level are provided in Appendix B of this document.

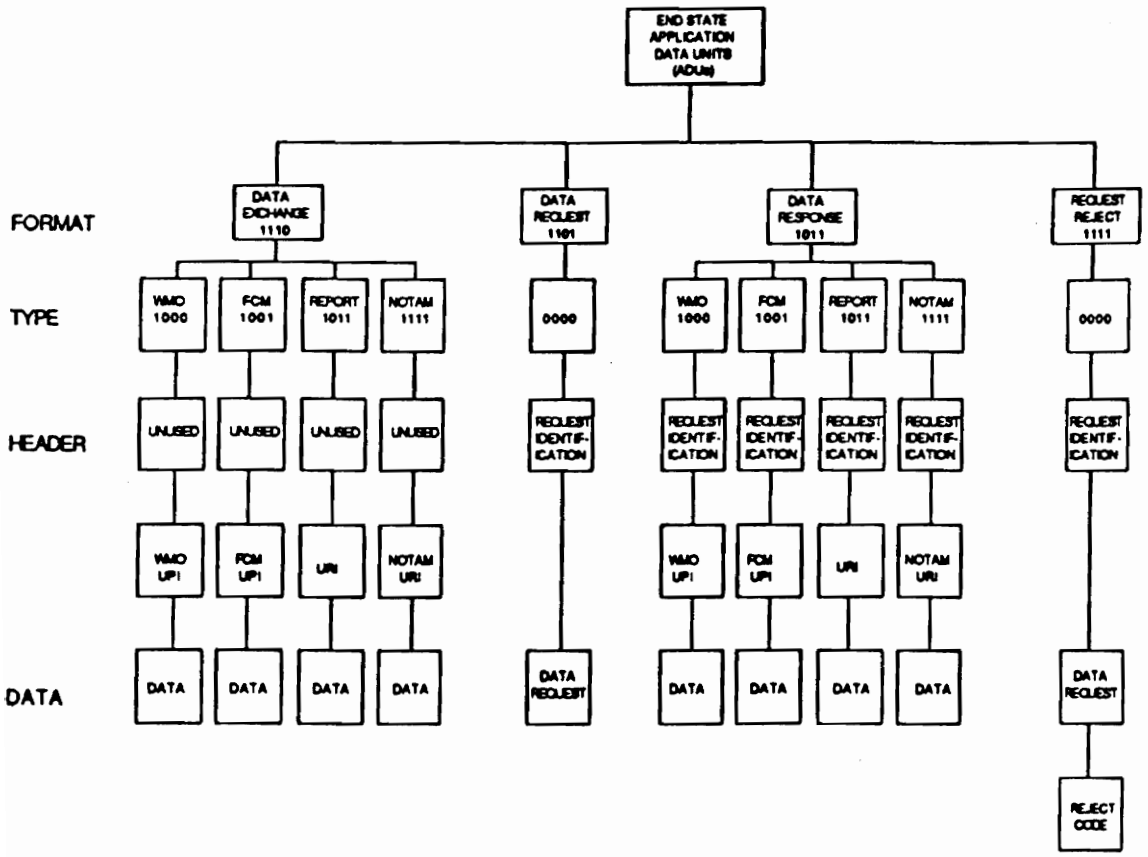

FIGURE 3.2.2-1. END STATE USER APPLICATION DATA UNITS

3.3 Traffic loading and sizing.

The formats to be handled by the WMSCR have been defined. They are defined in Appendices A and B. The next step is to define the routing of data among the subsystems via the WMSCR, and then provide the volume and frequency of the data the WMSCR must support.

3.3.1 Assumptions.

- This Test Data Set Analysis has been prepared with all available data resources as provided in section 6.0.

- Even these references are not complete, and because of this the MPS data requirements and formats have not been addressed; they currently don't exist.

- The ADUs provided in Appendices A and B are currently being prepared and may change.

- Data traffic requirements for current WMSC users, when unobtainable, was incorporated from FAA-E-2764 (see section 6.0).

- Data distribution requirements, when undefined, were addressed according to potential FAA field needs that may require data exchanges not officially documented.

- Appendix C, which consists of the best information available, represents a reasonable description of the WMSC's traffic loading.

- Appendix E, which consists of the best information available, represents a reasonable description of the WMSCR's traffic loading and the number of the different end state systems supported.

- Based on current field experience, sections 3.4.1 and 3.4.2 represent a reasonable allocation of WMSCR hourly data.

- The Central Flow MWP (CFMWP) is basically two MWPs housed in the FAA Central Flow Facility, and is addressed as another MWP interface.

3.3.2 Data routing (source/sink) requirements.

As part of the running of the Test Data Set, the WMSCR must route the data it receives from its various users to those users allocated for the receipt of such data. Routing requirements are variable. In the field, they are updated or modified through coordination with FAA field operations personnel. The routing requirements will be provided to

verify the WMSCR is capable of processing each type of user ADU. It is understood operationally that routing requirements change based on user needs; however, the source/sink allocation of the Test Data Set Formulation is concerned with WMSCR data exchange functionality. This can be done without knowing the exact source/sink routing for a specific instant. The WMSCR's data routing requirements for the Test Data Set Formulation are defined in Figure 3.3.2-1. From Figure 3.3.2-1, it is seen which users receive and/or transmit data via the WMSCR to the other users. The input/output routing allocation provided is a reasonable scenario based on current and future needs.

SYSTEM \ INTERFACE	NWSTG	MWP	AWP	CNSP	RWP	NSSFC	KAWN	APAD	LSAS	ADAS	WCP	AIRLINES	FSDPS-1	9020/HOST	AFTN	TMP	CFMWP	MPS	WMSCR
NWSTG		B	O		B	O	O	O	O	I	O	O	O			O	O		B
MWP	B	B			B	I	I				O						B		B
AWP	I			B	I	I	I	O		I		O							B
CNSP			B					O	B		O	O	B	O					B
RWP	B	B	O		B	B	B		O			O					O		B
NSSFC	I	O	O		B		O		O		O		O						B
KAWN	I	O	O		B	I			O		O	O							B
APAD	I		I	I		I													I
LSAS	I			B	I	I	I				O						O		B
ADAS	O		O																O
WCP	I	I		I	I	I	I												I
AIRLINES	I		I	I	I	I	I												B
FSDPS-1	I			B															B
9020/HOST	I			B															B
AFTN	I																		B
TMP																I			I
CFMWP		B																	B
MPS																			B
WMSCR	B	B	B	B	B	B	B	O	B	I	O	B	B	B	B	O	B	B	B

KEY

I: SYSTEM RECEIVES INPUT "ONLY" FROM INTERFACE.

O: SYSTEM TRANSMITS OUTPUT "ONLY" TO INTERFACE

B: SYSTEM TRANSMITS AND RECEIVES WITH INTERFACE

FIGURE 3.3.2-1. WMSCR DATA ROUTING REQUIREMENTS

Figure 3.3.2-1 gives the high-level scenario for distribution of data by WMSCR. It basically provides a means for exercising all of the ADUs that the WMSCR must support. This figure is based on the current WMSC circuit requirements presented in Appendix C for the type of data exchange -either input, output or both- of those current WMSC users, identified in Appendix D by WMSC circuit, that the WMSCR will support in the end state. It is also based on the data exchange requirements presented in Appendix E.

3.3.3 WMSCR traffic sizing.

Appendix C contains a sample of the current loading on the WMSC system. The WMSC handles, on the average, approximately 6,068 kilobytes of data per hour, which 484 kilobytes are input and 5,584 kilobytes are output. Currently, about 92 percent of the WMSC's traffic is for distribution. For a worst case scenario, The WMSC may be required to handle over 8,200 kilobytes in a given hour, of which 92 percent of the traffic is still associated with data that is being distributed.

In the end state, traffic requirements are expected to increase, and this is mainly due to the implementation of new systems or users of the WMSCR. The average aggregate data traffic expected for the WMSCR is approximately 26,000

kilobytes of data in one hour. The worst-case traffic load will be significantly higher. Details are provided in the following sections to address the worst-case load.

3.3.4 Growth requirements.

The WMSCR is being designed so that one of its nodes can take over the WMSCR system if the other node fails. If a failure occurs, there is allowed up to a ten percent degradation. In an effort to field a system that can accommodate growth, the WMSCR is being required to handle a 100 percent increase or growth in data traffic distribution requirements. It is, therefore, necessary that the Test Data Set incorporate a 100 percent growth margin above the data sizing which is currently expected. This way, the WMSCR can handle the tripling of data that is expected in the end state, and also accommodate a 100 percent increase in traffic without upgrading the system. In addition to this requirement, the WMSCR must be able to accommodate yet another 100 percent growth in traffic by hardware enhancement through upgrades to the central processing units and providing additional data ports.

3.4 WMSCR data distribution requirements.

The WMSCR deals with data on an hourly basis. At the top or beginning of each hour, the WMSCR has a schedule of data

that must be distributed to its users. A standard hour is defined for both input and output of data. In this way, the timing of the data traffic can be more realistically described. The standard hour is divided into ten six-minute time intervals over which a percentage of the total data expected for that hour is associated. The assignments of the percentages is based on the way in which the WMSC receives and distributes its scheduled and nonscheduled data today. Unscheduled data can come in any time during the hour, and some stations will deliver their scheduled data either early or late. This is why there will be a percentage assigned to each time interval of the standard hour.

3.4.1 Input distribution.

For input requirements, the standard hour is as follows:

Minute Interval	Percent of Input Expected
00 - 05	20 %
06 - 11	10 %
12 - 17	10 %
18 - 23	5 %
24 - 29	20 %
30 - 35	10 %
36 - 41	5 %
42 - 47	10 %
48 - 53	5 %
54 - 59	5 %
TOTAL	100 %

This assigns 65 percent of the expected input to occur within the first 30 minutes of the hour and 75 percent of all of the data to be received in the first 36 minutes.

The input data sizing that the WMSCR expects from its users on an hourly basis is provided in Appendix E. To go along with a worst case environment for the WMSCR, those data which are expected to occur over periods of time greater than one hour but less than one day, e.g., three per day as

in the case of Alphanumeric/Graphic Data Display Requests from KAWN or NWS Terminal Forecasts that are expected to occur 4 times per day, must have one full message included in the hour. Those that are expected to occur in quantities such as 69 per day, like the Meteorological Impact Statements, are averaged to an hourly basis rounding up to the nearest whole number or complete ADU. (The WMSCR doesn't process pieces of an ADU.)

With this in mind, the frequencies and sizes are used from Appendix E. Those interfaces marked with a "+" used estimates in FAA-E-2764b. The estimates are derived from a detailed study that included estimates like those contained in Appendix C in conjunction with the circuit information provided in Appendix D.

For those interfaces covered in Appendix E, the Test Data Set Formulation load for the hour is calculated as follows. The expected worst-case data size is calculated on an hourly basis. Messages with a frequency of less than one per hour are incorporated as if they had a frequency of one per hour. The WMSCR only processes whole messages. One of each type of low frequency message could arrive during the same hour. Other messages that have a frequency of greater than one per hour, use the hourly average. After the worst-case hour is

calculated, the 100 % growth margin is incorporated.

In general, each interface is addressed as follows:

USER'S WORST-CASE HOURLY DATA LOAD (kilobytes)	**GROWTH FACTOR**	**TEST DATA SET HOURLY LOAD** (kilobytes)
W	100 %	**2W**

Where **W** is the user's input or output data sizing, and **2W** incorporates the 100 percent growth margin.

A sample calculation for the MWP input Test Data Set Formulation Load is provided below:

SOURCE	**MESSAGE NAME**	**SIZE** (kilobytes)	**FREQUENCY**
MWP	CWA *	0.200	3 per DAY
	GIM *	0.200	3 per DAY
	HAZ WX AO	0.200	1 per HOUR
	MIS *	0.200	3 per DAY
	PIREPS	0.090	1 per HOUR

These sizes and frequencies are now addressed to an hourly basis. (Note: * indicates that this is a low frequency message and one complete message of this type is incorporated into the worst hour.)

Appendix E lists the full message name and other size and frequency characteristics. Under "I/F#" of the Appendix,

how many of each kind of user supported is defined. Now the worst-case hour for the user, in this case the MWP, must be adjusted by the number of that kind of user expected. From Appendix E, there are 23 MWPs expected. The calculations for all 23 MWPs are provided in the following example.

SOURCE	MESSAGE NAME	HOURLY LOAD (kilobytes)	NUMBER OF MWPs	TOTAL (kilobytes)
MWP	CWA *	0.200	23	4.600*
	GIM *	0.200	23	4.600*
	HAZ WX AO	0.200	23	4.600
	MIS *	0.200	23	4.600*
	PIREPS	0.090	23	2.070
			TOTAL	20.470

* Indicates that one full message of this type is expected in the worst-case hour. (See sample calculation for MWP on previous page.)

The Test Data Set Formulation load for MWP input is calculated as follows:

MWP WORST-CASE HOURLY DATA LOAD (kilobytes)	GROWTH FACTOR	TEST DATA SET HOURLY LOAD (kilobytes)
20.470	100 %	40.940

The expected Test Data Set Formulation load for input from the WMSCR users is as follows:

USER	WORST CASE	GROWTH MARGIN	LOAD
NWSTG	1016.4900	100 %	2032.9800
MWP	20.4700	100 %	40.9400
AWP	62.4530	100 %	124.9060
CNSP	21.4500	100 %	42.9000
RWP	324.8700	100 %	649.7400
NSSFC	0.7000	100 %	1.4000
KAWN	20.8200	100 %	41.6400
APAD+	0.0000	100 %	0.0000
LSAS+	39.1000	100 %	78.2000
ADAS	386.4000	100 %	772.8000
WCP	0.0000	100 %	0.0000
AIRLINES	0.5800	100 %	1.1600
FSDPS-1+	3.6000	100 %	7.2000
9020/HOST+	4.6000	100 %	9.2000
AFTN	325.0010	100 %	650.0020
TMP	0.0000	100 %	0.0000
CFMWP	0.4000	100 %	0.8000
MPS	0.0000	100 %	0.0000
OTHER WMSCR	175.0000	100 %	350.0000
TOTAL INPUT			**4803.8680 kilobytes**

\+ Derived from FAA-E-2764b

3.4.2 Output distribution.

Output distribution follows the same rationale as section 3.4.1 in formulating the standard hour for output and the output data sizing.

For output requirements, the standard hour is as follows:

Minute Interval	Percent of Output Expected
00 - 05	5 %
06 - 11	20 %
12 - 17	10 %
18 - 23	10 %
24 - 29	5 %
30 - 35	20 %
36 - 41	10 %
42 - 47	5 %
48 - 53	10 %
54 - 59	5 %
TOTAL	100 %

This assigns 50 percent of the expected output to occur within the first 30 minutes of the hour and 70 percent of all of the data to be transmitted in the first 36 minutes.

The expected output to the WMSCR users is as follows:

USER	WORST CASE	GROWTH MARGIN	LOAD
NWSTG	239.8500	100 %	479.7000
MWP	5635.0000	100 %	11270.0000
AWP	993.1060	100 %	1986.2120
CNSP	4.0250	100 %	8.0500
RWP	21995.5785	100 %	43991.1570
NSSFC	20.3500	100 %	40.7000
KAWN	63.2750	100 %	126.5500
APAD+	50.3500	100 %	100.7000
LSAS+	1292.8000	100 %	2585.6000
ADAS	0.0000	100 %	0.0000
WCP	21592.4000	100 %	43184.8000
AIRLINES	50.7250	100 %	101.4500
FSDPS-1+	694.7500	100 %	1389.5000
9020/HOST+	348.8000	100 %	697.6000
AFTN	325.0000	100 %	650.0000
TMP	600.0000	100 %	1200.0000
CFMWP	490.4500	100 %	980.9000
MPS	0.0000	100 %	0.0000
OTHER WMSCR	175.0000	100 %	350.0000
TOTAL OUTPUT			**109142.9190 kilobytes**

+ Derived from FAA-E-2764b

3.5 Test Data Set specification.

At this point, the specification for the Test Data Set to be constructed can be given. The Test Data Set Formulation addresses all of the current and future ADUs to be encountered. It addresses a reasonable data routing scenario. Traffic sizing and loading which include growth requirements and worst-case message arrival are also specified by the Test Data Set Formulation. All of these requirements resulting from the Test Data Set Formulation are to be utilized by the WMSCR production Contractor for the construction of an actual Test Data Set.

The Appendices to this Test Data Set Formulation are considered a part of the Formulation. In an effort present a concise specification for the Test Data Set to be constructed, the Appendices and other Sections and Figures are referenced appropriately. The Test Data Set specification is in summary form for presentation purposes; however, it must be understood that the complete specification consists of the summary and referenced material.

The Test Data Set must be in accordance with the requirements summarized below:

TEST DATA SET SPECIFICATION SUMMARY*

USER	HOURLY DATA LOAD (kilobytes)	PERCENT INPUT	PERCENT OUTPUT	ADU FORMAT
NWSTG	2512.6800	19.1	80.9	B
MWP	11310.9400	0.4	99.6	B
AWP	2111.1180	5.9	94.1	A
CNSP	50.9500	84.2	15.8	B
RWP	44640.8970	1.5	98.5	B
NSSFC	42.1000	3.3	96.7	B
KAWN	168.1900	24.8	75.2	B
APAD+	100.7000	0.0	100.0	A
LSAS+	2663.8000	2.9	97.1	A
ADAS	772.8000	100.0	0.0	B
WCP	43184.8000	0.0	100.0	B
AIRLINES	102.6100	1.1	98.9	B
FSDPS-1+	1396.7000	0.5	99.5	A
9020/HOST+	706.8000	1.3	98.7	A
AFTN	1300.0020	50.0	50.0	A
TMP	1200.0000	0.0	100.0	B
CFMWP	981.7000	0.1	99.9	B
MPS++				
OTHER WMSCR	700.0000	50.0	50.0	B

TOTAL OUTPUT 113946.7870 kilobytes

* Data distribution requirements presented in Figure 3.3.2-1 must be met. The data must be arranged in accordance with the standard hours defined in Sections 3.4.1 and 3.4.2.

A ADUs must be consistent with Appendix A.

B ADUs must be consistent with Appendix B.

\+ At least one of each type of ADU in the referenced Appendix must be used. All other users must utilize the message types presented in Appendix E and round up to the nearest whole message per the frequencies in Appendix E.

++ The MPS is not addressed in this study, requirements are undefined.

4.0 VERIFICATION VIA THE TEST DATA SET.

The Test Data Set is to be used to verify that the WMSCR can support the various ADUs expected in the end state environment, and also that the WMSCR can handle not only the traffic expected, but also a growth factor of 100 percent.

The Test Data Set itself must be examined to ensure it addresses all of the ADUs in their appropriate proportions. Once the Test Data set is verified, it is to be continuously run through the WMSCR for testing WMSCR internal functional and performance requirements.

In order to produce the Test Data Set for the WMSCR, several components of this paper must be utilized. First, all of the data must be formatted in accordance with the ADUs depicted in Figures 3.2.1-1 and 3.2.2-1. The portion of the ADUs that is used by WMSCR for application purposes must be correct so the WMSCR can route the data received for appropriate processing. See Appendices A and B for definition of the fields of the ADUs that the WMSCR will utilize.

Since the WMSCR never modifies the contents of the data it receives other than separating individual reports, these ADUs are to be used to address the various types of data

presented in Appendix E. The actual contents of the data fields of the ADUs are not important; however, the data must be of the proper size, as is also addressed in Appendix E, to exercise the communications and applications processing functions of the WMSCR.

The input and output requirements of the WMSCR users must be met as addressed in sections 3.4.1 and 3.4.2. A standard input and output hour were presented in these sections to address the percentage of the hour's traffic that should be encountered in each six-minute time interval.
The Test Data Set is to be arranged so that the data arrives and is distributed according to the standard input and output hours and in accordance Figure 3.3.2-1 used in conjunction with Appendix E.

The Test Data Set will verified by examination if it meets all of the requirements as specified in Section 3.5.

5.0 CONCLUSION.

The WMSCR, as an integral component of the FAA's modernization program as detailed in the Brown Book, is being procured with the utmost in flexibility and accommodation of new and future requirements in mind. This approach is based on addressing the aging and inflexible system that makes up today's NAS environment.

In order to ensure flexibility in both accommodating the various users the WMSCR will have to support, and the potential growth of new users and or newer data requirements, the Test Data Set has been detailed to address these concerns. It is not intended to be a realistic description of the actual end state NAS environment for WMSCR in regard to traffic sizes and frequencies. In reality, future requirements of defined and undefined systems can only be approximated. This, in addition to new types of meteorological data that will be developed is why the Test Data Set is to be used to verify whether or not the WMSCR can handle the worst possible scenario that can be foreseen at the current time.

It is true that the aging WMSC has a throughput of approximately 8,200 kilobytes of data per hour, but this 20 plus year old processor is approaching its limit. The Test

Data Set will require the WMSCR system to handle close to 114,000 kilobytes of data in one hour. This is almost 14 times the current maximum throughput scenario for the WMSC. However, since the throughput power of the WMSCR is 144,000 kilobytes per node, it is felt to be of an appropriate magnitude to be used in determining whether or not the WMSCR can perform both its distribution and internal processing functions under very stressed conditions.

The real intent behind the Test Data Set is to prove that the FAA is acquiring a system that will easily handle all of the data processing and traffic demands it should ever encounter in its life time, a minimum of twenty years. It is hoped that this approach will make the WMSCR a very flexible yet powerful asset to the future NAS. This Test Data Set may ensure that the WMSCR may beat the WMSC's longevity record without ever placing restrictions on its users for the type and amount of data they feel they need. This, in itself, accomplishes in part one of the goals of the Brown Book: to improve the FAA's services to the ever-growing demands of the aviation community, whether they are commercial airlines, the Military, or even the general aviation enthusiast.

It is with this in mind that all of the aspects of the Test

Data Set Analysis as specified in Section 3.5, together with the proposed verification of the WMSCR using the Test Data Set as described in Section 4.0 be utilized for the preparation and review of the actual Test Data Set to be produced by the WMSCR Contractor. This effort will be under guidance of the WMSCR SEIC Project Management Office to ensure that the Contractor's Test Data Set is in accordance with the intent of this paper. This paper is not meant to preclude any revisions to either traffic or format requirements as necessitated by the evolving WMSCR design and user community.

6.0 BIBLIOGRAPHY.

The following facilities provided data traffic and format information:

Federal Aviation Administration
800 Independence Avenue, S.W.
Washington, DC 20591

Federal Aviation Administration
National Communications Center
1200 East Bannister Road
Kansas City, MO 64131

The following FAA documents were used in addressing the data communications concerns of the WMSCR:

FAA-E-2764b, Weather Message Switching Center Replacement System Specification, April 15, 1988

Specification Change Notice 1 to FAA-E-2764b, May 5, 1989

Draft Specification Change Notice 2 to FAA-E-2764b, pending approval May 30, 1990

FAA Order 7110.80D, Data Communications, February 9,1989

NAS-SS-1000, NAS System Specification Functional and Performance Requirements for the National Airspace System Air Traffic Control Element, August 9, 1986

National Airspace System Data Dictionary, January 13, 1989

National Airspace System Plan for Facilities, Equipment and Associated Development, June 1986

DTFA01-88-C-00035, Weather Message Switching Center Replacement Contract

Other publications:

ICAO Annex 10, Aeronautical Telecommunications Volume 2

FCM-S2, Standard Formats for Weather Data Exchange Among Automated Weather Information Systems

FCM-S3, Standard Telecommunications Procedures for Weather Exchange on the Interdepartmental Meteorological Data Exchange System

Other references:

B. S. Blanchard and W. J. Fabrycky, Systems Engineering and Analysis, Prentice-Hall, 1981

M. Schwartz, Telecommunication Networks, Protocols, Modeling and Analysis, Addison-Wesley, 1987

D. Roth, An Analysis of Alternative Data Communications Networks for the Weather Message Switching Center Replacement, June 1989

APPENDIX A

CURRENT USER DATA FORMATS TO BE SUPPORTED BY WMSCR

RS = Record Separator. Precedes individual records in text. Absence of RS indicates either last record of one or more records, or the text is the WMO Product with no individual records.

ETX = End of Text character.

NOTE: N is associated with the last byte of the format that contains the ETX character.

For NOTAM DATA:

VVVVVV = Catalog Number or Category Code (3-6 Bytes). Unless otherwise indicated in the following figures, i.e., assigned to specific bytes.

** CCCCCCCCC = user data, which may be variable up to 9 bytes. Inserted by WMSCR for CNSP, if message is "D". If message is "R", the field may or may not be present, depending on source location of the request message.

NOTE: Quotation marks (" ") indicate the actual characters/numbers used.

"D" = Indicates Data ADU.

"!" = NOTAM Indicator.

"R" = Indicates Request ADU.

")" = Request Reply for the WMSCR to relay the NOTAM request to the CNSP which will be routed back through the WMSCR, which is responsible for delivery of the NOTAM to the original requestor.

DATA REQUEST PURSUANT to APPENDIX IV of FAA-E-2764b.

REQUEST IDENTIFICATION is variable in size to the STX character.

SOH = Start of Header character.

Note: Plus sign (+), indicates convention that if multiple data records, i.e., reports, are sent, then RS is used; the ETX is used at the very end of the ADU.

For NADIN 1A Gateway Users:

"GG" = ICAO priority designator for weather data.

ADDRXXXX = 8-character alpha ICAO address.

FS = File Separator character.

CR-LF-FS = Alignment and end of address delimiter (FS).

ORIGXXXX = 8-character alpha ICAO originator.

CR-LF-STX = Alignment and Start of Text.

KEY TO CURRENT ADUs:

GENERAL:

Note: All entries are in ASCII.

CATALOG NUMBER = 3, 4, 5, or 6 bytes.

DDHHMM = Date Time Group: Day, Hour, Minute of current time.
DD = Day (01-31).
HH = Hour (00-23).
MM = Minute (00-59).

CR = Carriage Return.

LF = Line Feed Character.

STX = Start of Text Character.

TTAAii, CCCC, YYGGgg = WMO header where:

TT = Data Type (2 alpha characters).
AA = Geographic Designator (2 alpha's).
ii = Bulletin Number (if present, can be from 1 to 2 numerics).

CCCC = Location Identifier (4 alpha's).

YY = Day (01-31).
GG = Hour (00-23).
gg = Minute (00-59).

* Fields are optional. If absent, header is compressed accordingly.

SP = Space character.

BBB = Modifier (3 alpha characters).

Valid BBB forms are:

a) RTD - Delayed routine WMO report.
COR - Correction to previous report.
AMD - Amended processed information.

b) RRx - Same as RTD, but see "x" below.
CCx - Same as COR, but see "x" below.
AAx - Same as AMD, but see "x" below.

x = Alpha characters A through Z, where A is for the first bulletin after the initial bulletin, B is for the second bulletin after the initial bulletin, etc., up to Y. Then, Y is for bulletins following which a system failure has caused a loss of the record containing the sequence of character values used for "x". Z is for bulletins prepared or compiled more than 24 hours after the initial observation.

Bi = Modifier Count (1 numeric). Bi is subset of BBB only.

NMAX = Maximum 3700 Bytes for NADIN 1A Users.

VT = Vertical TAB character.

CR-LF-VT-ETX = End of message sequence.

CR-LF = alignment.

"KNKAWX"XX = 8-character Address Indicator from 9020/Host to WMSCR and/or 8-character Originator from WMSCR to 9020/Host with 7th and 8th characters denoting the following type of data exchange:

NT = NOTAM data
SO = Surface Observation
WS = Sigmet
RQ = Request-Reply

Note: "KNKAWX"XX as defined above is exclusive for data exchange with FAA ARTCC 9020/Host only. Addressees Originator for weather products to other domestic and international users, i.e., AFTN, should be in accordance with ICAO DOC 8585 and DOC 7910, e.g., KNKAYMYX.

Note: ZCXx = Identifier for internal 9020/Host control.
Nx = Sector number for internal 9020/Host control.

For APAD Users:

NNN = 3-digit sequence number.

CLLLL = 5-digit catalog number.

SDI(V) = Static Database Information (Variable length string data). Precedes reports or WMO Header.

CR-CR-LF-RS = Alignment and record separator preceding reports or bulletion header.

Note: The header beginning with "TTAAii" might not be present for APAD users.

Byte	
1	CATALOG NUMBER
3	
	D D
	H H
	M M
	CR CR
	LF STX
	T T
	A A
	i* i*
	SP C
	C C
	C SP
	Y Y
	G G
	g g
	SP* B*
	B* B*
	SP* Bi*
	CR CR
	LF RS
	DATA TEXT
	CR CR
N	LF ETX

FIGURE A.1-1: SAS GATEWAY and AWP WMO Product ADU

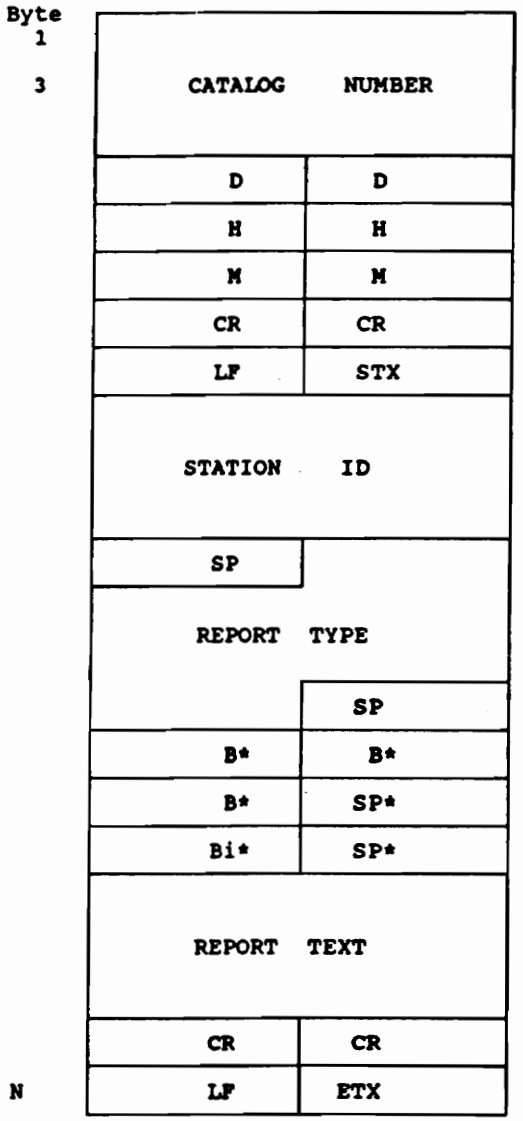

FIGURE A.1-2: SAS GATEWAY and AWP WEATHER REPORT ADU

Byte				
1	V	V	V	V
5	V	V	SP	D
9	D	H	H	M
13	M	SP	C**	C**
	C**	C**	C**	C**
	C**	C**	C**	CR
	CR	LF	"D"	STX
	"!"			
	NOTAM DATA			
N	CR	CR	LF	ETX

FIGURE A.1-3: AWP NOTAM DATA ADU TO WMSCR

Byte				
1	V	V	V	V
5	V	V	SP	D
9	D	H	H	M
13	M	SP	C**	C**
	C**	C**	C**	C**
	C**	C**	C**	CR
	CR	LF	"R"	STX
	")"	NOTAM REQUEST DATA		
N	CR	CR	LF	ETX

FIGURE A.1-4: AWP NOTAM REQUEST ADU TO WMSCR

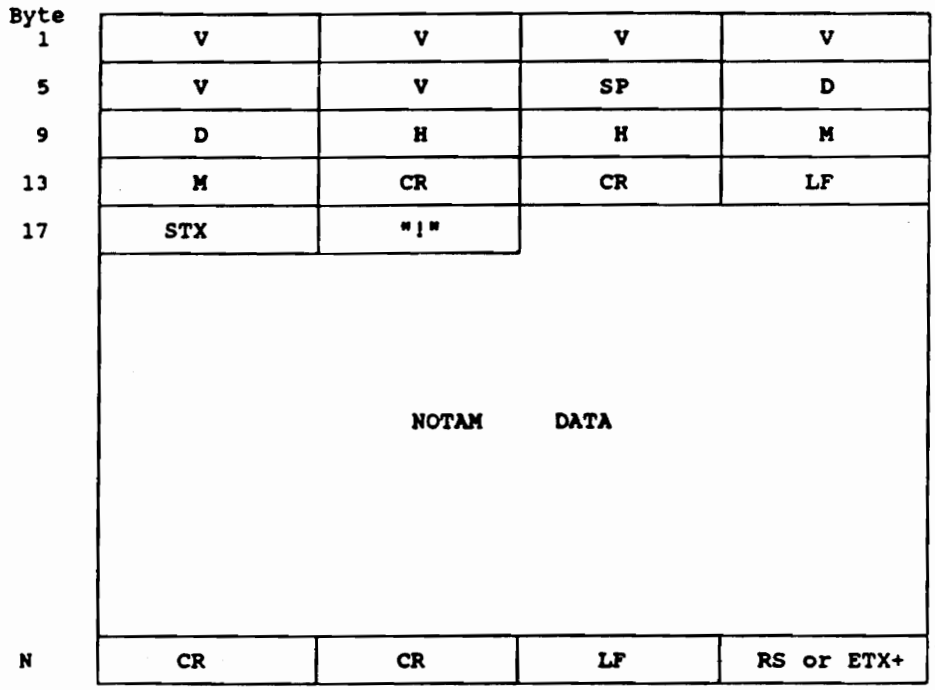

FIGURE A.1-5: AWP NOTAM DATA ADU FROM WMSCR

Byte				
1	V	V	V	V
5	V	V	SP	D
9	D	H	H	M
13	M	SP	C**	C**
	C**	C**	C**	C**
	C**	C**	C**	CR
	CR	LF	STX	
	NOTAM RESPONSE DATA			
N	CR	CR	LF	ETX

FIGURE A.1-6: AWP NOTAM REQUEST/RESPONSE ADU FROM WMSCR

Byte				
1	V	V	V	V
	V	SP	D	D
	H	H	M	M
	SP	C**	C**	C**
	C**	C**	C**	C**
	C**	C**	CR	CR
	LF	"D"	STX	"!"
	NOTAM DATA			
N	CR	CR	LF	ETX

FIGURE A.1-7: SAS GATEWAY NOTAM DATA ADU TO WMSCR

Byte 1				
	V	V	V	V
	V	SP	D	D
	H	H	M	M
	SP	C**	C**	C**
	C**	C**	C**	C**
	C**	C**	CR	CR
	LF	"R"	STX	")"
	NOTAM REQUEST DATA			
N	CR	CR	LF	ETX

FIGURE A.1-8: SAS GATEWAY NOTAM REQUEST ADU TO WMSCR

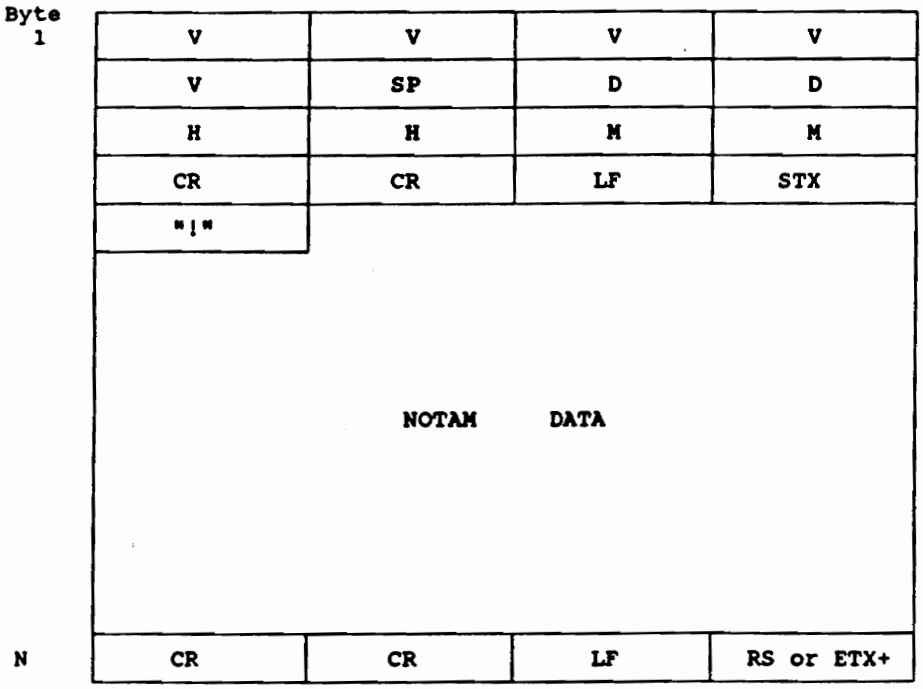

FIGURE A.1-9: SAS GATEWAY NOTAM DATA ADU FROM WMSCR

Byte 1				
	V	V	V	V
	V	SP	D	D
	M	H	M	M
	SP	C**	C**	C**
	C**	C**	C**	C**
	C**	C**	CR	CR
	LF	STX		
	NOTAM RESPONSE DATA			
N	CR	CR	LF	ETX

FIGURE A.1-10: SAS GATEWAY NOTAM REQUEST/RESPONSE ADU FROM WMSCR

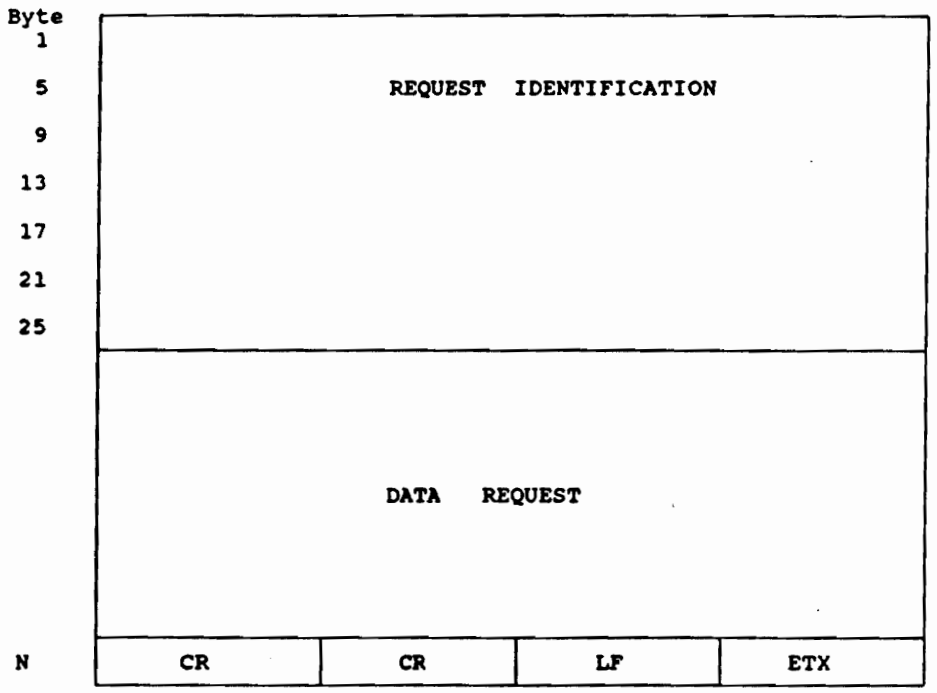

FIGURE A.1-11: SAS GATEWAY and AWP DATA REQUEST ADU

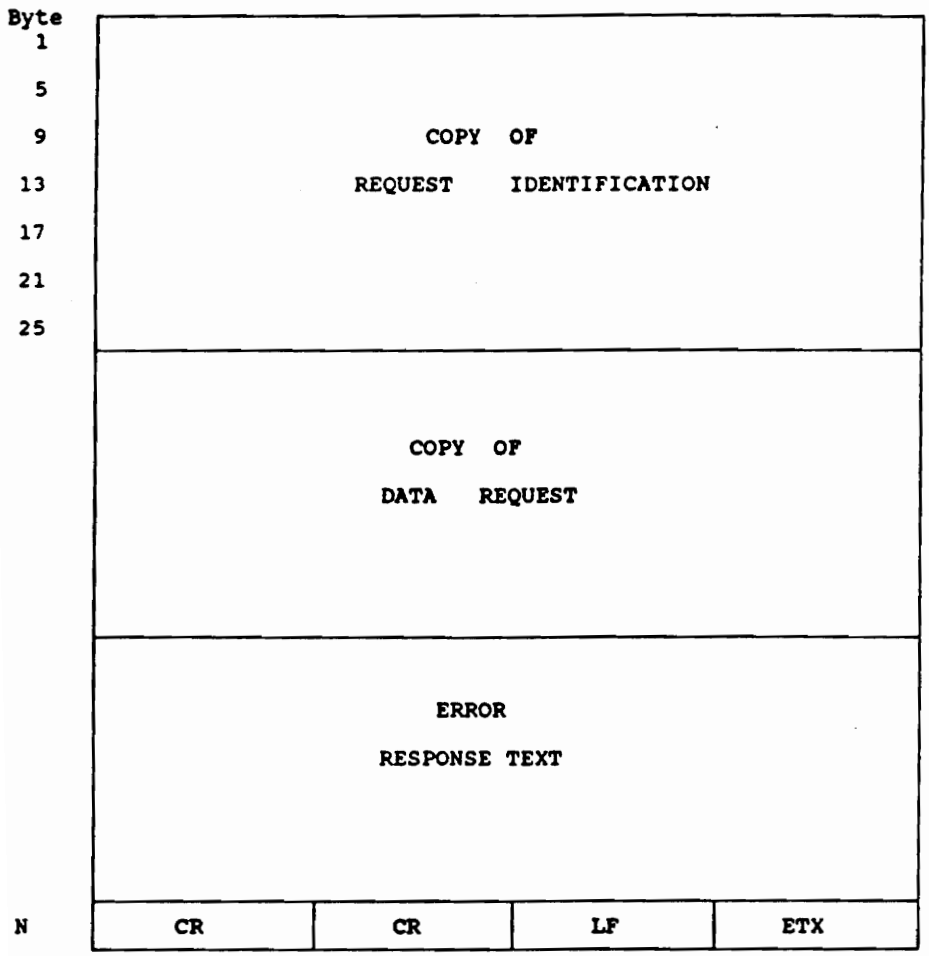

FIGURE A.1-12: SAS GATEWAY and AWP DATA REQUEST REJECT ADU

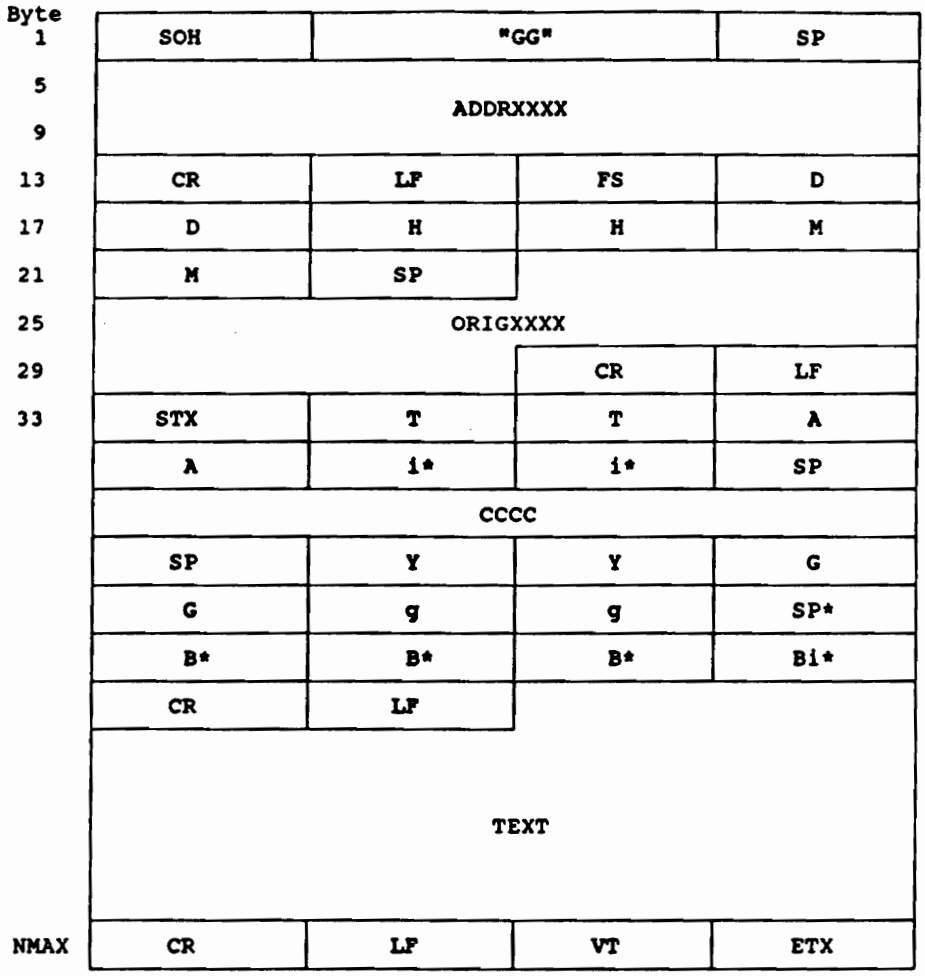

FIGURE A.1-13: NADIN 1A USERS WMO ALPHANUMERIC PRODUCT ADU

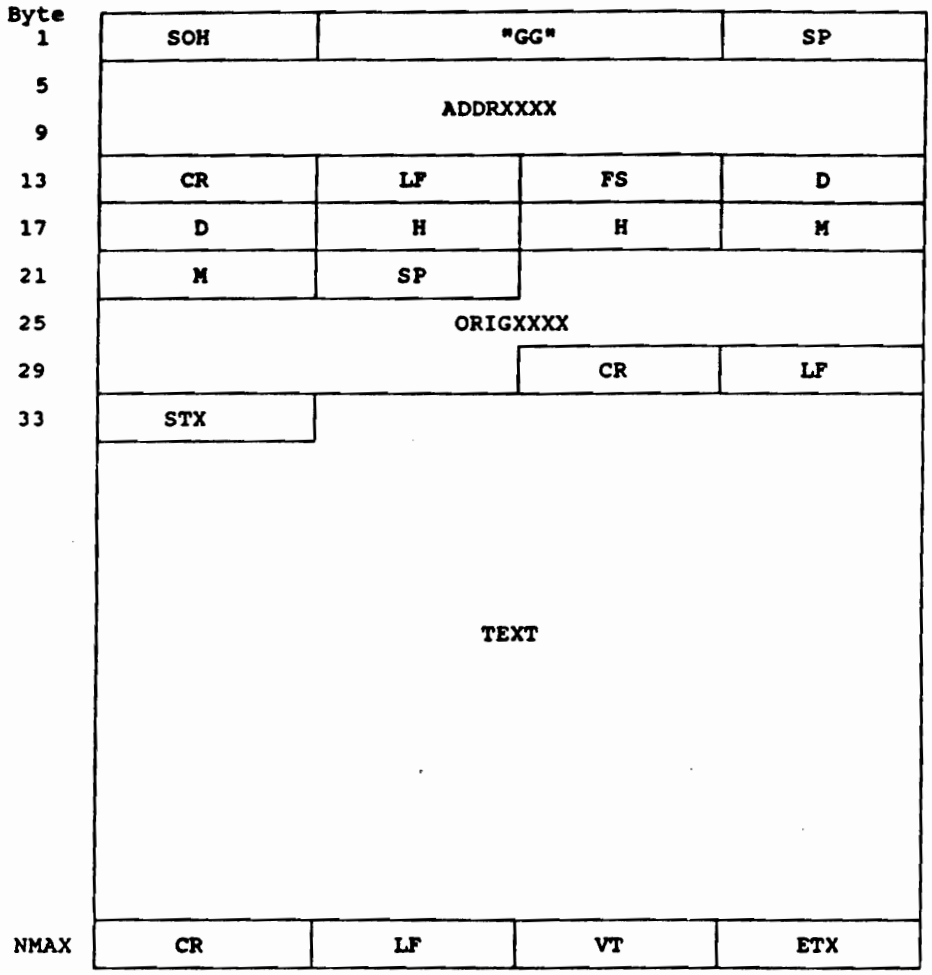

FIGURE A.1-14: NADIN 1A USERS WEATHER and NOTAM REPORT ADU TO WMSCR

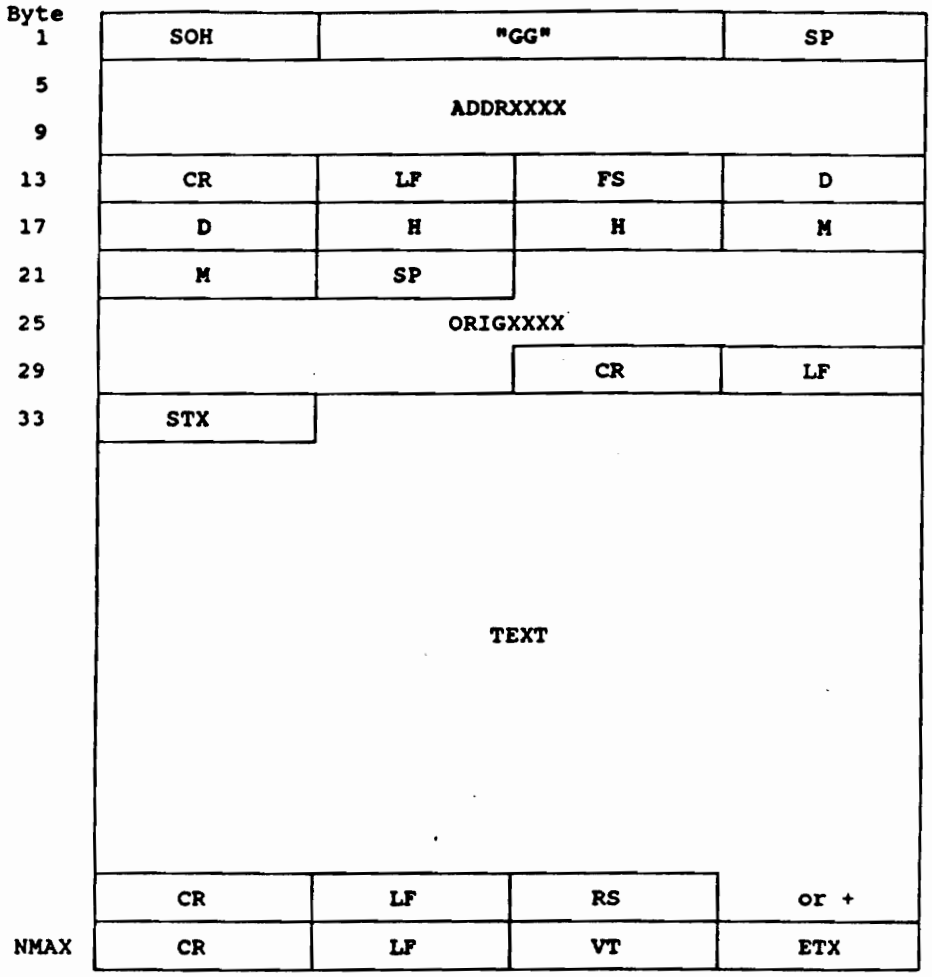

FIGURE A.1-15: NADIN 1A USERS WEATHER and NOTAM REPORT ADU FROM WMSCR

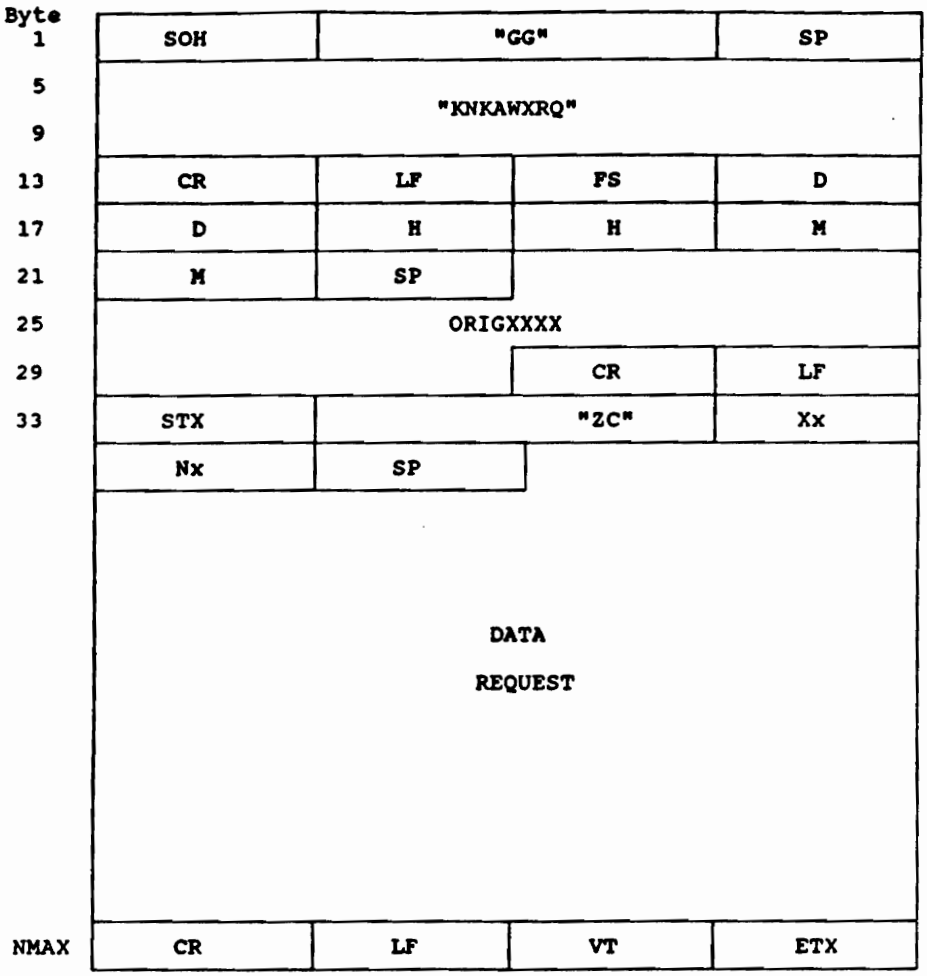

FIGURE A.1-16: NADIN 1A USERS(9020/HOST) DATA REQUEST ADU TO WMSCR

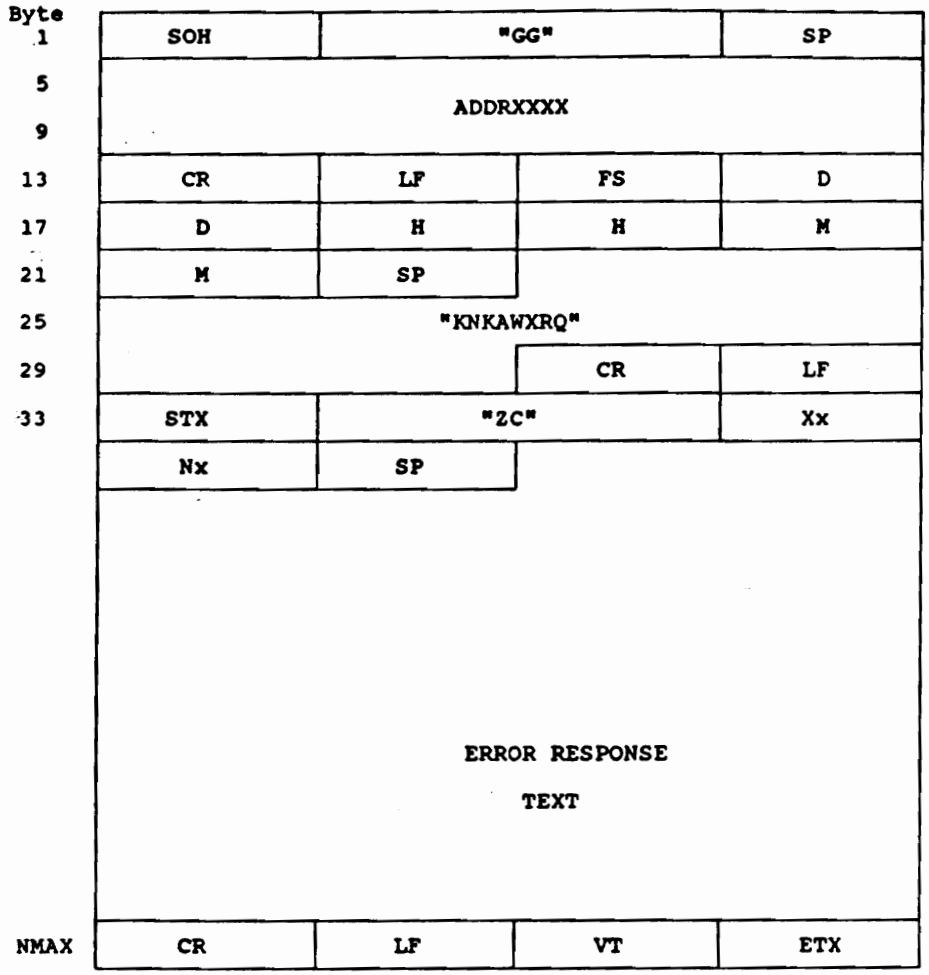

FIGURE A.1-17: NADIN 1A USERS(9020/HOST) REQUEST REJECT ADU

Byte				
1	SOH	NNN		
5	CLLLL			
9		STX	SDI(V)	D
	D	H	H	M
	M	CR	CR	LF
	RS	T	T	A
	A	i*	i*	SP
	CCCC			
	SP	Y	Y	G
	G	g	g	SP*
	B*	B*	B*	Bi*
	CR	CR	LF	
	TEXT			
N	CR	CR	LF	RS or ETX

FIGURE A.1-18: APAD USERS WMO ALPHANUMERIC PRODUCT ADU

APPENDIX B

END STATE USER DATA FORMATS TO BE SUPPORTED BY WMSCR

KEY TO END STATE ADUs:

GENERAL:

Note: All entries are in ASCII, except bytes 11-16 each contain two binary coded decimal (BCD) numbers in bits 1-4 and 5-8 of the respective bytes.

TTAAii, CCCC = Portion of WMO header where:

TT = Data Type (2 alpha characters).
AA = Geographic Designator (2 alpha's).
ii = Bulletin Number (if present, can be from 1 to 2 numerics).

CCCC = Location Identifier (4 alpha's).

DDHHMM = Date Time Group, in BCD: Day, Hour, Minute of current time.

DD = Day (01-31).
HH = Hour (00-23).
MM = Minute (00-59).

SP = Space character.

VERSION: Consists of the BCD MODIFIER AND COUNT, MCCC.

MODIFIER, M: 0 - Normal
1 - Amended
2 - Corrected
3 - Retarded

M is in BCD format.

COUNT, CCC: Incremental count of the modifications; 3 BCD numerics.

MODE: 3 numerics.

SUBMODE: 3 numerics.

OOOO: Originator Identification, 4 alphas.

Station ID: Station Identification, 3-6 alphanumerics.

Report Type: 2-4 alphanumerics.

: Corresponds to the TYPE portion of the FORMAT/TYPE used to identify the Application Data Unit (ADU).

STX = Start of Text character.

RS = Record Separator. Precedes individual records in text. Absence of RS indicates either last record of one or more records, or the text is the WMO Product with no individual records.

ETX = End of Text character.

Note: "RS or ETX", indicates convention that if multiple data records, i.e., reports, are sent, then RS is used; the ETX is used at the very end of the ADU.

Note: N-1 is associated with the next to last byte of the format that contains the ETX character.

DATA REQUEST PURSUANT to APPENDIX IV of FAA-E-2764b.

REQUEST IDENTIFICATION is variable in size to the STX character.

Table B.1-1: Format/Type Byte Codes

FORMAT	FORMAT CODE	TYPE AND CODE: WMO	FCM	REPORT	NOTAM
DATA EXCHANGE	1110	1000	1001	1011	1111
DATA REQUEST	1101	1000	1001	1011	1111
DATA RESPONSE	1011	1000	1001	1011	1111
REQUEST REJECT	1111	1010 INVALID REQUEST 1000 DATA UNAVAILABLE			

Table B.1-2: Format/Type Byte Combinations

VALID FORMAT/TYPE BYTE CODES:

	FORMAT/TYPE	
DATA EXCHANGE	**11101000**	WMO
	11101001	FCM
	11101011	REPORT
	11101111	NOTAM
DATA REQUEST	**11011000**	WMO
	11011001	FCM
	11011011	REPORT
	11011111	NOTAM
DATA RESPONSE	**10111000**	WMO
	10111001	FCM
	10111011	REPORT
	10111111	NOTAM
REQUEST REJECT	**11111010**	INVALID REQUEST
	11111000	DATA UNAVAILABLE

Table B.1-3: Universal Product Identifier (UPI) and Universal Report Identifier (URI) Description

IDENTIFIER BYTES	TYPE			UPI/URI FIELD
	WMO UPI	FCM UPI	REPORT URI	
1-6	TTAAii	Mode/ Submode	Station ID	FIELD 1
7-10	CCCC	OOOO	Report Type	FIELD 2
11-13	DDHHMM	DDHHMM	DDHHMM	FIELD 3 DATE TIME
14	SP	SP	SP	FIELD 4
15-16	MCCC	MCCC	MCCC	FIELD 5 VERSION

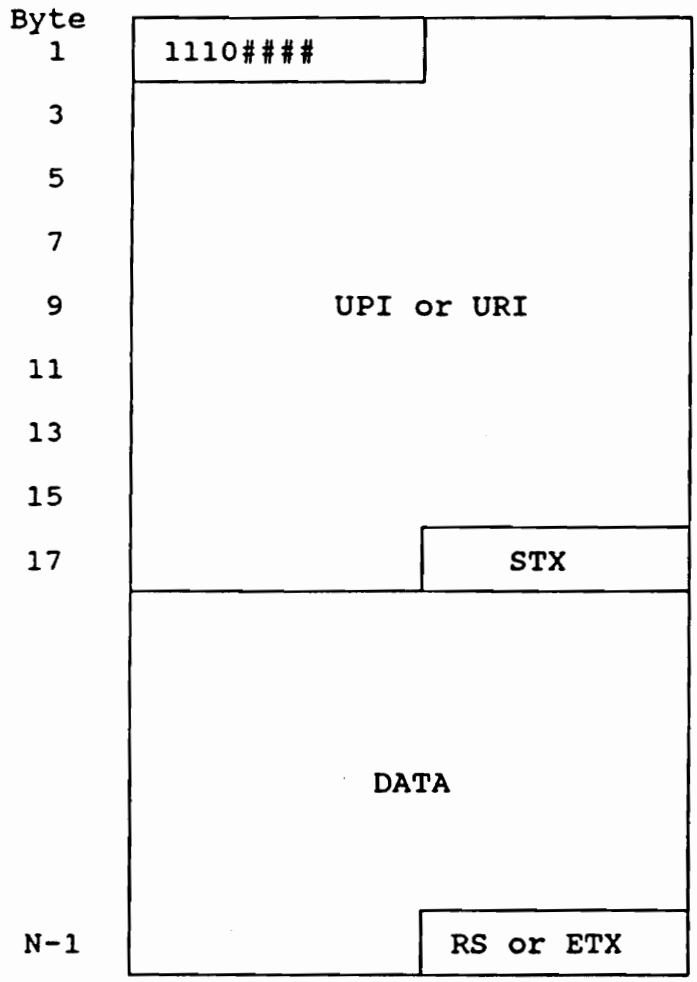

FIGURE B.1-1: END STATE Data Exchange Product ADU

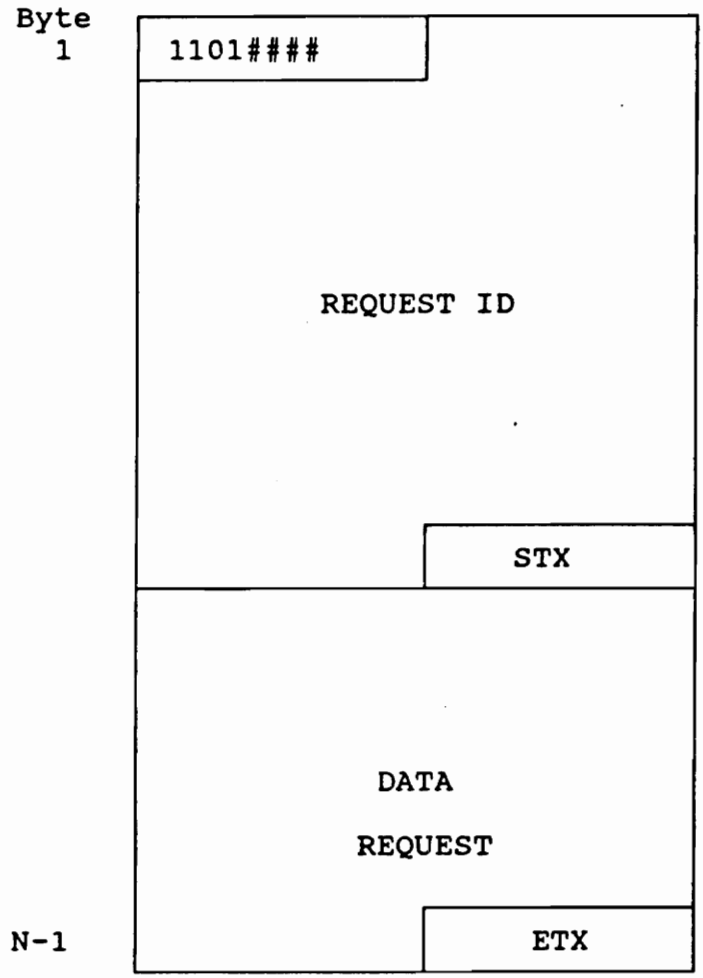

FIGURE B.1-2: END STATE Data Request ADU

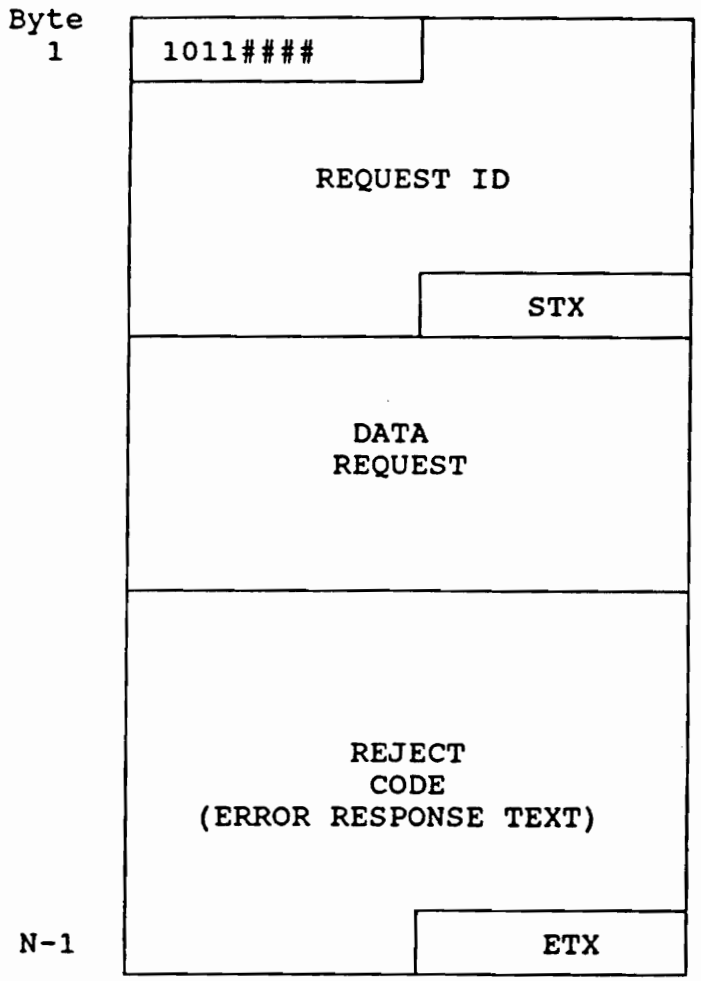

FIGURE B.1-3: END STATE Data Request Reject ADU

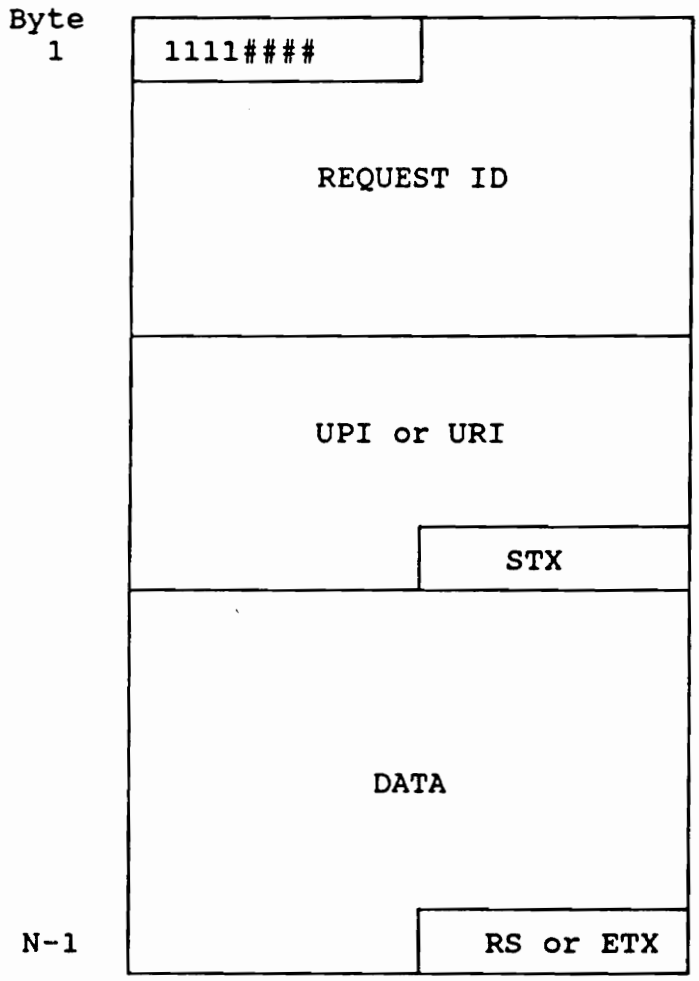

FIGURE B.1-4: END STATE Data Request Response ADU

APPENDIX C

WMSC CIRCUIT TRAFFIC SAMPLE

APPENDIX C: WNSC Circuit Traffic Sample
24-hour traffic in kilobytes for Circuits 102 through 149

Circuit	10/06/88 in	10/06/88 out	10/07/88 in	10/07/88 out	10/08/88 in	10/08/88 out	01/02/89 in	01/02/89 out	01/03/89 in	01/03/89 out	01/04/89 in	01/04/89 out	01/05/89 in	01/05/89 out
102	26.458	3370.350	26.075	3327.343	24.278	2785.024	34.830	3691.504	27.651	3091.441	25.312	3356.808	27.036	3163.396
103	50.568	3396.403	45.014	3254.644	39.700	3088.412	51.541	4408.072	42.294	3594.407	68.537	4078.440	53.654	3196.425
104	35.424	3987.889	37.420	3317.873	32.760	2646.250	45.149	3656.338	44.437	3206.207	47.551	3500.466	34.520	3122.885
105	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
106	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
107	5.883	2062.878	4.336	1950.592	5.733	1785.628	9.317	2310.787	6.309	2137.821	8.428	2283.544	8.293	2146.011
108	8.635	1962.199	11.544	3012.899	6.757	1725.165	16.076	2143.231	12.050	1833.056	20.397	2196.598	15.636	2051.317
109	2.448	1204.367	2.166	1204.071	2.498	1151.119	3.188	1459.970	5.513	1397.912	6.976	1470.064	3.775	1206.051
110	3.582	1236.128	4.366	1282.959	3.616	1205.053	3.931	1583.174	6.151	1459.300	3.289	1428.751	2.109	1241.698
111	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
112	0.000	1696.585	0.000	1713.247	0.000	1607.364	0.000	2299.088	0.000	1953.510	0.000	1913.745	0.000	1905.873
113	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
114	4738.289	2041.184	4761.143	2037.833	4604.906	1965.658	5775.120	2774.925	4917.943	2202.550	5523.904	2355.539	5041.834	2113.527
115	2657.614	0.000	2621.425	0.000	2579.685	0.000	2789.821	0.000	2641.530	0.000	3038.957	0.000	2613.723	0.000
116	28.678	3374.580	25.718	3029.094	28.551	2883.842	30.783	3853.849	30.925	3340.762	27.330	3440.262	25.050	3279.865
117	45.040	3669.818	40.211	3185.340	43.046	2944.996	53.688	4160.870	53.110	3966.210	46.754	3809.944	50.989	4173.998
118	47.834	3142.133	52.122	3446.329	47.492	28122.313	61.445	3870.153	61.313	3237.466	59.962	3579.366	45.309	3304.455
119	24.507	3101.878	28.328	2927.249	25.263	2769.220	30.069	3603.419	29.919	3199.463	35.027	3360.733	29.776	3090.957
130	0.304	1827.430	0.484	2961.380	0.000	674.193	0.000	0.000	0.702	1295.225	1.216	3838.008	4.087	3699.568
132	2648.657	2743.214	2319.887	2714.910	1850.327	2591.999	2294.411	3297.484	2097.382	2796.074	2559.337	2946.173	2195.591	2690.368
133	1.593	801.732	1.742	746.460	2.654	721.299	0.248	925.906	0.269	776.532	0.750	800.438	2.423	746.916
134	4.186	7094.141	2.913	7182.426	0.335	6356.242	4.135	7279.584	3.543	6394.217	3.739	7242.993	2.956	6479.863
135	13.061	6376.318	10.405	6102.766	6.594	5545.355	5.556	6768.127	6.244	5968.308	6.936	6750.601	5.891	5961.448
136	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	352.655	0.000	2667.041
137	6.191	2972.832	4.849	2957.425	4.249	2626.027	4.057	2785.011	3.856	2576.861	5.103	3174.819	3.611	2683.835
138	2.175	1209.923	2.896	1223.644	4.522	1184.278	1.125	1452.585	2.616	1348.696	1.400	1363.388	2.243	1292.772
139	2.381	3390.368	0.103	1930.797	0.000	530.407	0.498	840.739	1.085	1238.251	0.604	2889.674	0.336	786.935
140	39.529	2198.568	34.994	2201.635	25.581	1731.128	33.031	2637.005	26.571	2254.245	2587.066	2623.886	36.592	2323.982
141	26.082	2252.456	19.719	1817.971	19.923	1479.616	24.387	2038.749	23.606	2169.885	23.612	1865.452	17.668	1670.036
142	26.074	1870.347	25.556	1901.894	19.170	1635.686	20.479	2250.028	16.457	2024.690	26.934	2054.428	23.739	1981.075
143	25.733	2310.009	23.717	2083.452	23.830	1758.504	25.521	2297.048	24.723	2146.270	28.435	2285.372	19.863	1980.348
148	0.000	5377.615	0.000	5249.783	0.000	4874.606	0.000	5879.093	0.000	5196.098	0.000	5870.063	0.000	5177.071
149	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

APPENDIX C: WMSC Circuit Traffic Sample
24-hour traffic in kilobytes for Circuits 151 through 186

Circuit	10/06/88 in	10/06/88 out	10/07/88 in	10/07/88 out	10/08/88 in	10/08/88 out	01/02/89 in	01/02/89 out	01/03/89 in	01/03/89 out	01/04/89 in	01/04/89 out	01/05/89 in	01/05/89 out
151	0.000	5086.364	0.000	4899.783	0.000	4452.808	0.000	5470.921	0.000	4859.192	0.000	5466.249	0.000	4811.498
153	0.000	2461.389	0.000	2463.278	0.000	2324.885	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
154	0.000	2387.081	0.000	2337.901	0.000	2246.971	0.000	2545.747	0.000	2302.836	0.000	2539.090	0.000	2254.666
155	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
156	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
157	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
159	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
160	26.551	1168.877	26.531	1339.144	22.489	982.003	34.970	1407.377	28.177	1114.843	34.672	1395.762	34.593	1391.718
161	5.164	1292.861	3.866	1226.537	3.355	1134.345	7.059	1723.643	4.529	1560.966	2.625	1430.024	3.627	1387.441
162	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
163	40.412	2177.122	35.527	1897.481	36.773	1567.854	35.112	2086.258	29.211	1834.920	40.983	2136.592	40.082	1901.810
164	8.965	1402.535	8.730	1264.183	6.910	1063.145	7.462	1419.539	5.705	1172.667	11.487	1509.483	9.154	1355.297
165	14.198	1700.163	15.560	1627.156	16.690	1792.680	16.303	1912.837	18.195	2080.466	15.947	1868.539	12.381	1480.216
166	23.755	1180.295	24.672	1297.722	19.941	1017.124	26.852	1569.312	24.736	1407.353	33.537	1350.029	21.414	1182.354
167	44.280	1388.110	30.449	1494.561	37.637	1304.431	41.656	1771.443	42.487	1807.732	34.692	1702.853	36.678	1592.067
168	25.062	2567.969	26.440	3014.978	24.244	2297.481	30.524	2521.101	30.223	2235.047	25.425	2386.541	24.332	2161.388
169	22.799	1984.721	24.426	1982.693	22.588	1821.500	26.941	2590.061	23.451	2217.955	22.377	2882.479	25.626	2654.042
170	7.522	1323.786	17.578	1345.889	8.038	1235.472	14.950	1952.912	9.610	1573.279	8.693	1560.978	10.730	1553.013
171	12.104	1250.710	11.723	1305.074	10.682	1197.220	10.246	1725.647	16.243	1480.167	13.057	1454.681	15.189	1407.941
172	10.452	1492.708	9.082	1240.720	8.329	1266.669	8.317	1525.951	10.305	1491.323	10.342	1442.046	8.854	1400.080
173	8.911	634.532	7.402	585.957	8.578	577.221	5.855	1263.138	6.749	1194.895	5.698	1456.370	5.458	1291.072
174	80.814	1485.723	82.179	1393.600	75.271	1184.936	61.842	1436.307	55.412	1261.730	65.809	1638.249	54.776	1341.432
175	278.622	2376.171	288.406	2412.576	302.515	2360.467	287.890	2619.241	255.112	2366.449	346.163	2779.364	274.754	2400.030
176	63.737	18.680	52.702	18.598	41.324	11.208	59.906	17.309	89.985	22.495	104.010	32.938	56.459	19.915
177	0.000	2708.152	0.000	2656.920	0.000	2530.829	0.000	3459.262	1.239	2837.674	0.655	2981.173	2.008	2758.895
178	0.740	2691.245	1.090	2661.504	0.596	2584.321	0.527	3089.879	0.230	2608.909	0.136	2783.549	0.428	2534.659
179	0.000	4519.818	0.000	4504.559	0.000	0.000	0.000	5116.922	0.000	4476.087	0.000	4886.022	0.000	4393.478
180	88.599	2712.918	92.531	2659.757	91.066	2533.092	125.932	3460.018	127.369	2774.617	144.314	3011.581	123.136	2801.442
181	1.135	1043.618	1.778	1079.176	0.028	977.262	0.000	1255.370	14.864	1335.653	15.943	1318.966	19.662	1397.557
182	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
183	0.000	5025.024	0.000	4883.263	0.000	4542.342	0.000	6460.939	0.000	5691.405	0.000	6475.428	0.000	5729.906
184	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
185	0.000	5027.337	0.000	4885.320	0.000	4539.322	0.000	5597.532	0.000	4955.892	0.000	5535.631	0.000	4943.255
186	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
total	11234.757	131779.254	10867.805	129242.346	10138.524	133934.972	12120.750	142265.405	10880.031	127470.009	15094.121	142856.827	11046.045	130282.888

APPENDIX C: **WMSC Circuit Traffic Sample**
Statistical analysis in kilobytes for Circuits 102 through 149

Circuit	average in	average out	std dev in	std dev out	minimum in	minimum out	maximum in	maximum out
102	27.3771	3255.1237	3.2104	260.6201	24.2780	2785.0240	34.8300	3691.5040
103	50.1869	3573.8290	8.8621	457.0776	39.7000	3088.4120	68.5370	4408.0720
104	39.6087	3348.2726	5.5057	394.9536	32.7600	2646.2500	47.5510	3987.8890
105	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
106	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
107	6.8999	2096.7516	1.6663	170.7645	4.3360	1785.6280	9.3170	2310.7870
108	13.0136	2132.0664	4.3454	391.0620	6.7570	1725.1650	20.3970	3012.8990
109	3.7949	1299.0791	1.6729	127.2977	2.1660	1151.1190	6.9760	1470.0640
110	3.8634	1348.1519	1.1363	132.3927	2.1090	1205.0530	6.1510	1583.1740
111	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
112	0.0000	1869.9160	0.0000	213.1106	0.0000	1607.3640	0.0000	2299.0880
113	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
114	5051.8770	2213.0309	404.7179	258.4192	4604.9060	1965.6580	5775.1200	2774.9250
115	2706.1079	0.0000	149.2875	0.0000	2579.6850	0.0000	3038.9570	0.0000
116	28.1479	3314.6077	2.1136	287.6345	25.0500	2883.8420	30.9250	3853.8490
117	47.5483	3701.5966	4.8032	440.1022	40.2110	2944.9960	53.6880	4173.9980
118	53.6396	6957.4593	6.5789	8643.4248	45.3090	3142.1330	61.4450	28122.3130
119	28.9841	3150.4170	3.2407	254.3495	24.5070	2769.2200	35.0270	3603.4190
130	0.9704	2042.2577	1.3315	1386.8159	0.0000	0.0000	4.0870	3838.0080
132	2280.7989	2825.7460	250.9480	217.1178	1850.3270	2591.9990	2648.6570	3297.4840
133	1.3827	788.4690	0.9103	62.5115	0.2480	721.2990	2.6540	925.9060
134	3.1153	6861.3523	1.2279	395.8232	0.3350	6356.2420	4.1860	7279.5840
135	7.8124	6210.4176	2.6122	414.8771	5.5560	5545.3550	13.0610	6768.1270
136	0.0000	431.3851	0.0000	920.7777	0.0000	0.0000	0.0000	2667.0410
137	4.5594	2825.2586	0.8267	201.5842	3.6110	2576.8610	6.1910	3174.8190
138	2.4253	1296.4694	1.0345	90.2158	1.1250	1184.2780	4.5220	1452.5850
139	0.7153	1658.1673	0.7560	1032.8091	0.0000	530.4070	2.3810	3390.3680
140	397.6234	2281.4927	893.8486	283.4293	25.5810	1731.1280	2587.0660	2637.0050
141	22.1424	1899.1664	2.8203	254.6252	17.6680	1479.6160	26.0820	2252.4560
142	22.6299	1959.7354	3.6816	174.9510	16.4570	1635.6860	26.9340	2250.0280
143	24.5460	2123.0004	2.4097	187.8229	19.8630	1758.5040	28.4350	2310.0090
148	0.0000	5374.9041	0.0000	345.6793	0.0000	4874.6060	0.0000	5879.0930
149	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

APPENDIX C: WMSC Circuit Traffic Sample
Statistical Analysis in kilobytes for Circuits 141 through 186

Circuit	average in	average out	std dev in	std dev out	minimum in	minimum out	maximum in	maximum out
151	0.0000	5006.6879	0.0000	340.4037	0.0000	4452.8080	0.0000	5470.9210
153	0.0000	1035.6503	0.0000	1196.6181	0.0000	0.0000	0.0000	2463.2780
154	0.0000	2373.4703	0.0000	115.6752	0.0000	2246.9710	0.0000	2545.7470
155	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
156	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
157	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
159	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
160	29.7119	1257.1034	4.6401	156.0047	22.4890	982.0030	34.9700	1407.3770
161	4.3179	1393.6881	1.3495	186.5384	2.6250	1134.3450	7.0590	1723.6430
162	0.0013	0.0000	0.0031	0.0000	0.0000	0.0000	0.0090	0.0000
163	36.8714	1943.1481	3.8423	196.0314	29.2110	1567.8540	40.9830	2177.1220
164	8.3447	1312.4070	1.7266	143.5584	5.7050	1063.1450	11.4870	1509.4830
165	15.6106	1780.2939	1.7265	183.4318	12.3810	1480.2160	18.1950	2080.4660
166	24.9867	1286.3127	4.0794	166.2352	19.9410	1017.1240	33.5370	1569.3120
167	38.2684	1580.1710	4.5083	178.8097	30.4490	1304.4310	44.2800	1807.7320
168	26.6071	2454.9293	2.4782	265.8659	24.2440	2161.3880	30.5240	3014.9780
169	24.0297	2304.7787	1.5964	375.0012	22.3770	1821.5000	26.9410	2882.4790
170	11.0173	1506.4756	3.5268	220.8784	7.5220	1235.4720	17.5780	1952.9120
171	12.7491	1403.0629	2.0792	163.8284	10.2460	1197.2200	16.2430	1725.6470
172	9.3830	1408.4996	0.8888	105.0223	8.3170	1240.7200	10.4520	1525.9510
173	6.9501	1000.4550	1.2947	355.3592	5.4580	577.2210	8.9110	1456.3700
174	68.0147	1391.7110	10.6514	138.2495	54.7760	1184.9360	82.1790	1638.2490
175	290.4946	2473.4711	26.4447	150.0534	255.1120	2360.4670	346.1630	2779.3640
176	66.8747	20.1633	20.4720	6.1142	41.3240	11.2080	104.0100	32.9380
177	0.5574	2847.5579	0.7388	281.8530	0.0000	2530.8290	2.0080	3459.2620
178	0.5353	2707.7237	0.2970	172.8517	0.1360	2534.6590	1.0900	3089.8790
179	0.0000	3985.2694	0.0000	1644.7885	0.0000	0.0000	0.0000	5116.9220
180	113.2781	2850.4893	20.5355	283.2676	88.5990	2533.0920	144.3140	3460.0180
181	7.6300	1201.0860	8.0945	152.7402	0.0000	977.2620	19.6620	1397.5570
182	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
183	0.0000	5544.0439	0.0000	704.4606	0.0000	4542.3420	0.0000	6475.4280
184	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
185	0.0000	5069.1841	0.0000	346.7664	0.0000	4539.3220	0.0000	5597.5320
186	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
total	11626.0047	133975.9573	1880.5222	26230.6562	10013.4570	105382.3800	15543.7720	181775.0610

APPENDIX D

WMSC CIRCUITS

WMSC CIRCUIT	USER	TELCO CIRCUIT NUMBER	NOTES
102	FSDPS-1	GD34175 Port C	
103	FSDPS-1	GD34176 Port A	
104	FSDPS-1	GD34176 Port B	
105	NADIN 1A	GD56865	
106	NADIN 1A	GD56822	
107	CWSU	FAC 6521	*
108	CWSU	FAC 6520	*
109	CWSU	FAC 6523	*
110	CWSU	FAC 6522	*
111	IVRS	523-5049	NOT IN END STATE
112	IVRS	FDEA915532	NOT IN END STATE
114	KWBC	90488-601	NWSTG IN END STATE
115	KWBC	90488-605	NWSTG IN END STATE
116	FSDPS-1	GD34175 Port A	
117	FSDPS-1	GD34174 Port D	
118	FSDPS-1	GD25832	

WMSC CIRCUIT	USER	TELCO CIRCUIT NUMBER	NOTES
119	FSDPS-1	GD34174 Port A	
130	FSDPS-1	75DDJ020007 Port B	
132	KAWN	AFC 562	
134	ATA/West	GD90073	
135	ATA/East	GD90070	
136	E-Systems	GD90087	
137	ALASCOM	FAC 6550	
138	FLW/CTRL	FAC 6519	TMP IN END STATE
139	McCLEAN	WUW14263	
140	LSAS	FAC 6501	
141	LSAS	FAC 6502	
142	LSAS	FAC 6503	
143	LSAS	FAC 6504	
148	FED/EX	FDEC 565506	
149	ARINC	FDEC 23629	
151	DELTA AL	FDEA 468552	

WMSC CIRCUIT	USER	TELCO CIRCUIT NUMBER	NOTES
153	REPUBL AL	FDEC 92212	
154	UNITED AL	FDEC 559200	
155	WESTRN AL	FDET 6560	
160	LSAS	FAC 6505	
161	LSAS	FAC 6506	
163	LSAS	FAC 6508	
164	LSAS	FAC 6509	
165	LSAS	FAC 6510	
166	LSAS	FAC 6511	
167	LSAS	FAC 6512	
168	LSAS	FAC 6513	
169	LSAS	FAC 6514	
170	LSAS	FAC 6515	
171	LSAS	FAC 6516	
172	LSAS	FAC 6517	
173	LSAS	FAC 6518	
174	LSAS/ALSK	FAC 6550	
175	LSAS/NWS	FAC 6550	
176	CNSP	FAC 812	

WMSC CIRCUIT	USER	TELCO CIRCUIT NUMBER	NOTES
177	NSSFC	85FDDM010002	
178	AWANS	90488-607	NOT IN END STATE
179	MITRE	GD90080	
181	FSDPS-1	FAC 6524	
182	DUATS	RESERVED	
183	SITA	FDEC 646505	
184	DUATS	RESERVED	
185	NGOVT	604	
186	DUATS	RESERVED	

* The CWSU function will be taken over by CFMWP (MWP)

APPENDIX E

WMSCR END STATE TRAFFIC ESTIMATES

APPENDIX E: WMSCR END STATE TRAFFIC ESTIMATE IN KILOBYTES (KB) PER HOUR (HR)

SOURCE	SINK	MESSAGE	SIZE	FREQ	I/F #	AVE/HOUR	CUM I/F TOT
ADAS	WMSCR	AWOS HOURLY SURFACE WX OBS. MSG (#1)	0.2 KB	79 HR	23	15.800 KB/HR	363.400 KB/HR
		AWOS SPECIAL SURFACE WX OBS. MSG (#1)	0.2 KB	5 HR	23	1.000 KB/HR	23.000 KB/HR
				INPUT		15.800 KB/HR	363.400 KB/HR
				OUTPUT		1.000 KB/HR	23.000 KB/HR
				TOTAL		16.800 KB/HR	386.400 KB/HR
KAWN	WMSCR	ALPHANUM/GRAPHIC DATA DISPLAY REQUEST (#2)	0.02 KB	3 DAY	1	0.003 KB/HR	0.003 KB/HR
		DOD HAZARDOUS WX INFORMATION	3.3 KB	4 DAY	1	0.550 KB/HR	0.550 KB/HR
		DOD SURFACE OBS.	0.09 KB	165 HR	1	14.850 KB/HR	14.850 KB/HR
		DOD TERMINAL FORECASTS	0.08 KB	660 DAY	1	2.200 KB/HR	2.200 KB/HR
		PIREPS (#4)	0.09 KB	5 HR	1	0.450 KB/HR	0.450 KB/HR
WMSCR	KAWN	ALPHANUMERIC WX INFORMATION (#2)	63.275 KB	1 HR	1	63.275 KB/HR	63.275 KB/HR
				INPUT		18.052 KB/HR	18.052 KB/HR
				OUTPUT		63.275 KB/HR	63.275 KB/HR
				TOTAL		81.328 KB/HR	81.328 KB/HR
AWP	WMSCR	NOTAMS (D)	0.035 KB	115 HR	1	4.025 KB/HR	4.025 KB/HR
		PIREPS (#4)	0.09 KB	27 HR	1	2.430 KB/HR	2.430 KB/HR
		WX INFORMATION REQUESTS (#1)	0.1 KB	560 HR	1	56.000 KB/HR	56.000 KB/HR
WMSCR	AWP	AWOS HOURLY SURFACE WX OBS. MSG (#1)	0.2 KB	905 HR	1	181.000 KB/HR	181.000 KB/HR
		AWOS SPECIAL SURFACE WX OBS. MSG (#1)	0.2 KB	95 HR	1	19.000 KB/HR	19.000 KB/HR
		CENTER WEATHER ADVISORY (#4)	0.2 KB	69 DAY	1	0.575 KB/HR	0.575 KB/HR
		DOD HAZARDOUS WX INFORMATION	3.3 KB	4 DAY	1	0.550 KB/HR	0.550 KB/HR
		DOD SURFACE OBS.	0.09 KB	165 HR	1	14.850 KB/HR	14.850 KB/HR
		DOD TERMINAL FORECASTS	0.08 KB	660 DAY	1	2.200 KB/HR	2.200 KB/HR
		GENERAL INFORMATION MESSAGE (#4)	0.2 KB	69 DAY	1	0.575 KB/HR	0.575 KB/HR
		ICAO AIRCRAFT REPORTS	0.09 KB	60 DAY	1	0.225 KB/HR	0.225 KB/HR
		ICAO AERODROME REPORTS	0.09 KB	70 HR	1	6.300 KB/HR	6.300 KB/HR
		ICAO AREA FORECASTS	0.24 KB	140 DAY	1	1.400 KB/HR	1.400 KB/HR
		ICAO RADAR REPORTS	0.09 KB	14 HR	1	1.260 KB/HR	1.260 KB/HR
		ICAO ROUTE FORECASTS	0.24 KB	2 DAY	1	0.020 KB/HR	0.020 KB/HR
		ICAO SYNOPSES	0.09 KB	752 DAY	1	2.820 KB/HR	2.820 KB/HR
		ICAO TABULAR WINDS FORECAST	0.27 KB	28 DAY	1	0.315 KB/HR	0.315 KB/HR
		ICAO TERMINAL AREA FORECASTS	0.2 KB	280 DAY	1	2.333 KB/HR	2.333 KB/HR
		ICAO WX WARNING/ADVISORIES	0.3 KB	11 DAY	1	0.137 KB/HR	0.137 KB/HR
		METEOROLOGICAL IMPACT STATEMENT (#4)	0.2 KB	69 DAY	1	0.575 KB/HR	0.575 KB/HR
		NWS AMENDMENTS	0.3375 KB	107 HR	1	36.113 KB/HR	36.113 KB/HR
		NWS AREA FORECASTS	1.2 KB	208 DAY	1	10.400 KB/HR	10.400 KB/HR
		NWS GRIDDED WINDS/TEMP ALOFT FORECAST	600 KB	2 DAY	1	50.000 KB/HR	50.000 KB/HR
		NWS PROGNOSTIC MAP DISCUSSION	2.8 KB	4 DAY	1	0.467 KB/HR	0.467 KB/HR
		NWS SEVERE WX OUTLOOK	1.5 KB	3 DAY	1	0.188 KB/HR	0.188 KB/HR
		NWS SURFACE OBS.	4.875 KB	1 HR	1	4.875 KB/HR	4.875 KB/HR
		NWS TERMINAL FORECASTS	35.5 KB	4 DAY	1	5.917 KB/HR	5.917 KB/HR
		NWS WX WARNINGS AND ADVISORIES	0.7 KB	1 HR	1	0.700 KB/HR	0.700 KB/HR
		PIREPS (#4)	0.09 KB	430 HR	1	38.700 KB/HR	38.700 KB/HR
		PROCESSED NOTAMS	0.13 KB	165 HR	1	21.450 KB/HR	21.450 KB/HR
		NWS HURRICANE/TROPICAL STORM ADVISORY	0.8 KB	3 DAY	1	0.100 KB/HR	0.100 KB/HR
		NWS SIGMETS AND AIRMETS	0.6 KB	5 HR	1	3.000 KB/HR	3.000 KB/HR
				INPUT		62.455 KB/HR	62.455 KB/HR
				OUTPUT		406.044 KB/HR	402.944 KB/HR
				TOTAL		468.499 KB/HR	465.399 KB/HR

APPENDIX E: WMSCR END STATE TRAFFIC ESTIMATE IN KILOBYTES (KB) PER HOUR (HR)

SOURCE	SINK	MESSAGE	SIZE	FREQ	I/F #	AVE/HOUR	CUM I/F TOT
CFMWP	WMSCR	GENERAL INFORMATION MESSAGE (#5)	0.2 KB	3 DAY	2	0.025 KB/HR	0.050 KB/HR
WMSCR	CFMWP	AWOS HOURLY SURFACE WX OBS. MSG (#1)	0.2 KB	905 HR	2	181.000 KB/HR	362.000 KB/HR
		AWOS SPECIAL SURFACE WX OBS. MSG (#1)	0.2 KB	95 HR	2	19.000 KB/HR	38.000 KB/HR
		CENTER WEATHER ADVISORY (#4)	0.2 KB	69 DAY	2	0.575 KB/HR	1.150 KB/HR
		GENERAL INFORMATION MESSAGE (#4)	0.2 KB	69 DAY	2	0.575 KB/HR	1.150 KB/HR
		HAZARDOUS WX AREA OUTLINE (#7)	0.2 KB	21 HR	2	4.200 KB/HR	8.400 KB/HR
		METEOROLOGICAL IMPACT STATEMENT (#4)	0.2 KB	69 DAY	2	0.575 KB/HR	1.150 KB/HR
		PIREPS (#4)	0.09 KB	430 HR	2	38.700 KB/HR	77.400 KB/HR
		WFO PRODUCTS	0.6 KB	1 HR	2	0.600 KB/HR	1.200 KB/HR
				INPUT		0.025 KB/HR	0.050 KB/HR
				OUTPUT		245.225 KB/HR	490.450 KB/HR
				TOTAL		245.250 KB/HR	490.500 KB/HR
CNSP	WMSCR	PROCESSED NOTAMS	0.13 KB	165 HR	1	21.450 KB/HR	21.450 KB/HR
WMSCR	CNSP	NOTAMS (D)	0.035 KB	115 HR	1	4.025 KB/HR	4.025 KB/HR
				INPUT		21.450 KB/HR	21.450 KB/HR
				OUTPUT		4.025 KB/HR	4.025 KB/HR
				TOTAL		25.475 KB/HR	25.475 KB/HR
EXT USR (AIRLINES)	WMSCR	ALPHANUM/GRAPHIC DATA DISPLAY REQUEST (#2)	0.02 KB	5 HR	1	0.100 KB/HR	0.100 KB/HR
		NOTAM REQUESTS	0.07 KB	3 HR	1	0.210 KB/HR	0.210 KB/HR
		PIREPS (#4)	0.09 KB	3 HR	1	0.270 KB/HR	0.270 KB/HR
WMSCR	EXT USR (AIRLINES)	CENTER WEATHER ADVISORY (#4)	0.2 KB	69 DAY	1	0.575 KB/HR	0.575 KB/HR
		DOD HAZARDOUS WX INFORMATION	3.3 KB	4 DAY	1	0.550 KB/HR	0.550 KB/HR
		DOD SURFACE OBS.	0.09 KB	165 HR	1	14.850 KB/HR	14.850 KB/HR
		DOD TERMINAL FORECASTS	0.08 KB	660 DAY	1	2.200 KB/HR	2.200 KB/HR
		GENERAL INFORMATION MESSAGE (#4)	0.2 KB	69 DAY	1	0.575 KB/HR	0.575 KB/HR
		HAZARDOUS WX AREA OUTLINE (#7)	0.2 KB	21 HR	1	4.200 KB/HR	4.200 KB/HR
		METEOROLOGICAL IMPACT STATEMENT (#4)	0.2 KB	69 DAY	1	0.575 KB/HR	0.575 KB/HR
		PROCESSED NOTAMS	0.13 KB	165 HR	1	21.450 KB/HR	21.450 KB/HR
		NWS SIGMETS AND AIRMETS	0.6 KB	5 HR	1	3.000 KB/HR	3.000 KB/HR
				INPUT		0.580 KB/HR	0.580 KB/HR
				OUTPUT		47.975 KB/HR	47.975 KB/HR
				TOTAL		48.555 KB/HR	48.555 KB/HR
AFTN	WMSCR	ALPHANUM/GRAPHIC DATA DISPLAY REQUEST (#2)	0.02 KB	1 DAY	1	0.001 KB/HR	0.001 KB/HR
		ALPHANUMERIC WX INFORMATION (#2)	325 KB	1 HR	1	325.000 KB/HR	325.000 KB/HR
WMSCR	AFTN	ALPHANUMERIC WX INFORMATION (#2)	325 KB	1 HR	1	325.000 KB/HR	325.000 KB/HR
				INPUT		325.001 KB/HR	325.001 KB/HR
				OUTPUT		325.000 KB/HR	325.000 KB/HR
				TOTAL		650.001 KB/HR	650.001 KB/HR
MPS	WMSCR	MAINTENANCE MANAGEMENT DATA RESPONSE	0	0	1	0.000 KB/HR	0.000 KB/HR
		MAINTENANCE STATUS REQUEST	0	0	1	0.000 KB/HR	0.000 KB/HR
WMSCR	MPS	MAINTENANCE MANAGEMENT DATA REQUEST	0	0	1	0.000 KB/HR	0.000 KB/HR
		MAINTENANCE STATUS RESPONSE	0	0	1	0.000 KB/HR	0.000 KB/HR
				INPUT		0.000 KB/HR	0.000 KB/HR
				OUTPUT		0.000 KB/HR	0.000 KB/HR
				TOTAL		0.000 KB/HR	0.000 KB/HR

APPENDIX E: WMSCR END STATE TRAFFIC ESTIMATE IN KILOBYTES (KB) PER HOUR (HR)

SOURCE	SINK	MESSAGE	SIZE	FREQ	I/F #	AVE/HOUR	CUM I/F TOT
MWP	WMSCR	CENTER WEATHER ADVISORY (#3)	0.2 KB	3 DAY	23	0.025 KB/HR	0.575 KB/HR
		GENERAL INFORMATION MESSAGE (#1)	0.2 KB	3 DAY	23	0.025 KB/HR	0.575 KB/HR
		HAZARDOUS WX AREA OUTLINE (#2)	0.2 KB	1 HR	23	0.200 KB/HR	4.600 KB/HR
		METEOROLOGICAL IMPACT STATEMENT (#3)	0.2 KB	3 DAY	23	0.025 KB/HR	0.575 KB/HR
		PIREPS (#4)	0.09 KB	1 HR	23	0.090 KB/HR	2.070 KB/HR
WMSCR	MWP	AWOS HOURLY SURFACE WX OBS. MSG (#1)	0.2 KB	905 HR	23	181.000 KB/HR	4163.000 KB/HR
		AWOS SPECIAL SURFACE WX OBS. MSG (#1)	0.2 KB	95 HR	23	19.000 KB/HR	437.000 KB/HR
		CENTER WEATHER ADVISORY (#3)	0.2 KB	69 DAY	23	0.575 KB/HR	13.225 KB/HR
		GENERAL INFORMATION MESSAGE (#1)	0.2 KB	66 DAY	23	0.550 KB/HR	12.650 KB/HR
		HAZARDOUS WX AREA OUTLINE (#2)	0.2 KB	20 HR	23	4.000 KB/HR	92.000 KB/HR
		METEOROLOGICAL IMPACT STATEMENT (#3)	0.2 KB	69 DAY	23	0.575 KB/HR	13.225 KB/HR
		PIREPS (#4)	0.09 KB	430 HR	23	38.700 KB/HR	890.100 KB/HR
		WFO PRODUCTS	0.6 KB	1 HR	23	0.600 KB/HR	13.800 KB/HR
				INPUT		0.365 KB/HR	8.395 KB/HR
				OUTPUT		245.000 KB/HR	5635.000 KB/HR
				TOTAL		245.365 KB/HR	5643.395 KB/HR
NWSTG	WMSCR	ICAO AERODROME REPORTS	0.09 KB	70 HR	1	6.300 KB/HR	6.300 KB/HR
		ICAO AIRCRAFT REPORTS	0.09 KB	60 DAY	1	0.225 KB/HR	0.225 KB/HR
		ICAO AREA FORECASTS	0.24 KB	140 DAY	1	1.400 KB/HR	1.400 KB/HR
		ICAO RADAR REPORTS	0.09 KB	14 HR	1	1.260 KB/HR	1.260 KB/HR
		ICAO ROUTE FORECASTS	0.24 KB	2 DAY	1	0.020 KB/HR	0.020 KB/HR
		ICAO SYNOPSES	0.09 KB	752 DAY	1	2.820 KB/HR	2.820 KB/HR
		ICAO TABULAR WINDS FORECAST	0.27 KB	28 DAY	1	0.315 KB/HR	0.315 KB/HR
		ICAO TERMINAL AREA FORECASTS	0.2 KB	280 DAY	1	2.333 KB/HR	2.333 KB/HR
		ICAO WX WARNING/ADVISORIES	0.3 KB	11 DAY	1	0.137 KB/HR	0.137 KB/HR
		NWS ALPHANUMERIC HOURLY FORECAST PRODUCTS	1.9375 KB	1 HR	1	1.938 KB/HR	1.938 KB/HR
		NWS ALPHANUMERIC UNSCHEDULED PRIORITY MSG	0.6 KB	1 12-HR	1	0.050 KB/HR	0.050 KB/HR
		NWS AMENDMENTS	0.3375 KB	107 HR	1	36.113 KB/HR	36.113 KB/HR
		NWS AREA FORECASTS	1.2 KB	208 DAY	1	10.400 KB/HR	10.400 KB/HR
		NWS GRIDDED WINDS/TEMP ALOFT FORECAST	600 KB	2 DAY	1	50.000 KB/HR	50.000 KB/HR
		NWS NARRATIVE RADAR REPORTS	1.8 KB	136 HR	1	244.800 KB/HR	244.800 KB/HR
		NWS PROGNOSTIC MAP DISCUSSION	2.8 KB	4 DAY	1	0.467 KB/HR	0.467 KB/HR
		NWS SURFACE OBS.	4.875 KB	1 HR	1	4.875 KB/HR	4.875 KB/HR
		NWS TERMINAL FORECASTS	35.5 KB	4 DAY	1	5.917 KB/HR	5.917 KB/HR
		NWS WX WARNINGS AND ADVISORIES	0.7 KB	1 HR	1	0.700 KB/HR	0.700 KB/HR
		NWS 6-HOUR PRECIPITATION FORECAST PROD.	6.7 KB	4 DAY	1	1.117 KB/HR	1.117 KB/HR
		UPPER WINDS FOR OCEANIC CONTROL	15.375 KB	2 DAY	1	1.281 KB/HR	1.281 KB/HR
		WFO PRODUCTS	0.6 KB	1 HR	1	0.600 KB/HR	0.600 KB/HR
		GENERAL INFORMATION MESSAGE (#2)	0.2 KB	3 DAY	1	0.025 KB/HR	0.025 KB/HR
		NWS ALASKA MOS FORECAST	1.175 KB	2 DAY	1	0.098 KB/HR	0.098 KB/HR
		NWS AVIATION AREA FORECAST	2.4 KB	2 DAY	1	0.200 KB/HR	0.200 KB/HR
		NWS EXTENDED PROG DISCUSSION	0.8 KB	4 DAY	1	0.133 KB/HR	0.133 KB/HR
		NWS HURRICANE/TROPICAL STORM ADVISORY	0.8 KB	3 DAY	1	0.100 KB/HR	0.100 KB/HR
		NWS OFFSHORE AVIATION FORECAST	0.8 KB	4 DAY	1	0.133 KB/HR	0.133 KB/HR
		NWS POP, CLOUDS, CEILING & WINDS	1.175 KB	2 DAY	1	0.098 KB/HR	0.098 KB/HR
		NWS SATELLITE DISCUSSION PRODUCTS	5 KB	6 DAY	1	1.250 KB/HR	1.250 KB/HR
		NWS SATELLITE PRODUCTS	0.8 KB	30 DAY	1	1.000 KB/HR	1.000 KB/HR
		NWS SEVERE WX OUTLOOK	1.5 KB	3 DAY	1	0.188 KB/HR	0.188 KB/HR
		NSW SIGMETS AND AIRMETS	0.6 KB	5 HR	1	3.000 KB/HR	3.000 KB/HR
		NWS SOUNDING ANALYSIS	6 KB	8 DAY	1	2.000 KB/HR	2.000 KB/HR
		NWS SUBTROPICAL STORM ADVISORIES	0.6 KB	4 DAY	1	0.100 KB/HR	0.100 KB/HR
		NSW UPPER WIND FALLOUT FORECAST	2.86 KB	2 DAY	1	0.238 KB/HR	0.238 KB/HR
		NWS RADAR SUMMARY	2.4875 KB	6 HR	1	14.925 KB/HR	14.925 KB/HR
		AIRCRAFT RECONNAISSANCE REPORT	0.3 KB	2 HR	1	0.600 KB/HR	0.600 KB/HR
WMSCR	NWSTG	AWOS HOURLY SURFACE WX OBS. MSG (#1)	0.2 KB	905 HR	1	181.000 KB/HR	181.000 KB/HR
		AWOS SPECIAL SURFACE WX OBS. MSG (#1)	0.2 KB	95 HR	1	19.000 KB/HR	19.000 KB/HR
		CENTER WX ADVISORY (#1)	0.2 KB	69 DAY	1	0.575 KB/HR	0.575 KB/HR
		METEOROLOGICAL IMPACT STATEMENT (#1)	0.2 KB	69 DAY	1	0.575 KB/HR	0.575 KB/HR
		PIREPS (#4)	0.09 KB	430 HR	1	38.700 KB/HR	38.700 KB/HR
				INPUT		397.155 KB/HR	397.155 KB/HR
				OUTPUT		239.850 KB/HR	239.850 KB/HR
				TOTAL		637.005 KB/HR	637.005 KB/HR

APPENDIX E: WMSCR AND STATE TRAFFIC ESTIMATE IN KILOBYTES (KB) PER HOUR (HR)

SOURCE	SINK	MESSAGE	SIZE	FREQ	I/F #	AVE/HOUR	CUM I/F TOT
NSSFC	WMSCR	NWS WX WARNINGS AND ADVISORIES	0.7 KB	1 HR	1	0.700 KB/HR	0.700 KB/HR
WMSCR	NSSFC	DOD HAZARDOUS WX INFORMATION	3.3 KB	4 DAY	1	0.550 KB/HR	0.550 KB/HR
		DOD SURFACE OBS.	0.09 KB	165 HR	1	14.850 KB/HR	14.850 KB/HR
		DOD TERMINAL FORECASTS	0.08 KB	660 DAY	1	2.200 KB/HR	2.200 KB/HR
				INPUT		0.700 KB/HR	0.700 KB/HR
				OUTPUT		17.600 KB/HR	17.600 KB/HR
				TOTAL		18.300 KB/HR	18.300 KB/HR
OTH WMSCR	WMSCR	ALPHANUMERIC INFORMATION	5.7 KB	15 HR		85.500 KB/HR	0.000 KB/HR
		STATUS AND BACK-UP INFORMATION (#1)	6 KB	15 HR		90.000 KB/HR	0.000 KB/HR
WMSCR	OTH WMSCR	ALPHANUMERIC INFORMATION	5.7 KB	15 HR		85.500 KB/HR	0.000 KB/HR
		STATUS AND BACK-UP INFORMATION (#1)	6 KB	15 HR		90.000 KB/HR	0.000 KB/HR
				INPUT		175.500 KB/HR	0.000 KB/HR
				OUTPUT		175.500 KB/HR	0.000 KB/HR
				TOTAL		351.000 KB/HR	0.000 KB/HR
RWP	WMSCR	CENTER WX ADVISORY	0.2 KB	3 DAY	21	0.025 KB/HR	0.525 KB/HR
		GENERAL INFORMATION MESSAGE	0.2 KB	3 DAY	21	0.025 KB/HR	0.525 KB/HR
		HAZARDOUS WX AREA OUTLINE (#1)	0.2 KB	1 HR	21	0.200 KB/HR	4.200 KB/HR
		METEOROLOGICAL IMPACT STATEMENT	0.2 KB	3 DAY	21	0.025 KB/HR	0.525 KB/HR
		PIREPS (#4)	0.09 KB	163 HR	21	14.670 KB/HR	308.070 KB/HR
WMSCR	RWP	CENTER WX ADVISORY (#1)	0.2 KB	69 DAY	21	0.575 KB/HR	12.075 KB/HR
		DOD HAZARDOUS WX INFORMATION	3.3 KB	4 DAY	21	0.550 KB/HR	11.550 KB/HR
		DOD SURFACE OBS.	0.09 KB	165 HR	21	14.850 KB/HR	311.850 KB/HR
		DOD TERMINAL FORECASTS	0.08 KB	660 DAY	21	2.200 KB/HR	46.200 KB/HR
		ICAO AIRCRAFT REPORTS	0.09 KB	60 DAY	21	0.225 KB/HR	4.725 KB/HR
		ICAO AERODROME REPORTS	0.09 KB	70 HR	21	6.300 KB/HR	132.300 KB/HR
		ICAO TERMINAL AREA FORECASTS	0.2 KB	280 DAY	21	2.333 KB/HR	49.000 KB/HR
		ICAO WX WARNING/ADVISORIES	0.3 KB	11 DAY	21	0.137 KB/HR	2.887 KB/HR
		NWS ALPHANUMERIC HOURLY FORECAST PRODUCTS	1.9375 KB	1 DAY	21	0.081 KB/HR	1.695 KB/HR
		NWS ALPHANUMERIC UNSCHEDULED PRIORITY MSG	0.6 KB	1 12-HR	21	0.050 KB/HR	1.050 KB/HR
		NWS GRIDDED WINDS/TEMP ALOFT FORECAST	600 KB	2 DAY	21	50.000 KB/HR	1050.000 KB/HR
		NWS SURFACE OBS.	4.875 KB	1 HR	21	4.875 KB/HR	102.375 KB/HR
		NWS TERMINAL FORECASTS	35.5 KB	4 DAY	21	5.917 KB/HR	124.250 KB/HR
		PIREPS (#4)	0.09 KB	430 HR	21	38.700 KB/HR	812.700 KB/HR
		UPPER WINDS FOR OCEANIC CONTROL	15.375 KB	2 DAY	21	1.281 KB/HR	26.906 KB/HR
		AIRCRAFT RECONNAISSANCE REPORT	0.3 KB	2 HR	21	0.600 KB/HR	12.600 KB/HR
		ICAO TABULAR WINDS FORECAST	0.27 KB	28 DAY	21	0.315 KB/HR	6.615 KB/HR
		NWS ALASKA MOS FORECAST	1.175 KB	2 DAY	21	0.098 KB/HR	2.056 KB/HR
		NWS AMENDMENTS	0.3375 KB	107 HR	21	36.113 KB/HR	758.363 KB/HR
		NWS AREA FORECASTS	1.2 KB	208 DAY	21	10.400 KB/HR	218.400 KB/HR
		NWS AVIATION AREA FORECAST (#2)	2.4 KB	2 DAY	21	0.200 KB/HR	4.200 KB/HR
		NWS EXTENDED PROG DISCUSSION	0.8 KB	4 DAY	21	0.133 KB/HR	2.800 KB/HR
		NWS HURRICANE/TROPICAL STORM ADVISORY	0.8 KB	3 DAY	21	0.100 KB/HR	2.100 KB/HR
		NWS NARRIATIVE RADAR REPORTS	1.8 KB	136 HR	21	244.800 KB/HR	5140.800 KB/HR
		NWS OFFSHORE AVIATION FORECAST	0.8 KB	4 DAY	21	0.133 KB/HR	2.800 KB/HR
		NWS POP, CLOUDS, CEILING & WINDS	1.175 KB	2 DAY	21	0.098 KB/HR	2.056 KB/HR
		NWS SATELLITE DISCUSSION PRODUCTS	5 KB	6 DAY	21	1.250 KB/HR	26.250 KB/HR
		NWS SATELLITE PRODUCTS	0.8 KB	30 DAY	21	1.000 KB/HR	21.000 KB/HR
		NWS SEVERE WX OUTLOOK	1.5 KB	3 DAY	21	0.188 KB/HR	3.938 KB/HR
		NWS SIGMETS AND AIRMETS	0.6 KB	5 HR	21	3.000 KB/HR	63.000 KB/HR
		NWS SOUNDING ANALYSIS	6 KB	8 DAY	21	2.000 KB/HR	42.000 KB/HR
		NWS SUBTROPICAL STORM ADVISORIES	0.6 KB	4 DAY	21	0.100 KB/HR	2.100 KB/HR
		NWS UPPER WIND FALLOUT FORECAST	2.86 KB	2 DAY	21	0.238 KB/HR	5.005 KB/HR
		NWS WX WARNINGS AND ADVISORIES	0.7 KB	1 HR	21	0.700 KB/HR	14.700 KB/HR
		WFO PRODUCTS	0.6 KB	1 HR	21	0.600 KB/HR	12.600 KB/HR
				INPUT		14.945 KB/HR	313.845 KB/HR
				OUTPUT		430.140 KB/HR	9032.947 KB/HR
				TOTAL		445.085 KB/HR	9346.792 KB/HR

APPENDIX E: WMSCR END STATE TRAFFIC ESTIMATE IN KILOBYTES (KB) PER HOUR (HR)

SOURCE	SINK	MESSAGE	SIZE	FREQ	I/F #	AVE/HOUR	CUM I/F TOT
WMSCR	TMP	NWS GRIDDED WINDS/TEMP ALOFT FORECAST (#2)	600 KB	2 DAY	1	50.000 KB/HR	50.000 KB/HR
				INPUT		0.000 KB/HR	0.000 KB/HR
				OUTPUT		50.000 KB/HR	50.000 KB/HR
				TOTAL		50.000 KB/HR	50.000 KB/HR
WMSCR	WCP	AWOS HOURLY SURFACE WX OBS. MSG (#2)	0.2 KB	905 HR	23	181.000 KB/HR	4163.000 KB/HR
		AWOS SPECIAL SURFACE WX OBS. MSG (#2)	0.2 KB	95 HR	23	19.000 KB/HR	437.000 KB/HR
		DOD HAZARDOUS WX INFORMATION	3.3 KB	4 DAY	23	0.550 KB/HR	12.650 KB/HR
		DOD SURFACE OBS.	0.09 KB	165 HR	23	14.850 KB/HR	341.550 KB/HR
		DOD TERMINAL FORECASTS	0.08 KB	660 DAY	23	2.200 KB/HR	50.600 KB/HR
		NWS GRIDDED WINDS/TEMP ALOFT FORECAST (#2)	600 KB	2 DAY	23	50.000 KB/HR	1150.000 KB/HR
		NWS SURFACE OBS. (#1)	4.875 KB	1 HR	23	4.875 KB/HR	112.125 KB/HR
		NWS TERMINAL FORECASTS (#2)	35.5 KB	4 DAY	23	5.917 KB/HR	136.083 KB/HR
		NWS WX WARNINGS AND ADVISORIES (#1)	0.7 KB	1 HR	23	0.700 KB/HR	16.100 KB/HR
		PIREPS (#5)	0.09 KB	430 HR	23	38.700 KB/HR	890.100 KB/HR
		PROCESSED NOTAMS	0.13 KB	165 HR	23	21.450 KB/HR	493.350 KB/HR
		NWS HURRICANE/TROPICAL STORM ADVISORY (#1)	0.8 KB	3 DAY	23	0.100 KB/HR	2.300 KB/HR
		NWS SIGMETS AND AIRMETS (#1)	0.3 KB	5 HR	23	1.500 KB/HR	34.500 KB/HR
		NWS RADAR SUMMARY (#1)	2.4875 KB	6 HR	23	14.925 KB/HR	343.275 KB/HR
				INPUT		0.000 KB/HR	0.000 KB/HR
				OUTPUT		355.767 KB/HR	8182.633 KB/HR
				TOTAL		355.767 KB/HR	8182.633 KB/HR
				WMSCR AGGREGATE	INPUT	1032.029 KB/HR	1511.084 KB/HR
				WMSCR AGGREGATE	OUTPUT	2606.401 KB/HR	24514.699 KB/HR
				WMSCR AGGREGATE	TOTAL	3638.430 KB/HR	26025.783 KB/HR

APPENDIX F

CONTROL CHARACTER BINARY REPRESENTATION

7-UNIT CODED CHARACTER SET
(IA-5, International Reference Version)

				b_7	0	0	0	0	1	1	1	1
				b_6	0	0	1	1	0	0	1	1
				b_5	0	1	0	1	0	1	0	1
b_4	b_3	b_2	b_1		0	1	2	3	4	5	6	7
0	0	0	0	0	NUL	TC_7 (DLE)	SP	0	@	P	`	p
0	0	0	1	1	TC_1 (SOH)	DC_1	!	1	A	Q	a	q
0	0	1	0	2	TC_2 (STX)	DC_2	" ⑥	2	B	R	b	r
0	0	1	1	3	TC_3 (ETX)	DC_3	#	3	C	S	c	s
0	1	0	0	4	TC_4 (EOT)	DC_4	¤ ⑥	4	D	T	d	t
0	1	0	1	5	TC_5 (ENQ)	TC_8 (NAK)	%	5	E	U	e	u
0	1	1	0	6	TC_6 (ACK)	TC_9 (SYN)	&	6	F	V	f	v
0	1	1	1	7	BEL	TC_{10} (ETB)	⑥	7	G	W	g	w
1	0	0	0	8	FE_0 (BS)	CAN	(	8	H	X	h	x
1	0	0	1	9	FE_1 (HT)	EM	)	9	I	Y	i	y
1	0	1	0	10	FE_2 ① (LF)	SUB	*	:	J	Z	j	z
1	0	1	1	11	FE_3 (VT)	ESC	+	;	K	[	k	{
1	1	0	0	12	FE_4 (FF)	IS_4 (FS)	, ⑥	<	L	\	l	|
1	1	0	1	13	FE_5 ① (CR)	IS_3 (GS)	-	=	M	]	m	}
1	1	1	0	14	SO	IS_2 (RS)	.	>	N	^ ⑥	n	~ ⑥
1	1	1	1	15	SI	IS_1 (US)	/	?	O	_	o	DEL

NOTES

Note 1. — *The format effectors are intended for equipment in which horizontal and vertical movements are effected separately. If equipment requires the action of CARRIAGE RETURN to be combined with a vertical movement, the format effector for that vertical movement may be used to effect the combined movement. Use of FE 2 for a combined CR and LF operation is not allowed for international transmission on AFS networks.*

Note 2. — *The symbol ¤ does not designate the currency of a specific country.*

Note 3. — *Position 7/14 is used for graphic character ~ (OVERLINE), the graphical representation of which may vary according to national use to represent (TILDE) or another diacritical sign provided that there is no risk of confusion with another graphic character included in the table.*

Note 4. — *The graphic characters in positions 2/2, 2/7, 2/12 and 5/14 have respectively the significance of QUOTATION MARK, APOSTROPHE, COMMA and UPWARD ARROW HEAD, however, these characters take on the significance of the diacritical signs DIAERESIS, ACUTE ACCENT, CEDILLA and CIRCUMFLEX ACCENT when they are preceded or followed by the BACKSPACE character (0/8).*

Note 5. — *When graphical representation of the control characters of the 7-unit coded character set is required, it is permissible to use the symbols specified in International Organization for Standardization (ISO) Standard 2047-1975.*