See Report No. RD-66-21

Federal Aviation Agency

ADVISORY CIRCULAR

FEDERAL AVIATION AGENCY · UNITED STATES OF AMERICA

AC NO: AC 00-19
GENERAL
EFFECTIVE: 7/8/66

Cancelled 00-2A

SUBJECT: SYSTEM DESCRIPTION FOR A MODERNIZED WEATHER TELETYPEWRITER COMMUNICATIONS SYSTEM

---

1. PURPOSE. This circular transmits, as an attachment, a technical report describing system improvements, which the Federal Aviation Agency plans to make in the operation of the Services A, C, and O weather teletypewriter communications networks.

2. REFERENCES. Weather Schedules Handbooks for Service A, 7330.5, dated May 20, 1966; Service C, AT P 7330.3B, dated May 1, 1965; Service O, AT P 7330.4A, dated April 24, 1964. Federal Aviation Agency Selection Order Number 1010.36 for the Modernized Weather Teletypewriter Communications System, dated May 19, 1966.

3. DISCUSSION. The attached system description is for distribution to all subscribers of the three referenced weather communications networks, and provides advanced information of pending changes, which are to be made in the system operation. Described in this document is a real time, store and forward, solid-state message switching center in which will be centralized all of the collection and relay functions now performed at 35 conterminous U.S. locations. As announced by the Administrator on May 18, 1966, Kansas City, Missouri, has been selected as the site for this center. September 1968 is the programmed date for complete implementation of the new system.

4. PROGRAM IMPACT. Two years have passed since the original user survey of requirements to be met by this system. Therefore, before final decisions are made on the circuit(s) to which users will be assigned, the number of circuits they will require, and what information will be scheduled on a given circuit, proposed circuit configurations and related scheduling will be distributed for review and comment, or in some cases coordinated in meetings.

   The more notable changes, which will be apparent to the users of these systems, are stated briefly as follows:

a. Assignment of users to new reconfigured circuits which will be increased in number and extended from all parts of the country into the switching center.

b. Reduction in the number of data entry stations per circuit resulting in faster acquisition of data in the switching center.

c. Increased use of standard 100 wpm supplemental circuits and potential for the innovation of high-speed dedicated circuits to provide increased distribution capacity to high data volume users.

d. Isolation of major users from users with average requirements, and certain government subscribers from nongovernment subscribers.

e. More timely receipt and more selective readout of information.

f. Request/reply feature permitting data entry stations to interrogate the center library for information required on a nonroutine basis.

Comments on this proposed system are invited. They should be forwarded to:

Federal Aviation Agency
Communications Staff, AT-30
800 Independence Avenue, S.W.
Washington, D.C. 20553

for William E. Morgan
Archie W. League, Director
Air Traffic Service

AD 644-409

Report No. RD-66-21

TECHNICAL REPORT
SYSTEM DESCRIPTION

Sub-Program No. 233-001

MODERNIZED WEATHER TELETYPEWRITER COMMUNICATIONS SYSTEM

MARCH 1966

FEDERAL AVIATION AGENCY

Systems Research & Development Service

Washington, D. C.

TECHNICAL REPORT

SYSTEM DESCRIPTION

MODERNIZED WEATHER TELETYPEWRITER COMMUNICATIONS SYSTEM

SUBPROGRAM NO. 233-001
REPORT NO. RD-66-21

Prepared by:

INTERSERVICE WORKING GROUP
ROBERT F. DECKER, CHAIRMAN

MARCH 1966

This report has been approved for General availability. It does not necessarily reflect FAA policy in all respects and it does not, in itself, constitute a standard, specification, or regulation.

John A. Weber

John A. Weber, Acting Director
Systems Research and
Development Service

Federal Aviation Agency
Communications Development Division
Systems Research and Development Service
Washington, D. C.

ABSTRACT

This System Description has been prepared by an interservice working group established by the Director, Systems Research and Development Service, and chaired by a representative of the Communications Development Division.

This document defines and describes a teletypewriter communications system designed to effect the collection and exchange of weather reports, forecasts and other related weather data on a national basis. It also provides for the exchange of data to and from overseas meteorological organizations. It is the primary digital data transfer system supporting the National Weather Services of the Weather Bureau, The Aviation Weather Services of the FAA and also provides a major support to the military weather services.

This design centralizes, consolidates and automates the message switching functions of the existing weather teletypewriter Services A, C and O within the Weather Message Switching Center (WMSC). It reconfigures circuitry and reschedules data distribution to more effectively meet users requirements. The WMSC is a solid state, real time, communications type, electronic data processor operating as a centralized store and forward message switch to automatically control and perform all polling, collection, storage, selection and redistribution functions related to the handling of weather and Notices to Airmen (NOTAM) message traffic carried by the system.

<u>TABLE OF CONTENTS</u>

CHAPTER PAGE

FIGURES

TABLES

1.0 INTRODUCTION

1.1 Basic Requirements

In its recent report on jet age planning the Agency has reaffirmed the view that: "Weather is, and will continue to be, a major factor affecting airspace and airport utilization". The FAA under close working agreements with the Weather Bureau has a major mission in providing aviation weather support to all aviation interests. The ultimate objective of all such support is to promote safe and efficient flight operations. It is apparent that to achieve this objective on a day-to-day basis, the best available weather intelligence -- presented in the most useable form -- must be continually available to pilots and air traffic controllers. Such weather intelligence comprising accurate, continuously updated observations of current weather conditions together with the best available forecasts of impending conditions is a prime requisite for operational decision making in air traffic management. Information of this type is essential to the selection and assignment of flight levels and tracks; the determination of fuel-payload ratios; the vertical and horizontal separation of individual aircraft; the rate at which terminals can accept and discharge aircraft; the avoidance of prolonged holding and abortive approaches with consequent diversion to an alternate terminal; the safety of aircraft landings; and the avoidance of severe weather conditions enroute. An unexpected delay of aircraft in the air, or delays feeding into the system, contribute to the difficulty of airspace management and the control of traffic, and to the economy (through increased fuel consumption) of the operation.

Weather systems are continually developing, moving, and changing in size and activity over the United States and the neighboring oceans and land areas. Each system whether large or small, simple or complex, fast or slow moving, vigorous or stagnant, presents a set of problems to forecasters and operational users which require immediate attention and resolution. To consider all the meteorological factors, it is necessary to maintain a constant watch of weather conditions over most of the Northern Hemisphere. Basically, this is done through a network of surface and upper-air observations which help to define the existing weather conditions on a three-dimensional scale. By analyzing these observations, taken simultaneously at thousands of locations including a high percentage of air terminals, a picture of the current weather in the form of maps and charts is produced.

It is not enough, however, to just measure air temperatures, pressures and other weather factors throughout the day. To be useful these weather measurements must be rushed to the forecasters and operational users before the weather has moved on and the information has grown stale. For aeronautical applications, updated observations are made at least every hour, and in rapidly varying conditions, every few minutes whenever significant changes occur. When the forecasts and warnings are made, they also must be rushed to the pilot. Therefore, we must have the fastest, high volume communications system that modern technology can produce, especially since the arrival of the jet-air age and manned space flight.

Ideally all data should be immediately available to all users within a very few minutes after its origination. Thereafter it should be updated regularly and frequently on a continuous basis.

The basic requirement for a weather communications system is, therefore one of providing for a massive inter-exchange of data on an instantaneous basis among thousands of stations which are frequently both sources for and users of weather information. It must draw on sources from over an area of hemispherical extent and serve custômers on a nationwide basis.

1.2 Design Considerations

The design problem is thus one of providing an economically practical approach to these impossible requirements. Any factor in the system which introduces delay of more than a few minutes in completing the total distribution of any product creates a serious performance deficiency. Likewise any factor which limits the number of reports or forecasts received by any user to less than full coverage of his area of operational interests, is also a serious deficiency in system performance. The seriousness of any such deficiency can only be broadly estimated. The delay or omission of "less important" data used only infrequently may on occasion figure heavily in a particular accident wherein the cost in money or lives may far transcend the cost of many other incidents in which "more important" data is involved.

The system design presented below is based on the concept of providing the best overall value for the money available, at a cost commensurate with the relative importance placed on the weather factor in the national economy. It does not pretend to completely satisfy all requirements for useful and desirable weather services. Rather it must meet requirements of a selective basis. Under these circumstances, it is quite probable that differences in opinion will exist as to which areas of interest should receive the greater emphasis. A certain degree of arbitrary decision is therefore involved in many features of the recommended design.

2.0 THE EXISTING SYSTEM

2.1 General

At present there are three essentially independent weather communications services which comprise the basic, civil, national weather digital communications system. These are designed as Services A, C and O.

Services A and C are domestic in extent. Each completely and independently covers the continental United States with a relatively dense network of multipoint circuits. Service O includes a number of overseas links entering the country at four principal gateway points. These are interconnected to a relatively less dense domestic network, for the exchange of data to and from overseas locations with selected United States weather offices. Figures 1, 2 and 3 depict the circuit coverage of these Services.

The relay and switching of messages between circuits on Service A is automated by means of the Automatic Data Interchange System (ADIS). This is an electromechanical system of somewhat limited flexibility for meeting growth and schedule change requirements. This network carries weather observational reports and forecasts of primary importance to aviation operations. It serves FAA Flight Service Stations and Air Route Traffic Control Centers, Weather Bureau Airport and Flight Forecast Centers, Airlines, Military Air Bases and many general public subscribers.

Services C and O employ manual switching and message relay methods. This involves the reperforation of paper tapes at relay points, the manual tearing of tapes to separate various data blocks and the retransmission of data to destination circuits. These methods are relatively slow, introduce errors and are also of limited flexibility and growth potential.

Service C carries meteorological data and data analyses of primary interest to meteorologist, climatologists, and hydrologists of the Weather Bureau, the military, airlines forecast offices and other special interests. It also carries all general public forecast products for widespread distribution by press, radio, and TV. However, it is not specialized to aviation, as is Service A, and few FAA offices require these products.

Service O carries a mixture of both types of data received from and distributed to overseas locations. It serves offices of the FAA, the Weather Bureau, the airlines, and through inter-service relays, the military weather and operations offices concerned with international air traffic. It also provides data of global extent for the broader scale analysis and forecasting functions of the Weather Bureau.

2.2 Configuration, Operation and Equipment

2.2.1 Service A (See Figure 1)

The present Service A network features automatic data relay among the various circuits which serve different geographic areas of the country. It is designated as the Automatic Data Interchange System or ADIS. The network is configured around five major Interchange Centers (I/C's) and 26 Send/Receive Centers (SR/C's) distributed throughout the U. S. Each major I/C controls 3 three-priority area circuits for a total of 15 area circuits in the system. Each of four I/C's additionally control 3 two-priority supplemental circuits, while the fifth I/C controls 2 such circuits. This is a total of 14 supplemental circuits for the system. Each I/C and SR/C controls another 2 or 3 local circuits, some of which are of dual priority and others are of single priority. This totals approximately 66 local circuits in the system. Priority levels in the above sense apply to the data selected for distribution to any one circuit from the high speed loop. The reports are sorted in groups of first, second, or third priority at the ADIS relay points and data in the higher priority group automatically pre-empts lower priority data during relay transmissions.

FEDERAL AVIATION AGENCY

EXISTING SERVICE A

Sept. 1965

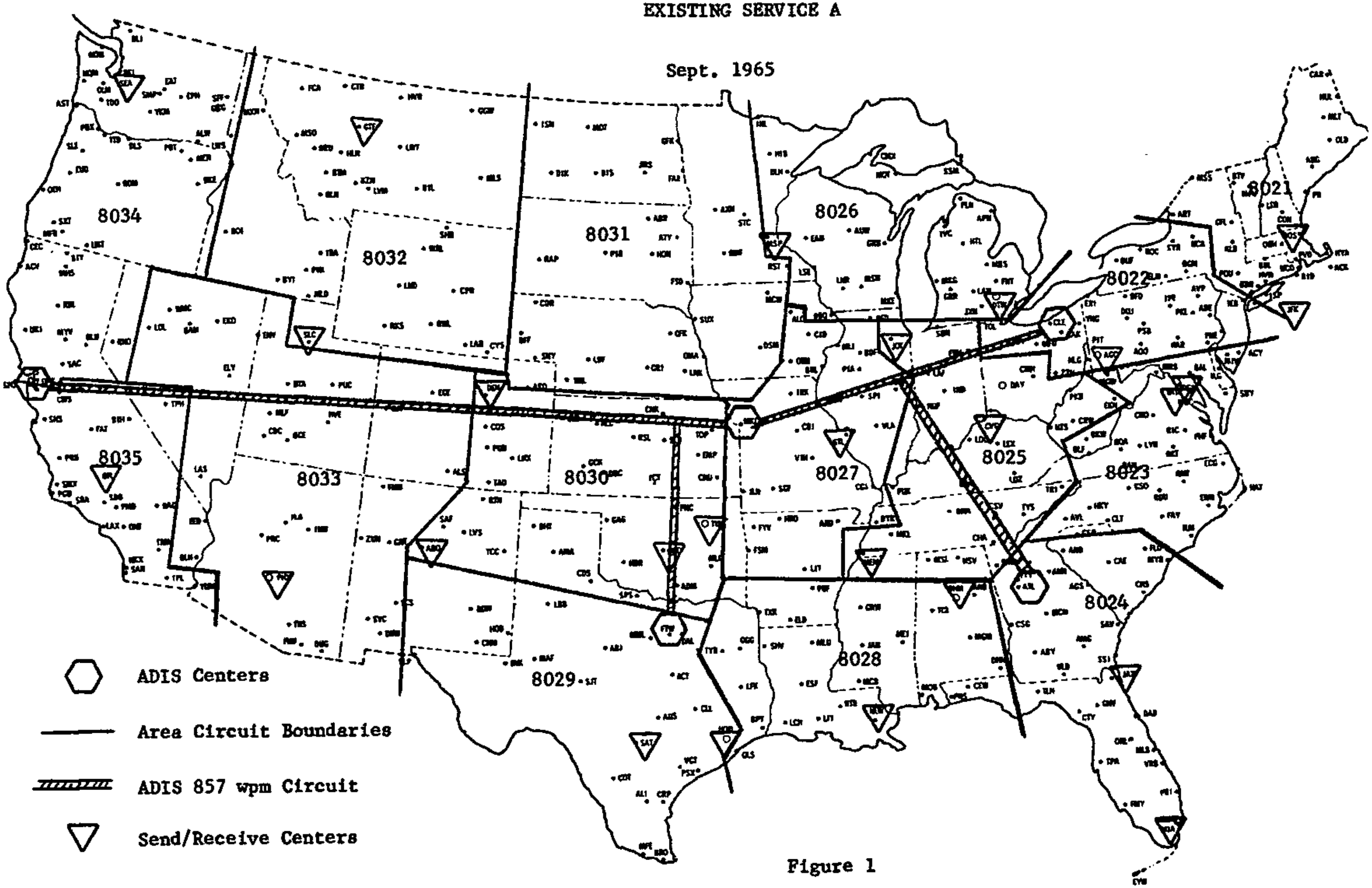


Figure 1

All area, supplemental and local circuits are multipoint, 100 wpm half duplex teletypewriter lines. Area circuits both collect and distribute data to and from their associated way stations. Approximately 30 to 40 Weather Bureau and FAA weather reporting points input data over each area circuit. Up to 150 or more users of all types, government, airline, civil, military, public, news services, etc., receive data over each area circuit. As shown in Figure 1 each area circuit covers a particular section of the nation.

Supplemental and local circuits operate as receive only circuits at the way stations. Supplemental circuits serve the same areas as the area circuits except only one Supplemental circuit covers the areas of circuits 8031 and 8032. Supplemental circuits serve much fewer users, primarily the larger Weather Bureau forecasting offices and larger airline offices. These users are also on the area circuits but require additional data over that which can be carried on the area circuits alone. Local circuits serve a similar purpose but extend only a short distance from the I/C or SR/C usually in the same city or to nearby airports. These primarily serve airline customers with special data requirements not fully met by the area circuits. Figure 1 includes the Send/Receive Center locations. Local circuits are not depicted as they do not extend between cities.

A single high speed (600 baud, 857 wpm) loop circuit interconnects all the I/C's and SR/C's. This circuit is used to accomplish inter-circuit relays and for the entry of certain data from forecast centers. It operates in the half-duplex mode.

All data collected on Service A is entered in response to polling calls initiated by automatic programming equipment. Both high and low speed programming units are used in the system for this purpose. The major data collection period on the low speed circuits begins each hour on the hour. Each circuit is automatically polled in parallel with all the others by the low speed programming units at each of the I/C's. Data which has already been manually punched onto tape and inserted in each way station's transmitter/distributor (T/D) by the local operator is automatically transmitted by the T/D upon receipt of the polling call. Data received sequentially from each station on a circuit is reperforated at the I/C onto a master collection tape for each circuit. The basic hourly sequence collection at the I/C's is completed in approximately 3-5 minutes, depending on the length of the weather reports. Master tapes are then available for relay over the high speed loop.

The transmission and reception of data on the high speed loop is automatically controlled by transceiving terminal equipment at the I/C's and S/RC's. This equipment consists of electronic receiving and transmitting distributors, multi-storage modules and other associated circuitry. The Kansas City I/C is designated as the primary net control statinn and Ft. Worth as the backup control station. At these locations Automatic Programming

Units/High Speed (APUHS) are provided to control the polling and scheduling on the high speed loop. Interchange Centers report to the Primary Control Center as each area circuit under their control completes its low speed collection. When a sufficient number of area circuit collections have been completed to insure a continuous flow of relayed data, the Primary Control Station initiates the high speed circuit poll. As each circuit is polled in the prescribed order, equipment at the I/C's recognize the call. Thus, the proper high speed transmitter is enabled permitting data to flow on the high speed line in the same order as it was originally collected. Data on the high speed line passes through every I/C and SR/C. Here Message Directors are used to select out all individual messages or message blocks required by the area, supplemental and local circuits served by the particular I/C or SR/C. Individual reports are selected by means of the regular station identifiers for each report. Message blocks composed of more than one report or other composite data are preceded by special diversion codes for this purpose. Up to 1100 different messages or message blocks may be identified by a Message Director. Message Directors are capable of diverting any selected messages to any one or combination of output reperforators (up to 12 for SR/C's or 24 for I/C's). These reperforators copy at high speed and punch continuous tapes of the selected messages directed to them. Data is divided into three priority groups for area circuit distribution and into two priority groups for supplemental and local circuit distribution. One reperforator is required for each priority group for each circuit. Reperforators feed low speed transmitter/distributors for each circuit, which automatically retransmit the selected data at 100 wpm. This continues as long as data is available and a scheduled collection action is not in progress. Priority one readout pre-empts priority two or three, etc.

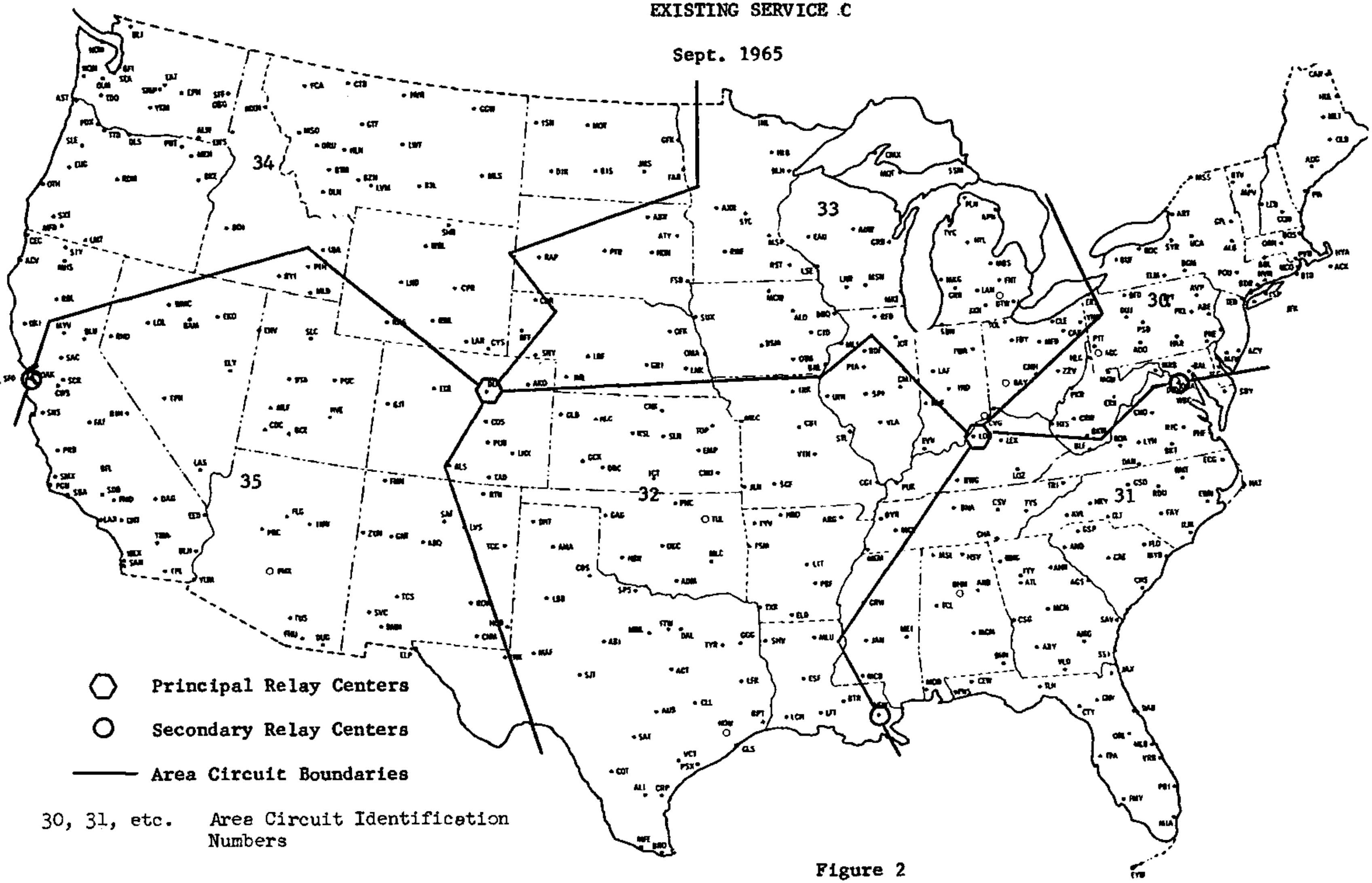
Thus, each circuit may receive a selection of data roughly tailored to its individual requirements with a limited degree of rearrangement possible on the basis of priority consideration.

Although automatic in operation, this equipment is electro-mechanical in nature and employs fix wired logic. The number of discrete diversion codes is limited to 1100, and the priority procedures tend to result in a random order of reports unless confined to the latter one half to one third of the high speed relay period. Thus the system lacks the required flexibility and expandability features necessary to readily and economically meet the ever changing needs of weather dependent operations.

FEDERAL AVIATION AGENCY

EXISTING SERVICE C

Sept. 1965



Principal Relay Centers

Secondary Relay Centers

Area Circuit Boundaries

30, 31, etc. Area Circuit Identification Numbers

Figure 2

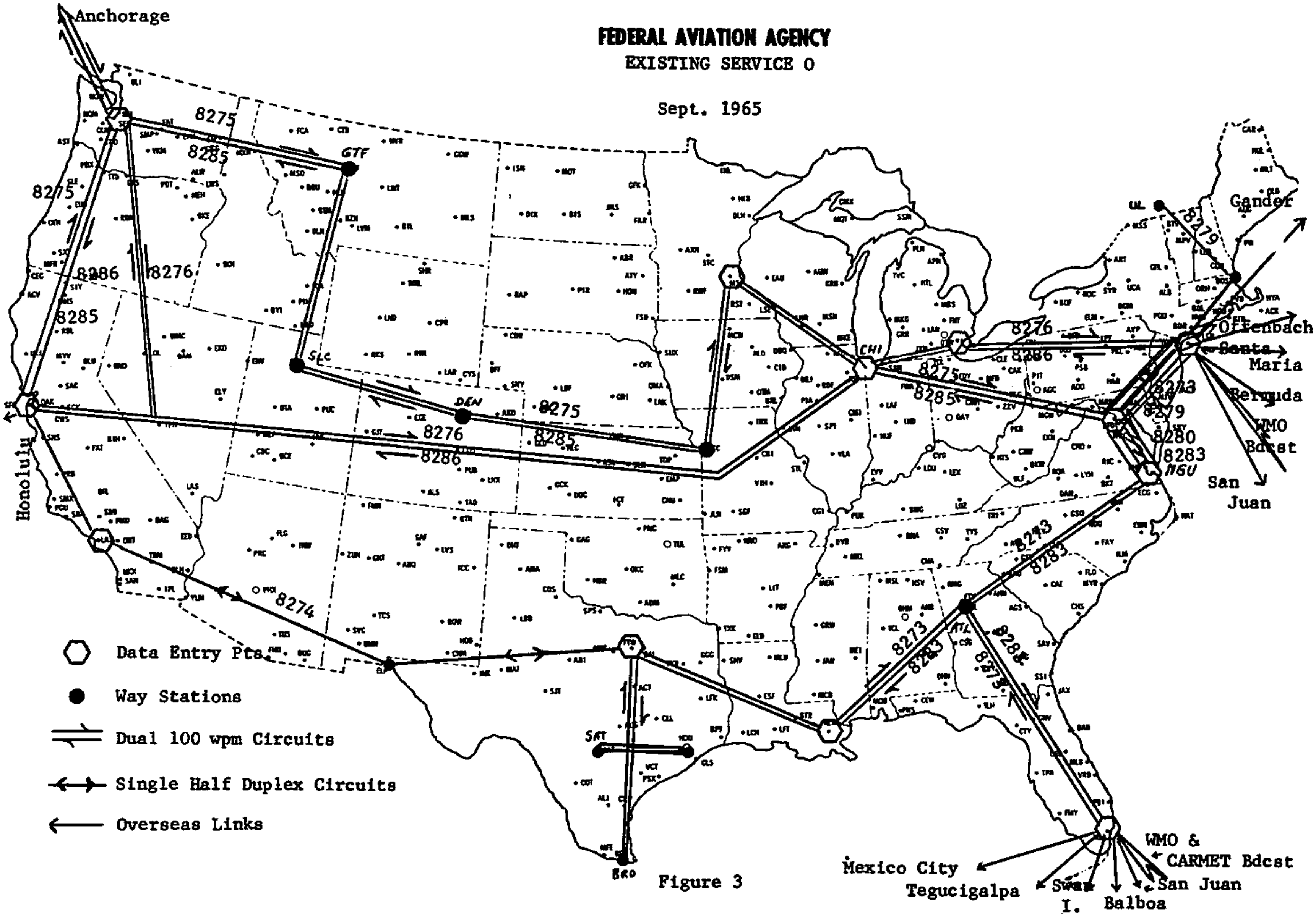

FEDERAL AVIATION AGENCY
EXISTING SERVICE 0
Sept. 1965
Anchorage
Honolulu
Gander
Offenbach
Santa Maria
Bermuda
WMO Bdcst
San Juan
Mexico City
Tegucigalpa
Swan I.
Balboa
WMO & CARMET Bdcst
San Juan
8275
8285
8286
8276
8274
8273
8283
8279
8280
GTF
SLC
DEN
CHI
NGU
SAT
BRO
Data Entry Pts.
Way Stations
Dual 100 wpm Circuits
Single Half Duplex Circuits
Overseas Links

Figure 3

2.2.2 Service C (See Figure 2)

The Service C network employs manual torn tape relay methods. It consists of six multipoint, 100 wpm, teletypewriter circuits which cover the U. S. Each circuit covers a particular section of the country in a non-overlapping pattern. There are two principal relay points, one in Denver, Colorado, the other in Louisville, Kentucky, each of which receives and retransmits data to four of the circuits, two of which are common to both relay centers. Data is both collected and distributed over these circuits, the multipoint way stations on each circuit receive all data on their circuit of origin at the time it is entered by the source stations. Data from the two central circuits, common to both relay centers are then relayed directly to the other four circuits by the relay points. Data from the two east coast and two west coast circuits reach each other thereafter by multiple relay via the two central circuits. One hundred word per minute reperforators, transmitter distributors and automatic polling equipment are the principal relay equipments used.

2.2.3 Service O (See Figure 3)

Service O consists of both domestic and overseas teletypewriter circuits. There are nine (9) multipoint landline circuits connecting data entry points within the conterminous U. S., Alaska, and Canada. All operate at 100 wpm. Six of these are major transcontinental landline circuits operating as three dual pairs, each pair covering a single route with two half-duplex circuits, each handling traffic on a one-way basis in opposite directions. Stations must have independent receiving equipment on each leg to receive all traffic on any one of these circuit pairs, as normally scheduled. Should one circuit of a pair fail, however, the other leg could handle traffic in both directions.

There are 7 point-to-point radio teletypewriter circuits operating out of the FAA Gateway IFSS's located at New York and Miami. These connect with various overseas points. Six of these operate at 60 wpm, one operates at 50 baud or 66 wpm. Cable circuits operate at 100 wpm between San Francisco and Honolulu and New York and Offenbach, Germany. Another cable link operates at 60 wpm between New York and Bermuda, and a 75 wpm landline teletypewriter link from New York to Gander carries some weather data intermixed with Aeronautical Fixed Telecommunications Network (AFTN) traffic. Additionally there are three radio teletypewriter broadcasts at 60 wpm, two from Miami and one from New York. A final 66 wpm radio teletypewriter circuit connects San Juan, St. Thomas and St. Croix. There is some additional circuitry of a local or specialized nature not specifically covered in the basic Service O schedules. These are utilized at the gateway points for data exchanges related to editing or they serve to pick up additional data from various miscellaneous sources. Data relays among all Service O circuits are accomplished at the Gateway Stations by manual, torn tape procedures. Equipment is similar to Service C except there is no automatic polling.

2.2.4 Operating Schedules

Detailed operating schedules and data distribution lists for Services A, C and O are contained in the following FAA, Air Traffic Service Handbooks:

a.	Service A Weather Schedules	AT P 7330.2A
b.	Service C Weather Schedules	AT P 7330.3A
c.	International Weather Schedules Service O	AT P 7330.4A

2.3 Deficiencies of the Present System

The principal deficiencies of the present system, which will be substantially reduced or eliminated by the new design, are in the areas discussed below:

a. Data Volume.- The total data volume required to meet the operational needs of weather users is continually expanding. New types of observational data are frequently introduced, some growth in reporting locations occurs from time to time, and weather output products in the form of new analyses and specialized forecasts grow steadily. In the case of Service O, new reporting areas at overseas locations are established, areas of sparse reporting become more densely covered, or new types of data are introduced into the system.

The existing communications services are approximately 30% behind at present in meeting the total volume capability required and are falling further behind. This is due in part to the repeated deferment of previously proposed weather communications expansion programs in favor of broader interagency coordination efforts and program proposals which have not materialized into substantive improvement projects. Although the volume requirement could be met by adding essentially more of the same type of facilities used at present, the inherent capability of these facilities to meet further changes in a flexible, efficient and effective manner is severely limited, and the costs for Service A alone would exceed present program estimates for the total system. The timeliness and selectivity criteria discussed further below would also be severely compromised if this were done.

b. Timeliness.- Timeliness is a prime requisite in the exchange of weather data. No more than a few minutes can be tolerated between the generation of any weather measurement, observation or derived product and its delivery to all users without seriously reducing or completely destroying the value of the data.

Although no system within economic reason can really meet the timeliness criteria in full measure, the present system lags far behind the levels which are now feasible under present technology. Substantial speedup in data handling is therefore an important objective of the new system design.

c. Selectivity.- Selectivity is closely related to the above factors. Indeed, all three factors are closely interrelated. A deficiency in one is reflected as a deficiency in each of the others and an improvement in one automatically improves the others.

Each user has a specific range and quantity of data required for his particular application. In the present system, a collection of individual reports must be grouped together and treated as a single package during the distribution of relayed data. This is necessary because of the lack of capability to handle a large variety of individual items on a separate basis. The items contained in these relayed groups cannot be easily rearranged into different orders of transmission. Thus many users on multipoint circuits must receive unneeded data and/or lower priority data before receiving higher priority data. The ability to select, tailor and rearrange the transmission order of the data rapidly and frequently from circuit to circuit and minute to minute is a further essential requirement of the new system design.

d. Cost Benefit.- For the service provided the costs to operate and maintain the present Services A, C & O are high. New equipments, techniques and tariffs make it possible to replace those systems with a system that can provide greatly improved service and still achieve a substantial savings in operating costs.

The system design described in the following chapter is therefore engineered to overcome the above deficiencies of the present system and provide the flexibility and expandability features required to keep abreast of expected changes over the next several years.

3.0 THE IMPROVED SYSTEM

3.1 General Design

The improved system will combine all the message switching and relay functions of Services A, C and O into one major center. The circuit control and message switching functions will be performed automatically by an electronic computer operated as a real-time communications message switch. A major rearrangement of circuit configuration is also being made. In particular all A & C circuits will be extended directly into the computer center under Telpak Trunk Tariffs. Certain of the Service O radioteletypewriter or cable circuits from overseas points will pass through a planned AFTN switch to be collocated and interconnected with the A, C & O switch. Other Service O circuits will extend directly to the weather message switch. Various 3 KC links for direct computer to computer data exchanges are also planned. These will extend between the weather switch and the National Meteorological Center at Suitland, Maryland, and between the weather switch and the Air Force Weather Relay Center at Tinker Air Force Base, Oklahoma. Provisions are also being made to accommodate additional computer-to-computer links to connect with other central switches if required. Possible requirements are with the Canadian Meteorological Service, with Aeronautical Radio, Inc., the telephone company, and others.

With one major switching center, data distribution procedures become more flexible and data from the three Services A, C & O may be easily intermixed over a single line when desirable to do so. However, collection functions will continue to be organized primarily in terms of A and C types of data. Data collected within the 48 States for overseas circuits will be collected as A or C data. Figures 4 thru 11 are typical of the circuits planned for the new system. Exact configurations are not firm at this time and are subject to change as requirements vary and design work continues up to the time of implementation. Circuits are further identified and described below.

3.2 Circuit Configuration

3.2.1 Service A Area Circuits

Figure 4 illustrates the Service A area circuits used for the collection and partial distribution of domestic Service A type data. These are half-duplex, 100 wpm, landline teletypewriter circuits each serving a particular section of the country. Approximately 35 circuits are planned for this function. The exact number of circuits for the system is not critical to the central switch design or to system operation. It will be subject to revision as necessary during the life of the system. WMSC capacity and programming structure is being designed to accommodate a wide range in the numbers of circuits by simple programming changes. The order of magnitude of the total circuit capacity of the WMSC is approximately 300 to 400, 100 wpm circuits and 15 high speed circuits.

The Service A area circuits are configured so that approximately 10 to 15 hourly observations will be collected per circuit and 175 to 180 reports will be routinely distributed. The circuits will provide the basic A data

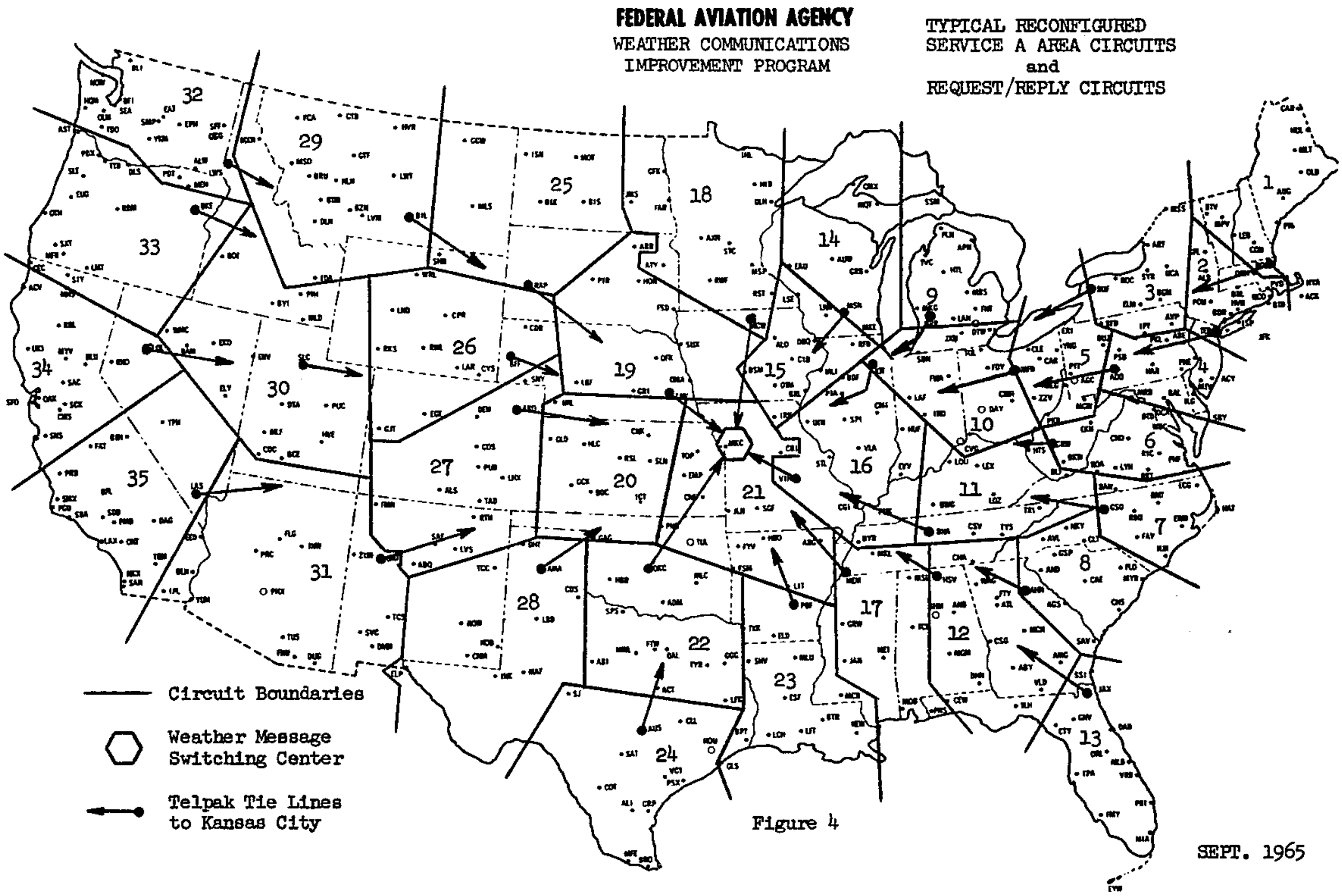

FEDERAL AVIATION AGENCY
WEATHER COMMUNICATIONS
IMPROVEMENT PROGRAM
TYPICAL RECONFIGURED
SERVICE A AREA CIRCUITS
and
REQUEST/REPLY CIRCUITS
Circuit Boundaries
Weather Message
Switching Center
Telpak Tie Lines
to Kansas City
SEPT. 1965

Figure 4

TYPICAL RECONFIGURED
SERVICE C CIRCUITS
AREA & FORECAST CENTER

FEDERAL AVIATION AGENCY

WEATHER COMMUNICATIONS
IMPROVEMENT PROGRAM

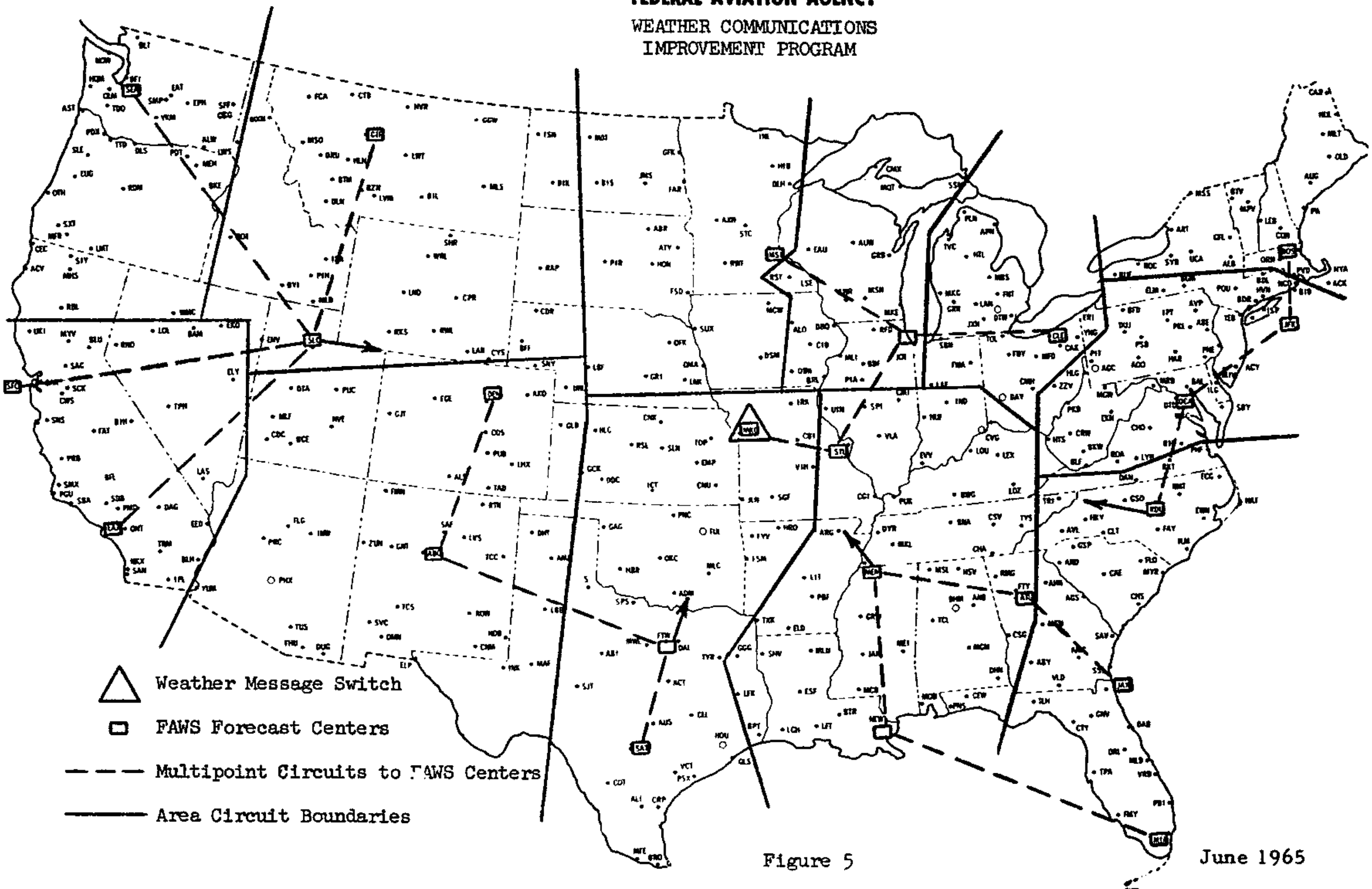


Figure 5

June 1965

required within each circuit's area and will meet the routine requirements of the smaller FAA and USWB users. This will permit the completion of all hourly report collections within 2 minutes and the completion of all hourly report distributions within 20 minutes over 100 wpm circuits. Each circuit extends directly and individually into the WMSC. Circuit mileage between the center and the nearest point of connection on any circuit will in general be covered by Telpak tariffs applicable to trunks composed of many other government circuits. Thus, trunk rates are available without the necessity of organizing a trunking system among the weather circuits themselves.

3.2.2 Service C Area Circuits

Figure 5 illustrates similar 100 wpm, multipoint, half-duplex area circuits for the collection and major distribution of Service C type data. Operation is similar to the Service A circuits but with larger areas of coverage, fewer numbers of circuits, more sources and recipients of data per circuit, and with the principal collection cycles on three and six hourly bases rather than hourly. Approximately 12 circuits are planned at present. This will speed up data collection and distribution over these circuits as compared to present day operation. More important in this case, however, is the elimination of manual torn tape switching procedures of the present Service C. These circuits also extend directly to the WMSC under Telpak tariffs.

3.2.3 FAWS Point-to-Point Circuits

Figure 6 illustrates the 32, 100 wpm, half-duplex point-to-point circuits to the Flight Advisory Weather Service Offices (FAWS) of the Weather Bureau. These major aviation weather forecast offices require larger amounts of data than most other types of using offices. They also originate a variety of forecast and advisory products which must be transmitted to the Center in a timely manner. All FAWS products will be collected by the WMSC over these circuits and Service A type data supplementing the regular area circuit will be distributed to the FAWS offices by the Center. The FAWS offices will normally have drops on the local area circuits for both A and C data in addition to the point-to-point circuit. In some cases a few other government users in the vicinity of the FAWS offices may be provided drops on these circuits where their requirements closely match those of the FAWS. In particular NAS ARTCC computers will be fed selected data from these circuits. Data destined for the NAS computers will carry a special diversion code for automatic selection and reception by the computer. In many cases FAWS offices are located in the same city as the ARTC Centers and short branch circuits will suffice. In a few cases extensions to another city will be required. Data content of these circuits will be principally dictated by FAWS requirements. In some instances where the NAS computers may need additional items they will be included.

FEDERAL AVIATION AGENCY
WEATHER COMMUNICATIONS IMPROVEMENT PROGRAM

TYPICAL NEW
FAWS & SUPPLEMENTARY
CIRCUITS

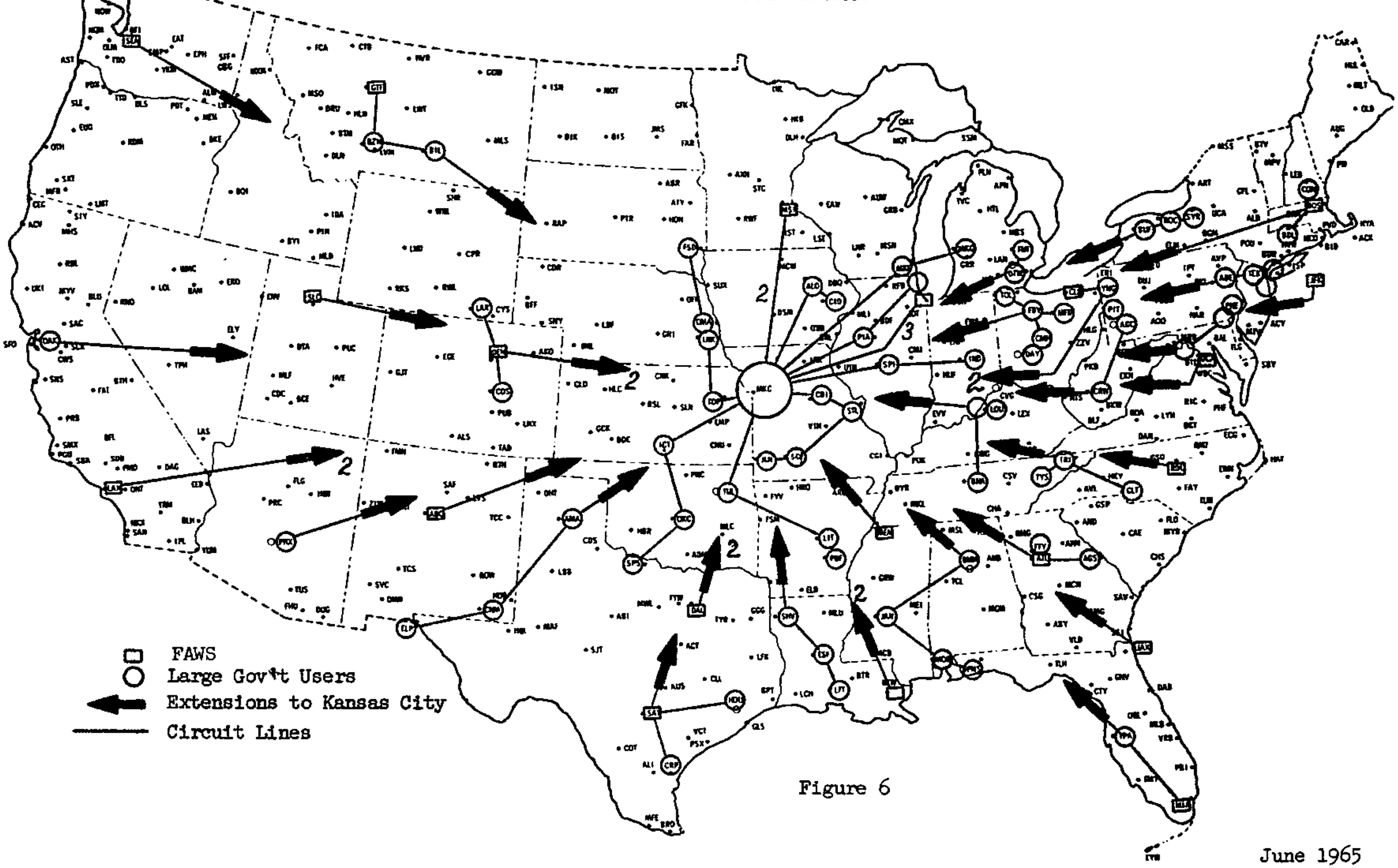


Figure 6

June 1965

2○ = Number of High Volume Users

FEDERAL AVIATION AGENCY
WEATHER COMMUNICATIONS IMPROVEMENT PROGRAM

TYPICAL CIRCUITS FOR HIGH VOLUME NON-GOVERNMENT USERS SERVICE A DATA

E

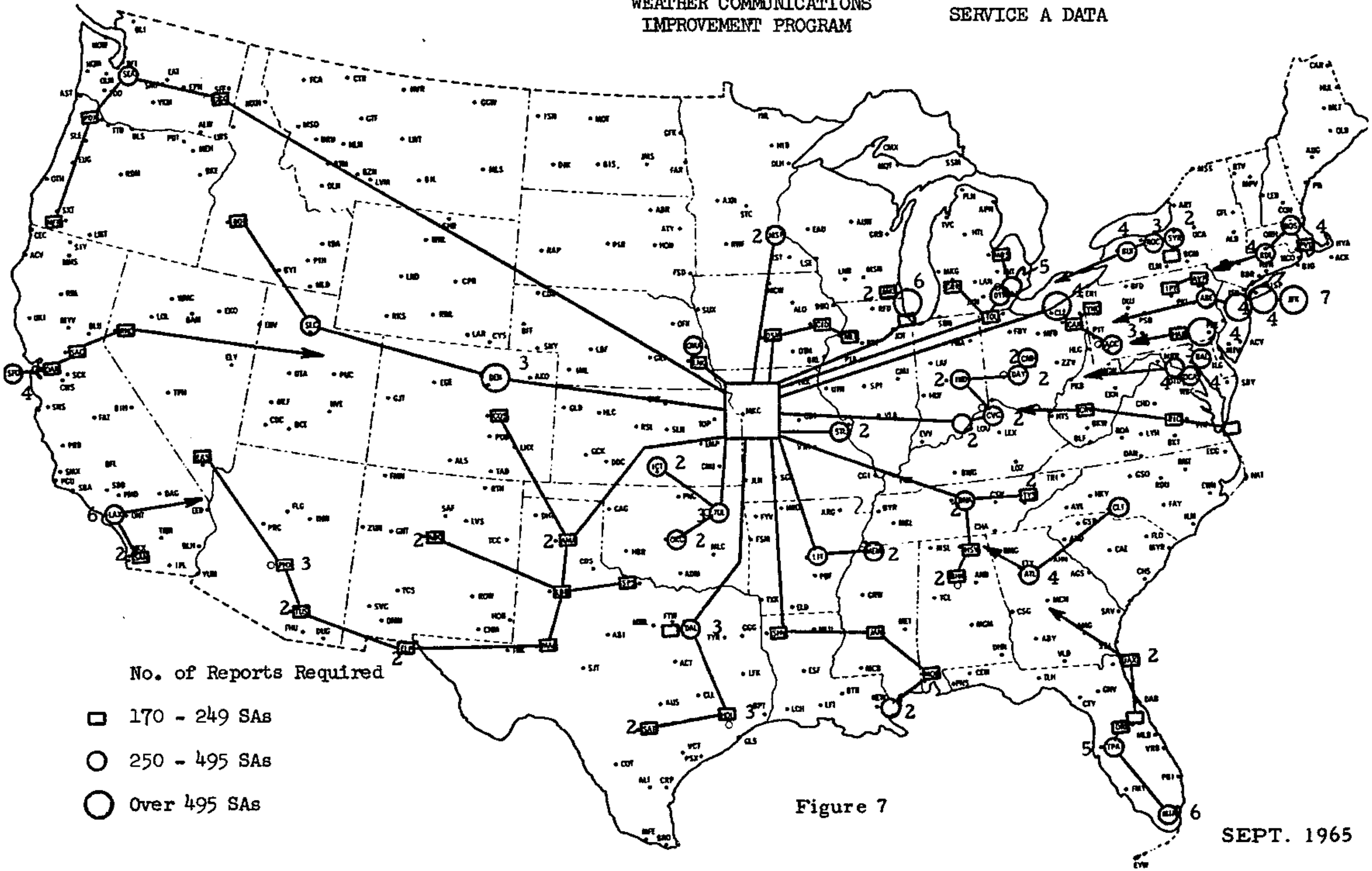


Figure 7

SEPT. 1965

3.2.4 Request/Reply Circuits

Figure 4 also illustrates the 35 request/reply circuits planned for initial operation. Since the request/reply feature is a new and untested mode of operation, these circuits are subject to considerable revision both as to number and coverage as experience is gained. These are 100 wpm, half-duplex, multipoint circuits, each of which is presently planned to have the same coverage as a corresponding Service A area circuit. No meteorological data is collected on these circuits, the input to the switching center will be only the request messages received from the way stations. Data will be distributed from the WMSC in response to these requests. Requests will be limited, in initial operations, to selected hourly observational reports, not received by the requesting station on routine distribution circuits. This will be data required on a relatively infrequent basis by the requesting station. Depending upon the circuit loading experienced during this mode of operation, the request capability may be extended to other types of messages. By a modification of present way station stunt boxes, or their replacement by more advanced models, the printer of those other users on the request/reply circuits which are not awaiting a reply can be placed in suppression. The switching center equipment will have the necessary capability to perform this function, but it is not planned for implementation in the initial system operation.

3.2.5 State Forecast Center Circuits

Figure 5 also depicts the 4, 100 wpm, auxiliary, multipoint, half-duplex circuits to the 22 Weather Bureau State Forecast Centers. These circuits will carry Service C type data to and from the State Forecast Centers, which are in general located in the same city as the FAWS offices who will also have drops on these circuits. Four or five cities will be served by each circuit.

3.2.6 Supplementary Circuits to High Volume Government Users

Figure 6 also depicts the 100 wpm, multipoint, distribution only circuits serving large volume civil government users. No data will be collected by the Center over these circuits. In general, data on these circuits will supplement the data carried on the regular area circuits or will provide specially tailored distribution to a certain class of user.

3.2.7 Supplementary Circuits to High Volume Non-Government Users

Figure 7 shows similar 100 wpm distribution only circuits to non-government users, principally airlines. There are approximately 59 circuits for this purpose. These provide supplementary or specially tailored distributions to users with requirements for over 170 hourly observations (SA's). Requirements grouping are shown by the legend.

FEDERAL AVIATION AGENCY
WEATHER COMMUNICATIONS
IMPROVEMENT PROGRAM

TYPICAL SUPPLEMENTARY
CIRCUITS FOR MILITARY
USERS

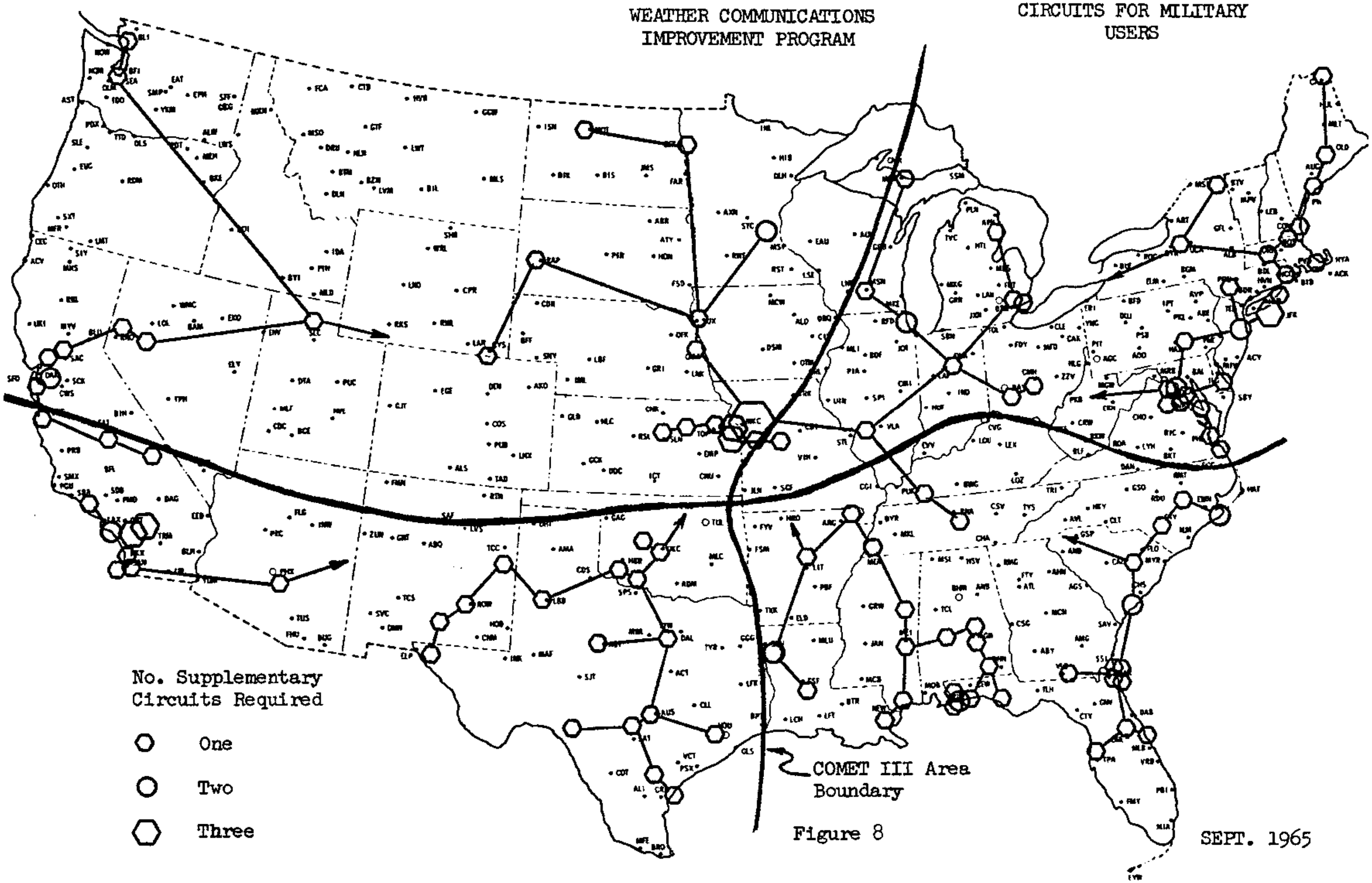


Figure 8

SEPT. 1965

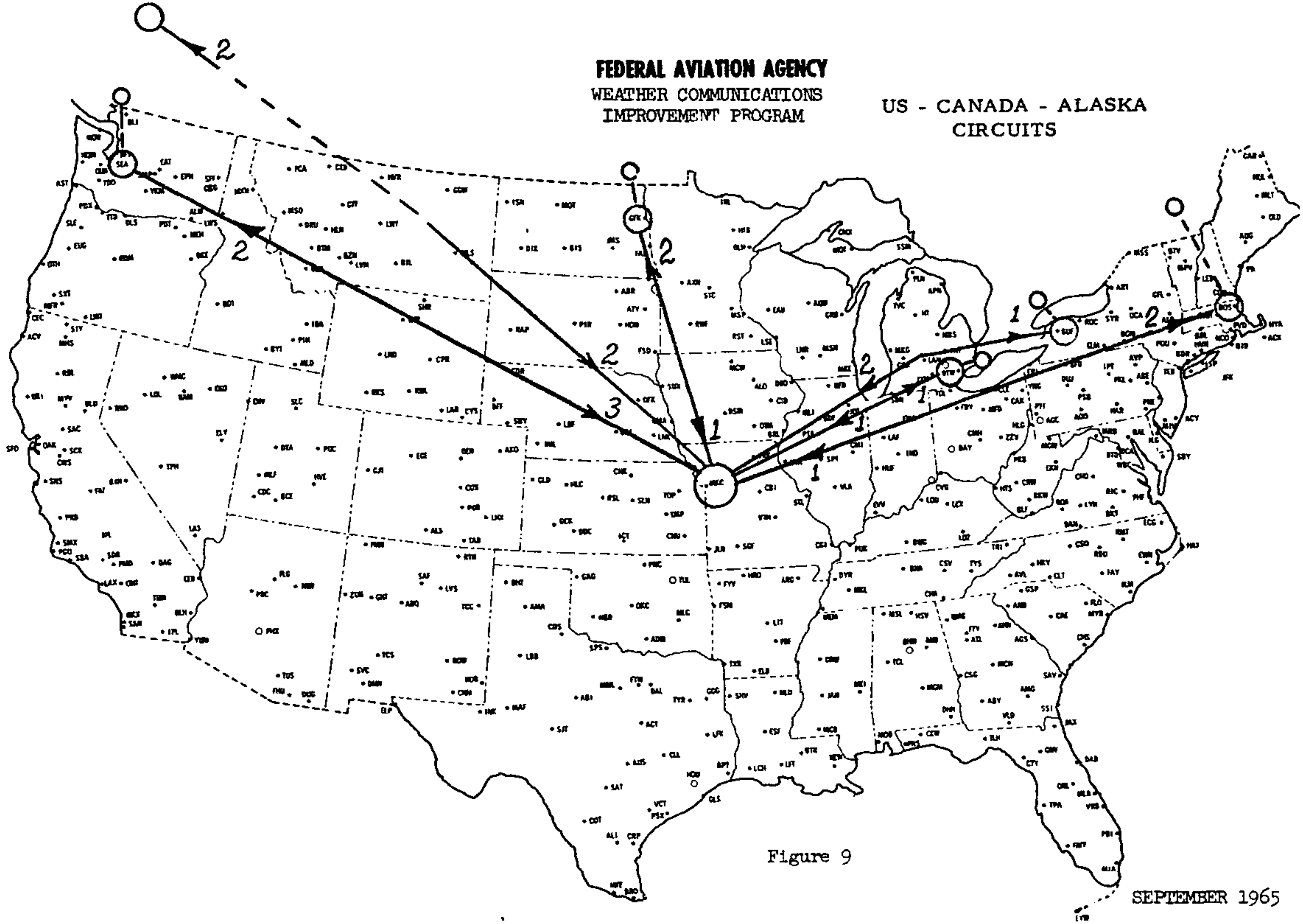


Figure 9

SEPTEMBER 1965

3.2.8 Supplementary Circuits to Military Bases

Figure 8 covers the supplementary circuits to the military bases. Stations shown are only those whose requirements for hourly observations exceed 170 reports. Other military bases will receive their requirements on regular area circuits. Also shown are the existing Military Comet III area boundaries. These distribution only circuits may be served by the WMSC if appropriate agreements are completed with the military. These circuits carry Service C and Service O type data.

3.2.9 Canadian and Alaskan Links

Figure 9 shows the 100 wpm links between the WMSC and Alaska and Canada. To receive "A" data from Canada all four legs of two of Canada's full duplex circuits will be extended to the switch. Four distribution only circuits will deliver to Canada the U. S. "A" data which they require. Service C data will be exchanged on 8 unidirectional circuits. Exchange of data with Alaska will be accomplished by extending the two half-duplex Alaskan area circuits to the switch. The WMSC will extract from the Alaskan and Canadian circuits all messages that are required for distribution on any of the circuits served by the switch.

3.2.10 Overseas Circuits and Domestic Links

Figure 10 covers the Service O circuit requirements. Service O circuits are being configured in two phases. This is due to the implementation of the Aeronautical Fixed Telecommunications Network (AFTN) Switch which is scheduled to commence operation prior to the A, C and O Switch. Figure 10 depicts the final phase only.

3.2.10.1 Phase I

The five radio teletypewriter, landline and cable circuits currently entering the New York area, with the exception of the New York to San Juan radio link, will be extended over landline Telpak Trunks to the AFTN Switch. The San Juan to New York link will be discontinued. Data now carried on this link will be entered in a new cable circuit from San Juan directly to the AFTN Switch. In the Miami area the present radio circuits from Tegucigalpa, Swan Island, Balboa, and San Juan will be consolidated at Balboa and San Juan into the required number of 100 wpm cable channels. These will be included in two submarine cables being activated, one from each of the latter two locations and extending directly into the AFTN Switch. The Mexico City high frequency radio circuit will be converted to 100 wpm landline/microwave operation and likewise extended directly to the AFTN Switch. The required number of landline teletypewriter 100 wpm circuits in Telpak Trunks will be provided between the AFTN Switch and the New York

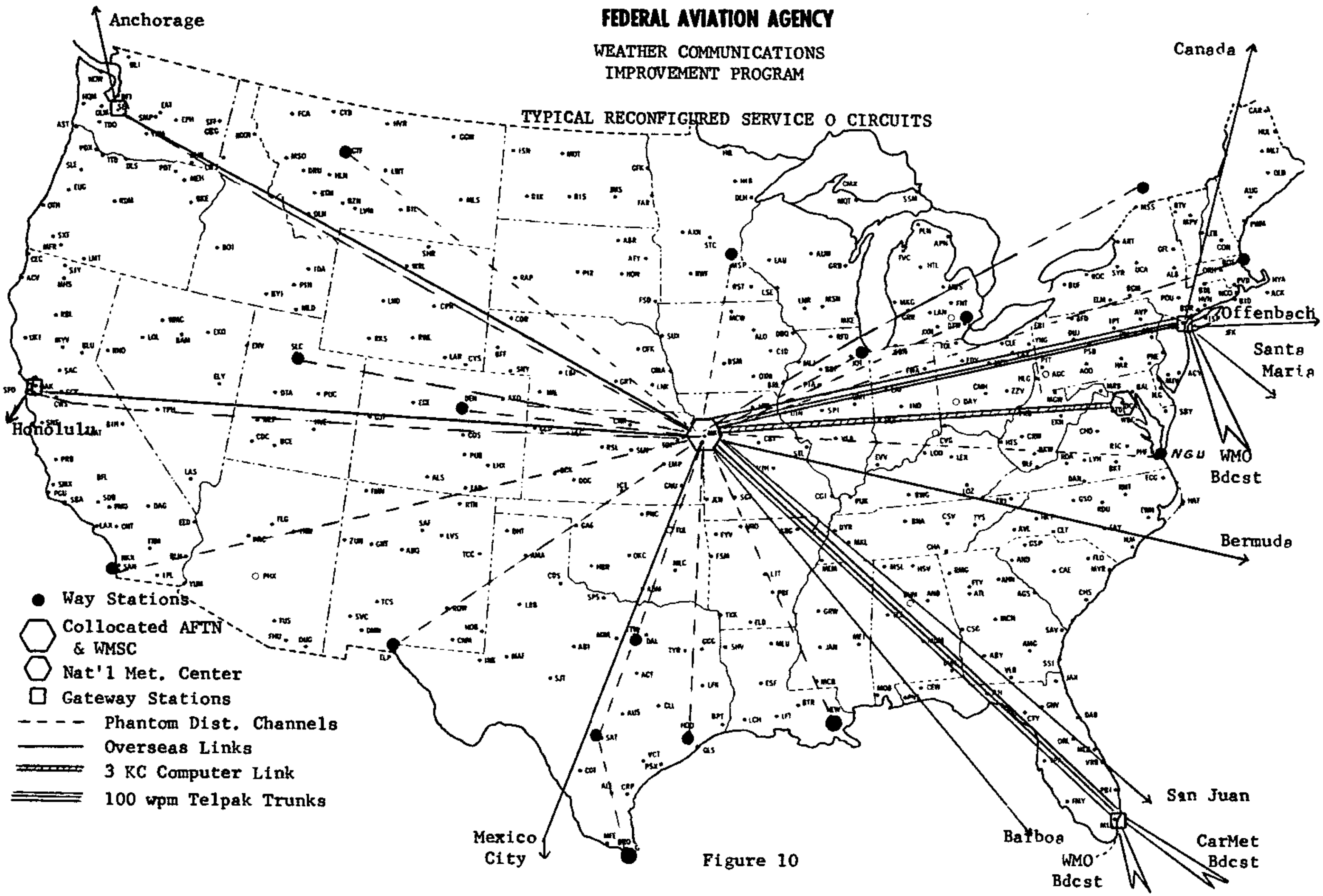

FEDERAL AVIATION AGENCY
WEATHER COMMUNICATIONS
IMPROVEMENT PROGRAM
TYPICAL RECONFIGURED SERVICE O CIRCUITS
Anchorage
Canada
Offenbach
Santa
Maria
WMO
Bdcst
NGU
Bermuda
San Juan
CarMet
Bdcst
WMO
Bdcst
Balboa
Mexico
City
Honolulu
Way Stations
Collocated AFTN
& WMSC
Nat'l Met. Center
Gateway Stations
Phantom Dist. Channels
Overseas Links
3 KC Computer Link
100 wpm Telpak Trunks

Figure 10

and Miami areas. These will remotely key the WMO Broadcasts from New York and Miami and the Caribbean Meteorological Broadcast (CARMET) from Maimi. A complete, prepackaged distribution list of data for these broadcasts will be assembled by the switch from overseas and domestic sources. Any code or format conversions or message subdivision will be accomplished by the AFTN Switch. This will be done automatically insofar as practical. Where necessary, the switch will divert undecipherable data to a position where this function can be accomplished manually. Other circuits in this group will deliver to the New York and Miami areas selected data from the incoming overseas circuits which are required for local use at these locations. The switch will in turn receive over these circuits the data generated locally by New York and Miami which is required for inclusion in the meteorological broadcasts and for distribution over the domestic Service O circuits that will be served by the switch. Drops on Service A and C circuits will also be extended to the AFTN Switch to provide the necessary A and C data inputs required for assembling the meteorological broadcast packages and for various international exchanges. The Service O domestic circuits 8273, 8283, 8275, 8285, 8276, 8286, and 8279 will be connected directly into the AFTN Switch (not shown in Figure 10). All data previously entered on these circuits by New York and Miami will now be entered by the switch. Data entered on these circuits at other locations, the remainder of the Service O domestic circuits and the San Francisco to Honolulu link will operate in their present configuration and mode.

3.2.10.2 Phase II

With the activation of the WMSC, these circuits will terminate directly in the weather switch. The San Francisco to Honolulu circuit will also be extended directly to the WMSC. All input from overseas locations will then be available at WMSC and all storage and switching of meteorological data will be done by this Center.

All inputs generated locally by the U. S. forecast centers that presently enter data into the Service O system will be collected over the links from the computer center to the forecast centers as previously described for Services A and C data. All domestic observational data needed for export will be collected on previously described area circuits. These data will be transmitted to the overseas circuits by the WMSC. Any changes in format required for this distribution will be accomplished at the center. Both automatic and some manual operations will be required to accomplish this function. Present indications are that all distribution of data to the U. S. locations currently on Service O circuits can be accomplished over the multipoint distribution circuits from the center previously described. These are shown as dotted lines on Figure 10 since they would already exist for other distribution purposes and O data would be merely added to them. These circuits would carry a combination of C and O and possibly some A type data. However, circuit mileage equivalent to the present Service O domestic circuits has been retained in the cost estimates since this

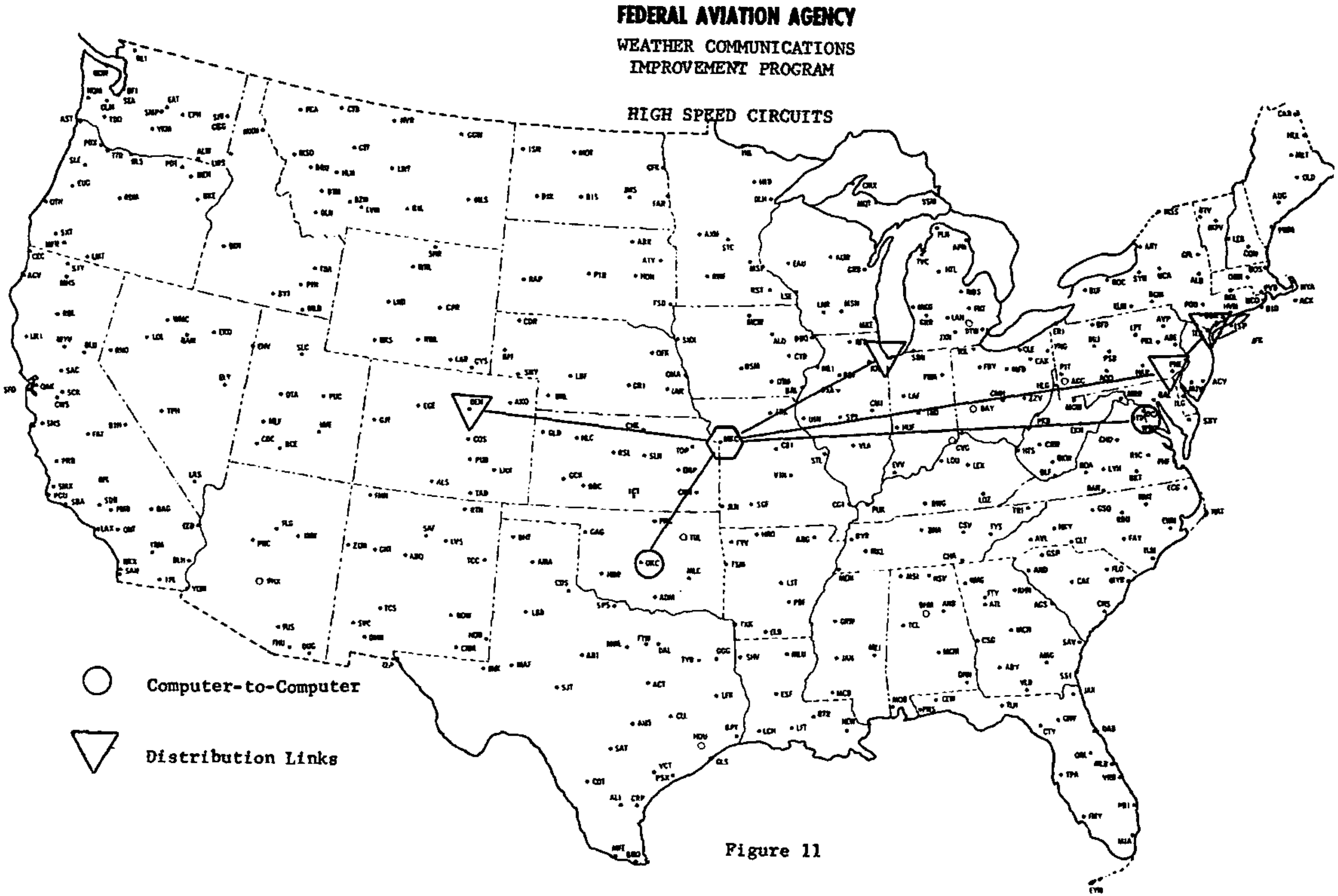

FEDERAL AVIATION AGENCY
WEATHER COMMUNICATIONS
IMPROVEMENT PROGRAM
HIGH SPEED CIRCUITS
Computer-to-Computer
Distribution Links

Figure 11

feature is not yet firm. Data for all circuits and meteorological broadcasts from New York and Miami will be selected, arranged in proper sequence and transmitted by the WMSC to the radio transmitting facilities.

3.2.11 High Speed Links

Figure 11 illustrates the high speed (1200-2400 baud) computer-to-computer links. These include circuits from the Weather Switch to the National Meteorological Center, Suitland, Maryland, and to Tinker Air Force Base. These circuits may be either full or half-duplex depending upon total data requirements and may be simply converted to either mode as necessary. In general, all data collected by the A, C & O networks will be programmed to Suitland in such order and with such data selection as may be specified by the Weather Bureau. Products generated by the National Meteorological Center for distribution to A, C & O users will be delivered on a scheduled basis to the weather switch over this link. The link to Tinker Air Force Base will deliver all A, C & O data required by the Air Force Global Weather Center at Offutt Air Force Base and for the Navy Forecast Center at Monterey. Also any A, C & O data to be distributed by the Air Force over their weather communications circuits would be exchanged over this link. Overseas data received by the Air Force over various military links, required for distribution over the civil system circuits that may be established to meet the military Comet III requirements, will be transmitted to the weather switch over this link.

It is planned that additional high speed circuits may be phased into operation at some future time to serve very high volume users. This is dependent upon the availability of economical and reliable high speed printers and upon the nature of the requirements changes which may occur. Figure 11 therefore depicts three potential circuits of this type in addition to the computer-to-computer links described above.

3.3 Circuit Mileage

Table I provides comparative circuit mileage figures, for the existing and the improved system. Figures are illustrative of the order of magnitude required for the improved system. The specific circuit connections are not as yet fully determined and are subject to continuously changing requirements. The WMSC hardware and operational programs are sufficiently flexible to permit easy adjustment to last minute requirements within a few weeks of its operational activation. Circuit connections will be updated as required during the period before activation of the WMSC.

TABLE I

CIRCUIT MILEAGE CHART

Service A	Existing System		Improved System	
	No. of Circuits	Mileage	No. of Circuits	Mileage
100 WPM Circuits				
Area	15 }	62,908	35	64,440
Supplementary	14 }			
Civil Government	Combined in above		25	19,000
Non-Government	Figures		59	45,400
Military	none	none	16	26,730
Local	66	6,520	none	none
Request/Reply	none	none	35	45,125
FAWS Point-to-Point	none	none	32	28,800
Canadian Links	*	*	8	7,500
Total	95	69,428	210	231,995
High Speed Circuits				
ADIS Loop	1	9,476	none	none
Computer Links	none	none	3	2,010
Total High Speed	1	9,476	3	2,010
Grand Total Service A	96	78,904	213	234,005
Service C				
Area Circuits	6	34,200	12	40,600
Supplementary to Forecast Centers	none	none	5	8,800
Canadian Links	*	*	8	7,500
Total Service C	6	34,000	25	56,900
Service O				
Domestic Circuits	9	28,322	9	29,822
Grand Total for System	111	141,226	247	320,727

NOTE:
*Data relayed to U. S. Circuits by U. S. border stations having drops on both Canadian and U. S. circuits

3.4 Data Collection and Distribution Lists

Data collection and distribution lists are being prepared from requirements data received from a field survey. The survey was conducted in the Spring of 1964 and included data from all civil and military governmental users and from many commercial and industrial users, particularly the airlines.

Specific lists are not available at the present time and, due to the constantly changing nature of requirements and data availability, will always be of a fluid nature. Computer programming is being designed to permit easy adjustment at any time. Lists for initial operation will be firmed up during the last few months preceding system activation. Working lists for initial coordination and adjustment will be available in the Winter and Spring of 1965-1966.

In general, stations are being assigned to circuits to take maximum advantage of any similarities in requirements among stations on any one multipoint circuit. Circuit mileage considerations are also a significant factor in the grouping of stations on a circuit. Distribution lists will then represent the combined totals of the essential requirements of the users on the circuit. Distribution over area circuits will be tailored to the requirements of FAA and Weather Bureau users only. Other users will be given drops on these circuits when they are reasonably compatible with the requirements determined on the basis of the above. All other requirements will be met by the various supplemental distribution only and request/reply circuits. Major users, such as forecast centers, will have essentially dedicated circuits of their own. Other users will again be grouped on multipoint circuits in accordance with requirements compatibility and reasonable geographic relationship criteria.

3.4.1 Message Statistics

Message types, lengths, cycle times and number in the system at any time are summarized in Tables II, III, IV and V. A typical schedule of the types, numbers and timing of messages on the Service A circuits is given in Figures 12 and 13. Schedules for Service C and O data will be generally similar to those presently published in the manuals for these Services.

3.5 Message Switch

3.5.1 General

The Weather Message Switching Center is a high speed, general purpose, digital, solid state, stored program data processing system. It includes the following basic components:

a. Computing, memory and input/output elements

b. External equipment interface adapters

c. Bulk storage units

d. Magnetic tape drives and control units

e. Card Reader and Card Punch

f. High Speed Printer

g. Monitoring and Supervisory Consoles

h. Power Supply Units

i. Off-line Test Equipment

j. Real-Time Clock

Figure 14 illustrates the computer configuration in block diagram form.

The system features modularity in design and construction. It is capable of expanding independently in input/output transfer capability and operating speed, computing capacity and effective speed, and active shared memory capacity. Modularity also provides an important fail soft capability. Failure of single active modular units of any particular type either alone or simultaneously with modules of other types do not completely incapacitate the system. Redundant modules for the various types will automatically maintain full service capability under the vast majority of failure situations. If multiple failures use up available spares, the modularity in the active elements still provides for a substantial percentage of full capacity operation using less than the full complement of active elements. The possibility of simultaneous failures of sufficient active and redundant modules to completely disrupt system operation is thus extremely remote.

Redundant memory capacity is provided such that in the event of a memory module failure any data stored in the failed element required to maintain normal operation is available under program control from another source.

TABLE II

SUMMARY
FOR
SERVICES A, C AND O

Service (1)	Number of Message Types[2]	Number of Messages[3]	Number of Terminals	Total Characters
Service "A"				
Schedule Operation	11	2013	(4)	326,000
Nonschedule	9	1114	(4)	92,000
Service "C"	25	1038	1698	309,500
Service "O"	49	1009	7445	914,500
Totals		5174		1,642,000

NOTES:

1. Service A encompasses operational aviation weather data and NOTAMS. Service C primarily encompasses all other domestic and Canadian weather data. Service O encompasses both operational aviation weather and synoptic data exchanges between the U. S. and overseas locations.

2. Message types refer to the meteorological content of the message i.e., Terminal Forecast, Surface Observation, Radar Report, Map Analysis, etc.

3. Individual messages are distinguished by the geographical location to which the data type applies.

4. Each message will carry data about one terminal or area.

TABLE III

-SERVICE A-

Scheduled Operations

Message Type	Cycle Time Hours	Number of Messages	Characters per Message	Total Characters	Remarks
SA Aviation Surface Observations	1	800	80	64,000	
SW Supplementary Observations	1	400	60	24,000	200 More than today
FT-1 12-hour Terminal Forecast	6	450	140	63,000	
FT-2 24-hour Terminal Forecast	6	125	140	18,000	On Service C Today
FD Winds Aloft Forecast	6	110	60	7,000	
FA Area Forecasts	6	40	2300	92,000	
FN-1 Regional Weather Prognosis	6	1	400	500	
FS-1 12-hour Prognosis	6	1	400	500	
AS-2 Surface Analysis & Prognosis	6	1	750	1,000	
UA Sum. - Pilot Report Summary	1	60	800	48,000	
SD-1 Radar Report Summary	1	25	300	8,000	
Totals		2,013		326,000	

NOTE: 95% or more of the messages listed above will be available for collection and distribution for each of their stated cycle times. All messages will remain in primary or bulk storage until replaced or their cycle time has been exceeded.

Table III continued on page 31.

Table III continued from page 30

Non-scheduled in that data entry is not mandatory to schedule or non-schedule poll.

Message Type	Cycle Time Hours	Number of Messages[2]	Characters per Message	Total Characters	Length of Time in Primary or Bulk Storage[1]	Remarks
NOTAMS Notices to Airmen	1/3	400	70	28,000	Until Canceled	800 identifiers could have NOTAMS
UA Pilot Reports	Note 3	200	70	14,000	One Hour	600 identifiers could have UA's
FT-1 Amended 12-hr., Forecast	Note 4	100	140	-----	------	Will replace scheduled FT-1
FT-2 Amended 24-hr., Forecast	Note 4	30	140	-----	------	Will replace scheduled FT-2
SA Special Surface Observation	Note 3	300	60	18,000	One hour or when replaced by Scheduled SA	Could come from any SA & SW Source
SD Radar	Note 3	50	140	7,000	One Hour	
WW Weather Warning	Note 5	10	1200	12,000	One Hour	Also severe weather observations
FL's Flight Advisories	Note 4	20	300	6,000	One Hour	----------
WH Hurricane	Note 4	4	1800	7,000	Two hours	----------
Totals		1,114		92,000		

Table III continued on page 32.

Table III continued from page 31.

NOTES:

1. These are maximum times.

2. Estimated maximum number of messages in the system at any given time.

3. These messages enter the system from way stations during scan periods. There are mandatory scan periods each hour at 20 and 40 minutes.

4. These messages will enter the system from forecast centers on point to point circuits as they become available. Usually not more than one forecast ammendment will be issued during its cycle period.

5. This is the top priority message in the system. It has interrupt capabilities - and will enter the system randomly.

TABLE IV

SERVICE C

Message Type	Cycle Time hours/days	Number of Messages per Cycle	Characters per Message	Total Characters	Remarks
AB Weather Summary	6 hr.	1	3,000	3,000	
AB-1 Weekly Weather Crop Summary	7 da.	1	3,000	3,000	
AB-2 Temperature & Precipitation Bal.	12 hr.	4	1,250	6,000	
AB-3 National Forecast Summary	(1)	1	3,000	3,000	
AS Surface Map Analysis	12 & 24 hr.	3	1,200	4,000	
AU Upper Air Analysis	12 hr.	2	1,500	3,000	
FE 5 day State Forecast	(2)	23	1,750	40,500	May increase to 50.
FK Air Pollution Forecast	24 hr.	1	400	500	
FM Temperature Extreme Forecast	24 hr.	22	210	5,000	
FN Regional Weather Synopsis	6 hr.	5	1,500	7,500	
FP State Forecasts	6 hr.	56	270	15,500	May increase to 140.

Table IV continued on page 34

Table IV continued from page 33

Message Type	Cycle Time hours/days	Number of Messages per Cycle	Characters per Message	Total Characters	Remarks
FP 1 Guidance Forecasts	6 hr.	9	900	8,500	
FS 5 day Prognosis	(3)	5	2,800	14,000	Varies from 900 to 3,150 characters
FU 5 day Prognosis & Anomalies	(3)	3	4,500	13,500	Varies from 700 to 5000 characters
FX Quantitative Precip. Forecast Prognostic Map Discussion	12 hr.	2	2,100	4,500	
FW Winter Sports	(4) 24 hr.	22	500	11,000	
IQ Geophysical Alert Message	24 hr.	1	80	-------	
SI Synoptic Surface Reports (intermediate hours)	6 hr.	50	50	3,000	Includes 10 ship reports from San Francisco
SM Synoptic Surface Reports	6 hr. 6 hr.	305 27	50 (5)	15,500 30,000	
SR Crop, River, Corn & Wheat, Fruit, Fire, Horticulture Reports	24 hr.	110	220	24,500	Messages may be as short as 20 characters

Table IV continued on page 35

TABLE V

SERVICE O

Message Message Type	Cycle Time hours/day	Number of (1) Message Blocks	Number of Terminals (2)	Average Maximum Cktrs. per Message (M) Terminal (T)	Total Characters	Remarks
AB Weather Summary		1		480M	500	
AH Grid Point, 5 day Mean	5 days	4		1500M	6000	
AS Surface Weather Analysis	6-12 hrs.	10		900M	9000	
AU Upper Air Analysis	3-12 hrs.	7		1400M	10000	
CE Climatological Data	28-30 days	1		1000M	1000	Data is for terminals, but the number of terminals is not available (CE through CU)
CH Climatological Data	28-30 days	1		210M	500	
CO Climatological Data	28-30 days	2		500M	1000	
CS Climatological Data	28-30 days	14		300M	4500	
CU Climatological Data	28-30 days	18		750M	13500	

Table V continued on page 38

Table V continued from page 37

Message Type	Cycle Time hours/day	Number of (1) Message Blocks	Number of Terminals(2)	Average Maximum Cktrs. per Message (M) Terminal (T)	Total Characters	Remarks
FA Area Forecasts	6 hrs.	23		1500M	34500	
	6 hrs.	5		1500M		In Service "A" storage
FC Terminal Forecast	3 hrs.	1	16	1800M	2000	For Air Force
FD Wind Aloft Forecast & Ana.	6 hrs.	1	20	60T	1500	
		16	100	60T		In Service A Storage - 1 to 52 Terminals/ Message
FL Flight Advisories	As required	1	10	300T		In Service A storage.
	As required	2		600M	1500	For Air Force
FN Regional Weather Synopsis	6 hrs.	1		1440M	1500	
		3		1440M		In Service A storage
FP Public Forecasts	6 hrs.	3		420M	1500	

Table V continued on page 39

Table IV continued from page 34

Message Type	Cycle Time hours/day	Number of Messages per Cycle	Characters per Message	Total Characters	Remarks
UF Upper Air Fallout Data	12 hr.	80	40	3,500	
UC RAWINS & PIBALS	12 hr.	80	240	19,500	(Assumed these to be UJ Stations)
UG PIBALS	12 hr.	85	120	10,500	
UJ RADIOSONDS, RAWINS & PIBALS	12 hr.	80	540	43,500	
	12 hr.	4	540	2,500	Field irregularly
UN Rocket Winds	24 hr.	9	200	2,000	
UP Upper Air Observations	6 hr.	3	(6)	4,000	
UZ Mean Layer Wind Reports	6 hr.	34	30	1,000	
WH Hurricane Bulletins & Advisories	6 hr.	8	1,800	5,500	Issued as required; Max. of 3 at one time
WW Winter Storm Bulletins	---	2	1,000	2,000	Issued as required
Totals		1,038		309,500	

NOTES:
1. Available on Fridays and Saturdays.

2. Available three times a week; Mondays, Wednesdays and Fridays

Table IV continued on page 36

Table IV continued from page 35

3. Available three times a week; Sundays, Tuesdays and Thursdays.

4. Reports irregularly filed for transmission

5. These 27 messages contain 270 land and about 325 ship reports. There are from 3 to 120 reports per message. Total characters 50 x 595 = 30,000.

6. These 3 Messages contain 31 upper air observations. There are 6 to 14 observations per message. Total characters 31 x 120.

7. All messages will remain in primary or bulk storage until replaced, or distributed, or the cycle time has been exceeded or 6 hours has passed since entry.

Table V continued from page 40

Message Type	Cycle Time hours/day	Number of (1) Message Blocks	Number of Terminals (2)	Average Maximum Cktrs. per Message (M) Terminal (T)	Total Characters	Remarks
SM Main Surface Observations	6 hrs.	189	2911	60T	175000	1 to 143 Terminals/ Message.
		31	641	60T	38500	Ship Reports; 1 to 85 Terminals/ Message.
		10	292	60T		In Service "C" storage; 6 to 53 Terminals/ Message.
SN Hourly Synoptic Surface	1 hr.	3	8	60T	500	1 to 4 Terminals/ Message
SP Special Terminal Obs.	As required	3	10	60T	1000	
SX Special Terminal Obs.	As required	9	9	200M	2000	Number of terminals - not available.

Table V continued on page 42

Table V continued from page 41

Message Type	Cycle Time hours/day	Number of (1) Message Blocks	Number of Terminals (2)	Average Maximum Cktrs. per Message (M) Terminal (T)	Total Characters	Remarks
UA Pilot Reports	1, 6, 12 hr.	43		380M	16500	Collective varies from 60-1800 characters
UC Combined Pilot Balloon & RAWIN	6, 12 hrs.	14	60	180T	11000	1 to 20 Terminals/ Message.
		2	9	180T	2000	1 to 5 Terminals/ Message, Ships.
UF Upper Air Fallout Data	24 hrs.	4	19	60T	1500	1 to 15 Terminals/ Message.
UG Pilot (part B)	6, 12 hrs.	6	14	180T	2500	1 to 7 Terminals/ Message.
UH Pilot (part C)	6 hrs.	6	50	90T	4500	1 to 36 Terminals/ Message.

Table V continued from page 43

Table V continued from page 38

Message Type	Cycle Time hours/day	Number of (1) Message Blocks	Number of Terminals (2)	Average Maximum Cktrs. per Message (M) Terminal (T)	Total Characters	Remarks
FS Surface Prognosis	12 hrs.	3		1860M	6000	
		2		1860M		In Service C storage
FT Terminal Forecast	6 hrs.	72	260	125T	32500	1 to 16 Terminals/ Message.
		14	82	125T		In Service A storage; 4 to 10 Terminals/ Message.
		31	118	125T	15000	1 to 13 Terminals/ Message, For Air Force.
FU Upper Air Prognosis	6, 12 & 24 hrs.	34	34	835T	28500	
FX Forecast Track Component	6 hrs.	1		270M	500	

Table V continued on page 40

Table V continued from page 39

Message Type	Cycle Time hours/day	Number of (1) Message Blocks	Number of Terminals (2)	Average Maximum Cktrs. per Message (M) Terminal (T)	Total Characters	Remarks
Notices	24 hrs.	6		1200M	7500	
SA Terminal Observations	1 hr.	48	411	90T	37000	Some in Service A storage - 1 to 84 Terminals/ Message.
		2	140	90T		In Service A storage - 70 Terminals/ Message.
SD Radar Observations	3 hrs.	4		90M	500	
SE Seismological	As required	2		120M	500	
SF Sferics	As required	4		180M	1000	
SG Microseismological	12 hrs.	1	2	90T	500	
SI Intermediate Surface Observations	6 hrs.	70	498	50T	25000	1 to 40 Terminals/ Message

Table V continued on page 41

Table V continued from page 42

Message Type	Cycle Time hours/day	Number of (1) Message Blocks	Number of Terminals (2)	Average Maximum Cktrs. per Message (M) Terminal (T)	Total Characters	Remarks
UI Pilot (parts A and B)	6 hrs.	13	98	120T	12000	1 to 17 Terminals/ Message.
UJ Combined RAOB and RAWIN	6, 12 hrs.	27	65	600T	39000	1 to 14 Terminals/ Message.
UK Temperature (part B)	12 hrs.	14	121	300T	36500	1 to 29 Terminals/ Message; 26 Terminals may be in "C".
UL Temperature (part C)	12 hrs.	32	374	108T	40500	1 to 71 Terminals/ Message; 68 may be in "C"
UM Temperature (parts A and B)	12 hrs.	28	148	420T	62500	1 to 15 Terminals/ Message; 43 may be in "C"

Table V continued on page 44

Table V continued from page 43

Message Type	Cycle Time hours/day	Number of (1) Message Blocks	Number of Terminals (2)	Average Maximum Cktrs. per Message (M) Terminal (T)	Total Characters	Remarks
UN Rocketsonde	24 hrs.	2		540M	1500	
UP Pilot Balloon (part A)	6, 12 hrs.	21	152	90T	14000	1 to 19 Terminals/ Message; 76 Terminals may be in "C" storage.
UR Reconnaissance Flights	3 hrs.	11		360M	4000	Includes Hurricane and Research Flights
US Radiosonde/ Rawinsonde	12 hrs.	61	690	210T	145000	1 to 104 Terminals/ Message; 113 Terminals may be in "C"
UW RAWIN	12 hrs.	18	28	570T	16000	1 to 8 Terminals/ Message
UX Misc. Upper Air	12 hrs.	19	66	105T	10000	

Table V continued on page 45

Table V continued from page 44

Message Types	Cycle Time hours/day	Number of (1) Message Blocks	Number of Terminals (2)	Average Maximum Cktrs. per Message (M) Terminal (T)	Total Characters	Remarks
WH Hurricane Reports and Warnings	As required	28		1050M	29500	
WW Weather Warnings	As required	6		1080M	6500	For Air Force.
Totals		1009	7445		915000	
Total less requirements for Air Force		919	7018		851000	

NOTES:

1. Total numbers of different geographical designator heading within each message type. Each heading designates discrete block of messages grouped for distribution as a single transmission.

2. Total number of terminals or individual messages within overall message type. A variable number of these are included in any one message block. Some terminals are duplicated in more than one block.

3. All messages will remain in primary or bulk storage until replaced or distributed or the cycle time has been exceeded or 6 hours has passed since entry.

4. For initial operation, message blocks will be handled intact throughout the system. The WMSC shall have the capacity to breakdown blocks for distribution of individual terminal messages or individual messages for possible future operational procedures.

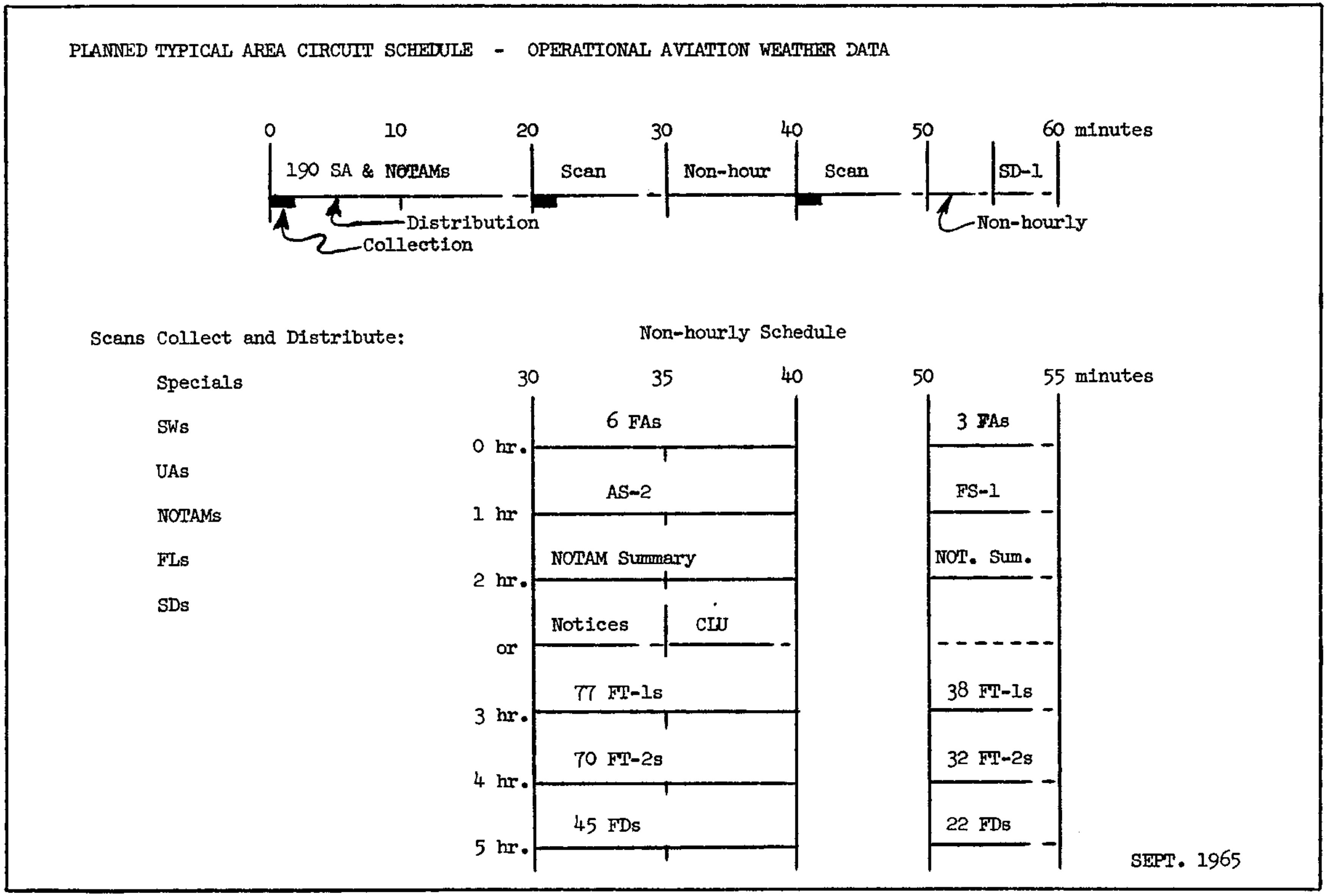

PLANNED TYPICAL AREA CIRCUIT SCHEDULE - OPERATIONAL AVIATION WEATHER DATA
0
10
20
30
40
50
60 minutes
190 SA & NOTAMs
Scan
Non-hour
Scan
SD-1
Distribution
Collection
Non-hourly
Scans Collect and Distribute:
Specials
SWs
UAs
NOTAMs
FLs
SDs
Non-hourly Schedule
30
35
40
50
55 minutes
6 FAs
3 FAs
0 hr.
AS-2
FS-1
1 hr
NOTAM Summary
NOT. Sum.
2 hr.
Notices
CLU
or
77 FT-1s
38 FT-1s
3 hr.
70 FT-2s
32 FT-2s
4 hr.
45 FDs
22 FDs
5 hr.
SEPT. 1965

Figure 12

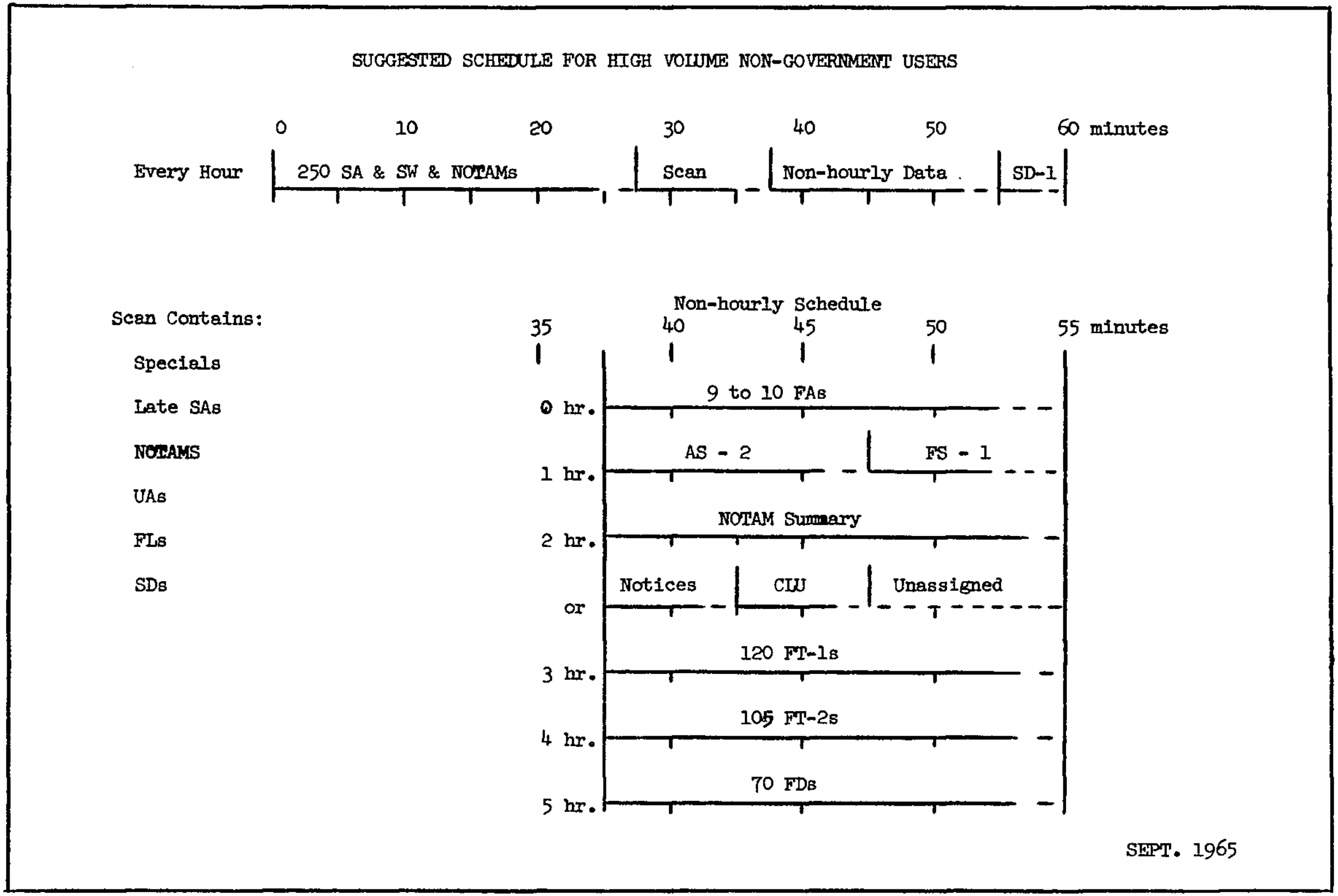

SUGGESTED SCHEDULE FOR HIGH VOLUME NON-GOVERNMENT USERS
0
10
20
30
40
50
60 minutes
Every Hour
250 SA & SW & NOTAMs
Scan
Non-hourly Data
SD-1
Scan Contains:
Specials
Late SAs
NOTAMS
UAs
FLs
SDs
Non-hourly Schedule
35
40
45
50
55 minutes
0 hr.
9 to 10 FAs
1 hr.
AS - 2
FS - 1
2 hr.
NOTAM Summary
or
Notices
CLU
Unassigned
3 hr.
120 FT-1s
4 hr.
105 FT-2s
5 hr.
70 FDs
SEPT. 1965

Figure 13

BLOCK DIAGRAM - WEATHER MESSAGE SWITCHING COMPUTER

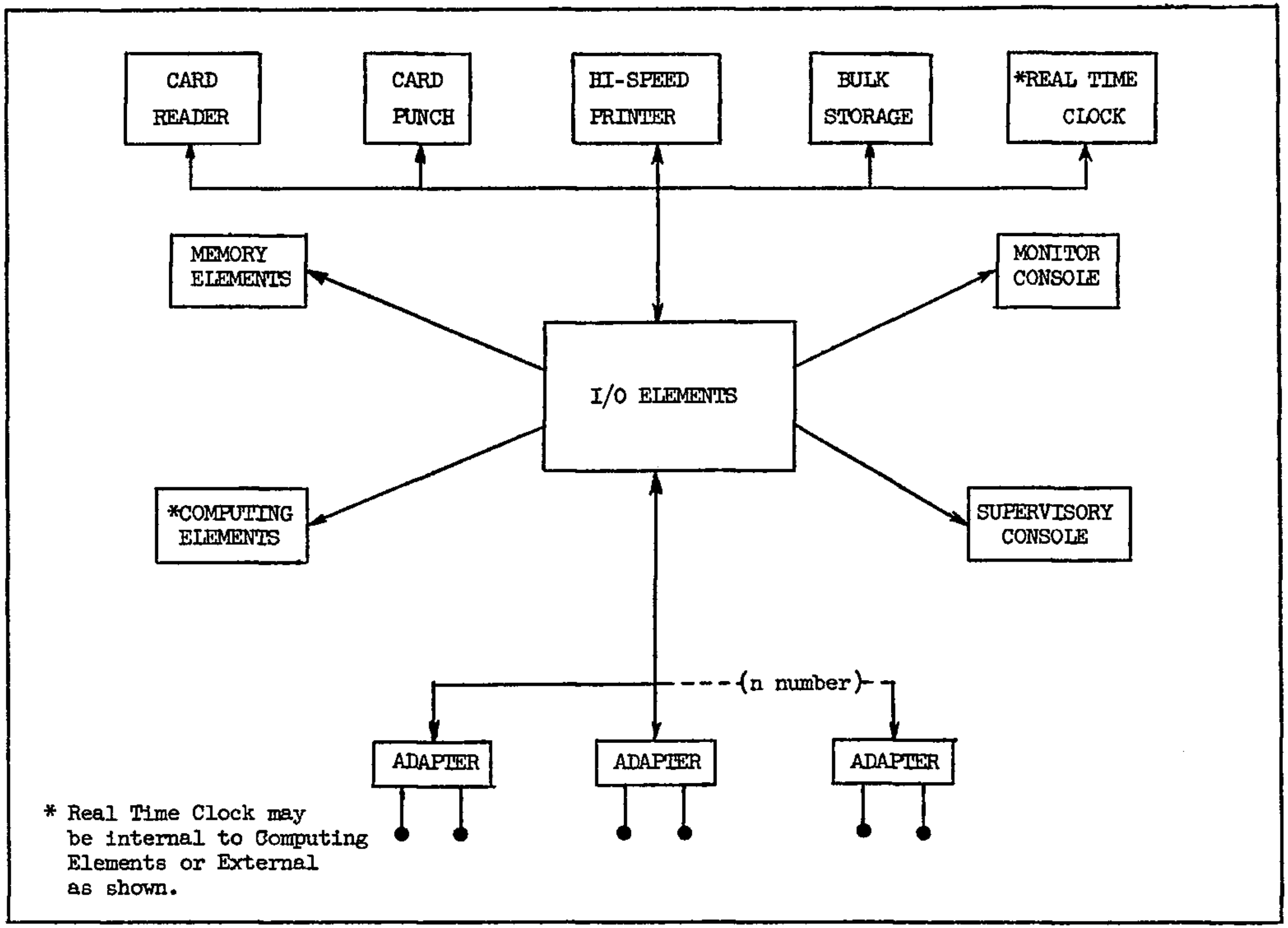


FIG. 14

3.5.1.1 Functional Description

The WMSC will perform the following functions under stored program control:

a. Accept various types of messages from both high and low speed communications circuits using polling, monitoring, and priority interrupt techniques;

b. Transmit the messages on both high and low speed communications circuits with each circuit receiving messages according to a predetermined distribution list;

c. Transmit messages not on the normal distribution list of the requesting stations circuit through a request/reply procedure;

d. Accept, verify, convert and retransmit NOTAMS, and assemble and maintain current master file thereof;

e. Record data for use in performing a comprehensive message traffic analysis;

f. Perform the message traffic analysis using the data obtained from (d) above;

g. Monitor its own and the communication circuit operation indicating any failures or malfunctions that occur; and

h. Take appropriate remedial action using available redundant elements when a failure or malfunction occurs.

3.5.2 The major message acquisition functions will be performed by the line adapter units in the following manner. A polling code of up to 10 characters will be transmitted by the adapter units. This code locks out all but one station transmitter. A maintenance adjustable "no response" delay of up to 10 seconds is provided to cover propagation delays of the polling signal and the reply. This will be set for the farthest station on the circuit. If no reply is received after this time, the next station is polled. If the message missed was a scheduled message, the station is repolled at the end of the first polling cycle. If a reply is received, it is stored in the memory for retransmissions as required by stored distribution lists. If more than one individual message is transmitted at one time by a particular entry point, the entry point will insert a message separation code between reports. The computer will then handle data between separation codes as individual messages. When the message or messages is received, the adapter unit will time out for approximately 300 milliseconds after the last character has been received, before polling the next station or beginning distribution. An end of message (EOM) code will be added by the adapter unit for subsequent handling by other elements of the WMSC. The message separation code and the end of message code will be the same characters. Polling will continue in this manner to the end of the polling sequence. If a station fails to respond to a repoll for a scheduled message after the completion of the initial poll, the message processor provides an indication to the operator console of a possible station outage.

Certain circuits, such as the Canadian and Alaskan extensions, connected to the switch will not be controlled by the switch. The switch will monitor these circuits and select and store those messages it requires for distribution, by recognizing the message identifying codes that follows the start of message or end of message code.

3.5.2.1 Priority Message Handling

To provide for the acceptance of priority messages (such as tornado reports, etc.), the adapter units will also monitor circuits during input and output operations to detect a break in the circuit. If a break is initiated by a way station in order to transmit urgent traffic, the computer will discard any incoming message (to the computer) which has been partially received and will prepare to receive the urgent message. If the computer is transmitting, it will stop, make provision for retransmitting the message, and prepare to receive the urgent message. It then waits up to six seconds for the transmission of the urgent message. If no transmission begins within the "no response" delay period it will provide an indication to the operator or supervisor of possible circuit outage. If transmission begins, the data is accepted, stored and distributed in accordance with the distribution lists. Urgent messages are timed out as previously described after receipt of the last character and the computer then resumes normal operation.

3.5.2.2 NOTAM Message Handling

NOTAMS may be received as appended data on hourly weather observations or as separate transmission. Data is coded in the NOTAM Q code whenever this code provides suitable code groups. Otherwise it is expressed in abbreviated English using standard contractions as applicable. All incoming NOTAMS are checked by the message center for Q code validity, for meaningful Q code combinations, for properly sequenced serial number, and for valid source identifier. Invalid NOTAMS are deleted from weather reports before they are relayed and when separated from observations are withheld from further distribution. The message center will immediately and automatically generate a message to any circuit from which an invalid NOTAM has been received.

Valid NOTAMS are relayed with hourly observations and where separate are immediately distributed in accordance with an appropriate distribution list. Q code NOTAMS are converted to plain abbreviated English in accordance with standard contractions and used to make up a current NOTAM Summary. The NOTAM Summary is maintained up to date at the switching center by messages received each hour, confirming, cancelling or adding new NOTAMS. Each area circuit receives a Summary every 6 hours containing the NOTAMS which have been originated by stations whose weather reports normally appear on that circuit.

3.5.2.3 Circuit Monitoring

Other functions performed during input/output operations include monitoring the circuits to determine excessive signal distortion or breaks and provide indication to a supervisor; determining when a circuit has returned to normal operation after an outage or excessive signal distortion, provide an indication to a supervisor and store data on the duration of the outage; providing an identification for each message since polled stations do not transmit their station identification; providing a character count for each message; and detecting the presence of special characters (such as wind arrows used as a NOTAM indicator) in a message and processing these as separate messages.

3.5.3 Message Distribution Functions

Message distribution will be made in accordance with stored distribution lists applicable to each circuit on an individual basis. As a rule all data on a circuit are wanted by all users but the computer is capable of supplying a select code of three to six characters that will place selected stations in a print suppression or print enable condition so that data not required by particular stations on a multipoint circuit would not be read out. Way station stunt boxes would require modification to use this feature. This will not be done for initial operation of the system.

3.5.3.1 Scheduled Messages

As messages are received during scheduled message collection periods, the message identifications are compared with the various distribution lists and as soon as the first message is available for any distribution only (from the computer) circuit, transmission to that circuit will commence. On the half-duplex circuits distribution will not commence until all input messages for any particular collection schedule have been received. The computer will provide a suitable indication to any circuit when scheduled data are missing.

3.5.3.2 Unscheduled Messages

Unscheduled messages collected during scan periods between scheduled collections and distributions will be accumulated into groups of similar message types as appropriate and distributed in these organized blocks of data insofar as the nature and order of the incoming data will permit. On the circuit of origin scan data will appear in random order and arrangement. It will appear in block form only on circuits to which it is relayed.

3.5.3.3 Priority Interrupt Messages

Priority interrupt messages will be transmitted to receiving circuits within one minute of their receipt by the computer, interrupting other transmissions in progress which have not been completed within this one-minute period.

3.5.4 Request Reply Service

Request/reply service will be provided by this system. Procedures are subject to experimental trials during initial system operation and may be varied on a test basis to determine the most practical methods of operation. Both the regular area collect/distribute circuits and separate request/reply circuits are being considered for this function. The computer is capable of recognizing and responding to request messages for any system data stored in the memory. Initially requests will be limited to selected hourly observations and possibly terminal forecasts not routinely received by the requesting station. The computer will be programmed to respond only to authorized requests. Other requests will be recorded and summarized for study and determination of appropriate action to provide the best service to the using community as a whole.

3.5.5 Record Keeping and Traffic Analysis

The computer will maintain records on traffic volume, peak periods, system outages, message errors of various types, deviations from schedules and so forth and will summarize and analyze this data for use in adjusting schedules and procedures for improved service.

4.0 CONTROL CODES AND OPERATIONAL PROCEDURES

4.1 General

Conditioning, circuit control, and end codes are required for operation of the automated communications system. These codes enable the message processing equipment to recognize individual messages in sufficient detail to allow unambiguous selection of the proper handling procedures and the performance of certain circuit control functions at the way stations on the multipoint circuits.

The design of the coding structure enables the automated equipment to determine the disposition of each message without requiring the reading and interpretation of the data content. The complexity of manual message preparation has also been minimized to expedite data handling at the source and avoid the introduction of human error.

The modernized communication system integrates a number of weather services of varying degrees of automation, ranging from the essentially manual Service C to the highly automated Service A (ADIS) network. The latter system has already a well developed coding structure, which could be readily interpreted by the computer-controlled system were its handling procedures no more sophisticated than ADIS. However, the new system will store, retrieve and disseminate weather and NOTAM data according to message type as well as origin, and certain information carried only as blocks in ADIS will be separated into individual reports. Most of the ADIS formats already contain the necessary information for this purpose, but often not rigidly controlled since it is used only for human interpretation or display (printer) layout. In a few cases, no adequate identification of message type is made.

The improved system will use essentially the same conditioning and origination identification codes as the ADIS system, supplemented where necessary by additional code groups for unique new circuit control functions. In addition, a rigid structure of message type identification is being set up, consisting of two or three characters immediately following the station identifier code. Where messages are transmitted in blocks, the identification is inserted only in the block heading; otherwise it is part of the format of each individual message. Where messages are already identified (e.g., NOTAM, PIREP, FT-1, etc.) the first two or three characters of such identification, if unique, serves the required function.

In order to perform new procedures, to exploit the data handling capacity of the WMSC (circuit assurance, urgent message handling, request/reply, selective transmission and reception), certain minor changes to way station stunt boxes and transmitter control circuitry may be incorporated at a later time as a means of attaining more efficient circuit operation, but are not planned for immediate use.

To preclude the need for extensive modification of existing way station equipment or an immediate retraining of field operating personnel, the introduction of radically new or modified coding procedures is being held to the minimum and only those changes essential for effective use of the WMSC control capabilities and adequate system performance are being implemented at this time.

4.1.1 Phased System Change-Over Plan

During the change over period to the new system operation, it is essential that no lapses in service of more than a few minutes occur whether due to equipment connection transfer or to incorrect operator procedures. A step-by-step turnover plan with parallel service where feasible and a minimum number of procedural changes has been prepared. To ensure that the implementation period can be traversed in an orderly and secure (fail safe) manner a phased changeover from current coding procedures, first to interim implementation procedures, and then to final system procedures will be used. This is linked with a specific plan for progressive cut-over to new circuits.

In accordance with this plan, no changes to way station equipment will be required, and only minor or easily accomplished coding procedural changes are necessary.

The steps in this plan are as follows:

4.1.1.1 Step 1

The Weather Message Switching Center (WMSC) will be programmed to assume the present APUHS function of controlling the ADIS high-speed circuit at the start of the implementation period. This will provide greater flexibility in high-speed circuit scheduling, and avoid the necessity of making several changes to the APUHS program, which would be more expensive than WMSC program changes.

4.1.1.2 Step 2

On Service A circuits, the new low speed circuits connecting the WMSC with the individual forecast centers will be established as a next step. In this way, the problem of recognizing forecast center transmissions at the WMSC from the ADIS high-speed circuit without disrupting ADIS equipment operation, will be avoided. For a short test period, forecast centers will transmit their data on ADIS in the present formats, and on the new circuits in the new formats. Then when these new circuits are operating satisfactorily and the WMSC is receiving the data, the transmissions on the ADIS high-speed circuit will be discontinued, and the WMSC will relay the forecast center data onto ADIS, translated into current ADIS formats. The Service A area circuits will then be implemented on an area-by-area basis. Required coding changes on Service A are summarized in Table VI and illustrated by examples in Table VII.

Table VI. Summary of Operator Coding Procedure Changes - Service A

Message Type	On existing circuits, during implementation	On new MPC-controlled circuits
1. Area circuit way-station transmissions		
SA, scheduled hourly reports	No changes	No changes required, Minor refinements optional
SA, unscheduled (special, missing, corrected) NOTAM, PIREP (as separate messages, unscheduled)	Content designator (e.g. SA, PIREP, UA) must follow location identifier and space	No further changes
SD, SW	Must be transmitted as individual messages, each with standard header: ≡<<↓ (location identifier)↓>SW following present ADIS diversion codes Extra ↓ is added to prevent incorrect diversion by ADIS message directors	Delete present ADIS diversion codes. Delete extra . after location identifier
2. Forecast center transmissions		
FA, UA, WH, FL, FN-1, SD-1, WW, AC, AS-2, NOSUM	Not applicable, assuming new forecast center circuits are implemented first.	Delete present ADIS diversic codes. Change header into standard format: ≡<↓<<↓(location identifier)> (content designator)>DTG<≡ (valid time, if applicable)<≡
FT-1, FD	Not applicable, assuming new forecast center circuits are implemented first.	Delete present ADIS codes Change header into standard format as for FA, etc. Precede each individual fore-cast in block with standard message separator code ≡<<↓

TABLE VII

STANDARDIZED AND SIMPLIFIED WAY-STATION AND FORECAST CENTER TRANSMISSIONS

SERVICE A

NO.	MESSAGE TYPE	PRESENT	IMPLEMENTATION	MODERNIZED
		AREA CIRCUIT WAY STATIONS		
	SCHEDULED HOURLY REPORTS			
1	SA	≡<↓<<↓TOL>(TEXT)	≡<↓<<↓TOL>(TEXT)	≡<↓<<↓TOL>(TEXT)
2	SA-Polled station entering another's report	≡<↓<<↓LOU><≡ <<↓SDF>(TEXT)	≡<↓<<↓LOU> ≡<<↓SDF> TEXT)	≡<↓<<↓LOU> ≡<<↓SDF>(TEXT)
3	SA-Polled station entering its own and another's report	≡<↓<<↓LUK>(TEXT)≡<↓ <<↓CVG>(TEXT)	≡<↓<<↓LUK>(TEXT)≡<↓ <<↓CVG>(TEXT)	≡<↓<<↓LUK>(TEXT) ≡<<↓CVG>(TEXT)
	UNSCHEDULED REPORTS			
4	Special - Urgent	↑↑↓↓↓↓<<↓TOP>(S TEXT)≡<↓	↑↑↓↓↓↓<<↓TOP> SPL>(TEXT)≡<↓	≡<<↓TOP>SPL>(TEXT)
5	SA - Missing	≡<↓<<↓TOL>(TEXT)	≡<↓<<↓TOL> SA>(TEXT)	≡<↓<<↓TOL>SA>(TEXT)
6	SA - Corrected	≡<↓<<↓ACG<≡ <<↓PIT>(COR TEXT)	≡<↓<<↓AGC ≡<<↓PIT> SA>(COR TEXT)	≡<↓<<↓AGC> ≡<<↓PIT> SA>(COR TEXT)
7	NOTAM, PIREP (as separate messages)	≡<↓<<↓UCA>↑→↓( )	≡<↓<<↓UCA>↑SA↓>(TEXT)	≡<↓<<↓UCA> NOTAM >(TEXT)
8	SW and SD	≡<↓<<↓TLH<<↓GDW><<↓↑039><<↓↑054><≡ AQQ>(TEXT)	≡<↓<<↓TLH<<↓GDW><<↓↑039><<↓↑054> ≡<<↓AQQ↓>SW>(TEXT)	≡<↓<<↓TLH> ≡<<↓AQQ> SW>(TEXT)
9	Request (RQ)			≡<↓<<↓LRD>RQ > SA> PBF> SLN
		REQUEST - REPLY WAY STATIONS		
10	RQ-Station wants monitor copy **	*	≡<↓<<↓DCA>RQ>SA>PBF>SLN	Same as implementation
11	RQ-Station does not want copy**		**Monitor copy not applicable	
12	Urgent report			
		FORECAST CENTERS		
13	FA, WH, FN-1, SD-1 WW, AC, AS-2, NOSUM FS-1	* <<DQX><≡ FA>DTW>(DTG)<≡ (TEXT)≡<↓	NOT APPLICABLE ASSUMING NEW FORECAST CENTER CIRCUITS ARE IMPLEMENTED FIRST	≡<↓<<↓DTW>FA>(DTG)<≡ (TEXT)
14	UA, FL	≡<↓<<↓MEM>UA>(DTG)<≡ --(TEXT)	MPC WILL DELIVER TO ADIS MESSAGES WITH PRESENT CODES	≡<↓<<MEM>UA>(DTG)<≡ (TEXT)
15	FT-1, FD, FT-2	* <<↓HHA><≡ (VALID PERIOD) <≡ MIA>(TEXT)<≡ DAB>(TEXT)≡<↓ * <<↓↑124><≡ (VALID PERIOD)<≡ VRB>(TEXT)<≡ GNV>(TEXT)≡<↓		≡<↓<<↓MI A>FT 1 >(DTG)<≡ (VALID PERIOD) ≡<<↓MIA>(TEXT) ≡<<↓DAB>(TEXT) ≡<<↓VRB>(TEXT) ≡<<↓GNV>(TEXT)

*TRANSMITTED DIRECTLY ON ADIS HIGH-SPEED CIRCUIT APUHS TRANSMISSIONS ARE OMITTED FOR BREVITY.

NOTES:

Solid underlined portions are transmitted by APULS (Present Implementation) or WMSC (Modernized, Optimum). Dashed underlined letters and numbers are not copied by way station printers. For scheduled reports from way stations, the message type is contained in a separate heading, transmitted by APULS or the WMSC. Only circuit control transmissions (underlined), call directing codes (dashed underlined) and details of message preamble essential for WMSC identification of the message are shown. Details included to show context are contained within parentheses. A detailed discussion of the formats is contained in Sections 4.0 of this exhibit.

TABLE VIII

STANDARDIZED AND SIMPLIFIED WAY-STATION AND FORECAST CENTER TRANSMISSIONS

SERVICE C

NO.	MESSAGE TYPE	PRESENT	MODERNIZED
	AREA CIRCUIT WAY STATIONS		
1	Scheduled reports with numerical indicators; SI, SM, UJ	≡<<↓TOL>↑536>(TEXT)	≡<↓<<↓TOL> ≡<<↓↑536>(TEXT)
2	Scheduled reports with alphabetic indicators: SR, UG, UZ	≡<<↓SYR>(TEXT)	≡<↓<<↓SYR>(TEXT)
3	Unscheduled reports with numerical indicators: SI, SM, UC, UJ	SPL>SM>TOL>↑536>(TEXT)	≡<↓<<↓TOL> ≡<<↓↑536>SM>(SPL DTG TEXT)
4	Unscheduled reports with alphabetic indicators: FW, SR, UG, UN, UZ	FW> SSM>(DTG TEXT)	≡<↓<<↓SSM>FW>(DTG TEXT)
	FORECAST CENTERS		
5	Single messages: AB, ABI, AB2, AB 3, AS2, ASPA, AUPA, FE, FK, FM, FN, FP1, FP2, FS, FX, IQSY, UX, UM, UL, WH, WW	FN>SFO>DTG<≡ (TEXT)	≡<↓<<↓SFO>FN>DTG<≡ (TEXT)
6	Multiple messages: FP,*FT2, UF *FT2 messages will be handled on Service A type circuits in the new system	FP-30>DTG≡ ≡<<↓DCA-1>(VALID TIME)<≡≡ (TEXT)<≡ (TEXT)<≡≡ DCA-2(VALID TIME)<≡≡ (TEXT)<≡ (TEXT)<≡	DCA>FP>DTG≡ ≡<↓<<↓DCA-1>(VALID TIME)<≡≡ (TEXT)<≡ (TEXT)<≡≡ ≡<<↓DCA-2>(VALID TIME)<≡≡ (TEXT)<≡ (TEXT)<≡≡

NOTES:
Underlined portions are transmitted by Trigger Station (Present) or WMSC (Modernized, Optimum). For scheduled reports from way stations, the message type is contained in a separate heading, transmitted by the Trigger Station or WMSC. Only circuit control transmissions (underlined) and details of message preamble essential for WMSC identification of the message are shown. Details included to show context are contained within parentheses. A detailed discussion is contained in Sections 4.0 of this exhibit.

4.1.1.3 Step 3

On Service C, new message codes will be implemented throughout Service C before these circuits and these data are introduced to the WMSC and the improved system. In particular, the location identifier to which each individual report pertains must be preceded by a standard code, and followed by a space function, and, for all unscheduled messages, a content designator. For scheduled messages blocks, the content designator will be included in the block header.

The standard code preceding the location identifier will be either the Master Conditioning Code (MCC) or the Message Separator Code (MSC) as discussed in detail later and illustrated by examples in Table VIII. Table VIII follows the same format as Table VII, except that the "Implementation" column is omitted, since no special implementation codes will be needed.

4.1.1.4 Step 4

When the new codes have been implemented on Service C, the existing circuits will be extended to the WMSC, for WMSC recognition and storage of all Service C messages. WMSC control of the circuits will then be instituted, replacing present trigger stations, and the WMSC will take over the function of relaying data between circuits permitting the decommissioning of the present relay stations at Louisville and Denver. The number of Service C circuits will then be increased on a step-by-step basis, as required.

4.1.1.5 Step 5

On service O, present procedures and message formats will be continued to a large extent. No polling of stations will be necessary. Messages will be identified and distributed by the block and bulletin headings in current use. Unidentifiable messages will be directed to a supervisor for manual handling. Circuits will be extended to the message center as convenient.

4.1.1.6 Step 6

Request/Reply circuit request type messages are illustrated in Table VII. Polling will be accomplished in a manner similar to the scans on Service A and distribution formats and procedure will be similar to those for Service A. These circuits will be installed during the latter portion of the installation period.

4.2.0 Definitions.

Symbols and abbreviations used in this section are defined below:

↓ Symbol for the nonprinting letters shift character

↑ Symbol for the nonprinting figures shift character

> Symbol for the nonprinting space character

< Symbol for the nonprinting carriage return character

≡ Symbol for the nonprinting line feed character

□ Symbol for the nonprinting blank character

(...Text...) One or more lines of text including portions of headings and format effectors.

ACDC All-printer call directing code

ADIS Service A Data Interchange System

APUHS Automatic Program Unit, High Speed

APULS Automatic Program Unit, Low Speed

ASR Automatic Send-Receive

COMET CONUS Meteorological Teletype System (Air Force)

DTG Date-time group

EOA End-of-address code (>)

EOL End-of-line code (<≡)

EOM End-of-message code (≡<↓)

FAWS Flight Advisory Weather Service

IC Interchange Center

ICDC Individual-printer call directing code

MCC Master conditioning code (≡<↓<<↓), made up of the present EOM and conditioning code.

MDC Master disconnect (conditioning) code (≡<↓), same as EOM

MPC Message Processing Center

MSC Message Separator code (≡<<↓)

R/O Receive-only

RQ Designator for a request message

RTSC Routing transmitter start code

SOM Start of message code, used as conditioning code in Service A, and for MPC recognition in improved system (<<↓)

S/R Send-receive

S/RC Send-Receive Center

T/D Transmitter-Distributor

TSC Transmitter start code (Station identification characters)

UTSC Urgent transmitter start code

wpm Words per minute

The familiar abbreviated forms of weather message type identifiers, which are used frequently in the report, are not included in this list. They are the standard identifiers (SA, SM, FA, etc.) currently used in Services A, C, and O.

4.3 Details of Codes for Collect-Disseminate Circuits.

Included in this classification are Service A area circuits and FAWS circuits, circuits replacing present Service C and O circuits and tie lines terminating in WMSC input buffers. Users of these circuits will normally receive a print-out of all transmissions on the circuit of origin.

All way-station transmissions will be from punched tape read by the Model 28 Transmitter/Distributer (T/D). To send a message, the operator will follow essentially the procedure now prescribed for Service A. He will normally insert a prepared tape in the T/D and set a control to prepare its start circuit. Reading of the tape will commence after completion of the T/D start circuit by contacts on the Model 28 stunt boxes. The stunt box, which monitors the line, will close these contacts upon recognition of the transmitter start code assigned to the station. This transmitter start code will occur in a polling sequence sent on the line by the WMSC. In an emergency, after an urgent message tape has been inserted in the T/D, the circuit may be preempted by operating the break key twice, then starting the T/D manually as soon as the circuit is quiet.

The WMSC, which controls station transmission by sending polling commands on the line, can intersperse these command sequences at will with data messages programmed for transmission to the circuit.

4.3.1 Circuit Control Codes

Control of the low-speed collect-disseminate circuits will be exercised by the WMSC, employing the common elements of the codes now used for Service C and for Service A area circuits. The WMSC's polling operation will be quite similar to that of the APULS but can be varied according to schedule and station response to omit unnecessary commands. Use of existing circuit control coding and operation saves the considerable cost of reprogramming most of the stunt boxes on Model 28 ASR teleprinters in use on Service A and C. This does, however, result in a somewhat longer and slower polling cycle than that which would be possible if stunt boxes were to be reprogrammed.

Three compact circuit control codes will be employed routinely, while a fourth will be required on occasion. The codes, and the reaction which they will produce at the way stations, are described in the following paragraphs.

4.3.1.1 Master Conditioning Code (MCC) (≡<↓<<↓)

This code can be recognized by both Service A and Service C stunt boxes as now programmed. The six characters should be sent in succession to insure conditioning of all ASR stunt boxes. This code performs two functions. Transmission of the code on the circuit will cause sequential operation, latching, unblocking, unlatching and restoration of a series of function levers in the stunt boxes of each transmitting station. This will result in latching the last lever of the sequence, conditioning the stunt boxes to accept and react to the code which follows. The MCC can also serve as a format effector, positioning the type boxes of all printers at the beginning of a blank line.

4.3.1.2 Transmitter Start Code (TSC)

The TSC will consist of three letters or numbers which, following transmission of the MCC, will call in the desired way station transmitter. This code will be the location identifier assigned to the way station. The three characters of the TSC must immediately follow the MCC, so that these characters form one sequence commencing with the MCC. Receipt of the TSC in this manner at the desired station will cause the series of function levers corresponding to the station's TSC to continue the operating sequence commenced by the MCC, with the lever representing the last character in the TSC closing a contact in the T/D start circuit. Receipt of the first character of the TSC at all stations will cause unlatching of the lever previously latched by the MCC. At the undesired stations this terminates the consecutive operation of the series of levers, and prevents transmission from any station other than the one selected by the specific TSC. All printers on the circuit will print out each TSC.

4.3.1.3 End of Address Code (EOA)

The EOA will consist of a space character, and will be received immediately following the TSC. It will serve only as a format effector on these circuits as long as existing stunt box programming is employed. Eventual reprogramming of stunt boxes could give the EOA an important circuit control function, such as turning on selected printers on Request/Reply circuits.

4.3.1.4 End of Message Code (EOM)

The EOM code, consisting of the characters ≡<↓ is routinely required on present Service A circuits, and will be included as the first three characters of the MCC in the modernized system. In addition, on multi-station circuits, a station will continue to end its tape with this EOM under certain circumstances. A station transmitting a message beginning with the MSC and the TSC of another station on the circuit must conclude its transmission with the EOM. An example of the transmission of a NOTAM under these circumstances is given in paragraph 13.41 of FAA/ATS publication, Service A Weather Schedules, AT P 7330.2A CH 7 dated 4/30/65.

4.3.2 Circuit Control Operation

To provide further explanation of the operation of the circuit control functions within the modernized system, some control routines are outlined in the following paragraphs. The routines represent the principal modes of operation of the low-speed circuits, viz., schedule collections, unscheduled collections, urgent traffic collections, and dissemination.

4.3.2.1 Scheduled Collections

Scheduled collections for weather observations on low-speed area circuits will occur at least once each hour on Service A circuits and at least every three hours on Service C circuits. The operating procedure for these collectives will be as follows: The WMSC will poll the stations on each circuit, in turn, for transmission of their observation; as each is received at the WMSC, it will be entered into storage, and it will also be copied by all operating printers connected to the circuit as part of the routine dissemination to all stations on the circuit, and for checking by the originating station. Any station not scheduled to report may be omitted for this polling cycle. In accordance with this procedure, the sequence of events, in terms of WMSC control transmissions and way-station reactions to these controls, will be as follows:

a. The WMSC sends any required block header, which is copied by all printers on the circuit.

b. The WMSC sends the MCC, (≡<↓<<↓) all printers are positioned at the beginning of a blank line and all stunt boxes are then prepared to recognize their individual TSC.

c. The WMSC sends the first TSC, e.g., TOL, followed by a space. All printers print out TOL, and space. Assuming Toledo has a tape ready, this triggers its T/D and the observation is transmitted to the circuit, copied by all printers on the circuit and received and processed by the WMSC.

d. On cessation of transmission by Toledo, the WMSC times a predetermined short period of quiet on the circuit.

e. At the end of the time-out period the WMSC repeats steps (b), (c) and (d), calling in the second station of the following sequence and so on until the poll is completed. Returning to step (c), if the WMSC receives no transmission from Toledo, the WMSC immediately executes a time-out longer than step (d).

Scheduled SA message control codes are shown in Examples 1, 2 and 3 in Table VII, and SM and UG in Examples 1 and 2 in Table VIII.

4.3.2.2 Unscheduled Collections

Unscheduled collections will be conducted on all low-speed circuits, at varying intervals. On many circuits, a continuous scan of all transmitting stations will be conducted by the WMSC, and each scan may be considered as an unscheduled collection sequence. On other circuits, continuous scans will be conducted during part of each hour.

The procedure will be similar to that for scheduled collections, omitting Step (a). Examples 5 through 9 in Table VII and 3 and 4 in Table VIII illustrate unscheduled message collection control codes.

4.3.2.3 Urgent Traffic Collections

A way station having an urgent message to send will seize the circuit by operating the break key twice, interrupting any transmission in progress, including that of the WMSC. As soon as the circuit is quiet, the operator manually starts his T/D, which transmits the urgent message from the tape which he has already placed in the T/D. The transmission will be copied by all printers on the circuit and received and processed by the WMSC. On cessation of the urgent transmission the WMSC will execute the step (d) timeout of the polling procedure. Following this, if a station was interrupted, it will re-poll that station, or if its own transmission was interrupted it will resume transmission immediately after the completion of the last message or control sequence. Example 4, Table VII, illustrates the transmission of an urgent special message.

4.3.2.4 Dissemination

The dissemination of messages on the circuit from which they were collected has been discussed in the preceding paragraphs. The procedure for disseminating messages originating on other circuits will only require that the WMSC terminate a collection cycle and transmit the messages which it is programmed to deliver to the circuit. The WMSC can interrupt its own transmission at any time to disseminate messages of higher priority. It can employ the double break procedure described in the preceding subparagraph to interrupt a way station transmission for the same purpose. All messages transmitted on the circuit by the WMSC will be copied by operating printers connected to the circuit. An exception to this is that the air traffic control computer shall not receive all messages on the forecast center circuit.

4.3.3 Way-Station Message Transmission

4.3.3.1 Message Preparation

Messages arriving at the WMSC from the low-speed circuits will be stored and routinely distributed according to content and origin in predetermined broadcast patterns. There may be variations of this general procedure. An example is the receipt of a request from, and retrieval and delivery of the requested message to, a specific station to satisfy a non-routine requirement.

Positive and straight forward identification of each message upon arrival at the WMSC is necessary to permit economical and expeditious handling of traffic. This requires making the separation between messages, and placing the address or content and origin information in fixed location and order in the message preamble. The formats now employed for Service C will require at least the regular use of a condition code, and the limitation of variations in preparation of the first part of the message tape, which will contain the content and origin information. Present Service A formats require the greatest change. The changes include the discontinuance of those select codes which are not station identifiers, and reduction in variations in the location and order of the content and origin information.

4.3.3.2 Way Station Message Formats

The following subsections include outline formats for transmission of typical reports and requests from way stations, and the complementary circuit control transmissions of the WMSC. The formats show the location and order of the information necessary to identify the message at the WMSC, and are not necessarily to be used for dissemination of the message. Two general formats, headed and non-headed, are shown in typical examples in Tables VII and VIII. In each example the message begins with the message identification group, preceded by the non-printing MCC. The complete message identification group consists of two alphanumeric sub-groups with necessary shift and space characters. The first sub-group designates a station and is a location identifier or an international station number such as SFO or 494. For most messages, this is transmitted by the WMSC and serves also as the TSC. The second sub-group is a content designator, for example, SM SR2 or NOTAM. An abbreviated message identification group, for scheduled, non-headed messages, omits the content designator. An advantageous feature of the foregoing formats is the establishment of a consistent order for the information which the WMSC will read in the message identification group, for both headed and non-headed messages, thus permitting simple and expeditious WMSC procedures. This consistency also greatly simplifies operator procedures.

Except where needed to show context, these outline formats show only the details of message preamble essential for WMSC identification of the message. Details included to show context are contained within parentheses. Portions transmitted by the WMSC are underlined. Format effectors (non-printing characters) required only for message print-out are not shown. Any format effectors such as line feeds, required by receiving equipment to physically separate messages disseminated by the WMSC, may be inserted by the WMSC. Within the message text, operators will continue to use the end-of-line sequence: carriage return-line feed (< ■). The carriage return should always precede the line feed, in order to provide additional time for the return of the printer carriage before printing resumes. Letters shift characters perforated at the end of tapes to permit the end-of-transmission code to clear the T/D reading pins are not shown in the format examples.

4.3.3.2.1 Hourly and Three Hourly Collections

A common transmission format will be employed for the scheduled SA (Service A), SM, SI and other regularly scheduled reports such as the UG, UJ and UZ (Service C) which are collected from stations on appropriate circuits in blocks of individual messages. The WMSC will generate appropriate weather headings for these collections in accordance with paragraph 610 of FAA/ATS publication, Communication Procedures, AT P 7300.1, as they are required for collection of blocks. The content identification will appear in the heading, the WMSC deriving this information from the time schedule, thus making it unnecessary for the individual stations to include it in their reports. Example 1, 2 and 3 in Table VII and 1 and 2 in Table VIII illustrate these formats.

4.3.3.2.2 Non-Hourly Scheduled Collections

Two transmission formats are required for these collections. One format is used for products such as the FA and the other is provided for the FT-1 and similar products having texts which may be subdivided for dissemination. The first type is illustrated by Example 13 in Table VII and Example 5 in Table VIII. Examples 15 and 6 in Tables VII and VIII respectively illustrate the l tter type, in which the WMSC has the option of separating the block into individual messages for dissemination in any desired pattern. Any block may be coded in this way.

4.3.3.2.3 Unscheduled Weather Collections

Both weather and request messages will be transmitted at random times in response to an WMSC poll. In an emergency a message classified as Urgent may be transmitted independently of a poll. Any type of report, including those normally transmitted within scheduled periods can appear[1]. This makes it imperative that each transmission include a content indicator, either in a heading or with the location identifier or index number in the preamble of the nonheaded message.

[1] Due to their random origin, special, missing and corrected SA's and SW's, SD's, individual PIREPS and individual NOTAMS will print out on the circuit of origin in no particular order. The WMSC will, however, assemble these reports in blocks by type for dissemination to other circuits.

Example 14, Table VII shows Memphis entering its Area PIREP Summary as a headed, complete block.

Examples of stations entering non-headed messages are as follows: Example 4, Table VII shows Topeka entering on Urgent Special Aviation Weather Report. Topeka is not being polled, but is seizing the circuit by sending a double break. The reperforator unblind code, location identifier and lock code have been punched at the beginning of the tape which Topeka has prepared.

Example 5 shows Toledo entering a missing or late Aviation Weather Report.

Example 6 shows Allegheny County entering Greater Pittsburgh's corrected Aviation Weather Report. The designator COR is part of the text, not required for WMSC recognition.

Example 7 shows Utica entering its individual NOTAM.

Example 8 shows Tallahassee entering a Supplementary Aviation Weather Report for Apalachicola.

Example 9 shows Laredo requesting Aviation Weather Reports made by Pine Bluff and Salina.

4.4.0 Implementation Period Coding

4.4.1 General

During the implementation period, it will be necessary to provide an interface between the high-speed ADIS trunk in the present system, and the WMSC of the new system. During this phase, the WMSC will act as an additional interchange center on ADIS and will control the high speed ADIS circuit. The WMSC must therefore be capable of recognizing data received from the ADIS trunk, and of effecting the required disposition of these data: second, the WMSC must be capable of transmitting all data collected on the circuits which it controls onto the ADIS trunk, coded in such a way that the present ADIS equipment may effect diversion to the low-speed circuits in accordance with present programs.

Data carried on ADIS can be divided into several groups according to the type of originating location and the manner of introduction into the system. From the way stations on the low-speed area circuits, there are scheduled collections and unscheduled collections of weather data. The scheduled collections occur at fixed times and are preceded by block headers, readily identifiable by the WMSC, and each individual message within the block is preceded by a start-of-message code and the station identifier, and followed by an end-of-message code, so that the messages may easily be separated for storage and subsequent dissemination. The unscheduled collections contain various types of messages, some identified in a standard manner, and some not. Minor changes in coding and identification procedures are required for some of these messages. From the ADIS S/RC's, blocks of data of various types are relayed on ADIS from COMET, Canadian, and Mexican, and Caribbean collectives, from the FAWS centers, and from other forecast offices. WMSC recognition problems are most critical in the forecast center transmissions, most of which consist of blocks of individual messages which, in their present form, cannot be readily separated by the WMSC. The problem of WMSC recognition of forecast center transmission will be overcome by connecting the new WMSC to forecast center 100 wpm circuits, as the first step in the implementation procedure. In this way, the need for special implementation period codes for these messages will be eliminated, and the messages may be coded, as previously described, in final system form. Interim programming of the WMSC will provide for transmission of these messages onto the ADIS high-speed trunk, by the WMSC, in their present ADIS form, so that, during the implementation phase, present users of the messages will be virtually unaware of the change.

In present ADIS operations, diversion is accomplished through the use of "select" codes. There are approximately 1100 of these codes designed into the ADIS message diversion equipment. Most of them correspond to location identifiers assigned to the weather reporting station, while others are assigned to a designated type of material from a specific location. For example, hourly surface observations (SA), Pilot Weather Reports (PIREP's) and Notices to Airmen (NOTAM's) originating at a common location share a common "select" code which is the location identifier assigned to that point. Also, each FAWS center is assigned separate select codes which are not location identifiers, for diversion of its Aviation Area Forecasts, Hurricane Advisories, Flight Advisories, Terminal Forecasts and Winds Aloft Forecasts.

In the cases where the originating station location identifier is used to effect ADIS diversion, the WMSC will use these same identifiers, supplemented by a block header, by time of occurrence or by a message type identifier immediately following the location identifier. In a few cases where a message type identifier is not presently used one will be added. However, in cases where one or more of the select codes which are not location identifiers precede the data, some minor changes will be made as further described below. Thus, in all cases WMSC recognition will be based on a small group of characters, well standardized in location and having only minor variations in form. This group will start with either the MCC ≡<↓<<↓ or MSC ≡<<↓ each of which ends in the SOM code <<↓ for which the WMSC will be searching, followed by a location identifier of 2, 3 or 4 characters, then a space character. For all unscheduled messages on the area circuits, the space will be followed immediately by a content designator.

4.4.2 Discussion and Examples of Coding on Service A during Implementation

Data traffic will arrive at the ADIS-WMSC Interface in blocks of one or more messages. The block may commence with a weather heading or with a non-headed message. The hourly scheduled SA blocks have headings now coded as discrete messages. They are followed by non-headed SA messages containing the meteorological information to which the heading pertains. Some unscheduled messages have headings which are an integral part of a single discretely coded message. Other unscheduled messages are non-headed and are discretely coded.

In the following sub-sections the various messages appearing on the ADIS high-speed circuit are classified according to the format categories outlined in the preceding paragraph. The formats are illustrated by examples in Table VII, and the utility of these formats for WMSC recognition is discussed. The table indicates both the present formats and the formats required during the implementation phase, so that the required changes are immediately apparent. Since the underlined portions in the examples are' transmitted by the APULS or the WMSC, it is apparent that the changes required of the way-station operators are minimal. The messages transmitted by forecast centers are omitted from the following discussion since they will be transmitted directly on the new circuits to the WMSC, making WMSC recognition of forecast center messages from the ADIS high speed circuit unnecessary. All unscheduled way-station transmissions on the area circuits will be in the form of individual messages, with a message type identifier following the location identifier at the head of each message.

4.4.2.1 Hourly Aviation Weather (SA) Headings

SA headings are coded as discrete messages and will arrive at the ADIS-WMSC interface during scheduled periods. These headings are automatically generated by the APULS and appear on the high-speed circuit in the following typical form: ≡<↓<<↓↑021>↓SA(↑21180200≡<↓) in which 021 indicates the area circuit of origin. Here the group of characters preceding the parentheses contains all of the information necessary for WMSC identification in fixed order and form, the only variable being the last two digits of the circuit number.

4.4.2.2 Non-Headed Scheduled Messages

Domestic Service A messages included in this classification are discretely coded individual station reports which make up the bodies of fifteen separately headed blocks of SA data. They will appear at the ADIS-WMSC interface during a scheduled period at the beginning of each hour as shown in Example 1 of Table VII in which TOL is a location identifier which indicates the origin of the data contained in the text. Examples 2 and 3 show similar formats, in which one station enters another's report. It should be noted that the content designator (SA) does not appear in the preamble of these individual station reports. The WMSC can identify these messages by referring to the time schedule to determine content and by recognizing the location identifier immediately following the SOM (<<↓) to determine origin. USAF, Canadian, Mexican and Caribbean station reports, as they appear on the ADIS high-speed circuit, are similarly coded, permitting similar WMSC recognition.

4.4.2.3 Unscheduled Messages

Messages in this category may be further classified in two sub-categories; (a) messages such as PIREP's which employ a location identifier as the select code, and ( ) SW and SD messages which employ character combinations as the select codes which have no other special significance.

4.4.2.3.1 Location Identifier Select Codes

Messages in this sub-category are individual PIREP's and NOTAM's special, missing, and corrected Aviation Weather Reports.

4.4.2.3.1.1 PIREP's and NOTAM's

These will appear at the ADIS-WMSC interface in the form of Example 7, in which UCA refers to the station of origin of the data. The characters ↑→↓ are the special pre-NOTAM code. The word PIREP will appear in this position on PIREP messages. Here again the preamble contains the origin and content information in a standard order following the conditioning code, thus permitting ready recognition by the WMSC.

4.4.2.3.1.2 Special, missing and corrected Aviation Weather Reports

These now employ an abbreviated version of the preceding typical form, omitting the content designator. To permit positive WMSC identification of these messages, the appropriate content designator (SA in most cases) will be inserted in the preamble at the point of entry on the Service A network. Such messages will then arrive at the ADIS-WMSC interface in the format of Examples 5 and 6, which will permit positive and straight forward WMSC recognition. Example 4 illustrates a similar format for an urgent special. In this case the break-break procedure is used to seize the circuit. The implementation period format is the same as present, except that the content designator SPL will be used, rather than S, for more positive WMSC recognition. This designator is currently used for Service C specials.

4.4.2.3.2 Select Codes Not Indicating Origin

SD and SW reports presently appear on the high-speed circuit at irregular intervals preceded by special select codes which do not uniquely identify the origin of the message. Their formats are otherwise similar, so they may be considered together. An example of the present transmission format is given in Table VII, in which TLH is the transmitting station, GDW, 039 and 054 are special diversion codes, and AQQ is the station whose SW is being transmitted. The WMSC will be attempting to identify the message by its normal procedures, searching for a SOM - select code - space - content designator sequence. On this basis, TLH, GDW, 039 and 054 will be ignored, since they are not followed by content designators. (Furthermore, GDW, 039 and 054 are not location identifiers that will be programmed in the WMSC.) The addition of the MSC preceding AQQ will permit WMSC recognition, if AQQ is followed by a space and the content identifier, SW. However, during the implementation phase this would result in incorrect diversion of the message, since AQQ is a special diversion code used for a block of FD messages. To prevent incorrect diversion, a letters shift will be added between the location identifier and the space, as shown in the example, for the implementation phase.

Considering all the SW messages at present transmitted on Service A there are about 20 where this problem of potential incorrect diversion arises. In most cases, the SW location identifier is used for diversion of groups of FT-1 messages. Of the 20 SD messages on Service A, the problem would arise in 5 cases, where the SD originating station also transmits a SA message, and hence would result in diversion according to the pattern for the SA from that station. In order to standardize way-station operator procedures, and extra letters shift will be inserted for all SW and SD messages during the implementation phase.

4.4.3 WMSC Transmissions onto the ADIS High-Speed Circuit

During the implementation phase of the modernized system, the newly activated WMSC will be required to introduce traffic onto the ADIS high-speed trunk circuit in a manner similar to the present IC's and S/RC's. The data transmitted by the WMSC must be composed and formatted in accordance with present procedures, so that diversion to low-speed circuits in the unconverted part of the system will be effected by the message directors at the IC's and S/RC's without program changes.

The WMSC will take over the functions of the APUHS at the beginning of the implementation period. As circuits served by a particular I/C are cut over to WMSC operation, the WMSC will poll itself for the data from these circuits and will poll the remaining I/C's as in regular ADIS operation until all I/C's are phased out. This will avoid the necessity of making numerous changes to the APUHS program as implementation proceeds, which would be difficult. Instead a simpler interim WMSC program will be required which will initially duplicate the present APUHS transmission of high speed control functions, and provide for the successive changes as implementation advances.

The system control code used by APUHS for sequential collection and distribution of data on the high-speed circuit is a 10 character code - ↑<↓<<↓ (2 variable characters) ⇛ - where the two variable characters identify the high-speed transmitter, at an IC or S/RC, being polled. The polled transmitter responds with data, or with the "not available" signal, ↑<↓ . The polls must, of course, be conducted in accordance with the present ADIS schedule.

There are no significant problem areas associated with the transmission of data onto the ADIS high-speed line by the WMSC during the implementation period. An interim program will be required to ensure that all transmissions conform to present ADIS format. SA messages will be transmitted in block form having the required area circuit header for diversion of the data heading and date-time groups. For compatibility with existing ADIS message directors, existing area select codes will be used. This will require the WMSC to form blocks of SA reports according to ADIS area circuit groupings for relay into ADIS. Each individual message within the block must be preceded by the present ADIS start-of-message code (<<↓) and followed by the end-of-message code (≡<↓). In addition, the lock code (>) must follow the location identifier. Present area circuit headers used with these reports have the form ≡<↓<<↓↑ (area select code)>↓ SA ↑ (circuit code DTG)≡<↓ .

During the remainder of each hour, the WMSC will transmit data normally transmitted by an interchange or send/receive center into the ADIS high-speed circuit. The WMSC must be programmed to insert select/diversion codes in accordance with present ADIS procedures.

4.4.4 Implementation Coding for Service C Data

The present Service C teletypewriter system is composed of six 100 wpm circuits, numbered 30 through 35. The circuits are interconnected through two relay stations, located at Denver and Louisville, where relays from circuit to circuit are performed by means of manual torn-tape operations. The entire system is operated in accordance with a rigid schedule, with the exception of "star" periods, during which unscheduled messages may be transmitted.

Weather reports of various types are transmitted on the Service C circuits by individual weather stations, by forecast offices, by the two major relay stations and by several other relay points which introduce reports from outside the domestic United States. All reports entered by the individual stations in accordance with the schedule are transmitted under the control of a trigger station, which sends polling signals to each station on its circuits at the required times. Transmission by the forecast offices and relay stations are made in accordance with the schedule, in the specified order of transmitting points on each circuit, without the benefit of polling by a centralized control point.

During the implementation of the modernized communications system, it will be necessary to provide an interface between the present Service C and the WMSC. Implementation of the final codes will be made at one time, nationwide, prior to commencing the implementation of the WMSC. These codes will have no appreciable adverse effect on the present Service C and will enable the WMSC to recognize all data originating both on new circuits under its control and on the remaining old circuits during the implementation period. Circuit change-over will be accomplished by first connecting the existing six circuits to the WMSC and decommissioning the present relay stations at Louisville and Denver. Circuits will then be increased and reconfigured on a phase-in basis. An interim WMSC program will be required to initially duplicate existing collections and relays and then to accommodate the circuit changes which will be made as implementation progresses.

The methods of coding messages in the final system, both for individual station transmissions of single or multiple reports and for stations entering complete blocks or portions of blocks, scheduled or unscheduled, and headed or non-headed, are illustrated by examples in Table VIII.

The various forecast offices enter blocks of data of many different types on Service C circuits, in a prescribed order at scheduled times. These blocks are not preceded by any polling characters, and, if they are correctly headed in accordance with the coding plan for the final system, as illustrated in Table VIII, the WMSC will have no difficulty in recognizing the data and handling them appropriately for storage and dissemination on other Service C circuits. Individual reports within blocks must, of course, be separated by the required message separator code so that they may be stored or disseminated individually by the WMSC.

4.4.5 Coding Considerations on Service O

During initial operations of the WMSC, Service O data will continue to be handled in blocks of messages or composite bulletins as used in the present Service O operation. Block or bulletin headings are listed in the International Weather Schedules Service O referenced in Part 2, Contents of Weather Collections.

Data originating in the U. S. for transmission to overseas points via Service O circuits will be collected by the WMSC over the circuits previously discussed or will be provided from the W. B. National Meteorological Center, Suitland, Maryland, over the high-speed link in accordance with procedures to be detailed at a later time. Data received from overseas points will not reliably follow uniform coding procedures for indicating the beginning and ending of blocks or bulletins during transmission. In most cases bulletins will be separated by a series of line feeds on the order of four or more. In some cases end of bulletins will be indicated by 4N's following the line feeds and the letters ZCZC may precede the headings previously referenced. The WMSC must be programmed to recognize the bulletin headings on the above basis insofar as possible. Data which cannot be recognized by the WMSC will be diverted to a manual supervision position for identification and disposition. More uniform procedures for indicating stop and start of messages are being sought and when established should be similar to the message separating codes on Services A and C.

6-3505

Federal Aviation Agency, Systems Research and Development Service, Washington, D. C.
MODERNIZED WEATHER TELETYPEWRITER COMMUNICATIONS SYSTEM by Agency Working Group, Robert F. Decker, Chairman, March 1966, 76 pp, incl. illus.
(Subprogram No. 233-001, Report No. RD-66-21)

Unclassified Report

This System Description has been prepared by an interservice working group established by the Director, Systems Research and Development Service and chaired by a representative of the Communications Development Division.

This document defines and describes a teletypewriter communications system designed to effect the collection and exchange of weather reports, forecasts and other related weather data on a national basis. It also provides for the exchange of data to and from overseas meteorological organizations. It is the primary digital data transfer system supporting the National Weather Services of the Weather Bureau, The Aviation Weather Services of the FAA and also provides a major support to the military weather services.

(over)

UNCLASSIFIED

I. Decker, Robert F.
II. Subprogram No. 233-001
III. Report No. RD-66-21

Descriptors

Weather Service
Teletypewriter
EDP Message Switch
NOTAMS

UNCLASSIFIED

Federal Aviation Agency, Systems Research and Development Service, Washington, D. C.
MODERNIZED WEATHER TELETYPEWRITER COMMUNICATIONS SYSTEM by Agency Working Group, Robert F. Decker, Chairman, March 1966, 76 pp, incl. illus.
(Subprogram No. 233-001, Report No. RD-66-21)

Unclassified Report

This System Description has been prepared by an interservice working group established by the Director, Systems Research and Development Service and chaired by a representative of the Communications Development Division.

This document defines and describes a teletypewriter communications system designed to effect the collection and exchange of weather reports, forecasts and other related weather data on a national basis. It also provides for the exchange of data to and from overseas meteorological organizations. It is the primary digital data transfer system supporting the National Weather Services of the Weather Bureau, The Aviation Weather Services of the FAA and also provides a major support to the military weather services.

(over)

UNCLASSIFIED

I. Decker, Robert F.
II. Subprogram No. 233-001
III. Report No. RD-66-21

Descriptors

Weather Service
Teletypewriter
EDP Message Switch
NOTAMS

UNCLASSIFIED

Federal Aviation Agency, Systems Research and Development Service, Washington, D. C.
MODERNIZED WEATHER TELETYPEWRITER COMMUNICATIONS SYSTEM by Agency Working Group, Robert F. Decker, Chairman, March 1966, 76 pp, incl. illus.
(Subprogram No. 233-001, Report No. RD-66-21)

Unclassified Report

This System Description has been prepared by an interservice working group established by the Director, Systems Research and Development Service and chaired by a representative of the Communications Development Division.

This document defines and describes a teletypewriter communications system designed to effect the collection and exchange of weather reports, forecasts and other related weather data on a national basis. It also provides for the exchange of data to and from overseas meteorological organizations. It is the primary digital data transfer system supporting the National Weather Services of the Weather Bureau, The Aviation Weather Services of the FAA and also provides a major support to the military weather services.

(over)

UNCLASSIFIED

I. Decker, Robert F.
II. Subprogram No. 233-001
III. Report No. RD-66-21

Descriptors

Weather Service
Teletypewriter
EDP Message Switch
NOTAMS

UNCLASSIFIED

Federal Aviation Agency, Systems Research and Development Service, Washington, D. C.
MODERNIZED WEATHER TELETYPEWRITER COMMUNICATIONS SYSTEM by Agency Working Group, Robert F. Decker, Chairman, March 1966, 76 pp, incl. illus.
(Subprogram No. 233-001, Report No. RD-66-21)

Unclassified Report

This System Description has been prepared by an interservice working group established by the Director, Systems Research and Development Service and chaired by a representative of the Communications Development Division.

This document defines and describes a teletypewriter communications system designed to effect the collection and exchange of weather reports, forecasts and other related weather data on a national basis. It also provides for the exchange of data to and from overseas meteorological organizations. It is the primary digital data transfer system supporting the National Weather Services of the Weather Bureau, The Aviation Weather Services of the FAA and also provides a major support to the military weather services.

(over)

UNCLASSIFIED

I. Decker, Robert F.
II. Subprogram No. 233-001
III. Report No. RD-66-21

Descriptors

Weather Service
Teletypewriter
EDP Message Switch
NOTAMS

UNCLASSIFIED

UNCLASSIFIED

This design centralizes, consolidates and automates the message switching functions of the existing weather teletypewriter Services A, C and O within the Weather Message Switching Center (WMSC). It reconfigures circuitry and reschedules data distribution to more effectively meet users requirements. The WMSC is a solid state, real time, communications type, electronic data processor operating as a centralized store and forward message switch to automatically control and perform all polling, collection, storage, selection and redistribution functions related to the handling of weather and Notices to Airmen (NOTAM) message traffic carried by the system.

UNCLASSIFIED

UNCLASSIFIED

This design centralizes, consolidates and automates the message switching functions of the existing weather teletypewriter Services A, C and O within the Weather Message Switching Center (WMSC). It reconfigures circuitry and reschedules data distribution to more effectively meet users requirements. The WMSC is a solid state, real time, communications type, electronic data processor operating as a centralized store and forward message switch to automatically control and perform all polling, collection, storage, selection and redistribution functions related to the handling of weather and Notices to Airmen (NOTAM) message traffic carried by the system.

UNCLASSIFIED

UNCLASSIFIED

This design centralizes, consolidates and automates the message switching functions of the existing weather teletypewriter Services A, C and O within the Weather Message Switching Center (WMSC). It reconfigures circuitry and reschedules data distribution to more effectively meet users requirements. The WMSC is a solid state, real time, communications type, electronic data processor operating as a centralized store and forward message switch to automatically control and perform all polling, collection, storage, selection and redistribution functions related to the handling of weather and Notices to Airmen (NOTAM) message traffic carried by the system.

UNCLASSIFIED

UNCLASSIFIED

This design centralizes, consolidates and automates the message switching functions of the existing weather teletypewriter Services A, C and O within the Weather Message Switching Center (WMSC). It reconfigures circuitry and reschedules data distribution to more effectively meet users requirements. The WMSC is a solid state, real time, communications type, electronic data processor operating as a centralized store and forward message switch to automatically control and perform all polling, collection, storage, selection and redistribution functions related to the handling of weather and Notices to Airmen (NOTAM) message traffic carried by the system.

UNCLASSIFIED

Federal Aviation Agency, Systems Research and Development Service, Washington, D. C.
MODERNIZED WEATHER TELETYPEWRITER COMMUNICATIONS SYSTEM by Agency Working Group, Robert F. Decker, Chairman, March 1966, 76 pp, incl. illus.
(Subprogram No. 233-001, Report No. RD-66-21)

Unclassified Report

This System Description has been prepared by an interservice working group established by the Director, Systems Research and Development Service and chaired by a representative of the Communications Development Division.

This document defines and describes a teletypewriter communications system designed to effect the collection and exchange of weather reports, forecasts and other related weather data on a national basis. It also provides for the exchange of data to and from overseas meteorological organizations. It is the primary digital data transfer system supporting the National Weather Services of the Weather Bureau, The Aviation Weather Services of the FAA and also provides a major support to the military weather services.

(over)

UNCLASSIFIED

I. Decker, Robert F.
II. Subprogram No. 233-001
III. Report No. RD-66-21

Descriptors

Weather Service
Teletypewriter
EDP Message Switch
NOTAMS

UNCLASSIFIED

Federal Aviation Agency, Systems Research and Development Service, Washington, D. C.
MODERNIZED WEATHER TELETYPEWRITER COMMUNICATIONS SYSTEM by Agency Working Group, Robert F. Decker, Chairman, March 1966, 76 pp, incl. illus.
(Subprogram No. 233-001, Report No. RD-66-21)

Unclassified Report

This System Description has been prepared by an interservice working group established by the Director, Systems Research and Development Service and chaired by a representative of the Communications Development Division.

This document defines and describes a teletypewriter communications system designed to effect the collection and exchange of weather reports, forecasts and other related weather data on a national basis. It also provides for the exchange of data to and from overseas meteorological organizations. It is the primary digital data transfer system supporting the National Weather Services of the Weather Bureau, The Aviation Weather Services of the FAA and also provides a major support to the military weather services.

(over)

UNCLASSIFIED

I. Decker, Robert F.
II. Subprogram No. 233-001
III. Report No. RD-66-21

Descriptors

Weather Service
Teletypewriter
EDP Message Switch
NOTAMS

UNCLASSIFIED

Federal Aviation Agency, Systems Research and Development Service, Washington, D. C.
MODERNIZED WEATHER TELETYPEWRITER COMMUNICATIONS SYSTEM by Agency Working Group, Robert F. Decker, Chairman, March 1966, 76 pp, incl. illus.
(Subprogram No. 233-001, Report No. RD-66-21)

Unclassified Report

This System Description has been prepared by an interservice working group established by the Director, Systems Research and Development Service and chaired by a representative of the Communications Development Division.

This document defines and describes a teletypewriter communications system designed to effect the collection and exchange of weather reports, forecasts and other related weather data on a national basis. It also provides for the exchange of data to and from overseas meteorological organizations. It is the primary digital data transfer system supporting the National Weather Services of the Weather Bureau, The Aviation Weather Services of the FAA and also provides a major support to the military weather services.

(over)

UNCLASSIFIED

I. Decker, Robert F.
II. Subprogram No. 233-001
III. Report No. RD-66-21

Descriptors

Weather Service
Teletypewriter
EDP Message Switch
NOTAMS

UNCLASSIFIED

Federal Aviation Agency, Systems Research and Development Service, Washington, D. C.
MODERNIZED WEATHER TELETYPEWRITER COMMUNICATIONS SYSTEM by Agency Working Group, Robert F. Decker, Chairman, March 1966, 76 pp, incl. illus.
(Subprogram No. 233-001, Report No. RD-66-21)

Unclassified Report

This System Description has been prepared by an interservice working group established by the Director, Systems Research and Development Service and chaired by a representative of the Communications Development Division.

This document defines and describes a teletypewriter communications system designed to effect the collection and exchange of weather reports, forecasts and other related weather data on a national basis. It also provides for the exchange of data to and from overseas meteorological organizations. It is the primary digital data transfer system supporting the National Weather Services of the Weather Bureau, The Aviation Weather Services of the FAA and also provides a major support to the military weather services.

(over)

UNCLASSIFIED

I. Decker, Robert F.
II. Subprogram No. 233-001
III. Report No. RD-66-21

Descriptors

Weather Service
Teletypewriter
EDP Message Switch
NOTAMS

UNCLASSIFIED

This design centralizes, consolidates and automates the message switching functions of the existing weather teletypewriter Services A, C and O within the Weather Message Switching Center (WMSC). It reconfigures circuitry and reschedules data distribution to more effectively meet users requirements. The WMSC is a solid state, real time, communications type, electronic data processor operating as a centralized store and forward message switch to automatically control and perform all polling, collection, storage, selection and redistribution functions related to the handling of weather and Notices to Airmen (NOTAM) message traffic carried by the system.

UNCLASSIFIED

UNCLASSIFIED

This design centralizes, consolidates and automates the message switching functions of the existing weather teletypewriter Services A, C and O within the Weather Message Switching Center (WMSC). It reconfigures circuitry and reschedules data distribution to more effectively meet users requirements. The WMSC is a solid state, real time, communications type, electronic data processor operating as a centralized store and forward message switch to automatically control and perform all polling, collection, storage, selection and redistribution functions related to the handling of weather and Notices to Airmen (NOTAM) message traffic carried by the system.

UNCLASSIFIED

UNCLASSIFIED

This design centralizes, consolidates and automates the message switching functions of the existing weather teletypewriter Services A, C and O within the Weather Message Switching Center (WMSC). It reconfigures circuitry and reschedules data distribution to more effectively meet users requirements. The WMSC is a solid state, real time, communications type, electronic data processor operating as a centralized store and forward message switch to automatically control and perform all polling, collection, storage, selection and redistribution functions related to the handling of weather and Notices to Airmen (NOTAM) message traffic carried by the system.

UNCLASSIFIED

UNCLASSIFIED

This design centralizes, consolidates and automates the message switching functions of the existing weather teletypewriter Services A, C and O within the Weather Message Switching Center (WMSC). It reconfigures circuitry and reschedules data distribution to more effectively meet users requirements. The WMSC is a solid state, real time, communications type, electronic data processor operating as a centralized store and forward message switch to automatically control and perform all polling, collection, storage, selection and redistribution functions related to the handling of weather and Notices to Airmen (NOTAM) message traffic carried by the system.

UNCLASSIFIED

UNCLASSIFIED