DOT/FAA/SE-92/5

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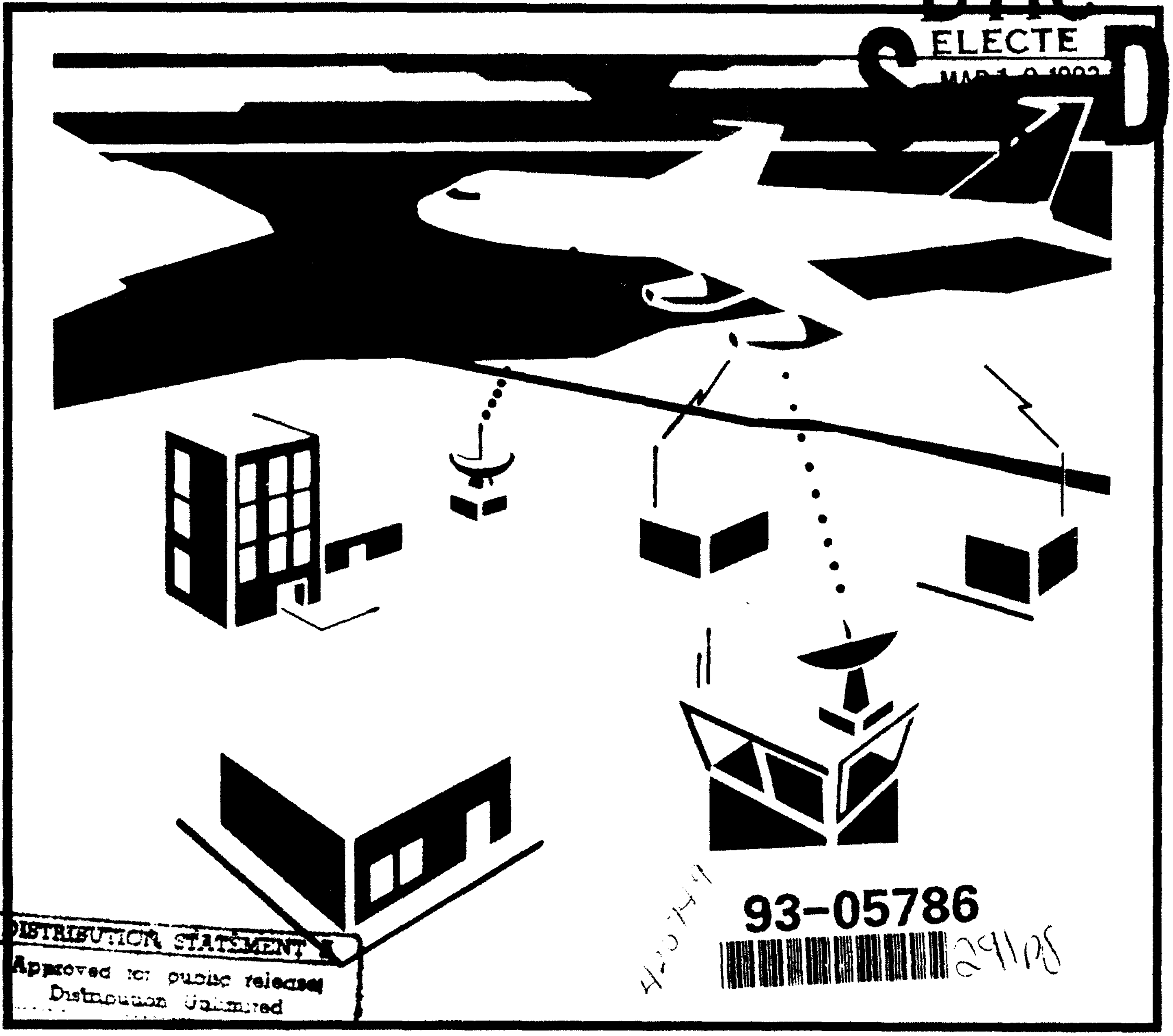
National Airspace System

Air Traffic Control and Airspace Management Operational Concept

NAS-SR-132

U.S. Department
of Transportation

**Federal Aviation
Administration**



420749

93-05786

29105

December 1992

NOTICE

Technical Report Documentation Page

1. Report No.
DOT/FAA/SE-92/5

2. Government Accession No.

3. Recipient's Catalog No.

4. Title and Subtitle
National Airspace System Operational Concept
Air Traffic Control and Airspace Management
NAS-SR-132

5. Report Date
December 1992

6. Performing Organization Code

7. Author(s)
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8. Performing Organization Report No.

9. Performing Organization Name and Address
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10. Work Unit No. (TRAIS)

11. Contract or Grant No.
DTFA01-91-Y-01004

12. Sponsoring Agency Name and Address
U.S. Department of Transportation
Federal Aviation Administration
800 Independence Ave., SW
Washington, DC 20591

13. Type of Report and Period Covered

14. Sponsoring Agency Code
ASE-300, Thomas Higgins

15. Supplementary Notes

16. Abstract

The NAS has a responsibility to assist in the safe and efficient flow of traffic from departure aerodrome (or entrance to the system) to destination aerodrome (or exit from the system). It provides flight control services in the en route, terminal, and oceanic airspace. It also provides search and rescue services to locate lost aircraft. In order to exercise control of aircraft, the NAS must have information about the expected routes, times, altitudes of flight, and aircraft characteristics. It must also have information about current location, altitude, and track for each participating aircraft in the system.

This concept, and the other seven operational concepts, will complete the description of the system requirements as described in the NASSRS.

The eight operational concepts are: Communications (NAS-SR-136); Navigation (NAS-SR-134); Monitoring (NAS-SR-133); Maintenance and Support (NAS-SR-137); System Effectiveness (NAS-SR-138); Air Defense and Law Enforcement Surveillance (NAS-SR-135); Flight Planning (NAS-SR-131); and Air Traffic Control and Airspace Management (NAS-SR-132).

17. Key Words
Air Traffic Control
Airspace Management
National Airspace System

18. Distribution Statement
Document is available to the public through
the National Technical Information Service
Springfield, VA 22161

19. Security Classif. (of this report)
UNCLASSIFIED

20. Security Classif. (of this page)
UNCLASSIFIED

21. No. of Pages
269

22. Price

Form DOT F 1700.7 (8–72)

Reproduction of completed page authorized

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1.2 Objective

The objective of this operational concept, which is based upon the National Airspace System System Requirements Specification (NASSRS) paragraph 3.2, is to describe how Air Traffic Control and Airspace Management requirements are met in the future NAS.

More specifically, the purpose of this document is to accomplish the following:

- Provide a common operational perspective across those subsystems, operators, and users that provide air traffic control and airspace management.
- Show the interrelationship between subsystems, facilities, information, and operators/users.

1.3 Scope

This operational concept describes air traffic control and airspace management capability provided in the NAS as outlined in Section 3.2 of the NASSRS. The operations described are limited to those associated solely with air traffic control and airspace management.

The specific paragraphs in the NASSRS Section 3.2 are as follows:

3.2.1 Airspace Management

- 3.2.1.A Projection of Demand and Capacity
- 3.2.1.B Projection of Arrivals and Departures
- 3.2.1.C Determination of Current Location, Altitude, Speed, and Track for Participating Aircraft
- 3.2.1.D Prediction of Location, Altitude, Speed and Track
- 3.2.1.E Weather Data for Flow Control
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1.4 Methodology

The methodology employed to develop this operational concept is similar to the methods and tools used for system development in that successive levels of decomposition of the air traffic control and airspace management functions are represented. This document starts with the overall concept and proceeds to its most elemental levels of support, diagrammatic tools, and techniques that constitute air traffic control and airspace management within the NAS. These analytical tools are:

1. Operational Block Diagram/Description. The operational block diagram illustrates the connectivity between major elements of the

NAS, i.e., processors, specialists/controllers, and the user for those elements that support the service. The operational block diagram in this operational concept is extracted from the overall NAS operational block diagram. Principal features of the operational block diagram/description include the following:

a. Each specialist/controller is indicated by a number. This number remains the same in every NASSRS operational concept.

b. Dotted lines segregate facilities.

c. Solid lines show digital data flow, and voice data flow is also shown. Each type of data flow is appropriately labeled.

d. The blocks within each facility are the major processors.

2. Operational Flow Diagrams/Descriptions. An operational flow diagram and associated description for each specialist provides detail about the inputs, processes, outputs, and interfaces for each operator; thus, the operational flow diagram provides an expansion of each element of the NAS shown in the air traffic control and airspace management master block diagram. Operational flow diagrams are used to functionally describe the products and services of individual specialists. Principal features of the Operational Flow Diagram include the following:

a. Dotted lines segregate facilities.

b. Larger white boxes at the center of each diagram indicate specialist/controller/user functions. Shaded boxes indicate supporting systems.

c. The functions listed by lower case alphabetic characters in the white and shaded boxes are explained in the text.

3. Operational Sequence Diagrams/Descriptions. The operational sequence diagram and associated description show a typical sequence of steps taken by operators/users in supporting air traffic control and airspace management operations. Principal features of an operational sequence diagram include the following:

a. Users, specialists, and computer systems involved with providing air traffic control and airspace management functions are listed along the vertical axis. When required for clarity, other FAA facilities may also be listed on the vertical axis.

b. The horizontal axis represents time. Sequential events or functions performed are indicated within separate boxes. Events which may occur simultaneously or near-simultaneously are shown vertically.

c. Decision points or points where alternate paths may be followed are indicated by a diamond shape.

d. Circles, if used, are connectors and indicate exit to, or entry from, another diagram. Circles with a lower case alphabetic character reference an operator function described in the figure listed below the circle. Circles connect either to another sheet of the same diagram or to another diagram; the relevant figure number is listed underneath if connection is to a different diagram. Thus, the relationship between operator/user interactions and relevant NAS subsystems can be depicted.

4. Operational Scenario Diagrams/Descriptions The operational scenario diagram and associated descriptions depict a specific predefined situation and illustrates a particular subset of the generalized operational sequence or unusual situation not covered by the operational sequence diagrams. Principal features of operational scenario diagrams include the following:

   a. Users and specialists/controllers involved with providing the service are listed along the vertical axis.

   b. The horizontal axis represents time. Sequential events or functions performed by an operator/user are indicated within separate boxes. The numbers on the right side of the blocks refer to numbers in the text.

1.5 Document Organization

Each of the following twelve sections of this document is divided into six subsections:

Support provides an overview description of the air traffic control and airspace management functions and introduces (identifies) the personnel complement and physical entities (facilities and computer systems), which provide the required support.

Information describes the information used to provide air traffic control and airspace management support.

Functions provides descriptions of the functional decomposition of air traffic control and airspace management services.

Correlation of Operational Requirements correlates the air traffic control and airspace management requirements paragraphs of NAS-SR-1000 with the paragraphs that describe the functions being performed by the specialists/controllers.

Operational Sequences illustrates the interactions between NAS personnel and systems (Computer-Human Interface, CHI) during the planning and implementational phases of air traffic control and airspace management services.

Operational Scenarios describes operational scenarios for hypothetical interactions between users and operators/specialists for specific cases.

1.6 NAS Facilities/Systems/Positions

Figure 1-1 is an overview of NAS/user interfaces for air traffic control and airspace management and illustrates the NAS facilities and systems involved. The overall box labelled "NAS" in Figure 1-1 is comprised of the following entities:

Traffic Management Facility (TMF) consists of the Air Traffic Control Command Center (ATCCC) and the Traffic Management Processor (TMP) which is located at the FAA Technical Center (FAATC). The TMF is a national system of procedures, specialists, software, computer supported services, work stations, communications equipment, and data bases.

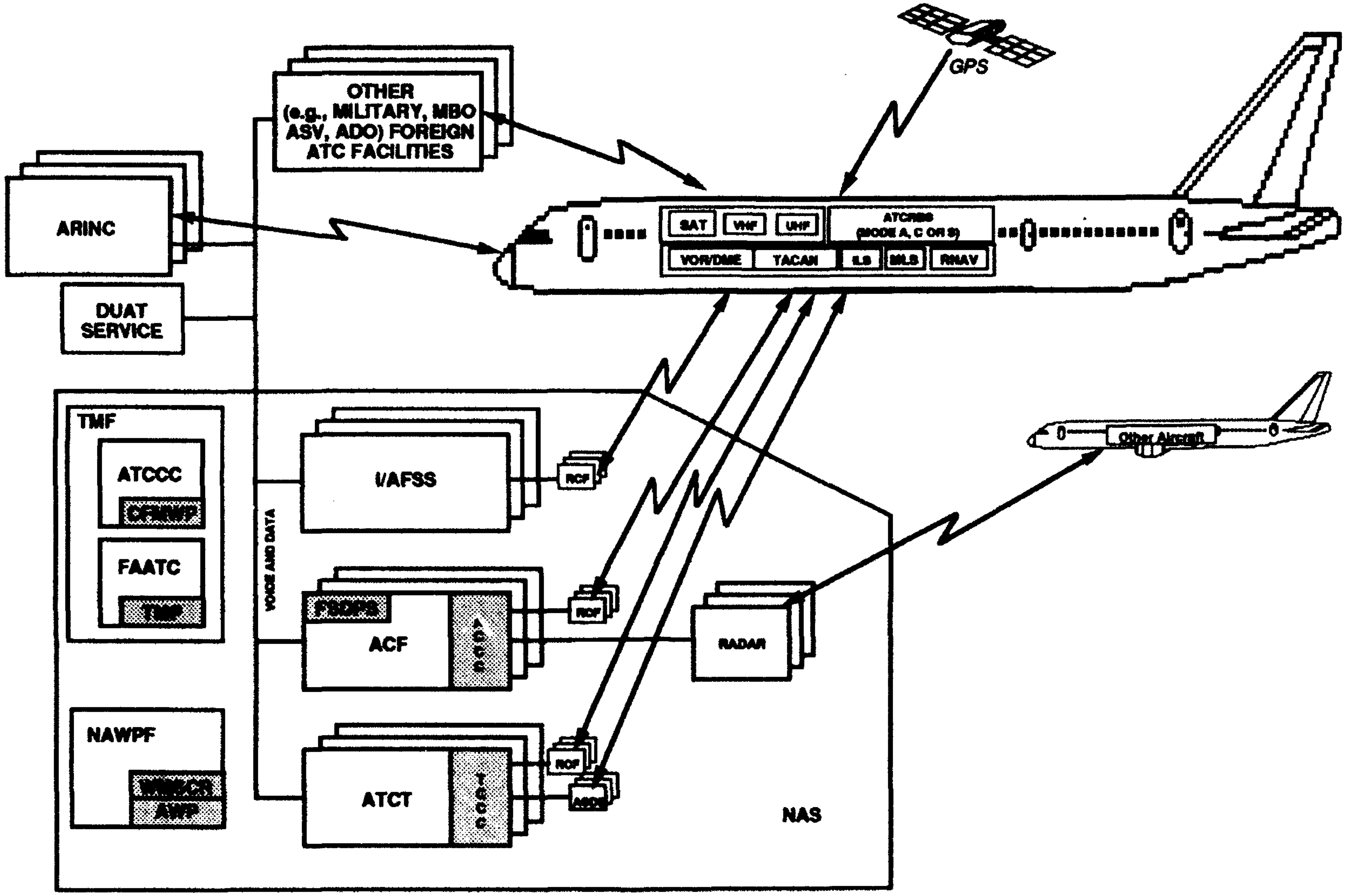


FIGURE 1-1

OVERVIEW OF NAS/USER SYSTEMS FOR
AIR TRAFFIC CONTROL AND AIRSPACE MANAGEMENT

These ensure an orderly, precise, safe, and efficient flow of controlled air traffic through the application of management, systems, and planning processes which are utilized to minimize delays, maximize airport and airspace utilization, and optimize fuel usage.

National Aviation Weather Processing Facility (NAWPF) serves as the centralized locations for collecting, formatting, editing, and distributing aviation weather products and Notices to Airmen (NOTAMS) for the NAS. This facility includes the Weather Message Switching Center (WMSC) Replacement, which provides the interface between the NAS and the National Meteorological Center of the National Weather Service. The Aviation Weather Processor (AWP) serves as the centralized locations for the collection and distribution of flight service weather products and processed NOTAMs for the Automated Flight Service Stations.

Automated Flight Service Stations (AFSS) or International AFSS (I/AFSS) is a facility manned by flight service specialists who support pilots by providing pilot weather briefings, flight emergency assistance, flight plan filing, En route Flight Advisory Service (EFAS).

Area Control Facility (ACF) contains processing, communications, and position equipment to support air traffic control and flight service operations within designated geographic and airspace boundaries. The Area Control Computer Complex (ACCC) is the equipment and software that provides the automation support for air traffic control services at the regional level. The Flight Service Data Processing System (FSDPS) provides centralized data base and processing capabilities to support the flight services performed by specialists in the associated AFSS facilities.

Air Traffic Control Tower (ATCT) is the facility responsible for the control of aircraft arriving or departing an airport, operating within the airport traffic control area or taxiing on the airport. ATCT operational services are provided by controllers using the Tower Control Computer Complex (TCCC) and the Airport Surface Detection Equipment (ASDE), which provides tower controllers with real-time, high resolution display of the locations of vehicles and aircraft on the airport movement area.

Figure 1-2 is an operational block diagram showing the interrelationships between equipment, facilities, operators/users and the information necessary to support air traffic control and airspace management. Those systems which are monitored by the Remote Maintenance Monitoring System (RMMS) are depicted in black.

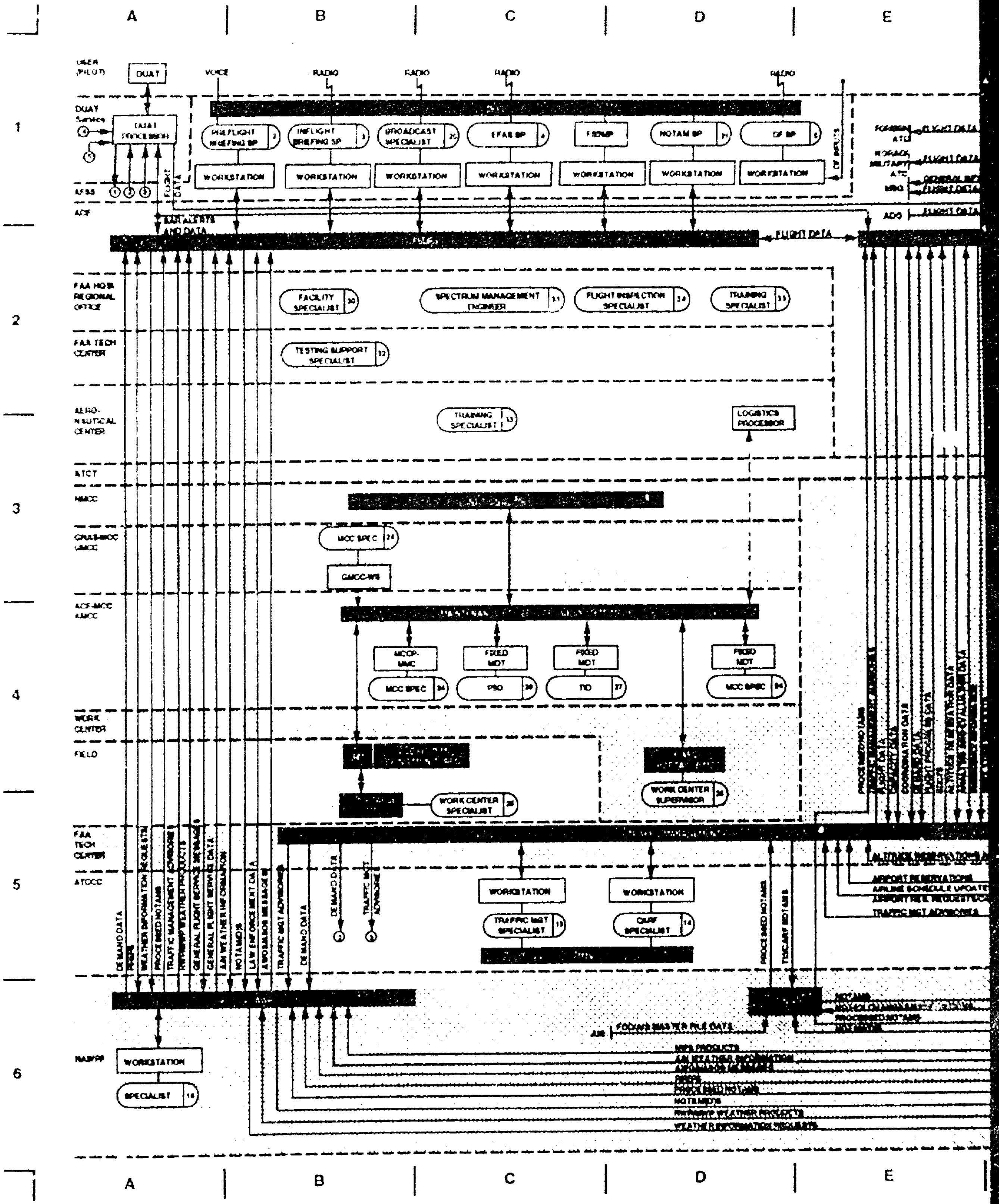
A succinct description of the functions associated with each specialist position represented in the block diagram (Figure 1-2) is provided in the following paragraphs. Included with each description is a reference to the current procedures manual for the position and to those NAS projects that are most likely to affect how the specialist provides the service.

AUTOMATED FLIGHT SERVICE STATION (AFSS)

Position 2: Preflight Briefing Position

Function: Provide preflight briefing to pilots, enter flight plans, inform users about airspace reservations related to military operations.
Description: The AFSS specialist delivers preflight briefings to pilots either over the phone or in person and enters the flight plans into the Flight

NAS


A
B
C
D
E
1
2
3
4
5
6
USER (PILOT)
DUAT
VOICE
RADIO
RADIO
RADIO
RADIO
DUAT Service
DUAT PROCESSOR
4
5
1
2
3
FLIGHT DATA
AFSS
ACF
PREFLIGHT BRIEFING SP 2
INFLIGHT BRIEFING SP 3
BROADCAST SPECIALIST 20
EFAS SP 4
FSDMP
NOTAM SP 11
DF SP 5
DF INPUTS
WORKSTATION
WORKSTATION
WORKSTATION
WORKSTATION
WORKSTATION
WORKSTATION
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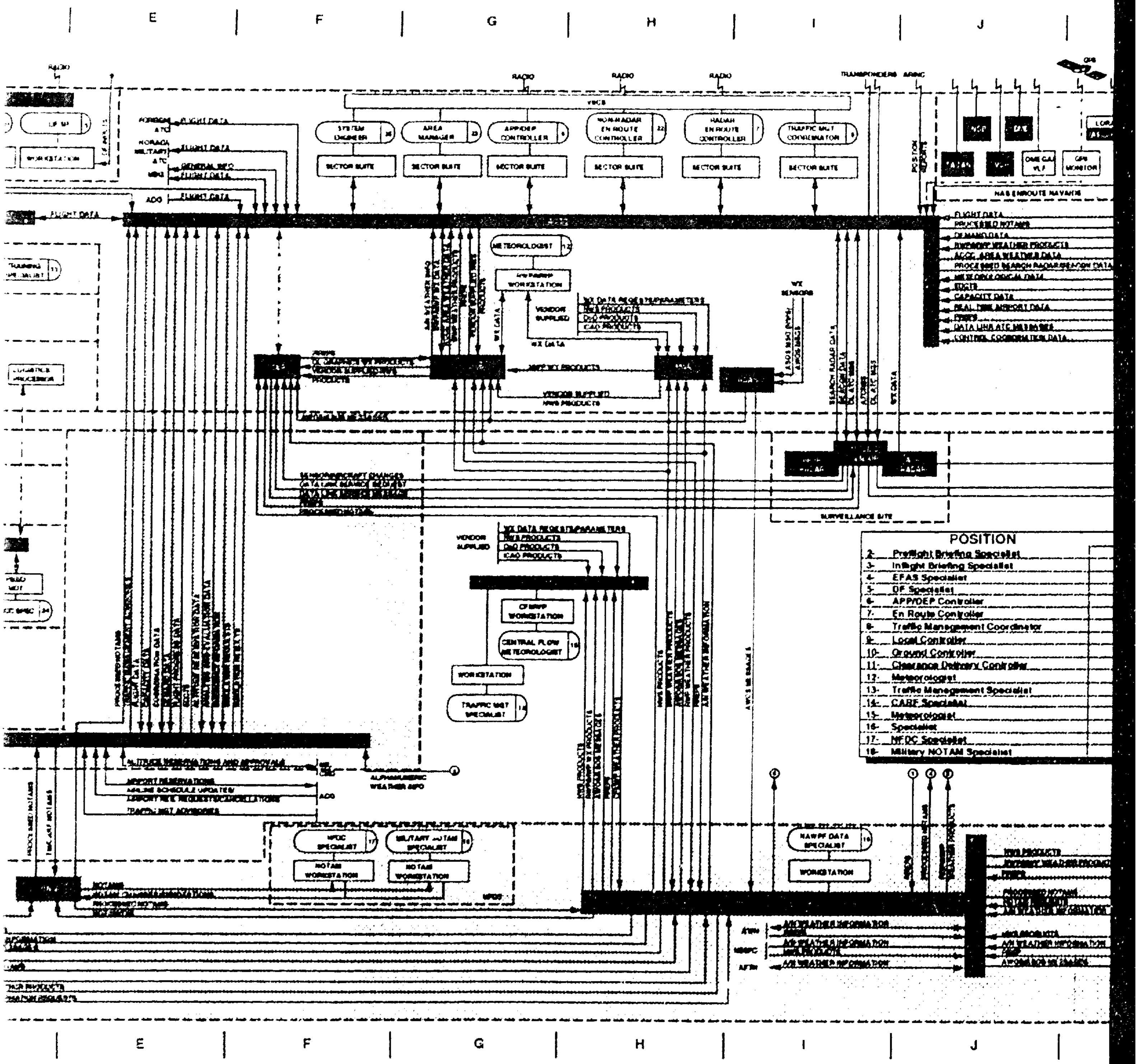
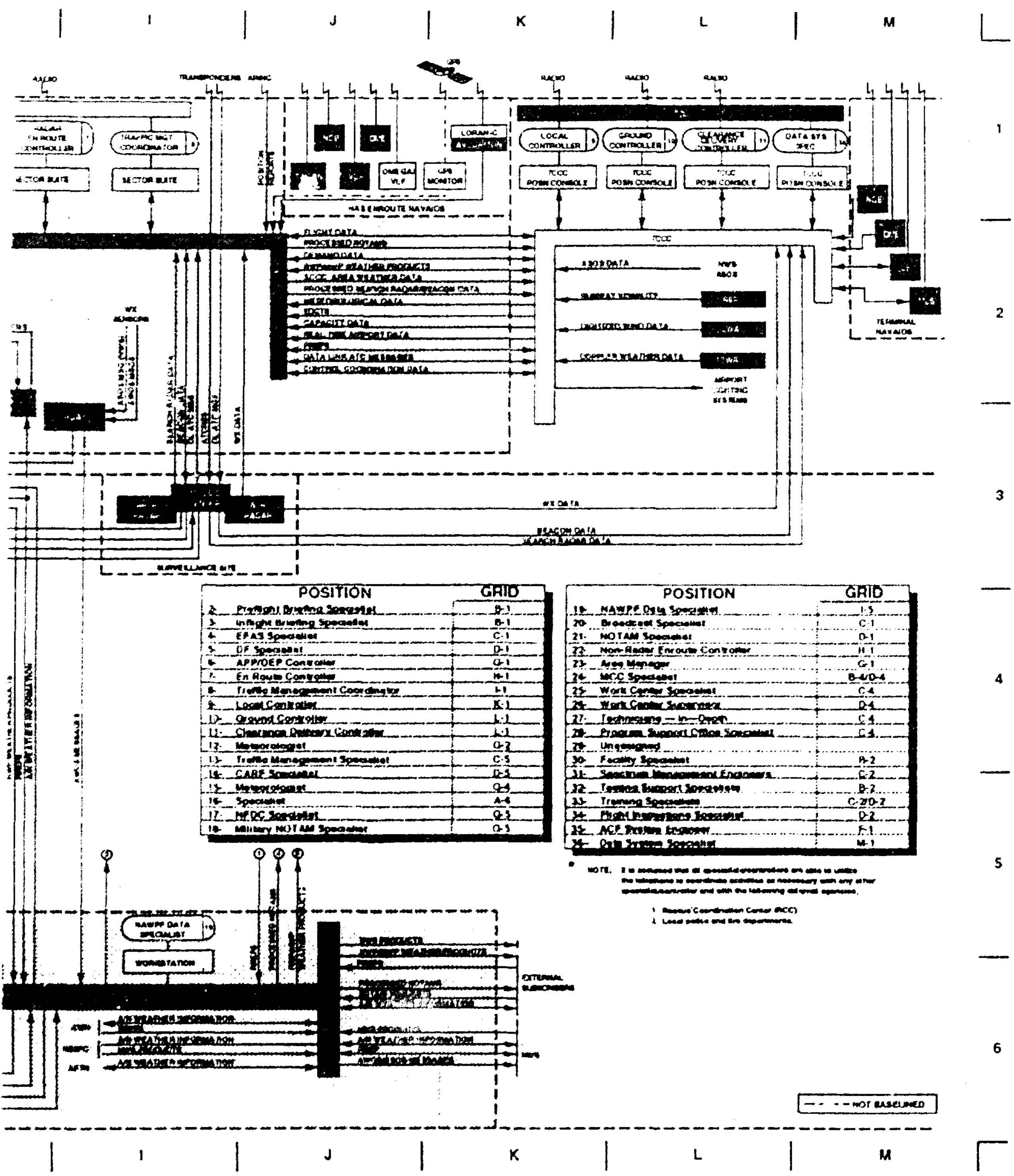
SAR ALERTS AND DATA
FLIGHT DATA
FOREIGN ATC
FLIGHT DATA
NORAD, MILITARY ATC
FLIGHT DATA
MSG
FLIGHT DATA
ADO
FLIGHT DATA
FAA HQS REGIONAL OFFICE
FACILITY SPECIALIST 30
SPECTRUM MANAGEMENT ENGINEER 31
FLIGHT INSPECTION SPECIALIST 34
TRAINING SPECIALIST 33
FAA TECH CENTER
TESTING SUPPORT SPECIALIST 32
AERONAUTICAL CENTER
TRAINING SPECIALIST 13
LOGISTICS PROCESSOR
ATCT
NMCC
GNAS-MCC GMCC
MCC SPEC 24
GMCC-WS
ACF-MCC AMCC
MCCP-MMC
MCC SPEC 34
FIXED MDT
PSO 36
FIXED MDT
TID 37
FIXED MDT
MCC SPEC 34
WORK CENTER
FIELD
WORK CENTER SPECIALIST 35
WORK CENTER SUPERVISOR 36
FAA TECH CENTER
ATCCC
DEMAND DATA
WEATHER INFORMATION REQUESTS
PROCESSED NOTAMS
TRAFFIC MANAGEMENT ADVISORIES
GENERAL FLIGHT SERVICE MESSAGES
GENERAL FLIGHT SERVICE DATA
AIR WEATHER INFORMATION
NOTAMS
LAW ENFORCEMENT DATA
ABNORMAL MESSAGES
TRAFFIC MGT ADVISORIES
DEMAND DATA
DEMAND DATA
TRAFFIC MGT ADVISORIES
2
3
WORKSTATION
WORKSTATION
TRAFFIC MGT SPECIALIST 13
CARF SPECIALIST 14
PROCESSED NOTAMS
PROCESSED NOTAMS
COORDINATION DATA
ALTITUDE RESERVATIONS
AIRPORT RESERVATIONS
AIRLINE SCHEDULE UPDATE
AIRPORT RES. REQUESTS
TRAFFIC MGT ADVISORIES
NOTAMS
PROCESSED NOTAMS
AIS
FOCUS MASTER FILE DATA
NASPP
WORKSTATION
SPECIALIST 16
AIR WEATHER INFORMATION
PROCESSED NOTAMS
NOTAMIDS
WEATHER INFORMATION REQUESTS
A
B
C
D
E

NAS OPERATIONAL BLOCK DIAGRAM



2

iRAM



POSITION	GRID
2- Preflight Briefing Specialist	B-1
3- Inflight Briefing Specialist	B-1
4- EFAS Specialist	C-1
5- DF Specialist	D-1
6- APP/DEP Controller	G-1
7- En Route Controller	H-1
8- Traffic Management Coordinator	I-1
9- Local Controller	K-1
10- Ground Controller	L-1
11- Clearance Delivery Controller	L-1
12- Meteorologist	G-2
13- Traffic Management Specialist	C-5
14- CARF Specialist	D-5
15- Meteorologist	G-4
16- Specialist	A-4
17- NFDC Specialist	G-5
18- Military NOTAM Specialist	G-5

POSITION	GRID
19- NAWPF Data Specialist	I-5
20- Broadcast Specialist	C-1
21- NOTAM Specialist	D-1
22- Non-Radar Enroute Controller	H-1
23- Area Manager	G-1
24- MCC Specialist	B-4/D-4
25- Work Center Specialist	C-4
26- Work Center Supervisor	D-4
27- Technician — In—Depth	C-4
28- Program Support Office Specialist	C-4
29- Unassigned	
30- Facility Specialist	B-2
31- Spectrum Management Engineers	C-2
32- Testing Support Specialists	B-2
33- Training Specialists	C-2/D-2
34- Flight Inspections Specialist	D-2
35- ACF System Engineer	F-1
36- Data System Specialist	M-1

* NOTE: It is assumed that all specialists/controllers are able to utilize the telephone to coordinate activities as necessary with any other specialist/controller and with the following external agencies.

1) Rescue Coordination Center (RCC)
2) Local police and fire departments.

Figure 1-2
NAS Operational Block Diagram

3

Service Data Processing System (FSDPS) data base and provides information on airspace reservations affecting proposed flight routes.

Procedures: FAA Handbook 7110.10, Flight Services

Projects: Capital Investment Plan, Chapter 2, Section 3: Flight Service and Weather: Project 23-01, Flight Service Automation System (FSAS).

Position 3: In-flight Briefing Position

Function: Provide the pilot with available meteorological and aeronautical information in-flight, assist with flight plan changes, and provide information on special use airspace.

Description: AFSS specialists provide in-flight assistance to the pilot by updating preflight briefings, accepting modifications to the flight plan, closing flight plans, and providing information on special use airspace.

Procedures: FAA Handbook 7110.10, Flight Services

Projects: Capital Investment Plan, Chapter 2, Section 3: Flight Service and Weather: Project 23-01, Flight Service Automation System (FSAS).

Position 4: En Route Flight Advisory Service (EFAS) Position

Function: Provide weather advisories to en route pilots upon request.

Description: The EFAS/Flight Watch specialist provides en route pilots with weather advisories, which focus primarily on real-time or near-time en route weather that could affect the aircraft's flight. The EFAS specialist also serves as the primary point of contact for the collection of Pilot Reports (PIREPs).

Procedures: FAA Handbook 7110.10, Flight Services

Projects: Capital Investment Plan, Chapter 3, Section 3: Flight Service and Weather: Project 33-08, Hazardous In-Flight Weather Advisory Service (HIWAS).

Position 5: Direction Finder (DF) Specialist

Function: Provides location of aircraft to pilots requesting assistance.

Description: A specialist in the AFSS provides location and bearings to lost pilots using Very High Frequency (VHF) DF equipment. The specialist may talk directly to the pilot or he may relay the DF instructions through the specialist who is handling the emergency.

Procedures: FAA Handbook 7110.10, Flight Services

Projects: Capital Investment Plan, DF, Project 11, Ground to Air Systems.

Position 20: Broadcast Specialist

Function: Records and broadcasts advisories as needed.

Description: The broadcast specialist advises the pilots of weather conditions likely to be encountered by telephone and Very High Frequency Omnidirectional Range (VOR) broadcasts.

Procedures: FAA Handbook 7110.10, Flight Services

Projects: Capital Investment Plan, Flight Service and Weather Systems: Project 1, Flight Service Automation System (FSAS).

Position 21: Notice to Airmen (NOTAM) Specialist

Function: Monitors and queries flight database for overdue and unreported aircraft. Initiates and coordinates Search and Rescue (SAR) procedures.
Description: Once notified that an aircraft on a VFR Flight Plan is 30 minutes overdue (15 minutes if over hazardous areas), the NOTAM Specialist detects the need for SAR and initiates initial information requests and information request (INREQ) messages.

Procedures: FAA Handbook 7110.10, Flight Services

Projects: Capital Investment Plan, Flight Service and Weather Systems: Project 1, Flight Service Automation System (FSAS).

Other Organizations

Because of the variety of in-flight assists, many different organizations may be involved. For example Aeronautical Radio, Inc., (ARINC) could become involved in an assist to an aircraft flying over the ocean. ARINC provides High Frequency (HF) radio service for the FAA for aircraft that are out of VHF radio range. The Rescue Coordination Center (RCC), operated by the U.S. Air Force, is alerted on any emergency assist but would not become actively involved until there was reason to believe the aircraft was involved in a major mishap. Local fire/rescue and medical assistance are also, on occasion, called upon.

AREA CONTROL FACILITY (ACF)

Position 6: Approach/Departure Controller

Function: Provides sequencing instructions to pilots on approach to and departure from an airport.
Description: The approach/departure controllers are located in the ACF. They provide sequencing of aircraft within terminal airspace, ensure separation between aircraft; issue control instructions; monitor radios; and accept and initiate automated hands-off.

Procedures: FAA Handbook 7110.65, Air Traffic Control

Projects: Capital Investment Plan ATC En Route Systems: Project 12, Advanced Automation System (AAS)Project 13, Automated En Route Air Traffic Control (AERA)Project 14, Integration of Nonradar Approach Control Into Radar Facilities Project 15, Area Control Facilities NAS Plan ATC Terminal Systems: Project 15, Combine Radar Approach Control into Air Route traffic Control center (ARTCC).

Position 7: En Route Radar Controller

Function: Provide in-flight assistance mainly to pilots flying instrument flight rules (IFR) to follow their flight plans.
Description: En route controllers ensure separation, issue control instructions, sequence aircraft, monitor radios, accept and initate automated hand-offs, provide pilots in-flight assitance, and forward flight plan changes as required.

Procedures: FAA Handbook 7110.65, Air Traffic Control

Projects: Capital Investment Plan, Chapter 2, Section 1: En Route Systems, Project 21-12, Advanced Automation System (AAS); Project 21-13, Automated En Route ATC (AERA); Project 21-15, Area Control Facilities (ACF).

Position 22: Non-Radar Controller

Function: Manages air traffic by providing aircraft separation services in a non-radar environment.

Description: The primary responsibility of the non-radar controller is to ensure aircraft separation in areas of mountainous terrain or over large bodies of water (oceans). Controllers review progress reports, flight data displays, alert displays, and situation displays which depict the trajectories and expected trajectories of aircraft flight. Trajectory data is based upon flight plan data for non-Automatic Dependent Surveillance (ADS) equipped aircraft, surveillance data for ADS-equipped aircraft, wind data, and aircraft performance data (i.e., speed, climb and descend rates, turn rates, etc.).

Procedures: FAA Handbook 7110.65, Air Traffic Control

Projects: Capital Investment Plan: En Route System; Project 2, Flight Data Entry and Printout Devices; Project 4, En Route Automated Radar Tracking System (EARTS) Enhancements; Project 5, Oceanic Display and Planning System (ODAPS); Project 7, Modern ATC Host Computer; Project 11, Voice Switching and Control System (VSCS); Project 12, Advanced Automation System (AAS); Project 13, Automated En Route Air Traffic Control (AERA); Project 15, Area Control Facilities (ACF); Project 16, Offshore Flight Data Processing System (OFDPS) Ground-to-Air System: Project 1, Air/Ground (A/G) Communications Equipment Modernization; Project 3, VOR/TACAN (VORTAC); Project 4, Nondirectional Beacon (NDB)

Position 23: Area Manager

Function: Coordinates Search and Rescue operations from the ACF.

Description: The Area Manager receives information on overdue/unreported aircraft from controllers in the ACF and attempts to contact appropriate agencies. The Area Manager prepares and ensures that the Alert Notice (ALNOT) is distributed to appropriate agencies.

Procedures: FAA Handbook 7210.3, Facility Operation and Management

Projects: Capital Investment Plan, En Route Systems: Project 15, Area Control Facilities (ACF).

Position 8: Traffic Management Coordinator (TMC)

Function: Manage traffic at the local level and review airspace reservations in terms of impacts on controllers.

Description: TMCs use the processing capabilities of the Area Control Computer Complex (ACCC) to satisfy national traffic management directives and to resolve traffic flow problems within the ACF's area of jurisdiction.

Procedures: FAA Handbook 7110.65, Air Traffic Control

Projects: Capital Investment Plan: Chapter 2: Project 21-06, Traffic Management System (TMS); Section 3, Project 23-06, Central Weather Processor (CWP); Project 23-04, Weather Message Switching Center Replacement (WMSCR).

Position 12: ACF Meteorologist

Function: Prepares weather information for use at the local level.

Description: The meteorologist provides weather consultation and advice to managers and the staff within the ACF and to other supported FAA facilities. This is accomplished through briefings and products describing actual or forecast adverse weather conditions which may affect air traffic flow or operational safety over the ACF's portion of the NAS. The Center Weather Service Unit (CWSU) provides weather information dissemination services, making products available to outside users including pilots (via Mode S through the Data Link Processor (DLP)), airline dispatchers, and service companies. The meteorologist is supported by the Real Time Weather Processor (RWP) and the Meteorologist Weather Processor (MWP) through the MWP workstation.

Procedures: National Weather Service (NWS), "National Weather Service Operations Manual". FAA and NWS, "Aviation Weather Services".

Projects: Capital Investment Plan, Flight Service and Weather Systems: Project 2, Real Time Weather Processor (RWP) and Meteorologist Weather Processor (MWP) NAS Plan, Ground-to-Air Systems: Project 16, Weather Radar Program

Other Organizations

Some non-NAS organizations are involved with aircraft communications in non-radar environments, particularly in oceanic areas. ARINC provides HF radio service for the FAA when aircraft are out of VHF or Ultra High Frequency (UHF) radio range. The military base operation (MBO) and the airline dispatch office (ADO) occasionally become involved in contacting aircraft or relaying messages to aircraft because pilots may not be monitoring appropriate frequencies.

AIR TRAFFIC CONTROL TOWER (ATCT)

Position 9: Local Controller

Functions: Provide clearances and advisories to aircraft within the airport traffic area and to aircraft on (or about to be on) the active runway(s).
Description: The local controller is located in the air traffic control tower (ATCT). The local controller provides final instructions to aircraft landing at an airport, and also provides aircraft departure instructions. Local controller responsibilities can include departure and arrival spacing, sequencing, and traffic flow except when these services are provided by the approach/departure controller. The ATCT local controller's area of jurisdiction is at least the active runways, and usually the entire airport traffic area. On departure, the ATCT local controller directs pilots when to contact the ACF departure controller, and thus effects transfer of control of the aircraft to the departure controller.

Procedures: FAA Handbook 7110.65, Air Traffic Control

Projects: Capital Investment Plan, Chapter 2, Section 2: Terminal Project 22-13: ATC/Terminal Radar Approach Control Facility (TRACON) Establishment, Replacement and Modernization; Chapter 2, Section 1: En Route Systems, Project 21-12, Advanced Automation System (AAS); Project 21-15, Area Control Facilities (ACF).

Position 10: Ground Controller

Functions: The ground controller sequences departing aircraft for takeoff on the assigned runway.
Description: The ground controller is located in the ATCT. Ground controllers are supported by the Tower Control Computer Complex (TCCC) through the TCCC Position Console (TPC). The ground controller issues instructions to

departing aircraft to direct and sequence the aircraft, according to the departure clearance time and destination, to the current takeoff runway. The ground controller then releases the aircraft to the local controller for actual departure.

For arriving aircraft, the ground controller directs aircraft to the appropriate taxiways and gates and may have to sequence aircraft if several runways are being used for landings.

Procedures:	Same as position 11
Projects:	Same as position 11

Position 11: Clearance Delivery Controller
Function: Issue pilots flight plan clearance prior to takeoff.
Description: Inform pilots of changes in the intended route of flight by reading out the processed flight plan or indicating that the pilot is "cleared as filed" if the flight data is the same as the filed flight plan.

Description: The clearance delivery controller is located in the ATCT with the local and ground controllers. The TCCC supports clearance delivery through the TCCC Position Console. When ready to depart, the pilot requests departure clearance. The clearance delivery controller receives instrument flight rules (IFR) and, less frequently, visual flight rules (VFR) Flight Plan information from the TCCC. The clearance delivery controller also receives departure information from pilots who are ready to taxi once they get clearance. The controller may also receive requests from pilots to amend their previously filed flight plans.

When the flight plan or departure information is complete, the clearance delivery controller issues the aircraft a departure clearance that provides the initial sequence for departing traffic. *If a clearance cannot be granted,* the clearance delivery controller provides the aircraft delay information.

Procedures:	FAA Handbook 7110.65, Air Traffic Control FAA Handbook 7210.3, Facility Operation and Administration.
Projects:	Capital Investment Plan, Chapter 2, Section 2: Terminal Project 22-13: ATCT/Terminal Radar Approach Control Facility (TRACON) Establishment, Replacement and Modernization; Chapter 2, Section 1: En Route Systems, Project 21-12, Advanced Automation System (AAS); Project 21-15, Area Control Facilities (ACF).

Other Organizations

Virtually all aspects of actual airport movement area control are handled by FAA subsystems and FAA specialists. Commercially owned ramp areas may allow an aircraft clearance from a gate via commercially owned communications systems such as ARINC; however, control on the actual airport movement area is fully FAA supported.

TRAFFIC MANAGEMENT FACILITY

The Traffic Management Facility (TMF) is the national level element of traffic management. The TMF consists of two unique facilities, the Air Traffic Control Command Center (ATCCC) and the Traffic Management Computer Center (TMCC). The ATCCC is the operational component of national level traffic management. The ATCCC is staffed with specialists and meteorologists. The Central Flow Meteorologist Weather Processor (CFMWP) at the ATCCC provides the weather processing required to support the responsibilities of the meteorologists. The TMCC houses the Traffic Management Processor (TMP) which provides the processing required to support the responsibilities of the specialists at the ATCCC. The major function provided by each ATCCC position is described below.

Position 13: Traffic Management Specialist

Function: Manage traffic at the national level and identify, negotiate the resolution of, and accommodate changes arising from airspace reservation conflicts.
Description: Traffic Management Specialists (TM Sps) use the processing capabilities of the Traffic Management Processor to develop traffic management directives in response to present and predicted national traffic flow problems. TM Sps negotiate with military commands, military and non-military users concerning changes to airspace reservations or conflicting flight plans.

Procedures: FAA Handbook 7210.47, Traffic Management System

Projects: Capital Investment Plan: Chapter 2: Project 21-06, Traffic Management System (TMS); Section 3, Project 23-06, Central Weather Processor (CWP); Project 23-04, Weather Message Switching Center Replacement (WMSCR).

Position 14: Central Altitude Reservation Function (CARF) Specialist

Function: Manage Altitude Reservations and coordinate, plan, and approve special use airspace request for Altitude Reservations (ALTRV).
Description: CARF Specialists use the processing capabilities of the TMP to provide coordination for NAS users (usually the military) who have special requirements for reserved blocks of airspace and provide this information to users as NOTAMs.

Procedures: FAA Handbook 7610.4, Special Military Operations

Projects: Capital Investment Plan: Chapter 2: Project 21-06, Traffic Management System (TMS)

Position 15: Central Flow Meteorologist

Function: Prepare weather products for use at the national level.
Description: Central Flow (CF) meteorologists use the processing capabilities of the Central Flow Meteorologist Weather Processor (CFMWP) to provide the TM Sps with information concerning weather that may impact national flow.

Local traffic management is performed by the Traffic Management Units (TMUs) and meteorologists located at each Area Control Facility. TMUs consist of TMU personnel, called Traffic Management Coordinators (TMCs), and their workstations. Area Control Computer Complexes (ACCCs), located at each ACF, provide the processing required to support the responsibilities of the TMCs. Weather processing capabilities are provided to the meteorologists at each ACF via the Real-time Weather Processor (RWP) and the Meteorologist Weather Processor (MWP).

Procedures: FAA Handbook 7210.47, Traffic Management System

Projects: Capital Investment Plan: Chapter 2: Project 21-06, Traffic Management System (TMS); Section 3, Project 23-06, Central Weather Processor (CWP); Project 23-04, Weather Message Switching Center Replacement (WMSCR).

Other Organizations

The involvement of organizations external to the NAS in traffic management operations is limited to the provision of demand data. An Airline Schedule Vendor (ASV) (e.g., the Official Airline Guide (OAG)) provides a data base of flight data for scheduled airline flights. Updates to airline schedules are provided by airline dispatch offices (ADOs) as flights are added, canceled, combined, and rescheduled. The Military provides flight data for all routinely scheduled military activity and special CARF missions.

2.0 AIRSPACE MANAGEMENT

Maximum safety and efficiency in the use of airspace or aerodromes results from a flow of air traffic which matches airspace user demands with available capacity, reduced congestion and unnecessary delays, allows delays to be taken on the ground whenever possible, and accomplish military operations and national defense requirements. Maintaining this type of traffic flow imposes a requirement for a traffic management function which collects data on current and predicted airspace capacity and demand and compares these to detect potential and actual airspace saturation.

2.1 Support

"Airspace Management", as it is described in Section 3.2.1 of the National Airspace System-System Requirements Specifications (NASSRS), is also known as "Flow Control", and is most often referred to as "Traffic Management". Traffic management serves to organize air traffic in the aggregate so that it can be managed with maximum safety and throughput, while minimizing delays, controller stress, and interference with pilot intent.

This document examines the information flows required in traffic management processes and describes these processes, including the manual and automated tasks involved, the coordination (throughout this document, the term coordination is intended to cover all types of traffic management related business conduct including sharing of information and negotiating courses of action) that will take place between traffic management and other NAS personnel, and human interaction with NAS equipment. Thus, the NASSRS requirements can be validated by insuring that all necessary information, system functions, and connectivities are included in the requirements.

Figure 2-1 is an overview of NAS/user interfaces for airspace management and illustrates the NAS facilities and systems involved. Figure 2-2 is an operational block diagram showing the interrelationships between equipment, facilities, operators/users and the information necessary to support airspace management. The following paragraphs describe the NAS requirements for airspace management.

2.2 Information

The information utilized in traffic management operations can be grouped into five broad categories:

- Capacity data
- Demand data
- Load data
- Meteorological data
- Traffic flow data.

Each of these categories is described in the following paragraphs.

2.2.1 Capacity Data

Capacity data are theoretical estimates of the numbers of aircraft per unit of time that can be accommodated by a particular NAS resource. System resource capacity estimates used in traffic management include the following:

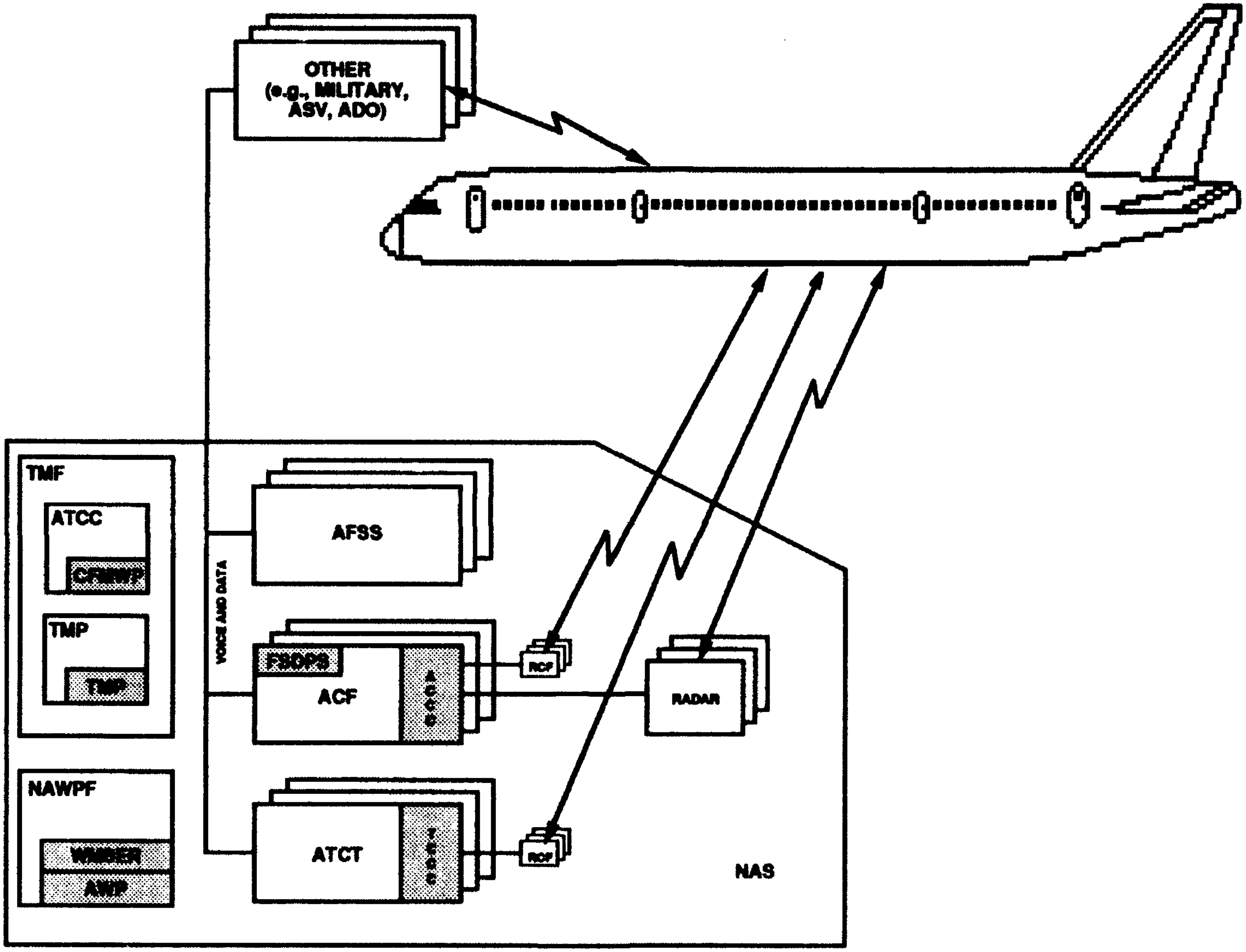
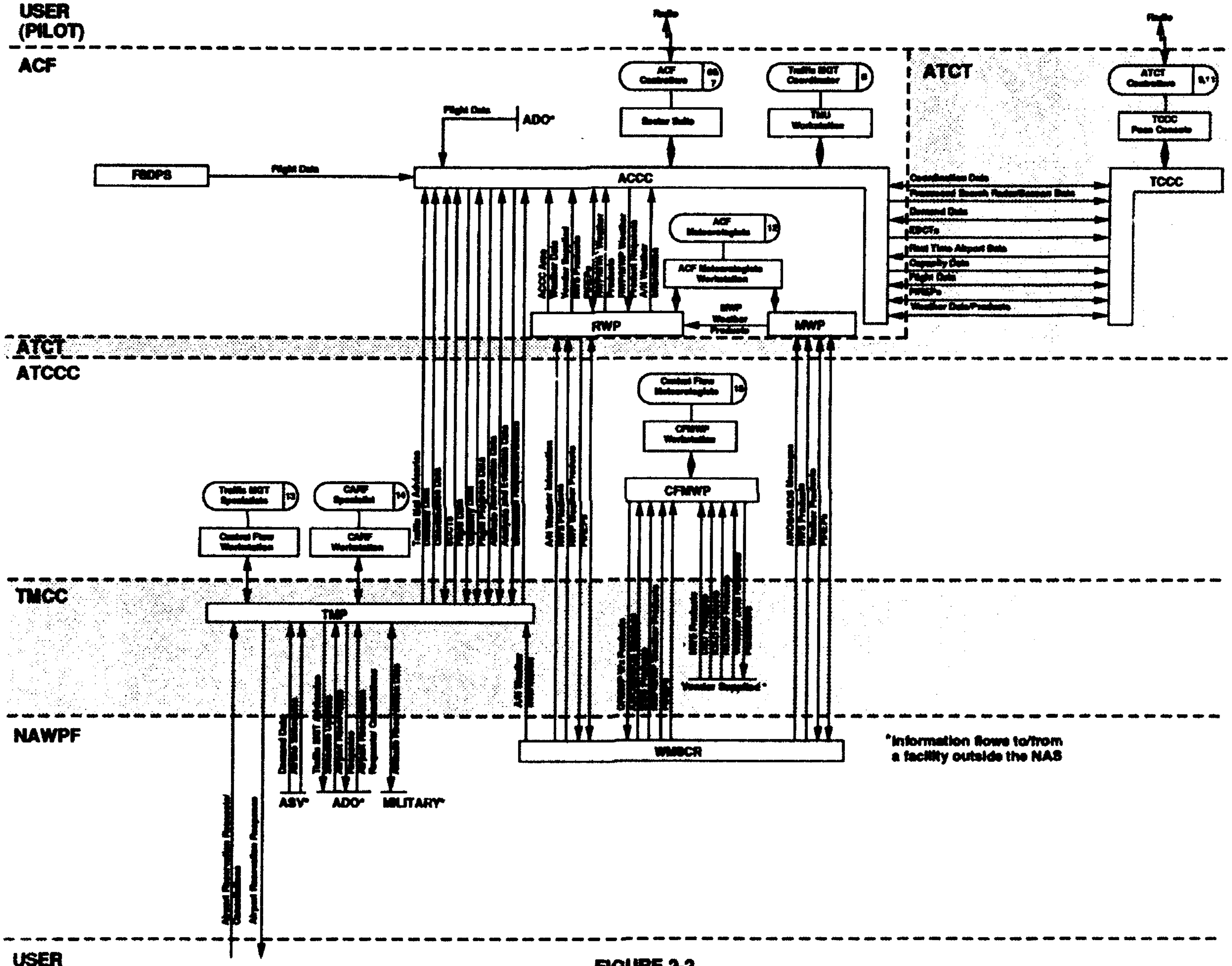


FIGURE 2-1

OVERVIEW OF NAS/USER SYSTEMS FOR AIRSPACE MANAGEMENT



*Information flows to/from a facility outside the NAS

FIGURE 2-2
AIRSPACE MANAGEMENT
OPERATIONAL BLOCK DIAGRAM

Arrival Capacity -- the number of arrival aircraft that can be accommodated by an airport during a specific time interval. Arrival capacity depends on many factors including the structure of the terminal airspace, the prevailing weather conditions, the runway configuration being used, the mix of aircraft types in the arrival stream, and the availability of gates or other space for receiving arrival aircraft.

Departure Capacity -- the number of departing aircraft that can be accommodated by an airport during a specific time interval. Departure capacity depends on many factors including the structure of the terminal airspace, the prevailing weather conditions, the runway configuration being used, and the mix of aircraft types in the departure stream.

Sector Capacity -- the number of aircraft that can traverse a particular sector within a specific time interval or the number of aircraft that a sector can accommodate at a specific instant. Sector size, airway structure, weather conditions, and traffic mix are some of the factors which determine sector capacity.

Fix Capacity -- the number of aircraft that can cross a fix (or come near it) within a specified altitude range and within a specific time interval. Fix capacity is limited by the required aircraft spacing and the speed of the aircraft crossing the fix.

Airway Capacity -- the number of aircraft that can be accommodated by an airway segment within a specified altitude range and within a specific time interval. Airway capacity is limited by the required aircraft spacing and the speed of the aircraft traversing the airway.

Sector, fix, and airway capacities are used to determine sector, fix, and airway alert threshold values. Arrival and departure capacities determine airport capacity. Airport capacity data is sent from each Tower Control Computer Complex (TCCC) to its parent Area Control Computer Complex (ACCC). The TMP collects all capacity data from each ACCC. Capacity data is used in flow planning and in the analysis and evaluation of flow control actions.

2.2.2 Demand Data

Demand data are estimates of the number of aircraft per unit of time that will demand the use of a particular NAS resource. Demand estimates used in traffic management include the following:

Arrival Demand -- the number of aircraft that are predicted to arrive at an airport during a specific time interval.

Departure Demand -- the number of aircraft that are predicted to depart from an airport during a specific time interval.

Sector Demand -- the number of aircraft that are predicted to traverse a particular sector within a specific time interval or the number of aircraft that are expected to be in a sector at a specific instant.

Fix Demand -- the number of aircraft that are predicted to cross a fix (or come near it) within a specified altitude range and within a specific time interval.

Airway Demand -- the number of aircraft that are predicted to traverse an airway segment within a specified altitude range and within a specific time interval.

Demand predictions are derived from flight plan information and historical demand data. There are many sources of flight plan data including the following:

- Flight plans for scheduled airline flights provided by an Airline Schedule Vendor (ASV)
- Airline schedule updates provided by Airline Dispatch Office (ADO)
- Flight plans for routinely scheduled military activity
- Flight plans from approved Central Altitude Reservation Function (CARF) reservations
- Flight plans for unscheduled flights filed through FSDPS.

Historical data is used to predict the number of Visual Flight Rules (VFR) flights without flight plans. Historical demand data can be substituted for any of the flight plan sources listed above when that information is not yet available.

Demand data is used to forecast traffic flow problems and is used in the analysis and evaluation of flow control actions.

2.2.3 Load Data

Load data are the number of aircraft that are accommodated by a particular NAS resource in a specific span of time. The types of load data used in traffic management are similar to the types of demand data listed in Section 2.2.2, but load data are actual utilization numbers rather than predictions.

2.2.4 Meteorological Data

Meteorological data utilized in traffic management operations include Central Flow Meteorological Weather Processor (CFMWP) weather products for use at the national level and Real-Time Weather Processor/Meteorological Weather Processor (RWP/MWP) weather products for use at the local level. These products are used to consider the impact of expected weather conditions in flow control decisions. Weather products can be presented in many forms including the following:

- Alphanumeric (A/N) products
- Graphic products
- Formatted Pilot Weather Reports (PIREPs)
- Mosaic weather radar maps
- Weather briefings.

RWP/MWP weather products typically used by traffic management coordinators include the following:

Center Weather Advisory -- a free-text alphanumeric product which contains a near-term forecast of conditions beginning within two hours of issuance and reflecting conditions in existence at the time of issuance.

Meteorological Impact Statement -- a textual synopsis of weather conditions expected to impact traffic flow within the ACF's area of jurisdiction. It describes conditions expected to begin approximately four to 12 hours after issuance.

Hazardous Weather Area Outline -- a graphical product that depicts a composite of all weather hazards to aircraft that exist within the ACF's area of jurisdiction.

Mosaic Weather Radar Maps -- these include precipitation mosaic maps and turbulence mosaic maps which cover three different altitude ranges with geographical coverage extending beyond the ACF's area of jurisdiction.

Weather Briefings -- these include discussions of current and forecast weather conditions relevant to the ACF's area of jurisdiction, including terminal weather.

CFMWP weather products are tailored to emphasize the weather's impact on national traffic flow. They cover larger geographical areas and longer time periods (up to 24 hours in advance) than RWP/MWP products. Otherwise, the weather products available to traffic management specialists are similar to those available to TMCs.

The Weather Message Switching Center Replacement (WMSCR), a system that operates at each of the two National Aviation Weather Processing Facilities (NAWPFs), plays a support role in traffic management weather processing. The WMSCR serves as the NAS's gateway for receipt and distribution of weather data. It collects weather data from systems external to the NAS, and it distributes the data to the RWPs and MWPs for use by the ACF Meteorologists and to the CFMWP for use by the Central Flow Meteorologists. The WMSCR also provides for the exchange of weather products between the RWP/MWPs and the CFMWP.

The Aviation Weather Processor (AWP) is another system that operates at each of the NAWPFs. The AWP receives traffic flow data from the Traffic Management Processor (TMP), edits it, specifies the geographic coverage area associated with it, and makes it available to the Flight Service Data Processing System (FSDPSs) at the appropriate Area Control Facilities (ACFs).

2.2.5 Traffic Flow Data

Traffic flow data includes traffic management directives, which are statements of actions or results required by the Air Traffic Control Command Center (ATCCC), and local traffic management instructions.

Traffic management directives are generated and evaluated by Traffic Management Specialists (TM Sps) in response to present and predicted national traffic flow problems, using the processing capabilities of the TMP. These directives include departure delays (i.e., Estimated Departure Clearance Times (EDCTs)) and interfacility flow restrictions. The TMP distributes departure delays to the appropriate ACF's ACCCs. The ACCCs then forward the delays to the appropriate Air Traffic Control Towers (ATCTs) TCCCs. Major interfacility flow restrictions are forwarded by the TMP to the appropriate ACF's ACCCs for Traffic Management Coordinator (TMC) implementation. The TMP also forwards traffic management directives to the Aviation Weather Processor (AWP) so they can be annotated for geographic retrieval and forwarded to the appropriate FSDPS.

Strategies for the resolution of local traffic flow management problems are coordinated at the ACF, between the traffic management coordinators, the ACF controllers, and the Area Supervisor.

2.3 Functions

This section describes in more detail the functions that provide Airspace Management. An operational flow diagram is provided for each position. Each of these diagrams illustrates data inputs and outputs, interfaces, and the major traffic management functions associated with each position. The data inputs and outputs are taken from the NAS Level 1 Design Document. The major functions are shown in the central block of each diagram and discussed in the corresponding paragraphs of the text. The major functions provided by processing equipment are also discussed. NASSRS airspace management requirements are referenced when appropriate, to show correlation between the requirements and the functions discussed here.

2.3.1 Traffic Management Specialist (Position 13)

The traffic management specialist (Position 13 in Figure 2-2) utilizes the TMP to perform the various functions associated with national traffic management. The central flow work station provides the data entry and display equipment through which the traffic management specialist accesses the traffic management programs in the traffic management processor. The functions outlined in Figure 2-3, the Traffic Management Specialist (Position 13), Operational Flow Diagram, are described in the corresponding paragraphs below.

a. TMP Processing. The TMP provides data base, analysis, and simulation support to the traffic management specialists. Traffic management specialists direct the TMP to perform activities using data and programs resident in the equipment. The TMP automatically distributes information to, and receives information from, many other NAS processing systems. Major functions of the TMP that support the traffic management specialist position include the following:

   - Maintain and Access Demand Data Base
   - Maintain and Access Capacity Data Base
   - Perform Delay Simulation and Analysis
   - Perform Sector Loading Computations
   - Maintain Sector Loading Data Base
   - Perform Trial Reroutes
   - Maintain Airport Reservation Data Base
   - Perform Analysis and Evaluation Computations
   - Maintain Analysis and Evaluation Data Base
   - Support Data Collection and Distribution
   - Process Aircraft Position Updates.

   NASSRS requirements: 3.2.1.A,B,D,F,G

b. Monitor and Determine National Air Traffic Trends. The traffic management specialist continuously views data presented by the TMP and monitors conditions (i.e., capacities, demands, weather systems) that could impact national traffic flow.

   NASSRS requirement: 3.2.1.A

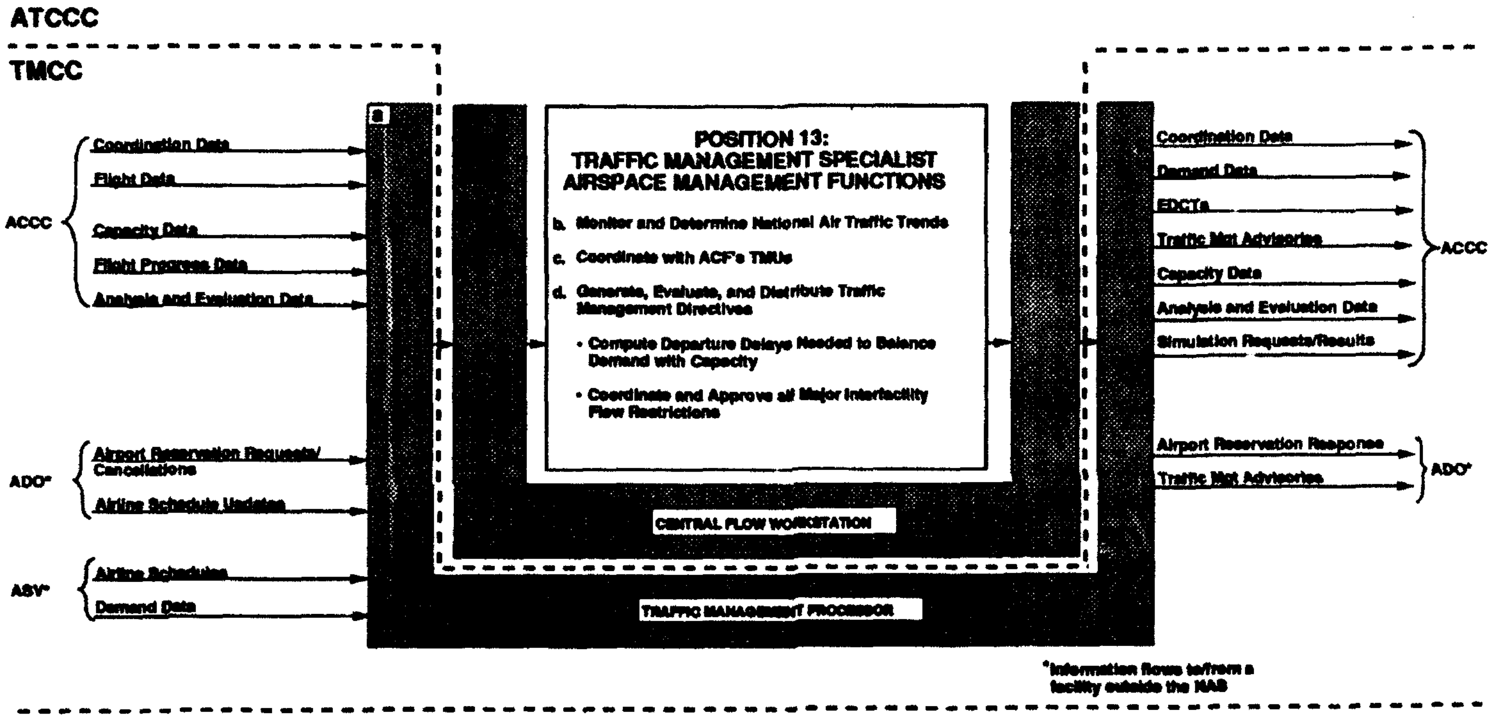


FIGURE 2-3
TRAFFIC MANAGEMENT SPECIALIST (POSITION 13)
OPERATIONAL FLOW DIAGRAM

c. Coordinate with ACF's Traffic Management Units (TMUs). Traffic management specialists maintain close coordination with traffic management coordinators at ACFs that are affected by, or are predicted to be affected by traffic flow problems.

NASSRS requirement: 3.2.1.A

d. Generate, Evaluate, and Distribute Traffic Management Directives. Traffic management specialists generate traffic management directives in response to present and predicted national traffic flow problems. They use the delay simulation capabilities of the TMP to determine the departure delays needed to balance demand with capacity. They use the trial reroute capabilities of the TMP to analyze rerouting alternatives. Once the appropriate directive is entered by the traffic management specialist through the central flow work station, the TMP will automatically distribute the directives to the appropriate facilities.

NASSRS requirements: 3.2.1.A

2.3.2 CARF Specialist (Position 14)

The CARF specialist (position 14 in Figure 2-2) provides support to NAS users who have special requirements for reserved blocks of airspace. The largest user of this service is the military. The CARF workstation provides the data entry and display equipment through which the CARF specialist accesses the altitude reservation programs within the TMP. The altitude reservation programs assist the CARF specialist in the computational aspects of airspace blocking. Four-dimensional space/time computations are used to ensure that CARF reservations do not conflict with each other and that the impacts of CARF missions on the normal air traffic flow are minimized. The functions outlined in Figure 2-4, the CARF Specialist (Position 14) Operational Flow Diagram, are described in the corresponding paragraphs below.

a. TMP Processing. The TMP provides data base and analysis support to the CARF specialists. The major functions of the TMP that support the CARF specialist position include performing CARF Conflict Analysis and maintaining the CARF Data Base.

NASSRS requirements: 3.2.1.G

b. Receive and Review Reservation Requests. The TMP will receive CARF altitude reservation requests via data communications channel, or by manual entry by a CARF specialist. CARF specialists check requests for correctness and completeness.

NASSRS requirement: 3.2.1.G

c. Monitor Requests and Verify the Availability of Airspace. CARF specialists closely monitor altitude reservation requests and verify the availability of airspace using the CARF conflict analysis capability of the TMP.

NASSRS requirements: 3.2.1.G

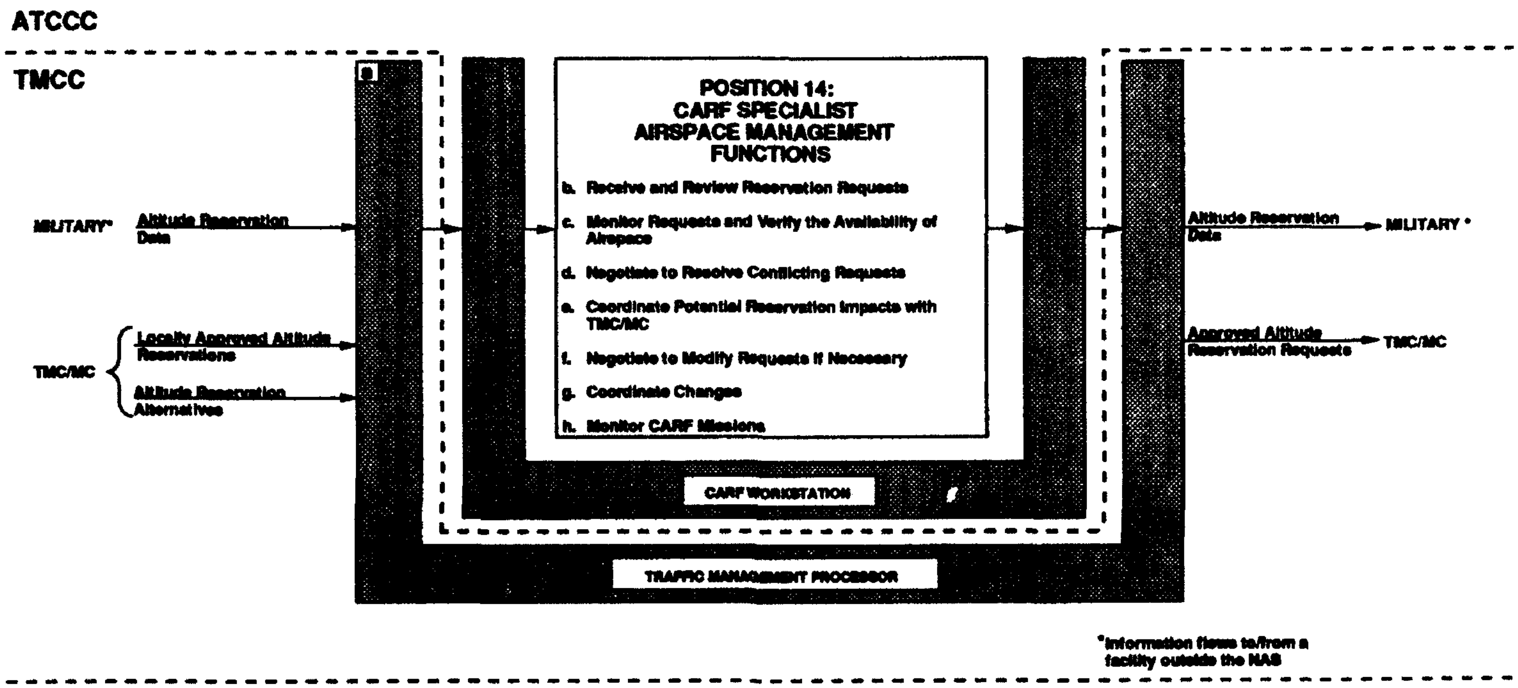


FIGURE 2-4
CARF SPECIALIST (POSITION 14)
OPERATIONAL FLOW DIAGRAM

d. Negotiate to Resolve Conflicting Requests. Conflicts in airspace reservation requests are dealt with through verbal coordination and negotiation between the CARF specialists and the reservation requestors.

NASSRS requirements: 3.2.1.G

e. Coordinate Potential Reservation Impacts with TMC/Military Coordinator TMC/MC). CARF specialists will also communicate with TMCs at affected ACFs. The CARF specialists and the TMCs will coordinate on minimizing the impacts of altitude reservations on the normal air traffic flow.

NASSRS requirements: 3.2.1.G

f. Negotiate to Modify Requests If Necessary, Coordinate Changes. If the CARF specialists and TMCs determine that the altitude reservation impacts are too great, the CARF specialist will negotiate to change the reservation. It is the CARF specialists' responsibility to coordinate any changes.

NASSRS requirements: 3.2.1.G

g. Monitor CARF Missions. During the CARF mission, the CARF specialist monitors its progress.

NASSRS requirement: 3.2.1.G

2.3.3 Central Flow Meteorologist (Position 15)

The central flow meteorologist (position 15 in Figure 2-2) utilizes the weather processing capabilities of the CFMWP to prepare analyses of national weather data for use by the TM Sps. The central flow meteorologist also provides weather consultation and advice to the traffic management specialists. The central flow meteorologists workstation provides the data entry and display equipment through which the central flow meteorologist accesses weather data. The functions outlined in Figure 2-5, the Central Flow Meteorologist (Position 15), Operational Flow Diagram, are described in the corresponding paragraphs below.

a. CFMWP Processing. The CFMWP provides the processing support required to automatically produce and disseminate weather products used by central flow meteorologists and traffic management specialists.

NASSRS requirements: 3.2.1.E

b. Receive and Analyze Meteorological Data from the CFMWP. The CFMWP provides the central flow meteorologist with aviation weather information that is used in the preparation of products and briefings for the TM Sps.

NASSRS requirements: 3.2.1.E

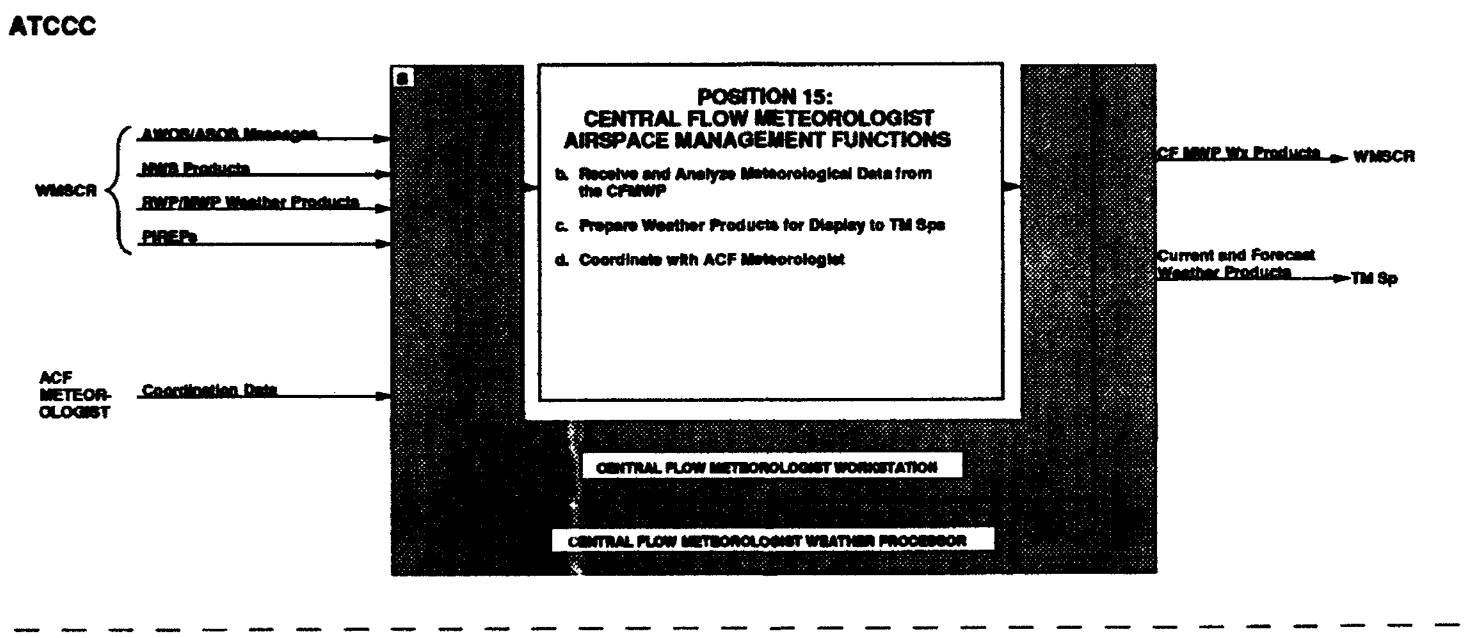


FIGURE 2-5
CENTRAL FLOW METEOROLOGIST (POSITION 15)
OPERATIONAL FLOW DIAGRAM

c. Prepare Weather Products for Display to TM Sps. Central flow meteorologists are responsible for the preparation of weather products that provide TM Sps with information concerning current and forecast weather that may impact national traffic flow.

NASSRS requirements: 3.2.1.E

d. Coordinate with ACF Meteorologist. Central flow meteorologists coordinate with ACF meteorologists by voice concerning current and forecast weather conditions that may affect ACF areas.

NASSRS requirements: 3.2.1.E

2.3.4 Traffic Management Coordinator (Position 8)

The TMC (position 8 in Figure 2-2) utilizes the ACCC to perform the various functions associated with local traffic management. The TMU work station, which is an ACCC sector suite tailored for use by TMCs, provides the data entry and display equipment through which the TMC accesses the local traffic management functions of the ACCC. The functions outlined in Figure 2-6, the Traffic Management Coordinator (Position 8), Operational Flow Diagram, are described in the corresponding paragraphs below.

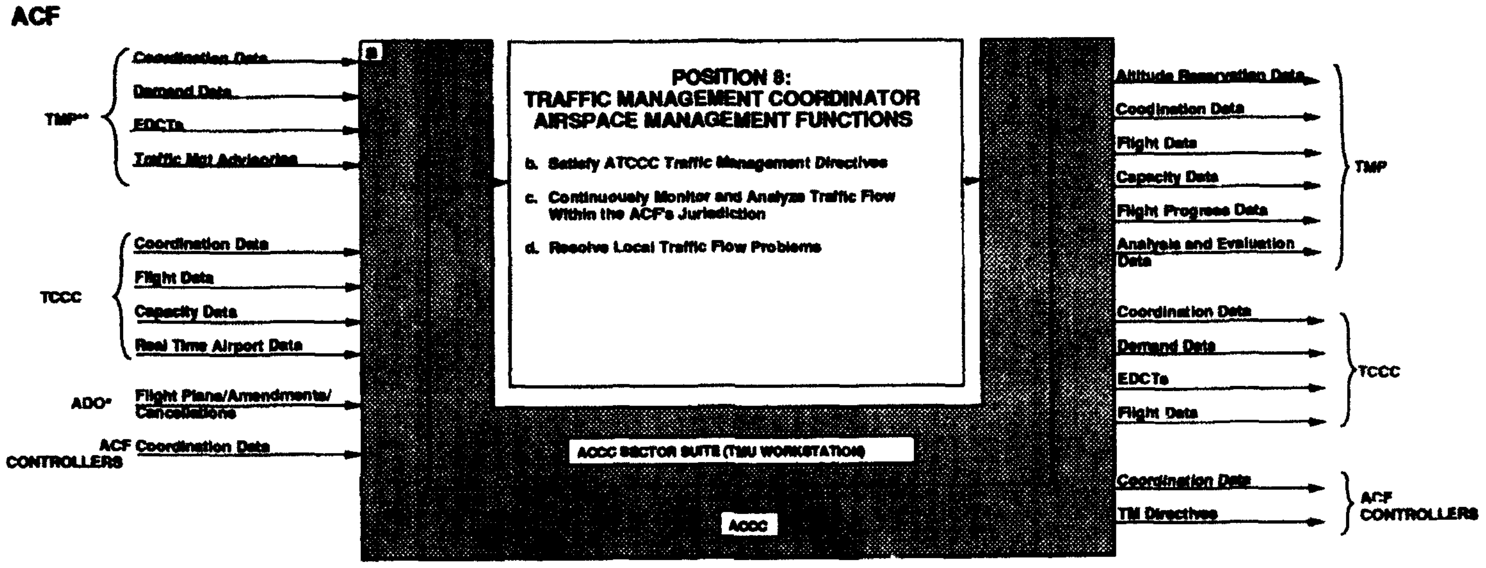
a. ACCC Processing. The ACCC provides the principal processing support to the traffic management coordinators. Some data base and data processing services are provided to traffic management coordinators by the TMP through the ACCC. Major functions of the ACCC that support the TMC position include the following:

- Maintain Local Demand Data Base
- Perform Runway Configuration Management
- Perform Departure Flow Management
- Perform Metering
- Perform Local Sector Loading Computations
- Provide Weather Data to the TMU Workstation
- Compute the Impact of Ground Delays
- Compute the Impact of Reroutes
- Process Flow Restrictions
- Store and Analyze Altitude Reservation Requests
- Display Airport Reservation Lists
- Perform Local Analysis and Evaluation Computations
- Support Data Collection and Distribution
- Process and Send Aircraft Position Updates

NASSRS requirements: 3.2.1.A-G

b. Satisfy ATCCC Traffic Management Directives. It is the TMCs responsibility to ensure the satisfaction of traffic management directives within the ACF's area of jurisdiction.

NASSRS requirements: 3.2.1.A



*Information flows to/from a facility outside the NAS

FIGURE 2-6
TRAFFIC MANAGEMENT COORDINATOR (POSITION 8)
OPERATIONAL FLOW DIAGRAM

c. Continuously Monitor and Analyze Traffic Flow within the ACF's area of jurisdiction. The TMC continuously views the data displayed by the local traffic management functions of the ACCC and monitors conditions that could impact local traffic flow.

NASSRS requirements: 3.2.1.A

d. Resolve Local Traffic Flow Problems. The TMCs develop and execute local traffic management programs in response to present and predicted local traffic flow problems.

NASSRS requirements: 3.2.1.G

2.3.5. ACF Meteorologist (Position 12)

The ACF meteorologist (Position 12 in Figure 2-2) utilizes the weather processing capabilities of the RWP and the MWP to prepare analyses of local weather data for use by the TMCs. The ACF meteorologist also provides weather consultation and advice to the TMCs. The ACF meteorologist's workstation provides the data entry and display equipment through which the ACF meteorologist accesses weather data. The functions outlined in Figure 2-7, the ACF Meteorologist (Position 12), Operational Flow Diagram, are described in the corresponding paragraphs below.

a. RWP and MWP Processing. The RWP and MWP provide processing support to automatically produce and disseminate weather products used by ACF meteorologists and TMCs.

NASSRS requirements: 3.2.1.E

b. Receive and Analyze Meteorological Data from the RWP and MWP. The RWP and MWP provide the ACF meteorologists with all aviation weather information that is used in the preparation of products and briefings for the TMCs.

NASSRS requirements: 3.2.1.E

c. Prepare Weather Products for Display to TMCs. ACF meteorologists are responsible for the preparation of weather products that provide traffic management coordinators with information concerning current and forecast weather that may impact local traffic flow.

NASSRS requirements: 3.2.1.E

d. Coordinate with Central Flow Meteorologist. ACF meteorologists coordinate with central flow meteorologists by voice concerning current and forecast weather that may impact national traffic flow.

NASSRS requirements: 3.2.1.E

2.3.6. ACF Controllers (Positions 6 and 7)

ACF controllers (Position 6 and 7 in Figure 2-2) obtain airspace utilization information through the ACCC to manage the traffic within their assigned airspace.

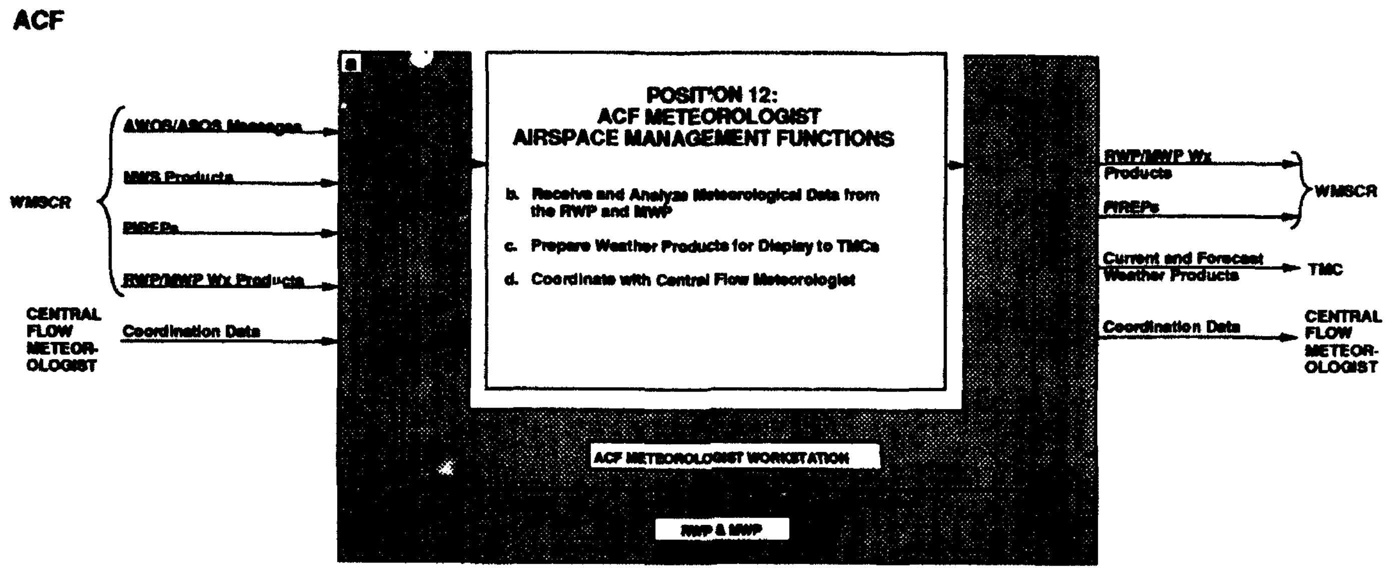


FIGURE 2-7
ACF METEOROLOGIST (POSITION 12)
OPERATIONAL FLOW DIAGRAM

The sector suite provides the data entry and display equipment through which the ACF controllers access automation support of the ACCC. The functions outlined in Figure 2-8, the ACF Controllers (Position 6 and 7), Operational Flow Diagram, are described in the corresponding paragraphs below.

a. ACCC. The ACCC receives coordination data, demand data, and capacity data from Traffic Management Specialists within the ACF and from other ACFs. The ACCC transfers flow control information between local traffic coordinators, controllers, and ATCCC specialists.

NASSRS requirements: 3.2.1.G

b. Implement Flow Control Restrictions. The ACF controllers are responsible for the implementation of flow control restrictions within their airspace.

NASSRS requirements: 3.2.1.E

2.3.7 ATCT Controllers (Positions 9 and 11)

The ATCT Controllers (positions 9 and 11 in Figure 2-2) utilize the TCCC to fulfill the tower traffic management duties. These duties are limited and are of a supporting nature. The TCCC position console provides the data entry and display equipment through which the ATCT controllers access the automation support of the TCCC. The functions outlined in Figure 2-9 the ATCT Controllers (Position 9 and 11), Operational Flow Diagram, are described in the corresponding paragraphs below.

a. TCCC Processing. The TCCC receives coordination data, demand data, EDCTs, and flight data from its parent ACCC. The TCCC forwards data required by the local and national traffic management functions to the ACCC. This data includes airport capacity data (including runway configuration) and some other real-time airport data.

NASSRS requirements: 3.2.1.B

b. Determine Airport Capacity. The ATCT controllers are responsible for selecting the runway configuration in conjunction with the arrival/departure controllers, setting the Airport Acceptance Rate (AAR) and airport capacity in conjunction with the ACF and the ATCCC.

NASSRS requirements: 3.2.1.B

c. Coordinate with TMCs. The ATCT controllers coordinate with the TMCs at their parent ACF about airport capacity and departure slot assignments.

NASSRS requirements: 3.2.1.B

d. Implement Departure Delays. The ATCT controllers are responsible for the implementation of departure delays.

NASSRS requirements: 3.2.1.B

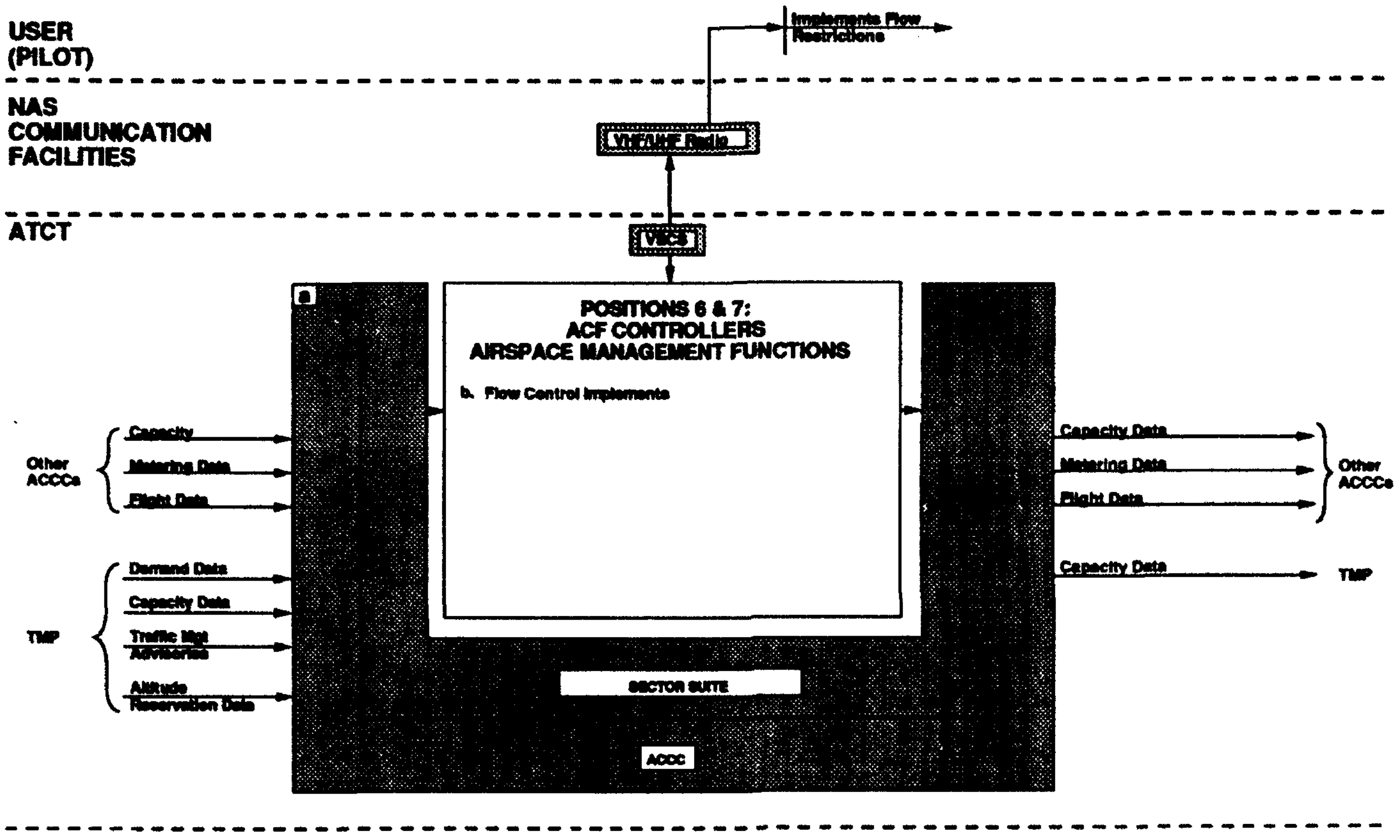


FIGURE 2-8
ACF CONTROLLERS (POSITIONS 6 AND 7)
OPERATIONAL FLOW DIAGRAM

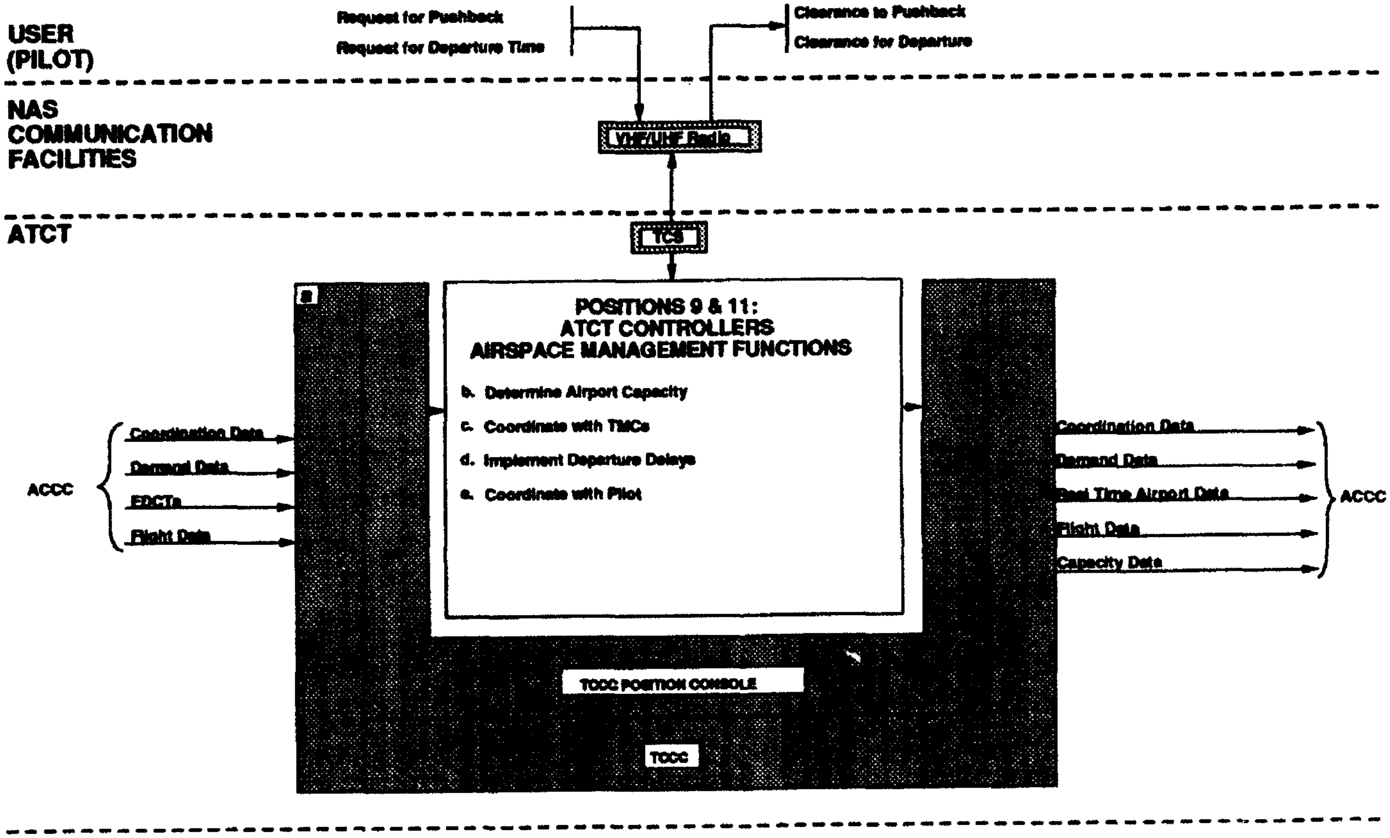


FIGURE 2-9
ATCT CONTROLLERS (POSITIONS 9 AND 11)
OPERATIONAL FLOW DIAGRAM

- **Coordinate with Pilot**. The ATCT controllers coordinate with pilots about departure requests and slot assignments.

  NASSRS requirements: 3.2.1.B

2.4 Correlation with Operational Requirements

Table 2-1, the Airspace Management Operational Requirements Correlation, summarizes the correlation of airspace management operational requirements as stated in Section 3.2.1 of the NASSRS with the functions described in Section 2.3 of this document. All NASSRS airspace management requirements are listed by paragraph number vertically in the table. Paragraphs which are introductory in nature, do not state an explicit operational requirement, or reference other portions of the NASSRS, are indicated with a dash. The fact that a correlation is shown does not necessarily indicate that the requirement is completely fulfilled.

TABLE 2-1
AIRSPACE MANAGEMENT
OPERATIONAL REQUIREMENTS CORRELATION

Position	Traffic Management Specialist				CARF Specialist							Central Flow Meteorologist				Traffic Management Coordinator				ACF Meteorologist				ACF Controllers		ATCT Controllers				
NAS-SR-1000 Paragraph Paragraph	2.3.2.1.a	2.3.2.1.b	2.3.2.1.c	2.3.2.1.d	2.3.2.a	2.3.2.b	2.3.2.c	2.3.2.d	2.3.2.e	2.3.2.f	2.3.2.g	2.3.3.a	2.3.3.b	2.3.3.c	2.3.3.d	2.3.4.a	2.3.4.b	2.3.4.c	2.3.4.d	2.3.5.a	2.3.5.b	2.3.5.c	2.3.5.d	2.3.6.a	2.3.6.b	2.3.7.a	2.3.7.b	2.2.7.c	2.3.7.d	2.3.7.e
3.2.1 General Requirements	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
.A Capacity and Demand of Sectors and Airways	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
.A.1 Capacity of Sectors and Airways	X															X														
.A.2 Demand of Sectors and Airways	X																													
.A.3 Time Period of Data	X																													
.A.4 Availability of Data	X															X														
.B Capacity and Demand of Aerodromes	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
.B.1 Capacity of Aerodromes	X															X								X	X	X	X	X		
.B.2 Arrival and Departure Demand	X															X														
.B.3 Exchange of Data	X																													
.C Current Aircraft Position	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
.C.1 Position Reports to TMCs																X														
.C.2 Availability																X														
.D Predictions of Aircraft Position	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
.D.1 Short-term Predictions	X															X														
.D.2 Accuracy	X															X														
.D.3 Time Period of Data	X															X														
.D.4 Availability of Data	X															X														
.E Current and Forecast Weather	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
.E.1 Availability of Data												X				X				X										
.E.2 Time Period of Data												X		X																
.E.3 Geographic Coverage Area												X		X		X				X		X								
.E.4 Environmental Data												X	X																	
.E.5 Weather Radar Mosaic												X	X																	
.E.6 Display of ACF Weather at ATCCC												X	X							X										
.F Detection of Saturation	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
.F.1 Prediction of Saturation	X															X														
.F.2 Traffic Count Summary	X															X									X					
.F.3 Sector Workloads	X															X														
.F.4 Detection of Noncompliance																														
.F.5 Evaluation of Alternate Clearances																														
.F.6 Provide Information to Military																														
.G Allocation of Saturated Capacity	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
.G.1 Trial Reroutes	X		X													X														
.G.2 Data Transfer	X		X													X														
.G.3 Metering																X														
.G.4 CARF					X	X	X	X	X	X						X														
.G.5 Traffic Management Directives	X																													
.G.6 Local Flow Restrictions																X			X					X						
.G.7 Analysis and Evaluation	X															X														

2.5 Operational Sequences

The operational sequences presented in this section depict the actual processes of traffic management. They are general and do not depict specific situations. Typical steps taken in providing traffic management services, including manual tasks, fully automated tasks, and tasks involving personnel/equipment interaction, are shown sequentially in the operational sequence diagrams. Shaded boxes indicate tasks that require personnel interaction with automation. Fully automated tasks are represented by boxes located in the shaded rows. Each box in each of the sequence diagrams is numbered and referenced parenthetically in an accompanying description.

Traffic management operations (with the exception of oceanic operations and operations during emergency situations) are described in the operational sequences that follow. These sequences are presented as complete processes to show all of the personnel and automation involved. Many of the steps, or groups of steps that are shown as part of complete sequences, however, are actually on-going processes that continue most of the time during traffic management operations, and can also take place as separate processes.

2.5.1 En Route Flow Management Operational Sequence

The purpose of en route flow management is to anticipate and prevent saturation of en route airspace. En route airspace saturation is prevented by regulating the demand for the en route airspace to ensure that it does not significantly exceed the capacity. Figure 2-10, the En Route Flow Management Operational Sequence Diagram, illustrates this process.

The TMP and the ACCCs maintain data bases of adapted sector, fix, and airway loading alert thresholds. These threshold values are used to call attention to sectors, fixes, or airways where traffic loads are at saturation or approaching saturation. The thresholds are set at the time the system is established, and reviewed periodically by TMCs in coordination with area supervisors and ACF controllers (1).

Any changes to the adapted values require careful consideration and coordination by the TMCs and the TM Sps (2). If changes are made, the ACCCs and TMP will receive them and update their alert threshold data bases accordingly (3).

The TMP receives and stores demand data for use in projecting demand on en route airspace (4, 5, 6, 7). TM Sps, using the TMP, determine the overall demand (8) and consider it in making national flow control decisions. The TMP sends appropriate portions of the overall demand data to each ACCC (9). TMCs, using the ACCC, determine the overall local demand (10) and consider it in making local flow control decisions.

Weather is a major factor in all flow control decisions, including those involved in en route flow management. Weather products are provided to TMCs and TM Sps (11, 12, 13, 14). The TM Sps, using the weather information provided by the central flow meteorologists and the demand data

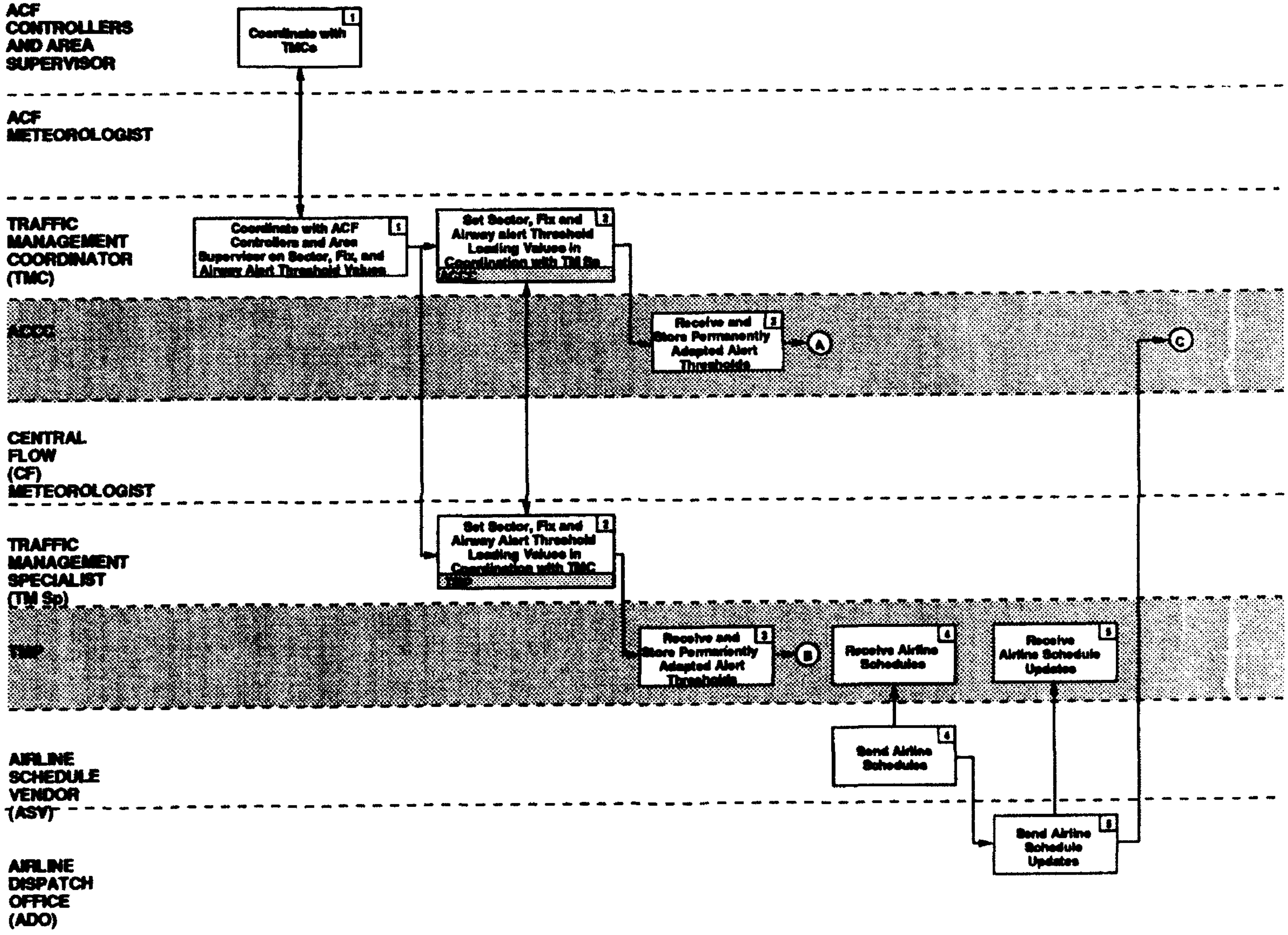


FIGURE 2-10
EN ROUTE FLOW MANAGEMENT
OPERATIONAL SEQUENCE DIAGRAM

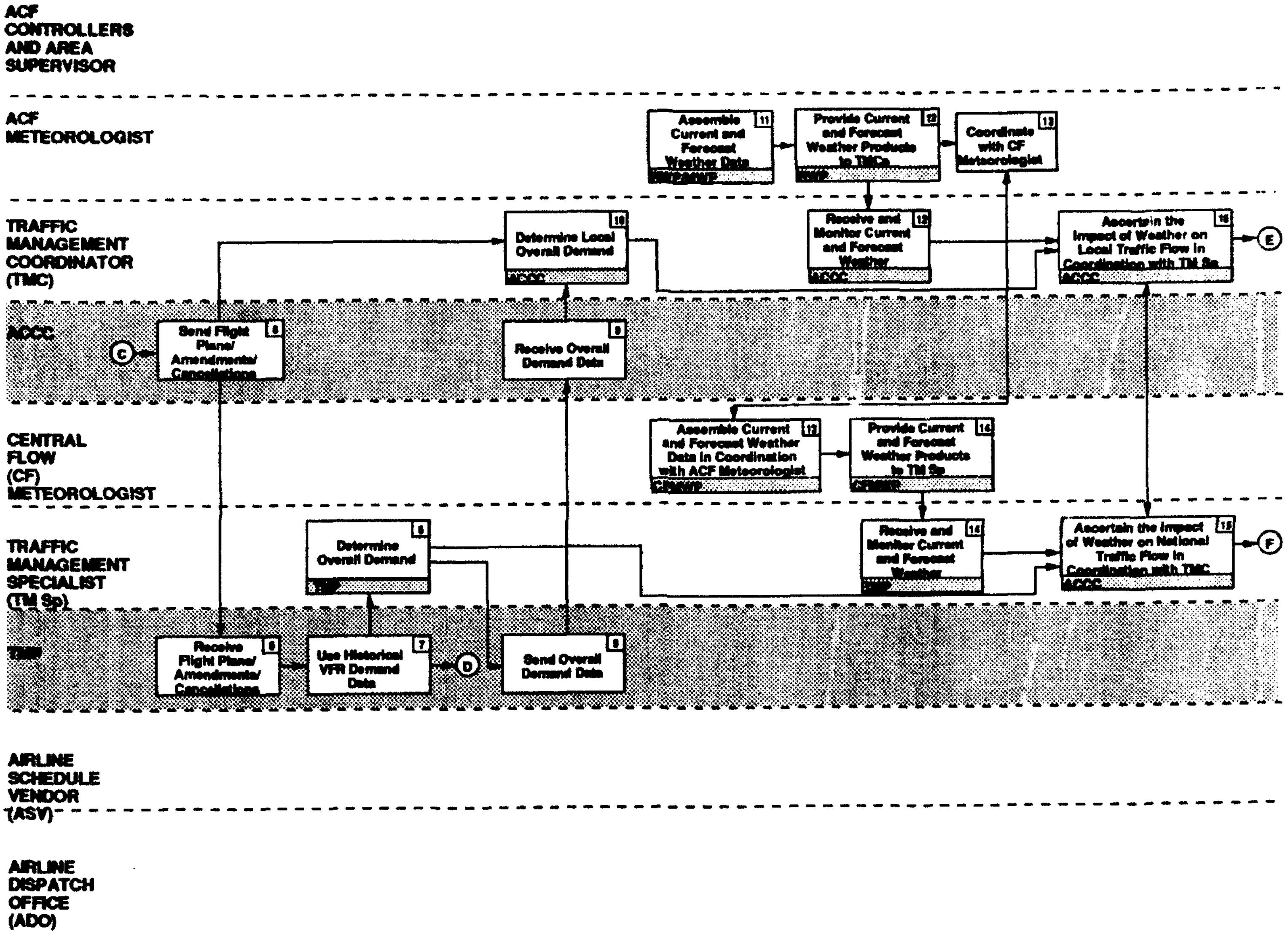


FIGURE 2-10
EN ROUTE FLOW MANAGEMENT
OPERATIONAL SEQUENCE DIAGRAM (CONTINUED)

provided by the TMP, ascertain the impact of the weather on national traffic flow (15). The TMCs, using the weather information provided by the ACF meteorologists and the demand data provided by the ACCC, ascertain the impact of the weather on local traffic flow (16). The TMCs and TM Sps coordinate on weather conditions as needed.

Having judged the impact of weather patterns on national traffic flow, the TM Sps select national routing schemes appropriate to the forecast conditions (17). The trial rerouting function of the TMP may be used in determining the preferred national routes. TMCs, having judged the impact of weather patterns on local traffic flow, select local routing schemes appropriate to the forecast conditions (18). The local trial rerouting function of the ACCC may be used in determining the preferred local routes. Coordination on routing schemes takes place between the TMCs, neighboring TMUs and TM Sps as needed. TMCs enter the selected routing parameters into the ACCC for automatic inclusion into all impacted flight plans and the routing scheme is implemented.

As conditions change, TMCs may find it necessary to temporarily modify the alert thresholds (19). If modification is necessary, the TMC makes the changes (20) and instructs the ACCC to forward the modified values to the TMP for use in its loading calculations. The TMP receives the modified values and temporarily updates the alert thresholds accordingly (21). The TMP automatically calculates predicted loads for each sector, fix, and airway based on the most up-to-date demand data (22). The TMP then compares the predicted sector, fix, and airway loads with their respective alert threshold values (23). If the predicted loading values do not exceed the alert threshold values, the TM Sp receives notification that no loading problems exist (24) and continues to monitor conditions and loads throughout the NAS (25). If the predicted loading values do exceed the alert threshold values, the TM Sp is alerted and examines the alert to determine if flow control action is necessary (26). If it is determined that the alert does not warrant flow control action, the TM Sp continues to monitor conditions and loads throughout the NAS (27). If the alert does warrant flow control action, the TM Sp proceeds to act on the alert.

Having determined that the alert warrants flow control action, the TM Sp instructs the TMP to send the alert data to the TMCs at impacted ACFs (28). The TM Sps and TMCs examine potential solutions to the predicted overload problems (29, 30). Potential solutions include reroutes and ground delay programs. The TM Sps coordinate the potential solutions with the TMCs at all impacted ACFs, and take their inputs and constraints into account in formulating alternatives for resolving the alert (31). The TMCs then coordinate the alternatives with the ACF controllers and area supervisors of the impacted sectors, and take their inputs and constraints into account (32). The TM Sps, in coordination with the TMCs, determine a suitable course of action to resolve the alert (33). If the agreed upon course of action is a reroute, the TMCs, ACF controllers, and area supervisors at the impacted ACFs proceed to implement the reroute (34). If the agreed upon course of action is a departure delay, the TM Sps proceed to implement the delay program (35).

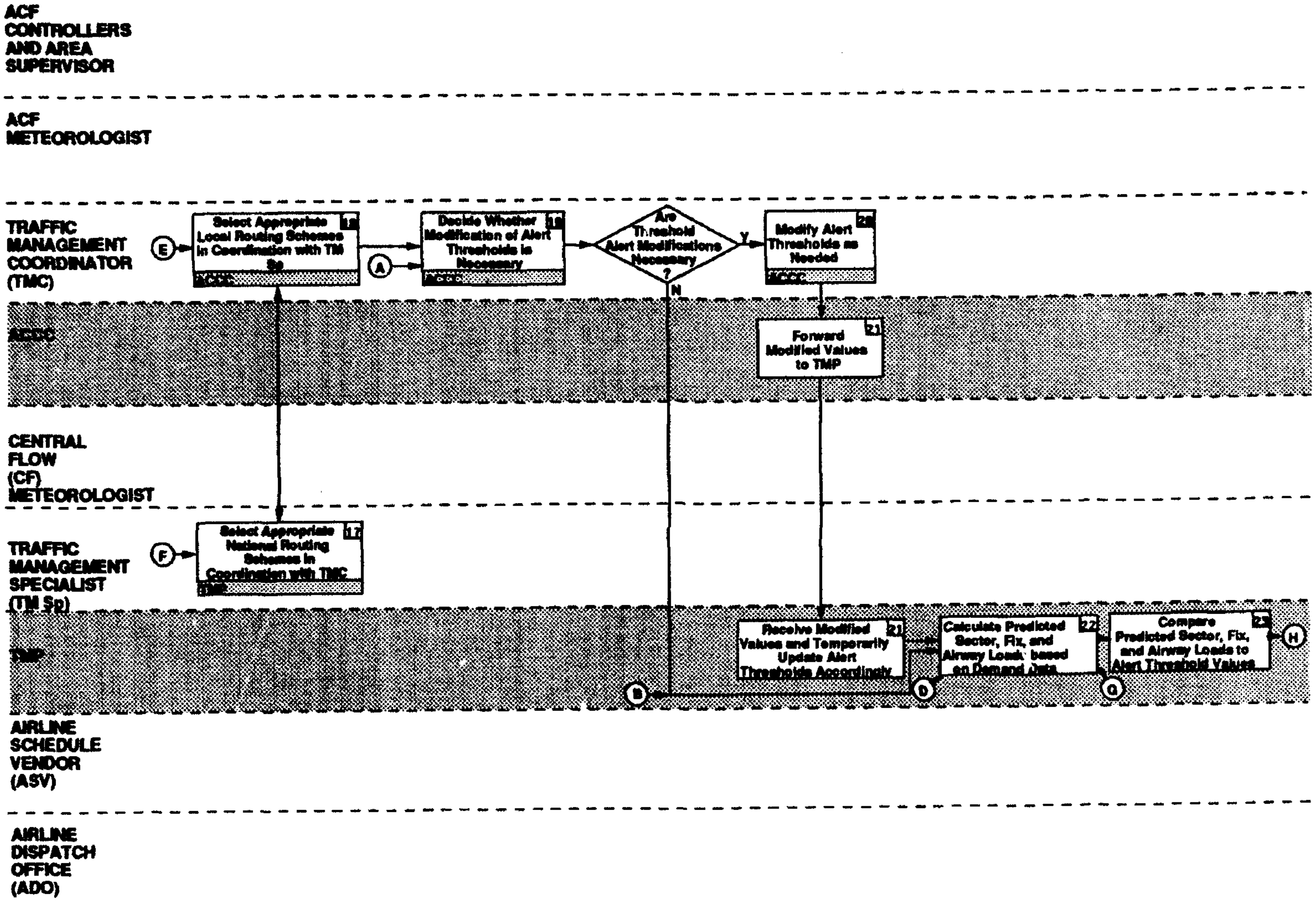


FIGURE 2-10
EN ROUTE FLOW MANAGEMENT
OPERATIONAL SEQUENCE DIAGRAM (CONTINUED)

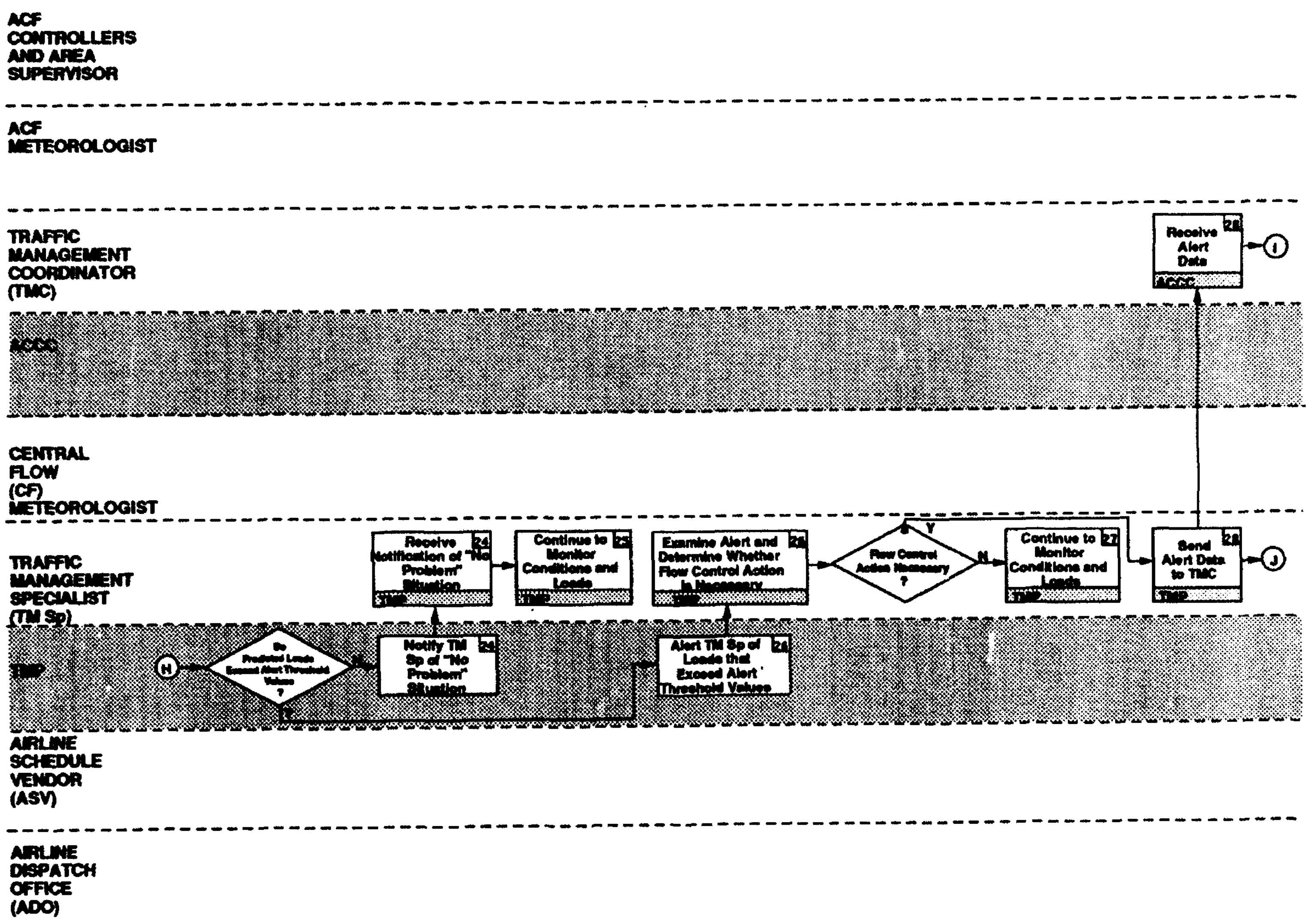


FIGURE 2-10
EN ROUTE FLOW MANAGEMENT
OPERATIONAL SEQUENCE DIAGRAM (CONTINUED)

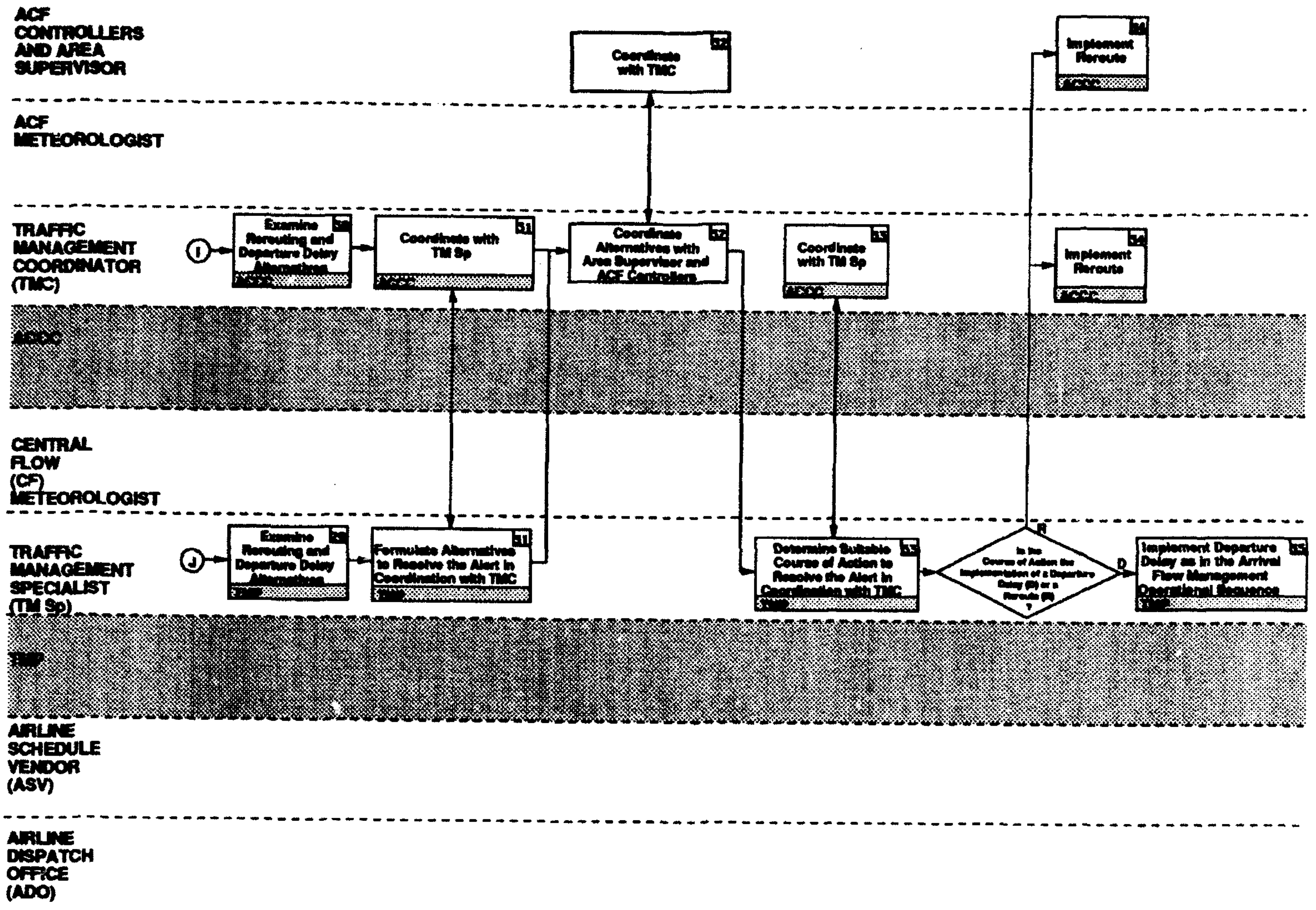


FIGURE 2-10
EN ROUTE FLOW MANAGEMENT
OPERATIONAL SEQUENCE DIAGRAM (CONTINUED)

In addition to resolving overload problems predicted by the TMP, en route flow management also resolves locally predicted overload situations. The TMP provides predicted sector, fix, and airway loading data to each ACCC (36). The ACCCs use this data in conjunction with actual flight data to compute near-term forecasts of local sector, fix, and airway loads (37). These near-term forecasts are more accurate than the long-term forecasts received from the TMP. The TMC accesses the near-term forecasted loads (38) and examines them in coordination with ACF controllers and area supervisors to determine whether flow control actions are necessary (39). If it is decided that the predicted loads are manageable, the TMCs continue to monitor conditions and predicted loading to detect any future problems (40). If it is decided that the predicted loads exceed the abilities of the various sectors, the TMCs proceed to initiate a local flow control procedure to alleviate the problem.

Having determined that the predicted loads warrant local flow control action, the TMCs coordinate with the area supervisors and ACF controllers of impacted sectors to determine a suitable course of action (41). If the problem is severe or wide-spread enough, the TMC will elect to internally reroute traffic flows. The TMC examines local rerouting alternatives using the local trial reroute capability of the ACCC (42). Based on the results of the trial reroutes, the TMC, in coordination with supervisors and controllers of impacted sectors, selects the preferred local routing (43). The TMCs, supervisors, and controllers proceed to implement the reroute (44).

If the local loading problem is not severe, or is limited to a few sectors, the TMC will elect to implement a general metering program. The TMC determines the maximum rate or minimum spacing for aircraft to enter a sector or cross a fix in coordination with the controllers and supervisors of the impacted sectors (45).

The metering rate is forwarded to the ACCC (46) and is reviewed by the TMC (47). The metering rate schedule is forwarded (48) to the ACF controllers and Area Supervisor (48) who then meter the traffic accordingly (49).

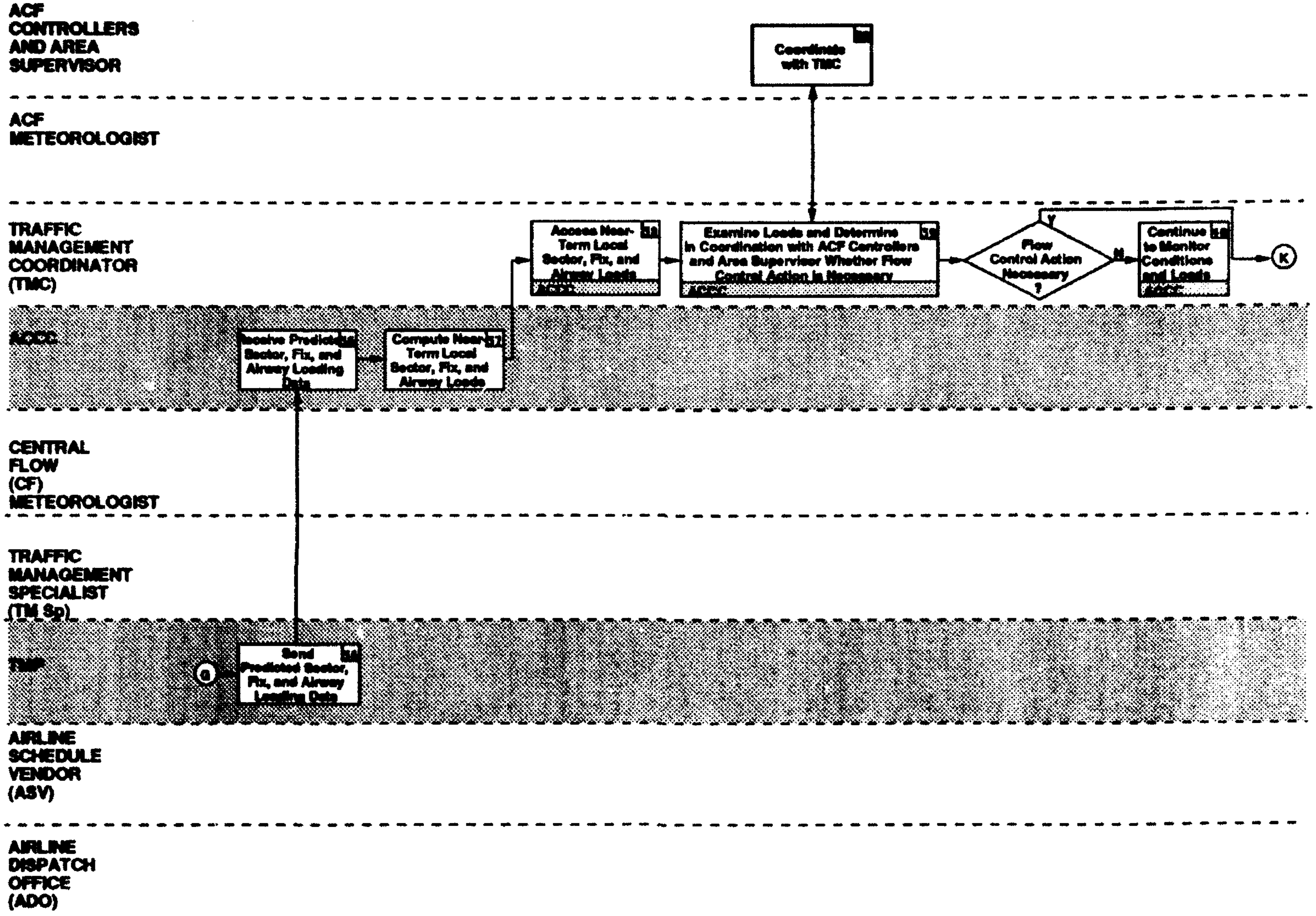


FIGURE 2-10
E'N ROUTE FLOW MANAGEMENT
OPERATIONAL SEQUENCE DIAGRAM (CONTINUED)

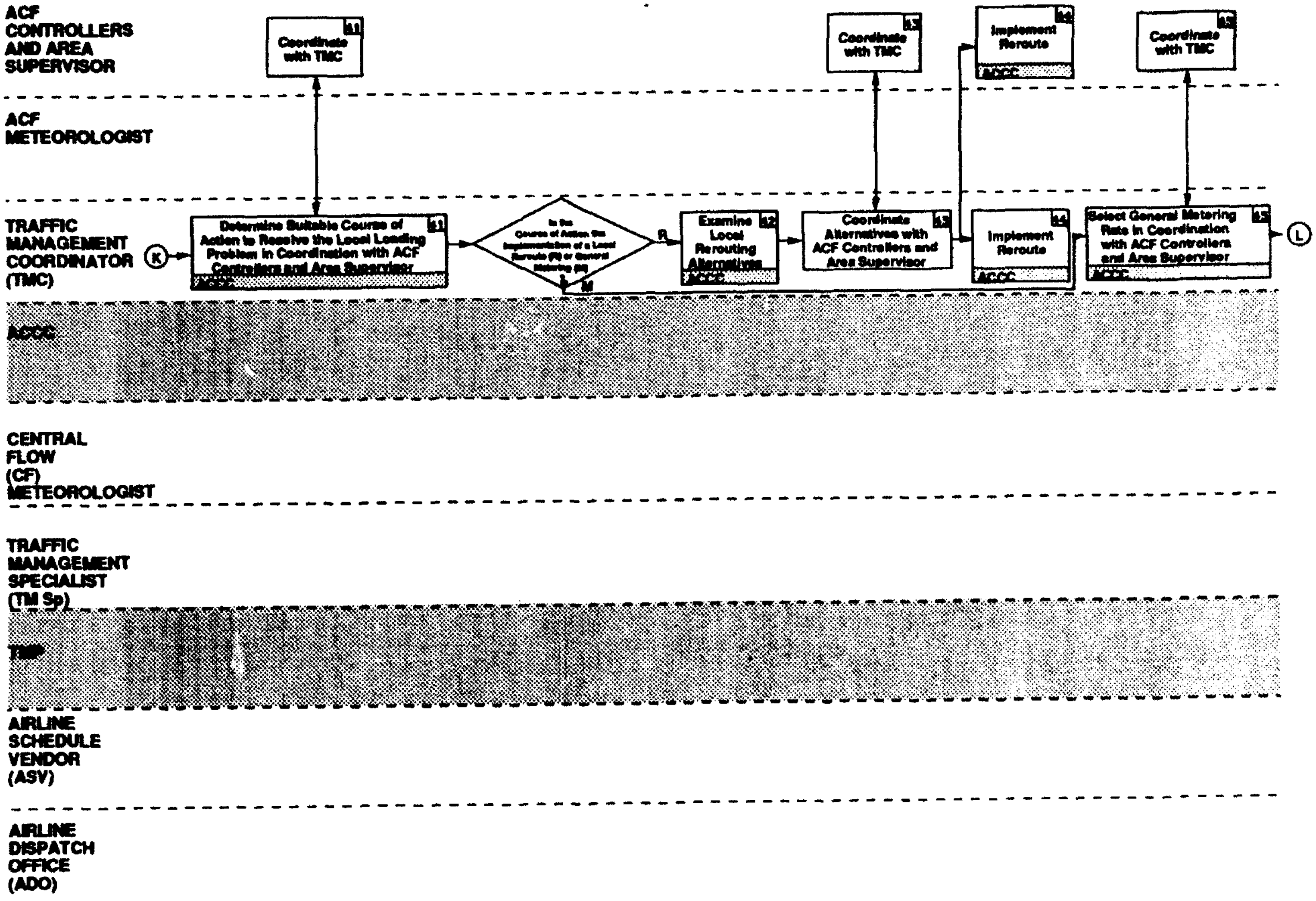


FIGURE 2-10
EN ROUTE FLOW MANAGEMENT
OPERATIONAL SEQUENCE DIAGRAM (CONTINUED)

FIGURE 2-10
EN ROUTE FLOW MANAGEMENT
OPERATIONAL SEQUENCE DIAGRAM (CONCLUDED)

2.5.2 Central Altitude Reservation Function (CARF) Operational Sequence

The purpose of CARF is to provide for the pre-coordination of mass movements of military aircraft, and the reservation of specific blocks of airspace for these military missions. CARF ensures that multiple missions do not conflict with each other and that these missions do not disrupt normal air traffic flow. Figure 2-11, the CARF Operational Sequence Diagram, illustrates the CARF process.

The Military Base Operator (MBO) of a military unit that is planning a CARF mission prepares an altitude reservation request for the mission and forwards it to a CARF specialist at the ATCCC (1). The altitude reservation request provides all details of the mission, including the airspace needed and the duration of the mission. The CARF specialist, using the TMP, reviews the reservation request for correctness and completeness, alerts the filing MBO to any errors or omissions, and coordinates any necessary corrections to the request.

After reviewing the altitude reservation request, the CARF specialist uses the TMP to check the request for conflicts with other CARF missions (2). The TMP alerts the CARF specialist to any potential conflicts. If the TMP finds no conflict between CARF missions, the CARF specialist forwards the altitude reservation request to each impacted ACF for local conflict checking by the TMC/MC. If the TMP does identify a conflict, the CARF specialist proceeds to resolve it.

Having judged that a conflict exists, the CARF specialist uses the CARF conflict analysis capability of the TMP to develop alternatives to the altitude reservation request (3). The TMP ensures that the alternatives are free of conflict with other CARF missions. The CARF specialist coordinates the alternatives with the filing MBO and negotiates until a satisfactory solution is found (4). The CARF specialist then modifies the request to reflect the revisions necessary to resolve the conflict (5). Now that no conflict between CARF missions exists, the CARF specialist forwards the altitude reservation request to each impacted ACF for local conflict checking by the TMC/MC (6).

The TMC/MC uses the ACCC to check the request for conflicts with civil traffic (7) and judges the ability of the ACF controllers to handle the mission. Airline schedules and historical demand data are used in the analysis. If it is determined that the mission presents no problem, the TMC/MC sends a local approval of the reservation to the TMP so the CARF specialist may approve the mission (8). If, however, it is determined that the mission creates a local conflict, the TMC/MC proceeds to resolve it.

Having judged that the requested mission creates a conflict locally, the TMC/MC uses the altitude reservation analysis capability of the ACCC to develop alternatives to the altitude reservation request (9). The ACCC ensures that the alternatives do not conflict with civil traffic flows. The TMC/MC forwards the alternatives to the CARF specialist (10). The CARF specialist must then check the alternatives for conflicts with other CARF missions (11).

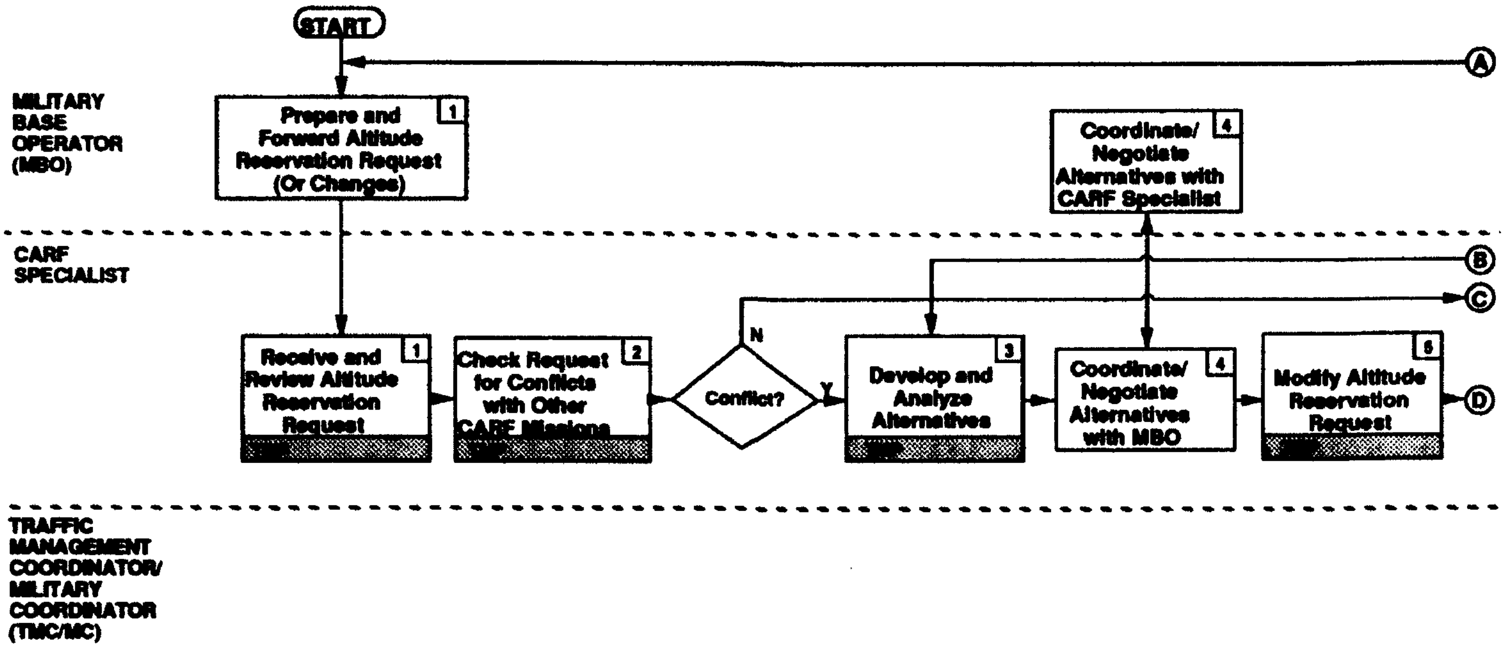


FIGURE 2-11
CARF OPERATIONAL SEQUENCE DIAGRAM

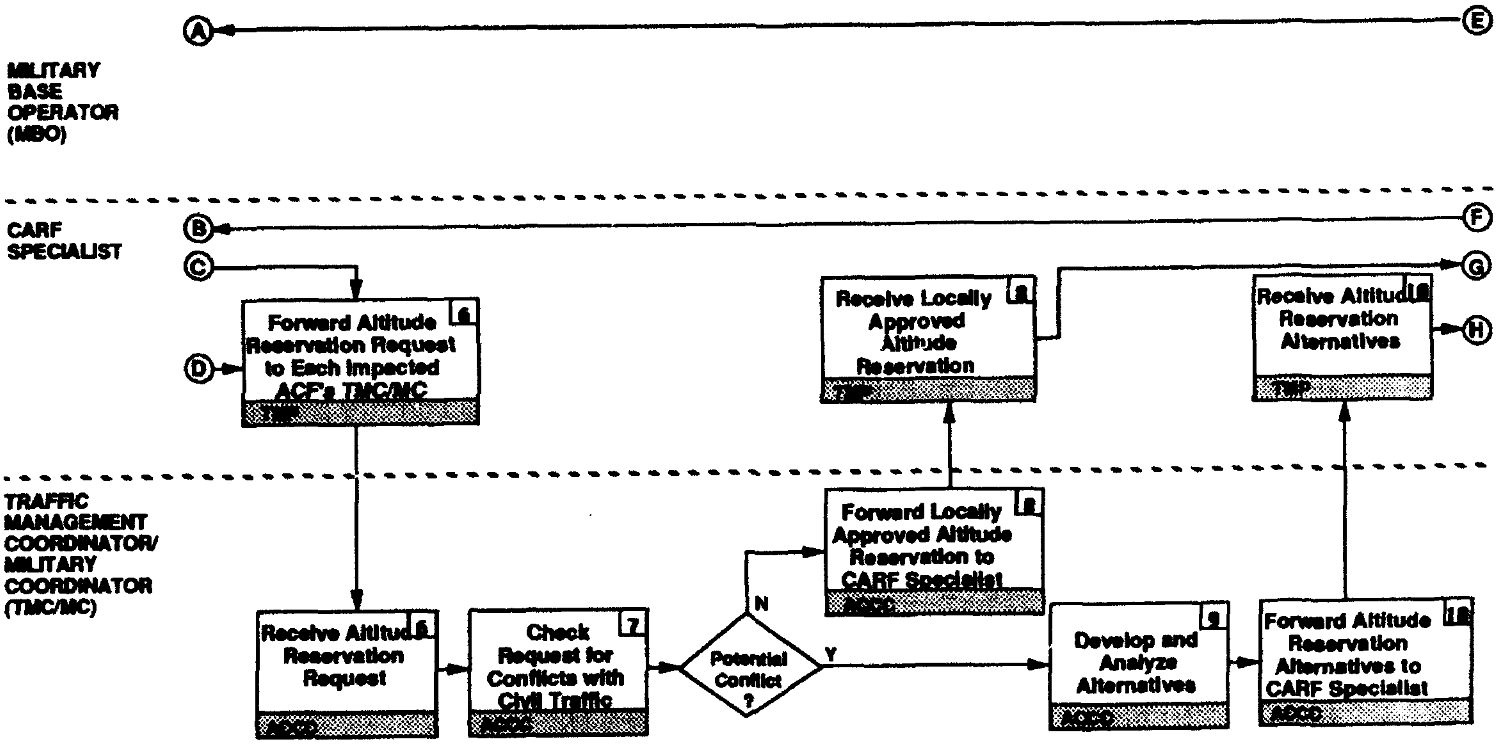


FIGURE 2-11
CARF OPERATIONAL SEQUENCE DIAGRAM
(CONTINUED)

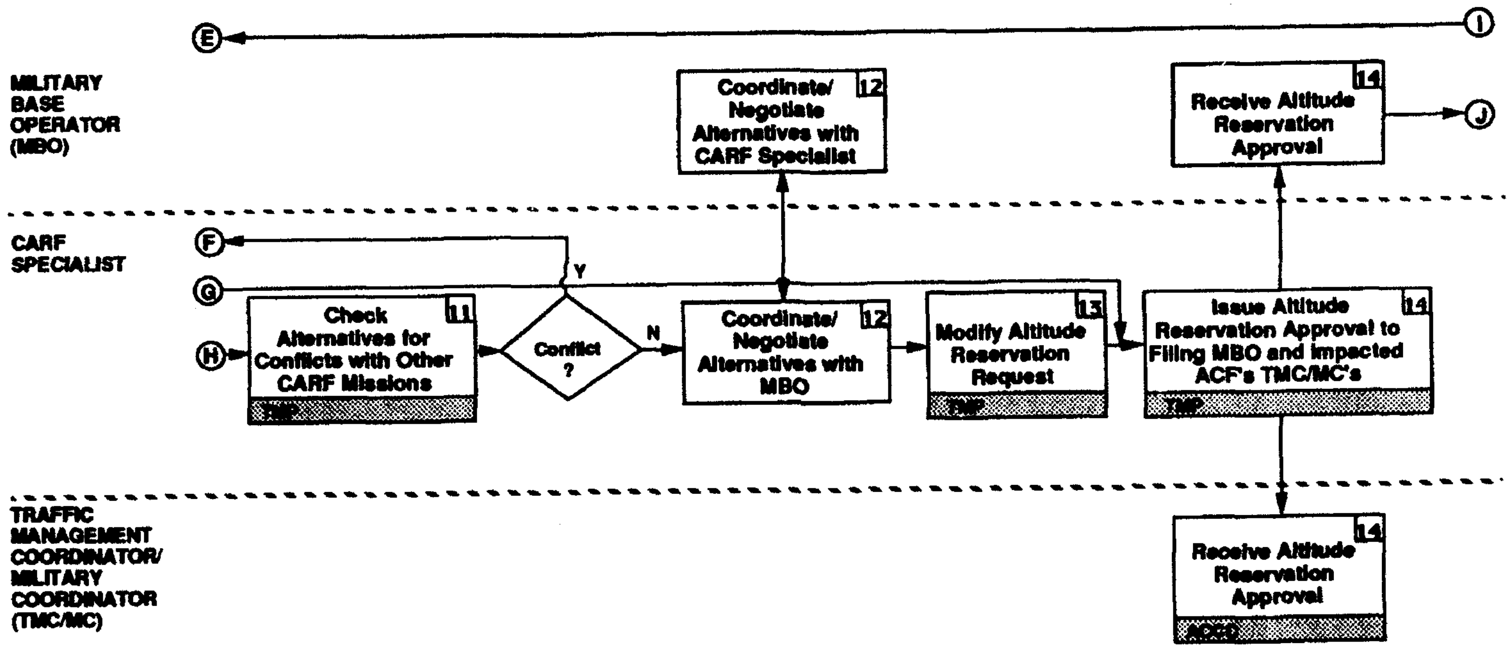


FIGURE 2-11
CARF OPERATIONAL SEQUENCE DIAGRAM
(CONTINUED)

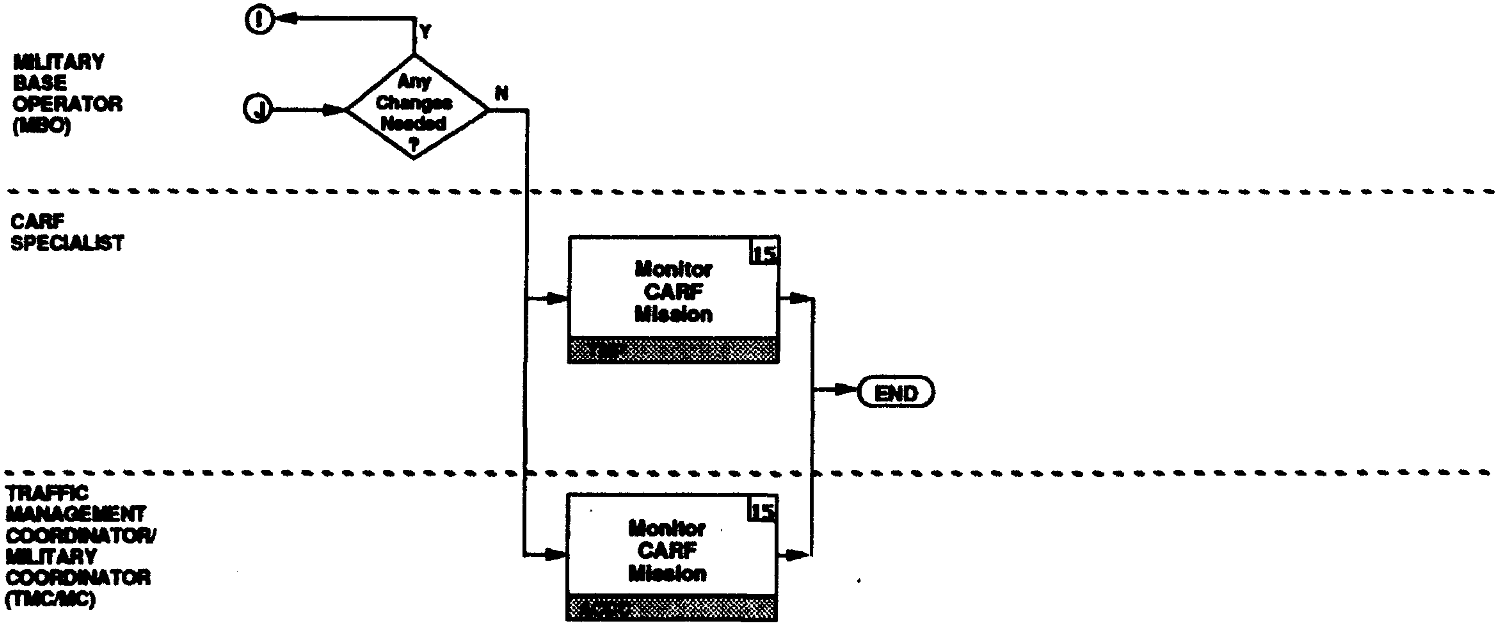


FIGURE 2-11
CARF OPERATIONAL SEQUENCE DIAGRAM
(CONCLUDED)

In the unlikely event that all of the alternatives conflict with other CARF missions, the process of developing alternatives and conflict checking must be repeated. If, however, one or more of the locally developed alternatives does not create a conflict with other CARF missions, the CARF specialist proceeds to negotiate the non-conflicting alternative(s) with the filing MBO until a satisfactory alternative is found (12). The CARF specialist then modifies the request to reflect the agreed-upon conflict free alternative (13). The CARF specialist approves the reservation, and forwards the approval to the filing MBO and the impacted ACFs (14). The entire CARF process must be repeated if the filing MBO chooses to alter the mission.

During the CARF mission, the CARF specialist and the TMCs at affected ACFs monitor the progress of the mission and act as needed if any problems are encountered (15).

2.6 Ground Delay Operational Scenario

The operational scenario presented in this section depicts a specific hypothetical traffic management situation that warrants the implementation of a national ground delay program, a tool often used in national arrival flow management. A ground delay program is implemented when arrival demand at a particular airport or group of airports is predicted to significantly exceed the arrival capacity of those airports. When the demand on a NAS resource such as an airport significantly exceeds the capacity of the resource, delay is inevitable. A ground delay program allows the delay to be absorbed on the ground, rather than in an airborne holding pattern. The benefits of the ground delay approach to absorbing delay include the reduction of costly fuel consumption and reduced controller workload. Figure 2-12, the Ground Delay Operational Scenario Diagram, illustrates the implementation of a ground delay program.

The TMP receives and maintains airport capacity data (1, 2, 3). The TMP receives and stores demand data for use in projecting the demand on airports (4, 5, 6, 7). The TM Sps and TMCs receive weather products (11, 12, 13, 14) which indicate severe weather that is expected to develop along the northern East Coast and reduce visibility at all New York metropolitan airports by late afternoon. The reduced visibility is expected to decrease the capacities of the New York metropolitan area airports by 30 percent.

The TM Sp requests the TMP to run delay simulations (12) that will enable him to judge the impact of demand on airport operations in light of the predicted severe weather conditions. Based on the simulation results, the TM Sp decides, in coordination with the TMCs at the New York ACF, that ground delays must be issued to all aircraft destined to New York airports during the late afternoon and the early evening hours (13). The TM Sp instructs the TMP to compute the ground delays needed to balance the demand for the New York airports with the predicted decrease in the airports' capacities (14). The delay data is sent to all ACFs affected by the ground delays (15). Each ACCC receives departure delays for all affected flights departing from airports within its area of jurisdiction, and automatically includes the delays in each affected flight's departure flight data (16). The ACCCs then send the revised flight data to the affected ATCTs (17). The ATCT controllers implement the ground delay program by releasing flights destined to New York airports at the appropriate times (18).

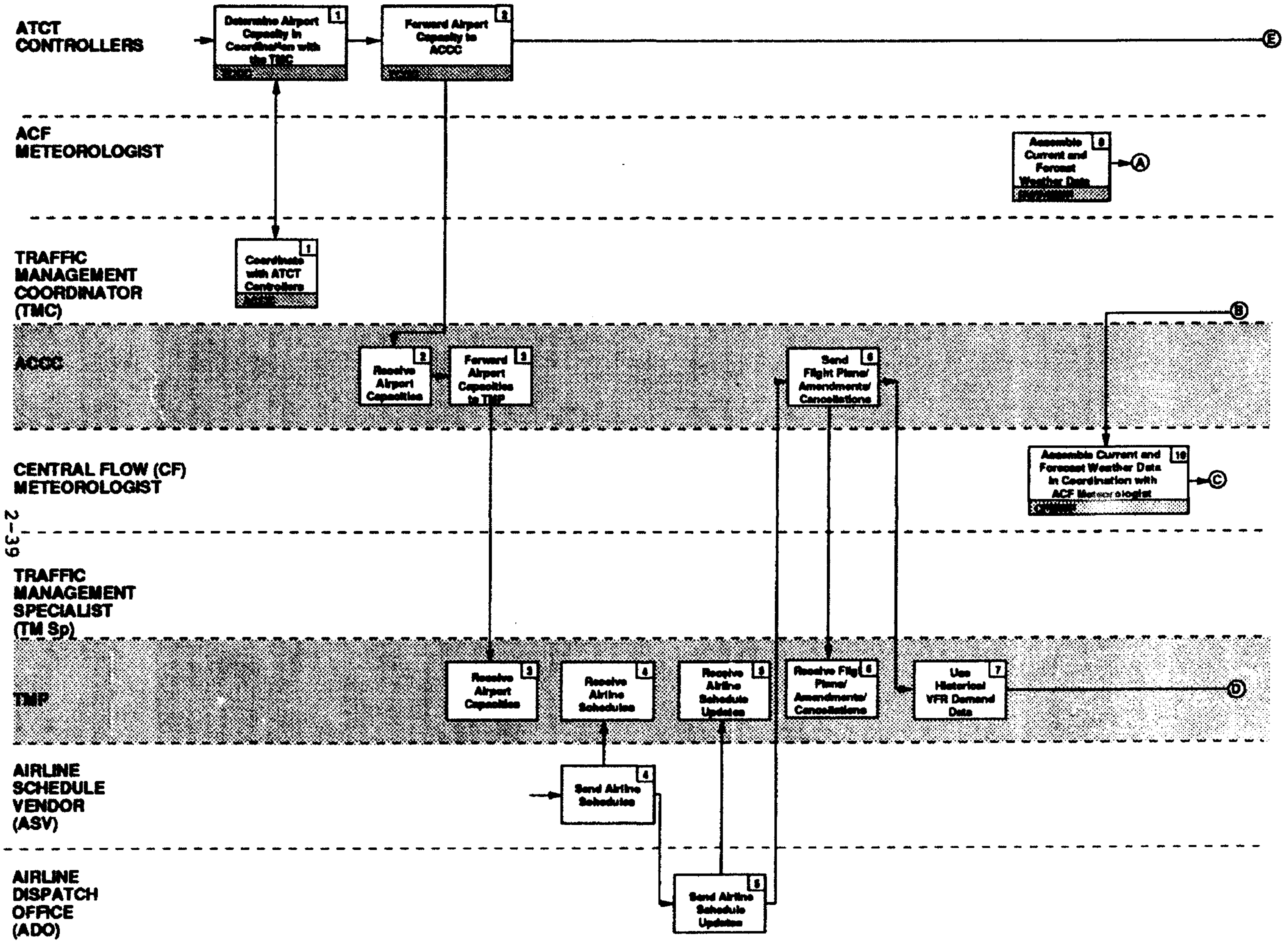


FIGURE 2-12
GROUND DELAY
OPERATIONAL SCENARIO DIAGRAM

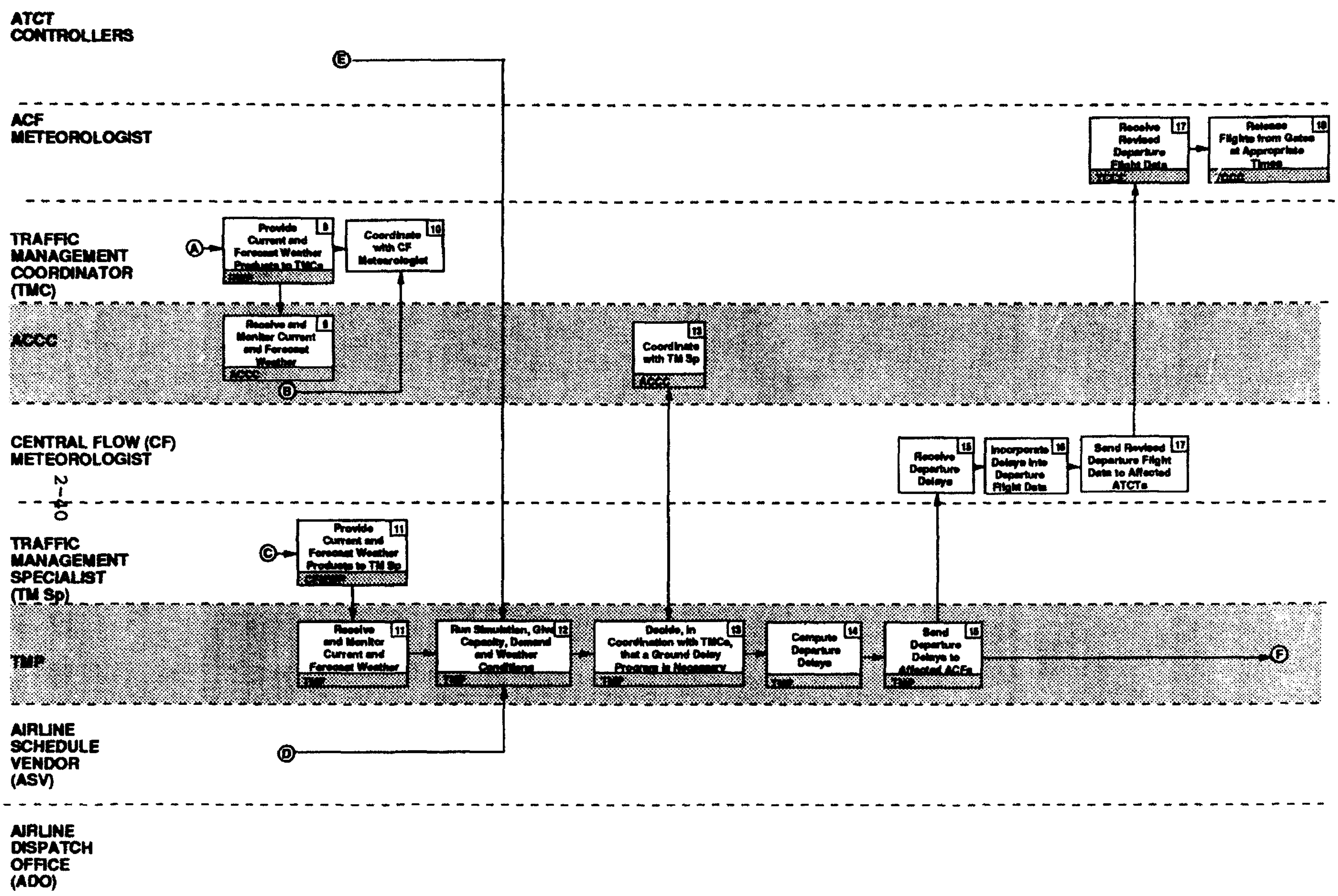


FIGURE 2-12
GROUND DELAY
OPERATIONAL SCENARIO DIAGRAM
(CONTINUED)

As part of the implementation of the delay program, the TM Sp composes a system delay status message, and distributes it to all facilities that require delay information (19).

After the implementation of the ground delay program, the TM Sp monitors the progress of the program in coordination with the TMCs at the New York ACF (20). The TM Sp compares the planned arrival rate with the actual arrival rate of aircraft at the New York airports, and determines that the performance of the ground delay program is as planned. The TM Sp monitors forecast weather conditions for the New York area and gradually phases out the ground delay program in response to improved forecasts (21).

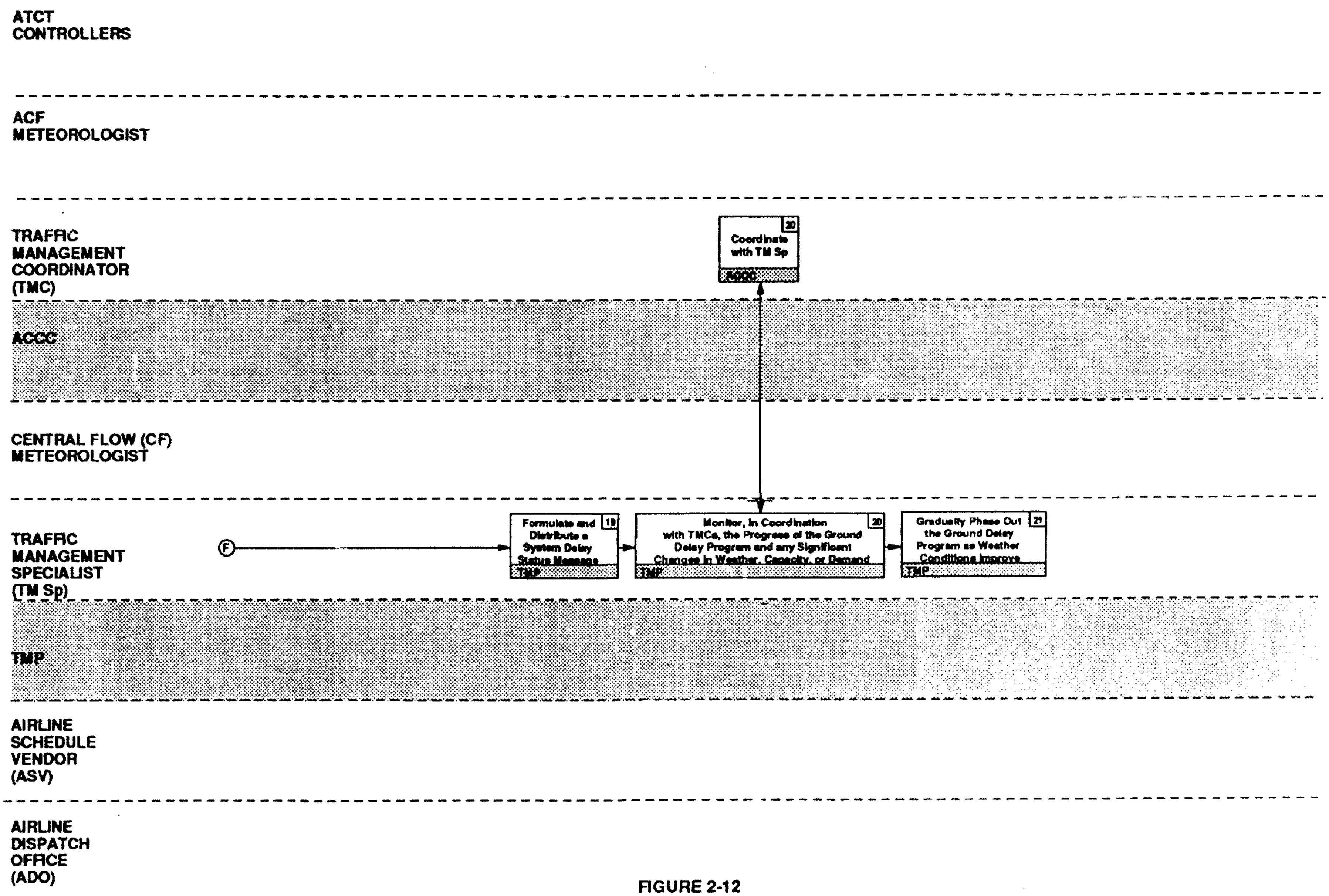


FIGURE 2-12
GROUND DELAY
OPERATIONAL SCENARIO DIAGRAM
(CONCLUDED)

3.0 APPROACH AND DEPARTURE SEQUENCING

To make the most efficient use of airspace, a specialist must provide instructions to users which will result in the establishment of landing and departure sequences at specific aerodromes. This sequencing imposes a requirement on the National Airspace System (NAS) to provide accurate location information.

3.1 Support

The NAS is required to support approach and departure sequencing activities, as described in Section 3.2.2 of the NAS Systems Requirements Specification (NASSRS). Figure 3-1, Overview of NAS/User Systems for Approach/Departure Sequencing, illustrates all the NAS facilities, systems, and user systems that support the approach and departure sequencing functions.

Approach and departure sequencing is supported by Flight Service Data Processing Systems (FSDPS), Area Control Computer Complexes (ACCC), Tower Control Computer Complexes (TCCC), Air Traffic Control (ATC) Radar Beacon Systems (ATCRBS) (Mode A, Mode C, or Mode S), ATC specialists (including controllers), and pilots.

3.1.1 NAS Facilities/Systems/Positions

The NAS facilities, systems, specialist positions, and major information paths that may be involved in approach and departure sequencing operations are shown in Figure 3-2, Approach and Departure Sequencing Operational Block Diagram.

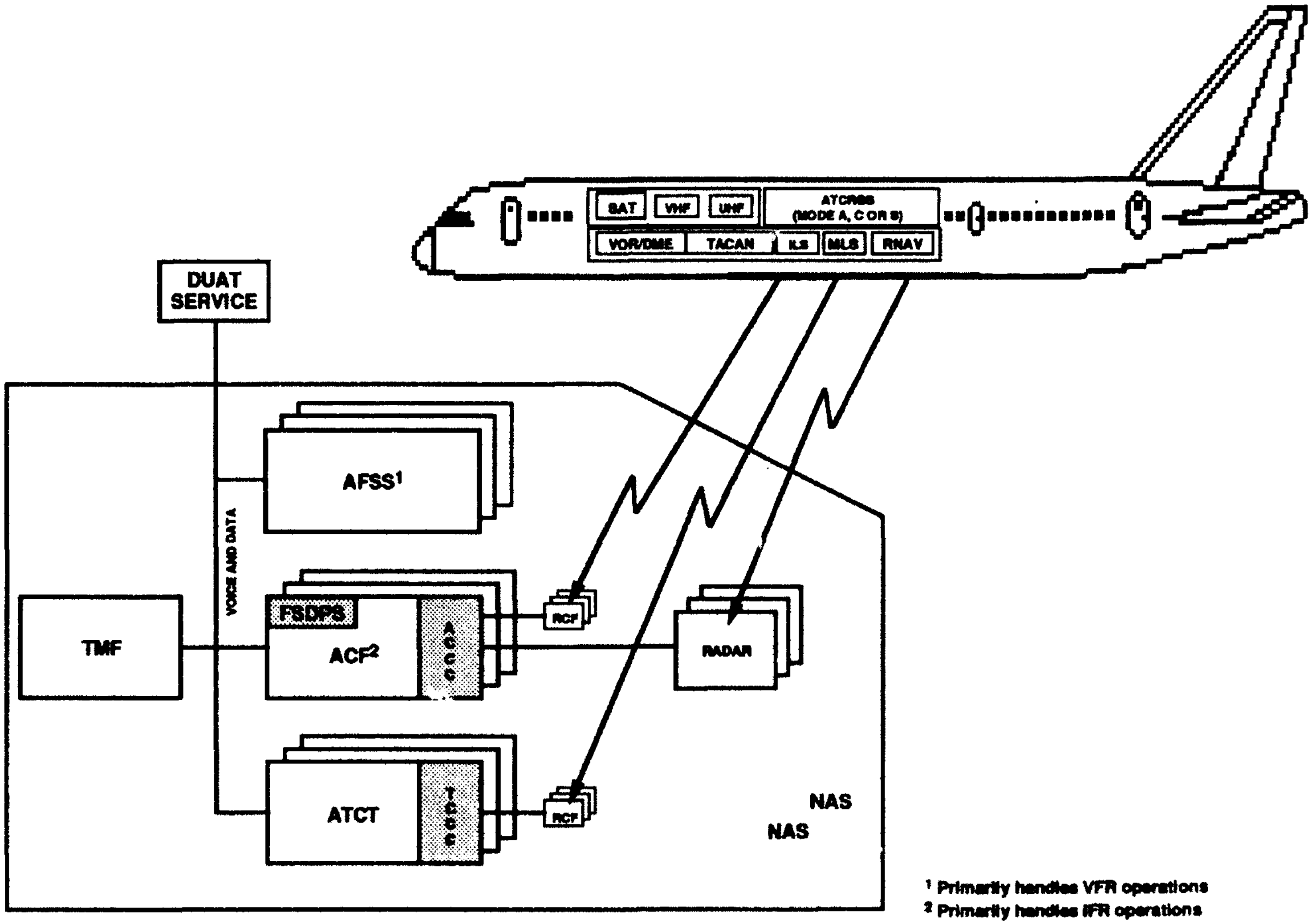
The primary purpose of the ACCC is to provide continual automated assistance to controllers within an Area Control Facility (ACF). The ACCC includes both the equipment and software required to support the control of aircraft in a volume of airspace under the air traffic jurisdiction of an ACF. The ACCC includes computers, computer software, displays, input/output devices, and controller/operator workstations. The ACCC provides controllers at an ACF with the ability to track all aircraft within the responsibility of their region. Controllers interface with the ACCC through sector suites.

The Air Traffic Control Tower (ATCT) has primary responsibility for control of aircraft arriving or departing from an airport, operating within the airport traffic control area, or taxiing on the airport. The TCCC provides automation support for those controllers who work in an ATCT. A TCCC include the equipment and software that supports control of aircraft, including the airport surface, under the air traffic jurisdiction of an ATCT. This also includes control of those airport systems that are related to ATC. ACCCs and TCCCs have the same equipment and software to the extent possible.

The FSDPS is a data processing system for the Automated Flight Service Stations (AFSSs) that is used to process instrument flight rules (IFR) and visual flight rules (VFR) flight plans filed mainly by general aviation pilots. (Commercial aviation flies flight plans directly with the ACF.)

3.1.2 User Systems

The aircraft in Figure 3-1 shows supporting user systems which include the following:



[1] Primarily handles VFR operations
[2] Primarily handles IFR operations

FIGURE 3-1

OVERVIEW OF NAS/USER SYSTEMS FOR APPROACH/DEPARTURE SEQUENCING

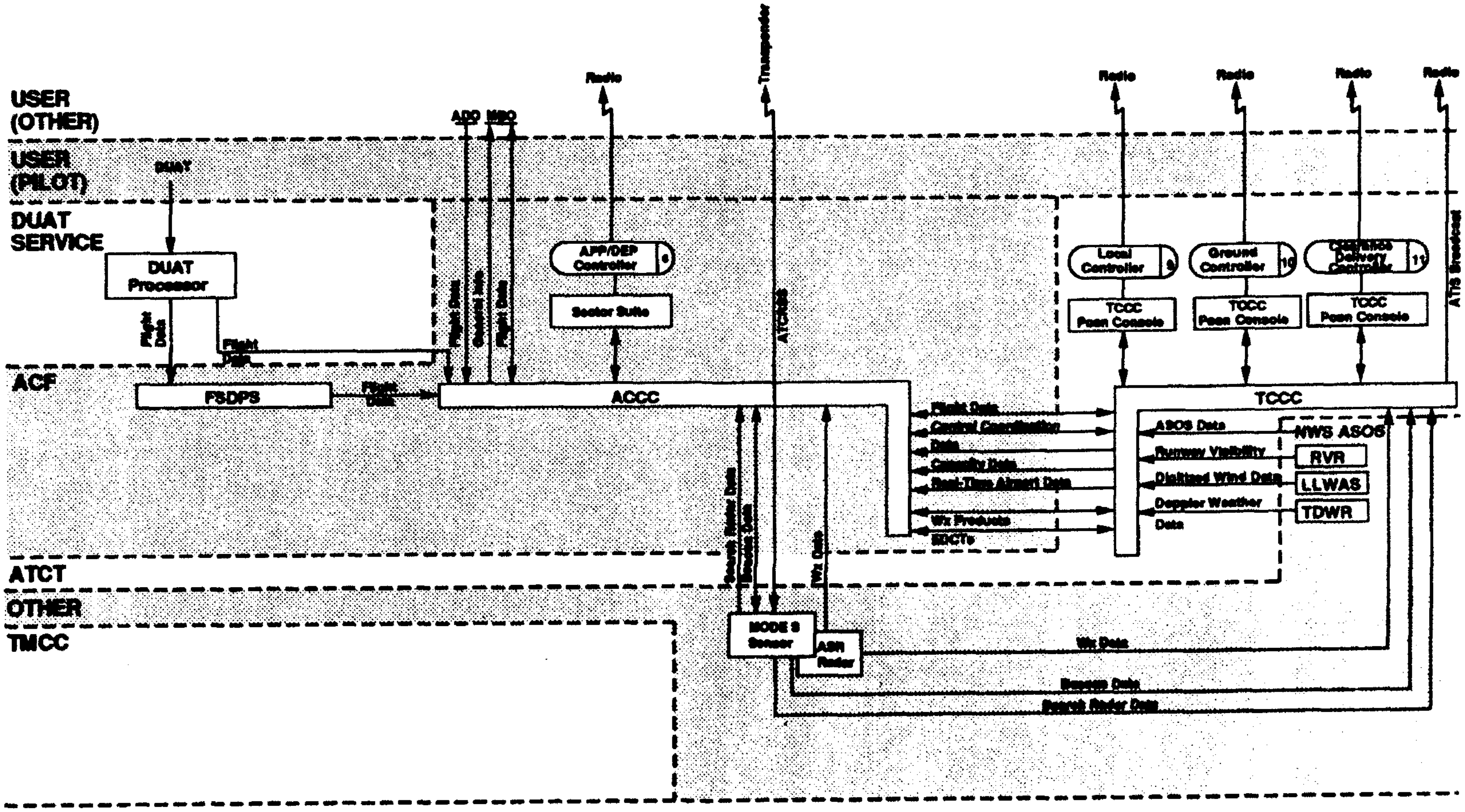


FIGURE 3-2

APPROACH AND DEPARTURE SEQUENCING
OPERATIONAL BLOCK DIAGRAM

- Two-way radios for voice communication which could be either Very High Frequency (VHF), Ultra High Frequency (UHF), satellite, or a combination;

- Data communication transcription systems which could be Mode S, satellite, VHF, or a combination;

- Surveillance transponders such as Air Traffic Control Radar Beacon System (ATCRBS) (Mode A, C, or S); and

- Navigation equipment including VOR, DME, TACAN, ILS, MLS, and RNAV such as INS.

Few, if any aircraft have all of the above systems, but most aircraft have some combination of the above systems.

3.2 Information

This section describes the information required or used in the approach and departure sequencing service processed through the NAS hardware and software systems and also information exchanged directly between the pilot and controller.

3.2.1 Information Processed Through the NAS

This subsection describes information required or used for the approach and departure sequencing service processed through NAS hardware and software systems.

ACF sector suites and TCCC position consoles display to controllers the following information for controlled aircraft within assigned airspace:

- Unique aircraft identification
- Position of aircraft (controlled or uncontrolled)
- Reported altitude
- Course
- Speed
- Aircraft performance characteristics

Controllers provide the ACCC with airport acceptance rates, and specify desired sequence and time at meter fixes on approach or departure routes for airports. The ACCC generates traffic sequencing and spacing advisories in response to the above information input by controllers.

Information on significant deviations between actual flight paths of controlled aircraft in assigned airspace and the flight path assigned by the specialists is available to controllers. If the aircraft has deviated beyond specified limits from its assigned position in a lateral or vertical direction, the ACCC displays the information to the controller. Flight data for departing and approaching aircraft, traffic flow data, and various weather products are available to controllers. Specifically tower controllers require information on current local traffic flow, local inbound traffic flow, flow metering, flight plans, precipitation, winds aloft, local wind, barometric pressure, and runway surface conditions, in order to provide runway recommendations.

Much of the information processed by the ACCC and TCCC comes from bulk data entry of flight plans for commercial aircraft, from military base operations, and from IFR and VFR pilot-submitted flight plans for general aviation. Information submitted by the pilot through an IFR Flight Plan includes the following:

- Aircraft identification
- Aircraft type, special equipment
- Computed true airspeed (TAS)
- Departure airport identifier code
- Proposed departure time
- Requested en route altitude or flight level
- Defined route of flight
- Destination airport identifier code
- Estimated time en route
- Fuel on board in hours in minutes
- Alternate airports for landing
- Total number of persons on board including crew

Information submitted by a pilot through a VFR flight plan includes the following:

- Aircraft identification
- Aircraft type, special equipment
- True air speed (TAS)
- Departure airport identifier code
- Proposed departure time
- VFR Altitude
- Defined route of flight
- Destination airport identifier code
- Estimated time en route
- Fuel on board in hours and minutes
- Alternate airports for landing
- Total number of persons on board including crew

In addition, information is available to controllers from NAS weather processors. Global weather data provides information covering wide geographical areas (e.g., snow or thunderstorms moving through an area) that could limit or prevent approach to or departures from an airport. Also weather data specific to an airport is available (e.g., wind shear data or wind data) that could be used to notify approaching aircraft not to land or that could be used to change a runway configuration.

3.2.2 Information Obtained from the Pilot

Information required to be supplied by the pilot includes the following:

- Pilots instructed by ATC to follow another aircraft notify the controller if they lose sight of the aircraft being followed.

- Pilots notify the ATC controller any time a clearance is not fully understood, or is considered unsafe.

- Pilots who wish to make a "contact approach" receive a clearance for this approach from ATC (implies that the flight is operating clear of clouds, has at least one mile visibility, and can expect conditions to continue to the destination airport), and provides ATC immediate notification if pilot is unable to continue the contact approach.

- Pilots are required to notify ATC when they can not maintain ATC assigned airspeed within plus or minus 10 knots, (or 0.02 Mach).

- Pilots notify ATC of minimum fuel status when fuel supply has reached a point that no delay can be accepted upon reaching the final destination.

- Pilots inform controllers if aircraft being followed, or other traffic alerted to is in sight.

- Pilots notify ATC if they are performing a missed approach.

3.3 Functions

The following paragraphs describe in more detail the functions provided by the controller positions introduced in 2.1 and by the equipment that support the controllers. The operational flow diagrams associated with each paragraph illustrate the information flow between the controller and the user and between the controller and data processing equipment. The functions performed by the controllers are all covered by the requirements specified in the NASSRS. The pertinent NASSRS paragraphs that specify the functions being performed by the controller are referenced in each of the paragraphs below.

3.3.1 Approach/Departure Controllers (Position 6)

Figure 3-3 illustrates all of the primary functions performed for approach and departure sequencing by an approach or departure controller and the information that flows to and from the controller.

Approach controllers, at an ACF, sequence IFR and VFR aircraft approaching larger airports (Class B airspace) or medium sized airports (Class C airspace. The approach controller accepts a hand-off from the en route controller, and after directing the aircraft to the airport, transfers control of the aircraft to the local controller at the ATCT (where applicable).

Departure controllers accept a transfer of control from the local controller after an IFR or VFR takeoff and directs the aircraft to join its filed route of flight. (However, if an aircraft has taken off from an uncontrolled airport, but enters controlled airspace, then the departure controller is responsible for sequencing within the controlled airspace.) The departure controller hands-off the aircraft to the en route controller.

On an aircraft's approach to an airport, the approach controller accepts the hand-off from the en route controller. The approach controller provides the pilot vectors and instructions to direct the aircraft from the outer fix to the final runway approach. The approach controller may also sequence the aircraft using Standard Arrival Routes (STARs) and altitude assignments. The approach controller sequences approaching aircraft based on various factors such as, aircraft speed, altitude, current heading, airport noise abatement procedures, and desired runway (if the pilot has a preference).

On an aircraft's departure from an airport, the departure controller accepts the hand-off from the local controller. The departure controller provides each aircraft the appropriate vectors, speed, and altitude based on the

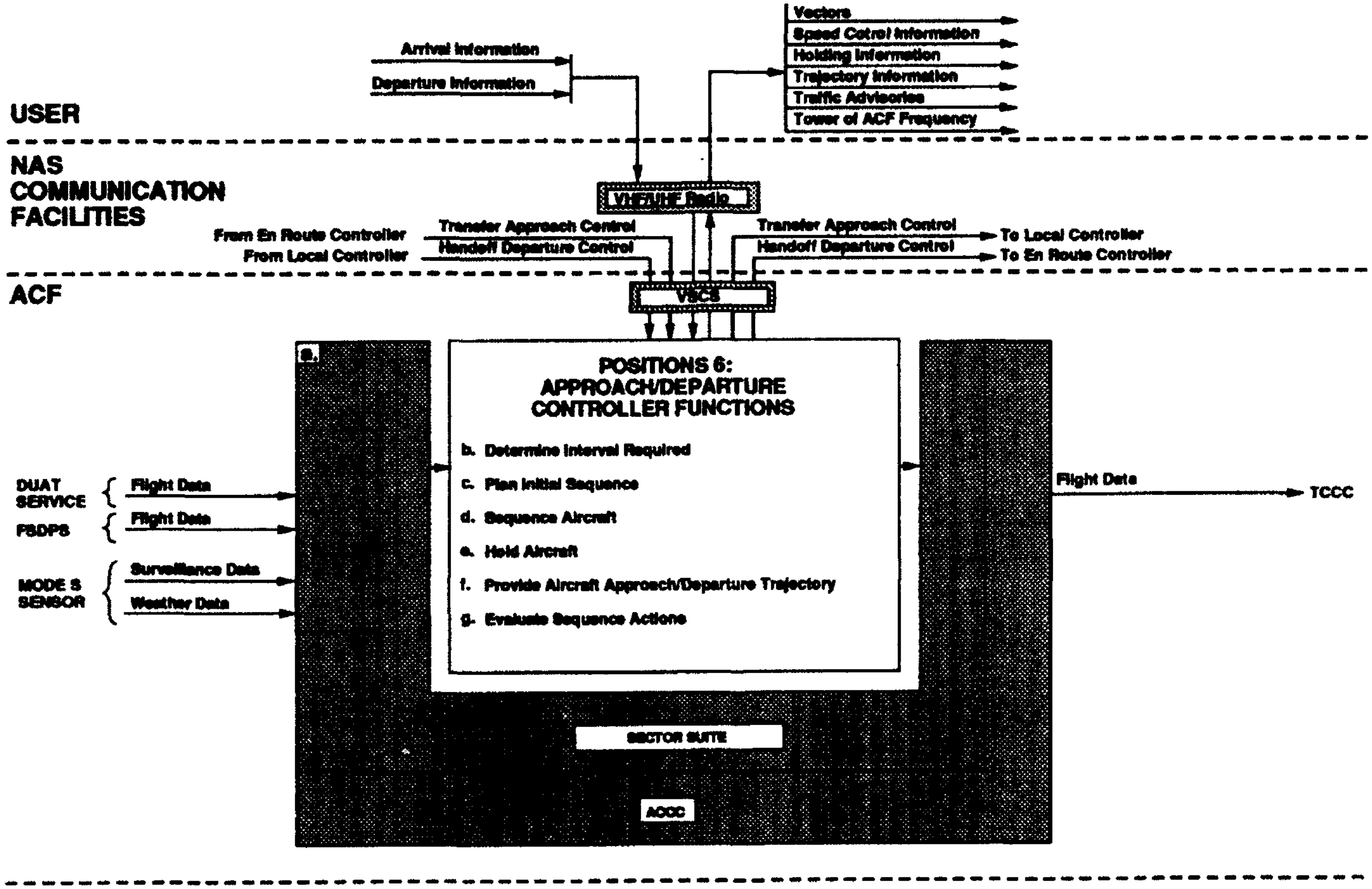


FIGURE 3-3
APPROACH/DEPARTURE CONTROLLER (POSITION 6)
OPERATIONAL FLOW DIAGRAM

aircraft's final destination, traffic separation, and/or standard instrument departure (SID).

a. ACCC Processing. The ACCC provides automated assistance to the approach/departure controllers within the area of jurisdiction of the parent ACF. The ACCC processes flight plans, performs route processing, and provides position information. The approach/departure controller interfaces with the ACCC through a sector suite.

   NASSRS requirement: 3.2.2.A,B,D,E

b. Determine Interval Required. The approach and departure controllers, with the assistance of the ACCC, determines the interval required between aircraft, the point at which it is to be accomplished, and the speed adjustments required.

   NASSRS requirement: 3.2.2.C

c. Plan Initial Sequence. The approach controller determines an initial sequence for aircraft approaching an airport based on aircraft position, speed, and altitude, as shown on the approach controller's display. After formulating the sequence, the approach controller establishes the aircraft sequence through some combination of vectoring, speed control, holding, and rerouting. The approach controller can direct an aircraft into a holding pattern in order to establish a sequencing pattern.

   NASSRS requirement: 3.2.2.C

d. Sequence Aircraft. The approach/departure controllers sequences aircraft based on aircraft configuration, altitude, speed, required spacing, time and distance required to achieve heading changes, relative speed of aircraft preceding and following, and the effect of wind on aircraft tracks, ground speeds, and turning distances.

   NASSRS requirement: 3.2.2.C,E

e. Hold Aircraft. The approach controller can direct an aircraft into a holding pattern in order to establish a sequencing pattern. Aircraft approaching an airport may be placed in a sequential holding pattern at a specific altitude. The approach controller may direct each aircraft in a holding pattern to descend as their turn to land progresses until the approach controller can vector the aircraft on a final approach to the runway. Also the approach controller can refuse permission for a VFR aircraft requesting entry to an ARSA due to traffic overload conditions.

   NASSRS requirement: 3.2.2.C

f. Provide Aircraft Approach/Departure Trajectory. The approach controller with the support of the ACCC provides aircraft not following a STAR or instrument approach a final descent trajectory into the terminal airspace. The departure controller upon acceptance of control from the local controller and using the ACCC provides each aircraft not using a SID with a trajectory to direct the aircraft to join its filed flight plan route.

NASSRS requirement: 3.2.2.C,E

g. Evaluate Sequence Actions. The approach controller, with the support of the ACCC, evaluates sequence actions to determine if the desired sequence has been achieved and if any further actions are needed to correct or adjust the sequence.

NASSRS requirement: 3.2.2.C,E

3.3.2 Local Controller (Position 9)

Figure 3-4 illustrates all of the sequencing functions performed by the local controller at the ATCT. Normally during both IFR and VFR departures, the local controller receives control from the ground controller, provides the aircraft departure instructions, and shortly after the aircraft has departed the runway, passes control to the departure controller at the responsible ACF. Normally for IFR and VFR arrivals, the local controller receives a transfer of control from the approach controller located at the ACF, and issues landing instructions to the aircraft approaching the runway. At smaller airports, the local controller sequences approaching aircraft after receiving a transfer of control from the en route controller.

However, if the flight is VFR and entirely confined to the local controller's airspace, then the local controller has complete control over sequencing approaches.

a. TCCC Processing. The local controller accesses the TCCC through a position console. The TCCC maintains critical information required by the local controller such as, flight plan data, position data, weather conditions, airport, area, and equipment data, and graphic weather data. The local controller inputs departure or arrival times, airport acceptance rates, and runway configurations. Metering and sequencing information is passed between the ACCC and the TCCC.

NASSRS requirements: 3.2.2.A,B

b. Receive Air Traffic Movement Request. The local controller monitors the radio for air traffic movement requests from departing and arriving aircraft.

NASSRS requirements: 3.2.2.B,D

c. Issue Departure/Arrival Instructions. The local controller issues information/instructions to departing aircraft to taxi into position for takeoff, ensures that the runway is clear of obstructions, issues departure instructions, and issues takeoff clearances. During arrivals, the local controller ensures that the pilot has the current Automatic Terminal Information Service (ATIS) information, and then provides aircraft with specific traffic pattern instructions establishing aircraft

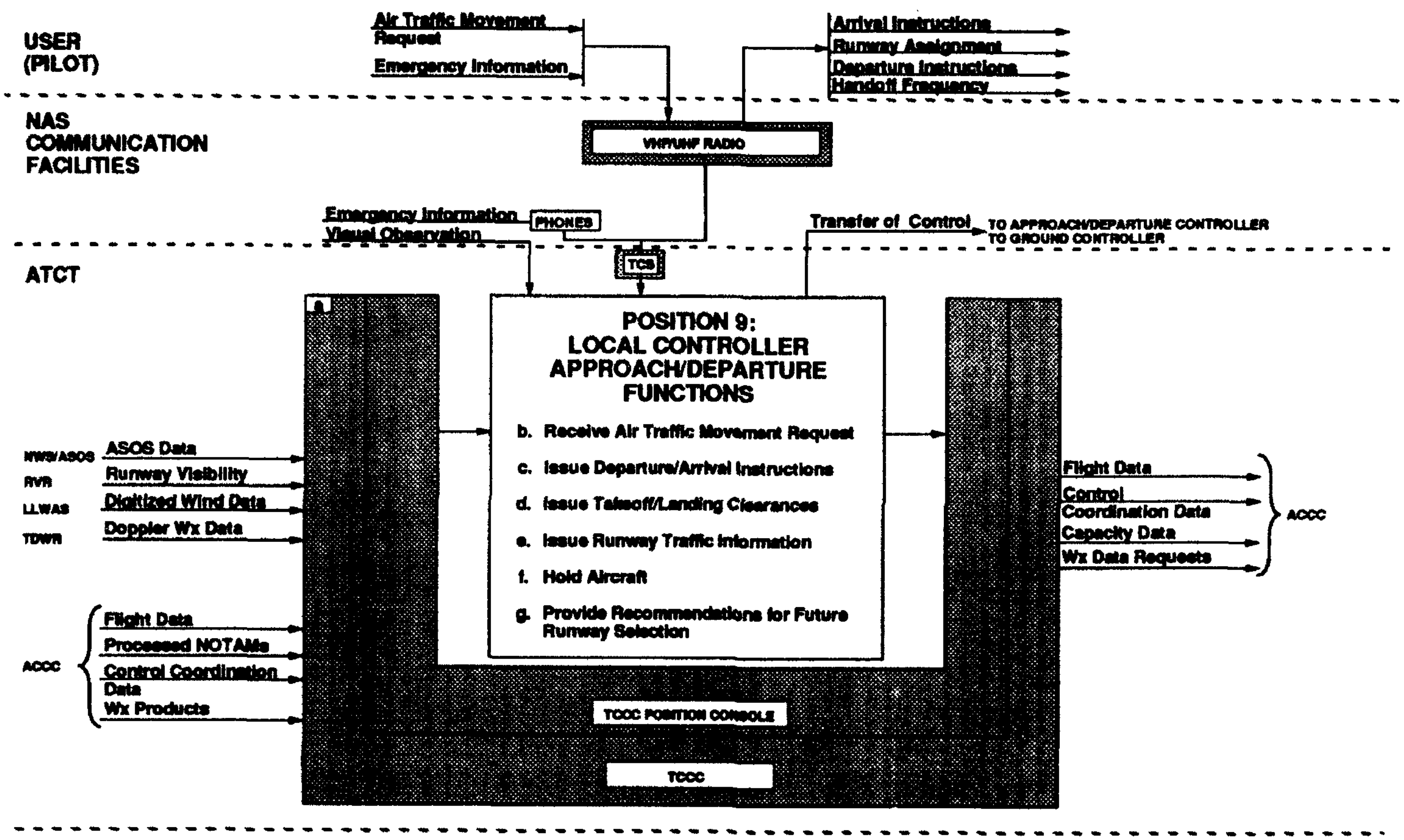


FIGURE 3-4
LOCAL CONTROLLER (POSITION 9)
OPERATIONAL FLOW DIAGRAM

spacing and sequencing (except if spacing and sequencing has been performed by approach control).

NASSRS requirement: 3.2.2.C,D,F

d. Issue Takeoff/Landing Clearances. The local controller issues the appropriate takeoff or landing clearance for each aircraft after ensuring that the runway surface is clear and that separation and wake turbulence avoidance standards are met.

NASSRS requirement: 3.2.2.B,C,D,E

e. Issue Runway Traffic Information. The local controller keeps the arriving aircraft informed of runway traffic information relevant to sequencing the aircraft approach.

NASSRS requirement: 3.2.2.F,G

f. Hold Aircraft. At smaller airports, the local controller performs approach sequencing. The local controller can direct an aircraft into a holding pattern in order to establish an approach sequence. Aircraft approaching an airport may be placed in a sequential holding pattern at a specific altitude. The local controller may direct each aircraft in a holding pattern to descend, as their turn to land progresses, until the local controller has vectored each aircraft on a final approach to the runway.

NASSRS requirement: 3.2.2.C

g. Provide Recommendations For Future Runway Selection. The local controller, in consultation with the tower supervisor, analyzes all available information that could affect the airport runway configuration, including traffic patterns, weather, and metering information. The local controller, in consultation with the tower supervisor, determines the appropriate future runway configuration for the airport.

NASSRS requirement: 3.2.2.D

3.3.3 Ground Controller (Position 10)

Figure 3-5 illustrates all of the primary approach and departure sequencing functions performed by the ground controller. The ground controller performs the primary departure sequencing function by directing each aircraft onto a taxiway leading to a departure runway, and then transferring control of the aircraft to the local controller. The order in which aircraft are in line to use the runway generally determines the departure sequence.

Departure delays may be initiated by traffic management specialists. These departure delays, referred to as Estimated Departure Clearance Times (EDCTs), are processed by the ACCC and can change the departure sequence. Aircraft are sequenced for takeoff when they are in position on the airport taxiway leading to the departure runway. However, at some airports, the ground controllers have the flexibility to revise an aircraft sequence once the aircraft are lined up. For arrivals, the local controller transfers control to the ground controller.

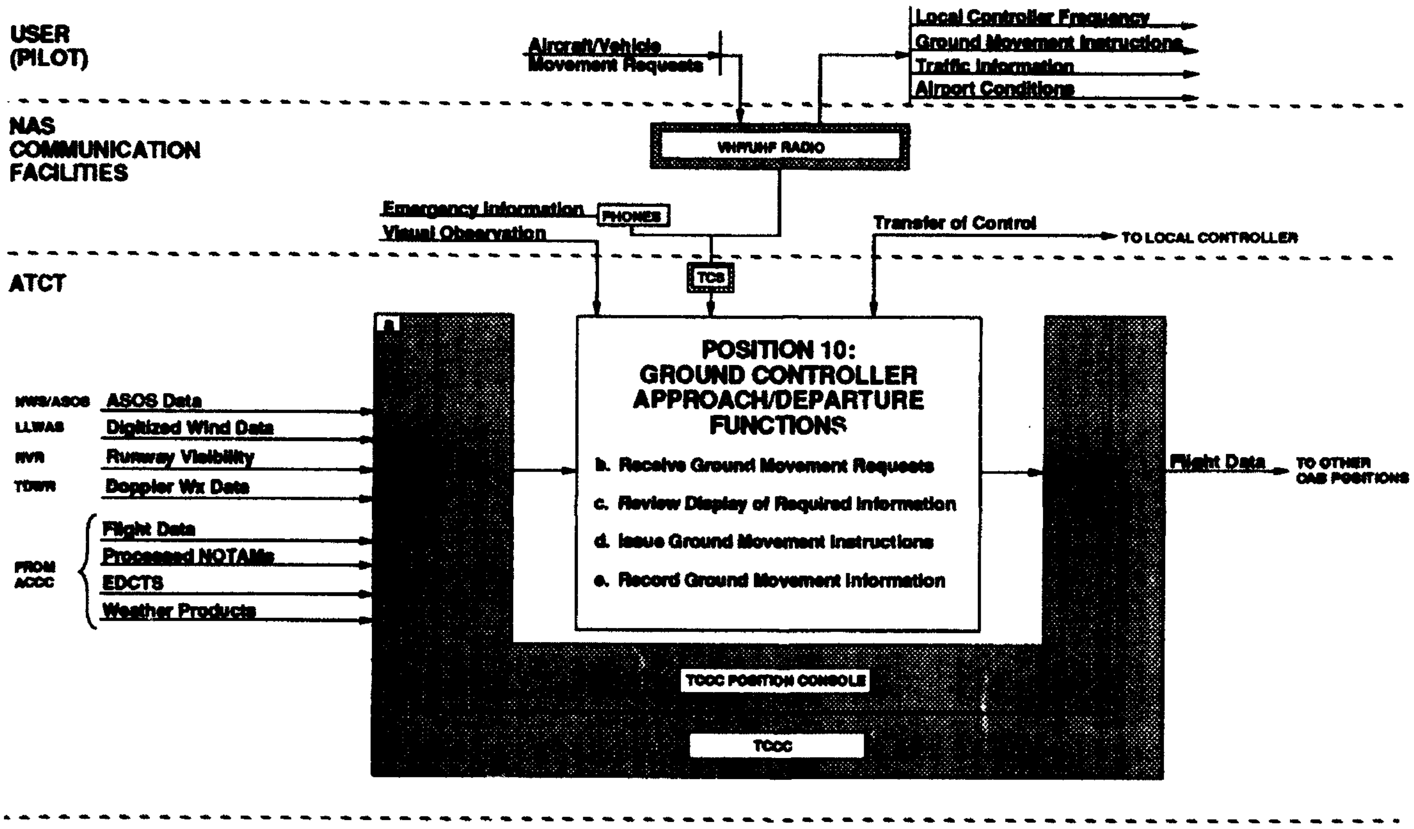


FIGURE 3-5
GROUND CONTROLLER (POSITION 10)
OPERATIONAL FLOW DIAGRAM

a. TCCC Processing. The ground controller interfaces with the TCCC through a position console. The TCCC provides the controller information that is required to be available continuously such as: critical airport, equipment, weather data, and processed NOTAMS. EDCTs are processed by the ACCC and are passed to the ground controller through the TCCC.

   NASSRS requirement: 3.2.2.A,B,D

b. Receive Ground Movement Requests. The ground controller monitors the radio for ground movement requests from aircraft parked in terminal areas.

   NASSRS requirement: 3.2.2.B,D

c. Review Display of Required Information. The ground controller reviews the display of aircraft departures on the position console. The departure list contains a list of aircraft call signs for all aircraft proposed to depart within a specific number of minutes, ordered by proposed departure time.

   NASSRS requirement: 3.2.2.D

d. Issue Ground Movement Instructions. The ground controller issues ground movement instructions to the aircraft. The ground controller directs the aircraft from the parking area through the airport to the taxiway leading onto the departure runway. The order of the aircraft along the taxiway normally determines the sequence in which the local controller allows the aircraft to depart the airport, with the constraint that the local controller cannot allow an aircraft to depart before its EDCT. The ground controller directs arriving aircraft from the time it leaves the active runway to the parking area.

   NASSRS requirement: 3.2.2.D

e. Record Ground Movement Information. The ground controller inputs to the TCCC information received directly from the pilot such as, changes to flight plans or flight data, or data observed, such as departure times.

   NASSRS requirement: 3.2.2.D

3.3.4 Clearance Delivery Controller (Position 11)

Figure 3-6 illustrates all of the primary functions performed by the clearance delivery controller and the information that flows to and from this controller. Prior to takeoff, IFR and VFR flight data received from flight plans and VFR departure information received from radio are entered into the ACCC. The ACCC processes flight clearances, and transmit the clearance or delay information to the TCCC. Flight clearances (or delay information when necessary) are displayed to the clearance delivery controller who reviews the information, and then transmits the clearance and instructions to the pilot.

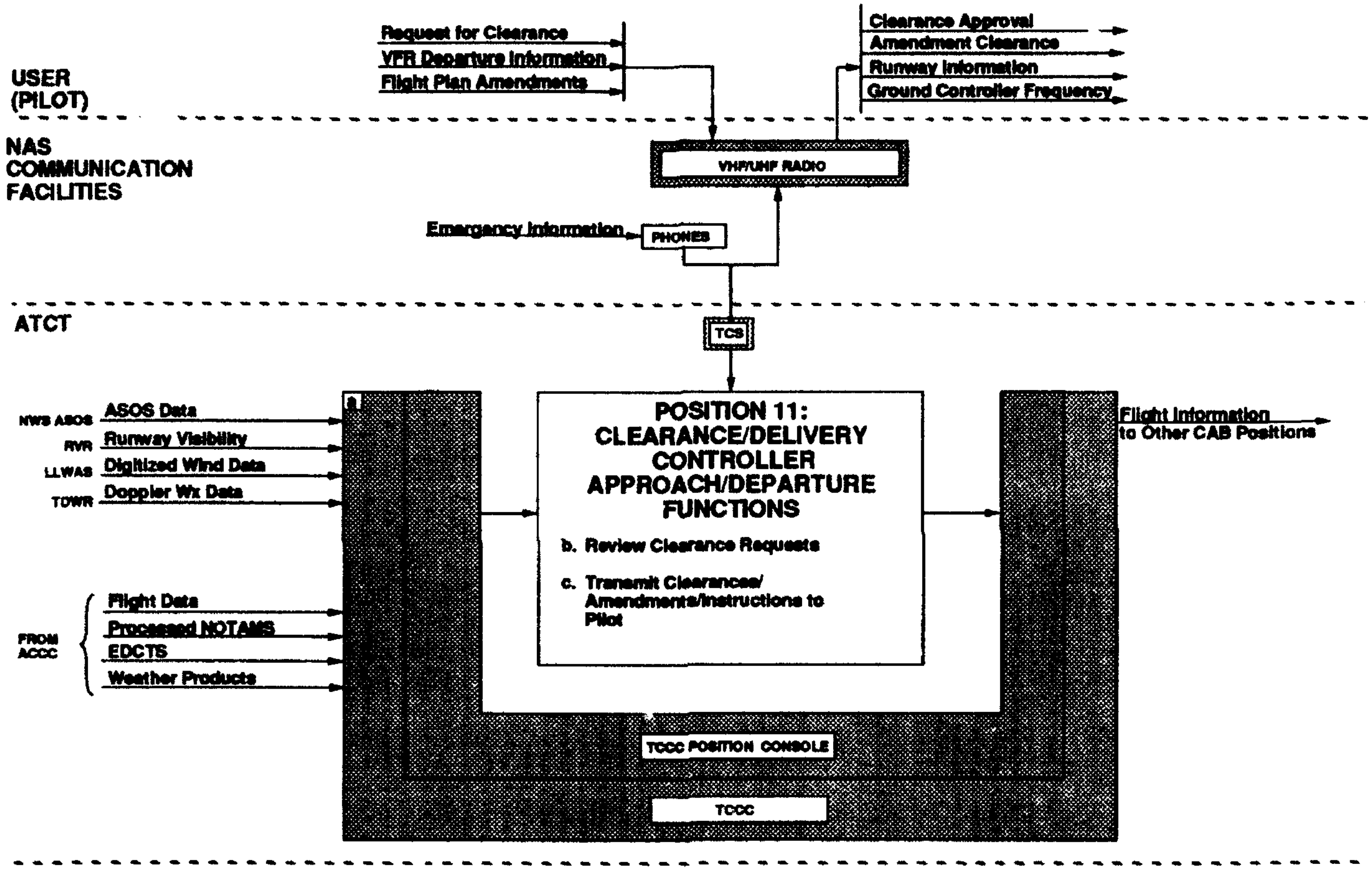


FIGURE 3-6
CLEARANCE/DELIVERY CONTROLLER (POSITION 11)
OPERATIONAL FLOW DIAGRAM

a. TCCC Processing. The TCCC displays arrival and departure flight data clearance delivery lists at the clearance delivery controller's position console.

NASSRS requirement: 3.2.2.B,D

b. Review Clearance Requests. The clearance delivery controller reviews clearance requests displayed through the position console.

NASSRS requirement: 3.2.2.D

c. Transmit Clearances/Amendments/Instructions To Pilot. The clearance delivery controller transmits both VFR and IFR clearances to the pilot. The clearance delivery controller transmits delay information if clearances cannot be obtained.

NASSRS requirement: 3.2.2.D

2.4 Correlation With Operational Requirements

Table 3-1 summarizes the correlation of the approach and departure sequencing operational requirements paragraph of NAS-SR-1000 with the paragraphs describing the functions being performed by specialists/ controllers. All the approach and departure sequencing paragraph numbers of NAS-SR-1000 are listed; paragraphs which are introductory in nature, do not state an explicit operational requirement, or which reference other portions of NAS-SR-1000 are indicated with a dash. The fact that a correlation is shown between a requirements paragraph and a paragraph describing the specialist/controller functions should not be construed as indicating that the requirement is completely fulfilled.

TABLE 3-1
APPROACH/DEPARTURE SEQUENCING
OPERATIONAL REQUIREMENTS CORRELATION

	Position	Clearance Delivery Controller			Ground Controller					Local Controller							Approach/ Departure Controllers						
NAS-SR-1000 Paragraph	Paragraph	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3.2.2	General				X					X							X						
.A	Provide A/C Information				X					X							X						
.A.1	Unique A/C Identification				X					X							X						
.A.2	Position				X					X							X						
.A.3	Altitude				X					X							X						
.A.4	Course				X					X							X						
.A.5	Speed				X					X							X						
.A.6	Performance				X					X							X						
.B	A/G Voice/Data Communication		X			X					X			X			X						
.C	Issue Sequencing Advisories														X			X			X		
.C.1	Generate Advisories											X	X		X			X			X		
.C.2	Adjust Traffic Sequence											X		X	X			X	X	X	X	X	
.C.3	Respond to Inputs													X				X		X			
.C.4	Evaluate Alternate Clearance												X	X									X
.D	Process Departure Requests	X				X						X											
.D.1	Receive Requests	X	X			X					X			X									
.D.2	Display to Specialists		X	X	X		X			X													
.D.3	Provide Departure Information			X				X	X			X					X						
.E	Compare Flight Paths													X			X			X		X	
.E.1	Actual vs. Assigned Paths													X			X			X		X	X
.E.2	Adjust Trajectory													X			X			X		X	X
.E.3	Notify of Deviations													X			X			X		X	
.F	Recommend Current Runway Selection											X	X	X								X	
.G	Recommend Future Runways															X							
.G.1	Analyze Selection Information															X							
.G.2	Future Runway Configuration															X							

3.5 Operational Sequences

Figures 3-7 and 3-8 each illustrate a common sequencing of the functions described in Section 3.3 and show how the various specialists interact with the user, other specialists, and NAS subsystems to provide the approach and departure sequencing service. Figure 3-7 shows a general sequence of operator/user interactions within the ACF and ATCT for arrival flow sequencing. Figure 3-8 shows a general sequence of operator/user interactions within the ACF and ATCT for departure flow sequencing.

The numbers in the upper right hand corner of the action rectangles and upper vertices of the decision diamonds are reference numbers and progress more or less as time progresses during the operation. The cross hatching indicates an interaction with, and processing by, automatic data processing equipment (ACCC/TCCC).

3.5.1 Arrival Flow Sequencing Using Approach Control

In Figure 3-7 approach controllers at ACFs monitor radio frequencies for incoming aircraft (1). If the aircraft is VFR, the pilot contacts the approach controller requesting arrival instructions (2). If the aircraft is IFR, then the approach controller accepts a hand-off from the en route controller (3). The approach controller determines the desired sequence and required spacing for the aircraft with the support of the ACCC (4).

Using the ACCC, the approach controller determines the required aircraft speed, spacing, and trajectory (altitude and direction) needed to properly sequence the approaching aircraft (5). The approach controller issues the approach clearance to the aircraft, (5) providing the aircraft pilot with the appropriate speed, spacing, and trajectory information (7). The pilot adjusts the aircraft's speed, heading, and altitude, as necessary (8).

The approach controller then monitors the aircraft's progress (9), using the ACCC, to compare the actual flight path to the path assigned by the controller. If the ACCC notifies the controller that the aircraft has deviated from the assigned speed, spacing, and trajectory (10), then the controller again provides information to the pilot to adjust the speed, spacing, or trajectory (7), and steps (7) through (9) repeat. When the approach controller has determined that the aircraft is sequenced correctly, spaced safely with other aircraft, and on a proper trajectory towards the landing runway, the approach controller monitors the aircraft in preparation for hand-off to the local controller.

Before the aircraft enters the local controller's airspace (11), the approach controller hands the aircraft off to the ATCT local controller (12). The local controller uses the TCCC to monitor the aircraft's trajectory, comparing the actual flight path with the path assigned (13). If the TCCC notifies the controller that the aircraft has deviated from its assigned trajectory (14), then the local controller, with the support of the TCCC, provides additional instructions to the aircraft to adjust the aircraft trajectory (15). The pilot adjusts the aircraft speed and trajectory, as necessary (16). Steps (13) through (16) repeats until the aircraft is on a final approach to the runway.

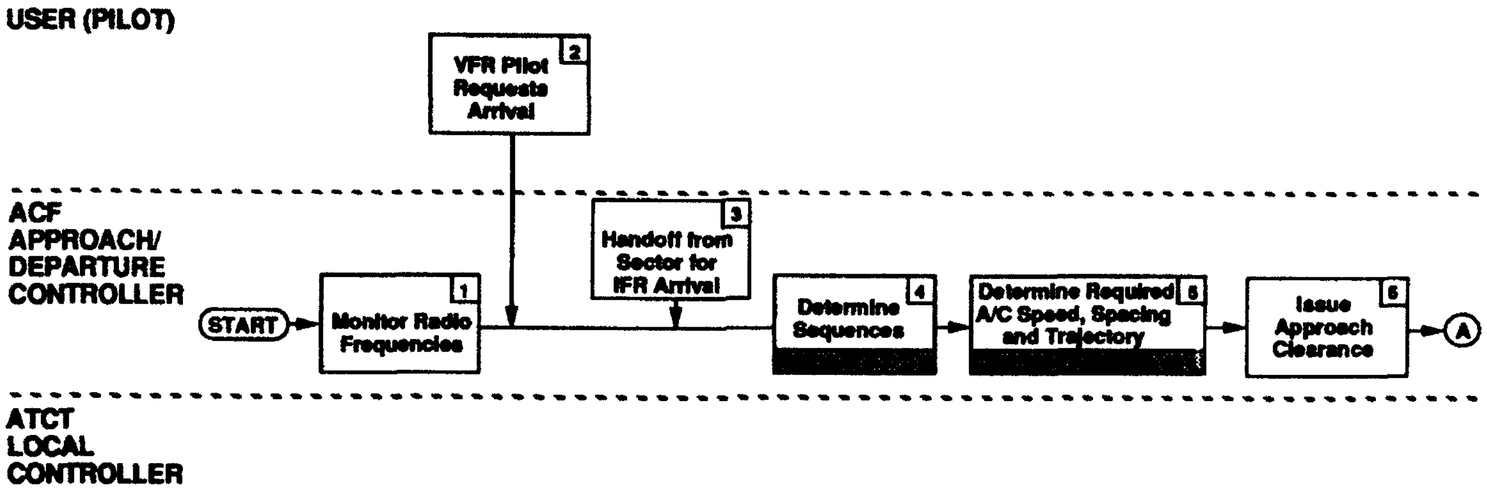


FIGURE 3-7

ARRIVAL FLOW SEQUENCING
OPERATIONAL SEQUENCE DIAGRAM

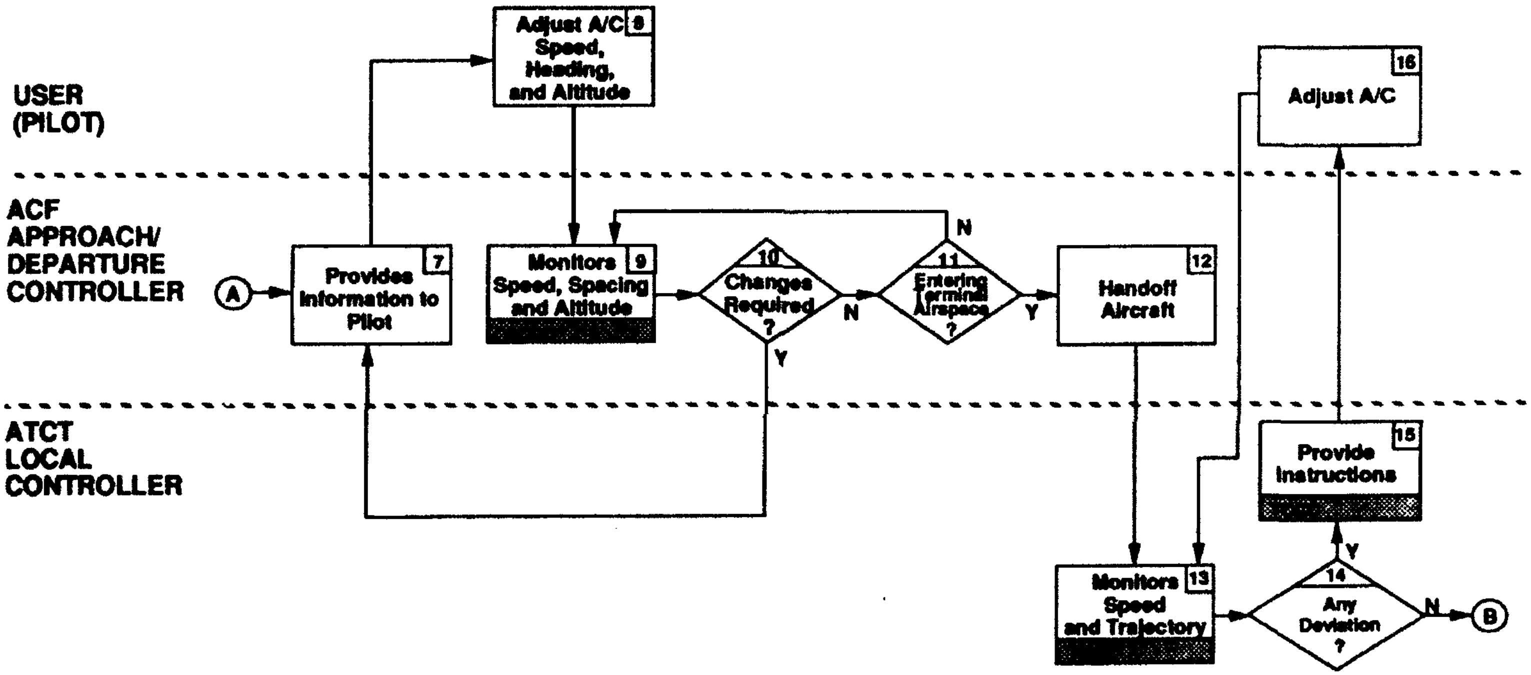


FIGURE 3-7

ARRIVAL FLOW SEQUENCING
OPERATIONAL SEQUENCE DIAGRAM
(CONTINUED)

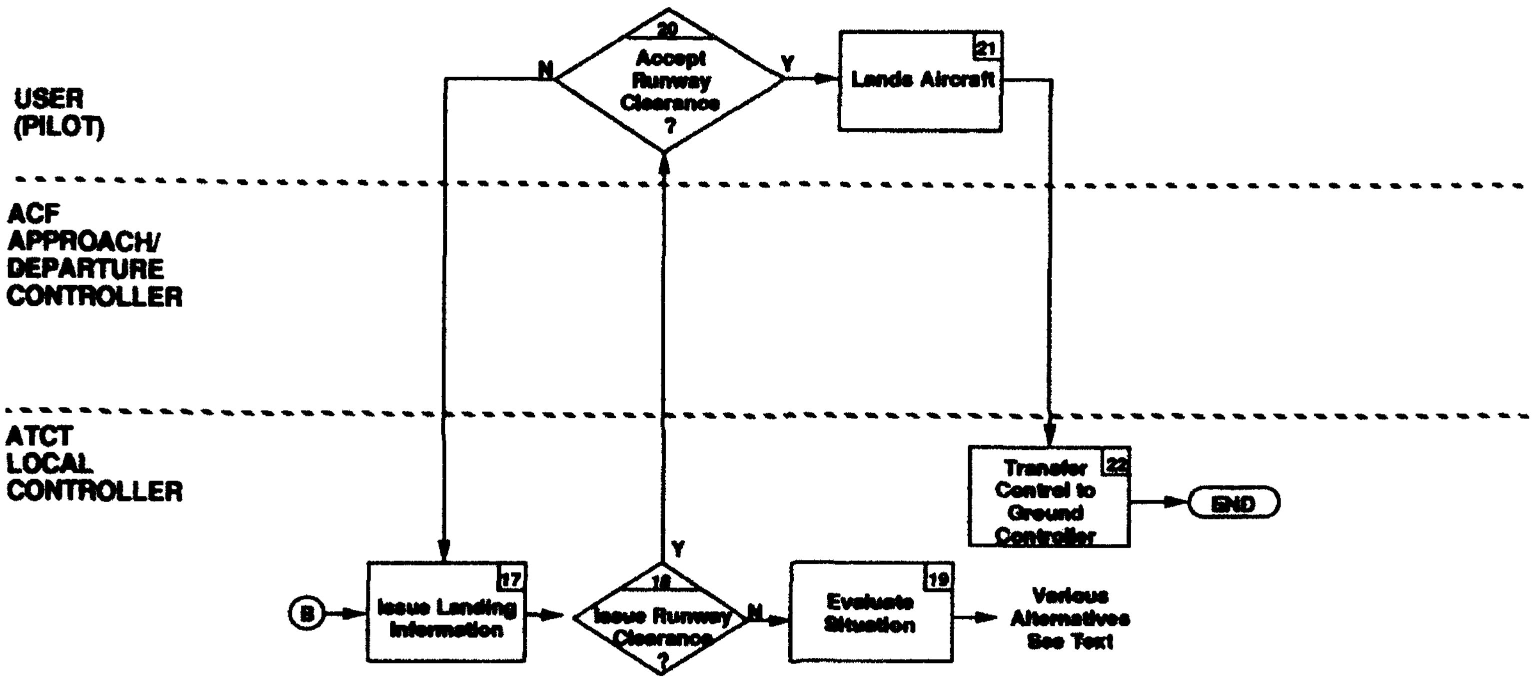


FIGURE 3-7

ARRIVAL FLOW SEQUENCING
OPERATIONAL SEQUENCE DIAGRAM
(CONCLUDED)

The local controller issues the aircraft landing information (17). With support from the TCCC, the local controller determines whether or not to issue the aircraft a runway clearance (18). If the local controller decides not to issue a runway clearance because of some condition (e.g., aircraft on the active runway), the controller evaluates the situation (19).

Based on an evaluation of the situation, the controller may direct the aircraft to be resequenced for landing, or the local controller may determine that some other course of action is necessary due to airport conditions. If the local controller issues the runway clearance, then the pilot can accept the runway clearance or request a new clearance, (20). If the pilot accepts the runway clearance, the pilot lands the aircraft (21), and the local controller transfers control of the aircraft to the ground controller (22). If the pilot requests a new clearance because of a situation clearance that the pilot is aware of, then the local controller either issues a new clearance or provides further instructions depending on the immediate situation.

3.5.2 Departure Flow Sequencing

In Figure 3-8 the pilot requests departure clearance (1). The ATCT clearance delivery controller processes the clearance request via the TCCC (2). When the departure request has been processed, the clearance delivery controller instructs the pilot to contact the ground controller (3). The ground controller issues taxi instructions to the aircraft with the support of the TCCC (4). The sequence in which the ground controller lines the aircraft along the taxiway leading to the runway determines the aircraft departure sequence. When the aircraft are in sequence on the taxiway, the ground controller transfers control of the aircraft to the local controller for departure clearance (5).

The local controller grants each aircraft clearance to depart maintaining a specific spacing between each aircraft in a specific departure sequence (6). The pilot maneuvers the aircraft onto the runway and takes off (7). The ATCT local controller hands-off the aircraft to the ACF departure controller (8). The ACF departure controller monitors the appropriate radio frequencies (9). The pilot calls the departure controller (10).

The departure controller provides each departing aircraft appropriate instructions necessary to direct the aircraft to its destination (11). The pilot adjusts the aircraft trajectory as necessary (12). With the support of the ACCC, the departure controller monitors the aircraft trajectory comparing the actual flight path to the assigned path (13). If the ACCC shows that the aircraft deviates from the assigned path (14), then the departure controller provides further trajectory instructions, with the help of the ACCC, to redirect the aircraft on its assigned trajectory (15). If the aircraft is flying IFR, the controller hands-off the aircraft to the en route controller when the departure controller ensures that the aircraft is on a proper trajectory prior to leaving the terminal area (16).

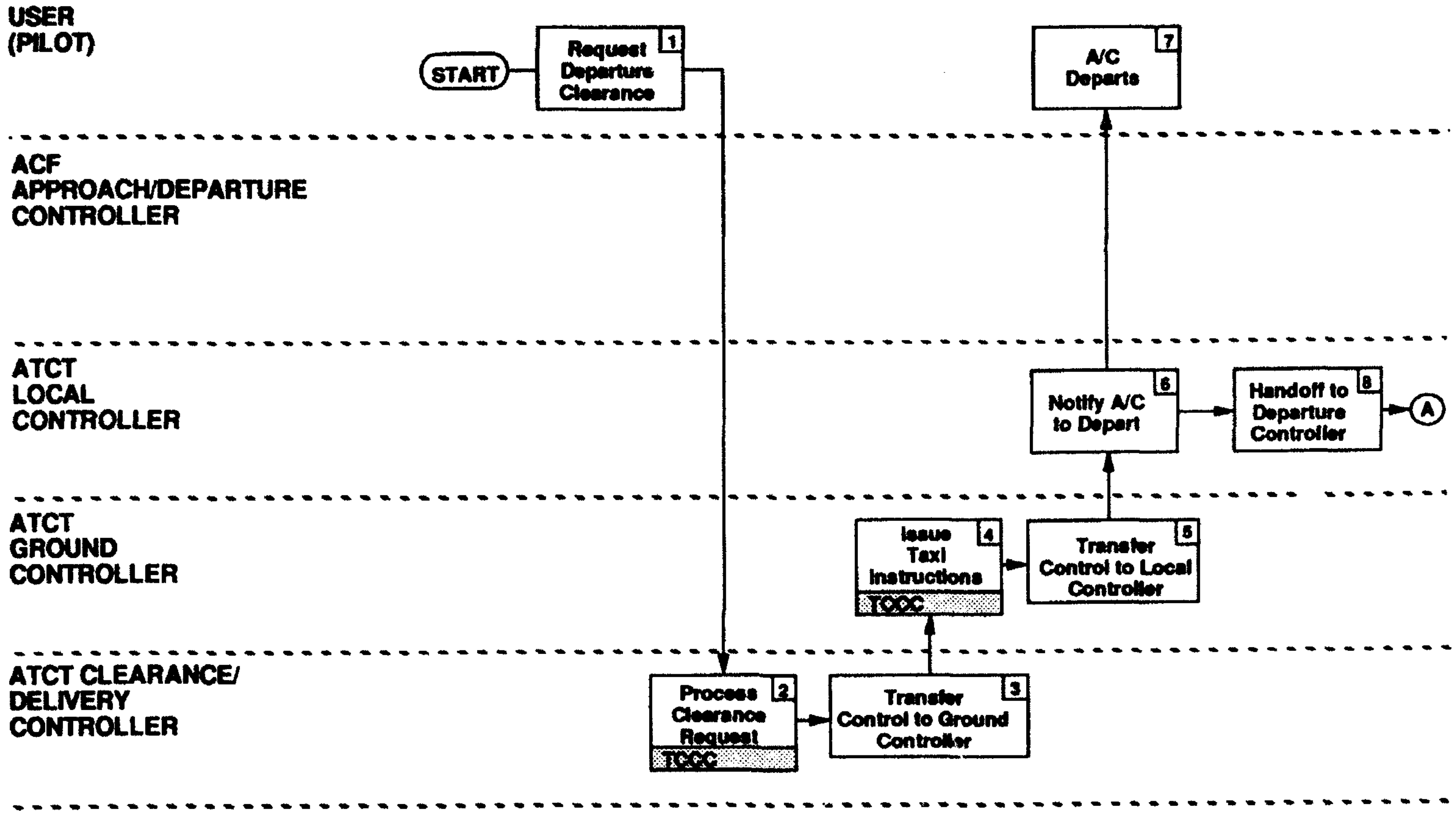


FIGURE 3-8
DEPARTURE FLOW SEQUENCING
OPERATIONAL SEQUENCE DIAGRAM

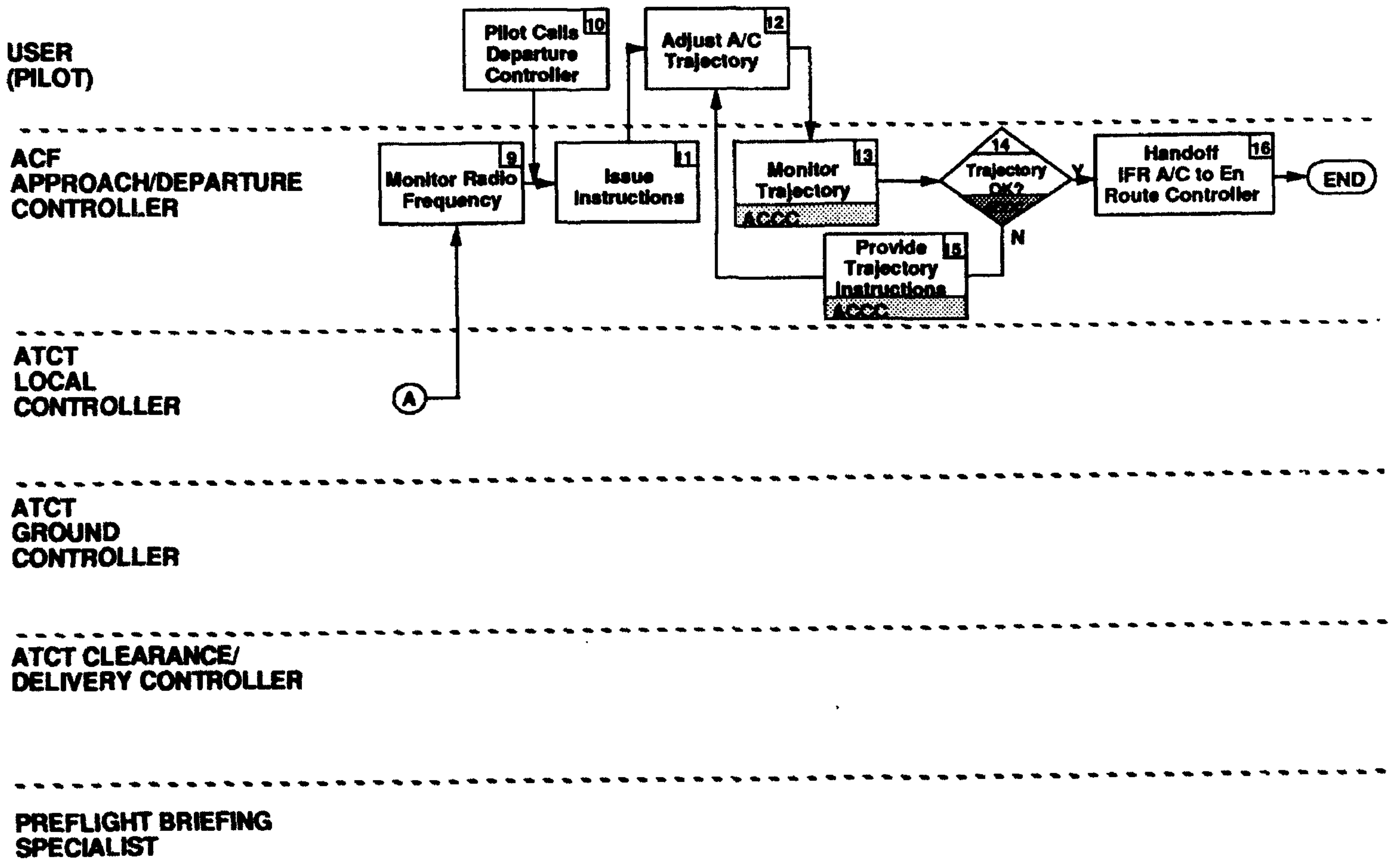


FIGURE 3-8
DEPARTURE FLOW SEQUENCING
OPERATIONAL SEQUENCE DIAGRAM
(CONCLUDED)

3.6 Operational Scenario

Figure 3-9 presents an operational sequence for a specific hypothetical situation (scenario). It is similar to the sequence diagram in Figures 3-6 and 3-7 in that it shows functional sequences and interactions between specialists and users and among specialists. The difference is that the operational scenario shows more detail and only shows one branch where a decision is made.

The scenario described is approach sequencing between VFR and IFR aircraft in terminal airspace. Each row shows the actions of one of the participants and the numbers in the upper right hand corners of the action rectangles generally represents the sequence of their occurrence. The connections between rows illustrates the communications medium.

Figure 3-9 presents an approach scenario: Approach sequencing between a VFR and several IFR aircraft. A VFR aircraft contacts the approach controller (1). The ACF approach controller begins radio contact with the VFR aircraft (2) before the VFR aircraft enters the Class C airspace around the airport (3). The approach controller provides the VFR aircraft instructions to sequence the aircraft with IFR aircraft approaching the airport. The approach controller provides the aircraft with the appropriate vectors, speed, and altitude required to approach the airport in the proper sequence, and the runway assignment (4). The aircraft follows the approach controller instructions to the airport (5). The ACF approach controller monitors the VFR aircraft trajectory with the information provided through the ACCC (6). If the aircraft is on a proper trajectory and is within the terminal airspace, then the approach controller performs a hands-off to the local controller (7).

The ATCT local controller begins radio contact with the VFR aircraft (8). The local controller provides the aircraft with landing instructions (9). The pilot approaches the airport following the local controller's instructions (10). The local controller monitors arriving aircraft through the position console display (11). When the local controller has checked the runway for obstructions and winds, the controller clears the arriving VFR aircraft for landing (12). The pilot lands the aircraft (13). The ATCT local controller transfers control to the ground controller in the ATCT (14). After landing and moving off the runway onto the taxiway, the pilot contacts the ground controller for further instructions (15). The ATCT ground controller directs the VFR aircraft to its final position for parking (16).

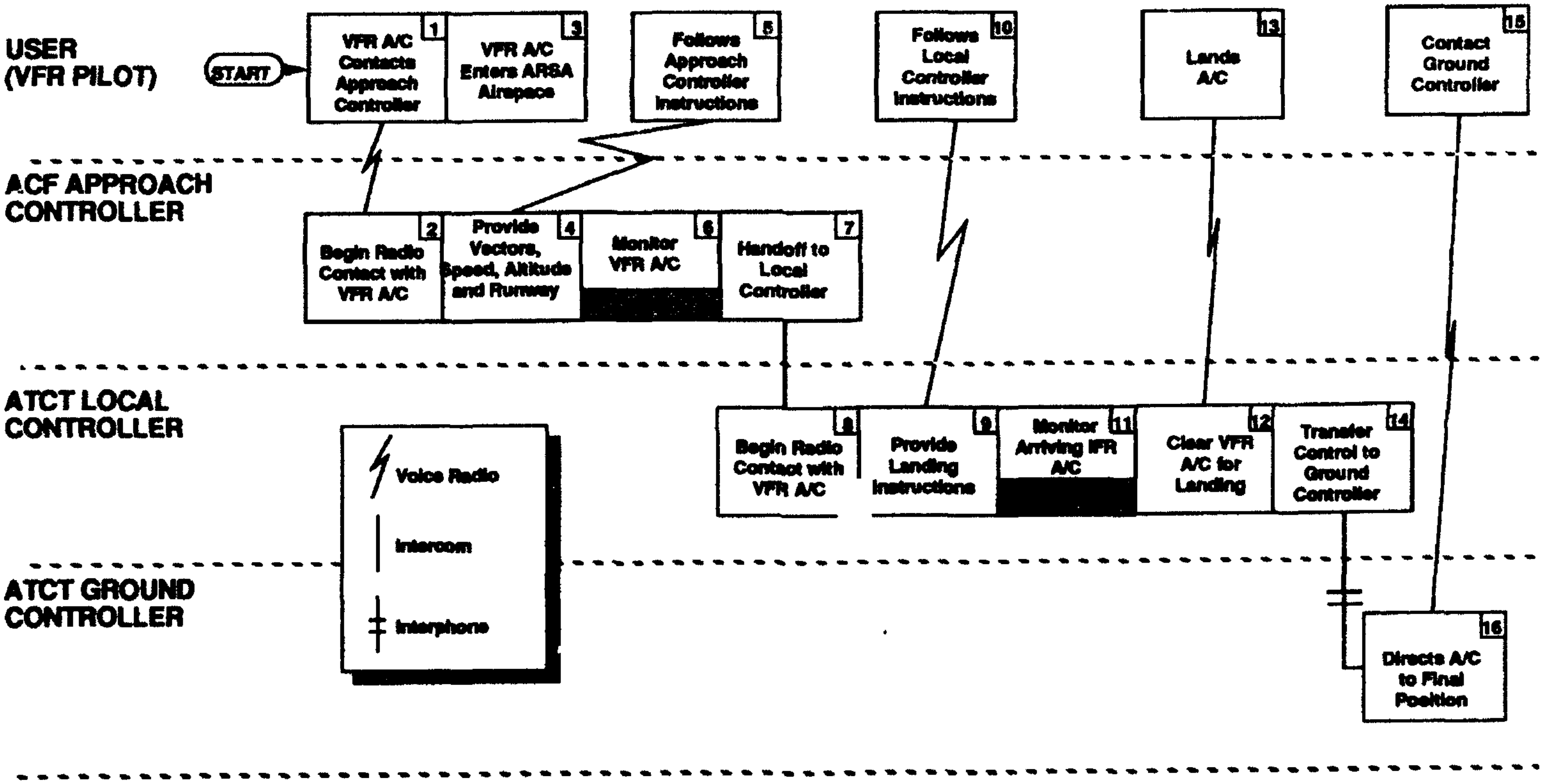


FIGURE 3-9

APPROACH SEQUENCING
OPERATIONAL SCENARIO DIAGRAM

4.0 AIRCRAFT SEPARATION

In order to maintain a safe environment, the National Airspace System (NAS) is required to maintain separation appropriate to the flight conditions and types of aircraft in the system. The NAS is required to have information about all controlled aircraft in controlled airspace. The NAS shall notify the specialist when it detects a potential or actual reduction in aircraft separation to less than the required minimum. The NAS shall notify specialists and users when a deviation from an approved clearance is detected. The NAS is also required to determine recommended maneuvers that avoid or remedy such situations.

4.1 Support

Major functions of aircraft separation operations are supported by the Area Control Computer Complex (ACCC), Flight Service Automation System (FSAS), Flight Service Data Processing System (FSDPS), Real-time Weather Processor (RWP), Data Link Processor (DLP), Tower Control Computer Complexes (TCCC), Voice Switching And Control System (VSCS), Air Traffic Control Radar Beacon System (ATCRBS), Automatic Dependent Surveillance (ADS), Altitude-Encoded Beacon Reply (Mode C) and Mode Select Beacon System (Mode S) transponders, and controllers. NAS subsystems that contain processing capabilities or position equipment that support operational services to maintain separation are discussed in Section 4.3, Functions.

Figure 4-1 illustrates the NAS facilities, systems, and user systems that are involved with the aircraft separation functions.

4.1.1 User Systems

Figure 4-2 shows two way radio systems for voice communications (Very High Frequency (VHF), Ultra High Frequency (UHF), High Frequency (HF)), data communications (Satellite, Mode C, and Automatic Communications Addressing and Reporting System (ACARS)), and systems to assist in surveillance (ATCRBS, Mode S, and ADS). Few, if any aircraft have all of these systems, but almost all have some.

4.2 Information

The information generated or used in the processes associated with aircraft separation can be categorized as follows:

- Information generated/displayed through the ACCC
- Information generated/displayed through the TCCC

The following paragraphs elaborate on specific information provided by the ACCC and TCCC systems. The pertinent NAS System Requirements Specification (NASSRS) paragraphs (Section 3.2.3) that specify the information generated/displayed through the ACCC/TCCC (NAS subsystem) are referred to in the paragraphs below.

4.2.1 Information Generated/Displayed Through the ACCC

Information that the specialist needs is provided by the ACCC, and is generated and displayed by the sector suites. Information also includes messages that are provided to the controllers to change data contained in the

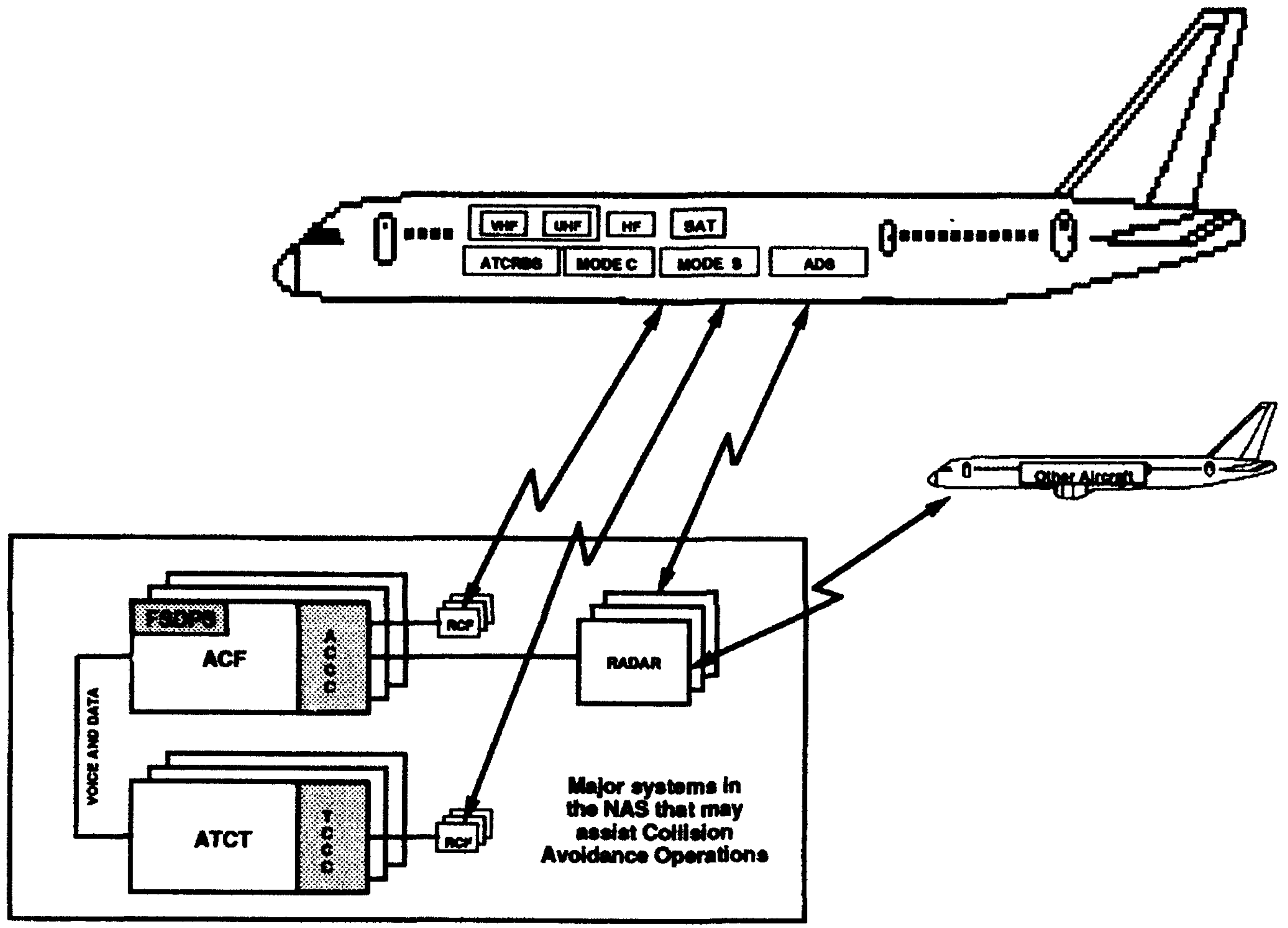


FIGURE 4-1

OVERVIEW OF NAS/USER SYSTEMS FOR AIRCRAFT SEPARATION

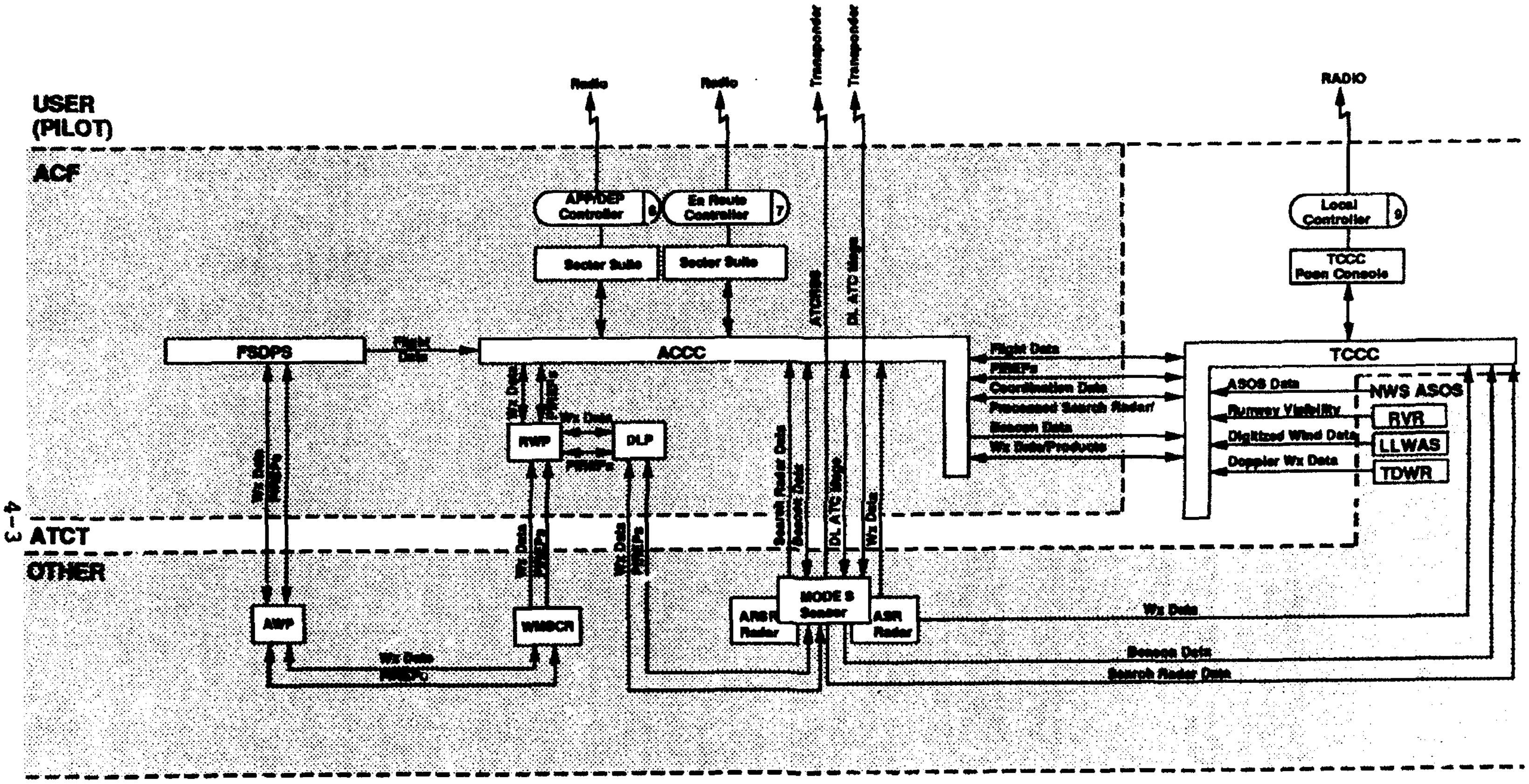


FIGURE 4-2

AIRCRAFT SEPARATION
OPE.'ATIONAL BLOCK DIAGRAM

system data base. Controllers receive information associated with aircraft separation as follows:

a. <u>Track Control</u>. Track data message information pertaining to aircraft separation is as follows:

- Track Message. The track status message enables the controller to manually drop or start the tracking function for a particular aircraft.

- Vertical Velocity Readout. This message enables the controllers to display the vertical velocity of an aircraft.

- Collision Risk Assessment Messages. The situation display presents Conflict Alert (CA) and Conflict Resolution Advisory (CRA) information to controllers. These alerts result from surveillance processing and include aircraft-to-aircraft violations, special use airspace violations, as well as alerts resulting from the monitoring of aircraft-to-terrain Minimum Safe Altitude Warning (MSAW) parameters. The ACCC will display at least one resolution advisory maneuver for each predicted violation. The controllers can suppress/restore the display of CA, MSAW, and CRA information.

- Geographic Data Messages. The controllers can display Full Data Blocks (FDB) for aircraft. The geographic map data includes, but is not limited to several groups of fixes, airways, sector boundaries (grouped by altitude), special use airspace boundaries, airports, minimum vector altitudes, military routes, holding pattern airspace (grouped by airport runway configuration), and others. The controller can emphasize/de-emphasize the display of the geographic map data.

- Handoff Messages. If automatic handoff is not initiated or inhibited, the handoff message enables controllers to manually initiate the transfer of radar identification of an aircraft from one sector controller to another. A retract handoff message provides the means for the initiating controller to take back a handoff.

- Reminder List. The reminder list includes aircraft call sign information to remind the controller to perform a control action which was planned in the trajectory. The information is displayed prior to the starting point of a maneuver.

b. <u>Flight Data</u>. The flight data and messages pertaining to aircraft separation are as follows:

- Flight Data Amendment. This message is used to modify, add to, or delete previously entered flight data for any flight plan.

- Progress Report. This message is used to update the aircraft position in time for an active flight plan.

- Reported Altitude. This message is used to enter, modify, or delete a reported altitude.

- Transfer Flight Plan. This message is used to cause the transmission of flight plan data to a facility (ACCC, or TCCC).

- Request Flight Data Entries (FDEs). This message allows the controller to request one or more FDEs from another sector and/or facility to be displayed in the Flight Data Area at the requesting sector.

- FDE Point Out. This function is used to display a FDE at a sector which has an interest in the aircraft's position, but would not normally receive an FDE based on the aircraft's normal route of flight. The display has the capacity to show flight plan information for a minimum of 50 aircraft per sector.

- Runway Assignment. This message is used to assign or reassign a runway to an aircraft.

- Approach Type. This message is used to identify the type of approach (e.g., instrument landing system approach, visual approach, contact approach, touch and go, and various military approaches) an aircraft is going to make to a runway.

- Flight Plan. This message is used to enter flight plan data into the system for a flight. The controllers may request the display of the planned route of any aircraft on the situation display for which flight plan information is available. They can also suppress/restore the display of FDBs and associated FDEs from all displays.

- Implement Reroute. This message is used to enter a proposed reroute into a flight plan or trial plan, after the controller/ACCC has determined that the new route will satisfy a flow restriction.

- Create/Delete Route. This message is used to create or delete a route or route segment. If a route identifier is not entered, the system automatically assigns a route identifier to the designated route or route segment.

c. Traffic Management Data. The traffic management data includes a traffic management advisory list, which contains flow restrictions, and a metering advisories list. The data assists the controller in properly spacing aircraft at a rate which can be accepted by adjacent ATC facilities or airports.

d. Weather Data. The en route and approach/departure controllers are provided with the following weather products; radar graphic, non-radar graphic, alphanumeric text, and pilot weather reports. The radar products include those supplied by the RWP which consists of the Next Generation Weather Radar (NEXRAD) products, and those various products from weather channels of surveillance radars which include terminal ASR-9 radar products. The alphanumerical text products are generated by the National Weather Service (NWS) Center Weather Service Unit Meteorologist (CWSUM), the National Aviation Weather Advisory Unit (NAWAU), or automatically by local systems (e.g., Automated Surface Observing System (ASOS)). The radar graphic products include a number of mosaic maps depicting precipitation, turbulence, and storm parameters. The alphanumeric products include surface observations, terminal and area forecasts, convective outlooks, hurricane advisories, convective and non-convective Significant Meteorological Information (SIGMETS), Airman's Meteorological Information (AIRMETS), center weather statements, and center weather advisories. The pilot reports (PIREPS) include winds and temperatures aloft. In general the products are for the ACF area plus 150 nautical miles (nmi).

e. Automation Processing Data. Automation processing data and messages required to ensure aircraft separation are as follows:

- Trial Plan Build/Amend. The controllers can create a trial plan. They can also modify, add to, or delete information from a previously entered trial plan.

- Retrieve Plan. The controllers can retrieve a previously stored trial plan or flight plan for trial plan processing.

- Implement Trial Plan. The controllers can establish a new flight plan from a trial plan or replace an existing flight plan for an aircraft.

- Automated En Route ATC (AERA) Alert Messages. The AERA alerts result from violations of the strategic (20-minute look-ahead) time parameter and include aircraft-to-aircraft, aircraft-to-airspace, and flow restriction violations. Alerts resulting from flight plan trajectory information are classified as priority (need immediate attention) and advisory (may need future attention). Alerts resulting from trial plan trajectory processing are referred to as Trial Plan Alerts.

- Quick Trial Planning. The controllers can initiate quick trial planning to construct up to four trial plans. The trial plans are based on the type of maneuver specified by the controllers. The maneuver type includes altitude change, lateral route offset, speed change, and vectors.

- Reconformance Aid. The controllers can construct a trial plan to restore conformance between an aircraft's vertical and lateral track position and its flight plan.

4.2.2 Information Generated/Displayed Through the TCCC

Information provided by the TCCC is generated and displayed on the logical displays and includes messages to change data contained in the system data base. The information given to the controllers associated with aircraft separation is:

a. Track Data. The TCCC track data and messages are the same as the ACCC's stated in Section 4.2.1.a; except that the reminder list and the aircraft conflict data are not presented to the TCCC Position Console (TPC). The data provided are:

- Track Message
- Vertical Velocity Readout

- Collision Risk Assessment Messages
- Geographic Data Messages
- Handoff Messages

b. Flight Data. The TCCC flight data and messages are the same as the ACCC's stated in Section 4.2.1.b; except implement reroute, and create/delete route are not presented to the TCCC TPC. The data provided are:

- Flight Data Amendment
- Progress Report
- Reported Altitude
- Transfer Flight Plan
- Request FDEs
- FDE Point Out
- Runway Assignment
- Approach Type
- Flight Plan

c. Traffic Management Data. The TCCC traffic management data are similar to the ACCC's traffic management advisory list and a metering advisory list. In addition, the following messages are included:

- Runway configuration list. This list displays runway configurations, basic weather, demand, and airport status information.

- Departure flow list. This list contains information and advisory data calculated by the Departure Flow Management function (it regulates the flow and the rate of aircraft departures appropriate to that airspace at a certain fix).

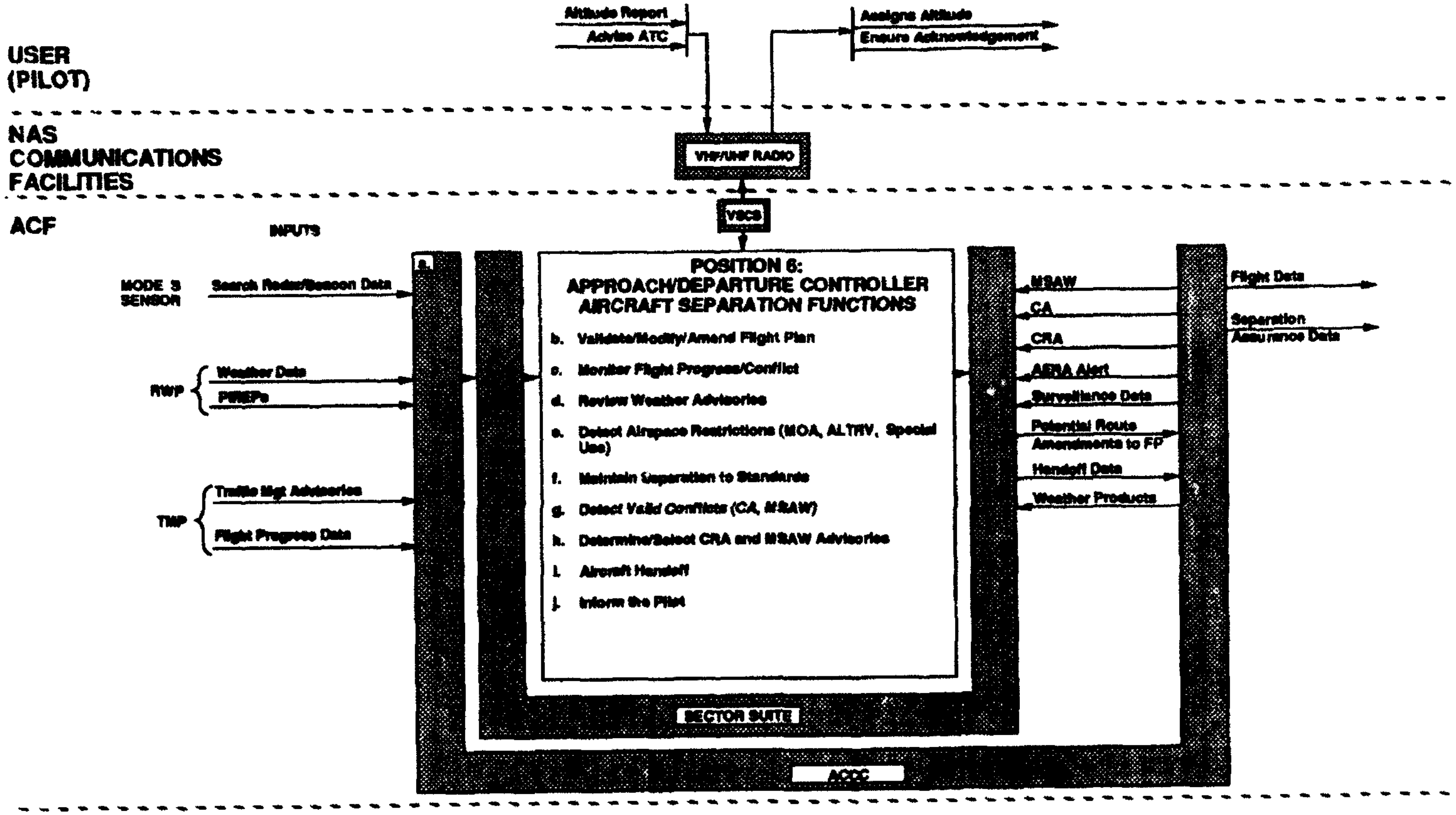
d. Weather data. Weather products for the immediate terminal area include relevant ACCC alphanumeric products, and alphanumeric and graphic products generated by the sensors and systems installed at that airport. At a typical large airport the sensors and systems would include the ASR-9 terminal radar, TDWR, RVR, LLWAS, and OASES. The products include wind shear/microburst alerts and such basic observations as ceiling and prevailing visibility. When the TCCC receives an ACCC product that reports a hazardous weather condition, (e.g., SIGMET) an alert is displayed to the controller.

4.3 Functions

The following paragraphs elaborate on functions provided by the controller positions and supporting equipment. The operational flow diagrams illustrate the information flow between the controller and the user, and between the controller and data processing equipment. The focus is on functions specifically related to the aircraft separation service. Pertinent NASSRS paragraphs specifying the functions performed by the controllers are referred to below.

4.3.1 Approach/Departure Controllers (Position 6)

Figure 4-3 illustrates the aircraft separation functions and services provided by approach/departure controllers (Position 6) at the Area Control Facility



NOTE: Equipment is represented by background filled boxes

FIGURE 4-3
APPROACH/DEPARTURE CONTROLLER (POSITION 6)
OPERATIONAL FLOW DIAGRAM

(ACFs). Functions are identified by lower case letters and are described in the corresponding paragraphs below.

a. ACCC Processing. The ACCC performs the following in support of the Approach/Departure Controller's functions:

- Receive and process surveillance messages from both Mode S radar beacon system sites and ATCRBS sites.
- Activate and drop instrument flight rules (IFR) flight plans.
- Generate tracking for all tracks that were initiated automatically or manually.
- Accept, store, and process IFR and visual flight rules (VFR) flight data.
- Process CA, MSAW, and CRA, and report violations.
- Detect when a controlled track not in handoff to a sector and not previously pointed out to the sector enters that sector.
- Process weather data.

NASSRS requirements: 3.2.3.A

b. Validate/Modify/Amend Flight Plans. The controllers may retrieve the flight plan, modify it, and reenter it as a new flight plan. They have the capability to specify a trial plan or to designate the trial plan as a new flight plan.

NASSRS requirements: 3.2.3.B,H,O

c. Monitor Flight Progress/Conflict. One of the functions of approach/departure controllers is to monitor the aircraft's flight progress when handoff occurs between them and en route controllers. The approach/departure controllers monitor the flight progress of all aircraft in their sectors. The controllers provide correction advisories to aircraft deviating from their planned route of flight. They display the planned route of any flight on the situation display for which flight plan information is available. After controllers have entered a trial plan or the ACCC has created a trial plan, controllers display the associated trial plan route of the aircraft. Conflicts or restriction violations are indicated on the alert display. If the alert display indicates no potential conflicts or violations, controllers may then initiate a flight plan.

NASSRS requirements: 3.2.3.A,B,C,H,O

d. Monitor Weather Advisories. Controllers monitor current and forecasted weather information using the sector suite to display alphanumeric and graphic weather data stored in the system. They respond to a pilot's request to deviate around a hazardous weather area and provide specific weather information such as altimeter settings and winds aloft. Data link processors relay weather information directly to the cockpit.

NASSRS requirements: 3.2.3.D,H

e. Detect Airspace Restrictions. The controllers detect estimated violations of airspace restrictions and reroute controlled aircraft to avoid the use of restricted airspace (special use airspace).

NASSRS requirements: 3.2.3.I,L

f. Maintain Separation Standards. The controllers ensure separation minima (the minimum longitudinal, lateral, or vertical distances by which aircraft are spaced through the application of ATC procedures) in a radar environment. This function is performed on a continuous basis.

NASSRS requirements: 3.2.3.K

g. Detect Valid CA and MSAW. The ACCC detects CAs and MSAWs, and displays the alert messages to controllers on the alert display.

NASSRS requirements: 3.2.3.K,L

h. Determine/Select CRA and MSAW Advisories. The controllers review the CRA and MSAW advisories at their sector suites. These ACCC generated advisories represent recommended maneuvers to solve the identified conflicts. The ACCC displays a rank ordered list of maneuvers for each predicted conflict. The controller either picks one of these maneuvers or formulates his/her own maneuver.

NASSRS requirements: 3.2.3.K,L

i. Aircraft Handoff. Transfer of aircraft radar identification between two radar controllers is referred to as a handoff. As an aircraft progresses through the system its radar identification is transferred from one ACF/sector to the next ACF/sector. This transfer causes all flight information to be transmitted from the sending facility/sector to the receiving facility/sector. If further identification of an approaching aircraft is necessary, the controllers may contact the pilot and request identity confirmation. The receiving controllers then acknowledge all transfers either by voice or through the entry of computer messages. Handoffs also occur between the approach/departure controllers and en route controllers resident in the same facility, and between approach/departure controllers and local controllers.

NASSRS requirements: 3.2.3.H,O

j. Inform the Pilot. The controller informs the pilot of the primary threats and the recommended maneuver based on the selected conflict resolution.

NASSRS requirements: 3.2.3.K

4.3.2 Functions of En Route Controllers (Position 7)

Figure 4-4 illustrates the aircraft separation functions and services provided by the en route controller (position 7) at the ACF. Lower case letters identify the functions performed by the controllers and their support equipment, and are described in the corresponding paragraphs below.

a. ACCC Processing. In support of the en route controller's functions related to aircraft separation, the ACCC performs the items listed in paragraph 4.3.1.A

b. Validate/Modify/Amend Flight Plans. See Paragraph 4.3.1.B

c. Monitor Flight Progress/Conflict. See Paragraph 4.3.1.C

d. Review Weather Advisories. See Paragraph 4.3.1.D

e. Detect Airspace Restrictions. See Paragraph 4.3.1.E

f. Maintain Separation Standards. See Paragraph 4.3.1.F

g. Check and Evaluate Future Separation. The controllers may compare flight path projection and detect potential conflicts (automated problem detection, (APD) for 20 minutes in advance. For all AERA alerts (priority or advisory) the controllers may also formulate problem resolutions.

   NASSRS requirements: 3.2.3.A,B,C,H,K,L

h. Detect Valid Conflicts (CA, MSAW). See Paragraph 4.3.1.G

i. Determine/Select CRA and MSAW Advisories. See Paragraph 4.3.1.H

j. Aircraft Handoff. See Paragraph 4.3.1.I

k. Inform The Pilot. See Paragraph 4.3.1.J

4.3.3 Functions of Local Controllers (Position 9)

Figure 4-5 illustrates the functions and services provided by the local controller (Position 9) at an ATCT. The functions are identified by lower case letters and are described in the corresponding paragraphs below.

a. TCCC Processing. The TCCC provides an automated information system to support the ATCT controllers by providing an interface with an ACCC at a parent ACF. External data received by the TCCC includes surveillance data, separation assurance assistance data, airport environment data, and flight plan data. The TCCC has two modes of operation: normal and stand-alone. The TCCC transitions to the stand-alone mode of operation when communications with an ACCC become unavailable. Separation assurance automation capabilities are not provided in the stand-alone mode.

   NASSRS requirements: 3.2.3.A

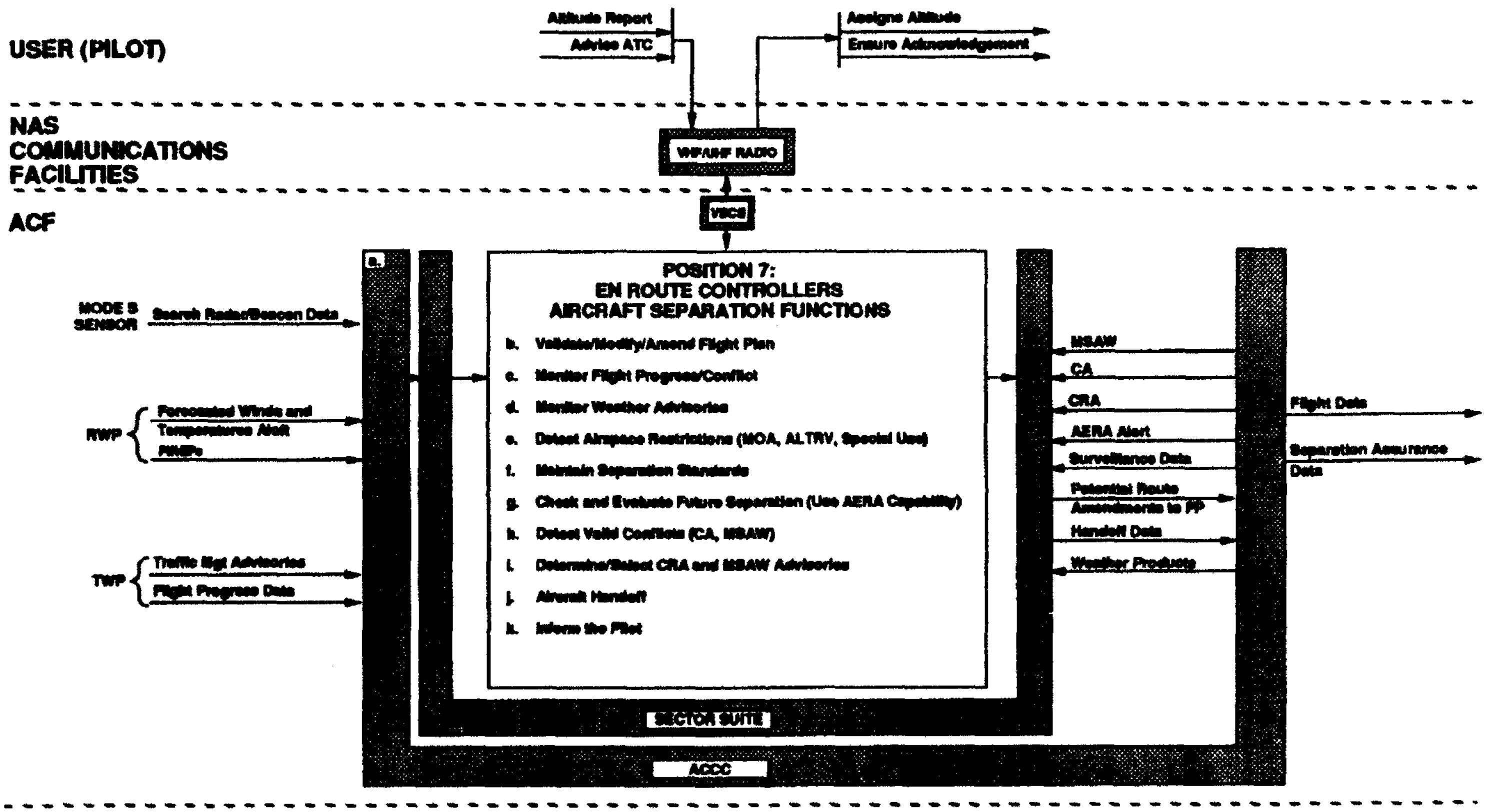


FIGURE 4-4
ENROUTE CONTROLLER (POSITION 7)
OPERATIONAL FLOW DIAGRAM

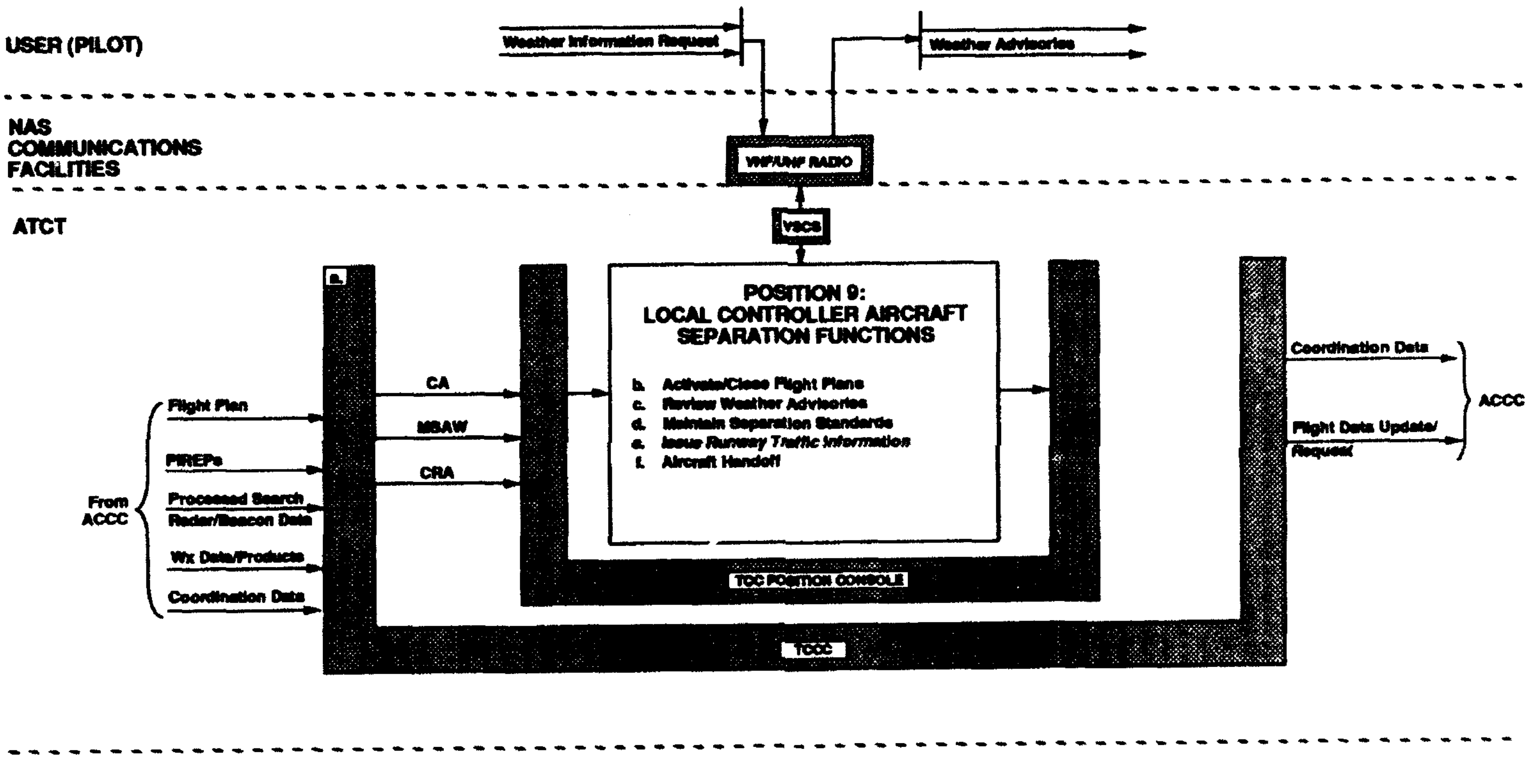


FIGURE 4-5
LOCAL CONTROLLER (POSITION 9)
OPERATIONAL FLOW DIAGRAM

b. <u>Activate/Close Flight Plans</u>. In towers without a TCCC, the controller may activate and close an IFR flight plan by contacting the appropriate ACF controller. If requested by the pilot, the controller may activate and/or close a VFR flight plan by contacting the Automated Flight Service Station (AFSS).

NASSRS requirements: 3.2.3.B,H,O

c. <u>Review Weather Advisories</u>. In addition to reviewing the weather advisories in paragraph 4.3.1.d, they are also responsible for providing wind shear alert information to pilots.

NASSRS requirements: 3.2.3.D

d. <u>Maintain Separation Standards</u>. The controllers provide separation by spacing aircraft that are landing and taking off.

NASSRS requirements: 3.2.3.ALL

e. <u>Issue Runway Traffic Information</u> In order to ensure aircraft separation, the local controllers consider the conditions of runways available for use. They keep arriving aircraft informed of runway traffic information, and notify pilots of aircraft crossing or departing the runway.

NASSRS requirements: 3.2.3.I

f. <u>Aircraft Handoff</u>. The local controller accepts/hands-off/ transfers control of the aircraft to/from the approach/departure or en route controller (depending on the relationship of the particular tower with the ACF).

NASSRS requirements: 3.2.3.I

4.4 Correlation with Operational Requirements

Table 4-1 summarizes the correlation of the aircraft separation operational requirements paragraphs of NAS-SR-1000 with the previous paragraphs in this document that describe the functions performed by the controllers and the information generated/displayed by the ACCC/TCCC. Aircraft separation paragraphs from Section 3.2.3 of NASSRS which are introductory in nature, do not state an explicit operational requirement, or which reference other portions of NAS-SR-1000, are indicated with a dash. A correlation shown between the requirements paragraph and a paragraph describing the information and functions performed does not indicate that the requirement is fulfilled.

TABLE 4-1
AIRCRAFT SEPARATION OPERATIONAL REQUIREMENTS CORRELATION

Position	Information									Approach/Departure Controller											En Route Controller													Local Controller					
Paragraph	ACCC					TCCC																																	
NAS-SR-1000 Paragraph	2.2.1.a	2.2.1.b	2.2.1.c	2.2.1.d	2.2.1.e	2.2.2.a	2.2.2.b	2.2.2.c	2.2.2.d	2.3.1.a	2.3.1.b	2.3.1.c	2.3.1.d	2.3.1.e	2.3.1.f	2.3.1.g	2.3.1.h	2.3.1.i	2.3.1.j	2.3.1.k	2.3.2.a	2.3.2.b	2.3.2.c	2.3.2.d	2.3.2.e	2.3.2.f	2.3.2.g	2.3.2.h	2.3.2.i	2.3.2.j	2.3.2.k	2.3.2.l	2.3.2.m	2.3.4.a	2.3.4.b	2.3.4.c	2.3.4.d	2.3.4.e	2.3.4.f
3.2.3 Aircraft Separation	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.A Acquire Actual Flight Information	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.A.1.a Aircraft Position/En Route										X											X																		
.A.1.b Aircraft Position/Terminal																																		X					
.A.1.c Speed/En Route										X											X																		
.A.1.d Speed/Terminal																																		X					
.A.1.e Reported Altitude		X					X			X											X													X					
.A.1.f Aircraft Track	X					X				X		X									X		X											X					
.A.2 Project Flight Paths (20 Minutes)										X						X											X												
.A.3 Update Flight Position		X					X			X						X					X						X												
.A.4 Flight Information										X		X											X													X			
.B Acquire Flight Plan Information	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.B.1 Validate Flight Plans										X	X										X	X												X	X				
.B.2 All IFR Aircraft										X	X										X	X												X	X				
.B.3 Update Flight Plan		X								X	X										X	X												X	X				
.B.4 Provide Clearance to Facility Not Constrained by Physical ATC		X								X	X										X	X												X	X				
.B.5 Provide Clearance to Valid Flight Plans										X		X				X							X				X												
.B.6 Create/Maintain 4-Dimensional Trajectory										X		X				X							X				X												
.B.7 Process Alternative Clearances		X			X					X											X								X										
.C Flight Plan Association Checks	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.C.1 Project Flight Paths	X					X				X											X																		
.C.2 Provide 4-Dimensional Trajectory					X					X						X											X												
.C.3 Conformation Criteria					X					X						X					X																		
.C.4 Trial Plan					X					X																	X												
.C.5 Reminders to Specialist										X											X																		
.C.6 Alert the Specialist	X									X											X																		
.D Weather Information for Flight Path Prediction	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.D.1 Weather Product				X					X	X			X											X												X			
.D.2 Use of Weather Data (Current, Forecast)				X					X	X			X											X												X			
.D.3 Display Seven Level of Precipitation Intensity				X					X	X			X											X												X			
.E Detection of ADIZ, DEWIZ Zone	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.F Separation of A/C in Parallel Runways	-	-	-	-	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	-
.F.1 Runway 2500 Feet Apart/Successive A/C										X																											X	X	
.F.2 Runway 4300 Feet Apart/Simultaneous A/C										X																											X	X	

TABLE 4-1
AIRCRAFT SEPARATION OPERATIONAL REQUIREMENTS CORRELATION (CONTINUED)

Position	Information									Approach/Departure Controller											En Route Controller													Local Controller					
Paragraph	ACCC					TCCC																																	
NAS-SR-1000 Paragraph	2.2.1.a	2.2.1.b	2.2.1.c	2.2.1.d	2.2.1.e	2.2.2.a	2.2.2.b	2.2.2.c	2.2.2.d	2.3.1.a	2.3.1.b	2.3.1.c	2.3.1.d	2.3.1.e	2.3.1.f	2.3.1.g	2.3.1.h	2.3.1.i	2.3.1.j	2.3.1.k	2.3.2.a	2.3.2.b	2.3.2.c	2.3.2.d	2.3.2.e	2.3.2.f	2.3.2.g	2.3.2.h	2.3.2.i	2.3.2.j	2.3.2.k	2.3.2.l	2.3.2.m	2.3.4.a	2.3.4.b	2.3.4.c	2.3.4.d	2.3.4.e	2.3.4.f
3.2.3 .G Provide Surveillance Coverage	-	-	-	-	-	-	-	-	-	X	-	-	-	-	X	-	-	-	-	-	X	-	-	-		X	-	-	-	-	-	-	-	X	-	-	-	X	
.G.1 En Route Area without Mode S																																							
.G.2 Terminal Area without Mode S																																							
.G.3 En Route Area with Mode S																																							
.G.4 Terminal Area with Mode S																																							
.G.5 Response Time																																							
.G.6 Update Actual Flight Position																																							
.G.7 Coverage in Alaska																																							
.H Display Controlled A/C Position and Related Data	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		X	-	-	-	-
.H.1 Flight Data Entry Contents	X	X				X	X			X		X									X		X												X				
.H.2 Inhibit/Reposition Display Information		X					X			X		X									X		X												X				X
.H.3 Flight Plan Information under Control/About to Enter Sector		X					X			X	X								X		X	X										X							
.H.4 Display Flight Plan Data		X					X			X											X														X	X			
.H.5 Capacity of Flight Data Display										X											X														X				
.H.6 Record/Maintain a History										X											X										X				X				
.H.7 Capability to Discriminate Display Information										X	X										X														X				
.H.8 Display Critical Information										X											X	X													X				
.H.9 Display Priority or Advisory Alert																X												X											
.I Display Geographical Information	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.I.1 Display Information on Special Use Airspace										X				X							X				X													X	
.I.2 Display Geographic Map Data		X					X														X																	X	
.J Tracking Performance Requirements	X	-	-	-	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.K Generate Clearances	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.K.1 Provide Clearances			X					X									X	X			X							X			X								
.K.2 Deliver Clearances										X						X		X			X						X		X		X								
.K.3 Clearance via Data Link																X											X												
.K.4 Alert the Specialist (Conformance Criteria)										X										X	X												X						
.K.5 Notify Users																				X													X						
.L Detect Actual/Potential A/C Separation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
.L.1 Update Flight Plan										X						X					X						X												
.L.2 Compare/Project (20 Minutes) Flight Path in Advance										X					X	X					X					X	X												
.L.3 Detect CA in Terminal/En Route										X							X				X							X											
.L.4 Alert Symbol (Actual and Potential)	X					X				X						X					X						X												
.L.5 Priority/Advisory Messages	X					X				X						X					X						X												

TABLE 4-1
AIRCRAFT SEPARATION OPERATIONAL REQUIREMENTS CORRELATION (CONCLUDED)

Position	Information									Approach/Departure Controller											En Route Controller													Local Controller					
	ACCC					TOCC																																	
Paragraph NAS-SR-1000 Paragraph	2.2.1.a	2.2.1.b	2.2.1.c	2.2.1.d	2.2.1.e	2.2.2.a	2.2.2.b	2.2.2.c	2.2.2.d	2.3.1.a	2.3.1.b	2.3.1.c	2.3.1.d	2.3.1.e	2.3.1.f	2.3.1.g	2.3.1.h	2.3.1.i	2.3.1.j	2.3.1.k	2.3.2.a	2.3.2.b	2.3.2.c	2.3.2.d	2.3.2.e	2.3.2.f	2.3.2.g	2.3.2.h	2.3.2.i	2.3.2.j	2.3.2.k	2.3.2.l	2.3.2.m	2.3.4.a	2.3.4.b	2.3.4.c	2.3.4.d	2.3.4.e	2.3.4.f
3.2.3.L.6 Inhibit Alerts for MARSA and ALTRV Conditions										X											X				X														
.L.7 Provide Collision Risk Assessment (e.g., CRA)	X					X				X								X			X							X	X		X				X				
.M Generate Resolution Advisories	X	–	–	–	–	X	–	–	–	X	–	–	–	–	–	–	–	X	–	–	X	–	–	–	–	–	–	–	X	–	–	–	–		X	–	–	–	–
.N Detect and Identify Conflict	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–		X	–	–	–	–
.O Aircraft Handoff	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–		X	–	–	–	–
.O.1 Provide Handoff with no Loss of Separation																			X													X							
.O.2 Alert a Receiving Specialist											X								X		X	X										X				X			
.O.3 Automatic Handoff																			X		X											X							
.P Available on a Continuous Basis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–		–	–	–	–	–

4.5 Operational Sequences

Figures 4-6 and 4-7 illustrate a common sequencing of the functions described in Section 4.3 and show how the various specialists interact with the user, other specialists, and NAS subsystems to provide aircraft separation. Figure 4-6 shows a general sequence of operator/user interactions within the ACF environment to check and evaluate aircraft separation in controlled airspace. Figure 4-7 shows illustrates the aircraft separation and conflict resolution operational sequences in terminal airspace.

In order to ensure separation, specialists advise only controlled aircraft. In the automated environment, AERA services can be extended to VFR aircraft in which the pilot has filed a flight plan requesting ATC separation service. The number in the upper right hand corner of the action rectangles and upper vertices of the decision diamonds are reference numbers and progress more or less as time progresses during the operation. The cross hatching indicates an interaction with, and processing by, automatic data processing equipment (ACCC/TCCC).

4.5.1 Checking and Evaluating Aircraft Separation for ACF Controllers

Figure 4-6 describes the complete spectrum of aircraft separation operations in terms of functional activities in the ACF environment for all controllers. Each major activity is divided into sub-activities (double numbers in the figure) to describe complete controller and system interactions with respect to aircraft separation. The major activities are aligned vertically on Figure 4-6 to indicate that there is no specific time sequence in which they are performed. The functions are performed repeatedly as required to assure safe aircraft-to-aircraft and aircraft-to-airspace separation. These are general functions performed by all ACF controllers, and some controllers may perform more or less of these functions depending on position responsibilities.

The ACF controllers review the flight data display for future aircraft separation (1) and receive flight plan changes (1.1) from the pilot (1.1.1). The ACF controllers enter flight plan amendments into the ACCC (1.2), and receive pilot position reports (1.3). They evaluate flight data and determine a future course of action (1.3). They construct and amend the trial plan via the ACCC (1.4), and then evaluate the trial plan results (1.5). The ACF controllers review the situation display for potential violation of flow restrictions (2). They receive and review metering data with the support of the Traffic Management Unit (TMU) (2.1). They review their display for potential violations of lateral and altitude conformance criteria (3), and detect non-conformance when displayed by the ACCC (3.1). The ACF controllers request and observe real time weather information (4), determine any weather impact on routes and flow plans (4.1), and issue weather advisories and updates to the pilot (4.2). The ACF controllers review the display for potential violations of airspace separation standards (5). This includes the detection of aircraft intruding into special use airspace (5.1), and aircraft penetrating the Air Defense Identification Zone (ADIZ) and Distant Early Warning Identification Zone (DEWIZ) (5.2). ACF controllers manage approach traffic sequencing with the support of ACCC (6), and receive notices of missed approaches from the ATCT controllers (6.1).

The ACF controllers review the situation display for potential violations of aircraft separation standards (7), and with the support of ACCC (APD, CA, and MSAW (7.1)), they detect various conflicts.

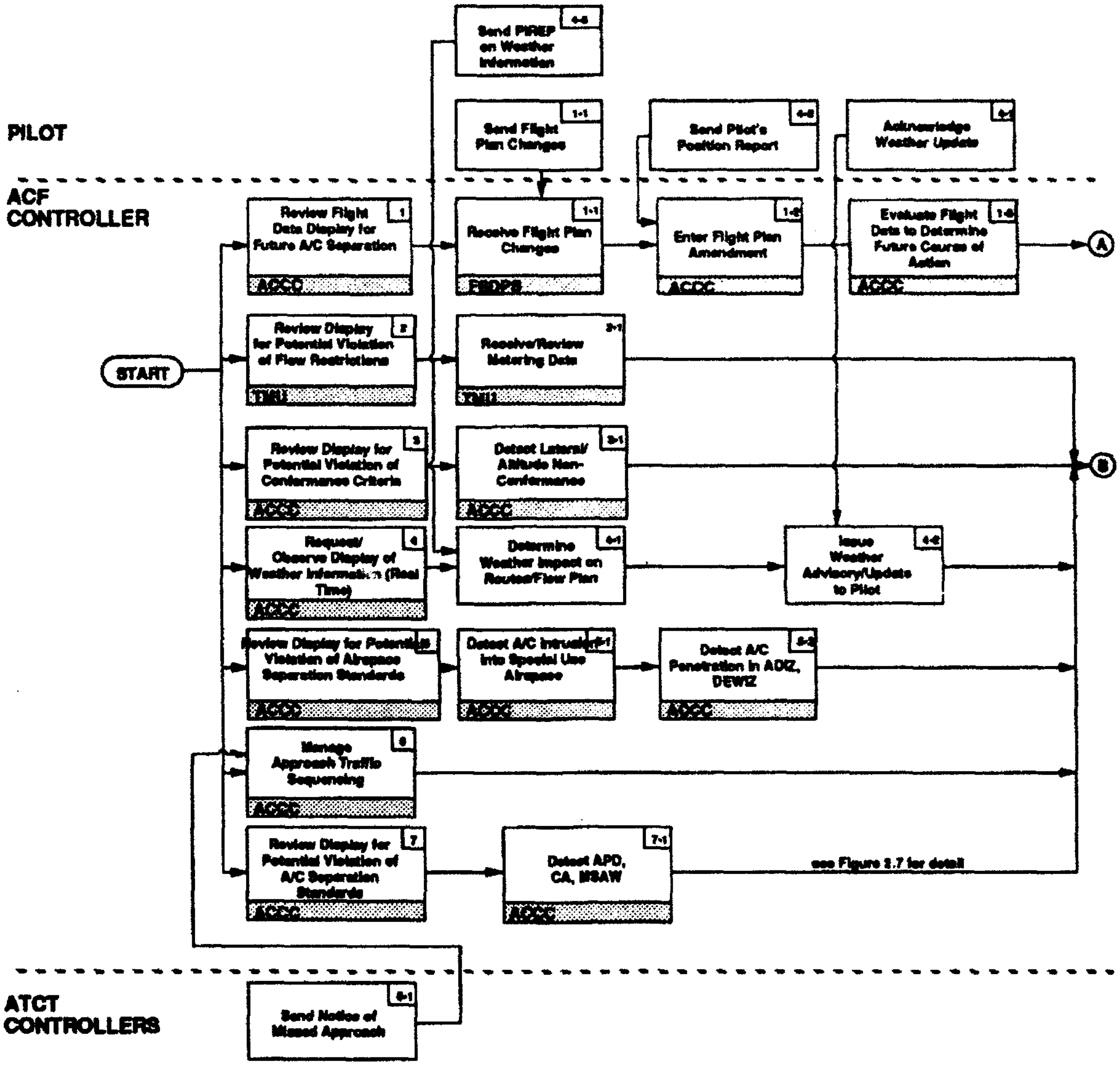


FIGURE 4-6
AIRCRAFT SEPARATION
OPERATIONAL SEQUENCE DIAGRAM

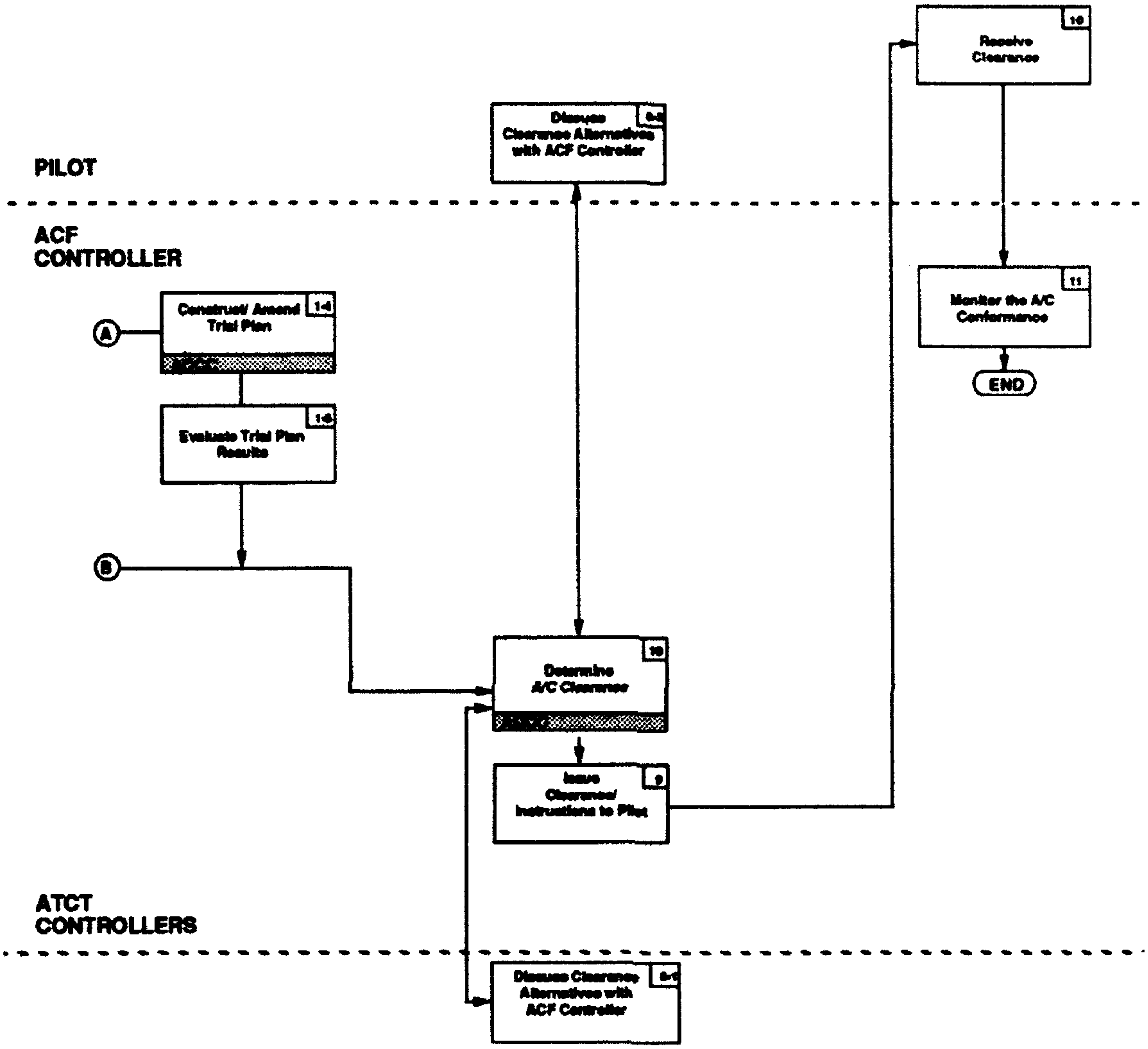


FIGURE 4-6
AIRCRAFT SEPARATION
OPERATIONAL SEQUENCE DIAGRAM (CONCLUDED)

The ACF controllers determine aircraft clearances sometimes with the assistance of an automated plan from the ACCC (8), and sometimes by discussing clearance alternatives with the ATCT controllers (8.1) and the pilot (8.2). The ACF controllers issue clearance instructions to the pilot (9). The pilot receives the clearance (10), and finally, the ACF controllers monitor the aircraft conformance with the clearance (11).

4.5.2 Aircraft Separation Assurance and Conflict Resolution for Local Controllers

Figure 4-7 illustrates a general sequence of operator/user interactions necessary to issue an appropriate maneuver to controlled aircraft to ensure separation.

Depending on the weather and how close the aircraft is, the conflict may be detected visually or only by radar and the CA function (1). If it is directly observable through the window of the tower cab (2), the local controller mentally projects the aircraft's future position/altitude and estimates its track/ velocity vector (3). To do this, he/she may refer to the radar/beacon data presented on their display.

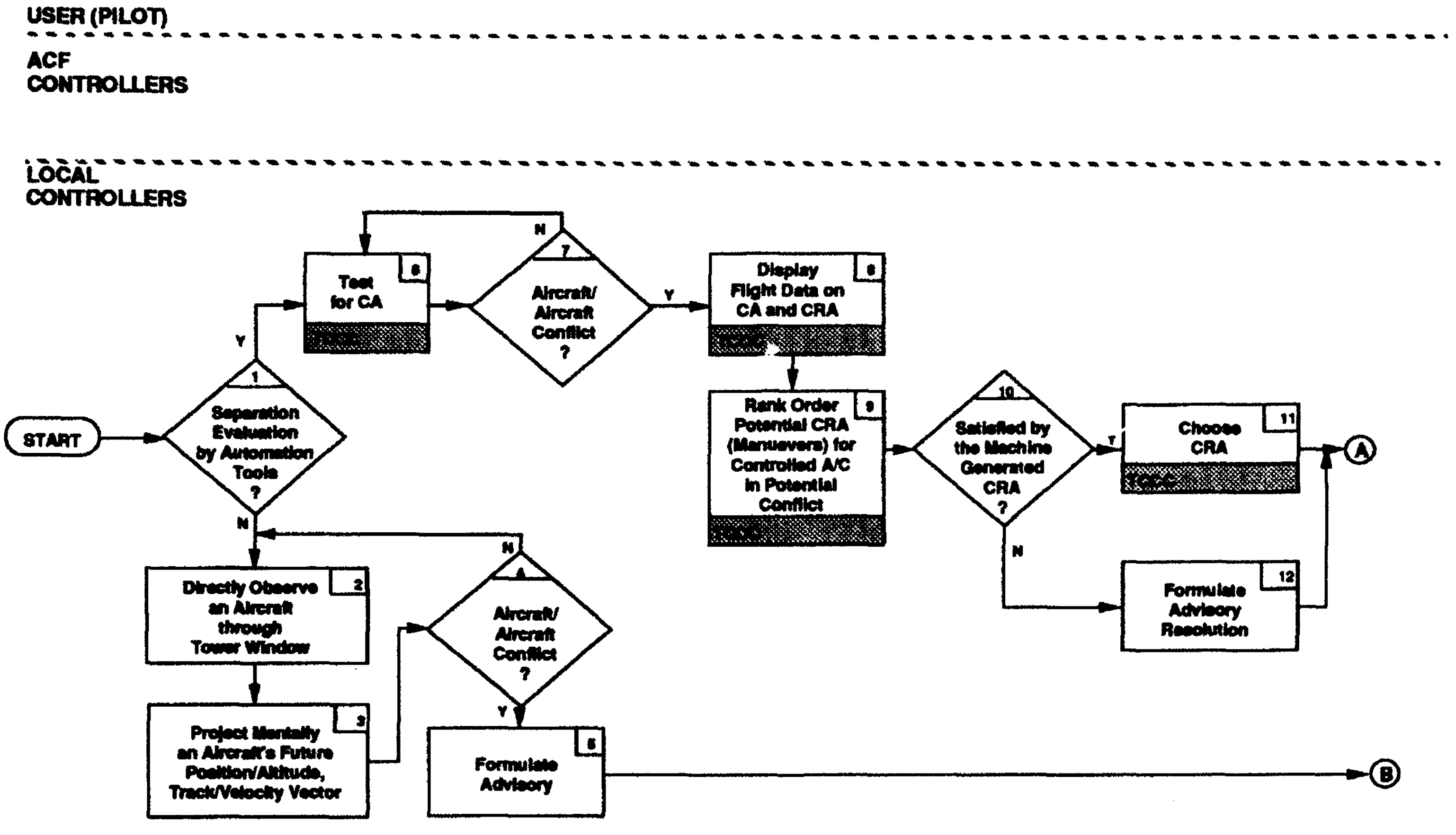
If a potential conflict is determined (4), the controller formulates an advisory and resolution to the potential conflict (5). If the conflict is detected by the CA function (6), and the CA and CRA function (7) the TCCC displays the flight data (flight plans, and flight plan amendments) (8). Possible CRA maneuvers for controlled aircraft involved in the predicted conflict are ranked by the ACCC and sent to the TCCC (9). If the conflict is valid and the local controller is satisfied by the machine generated conflict resolutions (10), and chooses a CRA (11); otherwise, the controller formulates another advisory/resolution (12). If the situation warrants, the local controller advises the appropriate ACF controllers on the conflict situation, including the positions of primary threats (13) and also issues a clearance to the pilot (14). Finally, the pilot acknowledges the advisory (15).

4.6 Operational Scenario

The operational scenario presents a specific hypothetical situation. It is similar to the sequence diagrams in Figures 4-6, and 4-7; however, the scenario shows more detail and shows only one branch where a decision is made. Figure 4-8 illustrates two data link equipped aircraft (USAir 940 and United Airlines (UAL) Flight 300) that are involved in a predicted possible violation of separation minima.

Specifically, there is a predicted aircraft-to-aircraft conflict about 20 minutes into the future (an AERA alert). Both aircraft are in sector 10 and data link is used for delivery of the clearance. The controller responsible for sector 10 is controlling the UAL 300 and USAir 940 aircraft in conflict.

The aircraft pair is involved in an aircraft-to-aircraft conflict in sector 10 in controlled airspace (1). With the support of the ACCC, the point of violation is predicted to be in sector 10 in less than 20 minutes (1.2). The controller monitors and reviews the APD data on his sector suite (2). He then formulates a problem resolution to the APD (3). The controller, with the support of the ACCC, implements the resolution for UAL 300 to climb to Flight Level (FL) 290 (4). The controller instructs the automation system to use the data link capability to transmit the clearance to the aircraft (5). The pilot



NOTE: Equipment is represented by background-filled boxes

FIGURE 4-7
AIRCRAFT SEPARATION ASSURANCE AND CONFLICT RESOLUTION
FOR LOCAL CONTROLLER OPERATIONAL SEQUENCE DIAGRAM

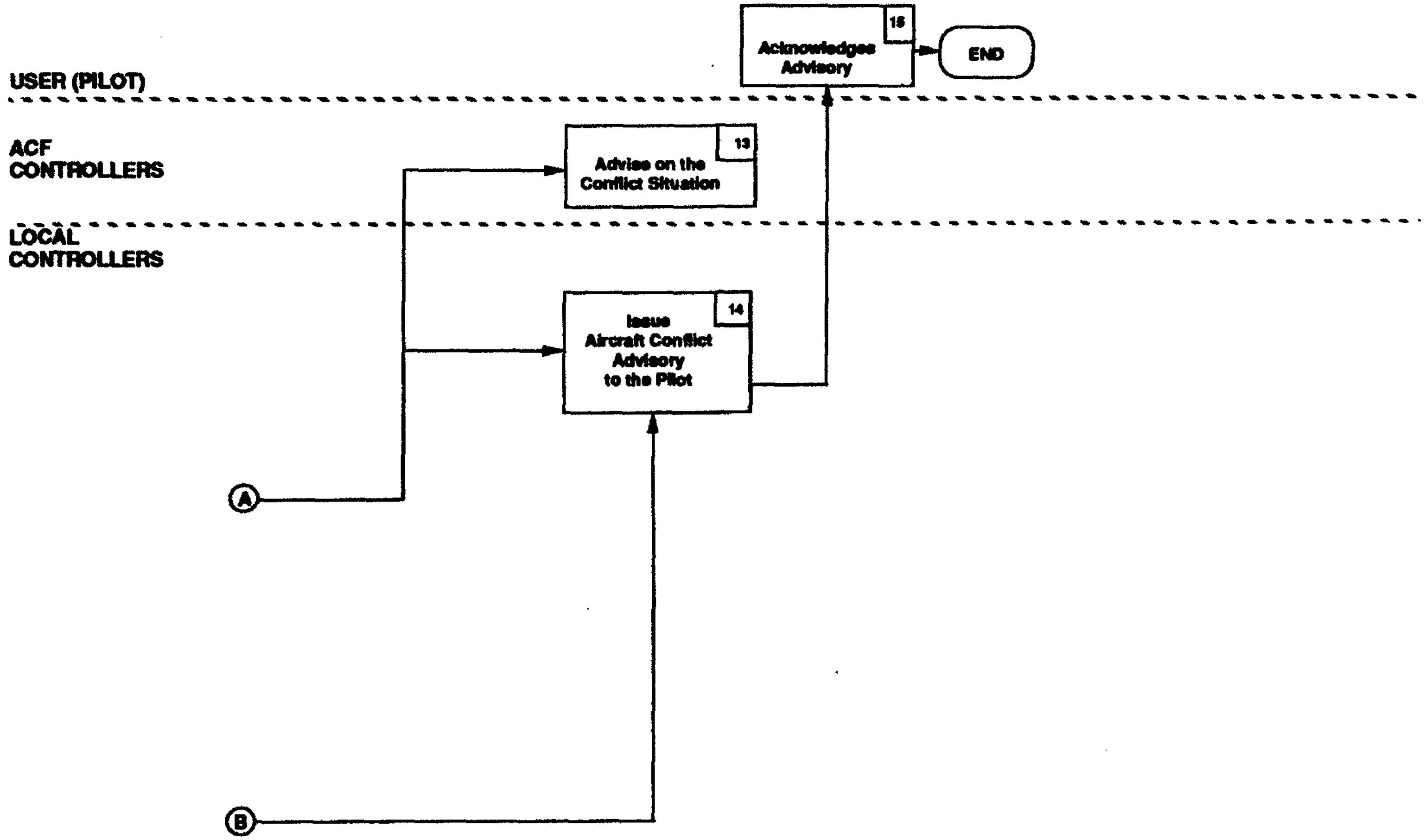


FIGURE 4-7
AIRCRAFT SEPARATION ASSURANCE AND CONFLICT RESOLUTION FOR LOCAL CONTROLLER OPERATIONAL SEQUENCE DIAGRAM (CONCLUDED)

accepts the clearance by use of data link (6). The system automatically updates UAL 300's flight plan (7), and the system notifies the controller that the resolution is accepted (8).

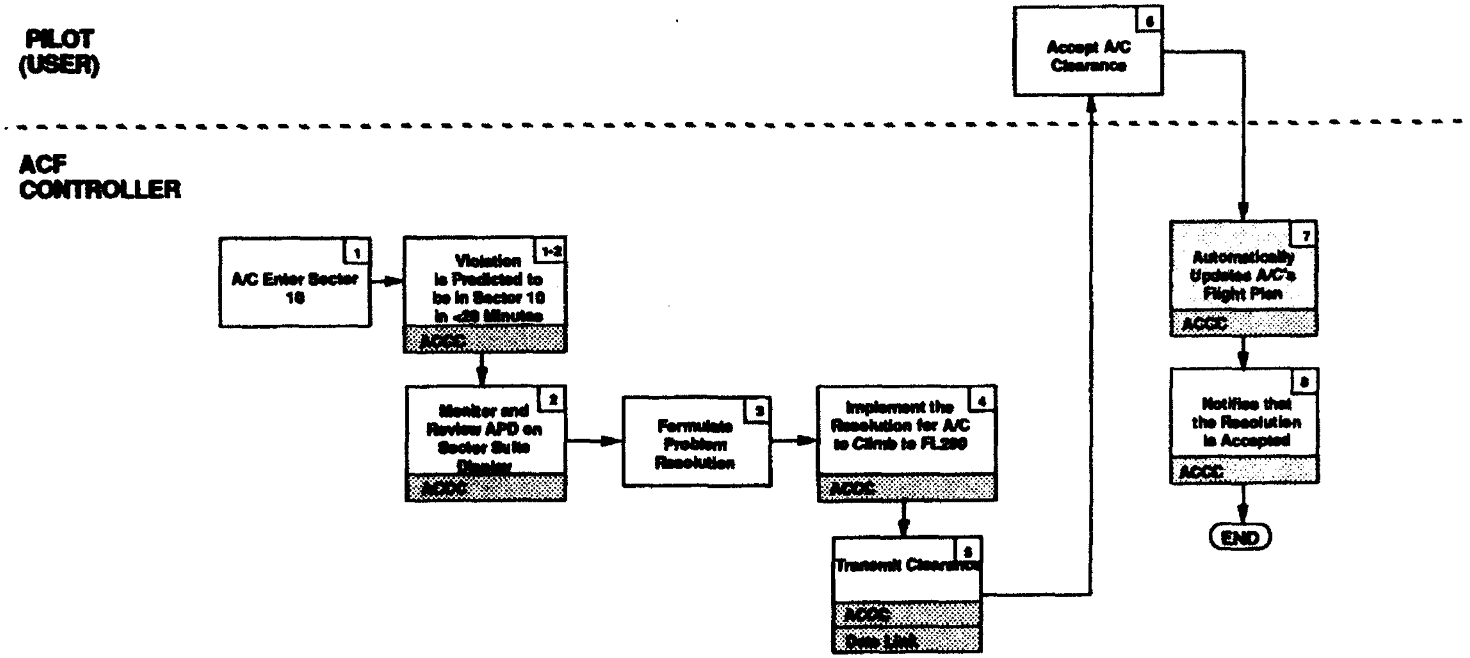


FIGURE 4-8
AIRCRAFT SEPARATION OPERATIONAL
SCENARIO DIAGRAM

5.0 CONTROL OUTSIDE OF INDEPENDENT SURVEILLANCE

The transmittal of accurate and timely position information allows controllers to provide safe and timely separation instructions to aircraft flying in areas where radar surveillance coverage is not available.

This document contains an operational concept which describes how specialists manage aircraft without the benefit of radar surveillance. Areas not having radar surveillance generally include areas more than one hundred miles offshore and mountainous terrain.

The NAS System Requirements Specification (NASSRS), Section 3.2.4, defines surveillance as "the detection, location, and tracking of aircraft within NAS airspace for the purposes of control, separation, and identification." NASSRS differentiates surveillance systems as follows:

- Independent. A system which requires no airborne compatible equipment (primary radar targets).
- Independent Cooperative. A system which requires airborne compatible equipment (ATC Radar Beacon System (ATCRBS), Modes C and S).
- Dependent. A system which requires input from navigation equipment aboard the aircraft either via data link or via voice transmission (pilot reports, LORAN Offshore Flight Following).

Control when outside of independent surveillance excludes independent surveillance systems (i.e., primary radar based), and independent cooperative surveillance (e.g., ATCRBS, Modes C and S). NASSRS Section 3.2.4 requirements refer to controlling aircraft in dependent surveillance areas; i.e., those areas where radar coverage is not available, and which require input from on-board navigation equipment via either data link transmissions or voice transmissions.

The United States (US) is responsible for providing aircraft separation services in all fifty states and US territories. In addition, the International Civil Aviation Organization (ICAO), a United Nations (UN) aviation governing body, contracts the US to provide aircraft separation services in designated oceanic regions.

Due to great distances and line-of-sight limitations, air traffic control (ATC) specialists cannot determine aircraft position through the use of land-based radar surveillance techniques. Line-of-sight constraints correspond to limitations resulting from great distances (i.e., curvature of the earth) and signal blockage (e.g., mountains, etc.). Because costs prohibit the use of complete land-based radar coverage, other techniques for managing air traffic are employed over geographical regions where land-based radar surveillance coverage does not exist.

Throughout NAS documentation, the term "radar surveillance" describes land-based radar surveillance equipment as opposed to space-based equipment which could be developed in the future, but beyond the time frame of the current end-state NAS. For purposes of this document, the term "non-oceanic" refers to non-radar areas over land. Also, the term "control when outside of independent surveillance coverage" is used synonymously with the term "non-radar" control, which includes both oceanic and mountainous terrain airspace.

Aircraft operating outside of independent surveillance coverage (including independent cooperative surveillance) must rely heavily on procedural methods to determine and report aircraft position data to ATC facilities. Generally, these position reports are derived from navigational aids or from the aircraft's internal navigation system. The NAS is required to assist users in accurately determining their position and transmitting this information, either by voice or data link, to specialists. The NAS shall receive, process, and display this information and assist control specialists in providing safe and timely instructions to users to avoid noncompliance with separation standards.

5.1 Support

NAS is required to manage aircraft in non-radar environments. Figure 5-1, Overview of NAS/User Systems for Control When Outside of Independent Surveillance Coverage, illustrates that the Area Control Facilities (ACFs) provide non-radar separation services for NAS. Major functions of non-radar separation are supported by the Advanced Automation System (AAS) Area Control Computer Complex (ACCC) processor.

Some NAS flight plan information is provided by the International/Automated Flight Service Station (I/AFSS) facilities. The I/AFSS transmits flight plan information into the Flight Service Data Processing System (FSDPS) located in the ACF. Many other organizations outside of NAS also provide flight plan information such as foreign ATC facilities, Airline Dispatch Offices (ADO), and Military Base Operations (MBO) facilities. Even though these organizations are outside of NAS, NAS must provide an interface for receipt of flight plan data.

Each aircraft must provide a direct or indirect method of communications with the ACF to allow the ATC specialists to manage air traffic. In oceanic areas, users transmit aircraft location periodically over high frequency (HF) radio to Aeronautical Radio, Inc. (ARINC). Those users which have Automatic Dependent Surveillance (ADS) equipment data link aircraft position information to satellites; the satellites in turn, transmit the information down to satellite ground stations.

In non-oceanic areas and in some oceanic areas, users transmit position information using voice communications over very high frequency (VHF) or ultra high frequency (UHF) radio. The Remote Communications Facilities (RCFs), ARINC, and satellite ground stations transmit aircraft position information into the ACFs. The following paragraphs describe the support received from NAS facilities, systems, positions, other outside-NAS organizations, and user systems.

NAS and non-NAS facilities, systems, non-radar positions, and major information paths that may be involved in managing air traffic in non-radar environments for Control When Outside of Independent Surveillance Coverage are shown in Figure 5-2.

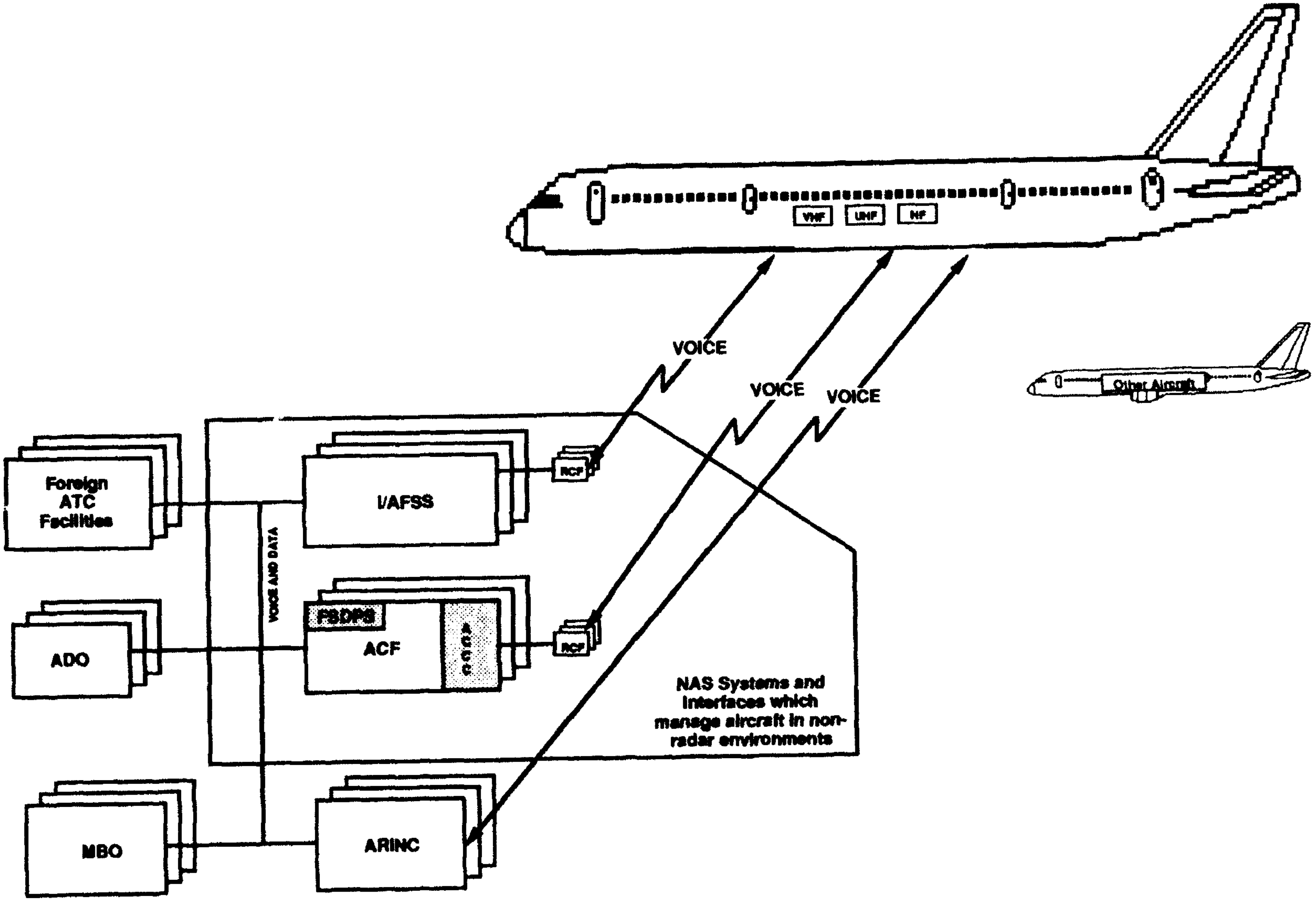
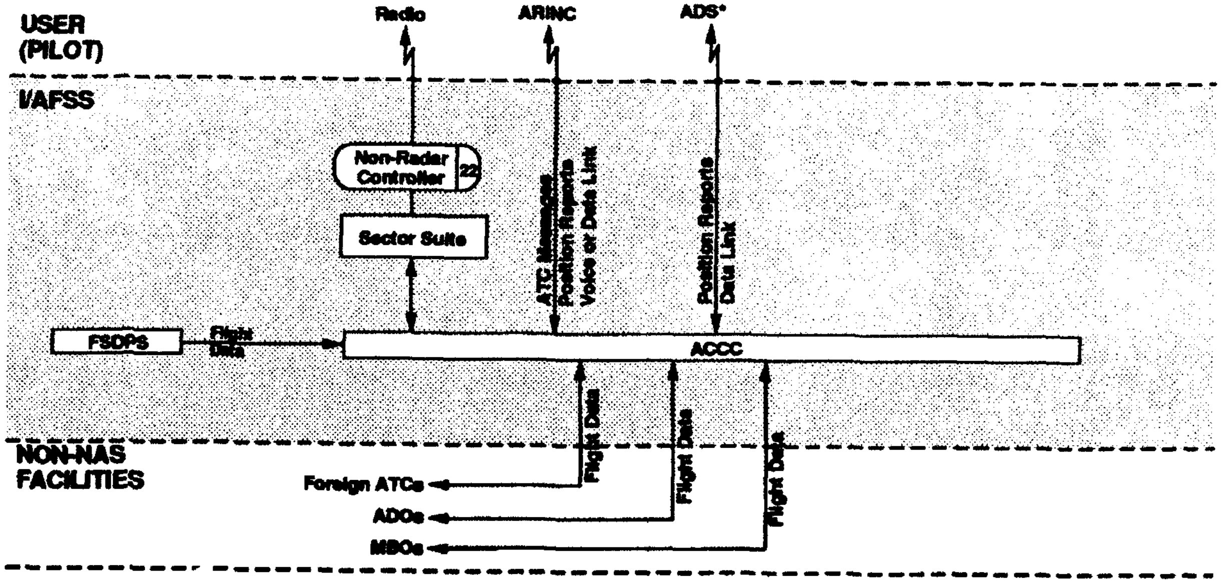


FIGURE 5-1

OVERVIEW OF NAS/USER SYSTEMS FOR CONTROL WHEN OUTSIDE INDEPENDENT SURVEILLANCE COVERAGE



* Not Baselined

FIGURE 5-2

CONTROL WHEN OUTSIDE INDEPENDENT SURVEILLANCE COVERAGE
OPERATIONAL BLOCK DIAGRAM

5.1.1 Other Organizations

Some non-NAS organizations are involved with aircraft communications in non-radar environments, particularly in oceanic areas. ARINC provides an HF radio service for the FAA when aircraft are out of VHF or UHF radio range. The MBO and the ADO occasionally become involved in contacting aircraft or relaying messages to aircraft because pilots may not be monitoring appropriate frequencies.

5.1.2 User Systems

The aircraft requires two-way radio systems for voice communications (VHF, UHF and HF). In addition to voice communications, ADS equipment assists controllers by enabling pilots to automatically transmit aircraft identification (ACID) and position information.

5.2 Information

This section describes the information required by the NAS to manage aircraft in non-radar environments. The information is categorized into two major areas: Information required from users, and information required from NAS.

5.2.1 Information From Users

Section 3.2.4 of the NASSRS requires that the NAS be capable of receiving information in non-radar areas which includes:

- Aircraft Identification (ACID)
- Aircraft Type
- Position
- Speed
- Clearance Limit (or Destination)
- Estimate of Time of Arrival at Reporting Fixes
- Altitude
- Remarks

This information may be provided directly by NAS users or indirectly through ARINC for NAS users.

5.2.2 Information from NAS

The ACCC presents information to the non-radar controller in the form of alphanumeric and graphic displays on sector suites. Information that the controller may need to manage aircraft are as follows:

a. Surveillance Data. The ACCC receives, processes, and displays ADS surveillance data received from satellite ground stations. Surveillance data includes ACID, altitude, and the latitude and longitude as calculated by the aircrafts' Area Navigation (RNAV) equipment. The ACCC correlates ADS position reports with the calculated flight plan positions. Whenever the lateral, and vertical position differences are within parameter tolerances, the aircraft's flight path (track) is considered to be in conformance with the flight plan; otherwise, it is out of conformance. Alert indicators in the full data block warn the controller if the aircraft is vertically or laterally out of conformance. Longitudinal differences between ADS position reports and extrapolated aircraft trajectories are adjusted upon receipt of the position report.

b. Flight Plan Data. Flight plan processing software in the ACCC calculates the extrapolated aircraft trajectory based upon flight plan data, position reports, aircraft performance data and wind data. This extrapolated aircraft position data is presented on the situation display. The controller may also request one of three different "look ahead" functions: 1) a display of the aircraft's future route, 2) a display of the aircraft's distance in miles, and 3) a display of the aircraft's distance in minutes based upon the current aircraft velocity."

c. Automated En Route Air Traffic Control (AERA) 1. AERA 1 software is hosted in the ACCC processor and provides controllers with an interactive method of planning and monitoring aircraft flow. AERA 1 capabilities allow controllers to create or modify flight plans by creating trial (flight) plans. Trial plans are processed as proposed flight plans. When a trial plan is initiated by the controller, AERA 1 processing invokes an aircraft-to-aircraft and aircraft-to-airspace conflict probe.

5.3 ACF Non Radar Controller (Position 22)

The following paragraphs elaborate on the functions and equipment which support the non-radar controller of position Number 22 introduced in Section 5.1. The operational flow diagram associated with the non-radar controller illustrates the information flow between the non-radar controller, the pilot, and the data processing equipment. The focus is on functions specifically related to managing aircraft in non-radar environments. The pertinent NASSRS paragraphs that specify the functions being performed by the controller is also referenced.

Figure 5-3 illustrates the primary functions performed by the non-radar controller in order to manage air traffic. It also shows the information that flows to and from the non-radar controller.

The flight plan conflict probe (Item f. in Figure 5-3) is performed automatically by the ACCC. Conflict probe processing is triggered by several activities:

- Any change in a flight plan.
- Initiation of a trial plan or quick trial plan.
- At a parameter time, prior to reaching the non-radar boundary.
- Periodically at parameter time intervals.

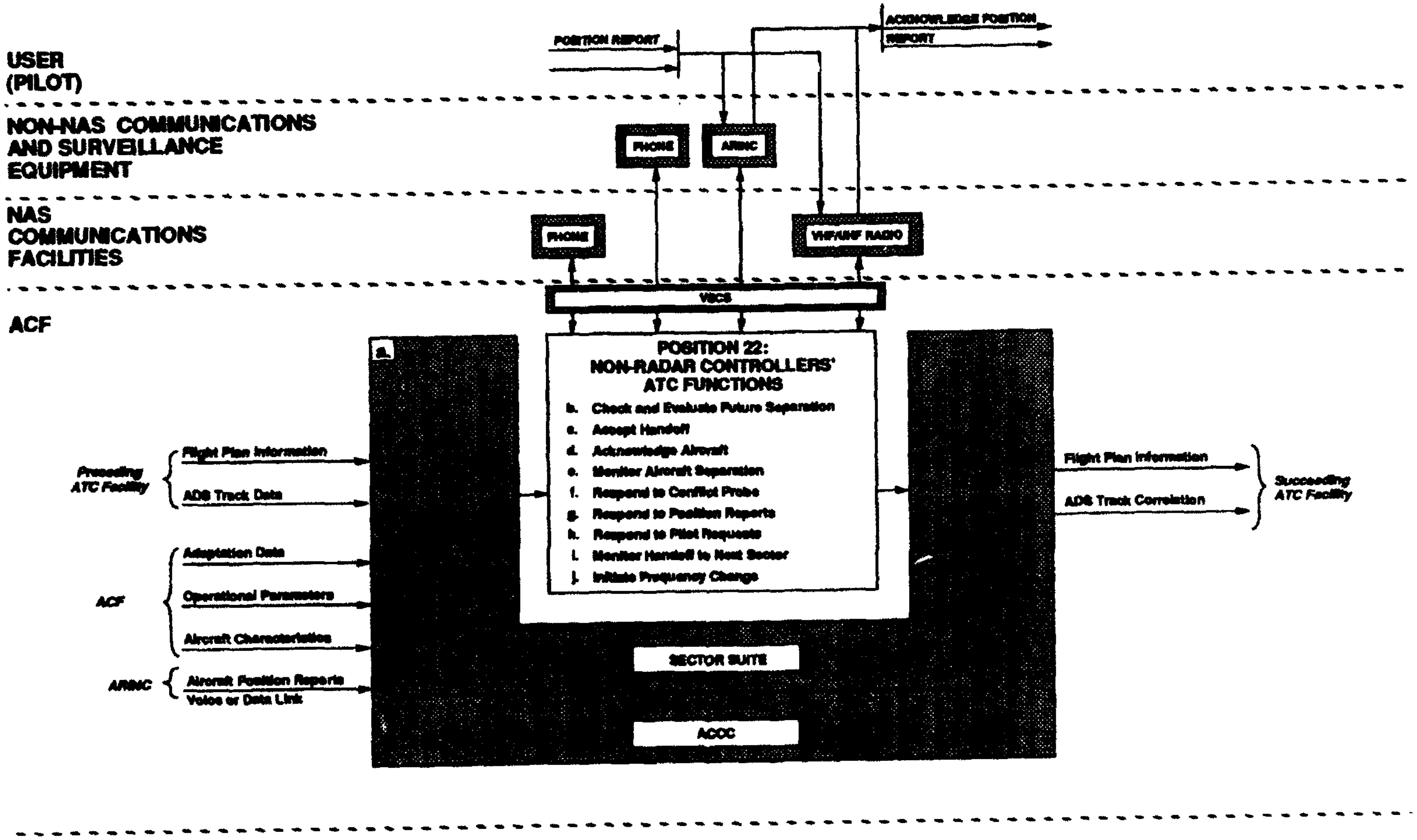


FIGURE 5-3
NON-RADAR CONTROLLER (POSITION 22)
OPERATIONAL FLOW DIAGRAM

When the conflict probe is triggered, as a result of a parameter time before entry into non-radar airspace, one of four options for placement of the conflict probe results are as follows:

- The sector where the aircraft is located.
- The sector where the potential conflict occurs.
- Both a. and b.
- Both a. and b., plus any intervening sectors.

Placement of the conflict probe results determines which controller resolves the conflicts, e.g., the controlling sector, the intervening sector(s), or the sector where the conflict occurs. For the purposes of this operational concept, the flight plan conflict probe is addressed apart from the sector that may trigger it.

a. ACCC Processing. The ACCC provides automated assistance to the controller so that he or she can manage air traffic by providing separation between aircraft, or by providing separation from special airspace boundaries where aircraft are not permitted to penetrate. The ACCC accepts, processes, stores, and distributes the latest available surveillance and flight plan data for display on sector suites. For ADS-equipped aircraft, the ACCC automatically hands off a target to the next sector based on the following criteria:

1. At a parameter time from the sector boundary.
2. At an adapted point.
3. At a specified altitude.

NASSRS requirements: 3.2.4.A,B

b. Check and Evaluate Future Separation. Before accepting an inbound aircraft, the non-radar controller ensures that the inbound flight is separated from all other aircraft currently in the sector. By referring to the situation display, alert display, flight data display, and other displays, the controller can assess the current and future traffic situation. The assessment of the future traffic situation allows the controller to foresee any conflicts between the inbound aircraft to other aircraft and to special airspace areas.

NASSRS requirements: 3.2.4.B

c. Transfer of Control. The term "transfer of control" is used to describe the transfer of control responsibility between one sector and another sector in a non-radar environment. The non-radar controller sees an ACID in the inbound list a parameter number of minutes prior to the aircraft actually crossing the boundary into his or her sector. The data block also indicates that an aircraft is in a transfer status. After future separation is ensured, the controller may either initiate an accept transfer of datablock control message and type an ACID into the data entry area, or perform a trackball function on the sector suite.

NASSRS requirements: 3.2.4.A,B

d. Acknowledge Aircraft. When an aircraft flying over mountainous terrain enters a new sector or new ATC facility, the pilot contacts the controller via VHF or UHF radio and states the position and altitude of the aircraft. During this time, any pilot requests received by the controller are either processed or are noted in the scratch pad display area of the sector suite.

NASSRS requirements: 3.2.4.A,B

e. Monitor Aircraft Separation. Controllers continually review aircraft and airspace separation by referring to the situation display, the alert display, the flight data display, and other displays. They mentally project all aircraft routes and altitudes in time, in order to identify future aircraft pairs (conflicts) or future protected airspace penetration. When a potential aircraft pair is visualized or an alert is displayed, they may project the aircraft route on the situation display. If a future conflict exists between aircraft, the controller may initiate a quick trial plan to change an aircraft's altitude, or initiate a trial plan to amend an aircraft's route of flight.

NASSRS requirements: 3.2.4.A,B

f. Respond to Conflict Probe. Conflict probes are initiated automatically by the ACCC. If the ACCC detects a conflict, an alert is presented on the appropriate controller's display. After an alert is presented on the situation display, the controller initiates either a quick trial plan or a trial plan. If the quick trial plan is initiated, the ACCC triggers conflict probe processing for aircraft-to-aircraft and local sector or ACF aircraft-to-airspace conflicts. If the trial plan is initiated, the ACCC triggers conflict probe processing for aircraft-to-aircraft and aircraft-to-airspace processing. After a conflict-free trial plan is developed, the controller triggers another conflict probe by initiating a flight plan message.

NASSRS requirements: 3.2.4.A

g. Respond to Position Reports. In non-radar environments position reports initiated from an aircraft may be transmitted into the ACF several different ways. If an aircraft is in non-oceanic airspace, the pilot talks directly with the controller using air/ground (A/G) communications. Position reports obtained from A/G communications must be entered manually into the flight plan database by the non-radar controller. Oceanic ARINC position reports are entered automatically into the flight plan database if the ACCC determines that the message is valid. If the message does not pass all of the ACCC checks, it is electronically displayed to the controller for his or her follow-up action. ADS data link position reports are automatically transmitted into the ACF, processed by the ACCC, and flight progress is displayed on the situation display.

NASSRS requirements: 3.2.4.A,B

h. Respond to Pilot Requests. Controllers respond to pilot requests when time permits. The ACCC aids controllers by allowing them to enter a message into the controller scratch pad display area of the sector suite. This tool assists controllers by reminding them about pilot requests which have not yet been granted. Many pilots request higher or lower altitudes, or they may request a direct routing instead of being required to fly an airway. These requests may involve initiating trial plans.

NASSRS requirements: 3.2.4.A,B

i. Monitor Handoff to Next Sector. For non-ADS-equipped aircraft, the controlling sector controller either enters an ACID into the flight data display and initiates a handoff entry, or performs a trackball function. A handoff indicator appears in the full data block, and a duplicate copy of the full data block is displayed as a target on the next sector's situation display. The ACID is also displayed in the receiving controllers inbound list.

NASSRS requirements: 3.2.4.A,B

j. Initiate Frequency Change. In non-oceanic airspace, frequency changes may occur within large sectors. The controller contacts the pilot via VHF or UHF radio and requests that the pilot contact him or her on the new frequency. If the aircraft is transiting into a new sector within the ACF or transiting into the next ACF area, generally a new frequency is given to the pilot using VHF or UHF radio. (In oceanic areas, ARINC institutes the same procedures when a pilot reports over a compulsory reporting point.)

NASSRS requirements: 3.2.4.A

5.4 Correlation with Operational Requirements

Table 5-1 summarizes the correlation of the non-radar operational requirements paragraphs of NAS-SR-1000 with the above paragraphs describing the functions being performed by the non-radar controller. All non-radar paragraph numbers of NAS-SR-1000 are listed. Paragraphs which are introductory in nature are indicated with a dash. The fact that a correlation is shown between a requirements paragraph and a paragraph describing the non-radar controller functions performed should not be construed as indicating that the requirement is completely filled.

TABLE 5-1
REQUIREMENTS CORRELATION FOR CONTROL WHEN OUTSIDE INDEPENDENT SURVEILLANCE COVERAGE

NAS-SR-1000 Paragraph	***Position***	***Non-Radar Controller***									
	Paragraph	**2.3.a**	**2.3.b**	**2.3.c**	**2.3.d**	**2.3.e**	**2.3.f**	**2.3.g**	**2.3.h**	**2.3.i**	**2.3.j**
3.2.4.A	Manage Traffic with Supplemental Navigation	X		X	X	X	X	X	X	X	X
.B	Receive, Process and Display	—	—	—	—	—	—	—	—	—	—
.B.1	Data Entry Equipment, Satellites, and User Sources	X		X	X	X		X	X	X	
.B.2	Flight Information	X		X	X	X		X		X	
.B.3	Process and Display	—	—	—	—	—	—	—	—	—	—
.B.3-1	Position and Identification Information	X		X	X	X		X		X	
.B.3-2	Oceanic and Remote Areas	X	X	X	X	X	X	X	X	X	X
.B.4	Estimate, Store and Update	—	—	—	—	—	—	—	—	—	—
.B.4-1	Current Position	X		X	X	X		X		X	
.B.4-2	Flight Plan Information	X		X	X	X		X	X	X	
.B.5	Display Capacity	—	—	—	—	—	—	—	—	—	—
.B.5-1	100 Oceanic Aircraft	X	X	X	X	X		X		X	
.B.5-2	50 Non-Oceanic Aircraft	X	X	X	X	X		X		X	

5.5 Operational Sequences

Figure 5-4 illustrates a common sequencing of the functions described in Section 5.3. Figure 5-4 illustrates how the conflict probe is implemented in order to manage air traffic.

The figure contains shadowed rectangles and decision diamonds which indicate that the function is performed solely by the AERA 1 processing software in the ACCC. A shadowed box inside the rectangle indicates that the controller must either initiate the function or interact with the ACCC. Rectangles and decision diamonds that are not shadowed, require controller judgment based upon procedures, training, experience, and the air traffic situation occurring at that moment. The dotted lines represent the controller's interaction with the user and the next controlling sector.

The next controlling sector could physically be in the same ACF, the next ACF in the aircraft's route, or could perhaps even be a foreign ATC facility. The numbers in the upper right hand corner of the action rectangles and upper vertices of the decision diamonds are reference numbers which refer to a textual description of the function.

5.5.1 Managing Non-Radar Air Traffic

Figure 5-4, Non-Radar Controller Operational Sequence Diagram, illustrates how controllers manage air traffic in a non-radar environment. As air traffic progresses through airspace, most of the tasks shown on Figure 5-4 are performed by the controller. When a sector's airspace is saturated, procedures specify the priority duties of the controller. The controller's first priority is to separate aircraft. The second priority is to respond to position reports; and when time is available, the controller may grant pilot requests. Since radio coverage may not always be available in oceanic areas, ARINC provides an interface between the controller and pilot. This operational sequence assumes that either a direct or an indirect communication link exists between the controller and pilot.

The controller must monitor the inbound list (1) and evaluate the future trajectory of the inbound aircraft (2). The controller must also monitor the alert list continually to avoid any future conflicts (3). If there is a conflict (4), the controller's first priority is to separate aircraft; therefore, the controller needs to resolve conflicts before accepting a handoff from the previous sector. Using techniques shown in Figure 5-4, the controller resolves conflicts by initiating either a quick trial plan or a trial plan. After a conflict-free trial plan is developed, the controller initiates a flight plan. Each of these functions triggers the flight plan conflict probe (5).

Since the options and paths of the conflict probe are somewhat lengthy, Figure 5-4 is not repeated each time the controller resolves a conflict in this sequence. In other words, instead of re-explaining how the controller uses the quick trial plan, trial plan, and flight plan, Figure 5-4 shows one box that is labeled, "resolve conflicts."

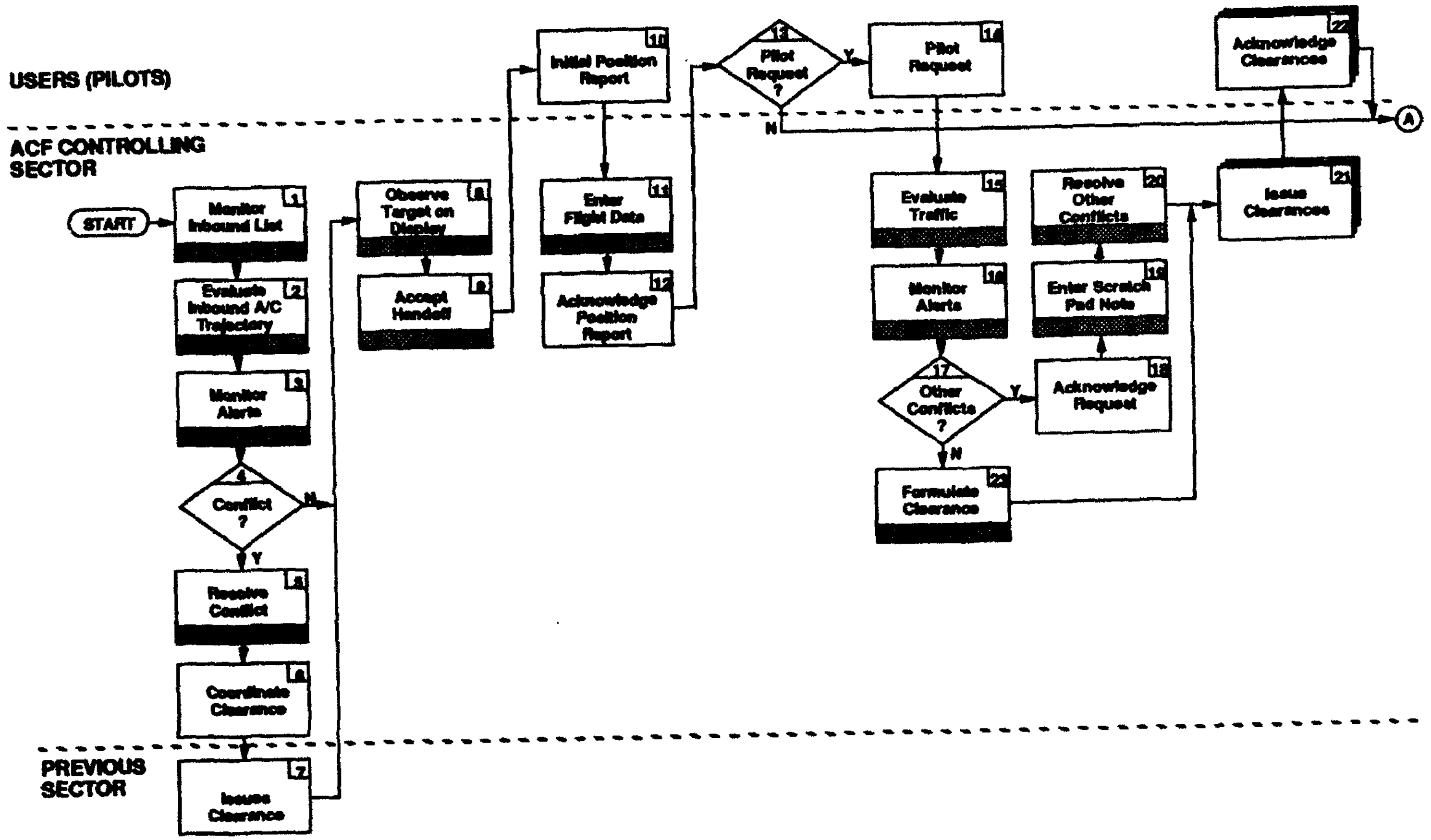


FIGURE 5-4
NON-RADAR CONTROLLER
OPERATIONAL SEQUENCE DIAGRAM

Since the inbound aircraft is still under the control of the previous sector, any new or revised clearance for an inbound aircraft must be coordinated with the previous sector (6). Most coordination between sectors involves using the intercom to contact the previous sector, and then the previous controller displays either the trial plan or flight plan (depending upon local sector procedures). Upon his or her approval, the previous sector controller then issues the clearance to the aircraft (7). After a mileage or time parameter, the controller can observe the inbound aircraft on the situation display (8) and accept the handoff message (9).

In an oceanic sector, the pilot communicates with ARINC over compulsory reporting points. In a non-oceanic area, inbound aircraft contact the ACF on the new frequency and give the controller a position report (10). The controller enters the position report into the flight plan database (11) and acknowledges the pilot (12). If the pilot wants an altitude or route change (13), he or she usually makes the request at the time of initial contact with the controller (14).

Because the controller's first priority is to separate aircraft, he or she evaluates traffic in the sector (15) and monitors the alert display (16). If there is a conflict between other aircraft in the sector (17), the controller acknowledges the pilot request (18), and enters the request into the scratch pad display (19). The controller then resolves the conflict between the other aircraft in the sector using the conflict probe (20), issues clearances (21), and waits for the pilot acknowledgements (22). If there are no other conflicts at the time of the pilot request, the controller formulates a clearance using the conflict probe (23), issues the revised clearance to the requesting pilot (21), and waits for pilot acknowledgement (22).

Aircraft leaving the sector must be handed off to the next sector. If an aircraft is ADS-equipped, surveillance data allows the ACCC to automatically initiate the handoff to the next sector. If an aircraft does not have ADS equipment, the ACCC does not have surveillance data, and the controller must initiate the a non-radar data block transfer (24). Also before the non-oceanic aircraft crosses the sector's boundary, the controller requests that the pilot change their radio frequency in order to contact the next sector or ATC facility (25) (26).

Pilots transiting oceanic areas report aircraft positions to ARINC when reaching published compulsory reporting points. Controllers monitor their displays for these position reports (27). The controller, again, checks the alert display for any conflicts (28).

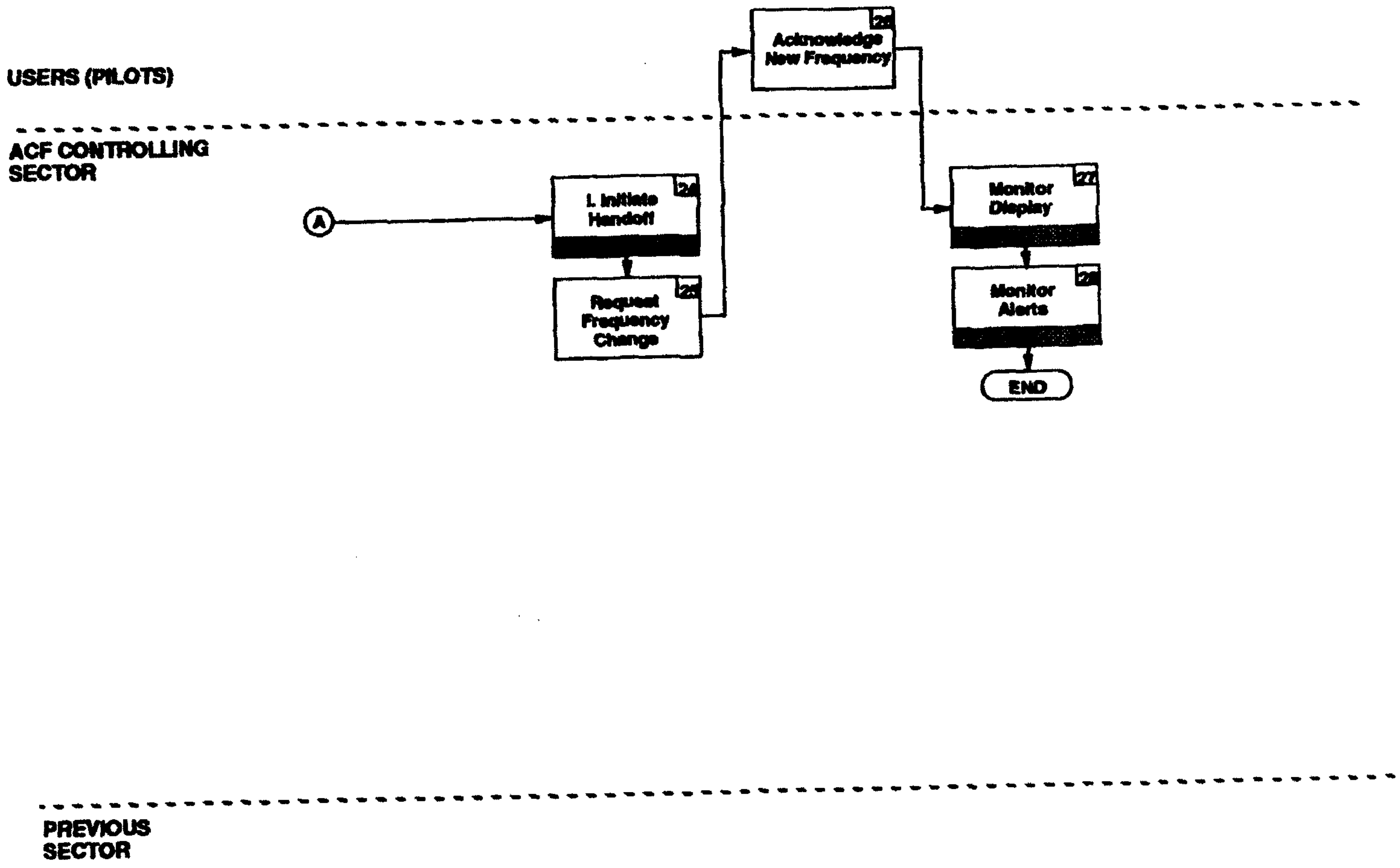


FIGURE 5-4
NON-RADAR CONTROLLER
OPERATIONAL SEQUENCE DIAGRAM (CONCLUDED)

5.6 Flight Plan Conflict Probe Operational Scenario

Figure 5-5 presents a hypothetical operational scenario showing how the non-radar controller interfaces with and operates the flight plan conflict probe. This operational scenario is similar in format to the operational sequence diagrams in Section 5.5, except that the operational scenario shows more detail and no decision branches.

In this scenario, the controller attempts to resolve an aircraft conflict by changing an aircraft's altitude. The results of the conflict probe indicate that a new conflict would be created with another aircraft; therefore, the controller changes control strategy and revises the aircraft's route of flight.

The controller monitors the alert display continually (1), and then sees an alert message involving an altitude conflict between two instrument flight rules (IFR) aircraft; N1234 and N6789 (2). The controller evaluates different control strategies and decides to change N1234's current altitude of 10,000 feet to 12,000 feet (3). The controller then initiates the quick trial plan function (4), which, in turn, triggers the quick trial plan conflict probe processing (5). The alert display notifies the controller about the results of the probe (6). In this scenario, N1234's altitude change conflicts with another aircraft (7).

The controller re-evaluates control strategies and decides to try and change N1234's route instead of the altitude (8). In order to change N1234's route, the controller chooses the trial plan option, enters the revised route, and initiates the trial plan (9). After triggering the conflict probe (10), the controller monitors the alert display (11). Since a strategic airspace alert message is displayed (12), the controller monitors the flight data area for the new trial plan (13). The new trial plan shows a way to route N1234 around the strategic airspace by listing the ATC preferred routing. Since the new routing is advantageous to N1234, the controller accepts the trial plan (14), and initiates the flight plan (15). The conflict probe function is triggered as a result of the flight plan initiation (16) and the alert display lists a message showing no conflicts (17). The controller issues the new clearance to the pilot of N1234 via VHF radio (18) and the pilot acknowledges.

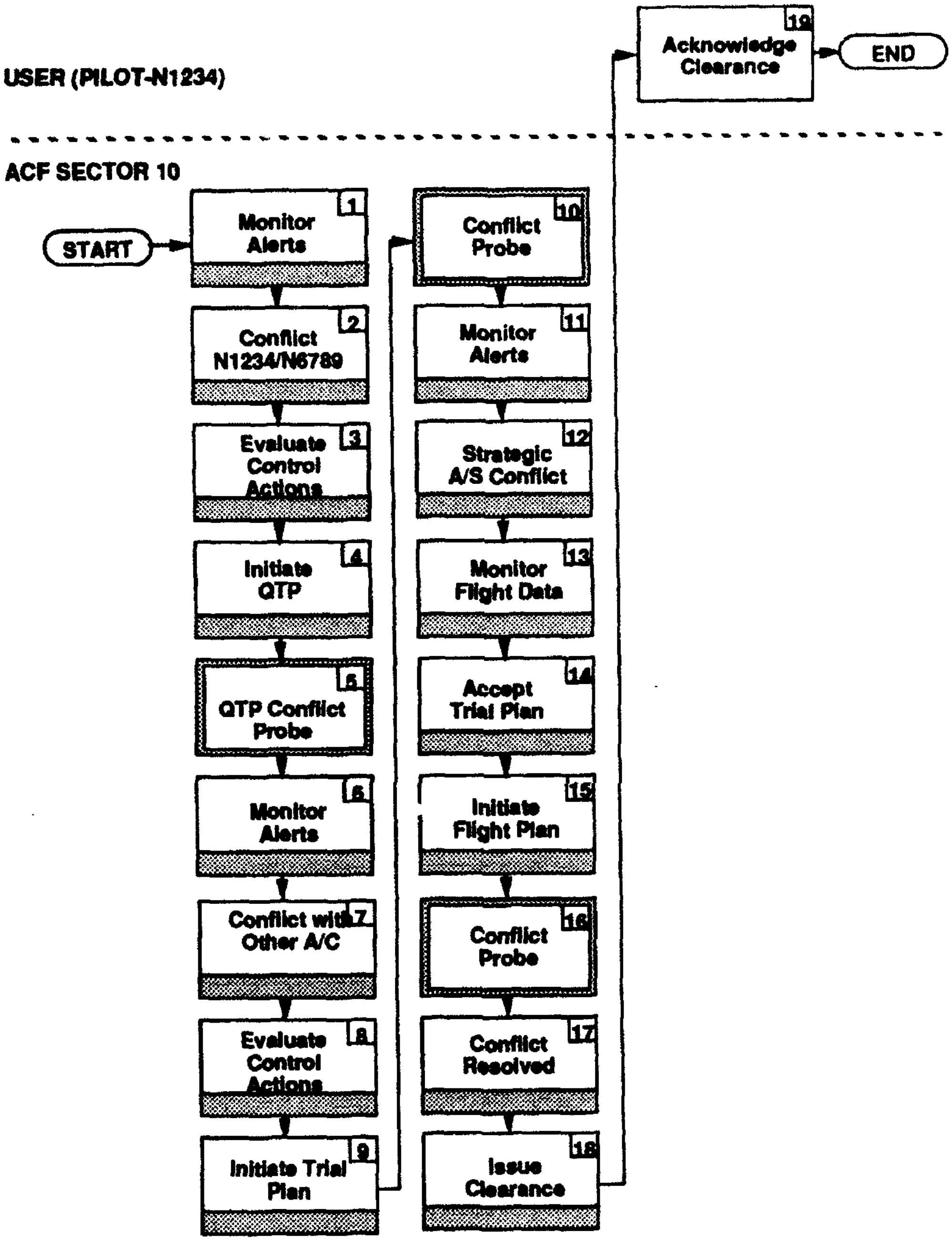


FIGURE 5-5
FLIGHT PLAN CONFLICT PROBE
OPERATIONAL SCENARIO DIAGRAM

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6.0 COLLISION AVOIDANCE

The first priority of air traffic control is to maintain safety in flight by separating aircraft. (This does not include independent airborne systems, such as Traffic Alert and Collision Avoidance System - TCAS). The capability is required to provide assistance in predicting and avoiding imminent collisions or near-collisions. The National Airspace System (NAS) shall predict potential collisions in sufficient time to allow avoidance actions to be taken without causing further conflict.

This document will include separation assurance functions which identify imminent conflicts (less than two minutes to violations) and also the Automated En Route ATC (AERA) functions. AERA functions will assist the controller in prediction and resolution of situations in which the time-to-violation is relatively long (20 minutes look-ahead-time). Section 3.2.5 of the NAS System Requirements Specification (NASSRS) states functions that require AERA 2, (generating and evaluating maneuvers to resolve problems). In this sense, a "problem" is a predicted potential loss of adequate separation among aircraft or between aircraft and protected airspace.

This document does not include collision avoidance systems which deal with situations in very short time-frames where a violation of separation minima has already occurred,(e.g., Traffic Alert and Collision Avoidance System (TCAS) and Airspace and Traffic Advisory Service [ATAS]). Section 3.2.5 of the NASSRS clearly states that independent airborne systems (i.e, TCAS) are not a part of NAS air traffic control (ATC).

An operational concept which describes separation services is in a separate NAS operational concept (Aircraft Separation Operational Concept). The document covers the requirements delineated in Section 3.2.3 of the NASSRS. Section 3.2.3 of the NASSRS describes aircraft separation functions, although not all of the requirements are directly related to aircraft separation. Aircraft Separation Operational Concept provides a more extended view of separation functions.

6.1 Support

Figure 6-1, Overview of NAS/User Systems for Collision Avoidance, illustrates the NAS facilities, systems, and user systems that are involved with the collision avoidance functions.

Major functions of collision avoidance operations are supported by the Area Control Computer Complex (ACCC), Tower Control Computer Complex (TCCC), Voice Switching And Control System (VSCS), Air Traffic Control Radar Beacon System (ATCRBS), Altitude-encoded Beacon Reply (Mode C) and Mode Select-Beacon System (Mode S) Transponders and controllers. NAS subsystems that contain processing capabilities or position equipment that support operational services to avoid collision are discussed in Section 6.3, Functions.

The NAS facilities, systems, specialist positions, and major information paths that may be involved in a collision avoidance operation are shown in Figure 6-2, Collision Avoidance Operational Block Diagram.

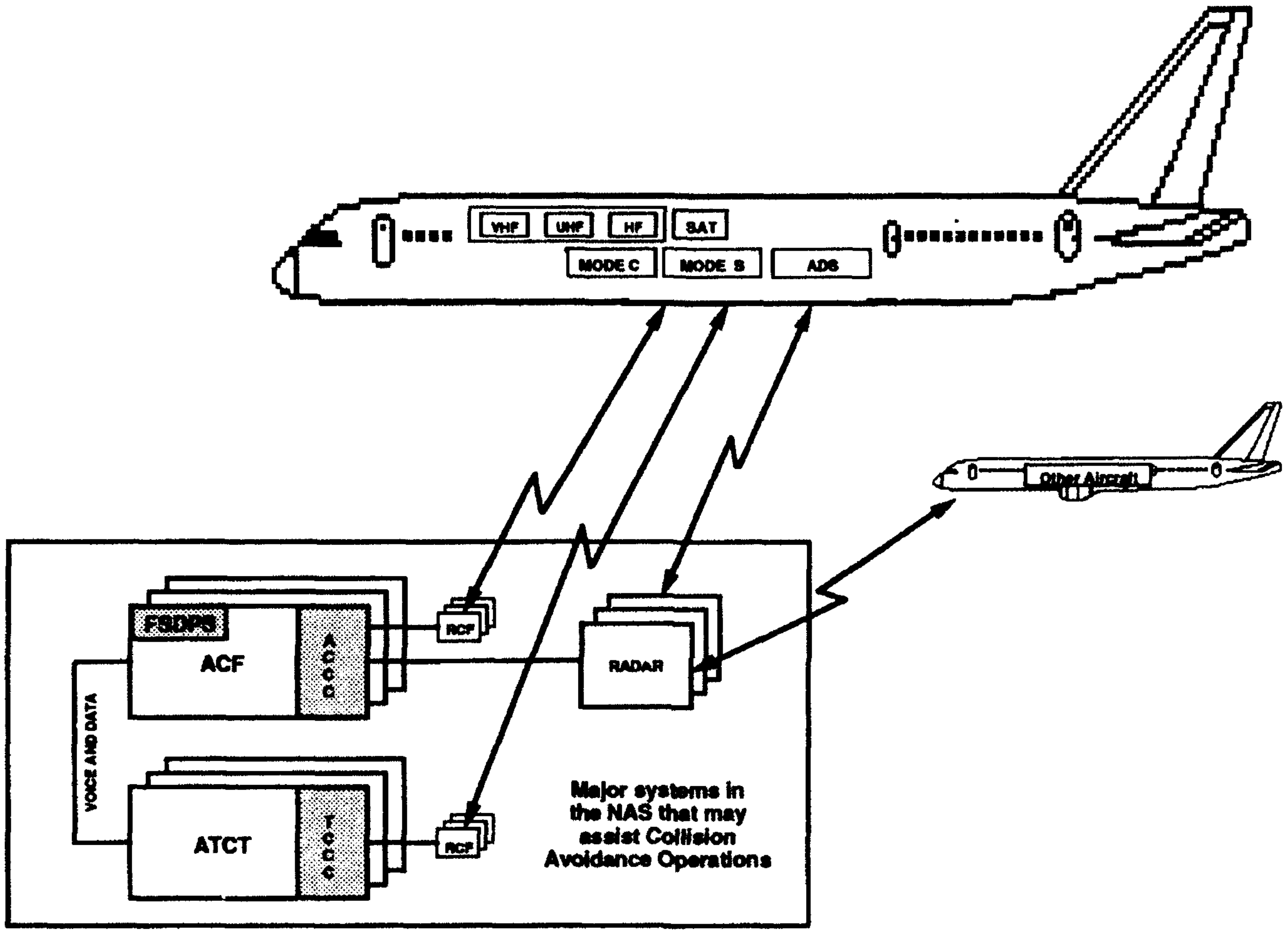


FIGURE 6-1

OVERVIEW OF NAS/USER SYSTEMS FOR COLLISION AVOIDANCE

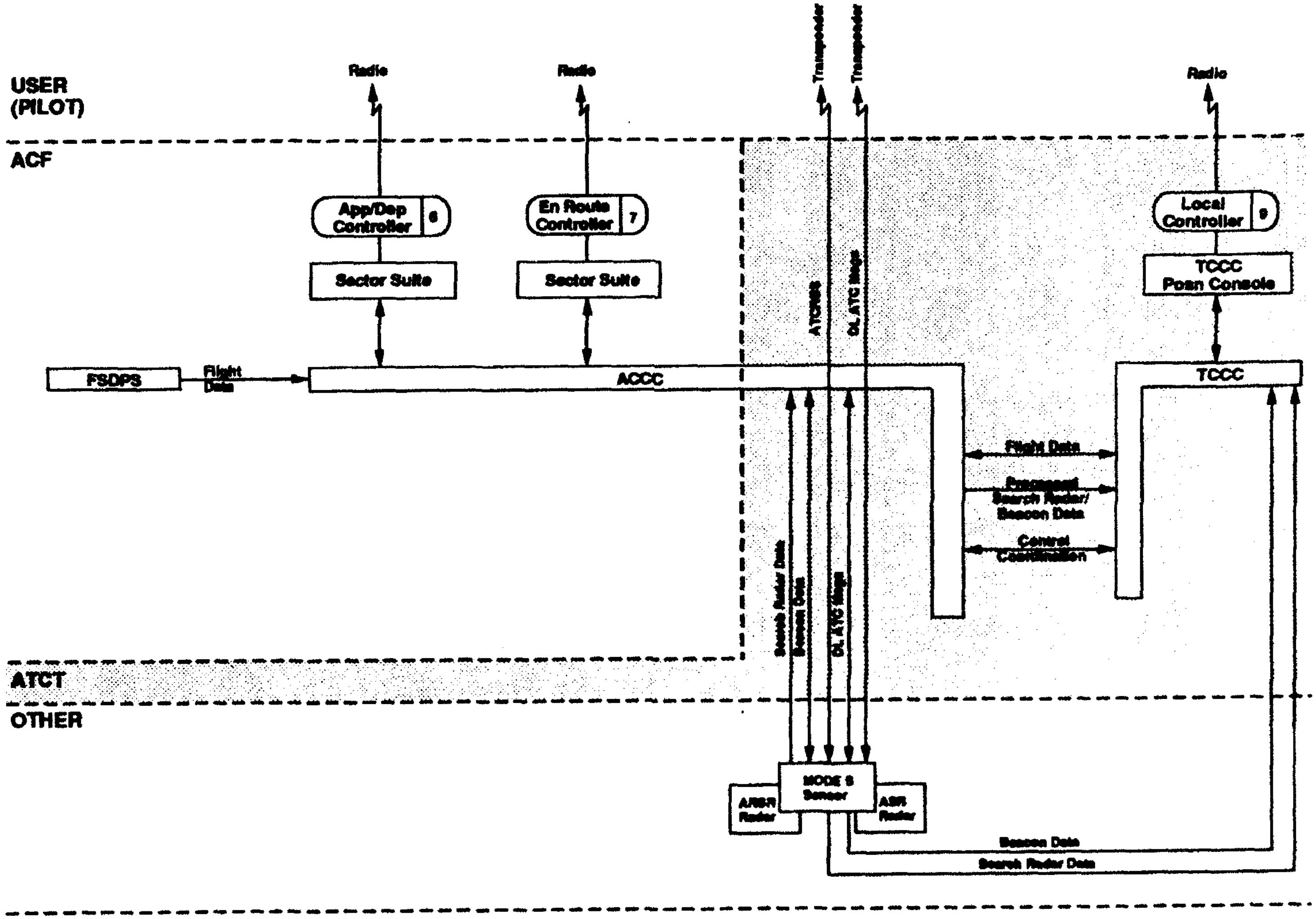


FIGURE 6-2

COLLISION AVOIDANCE
OPERATIONAL BLOCK DIAGRAM

6.1.1 User Systems

The aircraft in Figure 6-1 shows two way radio systems for voice communication; very high frequency (VHF), ultra high frequency (UHF), high frequency (HF), and satellite, and data communication (Mode S) and systems to assist in surveillance ATC Radar Beacon System (ATCRBS), (Mode C & S), and Automatic Dependent Surveillance (ADS). Few, if any aircraft will have all of these systems, but most all will have some. A Mode C transponder which reports altitude, is required for aircraft operating under visual flight rules (VFR) to obtain the collision avoidance service.

6.2 Information

This section describes the information required or used in the collision avoidance service obtained through the NAS.

The ACCC/TCCC will present information/data to the controllers in the form of interactive adaptable alphanumeric and graphic displays.
Information/data that the controllers may need to provide collision avoidance are as follows:

- Surveillance Data. The ACCC receives, processes and displays surveillance data from both ATCRBS (including Mode S) and primary radar. Primary radar provides information on aircraft position. In addition to position, ATCRBS provides altitude and aircraft identification. Further, the ACCC will calculate and have available for display aircraft speed and direction.

- Separation Assurance Data. The system will display Conflict Alert (CA), Conflict Resolution Advisories (CRA), and incident reporting for each tracked aircraft pair.

  CA. The controllers can predict violations of separation minima along the track extrapolation vector line or by extrapolating from history positions for short look-ahead times (normally two minutes or less). CA processing performs this same function using the track extrapolation vector as a backup to the controller. CA functions are implemented for terminal and for en route airspace. It will provide different alerting criteria for terminal and en route operations for the following cases for Mode C equipped aircraft:

  - IFR/IFR pairs
  - IFR/controlled VFR pairs
  - IFR/uncontrolled VFR pairs
  - Controlled VFR/controlled VFR pairs
  - Controlled VFR/uncontrolled VFR pairs

  CRA. The ACCC will generate and display alternative resolutions of tactical (short-term) situations that ensure adequate aircraft separation and minimal disruption of system operations.

<u>Incident Reporting</u>. The report given to the controllers will include aircraft identifications, controlling positions, and the proximity in lateral and vertical distance.

- <u>AERA Data</u>. AERA provides Automated Problem Detections (APD) and Automated Problem Resolutions (APR) out to times of about 20 minutes. AERA provides the controllers with tools to evaluate the effects of requesting direct route prior to granting the clearance. The controllers can create, modify, or delete a trial plan. (A trial plan is a flight plan that is proposed as a new flight plan or a possible replacement for an existing flight plan. It is built or amended either by the controller or automatically by the ACCC). They can also display the route of aircraft associated with a trial plan to help resolve predicted aircraft. The use of AERA tools by the controllers is optional.

6.3 Functions

The following paragraphs elaborate on functions provided by the controller positions introduced in Section 6.1 and by the equipment that support the controllers. The operational flow diagrams associated with each paragraph illustrate the information flow between the controller and the user and between the controller and data processing equipment. The focus is on functions specifically related to collision avoidance service. The pertinent NAS System Requirements Specification (NASSRS) paragraphs that specify the functions being performed by the controllers are referenced in each of the paragraphs below.

6.3.1 Approach/Departure Controller (Position 6) And En Route Controller (Position 7)

En route and approach/departure controllers are analyzed together because for this service they are functionally identical. Approach/Departure controllers monitor terminal control airspace, whereas en route controllers monitor en route airspace. They are both radar controllers. They maintain separation between aircraft and between aircraft and restricted airspace by providing users with the maneuvers required to avoid conflicts (separation violations).

Figure 6-3, Approach/Departure and En Route Controller Operational Flow Diagram, illustrates the collision avoidance functions and services provided by the controllers (Position 6 and 7) at the Area Control Facility (ACF). Lower case letters identify the functions performed by the controllers and their support equipment and are described in the corresponding paragraphs below.

a. <u>ACCC Processing</u>. One of the purposes of the ACCC is to provide automated assistance to the controllers so that they can maintain safe separation between aircraft. An ACCC includes computers, computer software, displays, input/output devices, and controller/operator workstations. An ACCC will support the continuous control of air traffic. The ACCC provides controllers at an ACF with the ability to track all aircraft within the responsibility of their region. Controllers will interface with the ACCC through sector suites. A sector suite will consist of one to four consoles. Each common console will consist of two physical displays, an interactive display and input devices (e.g.,

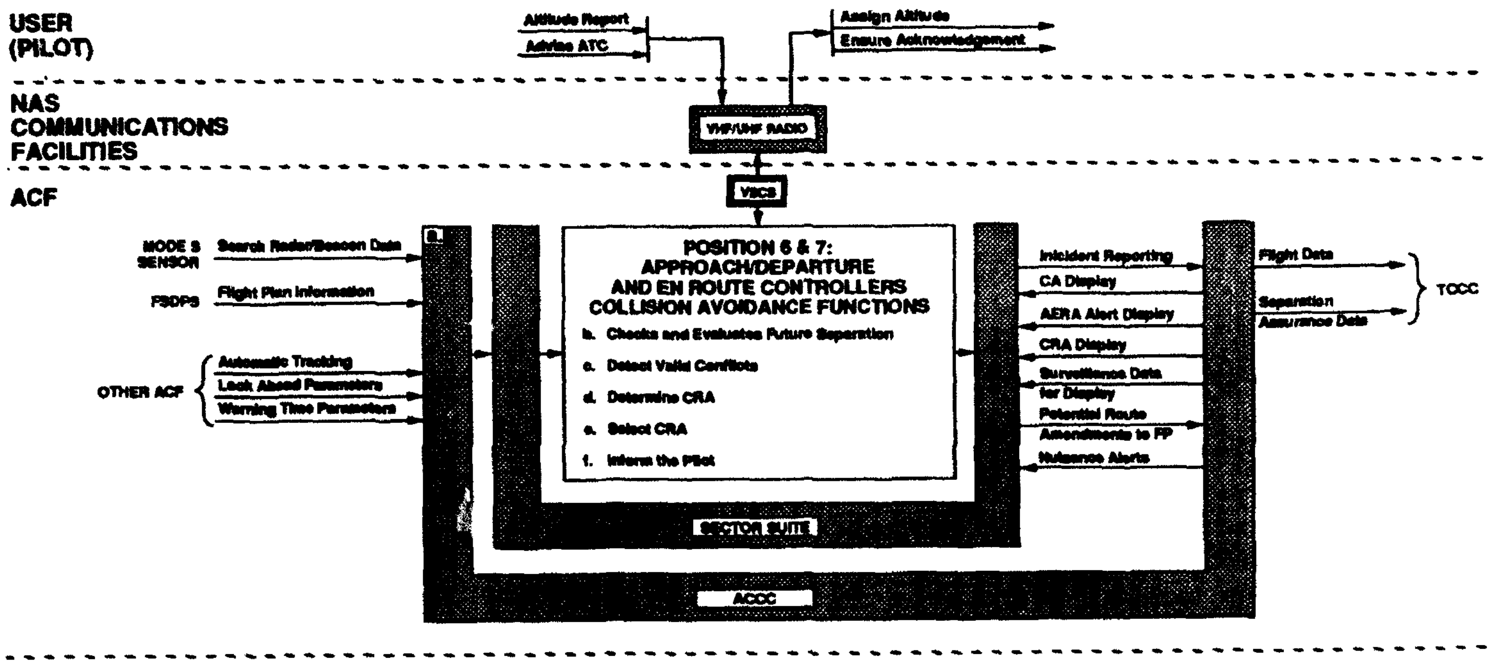


FIGURE 6-3
APPROACH/DEPARTURE AND EN ROUTE CONTROLLERS (POSITION 6 &7)
OPERATIONAL FLOW DIAGRAM

keyboard and cursor positioning/selecting device). One physical display will be the main display and the other will be used as an auxiliary display. Capabilities are functions which are directly or indirectly related to collision avoidance.

NASSRS requirements: 3.2.5.A

b. Checks and Evaluates Future Separation. The controllers will ensure separation by mental assessment of the situation presented to them, at the sector suites, augmented by automation tools. They may mentally project an aircraft's future position/altitude path, or project a flight plan to avoid potential conflict. To do this, they may refer to radar/beacon data presented on their display. The controllers may input flight plan data which will be translated by AERA into a four-dimensional trajectory (the three spatial dimensions, plus time) representing the expected flight path of the aircraft. The trajectory is then compared against other flight trajectories by AERA. Any problems detected by this comparison are presented to the controllers for evaluation and resolution. Another use of the AERA trajectory is the construction by the controllers of "trial" trajectories to examine flight plan amendments.

NASSRS requirements: 3.2.5.A,B,D,

c. Detect Valid Conflicts. A CA can be presented to the controllers on their sector suites display. CA can be suppressed by controllers input action.

NASSRS requirements: 3.2.5.A.2-4;F

d. Determine Conflict Resolution Advisory (CRA). CRA will be determined by the ACCC and presented to the controllers at the sector suites. If the controllers are not satisfied by these machine generated resolutions, they will formulate their own resolution.

NASSRS requirements: 3.2.5.D.3, E,F

e. Select CRA. The ACCC will rank order conflict resolution maneuvers for each predicted conflict, but the decision as to which maneuver to recommend from the display list or to formulate their own maneuver is the controller's responsibility.

NASSRS requirements: 3.2.5.D.4, F

f. Inform The Pilot. The controllers (positions 6 and 7) will issue advisory alerts and clearances to the pilot based on the selected conflict resolutions. The pilot will be informed by the controllers of potential separation violations, the primary threats, and the recommended maneuvers to avoid those threats.

NASSRS requirements: 3.2.5.C.4&5; F

6.3.2 Functions of Local Controllers (Position 9)

Figure 6-4, Local Controller: Collision Avoidance Operational Flow Diagram, illustrates the functions and services provided by the local controllers at an air traffic control tower (ATCT). Lower case letters identify the functions performed by the controllers and their support equipment. The functions are described in the corresponding paragraphs below.

a. TCCC Processing. The TCCC provides an automated information system that supports the ATCT controllers. ACCCs and TCCCs will have the same equipment and software to the extent possible. The TCCC has two modes of operation: normal and stand-alone. The TCCC will transition to the stand-alone mode of operation when communication with an ACCC becomes unavailable. Separation assurance automation capabilities will not be provided in the stand-alone mode. The majority of the external data received by the TCCC are surveillance data, separation assurance assistance, environment data, and flight plan data.

   NASSRS requirements 3.2.5.A

b. Checks and Evaluates Separation. The primary focus of the local controller's job is to ensure the safe and expeditious flow of air traffic through direct (visual) observation out the tower window. The controller can directly observe an aircraft/aircraft conflict in the local airspace area. Thus, the controller observes the aircraft then judges the separation. The controller will also review the situational display for flight data, radar returns, CAs and CRAs and use that information as appropriate. All of the above functions are performed on a continuous basis.

   NASSRS requirements: 3.2.5.A.1; F

c. Detect Valid CA(s). A conflict may be detected in many ways. If the automation system detects an aircraft/aircraft conflict, a CA is generated on the situation display. The local controllers determine the validity of the alert.

   NASSRS requirements: 3.2.5.A.3 & 4; F

d. Determine CRA. The controllers also review the CRA generated by the automation system or formulate their own advisory when not satisfied by the system generated resolutions. Action to resolve the conflict situation will be taken by the controllers.

   NASSRS requirements: 3.2.5.D & E, F

e. Select CRA. The TCCC will rank order conflict resolution maneuvers for each predicted conflict, but the decision as to which maneuver to recommend from the display list or to formulate their own maneuver is the controller's responsibility.

   NASSRS requirements: 3.2.5.D.4; F

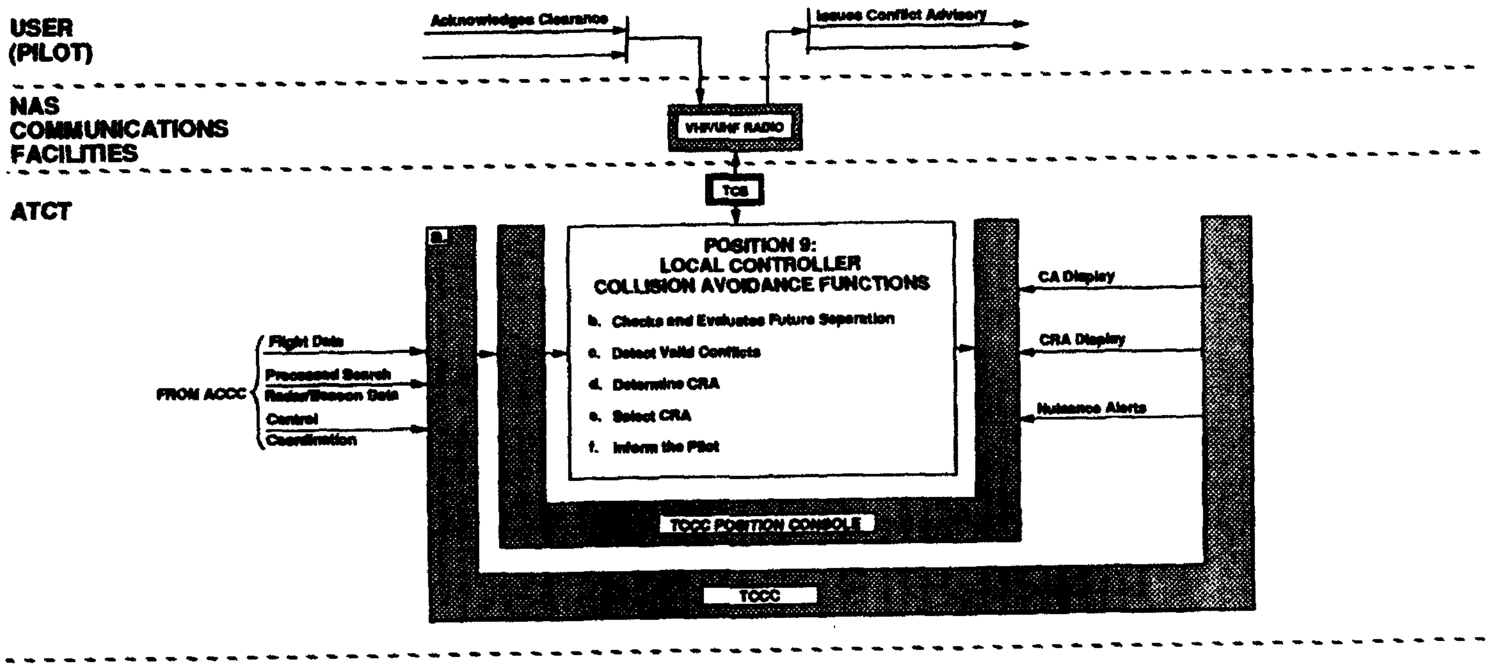


FIGURE 6-4
LOCAL CONTROLLER (POSITION 9)
OPERATIONAL FLOW DIAGRAM

f. Inform The Pilot. The controllers will inform the pilot of the primary threats, and the recommended maneuver based on the selected conflict resolution.

NASSRS requirements: 3.2.5.C.4 & 5;

6.4 Correlation With Operational Requirements

Table 6-1, Collision Avoidance Operational Requirements Correlation, summarizes the correlation of the collision avoidance operational requirements paragraphs of NAS-SR-1000 with the previous paragraphs in this document that describe the functions being performed by the controllers. All collision avoidance paragraphs from Section 3.2.5 of NASSRS which are introductory in nature, do not state an explicit operational requirement, or which reference other portions of NAS-SR-1000 are indicted with a dash. The fact that a correlation is shown between the requirements paragraph and a paragraph describing the specialist/controller functions performed should not be construed as indicating that the requirement is completely fulfilled.

TABLE 6-1
COLLISION AVOIDANCE OPERATIONAL REQUIREMENTS CORRELATION

NAS-SR-1000 Paragraph	Position / Paragraph	Approach/Departure and En Route Controller						Local Controller					
		2.3.1.a	2.3.1.b	2.3.1.c	2.3.1.d	2.3.1.e	2.3.1.f	2.3.2.a	2.3.2.b	2.3.2.c	2.3.2.d	2.3.2.e	2.3.2.f
3.2.5	Collision Avoidance Requirements	—	—	—	—	—	—	—	—	—	—	—	—
.A	Flight Path Protection	X	X						X				
.A-1	Track Information	X	X						X				
.A-2	Conflict Alert (CA)	X		X						X			
.A-3	CA Display	X		X						X			
.A-3a	CA in Terminal Airspace	X		X						X			
.A-3b	CA in En Route Airspace	X		X									
.A-4	Nuisance Alert	X		X						X			
.B	Look-Ahead Times	X	X						X	X			
.B-1	Separation Assurance	X	X	X	X	X	X	X	X	X	X	X	X
.B-2	Long Look-Ahead (20 Min) Time	X	X										
.B-3	Aircraft Routing not Available	X		X					X				
.B-4	Flight Path Updated once per Scan	X	X	X	X	X				X	X		
.C	Alerts of Potential Collision	X		X							X		
.C-1	Alert the Controller by Aural/Visual Signal	X		X	X	X				X	X		
.C-2	Display Alert	X		X	X						X		
.C-3	Display of Call Sign	X											
.C-4	Alert Equipped Users	X			X		X						X
.C-5	Notify CRA to Users	X					X						X
.D	Determine CRA	X	X		X						X		
.D-1	Evaluate Maneuvers	X	X		X						X		
.D-2	Current CRA Status	X	X		X						X		
.D-3	CRA Advisories	X	X		X						X		
.D-4	Rank CRA	X				X						X	
.E	Display CRA	X			X	X					X		
.E-1	Display CRA within Specific Time	X			X						X		
.E-2	Display at least one CRA	X	X		X						X		
.F	Available on a Continuous Basis	X	X	X	X	X	X		X	X	X	X	X

6.5 Operational Sequences

Figure 6-5 illustrates a common sequencing of the functions described in Section 6.3 and show how the various specialists interact with the user, other specialists, and NAS subsystems to provide the collision avoidance service. Figure 6-5 shows a general sequence of operator/user interactions in the ACF environment for controllers in controlled airspace to avoid collision.

In the automated environment, AERA services can be extended to the Controlled Visual Flight Rules (CVFR) aircraft in which the pilot has filed a flight plan requesting ATC separation service. The number in the upper right hand corner of the action rectangles and upper vertices of the decision diamonds are reference numbers and progress more or less as time progresses during the operation. The functions occurring almost concurrently are indicated by the double number. The cross hatching indicates an interaction with, and processing by, automatic data processing equipment (ACCC).

6.5.1 Performing Aircraft Conflict Resolution for ACF Controllers

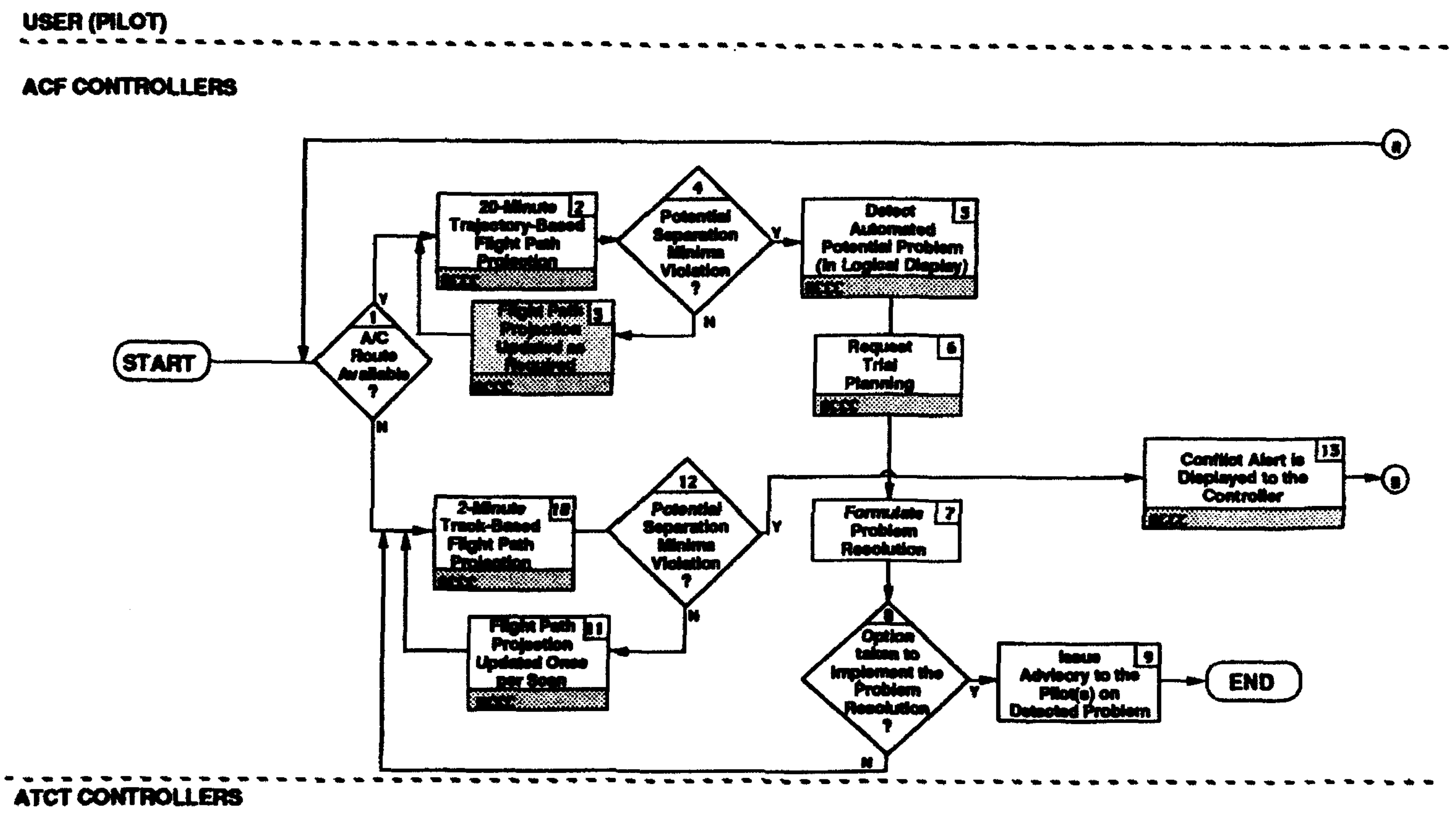
Figure 6-5, Performing Aircraft Conflict Resolution Operational Sequence Diagram For ACF Controllers, illustrates the interactions necessary to issue an appropriate maneuver to controlled aircraft to avoid collision.

An aircraft flight plan may or may not be available to the controllers (i.e., no flight plan is available for uncontrolled VFR) (1). If routing information is available (IFR and controlled VFR), the controllers may consider the entire 20 minute trajectory based on flight path projection into the future by the ACCC (2), which will be updated as required (the conditions are stated in the system database) (3). If a potential separation minima violation takes place (4), it may lead to the use of automation tools (AERA capabilities) which are provided by the ACCC. The controllers may review and detect the Automated Problem Detection (APD) displayed on the logical display of the sector suite (5). Using the ACCC, controllers may request trial planning (6). The controllers may formulate problem resolutions of the automatically detected problem (7). It is the controllers' option to implement the problem resolution (8). If they decide to implement the resolution, then they will issue an advisory to the pilot(s) (9).

Otherwise, they may consider only a two minute track based flight path projection (10); flight path projection will be updated by the surveillance equipment at least once per scan (11).

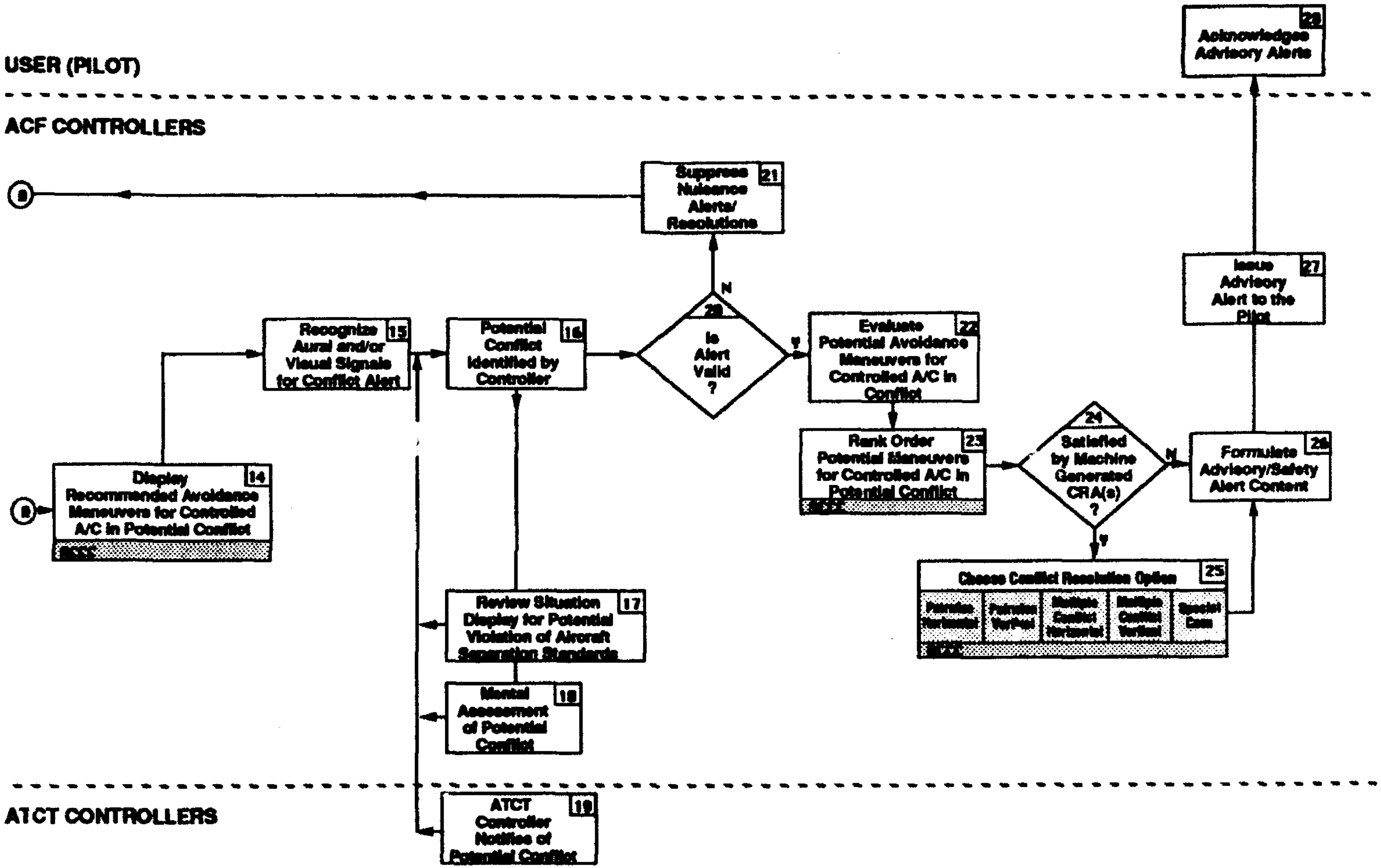
For all aircraft, if parameters associated with a potential separation minima violation have been satisfied (12) in the short look-ahead time frame (typically 2 minutes or less), then CA is displayed to the controllers by the system (13) and also recommended avoidance maneuvers for a controlled aircraft in potential conflict are displayed to the controllers by the ACCC (14).

The controllers will recognize to the aural and/or visual signals for CA (15). Normally the controllers will be aware of the situation prior to the CA and will be managing the situation, but if they aren't, the ACF controllers will identify the potential conflicts (16). The controllers will then review the situation display for potential violation of aircraft separation standards (17). The controller's mental assessment of potential conflict is necessary (18). (In addition, the ATCT controllers will notify the ACF controllers of



NOTE: Equipment is represented by background-filled boxes

FIGURE 6-5
CONFLICT RESOLUTION
OPERATIONAL SEQUENCE DIAGRAM



NOTE: Equipment is represented by background-filled boxes

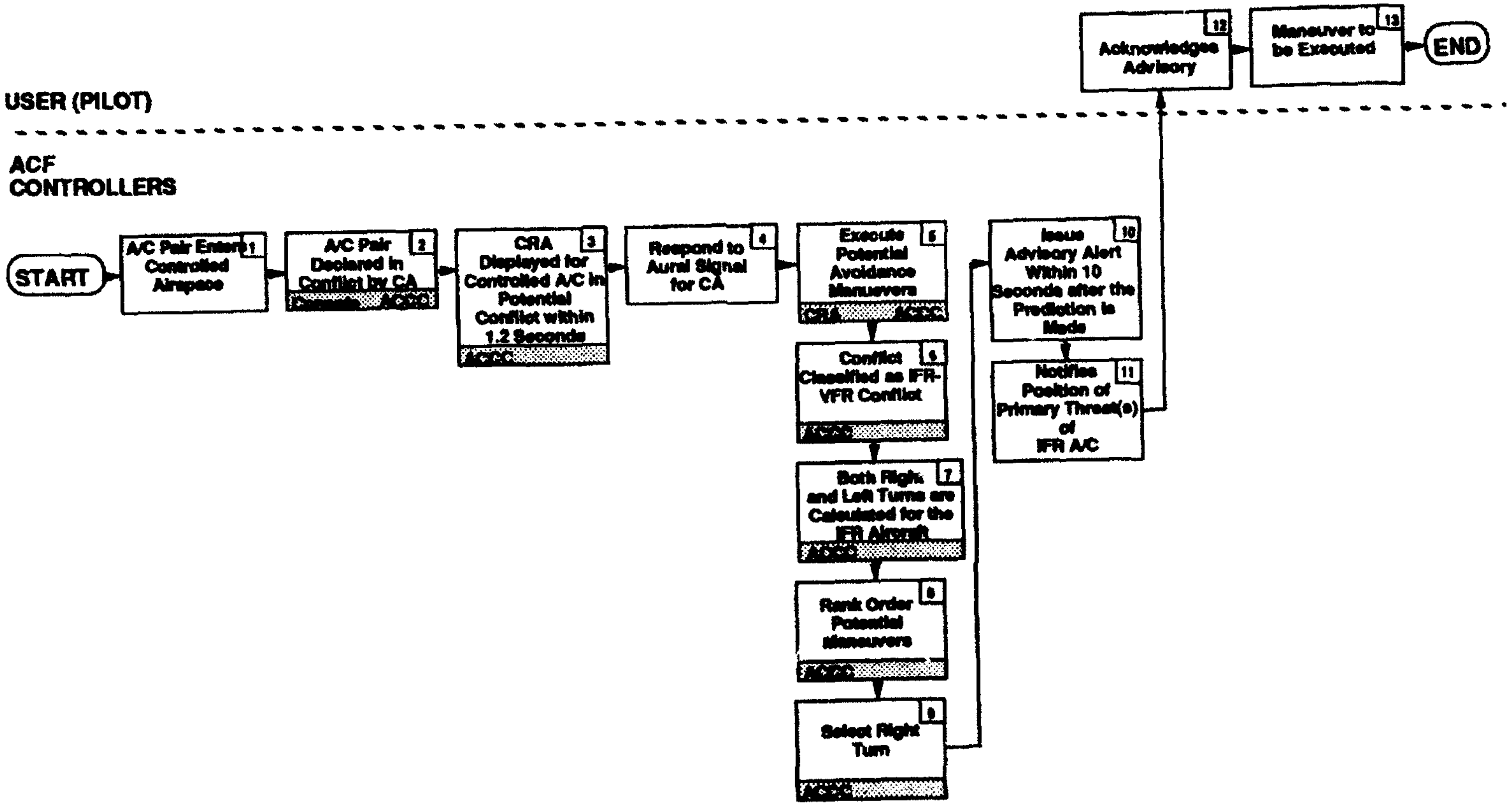
FIGURE 6-5
CONFLICT RESOLUTION
OPERATIONAL SEQUENCE DIAGRAM (CONCLUDED)

any potential conflict detected in their sector suits which are moving towards the ACF environment (19)). The controllers determines the validity of the alert (20). If the alert is not valid, then the controllers will suppress the nuisance alerts and resolutions (21). If the alert is valid, then potential avoidance maneuvers for controlled aircraft in conflict will be evaluated (22). Possible maneuvers for controlled aircraft involved in the predicted collision (resolutions) will be ranked by the system or if the controllers are not satisfied, they may make their own judgment (23). If the machine generates conflict resolutions and the controllers are satisfied, then they will choose the conflict resolutions (24 & 25) from those displayed by the ACCC, otherwise the controllers will formulate their own advisory/safety alert (24 & 26). The controllers will issue a clearance to the pilot (27), informing the pilot of the relative positions of the primary threats and finally, the pilot will acknowledge the clearance (28).

6.6 Operational Scenario

Figure 6-6, Collision Avoidance Scenario: Conflict Detection Between Controlled (IFR) And An Uncontrolled (VFR) Aircraft In En Route Airspace, presents an operational sequence for a specific hypothetical situation. It is similar to the operational sequence diagrams in Figures 6-5; however, the scenario shows more detail. The scenario assumes a conflict detection between a controlled (IFR) and an uncontrolled (VFR) aircraft in en route airspace.

An aircraft pair enters controlled airspace (1). The scenario is entered when the ACF controller becomes responsible for ensuring separation to avoid collision. The specialist will maneuver only the controlled aircraft. The aircraft pair is declared in conflict by the CA algorithms in the ACCC (2). The CRA are displayed for the controlled aircraft in potential conflict within 1.2 seconds after the prediction of a potential separation violation (3). The controller detects a conflict alert on his console, and responds to an aural signal signifying the conflict alert (4). The controller with the assistance of the ACCC will evaluate potential avoidance maneuvers (5). The conflict is classified as IFR-VFR conflict by the system because one aircraft is controlled by the NAS center and the other is not (6). Next, both right and left turns are calculated for the IFR aircraft (7). The system will rank-order potential maneuvers for the controlled aircraft in potential conflict (8). The controller selects a right turn (9). The controller will issue an advisory alert within 10 seconds after the prediction is made (10), then he notifies the position of the primary threats of IFR aircraft to the pilot (11). The pilot acknowledges the controller's advisory (12), and finally, the pilot will maneuver (13).



NOTE: Equipment is represented by background-filled boxes

FIGURE 6-6
CONFLICT RESOLUTION
OPERATIONAL SCENARIO DIAGRAM

7.0 WEATHER AVOIDANCE

Hazardous weather is a significant threat to safety of flight for all aircraft, particularly in the very critical take-off and landing phases of flight. The degree of hazard posed by the weather depends upon its intensity, the characteristics of the aircraft, and the phase of flight (take-off, en route, landing). The National Airspace System (NAS) is required to provide assistance to users in avoiding hazardous weather.

7.1 Support

The NAS is required to provide hazardous weather avoidance services to users. This requirement is described in Section 3.2.6 of the NAS System Requirements Specification (NASSRS). Weather avoidance services may be provided by Automated Flight Service Station (AFSS) specialists, en route controllers at an Area Control Facility (ACF), approach/departure controllers, or the local controller at an aerodrome with an Airport Traffic Control Tower (ATCT). Weather avoidance services for the pre-flight phase have not been described since they are considered more properly under the purview of flight planning and it is assumed that the user (pilot) will not fly unless the weather permits.

Figure 7-1 is an overview of NAS/User Interfaces for weather avoidance and illustrates the NAS facilities and systems involved in weather avoidance.

Figure 7-2 is an operational block diagram showing the interrelationships between equipment, facilities, operators/users, and the information necessary to support hazardous weather avoidance operations.

7.2 Information

Major sources of weather information for pilots who wish to communicate with a person instead of interrogating a data base will be the specialists at the AFSSs and the controllers at the ACFs and ATCTs.

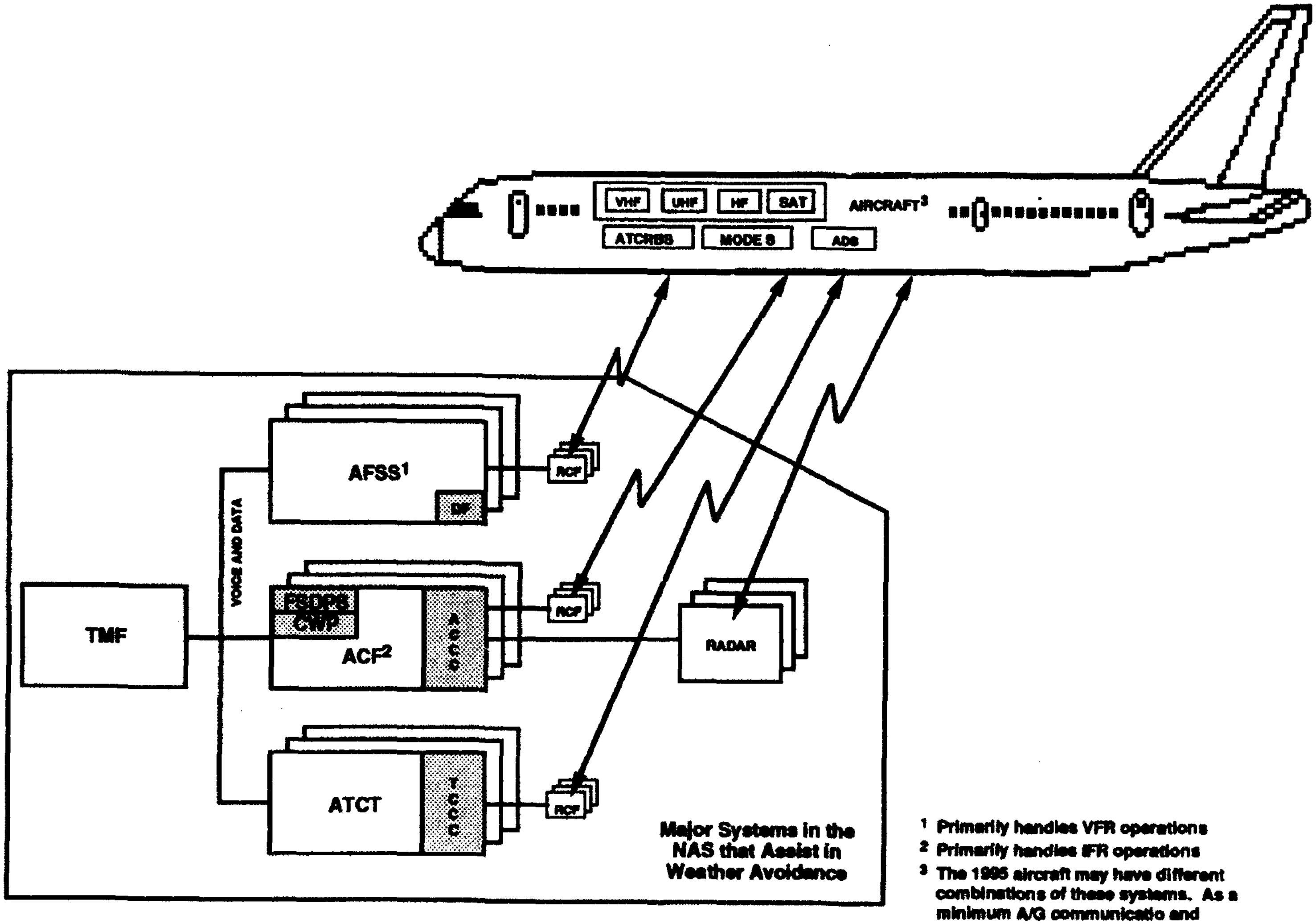
The following categories of hazardous weather products are available to specialists and controllers:

- Alphanumeric text
- Graphic products
- Pilot weather reports
- Weather radar products

These products will be used in operations related to hazardous weather avoidance, and are transmitted on a routine or a request/reply basis.

7.2.1 Alphanumeric Text

Alphanumeric products related to hazardous weather are available to controllers via the Real Time Weather Processor/Meteorologist Weather Processor (RWP/MWP). Real-time airport data is obtained directly from various sensors at the airports by the TCCC, and will subsequently be transmitted to the ACCC for storage and use by other controllers.



[1] Primarily handles VFR operations

[2] Primarily handles IFR operations

[3] The 1995 aircraft may have different combinations of these systems. As a minimum A/G communicatio and surveillance enhancements are assumed

FIGURE 7-1

OVERVIEW OF NAS/USER INTERFACES FOR WEATHER AVOIDANCE

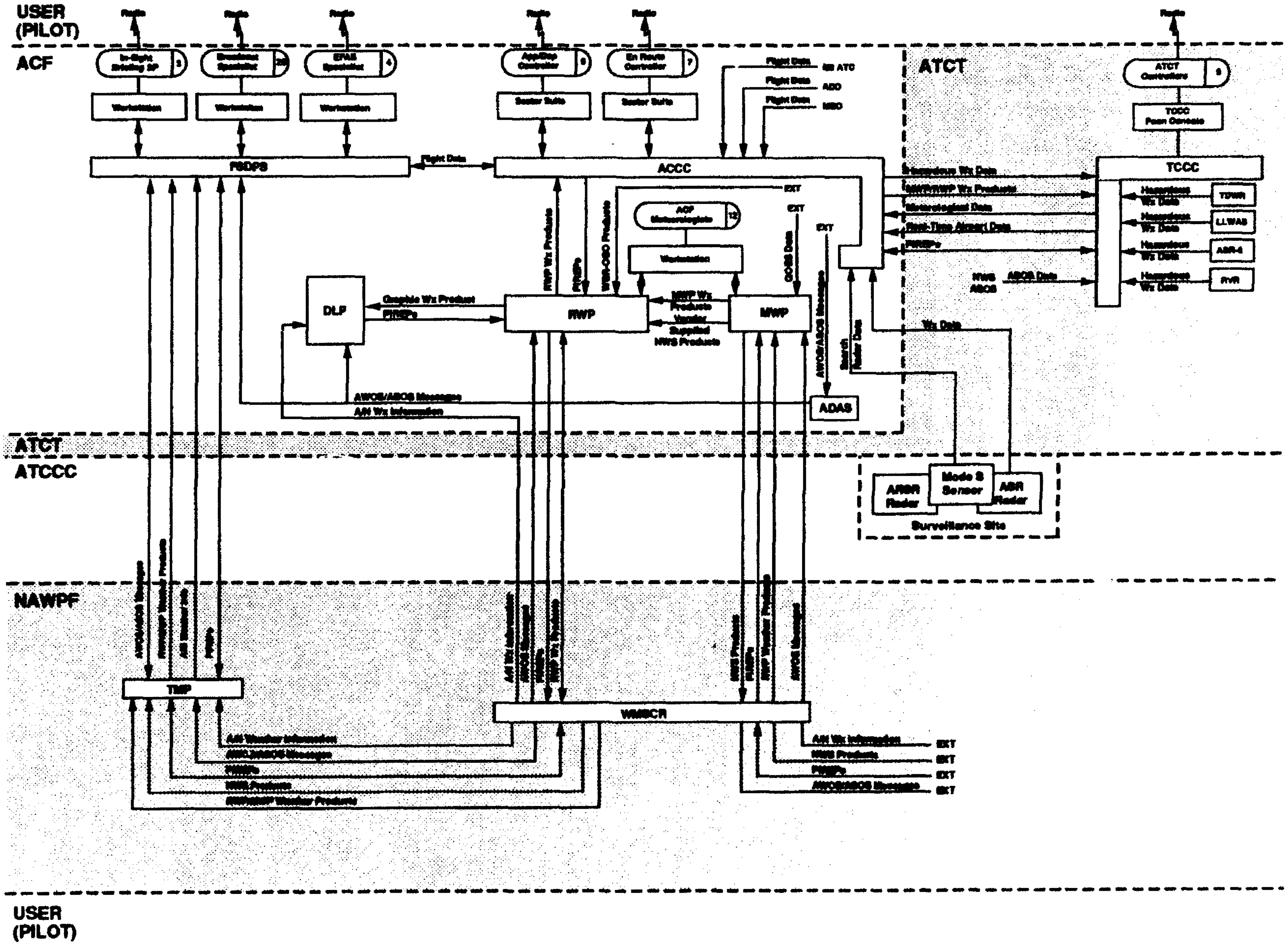


FIGURE 7-2
WEATHER AVOIDANCE
OPERATIONAL BLOCK DIAGRAM

7.2.2 Graphic Products

The RWP/MWP provides two graphic products to the ACCC for use by controllers. These products are the Hazardous Weather Area Outline (HZW) and the IFR Area Outline (IAO), both of which are manually generated by the ACF meteorologist.

7.2.3 Pilot Weather Reports

Pilot weather reports (PIREPs) are in-flight observations made by pilots and reported to FAA ground personnel. The RWP/MWP maintains a data base containing all PIREPs acquired through the Flight Service Automation System (FSAS), the Data Link Processor (DLP) via the Mode S data link, the Area Control Computer Complex (ACCC) and Tower Control Computer Complex (TCCC) by controllers, and directly from the ACF meteorologist (the ACF meteorologist would have received PIREPs from the controllers). The RWP/MWP transmits PIREPs acquired from the FSAS, DLP, and the ACF meteorologist to the ACCC. The PIREPs collected and entered by the controllers are transmitted to the RWP/MWP for dissemination to other NAS users.

7.2.4 Weather Radar Products

The RWP acquires weather radar products from individual WSR-88D radars that provide coverage for the given RWP's ACF area of responsibility plus a 150 nautical mile buffer zone. The RWP processes and mosaics the data before transmitting them to the ACCC.

In addition to the WSR-88D data provided by the RWP, controllers have access to other weather radar products provided by the en route and terminal surveillance radars and Terminal Doppler Weather Radar (TDWR). The weather channel of Air Route Surveillance Radar (ARSR-4s) provides additional precipitation data to the ACCC to be used as a backup and/or gap fillers to the WSR-88D data. In terminal areas, the weather channel of the Airport Surveillance Radar (ASR-9) will provide precipitation data to the TCCC for use by local controllers. The same data is also available to approach/departure controllers through the ACCC. These data have a greater update rate than the WSR-88D data and will consequently be more timely. Lastly, the TDWR provides weather radar data to towers at major terminals. The TDWR has the capability to generate information about hazardous weather such as wind shear, microburst, and gust fronts on a frequently updated and near-real-time basis.

7.3 Functions

The following paragraphs describe in more detail the functions provided by the specialist/controller positions introduced in Section 2.1. Positions 6 and 7, the approach/departure controller and the en route controller, provide similar enough services that they are covered in one paragraph. The Operational Flow Diagrams associated with each paragraph illustrate the information flow between the specialist and the user, between the specialist and other specialists, and between the specialist and data processing equipment. The functions performed by the specialists are all covered by requirements specified in the NASSRS. The pertinent NASSRS paragraphs that specify the function being performed by the specialist are referenced in each of the paragraphs below. As used in this paragraph, the term "specialist" also includes controllers.

7.3.1 In-Flight Briefing Specialist (Position 3)

The in-flight briefing specialist provides weather briefings to en route pilots. Detailed, abbreviated, and outlook briefings are provided upon request. When weather conditions along the route of flight appear marginal and could pose a threat to safety, the pilot switches to the flight watch frequency and/or contacts the En Route Flight Advisory Service (EFAS) specialist for further guidance.

Figure 7-3 is an operational flow diagram describing the functions and services provided by the in-flight briefing specialist at the AFSS. Functions performed by the equipment and the specialist are lettered within each block and are described in the corresponding paragraphs below.

a. FSDPS Processing. The FSDPS provides the processing capability and support to enable the AFSS specialist to retrieve preflight weather briefings. It also supports automatic notification of critical weather events to specialists. In addition, the FSDPS provides a capability for entry, processing and transfer of flight plan data. This includes providing appropriate information to the pilot or specialist when it is determined, based on traffic flow directives in effect, that traffic flow restrictions will impact his/her flight plan.

   NASSRS requirements: 3.2.6.C

b. Provides in-Flight Weather Briefings. Upon pilot request, the in-flight specialist provides detailed, abbreviated, or outlook weather briefings. He also recommends, if weather conditions warrant, that the pilot contact the En Route Flight Advisory Service, also known as Flight Watch, for appropriate weather advisories.

   NASSRS requirements: 3.2.6.B

c. Enters Flight Plan Amendments, Changes. The AFSS in-flight specialist is generally responsible for entering flight plan amendments and changes resulting from adverse weather into the FSDPS.

   NASSRS requirements: 3.2.6.B

7.3.2 EFAS Specialist (Position 4)

The EFAS/Flight Watch specialist provides, upon pilot request, weather advisories for the pilot's route of flight. This service is available to all (including air carrier).

Figure 7-4 is an operational flow diagram describing the functions and services provided by the EFAS/Flight Watch specialist at the AFSS. Functions performed by the equipment and the EFAS specialist are lettered within each block and are described in the corresponding paragraphs below.

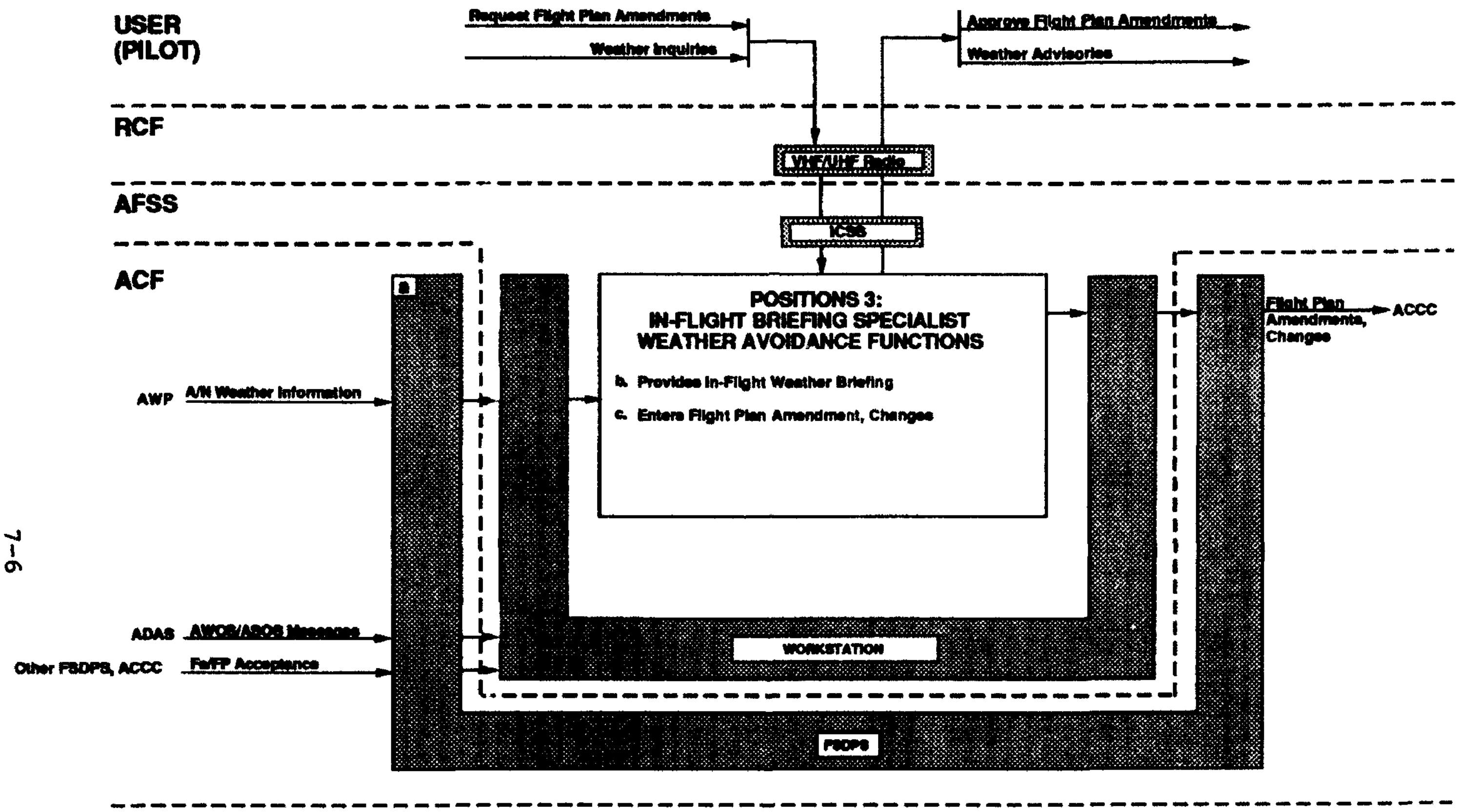


FIGURE 7-3
IN-FLIGHT BRIEFING SPECIALIST (POSITION 3)
OPERATIONAL FLOW DIAGRAM

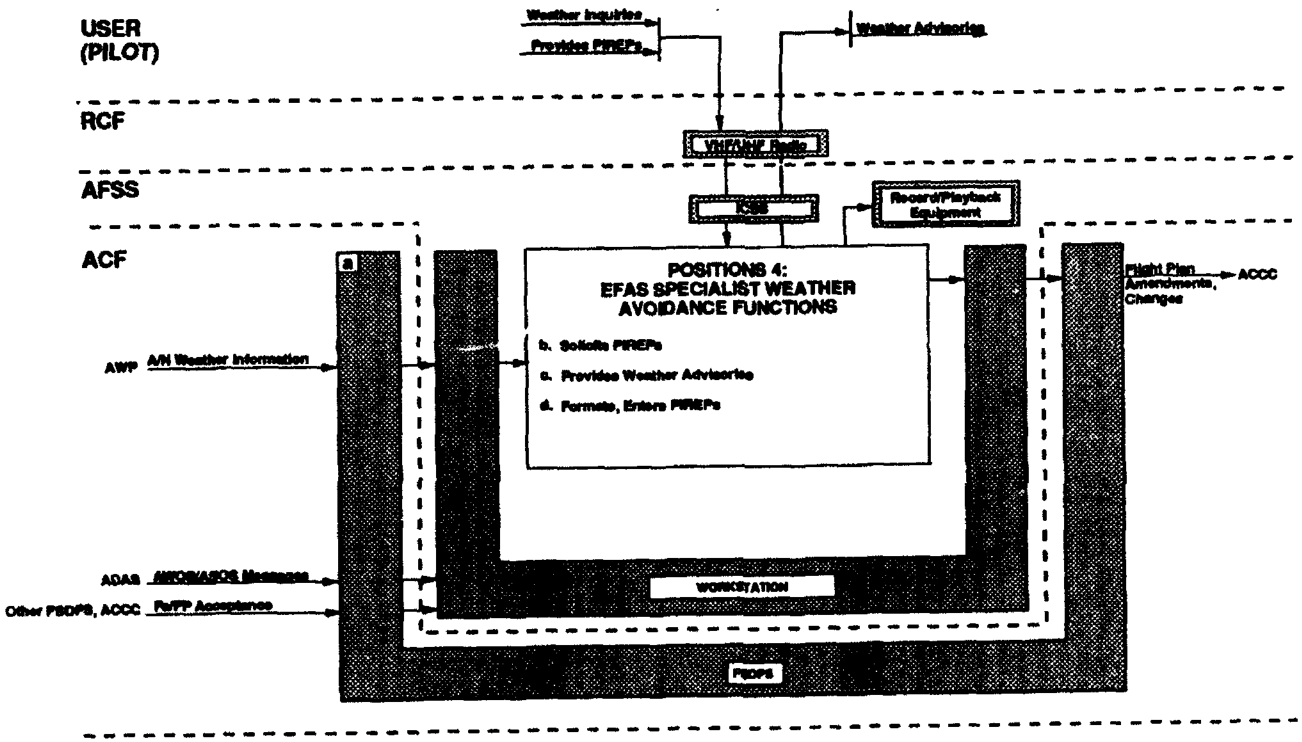


FIGURE 7-4
EFAS SPECIALIST (POSITION 4)
OPERATIONAL FLOW DIAGRAM

a. FSDPS Processing. The FSDPS provides the processing capability and support to enable the AFSS specialist to retrieve preflight weather briefings. It also supports automatic notification of critical weather events to specialists. In addition, the FSDPS provides a capability for entry, processing and transfer of flight plan data. This includes providing appropriate information to the pilot or specialist when it is determined, based on traffic flow directives in effect, that traffic flow restrictions will impact his/her flight plan.

NASSRS requirements: 3.2.6.C

b. Solicits PIREPs. EFAS specialists are the primary collection point for PIREPs. Weather reports are solicited from pilots to provide additional information on upper winds, temperatures, wind shear, turbulence, precipitation, icing, and other weather phenomena encountered. PIREPs may be solicited during routine aircraft contacts, or by broadcasting a request over the Radio Communications Facility (RCF) radios. If the weather conditions reported differ significantly from the current forecast, the EFAS specialist notifies aircraft that may be affected, other AFSS specialists, the ACF meteorologist, and the NWS.

NASSRS requirements: 3.2.6.B;C

c. Provides Weather Advisories. The EFAS specialist can access the same weather information available to other AFSS specialists; however, his/her primary focus is on weather advisories and conditions such as location and extent of weather phenomena, weather intensity, wind speed and direction, precipitation rates, turbulence, icing, temperature, direction and rate of storm movement, and any other phenomena which, in his judgment, could affect the safety of flight.

Upon request, the EFAS specialist provides complete and timely weather advisories, including pertinent information contained in PIREPS, and recommends appropriate actions to assist the pilot in avoiding hazardous weather. These recommendations may include route changes, course deviations, and altitude changes. If the pilot has already encountered hazardous weather, the EFAS specialist provides assistance in getting out of the hazardous weather area.

NASSRS requirements: 3.2.6.C

d. Formats, Enters PIREPs. The EFAS specialist receiving a PIREP ensures its completeness, ascertains that it is not a duplicate of information he/she has already received and forwarded, formats and enters the PIREP into the FSDPS for transfer to the Aviation Weather Processor (AWP). If the PIREP is considered of special urgency to other specialists or controllers, it is forwarded immediately.

NASSRS requirements: 3.2.6.B;C

7.3.3 Approach/Departure Controller (Position 6) and En Route Controller (Position 7)

Weather avoidance services provided by approach/departure controllers and en route controllers are sufficiently similar to warrant a common description although the focus of the services provided is somewhat different. En route controllers keep pilots informed of hazardous weather conditions along their route of flight; approach/departure controllers advise pilots during the descent/climb out phases of flight of hazardous weather phenomena such as wind shear, turbulence, convective activity, and thunderstorms near the airport. En route and approach/departure controllers provide weather avoidance services on a time-permitting basis.

Figure 7-5 is an operational flow diagram describing the functions and services provided by the approach/departure and en route controllers at the ACF. Lettered blocks identify the functions performed by the controllers and are described in the corresponding paragraphs below.

a. ACCC Processing. The ACCC accepts, processes, stores, displays and distributes the latest available current and forecast alphanumeric and graphic weather data to the appropriate ACCC and TCCC positions. The ACCC processes hazardous weather alert messages within 30 seconds of receipt and displays hazardous weather alerts to the controller within a maximum of 3 seconds of request or completion of processing.

NASSRS requirements: 3.2.6.C;D;H

b. Provides Hazardous Weather Advisories. The approach/departure controller will use his/her sector suite to access the weather data stored in the ACCC. He/she has access to the same weather data as are available to the en route controller. In addition, he/she is using real-time airport data including runway visibility data provided by Runway Visual Range (RVR), wind shear alert data from Low Level Wind Shear Alert System (LLWAS), and surface data from Automated Weather Observation Station (AWOS). TDWR data indicates the detection of wind shear and microbursts in the vicinity of major airports. The en route controller keeps pilots informed of hazardous weather conditions such as convective activity, thunderstorms, and tornadoes that are present along their route of flight. He/she also provides pilots with other weather and aeronautical information such as winds and temperatures aloft and altimeter setting. The en route controller's role however is not primarily to distribute weather information. He/she may refer the pilot to the appropriate EFAS facility for more extensive and accurate weather information

NASSRS requirements: 3.2.6.C

c. Recommends Weather Avoidance Tactics. Even though the final decision on how to handle the flight in adverse conditions remains with the pilot, the controller, at the pilot's request, may guide the aircraft to safer airspace. The recommended tactic will depend on the weather information on hand and the airspace for which the controller is responsible.

NASSRS requirements: 3.2.6.E;F;G;H

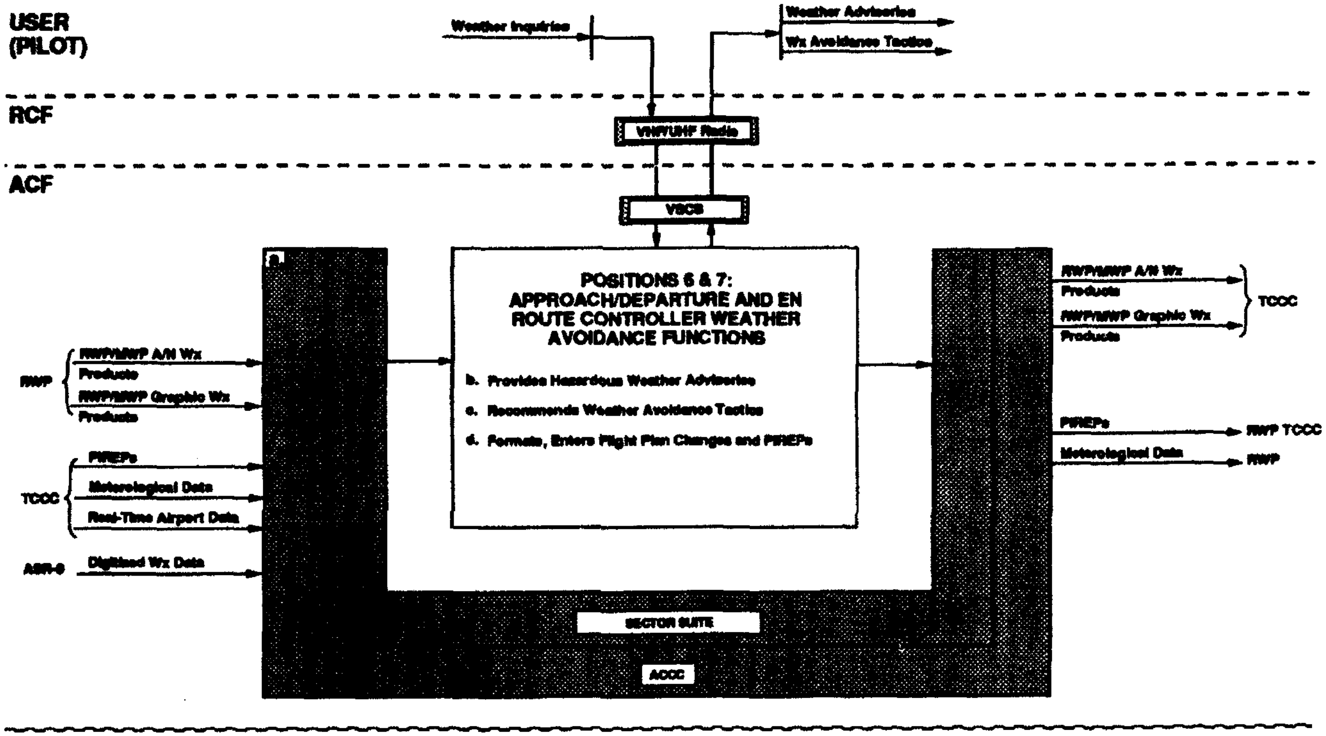


FIGURE 7-5
APPROACH/DEPARTURE AND EN ROUTE CONTROLLER (POSITIONS 6 & 7)
OPERATIONAL FLOW DIAGRAM

d. Formats, Enters PIREPs. The controller receiving a PIREP formats and enters the PIREP into the ACCC. If the PIREP is considered of special urgency to other controllers or specialists, it is forwarded immediately on a priority basis.

NASSRS requirements: 3.2.6.B

7.3.4 Local Controller (Position 9)

Figure 7-6 is an operational flow diagram describing the functions and services provided by the local controller at an ATCT. Lettered blocks identify the functions performed by the TCCC and the local controller and are described in the corresponding paragraphs below.

a. TCCC Processing. The TCCC accepts digitized weather maps and weather text data from the ACCC and local weather data from airport sources and alerts the controller to hazardous weather occurring in the terminal area. The TCCC also accepts, maintains, and distributes data from environmental sensors and ground based air traffic control equipment, and disseminates airport environmental data to its parent ACCC.

NASSRS requirements: 3.2.6.C;J

b. Provides Hazardous Weather Advisories. The local controller provides aircraft entering the airport traffic area for landing with advisories concerning airport conditions and local weather information such as wind direction and speed, gusts, altimeter setting, runway visibility, and wind shear alert data. The local controller also provides hazardous weather advisories to departing aircraft.

NASSRS requirements: 3.2.6.C;I

c. Recommends Weather Avoidance Tactics. Even though the final decision on how to handle the flight in adverse conditions remains with the pilot, the controller, at the pilot's request, may guide the aircraft to safer airspace. The recommended tactic will depend on the weather information on hand and the airspace for which the controller is responsible.

NASSRS requirements: 3.2.6.E;F;H

7.3.5 ACF Meteorologist (Position 12)

The RWP/MWP provides automatic processing and distribution of weather products; additionally, the RWP/MWP supports an associated work station and provides the meteorologist with the capability of annotating weather data and creating unique weather products for distribution to other facilities. The RWP/MWP is part of the ACF and provides weather information over the ACF area plus 150 miles beyond the ACF boundary.

Figure 7-7 is an operational flow diagram of the functions performed by the ACF meteorologist. Functions performed by the equipment and the ACF meteorologist are lettered within each block and are described in the corresponding paragraphs below.

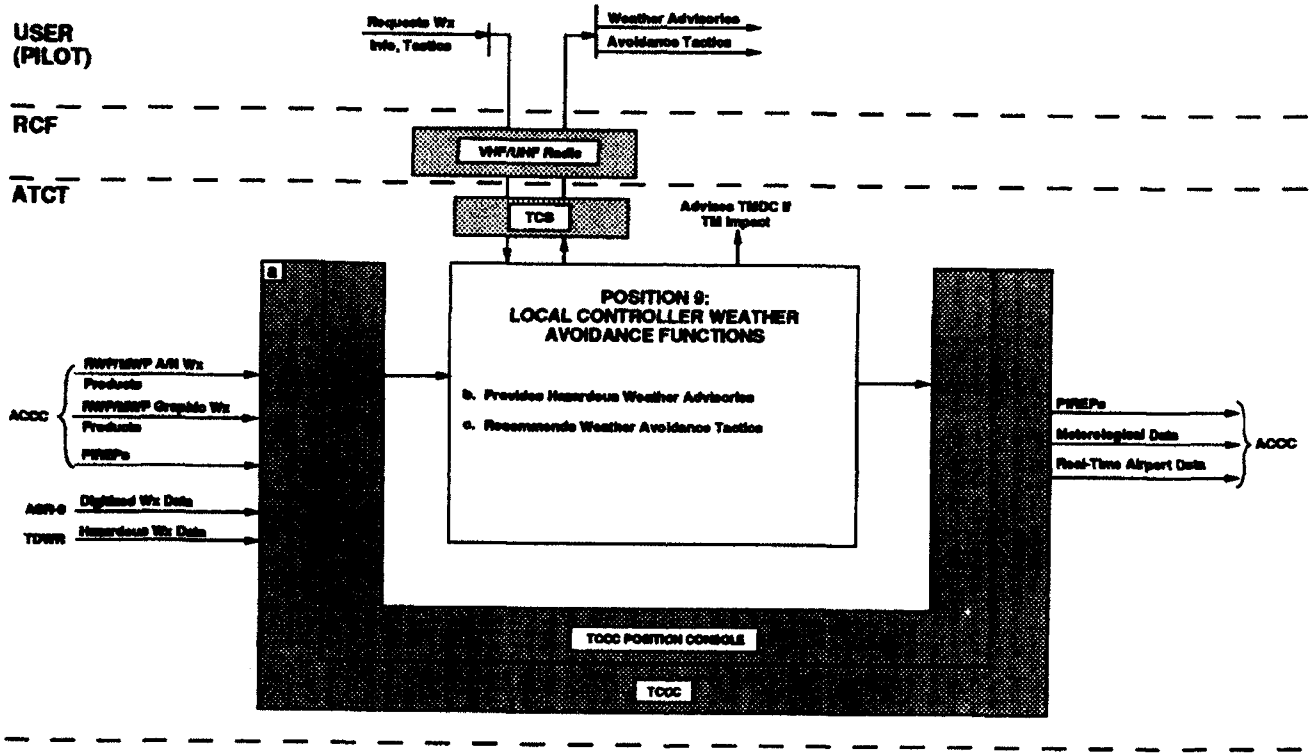
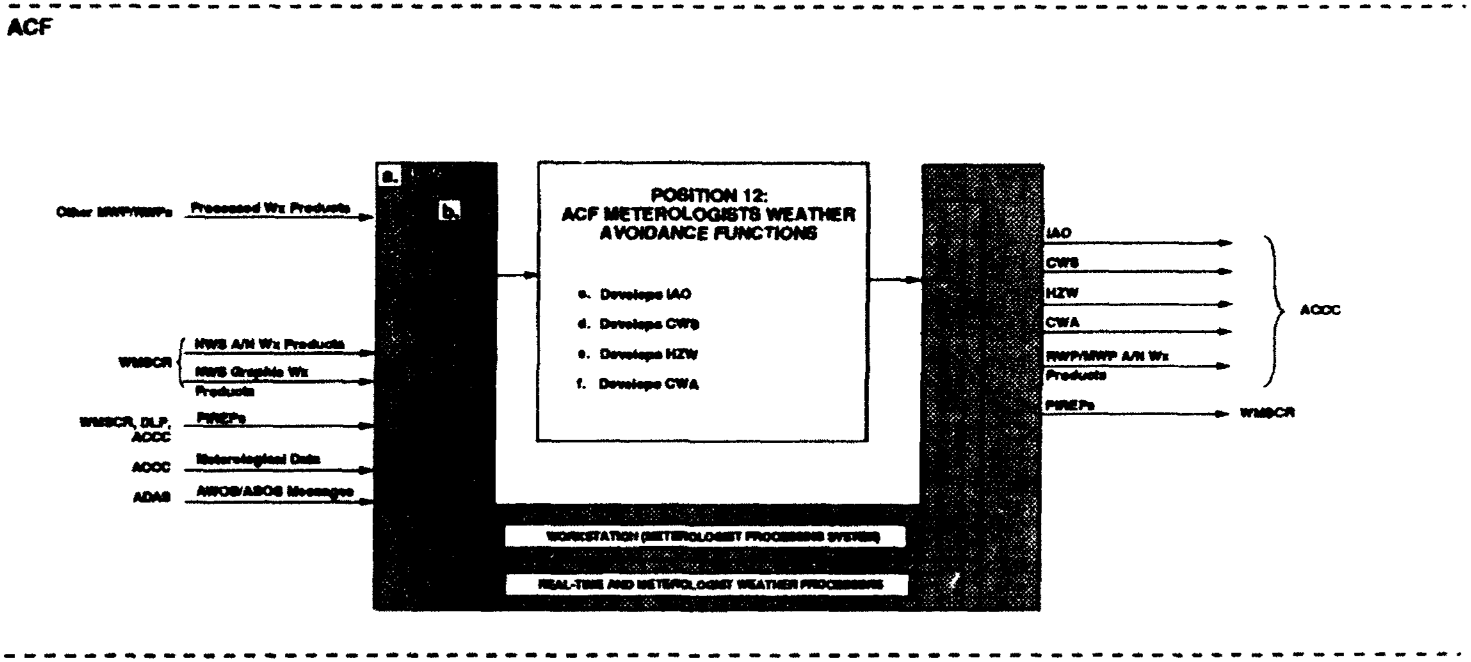


FIGURE 7-6
LOCAL CONTROLLER (POSITION 9)
OPERATIONAL FLOW DIAGRAM



NOTE: Equipment is represented by background-filled boxes

FIGURE 7-7
ACF METEROLOGIST (POSITION 12)
OPERATIONAL FLOW DIAGRAM

a. RWP Processing. The RWP receives WSR-88D weather radar N-Products from multiple weather radars, National Weather Service (NWS) weather products, and weather data from other sources. All weather data received by the RWP are stored and updated in the RWP data base. The RWP decodes, filters, combines, and mosaics the data from individual weather radars to create 11 C-Products. Since the primary source of area weather information is the WSR-88D radars, the basic update rate for the Central Weather Processor (CWP)-generated products is five (5) minutes, which is the update rate of the radars.

NASSRS requirements: 3.2.6.A;B;C;D

b. MWP Processing. The Meteorologist Weather Processing System (MWP) provides processing support to automatically receive, process, and disseminate weather products for use by the ATC personnel, meteorologists and pilots. The MWP provides interactive display workstation support to the ACF meteorologist to display, annotate and disseminate weather products. The MWP also provides a display terminal for use by the ACF Traffic Management Unit to display weather products.

NASSRS requirements: 3.2.6.A;B;C;D

c. Develops IFR Area Outline (IAO). Instrument flight rules (IFR) IAOs are prepared hourly. They identify current Instrument Meteorological Conditions (IMC) and Visual Meteorological Conditions (VMC). This product is used by traffic management personnel at the local ACF and at the Air Traffic Control Command Center (ATCCC) to assess the impact of flight conditions on terminal capacity. These IAO products are also used by flight service specialists to provide pilots flying IFR or visual flight rules (VFR) with preflight information, and to advise VFR pilots during preflight briefings against flight through areas falling under the IFR or MVFR category.

NASSRS requirements: 3.2.6.C

d. Develops Meteorological Impact Statement (CWS). This product is an unscheduled textual synopsis of weather in the ACF area and is an air traffic-oriented forecast of conditions expected to begin approximately 4 to 12 hours after it is issued. It is developed principally from NWS alphanumeric and graphic weather products, Geostationary Operational Environment Satellite (GOES) data, and RWP/MWP analysis products available to the meteorologist. The CWS is intended for use by personnel responsible for making flow control decisions.

NASSRS requirements: 3.2.6.C

e. Develops Hazardous Weather Area Outline (HZW). The HZW is a composite of all hazards to aircraft in one product and is created on an "as required" basis. The HZW is developed from WSR-88D N-Products and C-Products, NWS alphanumeric weather products, GOES data, PIREPs, AWOS/Automated Surface Observing System (ASOS) data, and lightning data. The HZW is updated as required, but generally not more often than once every 15 minutes.

NASSRS requirements: 3.2.6.C

f. Develops Center Weather Advisory (CWA). The CWA is an unscheduled near-term forecast for adverse weather conditions occurring or expected to begin within the next two hours and is issued for the guidance of ACF personnel, air crews in flight, and other designated facilities and personnel. The CWA is developed from WSR-88D N-Products and C-Products, NWS alphanumeric weather products, GOES data, PIREPs, AWOS/ASOS data, and lightning data.

NASSRS requirements: 3.2.6.B;C

7.3.6 Broadcast Specialist (Position 20)

The broadcast specialist is supported by the FSDPS and works in coordination with other specialists at the AFSS. Figure 7-8 is an operational flow diagram of the functions performed by the broadcast specialist to assist pilots in avoiding hazardous weather.

a. FSDPS Processing. The FSDPS provides the processing capability and support to enable the AFSS specialist to retrieve preflight weather briefings. It also supports automatic notification of critical weather events to specialists. In addition, the FSDPS provides a capability for entry, processing and transfer of flight plan data. This includes providing appropriate information to the pilot or specialist when it is determined, based on traffic flow directives in effect, that traffic flow restrictions will impact his/her flight plan.

NASSRS requirement 3.2.6.B

b. Prepares Weather Broadcasts/Recordings. The broadcast specialist prepares telephone and Very High Frequency Omnidirectional Range (VOR) broadcasts to advise pilots of weather conditions likely to be encountered. These telephone and Very High Frequency Omnidirectional Range Station (VOR) broadcasts include Pilot's Automatic Telephone Answering Service (PATWAS), Transcribed Weather Broadcast (TWEB), Hazardous Inflight Weather Advisory Service (HIWAS) broadcasts, Alaskan scheduled broadcasts, and unscheduled broadcasts. HIWAS provides continuous prerecorded weather advisories over selected VORs and includes Severe Weather Forecast Alerts (AWW), Significant Meteorological Information (SIGMETs), convective SIGMETs, CWA's, Airman's Meteorological Information (AIRMETs), and urgent PIREPs.

NASSRS Requirement: 3.2.6.B

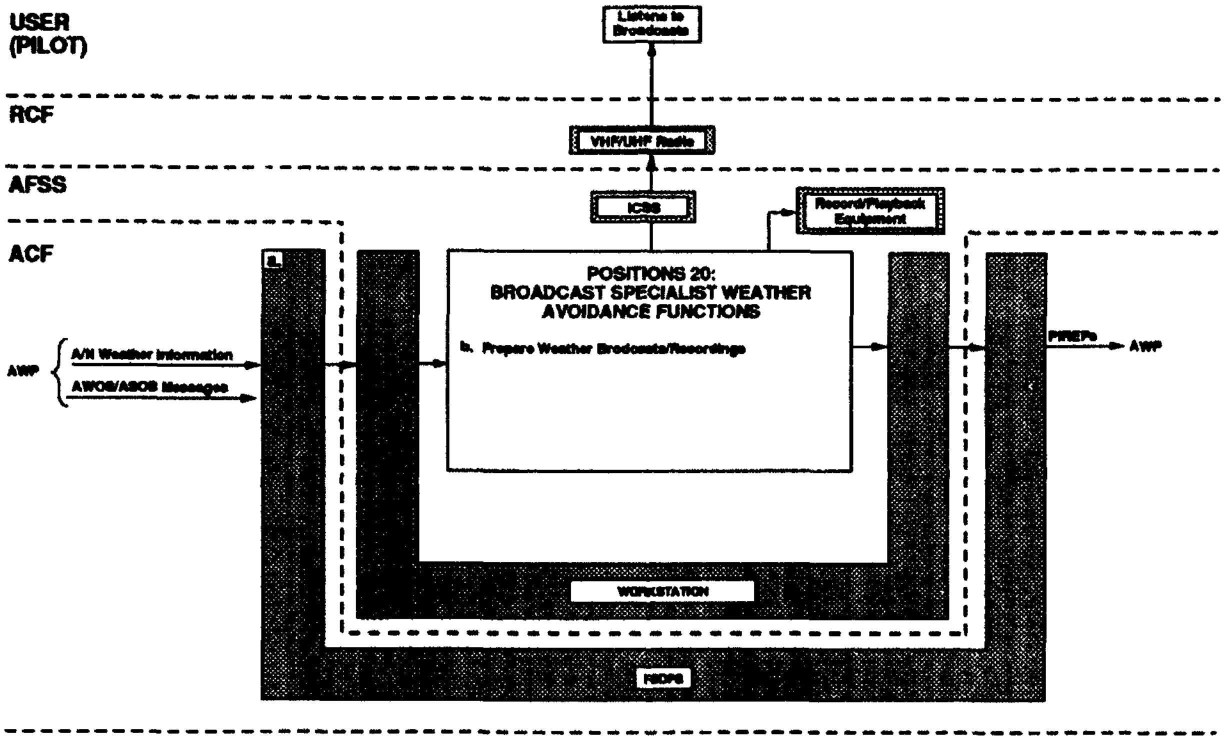


FIGURE 7-8
BROADCAST SPECIALIST (POSITION 20)
OPERATIONAL FLOW DIAGRAM

7.4 Correlation with Operational Requirements

Table 7-1 summarizes the correlation of the weather avoidance operational requirements paragraphs of NAS-SR-1000 with the paragraphs describing the functions being performed by specialists/controllers. All weather avoidance paragraph numbers of NAS-SR-1000 are listed; paragraphs which are introductory in nature, do not state an explicit operational requirement, or which reference other portions of NAS-SR-1000 are indicated with a dash. The fact that a correlation is shown between a requirements paragraph and a paragraph describing the specialist/controller functions performed should not be construed as indicating that the requirement is completely fulfilled.

TABLE 7-1
WEATHER AVOIDANCE OPERATIONAL REQUIREMENTS CORRELATION

NAS-SR-1000 Paragraph	Position	In-Flight Briefing SP			EFAS Specialist				Approach/ Departure and En Route Controller				Local Controller			ACF Meterologist						Broadcast Specialist	
	Paragraph	2.3.1.a	2.3.1.b	2.3.1.c	2.3.2.a	2.3.2.b	2.3.2.c	2.3.2.d	2.3.3.a	2.3.3.b	2.3.3.c	2.3.3.d	2.3.4.a	2.3.4.b	2.3.4.c	2.3.5.a	2.3.5.b	2.3.5.c	2.3.5.d	2.3.5.e	2.3.5.f	2.3.6.a	2.3.6.b
3.2.6	Weather Avoidance Requirements	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3.2.6.A	Aircraft separation															X	X						
.B	Weather data requirements		X	X		X						X				X	X				X		
.C	Hazardous weather	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
.C.1	Alerts	X			X	X	X	X	X	X			X	X		X	X				X	X	X
.C.2	Parameters						X		X	X			X	X		X	X	X		X	X		
.C.3	Accuracy						X		X	X			X	X		X	X	X		X	X		
.C.4	User airspace envelope						X		X	X			X										
.C.5	Specialist airspace envelope	X			X				X	X				X		X	X	X	X	X	X	X	
.C.6	CONUS weather summary	X			X				X	X								X	X	X	X	X	
.C.7	Formats/intensity								X	X			X	X				X		X			
.C.8	Aural alert	X			X				X	X			X	X		X	X					X	
.C.9	Acquisistion itime/currency	X			X				X	X						X	X					X	
.C.10	Terminal area currency								X				X	X									
.D	Weather intensity	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
.D.1	Intensity levels								X							X	X						
.D.2	Accuracy								X							X	X						
.E	Avoidance recommendations	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
.E.1	Type of recommendations										X				X								
.E.2	avoidance recommendation factors										X				X								
.E.3	Request for service										X				X								
.F	Voice/data communications										X				X								
.G	Avoidance actions impact										X												
.H	Continous avaliability								X						X								
.I	Wind shear										X			X									
.J	Surface winds	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
.J.1	ATCT operational area												X										
.J.2	Wind paraameters/accuracy												X										
.J.3	Real-time display												X										

7.5 Operational Sequences

Operational sequence diagrams have been developed to illustrate the interactions between users (pilots) and specialists/controllers for different categories/conditions of flight. These diagrams are general in nature and no effort has been made to depict a specific situation.

7.5.1 En Route VFR Operational Sequence

Figure 7-9 illustrates a general sequence of operator/user interactions for VFR flight conditions by a general aviation pilot.

A pilot wishing to inquire about weather conditions along his/her route of flight (1) has many sources of information. He/she may receive weather information via Mode S, or access weather information recorded by the broadcast specialist (2). Recorded weather information includes TWEBs (3), HIWAS (4), and any unscheduled broadcasts (5) prepared to inform pilots of hazardous weather phenomena. In addition, the pilot may also contact the in-flight specialist at the AFSS for a weather briefing (6). The in-flight specialist may recommend that the EFAS specialist be contacted for up-to-date weather advisories (7). The EFAS specialist provides weather advisories (8) appropriate to the pilot's route of flight to assist him in determining if he/she needs to modify his flight plan. If the pilot determines to modify his flight because of hazardous weather (9), he/she notifies the in-flight specialist that he/she wishes to amend his flight plan (10). The in-flight specialist enters the amended flight plan into the FSDPS via his/her work station (11). The FSDPS checks if the amended flight plan is properly formatted (12). The in-flight specialist will inform the pilot as to the validity of the amended flight plan; if it is not valid, the corrected information is obtained and resubmitted. The pilot will alter his/her course as required to follow the amended flight plan (13). The pilot will still periodically query weather information to keep abreast of potentially rapid weather changes which could affect his/her flight.

It should also be noted that the sequence of events portrayed is not a mandatory sequence. For example, the pilot could decide to modify his/her route of flight without having received the weather advisories provided by the EFAS specialist. Care should thus be exercised in interpreting any operational sequence.

7.5.2 En Route IFR Operational Sequence

Figure 7-10 illustrates a general sequence of operator/user interactions for IFR flight conditions by a general aviation pilot. The general sequence of operations is similar to that for VFR until the pilot decides to modify his route of flight (9) except that, in this case, the pilot requests weather avoidance services from the en route controller after amending the route of flight 10). The en route controller provides weather avoidance services, if time permits, by recommending a course change, landing at an alternate airport, climbing or descending to a different altitude, etc., (11). Flight plan changes are coordinated with the pilot and entered into the system (12) via the en route controller's work station. If it is expected that rerouting of aircraft to avoid hazardous weather will lead to air traffic congestion (14), the en route controller will advise his/her supervisor or the Traffic Management Coordinator (TMC) to provide for local traffic flow coordination (15). The pilot executes the weather avoidance maneuver agreed upon with

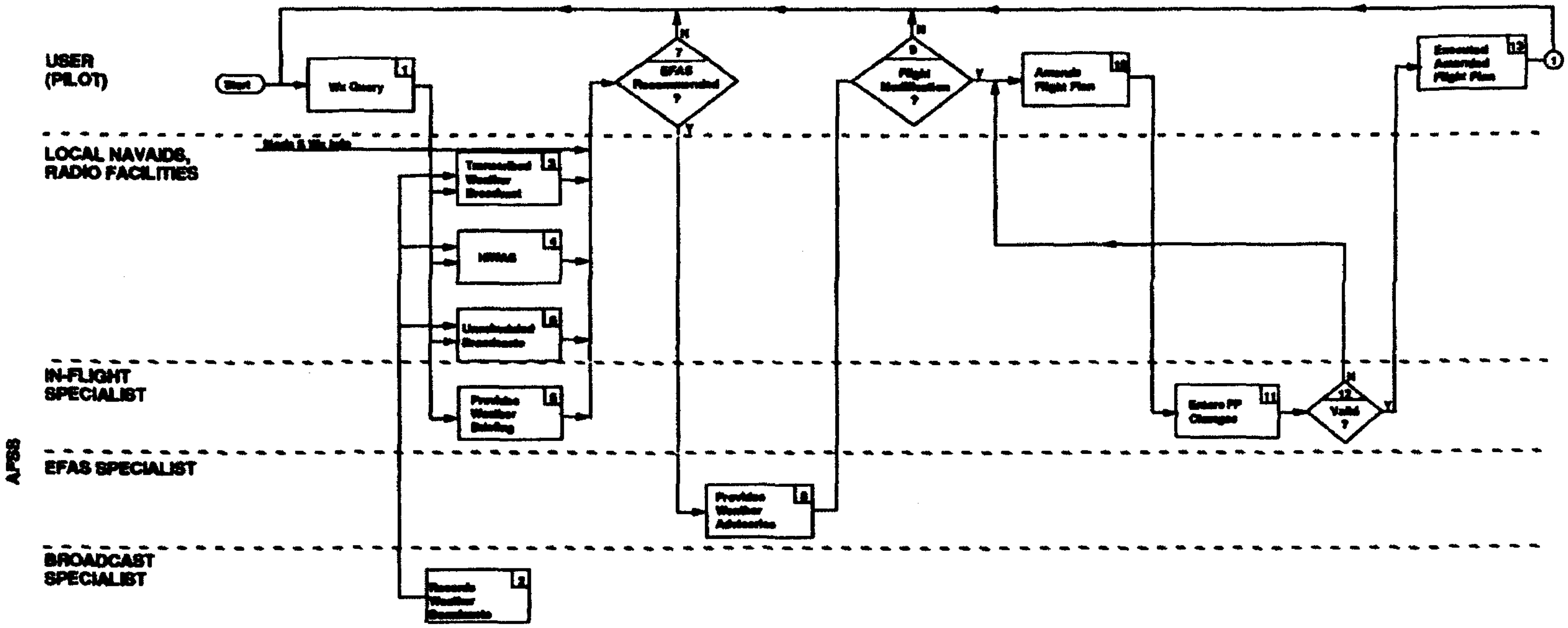


FIGURE 7-9
EN ROUTE VFR
OPERATIONAL SEQUENCE DIAGRAM

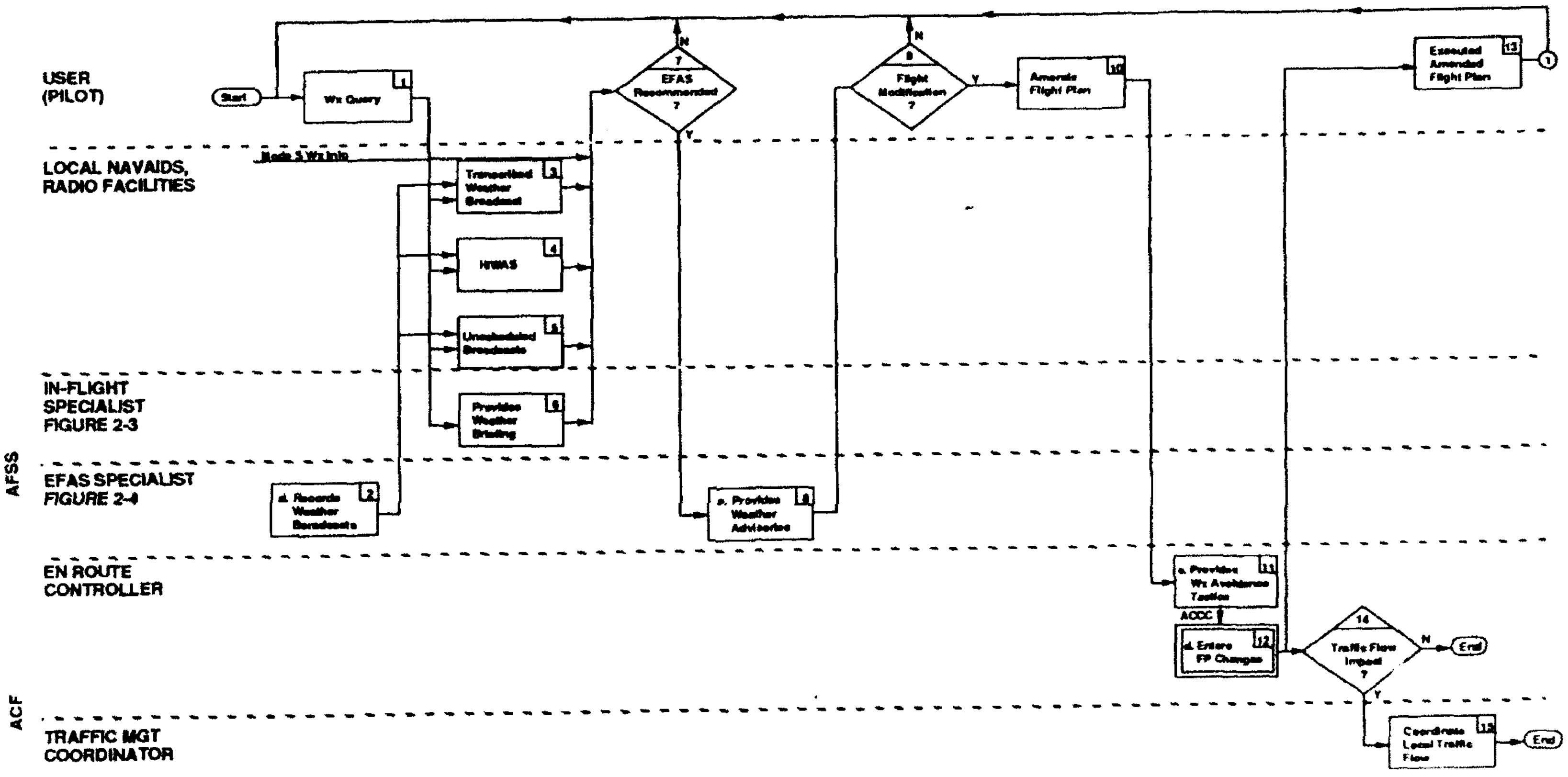


FIGURE 7-10
EN ROUTE IFR
OPERATIONAL SEQUENCE DIAGRAM

the en route controller (13); however, the pilot still periodically inquires about the weather to keep abreast of potentially rapid weather changes which could affect his/her flight.

7.6 Weather Avoidance Operational Scenario

Figure 7-11 presents an operational sequence for a specific hypothetical situation. It is similar to the operational sequence diagrams in Figures 7-3 through 7-10; however, the scenario shows more detail and represents hypothetical interactions between operators/users for a specific case.

The scenario assumes an aircraft flying by instrument flight rules (IFR) and approaching the destination airport control zone. The aircraft is flying in inclement weather with scattered thunderstorms within a radius of 50 miles of the airport. The scenario is entered as the controller responsible for the sector adjacent to the approach/departure controller's sector initiates the handoff of the aircraft (1). The approach/departure controller accepts the handoff (2) while the adjacent controller indicates the frequency which the pilot should use to contact the approach/departure controller (3). The pilot receives the frequency change (4) and contacts the approach/departure controller (5). Meanwhile, the adjacent controller terminates radar service to the aircraft (6). The approach/departure controller issues appropriate clearances to the aircraft now under his control (7). The pilot observes lightning in the cumulonimbus clouds ahead of him and notifies the controller (8) who receives the information (9) and determines that the PIREP is sufficiently urgent to broadcast the information to other users within his sector (10). With increasing storm cell intensity, the Terminal Doppler Weather Radar (TDWR) detects increasing wind shear conditions and automatically notifies the controller (11) of imminent hazardous weather. The controller receives notice of the development of a potential microburst which may be on the approach path of several aircraft (12) and broadcasts a weather advisory to that effect (13).

The pilot determines that he should avoid this area of hazardous weather and requests assistance (14) from the approach/departure controller. The controller, at the pilot's request, vectors the aircraft to a holding area (15). The pilot acknowledges and complies with the controller's recommendation (16). The controller observes that the microburst has dissipated (17) some 15 minutes later, and broadcasts this information to the aircraft in his sector (18). After receiving the proper clearances, the pilot may continue his flight to the destination airport.

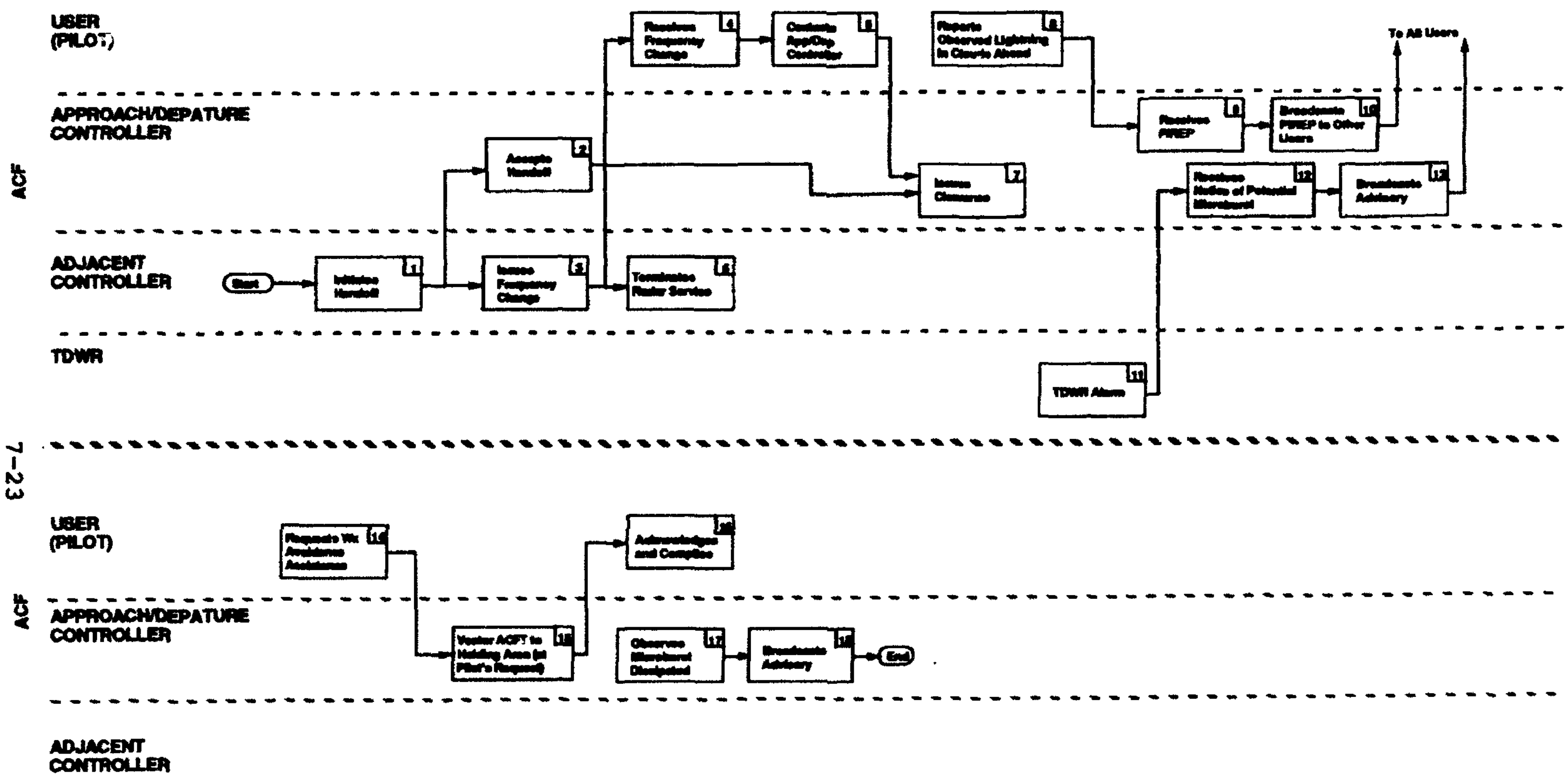


FIGURE 7-11
WEATHER AVOIDANCE
OPERATIONAL SCENARIO DIAGRAM

8.0 GROUND AND OBSTACLE AVOIDANCE

Safe operation requires that aircraft maintain specific distances from the ground, mountainous terrain, and man-made obstacles (such as buildings, antenna towers, and overhead lines). Although maintaining appropriate clearance is ultimately the responsibility of the user, the National Airspace System (NAS) is required to provide assistance.

8.1 Support

Although maintaining appropriate obstacle clearance is ultimately the responsibility of the user, the NAS is required to provide ground and obstacle avoidance assistance to its users. This requirement is described in Section 3.2.7 of the NAS System Requirements Specification (NASSRS). Ground and obstacle avoidance assistance is provided by Approach/Departure and En Route Controllers at an Area Control Facility (ACF), and Local and Clearance Delivery Controllers in Air Traffic Control Towers (ATCT). The NAS provides these services to instrument flight rules (IFR) aircraft and, upon request, to properly equipped visual flight rules (VFR) aircraft. Ground obstacle avoidance services provided by the NAS is contingent upon users having an operational altitude encoding transponder (Mode C/S) as part of their basic equipment.

Figure 8-1 is an overview of NAS/user interfaces for ground and obstacle avoidance assistance and illustrates the NAS facilities and systems involved.

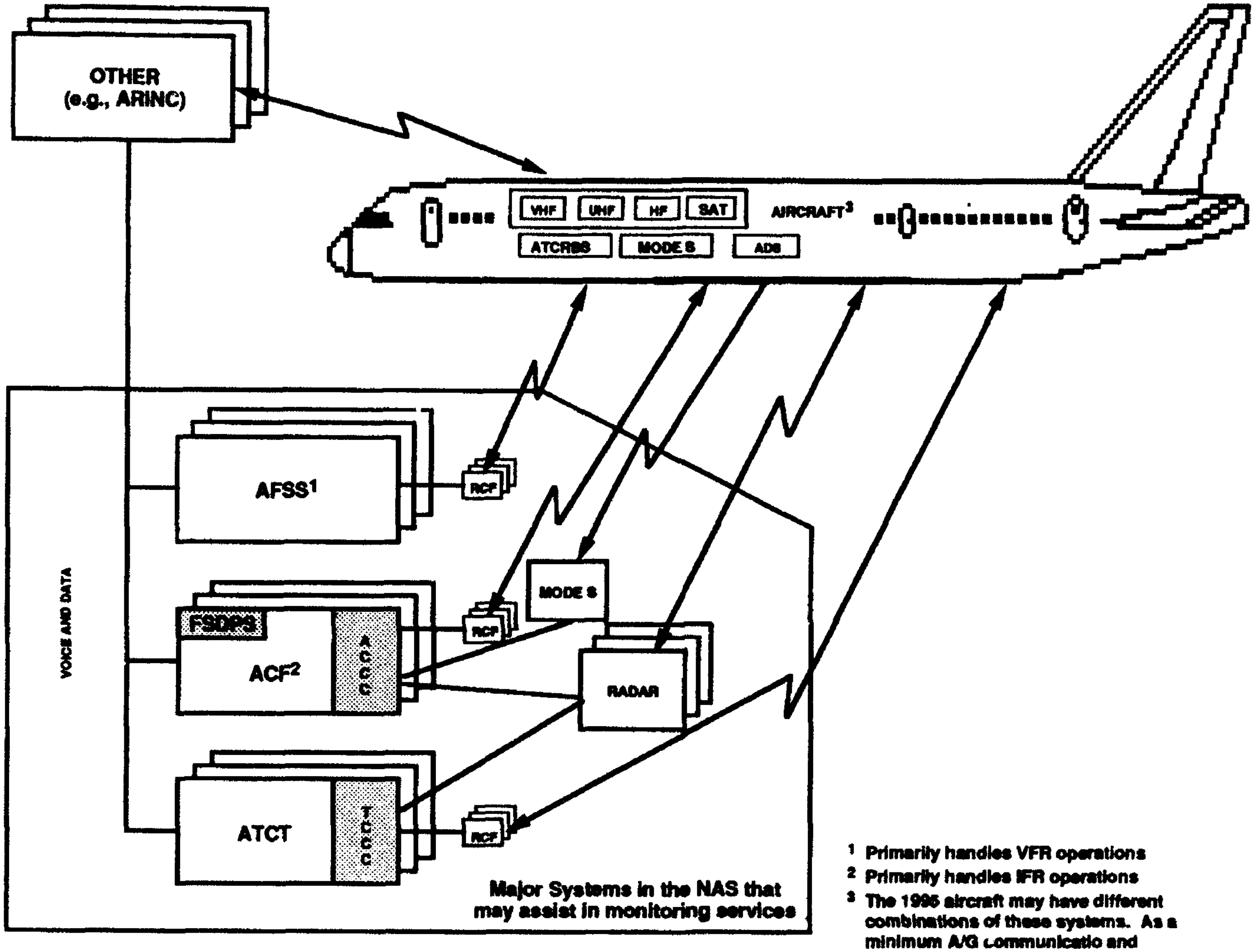
Figure 8-2 is an operational block diagram showing the interrelationships among equipment, facilities, operators/users, and the information necessary to support ground and obstacle avoidance assistance. The following paragraphs briefly summarize the functions of ground and obstacle avoidance assistance at each position shown in Figure 8-2.

8.2 Information

The function of ground and obstacle avoidance assistance requires a core of information obtained from a number of sources within the NAS. This information is derived from the filed flight data base within the Flight Service Data Processing System (FSDPS), the Area Control Computer Complex (ACCC), and the Tower Control Computer Complex (TCCC) and provides the initial filed altitude requests to the specialists who can review it for correctness. Additionally, each area within the Approach/Departure and En Route controllers' airspace has been pre-programmed with minimum safe altitudes. Once a computer-tracked aircraft enters an area below its predetermined safe altitude, the controller is alerted.

8.2.1 Information Generated from Flight Data

In addition to the information required in Section 3.2.7 of the NASSRS, the following information from Section 3.2.3 establishes the foundation for the flight data information that is presented to the specialists. Accurate and current information on ground, terrain, and known obstacles are depicted on the controllers' sector suite display. The controller references this information when providing ground and obstacle avoidance services. After the flight plan information is loaded, the ACCC generates and displays flight information to the controller on the sector suite. This information depicts the position of the aircraft for the controller's reference. Once a track is started, either automatically by the NAS or manually by the



[1] Primarily handles VFR operations

[2] Primarily handles IFR operations

[3] The 1995 aircraft may have different combinations of these systems. As a minimum A/G communicatio and surveillance enhancements are assumed

FIGURE 8-1

OVERVIEW OF NAS/USER SYSTEMS FOR GROUND AND OBSTACLE AVOIDANCE

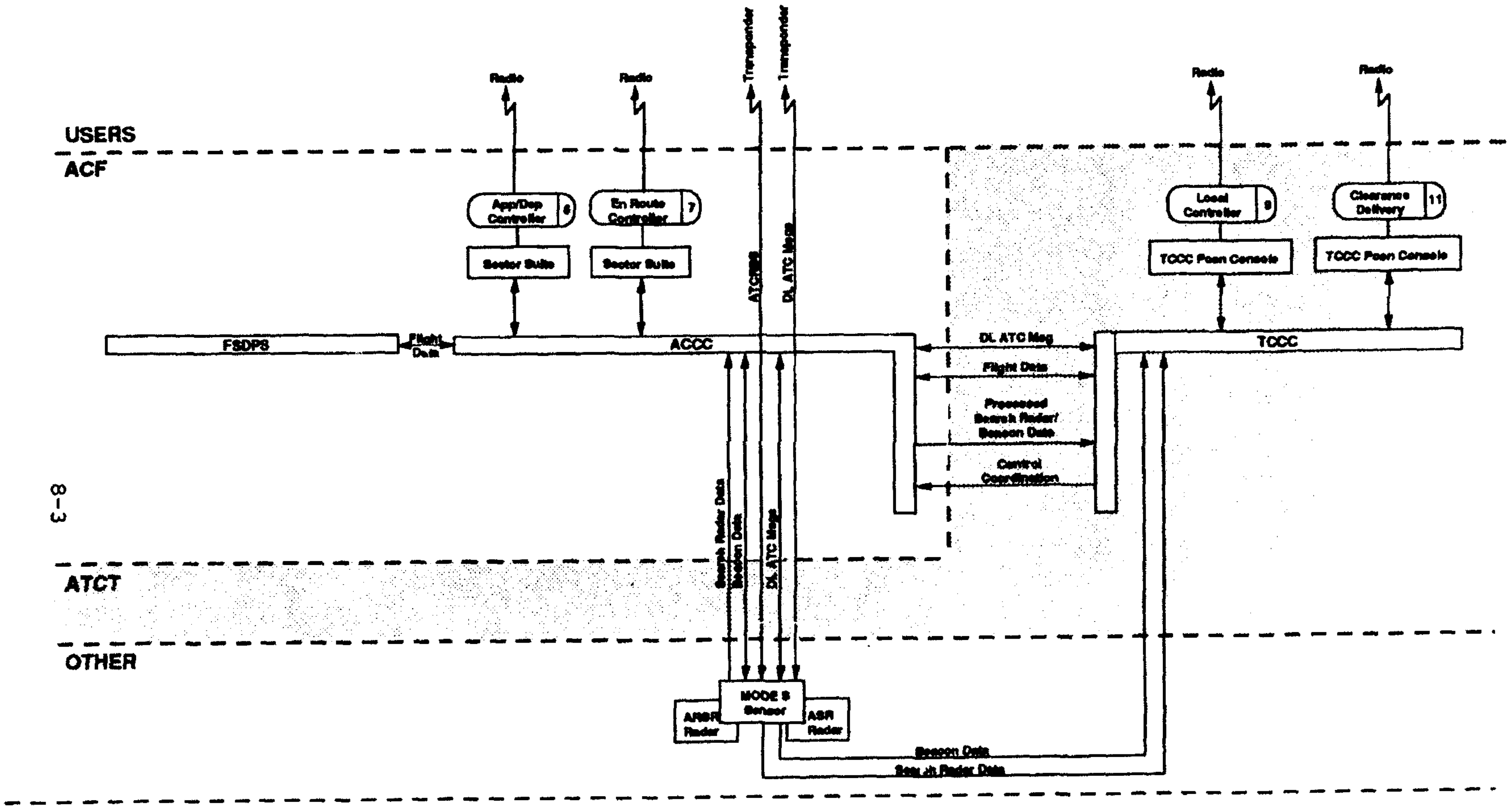


FIGURE 8-2

GROUND AND OBSTACLE AVOIDANCE
OPERATIONAL BLOCK DIAGRAM

controller, the flight information (data block) is updated by the NAS to provide the flight position of the aircraft and any changes in the aircraft's altitude or speed are detected.

Flight information is acquired and passed to the next area of jurisdiction (controlled airspace) prior to the aircraft entering that area of jurisdiction. This passing of information is accomplished at a specified time or distance from the next specialist's airspace. Flight plan information, drawn from the flight plan data base, is acquired and depicted on the controller's display. This information, including any changes in route, altitude, or speed is used by the controller when providing ground and obstacle avoidance services. The NAS displays the route readout (clearance-based trajectory) on all valid flight plans, including any route changes, to the controller.

The NAS correlates the actual flight plan information with the filed flight plan information and updates the flight plan data base with actual changes. For example, if headwinds slow an aircraft such that it no longer is proceeding at its filed airspeed, the NAS recalculates the aircraft's airspeed and updates the data base accordingly. This will allow a more accurate determination of the aircraft's position at any time.

The NAS also assists the specialist with his/her assigned route and, in the event the aircraft must leave its intended route of flight (safety advisory), the NAS recommends the correct action to return the aircraft to its original route of flight.

8.2.2 Information from the Flight Plan

The active flight plan of an aircraft is used to provide ground and obstacle avoidance assistance by providing identification, current and projected location (position), altitude, speed, and track. This information is used by the controllers and the NAS systems to provide early signs of conflict or to trigger the alarm monitoring process.

8.2.3 Information from the NAS

The NAS provides information to support ground and obstacle avoidance assistance in the form of accurate and current location and elevation on the ground, terrain, and known obstacles throughout the area of NAS responsibility. This information is provided, upon request, to both users and specialists in a visually accurate format.

The NAS provides a system which will alert the specialist via automated functions such as Minimum Safe Altitude Warning (MSAW or E-MSAW for En Route). These functions use the ground, terrain, and known obstacles data resident in the NAS, altitude information from the aircraft's Mode C altitude encoding altimeter, and the flight data for the aircraft to provide ground and obstacle avoidance assistance.

8.3 Functions

The following paragraphs describe in more detail the functional services provided by the specialist/controller positions introduced in Section 2.1. The operational flow diagrams associated with each paragraph illustrate the information flow between the specialist and the user, the specialist and other specialists, and between the specialist and data processing equipment. The functions performed by the NAS are explicitly covered by requirements specified in the NASSRS. The pertinent NASSRS paragraphs that specify the function being performed are referenced in each of the paragraphs that follow.

8.3.1 Approach/Departure Controller (Position 6) and En Route Controller (Position 7)

Since ground obstacle avoidance services provided by Approach/Departure and En Route Controllers are essentially the same they will be combined for this operational concept.

The Approach/Departure controller and the En Route controller provide ground and obstacle avoidance assistance to aircraft in terminal and en route areas by issuing Minimum En Route Altitude (MEA), Minimum Obstruction Clearance Altitude (MOCA), Minimum IFR Altitude (MIA), and Minimum Vectoring Altitude (MVA) to aircraft. Additionally, when an aircraft is in unsafe proximity to terrain or obstacles, these controllers are alerted by the use of automated functions such as Minimum Safe Altitude Warning (MSAW). Once alerted, these controllers immediately issue a safety advisory to the endangered aircraft, including the proper aircraft altitude for a specific location.

Figure 8-3 is an operational flow diagram describing the functions and services provided by the Approach/Departure and En Route controllers in the ACF. Letter blocks which identify the functions performed by these controllers are described in the corresponding paragraphs below.

a. ACCC processing. The ACCC houses the flight data base that includes both the altitude of the aircraft as well as predetermined minimum safe altitudes (including MEA, MOCA, MIA and MVA) for particular areas. The ACCC is accessed through sector suites.

   NASSRS requirement 3.2.7.C

b. Obtaining accurate obstacle information available for monitoring services. Current and complete information on ground, terrain, and known obstacles are available to specialists from the NAS at their working positions in a visual format.

   NASSRS requirements 3.2.7.B;C

c. Provides predicted potential encounters. The Approach/Departure and En Route controllers are notified through their sector suites of potential encounters based on current clearance-based trajectories and short-term projections. The NAS provides the capability to evaluate alternate clearance-based trajectories and with respect to potential encounters with the ground, terrain, and obstacles.

   NASSRS requirement 3.2.7.D

d. Receives Alerts and Alerts the Pilot. The NAS alerts the Approach/Departure and En Route Controllers, within 75 seconds of the predicted time of encounter, both aurally and visually, through the MSAW. The Approach/Departure or En Route controller

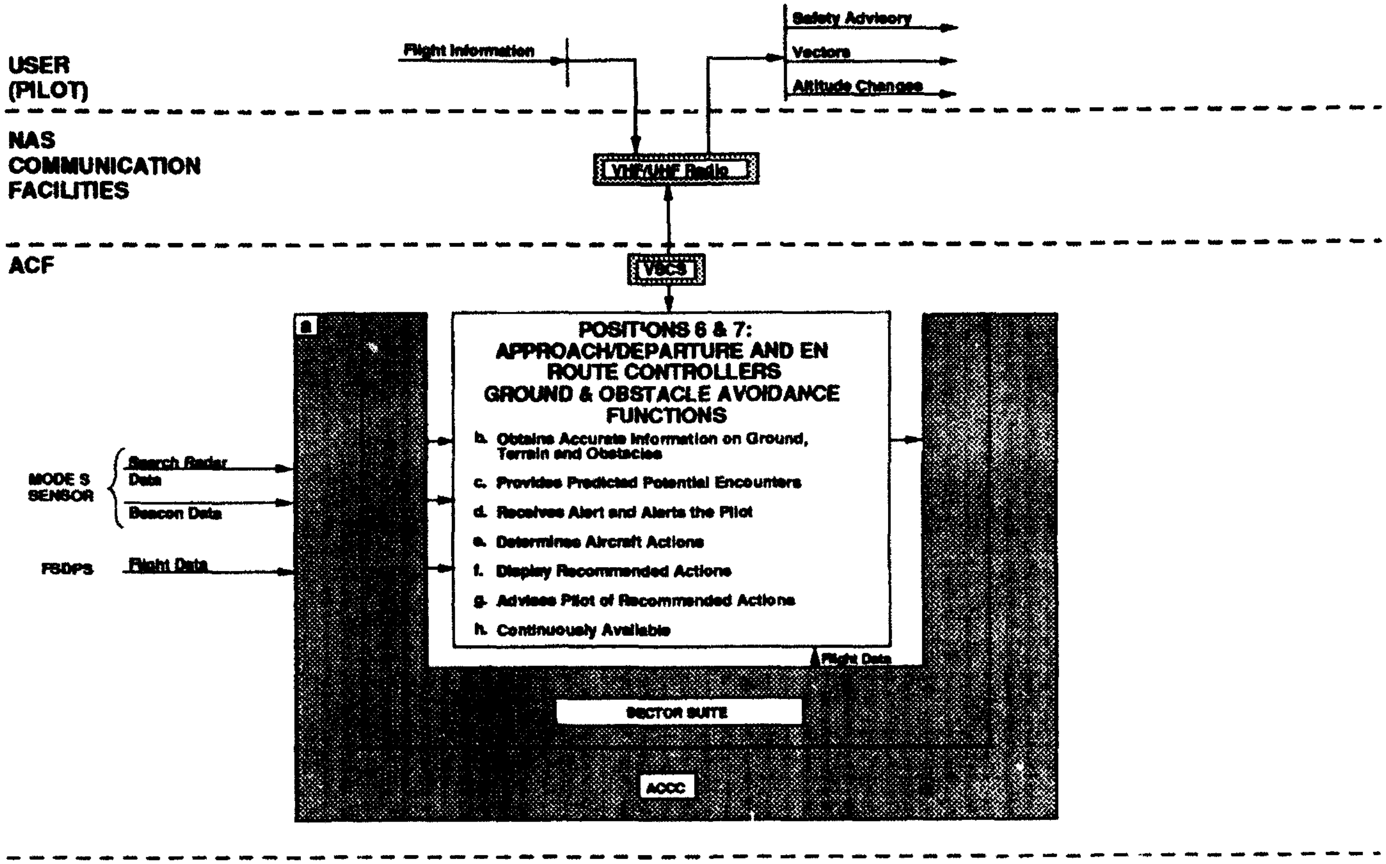


FIGURE 8-3
APPROACH/DEPARTURE AND EN ROUTE
CONTROLLERS (POSITIONS 6 AND 7)
OPERATIONAL FLOW DIAGRAM

relays this alert to the user within 65 seconds via voice and/or air-ground data communications.

NASSRS requirement 3.2.7.E

e. Determines aircraft actions. Once notified of a potential encounter with the ground or with an obstacle, the ACCC alerts the controller to the conflict and determines the action the aircraft should take to avoid the encounter.

NASSRS requirement 3.2.7.F

f. Displays recommended action. Once the recommended action to avoid the ground or obstacle has been determined, the ACCC displays the recommended action or actions to the specialist through their Sector Suite.

NASSRS requirement 3.2.7.G

g. Advises pilot of recommended actions. ACF controllers advise pilots of recommended or alternative actions in sufficient time to avoid the encounter.

NASSRS requirement 3.2.7.G

h. Continuous monitoring. Approach/Departure and En Route controllers have ground and obstacle avoidance capabilities available to them on a continuous basis. These services are provided to the controllers and users at all times.

NASSRS requirement 3.2.7.H

8.3.2 Local Controller (Position 9)

Local Controllers provide ground and obstacle avoidance assistance to airborne aircraft within the Airport Traffic Area. This assistance is provided through the use of the Tower Computer Control Complex (TCCC) and Digital Bright Radar Indicator Tower Equipment (DBRITE). When an aircraft is observed in close proximity to the ground, Local Controllers are alerted by the MSAW function within the TCCC and immediately issue a safety advisory to the pilot, including the safe altitude for the aircraft's position.

Figure 8-4 is an operational flow diagram describing the functions and services provided by Local controllers working in control towers. Letter blocks that identify the functions performed by these controllers are described in the corresponding paragraphs below.

a. TCCC processing. The TCCC houses the flight data base which includes the aircraft's route of flight and altitude. The TCCC is accessed through TCCC Position Consoles.

NASSRS requirement 3.2.7.D

b. Obtains Accurate obstacle information for monitoring. Current and complete information on ground, terrain, and known obstacles is

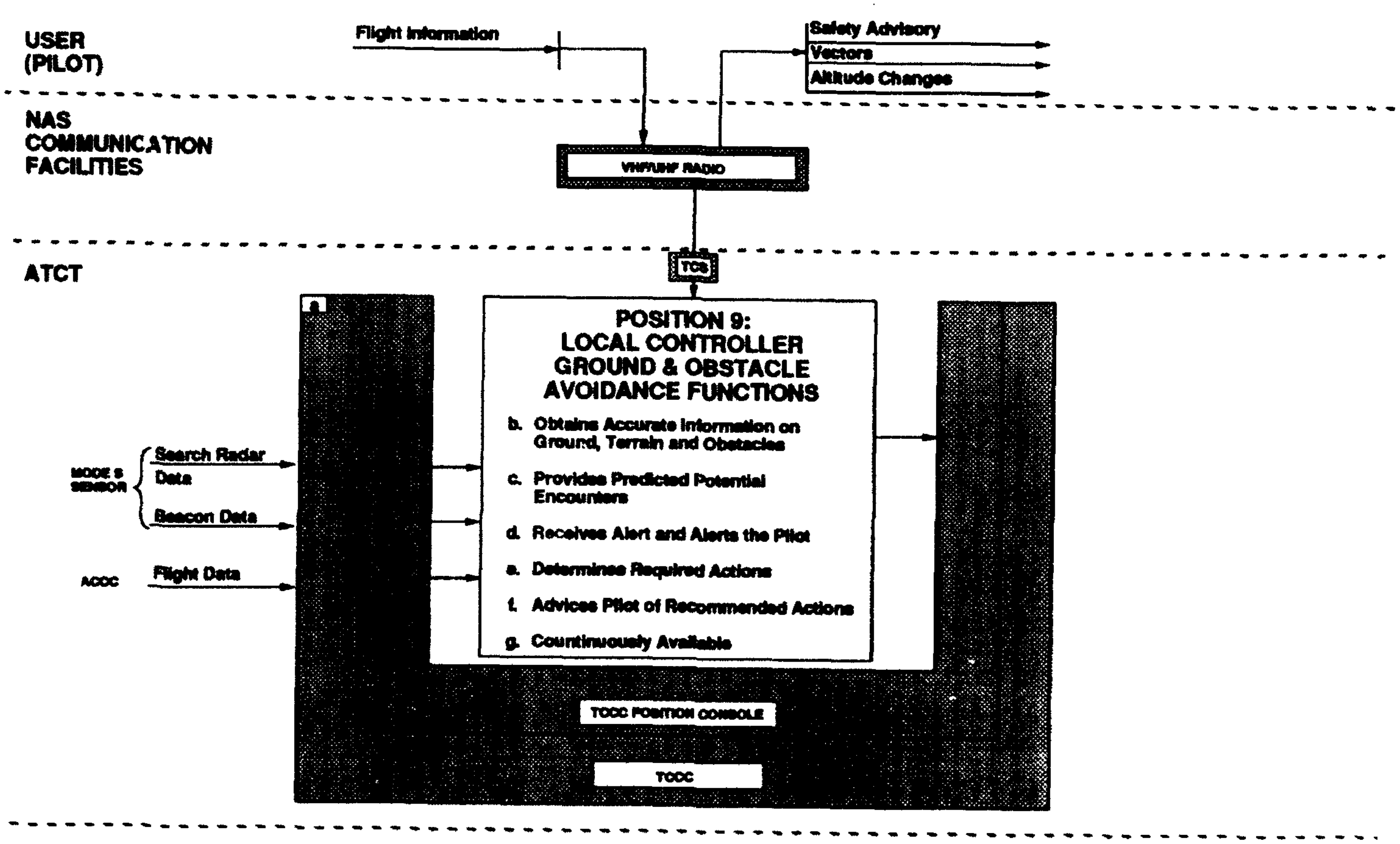


FIGURE 8-4
LOCAL CONTROLLER (POSITION 9)
OPERATIONAL FLOW DIAGRAM

available to specialists at their working positions in a visual format.

NASSRS requirement 3.2.7.C

c. Provides Predicted potential encounters. The Local controller is notified of potential encounters with the ground, terrain, or obstacles based on current clearance-based trajectories and short-term projections from the TCCC (through the DBRITE).

NASSRS requirement 3.2.7.D

d. Receives Alert and Alerts the Pilot. The TCCC alerts the Local controller, both aurally and visually, within 40 seconds in advance of the predicted time of the encounter, through the DBRITE. The local controller alerts the pilot at least 30 seconds in advance of the predicted time of the encounter.

NASSRS requirement 3.2.7.E

e. Determines aircraft actions. Once alerted of a potential encounter with the ground or an obstacle, the TCCC sends an alert message to the controller via DBRITE of the conflict and determines the action the aircraft should take to avoid the encounter.

NASSRS requirement 3.2.7.F

f. Advises pilot of recommended actions. Local controllers advise pilots of recommended or alternate actions in sufficient time to avoid the encounter.

NASSRS requirement 3.2.7.G

g. Continuous Monitoring. Local controllers have ground and obstacle avoidance capabilities available to them on a continuous basis.

NASSRS requirement 3.2.7.H

8.3.3 Clearance Delivery Controller (Position 11)

Clearance Delivery controllers in the control towers preview flight plans prior to their issuance to pilots to check for the correct altitude for the aircraft's route of flight. The aircraft's proposed altitude for its intended route of flight is checked against the MEA and the MOCA within the Airport Traffic Area to ensure obstacle avoidance.

Figure 8-5 is an operational flow diagram describing the functions and services provided by the Clearance Delivery controller in the control tower. Letter blocks that identify the functions performed by these controllers are described in the corresponding paragraphs below.

a. TCCC processing. The TCCC houses the flight data base that includes both the altitude of the proposed aircraft and its

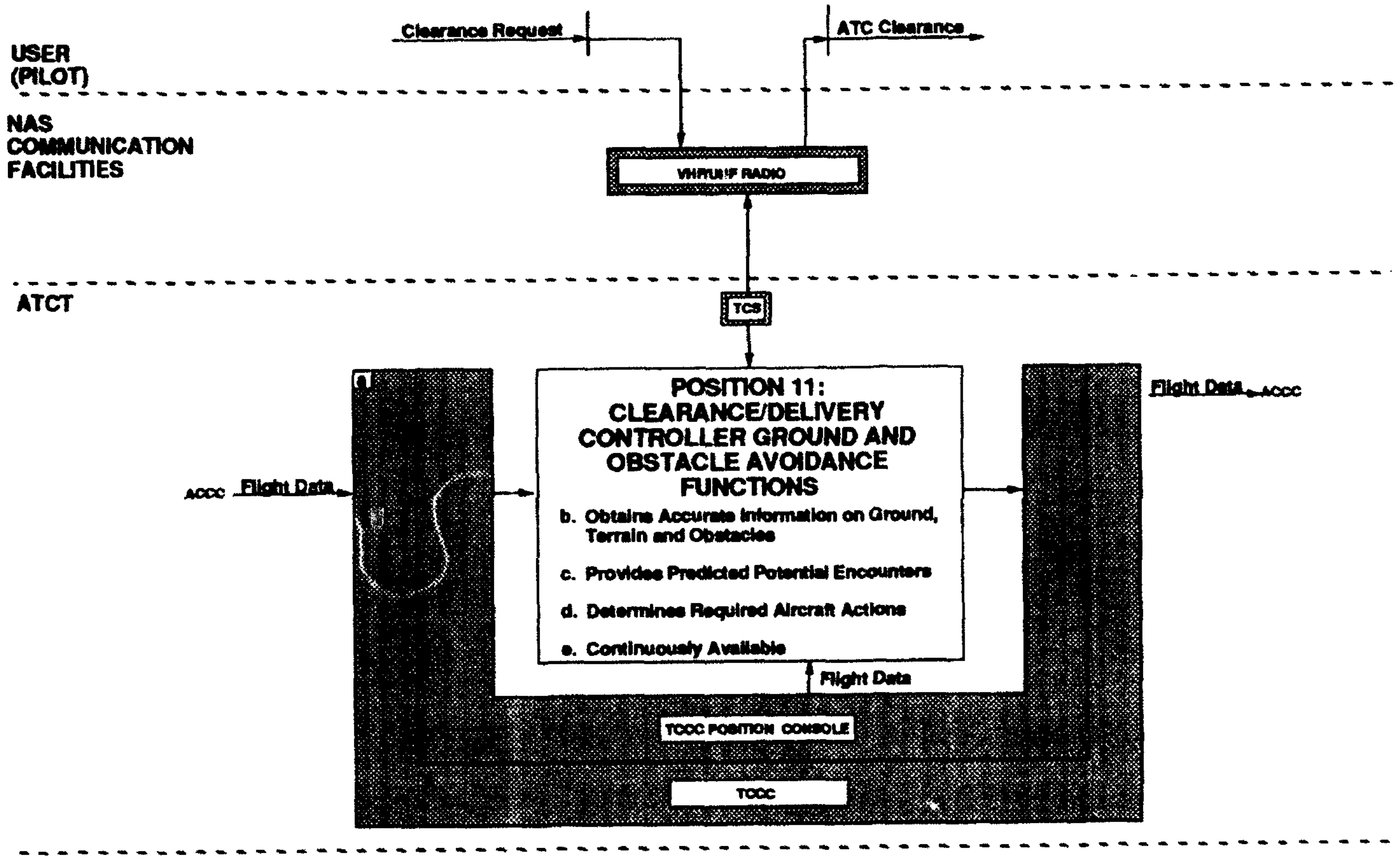


FIGURE 8-5
CLEARANCE/DELIVERY CONTROLLER (POSITION 11)
OPERATIONAL FLOW DIAGRAM

intended route of flight. The TCCC is accessed through the TCCC Position Consoles.

NASSRS requirement 3.2.7.D

b. Obtains Available obstacle information for monitoring. Clearance Delivery controllers maintain accurate, complete, and current aeronautical information for their particular area of responsibility. This information is used in ensuring the correct obstacle clearance or minimum en route altitude. This information is posted adjacent to the specialists' positions.

NASSRS requirement 3.2.7.C

c. Provides Predicted potential encounters. Prior to issuing the clearance, the Clearance Delivery controller predicts potential encounters with the ground, terrain, or obstacles after reviewing a flight plan. This controller ensures the requested assigned altitude for a route of flight will have the MOCA and MEA within the control towers' area of jurisdiction.

NASSRS requirement 3.2.7.D

d. Determines aircraft actions. The Clearance Delivery controller, after reviewing a proposed route of flight and altitude request, determines the correct altitude for the route of flight and relays this information to the pilot as part of the clearance procedures.

NASSRS requirement 3.2.7.F

e. Continuous Monitoring. Clearance Delivery controllers continuously review proposed clearances for obstacle avoidance within their assigned airspace.

NASSRS requirement 3.2.7.H

8.4 Correlation with Operational Requirements

Table 8-1 summarizes the correlation of the ground and obstacle avoidance requirements paragraphs of NAS-SR-1000 with the paragraphs describing the functions being performed by specialists/controllers. All ground and obstacle avoidance paragraph numbers of NAS-SR-1000 are listed; paragraphs which are introductory in nature and do not state an explicit operational requirement or reference other portions of NAS-SR-1000 are indicated with a dash. The fact that a correlation is shown between a requirements paragraph and a paragraph describing the specialist/controller functions performed should not be construed as indicating that the requirement is completely fulfilled.

TABLE 8-1
GROUND & OBSTACLE AVOIDANCE
OPERATIONAL REQUIREMENTS CORRELATION

NAS-SR-1000 Paragraph	Position	Approach/Depature and En Route Controller								Local Controller							Clearance Delivery Controller				
	Paragraph	2.3.1.a	2.3.1.b	2.3.1.c	2.3.1.d	2.3.1.e	2.3.1.f	2.3.1.g	2.3.1.h	2.3.2.a	2.3.2.b	2.3.2.c	2.3.2.d	2.3.2.e	2.3.2.f	2.3.2.g	2.3.3.a	2.3.3.b	2.3.3.c	2.3.3.d	2.3.3.e
3.2.7	General	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
3.2.7.A	Paragraph 3.2.3 Req's	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
.B	Complete Obs. Information		X								X										
.B1	Ground & Terrain		X								X										
.B2	Man-Made Obs.		X								X										
.C	Avail/Accurate Data	X	X								X							X			
.C1	Info. Upon Request	X	X								X							X			
.C2	Info. for Specific Areas	X	X								X							X			
.C3	Info. in Visual Format	X	X								X							X			
				X																	
.D	Detect Gnd. Encounters			X						X		X					X		X		
.D1	Predict Gnd. Encounters			X						X									X		
.D2	Projected Encounters									X									X		
				X																	
.D3	Alternate Clearances									X									X		
.E	Encounter Alert				X								X								
.E1	Advanced Alert				X																
.E2	Aural/Visual Alarm				X																
.E3	User Alert				X																
.F	Determine Aircraft Action					X								X						X	
.G	Display Action						X	X							X						
.H	Continuous Service								X							X					X

8.5 Operational Sequence

Operational sequence diagrams have been developed to illustrate the interactions between users (pilots) and specialists/controllers for different categories/conditions of flight. These diagrams are general in nature and no effort has been made to depict a specific situation.

8.5.1 Terminal Operational Sequence

ACF controllers assigned to provide coverage for the terminal areas around airports have the capability to provide ground and obstacle avoidance assistance to pilots. This assistance is provided to arriving, departing, and overflight traffic within the terminal and en route areas. Figure 8-6 illustrates a general sequence of operator/user interactions for ground and obstacle avoidance assistance provided by Approach/Departure and En Route controllers working in the ACF.

An arriving aircraft being tracked by the Approach or En Route controller has been sequenced with other arriving aircraft for landing at a particular airport. Using the aircraft's altitude encoding altimeter, the ACCC detects that the aircraft has descended below its assigned altitude and is soon to be in close proximity to the ground (1). The ACCC predicts that with the aircraft's present flight path and altitude, the aircraft will encounter the ground (2). The ACCC, through the sector suite, alerts the Approach/Departure or En Route controller that the aircraft is in close proximity to the ground (5) and simultaneously determines avoidance action to avoid the encounter (3), issues him a set of actions to avoid the predicted encounter (4). The ACCC relays the avoidance instruction through data communications at the same time the Approach/Departure or En Route controller immediately issues a safety advisory to the aircraft including the safe altitude for the area that it is in and the corrective actions to be taken (6). The aircraft executes the recommended maneuver and avoids encountering the ground (7).

8.5.2 Tower Operational Sequence

Figure 8-7 depicts the ground and obstacle avoidance assistance provided to pilots by the Local controller.

While monitoring an approach to the airport on DBRITE, the Local controller is alerted that the aircraft is descending below the established glide slope (1). The TCCC predicts that the aircraft will encounter the ground (2) and alerts the controller (5). The TCCC determines the proper action to take to avoid the encounter (3) and simultaneously displays the action to the controller (4). The Local controller immediately issues the maneuver instruction to the pilot (6) who initiates the action and avoids the encounter (7).

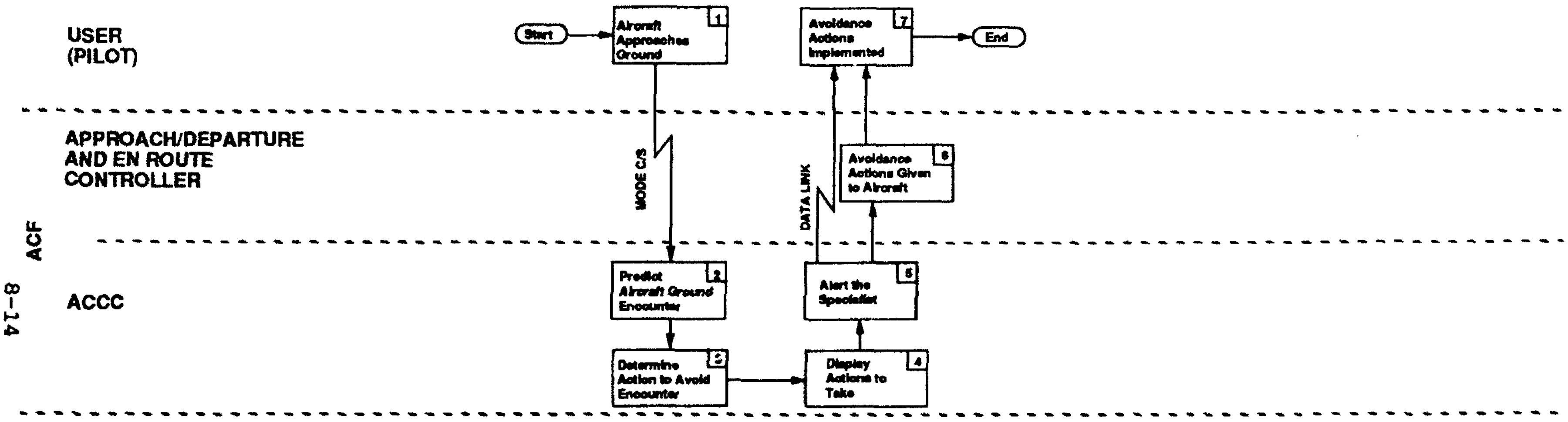


FIGURE 8-6
APPROACH/DEPARTURE AND EN ROU CONTROLLERS
TERMINAL OPERATIONAL SEQUE E DIAGRAM

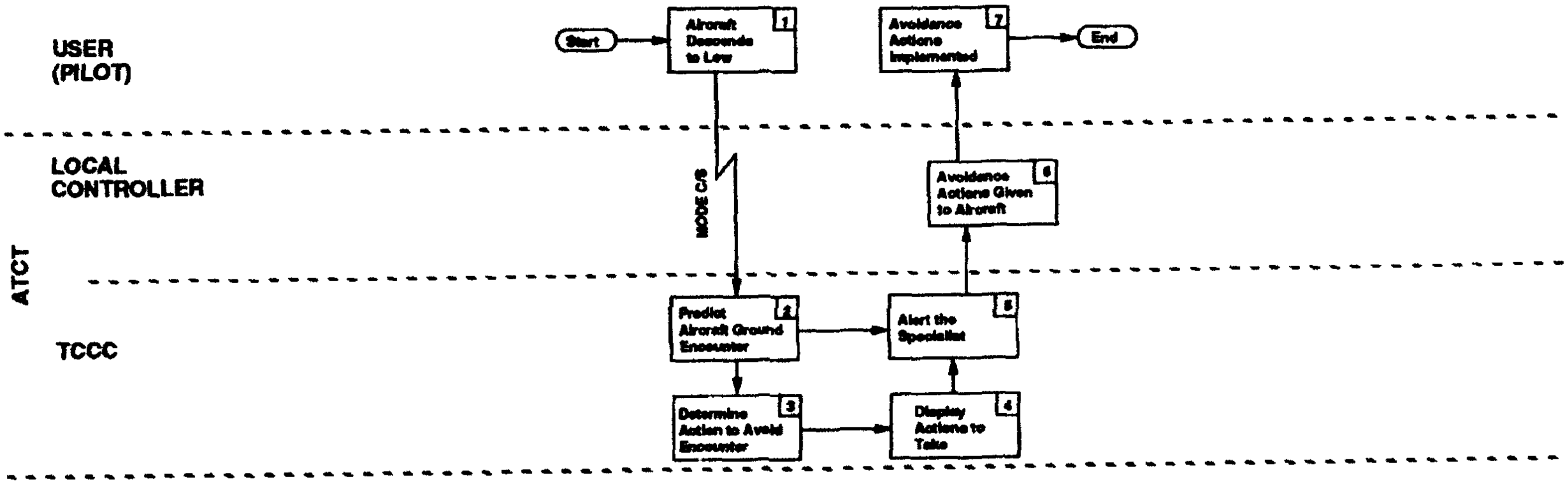


FIGURE 8-7
LOCAL CONTROLLER TOWER
OPERATIONAL SEQUENCE DIAGRAM

8.6 Operational Scenario

8.6.1 IFR Operational Scenario

In the scenario shown in Figure 8-8, N2025T, a Beech King Air, is being vectored for an Instrument Landing System (ILS) approach. The pilot of N2025T spots a flock of birds ahead and slightly above his altitude. The pilot descends to get below the birds (1) when the MSAW (2) alerts the approach controller that N2025T has gone below the prescribed altitude (3/4). The Approach controller immediately issues a low altitude alert (5), advises N2025T to check his altitude (6), and issues the appropriate altitude (7). After safely clearing the birds, the pilot climbs back up to the recommended altitude (8).

8.6.2 Tower Operational Scenario

Figure 8-9 describes a similar scenario where N222MM, a MU-2, is making an instrument approach. The pilot of N222MM reports the outer marker in-bound and the Local controller, looking at the DBRITE, observes the aircraft, checks for traffic, then issues a clearance to land.

N222MM descends below the prescribed altitude for this approach (1). The TCCC predicts an encounter with the ground (2). The Local controller is alerted through the DBRITE from the TCCC that N222MM is too low (5). At the same time the TCCC determines the proper action to avoid the ground (3) and simultaneously presents the proper action to the controller (4). The Local controller immediately issues the avoidance maneuver to the aircraft (6). The pilot initiates the climb back to the proper altitude (7) and completes the approach safely.

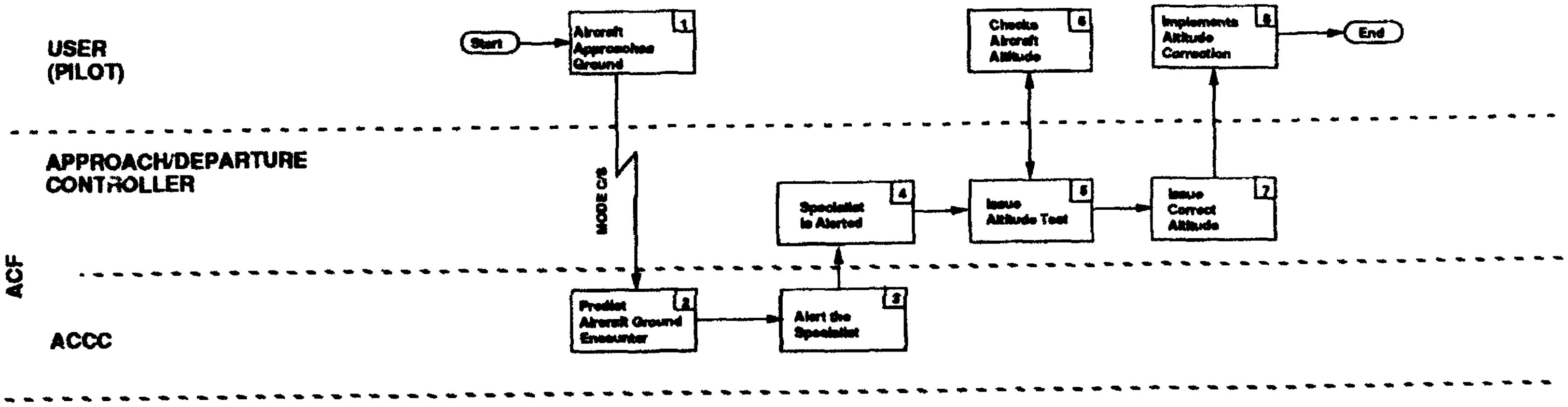


FIGURE 8-8
IFR
OPERATIONAL SCENARIO DIAGRAM

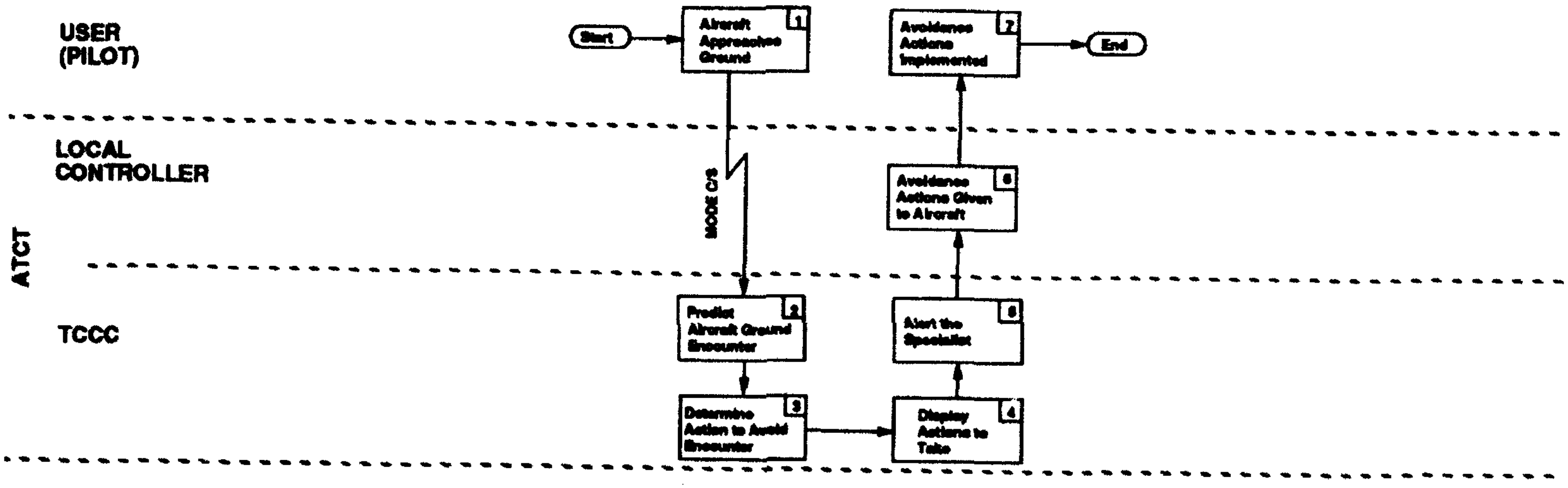


FIGURE 8-9
CONTROL TOWER
OPERATIONAL SCENARIO DIAGRAM

9.0 IN-FLIGHT EMERGENCY ASSISTANCE

In flying an aircraft, a pilot may experience many situations for which special assistance is needed. The seriousness of these range from concerns about safety to life threatening. In such situations, the pilot may request assistance from the National Airspace System (NAS) via contact with a controller or other specialist. When the NAS provides in-flight assistance to a user (pilot) this is called a "flight assist" and will be referred to by that term or by the phrase "in-flight assistance" for the remainder of the document. An in-flight emergency is a special case where the urgency of the situation is more severe.

The NAS is required to respond to such requests from in-flight users. This requirement is described in Section 3.2.8 of the NAS Systems Requirement Specification (NASSRS). Any situation that is deemed threatening to the safety of the flight is considered an emergency and is declared as such by the pilot, the controller or the specialist handling the assist or the operator of the aircraft (e.g., the company that owns the aircraft). Most assists involve either locating a lost pilot or landing the aircraft safely, as soon as possible, or both.

9.1 Support

Figure 9-1, Overview of NAS/User Interfaces for In-flight Assistance illustrates all the NAS facilities, systems, outside organizations, and user systems (e.g., Aeronautical Radio Incorporated (ARINC) and the Rescue Coordination Center (RCC)) that might be involved with an in-flight assist. The diagram illustrates that, at one time or another, a major portion of the NAS could be involved with an assist. The aircraft in Figure 9-1 is discussed in more detail in Section 9.1.3.

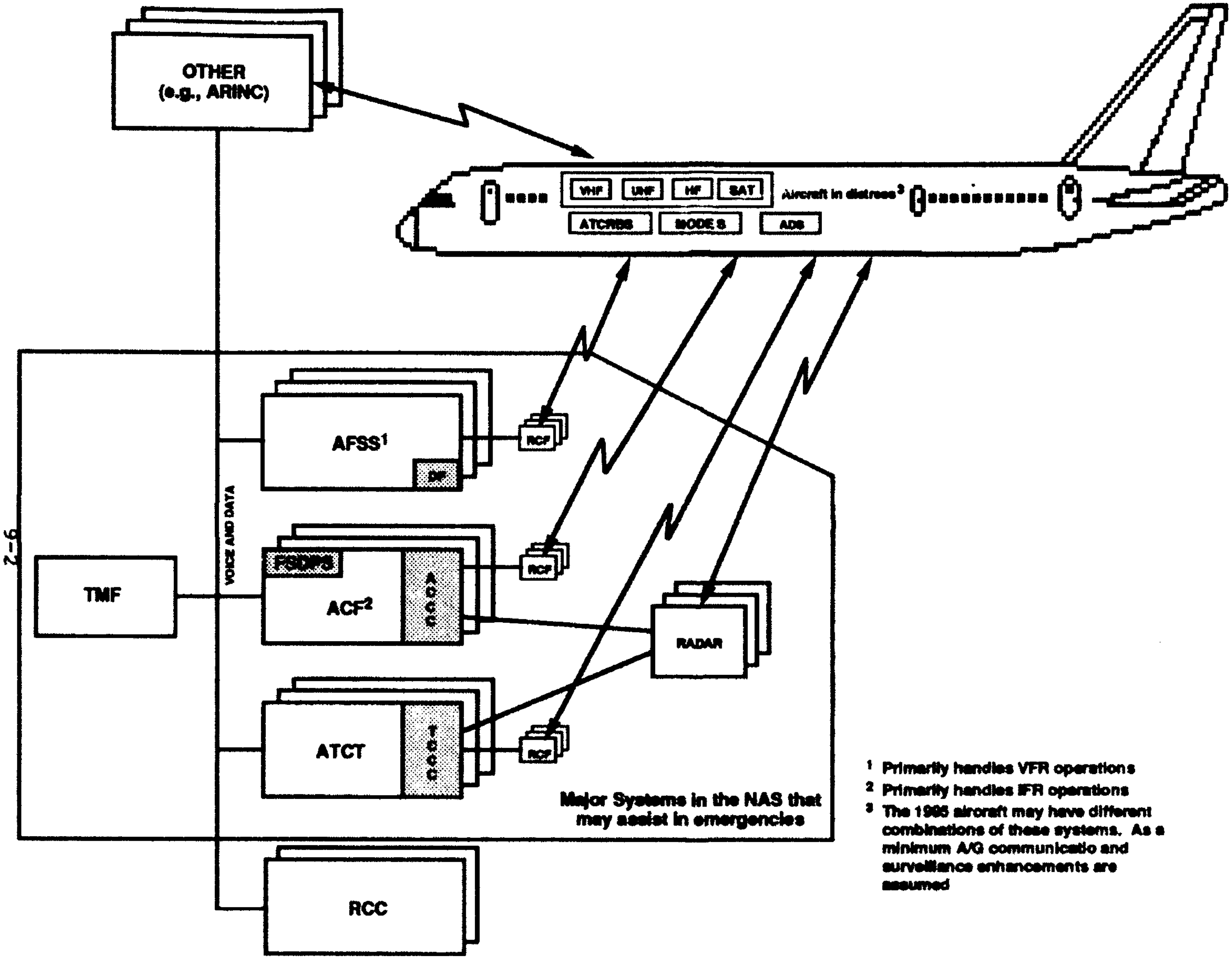
The NAS facilities, systems, specialist positions and major information paths that may be involved in an in-flight assist are shown in Figure 9-2, In-Flight Assistance Operational Block Diagram.

9.1.1 Other Organizations

Because of the variety of in-flight assists, many different organizations may be involved. For example ARINC could become involved in an assist to an aircraft flying over the ocean. ARINC provides an High Frequency (HF) radio service for the FAA for aircraft that are out of VHF radio range. The RCC, which is operated by the U.S. Air Force, is alerted on any emergency assist, but would not become actively involved until there was good reason to believe the aircraft had a major mishap. Local fire/rescue and medical assistance are also, on occasion, called upon to stand by.

9.1.2 User Systems

The aircraft in Figure 9-1 shows two way radio systems for voice communications (VHF, Ultra High Frequency (UHF), HF, and satellite), data communications (Mode Select Beacon System (Mode S) and ARINC (or Automatic) Communications Addressing and Reporting System (ACARS)) and systems to assist in surveillance (Air Traffic Control Radar Beacon System (ATCRBS), Mode S, and Air Defense Sector (ADS)). Few, if any, aircraft will have all of these systems but most all will have some. To request and receive inflight emergency assistance will require at least a two way radio. ATCRBS, MODE S and ADS will assist the controller in locating and identifying lost aircraft so equipped.



¹ Primarily handles VFR operations

² Primarily handles IFR operations

³ The 1995 aircraft may have different combinations of these systems. As a minimum A/G communicatio and surveillance enhancements are assumed

FIGURE 9-1

OVERVIEW OF NAS/USER SYSTEMS FOR IN-FLIGHT ASSISTANCE

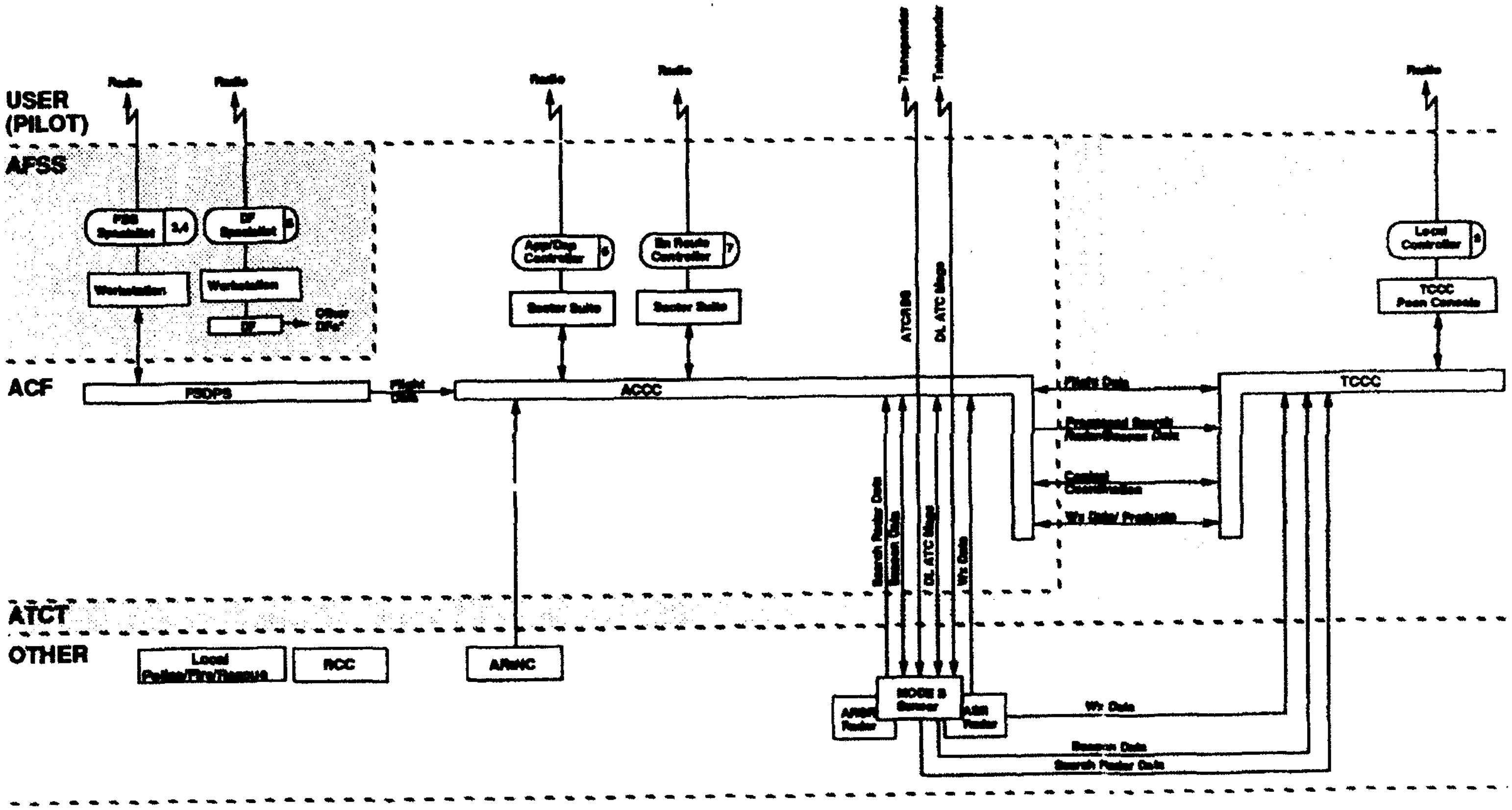


FIGURE 9-2
IN-FLIGHT ASSISTANCE
OPERATIONAL BLOCK DIAGRAM

9.2 Information

Since in-flight assists are varied and unpredictable, the information used in providing in-flight assistance will also vary and be unpredictable. However most assists fall in one or more standard categories.

9.2.1 Information About the Aircraft, Crew and Passengers

FAA has defined the information that should be obtained in any inflight emergency assist. The minimum information is:

- Aircraft identification and type
- Nature of emergency
- Pilot's desires

Desired information is:

- Aircraft altitude
- Fuel remaining in time
- Pilot reported weather
- Pilot capability for IFR flight
- Time and place of last known position
- Heading since last known position
- Airspeed
- Navigation equipment capability
- Navigation Aid (NAVAID) signals received
- Visible land marks
- Aircraft color
- Number of people on board
- Point of departure and destination
- Emergency equipment on board

Some of this information is contained in the flight plan, some has to be obtained verbally.

9.2.2 Information Obtained Through the NAS

Information that the specialist may need from or through the NAS include:

- Appropriate fixes toward which to vector a lost pilot

- Appropriate airports to make an emergency landing including:
  - Airport name and identifier
  - Heading to airport
  - Distance to airport
  - Estimated time to airport
- Location and quantity of available emergency vehicles
- Weather in areas of interest
- Traffic in areas of interest
- Other information pertinent to the specific assist (e.g., for an assist where there is a mechanical problem, the specialist tries to locate expertise that could give helpful advice)

9.3 Functions

The following three paragraphs describe in more detail the functions provided by the five specialists positions introduced in 2.1.1. Positions 3, 4, and 5, the three types of controllers, provide similar enough services that they are all covered in one paragraph. The operational flow diagrams that go with each paragraph illustrate the information flow between the specialist and the user, between the specialist and other specialists, and between the specialist and data processing equipment. Most information flow is unformatted verbal communications. The functions performed by the specialists are all covered by requirements specified in the NASSRS. The pertinent NASSRS paragraphs that specify the function being performed by the specialist are referenced in each of the paragraphs below.

9.3.1 AFSS Specialists (Position 3 and 4)

Figure 9-3 illustrates all Automated Flight Service Station (AFSS) of the primary functions performed for in-flight assistance by a AFSS specialist and the information that flows to and from the specialist. AFSS specialists, in particular in-flight and En Route Flight Advisory Service (EFAS) specialists, may be contacted by pilots requesting assistance. The most likely pilots would be those flying VFR since their primary support comes from flight service stations. The specialist may handle the entire request utilizing all necessary and available NAS and other resources or he may hand-off the responsibility to a controller at an Area Control Facility (ACF) or Air Traffic Control Tower (ATCT).

a. Flight Service Data Processing System (FSDPS) Processing. The FSDPS provides the processing and support to enable the AFSS specialist to retrieve preflight weather briefings as well as file and amend flight plans (both instrument flight rules IFR and visual flight rules VFR). The FSDPS forwards flight plans to the affected Area Control Computer Complex (ACCC) IFR and other FSDPSs (VFR) as required.

NASSRS requirements: 3.2.8.E

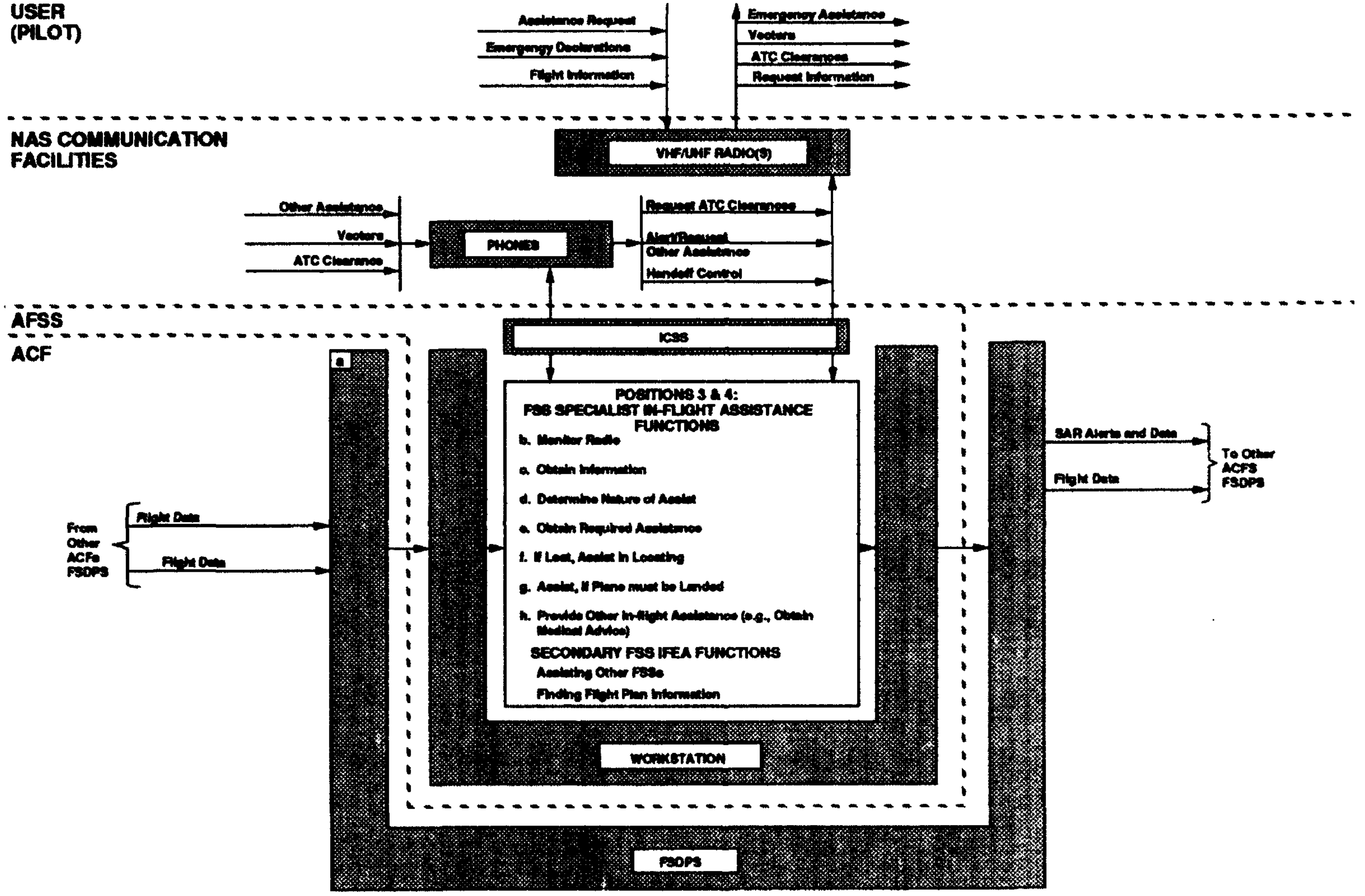


FIGURE 9-3
FSS SPECIALIST (POSITIONS 3&4)
OPERATIONAL FLOW DIAGRAM

b. Monitor Radio. In order to respond in a timely fashion to an assistance request, radios are continuously monitored by the specialist.

NASSRS requirements: 3.2.8.A,C,D

c. Obtain Information. To properly respond to the assistance request the specialist expeditiously provides all necessary information. If an emergency is declared certain information is obtained. Information will be obtained primarily via voice radio with the pilot and secondarily via the flight plan. The flight plan will be resident in the specialist's FSDPS if the pilot filed a flight plan, is flying VFR, and the emergency occurred in the departure AFSS areas (FSDPS will be located in the ACF). If the emergency occurs outside this areas, the specialist will obtain the flight plan information from the FSDPS in the departure AFSS by contacting a FSS at that AFSS.

NASSRS requirements: 3.2.8.A,E

d. Determine Nature of Assist. The specialist using the information obtained above determines the nature of the assistance required. For example, he determines if it is an emergency, whether or not he needs outside help and whether or not he should maintain responsibility for handling the assist.

NASSRS requirements: 3.2.8.B

e. Obtain Other Assistance. If the assist is an emergency' the specialist notifies the ACF and Direction Finder (DF) net control. The ACF in turn notifies the RCC. Depending on the nature of the assist other resources may be requested, e.g., if the Emergency Locator Transmitter (ELT) signal is heard or reported, the RCC is notified directly.

NASSRS requirements: 3.2.8.B

f. If Lost, Assist in Locating. If the aircraft has a beacon (ATCRBS or Mode S) the ACF may be able to locate it using available radars. The flight service specialist would request this service from a controller at the ACF or ATCT. Aircraft with working VHF transceivers can also be located via direction finding equipment, either single stations or networks.

NASSRS requirements: 3.2.8.F,G

g. Assist if Plane Must be Landed. While FSSs will not normally be equipped nor trained to provide ATC type services in directing aircraft to an airport, they may have to in an emergency. To minimize confusion and disruption of services to the user, changing frequencies is avoided. This assistance may be in the form of relaying ATC instructions from a controller or providing DF orientation.

NASSRS requirements: 3.2.8.A,F,G

h. Provide Other In-Flight Assistance. While most assistance is to either help locate a lost pilot or safely land the aircraft expeditiously, sometimes the assistance might be to provide technical or medical advice. The specialist may have to obtain such advice from outside sources.

NASSRS requirements: 3.2.8.B

9.3.2 AFSS DF Specialist (Position 5)

Figure 9-4 illustrates all of the primary functions performed by the AFSS specialist who operates the DF equipment (DF specialist) and the information that flows to and from this specialist. Using the DF equipment, the DF specialist determines the aircraft's position and may provide bearings to a desired fix. (Since the DF is only used intermittently it would normally not be manned by a dedicated individual. Most AFSS specialists would be trained to use the equipment as an adjunct to their normal duties).

a. DF. The DF equipment calculates the aircraft's location from the correct signals which were preselected by the specialist from radio clues provided by the pilots. The DF may use a single station or a network of stations.

NASSRS requirements: 3.2.8.F

b. Locate Aircraft. The DF specialist locates aircraft using the DF equipment and verbally transmits the information to the pilot directly or indirectly via the controller or specialist who has primary responsibility for the assist. If the specialist is working from a network DF station, the correct signal can be selected from multiple receivers. If the specialist is working from a DF that has one receiver, the pilot is requested to maneuver the aircraft and provide several signals.

NASSRS requirements: 3.2.8.F

c. Provide Vectors to a Fix. The DF specialist can determine vectors to a fix using the DF computed location and fixes internally stored in the DF equipment (e.g., an airport). The DF equipment will calculate the vectors (distance and magnetic bearing). The specialist then transmits the vector either directly to the pilot or indirectly via the controller or specialist who has the primary responsibility for the assist.

NASSRS requirements: 3.2.8.G

9.3.3 ATCT Controllers (Positions 6, 7, and 9)

Figure 9-5 illustrates all of the primary functions performed by the air traffic control specialists (controllers) and the information that flows to and from this controller. Controllers may be contacted by pilots requesting in-flight assistance. The pilots may be flying IFR or VFR. Lost IFR pilots who seek assistance would contact an ATC controller rather than a flight service specialist.

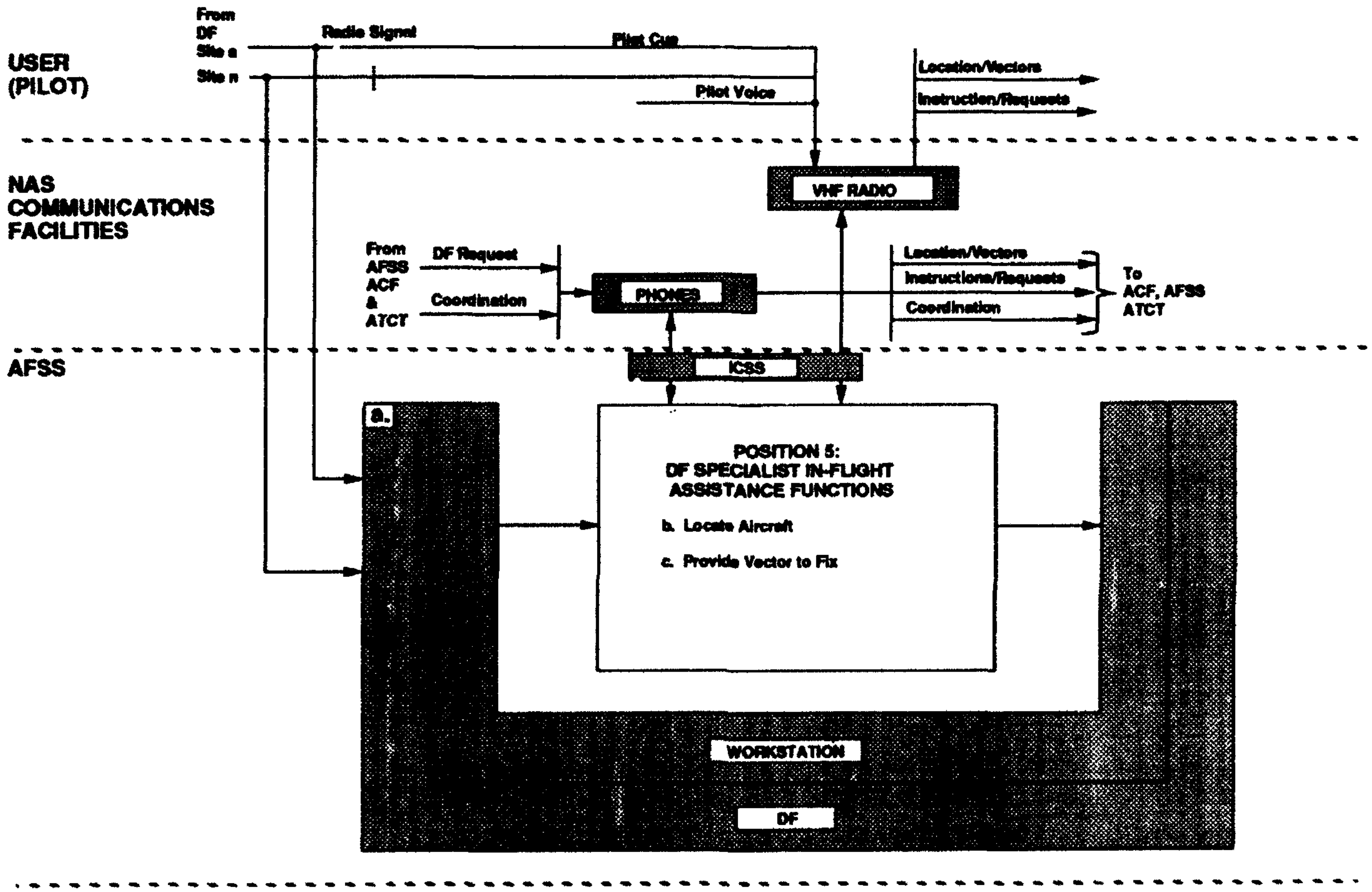


FIGURE 9-4
DF SPECIALIST (POSITION 5) OPERATIONAL
FLOW DIAGRAM

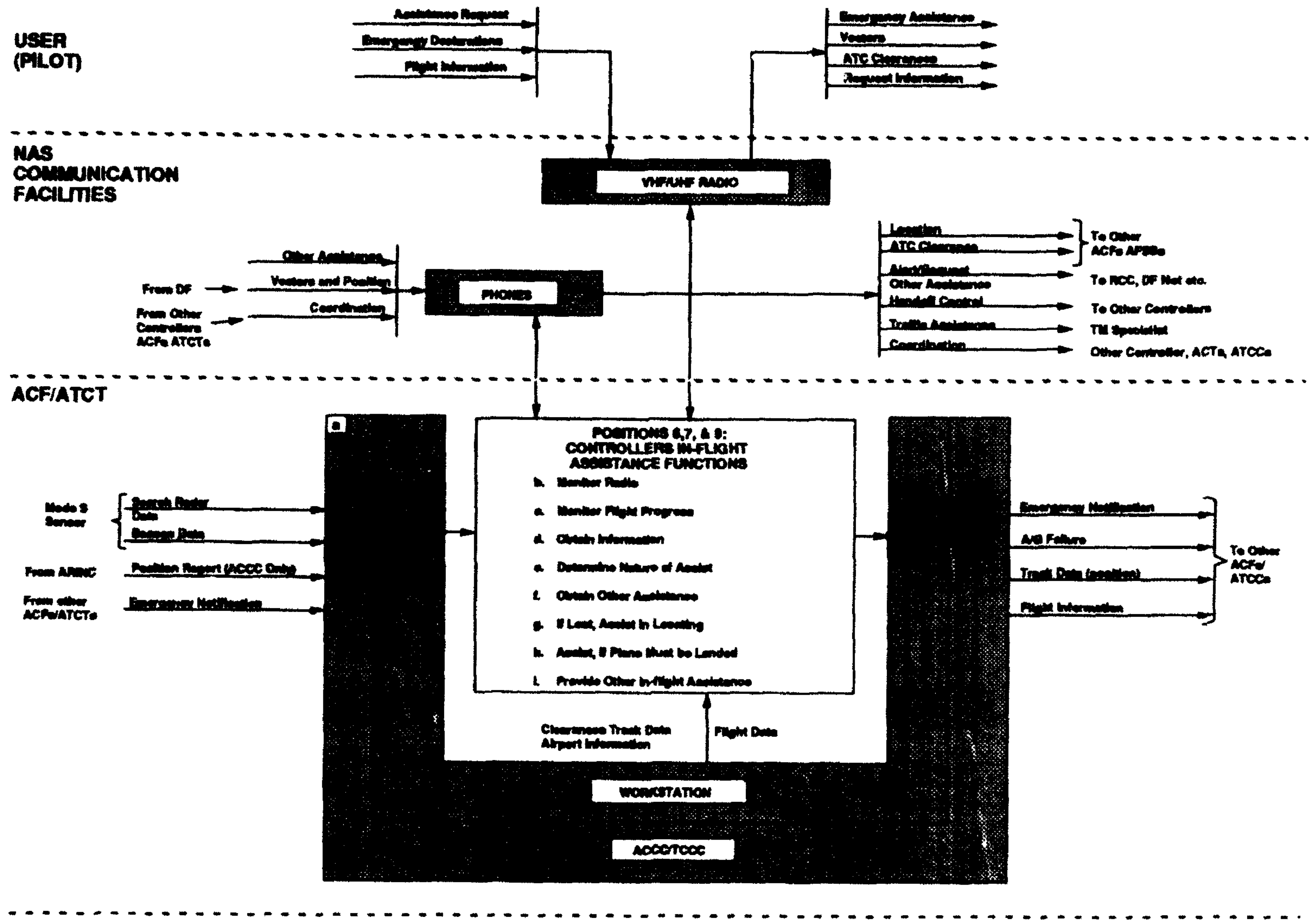


FIGURE 9-5
APPROACH/DEPARTURE, ENROUTE, AND LOCAL
CONTROLLERS (POSITIONS 6, 7, AND 9)
OPERATIONAL FLOW DIAGRAM

The controller may be an approach, departure or en route controller at an ACF or a local controller at an ATCT. The service provided and most of the functions performed are identical. The controller will request all necessary NAS and outside services in order to provide the assistance. The controller may maintain responsibility or transfer the responsibility to another controller.

a. ACCC/TCCC. The ACCC/Tower Control Computer Complex (TCCC) provide all the control functions for the aircraft requiring assistance to the controller that he/she would use in controlling any aircraft. In addition, for assists where the aircraft needs to land as soon as possible, the ACCC and TCCC will have an emergency airport list available. The list will be specific to the subject aircraft and will provide critical information (e.g., heading, distance and time to land) on five airports listed in ascending order according to distance from the airport.

   NASSRS requirements: 3.2.8.B,C

b. Monitor Radio. In order to respond in a timely fashion to an assistance request, radios are continuously monitored by the controller. Also, during the assists, the controller continues the vigilance in case the radio link is lost and other communications must be attempted.

   NASSRS requirements: 3.2.8.A,C,D

c. Monitor Flight Progress. This normal controller function of monitoring the aircraft's radar position and beacon data on the sector suite's display, takes on an additional degree of criticality during an in-flight assist. (Also during monitoring of normal flights, the simultaneous loss of track data and communications is one condition which could result in the controller declaring an emergency and initiating search and rescue. This is considered a search and rescue function and not an inflight assist. Search and rescue will be addressed in a separate document.)

   NASSRS requirements: 3.2.8.A

d. Obtain Information. To properly respond to the assistance request the controller expeditiously provides all necessary information. If an emergency is declared certain information is obtained. Information about the aircraft, pilot, crew and passengers will be obtained primarily via voice radio with the pilot and secondarily via his flight plan. If possible the controller will avoid handing off the assist to another controller in order to minimize changing radio frequencies. The flight plan will be resident in the controller's ACCC or TCCC. Because of the unpredictability and variability of assistance requests, other information from various sources may also have to be obtained. Obtaining information may be augmented by Mode S data link from aircraft so equipped.

   NASSRS requirements: 3.2.8.A,E

e. Determine Nature of Assist. The controller using the information obtained above determines the nature of the assistance required. For example, he determines if it is an emergency, whether or not he needs outside help and whether or not he should maintain responsibility for handling the assist.

NASSRS requirements: 3.2.8.B

f. Obtain Other Assistance. If an emergency is declared, the local controller notifies the ACF (the ACF in turn notifies the RCC) and an approach/departure or en route controller must notify the RCC directly. Also the DF net is alerted. Depending on the nature of the assist other resources may be requested. If the aircraft must be landed, it is usually a local controller who will request fire and rescue assistance at the target airport. If traffic has to be rerouted, the Traffic Management Coordinator (TMC) is consulted.

NASSRS requirements: 3.2.8.B

g. If Lost, Assist in Locating. If the aircraft has a beacon (ATCRBs or Mode S) the controller may be able to locate it using available radars. Aircraft with working VHF transceivers can also be located via direction finding equipment, either single stations or networks. The controller would request this service from the specialist at the AFSS.

NASSRS requirements: 3.2.8.F,G

h. Assist if Aircraft Must be Landed. The controller may provide assistance in landing the aircraft. For example, in a critical situation handing off the aircraft from one controller to the next may not be done. For example, an en route controller, who originally received the request and has radar coverage to the target airport, might arrange through his supervisor to control the assist until the aircraft has landed.

NASSRS requirements: 3.2.8.A,F,G

i. Provide Other In-Flight Assistance. While most assistance is to either help locate a lost pilot or safely land the aircraft expeditiously, sometimes the assistance might be to provide technical or medical advice. The controller may have to obtain such advice from outside sources.

NASSRS requirements: 3.2.8.B

9.4 Correlation with Operational Requirements

Table 9-1 summarizes the correlation of the in-flight assistance operational requirements paragraph of NAS-SR-1000 with the paragraphs describing the functions being performed by specialists/controllers. All in-flight assistance paragraph numbers of NAS-SR-1000 are listed; paragraphs which are introductory in nature, do not state an explicit operational requirement, or which reference other portions of NAS-SR-1000 are indicated with a dash. The fact that a correlation is shown between a requirements paragraph and a paragraph describing the specialist/controller functions performed should not be construed as indicating that the requirement is completely fulfilled.

TABLE 9-1
IN-FLIGHT ASSISTANCE OPERATIONAL REQUIREMENTS CORRELATION

POSITION	FSS SPECIALIST								DF SPECIALIST					CONTROLLER								
NAS-SR-1000 PARAGRAPH / PARAGRAPH	2.3.1.a	2.3.1.b	2.3.1.c	2.3.1.d	2.3.1.e	2.3.1.f	2.3.1.g	2.3.1.h	2.3.2.a	2.3.2.b	2.3.2.c	2.3.2.d	2.3.2.e	2.3.3.a	2.3.3.b	2.3.3.c	2.3.3.d	2.3.3.e	2.3.3.f	2.3.3.g	2.3.3.h	2.3.3.i
3.2.8 General	—	—	—	—	—	—	—	—	—		—		—	—	—	—	—	—	—	—	—	—
3.2.8 .A Monitor radio radar			X				X									X					X	
.A1 A/G		X													X		X					
.A2 Radio/responsibility		X													X		X					
.A3 Recording		X													X		X					
.A4 Frequency changes		X															X					
.A5 Notifying others		X															X					
.A6 Information type		X															X					
.B Evaluating action				X	X			X										X	X			X
.B1 NAS information														X								
.B2 Recommendation basis														X								
.C Comm. failure	—	—	—	—	—	—	—	—	—		—		—	—	—	—	—	—	—	—	—	—
.C1 Alerting ACFs	X													X	X							
.C2 By data message	X													X	X							
.D Comm. failure		X													X							
.E Aquiring information	X		X																			
.F Determine location							X	X												X	X	
.F1 Transponder location														X								
.F2 Accuracy														X								
.F3 VHF location									X		X											
.G Providing direction							X	X					X							X	X	

9.5 Operational Sequences

Figures 9-6 illustrates a common sequencing of the functions described in Section 9.3 and show how the various specialists interact with the user, other specialists and outside organizations. Figure 9-6 illustrates AFSS specialists assisting VFR pilots. Each row (space between dotted lines) contains only the actions (functions) of one specialist, one user or outside organization.

The numbers in the upper right hand corner of the action rectangles and upper vertices of the decision diamonds are reference numbers and progress more or less as time progresses during the assist. The letters that precede the action statements in the action rectangles correspond to the functions on Figures 9-3, 9-4, and 9-5. The cross hatching indicates an interface with, and processing by, automatic data processing equipment (FSDPS or ACCC/TCCC). Not all of the functions listed on Figures 9-3, 9-4, and 9-5 are shown on Figures 9-6 because the variety of assist situations would make the diagrams too complicated.

For example, in Figure 9-6 it shows, that if an aircraft must be landed, it is handed off to ATC. (Steps 7 and 8). While this is most likely to be true, there are situations where the AFSS specialist would maintain control and vector the aircraft to a landing site, using location information from the DF or radar information relayed from a controller. (See the input and output data on Figure 9-3.) To illustrate some uncommon assists, explicit hypothetical situations were devised (scenarios). These are presented in Section 9.5.

9.5.1 In-Flight Emergency Assistance to VFR Pilots

In Figure 9-6 the FSS specialist is monitoring his radio (1) when a pilot requests assistance (2). The specialists requests information from the pilot and the FSDPS as appropriate (3). (The sequence varies; the specialists may first query the pilot for basic data then query the FSDPS for the flight plan, or he may query the pilot for all information.) Once he obtains all necessary information (3 and 4), he can determine the nature of the assist (5, 7, and 9). If the pilot is lost the most likely assistance in finding him would come from the DF (6), although assistance could come from an ATC controller (see Section 9.5, and Figure 9-8).

If assistance in landing the aircraft is needed at a controlled airport the responsibility for the assist would be handed over to ATC (8). (The circle with the A, is a connect point to the next Figure 9-7.) If outside help is needed (9), the specialist will contact the appropriate organization (10), which will respond, (11) with, for example, medical advice. The specialist provides the assistance (12), to the user (13).

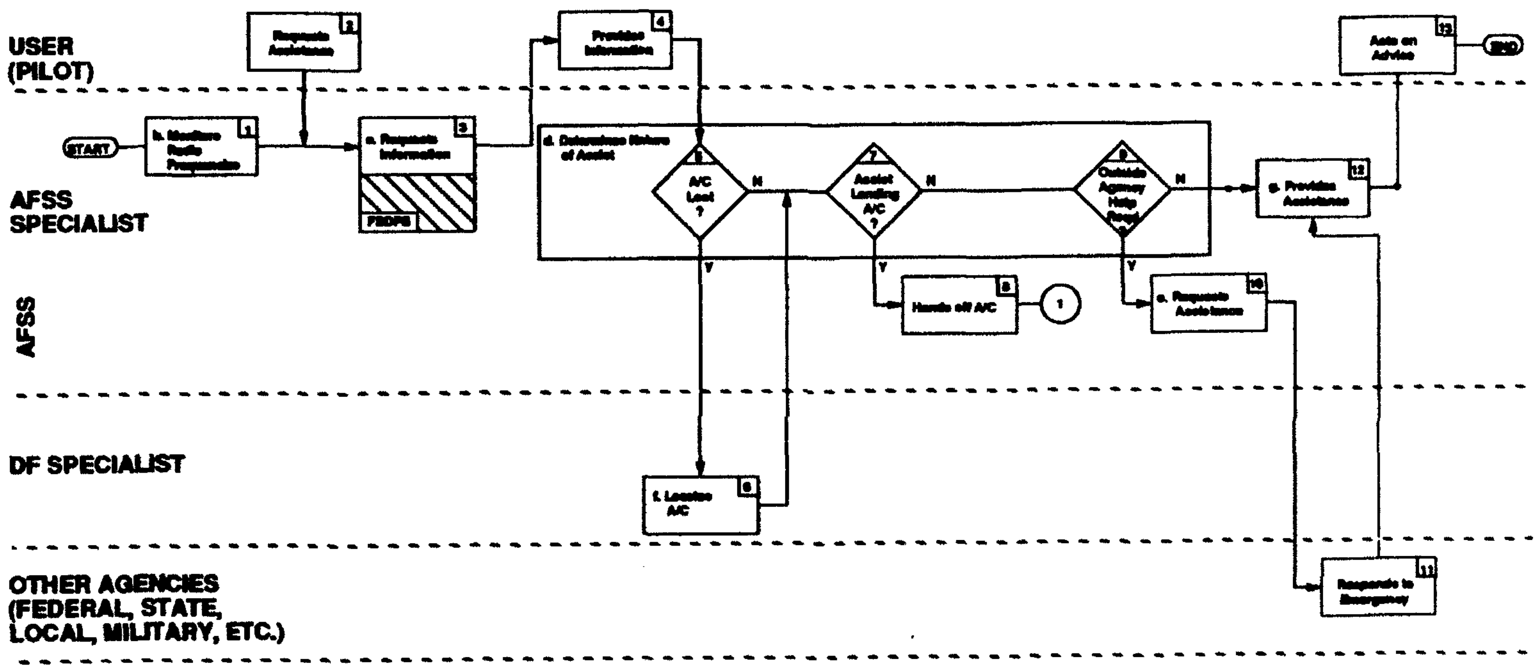


FIGURE 9-6
IN-FLIGHT EMERGENCY ASSISTANCE TO VFR PILOTS
OPERATIONAL SEQUENCE DIAGRAM

9.6 Operational Scenarios

Figures 9-7 through 9-11 present operational sequences for specific hypothetical situations (scenarios). They are similar to the sequence diagrams in Figures 9-6 in that they show functional sequences and interactions between specialists and users and amongst specialists, but differ in that they show more detail and only show one branch where a decision is made.

Again, each row illustrates the action of one of the participants and the numbers in the upper right hand corners of the action rectangles generally represents the sequence of their occurrence. The connections between rows illustrates the communications medium.

In Figures 9-7 through 9-11 there are branch points which signal that a different decision or outcome took place and reference a different scenario, which requires referring to another figure. For example, refer to Figure 9-7, block 8. In this scenario the ATC specialist (controller) "locates the beacon". If he does not locate the beacon, the reader is directed to go to Figure 9-9.

9.6.1 VFR Assists

Figures 9-7 through 9-11 present five variations of a scenario which involve a lost general aviation aircraft being assisted by an AFSS specialist. The first scenario (Figure 9-7) a pilot declares an emergency and contacts the specialist at the AFSS (1), (2). The specialist asks the pilots about the nature of the emergency (3) and obtains the needed information from the pilot (4). Other specialists assist by querying the database in the FSDPS (5). The specialist alerts the DF specialist (6) to assist in locating the lost pilot (7). The specialist then requests location assistance from ATC (8). The controller locates the aircraft via his beacon (9). Then the specialist turns over responsibility to the controller (16 and 17), who vectors the aircraft to a known fix (18 and 19).

There are three branch points on this scenario that lead to three other scenarios: Branch 1 on action 8, the beacon is not located, which leads to Figure 9-8; Branch 2 on action 11, control is not transferred, which leads to Figure 9-9; and Branch 3 on action 14, unable to contact ATC specialist, which leads to Figure 9-10.

Figures 9-8 and 9-9 are straight-forward and require no additional comment. Figure 9-10 illustrates a scenario, where during the assist, radio communications with the pilot is lost and search and rescue must be initiated. In this scenario the ATC specialist notifies the AFSS specialist that contact has been lost (2) and the AFSS specialist acknowledges (3). Once it has been determined that control of the situation should remain with the AFSS specialist (4) the ATC specialist notifies ATC facilities (5) and pilots (6) who receive notification (7). Once 30 minutes past the fuel exhaustion time (8) the AFSS specialist notifies the Rescue Coordination Center and begins the search and rescue process (9).

Also this scenario has a branch point on action 7, where another pilot has made visual contact with the lost aircraft and in the scenario in Figure 9-11, assists in vectoring him to a fix.

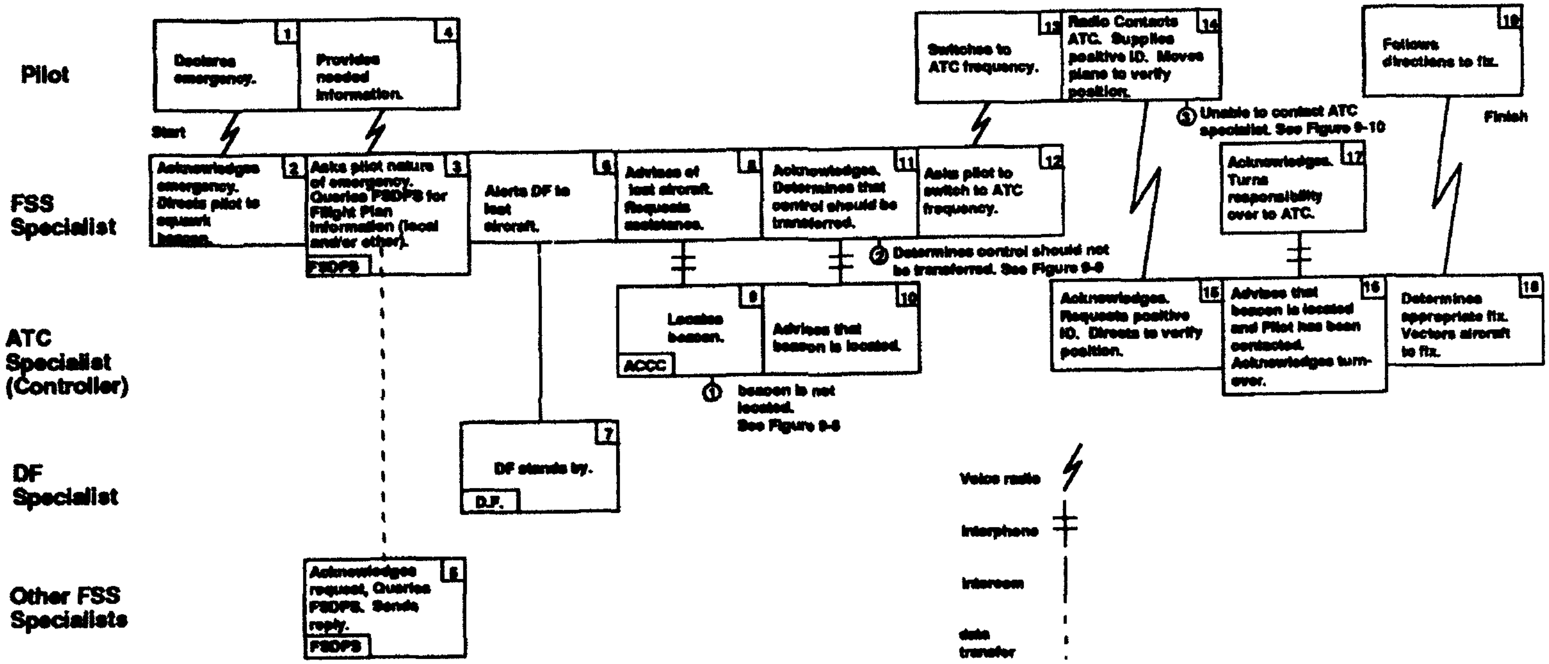


FIGURE 9-7
FIND LOST AIRCRAFT USING ATCRBS BEACON
OPERATIONAL SCENAIRO DIAGRAM

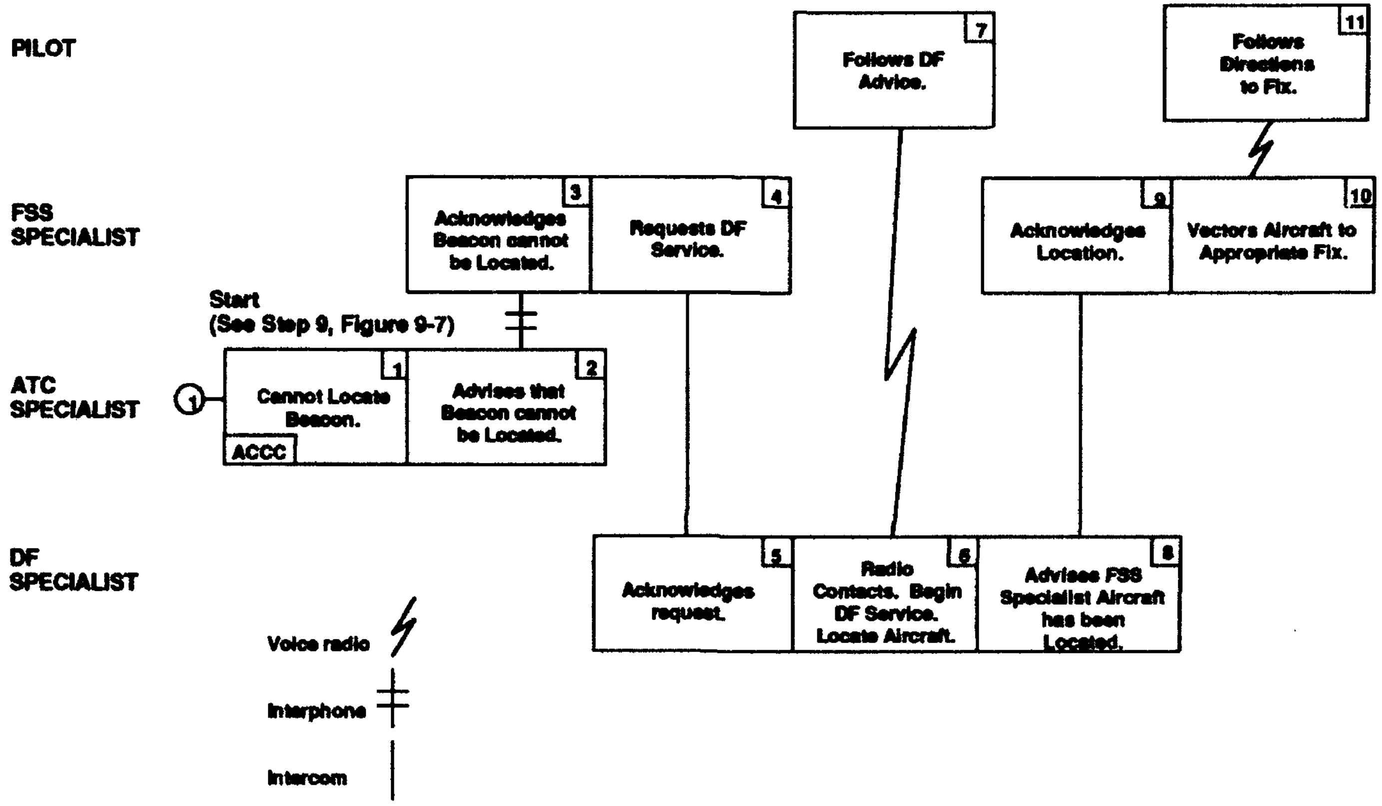


FIGURE 9-8
FIND LOST AIRCRAFT USING DF
OPERATIONAL SCENARIO DIAGRAM

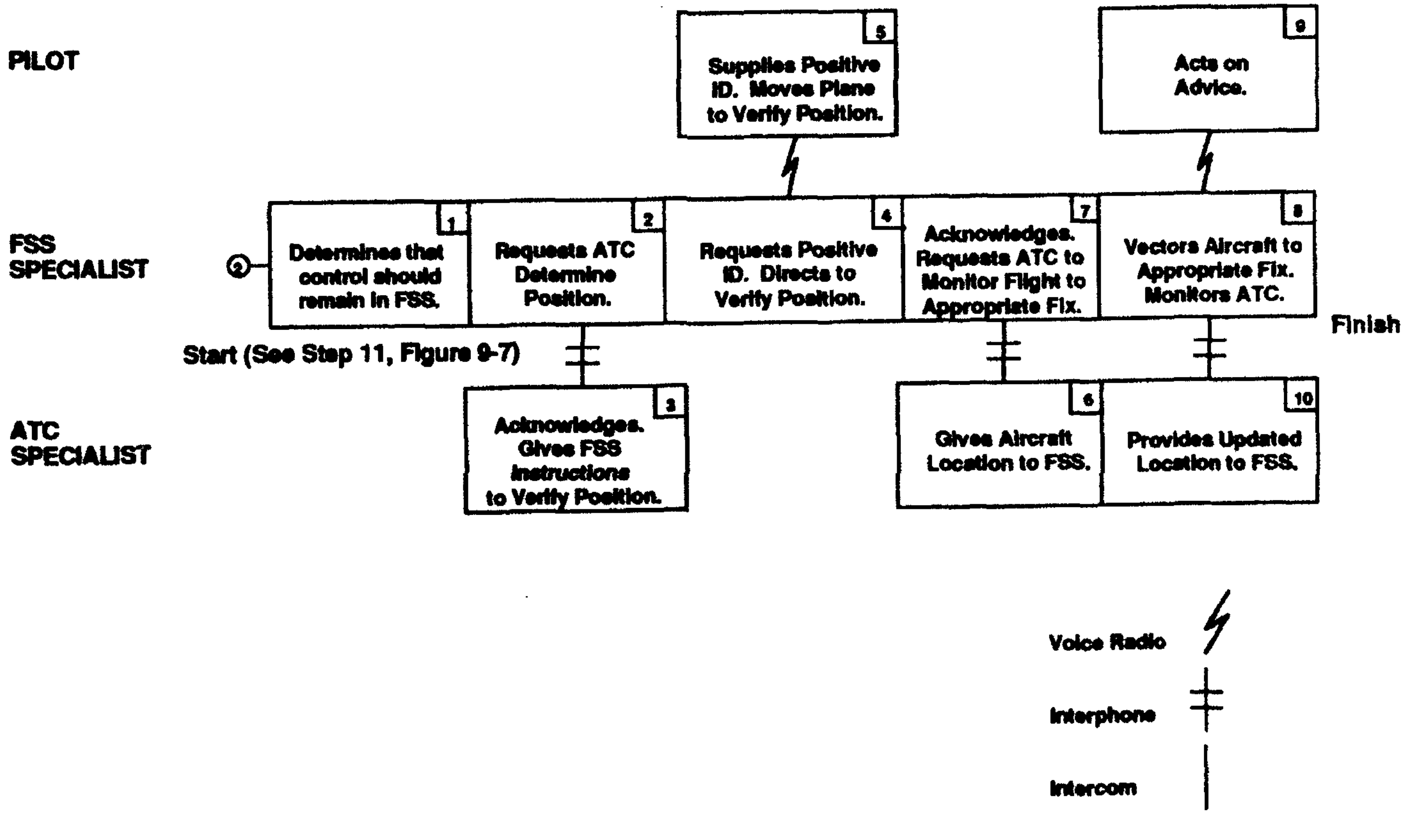


FIGURE 9-9
LOCATE AIRCRAFT VIA ATCRBS OR MODE S BEACON
OPERATIONAL SCENARIO DIAGRAM

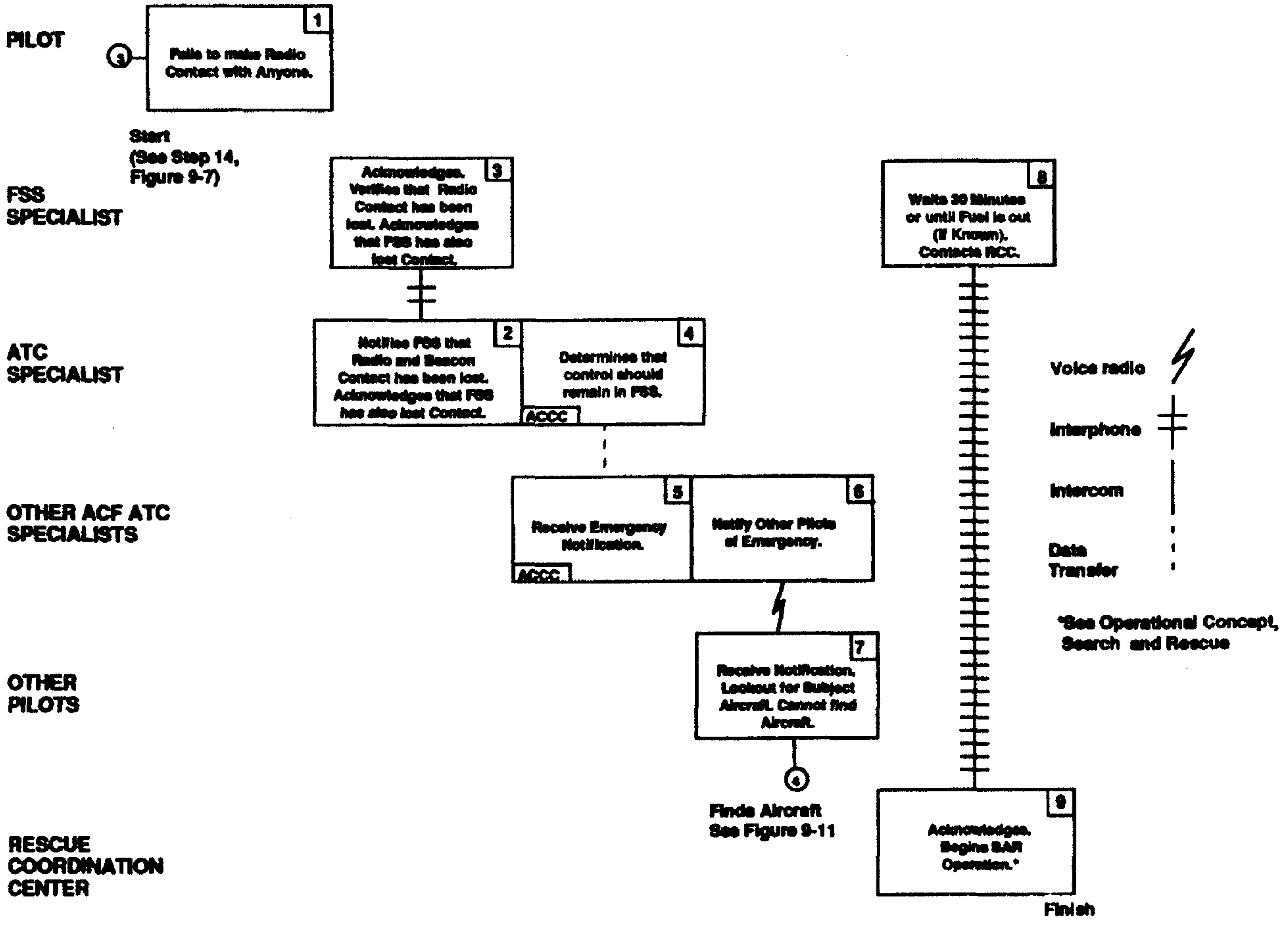


FIGURE 9-10
SEARCH AND RESCUE INITIATED
OPERATIONAL SCENARIO DIAGRAM

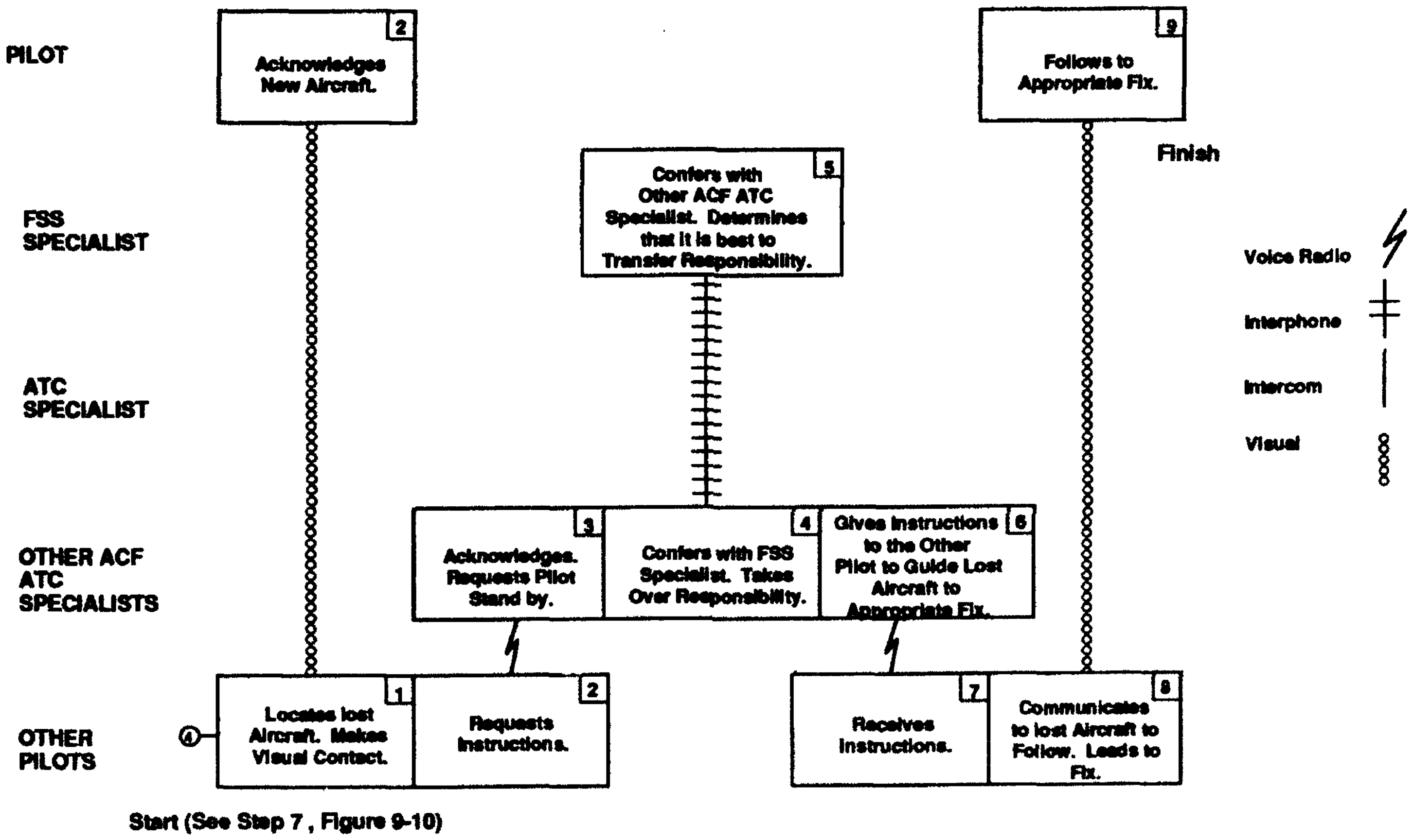


FIGURE 9-11
LOST AIRCRAFT
OPERATIONAL SCENARIO DIAGRAM

10.0 SEARCH AND RESCUE

There are many emergency situations which require National Airspace System (NAS) assistance. They include aircraft becoming lost, overdue, or making a forced landing. Many Federal, state, and local agencies supply resources for providing Search and Rescue (SAR) assistance. The NAS is required to detect the need, and to initiate and assist in SAR operations. The National Airspace System Requirements Specification (NASSRS), NAS-SR-1000, describes the requirements for providing this assistance to the users.

10.1 Support

The NAS is required to provide Search and Rescue assistance services to users. This requirement is described in Section 3.2.9 of the NASSRS. SAR assistance may be provided by Automated Flight Service Station (AFSS) specialists, En Route and Approach/Departure Controllers at an Area Control Facility (ACF), or the Clearance Delivery controller at an Airport Traffic Control Tower (ATCT).

Figure 10-1 is an overview of NAS/user interfaces for SAR services and illustrates the NAS facilities and systems involved.

Figure 10-2 is an operational block diagram showing the interrelationships between equipment, facilities, operators/users and the information necessary to support SAR operations.

10.2 Information

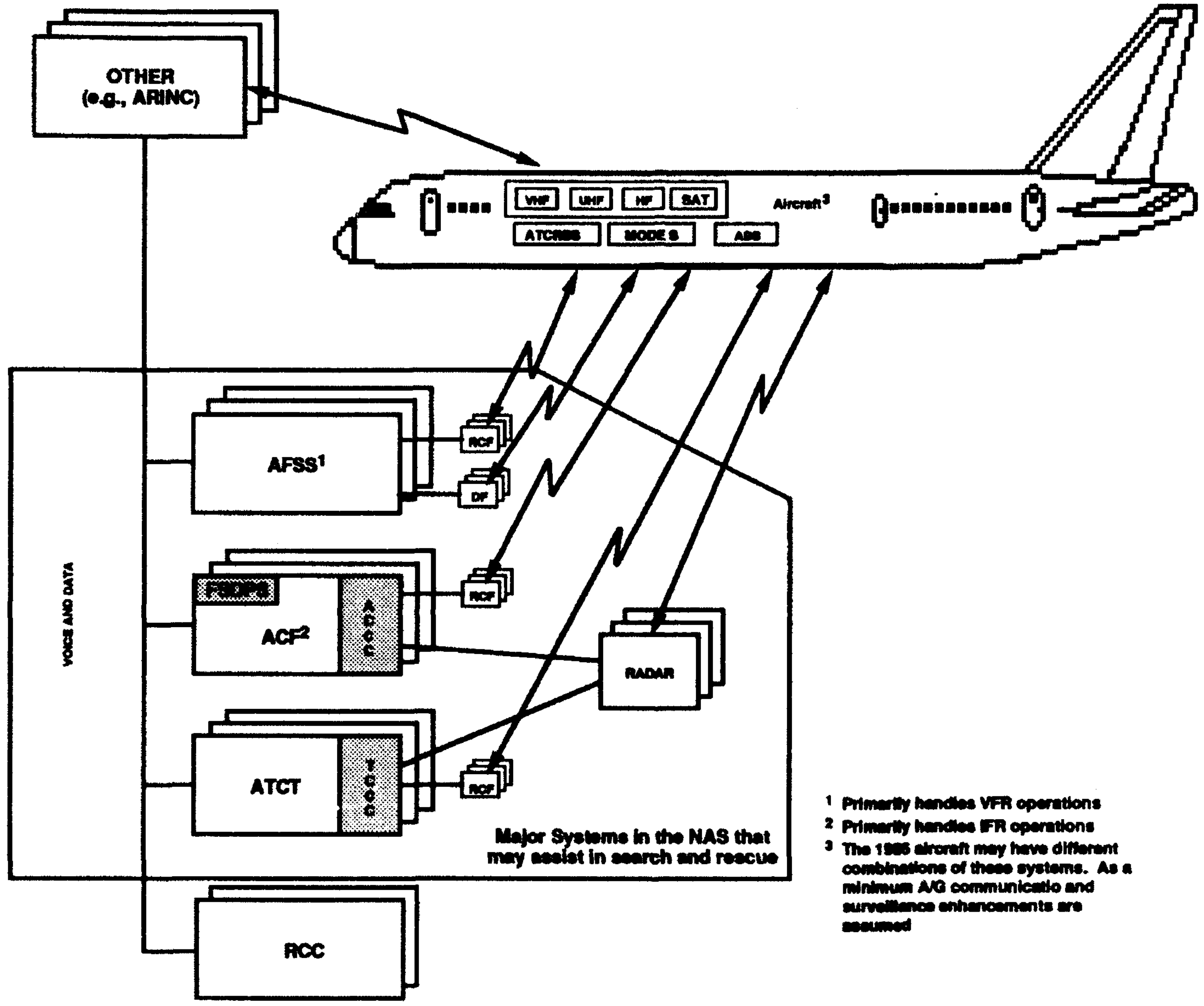
Since SAR is an effort that increases in intensity over time and expands in terms of the scope of resources required until a lost aircraft is found, the amount of information required to provide search and rescue will vary. Most SAR operations will require, however, a core of information obtained from a number of sources within the NAS.

10.2.1 Information from the Flight Plan

Flight plan information is obtained from the filed flight plan and amendments. Other information such as last known position of the aircraft and the last recorded heading is determined from actual pilot reports or other data. When SAR is initiated, further information is obtained from the flight plan. This flight plan information is stored in one of several processors, depending on where the flight plan was filed. The information is then made available if a SAR request is received concerning the particular flight plan in question. Additional fields obtained from the complete flight plan information provide a more detailed description, and include color of aircraft, the number of people on board, the amount of fuel on board before departure, the pilot's name and address, etc. This information may be stored at the Flight Service Data Processing System (FSDPS), a Direct User Access Terminal (DUAT) service, or the Area Control Computer Complex (ACCC).

10.2.2 Information about Weather Conditions

Information concerning weather conditions including the weather conditions in the area of last recorded or last known position of the aircraft, and the weather conditions along the last reported heading or predicted flight path as projected, are required as a minimum for SAR operations. This weather information is obtained from such sources as the FAA and the National Weather Service (NWS) and is available to the specialist through the FSDPS.



1 Primarily handles VFR operations

2 Primarily handles IFR operations

3 The 1995 aircraft may have different combinations of these systems. As a minimum A/G communicatio and surveillance enhancements are assumed

FIGURE 10-1

OVERVIEW OF NAS/USER SYSTEMS FOR SEARCH AND RESCUE

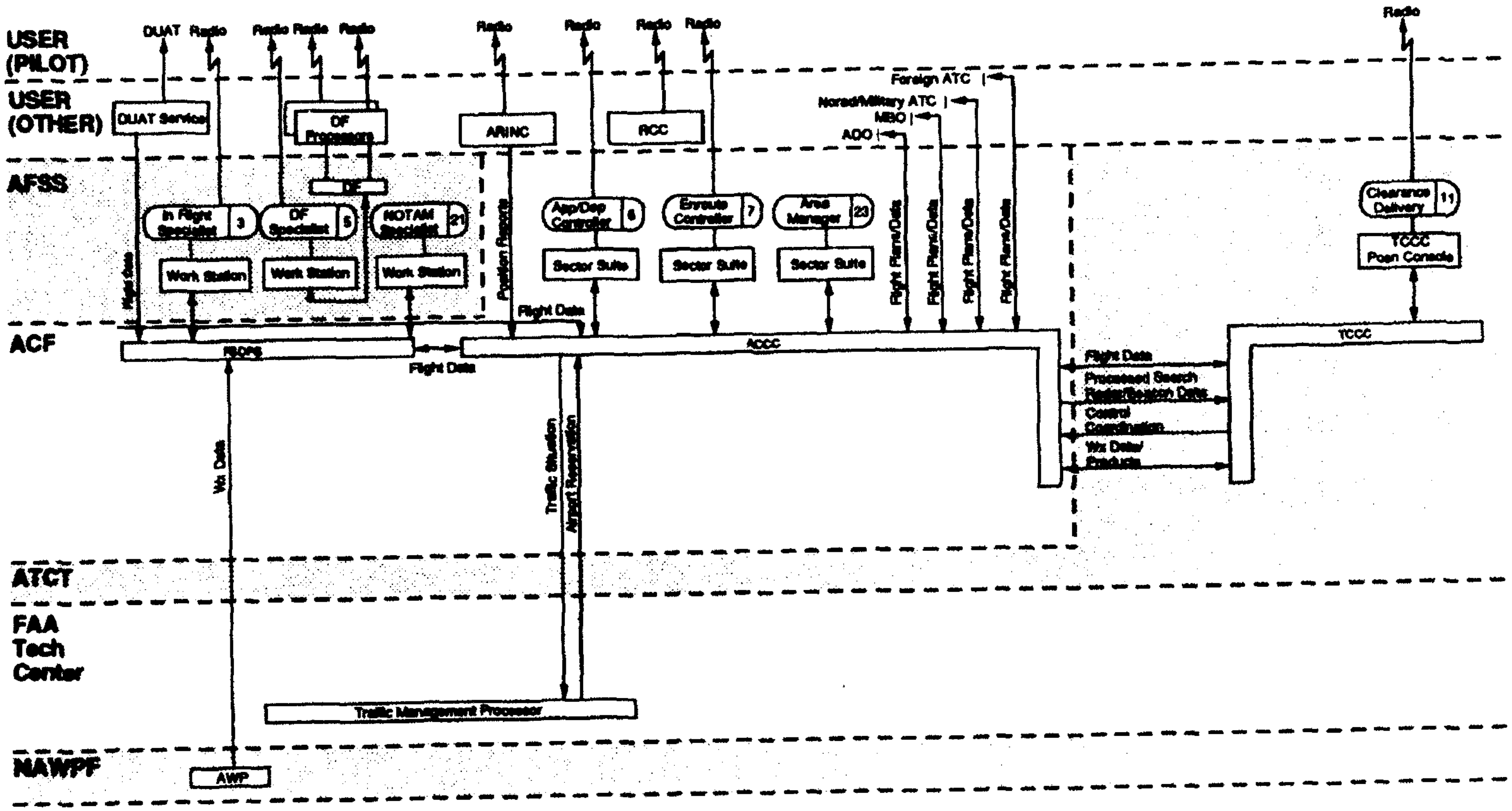


FIGURE 10-2

SEARCH AND RESCUE
OPERATIONAL BLOCK DIAGRAM

10.2.3 Information about ELT signals

Most aircraft in the United States are equipped with an Emergency Locator Transmitter (ELT). This transmitter is battery operated and emits a distinctive audio tone on 121.5 MHz or 243.0 MHz. If armed they are designed to automatically activate when subjected to crash generated forces and continuously emit these signals. The location of any ELT signal is determined from direction finding (DF) triangulation within the NAS or through outside agencies, pilot reports (PIREP), and Search and Rescue Satellite (SARSAT). SARSAT is a group of satellites that circle the earth monitoring frequencies 121.5/243.0 MHz. When an ELT is detected the satellite relays the position of the transmission to the satellite tracking facility, which in turn relays the information to the RCC.

10.2.4 Information from the NAS

The NAS facilities and resources provides a list of aerodromes, terminal areas, and Area Control Facilities (ACFs) located within a 100-mile-wide corridor along the projected route from the last known or last reported position of the aircraft. This allows SAR personnel to determine the initial area of search.

10.3 Functions

The following paragraphs describe in more detail the functions provided by the specialist/controller positions introduced in Section 2.1. The Operational Flow Diagrams associated with each paragraph illustrate the information flow between the specialist and the user, between the specialist and other specialists, and between the specialist and data processing equipment. The functions performed by the NAS are explicitly covered by requirements specified in the NASSRS. The pertinent NASSRS paragraphs that specify the function being performed by the NAS are referenced in each of the paragraphs that follow. As used in this paragraph, the term "specialist" also includes controllers.

10.3.1 In-Flight Specialist (Position 3)

The In-Flight Specialist provides SAR assistance once notified that an aircraft is overdue or unreported. The In-Flight Specialist is responsible for monitoring all in-flight frequencies, including the emergency frequencies of 121.5/243.0 MHz for ELT transmissions.

Figure 10-3 is an operational flow diagram describing the functions and services provided by the In-Flight Specialist at the Automated Flight Service Station (AFSS). Functions performed by the equipment and the In-Flight Specialist are lettered within each block and are described in the corresponding paragraphs below.

a. FSDPS Processing. The Flight Service Data Processing System (FSDPS) provides the processing capability and support to enable the AFSS specialist to assist in SAR by providing aerodrome information within a 100 mile-wide corridor along the projected route of flight.

   NASSRS Requirement 3.2.9.E

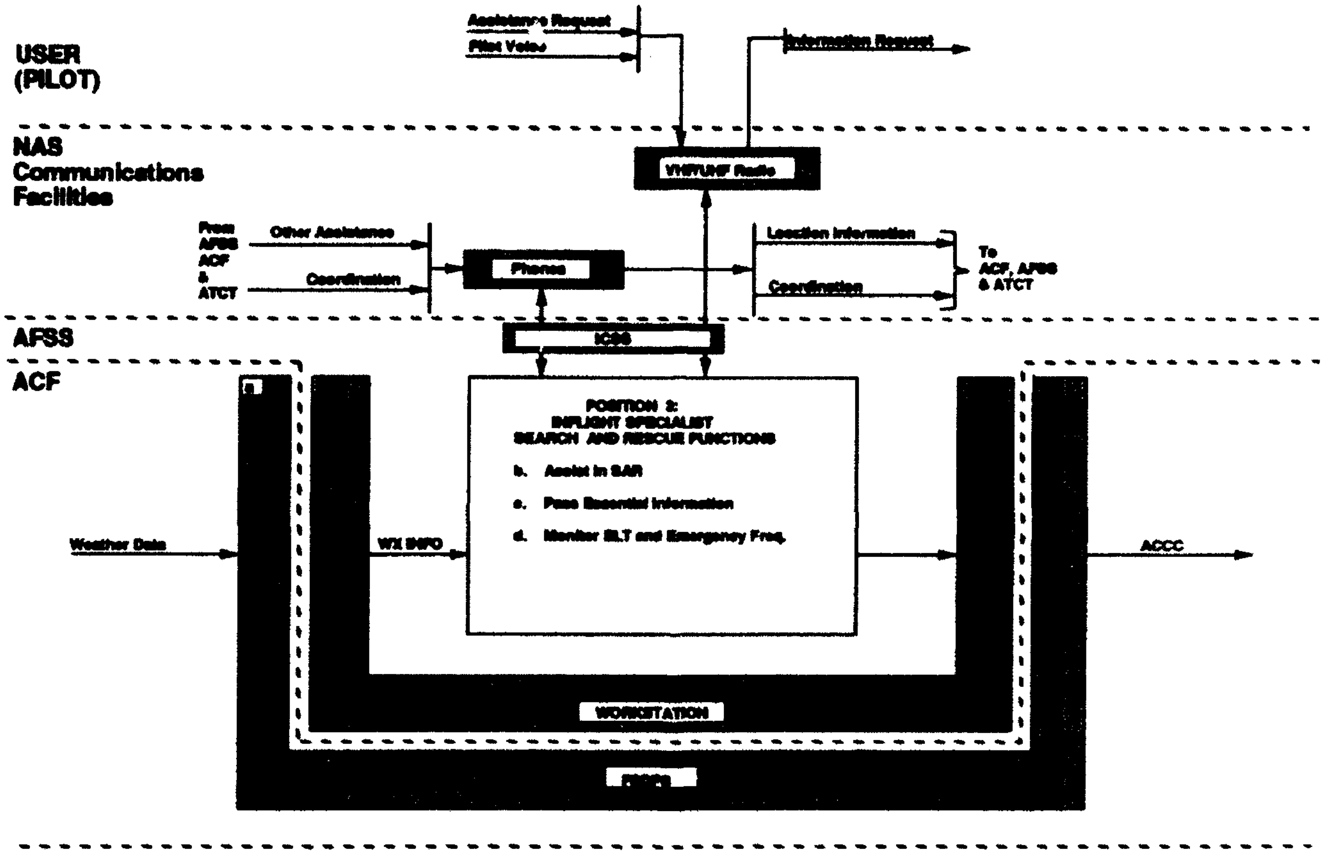


FIGURE 10-3
IN-FLIGHT SPECIALIST (POSITION 3)
OPERATIONAL FLOW DIAGRAM

b. Assistance in Search and Rescue. The In-Flight Specialist provides essential information concerning overdue/unreported aircraft, including: information contained on original and amended flight plan, last recorded or last known position, last recorded heading, and weather conditions along projected path.

NASSRS Requirement 3.2.9.C

c. Essential Information. The FSDPS provides essential information from the flight data base to the specialist.

NASSRS requirement 3.2.9.C

d. Monitors for ELT. The In-Flight Specialist monitors 121.5/243.0 MHz for ELT transmissions.

NASSRS Requirement 3.2.9.D

10.3.2 Direction Finder Specialist (Position 5)

The DF Specialist assists SAR operations by determining an aircraft's location using direction finding equipment. This specialist also monitors 121.5 and 243.0 MHz for ELT transmissions and can determine the geographical coordinates of the transmitting aircraft.

Figure 10-4 is an operational flow diagram describing the functions and services provided by the DF Specialist at the AFSS. Functions performed by the equipment and this specialist are lettered within each block and are described in the corresponding paragraphs below.

a. DF. The DF equipment determines the aircraft's location from the radio signals transmitted from the aircraft.

NASSRS Requirement 3.2.9.C

b. Provide assistance in Search and Rescue operations (such as position information). The Direction Finder Specialist determines the aircraft's position using the DF equipment.

NASSRS Requirement 3.2.9.C

c. Monitor transmissions from Emergency Locator Transmitters (ELT). The DF Specialist monitors frequency 121.5/243.0 MHz to detect ELT transmissions.

NASSRS Requirement 3.2.9.D

d. Provide geographic coordinates of ELT transmission sites. Upon receiving an ELT transmission, or report of an ELT transmission from a non-ATC source, the DF Specialist utilizes his DF equipment, or a combination of pilot reports and satellite reports, to determine the geographic coordinates of ELT transmission sites.

NASSRS Requirement 3.2.9.D

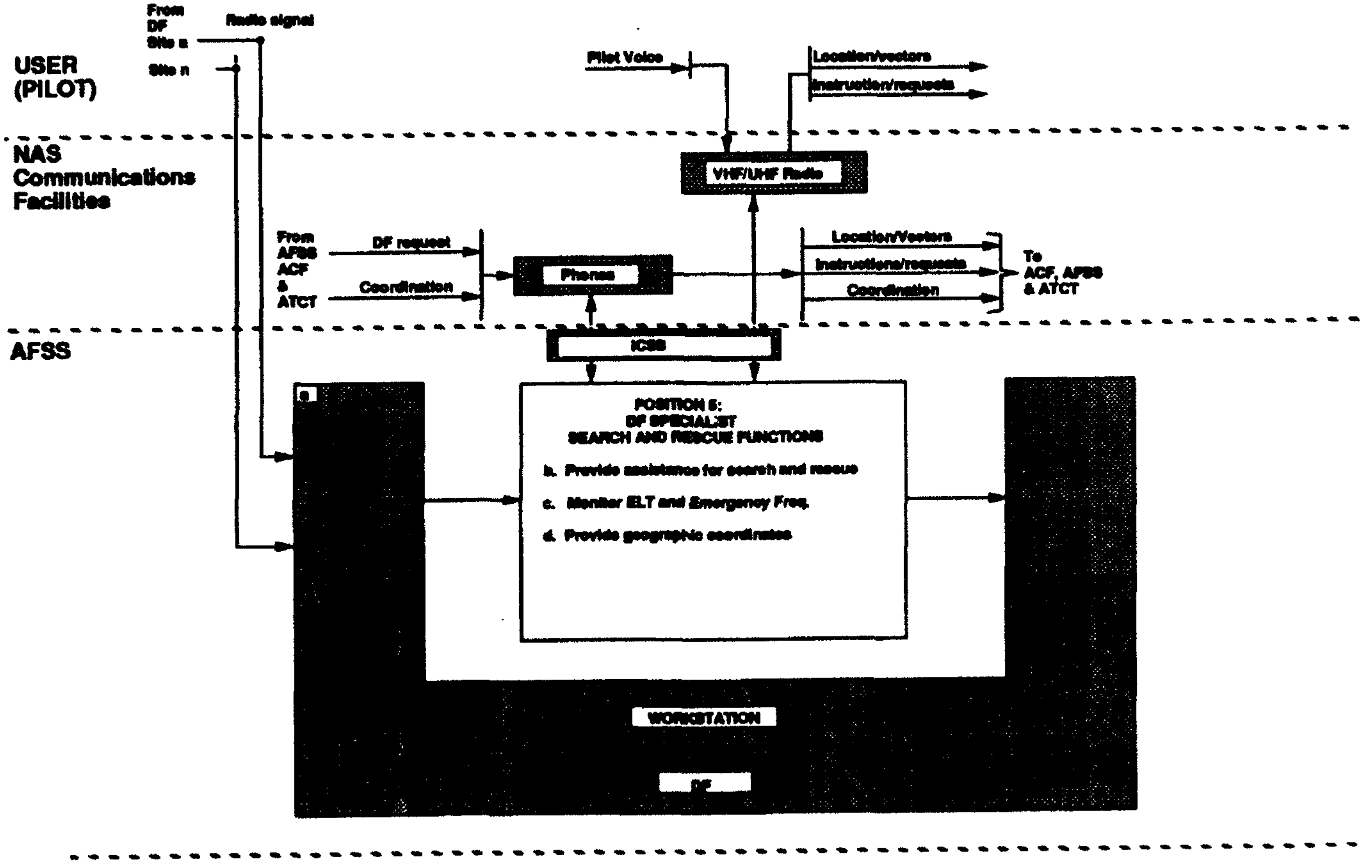


FIGURE 10-4
DF SPECIALIST (POSITION 5)
OPERATIONAL FLOW DIAGRAM

10.3.3 NOTAM Specialist (Position 21)

Notice to Airmen (NOTAM) Specialists are notified by the FSDPS whenever a visual flight rules (VFR) flight plan is 30 minutes overdue (15 minutes when over established hazardous areas). From their position they can query the flight data base to review the full flight plan for further information.

The NOTAM Specialist initiate a communications search within a 100-mile-wide corridor along the aircraft's intended route of flight. If not found, an initial information request message, or "QALQ" message, is generated. This message is issued to the departure station to request additional information. If the results of this action are negative, the NOTAM Specialist initiates an Information Request (INREQ) to all stations along the same 100-mile-wide corridor (including terminal control facilities and ACF's) and to the Rescue Coordination Center (RCC). If the aircraft is not found within one hour after the INREQ, or the results are negative, the NOTAM Specialist issues an Alert Notice (ALNOT). Once an ALNOT is issued the NOTAM Specialist calls the RCC to confirm receipt of the ALNOT message.

If after one hour the aircraft is not located or the search results are negative, all pertinent available information about the overdue aircraft not already provided is forwarded to the RCC. The RCC notifies outside agencies such as the Civil Air Patrol, U.S. Coast Guard, state and local law enforcement agencies, etc.

Figure 10-5 is an operational flow diagram describing the functions and services provided by the NOTAM Specialist in the AFSS. Functions performed by the equipment and the NOTAM specialist are lettered within each block and are described in the corresponding paragraphs below.

a. FSDPS Processing. The FSDPS provides the processing capability and support to enable the AFSS Specialist to detect when an aircraft on a VFR flight plan is 30 minutes overdue (15 minutes for aircraft operating over NAS-designated hazardous areas).

   NASSRS Requirement 3.2.9.A

b. Detect Overdue or Unreported Aircraft. The NOTAM Specialist is alerted when the difference between the current time and the expected time of arrival (ETA) exceeds 30 minutes (15 minutes over NAS-designated hazardous areas).

   NASSRS Requirement 3.2.9.A

c. Initiate Search and Rescue. Once notified by the FSDPS that an aircraft is overdue or unreported, the NOTAM Specialist initiates SAR procedures.

   NASSRS Requirement 3.2.9.B

d. Assist in Search and Rescue Operations. The NOTAM Specialist assists in SAR operations by providing essential information concerning flight plan, last known position, last known heading, weather conditions along last known position, and weather

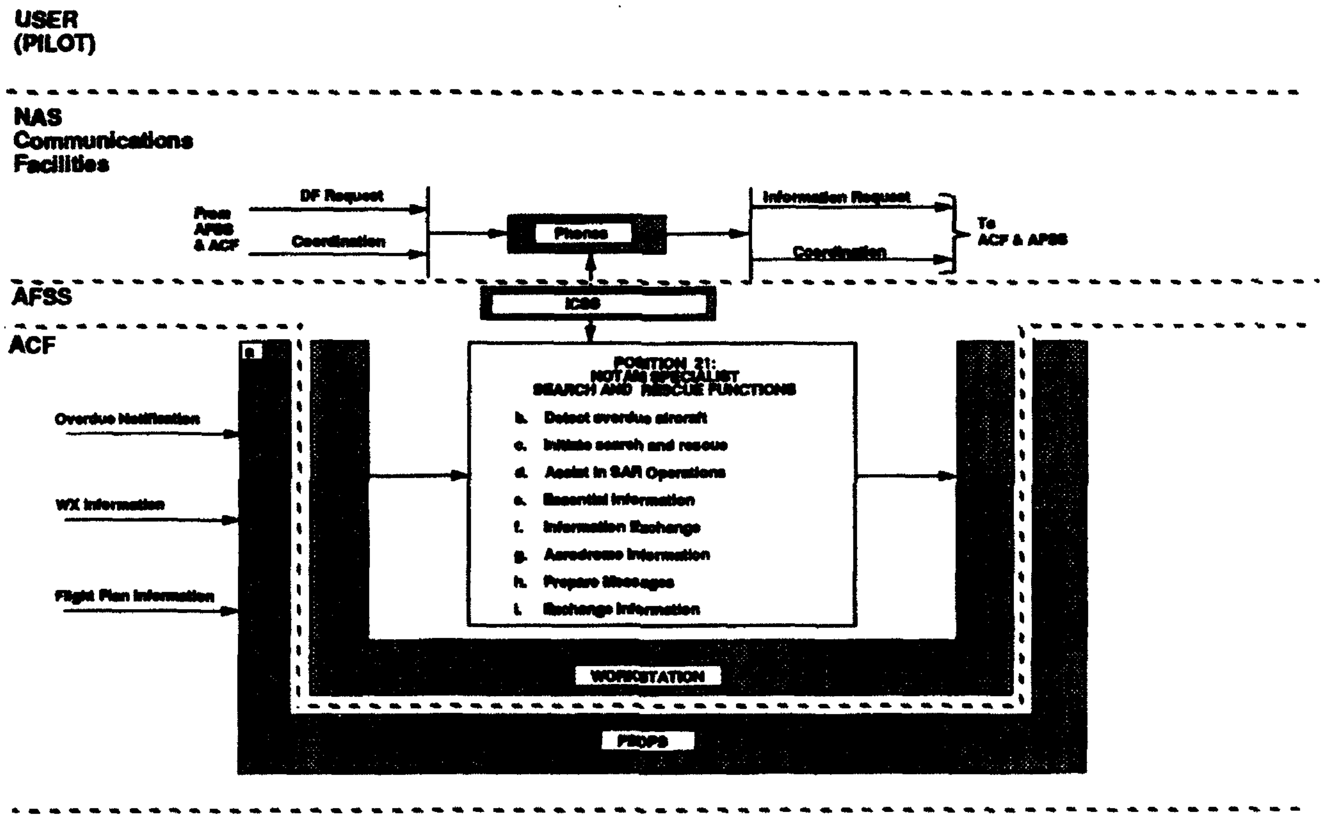


FIGURE 10-5
NOTAM SPECIALIST (POSITION 21)
OPERATIONAL FLOW DIAGRAM

conditions projected along last reported heading or projected flight path.

NASSRS Requirement 3.2.9.C

e. Essential Information. Essential flight plan information is provided to the NOTAM Specialist through the FSDPS. This information is loaded into the FSDPS by AFSS personnel, the Direct User Access Terminal (DUAT), or military base operations.

NASSRS Requirement 3.2.9.C

f. Information Exchange. The NOTAM Specialist exchanges essential information with the appropriate rescue coordination center; military, Federal, state, or local SAR facilities; any neighboring foreign ATC and/or military ATC facilities; and airborne pilots in the area.

NASSRS Requirement 3.2.9.C

g. Aerodrome Information. The NOTAM Specialist position is capable of requesting a list of aerodromes, terminal areas, and ACF's located within a 100-mile-wide corridor along the projected route of the overdue/unreported aircraft.

NASSRS Requirement 3.2.9.E

h. Prepare Messages. The NOTAM specialist prepares and review messages prior to transmission. These messages contain, as a minimum, the following information:

1. Type of emergency
2. Aircraft identification
3. Aircraft type and description
4. Destination
5. Aircraft endurance (from flight plan)
6. Last recorded position
7. Last recorded heading
8. Number and identification (if available) of passengers
9. Other remarks deemed pertinent by specialist.

NASSRS Requirement 3.2.9.F

i. Exchange Information. The NOTAM Specialist exchanges information with all agencies and facilities concerned with Search and Rescue activities.

NASSRS Requirement 3.2.9.G

10.3.4 Approach/Departure Controller (Position 6) and En Route Controller (Position 7)

The Approach/Departure Controller and En Route Controller provide assistance to SAR operations when notified that an aircraft is overdue/unreported. The services provided are sufficiently similar to warrant a common description although the focus of the services provided is somewhat different.

Approach/Departure Controllers, when notified of an overdue aircraft in their sector, promptly notifies supervisory personnel who advise the Area Manager. The Area Manager initiates SAR procedures. The AFSS is notified if the aircraft was on a VFR flight plan, or the host ACF if the aircraft was on an instrument flight rules (IFR) flight plan.

When notified by other controllers or through his Sector Suite that an aircraft is overdue/unreported, En Route Controllers initiate SAR procedures for aircraft on an IFR flight plan by notifying their Area Supervisor.

Figure 10-6 is an operational flow diagram describing the functions and services provided by the Approach/Departure Controller and En Route Controller in the ACF. Lettered blocks identify the functions performed by these controllers, which are described in the corresponding paragraphs below.

a. ACCC Processing. The Area Control Computer Complex (ACCC), which is used by both Approach/Departure Controllers and En Route Controllers, houses the flight data base that is used to review an IFR aircraft's flight plan. The ACCC is accessed through Sector Suites.

NASSRS Requirement 3.2.9.B, 3.2.9.C

b. Detect Overdue Or Unreported Aircraft. The Approach and En Route Controllers are notified when the difference between the current time and the expected time of arrival (ETA) at the destination terminal exceeds 30 minutes.

NASSRS Requirement 3.2.9.A

c. Initiate Search and Rescue. When notified that an aircraft is overdue, these controllers initiate SAR procedures.

NASSRS Requirement 3.2.9.B

d. Provide Assistance. Both the Approach/Departure and En Route Controllers query their databases to determine information on an aircraft's filed flight plan, last known position, and weather conditions at the nearest weather reporting station.

NASSRS Requirement 3.2.9.C

e. Essential Information. The ACCC provides the Approach and En Route Controllers with essential information through their Sector Suites.

NASSRS Requirement 3.2.9.C

f. Monitoring ELT Transmissions. All air traffic control facilities monitor 121.5/243.0 MHz for ELT transmissions on a continuing basis. Additionally, these facilities initiate SAR procedures when notified of an ELT transmission from non-ATC sources, such as pilots, amateur radio operators, and satellites.

NASSRS Requirement 3.2.9.D

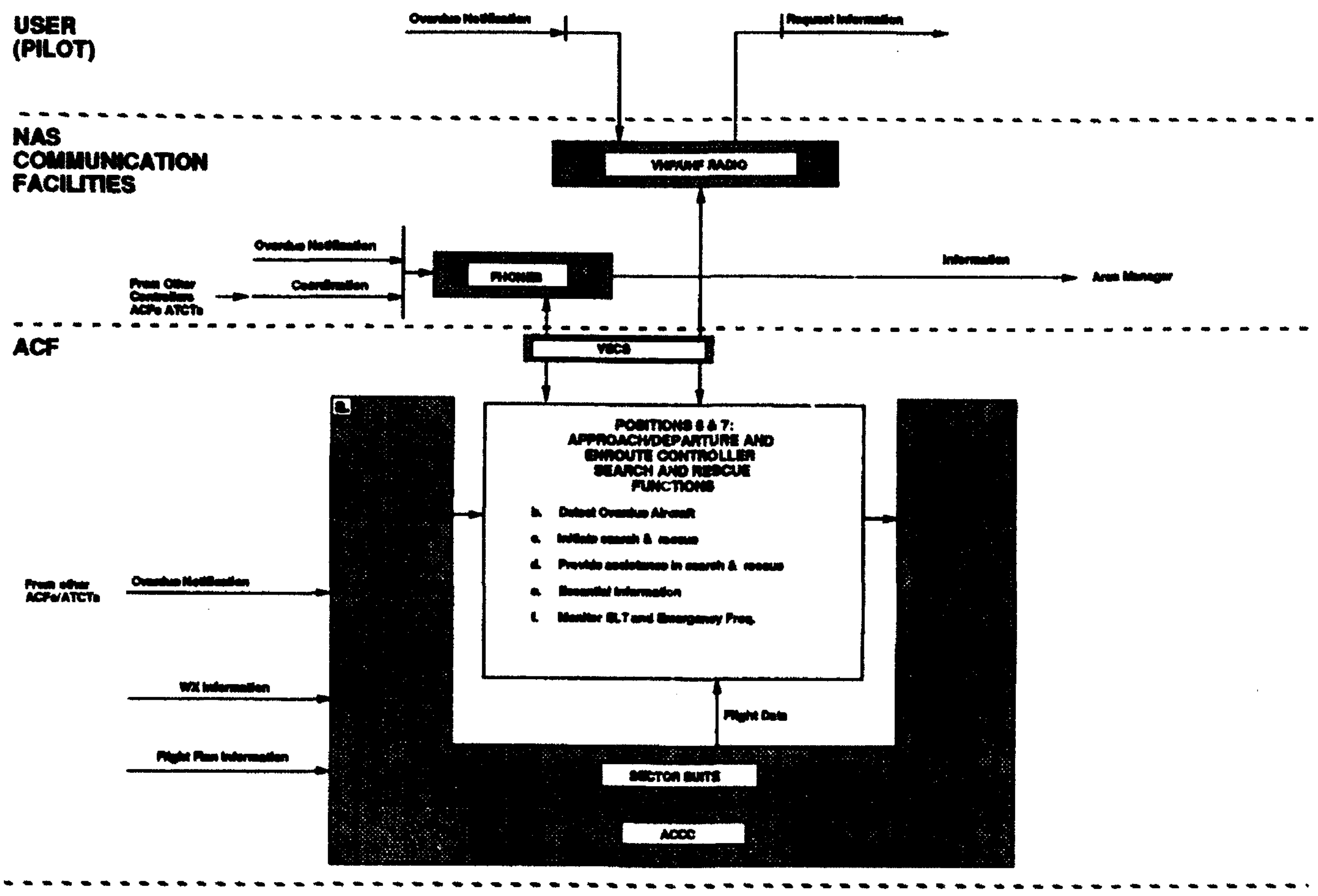


FIGURE 10-6
APPROACH/DEPARTURE AND ENROUTE
CONTROLLERS (POSITIONS 6 AND 7)
OPERATIONAL FLOW DIAGRAM

10.3.5 Area Manager (Position 23)

Once notified of an overdue or unreported aircraft, the Area Manager notifies the appropriate facilities with all pertinent information about the aircraft. Upon receiving an INREQ or ALNOT, the Area Manager checks facility records to determine if the aircraft had been contacted by his facility. He notifies the originator of the results of this check within one hour of the time the alert was received.

If his facility had been working the aircraft, the Area Manager initiates an Alert Notice (ALNOT) and pass all pertinent information to the RCC as soon as it is available. Once sent, the Area Manager calls the RCC to confirm receipt of the ALNOT message.

The Area Manager transfers responsibility for further search to the RCC when one of the following occurs:

- Thirty minutes have elapsed after the estimated aircraft fuel exhaustion time.
- The aircraft has not been located within one hour after ALNOT issuance.
- The ALNOT search has been completed with negative results.

The Area Manager cancels the ALNOT when the aircraft is located or the search is abandoned.

Figure 10-7 is an operational flow diagram describing the functions and services provided by the Area Manager. Lettered blocks identify the functions performed, which are described in the corresponding paragraphs below.

a. ACCC Processing. The ACCC, which is used by the Area Manager, houses the flight data base that is used to review an IFR aircraft's flight plan.

   NASSRS Requirement 3.2.9.C

b. Exchange of Essential Information. The Area Manager working in the ACF has access to the same information as the En Route and Approach Controllers as well as: the appropriate Rescue Coordination Center; military, Federal, state, and local search and rescue facilities; adjacent foreign ACF and/or military ACF facilities; and pilots airborne in the immediate area to further the exchange of essential information.

   NASSRS Requirement 3.2.9.C

c. Airspace Reservation. The Area Manager, working through his sector suite, accesses the ACCC to create an airspace reservation in the immediate area of search and rescue operations.

   NASSRS Requirement 3.2.9.C

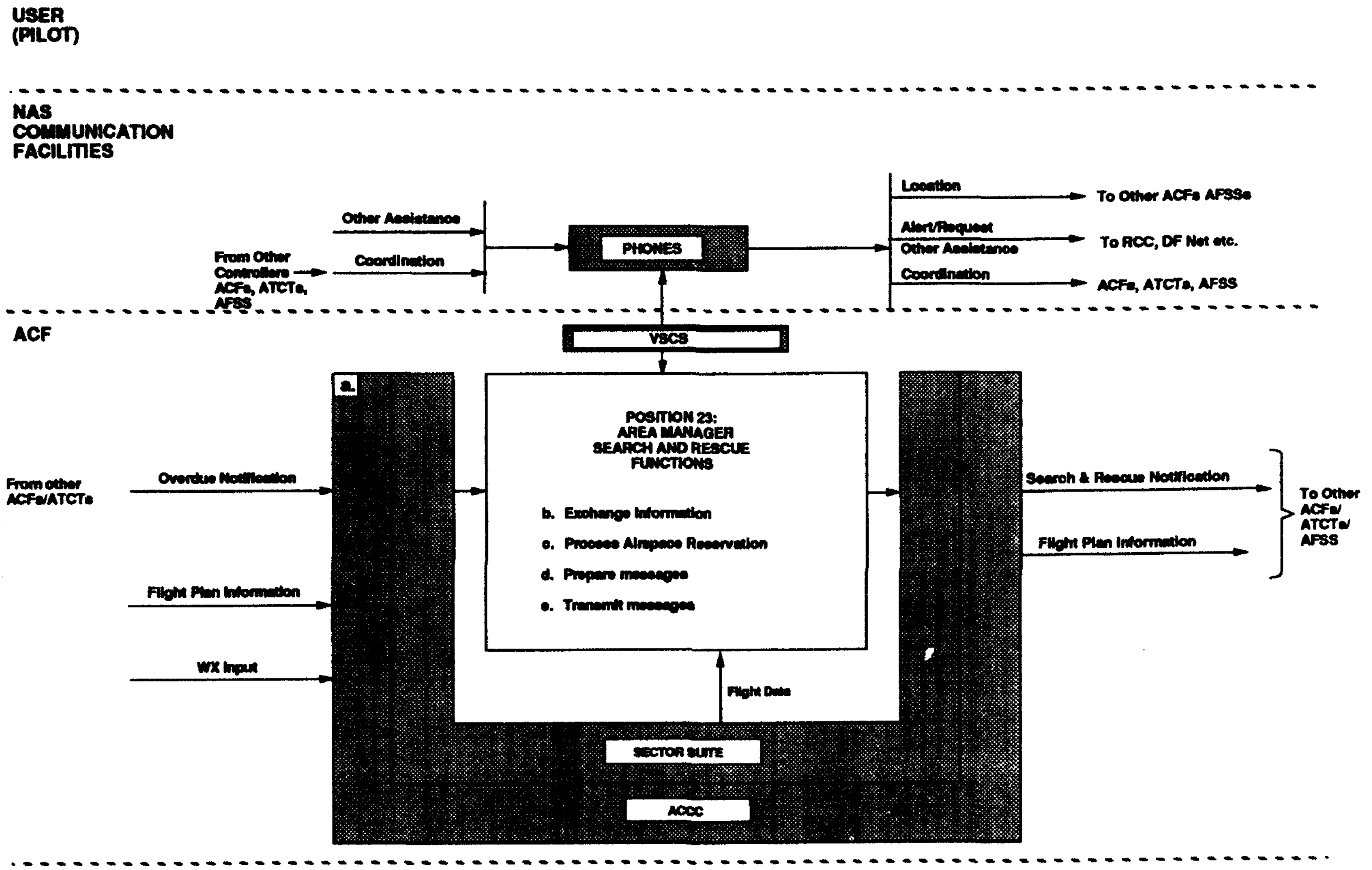


FIGURE 10-7
AREA MANAGER (POSITION 23)
OPERATIONAL FLOW DIAGRAM

d. Prepare Messages on Overdue/Unreported Aircraft. The En Route Controllers in the ACF are primarily responsible for initiating SAR on IFR aircraft. When notified that an aircraft is 30 minutes overdue or unreported, the Area Manager prepares and reviews an Alert Notice (ALNOT) message to be transmitted along the aircraft's projected route of flight.

NASSRS Requirement 3.2.9.F

e. Transmit Messages Concerning an Overdue/Unreported Aircraft. Once an ALNOT has been reviewed by the Area Manager, it is transmitted via the NADIN network to all agencies and facilities concerned with SAR activities.

NASSRS Requirement 3.2.9.G

10.3.6 Clearance Delivery (Position 11)

The Clearance Delivery Controller, when notified that an aircraft is overdue or unreported, assists in SAR operations. This controller checks with aircraft on his frequencies, queries the flight database, and advises the supervisory personnel, who forwards any information to the Area Manager in his host ACF.

Figure 10-8 is an operational flow diagram describing the functions and services provided by the Clearance Delivery Controller in the Control Tower. Lettered blocks identify the functions performed and are described in the corresponding paragraphs below.

a. TCCC Processing. The Tower Control Computer Complex (TCCC), through the TCCC Position Console, is the primary tool that controllers use to access the flight database.

NASSRS Requirement 3.2.9.C

b. Detect Overdue Or Unreported Aircraft. The Clearance Delivery Controller is alerted by TCCC through his TCCC Position Console when the difference between the current time and the expected time of arrival (ETA) at the destination terminal exceeds 30 minutes.

NASSRS Requirement 3.2.9.A

c. Assist In Search And Rescue. The Clearance Delivery Controller provides essential information contained on the original flight plan, last known position, last recorded heading, and weather conditions (if known).

NASSRS Requirement 3.2.9.C

d. Monitor For ELT Transmissions. Tower Controllers monitor 121.5/243.0 MHz for ELT transmissions.

NASSRS Requirement 3.2.9.D

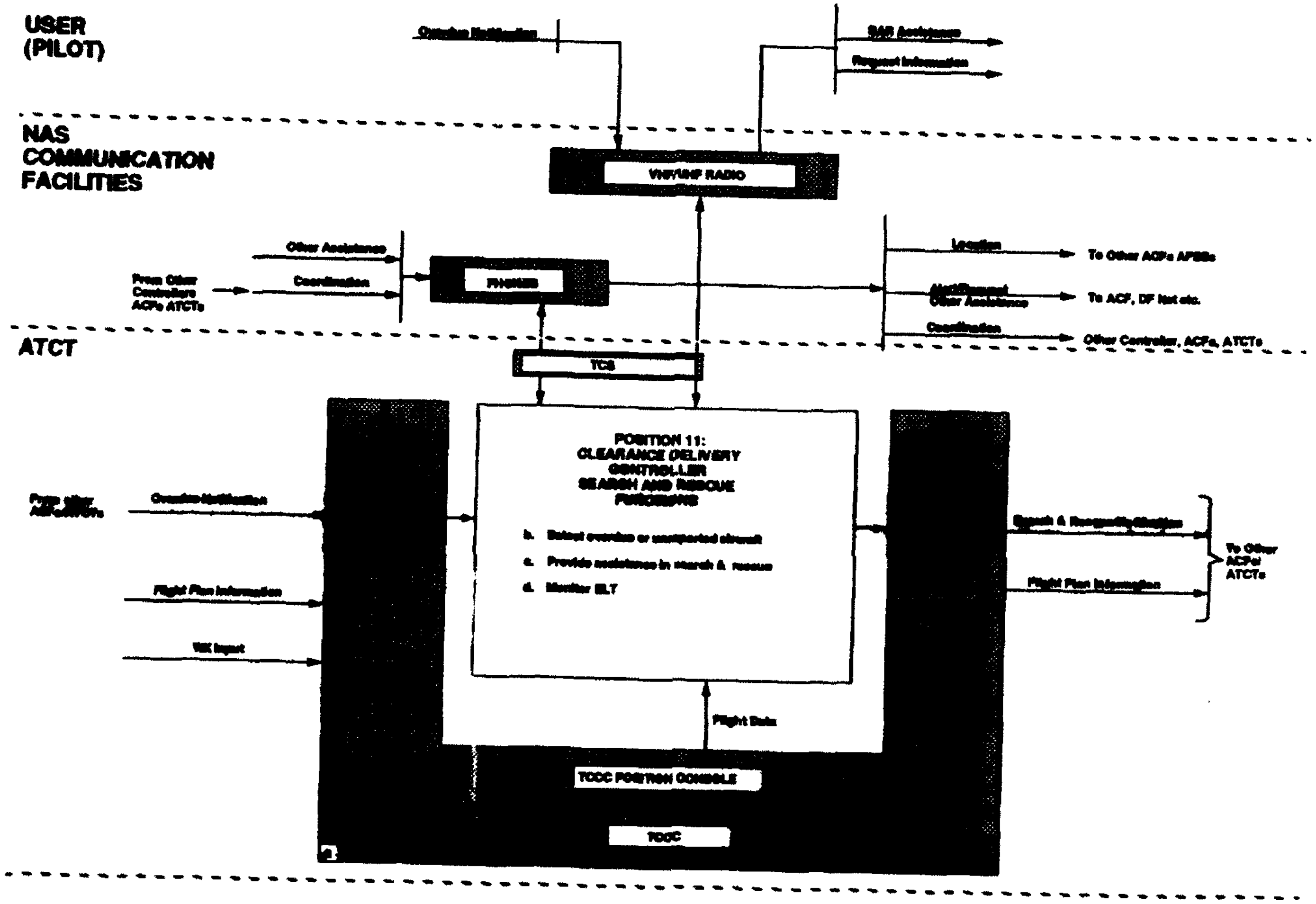


FIGURE 10-8
CLEARANCE DELIVERY CONTROLLER (POSITION 11)
OPERATIONAL FLOW DIAGRAM

10.4 Correlation with Operational Requirements

Table 10-1 summarizes the correlation of the SAR operational requirements paragraphs of NAS-SR-1000 with the paragraphs describing the functions being performed by specialists/controllers/managers. All SAR paragraph numbers of NAS-SR-1000 are listed; paragraphs which are introductory in nature, do not state an explicit operational requirement, or reference other portions of NAS-SR-1000 are indicated with a dash. The fact that a correlation is shown between a requirements paragraph and a paragraph describing the specialist/controller/manager functions performed should not be construed as indicating that the requirement is completely fulfilled.

TABLE 10-1
SEARCH AND RESCUE OPERATIONAL REQUIREMENTS CORRELATION

POSITION PARAGRAPH NAS-SR-1000 PARAGRAPH	IN-FLIGHT SPECIALIST				DF SPECIALIST				NOTAM SPECIALIST									APPROACH AND EN ROUTE CONTROLLER						AREA MANAGER					CLEAR. DEL. CONTROLLER			
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3.2.9 General																																
3.2.9 .A Detect Overdue Aircraft									X	X									X											X		
.A1 ATC Overdue Notice									X	X								X	X											X		
.A2 AFSS Overdue Notice									X	X																						
.A3 FIR Overdue Notice									X	X																						
.B Initiate SAR Operations											X									X												
.C Assist in SAR Operations	X	X			X	X						X													X						X	
.C1 Provide Essential Info.	X	X	X									X	X								X			X					X		X	
.C2 Retrieve Essential Info.	X		X										X								X	X		X					X			
.C3 Info. and Comm. Exchanged														X											X							
.C4 Process Airspace Res.																										X						
.D Monitor of ELT				X			X	X															X									X
.D1 ELT Frequency Monitor				X			X																X									X
.D2 ELT Monitor by ATC FACs				X																			X									
.D3 Non-ATC Source Reports																							X									
.D4 Geographic Coords of ELT								X																								
.E Facilities To Be Contacted	X														X																	
.F Messages For Transmission																X											X					
.F1 Message Preparation																X											X					
.F2 Message Review																X											X					
.G SAR Info. Exchange																	X											X				
.G1 Real-Time Info. Exchange																	X											X				
.G2 Input From Other Agencies																	X											X				

10.5 Operational Sequence

Operational sequence diagrams have been developed to illustrate the interactions between users (pilots) and specialists/controllers for different categories/conditions of flight. These diagrams are general in nature and no effort has been made to depict a specific situation.

10.5.1 VFR Operational Sequence

Figure 10-9 illustrates a general sequence of operator/user interactions for SAR of an aircraft on a VFR flight plan.

An aircraft on a VFR flight plan is 30 minutes overdue at its destination airport (1). The NOTAM Specialist gets a flashing message on his/her screen that an aircraft is overdue (2). The NOTAM Specialist queries the database to find out more information about the aircraft (3). The NOTAM Specialist obtains essential information on: the aircraft's last recorded, or last known, position; last recorded heading; and weather information (4). Once this information has been reviewed, the NOTAM Specialist initiates a search of all adjacent flight plan area airports (including appropriate terminal area facilities and ACF Sectors) (5). The communication search does not locate the aircraft (6), the NOTAM Specialist then transmits the "QALQ" message to the departure station (9). If the aircraft is found through the communications search (6) then the flight plan database (7) is updated (8) and the sequence ends.

Upon receipt of the "QALQ" message from the NOTAM Specialist the departure AFSS or the DUAT service forward any additional information (10) not previously sent and initiate a physical check of the appropriate airport (11). If the aircraft is found (12), the flight data base is updated (13) and the "QALQ" message is canceled (14). If the aircraft is not found (12), then the destination AFSS transmits all other information (15).

If the aircraft is still not located, the NOTAM Specialist transmits an Information Request (INREQ) Message (16) to the departure aerodrome, terminal areas, ACF Sectors within a 100-mile-wide corridor along its route of flight and the RCC. All stations receiving the INREQ message check their facility records (17, 18) and if the aircraft is found (19), the specialist updates the flight data base (20) and cancels the INREQ message (21). If the aircraft is not found (19) within one hour or the results of the INREQ are negative, the NOTAM Specialist transmits an Alert Notice (ALNOT) to all terminal areas, ACF within a 100-mile-wide corridor along its intended route of flight (22) and the RCC.

Upon receipt of the ALNOT message, these facilities conduct a communications search of their respective areas (23) including notifying local law enforcement agencies to assist them. Within one hour of the ALNOT receipt, these facilities notify the NOTAM Specialist of the results of their search (24). If the aircraft is located (25), the flight plan data base is updated, all stations on its route of flight are notified, and the ALNOT message is canceled (27).

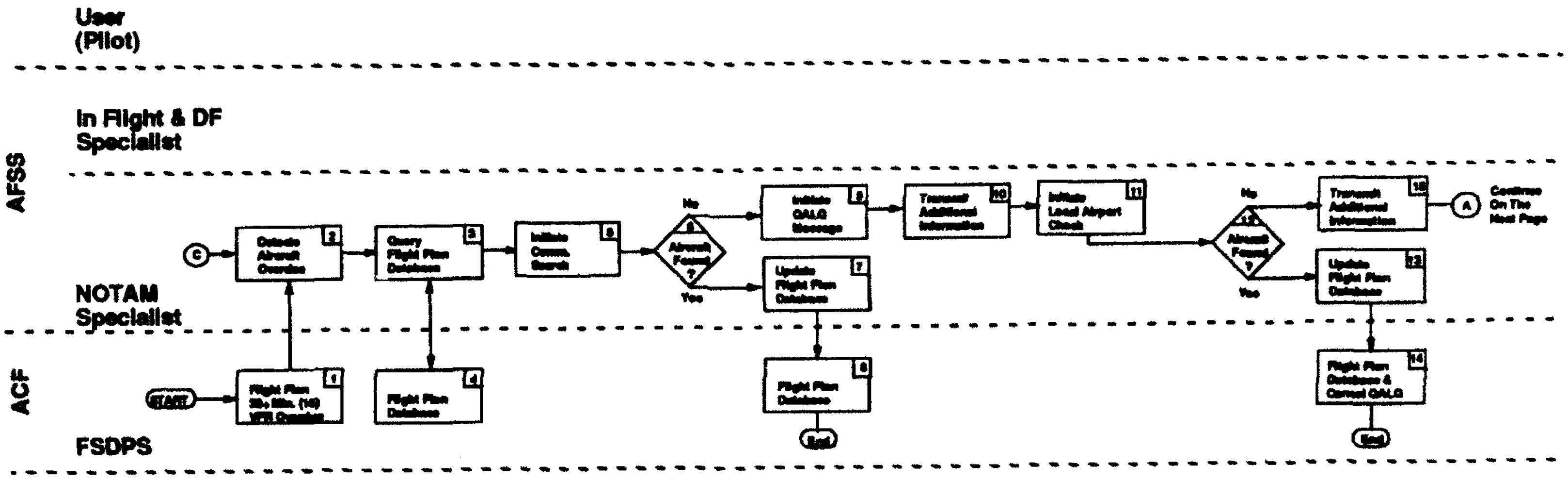


FIGURE 10-9
EN ROUTE VFR
OPERATIONAL SCENARIO DIAGRAM

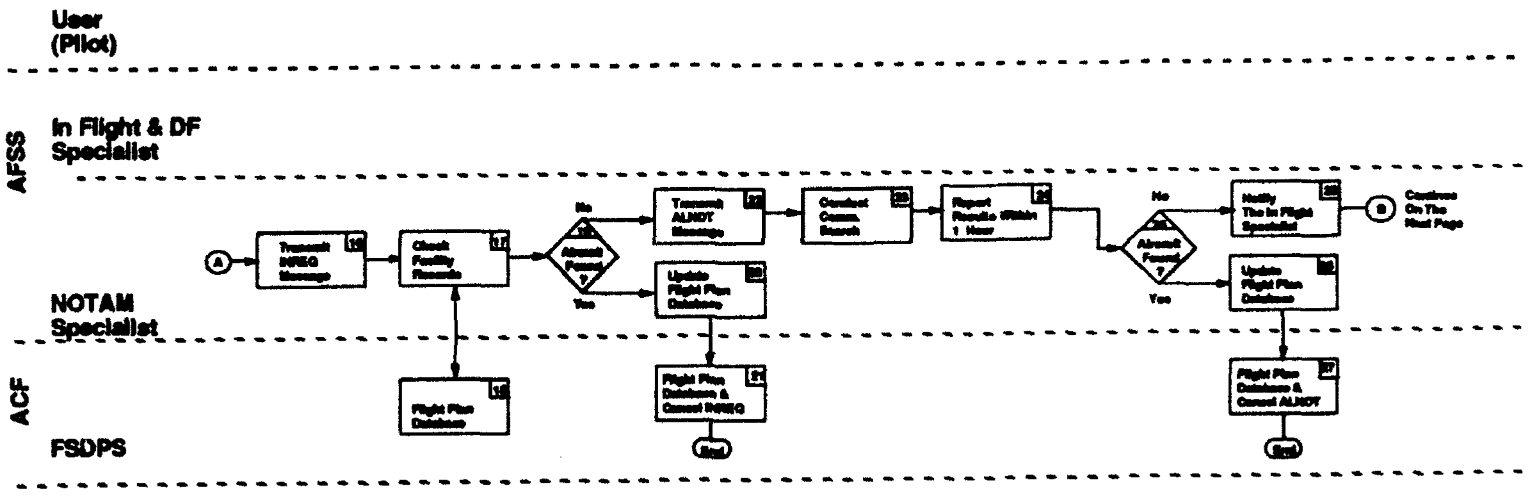


FIGURE 10-9
EN ROUTE VFR
OPERATIONAL SEQUENCE DIAGRAM (CONTINUED)

If the aircraft is not located (25), the NOTAM Specialist notifies the In-Flight Specialist to request (28) aircraft traversing the area of the aircraft's last known position (29) to monitor 121.5/243.0 MHz for an ELT (30). The In-Flight Specialist notifies the NOTAM Specialist of results (31). If this search is unsuccessful (32) or it has been one hour since the ALNOT message was transmitted, the NOTAM Specialist notifies the RCC (33) and provides all pertinent information. If the aircraft is not located by RCC (34), the NAS/Air Traffic search is suspended (35), and all facilities are notified.

If the aircraft is located (34), the flight data base is updated (36) and the ALNOT message is terminated.

When notified by the NOTAM Specialist to ask for assistance in monitoring 121.5/243.0 MHz for an ELT, the In-Flight Specialist (32) gets the geographic coordinates of the downed aircraft through the use of the DF equipment (38) receiving the ELT signal or the signal from an aircraft orbiting the downed aircraft.

Once these coordinates are determined, the In-Flight Specialist notifies the NOTAM Specialist (39), who notifies the RCC (40).

10.6 Operational Scenario

Figure 10-10 presents an operational scenario for a VFR aircraft in need of SAR assistance. It is similar to the operational sequence diagrams in Figure 10-9; however, this scenario represents the interactions between operators/ users for a specific case. This scenario describes an aircraft on a VFR flight plan which is 30 minutes overdue. The NOTAM Specialist detects a flashing message on his work station terminal screen announcing that N2346J, a Piper Cherokee (PA-28) on a VFR flight plan from Milville, NJ to Leesburg, VA, is overdue at its destination airport (1).

The Notam Specialist queries the flight database to call up N2346J's flight plan to obtain further information as to last known position (2). With this information, the NOTAM Specialist initiates a communications search request to try to locate the aircraft (3). Adjacent facilities make an attempt to locate the aircraft (4) and the aircraft is not found. The NOTAM Specialist gets no further information (5) as to the whereabouts of N2346J he then initiates an initial information request ("QALQ" message) (6). The results of the "QALQ" message were negative (7) the NOTAM Specialist then calls up from his database a list of all aerodromes, terminal areas, and ACFs located within a 100-mile-wide corridor along N2346J's route of flight (8). The NOTAM Specialist then prepares, reviews, and transmits an Information Request (INREQ) to these adjacent aerodromes, terminal areas, ACF's, and the RCC (9). If N2346J is not found through the INREQ action (10), then the NOTAM Specialist initiates an Alert Notice (ALNOT) (11) to the facilities along the aircraft's route of flight (including the RCC) (12). If N2346J has not been found (13) within one hour after ALNOT issuance, the NOTAM Specialist relays all current pertinent information about the aircraft to RCC (14).

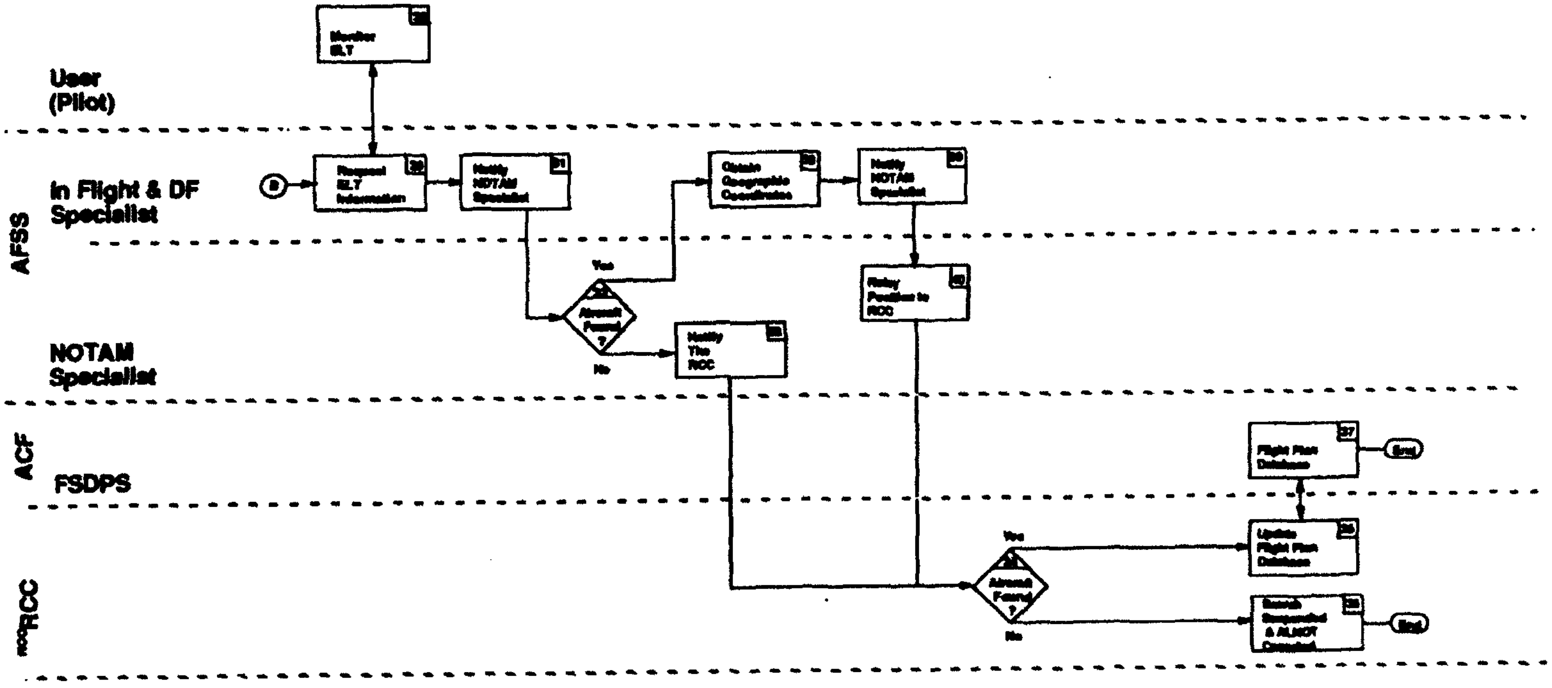


FIGURE 10-9
EN ROUTE VFR
OPERATIONAL SEQUENCE DIAGRAM (CONCLUDED)

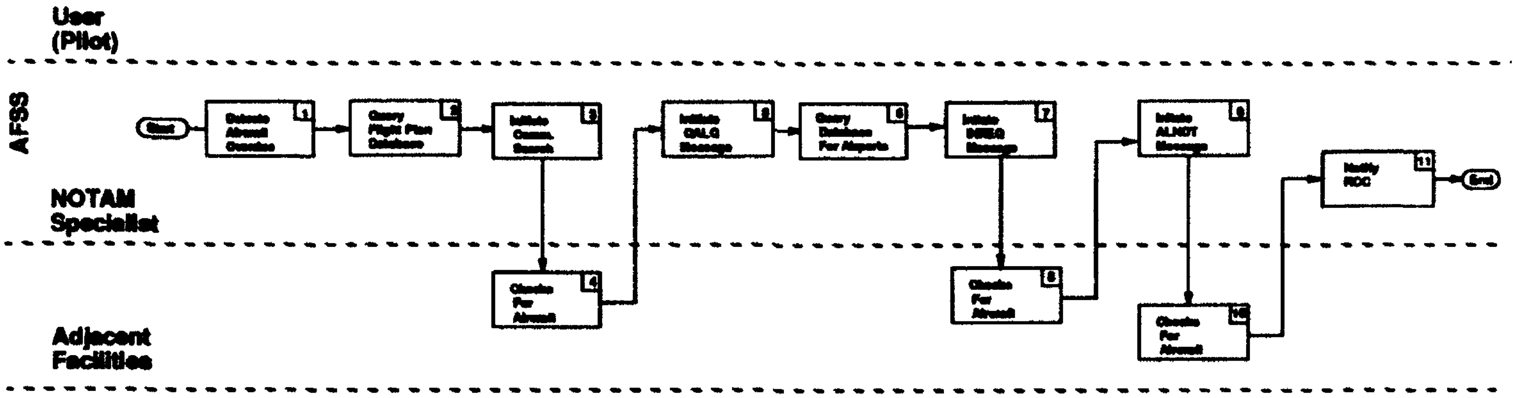


FIGURE 10-10
EN ROUTE VFR
OPERATIONAL SCENARIO DIAGRAM

11.0 SUPPORT OF MILITARY OPERATIONS

The National Airspace System (NAS) shall be capable of supporting both routine and special military aircraft operations including, but not limited to, the following: reservation of airspace for special use, including both permanently dedicated areas and areas allocated temporarily to support specific military missions; permanently delegated approach control airspace; en route training, refueling, and deployment missions; aircraft surge launch and recovery, missions; logistic support and administrative missions; supersonic operations; remotely piloted vehicle operations; artillery missile operations; and other military operations requiring the use of the NAS. The NAS shall be capable of disseminating information regarding military aircraft activity to non-participating civil and military system users. The NAS shall be capable of responding to national defense requirements as specified by Executive Order 11161 and other wartime/contingency directives.

11.1 Support

To maintain the readiness necessary to carry out its assigned mission of national defense, the military operates in the NAS and participates in the provision of its services. The NAS, therefore, supports both routine and special military air operations and interfaces with military air traffic control and airspace management systems. Provisions for operations during a national emergency, when various contingency plans have to be implemented, are also supported by the NAS. This requirement is described in Section 3.2.10 of the NAS Systems Requirements Specification (NASSRS).

Compatible military uses such as logistics support and administrative missions are absorbed by the NAS as routine operations. Incompatible and hazardous military air operations are segregated from or otherwise avoided within the NAS to ensure the safety of other aircraft.

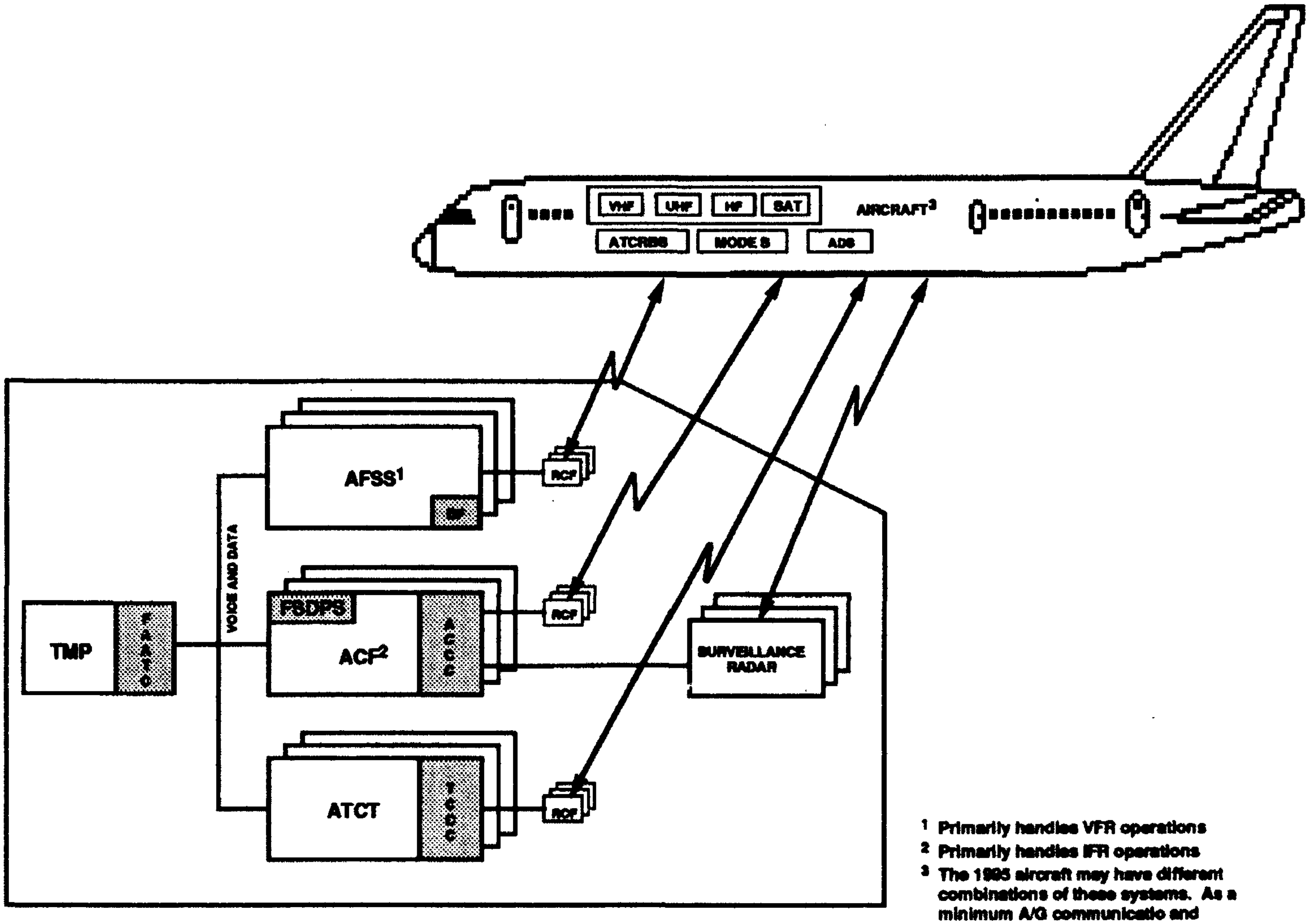
Support of military operations is contained within six basic categories: airspace reservations (includes all the various types of permanent and/or temporary airspace for special use); military flight plans; delegated airspace for military operated approach control; dissemination of information on military operations to the operators of other aircraft; contingency/wartime plans; and Notice To Airman (NOTAM).

Figure 11-1 is an overview of NAS/user interfaces for support of military operations and illustrates the NAS facilities and systems involved. Figure 11-1 is an operational block diagram showing the interrelationships between equipment, facilities, operators/users and the information necessary to support of military operations. The following paragraphs describe the NAS requirements for support of military operations.

11.1.1 Other Organizations

The NAS receives flight plan reservations from the military users, who include:

- Central Altitude Reservation Facilities (CARF)
- Military Scheduling Activities
- Military Base Operations



¹ Primarily handles VFR operations
² Primarily handles IFR operations
³ The 1995 aircraft may have different combinations of these systems. As a minimum A/G communicatio and surveillance enhancements are assumed

FIGURE 11-1

OVERVIEW OF NAS/USER SYSTEMS FOR SUPPORT OF MILITARY OPERATIONS

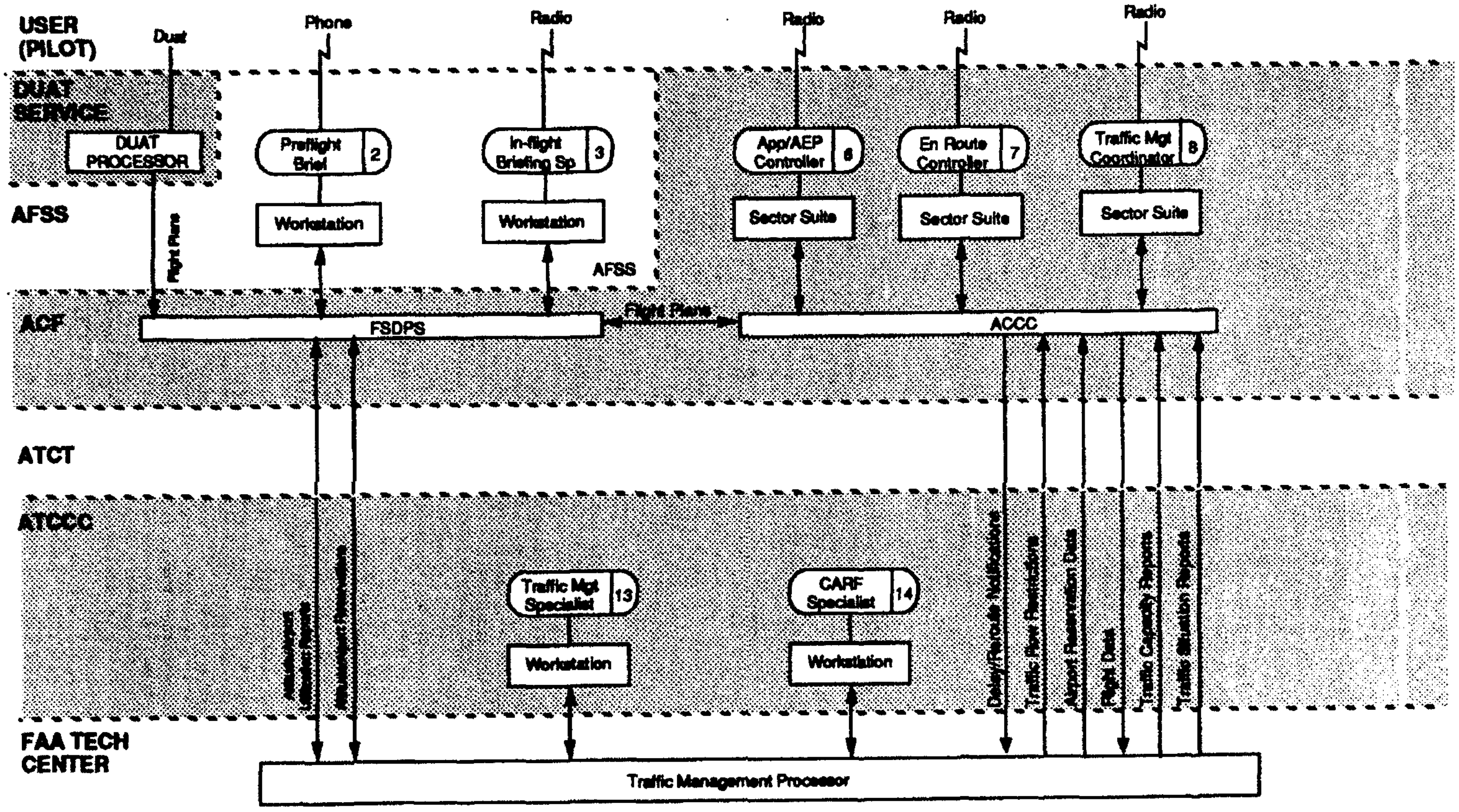


FIGURE 11-2

MILITARY OPERATIONS SUPPORT
OPERATIONAL BLOCK DIAGRAM

- Major Air Force, Navy, and Marine Corp Commands Requiring Airspace Reservations
- Military Non-ATC Facilities Such as Range Control Activities, Fleet Scheduling Activities, and Air Defense Facilities

11.1.2 User Systems

The systems required to support military operations include ultra high frequency (UHF) and very high frequency (VHF) Radio, Mode S data link, Interfacility Data Link (IDL), Direct User Access Terminal (DUAT), and Surveillance Radar.

To Process its request for special use airspace the military may use a variety of these systems to accomplish its goals. Specialists, in responding to the military request for, or status of special use Airspace, use any or all of these systems.

11.2 Information

Information needed to support military operations relates to aircraft and their use or avoidance of reserved airspace.

11.2.1 Information about Aircraft

The following data concerning aircraft and their proposed or actual routes of flight in or around reserved airspace is required:

- Aircraft characteristics,
- Aircraft positions,
- Designated aircraft (military aircraft for which separation assurance functions are inhibited),
- Flight plans.

11.2.2 Information about Airspace

Data concerning the military's use of segments of the National Airspace, including their dimensions and the rules governing the use of the National Airspace during National emergencies, is required. This includes:

- Airspace Reservations, and
- National Emergency Airspace Plans.

11.3 Functions

The following paragraphs describe in more detail the functions provided by the specialists positions introduced in 2.1.1. The Operational Flow Diagrams accompanying each paragraph illustrates the informational flow between specialist and users, and between specialists and data processing equipment. The functions of the specialists are related to paragraphs in the NASSRS. Pertinent references from the NASSRS that specify the functions performed by the specialists are included with each description.

11.3.1 Pre-Flight Briefing Specialist (Position 2)

Figure 11-3 is an operational flow diagram depicting the NAS and user interface with pre-flight briefing specialists. The functions performed and the support provided are lettered in the appropriate box and are described in the corresponding paragraphs below.

a. Flight Service Data Processing System (FSDPS) Processing. The FSDPS aids the specialist's flight planning support function by maintaining (retrieving, processing and storing) specified flight plans, generating proposed airspace reservation utilization statistics and generating alternate routes based on these statistics.

   NASSRS requirements: 3.2.10.A

b. Automated Flight Service Station (AFSS) Work station. The Pre-Flight Briefing Specialist interfaces with the FSDPS via his work station. In doing so, he acts as surrogate for the user in receiving and providing flight plan information.

   NASSRS requirements: 3.2.10.E

c. Integrated Communications Switching System (ICSS). The specialist interfaces with the user through voice communications either directly, by telephone, or for users on board aircraft, via VHF/UHF radio.

   NASSRS requirements: 3.2.10.D

11.3.2 In-Flight Briefing Specialist (Position 3)

Figure 11-4 is an operational flow diagram depicting the NAS and user interface with In-Flight Briefing Specialists. The functions performed and the support provided are lettered in the appropriate box and are described in the corresponding paragraphs below.

a. FSDPS Processing. The FSDPS aids the In-flight Specialist's flight planning support function by generating proposed airspace reservation utilization statistics.

   NASSRS requirements: 3.2.10.A

b. AFSS Workstation. The AFSS work station is the primary support for the computer-human interface between the flight service specialist and the FSDPS in the Area Control Facility (ACF).

   NASSRS requirements: 3.2.10.E

c. ICSS. The specialist interfaces with the user through voice communications (VHF/UHF radio) through the ICSS.

   NASSRS requirements: 3.2.10.D

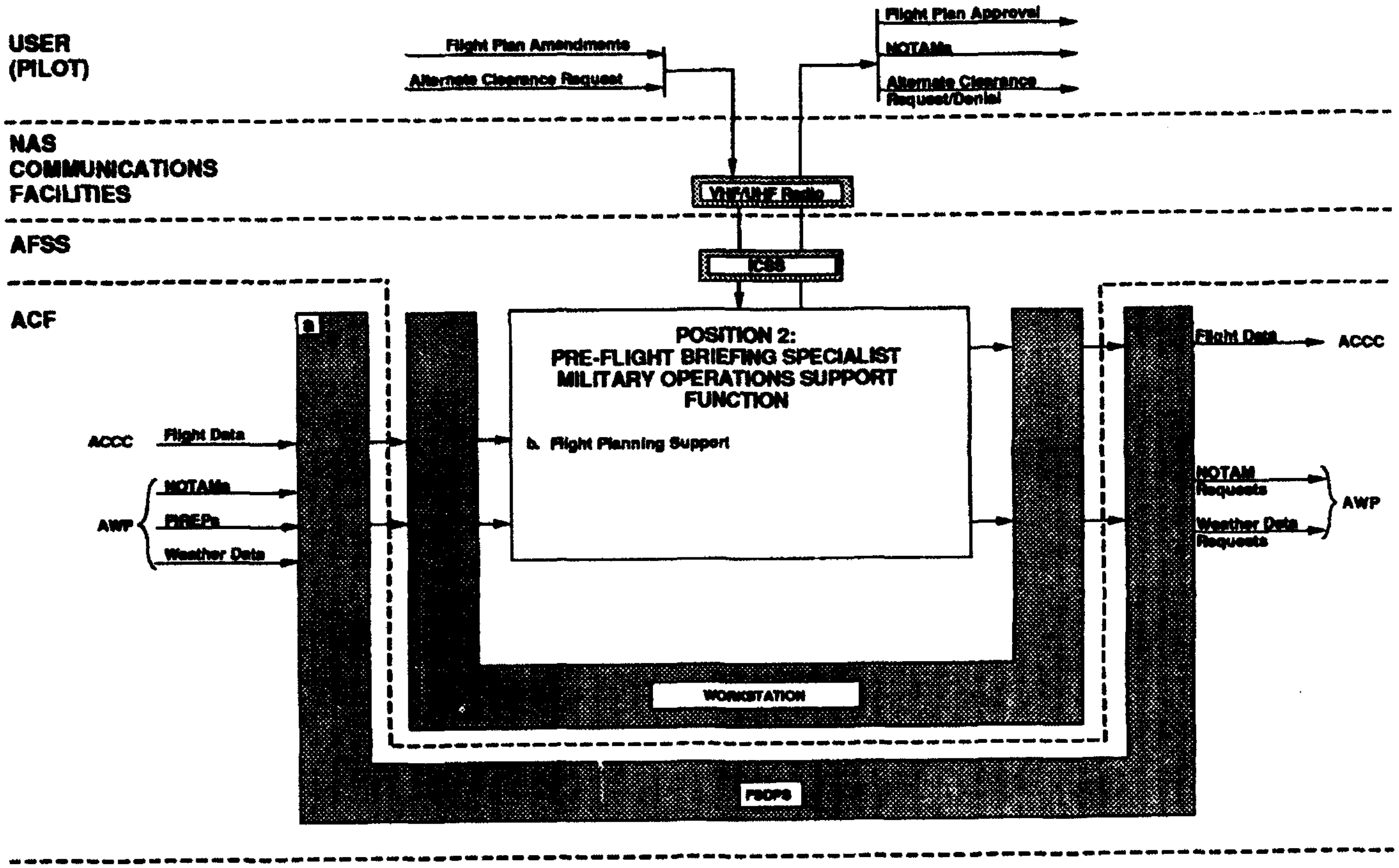


FIGURE 11-3
PRE-FLIGHT BRIEFING SPECIALIST (POSITION 2)
OPERATIONAL FLOW DIAGRAM

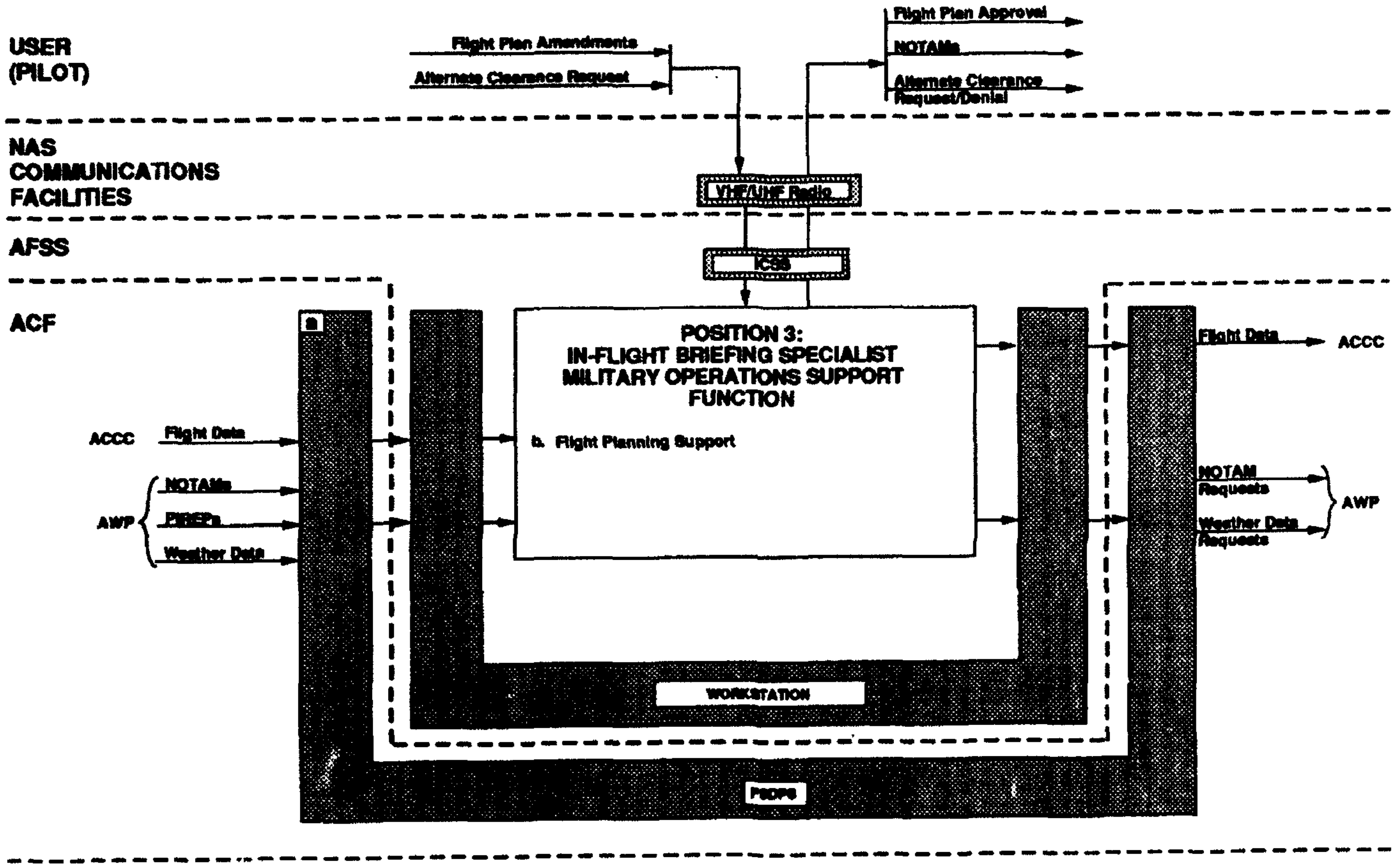


FIGURE 11-4
IN-FLIGHT BRIEFING SPECIALIST (POSITION 3)
OPERATIONAL FLOW DIAGRAM

11.3.3 Approach/Departure Controller (Position 6)

Figure 11-5 is an operational flow diagram depicting the NAS interface with the approach/departure controller. The function performed and the support provided are lettered in the appropriate box and described in the corresponding paragraphs below.

a. Area Control Computer Complex (ACCC) Processing. The ACCC provides the identification, position and planned route of flight for each aircraft operating within the controlled area. Interfacility hand-offs are achieved through the ACCC. Using the aircraft identification, the ACCC establishes internal data linkages between it, the aircraft's position and its flight plan. The ACCC maintains the linkage until the control of the flight is transferred to an adjacent control facility. The ACCC performs the flight plan updates, detects actual and potential aircraft conflicts and resolves these conflicts for each aircraft operating in the ACF's environment.

   NASSRS requirements 3.2.10.A,B,C,E-J.

b. Sector Suite Processing. The sector suite interfaces the controller with the data provided by the ACCC. Initial requests for specific aircraft characteristics or airspace configuration data results in the sector issuing requests to and receiving the requested data from the ACCC which it then stores in his environment for effecting any subsequent requests. Once the data is stored, it displays the appropriate response to the controllers including aircraft characteristics in alphanumeric format and airspace configurations in graphic format. Aircraft positions together with their related flight information are generated on a graphic display which is enhanced for any aircraft that either deviates from the conformance bounds of its clearance based trajectory, or is involved in a potential or actual conflict. For special situations (i.e., deviations/conflicts), the sector suite can also generate associated information on alphanumeric display such as alternate clearance(s), and conflict resolution advisories.

   NASSRS requirements: 3.2.10.A,B,C,E-J

c. Voice Switching and Control System (VSCS). VSCS provides communications with military aircraft along specific routes and designated low-level training routes.

   NASSRS requirements: 3.2.10.D

d. Receive/Transfer Control. Receiving and transferring control of aircraft is called hand-offs. Hand-offs are accomplished between military and civil air traffic controllers through data communications with the adjoining facility, and voice communication with the transitioning aircraft. Hand-offs can also occur between the Approach\Departure Controller and en route

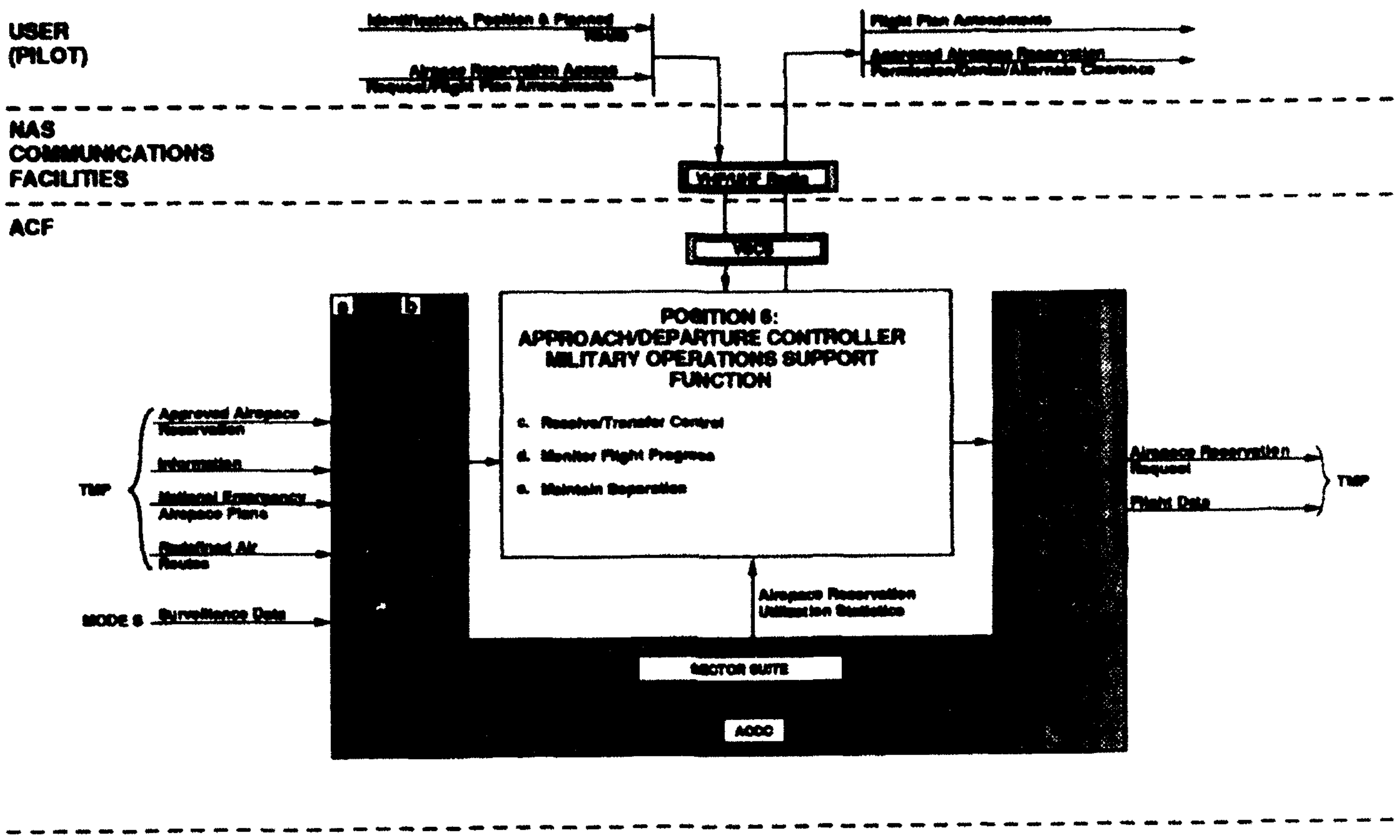


FIGURE 11-5
APPROACH/DEPARTURE CONTROLLER (POSITION 6)
OPERATIONAL FLOW DIAGRAM

controllers resident in the same facility. Within the ACF, hand-offs occur in the same manner as stated above without voice communication.

NASSRS requirements: 3.2.10.F,G,H,J

e. Monitor Flight Progress. In the interim between the time the approach/departure controller acknowledges an inter-facility hand-off and the time the aircraft is transitioned to an en route controller via an intra-facility hand-off, the Approach/Departure Controller monitors the aircraft's flight progress.

NASSRS requirements: 3.2.10.F,G

f. Maintain Separation. The Approach/Departure Controllers maintain separation between aircraft and between aircraft and airspace reservations by providing users with maneuvers required to remedy or avoid conflicts.

NASSRS requirements: 3.2.10.F,G,H,I

11.3.4 En Route Controller (Position 7)

Figure 11-6 is an operational flow diagram depicting NAS interface with the en route controller and the interface between the en route controller and the user. The functions performed and the support provided are lettered in the appropriate box and are described in the corresponding paragraphs below.

a. ACCC Processing. The ACCC provides the identification, position and planned route of flight for each aircraft operating within the controlled area. Interfacility hand-offs are achieved through the ACCC. Using the aircraft identification, the ACCC establishes internal data linkages between it, the aircraft's position and its flight plan. The ACCC maintains the linkage until the control of the flight is transferred to an adjacent control facility. The ACCC performs the flight plan updates, detects actual and potential aircraft conflicts and resolves these conflicts for each aircraft operating in the ACF's environment. Data provided on request in support of this and the remaining function performed by the controller include the aircraft characteristics of specific aircraft types, and various airspace configurations such as air routes and airspace reservations.

NASSRS requirements: 3.2.10.A,B,C,E-J

b. Sector Suite Processing. The sector suite interfaces the controller with the data provided by the ACCC. Initial requests for specific aircraft characteristics or airspace configuration data results in the sector issuing requests to and receiving the requested data from the ACCC which it then stores in his environment for effecting any subsequent requests. Once the data is stored, it displays the appropriate response to the controllers: aircraft characteristics in alphanumeric format, airspace configurations in graphic format. Aircraft positions together with their related flight information are generated on a graphic display which is enhanced for any aircraft that either deviates from the conformance bounds of its clearance based

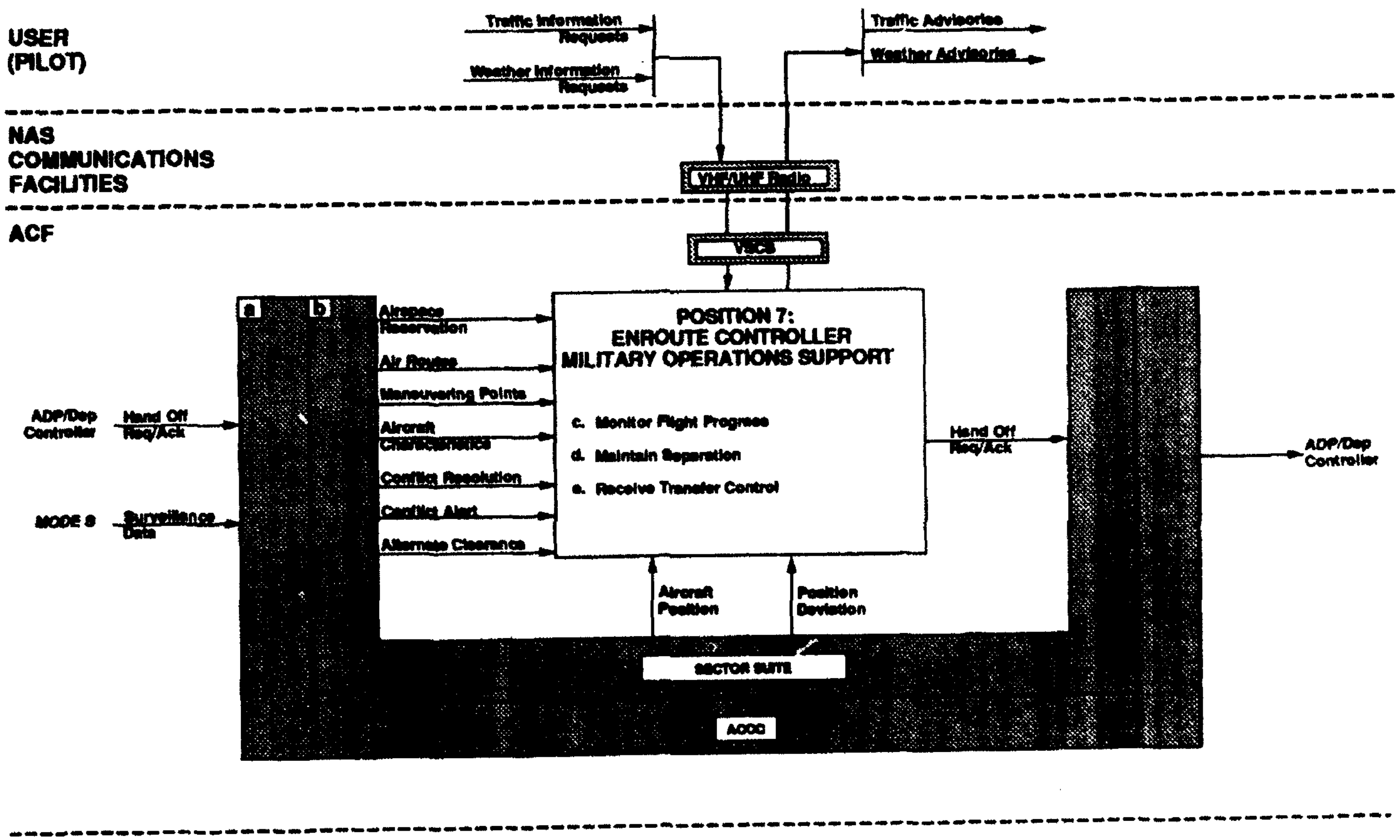


FIGURE 11-6
ENROUTE CONTROLLER (POSITION 7)
OPERATIONAL FLOW DIAGRAM

trajectory, or is involved in a potential or actual conflict. For special situations (i.e., deviations/conflicts), the sector suite can also generate associated information on alphanumeric display such as alternate clearance(s), and conflict resolution advisories.

NASSRS requirements: 3.2.10.A,B,C,E-J

c. VSCS. VSCS provides communications capability with military aircraft operating on low-level military training routes.

NASSRS requirements: 3.2.10.D

d. Monitor Flight Progress. The En Route Controller monitors the flight progress of all aircraft in his sector via the information provided to him from the ACCC as presented by his sector suite. When aircraft deviate from their planned routes of flight, the controller provides users with the appropriate remedies via UHF/VHF voice communications.

NASSRS requirements: 3.2.10.F,G,H,J

e. Maintain Separation. En route controllers maintain separation between aircraft and between aircraft and airspace reservations by providing users with maneuvers required to remedy or avoid conflicts.

NASSRS requirements: 3.2.10.F,G,H,I

f. Receive/Transfer Control. Receiving and transferring control of A/C is called hand-offs. Hand-off are accomplished between military and civil air traffic controllers through data communications with the adjoining facility, and voice communication with the transitioning aircraft. Hand-offs can also occur between the Approach\Departure Controller and en route controllers resident in the same facility. Within the ACF, hand-offs occur in the same manner as stated above without voice communication.

NASSRS requirements: 3.2.10.F,G,H,J

11.3.5 Traffic Management Coordinator (TMC) (Position 8)

Figure 11-7 is an operational flow diagram depicting the NAS interfaces with the traffic management specialist. The functions performed and the support provided are lettered in the appropriate box and are described in the corresponding paragraphs below.

a. ACCC Processing. The ACCC supports the traffic management coordinator by supplying him with the information needed to support his accommodation and flight planning support functions. The ACCC provides support for the accommodation function by providing the sector suite with the parameters required for presentation of the airspace reservation. The ACCC supports the flight planning support function by providing requested airspace utilization statistics. Requests for proposed utilization statistics are passed to the resident FSDPS and its response is

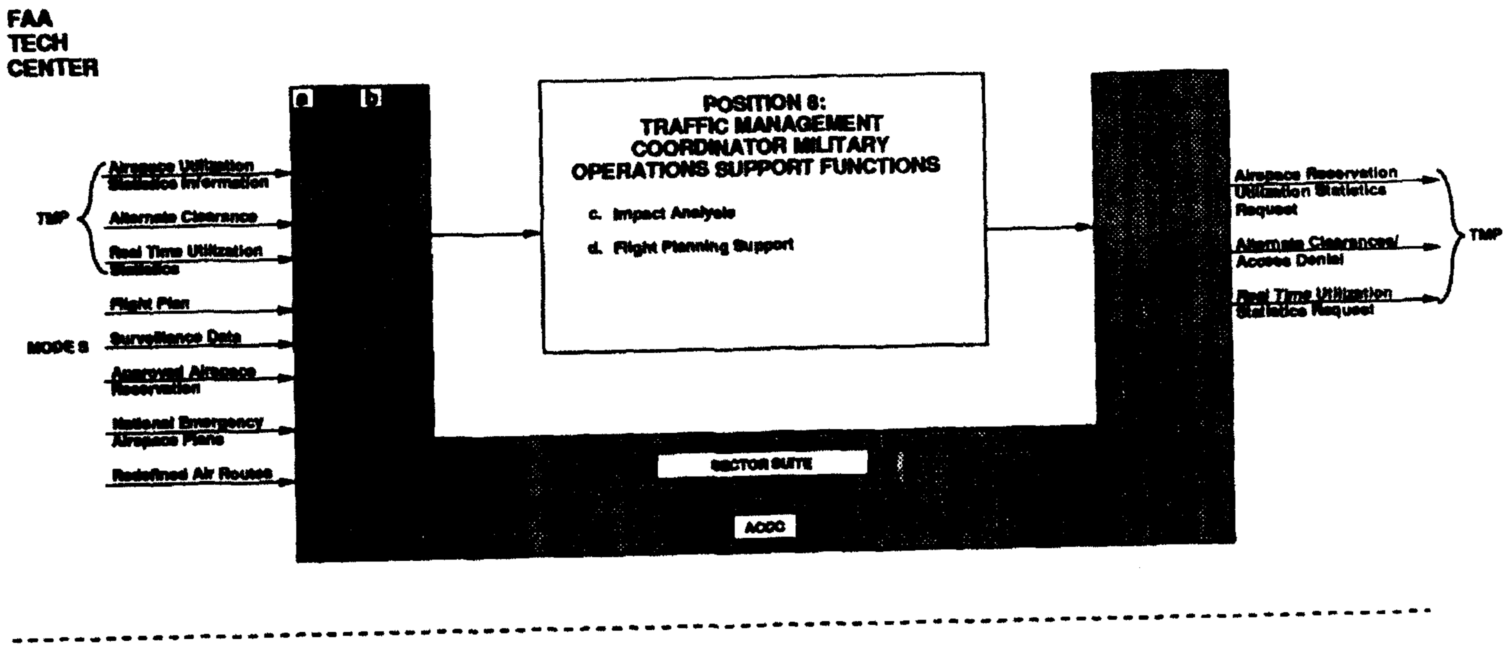


FIGURE 11-7
TRAFFIC MANAGEMENT COORDINATOR (POSITION 8)
OPERATIONAL FLOW DIAGRAM

passed to the sector suite. Responses to requests for real-time utilization statistics are achieved by accessing the aircraft positions for all aircraft operating with the airspace reservation. Using the combined utilization statistics (proposed and real-time), the ACCC also provides the alternate clearance for in-flight users.

NASSRS requirements: 3.2.10.A.B,E

b. Impact Analysis. Upon receipt of an airspace reservation at a controlling ACF, the Traffic Management Coordinator will review the reservation in terms of its impact on controllers (both civil and military located at adjacent military ATC facilities). As a result of his review, he may brief the controllers on his findings to assure that they understand the impact or amendments required.

NASSRS requirements: 3.2.10.E

c. Flight Planning Support. Flight plans are evaluated by the Traffic Management Coordinator in terms of their potential threat to air traffic safety. To support his evaluation, he queries the ACCC for real-time and/or proposed utilization statistics concerning the airspace reservation. He may also receive at this time, alternate routes to those proposed. For non in-flight users, he indicates his approval; for in-flight users, he accesses the associated flight plan, makes the required amendment(s), indicates his approval and communicates the results to the user.

NASSRS requirements: 3.2.10.B

11.3.6 Traffic Management Specialist (Position 13)

Figure 11-8 is an operational flow diagram depicting the NAS interfaces with the traffic management specialist. The functions performed and the support provided are lettered within the appropriate box and are described in the corresponding paragraphs below.

a. Traffic Management Processor (TMP) Processing. The TMP manages the message traffic and data flow between traffic management specialists and other system operators located at FAA and military facilities. The TMP performs airspace reservation analysis, such as completeness analysis and conflict analysis.

NASSRS requirements: 3.2.10.A,B,C,I

On receipt of an airspace reservation or modification, should any of the required data be absent, the TMP generates and delivers a message to the originator of the data indicating what data is required. In the case of airspace reservations that indicate aircraft movement, these messages include requests for flight plans and/or aircraft characteristics. Once the airspace reservation is complete, the TMP conducts conflict analysis. The ensuing distribution of the airspace reservation including any attendant military flight plans and aircraft characteristics as well as notices to non-participating users is achieved by the TMP.

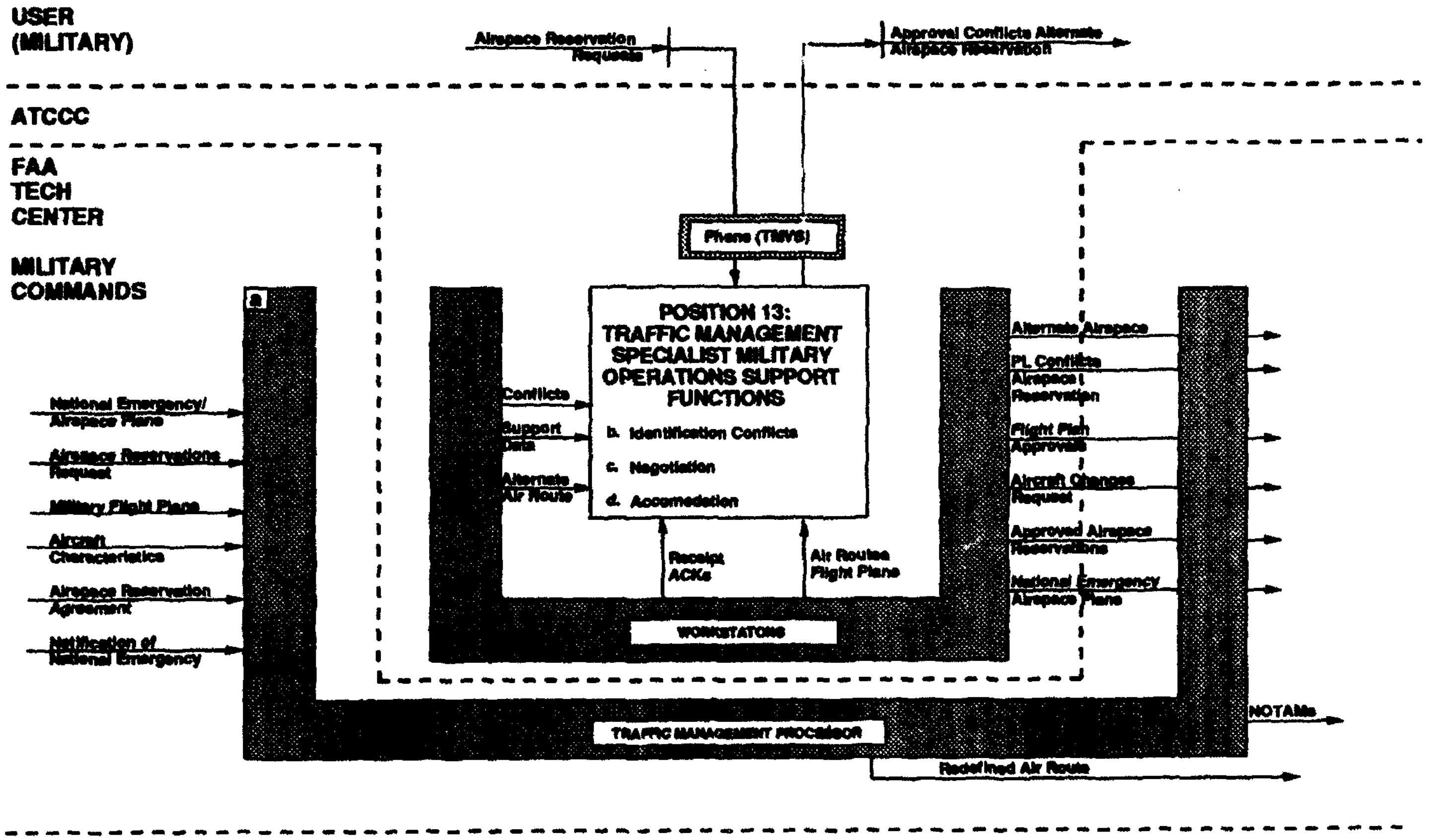


FIGURE 11-8
TRAFFIC MANAGEMENT SPECIALIST (POSITION 13)
OPERATIONAL FLOW DIAGRAM

When an airspace reservation is complete, or when it is approved, it is analyzed to determine the numbers and types of conflicts it will impose on non-participating users and on air routes. It performs the former analysis by comparing the location, airspace volume, intended use and schedule with filed flight plans. When an airspace reservation is approved and conflict analysis is performed for the last time, each linked user is notified via a message generated by the TMP of the conflict and requested to refile his flight plan. Prior to approval, and at the request of the specialist, the TMP may deliver the conflicts and any attendant alternative airspace reservation to the military command who sent the original.

If the airspace reservation is of the type that would prohibit the flow of aircraft, in addition to the foregoing analysis, established air routes are examined for any possible interference. If any exist, the TMP retrieves all supporting information that could be used to redefine the air route and deliver it to the specialist. If the specialist so desires, he may request the TMP to generate alternatives.

NASSRS requirements: 3.2.10.A,E

b. Identification of Conflicts. The traffic management specialist receives airspace reservations from military commands and in-flight military users. At the military's discretion, the identities of aircraft, for which the associated separation assurance functions are normally provided by NAS, will be inhibited.

NASSRS requirements: 3.2.10.I

If there are no conflicts, the specialist integrates the airspace reservation into the NAS via accommodation. If conflicts do exist, he may inform the originator of the airspace reservation of the conflicts, or request the TMP to determine an alternative and enter into negotiations with him.

NASSRS requirements: 3.2.10.I

c. Negotiations. Negotiations occur between the Traffic Management Specialist and the military user or the military command whenever conflicts arise from attempting to integrate a proposed airspace reservation into the NAS. If the airspace reservation originated from an in-flight user, the conflicts and alternatives presented to the specialist by the TMP on his request are transmitted by the specialist via voice communications. If the airspace reservation originated at a military command, the specialist may notify the command of the alternative and/or the conflicts by requesting the TMP to send these products to them. Ultimately, agreement is reached and the airspace reservation and its impact to the system are accommodated.

NASSRS requirements: 3.2.10.B

d. Accommodation. When the FAA and the military reach agreement concerning an airspace reservation, the traffic management specialist informs the TMP of this event. If the conflicts imposed by the airspace reservation require a redefinition of an established air route, the TMP presents to the specialist the problem area, support data regarding navigational aids in the immediate vicinity, and alternative air routes if requested. The specialists may either select one of these alternatives, or specify one of his own. Having done so, the airspace reservation awaits integration. Integration of the airspace reservation is entered by the specialist at his work station.

NASSRS requirements: 3.2.10.A.

11.3.7 Central Altitude Reservation Facility (CARF) Specialist (Position 14)

Figure 11-9 is an operational flow diagram depicting the NAS interfaces with the CARF Specialist. The functions performed and the support provided are lettered within the appropriate box and are described in the corresponding paragraphs below.

a. TMP Processing. The TMP, located at the FAA Technical Center manages the message traffic and data flow between CARF Specialists and the Consolidated NOTAM System Processor (CNSP).

NASSRS requirements: 3.2.10.A,B

b. Originate CARF NOTAM. CARF Specialists at the Air Traffic Control Command Center (ATCCC) receive information from military sources or from the ACF concerning altitude reservations. The specialist generates a CARF NOTAM via the ATCCC Work Station and receives a comeback copy as confirmation of input.

NASSRS requirements: 3.2.10.E

c Deliver CARF NOTAMs to NAS specialists and users. When necessary specialists provide CARF NOTAMs to other specialists and users.

NASSRS requirements: 3.2.10.E

11.4 Correlation with Operational Requirement

Table 11-1 summarizes the correlation of the military operations support operational requirements paragraphs of NAS-SR-1000 with the paragraphs describing the functions being performed by specialists. All paragraph numbers of NAS-SR-1000 are listed. The fact that a correlation is shown between a requirements paragraph and a paragraph describing the specialist/controller functions performed should not be construed as indicating that the requirement is completely fulfilled.

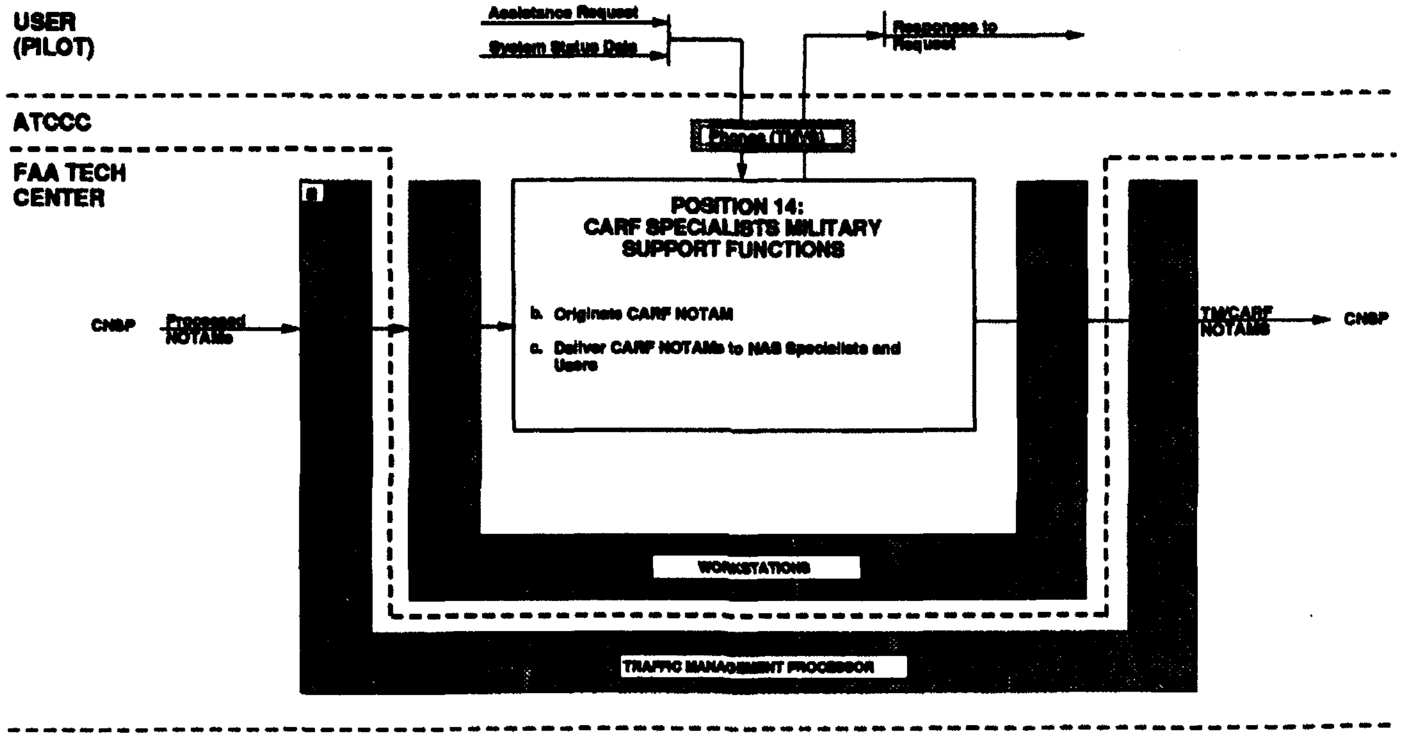


FIGURE 11-9
CARF SPECIALIST (POSITION 14)
OPERATIONAL FLOW DIAGRAM

TABLE 11-1
MILITARY OPERATIONS SUPPORT
OPERATIONAL REQUIREMENTS CORRELATION

POSITION / PARAGRAPH / NAS-SR-1000 PARAGRAPH	PRE-FLIGHT BRIEFING SPECIALIST		APPR/DEP CONTROLLER					EN-ROUTE CONTROLLER					TRAFFIC MANAGEMENT COORDINATOR					TRAFFIC MANAGEMENT SPECIALIST				CARF SPECIALIST		
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3.2.10 Support of Militar Operations	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
.A Process Reservations	X												X	X	X	X	X	X	X	X	X	X	X	
.B Issuing Alternatives	X												X		X	X	X	X			X	X	X	
.C Classified & Usuage			X	X				X					X					X			X	X	X	
.D Low Level TNG Routes		X	X					X										X			X			
.E Status Information			X	X			X	X	X			X						X			X			X
.F Reservation Detection			X	X	X		X	X	X	X		X												
.G Penetration Alert				X					X															
.H Altitude Courses							X					X	X		X	X	X	X		X	X	X	X	X
.I Inhibit Separation					X	X				X	X									X	X			
.J Military ATC FACs													X					X		X	X	X	X	

11.5 Operational Sequences

The following describes the military operations support in terms of functional/activity sequences. Interweaved with the descriptive text are operational sequence diagrams which identified both the function performed and corresponding activities. Each activity is numbered sequentially and referenced by the text.

11.5.1 Airspace Reservation Filing Sequence

As shown in Figure 11-10, airspace reservations may be developed by in-flight military users (1), or by land based military organizations (2). If proposed by an in-flight military user, traffic management specialists at the ATCCC enter his airspace reservation proposal into the TMP (3), whereas land based military organizations transmit their proposals to the TMP by Interfacility Data Link. In either case, the TMP stores the proposed reservation (4), analyzes the data for completeness, and, if complete (5), determines if any conflicts would result to non-participating users and/or other airspace configurations (6).

If the proposed airspace reservation is incomplete (e.g., one of its dimensions is missing), the TMP generates a message to the provider of the data who responds with the missing information (7), (8). The sequence for conflicts discovered during conflict analysis is shown in Figure 11-11 (9).

If there is no conflict and if the reservation was initiated by an in-flight military user (10), the TMP notifies the traffic management specialist who responds by indicating acceptance of the airspace reservation (11), and for the in-flight military user, conveys this information to him (12). For the land based military organization, the TMP generates and delivers acceptance notification to them (13), and distributes the airspace reservation (14) to the Area Control Center Computer(s) where it is located. The ACCC(s), including military approach control computers, store this information for use at the times designated by the airspace reservation (15).

11.5.2 New Airspace Reservation Conflict Sequence

If a filed airspace reservation conflicts with a filed flight plan, (see Figure 11-11), the TMP in an attempt to mitigate or eliminate the conflicts, generates alternative airspace reservations (1). Depending on the source of the airspace reservation, the TMP notifies the military, directly or through the TMS (2) of the conflicts and alternatives. If the conflict is immediate (3) the TMS warns the in-flight aircraft (4). The pilot would then change his course and/or flight plan (5). Negotiation between the military and FAA ensues until agreement is reached on alternative airspace reservations (6). Then, the TMS incorporates the changes and performs final checks (7). The TMP distributes the changes to the affected ACCCs (8) and the FSDPSs (9).
If a filed flight plan is still in conflict then pilots receive NOTAM from the ACCC. The pilot on the ground may receive a notice to amend his flight plan directly from the FSDPS or from the Flight Station Specialist (FSS) (10).

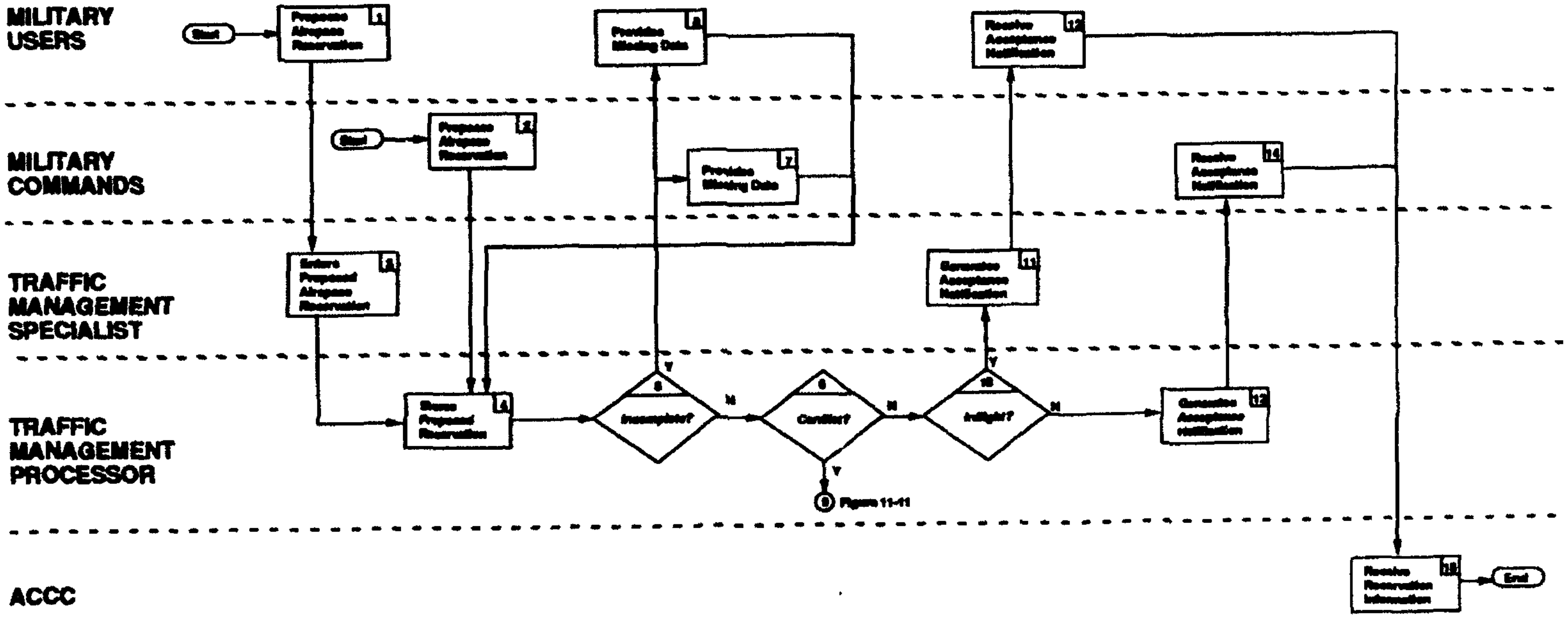


FIGURE 11-10
AIRSPACE RESERVATION
OPERATIONAL SEQUENCE DIAGRAM

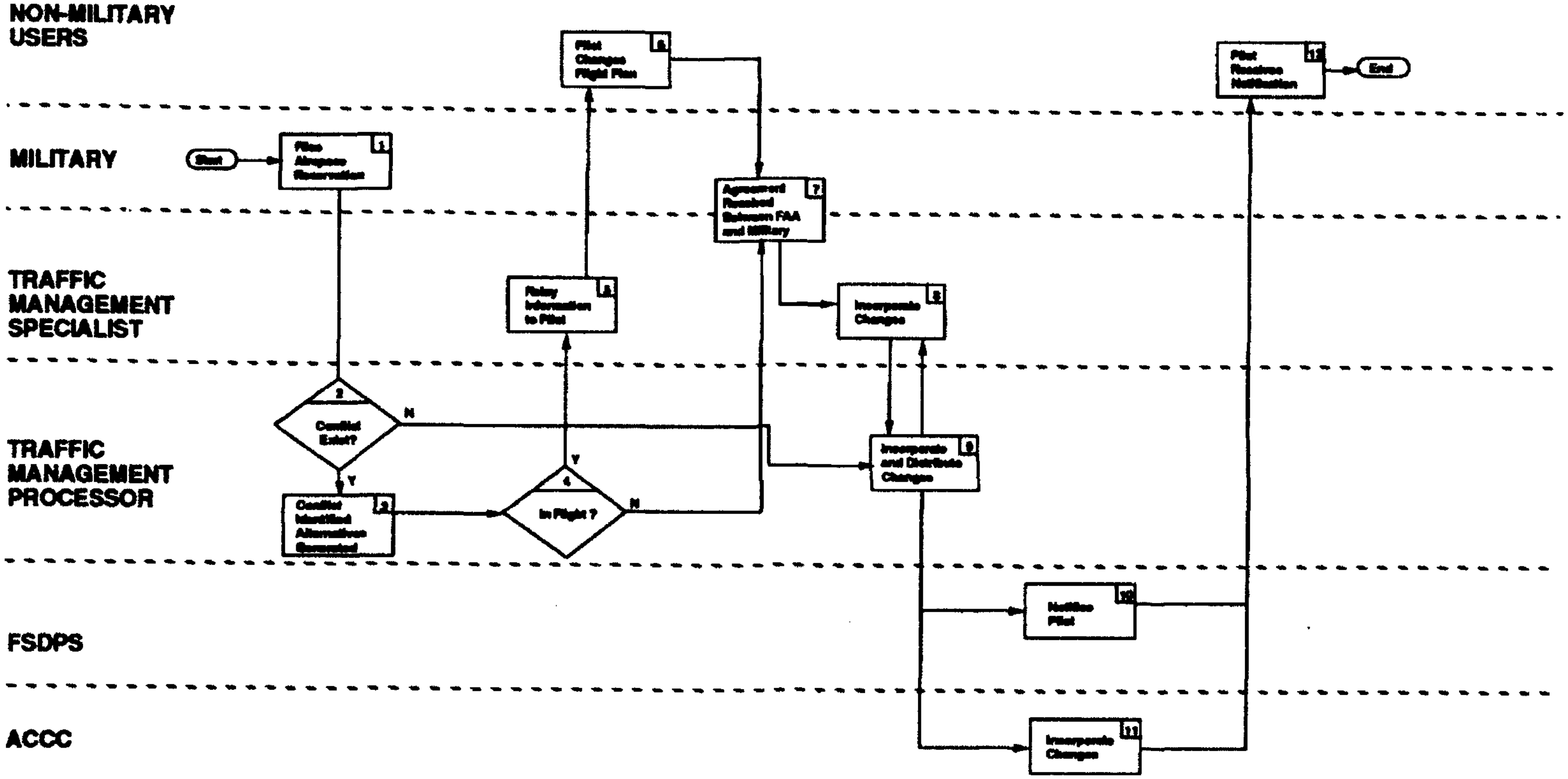


FIGURE 11-11
NEW AIRSPACE RESERVATION CONFLICT
OPERATIONAL SEQUENCE DIAGRAM

11.6 Operational Scenarios

This section gives an example of how special use airspace is handled by the NAS. Scenario 1 shows how the NAS handles a modification to an existing Restricted Area.

11.6.1 Modification of Existing Restricted Area

The airspace planners at Ft. A.P. Hill, Virginia would like to extend the upper limit of R6601 from five thousand feet to fifteen thousand feet to allow for the firing of a new weapon. As shown in Figure 11-12, personnel at the military base enter modifications to the existing airspace reservation and transmit the result to the FAA for their review (1).

Since R6601 underlies V-376, a major arrival route for Washington National airport in which jet aircraft descend down to ten thousand feet and propeller driven aircraft descend as low as six thousand feet. The proposed airspace reservation is not accepted because of the conflict (2).

After further discussions between the FAA traffic managers and the military (3), it is determined that since the firing would occur early on weekend mornings, when proposed use of the airspace would be minimal, a change in the schedule would be beneficial (4). However, jet traffic is still a factor in their decent down to ten thousand feet (5). Therefore, the request for additional airspace came back approved, but only to nine thousand feet(6). The airspace planners at A.P. Hill decide to accept the additional airspace to nine thousand feet and adjust the trajectory of their weapon accordingly (7). Then, the TMP approves the reservation change (8).

Having reached agreement (9), final modification to the airspace reservation is made (10). The TMP generates notices for the affected users of propeller driven aircraft (11). After that, TMP distributes airspace reservation information upon request (12). The users in the airspace amend their flight plans to fly around the airspace reservation upon receiving the notice (13).

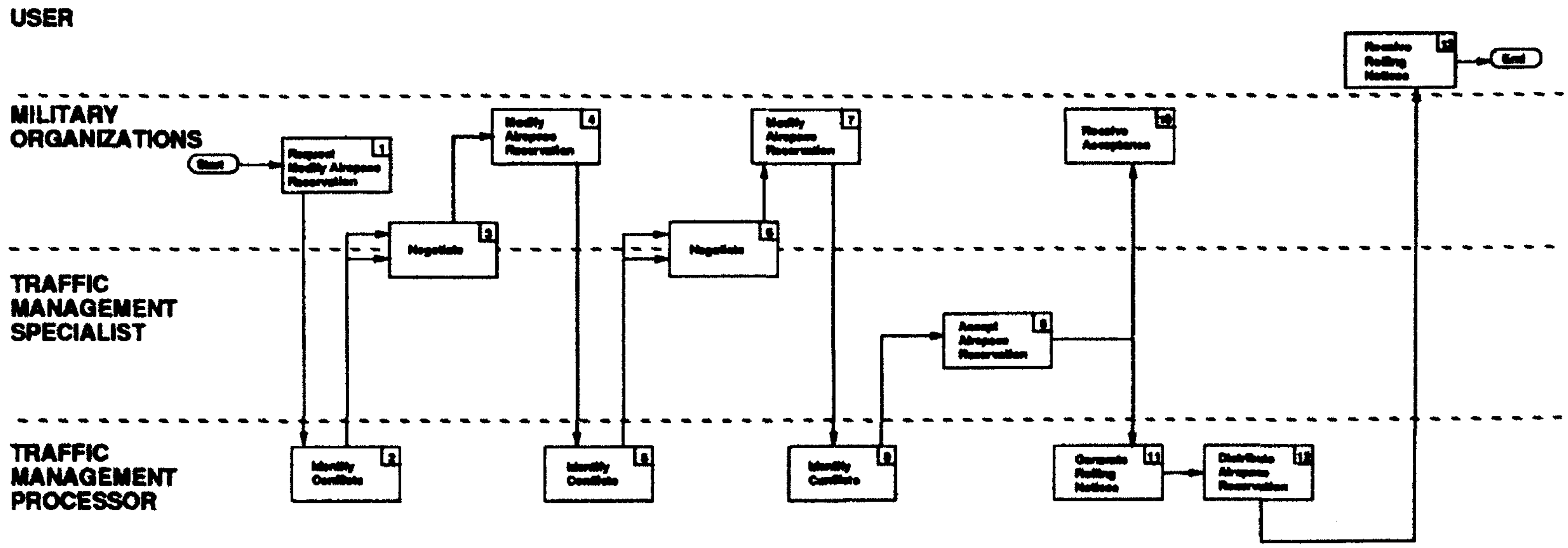


FIGURE 11-12
MODIFICATION OF EXISTING RESTRICTED AIRSPACE
OPERATIONAL SCENARIO DIAGRAM

12.0 AIRPORT MOVEMENT AREA CONTROL

The National Airspace System (NAS) has responsibility for the control and separation of aircraft and vehicles on the movement areas of qualifying (FAA-designated) aerodromes in all weather conditions. This shall include separation of aircraft from obstructions.

The control and separation of aircraft and vehicles on the airport movement area is based mainly on radio and visual contact between the aircraft and controller, supplemented (at many major facilities) by the controller's use of Airport Surface Detection Equipment (ASDE)-3. Several control positions as well as a supervisory position, where available, are involved in providing this control in the Air Traffic Control Tower (ATCT). The positions are supported by various automated aids which are provided via the Tower Control Computer Complex (TCCC) Position Console or tower workstation. Weather information, air traffic control clearances, and movement instructions including departure sequencing are provided to the pilot during airport movement area control operations.

The purpose of this document is to present an operational concept for Airport Movement Area Control that outlines the basic capabilities of and necessary interactions within the NAS to provide functional control of the movement area. This area includes all runways, taxiways, and other areas of an airport that are used for taxiing, takeoff, and landing of aircraft, exclusive of loading ramps and parking areas. At airports with a tower, specific approval must be obtained from Air Traffic Control (ATC) before an aircraft or ground vehicle may enter the movement area.

12.1 Support

Section 3.2.11 of the NAS System Requirements Specification (NASSRS) describes the support for airport movement area control. An overview of the support facilities and systems for airport movement area control is presented in Figure 12-1. An Operational Block Diagram, Figure 12-2, shows the major information connectivities among the user, specialist positions, and system components for airport movement area control. NAS facilities, systems, and positions are discussed in Section 12.1.1; other organizations involved in airport movement area control as well as user systems are discussed in Sections 12.1.2 and 12.1.3, respectively.

Airport movement area control operations are supported mainly by the TCCC processing system. This system has the capability to process and display surveillance, flight, and environmental data. Some towers have an alternate TCCC configuration that will process and display only flight and environmental data. During Normal Mode of operation, the TCCC will exchange information with its parent Area Control Computer Complex (ACCC). When communications between the TCCC and the associated ACCC become unavailable, the TCCC will transition to Stand-Alone Mode. In this mode the TCCC will continue all processing and display functions possible, such as limited surveillance processing and flight data display. Airport environmental data processing and display will be the same in either mode.

While providing the information briefly outlined above, the TCCC will also afford tower controllers operational control of airport equipment, mainly airport surface and approach lights. A TCCC Position Console (TPC) referred to here as a tower workstation serves as the interface between the tower processing system and the tower controllers.

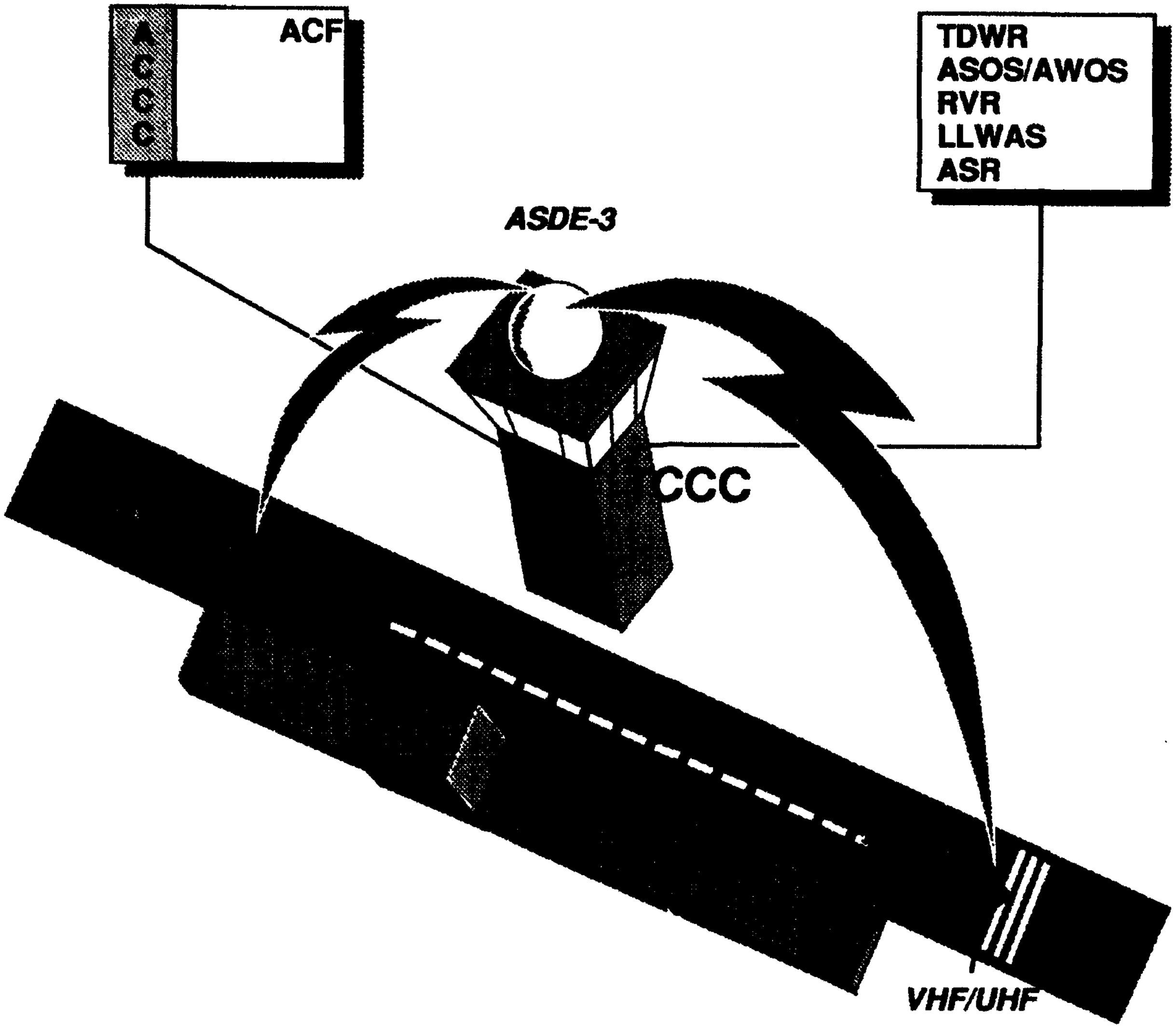


FIGURE 12-1
OVERVIEW OF NAS/USER SYSTEMS FOR AIRPORT MOVEMENT AREA CONTROL

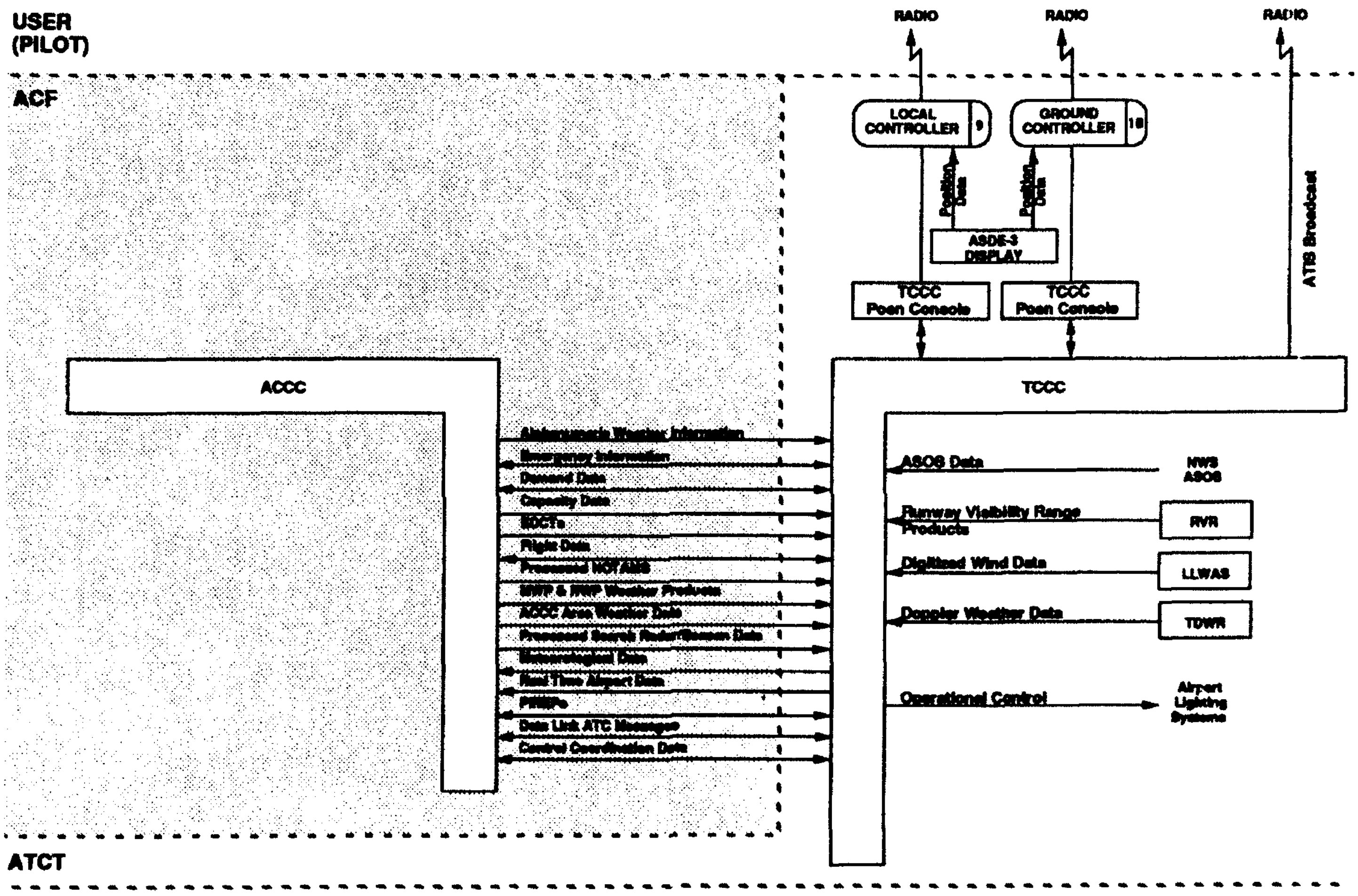


FIGURE 12-2
AIRPORT MOVEMENT AREA CONTROL
OPERATIONAL BLOCK DIAGRAM

Automatic Terminal Information System (ATIS) broadcasts, providing recorded information about airport status and conditions, will be available to pilots through a listen-only Tower Communications System (TCS) connection.

Airport Surface Detection Equipment (ASDE-3) will display aircraft and ground vehicle airport surface position data to the controllers at qualifying airports independent of the TCCC. A TCS will provide voice communications at ATCTs, enabling controllers to communicate with aircraft, each other, airport service vehicles, and other ATC facilities.

All airport towers will have a TCS. In the event of a failure in the TCS, controllers will resort to the use of a light gun to communicate with aircraft and vehicles on the ground.

12.1.1 Other Organizations

Virtually all aspects of actual airport movement area control are handled by FAA subsystems and FAA specialists. Commercially owned ramp areas, however, may allow an aircraft clearance from a gate via commercially owned communications systems such as Aeronautical Radio Incorporated (ARINC), however, control on the actual airport movement area is fully FAA supported.

12.1.2 User Systems

The user's interface to the controllers is ultra high frequency (UHF) and very high frequency (VHF) voice radio, with the prospect of data link in the future. The TCS provides ATIS radio broadcasts for pilots. ARINC may also provide the pilot information prior to entering the airport movement area.

12.2 Information

This section summarizes information generated by and received through performing airport movement area control services. Figures 12-3 and 12-4, Operational Flow Diagrams, picture the basic interactive communication flow between the two controller positions and the pilot, and the NAS subsystems on which this communication depends. The following paragraphs elaborate on specific information provided by the pilot, the controllers, and by NAS subsystems.

12.2.1 Information from Pilots/Operators

Pilots and operators of ground vehicles will provide their position and identification on the airport movement area to the controller when queried and will supply any weather or surface condition information appropriate.

12.2.2 Information from Controllers

Controllers will provide movement instructions to pilots and ground vehicle operators. The controller determines the location and identity of aircraft and vehicles on the airport surface. The controller effectively informs and separates all traffic.

Controllers provide information not only to the pilots and operators, but also to each other.

- Local and ground controllers verbally coordinate active runway crossings.

- Flight strips are routed to the next controller position as directed by the previous controller.

- Controllers provide each other relief briefings upon relinquishing a controller position to the next controller.

Any relevant information not contained in the most recent ATIS broadcast will be relayed to pilots and vehicle operators as needed. This could include recent runway or other hazardous conditions.

The TCS is required to provide not more than one hour of total system outage in 20 years. In the event of a radio communications failure, controllers will utilize any existing alternative equipment installed in the tower cab, such as portable transceivers, battery operated UHF and/or VHF transmitters, etc. to mitigate the outage. In the event of radio failure in the plane, controllers will issue limited instructions using a light gun which can precisely aim a narrow beam of red, green, or white light.

12.2.3 Information Provided by NAS Subsystems

At qualifying airports, the ASDE-3 will provide surveillance information on aircraft and vehicles, both moving and fixed, located on or near the surface of airport movement and holding areas during all weather and visibility conditions. This data will be displayed to the ground and local control positions independent of the TCCC.

The TCCC will automatically generate the ATIS message. This message will be updated with the arrival of a new surface observation (SA); with a change in the source data such as a runway configuration change, instrument approach change, etc.; and by a controller input.

12.3 Function

The two tower operational control positions, Ground Control and Local Control, perform the functions summarized in Figures 12-3 and 12-4. As described in the scope of this document, these positions are site-adapted to accommodate the variety of capacities, configurations, and other specific idiosyncrasies among airports. The following controller function as described are, therefore, applicable to generic position specialist operations; in reality they may be carried out by multiple controllers or by a different variation of one of the two positions to balance the workload.

Close coordination is required between various controller positions. When a ground controller has an aircraft or ground vehicle holding short to cross an active runway, coordination with the local controller is necessary to give the aircraft or vehicle clearance to promptly cross.

Along with the local controller, a supervisory position or cab coordinator may coordinate arrival and/or departure information via interfacility communications systems. Delay information from the ACCC and other facilities will be received and passed to the appropriate controller(s) by the cab coordinator. This position does not exercise immediate control of the airport movement area, but provides another set of eyes observing the situation on the airport movement area and in the tower cab to facilitate operations on and around the airport surface. The supervisor may provide, interpret, or help coordinate information such as flow control restrictions. The cab coordinator or supervisor may also participate in runway configuration decisions.

The clearance delivery position in the tower cab has also been excluded from this itemized list of functional operational control of the movement area since this position does not directly exercise control of the airport movement area. Clearance delivery does, however, provide critical ATC information such as delay, weather, route, airport, and emergency information often regarding the aircraft's future movement on the airport surface.

Specific tasks/responsibilities are not included in the list of controller functions following in Figures 12-3 and 12-4 and the corresponding text. Position detail such as specialists monitoring their respective frequencies, visually monitoring the movement area, utilizing the ASDE and/or radar display, and monitoring their workstations will be considered a routine procedure as opposed to an operational function and will, therefore, not be depicted on the diagrams.

The following two sections elaborate on the diagrams. Sections 12.3.1 and 12.3.2 correspond to Figures 12-3 and 12-4.

12.3.1 Ground Controller (Position 10)

The ground controller mainly issues movement instructions to aircraft and ground vehicles. This position is responsible for establishing the location and identity of every aircraft and vehicle on the movement area. Figure 12-3 illustrates specific functions that this position performs.

a. Airport Surface Detection Equipment (ASDE). The airport surface detection equipment provides tower controllers with real-time, high resolution display of the locations of vehicles and aircraft on the airport movement area. Controllers use this information to control the movement of aircraft and other vehicles on the airport surface.

   NASSRS requirement 3.2.11.A,B,C

b. Tower Communications System (TCS). The TCS provides the capability for ATCT controllers to communicate with aircraft and vehicles on the airport surface.

   NASSRS requirements 3.2.11.F

c. Give Pushback/Taxi Clearance If there is no need for delay, the ground controller will give the pilot clearance to pushback. When necessary, in tight taxiway to gate areas, the ground controller may also need to give clearance to start engines. If, because of a delay situation the ground controller cannot grant the clearance to pushback and taxi, the controller will notify the pilot, and a gatehold will continue to be in effect.

   NASSRS requirements 3.2.11.F

d. Provide Interactive Aircraft/Ground Vehicle Movement Instructions Once the aircraft has pushed back from the gate and has started its engines, the ground controller will establish and maintain aircraft identity and location on the movement area. In the case that the airport has a ramp tower, however, the ground controller will not be concerned with the guidance of the aircraft until the aircraft reaches the end of the airline-owned ramp area. The

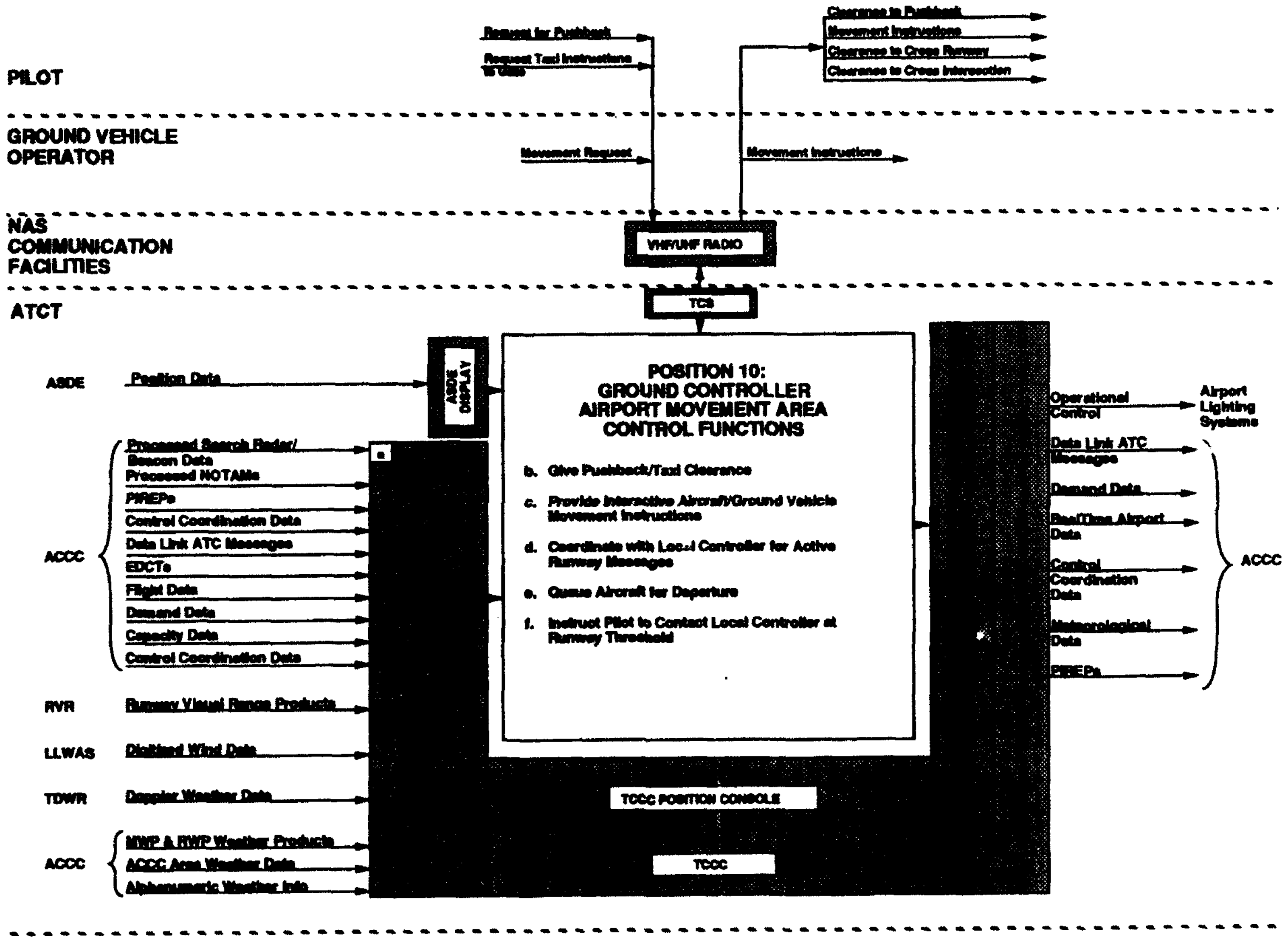


FIGURE 12-3
GROUND CONTROLLER (POSITION 10)
OPERATIONAL FLOW DIAGRAM

ground controller, mainly through visual contact, will be aware of all movement on the airport movement area. The ASDE-3 display in the tower will supplement this direct visual contact especially during foul weather and adverse lighting situations, providing position data on all aircraft and ground vehicles.

NASSRS requirements: 3.2.11.A,B,C

The ground controller will then plan, establish, and coordinate taxi traffic flow, anticipating and controlling aircraft and ground vehicle movement. If a ground delay exists, the ground controller may instruct the pilot to taxi to a holding area or "penalty box" on the movement area, or the controller may instruct the pilot to taxi in a certain ground pattern. These types of delay absorbing mechanism are dependent on availability of gates and holding areas at an airport.

NASSRS requirements: 3.2.11.F

e. Coordinate with Local Controller for Crossing of Active Runway. If there is a potential conflict at a taxiway or runway intersection, the ground controller will direct an aircraft to hold short of a specified taxiway or runway until further notice or until a specific aircraft or vehicle passes. Interaction with the local controller is necessary for crossing of active runways. The ground controller will verbally notify the local controller that there is an aircraft or vehicle ready to cross the active runway. The local controller will subsequently notify the ground controller when there is a break in the arrival and departure flow on that runway. Arrivals and departures take priority over runway crossings.

NASSRS requirements: 3.2.11.F

f. Queue Aircraft for Departure. After interactively directing aircraft to the assigned runway via airport taxiway, instructing them to hold short and proceed as necessary, the ground controller will place the aircraft in the runway departure queue. Normally aircraft will be sequenced in the order in which they called the clearance delivery controller. The aircraft will wait in line, moving up the queue as instructed, as aircraft ahead are one by one cleared to takeoff by the local controller.

NASSRS requirements: 3.2.11.F

g. Instruct Pilot to Contact Local Controller at Departure Queue. The ground controller will instruct the pilot to contact the local controller when the aircraft is in the departure queue of the active departure runway.

NASSRS requirements: 3.2.11.F

12.3.2 Local Controller (Position 9)

The local controller issues takeoff and landing clearances and helps in sequencing and coordinating arrivals and departures. The following (Figure 12-4) is a list of more specific functions the local control position provides.

a. Tower Control Computer Complex (TCCC). The TCCC provides an automated tower cab information system and the primary operational position equipment for ATCT controllers. The TCCC generally presents local environment and airport system status, flight, and surveillance data to the controllers and provide control over the local airport systems.

   NASSRS requirements 3.2.11.E

b. Tower Communications System (TCS). The TCS provides the capability for ATCT controllers to communicate with aircraft and vehicles on the airport surface.

   NASSRS requirements: 3.2.11.F

c. Issue Instructions to Clear the Runway. If necessary, the local controller may issue instructions to pilots to expedite the aircraft's exiting of the runway.

   NASSRS requirements: 3.2.11.F

d. Issue Takeoff Clearances and Control Instructions. When an aircraft is first in the departure queue, the local controller will give the pilot clearance to takeoff, after which the pilot will taxi onto the runway and promptly depart.

   NASSRS requirements: 3.2.11.F

e. Coordinate with Ground Controller for Crossing of Active Runway The ground controller will verbally notify the local controller when there is an aircraft or vehicle ready to cross an active runway. The local controller will then notify the ground controller when there is a break in the arrival and departure flow on that runway. Arrivals and departures take priority over runway crossings.

   NASSRS requirements: 3.2.11.F

f. Instruct Pilot to Contact Ground Controller upon Exiting Active Runway. Upon landing, the pilot will exit the active runway as promptly as possible. The local controller may clarify or expedite this process if necessary. The pilot will be instructed to contact the designated ground control frequency for any clarifications of movement instructions to the appropriate gate.

   NASSRS requirements: 3.2.11.F

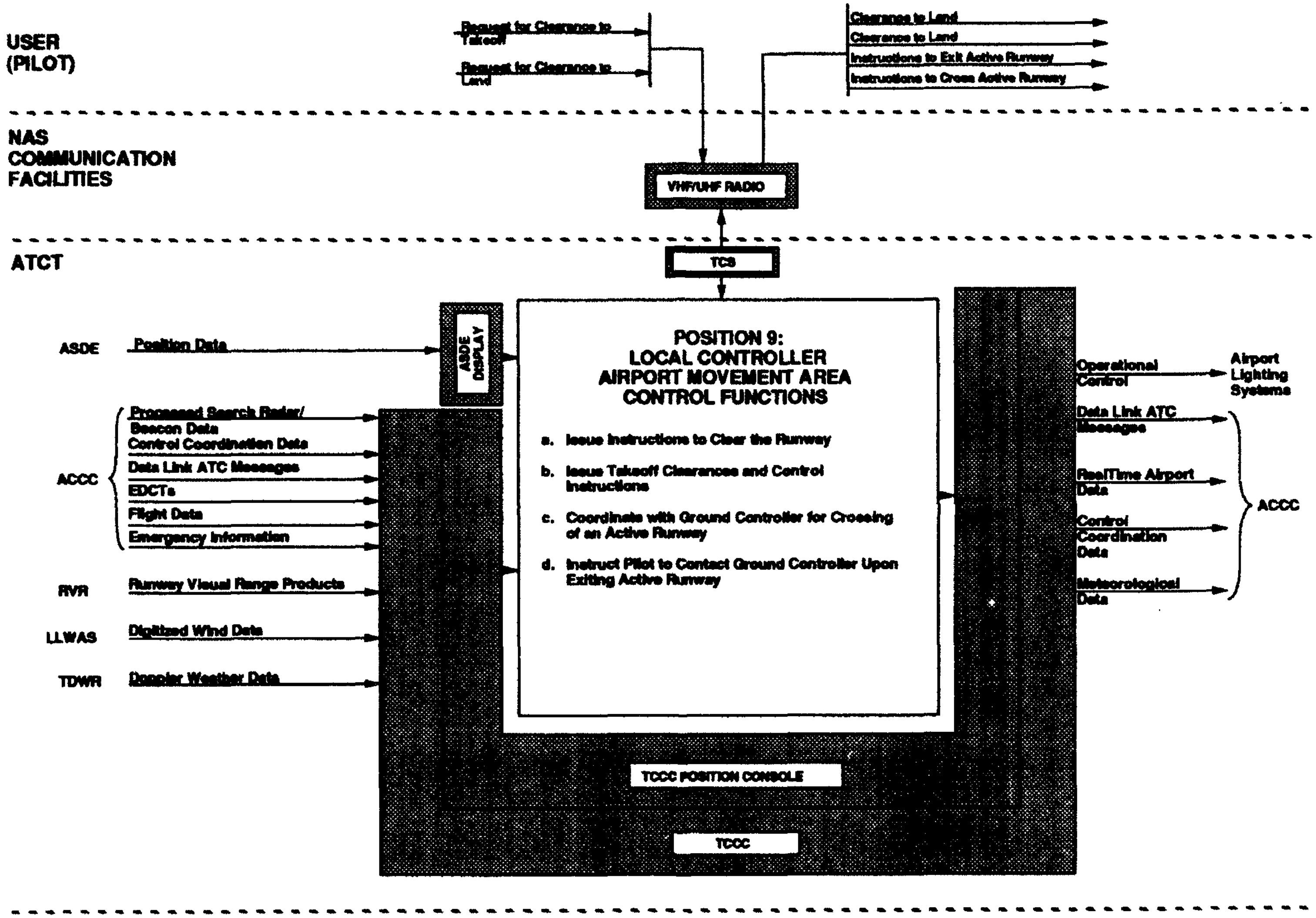


FIGURE 12-4

LOCAL CONTROLLER (POSITION 9)
OPERATIONAL FLOW DIAGRAM

12.4 Correlation With Operational Requirements

Table 12-1 summarizes the correlation of the paragraphs of NAS-SR-1000 related to airport movement area control with pertinent paragraphs in this operational concept.

The fact that a correlation is shown between a requirement paragraph and a paragraph describing the controller function performed should not be construed as indicating that the requirement is completely fulfilled.

TABLE 12-1
AIRPORT MOVEMENT AREA CONTROL OPERATIONAL REQUIREMENTS CORRELATION

NAS-SR-1000 Paragraph	Position	Support			Information			Airport Movement Area Control Functions																			
	Paragraph	2.1.1	2.1.2	2.1.3	2.2.1	2.2.2	2.2.3	2.3	2.3.1	2.3.1.a	2.3.1.b	2.3.1.c	2.3.1.d	2.3.1.e	2.3.2	2.3.2.a	2.3.2.b	2.3.2.c	2.3.2.d	2.3.2.e	2.3.2.f	2.3.3	2.3.3.a	2.3.3.b	2.3.3.c	2.3.3.d	2.3.3.e
3.2.11	General	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
.A	Location and Identity of Aircraft and Vehicles	X					X								X		X										
.A.1	Detect all Aircraft and Vehicles	X					X								X		X										
.A.2	Surface Detection Coverage	X					X								X		X										
.A.3	Surveillance Coverage	X					X								X		X										
.A.4	Detection during Specified Weather Conditions	X					X								X		X										
.A.5	Detection regardless of Equipment on aircraft	X					X								X		X										
.A.6	Discriminate Traffic to Specified Separation and Range	X					X								X		X										
.A.7	Display Position of Aircraft and Vehicles to Specified Precision	X					X								X		X										
.A.8	Determine if Aircraft enters or exists Active Runway during Reduced Visibility	X					X								X		X	X							X		
.A.9	Determine if Aircraft is in Position for Takeoff and on Proper Runway	X					X								X		X			X				X			
.B	Display Position Data under all Lighting Conditions	X					X								X		X										
.B.1	Display at least Location and Alphanumeric Data														X		X										
.B.2	Display Position Data with no Reflection or Glare	X					X								X		X										
.C	Display Data in Relation to Appropriate Geographic Information	X					X								X		X										
.C.1	Overlay Movement Area Outline Map on Position Displays	X					X								X		X										
.C.2	Specialist can modify Display for Desired Information	X					X								X		X										
.C.3	Display Movement Area Outlines to Specified Precision	X					X								X		X										
.D	Unobstructed View of the Airport Movement Area	X				X		X							X		X										
.E	Provide Airport Movement Area Control Continuously	X				X		X							X		X										
.F	Provide Alternative Forms of Communication in Case of Failure					X																					

12.5 Operational Sequences

Figures 12-5 and 12-6 illustrate control of the airport movement area through the following control situations: departure of an aircraft and movement of ground vehicles. A departure begins as the aircraft at the gate contacts clearance delivery for a pre-departure/ route clearance and ends upon takeoff. Actual functional control on the airport movement area beginning when the departing aircraft pushes back from the gate, however. Arrival control on the movement area begins with touchdown of the aircraft and continues through to the arrival gate or ramp.

Functionally, the movement of ground vehicles on taxiways and runways is monitored as the movement of aircraft is monitored by the ground controller and coordinated with the local controller for active runway crossing. Since the operational goal of a ground vehicle does not include takeoff and landing, ground vehicle movement has been addressed in a separate operational sequence diagram.

These operational sequence diagrams generically describe the variety of interactions between the pilot, the ground vehicle operator, the ground controller, and the local controller to provide effective airport movement area control.

Chronologically illustrating the functional flow of airport movement area control between the pilot or operator and the key specialists or positions can be complicated; for clarity, certain lower level detail is not included. Continual responsibilities/tasks of the specialist such as monitoring their respective frequencies, visually monitoring the movement area, and monitoring their workstation (including equipment) are considered understood and, therefore, not depicted on the diagrams. Similarly, pilot tasks such as engine start are not represented. At any time unanticipated events can alter these sequences.

Ground Controller is abbreviated to GC, and Local Controller to LC where space is limited.

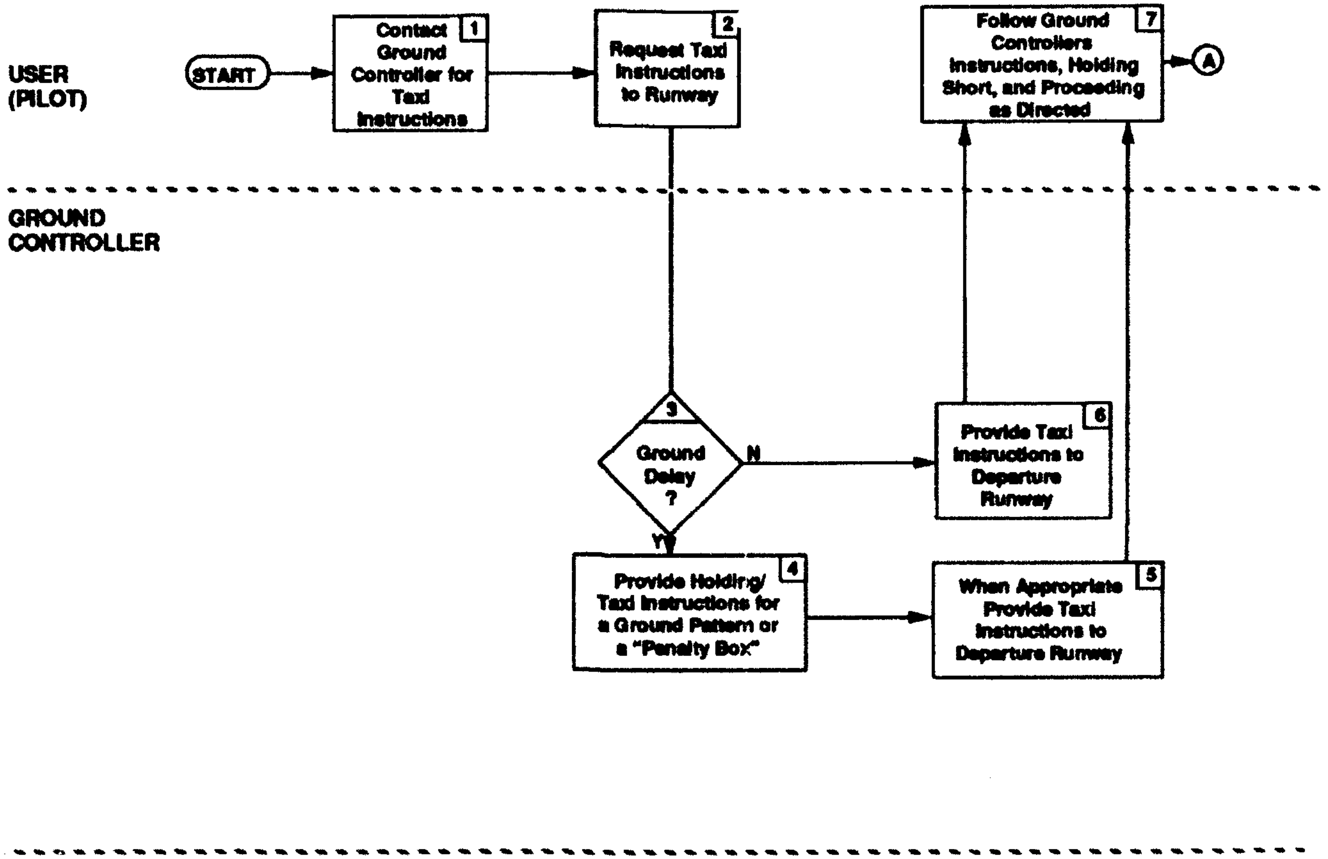


FIGURE 12-5
AIRPORT MOVEMENT AREA CONTROL
OPERATIONAL SEQUENCE DIAGRAM

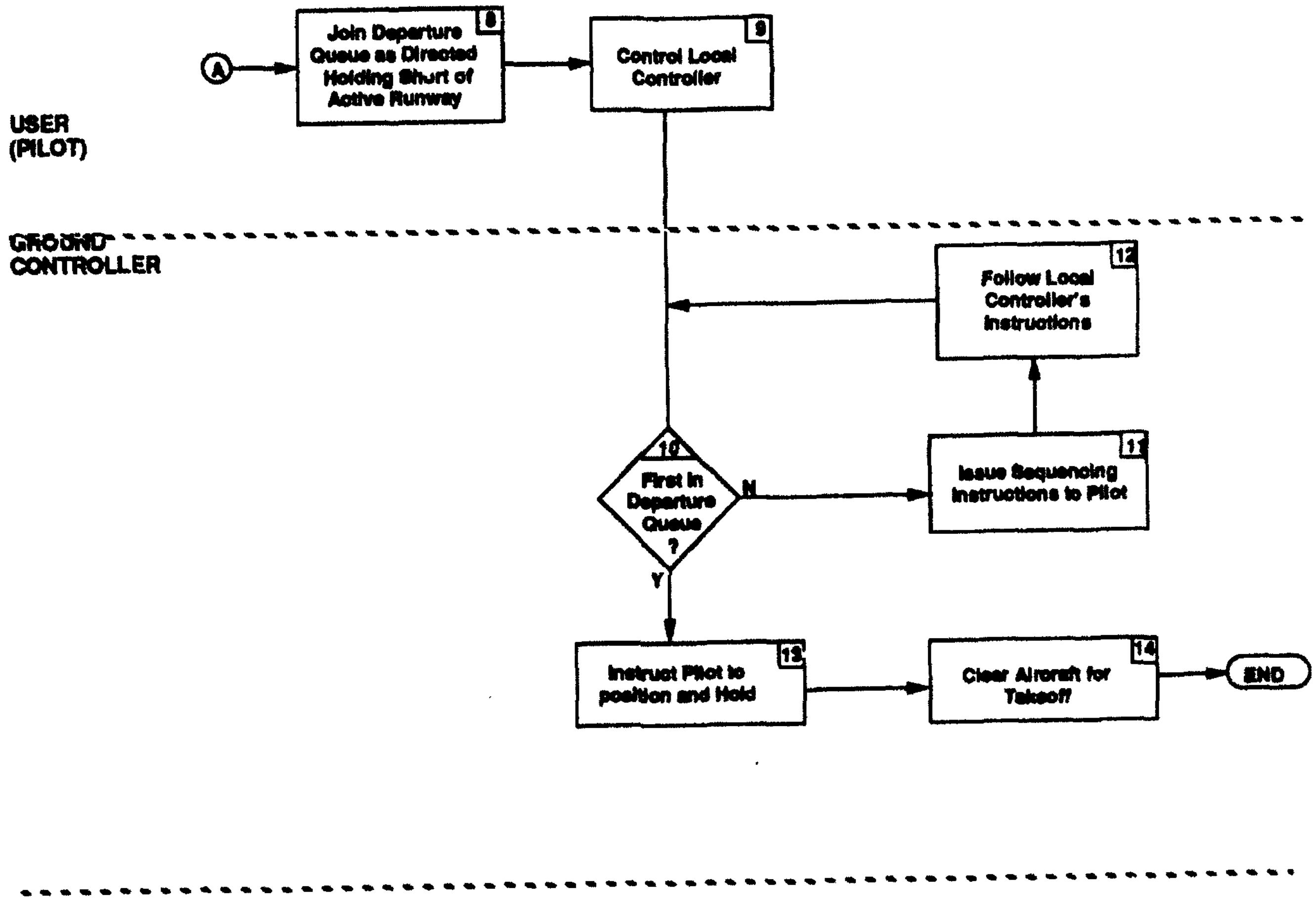


FIGURE 12-5
AIRPORT MOVEMENT AREA CONTROL
OPERATIONAL SEQUENCE DIAGRAM
(CONCLUDED)

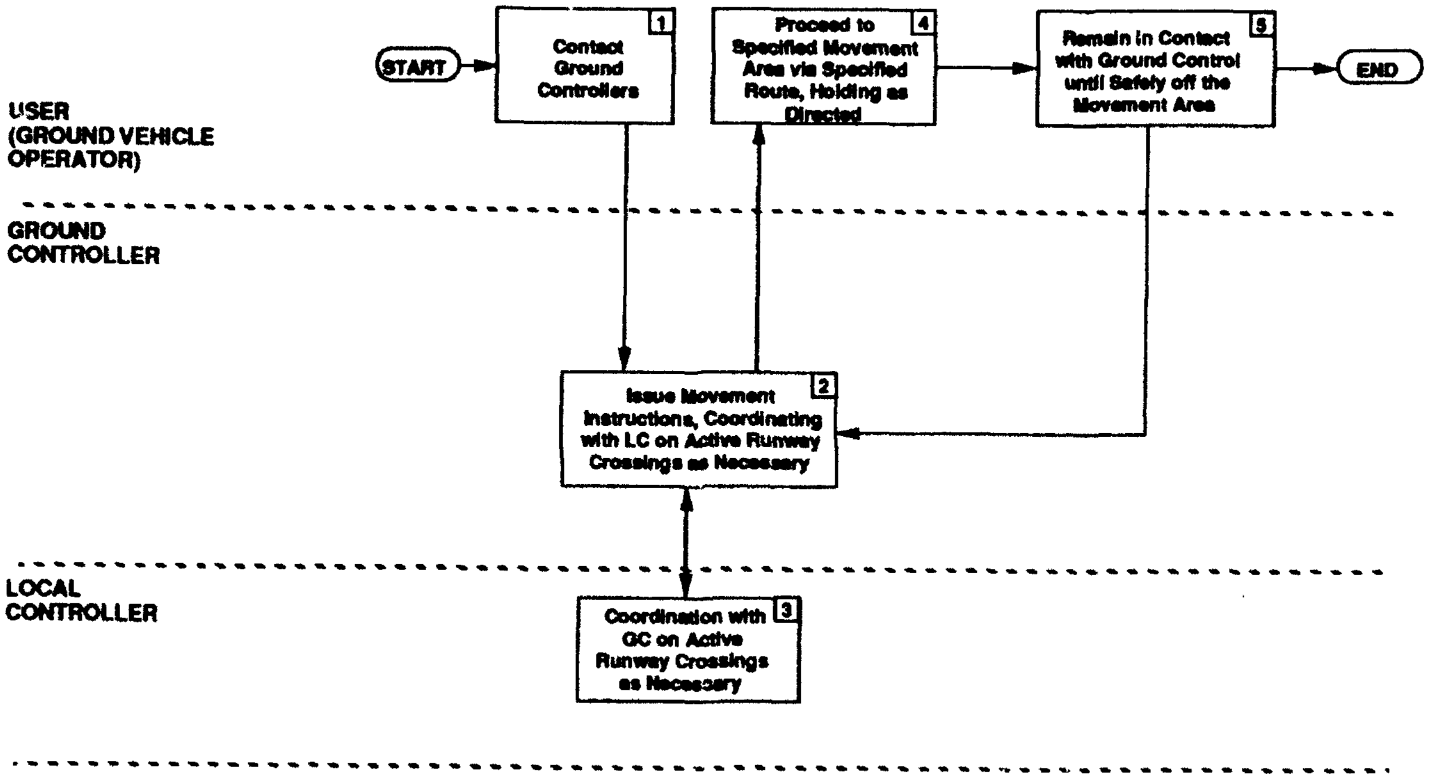


FIGURE 12-6
GROUND VEHICLE
OPERATIONAL SEQUENCE DIAGRAM

12.6 Operational Scenarios

Figure 12-7 illustrates a hypothetical operational scenario for control of the airport movement area. This scenario shows control of two snow removal vehicles on the airport movement area.

Control positions in this particular air traffic control tower include a clearance delivery controller (who also takes care of flight data functions during non-peak operation times such as during this scenario), a ground controller, as well as a local controller and an assistant local controller. Only the ground and local controllers have direct control of the aircraft and vehicles on the movement area. Interactions between the pilot and clearance delivery controller are included in the departure aircraft scenario, however, in order to maintain the flow of the scenario.

12.6.1 Ground Vehicle Airport Movement Area Control Operational Scenario

Two snow removal vehicles contact the ground controller in order to enter the airport movement area (1). The ground controller gives the vehicles clearance to enter the movement area and issues further movement instructions as necessary, cautioning the operator to hold short of the active runway that must be crossed to reach the closed runway (2 through 5).

When the two vehicles reach the taxiway/runway intersection, the ground controller informs the local controller that there are vehicles waiting to cross the active runway (6). The local controller alerts the ground controller that there is a break in the relatively steady stream of arriving aircraft (7), at which point the ground controller instructs the snow removal vehicle operators to promptly cross the active runway (8). The ground controller continues to watch the progress of the vehicles and snow removal process (9).

A few hours later, one operator of the snow removal equipment contacts the ground controller to report that the runway is clear of snow (10). The ground controller passes this information along to the tower cab supervisor (11). The supervisor subsequently coordinates with the controllers and decides to resume a normal two runway operation. The ATIS message is promptly changed to reflect the new airport runway configuration.

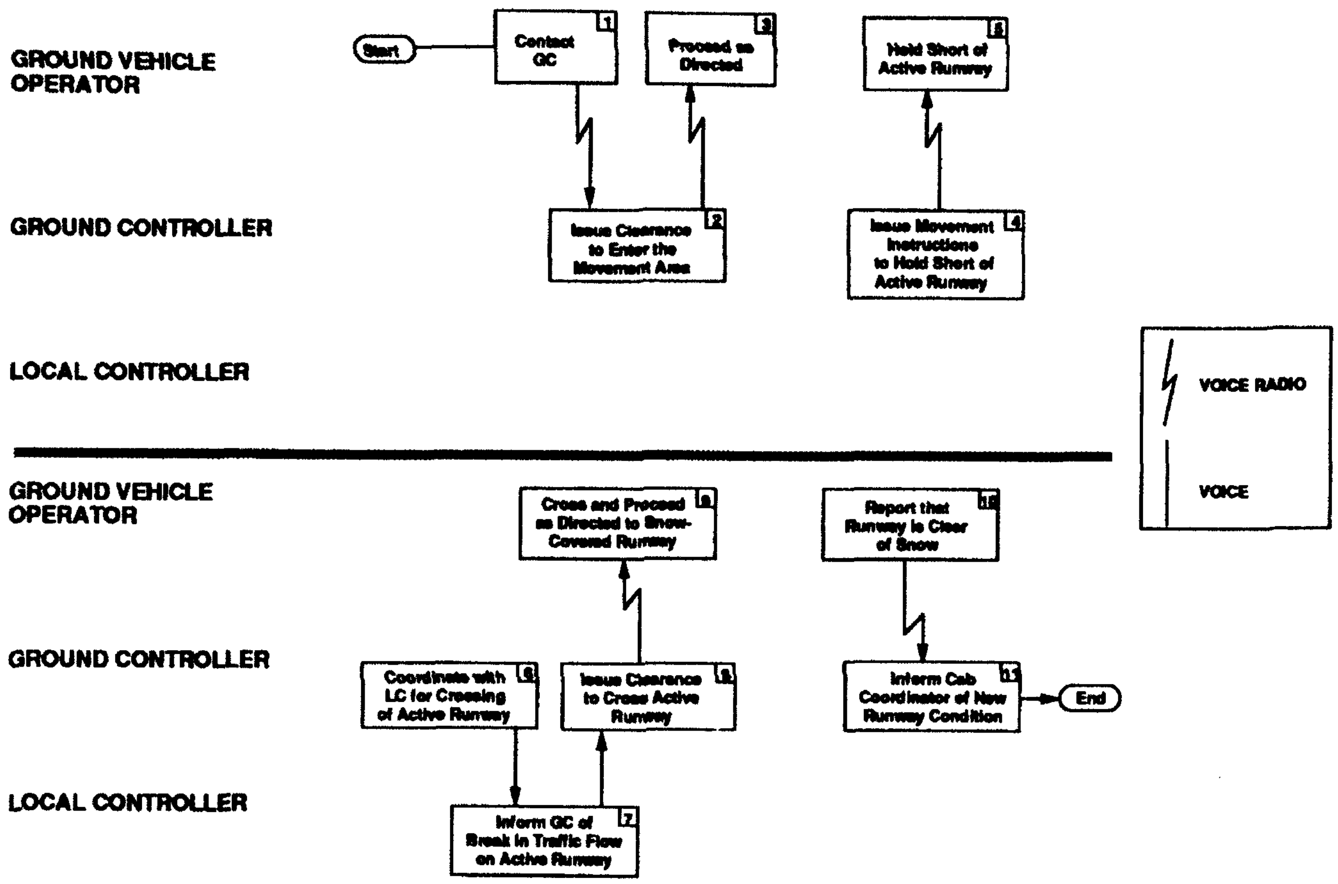


FIGURE 12-7

GROUND VEHICLE
OPERATIONAL SCENARIO DIAGRAM

ACCRONYMS

ACRONYM	MEANING
A/C	Aircraft
A/G	Air/Ground
A/N	Alphanumeric
AAR	Airport Acceptance Rate
AAS	Advanced Automation System
ACARS	Automatic Communications Addressing and Reporting System
ACCC	Area Control Computer Complex
ACF	Area Control Facility
ACFT	Aircraft
ACID	Aircraft Identification
ADAS	Automated Data Acquisition System
ADIZ	Air Defense Identification Zone
ADO	Airline Dispatch Office
ADS	Automatic Dependent Surveillance
AERA	Automated En Route ATC
AFSS	Automated Flight Service Station
AIRMET	Airman's Meteorological Information
ALNOT	Alert Notice
ALTRV	Altitude Reservation
APD	Automated Problem Detection
APP	Approach
APR	Automated Problem Resolution
ARINC	Aeronautical Radio Incorporated
ARSA	Airport Radar Service Area
ARSR	Air Route Surveillance Radar
ARTCC	Air Route Traffic Control Center
ASDE	Airport Surface Detection Equipment
ASOS	Automated Surface Observing System
ASR	Airport Surveillance Radar
ASV	Airline Schedule Vendor
ATAS	Airspace and Traffic Advisory Service
ATC	Air Traffic Control
ATCCC	Air Traffic Control Command Center
ATCRBS	Air Traffic Control Radar Beacon System
ATCS	Air Traffic Control System
ATCT	Air Traffic Control Tower
ATIS	Automated Terminal Information Service
AWOS	Automated Weather Observation Station
AWP	Aviation Weather Processor
AWW	Severe Weather Forecast Alerts (formerly Alert Weather Watch)
CA	Conflict Alert
CARF	Central Altitude Reservation Function
CF	Central Flow
CFCF	Central Flow Control Function
CFMWP	Central Flow Meteorologist Weather Processor
CHI	Computer-Human Interface
CNSP	Consolidated NOTAM Processor
CRA	Conflict Resolution Advisory
CVFR	Controlled Visual Flight Rules
CWA	Center Weather Advisory
CWP	Central Weather Processor
CWS	Meteorological Impact Statement
CWSU	Center Weather Service Unit
CWSUM	Center Weather Service Unit Meteorologist

DBRITE	Digital Bright Radar Indicator Tower Equipment
DEP	Departure
DEWIZ	Distance Early Warning Identification Zone
DF	Direction Finder
DLP	Data Link Processor
DME	Distance Measuring Equipment
DUAT	Direct User Access Terminal
EARTS	En Route Automated Radar Tracking System
EDCT	Estimated Departure Clearance Time
EFAS	En Route Flight Advisory Service
ELT	Emergency Locator Transmitter
ETA	Estimated Time of Arrival
EXT	External
E-MSAW	En Route Minimum Safe Altitude Warning
FAA	Federal Aviation Administration
FAATC	FAA Technical Center
FAC	Facilities
FDB	Full Data Block
FDE	Flight Data Entry
FIR	Flight Information Region
FL	Flight Level
FP	Flight Plan
FSAS	Flight Service Automation System
FSDPS	Flight Service Data Processing System
FSS	Flight Service Station
GC	Ground Control
GOES	Geostationary Operational Environmental Satellite
HF	High Frequency
HIWAS	Hazardous Inflight Weather Advisory Service
HZW	Hazardous Weather Outline
I/AFSS	International AFSS
IAO	IFR Area Outline
ICAO	International Civil Aviation Organization
ICSS	Interfacility Communication Switching System
ID	Indentification
IDL	Interfacility Data Link
IFEA	In-Flight Emergency Assistance
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
INFO	Information
INREQ	Information Request
INS	Inertial Navigation System
LC	Local Control
LLWAS	Low-Level Wind Shear Alert System
LORAN	Long Range Navigation
MBO	Military Base Operations
MDA	Minimum Descent Altitude
MEA	Minimum En Route Altitude
MHZ	One Million Hertz
MIA	Minimum IFR Altitudes
MLS	Microwave Landing System
MOCA	Minimum Obstruction Clearance Altitude
Mode A	Basic ATCRBS

Mode C	Altitude-encoded Beacon Reply
Mode S	Mode Select Beacon System
MSA	Minimum Safe Altitude
MSAW	Minimum Safe Altitude Warning
MVA	Minimum Vectoring Altitude
MVFR	Marginal Visual Flight Rules
MWP	Meteorologist Weather Processor
NAS	National Airspace System
NASP	National Airspace System Plan
NASSRS	NAS System Requirements Specification
NAVAID	Navigational Aid
NAWAU	National Aviation Weather Advisory Unit
NAWPF	National Aviation Weather Processing Facility
NDB	Nondirectional Beacon
NEXRAD	Next Generation Weather Radar
NOTAM	Notice(s) to Airmen
NMI	Nautical miles
NWS	National Weather Service
OAG	Officail Airline Guide
ODAPS	Oceanic Display and Planning System
OFDPS	Offshore Flight Data Processing System
PATWAS	Pilot's Automatic Telephone Weather Answering Service
PIREP	Pilot Report
RCC	Rescue Coordination Center
RMMS	Remote Maintenance Monitoring System
RNAV	Area Navigation
QALQ	Initial Information Request Message
QTP	Quick Trial Plan
RCC	Rescue Coordination Center
RCF	Remote Communication Facility
RVR	Runway Visual Range
RWP	Real-time Weather Processor
SA	Surface Observation
SAR	Search and Rescue
SARSAT	Search and Rescue Satellite
SAT	Satellite
SID	Standard Instrument Departure
SIGMET	Significant Meteorological Condition
SIGMET	Significant Meteorological Information
SP	Specialist
STAR	Standard Terminal Arrival Route
TACAN	Tactical Air Navigation
TACAN	Tactical Aircraft Control and Navigation
TAS	True Air Speed
TCA	Terminal Control Area
TCAS	Traffic Alert And Collision Avoidance
TCCC	Tower Control Computer Complex
TCS	Tower Communications System
TDWR	Terminal Doppler Weather Radar
TMC	Traffic Management Coordinator
TMC/MC	Traffic Management Coordinator/Military Coordinator

TMCC	Traffic Management Computer Center
TMF	Traffic Management Facility
TMP	Traffic Management Processor
TMS	Traffic Management System
TMSps	Traffic Management Specialists
TMU	Traffic Management Unit
TP	Trial Plan
TPC	Tower Control Computer Complex Position
TRACON	Terminal Radar Approach Control
TWEB	Transcribed Weather Broadcast Console
UAL	United Airlines
UHF	Ultra High Frequency
US	United States
UN	United Nations
VFR	Visual Flight Rules
VHF	Very High Frequency
VMC	Visual Meteorological Conditions
VOR	Very High Frequency Omnidirectional Range Station
VORTAC	Collocated VOR and TACAN
VSCS	Voice Switching And Control System
WMSCR	Weather Message Switching Center Replacement
WX	Weather

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GLOSSARY

AREA CONTROL COMPUTER COMPLEX (ACCC) - The common automation system equipment and software that support control of aircraft in a specific area, and which is located within each area control facility. The ACCC is one portion of the AAS.

AREA CONTROL FACILITY (ACF) - The planned 23 facilities that result from consolidation of existing ARTCC and TRACON/TRACAB facilities. An ACF may be formed from an existing ARTCCC or may be created in a new building. The number, location, and implementation dates of ACFs are in accordance with the National Airspace System Plan. There will be 20 CONUS ACFs converted from ARTCCs; plus Honolulu, Anchorage, and the New York TRACON. Each can accomplish an en route and approach/departure control.

AERODROME - A defined area on land or water (including any buildings, installations, and equipment) intended to be used either wholly or in part for the arrival, departure, and movement of aircraft. Aerodromes may include airports, heliports, and other landing areas.

AIRCRAFT - Device/s that are used or intended to be used for flight in the air; when used in air traffic control terminology may include the flight crew.

AIR TRAFFIC CONTROL COMMAND CENTER (ATCCC) - An Air Traffic Operations service facility consisting of four operational units.

1. Central Flow Control Function (CFCF) - Responsible for coordination and approval of all major inter-center flow control restrictions on a system basis in order to obtain maximum utilization of the airspace.
2. Responsible for coordinating, planning, and approving special user requirements under the Altitude Reservation concept.
3. Airport Reservation Office (ARO) - Responsible for approving IFR flights at designated high density traffic airports (John F. Kennedy, LaGuardia, O'Hare and Washington National) during specified hours.
4. ATC Contingency Command Post - A facility that enables the FAA to manage the ATC system when a significant portion of the system's capabilities have been lost or are threatened.

ALNOT - A request originated by an Automated Flight Service Station (AFSS) or an Area Control Facility (ACF) for an extensive communications search for overdue, unreported, or missing aircraft.

ALTITUDE RESERVATION (ALTRV) - Airspace utilization under prescribed conditions normally employed for the mass movement of aircraft or other special requirements which cannot otherwise be accomplished. ALTRVs are approved by the appropriate FAA facility.

ALTITUDE RESTRICTION - An altitude or altitudes, stated in the order flown, which are to be maintained until reaching a specific point or time. Altitude restrictions may be issued by ATC due to traffic, terrain, or other airspace considerations.

ATCCC SPECIALIST - Traffic management specialist resident at the Air Traffic Control Command Center (ATCCC) who coordinates with local traffic managements specialists at ARTCCs and manages flow control operations. See ATCCC description.

AUTOMATED FLIGHT SERVICE STATION (AFSS) - A station that provides interactive alphanumeric and graphic work stations for the flight service specialist.

BEARING - The horizontal direction to or from any point, usually measured clockwise from true north, magnetic north, or some other reference point, through 360 degrees.

DIRECTION FINDER (DF) - A radio receiver equipped with a directional sensing antenna used to take bearings on a radio transmitter. Specialized radio direction finders are used in aircraft as air navigation aids. Others are ground-based, primarily to obtain a "fix" on a pilot requesting orientation assistance or to locate downed aircraft. A location "fix" is established by the intersection of two or more bearing lines plotted on a navigational chart using either two separately located Direction Finders to obtain a fix on an aircraft or by a pilot plotting the bearing indications of his DF on two separately located ground-based transmitters both of which can be identified on his chart.

DIAL UP ACCESS TERMINAL (DUAT) - The capability for direct user access terminals to file flight plans into the NAS and access weather information from the National Graphic Weather Display System

DIGITAL BRITE RADAR INDICATOR TOWER EQUIPMENT (DBRITE) - Alphanumeric display systems for control towers using digital scan converter systems in a radar scope-type presentation.

EMERGENCY - A safety condition of being threatened by serious and/or imminent danger which requires immediate or timely assistance.

EMERGENCY LOCATOR TRANSMITTER (ELT) - A radio transmitter attached to the aircraft structure which operates from its own power source on 121.5 MHz and 243.0 MHz. It aids in locating downed aircraft by radiating a downward sweeping audio tone, 2-4 times per second. It is designed to function without human action after an accident.

EN ROUTE - One of three phases of flight services (terminal, en route, oceanic). En route service is provided outside of terminal airspace and is exclusive of oceanic control.

EN ROUTE AIR TRAFFIC CONTROL SERVICES - Air traffic control service provided for aircraft on IFR flight plans, generally by ARTCCs, when these aircraft are operating between departure and destination terminal areas. When equipment capabilities and controller workload permit, certain advisory/assistance services may be provided to VFR aircraft.

EN ROUTE MINIMUM SAFE ALTITUDE WARNING (E-MSAW) - A function of the NAS Stage A en route computer that aids the controller by providing an alert when a tracked aircraft is below, or predicted by the computer to go below, a predetermined minimum IFR altitude.

FIX - A geographical position that is determined by visual reference to the surface, by reference to one or more radio NAVAIDS, by celestial plotting, or by another navigational device.

FLIGHT INFORMATION REGION (FIR) - An airspace of defined dimensions within which Flight Information Service and Alerting Service are provided.

1. Flight Information Service - A service provided for the purpose of giving advice and information useful for the safe and efficient conduct of flights.

2. Alerting Service - A service provided to notify appropriate

organizations regarding aircraft in need of search and rescue aid and assist such organizations as required.

FLIGHT PATH - A line, course, or track along which an aircraft is flying or intended to be flown.

FLIGHT PLAN - Specified information relating to the intended flight of an aircraft that is filed orally or in writing with an ATC facility.

FLIGHT SERVICE STATION (FSS) - Air traffic facilities which provide pilot briefing, en route communications, and VFR search and rescue services; assist lost aircraft and aircraft in emergency situations; relay ATC clearances; originate Notices to Airmen; broadcast aviation weather and NAS information; receive and process IFR flight plans; and monitor NAVAIDS. In addition, at selected locations, FSSs provide En Route Flight Advisory Service (Flight Watch), take weather observations, issue airport advisories, and advise Customs and Immigration of transborder flights.

HANDOFF - A Controller action taken to transfer the radar identification of an aircraft from one Controller to another if the aircraft will enter the receiving Controller's airspace and radio communications with the aircraft will be transferred.

HAZARDOUS AREA REPORTING SERVICE - Flight monitoring for VFR aircraft crossing large bodies of water, swamps, and mountains. This service is provided for the purpose of expeditiously alerting SAR facilities when required. Radio contacts are desired at least every 10 minutes. If contact is lost for more than 15 minutes, SAR will be alerted.

INSTRUMENT FLIGHT RULES (IFR) - Rules governing the procedures for conducting instrument flight. Also a term used by pilots and controllers to indicate type of flight plan.

IFR AIRCRAFT/IFR FLIGHT - An aircraft conducting flight in accordance with instrument flight rules.

IFR CONDITIONS - Weather conditions below the minimum for flight under visual flight rules.

INFORMATION REQUEST (INREQ) - A request originated by an AFSS for information concerning an overdue VFR aircraft.

INTERFACILITY - Between adjacent facilities; for example: between ACF and ACF, or between ACF and ATCT, as contrasted with intrafacility.

INTRAFACILITY - Within a single facility; for example: between two sectors within the same ACF, as contrasted with interfacility.

MINIMUM DESCENT ALTITUDE (MDA) - The lowest altitude, expressed in feet above mean sea level, to which descent is authorized on final approach or during circle-to-land maneuvering in execution of a standard instrument approach procedure where no electronic glide slope is provided. (See Nonprecision Approach Procedure)

MINIMUM EN ROUTE IFR ALTITUDE (MEA) - The lowest published altitude between radio fixes which assures acceptable navigational signal coverage and meets obstacle clearance requirements between those fixes. The MEA prescribed for a federal airway, or segment thereof, area navigation low or high route, or other direct route applies to the entire width of the airway, segment, or route between the radio fixes defining the airway, segment, or route. (Refer to FAR Parts 91 and 95; AIM)

MINIMUM IFR ALTITUDES (MIA) - Minimum altitudes for IFR operations as prescribed in FAR Part 91.

MINIMUM OBSTRUCTION CLEARANCE ALTITUDE (MOCA) - The lowest published altitude in effect between radio fixes on VOR airways, off-airway routes, or route segments which meets obstacle clearance requirements for the entire route segment and which assures acceptable navigational signal coverage only within 25 statute (22 nautical) miles of a VOR. (Refer to FAR Part 91 and 95)

MINIMUM SAFE ALTITUDE (MSA) - The minimum altitude specified in FAR Part 91 for various aircraft operations.

MINIMUM SAFE ALTITUDE WARNING (MSAW) - A function of the ARTS III computer that aids the controller by alerting him when a tracked Mode C-equipped aircraft is below, or is predicted by the computer to go below, a predetermined minimum safe altitude. (Refer to AIM)

MINIMUM VECTORING ALTITUDE (MVA) - The lowest MSL altitude at which an IFR aircraft will be vectored by a Radar Controller, except as otherwise authorized for radar approaches, departures, and missed approaches.

MODE S - A surveillance system which provides a digital data link with properly equipped aircraft.

NATIONAL AIRSPACE SYSTEM (NAS) - The common network of U.S. airspace; air navigation facilities, equipment, and services; airports or landing areas; aeronautical charts, information, and services; rules, regulations, and procedures; technical information, manpower, and material. Included are system components shared jointly with the military.

NATIONAL SEARCH AND RESCUE PLAN - An interagency agreement which provides for the effective utilization of all available facilities in all types of search and rescue missions.

NOTICES TO AIRMEN (NOTAM) - A notice containing information (not known sufficiently in advance to publicize by other means) concerning the establishment, condition, or change in any component (facility, service, or procedure of, or hazard to the national airspace system), the timely knowledge of which is essential to personnel to personnel concerned with flight operations.

OBSTACLE - An existing object, object of natural growth, or terrain at a fixed geographical location or which may be expected at a fixed location within a prescribed area with reference to which vertical clearance is or must be provided during flight operation.

OBSTRUCTION - Any object/obstacle exceeding the obstruction standards specified by FAR Part 77, Subpart c.

OBSTRUCTION LIGHT - A light or one of a group of lights, usually red or white, frequently mounted on a surface structure or natural terrain to warn pilots of the presence of an obstruction.

QALQ MESSAGE - An initial informational inquiry made from a Flight Service Station on the whereabouts of a VFR aircraft.

REMOTE AREAS - Sparsely populated areas such as mountains, swamps, and large bodies of water.

REMOTE COMMUNICATIONS OUTLET (RCO) and Remote Transmitter/Receiver (RTR) - An unmanned communications facility remotely controlled by air traffic personnel. RCOs serve FSSs; RTRs serve terminal ATC facilities. An RCO or RTR may be UHF or VHF. The RCO extends the communication range of the air traffic facility.

REPORTING POINT - A geographical location in relation to which the position of an aircraft is reported.

RESCUE COORDINATION CENTER (RCC) - A search and rescue (SAR) facility equipped and manned to coordinate and control SAR operations in an area designated by the SAR plan. The U.S. Coast Guard and the U.S. Air Force have responsibility for the operation of RCCs.

ROUTE - A defined path, consisting of one or more courses in a horizontal plane, which aircraft traverse over the surface of the earth.

SAFETY ALERT - A safety alert issued by ATC to aircraft under their control.

SEARCH AND RESCUE/SAR - A service which seeks missing aircraft and assists those found to be in need of assistance. It is a cooperative effort using the facilities and services of available Federal, state, and local agencies.

SECTOR SUITE (S/S) - Refers to the composition of functions which directly comprise either the Controller or Sector Suite Console/Support processing elements.

SECTOR SUITE WORK STATION - A group of consoles containing displays and input devices whereby ATC specialists (Controllers or Supervisors) interface with the ACF.

SPECIAL USE AIRSPACE - Airspace of defined dimension identified by an area on the surface of the earth wherein activities must be confined because of their nature and/or where limitations may be imposed on aircraft operations that are not a part of those activities. Types of special use airspace are:

1. Alert Area - Airspace which may contain a high volume of pilot training activities or an unusual type of aerial activity, neither of which is hazardous to aircraft. Alert areas are depicted on aeronautical charts for the information of non-participating pilots. All activities within an Alert Area are conducted in accordance with Federal Aviation Regulations. Pilots of participating aircraft and pilots crossing the area are equally responsible for collision avoidance.

2. Controlled Firing Area - Airspace wherein activities are conducted so controlled as to eliminate hazards to nonparticipating aircraft and to ensure the safety of persons and property on the ground.

3. Military Operations Area (MOA) - An MOA is an Airspace assignment of defined vertical and lateral dimensions established outside positive control areas to separate/segregate certain military activities from IFR traffic and to identify for VFR traffic where these activities are conducted (refer to AIM).

4. Prohibited Area - Designated airspace within which the flight of aircraft is prohibited (refer to en route charts, AIM).

5. Restricted Area - Airspace designated under FAR, Part 73, within which the flight of aircraft, while not wholly prohibited, is subject to restriction. Most restricted areas are designated joint use and IFR/VFR operations in the area may be authorized by the controlling ATC facility when it is not being utilized by the using agency. Restricted areas are depicted on en route. Where joint use is authorized, the name of the ATC controlling facility is also shown (refer to FAR, Part 73, and AIM).

6. Warning Area - Airspace which may contain hazards to non participating aircraft in international airspace.

SPECIALIST - The internal individual or group who provides service through the NAS (e.g., controllers, engineers, maintenance and management personnel).

SURVEILLANCE - The detection, location, and tracking of aircraft within NAS airspace for the purposes of control, separation, and identification. Surveillance systems are electronic in nature; visual methods are purposely excluded. In the case of dependent surveillance, the aircraft provides all flight information. Surveillance systems are differentiated as independent, independent cooperative, and dependent:

1. Independent Surveillance - A system which requires no airborne compatible equipment

2. Independent Cooperative Surveillance - A system which requires airborne compatible equipment (e.g., ATCRBS, Mode S)

3. Dependent Surveillance - A system which requires input from navigation equipment aboard the aircraft either via a data link (e.g., LOFF) or via voice transmission (pilot reports)

TERMINAL AREA - A general term used to describe airspace in which approach control service or airport traffic control service is provided.

TERMINAL AREA FACILITY - A facility providing air traffic control service for arriving and departing IFR, VFR, Special VFR, Special IFR aircraft and, on occasion, en route aircraft.

TOWER/AIRPORT TRAFFIC CONTROL TOWER - A terminal facility that uses air-ground radio communications, visual signaling, and other devices to provide ATC services to aircraft operating in the vicinity of an airport or on the movement area. Authorizes aircraft to land or takeoff at the airport controlled by the tower or to transit the airport traffic area regardless of flight plan or weather conditions (IFR or VFR). A tower may also provide approach control services.

TRANSFER OF CONTROL - The action whereby control responsibility for an aircraft is transferred from one controller to another.

TRANSFERRING CONTROLLER/FACILITY - A Controller/facility transferring control of an aircraft to another Controller/facility.

TRAFFIC MANAGEMENT COORDINATOR - A traffic management specialist resident at the ARTCC traffic management unit (TMU) providing coordination between the national level central flow control function of the ATCCC and local ARTCC controllers.

TRAFFIC MANAGEMENT SPECIALIST - Specialist resident at the Air Traffic Control Command Center (ATCCC) who coordinates between local traffic management specialists at ARTCCs and manages flow control operations. See ATCCC description.

TRAFFIC MANAGEMENT UNIT (TMU) - A non-control, coordination position at the ARTCC connected to the central flow control function at the ATCCC and responsible for dissemination of flow control information at the local level.

USER - The external individual or group that receive services from the NAS (e.g., Pilot, Air Carrier, General Aviation, Military, Law Enforcement Agencies, etc.).

VISUAL FLIGHT RULES (VFR) - Rules that govern the procedures for conducting flight under visual conditions. The term 'VFR' is also used in the United States to indicate weather conditions that are equal to or greater than minimum VFR requirements. In addition, it is used by pilots and controllers to indicate the type of flight plan.

VFR AIRCRAFT/VFR FLIGHT - An aircraft conducting flight in accordance with visual flight rules or operating on a Special VFR clearance.

VFR CONDITIONS - Weather conditions equal to or better than the minimum for flight under visual flight rules.

VISUAL METEOROLOGICAL CONDITIONS (VMC) - Meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling equal to or better than the specified minima.