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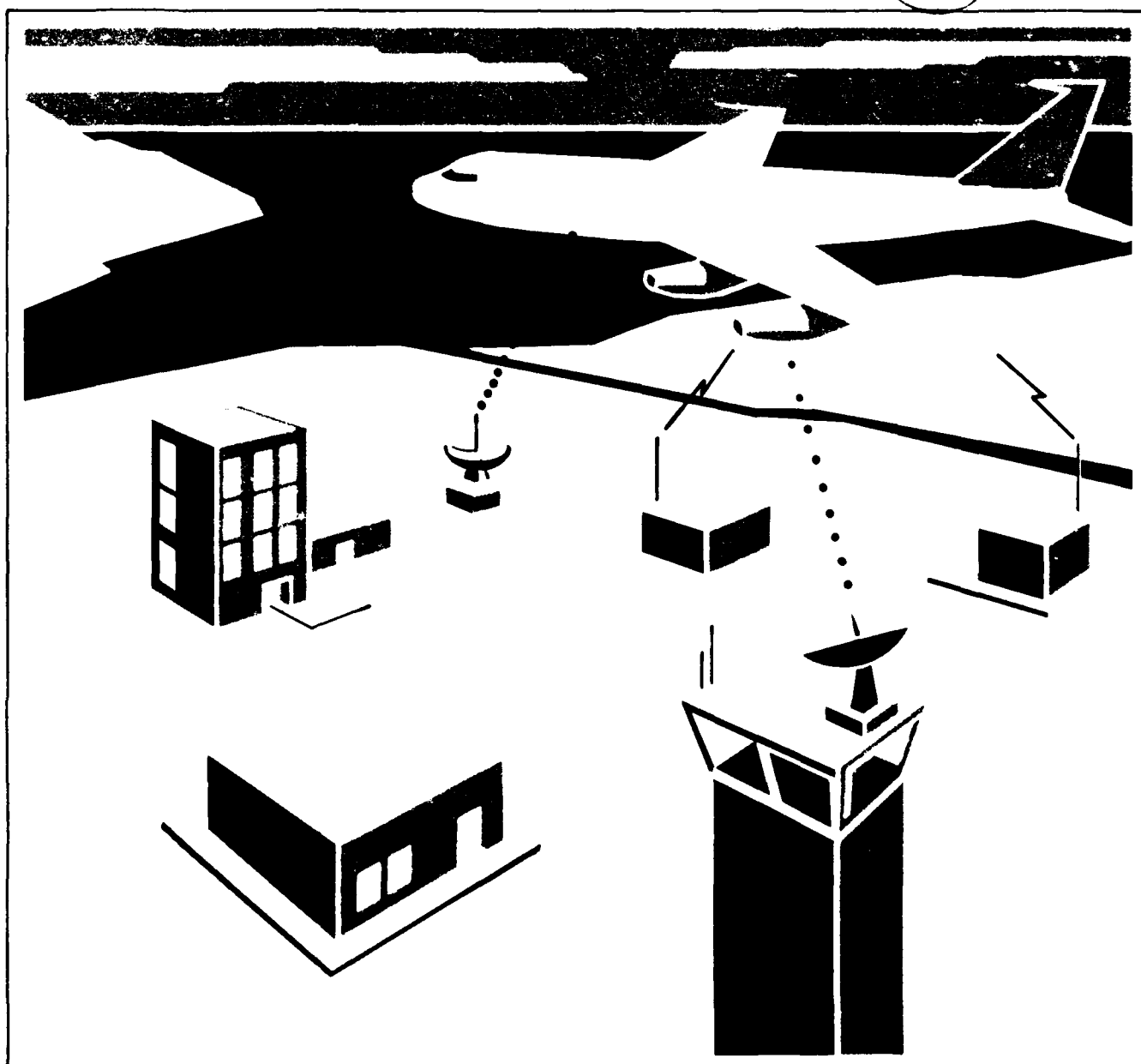
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National Airspace System

Communications Operational Concept

NAS-SR-136

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16. Abstract A requirement for the National Airspace System (NAS) is to provide for communications, as identified in the NAS System Requirement Specification, NAS-SR-1000 (NASSRS). This document presents a concept of operation for air-ground, ground-ground communications connectivity and capability, and national emergency communications. This concept describes the capabilities and shows the relationships between subsystems, facilities, information, and operators/users. It is intended to provide a common perspective for personnel involved in communication activities, assist in determining whether communications meet formal requirements, and support coordination among the organizations involved. This concept describes communications as specified in paragraph 3.6 of the NASSRS including paragraphs 3.6.1, 3.6.2, 3.6.3, and 3.6.4. This concept is one of eight operational concepts. The remaining yet to be written concepts will complete the description of the system requirements as detailed 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 (NAS-SR-135); Flight Planning (NAS-SR-131); and Support of Military Operation (NAS-SR-3.2.10).			
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1.0 INTRODUCTION

1.1 Background

The transfer of information between aircraft and ground based facilities (air-ground), between and within ground based facilities (ground-ground), and communications between National Airspace System (NAS) facilities and national emergency facilities is essential for safe and efficient operation of the NAS. This information, such as flight plans, flight movement, weather, surveillance, monitoring and control information is passed using both voice and data communications. Additionally, the communication systems utilized must be available continuously and reliably, and provide voice privacy when required.

1.2 Objective

The objective of this operational concept, which is based upon the National Airspace System System Requirements Specification (NASSRS), is to describe how air-ground, ground-ground communications connectivity, ground-ground communications capabilities, and national emergency communications will be utilized in the NAS "end state" system. This document is intended as a descriptive document to provide management and technical personnel of the FAA, as well as outside organizations, with a clear understanding of how communications within the NAS will be provided. Additionally, it is intended for use as an internal FAA management tool to support the NAS design, engineering, and acquisition activities and to manage and control change to the NAS. More specifically, the purpose of this document is to:

- Provide a common operational perspective across communications subsystems, operators, and users.
- Show the interrelationship between subsystems, facilities, information, and operators/users.

The NASSRS does not impose specific requirements for procedures, services, or regulation upon the users or specialists operating within the NAS. This document will undergo continuing review and update to reflect current FAA planning with respect to proposed capabilities and to ensure consistency with program/system developments. Projections, estimates, and/or assumptions made herein are based on available information which may change over time, resulting in modification of the NASSRS.

1.3 Scope

This operational concept describes communications capability provided in the NAS as outlined in Section 3.6 of the NASSRS. The operations described are limited to those associated solely with communications.

The specific paragraphs in the NASSRS Section 3.6 are as follows:

3.6.1 AIR-GROUND COMMUNICATIONS

- 3.6.1.A Air-Ground Communications Within the NAS Jurisdiction
- 3.6.1.B Protection from Interference
- 3.6.1.C Storage & Retrieval of Air-Ground Communications
- 3.6.1.D Operating Position Monitoring
- 3.6.1.E Air-Ground Communication Available Continuously
- 3.6.1.F Reconfiguration of Air-Ground Communications

3.6.2 GROUND-GROUND INTERFACILITY COMMUNICATIONS CONNECTIVITY

- 3.6.2.A Communications between NAS Facilities
- 3.6.2.B Communications between FAA and Non-NAS Facilities
- 3.6.2.C Secure Data Communications between NAS and DoD Facilities

3.6.3 GROUND-GROUND COMMUNICATIONS CAPABILITY

- 3.6.3.A Communications Within or Between NAS Facilities
- 3.6.3.B Reconfiguration of Communication Capabilities
- 3.6.3.C Storage & Retrieval of Ground-Ground Communications
- 3.6.3.D Interfacility and Intrafacility Communication Available Continuously
- 3.6.3.E User Verification and Access Control

3.6.4 NATIONAL EMERGENCY COMMUNICATIONS

- 3.6.4.A Minimum Essential Communications
- 3.6.4.B Emergency Communications Capabilities

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 communications 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 communications 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 communications master block diagram. Operational flow diagrams are used to functionally describe the products and services of individual specialists.
3. Operational Sequence Diagrams/Descriptions. The operational sequence diagram and associated description show a typical sequence of steps taken by operators/users in supporting communication operations. Principal features of an operation sequence diagram include the following:
 - a. Users, specialists, and computer systems involved with providing communication 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 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.

1.5 Document Organization

The remainder of this document is organized in the following manner. Section 2 is the main body of the document and is divided into six subsections. Section 2.1 provides an overview description of the communications functions and introduces (identifies) the personnel complement and physical entities (facilities and computer systems), which provide the required support. Section 2.2 describes the information used to provide communications support. Section 2.3 provides descriptions of the functional decomposition of communications services. (Sections 2.1, 2.2, and 2.3 reference related NASSRS 3.6 subsystems.) Section 2.4 presents correlation requirements for communications support. Section 2.5 provides a sequence of interactions between system and personnel entities during the planning and the implementational phases of communications services. Section 2.6 describes communications operational scenarios.

2.0 COMMUNICATIONS

2.1 Support

In order to provide required services to its users the NAS must ensure it has air-ground communications, ground-ground interfacility communications connectivity, ground-ground communications capabilities, and national emergency communications. Air-ground and ground-ground communications are utilized by specialists in automated flight service stations (AFSS), area control facilities (ACF) airport traffic control towers (ATCT) to pass information. Additionally, flight information must be passed within and between these ATC facilities, the FAA Headquarters Operations Center and the Air Traffic Control Command Center (ATCCC) in Washington, D.C. In the event of a national emergency the facilities within the NAS need to ensure voice and data communications are continuously available. This communications capability will provide national decision makers and military commanders with information on the operational status of the NAS, control of the national emergency, and reconstitution of the NAS.

2.1.1 Positions/Systems/Functions

Figure 2-1 is an overview of NAS/user interfaces for communications and illustrates the NAS facilities and systems involved. Figure 2-2 is an operational block diagram showing the inter-relationships between equipment, facilities, operators/users and the information necessary to support communications within the NAS.

Position(s) 2 through 4, 20, 21: AFSS Specialists

Functions: Preflight Briefings, Inflight Briefings, En Route Flight Advisory Service (EFAS), Weather Broadcasts, Direction Finder and NOTAM Advisories.

Description: Air traffic personnel that provide pilot briefings; en route communications; and VFR search and rescue services; relay ATC clearances; originate Notice to Airmen; broadcast aviation weather; receive and process VFR and IFR flight plans; and monitor NAVAIDS.

Procedures: FAA Handbook 7110.10, Flight Services

Projects: Capital Investment Plan, Chapter 2, Section 3: Project 23-01, Flight Service Automation System (FSAS); Project 23-13, Integrated Communications Switching System (ICSS); Section 4: Project 24-02 Communications Facilities Consolidation/Network; Project 24-11, Direction Finder; Section 5: Project 25-02, Data Multiplexing Network (DMN); Project 25-03, RML Replacement and Expansion; Project 25-07, National Airspace Data Interchange Network (NADIN) II; Project 25-08, Radio Control Equipment (RCE).

Position(s) 6 through 8, 12, 22 and 23: ACF Specialists

Function: Approach/Departure and En Route Control, Area Management, and Traffic Management.

Description: These controllers expedite the safe movement of air traffic through the Area Control Facility airspace in both the terminal and en route environments. Traffic Management coordinators provide support to the air traffic specialists by providing traffic flow information for the controllers use. Area Manager/supervisory personnel provide air traffic control management.

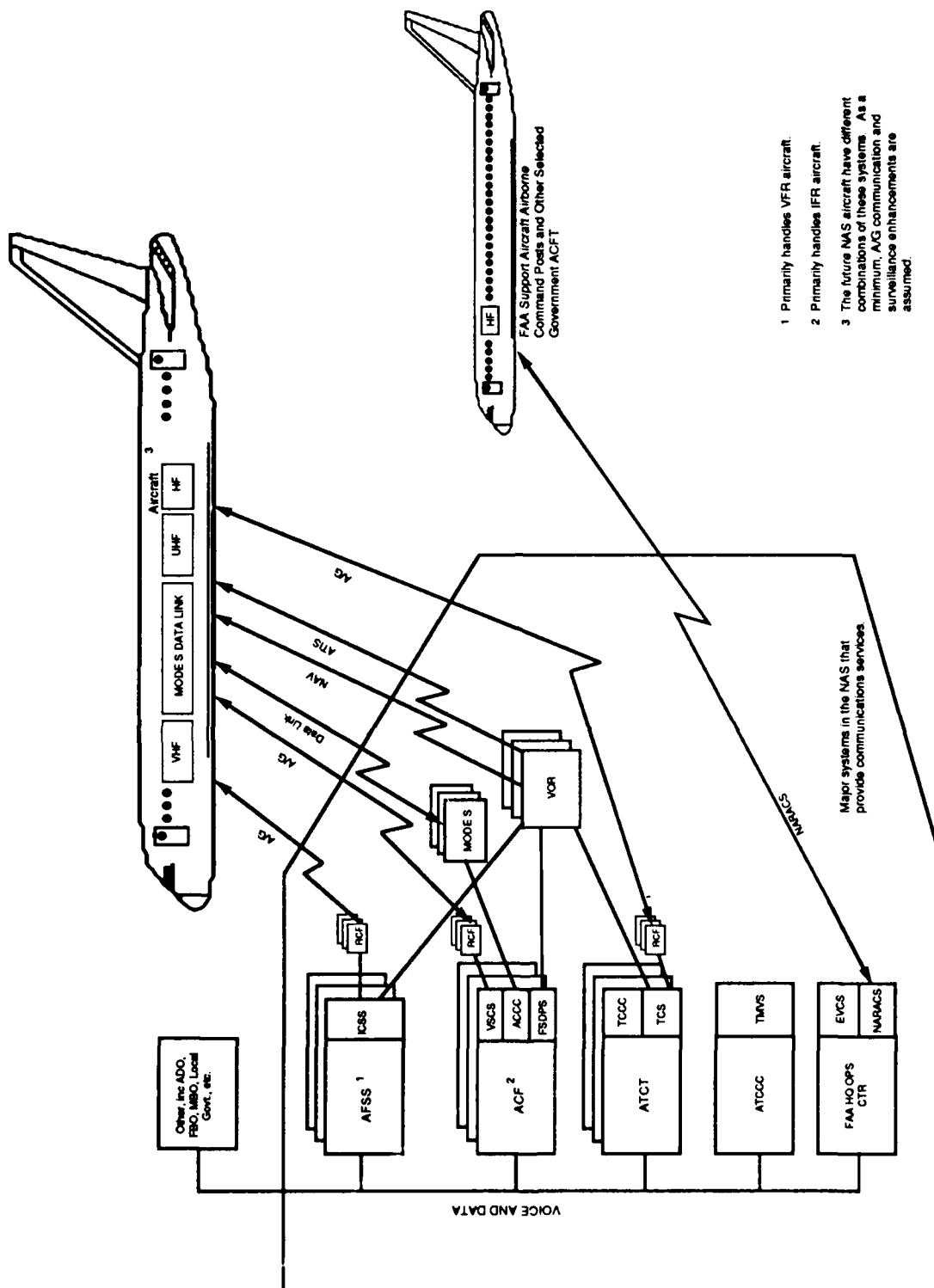


FIGURE 2-1
OVERVIEW OF NAS/USER INTERFACES
FOR COMMUNICATIONS

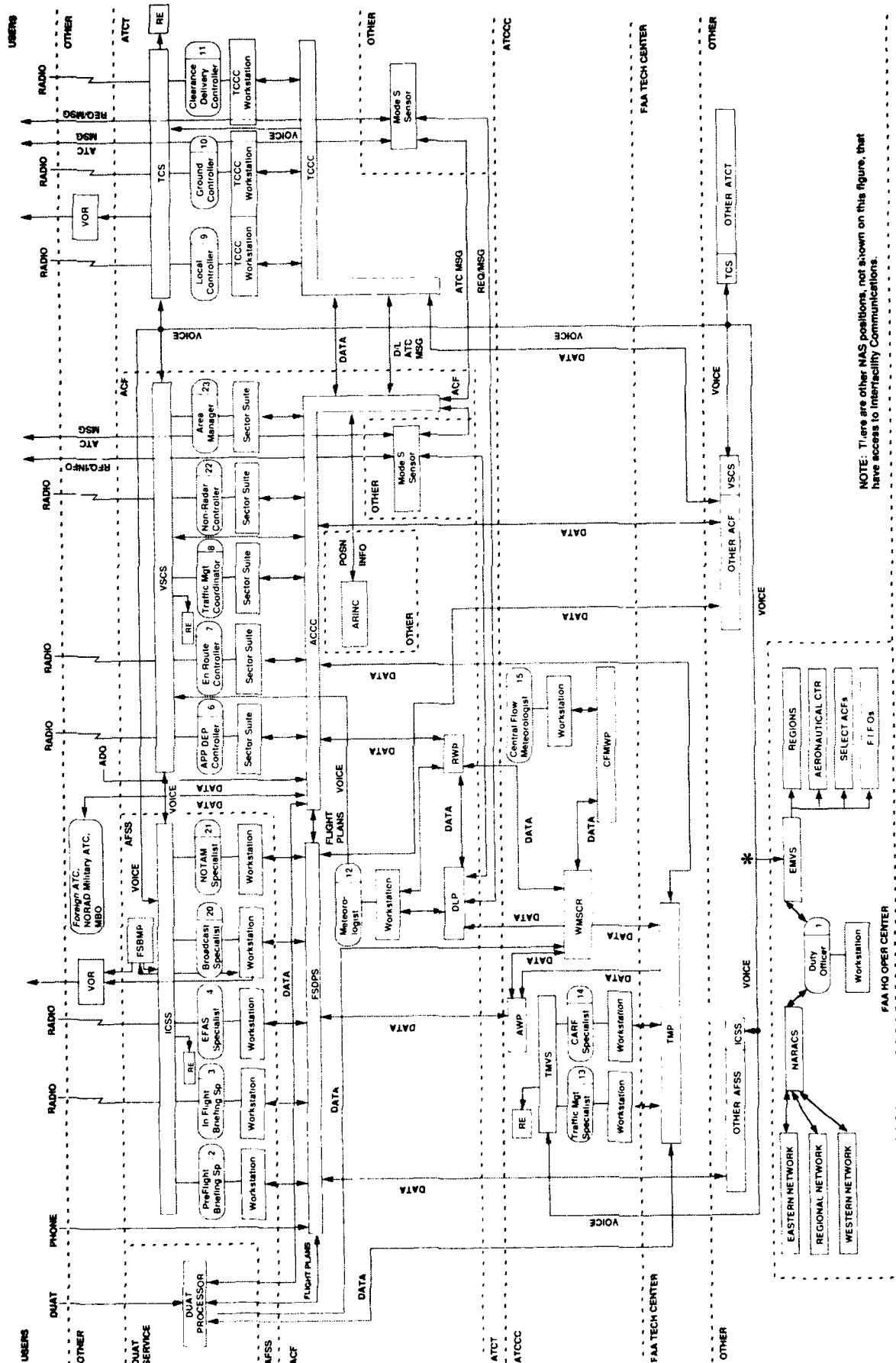


FIGURE 2-2
COMMUNICATIONS CONNECTIVITY
BLOCK DIAGRAM

* Not Currently Baseline

Procedures: FAA Handbook 7110.65, Air Traffic Control

Projects: Capital Investment Plan, Chapter 2, Section 1: Project 21-11, Voice Switching and Control System (VSCS); Project 21-15, Area Control Facilities (ACF); Section 4: Project 24-02, Communications Facilities Consolidation/Network; Project 24-12 Mode S; Section 5: Project 25-02, Data Multiplexing; Project 25-03, RML Replacement and Expansion; Project 25-07, National Airspace Data Interchange Network (NADIN) II; Project 25-08, Radio Control Equipment (RCE).

Position(s) 9 through 11: ATCT Controllers

Function: Local Control, Ground Control, and Clearance Delivery Control.

Description: Specialists in an ATCT that control aircraft arriving or departing an airport within the airport traffic area or taxiing on the airport.

Procedures: FAA Handbook 7110.65, Air Traffic Control

Projects: Capital Investment Plan, Chapter 2, Section 2: Project 22-11, Multi Voice Recorder; Project 22-12, Tower Communications System; Section 4: Project 24-02, Communications Facilities Consolidation/Network; Project 24-12, Mode S; Section 5: Project 25-02, Data Multiplexing; Project 25-03, RML Replacement and Expansion; Project 25-07, National Airspace Data Interchange Network (NADIN) II; Project 25-08, Radio Control Equipment (RCE).

Position 1: FAA Headquarters Operations Center Specialists

Function: Operations Center, Aviation Command Center, Management Operations Center, and Intelligence Support.

Description: The primary mission of the operations center specialists is to provide around-the-clock support to FAA's key management officials including the Secretary of Transportation, FAA Administrator, Deputy Administrator, Executive Directors, and Associate Administrators during both day-to-day operations and crises. These specialists collect information, coordinate and direct FAA resources and operations during times of crisis. A telecommunication center, which is remotely located, provides support to the operation center specialists. The telecommunication center is equipped with secure, FAA proprietary, major air carrier subscriber system, public, and teletype systems. The telecommunication center also has both secure and non-secure facsimile capabilities. Secure telephone service is also available to the specialists.

Procedures: FAA Order 1770.6A, Operations Center

Projects: Capital Investment Plan: Chapter 2: Section 5: Project 25-07, National Airspace Data Interchange Network (NADIN) II; Section 6: Project 26-14, National Radio Communications Systems (NARACS).

Position(s) 13 through 15: Air Traffic Control Command Center (ATCCC) Specialists

Function: Central Flow Control Facility (CFCF), Central Altitude Reservation (CARF), Airport Reservation (ARO), ATC Contingency Command Post.

Description: The ATCCC specialists provide national level management and monitoring of current air traffic flow, aircraft operations, en route sector and airport utilization, and future system utilization.

Procedures: FAA Order 7210.47A Traffic Management System

Projects: Capital Investment Plan: Chapter 2: Section 1: Project 21-06, Traffic Management System (TMS); Section 3, Project 23-02, Central Weather Processor (CWP); Project 23-04, Weather Message Switching Center (WMSC) Replacement. Project 25-02, Data Multiplexing; Section 5, Project 25-07, National Airspace Data Interchange Network (NADIN)II; Section 6: Project 26-14: National Radio Communications System (NARACS).

2.2 Information

The NAS is capable of transferring information between aircraft and NAS ground facilities via air-ground voice and data communications within the en route and terminal airspace of the conterminous United States, Alaska, Hawaii, and Puerto Rico. The NAS is also required to provide communications between NAS facilities and communications systems outside the NAS, both governmental and non-governmental. These communications capabilities must exist between selected operating, supervisory, maintenance, and administrative positions at separate NAS facilities.

In the event of a national emergency the NAS provides communications for national decision makers and military commanders. It provides information on operational status of the NAS for executive crisis management and control of national emergency and reconstitution of the NAS. It will also provide for effective control of the NAS by the National Command Authority (NCA), DoD, and FAA.

The following paragraphs describe the information related to and passed by various facilities. Each paragraph relates directly to their corresponding paragraphs in the NASSRS.

2.2.1 Information Used in Air-Ground Communications

In order to provide required services to its users the NAS must ensure it has continuous air-ground communications. This requirement is described in Section 3.6.1 of the NASSRS. Air-ground communications are utilized by Automated Flight Service Station (AFSS) specialists, En Route and Approach/Departure Controllers at an Area Control Facility (ACF), or Tower Controllers at an Airport Traffic Control Tower (ATCT) to pass and receive back information from pilots.

2.2.1.1 Air-Ground Communications within the NAS

Air-ground communications within the NAS consists of equipment that enables air traffic specialists to communicate with pilots. Information passed between pilots and controllers is communicated via voice using very high frequency (VHF) and ultra high frequency (UHF) radios and data link for both civilian and military users. The following paragraphs describe voice communications within the NAS.

Air-ground communications must provide for reception at appropriate altitudes so users may contact the necessary ATC facility (AFSS, ACF, ATCT) to receive their services.

Air-ground communications such as radio transmissions are provided by remote communications facilities (RCFs) using VHF and UHF radio transmitters and receivers transmitting on frequency ranges of 117.975 to 136.000MHz and 225 to 400MHz respectively. The RCFs provide the voice communications links between pilots flying within the NAS and ground based controllers, specialists, and processors. These RCFs provide two-way voice communication links and some broadcast links supplied to specific VHF omnidirectional range facilities (VORs). When the specialist transmits, the communications outlet will use the analog voice signal it

receives to modulate a carrier which then can be transmitted to the pilot. The outlet receives the reply by demodulating the radio signal received from the aircraft and sends the resulting analog voice signal to the intended specialist via the NAS Interfacility Communications System (NICS).

The NICS provides the voice and data communications interconnectivity between facilities and sites within the NAS. The transmission function of the NICS provides the connectivity to the distributed facilities and equipment of the NAS. The NICS radio control equipment (RCE) supports ground-to-air voice communications and connectivity between the voice switching equipment in the operational ATC facilities (e.g., AFSS, ACF, ATCT) and the ground-to-air radio equipment in the remote communications facilities.

A second type of air-ground communications is the voice capability of the VHF Omni Range (VOR). AFSS specialists can transmit messages such as weather and aeronautical information over the VOR transmitter. The Flight Service Broadcast Message Processor (FSBMP) automatically generates weather messages that are continuously broadcast over certain VORs. When pilots receive the navigation signal from the VOR they also receive the transmitted messages over their headset/speaker. Additionally, the VOR voice feature can be used for emergency one-way communications to the pilots using this VOR for navigation.

Automatic Terminal Information Service (ATIS) messages are another example of one-way communications capability within the NAS. ATIS messages are terminal information transmitted to pilots that intend to land at that particular airport. These messages consist of weather, landing runway in use, type of instrument approach to that runway, and any other information necessary to relieve controllers from routine, repetitious communications to each aircraft arriving or departing an airport. Pilots normally receive the ATIS message prior to entering the terminal airspace so the controllers will not have to repeat this information. ATIS messages are formulated by ATCT controllers and input through their workstation into the TCCC. From the TCCC these messages are passed through the TCS to the RCFs, and/or VORs, through the NICS. The messages are then transmitted to pilots.

The other major communication system used in the NAS to pass aeronautical information is data link. Aeronautical data link provides the capability to send messages to and receive messages from suitably equipped aircraft. The Mode S sensor is a combined beacon interrogator and ground-air-ground data link system which is part of the surveillance facilities. This sensor provides a means for automated data communications between the aircraft and the various ground-based processors. The Mode S sensor exchanges ATC data link messages with the ACCC in the ACF in digital format via the NICS. The ACCC then passes the message to the TCCC which relays it to the requesting specialist. Through this data link arrangement, the pilot has an automated communications link with the various controllers and specialists in the system to supplement voice communications.

For weather information and products, the Mode S sensor sends Pilot Reports (PIREPs) and data link service requests to the Data Link Processor (DLP) located in the ACF. The DLP also sends weather information to the Mode S sensor for relay to suitably equipped aircraft. Through this data link arrangement, the pilot has access to specific weather and aeronautical information stored at the DLP. The Mode S sensor also sends sensor/aircraft changes to the DLP when an aircraft enters or leaves its area of coverage.

When a data link service request for current weather, NOTAMS, PIREPs, hazardous weather, or other available data is received, the DLP decodes the message, compiles the necessary data from its data base and encodes the appropriate data link service message. The encoded data link service

message is returned to the requesting aircraft via the appropriate Mode S sensor. PIREPs, which require no reply, are received by the DLP from the Mode S data link and forwarded for use and distribution.

2.2.1.2 Protection from Interference

Air-ground communications must be clearly intelligible and free from interference to ensure uninterrupted communications between pilots and air traffic specialists. There must be no interference from undesired signals from the same or adjacent facilities. This is accomplished through the use of interference suppression devices and ancillary devices such as multicouplers, combiners, filters, and cavities. Multicouplers and combiners are used to reduce the number of antennas required, especially at VORTACs. Other efforts undertaken to reduce interference include electromagnetic compatibility analysis, large-scale frequency assessment studies, formal spectrum certification, national and international frequency coordinations, radio propagation studies, and facility networking. Together, these procedures and systems ensure that communications between pilots and controllers exchanging essential flight information will not be interrupted and is free from interference.

2.2.1.3 Storage and Retrieval

The NAS is able to receive, store, and readily retrieve all NAS air-ground communications, both voice and data. Air-ground voice communications are stored on Recording Equipment (RE), such as multichannel voice recorders. These recorders allow NAS specialists to retrieve communications from both on-line (within 30 minutes) and off-line storage (within 60 minutes) in the event they need to playback this information. These voice recorders record all voice communications and are interfaced with the Voice Switching and Control System (VSCS) in ACFs, the Integrated Communications Switching System (ICSS) in AFSSs, the Tower Communications System (TCS) at ATCTs and through the TMVS at the ATCCC. Each facility retains voice transmissions for no less than 15 days and data messages for not less than 30 days.

2.2.1.4 Position Monitoring

The NAS also has the capability to monitor any operating position without introducing any change in transmission or reception characteristics. This allows NAS personnel to monitor a position (e.g. emergency situations or training situations) without interfering with the specialist. Managers, or trainers, can monitor conversations between a specialist and a pilot or other specialists to obtain information and provide assistance if needed or provide feedback for training.

2.2.1.5 Available Continuously

Since air traffic control services are required 24 hours a day, 365 days a year, the NAS must ensure that air-ground, ground-ground and emergency communications are available to specialists and pilots on a continuous basis. This is accomplished through a series of primary and secondary transmitters and receivers at each location. There are primary and backup power sources at each location to ensure there is adequate power, both commercial and backup generators. A third source of power for communications is batteries for selected systems at certain locations.

2.2.1.6 Reconfiguration

In the event of a planned or unplanned reconfiguration within a facility, such as a position outage or combining positions at night due to traffic conditions, the NAS has the capability to reconfigure communications systems accordingly. The NAS is capable of reconfiguring specialists' positions, including reassigning their communications capability, to support these position changes. The switching functions of the VSCS adds

this operational flexibility needed to reconfigure resources (combine sectors) or reroute service in the event of equipment failure.

Specialists in adjacent ACF facilities have air-ground voice and data communications capability in the event of the adjacent ACF failure. This enables specialists in adjacent ACFs to reconfigure communications to allow access to the RCF facilities of the ACF that had a catastrophic failure, thereby enabling them to stabilize the situation and operate in a very limited role during such a contingency. In the event of an ACF failure, adjacent ACFs will establish ground/air voice communications for ATC purposes (in addition to processing en route and terminal radar data for that airspace) and will support the TCCCs assigned to the failed ACF.

2.2.2 Information About Ground-Ground Interfacility Communications Connectivity

Ground-ground communications connectivity within the NAS is necessary to allow for essential information to be passed between facilities. This information is described in paragraph 3.6.2 of the NASSRS.

2.2.2.1 Communications Between NAS Facilities

The NAS provides an inter/intrafacility communications connectivity for the transfer of information among all other elements and between these elements and the specialists, external users, military ATC facilities and government agencies by utilizing, as a minimum, the following:

- Voice Networks
- Data Networks
- Independent Emergency Communications

The NAS Interfacility Communication System (NICS) architecture combines and integrates communication functions into one network. The NICS includes the equipment which provides voice and data communication interconnectivity between facilities and sites within the NAS. The NICS will also provide voice and data communication access to other systems external to NAS, such as military, governmental and non-governmental, local law enforcement agencies, etc. The transmission function of the NICS provides the connectivity to the distributed facilities and equipments of the NAS.

Ground-ground interfacility communications connectivity enables facility managers, supervisors, specialists, and personnel at other FAA-manned facilities to establish communications with personnel in any other FAA-manned facility through the use of both FAA owned and leased communication networks. Ground-ground interfacility communications consists of both voice and data transmissions.

The Automated Flight Service Stations (AFSS), Area Control Facilities (ACF), Air Traffic Control Towers (ATCT), FAA Headquarters Operations Center, and the Air Traffic Control Command Center (ATCCC) have interfacility direct-access voice connectivity to coordinate flight data, weather information, and traffic coordination information between them. Each ACF, AFSS, and ATCT is connected to its adjacent ACF, AFSS, and ATCT respectively, as well as to associated ATC facilities for the purpose of passing information.

Communication systems within the NAS provide the capability for connectivity between selected operating, supervisory, maintenance, and administrative positions within ACFs, AFSSs, ATCTs, the FAA Headquarters Operations Center and the ATCCC to other adjacent or associated NAS facilities. In addition to direct-access connectivity the NAS maintains interfacility direct-access backup voice connectivity in the event of an unplanned facility outage.

In the event of an ACF failure, adjacent ACFs will no longer have direct-access voice and data connectivity to the failed ACF. ACF interfacility direct-access back up voice and data connectivity will be provided by both the adjacent ACFs and designated non-adjacent ACFs. Also in this type of event, ATCTs and AFSSs associated with the failed ACF will be provided interfacility direct-access back up voice and data connectivity by these same adjacent and designated non-adjacent ACFs. AFSSs also have interfacility direct-access backup voice and data connectivity with designated ACFs adjacent to the primary ACFs. ATCTs have interfacility direct-access backup voice and data connectivity with designated ACFs adjacent to the primary ACF.

Indirect-access voice connectivity exists between facilities to pass weather, traffic, and flight plan information. Each ACF is connected to its adjacent ACF, associated ATCTs and AFSSs, the FAA Headquarters Operation Center, ATCCC, airline dispatch offices, designated DoD facilities, and other NAS facilities. ATCTs are connected for indirect-access voice to associated ACFs and AFSSs, other ATCTs associated with the same ACF, the ATCCC and FAA Headquarters Operations Center, airline dispatch offices, designated DoD facilities and other NAS facilities. AFSSs are provided indirect-access voice to associated ACFs and ATCTs, other AFSSs associated with the same ACF, the ATCCC and FAA Headquarters Operations Center, airline dispatch offices, designated DoD facilities, and other NAS facilities. The ATCCC and FAA Headquarters Operations Center are provided interfacility indirect-access voice connectivity with each other, all ACFs, ATCTs, AFSSs, airline dispatch offices, designated DoD facilities and certain other NAS facilities. Additionally, these two facilities are also connected to selected federal and state law enforcement agencies.

Data communication interface (Table 2-1) is also provided for NAS weather facilities, navigational aids, NAS maintenance facilities, NAS surveillance and weather sensors which will be described in other operational concepts.

2.2.2.2 Communication Between NAS and Non-NAS Facilities

The NAS is interfaced with non-NAS facilities, including airline dispatch offices, federal and local law enforcement agencies, U.S. and foreign military and ATC facilities. The DoD facilities include air defense, ATC facilities, military base operations centers, and certain major command units. The NAS includes military ATC facilities that control both civilian and military air traffic. These military facilities are directly interfaced with FAA ATC facilities.

Communications between FAA and non-NAS facilities, except DoD, is accomplished by use of the Private Automatic Branch Exchange (PABX). The PABX is also used to provide telephone call switching capabilities between offices and work areas located within the ACF building and for access to the public switched network and the Federal Telecommunications System (FTS). Other communications between NAS and non-NAS facilities is accomplished through transmission equipment which interfaces directly with the external communications systems.

The NICS also provides voice communications interface to such external users as DoD, airline, governmental, non-governmental, international, weather services, pilots, air defense, and the FAA Headquarters Operations Center.

In addition to voice connectivity, data communications is passed between all NAS facilities, selected DoD facilities, and non-NAS facilities. This data communication interface capability includes the transmission of surveillance data, weather products, air traffic control, flight planning and maintenance, and operations information. The exchange of surveillance information with properly equipped sources external to the NAS compliments the NAS surveillance coverage. These sources include: joint use

Table 2-1
NAS INTERFACILITY DATA COMMUNICATIONS CONNECTIVITY

FROM	TO										
	ACFs	ATCTs	AFSSs	ATCCC	FAA Hdqt OPS Ctr	Mode S Data Link Fac	NAS Maint Fac	NAS Weather Fac	NAS Surv Fac	Remote Comm Fac	Nav Aids
ACFs	X	X	X	X	X						
ATCTs	X	X	X	X	X						
AFSSs	X	X	X	X	X						
ATCCC	X	X	X	X	X						
FAA Hdqt OPS Ctr	X	X	X	X	X						
Traffic Mgmt Fac	X	X	X	X	X						
Mode S Data Link Fac	X	X	X	X	X						
NAS Maint Fac	X	X	X	X	X				X	X	X
NAS Weather Fac	X	X	X	X	X				X		
NA Surv Fac	X	X	X	X	X						
Remote Comm Fac	X	X	X	X	X						
NAV Aids											

* Besides the Normal Communications Hierarchy Represented Here, Data Communications Shall Also be Provided Between All ACFs, ATCTs, and AFSSs that are Within 100 NMI of a Military Operations Area (MOA) or a Strategic Air Command (SAC) Instrument Route.

surveillance facilities, military radars and surveillance processing facilities, and airline tracking networks, such as ARINC. Airline dispatch offices are connected to provided automatic flight plan filing and cancellation capabilities.

NAS facility personnel have access to DOD data communications networks, such as the Automated Digital Network (AUTODIN), to pass data between NAS facilities and DoD facilities. Selected FAA facilities having access to AUTODIN use it for management communications with all other government agencies served by connected elements of the National Communication System (NCS). Unclassified messages addressed to FAA activities served by AUTODIN and also addressed to activities served only by FAA systems are forwarded to all addresses via the agency system. The AUTODIN is located in a physically secure area of the facility and is not interfaced with the NAS.

Data communication between DoD and NAS facilities is accomplished through several types of switching systems. In particular, DoD facilities data communications is passed to the NICS through the DoD AUTODIN. The AUTODIN passes data communication to two types of switching systems within the NICS. The first, NADIN IA, is a message switched network which provides the connectivity necessary to interface with the second type, the NADIN II packet switched network. The NADIN II is the switching system that serves the NAS facilities. It routes data traffic to data users and facilities through the utilization of the long haul trunks of the Backbone Interconnection Network. This network provides the point-to-point connectivity between the voice and data users of the NICS. The Backbone Interconnection Network connect the NAS facilities (ATCTs, AFSSs, and ACFs) to each other.

2.2.2.3 Secure Communications Between NAS and DoD Facilities

The NAS provides the capability for secure voice and data communications between selected NAS facilities and between selected NAS facilities and DoD facilities. The AUTODIN, a high-speed, computer-controlled communications system that is used by both civil and military agencies for classified communications, provides the capability to pass this information. FAA Headquarters, regional headquarters, and ACFs have AUTODIN capability. All classified traffic is encrypted upon entering the AUTODIN system, transmitted through the network, and restored to its original state by decryption at the terminating facility. However, it should be noted that the AUTODIN is not interfaced with computer equipment performing ATC functions in NAS facilities. The AUTODIN system is located in a area that is physically secure from non-essential personnel.

2.2.2.4 Secure Unclassified Voice and Data Communications

The NAS provides the capability for secure unclassified voice and data communications. For example, there are occasions when senior level FAA/DOT officials need to discuss information that, while not classified, needs to be secure from open communications. Types of unclassified information requiring security include:

- National Transportation Safety Board accident investigations
- Terrorism
- Hijacking
- Bomb threats
- VIP travel
- Personnel data
- Certification of aircraft
- Violations of Federal Aviation Regulations, and
- Information that is proprietary to Government and industry

2.2.3 Ground-Ground Communications Capability

The requirement to provide ground-ground communications capability within the NAS is described in paragraph 3.6.3 of the NASSRS. This section describes the capabilities of ground-ground communications within the NAS.

2.2.3.1 Communication Within or Between NAS facilities

The NAS is capable of transferring information between selected operating, supervisory, maintenance, and administrative positions within or between NAS facilities. These facilities include ACFs, ATCTs, AFSSs, the ATCCC, and the FAA headquarters Operations Center. This capability consists of both direct-access voice and indirect-access voice (interfacility/intrafacility) and data communications.

In addition to voice connectivity, data communications is passed between all NAS facilities, selected DoD facilities, and non-NAS facilities. This data communication interface capability includes the transmission of surveillance data, weather products, air traffic control, flight planning and maintenance, and operations information. The exchange of surveillance information with properly equipped sources external to the NAS compliments the NAS surveillance coverage. These sources include: joint use surveillance facilities, military radars and surveillance processing facilities, and airline tracking networks.

2.2.3.2 Reconfiguration of Communications Capabilities

Reconfiguration of communication capabilities allows supervisory personnel to transfer communications capabilities from one position to another to support changes in operating responsibilities.

2.2.3.3 Storage and Retrieval of Ground-Ground Communications

The storage and retrieval of ground-ground communications is accomplished through the recording of both voice and data communications at ACFs, ATCTs, AFSSs, the ATCCC, and the FAA headquarters Operations Center. Storage of voice and data communications is retained in "off-line" storage for not less than 15 days. Voice recordings are retrievable from "off-line" storage within 60 minutes of a request by an authorized FAA supervisor. Data messages are recorded on electronic media and are capable of being retrieved from off-line storage for review. This information can be retrieved at a later date for replay if needed.

2.2.3.4 Continuous Interfacility and Intrafacility Communications

Ground-ground communications capability must be available on a continuous basis. Backup power is available at all NAS locations to ensure continuous interfacility and intrafacility communications. Inter and intrafacility primary and secondary network equipment, lines and services are required to insure a 24 hour a day operational environment. Additionally, the duplicate receivers and transmitters at the RCFs aid in providing continuous communications.

2.2.3.5 User Verification and Access Control

User verification and access control are used to limit access to NAS systems, computer operational programs and data bases. For example, the DUAT system only allows the general public to file a flight plan through the DUAT service which, in turn, forwards the flight plan to the FSDPS or ACCC at the ACF. The DUAT service does not allow direct user access into the NAS. There are a number of flight planning service organizations within the U.S. and other countries that also have access to the NAS. However, these organizations have specific functions to perform for the NAS and have a specific approval for limited access the NAS.

User verification and access methods have been developed for FAA employees and contractor personnel that need access to the NAS systems and programs. These methods include user identification and authentication codes (passwords), various sensitivity levels and secondary controls. For example, the NAS only allows specialists into the system to the level they need to perform their function. Through user identification and authentication codes a controller is not allowed access into the source code for computer programs. Conversely, a systems specialist is prevented from logging on at a sector suite to perform the duties of a controller. At the beginning of each shift the systems engineer will log into the system at an ACF but must use yet another authentication code to reconfigure the system (secondary control).

2.2.4 National Emergency Communications

As described in paragraph 3.6.4 of the NASSRS, the NAS ensures that minimum essential emergency communications required to support the NAS and DoD are capable and available. This support includes:

- Security Control of Air Traffic and Navigation Aids (SCATANA)
- Civil Reserve Air Fleet (CRAF)
- War Air Service Program (WASP)
- Air Carrier Dispersal
- State and Regional Disaster Airlift (SARDA)
- Continental U.S. Airborne Reconnaissance for Damage Assessment (CARDA)
- Special Air Traffic Procedures
- Military Flight Inspection
- Monitoring Civil Airlift Operation for DoD

2.2.4.1 Minimum Essential Communications

In order to accomplish these requirements the NAS must have the communications systems necessary to coordinate between the FAA, DoD, airline operations, state and local governments.

The National Radio Communications System (NARACS) is a voice and data communications system between FAA headquarters, regional offices, support aircraft, and major facilities. It provides the minimum essential communications capability necessary to direct the management, operation, and reconstitution of the NAS in support of FAA/DOT/DoD missions during a national, regional, or local emergency, when normal common carrier telecommunications are interrupted. Additionally, NARACS provides day-to-day FAA maintenance operations or communications support to flight check aircraft, crash site investigations, aviation security, and communications with other agencies.

NARACS provides command and control communications capability to evaluate and initiate reconstitution of the NAS. NARACS is interoperable with the DoD, FEMA, National Command Authority (NCA), military command posts (including airborne), USCG, other government agencies, local police, fire, civil defense, and amateur radio. The NARACS is independent of common carrier telecommunications and provides voice and data privacy for unclassified sensitive communications. NARACS provides a high frequency/single sideband (HF/SSB) communications network that is high altitude electromagnetic pulse (HEMP) survivable and endurable. The NARACS is capable of being operated by nontechnical personnel and provides for automatic connectivity, frequency selection, channel optimization, and selective calling.

The NARACS is composed of three integrated subsystems. The backbone network connects the FAA Headquarters Command Center in Washington, D.C., with the three National Emergency Operating Facilities (NEOFs). NEOF-1 is the primary relocation site for FAA Headquarters Command Center staff and acts as network control for the backbone.

The command network is split into Eastern and Western networks. The Eastern network uses facilities at NEOF-2 to communicate with all major FAA facilities east of the Mississippi River including all regional offices, regional emergency operating facilities (EOF), flight standards national and district offices, ACFs, the FAA Technical Center, major airports and FAA support aircraft. The Western network uses the facilities at NEOF-3 to communicate with all major FAA facilities west of the Mississippi River including the FAA Aeronautical Center at Oklahoma City, all regional offices, regional EOFs, flight standards national and district field offices, ACFs (including Anchorage and Honolulu), major airports and FAA support aircraft. Additionally, each NEOF is robust enough to communicate with each other if Headquarters and NEOF-1 are decommissioned.

Regional networks provide communications among the regional offices/ regional operations centers, each ACF in the region, selected sector offices, field facilities, airport terminals, automated flight service stations, work center locations, FAA mobile units and FAA support aircraft.

2.2.4.2 Minimum Capabilities

The following paragraphs describe the six major capabilities of these emergency communications.

Connectivity for emergency communications within the NAS is achieved by means independent of common carrier to rapidly disseminate information from FAA headquarters to regional and sector facilities and, in turn, rapidly communicate the operational status of those facilities back to headquarters. The NARACS remains independent of common carriers by operating on High Frequency/Single Side Band (HF/SSB) radio.

Survivability during national emergency situations means that the communications systems utilized are protected from nuclear, high-altitude electromagnetic pulse (HEMP). This is accomplished by locating the NARACS equipment inside specially shielded rooms within each facility.

The endurance of these communications systems means that they are capable of operation for a 30-day period without commercial power at selected critical facilities. The NARACS is powered by backup generators that are independent of commercial power. This ensures the uninterrupted power source necessary to maintain the system. The capability of these emergency communications systems ensures that headquarters, National Emergency Operations Facilities (NEOFs), regional offices, and Area Control Facilities (ACFs) are capable of simultaneous voice and data communications with two other locations. Also, headquarters, NEOFs and other selected locations, are capable of off-line data generation, and data storage.

Vulnerability of the NAS emergency communications network is precluded by means voice and data encryption to secure all classified or sensitive National Security related communications.

Interoperability of NAS emergency communications systems ensures that this network is capable of interoperating with DoD/USAF, NCA, military command posts (including airborne command post), USCG, Federal Emergency Management Administration (FEMA), other federal agencies, civil defense, amateur radio, local police, and fire departments.

2.3 Functions

The following paragraphs describe in more detail the functions provided by the specialist positions introduced in Section 2.1. The operational flow diagrams associated with each paragraph illustrate the information flow between the specialist within their respective facility and the user, 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.

2.3.1 AFSS Specialists (Positions 2 through 4, 20, 21)

The AFSS Specialists provide flight service functions to pilots using air-ground and ground-ground communications through the Integrated Communications Switching System (ICSS). This communication capability is available continuously to specialists and can be reconfigured to the specialist's operational needs. In addition to the ICSS, AFSS personnel have voice capability using VOR equipment to provide emergency voice transmission to pilots. The operation of the voice feature of the VOR is available through the ICSS interface with the AFSS work station. Another system in use at the AFSS to provide communications to users is the Flight Broadcast Message Processor (FSBMP). The FSBMP receives automatic alert messages from the FSDPS (including weather messages, hazardous weather messages, and preflight briefing messages) and transmits them over the VOR.

These specialists coordinate flight service functions with other specialists through the FSDPS for data and the ICSS for voice communication. This communication capability is available continuously to specialists and can be reconfigured to the operational needs of the specialist.

Figure 2-3 is an operational flow diagram describing the air-ground and ground-ground communication interfaces provided to the specialists at the AFSS. Functions performed by the equipment and these specialists are lettered within each block and are described in the corresponding paragraphs below.

- a. FSDPS Processing. The FSDPS supports the AFSS work station which is combined in various configurations to support the different AFSS operational positions. Data communication between NAS facilities is provided by the FSDPS. The FSDPS is part of the ACF that provides weather and flight data to specialists in AFSSs. The FSDPS interfaces with the DUAT processor for passing flight data and SAR file/amend flight plans. The FSDPS provides specialists and pilots with the capability to retrieve weather, NOTAMS, and other information required by pilots to conduct their proposed flight.

NASSRS Requirement 3.6.1.A,E,F, 3.6.2.A-C, 3.6.3.B

- b. Integrated Communications Switching System (ICSS). The AFSS voice communications with pilots will be primarily supported via radio contact through ICSS interface with the ground-to-air communications facilities or by telephone. The ICSS provides for the independent operation of each frequency (VHF/UHF) of the ground-air communications between AFSS specialists and pilots. The ICSS also provides supervisory personnel the ability to monitor any operating position within the AFSS without distracting the specialist. The ICSS provides ground-ground interfacility communications connectivity between the AFSS and NAS facilities and between AFSS and non-NAS facilities. The ICSS at the AFSS enables specialists to communicate with personnel in the ACF through their VSCS, and ATCTs using their TCS; the ATCCC through the TMVS, the EVCS at the FAA Hq Ops Center and other AFSSs and their ICSSs. The ICSS interfaces with Military Base Operations (MBOs) to allow AFSS specialists to conduct preflight briefings and to allow MBOs to input flight data, PIREPs, and Special Use Airspace information. The ICSS enables voice

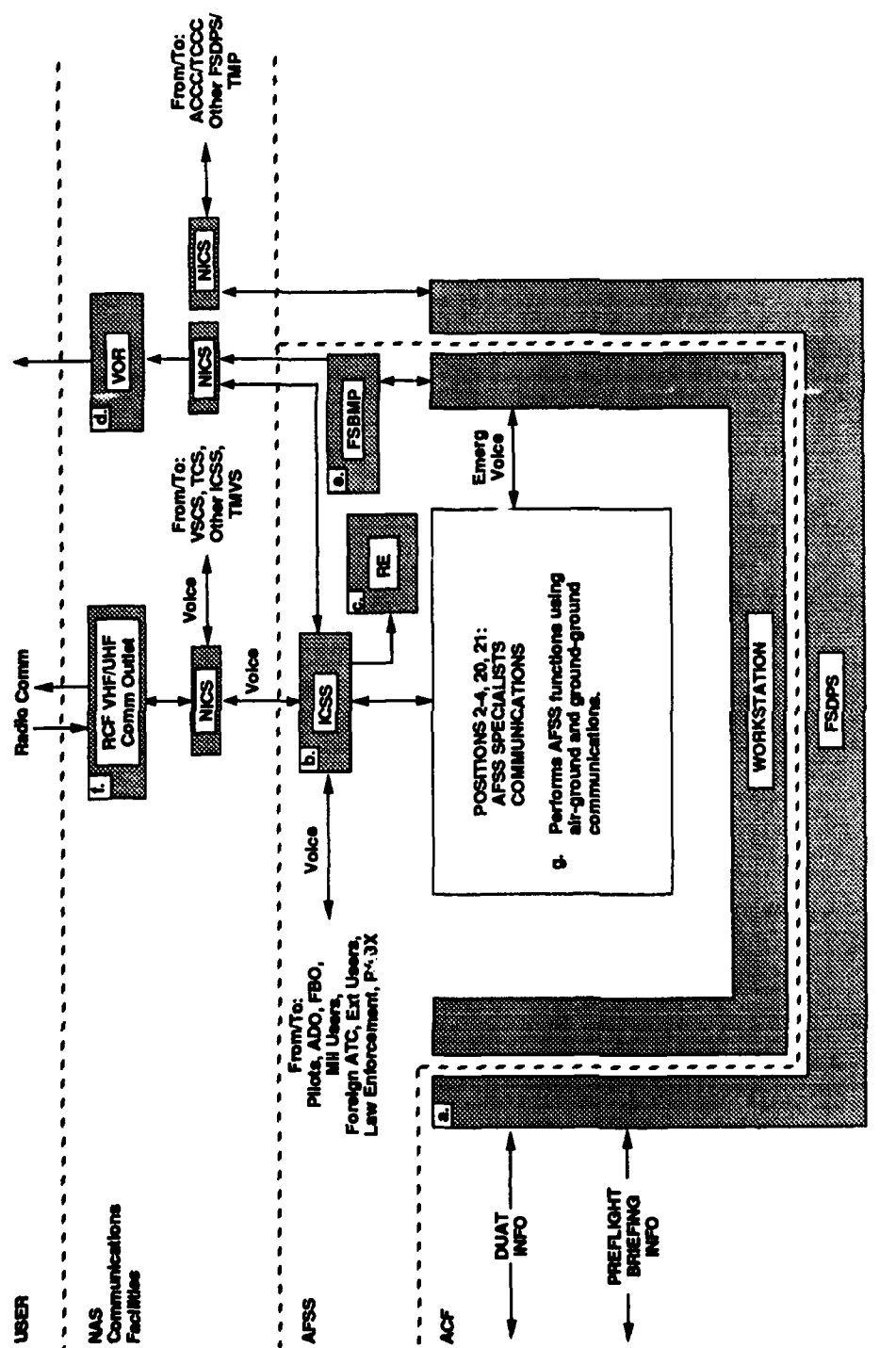


FIGURE 2-3
AFSS OPERATIONAL
FLOW DIAGRAM

communications interface with PABXs and Transmission Equipment (TE) for commercial network access, local law enforcement officials, airline dispatch offices, fixed based operators, foreign ATC facilities, and military users.

NASSRS Requirement 3.6.1.A,B,D-F, 3.6.2.A-C, 3.6.3.A,B,D

- c. Recording Equipment. Multichannel voice recorders are utilized to record all voice communications between air traffic specialists and pilots. The ICSS provides the communications interface required to record these messages.

NASSRS Requirement 3.6.1.C, 3.6.3.C

- d. VOR Voice. The VOR is interfaced with the ICSS and FSBMP to provide aeronautical, meteorological, and emergency assistance messages to pilots. Emergency assistance messages generated by the AFSS specialists are sent to the VOR in analog voice form via the NICS.

NASSRS Requirement 3.6.1.A

- e. Remote Communications Facility (RCF). The remote communication facility (RCF) provides two-way voice communication links between specialists in an AFSS and pilots in the air or on the ground. This is accomplished using ground based VHF and UHF transmitters and receivers. Communications with vehicles on the ground include both aircraft and airport surface vehicles. One-way communications links are provided by RCFs for transmitting weather and ATIS information to pilots. These transmitters and receivers will be fixed tuned and designated for special use. However, there are some variable tuned units which can be used to spare fixed tuned units either in the same facility or in adjacent facilities (backup). Additional frequencies, relocation of certain RCFs, interference suppression devices such as multicouplers, combiners, filters, and cavities have been added to provide for interference free communications.

NASSRS Requirement 3.6.1.A,B,E

- f. Perform AFSS Services Using Air-Ground and Ground-Ground Communications Systems. AFSS specialists utilize the ICSS to perform air-ground communications with users and ground-ground communications between NAS and non-NAS facilities.

NASSRS Requirement 3.6.1.A, 3.6.2.A, 3.6.3.A

2.3.2 ACF Specialists (Positions 6 through 8, 22 and 23)

The ACF specialists transmit and receive flight information to pilots using air-ground communications and with other controllers using ground-ground communications through the Voice Switching and Control System (VSCS). The VSCS is interfaced with the Area Control Computer Complex (ACCC) in the ACF, which provides configuration and status information. ATC messages are sent via data link from the controllers position console, through the ACCC to the Mode S sensor to the Mode S transponder and data link avionics aboard the aircraft.

The ACF specialists coordinate flight information with other specialists through the Voice Switching and Control System (VSCS) for voice communication and the Area Control Computer Complex (ACCC) for data communication. This communication capability is available continuously to specialists and can be reconfigured to the operational needs of the specialist.

Figure 2-4 is an operational flow diagram describing the air-ground and ground-ground communication interfaces provided to specialists at the ACF. Functions performed by the equipment and these specialists are lettered within each block and are described in the corresponding paragraphs below.

- a. ACCC Processing. The ACCC interfaces with the Mode S Sensor to provide pilots with automated communications links to supplement voice communications. The ACCC interfaces with the TCCC for processing ATC clearances for relay to the pilot via the Mode S Sensor. Airline dispatch offices interface with the ACCC for the purpose of changing or canceling pre-filed flight plans. The ACCC supports VSCS by providing ATC management with reconfiguration control for position consolidation, status of VSCS console equipment, and air-ground/ground-ground resources connected to the ACCC. Data communications between NAS facilities is accomplished through the interface of the ACCC and through the NICS to the: air dispatch office, other ACCCs, foreign ATC, FSDPSs, TCCCs, military users, military ATC, DUAT service and ARINC.

NASSRS Requirement 3.6.1.D,F,

- b. Voice Switching and Control System (VSCS). The VSCS provides a local voice switching node to connect ACF operational positions (controller work stations) to VHF/UHF transmitters and receivers or transceivers. The VSCS operates in conjunction with the radio control equipment (RCE) and the VHF/UHF communications outlet to continuously provide two way communications capability between the pilot and controller. The VSCS also provides supervisory personnel the ability to monitor any operating position within the ACF without distracting the specialist. VSCS receives area/sector and facility reconfiguration control from the ACCC to facilitate these functions. VSCS provides the primary ground-ground interphone function as a voice switch which provides voice connectivity between air traffic operational positions within the ACF (controllers, area managers, TMCs, and CWSU meteorologists) and between these specialists and other specialists within the NAS. The VSCS provides standard trunk interfaces to external facilities and systems. The VSCS interfaces with the TCS at the ATCT, ICSS at AFSSs, TMVS for the ATCCC, EVCS at the FAA Headquarters Operations Center and other VSCSs, military ATC, and military base operations. The VSCS also provides ground-ground voice connectivity with non-NAS facilities such as PABXs and TEs for exchange of administrative information and to allow accessing the FTS system and the DoD network, foreign ATC facilities for international operations, airline dispatch offices, Rescue Coordination Centers, and North American Aerospace Defense Command (NORAD) for the coordination of flight plan information.

NASSRS Requirement 3.6.1.A,B,D-F, 3.6.2.A-C, 3.6.3.A,B,D,E

- c. Mode S Sensor. The Mode S Sensor exchanges datalink ATC messages with the ACCC in digital format via the NICS. The Mode S Sensor then relays the ATC messages to the pilot.

NASSRS Requirement 3.6.1.A

- d. Recording Equipment. Multichannel voice recorders are utilized to record all voice communications between air traffic specialists and pilots. The communications interface required to record voice messages is provided by the VSCS.

NASSRS Requirement 3.6.1.C, 3.6.3.C

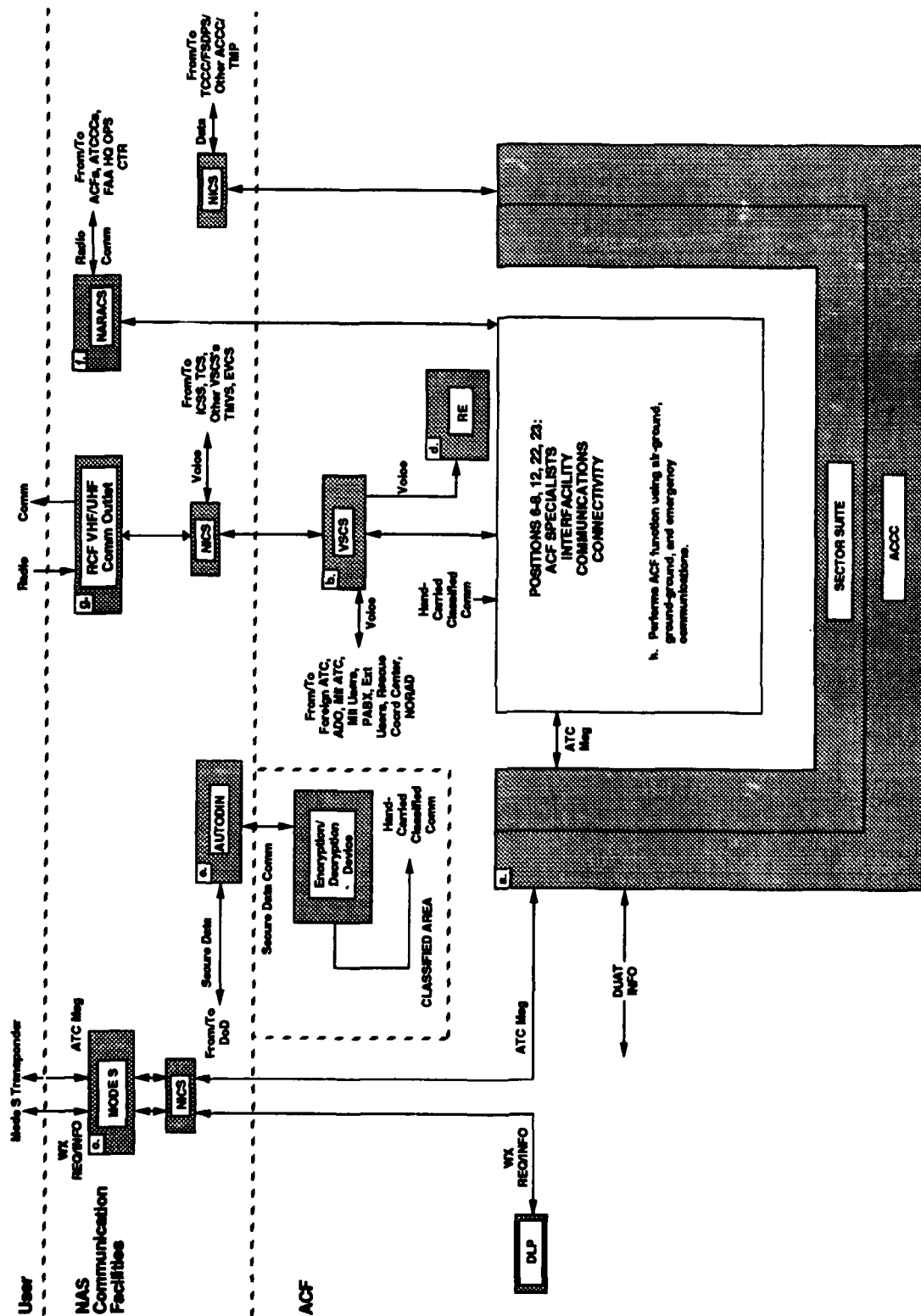


FIGURE 2-4
ACF OPERATIONAL
FLOW DIAGRAM

- e. AUTODIN for Secure Data Communications. Classified messages (Secret and below) and flight plans are forwarded from DoD facilities to ACFs via the AUTODIN. The AUTODIN is a high-speed, secure, computer-controlled communications system used to transmit both classified and unclassified messages to NAS facilities. Classified messages and flight plans are encrypted before entering the AUTODIN system and are transmitted over the network, and restored to their original state at the receiving ACF. The cryptographic equipment located in ACFs is located separate from and is not interfaced to the computer equipment performing NAS functions.

NASSRS Requirement 3.6.2.C

- f. NARACS. The National Radio Communications System is a voice and data radio communications system between FAA headquarters, regional offices, support aircraft, and major facilities. It provides the minimum essential communications capability necessary to direct the management, operation, and reconstitution of the NAS in support of FAA/DOT/DoD missions during a national, regional, or local emergency, when normal common carrier telecommunications are interrupted. NARACS provides day-to-day FAA maintenance operations or communications support to flight check aircraft, crash site investigations, aviation security, and communications with other agencies.

NASSRS Requirement 3.6.4.A,B

- g. Remote Communication Facility The RCF provides two-way voice communication links between groundbased personnel (controllers in either an ACF or ATCT and AFSS specialists in an AFSS) and pilots in aircraft in the air or on the ground. This is accomplished using ground based VHF and UHF transmitters and receivers. Communications with vehicles on the ground include both aircraft and airport surface vehicles. One-way communications links are provided by RCFs for transmitting weather and ATIS information to pilots. These transmitters and receivers will be fixed-tuned and designated for special use. However, there are some variable tuned units which can be used to spare fixed tuned units either in the same facility or in adjacent facilities (backup). Additional frequencies, relocation of certain RCFs, interference suppression devices such as multicouplers, combiners, filters, and cavities have been added to provide for interference free communications.

NASSRS Requirement 3.6.1.A,B,E

- h. Perform ACF Functions Using Air-Ground and Ground-Ground Communications Systems. ACF specialists utilize the ACCC and the VSCS to perform air-ground communications with users. These specialists also use the ACCC and VSCS to perform ground-ground voice and data communications between NAS facilities and between NAS and non-NAS facilities. ACF specialists utilize the AUTODIN for secure communications with DoD facilities.

NASSRS Requirement 3.6.1.A, 3.6.2.A, 3.6.3.A

2.3.3 ATCT Specialists (Positions 9 through 11)

ATCT controllers communicate with pilots using air-ground communications and other controllers using ground-ground communications through the Tower Communication System (TCS).

ATCT controllers coordinate flight information through the Tower Control Computer Complex (TCCC) for data communications. This communication

capability is available continuously to specialists and can be reconfigured to the operational needs of the specialist.

Figure 2-5 is an operational flow diagram describing the air-ground and ground-ground communication interfaces provided to specialists in the ATCT. Functions performed by the equipment and these specialists are lettered within each block and are described in the corresponding paragraphs below.

- a. TCCC Processing. The ACCC provides data link ATC message service to the Tower Control Computer Complex (TCCC) through the NICS for sending and receiving clearances and messages to pilots. The TCCC provides the ability to combine or reconfigure operational control positions from one physical location in the facility to another. The interface between the TCCC and the TCS enables the output of ATIS data (analog voice) from the TCCC to the TCS. The TCS sends the ATIS data through the local communications outlet for broadcasting.

NASSRS Requirement 3.6.1.A,F 3.6.3.A,B

- b. Tower Communications System (TCS). The TCS provides voice communications connectivity to the VHF/UHF communications outlets for the exchange of air traffic control information between controllers and pilots. ATCT controllers input spoken remarks to the ATIS broadcast, prior to release of the broadcast from the TCCC. TCS provides an interface to voice recorders for recording all operational voice communications. The TCS also provides supervisory personnel the ability to monitor any operating position within the ATCT without distracting the specialist. The TCS interfaces with VSCS at ACFs, ICSS at AFSSs, the TMVS at the ATCCC, EVCS at the FAA Headquarters Operations Center, and the TCS at other ATCTs. The TCS provides tower connectivity for exchange of administrative voice communication via the PABX with other networks such as FTS, and public networks.

NASSRS Requirement 3.6.1.A,B,D-F 3.6.2.A-C, 3.6.3.A,B,D,E

- c. Recording Equipment. Multichannel voice recorders are utilized to record all voice communications between air traffic specialists in ATCTs and pilots. The TCS provides the communications interface between the TCS and the voice recorder for messages that require recording.

NASSRS Requirement 3.6.1.C, 3.6.3.C

- d. Mode S Sensor. The TCCC forwards ATC clearances to the ACCC, which in turn, forwards it to the Mode S Sensor. The Mode S Sensor then relays the ATC messages to the pilot. The pilot can also pass his response to the clearance back through the Mode S sensor, through the ACCC, to the TCCC for display to the ATCT controller.

NASSRS Requirement 3.6.1.A

- e. VOR. The ATCT controller passes ATIS messages in analog form from the TCS to the local VOR for broadcasting.

NASSRS Requirement 3.6.1.A

- f. Remote Communication Facility. The RCF provides voice two-way communication links between groundbased personnel (controllers in either an ACF or ATCT and AFSS specialists in an AFSS) and pilots in aircraft in the air or on the ground. This is accomplished using ground based VHF and UHF transmitters and

receivers. Communications with vehicles on the ground include both aircraft and airport surface vehicles. One-way communications links are provided by RCFs for transmitting weather and ATIS information to pilots. These transmitters and receivers will be fixed tuned and designated for special use. However, there are some variable tuned units which can be used to spare fixed tuned units either in the same facility or in an adjacent facilities (backup). Additional frequencies, relocation of certain RCFs, interference suppression devices such as multicouplers, combiners, filters, and cavities have been added to provide for interference free communications.

NASSRS Requirement 3.6.1.A,B,E

- g. Perform ATCT Functions Using Air-Ground and Ground-Ground Communications Systems. ATCT specialists utilize the TCCC and TCS to perform air-ground communications with users and ground-ground communications systems to coordinate with NAS facilities and non-NAS facilities.

NASSRS Requirement 3.6.1.A, 3.6.3.A

2.3.4 FAA Headquarters Operations Center Specialist (Position 1)

FAA Headquarters Operations Center specialists coordinate information throughout NAS facilities through the Emergency Voice Communications System (EVCS). FAA Headquarters Operations Center specialists are primarily responsible for aviation incidents and accidents requiring either executive level action or decisions, interagency coordination, or activation of a headquarters crisis response team (e.g., major aircraft crash, air piracy).

Figure 2-6 is an operational flow diagram describing the ground-ground communication interfaces provided to specialists in the FAA Headquarters Operations Center. Functions performed by the equipment and these specialists are lettered within each block and are described in the corresponding paragraphs below.

- a. Workstation. The workstation provides the specialist a means of accessing data and communication information to facilitate the ground-ground interfacility communications process. It contains notification lists, access methods for communication lines and other similar types of support.

NASSRS Requirement 3.6.2.B

- b. Emergency Voice Communications System (EVCS). The FAA Headquarters Operations Center utilizes the EVCS to provide ground-ground interfacility and executive communication connectivity between Headquarters and ACFs, ATCTs, FIFOs, Regional Offices, the FAATC, and the Aeronautical Center. The EVCS consists of a dedicated private telephone network and PABXs located at headquarters, regions and ACFs. Direct hotlines are used to communicate with National Operations Centers at other DoD, Federal departments and agencies. EVCS also provides contact with DoD facilities. The EVCS interfaces with commercial public switched networks, the FTS, external facilities such as DOD, governmental and non-governmental agencies, etc., the VSCS at ACFs, ICSS at AFSSs, TCS at ATCTs, and the TMVS at the ATCCC.

NASSRS Requirement 3.6.2.B

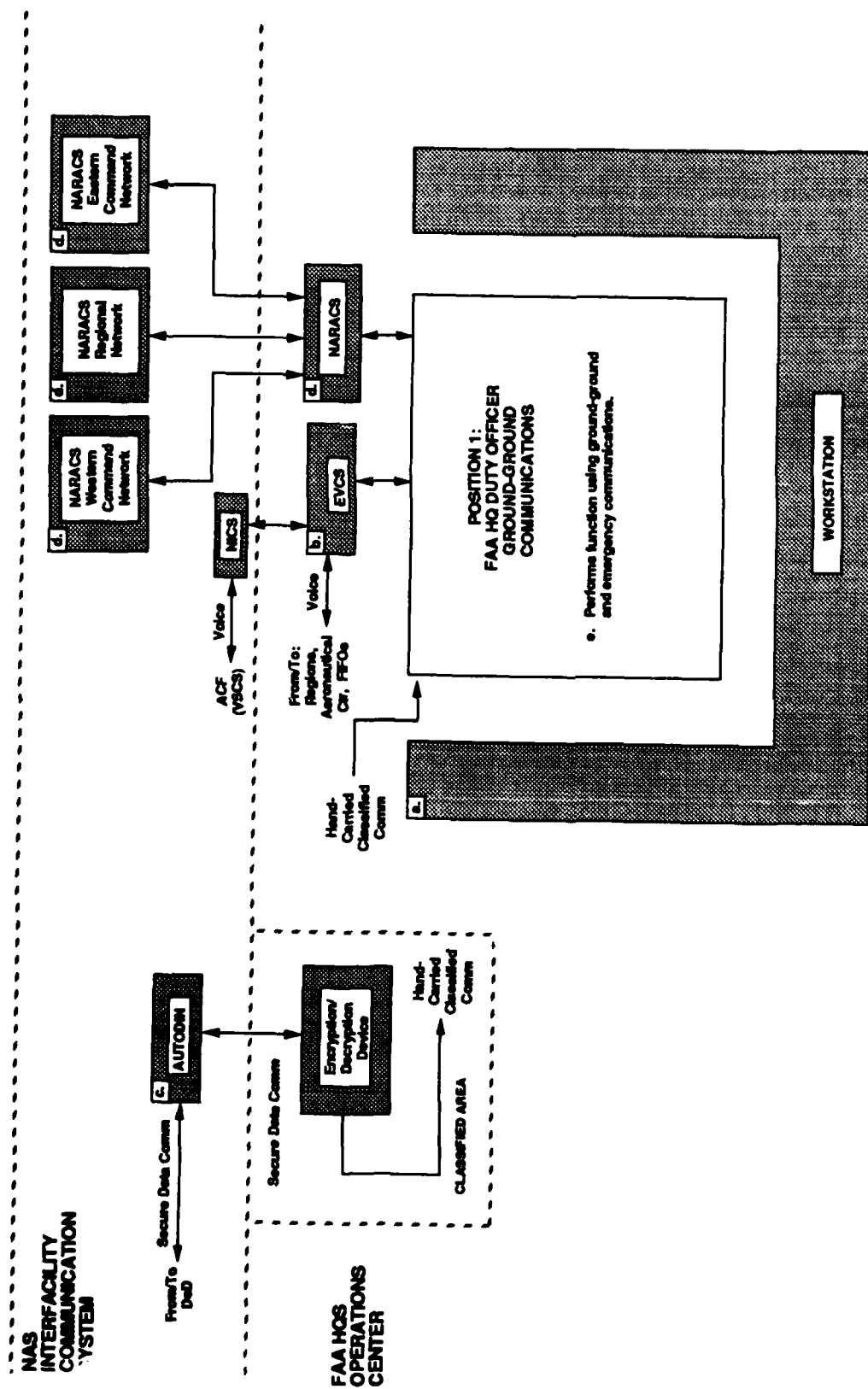


FIGURE 2-6
FAA HEADQUARTERS OPS CENTER
OPERATIONAL FLOW DIAGRAM

- c. Secure Communications (Voice and Data) Between NAS and DoD Facilities. The FAA Headquarters Operations Center utilizes secure telephone units (STU) for secure voice communications with DoD facilities. The AUTODIN provides secure data communications for transmitting classified messages between DoD and the FAA Headquarters Operations Center.

NASSRS Requirement 3.6.2.C

- d. NARACS. The National Radio Communications System is a voice and data radio communications system between FAA headquarters, regional offices, support aircraft, and major facilities. It provides the minimum essential communications capability necessary to direct the management, operation, and reconstitution of the NAS in support of FAA/DOT/DOD missions during a national, regional, or local emergency, when normal common carrier telecommunications are interrupted. NARACS provides day-to-day FAA maintenance operations or communications support to flight check aircraft, crash site investigations, aviation security, and communications with other agencies.

NASSRS Requirement 3.6.4.A,B

- e. Perform FAA Headquarters Operations Center Functions Utilizing Ground-Ground Interfacility Communications Systems. FAA Headquarters Operations Center specialists utilize the EVCS to perform ground-ground communications with both NAS facilities and non-NAS facilities. The AUTODIN is used for secure data and for secure telephone voice communications with DoD facilities.

NASSRS Requirement 3.6.3.A

2.3.5 ATCCC Specialists (Positions 13 through 15)

The Traffic Management Processor (TMP) is used to process flight data from other NAS facilities. ATCCC specialists utilize the Traffic Management Voice System (TMVS) to coordinate flight information with Traffic Management Coordinators (TMCs) in ACFs and ATCTs. This communication capability is available continuously to specialists and can be reconfigured to the operational needs of the specialist.

Figure 2-7 is an operational flow diagram describing the ground-ground communication interfaces provided to specialists in the ATCCC. Functions performed by the equipment and these specialists are lettered within each block and are described in the corresponding paragraphs below.

- a. Traffic Management Processor. Flight data is passed to the ATCCC from the TMP located at the FAA Technical Center. Data is passed between the TMP and non-NAS facilities such as airline dispatch offices, airline schedule vendors, DUAT service and pilots via telephone.

NASSRS Requirement 3.6.2.A

- b. Traffic Management Voice System (TMVS). The TMVS provides a communications control system configured for the ATCCC to provide rapid voice communication capability with NAS facilities, including the VSCS in ACFs, ICSS in AFSSs, and the TCS in ATCTs. The TMVS also accesses DOD systems for communication with military facilities. The TMVS interfaces with federal telephone systems and dedicated phone lines outside the government systems.

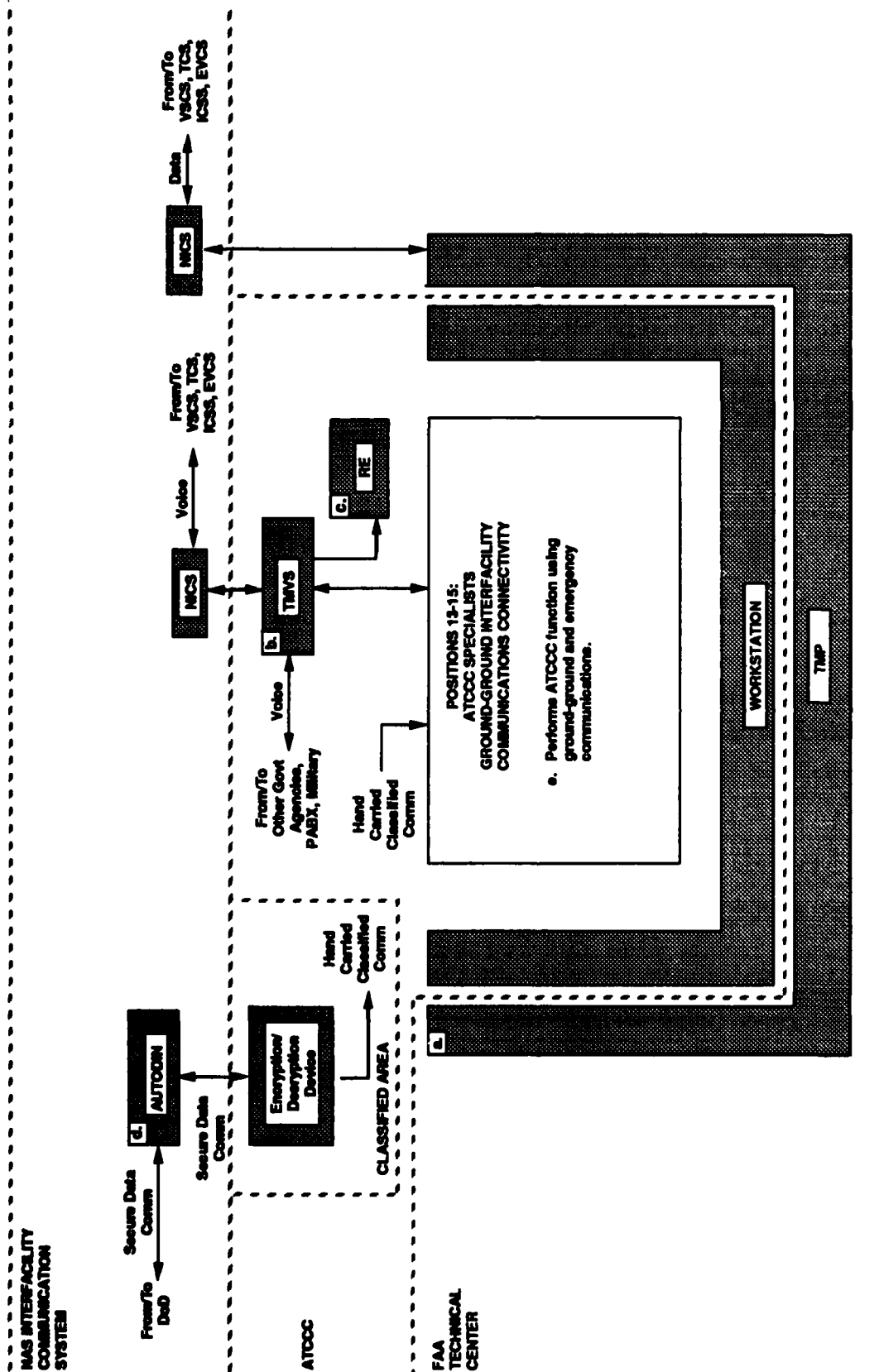


FIGURE 2-7
ATCCC OPERATIONAL
FLOW DIAGRAM

The TMVS interface enables ATCCC specialists to communicate with law enforcement organizations, other government agencies, and foreign ATC airline representatives.

NASSRS Requirement 3.6.2.A

- c. Recording Equipment. Multichannel voice recorders are utilized to record all voice communications between air traffic specialists in ATCTs and pilots. The TCS provides the communications interface between the TCS and the voice recorder for messages that require recording.

NASSRS Requirement 3.6.1.C, 3.6.3.C

- d. AUTODIN for Secure Communications. The AUTODIN terminal provides DoD/FAA interface with the capability of sending and receiving classified messages over secure communications lines. The AUTODIN system provides the DoD, FAA, Coast Guard, State Department, and certain other government departments and agencies with the means to exchange classified messages.

NASSRS Requirement 3.6.2.C

- e. Perform ATCCC Functions Utilizing Ground-Ground Interfacility Communications Systems. ATCCC specialists utilize both the TMP and the TMVS to perform ground-ground communications with other NAS facilities and non-NAS facilities. ATCCC specialists also utilize the AUTODIN for secure communications with DoD facilities.

NASSRS Requirement 3.6.4.A,B

2.4 Correlation with Operational Requirements

Table 2-2 summarizes the correlation of the air-ground, ground-ground communications connectivity, ground-ground communications capability, and emergency communications requirements graph of NAS-SR-1000 with the paragraphs in this document describing the communication functions being performed by specialists/controllers. All communications 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 2-2
COMMUNICATIONS CONNECTIVITY OPERATIONAL REQUIREMENTS CORRELATION

NAS FACILITIES	INFOR- MATION	AFSS SPECIALISTS					ACF SPECIALISTS					ATCT SPECIALISTS					FAA HQ SPECIALISTS					ATCCC SPECIALISTS				
		231a	231b	231c	231d	231e	232a	232b	232c	232d	232e	232f	233a	233b	233c	233d	233e	234a	234b	234c	234d	235a	235b	235c	235d	235e
NAS-SR-1000 PARAGRAPH																										
3.6.1 AG COMM GENERAL																										
3.6.1A AG Comm within NAS Jurisdiction																										
3.6.1B Protection From Interference																										
3.6.1C Storage/Retrieval of AG Comm																										
3.6.1D Operating Position Monitoring																										
3.6.1E AG Comm Available Continuously																										
3.6.1F Reconfiguration of AG Comm																										
3.6.2 G/G COMM CONNECTIVITY GENERAL																										
3.6.2A Comm between NAS Facilities																										
3.6.2B Comm between FAA & Non- NAS Facilities																										
3.6.2C Secure Data Comm between NAS & DoD Facilities																										
3.6.3 G/G COMM CAPABILITIES GENL																										
3.6.3A Comm within or between NAS Facilities																										
3.6.3B Reconfiguration of Comm Capabilities																										
3.6.3C Storage/Retrieval of G/G Comm																										
3.6.3D Inter-/Intrafacility Comm Available Continuously																										
3.6.3E User Verification & Access Control																										
3.6.4 NATIONAL EMERGENCY COMM GENERAL																										
3.6.4A Minimum Essential Comm																										
3.6.4B Emergency Comm Capabilities																										

2.5 Operational Sequence

Operational sequence diagrams have been developed to illustrate the interactions of communications systems between and within NAS facilities. These diagrams are general in nature and no effort has been made to depict a specific situation.

2.5.1 AFSS Air-Ground Communications Sequence (Voice)

Figure 2-8 illustrates a general sequence of operator/user interactions between pilots and AFSS specialists. In this sequence an En route Flight Advisory Service (EFAS) specialist receives a call on his VHF radio from a pilot requesting inflight weather conditions along his route of flight (1). The EFAS specialist queues up the weather conditions for the requested route of flight (2) from the FSDPS (3). The EFAS specialist then transmits the weather data to the pilot via radio (4). Once the pilot receives the weather briefing via radio (5) and no longer needs the inflight service he notifies the specialist (6). The EFAS Specialist acknowledges the pilot's intentions and terminates the service (7).

2.5.2 DUAT Ground-Ground Communications Between NAS and Non-NAS (Data) Sequence

Figure 2-9 describes one form of ground-ground communication connectivity involving the transfer of data from a non-NAS source to a NAS source. In this sequence a pilot can file his IFR flight plan from his home using his personal computer as a Direct User Access Terminal (DUAT). This terminal allows the pilot to communicate with the DUAT service and file his flight plan (1). This information is forwarded over commercial phone lines to the DUAT service where the flight plan is formatted and processed (2). The DUAT service then forwards the flight plan via the NICS to the ACCC (3). The ACCC forwards the flight plan to the appropriate facility, in this case an ATCT, via the NICS to the TCCC (4). The TCCC servicing the departure terminal airport holds the flight plan where, at the appropriate time, the Clearance Delivery Controller will transmit the clearance to the pilot either by voice or data link.

2.5.3 ACF Air-Ground Communications Sequence (Voice/Data Link)

Approach/Departure and En route Controllers working in the ACF use the VSCS to communicate with pilots for voice and through the Mode S sensor for data link. The following sequences are reflective of both types of controllers and therefore appear together as ACF controllers.

Figure 2-10 portrays the air-ground communication that takes place when a pilot establishes contact with a controller upon entering the sector from an adjacent sector and the on-going communication within the sector. The pilot makes initial contact via voice channel to alert the controller that he is on the proper frequency (1). The ACF controller acknowledges (2). The pilot, encountering turbulence, contacts the controller via voice and requests an immediate descent from the controller (3). The ACF controller acknowledges the descent request (4) and checks the traffic situation in the sector (5) to determine if a lower altitude is available from the ACCC. When a lower altitude is available (6) the ACF controller issues the descent clearance to the pilot (7). The pilot acknowledges the clearance to descend to the new altitude (8) and the ACF controller receives the descent acknowledgement (9). The pilot descends and once level at the new altitude, informs the ACF controller via data link (10). The ACF controller observes the data block change that the aircraft is level at the new altitude (11). When the pilot approaches the boundary of the sector, and the ACF controller has completed the handoff to the next sector, the controller advises the pilot via data link to contact the next controller on a designated frequency (12). The pilot acknowledges the data link message (13) which results in both data link and voice communications control being transferred to the next controller.

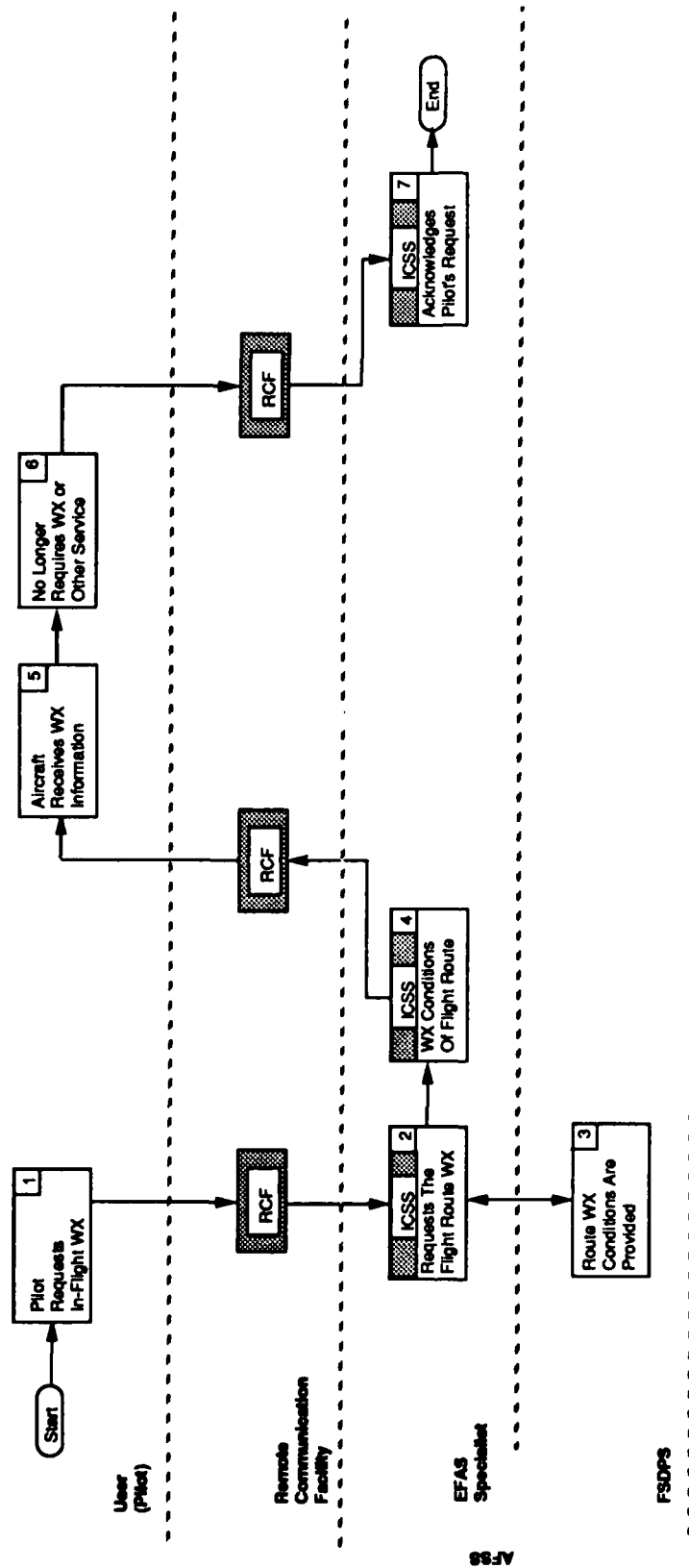


FIGURE 2-8
AFSS AIR-GROUND COMMUNICATIONS
SEQUENCE DIAGRAM

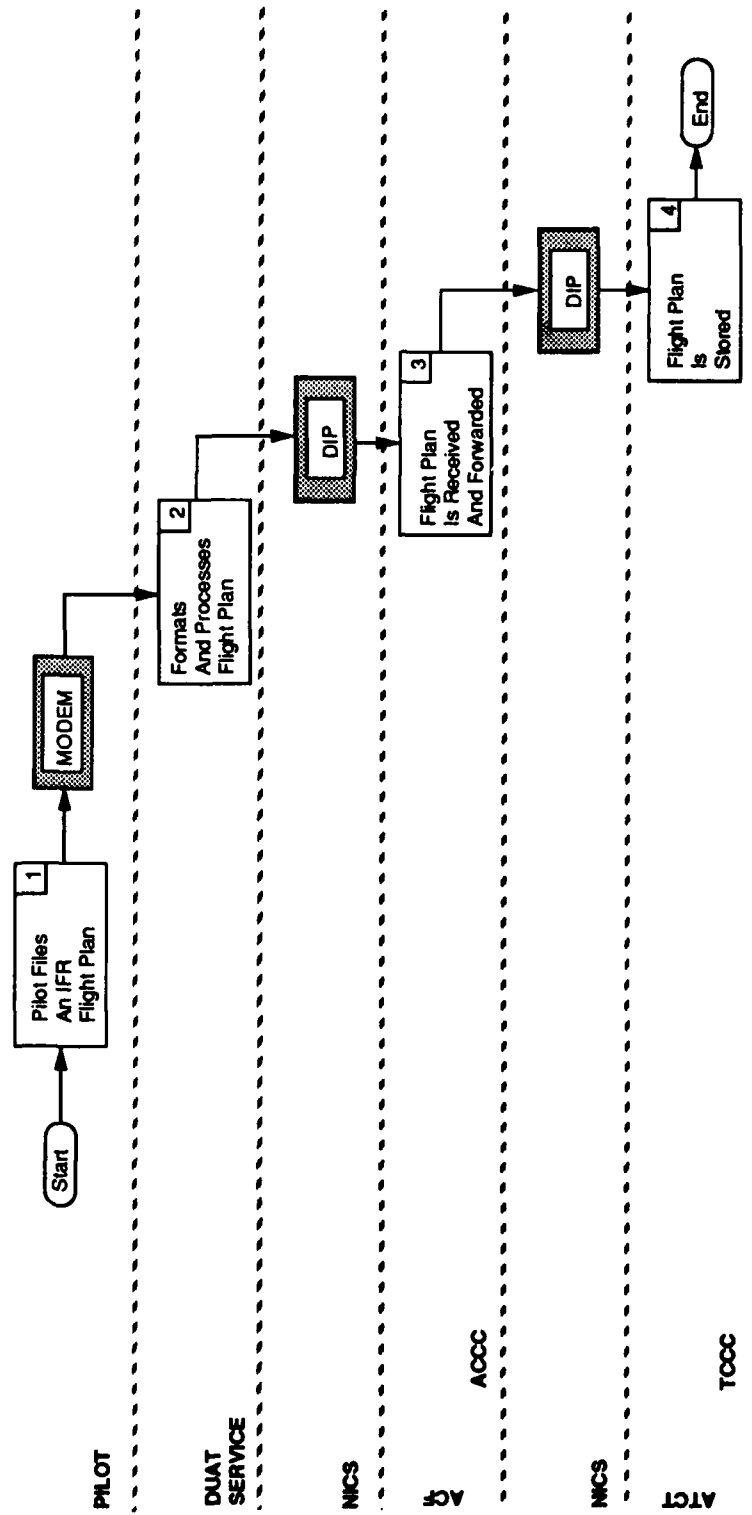


FIGURE 2-9
AFSS (DUAT) GROUND-GROUND COMMUNICATION
SEQUENCE DIAGRAM

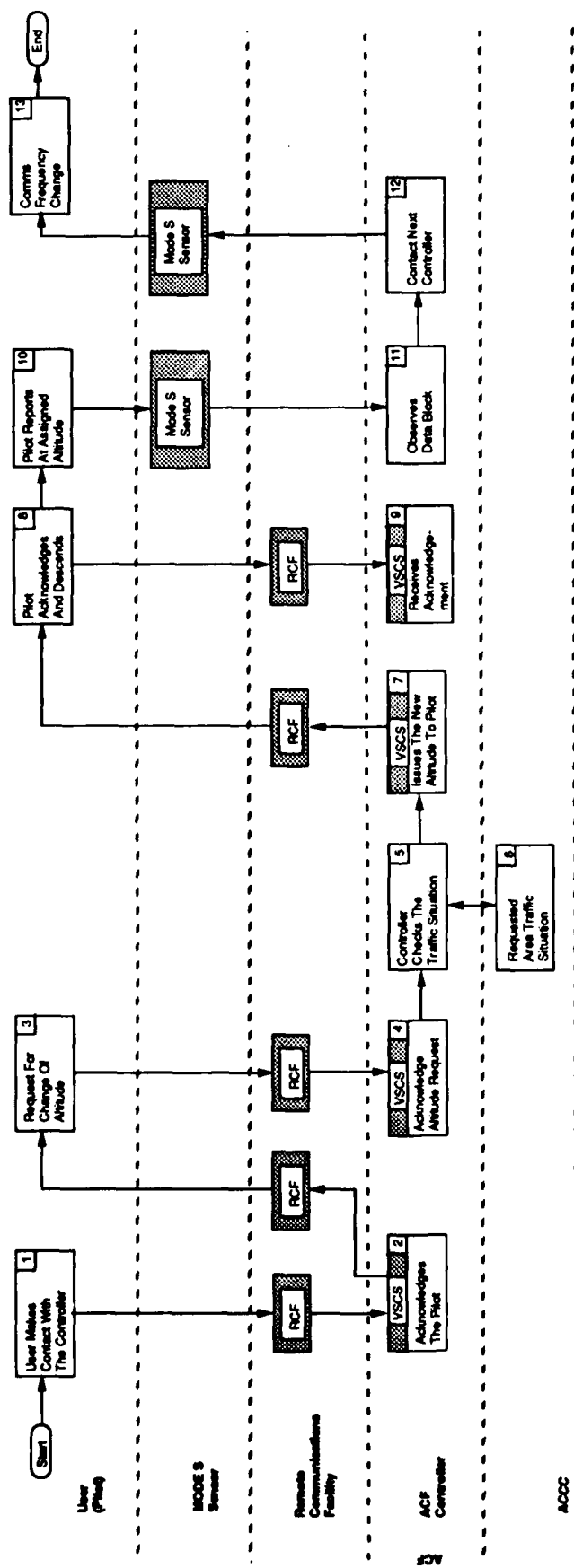


FIGURE 2-10
ACF AIR-GROUND COMMUNICATIONS
SEQUENCE DIAGRAM

2.5.4 ACF Ground-Ground Communications Between NAS Facilities (Data) Sequence

Figure 2-11 describes a ground-ground data communication sequence between NAS facilities. In this sequence a military base operations specialist files a flight plan on a military aircraft with the serving ACF. The specialist sends the flight plan to the ACCC in the ACF from his workstation (1). The MBO is connected to the NADIN IA message switch (2) which is interfaced with the NADIN II packet switch (3). This interface (NICS) permits data communications from the MBO to be passed to the ACCC in the ACF (4). The ACCC stores the flight plan until 30 minutes prior to requested departure at which time the flight plan is forwarded to the appropriate controllers' sector suite (5). Since the flight plan requires a routing change, the ACCC will automatically amend the flight plan (6) and forward the revision back through the NICS (7) (8) to the MBO for relay to the military pilot (9).

2.5.5 Ground-Ground Secure Communications Between DoD and NAS Facilities Sequence

This sequence describes the transmission of a classified message from the DoD to NAS facilities over secure communication systems. Figure 2-12 portrays how a classified message (1) is encrypted (2) at the source and forwarded via the DoD's AUTODIN to the ATCCC where it is decrypted (3) and given to the TMS personnel (4). Simultaneously, the classified message is passed to the encryption equipment at the ACF (5) where it is decrypted and given to the TMC (6) and affected controller (7).

2.5.6 ATCT Air-Ground Communications Sequence (Voice)

Figure 2-13 describes the communications between the controller in the Air Traffic Control Tower (ATCT) and the pilot. In this sequence, the pilot approaching his destination airport obtains the local airport weather, runway in use and type of approach to expect (1) by copying the Automatic Terminal Information Service (ATIS) message (2), by monitoring the local VHF voice broadcast with his radios. The pilot then contacts the Local Controller on his VHF radio to request landing clearance (3). The Local Controller acknowledges the request (4), then checks the traffic situation (5) with the TCCC (6), as well as visually, and issues landing instructions to the arriving aircraft (7). The pilot acknowledges the information (8) and follows the Local Controller's instructions. After landing the pilot is advised to contact the Ground Controller after he turns off the runway (9). The pilot then contacts the Ground Controller (10) who advises him to taxi to the parking ramp (11), which he does (12).

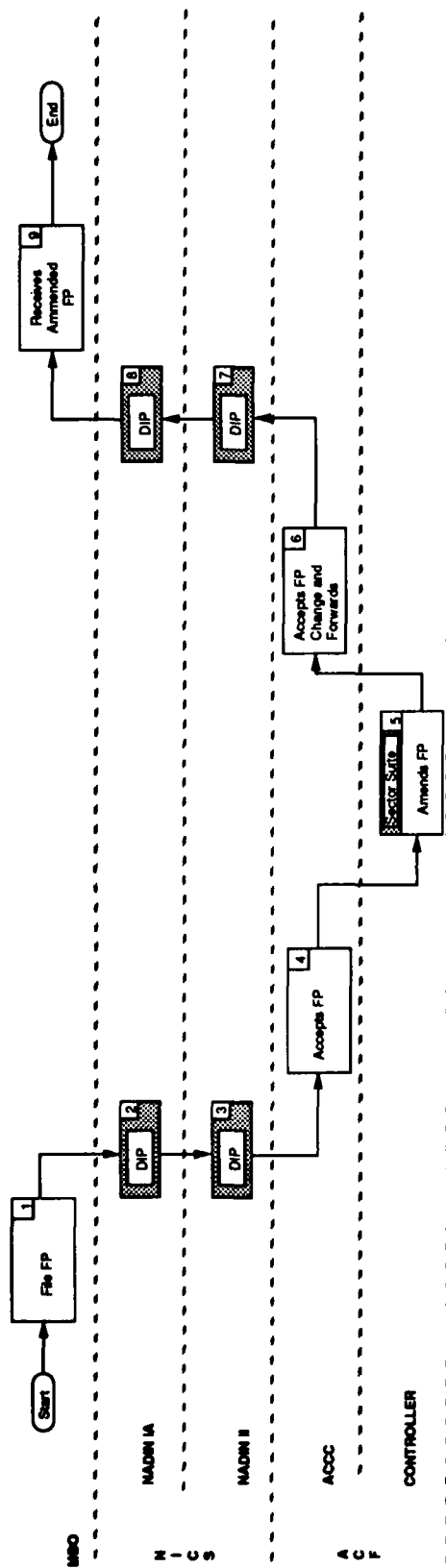


FIGURE 2-11
ACF GROUND-GROUND COMMUNICATIONS
SEQUENCE DIAGRAM

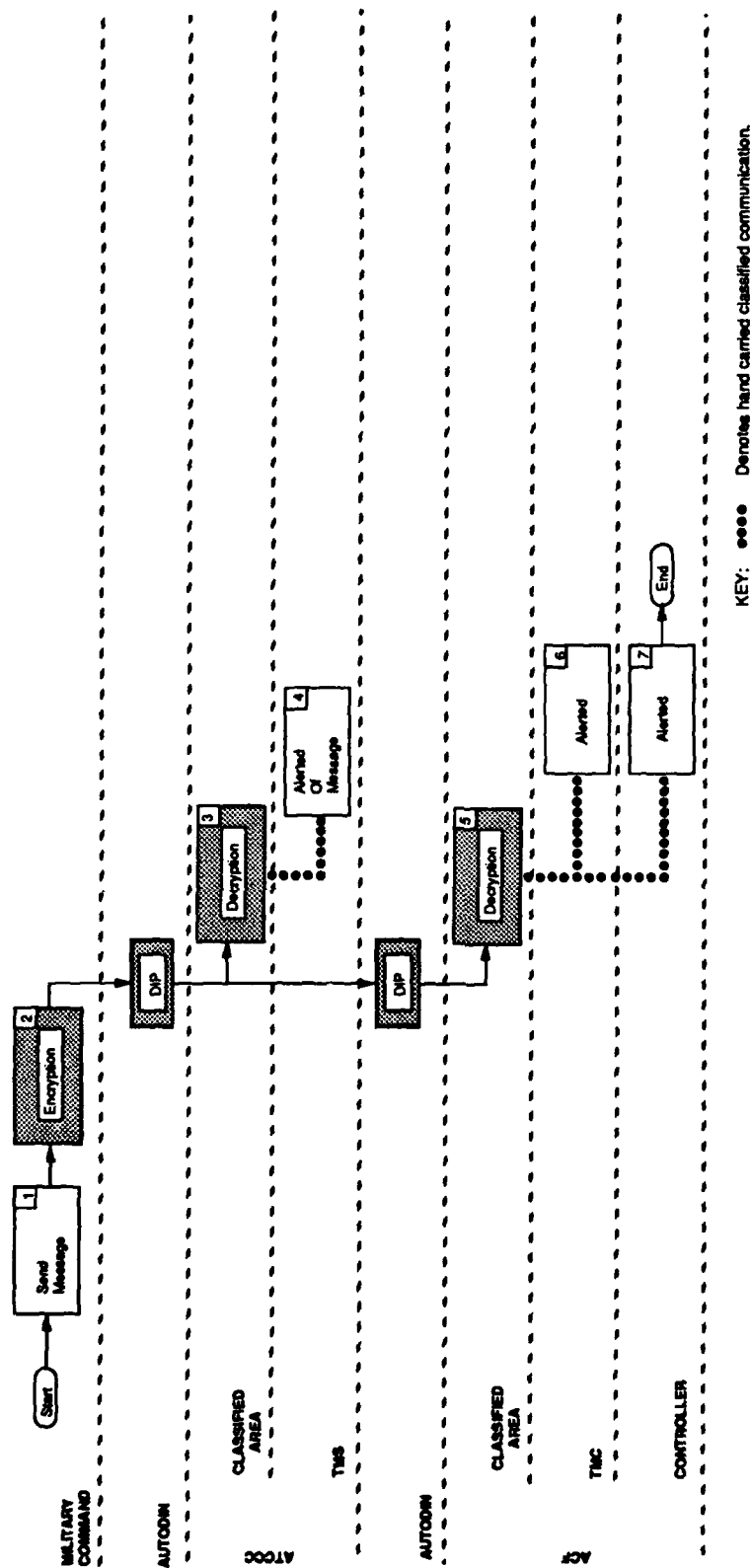


FIGURE 2-12
GROUND-GROUND SECURE COMMUNICATIONS
SEQUENCE DIAGRAM

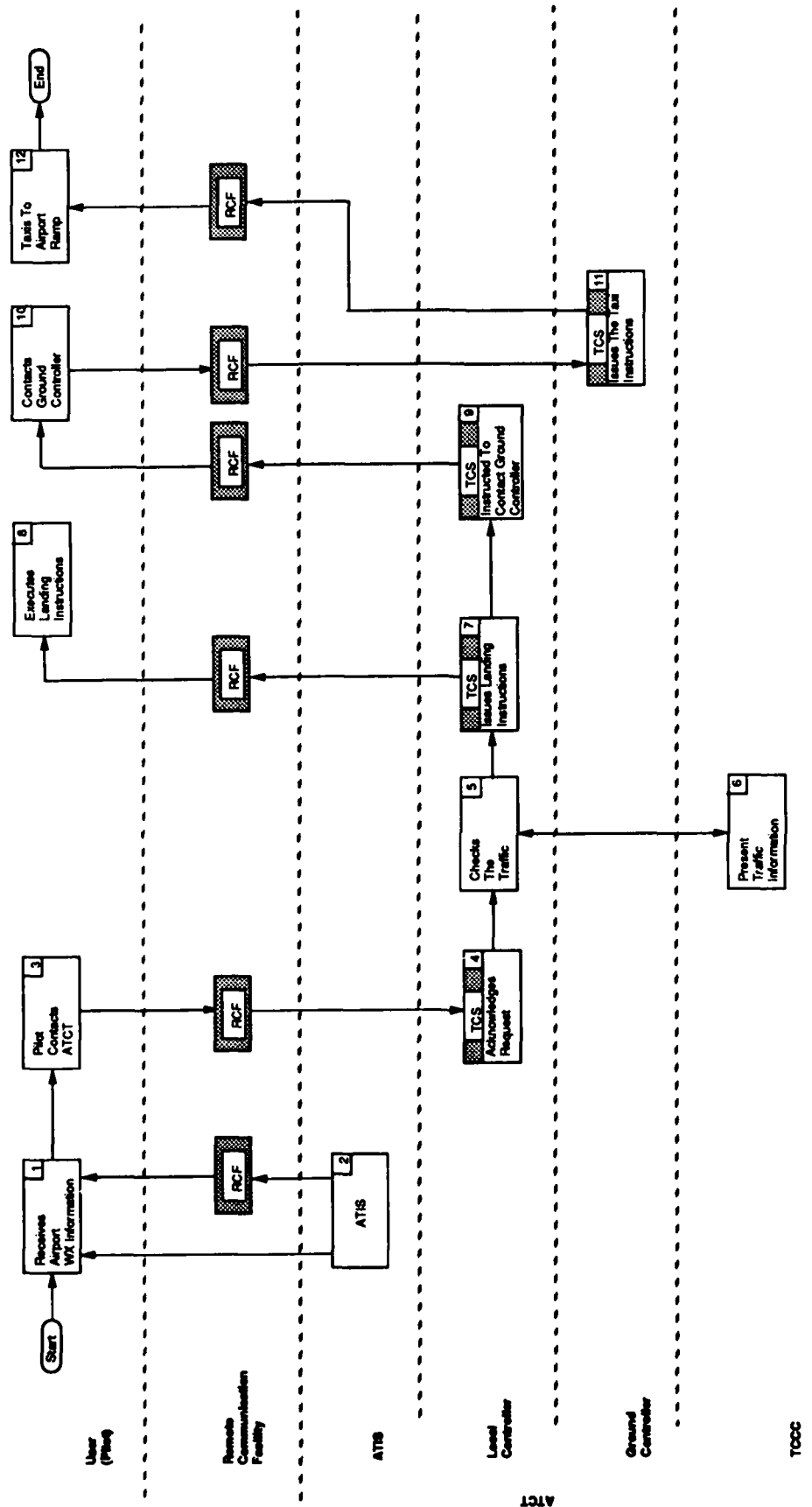


FIGURE 2-13
ATCT AIR-GROUND COMMUNICATIONS
SEQUENCE DIAGRAM

2.5.7 ATCT Ground-Ground Communications Between NAS Facilities (Voice) Sequence

Figure 2-14 describes a ground-ground sequence involving voice communications between NAS facilities. For the purposes of describing the voice communications it is assumed that the following calls are made after the appropriate data messages are sent. In this sequence an ATCT reports that they must restrict traffic arriving at their airport due to an emergency. The tower specialist, using the TCS (1), notifies the approach controller at the ACF through his VSCS (2) to implement arrival restrictions. The tower controller then notifies the TMC at the ACF, again using the TCS to VSCS connection (3), of the problem. The TMC then notifies the TMS at the ATCCC via a VSCS to TMVS communication connection to inform him of the restrictions (4). The TMS specialist, using the TMVS, contacts the ACF controller on the VSCS and advises of the restrictions (5).

2.5.8 ATCCC Ground-Ground Communications Between NAS Facilities Sequence (Voice/Data)

Figure 2-15 describes the arrival restrictions needed to be implemented at an airport due to traffic saturation. The ACF that feeds the traffic into this airport has already been notified but the adjacent ACFs that feed traffic to the serving ACF have not. In this sequence the Traffic Management Specialist (TMS) at the ATCCC, using the TMVS (1), coordinates with the Traffic Management Coordinator (TMC) through VSCS (2) and the ATCT specialist through the TCS (3) to agree on arrival rates. The TMS inputs the flow restriction message (4) into the Traffic Management Processor (TMP) (5). The TMP forwards the message to the serving ACFs' ACCC (6) which then forwards the message to the Traffic Management Coordinator (TMC) via his sector suite (7). The ACCC also forwards the flow restriction and any other metering information to the other ACCCs (8) in adjacent ACFs which notifies the TMC (9) as well as the appropriate TCCC (10).

2.5.9 FAA Headquarters Operations Center Ground-Ground Communications Between NAS and Non-NAS Facilities (Voice)

Figure 2-16 describes voice communications between the FAA Headquarters Operations Center and non-NAS facilities. This sequence describes the events and voice communications interface between the Operations Center and other NAS and non-NAS facilities during an emergency situation. This sequence begins when an Area Manager at an ACF contacts the Regional Operations Center and makes an initial hijack report with the Regional Duty Officer through the VSCS at the ACF (1). The VSCS is connected to the EVCS at the Operations Center by the NICS. Once the Operations Center is notified, the Duty Officer initiates notification of key personnel at the FAA Headquarters Operations Center using the EVCS (3). The operations officer continues the conference call with the ATC facility (4) and notifies the affected air carrier operations center (5), via PABX, and the and other appropriate agencies, in this case, the FBI (6). Once the telephone conference is established each party can freely talk and exchange information. As the event progresses, the Operations Center continues to exchange information with the ATC facility (7), the air carrier operations center (9) and the FBI (10) until the situation is resolved at which point the ATC facilities, the affected air carrier operations center, and other affected agencies terminate their participation (11).

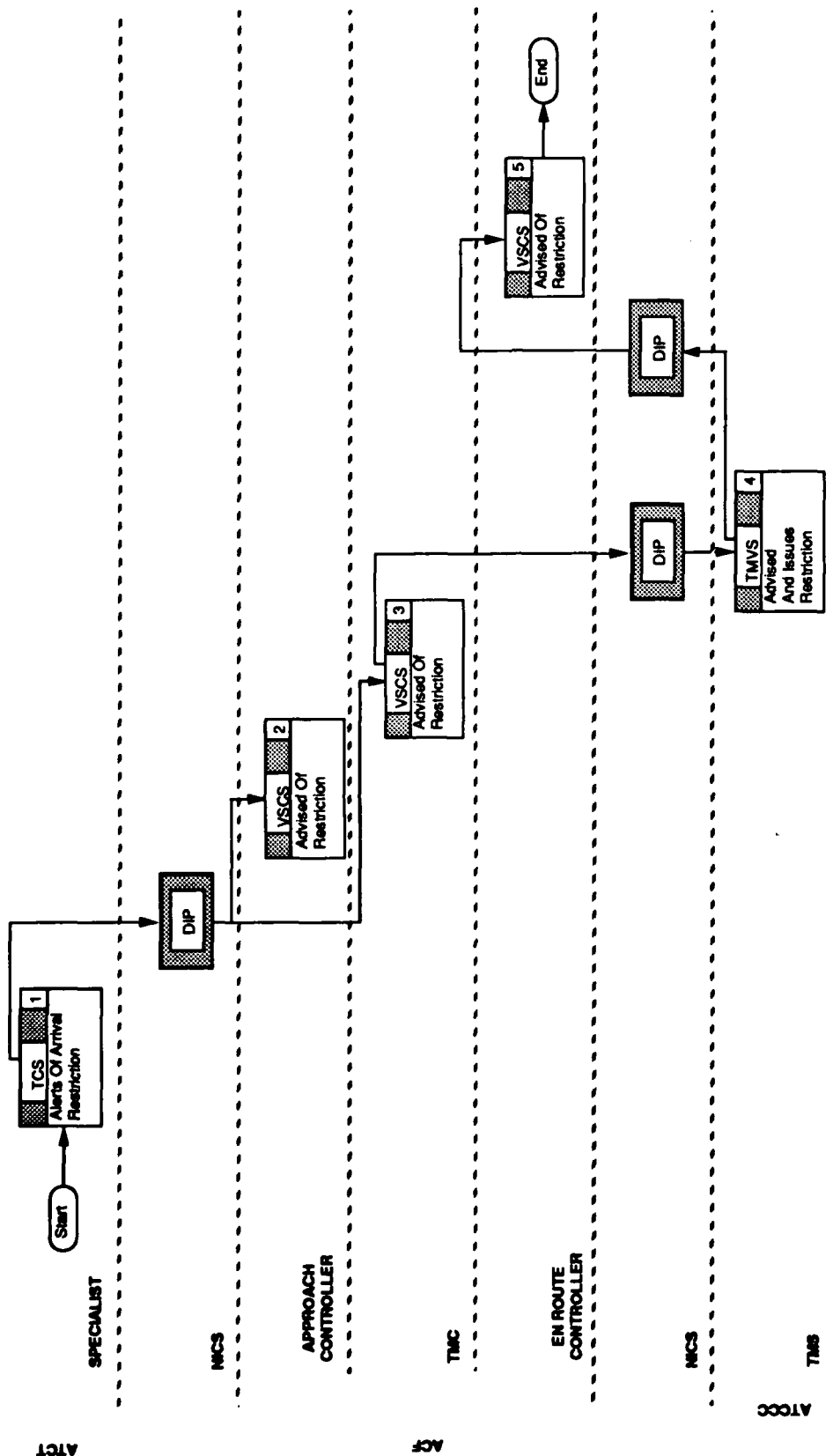


FIGURE 2-14
ATCT GROUND-GROUND COMMUNICATIONS
SEQUENCE DIAGRAM

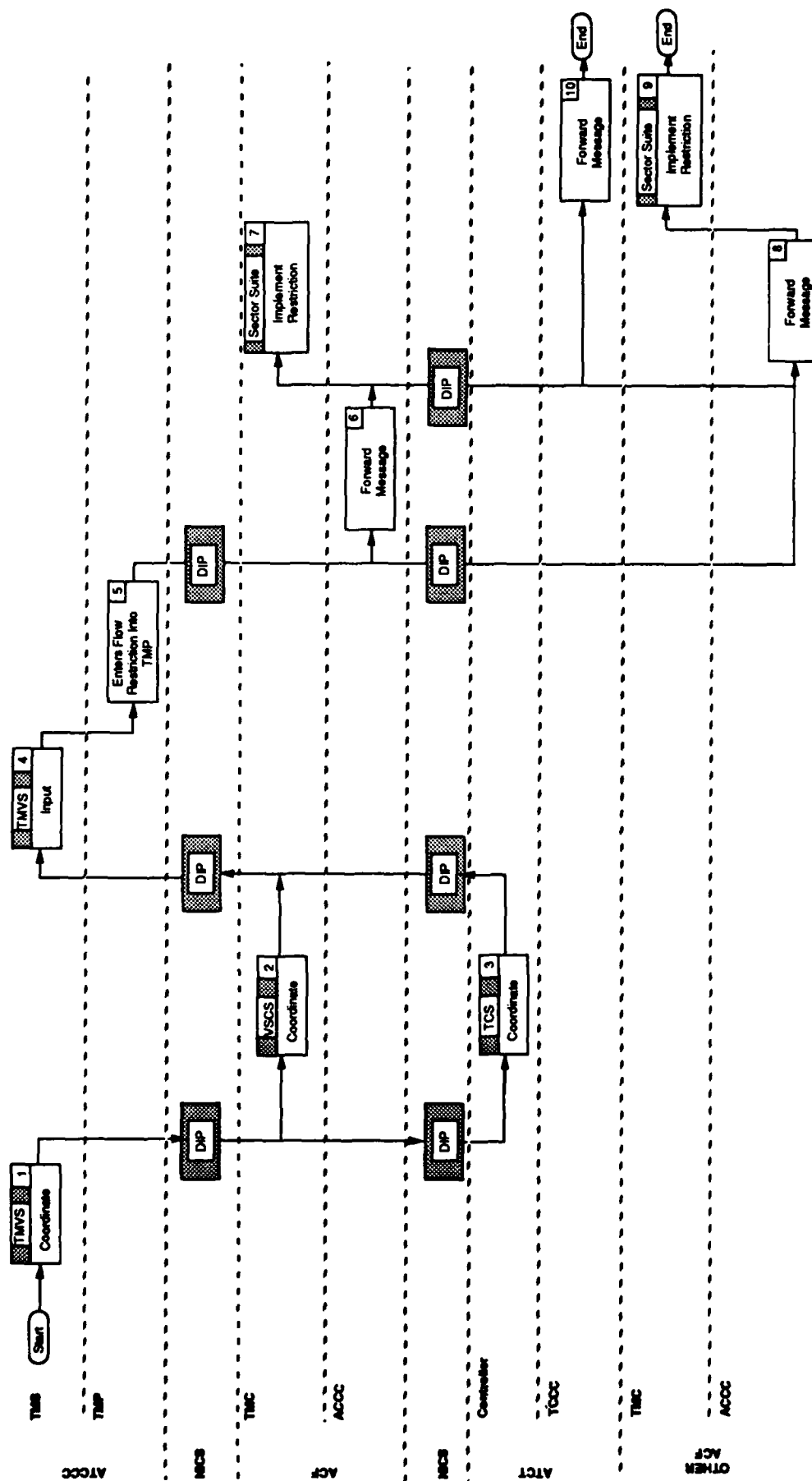


FIGURE 2-15
ATCCC GROUND-GROUND COMMUNICATIONS
SEQUENCE DIAGRAM

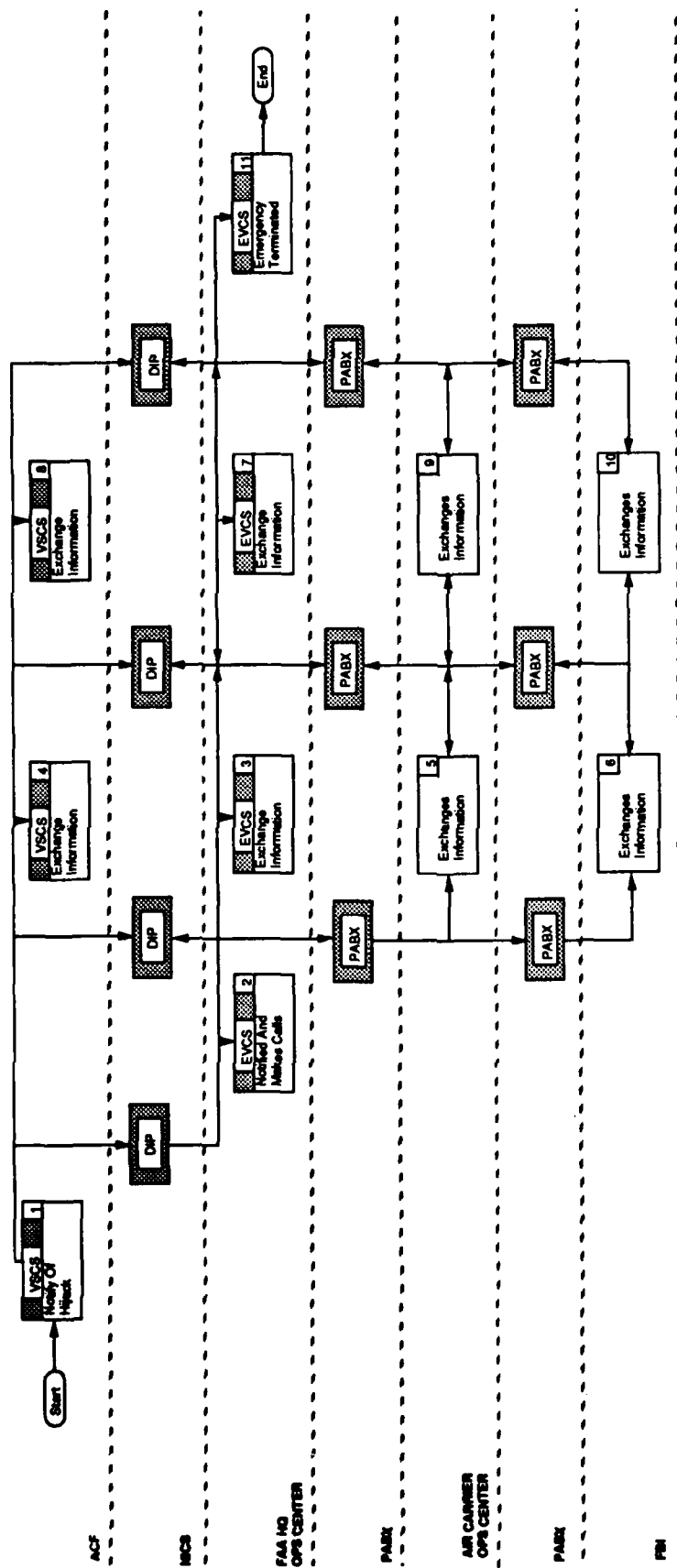


FIGURE 2-16
FAA HEADQUARTERS OPS CENTER
GROUND-GROUND COMMUNICATIONS
SEQUENCE DIAGRAM

2.6 Operational Scenario

Specific hypothetical situations illustrating communications capability within the NAS are presented in the following paragraphs.

2.6.1 AFSS Air-Ground Communications Scenario (Voice)

Figure 2-17 presents an operational sequence for an AFSS specialist communicating with a pilot through the ICSS. It is similar to the operational sequence diagrams in Figure 2-8; however, this scenario represents the interactions between operators/users for a specific case. In this sequence an En Route Flight Advisory Service (EFAS) specialist receives a call on his VHF radio from the pilot of N2222MM requesting inflight weather conditions on his flight from Martinsburg, WV to Manassas, VA (1). The EFAS specialist queues up the weather conditions (2) from the FSDPS (3). The EFAS specialist then transmits the weather data to the pilot of N2222MM via radio (4). Once the pilot receives the weather briefing via radio (5) and no longer needs the inflight service he notifies the specialist and changes frequency (6), which the specialist acknowledges (7).

2.6.2 DUAT Ground-Ground Communications Between NAS and Non-NAS (Data) Scenario

Figure 2-18 describes an operational scenario for ground-ground communications utilizing the DUAT service. It is similar to the operational sequence diagram in Figure 2-9, however, this scenario represents the interfaces between ground-ground communication systems for a specific case. This scenario assumes a pilot wants to file an IFR flight plan from Dulles Airport, Virginia to Burke Lakefront airport in Cleveland, Ohio using his personal computer. Since his computer terminal is configured with a modem and associated software to allow it to communicate with the DUAT service, it is referred to as a direct user access terminal (DUAT). The pilot of N101NH gains access to the DUAT service from his modem via commercial phone lines and files his flight plan (1). The DUAT service formats, processes, and forwards the flight plan to the ACCC (2) at the ACF via the NICS. The ACCC forwards the flight plan to the TCCC at Dulles via the NICS (4). The TCCC will hold the flight plan in its database until the appropriate time for clearance delivery.

2.6.3 ACF Air-Ground Communications Scenario (Voice/Mode S Data Link)

In the third scenario, Figure 2-19 presents an operational scenario for an aircraft in contact with an ACF controller. It is similar to the operational sequence diagrams in Figure 2-10; however, this scenario shows more detail and represents the interactions between operators/ users for a specific case. In this scenario the use of both data link and voice are used to demonstrate the interaction of the two methods of communication.

Once handed-off from an adjacent sector, the pilot of N2025M is advised via data link to contact the next sector of the Washington ACF. The pilot makes initial contact with the next controller via voice channel, alerting him that he is on the assigned frequency (1). The ACF controller confirms from the aircraft data block that he is in control of N2025M, acknowledges this with the pilot via voice, and observes that the aircraft is level at FL220 (2). The pilot of N2025M starts to pick up light rime ice and immediately asks the controller for a lower altitude (3), electing to make his request via voice due to the urgent nature of the situation. The ACF controller acknowledges the altitude request via voice (4) and checks for a lower altitude with reference to the traffic within his sector through the ACCC (5). As soon as it is available the ACF controller enters a new altitude assignment of FL180 into the sector suite and transmits the

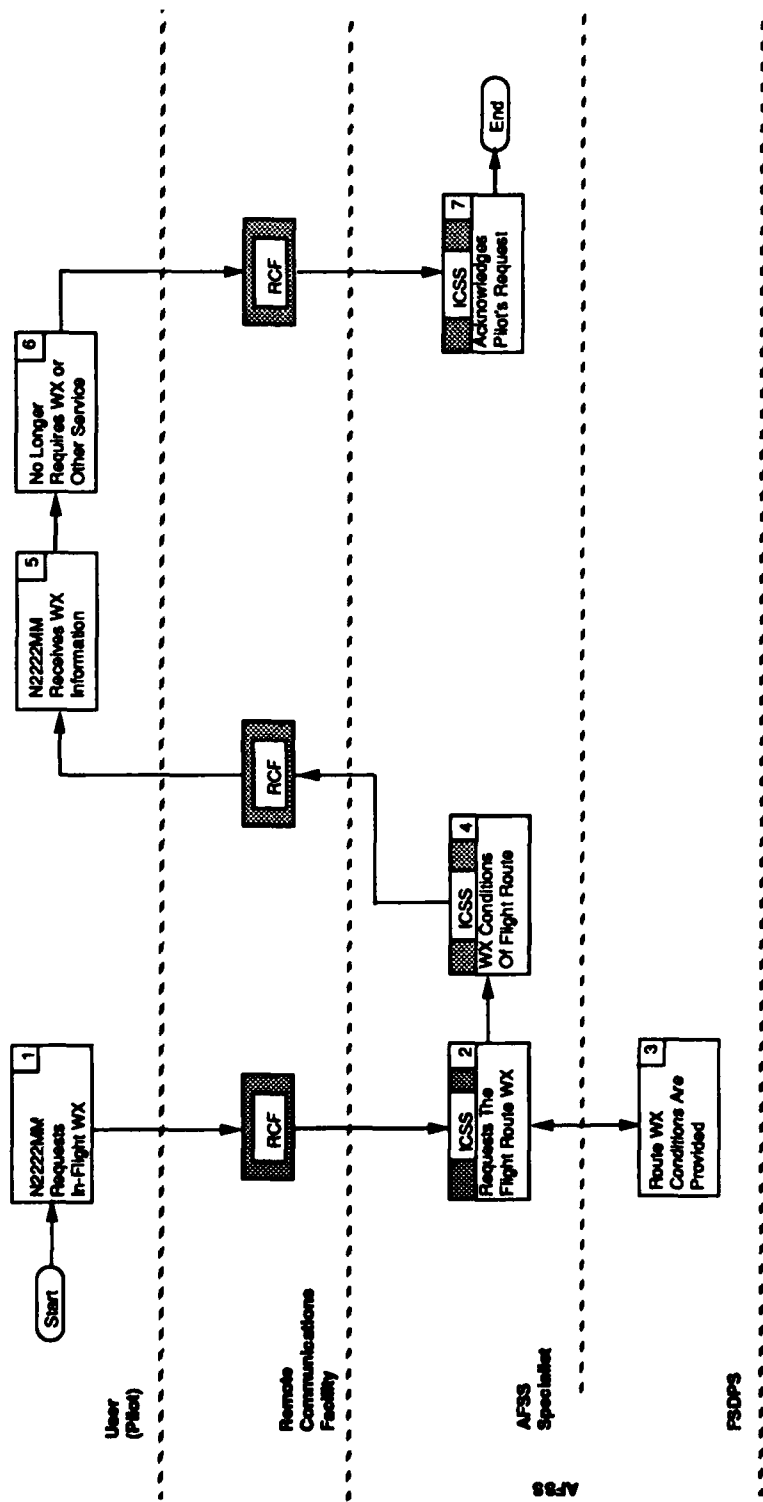


FIGURE 2-17
AFSS AIR-GROUND COMMUNICATIONS
SCENARIO DIAGRAM

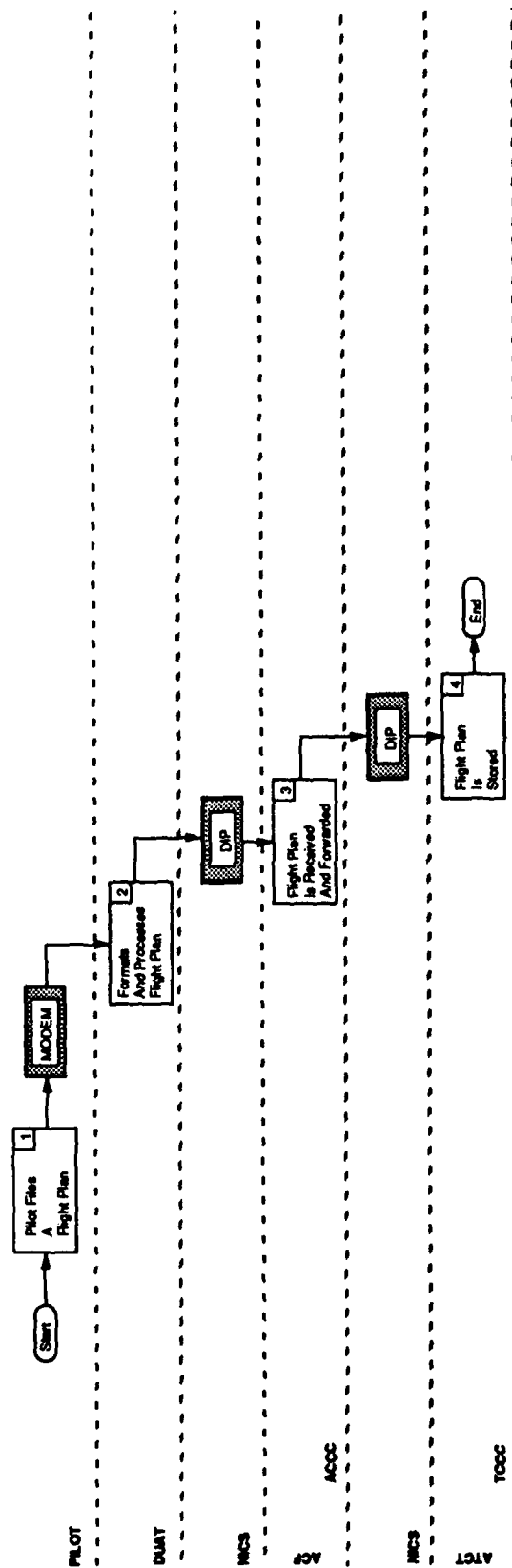


FIGURE 2-18
AFSS (DUAT) GROUND-GROUND COMMUNICATIONS
SCENARIO DIAGRAM

altitude assignment via voice to the pilot of N2025M (6). The pilot acknowledges the altitude change via data link (7) and starts his descent. The ACF controller monitors the aircraft's descent via the aircraft's data block (8), and confirms the pilot's new altitude (9) via the data link as viewed on the aircraft data block (10). When N2025M approaches the boundary of the next sector (11), the ACF controller completes an automatic hand-off to the next sector and instructs N2025M by data link to contact the next controller on a designated frequency (12). The pilot acknowledges the data link message (13) which results in both data link and voice communications control being transferred to the next controller and contacts the next controller.

2.6.4 ACF Ground-Ground Communications Between NAS Facilities (Data) Scenario

Figure 2-20 presents an operational scenario for the exchange of data between NAS facilities. This scenario includes multiple NAS facilities to show how data is passed between them. In this example the MBO at Offutt AFB forwards a composite IFR-VFR-IFR flight plan to the ACCC at the Minneapolis ACF. The aircraft intends to fly IFR from Offutt AFB direct Omaha VORTAC V307 Pawnee VORTAC cancel IFR proceed VFR to the entrance point for VR-511 MTR and fly the route into the Kansas City ACF airspace back into Minneapolis ACF airspace. After exiting the VR route the pilot will contact the Minneapolis ACF controller to pick up the IFR return portion of the flight plan. This portion of the flight plan requests direct Pawnee VORTAC V307 Omaha direct Offutt AFB.

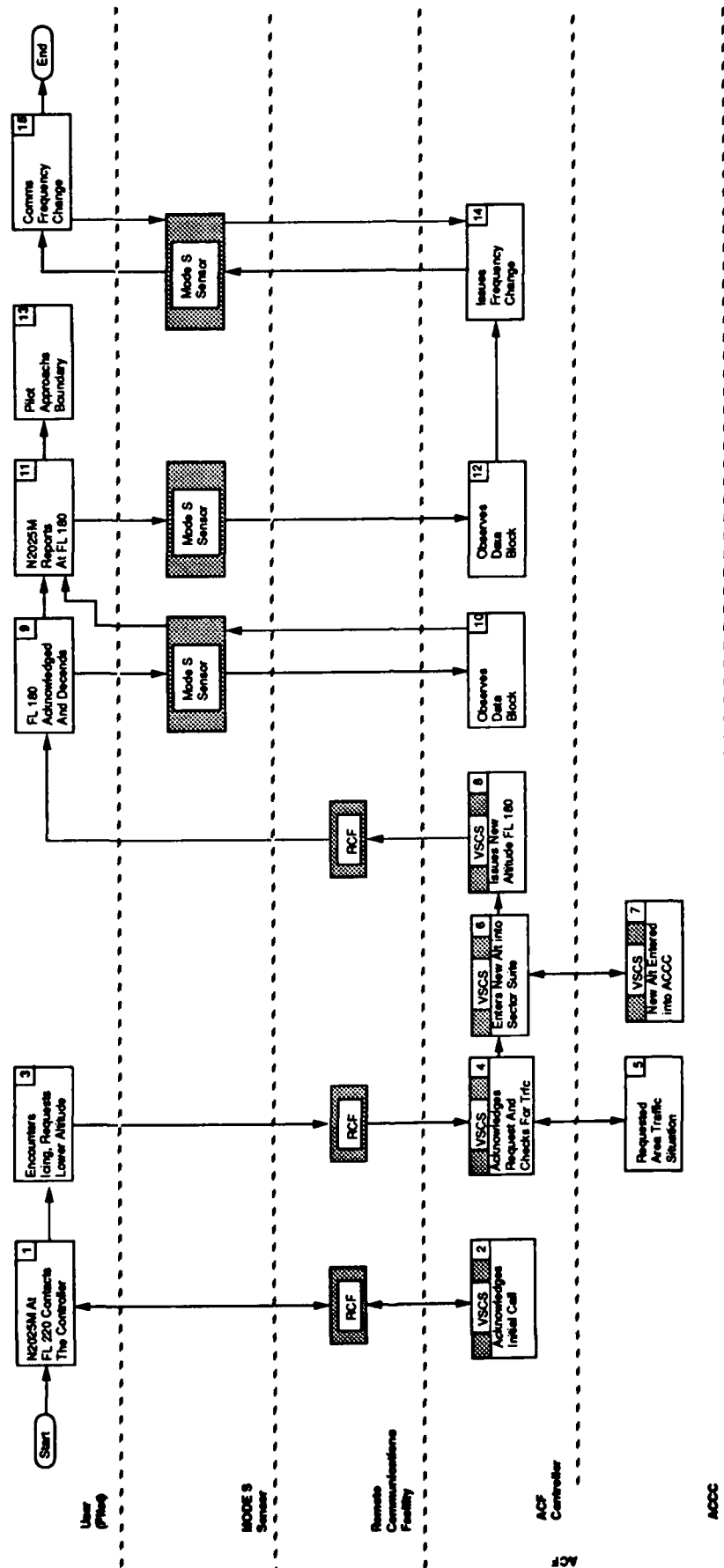
Once the flight plan is passed to the ACCC at the Minneapolis ACF the ACCC stores the flight plan until 30 minutes prior to requested departure when it forwards the flight plan to the appropriate sector. Once the aircraft departs, the flight plan appears on the controllers' departure list. Since the aircraft is on a composite IFR-VFR-IFR flight plan, the ACCC forwards the flight plan to the FSDPS within the ACF via a Local Communication Network (LCN). Since VR-511 lies within the Columbus AFSS area of responsibility the flight plan is forwarded the Columbus AFSS via the NICS which alerts the specialist through his workstation. Concurrently, the ACCC forwards the information to the Kansas City ACF's ACCC via the NICS since VR-511 also falls within the Kansas City ACF's airspace. The Kansas City ACCC accepts the information and forwards it to the appropriate controllers via their sector suites. This ACCC also forwards the activation information to the FSDPS within the ACF via an LCN which forwards the information to the specialist at Wichita AFSS. This information is presented to the specialist through his workstation. The Kansas City ACCC forwards the return portion of the composite flight plan back to the Minneapolis ACCC for the sector that will handle to aircraft's return leg.

2.6.5 Secure Communications Between DoD and NAS Facilities Scenario

The next scenario describes how classified data is passed on a secure communication system between DoD and NAS facilities. In Figure 2-21, a specialist at the 4th Tactical Fighter Wing Base Operations at Seymour-Johnson AFB, inputs a classified flight plan (1). The flight plan is encrypted (2) and is transmitted via the AUTODIN. The flight plan is forwarded to the CFCF at the ATCCC where it is decrypted (3) and given to the TMS (4) for planning purposes. At the same time the flight plan is forwarded to the Washington ACF, also via the AUTODIN, where it is decrypted (5). The flight plan is then given to the TMC (6) and the controllers (7) affected.

2.6.6 ATCT Air-Ground Communications Scenario (Voice)

Figure 2-22 presents an operational sequence for tower controllers communicating with pilots through the TCS. It is similar to the operational sequence diagrams in Figure 2-13; however, this scenario represents the interactions between operators/users for a specific case.



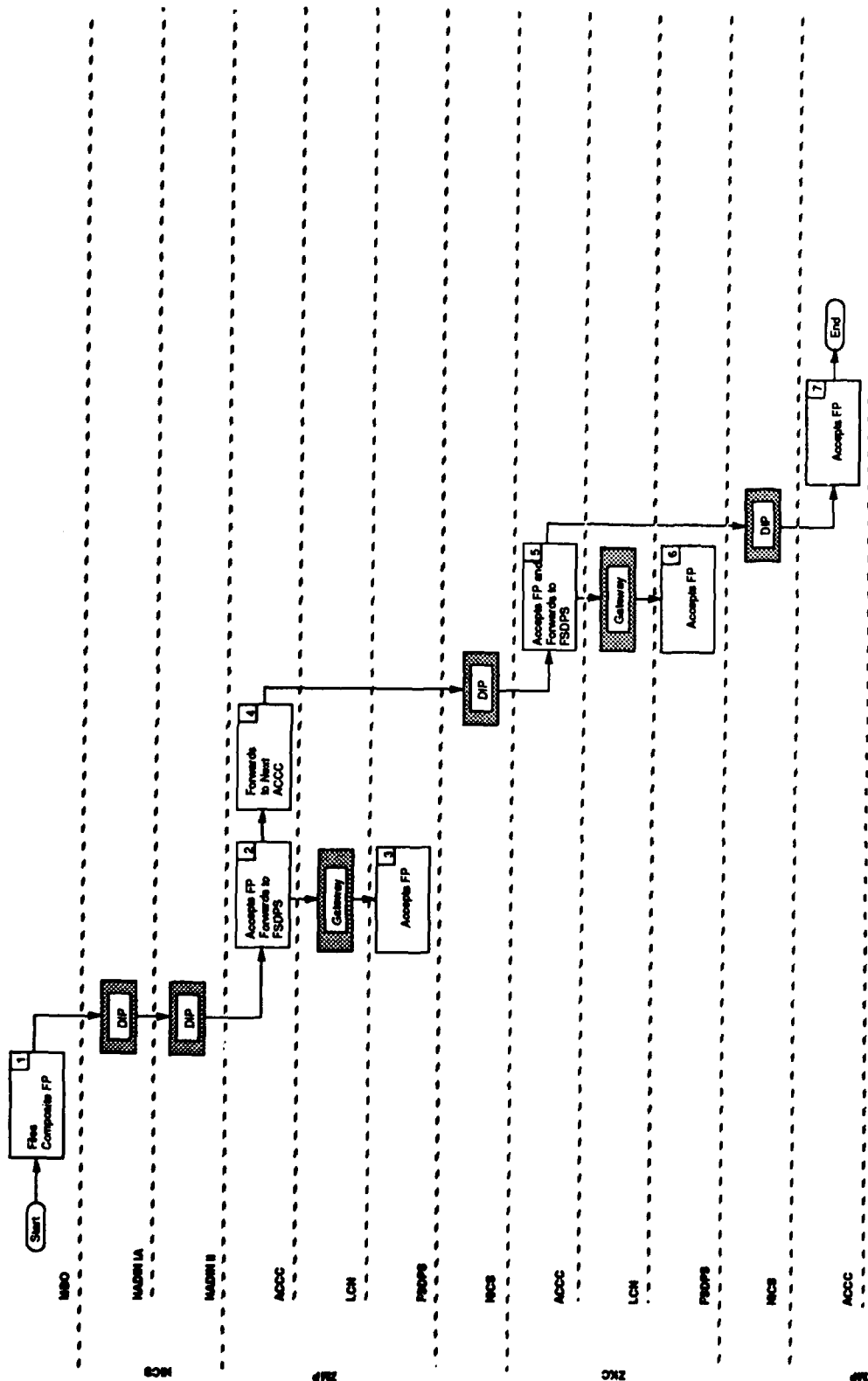
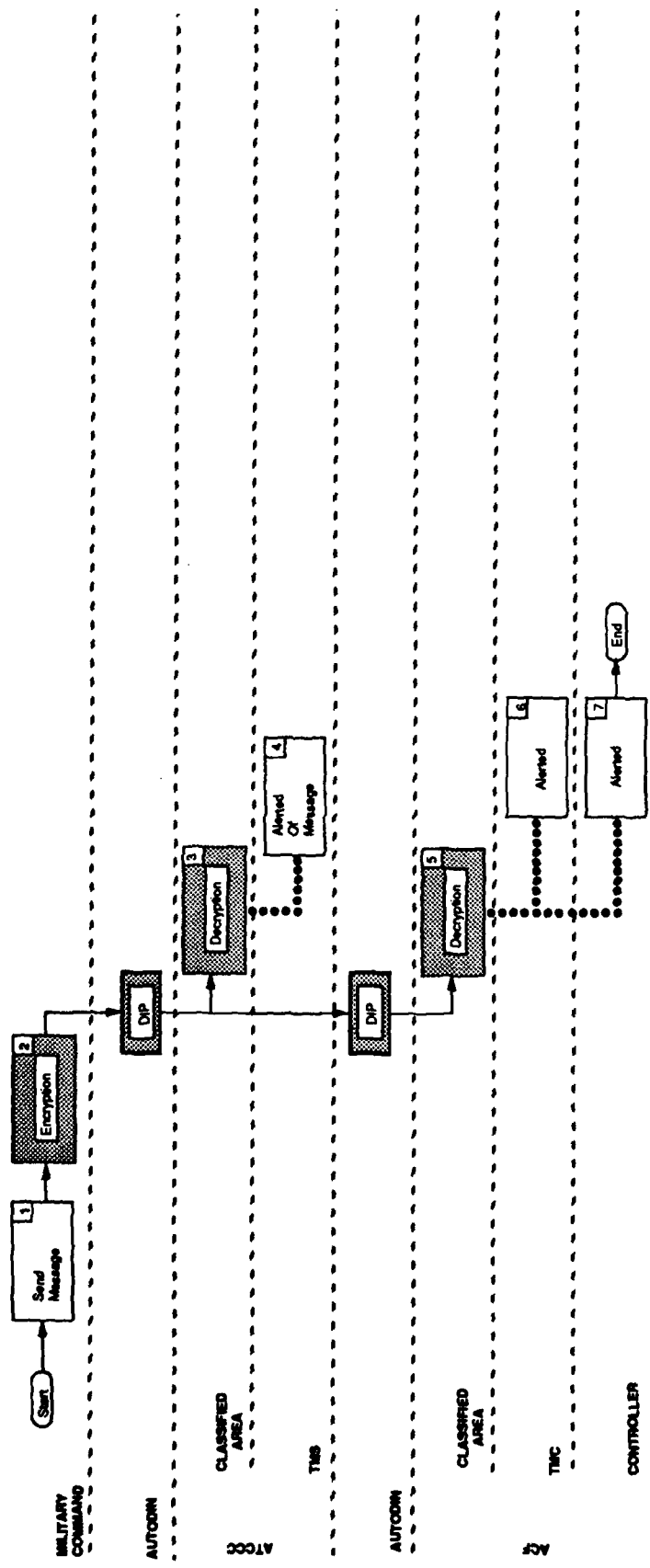


FIGURE 2-20
ACF GROUND-GROUND COMMUNICATIONS
BETWEEN NAS FACILITIES



KEY:..... Denotes hand carried classified communication.

FIGURE 2-21
GROUND-GROUND SECURE COMMUNICATIONS
SCENARIO DIAGRAM

This scenario depicts the Local Controller issuing landing clearance to a pilot using the VHF radio frequency.

The pilot of N4327J first obtains the airport and weather information (1) for Hagerstown Airport from the ATIS (2) via data link. The pilot of N4327J then contacts the Hagerstown Tower stating his position, that he has the ATIS information, and requests landing instructions (3). The Local Controller acknowledges the pilot of N4327J (4), checks the traffic situation (5) with the TCCC (6) as well as visually, and issues landing instructions to the pilot of N4327J (7). The pilot of N4327J acknowledges and executes the landing instructions (8). Upon taxiing clear of the runway, the pilot of N4327J contacts the Ground Controller requesting taxi instructions (9) via radio. The Ground Controller issues taxi instructions to N4327J to taxi to the ramp via radio (10). The pilot of N4327J taxis to the ramp (11).

2.6.7 Communications Between NAS Facilities (Voice) Scenario

This operational scenario shows the ground-ground voice communications connectivity between NAS facilities. It is similar to the operational sequence diagram Figure 2-14; however this scenario portrays the communications connectivity for a specific situation. In Figure 2-23, an aircraft blows a tire on landing at Washington National Airport. Since the aircraft has stopped on the runway at midfield, arrival traffic must be delayed. The Tower Controller, using the TCS notifies the Washington ACF sector of the situation (1). The Arrival Controller at the IRONS LOW sector answers the Tower Controller using the VSCS (2) and receives the information. The Tower Controller then notifies the TMC via the VSCS of the arrival restrictions (3). The TMC in turn notifies the TMS at the ATCCC of the restriction. The TMS receives this voice call over the TMVS (4). The TMS using his TMVS, calls the En route Controller at the ACF through his VSCS (5) and advises him to restrict traffic into the approach controller's airspace.

2.6.8 ATCCC Ground-Ground Communications Between Facilities Scenario (Voice/Data)

Figure 2-24 portrays ground-ground communications necessary to coordinate flow control restrictions and is similar to the operational sequence diagram Figure 2-15. In this scenario severe weather has hampered landing operations at John F. Kennedy Airport in New York. Due to the increased amount of spacing between aircraft, further additional in-trail separation is needed between aircraft that are already in the system and en route to JFK. The Traffic Management Coordinators at JFK (1) and the New York ACF (2) have coordinated with the specialists at the ATCCC concerning the arrival rate into JFK through their respective communications systems. Once they have agreed on the additional spacing (3) the ATCCC specialist inputs the new flow restrictions (4) into the TMP (5), and sends the information to the affected ACFs currently controlling Kennedy bound traffic. This flow information data is then passed to the ATCCC (6) within the ACF which is then passed to the concerned ACF Traffic Management Specialists (7) and controllers working the Kennedy traffic (8).

2.6.9 Communications between NAS and Non-NAS Facilities (Voice) FAA Headquarters Operations Center Scenario

This scenario (Figure 2-25) describes the ground-ground communications that take place between the FAA Headquarters Operations Center and other NAS and non-NAS facilities during a hijack situation. It is similar to the operational sequence diagram in Figure 2-16; however, this scenario shows more detail and represents the ground-ground communication interfaces between the facilities involved. This scenario begins when Eastern Airlines Flight 947 (EA 947), from Washington National en route to Miami, FL, notifies the Washington ACF of a hijack situation. The Area

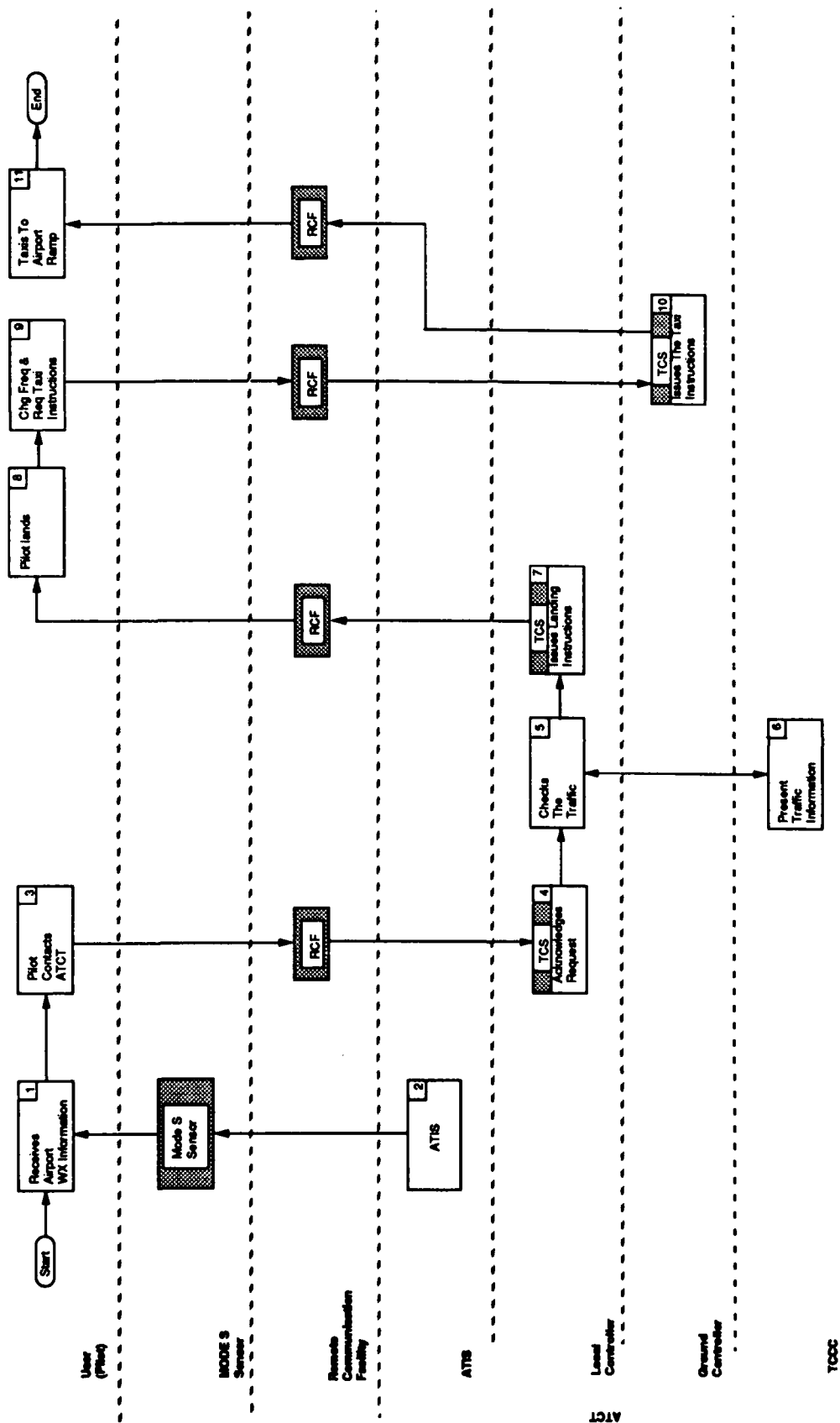


FIGURE 2-22
ATCT AIR-GROUND COMMUNICATIONS
SCENARIO DIAGRAM

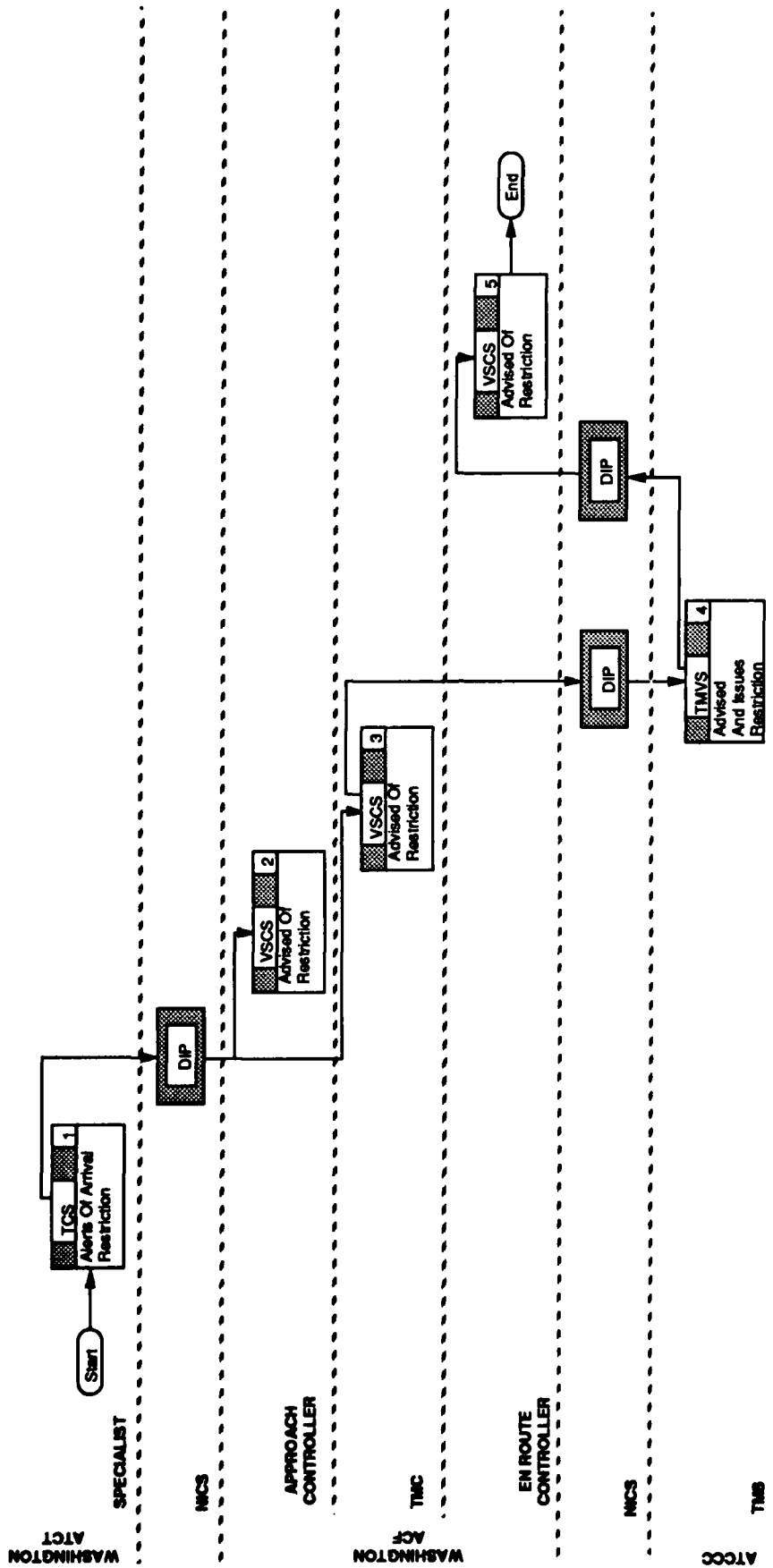


FIGURE 2-23
ATCT GROUND-GROUND COMMUNICATIONS
SCENARIO DIAGRAM

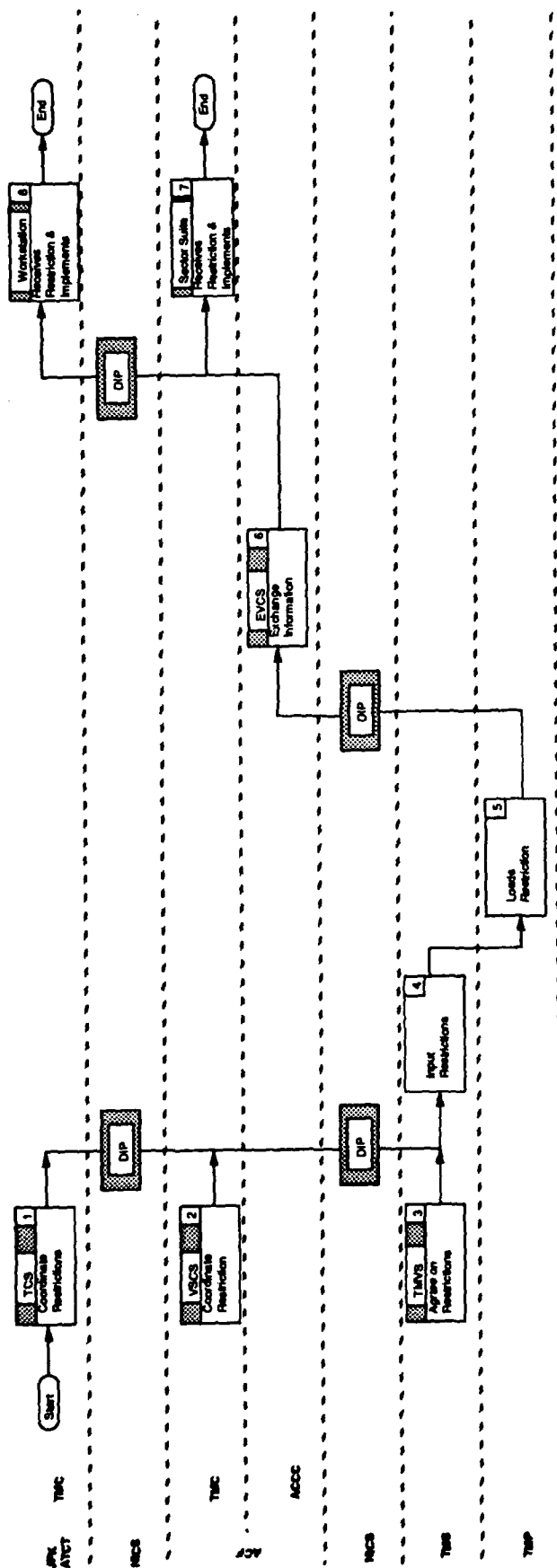


FIGURE 2-24
ATCCC GROUND-GROUND COMMUNICATIONS
SCENARIO DIAGRAM

Manager from Washington ACF notifies the Operations Center using the VSCS voice (1). The Washington VSCS is interfaced to the NICS which is interfaced with the EVCS at the Operations Center. The Duty Officer at the Operations Center receives the call (2) and while the Washington ACF is still connected (3) he immediately notifies the Eastern Airlines Operations Center (5) through the PABX on commercial telephone lines. The FBI (6) is also notified through the PABX. The TMS at the ATCCC receives a call over the TMVS, which is interfaced with the NICS in case EA 947 needs a change in routing that will affect traffic flow (7). As each affected facility joins the telephone conference they are able to discuss the situation with each other. At this point the pilot of EA 947 informs the Washington ACF that the hijack situation has stabilized and requests to land at Raleigh-Durham Airport, NC. The Duty Officer at the FAA HQ Operations Center contacts the Raleigh-Durham ATCT supervisor, adds him to the telephone conference call, and briefs him as to the situation (8). As the situation continues, the Washington ACF (9), the Eastern Ops Center (11), the FBI (12), and the TMS at the ATCCC (13) continue to monitor the situation and provide information as necessary. When EA 947 lands at Raleigh-Durham without incident the TMS at the ATCCC (14), the FBI (15), and the Washington ACF (16) terminate their connection while the Eastern Ops Center (17), the ATCT at Raleigh (18) and the Operations Center (19) continue the conference until the local authorities have terminated the emergency and the situation has concluded.

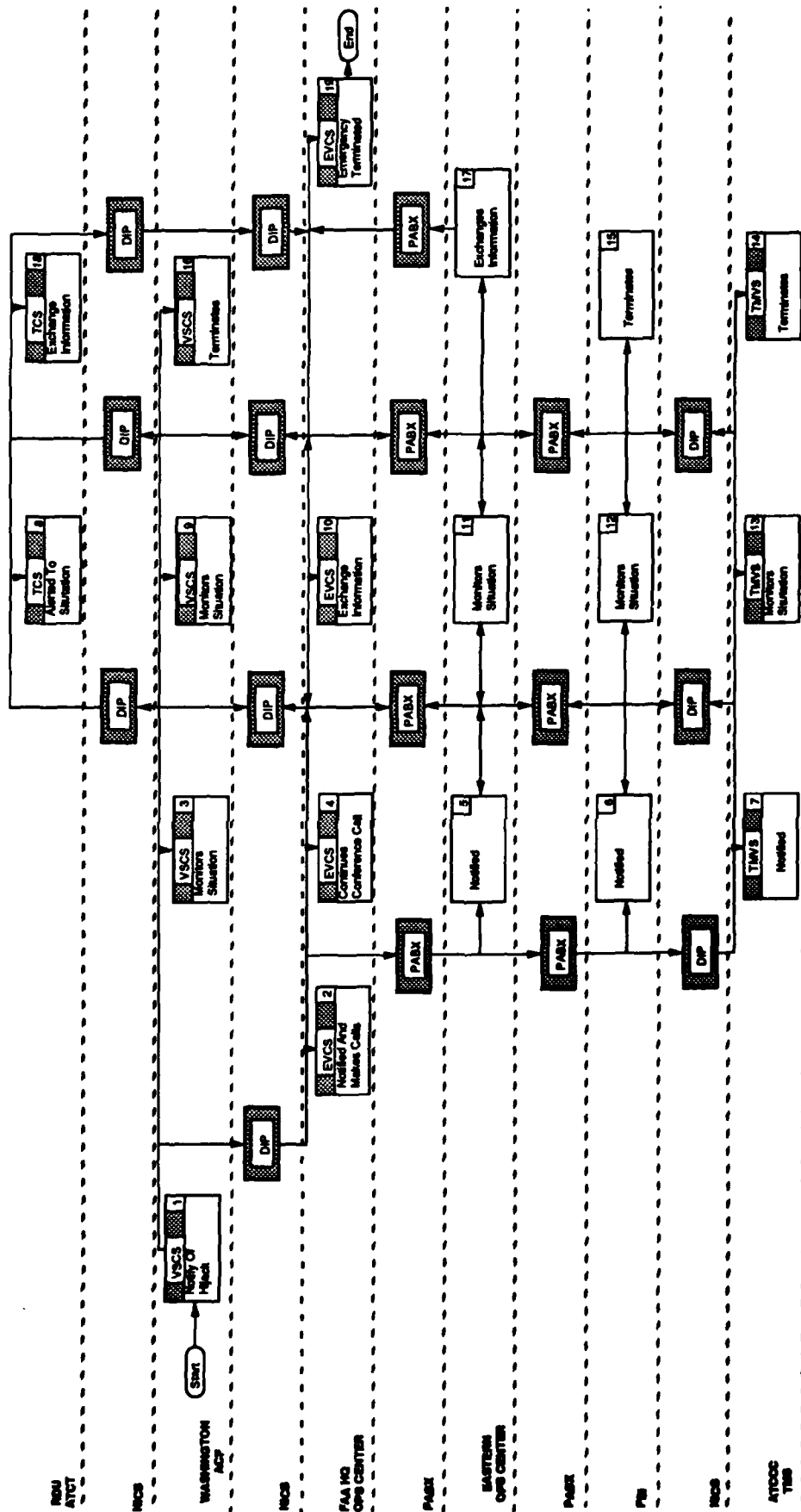


FIGURE 2-25
FAA HQ OPS CENTER
GROUND-GROUND COMMUNICATIONS
SCENARIO DIAGRAM

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GLOSSARY

ACF BACKUP - The capability to provide alternate control over the airspace of an ACF that has experienced a catastrophic failure.

ADJACENT FACILITY - A facility whose assigned airspace borders that of the facility being discussed. This applies to an ACF bordering another ACF and to an ATCT bordering an ACF.

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.

AIRPORT TRAFFIC CONTROL TOWER (ATCT) - A terminal facility that provides ATC services to aircraft operating in the vicinity of an airport or on the airport 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/departure control services.

AIR TRAFFIC CONTROL COMMAND CENTER (ATCCC) - An air traffic service facility consisting of Central Flow Control Facility (CFCF), Central Altitude Reservation Function (CARF), Airport Reservation Office (ARO), and the ATC Contingency Communication and Post.

ATCCC SPECIALIST - Traffic management specialist resident at the Air Traffic Control Command Center (ATCCC) who coordinates with local traffic management specialists at ACFs and manages flow control operations.

AREA CONTROL FACILITY (ACF) - A facility established to provide air traffic control service to aircraft principally during the en route phase of flight.

AUTOMATED FLIGHT SERVICE STATION (AFSS) - 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 AFSSs provide En Route Flight Advisor Service (Flight Watch), take weather observations, issue airport advisories, and advise Customs and Immigration of transborder flights.

CATASTROPHIC FAILURE - The inability of an ACF to perform its operational responsibilities, regardless of cause, as determined by operational authorities.

CLASSIFIED INFORMATION - Official information, including foreign classified information, which has been designated as requiring protection in the interest of national security.

DIRECT-ACCESS VOICE COMMUNICATIONS - Means whereby a specialist can activate voice communications to a designated position in a different facility with a single action on a single device.

DIRECTION FINDER (DF) - A radio receiver equipped with a directional sensing antenna used to take bearings 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.

EMERGENCY - A condition of being threatened by serious and/or imminent danger which requires immediate or timely assistance and action.

EN ROUTE FLIGHT ADVISORY SERVICE/FLIGHT WATCH (EFAS) - A service designed to provide timely weather information pertinent to the type of flight, intended route of flight, and altitude.

FLIGHT PLAN - Specified information relating to the intended flight of an aircraft that is filed orally or in writing with an ATC facility.

FLOW CONTROL - Measures taken to adjust the flow of traffic into a given airspace, along a given route, or bound for a given airport so as to ensure the most effective utilization of the airspace.

IFR AIRCRAFT/IFR FLIGHT - An aircraft conducting flight in accordance with instrument flight rules.

INDIRECT-ACCESS VOICE COMMUNICATIONS - Means whereby a specialist can establish voice communications with a designated position through multiple actions on one or more devices.

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.

INTEGRATED COMMUNICATIONS SWITCHING SYSTEM (ICSS) - A system which provides voice communications switching service for automated flight service stations (AFSSs). This system provides intercom, interphone, and radio communication switching services.

MODE S SENSOR - The Mode S Sensor is a combined beacon interrogator and ground-air-ground data link system that is part of the surveillance facilities. The purpose of Mode S is to provide beacon surveillance coverage in conjunction with search radar coverage and to provide automated data communications between the aircraft and various ground-based processors.

NATIONAL RADIO COMMUNICATIONS SYSTEM (NARACS) - A system which provides the minimum essential communication and control communications capability necessary to direct the management, operation, and the constitution of the NAS in support of FAA/DoT/DoD missions during a national, regional, or local emergency when normal communication on carrier telecommunications are interrupted.

NATIONAL AIRSPACE SYSTEM (NAS) - The NAS as used herein describes the FAA facilities, hardware, software, and the personnel who operate and maintain that equipment to provide services to the user.

NOTICE 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 in, the National Airspace System) the timely knowledge of which is essential to personnel concerned with flight operations.

PIREP - A report of meteorological phenomena encountered by aircraft in flight.

SPECIALIST - The internal individual or group who provide service through the NAS (e.g., controllers, engineers, maintenance and management personnel).

TERMINAL AREA - A general term used to describe airspace in which approach/departure control service or airport traffic control service is provided.

TOWER COMMUNICATIONS SYSTEM (TCS) - A system which provides modern voice communications switch and control services for intercom, interphone, and air-ground voice connectivity for ATCTs.

TRAFFIC MANAGEMENT COORDINATOR (TMC) - 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 (TMS) - A specialist resident at the Air Traffic Control Command Center (ATCCC) who coordinates between local traffic management specialists at ARTCCs/ACFs and manages flow control operations. See ATCCC description.

TRAFFIC MANAGEMENT PROCESSOR - The Traffic Management Processor provides an automated capability to directly assist, support, and provide data base for flow management, planning reservation, contingency response, prediction, and data (directives) generation responsibilities of the specialists at the ATCCC.

TRAFFIC MANAGEMENT UNIT (TMU) - A non-control, coordination position at an 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).

VISUAL FLIGHT RULES (VFR) - Rules that govern the procedures for conducting flight under visual conditions.

VOICE SWITCHING AND CONTROL SYSTEM (VSCS) - A system which provides voice communications services and performs the intercom, interphone, and air-ground voice connectivity and control function needed for air traffic control operations in ARTCCs and ACFs.

ACRONYMS/ABBREVIATIONS

<u>ACRONYM</u>	<u>MEANING</u>
ACCC	Area Control Computer Complex
ACF	Area Control Facility
ADO	Airline Dispatch Office
AFSS	Automated Flight Service Station
ARINC	Aeronautical Radio Incorporated
ARO	Airport Reservation Office
ATC	Air Traffic Control
ATCCC	Air Traffic Control Command Center
ATCT	Airport Traffic Control Tower
ATIS	Automatic Terminal Information Service
AUTODIN	Automated Digital Network
CARF	Central Altitude Reservation Function
CFCF	Central Flow Control Function
COMCEN	Communications Center
CONUS	Continental United States
CWP	Central Weather Processor
DIP	Drop/Insert Point
DLP	Data Link Processor
DoD	Department of Defense
DOT	Department of Transportation
DUAT	Direct User Access Terminal
EFAS	En Route Flight Advisory Service
EOF	Emergency Operations Facility
ETN	Electronic Tandem Network
EVCS	Emergency Voice Communication System
FAA	Federal Aviation Administration
FAATC	FAA Technical Center
FBI	Federal Bureau of Investigation
FBO	Fixed Base Operator
FEMA	Federal Emergency Management Agency
FIFO	Flight Inspection Field Office
FSAS	Flight Service Automation System
FSBMP	Flight Service Broadcast Message Processor
FSDPS	Flight Service Data Processing System
FSS	Flight Service Station
FTS	Federal Telecommunications System
HEMP	High-Altitude Electromagnetic Pulse (Nuclear)
HF	High Frequency
HF/SSB	High Frequency/Single Side Band
IC	Intercom
ICSS	Integrated Communication Switching System
IFR	Instrument Flight Rules
IP	Interphone
LCN	Local Communications Network
MBO	Military Base Operations
MTR	Military Training Route
NADIN	National Data Interchange Network
NAS	National Airspace System
NASSRS	National Airspace System-System Requirements Specification
NARACS	National Radio Communications System
NAVAIDS	Navigation Aids

NCA	National Command Authority
NCS	National Communication System
NEOF	National Emergency Operational Facility
NICS	NAS Interfacility Communications System
NORAD	North American Air Defense Command
NOTAM	Notice to Airmen
PABX	Private Automatic Branch Exchange
PIREP	Pilot Report
RCE	Radio Control Equipment
RCF	Remote Communications Facility
RE	Recording Equipment
RML	Radar Microwave Link
SAR	Search and Rescue
TCCC	Tower Control Computer Complex
TCS	Tower Communication System
TE	Transmission Equipment
TMC	Traffic Management Coordinator
TMP	Traffic Management Processor
TMS	Traffic Management System
TMVS	Traffic Management Voice Switch
UHF	Ultra High Frequency
USAF	United States Air Force
USCG	United States Coast Guard
VFR	Visual Flight Rules
VHF	Very High Frequency
VOR	VHF Omni Range
VSCS	Voice Switching and Control System
WMSC	Weather Message Switching Center
WX	Weather