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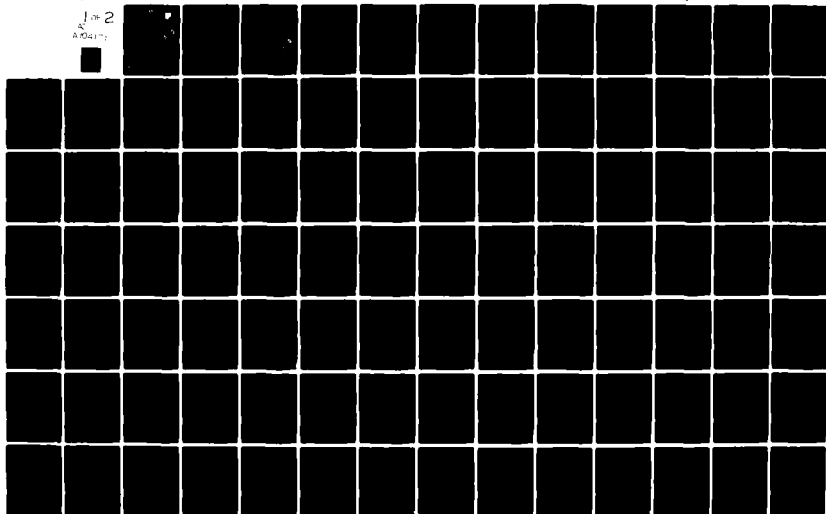
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**RADC-TR-81-149**  
Final Technical Report  
June 1981

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## **MICROPROCESSOR FRONT-END TERMINAL STUDY**

**Bunker Ramo**

**Raymond Arnold**  
**Ward Neely et al**

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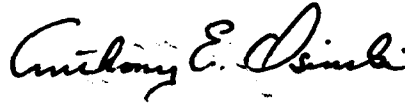
**ROME AIR DEVELOPMENT CENTER**  
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| 19. KEY WORDS (Continue on reverse side if necessary and identify by block number)<br>Microprocessors<br>Intelligent Terminals<br>Communication Protocols<br>System Analysis                                                                                                                                                                                                                                                                                                                                                                                                                               |                                     |                                                                                       |
| 20. ABSTRACT (Continue on reverse side if necessary and identify by block number)<br>The objective of this effort was the definition and description of a modular "intelligent" display terminal for the TACS system which incorporates a programmable microprocessor as a "front-end" to handle communication and teleprocessing interfaces and protocols. The unit should be able to function as a stand alone terminal, as a terminal to a processing facility or as an independent mode on a network of data processing systems. The main emphasis of the system analysis was JINTACCS messages at the |                                     |                                                                                       |

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## 1. INTRODUCTION

1.1 Purpose. The purposes of this project are to describe the requirements for a computer system at various components of the Tactical Air Control System (TACS) and to recommend data processing equipment that could be procured to further investigate these requirements. The equipment shall include a programmable microprocessor as a "front end" to handle communication interfaces and protocols. For this reason, the equipment shall be called the Microprocessor Frontend Terminal (MFT). The equipment shall also provide a general data processing capability and shall be able to operate in any of the following modes:

- (a) As a communication front end to another computer
- (b) As an intelligent terminal to another computer
- (c) As a stand-alone data processing system
- (d) As an independent node in a network of data processing systems.

1.2 Approach. The work was divided into two concurrent efforts to pursue the dual purposes of the project. The results of those efforts were brought together to produce the desired equipment recommendation. The two efforts were as follows:

1.2.1 TACS facilities survey. The military units that comprise the TACS were identified, and their organizations, duties, and responsibilities were examined. These units are the environment in which the MFT must operate. They are described in Paragraph 2. The detailed functional requirements that are placed upon the MFT by various TACS components are described in Paragraph 4. The reference documents that provided the necessary information are listed in Appendix A.

1.2.2 Equipment survey. The microprocessor-based data processing equipment now available on the commercial market was investigated. Its technical capabilities were assessed and compared with the functional requirements as they emerged from the facilities survey. The progress of the equipment survey is described in Paragraph 3. A summary of the hardware characteristics implied by the functional requirements is given in Paragraph 4, and the recommended configuration is described in Paragraph 5.

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1.3 Summary. The aerial functions of the Tactical Air Force (TAF) are supported by a well defined group of command and control tasks that can be effectively supported by a network of data processing systems. These tasks are characterized chiefly by the information that they handle and are virtually independent of the specific mission and organization of the TAF. Much of this independence is due to the efforts of the Joint Interoperability of Tactical Command and Control Systems (JINTACCS) organization. The information formatting standards developed by this group make it possible for the TAF to communicate directly with units of any other armed service of this country or any friendly nation. The information necessary to conduct almost any type of aerial mission has been specified, and a data processing system can be designed to respond to any or all of this information.

Coupled with the JINTACCS standards are the standards for data transmission protocols established by the worldwide AUTODIN network. Even if the MFT is not actually communicating with members of the AUTODIN network, it can utilize the same transmission standards within a local TACS network. The basis for the design of an MFT information control program is presented in Appendixes B through E.

The data processing services necessary to support the TACS command and control tasks can be provided by microprocessor-based equipment that is now available for off-the-shelf delivery from a single vendor. No such equipment is now in use by the TAF, but equivalent configurations have been extensively tested in commercial and industrial applications. There is no need to develop new equipment items to satisfy TAF needs, and, in fact, there is no need to experiment initially with hardware that has not been proven in other applications. System development and experimentation can be confined to the applications programs that must be created to support the TACS command and control tasks. An equipment configuration will be recommended for the MFT that utilizes up to five microprocessors to apply all of the advantages of integrated circuit technology to the requirements of the TACS.

## 2. MFT ENVIRONMENT

2.1 Tactical Air Force. The Tactical Air Force (TAF) is an organization of specialized Air Force units that is created to undertake a specific combat mission. The organization may be as large as a numbered air force (such as the 9th U.S. Air Force), or it may contain only a few of the units from a numbered air force. Regardless of its size, the TAF has a single commander, the COMTAF, who is responsible for every aspect of its operations. The TAF usually serves as a component of a Joint Task Force (JTF) that includes elements from U.S. or allied nations' naval and ground forces. A single JTF commander provides broad joint-service, multi-service tactical guidance and mission role assignments. He may, in turn, be responsible to a Theater Commander, to the U.S. Joint Chiefs of Staff, or to some multi-national organization.

The combat functions, the organization, and the communications of the TAF are described briefly in the following paragraphs. The intent is to identify the staff operations that could be supported by a network of data processing equipment. More complete information is available in the three documents that served as references. These are:

- (a) "TACR 55-45, Tactical Air Force Headquarters and the Tactical Air Control Center", Draft, January 1980.
- (b) "TAC CONPLAN 61 - TAC Standard Communications Plan", January 1980 (FOUO).
- (c) "Tactical Air Forces Integrated Information System (TAFIIS) Master Plan, September 1980 (SECRET)

2.1.1 TAF combat functions. All of the major combat functions that may be conducted within the TAF are described here. The exact nature and extent of the functions of any TAF depend upon the geographic and political situations, the type of operation, the presence of other friendly forces, and upon natural factors such as weather and terrain. The first requirements for data processing equipment such as the MFT are clear. The equipment must be air transportable, and its exact functions must be readily adaptable to a wide variety of operations. These and other requirements are discussed in Paragraph 4.

2.1.1.1 Counter air operations. The purpose of counter air operations is to destroy or neutralize the enemy's aerial offensive and defensive systems. Offensive counter air activities are conducted to destroy enemy aircraft in the air and also to disable ground facilities and weapons before they can be used to attack. Defensive counter air activities are employed to defend against aerial attack upon friendly forces. Counter air operations are provided by specially trained and equipped squadrons that are assigned as necessary to the TAF.

2.1.1.2 Offensive air support. Offensive air support operations assist friendly ground forces and usually attack enemy ground forces and installations. Close air support is a term that refers to action against enemy forces close to and in engagement with friendly forces. Battlefield air interdiction describes action against enemy forces that threaten but are not yet engaged with friendly units. If the TAF mission requires offensive air support, one or more specialized squadrons will be included in the organization.

2.1.1.3 Air interdiction. Air interdiction refers to tactical air operations that are directed against the enemy's rear area to neutralize military capabilities before they can be used against friendly forces. Air interdiction targets include transportation systems, concentration points, communications facilities, stockpiled supplies, and industrial installations. These operations differ from other offensive actions against ground targets because of the range and size of the aircraft and the types of weapons that are delivered. One or more squadrons may be included in the TAF to provide air interdiction.

2.1.1.4 Tactical air reconnaissance. This function employs airborne collection devices to gain knowledge of the enemy and his environment. It comprises not only the collection of data but also the processing and interpreting of that data and the distribution of the resulting intelligence. Its products are printed reports, data displays, magnetic tapes, and photographic imagery. Specially trained and equipped squadrons are available to provide reconnaissance for the TAF. Their equipment and functions will be adjusted to the type of mission. Reconnaissance units now use specialized data processing systems of different kinds and probably would be principal users of any new tactical equipment such as the MFT.

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2.1.1.5 Tactical air lift. This function provides air movement of combat troops and supplies throughout the theater of operations and particularly to the combat zones. It includes aeromedical evacuation, flare drops, and leaflet drops. Tactical airlift facilities can also be used to augment the strategic air lift system that brings troops and supplies to the theater of operations. This function is also provided by specially equipped and trained squadrons that are assigned to the TAF only as needed.

2.1.1.6 Air combat support. Functions in this category include electronic warfare, combat search and rescue, and air refueling. Electronic warfare refers to the detection and neutralization of enemy electronic devices such as radio and radar. Combat search and rescue recovers personnel and equipment from crashed aircraft. Air refueling operations use specially equipped tanker aircraft to extend the flying range of tactical fighter and reconnaissance aircraft. Each of the combat support functions requires special equipment and specially trained units that are assigned to the TAF as necessary.

2.1.1.7 Airspace management. This function coordinates, integrates, and regulates the flow of aerial traffic throughout the entire area of a tactical operation. It also coordinates friendly ground-based air defense system activities with aerial traffic.

2.1.1.8 Air traffic regulation. This function implements the policies of the airspace management function. It uses radar surveillance and control, electronic flight monitoring data, and periodic position reports to promote safe and rapid movement of aircraft throughout the TAF operational area.

2.1.1.9 Special operations. This function includes support activities such as counterinsurgency, unconventional and psychological warfare, and military civic actions. The size, composition, and equipment of a force devoted to any of these special functions are dependent upon the nature of the mission.

2.1.2 TAF organization. The TAF has a single commander who directs the activities of all subordinate units that may be provided to accomplish his mission. The TAF commander (COMTAF) establishes a centrally located headquarters and depends upon electronic communication for contact with his combat forces. He is directly supported and advised by a staff of specialists who receive reports from and transmit orders to the remotely located combat units. The number and the functions of the combat units may vary with the mission, but the duties of the headquarters staff remain relatively constant.

Each subordinate unit also has a commander and a headquarters staff to carry out his orders. The staff elements at all the various echelons hold the TAF together using several systems of communication. They would be the users of a tactical data processing system. To specify such a system, it is necessary to understand not only the functions of headquarters staff elements but also the characteristics of the tactical communication facilities.

2.1.2.1 TAF Headquarters. The TAF Headquarters (TAFHQ) consists of command and staff elements that plan and direct the employment of tactical air resources. Through the TAFHQ, the COMTAF apportions his resources among the combat functions that were previously described. The standard staff elements of the TAFHQ are shown in Figure 1. Combat operations are directed by the Deputies for Operations, Intelligence, Logistics, and Communications. Their duties are described briefly in the following paragraphs with emphasis upon those duties that could be assisted by a data processing system. The remaining staff elements shown in Figure 1 provide non-combat support and will be not be discussed here.

- (a) Deputy for Operations (DO). The DO and his staff plan and direct air combat operations. They exercise operational control over subordinate units, make recommendations for force apportionment, and establish requirements for intelligence collection.
- (b) Deputy for Intelligence (IN). The IN and his staff are responsible for intelligence support to the TAFHQ and all subordinate units. They provide overall guidance and technical direction to intelligence elements within the TAF. They also provide the management interface with theater and national intelligence systems.

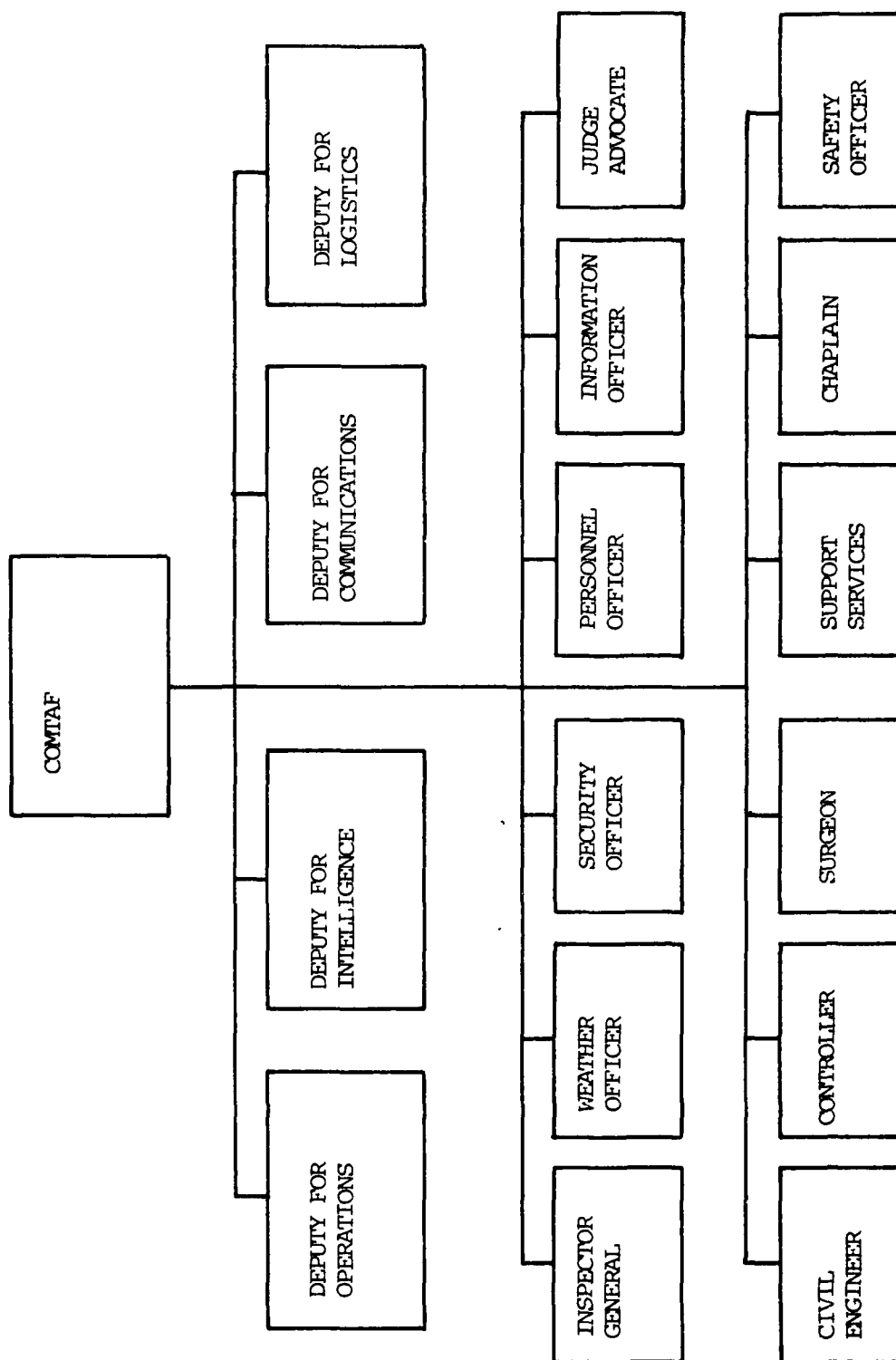


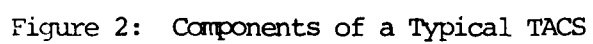
Figure 1: Tactical Air Force Headquarters Organization

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- (c) Deputy for Communications (DC). The DC and his staff plan and direct the installation and operation of Air Force communications and electronic facilities for the entire TAF. They coordinate with other U.S. and allied military and civilian authorities to affect optimum use of all available facilities.
- (d) Deputy for Logistics (LG). The LG and his staff supervise subordinate elements that provide expendable supplies such as food, fuel, armament, and spare parts. They direct logistical planning, supply, maintenance, transportation, and procurement.

2.1.2.2 Tactical Air Control System (TACS). The TACS is the network of military organizations and communications necessary to plan, direct, and control tactical air operations and to coordinate air operations with other armed services and nations. A schematic diagram of the organizations and internal and external communication channels that comprise a typical TACS appears in Figure 2. The central point of the TACS is located at the TAFHQ and more specifically at the Tactical Air Control Center (TACC). The air combat units are at the Wing Operations Centers (WOCs) shown in Figure 2. The TACC and the WOC are the most important elements of the TACS and are described completely in Paragraphs 2.2 and 2.3. The communication facilities that bind together the elements of the TACS are described in Paragraph 2.1.3. All of the organizations that may be included in the TACS are described briefly in the remainder of this paragraph.

2.1.2.3 Tactical Air Control Center (TACC). The TACC is the operations center for the COMTAF. It is manned by staff elements reporting to the Deputies for Operations and Intelligence. The TACC plans, directs, and monitors the execution of all the previously described TAF combat functions. The TACC receives, evaluates, displays, stores, and distributes a great deal of data. It therefore has an urgent need for the benefits of an integrated data processing system. The proposed MFT could provide many, but not all, of the data processing services needed at the TACC.



2.1.2.4 Wing Operations Center (WOC). The wing is the principal tactical air unit, and the WOC is the facility from which the wing commander directs his resources. These resources consist primarily of flying squadrons which perform the TAF combat functions such as fighter support, reconnaissance, and airlift. The WOC possesses communication links to all assigned and attached units as well as to the TACC. When deployed, the WOC is established at a temporary location called the Tactical Air Base (TAB). Some, but not all, subordinate units will also be located at the TAB. A single TAF may include from one to nine WOCs. The WOC exchanges a large amount of data with many other components of the TACS. It has a need to select, evaluate, store, and recall this data, and it therefore also requires a data processing system. A key requirement of such a system is that it must be capable of communicating directly with other similar systems by using presently available tactical communications facilities. The proposed MFT shall be capable of meeting all of the data processing needs of any WOC.

2.1.2.5 Control and Reporting Center (CRC). The CRC directs the air defense, airspace control, and mission monitoring functions for the TAF under the general supervision of the TACC. It supervises radar elements, scrambles air defense aircraft, and coordinates with ground based anti-aircraft defense systems. It also coordinates airspace usage with allied forces and other components of the JTF. Figure 2 shows connections from the CRC to the Army Air Defense Command Post (AADCP) and the Navy Fleet Operations Center (FOC). The CRC includes an Air Traffic Regulation Center, and it may be designated by COMTAF to serve as an alternate TACC. Figure 2 shows that much of the message traffic between the TACC and the more widely dispersed subordinate units must be relayed through the CRC. An MFT must be placed at the CRC to support local operations and to communicate data to the TACC and the WOCs. The CRC, in particular, illustrates the requirement for an MFT to be able to function as a store-and-forward switching center as well as to function as a terminal in the network.

2.1.2.6 Control and Reporting Post (CRP). A CRP is subordinate to the CRC. It provides radar surveillance and control within a subsector of the TAF area of responsibility. More than one CRP may be employed, depending upon the area size, terrain features, and the anticipated level of air operations. A CRP has capabilities similar to those of a CRC, and it may assume the functions of a CRC when directed by the TACC. The CRP must have an MFT to provide data communication with other TACS elements and to perform local data processing services. The MFT at the CRP may not need a full range of data processing capabilities, but it will have an important store-and-forward function. The CRP thus illustrates a general requirement for the MFT to be capable of being adapted in the field to the needs of the using organization.

2.1.2.7 Air Support Operations Center (ASOC). This unit coordinates air support operations with ground forces, and it is usually colocated with an Army Corps Tactical Operations Center. The ASOC accepts requests for close air support and reconnaissance, scrambles allocated missions, and directs both immediate and preplanned missions through its subordinate Tactical Air Control Parties (TACPs). The ASOC possesses personnel with a variety of combat skills and is thus a good choice to serve as an alternate TACC. The ASOC must therefore have an MFT and must be capable of receiving and storing the data that would enable it to perform as the TACC. The ASOC MFT must be adaptable in the field to new functions, and it must provide a store-and-forward capability. Eventually, the MFT must be capable of being programmed to exchange data with other data processing systems used by other armed services and nations. This is not expected to be a difficult requirement for the MFT because widespread efforts are now under way to standardize data formats and communication protocols.

2.1.2.8 Air Lift Control Center (ALCC). The ALCC has overall responsibility for directing airlift operations to support the TAF. It reports to the COMTAF and is colocated with TAFHQ and the TACC. Because of the size of the headquarters area, the ALCC needs electronic data communications with the TACC as well as with other elements of the TACS. The ALCC also manages strategic airlift missions which enter the TAF's geographic area. For this purpose, the ALCC reports directly to the Commander-in-Chief, Military Air Lift Command, through the Defense Communications System.

2.1.2.9 Air Lift Control Element (ALCE). An ALCE is established at each airfield and landing zone to provide operational control of airlift aircraft. All ALCEs are subordinate to the ALCC but are colocated with the WOCs that utilize airlift aircraft. Because of their relatively small volume of data and their proximity to the WOCs, the ALCEs probably will not need MFTs.

2.1.2.10 Airborne Battlefield Command and Control Center (ABCCC). The ABCCC is an airborne extension of the Combat Operations Division of the TACC (see Paragraph 2.2.3). It is carried by a specially modified aircraft that contains extensive facilities for voice and radio teletype communication. The ABCCC can maintain contact with mission aircraft for long distances and over terrain that would block ground-based communications. It can be used as an airborne ASOC or as a relay station for the TACC. Although the ABCCC sends and receives data messages needed by many components of the TACS, it is not a candidate for installation of an MFT because it does not use the requisite communication facilities. It will be shown below that any MFT could communicate with the ABCCC by relaying through a unit such as the Message Processing Center (Paragraph 2.1.2.12) that would operate both an MFT and a radio teletype station. A requirement may be established for an MFT to be capable of both producing and accepting punched paper tapes in some functional configurations to communicate with teletype equipment.

2.1.2.11 Airborne Warning and Control System (AWACS). This is an aircraft equipped with extensive radar and communications equipment. It performs surveillance, warning, and control functions and also provides information for battle management. An AWACS is normally subordinate to the CRC, and it performs as a CRP. During the initial stages of a TAF deployment, the AWACS may perform the functions of a CRC or even some of the functions of the TACC. It is not proposed to install an MFT in an AWACS. A ground based MFT may relay data to and from an AWACS through radio teletype at a unit such as the Message Processing Center.

2.1.2.12 Message Processing Center (MPC). The MPC manages digital data links that transfer radar track information from computers at the CRC and the CRPs to the AWACs and to similar command and control systems operated by other armed services. Figure 2 shows that the TACS often can include terminals in the Navy Fleet Operations Center (FOC) and at the Army Air Defense Command Post (AADCP). The MPC also prepares and distributes prearranged technical and tactical data prior to a tactical situation. The MPC requires an MFT both to handle relay traffic for airborne elements and also to distribute background data to other components of the TACS.

2.1.2.13 Forward Air Control Post (FACP). This is a mobile radar element that is deployed into forward areas to extend radar coverage, to provide early warning of attack, and to control air operations. It is subordinate to the CRC or to a CRP. The TACS may include several FACPs if they are required by the tactical situation. It is not proposed at present to provide an MFT for any FACP because of the low volume of data traffic that is anticipated. This traffic can be handled by radio teletype.

2.1.2.14 Air Support Radar Team (ASRT). This is a highly mobile element equipped with precision, beacon-tracking radar. It provides all-weather, ground-directed bombing guidance and also provides all-weather navigation assistance for reconnaissance and airlift aircraft. The ASRT is normally controlled by the TACC. Several ASRTs may be included in the TACS, if required. It does not appear to be necessary to equip an ASRT with an MFT.

2.1.2.15 Tactical Air Control Party (TACP). TACPs are forward operating mobile facilities that deploy with Army echelons from corps down to battalion. As a forward extension of the ASOC, they assist ground force commanders in planning, requesting, coordinating and controlling tactical air support missions. The TACP provides the functional interface between the Army unit to which it is attached and the air units providing tactical air support.

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2.1.3 TAF communications. The TAF uses three different electrical communication systems depending upon the tactical situation and the duties of the communicating units. In many situations, all three systems will operate concurrently. Most communication is conducted by voice transmission, but teletype and digital data signals are also used. Any proposed data processing network for the TAF will be required to share available tactical communication facilities with existing services.

The equipment now in use is collectively designated as the 407-L system. Modernized equipment is being developed under the TRI-TAC program, but no substantial deliveries to the field are expected for several years. The existing equipment imposes certain technical restrictions upon data processing devices. These restrictions are discussed in Paragraph 5.1. The TRI-TAC equipment may alter the interface requirements to a certain extent, but it seems unlikely that outright incompatibility with existing equipment would be created. The three present communication systems are described briefly in the following paragraphs. Technical descriptions of the equipment and explanations of the communications terminology may be obtained from AFM 11-1, Vol. III, "Administrative Practices, Communications Electronics Terminology".

2.1.3.1 TACS wideband communication system. This system provides the principal means of telephone communication between geographically separated units on the ground. It is also the system that would be used to support a data processing network. It uses radio equipment that is bulky, expensive, and difficult to install. For these reasons, the wideband communication system is not available during the initial hours of a tactical operation, and it is not provided to the smaller and more mobile units. The MFT is required to provide a stand-alone data processing capability to afford access to previously stored data during the crucial period immediately following deployment.

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A typical arrangement of this system is shown in Figure 3. Each interconnecting line represents 24 telephone trunks. Many of the trunks are designated "sole user channels" and are assigned permanently to important services that require unrestricted communication. The remaining trunks are shared through a telephone switchboard by all other users. Local telephones within the headquarters area are connected to the switchboard with temporary wire circuits. The distance between two sets of wideband radio equipment cannot exceed approximately 75 nautical miles depending upon terrain, so that it is frequently necessary for a caller to arrange a connection through two or more manual or automatic switchboards. A sole user channel can be permanently connected through a switchboard. With additional equipment, it is also possible for as many as four teletype circuits to simultaneously use a single sole user channel. The wideband system can communicate with similar tactical telephone systems used by other armed services and nations. It can also be connected into the Defense Communication System and can provide both voice and data communication from the TAF to any of the users of that system.

2.1.3.2 High frequency independent side band (HF/ISB) radio net. This system utilizes smaller, readily relocatable radio equipment to provide point-to-point communications between tactically deployed units. It affords only one voice channel between any two communicating units, and this channel must be shared by all users. A typical TACS HF/ISB system is illustrated in Figure 4. It is the first service to be established during a tactical movement and the last to be deactivated. It backs up the wideband system after that service has been established, and it serves locations that are outside the range of the wideband system. Mobile HF/ISB radio stations may be used as terminals in the Defense Communication System AUTOVON and AUTODIN networks. AN HF/ISB net may be used for teletype communication, and a "torn tape" manual relay facility is often established at the TAFHQ and the TACC. If there is a requirement for a data processing system to communicate with the teletype system, a manual interconnection procedure would probably be established at the torn tape facility.

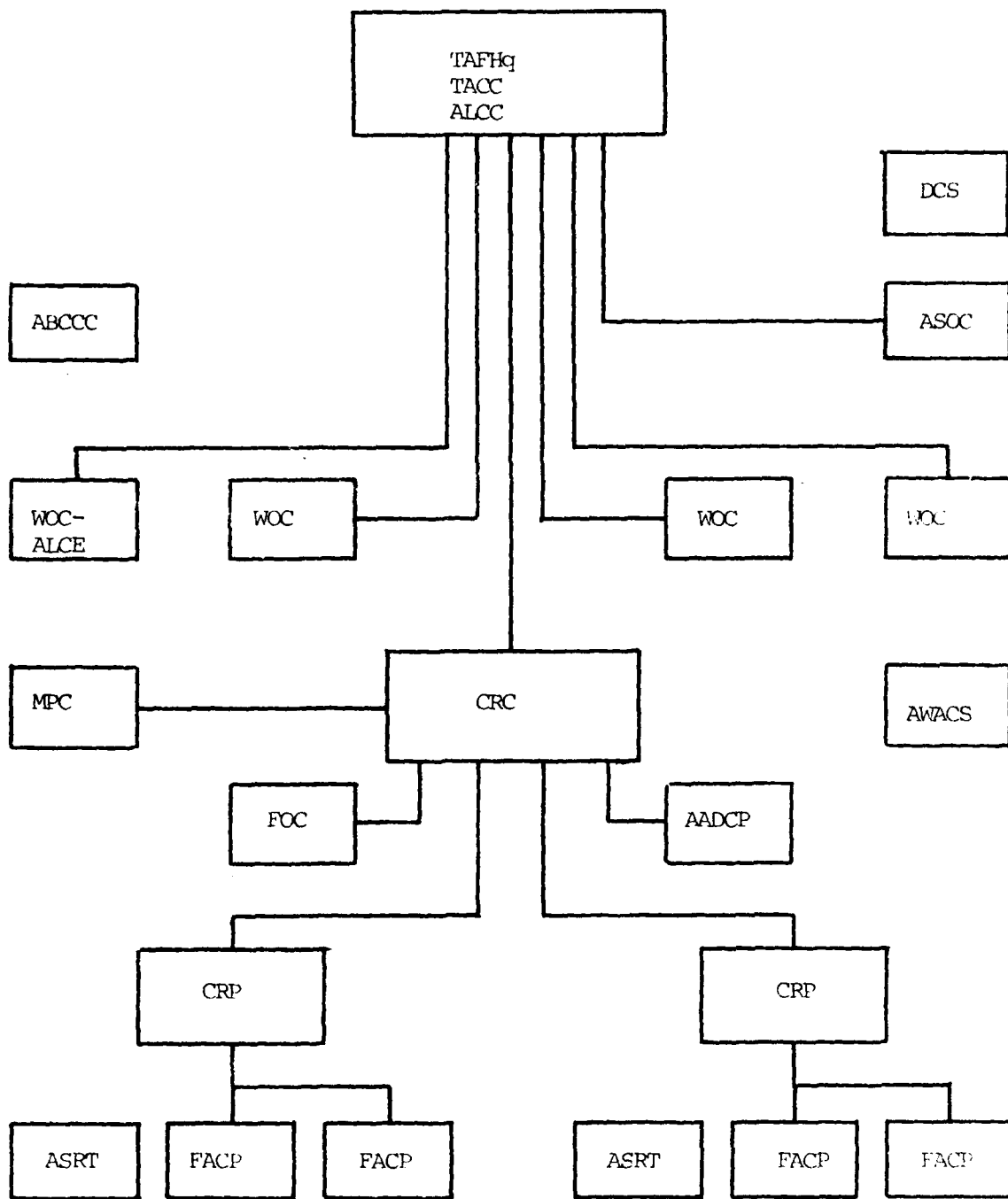


Figure 3: Typical TACS Wideband Communication System

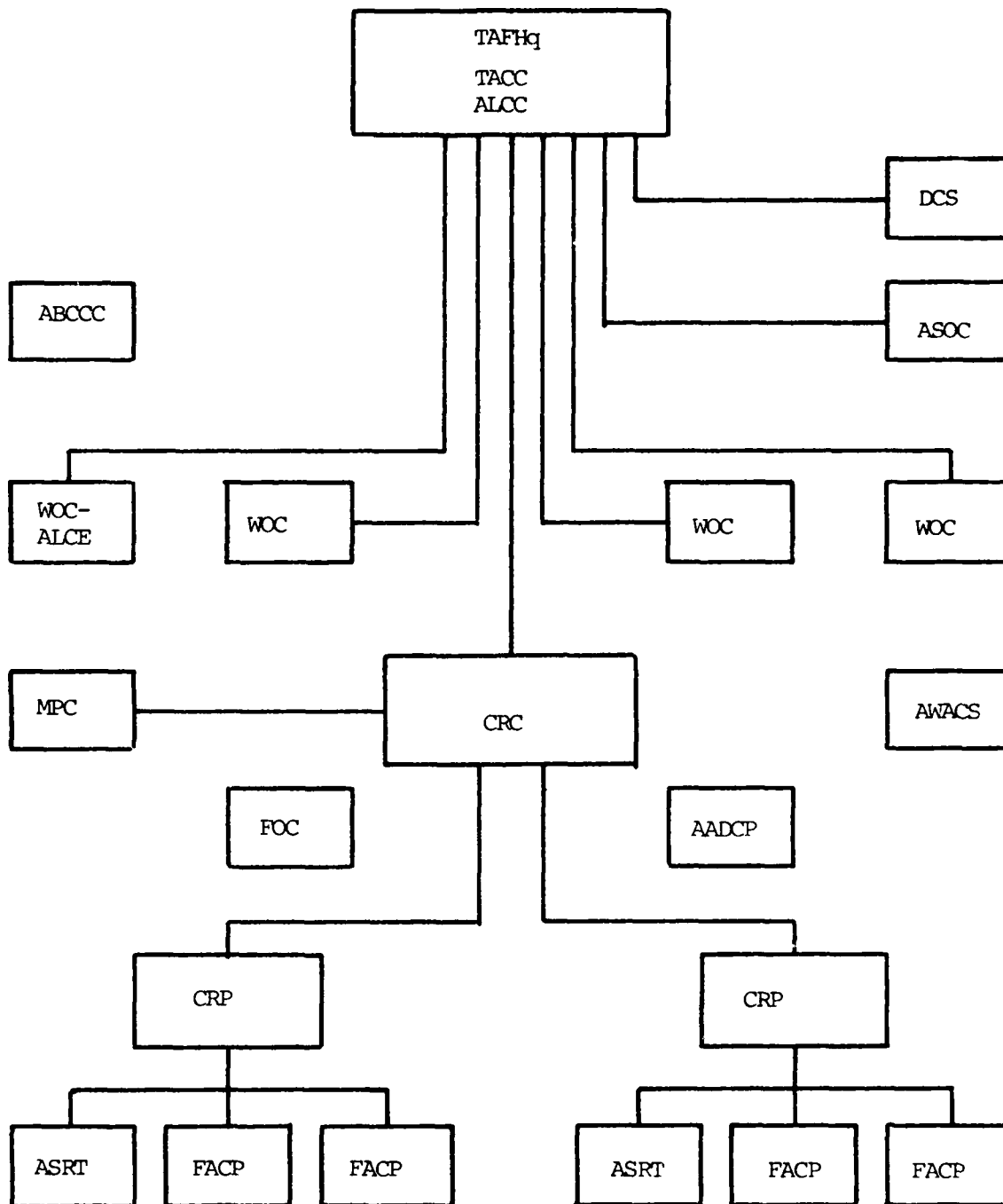


Figure 4: Typical TACS HF/ISB Communication System

2.1.3.3 High frequency single sideband (HF/SSB) radio nets. Approximately 18 different communication networks using HF/SSB radios are routinely established within the TACS to provide communication to units not served by the wide-band or HF/ISB systems. These networks are used to communicate between ground stations and aircraft in flight. In particular, several different HF/SSB networks provide voice, teletype, and digital data links between the TACC and its airborne counterparts in the AWACS and ABCCC aircraft. The digital data links are part of the two TACS Automatic Data Links known as TADIL A and TADIL B. These transfer radar track information and are not available for transmitting the conventional operations and intelligence messages that would be handled by an MFT.

2.2 TACC organization. The TACC has been described previously as the COMTAF's operations center and the heart of the Tactical Air Control System. It is served by all of the TAF communication systems, and it would be the central component of any proposed data processing network. The TACC is manned by staff elements that report to the Deputies for Operations and Intelligence as shown in Figure 5. The Operations staff and the Intelligence staff both have planning functions as well as execution functions, and both are separated into two divisions. The Director of Combat Operations is the senior officer and is the supervisor of the TACC. The organizations of the four divisions are described in the following paragraphs. The functions of the TACC are each executed in part by different organizations of the TACC and in part by other components of the TACS. For this reason, the tasks of the TACS as a whole are described together in Paragraph 2.4.

2.2.1 Combat Plans Division. This division plans the day-to-day expenditure of air resources and the corresponding airspace management procedures. Plans are based upon the TAF objectives outlined by the Deputy for Operations in the daily Air Operations Order. The plans are also based upon a large amount of data that describes all aspects of the current situations of both friendly and enemy forces. It will be shown later that the requisite data is provided in various ways by other TACC divisions and by many subordinate organizations. The major product of the Combat Plans Division is the Air Tasking Order which contains the detailed plans for all units and which is distributed throughout the TACS.

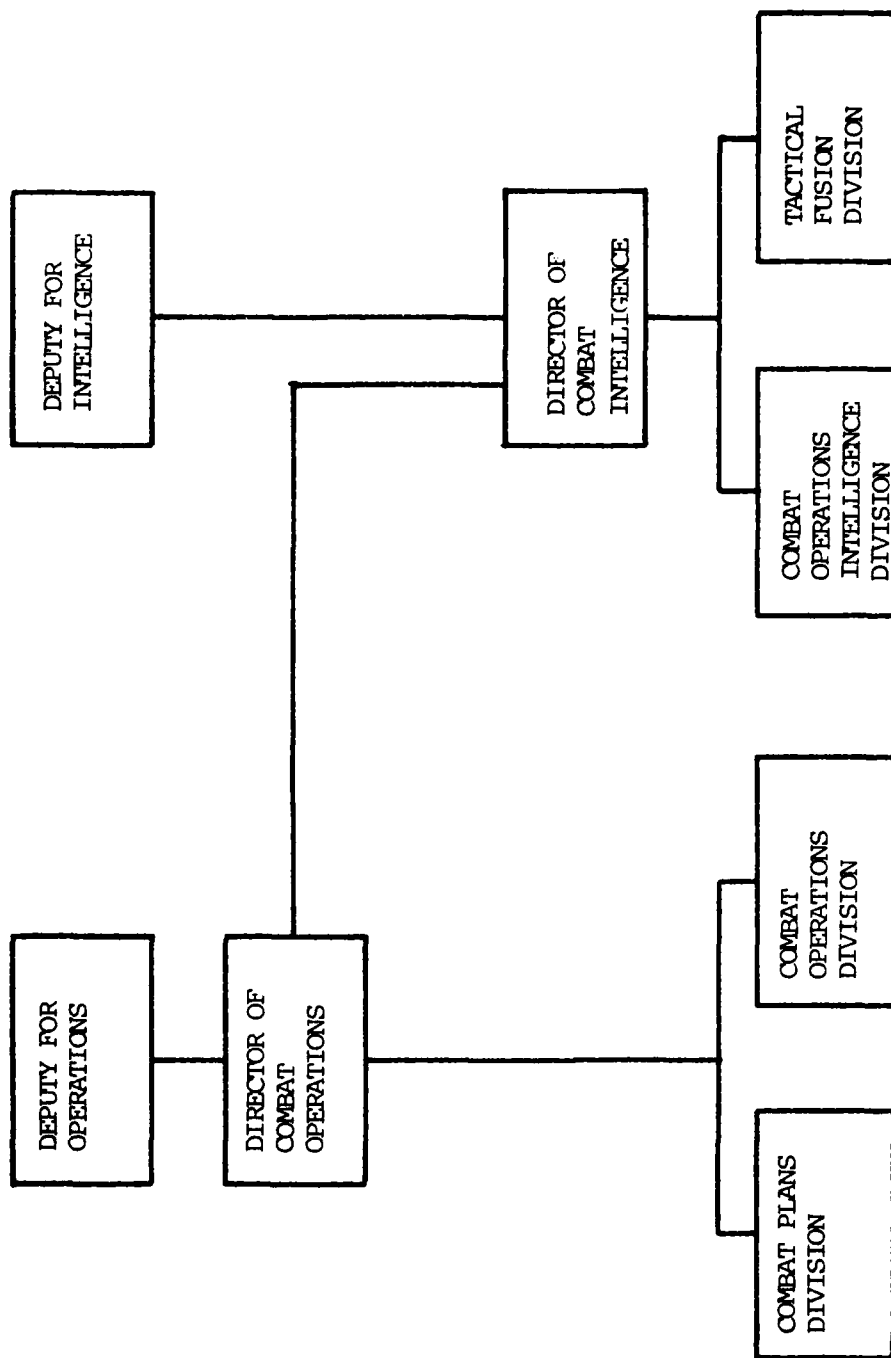


Figure 5: Tactical Air Control Center Organization

2.2.1.1 Organization. The Combat Plans Division is composed of branches whose duties correspond generally to the TAF combat functions that have been previously described. A typical organization is shown in Figure 6. The exact composition of the division at any time depends upon the combat functions required to carry out the specific mission.

- (a) Fighter Planning Branch. This branch is composed of fighter officers who plan the employment of tactical fighter aircraft in counter air, interdiction, and offensive air support functions.
- (b) Reconnaissance Planning Branch. This branch is composed of reconnaissance officers who plan the employment of reconnaissance aircraft.
- (c) Specialized Support Planning Branch. This branch plans aerial refueling, forward air control, search and rescue, AWACS and ABCCC utilization, and airspace management.
- (d) Command, Control, and Communications Countermeasures (C3CM) Combat Support Branch. This branch plans electronic warfare, suppression of enemy air defense, and communications countermeasures.
- (e) Special Operations Branch. This branch plans unconventional warfare and psychological warfare operations.
- (f) Air Lift Planning Branch. This branch plans airlift operations, but only if an ALCC is not assigned to the TAF.
- (g) Component Services Liaison Branch. This branch is composed of liaison officers from other armed services and nations that are participating with the TAF in a joint operation.
- (h) Operational Status Branch. This branch provides the administrative services necessary to receive, record, and post data and to maintain a log.

2.2.1.2 Duties. Each branch is manned by officers who are trained and experienced in the combat functions assigned to that branch. These officers all have similar duties that can be summarized as follows:

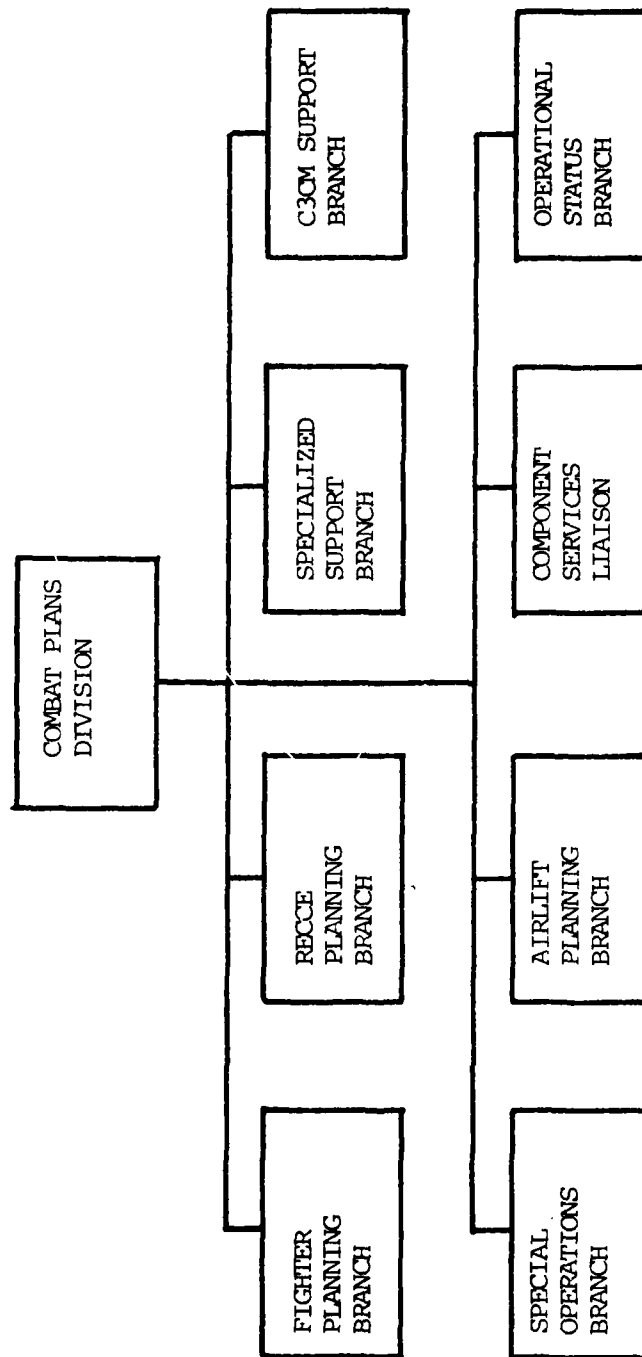


Figure 6: TACC Combat Plans Division Organization

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- (a) Monitor the status of their resources. The resources are the flying and support units that have been described as components of the TACS. Status information is actually obtained and displayed by other TACC elements. The necessary information describes the availability and locations of aircraft, aircrews, airfields, munitions and fuel.
- (b) Monitor the combat situation. The situation includes the identities, locations, activities, and capabilities of all friendly and enemy units in the area of interest. It includes the provisions and results of the last Air Tasking Order and the current directions from the COMTAF. It also includes the nature of the terrain and weather in the geographic area of interest. This information is collected and presented graphically and verbally by other TACC elements.
- (c) Review requests for missions. Depending upon the type of combat function involved, these requests are either inherent in the Air Operations Order or are received over communication channels from other components of the TACS or the Joint Task Force. Requests are evaluated for completeness, appropriateness, and urgency. Requests may be rejected, combined or tentatively approved.
- (d) Recommend commitment of resources. Recommendations are based upon consideration of all available data and upon the application of personal experience and judgment. Recommendations are subject to review by superiors and to coordination with other TAF missions. Approved missions are described in the Air Tasking Order by identifying the flying units, the number and type of aircraft, the special equipment or armament, the general route, and the times of take-off, arrival on target, and return.
- (e) Maintain a daily events log. All correspondence and verbal agreements relative to commitment of resources are kept for reference by supervision and by personnel of other shifts.

2.2.2 Combat Operations Intelligence Division. This division is colocated with the Combat Plans Division in the TACC. It provides the detailed information to support the planning process that culminates in the Air Tasking Order. The division has four branches, as shown in Figure 7. Their duties are the following:

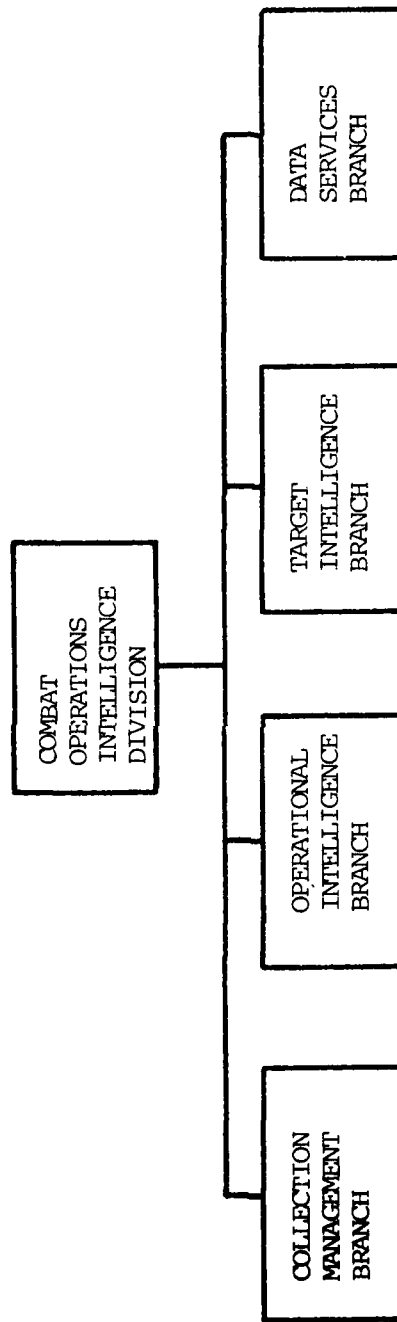


Figure 7: TACC Combat Operations Intelligence Division Organization

2.2.2.1 Collection Management Branch. This branch works closely with the Reconnaissance Planning Branch of the Combat Plans Division. Both branches are staffed by reconnaissance officers, and together they have the following duties:

- (a) Monitor the status of their resources. These resources are the flying squadrons that are specially equipped to collect information from the air. The branch also knows the availabilities and capabilities of data collection resources not directly subordinate to the TAF.
- (b) Review requests for intelligence collection. These requests may be preplanned requests based upon the provisions of the Air Operations Order, or they may be immediate requests received from other elements of the TACC, the TACS, or the JTF. Requests are evaluated for completeness, appropriateness, and urgency. Requests may be rejected, combined, satisfied from the results of previous collection efforts, or tentatively approved.
- (c) Prepare collection plan. The plan provides for the satisfaction of as many requests as possible with the available collection resources. It identifies the flying units, the sensors to be used, and the times at which sorties should take off, appear over target, and return. The collection plan is coordinated with other proposed TAF missions and is incorporated into the Air Tasking Order.
- (d) Monitor collection results. The status of each collection mission is continually displayed. The collected data is reviewed, analyzed, and sent to requestors. Unfulfilled requests are retained for future action, and the status of all requests is displayed at the TACC and reported to requestors.

2.2.2.2 Operational Intelligence Branch. This branch evaluates all available information to determine enemy capabilities and vulnerabilities. It has the following duties:

- (a) Maintain Enemy Order of Battle files. These files describe enemy air, ground, and naval units, installations, and weapons systems capabilities that are a direct or indirect threat to friendly forces or that support a threat to friendly forces. The files are maintained by this branch acting independently or in coordination with lateral services or national agencies.

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- (b) Maintain Battle Situation files. These files depict specified lines of demarcation in the immediate battle area. The lines of demarcation are coordinated with friendly ground forces. They include the FEBA (forward edge of the battle area), the FLOT (forward line of own troops), and the FSCL (fire support coordination line).
- (c) Maintain the Current Situation Map. This map is provided for the use of all TACC personnel. It shows key items from the order of battle files including locations and identities of friendly and enemy units and installations. The map also shows the usual lines of demarcation.
- (d) Monitor incoming intelligence. All incoming reports are evaluated, and their contents are used to update the order of battle files and the current situation map. Significant events and potential threats are reported verbally to other TACC elements as appropriate.
- (e) Prepare routine intelligence reports. These reports contain standardized summaries of current intelligence. They are distributed at regular intervals to higher, lateral, and lower units. Among these reports are the INTSUM, DISUM, INTREP, and OB Report.
- (f) Recommend additional intelligence collection. This branch is in the best position to detect gaps in the intelligence data base and to recommend special collection to the Collection Management Branch.

2.2.2.3 Target Intelligence Branch. This branch examines the current combat situation and selects enemy forces and installations as potential targets for air attack. Its duties are as follows:

- (a) Monitor incoming intelligence. Identify potential targets.
- (b) Weaponeer all potential targets. Weapons appropriate to the target are selected from the air resources available to the TAF.
- (c) Nominate targets. Targets are recommended for the Fighter Planning Branch to nominate for counter air and air interdiction operations. Assistance is given in describing approved targets and sorties for the Air Tasking Order.

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- (d) Maintain the Installation Data Base. This is a file describing enemy installations as potential targets. Associated with it are current target lists.
- (e) Maintain the Target Nominations Briefing Map. This map is used to display the locations of targets nominated for attack on the next day's preplanned ATO. It will display airfields, missile and AAA sites, electronic weapon systems, threat envelopes, and proposed targets.
- (f) Monitor mission results. Results obtained from air crew messages, intelligence reports, and reconnaissance mission results are analyzed to determine the degree of success of the attack. Target damage assessments are made, and targets are identified for reattack.
- (g) Coordinate data collection requirements. Pre-attack, post-attack, and route area imagery reconnaissance coverage are recommended to the Collection Management Branch.

2.2.2.4 Data Services Branch. This branch provides operational software and hardware support for the Display Control/Storage and Retrieval (DC/SR) equipment. The branch processes most of the intelligence reports that are originated by or received by the TACC. Duties of the personnel in this branch are determined by the nature of the DC/SR, which is not widely implemented and which may be replaced. A similar organization would presumably always be necessary to supervise the flow of digital information throughout the TACS.

2.2.3 Combat Operations Division. This division supervises the execution of the Air Tasking Order. It controls and coordinates the activities of all subordinate combat units under the direction of the COMTAF and his senior staff officers.

2.2.3.1 Organization. A typical organization of the Combat Operations Division is shown in Figure 8. It generally parallels that of the Combat Plans Division. Both have elements devoted to each of the TAF combat functions, but an exact correspondence between functions and staff elements is not evident in the present organizations. In any given tactical situation, some of the support functions are exercised infrequently or not at all, while several support functions appear to be supplied by a single type of flying unit. The organizations of both divisions can be adjusted to the demands of the specific tactical situation.

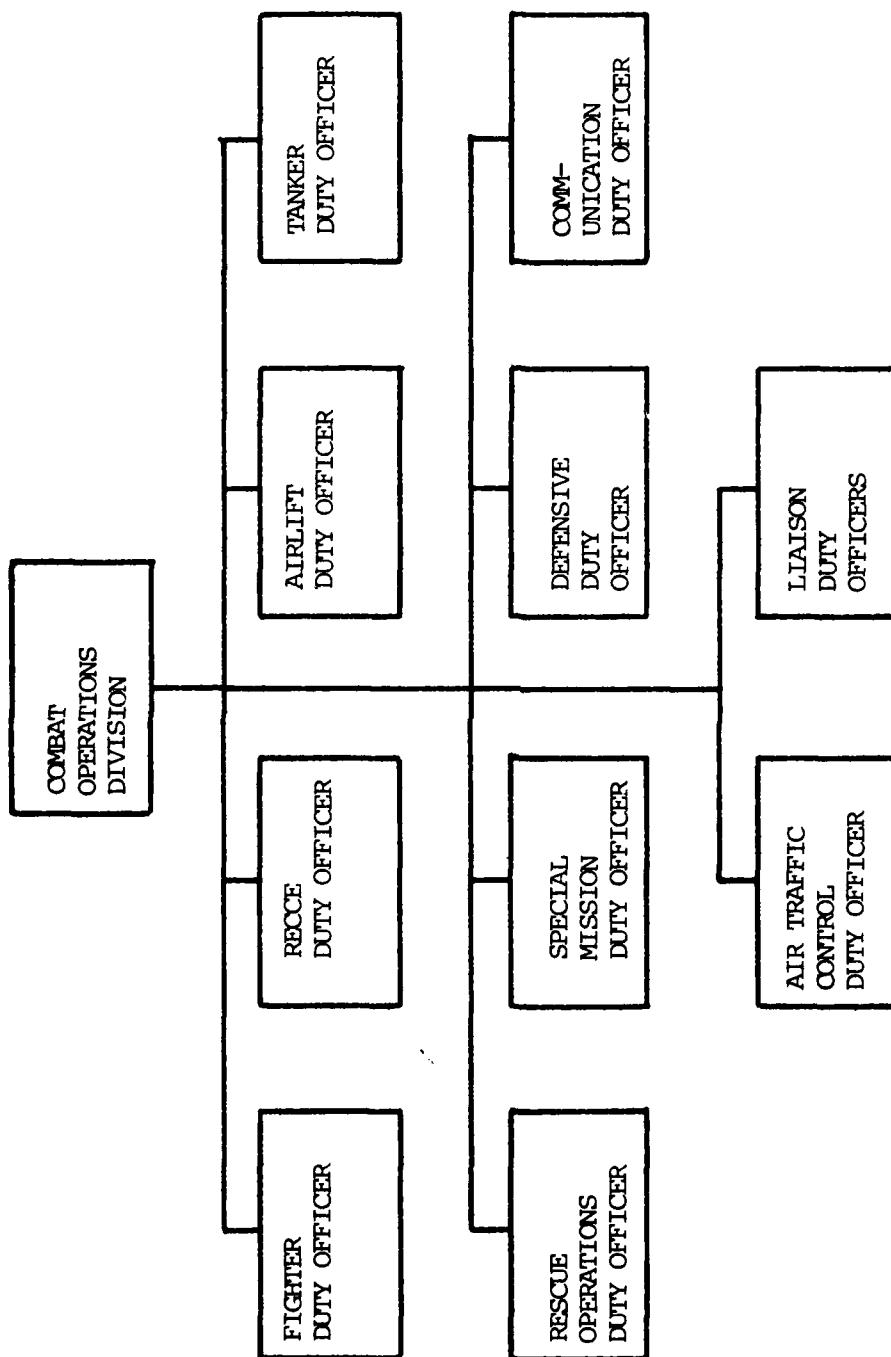


Figure 8: TACOC Combat Operations Division Organization

2.2.3.2 Duties. The staff is comprised primarily of duty officers, each of whom monitors the flying units responsible for executing one or more of the combat functions. The duty officers maintain direct radio and telephone contact with subordinate units to monitor the progress of missions, to assess the success of missions, and to evaluate the capabilities of aircraft, aircrews, and airfields to undertake future missions. The duty officers may take corrective action within certain limits, or the COMTAF or one of his deputies may personally direct employment of forces through the duty officers. Non-commissioned officers of this division maintain display boards which show the status of all flying units and the mission schedules.

2.2.4 Tactical Fusion Division. The principal assignment of this division is to support the Combat Operations Division by receiving, analyzing, and distributing battlefield information and intelligence. This division also provides current intelligence to other components of the TACC and the JTF. Prior to hostilities, this division produces indications and warning intelligence. During hostilities it detects immediate threats to friendly forces and issues threat alerts. The division also works closely with the Target Intelligence Branch to identify and nominate targets for reconnaissance or attack. During the tactical operation, this division presents current intelligence to the entire TACC staff on the Theater Situation Display and the Forward Area Display. These are large wall-mounted maps upon which symbols are continually adjusted to depict the current battlefield situation.

A typical organization of the Tactical Fusion Division is shown in Figure 9. The two intelligence analysts are assisted by non-commissioned officer specialists who collect, organize and display information. This organization will also be adapted to the specific tactical situation.

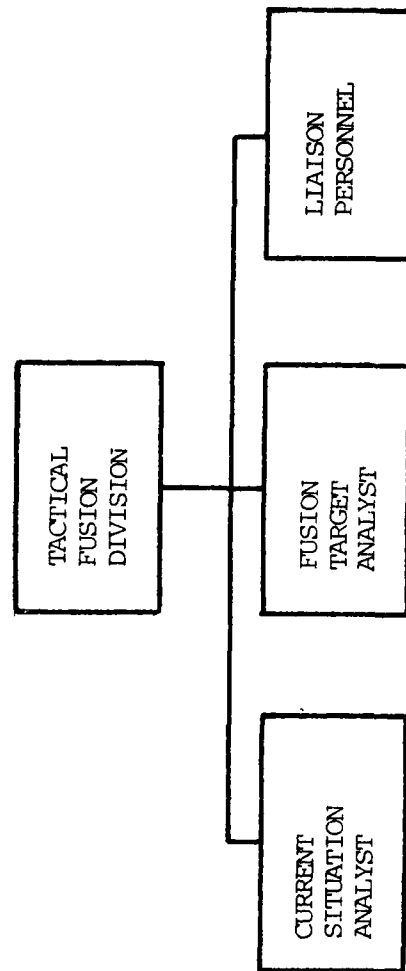


Figure 9: TACOC Tactical Fusion Division Organization

2.3 Wing Operations Center organization. It has already been stated that the wing is the principal tactical air unit of the TAF, and the Wing Operations Center (WOC) is the facility from which the wing commander directs his resources. The WOC is directly subordinate to the TACC, and it normally maintains both radio and telephone communication with the TACC and with many other elements of the TACS. The number and type of flying squadrons that comprise the wing will vary with TAF mission and objectives. For this reason, the staffing of the WOC will also vary in size and in duty assignments. A typical WOC organization is illustrated in Figure 10 and described in the following paragraphs. All other facilities of the TACS will have operations centers similar to that of the WOC.

2.3.1 WOC duty officer element. This element reports to the TACC the status of all aircraft, aircrews, airfields, munitions, and fuel. It receives and reviews the Air Tasking Order, relays assignments to subordinate units, and coordinates with the TACC on problems with missions. It maintains contact with aircraft in flight and reports mission status to the TACC.

2.3.2 Intelligence element. This element maintains enemy order of battle and current intelligence files and displays. It receives intelligence reports from the TACC and sends selected portions to subordinate units. It derives information from aircrew debriefings and submits intelligence reports to the TACC. This element also conducts the WOC targeteering and weaponeering intelligence activities.

2.3.3 Ground liaison element. This element maintains friendly force order of battle. It coordinates with units of other armed services to provide or request operational support. It also maintains a map display of the friendly situation including the FEBA the FLOT, the FSCL, and any other lines of demarcation.

2.3.4 Maintenance element. This element coordinates with all subordinate flying units on all aspects of equipment maintenance. It periodically reports maintenance status to the TACC.

2.3.5 Resources management element. This element maintains records of the expenditure and availability of munitions, fuel, and lubricants. It reports this information to the TACC.

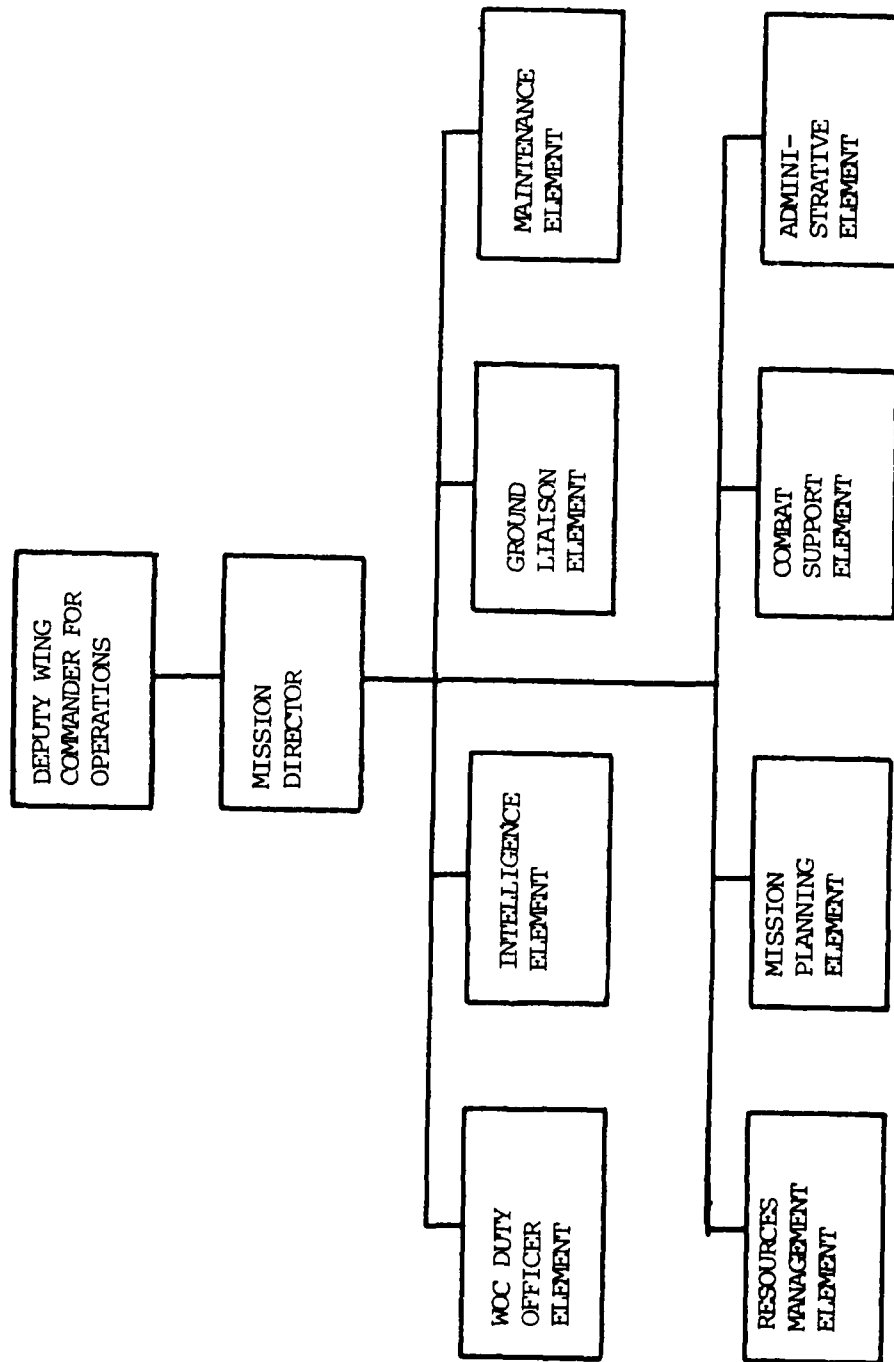


Figure 10: Wing Operations Center Organization

2.3.6 Mission planning element. This element receives the ATO and breaks out the portion that applies to the local wing. It reviews the combat situation and the facilities status provided by other WOC elements. It develops an optimum routing giving consideration to many details including threat locations, terrain and weather features, fuel availability, aircraft capability, and support unit requirements. Most of these factors have been also considered by the TACC during ATO preparation. The mission planning element creates detailed mission schedules for transmission to all flying and support units.

2.3.7 Combat support element. This element handles airbase operations including security police, disaster preparedness, civil engineering, and airfield status.

2.3.8 Administrative element. This element handles all administrative services for other WOC staff elements.

2.4 TACS command and control tasks. Simply stated, the purpose of the Tactical Air Force is to employ aircraft to accomplish a specific combat objective. The combat functions available to achieve this purpose have been described, and an organization capable of executing these functions has also been described. The organization contains two types of individuals; those few who execute the aerial tasks, and all of the others who support those tasks. Within the support group are those individuals who plan the aerial tasks, monitor the execution, and record the results. Their tasks will be described here because many of them can be helped with data processing equipment. These tasks as a whole are often called the command and control tasks.

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It will be shown that the command and control tasks are, in general, independent of the specific TAF objective and of the particular combat functions necessary to achieve that objective. They are also independent of the details of the personnel organization, although an organization must be provided to implement them and the conventional command structure must be observed. The command and control tasks do, however, depend upon a continuous flow of information inward to the various command centers and a corresponding flow of orders outward to the operating units. The nature of the information, the procedures for using that information, and the structure of the resulting orders are all clearly specified in official documents. The command and control network is, in fact, a highly structured manual data processing system that could be readily converted into an automated system.

In the following paragraphs, 15 command and control tasks are described in terms of the information that they handle. Each task receives input information, processes it in some manner, and produces output information. Each segment of output information becomes input to another task so that the entire command and control operation consists of a repetitive cycle of tasks. Information can appear as a data message, as an order or command, as a visual display, as a printed report, or as a file containing many messages or reports. Both data messages and commands are assumed to be those defined by the Joint Interoperability of Tactical Command and Control Systems (JINTACCS) organization for use by all U.S. and NATO services. These formats have seen little or no use in the field at this time, but they have been approved in principle by the Air Force. An explanation of JINTACCS terminology and procedures is provided in Appendix B. Some of the JINTACCS message formats used by the TAF command and control tasks are described in Appendix C. The contents of these formats as they would appear in a data processing system are listed in Appendixes D and E.

The visual displays and printed reports that also constitute information elements are those now used by the TAF according to TAC REG 55-45 (draft). The use of these elements is clear, but the actual data contents will vary to conform to the JINTACCS structure of the message information. The data files that are named herein are not explicitly described in any Air Force documentation although they represent collections of data that often appear as visual displays and printed reports. The use of files in this discussion tends to simplify the descriptions of information flow. It also prepares for the design of data processing programs to implement the command and control tasks.

For the purpose of explanation, the 15 tasks can be divided into four groups. These are:

- (a) Mission control tasks
- (b) Current information reporting tasks
- (c) Background information maintenance tasks
- (d) Information analysis tasks

Since all of the activities of all elements of the TACS are ultimately directed to sending aircraft on missions, the central group is the mission control tasks. The other groups provide the information that permits the planning and execution of missions. Some of the information is background that seldom changes and that is produced by agencies outside the TACS. More important is the current information that gives a snapshot of the tactical situation. It permits evaluation of the success of the previous mission, and it determines the plan for the next mission. Finally, intelligence is created by combining various kinds of information through the application of standard procedures tempered by human judgment. This type of information is produced when, for example, a few of the known enemy installations are selected as targets for offensive missions, and those targets are ranked according to relative importance. Figure 11 depicts the cyclical process of sending missions and gaining information to support new missions.

2.4.1. Mission control tasks. The four mission control tasks are performed consecutively and are, of course, interdependent. Requests for missions are received, missions are planned, resources are tasked to execute the missions, and finally the execution of the missions is monitored and controlled.

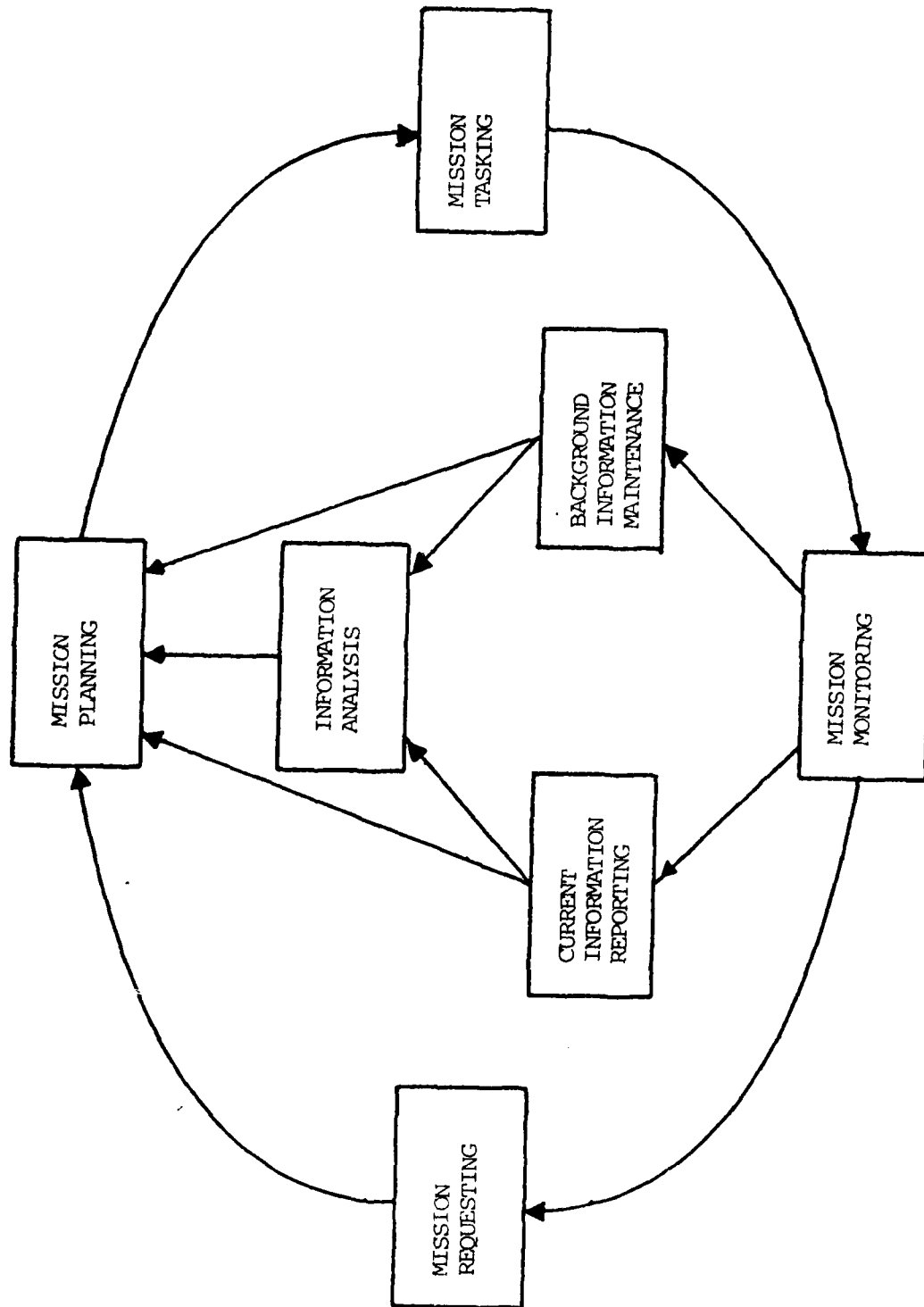


Figure 11: The Command and Control Cycle

2.4.1.1 Mission request processing. Missions are identified by the TAF functions that they perform and therefore by the type of aircraft that fly them. Many missions are preplanned to meet the provisions of the Operations Order that describes in general terms the COMTAF's objectives. Other missions are immediate in nature and are requested on a daily basis by various components of the JTF and the TAF to support their own objectives. The requests are submitted to the TACC over TACS communication channels in standardized message formats. The requests are checked for completeness and relevance, are segregated by mission type, and are combined with similar requests. The pertinent details of all mission requests are posted on display boards that serve as input to the mission planning task. Some requests may be rejected at this time due to lack of appropriate resources or because of conflict with the commander's order regarding apportionment of resources. A message is sent to each requestor to advise whether or not the request is still under consideration. The information formats that are used by this task are listed in Table 1.

2.4.1.2 Mission planning. The daily process of mission planning depends upon the availability of many kinds of information. The current status of all enemy elements in an area of several hundred square miles must be known. Some of these elements are designated as targets for aerial attack while others are identified as threats to attack missions. The locations and intentions of friendly units in the area must be known, and significant terrain and weather conditions must be considered. The current status of aerial resources must be known in terms such as the numbers and types of aircraft and the quantities of fuel and munitions. The summarized requests for missions are balanced against this aggregate of information to produce a general mission plan that best fits the COMTAF's objectives. The plan is formulated at the TACC into the Air Tasking Order (ATO) and is transferred in whole or in part to all elements of the TACS and to lateral and higher commands. Subsidiary activities produce responses to mission requests, create new requests for information collection, and generate summary activity reports for higher headquarters. The information formats used by this task are listed in Table 2.

2.4.1.3 Mission tasking. Receipt of the tasking orders (ATOs) at the various WOCs initiates the detailed planning necessary to implement individual missions. Specific squadrons, aircraft, and aircrews are assigned to the missions, and detailed flight plans are worked out by each aircrew to include such items as times, headings, communications frequencies, and the operating parameters of electronic equipment and armament. This task requires access to much of the same information that contributed to the mission planning task. The geographic area of interest of each individual WOC may be smaller than that of the TACC, but more detailed information may be required within that area. Information displays similar to those at the TACC are maintained at each WOC. The information formats used by this task are listed in Table 3.

2.4.1.4 Mission monitoring. Radio contact is maintained insofar as possible with mission aircraft by both ground and airborne control stations during the period from take-off to landing. Many message formats are specified for the mission monitoring task to standardize the type of information to be exchanged and to facilitate control and coordination of the aircraft. The current status of each mission is continually displayed at the WOC and the TACC as well as at many of the other elements of the TACS. The observations of the aircrew regarding such things as enemy disposition, threat locations, potential targets, and bomb damage assessment are an important source of the information that will guide subsequent missions. These observations may be transmitted while in flight or may be elicited during debriefing. The information is fitted into the format of one or more standard messages for transmission throughout the TACS. The formats used by the mission monitoring task are listed in Table 4.

2.4.2 Current information reporting tasks. Current information is that which is derived from observations of the battlefield and from routine reports of task force components. This information is divided for convenience in handling into the categories of TAF resources availability, friendly forces disposition, and enemy forces disposition.

2.4.2.1 TAF resources availability. The resources are the aircraft, aircrews, fuel, armament, and the specialized reconnaissance, surveillance, and electronic warfare equipment. Several different message formats are specified to permit reporting the information necessary to describe the status of different types of units. The TACC maintains display boards showing the status of all units in the TACS, while each WOC displays similar information about its own subordinate units. The WOCs send status messages to the TACC both on a routine schedule and as necessary to advise of status changes. The information formats used by this task are listed in Table 5.

2.4.2.2 Friendly force disposition. For the planning of some types of aerial missions, it is necessary to know the locations and probable movements of friendly ground forces. This information is reported informally through elements such as the ASOC and the MPC that are responsible for maintaining communication with all friendly ground and naval forces in the JTF or in the general area of interest. Friendly force disposition is often summarized for planning and coordination purposes by defining lines of demarcation that are expressed as strings of coordinates and drawn on map displays at the TACC and the WOCs. Few information formats have been specified for transmitting friendly force disposition. These formats are listed in Table 6.

2.4.2.3 Enemy force disposition. The mission planning process obviously requires detailed current information about the enemy. A principal source of this information is provided by the regular TAF reconnaissance missions. Other sources are the reconnaissance efforts managed at the theater and national levels. Observations made by mission aircrews and by allied ground forces often provide useful information. A large group of message formats has been specified for standardizing the reporting of enemy force disposition. The messages are transmitted throughout the TACS, and the information is usually expressed graphically on map displays. This information not only contributes directly to the mission planning task, but it also provides the basis for the three information analysis tasks described in Paragraph 2.4.4. The examination and analysis of enemy information always results in the generation of requests for reconnaissance missions to be conducted not only by the TAF but also by other JTF components and by national agencies. The information formats used for enemy force disposition reporting are listed in Table 7.

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2.4.2.4 Weather forecasts. Weather information is transmitted regularly throughout the TACS over a radio teletype network dedicated to this service. The information is usually posted on a display board at the TACC and at the WOCs so that it is readily accessible to all personnel. The JINTACCS formats used for weather forecasts are listed in Table 8.

2.4.3 Background information maintenance tasks. Background information is that which does not change from day to day. It is usually obtained prior to the tactical action, and it often consists of voluminous technical reports and documents.

2.4.3.1 TAF resources capabilities. Mission planning and tasking require a detailed technical knowledge of the capabilities of various types of aircraft, airborne sensors, and weapons. Although the planning officers are often experienced aircrew members, they must occasionally refer to technical manuals for the necessary information. A list of the publications prescribed for use at the TACC is given in Table 9. Some or all of these are probably needed at the WOCs and at most other unit headquarters.

2.4.3.2 Terrain description. Knowledge of terrain features is obtained from printed maps that are carried by every unit. Map sections are routinely combined into wall-mounted displays that cover the entire area of interest. Symbols to depict important elements of current information are positioned manually on these displays. The principal map displays at the TACC are the Forward Area Display and the Theater Situation Display. Similar map displays are maintained at each WOC and at the headquarters of many other units.

2.4.3.3 Friendly force capabilities. Mission planning sometimes requires a technical knowledge of the capabilities available within naval and ground forces that may be components of the JTF. Aircraft, airborne sensors, and weapons employed by other services might be capable of complementing and supplementing those of the Air Force. There appears to be no formal method of obtaining information of this sort except through liaison officers from other services who are assigned to the TACC.

2.4.3.4 Enemy force capabilities. Information about specific enemy units, weapons, equipment and personnel is collected routinely from many sources. It is essential to mission planning because it permits the selection of targets and the assessment of enemy resistance to attack. Some of this information is stored in computer files at the national and theater levels, but it is now available to tactical units only in printed form.

2.4.4 Information analysis tasks. It is difficult to enumerate tasks in this group because they all require the application of human judgement and experience to all of the available current and background information. Three of the tasks can be described in some detail because much of the judgement and experience has been incorporated into fairly complex sets of rules and procedures for information analysis. Attempts have been made to implement the routine portions of these tasks with computer programs, but no automated assistance is yet available at the tactical airbase

2.4.4.1 Threat assessment. Aerial missions must be planned to avoid, insofar as possible, known enemy defenses such as missile launch sites and anti-aircraft artillery. The locations are obtained as current information from reconnaissance sources or from air crew observation. The actual capabilities of weapons are obtained from background information files. This information may be combined to produce an estimate of the probability of success in neutralizing or circumventing these threats or in attacking despite them.

2.4.4.2 Target nomination. Targets for aerial attack may be fixed installations such as factories, dams and railheads about which much background information is available. Targets may also be mobile units whose locations are items of current information but whose capabilities and potential threats may be supplied from the background information files. The relative importance of the available targets must be estimated in terms of the COMTAF's current objectives. The selection of targets for attack must be made with consideration for the known threats and the capabilities of the resources available to the TAF. Some of the information can be reduced to numerical values, but the final selection of targets requires human judgement.

2.4.4.3 Penetration analysis. After a target has been selected and the known threats have been analyzed, a routing for mission aircraft may be planned. The plan must consider such factors as the range and altitude capabilities of TAF aircraft. It must provide for the use of all available threat avoidance and neutralization capabilities. Two or more feasible routes may be developed by routine analysis methods, but the final choice of route must be made through human judgement.

2.5 Present Tactical Data Processing Systems. The Data Control, Storage and Retrieval System (DC/SR) is the only computer system now available to support the TAF in the field. It is intended to be deployed with the TACC, and it receives information over tactical telephone channels from remote teletype terminals. The Computer Assisted Force Management System (CAFMS) is now under development at Langley Air Force Base. It will include a computer complex at the TACC and a large number of intelligent terminals to be deployed with other TACS components. It will communicate over tactical telephone channels and will support the construction and distribution of the Air Tasking Order. Neither the DC/SR nor CAFMS is microcomputer based, and therefore neither is well suited to the tactical environment.

TABLE 1  
MISSION REQUEST PROCESSING DATA FORMATS

MISSION REQUESTS

|      |            |                                                            |
|------|------------|------------------------------------------------------------|
| A425 | ERTM       | Elint Requirement Tasking Message                          |
| D100 | JTACARSREQ | Joint Tactical Air Reconnaissance/<br>Surveillance Request |
| D120 | JRSRR      | Joint Remote Sensor Report/Request                         |
| D200 | JCASINTREQ | Joint Close Air Support/Interdiction<br>Request            |
| D630 | ALREQ      | Airlift Request                                            |
| D634 | HELOALREQ  | Helicopter Airlift Request                                 |
| D660 | JAIRREQ    | Joint Air Mission Request                                  |
| D666 | JESCREQ    | Joint Escort Request                                       |
| D667 | JRECREQ    | Joint Reconnaissance/Surveillance Request                  |
| D668 | JSUPREQ    | Joint Support Request                                      |

REQUEST RESPONSES

|      |            |                                                         |
|------|------------|---------------------------------------------------------|
| A651 | EMPLOYALOC | Air Employment/Allocation Plan                          |
| A661 | REQSTSTSK  | Air Mission Request Status/Tasking Message              |
| B702 | JLNCHREP   | Joint Launch Report                                     |
| D120 | JRSRR      | Joint Remote Sensor Report/Request                      |
| F625 | REQCONF    | Request Confirmation Message                            |
| F631 | ALMSNSCD   | Airlift Mission Schedule                                |
| F636 | HELOALCONF | Helicopter Airlift Mission Data<br>Confirmation Message |
| F654 | CROSSCONF  | Cross-Force Mission Data Confirmation<br>Message        |

DATA FILES OUT

Mission Status  
Sortie Employment  
Mission Request

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TABLE 2  
MISSION PLANNING DATA FORMATS

COMMANDS IN

|      |            |                                          |
|------|------------|------------------------------------------|
| A421 | EXORD      | Execution Order                          |
| A422 | FRAGORDER  | Operation Fragmentary Order              |
| A650 | APORALOT   | Apportionment/Allotment Message          |
| A690 | TACOPDAT   | Tactical Operational Data Message        |
| A691 | TECHOPDAT  | Technical Operational Data Message       |
| C440 | RPTMINEOPS | Report Intention/Completion of Minefield |
| E400 | OPLANCHG   | Operations Plan Change                   |
| E445 | STRIKEWARN | Friendly Nuclear Strike Warning          |
| F750 | DESIGAREA  | Designated Area Message                  |

DATA FILES IN

Mission Status  
Sortie Employment  
Mission Request  
Theater Situation Display  
Forward Area Display  
Rescue Status  
TACS Facility Status  
Tactical Unit Status  
Tactical Unit Munitions Status  
Air Defense Fighter Status Display  
SAM/ADA Weapons Status  
Airbase/Flight Facility Status

MISSION REQUESTS OUT

|      |            |                                                 |
|------|------------|-------------------------------------------------|
| A651 | EMPLOYALOC | Air Employment/Allocation Plan                  |
| D200 | JCASINTREQ | Joint Close Air Support/Interdiction<br>Request |
| D260 | RFR        | Request For Report                              |
| D630 | ALREQ      | Airlift Request                                 |
| D634 | HELOALREQ  | Helicopter Airlift Request                      |
| D660 | JAIRREQ    | Joint Air Mission Request                       |
| D666 | JESCREQ    | Joint Escort Request                            |
| D668 | JSUPREQ    | Joint Support Request                           |

REQUEST RESPONSES OUT

|      |           |                                            |
|------|-----------|--------------------------------------------|
| A661 | REQSTSTSK | Air Mission Request Status/Tasking Message |
| F625 | REQCONF   | Request Confirmation Message               |

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TABLE 2 (cont.)  
MISSION PLANNING DATA FORMATS

|      |            |                                                         |
|------|------------|---------------------------------------------------------|
| F631 | ALMSNSCD   | Airlift Mission Schedule                                |
| F636 | HELOALCONF | Helicopter Airlift Mission Data<br>Confirmation Message |
| F654 | CROSSCONF  | Cross-Force Mission Data Confirmation                   |

COMMANDS OUT

|      |            |                                       |
|------|------------|---------------------------------------|
| A421 | EXORD      | Execution Order                       |
| A422 | FRAGORDER  | Operation Fragmentary Order           |
| A440 | WARNORD    | Warning Order                         |
| A651 | EMPLOYALOC | Air Employment/Allocation Plan        |
| E400 | OPLANHC    | Operations Plan Change                |
| F401 | EWEM       | Electronic Warfare Employment Message |

SUMMARY REPORTS OUT

|      |          |                                    |
|------|----------|------------------------------------|
| C400 | SITREP   | Commander's Situation Report       |
| G423 | OPSUM    | Operations Summary Report          |
| G424 | EWMSNSUM | Electronic Warfare Mission Summary |

DATA FILES OUT

Fighter Mission Schedule Display  
Reconnaissance Mission Schedule Display  
Airlift Mission Schedule Display  
Tanker Mission Schedule Display  
Support/C3CM Mission Schedule Display  
ATO Production Display

TABLE 3  
MISSION TASKING DATA FORMATS

COMMANDS IN

|      |           |                                         |
|------|-----------|-----------------------------------------|
| A421 | EXORD     | Execution Order                         |
| A422 | FRAGORDER | Operation Fragmentary Order             |
| A440 | WARNORD   | Warning Order                           |
| A635 | HELOALDAT | Helicopter Airlift Mission Data Message |
| A652 | SORTALOT  | Sortie Allotment Message                |
| A653 | CROSSDAT  | Cross-Force Mission Data Message        |
| A770 | ALORD     | Alert Launch Order                      |
| E400 | OPLANCHG  | Operations Plan Change                  |
| E402 | EWAM      | Electronic Warfare Approval Message     |

DATA FILES IN

Fighter Mission Schedule Display  
Reconnaissance Mission Schedule Display  
Airlift Mission Schedule Display  
Tanker Mission Schedule Display  
Support/C3CM Mission Schedule Display  
Forward Area Display  
Theater Situation Display

REQUEST RESPONSES IN

|      |          |                     |
|------|----------|---------------------|
| B702 | JLNCHREP | Joint Launch Report |
|------|----------|---------------------|

MISSION REQUESTS OUT

|      |          |                                   |
|------|----------|-----------------------------------|
| A425 | ERTM     | ELINT Requirement Tasking Message |
| A653 | CROSSDAT | Cross-Force Mission Data Message  |

COMMANDS OUT

|      |             |                                            |
|------|-------------|--------------------------------------------|
| A635 | HELOALDAT   | Helicopter Airlift Mission Data Message    |
| A653 | CROSSDAT    | Cross-Force Mission Data Message           |
| A661 | REQSTATASK  | Air Mission Request Status/Tasking Message |
| A770 | ALORD       | Alert Launch Order                         |
| A900 | ADSCRAMORD  | Air Defense Scramble Order                 |
| A901 | SARSCRAMORD | Search and Rescue Scramble Order           |
| A902 | TNKSCRAMORD | Tanker Scramble Order                      |
| A903 | CASSCRAMORD | Close Air Support Scramble Order           |
| E710 | AIRDEFCOM   | Air Defense Command Message                |
| F654 | CROSSCONF   | Cross-Force Mission Data Confirmation      |

TABLE 4  
MISSION MONITORING DATA FORMATS

DATA FILES IN

Fighter Mission Schedule Display  
Reconnaissance Mission Schedule Display  
Airlift Mission Schedule Display  
Tanker Mission Schedule Display  
Support/C3CM Mission Schedule Display

DATA MESSAGES IN

|      |              |                                       |
|------|--------------|---------------------------------------|
| B703 | AIREVENT     | Significant Air Event Report          |
| B750 | JINFLT       | Joint Inflight Report                 |
| C240 | FMR          | Forward Air Controller Mission Report |
| C420 | SARSIT       | Search And Rescue Situation Summary   |
| C482 | SARIR        | Search And Rescue Incident Report     |
| C900 | TAKEOFFREP   | Take Off Report                       |
| C901 | LANDINGREP   | Landing Report                        |
| C902 | ABORTREP     | Abort Report                          |
| C903 | TNKINFLTREP  | Tanker Inflight Report                |
| C904 | AIRDELAYREP  | Air Delay Report                      |
| C905 | GNDDELAYREP  | Ground Delay Report                   |
| C908 | ARRIVALREP   | Arrival Report                        |
| C909 | DEPARTURERE  | Departure Report                      |
| C910 | ADVISORYREP  | Airlift Advisory Report               |
| C913 | CGOEXCREP    | Cargo Exception Report                |
| C926 | TACACTIONREP | Tactical Action Report                |
| C927 | OFFACTIONREP | Offensive Action Report               |
| C928 | WEACOMITREP  | Weapons Commitment Report             |
| C929 | ECTARREP     | Electronic Tactical Action Report     |

TECHNICAL CONTROL MESSAGES

|      |             |                             |
|------|-------------|-----------------------------|
| B711 | ENGSTS      | Engagement Status           |
| C906 | DISTRESSREP | Aircraft in Distress Report |
| C907 | DOWNEDPIREP | Downed Pilot Report         |
| C914 | INITIALREP  | Initial Report              |
| C915 | UPDATEREP   | Update Report               |
| C916 | CORECMREP   | Correlated ECM Report       |
| C917 | UNCORECMREP | Uncorrelated ECM Report     |
| C918 | ECMTERMREP  | ECM Termination Report      |
| C919 | ORBITREP    | Orbit Report                |
| C920 | SPLITTRKREP | Split Track Report          |
| C921 | MERGTRKREP  | Merging Track Report        |

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TABLE 4 (cont.)  
MISSION MONITORING DATA FORMATS

|      |              |                                    |
|------|--------------|------------------------------------|
| C922 | MASSTRKREP   | Mass Track Report                  |
| C923 | IFFEMERGREP  | IFF Emergency Report               |
| C924 | CONTACLSTREP | Contact Lost Report                |
| C925 | EMERGREP     | Emergency Report                   |
| E706 | INITHAND     | Initiate Handover Message          |
| E707 | RECHAND      | Receive Handover Message           |
| E710 | ARDEFCON     | Air Defense Command Message        |
| E715 | AIRDEFWARN   | Air Defense Warning Message        |
| E900 | MSNACFTMSG   | Mission Aircraft Message           |
| E901 | MSNCNTRLMSG  | Mission Control Message            |
| F632 | FLTCONTINFO  | Flight Control Information Message |
| F751 | ECMDAT       | ECM Data Message                   |
| F752 | TRKMAN       | Track Management Message           |
| F753 | TRKREP       | Track/Point Report                 |
| F754 | FLTPLAN      | Flight Plan Message                |
| F755 | TRKINTEL     | Track Intelligence Message         |

TABLE 5  
TAF RESOURCES AVAILABILITY DATA FORMATS

DATA MESSAGES IN

|      |               |                                        |
|------|---------------|----------------------------------------|
| B704 | ABCHANGE      | Airbase Change Report                  |
| B705 | ACSAMSTAT     | Alert Aircraft/SAM Status Report       |
| B900 | TACOPLINEUP   | Aircraft Lineup Report                 |
| B901 | UNITSTATREP   | Tactical Unit Status Report            |
| B902 | FCLTYSTATREP  | TACS Facility Status Report            |
| B903 | RESUSTATREP   | Rescue Unit Status Report              |
| B904 | CNTRLCAPREP   | Control Capability Report              |
| B905 | ALCESTATREP   | Air Lift Control Element Status Report |
| B906 | CCTSTATREP    | Combat Control Team Status Report      |
| B907 | ARPSTATREP    | Aerial Port Equipment Status Report    |
| B908 | CASALSTATREP  | Close Air Support/Alert Status Report  |
| B909 | TACMUSTATREP  | Tactical Unit Munitions Status Report  |
| B910 | AIRDEFFTRSTAT | Air Defense Fighter Status Report      |
| B911 | SAMSTATREP    | SAM/ADA Weapon Status Report           |
| C460 | COMSPOT       | Communications Spot Report             |
| C490 | OPREP-3PNF    | OPREP-3 Pinnacle/NUCFLASH              |
| C491 | OPREP3-PFB    | Pinnacle/Front Burner                  |
| C492 | OPREP-3PED    | OPREP-3 Pinnacle Emergency/Destruction |
| C493 | OPREP-3PEV    | OPREP-3 Pinnacle/Emergency Evacuation  |
| C494 | OPREP-3PBA    | OPREP-3 Pinnacle/Broken Arrow          |
| C495 | OPREP-3BS     | OPREP-3 Bent Spear                     |
| C496 | OPREP-3FG     | OPREP-3 Faded Giant                    |
| C928 | WEACOMITREP   | Weapons Commitment Report              |
| C929 | ECTARREP      | Electronic Tactical Action Report      |
| G424 | EWMSNSUM      | Electronic Warfare Mission Summary     |

DATA FILES OUT

Air Defense Fighter Status Display  
SAM/ADA Weapons Status Display  
Airbase/Flight Facility Display  
TACS Facility Status  
Tactical Unit Status  
Tactical Unit Munitions Status  
Rescue Status

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TABLE 6  
FRIENDLY FORCE DISPOSITION DATA FORMATS

DATA MESSAGES IN

|      |            |                                           |
|------|------------|-------------------------------------------|
| A210 | FMC        | Fire Mission Command                      |
| A260 | FSC        | Fire Support Coordination Measures Report |
| A690 | TACOPDAT   | Tactical Operational Data Message         |
| B260 | FRD        | Friendly Unit Location                    |
| C440 | RPTMINEOPS | Report Intention/Completion of Minefield  |
| C441 | NBC4       | NBC4 Report                               |
| C442 | NBC3       | NBC3 Report                               |
| C444 | NBC5       | NBC5 Report                               |
| F750 | DESIGAREA  | Designated Area Message                   |

DATA FILES OUT

Forward Area Display  
Theater Situation Display

SUMMARY REPORTS OUT

|      |        |                                            |
|------|--------|--------------------------------------------|
| C400 | SITREP | Commander's Situation Report               |
| C420 | SARSIT | Search And Rescue Situation Summary Report |
| G423 | OPSUM  | Operations Summary                         |

TABLE 7  
ENEMY FORCE DISPOSITION DATA FORMATS

DATA MESSAGES IN

|      |              |                                                   |
|------|--------------|---------------------------------------------------|
| A100 | TARBUL       | Target Bulletin                                   |
| B703 | AIREVENT     | Significant Air Event Report                      |
| B750 | JINFLT       | Joint Inflight Report                             |
| C100 | IPIR         | Initial Photo Interpretation Report               |
| C101 | SUPIR        | Supplemental Photo Interpretation Report          |
| C102 | MIPIR        | Multi-Mission Imagery Photo Interpretation Report |
| C110 | INTREP       | Intelligence Report                               |
| C111 | TACREP       | Tactical Report                                   |
| C112 | TGTINFOREP   | Target Information Report                         |
| C113 | HOTPHOTOREP  | Hot Photo Report                                  |
| C120 | MIJIFEEDER   | Meaconing, Intrusion, Jamming Interference Report |
| C121 | TACELINT     | Tactical ELINT Report                             |
| C130 | MISREP       | Mission Report                                    |
| C131 | SENREP       | Sensor Report                                     |
| C240 | FMR          | Forward Air Controller Mission Report             |
| C451 | VULWARN      | Vulnerability Warning Message                     |
| C485 | NBC1         | NBC1 Report                                       |
| C486 | OPREP-3P     | OPREP-3 Pinnacle                                  |
| C487 | OPREP-3      | OPREP-3                                           |
| C927 | OFFACTIONREP | Offensive Action Report                           |
| C928 | WEACOMITREP  | Weapons Commitment Report                         |
| C929 | ECTARREP     | Electronic Tactical Action Report                 |
| E715 | AIRDEFWARN   | Air Defense Warning Message                       |
| F751 | ECMDAT       | Electronic Countermeasures Data Message           |
| F755 | TRKINTEL     | Track Intelligence Message                        |
| G424 | EWMSNSUM     | Electronic Warfare Mission Summary                |
| G480 | NBC2         | NBC2 Report                                       |

REQUEST RESPONSES IN

|      |      |                                                  |
|------|------|--------------------------------------------------|
| D111 | RRII | Response to Request for Intelligence Information |
|------|------|--------------------------------------------------|

MISSION REQUESTS OUT

|      |            |                                                         |
|------|------------|---------------------------------------------------------|
| A425 | ERTM ELINT | Requirement Tasking Message                             |
| D100 | JTACARSREQ | Joint Tactical Air Reconnaissance/ Surveillance Request |
| D110 | RII        | Request For Intelligence Information                    |

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TABLE 7 (cont.)  
ENEMY FORCE DISPOSITION DATA FORMATS

|      |         |                                          |
|------|---------|------------------------------------------|
| D120 | JRSRR   | Joint Remote Sensor Report/Request       |
| D667 | JRECREQ | Joint Reconnaissance/Surveillance Report |

SUMMARY REPORTS OUT

|      |          |                                    |
|------|----------|------------------------------------|
| G130 | DISUM    | Daily Intelligence Summary         |
| G131 | INTSUM   | Intelligence Summary               |
| G424 | EWMSNSUM | Electronic Warfare Mission Summary |

DATA FILES OUT

Forward Area Display  
Theater Situation Display

TABLE 8  
WEATHER FORECASTS DATA FORMATS

DATA MESSAGES OUT

|      |              |                       |
|------|--------------|-----------------------|
| C520 | SEVERE STORM | Severe Storm Warning  |
| C521 | WXFCST       | Weather Forecast      |
| C522 | WXRPT        | Weather Report        |
| C523 | PTWXWARN     | Point Weather Warning |

DATA FILES OUT

Weather Forecast Display

TABLE 9  
TAF RESOURCES CAPABILITIES DATA FILES

TAC Tactical Electronic Warfare Analysis (TEWA) Chart  
TACM 3-1, Vol. I, Tactical Fighter Weapons Equipment  
Weapons Delivery Tactics  
Weapons Delivery Programs (-34, -25 Tech Orders)  
Weapons Delivery Limitations (-1 Tech Orders, Sec 5)  
Aircraft Performance Data (-1 Tech Orders)  
TAC 200-3 Collection Management Guide  
Joint Munitions Effectiveness Manuals

TABLE 10  
ENEMY FORCE CAPABILITIES DATA FILES

Air Order of Battle Listing  
Missile Order of Battle Listing  
Electronic Order of Battle Listing  
Command, Control, and Communications Order of Battle Listing  
Naval Order of Battle Listing  
National Intelligence Survey (NIS) - Basic Fact Book  
Military Intelligence Survey (MIS)  
DIA Fact Book  
DIA Aircraft Handbook - ECC  
DIA Aircraft Handbook - Free World  
DIA Aircraft Armament Handbook - ECC  
DIA Aircraft Armament Handbook - Free World  
DIA Defense Missile System Handbook  
DIA Ground Launched Guided Missile Systems Handbook -  
USSR and PCR (FTD)  
DIA Radar Handbook, Vols. I-IV  
DIRNSA ELINT Parameter Limits (EPL) List

### 3. MICROCOMPUTER SURVEY

#### 3.1 Introduction.

3.1.1 Purpose. The purpose of the survey is to identify commercially available data processing equipment that could be used as a test bed for establishing the functional requirements of components of the Tactical Air Control System (TACS). The data processing equipment is to be based upon a microprocessor and is to be capable of providing digital communication through existing tactical communication facilities. In addition to its function as a communication "front end", the equipment is also to provide a stand-alone data processing capability during those periods of deployment when communication to other TACS components is not available. The data processing equipment as a whole has been designated the Microprocessor Front End Terminal (MFT).

3.1.2 Approach. In general, the approach was to assume that certain standard components must be included in the system, to establish some selection criteria for these components, and to identify suitable sources of information about them.

3.1.2.1 System components. A preliminary investigation revealed that there are several tasks at each tactical headquarters that could be effectively supported by a data processing system. Many similar tasks have been automated with large scale computers and more recently with minicomputers. The presently available systems are not satisfactory for use at the tactical air base because they are too large and too fragile for air transport. Most of them require filtered, conditioned air and more electrical power than can be provided under tactical conditions. The use of integrated circuit chips avoids all of the problems inherent in the systems now available. The basic requirement is for a general purpose computer system that offers all or most of the advantages of modern integrated circuit technology while providing all of the data processing functions of the typical minicomputer system. A general purpose microcomputer system is assumed to comprise at least the following components:

- (a) A central processing unit (CPU) containing the microprocessor and the support chips necessary to make it a programmable computer.
- (b) Main memory for the temporary storage of 64K bytes or more of programs and data.

- (c) Mass memory for the permanent storage of 10 to 20 megabytes of programs and data.
- (d) At least one interactive user terminal including a keyboard and a display device such as a cathode ray tube.
- (e) A printer for copying stored data on paper.
- (f) From four to twelve serial input-output ports in addition to those necessary for the peripheral devices listed above.

3.1.2.2 General selection criteria. The MFT is viewed as a test bed for establishing detailed requirements through experimentation. Since quantitative performance requirements have yet to be established, there appears to be no need to provide for experimentation with the most recently announced developments in microcomputer technology. Equipment in this category is expensive, not readily available, and is itself in an experimental stage. The decision was made to seek a microcomputer system that satisfied the following criteria:

- (a) All components of the system should be available from the same vendor. This assures that the components have been designed to function together and have been tested as a system before delivery. It is unlikely that all of the components would actually be manufactured by the vendor.
- (b) The system should be now in use by several customers and should be offered for "off-the-shelf" delivery. Relatively few microcomputer systems have been sold for business and professional use, so production problems may be encountered despite this stipulation.
- (c) The vendor should be capable of providing initial system checkout and integration. He should also offer on-call maintenance service and a stock of replacement parts. It is also necessary to point out that the vendor should show some evidence of financial stability. Most of the systems are offered by companies that were established within the last five years. Many companies have failed, but survival and moderate expansion for about four years seem to offer a reasonable expectation that the vendor will support his product.

- (d) The equipment design should provide for system modification by the addition of a wide range of plug-in modules. A variety of modules should be available from the vendor, but the system should also accept plug-ins offered by other suppliers. This will allow experimentation with the use of various system functions and will also permit the controlled investigation of new technological developments.

3.1.2.3 Data sources. The first step in the microcomputer survey was to obtain nine reports by the Datapro Research Corporation of Delran, NJ. This organization publishes a wide variety of reports on data processing and office system hardware, software, services and companies. Their facilities make it possible for them to collect and collate much more information than could be obtained by any individual. Their tabular presentation of essential facts about nearly all of the microcomputers on the market makes possible a preliminary selection of candidates for the MFT test bed. The Datapro reports are listed in Appendix A. Those that proved to be most valuable for this survey are discussed in Paragraph 3.2.

A supplementary step in the survey was to obtain subscriptions to most of the periodicals that deal with various aspects of the microcomputer industry. These periodicals sometimes publish their own surveys of available microcomputers and peripheral equipment. Their surveys generally contain less information than the Datapro reports, but they sometimes provide more timely information. The principal value of the periodicals lies, however, in the advertisements placed by the many companies who offer one or more products directly related to microcomputers. The appearance of a product in an advertisement does not necessarily mean that the product is currently available or that it will perform as claimed. It does, however, indicate the trends in new equipment development, and it permits planning for future enhancements to a currently available system. The publications that were used are listed in Appendix A. The information presented by them is extremely repetitious, and therefore no specific references are made in the following discussion to any periodicals.

The third source of survey information was the publications of the various vendors. It is possible to become inundated with material of this sort to the point where almost none of it has any impact. The most useful information was obtained by writing to vendors who were shown by the Datapro reports to have products with the desired characteristics. In several cases it was possible to obtain very useful information from local dealers and distributors. No listing is included of the manufacturer's literature that was obtained for this survey. A few specific references are made in the following paragraphs.

At the outset of the survey it seemed advisable to obtain the technical specifications of all currently available microprocessor and support chips. "An Introduction to Microcomputers" in three volumes, by Adam Osborne, provides a very comprehensive source of this information. It soon became evident, however, that there was little need to choose between microprocessor chips because only a few were used in commercially available general purpose computers. The others were intended for special purpose controllers, were obsolete, or were too new to have gained much acceptance by system vendors. A Datapro report that provides a much simplified comparison of microprocessor chips proved to be adequate. It will be cited in the next paragraph.

3.2 Survey of Reports. Nine Datapro reports were obtained because their descriptions suggested that they could provide useful information. Examination of these reports led to the conclusion that it was feasible to base the equipment selection on the contents of only two of them. The observations that led to this conclusion are briefly as follows:

3.2.1 "All About Microcomputers", June 1980. This report contains detailed specifications of 149 microcomputer models from 49 vendors. All of these models are either currently being shipped or are due to be delivered shortly. It is evident that several of the entries could satisfy the preliminary requirements for an MFT. The discussion in Paragraph 3.4 is based largely upon this volume.

3.2.2 "All About Personal Computers", May 1980. This report describes 15 microcomputers. Some of these also appear in "All About Microcomputers". Datapro attempts to differentiate between "personal computers" and those supplied to OEMs (original equipment manufacturers). The distinction is very difficult because all of the systems use the same types of microprocessors and all have approximately equivalent data processing capabilities. Datapro suggests that a personal computer is one that sells for \$2000 or less and that is sold to non-professional programmers. The major distinction for the purposes of this survey is that none of the low-priced computers offers the necessary expansion capability and flexibility of system configuration. This distinction removes from consideration the Radio Shack TRS-20 that is by far the most widely sold and most widely known microcomputer.

3.2.3 "All About Small Business Computers", January 1980. This report describes 266 data processing systems offered by 71 suppliers. These are general purpose computers, and virtually all of them appear to be capable of meeting the initial requirements stated for the MFT. Many of these business computer systems are built around a microprocessor chip, but the remainder qualify technically as minicomputers rather than microcomputers. Datapro is again unable to make a clear distinction between this and other categories except to point out that business computers tend to be higher priced and to include software and peripheral devices that accommodate business applications. These business computers can be safely excluded from consideration for an MFT test bed because they tend to be too bulky, too fragile, too decorative, and too expensive for use at a tactical unit headquarters.

3.2.4 "All About Communications Processors", May 1980. This report describes 84 units currently marketed by 39 suppliers. None of these is mentioned in any of the previous references although nearly all appear to be microprocessor based. In Datapro's words, "A communications processor, in the context of this report, is simply a digital computer that has been specifically programmed to perform one or more control and/or processing functions in a data communications network". Almost any general purpose computer can be programmed to handle the communication function. The devices in this reference need not be considered for possible use as an MFT for the following reasons:

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- (a) Many are designed to work as a front end terminal in conjunction with a particular vendor's large scale computer or "mainframe".
- (b) Many have "hard-wired logic" that cannot be programmed for other data processing functions.
- (c) All are programmed for various commercial communication systems rather than for the military system within which the MFT must operate.

3.2.5 "Microprocessor Specifications", May 1980. This report describes 114 microprocessors from 21 manufacturers. It gives a semi-technical discussion of the important characteristics of microprocessor chips in general, and it gives some assistance in selecting a chip for a particular application. The publication is of limited value to this survey because the large majority of the chips that it describes have not been incorporated into complete systems for use as general purpose computers. Many chips appear to be intended for use in special purpose device controllers. Some of the tabulated items are printed circuit boards that contain not only the microprocessor, but also the interconnections and support chips necessary to make a complete controller. A few of the more versatile microprocessors appear in more than one entry because they are produced by two or more manufacturers and are also incorporated into printed circuit boards.

3.2.6 "All About User-Programmable Terminals", November 1979. This report describes 108 systems from 52 vendors. A check of the tabulated data shows that all of these devices are computers and some appear to qualify as general purpose computers. Datapro offers a lengthy discussion of their reason for separating this group of devices from the business computers, communication processors, personal computers, and microcomputers described in the other reports. The distinction is not very important for the purposes of this survey because the tabulated data can be compared with the general characteristics that have been specified for an MFT. No programmable terminal is found to be suitable, but the comparison is described in Paragraph 3.3 to give some insight into the type of commercial equipment that is available.

3.2.7 Additional reports. Three reports were reviewed but will not be discussed as a part of this survey. They deal with graphic display devices, facsimile devices, and printers. The previously named documents show that it is possible to obtain a complete system from a single vendor. Since this is true, there is little to be gained by selecting equipment from several different vendors. Printers in particular are very competitive, and it is possible to obtain satisfactory devices from several vendors. Graphic displays and facsimile devices are far less common, and suitable equipment may be obtainable only from vendors that specialize in that type of equipment. In any case, the latter two peripherals are not required for the initial implementation of an MFT although they will be recommended for advanced experimentation.

3.3 Survey of User-Programmable Terminals. The Datapro report on 108 programmable terminals tabulates 54 characteristics of these devices in 11 different categories. Some of these characteristics are directly related to the general requirements for an MFT. It was found to be possible to eliminate from further consideration all of the terminals described in those tables. The process of elimination is described in the following paragraphs. The relevant characteristics do not represent all of those given by Datapro and are not presented in the same order. Many of the chosen characteristics are interrelated, and few of the terminals were eliminated on the basis of a single adverse characteristic.

3.3.1 Processor description. The fundamental requirement for an MFT is that it contain at least one microprocessor. Forty-five of the 108 terminals are based upon minicomputers and must be eliminated. Minicomputers are usually built with integrated circuit chips of the "discrete logic" variety. They may be faster and more versatile than some microcomputers, but they are also larger and more expensive.

3.3.2 Stand-alone capability. Another fundamental MFT requirement is that it can stand alone as a data processor without support from a host computer. Twenty three of the terminals are regarded by their vendors as being unsuitable for stand-alone use as a small business computer. Thirteen of the 23 contain microprocessors, so that examination of the first two characteristics has eliminated over half of the programmable terminals.

3.3.3 Interactive keyboard display. All of the terminals include a keyboard to allow the user to communicate with the computer. Most of them communicate to the user with a display that probably always consists of a cathode ray tube (CRT) screen. The remainder communicate to the user with a printer that operates like an electric typewriter. Printer terminals are relatively slow, awkward and expensive to use. The MFT requires the speed and ease of use of at least one CRT display, and therefore the 15 terminals that provide only printers must be eliminated. Ten of these were not eliminated by previous considerations.

3.3.4 Main memory. This is the temporary memory that contains programs and data during processing. Most modern processors utilize semiconductor memory which is so inexpensive that a truly general purpose computer should contain the maximum that can be handled by most microprocessors. This maximum is 64K bytes, and the charts show that 29 of the terminals cannot be obtained with this much main memory. It is of interest to note that two of the Texas Instruments terminals use from 20K to 80K bytes of bubble memory as the main storage. There is no reason to use bubble memory in the MFT at this time, but it may soon be an important means of mass storage.

3.3.5 Mass storage. A truly important requirement for the MFT is that it be capable of storing large amounts of data where it is readily accessible to the user through the central processor. This type of storage is called mass storage, and it provides for placing data in magnetic form on disks, diskettes, or tapes. Punched paper tapes and punched cards appear to be used rarely, if at all, with these terminals. Disks come in several varieties, of which the so-called Winchester disk is the most modern and probably the most generally satisfactory. Many disk drives can make at least 20 megabytes of data accessible to the processor. Diskettes, or floppy disks, are available in several different configurations and combinations, but they seldom make more than two megabytes of data available to the processor.

Tapes are supplied in cassettes, in cartridges, or sometimes on open reels. They can contain very large amounts of data, but the data is not readily accessible to the processor because the tape must be moved by mechanical means. The MFT will require at least 20 million bytes of disk storage and may also require some floppy disk storage. Magnetic tapes, paper tapes, and punched cards are not needed. The Datapro charts show that 79 of the programmable terminals are not capable of using disk drives, although some of these can use floppy or minifloppy diskettes. Of the remaining 29, only nine are claimed to be available with Winchester disks.

3.3.6 Communication parameters. The MFT clearly needs the capability to transmit data over at least one telephone channel. All of the terminals in the Datapro chart have this capability in some form. With one or two exceptions they include interfaces that conform physically and electrically to the RS-232 standard which would be acceptable in an MFT. Only three of them also provide the Mil-188C military standard interface, and those are all minicomputer based. Most of the terminals communicate with ASCII characters, as will the MFT, but nine of them are exclusively IBM-compatible and recognize only EBCDIC characters. Most of the terminals are capable of half duplex or full duplex operation in either a synchronous or asynchronous mode at speeds up to at least 2400 bits per second. These appear to conform to MFT requirements except for the fact that none have been specifically designed to synchronize with military communication equipment.

Some of the terminals have evidently been programmed or wired to respond to one or more of the commercial communication protocols including BSC, SDLC, and HDLC. These are of no value to the MFT which must conform to a military protocol, but this would need careful investigation. More important is the fact that none of these terminals appears to be capable of managing more than one communication channel. It will be shown that the MFT must be capable of using from four to 12 communication channels concurrently. If this were the sole reason for eliminating a terminal from consideration, it would require closer investigation because optional control of multiple channels might be available.

3.3.7 Input-output devices. The MFT clearly needs a medium speed printer and several serial input-output ports to which can be connected various peripheral devices. At least one I/O port may be needed in some circumstances to communicate with a local or remote Teletype terminal or torn-tape relay center. One or more ports can be used to drive video monitors for displaying tabular information, and at least one additional port will eventually be needed for a data digitizing device. Forty-one of the terminals provide no spare I/O ports, and many of the rest appear to provide only one. About 44 of the terminals appear to be incapable of driving a line printer. These terminals frequently use serial printers which are much slower than the typical line printer. Two of the charted terminals are reported to provide four serial ports, two more offer up to eight ports, and one claims a "wide selection of interfaces". In general, it appears that inadequate flexibility in equipment configuration would be a serious problem in attempting to use most of these programmable terminals as an MFT.

3.3.8 Software support. The MFT, like virtually any other general purpose computer system, requires certain standard software packages. These are often supplied by the equipment vendor and are adapted to the particular CPU and set of peripherals. All of the vendors of the charted terminals provide some sort of software support, but the descriptions are necessarily very brief, and there is no way to judge the quality of the software that is actually provided. Even the judgement of software quality and applicability is a very subjective undertaking and should never be the sole basis for system rejection. However, some observations are possible. The MFT will be expected to handle communications in real time while concurrently performing storage, retrieval and processing of data under the interactive direction of one or more users. In short, the MFT software must have a multiprogramming or multitasking capability. The Datapro charts show specifically that 53 of the terminals are not claimed to have this capability. Several more can handle only two tasks, and a few invite further investigation by claiming to handle up to 256 concurrent tasks.

The MFT would probably be programmed in assembly language where speed of operation and economy of storage are of paramount importance, as in the communication control programs. Most the remaining MFT applications programs could most efficiently be programmed in some higher level language. Selection of such a language is also a subjective matter, but at least several languages should be made available by the equipment vendor. The programmable terminals are obviously intended for business applications, and the languages most often supplied are COBOL, BASIC, RPG, and several obscure variations of these such as TIBOL, KOBOL, Interactive COBOL, and MOBOL. None of these should be chosen for the MFT. FORTRAN is available for a few terminals, and PASCAL is available for fewer still. Either of these could be acceptable for MFT programming depending upon the quality of the specific language implementation.

3.3.9 Microprocessor type. Choice of a specific microprocessor chip remains another subjective activity despite the fact that many articles have been written to compare various devices under many different conditions. As stated above, 73 of the 108 terminals use microprocessors. One terminal uses the 12-bit 6100 chip, and two use a 4-bit-slice chip, the AMD 2900. Seventeen terminals use 16-bit CPU's including the TMS 9900, a special Intel 8000, the Micronova, and the LSI-11 chip set. The remaining CPU's are all 8-bit devices including 27 8080A/8085's, 9 6800's, 5 Z-80A's, and one each of 6512, IMP, and 1802. If a choice were to be made solely upon the type of microprocessor, the following points should be given consideration:

3.3.9.1 Word length. A 16-bit word probably offers some advantages in speed over an 8-bit word. Addressing any location in a 64K main memory requires 16 bits, and it is usually faster to present the address in a single group of 16 bits rather than in two consecutive groups of 8 bits each. The relative frequencies of the system clocks and the inherent speed of the memory chips must also be considered. Certainly there is no justification for the conclusion that a 16-bit word is twice as efficient as an 8-bit word.

Only one chip, the 6100, offers a 12-bit word length. This chip was designed to make possible a low cost reproduction of the Digital Equipment Corporation's PDP-8 minicomputer. The PDP-8 was the first popular minicomputer, and more of them have been sold than any other minicomputer. A huge library of programs exists for the PDP-8, and the 6100 chip permits taking advantage of these programs. The design of the PDP-8 is primitive in comparison with modern microprocessors, and there is no reason to consider a 6100 based system for use as the MFT.

3.3.9.2 Popularity. Owing to the explosive growth of microcomputer technology, it must be assumed that any chip chosen today will become obsolete in a very few years. This suggests that a popular chip should be selected because there is greater likelihood that an upward compatible chip will be available in the future. Instruction sets are all complex, and they vary widely in characteristics from one chip to another. Conversion of programs from one set to another can be difficult and can produce a loss in efficiency where a gain is expected. On the basis of the sampling represented by this Datapro report, the 6100, the AMD 2900, the 6512, the IMP, and the 1802 microprocessor chips should all be avoided because of relatively low popularity. Other samplings are likely to give similar results.

3.3.9.3 Obsolescence. The rapid growth of the technology also suggests that it would be unwise to select a microprocessor chip that has already been superceded by a newer and more powerful chip. The 8080 is one of the most widely known and used chips, and the contents of the Datapro report verify that statement. The 8080 has been superceded by the 8085 from the same vendor (Intel) and by the Z-80A from a competitor (Zilog). The 8085 offers little improvement for the software designer since only two instructions have been added to the 8080 set. The Z80A, on the other hand, offers significant improvements, both electrically and logically. It can also execute all programs written for the 8080. The Z80A has itself been superceded by a whole series of 16-bit chips, the Z8000 series. According to the Datapro report, at least, no programmable terminals have yet been offered with Z8000 microprocessors. It may not be advisable to wait for such systems, but it seems unwise to purchase new equipment that contains an 8080A or 8085 microprocessor when systems are available with the Z80A.

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The 6800 chip was introduced at about the same time as the 8080 and was intended to be directly competitive. It never gained the popularity of the 8080 although it offered several technical advantages. The design of the 6800 has been improved in the 6802 and 6809, but the latter two chips do not appear in off-the-shelf terminals according to this Datapro chart. The Z80A is a better choice than the 6800 and is the best choice of all of the 8-bit microprocessors represented in the chart.

3.3.9.4 System architecture. The apparent advantages of the Z80A can be readily overshadowed by other system characteristics. The chart shows five systems that contain Z80As. One of these must be rejected because it does not possess a CRT-type terminal. The second and third must be eliminated because they have no disk storage and insufficient software support. The fourth also lacks software support because it offers only the BASIC language and what appears to be a report formatting language that is unique to the vendor. The fifth Z80A based system has little expansion capability in terms of input-output ports, and it has no multiprogramming capability.

3.3.10 Summary. This Datapro report shows that none of the 108 user-programmable terminals can be considered for use as an MFT. The most common deficiencies are lack of hard disk storage, lack of sufficient communication capability, and lack of ability to accommodate additional peripheral devices.

3.4 Survey of 149 Microcomputers. The Datapro report on 149 microcomputers tabulates 61 characteristics of these devices in 11 different categories. The characteristics are similar to but not the same as those used to compare the user-programmable terminals. The evaluation of 61 characteristics is not as difficult as it might seem because some are of relatively minor importance and some are redundant. For example, under the category of "Packaging", the table gives the number of printed circuit boards that comprise the computer, the size of the board, the number of chips used, and whether or not a power supply, a control console, and a cabinet are supplied. The microprocessor chip is identified, but the chip technology, the data word size, the instruction word size, the number of instructions, and the number of registers are also given when these are all characteristics of the chip.

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Examination of the chart shows that many of the microcomputers are not really general purpose computers of the sort needed for an MFT. It is difficult to identify the special purpose devices because vendors are understandably reluctant to place limitations upon their products. Five characteristics were singled out that rapidly cut down the number of entries which deserve detailed consideration. These characteristics are not necessarily the most important for an MFT, and they are not necessarily applied in the order of relative importance. They are, however, essential characteristics that can be examined objectively.

3.4.1 Direct memory access. The MFT must be capable of managing an intermittent flow of data on a communication channel while concurrently performing other tasks involving the user's interactive terminal and the mass storage device. The most efficient way to coordinate these operations is to include in the system design a direct memory access (DMA) controller chip that moves data from an input-output port to main memory with minimum disturbance to the CPU. Most general purpose computers have this chip as a standard component, but many special purpose devices do not. The chart shows that 48 of the 149 microcomputers have no DMA capability. Two of the most widely distributed microcomputers, the Commodore Pet 2001 and the Radio Shack TRS-80 Model 1 are thus eliminated.

3.4.2 Main memory capacity. The MFT will execute programs of moderate complexity, and these programs will work with large volumes of data from mass storage. The main memory is used to store both programs and data during program operation, so the maximum available size of main memory is required. Any 8-bit microprocessor chip can manage 64K bytes of main memory, so it is reasonable to require that a candidate system be capable of providing that amount. Many systems can be supplied with variable amounts of main memory up to a maximum of 64K, and these systems are not excluded. The chart shows that, of the remaining 101 microcomputers, 26 cannot be obtained with 64K bytes of main memory.

One reason for the lack of main memory is that the system dedicates up to 16K bytes of read-only memory (ROM) to the storage of a BASIC language interpreter. This is a common practice in microcomputers intended primarily for "personal" or non-professional use. BASIC is easy to use, but it produces programs that are far too slow for most of the applications foreseen for the MFT. The very popular Apple Computer must be eliminated for this reason even though it offers a choice of BASIC or PASCAL in ROM.

3.4.3 Vendor stability. The "Comments" category in the chart shows that one vendor (Automated Computer Systems) did not answer inquiries for information in 1980 although it did respond in 1979. Two of this company's products were previously eliminated, but the remaining four products are now eliminated to reduce the number of units still under consideration to 72.

Many of the companies in the microcomputer industry are young and very small. Past experience indicates that some of these will soon disappear through failure, acquisition or reorganization. Even those larger companies that have developed in other industries can abandon their commitment to the microcomputer market on short notice and can leave their products without support. Some observations about other specific companies will be made in the following paragraphs.

3.4.4 Principal application. Many of the devices shown on the chart are manufactured for sale to OEMs who will incorporate them into other products for sale to an end user. Some of these are identified as "single board computers". These are often complex printed circuit boards that contain a microprocessor chip and several support chips including substantial amounts of main memory. They sometimes include a cabinet and a power supply, but they do not include the peripheral devices such as CRT terminals and printers that make a complete general purpose computer. Other devices on the chart are indicated to be "prototyping systems" or "simulators" or "teaching aids" or "microcomputer development tools". All of these are intended for special applications rather than for general purpose data processing. Forty of the charted devices fall into one or another of these special applications.

In this group are four products of Computer Automation, Inc. These are the "Naked Mini" line of computers. The vendor proclaims them to be minicomputers rather than microcomputers, and they probably shouldn't be listed. In any event they can be excluded because they are offered for sale only to OEMs according to the company's sales brochure.

3.4.5 Microprocessor type. At this point, 35 microcomputers remain as candidates for selection, and it becomes necessary to examine the characteristics that describe the microprocessor itself. It will be shown that 16 8-bit devices and one 16-bit device remain for consideration. The process of selection by type of microprocessor is as follows:

- (a) The MP12 by Fabri-Tek, Inc. contains a CPU made up of small scale and medium scale integrated circuit chips of the transistor-transistor-logic (TTL) variety. This qualifies the system as a minicomputer rather than a microcomputer. Even if an error was made in the chart, the system uses a 12-bit word that emulates the outdated PDP-8 minicomputer architecture. The MP12 must be excluded.
- (b) Three of the remaining systems use an 8080A microprocessor, one uses the very similar 8085A, and 14 systems use the Z-80A. The latter is more modern and is generally regarded as far superior to the first two. Since there are so many Z-80A systems, there is no reason to further consider any 8080A or 8085A based systems.
- (c) Five systems use other types of 8-bit microprocessors. One uses a 6800 while two others use the 6809, a more modern member of the same family. The 6800 system should be excluded. Another system uses the CDP 1802, a chip better adapted to special purpose controller use. This system (by Diversified Technology, Inc.) is probably used for development work rather than for general data processing, and it should be excluded. The remaining system uses the 6502 microprocessor. Millions of these chips have been sold, and many have been included in popular microcomputers of the "personal" variety such as the Apple and the six models by Ohio Scientific. The remaining 6502 system is the ETC-1000 by Electronic Tool Co., an organization which appears to be a custom configuration specialist. There is no reason to choose the 6502 when systems containing the Z-80A and the 6809 are available.

- (d) The remaining seven systems use microprocessors with 16-bit words. Three of those systems are by Digital Equipment Corporation (DEC), and two more are by Plessey Microsystems using DEC computers. All five of these systems are variations of the same LSI-11 microcomputer. The LSI-11 qualifies in all respects as a candidate for selection as an MFT. It will be discussed further in Paragraph 3.4.7.
- (e) The Data General MP/100 system also appears on the charts, and it could probably satisfy all of the requirements for an MFT. It has not been as widely distributed as the LSI-11, does not enjoy the same degree of software and maintenance support, and does not offer any advantages over the LSI-11. The remaining 16-bit machine is the Texas Instruments 9900/4 Home Computer that is not competitive in any way with the DEC and Data General machines. If compared with the 8-bit systems, it would be excluded because it dedicates 26K bytes of main memory to a ROM containing a BASIC interpreter. This fact is not evident from the Datapro charts.

3.4.6 Selection of 8-bit devices. Sixteen 8-bit systems remain. These contain two microprocessor chips, the Z-80A and the 6809. Nine vendors are represented, and the characteristics of the vendor now become of primary importance. The selection of a single vendor can be justified as follows:

3.4.6.1 Cromemco, Inc. This company is represented in the charts by four Z-80A based systems. It advertises frequently in many of the microcomputer-oriented publications. It publishes a complete catalog and maintains a network of dealers which now covers 42 states and 35 foreign countries. The Datapro charts indicate no deficiencies in any of the four systems that would remove them from consideration. The catalog shows that these systems have many additional qualities which would be advantageous in an MFT. This vendor is judged to be completely capable of supplying a satisfactory MFT test bed.

3.4.6.2 Dynabyte, Inc. This company supplies two Z-80A based systems according to the charts. It advertises infrequently and apparently offers a line of equipment similar in many respects to that of Cromemco. Advertising is oriented toward business applications such as accounting and word processing. Probably an MFT could be assembled from Dynabyte products, but the company is evidently much smaller than Cromemco and has a very limited dealer structure.

3.4.6.3 Heurikon Corporation. This company offers two Z-80A based systems that appear to be satisfactory for use as an MFT except for the fact that they depend upon a cross-assembler rather than a resident assembler. No advertisements from this company have been located, so it seems likely that they are supplying a small localized market for a special purpose computer. There is nothing to be gained by selecting their product.

3.4.6.4 Infinite, Inc. This company offers one model that can be obtained with an 8080A, an 8085, or a Z80A chip. The company occasionally places small advertisements that suggest it is really in the business of supplying plug-in printed circuit boards to OEMs. At best, the product appears to be an intelligent terminal that does not provide many of the capabilities needed in an MFT.

3.4.6.5 North Star Computers, Inc. This company offers a Z-80A based system that is advertised widely and evidently is well accepted by users. Their impressive catalog displays a complete line of equipment including a hard disk drive capable of storing 18M bytes of information. The company advertises in the personal computer market and also in the small business market. Their products could doubtless meet most of the requirements for an MFT. The packaging of the equipment is definitely inferior to that of Cromemco for an industrial or tactical military environment. The dealer network appears to be smaller than Cromemco's, and the equipment design does not provide for some of the useful expansion options that are offered by Cromemco. Those options will be discussed in Paragraph 3.4.7.

3.4.6.6 Quay Corporation. This company offers three Z-80A based systems that have survived the preliminary selection processes. The company advertises in the personal computer publications but appears to be interested in selling to OEMs. It is attempting to offer low-priced competition to North Star. There is no evident reason to select the product of this company.

3.4.6.7 Radio Shack. This company offers the TRS-80 Model II, a Z-80A based system that appears to meet many of the requirements for an MFT. The system enjoys wide distribution and probably has better maintenance support than any other product in this group. It is intended primarily for business applications and does not have packaging that is sufficiently compact and rugged for air transport and for employment at the tactical air base. No mass storage other than multiple minifloppy diskettes is offered by the vendor. Expansion capability is very limited and is inadequate for use of this system as an MFT.

3.4.6.8 Southwest Technical Products Corporation. This company offers the only two systems in the charts that include the 6809 microprocessor. This is a more modern version of the 6800 chip and may justify the vendor's claim that it is the most powerful 8-bit microprocessor available today. The company advertises extensively in the personal computer market but is willing to sell to OEMs. Their catalog is less impressive than their advertisements. The company evidently has no dealer network and offers no maintenance support. Expansion capability is limited, and many peripheral devices are not supplied by the vendor although they could be obtained elsewhere. The attractive features of the 6809 are not sufficient to justify selection of a system from this company.

3.4.7 Conclusion. The selection process has singled out two systems that would be excellent choices for use as an MFT test bed. One CPU uses an 8-bit word while the other uses a 16-bit word. There is an undeniable advantage in the use of a 16-bit word, but the actual value of the advantage can only be judged subjectively in the context of the particular data processing application and with consideration of other system characteristics. Many different criteria could be suggested for system comparison, but only two are believed to be necessary in this instance. These criteria are as follows:

3.4.7.1 Flexibility of system configuration. The MFT must serve any of several different elements of the TACS. These elements have data processing needs that vary in degree and type of service. It should be possible to alter the amount of mass storage that is provided for programs and data. It should also be possible to alter the number of input-output channels that must be managed. Some applications will probably be identified that require a graphic display capability, but these will probably not require implementation at all elements of the TACS. Some applications will require multiple video monitors, and some may require an additional interactive user terminal. As experimentation with the MFT progresses, it is to be expected that requirements for the initial set of applications will be expanded while entirely new applications will be suggested. In general, the selected microcomputer system should be capable of accepting a wide variety of peripheral device ports and controllers. The vendor should provide most of the common peripheral devices, and the system should be capable of accepting plug-in modules produced by other vendors.

The Cromemco systems utilize the so-called S-100 bus which provides standard interconnections for peripheral devices. The electrical and mechanical configurations of this bus have been approved by the Institute of Electrical and Electronic Engineers (IEEE). For this reason, several system vendors have incorporated the S-100 bus in their designs, and hundreds of companies are offering for sale an ever-increasing number of devices that are designed to plug into the bus. Cromemco systems can accept a dozen or more optional plug-ins to supplement those that comprise the basic system. The company sells a broad line of plug-ins that can vary system characteristics to fit practically any application. In particular, Cromemco offers a plug-in I/O Processor that contains a Z-80A microprocessor which can be programmed to work concurrently with and under the control of the main CPU. This product is believed to be unique in the industry at the present time. It permits the design of an economical and efficient multi-processor capability into a single integrated equipment configuration. The main CPU and each of the auxiliary CPUs can be fitted with independent read-only memory modules for programs and random-access memory modules for data storage. All can be given access to a single mass storage device through a very effective direct memory access capability. The outstanding flexibility of the Cromemco equipment makes possible the design of an MFT that takes full advantage of the newest microprocessor technology.

The three models of the DEC LSI-11 microprocessor are available in a variety of complete systems including the PDP-11/03 by DEC. Several other vendors also offer systems that combine some DEC equipment with the products of other manufacturers. The Datapro report mentioned only one of these vendors, Plessey Microsystems. Many manufacturers also offer plug-in devices that can be accepted by the DEC bus. This is such a large market that the January 1981 issue of "Digital Design" magazine featured an article entitled "The DEC Compatible World". The article lists scores of products that are marketed to take advantage of the wide popularity of the LSI-11. The list is probably as large as the list of S-100 bus suppliers and may include many of the same names. Despite this broad support, the LSI-11 is believed to be a poorer choice than a Cromemco system for the following reasons:

- (a) DEC does not offer all types of peripheral devices for its own systems, and no other vendor is known that can supply a complete selection. DEC is so large that it must move slowly in offering new devices such as Winchester disks that represent the latest technology. Other manufacturers may temporarily supply the new devices but move on to other markets when DEC finally makes a selection. Assembling an MFT around an LSI-11 would probably require dealing with several vendors.
- (b) The backplane supplied by DEC for the LSI-11 offers less expansion capability than the Cromemco system. There appears to be no plug-in module that is equivalent to the Cromemco I/O Processor. To produce an MFT with a multi-processing capability, it would be necessary to add a complete PDP-11/03 for each additional processor. Interconnections would be more difficult and less efficient since the CPUs could not share the same bus. Shared use of a single mass storage disk would be virtually impossible.
- (c) Although comparison is difficult, the cost of an MFT built from DEC-compatible equipment appears to be about twice the cost of a similar configuration from Cromemco. The cost of a second CPU from DEC would be about five times the cost of the equivalent I/O processor card from Cromemco. Standard system software from DEC costs about three times as much as a set of similar packages from Cromemco. Weight, power consumption, and total displaced volume of equipment appear to be similar.

3.4.7.2 Growth capability. To serve effectively as a test bed for determining TAF requirements, the MFT must be capable of controlled modification to accept new devices and techniques of operation. Applications that are developed on the MFT must be transferable to different equipment configurations with a minimum of difficulty. Applications must also be transferable to systems offered by different vendors to reap the benefits of competition if a large number of MFT-like systems are to be procured. All of these benefits are made available to the computer purchaser for the first time by the choice of a microcomputer based system. Their magnitude of the benefits depends upon the choice of microprocessor.

The 8080 microprocessor was introduced in 1973 and has become the most widely used computer in history. In 1976, the Z-80A was introduced. It was compatible with 8080A programs but offered substantial improvements. In 1979, the Z8000 became available and offered an even greater degree of improvement over the Z-80A. The Z8000 is a 16-bit machine that is comparable in power to mainframes such as the IBM 360/370 series and to the largest of the minicomputers such as the DEC PDP-11/70. No off-the-shelf systems yet use the Z8000, but when they are available, Z-80A programs can be translated to run on them. Meanwhile a very large number of peripheral devices have been developed using support chips compatible with the 8080A and the Z-80A. The great majority of these devices connect to the S-100 bus. In choosing to build systems around the Z-80A chip and the S-100 bus, Cromemco has probably offered its customers the greatest possible capacity for growth.

The DEC LSI-11 microcomputer uses the MCP-1600 chip set which can be microprogrammed to emulate many different 8- and 16-bit computers including the DEC PDP-11/34 minicomputer. The chip set is available to OEMs, but only one, Alpha Microsystems, is known to market a system based upon it. The MCP-1600 is more powerful than the 8-bit Z-80A and may be equivalent to the Z8000 in capability. It now has a great many users and is usually microcoded to be compatible with the whole DEC PDP-11 family of minicomputers, so it is not likely to be replaced for many years. As previously mentioned, a great many vendors offer DEC-compatible equipment that often is at the forefront of the technology. DEC itself can be said to offer a system with excellent current capability but with limited possibilities for growth through the exploitation of new technology.

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3.4.7.3 Recommendation. The equipment offered by Cromemco Incorporated is the most responsive to the general selection criteria stated in Paragraph 3.1.2.2. A detailed configuration of this equipment will be described in Paragraph 5 after the functional and operational requirements have been established.

#### 4. MFT FUNCTIONAL TASK REQUIREMENTS

4.1 Approach. The methodology used to determine the functional requirements for each of the 15 command and control tasks as described in Paragraph 2.4 and is based upon two primary factors. These are:

- (a) The type and volume of data elements found in formatted data exchange messages.
- (b) The internal processing and display of that data to provide maximum user assistance in completing designated command and control tasks at the WOC level only.

The functional requirements for each are stated in user terms and will reflect what the data processing functions must provide to the user. No attempt is made to specify the exact internal data processing programs that accomplish the user requirements.

#### 4.2 Mission Control Task Requirements

4.2.1 Mission request processing. The requirements of this task are to provide the user with an ability to input user-determined mission request data, visually review individual mission request data in a user-defined format and visually review current status displays of all mission request data files.

4.2.2 Mission plan processing. The requirements of this task are to provide the user with the ability to separately implement each of the specific program routines associated with the detailed mission planning of an individual tasked mission and view the results of each routine in graphic display if applicable. Examples of routines for individual tasked mission include:

- (a) Availability and capability of specific weapon systems to perform the mission.
- (b) Weapon system delivery tactics.
- (c) Standard route profiles.
- (d) Threat assessment.
- (e) Terrain effect on mission.
- (f) Target material requirements.
- (g) Safe area location.

The crew products required from the accomplishment of this task are:

- (a) The Pilots Flight Plan and Flight Log (similar to AF Form 70).
- (b) A mission strip flimsy in graphic form depicting key enroute locations, threats, safe areas, and targets.
- (c) Specific target materials as required.

4.2.3 Mission tasking processing. The requirements of this task are to provide the user with all data applicable to individual tasked missions provided in the Air Tasking Order. The user must have the ability to view the data in several user defined sorts and allocate specific aircraft and aircrews to each mission.

4.2.4. Mission monitoring processing. The requirements of this task are to provide the user with the ability to input user-determined mission debrief data, visually review individual mission debrief data in a user-defined format and visually review current status displays of all mission debrief data files.

#### 4.3 Current Information Task Requirements

4.3.1 Resource availability processing. The requirements of this task are to provide the user with the ability to input user-determined resource availability data, to visually review all resource availability data by type of resource, and to visually review current status displays of all resource availability data files by resource type in user defined formats.

4.3.2 Friendly force disposition processing. The requirement of this task is to provide the user with a graphic display of friendly force locations by type and geographic area as defined by the user.

4.3.3 Enemy force disposition processing. The requirement of this task is to provide the user with a graphic display of enemy force locations by type and geographic area as defined by the user.

4.3.4 Weather processing. The requirement of this task is to provide the user with a graphic display of weather data by type and geographic area as defined by the user.

#### 4.4 Background Information Task Requirements

4.4.1 Resource capabilities processing. The requirement of this task is to provide the user with a display of capability data by weapon system type. This task uses data that changes infrequently. The user must have a data update capability.

4.4.2. Terrain description processing. The requirement of this task is to provide the user with a graphic display of user selected terrain data by terrain type and geographic area as defined by the user.

4.4.3 Friendly force capabilities processing. The requirement of this task is to provide the user with a display of friendly force weapon systems capabilities by weapon type.

4.4.4 Enemy force capabilities processing. The requirement of this task is to provide the user with a display of enemy force weapon systems capabilities by weapon type.

#### 4.5 Information Analysis Task Requirements

4.5.1 Threat assessment processing. The user graphic display requirement of this task is directly related to routines in the mission planning requirement.

4.5.2 Target nomination processing. The requirement of this task is to provide the user with a graphic display of individual target data in several user-defined sorts such as target type, target location, target priority, etc. This task is directly related to the mission request, mission plan and mission tasking requirements.

4.5.3 Penetration analysis processing. The user graphic display requirement of this task is directly related to routines in the mission planning requirement.

4.6 MFT Modular Structure. In the tactical environment there is a demanding need to perform basic independent tasks simultaneously and with a maximum of speed and efficiency. Many of these tasks are repetitive and cyclic. They can be easily grouped into three major categories. One group deals with the receipt and dissemination of data in a prescribed data format and communications protocol. A second group performs data file storage, update and retrieval functions as well as specific applications programs. The third group handles all functions related to data display and user interaction with the computer system.

Based upon this grouping of functional tasks, a modular configured design would include a Communications Subsystem, a Storage and Retrieval Subsystem, and a Display Subsystem. Each subsystem must have the independent and simultaneous ability to perform its assigned tasks, and pass the results of those tasks to another subsystem, as necessary, without interruption. Each subsystem must be self-contained, must have high reliability, must have the flexibility to accommodate new technology capabilities, and must be maintainable by non-technicians. The subsystems must interface physically and electrically with minimum complexity to form a total system. The total system must have the ability to be easily tailored or reconfigured to meet a variety of physical and operational combat environments.

4.7 Communication. It has been shown in Paragraph 3 that many of the 15 command and control tasks depend upon the flow of information between components of the TACS and also of the JTF. A principal requirement for the MFT is that it be capable of supporting this flow of information at any of the component units. The dimensions of the requirement depend upon the number of message types to be recognized, the number of functional tasks to be supported by the MFT, and the amount of message traffic generated by each task.

4.7.1 Message types. It has been mentioned that JINTACCS message formats soon will be used by all of the armed services and allied nations. The formats associated with each command and control task have been listed in Tables 1 through 10. These formats fall into four categories, as follows:

- (a) Data messages. These contain information that could be placed in computer files and recalled in one form or another to support one or more of the command and control tasks. These form the principal load on the MFT.

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- (b) Transfer messages. These messages contain summary type free-text information that must be generated by humans rather than by computer programs. The MFT would usually be expected to assist in the preparation of these messages, to transmit them, and to receive them.
- (c) Control messages. These messages are exchanged by voice radio between ground stations and aircraft or other mobile ground stations. They report current status or provide in-flight control. They are seldom written and will not appear in digital form so will not be processed by any MFT.

Table 11 lists in alphanumeric order all 144 of the JINTACCS formats that could be used within the TACS. These formats are assigned to one of the four groups described above.

4.7.2 Data messages. Table 12 shows the 68 data messages that were designated in Table 11. Additional information about them is given as follows:

- (a) LEN. This column gives the estimated average length in characters of messages in each format. These figures cannot be exact because the JINTACCS specifications provide for wide latitude in the structure of most formats. They are intended to support a first approximation of message traffic volume.
- (b) IN. This column shows the estimated number of such messages that will arrive at a WOC in a 24-hour period under typical tactical conditions.
- (c) OUT. This column shows the estimated number of such messages to leave a WOC in a 24-hour period. The IN/OUT estimates are based upon first hand experience with equivalent message types, but they are still only rough approximations.
- (d) PBH. This shows the clock time of the peak busy hour of the day for messages of this type. This value appears to have little significance.

4.7.3 Transfer messages. Table 13 shows the 23 transfer messages that were identified in Table 11. The same type of estimates are shown for these formats. It seems reasonable to conclude that the communication channel traffic generated by these messages will not produce a significant load on the system. There will, however, be a need for the MFT to store these formats and to provide programmed checks.

4.7.4 Component versus application. The various components of the TACS have specialized duties so that not all of them participate in all of the command and control tasks. Table 14 shows columns for each of the eight applications that require the exchange of data and transfer messages. A row is provided for each of the TACS components described in Paragraph 2. An X at the junction indicates that the component participates to some degree in that application. The table suggests that it may be advisable to vary the MFT hardware and software at different components to minimize cost, space problems, and training requirements. Like all of the other tables, this table is open to considerable discussion. It illustrates the type of information that should be sought by experimentation.

TABLE 11  
JINTACCS MESSAGE SUMMARY

| MESSAGE | DATA         | TRANS | TACC | CTRL |
|---------|--------------|-------|------|------|
| A100    | TARBUL       | X     |      |      |
| A210    | FMC          |       | X    |      |
| A260    | FSC          | X     |      |      |
| A421    | EXORD        | X     |      |      |
| A422    | FRAGORDER    | X     |      |      |
| A425    | ERTM         | X     |      |      |
| A440    | WARNORD      | X     |      |      |
| A635    | HELOALDAT    | X     |      |      |
| A650    | APORALOT     |       | X    |      |
| A651    | EMPLOYALOC   |       | X    |      |
| A652    | SORTALOT     |       | X    |      |
| A653    | CROSSDAT     | X     |      |      |
| A661    | REQSTSTSK    | X     |      |      |
| A690    | TACOPDAT     | X     |      |      |
| A691    | TECHOPDAT    | X     |      |      |
| A770    | ALORD        | X     |      |      |
| A900    | ADSCRAMORD   | X     |      |      |
| A901    | SARSCRAMORD  | X     |      |      |
| A902    | TNKSCRAMORD  | X     |      |      |
| A903    | CASSCRAMORD  | X     |      |      |
| B260    | FRD          | X     |      |      |
| B702    | JLNCHREP     | X     |      |      |
| B703    | AIREVENT     | X     |      |      |
| B704    | ABCHANGE     | X     |      |      |
| B705    | ACSAMSTAT    | X     |      |      |
| B711    | ENGSTS       |       |      | X    |
| B750    | JINFLT       |       |      | X    |
| B900    | TACOPLINEUP  | X     |      |      |
| B901    | UNITSTATREP  | X     |      |      |
| B902    | FCLTYSTATREP | X     |      |      |
| B903    | RESUSTATREP  | X     |      |      |
| B904    | CNTRLCAPREP  |       | X    |      |
| B905    | ALCESTATREP  | X     |      |      |
| B906    | CCTSTATREP   |       | X    |      |
| B907    | ARPSTATREP   | X     |      |      |

TABLE 11 (cont.)  
JINTACCS MESSAGE SUMMARY

| MESSAGE            | DATA | TRANS | TACC | CTRL |
|--------------------|------|-------|------|------|
| B908 CASALSTATREP  | X    |       |      |      |
| B909 TACMUSTATREP  | X    |       |      |      |
| B910 AIRDEFFTRSTAT | X    |       |      |      |
| B911 SAMSTATREP    |      |       | X    |      |
| C001 MSGCHANGERE   | X    |       |      |      |
| C100 IPIR          | X    |       |      |      |
| C101 SUPIR         |      |       | X    |      |
| C102 MIPIR         |      |       | X    |      |
| C110 INTREP        | X    |       |      |      |
| C111 TACREP        |      |       | X    |      |
| C112 TGTINFOREP    | X    |       |      |      |
| C113 HOTPHOTOREP   | X    |       |      |      |
| C120 MIJIFEEDER    | X    |       |      |      |
| C121 TACELINT      | X    |       |      |      |
| C130 MISREP        | X    |       |      |      |
| C131 SENREP        |      |       | X    |      |
| C240 FMR           | X    |       |      |      |
| C400 SITREP        |      | X     |      |      |
| C420 SARSIT        |      |       | X    |      |
| C440 RPTMINEOPS    | X    |       |      |      |
| C441 NBC4          |      | X     |      |      |
| C442 NBC3          |      | X     |      |      |
| C444 NBC5          |      | X     |      |      |
| C451 VULWARN       |      |       | X    |      |
| C460 COMSPOT       | X    |       |      |      |
| C482 SARIR         |      |       |      | X    |
| C485 NBC1          |      | X     |      |      |
| C486 OPREP-3P      |      | X     |      |      |
| C487 OPREP-3       |      | X     |      |      |
| C490 OPREP-3PNF    |      | X     |      |      |
| C491 OPREP-3PFB    |      | X     |      |      |
| C492 OPREP-3PED    |      | X     |      |      |
| C493 OPREP-3PEV    |      | X     |      |      |
| C494 OPREP-3PBA    |      | X     |      |      |
| C495 OPREP-3BS     |      | X     |      |      |

TABLE 11 (cont.)  
JINTACCS MESSAGE SUMMARY

| MESSAGE           | DATA | TRANS | TACC | CTRL |
|-------------------|------|-------|------|------|
| C496 OPREP-3FG    |      | X     |      |      |
| C520 SEVERE STORM | X    |       |      |      |
| C521 WXFCST       | X    |       |      |      |
| C522 WXRPT        | X    |       |      |      |
| C523 PTWXWARN     | X    |       |      |      |
| C900 TAKEOFFREP   | X    |       |      |      |
| C901 LANDINGREP   | X    |       |      |      |
| C902 ABORTREP     |      |       |      | X    |
| C903 TNKINFLTREP  |      |       |      | X    |
| C904 AIRDELAYREP  |      |       |      | X    |
| C905 GNDDELAYREP  |      |       |      | X    |
| C906 DISTRESSREP  |      |       |      | X    |
| C907 DOWNEDPIREP  |      |       |      | X    |
| C908 ARRIVALREP   | X    |       |      |      |
| C909 DEPARTURERE  | X    |       |      |      |
| C910 ADVISORYREP  | X    |       |      |      |
| C913 CGOEXCREP    |      | X     |      |      |
| C914 INIATIALREP  |      |       |      | X    |
| C915 UPDATERE     |      |       |      | X    |
| C916 CORECMREP    |      |       |      | X    |
| C917 UNCORECMREP  |      |       |      | X    |
| C918 ECMTERMREP   |      |       |      | X    |
| C919 ORBITREP     |      |       |      | X    |
| C920 SPLITTRKREP  |      |       |      | X    |
| C921 MERGTRKREP   |      |       |      | X    |
| C922 MASSTRKREP   |      |       |      | X    |
| C923 IFFEMERGREP  |      |       |      | X    |
| C924 CONTACTSTREP |      |       |      | X    |
| C925 EMERGREP     |      |       |      | X    |
| C926 TACACTIONREP |      |       |      | X    |
| C927 OFFACTIONREP |      |       |      | X    |
| C928 WEACOMITREP  |      |       |      | X    |
| C929 ECTARREP     | X    |       |      |      |
| D100 JTACARSREQ   | X    |       |      |      |
| D110 RII          | X    |       |      |      |

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TABLE 11 (cont.)  
JINTACCS MESSAGE SUMMARY

| MESSAGE | DATA        | TRANS | TACC | CTRL |
|---------|-------------|-------|------|------|
| D111    | RRII        | X     |      |      |
| D120    | JRSRR       |       | X    |      |
| D200    | JCASINTREQ  | X     |      |      |
| D260    | RFR         | X     |      |      |
| D630    | ALREQ       | X     |      |      |
| D634    | HELOALREQ   | X     |      |      |
| D660    | JAIRREQ     | X     |      |      |
| D666    | JESCREQ     | X     |      |      |
| D667    | JRECREQ     | X     |      |      |
| D668    | JSUPREQ     | X     |      |      |
| E400    | OPLANCHG    |       | X    |      |
| E402    | EWAM        |       | X    |      |
| E445    | STRIKEWARN  | X     |      |      |
| E706    | INITHAND    |       |      | X    |
| E707    | RECHAND     |       |      | X    |
| E710    | ARDEFCOM    | X     |      |      |
| E715    | AIRDEFWARN  |       |      | X    |
| E900    | MSNACFTMSG  |       |      | X    |
| E901    | MSNCNTRLMSG |       |      | X    |
| F260    | RRM         | X     |      |      |
| F401    | EWEM        |       | X    |      |
| F541    | AKNLDG      |       | X    |      |
| F542    | RETRANS     |       | X    |      |
| F625    | REQCONF     | X     |      |      |
| F631    | ALMSNSCD    | X     |      |      |
| F632    | FLTCONTINFO |       |      | X    |
| F636    | HELOALCONF  | X     |      |      |
| F654    | CROSSCONF   | X     |      |      |
| F750    | DESIGAREA   | X     |      |      |
| F751    | ECMDAT      |       |      | X    |
| F752    | TRKMAN      |       |      | X    |
| F753    | TRKREP      |       |      | X    |
| F754    | FLTPLN      |       |      | X    |
| F755    | TRKINTEL    |       |      | X    |
| G130    | DISUM       | X     |      |      |

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TABLE 11 (cont.)  
JINTACCS MESSAGE SUMMARY

| MESSAGE       | DATA | TRANS | TACC | CTRL |
|---------------|------|-------|------|------|
| G131 INTSUM   | X    |       |      |      |
| G423 OPSUM    |      |       | X    |      |
| G424 EWMSNSUM | X    |       |      |      |
| G480 NBC2     |      | X     |      |      |

TABLE 12  
DATA MESSAGE SUMMARY

| DATA | MESSAGE      | LEN   | IN | OUT | PBH   | APPLICATION      |
|------|--------------|-------|----|-----|-------|------------------|
| A100 | TARBUL       | 400   | 18 | 0   | 2200  | EDIS             |
| A260 | FSC          | 800   | 4  | 0   | 0500  | FDIS             |
| A422 | FRAGORDER    | 1500  | 2  | 0   | -     | MPLAN,MTASK      |
| A425 | ERTM         | 900   | 4  | 0   | 2400  | MREQ,MTASK,EDIS  |
| A635 | HELOALDAT    | 2500  | 2  | 0   | 2400  | MTASK            |
| A653 | CROSSDAT     | 12500 | 4  | 0   | 2400  | MTASK            |
| A661 | REQSTSTSK    | 6000  | 4  | 0   | 2400  | MREQ,MPLAN,MTASK |
| A690 | TACOPDAT     | 3000  | 1  | 0   | -     | MPLAN,FDIS       |
| A691 | TECHOPDAT    | 3000  | 1  | 0   | -     | MPLAN            |
| A770 | ALORD        | 500   | 10 | 0   | -     | MTASK            |
| A900 | ADSCRAMORD   | 600   | 20 | 0   | -     | MTASK            |
| A901 | SARSCRAMORD  | 600   | 5  | 0   | -     | MTASK            |
| A902 | TNKSCRAMORD  | 600   | 3  | 0   | -     | MTASK            |
| A903 | CASSCRAMORD  | 900   | 15 | 0   | -     | MTASK            |
| B260 | FRD          | 700   | 18 | 0   | -     | FDIS             |
| B702 | JLNCHREP     | 600   | 0  | 15  | -     | MREQ,MTASK       |
| B703 | AIREVENT     | 900   | 0  | 72  | -     | MMON,EDIS        |
| B704 | ABCHANGE     | 1400  | 0  | 4   | -     | RESOR            |
| B705 | ACSAMSTAT    | 800   | 0  | 8   | -     | RESOR            |
| B900 | TACOPLINEUP  | 1400  | 0  | 1   | -     | RESOR            |
| B901 | UNITSTATREP  | 1000  | 0  | 3   | 0,8,1 | RESOR            |
| B902 | FCLTYSTATREP | 600   | 0  | 3   | -     | RESOR            |
| B903 | RESUSTATREP  | 600   | 0  | 2   | -     | RESOR            |
| B905 | ALCESTATREP  | 800   | 0  | 3   | -     | RESOR            |
| B907 | ARPSTATREP   | 1400  | 0  | 3   | -     | RESOR            |
| B908 | CASALSTATREP | 700   | 0  | 2   | 6,12  | RESOR            |
| B909 | TACMUSTATREP | 1400  | 0  | 2   | 6,12  | RESOR            |
| B910 | AIRDEFFTRSTA | 400   | 0  | 4   | -     | RESOR            |
| C001 | MSGCHANGERE  | -     | -  | -   | -     | ALL              |
| C100 | IPIR         | 1300  | 20 | 0   | -     | EDIS             |
| C110 | INTREP       | 500   | 35 | 5   | -     | EDIS             |
| C112 | TGTINFOREP   | 600   | 10 | 0   | -     | EDIS             |
| C113 | HOTPHOTOREP  | 750   | 20 | 0   | -     | EDIS             |
| C120 | MIJIFEEDER   | 600   | 6  | 6   | -     | EDIS             |
| C121 | TACELINT     | 800   | 12 | 0   | -     | EDIS             |

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TABLE 12 (cont.)  
DATA MESSAGE SUMMARY

| DATA | MESSAGE      | LEN  | IN | OUT | PBH   | APPLICATION      |
|------|--------------|------|----|-----|-------|------------------|
| C130 | MISREP       | 700  | 72 | 72  | -     | EDIS             |
| C240 | FMR          | 500  | 15 | 0   | -     | MMON,EDIS        |
| C440 | RPTMINEOPS   | 600  | 2  | 0   | -     | FDIS,MPLAN       |
| C460 | COMSPOT      | 600  | 3  | 0   | -     | RESOR            |
| C520 | SEVERE STORM | 700  | 3  | 0   | -     | WETHR            |
| C521 | WXFCST       | 1000 | 4  | 0   | -     | WETHR            |
| C522 | WXRPT        | 600  | 12 | 0   | -     | WETHR            |
| C523 | PTWXWARN     | 400  | 3  | 0   | -     | WETHR            |
| C900 | TAKEOFFREP   | 300  | 0  | 72  | -     | MMON             |
| C901 | LANDINGREP   | 300  | 0  | 72  | -     | MMON             |
| C908 | ARRIVALREP   | 400  | 0  | 15  | -     | MMON             |
| C909 | DEPARTURERE  | 400  | 0  | 15  | -     | MMON             |
| C910 | ADVISORYREP  | 400  | 0  | 5   | -     | MMON             |
| C929 | ECTARREP     | 500  | 0  | 20  | -     | MMON,RESOR,EDIS  |
| D100 | JTACARSREQ   | 700  | 30 | 10  | -     | MREQ             |
| D110 | RII          | 600  | 0  | 15  | -     | EDIS             |
| D111 | RRII         | 2000 | 5  | 0   | -     | EDIS             |
| D200 | JCASINTREQ   | 800  | 15 | 0   | -     | MREQ,MPLAN       |
| D260 | RFR          | 600  | 10 | 0   | -     | MPLAN            |
| D630 | ALREQ        | 900  | 8  | 0   | -     | MREQ,MPLAN       |
| D634 | HELOALREQ    | 900  | 4  | 0   | -     | MREQ,MPLAN       |
| D660 | JAIRREQ      | 1100 | 15 | 3   | -     | MREQ,MPLAN       |
| D666 | JESCREQ      | 700  | 15 | 5   | -     | MREQ,MPLAN       |
| D667 | JRECREQ      | 700  | 30 | 10  | -     | MREQ,EDIS        |
| D668 | JSUPREQ      | 500  | 10 | 5   | -     | MREQ,MPLAN       |
| F260 | RRM          | -    | -  | -   | -     | ALL              |
| F625 | REQCONF      | -    | -  | -   | -     | MREQ,MPLAN       |
| F631 | ALMSNSCD     | 1100 | 0  | 2   | 5,11  | MREQ,MPLAN       |
| F636 | HELOALCONF   | 1100 | 0  | 2   | 3,9   | MREQ,MPLAN       |
| F654 | CROSSCONF    | 6000 | 0  | 4   | 0300  | MREQ,MPLAN,MTASK |
| F750 | DESIGAREA    | 800  | 4  | 0   | -     | MPLAN,FDIS       |
| G131 | INTSUM       | 4000 | 4  | 4   | 6 hrs | EDIS             |
| G424 | EWMSNSUM     | 2000 | 0  | 30  | -     | MPLAN,RESOR,EDIS |

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TABLE 13  
TRANSFER MESSAGE SUMMARY

| TRANSFER MESSAGE | LEN  | IN | OUT | PBH | APPLICATION |
|------------------|------|----|-----|-----|-------------|
| A421 EXORD       | 400  | 2  | 0   | -   | MPLAN,MTASK |
| A440 WARNORD     | 600  | 10 | 0   | -   | MPLAN,MTASK |
| C400 SITREP      | 1500 | 0  | 2   | -   | MPLAN,FDIS  |
| C441 NBC4        | 400  | 0  | 1   | -   | FDIS        |
| C442 NBC3        | 600  | 1  | 0   | -   | FDIS        |
| C444 NBC5        | 600  | 0  | 1   | -   | FDIS        |
| C485 NBC1        | 500  | 0  | 1   | -   | EDIS        |
| C486 OPREP-3P    | 600  | 0  | 2   | -   | EDIS        |
| C487 OPREP-3     | 600  | 0  | 4   | -   | EDIS        |
| C490 OPREP-3PNF  | 500  | 0  | 1   | -   | RESOR       |
| C491 OPREP-3PFB  | 700  | 0  | 3   | -   | RESOR       |
| C492 OPREP-3PED  | 600  | 0  | 1   | -   | RESOR       |
| C493 OPREP-3PEV  | 600  | 0  | 1   | -   | RESOR       |
| C494 OPREP-3PBA  | 600  | 0  | 1   | -   | RESOR       |
| C495 OPREP-3BS   | 600  | 0  | 1   | -   | RESOR       |
| C496 OPREP-3FG   | 600  | 0  | 1   | -   | RESOR       |
| C913 CGOEXREP    | 1000 | 1  | 1   | -   | MMON        |
| E400 OPLANCHG    | 900  | 1  | 0   | -   | MPLAN,MTASK |
| E445 STRIKEWARN  | 500  | 3  | 0   | -   | MPLAN       |
| F541 AKNLDG      | -    | -  | -   | -   | ALL         |
| F542 RETRANS     | -    | -  | -   | -   | ALL         |
| G130 DISUM       | 2000 | 1  | 0   | -   | EDIS        |
| G480 NBC2        | 600  | 0  | 1   | -   | EDIS        |

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TABLE 14  
COMPONENT VERSUS APPLICATION

| TACS<br>COMPONENT | A P P L I C A T I O N S |       |       |      |       |      |      |       |
|-------------------|-------------------------|-------|-------|------|-------|------|------|-------|
|                   | MREQ                    | MPLAN | MTASK | MMON | RESOR | FDIS | EDIS | WETHR |
| TACC              | X                       | X     | X     | X    | X     | X    | X    | X     |
| WOC               | X                       | X     | X     | X    | X     | X    | X    | X     |
| SQDRN             | -                       | X     | X     | -    | X     | X    | X    | X     |
| CRC               | -                       | -     | -     | X    | -     | -    | -    | X     |
| CRP               | -                       | -     | -     | X    | -     | -    | -    | X     |
| ASOC              | X                       | X     | X     | X    | X     | X    | X    | X     |
| ALCC              | X                       | X     | X     | X    | X     | -    | -    | X     |
| ALCE (WOC)        | X                       | X     | X     | X    | X     | X    | X    | X     |
| ABCCC             | -                       | -     | X     | X    | X     | X    | X    | X     |
| AWACS             | -                       | -     | X     | X    | X     | X    | X    | X     |
| FACP              | -                       | -     | -     | X    | -     | -    | -    | X     |
| ASRT              | -                       | -     | X     | X    | -     | -    | -    | X     |
| TACP              | -                       | -     | X     | X    | -     | -    | X    | X     |
| EXTERNAL          | X                       | -     | -     | -    | X     | X    | X    | -     |

5. CONCLUSIONS AND RECOMMENDATIONS.

5.1 Conclusions. The requirements for the MFT equipment may be summarized as follows:

5.1.1 Physical requirements. These are implied by the fact that the MFT must function at a tactical air base.

- (a) The equipment shall operate satisfactorily without conditioned air and without any external protection from dust and dirt.
- (b) The equipment shall operate with the electrical power available from a field generator shared with other services. It should not require more than 500 watts.
- (c) The equipment shall be capable of being mounted semi-permanently in a standard transportable shelter such as the Air Force Quick Reaction Package (QRP). Mounting in a regulation 19 inch steel equipment rack is preferred.
- (d) The equipment shall be capable of withstanding the shock and vibration associated with air transport. It need not operate during transport.
- (e) The equipment shall be small enough in weight and volume to be relocatable by two men without special tools. A gross weight of less than 200 pounds is desirable.

5.1.2 Operational requirements.

- (a) The equipment shall include at least four serial communication ports that are electrically compatible with standard military communication equipment. Conformity with MIL-188-C is desired, but use of the RS-232 standard is acceptable. The equipment shall be capable of providing a synchronizing signal for cryptographic equipment.
- (b) The equipment and the programs shall not require the presence of specially trained computer operators, maintenance programmers, or computer technicians. The system shall be operable by personnel who use it to assist in the performance of their normal tactical duties.

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- (c) An alphanumeric terminal shall be provided that includes a keyboard sealed from the effects of dust and moisture. It shall also include a monochrome cathode ray tube display with a diagonal measurement of at least 12 and not more than 17 inches. From eight to 16 programmable function keys shall be included.
- (d) The principal mass storage medium shall be a Winchester disk with a capacity of at least 10 million bytes. Two floppy disk drives shall be available for optional use in some applications and for program development. Five inch, double density, single or double sided diskettes are preferred. The system shall be capable of modification to accept other mass storage media, such as bubble memory, when they become available.
- (e) The system shall include a dot matrix impact printer with a carriage width of 132 columns. The printer shall print from 60 to 200 characters per second and shall provide tractor feed of standard fan-fold paper.
- (f) The central processing unit (CPU) shall contain at least one microprocessor with a word length of 8 or 16 bits. The use of multiple microprocessors in a multiprocessor configuration is strongly recommended.
- (g) The CPU shall contain at least 64K bytes of semiconductor memory as the main data and program storage. The optional capability to store and use programs in programmable read-only memory (PROM) shall also be provided.
- (h) The system shall include the optional capability to drive from one to four remotely located video monitors for the presentation of key-selectable tabular data displays. The monitors shall contain monochrome cathode ray tube displays with a diagonal measurement of not less than 19 inches.
- (i) The system shall provide for the optional addition of a graphic display terminal of the raster scan type for optional later development. It should also be possible to add color graphics at a later date.

5.2 Recommendation. A test bed that permits development, testing, and demonstration of applications programs for an MFT can be created with off-the-shelf equipment available from Cromemco, Incorporated. A list of equipment items recommended for the initial installation is shown in Table 15. This equipment provides the two computer systems illustrated in Figures 12 and 13. The standard configuration in Figure 12 includes the three recommended subsystems in a multiprocessor arrangement. This configuration would satisfy the requirements of a WOC, in particular. The minimum MFT configuration shown in Figure 13 would be usable at one of the less demanding TACS components, such as the CRC. Together, they permit the use of actual or simulated communication channels in program development and in system demonstration.

TABLE 15

RECOMMENDED MFT DEVELOPMENT SYSTEM

- 1 Cromemco Z-2H Hard Disk Storage Computer System.  
Including 1 11-megabyte hard disk drive  
2 floppy disk drives  
64K main storage
- 1 Cromemco System Two Disk Computer.  
Including 2 floppy disk drives  
64K main storage
- 2 CRT Terminals, Model 3102
- 1 Line Printer, Model 3703
- 1 Programmable Read Only Memory Board, Model 8KBS  
Providing 8K bytes of PROM  
1 PROM programmer
- 2 Programmable Read Only Memory Boards, Model 16KPR  
Providing 16K bytes of PROM
- 3 I/O Processor Boards, Model IOP  
Including Z-80A microprocessor  
16K bytes of random storage  
16K bytes of PROM capacity
- 3 Serial Communication Interface Boards, Model QDRT
- 1 Fifteen Inch Video Monitor, SANYO Model 4215

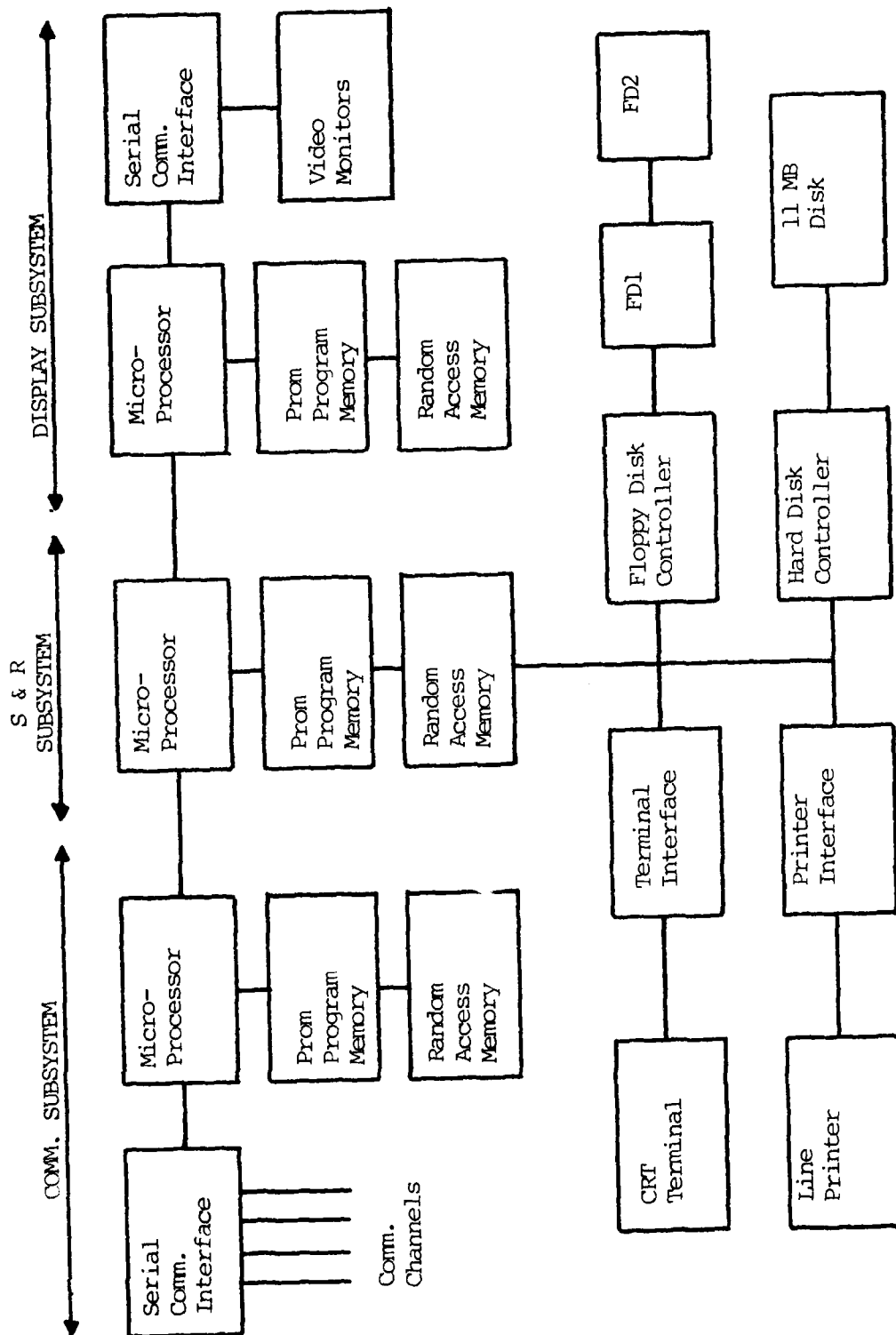


Figure 12: Standard MFT Equipment Configuration

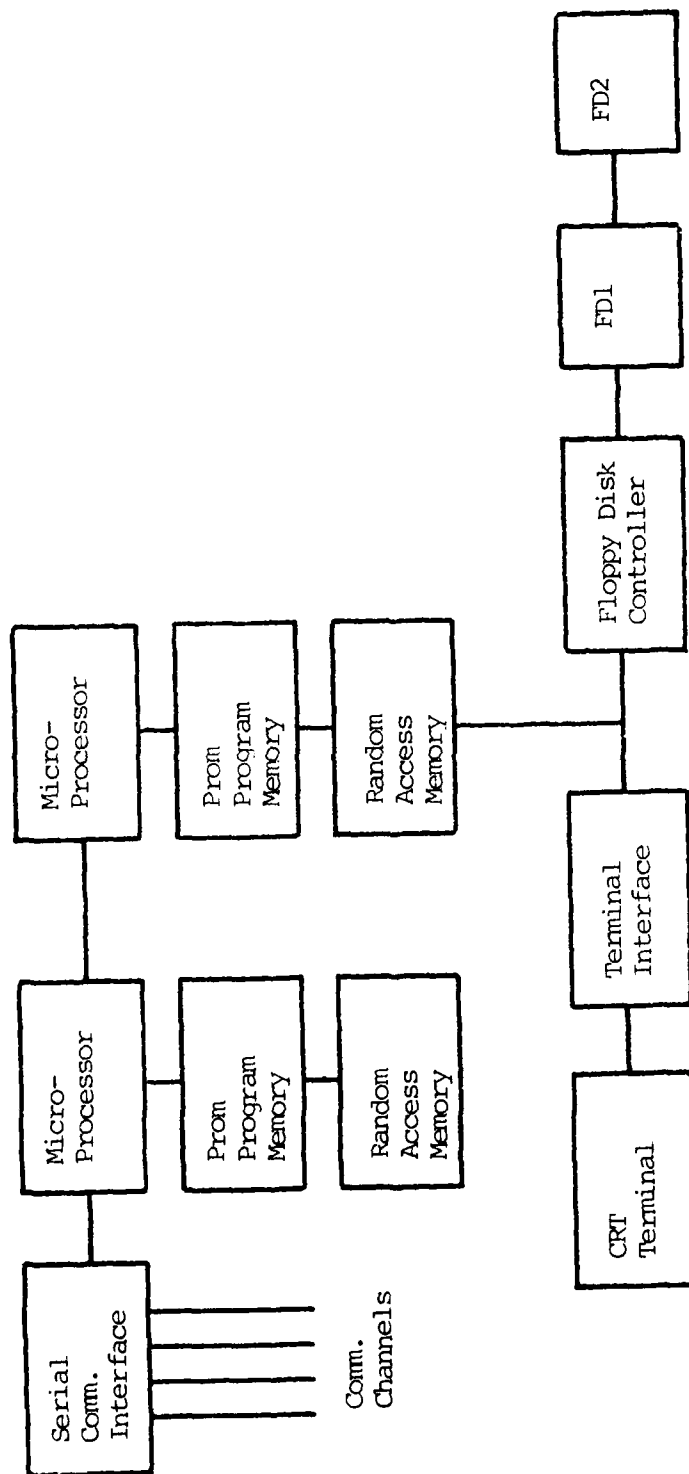


Figure 13: Minimum MFT Equipment Configuration

APPENDIX A  
REFERENCES

1. TAF ORGANIZATION REFERENCES.

- (a) "TACR 55-45, Tactical Air Force Headquarters and the Tactical Air Control Center", Draft, January 1980.
- (b) "TAC CONPLAN 61 - TAC Standard Communications Plan", January 1980 (FOUO).
- (c) "Tactical Air Forces Integrated Information System (TAFIIS) Master Plan", September 1980 (SECRET)
- (d) "Tactical Unit Operations Center Functions/Information Flow", 1 October 1979, USAF Tactical Air Warfare Center, Eglin Air Force Base, Florida.
- (e) "Operational Automated Penetration Analysis/Mission Planning Capability Users Conference Minutes", 8-11 January 1980, HQ TAC, DCS/Operations for Control and Support.
- (f) "Tactical Air Force Integrated Information System (TAFIIS) Master Plan (U)", Volumes 1 through 8, September 1980, TAFIG/IIAC, Langley AFB, Va.
- (g) "JINTACCS Technical Interface Design Plan (Test Edition)", Volume II, Intelligence (U), April 1979 DAAC-JI (CONF).
- (h) "JINTACCS Technical Interface Design Plan (Test Edition)", Volume VI, Air Operations (U), August 1979, DAAC-JI (CONF).
- (i) "JINTACCS Message Standards Catalog of Keyword Data Sets", Draft 7, 5 Feb 1979; Change 1, April 1979.
- (j) "JINTACCS Message Element Dictionary", Parts I, II, and III with CONFIDENTIAL Supplement.
- (k) "JINTACCS Technical Interface Concepts (U)", Second Draft, May 1977, DAAC-JI, (CONF).
- (l) "JINTACCS Technical Interface Design Plan, (Test Edition)", Appendix D: "Terms and Definitions", Fourth Draft, 3 May 1979, DAAC-JI.
- (m) "JINTACCS Technical Interface Design Plan", Appendix E: "Character-Oriented Message Text Formatting Rules", Update 3, 15 July 1979, DAAC-JI.
- (n) "JINTACCS Technical Interface Design Plan, (Test Edition)", Appendix H: "Data and Communications (U)", Working Draft 5, 11 January 1980 (CONF).

2. MICROCOMPUTER REFERENCES.

- (a) "An Introduction to Microcomputers", Volumes 1 through 3, September 1978, with updates to August 1979, Osborne and Associates, Inc., Berkeley, CA
- (b) "All About Microcomputers", June 1980, Datapro Research Corporation, Delran, NJ
- (c) "All About Personal Computers", May 1980, Datapro.
- (d) "All About Small Business Computers", Jan 1980, Datapro.
- (e) "All About Communications Processors", May 1980, Datapro.
- (f) "Microprocessor Specifications", May 1980, Datapro.
- (g) "All About User-Programmable Terminals", Nov 1979, Datapro.
- (h) "All About Graphic Display Devices", May 1980, Datapro.
- (i) "All About Facsimile Devices", May 1980, Datapro.
- (j) "All About Computer Printers", May 1980, Datapro.

3. PERIODICAL REFERENCES.

- (a) "Computer Design", Pennwell Publishing Co., Winchester, MA.
- (b) "Electronic Design", Hayden Publishing Company, Inc., Rochelle Park, NJ.
- (c) "Digital Design", Benwill Publishing Corp., Boston, MA.
- (d) "EDN", Cahners Publishing Company, Boston, MA.
- (e) "Computer Decisions", Hayden Publishing Company, Inc.
- (f) "Infosystems", Hitchcock Publishing Company, Wheaton, IL.
- (g) "Mini-Micro Systems", Cahners Publishing Company
- (h) "Small Business Computers", SBC Publishing Company, Inc., Montclair, NJ.
- (i) "Electronic Products", United Technical Publications, Garden City, NY.
- (j) "Byte", Byte Publications, Inc., Peterborough, NH.
- (k) "Signal", Journal of the Armed Forces Communications and Electronics Association", Falls Church, VA.
- (l) "Computerworld", CW Communications, Inc., Framingham, MA.
- (m) "Creative Computing", Creative Computing, Morristown, NJ.
- (n) "Microcomputing", Wayne Green, Inc. Peterborough, NH.
- (o) "Personal Computing", Hayden Publishing Company, Inc.
- (p) "Interface Age", McPheters, Wolfe and Jones, Cerritos, CA.

APPENDIX B  
JINTACCS SUMMARY

1. INTRODUCTION

1.1 Purpose. The purpose of this appendix is to provide sufficient background information to enable the reader to understand the JINTACCS approach to message format design as it applies to the data messages to be used for the TACS command and control tasks. Examples of the message formats themselves are described completely in Appendix C to this final technical report.

1.2 JINTACCS Concepts. The Joint Interoperability of Tactical Command and Control Systems (JINTACCS) program is sponsored by the Department of the Army, Office of the Assistant Chief of Staff for Automation and Communications (DAAC-JI). Its purpose is to standardize the formats and language of electrically transmitted messages used by USAF, ARMY, NAVY, USMC, NSA and DIA. Several hundred message formats have been developed and described in voluminous documentation. In the Intelligence area, at least, many of the formats have been tested and demonstrated but none are in actual use. JINTACCS formats should be implemented in the design of the MFT application programs whenever possible. To supplement these formats, existing message formats could be used or JINTACCS - compatible formats could be devised. The underlying concepts for message format design are given in various references and are restated as follows:

- (a) To design messages containing sufficient plain language content to make them understandable by humans, together with sufficient structuring to make them easily processed by computers.
- (b) To achieve the widest utilization of message formats by making them acceptable to teletypewriter terminals.
- (c) To provide formatting only for the textual portions of messages. The communications header portions will continue to be specified in Joint Army, Navy, Air Force Publication (JANAP) 128, current edition; Allied Communications Publications (ACP) 126 and 127, current editions; and appropriate US and NATO supplements thereto.

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- (d) To reduce the time and effort involved in the drafting, transmission, analysis, interpreting, and processing of messages used by command and control systems in all defense conditions from peacetime to general war.
- (e) To facilitate the exchange of information between US and NATO authorities.

1.3 References. The list of JINTACCS documentation for all purposes is very large and is continually increasing. Most of these documents have not been reviewed during the preparation of this report. Those listed below have been used and are believed to be adequate for designing many if not all of the MFT application programs.

- (a) JINTACCS Technical Interface Design Plan (Test Edition), Volume II, Intelligence (U), April 1979 DAAC-JI (CONF).
- (b) JINTACCS Technical Interface Design Plan (Test Edition), Volume VI, Air Operations (U), August 1979, DAAC-JI (CONF).
- (c) JINTACCS Message Standards Catalog of Keyword Data Sets, Draft 7, 5 Feb 1979; Change 1, April 1979.
- (d) JINTACCS Message Element Dictionary, Parts I, II, and III with CONFIDENTIAL Supplement.
- (e) JINTACCS Technical Interface Concepts (U), Second Draft, May 1977, DAAC-JI, (CONF).
- (f) JINTACCS Technical Interface Design Plan, (Test Edition), Appendix D: Terms and Definitions, Fourth Draft, 3 May 1979, DAAC-JI.
- (g) JINTACCS Technical Interface Design Plan, Appendix E: Character-Oriented Message Text Formatting Rules, Update 3, 15 July 1979, DAAC-JI.
- (h) JINTACCS Technical Interface Design Plan, (Test Edition), Appendix H: Data and Communications (U), Working Draft 5, 11 January 1980 (CONF).

## 2. JINTACCS MESSAGE IDENTIFICATION

2.1 Message Types. JINTACCS messages are either character-oriented messages (COM) or bit-oriented messages (BOM). The former are structured in a keyword format using alphanumeric characters suitable for both human and machine use. The latter are structured in binary digits and are therefore restricted to machine interpretation. The Microprocessor Front-End Terminal (MFT) is intended for interactive use by humans and it will therefore process no BOMs. The structure of COMs is described in the document named at item (g) of the preceding paragraph. The provisions of this document are summarized in the following paragraphs.

2.2 Message Identifiers. An alphanumeric identifier is assigned to each JINTACCS message format. The identifier is composed of an initial letter followed by a three digit number.

- (a) The initial letter indicates the purpose of the message as shown in the following table:

- A. Orders And Directives
- B. Status
- C. Reports
- D. Planning and Support Requests
- E. Force and Weapon Control
- F. Information Exchange
- G. Summary
- H. Spare
- M. Bit-Oriented Messages

- (b) The three digit number indicates the functional group as shown in the following table:

- 001-099: Common Messages
- 100-199: Intelligence
- 200-299: Fire Support
- 300-399: Amphibious
- 400-599: Operations Control
- 600-799: Air Operations
- 800-899: Spare
- 900-999: TAF Operations

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- (c) Within each functional group, sets of numbers are reserved for particular subjects. The subjects used in the Intelligence Group, for example, are shown in the following table:

|          |              |
|----------|--------------|
| 100-109: | Photo        |
| 110-119: | Immediate    |
| 120-129: | ELINT        |
| 130-139: | After Action |
| 140-149: | Nuclear      |
| 150-159: | Biological   |
| 160-169: | Chemical     |
| 170-199: | Spare        |

2.3 Message Names. In addition to the message identifier, each message format is assigned a unique descriptive name and an abbreviated name that is commonly used. Both the names and the abbreviations are sometimes identical to message formats that are now in use. The contents of the JINTACCS versions are similar to but not identical to the older versions. For example, all of the message formats currently defined for the Intelligence Functional Group are listed in the following table:

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|      |              |                                                          |
|------|--------------|----------------------------------------------------------|
| A100 | TARBUL       | Target Bulletin                                          |
| C100 | IPIR         | Initial Photo Interpretation Report                      |
| C101 | SUPIR        | Supplemental Photo Interpretation Report                 |
| C102 | MIPIR        | Multi-Mission Imagery Photo Interpretation Report        |
| C110 | INTREP       | Intelligence Report                                      |
| C111 | TACREP       | Tactical Report                                          |
| C112 | TGTINFOREP   | Target Information Report                                |
| C113 | HOTOPHOTOREP | Hot Photo Report                                         |
| C120 | MIJIFEEDER   | Meaconing, Intrusion, Jamming Interference Feeder Report |
| C121 | TACELINT     | Tactical ELINT Report                                    |
| C130 | MISREP       | Mission Report                                           |
| C131 | SENREP       | Sensor Report                                            |
| D100 | JTACARSREQ   | Joint Tactical Air Reconnaissance Surveillance Request   |
| D110 | RII          | Request for Intelligence Information                     |
| D111 | RRII         | Response to Request For Intelligence Information         |
| D120 | JRSRR        | Joint Remote Sensor Report/Request                       |
| G130 | DISUM        | Daily Intelligence Summary                               |
| G131 | INTSUM       | Intelligence Summary                                     |

It will be noted that messages have not yet been defined for several of the subjects, such as chemical data. In several cases a JINTACCS message identifier has been associated with a well-known name and abbreviation (e.g., IPIR, MIPIR, SUPIR), but a JINTACCS format has not yet been approved. It is therefore to be expected that new formats will be added to the Intelligence Functional Group, and existing formats will be altered.

### 3. MESSAGE STRUCTURE

3.1 Format Definitions. A message format is defined as an ordered collection of formatted groups called data sets. Each data set starts with a unique keyword known as a set identifier. The keyword is followed by one or more data fields, and any data field may be individually identified by a keyword called either a field descriptor or a header. The components of a data set are separated by punctuation marks called delimiters. The keywords and delimiters are provided to promote human understanding of the message format as it is displayed on the screen of a computer terminal. They will not be stored in computer files or transmitted over communication lines with the corresponding data words.

The entries which may be made in each of the data fields are described in the JINTACCS message specifications. Each data field is assigned a unique name called the data field identifier (DFI). Any data field may appear in two or more data sets, and any data set may appear in two or more message formats. Data fields contain values for either one specific data item or a chain of linked data items. Fields may be of fixed or variable length. The specification gives the length and the type of the allowable values but not whether the length is fixed or variable.

3.2 Data Set Description. There are three types of data sets, and any message format may be composed of any number of data sets in any combination of types.

3.2.1 Linear data set. A linear data set is generally used when the information concerning one aspect of the message subject can be expressed sequentially in one 69-character Teletype line. The position, length and information content of each data field are given in the format specification. A field descriptor may be specified to precede or follow any data field to contribute to ease of use and understanding. The first entry in a linear data set is always the set identifier. This is a group of from three to eight alphabetic characters that suggests the type of information in the data set. The last entry is the end of set delimiter which is always a pair of slant symbols (//). Each data field is preceded by a field delimiter which is always a single slant symbol (/). If a field descriptor is used within a data field, it is separated from the data entry by a colon (:). The maximum number of data characters that may be inserted in the field is shown by the number of dots between delimiters. A typical linear data set would appear on the user's screen as follows:

```
PHOTODAT/PHOTIME:...../...../...../SCALE:...../PCTCOV:....//
```

3.2.2 Columnar data set. This type of data set is used to display information in columnar form under a single 69-character line composed of column headers. The position, length and information content of each data field are given in the format specification. A columnar data set always starts with a set identifier at the left margin of the first line. The set identifier consists of a numeric character followed by up to seven alphabets. The second line consists of a field marker (/) at the left margin followed by the specified column headers separated by an appropriate number of blanks. The third line and any number of succeeding lines all consist of a field marker (/) at the left margin followed by data fields separated by an appropriate number of blanks. The data fields are to be filled in by the user with valid data entries or with hyphens (-) to indicate that no data is available. The final data line is always terminated by the end of set marker (//).

The correlation of data between two or more columnar data sets can be achieved by the use of data entry (DE) subfields. The header line will have DE as the first column header. All data lines that refer to the same entity or event will have the same two-digit numeric value inserted in the DE column. The values will start with 01 and may go as high as 99 within each message.

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A typical columnar data set would appear on the user's screen as follows:

```
LBL
/DE TGTTYP SUBTYP QTY  SIZ  RAD      LGTH    WPTH    HEIGHT
/.. ..... ..... ....  .... .....  .....  .....
/.. ..... ..... ....  .... .....  .....  .....//
```

3.2.3 Free text data set. This type of data set is used to express unformatted narrative information of indefinite length. A set identifier and a field marker (/) are placed at the left margin of the first line, and an end of set marker (//) is placed after the last data word. The maximum length of the free text data is specified in each individual message format where the set is used. Three kinds of free text data sets are available and are differentiated by their set identifiers, as follows:

- (a) Amplification. This data set is always preceded by the keyword AMPN and a field marker. It is used to insert an explanation or additional information concerning another data set. It must follow immediately after the set that it amplifies.
- (b) Narrative. This data set is always preceded by the keyword NARR and a field marker. It is used to insert an explanation or additional information concerning two or more preceding data sets. The relationships between the data sets must be self-evident.
- (c) Remarks. This data set is always preceded by the keyword RMKS and a field marker. It is used to insert an explanation or additional information concerning the entire message. If this set is used, it is the last data set in the message format.

### 3.3 Rules for Message Structuring.

3.3.1 Set occurrence. The message format consists of any number of set definitions. The order of the sets is fixed by the format specification, but all sets need not appear in a specific data message. Each set in the format is designated as mandatory (M), conditional (C), or optional (O). A mandatory set must be included every time the message format is used. An optional set will be omitted together with its set identifier when none of the data to complete the set is available. A conditional set will be used only under certain conditions that are described in individual message specifications. Any set may be used in two or more message formats. The structure of the set is always the same.

3.3.2 Set repetition. Any set may be designated as repeatable in an individual message format specification. Such a set may be repeated without limit at the discretion of the message writer. Repeatability is not an inherent characteristic of a set and may vary among the formats that contain the set.

3.3.3 Set continuation. A single message line will contain a maximum of 69 characters. Sets will usually occupy a single line but may be continued on consecutive lines. A field may not be divided between lines. The second and subsequent lines of a set must begin with a field marker at the left margin. Parts of two sets may not appear on a single line since the set identifier must always start at the left margin. An end of set marker may not be divided between two lines.

3.3.4 Groups of sets. A segment of a message is a group of sets that contains related information and that may be repeated as a group without limit at the discretion of the message writer. Repeated segments appear immediately after the original segment. A nested segment is a smaller grouping of sets within a larger segment. Nested segments may be repeated within the overall segment. Segmentation is not an inherent characteristic of any set and may vary among the formats that contain the set.

3.3.5 Field occurrence. The set consists of any number of field definitions. The order of the fields is fixed by the format specification. Each field in the set is designated as mandatory, conditional, or optional. The definitions for these terms are the same as for the set occurrence. Any field may be used in two or more set specifications. Each field has one unique Data Field Identifier that provides a general description of its data contents. A field may also have two or more Data Use Identifiers that describe the application of the field in a particular data set. The length and content of the values for two different Data Use Identifiers need not be the same.

3.3.6 Field repetition. The final field, or group of fields, in a linear data set may be specified to be repeatable. Repeatable fields are designated in the specification by an R.

3.3.7 Groups of fields. A group is a collection of associated fields that is assembled in one sequence and placed at the end of the set to allow its repetition. A group of fields is indivisible and is designated in the specifications by an R next to each field in the group.

3.3.8 Message parts. Message formats may be specified to be divided into separate parts by inclusion of a set with the set identifier PART.

3.3.9 Common sets. All message formats start with seven common sets and end with an eighth. The first set is always mandatory, and it contains the security classification. The last set contains downgrading instructions for classified messages. Incidentally, the classification set appears to be the only JINTACCS set that does not begin with a set identifier. The other common set identifiers are as follows: FLAGWORD, SIC, EXER, OPER, MSGID, AUTOPRO, and DWNGRADE.

#### 4. MESSAGE PROCESSING.

4.1 Procedures. A computer system that processes messages in JINTACCS format must store complete descriptions of all messages. These descriptions will assist the user in composing outgoing messages. They will also be used to check incoming messages prepared by other systems. Much of the data content of messages arriving at any MFT will be placed in data files automatically without the need for approval or modification by users. For this reason, proper preparation of messages is essential and must be guided by a computer program. Processing information is stored in the form of message formats, data set descriptions, data field descriptions, and field validation specifications.

4.2 Message Formats. Some of the 144 message formats that could be originated or received by components of the TACS are presented in Appendix C. The formats are given in alphabetic/numeric order according to message identifier. The table of contents also shows the abbreviated name and the descriptive name for each format. A format is described by giving skeleton descriptions of the data sets that comprise it. The keyword, any data field identifiers, all field delimiters, and the end of set delimiter are shown. The actual length of each field is not shown, but rather all fields are represented by single spaces. The maximum length of all the data fields in the data set is given followed by an M to indicate mandatory use of the data set, a C to indicate conditional use, or an O to indicate optional use. If a data set is repeatable, a R follows the M/C/O entry. If a data set is part of a repeating group, the number assigned to that group follows the other codes. In many cases, a name has been assigned to a data set to aid in understanding its purpose. The name appears in the right-hand column.

4.3 Data Sets. Examination of the message formats will show that many data sets are used in more than one format. In particular, about 12 data sets appear in the headings of most formats, and the data set that contains downgrading instructions is used at the end of most formats. For efficiency and economy of storage, it would be advisable to build a computer file of the descriptions of all data sets used in all formats that might be used by the computer. Appendix D shows the information that should be stored for some of the data sets found in the TAF message formats. The set identifier is followed by the numbers assigned by JINTACCS to the data field identifiers and data use identifiers that comprise the data set. The field descriptions are to be stored in another file as described in the next paragraph.

4.4 Data Field Identifiers. Appendix D shows that many of the data fields are used in two or more data sets, and therefore field descriptions should be stored in a separate computer file. Appendix E shows the information that should be stored for some of the data fields found in the data sets of Appendix D. The list is in two parts. Some fields are composed of other fields, and these combined data fields are listed in the first part together with their component fields. The second part shows the descriptions of the individual data fields. The type of characters, the maximum length in characters, and the type of validation is given in addition to the field name that is provided only to aid human understanding. The allowable values for many of the data fields have been placed in tables by the JINTACCS specification. The contents of some of these tables are shown in Appendix E. Other fields may contain entries specified as a range of values. For example, the number of a month would fall in the range 1-12. Typical ranges are not illustrated here but must be included in the application program that check JINTACCS messages.

APPENDIX C  
SAMPLE JINTACCS MESSAGE FORMATS

A100 TARBUL  
Target Bulletin

Purpose: To provide a continuous update to the list of active targets which may have to be taken under attack by supporting arms to assist the supported unit and to report the analysis of others on known targets.

| <u>DESCRIPTIVE ITEMS</u>     | <u>DATA ITEMS</u> |                      |
|------------------------------|-------------------|----------------------|
| / / //                       | 43 M              | CLASSIFICATION       |
| FLAGWORD/ / //               | 30 C              | ROUTING INDICATORS   |
| SIC //                       | 3 C               | SUBJECT IDENTIFIER   |
| EXER/EXERCISE: //            | 55 C              | EXERCISE NAME        |
| OPER/ //                     | 64 C              | OPERATION NAME       |
| MSGID/TARBUL/ / //           | 47 M              | MSG IDENTIFICATION   |
| AUTOPRO/A100/ / / / / / //   | 32 C              | AUTO. SYSTEMS INSTR. |
| -----                        |                   |                      |
| HEADING/NEW TARGET//         | - C               |                      |
| 9AA DE                       | 41 C R            | NEW TARGET DESCR.    |
| TGT-LST-PRT                  |                   |                      |
| MSG-REF-DTG                  |                   |                      |
| TGT-ID                       |                   |                      |
| TGTTYP                       |                   |                      |
| SUBTYP //                    |                   |                      |
| 1AN DE                       | 56 C R            | TERRAIN DESCRIPTION  |
| TERRAIN-FEATURE-NAME         |                   |                      |
| LOCATION //                  |                   |                      |
| HEADING/TARGET DAMAGED//     | - C               |                      |
| 9AB TGT-LST-PRT              | 28 C R            | TARGET STATUS        |
| TGT-ID                       |                   |                      |
| TGTSTATUS                    |                   |                      |
| PCTDAM //                    |                   |                      |
| HEADING/TARGET DESTROYED//   | - C               |                      |
| 9AC TGT-LST-PRT              | 16 C R            | TARGET DESCRIPTION   |
| TGT-ID //                    |                   |                      |
| HEADING/TARGET REACTIVATED// | - C               |                      |
| 9AC TGT-LST-PRT              | 16 C R            | TARGET DESCRIPTION   |
| TGT-ID //                    |                   |                      |
| HEADING/TARGET CANCELLED//   | - C               |                      |
| 9AC TGT-LST-PRT              | 16 C R            | TARGET DESCRIPTION   |
| TGT-ID //                    |                   |                      |
| -----                        |                   |                      |
| DWNGRADE/ //                 | 25 C              | DOWNGRADING INSTR.   |

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A210 FMC  
Fire Mission Command

Purpose: This message is used to check fire, to cease loading, to cancel check fire, to cancel cease loading, and to provide specified information to an observer.

|                   |      |                      |
|-------------------|------|----------------------|
| / / //            | 43 M | CLASSIFICATION       |
| SIC //            | 3 -  | SUBJECT IDENTIFIER   |
| EXER/EXERCISE: // | 55 C | EXERCISE NAME        |
| OPER/ //          | 64 C | OPERATION NAME       |
| MSGID/FMC/ / //   | 47 M | MSG IDENTIFICATION   |
| -----             |      |                      |
| CMD/ //           | 6 C  | FIRE SUPPORT COMMAND |
| EFDT/ / //        | 10 O | EFFECTIVE DATE-TIME  |
| FPN/ //           | 6 O  | FIRE PLAN DESIG.     |
| TNO/ //           | 6 O  | F.S. TARGET NBR.     |
| GRID/ / / //      | 32 O | UTM GRID DESIG.      |
| OBR/ //           | 3 O  | OBSERVER NUMBER      |
| ROB/ //           | 6 C  | REPORT TO OBSERVER   |
| -----             |      |                      |

COMMENT:

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A260 FSC  
Fire Support Coordination Measures Report

Purpose: To propose, promulgate, and/or modify a fire support coordination measure.

| <u>DESCRIPTIVE ITEMS</u> |      | <u>DATA ITEMS</u>   |
|--------------------------|------|---------------------|
| ///                      | 43 M | CLASSIFICATION      |
| SIC //                   | 3 -  | SUBJECT IDENTIFIER  |
| EXER/EXERCISE: //        | 55 C | EXERCISE NAME       |
| OPER/ //                 | 64 C | OPERATION NAME      |
| MSGID/FSC/ / //          | 47 M | MSG IDENTIFICATION  |
| -----                    |      |                     |
| OPT/ / //                | 6 O  | ACTION INDICATORS   |
| EFDT/ / //               | 10 M | EFFECTIVE DATE-TIME |
| MEA/ //                  | 6 M  | FSC MEASURE         |
| ATH/ //                  | 10 M | AUTHORITY           |
| APR/ //                  | 3 O  | APPROVED/PROPOSED   |
| FPN/ //                  | 6 O  | FIRE PLAN DESIG.    |
| PNT/ / / / //            | 34 C | POINT               |
| CIR/ / / / //            | 36 C | CIRCLE              |
| ACA/ / / / / //          | 33 C | COVERAGE            |
| ARES/ //                 | 2 C  | AUTHORIZE/RESTRICT  |
| APR/ //                  | 3 O  | APPROVED/PROPOSED   |
| -----                    |      |                     |
| DWNGRADE/ //             | 25 C | DOWNGRADING INSTR.  |

COMMENT:

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A421 EXORD  
Execution Order

Purpose: To implement an operations plan or order.

| <u>DESCRIPTIVE ITEMS</u> |      | <u>DATA ITEMS</u>  |
|--------------------------|------|--------------------|
| / / //                   | 43 M | CLASSIFICATION     |
| SIC //                   | 3 C  | SUBJECT IDENTIFIER |
| EXER/ //                 | 55 C | EXERCISE NAME      |
| OPER/ / / //             | 64 C | OPERATION NAME     |
| MSGID/EXORD/ / //        | 47 M | MSG IDENTIFICATION |
| -----                    |      |                    |
| EXECUTE/ / / //          | 61 M | OPS PLAN DESCR.    |
| AKNLDG/ //               | 1 M  | ACKNOWLEDGEMENT    |
| -----                    |      |                    |
| DWNGRADE/ //             | 25 C | DOWNGRADING INSTR. |

COMMENT:

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A422 FRAGORDER  
Operation Fragmentary Order

Purpose: To provide an abbreviated operations order or a change to an operations order for a limited portion of a given operation.

| <u>DESCRIPTIVE ITEMS</u>       | <u>DATA ITEMS</u> |                    |
|--------------------------------|-------------------|--------------------|
| / / //                         | 43 M              | CLASSIFICATION     |
| SIC //                         | 3 C               | SUBJECT IDENTIFIER |
| EXER/ //                       | 55 C              | EXERCISE NAME      |
| OPER/ / / / //                 | 64 C              | OPERATION NAME     |
| MSGID/FRAGORDER/ / //          | 47 M              | MSG IDENTIFICATION |
| -----                          |                   |                    |
| PLANORD/OPLMNO: /OPERNO: /     |                   |                    |
| ANXNO: /APNDXNO: /TABNO: /     |                   |                    |
| ENCNO: /PAGENO: /              |                   |                    |
| PARANO: /LINENO: //            | 45 C              |                    |
| FRAGORD/ / //                  | 27 M              |                    |
| NARR/ //                       | - C               | FREE TEXT          |
| HEADING/SITUATION//            | - C               |                    |
| AMPN/ //                       | - C               | FREE TEXT          |
| HEADING/MISSION//              | - C               |                    |
| AMPN/ //                       | - C               | FREE TEXT          |
| HEADING/EXECUTION//            | - C               |                    |
| AMPN/ //                       | - C               | FREE TEXT          |
| HEADING/ADMIN AND LOG//        | - C               |                    |
| AMPN/ //                       | - C               | FREE TEXT          |
| HEADING/COMMAND AND SIGNAL//   | - C               |                    |
| AMPN/ //                       | - C               | FREE TEXT          |
| HEADING/TASKED ORGANIZATIONS// | - C               |                    |
| 5UNIT UQ                       | 91 C              |                    |
| UNITID                         |                   |                    |
| UNITLOC                        |                   |                    |
| UNITLOC                        |                   |                    |
| UNITLOC                        |                   |                    |
| CMNTS //                       |                   |                    |
| AMPN/ //                       | - C               | FREE TEXT          |
| HEADING/TASK ASSIGNMENTS//     | - C               |                    |
| AMPN/ //                       | - C               | FREE TEXT          |
| HEADING/SPECIAL INSTRUCTIONS// | - C               |                    |
| AMPN/ //                       | - C               | FREE TEXT          |
| AKNLDG/ //                     | 1 M               |                    |
| -----                          |                   |                    |
| DWNGRADE/ //                   | 25 C              | DOWNGRADING INSTR. |

COMMENT:

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A425 ERTM  
ELINT Requirement Tasking Message

Purpose: For use by operational commanders to task resources under their operational control for the purpose of ELINT collection or to request ELINT collection from sources outside their operational control.

| <u>DESCRIPTIVE ITEMS</u> |  | <u>DATA ITEMS</u>       |
|--------------------------|--|-------------------------|
| / / / /                  |  | 43 M CLASSIFICATION     |
| SIC / /                  |  | 3 C SUBJECT IDENTIFIER  |
| EXER/ / /                |  | 55 C EXERCISE NAME      |
| OPER/ / / / /            |  | 64 C OPERATION NAME     |
| MSGID/ERTM/ / / /        |  | 47 M MSG IDENTIFICATION |
| -----                    |  |                         |
| AREAREQ/ / / /           |  | 51 M R                  |
| 5ELRQR DE                |  | 45 M R                  |
| EMIT-DESIG               |  |                         |
| L                        |  |                         |
| I                        |  |                         |
| P                        |  |                         |
| E                        |  |                         |
| REQACC                   |  |                         |
| ACPTACC                  |  |                         |
| ERR                      |  |                         |
| ERA                      |  |                         |
| TR                       |  |                         |
| TA                       |  |                         |
| DUR / /                  |  |                         |
| 5FRQRNG DE               |  | 24 C                    |
| LOWFRQ                   |  |                         |
| UPFRQ / /                |  |                         |
| RMKS/ / /                |  | - C FREE TEXT           |
| -----                    |  |                         |
| DWNGRADE/ / /            |  | 25 C DOWNGRADING INSTR. |

COMMENT:

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A440 WARNORD  
Warning Order

Purpose: To inform subordinate units of contemplated action and to initiate execution planning.

| <u>DESCRIPTIVE ITEMS</u>     |      | <u>DATA ITEMS</u>  |
|------------------------------|------|--------------------|
| / / //                       | 43 M | CLASSIFICATION     |
| SIC //                       | 3 C  | SUBJECT IDENTIFIER |
| EXER/ //                     | 55 C | EXERCISE NAME      |
| OPER/ / / //                 | 64 C | OPERATION NAME     |
| MSGID/WARNORD/ / //          | 47 M | MSG IDENTIFICATION |
| -----                        |      |                    |
| HEADING/SITUATION//          | C    |                    |
| AMPN/ //                     | - C  | FREE TEXT          |
| HEADING/MISSION//            | C    |                    |
| AMPN/ //                     | - C  | FREE TEXT          |
| HEADING/EXECUTION//          | C    |                    |
| AMPN/ //                     | - C  | FREE TEXT          |
| HEADING/ADMIN AND LOG//      | C    |                    |
| AMPN/ //                     | - C  | FREE TEXT          |
| HEADING/COMMAND AND SIGNAL// | C    |                    |
| AMPN/ //                     | - C  | FREE TEXT          |
| AKNLDG/ //                   | 1 M  |                    |
| -----                        |      |                    |
| DWNGRADE/ //                 | 25 C | DOWNGRADING INSTR. |

COMMENT:

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A635 HELOALDAT  
Helicopter Airlift Mission Data Message

Purpose. To provide mission details on a helicopter airlift mission from the requesting agency to the complying agency. To be used by a component commander to task the forces from other services that have been chopped to that commander.

| <u>DESCRIPTIVE ITEMS</u>       | <u>DATA ITEMS</u>         |
|--------------------------------|---------------------------|
| / / //                         | 43 M CLASSIFICATION       |
| SIC //                         | 3 C SUBJECT IDENTIFIER    |
| EXER/EXERCISE: //              | 55 C EXERCISE NAME        |
| OPER/ //                       | 64 C OPERATION NAME       |
| MSGID/HELOALDAT/ / //          | 47 M MSG IDENTIFICATION   |
| AUTOPRO/A635/ / / / / / //     | 32 C AUTO. SYSTEMS INSTR. |
| CANX/ / / /AMD: //             | 49 C REFERENCE MESSAGE    |
| -----                          |                           |
| 6HELODAT MSNNO                 | 46 M R                    |
| REQNO                          |                           |
| PRY                            |                           |
| HELSN                          |                           |
| ACSIGN                         |                           |
| NOTPAC                         |                           |
| SIF //                         |                           |
| ALERT/ /ALRT: /FROM: /TO: /    |                           |
| ALRTLOC: //                    | 44 C R                    |
| REFNO/ //                      | 6 M R                     |
| 6LOAD DE                       | 60 C R                    |
| ONLOC                          |                           |
| ONTIME                         |                           |
| QTY                            |                           |
| LDTYP                          |                           |
| OFFLOC                         |                           |
| OFFTIME                        |                           |
| QTY //                         |                           |
| TIMEAMP/ / / //                | 19 C R                    |
| 7LOAD DE                       | 41 C R                    |
| CARGOWT                        |                           |
| CARGOSZ                        |                           |
| LGTH                           |                           |
| WDTH                           |                           |
| HEIGHT                         |                           |
| EX-IN                          |                           |
| H //                           |                           |
| LANDPT/ /PTNM: / //            | 41 C                      |
| LANDSTS/ /MRKING: / /LSSTAT: / |                           |

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|                             |        |                    |
|-----------------------------|--------|--------------------|
| CNTCS: / / / MSNNO: /       |        |                    |
| DE: //                      | 59 C   |                    |
| HEADING/MISSION CONTROL AND |        |                    |
| SUPPORT DATA//              | - C    |                    |
| 7CONTROL REF                | 60 C R |                    |
| C                           |        |                    |
| CALLSIGN                    |        |                    |
| PRIFRQ                      |        |                    |
| SECFRQ                      |        |                    |
| REPIN //                    |        |                    |
| SUPPORT/ / / //             | 22 C   |                    |
| 6RDZ REF                    | 41 C R |                    |
| L                           |        |                    |
| RDZREF                      |        |                    |
| RENDCS                      |        |                    |
| PRIFRQ                      |        |                    |
| SECFRQ //                   |        |                    |
| 7RDZ REF                    | 26 C R |                    |
| ATIME                       |        |                    |
| RDZLOC                      |        |                    |
| DAL //                      |        |                    |
| ROUTEREF/ //                | 6 C R  |                    |
| 6ROUTE DE                   | 59 C R |                    |
| ROUTEPT                     |        |                    |
| TYP                         |        |                    |
| ATIME                       |        |                    |
| DTIME                       |        |                    |
| SPD                         |        |                    |
| ALT                         |        |                    |
| ROUTE //                    |        |                    |
| AKNLDG/ //                  | 1 C    |                    |
| -----                       |        |                    |
| DWNGRADE/ //                | 25 C   | DOWNGRADING INSTR. |

COMMENT:

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A661 REQSTSTSK  
Air Mission Request Status/Tasking Message

Purpose: To inform the requesting component whether a request has been approved or disapproved and to inform the complying command that it will satisfy the request. When authorized, this message can be used between components.

| <u>DESCRIPTIVE ITEMS</u>      | <u>DATA ITEMS</u>         |
|-------------------------------|---------------------------|
| / / //                        | 43 M CLASSIFICATION       |
| SIC //                        | 3 C SUBJECT IDENTIFIER    |
| EXER/EXERCISE: //             | 55 C EXERCISE NAME        |
| OPER//                        | 64 C OPERATION NAME       |
| MSGID/REQSTSTSK/ / //         | 47 M MSG IDENTIFICATION   |
| AUTOPRO/A661/ / / / / //      | 32 C AUTO. SYSTEMS INSTR. |
| CANX/ / / /AMD: //            | 49 C REFERENCE MESSAGE    |
| -----                         |                           |
| REF/ / / / / //               | 60 M R                    |
| HEADING/REQUEST STATUS//      | - C                       |
| 6APPDIS REQNO                 | 41 M R                    |
| REQCMD                        |                           |
| REQSTS                        |                           |
| COMCMD                        |                           |
| RPRY //                       |                           |
| HEADING/CROSS FORCE TASKING// | - C                       |
| 6REQUEST REQNO                | 47 M                      |
| PRY                           |                           |
| AMSN                          |                           |
| TOT                           |                           |
| TFT                           |                           |
| NOTPAC                        |                           |
| MSNLOC //                     |                           |
| TIMEAMP/ / / //               | 19 C R                    |
| MSNLCAMP/ /MSNLCTYP: / //     | 41 C R                    |
| TANKDAT/ /ARSYS: /FUREQ: /    |                           |
| FUEL: //                      | 16 C R                    |
| RECDAT/ /RECTYP: /TYP: /      |                           |
| TYPSEN: /PHOTO: /FILM: /      |                           |
| STEREO: //                    | 28 C R                    |
| ESCDAT/ /ORDTYP: / //         | 32 C R                    |
| HELOLIFT/ /ONLOC: /OFFLOC: /  |                           |
| NOPAX: /PAXTYPE: /            |                           |
| TOTALWT: / //                 | 86 C R                    |
| 6EW REF                       | 33 C R                    |
| EWTYP                         |                           |
| GENTYP                        |                           |

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EMIT  
ELNOT //  
AKNLDG/ //

1 C

-----  
DWNGRADE/ //

25 C

DOWNGRADING INSTR.

COMMENT:

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A690 TACOPDAT  
Tactical Operational Data Message

Purpose: To permit the joint operational commander to establish air defense and anti-air warfare responsibilities in a tactical area. To permit an area commander to provide supplementary orders for his area of responsibility.

| <u>DESCRIPTIVE ITEMS</u>  | <u>DATA ITEMS</u> |                      |
|---------------------------|-------------------|----------------------|
| / / //                    | 43 M              | CLASSIFICATION       |
| SIC //                    | 3 C               | SUBJECT IDENTIFIER   |
| EXER/EXERCISE: //         | 55 C              | EXERCISE NAME        |
| OPER/ //                  | 64 C              | OPERATION NAME       |
| MSGID/TACOPDAT/ / //      | 47 M              | MSG IDENTIFICATION   |
| AUTOPRO/A690/ / / / / //  | 32 C              | AUTO. SYSTEMS INSTR. |
| CANX/ / / /AMD: //        | 49 C              | REFERENCE MESSAGE    |
| -----                     |                   |                      |
| REF/ / / / / //           | 60 C R            |                      |
| EFFECTIV/ / /SUP: //      | 16 M              |                      |
| AAW/ / / //               | 50 C R            |                      |
| GND/ / / //               | 44 C R            |                      |
| CAP/ /ALT: / / / / //     | 79 C R            |                      |
| AEW/ /MINALT: / / / //    | 49 C R            |                      |
| AUTOCAT/ /MINALT: /TX: /  |                   |                      |
| REC: / //                 | 56 C R            |                      |
| AAR/ /ALT: / / / //       | 50 C R            |                      |
| DUTIES/ / //              | 23 C R            |                      |
| SURVEIL/ / /SECLIMIT: /   |                   |                      |
| SECLIMIT: / //            | 61 C R            |                      |
| DEFENSE/ / /SECLIMIT:     |                   |                      |
| SECLIMIT: / //            | 61 C R            |                      |
| HANDO/ / //               | 40 C R            |                      |
| MEX/ /RAD: / //           | 47 C R            |                      |
| SAFERAD/ /RAD: /CTRBRG: / |                   |                      |
| WDTH: /LOALT. /UPALT: //  | 34 C R            |                      |
| SAFECOR/ /WDTH: /LOALT: / |                   |                      |
| UPALT: / //               | 48 C              |                      |
| 6VOICNET VOICENET         | 22 C              |                      |
| PRIFRQ                    |                   |                      |
| SECFRQ: //                |                   |                      |
| 6CRYPTO NETREF            | 132 C             |                      |
| CDDAY                     |                   |                      |
| FROM                      |                   |                      |
| TO                        |                   |                      |
| ENCRYPT                   |                   |                      |
| ENCRDEV //                |                   |                      |

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|                             |        |                    |
|-----------------------------|--------|--------------------|
| EMP/EMCOM: /FROM: /TO: //   | 15 C R |                    |
| 6ZZ/ZZPOS: /TIMPOS: /CRS: / |        |                    |
| SPD: /AAWAX: /ANGLE: //     | 30 C   |                    |
| CTRLPT/ / / / //            | 49 C R |                    |
| MARSH/ / /CALLSIGN: / //    | 56 C R |                    |
| SPDIS/ / / //               | 28 C R |                    |
| AKNLDG/ //                  | 1 C    |                    |
| -----                       |        |                    |
| DWNGRADE/ //                | 25 C   | DOWNGRADING INSTR. |

COMMENT:

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A770 ALORD  
Alert Launch Order

Purpose: To launch alert aircraft that have been tasked for cross-force missions.

| <u>DESCRIPTIVE ITEMS</u>        | <u>DATA ITEMS</u>         |
|---------------------------------|---------------------------|
| ///                             | 43 M CLASSIFICATION       |
| SIC //                          | 3 C SUBJECT IDENTIFIER    |
| EXER/EXERCISE: //               | 55 C EXERCISE NAME        |
| OPER//                          | 64 C OPERATION NAME       |
| MSGID/ALORD/ //                 | 47 M MSG IDENTIFICATION   |
| AUTOPRO/A770/ // // // // //    | 32 C AUTO. SYSTEMS INSTR. |
| -----                           |                           |
| LAUNCH/MSNNO: /LNCHTIM: /       |                           |
| INITCON: / /ENLCON: // //       | 83 M R                    |
| HEADING/OTHER MISSION DATA//    | - O                       |
| 6TARGET REF                     | 49 C                      |
| TG                              |                           |
| TGTLOC                          |                           |
| RESDES                          |                           |
| TGTTYP                          |                           |
| SUBTYP                          |                           |
| QTY //                          |                           |
| REFMAR/ // // //                | 32 C R                    |
| TGTDAT/TGTID: /TGTLOC: /TRAD: / |                           |
| TLGTH: /TWDTH: /ALIGNMT: /      |                           |
| DOP: /TIMPOS: /HDG: // //       | 85 C R                    |
| GNDFRND/ /MRKING: //            |                           |
| TIMPOS. // //                   | 39 C R                    |
| BCNREF/ // //                   | 26 C R                    |
| 6SHIP DE                        | 26 C R                    |
| REF                             |                           |
| SID                             |                           |
| QTY                             |                           |
| SHPTYP                          |                           |
| HULL                            |                           |
| TG //                           |                           |
| 7SHIP DE                        | 50 C R                    |
| TIMPOS                          |                           |
| SHIPLOC                         |                           |
| CRS                             |                           |
| SPD //                          |                           |
| 6REFUEL REF                     | 58 C R                    |
| TANKERCS                        |                           |
| ANCHOR                          |                           |

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|                 |           |        |                    |
|-----------------|-----------|--------|--------------------|
|                 | RFLTIME   |        |                    |
|                 | ALT       |        |                    |
|                 | ONFU      |        |                    |
|                 | FUEL      |        |                    |
|                 | ARSYS //  |        |                    |
| 7REFUEL         | REF       | 38 C R |                    |
|                 | PRIREFL   |        |                    |
|                 | SECRFL    |        |                    |
|                 | PRIOFF    |        |                    |
|                 | SECOFF // |        |                    |
| ALT/REF: / / // |           | 18 C R |                    |
| AKNLDG/ //      |           | 1 C    |                    |
| -----           |           |        |                    |
| DWNGRADE/ //    |           | 25 C   | DOWNGRADING INSTR. |
| <u>COMMENT:</u> |           |        |                    |

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A900 ADSCRAMORD  
Air Defense Scramble Order

Purpose: Used by the TACC and CRC to provide Air Defense  
scramble instructions to the WOC.

| <u>DESCRIPTIVE ITEMS</u> |      | <u>DATA ITEMS</u>    |
|--------------------------|------|----------------------|
| / / //                   | 43 M | CLASSIFICATION       |
| FLAGWORD/ / //           | 30 C | ROUTING INDICATORS   |
| EXER/EXERCISE: //        | 55 C | EXERCISE NAME        |
| OPER/ / / //             | 64 C | OPERATION NAME       |
| MSGID/ADSCRAMORD/ / //   | 47 M | MSG IDENTIFICATION   |
| AUTOPRO/A900/ / / / / // | 32 C | AUTO. SYSTEMS INSTR. |
| -----                    |      |                      |
| SEGMENT/SCRAMBLE//       | - M  |                      |
| FLTSZTYP/ //             | 8 M  |                      |
| VCTCLALT/ / / //         | 12 M |                      |
| CSTACFRQ/ / //           | 28 M |                      |
| RMKS/ //                 | - O  | FREE TEXT            |
| -----                    |      |                      |
| DWNGRADE/ //             | 25 C | DOWNGRADING INSTR.   |
| <u>COMMENT:</u>          |      |                      |

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APPENDIX D  
JINTACCS DATA SET SUMMARY

| <u>SET IDENT</u> | <u>DFI/DUI</u> | <u>OCCUR</u> | <u>MANDATORY ENTRY</u>      |
|------------------|----------------|--------------|-----------------------------|
| ADD              |                | C            | (NO DATA FIELD IDENTIFIERS) |
| AFTER            |                | C            | (NO DATA FIELD IDENTIFIERS) |
| AID              | E564-15        | C            |                             |
|                  | E564-8         | M            |                             |
|                  | E564-9         | O            |                             |
|                  | E564-9         | M            |                             |
|                  | E564-11        | O            |                             |
|                  | E564-12        | M            |                             |
|                  | E487-47        | O            |                             |
|                  | E564-5         | O            |                             |
|                  | E982-1         | O            |                             |
|                  | E564-7         | O            |                             |
|                  | C315-3         | O            |                             |
| AIRDROP          | E987-4         | M            | DELADDR                     |
|                  | C011-9         | M            | DROPLOC                     |
|                  | C012-17        | C            | DROPLOC                     |
|                  | C683-4         | C            | DROPLOC                     |
|                  | E493-2         | C            | RUNHDG                      |
|                  | E002-1         | M            | CALLSIGN                    |
|                  | E651-2         | M            | PRIFRQ                      |
|                  | E681-2         | C            | PRIFRQ                      |
|                  | E651-3         | M            | SECFRQ                      |
|                  | E681-3         | C            | SECFRQ                      |
| AIRWHAT          | E031-1         | C            |                             |
|                  | E034-1         | C            |                             |
|                  | E141-1         | C            |                             |
|                  | C142-7         | M            |                             |
|                  | E032-4         | C            |                             |
|                  | E071-1         | C            |                             |
| AKNLDG           | E319-3         | M            |                             |
| ALT              | E673-1         | C            | REF                         |
|                  | E1028-1        | M R          |                             |
|                  | E491-1         | M R          |                             |
| AMPN             |                |              | (A FREE TEXT SET)           |
| APPOR            | E987-18        | M            |                             |
|                  | E922-1         | M            |                             |
|                  | E107-4         | M R          |                             |
|                  | E027-16        | M R          |                             |
|                  | E031-17        | M R          |                             |
| ARDAT            | E673-1         | M            |                             |
|                  | E491-2         | M            | ALT                         |
|                  | E651-20        | M            | PRIRFL                      |

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| <u>SET IDENT</u> | <u>DFI/DUI</u> | <u>OCCUR</u> | <u>MANDATORY ENTRY</u>      |
|------------------|----------------|--------------|-----------------------------|
|                  | E681-20        | C            | PRIRFL                      |
|                  | E651-21        | M            | SECRFL                      |
|                  | E681-21        | C            | SECRFL                      |
|                  | E651-22        | M            | PRIOFF                      |
|                  | E681-22        | C            | PRIOFF                      |
|                  | E651-23        | M            | SECOFF                      |
|                  | E681-23        | C            | SECOFF                      |
|                  | E538-2         | M            | FUEL                        |
|                  | E539-1         | M            | ARSYS                       |
|                  | E907-4         | C            | UNCMTFU                     |
| AUTOPRO          | E339-1         | M            | (ACTUAL MESSAGE ID)         |
|                  | C051-20        | M            |                             |
|                  | E517-2         | C            |                             |
|                  | E328-1         | C            |                             |
|                  | E319-1         | C            |                             |
|                  | E333-1         | C            |                             |
|                  | C327-1         | C            |                             |
|                  | E242-1         | C            |                             |
| BCNREF           | E500-1         | M            |                             |
|                  | E673-1         | M R          |                             |
| CANCEL           |                | C            | (NO DATA FIELD IDENTIFIERS) |
| CANX             | E050-1         | M            |                             |
|                  | E146-1         | M            |                             |
|                  | C147-1         | M            |                             |
|                  | E345-1         | C            | AMD                         |
| (CLASIF)         | E148-2         | M            | (CLASSIFICATION)            |
|                  | E331-1         | C R          |                             |
|                  | E149-1         | C R          |                             |
| COLLINFO         | E314-1         | C            |                             |
|                  | E337-1         | C            |                             |
|                  | E001-2         | C            |                             |
|                  | E336-1         | C            |                             |
| COMMAND          | E987-18        | M            |                             |
| CONTROL          | E007-1         | M            | CONT                        |
|                  | E002-1         | M            |                             |
|                  | E651-2         | M            |                             |
|                  | E681-2         | C            |                             |
|                  | E651-3         | M            |                             |
|                  | E681-3         | C            |                             |
|                  | C469-7         | C            |                             |
|                  | C497-6         | C            |                             |
|                  | C498-7         | C            |                             |
|                  | E500-22        | C            |                             |
|                  | C542-8         | C            |                             |
| DELETE           |                | C            | (NO DATA FIELD IDENTIFIERS) |

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| <u>SET IDENT</u> | <u>DFI/DUI</u> | <u>OCCUR</u> | <u>MANDATORY ENTRY</u>     |
|------------------|----------------|--------------|----------------------------|
| DES              | E150-5         | M            | DES                        |
| DFC              | E150-7         | M            | DFC                        |
| DWNGRADE         | E679-1         | M            |                            |
| EMP              | E689-1         | M            | EMCOM                      |
|                  | C143-6         | M            | FROM                       |
|                  | C143-7         | C            | TO                         |
| EMTRWHAT         | E031-1         | C            |                            |
|                  | E109-1         | C            |                            |
|                  | E141-1         | C            |                            |
|                  | C142-7         | M            |                            |
| ENLOS            | E031-7         | C            | ACTKIA                     |
|                  | E031-8         | C            | ESTKIA                     |
|                  | E031-9         | C            | ESTWIA                     |
|                  | E031-10        | C            | CPTRD                      |
| ESCDAT           | E673-1         | C            |                            |
|                  | E495-2         | M            | ORDTYP                     |
|                  | C496-2         | M R          |                            |
|                  | C619-2         | C R          |                            |
| EXER             | E335-1         | M            | EXERCISE                   |
| FACDAT           | E673-1         | C            |                            |
|                  | E651-2         | M            |                            |
|                  | E581-2         | C            |                            |
|                  | E651-3         | M            |                            |
|                  | E681-3         | C            |                            |
| FLAGWORD         | E334-1         | M            |                            |
|                  | E479-1         | C            |                            |
| GNDFRND          | E673-1         | C            |                            |
|                  | E212-1         | M            | MRKING                     |
|                  | E467-1         | C            |                            |
|                  | C143-19        | M            | TIMPOS                     |
|                  | C011-6         | M R          |                            |
|                  | C012-16        | C R          |                            |
|                  | C498-9         | C R          |                            |
| GNDWHAT          | E031-1         | C            |                            |
|                  | E066-1         | C            |                            |
|                  | E141-1         | C            |                            |
|                  | C142-7         | M            |                            |
|                  | E032-4         | C            |                            |
|                  | E071-1         | C            |                            |
| HEADING          | E326-2         | M            | (SPECIFIED BY MSG. FORMAT) |
| HELOLIFT         | E673-1         | C            |                            |
|                  | C011-17        | M            | ONLOC                      |
|                  | C012-25        | C            | ONLOC                      |
|                  | E500-33        | C            | ONNAM                      |
|                  | C011-18        | M            | OFFLOC                     |

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| <u>SET IDENT</u> | <u>DFI/DUI</u> | <u>OCCUR</u> | <u>MANDATORY ENTRY</u> |
|------------------|----------------|--------------|------------------------|
|                  | C012-26        | C            | OFFLOC                 |
|                  | E500-34        | C            | OFFNAM                 |
|                  | E031-53        | C            | NOPAX                  |
|                  | E476-1         | C            | PAXTYPE                |
|                  | C453-4         | C            | TOTALWT                |
|                  | C619-1         | C R          |                        |
| IDC              | C011-8         | C            |                        |
|                  | E150-11        | C            | MPR                    |
| IMR              | C075-9         | M            |                        |
|                  | E584-3         | M            |                        |
|                  | E944-1         | M            |                        |
|                  | E564-3         | C            |                        |
|                  | E564-4         | M            |                        |
|                  | E564-5         | M            |                        |
|                  | E982-1         | M            |                        |
|                  | E564-7         | O            |                        |
|                  | E487-46        | O            | URG                    |
| IPIR             | E517-2         | M            |                        |
|                  | E487-48        | M            | SER                    |
|                  | E584-3         | M            | PRJ                    |
|                  | E944-1         | M            | MSN                    |
|                  | C033-2         | C            | DTZ                    |
|                  | C981-2         | C            |                        |
| ISR              | E499-2         | M            | ISR                    |
|                  | C064-1         | M            |                        |
|                  | E491-7         | M            | PENALT                 |
| ITEMID           | E487-43        | M            | ITM                    |
|                  | C010-1         | M            |                        |
|                  | C943-1         |              |                        |
|                  | E119-1         | M            | CAT                    |
|                  | E057-3         | M            |                        |
| MARWHAT          | E031-1         | C            |                        |
|                  | E198-1         | C            |                        |
|                  | E141-1         | C            |                        |
|                  | C142-7         | M            |                        |
|                  | E032-4         | C            |                        |
|                  | E071-1         | C            |                        |
| MIPIR            | E517-2         | M            |                        |
|                  | E487-48        | M            | SER                    |
|                  | E584-3         | M            | PRJ                    |
|                  | E944-1         | M            | MSN                    |
|                  | C033-2         | C            | DTZ                    |
|                  | C981-2         | C            | DTZ                    |
| MSGID            | E050-1         | M            |                        |
|                  | E146-1         | C            |                        |

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| <u>SET IDENT</u> | <u>DFI/DUI</u> | <u>OCCUR</u> | <u>MANDATORY ENTRY</u> |
|------------------|----------------|--------------|------------------------|
| MSGREF           | C147-1         | C            |                        |
|                  | E050-1         | M            |                        |
|                  | E146-1         | M            |                        |
|                  | C147-1         | M            |                        |
|                  | C051-20        | M            | DRAFTDAT               |
| MSNID            | E345-1         | C            | AMD                    |
|                  | E001-1         | M            | MSNNO                  |
|                  | E003-1         | C            | REQNO                  |
|                  | E004-1         | C            | FRAG                   |
|                  | E005-1         | C            | OPORD                  |
|                  | E002-1         | O            |                        |
| MSNLCAMP         | E500-16        | M            |                        |
|                  | E629-1         | M            | MSNLCCTYP              |
|                  | C011-2         | M R          |                        |
|                  | C012-12        | C R          |                        |
|                  | C329-3         | C R          |                        |
|                  | C498-4         | C R          |                        |
|                  | C683-2         | C R          |                        |
| NARR<br>NOTES    | E673-1         | C            | (A FREE TEXT SET)      |
| OBEQ             | E673-3         | M R          |                        |
|                  | E031-19        | M            |                        |
|                  | E564-14        | M            |                        |
|                  | E066-1         | M            |                        |
|                  | E151-1         | O            |                        |
| OBID             | E150-10        | O            |                        |
|                  | E985-1         | M            |                        |
|                  | C075-7         | O            |                        |
|                  | E150-9         | C            |                        |
|                  | E942-1         | M            |                        |
|                  | E584-3         | M            |                        |
|                  | E944-1         | M            |                        |
|                  | E564-3         | C            |                        |
|                  | C075-6         | M            |                        |
|                  | E336-1         | M            |                        |
| OPER<br>OTID     | E487-44        | C            | REQ                    |
|                  | E059-1         | M            | CTY                    |
|                  | C011-1         | M            |                        |
|                  | C012-23        | O            | UTM                    |
|                  | C542-10        | O            | UTM                    |
| PERCOV           | E986-1         | O            | MRG                    |
|                  | C143-6         | M            | FROM                   |
| PERID            | C143-7         | M            | TO                     |
|                  | C143-6         | M            |                        |
|                  | C143-7         | M            |                        |

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| <u>SET IDENT</u> | <u>DEF/DUI</u> | <u>OCCUR</u> | <u>MANDATORY ENTRY</u> |
|------------------|----------------|--------------|------------------------|
| PERIOD           | C051-4         | M            | ENDING                 |
| PHOTODAT         | C143-10        | M            | PHOTIME                |
|                  | E122-1         | O            |                        |
|                  | E087-1         | O            |                        |
|                  | E086-1         | O            | SCALE                  |
|                  | E027-4         | O            | PCTCOV                 |
| PPC              | E150-8         | M            | PPC                    |
| PRM              | C110-2         | C            |                        |
|                  | E320-1         | C            |                        |
|                  | E088-1         | C            | PRI                    |
|                  | E325-1         | C            |                        |
|                  | E093-1         | C            | PD                     |
|                  | E092-1         | C            |                        |
|                  | E091-1         | C            |                        |
|                  | E089-1         | C            |                        |
| PROTFREQ         | C652-1         | M R          |                        |
|                  | E908-3         | M R          |                        |
| RECCE            | E046-1         | M            | EEICAT                 |
|                  | E047-1         | M            | PHOTCONF               |
| RECDAT           | E673-1         | C            |                        |
|                  | E107-8         | M            | RECTYP                 |
|                  | E122-1         | M            | TYP COV                |
|                  | E121-1         | C            | TYP SEN                |
|                  | E104-1         | C            | PHOTO                  |
|                  | E112-1         | C            | FILM                   |
|                  | E102-1         | C            | STEREO                 |
| REF              | E050-1         | M            |                        |
|                  | E046-1         | M            |                        |
|                  | C143-1         | M            |                        |
|                  | E580-1         | M            |                        |
|                  | C147-1         | O            |                        |
|                  | E332-1         | O            |                        |
| REFMAP           | E673-1         | C            |                        |
|                  | E117-1         | M            |                        |
|                  | E116-1         | O            |                        |
|                  | E487-36        | O            |                        |
| REPORT           | E987-4         | M            | DELADDR                |
|                  | C143-25        | M            | LTIOV                  |
|                  | E031-11        | M            | DPRIOROK               |
|                  | E031-1         | C            | QTY                    |
|                  | E111-1         | C            | REC PROD               |
|                  | E911-1         | C            | SCL                    |
|                  | E050-2         | C R          |                        |
| REQDATA          | E003-1         | M            |                        |
|                  | E106-1         | C            | PREC                   |

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| <u>SET IDENT</u> | <u>DFI/DUI</u> | <u>OCCUR</u> | <u>MANDATORY ENTRY</u> |
|------------------|----------------|--------------|------------------------|
|                  | E105-1         | M            | PRY                    |
|                  | C075-3         | M            | DATEDES                |
|                  | C315-3         | C            | TOT                    |
|                  | C051-2         | M            | LTIOV                  |
|                  | E031-11        | C            | DPRIOROK               |
|                  | E107-8         | M            |                        |
|                  | E122-1         | M            |                        |
|                  | E121-1         | C            |                        |
|                  | E104-1         | C            | PHOTO                  |
|                  | E112-1         | C            | FILM                   |
|                  | E102-1         | M            | STEREO                 |
|                  | C113-1         | M            |                        |
| REQDATC          | C095-4         | M            |                        |
|                  | C006-12        | C            |                        |
|                  | C124-13        | C            | RUNINHGD               |
| REQDATD          | E001-1         | C            | MSNNO                  |
|                  | E002-1         | C            |                        |
|                  | E034-1         | C            |                        |
|                  | C315-5         | C            | TOFF                   |
|                  | C315-4         | C            | ETOT                   |
|                  | E002-3         | C            | INITCONT               |
|                  | C110-2         | C            | RFREQ                  |
|                  | C006-15        | C            | ORBITPT                |
|                  | E002-2         | C            | FINCONT                |
|                  | C110-2         | C R          | RFREQ                  |
| REQDATF          | C051-3         | M            | DATDES:                |
|                  | E105-1         | C            | PRY                    |
|                  | C051-2         | C            | LTIOV                  |
| REQUEST          | E003-2         | M            | REQNO                  |
|                  | E936-1         | M            | PRY                    |
|                  | E937-1         | C            | PRY                    |
|                  | E938-1         | C            | PRY                    |
|                  | E107-4         | M            | AMSN                   |
|                  | C084-2         | M            | TOT                    |
|                  | C143-47        | C            | TOT                    |
|                  | E617-2         | C            | TOT                    |
|                  | C084-3         | C            | TFT                    |
|                  | C143-48        | C            | TFT                    |
|                  | C496-1         | C            | NOTPAC                 |
|                  | C011-2         | M R          |                        |
|                  | C012-12        | C R          |                        |
|                  | C498-4         | C R          |                        |
|                  | E500-16        | C R          |                        |
|                  | C554-2         | C R          |                        |
|                  | C555-2         | C R          |                        |

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| <u>SET IDENT</u> | <u>DFI/DUI</u> | <u>OCCUR</u> | <u>MANDATORY ENTRY</u> |
|------------------|----------------|--------------|------------------------|
|                  | C556-2         | C R          |                        |
|                  | C683-2         | C R          |                        |
| RFP              | E108-1/        | M            |                        |
|                  | E475-1         |              |                        |
|                  | C143-6         | C            | FROM                   |
|                  | C143-7         | C            | TO                     |
|                  | C062-1         | C            | WDTH                   |
|                  | C036-2         | C            | ALTMX                  |
|                  | C036-3         | C            | ALTMN                  |
|                  | C006-13        | C            | LOCFM                  |
|                  | C006-14        | C R          | LOCTO                  |
| RMK              | E150-6         | M            | RMK                    |
| RMKS             |                |              | (A FREE TEXT SET)      |
| ROUTEREF         | E673-1         | M R          |                        |
| SIC              | E332-1         | M R          |                        |
| SOI              | C143-4         | M            |                        |
|                  | C315-2         | M            |                        |
|                  | E118-1         | M            |                        |
|                  | E109-1         | M            |                        |
|                  | C340-1         | M            |                        |
|                  | C341-1         | M            |                        |
|                  | C012-1         | M            |                        |
|                  | C061-5         | M            |                        |
|                  | C062-3         | M            |                        |
|                  | E999-2         | M            | TB                     |
|                  | E126-1         | M            | NR                     |
|                  | E059-1         | M            |                        |
|                  | E316-1         | M            |                        |
|                  | C016-1         | O            |                        |
| SOURCE           | E053-1         | C            |                        |
|                  | C143-8         | M            |                        |
|                  | C054-1         | C            |                        |
| STATACT          | E983-2         | M            | STA                    |
|                  | E983-3         | O            |                        |
|                  | E584-2         | M            |                        |
|                  | E942-1         | O            | SGN                    |
|                  | E584-3         | O            | PRJ                    |
|                  | E944-1         | C            | MSN                    |
|                  | E564-3         | C            |                        |
|                  | C075-8         | C            | IMDATE                 |
|                  | E984-1         | C            | NRG                    |
| SUPIR            | E517-2         | M            |                        |
|                  | E487-48        | M            | SER                    |
|                  | E584-3         | M            | PRJ                    |
|                  | E944-1         | M            | MSN                    |

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| <u>SET IDENT</u> | <u>DFI/DUI</u> | <u>OCCUR</u> | <u>MANDATORY ENTRY</u> |
|------------------|----------------|--------------|------------------------|
|                  | C033-2         | C            | DTZ                    |
|                  | C981-2         | C            | DTZ                    |
| SUPPORT          | E673-1         | C            |                        |
|                  | E107-4         | M R          |                        |
|                  | E001-1         | M R          |                        |
|                  | E003-2         | C R          |                        |
| SUPREQ           | E019-1         | C            | TGTTYP                 |
|                  | C006-6         | C            | TGTLOC                 |
|                  | C143-11        | C            | DESDT                  |
| TANKDAT          | E673-1         | C            |                        |
|                  | E539-1         | M            | ARSYS                  |
|                  | E907-5         | M            | FUREQ                  |
|                  | E538-2         | M            | FUEL                   |
| TASKUNIT         | E987-21        | M            |                        |
|                  | E150-1         | C            |                        |
| TGTCOD           | C183-1         | M R          |                        |
| TGTDAT           | E500-27        | C            | TGTID                  |
|                  | C554-3         | C            | TGTID                  |
|                  | C555-3         | C            | TGTID                  |
|                  | C556-3         | C            | TGTID                  |
|                  | C011-8         | C            | TGTLOC                 |
|                  | C012-2         | C            | TGTLOC                 |
|                  | C498-6         | C            | TGTLOC                 |
|                  | C683-7         | C            | TGTLOC                 |
|                  | C060-4         | C            | TRAD                   |
|                  | C061-4         | C            | TLGTH                  |
|                  | C062-4         | C            | TWDTH                  |
|                  | C124-7         | C            | ALIGNMT                |
|                  | E099-1         | C            | DOP                    |
|                  | C143-19        | C            | TIMPOS                 |
|                  | E067-2         | C            | HDG                    |
|                  | C064-1         | C            |                        |
|                  | C199-1         | C R          |                        |
| TGTPRI           | E107-4         | M            | AMSN                   |
|                  | E019-1         | M R          |                        |
|                  | C183-1         | M R          |                        |
|                  | E908-2         | M R          |                        |
|                  | E939-1         | M R          |                        |
| TIMEAMP          | E673-1         | C            |                        |
|                  | E682-1         | M R          |                        |
|                  | C084-1         | M R          |                        |
|                  | C143-1         | C R          |                        |
|                  | E617-1         | C R          |                        |
| TRPLN            | C006-49        | M            |                        |
|                  | C006-50        | C R          |                        |

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| <u>SET IDENT</u> | <u>DFI/DUI</u> | <u>OCCUR</u> | <u>MANDATORY ENTRY</u> |
|------------------|----------------|--------------|------------------------|
| TSKDAT           | E003-1         | C            | REQNO                  |
|                  | E004-1         | C            | FRAG                   |
|                  | E005-1         | C            | OPORD                  |
| TYP              | E050-2         | M            |                        |
|                  | C113-1         | C            | MAPREF                 |
| UNIT             | C095-1         | M            |                        |
| WHERE            | E002-1         | C            |                        |
|                  | C329-4         | C            |                        |
|                  | C330-1         | C            |                        |
|                  | E057-1         | C            |                        |
|                  | C124-14        | C            |                        |
|                  | C061-5         | C            |                        |
|                  | C062-3         | C            |                        |
|                  | C124-15        | C            |                        |
|                  | C064-3         | C            |                        |
|                  | C036-1         | C            |                        |
|                  | C305-1         | C            |                        |
|                  | E059-1         | C            |                        |
|                  | C095-2         | C            |                        |
|                  | C016-1         | C            |                        |
|                  | E987-37        | M            |                        |
| ZZREF            | E082-1         | M            | DE                     |
| 1AJ              | E119-1         | M            | FUNCT                  |
|                  | C016-1         | C            | TGT-ID                 |
|                  | E019-1         | C            | TGTTYP                 |
|                  | E020-1         | C            | SUBTYP                 |
|                  | E031-1         | C            | QTY                    |
|                  | E046-1         | C            | EEICAT                 |
|                  | E082-1         | M            | DE                     |
|                  | E057-1         | C            | TERRAIN-FEATURE-NAME   |
|                  | C006-6         | M            | TARGET-LOCATION        |
|                  | E128-1         | M            | LQFR                   |
| 1AL              | E082-1         | M            | DE                     |
|                  | C123-1         | C            | STR-ID                 |
|                  | E121-1         | C            | TYP-SEN                |
|                  | C196-1         | C            | SEN-CHAN               |
|                  | C006-7         | C            | STR-LOC                |
|                  | C075-5         | C            | IMPLDAT                |
|                  | E031-12        | C            | BATLIF                 |
|                  | E082-1         | M            | DE                     |
| 1AM              | E048-1         | C            | RCVRY                  |
|                  | E204-1         | C            | CALL-CHAN              |
|                  | C075-6         | C            | REMDAT                 |
|                  | E633-1         | C            | RLY-REQD               |
|                  | E082-1         | M            | DE                     |
| 1AN              |                |              |                        |

APPENDIX E  
DATA FIELD IDENTIFIER SUMMARY

PART 1 - COMBINED DATA FIELD IDENTIFIERS

| <u>CDFI</u> | <u>EDFI</u>                                                                  | <u>VAL</u> | <u>NAME</u>                  |
|-------------|------------------------------------------------------------------------------|------------|------------------------------|
| C006        | E176-1<br>C011-1/<br>C012-1                                                  | 16an       | LOCATION                     |
| C010        | E153-1<br>E154-1<br>E155-1                                                   | 10an       | BASIC ENCYCLOPEDIA NUMBER    |
| C011        | E017-1<br>E156-2<br>E157-2<br>E158-2<br>E018-1<br>E156-3<br>E157-3<br>E158-3 | 15an       | GEOGRAPHIC COORDINATES       |
| C012        | C159-1<br>C160-1<br>C161-1                                                   | 13an       | LOCATION, UTM 10 METER GRID  |
| C016        | E013-1<br>E008-1/<br>E009-1/<br>C010-1/<br>C317-1/<br>E304-1/<br>E487-25     | 13anv      | TARGET IDENTIFIER            |
| C033        | C075-1<br>E026-1                                                             | 7an        | DATE-TIME ZONE               |
| C036        | E177-1<br>E031-1<br>E029-4                                                   | 8an        | ALTITUDE                     |
| C038        | E192-4<br>E040-1<br>E041-1                                                   | 8an        | CLOSEST MISS CHARACTERISTICS |

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| <u>CDFI</u> | <u>EDFI</u>                                    | <u>VAL</u> | <u>NAME</u>               |
|-------------|------------------------------------------------|------------|---------------------------|
| C051        | E021-1<br>E022-1<br>E023-1<br>E024-1<br>E026-1 | 11an       | DATE AND TIME             |
| C054        | E056-1<br>E055-1                               | 2an        | EVALUATION OF INFORMATION |
| C058        | E057-4<br>E059-1                               | 40an       | PLACE OF BIRTH            |
| C060        | E031-1<br>E029-4                               | 7an        | RADIUS                    |
| C061        | E031-1<br>E029-4<br>E306-1                     | 8an        | LENGTH                    |
| C062        | E031-1<br>E029-4<br>E306-1                     | 8an        | WIDTH                     |
| C063        | E031-1<br>E029-4                               | 8an        | HEIGHT                    |
| C064        | E031-1<br>E306-1<br>E029-8                     | 8an        | SPEED OF MOVEMENT         |
| C068        | E069-1<br>E070-1<br>E071-1                     | 9a         | TARGET STATUS             |
| C073        | E168-1<br>E169-1                               | 3an        | MILITARY PAY GRADE        |
| C075        | E021-1<br>E022-1<br>E023-1                     | 6an        | DATE                      |
| C076        | E15101<br>E213-2<br>E066-1                     | 32an       | EQUIPMENT                 |

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| <u>CDFI</u> | <u>EDFI</u>                                    | <u>VAL</u> | <u>NAME</u>                 |
|-------------|------------------------------------------------|------------|-----------------------------|
|             | E213-2<br>E152-1                               |            |                             |
| C084        |                                                | 6an        | RELATIVE TIME, HRS AND MINS |
|             | E201-1<br>E209-1<br>E024-1<br>E025-1           |            |                             |
| C090        |                                                | 7an        | MEASURED SIGNAL STRENGTH    |
|             | E031-1<br>E029-7                               |            |                             |
| C095        |                                                | 24an       | UNIT DESIGNATOR             |
|             | E096-1<br>E097-1<br>E098-1                     |            |                             |
| C110        |                                                | 11an       | RADIO FREQUENCY             |
|             | E253-1<br>E029-6                               |            |                             |
| C113        |                                                | 26an       | MAP REFERENCE               |
|             | E117-1<br>E116-1<br>E115-1<br>E021-1<br>E022-1 |            |                             |
| C123        |                                                | 6an        | SENSOR STRING ID AND STATUS |
|             | E170-2<br>E170-3<br>E487-11<br>E173-1          |            |                             |
| C124        |                                                | 8an        | AXIS DAY-TIME               |
|             | E023-1<br>E024-1<br>E025-1<br>E026-1           |            |                             |
| C144        |                                                | 7an        | ELEVATION                   |
|             | E031-1<br>E029-4                               |            |                             |
| C147        |                                                | 7n         | MESSAGE SERIAL NUMBER       |
|             | E022-1<br>E023-1<br>E487-13                    |            |                             |
| C159        |                                                | 3an        | UTM GRID ZONE DESIGNATION   |
|             | E162-1<br>E163-1                               |            |                             |
| C160        |                                                | 2an        | UTM 100KM SQUARE ID         |
|             | E164-1                                         |            |                             |

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APPENDIX E  
DATA FIELD IDENTIFIER SUMMARY  
PART 2 - INDIVIDUAL DATA ELEMENTS

| <u>EDFI</u> | <u>VAL1</u> | <u>VAL2</u> | <u>NAME</u>                     |
|-------------|-------------|-------------|---------------------------------|
| E001        | 6anbf       |             | MISSION NUMBER                  |
| E002        | 17anbv      |             | CALL SIGN                       |
| E003        | 6anbv       |             | AIR TASK REQUEST NUMBER         |
| E004        | 4nf         |             | FRAG ORDER NUMBER               |
| E005        | 7anbv       |             | OP ORDER NUMBER                 |
| E007        | lat         | T007        | TYPE OF CONTROL AGENCY          |
| E008        | 6asnf       |             | TARGET IDENTIFIER               |
| E009        | 9anf        |             | THEATER TARGET NUMBER           |
| E013        | lat         | T013        | TARGET SYSTEM IDENTIFICATION    |
| E017        | 2nfr        | R1          | LATITUDE (00-90)                |
| E018        | 3nfr        | R2          | LONGITUDE (000-180)             |
| E019        | 6avt        | T019        | TARGET TYPE                     |
| E020        | 6avt        | T020        | TARGET SUBTYPE                  |
| E021        | 2nf         |             | YEAR                            |
| E022        | 2nfr        | R3          | MONTH (01-12)                   |
| E023        | 2nfr        | R4          | DAY (01-31)                     |
| E024        | 2nfr        | R5          | HOUR (00-24)                    |
| E025        | 2nfr        | R6          | MINUTE (01-60)                  |
| E026        | lar         | R7          | TIME ZONE (NO J)                |
| E027        | 3nv         |             | PERCENTAGE                      |
| E029        | 3avt        | T029        | UNIT OF MEASUREMENT             |
| E030        | 6anfp       | P030        | CALIBER, MM                     |
| E031        | 4anvx       | N031        | QUANTITY                        |
| E032        | 8anvt       | T032        | ORDNANCE TYPE                   |
| E034        | 20anl       | N034        | AIRCRAFT NAME                   |
| E035        | 7anl        |             | TYPE SURFACE TO AIR FIRE        |
| E037        | 3avt        | T037        | RELATIVE INTENSITY OF FIRE      |
| E040        | 2nfr        | R3          | CLOCKWISE DIRECTION (01-12)     |
| E041        | lat         | T041        | RELATIVE VERTICAL POSITION      |
| E042        | lat         | T042        | EVASIVE ACTION                  |
| E043        | 1last       | T043        | AIRCRAFT LOSS, CAUSE            |
| E044        | 4at         | T044        | DOWNED ACFT CREW STATUS         |
| E045        | 10at        | T045        | WEATHER TYPE                    |
| E046        | 2nf         |             | EEI CATEGORY                    |
| E048        | 2at         | T048        | SENSOR RECOVERY STATUS          |
| E050        | 20anvt      | T050        | MESSAGE TITLE                   |
| E052        | 4at         | T052        | TARGET UNIT SIZE                |
| E053        | 12ant       | T053        | TYPE INTELLIGENCE SOURCE        |
| E055        | lnr         | R9          | EVALUATION OF ACCURACY          |
| E056        | lar         | R10         | EVALUATION OF RELIABILITY (A-F) |

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| <u>EDFI</u> | <u>VAL1</u> | <u>VAL2</u> | <u>NAME</u>                           |
|-------------|-------------|-------------|---------------------------------------|
| E057        | 381         |             | TERRAIN FEATURE NAME                  |
| E059        | 2anl        | N059        | COUNTRY                               |
| E065        | 6at         | T065        | TYPE OF HUMAN SOURCE                  |
| E066        | 18anv       |             | EQUIPMENT NAME                        |
| E067        | 3at         | T067        | DIRECTION/HEADING                     |
| E069        | 3aft        | T069        | OCCUPANCY STATUS                      |
| E070        | 3aft        | T070        | OPERATIONAL STATUS                    |
| E072        | 27al        |             | NAME, INDIVIDUAL                      |
| E074        | 10anl       |             | PERSONAL ID NBR                       |
| E077        | 3avt        | T077        | INDICATION OF NBC TRAINING            |
| E078        | 8avt        | T078        | PROTECTIVE CLOTHING TYPE              |
| E079        | 5at         | T079        | VEGETATION AREA TYPE                  |
| E080        | 40anl       |             | ADDRESS, RESIDENTIAL                  |
| E081        | 20anl       |             | OCCUPATION                            |
| E082        | 2nf         |             | DATA ENTRY NUMBER                     |
| E087        | 4af         | T087        | QUALITY OF IMAGERY                    |
| E096        | 4anl        |             | UNIT NUMBER                           |
| E097        | 13avt       | T097        | ORGANIZATION TYPE                     |
| E098        | 7avt        | T098        | ECHELON                               |
| E099        | 6avt        | T099        | DEGREE OF PROTECTION                  |
| E100        | 12avt       | T100        | TYPE OF BARRIER/OBSTACLE              |
| E105        | 1nfr        | R12         | MISSION PRIORITY (1-4)                |
| E107        | 5avt        | T107        | MISSION TYPE                          |
| E108        | 5anvt       | T108        | RESTRICTIVE FIRE PLAN                 |
| E109        | 5an         | N001        | EMITTER DESIGNATION                   |
| E111        | 5avt        | T111        | RECCE PRODUCT DESIRED                 |
| E114        | 2at         | T114        | RADIO/RADAR FUNCTION                  |
| E115        | 2nf         |             | EDITION SERIAL NUMBER                 |
| E116        | 14anl       |             | CARTO. ITEM DESIGNATION               |
| E117        | 6anl        |             | SERIES DESIGNATOR                     |
| E118        | 5n          | N001        | ELINT NOTATION                        |
| E119        | 5nvl        | N119        | FUNCTIONAL CLASSIFICATION             |
| E120        | 6avt        | T120        | USE OF BARRIER/OBSTACLE               |
| E121        | 2aft        | T121        | TYPE OF SENSOR                        |
| E122        | 7avt        | T122        | TYPE OF RECCE COVERAGE                |
| E125        | 8avt        | T125        | ECM TYPE                              |
| E126        | 5anl        |             | TARGET SIGNAL NUMBER                  |
| E128        | 3at         | T128        | LOCATION QUALIFIER                    |
| E130        | 12avt       | T130        | ECM ACTION                            |
| E131        | 12avt       | T131        | ECM EFFECT                            |
| E132        | 3avt        | T132        | TARGET LIST PART                      |
| E135        | 20anl       |             | OPERATOR POSITION, EQUIPMENT AFFECTED |
| E137        | 6al         |             | SHIP TYPE                             |
| E138        | 5avt        | T138        | TYPE BIO/CHEM AGENT                   |
| E139        | 10ant       | T139        | TYPE ELECTRONIC INTERFERENCE          |

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| <u>EDFI</u> | <u>VAL1</u> | <u>VAL2</u> | <u>NAME</u>                     |
|-------------|-------------|-------------|---------------------------------|
| E140        | 18anl       |             | GROUND EQUIPMENT NAME           |
| E141        | 6avt        | T141        | ACTIVITY TYPE                   |
| E146        | 20anl       |             | MESSAGE ORIGINATOR              |
| E148        | 33avt       | T148        | SECURITY CLASSIFICATION         |
| E149        | 2a          | N149        | CONTROL AND RELEASE MARKING     |
| E150        | anl         | N150        | COMMENTS                        |
| E151        | 6avt        | T151        | EQUIPMENT CATEGORY              |
| E152        | 6anl        |             | EQUIPMENT MODEL                 |
| E153        | 4nl         |             | WORLD AREA NUMBER               |
| E154        | 1ant        | T154        | PROGRAM INDICATOR               |
| E155        | 5nf         |             | INSTALLTION ID SN               |
| E156        | 2nfr        | R13         | MINUTE OF ANGLE (00-59)         |
| E157        | 2nfr        | R13         | SECOND OF ANGLE (00-59)         |
| E158        | 1aft        | T158        | TERRESTRIAL HEMISPHERE          |
| E162        | 2nfr        | R6          | UTM GRID ZONE COLUMN (01-60)    |
| E163        | 1afr        | R14         | UTM GRID ZONE ROW (C-H:J-N:P-Z) |
| E164        | 1a          |             | UTM 100KM SQ COLUMN             |
| E165        | 1a          |             | UTM 100KM SQ ROW                |
| E166        | 4nf         |             | UTM 10M EASTING                 |
| E167        | 4nf         |             | UTM 10M NORTHING                |
| E168        | 1at         | T168        | MIL PERSONNEL CLASS             |
| E169        | 2nfr        | R15         | PAY LEVEL (01-11)               |
| E170        | 1at         | T170        | ARMED SERVICE                   |
| E173        | 1at         | T173        | SENSOR STRING STATUS            |
| E176        | 3aft        | T176        | COORDINATE CONVENTION           |
| E177        | 1aft        | T177        | DATUM PLANE                     |
| E178        | 2nvrR16     | RECCE       | TARGET CATEGORY (1-14)          |
| E179        | 6at         | T179        | FRIENDLY FIRE SUPPORT EFFECT    |
| E182        | 1af         | EEI         | RECCE TARGET CATEGORY (A-Z)     |
| E192        | 20anl       |             | NAME/NUMBER OF SHIP             |
| E201        | 2avt        | T201        | REFERENCE INDICATOR             |
| E202        | 2nf         |             | SENSOR IDENTIFICATION           |
| E204        | 9nf         |             | CALL CHANNEL                    |
| E205        | 4nf         |             | SENSOR CHANNEL                  |
| E209        | 1st         | T209        | ARITHMETIC SYMBOL               |
| E212        | 6avt        | T212        | FRIENDLY POSITION MARKINGS      |
| E213        | 1sbt        | T213        | DATA DELIMITER                  |
| E242        | env         |             | BLOCK COUNT                     |
| E253        | 8anvr       | R18         | RADIO FREQUENCY                 |
| E258        | 4avt        | T258        | ROUTE POINT TYPE                |
| E300        | 2anr        | R19         | DECISECOND OF ANGLE (.0-.9)     |
| E304        | 12l         |             | HULL TO EMITTER CORR NBR        |
| E306        | 4an         | N001        | DECIMAL QUANTITY                |
| E312        | 2nfr        | R13         | SECOND OF TIME (00-59)          |
| E314        | 2af         | N001        | COLLECTOR DIGRAPH               |

APPENDIX E  
DATA USE IDENTIFIER SUMMARY

PART 3 - VALIDATION TABLES

| ID   | I,N      | TABLE NAME/TABLE ITEMS       |        |        |        |         |        |
|------|----------|------------------------------|--------|--------|--------|---------|--------|
| T007 | (1, 5)   | TYPE OF CONTROL AGENCY       |        |        |        |         |        |
|      |          | F                            | I      | M      | O      | R       |        |
| T013 | (1, 6)   | TARGET SYSTEM IDENTIFICATION |        |        |        |         |        |
|      |          | A                            | B      | H      | P      | T       | X      |
| T019 | (6,68)   | TARGET TYPE                  |        |        |        |         |        |
|      |          | ABOAT                        | AIRFLD | ARM    | ASSY   | AUXLRY  | BASE   |
|      |          | BLDG                         | BRIDGE | CMDCTR | COMBIN | COMELT  | COMLN  |
|      |          | DAM                          | DROPZN | DTACP  | ECMAIR | ECMSUR  | ESMAIR |
|      |          | ESMDLT                       | ESMSUR | FERRY  | GOVINS | HQ      | INDCMX |
|      |          | LANDG                        | LDGZON | MBOAT  | NAVAID | NAVTE   | NAVTC  |
|      |          | NAVU                         | NVTF   | PARMIL | PCIVIL | PLSCFT  | PMIL   |
|      |          | POLSTA                       | PONT   | PORT   | PTLCFT | PWRIN   | RAFT   |
|      |          | RAILRD                       | ROWBT  | SAIL   | SAMPN  | STORAR  | SUPDMP |
|      |          | TFORD                        | TFORT  | TMADE  | TNATUR | TOWER   | VARMOR |
|      |          | VARTY                        | VBOAT  | VCSPT  | VENGNR | VOTHER  | VPLANE |
|      |          | WADA                         | WARTY  | WGUN   | WINDIV | WMORT   | WOTHER |
|      |          | WRKT                         | WSPEC  |        |        |         |        |
| T020 | (6, 356) | TARGET SUBTYPE               |        |        |        |         |        |
|      |          | ACFTPR                       | ADAHVY | ADALT  | ADAMED | ADAMSL  | ADAUNK |
|      |          | ADFHQ                        | AFBASE | AIRFLD | ALOGHQ | ARBASE  | ATPARM |
|      |          | ATPMEC                       | ATPVEH | ATRP   | ATSHQ  | AUNK    | BEACON |
|      |          | BLDCON                       | BLDMET | BLDMSN | BLDSP  | BLDUNK  | BLDWD  |
|      |          | BMGFLD                       | BRGAVL | BRGFFB | BRGFFP | BRGFFR  | BRGFLT |
|      |          | BRRFRY                       | BRGFTC | BRGFTS | BRGFTW | BRGFXD  | BRGMA  |
|      |          | BRGPNL                       | BRGRDY | BRGRR  | BRGUNK | BRGVC   | BRGVFB |
|      |          | BRGVFP                       | BRGVL  | BRGVS  | BRGVW  | BUOY    | CANTEN |
|      |          | CBATRY                       | CEW    | CFL    | CGENTR | CHEMPR  | CINFRA |
|      |          | CLASER                       | CLIGHT | CLSPKR | CMBAT  | CMDIV   | CMDLG  |
|      |          | CMDMED                       | CMDSM  | CMFWD  | CMICRO | CMNI    | CMRGT  |
|      |          | CODATA                       | COMPTR | COPTIC | COTHER | CPHOTO  | CRADAR |
|      |          | CRADIO                       | CRADOM | CRDAIR | CRDATA | CRDGND  | CRDODF |
|      |          | CRDODG                       | CRDOTE | CRDRAB | CRDRCM | CRDRDF  | CRDRED |
|      |          | CRT                          | CSORNG | CSRCHL | CSWBD  | CTDATA  | CTELE  |
|      |          | CTELEG                       | CTELEG | CTELEV | CTROPO | CTTY    | CUNK   |
|      |          | CWIRE                        | DAMRIP | DASSYA | DBLOCK | DCBTOP  | DHECKK |
|      |          | DCNTRM                       | DELECT | DESURV | DFARRP | DHEADP  | DLELEM |
|      |          | DLINK                        | DMERTH | DMONCR | DMSNRY | DMSTON  | DOPLP  |
|      |          | DPASAG                       | DPCNTR | DRELES | DSTART | DSTRING | DTACIC |
|      |          | DTACOC                       | DZEPQ  | DZSUP  | DZTRP  | FLKTWR  | FLOTHQ |
|      |          | FLTHQ                        | FRDCNC | FRDIMP | FRDNAT | FRDSTN  | FTRFLD |

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| <u>ID</u>   | <u>I,N</u>     | <u>TABLE NAME/TABLE ITEMS</u> |        |        |        |        |
|-------------|----------------|-------------------------------|--------|--------|--------|--------|
|             |                | GFHQ                          | HELFLD | HITECH | HZDLIT | ILSLCL |
|             |                | LITBCN                        | LORAN  | LRAVHQ | LTHOUS | LZFXWG |
|             |                | MAPORT                        | MARBAS | MIPORT | MKRBCN | MSLPR  |
|             |                | MVPR                          | NAVABS | NAVBAS | NAVNHQ | NNVLHQ |
|             |                | OBSTRC                        | OBSTWR | OPSTWR | PAGENT | PARMIL |
|             |                | PATROL                        | PDFCTR | PDSRTR | PEM    | PETRPR |
|             |                | PGENOF                        | PGUER  | PGUNER | PHOSTG | PILOT  |
|             |                | PINTEL                        | PIPE   | PMEDIC | PMINLR | PMP    |
|             |                | PNCO                          | POBSVR | POFF   | POP    | POW    |
|             |                | PSABOT                        | PSAPER | PSCOUT | PSNIPR | PSTBHD |
|             |                | PWKPTY                        | PWRESL | PWRHYD | PWRLN  | PWRNUC |
|             |                | PWRTHM                        | RADTWR | RAIL   | RCNFLD | ROAD   |
|             |                | RREQRP                        | RRFTRM | RRLDPM | RRPTRM | RRRLY  |
|             |                | RRTRLD                        | SAMHQ  | SHIPYD | SHORAN | SMIL2D |
|             |                | SMILL1                        | SMILL2 | SMILL4 | SMLEAF | SMNGAS |
|             |                | SSMHQ                         | STRI   | STRII  | STRIII | STRIV  |
|             |                | STRVII                        | SUPI   | SUPII  | SUPIII | SUPIV  |
|             |                | SUPV                          | SUPVII | SYPORT | TACAN  | TAVNHQ |
|             |                | TBLDGT                        | TBLDGV | TBUNKR | TCAVE  | TCHURC |
|             |                | TDEPRS                        | TEMPLC | TFHOLE | THELIP | THLTOP |
|             |                | TLAKE                         | TLANDS | TMARSH | TPILBX | TPOLST |
|             |                | TRAIL                         | TRDJCT | TRENCH | TREVET | TRIDGE |
|             |                | TRLSTP                        | TROAD  | TRR    | TRRCRS | TRRJCT |
|             |                | TSADLE                        | TSCHOL | TSTREM | TUNNEL | TVALEY |
|             |                | UNK                           | UNKWN  | VAHVY  | VALT   | VAMBL  |
|             |                | VAMPHB                        | VAN    | VAPC   | VARMOR | VARMUK |
|             |                | VARTY                         | VBIKE  | VBMBR  | VBUS   | VCART  |
|             |                | VCE                           | VCMPSR | VCRANE | VDITCH | VDOZER |
|             |                | VDUMPT                        | VENGNR | VFBMBR | VFIRET | VFORKL |
|             |                | VGLIDR                        | VGRADR | VHAMB  | VHASLT | VHATK  |
|             |                | VHELO                         | VHFTRK | VHLFT  | VHOBS  | VHWHEL |
|             |                | VLSPT                         | VLVTP  | VLWHEL | VMETB  | VMLCHR |
|             |                | VMWHEL                        | VOTHER | VPILED | VPLANE | VRECCE |
|             |                | VRLCHR                        | VROCK  | VRPV   | VRTANK | VSHOVL |
|             |                | VSPATY                        | VSPLOW | VSTOL  | VTANK  | VTETRN |
|             |                | VTOL                          | VTRAIN | VTRANS | VTRCTR | VTRLR  |
|             |                | VTRUCK                        | VTWAAA | VTWATY | VUNK   | VUTIL  |
|             |                | WTRTWR                        | WWY    |        |        | VWRECK |
| <u>T029</u> | <u>(3, 65)</u> | <u>UNIT OF MEASUREMENT</u>    |        |        |        |        |
|             |                | ACR                           | BBL    | CCM    | CM     | CPS    |
|             |                | CUI                           | CUM    | CUY    | DAY    | DBM    |
|             |                | DEG                           | DGG    | DGM    | DGT    | FT     |
|             |                | GHZ                           | HAM    | HR     | HZ     | IN     |
|             |                | KHZ                           | KM     | KPH    | KT     | KTS    |
|             |                | LB                            | LTN    | M      | MHZ    | MIL    |
|             |                |                               |        |        |        | MIN    |

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| <u>ID</u>   | <u>I,N</u> | <u>TABLE NAME/TABLE ITEMS</u> |        |             |        |                  |       |     |
|-------------|------------|-------------------------------|--------|-------------|--------|------------------|-------|-----|
|             |            | MLG                           | MLM    | MLT         | MM     | MPH              | MS    |     |
|             |            | MSE                           | MT     | MTT         | MW     | NM               | NSE   |     |
|             |            | PAL                           | PPS    | RAD         | SCM    | SEC              | SKM   |     |
|             |            | SM                            | SMM    | SMT         | SPC    | SQF              | SQI   |     |
|             |            | SQM                           | SQY    | TON         | W      | YD               |       |     |
| <u>T032</u> | (6, 13)    | ORDNANCE                      | TYPE   | 1000GP      | 2000GP | 250GP            | 500GP | CBU |
|             |            | FFAR                          |        |             |        |                  |       |     |
|             |            | GDBMB                         | GRNADE | GUNS        | ILLUM  | NAP              | RKT   |     |
|             |            | SNAKE                         |        |             |        |                  |       |     |
| <u>T037</u> | (3, 4)     | RELATIVE INTENSITY OF FIRE    |        |             |        |                  |       |     |
|             |            | HVY                           | LT     | MED         | UK     |                  |       |     |
| <u>T041</u> | (1, 3)     | RELATIVE VERTICAL POSITION    |        |             |        |                  |       |     |
|             |            | H                             | L      | X           |        |                  |       |     |
| <u>T042</u> | (1, 2)     | EVASIVE ACTION                |        |             |        |                  |       |     |
|             |            | N                             | Y      |             |        |                  |       |     |
| <u>T043</u> | (11, 21)   | AIRCRAFT LOSS, CAUSE          |        |             |        |                  |       |     |
|             |            | AD-ARTY                       |        | AD-SAM      |        | AIRBOMBS         |       |     |
|             |            | AIR-STRFNG                    |        | CLSN-OBSTL  |        | CRASH            |       |     |
|             |            | FIELD-ARTY                    |        | GND-ACDNT   |        | GUN-AA           |       |     |
|             |            | INTAC-URCVR                   |        | MIDAIR      |        | MSLS-AG          |       |     |
|             |            | MSLS-RKT-AA                   |        | MSLS-RKT-SS |        | NAV-GUNFIRE      |       |     |
|             |            | NUC-ACT                       |        | SABOT-EXT   |        | SABOT-INT        |       |     |
|             |            | SMALL-ARMS                    |        | UNK         |        | WEATHER          |       |     |
| <u>T044</u> | (4, 7)     | DOWNED ACFT CREW STATUS       |        |             |        |                  |       |     |
|             |            | AKIA                          | CHUT   | CPTD        | CPTI   | RESC             | SAFE  |     |
|             |            | UNK                           |        |             |        |                  |       |     |
| <u>T045</u> | (10, 71)   | WEATHER TYPE                  |        |             |        |                  |       |     |
|             |            | BLOW-DRIZ                     |        | BLOW-DUST   |        | BLOW-SAND        |       |     |
|             |            | BLOW-SNOW                     |        | CLEAR       |        | COLD FRONT       |       |     |
|             |            | CYCLONE                       |        | DRFTGSNOW   |        | DRIZZLE          |       |     |
|             |            | DRZLLSTHR                     |        | DRZLRain    |        | DUST             |       |     |
|             |            | DUSTSTORM                     |        | FOG         |        | FOGLSTHR         |       |     |
|             |            | FREEZ-DRIZ                    |        | FREEZE-RAIN |        | FUNNEL-CLD       |       |     |
|             |            | GROUNDFOG                     |        | HAIL        |        | HAILSHWR         |       |     |
|             |            | HAZE                          |        | HEAVY-RAIN  |        | HEAVY-SNOW       |       |     |
|             |            | HIGH-WINDS                    |        | HURRICANE   |        | HVYDRZLRN        |       |     |
|             |            | HVYFZDRZL                     |        | HVYFZRAIN   |        | HVYRNSHWR        |       |     |
|             |            | HVYRNSNO                      |        | HVYSNSHWR   |        | HVYTSTM HVYTSTMH |       |     |
|             |            | ICEPELLETS                    |        | ICEPLSTHR   |        |                  |       |     |
|             |            | ICING                         |        | LIGHTNING   |        | LIGHTRAIN        |       |     |
|             |            | LIGHTSNOW                     |        | MIST        |        | OCLD-FRONT       |       |     |
|             |            | RAIN                          |        | RAINLSTHR   |        | RAINSHWR         |       |     |
|             |            | RAINSNOW                      |        | RNSNOSHWR   |        | SANDSTORM        |       |     |
|             |            | SHALLOWFOG                    |        | SNOW        |        | SNOWLSTHR        |       |     |
|             |            | SNOWSHWR                      |        | SQUALLS     |        | SQUALLINE        |       |     |

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| <u>ID</u>   | <u>I,N</u> | <u>TABLE NAME/TABLE ITEMS</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|             |            | STAT-FRONT      TORNADO      TROFLINF<br>TROPDEPRN      TROP-STORM      TSTM<br>TSTMHAIL      TSTMLSTHR      TURB<br>TYPHOON      WARM FRONT      WATERSPOUT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <u>T048</u> | (2, 2)     | SENSOR RECOVERY STATUS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|             |            | NR      R                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <u>T050</u> | (20, 124)  | MESSAGE TITLE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|             |            | ABFACSTS      AIRDEFALRT<br>AIRDEFCMDMSG      AIRMSNREQ<br>AKNLOG      ALORD<br>ALRTACSAMSTS      AMMO REPT<br>APORTM      CALLFORFIRE<br>CASMSNASMT      CFMSNDATA<br>CHECKFIRE      COMMSPT<br>CONF      DESIGAREA<br>DESIGHOUR      DISUM<br>ECMDATA      EMPLOYALOC<br>ENGSTS      ERTM<br>EWATM      EWERM<br>EXORD      FIREMSNSUM<br>FIREPLNGMSG      FLTCONTINFO<br>FLTPLN      FRAGORD<br>FSCMEASREP      FUSTATREPT<br>FUTURE1      FUTURE2<br>FUTURE3      FUTURE4<br>FUTURE5      FUTURE6<br>HELO-TALREQ      HELOAVIL<br>HELODLY      HELOMSNDATA<br>HELORQST      HELOSKED<br>HOTPHOTOREP      IMPREP<br>INFLT      INITHAND<br>INTREP      INTSUM<br>IPIR      JAMDECMG<br>JATO      JCASINTREQ<br>JESCREQ      JRECREQ<br>JRSRR      JTACARSREQ<br>JTFSTAT      LANDLNDGFORC<br>LNCHDEV      LOGSIT<br>METB      METCM<br>METREQUEST      MIJIFEEDER<br>MIPIR      MISREP<br>MONCHGREP      MONTERMREP<br>MSGCHANGEREPT      MSGTOOBSR<br>MSNSUM      NBC1BC<br>NBC1N      NBC2BC |



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