MCWP 3-25.9

Marine Air Command & Control System (MACCS) Communications Handbook

(COORDINATING DRAFT)

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MACCS Communications Handbook

(COORDINATING DRAFT)

TABLE OF CONTENTS

Chapter 1. Fundamentals

General 1-3
Marine Wing Communications Squadron 1-3
Communication Sections 1-5

Chapter 2. System Description

Single Channel Radio Systems 2-1
Multichannel Radio Systems 2-7
Tactical Automated Switching Systems 2-12
Data Systems 2-19

Chapter 3. Planning

Staff Relationships 3-2
Systems Plannig and Engineering (SPE) 3-3
Circuit Descriptions 3-11
Initial Planning 3-23
Detailed Planning 3-25

Architecture 3-25
Publishing the Plan 3-27

Chapter 4. Operations

Employment/Deployment 4-1
Communications Control 4-1
Systems Control 4-2
Technical Control 4-7

Chapter 5. Training

Individual Training 5-1
Platoon Level Training 5-2
Unit Level Training 5-3
MACCS Training 5-3
ACE Training 5-4
Evaluating Training 5-4

Appendices

A ACE Communications Connectivity A-1
B Communications Operations Brief B-1
C Communications Planning Support Tools C-1
D Communications Architecture D-1
E Glossary E-1
F References and Related Publications F-1

Chapter 1

Fundamentals

GENERAL

The command and control environment is characterized by rapid change and continuous challenge. Implementation of maneuver warfare, with its emphasis on speed and tempo, demands compressed planning, decision, execution, and assessment cycles. The speed, flexibility, and maneuverability associated with aviation assets can compress the decision cycle for aviation command and control even further. At the same time, the volume of information that needs to be processed and analyzed to support decision making is expanding, threatening to overload the commander and his staff.

Communications and information systems must be able to satisfy the command and control requirements of the expeditionary battlefield. In the aviation combat element, communications and information systems must provide the ACE commander, his staff, and the agencies of the Marine air command and control system (MACCS) with the tools necessary to rapidly collect, process, analyze, and exchange information in support of operations planning and execution. Communications are methods or means of conveying information of any kind from one person or place to another (Joint Pub 1-02). Information systems are the organized collection, processing, transmission, and dissemination of information, in accordance with defined procedures, whether automated or manual (Joint pub 1-02). The requirement for reliable communications is inherent in all information systems. This publication focuses on the communications

aspect of communications and information systems (CIS) within the Marine air command and control system. Specific information systems used within the MACCS are addressed in the agency specific publications contained within the 3-25 series of Marine Corps warfighting publications.

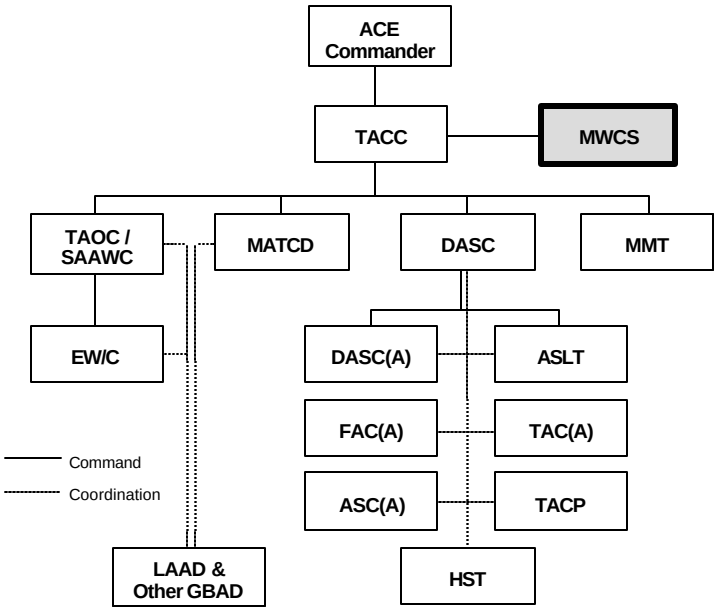
The planning for, and construction of, the aviation combat elements' communications architecture falls under the cognizance of the ACE G-6. Responsibilities for installing and operating communications and information systems is shared between communications units or detachments and functional area users. Functional users should be able to configure and operate the information systems supporting their respective functional areas. This includes serving as the configuration manager and conducting routine information system administration. Installation and maintenance of the ACE communications architecture is primarily accomplished by the Marine wing communications squadron (MWCS).

MARINE WING COMMUNICATION SQUADRON

The Marine wing communications squadron is the primary communications organization within the Marine aircraft wing (MAW) and is a subordinate squadron to the Marine air control group (MACG). It creates the communications system architecture that interfaces the aviation combat element command structure, Marine air command and control system agencies, and forward operating bases into an integrated system. There are three active duty and one reserve Marine wing communication squadrons to support Marine air-ground task force (MAGTF) communications requirements.

Marine wing communication squadrons 28 and 38 each consist of a headquarters and two Marine wing communications squadron

detachments. Marine wing communication squadrons 18 and 48 each consist of a headquarters element and one MWCS detachment. The MWCS headquarters and one detachment will normally deploy and collocate with the aviation combat element headquarters. Personnel and equipment from the operational platoons will be apportioned as required to support the integration of Marine air command and control system agencies into a single system, as well



as support the aviation combat element headquarters. Figure 1-1 depicts the MWCS as it relates to the ACE and the Marine air command and control system.

Figure 1-1. Marine Air Command and Control System

Mission

The Marine wing communications squadron is tasked to install, operate, and maintain expeditionary communications for the aviation combat element of a Marine air-ground task force, including the phased deployment of task organized elements.

Tasks

The Marine wing communications squadron is responsible to perform the following tasks—

- Assist in the systems planning and engineering of aviation combat element communications for command and control of the Marine air-ground task force aviation assets. The system planning process involves the Marine wing communications squadron, the Marine air control group S-6, and the aviation combat element G-6/S-6. Planning is based on the MAGTF mission, ACE tasking, and both the MAGTF and ACE concept of operations.

- Provide the senior operational systems control center (OSCC) for the aviation combat element communications system. The ACE operational systems control center is the sole coordinating agency for communications connectivity outside the aviation combat element.

- Provide the senior airfield operational systems control center at up to two airfields per detachment. The aviation combat element (or senior airfield) operational systems control center will advise and coordinate with subordinate OSCCs. This includes Marine wing support group (MWSG), Marine wing support squadron (MWSS), and Marine air command and control system agency operational systems control centers.

- Provide digital backbone communications in support of the ACE command element (CE), the primary agencies of the Marine air command and control system, and up to two forward operating bases (FOBs) per detachment.

- Provide tactical automated switching and telephone services for the ACE command element and tactical air command center (TACC). The tactical automated switching system (TASS) offers digital switching while providing secure and non-secure telephone service throughout the area of operation.

- Provide electronic message distribution for the ACE command element, primary Marine air command and control system agencies, and tenant units at up to two forward operating bases per detachment. Receipt and transmission of record message traffic can be accomplished through the use of a variety of computer and communications networking systems.

- Provide single channel radio communications support for the ACE command element, tactical air command center, and aviation combat element operations, as required.

- Provide deployed wide area network (DWAN), deployed local area network (DLAN), and server support for the ACE command element and primary Marine air command and control system agencies.

- Provide calibration and repair of all ground common test measurement diagnostic equipment (TMDE) within the aviation combat element.

- Provide third echelon cryptographic repair services for all ground common and Marine air command and control system assigned communications security equipment within the aviation combat element.

- Provide intermediate level maintenance (third echelon) on communications/electronics equipment, mobile electrical power equipment, and air environmental control equipment.
- Provide forth echelon maintenance for ground common critical low density (CLD) end items and associated secondary repairable maintenance float items, excluding Marine air command and control system peculiar equipment.
- Provide for the effective command and control of subordinate detachments.
- Provide internet protocol planning and administration for the aviation combat element headquarters and Marine air command and control system agencies.
- Provide communications support for the aviation combat element headquarters and tactical air command center.
- Deploy independent Marine wing communications squadron detachments to provide external communications for up to two airfields and four forward bases.

The Marine wing communications squadron can deploy or employ as a complete unit or may provide task organized detachments to support elements of the ACE. Detachments employed in support of specific MACCS agencies operate under the staff cognizance of the S-6 of the supported unit. These detachments, along with the communications sections organic to most of the subordinate units of the MACG, are key for the planning, installation, operation, and maintenance of an effective communications and information systems network, which is essential to support aviation command and control.

COMMUNICATIONS SECTIONS

Communications sections of individual units within the ACE provide communications support at the squadron/battalion level. They are organized to support the resident MACCS agencies, command posts, and communications networks of their parent organizations. Communications sections are found in the following organizations of the ACE—

- Marine air support squadron
- LAAD battalion (Headquarters and Services [H&S] battery)
- Marine air control squadron (tactical air operations center [TAOC] detachment)
- Marine wing support squadron (airfield operations division)

Chapter 2

Systems Descriptions

Each subordinate unit of the Marine air control group possesses organic communications equipment to support the communications requirements of their respective MACCS agencies. Refer to the agency specific handbook contained in the 3-25 series of warfighting publications for information on specific MACCS agency's organic communications equipment. This chapter presents the communications equipment used by the Marine wing communications squadron (which is not addressed in the other MCWP 3-25 series handbooks) to construct the ACE's communications network.

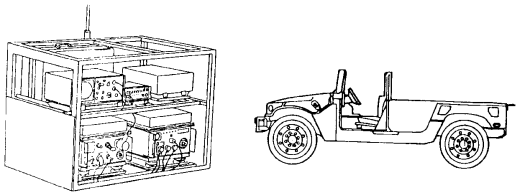
SINGLE CHANNEL RADIO SYSTEMS

The Marine wing communications squadron provides HF, VHF and UHF single channel radios in support of ACE command and control functions. The equipment contained in this chapter is organic to the Marine wing communications squadron.

High Frequency Radio Sets

The AN/MRC-138 is a single sideband radio set designed for vehicular installation. The set in figure 2-1 is a vehicular mounted AN/GRC-193. The AN/GRC-193B and AN/MRC-138B radio sets are the most frequently employed HF long haul radios. They are capable of providing HF single sideband (SSB) voice and data

communications stations for fixed (AN/GRC-193B) or mobile (AN/MRC-138B) applications. The radios operate in the 2.0000 to 29.9999 MHz frequency range with an output of 400 watts. The



AN/PRC-104 is a man-portable HF radio with identical features except that its power output is 10 watts.

Figure 2-1. AN/MRC-138 Radio Set

Very High Frequency Radio Sets

The Marine wing communications squadron possesses the following VHF SINCGARS (single-channel ground and airborne radio system) radio sets—

- **AN/MRC-145.** The AN/MRC-145 is a vehicle mounted VHF/FM radio with an operating frequency of 30 MHz to 87.975 MHz that operates in a single channel or frequency hopping mode. This radio system includes two receiver-transmitters that provide long range communications with a range of approximately 21 miles. The system has the capability to process digitized information at a rate of 600 bps to 4800 bps with an integral cryptographic capability. This radio system replaces the AN/MRC-110.

- **AN/PRC-119.** The AN/PRC-119 is a man-portable VHF/FM radio with a frequency range of 30 MHz to 87.975 MHz that operates in a single channel or a frequency hopping mode. It has a planning range of more than 5 miles. This radio has an integral cryptographic capability and is capable of processing digitized information at a rate of 600 bps to 4800 bps. It replaces the AN/PRC-77.

- **AN/VRC-88A.** The AN/VRC-88A is a bench mounted VHF/FM radio with an operating frequency of 30 MHz to 87.975 MHz that operates in a single channel or frequency hopping mode. This radio system includes one receiver-transmitter that provides short range communications with a range of approximately 5 miles. It has the capability to process digitized information from 600 bps to 4800 bps with an integral cryptographic capability. This radio system replaces the AN/GRC-160.

- **AN/VRC-90A.** The AN/VRC-90A is a bench mounted VHF/FM radio with an operating frequency of 30 MHz to 87.975 MHz that operates in a single channel or frequency hopping mode. This radio system includes one receiver-transmitter, with a 50 watt power amplifier, that provides long range communications of approximately 21 miles. It has the capability to process digitized information from 600 bps to 4800 bps with an integral cryptographic capability. This radio system replaces the AN/GRC-47.

- **AN/VRC-89A.** The AN/VRC-89A is the long-range/short-range vehicular configuration of the integrated communications security SINCGARS. Features of this radio include controllable output power with a maximum of 50 watts for the remaining radio transmitter, 8 non-volatile preset single channels, 6 nonvolatile frequency hopping preset channels, and operates over the 30 to 87.975 MHz frequency range in 25 KHz channels (2320 total

channels). The integrated communications security module is compatible with VINSON communications security devices. Additionally, the radio transmitter contains built-in test equipment, will support digital data communications with data rates of up to 16,000 bits per second, and is compatible in the single channel mode with the currently fielded VHF-FM family of radios. The AN/VRC-89A replaces the AN/VRC-12.

Ultrahigh Frequency Radio Sets

The AN/PRC-113 and AN/VRC-83 radio sets are UHF and VHF(AM) capable. The AN/PRC-113 is a man-portable radio while the AN/VRC-83 is a bench mounted or vehicular mounted system.

Compatibility. Within the ACE, single channel radio equipment is distributed between aviation and ground assets. Tables 2-1 through 2-4 (on pages 2-5 through 2-6) provide an overview of the communications compatibility. A by aircraft listing of single channel radio equipment available to the ACE is also included. The legend for the following tables is—

- **C** = Compatible systems however, spread and separations are not the same.
- **S** = Same frequency spread and separation.
- **R** = Receive only.

Radio	Freq (MHz)	PRC-77	GRC-160	PRC-119	MRC-145	PRC-113
ARC-54A	30-68.95	C	C	C	C	C
ARC-114	30-75.95	S	S	S	C	C
ARC-131	30-75.92	S	S	S	C	C
ARC-144	30-75.92	S	S	S	C	C
ARC-182	30-87.975	C	C	C	S	S
ARC-186	30-87.975	C	C	C	S	S
ARC-210	30-87.975	C	C	C	S	S

Table 2-1. VHF (FM) Radio Compatibility

Radio	Freq (MHz)	PRC-77	GCR-160	PRC-119	MRC-145	PRC-113
ARC-101	116-149.95					C
	149-151.95	R	R			C
ARC-115	116-149.975					S
ARC-175	116-151.975					C
ARC-84	118-135.95					C
ARC-182	30-87.975	C	C	S	S	
	108-117.975	R	R			C
	118-155.975					C
	225-399.975			S	S	S
ARC-186	30-87.975	C	C	S	S	
	108-151.975					
ARC-51A	225-399.95					C
ARC-116	225-399.975					C
ARC-159	225-399.975					S

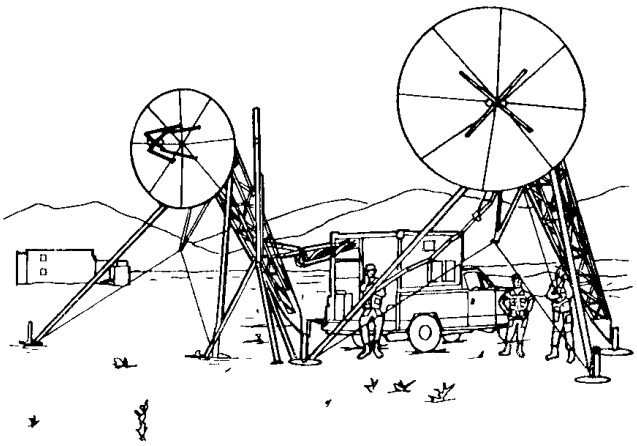
Table 2-2. VHF(AM) and UHF Radio Compatibility

Radio	Freq (MHz)	PRC-104	MRC-138	GRC-193
ARC-94	2-29.999	C	C	C
ARC-102	2-29.999	C	C	C
ARC-105	2-29.999	C	C	C
ARC-120	2-29.999	C	C	C
ARC-174	2-29.9999	S	S	S
ARC-190	2-29.9999	S	S	S
ARC-199	2-29.9999	S	S	S

Table 2-3. HF Radio Compatibility

R= Refit	F/A-18	AV-8B	EA-6B	KC-130	CH-53 A/D	CH-53E	CH-46E	AH-1W	UH-1N
ARC-51							1		
ARC-94					1	1	1		
ARC-102				1					
ARC-105			1						
ARC-114						1			1
ARC-159			1			2			1
ARC-174						1			
ARC-182	2	2	2R		2	2	2	2	2
ARC-186				2					
ARC-190				2					
ARC-199			1						
ARC-210	2R							1R	

Table 2-4. By Aircraft Single Channel Radio Listing



MULTICHANNEL RADIO SYSTEMS

The multichannel equipment listed below provides the essential connectivity for establishing telephone trunking, data transmission and tactical telephone service. Connectivity is established using the following means—

- **Line of Sight.** This method has a range of approximately 11 miles for super high frequency (SHF) systems and approximately 35 miles for UHF systems. This range can be extended or restricted by terrain, since distant antennas must have unimpeded line-of-sight to establish the link.

- **Obstacle Gain Defraction.** The range of this method is 11 to 60 miles and uses a hard man-made or natural object as a means of refracting energy. The terminating ends of the MUX link direct their antennas towards the highest point of a predetermined fixed object and use the refractive characteristics of SHF energy to bend the energy form back to the surface of the earth.

- **Troposcatter.** This method uses the troposphere and the reflective properties of SHF energy to secure the link. The terminating ends of the link orient their antennas in a predetermined direction and elevation to reflect the SHF energy off the troposphere and back to the surface of the earth. This method has a range of 60 to 100 miles that is sometimes difficult to obtain because of atmospheric conditions.

AN/TRC-170(V)3

Thie AN/TRC-170 is a member of the tri-service tactical communications system family of switchboards and tropospheric scatter radio terminals. They provide digital trunking between major

nodes. The AN/TRC-170 is a transportable, multichannel communications system capable of transmitting and receiving digital data over varying distances up to 100 miles. See figure 2-2. The AN/TRC-170 is capable of providing up to 144 full duplex digital channels. In addition, the Marine Corps' version of the AN/TRC-170 has a distinct antenna system called the OE-468. While operating in the dual diversity mode, it can be configured in either a line-of-sight, obstacle gain defraction, or tropospheric scatter mode of propagation. Radio frequency operation is in the 4.4 to 5.0 GHz frequency range with either a 3.5 MHz or 7.0 MHz bandwidth. Transmitted data rates are 128, 144, 256, 288, 512, 576, 1024, 1152, 1536, 2048, 2304, 4096, or 4608 kbps.

Figure 2-2. AN/TRC-170(V)3

The system can be employed in three ways: point-to-point, drop/insert, or as a relay between major sites to provide multiplexed and single channel communications between two or more sites, depending upon configuration. The TD-1236, MD-1026 and TD-1235 provide the primary communications interfaces for the system.

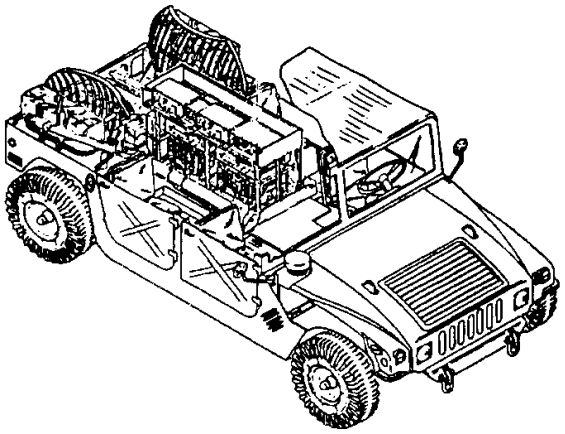
- **TD-1236, Trunk Group Multiplexer (TGM).** The trunk group multiplexer is a shelter mounted group multiplexer. It combines two, three, or four group inputs into a supergroup. The group inputs can be from 72 to 2304 kbps. The supergroup outputs range from 128 to 4608 kbps. The trunk group multiplexer can be used to supergroup up to four other group inputs into a one large group.

  - Group 1 must receive an unencrypted signal with a tri-service tactical communications system formatted frame. It is hardwired to "frame" because the framing subchannel of

the overhead channel for this group is used as the framing subchannel of the supergrouped output.

- The group input with the highest data rate must be connected to group 1. In general, the next highest group rate should be assigned to group 2, and so on.

- All groups to be multiplexed in the trunk group multiplexer must have the same modularity. The trunk group multiplexer may multiplex either the TRI-TAC 512 kbps rate family that has a channel modularity of eight, or the ATACs 576 kbps



rate family that has a modularity of nine.

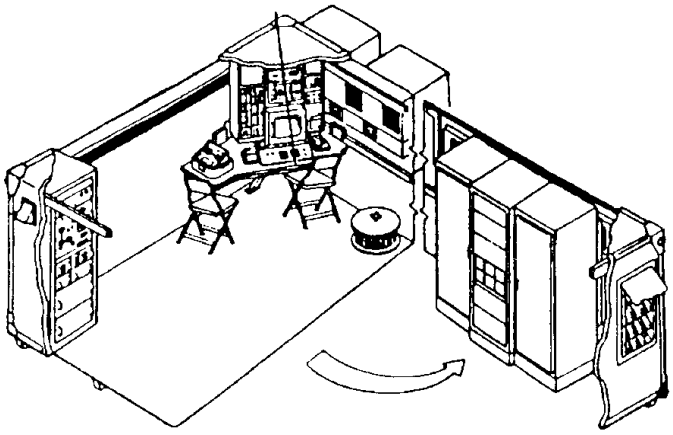
- If a non-TRI-TAC formatted group, or any TRI-TAC formatted group that is encrypted, is connected to groups 2, 3, or 4, the frame select switch for that group must be in the "not frame" position.

- If an unencrypted TRI-TAC formatted group is connected to groups 2, 3, or 4, the frame select switch should be in the "frame" position.

- **MD-1026, Group Modem (GM).** The group modem contains four independent group modems that convert balanced non-return-to-zero signals to either conditioned diphase or dipulse signals. The Marine Corps uses the condition diphase modem at rates from 72 to 4608 kbps. This provides cable interface with the TD-1234 remote multiplexer combiner, the group modem, the AN/TSQ-111 communications nodal control element, the AN/TTC-39, the conditioned diphase modem in the TD-1337, and the tactical satellite signal processor. The group modem is used to provide trunking capability normally between two switches or between a switch and another modem (e.g., a remote multiplexer combiner). The group modem provides access to three orderwires: the analog voice orderwire (AVOW), the digital voice orderwire (DVOW), and the data orderwire (DOW). Access to the DVOW and DOW is provided only at group rates of 256 kbps and higher.

- **TD-1235, Loop Group Modem (LGM).** The loop group modem is a shelter mounted loop multiplexer that multiplexes up to sixteen 32 kbps, four wire, full duplex, conditioned diphase subscriber loops in to a single group. The LGM is capable of supporting either DSVT/DNVT digital phones, or four wire, analog, full duplex analog circuits with an analog appliqué unit (AAU) card. The loop group modem is used to provide point-to-point single lines between two terminal devices (e.g., TA-954 to TA-954). The use of the LGM between major sites reduces the number of direct access services that have to be programmed into the switchboards. The loop group modem provides a power source to the terminal device that prevents its use between switchboards. Additionally, the loop group modem provides a

resync command for a trunk encryption devise and has no orderwire capability.



AN/MRC-142

The AN/MRC-142 provides mid-range UHF line-of-sight wideband communications over a distance of up to 30 miles. See figure 2-3. The AN/MRC-142 is capable of secure communications at rates of 256 or 576 kbps using an operating radio frequency between 1350 and 1850 MHz. The system provides for an analog voice orderwire and a digital voice order wire. Both require the use of a KY-57 to operate.

Figure 2-3. AN/MRC-142

This system can be employed in three ways: point-to-point, drop/insert, or as a relay between secondary or remote sites, providing multiplexed or single channel communications between two or more sites, depending upon configuration. The AN/MRC-142 has no integral multiplexers; it provides only a path for multiplexed communications between two points. The system is capable, with additional equipment (e.g., CX-11230, remote multiplexer combiner[s]) of terminating multiplexed communications at a remote site.

TACTICAL AUTOMATED SWITCHING SYSTEMS

The tactical automated switching system is established using the AN/TTC-42 and SB-3865 unit level circuit switch for digital secure and non-secure telephone service. Analog non-secure and hybrid circuit interface is provided by the SB-3614 switchboard.

AN/TTC-42 (V)

The AN/TTC-42 (V) is a sheltered telephone central office that provides automatic switching service and subscriber service functions to the tri-service tactical communications system family of four-wire, digital secure and non-secure voice terminal telephone instruments, and four-wire digital trunks (including both single channel and time division multiplex groups). See figure 2-4. The AN/TTC-42 (V) allows automatic and semi-automatic switching for selected analog loops and trunks, and is configured to provide switching at 16 kbs or 32 kbs. Each AN/TTC-42 has a communications security capability.

The AN/TTC-42 can operate in Marine Corps or joint Service circuit-switching networks as a communications security parent switch. Although it is not considered to be a joint network switch, employment may occur in any of following configurations—

- **Stand-Alone Switch.** Stand-alone switches use single channel termination as loop circuits to form a local, self-contained circuit switch network. Stand-alone switches can be converted to access other applications by using multichannel trunk connections to a higher level switch, such as the AN/TTC-39 series.

- **Access Switch.** Access switch applications allow other switches and local subscribers to gain entry into larger networks. Such connections usually occur using multichannel trunks, or tactical or strategic circuit switches.

- **Tandem or Nodal Switch.** Tandem or nodal switch applications provide traffic between switches, using their multichannel trunk lines.

Figure 2-4. AN/TTC-42

Employment Considerations. The following employment considerations apply to the AN/TTC-42—

- **Slave Timing Mode.** Modem 1 or 7 must be used to receive timing information when the switch is operated in the slave timing mode.
- **Internodal Buffering.** Modems 2 and 5 are associated with internodal buffers that are used to accommodate timing differences among switches having different master timing sources.
- **Remote Loop Group Multiplexers (RLGMs).** Modems 3 and 6 will accommodate remote loop group modems. This includes providing remote power to the RLGMs.
- **Analog Multiplexing.** There is no internal analog multiplexing capability with the AN/TTC-42. All interfacing with analog multiplexing must be done using single channels extended through CX-4566 assault cable.
- **Trunk Encryption Devices (TEDs).** The AN/TTC-42 has six (6) KG-94 trunk encryption devises that can be connected to any of the seven (7) multichannel groups. When all of the MUX groups are used, at least one group will be required to operate in a non-secure mode.
- **Communications Security Parent Switch (CPS).** The AN/TTC-42 has the capability of performing as a COMSEC parent switch for communications security subordinate switches.

SB-3865 (P)/TTC

The SB-3865 (P)/TT is a team transportable telephone switchboard that provides automatic switching service functions to the tri-

service tactical communications system family. The SB-3865 is capable of trunking with the AN/TTC-42 and has ports for thirty single channel lines and three time division multiplexed trunkgroups. The number of single channel and time division multiplexed groups can be increased by electrically interconnecting (stacking) two or three switches. All trunk connections are four-wire and provide full duplex operation. The single channel lines use binding post connectors for field wire such as WF-16 telephone cable. The time division multiplexed trunk groups use twin coaxial connectors for CX-11230 special purpose cable. Each switch can handle a mix of single channel and multiplexed groups, and provides sole-user as well as switched service.

This switch is normally employed at the sub-network level (squadron or battalion level) in one of the following configurations—

- **Stand-Alone Switch.** Stand-alone switches use single channel termination as loop circuits to form a local, self-contained circuit switch network. Stand-alone switches can be converted to access other applications by using multichannel trunk connections to a higher level switch, such as the AN/TTC-42.

- **Access Switch.** Access switch applications allow other switches and local subscribers to gain entry into larger networks. Such connections usually occur using multichannel trunks and tactical circuit switches.

- **Tandem or Nodal Switch.** Tandem or nodal switch applications provide traffic between switches, using their multichannel trunk lines.

Employment Considerations. The following employment considerations apply to the SB-3865—

- **Direct Access Service (DAS).** DAS can be provided for up to five subscribers from a single SB-3865 and for 10 subscribers from two or three unit stacks.
- **Processing Capability**
  - A single SB-3865 is capable of processing a combined total of 30 loops and trunks.
  - A stacked SB-3865 configuration is capable of processing a combined total of 60 (two SB-3865s) or 90 (three SB 3865s) loops and trunks.
- **Communications Security Subordinate Switch (CSS).** The SB-3865 is a COMSEC subordinate switch and must be electronically attached to a communications security parent switch to provide encrypted communications to subscribers.
- **Hybrid Stacking.** The SB-3865 is capable of hybrid stacking with a SB-3614. This configuration provides analog, non-secure service to the SB-3614 switch subscribers by using the internal four wire analog capability.

TD-1234, Remoter Multiplexer Combiner

The TD-1234, remoter multiplexer combiner (RMC), is a key component of the tri-service tactical communications system family of radios and switching systems. It is a combination loop and group multiplexer used in unattended field exposed locations. It provides a combination of up to (8) digital or analog circuits and is (4) wire only. The remoter multiplexer combiner multiplexes four wire, full duplex, conditioned diphase subscriber loops with an unbalanced conditioned diphase group (low group) into a single group output (the high group). The RMC is generally used in three modes: to

remote encrypted telephone access (two miles without a repeater or four miles with a repeater) from a SB-3865, an AN/TCC-42, or an AN/MRC-142; to provide point-to-point communications for (4) wire connections; or in a combination of the two.

There are three methods of employment for the remoter multiplexer combiner—

- **Group Modem.** In this method, the remoter multiplexer combiner is acting as a distant junction box for either a AN/TTC-42 or SB-3865. This is accomplished by electronically connecting the RMC to the switch via CX-11230 cable and/or a multiplexed radio system. The remoter multiplexer combiner can be no further than two miles from the switch or multiplexed radio system. It can provide up to eight digital or analog subscribers off the parent switch.

- **Group Modem Repeater.** The remote multiplexer combiner can be used to extend the distance between a distant RMC and its parent switch, as described in the previous paragraph. This is accomplished by inserting a RMC between the parent switch and the distant RMC. This can be repeated twice for each distant RMC, but a power source is required to provide power to the group modem repeater.

- **Loop Modem.** The loop modem provides for full duplex processing to and from two DSVTs/DNVTs, either via CX-11230 cable and/or a multiplexed radio system, without the aid of a switch.

Employment Considerations. Both the loop modem and analog appliqué unit cards have two channels on each card, the loop modularity is in multiples of two. The remoter multiplexer combiner can provide common battery power to digital telephones. This is a selectable function on the RMC. Digital phones can be no more

than 2 miles from the RMC using WF-16 field wire. Analog phones can be up to 2.4 miles from the remoter multiplexer combiner.

SB-3614

The SB-3614 is a tactical, ruggedized, automatic switchboard. The SB-3614 telephone switchboard provides service to (2) wire common battery signaling lines, 20 Hz ringdown lines or trunks, common battery dial pulse or dual tone multi-frequency lines, and (2) wire tone signaling trunks over 15 links in a non-blocking matrix arrangement. The unit itself has 30 lines/trunk, but interconnection with 2 additional SB-3614's provides 60 or 90 lines/trunks. The SB-3614 is also capable of being hybrid stacked with the SB-3865.

This switch is normally established at the battalion or squadron level and is not considered to be a joint network level switch. The SB-3614 is capable of processing 30 loops in a stand-alone mode, 60 loops when double stacked and 90 loops when triple stacked. The switch only provides analog telephone service, meaning that it is not capable of providing secure telephone/data communications to subscribers. The SB-3865 and SB-3614 can be connected in a hybrid stack configuration. This arrangement allows up to 30 additional analog telephones, minus the interconnecting trunks between the SB-3865 and SB-3614. The hybrid connection is made via the SB-3865 four-wire analog termination used as single channel analog trunks. For routing purposes, both switches are assigned the same identification number. Calls are completed directly to the assigned SB-3614 subscribers as though they were local calls. The SB-3614 interfaces with most analog telephone sets, switchboards and converter units. Five types of line cards provide interfacing based on the type of line or trunk required.

DATA SYSTEMS

The DLAN/DWAN has become a timely and essential means of sharing information between diversified and geographical separated users. The key components of the system include the tactical network server, the workstation, and the software.

Tactical Network Server

At the heart of the DLAN/DWAN is the tactical server that provides for the overall management and efficient support of the system. To list the required capabilities of the tactical network server would be a difficult task since technological improvements and software requirements change on a daily basis. The primary concern when planning for a DLAN/DWAN is the ability of the server to support the requirements of the system it is supporting. For example, if required, can the server support the incorporation of TCO or IAS into the network? It is more prudent to plan for a tactical network server to be capable of supporting a growing system, rather than just being able to process the initial system design needs. As the C2 system matures, so too must the supporting communications system.

Workstation

A computer workstation needs to have the capability to provide connectivity through the DLAN/DWAN and to process the current software standard in a timely manner. MAGTF C4I Software Baseline uses Marine Common Hardware Suite (MCHS) equipment, including the Hewlett-Packard TAC-4, CHS-2 Sun SPARC 20, and Intel C platforms running the DII common operating environment. The MAGTF C4I Software Baseline is completely

transportable across the GCCS hardware platforms. These systems are certified through the security accreditation process in accordance with current DISA requirements. While the MAGTF C4I Software Baseline maintains UNIX operating system segments, new development is based on Windows NT. The UNIX-based TAC-4 and CHS-2 platforms are interim application and data servers. A workstation can be described in two ways—

- **LAN Terminal.** A LAN terminal is a computer workstation that is directly tied to the server on a full time basis. This means that it is in close proximity to the tactical network server, usually within 1000 feet. The capabilities of LAN terminals vary, but all require a LAN card and electronic connectivity to the server. Connectivity can be in the form of a wire line or some type of wireless technology, that may extend or limit the terminal's distance from the tactical network server.

- **Dial-in Terminal.** A dial-in terminal is not connected to the tactical network server on full time basis. Connectivity is established by dialing-in through the tactical telephone system. This method is not limited by the tactical network server's capability, but by the equipment that supports the tactical automated switching system. Additionally, this arrangement requires an active serial port connection on the terminal, a KY-68 DSVT telephone and a KY-68-AN/UYK interface cable. The interface cable connects the terminal to the DSVT telephone, using the serial port connection on the computer and the data port connection on the DSVT. A DNVT can be used to replace a DSVT for a point-to-point data circuit or a data dial-in. It is modem capable to 9.6K; however, security concerns may limit its use in that capacity.

Software

The software used by the DLAN/DWAN must be standardized to provide seamless connectivity throughout the network. This includes network operating software and the end user software.

NIPRNet

Nonsecure internet protocol router network (NIPRNet) is an information network based on internet protocol routers and integrated digital network exchange (IDNX) smart multiplexers. NIPRNet is designed for sensitive, but unclassified, information transfer. It supports unclassified networks such as the Marine Corps Data Network.

SIPRNet

Secure internet protocol router network (SIPRNet) is an information network also based on internet protocol routers and IDNX smart multiplexers. It is designed for the exchange of classified information up to and including the secret level. SIPRNet supports the exchange of classified data between GCCS, DMS, CTAPS, TCO, IAS, and other tactical information systems. SIPRNet routers are often collocated with NIPRNet routers.

Router Use

Considerable effort has been invested into establishing a standard strapping for KG-84s and routers used with contingency theater automated planning system and joint deployable intelligence support

system, that use the SUN/SPARC 2/10 workstation. It should be noted that routers support SIPRNet and NIPRNet and are not tied exclusively to CTAPS. CTAPS, like TCO and IAS, is an application that can ride on SIPRNet/NIPRNet. JDISS standardized parameters recently agreed to include the use of balanced wide area network interfaces, routing instead of bridging internet protocol packets, and the use of the WAN point-to-point protocol (PPP). Employment considerations for router usage include—

- **Routing and Bridging.** Virtually all routers may be configured to either route or bridge IP packets. The joint deployable intelligence support system (JDISS) standard is to route instead of bridge, that requires an internet protocol address for both the wide and local area network ports of the router. Internet protocol routing may be done either statically or dynamically. Neither is mandated as the standard. JDISS does require open access to the DSNET-I/III network, achieved through either the maintenance of static IP tables or dynamically derived IP tables.

- **Point-to-Point Protocol.** Each router vendor offers several choices of layer two protocols, such as synchronous data link control, high-level data link control, link access procedure balanced, and PPP. The point-to-point protocol was developed to ensure maximum compatibility among routers provided by many vendors. For the same reason, JDISS selected point-to-point protocol as the standard wide area network port protocol. In addition, PPP provides useful "traps" that aid in troubleshooting communications problems. Point-to point protocol will be configured on all WAN ports supporting SPARC terminals, with the exception of gateway routers directly connecting to a packet switching node (PSN). Routers connecting directly to PSNs will use the DDN X.25 protocol. When acquiring a bridge/router in support of JDISS and CTAPS, ensure that the software supports point-to-point protocol.

- **Balanced versus Unbalanced Interfaces.** In order to standardize physical layer interfaces and provide for future upgrades, the joint deployable intelligence support system has selected the RS-449 balanced digital interface as the standard for router operations. There are exceptions however, such as the unbalanced interface that must be used when interfacing with STU-IIIs. JDISS standards in this regard do not intend to force the installation of RS-449 interfaces that must subsequently be converted to RS-232 to meet user needs. Rather, if the router provides the option, such as the CISCO 2000/3000 series provides with the CISCO fast serial processor, simply wire the appropriate interface to meet your needs or purchase a vendor-provided cable. Note that the serial connection to the CISCO 2501 is a mini SCSI (DB60), which is difficult to make. It is recommended that both the RS-232 and RS-449 vendor cables be purchased at the time of router purchase.

- **Ethernet Connection.** The standard joint deployable intelligence support system configuration runs Ethernet 802.3. It connects the attachment unit interface (AUI) 15-pin connector on the SPARC ethernet card to the AUI connector at the rear of the CISCO router via AUI/Ethernet tranceivers. Both transceivers should set the signal quality event (SQE) to "on." Additionally, BNC "T" connectors should be placed on the tranceivers. Both ends of the ethernet must be terminated with 50 ohm termination plugs connected to the electrical outermost connection of the "T" connectors. Multiple terminals may be attached to this local area network in a similar fashion.

- **STU-III Configuration.** STU-IIIs vary depending on the vendor, but all STU-IIIs have an unbalanced RS-232 interface. STU-IIIs will be configured for a full-duplex, synchronous data communications equipment data port in order to provide timing to the router port. The baud rate should be set to 9.6 kbps.

- **KG-84 Configuration.** There are various versions of KG-84s that can be used to support data systems. Information on switch setting and strapping standards is available in joint publications.

- **KG-194 and KG-194A Configuration.** As more capable multiplexers, like the FCC-100, are utilized, more capable KGs must also be used. As an example, the KG-84 cannot be used for data transfer above 64 kbps. The KG-194 and KG-194A are full-duplex key generators designed to provide trunk encryption and dycryption for digital data traffic. The KG-194 is non-ruggedized, rack mounted equipment. The KG-194A is tactical, ruggedized equipment with a rack mounting capability. Both devices are enhanced versions of the KG-94 and KG-94A, that have been modified to incorporate the FIREFLY remote rekey capability. Information on switch setting and strapping standards is available in joint publications.

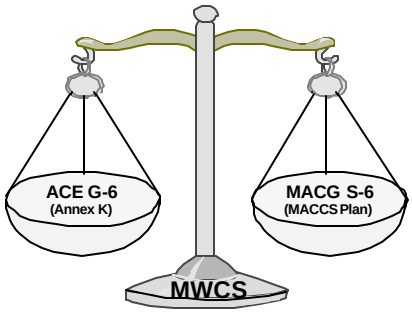
Chapter 3

Planning

MACCS communications planners (primarily from the Marine wing communications squadron) must construct a plan to satisfy two very distinct communications requirements—

- Providing communications support for connectivity requirements between the ACE, MAGTF, and adjacent command elements, as well as subordinate commands/agencies.
- Constructing the backbone communications system for the primary agencies of the Marine air command and control system.

The two requirements are generated from two sources, the ACE G-6/S-6 and the Marine air control group S-6. During operational planning, the MWCS works closely with both of these staff sections (figure 3-1). The key to success is a continuous information



flow between the communication planning staffs.

Figure 3-1. Staff Planning Balancing Act

STAFF RELATIONSHIPS

ACE G-6/S-6

The ACE G-6/S-6 is the senior communications staff within the aviation combat element. Its sections include operations, maintenance, and the information systems management office (ISMO). The ACE G-6/S-6 is the principle communication-electronics planner for the ACE commander. The staff uses the ACE commander's intent to plan and render communications-electronics support. Planning requires careful application and consideration of command, control, communication, computer, and intelligence (C4I) systems employment to support mission requirements, as well as a thorough knowledge of each unit's capabilities.

The senior Marine wing communications squadron representative is often dual-hatted as the aviation combat element S-6 during operations requiring less than a full ACE staff. This dual-hatting is a difficult task, often resulting in conflicts of interest, and should be cautioned against.

MACG S-6

The Marine air control group S-6 provides Marine air command and control system specific communications recommendations to the MACG commander and guidance to subordinate command and agencies.

MWSG S-6

The Marine wing support group S-6 provides organization specific communications recommendations to the MWSG commander and guidance to subordinate commands. Though not in the operational

systems control hierarchy, the MWSG S-6 is kept informed by the ACE operational systems control center on matters pertaining directly to Marine wing support group communications.

SYSTEMS PLANNING AND ENGINEERING (SPE)

Communications planning is conducted concurrently and in consonance with operational planning to ensure that adequate communications support will be provided when and where required. Digital communications technology has enhanced our warfighting capability while drastically changing user requirements; no longer is a single channel radio acceptable. High quality battlespace communications are a viable and attainable expectation. While the user may not fully understand the intricacies of digital communications, he nonetheless requires a more sophisticated connectivity to support existing digital systems such as CTAPS, TCO, and IAS, as well as emerging information system technologies.

Communications Requirements

Communication requirements address the needs of the commander by supporting his mission, concept of operation, and task organization. As the Marine wing communications squadron supports the aviation combat element, the following communications capabilities make up the majority of the physical implementation of those requirements: single channel radio, tactical automated switching systems, SHF/UHF multichannel radio, data communications (DWAN/DLAN), message distribution, UHF tactical satellite (TACSAT) and ground mobile forces satellite integration, system and technical control, ground common communications-electronics maintenance, and cryptographic equipment repair. Refer to

appendix A for a complete description of ACE communications connectivity requirements. Appendix B contains the communications operations brief and also identifies common requirements.

ACE Command Element. The ACE command element has communications requirements with higher, adjacent, and subordinate units. In planning for an operation, these requirements are consolidated by the ACE G-6/S-6. As part of systems planning and engineering, the requirements are staffed by the ACE G-6/S-6 and Marine wing communications squadron planners. The ACE G-6/S-6 then validates the requisites while the MWCS staff assists in developing a communications architecture based on these requirements.

MACCS Agencies. Marine air command and control system agencies have both intra-MACCS and external communications requirements. Marine wing communication squadron planners assist the MACG S-3/S-6 in planning the communications architecture supporting all tactical requirements. The MACG S-6 validates requirements while the MWCS staff determines the supportability of these requirements. The primary support provided by the Marine wing communications squadron to agencies of the MACCS is a digital switched backbone system and an internet protocol router data communications background system that augment their doctrinal and organic single channel radio systems. The MWCS, in effect, overlays a backbone multichannel and telephone switch architecture between agencies of the Marine air command and control system by means of either direct connectivity (e.g., TACC at primary airfield connected via mux to tactical air operations module at secondary airfield) or by indirect means (e.g., TACC at primary airfield connected via both MAGTF command and ground combat element mux to a direct air support center collocated with the GCE). It is important to note that the DASC, usually collocated with the senior fire support coordination center, receives its connectivity to the switched backbone system via the MAGTF, not from Marine wing communications squadron mux systems.

Airfields. The Marine wing communications squadron supports communications requirements between the ACE command element and subordinate Marine aircraft groups located at up to two separate airfields per detachment. This requires collocation of the tactical air command center with one airfield to ensure adequate resources are available.

System Considerations

Channel Rate Selection. The tri-service tactical communications (TRI-TAC) system allows individual channels to support any mode of transmission. Both 16 and 32 kilobits per second (kbps) standard channel rates can be used although 32 kbps is the joint TRI-TAC standard. Each have advantages and disadvantages that should be considered in the planning process.

16 kbps Channel Rate. This channel rate is designated as the joint standard for system interoperability. The NATO digital gateway standard for links between national formations is based on the 16 kbps channel rate. This rate provides adequate voice quality on poor channels with high error rates. These 16 kbps channels require less bandwidth, allowing more efficient use of the limited spectrum available in the band used by tactical multichannel radios. Additionally, 16 kbps channels must be used to interface with the US Army's multiple subscriber equipment that can only operate at this rate.

32 kbps Channel Rate. The use of 32 kbps allows circuits to have multiple analog/digital conversions that would be of poor quality at 16 kbps. 32 kbps is the preferred channel rate within the Marine aviation command & control community since there are numerous analog/digitial conversions within the overall system. Accordingly,

this channel rate has a larger bandwidth requirement than the 16 kbps channel rate.

Network Timing. As tactical communications networks become larger and more sophisticated, network timing issues become more critical. Timing provides the synchronization to maintain bit integrity, providing end-to-end communications security and low bit error rates. Communications planners must be aware of the capabilities of the different items of equipment in order to determine the optimum timing configuration for the network. The following general guidelines are recommended for use when developing the network timing plan—

- Keep the network timing system as simple and redundant as possible.
- Plan the timing system to minimize the impact of critical equipment losses/failure.
- Use the independent node clock approach to the maximum extent possible.
- Diagram the network and list the equipment at each node requiring or providing timing.
- Determine the master timing source for each node in the network. Select the most accurate source available. Note that the master source does not necessarily have to be located at the node.
- Determine an alternate master timing source, if possible, for each node in the network. Select the next most accurate source to be the alternate source. The impact of implementing the alternate timing source on the timing configurations of other equipment at the node should be minimized.

- Buffering of timing must be available in networks with more than one master source.

Independent Clock Approach. The TRI-TAC system was initially designed to work with the independent clock approach. In the independent clock approach, network timing is established by employing a frequency standard at each node to provide a stable local timing reference. This technique is inherently asynchronous since the frequency standards will vary slightly from node to node. The differences between the basic data rates of the incoming digital groups and that of the local timing source are accommodated through use of buffers to retime the incoming digital data streams to the timing used at the node. The basic timing elements of the independent clock network timing approach include—

- **Modem.** The modem is used to regenerate the incoming digital data stream and to convert the line signal to baseband.

- **Timing Sources.** The clock is used to provide a stable local timing source. As previously stated, only the most accurate source available should be used as a master timing source. The related accuracy after calibration of the various equipment timing sources is shown in table 3-1.

Timing Source	Accuracy (seconds)
AN/TSQ-111	1×10^{-12}
AN/TRC-170	1×10^{-11}
AN/TTC-39D	1×10^{-11}
AN/TTC-42	1×10^{-9}
SB-3865	1×10^{-8}

TD-1234	5×10^{-5}

Table 3-1. Accuracy of Various Timing Sources

- **Buffer.** The buffer is used to absorb differences between the frequency of local clock at the receiving node and the frequency that is associated with the incoming digital data stream. The clock frequency of the incoming digital data stream can differ from that of the local nodal clock due to the inherent differences in the clocks at the two nodes and the propagation delays in the internodal transmission systems. These factors, as well as the link transmission rate and the allowable buffer reset period, dictate the size requirements for the buffer. The buffers required for either cesium or rubidium standards are relatively small in size for the digital groups and facilities employed in terrestrial systems. Satellite links require larger buffers to compensate for range variation (doppler effect) due to the eccentricity of the satellite orbit.

Backbone Considerations

When employing a backbone communications systems, it is important to consider the amount of connectivity required and the duration of the support required.

AN/TRC-170. The AN/TRC-170 is normally used to connect major command and control nodes and major operating bases for extended periods of time. Additionally, the connectivity requirements between these sites exceed the capabilities of the AN/MRC-142.

AN/MRC-142. The AN/MRC-142 is normally used to provide connectivity between secondary C^2 nodes or sites that are mobile.

Switching Considerations (System Interface)

Joint. Both the AN/TTC-42 and SB-3865 switches are capable of operating in most joint service circuit switch networks. The AN/TTC-42 is fully capable of performing most functions within a joint circuit switch networks while the SB-3865 is normally associated with subnetwork levels.

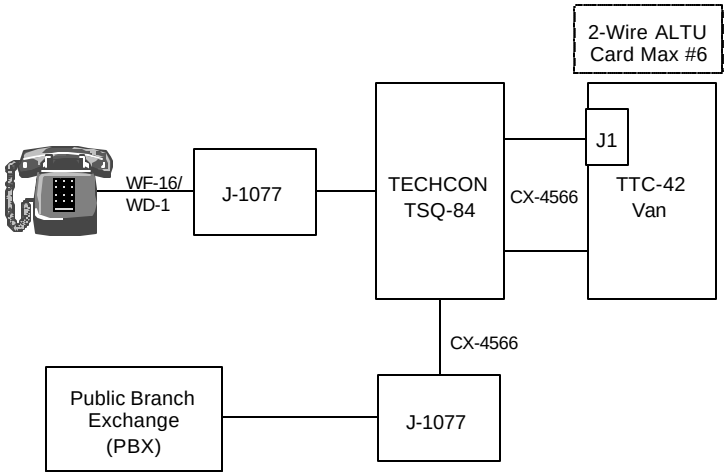
NATO. The AN/TTC-42 and SB-3865 are not capable of interfacing with the NATO trunking system without the assistance of an AN/TTC-39 family switch.

Commercial. The AN/TTC-42 is capable of processing analog connections routed through the analog loop terminal unit (ALTU) card from public branch exchange (PBX) terminals. The SB-3865 is not capable of processing two wire analog connections. To provide two wire PBX connectivity, the SB-3865 must be connected to a COMSEC parent switch (CPS) or a hybrid stacked with a SB-3614.

Defense Switching Network (DSN). The AN/TTC-42 switch can provide DSN access either in the stand-alone mode or when part of larger circuit switch network. The SB-3865 can provide DSN access through two means: hybrid stacking with a SB-3614 using a Type V card, or in a larger network if the SB-3865 is affiliated with a COMSEC parent switch (e.g., AN/TTC-42). The COMSEC parent switch will provide DSN access to the SB-3865 subscriber in this case. Analog subscribers must have the call service attendant at the CPS process the call.

Data Considerations

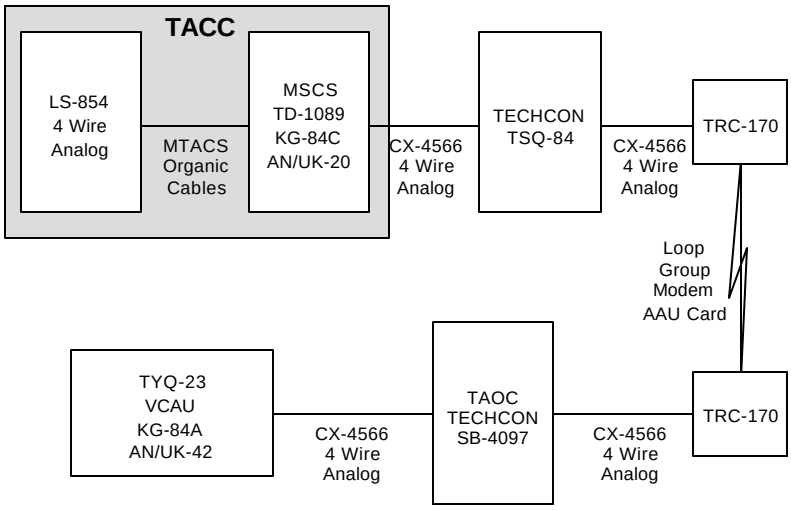
Message Distribution. With the incorporation of the message distribution system, general service (GENSER) message traffic can be distributed throughout a communications system by using the deployed local and wide area networks. However, some Marine air command and control system agencies may not have DLAN/DWAN access and would still require hard paper traffic.



Message Center Locations. The message center should be located to best provide access to the command/agencies it is tasked to support. Collocation of a message center and DLAN/DWAN servers makes prudent use of materials, work space and personnel. There are requirements for security, handling procedures (such as pick-up and release authority), and messenger services when providing paper message traffic services.

Special Compartmentalized Information Facilities (SCIF). Coordination with the SCIF is necessary to determine specific communication requirements.

Data Links. Three types of data links exist: router connections, server support, and point-to-point connections. Router considerations include: connections to other networks, internet protocol (IP) addressing, interior gateway protocol interoperability, exterior gateway protocols and connectivity, data rates, and cabling. Server



support considerations include: e-mail accounts, message distribution system support, software requirements, cabling, and network interface equipment. Point-to-point connection considerations include: data rates, end user equipment, and encryption set-up.

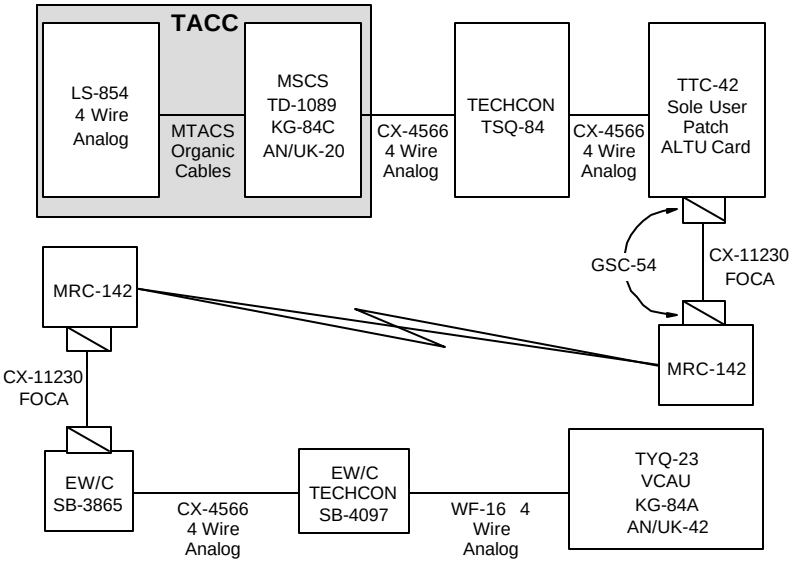
Special Systems. With the influx of new data based systems (e.g., TCO, GCCS, IAS, etc.), the distinction between communicators and operators has blurred. Communicators must understand the supported system in order to connect it to the network constructed

using the data links mentioned above. Operators are responsible for systems administration on these systems.

Single Channel Radio Considerations

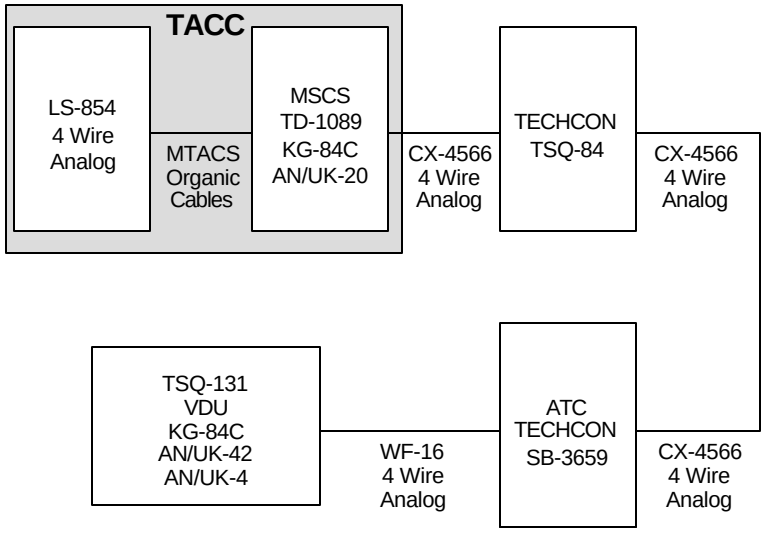
Frequency Spectrum. Single channel radio requirements must be balanced with the available frequencies allotted for an operation. Frequency management must begin during systems planning and engineering, and continue until single channel radio deactivation.

Cryptographic Requirements. Coordination of on-hand crypto-



graphic software (keymat) must be accomplished early in systems planning and engineering to ensure that all units and agencies have the required software.

MACCS Capabilities. Organic to each Marine air command and control agency are single channel radio assets. Coordination with these agencies is necessary to determine shortfalls and identify additional radio requirements that cannot be satisfied with organic

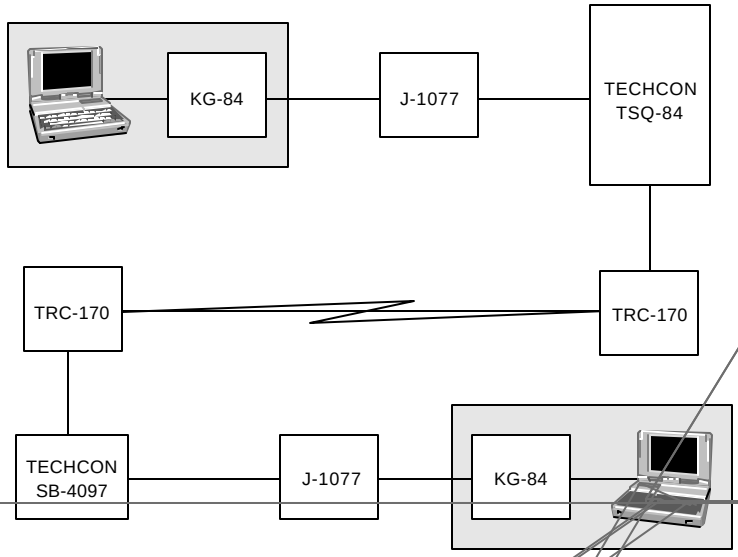


equipment.

Power Supply Considerations

Determining and planning for power supply and distribution is a crucial portion of systems planning and engineering. Each Marine wing communications squadron site must identify necessary electrical power requirements so that the utilities section can develop a power plan. This plan must be coordinated with the wire sections to deconflict cable runs. The utilities, communications-electronic maintenance, and motor transport section planners should be part of

the systems planning and engineering process at the onset of planning.



CIRCUIT DESCRIPTIONS

This section provides detailed description of various circuit types likely to be utilized by the Marine wing communications squadron when building a communications architecture.

level and below when a MAG headquarters is not acting as the ACE command element.

Tactical Air Command Center

The tactical air command center maintains organic single channel radio equipment. It requires Marine wing communication squadron support for telephone and switching service, message center service, local and wide area network connectivity, single channel radio augmentation, and connectivity for specialized MACCS specific control circuits.

Tactical Air Operation Center

The tactical air operations center, like the tactical air command center, maintains organic single channel radio equipment. It receives switched backbone connectivity to other Marine air command and control system agencies from MWCS multichannel radios, as well as support with message center service and local and wide area network service. The tactical air operations center has the additional capability of providing the unit level circuit switch with its organic assets and data circuits.

Early Warning/Control Site

The early warning/control (EW/C) site, a subordinate agency of the tactical air operations center, requires Marine wing communications squadron support in order to connect with the digital switch backbone to the tactical air operation center. The Marine wing communications squadron provides the multichannel radio connectivity between the tactical air operations center and the early

warning/control site to support the telephone and data circuits installed by the early warning/control site.

Direct Air Support Center

The direct air support center receives its backbone multichannel radio and tactical automated switching system support from the ground combat element.

Theater Missile Defense Detachment

The theater missile defense detachment receives its communications support from the Marine air control squadron. It also receives switched backbone connectivity from Marine wing communications squadron multichannel radios. (Note: The Marine Corps is planning to divest itself of 50 percent of its Hawk assets in fiscal year 1998 and is likely to divest the remainder in fiscal year 1999. Once accomplished, the theater missile defense detachment will be deactivated.)

MAG and MATCD

The Marine aircraft group's rotary- and fixed-wing elements have the same communications needlines. Internal airfield communications support for the MAG's is provided by the Marine wing support squadron, while external switched backbone connectivity is provided by the Marine wing communications squadron. The Marine air traffic control detachment (MATCD) is provided equipment support for connecting to the digital switched backbone network by the MWSS/MWCS system.

PUBLISHING THE PLAN

Based on the size and complexity of the operation, the Marine wing communications squadron contributes to the operational planning in a number of ways. For one, it may write the Annex K to an OPLAN. It may also publish a letter of instruction to provide technical expertise for the final product. The Marine wing communications squadron S-3 will publish milestones for document production and keep higher headquarters informed of the status of the product. The commanding officer will review all documents that are written by Marine wing communications squadron for publishing by higher headquarters.

Chapter 4

Operations

EMPLOYMENT/DEPLOYMENT

General communications support is provided to the aviation combat element by the Marine wing communications squadron. The MWCS deploys, in whole or in part (detachments), as a task-organized unit comprised of elements needed to satisfy the operational requirements of the supported air combat element. It employs organic equipment and personnel to provide communications connectivity for the ACE command element, the Marine air command and control system, and inter-airfield communications. The Marine wing communications squadron caters its capabilities to meet the mission requirements of the aviation combat element and can support ACE communication requirements across the spectrum of Marine air-ground task force operations. The Marine wing communication squadron's contribution to the Marine air-ground task force can vary from a small radio detachment, as may be found in a Marine expeditionary unit (special operations capable), to the complete squadron, with all associated equipment and personnel, as may be found in a Marine expeditionary force.

COMMUNICATIONS CONTROL

The Marine wing communications squadron is tasked with providing communications control (COMMCON) for the aviation combat element. Communications control is the method of organizing

communications personnel and facilities to provide positive control of telecommunications. It is the management, planning, direction, coordination, control, and evaluation of personnel, circuitry, and equipment to accomplish assigned missions and tasks. Communications control includes systems planning & engineering, system control, and technical control. The planning portion of communications control, systems planning and engineering, is addressed in chapter 3. The remainder of this chapter addresses the operational aspects of communications control: systems control and technical control.

SYSTEMS CONTROL

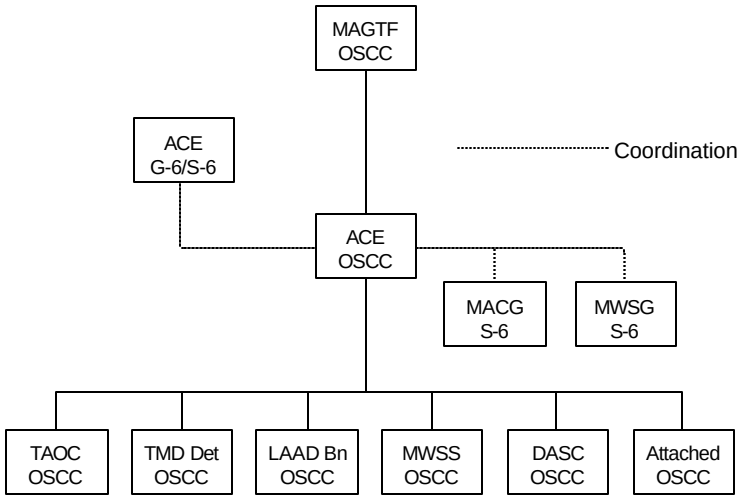
Operational systems control (OSC) is best described as managing the day-to-day operation of a communications system. Aviation combat element operational systems control functions are the responsibility of the aviation combat element G-6/S-6. Systems control at this level is primarily concerned with the development of systems planning and engineering for future requirements or operations. The tactical network automated planning system (TNAPS) is a useful systems control tool. TNAPS, in addition to being the joint standard planning tool, also provides the master log used for systems control.

The aviation combat element operational systems control center (OSCC), established by the Marine wing communications squadron, is the agency responsible for controlling and managing the aviation combat element communications-electronics system. Collateral agencies and unit OSCCs are responsible for managing their respective communications systems.

Operational Systems Control Center (OSCC)

The operational systems control center will manage, supervise, and coordinate the use of communications resources and the daily operations of the communications system. It is charged with ensuring that all circuits in a system or network are used to the best advantage and are carefully managed so as to effectively match available circuits with traffic demands. To accomplish this, the operational systems control center will—

- Monitor system performance and coordinate actions required for restoration of system outages with senior, adjacent, and subordinate OSCCs (figure 4-1), in accordance with installation or



restoration priorities established in the communications plan.

Figure 4-1. OSCC Structure

- Prepare and issue detailed directives and instructions to subordinate units for implementation of the communications plans and the supervision of their execution.
- Collect and analyze traffic data, service complaints, and outage reports to identify and correct system inadequacies, procedural deficiencies, and other sources of problems.
- Prepare and distribute information essential to the use or operation of the system. This includes directives, call signs, crypto change times, line route maps, and circuit diagrams.
- Identify recommendations to the ACE G-6/S-6 via the detachment commander for corrective actions when resources available are insufficient to provide satisfactory communications service.
- Direct and coordinate the operation of the local technical control facility (TECHCONFAC). Monitor circuit information from the TECHCONFAC to ensure timely restoration of outages in accordance with published restoration priorities.
- Implement and control the entire communications-electronics system as one cohesive yet flexible entity. Comply with OSCC orders and direct ACE and Marine air command and control system circuit activation and deactivation.
- Maintain appropriate records, files, logs, and trouble reports to provide the current status of all circuits supporting the command. Provide reports as required.
- Direct that alternate signal paths be used when primary paths are disrupted.
- Maintain circuit status/data for rerouting, restoration, and record purposes.

- Maintain current listings pertaining to the allocation and assignment of frequencies and call signs, subscriber directory information, and related instructions.
- Ensure that all communications-electronics elements are advised of weather conditions (e.g., atmospheric conditions, advisories) that may affect their operations.
- Use the following means to fulfill operational systems control center responsibilities—
  - **Communications Coordination Net.** When established, this circuit links all communications facilities and is terminated in the OSCC.
  - **Multichannel Radio.** When established, one channel is normally reserved for an OSCC-to-OSCC hotline.
  - **Status Log.** A status log depicting the current status of all circuits (e.g., radio, wire, telephone and mutlichannel radio) is maintained in the OSCC facility.
  - **OSCC Log Book.** This is a chronological record of identified problems and actions taken to gain solutions.

OSCC Personnel

Operational systems control center watch standees include the watch officer, watch chief, and the clerk.

Watch Officer (WO). The watch officer is the individual responsible for the operation of the operational systems control center. His duties include, but are not limited to—

- Supervision of personnel assigned to the watch.

- Coordination of call signs, frequencies, and cryptographic assignments.
- Maintenance of systems, circuits status charts, equipment status charts and logbooks.
- Submission of circuit status reports to the OSC staff as required.
- Receipt of outage reports and completion of trouble tickets.
- Installation and restoration of circuits per established priority restoration policy.
- Coordination of circuit preemption with all concerned agencies.
- Monitoring the progress of equipment under repair of the maintenance section.
- Coordination of requests from external control centers for technical assistance and test equipment.

Watch Chief (WC). The watch chief is the individual responsible for assisting the WO in the performance of his duties. The watch chief's specific responsibilities include—

- Continuous coordination of circuit restoration in the order of established priorities.
- Receipt of outage reports and completion of circuit trouble tickets.
- Ensuring that all publications, charts, and logs are properly maintained.
- Performing other duties as directed by the WO.

- Supervise the OSCC clerk.

Clerk. One clerk should be assigned to the watch and will perform the following duties—

- Maintain circuit and equipment status boards per information received from the watch chief.
- Perform other duties as directed by the watch chief.

TECHNICAL CONTROL

Technical control (TECHCON) is a means of exercising centralized technical supervision over the planning, installation, operation, and maintenance of circuits employed by communication agencies and other authorized subscribers. This is accomplished by rerouting circuits, using an alternate communication means, or activating redundant systems. Technical control provides for a common interface between the user and the communications system.

Technical Control Facility

The technical control facility (TECHCONFAC) operates under the cognizance of the operations officer during planning and is an auxiliary function of the operational systems control center during an operation. While the operational systems control center is the senior coordinating agency, the technical control facility supplies the technical expertise. TECHCON's scope is generally governed by the number and type of circuits employed and the number and type of adjacent control agencies. The technical control facility will assist in the implementation of the communication plan, and subsequently, in the maintenance of the communication system. The majority of TECHCON's functions require that it have access to the circuits that pass through its facility. The TECHCONFAC will provide

monitoring, performance testing, signal conditioning, circuit routing, and similar services. The goal of technical control is to provide the best possible circuit quality and limit circuit degradation due to natural or man-made causes.

System Activation

System activation is divided into link and circuit activation. Once a link has been activated, the operational systems control center will direct the technical control facility to start activating circuits across the link. The technical control facility will coordinate with the distant end TECHCONFAC to operationally check the channels on the link. Once complete, technical controllers will patch users on to the corresponding channel. The technical control facility will perform an on-line check of the circuit. A circuit is activated only when both users are satisfied with the circuit's operation.

Circuit Outage

The user will notify the operational systems control center as to any circuit problems. The operational systems control center will, in turn, inform the technical control facility of the specific circuit outage. The technical control facility will start troubleshooting to isolate and correct the problem, providing updates to the operational systems control center, as required, on the status of the circuit. Once the problem has been corrected, the operational systems control center will be informed of the reason for outage. Service will be restored by all available means according to established restoration priorities or as directed by the operational systems control center.

Link or System Outage

When a link or system outage occurs, the operator of the system will notify the operational systems control center of the situation. Maintenance personnel will be dispatched to assist in troubleshooting the affected links or system. Links or systems consist of any multichannel link, unit level circuit switch system, or power grid. Once the link or system is repaired, the operational systems control center is notified. The operational systems control center then directs technical control to ensure service is restored to the users. Technical control then informs the operational systems control system as to the results of the restoration effort.

Troubleshooting

Technical control is responsible for the restoration of service with minimum loss of operating time. Troubleshooting is accomplished through the fault isolation process, which determines the location of the problem within the network. The fault could be in the transmitting facilities, the receiving facilities, the media connecting them, the switch equipment, or the user's equipment terminating the circuit. Complete fault isolation instructions for all equipment is contained in related manuals. Generally, fault isolation begins with the recognition that a problem exists. Trouble recognition may be a result of quality control testing, equipment sensors and alarms, subscriber complaint, or any combination of these. Once recognized, coordinated actions to identify the location of the problem are initiated. When localized, appropriate corrective measures are taken.

System Deactivation

System deactivation is the orderly shut down of the communications system as directed by the operational systems control center and coordinated through the technical control facility.

Chapter 5

Training

Every Marine Corps leader has the responsibility to establish and conduct the technical and tactical training necessary to enable their Marines to successfully accomplish the unit's mission. The attributes that establish the basis of an effective training program include relevance, standardization, efficiency, and specificity. Considering the complex nature of amphibious, joint, and combined operations, and the ever increasing sophistication of communications and data systems, training for Marine wing communications squadron Marines is imperative for mission success. Proficiency at all levels of operation to include individual, platoon, unit, Marine air command and control system, and aviation combat element is the goal. The end state of meaningful, quality training is a confident and proficient Marine communicator.

INDIVIDUAL TRAINING

The individual training standards (ITS) manual, Marine Corps order (MCO) 1510.83, establishes standardized training requirements for personnel in the communications and data military occupational specialties (MOS). The individual training standards manual provides specific tasks that, when accomplished, will ensure communications and data personnel maintain military occupational specialty proficiency.

Formal Schools

The Marine Corps schools program provides training for officers and enlisted personnel at various career stages. Beginning with the entry level school (lieutenant/private), and progressing through the career level (captain/corporal-sergeant), intermediate level (major/staff sergeant-gunnery sergeant), and top level schools (lieutenant colonel/master sergeant-master gunnery sergeant), the formal school system is designed to provide both technical and tactical level training.

Marine Corps Institute (MCI)

The Marine Corps Institute program allows Marines of all ranks to continue their professional education through correspondence courses. With a variety of subject matter, the Marine Corps Institute program allows for technical development as well as leadership enhancement.

PLATOON LEVEL TRAINING

Platoon level training should be designed to focus on employment of the respective platoon's equipment. The training effort should be concentrated on operator proficiency. This should enhance the platoon's ability to install, operate, troubleshoot, and maintain a particular equipment suite. On-the-job training is conducted at this level along with cross training within the squadron.

UNIT LEVEL TRAINING

Unit level training should be designed to focus on the integration of the communications system (Marine wing communications squadron equipment), with emphasis on systems management and control. This training stresses communication control and technical control procedures.

MACCS TRAINING

Marine air command and control systems training can take on many forms, to include command post exercises (CPX), simulated exercises (SIMEX), and field training exercises (FTX). During MACCS training, the Marine wing communications squadron's focus should be on supporting and integrating Marine air command and control squadron system communications. Marine wing communications squadron personnel are intimately involved with planning and execution of the following Marine air command and control systems level training—

Marine Aviation Planning Problem (MAPP)

Marine aviation planning problem exercises are low cost, low overhead training that involve the systems planning and engineering portion of an operation based on a given tactical scenario. Marine wing communication squadron personnel provide/develop communications plans (Annex K) to support the given situation. These exercises are particularly effective in determining command and control requirements to support possible contingencies.

MACCS Integrated Simulated Training Exercises (MISTEX).

The MACCS integrated simulated training exercise is a locally-sponsored Marine air control group exercise that involves detailed preparation of a simulated scenario followed by execution at the Marine air command and control system level. For Marine wing communications squadron, the MISTEX provides a realistic training opportunity to support Marine air command and control system communications requirements.

ACE TRAINING

This training is the most complicated level of training for the Marine wing communications squadron. It can take on numerous forms, ranging from Marine ACE-only training to conducting training in the joint and combined arena. Normally, during this type of training, large portions of the ACE deploy, including fixed and rotary wing assets. Due to the large scale of this type of training, the full spectrum of communications support for command and control, along with the majority of MWCS equipment and personnel, is normally required during these exercises. ACE level and above training is the most beneficial training opportunity available.

EVALUATING TRAINING

The success of individual, platoon, and unit level training should be qualitatively measured to identify training deficiencies and to create a baseline for designing future training. At each level of training the evaluation process should exist to inform, reinforce standards of proficiency, and identify shortfalls needing reemphasis. The building

block approach to training and evaluation, starting at the individual training level with the basics and progressing through ACE level training as proficiency increases, fosters thoroughness, confidence, and success. This also prevents rudimentary aspects of individual, platoon, and unit level training having to be introduced during higher level (MACCS and ACE) training opportunities. Higher level training carries the added responsibility of facilitating the training and evaluation of supported units and agencies. If communications are lacking due to a training deficit, all related training risks degradation.

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Appendix A

ACE Communication Connectivity

COMMAND ELEMENT CONNECTIVITY

ACE command element communication connectivity consists of single channel radio nets, data circuits, and tactical automated switching circuits.

Single Channel Radio Nets

The aviation combat element command element monitors the following circuits—

- **MAGTF Command Net (HF/UHF- SATCOM).** This net provides a means for the commander to exercise command, and coordinate administrative and logistics functions with the major components of the MAGTF. Composition includes—
  - MAGTF command element
  - Ground combat element(s)
  - Aviation combat element(s)
  - Combat service support element
  - Separate units under commander landing force (CLF) operational control.

- **MAGTF Tactical Net (VHF/HF/UHF-SATCOM).** This net is used primarily for operational traffic between the CLF and the major combat elements. Composition includes—
  - MAGTF command element
  - Ground combat element(s)
  - Aviation combat element(s)
  - Combat service support element
  - Separate combat and combat support units under CLF operational control.
- **MAGTF Intelligence Net (VHF/HF/UHF).** This net provides for rapid collection and dissemination of intelligence information between the CLF and the major combat elements of the MAGTF. Composition includes—
  - MAGTF command element
  - Ground combat element(s)
  - Aviation combat element(s)
  - Combat service support element
  - Separate combat and combat support units under CLF operational control.
- **ACE Command Net (HF).** This net provides a means for the ACE commander to exercise command, and coordinate administrative and logistic functions with subordinate units. Composition includes—
  - ACE headquarters

- All Marine aircraft groups/dets
- Marine air control group/det
- Marine wing support group/det
- Independent, squadrons/battalions
- Attached units

- **ACE Intelligence Net (VHF/HF/UHF).** This net p rovides for rapid collection and dissemination of intelligence information between the ACE headquarters and subordinate units. Composition includes—
  - ACE Headquarters
  - TACC
  - Marine Aviation Groups/Squadrons
  - TAOC
  - Marine Wing Support Squadrons
  - DASC
  - Attached intelligence/early warning units

Data

The Marine wing communications squadron provides router services, direct connections, dial in capability and server support for ACE command element data requirements. The types of applications and services include E-mail, message distribution systems

(MDS), joint deployable intelligence support system (JDISS), global command and control systems (GCCS), tactical combat operations (TCO), MAGTF integrated logistics systems (MILOGS) and IAS. It is the users responsibility to provide the hardware, software and network interface equipment.

Tactical Automated Switching System

The Marine wing communications squadron provides all ACE command element telephone support. This includes a point to point hotline between the MAGTF commander and the tactical air commander (TAC).

MACCS AGENCIES CONNECTIVITY

The Marine air command and control system, unlike other communications systems, is organized by function rather than along the conventional chain of command. The communications system established to support interaction between a ground commander and higher, adjacent and subordinate commanders is significantly less effective with aviation. The speed and range of aircraft, air-to-air missiles, and surface-to-air missiles are tactical advantages, but they serve to complicate standard command and control systems. Aviation orders, such as engagement commands, issued along a chain of command based communications system would be slow and ineffective in an aviation context. In order to employ the MACCS effectively, the supporting communications structure must be as reliable and versatile as the dynamic and fast-paced operations it enables. The MWCS provides single channel radio support, tactical automated switching systems and data systems support to the MACCS.

Single Channel Radio

Tactical Air Command Center. The tactical air command center is composed of four sections: future plans, future operations, current operations, and air combat intelligence. Circuits monitored by the future plans and air combat intelligence sections vary depending upon the requirements of the operation, although the air combat intelligence section will always monitor the MAGTF intelligence net. The future operations section normally monitors the following circuits—

- MAGTF command net (HF/UHF- SATCOM)
- MAGTF tactical net (VHF/HF/UHF-SATCOM)
- MAGTF intelligence net (VHF/HF/UHF)
- ACE command net (HF)
- ACE intelligence net (VHF/HF/UHF)

In the current operations section, the specified watch standee normally monitors the indicated nets—

Senior Watch Officer. The senior watch officer selectively monitors any of the nets in the section as required by the mission.

Senior Air Coordinator. The senior air coordinator's primary nets include—

- **Command Action Net (HF/MUX).** This net provides a means for overall coordination of antiair warfare through the exchange of information pertaining to missile battery employment,

assignment of air targets, and interceptor/missile coordination. Composition includes—

- TACC/TADC
- TAOCs (SAAWC)
- EW/C

- **Direct Air Support Net (HF/MUX).** This net provides a means for the DASC to request direct air support aircraft from the TACC/TADC. Additionally, information pertaining to aircraft stationing, fuel and ordnance status, mission progress, etc., may also be passed over this net. Composition includes—
  - TACC/TADC
  - DASC
- **Tactical Air Command Net 1 (HF/UHF-SATCOM).** This net provides the primary means by which the TACC tasks subordinate elements. Composition includes—
  - TACC/TADC
  - TAOCs
  - DASC
  - All MAGs and squadrons
  - MATCD (as required)
  - EW/C (as required)
  - TMD Det (as required)

- LAAD Bn (as required)

- **Combat Information/Detection Net (CI/D)**. This net provides a means for reporting on unidentified or hostile aircraft, including initial contact reports, tracking, amplifying, and final disposition reports. Multiple nets are normally employed and are assigned to appropriate radar surveillance activities as requested. Normally, the TAOC is net control station on this circuit. Composition includes—

  - TACC
  - TAOC
  - EW/C
  - DASC (as required)
  - TMD Det firing sections (as required)
  - LAAD Bn (as required)
  - MATCD (as required)

Close Battle Cell. The close battle cell monitors the direct air support, combat information/detection (as required), and the tactical air request/helo request nets.

Deep Battle Cell. The deep battle cell monitors the direct air support, combat information/detection (as required), command action (as required), voice product net (VPN), tactical air direction (as required), deep battle air control (DBAC) net, and any other nets required by the operation.

Air Defense Cell. The air defense cell monitors the command action net (as required), the combat information/detection net (as required), and the air operations control net (HF/MUX). The latter provides the means for the tactical air operations center to request interceptor aircraft and to report friendly air defense situation information to the TACC/TADC. Information pertaining to combat air patrol (CAP) availability, stationing and assignment, surface-to-air unit status and employment, and aircraft/missile weapons coordination is passed on this net. This net is established and assigned for each TAOC in operation, and is composed of the TACC/TADC, the TAOCs, and EW/C.

Track Data Cell. The track data cell monitors the following communication nets—

- **Tactical Digital Information Links A/B (TADIL A, HF/UHF; TADIL B MUX).**
- **Data-Link Coordination Net (MUX/HF/UHF).** This net provides a means for maintenance to maintenance coordination of data-link operations. May be combined with the track supervision net for single channel operations. Generally one per TADIL-A, TADIL-B, ATDL-1. Composition includes—
  - TACC
  - TAOC
  - MATCD
  - TMD Det firing sections
  - Other service agencies employing tactical data links
- **Track Supervision Net (MUX/HF/UHF).** This net provides a means for track surveillance personnel to exchange voice

information to maintain a clear air picture. This net may be combined with the track supervision net as required. Composition includes—

- TACC
- TAOC
- EW/C

- **Interface Coordination Net (HF/UHF).** This net provides a means for command level coordination in the employment of certain tactical weapons and for interface command, control and coordination. This is normally a secure net used during joint operations/exercises. Composition includes—
  - TACC
  - TAOCs
  - Other service agencies (as required)

Analysis Cell. The analysis cell may monitor the nets assigned to the close battle, deep battle, air defense cells, or any other nets deemed appropriate.

Search and Rescue Coordination Cell. The search and rescue coordination cell will monitor—

- **Search and Rescue Net (UHF/HF/VHF).** The SAR net provides a means for the control and coordination of air rescue missions. Multiple nets may be required. Composition includes—
  - All elements within the command and control system

- Aircraft involved in SAR missions

- **Guard (UHF).** Provides a distress notification capability and is used by aircraft to declare an emergency. It further serves as a means for air control agencies to advise aircraft of emergency conditions or serious hazards to aircraft safety. Composition includes—

  - TACC/TADC
  - TAOC
  - DASC
  - All air traffic control facilities
  - All aircraft
  - Other agencies and elements within the Marine air command and control system.

Airspace Control Cell. The airspace control cell monitors communication nets as required to accomplish the mission.

Air Boss. The air boss requires hotlines or priority phone service between his location and the representative from whom he will receive tasking. Also, a common user telephone is required to allow him access to squadron maintenance, ordnance, and operations sections. Finally, he will need secure UHF communications to aircraft.

Direct Air Support Center. Specific watch standees in the direct air support center will normally monitor the indicated nets—

Senior Air Director. While the senior air director is capable of monitoring all of the DASC's nets. His primary nets are the tactical air command and the direct air support nets, and the DASC-FSCC hotline.

Helicopter Director. The helicopter director monitors—

- **Helicopter Direction Net (UHF/VHF).** This net p rovides a means for the helicopter direction center (HDC) to exercise positive control of inbound and outbound helicopters in the amphibious objective area. The radar controller in the HDC uses these nets to direct flight course and altitude of helicopters, holdings, letdowns and climb out when required, from the rendezvous point to the initial point. The DASC, ASC(A) and TAC(A) use these nets for terminal control of helicopters. Inbound and outbound UHF, VHF and HF helicopter direction nets are employed. The HF net is most often a back-up, and a means of providing long-range control of airborne helicopters. Composition includes—
  - DASC
  - Helicopters
  - Helicopter landing zone control teams
  - TAC(A)
  - TACP's
  - Other air control agencies (as required)
- **Tactical Air Traffic Control Net (UHF/HF).** This net provides a means for the TACC/TADC, TAOC and DASC to exercise control of all tactical aircraft in the objective area. Types of information passed over this net include aircraft reports of launches by mission number, clearing aircraft to their assigned control agencies, diverting aircraft as necessary, and completed mission reports prior to landing. Multiple TATC nets are required for the TACC/TADC, TAOC and DASC in order to

provide each agency with its own net(s). Composition includes—

- Controlling agencies(TACC/TADC/TAOC/DASC/ATC)
- Fixed-wing aircraft
- Helicopters

Tactical Air Director. The tactical air director will monitor the tactical air traffic control net and the tactical air direction net (UHF/HF).

- **Tactical Air Direction (TAD) Net.** The tactical air direction net provides a means for the direction of aircraft in the conduct of close air support missions, and for the direct air support center to brief support aircraft on routing, target information, and assignment to a forward air controller, FAC(A), etc. Multiple tactical air direction nets are required and are assigned to major air control agencies. This net is primarily UHF with a secondary VHF capability available in some cases. Composition includes—
  - TACC/TADC
  - DASC
  - TACP
  - Tactical fixed-wing aircraft
  - Other elements within the Marine air command and control system (e.g., TAC[A], FAC[A])

Tactical Air Request Net Control Operator. This operator monitors the tactical air request net (HF/VHF).

- **Tactical Air Request (TAR) Net.** This net provides a means for forward ground combat units to request immediate air support from the DASC. Intermediate ground combat echelons monitor this net and may approve, modify, or disapprove of a specific request. The DASC uses the net to brief the requesting unit on the mission details. Multiple tactical air request nets may be required depending on the scope of close air support operations. Composition includes—

  - DASC
  - HDC
  - TACP
  - TAC(A)
  - FAC(A)
  - ASC(A)

Helicopter Request Net Control Operator. This operator monitors the helicopter request net (HF/VHF).

- **Helicopter Request Net (HR).** This net is established during amphibious operations for the conduct of ship-to-shore movements. It is used by the tactical air control parties of helicopter units, and those units assigned on-call helicopter support. The net is also used to request immediate helicopter support from the direct air support center or helicopter direction center. Surface landed units will submit requests for immediate helicopter support to the direct air support center or tactical air command center (afloat) via tactical request nets. Preplanned helicopter support for helicopterborne and surface-based units will be submitted via command channels. This net is disestablished after

the ship-to-shore phase of the amphibious assault. Composition includes—

- TACP's of helicopterborne units
- DASC (when established ashore)
- TADC

Direct Air Support Center (Airborne). The direct air support center (airborne) (DASC[A]) will normally monitor the following circuits—

- Direct air support net
- Tactical air command net
- Tactical air traffic control net(s)
- Tactical air direction net(s)
- Helicopter direction net(s)
- Tactical air request/helicopter request net

Tactical Air Operations Center. Identified watch standees in the tactical air operations center will normally monitor the indicated nets—

Sector AntiAir Warfare Coordinator. The sector antiair warfare coordinator will monitor the command action net, the tactical air command net, and all other TAOC circuits, as required.

Senior Air Director. The senior air director will monitor the command action net, the air operations control net, and all other TAOC nets, as required.

Surveillance and Identification Director. The senior identification director monitors the combat information/detection net, the data-link coordination net, the handover/crosstell net (HF) and the anti-aircraft intelligence net (HF/MUX).

- **Antiair Intelligence Net (AAI).** The anti-aircraft intelligence net provides a means for surface-to-air missile batteries to report targets (acquired by battery surveillance radar) not previously reported on the combat information/detection net. Additionally, this net may be used by the TAOC to pass selected early warning contacts to missile firing batteries. Composition includes—
  - TAOCs
  - Battery command posts
  - Early warning/control activities (as required)

Senior Traffic Director. The senior traffic director monitors the tactical air traffic control net, search and rescue net, guard, and the handover/crosstell net. The senior traffic director also monitors the tanker net.

- **Tanker Net (UHF).** This net provides a means for in-flight refueling aircraft to communicate with the tanker. Additionally, it can be used by the TAOC to exchange information with the tanker. Such information would include fuel states and early warning. Composition includes—
  - Tanker(s)
  - In-flight refueling aircraft

- TAOC
- EW/Cs

Senior Weapons Director. The senior weapons director will monitor TADIL-C (UHF) and Army tactical data link-1 (ATDL-1). Additionally, he will monitor the—

- **Fighter Air Direction Net (UHF).** This net provides a means for air control agencies and elements to control aircraft conducting intercepts. Multiple nets are required and are assigned to each major control agency. Composition includes—
  - TAOC
  - EW/C
  - Interceptor aircraft
  - Other AAW elements within the air command and control system.
- **Anti-Aircraft Control Net (MUX/HF).** This net provides a means to control surface-to-air missile batteries. Types of information passed on this net include; target assignments, fire direction orders, weapons status commands, battery status reports, and progress of engagements and engagement reports. Composition includes—
  - TAOC
  - TMD Det firing sections
  - Early warning/control sites (as required)

Surveillance Operators. The surveillance operator monitors the combat intelligence/detection net.

Tactical Air Traffic Controller. The tactical air traffic controller will monitor the tactical air traffic control net, the handover net, and the cross-tell net.

Weapons Controller. The weapons controller is responsible for the positive control of all enroute or return-to-base aircraft assigned to his control frequency. During active air defense, he operates under the direction of the senior weapons director. The weapons controller monitors the fighter air direction net and the antiaircraft control net.

Assistant Weapons Controller. The assistant weapons controller also monitors the fighter air direction net and the antiaircraft control net

Early Warning/Control Site. Normally an early warning and control site will monitor the air operations control net, the combat/information detection net, the tactical air traffic control net, and the fighter air direction net (as directed).

Terminal Controllers. Terminal controllers include the tactical air coordinator (airborne), the air support coordinator (airborne), the forward air controller (airborne), and the tactical air control party. They will normally monitor the communications nets as indicated—

Tactical Air Coordinator (Airborne). The tactical air coordinator (airborne) could be required to monitor the tactical air direction net, the tactical air request/helicopter request net, and/or any of the following—

- **Tactical Air Control Party Local Net (VHF).** This net provides a means for coordination between the air officer and the

forward air controllers within the infantry battalion. Composition includes—

- Air officer
- Forward air controllers
- TAC(A)
- FAC(A)

- **MAGTF Air Observation Net (UHF/VHF).** This net provides a means for controlling air observation and for the transmission of information from landing force (LF) air observers to the LF headquarters and other LF units. It can be heavily used during visual reconnaissance operations. The net may be used for adjustment of artillery or naval gunfire on an emergency basis. Multiple nets may be employed. Composition includes—
  - Command element
  - Aerial observer
  - Ground combat element
  - Artillery battery fire direction center (FDC) (as required)
  - FSCC(s)
- **Division Artillery Air Spot Net (VHF).** This net provides artillery air observers with a means to transmit target information to artillery units and adjust fires. Multiple nets may be required. Composition includes—
  - GCE headquarters (as required)
  - Artillery air observers

- Artillery regiment
- Artillery battalions and batteries (as required)
- FAC(A)

- **Naval Gunfire Air Spot Net (UHF).** The naval gunfire air spot net provides a means for airborne spotting and adjustment of naval gunfire. This net is used to call for and adjust fire by the air spotter in the same manner as the shore fire control spotting network. Multiple nets may be required.

The brief should include the locations of logistic support and maintenance support activities and any procedures established for the request and utilization of that support.

Special Instructions (as required)

This area encompasses any items that require additional emphasis or specific instructions in order to ensure execution.

Communications to Support Intelligence. This includes any special connectivity or communications architecture necessary to support the intelligence efforts of the MAGTF and their circuit restoration priorities.

Communications to Support ATO Distribution. The ATO is the primary order for the execution of daily operations of the ACE. The timely distribution of the ATO is vital to mission accomplishment. Both primary and alternate means of ATO distribution should be briefed. The critical agencies in the ATO distribution chain should be identified.

Communications for MEDEVAC/SAR Operations. Any specific MEDEVAC or SAR communications procedures and special requirements should be identified in this area.

Communications to Support Special System. This section covers any special connectivity requirements needed to support the integration of special systems (e.g., CTAPS, TCO, IAS) into the MACCS.

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Appendix C

Communications Planning Support Tools

This appendix describes various planning tools that can be used to assist in the design of a communications architecture.

System Planning Engineering and Evaluation Device (SPEED)

SPEED is a combination of hardware and software that together supports the Marine Corps' tactical communications system planning, engineering and evaluation processes. The portable, stand alone system provides the capability to plan a tactical communications system and maximize the utility of that system by providing the means to evaluate system performance prior to installation. Software is distributed as a removable 200 megabyte hard disks and will support the following functions—

- Radio path profiling and area coverage analysis
- High frequency propagation analysis
- Position location reporting system network planning (line-of-sight and position location information studies)
- Unit level circuit switch (ULCS) network planning

SPEED also serves as the platform for the revised battlefield electronic communication-electronics operating instruction system (RBECS), which is the software required to operate single channel ground and airborne radio system (SINCGARS) radios in a frequency hopping mode. SPEED software is being fielded with the AN/UYK-85A microcomputer or the Marine common hardware site (MCHS) class C lightweight tactical computer. Included in the software package is a database of the technical profiles of Marine Corps and selected DOD communications-electronics equipment, and a set of defense mapping agency digital terrain maps.

Revised Battlefield Electronic Communications-Electronic Operating Instruction System

The RBECS software is designed to provide the spectrum manager with the capability to assign limited frequency resources, generate required spectrum management outputs (e.g., CEOI/SOI, spectrum management variables to support SINCGARS, and other JCEOIs/CEOIs/SOIs to support tactical communications-electronics systems) and distribute these outputs to subordinate organizational elements.

Tactical Network Analysis and Planning System (TNAPS)

TNAPS is a computer-based desktop system planning and system control tool that assists the planner with building an exercise/operation database, and with producing a series of output reports describing the resulting networks and equipment configurations. The system controller can use this database, with program support, to monitor and manage in-place communications. TNAPS allows tactical communications planning and control at two levels: the network level and nodal/equipment level. Network

planners/controllers are responsible for planning and managing the overall network. Nodal planners/controllers plan and manage a complete database for equipment within the node and generate all necessary worksheets and crew assignment sheets. Some of the functions of TNAPS are as follows—

- Exercise database control
- Subscriber database control
- Sites and inventory control
- Circuit switch network development
- Circuit switch graphics
- Message switch network development
- Transmission network development
- Transmission graphics
- COMSEC database control
- System control
- Reports

Mobile Oceanography Support System (MOSS)

The Mobile Oceanography Support System is located within the weather section of the Marine wing support squadron. MOSS is a rapid-response, on-scene environmental prediction system used to quickly determine the effects of the environment on sensors, platforms, and weapon systems. Locally collected meteorological

information is used to prepare analyses of present atmospheric and electromagnetic (EM) propagation conditions. All MOSS products are provided within a time frame consistent with the validity of the data and their practical potential for tactical exploitation. The analyses and the predictions are based on on-scene data, historical data, threat characteristics, and weapon/sensor characteristics. MOSS provides the most valid performance predictions when current details are available covering the area of interest, but it can provide best-guess predictions using data stored in the database.

Functions of MOSS

Environmental Data Assimilation. MOSS accepts locally acquired environmental data from various sources, catalogs the information, processes the data, then writes the data to available files for use by other functions. Data entered includes operator-entered surface, radiosonde, and refractivity data. This function also has the capability to check the quality of the environmental data in order to maximize the validity of the application module results.

Environmental Analysis. Generates analyses of existing environmental conditions affecting air and surface operations. These analyses are provided by atmospheric analysis and meteorological application programs. The analyzed data is presented in the form of graphic and tabular displays that can be hard copied and used for performance predictions.

Sensor/Detection Range/Coverage Prediction. Computes EM sensor range predictions based on meteorological environmental profiles. Output is used for detection and counter-detection of friendly and threat platforms. Force and threat platforms/sensor data base parameters can be used or modified for producing range

predictions. Output is provided in either spreadsheet, graphical, or tabular format.

Data File General and Maintenance. Provides the capability to create, maintain, and/or delete data files. Some of the data files are permanent in nature and are provided by shore-based sites. These include weapon/sensor system characteristics, climatological data, etc. These files are maintained and used for long periods of time and are changed only when updates are received from the software support activity. Other files are created by the operator based on locally available information (e.g., nonstandard weapon/sensor or platform characteristics). Still other files are transitory in nature due to the perishable nature of the data they contain (e.g., atmospheric and refractivity data files). Implicit in this function is the capability to ensure the integrity of the data files and to provide adequate safeguards to any classified data in the files.

MOSS Electromagnetic Propagation Products

Electromagnetic Coverage Diagram (COVER). The COVER program provides a display of radar detection or communication coverage in the vertical plane. COVER is used to determine how a chosen EM system will perform, under specified atmospheric conditions, in detecting or communicating with a given target or receiver.

The primary use of the coverage display is for long-range air-search, surface-based, or airborne radars, and surface-to-air or air-to-air communications systems. Secondary use of the coverage display can take the form of stationing aircraft for attack, ECM, and AEW missions, alerting surface units to holes in radar coverage against attacking aircraft or missiles, hardware performance assessment, and target detection and identification.

The coverage display should not be used for applications involving surface-based or airborne surface-search radars employed against ground targets, or for most types of gun or missile fire-control radars.

Electromagnetic Path-Loss (LOSS). The LOSS program provides a display of one-way path loss vs. range, or path loss for ES intercept vs. range. LOSS is used to assess the performance of user-specified EM systems under given atmospheric conditions. Path loss versus range is displayed with the system's path-loss thresholds, allowing the determination of maximum detection, communication, or intercept range.

The path-loss versus range display is used primarily for long-range air-search, surface-based or airborne radars. It can also be used to determine the intercept range of a radar or communications system by an ES receiver, and for surface-to-air or air-to-air communications systems. Secondary use of the path-loss versus range display is appropriate in every situation where a coverage diagram may be employed. In fact, the path-loss versus range display may be thought of as a horizontal slice of the coverage display. The path-loss versus range display should not be used for most types of gun or missile fire-control radar.

Electronic Counter Measure (ECM) Effectiveness Display. The ECM program provides a measurement of airborne jammer effectiveness against surface-based (victim) radars. The program can determine the optimum locations and flight paths of attack and tactical jamming aircraft by evaluating the effectiveness of a jamming device against a victim radar under given atmospheric conditions. Combat mission planners use this program to determine optimum radar placement. The ECM display can be used in determining the optimum placement of systems designed to jam surface-based

radars. However, the ECM display can only evaluate effectiveness on surface- based victim radars.

Platform Vulnerability (PV). The PV program provides vulnerability estimates of various emitters to a specified ES system under varying environmental conditions. This estimate is expressed as the maximum intercept range for each emitter. The PV program can be used in determining intercept ranges for surface-to-air, air-to-air, and air-to-surface emitters. The program is limited by a maximum intercept range output of 1000 km (541 nm).

Joint Spectrum Center (JSC)

Formerly the electromagnetic compatibility analysis center (ECAC), the JSC is a government-owned, contractor-operated center whose purpose is to provide advice and assistance on electromagnetic compatibility (EMC) matters to the secretary of defense, the joint chiefs of staff, the military Services, DOD components, and other departments of the US government.

Organization. The JSC is a joint DOD agency that receives policy guidance and program direction from the Chairman of the Joint Chiefs of Staff, and the Assistant Secretary of Defense for C^3I or their designees. A military director, provided by the USAF, oversees the entire JSC operation with four deputy directors from each of the military Services. The JSC draws upon the expertise of the engineering support service contractor (ESSC) to execute the EMC effort needed to support JSC sponsors.

Capabilities

Staff. JSC's staff is considered to be its most important asset. The government and ESSC staffs use their extensive EMC experience,

knowledge of JSC's databases, and analysis capabilities to provide products that meet each sponsor's needs. The ESSC staff consists of experienced EMC engineers and system analysts, spectrum planners, frequency managers, military operations specialists, computer programmers, data management specialists, and measurement technicians.

Databases. JSC maintains an extensive database resource to support DOD EMC analyses. This essential and unique resource contains the following databases—

- **Background Environmental Database.** This database contains automated and non-automated records of the electromagnetic environment of military and registered civilian communications-electronics operations worldwide.

- **Equipment Characteristics Database.** The equipment characteristics database contains over 80,000 records of basic technical characteristics of military and commercial communications-electronics systems.

- **Frequency Resource Record System (FRRS) Database.** The FRRS contains more than 180,000 DOD frequency-assignment records. Each record includes administrative and technical data such as the type of assignment, the assigned frequency, organizational information, and the equipment locations.

- **Tactical Database (TACDB).** The TACDB contains data on C-E configuration of military units and platforms, commercial aircraft and ships.

- **Space Systems Database.** The JSC space system database contains C-E characteristics of radio frequency equipment associated with space systems to include parameters for orbiting spacecraft.

- **Electro-Optical Database.** JSC is compiling both US and friendly country electro-optics systems characteristics in the electronic warfare integrated reprogramming format.

- **Topographic Database.** This JSC database contains digitized terrain-elevation data, obtained monthly for the DMA. Current coverage includes all of CONUS, Europe, the Middle East, Asia and portions of Canada, Africa and South America.

Analysis Models. JSC maintains more than 150 automated models, augmented by a comprehensive collection of manual techniques, that can be used to analyze antennas, propagation, transmitters, and receivers. Access to these analysis models, coupled with access to the database resources, enables JSC engineers to perform EMC analyses on most C-E systems. The following models can be provided—

- Antenna models
- Transmitter models
- Propagation models
- Frequency assignment models
- Receiver models
- Environmental analysis models
- Co-site analysis models
- Electro-optical analysis models
- Coverage contour models
- Radar analysis models

- ATC, IFF, NAVAIDS models
- Space spectrum analysis models

Requesting Support. To obtain EMC support, call or write—

JSC
120 Worthington Basin
Annapolis, MD 21402-5064
(410) 293-2457
FAX : (410) 293-2631, DSN 281-2631
Secure FAX (410) 293-2209, DSN 281-2631
Marine Corps Deputy Director (JSC/CM)
DSN 281-2555
(410) 293-2555

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Appendix D

Communications Architecture

This appendix details a notional communications architecture that could be employed in the ACE. Figure D-1 depicts the ACE multi-channel backbone connectivity. The major links between agencies are numbered. Figures D-2 through D-7 are circuit diagrams describing the numbered links.

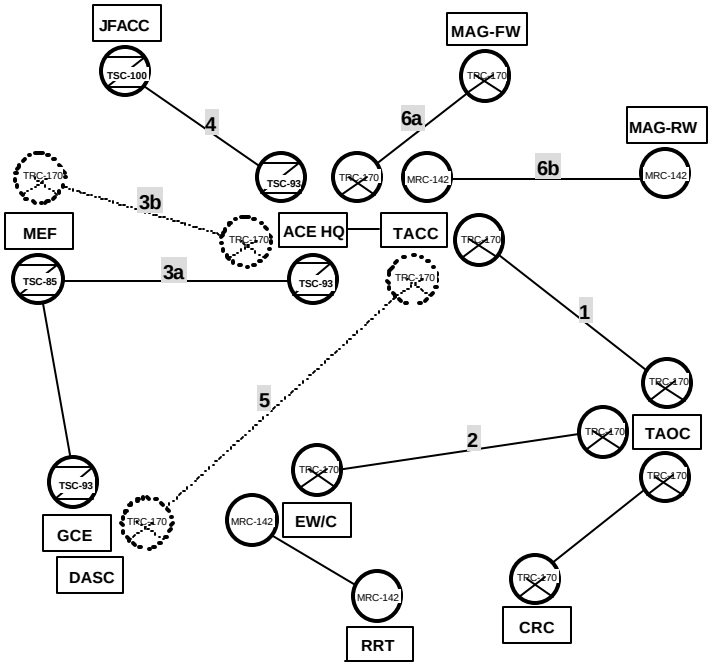


Figure D-1. ACE Multichannel Backbone Connectivity

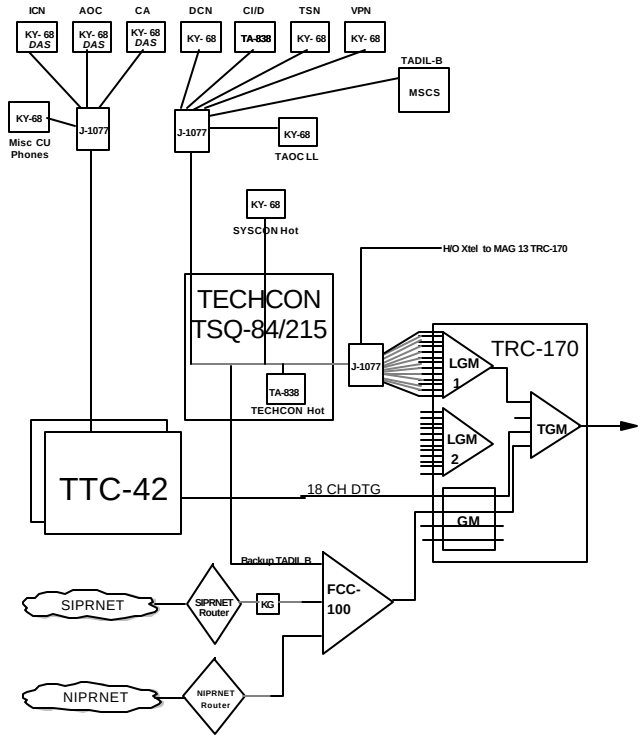


Figure D-2. TACC to TAOC Connectivity (Link #1)

Note: As planning factors, use a maximum distance of 120 miles and a maximum throughput of 4608 kbps for a TRC-170; 30 miles and 864 kbps for a MRC-142; and unlimited mileage and 576 kbps for a TSC-85/93.

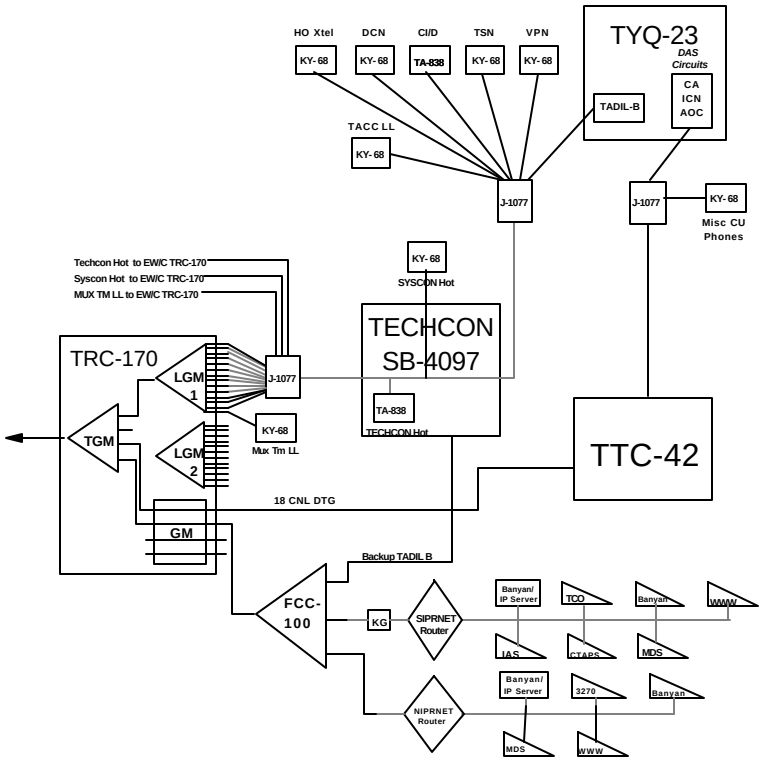


Figure D-2 (Cont). TACC to TAOC Connectivity (Link #1)

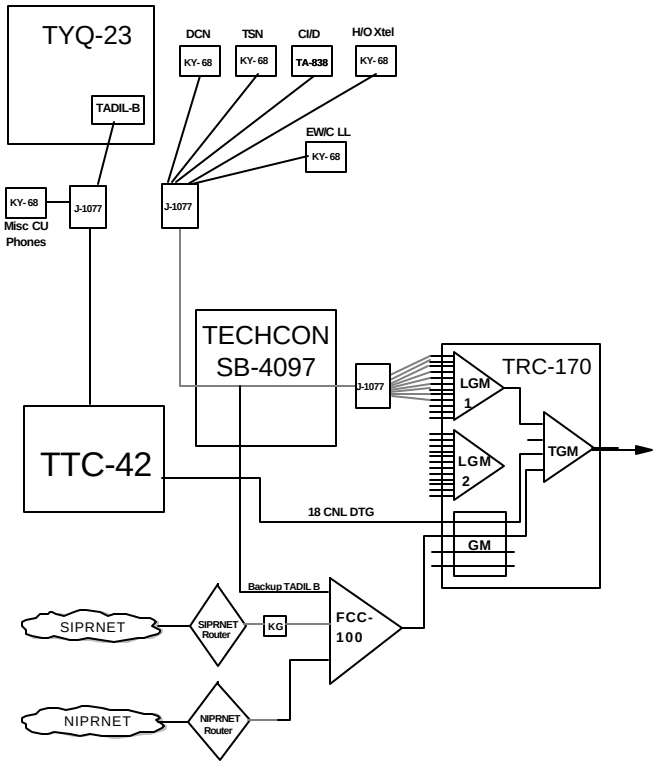


Figure D-3. TAOC to EW/C Connectivity (Link #2)

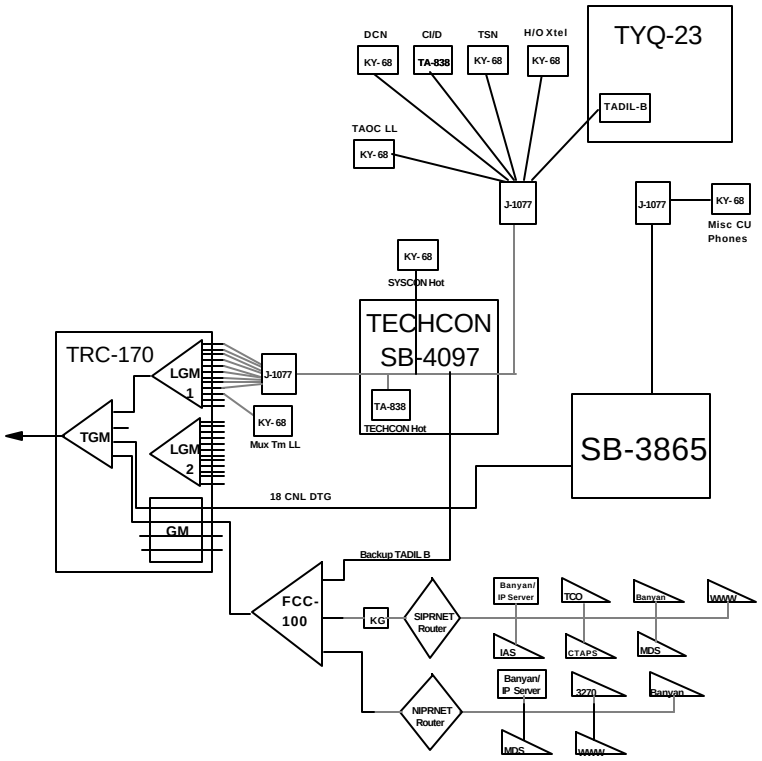


Figure D-3 (Cont). TAOC to EW/C Connectivity (Link #2)

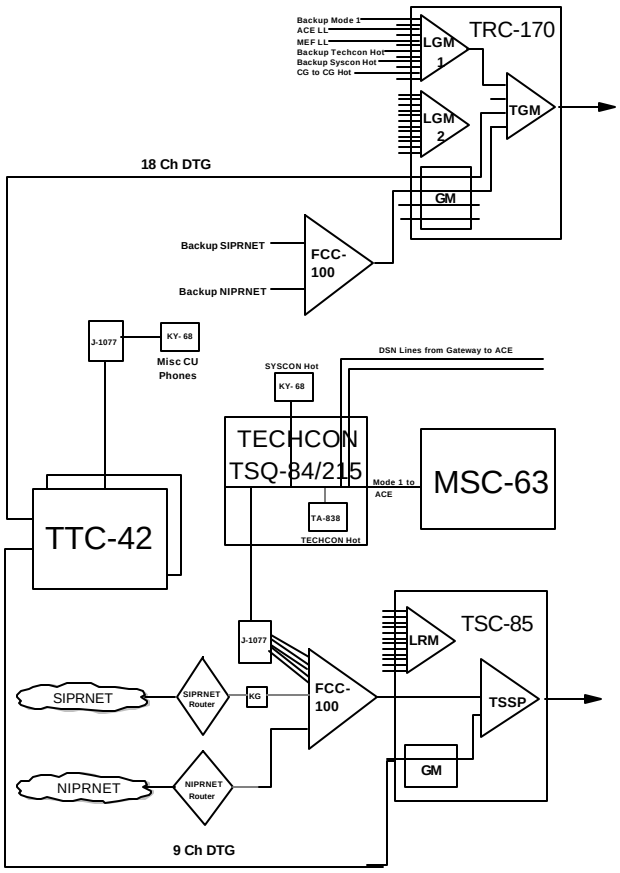


Figure D-4. MEF to ACE Connectivity (Link #3a/b)

Note: The link from MEF to ACE (link 3a) is the responsibility of the communications battalion and depending on terrain and distance will be either SATCOM (TSC-85/93) or terrestrial MUX

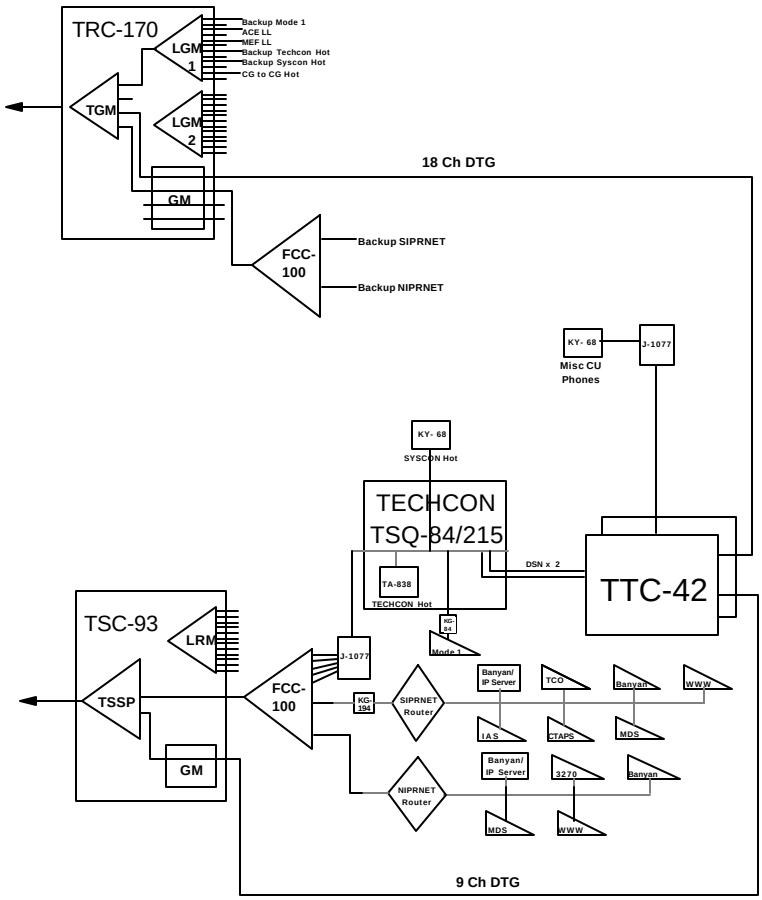
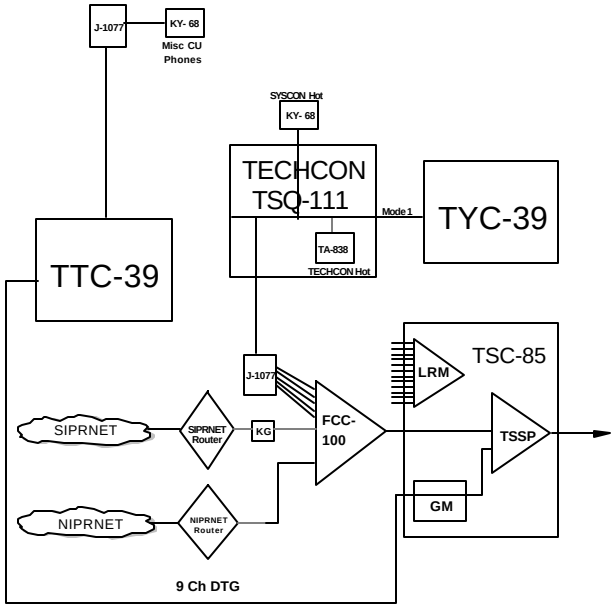


Figure D-4 (Cont). MEF to ACE Connectivity (Link #3a/b)

(TRC-170). If possible, MWCS would install a secondary TRC-170 (link 3b) in order to provide redundancy and increased bandwidth.

TRC-170s are preferred due to the increased bandwidth they provide. SATCOM links are restricted by satellite availability and total



throughput.

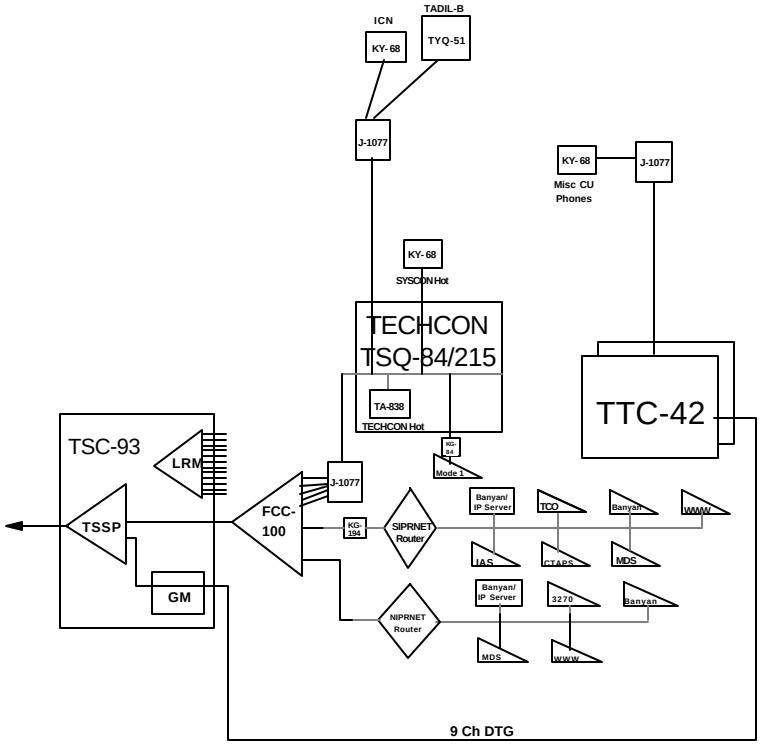


Figure D-5. JFACC to TACC Connectivity (Link #4)

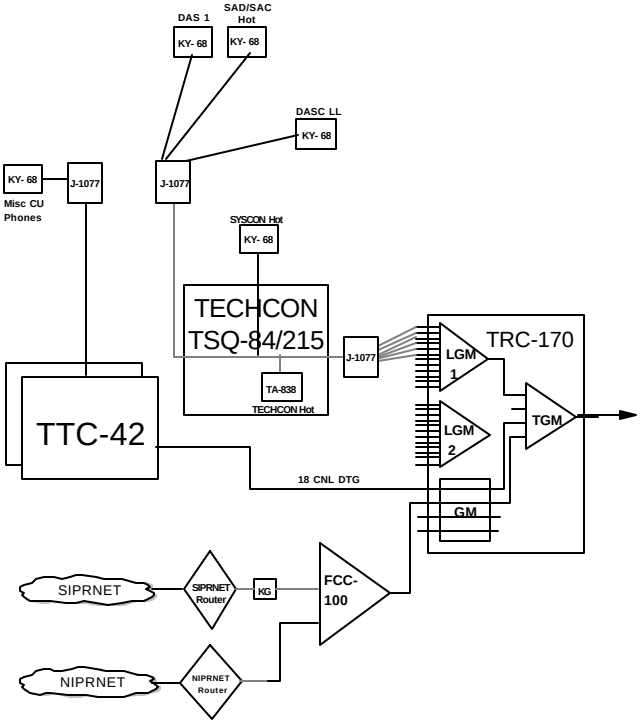


Figure D-5 (Cont). JFACC to TACC Connectivity (Link #4)

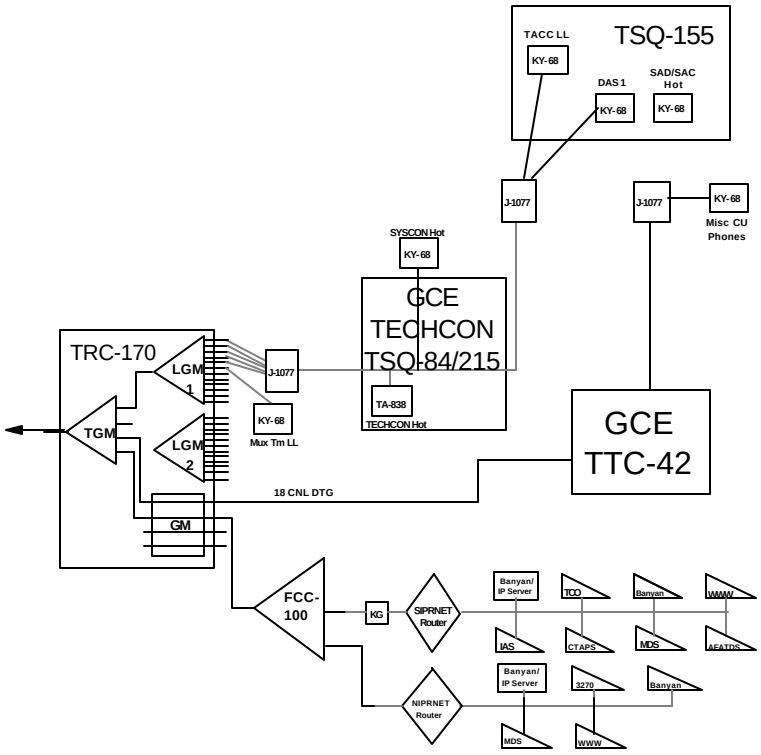


Figure D-6. TACC to DASC Connectivity (Link #5)

Note: The TACC to DASC link is situationally dependent. If permitted by location and concept of operations, MWCS would establish a link from the TACC to the DASC or from any other MACCS agency within TRC-170 range. The DASC is normally

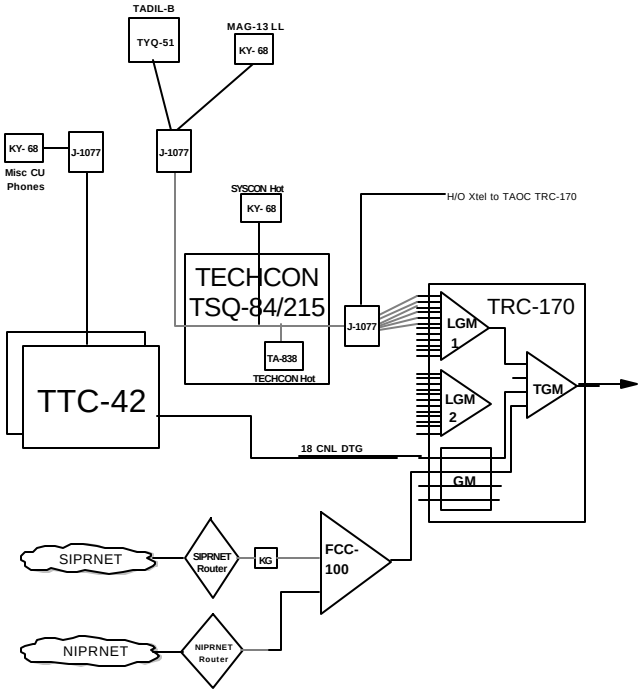
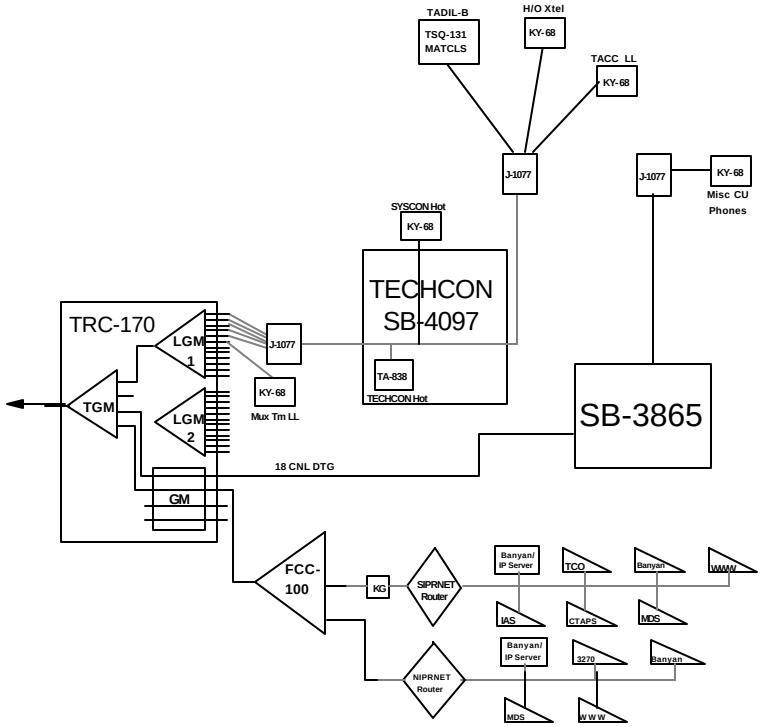


Figure D-6 (Cont). TACC to DASC Connectivity (Link #5)



located with the GCE's senior fire support coordination center. The TACC to DASC connectivity then provides a redundant link from ACE to GCE or MEF to GCE.

Figure D-7. TACC to MAG Connectivity (Link #6a/b)

Note: Multichannel connectivity in support of VMU is the responsibility of the Marine wing communications squadron. This support could include up to six remote receiving teams (RRT).

Figure D-7 (Cont). TACC to MAG Connectivity (Link 6a/b)

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Appendix E

Glossary

SECTION I. ACRONYMS.

AAI ..... antiair intelligence (net)
AAU ..... analog appliqué unit
ACE ..... aviation combat element
ALTU ..... analog loop terminal unit
AO ..... area of operations
ASC(A) ..... assault support coordinator (airborne)
ASIT ..... adaptable surface interface terminal
ATC ..... air traffic control
ATDL ..... Army tactical data link
ATF ..... amphibious task force
ATO ..... air tasking order
AUI ..... attachment unit interface
AVOW ..... analog voice orderwire
AWACS ..... airborne warning and control system
BCP ..... battery command post
BIT ..... built in test
BPS ..... bits per second
C2 ..... command and control
C4I ..... command, control, communications, computers, and
..... intelligence
CBS ..... common battery signaling
C-E ..... communications-electronics
CE ..... command element
CEOI ..... communications-electronics operating instructions

CI/D ..... combat information/detection (net)
CLD ..... critical low density
CLF ..... commander, landing force
CPS ..... COMSEC parent switch
CPX ..... command post exercise
COMMCON ..... communications control
COMSEC ..... communications security
COVER ..... electromagnetic coverage diagram
CRC ..... control and reporting center
CRE ..... control and reporting element
CSS ..... COMSEC subordinate switch
CTAPS ..... contingency theater automated planning system
CWAR ..... continuous wave acquisition radar
CWSAS ..... continuous wave sensor acquisition section
DAS ..... direct access service
DASC ..... direct air support center
DASC(A) ..... direct air support center (airborne)
DCE ..... data communication equipment
DGM ..... data group modem
DLAN ..... deployed local area network
DMA ..... defense mapping agency
DNVT ..... digital nonsecure voice terminal
DOW ..... data orderwire
DSN ..... defense switching network
DSVT ..... digital subscriber voice terminal
DTMF ..... dual tone multi-frequency
DTS ..... data terminal set
DVOW ..... digital voice orderwire
DWAN ..... digital wide area network
EA ..... electronic attack
ECAC ..... electromagnetic capability analysis center
EEFI ..... essential elements of friendly information
EM ..... electromagnetic

EMC ..... electromagnetic capability
EMCON ..... emissions control
EP ..... electronic protection
ES ..... electronic support
ESSC ..... engineering support service contractor
EW ..... electronic warfare
EW/C ..... early warning and control
FAAD ..... forward area air defense
FAC ..... forward air controller
FAC(A) ..... forward air controller (airborne)
FDC ..... fire direction center
FOB ..... forward operating base
FPU ..... forward participating unit
FRRS ..... frequency resource record system
FSCC ..... fire support coordination center
FTX ..... field training exercise
GBDS ..... ground based datalink
GCCS ..... global command and control systems
GENSER ..... general service
GM ..... group modem
GMF-SATCOM ... ground mobile force-satellite communications
HDC ..... helicopter direction center
HF ..... high frequency
IAS ..... intelligence analysis system
ICOM ..... integrated COMSEC
IFF ..... identification, friend or foe
IP ..... internet protocol
ISMO ..... information systems management office
ITS ..... individual training standards
JCEOI ..... joint communications-electronic operating instruction
JDISS ..... joint deployable intelligence support system
JFACC ..... joint force air component commander
JSC ..... joint spectrum center

JTIDS ..... joint tactical information distribution system
JTAOM ..... joint tactical air operations module
KPBS ..... kilobits per second
LAAD ..... low altitude air defense
LAN ..... local area network
LAPB ..... link access procedure balanced
LGM ..... loop group modem
LOSS ..... electromagnetic path loss diagram
MACCS ..... Marine air command and control system
MACG ..... Marine air control group
MAG ..... Marine aircraft group
MAGTF ..... Marine air-ground task force
MAPP ..... Marine aviation planning problem
MATCD ..... Marine air traffic control detachment
MCHS ..... Marine common hardware suite
MCTCA ..... Marine Corps tactical communications architecture
MDS ..... message distribution system
MILOGS ..... MAGTF integrated logistics system
MISTEX ..... Marine integrated simulated training exercise
MOS ..... military occupational specialty
MOSS ..... mobile oceanographic support system
MSE ..... multiple subscriber equipment
MUX ..... multichannel
MWCS ..... Marine wing communications squadron
MWSG ..... Marine wing support group
MWSS ..... Marine wing support squadron
NADGE ..... NATO air defense ground environment
NAVAID ..... navigational aid
NCS ..... net control station
NIPRNET ..... nonsecure internet protocol router network
NPG ..... network participation group
NRZ ..... non return to zero
NTDS ..... naval tactical data system

OJT ..... on-the-job training
OPLAN ..... operation plan
OPTASKLINK ..... operation tasking data link
OSC ..... operations system control
OSCC ..... operations system control center
PBX ..... public branch exchange
PPP ..... point-to-point protocol
PU ..... participating unit
PV ..... platform vulnerability
RD ..... ringdown
REBECS ..... revised battlefield electronic CEOI system
RF ..... radio frequency
RLGM ..... remote loop group multiplexers
RMC ..... remote multiplexer combiner
RU ..... reporting unit
SAAWC ..... sector antiair warfare coordinator
SACC ..... supporting arms coordination center
SAR ..... search and rescue
SATCOM ..... satellite communications
SCIF ..... special compartmentalized information facilities
SCR ..... single channel radio
SDLC ..... synchronized data link control
SHF ..... super high frequency
SIGINT ..... signals intelligence
SIMEX ..... simulated exercise
SINCGARS ..... single channel ground and airborne radio system
SIPRNET ..... secure internet protocol router network
SJS ..... shelterized JTIDS system
SPE ..... systems planning and engineering
SPEED ..... systems, planning, engineering, and evaluation devise
SQE ..... signal quality event
TAC(A) ..... tactical air coordinator (airborne)
TACC ..... tactical air command center (USMC)

TACC ..... tactical air control center (USN)
TACDB ..... tactical database
TACSAT ..... tactical satellite
TACP ..... tactical air control party
TADC ..... tactical air direction center
TADIL ..... tactical digital information link
TAOC ..... tactical air operations center
TAOM ..... tactical air operations module
TAR/HR ..... tactical air request/helicopter request (net)
TASS ..... tactical automated switching system
TATC ..... tactical air traffic controller
TCO ..... tactical combat operations
TDAR ..... tactical defense alert radar
TDS ..... tactical data system
TDMA ..... time division multiple access
TECHCON ..... technical control
TECHCONFAC ..... technical control facility
TED ..... trunk encryption devise
TGM ..... trunk group multiplexer
TMD ..... theater missile defense
TMDE ..... test measurement diagnostic equipment
TNAPS ..... tactical network analysis and planning system
TRI-TAC ..... tri-service tactical communications system
TSSP ..... tactical satellite signal processor
UHF ..... ultra-high frequency
ULCS ..... unit level circuit switch
VHF ..... very-high frequency
VPN ..... voice product net
WAN ..... wide area network

SECTION II. DEFINITIONS.

airborne tactical data system - An airborne early warning system capable of integration into the tactical data system environment. It provides an automated, operator-controlled capability for collecting, displaying, evaluating, and disseminating tactical information via tactical digital information links. It is part of the Naval Tactical Data System (NTDS). (Joint Pub 1-02) Also called ATDS.

amplitude modulation - Signal modulation in which the amplitude of the carrier frequency is varied above and below its normal value in accordance with the audio, the picture, or other intelligence signal to be transmitted.

analog communications - A continuous variable signal which conveys information by the change of the value or magnitude of signal. The signal can change in either amplitude, phase, frequency, or duration. Analog signals are alternating current and radio waves.

automated digital network - The principle long-range Defense Communications System digital network for transmitting record/data traffic on an automatic switching basis between and among a wide variety of fixed, transportable and mobile subscriber equipment.

command and control system - The facilities, equipment, communications, procedures, and personnel essential to a commander for planning, directing, and controlling operations of assigned forces pursuant to the missions assigned. (Joint Pub 1-02)

data link - The means of connecting one location to another for the purpose of transmitting and receiving data. (Joint Pub 1-02)

digital communications - signal having discrete states, usually two which indicate the presence of 2 different voltage levels. The signal is given meaning by assigning numerical values or other information to the various possible combinations of the discrete states of the signal.

directed net - A net in which no station other than the net control station can communicate with any other station, except for the transmission of urgent messages, without first obtaining permission of the net control station. (FMFRP 0-14)

electronic warfare - Any military action involving the use of electromagnetic and directed energy to control the electromagnetic spectrum or to attack the enemy. Also called EW. The three major subdivisions within EW are: electronic attack, electronic protection, and electronic warfare support.

a. **electronic attack** - That division of electronic warfare involving the use of electromagnetic or directed energy to attack personnel, facilities, or equipment with the intent of degrading, neutralizing, or destroying enemy combat capability. Also called EA. EA includes 1) actions taken to prevent or reduce an enemy's effective use of the electromagnetic spectrum, such as jamming and electromagnetic deception, and 2) employment of weapons that use either electromagnetic or directed energy as their primary destructive mechanism (lasers, RF weapons, particle beams).

b. **electronic protection** - That division of electronic warfare involving actions taken to protect personnel, facilities, and equipment from any effects of friendly or enemy employment of electronic warfare that degrade, neutralize, or destroy friendly combat capability. Also called EP.

c. **electronic warfare support** - That division of electronic warfare involving actions tasked by, or under direct control of, an operational commander to search for, intercept, identify, and locate sources of intentional and unintentional radiated electromagnetic energy for the purpose of immediate threat recognition. Thus, electronic warfare support provides information required for immediate decisions involving electronic warfare operations and other tactical actions such as threat avoidance, targeting, and homing. Also called ES. Electronic warfare support data can be used to produce signals intelligence (SIGINT), communications intelligence (COMINT), and electronics intelligence (ELINT). (Joint Pub 1-02)

emission control - The selective and controlled use of electromagnetic, acoustic, or other emitters to optimized command and control capabilities while minimizing, for operations security (OPSEC): a. detection by enemy sensors; b. minimize mutual interference among friendly systems; and/or c. execute a military deception plan. (Joint Pub 1-02) Also called EMCON.

frequency modulation (FM) - Angle modulation of a sine wave carrier in which the instantaneous frequency of the modulated wave differs from carrier frequency by an amount proportional to the instantaneous value of the modulating wave. A frequency modulation system is practically immune to atmospheric interference.

ground mobile force/tactical satellite communications - A DOD satellite system designed to provide large geographic areas with satellite coverage for ground mobile forces use. This program will share national resource satellites of the DCS, which must also support strategic requirements.

high frequency - The segment of the radio frequency spectrum that ranges from 3.000 megahertz (MHz) to 29.999 MHz. Normally associated with long distance single channel radio communications.

line-of-sight - A method of connecting radio waves by being in line or without obstructions between two stations or radios.

Marine air command and control system - A US Marine Corps air command and control system which provides the aviation combat element commander with the means to command, coordinate, and control all air operations within an assigned sector and to coordinate air operations with other Services. It is composed of command and control agencies with communications-electronics equipment that incorporates a capability from manual through semiautomatic control. (Joint Pub 1-02)

multichannel radio - A duplex circuit that uses (2) frequencies to provide two way communications which are multiplexed to provided several channels between the two stations or radios.

naval tactical data system - A complex of data inputs, user consoles, converters, adapters, and radio terminals interconnected with high-speed general purpose computers and its stored programs. Combat data is collected, processed, and composed into a picture of the overall tactical situation which enables the force commander to make rapid, accurate evaluations and decisions. (Joint Pub 1-02) Also called NTDS.

near vertical incident skywave - A type of radio propagation that uses a 60 or more degree take off angle to refract the radio waves so that the radio waves will return to a closely located receiver. Used when geography prevents normal skywave or ground wave HF communications.

obstacle gain defraction (OGD) - A form of interfacing SHF multichannel radio beams by defracting them off an obstacle and connecting it with the beam from the distant site which is doing the same.

operations security - A process of identifying critical information and subsequently analyzing friendly actions attendant to military operations and other activities to:

a. Identify those actions that can be observed by adversary intelligence systems.

b. Determine indicators hostile intelligence systems might obtain that could be interpreted or pieced together to derive critical information in time to be useful to adversaries.

c. Select and execute measures that eliminate or deduce to an acceptable level the vulnerabilities of friendly actions to adversary exploitation. (Joint Pub 1-02) Also called OPSEC.

operational systems control - The daily operations section that coordinates and controls the total communications architecture.

radio relay - Point-to-point radio transmission in which the signals are received and retransmitted by one or more intermediate radio stations. The retransmission may be either manual or automatic. (FMFRP 0-14)

super high frequency - the segment of the frequency spectrum that ranges from 3.0 to 30.0 gigahertz (GHz). Tactical super high

frequency communications within the MACCS operates in the range of 4.0 to 5.4 GHz.

systems planning & engineering - The function of determining the communication needs, coordinating tasks, planning and building circuit routes.

tactical digital information link - A Joint Staff approved, standardized communication link suitable for transmission of digital information. Current practice is to characterize a tactical digital information link by its standardized message formats and transmission characteristics. TADILs interface two or more command and control weapon systems via a single or multiple network architecture and multiple communication medial for exchange of tactical information. Also called TADIL.

technical control facility - An extension of OSC that controls the technical aspects of the communications architecture which includes the installation, maintenance and supervision of all circuits.

troposcatter - An over-the-horizon ground-to- ground radio system which utilizes the reflective properties of the troposphere to provide a multichannel communications system. A form of interfacing SHF multichannel radio beams by using a preplanned spot where the beams will interconnect and complete a path.

ultra high frequency -The segment of the frequency spectrum that ranges from 225 to 400 MHz.

very high frequency - A segment of the frequency spectrum that ranges from 30.00 to 75.95 MHz (frequency modulated) and 118.000 to 137.00 MHz (amplitude modulation).

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Appendix F

References and Related Publications

Joint Publications (JPs)

0-2	Unified Action Armed Forces (UNAAF)
1-02	Department of Defense Dictionary of Military and Associated Terms
3-0	Doctrine for Joint Operations
3-01.5	Doctrine for Joint Theater Missile Defense
3-02	Joint Doctrine for Amphibious Operations
3-52	Doctrine for Joint Airspace Control in a Combat Zone
3-54	Joint Doctrine for Operations Security
3-56	Command and Control Guidance for Joint Operations
3-56.1	Command and Control in Joint Air Operations
5-0	Doctrine for Planning Joint Operations
6-05.1	Joint Tactical Communications System Management
6-05.2	Joint Voice Communications Systems
6-05.3	Joint Data Communications Systems
6-05.5	Joint Communications Security
6-06.6	Joint Technical Control Procedures and Systems
6-05.7	Joint Network Management

Fleet Marine Force Manuals (FMFM)

3-1	Command and Staff Action
3-30	Communications
5-1	Organization and Function of Marine Aviation
5-30	Assault Support
5-50	Antiair Warfare
5-70	MAGTF Aviation Planning

Fleet Marine Force Reference Publications (FMFRPs)

0-14	Marine Corps Supplement to the DOD Dictionary of Military and Associated Terms
FMFRP 5-61	ICAC2: Multiservice Procedures for Integrated Combat Airspace Command and Control
FMFRP 5-62	TAGS: The Theater Air Ground System
FMFRP 5-71	Aviation Planning Documents

Marine Corps Doctrinal Publications (MCDP)

1	Warfighting
1-3	Tactics
3	Expeditionary Operations
5	Planning
6	Command and Control

Marine Corps Warfighting Publications (MCWPs)

3-25	Control of Aircraft and Missiles
3-25.3	Marine Air Command and Control System Handbook
3-25.5	Direct Air Support Center Handbook
3-25.6	Sector Antiair Warfare Coordinator Handbook
3-25.7	Tactical Air Operations Center Handbook
3-25.8	Marine Air Traffic Control Detachment Handbook
3-25.10	Low Altitude Air Defense Battalion Handbook

Marine Corps Orders (MCOs)

P3500.19	Training and Readiness Manual
3501.9B	Marine Corps Combat Readiness Evaluation System (MCCRES)

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