U.S. AIR FORCE

Military Auxiliary Radio System National Training Manual

Compiled and written by

Roger B. Hughes – AFA9HR / AFE9TS / AFN9TM National Training Manager

Reviewed by

Dennis McCord – AFA9AY / AFN9OO National Operations Officer
David J. Stapchuk – Chief US Air Force MARS

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PREFACE

AIR FORCE MARS

To: All new members, /T calls

You have been accepted into an elite organization that is tasked with providing emergency communications support for the United States Air Force and other Government Agencies, which include the Federal Emergency Management Agency (FEMA), the Shared Resources (SHARES) HF radio program, and other agencies of the Department of Defense and U.S. Government.

The opportunities offered by MARS for you to serve in public service support are limited only by your willingness to participate in the many programs that make this a unique organization.

Examples of some of the services offered by MARS are:

1. Dispatch of health, morale and welfare traffic to and from military service personnel world-wide.
2. Disaster communications support for federal, state and civilian governmental agencies and other disaster relief organizations when requested.
3. Engineering and technical support in all communications systems to continue state-of-the-art readiness status.
4. Management training for local military base support positions.

Air Force MARS utilizes both voice and digital modes.

You will first be trained to use the correct radiotelephone procedures required for communications support of military and allied national forces. Additional training is available for those members that desire to use digital capabilities.

After you have completed your initial training assignment you will then be re-assigned to the traffic net system in your MARS Division. This will be your primary assignment but you may participate in as many nets of the Air Force MARS program as you desire (excepting special assignment nets).

The expansion of your own horizons through your association with Air Force MARS and the members of this organization are limited only by your desire and capability.

Operations on USAF MARS are governed primarily by: *Allied Communications Publications* listed on http://jcs.dtic.mil/j6/cceb/acps/ and *Air Force MARS Operating Instructions*. Primarily of interest in the ACP series are:

1) ACP 121(I) - Communication Instructions – General
2) ACP 124(D) - Communications Instructions - Radiotelegraph Procedures
3) ACP 125(F) - Communication Instructions - Radio Telephone Procedures
4) ACP 126(C) - Communication Instructions - Teletypewriter (Teleprinter) Instructions
5) ACP 131(F) - Communication Instructions - Operating Signals

Of the above, item 3) is the most necessary to become familiar for operating nets. Item 5) is particularly comprehensive in terms of the Q-code and Z-code (which are used in digital transmissions) but has many more codes than are required for use in regular MARS activities. Item 4) has some useful guidelines for digital communications that remain applicable for modern digital modes despite being written for RATT (the military abbreviation for RTTY).

It is not the intent of this guide to cover all the material in these governing documents. It is the intent of this guide to cover the most salient and important aspects of those documents.

NOTE: Documents are not attached to this training guide but rather links to the original documents. This reduces the paper burden of printing out this document if desired and also allows the user to always reference the most up to date copy of the documentation. Note also that this document is a living document and will be updated and augmented during the year.

1. TRAINING REQUIREMENTS

1.1. Introduction

When you received your MARS station license and call sign assignment, you became a licensed MARS operator. You will be operating your amateur station on military frequencies, so a brief period of training is required to help you become familiar with MARS procedures. As a MARS volunteer you are essentially agreeing to operate your station, for a minimum of 12 hours each calendar quarter, on the established MARS networks. **Nine** of these hours must be on your Primary Assignment. The additional hours may be accrued on any Region or Division or State net. You should participate in (i.e., check in to) your State Administrative and the Region and Division Administrative Nets. When you have completed training almost all MARS nets will be open to you. **While you are in training, your primary assignment is Training**. The training assignment is temporary. When you complete training, you will receive a permanent assignment and the time requirement will then apply to that assignment.

1.2. Station Requirements

As noted in section 2.3.4 of the MOI of February 2013, there are certain station requirements that must be met. These are:

a) Applicants and/or current members must have an operational HF radio station prior to acceptance into the MARS program.
b) HF stations must be capable of operating on a minimum of two MARS frequencies, assigned by Division and Region MARS officials.
c) HF stations must have the capability of operating voice and one or more of the digital modes. Digital mode is defined as any computer-generated signal other than continuous wave (CW).
d) Unless specifically exempted from this requirement, all HF radio equipment must have a frequency stability and tolerance of +/- 20 Hz as set by the NTIA (National Telecommunications & Information Administration).

1.2.1. Digital Training

It should be noted from paragraph c) of section 1.2 that digital operation via computer generated signal from a computer sound-card or an external sound-card is an essential part of the requirements of being a MARS member. The reason for this is that digital message passing of traffic is far less error prone, especially with broadcast forward error correcting codes such as MT63 and MFSK. Error correction is even more robust with request-acknowledge protocols of point-to-point PACTOR communications. Digital modes are an essential part of modern MARS communications and capability in operating at least one of the digital modes is mandatory. Paragraph d) of section 1.2 on NTIA requirements assists in digital operations because excellent frequency stability improves stations' capabilities with digital modes.

1.2.2. Frequency Stability

The NTIA requirement is mandatory, unless specifically exempted, for all MARS stations because they are operating on military frequencies that adhere to observation of the NTIA requirements. These requirements are usually met with modern high-end radios that have oven controlled crystal oscillator (OCXO) technology or temperature controlled crystal oscillator (TCXO) technology, such as the ICOM IC-756PRO series. Sometimes OCXOs can be purchased as optional extras for some radios, e.g. the CR-282 high stability crystal unit for the ICOM IC-706MKIIG. In fact, most modern amateur radios come from the factory as upgradeable to NTIA compliance. Nearly all of the solid state amateur transmitters manufactured since the late 70's or early 80's claim a frequency stability and accuracy of plus or minus 10 ppm. One would think that this should satisfy the NTIA requirement of +/- 20Hz, but if we examine "+/- 10ppm", 10 ppm is ten parts per million, equal to 10 Hz at 1 MHz or 100 Hz at 10 MHz, 300 Hz at 30 MHz. Clearly, 10 ppm accuracy is inadequate to meet NTIA standards (+/- 20 Hz) except below 2 MHz. NTIA compliant HF radios typically have a frequency stability of less than 0.5 ppm, thereby satisfying compliance across the entire HF spectrum. As has been demonstrated, older radios do not meet this requirement and can often not be upgraded with an OCXO. If you have older equipment, you will require a specific exemption from this requirement. If you don't have an exemption, then you must upgrade your equipment to be NTIA compliant in order to operate on MARS frequencies.

1.3. Completion of Training

You are encouraged to complete training as soon as possible. There is no minimum time for training; however, you must complete your training within 180 days of the date on the AF Form 3661 which assigns you to training. When you feel that you are familiar with on-the air MARS procedures, you may demonstrate this by sending at least two "Drill" messages to your trainer. One of these messages must be an Exercise EEI. You are strongly encouraged to use a digital mode for one of these messages. Upon successful completion of these drill messages, you will be required to complete a "final examination" consisting of 50 questions. A score of 85% or better is required. You will also need to complete NCS training and demonstrate your capability as an NCS before you are released from training. Please note that ideally NCS training should be conducted purely on a dedicated training net; if it is conducted on a regular net, then an experienced ANCS should be supervising and should immediately assume control of NCS duties and relieve the trainee of both NCS and ANCS duties should urgent traffic suddenly appear on the net. This is to ensure that urgent emergency traffic can be passed correctly an accurately while a trainee is still in training. It is also highly recommended that members should take the following four FEMA courses: IS-100.a, IS-200.a, IS-700.a and IS-800.b, as a minimum set. The FEMA ISP course list may be seen at http://training.fema.gov/is/crslist.asp?page=all and the courses may be taken on-line. Each one concludes with an open-book blind test set of questions and, on passing, you will be given an electronic certificate in PDF form, a copy of which should

be sent to your State MARS Director. Your Divisional Training Manager and your State MARS Director will determine when you have successfully completed training. This is to provide some flexibility to accommodate different Regions needs and individual background. Divisions may augment the recommended training to accommodate divisional needs as they see fit.

1.4. Training on USAF MARS Procedures

Training on USAF MARS procedures is necessary even though you may be an experienced operator since MARS procedures are based on military procedures rather than amateur radio procedures. These MARS procedures have been developed over the years to facilitate rapid communications while emphasizing accuracy. All three MARS services have agreed to use a common procedure in order to allow for interoperability among the services. WITH A FEW EXCEPTIONS, trained USAF MARS operators are welcome to participate in Army or Navy/Marine-Corps MARS nets. If you choose to participate in nets of the other MARS services, be certain to observe and follow any unique policies and/or procedures you may observe.

1.5. Training Nets

In most Regions and Divisions, training nets are held on the Division frequency at regularly scheduled times. The schedule for training nets should have been provided to you along with the AF Form 3661 which assigned you to training. You may contact your Region or Division Training Director with any questions about the scheduled training nets. Other opportunities to receive training in a classroom situation may be made available to you. Information on these opportunities is provided by your Region or Division Training Director.

1.6. Participation Time Requirements

As a MARS volunteer operating on USAF frequencies, you have essentially agreed to donate your time and equipment in support of the USAF MARS mission and to participate for a minimum time each calendar quarter. To successfully operate on the Air Force networks, you will need to learn the prowords, net procedures, message format and message handling techniques that are unique to MARS. The goal of our training is to develop a system of skilled and active radio operators who can provide expertise in achieving our “Primary Mission”.

1.7. Arranging Prolonged Period of Inactivity

NOTE. Directives regarding prolonged periods of inactivity are quite clear. If at any time you find that you cannot meet minimum participation requirements, notify your State MARS Director or Net Manager of the duration and reason for your inactivity. Arrangements for extensions of time are easy to make if those arrangements are made before your membership is in jeopardy, but the responsibility for notifying the proper officials rests with you.

1.8. Assessment

At the end of each chapter there will be a small set of assessment questions (three to seven questions) that you will be expected to review with your Training Officer and/or mentor. These questions may be answered "open book" but you will be evaluated on your understanding and application of the basic concepts provided here. The objective of these questions is to help you focus on the key concepts that should have been learnt from reading each chapter.

On completion of each assessment, you should submit your answers to your mentor or training officer for review. Passing score is 100%, and you may use any resource available to you. Your mentor's job is to ensure your understanding of the material, and any wrong answer will be returned to you to make correct. The number of questions listed in this training manual is a small sample subset to promote discussion and understanding. Your mentor or training officer may well ask you to answer additional questions, and he or she is encouraged to do so, to ensure that you have a solid understanding of what is required to be a successful MARS operator.

To actively participate in MARS, your transceiver should be able to transmit and receive through the entire 2-30 MHz range, and your antenna system should be capable of working efficiently on all your region frequencies. Contact your mentor or MARS training officer if you have difficulty with these tasks.

1. How many hours of participation are required per calendar quarter to maintain membership in MARS?
2. What are the frequency stability requirements of HF radios for use in MARS?
3. Are stations required to be digital capable, or is this optional?
4. What is the maximum time you have to complete the training?
5. If you are going to be inactive for a period of time, who do you notify about this period of inactivity?

2. MARS OVERVIEW

2.1. A Brief MARS History

The current MARS program is a result of development and evolution. It has been different things at different times. The first volunteer Amateur Radio operators to serve the United States military formed the Army Amateur Radio System (AARS) in November 1925. That operation continued until the start of World War II when Amateur Radio operations were ordered suspended. Army Amateur Radio was reauthorized in 1946. The U.S. Army and U.S. Air Force formed the Military Amateur Radio System in 1948. It was later renamed to Military Auxiliary Radio System (MARS). In 1962, the Navy and Marine Corps MARS program was started.

2.2. MARS Mission

The Mission of the MARS program is (as per section 1.1. of the MOI of February 2013) defined as per DoD Instruction 4650.02, Military Auxiliary Radio System (MARS); it is Department of Defense (DoD) policy that MARS shall provide:

2.2.1. Department of Defense

Provide contingency radio communications support to U. S. Government operations through the utilization of organized volunteer radio operators and operating facilities under the appropriate authorities, as directed by and coordinated within the DoD. MARS is to provide contingency radio communications support to civil authorities at all levels, in fulfillment of DoD responsibilities under DoD Directives 5111.13, see http://www.dtic.mil/whs/directives/corres/pdf/511113p.pdf. It is also to provide contingency radio communications support to the DoD Components.

2.2.2. Emergencies

Assist in effecting normal communications under emergency conditions; MARS may provide communications engineering services and technical support and additional communication capacity to military units in training or responding to an actual event, on frequencies identified for MARS use and through MARS Nets.

2.2.3. Morale Traffic

Handle health, morale and welfare radio communications support to military members, civilian employees and contractors of DoD Components and civil agency employees and contractors, when in remote or isolated areas, in contingencies or whenever appropriate.

2.3. Program Emphasis

The emphasis of the program has moved from one to another of these objectives over the history of the program. For example, during the Viet Nam era, MARS was very heavily involved

with passing morale messages and phone patches between deployed military and their loved ones. That function has largely been taken over by the internet and cell phones. The present emphasis of the program is on providing communications to military, civil, and other disaster officials during periods of emergency, and providing them with information about the emergencies from within the affected area.

2.4. Structure and Organization

2.4.1. Background

Air Force MARS is a communication system made up of amateur radio operators who are trained to provide an emergency back-up COMMUNICATIONS CAPABILITY for the USAF Communications Command DEPARTMENT OF DEFENSE AND U.S. GOVERNMENT OPERATIONS. This is the primary mission. Even though we engage in other activities, these activities are all intended to support the primary mission either directly or indirectly.

2.4.2. Geographic Organization

For administrative and communication purposes, USAF MARS is organized by geographic units. States are grouped into Regions: Regions into Divisions. The Divisions are linked by Transcontinental Nets: (TRANSCON) Voice, TRANSCON DIGITAL (Sound Card Modes) and PACTOR BBS (Bulletin Board System). The Transcontinental, Division and Region nets are managed by MARS members on both the evening and daytime nets as well as on the weekends. At the Region level, MARS members will receive the traffic for direct delivery to the addressee, relay to other MARS channels or re-file into the Amateur Band. Each relay is expected to move the traffic closer to its final destination until delivery by local telephone is possible. Since this is not always possible, we rely on member's dedication and ingenuity to devise methods of delivery. Forwarding by radio is encouraged, so a process for re-filing messages into the Amateur Band to be delivered by the National Traffic System is authorized. This re-file process is explained in Chapter 7.

DIVISION	REGION	STATES IN USAF REGION	STATES IN FEMA REGION
North East	I – 1	CT, MA, ME, NH, RI, VT	As USAF
	II – 2	NJ, NY	As USAF plus PR and USVI
	III – 3	DE, MD (Including DC), PA, VA, WV	As USAF
South East	IV – 4	AL, FL (Including PR and USVI), GA, KY, MS, NC, SC, TN	As USAF minus PR and USVI
North Central	V – 5	IL, IN, MI, MN, OH, WI	As USAF
	VII – 7	IA, KS, MO, NE	As USAF
South Central	VI – 6	AR, LA, NM, OK, TX	As USAF
North West	VIII – 8	CO, MT, ND, SD, WY, UT	As USAF
	X – 0	AK, ID, OR, WA	As USAF
South West	IX – 9	AZ, CA, NV, HI, Guam, and Pacific Islands	As USAF

Table 1 - USAF Divisions and Regions by State comparing FEMA Regions

It will be noted that MARS regions and FEMA regions are completely in alignment except for regions 2 and 4. For reasons of easier radio propagation, Puerto Rico and the U.S. Virgin Islands were moved from FEMA Region 2 to USAF MARS Region 4. Other than that one change, the regions are completely in alignment with FEMA Regions as outlined in http://www.fema.gov/regional-operations. It will be noted that two THREE USAF MARS divisions consist only of a single region, namely Region 4 IS South East division, Region 6 is South Central division and Region 9 is South West division. These two divisions only have a single number associated with their call signs, whereas other divisions will have two or three numbers. Each region has a unique number but some divisions have more than one number. It is important to remember this when operating on nets between different divisions.

2.4.3. Routing of Traffic

Traffic originating locally will be routed in the reverse order. Traffic destined for a state in the same Region or Division as its origin will be passed on Division nets but traffic for another

Division must be routed into the TRANSCON network for relay into the Division of destination or the Division of the proper gateway station.

2.4.4. State Administrative Nets

State Admin nets are conducted on the Division frequencies for administrative purposes so members may have contact with their State MARS Directors. While these nets are open to all members in a Division, the primary purpose is for state administrative business. Traffic may be passed on the state nets when all state business has been completed.

2.4.5. Participation in Other MARS Networks

You are encouraged to participate in all the MARS Networks, but keep in mind that while you are in training, you are restricted to State, Region and Division traffic and administrative nets. The Administrative nets, the Division or Region Training nets and your own State Administrative net should provide you with current information.

2.4.6. U.S. Air Force MARS Program Administration

The total MARS program is administered through the office of Chief USAF MARS at Scott Air Force Base, IL. MARS management is through the State MARS Directors (SMD) and Region MARS Director (RMD) and Division MARS Director (DMD). SMD, RMD and DMD are MARS member positions appointed by Chief USAF MARS. Each DMD and RMD appoints a staff of Division and Region Officials who help with various activities. Division and Region Officials are authorized specific "billet call signs" that may be used while conducting activities related to the duties of their office. Each SMD may appoint a staff of State Officials to help with various aspects of state-level activities. WITH THE EXCEPTION OF THE STATE EMERGENCY COORDINATOR (SEC), State-level appointments do not normally authorize a specific "billet call sign". In addition to the Division, Region and State officials there are a few "National" Officials who have duties which are CONUS wide and are authorized the use of certain billet call signs. (See section 2.5.2 for a partial listing of billet call signs authorized for Division, Region and National Officials.)

2.5. Call Sign Assignments

2.5.1. Completion of Training

After training is completed, each MARS member is assigned a personal call sign that will remain with the member as long as the member resides in the original region. The "/T" suffix in your present call sign will be dropped to form your permanent call sign. e.g., AFA3AA/T becomes AFA3AA etc. If a member is appointed to an official position he will receive an additional call sign that will remain with the member for the duration of the appointment. The numeral in a call sign indicates the Region of residence licensing. If you should hear any Military Base MARS stations, they are assigned the prefix AGA, the Region numeral and a suffix that reflects the abbreviation of the base. e.g., AGA6TI (Tinker AFB, OK) AGA9TR (Travis AFB, CA) etc. The

exception to this is AGA5HQ which is the call sign assigned to the USAF MARS Headquarters station.

2.5.2. Partial List of Official Call Signs and Duties

Here is a partial list of representative Official Call signs and duties. The following call signs follow a template usage where the "#" will be a single numeral indicating the MARS Region of residence, 0 through 9. The <aa> indicates the Division (NE, SE, NC, SC, NW or SW). The <ss> is the 2-character US Postal Service State abbreviation.

2.5.2.1. Division Officials

AFN#<aa> -Division MARS Director
AFD#<aa> -Deputy Division MARS Director
AFE#DM -Division Digital Networks Manager
AFE#EC -Division Emergency Coordinator
AFE#RM -Division Records Manager
AFE#XC -Division Exercise Coordinator
AFF#VF -Division VHF Coordinator

2.5.2.2. Region Officials (Regions 1,2,3,5,7,8,10 only)

Regions 4, 6 and 9 are single-region Divisions so do not have Region Officials.

AFN#RD -Region MARS Director
AFD#RD -Deputy Region MARS Director
AFF#EC -Region Emergency Coordinator

2.5.2.3. State Officials

AFF#<ss> -State MARS Director
AFD#<ss> -Deputy State MARS Director
AFE#<ss> -State Emergency Coordinator

2.5.2.4. National Mars Officials

Section 14.6.1 of the MOI of February 2013 lists the Billet call signs of National Officials. That table is reproduced here for quick reference. All MARS members should be aware that they may here official billet call signs being used on nets when those officials are acting in an official capacity otherwise they will be using their regular MARS call sign. Members need to be aware that two call signs used during a long net may possibly belong to the same person, although for regular traffic nets officials will typically use their regular assigned call sign and not the billet call sign if they are not acting in an official capacity during the net.

CALL SIGN	BILLET TITLE	ISSUING AUTHORITY
AFN#AA	National Administrative Assistant (NAA)	Chief, USAF MARS
AFN#DT	National Director, TRANSCON HF Operations (NDTO)	Chief, USAF MARS
AFD#VN	Deputy Director, TRANSCON Voice Net Operations (DDTVNO)	National Director, TRANSCON HF Operations
AFD#DM	Deputy Director, TRANSCON Digital Operations (DDTDO)	National Director, TRANSCON HF Operations
AFD#LE	Deputy Director, Automatic Link Establishment (ALE) Operations (DDALEO)	National Director, TRANSCON HF Operations
AFN#EC	National Emergency Coordinator (NEC)	Chief, USAF MARS
AFD#EC	Deputy National Emergency Coordinator (DNEC)	National Emergency Coordinator
AFN#ML	National Military Liaison (NML)	Chief, USAF MARS
AFN#OO	National Operations Officer (NOO)	Chief, USAF MARS
AFN#PI	National Public Information Officer (NPIO)	Chief, USAF MARS
AFN#PL	National Planning Coordinator (NPC)	Chief, USAF MARS
AFN#PP	National Phone Patch Net Manager (NPPNM)	Chief, USAF MARS
AFD#PP	Deputy National Phone Patch Net Manager (DNPPNM)	National Phone Patch Net Manager
AFN#RM	National Records Manager (NRM)	Chief, USAF MARS
AFN#TM	National Training Manager (NTM)	Chief, USAF MARS
AFD#TM	Deputy National Training Manager (DNTM)	National Training Manager
AFN#SN	National Mission Support Network Manager (NMSNM)	Chief, USAF MARS
AFD#SN	Deputy National Mission Support Network Manager (DNMSNM)	National Mission Support Network Manager
AFN#TS	National Technical Services Manager (NTSM)	Chief, USAF MARS

Table 2 - National Billet Call Signs

2.5.3. Network Call Signs

Networks are assigned distinctive call signs or net designators which identify the geographic coverage, type of net and the mode of communication.
NOTE : All USAF MARS high frequency voice nets operate on upper sideband.

2.5.3.1. Transcon & National Nets

Net Call Sign	Description	Mode
TRANSCON	TRANSCON National Voice Net	USB
TDN	TRANSCON Keyboard-to-Keyboard Digital	Sound Card Digital Modes – Usually MFSK16
TRANSCON Multi-Mode Net	TRANSCON Multi-Mode Net	Net opens in USB and may switch to MT63 or other digital modes
TCN	TRANSCON CW Telegraphy Net	CW – net open to all
ALE	TRANSCON Automatic Link Establishment (ALE) Net	Restricted Net only open to members with ALE identifier. Primary mode: Data/digital conforming to MIL-STD-188-141, secondary mode: SSB.
PPN	Phone Patch Net	Restricted Net only open to specially approved members.
MSN	Mission Support Net	Restricted Net only open to specially approved members.

Table 3 - National Nets

Note that the Mission Support Net (MSN) is a restricted net that replaces the previous TRANSCON Space Support Net. As a restricted net, the MSN only allows registered members to sign in to the net. Registered members must have Mission Support Net listed as either a Primary Net or a Secondary Net on their AF 3661 form in order to participate. During regular net operations, there is strictly no-check-ins permitted of non-members to the net. If you are not a registered member, do not attempt to check in. The exception to this is during the weekly Admin net for MSN which takes place on Saturdays at 0801 PST (0001Z during winter hours), any MARS member may check in during the Admin portion of the Mission Support Net.

2.5.3.2. Division Traffic Nets

Network Call Signs for Division Traffic nets are of the format <AA><m><#> where <AA> denotes the Division ("NE", "SE", "NC", "SC", "NW", or "SW"); <m> denotes the mode ("S" for SSB, "M"

for Mixed, "D" for Digital, or "F" for FM) and # denotes the net number.
EXAMPLES:
NEM1 = Northeast Division Multi-Mode Traffic Net #1
NCD1 = North Central Digital Keyboard-to-Keyboard Traffic Net #1
NWS1 = Northwest Division SSB Voice Traffic Net #1

2.5.3.3. Other Division Nets

Network Call Signs for other Division Traffic nets are of the format <AA><TT><m><#> where <AA> denotes the Division ("NE", "SE", "NC", "SC", "NW", or "SW"); <TT> denotes the net type ("AD" for Administrative Nets, "EC" for ECOM Net, "TD" for Training Net, "TS" for Technical Service Net, or "XC" for exercise Net); <m> denotes the mode ("S" designating single side band (SSB) voice, "M" designating mixed mode ,i.e., digital and voice, "D" designating digital and CW modes) and # denotes the net number. Note that S is for SSB voice and is the mode designator used regardless of the net being on USB or LSB. Most MARS nets are on USB and all USAF MARS nets are on USB.
EXAMPLES:
NEADS1 = Northeast Division Administrative SSB Voice Net #1
NETSS1 = Northeast Division Technical Services SSB Voice Net #1
NETGS1 = Northeast Division SSB Voice Training Net #1
NETGS2 = Northeast Division SSB Voice Training Net #2
NWTGD1 = Northwest Division Digital Training Net #1
SCXCM1 = South Central Multi-Mode Exercise Net #1
SCECM1 = South Central Multi-Mode ECOM Net #1

2.5.4. Region Nets

Network Call Signs for Region nets are of the format <R><TT><m><#> where <R> denotes the Region (1 through 0); <TT> denotes the net type ("AD" for Administrative Nets, "EC" for ECOM Net, "TG" for Training Net, "TS" for Technical Service Net, or "XC" for exercise Net); <m> denotes the mode ("S" for SSB, "M" for Mixed, "D" for Digital, or "F" for FM) and # denotes the net number. Note that S is for SSB and not USB as per the MOI. Note that F for FM is not called out in the MOI of January 2012 and should be fixed there.

EXAMPLES:
4ADS1 = Region Four SSB Voice Administrative Net #1
4TGS1 = Region Four SSB Voice Training Net #1
4TGM1 = Region Four Multi-Mode Training Net #1
6ADS1 = Region Six SSB Voice Administrative Net #1
6TSS1 = Region Six SSB Voice Technical Services Net #1
6TGM1 = Region Six Multi-Mode Training Net #1

2.5.5. State Nets

Network Call Signs for State nets are of the format <R><ss><m><#> where <R> denotes the Region (1 through 0); <ss> denotes the two-character US Postal Service State abbreviation; <m> denotes the mode ("S" for SSB, "M" for Mixed, "D" for Digital, of "F" for FM) and # denotes the net number.

EXAMPLES:

3VAS1 = Virginia State SSB Net #1

2NYS1 = New York State SSB Net #1

1VTF1 = Vermont State FM Voice Net #1

4ALS1 = Alabama State SSB Voice Net #1

5WIM1 = Wisconsin State Multi-Mode Net #1

6NMD1 = New Mexico State Digital Net #1

This is a partial list of the various Networks and activities, but should give you an idea of the system used for network call sign assignments.

2.6. Assessment

Answer these questions and submit your answers to your Training Officer or mentor and answer additional questions that may be given to you.

1. What is the purpose of MARS?
2. How many geographic regions are in MARS?
3. How many geographic divisions are in MARS?
4. To which regions do the following call signs belong: AFA6TT, AFA4XX, AFE9TM?
5. The division training manager billet call sign for a division changes from AFE0TM to AFE8TM. Which division is involved? Why would the billet call sign change? (There are several potential reasons, think of them all.)
6. What duty or role of the people with the call signs AFE1EC, AFF1EC, AFF2RM, AFD2RD have?

3. BASIC PROCEDURES

3.1. Introduction

As you begin your activity in MARS there are a few basic procedures that will become evident. All USAF MARS nets are directed nets. i.e., they are directed by a net control station and set procedures will prevail. Initial transmissions will contain your call sign at the beginning. After the initial call between two stations, call signs may be dropped (note that your call sign must still always be repeated every 5 minutes) unless confusion is likely to arise by so doing. Administrative, training, and technical nets are often conducted informally. Traffic nets however, are always conducted formally, because this reduces verbiage and makes the net more efficient in terms of traffic passage. The term 'informal' refers to the use of first names and a few more relaxed procedures that will become evident as you monitor the various nets.

3.2. Formality

Formality will always be maintained during the following procedures—

1. When checking into a net.
2. When initially establishing contact. (Both when calling a station and when answering a call.)
3. When receiving a message.
4. When sending a message.
5. When answering Roll Call.

3.3. Informality

Informality may be allowed on a traffic net when the NCS has given permission for an "informal". This will allow informal comments between members on the net. Generally informal procedure will be allowed only after all of the traffic that can be passed, has been passed. Typically, informal comments are only passed when the directed net has been declared FREE by the NCS. Such a declaration does not remove the NCS from the net, the NCS remains in charge of the net. FREE is equivalent to the net being in informal mode. The term FREE is being used here in the same context as used by Army MARS to ensure greater interoperability of the services. That is, all MARS nets are ALWAYS directed nets with one station assuming NCS duties if a previous NCS can no longer be heard by other stations. The sole purpose for a free declaration, in times of excellent communications, is to allow more expedient communications after all traffic has been passed. A net should not be declared free if communications difficulties are immense, rather the NCS should pass NCS duties to another station with better communications capabilities (either temporarily or for the duration of the net) or close the net. While a net is in FREE status (where stations do not have to ask permission of the NCS and may call another station directly), a station may exchange informal comments with another station with the following limitations:

1) All comments must, in some way, relate to MARS business or the mission of MARS;
2) Comments need to be brief, consistent with clarity.
3) Stations must pause (releasing the Push-To-Talk (PTT) switch) between turnovers in transmission to allow for another station to break in. It is a good idea to release the PTT during any pause in transmission so that the sender can become aware of a station that may need to be heard.
4) NCS may interrupt an exchange at any time and stop the exchange by calling a directed net. Note again that all nets in MARS are directed in the sense of having an NCS. When the NCS calls the net directed all stations wishing to communicate must seek approval from the NCS first.

3.4. Ending of Transmissions

IMPORTANT: Every transmission, whether formal or informal, ends with either of the two prowords— OVER or OUT **but never both**.

3.4.1. The Proword OVER

OVER means that you are expecting a reply and is the signal to the other station indicating that he may transmit without interference.

3.4.2. The Proword OUT

OUT means that this is the last transmission of an exchange and no reply is necessary. When one station says OUT, that is the end of an exchange and the other station should not add another OUT. If there is more to be transmitted, you must re-establish contact by the calling method explained in the next section of this guide.

3.4.3. The Prowords WAIT and WAIT OUT

If it is necessary to pause during a transmission for any reason, the prowords WAIT or WAIT OUT will be used.

The proword WAIT is used when the pause required will last for only a few seconds; WAIT OUT is used when the pause requires more time. The time period associated with the use of WAIT OUT should be as short as possible so network operations are not delayed.

Although the proword WAIT OUT ends with OUT the communication between these two stations is not yet complete, therefore no other station will transmit during this pause unless they have emergency traffic or traffic of a higher precedence than that being handled.

3.4.4. The Proword ROGER

The proword ROGER signifies only that you understand the information transmitted to you, without indicating approval or disapproval.

3.4.5. The Proword WILCO

The proword WILL COMPLY or its contraction WILCO may be used interchangeably. It is used in response to a request or tasking and means that you understand the tasking (thus no need to use in conjunction with the proword ROGER) and agree to accomplish the task.

3.4.6. The Proword BREAK

The proword BREAK has two purposes.

- Used in the transmission of messages to signify the breakpoints between the message heading and the text of the message, spoken once as BREAK or written as the prosign BT, and again following the end of the message text.
- During voice message relay between two stations, BREAK spoken once tells the sending station to stop transmitting and allow the receiving station to request repetitions.

Do not use the proword BREAK to conclude communication with one station and immediately establish it with another.

3.4.7. The Proword WORDS TWICE

The proword WORDS TWICE is used when communication is difficult. It means transmit each phrase twice. If sent by the NCS to all stations, it indicates to all stations to transmit each phrase twice.

3.5. MARS Communications Protocols

MARS Communications are generally “Point-to-Point”, or one station communicating with another, one at a time. Authorized exceptions to this rule are: Net Control Stations when making net calls, and stations sending bulletins. Round table discussions are not allowed on the MARS circuits. If you must communicate with more than one station, you must say “OUT” when you have completed with one and then establish contact with the next station. After you have had a chance to monitor a few nets, you will see that this is not as complicated as it sounds. For years the above procedures have proved to contribute to effective and efficient communications. Procedures are not intended to be restrictive. AF MARS continues to utilize formal procedures as mandated in the governing documents and most importantly because the formal procedures work well.

3.6. Assessment

Answer these questions and submit your answers to your Training Officer or mentor and answer additional questions that may be given to you.

1. When should formal procedures be used and when are first names permitted to be used on a net?
2. When should the Proword OVER be used?

3. Under what typical conditions would the Proword WORDS TWICE be used? Which words and phrases are repeated and which are not?
4. Using WORDS TWICE, how would you transmit:
   THIS IS AFA3CC THE DOLPHINS ARE IN THE BAY. REQUESTING !00 BLANKETS AND 20 BOTTLES OF WATER. 500 GALLONS OF GASOLINE ARE NEEDED. OVER.

4. CALLING AND ANSWERING PROCEDURES

4.1. Preliminary Calls

A "preliminary call," sometimes referred to as simply a "call," is made to initiate a contact. An "answer" is a reply to a call. There are three types of preliminary calls; a single call, a collective call (also known as a group or net call), and a multiple call. Examples of each of the types of calls are given in the following subsections.

4.1.1. Single Call

One station calls another station to initiate communications. Example: AFA1AA, THIS IS AFA1BB, OVER.

4.1.2. Collective Call (or Net Call or Group Call)

One station (such as a Net Control Station) calls a groups of stations collectively. A preliminary call to open a net is an example. Example: NEM1, THIS IS AFA1XX (NCS), OVER. Sometimes, "Limited Collective Calls" may be used, where the NCS may call for only part of the whole group. Example: NEM1, THIS IS AFA1AA, STATIONS WITH TRAFFIC, OVER. In that case, the NCS expects to hear only answers from stations with traffic.

4.1.3. Multiple Call

One station calls a number of specified stations. Example: AFA1AA, AFA1BB AND AFA1CC, THIS IS AFA1XX, OVER. In the case of Multiple Calls, the stations answering should answer in the order in which they were called.

4.2. Answering a Preliminary Call

When answering a preliminary call, a MARS operator will use either "Full Procedure" or "Abbreviated Procedure."

4.2.1. Full Procedure

Full procedure means the transmission begins with the call sign of the station to whom the answer is directed. Example: AFA1BB THIS IS AFA1AA, OVER.

4.2.2. Abbreviated Procedure

Abbreviated procedure means the transmission begins with the proword THIS IS followed by the call sign of the station transmitting. Example: THIS IS AFA1AA, OVER.
Usually, abbreviated procedure is used to answer a Single Call (including continuity checks) and Multiple Calls. A net control station may direct stations to "USE FULL PROCEDURE" if he/she feels it necessary or desirable. In such case, of course, stations will follow the directive of the NCS and use full procedure. If communications conditions are difficult, a station answering a single call may find it desirable to use full procedure to answer as a way of confirming his/her

understanding of who was calling. However, because of the extra airtime involved, this use of full procedure should be limited.

4.3. Checking Into Nets Requires Full Procedure

Full procedure (with phonetics) will be used when checking into nets unless directed otherwise by the Net Control Station. Example: (for the Collective call by the NCS) SIERRA CHARLIE SIERRA ONE, SIERRA CHARLIE SIERRA ONE, THIS IS, ALPHA FOXTROT ALPHA ONE ALPHA ALPHA, OVER.

On initial check-in to a net, do not say "NO TRAFFIC" when you have no traffic. It is to be assumed by NCS that you have no traffic to list if you do not list the traffic. See the following example of an answer to the above response.

The answer using full procedure) would be:
ALPHA FOXTROT ALPHA ONE ALPHA ALPHA,<pause> THIS IS ALPHA FOXTROT ALPHA ONE X-RAY X-RAY SLANT TANGO, OVER.

And the NCS response would be:
ALPHA FOXTROT ALPHA ONE X-RAY X-RAY SLANT TANGO, THIS IS ALPHA,FOXTROT ALPHA ONE ALPHA ALPHA, ROGER, OUT
(Note the use of phonetics for your own call sign when initially checking into a net. If you feel it is necessary to prevent confusion, or that conditions are poor you may elect to use full phonetics for the Net Control's call sign as well as for your call sign.)

A word is necessary here on when to use alphanumeric call signs and when not. Initially, when calling into a net, full phonetics for the station should be used. Alphanumeric call signs, e.g. for AFA1AA saying the letters like a child says their ABC's, "Ay, Eff, Ay, One, Ay, Ay" are authorized when the NCS has declared that Alphanumeric call signs may be used.

4.4. Mixing alphanumerics and phonetics in a callsign with exception for Navy-Marine Corps callsigns

Is it allowed to mix alphanumeric and phonetic call signs? Within the same call sign, definitely not, with the exception of Navy-Marine Corps MARS call signs. The following would not be correct, AFA2AB saying "Ay, Eff, Ay, Two, ALPHA, BRAVO". Either full phonetics for the full call sign or full alphanumeric for the full call sign should be used, never a mixture of both within the same call sign. Now, in the February MOI of section 14.13(C) it is mentioned that the correct method to pronounce Navy-Marine Corps MARS call signs which always begin with NNN is to pronounce it as the letters N N N and never as NOVEMBER NOVEMBER NOVEMBER . Now because the latter is quite a mouthful to say, taking 9 syllables, Navy-Marine Corps MARS have

always shortened this to N N N with the letter pronunciation of "N N N" as "En En En". This pronunciation applies whether or not procedures require full phonetics or alphanumerical call signs. Consider the following example call:

NNN0XYZ DE AFA9HR OVER

Compare the means of delivering this call in full phonetics and then in alphanumerics:

FULL PHONETICS:
Pronounced as:
"N N N ZERO X_RAY YANKEE ZULU THIS IS ALPHA FOXTROT ALPHA NINER HOTEL ROMEO OVER"

ALPHANUMERICS:
Pronounced as:
"N N N ZERO X Y Z THIS IS A F A NINE H R OVER"

Where the N N N,X Y Z, A F A and H R are pronounced as the individual letters as per kindergarten ABC's.

Service	Callsign	Full Phonetics Pronunciation	Alphanumerics Pronunciation
USAF	AFA2RC	ALPHA FOXTROT ALPHA TWO ROMEO CHARLIE	Ay Eff Ay TWO aRe Cee
ARMY	AAR4BB	ALPHA ALPHA ROMEO FOWER BRAVO BRAVO	Ay Ay aRe FOUR Bee Bee
NAVY-MC	NNN0JKL	eN eN eN ZERO JULIET KILO LIMA	eN eN eN ZERO Jay Kay eL

Table 4 - Phonetic and Alphanumeric Call Signs by Service

So, Navy-Marine Corps MARS call signs are the exception where both alphanumeric and phonetic letter transcriptions apply to pronouncing the call sign when full phonetics are required. Army and Air Force call signs do not have this exception. Thus, e.g., AAR9XQ is always either full phonetic or alphanumeric, similarly AFA9AY is always full phonetic or alphanumeric. Stating e.g., "A F A NINER ALPHA YANKEE" is a negative and is not permitted on any MARS circuits. The Navy-Marine Corps MARS call sign exception is made because it aids in efficiency; 9 syllables reduced to 3 with a very recognizable intonation, even in heavy interference on the air. This has been approved for years solely because NNN is a unique prefix and there are no other variations such as NGE or NND in use. So, in the interests of efficiency, please do always use "N N N" when referring/communicating to any Navy-Marine Corps MARS station on the MARS nets.

What about the situation of calling the NCS using an alphanumeric call sign and using a full phonetic call for the other station, is this acceptable? In terms of efficiency, if the NCS has permitted the use of alphanumeric call signs and the calling station knows that he has a weak signal into the NCS, then he may call the NCS with the alphanumeric call sign and then use full phonetics for his own call sign. This will often increase the efficiency of communications on a net as the NCS in a directed net will know he is being called and the time efficiency of stations not stating his call sign in full phonetics each time is large with many communications taking place. Again, all MARS stations should realize that the importance is efficiency of communications while maintaining certain protocols. Note that weak signal conditions during years of sunspot minima and at other times demand a different procedure to good signal conditions as experienced during peaks of sunspot cycles. MARS is a dynamic network and so must change dynamically as conditions change during a net as well as during different periods of the 12 year sunspot cycle.

Do not confuse the phrase “Alphanumeric call signs” with the phrase “Abbreviated call signs”, such as AA for AA1AA. Abbreviated call signs are never allowed in MARS networks.

4.5. After Communications are Established, use Abbreviated Procedure

Once communications have been established between two stations, both should use abbreviated procedure until the communications is concluded. Example: (preliminary, single call using full procedure): `AFA1AA, THIS IS AFA1BB, OVER`
(answer using abbreviated procedure): `THIS IS AFA1AA, OVER`
(communications): `THIS IS AFA1BB, REQUEST YOU DO …..`
(communications): `THIS IS AFA1AA, WILCO, OUT.`

4.6. Abbreviated Procedure is Not the same as Abbreviated Call Signs

Caution: Do not confuse “abbreviated procedure” with “abbreviated call signs.” Abbreviated call signs, such as AA for AFA1AA, are **not** authorized in USAF MARS.

4.7. Signal Strengths

The signal strength system used in MARS is different to that used in typical ham radio communications. The details are outlined in §10.14.1 but the background shall be explained here. In typical radio usage, a Circuit Merit system was devised by HF radiotelephone professionals to better quantify the average quality of a voice signal. In telecomm engineering specifications the letters "CM" (voiced as "Charlie Mike") are followed by a figure from 0 to 5 - to indicate the quality of the voice.

However, in EmCom ICS (incident Command System) environments the stress is made on the use of plain language. So in the amateur EmCom community, in addition providing signal reports the use is made of the plain language equivalents of Circuit Merit, as used in aeronautical,

military and maritime HF practice. This is discussed here purely so that you understand the differences between CM and the system that is used in MARS and can operate on both MARS are other circuits and translate appropriately.

CM	PLAIN LANGUAGE	DESCRIPTION
CM5	"LOUD AND CLEAR"	No noise, "full quieting* " on FM. Rare on SSB unless conditions are superb. (*) - Used for FM communications only, unless your SSB radio uses a syllabic-derived squelch such as SINAD
CM4	"GOOD READABLE"	Slight noise typical of SSB under very good conditions.
CM3	"FAIR READABLE"	Marginal voice communications. Occasional fills needed, noisy.
CM2	"WEAK READABLE"	Unreliable, difficult copy, frequent fills needed.
CM1	"UNREADABLE"	Unintelligible. Signal barely evident.
CM0	"NOTHING HEARD"	No audio signal detectable.

Table 5- Circuit Merit system and natural language equivalent

The Circuit Merit system and the plain language equivalent is not used in MARS to describe voice communications clarity. The “FAIR READABLE” term in particular has no similar sounding MARS signal strength term and the phrase should never be used in responding to a radio check request from another MARS station.

On the military SSB frequencies that USAF MARS uses, the appropriate method is to respond with the signal strength and the readability of the signal. Strength and readability, although often dependent on each other, are treated as independent entities in a radio report given to another station, e.g., to the NCS during a Roll Call Radio Check.

The tables given below are a plain language version of the official tables in the ACP125(F) which are shown in §10.14.1. The additional descriptions when viewed here may help understand what is meant by the descriptions in the official documentation. It is only these particular signal strengths and these particular readability descriptions that can be used in MARS communications. Any other terms are not permitted on MARS circuits. Of course, if you are providing communications operator support at some other federal facility on a non-MARS network, you must use terms that are appropriate for that network. For MARS networks, only use the following terms.

Report of Signal Strength	Unofficial Meaning
LOUD	Your signal is very strong
GOOD	Your signal strength is good
WEAK	Your signal strength is weak
VERY WEAK	Your signal strength is very weak
FADING	Your signal strength fades to such an extent that continuous reception cannot be relied upon

Table 6 - Signal Strength description

Report of Readability	Unofficial Meaning
CLEAR	Your signal has excellent quality
READABLE	Your signal quality is satisfactory
UNREADABLE	Your signal quality is so bad that I cannot understand you
DISTORTED	Your signal is distorted or is suffering bad distortion
WITH INTERFERENCE	Your signal has interference (could be man-made or natural)
INTERMITTENT	Your signal is intermittent

Table 7 - Readability description

It will be noted that “FAIR” is not a signal strength classification and will not be used as such on MARS circuits.

When a station calls for a radio check, the assumption is that simply responding with a “ROGER” as in e.g.,

```
AFA7BB THIS IS NCS, RADIO CHECK, OVER
THIS IS AFA7BB, ROGER, OVER
THIS IS NCS, WEAK WITH INTERFERENCE, OUT.
```

This means that AFA7BB is responding with “LOUD CLEAR”. He does not need to say “LOUD CLEAR”, the response of ROGER automatically indicates that the transmission was heard LOUD CLEAR. Only when the response is different, e.g. LOUD DISTORTED or WEAK READABLE or some other combination other than LOUD CLEAR do the actual words need to be said. Note that there is nothing inherently wrong with stating LOUD CLEAR, but it is more efficient to simply ROGER the request if you believe the signal strength and readability to be LOUD CLEAR. Efficiency is the hallmark of MARS communication, so becoming efficient while following correct procedure is the best approach. Note that as a courtesy, the NCS station in the above also gave his report of the signal strength and readability of the station who called him, as a two-way report is far more beneficial and informative to all stations on the net than a one-way report.

4.8. Assessment

Answer these questions and submit your answers to your Training Officer or mentor and answer additional questions that may be given to you.

1. What is the difference between a single call and a collective call?
2. In what order should stations answer a multiple call?
3. Is “FAIR READABLE” an appropriate signal strength and readability report for use on MARS nets? Give full reasoning.

5. NET OPERATIONS

5.1. Authorized Nets

Authorized nets can be broken down into three types: those authorized during training, those authorized after completion of training and restricted nets that are only authorized after a special appointment. All nets may be monitored by any MARS member. Participation in a net, where you transmit, depends on the type of net. There is also a distinction between admin nets (for administrative purposes) and traffic nets (used to conduct the passage of traffic). As a trainee, you will not be eligible to participate in any admin nets but are encouraged to monitor them to learn more about the structure and organization of MARS. Billet call signs are often used in place of regular call signs by officials acting in official capacity during admin nets.

5.1.1. Nets Authorized While in Training

Current directives allow stations in training to participate only in State, Region and Division nets. Once training has been completed, there are numerous networks available.

5.1.2. Nets Authorized Upon Completion of Training

In addition to the various State, Division and Region nets, MARS stations that have completed training are authorized to participate in the various transcontinental nets. These include TRANSCON Voice, TRANSCON CW, TRR and TVRS Digital Nets.

5.1.3. Nets Not Authorized Unless Specially Appointed

There are a few restricted nets such as Phone Patch Net or Mission Support Net. Membership on phone patch nets or the Mission Support Net is by special appointment through your SMD and the special net managers. These two special restricted nets will be discussed briefly in the next couple of sections.

5.2. Phone Patch Net (PPN)

5.2.1. Phone Patch Net Purpose

As mentioned in section 9.0 of the MOI of February 2013, the Phone Patch Network provides pilots and aircrews in flight, as well as ground units, the opportunity to make official business and morale phone patches via an authorized AF MARS phone patch station.

5.2.2. Phone Patch Net is a Closed Net

The AF MARS Phone Patch Network is a closed net requiring specific assignment by AF Form 3661 action. What this means is that MARS Members are not authorized to use Phone Patch frequencies or conduct Phone Patch Operations unless they have been specially appointed to the net.

Member assignment to this network shall be made by the National Phone Patch Net Manager, in response to a member's phone patch net application, forwarded from the member's SMD. The member's SMD shall coordinate the member's acceptance to the net with NPPNM.

During regular net operations, there is strictly no-check-ins permitted of non-members to the net. If you are not a registered member, do not attempt to check in.

5.2.3. Special Requirements

If you are interested in becoming a Phone Patch Net operator, you should note that there are Special Equipment Requirements in order to be granted Phone Patch Network assignment on your AF Form 3661. These requirements include:

a) Capability to operate on assigned network frequencies.
b) RF output power and antennas capable of phone patch operations. Normally a one kilowatt (1 kW) amplifier and a full-size rotatable directional antenna are desired. The reason for this requirement is that good signal strength is required and reduced size antennas do not have sufficient gain. The ability to rotate the beam is essential because the aircraft are moving and the beam heading will need to be continually adjusted in most communications to maintain contact. Technically beam rotation could be via an antenna rotator or by an electrically steerable beam via a complex phased array. The simplest of these is a full size Yagi with a rotator, and is the recommended route for most MARS members.
c) Phone Patch equipment to allow the audio from the telephone circuit to be switched to the transmitter and the audio from the receiver to be switched to the telephone circuit. Such Phone Patch equipment should isolate the telephone circuit from the transceiver electronics and should allow coupling without background room noises being added to the transmitted signal or to the signal going to the telephone circuit.
d) The willingness to dedicate time in excess of the minimum MARS activity requirements.

5.2.4. Phone Patch Discussions

Discussion of classified information during a MARS phone patch is not authorized. MARS operators are not expected to determine the classified nature of phone patch conversations and shall not terminate patches when suspected violations occur. The operator should bring the information to the attention of the NCS. To preclude occurrences of this nature, the initiating and receiving parties shall be briefed on the insecurity of AF MARS phone patch circuits, by the phone patch operator, prior to the patch being initiated.

5.2.5. Further Details

Further details on the Phone Patch Network are available in section 9.0 of the MOI of February 2013.

5.3. Mission Support Net (MSN)

5.3.1. Mission Support Net Purpose

As mentioned in section 10.0 of the MOI of February 2013, the main mission of MARS is to provide contingency radio communications support to the DoD Components and to support civil authorities in fulfillment of DoD responsibilities under DoDI 4650.02 and DoDD 5111.13.

For purposes of this section the term "MSN User(s)" is defined as any U.S. Military, Active duty, Reserve, National Guard Units, SHARES, or other authorized civilian Government agency station(s).

5.3.2. Mission Support Net is a Closed Net

In order to more closely align AF MARS capabilities with the expanded MARS mission reflected in DoD Instruction (DoDI) 4650.02, the "Mission Support Network" (MSN) was established on 10 December 2010 and operates as a closed special purpose communications net.

a) MSN Operations are 24x7 on designated calling and working frequencies and is a closed net.
b) The MSN Administrative Net on a specific frequency and at a specified time, is the only MSN net open to any AF MARS Auxiliary station except "/T" to check in for the duration of that net.

As with the AF MARS Phone Patch Net and the TRANSCON Space Support Net that preceded the Mission Support Network, the MSN is a closed net requiring specific assignment by AF Form 3661 action.

If you are interested in receiving assignment to the Mission Support Net, the MSN Administrative Net can give you a feel for what happens during an MSN Net. If you wish to join the MSN team, you will need to apply to your SMD and your SMD will need to recommend you to the National Mission Support Network Manager for that assignment. It should be noted that the assignment can become either as a primary assignment on the AF Form 3661 or as a secondary assignment on the AF Form 3661, it is the individual applicant members choice. Note that if you choose to have this net as your primary net, then the minimum number of hours for MARS participation as 9 hours on your primary net will have to be met with participation on MSN nets.

During regular net operations, there is strictly no-check-ins permitted of non-members to the net. If you are not a registered member, do not attempt to check in.

5.3.3. Further Details

For more details on requirements for the Mission Support Net, please refer to section 10.0 of the MOI of February 2013.

5.4. Directed Nets

All USAF MARS nets are directed by a Net Control Station (NCS). You will be able to identify the purpose for a net, the call sign of the NCS and the mode of transmission by the Collective Call being used. e.g.,

NCS1 THIS IS AFA3AA OVER (North Central Division Traffic Net),
3TGS1 THIS IS AFF3TO OVER (Region 3 Training net),
3ADS1 THIS IS AFN3RD OVER (Region 3 Administrative net),
3ILS1 THIS IS AFF3IL OVER (Illinois Admin. net),
3KSF1 THIS IS AFA3IU OVER (Kansas VHF Net on FM Voice).

5.4.1. How to Check In

It is essential that every station, before transmitting, listen carefully to avoid doubling. Key down, state the NCS call sign, let up momentarily to again be sure of no doubling, and then complete the transmission if the frequency is clear.

5.4.1.1. Answers to a Collective Call

When you check in to a net, you are answering a collective call made by the NCS. Here are some examples of answers to that call.

AFA1BB<pause> THIS IS AFA3AA/T NO TRAFFIC OVER,
AFA2CC<pause> THIS IS AFA2PO ONE ROUTINE AFA4AA OVER,
AFA4DD<pause> THIS IS AFA4CC ONE PRIORITY AFA5CC, ONE ROUTINE SEATTLE OVER.

5.4.1.2. Initial Check In and Phonetics

On your initial call to check in to a net always use full phonetics for the NCS call sign and your call sign, unless the NCS has declared that alphanumeric call signs may be used for the net. On subsequent calls, after the NCS has you on his/her roster, phonetics are not necessary unless the NCS has declared that full phonetics must be used or as used the proword WORDS TWICE, which indicates that conditions are so bad that full phonetics for the call sign is expected. The use of phonetics is sometimes still advisable to prevent misunderstanding when propagation is poor or the frequency is noisy. As a new member in training checking in to a training or admin net you would say— (NCS call sign) <pause> THIS IS (Your call sign) (traffic status) OVER

e.g., AFA5EE<pause> THIS IS AFA5AA/T NO TRAFFIC OVER

If you have comments or queries, you would state that in your check in — (NCS call sign) <pause> THIS IS (Your call sign) (Comment or Query status) OVER

e.g., AFA6FF<pause> THIS IS AFA6AA/T WITH QUERIES OVER

After completing your call to check in, listen carefully to be certain that the NCS has recorded your call sign correctly. Your credit for participation is dependent on this and the NCS will report your time to a Net Manager who will in turn report to the Region or Division Records Manager.

5.4.2. Net Activity

After you have checked into a net, you are expected to remain available to the net for any traffic that might be destined for your immediate area. You will be listed on the NCS log and should remain available until the NCS closes the net. If you need to leave the frequency early, call the NCS and request to CLOSE. Once you are checked on to a net you can gain the attention of the NCS with the abbreviated call. "THIS IS (Your call sign) OVER". The NCS will answer with a full preliminary call using your call and his. When contact is established, make your request, e.g.,

AFA6AA THIS IS AFA6BB/T, REQUEST TO CLOSE, OVER.

5.4.3. Net Continuity Check (Roll Call/Radio Check)

On most nets, of one hour or more in duration, the NCS may hold a Net Continuity Check. The purpose of the Net Continuity Check is to ascertain propagation conditions between the NCS and those stations checked into the net. The net continuity check consists of a roll call of the stations checked in. Your response will be a Radio Check. (MARS term for signal report). The NCS will announce that a Roll Call will follow and then proceed calling each station by their call sign only. Stations will answer with an abbreviated procedure (this used to be known as an "abbreviated call" but was frequently confused with "abbreviated call sign" so the terminology has been changed) and a Radio Check: e.g.,

THIS IS AFA3AA, LOUD, CLEAR, OVER.

Other Radio Check reports might be— GOOD READABLE, WEAK READABLE, WEAK BARELY READABLE, WEAK UNREADABLE

Note: Do not include phrases such as "I have you", "You are", "Your signal is", etc. Do not say "Loud and Clear", just say "Loud Clear". Brevity saves time as the word "and" is superfluous in the above usage.

Roll Calls are held at the discretion of the NCS but usually not more than once an hour. On traffic nets of two hour duration roll is called approximately 5 minutes into the second hour. If the NCS for a one hour net chooses to make a Roll Call, this Roll Call will usually be at the half-hour, but may commence at 10 minutes prior to closure of the net. The NCS can choose the time to conduct a roll-call.

When the NCS has completed Roll Call, the NCS may, at his/her option, attempt to contact any stations who did not respond during the Roll Call.

Stations who do not respond to the Roll Call will be shown as closed on the NCS log and unresponsive stations will no longer be considered to be checked into the net.

5.4.4. Directed Net under Free or Directed Status

All MARS nets are Directed Nets in the sense that they always have an NCS station, who is in charge of maintaining net discipline and control. There must always be an NCS for the net. The NCS can change during the course of a net, but there must be an NCS. Any suitably trained MARS member can become an NCS and it is this dynamic capability to respond to changing conditions in terms of losing a control station that makes MARS nets strong. In general terms a free net is one without any control. MARS nets are never Free Nets in this sense.

An NCS may declare a net to be under "Free" or "Directed" status. When the Directed Net is under "Free" status, you may transmit without the permission of the NCS, as long as you are already checked in to the net. During a directed net the NCS may declare the net "Free" using the proword `THIS NET IS FREE`. At this time you may call any station on the net without first obtaining the permission of the NCS, but the NCS is still monitoring and directing the Net and may assume control at any time. All MARS procedures will still be used when the net is in Free Status. The only thing that has changed is the need to contact the NCS first. The net will remain FREE until the NCS declares the net to be in Directed status by using the proword `THIS IS A DIRECTED NET` at the end of a call to some other station, or if the NCS makes another Collective Call (Net Call). This Collective Call automatically puts the net back to a directed status and will remain so until the NCS declares that it is in FREE status. He does not need to state the proword `THIS IS A DIRECTED NET`. If you are unsure as to whether the net is in free or directed status, the safe and correct procedure is to assume that the net is directed, and ask permission of the NCS to contact the station.

5.4.5. Free Time and Recorded Traffic

At certain times when a frequency is not in use and there is no net in progress, members may use the frequency to contact other MARS members if there is a valid reason to communicate. This is sometimes referred to as "FREE TIME". If you plan to use one of the MARS frequencies, make certain that there is no net in progress and that you use the frequency for MARS related business only. Traffic that must be recorded should however only be passed on appropriate traffic nets such as Region, State, Division and Transcon Nets specifically designed for the purpose of passing traffic. It should not be passed during free time. If a message that needs to be recorded must be passed on an administrative, tactical or reporting net, the proword `MESSAGE` shall be transmitted immediately after the call to indicate that a message which requires recording is about to follow. "Recorded" here means that the message is written down

by the sender and receiver and kept on file (either electronically or handwritten), the NCS keeping a note of the precedence, message identifier (DTG of the message) transmitting station's message number and call sign and receiving stations number and call sign. The NCS does not need to record the message himself unless he is the targeted recipient of the message. If a message is relayed through many stations, each station will record the message. Again, the need to record is indicated by the proword MESSAGE in a communication, if the traffic needs to be passed on a tactical or reporting net. It is assumed that all messages passed on traffic nets specifically designed for the purposes of handling messages will always be recorded.

While you may hear some friendly chatter from time to time, the MARS nets should not be used for casual "Rag Chewing". MARS frequencies are Military Frequencies and are not Amateur Bands. If you are in doubt as to whether or not a net is in progress, use the regular check in procedure and a NCS should answer you if there is a net.

5.5. Assessment

Answer these questions and submit your answers to your Training Officer or mentor and answer additional questions that may be given to you.

1. What is the difference between an admin net and a traffic net?
2. Which nets are authorized during training?
3. Which nets are special purpose nets that are only authorized on special assignment?
4. What is the purpose of the Phone Patch net?
5. What is a directed net, a free net and a directed net in free status? Try to differentiate between MARS usage and general meaning.

6. MESSAGE FORMAT

6.1. Plaindress Message Format

The "Plaindress" message format used in MARS is simply a plain language form which is not encrypted or coded. This format contains three sections: a HEADING, a TEXT and an ENDING. Each of the sections is separated from the others with the proword BREAK. Many messages will have nothing in the "Ending" section.

The HEADING gives the precedence and time of the message as well as the sender and addressee of the message as well as the count of words in the message.

The TEXT is the body of the message containing the information from the original sender to the addressee.

The ENDING, although not always used, is provided for any additional information dealing with relay instructions or delivery information needed to help move the message through the system.

6.1.1. Heading

The HEADING is divided into 4 components.

1. The Beginning Procedure
2. The Preamble
3. The Address (Both From and To)
4. The Prefix (Group Count)

6.1.1.1. The Beginning Procedure

Sometimes called "the Procedure" consists of a Preliminary Call and the message serial number. Serial numbers begin with 1 and the count restarts each month. Typically, three digits are used as a minimum with preceding zeros when starting with 1, e.g. , 001, 002, …, 999, 1000, 1001. However, there is no fixed standard for numbering across all MARS networks. When a very long message needs to be split into component parts, then the message number is augmented with a letter. For example, a message which is too long to send in one transmission by be split into component parts, each with the same precedence and date-time-group and the message number would be 112A, 112B, 112C so that when message number 112 gets to the destination, the component parts can be assembled in the right order. Splitting of messages is rare on voice networks but was historically often required on RATT and may sometimes be seen on digital networks. Although preference should be to reduce the message down to the minimal size possible, agreeable to the sender, prior to introducing it into the MARS network.

e.g., AFA3AA THIS IS AFA3BB MESSAGE NUMBER SEVEN. This is the call sign of the receiving station, the call sign of the sending station, the proword MESSAGE indicating that the message (being transmitted on a tactical or reporting net) is to be recorded and the message number assigned by the sending station. As this message is relayed through the MARS system, the Procedure is the one-and-only part that changes on each relay. Note that the MESSAGE proword is only needed on tactical or reporting nets not primarily design for handling traffic. Messages should normally be passed on specific traffic nets, and on those nets it is assumed that the message needs recording and there is no need to use the MESSAGE proword.

6.1.1.2. The Preamble

The Preamble consists of the Precedence Proword (MARSGRAM, ROUTINE, PRIORITY or IMMEDIATE) followed by the proword TIME and the Date/Time Group (DTG). Note that the use of precedence level of IMMEDIATE is highly restricted. The precedence level of FLASH is not authorized for MARS use. The DTG is composed of the six digit origination time (2 digit day, 2 digit hour and 2 digit minutes); the zone indicator (always Z – spoken as ZULU); the month; and the 4 digit year.

e.g., R 012215Z JUNE 2012

Spoken as: ROUTINE TIME ZERO ONE TWO TWO ONE FIVE ZULU JUNE TWO ZERO ONE TWO

The first two numbers indicate the day of the month, the next two the hour and the last two the minutes. The letter Z for "ZULU" at the end of the numbers indicates (Universal Time Coordinated). All official time keeping is done in UTC on the basis of the 24 hour clock. The Date/Time group is used as the reference identifier for all messages and is assigned by the Originating MARS Station at the time the message is introduced into the system.

This is the complete address of both the Originator and the Addressee.

The Address starts with the proword "FROM" followed by the originator's name and address. Some confuse the terms "originator" and "originating station". The "Originator" is the person or entity for which the message is being sent. The "originating station" is the MARS station entering the message into the MARS system. The originator and the originating station are the same when a MARS operator is sending a message on his/her own behalf; but, they are different when a MARS operator sends a message from a third party. If the Originator and the Originating Station are different, then the call sign and location of the Originating station appears after a "Slant Bar" (/). In voice procedure this is sent as SLANT at the end of the FROM section of the ADDRESS.

The complete address of the addressee is preceded by the proword "TO". This address must be complete enough to make delivery a simple matter for the final MARS station in the relay chain. Telephone numbers should be included in all addresses.

6.1.1.3. The PREFIX (Now Optional in USAF MARS)

The Prefix is simply the "Group Count" which is a number that reflects the number of words or groups in the text of a message. The group count is preceded by the proword GROUPS. Message texts are usually kept to 25 words or less, written 5 words per line on transmission and reception forms to facilitate counting. Messages may also be sent without a group count. In that case, the proword 'GROUP NO COUNT" will be used instead of the proword GROUPS. This process should be used with judgment. When the group count is eliminated, a valuable check for accuracy has been lost.

6.1.2. The Text

The Text is the "body" of the message. It is the information being sent from the originator to the addressee. The proword BREAK indicates separation of the text from the heading and ending. BREAK appears at the beginning of the text and at the end of the text. This is the only way the proword "BREAK" is used. If you hear it used in place of "OUT", consider it an error in that operator's procedure. Each plain language word, each initial or group of initials, each numeral or group of numerals is counted as one group in the GROUP COUNT. Hyphenated words are counted as one group and are always spelled out for clarification. (More details on this are in the next section of the guide).

6.1.3. The Ending

In our present format there is generally no ending. However, this section is provided to allow any "Operators Note" such as comments by any relaying operator who may have any observation concerning the message. If an operator's note is added along the relay chain, then it should be sent along with the message on each subsequent relay.

6.2. Abbreviated Plaindress Message Format

Operational requirements for speed of handling may require abbreviation of plaindress headings. In such case, any or all of the following may be omitted: (1) Precedence, (2) Date, (3) Date-time group, (4) Group count. The Abbreviated format is a very valuable tool to be used during emergencies when stations are in direct communication with each other and the expedient passage of traffic is a requirement.

A message in abbreviated form will contain, at the very least, an address and a text. If the originator and the addressee are MARS stations and they are in direct communication with each other, then this highly abbreviated form may be used. If there is any intermediate relay station involved, the DATE/TIME group must be used in case that message needs to be identified at a

later time (The date/time group and the call sign of the originating station are always used to identify a message.)

The message number, precedence and group count may be eliminated if the message is between MARS stations and this elimination causes no confusion. Third party health and welfare messages will not be abbreviated.

6.2.1. Important Reminder

Once a MARS message has been introduced into the system, the operator at the originating station is responsible for the content of the message and nothing following the Beginning Procedure may be changed in the message by any relaying station or operator. If a mistake is apparent, this may be pointed out in an Operators Note in the ending section. If an operator's note is added to the original message, it should remain with the message until delivery to the addressee.

6.3. Sample Message

6.3.1. Voice Format (for message sent on a traffic net)

Beginning Procedure { THIS IS AFA3BB NUMBER ZERO ZERO ONE}
Preamble { ROUTINE TIME ZERO FOUR ONE NINER THREE ZERO ZULU JUNE WUN NINER NINER FIVE}
Address {FROM SGT. WILLIAM SMITH 4TH INFANTRY BTN. FT. SILL, OK 73503 /AFA4XX OK
TO MR. & MRS. JOSEPH SMITH 11512 S. STATE DRIVE, CHICAGO, IL 60691 TEL. 302-921-0078}
Prefix { GROUPS ONE SIX }
BREAK
Text { ENJOYING NEW ASSIGNMENT. WILL WRITE LONG LETTER EXPLAINING NEW DUTIES. HOPE TO SEE YOU SOON. BILL.}
BREAK
Ending { OP.NOTE: DO NOT ATTEMPT DELIVERY BEFORE 5 PM CHICAGO TIME.}
OVER

6.3.2. Voice Format (for a message sent on a tactical or reporting net)

Note the only difference here is the presence of the MESSAGE proword.

Beginning Procedure { THIS IS AFA3BB MESSAGE NUMBER ZERO ZERO ONE}
Preamble { ROUTINE TIME ZERO FOUR ONE NINER THREE ZERO ZULU JUNE WUN NINER NINER FIVE}
Address {FROM SGT. WILLIAM SMITH 4TH INFANTRY BTN. FT. SILL, OK 73503 /AFA4XX OK

TO MR. & MRS. JOSEPH SMITH 11512 S. STATE DRIVE, CHICAGO, IL 60691 TEL. 302-921-0078}
Prefix { GROUPS ONE SIX }
BREAK
Text { ENJOYING NEW ASSIGNMENT. WILL WRITE LONG LETTER EXPLAINING NEW DUTIES. HOPE TO SEE YOU SOON. BILL.}
BREAK
Ending { OP.NOTE: DO NOT ATTEMPT DELIVERY BEFORE 5 PM CHICAGO TIME.}
OVER

6.3.3. Digital Format

Here is the same message as sent by digital means (AMTOR, PACTOR Packet, MFSK, MT63 or Sound Card, etc., this time on a regular traffic net.

Beginning Procedure { DE AFA3BB NR 001}
Preamble { R 041930Z JUNE 2013}
Address {FM SGT. WILLIAM SMITH 4TH INF BTN FT. SILL OK 73503 /AFA6XX OK
TO MR AND MRS JOSEPH SMITH 1512 S. STATE DRIVE, CHICAGO IL 60691, TEL. 302-921-0078}
Prefix { GR 16}
BT
Text { ENJOYING NEW ASSIGNMENT. WILL WRITE LONG LETTER EXPLAINING NEW DUTIES. HOPE TO SEE YOU SOON. BILL.}
BT
Ending {OP. NOTE: DO NOT ATTEMPT DELIVERY BEFORE 5 PM CHICAGO TIME.}
K
NNNN

6.3.4. Digital Format – without explanation of sections

This is how the digital format looks without the section explanations when sent on a traffic net:

```
DE AFA3BB NR 001
R 041930Z JUNE 2013
FM SGT.  WILLIAM SMITH  4TH INF BTN  FT.  SILL OK 73503 /AFA6XX
OK
TO MR AND MRS JOSEPH SMITH  1512 S.  STATE DRIVE,  CHICAGO IL
60691, TEL. 302-921-0078
GR 16
BT
ENJOYING NEW ASSIGNMENT. WILL WRITE LONG LETTER EXPLAINING NEW
DUTIES.
HOPE TO SEE YOU SOON. BILL.
BT
OP. NOTE: DO NOT ATTEMPT DELIVERY BEFORE 5 PM CHICAGO TIME.
K
NNNN
```

6.3.5. Digital Format – without explanation of sections

This is how the digital format looks without the section explanations when sent on an administrative, tactical or reporting net, not intended to normally be used for traffic. You will note the prosign `ZBO` immediately follows the call. In digital, the prosign `ZBO` is equivalent to the proword `MESSAGE` used in voice traffic.

```
DE AFA3BB ZBO NR 001
R 041930Z JUNE 2013
FM SGT.  WILLIAM SMITH  4TH INF BTN  FT.  SILL OK 73503 /AFA6XX
OK
TO MR AND MRS JOSEPH SMITH  1512 S.  STATE DRIVE,  CHICAGO IL
60691, TEL. 302-921-0078
GR 16
BT
ENJOYING NEW ASSIGNMENT. WILL WRITE LONG LETTER EXPLAINING NEW
DUTIES.
HOPE TO SEE YOU SOON. BILL.
BT
OP. NOTE: DO NOT ATTEMPT DELIVERY BEFORE 5 PM CHICAGO TIME.
```

K
NNNN

6.3.6. Messages via Voice

It can be seen that the digital format is the best way to write out a message prior to sending via voice as well, as it has all the relevant pieces and it is relatively simple to read out the digital form for transmission by voice. Note however, that passing a message by voice is usually faster (requiring less repeats) if the transmission is slowed down to a natural cadence but at about 12-14wpm, and never above 20wpm. This means speaking slowly with pauses at the right points and occasionally spelling words using the proword I SPELL when introducing unusual or complicated words, e.g. YOU NEED TO ALTER YOUR CADENCE I SPELL CHARLIE ALPHA DELTA ECHO NOVMBER CHARLIE ECHO CADENCE APPROPRIATELY OVER.

6.4. Assessment

Answer these questions and submit your answers to your Training Officer or mentor and answer additional questions that may be given to you.

1. What are the three parts of a plaindress message?
2. When is the proword “BREAK” used in a message? Name all the locations where it should be used.
3. Write a short plaindress message to your Training Officer or mentor in digital format and review the structure.
4. A message is about to be sent with Operational Immediate precedence as:
   O 231700Z JUNE 2013
   How would you change the above to change this precedence to Routine? Note that you may need to reference the next chapter for additional information, but this chapter has sufficient data for you to accurately answer the question.

7. MESSAGE HANDLING

7.1. Introduction

When sending or receiving messages, keep in mind that information to be written down and prowords are the only things to be transmitted. If you will make some copies of the MARS MESSAGE FORM and keep them at your operating position. It will make both sending and receiving traffic very simple. The message form has spaces for five words per line for a maximum of five lines for the message text. This makes it easy to count the number of words. The prowords are designed to alert the receiving station as to what will follow. In most cases prowords are not written down.

Before sending messages, you must become familiar with the prowords and know how they are used in message transmission. Prowords are detailed in ACP-125(F), located at http://jcs.dtic.mil/j6/cceb/acps/acp125/ACP125F.pdf. As you monitor the traffic nets it will become evident that operators who use the prowords as they are intended are those who avoid making up their own non-MARS prowords. They are also the ones who avoid making extra comments during message transmission. You will probably notice that these well trained members are the ones who get their traffic on the way with the least difficulty. Unfortunately, you will occasionally hear supposedly trained MARS operators using other than the prescribed procedure, but these are the exception.

SPEAK SLOWLY AND DISTINCTLY. We pride ourselves in the ability to move traffic through the system accurately and quickly. Speed however, is secondary to accuracy. The few seconds gained by speaking too fast are frequently lost when the receiving station is forced to ask for fills. When sending traffic say words no faster than you can easily write them. This means saying words at a speed no faster than 20wpm. Very few people can write longhand at speeds in excess of 28wpm even in a perfect classroom setting. So, slow things down. 12-14wpm may sound slow, but if you are never asked for a fill, the overall transmission time and efficiency of the net improves.

Never say "ROGER" for a message or a fill unless you are certain that you have received it correctly. The proword "SAY AGAIN" is the only way to ask for fills. Do not hesitate to use "SAY AGAIN" for any part of a message that you question. "SAY AGAIN" is used with "ALL AFTER", "ALL BEFORE", "WORD AFTER" and "WORD BEFORE". Requests for fills may use combinations of these to clarify your request.

e.g., SAY AGAIN ALL AFTER Birthday and BEFORE New York.

Never say "ROGER" for a message if the number of words or groups in the text do not agree with the number in the GROUP COUNT. Our system makes it quite easy for a receiving station

to confirm all the necessary information while still in contact with the sending station. If the group count is wrong, a fast way to work out what is wrong is to ask the originating station to "LETTER THE TEXT", this means stating the first letter of each word phonetically for all the text. It is then fairly easy for the receiving station to work out where there are missing word/s and ask for a fill on the relevant section. Corrections are more difficult to obtain after contact has been terminated. If a "ROGER" has been received for a message and an error is discovered, originate another formal message, stating the mistake and its correction. This is the way to correct the mistake. In the same manner, if a cancellation of a message is required, a new message stating cancellation is the correct method to follow.

7.2. Use of Common Prowords

7.2.1. I Spell

Use the proword "I SPELL" for all proper names, unusual words, words that sound like other words but are spelled differently, plural or past tense words. i.e., Words ending with "s" or "ed.", all abbreviations, all initials and some acronyms. Sometimes poor propagation dictates the practice of spelling every word. This will be a judgment call by the sending operator who will always consider the need for accuracy even though this will slow the speed of transmission. The technique for using "I SPELL" is to pronounce the word (if pronounceable), then say "I SPELL", spell the word phonetically, then pronounce the word again (if pronounceable).

e.g., JIM, I SPELL, JULIET INDIA MIKE, JIM.

When spelling two or more words in sequence always treat each word individually, e.g.

TOM. I SPELL, TANGO OSCAR MIKE, TOM, SMITH, I SPELL, SIERRA MIKE INDIA TANGO HOTEL, SMITH

Some additional examples:
e.g., MR. AND MRS. (You would send) I SPELL MIKE ROMEO AND I SPELL MIKE ROMEO SIERRA
e.g., MARS (You would send) I SPELL MIKE ALPHA ROMEO SIERRA
e.g., J. P. MORGAN (You would send) JULIET PERIOD PAPA PERIOD MORGAN I SPELL MIKE OSCAR ROMEO GOLF ALPHA NOVEMBER MORGAN
ex4. ACP (You would send) I SPELL ALPHA CHARLIE PAPA

7.2.2. Figures

The proword FIGURES precedes all numerals (with some exceptions). Numerals are always expressed in single digits. e.g., FIGURES ONE SEVEN, not Figures Seventeen. You would write down the numerals "17" and count it as one group. If a number is to be sent as a word like Seventeen, it would be spelled phonetically to insure that no misunderstanding will result.

The exceptions all appear in the message heading. The message number is preceded by the proword NUMBER not FIGURES. The DATE/TIME Group is preceded by the proword TIME, not FIGURES and the Group Count is preceded by the proword GROUPS, not FIGURES. The proword FIGURES is never used in conjunction with those three prowords, (NUMBER, TIME and GROUPS).

7.2.3. Letters and Figures Mixed

If letters and figures appear together in the same group, you use the proword that reflects the first element of the group. If it a numeral then use FIGURES even though there are letters in the group. If the first element is a letter then use I SPELL. e.g., If it is A1C (send) I SPELL ALPHA ONE CHARLIE. If it is 1st (send) FIGURE ONE SIERRA TANGO.

7.2.4. Caution on Counting of Mixed Groups

Mixed groups can be sent different ways. If sent incorrectly in the text of a message, it will affect the group count. If a proword appears between the figures and the letter it will be counted as another group.

e.g., If 09I is sent FIGURES ZERO NINER INDIA, it is correctly sent as one group but if it is sent as FIGURES ZERO NINER I SPELL INDIA a trained operator would count it as two groups because of the extra proword I SPELL.

7.2.5. Other Prowords

The other prowords can be found in Annex A to Chapter 3 of ACP125(F) starting at p.42 in http://jcs.dtic.mil/j6/cceb/acps/acp125/ACP125F.pdf. Further discussion of other prowords may be covered on the training nets.

7.3. Message Reception

7.3.1. All Received OK

If you are receiving a message and you have heard everything perfectly, you can simply ROGER the message.
e.g., if alphanumeric call signs are allowed on the net and AFA6AB wants to ROGER the message,
THIS IS AFA6AB – ROGER – OUT

e.g., if the net is operating with full phonetic call signs,
THIS IS ALPHA FOXTROT ALPHA SIX ALPHA BRAVO – ROGER – OUT

If the message was numbered, then the acknowledgement would include the number.
e.g., suppose the message had number “026”
THIS IS ALPHA FOXTROT ALPHA SIX ALPHA BRAVO – ROGER NUMBER ZERO TWO SIX – OUT

7.3.2. Lettering The Text

If you are receiving a message and the GROUP COUNT does not agree with the actual number of words that you have copied, you may ask the sending station to "LETTER THE TEXT". The sender will respond by saying phonetically, the first letter or numeral of each group in the text. When you determine where the error occurred, you will then ask for fills using the "SAY AGAIN" procedure mentioned above.

7.3.3. Verify

VERIFY is used by the addressee to Verify the content and accuracy of a message received before receipt of the message is acknowledged. The addressee will originate a "Verify" message using the DTG (Date Time Group) and Station of Origin for identification. The originator will send the identical message again for verification. VERIFY may also be used with WORDS BEFORE and WORDS AFTER etc. to ask for verification of a section of a message. When a message to a number of addressees is queried by one station and found to be incorrect, the corrected version must be sent to all addressees.

Example:

AFA6CC transmits (prowords capitalized for emphasis here):

Alpha Foxtrot Alpha Niner Hotel Romeo – THIS IS Alpha Foxtrot Alpha Six Charlie Charlie – VERIFY Your One Zero Zero Eight Three Zero Zulu – WORD AFTER Arriving – Haiphong – OVER

AFA9HR transmits:

THIS IS Alpha Foxtrot Alpha Niner Hotel Romeo – ROGER – OUT (or WAIT or WAIT OUT)

AFA9HR operator checks the message with the originator and finds that the word after "arriving" should have been "Hong Kong" instead of "Haiphong." He therefore transmits a correction to all the original addressees. If the message had originally been sent to a net, e.g., MSN, then the message would be sent to the MSN net using the net call sign. Two addressees are assumed in this example:

Alpha Foxtrot Alpha Six Charlie Charlie – Alpha Foxtrot Alpha Niner Alpha Yankee – THIS IS – Alpha Foxtrot Alpha Niner Hotel Romeo – CORRECTION – My One Zero Zero Eight Three Zero Zulu – WORD AFTER Arriving – Hong Kong – OVER

In the above instance, if transmission conditions are less than optimal, it would be a very good idea to additionally use the "I SPELL" proword for the replacement word. Note also, that full phonetics have been used in the above. If the NCS has authorized ALPHANUMERIC call signs, then the above can be shortened to just saying the letters of the call signs as in "Ay, Ef, Ay, Six, Cee, Cee" etc.

7.4. Transmission Instructions

There are several procedures like READBACK, RELAY, RELAY TO and VERIFY which are used occasionally. You should make the effort to understand them in the event of necessity. Transmission instructions occur after the message number (if used) and before the precedence of the message.

7.4.1. Readback

READ BACK is used in the beginning procedure and thus may be added by any sending operator who may wish to hear the message read back to insure accuracy. Once the message is correctly read back to the sender, no "ROGER" is necessary. The sender upon hearing the message read back correctly responds with, "CORRECT OUT". If incorrect, he will respond with "WRONG" and correct the appropriate words.

7.4.2. Relay

RELAY is an understood instruction and is usually not stated. All messages going through one or more intermediate stations is a relay. The prosign RR is sometimes seen on data nets and indicates RELAY ROUTINE.

7.4.3. Relay To

RELAY TO is followed by a call sign or call signs and gives a specific order to the receiving station to relay to a specific station.

7.4.4. Do Not Answer

DO NOT ANSWER is used by the sender to indicate that acknowledgements are not to be sent for receipt of the message. Stations called are not to answer this call, receipt for this message, or otherwise transmit in connection with this transmission. When this proword is employed, the transmission shall be ended with the proword OUT. Remember, normally message transmissions end in the proword OVER, so OUT at the end of a message transmission gives you a very clear reminder that something is different. DO NOT ANSWER is useful when a message is being sent to a group of stations and the net time to wait for acknowledgements from each station would be prohibitive.

7.5. Originating Messages

For each message introduced into the MARS system there will be an originator and an originating station. They might be one and the same but in case of Health/Moral and Welfare

messages they often are not. The originator is the actual sender of the message whose name appears in the FROM line of the message. The Originating Station is the MARS station who first introduced the message into the AF MARS system. The originating station is responsible for putting the message into the proper format and is responsible for abiding by the restrictions placed on the origination of MARS Messages. i.e., No original death notices, no coded or encrypted messages, no foreign language texts, no messages which contain obvious false or misleading information and no messages which are of a commercial nature. The originating MARS operator will sometimes make some judgment calls when confronted by some of these restrictions. Once a message is introduced into the system, no station may refuse the traffic on the basis of the above restrictions. If you receive a message that you believe should not have gotten into the system, do not deliver it but turn it over the HQ USAF MARS and state your reason for non-delivery. In the case of an original death notice Headquarters would probably turn it over to proper channels. i.e., Red Cross—Clergyman etc.

7.5.1. ARRL Numbered Radiograms

The American Radio Relay League (ARRL) provides a list of pre-written texts to fit many occasions, including emergencies. USAF MARS encourages the use of these "canned" messages even in messages that are not to be refiled. In the text of your MARS message, use `ARL` (note just these three letters and not ARRL) and the number spelled out. (NOT figures).

e.g., `ARL FIFTY FOUR` sent as three groups. In delivery to a third party, that must be converted back to plain language. In this case (Many thanks for your good wishes.) See http://www.arrl.org/fsd-3-arrl-numbered-radiograms for a list of ARRL Numbered Messages.

7.5.2. Assigning Precedence

There are four levels of precedence available: ROUTINE, PRIORITY, IMMEDIATE and FLASH. These are listed from lowest to highest precedence. There used to be an additional lower level used only in MARS circuits called MARSGRAM, but that is no longer used and full adherence to ACP standards is currently observed. MARS members will not originate FLASH messages. MARS members will not normally originate IMMEDIATE. (IMMEDIATE may be available to some officials during emergencies covering a very widespread area that will necessitate special assistance, such as activating the National Guard, e.g., widespread rioting across many cities); however, MARS Members may relay and/or deliver these messages. FLASH messages will never be passed on MARS circuits. Most messages originated by MARS Members will be ROUTINE with PRIORITY being reserved for messages with a definite time factor, or an ACTUAL EVENT EEI message. For example, a flight arrival, or a deadline to be met, should always be passed as a PRIORITY precedence message. PRIORITY does not mean that the text of a message is more important than ROUTINE but only that this message should be handled ahead of Routine because of the time factor. It should be noted that Army MARS no longer relays EEI messages with IMMEDIATE precedence as the relay service is no longer subscribed to by other agencies.

7.5.2.1. Time Objective

Message originators do not normally select the means of communication to be used. This is a function of the communication service throughout the entire route of the message. Nevertheless, message originators should realize that various factors could, singly or collectively, add to the time required to complete the delivery of a message. Among these are:

a) The length of the message.
b) The overall message traffic load.
c) Encryption and decryption requirements.
d) The means of communications i.e., automatic or manual and delivery arrangements at terminals.
e) The number of relays required as opposed to point-to-point communications.
f) Poor transmission conditions.
g) Communications staffing problems.

Recognizing that these factors may affect the speed of service of any given message, the following general time objectives apply:

Precedence Symbol	Precedence Category	Time Objective
Z	FLASH	Not fixed. Handled as fast as humanly possible with a time objective of less than 10 Minutes. (Note that FLASH is not used in MARS).
O	IMMEDIATE	30 Minutes to 1 Hour.
P	PRIORITY	1 to 6 Hours.
R	ROUTINE	3 Hours to the start of business on the next working day.
Note: The objectives include the overall handling time from the time accepted by the communications facility at the point of origin to delivery to the addressee at the point of destination.		

Table 8 - Time Objective for Precedence Category

7.5.3. Punctuation

Generally, punctuation will not be used in the text of a MARS message. If you absolutely need to use punctuation to clarify the meaning of a text, then use only these approved abbreviations and count each one as a group and include it in the GROUP COUNT. Here are a few of the most common punctuations.

Punctuation	Spoken as	Symbol	Abbreviation
Full stop/period	Full stop	.	PD
Comma	Comma	,	CMM
Slant/Oblique	Slant	/	SLANT
Hyphen	Hyphen	-	
Left-hand bracket	Brackets on	(	PAREN
Right-hand bracket	Brackets off	)	UNPAREN
Colon	Colon	:	CLN
Semi-colon	Semi-colon	;	SMCLN
Question Mark	Question mark	?	QUES
Decimal point	Day-See-Mal	.	Point

Table 9 - Approved Punctuation

The "Abbreviation" column in the above indicates that an abbreviation may be used in a digital transmission if the symbol is not available on certain keyboards. As most modern keyboards have all the symbols, the symbol should be used in preference to the abbreviation if it is necessary to use punctuation in a MARS message.

Some confusion results in the distinction between Hyphen and DASH. If DASH is used, it is spelled out and counted as a group, making it necessary to count what came before and after as separate groups. If hyphen is used, it is simply said as part of a group and allows the hyphenated word to be counted as one group. e.g., R-390 is sent as `I SPELL ROMEO HYPHEN THREE NINER ZERO` and is counted as one group. It is recommended to always use Hyphen as DASH is not strictly in the official list of abbreviations.

e.g. suppose the text that needed to be transmitted was "Going home – maybe tomorrow – see you later". This phrase, which contains dashes, would be spoken as follows.

```
GOING HOME DELTA ALPHA SIERRA HOTEL MAYBE TOMORROW DELTA ALPHA
SIERRA HOTEL SEE YOU LATER
```

If you are the originator of the message, or can speak to the person asking you to send the message, see if it is possible to replace the dashes with something simpler, such as a comma (as hyphen would not be appropriate in the above), before introducing the message into the MARS network. You can't alter the message once it is in, but if you can discuss a simpler formatting

with the requester of the message before introducing it, you should do so in the interests of efficiency.

7.6. Passing Traffic

The NCS will direct stations to pass traffic based on the precedence of each message and the availability of addressee(s) or another station to relay that traffic. Higher precedence traffic will normally be passed before lower precedence traffic unless stations are not available to handle the higher precedence traffic. NCS will then direct the holding station on how to proceed.

e.g., AFA1AA THIS IS AFN3TD, CALL AFA7BB PASS ONE PRIORITY KANSAS OUT

Note that since the transmission from AFN3TD ends with the proword OUT, AFA1AA needs make no response to AFN3TD.

Having heard the directions of the NCS, the sending station calls the receiving station.

e.g., AFA7BB THIS IS AFA1AA, ONE PRIORITY OVER

Assuming AFA2BB copies AFA1AA well, he sends

e.g., AFA1AA THIS IS AFA7BB, OVER

If AFA7BB does not copy well he must notify AFA1AA of the problem using correct radio check prowords

e.g., AFA1AA THIS IS AFA7BB, WEAK READABLE, OVER Or

AFA1AA THIS IS AFA7BB, UNREADABLE, OVER

Once communications has been established between the two stations AFA1AA proceeds to pass the traffic.

e.g., THIS IS AFA1AA MESSAGE, (continue with the message header and text, pausing and unkeying the microphone approximately every 20 seconds to allow for a station with higher precedence traffic to break in.) AFA1AA ends his/her transmission with the proword OVER (If there are additional messages to send to this station, with the proword MORE TO FOLLOW, OVER.).

Assuming AFA7BB copied the message completely and does not need repetitions he sends

THIS IS AFA7BB, ROGER OUT

Or, to accept another message

THIS IS AFA7BB, ROGER OVER

If AFA7BB did not copy the message completely or missed it, he/she will ask for repeats using the proword SAY AGAIN and ALL BEFORE, ALL AFTER, etc. or other identifiers within the message:

e.g., THIS IS AFA7BB, SAY AGAIN ALL AFTER TO AND BEFORE BREAK, OVER

Note that this is different from the use of VERIFY. SAY AGAIN indicates that you missed something and want it repeated, whereas VERIFY indicates that you have the copy but are asking for a verification of the data to make sure you have it word for word accurate. In actual message passing the use of these terms will often be confused. If you have the message fully copied down, then requesting VERIFY is appropriate. If you have completely missing words or sections of the message or the entire message, then SAY AGAIN is the appropriate choice of proword.

7.7. Delivering Messages

MARS messages are relayed through the system with the intention of getting them close enough to their destination for a local telephone call. Since this is not always possible, a few guidelines for delivery should be mentioned. Generally, if you are the closest station to the destination, you are expected to accept traffic. Members are never asked to have “out of pocket” expense for delivery i.e., using your own postage or paying for long distance telephone. However, if you feel generous, you may deliver this way, but DELIVERY BY COLLECT TELEPHONE CALL IS NOT ALLOWED.

When messages cannot be delivered in the Air Force channels, refiling is encouraged. The Amateur Band NTS and the ARMY MARS or NAVY/Marine Corps MARS nets provide channels for refiling.

7.8. Service Messages

If you receive a message and cannot deliver it for any reason, i.e., addressee moved and left no forwarding address, incomplete or wrong address, party unknown etc., you must originate a "SERVICE" message back to the originating station. In the text of your service message refer to the DATE/TIME Group (DTG) of the original message and state briefly your reason for non-delivery. Note that the DATE/TIME Group (DTG) is the only reference to use. Do not use the message number, as it changes on each relay. In order to enable service messages to be transmitted to the originating station, the call sign of the originating station needs to be known. This call sign should be listed in the FROM part of the original message. Now, if the message is from a member of the public, then listing the call sign of the originating operator needs to be done slightly differently than if a full name and address of a MARS operator is used. Instead of:

FROM FirstName LastName Address / AFA#<xx>

The format that should be used is:

FROM FirstName LastName Address via AFA#<xx>

This way, there is never any confusion that the member of the public might be a MARS operator. Although, it is generally recommended not to use addresses on messages between MARS stations, if the message needs to be relayed across several states, then an address can at least help the NCS work out which stations on a net are best to handle the message. The "via AFA#<xx>" approach nicely distinguishes the fact that the message was originated via a MARS station and this makes it easy to route the service message back to the originating station. e.g. here is a message formatted with the "via AFA#<xx>" method of identifying the originating station.

```
DE AFA9HR NR 105
R 100058Z APRIL 2009
FR Lt. Col. Jasmine Donnelley
   Farallon Lighthouse,
   South East Farallon Island, CA via AFA9HR
TO Simon Donnelley
   2368 Central Avenue,
   Reno, NV 89501
   Tel. 775-555-0123
GP 24
BT
UNCLAS
Arrived at Farallon Research Station by seaplane.   All fine.
Bleak but beautiful.  Taking photos for you.   Give my love to
the kids.
Jasmine.
BT
NNNN
```

The service message for the above message can easily be routed back to the originating station even if the original message passed through multiple relay stations because the originating station is shown at the end of the FROM part of the heading. It is the originating station's responsibility to list their call sign in the FROM line. Once a message is entered into the system, the FROM line cannot be altered as it is a part of the message and everything including and following the precedence indicator to the second BREAK, denoting end of text body, cannot be altered while a message is in transit.

In practice you will see the group count eliminated and the word SERVICE or the initials SVC in place of a number. While this practice is in common usage it is not the most correct method. Previous training material has always advised to always count groups and use the word Service as the first word of the text to indicate the nature of the message. This is one of several practices where prescribed procedure has been changed by certain operators and then the entire system slips into a practice which may be in error.

7.9. Refile (MARS to Amateur)

Here are the steps to follow when you find that you must refile a message into the NTS (National Traffic System) on the amateur band. It will help if you are familiar with the amateur message format.

1. The message number may change or stay the same.
2. The precedence will probably stay the same. NOTE: Precedence for Amateur messages are Emergency, Priority, Welfare and Routine.
3. Put your amateur call sign as the station of origin.
4. The check number will be the MARS group count less any signature. (In the amateur format the signature appears outside the text)
5. Place of Origin is City, State or Country via MARS
6. Time filed is the hours and minutes only from the MARS message
7. Date is Month Day and Year.
8. The address is the TO: address from the MARS message. (There's no provision for a FROM address)
9. The prosign BT (pronounced BREAK) separates the Text from the heading.
10. The Text will be the same except for any signature. ie."Signed John","Love Bill" etc., and these will follow the text after the second BT.
11. Since there is no provision for a From address in the amateur message, it is recommended that the from address from the MARS message be added with the signature as an ending since information is already available.

The following is a MARS message and then below that is the same message as refiled into the Amateur Band NTS.

```
DE AFA3XY NR 112
R 281730Z JUNE 2013
FROM SGT EDWARD JONES 4TH INF BTN FT SILL OK 73530
TO MR AND MRS JOHN JONES 11615 STATE RD CHICAGO IL 60691 TEL 302-
921-0078
GR 16
BT
ENJOYING NEW HUMVEE WILL WRITE LONG LETTER EXPLAINING NEW DUTIES
```

```
HOPE TO SEE YOU SOON NED
BT
OVER
```

Same message as filed into the NTS (Amateur)

```
NUMBER 1 ROUTINE K0UER CHECK 15 OKLAHOMA VIA MARS TIME 1730Z 28
June 2013 TO: MR AND MRS JOHN JONES
11615 STATE RD CHICAGO, IL 60691
302-921-0078
BT
ENJOYING NEW HUMVEE  X WILL WRITE LONG LETTER EXPLAINING NEW
DUTIES X HOPE TO SEE YOU SOON BT SIGNED NED

Optional: SGT EDWARD JONES
4th INF BTN
FT SILL OK 73530
```

NOTE: The ARRL Amateur system uses an XRAY in the text for all punctuation. It is not counted in the check or group count.

7.10. Refile (Amateur to MARS)

Since the MARS message format is really more precise and you are trained in drafting MARS messages, this should be easier than the above procedure. Here are a few important things you should ask the sending station if you are asked to take traffic from the Amateur band and refile it into MARS: Is there a complete FROM Address, with telephone number? If the message cannot be delivered will you be able to reach the sender for notification? Is the text a subject that is acceptable on the MARS circuits? (See 7.5 ”Originating Messages”).

1. Re-number to fit your MARS sequence
2. Assign a proper MARS precedence.
3. New date/time group should reflect the Time originated into MARS
4. Complete From and To Address.
5. Move any signature up into the Text and eliminate any "XRAYS" from the Amateur message to arrive at an actual MARS Group Count and TEXT.

If the Amateur message has an HX, these instructions can be written out in the ending of your MARS message. In the MARS Heading there is no provision for HX instructions. If you receive a message which uses one, put it in plain language as an operators note at the end of your MARS message. Make certain if you accept an amateur message with HX instructions that the sender knows that MARS will not allow a collect call for delivery.

7.11. Assessment

Answer these questions and submit your answers to your Training Officer or mentor and answer additional questions that may be given to you.

1. How do you letter the text in a message to help verify what is wrong when the group counts do not match?
2. Demonstrate how you would use the proword “I SPELL” to say the following message text in a way that it would be correctly transcribed by the receiving operator:
   ADD THE LEMONS TO THE FOIE GRAS AND SERVE IMMEDIATELY
   There are several mechanisms by which this can be done, discuss these with your Training Officer or mentor.
3. What is a service message? How can it be sent to the originating station?

8. EMERGENCY COMMUNICATIONS

8.1. Background

Different systems have evolved over time to serve the needs of passing messages during emergencies. One system that has been in use since 1994 is the EEI (Essential Elements of Information) system. That system has largely been replaced by the SPOT (Situation, Position, Observation, Task) system. Both systems will be detailed here, although SPOT is recommended to be used in preference to EEI.

Essential Elements of Information (EEI) and SPOT reports are critical status reports provided to various DoD and DHS agencies, which provide insight into availability and limitations of local infrastructure during and immediately following an emergency or disaster event. These situations are reported because there is a potential that the event has or could adversely impact life, limb or otherwise impede the Public Safety. EEI and SPOT Reporting is an ongoing mission supported by MARS.

8.2. Overview

Both EEI and SPOT message reporting formats follow the convention of being formatted as Plaindress Messages, with the message body, in either SPOT format or EEI format, occurring between the BREAK (BT) prowords in the message. Thus the message will always be of the form (note the use of MESSAGE proword (ZBO) when this is transmitted on a tactical or reporting net and not on a traffic net:

```
DE AFA#<xx> ZBO NR 101
R 290200Z SEPTEMBER 2013   <Precedence R, P, O depends on event>
FR <name of originator, address> via AFA#<xx>
TO <name address of recipient or callsign>
BT
<Message Type>
<text of message in SPOT or EEI format>
<Message Type>
BT
<Optional operator remarks>
NNNN
```

In the above, the `<Message Type>` is one of:
ACTUAL EVENT or MARS EXERCISE depending on if it is an actual event of a MARS exercise
It will be noted that the `<Message Type>` is used both as the first part of the text body and as the final part of the text body. That is, if the message begins with MARS EXERCISE, it

must also end with MARS, similarly if it begins with ACTUAL EVENT it will end with ACTUAL EVENT. By this means, the type of message content is indicated clearly to the receiving station so that the textual body of the message will be interpreted correctly and false alarms will not be generated. The precedence given to the message will always be ROUTINE (prosign R) for MARS EXERCISE. The precedence for ACTUAL EVENT situations will be either PRIORITY (prosign P) or IMMEDIATE (prosign O) depending on the scale of the emergency. Typically PRIORITY will be used for ACTUAL EVENT situations with IMMEDIATE being reserved for large scale disaster situations necessitating special action, e.g. call out of the National Guard.

Augmenting the MARS EXERCISE or ACTUAL EVENT with the type of report included in the body may also be done if it is felt that confusion could arise in interpretation of the report received. Some means of doing this are to use the phrases, MARS EXERCISE SPOT REPORT or MARS EXERCSE EEI REPORT or ACTUAL EVENT SPOT REPORT or ACTUAL EVENT EEI REPORT. When augmenting with additional words, the phrase at the beginning and the end of the message body (the part between the BT prosigns) must be the same phrase.

8.3. Situation, Position, Observation, Task (SPOT)

The text within the message body for a SPOT report is listed as a set of 10 items. If sending by voice, each of the ten items would be spoken as “FIGURE ONE, FIGURE TWO” etc. When sent by digital means, then the numbers will simply be sent.

8.3.1. SPOT Message Body

A SPOT message body consists of the following:

1. Originator: (name and function or call sign)
2. Originator’s Location:
3. Originator’s Contact E-mail/Phone/Radio Net:
4. Date/Time Group of Report:
5. Type of Report:
____Telecommunications Outage
____Damage Report
____Weather
____Other
6. Specific Details of Report: (who, what, when, where)
7. Person Filing This Report: (name and call sign)
8. Email/Phone/Radio Net of Person Filing this Report:
9. Organization Tracking Number: (i.e., organization/date time group)

(Example: MARS 131600ZJAN2013)
10. Other Information (as required):

Now it may appear that there are some redundancies in the above, especially when one considers that this will be included in the body of a plaindress message where the sending station is already known. However, when the message to be transmitted is not coming from the MARS operator themselves, but is coming from a third party, then the above format loses its redundancy and the reason for the additional elements becomes clear.

8.3.2. Example Plaindress Message SPOT report filed by a MARS station

The following text shows a full plaindress message filed on a traffic net for a SPOT report. This example is derived from the National ECOM Manual.

```
DE AFA2UJ NR 202
R 131600Z JUNE 2013 <change precedence to P or O if ACTUAL EVENT>
FR AFA2UJ
TO AFN2EC
BT
MARS EXERCISE or ACTUAL EVENT
1. AFA2UJ
2. SYRACUSE NY
3. NES1
4. 131600Z JUNE 2013
5. DAMAGE REPORT
6. POWER OUT CITY OF SYRACUSE DAMAGED BY LARGE EARTHQUAKE
7. AFA2UJ
8. NES1
9. MARS 131600Z JUNE 2013
10. POWER OUT FOR 2 WEEKS
MARS EXERCISE or ACTUAL EVENT
BT
NNNN
```

8.3.3. Example Plaindress Message SPOT report originated via a third party

In this example, it will be seen that the message handling slightly adjusts for the sending of messages from a third party. Here the third party is not in any way a MARS member but has routed the traffic for passing through a MARS station. This would be quite typical for certain types of ECOM traffic.

```
DE AFA9HR NR302
R 270130Z SEPTEMBER 2013
FR Captain Alana Forrest via AFA9HR
TO AFA9HM / CA
BT
MARS EXERCISE SPOT REPORT
1. Captain Alana Forrest, Lod Gatos Police Department
2. Los Gatos, California
3. 408-354-8600
4. 270130Z SEPTEMBER 2013
5. DAMAGE REPORT - POWER OUTAGE
6. All power lost in entire county at 0115 after massive power
surge. Local gas stations cannot pump gas owing to power outage,
none in town have generators. Residents are not to drive to town
gas stations.
7. AFA9HR
8. Net 9M1
9. Los Gatos/Monte Sereno Police Release # LGMSPD-2013-064
10. Station running on battery power currently. 2hrs left.  Will
run car for additional power later.  Generator not working.
MARS EXERCISE SPOT REPORT
BT
NNNN
```

The above example uses the augmentation of SPOT REPORT and as such the message type is identified as MARS EXERCISE SPOT REPORT. Note that this phrase occurs at the beginning and end of the message body, and, is exactly the same text in both locations. It will be noted that the reference number in item 9 is the reference number of the third party document. Only in the absence of a third party document number should the MARS date-time-group reference be used in this location.

8.4. ESSENTIAL ELEMENTS OF INFORMATION (EEI)

8.4.1. Background

The MARS EEI concept is a product following the 1994 earthquake in Northridge, CA. Several government and military entities were subscribed to EEI reports generated by MARS members. This forwarding was handled by Army MARS for all MARS services. All government and military entities have cancelled their subscription to these reports. Part of the reason for this was that over reporting of the traditional MARS EEI report resulted in previous subscribers canceling their subscription to that product. In Army MARS NET-OP-ATD of 31 October 2012, it was documented that the MARS Governance Executive Board (MGEB) of US Army MARS had decided the following:

a. Discontinue the legacy MARS EEI report, and use of the term EEI in Army MARS.
b. Discontinue the use of "event identifier" codes.
c. Discontinue AAN3EEI@Winlink.org forwarding.
d. Implement USMTF Request for Information and Request for Information Response message types.
e. Implement USMTF SPOT Intelligence Report (SPIREP) message type. SPIREP will be directed to State or Region leadership, and only forwarded appropriately and if relevant. Origination of SPIREP shall be limited to exercises and events that are not managed by or otherwise known to authorities.
f. In the event hazardous conditions, criminal activity, or other factors relating to public safety are observed when normal communications infrastructure is available, the proper course of action is to contact the nearest Public Safety Answering Point (PSAP) by dialing 911.

So what does this mean for EEI message handling? This manual will present the old form of EEI handling in 1.1 with a table of the "event identifier" codes in 8.4.3 but it should be noted that "event identifier" codes are somewhat cryptic and a relic of cold-war era terminology, which is why they have been dropped in favor of plain language. Nonetheless, they are still shown here so that new members may understand them should they on occasion be used.

SPIREP (SPOT Intelligence Report) format is to be preferred going forward, but members may use both EEI format and SPIREP format in messages at the time of writing of this manual (July 2013). The SPIREP format will be discussed in this section also.

8.4.2. How to Draft and Send an EEI Message

Have on hand, a copy of MESSAGE FORM for EEI REPORTS and the ESSENTIAL ELEMENTS of INFORMATION (EEI) Event Identifiers and use these as guides when drafting the EEI message. As Army MARS no longer relays EEI messages, the TO address shown below should be appropriately selected. When drafting an EEI message for voice transmission put a regular MARS heading on it. E.g.,

Number
Precedence, Date/Time Group
FROM (your Name, Station and State)
TO Someone who can handle the message appropriately
INFO AFD4EC SC
Your Region or Division Emergency Coordinator
Your SMD
Other INFO Addressees

Note: The historical note of "Actual EEI's are addressed to AAN3EEI VA; Exercise EEI's are addressed to AFN2EC NY" is purely historical. These stations should no longer be destination station of EEI messages as they are no longer relayed by Army MARS.

This entire section is written here more as a historical reference to EEI reporting. You should contact your state or region emergency coordinator and read your ECOM Training manual, which will have updated procedures.

Use the following format for your text.

BT
MARS EXERCISE or **ACTUAL EVENT**
SUBJ: EEI REPORT

1. REF. EVENT IDENTIFIER: (Use applicable event identifier from page 8-3 or plain language if not on Identifier List)

A. INCIDENT LOCATION TIME: (Specify Town, City, County or State-wide area)

B. EMERGENCY MEDICAL: (Operational, Damaged, Destroyed, or Field Facilities available, etc.)

C. LOCAL TRANSPORTATION: (Indicate whether roads, bridges, local airports, railroads are affected and status – open, restricted, closed, damaged, destroyed. Provide enough information to disaster relief officials to aid in deciding how to get assistance to the affected area.)

D. GENERAL DAMAGE DESCRIPTION: (General description of damage or impact on Major structures such as Government buildings, schools, residences, commercial properties, public facilities; Fire stations, etc. Include location of shelters if applicable.)

E. UTILITY STATUS: (Gas, Water, Commercial Power, Sanitation Systems – Operational, Damaged, Destroyed, Needed.)

F. COMMUNICATIONS STATUS: (Telephone, Radio, Cellular Phone – Operational, Damaged, Unavailable)

G. SOURCE OF INFO: (Indicate Source of Information if different from originator of the message. Include MARS Call sign, Name of Official and Agency, Radio/TV Call sign or Network as applicable.)

H. REMARKS: (Include comments about expected changes in status of any of the above items such as power companies expect power to be cut for (specify estimated time). If applicable, include expected time of next report.)
MARS EXERCISE or **ACTUAL EVENT** (Same as beginning)
BT
NNNN

You can take this message to TRANSCON Voice net or you can take this message to TRANSCON Radio Relay (TRR) net for digital traffic or you can send it to a Digital Representative on your Division voice net who can relay it to one of the digital systems. Keep your descriptions brief and use NOT AFFECTED if a category is “Not applicable” or “Not Affected”, don’t write “N/A”.

If you have occasion to report an actual event use the same format with the following exceptions: Replace the words “MARS EXERCISE” with “ACTUAL EVENT” at both places in the text; that is, at both the beginning and the ending of the textual message body. An actual event message must be sent by the most expedient method available.

Email is allowed for actual events ONLY. When sending email, use an email subject line of “//MARS P/ ACTUAL EVENT EEI” for priority precedence. Do not send email to Army MARS, they do not relay EEI reports.

8.4.3. Essential Elements of Information (EEI) Event Identifiers

(Reference: US Army MARS National Emergency OPLAN 4-02, Dated 03 April 2002. Applicable to Air Force and Navy-Marine Corps MARS services).

EVENT: ……IDENTIFIER:

AIR CRASH..... FALLEN STAR
AIRBORNE POISON GAS..... ….POISON AIR
BIOLOGICAL EVENT..... BAD BUG
BOMBING INCIDENT..... LOUD BANG
BRIDGE DAMAGE/LOSS (MAJOR) ..... LOST SUPPORT
CHEMICAL SPILL ..... POISONED GROUND
CIVIL UNREST/RIOT..... BAD MAGIC
DAMAGING HAIL..... FALLING ICE
EARTHQUAKE..... ROLLING THUNDER
FLOOD..... TALL WATER
FOREST/GROUND FIRE..... …SCORCHED GROUND
GAS LEAK/EXPLOSION (MAJOR)..... HOT AIR
HEAVY WINDS (ONLY)..... MIGHTY WIND
HURRICANE..... HOWLING WIND
ICY ROADS/INTERSTATE/FREEWAYS..... BLACK ICE
INTERSTATE BLOCKED/DAMAGED (MAJOR) ..... BLOCKED LANE
MAJOR COMMUNICATIONS LINK DOWN..... LOST COMM
NUCLEAR..... NUCLEAR GRAYSTONE
OIL SPILL/WATER..... DARK WATER
POWER OUTAGE (MAJOR) ..... DARK DAY
SEARCH/RESCUE..... SECURE HAVEN
SEISMIC SEA WAVE..... TSUNAMI
SHIP WRECK/INCIDENT..... .DEEP SEA
TERRORIST THREAT..... HIDDEN SHADOW
TORNADO.....VIOLENT TWISTER
TRAIN WRECK/DERAILMENT..... BROKEN TRACKS
VOLCANO..... BRAZEN BRIMSTONE
WATER DAM BREAK/DAMAGED..... FAST WATER
WINTER SNOW STORMS.....WHITE BLANKET

COMMUNICATIONS SUPPORT ROLE(S) IDENTIFIERS:

EVENT:…… IDENTIFIER:

FEMA SUPPORT..... FEDERAL RESPONSE
JCS SUPPORT..... JOINT LIONS
NATIONAL GUARD/RESERVE SUPPORT..... ….CIVIL COVER
NCS SUPPORT..... .TOP COVER

NDMS SUPPORT..... MEDICAL LINK
SHARES SUPPORT..... COMMON FORTUNE

8.4.4. Message Form for EEI Reports (Voice)

_____THIS IS_____ NUMBER _____

ROUTINE or (PRIORITY) TIME_____ZULU_____ _____ (6 digit Date time) (Month) (Year)

FROM _____CALL SIGN_____ _____ (Name) (call sign) (State)

TO CALL SIGN AAN3EEI VA or AFN2EC NY

Note: Actual EEI's are addressed to AAN3EEI VA; Exercise EEI's are addressed to AFN2EC NY.

INFO_____ _____
_____

BREAK

REF. ACTUAL EVENT or MARS EXERCISE (Say one or the other, not both)

SUBJ. EEI REPORT

FIGURE 1 REF. EVENT IDENTIFIER
_____ (Event Identifier from List)

I SPELL ALPHA INCIDENT LOCATION TIME _____

(Area impacted) I SPELL BRAVO EMERGENCY MEDICAL
_____ (Status of Medical Facilities) I SPELL CHARLIE LOCAL TRANSPORTATION _____ (Status of Transportation Facilities) I SPELL DELTA GENERAL DAMAGE DESCRIPTION
F_____ (Exact location and Character of Damage) I SPELL ECHO.UTILITY STATUS _____
(Status of local Utilities) I SPELL FOXTROT COMMUNICATIONS STATUS
_____ (Status of Communication Facilities) I SPELL GOLF SOURCE OF INFO _____
Source of Information) I SPELL HOTEL REMARKS
_____ (Detailed description and estimate of resumption of normalcy) ACTUAL EVENT or MARS EXERCISE

(Say one or the other, not both)

BREAK

OVER

8.4.5. Sample EEI Message (Exercise)

DE AFA3DK NR 001
R 101730Z JAN 2007
FM DAN M. KIRBY/AFA7DK/MO
TO AFN2EC NY
INFO AFD4EC SC
AFE5EC WI
AFF7MO MO
BT
MARS EXERCISE
SUBJ. EEI REPORT
1. REF. EVENT IDENTIFIER: TALL WATER
A. INCIDENT LOCATION TIME: Cedar County Missouri
B. EMERGENCY MEDICAL: Not affected
C. LOCAL TRANSPORTATION: FLOODING ON MANY SECONDARY ROADS.
D. GENERAL DAMAGE DESCRIPTION: Flooding of low areas.
E. UTILITY STATUS: NOT AFFECTED
F. COMMUNICATIONS STATUS: NOT AFFECTED
G. SOURCE OF INFO: Cedar County Sheriff
H. remarks: RAIN EXPECTED FOR SEVERAL HOURS. ROADS EXPECTED TO GET WORSE.
POTENTIAL FOR CLOSING OF MANY SECONDARY ROADS LATER TODAY.
MARS EXERCISE
BT
NNNN

NOTE: Precedence for Actual EEI will be **Priority** or **Immediate**. Precedence for Exercise EEI will always be **Routine.**

MARS Exercise EEI Reports should be sent via digital if available to AFN2EC NY. If digital is not available the report may be sent by voice to a digital capable station that will place it into the digital system.

DO NOT SEND EXERCISE MESSAGES VIA EMAIL UNLESS YOU ARE INSTRUCTED TO DO SO BY THE CHIEF USAF MARS OR THE NATIONAL EMERGENCY COORDINATOR/AFN2EC.

DE AFA3DK NR 001
P 101730Z JAN 2007
FM DAN M. KIRBY/AFA7DK/MO
TO aan3eei@winlink.org **(See Notes:)**
INFO ZEN AFN2EC NY ZEN AFD4EC SC ZEN AFN5NC NE ZEN AFE5EC WI ZEN AFF3XX SMD ZEN AFA3XX SEC
BT
ACTUAL EVENT
SUBJ: EEI REPORT
1. REF EVENT IDENTIFIER: TALL WATER
A. INCIDENT LOCATION TIME: CEDAR COUNTY MISSOURI
B. EMERGENCY MEDICAL: NOT AFFECTED
C. LOCAL TRANSPORTATION: FLOODING ON MANY SECONDARY ROADS.
D. GENERAL DAMAGE DESCRIPTION: HEAVY RAINS HAVE CAUSED FLOODING OF LOW AREAS
E. UTILITY STATUS: NOT AFFECTED
F. COMMUNICATION STATUS: NOT AFFECTED
G. SOURCE OF INFO: Cedar County Sheriff
H. REMARKS: RAIN EXPECTED FOR SEVERAL HOURS. ROADS EXPECTED TO GET WORSE. POTENTIAL FOR CLOSING OF MANY SECONDARY ROADS LATER TODAY.
ACTUAL EVENT
BT
NNNN

NOTES:

Precedence for Actual EEI will be **Priority** or **Immediate**. Precedence for Exercise EEI will be **Routine.**

Actual EEI Reports should be sent via E-MAIL if available. The E-MAIL subject must be //MARS P/ACTUAL EEI.

The originating station that sends an Actual EEI Report by E-Mail is responsible for sending the info copies by CC's or other means (i.e., radio)

Actual EEI reports sent by digital mode (***in the event E-MAIL is unavailable***) will be sent via the **Winlink 2000 (WL2K** or **AirMail)** system.

DO NOT SEND EXERCISE MESSAGES VIA EMAIL UNLESS YOU ARE INSTRUCTED TO DO SO BY THE CHIEF USAF MARS OR THE NATIONAL EMERGENCY COORDINATOR/AFN2EC.

8.4.6. Example Digital EEI Exercise Message

Below is an example of an EXERCISE EEI message as it would be formatted for transmission by digital means:

DE AFA5JR NR 010
R 071410Z SEP 2007
FM LEO LIBERIO / AFA9LL / CA
TO AFN2EC NY
INFO AFD4EC SC
AFN3NC NE
AFE5EC WI
AFF3WI WI
BT
REF: MARS EXERCISE
SUBJ: EEI REPORT
1. REF: EVENT IDENTIFIER: LOST SUPPORT
A. INCIDENT LOCATION TIME: POLK COUNTY WI AND WASHINGTON AND CHISAGO COUNTIES MN
B. EMERGENCY MEDICAL: OPERATIONAL
C. LOCAL TRANSPORTATION: US HIGHWAY 8 BRIDGE BETWEEN ST CROIX FALLS WI AND TAYLORS FALLS MN CLOSED
D. GENERAL DAMAGE DESCRITION: STRUCTURAL DAMAGE TO US HIGHWAY 8 BRIDGE
E. UTILITY STATUS: NOT AFFECTED
F. COMMUNICATIONS STATUS: NOT AFFECTED
G. SOURCE OF INFO: REPORTED BY LOCAL RADIO STATION WPCA
H. REMARKS: TANKER TRUCK ACCIDENT ON BRIDGE CAUSED EXTENSIVE DAMAGE TO BRIDGE CAUSING BRIDGE CLOSURE. TRAFFIC REROUTED TO OTHER ROUTES. NO ESTIMATED TIME TO REPAIR.
MARS EXERCISE
BT
NNNN

8.5. Assessment

Answer these questions and submit your answers to your Training Officer or mentor and answer additional questions that may be given to you.

1. What is an EEI report?
2. When should and EEI report be sent as ROUTINE precedence, when at PRIORITY precedence and when at IMMEDIATE precedence?
3. What does event identifier ROLLING THUNDER mean?
4. What is the difference between an EEI report and a SPOT report?

5. Where should the text "MARS EXERCISE SPOT” appear in an emergency communciations message for a SPOT report sent during an exercise?

9. DIGITAL MODES

9.1. Introduction

This chapter is not intended to be a substitute for the TNC user's manual, or the software user's manual and help-files, available for the many software packages and equipment that are used by MARS members. For the most part, this is a personal choice. Members are encouraged to choose software in common use in their state or region and learn the operation of the software by experience and consultation with other MARS members. Some recommendations will be made for common soundcard software that is typically used by MARS members at the time of writing this manual. Recommendations of preferred modes will also be made in the text. HF stations must have the capability of operating one or more of the digital modes, where digital mode is defined as any computer-generated signal other than continuous wave (CW). As part of training there is no requirement to learn or use Morse code (CW) in order to become a member of MARS, but MARS members who are familiar with Morse code may use it on appropriate MARS nets.

9.2. Analog, Digital or Fuzzy

When talking of human readability of the signals, we are talking of either the audio output of the radio through a loudspeaker or the output on a printer or LCD display, which the human can examine and attempt to interpret. There are three mode types: analog, digital and fuzzy.

Modes used to transmit voice, such as FM and SSB and graphics modes such as TV, SSTV and facsimile are analog in nature. Analog modes are human readable. The operator simply listens to the voice or views the picture and makes sense of what is being communicated.

Transmissions of text and data are digital and typically need a computer program and sound card, or a TNC, to generate them, e.g., RTTY, PSK31, MFSK (MFSK16), MT63. Digital modes are not typically human readable, they require a computer to decode them into a form that can be recognized by a human. Although old operators of RTTY will instantly recognize the RYRYRY tone and some may be able to decode more, but, in general, digital modes are not human readable.

A third class of modes is fuzzy. This is a blend of coding and/or machine generation that describes human readable text and sounds. Examples of fuzzy modes are Morse code and Hellscheiber. While Morse code is digital in the sense of being keyed on and off, the timing is completely analog in nature so that when hearing dit-dah at slightly different pitches, one could assume any of: ET or A sent by one operator with variation in TX stability, E by one operator followed by T by another operator with both transmitting at the same speed, T by one fast operator followed by T of a slow operator, E by one operator followed by E of a very slow operator or T by one operator followed by E of a very slow operator. Human sent Morse code

is notoriously difficult for machines to decipher because the timing of the dots and dashes does not follow a precise notion (unless the operator has extremely perfect keying) and it is why, during the World War II, it was possible for people to recognize an individual's "fist" when transmitting certain pieces of text owing to natural variations in rhythm for that person. Similarly in Hellschreiber, although a text mode where the individual letters are sent by computer and subsequently received as an image, the image is not decoded by computer but rather decoded by the human operator who views the image. Noise in the image is filtered by the human eye-brain combination in the sense of Hellschreiber in a similar way to the way it is filtered by the ear-brain combination when listening to audio of Morse code.

9.3. Historical Background

Reliability, security and speed are the three fundamentals of military communications, with reliability ultimately the most important. Reliability must never be diminished or sacrificed to meet the conflicting demands of security, speed, or convenience. Modern digital communications provide a means of enhancing both the reliability and speed of communications within MARS. There are some who claim that the first radio communications using Morse code or continuous wave (CW) were digital communications. CW communications were the major method of communications in both the military and the Army Auxiliary Radio System (AARS), the precursor to MARS, up to World War II. CW communications provided a nominal 25 words per minute (wpm) speed. High-speed nets operated up to 40 wpm; reliability was determined by operator fatigue. Very few MARS members would be able to achieve these speeds in the 21st century, although CW is an approved mode for use on MARS nets. The author believes that CW can more accurately be thought of as a fuzzy mode (similar to the way Hellscheiber is a fuzzy pictorial way of sending text) since the well trained human brain can actual make sense of varying dot and dash lengths and still interpret what is intended. It takes significant effort for software to achieve this with human sent CW. For machine sent CW, decoding is far simpler for a computer to achieve.

During WWII, radioteletype digital communications using the 5-level Baudot code, identified as "RATT" in military terms and later "RTTY" in the amateur world came into common use. This new mode provided 60 and 100 wpm communications speed, but did not provide for any error detection or correction. Operators learned to correct for garble when the Letters shift or Numbers shift character was missed during transmission. Experienced operators could correct single character errors from context and knowledge of single bit errors. The use of punched paper tape prior to transmission offered an opportunity to correct typing errors and enhance reliability in message relay.

By 1950, the academic engineers had developed communications theory to the point that error correction and detection methods were theoretically possible but were not yet practical. An early attempt to put the new theories into practice was the British Piccolo system that used

multiple tones and required a bank of mechanically resonant vibrating reeds in the receiver. A modern digital variation of this is the MFSK system.

The development of the microprocessor made the modern amateur digital communications systems technically possible; the relaxation of FCC rules that inhibited the use of other than Baudot code in the amateur bands gave amateurs the go ahead to explore these exciting new possibilities. Radioteletype demodulators that were used to drive mechanical teleprinters were now connected instead to the new home computers of the 1980's. Eventually USA amateurs were permitted to use codes other than Baudot over the air, Packet radio, based on the AX.25 protocol derived from the landline packet switching protocol X.25 was enabled. With this development, error correcting digital transmission was made available to amateur operators and MARS members. Packet radio required a hardware device known as a Terminal Node Controller (TNC) or Data Controllers to interface the radio and the user's computer.

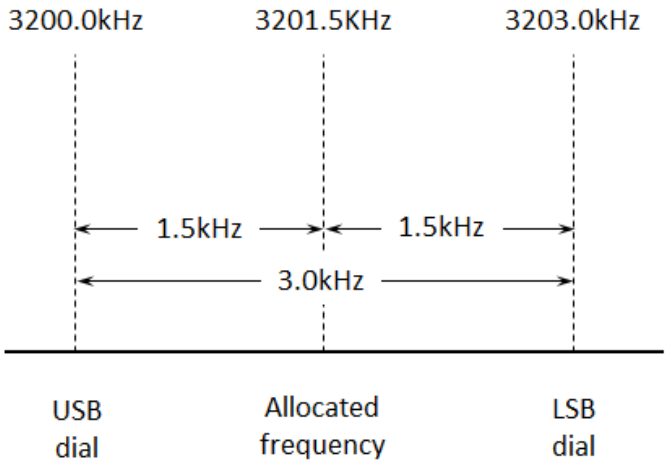
The development during the 1990's in complexity and speed of personal computers and the evolution of more sophisticated sound cards containing a digital to analog converter, an analog to digital converter and a sophisticated digital signal processor, together with open public domain access to control the soundcards enabled the digital sound card revolution. PSK31, developed by Peter Martinez (G3PLX), was the first of these modes to achieve popularity. This was followed by many new modes such as QPSK-31, MFSK16 and MT63. Nino Porcino (IZ8BLY) and Murray Greenman (ZL1BPU) contributed greatly to the development of both MFSK and MT63. In addition, older modes such at RATT, ASCII, and AMTOR were implemented in sound cards. This eliminated the need for expensive modulators/demodulators (modems) and TNCs except for PACTOR transmission because of licensing issues.

9.4. Digital Bandwidth and Placement of Signal

The emission bandwidth of any MARS digital transmission must not exceed the emission bandwidth of a radiotelephone signal. As recently as the last decade this bandwidth was defined as 2.8kHz. This is why until 13 May 2007, all the USAF frequencies when listed as USB dial frequency ended in ".1" or ".6", e.g., 3228.1kHz USB dial, when the center frequency was 1.4kHz up from that, viz., 3229.5KHz. On 13 May 2007, the ".1" and ".6" were dropped so that if a USB dial frequency previously ended in ".1" it would be changed to end in ".0" and if it previously ended in ".6" it would be changed to end in ".5". This did not actually move the authorized frequency allocation down by 100Hz from 3229.5kHz to 3229.4kHz, it stayed the same at 3229.5kHz; what changed was the bandwidth going up to from 2.8kHz to 3.0kHz. Of course, this made tuning easier for SSB on many rigs used by civilian MARS operators with the USB dial frequency being 1.5kHz below the allocated reference center frequency and the LSB dial frequency being 1.5kHz above the reference center frequency. Allocated frequencies are always specified in official documentation as channel center frequencies. For ease of use of the membership, the regional, state and TRANSCON frequencies are also listed with their USB dial

frequencies in the frequency allocation tables so that tuning to the proper frequency is less error prone.

Now, why is this discussion of bandwidth important? Let's consider a simple case first. Suppose you have a MARS frequency and the USB dial is specified as 3200.0kHz (This is not currently a MARS frequency, just using it as an example because the numbers avoid too much mental arithmetic and are easy to understand.) If you wish to transmit CW, you must put the transmitted signal into the center of the 3.0kHz channel allocation. This center would be 1.5kHz up from the USB dial frequency, viz., 3201.5kHz. This is shown in Figure 1 – Frequency Allocation and USB dial frequency. It will be noted that the USB dial frequency is below the allocated frequency and the LSB dial frequency is above the allocated frequency. (Note that on



USAF MARS circuits USB is the normal mode of operation.)

So, on switching your rig to CW, you would select a frequency of 3201.5kHz. Now, if you are using a sound card to generate CW, not by direct rig control but rather by using USB and injecting an audio tone, then the rig dial frequency will be at 3200.0kHz and the audio tone must be at 1,500Hz in order for the CW transmission to appear at the center of the allocated channel bandwidth. True CW (direct carrier switching) has very few RF artifacts. Audio tone generated CW can have suppressed sideband and carrier leakage as well as modulation products, so correct transmit level audio is important. This also true of AFSK (Audio Frequency Shift Keying) used for generating RTTY compared with direct FSK (Frequency Shift Keying) where the carrier is directly switched between two frequencies will, like direct CW, have very few RF artifacts. However, with modern rigs and careful setup, it is often impossible to distinguish if a sound card

Figure 1 – Frequency Allocation and USB dial frequency

is being used or not. Correct setup is the key to correct operation on digital modes via sound card.

Now, when transmitting on other modes such as MFSK and MT63, the signal should again be centered in the audio spectrum at 1,500Hz. This way, the transmission will always be correctly centered in the allocated MARS channel. There are some exceptions made to this with MT63. Historically, the older software of IZ8BLY could only start at 500Hz audio, so the default 1kHz wide mode, MT63-1K, started at 500Hz and ended at 1,500Hz audio, with the center being at 1,000Hz audio. Thus, this transmission would not be centered on the allocated frequency, but appear to be centered 500Hz too low. The related MT63-2K mode with a 2kHz wide bandwidth would however appear correctly centered, with a 500Hz start and a 2,500Hz end point. This is the exception and has been tolerated with some members only having older software. However, MixW and the much newer Fldigi software both allow the transmissions to be placed anywhere within the audio bandwidth, so if all members on a net are using these, it is strongly recommended that the digital transmissions be centered on 1,500Hz audio so as to keep the transmissions correctly in the center of the channel regardless of the digital mode being used.

9.5. Digital Modes

9.5.1. RATT (Radio Automatic TeleType) or RTTY (Radio TeleType)

RATT was the Military name, known in commercial and amateur usage as RTTY. This is the original radio teletype mode using the 5-level Baudot code. It is affectionately known as the 2nd digital mode after CW; instead of switching a single carrier on and off, it switched between two carriers, one representing “mark”, the other “space”. It is transmitted using either Frequency Shift Keying (FSK) or Audio Frequency Shift Keying (AFSK) modulation with a mark/space frequency of 2,125/2,295Hz and 170Hz shift. The five level code limits this mode to 32 characters, but the use of Letters/Figures shift allows 61 characters. This limits text to uppercase characters, numerals and a few punctuation marks. This is the reason most official messages in MARS are written in uppercase characters. Modern digital software is changing that concept and maintaining uppercase in some modern modes is problematic. There is no error detection or error correction with this mode. This mode has a 100% duty cycle but as the carriers are either on or off may be efficiently transmitted through a class-C amplifier. Linearity is not required.

9.5.2. Packet Radio

This mode uses an Amateur Radio modification of the international X.25 protocol for land line packet switching known as AX.25 protocol. The message is broken into packets which contain an address header, the data and a checksum. The receiving packet station computes the checksum of the received packet and compares it to the checksum sent by the transmitting station. If they agree, the packet is acknowledged (ACK) to the sending station who then sends the next packet.

Otherwise, the receiving station sends a negative acknowledgment (NAK) and the sending packet station re-sends the packet until an acknowledgment is received. This mode requires a high signal to noise ratios for a good throughput. It works well over a VHF FM channel at a signaling rate of 1200 or even 9600 baud. Speeds of 300 baud can be used on an HF channel, but experience over the last 20 years in MARS suggests that this mode be used only when none of the more robust HF modes are available.

9.5.3. AMTOR (Amateur Teletype Over Radio)

This is the amateur radio implementation of the commercial SITOR mode by G3PLX. It uses a 7-level Murray code and actually has two modes. Mode A or ARQ (Automatic Repeat reQuest) uses a short three character burst. Errors can be detected at the individual character level. This is a "connected" mode in which the sending station transmits the bursts and receiving station sends ACK or NAK short burst in between sending bursts. Mode B or FEC (Forward Error Correction) is a broadcast mode. Each character is sent twice, but the transmission of the second character is delayed by three characters to take advantage of the short burst nature of radio static. The receiving station software compares the two copies of each character. If either or both are valid characters that character is printed. If neither character is valid, then an error character is printed. Most AMTOR software uses the underscore "_" as the error character. The 7-level Murray code supports only the uppercase character set of the Baudot code. ARQ speeds are up to 100 wpm while the FEC mode is a fixed 50 wpm. AMTOR Mode B is available as the SITORB mode in Fldigi under Navtex/SitorB in the Op Mode menu.

9.5.4. PACTOR

PACTOR is a proprietary mode developed by Special Communications Systems (SCS) GMBH from Germany. They have developed three Levels or Modes. Level I has been licensed by other manufacturers for use with their terminal mode controllers. Levels II and III are still proprietary and can only be operated using one of the SCS TNCs such as the SCS PTC-IIe, IIex, or SCS II Professional. Most modern amateur HF TNCs are licensed to transmit PACTOR I. At least one Linux-based soundcard software package is capable of sending and receiving PACTOR I. Several software packages claim PACTOR I receive capability. PACTOR combines features of both Packet and AMTOR and the ASCII code is used for the characters. PACTOR I also uses the 170 or 200 frequency shift keying tone shift similar to Packet and AMTOR. Modulation of PACTOR II signals is based on differential phase shift keying (DPSK). PACTOR III uses a voice channel of 2.4kHz and with an optimal link, is 4 to 5 times faster than PACTOR II mode.

PACTOR III utilizes up to 6 speed levels and up to 18 tones spaced at 120 Hz. Maximum bandwidth is 2.2 kHz and a center frequency of 1.5 kHz. In the ARQ mode, there is a dynamic adjustment to speed. If repeated NAKs are sent by the receiving station, the sending station will slow the speed of transmission. When several slow speed packets are received without error,

the sending station will attempt to raise the speed. In addition to the basic signaling rates of 100 and 200 wpm additional message speed can be had by using optional Huffman compression.

The PACTOR FEC mode is similar to the AMTOR FEC mode except the sending operator can specify the number of times that a character is repeated. The number of repeats can be increased from the default value of 2 up to a value of 5. This brings about a major increase in broadcast transmission reliability at the price of speed. Because of the 200 wpm maximum speed, PACTOR transmissions need to use a minimum 200Hz shifts. PACTOR ARQ is the preferred mode used for HF MARS Message Center Systems (MMCS) operations.

9.5.5. PSK-31 (BPSK-31)

This was the first of the popular sound card modes. It was developed by Peter Martinez, G3PLX as a keyboard-to-keyboard digital mode. It uses narrow band phase shift keying at a modest data rate of 31.5 baud and a variable length code, also known as a varicode. The advantage of a varicode is that all characters can be transmitted with the most common characters having the shortest codes. Maximum typing speed is 50 wpm. It is a narrow band mode and the powerful DSP capability of sound cards makes it possible to copy signals even when they cannot be heard. The basic modulation scheme is BPSK (Binary Phase Shift Keying) without error correction. Since the emission bandwidth is on the order of 80Hz, a single voice channel can support more than a dozen simultaneous keyboard to keyboard transmissions. This is a potential major advantage for MARS in times of heavy traffic load as a single MARS frequency allocation channel could support simultaneous communications with a net operator being able to simultaneously monitor all communications within the channel using software such as Digipan, which allows simultaneous reception. However, such advanced channel usage has not typically been practiced in MARS, but is something that advanced exercises should practice on occasion. Typically, just one transmission occurs per channel in MARS circuits.

Because of the use of a varicode that favors the efficient transmission of lowercase letters, PSK-31 will have a higher wpm rating with lowercase text than with uppercase text. Additionally, in bad conditions, the longer sequences required for transmitting uppercase text will give rise to more errors and potentially garbled transmissions. Switching to lowercase text usage will often result in the transmissions being received without error. This is important for MARS messages, and it is recommended that the usual uppercase text body be converted with word to lowercase text prior to transmission in order to maximize the wpm of the transmission and reduce the likelihood of error in the received text.

Although a very convenient mode for keyboard to keyboard usage when pre-written texts are not needed to be loaded, extensive testing by Navy-Marine Corps MARS over a variety of conditions showed an average error rate for BPSK-31 of 3.8% or 1 error every 26 characters.

Whilst acceptable for conversation mode, it could cause problems if used to relay lengthy messages.

It should be noted that PSK-31 requires linearity in order to properly transmit the signal. If amplifying the signal, the amplifier must necessarily be operating inefficiently, as with voice, in class-A or class-AB. It is not possible to use class-C amplification with this mode. For typical MARS usage, with a single transmitting station per channel, amplification to get the signal through is fine. However, if advanced channel usage is being practiced (with multiple TX stations per channel), then amplification should not be done, because one strong signal will deafen the receiver to other simultaneous signals that are occurring on the channel.

9.5.6. QPSK-31

QPSK-31 is the FEC version of BPSK-31 and is often overlooked even though it demonstrates to be significantly superior to BPSK-31. Binary PSK transmits one bit at a time, using one of two possible phase states. Quaternary (or Quadrature) PSK sends two bits at a time, using one of four possible phase states. Alternatively, you can think of QPSK as sending a second BPSK signal that is 90^0 out of phase with the original BPSK signal. Both QPSK and BPSK send the same number of phase transitions per second, so QPSK can send twice as many bits as BPSK. Peter Martinez used this extra capacity to include a rate-1/2, constraint length 5 convolutional code to improve its efficiency. Rate-1/2 means a code that takes as long as the original transmission to send. A high degree of interleave and Viterbi decoding is used such that there are 32 opportunities to correctly receive any 5 bits in the Varicode stream. It is effective under poor propagation conditions. Complaints for this mode not working as well are usually owing to difficulties in correctly tuning. Tuning is twice as critical with QPSK as it is with BPSK. To be effective you must tune the received signal to an accuracy of 4Hz. Clearly both transmit and receive stations must have very stable transceivers to achieve this. Clever sound-card interface software, such as Digipan, somewhat removes the need for accurate tuning because it can identify where the signals are located and correctly decode them, keeping track of frequency changes using Automatic Frequency Control (AFC) within the software. This mode requires linearity in the same way as BPSK-31.

9.5.7. MFSK16 (MFSK)

MFSK (Multi-Frequency Shift Keying) (more specifically, MFSK16) is a multi-tone, FSK mode with Forward Error Correction (FEC) consisting of 16 tones(15.625 baud, 16 FSK tones at 15.625Hz spacing). It is loosely based on the old British Piccolo system using relatively narrow tone spacing. The French military had a similar system called Coquelet. MFSK16 has an effective 42 wpm data rate and uses about a 316 Hz bandwidth It has proven to be a good weak signal, long distance mode. The mode was created by Nino Porcino (IZ8BLY) and Murray Greenman (ZL1BPU). The DSP algorithm uses Fast Fourier Transform technology to decode the ASCII characters, and Constant Phase Frequency Shift Keying to send the coded signal. Continuous

Forward Error Correction (FEC) sends all data twice with an interleaving technique to reduce errors from impulse noise and static crashes. Because this mode used varicode, both lowercase and uppercase characters may be sent, in fact the full extended ASCII character set. This also makes it possible to transfer short data files between stations under fair to good conditions. The varicode used in MFSK16 is not the same as that used in BPSK-31, although the techniques are similar. The mode has good immunity to multi path phase shift. For several years, the TRANSCON digital network used MFSK16 as the primary mode to revert to if all else fails. The mode requires accurate tuning and frequency stable transmitters. A second version called MFSK8 (7.8125 baud, 32 FSK tones at 7.8125Hz spacing) is available with a lower baud rate but greater reliability for transpolar communications, when polar phase shift is a major problem. This second version requires even more accurate tuning and greater frequency stability. All MARS NTIA-compliant transceivers should not have any difficulties with the frequency stability requirements of either of these MFSK versions.

Mode	Symbol Rate	Typing Speed average/"paris " speed	FSK Tones	Bandwidth	Lowest S/N
MFSK8	7.8125 baud	26 wpm /36 wpm	32	316Hz	-15.5dB
MFSK16	15.625 baud	42 wpm/ 58 wpm	16	316Hz	-13.5dB

Table 10 - MFSK Characteristics

In the MFSK table of characteristics, you will note that there are two speeds listed. The higher speed is for sending the word "paris " with a following space 100 times and seeing how many of this standard word are transmitted in a minute. The figures of 36 wpm for MFSK8 and 58 wpm for MFSK16 are thus noted. But these are unrealistic in terms of typical English transmissions. MFSK uses a varicode in a similar way that Morse uses a varicode so some characters are quicker to transmit than others. The varicode used favors lower case transmission. For typical random words the more conservative average typing speed is also shown in the table, which is 26 wpm for MFSK8 and 42 wpm for MFSK16. It will be noted that both MFSK8 and MFSK16 occupy the same bandwidth of 316Hz.

MFSK can also be used to transfer small images. Not that there would probably be much need for this in MARS but confirming a building with earthquake damage via a picture could be a valuable asset when internet links may be severed in an earthquake. But again, time to transmit needs to be considered. No single transmission should be over a few minutes in length.

An MFSK transmission changes from one tone to the next smoothly, with no sudden change in phase, and no change in amplitude. Because tones are sent in a continuous phase (CPFSK) manner at constant amplitude, the transmission system does not require linearity. This means

that highly efficient class-C amplification may be used for MFSK. Note that MFSK is 100% duty cycle, so it is not the ideal mode to choose if running on reserve battery power. Although, it will often get the message through in one go, avoiding a repeat transmission, owing to its superior signal to noise ratio at the receiving station. That fact can itself conserve battery power.

9.5.8. MT63

This mode uses 64 tones and spreads the transmission of any single character over the frequency domain (spectral spreading) and time domain (temporal spreading). It is reported that the sophisticated FEC scheme used can recover from up to 25 percent obliteration of a character. The emission bandwidth is either 500, 1000 or 2000 Hz and is user selectable. Initial settings for MT63 are typically Bandwidth 1000 Hz, Non-Inverted, Long Interleave. This is generally the default for most software packages designed for this mode of operation. Tuning can be critical with older software and requires a very frequency stable transceiver on both ends. In the latest software, e.g. Fldigi, no special tuning technique is required because the signal capture logic is capable of locking with ±50 Hz frequency error (±80 Hz and higher in the latest software). Additional parallel receivers in the latest software allow for significant mis-tuning before performance degrades appreciably. The spreading of each character over time, does lead to some delay in the display of text. See Table 11 - MT63 Characteristics.

Mode	Symbol Rate	Typing Speed	Interleave (short/long)	Latency (short/long)	Bandwidth	Lowest S/N
MT63-500	5 baud	50 wpm	6.4s/12.8s	12.8s/25.6s	500Hz	-8dB
MT63-1K	10 baud	100 wpm	3.2s/6.4s	6.4s/12.8s	1,000Hz	-5dB
MT63-2K	20 baud	200 wpm	1.6s/3.2s	3.2s/6.4s	2,000Hz	-2dB

Table 11 - MT63 Characteristics

Interleave, the amount of temporal spreading that the signal receives, can either be short or long. As mentioned earlier the default mode is MT63-1K long interleave. Static crashes, interference, short fades are eliminated more effectively with long interleave. However, this does have an impact on overall latency of a transmission. When one operator finishes typing, the transmission will continue for another 6.4s. If the remote operator immediately starts replying, the original transmitting station won't see any reply for an additional 6.4s, hence a round trip latency of 12.8s. Even if the responding station is fast, the minimum time that the transmitting station has to wait is 12.8s. This makes short conversational QSOs difficult and can make net check-in of several stations tedious. If long interleave is used in MT63-500, the latency doubles to an incredible 25.6s. So the recommendation is to only use long interleave on MT63-

500 if the fades and interference are deep and long (circa 7-8s), otherwise the short interleave on this mode gives the same temporal spacing as MT63-1K with long interleave. This will permit fairly rapid turn-around in the communications.

If conditions are good, MT63-2K will give 200wpm message speed and is ideal for prewritten messages to be sent from file. MT63-2K should not be used for directly typing a message unless you can type sufficiently fast to justify the bandwidth usage. Most experienced typists will find MT63-1K more than fast enough to meet their needs with a 100wpm capability. Even if you type faster, the words will still be stored in a buffer and the added 3dB of S/N capability means that your message is more than likely to get through.

In extensive Navy-Marine Corps MARS testing under a variety of conditions, MT63-1K showed an average error rate 0.046% or 1 error every 2185 characters. This is clearly ideal for passing pre-written messages with high accuracy. Basically, if signal strength is good enough to obtain copy, the copy will be close to perfect, with very few errors. Too weak a signal strength and errors slowly increase until suddenly zero copy is obtained, rather than inaccurate copy. MT63 will perform under conditions that would cripple either RTTY, SITOR A/B or Pactor 1 and similar FSK modes.

Because this mode if quite quiet in terms of the signal it puts out (no horribly distracting whistles, just a loud waterfall like roar), it is possible to have a simultaneous SSB speech signal on the same channel as the MT63 signal. This is especially true if the signal is centered in the channel at 1,500Hz. This capability of having the MT63 being received correctly at the same time as speech can be heard legibly is an additional benefit of this mode.

This mode is about 80% duty cycle. But be wary of judging this from the average power meter on your radio. It may appear that the meter is stating 10% power, but the actual peak output power does indeed rise to a full 100% and a peak output power meter will show this. Do not adjust your sound card output to try to make the signal louder, you will distort the signal and potentially damage your radio by overdriving the finals. MT63 sounds quiet, but it is actually a strong signal. This mode requires high linearity. Any amplification must, like SSB voice, be class-A or class-AB.

This mode's performance has made it the mode of choice for traffic handling in most USAF MARS nets, many Navy-Marine Corps MARS nets and some Army MARS nets. Its broadcast capability means that any station on a net can copy the traffic and forward if necessary to a station that did not achieve copy.

9.5.9. Olivia

Olivia is a digital mode designed to work in difficult (low s/n ratios plus multipath propagation) conditions on HF bands (though it also works as well on VHF/UHF). When listening to it and

observing it on a waterfall display, the signal can be seen to be like a combination of MT63 and MFSK. The signal can be decoded even when it is 10-14 dB below the noise floor. It can also decode well under other noise, fading, man-made interference, flutter (polar path) and auroral conditions. The confusing item with Olivia is that there are many possible modes of usage. The formats vary in bandwidth (125, 250, 500, 1000, and 2000Hz) and number of tones used (2, 4, 8, 16, 32, 64, 128, or 256). This makes it possible to have 40 different Olivia formats which have different characteristics, speeds, and capabilities. The two most commonly used in MARS activities are 16-500 and 32-1000, known as Olivia 16 and Olivia 32 respectively. The characteristics of these two specific formats are shown in the following table.

Format	Symbol Rate	Typing Speed	FSK Tones	Bandwidth	Lowest S/N
16-500	31.25 baud	20 wpm	16	500Hz	-13dB
32-1000	31.25 baud	24 wpm	32	1000Hz	-12dB

Table 12 - Olivia Characteristics

The reason that these two formats are chosen is that they provide reasonable robustness with -12dB of S/N capability in 32-1000 and -13dB of S/N in 16-500 and acceptable speeds of just over 24wpm and nearly 20wpm respectively. Although 16-500 is slightly slower, it also uses less bandwidth so two or three transmissions could occur in the bandwidth of a single MARS channel. Although six is mathematically possible in 3kHz bandwidth, typical transceiver limitations of not transmitting in the lower 500Hz of audio and not transmitting in the upper 500Hz of audio would limit it to four sets of 500Hz signals, but coupling this with the need for some spacing between sub-channels of say 250Hz, reduces capacity. So, in real terms, a max of three simultaneous transmissions could, with careful arrangement, occur in a single MARS channel. Naturally, Olivia should only be used for poor propagation conditions, as other modes such as MT63 give far better throughput when conditions are good. Of course, even when conditions are good, if one is operating on emergency power and has a severely reduced transmitted power output, then Olivia can be a useful way of getting the message communicated.

Olivia is 100% duty cycle and requires linearity in the transmitter and amplifier. Any amplifier must be operated in class-A or class-AB.

9.5.10. ALE

ALE is an acronym for Automatic Link Establishment. It can be viewed as a digital HF system rather than a digital mode as it uses several modes. The ALE system provides selective calling and handshake, link quality analysis and channel selection, scanning, and sounding. Participating stations have radio equipment designed to ascertain automatically the highest quality reliability of linking together two or more stations operating on the same frequency, given a group of frequencies customarily in different bands, therefore accommodating changes

in day, night, and solar cycle propagation, and other propagation anomalies. Stations can communicate automatically or manually with each other with digital/data being the primary mode and SSB voice being the secondary mode. It is important to the MARS mission as it is the method of HF digital communications used by several of our served agencies such as DoD, SHARES and FEMA.

Until recently this system was only available to MARS member willing to purchase the expensive commercial hardware implementations as there are few ALE devices that have moved to the surplus property inventory. It is an implementation of Mil-Std 188-141B (now revised to Mil-Std 188-141C) and FED-STD 1045A.

Charles Brain, G4GUO, wrote a computer soundcard implemented version of ALE nicknamed PC-ALE that opened this system up to MARS members at relatively low cost. Mr. Brain released his source code to a MARS development team that has continued to be developed and the current software is now nicknamed MARS-ALE. The ability of the sound card version of ALE to connect with a military hardware was demonstrated during Grecian Firebolt 2004 and 2005. Because of the requirement for military users of ALE to be registered with their parent service, MARS members must obtain permission to operate ALE and be assigned an ALE Identifier prior to transmitting on the ALE nets.

9.6. Digital mode software recommendations

It is difficult to recommend different software for different people but the following are known to be good.

Digipan – http://www.digipan.net/ – DigiPan stands for "Digital Panoramic Tuning" and brings the ease and simplicity of PANORAMIC reception and transmission to BPSK31, QPSK31, and other PSK variants. DigiPan provides a panoramic display of the frequency spectrum in the form of an active dial scale extending the full width of the computer screen. It is possible to decode 20 or more PSK31 stations at one time. It is very popular and extremely easy to use.(Freeware)

FLdigi – http://www.w1hkj.com/FldigiHelp-3.21/index.html - Fldigi is a complete digital multi-mode program with many advanced features including rig control. It works on Windows, Mac OS X and Linux operating systems. It is very easy to use and quite modern in its algorithmic processing for digital modes. It is currently the most highly recommended system for MARS usage because of the a similar look and feel interface regardless of operating system of the computer on which it is running. This common look and feel means that new software does not have to be learned if called to a deployment to other stations. Includes support for CW, Feld Hell, BPSK31, QPSK31, MT63 (all types), MFSK (all types), Olivia (all types) and many more. In fact, nearly all modes, with the exception of PACTOR, are supported. There is an additional

software available called Flarq which allows Automatic Repeat Request to be used for achieving 100% copy between two stations with the normal digital modes such as MT63. (Freeware)

Hamscope - http://www.qsl.net/hamscope/ - PSK31, RTTY, ASCII, MFSK, Packet and CW (Freeware)

MixW - http://mixw.net/ - This is multi-mode software and has been used a lot in the past. The software has not been updated in a long time. The software can be extended to handle Olivia with a downloadable add-on. It is Windows only software. With the RigExpert interface it can also do rig control. (Shareware - $50)

MultiPSK - http://f6cte.free.fr/index_anglais.htm - This is a French developed multi-mode program. It is Windows only software. The software has a complex, non-intuitive GUI, but does boast support for a large number of modes including Packet and PACTOR I. (Freeware).

IZ8BLY software for MT63, is no longer recommended for MARS use as it is somewhat dated in operation, with the last update back in 2004. It is Windows XP and DOS only. It is mentioned here only to state that if you are using it, you should update to one of the more modern pieces of software for MT63.

There are many other software programs available, but the above offer more than sufficient coverage for most MARS usage. Fldigi is the software package most recommended at the time of writing this version of the training manual and all MARS members should become familiar with its usage as it covers the most frequently needed modes and is the most up-to-date, operating system agnostic software currently available.

9.7. Equipment setup instructions

To utilize digital modes, the computer needs to be connected to the transceiver. There are several means of achieving this.

9.7.1. Acoustically coupled connection through microphone and speakers

In this mode, there is no physical connection between the computer and the radio. The computer soundcard plays the sounds into the speaker and the transceiver microphone is keyed and used to listen to the speakers on the computer in order to transmit the audio. To receive and decode a digital signal, the built-in microphone of the laptop computer or some external microphone listens to the sound coming out of the radio speakers. Transmit and receive audio is then acoustically coupled from microphone to speaker and vice versa. Of course, if you do this, you'll need a quiet room, you'll have to operate with voice control (VOX) or manual transmit control (PTT) and you'll have to watch your levels.

The advantage of this manner of connecting things is that it is simple. This mode can well be used in an emergency with a laptop computer. The key difficulty is in arranging the transmission

properly. The microphone on the transceiver needs to be keyed prior to pressing the send on the computer software. VOX can work, but sometimes the delay can result in key data being lost, so manual PTT operation is better. Although, if typing by hand, one hand is potentially now holding the microphone on and unable to type. This is fine for sending a prepared message, but difficult for interactive communication. Receiving is simply un-keying the transceiver microphone and letting the sounds from the radio enter the computer through the computer's microphone.

The disadvantage of this technique is that environmental sounds can enter the transmission and can interfere with reception. Many of the digital modes are quite deafening in their tonal quality, so this audio connection method does not suit operations at night in an environment where such noises would disturb people. Even family members would find such tones disturbing. Note that any additional noises that normally come through the computer sound card, should be disabled prior to using this technique. The "ding" tone of new email arriving would interfere with a digital transmission and any sound effects would also be inappropriate to appear on air.

9.7.2. Computer control of PTT and frequency

It is possible to manually tune your radio and operate without computer control, but life will be much easier if your software can control your radio. Computer control can be broken down into PTT control and full frequency control. PTT control is very much a recommended thing to occur, but full frequency control needs to be considered carefully. The reason for caution on the latter is that inadvertent mistakes can lead to band switching when the transceiver may not be tuned to the transmit frequency and the antenna not being tuned to the right frequency. This can be problematic when an amplifier is also connected to the system. Novice users are recommended to initially adopt PTT control only by computer and leave the dial frequency control remain under manual control. In this mode you want to leave the Waterfall display to always show audio frequencies. It is also useful to monitor the transmitted signal on the waterfall, as it helps you learn what different types of signal look like during transmission. This way, you will be more than likely to recognize them when you hear them on MARS channels.

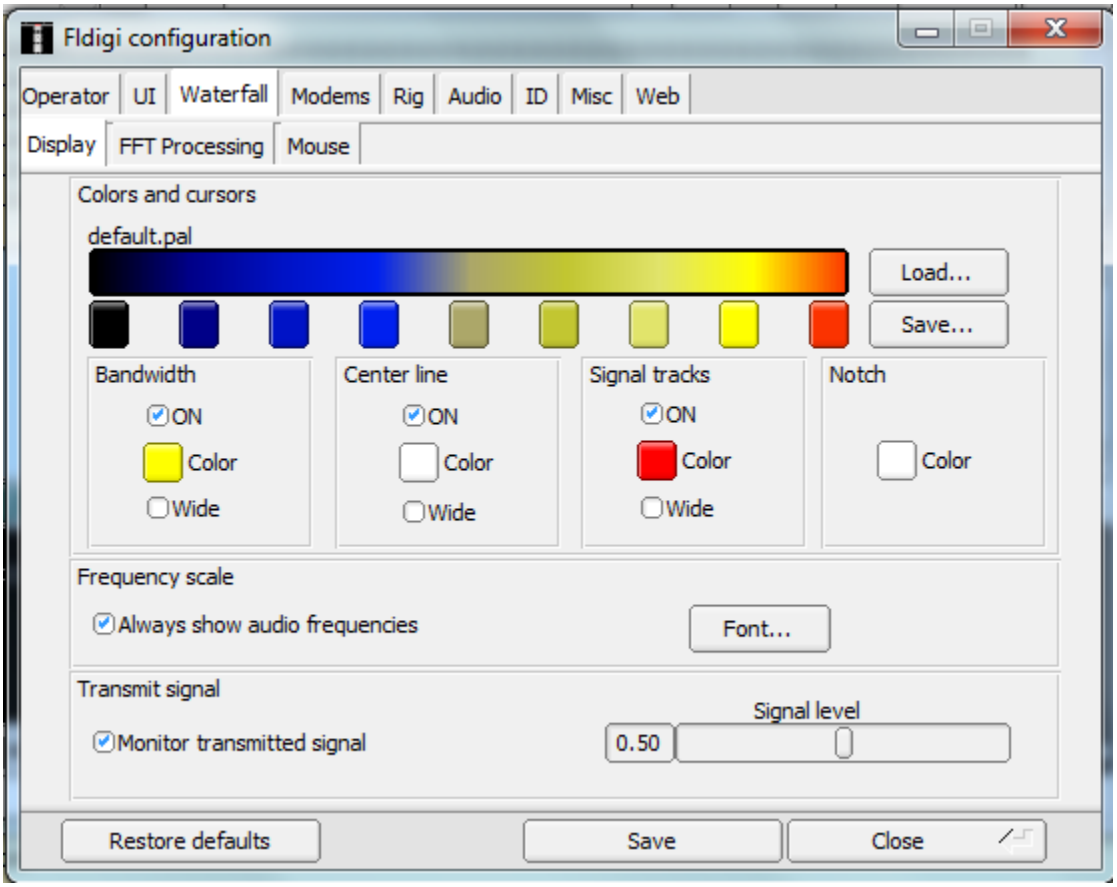


Figure 2 - Fldigi Waterfall setup

All software used with direct connection interfaces allows PTT control of the transceiver. Some software when combined with specific interfaces can also allow frequency selection to be done

by the digital sound software. Both Fldigi and MixW have this capability with the appropriate interfaces.

9.7.3. Direct connection of computer to radio using computer soundcard

The old serial connections of RS-232 are no longer provided on modern computers, so one needs to use a USB connection to the radio. It is better to purchase a newer interface that provides a USB connection rather than attempting to use a USB to RS-232 adapter card with an old RS-232 serial interface based connection. It can work, but it is not recommended. Donner Digital interface is of this type that still uses RS-232 so needs an auxiliary USB to RS-232 adapter for use with modern computers.

Typical interfaces that provide direct USB type of connection are RIGblaster series of connectors. Adapter cables are required for most radios and your radio will need data/aux jacks on it to allow control. By being a USB interface, it is powered directly from the USB connection and does not need an external power supply.

Because the sound from the computer soundcard is connected through to the radio, again any auxiliary tones that you have on your computer should be switched off prior to using this type of interface. The advantage of a direct connection is that the digital mode can be run in a completely silent manner with no sounds “warbling” around the house or the hospital late at night. This makes digital operation much more discrete.

One issue with computer soundcard usage is that of an old Windows operating system bug with regard to soundcards that makes the transmit tone at the wrong frequency. Typically, in the software you will need to RX frequency offset at 0 ppm, but you will need to adjust the TX frequency offset to -7,000 ppm (note the minus sign in front of the number, that is very significant.) Often, first time users of digital modes state that they can decode all the other stations, but the other stations can’t decode them. Frequently it is this TX offset adjustment that needs to be done to correct the situation. This adjustment is only required for Windows operating system computers as the sound card bug is part of the Windows system only and does not affect Mac OS X and Linux based systems.

Running other programs and rebooting your computer may reset your sound card parameters. You may find that you have to readjust your card the next time you need to use it for communications. This is another limitation of using a computer soundcard.

9.7.4. Direct connection of computer to radio using external soundcard

The type of interface that fits in this category is the RigExpert (as used with MixW software) and more recently the Tigertronics SignalLink interface which works with all software. There are several other external soundcard interfaces of this type. In this type of connection the computer soundcard is not used to generate the tones. Instead, an external soundcard is used.

The connection is still direct, so that silence can be observed in the operating station with immunity from environmental noises such as dogs barking, just as with any direct connection. The difference here is that because the external soundcard is driven by the digital software, and nothing else, only the digital software sounds are communicated to the radio and only the signals from the radio are communicated to the digital software. Other computer sound effects such as arriving mail, playing a CD, having an incoming Skype call, etc., all go to the regular computer soundcard which is not connected to the radio. As a result, this type of connection is the best for having an active computer usage and not needing to alter any computer settings prior to using the digital soundcard software.

There is an additional advantage of this type of connection. The external soundcard is operating outside of the operating system of the computer and operating system bugs do not affect the frequency of tones generated by the soundcard. Thus, the Windows bug for using the computer soundcard, does not affect things when using an external soundcard. An initial TX offset of 0 ppm can be safely assumed. Additionally, level adjustment for an external soundcard is always fixed. Rebooting of your computer will not result in the soundcard levels being reset.

9.7.5. Frequency alignment for RX ppm, TX ppm and TX offset

There are many steps involved in the setup. These are outlined here to assist you in quickly resolving any problems you may experience in getting operational in digital. Sometimes everything works out perfectly with zero effort and sometimes things just don't seem to make sense. The steps in this section help resolve these difficulties or at least point you in the appropriate direction to consider possible solutions. RIT should never be used in operating in digital modes. RX ppm is an alignment adjustment to allow for the sound card sampling rate and the sampling rate in the software not being in perfect alignment. TX ppm is the same, but affects only the transmitted audio rather than the receive audio. TX offset is a number of Hertz change in the transmitted signal. These terms are from Fldigi, but other software has similar terms.

9.7.5.1. Frequency alignment of the transceiver

In being able to communicate with other MARS members, it is important to ensure that your radio itself is operating at the right frequency. In normal MARS communications, if you are using the RIT (Receiver Independent Tuning) knob to make voices seem normal, your radio is probably out of alignment if the dial frequency is displaying appropriately. The simplest technique is to listen on 2.5MHz, 5MHz, 10 MHz or 15MHz to either WWV (located in Fort Collins, Colorado, with male voice) or WWVH (located on the Island of Kauai, Hawaii, with female voice) and to first double check that your radio is aligned such that you can hear the

signal at the right frequency when your radio is displaying the appropriate frequency. Both WWV and WWVH use double sideband amplitude modulation

Secondly, the transmit signal needs to be considered. Although your radio may be stating e.g., USB dial 3366.000kHz and you are receiving perfectly on that frequency, it does not necessarily mean that you are transmitting perfectly on that frequency. It is easy to be off by as much as 100Hz. How to check this? You need the help of another MARS member, but doing it by voice is tricky. It is much easier to set your radio to CW mode, adjust the frequency to middle of the MARS band (1.5kHz above the USB dial frequency, 3367.500kHz in this example) and briefly transmit a carrier. Your MARS colleague can then (assuming is radio is properly tuned for receive) tell you if your transmit frequency is slightly high or slightly low. He will need a radio than can display down to the nearest single digit in Hz, i.e. three decimal places when the main display is in kHz. He will also need to set all his CW filters to the narrowest bandwidth so as to carefully determine the exact frequency of your transmitted carrier. For you to adjust your transmit frequency, there is usually a small transmit offset alignment screw on most transceivers. Small adjustments of this screw will allow you to get the signal to the right frequency.

9.7.5.2. Frequency alignment of the soundcard software

Now that your radio is properly aligned, let's now check your soundcard software for frequency alignment. Typically most soundcard software will recommend tuning to some time signal station such as WWV or WWVH. Tuning is typically done using some SSTV mode (MixW) or a WWV mode (Fldigi). A pictorial display of a line representing the WWV signal will show and the line will slowly develop as you listen to the signal. Several minutes of listening in this mode is required in order to calibrate the soundcard RX ppm change. The objective (in high magnification mode) is to get the line as vertical as possible.

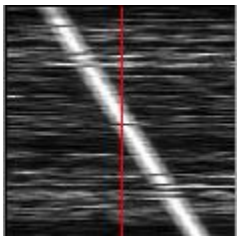


Figure 3 - WWV at -1000ppm, 5x scale

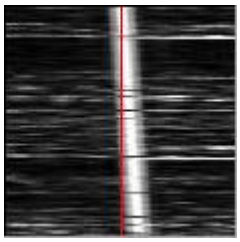


Figure 4 - WWV at -20ppm, 5x scale

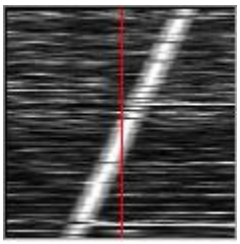


Figure 5 - WWV at +700ppm, 5x scale

If the line is almost horizontal, even at a 1x scale, then a severe correction is required. Typically, the correction required on most modern soundcards will be small (a couple of hundred ppm at

most). If the slope is negative, you will need to put a positive entry into the RX ppm field. If the slope is positive, like in Figure 5, then the number entered into the RX ppm box will be negative.

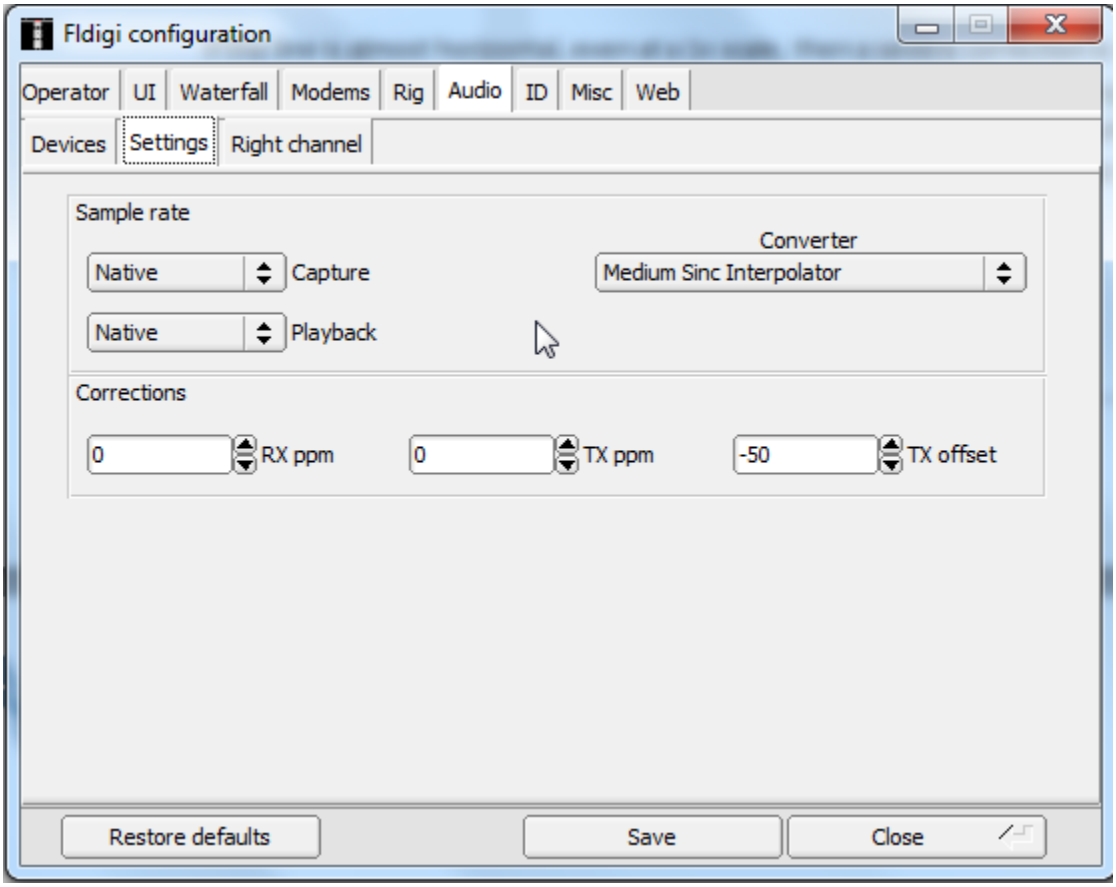


Figure 6 - Fldigi setting of RX ppm, TX ppm and TX offset

The TX ppm adjustment needs to be considered next. Now, although the RX ppm has been properly aligned, there are sometimes some difficulties in terms of getting the soundcard output at the right audio frequency, there is a separate TX ppm adjustment to do this. There are a variety of techniques in doing this. One is to use another MARS colleague who can check if a tone you are transmitting on 1,500Hz audio is coming in on his waterfall at the same position. Best done with the waterfall display magnified (to the max of x4 of Fldigi) while watching the tone come in and, for the station doing the monitoring, e.g., in Fldigi, setting the mode to Freq Analysis, or simply using CW mode (using the Tune button) on his radio and tuning in to the nearest single Hz. The monitoring station can then tell the transmitting station if the signal was high or low. As the TX ppm alters frequencies differently throughout the audio spectrum, effectively either stretching a 1,000Hz wide signal wider than it should be or squeezing it narrower than it should be, testing at various audio frequencies is required.

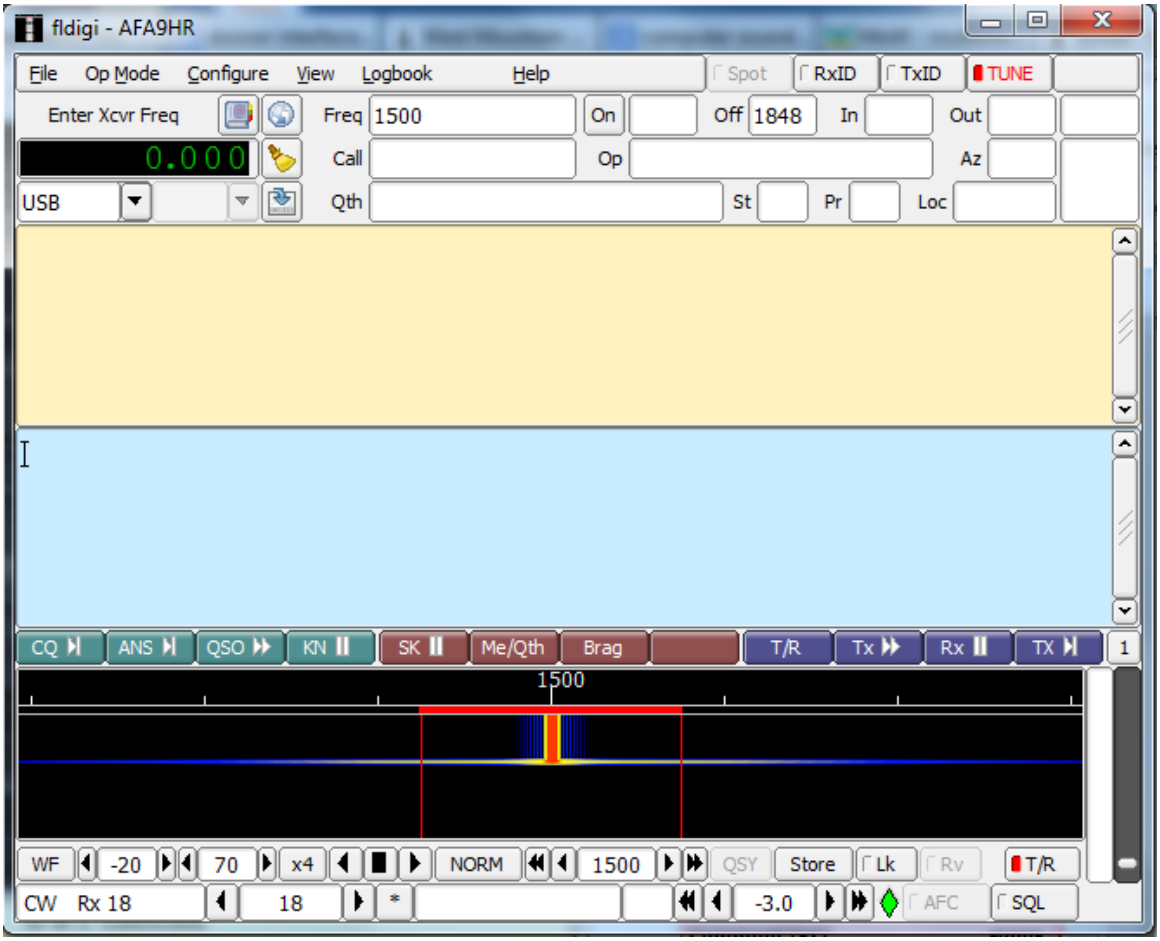


Figure 7 - Tuning TX at 1500Hz

An alternative technique to this is to transmit an MT63-1K signal and have your colleague monitor the bandwidth edges. Using guesswork, one can make adjustments to the TX ppm to assist in getting things right.

Another technique is to record the output from the soundcard into a digital recording device and then play it back to the computer using the computers speaker. This is typically a very good way of validating if your transmitted signal will be readable. It is best to do this with MT63-500, as errors in frequencies make receiving this mode more difficult than with receiving MT63-1K.

For Windows computers only, there is also a software soundcard checking mechanism that can be used, called CheckSR. See http://www.pa-sitrep.com/NBEMS/Fldigi_calibration.htm for details.

9.7.6. Level adjustment of the audio signal

This depends on whether you are using an acoustically coupled connection, a computer soundcard (internal) or an external soundcard (2nd soundcard in addition to the computer soundcard). Note that for most soundcard modes it is best to always turn off any speech compressor on the radio. For direct connections, the voltage levels for different radios need to be considered.

For reception of digital signals, the soundcard gain needs to be adjusted so that there is a signal visible in the waterfall of the soundcard software. The transmission of digital signals, the output needs to be at an appropriate level for the radio in question. On external soundcards, there is often an additional level control on the soundcard itself, which can be used to adjust the signal driven to the radio. Typically, the radio RF gain should be on maximum and the radio microphone gain should be left at the default setting for normal SSB voice usage. When adjusting an external soundcard output level, and feeding the transceiver output into a 50Ω load, the audio should typically be adjusted to enable 50% of full RX output when using PSK31, or 100% when using CW from the soundcard. The ALC on the radio should not activate during transmit. This is quite important. ALC activation means that absolute linearity, which is essential during transmission of many digital modes, is being lost. The ALC should never activate during digital mode operation.

Once properly set up, it will usually not be necessary to ever make any adjustments again when using an external soundcard. Using an internal computer soundcard can often require going through the steps again if new software that uses the soundcard is installed or if you make changes to allow a Skype call to be handled effectively etc. Refer to your particular computer soundcard or external soundcard instructions for setting up the levels.

Remember, in an emergency simple acoustic coupling of holding the transceiver microphone near the laptop speakers and positioning the laptop near the transceiver's speaker can allow effective digital communications to take place. Some adjustment of volume and microphone gain will be required, but this can often very quickly get a digital transmission working under emergency field conditions.

9.7.7. Transmitting with Fldigi

This section outlines a few important considerations when using soundcard software. Although Fldigi has been used, the equivalent techniques are available, and should be used, in other digital soundcard software.

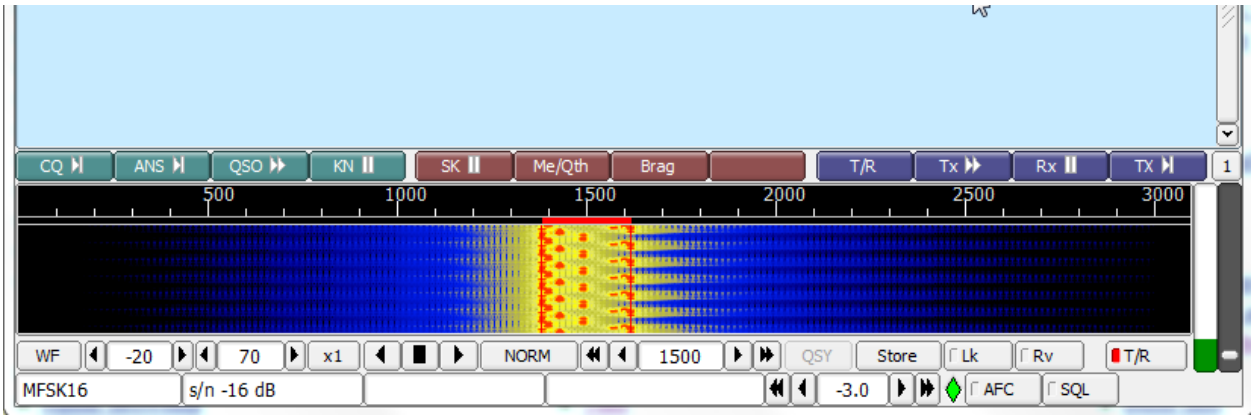


Figure 8 - Fldigi with MFSK16 idle

9.7.7.1. TX frequency lock

Now in the picture of Figure 8, which shows an MFSK8 signal transmitting the idle tones, it will be noted that there are some interesting elements on the far bottom right of the display. The "Lk" refers to "Lock" and means, when selected, that the frequency is locked. Subsequent changes to the TX audio frequency from 1,500Hz (shown in the bottom middle) will not result in the X audio frequency changing. It is recommended that MARS stations use this to prevent their TX frequency changing as the receive frequency adjusts for drift (see AFC in a moment). Next o "Lk" is "Rv". The "Rv" stands for "Reverse" and will swap the waveform around with the high audio frequencies becoming low. The purpose of this setting is to reverse things when LSB has been selected instead of USB on the radio. Remember most digital transmissions are done with the radio in USB mode and transmitting in LSB will result in the tones being the opposite way around to what most people would expect. This switch should typically be off in normal USAF MARS usage as we always use USB for all frequencies anyway. Note that in Fldigi software, the TX lock switch will automatically deactivate when changing to a different digital operating mode, e.g., switching from MFSK16 to MT63-1K. If the AFC has moved the receive frequency, then the new transmit frequency center will be at whatever value the last receive frequency was. This needs to be carefully borne in mind when changing mode to always recheck your center frequency.

9.7.7.2. Tracking a drifting signal with AFC

Below the "Lk" and "Rv" switches is one labeled "AFC". AFC stands for Automatic Frequency Control and, when enabled, will permit the receive frequency to attempt to follow the other station as their transmit frequency drifts to permit the digital software to always keep a

synchronized lock on the signal waveform. This has great advantages in that a badly drifting signal can always be decoded quite efficiently. The disadvantage is that the frequency shown in the display, which may have started at 1,500Hz, will now change to a different value, e.g., 1,437Hz. As soon as the transmission is complete and you now respond with a transmission yourself, you will be centered on 1,437Hz instead of 1,500Hz. Two problems can occur. Firstly, this can confuse the other station if they had not realized their TX drift and did not have any AFC activated. When you transmit you would appear low on their waterfall. The second problem is that if both stations have their AFC switched on, they will both chase each other as they drift. This is not a problem in the two stations remaining in contact, but is a problem for a net since the frequencies will be moving around a lot and if someone can't hear both sides of a transmission, the ability to lock on the changing frequency will be lost. The solution to this problem is twofold. Firstly, don't use the AFC unless you really need to, e.g., to communicate with someone who is using a radio that is not NTIA compliant and is drifting a lot in frequency. Secondly, use the transmit frequency lock function "Lk" to ensure that you lock your transmit frequency properly at 1,500Hz before listening to other stations.

9.7.7.3. Setting the right value for squelch

In the reception of digital signals, you will often see a lot of noise in the receive window with random characters being displayed. This random display is what you typically get with the squelch, labeled "SQL" in the bottom right of the Fldigi window, turned off. This is the soundcard software at its most sensitive and all signals that are decodable will be received. But, getting lots of garbage characters between received messages is problematic for sorting. So to change this, you can click on the "SQL" button and then adjust the sliding scale to the right. If you adjust the scale to the bottom, the "SQL" indicator light will glow green in color instead of grey when the switch is off. If you adjust the sliding scale higher (making the receiver more deaf), the light will eventually turn to orange in color indicating that the squelch circuitry is active and no noise will appear in the receive window. If a genuine signal that you wish to receive is above the noise floor set by the sliding squelch control, then you will receive the transmission with the squelch light changing to green in color during the reception of the transmission and reverting to orange at the end of the transmission. Of course, setting the squelch control too high will prevent all noise, but also prevent all the weaker station signals from being received. So the minimum possible, while still not printing too much random text, is probably the optimal setting for reception purposes.

9.7.8. Fldigi auxiliary software

There are three auxiliary programs that can be used with Fldigi that can have advantages provided they are used in the right way. These programs are Flarq, FLwrap and Flmsg. The right way of using these programs is to ensure that all intended receiving stations are also using Fldigi and also have the appropriate auxialiary program installed and operating at their station. Failure to observe this guideline will result in receiving stations with different software receiving

stations having multiple control characters printed out in their messages. For those unfamiliar with each of these programs, a short description will be provided for each.

- Flarq – Automatic repeat request program
- FLwrap – compress, wrap and unwrap files
- Flmsg – forms management editor

9.7.8.1. Flarq - Automatic repeat request program

Benefits:

- Allows two stations to be sure that data is transferred accurately between them, works nicely with MT63.
- 1-to-1 communications, so although not encrypted, slightly more secure
- Special codes are inserted into the transmission to allow the software to determine when data needs to be retransmitted

Limitations:

- Can't be used on a broadcast net, it is 1-to-1 usage only
- Special codes will appear as additional characters in a message not intended for the receiving station
- Recommended to be used by MARS members who both have the software and arrange appropriately for the passing of the traffic.

9.7.8.2. FLwrap - compress, wrap and unwrap files

Benefits:

- Ensures exact transmission and informs if there is an error
- Works with multiple stations but every time a stations receives in error, a new transmission would be needed
- Totally manual. This is a benefit for stations that do not have a transceiver under software control.
- On a broadcast net, stations that do not get a correct copy will be informed by the software and will need to ask for a retransmission.

Limitations:

- Lots of additional control characters and wild characters appearing in the message owing to compression. Without FLwrap at the receiving end, the message is unintelligible.
- Should only be used if all stations on the net have both Fldigi and FLwrap installed.

9.7.8.3. Flmsg- forms management editor

Benefits:

- Provides common forms for messages, such as Army or Navy MARS messages, Red Cross 5739 – On-site detailed damage assessment, ICS-213 – Emergency management report, Plaintext.
- Avoids the problem of message buried in a buffer and the operator manually selecting the relevant section of text from Fldigi receive window and then saving to a file.
- Many amateur ECOM nets use this software

Limitations:

- Control characters used in messages. If no Flmsg and Fldigi at RX station, control characters seen in message, which makes message copy and understanding difficult.
- If communication conditions are poor, the relevant section control characters could be corrupted and then the message would be garbled.
- All stations on the net must have Flmsg.
- Only use if pre-arranged with receiving station/s

9.7.8.4. Summary of usage of auxiliary Fldigi software

Fldigi is good software, and the auxiliary software packages can give added benefits, but there is a need to keep things general to enhance 1-to-many interoperability required in MARS circuits.

Flarq

- 1-1 only
- RX station is also a TX station, needs computer TCVR control
- RX station must have Flarq

FLwrap

- 1-to-many
- All RX stations must have Flwrap or message is unintelligible

FLmsg

- 1-to-many
- All RX stations must have Flmsg and Fldigi or control characters seen
- Do not use if stations on the net are using other soundcard software

9.8. Morse nets and soundcard usage

In fact, the original operating mode, CW, is a digital mode. Morse code uses binary symbols (dots and dashes), and it uses variable-length character encoding like PSK31. Although nowadays thought of as a fuzzy mode because it really needs the human ear-brain combination to decode signals that are sent by hand, it is certainly very easy for a computer to decode the Morse signals, albeit without any forward error correction, that are sent by a computer, as these signals would be perfectly timed with a dash being three times the length of a dot, the space between dots and dashes of the same letter being one dot, the space between letters of the same word equaling one dash and the space between two words being seven dots in duration (which was raised from five, which was used in very early Morse transmissions). One would think that it would be possible for a digital soundcard operator to quickly transmit CW using his favorite digital soundcard software. This is indeed possible. But there are some words of caution and etiquette in attempting to do so.

Firstly, it is recommended that you should be able to copy by ear CW sent at speeds of 18 wpm before you enter any CW net, unless it is specifically set up for the purposes of training in CW. The capability of transmitting CW by hand at 18 wpm and receiving at slightly higher speeds is to be considered a bare minimum for participating in the TCN (TRANSCON CW Net). Experienced operators routinely use 24 wpm on such a net and under good conditions some operator pairs will be able go as fast as 42 wpm accurately. So CW via soundcard should not be considered a way of cheating the learning to get on such a net. You need to be able to understand by ear at least as fast as you are sending. In manually transmitted Morse code, it is often possible for people to be able to send at a faster rate than they are able to receive, so using a soundcard to do the CW transmission is good provided some conditions are followed.

On a CW practice net, using a computer to generate the CW will guarantee that the spacing of the tones used for the letters is absolutely accurate, which can help learners progress more quickly. Additionally, it is possible in several programs (Fldigi included) to use Farnsworth spacing for raw beginners. In Farnsworth spacing the speed for the individual characters can be set to a fixed high speed, 18 wpm is recommended for beginners, and the overall transmission speed then reduced to say 12 wpm. This way space is increased between each of the letters to allow a little more “thinking time” for people to refresh their skills, yet they are learning the appropriate character at full speed and getting used to the sound of the character. Gradually, the overall speed can be increased to 14 wpm, 16 wpm and eventually 18wpm. The Farnsworth speed setting is ignored if the overall transmit speed is greater than the Farnsworth character speed (the gap between words and letters is never decreased below the normal international standard for Morse communications). This setting is available under “Configure -> Modems” in the Fldigi software.

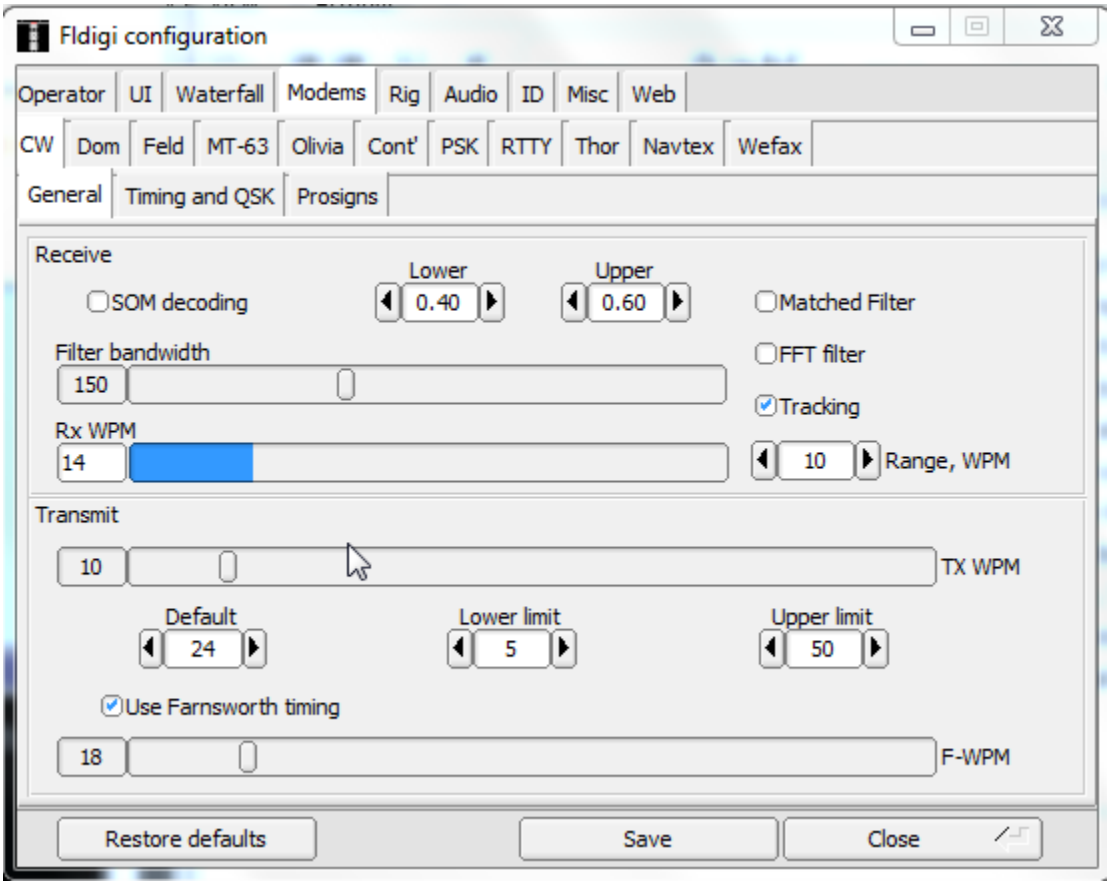


Figure 9 - Farnsworth timing for learners

In the figure, it will be seen that the "Use Farnsworth timing" has been enabled with a F-WPM setting of 18 (shown at left of lowest slider bar in the figure). The TX WPM setting is just 10 (shown at left of the slider bar higher in the figure). So with the setting in the above figure, the characters are sent at 18 wpm but the overall speed of transmission has been scaled down to a steady 10 wpm. Naturally, you do not want to use Farnsworth setting for transmitting messages on actual CW traffic or admin nets; Farnsworth timing should only be used for CW training nets to improve operator speeds.

Another area of important consideration when using a soundcard for CW, is that the prosigns and operating signals need to be sent specially. The BT prosing is normally written with a macron (a line over the letters) such as $\overline{\mathrm{BT}}$. This means that a single character is sent (-…-) with no letter space between the B and the T. Similarly the unknown station symbol $\overline{\mathrm{AA}}$ is sent as (.-.-) and not as AA (.- .-), which means All After. So what does this mean for the prospective soundcard user? It means that you must use the appropriate prosign symbols when transmitting the text. In Fldigi, the $\overline{\mathrm{BT}}$ prosign representing Break Transmission is actually transmitted by typing the "=" character. On reception, because modern software has a difficulty

in showing the macron character, it is shown as <BT>. Using correctly formed Morse prosigns is a very important part of correctly sending CW by soundcard. Learn the characters that represent the single character prosigns you need. If you have a message that you have previously saved from another digital mode, you will need to change some letters to become the corresponding prosign prior to transmission on a predominantly manual (human keying and human decoding) CW net. Clearly some prosigns such as FM and TO are simply sent as two separate characters as these do not have macrons above them in the telegraphy manual and do not need to be changed for sending a message via CW. Although cancelled on 12 March 2004, because no military services currently use CW other than MARS, the best reference for CW transmission on MARS remains the cancelled ACP 124 (D) document, "Communications Instructions Radio Telegraph Procedure", dated October 1983. See http://jcs.dtic.mil/j6/cceb/acps/acp124/ACP124D.pdf.

The following table gives a list of Prosigns for CW usage.

PROSIGN	MEANING
$\overline{\text{AA}}$	Unknown station
AA	All After
AB	All Before
$\overline{\text{AR}}$	End of transmission (OUT in speech)
$\overline{\text{AS}}$	Wait
B	More to follow
$\overline{\text{BT}}$	Break Transmission
C	Correct (or correction)
DE	From (THIS IS in speech)
EEEEEEEE	Error
F	Do not answer
FM	From (Originators designator follows)
G	Repeat back

GR (numeral)	Group count
GRNC	Groups Not Counted
$\overline{\text{HM}}$ $\overline{\text{HM}}$ $\overline{\text{HM}}$	Emergency silence
II	Separative sign (Important Information)
$\overline{\text{IMI}}$	Repeat
INFO	Information addressee/s
$\overline{\text{INT}}$	Interrogative
$\overline{\text{IX}}$	Execute to follow (not typically used in MARS)
K	Invitation to transmit (OVER in speech)
NR	Number
O	Immediate Precedence
P	Priority precedence
R	Received (ROGER in speech)
R	Routine precedence
T	Transmit to
TO	Action addressee/s
WA	Words After
WB	Words Before
Z	Flash precedence

Table 13 - Prosigns for CW usage

In respect of transmitting messages by CW, special note also needs to be made of the prosign II. The Separative Sign (Prosign II), written as a short dash is used to avoid mistakes in reception which might occur if letters or figures of adjacent groups are run together. The separative sign is used in messages as follows:

a. Before and after all prosigns in the procedure and preamble components of the heading, except DE, <AA>, NR and <IX>. The separative sign after a prosign is omitted when the prosign is followed by the <BT>.
b. To separate each element of the Address component i.e., preceding the prosigns FM, TO, INFO and XMT.

See ACP 124 (D) for a fuller description.

Firstly, examine the following digital message and then see what is changed:

```
AFA9AY DE AFA9HR AS
after a few seconds delay
DE AFA9HR NR 423
R 221330Z JULY 2013
FM AFA9HR / CA
TO AFA9AY / CA
GRNC
BT
ALMOST COMPLETED THE MANUAL. WILL SEND DRAFT VIA EMAIL.
BT
K
NNNN
```

When compiled for transmission via Morse, the following would typically be written down.

```
AFA9AY DE AFA9HR <AS>
after a few seconds delay
DE AFA9HR NR 423
- R - 221330Z JULY 2013
- FM AFA9HR / CA
- TO AFA9AY / CA
GRNC
<BT>
ALMOST COMPLETED THE MANUAL. WILL SEND DRAFT VIA EMAIL.
<BT>
K
NNNN
```

Note the use of the Separative Sign before the precedence and before the DTG as well as before the FM and TO parts of the address. In the above the prosign for Break is written as <BT> and the prosign for WAIT is written as <AS> to save needing to write the macron above the letters in this document. In Fldigi, the above would be typed as:

```
AFA9AY DE AFA9HR <
after a few seconds delay
DE AFA9HR NR 423
II R II 221330Z JULY 2013
II FM AFA9HR / CA
II TO AFA9AY / CA
GRNC
=
ALMOST COMPLETED THE MANUAL. WILL SEND DRAFT VIA EMAIL.
=
K
NNNN
```

Note that the default character in Fldigi for the prosign $\overline{AS}$ is the "<" character. When the above is received by Fldigi the Separative Sign "II" will still be printed as II but the "=" will be printed as "<BT>" and the "<" as "<AS>". By observing these conventions, it is possible for a modern soundcard operator to work with experienced CW operators without breaking protocols that have been carefully established over the years.

9.9. Assessment

Note that you should by now have your laptop set up with appropriate soundcard software and have an interface to your radio to enable you to participate in digital traffic passing, which is an essential requirement of MARS participation. Answer these questions and submit your answers to your Training Officer or mentor and answer additional questions that may be given to you.

1. Why are digital modes so useful in MARS?
2. What is the cheapest and quickest way to interface a laptop computer to a radio in an emergency? What are the disadvantages of this technique?
3. What is the bandwidth of MT63-1K?
4. Where in the MARS channel should digital transmissions including CW be placed?
5. Which of the modes MT63-500, MT63-1K, MT63-2K, MFSK16 has the best signal-to-noise ratio? When would you choose to use that mode? Under what conditions would MT63-2K mode be most suitable?

10. NCS OPERATIONS

10.1. Introduction

On 22 Nov 2007 the Chiefs of Air Force, Army and Navy-Marine Corps MARS promulgated a document entitled Standard Operating Procedure for Calling and Operating a Voice Net (generally referred to as the "Voice SOP") setting forth the procedures that would be required to be used on MARS nets as of 01 Jan 2008. The Voice SOP superseded the previous procedures for all Air Force, Army and Navy-Marine Corps MARS voice nets.

The purpose of the Voice SOP is to provide a set of standard procedures that will serve to encourage and support interoperability among the various MARS services. Having standardized procedures allows stations from one MARS service to participate in nets hosted by another MARS service without requiring additional training on the "unique" procedures of the host service. Such interoperability is not only desirable but may be crucial when fulfilling the role of providing emergency communications support.

It is assumed that every MARS member who has completed training is capable of performing the duties of the Net Control Station (NCS). You may choose to volunteer to perform the NCS function or you may be assigned, at any time, to perform the duties of NCS. Thus it is important that you are familiar with the procedures in the Voice SOP. This guide only summarizes the most common NCS functions. The Voice SOP details additional possible NCS actions such as imposing SILENCE, directing use of FULL and ABBREVIATED PROCEDURE, etc.

10.2. Terminology Used

To minimize confusion, this manual will use the same terms and substitutions as in the Voice SOP:

1. A1B2 is a sample net designator
2. NCS is the net control station (this would be substituted with the net control's actual call sign)
3. FRQ1 represents a frequency designator
4. AAA, BBB, CCC, etc. represent stations on the net. (Note: these are not abbreviated call signs. Abbreviated call signs are not authorized on USAF MARS nets.) In actual practice these would be replaced by the appropriate call signs in use, e.g. AFA9HR, AAR9XQ etc.

10.3. General Operating Principles

USAF MARS non-automated networks are directed by USAF MARS net control stations. The NCS may be assigned or drawn from net participants. In the absence of the assigned NCS or ANCS, any member present may open and operate the scheduled network. Sustained emergency communications operations will require a large pool of operators qualified and ready to assist in

maintaining continuous networks. As such, all USAF MARS members are required to understand basic NCS functions and be prepared to assume NCS responsibilities.

THE NCS controls and coordinates the net activities. A typical net outline will flow as follows:

- NCS transmits net call
- Initial members check-ins
- NCS acknowledges check-ins
- NCS recognizes or assigns ANCS
- NCS directs/clears all listed traffic
- NCS conducts official MARS business
- NCS or designated instructor conducts training
- NCS may poll the net for information, questions or comments if appropriate
- NCS declares net free as appropriate
- NCS closes the net

10.3.1. Directed Nets

All USAF MARS are directed nets unless declared otherwise by the NCS. This means every station must have NCS permission to transmit.

Nets are under the direct and immediate control of the net control station (NCS). The NCS is responsible to maintain net discipline and to ensure that all stations are operating within prescribed frequency tolerance.

It is often expedient to have an Alternate Net Control station (ANCS) assigned in advance, or for NCS to designate an ANCS station at the start of the net. The NCS could suddenly, and without warning, be gone from the net.

10.3.2. Stations must check in before conducting business

Stations must first be checked into a net before they may conduct any business on the net. The net status automatically returns to directed status whenever a station checks in. The NCS may then continue the net in directed status or change it to free status as appropriate.

10.3.3. Constant watch required

Once checked in stations are expected to maintain constant watch on the net, be prepared to respond when called, and be prepared to receive traffic at any time. Stations are expected to remain for the duration of the net unless granted permission by NCS to close down sooner. If a station needs to leave for several minutes, the station should inform the NCS that they are leaving their post for <X> minutes and then inform the NCS when they are back at their post. If

you don't know how long you will be gone, then inform the NCS that you will be closing. (Officially, in active military, you need to request to close but, if as a civilian volunteer operator, simply informing the NCS of closure of your station is perfectly acceptable.) When you return, you must then check back into the net with the NCS, although remember that the NCS may have changed during the course of your absence, so don't assume the previous NCS call sign; you cannot immediately jump in to a net and go straight to business without checking back in.

10.3.4. Brevity

Superfluous wording must be eliminated from transmissions. Stations are expected to use prescribed procedures at all times. Transmissions shall be short and concise, consistent with clarity.

10.3.5. Proword usage

Stations will use only authorized prowords and in accordance with their proper meaning only.

10.3.6. Call signs only while net is formal, no personal names

Stations should not expect pleasantries or unnecessary explanations during a directed net. The use of personal names is not authorized while a net is in a formal status. The net status must be informal for personal names to be used. If there is traffic still listed to be passed on the net, the net is by definition still in formal status.

10.3.7. Record traffic

Record traffic must first be listed with the NCS, shall be passed to another station only at the direction of NCS, and only when the net is in directed net status.

10.4. Prior to Opening the Net Check-in of ANCS

If ANCS(s) are assigned for the upcoming net, the NCS will call each in order to determine readability and traffic status: e.g.

```
BBB THIS IS AAA, RADIO CHECK, LIST YOUR TRAFFIC, OVER
```

BBB would respond to the Radio Check and traffic listing: e.g.,

```
1) THIS IS BBB, GOOD READABLE, NO TRAFFIC OVER

   or
2) THIS IS BBB, ROGER, OVER
```

And AAA will acknowledge: e.g.

```
1) THIS IS AAA, GOOD READABLE, ROGER, OUT
2) THIS IS AAA, ROGER, OUT
```

And then proceed to call other assigned ANCS(s). Note that in the above, AAA asked BBB to "LIST YOUR TRAFFIC" and although correct for BBB to say "NO TRAFFIC", it is not required. In the second example, it will be seen that the Signal Report is LOUD CLEAR and NO TRAFFIC is listed because the ROGER means LOUD CLEAR and if traffic is not listed, it is to be assumed that there is no traffic. Again the prowords LOUD CLEAR could be used but are unnecessary because their meaning is encompassed with use of the ROGER proword.

If no ANCS is assigned for the net or the NCS is unable to contact assigned ANCS(s), the NCS will appoint ANCS(s) after opening the net. See "Appointing an ANCS" on page 5.

10.5. Opening a Net

Every net has a net designator as determined by type, administrative level, and location of the net. The net designator not only identifies a specific net, it also serves as a special case of collective call sign representing all stations checked into a net, or wishing to check in.

NCS will make sufficient call ups at the start of the net in an effort to capture all the stations wishing to check in. NCS then proceeds with handling listed traffic, then any other net business and comments between stations. Training should be conducted as required, or as directed by competent authority. Typically training, if not on a specialized training net will only occur after all other higher precedence net business, such as passing of record traffic, has been completed. Training will always be done with the net in directed net status.

10.6. Conducting a radio check callup

At the designated time the Net Control Station (NCS) will call the net as follows:

10.6.1. Initial call in good conditions

NCS starts the net with a call up by transmitting:

```
A1B2, A1B2 THIS IS NCS OVER
```

Note: The net designator is stated twice only in the first call up. This call up serves multiple functions. It announces the net, puts the net in directed net mode, and authorizes stations to transmit for such purposes as checking in and listing traffic. Note that NCS in the above will be replaced by the call sign of the station acting as NCS. You don't need to tell people that you are the NCS unless there is confusion.

Subsequent call ups are made as follows:

```
A1B2 THIS IS NCS OVER
```

10.6.2. Initial call in poor conditions

When conditions are poor NCS will transmit the call up using words twice, without use of the proword WORDS TWICE. e.g.

A1B2, A1B2 THIS IS NCS, NCS OVER

Subsequent call ups are made as follows:

A1B2, A1B2 THIS IS NCS, NCS OVER

Note: It is good practice to give the NCS call sign and net designator in full phonetics on all net calls.

10.6.3. Acknowledging check-ins.

NCS must acknowledge all check-ins. This should be done in the order stations checked in. NCS transmits:

AAA, BBB, EEE, CCC, GGG THIS IS NCS, ROGER, OUT

If NCS did not fully hear a station, example CCC, then NCS withholds acknowledging that station, finishes the remainder of the acknowledgements, then transmits:

CCC THIS IS NCS, SAY AGAIN OVER

If NCS heard a station but did not hear the call sign, or only part of the call sign, NCS transmits an UNKNOWN STATION call up (prosign AA in digital, or $\overline{AA}$ in CW). Note that only stations who attempted check in, but were not acknowledged are authorized to transmit at this time. NCS transmits:

UNKNOWN STATION THIS IS NCS, OVER.

If necessary, NCS may call another station on the net to relay an unknown station's transmission.

If NCS hears no stations during a net call, he/she may transmit: e.g.,

THIS IS NCS, NOTHING HEARD OUT

and continues conducting net operations.

If a station is late to check in to the net, it is good practice for the NCS to state "YOU FOLLOW <callsign>" where <callsign> is the call sign of the previous station to check in to the net. This way, on a roll-call, the station will be able to respond in the appropriate order.

EEE THIS IS NCS ROGER YOU FOLLOW DDD OUT

It is important that all stations either copy the net roster at the beginning of the net or, if they checked in late, at a minimum record their position in the net roster by noting the station they follow as indicated by the NCS. It is not typically necessary for the NCS to transmit the entire net roster during the net, but this may be done so if deemed appropriate by the NCS by using an abbreviated plaindress format message. This may be deemed necessary if transferring control of the net to another NCS.

10.6.4. Use of Voice Color for Station Identification

A station will NOT be checked in by the NCS recognizing the station by voice color alone. If the NCS cannot discern the call sign, then the NCS should call that station again when conditions may be better, if another station on the net cannot relay the station in. Clearly a knowledgeable operator may enter in the log notes "unknown station, sounded similar to AFA#<nn>" and attempt to call that station later as "UNKOWN STATION THIS IS NCS OVER".

Validating (not recognizing) by voice color is essential in times of enemy activity. Suppose a well-known station, possibly an area director call sign checks in, e.g., AFA6<dd>, and is heard by the NCS as LOUD CLEAR then the NCS would write AFA#<dd> in the log but if the NCS hears the stations voice with a completely different voice color to the anticipated accent, e.g., suppose a Texan accent is known of the station but the station comes through with a heavy Jamaican accent and some slight mistakes in the procedural word choices atypical of what the NCS expects of the station, then he would be right to add to his notes "potential imposter" or other description. The NCS can still proceed in a professional manner but could check by phone (after the net if necessary) if the station was indeed on the net and also be wary of following outrageous orders. E.g., requesting 10,000 blankets at some location that doesn't need them , thereby depleting stocks for areas that do. Voice color is just as important as keying style was in WWII for telegraphy operators stationed overseas. People at places like GCHQ and communications facilities here in the USA knew the keying fist style of those operators so they could assess if a station had been compromised.

You cannot use voice color alone to identify a station in the log as if you can't identify the call sign being spoken, what use is it in having the station listed in the log? You would be unable to relay anything from that station. However, if you can recognize the station by call sign then voice color is helpful in being sure that the station is genuine. So voice color can help validate a station but voice color alone is not permitted to recognize an unreadable station into a net.

We rarely have deliberate interference on the MARS channels, unlike on some amateur HF channels but we cannot assume that will always be the case. If there is an organization that seeks to do harm to the USA and detonates some device to compound a natural disaster such as a hurricane or earthquake, then they might also arrange to impede assistance on MARS frequencies as well. So voice color becomes important on those occasions and another reason

why regularly checking into your local regional nets frequently during condition normal is important.

10.6.5. Limiting Check-ins

It may be desirable on larger nets to limit check-ins by type or geographic area. This must be approved for each net or series of nets (e.g. all Region ECOM nets) by the respective director or Chief MARS (authority to approve may be delegated if authorized by the respective Chief MARS).

These check in limiters shall not be used except where a large number of check-ins is anticipated and their use serves to help reduce doubling, save air time, and minimize confusion. Their use, when authorized, is not mandatory, unless so prescribed by competent authority. They exist as a tool to aid NCS in maintaining net control and discipline. Only authorized phrases shall be used to modify the call up process.

Each subsequent call up may use a different limiter, such as calling for stations one state at a time. Use of a limiter does not require that NCS always use limiters on every call up. This should be based on a logical balance of the extra air time required versus the benefit of reducing problems.

The limiting call up would be:

`A1B2, A1B2 THIS IS NCS,` (insert phrase here) `OVER`

The following are authorized phrases to limit check-ins and would replace the "insert phrase here" in the above call up.

- `STATIONS WITH RECORD TRAFFIC ONLY`
- `STATIONS WITH PRIORITY TRAFFIC ONLY` (this would include any traffic of higher precedence. May be used in combination with a geographic area, e.g., `DADE COUNTY FLORIDA STATIONS WITH PRIORITY TRAFFIC ONLY`)
- `ALL NEW YORK ARMY MARS STAFF ONLY` (substitute Navy or AF as appropriate. Replace "`NEW YORK`" with any logical MARS administrative or operational zone such as Region Five, or Central Area)
- `ALL SAN DIEGO STATIONS` (substitute `SAN DIEGO` with any generally understood geographic area including, but not limited to, state, county, borough, or city)
- `ALL STAFF REGION SIX` (this could be further limited by requesting only ECOM staff, only training staff, or any logical limitation of station type); or, by use of a collective call sign if that is most expedient.

10.7. Free and Directed Net Status

All nets will always begin in directed net status. This means every station must have NCS permission to transmit. Record traffic may only be passed when the net is in directed net status.

After all traffic, training, and net business has been handled, the NCS may put the net into Free Net status, if Free Net is authorized by transmitting, e.g.,

```
A1B2 THIS IS NCS THE NET IS FREE OUT
```

Free Net means stations may contact each other directly without prior permission of NCS. A station may exchange informal comments with another station with the following limitations:

1) All comments must, in some way, relate to MARS business or the mission of MARS;
2) Comments need to be brief, consistent with clarity.
3) Stations must pause between turnovers in transmission to allow for another station to break in.
4) NCS may interrupt an exchange at any time and stop the exchange by calling a directed net.

The NCS may return the net to directed status by transmitting, e.g.

```
A1B2 THIS IS NCS THIS IS A DIRECTED NET OUT
```

or by making a net call: e.g.

```
A1B2 THIS IS NCS OVER
```

Remember that any net call by the NCS automatically brings the net from Free Status to Directed Status.

10.8. Abbreviated Call Signs

Abbreviated call signs are not authorized on USAF MARS nets.

10.9. Alternate Net Control Station (ANCS)

It is often expedient to have an Alternate Net Control station (ANCS) assigned in advance, or for NCS to designate an ANCS station at the start of the net. The NCS could suddenly, and without warning, be gone from the net.

The primary duties of the ANCS are:

- Serve as a backup to the NCS by logging check ins
- Assume NCS duties if the NCS is gone from the net
- Other duties assigned by the NCS

The NCS may appoint any station checked into the net as an ANCS. Usually this appointment should be made fairly early in the net to maximize the availability of the ANCS. To appoint BBB, for example, as an ANCS the NCS would transmit: e.g.,

BBB THIS IS NCS, ASSUME ALTERNATE NET CONTROL OVER

To which BBB would respond: e.g.

THIS IS BBB, WILCO OVER

And NCS will confirm with: e.g.

ROGER OUT

Note: The appointment as an ANCS is a directive of the NCS rather than a request. Stations refusing to accept appointment as an ANCS must provide justification why he/she cannot accept the appointment.

10.10. Changing Net Control Station

Occasionally it may be necessary or desirable to transfer net control to another station. This could be for a brief period or for the duration of the net. Note that when the NCS is changed, it is normally good practice to perform a call-up of all the stations to ensure that the new NCS has an understanding of the propagation between his station and the stations on the net. Because of this fact, it is unwise to change the NCS frequently during the net, one or two changes during a one hour net would normally suffice.

Assuming CCC is NCS and wishes to transfer control to AAA:

AAA THIS IS CCC, ASSUME CONTROL, OVER

CCC THIS IS AAA, WILCO OUT.

AAA is now NCS. AAA will immediately make a call up of stations on the net.

A1B2 THIS IS AAA, OVER

This notifies the net that AAA has assumed control, puts the net in directed status, and authorizes stations to check in or otherwise contact AAA, who is the new NCS.

Variations could include some instruction from NCS to AAA such as:
AAA THIS IS CCC, ASSUME CONTROL FOR 10 MINUTES, OVER

or

AAA THIS IS CCC, ASSUME CONTROL UNTIL (state a time), OVER

When CCC returns and wishes to resume control CCC will, at a call up or on a free net, transmit:

AAA THIS IS CCC, I ASSUME CONTROL, OVER

At this point AAA will acknowledge CCC and notify CCC of any changes in net status, new traffic listings, traffic passed, and stations that checked in or closed down while AAA was net control. CCC will acknowledge this information then make a call up. (It is never acceptable for CCC to tell AAA, "I was monitoring the entire time and have all the information." This does not confirm to AAA that CCC in fact does have all the information.)

10.11. Loss of NCS

It may happen that NCS suddenly, and without warning, disappears from the net. This could be due to equipment failure, power outage, sudden change in propagation, or any number of reasons. If an ANCS has been assigned in advance and he or she suspects something has happened to NCS, that station will first attempt to contact NCS. If no contact is made, the ANCS will ASSUME CONTROL, make a call up, and proceed as outlined above. If no ANCS has been designated any station who hears the net well shall assume NCS duties.

10.12. Passing Traffic

When ready, the NCS will call stations to pass their traffic based on the precedence of each message and the availability of addressee(s) or another station to relay that traffic. NCS will then direct the holding station on how to proceed. Example A assumes that station CCC is not reachable directly from AAA and the NCS station already knows this and has chosen to route the traffic through BBB.

Example A:

AAA THIS IS NCS, CALL BBB PASS ONE PRIORITY CCC OUT

BBB THIS IS AAA, ONE PRIORITY CCC OVER

Assuming BBB copies AAA well, he/she sends:

AAA THIS IS BBB, OVER

AAA on hearing that BBB is ready, then responds with the message:

THIS IS AAA MESSAGE, RELAY PRIORITY CCC (continue with the message header and text, pausing (while unkeying the microphone) approximately every 20 seconds to allow for a station with higher precedence traffic to break in.)

AAA ends his/her transmission with either

OVER

or in the case where there are additional messages to send to this station,

MORE TO FOLLOW, OVER

It is unacceptable to end a message transmission with OUT as a receipt of the message is normally required. The only exception to this is when the message uses the header modifier proword DO NOT RESPOND and the message is sent twice using I SAY AGAIN. In this particular case, the message may be terminated with OUT.

Assuming BBB copied the message completely and does not need repetitions he sends

THIS IS BBB, ROGER OUT

Or, to accept another message

THIS IS BBB, ROGER OVER

Example B:

If BBB does not copy well he must notify AAA of the problem using correct radio check prowords

AAA THIS IS BBB, WEAK READABLE, OVER

Or

AAA THIS IS BBB, VERY WEAK UNREADABLE, OVER

BBB may request fills from AAA regarding missing words or sections of the transmission, again using the appropriate prowords for this usage such as combinations of WORDS BEFORE, WORDS AFTER, ALL BEFORE, ALL AFTER, in order to precisely narrow down the relevant section.

10.13. Breaking the Net

A station may interrupt the current flow of communications on a net if he or she has a communication of higher precedence which must be conveyed as quickly as possible. Such communications includes:

a) record traffic of a higher precedence than the traffic being passed;
b) non-record traffic communication for one or more stations that is urgent, time sensitive, and may impact the safety of persons or property.

The station wishing to break the net should wait for the next natural pause in the communication currently taking place; preferably waiting for the end of that communication. The content of the breaking station's communication should be the determining factor for establishing urgency, not simply that the station has, for example, a PRIORITY precedence message and a ROUTINE message is currently being sent. Breaking the net is a rare event. Normally, waiting a minute or two is not going to make a difference. If the breaking station knows the current communication is lengthy or several messages are going to be sent then interrupting may be necessary.

EXAMPLE: When a station has determined it is essential to break the net he or she shall wait for a pause in the current transmission. He or she will then transmit the precedence of his/her traffic three times, e.g.:

`PRIORITY, PRIORITY, PRIORITY` (pause) `NCS, THIS IS AAA, OVER`

The pause is to see that the other station has heard and is not continuing his or her transmission. Note that AAA is directing attention to the NCS station.

NCS will transmit:

`AAA, THIS IS NCS, OVER`

AAA will then list his or her traffic or reason for breaking the net.

If it is evident that NCS does not hear the breaking station any station on the net may relay by calling NCS and advising him or her of the breaking station. This should normally be one of the stations being interrupted. If NCS hears the breaking station, but it appears the station currently engaged in communications did not, NCS will acknowledge the breaking station by transmitting

`AAA, THIS IS NCS, WAIT OUT`

NCS will then take steps to regain control of the net.

10.14. Net Continuity Check (Roll Call/Radio Check)

On most nets, with a duration of longer than one hour, the NCS may hold a Net Continuity Check. The purpose of the Net Continuity Check is to ascertain propagation conditions between the NCS and those stations checked into the net. This consists of a roll call of the stations checked in. Stations' response will be a Radio Check. (MARS term for signal report).

10.14.1. Signal Strength and Readability

A station wanting to inform another station of his signal strength and readability will do so by means of a short concise report of actual reception such as, "WEAK READABLE", "LOUD DISTORTED", "WEAK WITH INTERFERENCE", etc. Reports such as "FIVE BY FIVE", "FOUR BY

FOUR", or "LIMA CHARLIE" will not be used to indicate strength and quality of reception (See ACP-125(F) section 611)

Report of Signal Strength	Meaning
LOUD	Your signal is very strong.
GOOD	Your signal strength is good.
WEAK	Your signal strength is weak.
VERY WEAK	Your signal strength is very weak.
FADING	Continuous reception is not possible due to fading

Table 14 - Signal Strengths

Report of Readability	Meaning
CLEAR	The quality of your transmission is excellent
READABLE	The quality of your transmission is satisfactory
UNREADABLE	I cannot read you
DISTORTED	Your signal is distorted
WITH INTERFERENCE	Your signal has interference
INTERMITTENT	Your signal is intermittent

Table 15 - Readability

Note: Do not include phrases such as “I have you”, “You are”, “Your signal is”, etc.

Any station may ask another station with a need for a signal report may, at any point during the net (after NCS approval to contact station when net is in Directed Status), ask another station for a Radio Check, by transmitting, e.g.

```
AAA THIS IS BBB. RADIO CHECK, OVER
```

AAA hears BBB loud and clear and replies:

```
BBB THIS IS AAA. ROGER, OUT
```

Note “LOUD CLEAR” is not verbalized in the example. It is assumed the signal report is Loud and Clear. Note: Do not include phrases such as “I have you”, “You are”, “Your signal is”, etc. These words are unnecessary and slow down net communications when there are many stations on the net. Additionally, there is no signal strength term “Fair”. Only those listed in table.

10.14.2. Making a Roll Call and/or Radio Check

The NCS will announce that a Roll Call will follow and then can proceed in different ways.

```
A1C2 THIS IS NCS, ROLL CALL RADIO CHECK FOLLOWS IN TWO MINUTES
```

The significance of the words ROLL CALL is that this is when the NCS is checking for logging and administrative purposes stations to be allocated certain time criteria. Although, any Radio Check could be used for the same purpose. So the words ROLL CALL are actually superfluous, and have simply been historically as a means of mustering more attention in net members. Roll Call is really a group radio check so that all members on a net are given a radio check.

The NCS may wish to obtain a radio check from every station in the net, to check propagation conditions or determine if communications still exist. If conditions are poor, or stations called into the net over such a long period of time that individuals do not know where they are placed in the roster, then the NCS may proceed by calling each station by their call sign only. Stations called will answer with an abbreviated call and a Radio Check: e.g.

Good Form of Call

NCS says,

```
A1C2 THIS IS NCS RADIO CHECK FOLLOWS
AAA OVER
```
waits for AAA who responds with
```
THIS IS AAA ROGER OVER
```
NCS responds with
```
ROGER OUT
```
and then calls BBB
```
BBB OVER
```
and BBB responds with
```
THIS IS BBB LOUD DISTORTED OVER
```
and NCS responds with
```
GOOD READABLE OUT
```
and then calls CCC
```
CCC OVER
```

Incorrect Form of Call

The very long form of roll call radio check call, with the NCS stating for each station, e.g.,:

AAA ROLL CALL RADIO CHECK OVER
waits for response from AAA then says GOOD READABLE OUT
BBB ROLL CALL RADIO CHECK OVER
waits for response from BBB then says GOOD WITH INTERFERENCE OUT
CCC ROLL CALL RADIO CHECK OVER
and so on…

The above Inefficient Form is not approved as a means of quickly getting a Roll Call Radio Check done on the net. After the fact that it is a roll call has been announced, calling each station with just their call sign is sufficient for the responses.

Preferred Efficient Form

When all stations know their check-in order in the net roster, the NCS may adopt a far more efficient means of doing a Roll Call Radio Check provided most stations on the net can hear each-other calling. This method does not work well in extremely poor propagation conditions. The NCS will make a call to the net call sign, ending with the proword "OVER". A response from all net stations is required in net order.

A1C2 THIS IS NCS. RADIO CHECK, OVER

All net stations hear NCS loud and clear except BBB and DDD. The replies of each station, in net roster order, are:

THIS IS AAA. ROGER, OVER
THIS IS BBB. WEAK WITH INTERFERENCE, OVER
THIS IS CCC. ROGER, OVER
THIS IS DDD. GOOD READABLE, OVER

The NCS indicates his reception of each of the net stations was loud and clear by replying:

A1C2 THIS IS NCS. ROGER, OUT

If all stations were not loud and clear (for the NCS), for example BBB who was weak and distorted, and CCC, who was not heard, the NCS would transmit:

A1C2 THIS IS NCS. ROGER. BBB WEAK AND DISTORTED. CCC NOTHING HEARD. OUT

It will be noted that this efficient form is the one that all USAF MARS nets should strive to achieve.

10.14.3. When to do a Net Radio Check (Roll Call)

Roll Calls are held at the discretion of the NCS but usually not more than once an hour. On traffic nets of two hour duration roll is called approximately 5 minutes into the second hour. If the NCS for a one hour net chooses to make a Roll Call, this Roll Call will usually be at the half-hour.

10.15. Closing Down the Net

At the appointed time for a net to end, and NCS is satisfied that all traffic has been handled, NCS will close the net as follows: e.g.

A1B2 THIS IS NCS, CLOSE DOWN, OUT

Note1: ACP-125 uses the words CLOSE DOWN NOW while common USA practice is to say CLOSE DOWN. Either method is acceptable.

Note2:Do not confuse the proword CLOSING DOWN with CLOSE DOWN. E.g.

A1B2 THIS IS NCS, CLOSING DOWN, OUT

The above simply means that the NCS (for whatever abrupt reason) has closed his own station down. The net is still running. As all USAF MARS nets have to be directed, if the NCS did not previously ask another station to assume the role, then one of two things can happen. In a continuous net, there may be a pre-assigned NCS to take over the direction of the net at a prescribed time. Or, if no station announces that it has assumed control then one of the stations already on the net must assume control and act as NCS. If a CLOSE DOWN instruction is given it means that the net is closed down.

It is imperative that NCS be aware whether a net is authorized to continue on past the designated end time. If it is not, NCS must arrange with stations holding traffic to dispose of that traffic on another net. This must be done well enough in advance of net end time to adequately take care of this business.

In some cases NCS may be authorized to close down a net before the designated end time. For example, suppose R2D2 net is assigned a one hour slot, but is authorized to close down after 30 minutes of operation if there is no further traffic or business to handle. The NCS can close the net early.

Optionally, the NCS may desire all stations respond to the direction to close down. This is important when there is a need for accountability of personnel; to be certain all stations have the message the net is closed. In this case, the NCS transmits, "R2D2 THIS IS NCS CLOSE DOWN, OVER". Because a call to the net was made with the proword OVER, all stations in the net are required to respond in net order. Example: "THIS IS (Station Call sign), ROGER, OUT".

MARS stations are encouraged to practice closing networks using both methods.

Once the net is closed down no further NET-RELATED transmissions are authorized. The net frequencies are not to be used for "rag chewing". If there are any informal communications that need to take place between members of the net, they shall take place before net closure, not after net closure.

10.16. Reporting Net Activity

It is the duty of the NCS to report the activity of his/her net including:

a) stations that checked into the net
b) actual time each station participated in the net
c) traffic handled on the net

The routing of net reports varies from USAF MARS area/region to area/region. Contact your Region or Area Records Manager for guidance as to format and routing.

10.17. Assessment

Answer these questions and submit your answers to your Training Officer or mentor and answer additional questions that may be given to you.

1. Who should maintain the net roster? What is it and why does knowing order of stations increase operational net efficiency? Does the ANCS need to be given the full net roster?
2. Do all nets have an NCS? Who can be an NCS? How does an NCS open a net and close a net? What steps are present in all nets?
3. For a net in your region, illustrate how you would act as an NCS and make an initial net call.
4. Why is having an ANCS important to efficient operation of a net?
5. When multiple messages are listed, what is the order of passing of traffic? Consider precedence, first-come-first-served and several messages of different precedence from the same station.
6. When traffic is listed and is being passed, how do you handle a new check-in to the net that has higher precedence traffic?
7. Suppose NCS and ANCS both suddenly cease to be able to transmit, who should become NCS? Illustrate how this should occur and how stations should cope with multiple stations claiming to be NCS. Discuss with your Training Officer or mentor the best approaches for different circumstances and radio conditions.

11. ANTENNAS

A word needs to be made about suitable antennas for MARS. This is not intended to be a comprehensive guide as there are many great manuals out in the amateur and professional space regarding antenna construction. This is intended as a quick guide to help the newcomer understand what will get a station operating more quickly and more effectively.

11.1. Best antenna for MARS use?

The best antenna for MARS use is an almost impossible question to answer as there are many variables that need to be considered including size, cost, effectiveness, radiation efficiency, power handling, strength, wind loading, beam widths, ease of orientation and setup, and so on.

Depending on whether operation is anticipated on regional nets and transcontinental nets, different antennas are required. With each of these different difficulties occur, e.g.,

- Beam pattern, azimuth plus elevation
- Single frequency or multiple frequency
- Antenna impedance will vary widely with different frequency
- Feed line will alter impedance if it does not match impedance of antenna
- Loops, dipoles, EDZ, all have unique characteristics

The correct solution is to use the right one for what you need to achieve.

In short, for a new MARS member wanting to operate only on their regional net, probably a simple center fed dipole as long as you can get is the best. If space is tight, arrange the ends so that its a Z configuration when viewed from above. That'll give you the opportunity to make it a little longer yet keep the main radiating element of the antenna as long as possible.

Cobra Senior and Cobra Junior antennas work well, but the junior will be really struggling down at 3.2MHz, and be difficult to tune. Linear loading is the technique that allows them to operate so low on frequency compared to what their physical length would indicate as being possible. For a cheap commercial antenna, these work quite well provided you have an antenna tuner.

So, what is really required here is to phrase the question not as what is the best antenna, but rather what is the best antenna system? The best antenna system for a new operator is one in which he can operate on as many frequencies as possible, as efficiently as possible, for minimum outlay. This is best achieved by a center fed doublet. I use the phrase doublet deliberately here as an antenna is only really a half wave dipole when it is tuned to be half a wavelength long. The antenna needs to be as long as is needed for you to operate on the lowest frequency that you wish to operate on. The typical regional HF MARS frequencies are

usually a triplet of three frequencies from the low (circa 3.2MHz) to medium (circa 4.5MHz) to high (circa 7.8MHz) ranges. Thus the lowest regional frequency is going to correspond to a wavelength of over 90m. Multi frequency amateur antennas are not typically going to do well on the MARS bands without some modification. The simplest approach is to choose a doublet that is as long as possible (so that it can operate on the lowest possible frequency) and then center feed it so that it may be efficiently driven with a ladder line feed. Attach the ladder line either directly to an ATU with a balanced input or feed it to a 1:1 current balun at the station and then use a short length of coax to connect that to the ATU.

The recommendation of a 1:1 balun is deliberate so as to avoid generated impedances becoming too low for the ATU to match. A 4:1 balun will typically result in the impedances becoming too low for the ATU to match. The ladder line, as any transmission line including coax, will act as an impedance transformer when the antenna feed point impedance does not directly match the intrinsic impedance of the ladder line. Adjusting the length of the transmission line will sometimes provide significant changes of impedance to permit a difficult to tune frequency to become tunable.

11.2. Ladder Line

Ladder line has extremely low loss at extremely high SWR. In MARS, the chances are that you will be unable to construct antennas for each of the frequencies, so you will be operating off frequency to such a severe extent that the SWR on the transmission line will be high. In these circumstances Coax as a transmission line fails miserably and suffers extremely high losses with high SWR on the line. Ladder line, whether window or open, is much better in this regard,

Window line, as comes supplied with the Cobra commercial antennas, does change impedance when wet so you need to retune the antenna differently in wet conditions to when used in dry. The way to prevent this being a problem is to list all the tuning measurements when wet and then list all the tuning measurements when dry for various frequencies, and keep them in a notebook. This way, if it is wet, you will know approximately where to tune the ATU to get it close to a good SWR and similarly if the weather is dry you will again know where to tune the antenna.

A very nice online resource for wire and ladder line (window type but high quality) is The Wireman. http://www.thewireman.com. Part # 552 is great, 450 Ohm window line. It is a tad more expensive than some, but nice and flexible. If you are not cranking out tons of power then Part #553 is good. The super power stuff is Part #554, but that is a lot more expensive and unless you are 100% QRO is typically not worth the cost. Remember also weight. The more power that ladder line can handle will result in thicker copper being used and hence more weight per unit length. This weight will be added to the weight of the antenna.

In the following table, the ATU (Antenna Tuning Unit) entries are recorded for a particular antenna in order to bring it to resonance under Wet and Dry conditions. The purpose of listing the numbers is to show that there is no simple correlation between the frequencies and the wet or dry conditions.

Frequency	Wet			Dry		
	C1	C2	L	C1	C2	L
RP	40	13	232	79	40	256
RQ	39	40	186	80	80	202
RR	70	30	156	40	60	112

Table 16 - ATU Entries for Frequencies Wet and Dry

There are many possible mappings at which 1:1 SWR into the antenna system may be achieved for various combinations of C1, C2 and L. Maintaining a table like this in a notebook enables the MARS operator to quickly switch frequency and bring his antenna system to a perfect match very quickly. It takes time to make the adjustments under different conditions, but maintaining a record will greatly assist in multi-frequency operation from a single antenna under widely varying circumstances. If a station is newly equipping for MARS operation, it is recommended to invest firstly in a good ATU before investing in a linear amplifier. Ideally, a roller inductor type ATU should be acquired. The reason for this is that it will allow tuning to occur outside the frequencies used for amateur bands more easily than a switched inductor (band-based) arrangement. Manual tuners from Palstar (www.palstar.com) are good examples of this type of roller inductor based tuner.

Much easier than window line, for ease of tuning purposes, is open wire ladder line. This is wet weather immune. It has the same impedance regardless of whether it is raining or sunny. Hence a notebook of antenna tunings for various frequencies only needs to contain one set of numbers rather than two sets of numbers when using open wire ladder line. Although 600Ω open ladder line can be easily constructed at home, there is an online source that seems to be well constructed. The location for this is: http://www.trueladderline.com. Their ordering page is at http://www.trueladderline.com/orderladder.html .

11.2.1. Balanced Antennas

Note that ladder line does not radiate provided you are feeding a balanced antenna. That is, connect it to the middle of the antenna and assuming both halves of the antenna are at the same height, both halves are the same length, same distance from large physical structures etc., then the system will be balanced. That way, currents in the antenna are balanced and in

opposite direction in both wires in the feed line. The resulting electrical field from one cancels the field from the other. The author frequently runs 1kW through window type ladder line just a few inches away from a computer with no issues of interference to the computer. Of course, if the antenna isn't balanced, then significant RF would result in the station.

11.2.2. Transmission lines and Impedance

A few words need to be said about feed line impedance and how it alters with length. The characteristic impedance of a transmission line is labeled Z_0. The value does not change with length. Typical amateur radio coax has $Z_0 = 50\Omega$, whereas window ladder line often has $Z_0 = 450\Omega$. The input impedance of the antenna at the antenna is Z_A.

If $Z_A = Z_0$ then any length of transmission line preserves the impedance. The transmission line does not have to be any specific length, the impedance of the output will be the same as the input in this case.

If $Z_A \neq Z_0$ (that is, they are different), which is nearly always the case, then transformation of the impedance occurs. There are some special cases of note:

- Feedline length 0.5λ (allow for velocity of radio wave in copper) – this is for a feedline adjusted to the shorter value to allow for the slower speed of propagation of radio waves in a feedline, the velocity varies by type of feedline.
    - Results in same value of impedance at end of feedline, e.g. $Z_A = 75\text{-}30j\Omega$, and $Z_0 = 300\Omega$, then impedance at end of 0.5λ electrical length feedline is $75\text{-}30j\Omega$
    - Really good because antenna impedance is not changed provided feedline length is exactly 0.5λ
    - Pragmatic difficulty in that length with change with frequency
- Feedline is 0.25λ (allow for velocity in transmission line again)
    - Short circuit at antenna becomes open circuit at input of feedline
    - Open circuit at antenna becomes short circuit at input of feedline
    - Big impedance transformations result for other frequencies
    - Avoid odd multiples of 0.25λ as the same problems will occur

In general, transmissions lines can be any length provided they are not an odd multiple of quarter of a wavelength for any frequency that you wish to operate on. It is best to consider the frequencies that you typically operate on and then choose the transmission line length accordingly. Naturally, there are some practical limitations in view of the fact that the line must be long enough to physically reach the antenna, but sometimes adding a little extra length can make a difficult to tune antenna more readily tunable.

11.3. How high should an antenna be?

Most people think that an antenna needs to be as high as possible, or at least at a minimum height of half a wavelength for the frequency of operation. Although this is true for achieving a very low take-off angle, which can result in long distance communication cherished by radio amateurs, this is not the main requirement for military communications. In most regional nets, communications are over relatively short distances of a few hundred miles, not several thousand. In these regional nets, the use of NVIS (Near Vertical Incidence Skywave) is the primary mode of communication to stations on the net. That is, the signal is typically going up to the ionosphere and refracting back down where the take-off angle from the station is 45 degrees or higher, often close to 80 degrees.

In these circumstances understanding the value of the hourly foF2 (the 90 degree incident highest frequency that can be reflected back down to earth by the F2 layer of the ionosphere) is of great importance. The Australian Government Radio and Space Weather Services site at: http://www.ips.gov.au/ provides a page specifically showing an hourly map of the foF2 values for the world (real-time, but delayed by an hour or two to allow them to compute the data) which is available at: http://www.ips.gov.au/HF_Systems/6/5 which is part of their extremely extensive HF Systems page at: http://www.ips.gov.au/HF_Systems. The HF Systems page has a lot of useful propagation information also.

Now, when examining NVIS propagation or “cloud burner” antennas in radio amateur parlance, one needs to consider what height is effective. For an NVIS antenna, the pattern does not badly degenerate if the antenna is lowered well below half a wavelength. In fact, it is possible to have good NVIS communications with an antenna mounted only 2ft above the ground. This technique is often used in forest valleys to quickly put up an antenna just eight feet off the ground which can communicate out of the valley with ease on HF, provided the operating frequency is below the foF2 value at that time of day. If the frequency is too low, then absorption by the D-layer will hinder communications, so as close to, but below the foF2 value is desirable.

The following table extracted from the Hughes USAF MARS lecture of 2009 shows the effects of antenna impedance with varying height. The antenna in all cases is simply a half wavelength dipole and the variation in height is shown in terms of wavelengths. In the table, the antenna is trimmed to a resonant length (where resonance is when the antenna impedance has a negligible imaginary component) and the reduction in resonant length is shown.

Height of Antenna	Effective Length	Resonant Length	Reduction per leg	Impedance at Resonance
0.5 λ (1/2)	0.5 λ	0.49 λ	1.0%	Z = 68.62 - j 0.45 Ω ($Z_{0.5}$ = 72.91 + j 34.46 Ω)
0.375 λ (3/8)	0.5 λ	0.489 λ	1.1%	Z = 88.07 - j 1.32 Ω ($Z_{0.5}$ = 94.23 + j 37.12 Ω)
0.25 λ (1/4)	0.5 λ	0.483 λ	1.7%	Z = 85.09 + j 1.79 Ω ($Z_{0.5}$ = 94.7 + j 63.85 Ω)
0.125 λ (1/8)	0.5 λ	0.481 λ	1.9%	Z = 55.14 + j 1.32 Ω ($Z_{0.5}$ = 61.86 + j 71.25 Ω)

Table 17 - Antenna Variation with Height

It can be seen from the table, that the length is slightly shorter for resonance as height is reduced from a “nice” half wavelength to a “low” one eighth of a wavelength. The antenna remains good from an impedance matching standpoint but what about the antenna pattern.

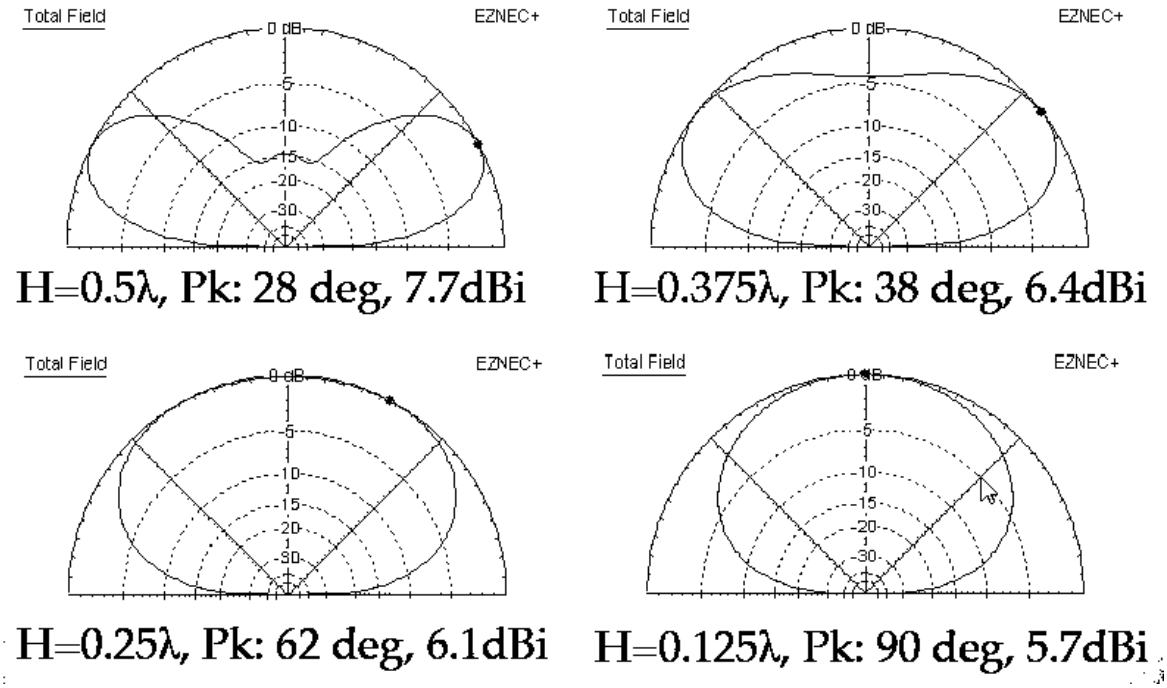


Figure 10 - Variations in Antenna Pattern with Height

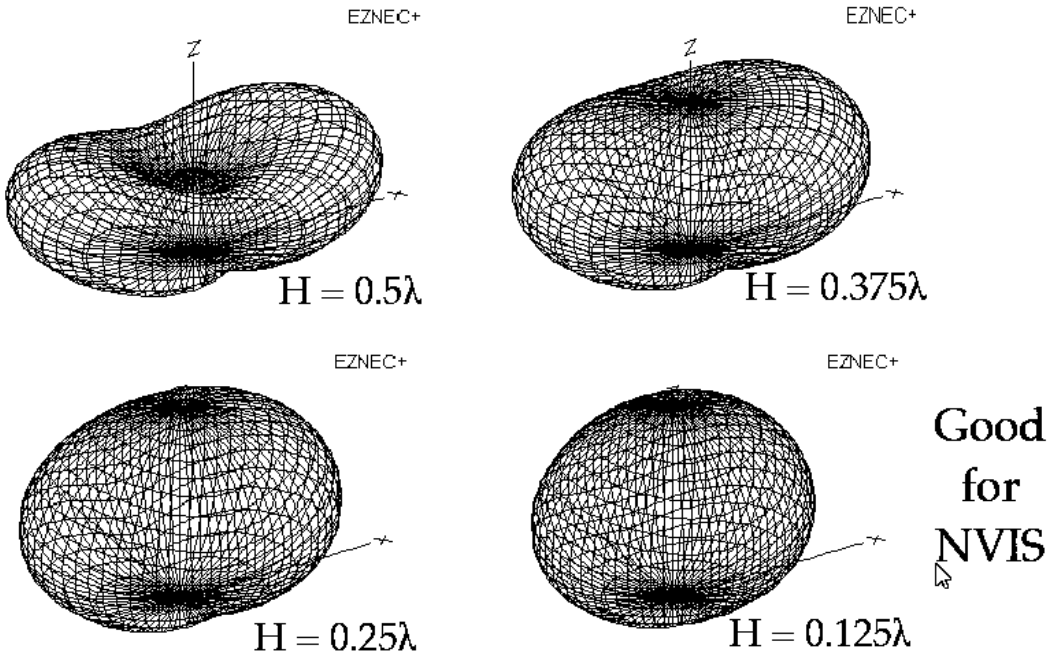


Figure 11 – Variations in 3D Antenna Pattern with Height

It will be noted that as the height is reduced to one eighth of a wavelength that the pattern loses its traditional gain but becomes more of a ball that radiates equally well in all directions but predominantly upward. As such, an antenna that is mounted low, loses its typical broadside radiation pattern and effectively becomes omnidirectional for elevation angles above 60 degrees. This makes it perfect for NVIS operations. So, unless your antenna is mounted high, the specific orientation of the antenna in your yard is not going to make much difference. In fact, it is possible to have one arm of a dipole facing East and another arm facing North with very little effect on the overall radiation pattern.

11.4. Further study

If you are interested in learning more about antennas and transmission lines and how to design them and operate them, then the ARRL course on Antennas is highly recommended. The *ARRL Antenna Modeling Course* book by the late L.B. Cebik, W4RNL, is particularly to be recommended as a first step in your further studies. Additional useful information is of course in the antenna handbooks but bear in mind that many designs are optimized for amateur frequencies and need some adjustment to operate successfully on MAS frequencies.

11.5. Assessment

Answer these questions and submit your answers to your Training Officer or mentor and answer additional questions that may be given to you.

1. What is the simplest antenna that will give wide frequency coverage for MARS usage?
2. Why is NVIS operation important for Regional MARS nets?
3. What advantages does NVIS give for local emergency communications when a high fixture cannot be quickly obtained?
4. Why are odd multiples of ¼ wavelength to be avoided for transmission lines?

12. MISCELLANEOUS INFORMATION

12.1. Logs

You are required to keep a log of all of your MARS activities. Any format of your choosing is acceptable if it shows the times that you enter nets, closing times, traffic activity and any other formal MARS activity. Since the station log is a legal document, entries should be made in ink with no erasures. Errors should be marked out with a single line and the corrected notation initialed by the operator on duty. As mentioned in section 3.8 of the MOI of February 2013, all logs are subject to be reviewed by the Chief, USAF MARS upon request. While many MARS Members keep their logs indefinitely, logs must be retained for at least one year. When an actual EEI event has occurred, the logs need to be kept for three years. An Amateur Radio Log book when dedicated to MARS usage is a perfect format for recording logs. Although ACP publications mention paper logs, it is to be noted that electronic computer copy may, at the discretion of the Chief of MARS, now be deemed acceptable for MARS usage provided sufficient back-up copies are made to preserve the records.

12.2. Time Keeping

All official time is kept in UTC (Coordinated Universal Time) on the basis of the 24 hour clock. Formerly this was called GMT (Greenwich Mean Time) and is sometimes referred to as military time. Since most of our HF nets are scheduled for convenient evening hours, we will occasionally refer to “Local Time” but this must be converted to UTC for official purposes such as logs, Message DTG etc.

When expressing time in UTC, the figures are followed by the letter Z to indicate the system being used.

12.3. Broadcasts and Bulletins

Broadcasts are released from HQ MARS and other selected officials on an as needed basis. The information in these broadcasts is addressed to all MARS members. Some of the information is merely informative but much of it is directive. All members are required to have current knowledge of the contents of these broadcasts. The broadcasts and bulletins are read a number of times on various nets and posted on various bulletin boards and web pages.

12.4. Frequency Tolerance

The frequency tolerance for the HF Fixed and Mobile service is defined in chapter 5.2.1 in the May 2013 edition of the NTIA Manual of Regulations (Red Book), see http://www.ntia.doc.gov/files/ntia/publications/redbook/2013/May_2013_Edition_of_the_NTIA_Manual.pdf. The NCS is responsible for ensuring the net is operating within prescribed tolerance and for ensuring all members on the net are within tolerance. It should be noted

that a frequency tolerance of 20Hz is typically only achieved with a radio equipped with an OCXO (Oven Controlled Crystal Oscillator).

12.4.1. Bandwidth

USAF MARS high frequency authorizations between 2-30 MHz are currently assigned 3 kHz voice and 3 kHz data channel bandwidths. HF radio equipment should be capable of transmitting and receiving data modes up to 3 kHz in bandwidth.

For VHF operations, only narrowband transmissions are permitted. Bandwidth shall not exceed 11 kHz.

12.5. Surplus Equipment

New members become eligible to request surplus equipment 6 months after completing training if at least minimum participation requirements have been met. Information about availability and procedure for requesting surplus equipment is available through your SMD. The state administrative net is the ideal place to get this information.

12.6. Return Address for MARS Correspondence

Mailed messages and MARS correspondence should carry the return address of HQ MARS:

38 CYRS/SCM (MARS) (Your Call sign / State.)
203 W LOSEY ST. ROOM 1200
SCOTT AFB IL 62225-5222

NOTE: The office symbol changes from time to time. Watch for announcements in the MARS BROADCASTS.

12.7. Drill Messages

The "Drill" Messages that you will send to complete training are simply messages in plain dress format. These messages can be an actual message to another MARS member or a third party. Actual messages will be relayed on through the system for delivery. In most cases the training message will be a factitious message in which case the word "DRILL" must appear as the FIRST and LAST word of the text. Both words "Drill" are counted in the Group Count. The purpose of the drill message is to demonstrate your ability to send messages in the MARS format using all the correct procedures and prowords. When sending Drill message use complete addresses and avoid the abbreviated format.

After sending the message on the air your trainer may make some suggestions and offer constructive help.

12.8. Training Final Exam

After satisfactorily sending the training drill messages you will receive a 50 question final exam. A score of 85% or better is required to complete training. The final exam is an open book test and is based on material found in this guide and discussed on the training nets. The final exam should be completed within 10 days.

12.9. Participation Time

Your time spent on the MARS Networks will be recorded and reported by various Net Managers of the respective nets. On some nets the actual time you are checked in is reported and on others, often you will be given a full hour for any time spent on certain administrative nets. Miscellaneous time may be reported to your SMD for time spent on MARS projects or MARS business such as attendance at MARS conferences, preparing net reports, repeater maintenance, MARS technical projects etc. The Divisional Training Manager assigned to you will provide you format used to send to the SMD of your state.

12.10. Call Sign Change

When you have met all of the training requirements, the Region or Division Training Director will notify your State MARS Director, who will send you an AF Form 3661 giving you a permanent assignment and authorizing the change in your call sign by dropping the /T suffix. Sometime later you will receive a MARS license and ID card (AF Form 3666) from USAF MARS Headquarters reflecting your modified call sign.

12.11. Chain of Command

The primary contact point for questions, comments or other issues relating to USAF MARS is your State MARS Director (SMD). If your SMD is unable to address a particular issue, your request will be forwarded to the appropriate Region Official or the Region MARS Director (RMD). If the RMD is unable to resolve the issue, it will be forwarded to the appropriate Division Official or the Division MARS Director (DMD). If the DMD still is unable to resolve the issue, it will be forwarded to HQ USAF MARS for final resolution.

It is imperative that the chain of command be strictly adhered to without deviation. Most USAF MARS officials are volunteers and already dedicate a significant amount of time to the USAF MARS program.

Failure to follow the chain of command can greatly increase the work load on these individuals and reflects poorly on the overall MARS program.

12.12. Frequency Designators

USAF MARS frequencies are referenced using a “frequency designator” rather than by the specific numerical frequency. These two or three character frequency designators allow USAF MARS operators to indicate specific frequencies without divulging the exact numerical

frequency to any third party that might be monitoring the radio transmissions. Frequency Designators are always given in phonetics e.g., FREQUENCY ROMEO HOTEL, for frequency RH.

In short, never give numerical MARS frequencies over the air.

The frequency designators and exact numerical frequencies are contained in the "USAF MARS Frequency Matrix" available through your State MARS Director or your Training Director.

In addition to never giving numerical MARS frequencies over the air, frequency designators and their corresponding numerical frequencies should never be transmitted together over the air via unencrypted voice or digital modes under any circumstance. This will help ensure operational security (OPSEC) and communications security (COMSEC) in support of exercise or operational requirements. This also applies to other Service MARS frequencies and designators. The importance of OPSEC/COMSEC should be emphasized as part of the training curriculum for all new AF MARS members.

12.13. Security

A word needs to be said about security. Once you have become a MARS member, you are technically an associate of the military. There are various terrorist organizations and bad individuals that wish to do harm to the country OR ITS ARMED FORCES. AS MARS IS AN ORGANIZED MILITARY AUXILIARY, such harm could potentially be directed at MARS members WHO MIGHT be thought of as "low risk" targets by a terrorist organization wishing to satisfy some power-struggle agenda OR SOMEONE WITH AN AXE TO GRIND AGAINST THE MILITARY. The bottom line here is "Be Vigilant".

Certain documents in MARS are labeled as "FOR OFFICIAL USE ONLY" (FOUO). There are strict guidelines for handling FOUO information and these are detailed in Department of Defense Manual (DoDM) 5200.01-V4, February 24, 2012 Enclosure 3, section 2, "FOUO INFORMATION". The manual is available for download at:
http://www.dtic.mil/whs/directives/corres/pdf/520001_vol4.pdf.

All AF MARS members need to fully understand the definition of FOUO as defined in the above manual and the guidelines for handling such information.

12.13.1. Addresses

For this reason, when giving sending messages over the air, the message should not contain the address and name of the MARS operator. If messages are between MARS operators, just the MARS call sign will be sufficient. If a message is to or from a third party and may need hand-delivery, then yes, an address can and should be used, but if the addressee is a MARS station then a delivery address should not be used. The objective here is to ensure that full names and addresses of MARS members are not released to enemy stations that may be monitoring the

nets. Also, on check-in to a net, it is not required to give the location of your station other than to the nearest large metropolitan area. From a propagation standpoint, other members of a net only need to know where you are to within 50 miles in order for propagation predictions to be used accurately and effectively. If living in a remote area, identifying your location to the village in which you live will make it trivial to find out who you are owing to the small number of ham addresses to be looked up in a township of 1,000 people or less. Hence, don't be too geographically accurate on air; just locate yourself to the nearest major metropolitan area. This way, it will give a monitoring station thousands of potential radio amateurs to check through on the FCC database.

12.13.2. Personal Names

If you use personal names during informal sessions on the nets, please only use first names to make it more difficult for monitoring stations to identify who you are. With a full name, it is possible to look up all the radio amateurs in a city and compare names on public databases and then put two and two together to deduce which radio amateurs are MARS members, their addresses etc. Again, this ties back into the earlier point about identifying location. Only the nearest major geographical city is needed.

12.14. Assessment

Answer these questions and submit your answers to your Training Officer or mentor and answer additional questions that may be given to you.

1. Why do logs need to be kept and for how long should logs be kept?
2. What information should be kept in a log as a minimum for all MARS stations?
3. If you are acting as an NCS, what additional information should be kept in the log?
4. Who is your primary contact for questions or issues relating to USAF MARS operation?
5. When you have passed your final training exam and satisfied all the training requirements for running a net and passing digital traffic and have been told that you have passed by your Training Officer, can you immediately operate on nets without using the /T in your call sign?
6. What is the form that details your primary and secondary assignment if applicable, your call sign, and the maximum power level that you can use?
7. Referencing the relevant subsection of Department of Defense Manual (DoDM) 5200.01-V4, February 24, 2012 Enclosure 3, section 2, "FOUO INFORMATION", how should printed FOUO information be stored in a building without Government or Government-contract building security, e.g., your home?