

MARS-ALE Software Development Briefing



NETCOM / 9th Army Signal Command

20 August 2005

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for

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MARS-ALE Objective

- Provide an economical PC based software tool which allows wide spread MARS integration of Automatic Link Establishment (ALE) capabilities into MARS operations with an objective to exploit ALE technology for use in Regional and Emergency Multimode Networks.



MARS-ALE family tree...

- MARS-ALE Standard Edition is based on an unreleased version (v1.06) of the PC-ALE MIL-STD-188-141 proof of concept software demonstrator developed by Mr. Charles Brain, G4GUO of the U.K.
- According to Mr. Brain , PC-ALE software has been in development for over 10 years by Mr. Brain and is currently used under license by MARS, SHARES, Danish Military for forwarding weather data and emails (when Pactor fails), the US Military, US Civilian Cargo Transports and others.
- MARS-ALE has been under development since the fall of 2004. After working with Mr. Brain and testing his PC-ALE 1.05 tool for nearly a year, he provided MARS the source code to develop a MARS specific version for “MARS use only”. Since then, the source code has been debugged and MARS-ALE has developed. MARS-ALE has been tailored in a number of ways for MARS-to-MARS communications, taking into account MARS operational needs and the mix of Amateur Radio and Commercial grade radio equipments being utilized.

MARS is not alone !



- Its not just the MARS program that has gone to the PC Software solution for its ALE needs. The U.S. Navy began Phase I of a Small Business Innovation Research (SBIR) project in of September 2003 to develop a software based ALE solution. For more information see:
http://www.critical.com/spawar_sbir_HFALE.htm
- The Navy objective was to develop an application that increases the number of reliable High Frequency (HF) communications links for sites with a large population of legacy HF assets and a limited number of Automatic Link Establishment (ALE) radios.
- The Navy requirement is pretty much like that of MARS and most other U.S. Government agencies, the need for an economical way to field more ALE capability meeting MIL-STD-188-141A.



Why is ALE important ?

- **MARS-ALE is important to the MARS program as all U.S. Government agencies which MARS provides support, utilize ALE and MARS needs an economical way to field an ALE capability to its volunteer membership.**
- **With MARS-ALE and a properly configured HF SSB radio system (with NVIS and Skywave antennae) interfaced to a PC sound device, it makes it possible to successfully enter an ALE network.**



What is MARS-ALE ?

- MARS-ALE is a PC software based MIL-STD-188-141x controller with MIL-STD-188-110x serial modem capability and FED-STD-1052 Appendix B, Data Link Protocol Controller.



- It is a MS-Windows 32 bit C++ MFC application which uses the PC Sound Device (a.k.a. Sound Card) as the modem.

MARS-ALE exceeds the basics !



- **FED-STD-1045 & MIL-STD-188-141A as used by the U.S. Government, Military and other nations worldwide, specifies the basic requirements of an ALE controller.**
- **MARS-ALE meets and exceeds all the basic requirements of the standards.**
- **Most hardware based ALE radios only provide the basic Selective Calling (Individual Call, All Call, Any Call, Group Call, Net Call), Scanning, Sounding and AMD single line message capability, while MARS-ALE provides all this and most items that are optional. Items not usually available from most ALE radio manufacturers.**



SELCAL and Broadcast

- **MARS-ALE supports both Selective Calling and Broadcast modes of operation.**
- **Both modes support ARQ, BRD (FEC) and File Transfer Protocol (FTP) operation.**
- **SELCAL Operation:**
 - **Each station can have one or more station addresses (Individual Address).**
 - **Each station may be member of one or more nets (Net Address).**
 - **Each station may be a member of one or more groups (Group Name).**



Beyond MIL-STD-188-141A

- MARS-ALE is also being developed to provide features of MIL-STD-188-141B
- In place now, in beta test form is Alternate Quick Call (AQC) ALE using the 8-ary FSK modem. AQC-ALE is much faster and reliable for linking under all types of channel conditions.
- Also in beta is AQC-ALE Burst mode.
- AQC-ALE per the standard can ONLY be used with 6 character (2 words) Addressing maximum.
- AQC-ALE per the standard operates at 5 ch/sec. scan rate only, which means some radios with lower RS-232 baud rates will not work well in Scanning/Sounding.



MARS-ALE Standard Edition minimum requirements

- At a minimum, a PC with 300Mhz or better CPU speed, 256MB RAM and MS-Windows Me or better OS with a REAL Creative Labs PCI sound card or USB port or other external port sound device, one RS-232 port is required.
- A 100w class HF SSB transceiver (optional internal or external ATU) and a minimum of 2.4Khz SSB bandwidth filtering. 2.8Khz filter or variable IF DSP filtering is recommended for best results.
- PC to transceiver interfacing via RS-232 for frequency and mode control and a means of PTT control either via computer command or RS-232 RTS/DTR line for keying.
- A broadband Near Vertical Incident Skywave (NVIS) performing antenna system for Regional applications and a Skywave performing antenna for wider area application for Scanning/Sounding operation.



It's all done with PC sound !

- At present, MARS-ALE uses the PC sound device in MARS-ALE Standard Edition for its modem exclusively.
- However, it is planned that MARS-ALE Professional Edition (PE) will also interface with ALE hardware radios where the internal or external ALE modem will be used for all its capabilities as exposed for remote control.
- MARS-ALE PE will then utilize the PC sound device for all FSK and PSK protocol and data modes not supported by the ALE hardware radio.



Supported Radio List

- As of 2005, most all known computer controlled Amateur Radio grade HF SSB transceivers and receivers are already supported.
- ICOM NEMA Marine Grade HF SSB transceivers are supported.
- Many Commercial Grade HF SSB transceivers and receivers are already supported.
- ALE based Commercial and Military grade transceivers (Codan, Datron, Harris, Motorola etc.) are planned if example radios are provided for the development effort.
- New radio make/models will be supported as they develop.

What does MARS-ALE look like ?



MARS-ALE Standard Edition MIL-STD-188-141A & MIL-STD-188-110 Controller

File Edit Tool Bar Configuration Tools Channels Addresses Scan Call Data AQC Clear Fill Help

TUNER

MIL-STD-188-110A Serial Modem Scan Group BOTTOM 4 ARMY ALE

Sync ALE Mode NORMAL

OFF RX Error

TO ALL MARS-ALE SDT MEMBERS
BT

MARS EXERCISE

SUBJ: ALERT NOTIFICATION LOST COMM
REF: ARMY MARS NATIONAL EMERGENCY OPLAN 4-02

A. DUE TO NATION WIDE INTERRUPTION OF SERVICE ALL LONG DISTANCE
LAND LINE AND CELLULAR COMMUNICATIONS HAVE BEEN INTERRUPTED
AND TO MANY AREAS LOST ALTOGETHER.

B. N/A

C. N/A

D. UNKNOWN

E. N/A

F. LOCAL LAND LINE AND CELLULAR

G. VERIZON GLOBAL NETWORKS 00

[23:57:42][FRQ 03347000][LINK
[23:55:38][FRQ 03242000][****
[23:55:38][FRQ 03242000][* HA
[23:55:38][FRQ 03242000][****
[23:55:38][FRQ 03242000][Rea
[23:55:38][FRQ 03242000][MARS
[23:55:38][FRQ 03242000][MARS-ALE started: Running AAR2EY build B007A9e]
[23:55:38][FRQ 10000000][Radio Setup: IC-7800 initialization completed]
[23:55:38][FRQ 10000000][Radio Setup: IC-7800 set Twin Peak Filter to OFF]
[23:55:37][FRQ 10000000][Radio Setup: IC-7800 set RTTY Filter to OFF]
[23:55:37][FRQ 10000000][Radio Setup: IC-7800 set Manual Notch to OFF]
[23:55:37][FRQ 10000000][Radio Setup: IC-7800 set Auto Notch to OFF]
[23:55:37][FRQ 10000000][Radio Setup: IC-7800 set Noise Reduction to OFF]
[23:55:37][FRQ 10000000][Radio Setup: IC-7800 set Noise Blanker to OFF]
[23:55:36][FRQ 10000000][Radio Setup: IC-7800 set PREAMP to OFF]
[23:55:36][FRQ 10000000][Radio Setup: IC-7800 set ATT to OFF]
[23:55:36][FRQ 10000000][Radio Setup: IC-7800 set AGC to SLOW]
[23:55:36][FRQ 10000000][Radio Setup: IC-7800 set Split Freq OFF]
[23:55:36][FRQ 10000000][Radio Setup: IC-7800 set Dual Watch OFF]
[23:55:36][FRQ 10000000][Radio Setup: IC-7800 being initialized]

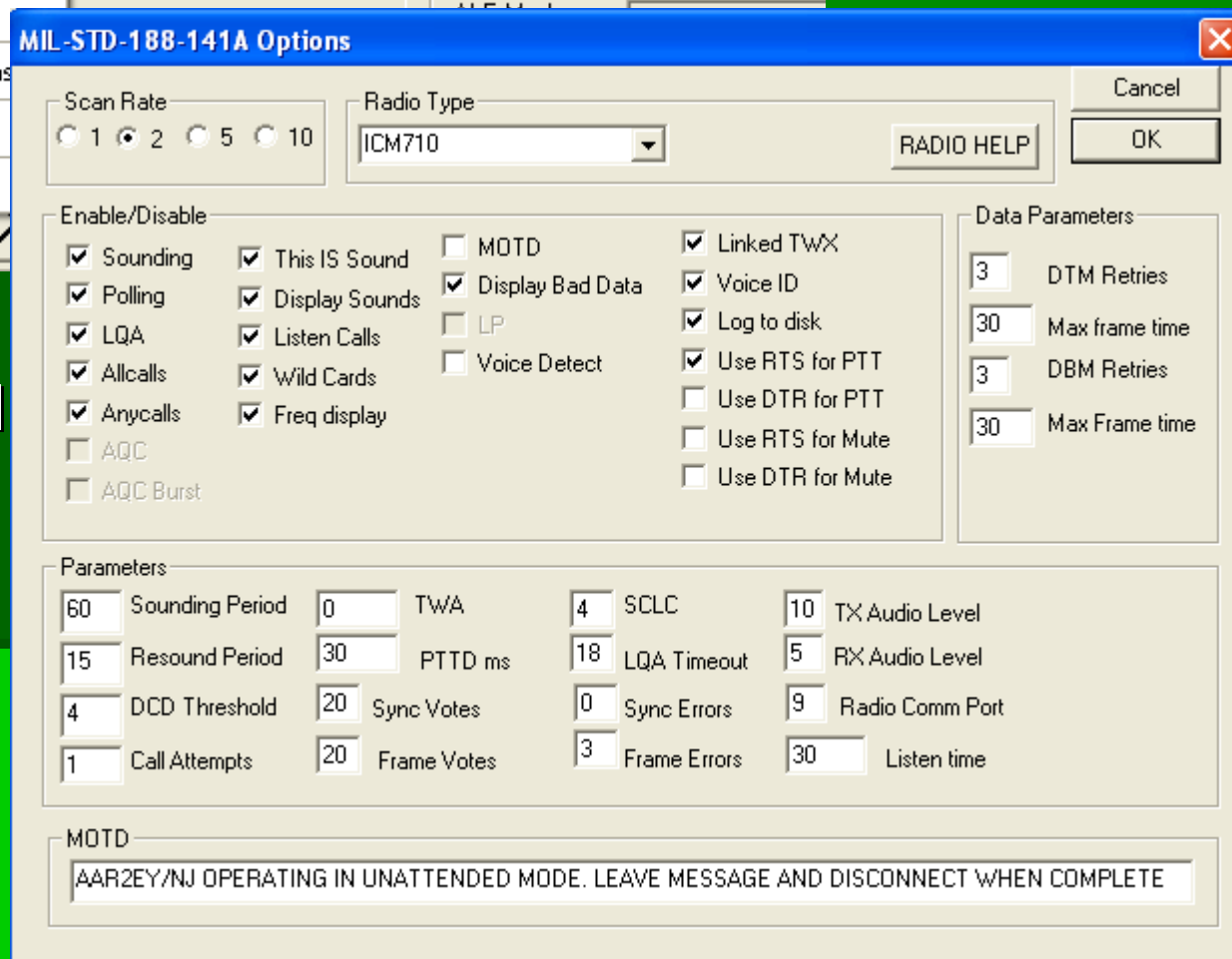
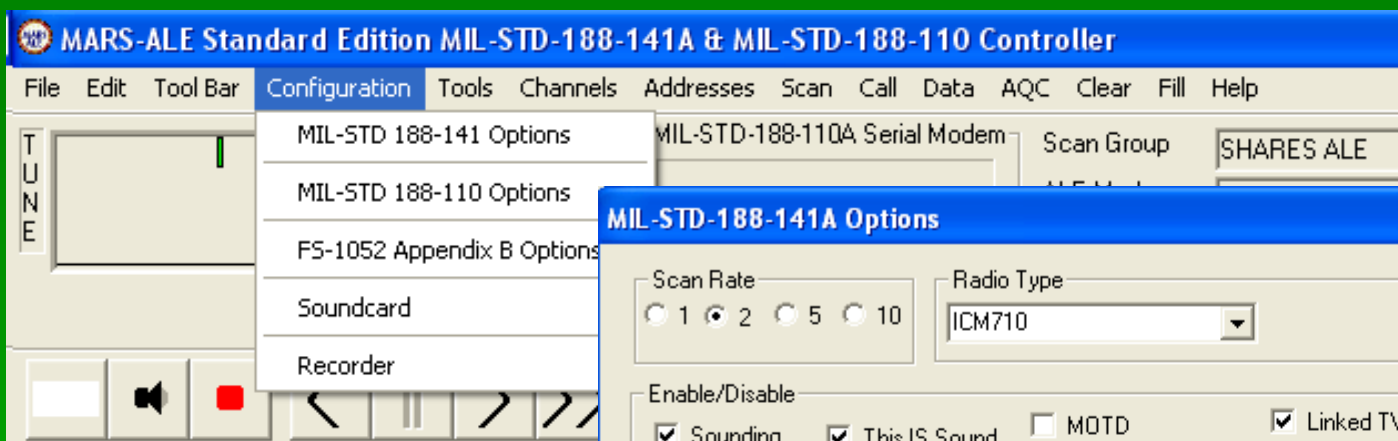
*****]
5-30-05 *]
*****]
present]

FRQ 03278000 LSB STOPPED ALWAYS F51052 1800hz 2.0kHz 7D15T15PNA BRDT=1 BRD300L I N F L MIN=75 FS=100 RC=10 ARC3005 CAP NUM SCRL

MARS-ALE looks like any well designed MS-Windows application that follows Microsoft standards.

- Message and Engineering window split can be resized and button bar can be docked or hidden.

MARS-ALE is GUI Friendly



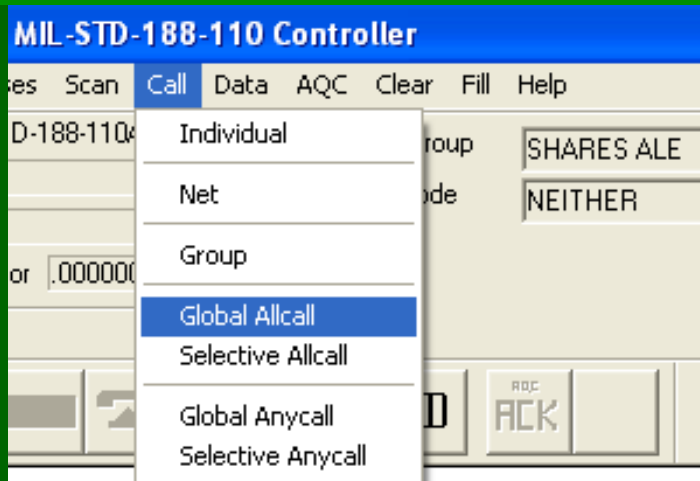
- Easy to use GUI menus provide all needed program setup.

- “Log to Disk” causes all messages sent and received to be automatically saved for later review.

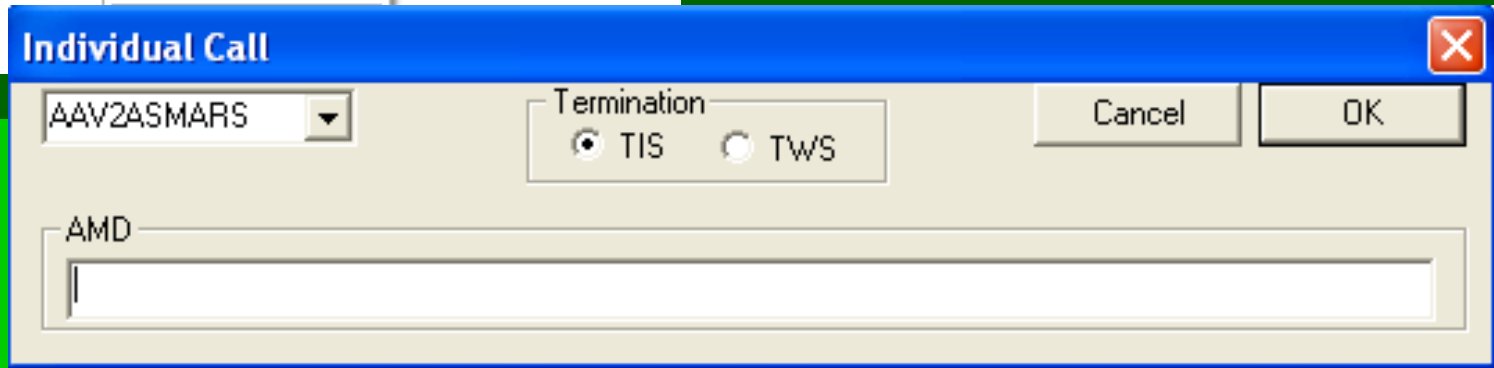


How do you make a call use MARS-ALE ?

■ Initiating an ALE call with MARS-ALE is a simple matter of one pull down menu and a dialog, much easier and faster than with an ALE radio



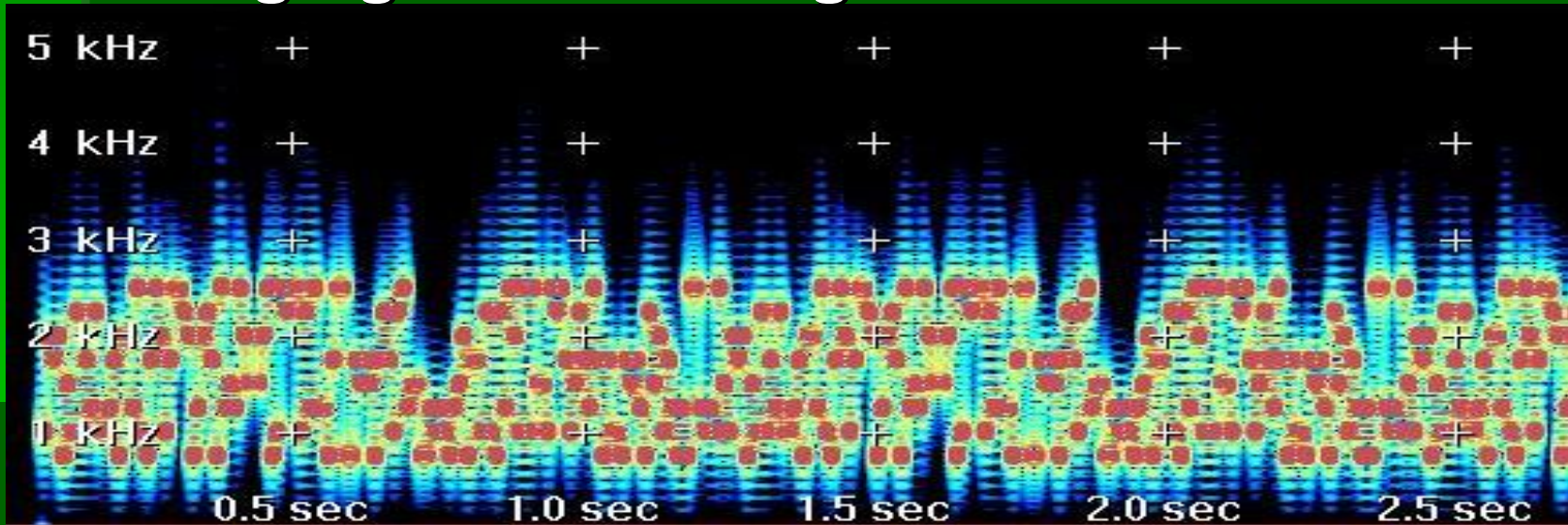
Individual addresses (i.e. AAR2EYMARS)
Net Call (i.e. AAM2RAF)
Group Call (i.e. AAR2JQ, AAR2EZ...5)
AllCall (Global or Selective)
AnyCall (Global or Selective)
WildCards (i.e. ??????MARS)





MARS-ALE and FSK

- MARS-ALE, as do all ALE controllers, initiates an ALE Link with one or more stations using an FSK modem and provides inherent messaging modes using the FSK modem.

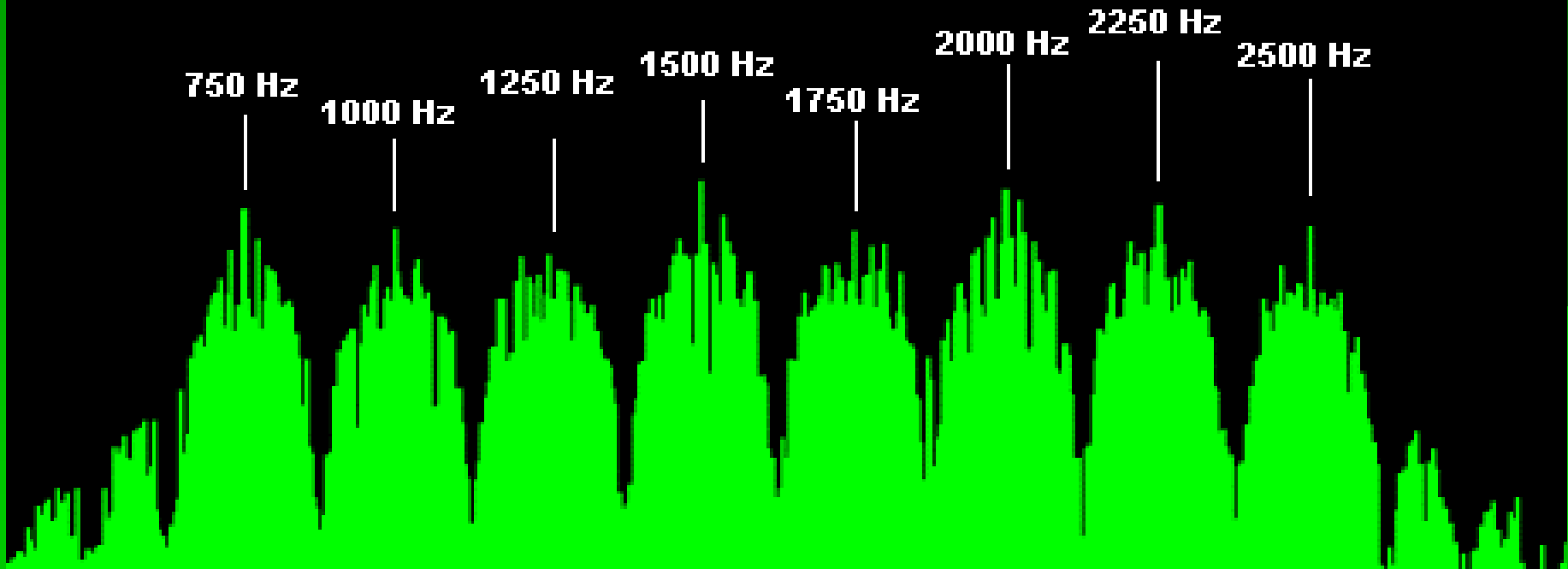


In the image above the ALE 8-ary tones are represented as 8 data bits in bandwidth in the vertical axis and duration of sending the data in the horizontal axis at 375 bits/sec or 125 baud.



MARS-ALE supports 8-ary

- **MARS-ALE currently supports the MIL-STD-188-141A 8-ary standard to 2.6Khz of required channel bandwidth.**
- NOTE: PC sound device can support 39-ary ALE out to 2.9Khz channel bandwidth.



MARS-ALE has High Speed PSK serial modem support as well !



- The MIL-STD-188-110x serial tone modem (supports BPSK, QPSK, 8PSK waveforms) is based upon Phase Shift Keyed (PSK) with the modulation at a constant Symbol rate of 2400BPS and provides a data rate of up to 2400BPS coded and 4800BPS un-coded.
- In addition, FED-STD-1052 (FS-1052) Data Link Protocol (DLP) is provided for high speed Broadcast (BRD), ARQ and FTP data modes with data rates of 75-2400BPS and with Short or Long Interleave.
- The 2400BPS data rate is in the same category as the PACTOR-III PSK modem maximum uncompressed speed of 2722BPS and within the same BW using 1500hz carrier and 1800BPS or less symbol rate selection, but without the cost of the hardware modem.
- STANAG 5066 DLP is also planned with its improved ARQ support.



MARS-ALE Messaging

- MARS-ALE supports ASCII and Binary messages via the standard ALE modem.
 - Automatic Message Display (AMD) ASCII up to 87 characters with option of confirmation.
 - Data Text Message (DTM) (longer messages in ASCII) supports both BRD and ARQ.
 - Data Block Message (DBM) (binary messages) supports BRD, ARQ and FTP.
- MIL-STD-188-110x serial modem and FS-1052 Data Link Protocol (DLP) provides BRD, ARQ and FTP for high speed messaging.



SELCAL and Broadcast

- In SELCAL or Broadcast type operations particular stations can be addressed, groups can be addressed or any stations on a channel without knowing who they are in advanced can be addressed.

You can call: { Individual addresses (i.e. AAR2EYMARS)
Net Call (i.e. AAM2RAF)
AllCall (Global or Selective)
AnyCall (Global or Selective)
WildCards (i.e. ??????MARS)

MIL-STD-188-110x modem



- **Asynchronous and Synchronous mode data rates between 75 and 4800 bit/s are possible. FEC for error control can be set according to the selected transmission speed.**
- **Interleaving of the transmitted data with an interleaver length between 0.6 and 4.8 s can also be selected.**
- **The modem supports additional waveforms and protocols such as FS-1052 DLP and the planned STANAG 5066 DLP.**



What is FS-1052 DLP ?

- **FED-STD-1052 Data Link Protocol (DLP) supports a data link layer protocol as defined by the International Organization for Standardization (ISO) network reference model.**
- **This protocol, when used in conjunction with an appropriate modem, provides a method for transmitting error-free data over an HF radio circuit.**
- **It provides Broadcast (BRD), Automatic Repeat Request Query (ARQ) (error-free point-to-point data transfer) modes at 75-2400BPS data rates.**
- **Used with the MIL-STD-188-110x modem with an 1800hz PSK carrier at 2400BPS symbol rate, it requires 3Khz IF BW channel as implemented to the standard.**

MIL-STD-188-110x tailored for MARS-to-MARS operation.



- MARS-ALE supports the standard 1800hz PSK carrier and 2400BPS symbol rate @ 3Khz BW
- MARS-ALE provides 2.0, 2.25, 2.5 and 3Khz BW selections based on user selected PSK carrier and symbol rate combinations which allow the use of filtering more common in Amateur Radio grade equipments and meets 2.8Khz NTIA channel requirements.
- At 150-2400BPS data rates, up to 2000BPS symbol rate can be used with full +/-75hz @ +/-3.5hz per/sec error correction in accordance with the standard under 2.8Khz BW

How to send MIL-STD-188-110x Broadcast FS-1052 Messages ?



Enter or paste one or more messages into the message window, select the Address from the pull down window, select the mode and click OK. I configured properly and an ALE link has not yet been established, the tool will first attempt to establish an ALE linked state.

Enter MIL-STD 188-110 Message

```
DE AAR2JQ NR 7
R 061816Z FEB 04
FM WASHBURN/AAR2JQ NJ
TO HOLLISTER/AAA9E AZ
INFO PERTGEN/AAA2NY NY
POPKIN/AAA2NJ NJ
FITZSIMMONS/AAR2CB NJ
HEIL/AAM2ENY NY
BT
MARS EXERCISE - NY 02-04
SUBJECT: EEI REPORT
1. REFERENCE WHITE BLANKET/NY-NJ
A. NY WATERWAY FERRY SHUT DOWN -
HOBOKEN-38TH ST NYC / 061710Z FEB 04
B. OPERATIONAL
C. NO FERRY SERVICE NY-NJ DUE TO ZERO
VISIBILITY AND WATER TURBULENCE
```

MILS-RX MILS-TX

TO: ARQ BRD Terminate when done Cancel OK

However, with MARS Immediate Link Step (MILS) an ALE link is not even needed to send a high speed FS-1052 message. The receiving station clicks MILS-RX the transmitting station selects the receiving station address and clicks MILS-TX and the message is sent.



MARS-ALE with TNC and 2nd PC Sound Device support

- Although not yet planned, there is no reason that TNC support for various standard hardware modems can not be added for such modes as AMTOR, CLOVER, GTOR, Pactor etc., to hand off to after an ALE link.
- Likewise, there is no reason that support for a second PC sound device in the system can not be supported for addition modes currently being used within MARS to include those designed specifically for the PC sound device, like MT63 or possibly the emerging Sound Card Amateur Message Protocol (SCAMP).

KISSing MSYS and embracing JNOS and STAGNAG 5066



- It is planned that MARS-ALE PE will provide a KISS interface with MSYS at our Gateways as the first phase of integration into the existing MARS Traffic Network.
- Later a JNOS interface is planned.
- Also planned is support for STANAG 5066
- MARS-ALE inherited from PC-ALE, an unfinished email and file transfer capability where UDP sockets are opened and it acts as a POP/SMTP server for any e-mail client, such as MS-Outlook, Eudora, etc. It is planned to finish and integrate this capability with JNOS and STANAG 5066 to provide users a seamless choice of using their email client, with MARS-ALE as a server to send/receive messages.

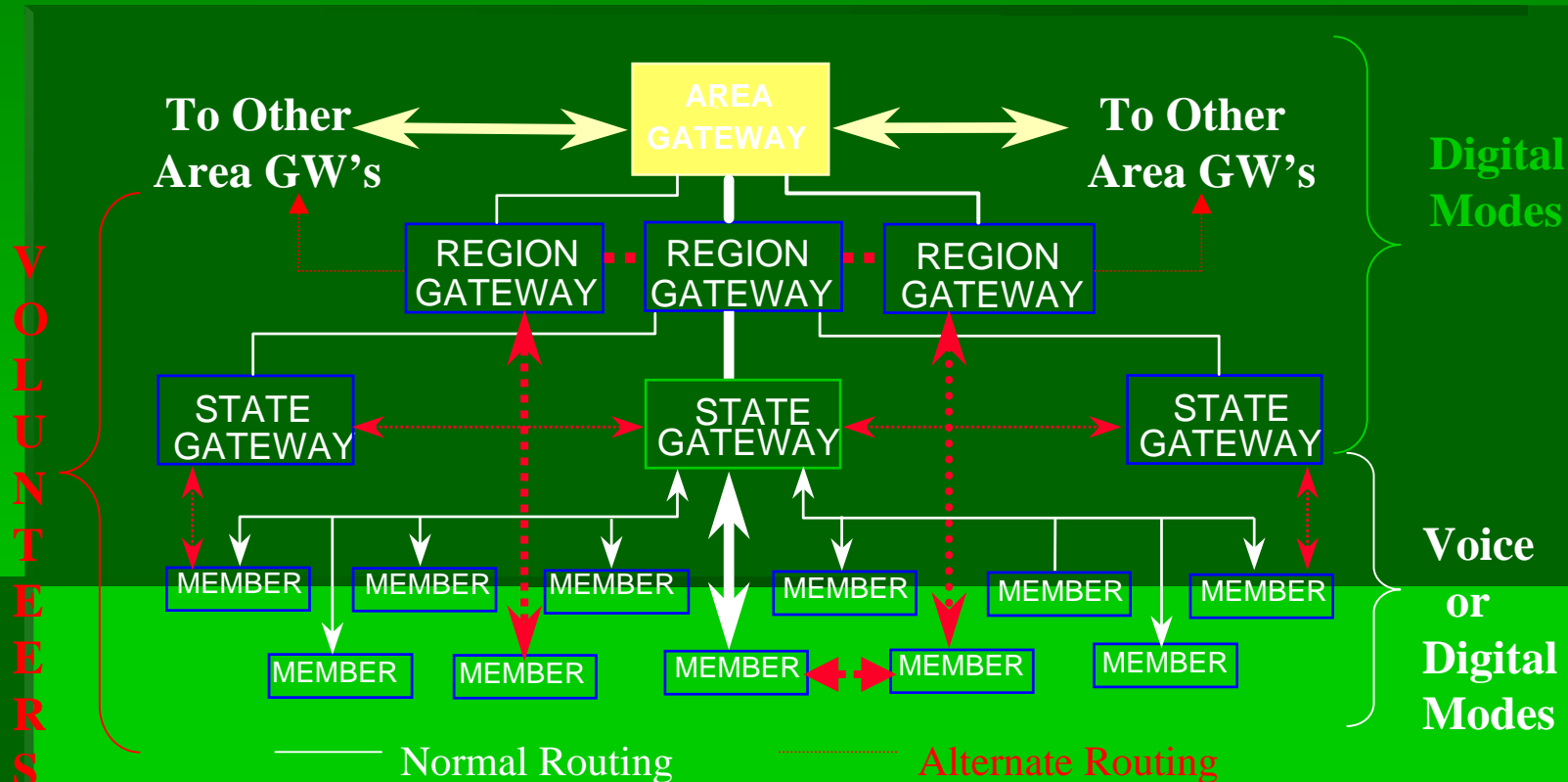
KISS Interface



- Any MARS-ALE PE station will be able to receive and forward traffic automatically as configured from member to member.
- PE at the State Gateway stations will normally serve as the portal via KISS and MSYS into the Region Gateway of the Network normally.
- MARS-ALE PE at any Gateway station will provide for both ALE modes and high speed access using any supported waveform and protocol and the MIL-STD-188-110 modem.



MARS-ALE PE with a KISS interface to MSYS will drop right into the Army MARS CONUS Voice & Digital HF/VHF Traffic Network as a first phase integration.



MARS-ALE PE shall provide AFSK ARQ @ 375BPS and PSK ARQ up to 2400BPS and FTP capability for member to member, member to State Gateway and member to Region Gateway alternate routing



JNOS INTERFACE

- **MARS-ALE with JNOS will interface to the MARS Message Center System (MMCS) using a TCP/IP socket connection with the standard POP3 (port 110) and SMTP (port 25) connectivity.**
- **Our first objective is to pass messages received by MARS-ALE over this interface.**
- **The other direction, JNOS to MARS-ALE has not yet been determined.**



STANAG 5066

- It appears likely that STANAG 5066 will become the foundation for the new U.S. HF email standard as it is being fielded within NATO and other international military communications systems already.
- With respect to the MARS program, the goal is to have a transparent connection with our Gateways and be in the position to have interoperability with our customers.
- The current state of HF system development is such that TCP/IP based services can not be reliably provided to HF users under an acceptably diverse set of channel conditions. We need to define what services and under what conditions a reliable TCP/IP connection can be maintained when standard TCP/IP protocols are adapted for use over HF subnetworks.
- To satisfy current requirements, STANAG 5066, with a suitable system of gateway access points, can provide a close approximation to the desired transparent service to and from HF users.

STANAG 5066 Technical



- **North Atlantic Treaty Organization Standardization Agreement (STANAG) 5066 defines technical standards required to ensure conformance for networked, error-free communication over High Frequency (HF) radio channels. STANAG 5066 contains minimum conformance standards for HF Electronic Mail (e-mail) software.**
- **Reliable data communications over HF radio is provided using ARQ data link protocol supported by an equalized single-tone HF data modem. Although other HF data modems such as parallel-tone or Orthogonal Frequency Division Multiplexed (OFDM) waveforms can be used, it has been developed and tested for MIL-STD-188-110A, STANAG 4285, and STANAG 4529 single-tone waveforms.**
- **The data transfer sublayer defined in STANAG 5066 supports automatic changes of the user data rate (that is, code rate) of the HF modem in response to changing channel conditions (adaptive data rate). This capability requires remote control of the HF modem. The profile is defined so nodes in which remote control of the modem, and hence adaptive data rate, is not available will interoperate with nodes which do have the capability.**

The End of the Beginning

- **Any Questions ?**

