MARS – ALE

What is ALE?
ALE is the acronym for Automatic Link Establishment, and it is the de facto worldwide standard for initiating and sustaining real time communications using high frequency radio while avoiding guesswork, beacon listing, and complicated predication charts.

How is ALE Used?
ALE is typically used for linking up operators for voice communications on SSB, but once a link is established, any mode of communications authorized for that frequency, channel, band, or sub-band can be used. The military uses ALE primarily to establish and maintain communications with over the horizon or terrain masked units. Domestically, ALE has been adopted as the back-store for long haul or terrain masked units between, federal, state, and local agencies when other long distance communications fail due to a natural or man made disaster.

What Equipment is Needed?
At a minimum, an operational, fully functional ALE station must have these components:

1. Dedicated ALE capable[1] HF Transceiver (dedicated = not used for any other purpose).
2. Programmable antenna tuner.
3. Broadband HF antenna
4. ALE controller implemented either in hardware or software.
5. MFSK modem[2] implemented either in hardware or software, and
6. List of ALE frequencies

How Does ALE Work?
Basically, the ALE controller causes the radio to scan a preset group of frequencies pausing slightly to listen for ALE signals from another ALE stations. When a signal is intercepted, the ALE controller stops scanning and listens to the signal long enough to determine if it is a call for that station or a routine sounding. The secret of why ALE is so successful is the **_LQA [4] (Link Quality Analysis)_** entry the ALE controller creates or updates. If the signal is a call, the receiving station will attempt to link with the calling station by acknowledging the call and handshaking with the calling station. The LQA database is perishable. i.e. , it loses its value quickly, hence the need for scanning and **_sounding,[3] "Not authorized in MARS"_** ,on a 24/7 basis. It should be noted an LQA bi-directional call can provide updates to the LQA Database as well as adding LQA request to a regular call.

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1. Radio must be able to scan a selected set of predefined frequencies at a rate of 2 to 10 channel per second 24/7 without inflicting damage to the radio. The components most affected are the band switching relays in the transmitter section of the typical ham transceiver. (there are only a limited number of ham transceivers for $1000 or less that can do this without modification)

2. The controller and modem functions are combined in the MARS-ALE software.

3. There are many other types of transmissions used in ALE operations, but only the function of a call directed to your station and a **_sounding, "Not authorized in MARS",_** are necessary for a basic understanding of ALE. A sounding is basically a "Here I am" transmission.

4. The ALE controller creates a database of LQA (**L**ink **Q**uality **A**nalysis) entries for each station heard sounding. The LQA data is used by the controller to determine the best frequency in the scan set for a successful link ta a specific station.

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How do You Use ALE?

To reach a station, the station operator simply enters the call sign just like dialing a phone number. The ALE controller selects the best available frequency based on the LQA data and sends out a calling signal containing the call signs. When the distant scanning station detects the first few characters of its call sign, it stops scanning and stays on that frequency. The station's' ALE controllers automatically handshake to confirm that a link is established and they are ready to communicate.

The receiving station, which was muted up till now, will emit an audio and visual alarm to alert the operator of the receiving station of an incoming call. It also indicates the call sign of the linked station. The operators then can talk in a regular conversation or send and receive digital messages.

If the called station fails to respond or the handshaking fails, the ALE controller of the originating node selects another frequency either at random or by selecting the next best channel as indicated by the LQA data.[5] At the conclusion of the QSO or link, one of the stations sends a disconnect signal to the other , and the ALE controllers return the stations to the scanning mode

Reliability

When combined with Near Incident Sky wave (NVIS) antenna or a broad band antenna and sufficient (roughly 10) spread across the spectrum, an ALE node can provide greater than 95% successful linking on the first call, nearly on par with SATCOM systems. This is significantly more reliable than cellphone and landline infrastructure following a man made or natural disaster.

How is ALE Used in the MARS Community?

How and when to use ALE in MARS operations is evolving. Codifying how to use ALE in otherwise static networks for passing routine message traffic is a non-trivial task. The complexity of static, directed networks, like those used by the duel-service MARS community, is controlled by specifying specific times and paths and delivering message by broadcast, but ALE is not static.

An ALE network is amorphous (lacking a clear structure or focus), and its complexity increases exponentially (with reference to an increase) more and more rapidly as the number of nodes, frequencies, and message count increase.

In the long term ALE holds great promise for a strong, even though it is lacking clear structure or focus, backbone of a robust, reliable, and efficient system to route and pass traffic automatically without requiring intervention of individual station operators. The concept for such a system is in place. It is an elegant system and takes some due diligence to understand and get operational. ALE can be used for simple peer-to-peer links, and a hybrid traffic network for message handling composed of key ALE stations at the National level, Regional levels and static, directed networks at the State level.

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5.   Whether the next frequency is random or the next best based on LQA data depends on the sophistication of the ALE controller.

Note: Edited and transcribed from an unknown author in Navy MARS.