ALE—THE COMING OF AUTOMATIC LINK ESTABLISHMENT

By Ronald E. Menold, AD4TB
106 Dovetree Ct
Sterling, VA 20164

Automatic link establishment (ALE) was developed to automatically select a frequency that will support automatic linking between stations in a network or point-to-point communication—*without operator assistance.* This new technology has given HF radio a renewed sense of being. The US government and governments of foreign countries are quite excited about ALE and its many uses. ALE offers a new approach in adaptive automated control via the HF medium. Once, skilled radio operators knowledgeable in HF propagation were the only answer to mastering long-haul HF communication. With ALE, significant training and cost is no longer required. ALE takes the guesswork out of the frequency selection process.

Many government agencies are talking about how ALE will benefit their specific communication programs, and eliminate the guesswork and operator intervention. It's important because of the complexities of HF propagation prediction. A frequency that's good one minute can fade or decay the next. ALE can remedy this by sampling the path on a timed basis.

Background

With the help of technological advantages in the area of integrated-circuit miniaturization, several companies began to design and address these new technologies by producing proprietary prototypes of automatic linking over HF communications channels. These systems were developed in the early '80s with similar features including, automatic signaling and response, selective calling, automatic handshaking, channel scanning and selection, and link quality analysis (LQA).

These proprietary systems all worked great in their own way, and were called *adaptive HF radios.* Keep in mind, several problems existed, such as incompatibility between the products of different manufacturers, thus establishing the requirement for a standard. This standard attempted to make manufacturers comply with interopera-bility for ALE links established among networks using similar equipment provided by different manufacturers. The signaling and handshaking schemes were not compatible. Consequently, this brought about the development of an ALE Federal Standard initiated in 1985.

What resulted five years later, in 1990, was a Federal Standard, FED STD-1045A. This release provides for standardized functions for call initiation, emissions, responses and acknowledgment signals relating to ALE.

How Does ALE Work?

ALE establishes a link between itself and another ALE-equipped radio without operator assistance. Under microprocessor control, ALE modes include automatic signaling, selective calling, and automatic handshaking. Other automatic functions related to ALE are channel scanning and selection, link quality analysis, polling, sounding, and message store-and-forward capabilities.

To fully understand how ALE works, you should know how link quality analysis plays an important function in the overall linking process.

What is LQA?

Link quality analysis is an automatic measure of the signal quality between two stations based on bit error rate (BER) and signal-to-noise and distortion (SINAD). The LQA memory is built up by passive or active measurements of short-term channel quality on designated frequencies. The active measurement employs special transmissions called *sounding.* This gives the listening stations a chance to measure channel quality at scheduled time intervals.

Passive measurements are those made only when links are established, or when other stations are heard by chance as they are calling third-party stations. In both types of channel measurements, all stations in a network agree in advance on the set of frequencies in the particular scan group they will use for ALE attempts. All stations not linked to others automatically revert to their scan mode and listen for scheduled or random ALE calls. LQA memory complements the ALE linking process. Let's examine how the complete ALE protocol works to establish a communication link.

The Full ALE Operation

First, the transceiver is set to the ALE scanning mode. Most units can scan up to 100 channels at two to five channels per second. While scanning, the receiver continuously monitors the activity for incoming ALE signals. When heard, these signals are evaluated for channel link quality, and the data is stored in memory for future reference.

Secondly, when a station wants to contact another station, the initiating radio checks its LQA memory for the latest, or best channel to use for that particular station. It verifies that the channel is not busy, and then transmits a digital call signal on that channel. This call signal follows a specific protocol and includes the selective call addresses of both the called and the calling stations. If the called station receives and decodes the call properly, it will respond with a specific signal acknowledgment.

On receiving the response, the calling station sends out a confirmation signal and a link is established. If no link is established on the first channel the initiating radio tried, the system then tries the other channels in that scan group—in order of remembered quality—until a link is established on one of the preprogrammed channels.

The ALE transmission tones sound unique and strange when you first hear them. The continuous warbling-tone calling sequence lasts about 20 to 90 seconds during the initial linking progress.

Automatic Message Display

Automatic message display (AMD) is a digital order-wire. An initiating station links with a distant station and sends a digital AMD message up to 90 characters long. If unattended, the distant terminal stores the message(s) for later reading. This AMD function is part of the framing signal and has an internal data rate of about 100 wpm.

ALE Test Results

ALE testing was conducted in two phases: bench hook-up and on-the-air tests. Both were successfully accomplished. Conclusive tests were conducted by several companies including Frederick, Harris, Sunair, Rockwell-Collins, and Transworld, all manufacturers of ALE controllers and peripheral HF equipment, including transceivers with embedded ALE capability. Equipment options include digital signal processing (DSP), high-speed modems and others too numerous to mention. Several government agencies were involved in testing the first HF ALE controllers during the latter part of 1990.

ALE can complement other digital formats and high-speed synchronous modems. Most units support 2400-bit/s 39-tone modems and others using unique protocols. In addition, some manufacturers offer optional DSP to enhance SSB voice or digital signals, reducing atmospheric interference and channel dynamics, to give processed-signal quality. There are many software packages and hardware interfaces produced by third-party vendors that work with many ALE units.

Your Tax Dollars at Work

ALE is causing quite a commotion. Not only are government agencies excited, but private industry has jumped on the bandwagon in support of government contracts. Just when many government agencies were scaling down their HF operations—with satellite and higher data rates taking preference—ALE arrived.

Amateur Benefits

Why isn't the gear on your amateur equipment dealer's shelf so you can purchase it and really start having fun? You can benefit from this new technology if you show the manufacturers the need is there for them to pursue development of a low-cost version that employs some of the same linking protocol as that of the high-end government models. If amateur response is high, the potential exists to encourage manufacturers to survey US and foreign amateur markets for potential

sales.

High-frequency ALE is a relatively new term in the amateur community where amateurs are learning of new digital modes such as PacTOR, Clover—and the latest arrival, G-TOR. Now, here comes this automatic linking protocol that takes all the guesswork out of propagation prediction. I don't know about *you,* but *I* have a lot of ideas for this thing called ALE!

Amateur Use

If you're like me, I have only a few minutes to conduct a scheduled contact. If that fails, I must try again later. Many of you have been in that situation, I'm sure. Remember the schedule you had with your relative or friend and missed it? Remember calling for five minutes (it seemed like five hours)? Remember blaming poor band conditions that interrupted your contact? Remember waiting until the next week—or month—to have another try? If you had an ALE controller, you could easily link with relatives and friends around the world. ALE can, in most cases, overcome propagation changes—provided you have prepro-grammed channels in several bands to increase your chances of linking.

If the FCC rules permitted, with ALE, you could instantly link with anyone—day or night—and leave an AMD message on a scheduled basis without the recipients being around. Remote control and other interfaces are just a few of the exciting things that are now being produced.

Undoubtedly, many amateurs have heard the ALE linking sound on government HF frequencies above and below the amateur bands but have failed to recognize it. *ALE has arrived*—and is here to stay. You have an opportunity to get involved in the future of ALE. It's yours for the asking!

ALE Disadvantages

There are a couple of detractors related to ALE that exist for amateurs. These are *frequency selection* and *interference* problems. Unlike the government, which has a greater selection of frequencies, amateurs are confined to specific bands. ALE requires a wide range of frequencies to select the best channel. In addition, the initial linking call could interfere with other digital signals on that same frequency. You must listen before transmitting or attempting to link. I can see how regulation and much discussion needs to take place before ALE will become practical for amateur use. It *can* be a reality—*if* the minds of many solve the problems that face our unique situation.

Summary

ALE is the perfect answer for the replacement of obsolete HF government stations. With government and military downsizing, this technology is a welcome replacement with FED STD 1045A in place. This new linking protocol can meet the communication requirements of the future. It's the perfect HF backup for voice and data when the primary means of communication fail. ALE offers a better mousetrap for your tax dollar and gives HF a renewed place in digital and voice communication throughout government and industry.

Further Reading

"The Growing Family of Federal Standards for HF Radio Automatic Link Establishment (ALE)," by Paul C. Smith, K3ZMO, and Dennis Bodson, W4PWF, July-December 1993 *QEX* (six-part series).

"ALE: A Cure for What Ails HF Communications," Packet Perspective, November 1993 *QST*, p 107.

"A Family of Federal Standards for HF ALE Radios," by Robert Adair, KA0CKS, and Dennis Bodson, W4PWF, November 1992 *QST*, p 73.

