MIL STD 188-141A

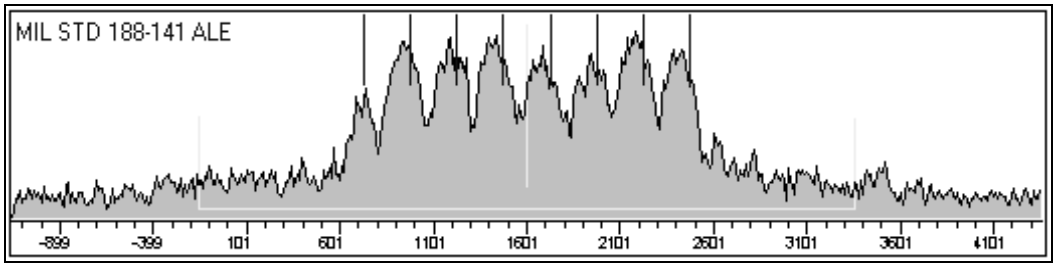
ALE (Automatic Link Establishment), 2G ALE

Automatic link establishment (ALE) is a communication system that permits HF radio stations to call and link on the best HF channel automatically without operator assistance. Typically, ALE systems make use of recently measured radio channel characteristics stored in a memory matrix to select the best frequency. When not in use, each radio receiver constantly scans through its assigned frequencies, listening for calls addressed to it.
After link setup it may be switched manually or automatically to a different modem for high-speed FSK/PSK data, or voice.

Its waveform is designed to pass through the AF pass band of standard SSB equipment. It consists of 8 tones (MFSK) located on 750 - 1000 - 1250 – 1500 - 1750 - 2000 - 2250 - 2500 Hz. Each tone is 8mS in duration. This gives 125 symbols per second. With 8 tones (symbols or elements) ALE supports 3 data bits per symbol. This results in a transmitted data rate of 375 bits per second.
The represented three bits of data per tone are as follows (least significant bit (LSB) to the right):

750 Hz	1000 Hz	1250 Hz	1500 Hz	1750 Hz	2000 Hz	2250 Hz	2500 Hz
000	001	011	010	110	111	101	100

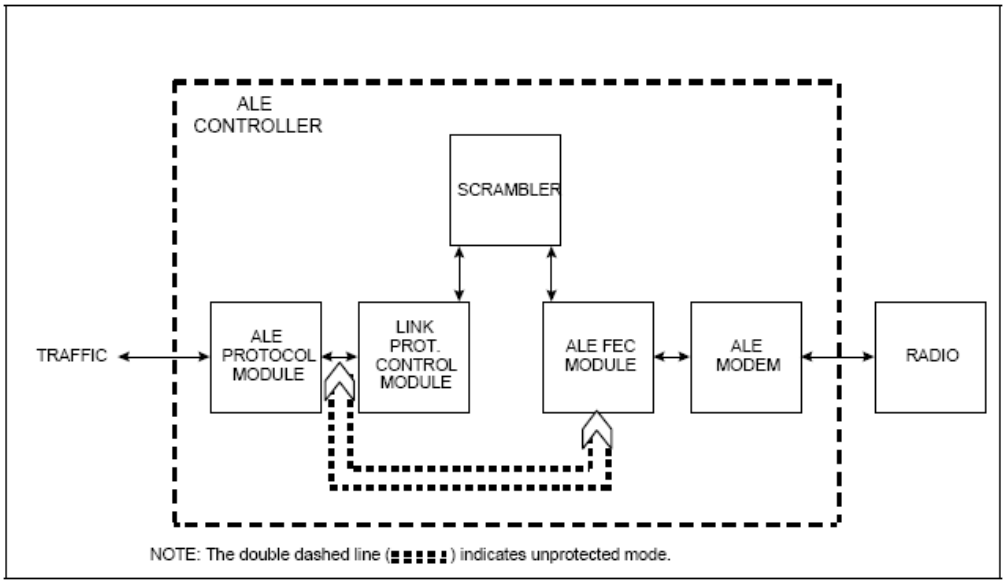
The bit stream of MIL 188-141A is structured in 24 bit frames. These include a preamble of 3 bit for the frame type and 3 ASCII characters with 7 bit or 21 unformated bit. The total frame is Golay encoded and interleaved which results into a frame of 49 bit (including on stuff bit). Each 49 bit frame is transmitted three times.



Picture 119: Spectrum of MIL STD 188-141A

LP MIL STD 188-141A can be used with linking protection LP. The linking protection control module (LPCM) performs all control functions specified and interfaces to the ALE controller.
Scrambler are performing all cryptographic operations on ALE words, under the control of the LPCM. Use of LP is not increasing the time to establish a link compared to the nonprotected Radio or degrading the probability of linking

The conceptual model of the MIL-STD-188-141 data link layer functions is shown in the following picture:



Picture 120: Linking Protection in MIL STD 188-141A

The following levels of LP are possible:

AL-0
AL-0 indicates that no linking protection is being employed. No protection is provided against interfering, unintentional, or malicious linking attempts.

AL-1
The AL-1 scrambler is using the lattice encryption algorithm. The AL-1 protection interval (PI) is 60 seconds, which provides slightly lower protection than any of the other available protected modes but allows for relaxed synchronization requirements.

AL-2
The AL-2 scrambler is using the same algorithm as specified for the AL-1. The AL-2 PI is 2 seconds.

AL-3
AL-3 is using distinct hardware scramblers and employs an algorithm and the corresponding interface control document (ICD) developed by the NSA. AL-3 PI is a maximum of 2 seconds.

AL-4 (classified application level)
AL-4 uses distinct hardware scramblers and employs an algorithm and the corresponding ICD developed by NSA The AL-4 PI is a maximum of 1 second.