

Additional Review Comments on:
ALERT2 AirLink Protocol Specification
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1. Introduction

This note contains additional review comments for the *ALERT2 AirLink Protocol Specification*, Version 1.0, dated May 2010, published by the National Hydrologic Warning Council (NHWC). These comments supplement the author's previous comments dated January 19th, 2011.

Enhancing the *ALERT2 AirLink Protocol Specification* to include support for a widely deployed on-the-air, link-layer frame format could dramatically reduce the cost to hydrologic warning system (HWS) vendors and operators of developing and deploying products that support the ALERT2 protocol suite. The link layer frame format used by the Maxon SD-171E and the Midland SD-171 radios and the ACC 513 modem (referred to here as the "ACC 513 frame format") appears to be an ideal candidate. These devices are readily available, widely deployed, commercial, off-the-shelf (COTS) radio/modem products that are offered by at least two vendors and that reportedly interoperate. Furthermore, the ACC 513 frame format is based on a freely available standard and could conceivably be implemented by other vendors. In particular, it may be practical to enhance the prototype AirLink demodulator to support this frame format.

This note proposes that the *ALERT2 AirLink Protocol Specification* be enhanced to permit remote stations to optionally use the ACC 513 frame format with the ALERT2 protocol suite. In general terms, remote stations could use the ALERT2 application layer protocol, the ALERT2 TDMA protocol, and portions of the ALERT2 link layer (AirLink) protocol with data radios that use the ACC 513 frame format. Likewise, ALERT2 repeaters that receive ALERT2 packets that use the ACC 513 frame format could still use the ALERT2 multiplexing (MANT) protocol. This enhancement would enable HWS operators and vendors to benefit from the new functionality provided by the ALERT2 protocols while gaining the cost advantage of existing COTS hardware products. Although these specific data radios do not support very narrowband (6.25 kHz channel) operation, the use of COTS equipment should facilitate the future migration to very narrowband radios. The use of these data radios will also position HWS vendors to more easily implement functionality that relies upon two-way communications with remote nodes.

This proposal is preliminary. As detailed below, the feasibility of this approach has not yet been demonstrated. Salo IT Solutions, Inc. (SaloITS) is prepared to work with interested parties, including the ALERT2 Technical Working Group (TWG), HWS vendors, and data radio vendors, to evaluate the feasibility of the enhancements proposed in this note.

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² The opinions expressed here are those of the author, and do not necessarily reflect those of any other individual or organization, including those that have funded, are funding, or may in the future fund the author's employer, Salo IT Solutions, Inc.

2. Support for ACC 513 Link Layer Frame Format

I suggest that the ALERT2 TWG consider extending chapter 4, “Modulation”, of the *ALERT2 AirLink Protocol Specification* to include support for the ACC 513 frame format, the link layer frame format used by the Maxon SD-171E and Midland SD-171 radios. The principal use of this optional, alternate on-the-air frame format would be to support remote-to-repeater and remote-to-base station links. The specification would continue to permit the use of the AirLink frame format in these configurations, although not on the same link as the ACC 513 frame format is being used. All other ALERT2 protocols could remain unchanged, although the TDMA protocol might be extended to eliminate the need for GPS receivers at remote sites.

2.1. Maxon SD-171E and Midland SD-171 Radios

The Maxon SD-171E VHF radio with the optional ACC-513 modem and the Midland SD-171 VHF radio with the optional ACC 513 modem appear, on paper and according to company claims, to interoperate. If this is the case in actual practice, then these radios demonstrate that interoperable data radios are available today from two different manufactures. Furthermore, because these radios both appear to have large installed bases, the two manufacturers ought to have strong motivation to continue to sell compatible radios well into the future.

The Maxon SD-171E and the Midland SD-171 appear to share a common ancestry, but are different radios. I have not yet had a chance to inspect these radios, but I believe that the Maxon SD-171E is a more recent implementation of the Midland SD-171. The ACC 513 modem uses Gaussian Filtered Minimum Shift Keying (GMSK) and operates at 4,800 bits-per-second (bps) when the radio is used in narrowband (12.5 kHz) mode. The frame format used by the ACC 513 modem is, I understand, loosely based on a small portion of the MPT 1327 standard, a standard developed in the United Kingdom for trunked radio networks.

2.2. Enhancements to *ALERT2 AirLink Protocol Specification*

I suggest that the ALERT2 TWG consider the following changes to Chapter 4, “Modulation”, of the *ALERT2 AirLink Protocol Specification*:

- Add language that permits ALERT2 remote systems to use the ACC 513 frame format. That is, ALERT2 remote systems may use either the ACC 513 frame format or the currently specified AirLink frame format.
- Include a description of the modulation and link-layer frame used by the ACC 513 modem. While I’m not sure whether the ACC 513 manuals and the MPT 1427 standard provide sufficient detail, I believe that Maxon and Midland have a strong incentive to ensure that the correct information is available to the TWG.
- Describe how an ALERT2 packet is to be encapsulated within an ACC 513 frame. Additional work is, I believe, necessary to determine how this should best be done, as described below.

- Specify that:
 - Remote ALERT2 nodes *may* transmit frames using the ACC 513 frame format.
 - ALERT2 repeaters and ALERT2 base stations *must* be able to be configured to receive either the current ALERT2 AirLink frame format or the ACC 513 frame format.
 - Only one frame format, AirLink or ACC 513, *should* be used on a radio frequency (RF) channel.
 - Remote ALERT2 nodes *should* (or maybe *must*) be able to receive and ALERT2 base stations and ALERT2 repeaters *should* (or maybe *must*) be able to transmit TDMA synchronization information over the ALERT2 channel. The details of this TDMA synchronization information should be documented in the ALERT2 TDMA protocol specification. This requirement may obviate the need for a GPS receiver in remote nodes that use the ACC 513 frame format.

3. Benefits of Supporting the ACC 513 Frame Format

If it is technically feasible, supporting the ACC 513 frame format may offer numerous advantages.

- Reduced ALERT2 development costs. The cost to HWS vendors of developing support for the ALERT2 protocol suite may be reduced, particularly compared to implementing the AirLink modulator in vendor hardware.
- Reduced ALERT2 system costs. The cost to HWS operators may be reduced, to the extent that COTS data radio vendors are able to realize manufacturing economies of scale that are impossible for a product that is unique to the HWS market. The list price of the Maxon DS-171E and ACC 513 is \$334.
- Reduced time to market. The use of a COTS data radio may reduce HWS vendors' time to market, particularly if the development of new hardware, such as an integrated AirLink modulator, can be avoided.
- Use of existing radio. Some HWS operators may already be using Maxon SD-171E or Midland SD-171 radios. In these cases, operators may need to merely add the ACC 513 GMSK modem to their existing radios. The list price of the ACC 513 modem is \$89.00.
- Positioned for very narrowband 6.25 kHz migration. HWS vendors and operators who use the ACC 513 modem *may* be well-positioned to migrate to 6.25 kHz operation. Maxon and Midland will have a strong incentive to offer very narrowband radios that are drop-in replacements for the SD-171E and the SD-171. To do otherwise would give their existing customers an opportunity to evaluate alternative very narrowband solutions.

- Facilitate implementation of functionality that requires two-way communications. If HWS vendors use the SD-171E or SD-171 data radios with the ALERT2 protocols, they should be able to use the same radio for features that require two-way communications. That is, a single data radio should be able to simultaneously support the ALERT2 protocols (using the ACC 513 frame format) and other protocols, including those that use two-way communications.
- Retain benefits of the ALERT2 protocols. The changes proposed here will permit HWS vendors and operators to gain most, probably all, of the benefits of the ALERT2 protocol suite, while gaining the economic benefits of less-expensive, high-volume COTS data radios.
- Transparent to ALERT2 applications. This proposal should require no modifications to ALERT2 applications, because remote stations will continue to use the ALERT2 application layer protocol.
- Eliminate need for GPS receivers at remote stations. The need for remote stations to have GPS receivers in order to synchronize their transmissions with TDMA time slots could be eliminated, if ALERT2 repeaters and base stations transmit TDMA timing information on the ALERT2 RF channel.

4. Status of this Proposal / Open Technical Issues

This proposal is based on my current understanding of the Maxon and Midland products, which is derived from vendor documentation and conversations with the vendors. I anticipate receiving a pair of Maxon data radios shortly, and should have a better understanding of these devices after I work with them. Likewise, I will have much greater confidence in the vendors' claims of inter-vendor interoperability after I have demonstrated it myself. If there is interest on its part, I would be happy to keep the ALERT2 TWG apprised of my progress and results.

The technical feasibility of this proposal has *not* yet been demonstrated. Open technical issues include:

- Can the prototype AirLink demodulator be modified to properly receive the ACC 513 frame format?
- How, precisely, should the ACC 513 frame format be used to transport ALERT2 packets? To what extent should the AirLink frame format be used, and to what extent should it be modified for use with the ACC 513 modem? Should the same forward error correction (FEC) algorithms and parameters be used?
- Can the Maxon SD-171E and the Midland SD-171 work with the ALERT2 TDMA protocol?

Ideally, a proof of concept implementation of the ALERT2 protocols integrated with the ACC 513 frame format can be developed as the ALERT2 TWG enhances the *ALERT2 AirLink Protocol Specification* to incorporate the changes proposed here.