Avoid Infrastructure by Centralized Polling of Emcomm Email

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Abstract

The San Diego ARES Emergency Medical Services (EMS) sub-group utilizes the Winlink 2000 system for medical message handling. The Winlink 2000 system has a dependency on Internet infrastructure which may not exist in a regional disaster.

Secondly, message density has increased to the point where trauma-center teams often have to wait for the channel. Winklink 2000 could address this by adding channels and RMS nodes, but not without a further dependence on infrastructure.

This paper describes a proof-of-concept test on an old idea: central polling of mail clients as a means of maximizing the traffic on the channel.

Introduction

The San Diego ARES group began experimenting with Winlink 2000 technology 3 or 4 years ago. Since that time, they have become committed to utilizing it for the detailed and complex medical information being passed by the Emergency Medical Services (EMS) sub-group.

Drilling with the system quickly proved its utility, far exceeding the ability of our best traditional message handlers. But, as suitable as the technology seems, the Winlink 2000 system has a dependency on Internet infrastructure which may not exist when the EMS group needs it most… in a regional disaster.

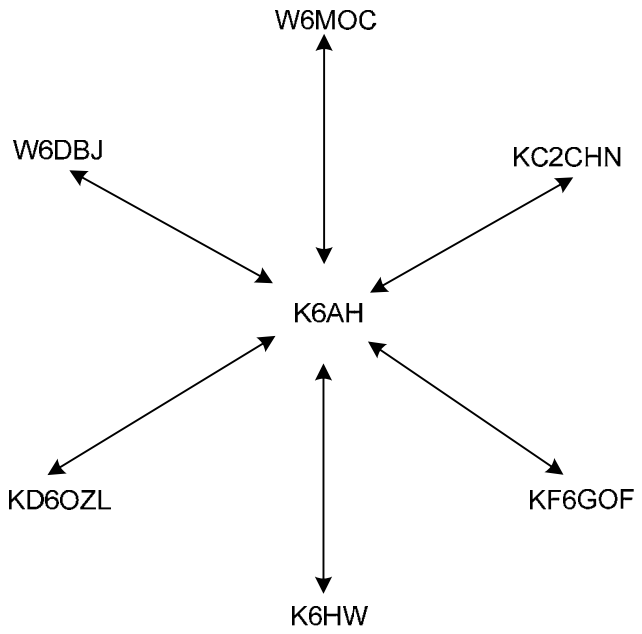
Secondly, message density has increased to the point senders have to wait for the channel. While the AX.25 packet protocol handles multiple concurrent sessions, the Medical Operations Center (MOC), the primary recipient and source of message traffic, can not. The solution was to assign each team 6-minute timeslots around the hour. This worked well but increased message latency and tended to underutilize the channel. Winklink 2000 could address this by adding channels and RMS nodes, but not without a further dependence on infrastructure.

Three members of the ARES EMS Team in North San Diego County, Dean, W6DBJ, Robert, KC2CHN, and I, K6AH, began experimenting with *Airmail*, a Winlink client, and its ability to connect to similar systems directly, without the aid of Winlink 2000 and the Internet. This technique, referred to as *peer-to-peer*, because of its inherent independence from other components, requires reconfiguration of the client and an advance-knowledge of participating stations. It does not support general email routing of internet addresses.

Our experiments proved out this ability and, after a few failed attempts, were passing messages amongst ourselves, both direct and via Palomar ARC's W6NWG-1 digipeater. We found it reliable and remarkably fast (a term I use loosely here… in today's world of mega-bps data rates to the home). And while this technique certainly deals with the Internet issue, it does not address the channel contention problem.

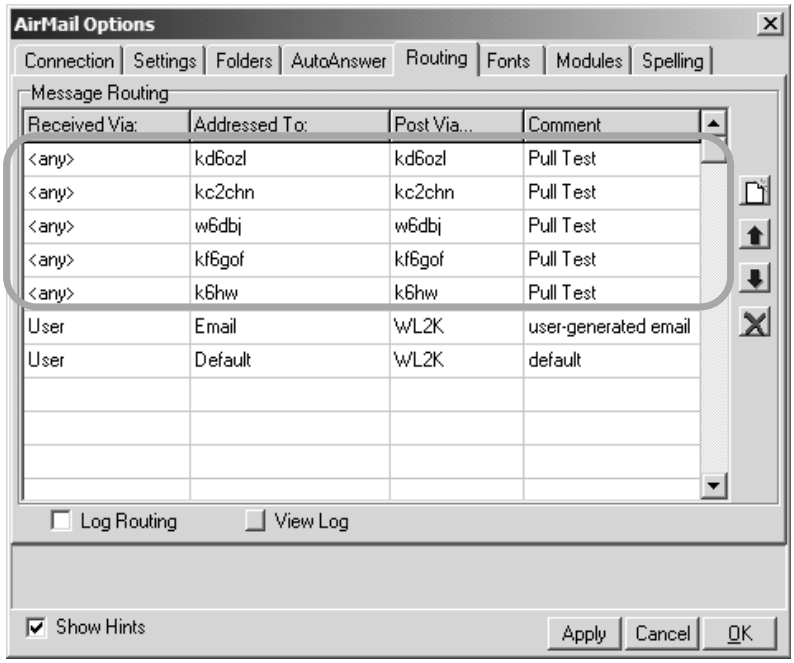
A Potential Solution

So to further a solution I began talking up the idea of turning the messaging scheme around: defining when stations would use the channel by polling them in a *round-robin* fashion, rather than leaving it up to the many that may want to send a message on the channel at any given time.

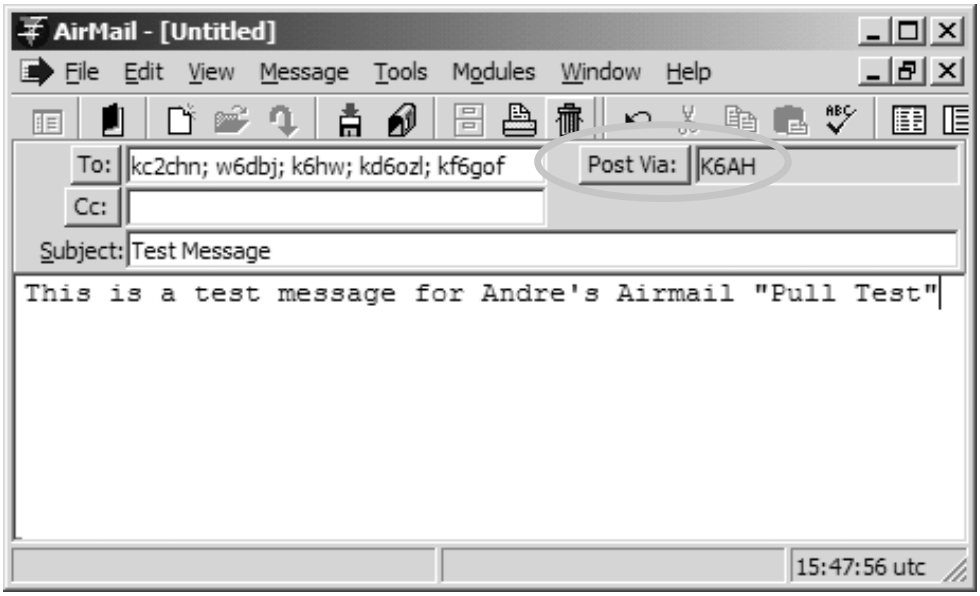


Airmail, or any other Winlink 2000 client for that matter, does not support this technique directly. But it can be performed manually by connecting with each of the remote stations one after another. It's cumbersome, but after two passes through the remote list, every possible sender/recipient combination will have been handled.

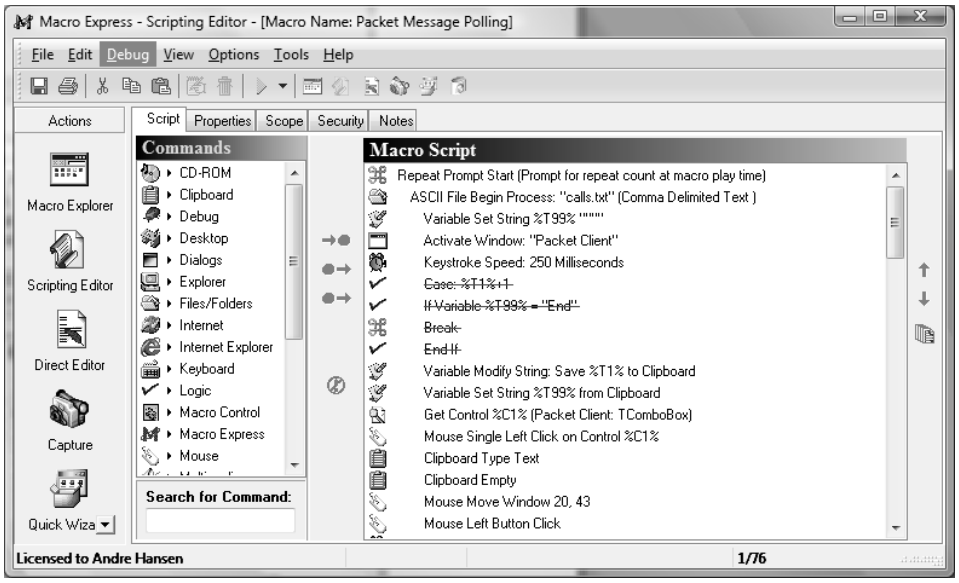
Each participant in the scheme requires a separate entry in polling stations' Airmail's routing table. Airmail supports up to 12 entries which effectively limits the number of participants this technique will support.



When sent, each message is posted via the central node---K6AH in this case.



Next was the challenge of automating the tedious polling process. This was accomplished through the use of a Windows keystroke/mouse macro application. This approach involves programmatically defining the mouse movements, mouse clicks and key-strokes that make up the aforementioned manual process. There are several macro applications on the market, but I chose Macro Express for its ease of use. Not being a programmer, I needed a more intuitive system than most of them offered.



The resulting system is certainly not *production-ready*, needing considerable work before fit for emergency deployment. But, providing it doesn't encounter unexpected problems, it is sufficient for proving out the concept.

Concept Test

Robert, KC2CHN, served the local ARES chapter as its technical advisor for Winlink and held classes as well as a weekly net to advance Winlink skills in the San Diego area, regardless of affiliation. I approached Robert to solicit the assistance of his net's members. They were eager to help. KC2CHN and W6DBJ wrote and distributed configuration instructions and W6DBJ worked with participants needing any extra configuration assistance.

The next problem was finding a location for the central polling site. The Palomar Amateur Radio Club (PARC) welcomed my request to use their repeater site atop 6,000'+ Mt. Palomar. Huge thanks go to the PARC Board of Directors and the following participants:

KD6OZL, Jim
KF6GOF, Norm
K6HW, Chuck
N6RMN, Craig
W6DBJ, Dean
KC2CHN, Robert
W5NYV, Michelle (PARC Site Coordinator)

On Saturday, April 5, 2008 we ran the test. It was run on 145.050 MHz and coordinated on 446.000 MHz simplex. The participants had various configurations of radios and TNCs. I was using a Kantronics KPC-3+ running 1200 baud packet and a Kenwood TM-D700, 50-watt radio running 10 watts. The systems were pre-tested for path and data connectivity. N6RMN was not reachable, lacking a path from his location in Canyon County (Riverside County). Minor last-minute participant configuration issues were resolved with the assistance of W6DBJ.

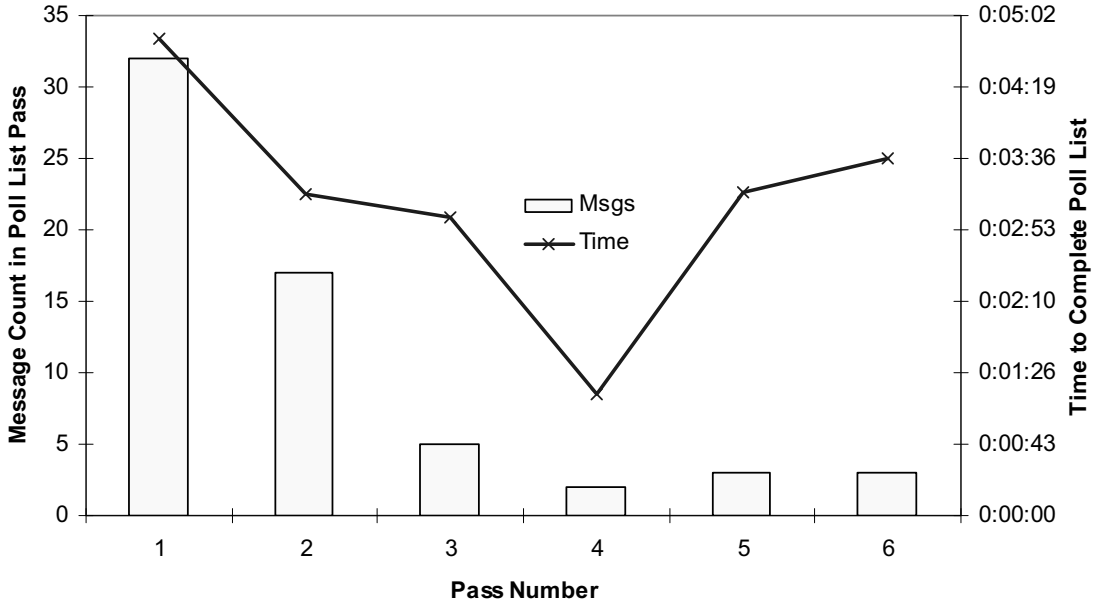
Initial results were discouraging. I ran into problems with the macro program. The problems seemed eerily familiar, but it took me 15 minutes to realize why… I had run into the same problems two weeks earlier testing with Dean and Robert. I had fixed the problems then and had saved the modified macro with a new name… but had neglected to update the test script with the new macro name---doo! Another senior moment. This was quickly resolved and from that point on the test ran flawlessly.

The objectives of the test were:

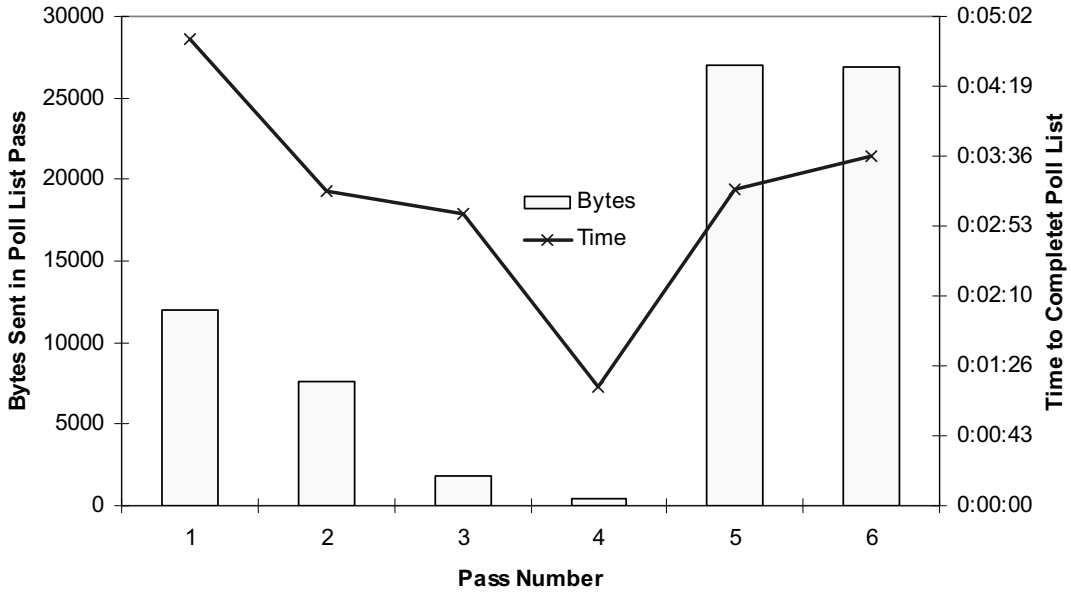
- identify at least one site that could serve as a central polling site for Winlink Peer-to-peer Polled messaging
- verify that a ham VHF radio can handle the packet transmit duty-cycle of this technique
- verify that the concept would work over a typical EMS traffic load
- baseline the throughput of the technique against the traditional approach
- understand what issues might surface in a county-wide implementation

Results

Participants had queued-up multiple messages to each other in preparation for the test. Initial peer-to-peer connects resulted in the many queued messages being transferred to my central station. Later in the first pass and throughout the second pass, these messages were delivered to recipients. By the fourth pass, there was little left to send/receive. At that point we attempted what I thought would be the *acid test*: a 13KB attachment broadcast to all participants. Pass five and six represent the sending and receiving of this message. The following graphs illustrate the results. The vertical bars represent the number of messages in the each pass. The line represents the time it took to complete each pass (I recognize the line is not appropriate for the nature of these data, but have chosen to use it nonetheless for contrast).



The next graph is similar, but illustrates the number of bytes sent in each pass.



The objectives were met:

- While it may not be the ideal site due to all the RF in the area, Mt. Palomar is clearly one site in San Diego County that could be used as a Winlink central polling site in a disaster. Multiple sites on the mountain, sufficiently distant from the repeater site, are even more suitable. Other repeater sites throughout the county are also prospective locations. Access to these repeaters from trauma sites should tend to define other suitable sites.
- At the end of pass four I checked my rigs temperature. It was no warmer than when the test started.
- During the 37 minute duration of test, 31 messages were passed. This exceeds the highest message load encountered in ARES drills.

Lessons Learned

While a short list, here are some lessons we learned, not directly related to the test objectives:

- It doesn't take a lot of power on VHF/UHF to cover the hundreds of square miles of San Diego County when you have the high ground. Ten watts was more than sufficient for the VHF FM data, and 2-3 watts was sufficient to coordinate the activities on UHF. These power levels presented no detectible interference to the repeaters on the Palomar site.
- The configuration assistance offered the participants were specific to peer-to-peer operations. It was evident that not all stations were configured the same for AX.25. Some stations took longer to transfer similar files and it appeared to me from listening tc the channel, that packet size was very large on some and small on others. It would behoove us to understand the impact this parameter has on transfer times and channel conditions.

Conclusions

The central-site Polled technique is a viable alternative to the traditional approach to Winlink. It successfully eliminates the Internet infrastructure from the architecture and substantially increases the utilization of the channel.

Beyond this though:

- It also provides a pro forma network that can be setup on any hilltop and on any frequency. In Southern California, the Two-meter Area Spectrum Management Association (TASMA) has allocated nine channels to packet data: 144.970, 145.030, 145.050, 145.070, 145.090, 145.630, 145.650, 145.670, and 145.690. And I suppose, in a real disaster, any channel not in use for disaster support becomes an alternative.
- The polling table which the macro uses to determine who is next in the round-robin sequence can be structured to go more frequently to the more important sites. In the following example, the Medical Operations Center (W6MOC) mail is picked-up and delivered twice as often as the other stations:
    - W6DBJ
    - KC2CHN
    - **W6MOC**
    - W6HW
    - KF6GOF v W6NWG-1
    - **W6MOC**
    - KD6OZL
- This technique works nearly as well through a digipeater. In the example, above, KF6GOF is configured as such through PARC's Palomar node on 145.050 MHz. In addition, TNCs and radios, such as Kenwood's TM-D700, are easily configured as pro forma digipeaters that can be strategically placed, based on the specific needs of a given disaster communications plan.
- The overhead attributable to ARES' current time-slot assignment technique (had that been used in our test) would have been equal to the 6-minute slice minus the average time to send and receive messages. This roughly equals 4.4 minutes. Comparing this to the overhead of sending calculated from the results, the polled technique has an overhead of 1.62 minutes… a 270% improvement. This, of course, translates into messages being sent in a fraction of the time of the time-slot assignment technique.
- Workload demands on the remote operator are reduced. They can focus on message preparation rather than fussing with getting them sent.

Next Steps

There are two directions I would like to explore next:

- Before this approach can be used by other experimenters, the macro code needs to handle error conditions more gracefully. I didn't take the time---nor have the talent for that matter---to take this much beyond where it is today. I would welcome the opportunity to work with a programmer to "harden" this application enough to make it available to others interested in pursuing this technique.
- Explore using a similar approach for long-haul traffic… using HF or 2M SSB Pactor-3, although the underlying radio technique is not particularly important. The San Diego Red Cross Chapter is wanting to exploit this technique to test infrastructure-less hubbed

networks in both San Diego and Imperial counties and then pass long-haul traffic between them…they reside on opposite sides of the 5,000' Cuyamaca Mountain range.

We will certainly run into limits which will restrict this technique's utility… the challenge will be to see how far we can get before Murphy gets the upper hand.