ACTUAL TEST OF WINLINK AUTOMATED EMAIL HF THROUGHPUT UNDER SIMULATED DISASTER CONDITIONS

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The Winlink Development Team has decades of experience providing communications where there were none. In a disaster situation, local communications as well as distant communications are important.

Local Communications allow shelters, providers, suppliers, and observers to develop and maintain a Common Operating Picture so that the best possible solutions can be developed and implemented. Voice & digital peer to peer communications are important. WINLINK offers email in both peer to peer (direct) and client-server (stored & forwarded) email. Local VHF users find that a local RMS_RELAY acts like a local radio email server, avoiding the need for email to be sent and retrieved from far away.

Distant Communications may be necessary for assets and resources to be requested, approved, and delivered. HF communications are often needed to get these distant communications delivered and received. RMS_RELAY predicts which distant HF stations can be contacted, and then arranges for successive efforts to send and receive those via PACTOR modem protocols.

To test the ability of KX4Z to carry out the necessary HF communications, a 4+ hour test was carried out. Utility power to the residence was turned off (KX4Z simply switches to solar backup battery power). Internet connections to the residents were disconnected. RMS_RELAY was then told to assume an Internet outage. [1] Email in and out of the system was conducted using VHF connections to KX4Z-7 (exactly simulating a disaster situation). Emails were sent and received to normal email addresses (e.g., "@gmail.com") as well as to WINLINK (@WINLINK.ORG) addresses.

RESULTS

There were successes and failures. This was the first multi-hour test of automated capabilities that I have personally performed. I have previously performed an 8-hour manual test, finding that communications were most difficult during the mid-day when the sun was most direct, and the D-layer absorption the highest. This test began at 0830 locally and concluded by 1300 locally so it included both easier and more difficult periods.

The automated antenna tuner wasn't orignally in auto-tuning mode. This was corrected by powering down and powering back up. That was a significant failure, which thankfully was caught by human observation that the output power was being limited by the transceiver to about 10 watts. After correction of the antenna tuner, output power of 50-75 watts were typical.

Early in the test, the WINLINK server software simply failed and exited. The exact failure mode was unfortunately unobserved. It is believed this resulted from excessive requests for CMS connections while the software was trying to send outgoing mail. (This conclusion has not be verified). Using RELAY connections for the remainder of the test resulted in no further failures.

7 messages, totaling 6,500 characters, were sent or received over HF during the test. The majority of

time utilized by the software was spent simply finding a distant station with an adequate signal. Observation of the automated system showed it was utilizing stations all over America and even into Mexico. Stations in Georgia and in New England turned out to be the most effective; a station in Virginia was also utilized. Frequency bands attempted by the automated software included the 40 meter, 30 meter and 20 meter amateur bands, with the best success on the 40 and 30 meter bands. With an adequate signal, PACTOR communications proceeded at rates of typically 1,000 characters per minute --- but dozens of minutes were spent simply finding an acceptable counterparty station.

DISCUSSION

More vigilance is needed to check the status of the LDG band antenna auto tuner. It can be switched to non-auto mode inadvertently. When reset, it automatically goes into auto-tuning mode.

In an emergency, VERY SHORT messages should be the rule in and out of a disaster area as throughput will be very, very limited. The FCC allows only narrow slivers of amateur radio bands to be utilized by automated servers such as KX4Z.

When experienced operators are available, it is likely that they will achieve a higher throughput by more quickly finding distant receiving stations. The automated software is limited in possible frequencies; a human has a somewhat wide range of choices. The automated software continues trying to pass messages to a poor recipient even when the throughput has declined dramatically; an experienced HF amateur would quickly abandon that link and move over to find a far better counterparty and achieve much higher throughput.

The secret then to achieving the highest possible throughput in and out of a disaster area with no communications would be a group of experienced HF operators to whom short critical messages are forwarded over VHF, and who then forward them using standard WINLINK manual procedures, giving instructions inside the message how return answer should be addressed.

Automated stations such as KX4Z and others can be guided to higher throughput by experienced operators overseeing their operation. In this case, when I observed that a link was “going nowhere” I simply aborted it, and the software moved on to the next predicted workable station. With experience, configuration choices within the software would cross off stations that have been found not to work well and significantly improve the automated throughput. Input from manual human operators as to which areas and stations are working best would be very helpful in this effort.

The expected throughput over HF WINLINK in and out of a disaster area is quite limited, but it is reasonable to expect a combination of human and automation could achieve a duty cycle of 10% of the observed actual PACTOR throughput in real conditions (approximately 1000 characters per minute) --- in other words, about 10% of 1000 char/min x 60 minutes/hour = 6000 characters per hour. With terse messages running at about 50-100 words per message (250-500 characters), this would equal about 12-24 messages in/out of a disaster area over HF per hour.

This test was carried out during springtime daylight conditions. My previous tests have suggested that as the D layer daytime absorption rises, it becomes more difficullt to find acceptable receiving stations. Nighttime throughput might be significantly greater, so disaster messages of lesser importance could possibly be held for nighttime transfer.

1 WINLINK RMS_RELAY has an apparent flaw, in that as long as the personal computer remains on the local WIFI network, the software does not recognize that Internet access may be gone. KX4Z requires wifi local access to maintain connection to VHF KX4Z-7 Raspberry Pi's. To overcome this flaw, in an emergency, the system would need to be placed into “simulated Internet outage” mode.