PiGate Emergency E-Mail Server

Mark Griffith, KD0QYN
501 S. Oak St.
Union MO 63084
mark.griffith@pigate.net

Abstract

Imagine an emergency communications system that is very small, self-contained, easily deployed, requires minimal power, and can be managed by anyone with the skills to connect to a web site. Disaster victims can then use their own tablet computer, smartphone, or other device to connect to this device and send e-mail to their family and friends, or any other e-mail address in the world, or even send a text message to their brother's phone.

Introduction

Amateur radio has a long history of providing communications during disaster situations. Ham operators spend a lot of time and lots of their own money to be able to help in times of need.

In the past, amateur operators have setup portable radio stations in all sorts of environments, and using, at first, Morse code (known in the amateur world as "CW") and then voice communications, they were able to provide a much needed capability when all other forms of emergency communications were unavailable.

As communications in our increasingly complex world have evolved, and as a result of the needs of emergency agencies that are served by the voluntary amateur radio force, digital methods of communications are becoming more necessary, for speed and, more importantly, accuracy. The demands that can be placed on a volunteer amateur operator to correctly transmit a list of much needed emergency equipment or medications using voice methods is staggering.

Additionally, people today are more "connected" than they have been at any time in history. Tens of millions of people in the world know about and use e-mail. The vast majority of these people also have smartphones and use them constantly. The notion of instantly being able to communicate with those you wish, no matter where you may be, is no longer a dream. Amateur radio itself seems to be an archaic or quaint way to talk to people around the country or world when all anyone needs to do is pick up their smartphone and verbally tell it to call their mother, or whomever else they wish, and the connection is made in seconds. This type of instant communication is greatly missed during a disaster situation when hundreds or thousands of people cannot connect to any of their family or friends just to tell them they are OK.

The challenge, then, is to try and bridge this gap, using amateur radio, an old, tried and trusted service, in a way that will give people an accurate, fast, and easy digital way to communicate using e-mail, a method that nearly everyone knows.

The Winlink 2000 System

As stated on Wikipedia, "Winlink, also known as the Winlink 2000 Network, is a worldwide radio messaging system that mixes internet technology and appropriate amateur radio frequency (RF) technologies. The system provides radio interconnection services including: email with attachments, position reporting, graphic and text weather bulletins, emergency relief communications, and message relay. The system is built and administered by volunteers without pecuniary interests. Winlink 2000 is a project of the Amateur Radio Safety Foundation, Inc. (ARSFI), a charitable entity and 501c(3) non-profit organization registered with the US Internal Revenue Service."

The Winlink2000 system is the backbone of the PiGate. In June 2016, Winlink handled over 65,000 email messages. There are currently nearly 1,000 Radio Message Server (RMS) stations around the world that are ready 24/7 to support the Winlink system. The ability of the PiGate to connect to that system, either via local Ethernet (if available in a disaster area), PACKET VHF radio, or PACTOR HF radio gives the PiGate the capability to handle emergency communications in any shelter or other site where disaster victims may be gathered.

VHF RMS Station Network

Many disaster scenarios in the past have be localized enough that the needs of responders would have been greatly enhanced if reliable communications was available just a few miles from the disaster site. Amateur radio operators using VHF voice communications has been most often used as the method that "always gets through". Amateur radio clubs and other organizations have been erecting new repeater sites all around the country. In many locations, there are so many repeaters that it is difficult to add a new one that can fit into the local repeater frequency allocations. As cheap and easy to use RMS software is developed and released by the Winlink development team, it is relatively simple to add RMS capability to an existing repeater. Expanding the Winlink RMS station list can do a great deal to help emergency communications, and with enough PACKET RMS stations throughout the country, any area should have reliable emergency communications.

The Raspberry Pi Mini-computer

The recent development of the Raspberry Pi computer at an extremely low cost allows something like the PiGate to be developed cheaply to be within the purchasing range of nearly all amateur radio licensees. This very small, fully functional computer, with very low power requirements, allows virtually unlimited ability due to its programming capabilities and the pre-built software packages that are available freely via download from the internet. In addition, the Raspberry Pi computer is very stable and reliable, two features that are very much needed in disaster scenarios.

The TNC-Pi

John Hansen at Coastal Chipworks developed a companion board for the Raspberry Pi that contains a fully featured KISS TNC. This board, in conjunction with the Winlink2000 PACKET RMS station network allows the PiGate to work in a majority of potential disaster locations, and provide quick, easy, and reliable email capability.

Pre-packaged Software

Several software products are freely available via the GNU Copyleft license and are integrated into the PiGate device. The integration of these products are what makes the PiGate work.

- AX25 radio communications protocol that uses the KISS TNC.
- Paclink-unix developed by a team of part time programmers. This provides the method of transmitting and receiving email via AX25 and other protocols.
- Exim4 mail transfer agent for sending and receiving email that are specially formatted for the Winlink2000 system.
- Hostapd to configure and bring up the WiFi hot spot.
- Dovecot to provide WiFi login authentication to the PiGate email server.
- Apache for the web service.
- A customized version of SquirrelMail to provide the email server.

Web Based Administration Software

Integrating all these products to work together also required a way to manage it all as there are a number of configuration files that need to be setup correctly for it all to work. Even with a complete knowledge of how this was done, making changes can easily lead to misconfiguration and the system failing. Creating a simple web interface that can be used from the web browser of a smart phone or tablet gives the PiGate administrator the ability to make changes needed during a disaster situation without having to resort to logging into the PiGate and edit numerous configuration files. This same interface is used to monitor the status of the PiGate as users (disaster victims) use the system to send email to their family and friends. See Figure 1 below.

The PiGate can be mostly automated, where there is little or no action needed by the station administrator once the initial setup is completed to allow disaster victims to send email. Configuration of some items, like the master RMS station list, are done through the web interface, upon demand and before deploying, while an internet connection is available.

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Amateur Radio Emergency Service

MENU

- Return to the Home page
- Change the PiGate admin user password
- Set the PiGate Clock
- Set the PiGate Timezone
- Change the PiGate WiFi SSID and password
- Set Default WL2K Callsign
- Edit the list of RMS stations
- Set Default WL2K RMS station
- Add a new PiGate e-mail user
- Delete a PiGate e-mail user
- View the PACKET log
- View the PACTOR log

Figure 1 The PiGate Administration page

How it all works

The basic premise of the PiGate is to provide users (disaster victims) with the ability to send email to their family and friends without needing someone to do it for them, which also provides them a measure of privacy. The key components are the WiFi hot spot, web based email server, the paclink-unix software and the AX25 protocol to do the actual connection to a Winlink2000 RMS station.

Once the initial station configuration is done by the amateur radio administrator, users are given the information to login to the WiFi hotspot, connect to the email server, and compose and send their email. Each user is normally given a separate login account to the email server. The user can use their smartphone, tablet, or laptop computer to make the connection using a web browser application and compose their email. This, of course, relies upon their having these devices and the batteries are good. If not, the amateur operator can choose to type in their email, or provide them with a device to use, or provide them the ability to charge their own devices. See Figure 2 below.
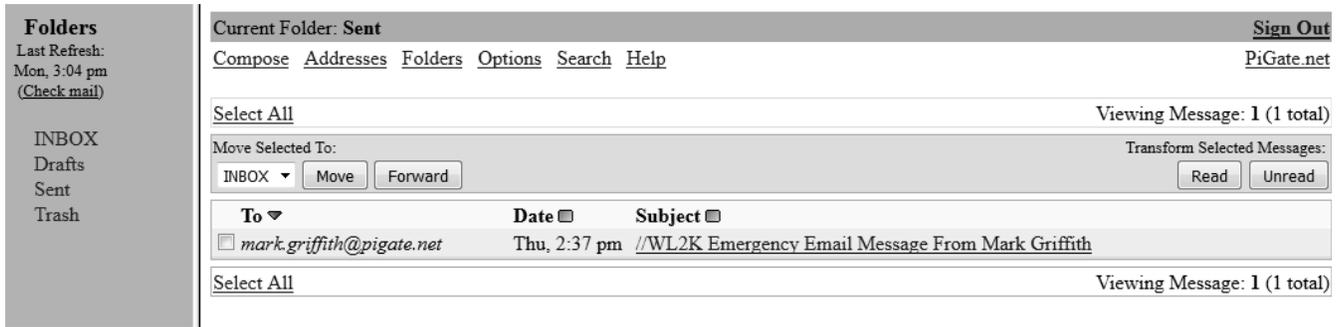
Figure 2 Email Server

To conform to normal message traffic protocols within a disaster area, the PiGate, by default, does not allow return email. Each email sent has the *Reply To* field set to NOCALL so return email will not be accepted. Each message composed is formatted so as to be acceptable to the WinkLink2000 system. Also, each one has a footer attached informing the recipient that this message was transmitted via amateur radio as a service to the community. Messages can also be sent as a text message to a recipient's smartphone, and the PiGate will detect these messages and format them differently to better use the SMS text message system. Everything was designed to be used from a smartphone and the touch screen system works well. Once an email is composed, it is placed in the outgoing message queue to be sent during the next radio transfer session.

Radio Transfer

The amateur administrator during the initial setup would have determined the RMS station to connect to for message transfer and tested this connection. This setup is then used for all future message transfers unless changed by the amateur operator. The operator can choose either PACKET VHF RMS stations, or PACTOR HF RMS stations. Connections to PACTOR stations are highly dependent upon many factors, so PACKET connections normally work much better, although the range with a VHF connection is limited. Even so, a great many locations within the USA have a PACKET RMS station within reasonable range and can be used for emergency email message transfer. Use of high gain antennas and digipeater relays can greatly extend that range. Consulting the Winlink2000 RMS station maps will be useful.

Winlink2000 Email Transfer

Once the message or messages are transferred to the RMS station, they are processed though the Winlink2000 global email system. Messages are sent either via internet connections between the several CMS servers or via radio links if the internet is not available. This insures email capability in even the most widespread disasters. Email messages appear in the inbox of the user they are addressed to just like any other email. Messages can also be sent as a text to a smartphone. Each cellular service provider has a method of sending an email as a text message, so simply using that method allows text to phone capability.

Conclusion

The PiGate system is designed to be portable, require minimum power, and ease of use. Combining these features with the capabilities provided by the Winlink2000 global email system provides a simple, robust platform that can be deployed in nearly any disaster scenario to provide "last mile" communications to emergency responders and disaster victims. People can use the device on their own, with little or no training, using their own smartphone or other device they are familiar with.

The PiGate software is provided free of charge to anyone that would like to download it and build a PiGate system. Regular updates are available from the PiGate web site. Even the nifty case is a downloadable 3D printer image which can be printed on nearly any 3D printer.

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Biography

Mark has been an active amateur radio operator since February, 2012. Prior to that, Mark received his first Technician class license in 1969 at the age of 16 and worked 2 meter AM in the New Jersey area as WA2HHF. After joining the USAF in 1971, he let his license lapse and only was relicensed in 2012 after a 40 year break. Mark spends nearly all of his on-air time using digital modes such as JT65, JT9, and some PSK and RTTY during contests. As a member of the local ARES chapter, Mark developed a desire to help improve the ability of amateur volunteers to use digital modes from disaster areas to improve the speed and quality of service.

This paper is provided to the Digital Communications Conference with full permissions to print it as necessary.