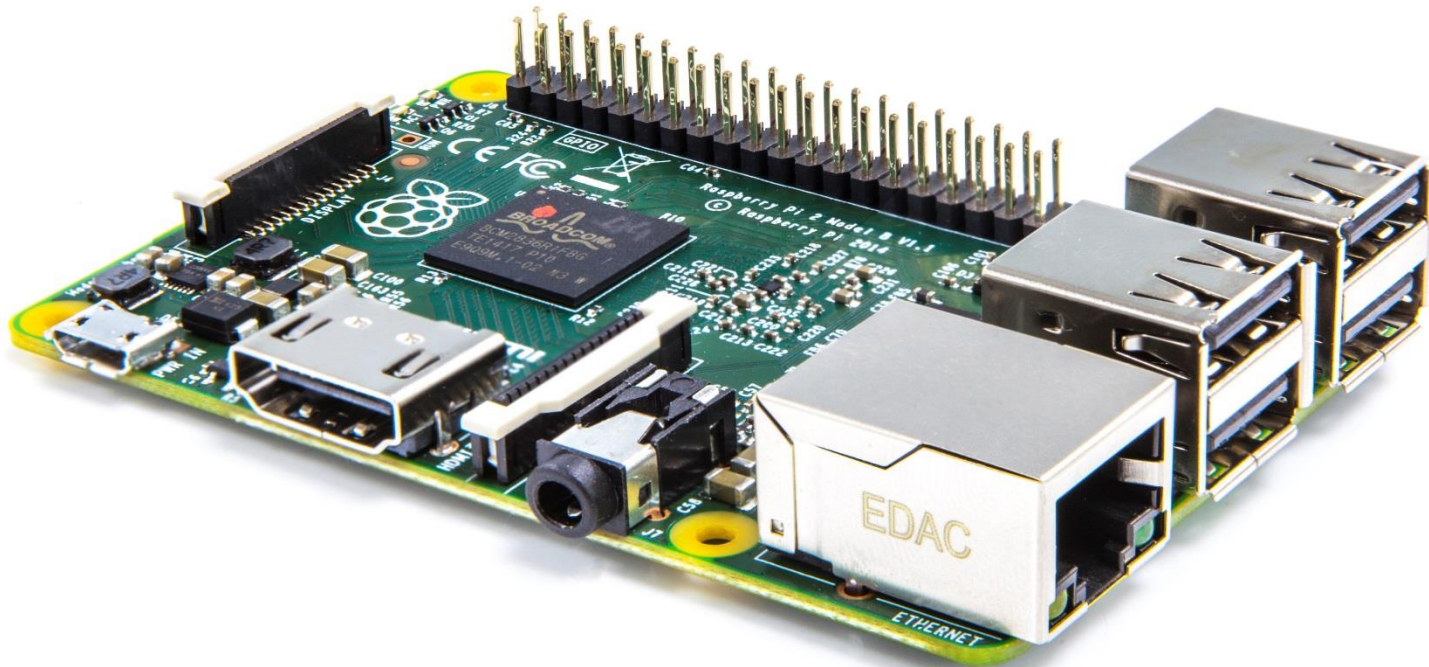# PiGate

Portable Emergency E-Mail Gateway

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What We Will Cover

- How/Why I thought this up
- My design process
- Specifics of the PiGate
- Field use
- Future development

Please hold all questions until the end of the presentation

Who Has a Smartphone?

- Can you get email on it?
- Can you get text messages?
- Do you have it with you all the time?
- Does it alert you when a text or email comes in?

HMS Bounty Rescue

Sinks during 2012 Hurricane Sandy. Captain used his Winlink 2000 account to e-mail the Coast Guard and rescue planes arrived within 60 minutes. **14 lives saved.**
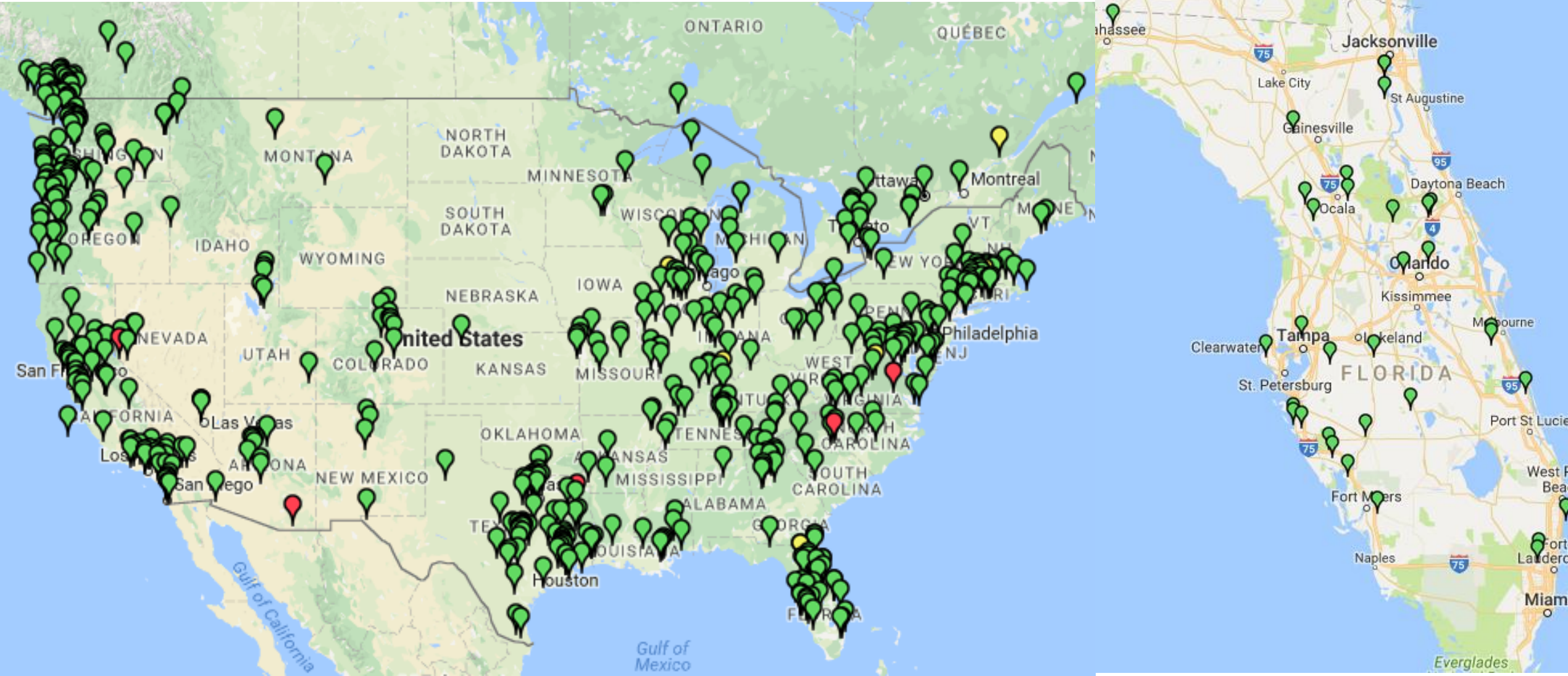
Winlink Global Email System

- All amateur radio worldwide system

- Used by maritime, government, Emcomm agencies in many countries

- "RMS" Radio Mail Server – link to Winlink2000 and internet

- Handled over 65,000 email msgs in June 2016 -780,000 yearly

- Nearly 700 VHF PACKET and HF PACTOR stations worldwide

RMS PACKET Stations in US

RMS PACTOR Stations Worldwide

How Can I Use Winlink2000 for EmComm?

Sending email is a proven reliable communication method

How can I do that from a disaster site?

Packet radio seems to be an answer – also PACTOR

But traditional packet system is not easy to setup

Same for HF WINMOR and PACTOR – lots of tweaking

Traditional Message Handling

Transmit the message via voice

Someone on the other end writes it down and gives message to recipient

There has to be a better way than 100 year old procedures

Traditional PACKET Radio Station

thanks TAPR

Antenna

Intrepid operator

more wires

Windows computer   TNC   wires

VHF radio
and power
supply
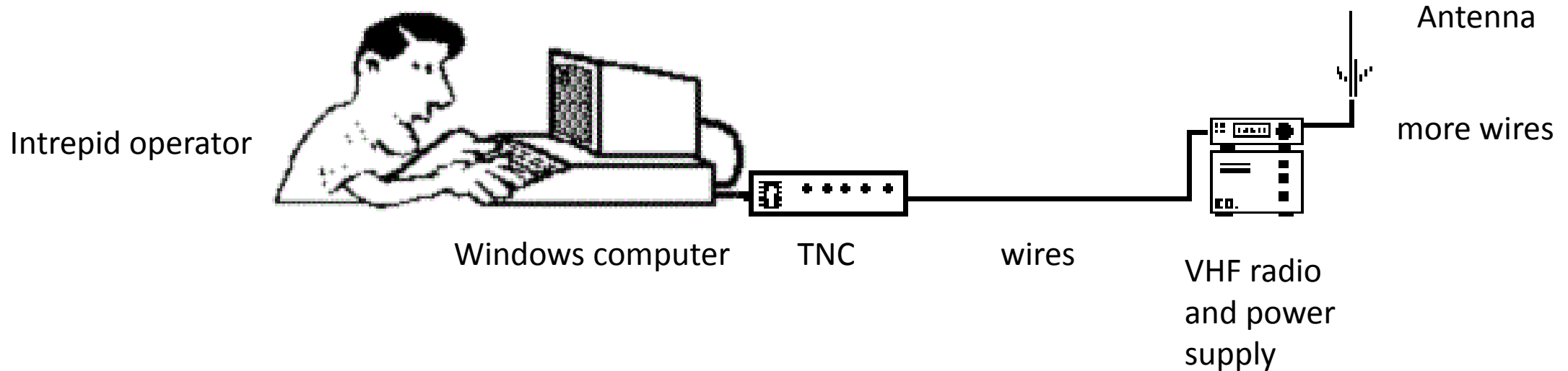
- Messages are sent to radio BBS to be picked up by other BBS users
- Everything located close by – probably the same room
- Probably lots of software tweaking and setup time at a disaster site
- Takes a lot of power (relatively)
- How can you send email to the internet?   You can't!

Can I use Existing New Technologies?

Can I get the best of both worlds? Email is great!

How can I merge new technology with amateur radio?

Can I get around co-locating all the equipment?

Can I make this so simple my wife could use it?

Development Goals

- When EVERYTHING else is down…..
- Send e-mail to **ANY** address outside the disaster area
- Portable – carry it onsite in a backpack
- Self contained – turn it on and its ready for use
- Low power consumption for extended battery life
- Use "off the shelf" hardware and software as much as possible
- Common user interface (Smartphone or Web) – no training necessary
- Automated (as much as possible)
- Minimal configuration setup made easy
- Easy to replicate

Result – The PiGate

Hardware needed

- Raspberry Pi mini-computer B+, Model 2 or 3 $35
- TNC-Pi 2 (terminal node controller for the Raspberry Pi) $40 kit
- Mini SD card (8, 16 or 32 Gb) Class 10 $13 (WalMart)
- USB WiFi dongle (with gain antenna)(not with Pi3) $15
- 2 Meter FM transceiver – Could be a handheld   use existing
- 2 Meter antenna – Portable or mobile   use existing
- Various cables to make connections $12
- 3D printed case $25
- 12 volt battery for power – The larger the better
- Total $140

Raspberry Pi 2 Model B or Pi 2/3

Low Cost - $35 assembled and tested
1Gb RAM Memory
4 core 900Mhz CPU (1.2Ghz Pi 3)
Uses Mini-SD card as hard drive
4 USB ports
Ethernet
HDMI video
3D graphics core
VERY LOW power consumption
Fully flavored OS – Raspbian Linux
A fully functional computer
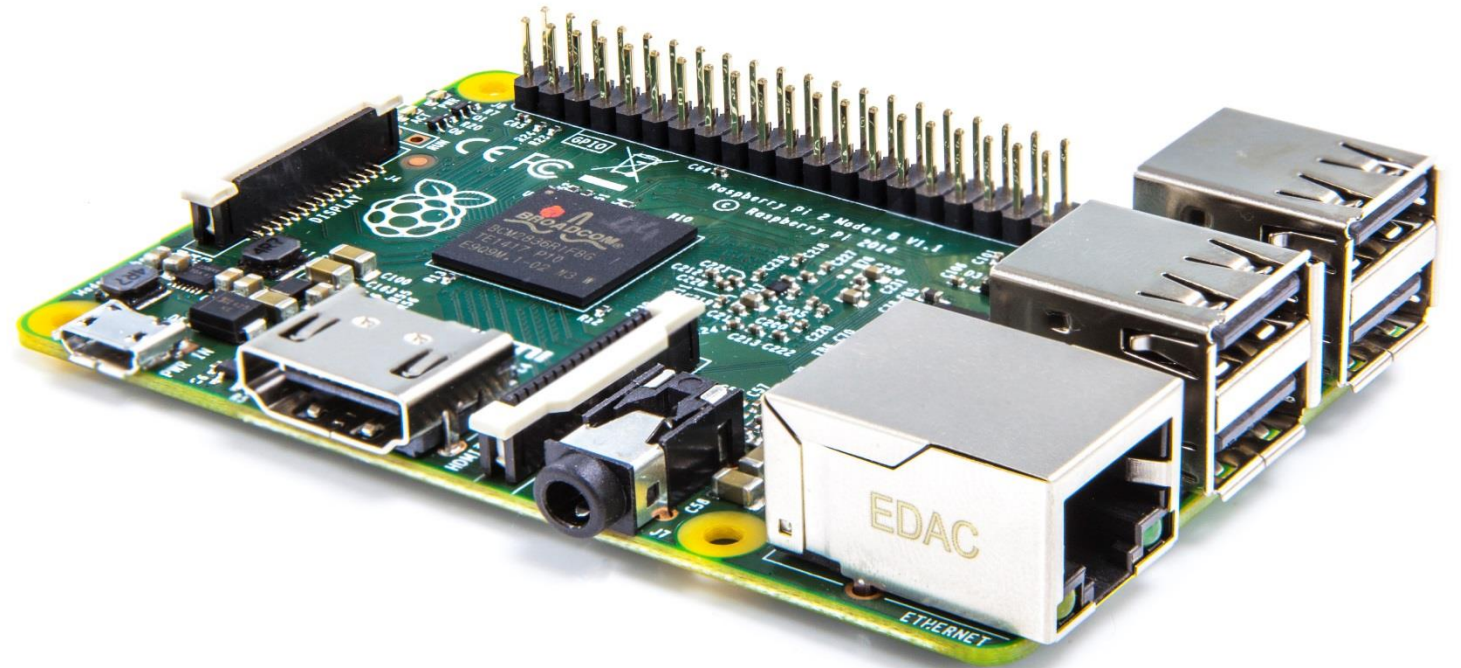
TNC-Pi from Coastal ChipWorks

Low Cost - $40 kit $65 assem.
Plugs into Raspberry Pi GPIO
KISS principle 1200 baud
DB-9 interface to VHF radio
Same size as Raspberry Pi

Add a couple cables

- TNC-Pi to VHF radio cable – home built
- Four lines (Tx/Rx Audio, PTT, Gnd)
- Can also use data ports available on some radios
- USB to serial dongle to serial cable to PACTOR modem
- Cable from modem to radio (purchased or home built)

Required Software – several pieces
(this was the hard part)

- Raspbian image kernel version 4.1.19 or less (05-27-2016)
- Several software packages needed to be integrated
- Integration of all this software is NOT EASY, but can be done
- Once configured can be easily copied

Paclink-Unix – Compiled on Raspberry Pi

- UNIX/Linux client interface to the Winlink 2000 e-mail system

- The first software package I worked with when developing

- Three modes supported
    1. TNC to packet VHF radio
    2. Serial port to a PACTOR modem
    3. Telnet if local Ethernet is available (not in most disaster scenarios)

AX25/PACKET – Debian downloaded package

- Version of the old X25 packet switching protocol used by banks and telecommunications fields in 1970's.
- Modified in the 1980's for Amateur radio use (the "A")
- Used mostly for amateur BBS before the internet
- On VHF speed is 1200 baud (1,200 BITS per second)
- On UHF speeds can be 9600 baud (not from PiGate)
- NO ERROR CORRECTION! Data can be lost or corrupted
- FX25 by TAPR presented 10 years ago

PACTOR – Additional mode for Paclink-Unix

- For HF communication
- Several modes available
- PACTOR 1 with ancient KAM+ or PK-232 hardware
- PACTOR 2 and 3 proprietary modes only available from SCS
- Speeds range from 20 to 5,200 baud
- PACTOR 1 speed comparable with RTTY (~45 baud)
- WINMOR ~2,800 baud (Windows only)
- Theoretical no limit on range (HF propagation)
- ERROR CORRECTING PROTOCOL! No data loss

Hostapd and isc-dhcp-server – DL packages

- Enables WiFi hotspot on the PiGate

- Incoming only – no connection to other WiFi

- Relatively good signal coverage

- Routing of data from the WiFi hotspot to the Pi's Ethernet port is disabled in the PiGate. (But could be done with some simple interface changes)

Web Server and Web Mail Application

- Connect to the e-mail Web app via PiGate WiFi hot spot

- Apache comprises over 55% of all web sites worldwide

- SquirrelMail very simple, easy to use, yet powerful and **customizable**

Postfix/Exim4

- Mail transfer agents – moves e-mail between the e-mail client and the paclink software
- Exim for outgoing e-mail – some Postfix files needed for incoming
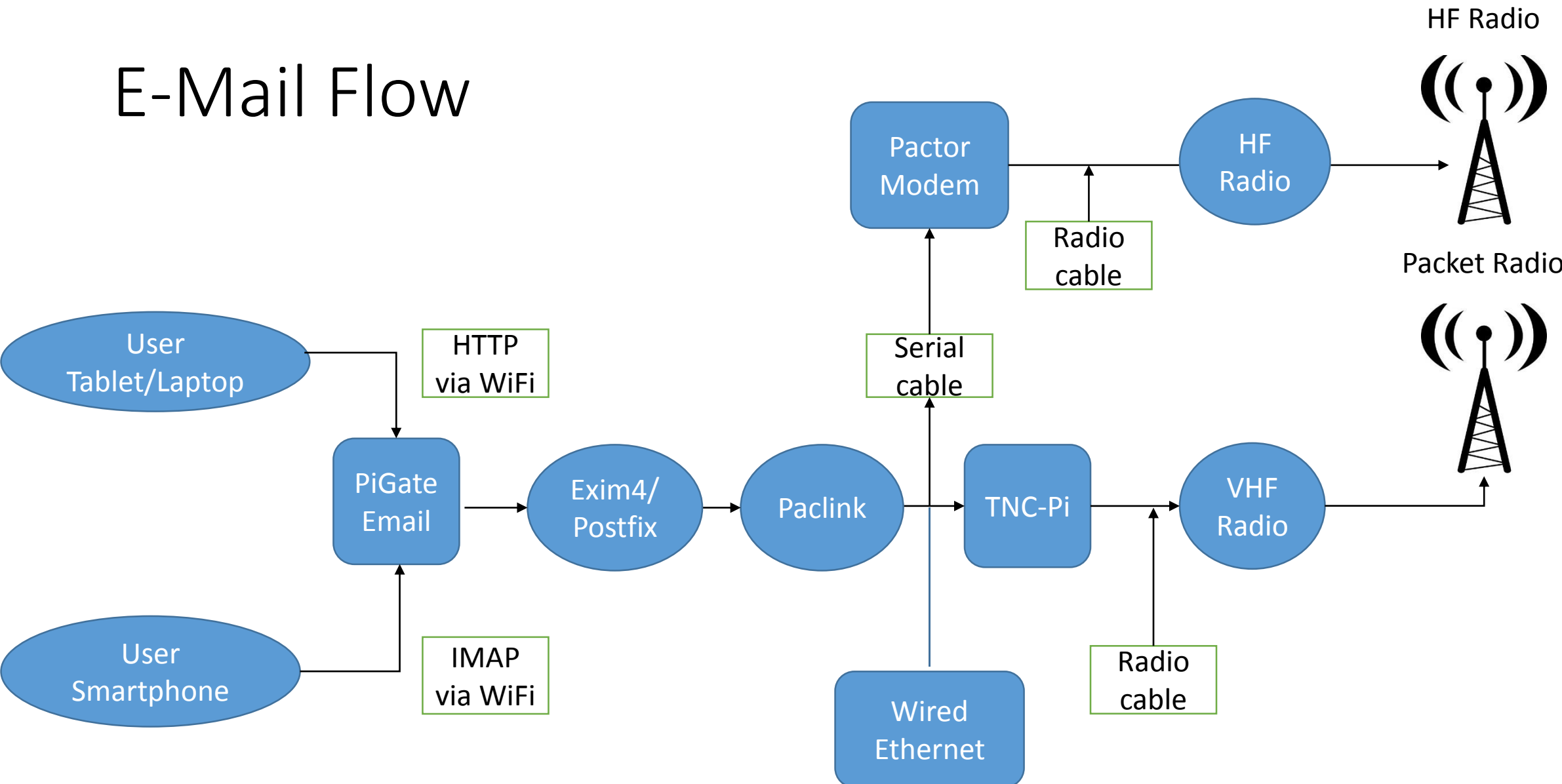
Dovecot

- IMAP server connects to the PiGate email system from user's smartphone/tablet or web-based email client

- Can use a smartphone e-mail app to send and receive-mail

- A little hard to setup but once done a few times is easy

- Would not recommend in a disaster scenario

E-Mail Flow

Finished!

Now for field testing

First Field Day was Enlightening

Where's My Car?
This is not really my car

My car has a great communications system. Why don't I just use that?

High gain antennas to reach more distance RMS stations

Capability to carry lots of batteries and has a built in generator

How can I each it?   200ft cable?

Replace this:
Old School
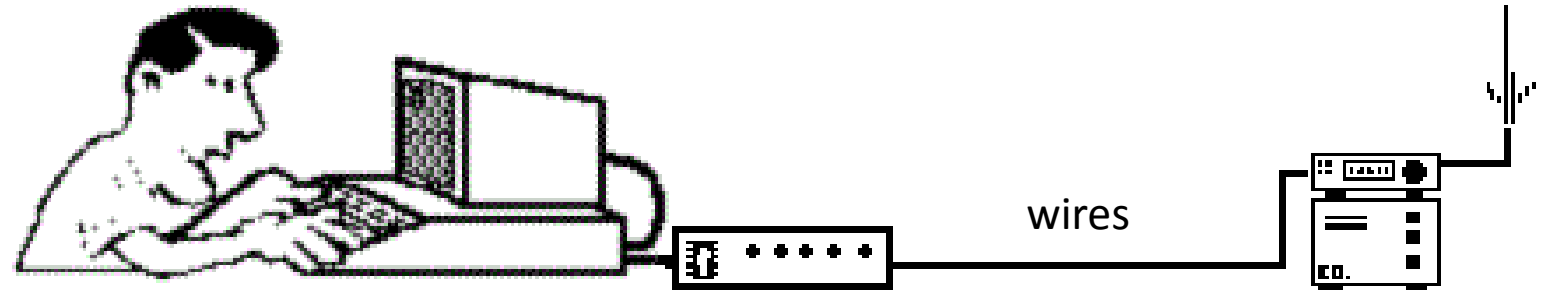
Packet Operator   Computer   TNC   wires   VHF radio

With this:
New Hotness

Cell phone   Not wires   PiGate   Car with VHF radio
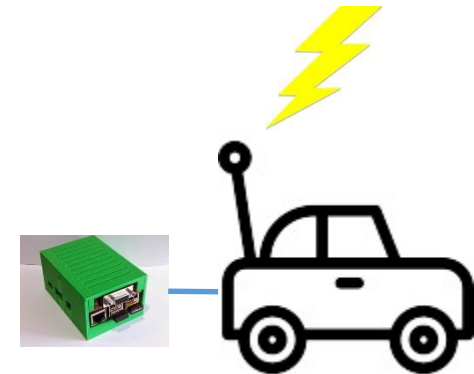
PiGate WiFi Hot Spot Coverage

- Only text being transmitted, no need for high throughput

- Pi 3 about 200 feet in open air – 75 feet within building or to outside

- An extender can add 400 feet

- That's 200 yards!

- All Part 15 rules

No need for a radio in the shelter!

PiGate as a BBHN or HSMM-Pi Node

- For more extended coverage
- A little more difficult
    1. Create a Mesh network
    2. Add the PiGate as a mesh node
    3. Advertise the web service
- Part 97 rules apply

How do "users" send email?
They use their own smartphones!

- Give them WiFi connection information:
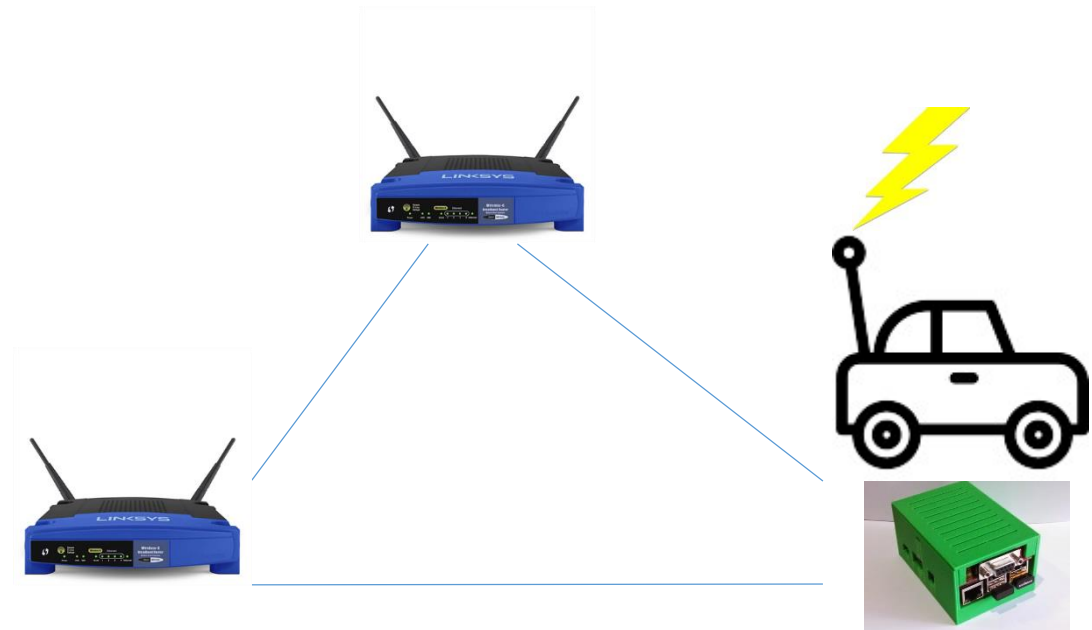 - Connect to hot spot: pigate/raspberry (SSID and password configurable)
  - Go to http://10.10.10.10/email.php (IP address configurable)
- E-mail users login to the e-mail application using username/password given to them after amateur admin creates new PiGate users.
  - Login with username and password provided
  - Compose e-mail, press 'send'
- Any number of e-mail users can be connected simultaneously
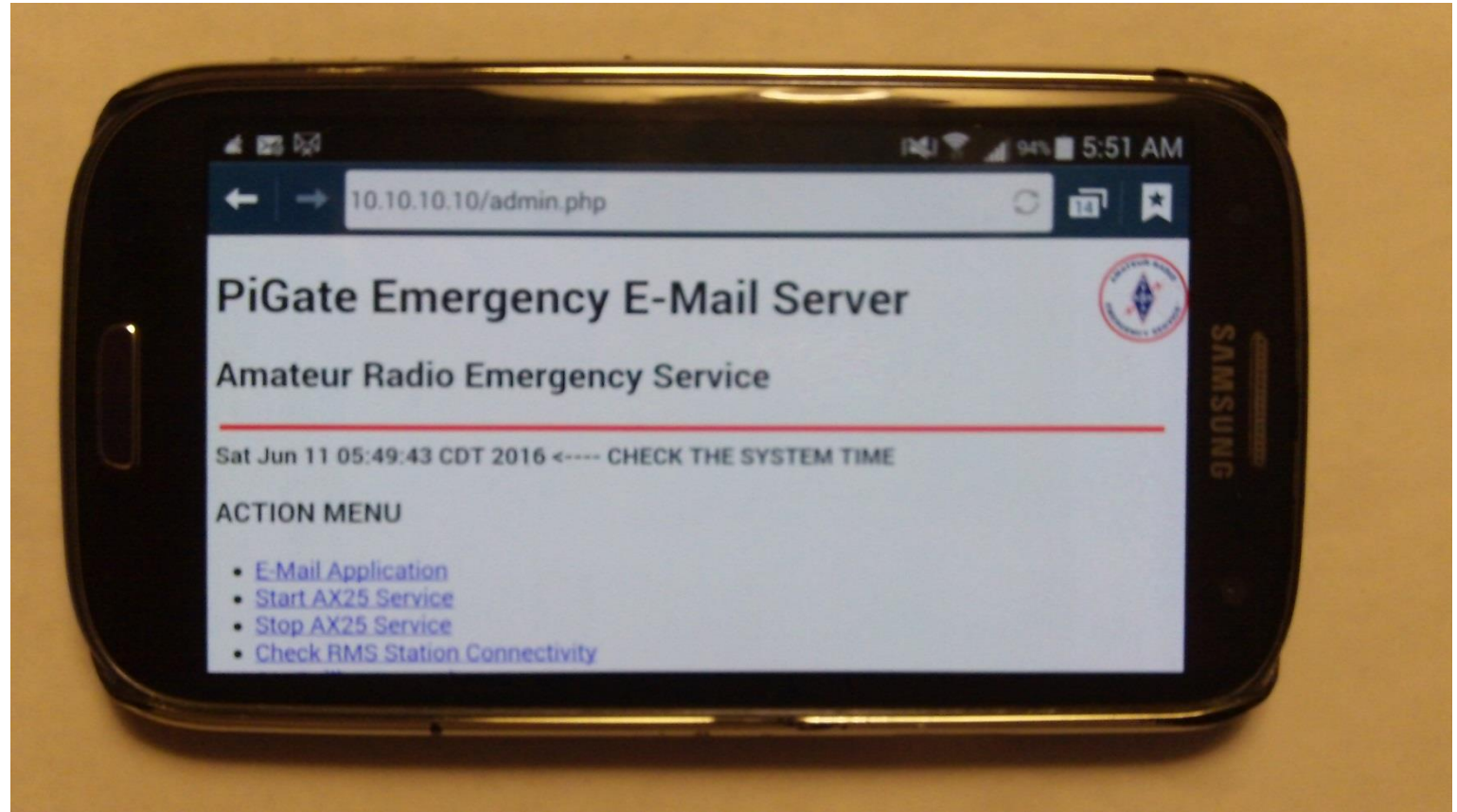- No standing in line to send a message

PiGate Email Server Login

Name:

Password:

Login

Designed for Touch Screen Use

- All Text with one small graphic

- Simple menu system – touch menu items to execute

- Fill out text boxes and/or touch buttons

- Works great with a tablet or touchpad (laptop also)

E-Mail Web Application

Folders
Last Refresh:
Mon, 3:04 pm
(Check mail)

INBOX
Drafts
Sent
Trash

Current Folder: **Sent**   Sign Out

Compose   Addresses   Folders   Options   Search   Help   PiGate.net

Select All   Viewing Message: **1** (1 total)

Move Selected To: Transform Selected Messages:

[INBOX ▾] [Move] [Forward]   [Read] [Unread]

To ▾	**Date** ☐	**Subject** ☐
☐ *mark.griffith@pigate.net*	Thu, 2:37 pm	//WL2K Emergency Email Message From Mark Griffith

Select All   Viewing Message: **1** (1 total)

Text Messages to Cell Phones

- Nearly all cell providers have special email addresses to send a text to a cell number

- Compose an email with that special address
  - 1234567890@txt.att.net

- PiGate software automatically determines if the email address is a phone number and changes the message format to suit

Web-Based Administration Software

PiGate Emergency E-Mail Server

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

Web Status Page

PiGate Emergency E-Mail Server

Amateur Radio Emergency Service

Fri May 27 19:47:48 CDT 2016 <---- CHECK THE SYSTEM TIME

This is the System Status Page

AX25 Service: Running
Nbr of messages in queue: **0**
Last RMS Poll Results: Success

Log in to Admin page

PiGate is Winlink Global Network Aware

- PiGate has a list of all RMS stations – can be easily updated

- Amateur operator selects which RMS station to poll

- As long as a reachable RMS station is on the air and connected to the internet, worldwide email capability exists

- Will switch automatically between PACKET, PACTOR or direct internet modes depending upon what RMS station is selected by the amateur operator

- Also has a list of all available data for every RMS station (Ver. 1.3)

Email Automatically Transferred

- All composed email go in outbound message queue

- RMS station is polled on a regular basis (configured in management software)

- Or can be set for "on demand" poll when a message shows up in the queue

- Or can be manually polled

CAVEATS

- Only one WinLink2000 e-mail callsign can be used to send e-mail
- Easily changed with the web management software
- Email replies are not allowed (standard EmComm practice)
- No email attachments allowed
- Radio links (VHF or HF) subject to all the variables of radio comm.

Easy to Maintain

- Backup of micro-SD card to image on Windows laptop
- Can be copied to additional PiGates with minimal configuration changes (enabled from the PiGate mangement web site)
- Should keep several prepared mini-SD cards on hand
- Perhaps more than one PiGate onsite

Ongoing Development – in no particular order

- Future enhancements forthcoming – ideas welcome
- GPS support for time and location– in development now
- Uses GPS location to determine closest RMS stations
- Parsing individual email users from email replies
- Add HTML document attachments to email
- Requesting email text bulletins and WX reports (ARRL, NOAA, NWS, etc)
- Support for Raspberry Pi displays (7 inch and 3.5 inch)
- Enhanced support for different PACTOR devices
- OLSR support native to PiGate
- WX data for boating/yachting crowd

Power Considerations

- Raspberry Pi runs on 5vdc USB port power

- VHF radio needs 12vdc power

- Use 12vdc to 5vdc power converter for Pi, 12vdc for radio

- 7Ah AGM battery will run the PiGate for approx. 10 hours

- 2 batteries in parallel and a solar panel would give 24/7 ability

Where Can I Get a PiGate?

- http://www.pigate.net
- All software freely downloadable as Raspbian images
- Burn to your own mini-SD card
- Can also download the 3D printer files to create the nifty case
- Raspberry Pi computer available from several sources
- TNC-Pi from http://www.coastalchipworks.com
- Assembled and fully tested PiGate available for a fee

We Need More RMS Stations!

References

- http://pigate.net
- http://www.winlink.org
- http://www.mcmelectronics.com
- http://tnc-x.com/TNCPi.htm
- http://k4gbb.serveftp.com/docs/tncpi.html
- http://k4gbb.serveftp.com/docs/Raspberry.html
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- https://samhobbs.co.uk/raspberry-pi-email-server
- https://learn.adafruit.com/setting-up-a-raspberry-pi-as-a-wifi-access-point/overview