

Ham Radio Digital Comms

For FUN

(And for Emergencies)

Gordon Gibby &
the Red Cross & ARES folks
*Talk given to Gainesville Amateur
Radio Society, in Gainesville,
Florida, on Feb. 21, 2017*
Version for WEB.



Amateur Radio
Digital & Voice
Emergency Communications
Gordon L. Gibby KX4Z BEE MS MD



**Free copies of the text,
Amateur Radio Digital & Voice
Emergency Communications
(Version 1.0,
published Jan. 7 2017)
were given to all attendees.**

dig into the book....

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VERSION 1.0

January 7 2017

This manual is the property of

who can be reached at:

COVER DESIGN

Emergency radio systems.

From Top to Bottom, Left to Right:
2-meter "go-box" based on Juentai JT-6188 / Signalink, with built-in storage battery & charger. A second 2-meter "go-box" based on Icom 28A, also with storage battery; both include a blue "combiner" box that allows mic & digital to work together; Middle 2-shelf homebrew box has an ICOM automated long-wire tuner and a rolled-up HF antenna & houses an HF Icom, as well as a Yaesu 2-meter, an SCS Pactor Modem; on the tiles are multiple Baofeng hand-held transceivers, a SURECOM digital simplex repeater controller and a portable laptop as well as a roll of RG8X coax.

You might want to put your **NAME** and maybe **CELL PHONE** number on your book....you can use it to record **EMERGENCY COMMS & MEDICAL INFORMATION** that might be helpful in a time of need.

Document Local Assets

Local Repeater	Frequency/Offset	Tones	Comment

Important local contact information

Contact	Phone #	Email
1.		
2.		
3.		
4.		
5.		
6.		
7.		

Important Local Emergency Information

Contact	Phone No.	Comment
LOCAL EMERGENCY #:		
POISON CONTROL		
Police non-emerg.		
Fire non-emerg.		
Electricity Supplier		
Gas Supplier		
Local Airport		
Local Airport Tower		

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**Document local
communica-
tions....**

**Local Contact
Info...**

**Local emergency
phone numbers**

Medical Information

ALLERGIES (list all medications & what happens)	Item	Reaction
	1 _____	1 _____
	2 _____	2 _____
	3 _____	3 _____
	4 _____	4 _____
	5 _____	5 _____
	6 _____	6 _____
MEDICATIONS (list all meds, dosages)	Medication	Dosing Schedule
	1 _____	1 _____
	2 _____	2 _____
	3 _____	3 _____
	4 _____	4 _____
	5 _____	5 _____
	6 _____	6 _____
Known Medical Problems	Describe	
Personal Physician	Name	Phone / Hospital
Specialist Physician		
Previous Surgeries?	Type	Approx Year
Other Important Information		

Page 33 --
Your own medical history...
which you won't be able to give if you are quite ill or unconscious.

Errata....

VHF CLIENT STATION CONSTRUCTION

There's more than one way to accomplish the digital connection, as shown in Table 5-1.

TABLE 5-1 Digital Connection Techniques (VHF)

Method	Hardware Required	Software Required
Classic Packet using a hardware TNC	TNC such as Kantronics KPC-3 or MFJ TNC-X	Simple terminal emulator software
Classic Packet using soundcard technology	Can be done with just a mic-to-speaker acoustic connection! Most use either internal or external soundcard device.	MixW ²⁹ is a full featured (commercial) windows-based software that can do packet via soundcard. Free trial versions are also available. With some effort, BPQ32 for Windows ³⁰ + any KISS soundcard software will also work (use terminal window)
Soundcard-based broadcast (less common for QSO's, but very useful for bulletins)	Tigertronics Signalink, or other interface to either external or internal computer soundcard	FLDIGI, Ham Radio Deluxe, MixW or similar will work fine for this.
WINLINK email access via Packet	TNC or Signalink, or other soundcard type interface; appropriate computer port (serial or USB)	WINLINK EXPRESS free software; if using soundcard, add UZ7HO soundmodem.exe ³¹

A simple VHF client can be built with a handheld FM transceiver capable of reaching a nearby VHF Packet RMS server, a sound-card interface such as a Signalink and a laptop computer running UZ7HO soundmodem.exe interface software and WINLINK EXPRESS client software.

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Don't know what I was THINKING....you can't do "classic packet" without auto control of your Push-ToTalk....it's an error corrected ARQ mode....

THE WHY

- 1 Common Operating Picture and Situational Awareness ...**
- 2 Three Key Communications Mode Abilities ...**

THE HOW

- 3 Building Team Competencies and Assets in North Central Florida**
- 4 The Basics That Apply To Everyone**
- 5 Portable Client Voice & Data Stations**
- 6 Homebrew Emergency Antennas.**
- 7 Brief Introduction to the Underlying Details of Packet Communications**
- 8 Brief Introduction to LINUX**
- 9 Raspberry Pi Digital Repeaters**
- 10 Homebrew "\$10TNC" Sound Card Interface Circuit**
- 11 Store and Forward Simplex Voice Repeater**
- 12 WINLINK Server Stations**
- 13 Wireless Network Development**
- 14 Maintaining Readiness**

1. BOOK COMPOSITION



Amateur Radio
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2. this is actually SIMPLE.....it is only about connecting to your.....

Microphone & Speaker

- There are some radios that take “1's & 0's” --- ***but I don't own anything that fancy.***
- All the “digital” in this presentation is done by feeding some sort of audio into the mic jack, and by grabbing some sort of audio from the receiver.
- SIMPLE AUDIO
- From there it may go to
 - ◆ Sound card, either external or on a laptop
 - ◆ older dedicated “TNC” (terminal node controller)
 - ◆ fancy fancy PACTOR modem
 - ◆ some other gizmmo



3. MY favorite brand of digital....



A lot of us STARTED with digital --- CW --- because that was our license, and all the equipment we could AFFORD.....

Distances were amazing.

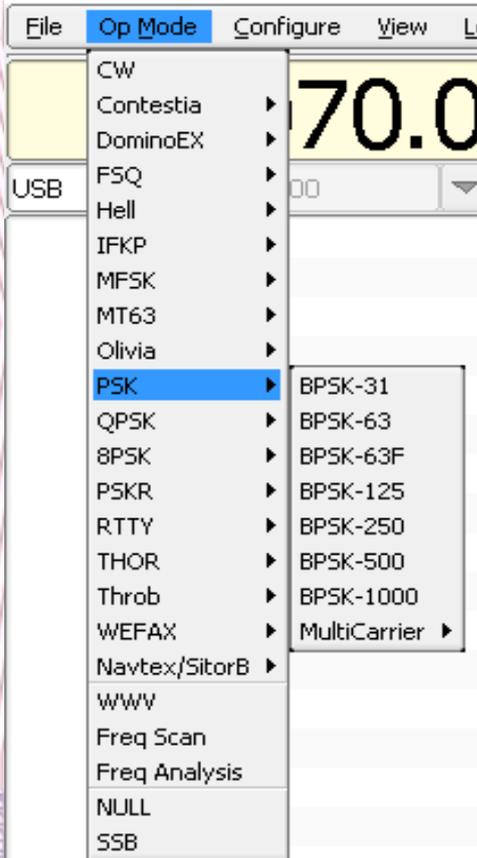
- Morse code is the original digital mode.
- Either on or off.
- Very narrow bandwidth, hence high signal to noise ratio possible with narrow filters.
- PSK31 is even narrower!!

**Getting started with digital
(the way I did)
is literally as easy as
downloading
a free software program.**

4. Digital Today

FLDIGI

fldigi - KX4Z



- **Digital is a hoot on HF**
- David Freese, Jr W1HKJ (37 yrs Coast Guard)--wrote FLDIGI, & more -- free!
- --> *Windows / Mac / Linux* <---
- Zillion modes
- PSK: 10 QSO's in one SSB pass-band.... narrow==>high S/N
- very minimal equipment (use speaker and mic even!)
- Make your own audio interconnection circuit (much like a phone patch)
- Or buy the Signalink
.....competitors increasing!!



David Freese

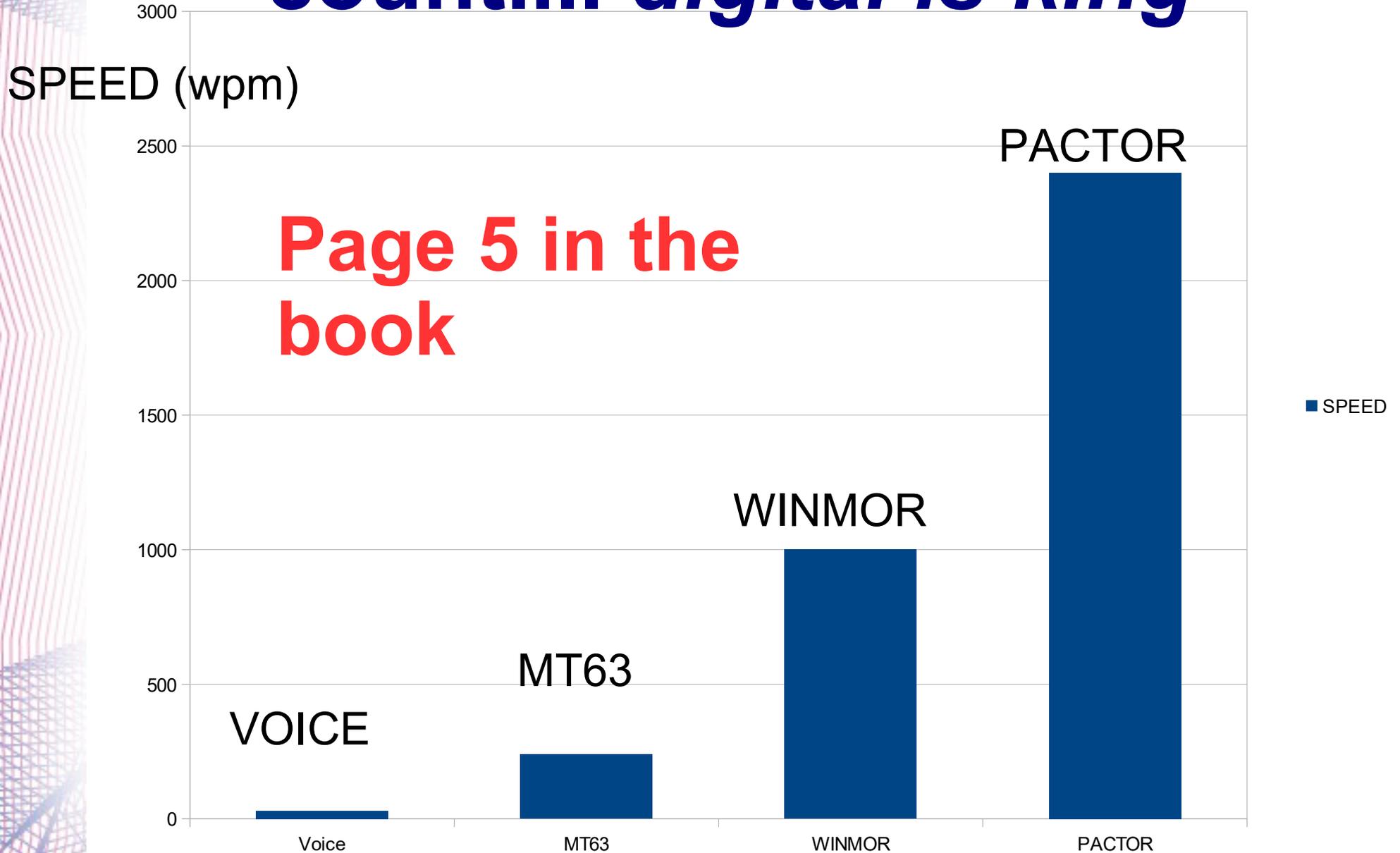
MODES, and
SUB-modes!!

Page 48 in the book

Most common HF modes

Mode	Chief Characteristic(s)
PSK31	very narrow; speed similar to typing
MT63	much wider & faster
RTTY	intermediate
WINMOR	used by winlink (soundcard)
PACTOR	Very fancy \$\$\$ modems, fast, accurate

5. When speed and accuracy count.... *digital is king*



6. Lets dive right into digital!

The screenshot shows the fldigi software interface. At the top, the title bar reads "fldigi - KX4Z". The menu bar includes "File", "Op Mode", "Configure", "View", "Logbook", and "Help". The main display area is divided into several sections:

- Frequency Display:** Shows "14070.000" in a large yellow box. Below it are fields for "Frq" (14071.314), "On", "Off" (1940), "In", "Out", "Call", "Op", "Az", "#out", "#in", and "Xch".
- Logbook Window:** A yellow box containing the text: "Read macro file: C:\Users\Gordon\fldigi.files\macros\macros.mdf", "Loaded logbook C:\Users\Gordon\fldigi.files\logs\glgtestlog.adi", "read 1 records in 0.00 seconds", and "i Tt".
- Transmit Window:** A light blue box containing the text: "THIS IS YOUR TRANSMIT WINDOW" and "DEMO" in large red letters.
- Spectrum Display:** A horizontal bar at the bottom showing a frequency spectrum with a red vertical line indicating the current frequency.

On the left side of the interface, there is a text box with the following text:

FLDIGI is FREE,
works WELL.
Config can be a bit
overwhelming....but
much of it is fluff

At the bottom of the interface, there is a control panel with various buttons and sliders, including "WF", "CQ", "ANS RPT", "QSO", "KN", "SK", "Me/Qth", "Brag", "T/R", "Tx", "Rx", "TX", "C Ans", "C rpt", "C Rep", "C Incr", "C Dctr", "Log QSO", "CW-CQ", "CQ +", "CQ-ID", and "KPSQL".

HF Digital

- Download/Install FLDIGI (almost any computer)
- Mic-to-Sprkr to start -- have fun!
- Listen for PSK31 70kHz up fm bottom of band
- Add signalink / equivalent for more ease



Gotchas!

- Use a SHIELDED usb cable from your signalink to your computer. I have had good results with this one from Amazon:
 - ◆ Mediabridge USB 2.0 - A Male to B Male Cable (10 Feet) - High-Speed with Gold-Plated Connectors - Black - (Part# 30-001-10B)
- A few loops of cable at the computer end, and a clip on ferrite to further reduce RFI.



What you learned having FUN on HF....can be life-saving in an EMERGENCY



Hurricane Sandy Oct 24, 2012

7. “Normalcy Bias”

- EVERYONE tends to think....things are going to keep on going the same.
- Dec 6, 1941
- Sept 10, 2001
- August 22, 2005.
- Next?

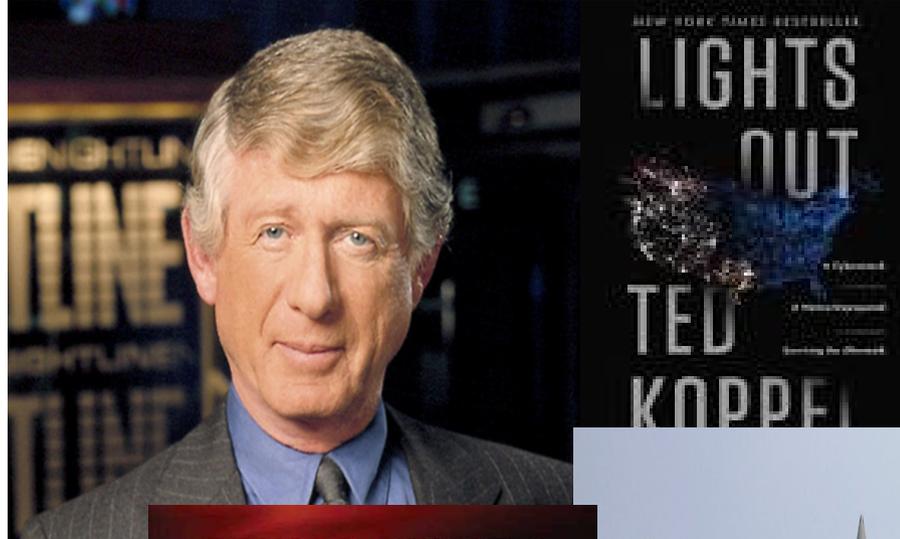


Superdome

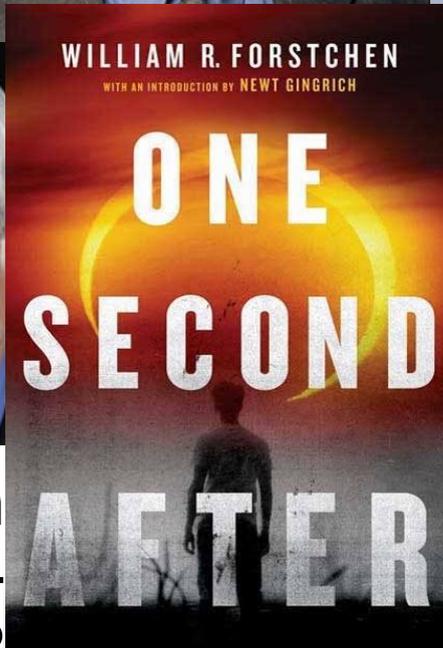


Fed. Gov. hasn't protected the average Joe

- So many **holes** in our plans.....big names are lining up to champion the neglected hazards



Cyber grid down --
Ted Koppel



Newt Gingrich
& Woolsey --
CIA head: EMP



Bioterrorism --
Bill Gates



Three important techniques

Software	Allows	Useful for
FLDIGI (HF or VHF)	in-line text in voice comms	Able to broadcast detailed bulletins of emergency information
WINLINK (HF or VHF)	email via radio	Error-free email for command/control, health & welfare when cell phones / etc. are down
EasyTerm (VHF only)	packet CHAT	allows directed or non- directed roundtable nets for shelter comms / ESF info sharing



David Freese
Alabama



Steve Waterman
Tennessee



Andrey S. Kopanchuk
Ukraine

Packet CHAT ran before and during last ARES Thurs. net -- not fast, but worked adequately. Learning opportunity --- W4DFU-8 (currently 145.030 & 145.770)

8. Packet resurgence...EmComm

- AX.25 PACKET was invented by hams, to allow digital transmission over radio using audio tones.
- All the rage---until smart phones / text messaging....then it ***died out***.
- Resurgence as people recognize its benefit in REAL CATASTROPHES (where accurate and massive communications are key to maintaining a common operating picture and keeping track of needs, assets, efforts).

9. EmCOMM & Lists

- Think about all the **LISTS** that are part of managing a **real** disaster.
- If phones/cell/internet down.....how?

1. Medical emergency requests
2. Trees down/roads blocked
3. Houses without power
4. Downed power lines
5. Contaminated water lines
6. Accidents
7. Materials requested
8. Current location of assets
9. Personnel for upcoming shifts
10. Hospital occupancies
11. Patients needing evac

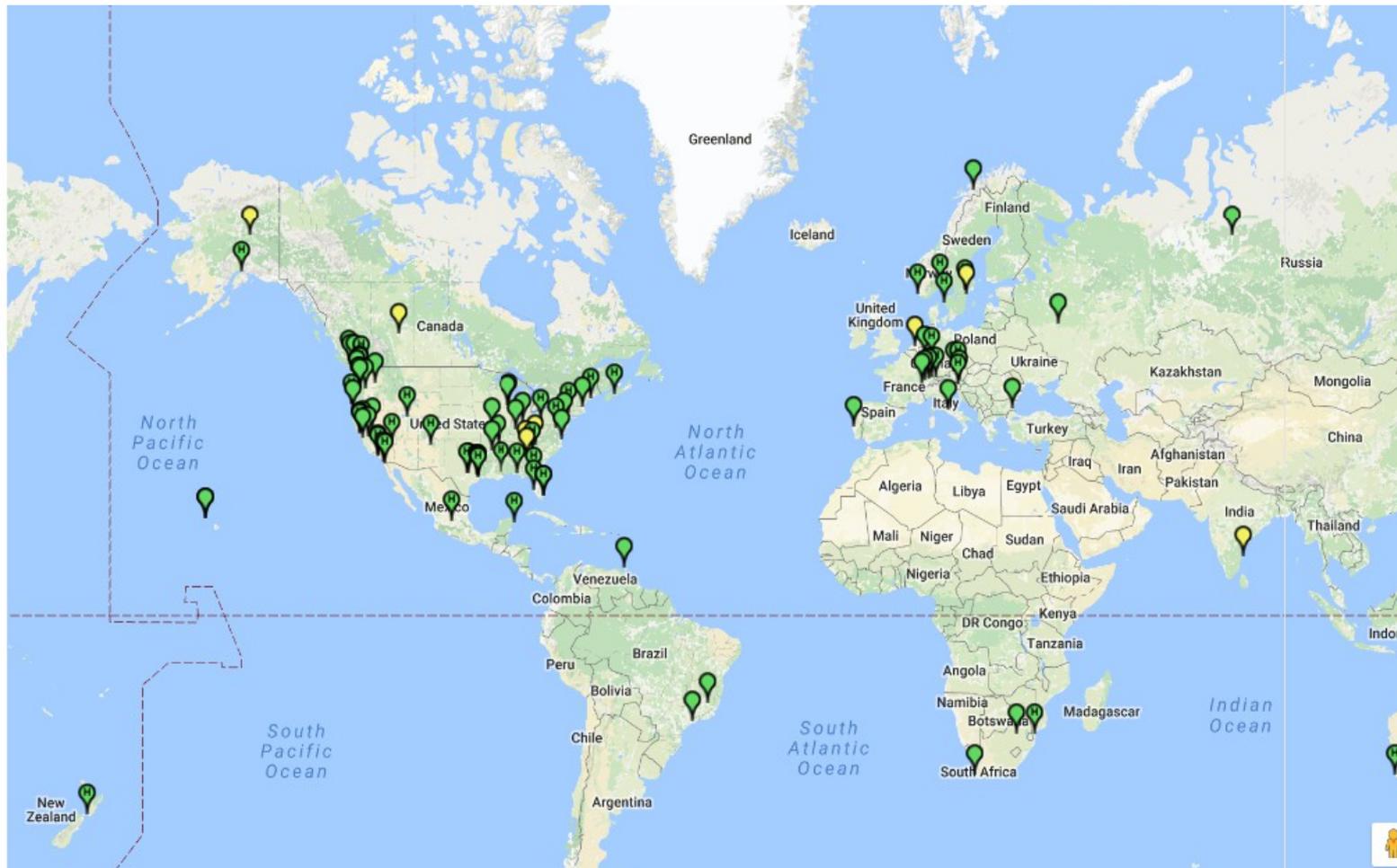
12. Hospital drug shortages
13. Hospital equipment shortages
14. Fuel locations & levels
15. Shelter staffing levels
16. Shelter occupancy levels
17. Shelter medical issues
18. ATMs working / not working
19. Businesses open / closed
20. Looting
21. Roof damage
22. Water damage

23. Incoming police assets
24. Incoming utility assets
25. Transportation assets
26. Communications issues
27. Comms frequencies
30. Damage assessments
31. Weather predict. by location
32. Creek flood stage levels
33. Triage reports
34. Casualty reports
35. Food asset levels
36. Water storage levels

37. Skilled labor assets / locations
38. ESF team compositions
39. FEMA personnel lists
40. Requests for mutual aid
41. Communications to governor
42. Communications to state EOC
43. National Guard status
44. School Status

You really need digital “record”
comms abilities if you have a **real**
emergency....

HF WINLINK

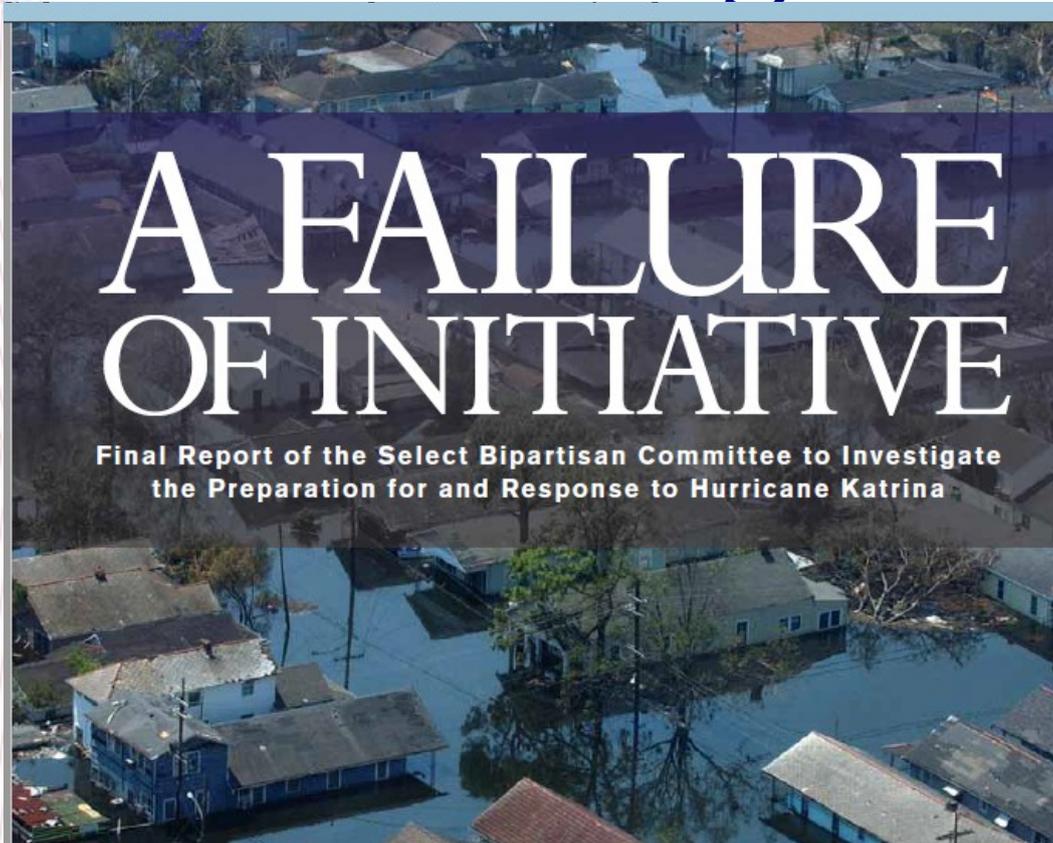


Worldwide PACTOR RMS Servers (Feb. 2017)

Government network similar -- USA only

“We will never lose comms”

Sure ya won't, pal!!



**Discussed on Page
3 in the book**

New Orleans: All the comms that were supposed to work.... *didn't.*

20 Million phone calls *didn't* on 1st day.

Police trunking systems...*didn't...*

Broadcast Radio/TV....*didn't*

Only a very very few comms remained.

And they were not enough.

Towers?



A downed communications tower, Plaquemines Parish, LA.

That's a “comm tower.”

As many as 2,000 cell towers quit.

Some police **went days** without hearing from any commanding officer....

We'll never lose comms!



Those antennas aren't going to work very well!

“The fact is that FEMA spends too much time responding to routine natural disasters, such as small-scale tornadoes and snowstorms,

and not enough time preparing for catastrophic natural disasters, such as hurricanes, earthquakes, and volcanic eruptions, which have wide regional impacts.

This increases the likelihood that the federal response to catastrophic events will be insufficient, as once again demonstrated by the response to Hurricane Sandy.”

<http://www.heritage.org/homeland-security/report/after-hurricane-sandy>

Hurricane Sandy: millions no power

Table.II.1: State Wide Customer Outages

PM Outage Reports									
State	29-Oct	30-Oct	31-Oct	1-Nov	2-Nov	3-Nov	4-Nov	5-Nov	6-Nov
Connecticut	2,073	626,559	502,465	348,294	232,142	132,805	64,955	30,608	7,371
Delaware	2,406	18,611	2,757						
District of Columbia		3,010							
Illinois		1,149							
Indiana		9,224							
Kentucky		8,379	2,941						
Maine		72,049	9,145						
Maryland	20,199	253,315	103,997	40,760	17,803	12,064	7,198	4,155	1,666
Massachusetts	30,413	256,039	82,809	12,883	2,248				
Michigan		69,006	35,422	10,004	10,020				
New Hampshire	18,190	136,565	55,809	8,324					
New Jersey	87,649	2,615,291	2,052,724	1,733,202	1,491,529	1,241,763	999,927	756,774	537,089
New York	105,089	2,097,933	1,948,282	1,525,969	1,269,392	871,161	654,623	492,575	348,985
North Carolina	15,466	1,998							
Ohio		267,353	162,637	96,880	60,273	25,244	10,007	2,589	
Pennsylvania	12,944	1,221,536	800,745	509,839	304,094	153,695	77,630	31,114	10,074
Rhode Island	11,009	116,592	50,468	21,376	5,962				
Tennessee		2,120							
Vermont		8,104							
Virginia	11,125	147,622	33,385	7,538	2,176				
West Virginia		271,765	218,490	139,581	95,956	60,689	41,618	33,868	25,598
Total	316,563	8,204,220	6,062,076	4,454,650	3,491,595	2,497,421	1,855,958	1,351,683	930,783

<https://superstormresearchlab.files.wordpress.com/2013/07/md-sandy-multi-state-outage-report-february2013.pdf>

The Bounty sinking -- all the usual comms.....*didn't*

Emergency Communication

- “... we got nothing when we tried calling out on HF. We tried calling the Maritime Mobile Net, but nothing was out there. As a last-ditch effort, we used Winlink to e-mail the Coast Guard for help. Within an hour, we heard a C-130 plane, and later, a helicopter overhead.”
- *Doug Faunt, N6TQS*
- (Bounty survivor)



**WINLINK
did**

Nice thing to have when you are on mission trips, etc....

People are making a difference.

**And having a heck of a good
time doing it!**

Marion County, Florida

Munroe Regional Medical Center, TimberRidge Emergency Dept, Ocala Regional Medical Center, West Marion Community Hospital, Kindred Hospital

Hospital Emergency Communications Team



2017

Front Row: Harold Wood W3HII, Earl Sweeney K4LSB, Dave Welker W2SRP, Ralph Welker WA2ENY, Sharon Malik KM4SMM, Pam Foster SCRIBE

Middle: Rich Holmquist KJ4VKG, Vince Tubman WD4IHL

Back: Paul Lewandowski KK4OFK, Bill Boyer WA3YOX, Don Foster KB1QIX, Allan Sanders KM4JMV, Ron Viola KS4SW, Bruce Twiss KI4NFA, Bill Tate KC8ZZ

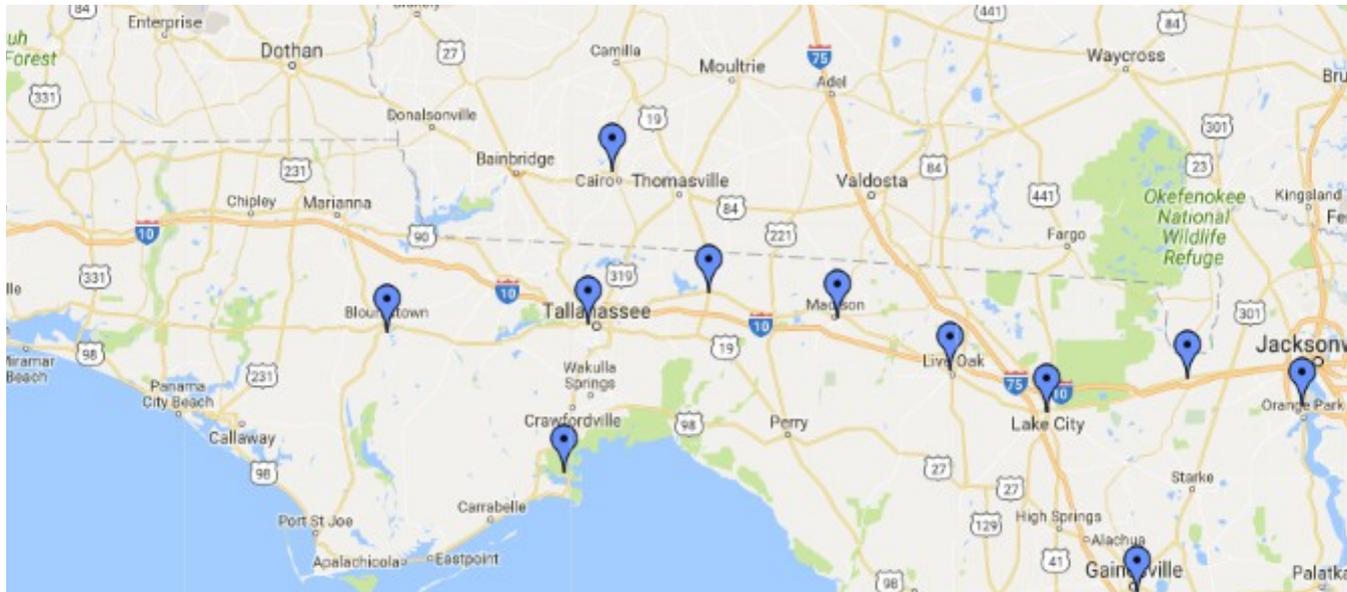
Not pictured: Stew Robinson KJ4BDE, Clinnon Alexander KK4MYD, Peter Kaminski KK4EXQ

Rosemary's Antenna Party



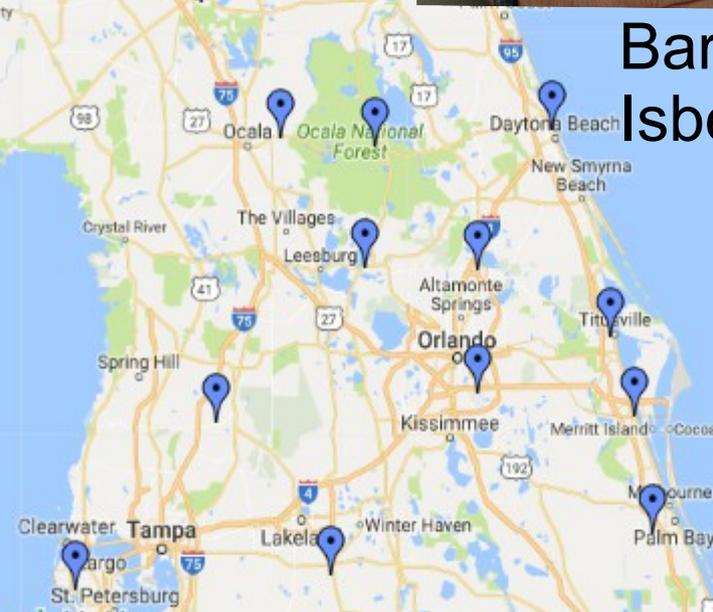
I cant even see the VHF antenna...

Barry Isbelle's SEDAN



SEDAN DIGITAL NETWORK

-- works for "classic packet" and also for WINLINK



Barry Isbelle

Depending on ONE digital repeater made me nervous

- Sure would be better to have backup
 - ◆ Under ordinary person control
 - ◆ Able to be fixed quickly
 - ◆ Able to have antenna replaced
 - ◆ Reconfigured easily if necessary (diff freq, etc)
- So a group began to install “residential digital node” --- based on linbpq free software on Raspberry Pi's

We built our digital repeaters to be TRANSPORTABLE to disaster area if need be.



John Wiseman
G8BPQ



Emergency Digital Highway



Fire tower to Fire tower /
or slingshot emplaced---
back to WM3B, KX4Z or
W4DFU-7/8

3kHz bandwidth
isn't fast, but
1000wpm is
1.5Million words /
day

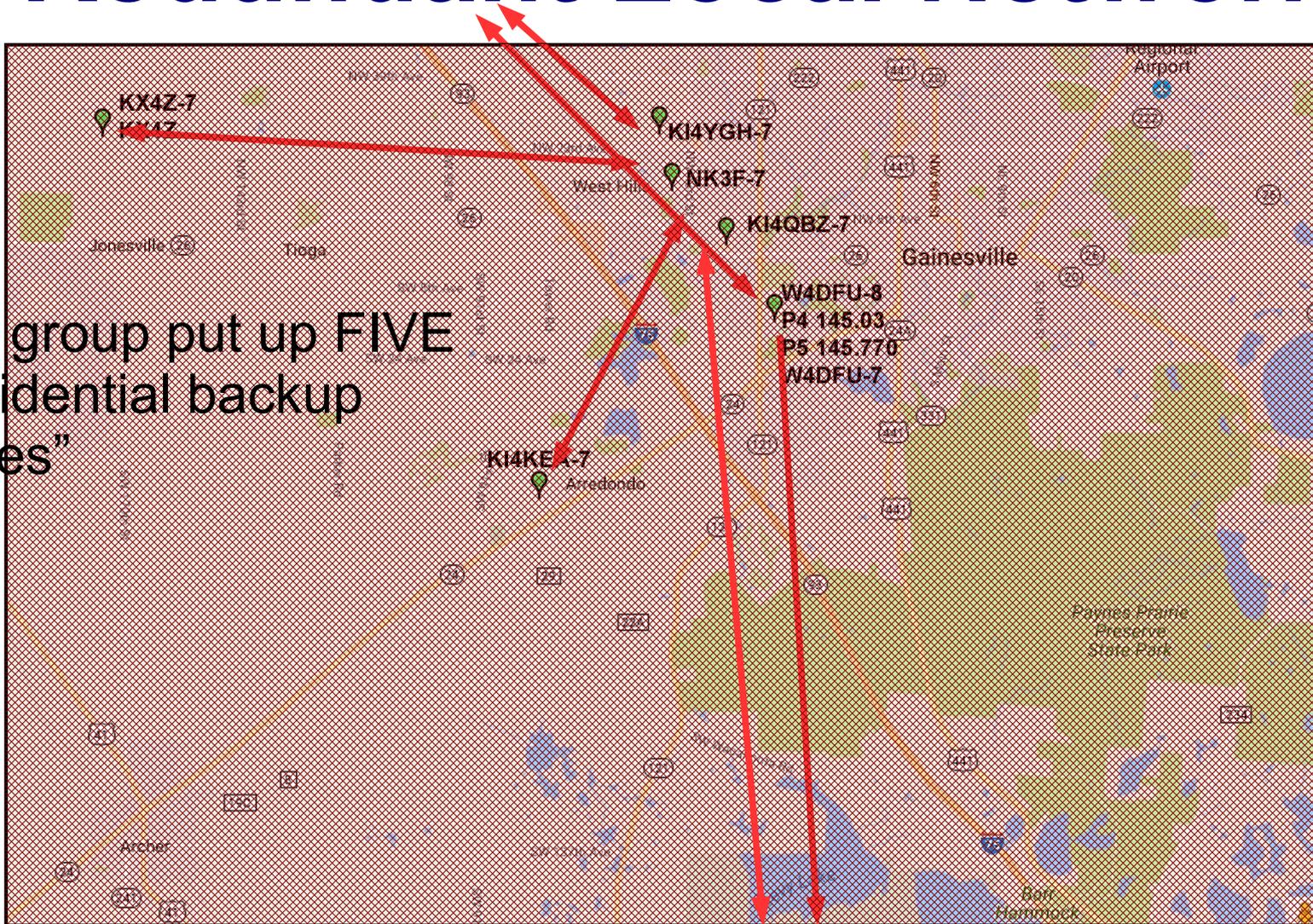
Local network--backup grows!



Jim, Rosemary, Art & Cindy, Tom,
Gordon, Mike; The Ocala HEC /
ARES / MERT groups

Redundant Local Network

Our group put up FIVE
“residential backup
nodes”



Possible future Nodes -- Williston, Cedar Key, ???

Williston -- WM3B -- is already up!