

Community Emergency
Communications using Inexpensive
Off-the-Shelf Radios
Neighbors Helping Neighbors

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December 14, 2019

Agenda

Part 1 - The Program

- Overview of the Personal Radio Services – FRS and GMRS
- The unlicensed Family Radio Service (FRS)
 - Radios and their characteristics
 - Selecting a radio
 - Neighborhood communications during outages
- The licensed General Mobile Radio Service (GMRS)
 - The Linkage to the Amateur (Ham) Radio Service
- Communications protocols – FRS, GMRS and Ham
- Support that we can provide
- Our pilot program – Owl's Head to St. George
- How to get involved

Part 2 – Some Details

- Getting the real specs for FRS radios
- FCC rules: Part 90 and Part 95
- Coverage testing
- Unattended voice recording

Summary

The Personal Radio Service (PRS)

The PRS, as defined by the FCC, consists of several two way radio services including FRS, GMRS, MURS and CB. For our purposes, we will focus on FRS and GMRS.

- FRS (Family Radio Service): This is an unlicensed low-power service using widely available and relatively inexpensive handheld radios.
- GMRS (General Mobile Radio Service): This is a licensed higher power service that also covers family members.
- Many FRS channels are shared with GMRS.



The Family Radio Service

Many people use inexpensive radios such as this one in conjunction with various outdoor activities.

While usually viewed as convenience items, FRS radios have the potential to be very useful tools when normal communications are disrupted.

Recent FCC rules changes made FRS even more versatile.

The next few slides will discuss the characteristics of FRS including strengths, limitations and will clarify some areas of confusion.



The Family Radio Service

There are now 22 FRS channels (frequencies). These are divided into 3 groups. FRS radios are regulated under Part 95 of the FCC Rules.

The FCC modified the rules in Sept. 2017 with a grace period of 2 years. The new rules increased the permitted power and also banned the manufacture of “combo” FRS/GMRS radios.

If an older FRS/GMRS radio does not exceed the new power limits, it may be used without a GMRS license. A license is required if the limits are exceeded. Newly manufactured radios are labeled FRS **or** GMRS.

Some legacy radios that meet the new FRS requirements have simply been relabeled. These may not offer some of the benefits of the new rules.

To add to the confusion, manufacturers don't publish the power ratings.

Channels	FRS Power
Old Rules	
1-7	½ watt
8-14	½ watt
15-22	Not permitted
New Rules	
1-7	2 watts
8-14	½ watt
15-22	2 watts

What to Look for in a Radio

Essentials:

- FRS, not FRS/GMRS. Some old stock may still be on the shelves.
- All 22 FRS channels
- Ability to use “Privacy Line” (PL) codes
- Option to use dry cell (alkaline) batteries (In case of power outage you may not be able to charge rechargeable batteries.)

Other Features:

- NOAA weather channel reception (fairly standard)
- Degree of ruggedness (waterproof, floating, etc.)
- Built in flashlight
- Built in GPS (e.g. Garmin)
- Texting capability (e.g. Garmin)

FRS Transmitting Range

The FRS UHF (ultra high frequency) channels are line of sight limited. This doesn't mean that you have to visually see the other person but range is optimized if there are no significant obstacles (hills, trees, buildings) in the path.

FRS antennas are built into the radio and cannot be upgraded. In the interest of compactness, they are also not very efficient.

To get the most range:

- Select radios that have power levels that are consistent with your needs. Our team can help with selection.
- Hold with the antenna in a vertical orientation.
- Try to operate in an open location. Going up a nearby hill will offer a substantial advantage. Sometimes moving just a few feet will help significantly.
- Be sure your batteries are charged or fresh.

What Does “Range” Mean?

FRS radio literature and packaging only state range in miles. This is extremely misleading. The fine print in the manual will (sort of) address the limitations but won't give you any real performance data.

Higher priced radios will generally state longer ranges but pricing also reflects added features (weatherproofing, built in flashlight, etc.)

Make/Model	List Price (pair)	Stated Range	Max Power (watts)
Midland T20	\$20	16 miles	0.450*
Motorola T107	\$30	16 miles	0.200
Motorola T260	\$60	25 miles	1.0
Midland T75	\$70	28 miles	0.475
Motorola T460	\$90	35 miles	1.72*
Cobra ACXT645	\$80	35 miles	2.0*
Uniden GMR5098	\$100	50 miles	1.9*

* These radios are also very close (or at) the ½ watt limit for channels 8-15.

What are PL Codes?

Each radio will have a number of Privacy Line (PL) codes that may be programmed for any channel. These are found in the manual. Each code will have an associated subaudible frequency. For example, with the Midland T20, Code 8 is 88.5 Hz. The frequencies are standardized but the numbering may vary from manufacturer to manufacturer. Details are in the manuals.

If the code is set, the radio will transmit the inaudible 88.5 Hz tone. If another radio is set for the same code/tone, the receiving radio will only hear a radio that is using that PL. This is used to filter out transmissions from other radios that are not using a PL or who are using a different PL.

However, a radio that does not have a PL set will hear any radio that is within range. In other words, the PL restricts your reception to just the radios that you want to hear. It does not actually provide privacy.

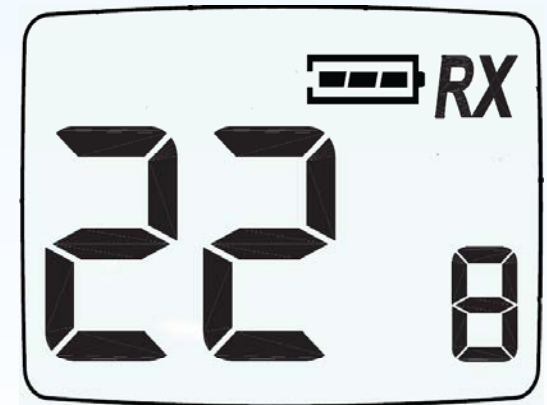


Figure shows reception on Channel 22 with PL Code 8.

How do I Use the Radio During an Outage?

A great radio is worthless if you have no one to talk to.

We'll discuss a tiered system for communications during disruptions of normal (telephone, cellular, internet) methods.

1. Communications between neighbors using FRS radios following the National SOS Radio Network (NSRN) model.
2. Communications to GMRS equipped amateur radio operators who can then relay the messages to appropriate parties.

We'll discuss #1 first.

Neighborhood Level

Having an ability to communicate is important. This could be to report a tree across the road, a medical issue or just to find out if anyone has some flour.

Do you have people (perhaps with specific skills) in your neighborhood or individuals with whom you might like to maintain contact?

If so, think about equipping each with an FRS radio.

Since you don't want to have your radio on all the time, set up a calling protocol with time and channel.

If a party is out of your range, find someone in-between that can act as a relay.

National SOS Radio Network

NSRN is a program of Radio Relay International. It has a suggested standard 3-step FRS calling protocol. This has been used in hurricane and flood zones to request help.

1. Set your radio to Channel 1 with privacy codes off. Transmit on the hour. Include your name, exact location and nature of the problem. This is the time when other members of your group should be monitoring. Be clear and brief.
2. Keep calling for 2 minutes.
3. Listen for 3 minutes for an answer. If you hear nothing, save your batteries by turning off your radio and waiting until the top of the next hour to try again.

**National SOSSM
Radio Network**

General Mobile Radio Service

GMRS may be considered as a companion service to FRS. There are significant similarities and differences.

Many FRS channels are shared with GMRS. This interoperability is unique and provides a high degree of flexibility.

- GMRS operators must have a FCC license (\$70 for 10 years, apply on line, no test). A single license covers the licensee and the licensee's spouse, children, step children, grandchildren, parents, grandparents, step parents, brothers, sisters, in-laws, uncles, nieces and nephews. Cousins are out of luck.
- GMRS radios have a power limit of 50 watts on most channels and external antennas may be used. (The manufacturers actually publish the output power levels!)
- The GMRS rules also permit the use of repeaters for range extension.

GMRS Radios

- Affordable handheld and mobile GMRS radios have been hard to come by until fairly recently (around 2017).
- Consumer handheld GMRS radios are now available from BTECH, Tera and Powerwerx. Midland is offering 15 and 40 watt radios.
- Handhelds are generally 4-5 watts and the antennas are removable. Higher power radios may be used mobile (in a vehicle) or in the home. Midland has models from 15 to 40 watts.



Midland 40 watt
Mobile GMRS radio



BTECH GMRS Handheld

FRS/GMRS Shared Channels

Channels	Function	FRS Power	GMRS Power
New Rules			
1-7	Shared simplex, general use	2 watts	5 watts
8-14	Closely located stations	½ watt	½ watt
15-22	FRS/GMRS simplex; repeater output	2 watts	50 watts

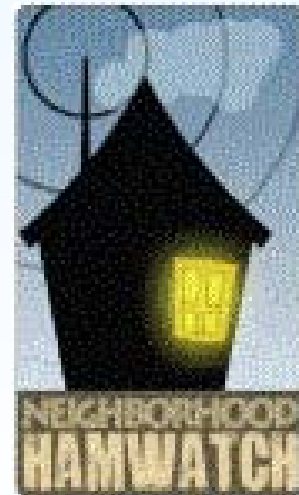
We use Channel 19 for FRS to GMRS communications because of the improved range potential.

Putting it Together

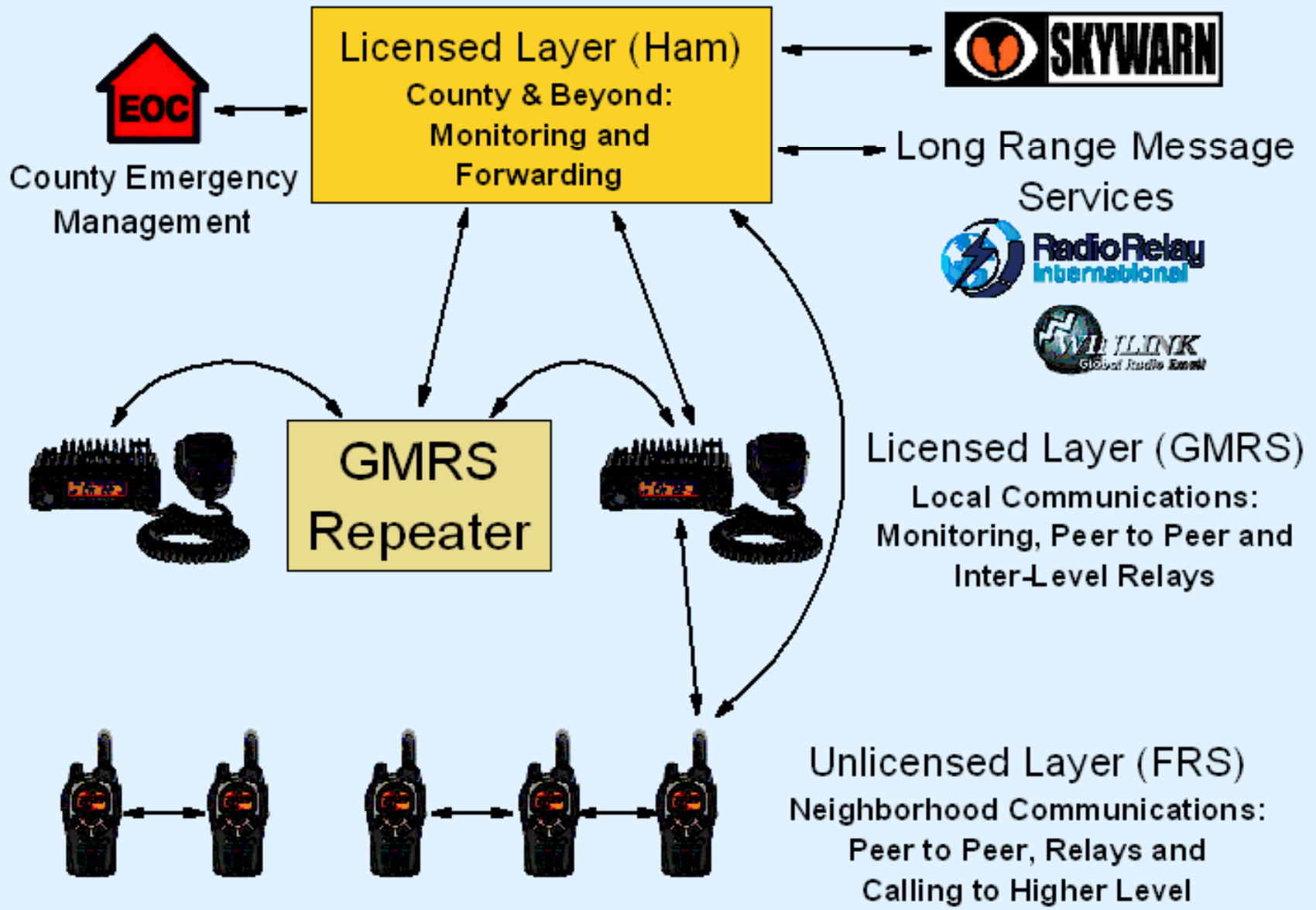
Well placed GMRS stations with tower or rooftop antennas can provide much better coverage than is possible with FRS. They can augment an FRS network.

Hams that are equipped with GMRS radios can act as relays between FRS users and more distant locations.

This program, also organized by Radio Relay International, is called Neighborhood HamWatch.



World-Wide Communications using Neighborhood HamWatch



What this Means to the Community

With a GMRS equipped ham operator within range, a person with an FRS (or GMRS) radio may:

- Make a call for assistance
- Submit a damage report
- Report suspicious activity
- Submit a storm report to the National Weather Service
- Send a personal message to family or friends anywhere in the USA. Messages are forwarded by ham radio services at no cost to the sender.

Knox County Storm/Outage Protocols

- There is an Amateur Radio Storm Net, sponsored by the Pen Bay Amateur Radio Club that is active at the top of each hour (generally 8:00 AM through 8:00 PM) during severe weather events. Scanner owners may monitor these on 147.060 or 145.490 MHz.
- Our GMRS stations operate on Channel 19 with an 88.5 PL tone. Do not use this channel for routine communications.
- GMRS equipped ham stations will either be attended or regularly monitored.
 - If attended, the preferred calling time is at 15 minutes before the hour.
 - If not attended, all stations have voice recorders that are active 24/7. Leave a brief, clear message.

Weather Reporting Options

Many Knox County residents are weather spotters for the Skywarn program.

There are numerous options for communicating weather data to the National Weather Service. These include:

- By telephone (land line or cell phone)
- By internet (email or Twitter)
- By amateur radio

FRS users can play a role!

Telephone & Internet

Telephones & the internet represent a primary means of weather reporting. However, these often fall victim to severe storms:

“One thing we noticed during the windstorm on Oct 29th (2018) is that as soon as power and communications go down the observations cease as well. I immediately thought of (your program) as this is exactly the scenario you are working to improve in your community. “

Margaret Curtis, Meteorologist, NWS Gray

An Emergency isn't Needed

Besides weather spotting during storms, FRS users would be welcome to participate in communications exercises that are sponsored by the Knox County EMA and its Amateur Radio ARES/RACES-CERT team. These exercises are held quarterly.

Support

Our team will be happy to provide support to get you going. This can include:

- Radio selection (borrow a radio before purchase!)
- Coverage testing – can you reach the parties you need to reach?
- Procedural training

And don't forget, you can use the radios when hiking, bicycling, when out-and-about on your property, etc.

Website: <http://ballyhac.com>

Email: KnoxHams@ballyhac.com

Pilot Program Specifics

Owls Head, So. Thomaston, Spruce Head, St. George,
Tenants Harbor, Port Clyde

Why this Area?

- Base of committed ham volunteers who are familiar with formal message relay procedures and are equipped with GMRS radios.
- Some key amateur radio infrastructure:
 - Winlink radio-email gateway in Tenants Harbor
 - RRI Digital Hub in Owls Head
- Communications here tend to have a variety of issues during storms. Some areas have poor coverage even in normal conditions.

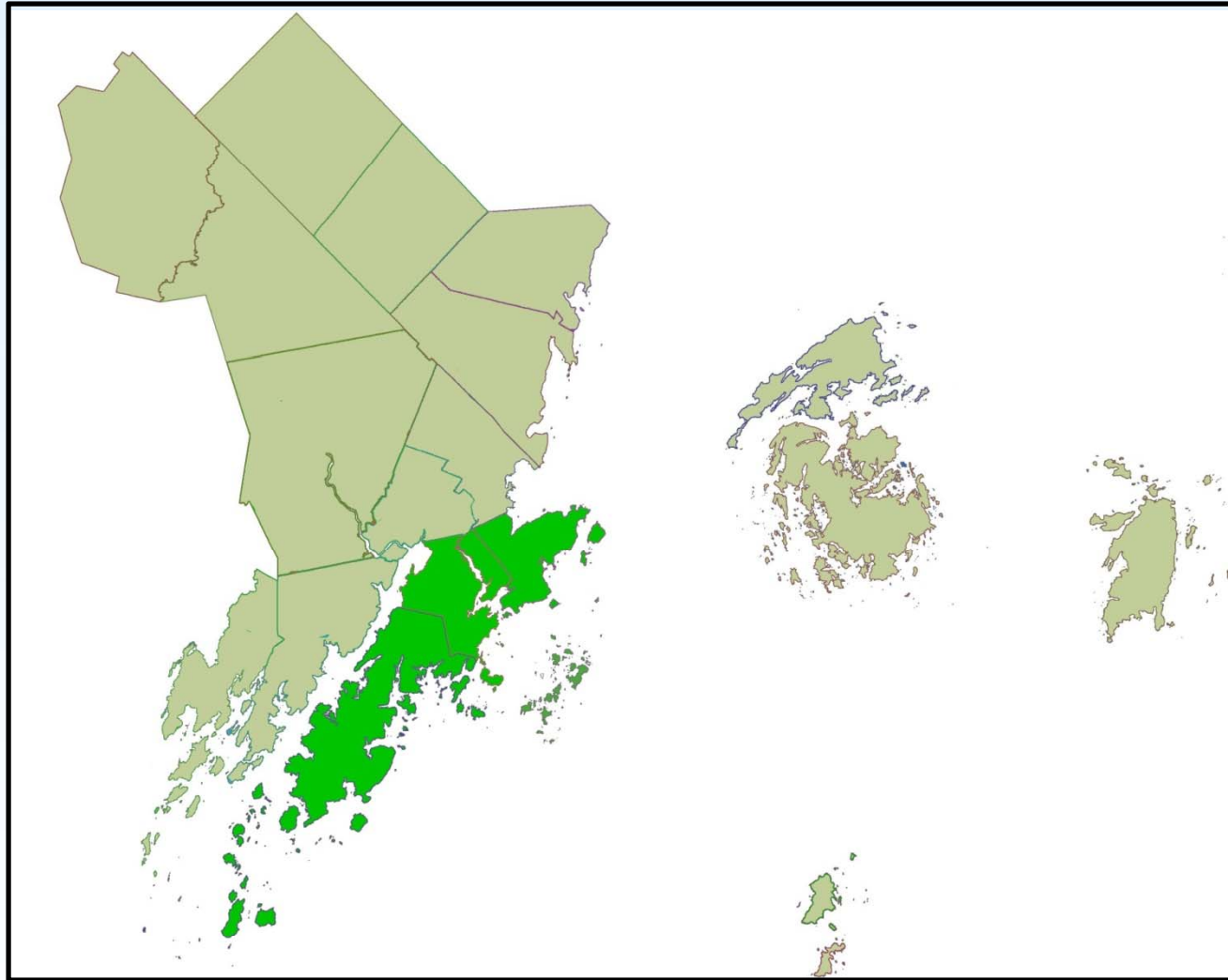
Who's Currently Involved

- KB1TCE/WQQB941 in Owl's Head
RRI Digital Traffic Station for Maine; FRS & GMRS monitoring; traffic relay.
- WD10/WQZI552 in Tenants Harbor
Winlink gateway, Knox County Packet Network; FRS & GMRS monitoring; traffic relay. Manages FRS/GMRS station at St. George fire house.
- KB1ZUN/WRCJ881 in Spruce Head
GMRS station being implemented; FRS & GMRS monitoring; traffic relay; may be the host site for the Spruce Head 675 GMRS repeater.

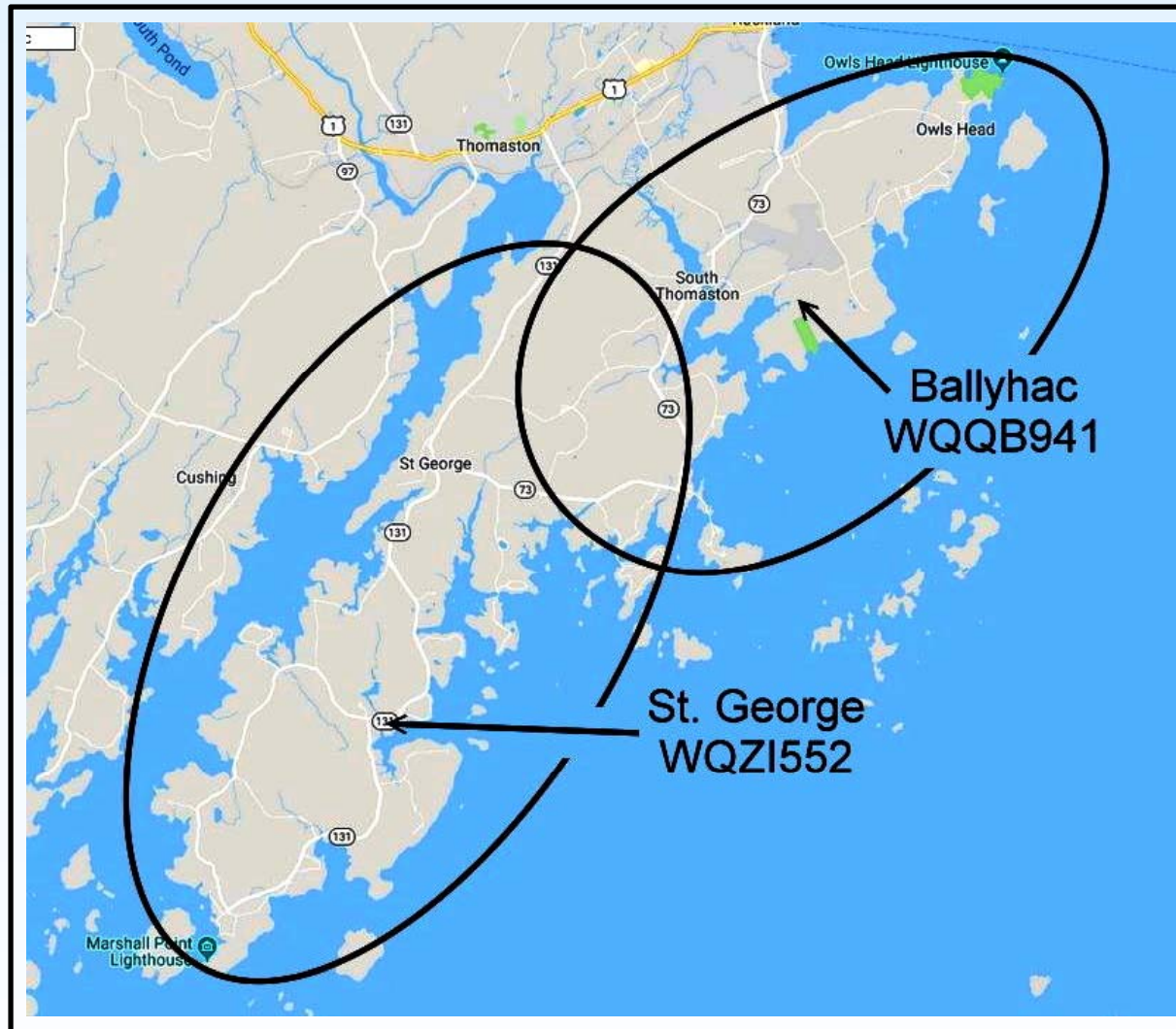
Also

- NY1B in Friendship
Primary Storm Net net control operator
- K1IRK/WRCH559 in Rockport
Potential new GMRS HamWatch station

Knox County Program Pilot Area



Pilot Area FRS Coverage



We Need Participants!

- We need more ham volunteers to improve coverage around the county.
- We need hams who will also support non-ham communications i.e. FRS and GMRS.
- The utility of this type of service is not well appreciated by the community since Maine does not have a recent history of disasters. History does not forecast the future....bad things could happen here. Outreach is critical.

Related Information

- Getting the detailed test information
- Part 95 vs Part 90 commercial radios
- GMRS repeaters
- FRS/GMRS channel usage for Knox County
- Message recording

How Can I Find the Real Specs?

For selected radios, information may be found at ballyhac.com

Otherwise you must look at the FCC database for the Part 95 certification documentation. This is on the web.

First you need the manufacturer's FCC code. As examples: Midland (MMA), Motorola (AZ4), Uniden (AMW), Cobra (BBO).

To find the list that has the Motorola radios, go to <http://fccid.io/AZ4>

If you have a radio and want to look up the information, remove the battery cover and look for the label. The FCC ID is there. For the Motorola T460 enter:
<http://fccid.io/AZ489FT4924>



Can Non-Part 95 Radios be Used for FRS or GMRS?

The official answer – NO

Some people use commercial (Part 90) radios.

For FRS, this is neither legal nor advisable:

- Antennas are not fixed
- Many technical specifications conflict

Part 90 radios, if operated within the power and other limitations, do meet the technical requirements of Part 95 for GMRS.

- GMRS repeaters usually use commercial radios without any issues or objections.

GMRS Repeaters

- Many are operated by hams.
- Frequently affiliated with emergency groups e.g. REACT, VOAD, neighborhood watch groups, etc.
- Access is generally restricted i.e. permission required or by membership in a community group.
- FRS radios are not repeater capable.
- mygmrs.com is an excellent resource for repeater information.

FRS/GMRS Channel Usage

Channel Usage Guidelines	
Channel	Use
1	High priority/emergency calling between FRS radios or with GMRS radios in the same neighborhood. Use highest FRS power available. This is consistent with National SOS Radio Network practice
2-7	General use between FRS and/or GMRS radios within a neighborhood.
8-14	General communications between closely positioned radios. Limited to ½ watt maximum.
19	For communications with a full power GMRS hub station, 88.5 PL
20	Spruce Head 675 GMRS repeater (when implemented)

Coverage Testing

Surecom SR-112 Simplex Repeater



SR-112 records voice and then retransmits. Remote station receives instant feedback on signal quality.

This is how our coverage plots were developed.

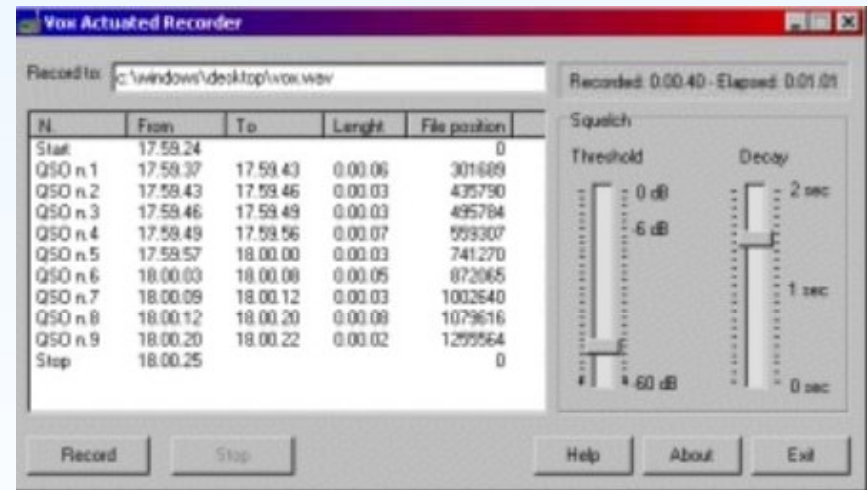
Unattended Monitoring Off-the-Shelf Implementation



Audio to Radio

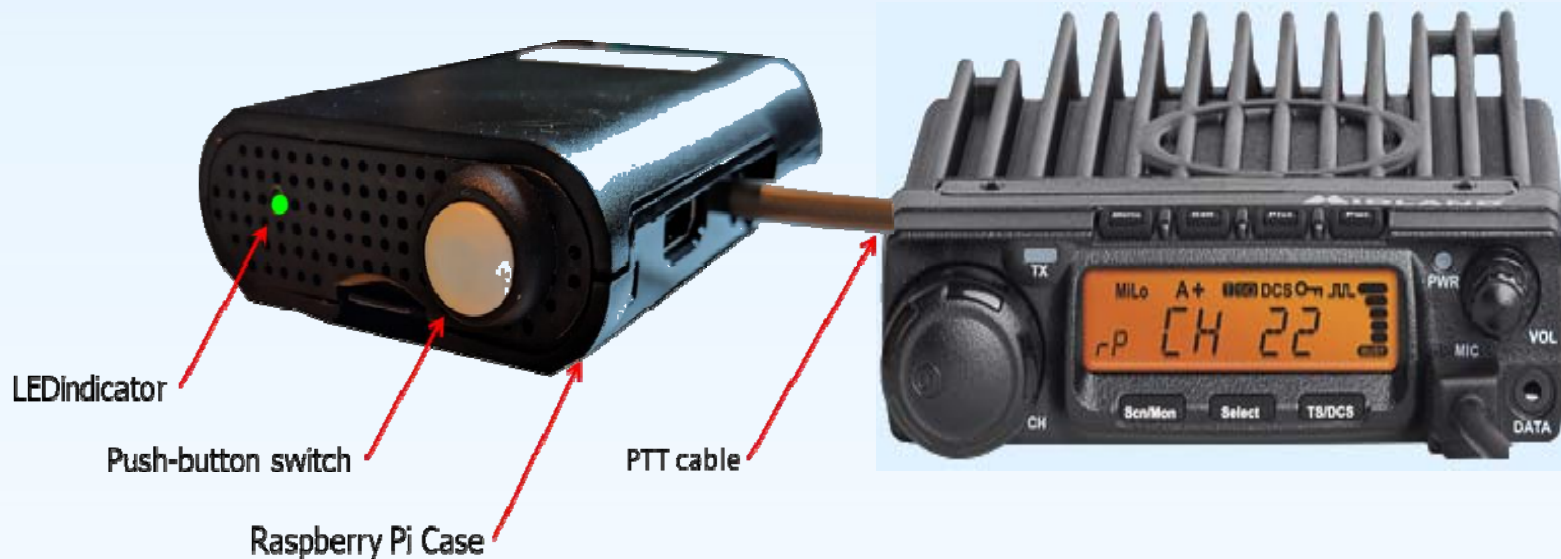
Voice/CW ID
15 Minute
Intervals

Audio from
Radio



PC Running Voice Actuated
Audio Capture Software

Unattended Monitoring Custom Implementation (St. George)



Raspberry Pi Running Voice Actuated Audio Capture
Software with Caller Acknowledgement

3 Operational Modes

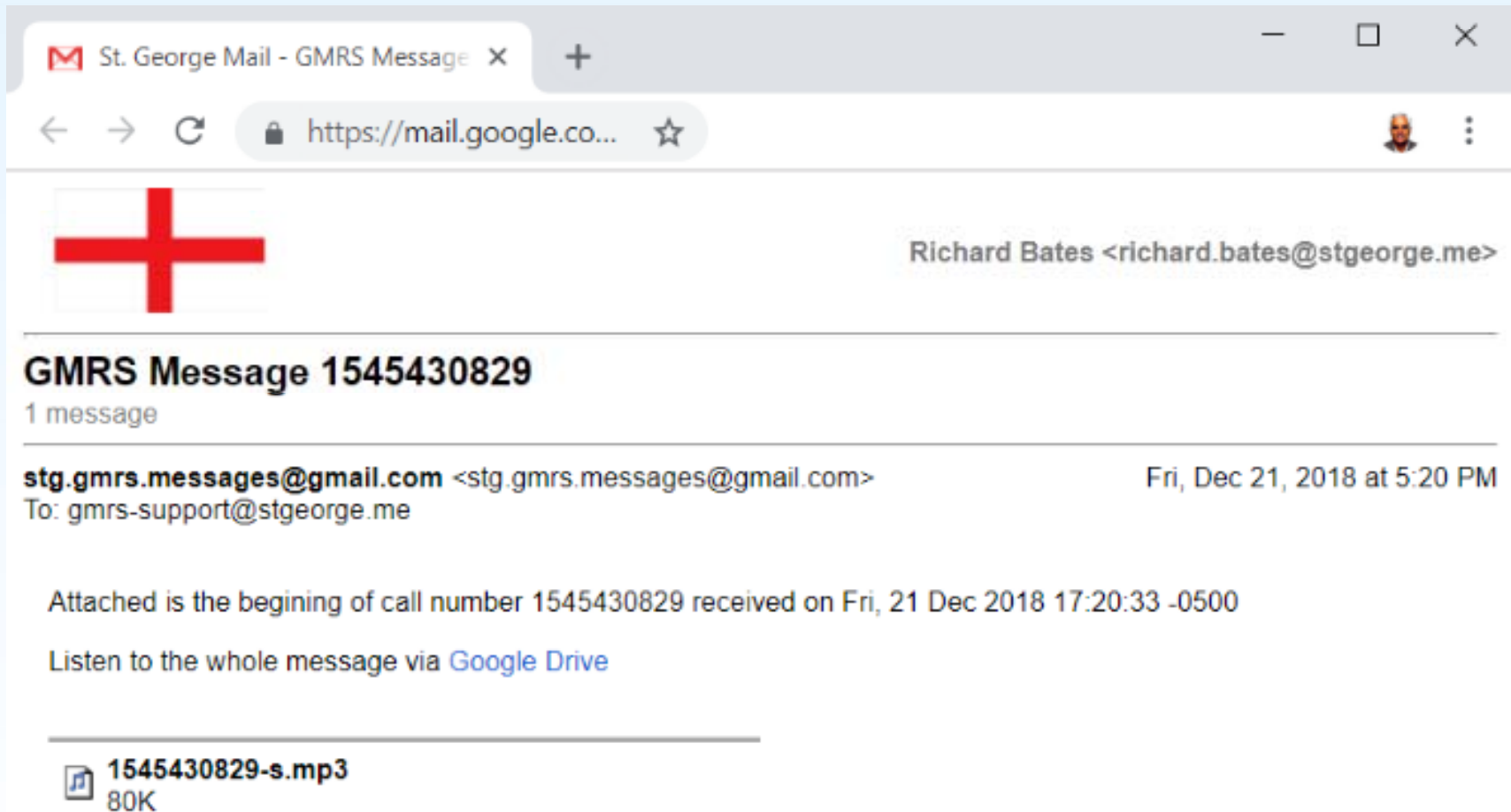
1. Stand-alone – Earpiece
2. Local Network Interface
3. Remote Email

Unattended Monitoring Local Network Interface

The screenshot shows a web browser window with the address bar displaying '192.168.0.153'. The page title is 'Received Radio Messages'. The content is organized into two sections: 'Pending' and 'Resolved'.

Message	Resolution
<p>Pending</p> <p>Dec 15, 2018 1:53:20 PM</p> <p>0:00 / 0:20</p>	<p>Resolution</p> <p>Submit</p>
<p>Resolved</p> <p>Dec 12, 2018 8:06:40 AM</p> <p>0:00 / 3:40</p>	<p>Dec 12, 2018 11:23:20 PM</p> <p>Made connection with caller and arrangements made to get them assistance.</p>
<p>Dec 14, 2018 4:33:20 AM</p> <p>0:00 / 4:04</p>	<p>Dec 14, 2018 8:43:20 AM</p> <p>Visited caller and provided assistance.</p>

Unattended Monitoring Remote Email



Summary: Current Status and Plans

Immediate Plans

- Finish all equipment installations
- Refine protocols and complete coverage maps
- Website needs some updating

Enhancements

- Involve non-ham communicators in our ARES/RACES exercises
- Enroll some weather spotters

Challenges

- Get community interest and involvement
- Convince more hams to invest in GMRS equipment
- We need constructive input

More Information

Program Website: <http://ballyhac.com>

Lots of information and links

Questions

Hands-On