Survival Communications Primer

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This FAQ, wiki or primer is a compilation of information gathered on various internet websites as well as FCC and ARRL sources. Subjective opinions are included in this document. Inspirations or ideas have also been taken from **AR-Jedi**, **Scoutmaster**, and **GySgtD** and others without their permission (screen names from various forums are used to protect privacy). While a lot of information here is ham related, almost all of it can be applied or applies to non-ham radio systems.

One thing I have to mention here. We are not trying to be or sound like ham radio snobs. We highly suggest a diversity in communications systems. I personally have computers, internet, landlines, cell phones, frs/gmrs radios as well as amateur radio equipment. The key is to understand how each works and the limitations of the equipment.

Why do I need comms?

Well, unless you want to be a hermit during an emergency situation, you need at least some sort of rudimentary communication system. At the very least some sort of receiver system is necessary. Depending on the situation, you may need information on how to take shelter (inclement weather), how to leave an area (terrorist, chemical spill, etc.) or many other considerations.

Your options are basically one way or two way comms. One way consists of am/fm radio, television, shortwave radio, internet websites and other radio services, etc. Two way comms consists of am/fm/ssb/cw/digital radio on ham bands and other radio services, cell phones, satellite phones, internet email and instant messaging, etc.

If you follow the rule of 3's, then you should have at least 3 methods of distance communications (not including yelling across the road or 2 cans on a string).

Do I need 2 way comms?

That is a bit subjective depending on your situation. However, it is highly recommended. Needed for communication with friends and family in a disaster situation where you are not together. Needed to call for help. Needed to ask for specific information from others who may have information.

Considerations when using the transmit (tx) part of 2 way comms.

There are a couple of considerations one should consider when transmitting. In general, all things being equal, more power equals more range. But there are many reasons why one should limit the power of transmissions. The general rule is to use the MINIMUM power required to communicate. For one, this reduces airwave pollution. If you are talking on your radio, you don't want some other radio operator talking over your conversation booming out 1000's of watts of power for no reason. Second, especially in emergency situations, minimum power means longer battery life. Another consideration is that when communicating, you may not want 'everyone' to hear what you are saying, particularly in an emergency situation. By using the minimum power, you will limit the number of 'ears' that can hear your comms.

A second consideration when transmitting is the *reason* and *to whom* you are transmitting. This generally falls into 2 categories in emergency/survival situations.
1) Calling for help. In this situation, you need to transmit with enough power so that 'aid' can year your call but low enough that you can conserve your battery for extended use. Perhaps you will need to guide any aid to your location, that would require using the radio for enough time for help to arrive. In this situation, where lives are on the line, using any method of wireless communication with any equipment is allowed.
2) Calling within your group. You may need to communicate with your group after some sort of disaster or emergency situation where the communications are not dealing with life and death. In this case, in general, you want to keep your power low. Also, as long as there is some sort of governmental entity, you will probably want to stay within the legal limits of your radio equipment. The FCC uses a system of 'Type Acceptance' where specific equipment is authorized for use with specific bands of air spectrum. This basically means that for most bands, you need a radio that is qualified for use on those frequencies. In general, amateur radio equipment is not type accepted for any of the services. You also, for example, would not be able to use a radio that is type accepted for the AIR band on the Marine band frequencies (unless the radio happens to be type accepted for both- I don't know if they exist) NOTE: For use on amateur radio bands, there is no type accepted equipment. You can build or modify any equipment and use it on the ham bands as long as you follow the other ham regulations in terms of operation.

Background on wireless communications and the FCC (thanks Jim –ARJedi)

This part is excerpted from a thread by AR-Jedi.
Also, most of the text can be downloaded from http://cynthion.com/tacoma.txt

> The usable-for-communications electromagnetic spectrum spans a frequency range from about 100 KHz to 100GHz. (aside, only a portion of that is usable by inexpensive equipment). In the USA, the federal communications commission (FCC) is responsible for administering the spectrum for US users; however, the FCC works closely on this with international bodies, for reasons which will soon become clear. The "administering" that the FCC performs includes dictating what frequency bands are to be used for what purposes, and also specifying operational requirements for those bands (e.g. TX power output, ERP, modulation type, etc).
>
> Since examples are worth thousands of words, I'll provide a few. 1) The FCC has decided that broadcast FM stations are to exist in the 88MHz to 108MHz range. There are certainly power limits however I've no idea at hand what they are. 2) The FCC has decided that CB exists at around 27MHz, and that the maximum TX power output is 4W. 3) The FCC has decided that FRS exists around 462/467MHz, with a maximum ERP specified. And for the last example, 4) ham (amateur radio) has a number of bands allocated, each with associated limitations on power/modulation etc. I could go on and on with cell phones, marine radios, garage door openers, key fobs, microwave towers, etc etc etc. basically, if the device is what is referred to by the FCC as an "intentional radiator", they have an assigned slot (band) for it and constraints on it's operation.
>
> Why the constraints? Well, one reason is for your physiological protection. High RF power can cause burns, blindness, and other problems. (The "invention" of the microwave oven was an accident -- technicians working on early radar antennas were developing burns when the units were powered). Another reason for the constraints is public safety. The last thing a 747 pilot on emergency approach into Kennedy airport needs is crosstalk with taxi dispatchers in NYC. Hence the wide berth the FCC gives around police, fire, and EMS frequencies.
>
> Now then, we see that the FCC regulates intentional radiator use by dividing the frequency spectrum into bands, and then sets characteristics for each of those bands that users must obey by.

A common question is, "is one frequency band 'better' than another"? The answer is "sometimes". For certain applications (more on this in a moment), a given frequency band may provide better range, fidelity, immunity to interference, and so forth. These factors, and others, that make a frequency usable for a given application were taken into consideration when the spectrum was allocated.

It is important to note here that transmitter power output is one of many, many factors that influence the range at which you can communicate over a given transmission path. While important, transmitter power output plays only one role in a multi-faceted problem. Antenna gain, antenna polarization, modulation type, receiver sensitivity, background noise level, path loss, and a dozen other issues factor into the equation. Show me a well designed 2W transmitter and I will show you a way to communicate ~6.5 billion miles. NASA does this every day with their Voyager 1 & 2 probes -- they are now twice as far away as Pluto. ……Much more in the links above.

Should I get my ham (amateur radio operator) license?

I think this is sort of a no brainer and there is a general consensus that everyone who is serious about being prepared for emergencies should get their ham license. I can see maybe 2 'legitimate' reasons why not to get licensed, but I would discount them both.

One is that no one else you know is licensed. I discount this 'reason' because once you get on the air you will meet many other people and many will have the same attitude about being prepared as you and I. Also, once you get into communications, you *may* be able to get other friends or family interested.

The other 'reason' that I can image that may hold some water is that you don't want to get on another government list. Well, you are probably on so many government lists, one more isn't going to make a difference. I think (IMO) that this is a bit on the too paranoid side, but I don't like to judge people.

Even if you decided that ham radio is not for you, I suggest you read over the next few sections to get a better understanding of frequencies/bands/modes and equipment. Starting with about page 8, we start discussing other non-ham specifics.

How do I get a license?

Go to http://www.ARRL.org to get much more general information about getting licensed to operate as a ham. On that site is listed the local radio clubs in your area. It also lists the times and locations for taking the FCC exams http://www.arrl.org/arrlvec/examsearch.phtml . The exams are given by other hams that have been certified to give the exams. There are four (4) testing elements.

Element 1 is a 5 word per minute Morse code exam. As far as I know, this is no longer adminstered and is no longer a requirement for any of the license classifications.

Element 2 is the technician level exam. It is 35 questions with some basic electronics theory, radio safety and some FCC operator's rules.

Element 3 is the general class exam. It is also 35 questions. The content is similar to the technician exam except that it requires a bit more in depth knowledge. The question pools are different.

Element 4 is the final exam and is used to get your extra class license. It is 50 questions long with very in depth knowledge required about different operating modes, techniques, theory, safety and rules.

To be licensed as an amateur radio operator, you must take and pass a minimum of element 2.

When you go into a testing session, you can take as many of the four tests as you want for the single session fee of $14.00. However, if you want to retake any tests that you fail, you need to pay the $14.00 again.

As for studying, the technician license is fairly simple. This site has several free resources to study elements 1, 2 and 3: http://www.frrl.org/education/ . Here is a link to the July 1, 2006 element 2 test question pool: http://www.ncvec.org/downloads/2006tech.pdf.

As for the General and Extra exams, I personally suggest the ARRL 'License Manuals'. See here: http://www.arrl.org/catalog/lm/ . There are also Q&A books available, however, they seem to be just covering the question pools (which are available for free on the internet) rather than actually covering the complete theory behind the operating modes and rules.

Also, go here http://www.qrz.com/p/testing.pl to take practice tests (elements 2, 3 and/or 4).

If you want to learn Morse code, *and I suggest you do*, you can download one of the many freeware programs that generate random letters at specified speeds. They also generate regular words and full conversations (QSOs). Here is the one I like:
http://www.g4fon.net/CW%20Trainer.htm
Note: I personally am still working on learning it because it is a great thing to know…

What is with the different license classes and bands?

For hams, there are basically 4 bands, HF (high frequency), VHF (very hf), UHF (ultra hf), and microwave. At this point microwave is mainly for experimental communications, so you will not see a lot of emergency communications on these frequencies.

> Jim- what does 2M mean? Why is it seemingly used interchangeably with 146MHz?
>
> Hams simultaneously use one of two terms to describe the band they are discussing: frequency or wavelength. The two are related by a constant known as C, the speed of light. It turns out that after you crunch the numbers, you can easily convert between the two terms using the following rule of thumb...
>
> 300/freq in MHz = wavelength in meters
> Or the same rule but turned around,
> 300/wavelength in meters = freq in MHz
>
> Hence:
> 300/146MHz ~= 2 meters
>
> And now you see why 146MHz and 2M are used interchangeably.

Similarly, some wavelength to frequency conversions for other popular HF and VHF/UHF ham bands...

40M	--> 300/40	~=	7.5MHz
20M	--> 300/20	~=	15MHz
10M	--> 300/10	~=	30MHz
6M	--> 300/6	~=	50MHz
1.25M	--> 300/1.25	~=	220MHz
70cm	--> 300/0.70	~=	440MHz

HF is the region of the electromagnetic spectrum that goes from about 30MHz and lower frequencies. VHF goes from 30 to 300 MHz and UHF goes from 300 MHz up to the bottom of the microwave range.

VHF and UHF are basically line of sight methods of communications (not counting sporadic-e, grey line, aurora, meteor scatter, eme and other less than common propagation methods). So if your antenna can 'see' the antenna you want to talk to then you should be good to go. UHF and VHF make extensive use of repeaters which are radios which are usually connected to antennas in highly elevated positions. These repeater radios receive on one frequency and transmit simultaneously on another frequency. This allows a user to transmit and his antenna can see the repeater antenna because of its elevated position. Also the retransmitted signal is sent from an elevated position so that it has a much broader range. A repeaters range can be up in the 10's of miles (30, 40, 50 or more). Typical handheld transmitters (HT), which usually max at about 5-6 watts of power, can maybe get 5 miles depending on the terrain without using a repeater.

HF on the other hand is suited for medium to long range communications. HF frequencies (depending on the season, time of day, and solar activity) will bounce off the upper atmosphere. So a signal from your location may go up, bounce off the ionosphere and come back down several hundred or thousand miles away. Communications between the North America and Europe, Asia, Antarctica, pretty much anywhere, is possible and happens all the time. You can set up your antenna system to send your main signal toward the horizon to try and get the furthest contacts, or you can point your signal mostly straight up (NVIS-Near Vertical Incident Skywave) and get the signal to bounce back down relatively near your location to get communications within 40-600 miles.

During emergencies such as tornados, earthquakes, flooding,etc. 80-95% of emergency communications will take place at the local level with VHF/UHF frequencies. There will probably be less use by volume of HF because of the nature of the operations. This will vary of course depending on the situation. In a more regional disaster such as a hurricane or the SE Asian tsunami, the use of HF may be a greater percentage as communication over greater distances and into and out of the affected area will be needed.

More from Jim- first, I hate to break this to you, but THE EARTH IS ROUND. No, I'm not kidding -- it really is spherical despite what they told you in school or at church. Ok, now that you are past that, you should visualize in your head that radio waves travel in a straight line. Since the earth curves, it is not possible to talk over distances of over about 20 miles without "help". this "help" can come in a multitude of ways, and is somewhat dependent on the height of the transmitter and receiver, the gain of their respective antennae, the frequency of transmission, the weather and other atmospheric conditions, the sun cycle, hams around you erecting things called repeaters, and a few dozen other things. Nevertheless, the key point here is that the further you are away from each other, the more likely it is that the curvature of the

earth is going to be the limiting factor. Always remember that without "help", radio communications are "line of sight".

HF, or high frequency (roughly defined as everything below about 30MHz [10 meters wavelength]) signals can bounce off of a charged belt (called the ionosphere) which completely envelopes the earth. HF thus can communicate over long distances by using one or more "bounces" -- you may have heard the CB term "skip". With just a few dozen watts, and a proper antenna, it's possible for you to talk (or more likely communicate using mores) with a station 2000 miles away. Interestingly, it is sometimes difficult to talk to nearby stations that are "under the skip", that is they are too close to you to hear the reflected wave. One primary disadvantage of HF communications is that the antenna has to be physically long. Nevertheless, HF can be a valuable asset in emergency communications -- like it was during hurricane Katrina when everything else was tits up. In general, when you think of HF you should think of long distance comms. With some exceptions, most HF rigs are designed for desktop use and the supporting equipment (power supplies, antenna tuner, etc) is heavy and not so portable. But there is a class of mobile and low power HF rigs which allow you to talk over great distances with just a few pounds of equipment. …

… the primary limitation of VHF/UHF is the short range imposed by the curvature of the earth combined with the fact that VHF/UHF signals do not bounce off of the ionosphere (in case you were wondering, they pass right through it). Of course it helps greatly with VHF/UHF to be up as high as possible, as this gives more "line of sight" distance -- the same way you can see much farther when atop a tall building. But that's not always practical. e.g., I live right at sea level -- no kidding. How can I, the low lying ham, communicate with any distance using VHF or UHF? Am I stuck trying to use HF for comms more than a few miles?

Enter the "repeater". Simply put, a repeater is an unattended radio advantageously located on a hill or with the antenna high up on a tower. The purpose of the repeater is to retransmit your signal in real time. It does this by listening on one frequency, called the input, and simultaneously transmitting the input audio on a second frequency, called the output. Accordingly, my radio would be set to transmit on the repeater's input frequency, and listen on the repeater's output frequency. (The difference is known as the "offset".) All that is required from a radio implementation standpoint is a little bit of frequency agility -- when you press the transmit button, your radio tunes it's transmitter to the required new frequency. When you unkey, it changes back. All this happens in milliseconds and without your involvement save for some initial settings. The beauty of this set up is that with a low power HT (typ, 0.5W to 5W) you can talk for perhaps hundreds of miles! The repeater provides the "help" for VHF and UHF, just like the ionosphere provided the "help" for HF.

There are 3 basic ham licenses and one sort of sub group (at this time). There is Technician, General and Extra. The sub group is this: if you have passed the 5 word per minute Morse code test, then as a Technician, you have some limited access to the HF bands.

A technician license allows the operator to use any UHF or VHF frequency with any mode.

A general licensee is allowed to use almost all of the HF bands (all modes) as well as all of the UHF and VHF. Some small sections of each HF band are reserved for extra and advanced licensees.

An extra class license allows the full use of all amateur bands with all modes.

For the actual US code regulations that govern amateur radio, see http://www.access.gpo.gov/nara/cfr/waisidx_05/47cfr97_05.html which lists '**PART 97--AMATEUR RADIO SERVICE'.**

What are these modes?

Modes are basically the way we modify a signal to carry information. The most common modes that everyone knows about are AM (amplitude modulation) and FM (frequency modulation). Others common modes include SSB, CW, and digital.

SSB is a method of amplitude modulation (AM) where the carrier wave and one of the side bands (there are 2 – upper and lower) is suppressed. This means that the signal you are sending out takes up smaller bandwidth and has higher power (relatively) than a traditional AM signal.

CW is short for continuous wave or the method for sending Morse code. This is the traditional method of communication with a very small bandwidth and is useful when communications conditions are poor.

Digital modes are various and include RTTY (radio teletype), PSK31, PSK63, Hellschreiber, packet modes, sstv, fstv and many others. There are new digital modes being invented everyday. In general these are text based modes that use some sort of computer interface to a radio. This is **not** at all internet based. It is simply a computer interfacing with a radio to send a signal. SSTV and FSTV are video modes with allow the transmission of pictures. There is also D-STAR which is a new digital mode based on the Japanese protocal. It is designed for simplex and repeater use on 2m, 70cm, 1.2 GHz.

There is also a hybrid mode of communication which does interface with the internet. The main types are IRLP, echolink and Wires. These are simply interfaces that allow radio users to send their signals to other users, radios or repeaters in other parts of the world. However, this relies on an internet connection and should not be relied on in emergency situations.

What sort of equipment is available? (just a small sampling)

HT (handi-talkies/handheld transceivers) – available for VHF/UHF, single band/dual band/triband/quad band. Transmit powers range from 300milliwatts (.3 watts) to 6 watts in general. Pros - Extremely portable, light weight, low power consumption, available with extremely wide receive frequencies (to pick up broadcast, shortwave, public service, aircraft and other services). Cons – relatively low transmit power with respect to other types of equipment. Stock rubber duck antennas are generally very poor radiators.

Mobile/Portable rigs – These can be used in an automobile, out in the field or in a backpack or on a bench as a base station. They are smaller an lighter than dedicated base stations, but are usually more suited for emergency communications because they may be more robust and easier to transport in different disaster situations. They may be low power (QRP) with only 5, 10 or 20 watts or up to about 100 watts full power. These are mainly available for HF, HF+ VHF/UHF, VHF only, UHF only or VHF/UHF.

Base stations – These typically have the most features of all radios including digital processing, filters to improve signals as well as other enhancements. Power on these rigs may go up to about 250 watts without the use of an external amplifier. These are mainly available for HF, or HF+ VHF/UHF.

Antenna – Basically the most important part of the radio system is the antenna. Without a good antenna system, your transmitter is just going to heat up the 'antenna' like a resistor.

Antenna length, is inversely proportional to the frequency being transmitted:

CB= 27 MHz
MURS= 151 MHz
GMRS= 462 MHz

So the CB antenna will be longest and the GMRS will be the shortest.

Antennas can come in almost any form and with a good antenna tuner, almost anything can be made to radiate (including a barbed wire fence or your aluminum house gutters). Some of the basic forms are wire dipoles,verticals and beams. Antennas are usually defined by the wavelength at which the antenna is designed to operate. The most basic is a ½ wavelength dipole fed with ladderline or coax at the center. If it is mounted low to the ground it is good for NVIS. Up higher at ¼ wavelength up, then better for DX (distance comms). Another basic form is a ¼ wavelength vertical. This is basically ½ of a ½ wave dipole. It is fed at the end and relies on a reflection from a ground plane or grounding radials. An ht antenna is sometimes a ¼ wave vertical without a good ground plane. Beams are directional antennas which allow the main power from the antenna to be directed in one directions. This lowers the amount of noise coming from other directions and increases the power toward your intended target. Beams can be in the form of a Yagi or a quad or several other types. A promising option (that I haven't tried) for emergency comms is a 'hamstick dipole'. See:
http://www.varaces.org/techrefs/HamstickDipoleFactSheet.pdf

Antenna tuners – these are devices that allow antennas that are not designed for a specified frequency to operate on that frequency. There are automatic and manual and they work by matching the impedance (by altering the capacitance and inductance) of the antenna and feedline to the transceiver.

Repeaters – not something that most hams will 'buy' or build, but may help pay for the upkeep and use of the repeaters. Most are open to use by any licensed ham with priority given to any emergency traffic. Most repeaters are owned and maintained by local ham clubs.

> Jim- the disadvantage of repeaters is simple: in order for the repeater to work, you need power and the antenna has to be upright. These are not likely conditions in areas overcome by, for example, a category 4 or 5 hurricane. while tons of lead acid batteries may delay the inevitable, there is a finite amount of no-AC-power operation time for any repeater unless expensive measures have been taken (e.g. a diesel genset and good sized fuel tank, as you would find mounted behind a police station). Nevertheless, hams are resourceful people and generally fixing the repeaters is an immediate priority in disaster areas. Moreover, all the equipment necessary for a repeater can be carried in the back of a Tacoma, with room to spare. So if a makeshift antenna can be erected on the mountainside, a substitute repeater can be up and running in a few hours to replace the one crushed by the flying oak tree.
>
> One way to look at a ham repeater is as an analog of a cell site. Having many cell sites make it possible for your low power cell phone to communicate anywhere the global phone network reaches. Similarly, hams link repeaters using point-to-point RF, the phone network, or these days using the internet. all of these methods allow greater "reach" from your low power HT. with the exception of point-to-point RF, the other methods require public infrastructure that may or may not be available when the SHTF.

Where do I get specific information about equipment?

Go to http://www.eham.net/reviews/ (ham as well as some commercial) and look there for reviews.
For details on the specifications of each rig, you can go to the manufacturers' websites. The 4 main UHF/VHF ham equipment manufacturers are Alinco, Icom, Kenwood and Yaesu. For HF, there are also many other manufacturers including Tentec, Elecraft, Hallicrafters, Heath, Drake, SGC and others. For commercial, some of the above as well as Motorola and Uniden.

For pictures and other information, you can try: http://www.rigpix.com/

What about power off the grid?

Most modern rigs run off of 12v dc power (13.8v really). So these can be run off of car batteries, gel cells, or ac-dc power supplies. The bigger rigs (mobile or base stations) should have a power supply that gives 20-25 amps continuous current. You could also run off of a generator, but this would also generally require an ac-dc power supply as well. You should have a way to recharge these batteries, so in a real outage situation, you need to be able to get access to 1) a generator, 2) a larger battery or 3) a solar or other charging supply. If you anticipate running off of batteries for an extended amount of time, you should consider using an ht to do most of your monitoring since they consume the least amount of power. See here for more:
http://losdos.dyndns.org:8080/public/ham/RACES-box.html

5, 7, 12 amp-hour sealed lead acid batteries are available at many sources, through the internet or computer electronics stores. At one time radio shack carried them, but I am not sure about their current stocking situation.

Whether I decide to get or not get my license what are my other options?

GMRS, MURS, FRS, Marine band, cell phones, internet, satellite phones.

GMRS requires a $80 license that covers you and all your extended family. It is a set of channelized frequencies in the UHF band utilizing FM, a few hertz above the UHF 440 band. There are GMRS repeater systems, but these are usually private and do no allow public access. They are allowed up to 50 watts and detachable antennae; however these are not common in consumer products. The type of radios you can get at a department or electronics store is typically in the 1-4 watt range with fixed antennas in the form of HT's. Commercial mobile and base stations are available at greater cost.

One issue to consider with GMRS is that it *will* be heavily congested during emergency situations since they are cheap and easy to get and licensing is some/many people don't even bother with. (I advocate getting your gmrs license if you have the radios as it covers the whole family and there is no testing involved.)

Name	Lower Frequency (MHz)	Upper Frequency	Motorola convention
"550"	462.550	467.550	ch 15
"575"	462.575	467.575	ch 16
"600"	462.600	467.600	ch 17
"625"	462.625	467.625	ch 18
"650"	462.650	467.650	ch 19
"675"	462.675	467.675	ch 20
"700"	462.700	467.700	ch 21
"725"	462.725	467.725	ch 22

This second set of frequencies shows the interstitial ranges shared with the FRS. These frequencies can only be used for simplex operations.

Name	Frequency (MHz)	Motorola convention
"5625" or "FRS 1"	462.5625	ch 1
"5875" or "FRS 2"	462.5875	ch 2
"6125" or "FRS 3"	462.6125	ch 3
"6375" or "FRS 4"	462.6375	ch 4
"6625" or "FRS 5"	462.6625	ch 5
"6875" or "FRS 6"	462.6875	ch 6
"7125" or "FRS 7"	462.7125	ch 7

FRS is a UHF citizens band (CB). No license is required. It is in the same range as the GMRS frequencies. FRS radios are limited to 500mW (.5 watts) and cannot have detachable antennae. Repeaters are not available.

Channel No.	(MHz)
1	462.5625
2	462.5875
3	462.6125
4	462.6375
5	462.6625
6	462.6875
7	462.7125
8	467.5625
9	467.5875
10	467.6125
11	467.6375
12	467.6625
13	467.6875
14	467.7125

Multi Use Radio Service (MURS) is VHF CB. No license required. There are 5 MURS channels a few hertz above the 144 ham band. Power is limited to 2 watts, but types or gain on antennas are not restricted. Repeater systems are prohibited, and antennas are restricted to 20 feet above the structure or 60 above ground (whichever is greater).

One note to consider is that at the moment, MURS is not a heavily used band. So if you are looking to be able to use the radios with minimal interference, that is a benefit. It also means that if you are trying to reach out to someone for help, there will be less of a chance of anyone being able to respond to you. The frequencies are listed:

151.820 MHz
151.880 MHz
151.940 MHz
154.570 MHz
154.600 MHz

Marine band radios are similar to ham vhf radios. However, (from the FCC) *to operate on land, you must have a special license, called a marine utility station license, to operate a hand-held marine radio from land -- a ship station license IS NOT sufficient. You may apply for this license by filing FCC Form 601 with the FCC. To be eligible for a marine utility station license, you must generally provide some sort of service to ships or have control over a bridge or waterway. Additionally, you must show a need to communicate using hand-held portable equipment from both a ship and from coast locations. Each unit must be capable of operation while being hand-carried by an individual. The station operates under the rules applicable to ship stations when the unit is aboard a ship, and under the rules applicable to private coast stations when the unit is on land.*

Citizens Band (CB) old standby. Popularity and use seems to have fallen to a degree, however there are probably plenty of people still using this band. Power limit is 4w (12w SSB), but you can use external antennae. 27MHz band or 11meter.

Channel	Frequency	Channel	Frequency
Channel 01	26.965 MHz	Channel 21	27.215 MHz
Channel 02	26.975 MHz	Channel 22	27.225 MHz
Channel 03	26.985 MHz	Channel 23	27.255 MHz
Channel 04	27.005 MHz	Channel 24	27.235 MHz
Channel 05	27.015 MHz	Channel 25	27.245 MHz
Channel 06	27.025 MHz	Channel 26	27.265 MHz
Channel 07	27.035 MHz	Channel 27	27.275 MHz
Channel 08	27.055 MHz	Channel 28	27.285 MHz
Channel 09	27.065 MHz *(emergency channel)*	Channel 29	27.295 MHz
Channel 10	27.075 MHz	Channel 30	27.305 MHz
Channel 11	27.085 MHz	Channel 31	27.315 MHz
Channel 12	27.105 MHz	Channel 32	27.325 MHz
Channel 13	27.115 MHz	Channel 33	27.335 MHz
Channel 14	27.125 MHz	Channel 34	27.345 MHz
Channel 15	27.135 MHz	Channel 35	27.355 MHz
Channel 16	27.155 MHz	Channel 36	27.365 MHz
Channel 17	27.165 MHz	Channel 37	27.375 MHz
Channel 18	27.175 MHz	Channel 38	27.385 MHz *(lsb, national calling frequency)*
Channel 19	27.185 MHz *(unofficial trucker's channel)*	Channel 39	27.395 MHz
Channel 20	27.205 MHz	Channel 40	27.405 MHz

Cell phones and Internet. We all know about those. Good during normal times. Possibly unreliable during emergencies.

> Cell and Landlines (AR-Jedi): (why is ham better than cell phones?) for two reasons:
>
> 1) the POTS (plain old telephone service) phone network is designed around a premise of about 0.16 erlangs, or 6 century call seconds (CCS). this is equivalent to about a 16% "occupancy rate" of the network. not all interLATA nor CO-to-CO trunks can accept this high of a rate however. once these occupancy rates are exceeded, you will just get a "fast busy" tone or a "your call can not be completed" message. in telecommunications circles, this is known as "oversubscription" -- that is, you have more customers than capacity. it is perfectly ok, as not everyone is on the phone at the same time. and if you build your network for 100% of your subscribers, you will be out of money. but when there is huge calling demand, there will be some problems.
>
> 2) the various cellular systems are even more oversubscribed; they are designed around a peak occupancy rate of about 5% (2 CCS). note that there is no "standard" number for this; in downtown NYC, a cell network may be engineered for a much higher occupancy; whereas in a farmland area, it will be engineered for a lower occupancy. this is simple economics for the service provider -- more subscriber capacity means more equipment (towers, sector antennas, base station switches, call handoff computers, etc) and more backhaul bandwidth. this translates to increased initial capital and also higher recurring costs (electricity, land/tower leases, etc). from an economic standpoint, the service provider puts "just enough" equipment in place for normal everyday traffic. but when the SHTF, the cell networks are quickly overburdened.

> as alluded to in the post above, this is why the cell (and POTS) networks sag during "events". and indeed, here in northern NJ, the phone networks were all but useless for about 24 hours post 9/11. between the massive calling volume and the loss of a major NYC central office, the networks were simply overwhelmed. it was a peak traffic profile that was never engineered for; sort of like putting double the weight onto a container ship and then wondering why it sank.

Satellite phones. High initial cost and high monthly service cost. But can be a good alternative if you have the resources.

TV audio receive:

Channel	MHz	Channel	MHz
2	59.75	36	607.75
3	65.75	37	613.75
4	71.75	38	619.75
5	81.75	39	625.75
6	87.75	40	631.75
7	179.75	41	637.75
8	185.75	42	643.75
9	191.75	43	649.75
10	197.75	44	655.75
11	203.75	45	661.75
12	209.75	46	667.75
13	215.75	47	673.75
14	475.75	48	679.75
15	481.75	49	685.75
16	487.75	50	691.75
17	493.75	51	697.75
18	499.75	52	703.75
19	505.75	53	709.75
20	511.75	54	715.75
21	517.75	55	721.75
22	523.75	56	727.75
23	529.75	57	733.75
24	535.75	58	739.75
25	541.75	59	745.75
26	547.75	60	751.75
27	553.75	61	757.75
28	559.75	62	763.75
29	565.75	63	769.75
30	571.75	64	775.75
31	577.75	65	781.75
32	583.75	66	787.75
33	589.75	67	793.75
34	595.75	68	799.75
35	601.75	69	805.75

Other:

What frequencies should I be listening to?

If you have a scanner or other wideband receive radio, you can program frequencies to be saved. You can certainly program the frs, gmrs, murs and cb frequencies in to monitor them if the radio is capable. However, there are other channels/sources to listen to.

First off, go here or someplace similar:
http://www.radioreference.com/modules.php?name=RR

This is a user maintained database with as many public frequencies as commonly known. It gives the frequencies for police, fire, municipal, county and state agencies. It also lists the type of radio system they use. Program in any that you think might be useful now or for the future. Many modern radios now have several hundred memory slots, so you should be able to get plenty in.

Note: many municipalities, especially the larger ones have or are going to 'trunked' or digital radio systems. This means that the frequency or channel that a specific group is using may jump to another frequency or channel. This is done to make the use of frequencies by a city or agency more efficient. However listening on a simple ham radio is a bit difficult to monitor this. If the system is trunked, and you can find out the list of frequencies that an agency uses, you can still monitor their transmissions, however in some cases, the conversation will switch to another channel. Usually as a listener, you can

get the gist of the conversation just by the few seconds that are available. This is not ideal, but it can work. Another option is to listen to the neighboring safety frequencies such as smaller municipalities or county sheriff's. Also, you may be able to find out the interdepartmental 'aid' frequency that allows different departments/cities to talk to each other and call for assistance.

Second, go here or someplace similar:
http://www.artscipub.com/repeaters/

This is a relatively good list of ham repeaters across the US. Even if you are only listening or not even a ham, listening to ham operators will probably keep you well informed during times of emergency. Pay particular attention to any repeaters that are listed as OEM (office of emergency management), EMA (emergency management agency), ARES (amateur radio emergency service), or RACES (radio amateur civil emergency service) affiliated.

Below are some somewhat standardized alphabets in use by emergency services.

	Law Enforcement				NATO/Military/International		
A	Adam	N	Nora	A	Alpha	N	November
B	Boy	O	Ocean	B	Bravo	O	Oscar
C	Charles	P	Paul	C	Charlie	P	Papa
D	David	Q	Queen	D	Delta	Q	Quebec
E	Edward	R	Robert	E	Echo	R	Romeo
F	Frank	S	Sam	F	Foxtrot	S	Sierra
G	George	T	Tom	G	Golf	T	Tango
H	Henry	U	Union	H	Hotel	U	Uniform
I	Ida	V	Victor	I	India	V	Victor
J	John	W	William	J	Juliet	W	Whiskey
K	King	X	X-ray	K	Kilo	X	X-ray
L	Lincoln	Y	Young	L	Lima	Y	Yankee
M	Mary	Z	Zebra	M	Mike	Z	Zulu

Applications and Case Studies:

CASE 1 - bluduk15 -Okay, I've read through most of this thread and still have a few newbie questions. I have two Icom F-21GM radios that are FRS/GRMS. I actually even paid the fee and got the requisite FCC GMRS license (probably the only one in the country to do so).

Anyway, these radios are great with an upgraded whip and other features, but they just don't have the range I need. I have some property in W. Texas that is mainly canyonland and need at least 5-10 mile range capability. The terrain has low foliage, but does have some canyon lands.

Can I use a mobile as a repeater on GMRS or do I need to get a ticket and upgrade to 2m? Would a Yaesu FX 170 give me the range I need, even in canyons from HT to HT? What setup would you suggest?

Thanks in advance.

GlockTiger-Jedi was right when he said lots of options with ham. A very easy route -- don't fear the licensing. As you can see arfcommers are popping up with new ham licenses every day!

He's right about a crossband repeater. All you need is one radio in about the $400 range and the ability

to read an owners manual to program it. You can slap a commercial dual band antenna on your windmill and leave her there with coax already run, so when you get to the location you just set up your radio and power source and you have an instant repeater for your HT's.

Here are some example figures (all new gear):
Yaesu FT-8800 dual band mobile w/ cross band repeat $370
Power Supply $100 or 12v deep cycle/agm/gel cell battery $50-100
Dual band base antenna -- $80-200
Feed line (coax) -- $.50/ft
Yaesu FT-60R dual band HT's $189 ea.

That said, I'd recommend you use mobiles in lieu of handhelds. You can always get HT's later, but might as well start with the extra power of mobile-mobile. Then as long as the terrain between you isn't hellacious, 8-10 miles will work just fine without a repeater.

You could buy an x-band capable mobile for each vehicle if you want, then you get HT's down the road and let the vehicle radio x-band repeat for you while you're away from the vehicle. Then you don't have to ever set up a base station repeater.

Application 1: Cross band repeating

In many circumstances, using an HT is the handiest way to go, but also has the least amount of power to get your signal out. One option is to use cross band repeating. Cross band repeating is in essence a way to amplify your signal using a more powerful transciever. Typically it is done to reach a repeater that cannot be accessed by your radio from your current position.

The typical way this is setup is to use an HT in conjuction with a dual band Mobile (which may be in an automobile). The user communicates from the HT to the Mobile (cross band repeater) to a distant main repeater. The HT transmits on channel uhf-a, the Mobile unit receives on uhf-a and retransmits simultaneously on vhf-a. The base repeater then recieves on vhf-a and simultaneously retransmits on vhf-b. Finally, for the user with the HT to receive, there are 2 options. 1)HT receives the signal directly from the base repeater on vhf-b or 2) the mobile receives vhf-b and retransmits simultaneously on uhf-b and the ht receives on on uhf-b. This second option is much harder on the mobile and will increase the ‘wear and tear’ on the equipment. There is also some debate as to whether 2) is entirely legal.

In this way, if you are inside a building or blocked by topography, you may be able to communicate with the main ‘base’ repeater.

Application 2: Encryption

Encryption on the amateur bands is strictly prohibited. There are some radio services that do allow encryption, but not on the ham bands. However, there are legal ways to limit the amount of people that will understand your transmissions when using ham frequencies. These all require that there be an openly published protocal for the mode you are using.

For example text messaging, you can send a text message over the ham bands. If you interface a computer to your radio, you can send text messages either live or with packets and someone listening in would not understand the message unless they were running the same type of software to translate the data. (see digital modes on page 6)

There is also morse code. While there are still many people who use it and many others learning, it does exclude those who do not know the code.

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