Crisis Communications

Just about any self-reliant, outdoors/wilderness, homesteading, Prepper or survivalist person should have emergency communications on their list of things to gain knowledge, goods and skills on. This is a very important aspect of preparedness and one well worth discussing.

Selecting the kind of crisis communications you need appears to be an easy task at first glance. However if your crisis plan is complete, you will quickly realize that there are many factors that are involved in determining your communication needs.

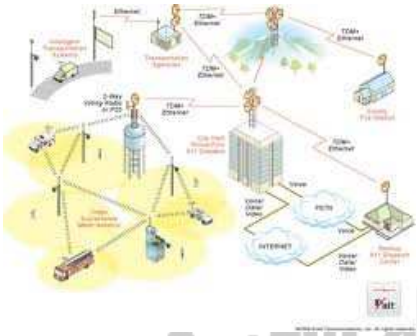


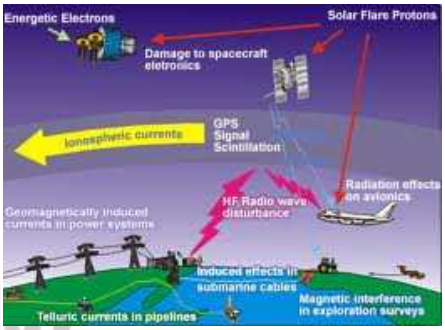
On top of this one must remember that **when selecting electronic equipment for use during emergencies that can last several weeks without electrical power, there are features an emergency radio should have that may not be realized when electrical power is available from the nearest wall outlet – AND - Nothing is 100% reliable ALL of the time!**



"Bad human communication leaves us less room to grow."
Rowan D. Williams

Another important thing to remember is that radio communication is way different than your landline or cell phone; not only in the technology used, but in the general communication indulged. IE: **Radio communications are *not* for** just saying hello and discussing your new toy, gadget, recipe or latest gossip. **They are for *minimal* communications,** usually to inform another of location and or needed directions/instructions concerning the issue/crisis at hand.





As part of your preparedness plan determine what your crisis communication needs are by evaluating the questions below and then the pro's and con's of the various crisis communication methods discussed in this document.

- **Will you need 2-way communications or just listening for information?** If you need 2-way communications ask yourself the following:

  - **What is your commitment in time and money** to not only acquire the communication system you need, but also the tenacity to learn any new knowledge, skills or licensing necessary to utilize the equipment?

  - **What type of environment will you be communicating in?**

    - Urban, rural, hilly, mountainous, flat, open water, local, cross country, etc?

      - Most radios are "line of sight" meaning that the single needs clear passage between the transmitter and the receiver. Concrete buildings or bridges, metal structures, hills, mountains, tunnels, caves and the like will absorb the transmission signal reducing the distance the signal travels.

    - The antenna will be the most important 'distance' factor after terrain.


- **Make a list of the people you want to stay in touch with during an emergency.** This will undoubtedly include family members, business associates, church friends and neighbors.
  - Where are these people located in relation to where you are located? Same town, different state, etc?
  - What is the terrain where they are located? (Urban, rural, hilly, mountainous, flat, open water, local, cross country, etc?)
  - What crisis communication equipment and knowledge do *they* have?
  - What repeaters or relays are between you and who you want to communicate with?
- **Determine what it would take to stay in touch with each person** (this includes their environment too).
  - For example, to stay in touch with my relatives who live in another part of the country will require an Amateur Radio, along with relay or repeater stations. To communicate with my fellow self-reliant homesteading friends, who are scattered over a wide geographic area, may also require the same. However, I can use either CB, FRS or GMRS radio to talk to the neighbors and friends who live in my subdivision and city.
- **Consider your resources.** Make sure that you attend to first things first. As important as staying in touch may be, it's not as important as food, water, and shelter. Make sure you take care of those things first, before you blow a bunch of money on high-tech communication gadgets.
  - If you have less that $100 to spend and need one-way communication, get a simple AM/FM/NOAA radio that will run on solar power or via a hand-crank mechanism to keep you "in the know" of what is going on around you.
  - If you need two-way communications and have a couple of hundred dollars, you can add a CB or FRS radio.
  - If you have a bit more to spend on 2-way communications you can go Amateur (HAM), GMRS or MURS.
- **Get a commitment from the people you want to talk to.** It won't do you any good to buy a radio if the people you want to talk to don't have one. Go figure.
  - This is why buying a radio is often a group decision. It's also helps if you are using similar equipment so you can help one another when there are problems.
- **Develop a communications plan as part of your preparedness plan.**

- How often do you want to talk to the people in your network?
- What are your procedures and protocols? Any "codes" that mean important things particular to your group?
- These are things you need to figure out together, long before you are in the middle of a crisis.

- **When you first start out Keep It Simple** – get a good set-up that is upgradable and expandable. You can always add to it as monies, time and experience call for it.
- **Run periodic test drills. Take a page from the military: practice, practice, practice.**

You want a system you can depend on in an emergency. The only way to do this is by getting comfortable with it ***before*** you need it. **Just purchasing a radio and then storing it in your closet to pull out and unpack during a crisis will NOT cut the cake!**

If you are new to preparedness communications and need 2-way communication abilities these three rules are first and foremost, when considering preparedness communications. ***DO NOT put this off for later.***

1. It takes someone listening for communications to work and the best radios in the world are useless if no one hears you call for help.

2. Establishing or connecting to a radio net of listeners, making sure that someone is out there listening for you, is VITAL and cannot be bypassed.

3. It's impractical for most people to listen to radios continuously, so having a schedule for stations on your "net" to listen makes radio communication practical. Either use a published schedule, or a regular interval (every day at 7pm, for example) for the net to come on-line.

Bottom Line: Form this "radio net" **NOW**; set a non-SHTF schedule for regular practice. If you live rural you may want some kind of weekly or monthly "check in" communication scheduled.

When I evaluated all these questions I discovered that:

- I have family and friends scattered not only locally, but nationally too.
- There are various buildings, mountains and other obstacles to overcome between me and the people I will want to communicate with - both locally and nationally.
- I have minimum to average funds and time to devote to equipment and learning.
- I have some previous "radio" experience through C.E.R.T., the Red Cross and CB REACT.; yet I know relatively little about the current technology for civilian 2-way radio communications.
- I need a system that will not only work for me in my current urban environment; I need it to work in my near future rural environment too.

- My family and friends currently have several existing radio services. Some are HAM, some GMRS and a few are CB.
- Whatever system I choose it has to be compatible with my existing group/network of "radio listeners"; whom I currently keep in touch with via a neighbor or my existing CB.

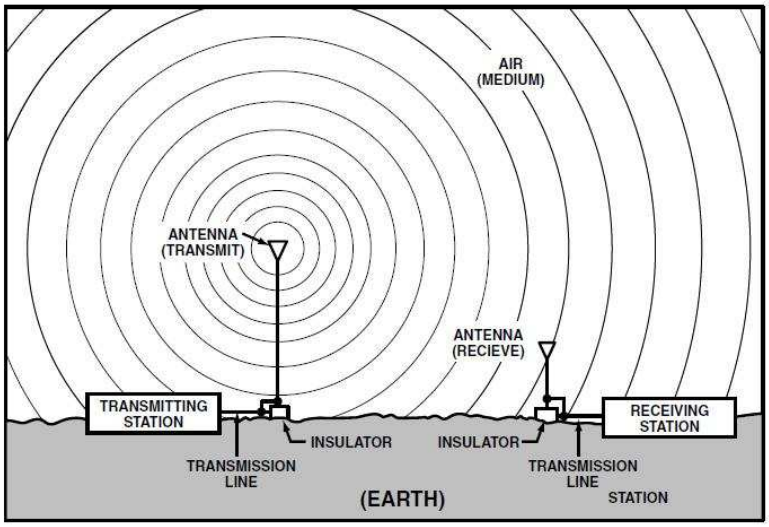
This means that for my specific situation I need an Amateur Radio System and if I can afford it, for the rest of my in town friends, some kind of shorter range FRS, GMRS, CB or more learning to modify the HAM to receive and transmit on these other frequencies – which by the way is currently illegal in the U.S.A. due to FCC regulations.




All righty then, before we review the various radio communication methods let's go over some terms you are likely to hear.

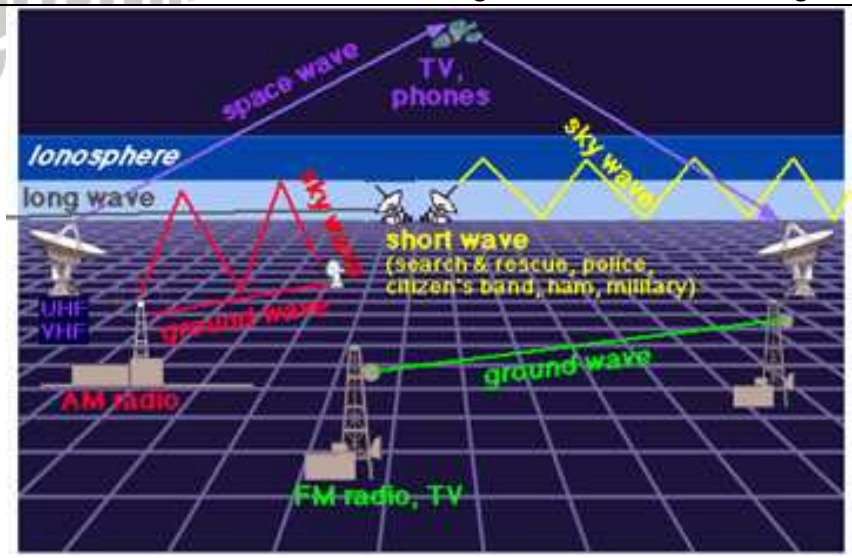
For those of you that like things a bit more technical, there are links in these 'definitions' and at the end of this document I listed all the resources, so you can go straight to the "horse's mouth" for detailed information. Also, please be aware that ***I am NOT an expert*** (far from it); I too am still learning about this, so much so that it took me three tries to get my HAM Tech license (ohm's just about killed me).

Basic Radio Communication Terminology:

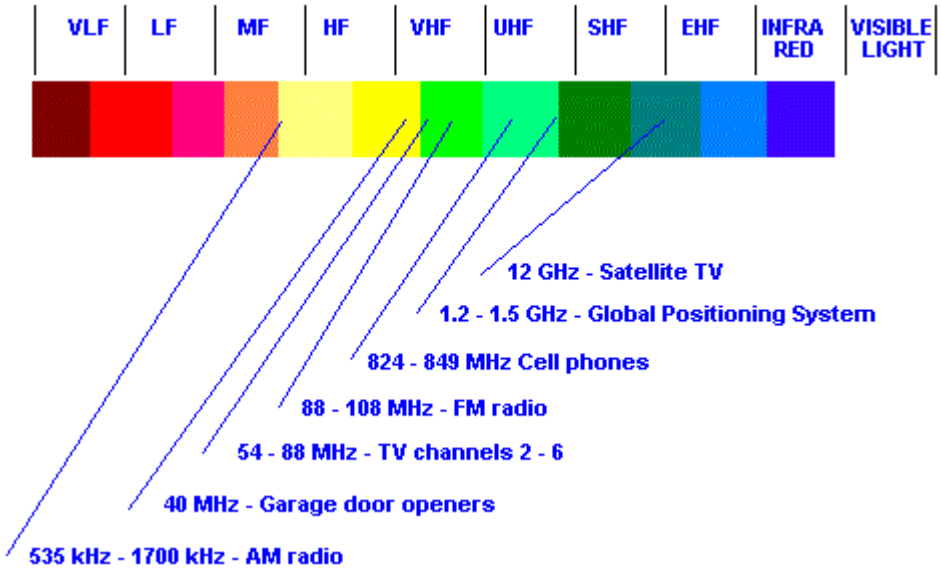
Radio	Radio is a technology that uses electromagnetic waves to convey information. Radio communication requires both a transmitting station (with a transmitter) and a receiving station (with a receiver). Because the nature of radio is electrical a radio station requires electrical power to work.
	Figure 4 – Electromagnetic Signal Radiation. 
Frequency	Is the number of occurrences of a repeating event per unit time. It is also referred

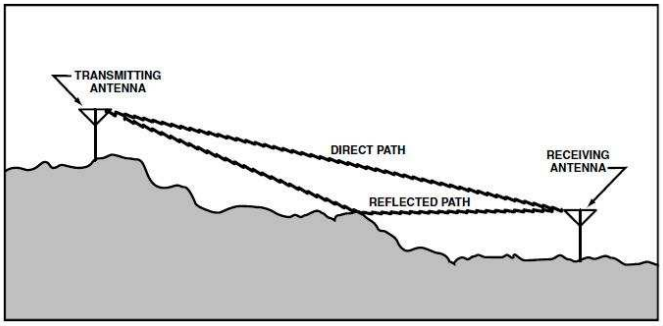
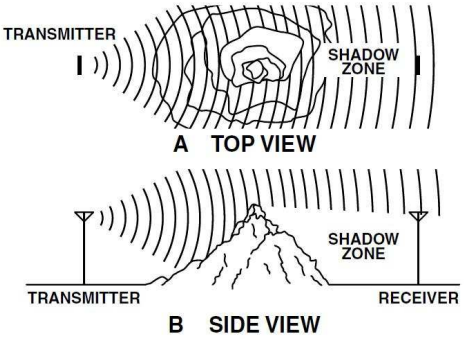
to as **temporal frequency**. The **period** is the duration of one cycle in a repeating event, so the period is the reciprocal of the frequency. Loosely speaking, 1 year is the period of the Earth's orbit around the Sun, and the Earth's rotation on its axis has a frequency of 1 rotation per day.

Waves, such as sound waves or light waves, can be oscillations, and therefore they may have a frequency. The frequency of an oscillating sound wave helps determine its pitch, while the frequency of a light wave helps determine its color.
Radio waves are non-ionizing radiation. The frequency of the radio waves differs for different applications:
1. Radio for audio: Amplitude modulation is used to transmit audio signals from one place to another through air or vacuum. There is a transmitter for transmitting signals and a receiver at receiving end to absorb signals.
2. Telephony: the cell phone communication uses radio signals. Earlier phones used frequency modulation; however some of the recent technologies are digital modulation of radio waves.
3. Video: the television signals are transmitted as radio signals. These signals are sent with amplitude modulation for video and FM or AM for sound. The frequency of video radio waves is 4.5 MHz
4. Navigation: satellite navigation systems use radio signals to communicate. A satellite transmits the signals and based on the position of the satellite and the tangential line around each satellite, the computer that receives the signal calculates and determines the position.
5. Heating: radio frequencies are used to generate heat inside generatingequipment. Microwave ovens use radio waves for heating food. Surgery equipment diathermy uses radio frequency for sealing blood vessels. Several induction furnace use radio waves for melting metals.
6. Amateur Radio: this radio offers several frequencies for amateurs who are licensed to communicate.
7. Radar for radio detection and ranging uses radio waves for detecting objects at a distance
8. The recent addition is the radio signals for transmission of digital data.

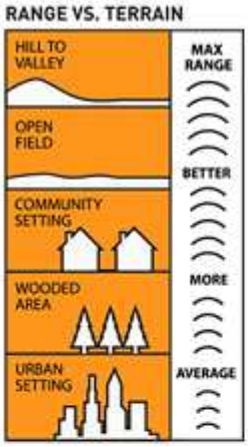


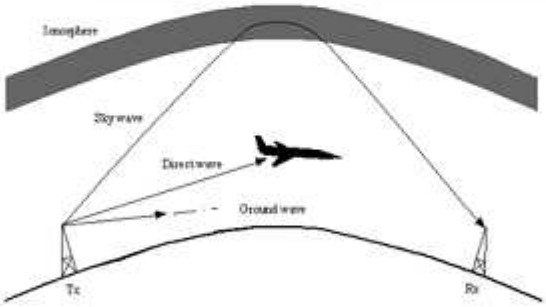
Various types (frequencies) of radio waves are used for communications.

Radio Frequency (RF)	Is a rate of oscillation in the range of about 3 kHz to 300 GHz, which corresponds to the frequency of radio waves, and the alternating currents which carry radio signals. RF usually refers to electrical rather than mechanical oscillations, although mechanical RF systems do exist.
Radio Spectrum	Electromagnetic waves vary in frequency from zero to infinity. This is the electromagnetic spectrum and the frequency is measured in Hertz (cycles per second). According to the FCC the range of this spectrum used for radio is from 9 Kilohertz (KHz) to 300 Gigahertz (GHz). However, most of the radio used for emergency communications will be in the Megahertz (MHz) range.
	
Two-way radio – Very High Frequency (VHF) and Ultra High Frequency (UHF)	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.
High Frequency (HF)	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. 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.
Bandwidth	Range of frequencies over which important performance parameters are acceptable. The bandwidth is expressed as three digits and a letter that occupies the position normally used for a decimal point. The letter indicates what unit of frequency is used to express the bandwidth. H indicates hertz, K indicates kilohertz, M indicates megahertz, and G indicates gigahertz. For instance, "500H" means 500 Hz, and "2M50" means 2.5 MHz.
Band	A band is simply a frequency range where stations are located. Think of listening to AM or FM radio. The AM band is the frequency range stretching from 530 to 1710 kilohertz; the FM band is 88 to 108 megahertz.
Modulation	Modulation is how radio waves convey information. If communication is by Morse code the modulation is called CW or 'center wave' modulation. However, voice communication is the method most likely to be used in an emergency. Voice is conveyed using one of several different types of modulation: 'amplitude modulation', or AM; 'frequency modulation' or FM; 'digital modulation' and its use for voice is currently limited to cell-phones, cordless phones and some commercial and military two-way radio systems.
RFI – Radio Frequency Interference	Is also called as **Electromagnetic interference (EMI)**. It is defined as a disturbance that arises in an electrical circuit either by an electromagnetic conduction or radiation released from any of the external source. The effective performance of the electrical circuit is limited or degraded by the disturbance in form of interruption or blockage. The source could be any could be of any thing; it can be an artificial object or natural one that carries quickly varying electrical currents. Examples are electrical circuit, the sun or the northern light. RFI, though to a minimum extent, can affect AM and FM radio, cell phone and television reception. It can be deliberately used for radio jamming in form of electronic warfare and can be accidentally used as a consequence of spurious emissions through intermodulation products.
	Figure 5 – Signal Paths.  Figure 6 – Terrain Blocking. 
Range	The range of any radio signal depends on many factors. For both receiving and transmitting stations the most important factors are the frequency of operation, the type and directionality of the antenna and the height of the antenna above the ground. Common terrain factors:

- Topography (hills, deep canyons, ridgelines, tall formations)
- Weather (such as thick clouds)
- Electromagnetic interference (lightning)
- Obstructions (dense forest, structures)
- Large metal surfaces (inside a vehicle, range is usually less than 1 mile)
- The human body (which is dense and watery) can also block radio waves. You may boost reception of incoming signals if you attach a radio to a section of your pack that remains away from your body instead of clipping it to your belt.





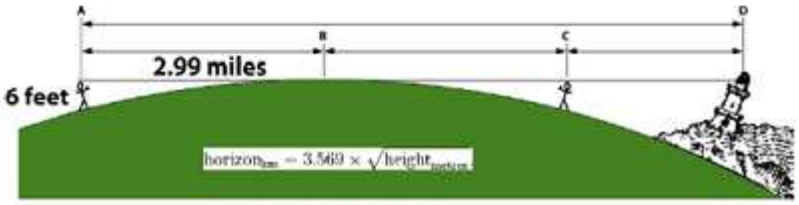
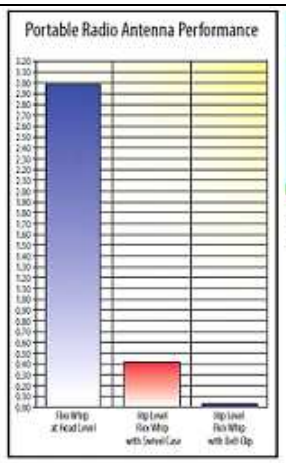
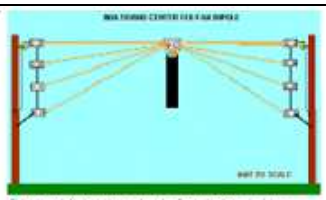
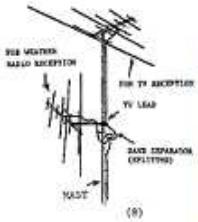


Figure 1

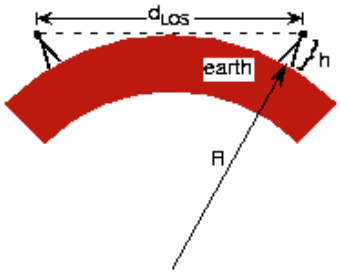
Antenna	Both the transmitting station and receiving station must have an antenna; the transmitting antenna converts electrical signals into electromagnetic waves and the receiving antenna converts electromagnetic waves back into electrical signals. In most cases the same antenna can be used for both transmitting and receiving and can be directional or Omni-directional (working equally well in all directions). The antenna will be the most important 'distance' factor after terrain.







Antenna length	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.
Line of Sight	Line of sight communication is in the VHF and higher frequencies of the RF

	spectrum where the wavelength is too short to pass over structures and hills, the transmitter and receiver antennas must be in line of site
	 **Figure 1:** Two antennae are shown each having the same height. Line-of-sight transmission means the transmitting and receiving antennae can "see" each other as shown. The maximum distance at which they can see each other, d_{LOS}, occurs when the sighting line just grazes the earth's surface. $$d_{\mathrm{LOS}} = 2\sqrt{2hR + h^2} \simeq 2\sqrt{2Rh}$$ where R is the earth's radius ($6.38 \times 10^6 m$).
Point to Point Operation	Direct communications between two radio stations
Repeater Operation	Allows two or more radio stations to communicate with each other through a third system, which relays transmissions over a single frequency pair.
Skip	Skip is an atmospheric condition in which your signal can travel thousands of miles and reach a distant station. For the SSB operator, skip is pretty reliable. The ionosphere is a layer of ionized air that encircles the earth. It is very useful for radio communications because it reflects radio waves back to Earth and well beyond the visible horizon. This is called 'skip' and can allow communications for several hundred miles and more. The range of frequencies where this occurs is generally between 3 to 50 MHz which includes the well-known 'shortwave' bands. Skip however is highly variable depending on the condition of the ionosphere. The major factors affecting skip are the time of day, the season of the year and the amount of sunspot activity.
VOX system	Voice Activation System automatically puts radio in transmit mode when the radio detects noise, facilitating hands-free operation when used with an optional headset.
Privacy Codes	Privacy codes are a nice feature to have because they effectively expand the number of channels you can use by adding 38 CTCSS (Continuous Tone Coded Squelch System) codes. For example, in the case of FRS radios, instead of having just 14 channels from which to choose, with these sub-channels you are effectively provided with 14 x 38 CTCSS codes, or 532 available channels. This makes it much easier to find a free channel in crowded areas such as stadiums, amusement parks or shopping malls. The term "privacy code," however, is a bit misleading because choosing a given code does not block or scramble that channel or in any way prevent others from listening in.
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.
Coded Tone Carrier	The CTCSS System prevents unwanted noise and/or conversation from being

Squelch System (CTCSS)	heard through your FRS radio's speaker. Only signals with the correct code will be heard.
Dual Tone Multi-Frequency (DTMF) Audio Frequencies	These are the tones transmitted when you press a key on your telephone touch pad. The tone of the button is the sum of the column and row tones. The ABCD keys do not exist on standard telephones.
Handheld Radios	Handheld radios are great for communication when your are very near to each other. Their range is limited by the type of radio and by terrain. At their best their range is approximately 10 miles and expect significantly less in mountainous areas.They are relatively lightweight and are good for the short range between the sender and receiver. You can use the handheld radio in two modes. The first is a one-way mode where you just provide information. If you want to communicate 2-way the farther the range the higher the price. These are easy to find, even at Target. This is two radios with a range of anywhere from a mile to ten miles. Range can vary depending on terrain and the type of radio. They range in price from $20 to over $100.
Linear Amplifier	Can significantly increase the operating distance of a radio. These amplifiers are used to boost the power of an outgoing signal as high as the operator's budget will allow. I have heard it said that amplifiers normally cost about a dollar a watt. This power will increase local reliability by allowing communication over the "skip" coming in and also allow you to talk very clearly to out of state or even out of country stations when skip conditions are good.
Links - HF, VHF and UHF	Problems can be encountered when transmitting data over HF links. Signal fading can be more serious when data is transmitted than with voice transmissions. Whereas a human operator can decide whether a missed word needs repeating, a data system cannot so decide and is required to produce an error free message. On the other hand data transmissions require a lower signal to noise ratio than speech. A voice radio link can also be used to carry packet radio. However the highest baud rate that can be used will be dependant upon the quality of the radio link. This is the case when data is passed over the telephone network where the quality of various lines vary. A baud is the number of pulses transmitted per second. On VHF and UHF circuits baud rates of 1200 to 9600 bauds are common. Because of effects such as multipath reception on HF the baud rate is lower, 300 bauds being common. An example of incorporating packet radio into a radio network can be seen in a unit developed by Dr S.A.G. Chandler of Warwick University, U.K. The unit can be used in developing counties which have limited telecommunications infrastructure, one network was established in the Bonthe area of Sierra Leone. The AFRICOM RADIO NETWORK CONTROLLER can be used to provide many very useful facilities on a radio network which would otherwise only have conventional voice capability. In its packet mode the unit enables the exchange of text messages between any two similarly equipped stations. If the stations are too far apart for direct contact then the messages can be automatically relayed via several intermediate stations. If the distant station is switched on, even though no operator is present, the text message can be received and stored. Amongst other parameters the unit measures the stations battery voltage and solar charging current every 15 minutes and stores this data for the previous and current day. This data can be requested by a distant station and will be

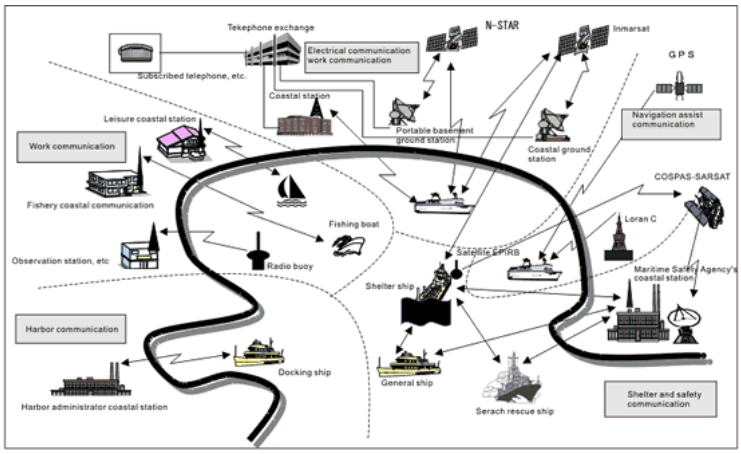
	automatically transmitted to that station. The unit can measure the transmitter power output and VSWR of the aerial system. Again this information can be requested by a distant station.It appears that this unit is most useful, not only in the management of the station itself, but also for remote measurements of all the stations in a network from the maintenance headquarters. An extension of the facilities envisaged by the author is that one station will collect daily, over the radio network, the 24 hour record of each stations parameters including transmitter power, VSWR etc. This data can then be transmitted via a store and forward packet satellite to another country, which may have the overall maintenance responsibility.
Links - Satellite	When communication facilities were first provided by satellites in the 1960's it was anticipated that this would result in the demise of short wave radio communication systems. Despite the vast number of satellites in orbit, providing many thousands of telephone and data channels, short wave radio is still in common use and is the only means of communication that many organisations can afford. Much of the international telecommunications traffic is carried by geostationary satellites in orbit at some 33,700 kilometres above the earth. Using one or two of these satellites gives virtually instantaneous communications between any two locations on the earth, except in the polar regions. Such satellites can cost $400,000,000. When instantaneous communications is not vital then a less costly satellite system is available using satellites in low earth orbit (LEO). These satellites can be in orbit some 800 kilometres above the earth and cost some $1,000,000. Such satellites are only visible to an earth station for up to 15 minutes at a time and take about one and a half hours to go around the earth. Hence messages are transmitted up to the satellite, stored and then transmitted down when the required ground station is in view. The satellite is a flying mailbox and the technique used is called STORE and FORWARD. LEO's are a suitable and affordable solution to the problem of transferring information between two places on the earth without dependence upon the telephone systems of the countries concerned. Telecommunications to, from and within some developing countries can be difficult and in some cases impossible. By 1992 two groups, Volunteers in Technical Assistance (VITA) and SatelLife, had provided a satellite. This had a store and forward facility and enabled text messages to be sent by various groups involved in helping in developing countries. LEO's were described by some people as "the poor mans satellite", but in this application they can be described more correctly as the "appropriate satellite". The opportunities offered by LEOs are limited, e.g. a satellite can only be contacted from a particular point on earth whilst it is passing over that particular region i.e. within a range of some 3,000 km from the ground station. Then the satellite is usable for 1 to 15 minutes during each pass and there are 2 or 3 consecutive usable passes, occurring at 100 minute intervals, every 12 hours. The method of handling the text messages is by packet radio. It may seem that a usable time of 10 minutes is rather short, but with a baud rate of 9,600 and a duplex system, the packet radio system used can in theory send and receive 700,000 characters in 10 minutes. In practice some 500,000 characters have been down-loaded in one pass. A ground station for the VITA system consisted of a computer e.g. laptop, a packet radio terminal node controller (TNC), a transmitter for 148 to 149.9 MHz with a power output of some 30 to 40 watts, a receiver for the 420 to 430 MHz band and a modest aerial array made of thin metal tubing. The whole system could be solar powered with the aid of a storage battery. The cost of a ground station was some $4,500 to $6,000 in 1997. Such a VITA ground station, provided the the UK based Baptist Missionary Society, was rapidly deployed at Vanga Hospital, Zaire at the time of the ebola outbreak in May 1995. This facility provided a data link from this remote area to the international community, via

	satellite UO_14. Similar additional equipment was later provided from USA for a link to the SatelLife satellite HS_2.
Mobile/Portable	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 and 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.
Mode – Continuous Wave (CW)	CW is 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.
Mode – Digital	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.
Mode – Single Side Band (SSB)	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.
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.
Modulation – Examples	N0N Continuous, unmodulated carrier - as previously commonly used for radio direction finding (RDF) in marine and aeronautical navigation. A1A Signalling by keying the carrier directly (aka CW or OOK) - as currently used in amateur radio. This is often but not necessarily Morse code. A2A Signalling by keying a tone modulated onto a carrier so that it can easily be heard using an ordinary AM receiver - as used for station idents of some NDB transmissions. This is usually but not exclusively Morse code. (An example of modulated continuous wave) A3E AM speech communication - as used for aeronautical VHF communications F3E FM speech communication - as used for marine and many other VHF communications J3E SSB speech communication - as used on HF bands by marine, aeronautical and amateur users A3E or A3EG Normal AM broadcast - as found on public LF and MF bands F1B FSK telegraphy, such as RTTY.[1] F2D Data transmission by frequency modulation of a radio frequency carrier with

	an audio frequency FSK subcarrier. Often called AFSK/FM. F8E or F8EH Normal FM stereo broadcast - as found on public VHF band, and as the audio component of broadcast television transmissions G1B PSK31 (BPSK31) C3F or C3FN Broadcast analogue television video signals * Note that there is some overlap, so a signal might legitimately be described by two or more designators. In such cases, there is often a traditionally preferred designator.
Modulation – Types of	N Unmodulated carrier A Double-sideband amplitude modulation (e.g. AM broadcast radio) H Single-sideband with full carrier (e.g. as used by CHU) R Single-sideband with reduced or variable carrier J Single-sideband with suppressed carrier (e.g. Shortwave utility and amateur stations) B Independent sideband (two sidebands containing different signals) C Vestigial sideband (e.g. NTSC) F Frequency modulation (e.g. FM broadcast radio) G Phase modulation D Combination of AM and FM or PM P Sequence of pulses without modulation K Pulse amplitude modulation L Pulse width modulation (e.g. as used by WWVB) M Pulse position modulation Q Sequence of pulses, phase or frequency modulation within each pulse V Combination of pulse modulation methods W Combination of any of the above X None of the above
Modulation – Types of Modulating Signal	0 No modulating signal 1 One channel containing digital information, no subcarrier 2 One channel containing digital information, using a subcarrier 3 One channel containing analogue information 7 More than one channel containing digital information 8 More than one channel containing analogue information 9 Combination of analogue and digital channels X None of the above
Modulation – Types of Transmitted Information	N No transmitted information A Aural telegraphy, intended to be decoded by ear, such as Morse code B Electronic telegraphy, intended to be decoded by machine (Radioteletype and digital modes) C Facsimile (Still images) D Data transmission, Telemetry or Telecommand (Remote control) E Telephony (Voice or Music intended to be listened to by a human) F Video (Television signals) W Combination of any of the above X None of the above
Morse code by light	Ships carry a set of blinker lights for communication by Morse code. These lights are essentially searchlights fitted with shrouds or shutters that can be quickly opened or closed.
Other 2-Way Radios	There are many different options for radios from simple CB radios, to Motorola

	radios, to Shortwave radios. They vary in price and range and all have their limitations. You can easily purchase a CB type radio at Radio Shack. If you don't plan on keeping these types of radios, renting is the best option.
Phone, Cell Phones	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. For any given provider/carrier you can probably expect coverage over 65-70% of the time. Based on conversations with cross-country auto Racers it appears the carriers with the best coverage are AT&T/Cingular and Verizon Wireless. If you have both of these you may get 75% coverage. Another option to consider is TracFone (www.tracfone.com). They are not a carrier but sell phones that work on any network. With these phones you buy minutes and can restock as you need to. The estimated coverage with these phones is 75-80% because they cover just about all the networks. You can order these phones online or most Target and Wal-Mart stores carry them.
Phone, POTS	Plain Old Telephone Service or Landline - The 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"
Phone, Satellite Phone	Satellite phones have better coverage though still not 100%. Often these don't work within vehicles and require external antennae. They are expensive to buy and maintain. Renting is relatively cheap, but the charge per minute is often a dollar or more. If you search the internet for 'Satellite Phone Rental' you will find many options.
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.
Scanner	Allows you to know what is going on around you. A good scanner setup that allows you to monitor: Fire, EMS, Local Police, County Police, State Police, Sheriff, FRS/GMRS, CB, Air and several HAM frequencies; is the great for getting the "larger" picture of any particular crisis in your area.
Signal Operating Instructions (SOI) and Radio Nets	Signal Operating Instructions (SOI) is the military name given to a whole host of methods and procedures to communicate; essentially, SOI is a protocol of behavior for people and equipment to communicate successfully.
Standing Wave Ratio (SWR) or Voltage Standing Wave Ratio (VSWR)	VSWR stands for Voltage Standing Wave Ratio and is often abbreviated to SWR. This is simply the amount of output power being reflected back into the radio. The higher the SWR the less efficiently your equipment is functioning. If the SWR is too high you will eventually cook your radio. An SWR reading of 2.0 or less is generally considered acceptable, this number should be as low as possible.

	Anything 3.0 or higher will eventually damage valuable equipment. The SWR is adjusted with the antenna, usually by sliding the radiating element in or out of an adjusting sleeve or by trimming the radiating element. In any case, follow the manufacturer's directions or seek the advice of an experienced operator.
Trunking System	A Trunking system allows multiple agencies to use shared frequencies without interfering with each other.
Federal Radio Commission (**FRC**)	Was a government body that regulated radio use in the United States from its creation in 1926 until its replacement by the Federal Communications Commission (FCC) in 1934. The Commission was created to regulate radio use "as the public convenience, interest, or necessity requires." The Radio Act of 1927 superseded the Radio Act of 1912, which had given regulatory powers over radio communication to the Secretary of Commerce and Labor. The Radio Act of 1912 did not mention broadcasting and limited all private radio communications to what is now the AM band.
- **Federal Communications Commission (FCC)**	Regulates and enforces all forms of inter-communication in the United States. These people are to free communication what the BATF is to firearms. Two-way communication is only legal through strict government guidelines. The very nature of the "ham license" only adds to the "law and order" society which the bureaucrats want to create. This licensing process is simply a means of keeping tabs on two-way communication. Nazi Germany was also interested in controlling communication as are all totalitarian regimes. The FCC replaced the **Federal Radio Commission** (**FRC**) in 1935 (created in 1926).
HELP – International Formats	
HELP - S O S	SOS is the commonly used description for the international Morse code distress signal (· · · — — — · · ·). From the beginning, the SOS distress signal has really consisted of a continuous sequence of three-dits/three-dahs/three-dits, all run together without letter spacing. In International Morse Code, three dits form the letter S, and three dahs make the letter O, so "SOS" became an easy way to remember the order of the dits and dahs. In modern terminology, SOS is a Morse "procedural signal" or "prosign", and the formal way to write it is with a bar above the letters: $\overline{\text{SOS}}$.
HELP - Three-in-a-row Rule	In general, three of any signal repeated at a regular interval signifies distress; whistles, gunshots, banging a wrench against a pipe, etc.



Antenna Information

Antennas are the single most important factor in the range or distance a signal can be transmitted and received clearly. Here height and power play their biggest roles.
I have purchased and started to read a book by Radio Shack called Antennas - Selection and Installation. It covers everything you need to know in order to choose and install the best possible antenna system for TV, FM, CB, cellular telephone, satellite and shortwave. Deals with the problem of TV and FM reception in fringe areas. Clear meaningful illustrations and easy-to-read text. (112 pages) It has been rather enlightening so far and I am only about a quarter of the way through it.

Another good site is http://www.iw5edi.com/ and the is a good little chart on *HF Multiband vertical antenna selection @* http://www.iw5edi.com/ham-radio/82/hf-multiband-vertical-antenna-selection

This next site is especially good for HAMS … http://www.hamradiosecrets.com/ and there article on Ham Radio Antenna Selection Tips http://www.hamradiosecrets.com/ham-radio-antenna.html it second to none. Here is an excerpt:

> "When choosing or building a ham antenna (amateur radio antenna), the most common compromises you have to make will fall in the following categories:
>
> - Cost (for a commercially made antenna or cost of parts if homemade).
> - Available space (both horizontal and vertical).
> - Durability.
> - Performance (of course!).
> - City bylaws (increasingly ... sigh!).
>
> The above are by no means the only types of compromises. But dealing (playing) with them constitute the kind of challenge I like to take up.
>
> If perfect antennas were possible I would make them and become a millionaire!
>
> The bad news is that the perfect antenna does not exist, even in theory! The theoretically perfect antenna can never be built ... because theory itself is not perfect!

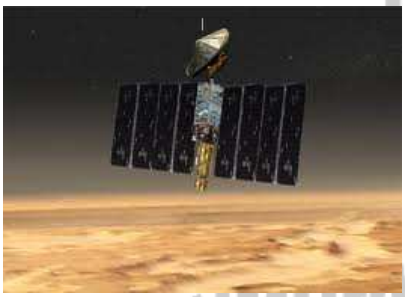
However, the **good news** is that experimenting with homemade antennas is one of the most accessible and enjoyable aspects of amateur radio."

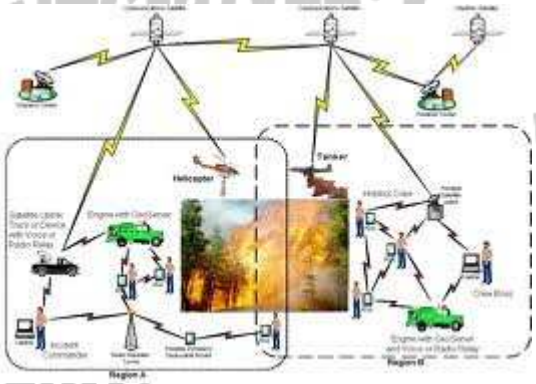
There is a great introduction to TV antennas is at http://www.warrenelectronics.com/antennas/antenna_guide.htm. Some of this information is still useful for HAM, GMRS, MURS, FRS.

And last but not least there is a downloadable PDF called *AN058 -- Antenna Selection Guide* by Richard Wallace found at http://focus.ti.com/lit/an/swra161b/swra161b.pdf which should any novice get started down the right path.

Radio Communication Practices

Relay Communication - This has been done for as long as radio has existed. One station (person) receives a message and passes it along to another station (person), that passes it to another station (person); until it finally reaches the destination. Hopefully the message won't be distorted by the time it reaches the intended receiver.





Repeater Communication - Allows two or more radio stations to communicate with each other through a third system, which relays transmissions over a single frequency pair. A repeater station is really just a special kind of base station which employs a very tall antenna. The repeater usually receives on a particular frequency for each communication method. For instance 467 MHz for GMRS. When it receives a signal (usually accompanied by a special code which this repeater listens for especially), the repeater then automatically (i.e., without further operator action or control) retransmits that same signal on the comparable frequency. *You must know the repeater's frequency and "call sign" or code in order to use it.*

A typical low-power handheld radio might be able to communicate with a base station on top of a mountain or a tall building 15 miles to even 30 or more miles distant.

Another kind of repeater, only recently introduced to GMRS, receives a signal on a 462 MHz frequency, and retransmits that same signal after a slight time delay on that same frequency. This kind of repeater can be much less expensive to purchase and operate, since it doesn't require a "duplexer" or a second antenna for receiving purposes. However, like a conventional repeater, this "store-and-forward"-type repeater still requires a control method to shut it down, if it is operated from a remote location.

The advantage of the repeater is in its capability to receive a signal from a distant transmitter, and to retransmit a signal which can be heard by a distant receiver, because of the station's greater antenna height.

If a repeater with a tall antenna can hear a mobile signal 20 miles away (a typical distance for a well-sited repeater), then it can usually transmit to another mobile unit anywhere within that same 20-mile radius. The two mobile units themselves do not need to be near each other. They could be at opposite sides of the 20-mile radius of coverage of the repeater, or 40 miles apart from each other, and still be able to communicate through the repeater.

Normal speech - When using a radio that uses voice communication it is necessary for the person receiving the transmission to understand what you are saying. You must therefore speak as clearly as possible. Hold the microphone away from your mouth at a constant distance (a thumb's length at minimum) and speak clearly with a steady volume. Don't scream into the mic or move it close to your mouth because it makes the received transmission sound garbled and distorted. If certain words are not understood despite good speech practices it may be necessary to spell the word. This is done using a 'phonetic alphabet'. There are two common variations of this one for military and one for civilian use. Use whichever is understood best by the receiver.

Coded or encrypted information - By law it is illegal to convey a message using code or encryption. This takes valuable time away from the NSA which is already too busy eavesdropping on the rest of US communications. Instead they may hand the message over to Homeland Security and lock you up as a terrorist - no trial, no lawyer, no right to habeus corpus and no protection from self-incrimination. I don't know if this has happened yet but I don't want to be the first. Until all the domestic US spy programs are dismantled it would be best to avoid encryption and codes.

Secrecy - In general DO NOT convey important information over the radio. Not even bits and pieces of information that can be reassembled by those that may be eavesdropping. *Use just enough range to make contact with the other station and no more*. This can be done using radios with less power, smaller antennas, directional antennas and even using geographical features to your advantage. *If you do not want the signal to travel several hundred miles use the higher frequencies* that will not skip. *If you do not want to be heard by spy satellites* use lower frequencies that will not penetrate the ionosphere.

Limit transmissions as much as possible to avoid detection. To avoid the transmitter being located by direction finders do not transmit for more than a few seconds at a time waiting a few seconds between each transmission. Do this even if it means breaking up a complete message into several separate transmissions. This is common practice for the military.

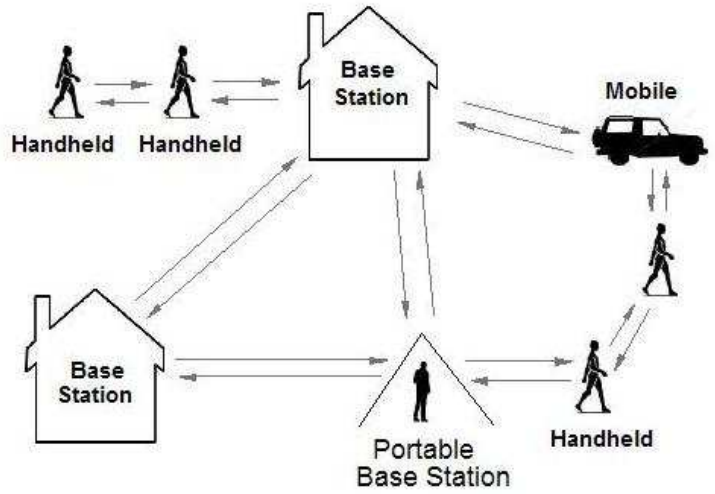
Civilian 2-Way Communication Methods:

Broadcast – Satellite television	Range is unlimited as long as your dish can be pointed at the satellite. But because the signal comes from a satellite reception can suffer due to many problems such as atmospheric ionization, interference from dust clouds or volcanic ash, problems in space like meteorites or space debris and malfunctions at the ground station sending the signal to the satellite.
Broadcast – Television	Television broadcast frequencies cover large and scattered chunks of the spectrum from 54 to 890 MHz. The range is limited like the FM broadcast band because of the high frequencies. However, they broadcast video information which can be invaluable. And there is a drawback which is due to the wide variation of frequencies. This means that a separate antenna is required for each station for maximum sensitivity. But this isn't a major problem because a relatively sensitive and efficient television antenna can be made easily from a roll of 'twin-lead' antenna wire

	(specs to follow at a later time).
Broadcast radio - AM broadcast band	The AM broadcast band is found between 535 kHz and 1705 kHz in the radio spectrum. It uses amplitude modulation and can be received by the simplest and cheapest of receivers even by a home made crystal radio. The low frequency range allows the transmissions to be carried for hundreds of miles by ground-wave propagation and sometimes thousands of miles at night. If a disaster occurs in a limited area distant AM stations will be heard even when local stations are off the air. Because of this ground-wave propagation on the band AM radio stations are organized geographically in a certain way. This system was designed under the 1950's mindset of civil defense when nuclear war was a very real possibility. The idea is to have some stations with very high power cover very large areas of the country without interference (called 'Class A' or 'Clear channel' stations). These stations have very specific responsibilities during national emergencies and disasters and are intended to provide important public information when called into service. It is a very good idea to keep a list of these stations and their frequencies close to your emergency AM receiver. Because the frequencies are so low on this band a very long antenna is required. Most people have noticed however that many AM receivers have no antenna at all. They do but it is really inside the radio in the form of a coil wound around a bar of ferrite. This is usually all that is necessary because AM radio stations transmit with a lot of power.
Broadcast radio - FM broadcast band	The FM broadcast band covers between 88 and 108 MHz of the radio spectrum. These are very high frequencies so stations do not have nearly the same range as AM broadcast stations. Thus, they are not required to abide by the same standards in an emergency situation even though they are still part of the Emergency Alert System. In most instances FM stations will not provide emergency information beyond telling you to tune to a Class A AM station for further information.
Broadcast radio - Shortwave radio	One of the best, alternative sources of news on the planet. You can tune into broadcasts from around the world. It’s safe to say there is something for everyone in the world of shortwave radio. it will give you a means to find out what people are experiencing in other parts of the country or the world.
HT (handi-talkies/handheld transceivers)	Are 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.
Marine Radio	The 156-160 MHz marine band is intended for use on the water. It is illegal to use a land based marine radio transceiver unless the station is licensed as a coast station by the FCC. Obtaining a coast station license is not easy. Only businesses and public safety agencies having a need to communicate with vessels on the water is even eligible. Activities of the Coast Guard are also covered in Federal regulations. Citizens on board boats under a certain length and weight are allowed to use mobile marine radio without a license. The average citizen may not operate a land based marine coast station or even a marine portable radio while on land.
Packet Radio	Packet radio is a form of data communication which has several forms e.g. X25 is in professional use, AX25 is used by amateurs and there are other formats. The text message to be transmitted is broken up into packets which may contain up to 256 characters. AX25 packets take the following form:They start and end with synchronising signal thus making the data within the packet a synchronous format.The second part of the packet is an address area which contains the destination, origin and any station through which the originator may wish the packet to be relayed. The relay stations are called digipeaters. They simply receive a packet and automatically transmit it to the next address on the packet. In addition to the text, each packet also contains control codes and error checking information. Until the receiving station confirms to the transmitting station that it has received the packet correctly, the same packet will be transmitted again. This procedure of re-tries will continue until the maximum number of re-tries e.g. 1O, is reached after which a failure will be indicated. The packet radio operating system, packet format and other information is stored either in the Terminal Node Controller (TNC) or a computer program which interfaces between the keyboardand the radio. The TNC switches the transmitter on and off automatically. Initially the operator has to establish contact with the distant station using the keyboard. A connection will be indicated either by text on the VDU or printer, or by illumination of the appropriate LED, after which the operator sends the message using the keyboard. A further command is necessary from the operator to disconnect the link otherwise automatic disconnection may occur if no messages have been passed for a given time e.g. 1 minute. In addition to a direct contact between two stations, packet radio is extensively used with mailboxes and bulletin boards. These facilities are similar to those which are available using modems over telephone lines. Mailboxes, as the name suggests, provide the facility for leaving mail at a distant station when the operator is not present. The mailbox may be at the distant station or some other station from where the mail can be collected, over the radio link. Bulletin Boards are again self explanatory. Messages are displayed on a bulletin board (BBS) at a station which has the necessary computer and software. These stations can be connected to and the list of bulletins observed. The full text of the required bulletin can then be down-loaded as indeed can any files or computer programs listed as being available at that particular BBS. In addition to PACKET there are other systems for passing data such as

	AMTOR and PACTOR, the latter being a combination of PACket and amTOR.
Personal Radio Services (PRS)	The Personal Radio Services include the venerable Citizen's Band (CB) radio service as well as the newer Family Radio Service (FRS).
Personal Radio Services (PRS) - Family Radio Service (FRS)	The Family Radio Service is another low-power service. It uses very high frequencies (462/467 MHz) so maximum range is limited to line-of-sight and therefore subject to radio dead-zones. However the radios are very small and light. Unlike CB radios that can be installed in a vehicle or home, FRS radios are required by law to run from batteries only and not an external power source. They are also required to use the built-in antenna with no provisions for an external antenna. There is no designated emergency channel for the FRS service. No license is required for an FRS radio. FRS radios **do not** require a license to use. "If you operate a radio that has been approved exclusively under the rules that apply to FRS, you are not required to have a license. FRS radios have a maximum power of 1/2 watt (500 milliwatt) effective radiated power and integral (non-detachable) antennas. FRS Range is generally stated as "up to 2 miles," you should note that this manufacturer's stated range should be construed as the absolute max, to be achieved only under optimal conditions (such as flat terrain, no obstructions and full batteries). Somewhere in the 1/4 to 1 mile range, depending upon conditions, is much more realistic. FRS radios may not legally be altered.
Personal Radio Services (PRS) – Citizen Band (CB)	Has been around since the late 1950's and some form of it exists in almost every country on Earth. Before the cell-phone boom it was the most common two-way radio ever made and its popularity has lasted for decades. It is easy to find, easier to install, and even easier to operate. With plenty of aftermarket antennas and other accessories it is highly flexible in the number of possible applications. It is widely used by truckers, farmers, civil and emergency services and that guy with the truck down the road. CB radio was intended to be replaced by the Family Radio Service but that never happened due to the continuing popularity of CB radio. CB radio no longer requires a license. It does have rules even though those rules are often ignored and rarely enforced. One of the most important rules is that channel 9 is restricted for emergency communication only. This rule is followed by most and many people monitor the channel on a regular basis. The non-profit organization REACT (www.reactintl.org) plays a significant role in emergency CB communications. CB radio works on frequencies around 27 MHz. At this frequency the most reliable communication is line-of-sight limiting its range to just a few miles. CB can reach beyond line of sight, and works pretty well in mountainous areas, but overall range is limited to four or five

	miles.
	
Short-Wave Radio	Short-wave bands are to be found on many broadcast radio receivers. There are various broadcast bands and to tune into them you are given the wavelength,for example 25, 31 or 41 metres. In radio communications the tuning information is given in kHz (kiloHertz) or MHz (MegaHertz), formerly Kc/s or Mc/s. Radio waves travel at the speed of light i.e. 300,000 km per second and because wavelength and frequency are related you can easily translate from wavelength to frequency by the relationship: **The short-wave band is referred to as the HIGH FREQUENCY (HF) band.** The HF band covers frequencies in the range 2 to 30 MHz.To communicate between two different places it is necessary to transmit radio waves to the distant receiver, but radio waves travel in straight lines and the earth is round, so how do we communicate over hundreds and thousands of miles? Such communication is possible because the earth is surrounded by the ionosphere. The ionosphere is made up of several ionised layers which are continually combining and then separating. They occupy a region between 100 and 300 kilometres above the surface of the earth. At certain times the layers will reflect radio waves back to earth, see Wave A in Fig.1. The ability of the ionosphere to reflect radio waves depends upon the electron density of the layer. The higher the electron density the more effective the ionosphere is as a reflector. The sun, shining on the ionosphere, causes the electron density to increase. Hence the density increases from dawn, being a maximum around midday and gradually decreasing towards night. In addition to this daily variation in density, there is also an annual cycle and a 11 year sunspot cycle. It is possible for radio waves to pass straight through the ionosphere without being reflected. To be of use for radio communications the radio waves must be reflected back to earth. Three of the factors which determine whether radio communication is possible are the time, the frequency in use and the distance between the radio stations.

Two-way - Cellular phone	Cellular phones are everywhere. They use very high frequencies and so have very short antennas. Cell phones are notoriously unreliable during a widespread emergency or disaster. The reason is because the phones do not connect with other phones directly but through a system of cell towers. The cell towers are connected to a network of microwave links, landlines and satellite services. If any of these fail the load is increased on the rest of the network. If several fail then the network fails by a cascade effect of overloading. For an area-wide emergency they are for all practical purposes useless.
Two-way radio – Part 15 – license	Under certain guidelines a person can transmit up to 100 mW on the AM broadcast band and 1 watt on a part of the spectrum between 160 and 190 kHz (sometimes called the 'LOWFER' band). The behavior of radio waves at these low frequencies is unique. Long distance communication can be achieved with a very small amount of transmitted power and the range is even better with snow on the ground. There are very few Part 15 devices available commercially that have any practical value in an emergency so the use of these devices should be limited to those with electronics knowledge and experience. For more information go to (www.lwca.org).
Two-way radio – Amateur Radio Service (ARS)	The Amateur Radio Service (aka 'ham radio') has made significant contributions to emergency radio communications since it began. An amateur radio operator is permitted to use various parts of the radio spectrum from 1.8 MHz all the way up to and including microwaves. The premier organization the American Radio Relay League (ARRL) has even launched its own orbiting communication satellites for use by amateurs. This service is a significant public resource that should not be overlooked or underestimated. A license is required. For more information go to (www.arrl.org). Cost for a dual-band, battery-powered, hand-held ham radio is as little as $200. Single-band models are about half that. A license is required to operate a ham radio. The good news is that Morse code requirements have been relaxed. For the beginning license level (Technician), there's no Morse code requirement at all.
Two-way radio – General Mobile Radio Service (GMRS)	Is for both commercial and private use. It is a land-mobile radio service available for short-distance two-way communications to facilitate the activities of an adult individual and his or her immediate family members, including a spouse, children, parents, grandparents, aunts, uncles, nephews, nieces, and in-laws (47 CFR 95.179). Normally, as a GMRS system licensee, you and your family members would communicate among yourselves over the general area of your residence or during recreational group outings, such as camping or hiking. Upon approval of a license the FCC will assign a frequency within a specified band usually above 30 MHz. Communication range depends on frequency and equipment but there are limitations. Use of the assigned frequency is not exclusive and may be assigned to other licensed users.

GMRS radios typically achieve greater ranges than FRS radios. GMRS range is generally specified by manufacturers as "up to 5 miles" and occasionally slightly more. Again, this is a maximum range, likely achieved only under optimal conditions. Realistic range for GMRS radios under most conditions is more likely 1-2 miles, depending upon the particular conditions.

GMRS radios may legally be outfitted or retrofitted with optional antennas, car antennas or home antennas to extend their range and require a license.

For people who don't want to learn how to use a ham radio, Mike Spenis recommends short range family radios like the popular Motorola Talkabouts. The FRS models don't require licensing, and they're simple enough for children to use.

You can find these at Radio Shack, Home Depot, or practically anywhere electronics are sold. Cost ranges from as little as $29 per pair up to around $100 per pair. More expensive models have more power and support all 14 FRS channels for maximum compatibility with other units, and may also support GMRS. The downside of these systems is their range, which is limited to a few miles and line of sight communications. They're generally sold in pairs because they're intended for person to person communications. Because of the multiple channels and codes in use, there's no one like Jim Bond monitoring these radios for emergencies.

Some of those personal radios are GMRS units, which extend the range a few more miles. By law, you need a license to operate. GMRS. That seems to be largely unenforced, and most people who buy them probably never realize they're supposed to have a license. To operate within the law, however, you should fill out FCC Form 605 and pay the $80 licensing fee, renewable every five years.

There are also dual FRS/GMRS radios. If a radio has 22 channels that means it supports all 14 FRS channels and all 8 GMRS channels. This GMRS and FRS FAQ is very informative.

There is a growing interest among large and small organizations to use the inexpensive “bubble-pack” GMRS radios for neighborhood emergency response teams, including CERT.

Misconceptions are common regarding the purpose of GMRS and the potential for volunteer groups to operate their radios which results in misuse in violation of FCC rules and incompatible with the services. These questions are designed to help you understand the role the GMRS can play for these groups and exactly what the

	responsibilities of the licensee are operating a GMRS system.
Two-way radio - Packet Radio	Another wireless medium is packet radio. If ham radio is analagous to a phone line, then packet radio is like using a modem for digital communications over that phone line. Like any digital medium, it can carry a variety of media, but its low bandwidth results in it being used for text rather than voice. Packet radio has been useful in some situations - including Hurricane Katrina - for organizing emergency information. You can find more information at Introduction to Packet Radio.
Two-way radio – Sat-comm.	The satellite phone is the only method of communication that is not limited by location. The frequency of operation is very high but line-of-sight needs to be with a satellite not with another ground station. So you can use a satellite phone anywhere on Earth except at the poles. Both the phones and the service are very expensive.
Two-way radio – Multi User Radio Service (MURS)	CB are AM modulated and MURS is FM modulated or 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, listeners will probably be scarce. 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. Formerly available only for business communications, the FCC has kept five MURS frequencies license-free and open for public use since 2000. Handheld radios broadcasting on MURS frequencies will experience a range of two miles to eight miles depending on terrain and obstructions, while MURS Base Stations can reach up to 20 miles. The stipulations for MURS use provided by the FCC restrict any transmitter in excess of two watts, but any type of antenna is allowed as long as the tower height (with antenna) is no greater than 60 feet high. All communications must also yield to any emergency communication on the same channel Another hidden benefit of MURS frequencies are the PL codes (Private Line codes) or CTCSS (Continuous Tone Coded Squelch System) which are sub-audible tones that allow users to operate on the same channel without hearing chatter directed to other users. There are 38 PL codes available to each of the five MURS frequencies, which makes for a combination of 190 different MURS channels. While this is not encryption, anyone not operating with the same PL code will hear “Mickey Mouse” when trying to listen in to your conversation.

High Frequency (HF)-Long Range HF radio	Cheap long range HF radio, as CB, FRS frequencies and GPRS is recommended, such as radio cancer product. The above applies to better MURS and business-band radio, unless your alignment or aggregation has its own base in captivity – and all radios are suited up for accountants and radio channels. These long range HF radio are **not a cheap** entertainment area. So at the manufacturer's claims on Radio 2-miles or 10 miles the second radio with great suspicion -Manufacturer's appear to be consistently too optimistic!
Narrowbanding - Analog to Digital	Digital technology is more efficient than analog, meaning more information can be transmitted in a given bandwidth. Commercial two-way radio users use 25 kHz wide channels for a single voice path so The FCC has foreseen this issue and has mandated all business and public safety radio users in the U.S. to transition from 25 kHz channel spacing to at least 12.5 kHz wide channels by the end of 2012. The two-way radio industry calls this "narrow banding." the FCC has stated that 12.5 kHz narrow banding is not enough and is already looking past 12.5 kHz and "strongly urges" business radio users to migrate to 6.25 kHz very narrow band channels. It is important to note that the FCC has not yet set a date certain for required migration to very narrow 6.25 kHz channel width.

Comparison of Methods

Citizens Band Radio Service	The service was originally created to provide the public with a simple, low-cost radio service on which to conduct personal business or commerce. - CB was created in the high-end of the short-wave radio spectrum. It is the old Amateur Radio Services eleven meter band. - Short-wave radio signals propagate over great distances. Low power CB radio can be heard around the world. Every eleven years the sunspot cycle causes reliable world-wide propagation. - The first CB rules and those of today forbid operators from talking to others that are over one-hundred fifty miles away. - When average citizens discovered they could talk great distances like Amateur Radio operators they began using CB illegally to "shoot skip." CB was rendered a useless wasteland by these outlaw hobbyists. - The problem of illegal CB use became so great that the FCC abandoned licensing of CB stations. The FCC even abandoned enforcement to a great extent by asking Congress to allow local jurisdictions to investigate complaints of illegal power amplifiers. The FCC does still occasionally locate and fine illegal operators but their emphasis has now been placed on enforcement activities directed at retailers of illegal CB radio equipment. - There is now complete anarchy on CB. Illegal hobbyists have had control of the band for decades.

	- Illegal CB operations were the impetuous behind extraordinarily restrictive covenants, codes, and restrictions against radio operation in homes and neighborhoods. In some areas of the country housing discrimination is reportedly being practiced against licensed radio hobbyists – including Amateur Radio Operators. - The use of illegal CB power amplifiers is still a problem throughout the United States. - There are very few home CB base stations now. - CB is widely used by the trucking industry so drivers can communicate with each other on the highways and in some cases their delivery depots. - CB hobby communication is frequently profane, off-color, and juvenile. Most would say it is not a radio service they would want their children to listen to. - CB is still used by some Americans in cars, by four-wheel-drive enthusiasts, in boats, and RV's. - The useful distance of a CB radio is greatly reduced during periods of short-wave band openings due to illegal hobby operations. - Very-local distance expectations between mobile units can be from less than one mile to tens of miles. - The CB clubs of the past died out with the popularity of CB. - Four-wheel drive clubs often have CB radios in all member vehicles. These clubs could be an excellent communications and transportation resource. They have their own communication and provide vehicles that can go where many cannot. - CB walkie-talkie's have very limited range because of low-profile and very inefficient antennas. - CB might be a useful way for neighbors in rural areas to talk to each other if they live within a few miles. - Local CB communication may be better at night when, in most cases, hobby operations cease as signal propagation decreases. - CB should not be considered a highly reliable communications resource. - There are legitimate users of CB that do use their radios for family communication. The PRA believes that encouraging such use may eventually have an effect of the usefulness of the radio service.
Multi-Use Radio Service	- **The Multi-Use Radio Service consists of five VHF radio frequencies.** Operation on these frequencies does not require an FCC license; however, unlicensed operation does require that transceivers meet very specific FCC MURS requirements. - Transceivers that do not meet MURS requirements may not be used without an FCC license. There are still licensed businesses sharing these radio channels. - Some major radio manufacturers were not pleased with the FCC's decision to create the MURS service and for this reason have stubbornly refused to make equipment for it. Because of this,

	MURS radios are not as easy to find or purchase as one might think. - VHF radio waves propagate better through forested areas. - Two watts on VHF may go considerably farther than two watts on UHF GMRS. - Businesses and unscrupulous radio dealers put customers on these five frequencies and deliberately failed to license. The widespread abuse of the licensing requirement prompted the FCC to license-by-rule just as the FCC did with the CB band. - Low-power VHF generally does not propagate like short-wave radio. - Interference is likely to come from existing business users and unlicensed business users. - Interference is more likely in urban areas. - These frequencies are often used as drive-up window channels at restaurants and as portable-to-portable business radios in stores, warehouses, malls, construction sites, and as itinerant devices. - Users of this radio service are required to share the frequencies they use. - MURS would be an acceptable very-local communications option for a neighborhood, particular where forests and rolling hills are plentiful.
Family Radio Service	- **The FRS is a license-free very-short-range radio service.** - FRS channels one through seven are shared with the General Mobile Radio Service. - GMRS licensees may have small base stations up to five watts effective radiated power on FRS one through seven. This rule can make FRS in a neighborhood useful if one licensed resident can communicate well with many local hand-held FRS radios. - FRS channels eight through fourteen are exclusive to the FRS. - Families and businesses are both allowed to use radios that are FCC approved for the Family Radio Service. - Anarchy reigns on the FRS in urban areas. Interference can be severe. - FRS radio waves travel line of sight. - Antenna height is more important to range than is the power of the radio. - Communication over tens of miles is possible from high altitudes. - Heavily forested areas limit the range of FRS. UHF radio waves are absorbed by vegetation. - Intentional interference on FRS is common. Call tones are typically used to interfere and annoy others. - Very-local use of FRS around a neighborhood or a home is very effective. - FRS radios are limited to one-half watt output. - Only the United States and Canada share a Family Radio Service on the same frequencies. Use of FRS radios in other countries is illegal. Some persons have obtained prior permission to use FRS frequencies in other countries but this is the exception and not the

	rule. - Manufacturer marketing claims of useful communication beyond several hundred feet to one half mile are greatly exaggerated and intended only to sell radios by creating unrealistic expectations in the minds of consumers. - Children should not use FRS radios unsupervised. Parents should know who their children are talking to especially with the new Hasbro text-messaging radios. - FRS radios are unfortunately also used by criminals. - Use of FRS radios as children's toys should be discouraged. - Use of FRS radios and other two-way radios by hunters to coordinate the hunting of game may be regulated in some states. In some states it is considered unsportsmanlike conduct to coordinate the hunt using two-way radios. - FRS radios are perfect for neighbors to use to keep in touch before, during, and after disasters. - FCC rules prohibit FRS radio connection to external antennas. - FCC rules prohibit FRS radio connection to telephone systems. - FCC rules prohibit FRS radio connection to store and forward repeaters.
General Mobile Radio Service	- **GMRS requires a $80 license that covers you and all your extended family.** Use of GMRS is limited to personal licensees. Organizations, clubs, and businesses are not eligible to license in GMRS. Individuals are licensed upon application and payment of a license fee. The renewable license is good for five years. - Personal licensees may conduct their personal business. - A person's GMRS license covers their immediate family members including members of the immediate family not living in the licensee's home. - A licensee is responsible for the proper operation of all radio equipment used as part of the licensee's system. - GMRS base stations and mobile units may use external antennas and power outputs up to fifty watts. - GMRS licensees may use up to five watts effective radiated power on GMRS interstitial channels also known as Family Radio Service channels one through seven. - GMRS allows the use of radio repeater stations. - Higher power outputs of GMRS radios make communications more reliable over greater distances. - GMRS repeaters are considered private property. Repeaters may be shared by licensees but sharing agreements must be in writing and kept with station records.
MURS vs FRS at 460 MHz	- MURS (at 150 MHz) permits four times more power (2 Watts TPO instead the 0.500 Watts ERP limit for FRS). - At MURS frequencies, signals bend over hills better, but FRS signals are better at bouncing off of surfaces and penetrating into/escaping out of buildings. - You may connect a MURS radio to an external or exterior antenna. FRS radios must employ a non-detachable antenna. For

vehicle-to-vehicle operation with external (roof-mount) antennas, MURS should provide **three to ten (or more) times** the range possible with FRS radios.

- High Band VHF freqs (100-300 mhz) have the advantage of wave lengths that are typicly longer then most foliage, yet shorter then most trees and buildings. There is virtually no atmospheric skip like on CB frequencies and far less atmospheric attenualtion as on GMRS frequencies. All this adds up to MURS having the best range per watt of transmitted power then any available frequency to the average person.

- There are many **similarities** when it comes to FRS radios and GMRS radios. As already mentioned, are both designed for the purpose and intent of the communication in a radius gp300, two-way Fashion. Furthermore, both in the UHF range are broadcast in FM. Both services are provided through walkie-talkie units available, since they are suitable for short distance communication. These radio services were originally designed for people to communicate with other members of his family, radius gp300, but over time, people have done that implements a connection to the economy are also services for the two-way communication.

- Differences: While radius gp300 FRS GMRS radio and radio are similar in The nature, there are some clear differences between the two services. GMRS radio operates normally on a single number to eight channels. These channels are clearly defined by the FCC. These range from one channel to another 15 22. The maximum power consumption shall be fifty radius gp300 watts, but the radios are used to communicate with others, tend to have an assessment of the power of radius gp300 1.0 watts to 5.0 watts. FRS radio normally operates on a section of fourteen channels, with the range of channel 1 channel 14 The channels will be used only with the FRS radio. The maximum power that can be used for this type of radio service that is only half a watt. Furthermore, it is necessary that you acquire an FCC license for GMRS channels broadcast radio. This does not apply to radio channels FRS.

- When it comes to the distance at radius gp300 which the two radio services can be used, the FRS-systems can not be changed radius gp300 anymore with antennas or any type of change in the signal. However GMRS radio equipment can be modified to increase the signal strength. As you can see, there are many differences between the only FRS radios and GMRS radios.

- Benefits: There are many pros and cons, when it comes to radio and FRS GMRS radio. The benefits associated with using this type of wireless services is that it takes more worried about being charged for air time or a call to the base to complete. This means no more radius gp300, surprise bills, expensive service contracts and monthly Taxes. Moreover, many appreciate the fact that there are fewer breakdowns in communication on these radios, such as mobile phones. Rarely have experienced static or drops the call. Furthermore, these devices, radio, which are easier to use,

	compact and cheaper than radius gp300 many phones on the market today. **- Disadvantages:** The disadvantages of Radio and GMRS FRS radio connected includes the fact that a license for GMRS radio operator for radius gp300, the service requested. Moreover, many people understand that many people want to communicate to implement the use of these radio services. The choice of how two devices is not as wide as the selection of phones on the market today. While both FRS and GMRS radio services, radio radius gp300 production, is important for both the pros and cons to weigh in determining whether it is right for you and your family.
MURS vs GMRS at 460 MHz	- GMRS handheld radios have typically two to five watts transmitter power. GMRS vehicular units transmit typically with ten to 50 watts. There is no limit on the ERP of GMRS stations operating on the *primary* channels. GMRS stations may transmit with no more the 5 Watts ERP on the seven "interstitial" frequencies (those shared with the FRS). - GMRS operation requires an FCC license. - At MURS frequencies, signals bend over hills better, but GMRS signals are better at bouncing off of surfaces and penetrating into/escaping out of buildings. - For vehicle-to-vehicle operation with external (roof-mount) antennas, MURS should provide one-and-a-half to four times the range possible with GMRS handheld radios also connected to roof-mount antennas. Depending on the surrounding terrain, MURS units connected to roof-mounted antennas might even outperform full-power (50 watt) GMRS mobile units, although the GMRS units should have a greater range in open terrain. - Many GMRS radios can communicate through repeater stations for extended range (typically up to twenty miles or more, sometimes *much* more). The new FCC Rules will prohibit repeaters in MURS. - Even though GMRS radios can transmit more power, their tranmitted signals are subject to attenuation. Atmosperic, and folige attenuation. Atmospheric attenuation is loss of signal due to particles (air, dust, moisture). Folige attenuation is just that, leaves that physicly aproximate a wave length or an even division of a wave length (1/2, 1/4) of the transmitted freq will absorb the signal, thus weakening the received signal. For GMRS this is in the range of 3"-12".
MURS vs CB at 27 MHz	- CB radios may transmit with more power than MURS units may, but communications range is highly dependent on channel congestion and atmospheric conditions. CB communications can also be significantly degraded by noise from vehicle ignition

	systems and from other man-made sources. - CB signals bend over hills and around obstacles much better than MURS (at 150 MHz) or FRS/GMRS (at 460 MHz) signals. - Vehicle-to-vehicle MURS communications will probably be comparable and possibly quite superior to that available in the CB service. - MURS communications will not suffer from the kind of long-range "skip" interference frequently encountered on CB radio at 27 MHz. - CB class B, CB are also affected by attenuation With a much lower freq, the wave length is much longer, 100″-400″. Trees and buildings absord most of the ground wave signal of CB tranmissions. As well, CB are AM modulated and MURS is FM modulated. Most electrial interference is AM modulated. This effects the CB receiver but not the FM receiver.
GPS and GPRS	Technology has made our lives easier, with the help of technology we have changed the way our society thrives. All of the world's economies rely on technology. Just imagine your life without cell phones? People would be lost without their communication devices. Technology can also be confusing for some people, terms like Wifi, Wimax, Wireless, broadband etc. All of this may be quite confusing for someone who's not very technology savvy. One of the most confusing set of terms is perhaps GPS and GPRS and people often mix them up. Meaning Behind Terms **GPS stands for Global Positioning System**, which works by connecting with satellites out in space. GPS is mainly used for guided navigation of roads, streets and terrain. It works anywhere in the world, even if you are in the middle of nowhere (provided your GPS device is fully charged). On the other hand, **GPRS stands for General Packet Data Service.** GPRS is used for internet packet data for mobile devices. **Primary Functions** **GPS is mainly used for real time navigation**, say you want to get from point A to B. A GPS device connects with satellites in space and guides you to your destination in real time so you never get lost. GPS can also be used as a communication device, such as a GPS mobile phone, which can work anywhere in the world, even in the middle of nowhere, since it uses satellites in space for communication. On the other hand, GPRS was being used by people for surfing on the internet using mobile devices but was soon replaced by 3G, which is significantly faster than GPRS. *However, GPRS is still popular in third world countries which have not yet made the switch to 3G or where 3G packets are too expensive.* **Pros and Cons** GPS is one of the most sophisticated technology in the world, since it needs no towers unlike a cell phone and can be used from anywhere in the world. However, GPS does not work indoors for example in buildings or homes, since it uses it's own signal power

	to reach the satellites in space. GPRS is a cheap and affordable way to surf the net using a mobile device. It works great indoors and outdoors provided you are within a cellular network of towers, but on the downside it's very slow compared to 3G. - Technology has many confusing terms that some people have a hard time keeping track of. A couple of the most confusing terms are GPRS and GPS which people often confuse.GPS stands for Global Positioning System, while GPRS means General Packet Data Service. They are similar sounding but have completely different functions. - GPS is used for communication as well as real time guidance from point A to B, while GPRS is used for packet data services on mobile devices such as surfing the internet. - GPS can work anywhere in the world but it cannot work indoors. GPRS is a cheap and affordable way to surf on the internet using a mobile device and works indoors, however, it's very slow according to today's standard.

Radio Range

The range or distance a transmission travels between the sender (transmitter) to the Receiver will vary considerably between radio types, antenna types, terrain, obstacles and atmospheric conditions. Follow those criteria with the power of each individual piece of equipment.

Because of all these variables it was very difficult to find specific range information on the various types of radio communication available to the public. There was one common thread from all the sources read and queried: ***If you're relying on the claims of the manufacturers, you'll probably be very disappointed.***

One of the best articles where extensive "real world" testing took place was on CB, FRS, GMRS and MURS can be read in its entirety at http://www.thetravelinsider.com/2003/0815.htm. Here are some quotes from that source:

> "Going to the shopping mall? Expect your radios to have as little as a 100 yd range!"
>
> "Wanting to keep in touch between two cars driving on the freeway? Expect as little as a 1 mile range."
>
> "Wanting to stay in touch with family at home while you drive to the shops? You'll be lucky to get 1 mile of communications, and in some conditions, less than 1/4 mile."
>
> "CB radios have the longest range of any of the different types of radio services considered in these articles but only if used with a good antenna. … But CB radios are probably your worst solution for communications between two people using hand-held portable radios with short antennas. They are not nearly as small in size as the FRS/GMRS radios, they are much more expensive. Because of the very inefficient antennas in such units, their range is probably inferior to the FRS/GMRS radios too. … Note that although CB range is the longest of any of the four radio services (CB, FRS, MURS, GMRS) discussed in this article series, their range is trivially short compared to the range of transmissions at lower frequencies in the High Frequency, Medium Frequency and Low Frequency radio bands. Unfortunately, you need to pass various tests and be licensed by the FCC in order to operate radio transmitters in these frequency bands, making it impractical for casual use. … **MURS radios are not on the mass-market yet and so are the most expensive solution.** On the other hand, the 'commercial' grade

of MURS radios that are on sale are often made to a higher quality and with better performance than the cheap 'consumer' grade FRS/GMRS radios, and if you can find such radios and are willing to pay the price, you will definitely get better performance than from FRS/GMRS radios. … **FRS radios will give you as little as 100 yds or less in office buildings and shopping malls (less if no line of sight and you're on two different floors, more if you are more or less in line of sight and on the same floor). … In semi-open ground, you'll get about half a mile of range, sometimes less (especially if things block the line of sight between you), and seldom more (mainly if you can have direct visual contact). … You'll get similar or sometimes slightly better range if you are both in your cars, but if the road you're on turns a corner, and the line of sight disappears, the range will of course reduce again. …** FRS radios are not allowed to have external antennas, and their maximum power is limited to half a watt. … A GMRS radio is identical to an FRS radio - it uses the same frequencies. But it might have two important differences. … The first difference is that it might be higher powered than the FRS radio. As discussed in part two and four of this series, **extra power does not always automatically mean extra range**, so don't be too excited by the extra power that a GMRS radio offers. **All that extra power really means is your batteries won't last as long!!! …** The second difference is that the **GMRS radio can have an external antenna.** As also discussed in parts two and four, the quality of your antenna is one of the most important factors in determining your range. … Generally it seems that **manufacturers claim an 'up to 2 mile' range for FRS radios and an 'up to 5-7 mile' range for GMRS radios (with built in antennas) and then claim 'boosts range by up to 75%' for an external antenna add-on.** So, this would suggest a best case range of about 12.25 miles for a moderately low powered GMRS radio with a 'normal' non-directional antenna. … These theoretical ranges were never experienced in actual testing conditions."

No results are shown for greater than 0.8 miles because none of the radios would receive signals at these greater ranges. Distances are direct 'as the crow flies' distances as measured by GPS.

Distance *(tenths of a mile)*	FRS	GMRS int antenna (Units A - B)	GMRS ext antenna (Unit B)
1	5	5 - 5	5
2	3	2 - 3	4
3 (place 1)	0	1 - 1	2
3 (place 2)	3	2 - 3	4
3 (place 3)	4	3 - 4	5
4 (place 1)	0	3 - 3	4
4 (place 2)	3	2 - 3	4
4 (place 3)	2	1 - 3	3
5 (place 1)	0	0 - 0	0
5 (place 2)	2	0 - 1	3
5 (place 3)	3	2 - 3	4
5 (place 4)	3	2 - 2	4
6	2	1 - 2	3
6	1	3 - 3	4
7	0	1 - 0	1

7	0	0 - 0	0
8	0	0 - 0	0
8	0	0 - 0	1

Analysis

1. Many times the old low powered FRS radio outperformed one of the new high powered GMRS radios and sometimes it even outperformed both of them. This shows that **radio design is more important than power**.
2. There was a surprising difference between the two different models of GMRS radio. This again confirms that **radio design is more important than power**.
3. Adding an external antenna did improve the quality of the signal quite noticeably, but did not give a big increase in range.
4. The biggest factor on range was the topography between the two units, with maximum range varying up to two-fold depending on the conditions.
5. You will get better results in a flat open space where you can see the person you're talking with, and you will get worse results within buildings.

Summary

In the real world, range experienced with generic consumer grade low cost FRS/GMRS radios seems to vary from a low of under 100 yds (this happened in a shopping mall) to a maximum of 0.8 miles.

This distance may stretch out to a mile or two, and possibly more if you can both actually see each other, with no obstructions between you.

For longer range between cars, CB radios with good (ie large!) external antennas are your best solution.

In general, the best way for most people to stay in touch is simply to use a cell phone. Especially if you never use all the included minutes in your monthly plan, using your cell phone is probably the best solution.

FRS radios are advertised as having a range of 'up to two miles'. I have typically experienced 0.25 - 0.5 miles. Disappointing, but usable.

Perhaps conveniently for sellers of two-way radios, the actual effective range between two radios can vary enormously depending on many different factors.

Not all receivers are equally sensitive to weak signals. Receiver sensitivity is usually measured, in a radio's specifications, in terms of microvolts for so many dB of either signal/noise ratio (CB and AM radios) or SINAD (FM radios such as MURS, FRS and GMRS). The lower the number, the better.

Note that some radios don't disclose their receiver sensitivity. It is a safe bet, in such cases, that the receiver is not a very good one!

For CB radios, more power usually gives you an appreciable impact in terms of more range. But, for the higher frequency radios, an increase in power has little or no impact whatsoever.

In our testing we found that the design and quality of the unit was more important than its power.

Batteries and Voltage

The power that the unit is capable of transmitting is a function of the square of the battery voltage. Voltage is very important. If you are choosing between regular alkaline batteries (at 1.5 volts each) and Ni-Cad or NiMH batteries (at 1.2 volts each) you will get a 56% increase in transmitted power with the alkaline batteries.

Sure, *more power doesn't always mean more range*, but that is no reason to accept any less than the most power your unit is capable of generating. Keep your batteries fresh and fully charged.

You will get noticeably better results and more range with an external antenna. Indeed, you'll usually find that the *single most important thing* you can do to improve your effective range for both transmitting and receiving signals is to get a properly designed and properly tuned antenna for your radio, and to locate it in the best position possible.

Of course if you're using a radio as a portable unit while walking around, there isn't much you can do about getting a better antenna, although sometimes you can substitute the standard short (eg 3") antenna for a longer (eg 6") antenna and that might give you some effective extra range.

Summary - How to Get the Best Range

More power is good, but not the most important thing.

The biggest impact on range will be the actual design of the radio - its receiver sensitivity in particular, and how viciously its squelch cuts out weak signals. Get a unit with manual squelch, if possible, and with a very low number for its receiver sensitivity.

The other most important impact has to do with your antenna. If it is possible to have an external antenna (FRS radios are not allowed external antennas, the other three types are) then this will make a positive difference. If you are stuck with the built in antenna, try and hold the radio as far away from you as possible (ie up in the air above your head - use an external microphone) and, if in a vehicle or building, as close to a window as possible where it can 'see' in the direction of the person you're hoping to communicate with.

Rechargeable batteries are wonderfully convenient, but if your radio is designed for using the same number of either regular alkaline or rechargeable batteries, *you'll get more range from the higher voltage alkaline batteries.*

Ok that covered CB, FRS, GMRS and MURS, what about HAM?

The only real good, not super technical test I found was: How much range can you get with a small hand-held HAM radio? At http://neufam.com/politics/whatsham.html and it stated the following:

> **"…***Going from one 5W radio to another directly would give you a range of about 15 miles.* (on VHF or UHF) That is the simplest answer, but us hams can do a lot more. … One thing hams can do is send their signal to a tower, where it is re-transmitted with greater power for a longer range. *This is called using a repeater. Doing this can extend your range very considerably, up to 100 miles in some cases. … Using a ham radio you can transmit to a satellite in earth orbit, and have your signal sent back down to earth. This technology allows hams*

to talk from one state to another using a small handheld radio. Satellite use can be inconvenient, though, because the timing must be just right for the satellite to be overhead. … ***The most versatile range-enhancing system we have today involves connecting repeater towers together with the internet.*** … This makes it possible for two people with low-power radios to talk from one country to another free of charge - for the most part as easy as making a telephone call. … In the old days, before satellites and internet, Hams were still capable of world-wide communications. *The method used then was to use shortwave frequencies (HF) which*, unlike UHF or VHF, have a tendency for worldwide communications by their very nature. … *Using shortwave frequencies, it is possible to talk from one country to another directly from radio to radio. Most radios that can do shortwave are still too big to carry around,* although there are a few small enough to walk around with. … To get the most common HAM license, Technician, you need to pass a 35 question test on safety, procedures, and basic radio operation. The questions to this test are available for study on several internet websites (most notably, www.qrz.com, then click on "Practice Exams") . There are other tests required for people who want to use shortwave frequencies, but the basic license gives you the ability to do everything else. … FRS is very similar, in many respects, to some Ham Radios for radio-to-radio communication. There are two main differences. First of all, FRS cannot take advantage of some of the range enhancing technology that hams have. Secondly, FRS is limited to much lower power. (500mw) On the other hand, FRS does not require any kind of license …. GMRS can do one of the range-enhancing tricks that hams use (Repeater operation). Unfortunately, though, repeaters on the GMRS band are very rare. GMRS is also limited to less power (2 watts for units that also use FRS frequencies), although GMRS has nearly four times as much power as allowed for FRS only. … The GMRS license is more or less just a bunch of paperwork to send in. … CB uses the same technology as AM radio, and as such the communications on CB can be somewhat noisy. Generally, local communications on ham radio are done using FM technology, so there is very little noise. **Most ham radio receivers are capable of receiving public service communication, just like a scanner.** In some states, a Ham Radio license is required to lawfully carry a police scanner in a car. Hams can also transmit on public service frequencies when given written authorization. Also, in certain emergencies hams can use any frequency to call for help or to answer a request for help. … **While of questionable legality, most scanners and ham radios are capable of receiving signals from cordless phones or baby monitors. …**"

Antennas

Little whip antennas, wire antennas in trees, and antennas atop a tower are all used, depending on the frequency in use. Lower frequencies have longer wavelengths. Longer wavelengths need larger antennas. The same antennas (used to transmit and receive) can be small, portable, put in trees or on the trunk of a car.

Hams, including the writer of this article, have communicated with other hams using the following types of antennas with antenna tuners:

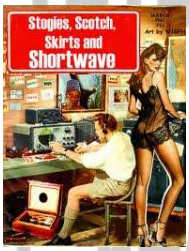
- Metal window screens in upper floors of hotels and motels
- Aluminum extension ladders, insulated from the ground, leaning against a house (the lower the frequency, the longer the ladder)
- Soldered-together rain gutters and downspouts
- Flat copper "burglar-tape" hidden behind wallpapered walls
- Extended "Slinky" toys supported by a rope through the middle, in an attic
- Camera-tripod-supported whip antenna
- Disguised flagpoles fed with buried coaxial cable
- Fine wires cast with a fishing rod between dormitory buildings

What keeps ham operators from transmitting on the same frequency?

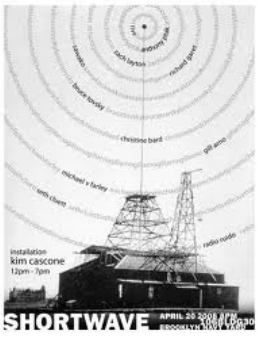
Many hams can be on the same frequency, but it depends on the propagation factors. VHF and UHF are line-of-sight, so many hams can be on the same frequency in one state. On short-wave bands, radios have **variable frequency tuning** to allow moving your transmitted signal (in very small increments) in between two other transmitting stations. Hams often do a lot more listening than transmitting. Often, they listen for another ham that identifies the station as being in a sought-after county, state, or country.

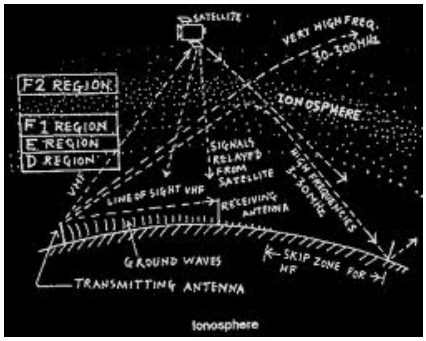
Hams collect confirmations of contacts using **QSL cards**. Hams collect the QSL cards and receive awards for contacting so many countries on certain frequency bands. VHF and UHF hand-held radios typically use **channeled** communications, using selectable fixed frequencies.

When it came to Shortwave Radio, the broadcast kind only, I could not find anything on ranges.


However your emergency alternative powered radio should include shortwave bands, so you can keep abreast of how the current crisis is affecting not only your country but other countries too. Knowing what is going on around you is known as “situational awareness” and it is vital to surviving the crisis at hand with the least trials and tribulations.





One of the best articles I found on shortwave was by Radio Shack at http://support.radioshack.com/support_electronics/doc66/66356.htm. Here is a synopsis of what that article says:

What is a shortwave radio?

On the technical side, a shortwave radio is a receiver that can receive radio transmission on frequencies between 3 and 30 MHz. The main characteristic of these frequencies is their ability to "propagate" for long

distances, making possible such world-wide communications as international broadcasting and coordination of long-distance shipping.

What do I need to know to use one?
Shortwave listening is a hobby with thousands of participants worldwide, and all you need to know to begin is how to tune a radio. There are no special knowledge or skill requirements; however, as you gain experience and develop special listening techniques, your listening enjoyment increases accordingly. These skills include keeping up on local and non-local issues which affect the broadcast, knowing how to troubleshoot your radio and antenna installation and maintenance. The basic equipment you would need is a radio and a list of frequencies. In most cases, you can receive many stations using the antenna that comes with the radio; however, to receive more distant stations, you can use an external long-wire antenna.

Shortwave radios are distinguished from each other by tuning method, size, and frequency range.

Here is what one manufacturers site had to say about 2-way Hand-Held UHF and VHF ranges (http://www.rfwiz.com/Maxon/RadioSelectionHelp.htm):

2-Way Radio Model Suggestion Table
(general suggestions only - no guarantee of range or service)

REQUIREMENTS			FREQ	ANT GAIN dB/TYPE/SIZE				MODEL SUGGESTION			
OPERATION	RANGE	AREA TYPE	BAND	BASE	MOB	RPTR	PORT	BASE	RPTR	MOBILE	PORT
Public Safety/ Business	25 m	Flat Terrain/ Rural	VHF UHF	0	0-3	NONE	FULL/ SHORT	Base1	NONE	Mobile1 Mobile2	Port 1 Port 2
Public Safety/ Business	25 m	Varied Terrain	VHF UHF	0-3	3	3-6	FULL	Base1	SRC-40	Mobile	Port 1 Port 2
Public Safety/ Business	25 m	Difficult Terrain	VHF UHF	3+	3+	6-10	FULL	Base2 Base1	Rptr2 SRC-40	Mobile2 Mobile1	Port 1 Port 2
Public Safety/ Business	10-25 m	Urban/City	UHF	3+	3+	6-10	FULL	Base2 Base1	Rptr2 SRC-40	Mobile2 Mobile1	Port 1 Port 2
Industrial	5-10 m	Buildings/ Structures	UHF	3+	3+	6-10	FULL/ SHORT	Base2 Base1	Rptr2 SRC-40	Mobile2 Mobile1	Port 1 Port 2
University	5-10 m	Buildings/ Structures	UHF	3+	3+	6-10	FULL	Base1 Base2	Rptr1 Rptr2	Mobile1 Mobile2	Port 1 Port 2
Dispatch	10-25 m	Rural	VHF	3-6	3+	NONE	FULL	SB-6K	NONE	Mobile1	Port 1 Port 2
	5-10 m	Urban/City	UHF	0-3	0-3	3-6	FULL/ SHORT	Base1	SRC-40 SR-6K	Mobile1	Port 1 Port 2

Farming	25+ m	Flat Terrain/ Rural	**VHF**	3-6+	3+	NONE	FULL	SB-6K	NONE	Mobile2 Mobile1	Port 1 Port 2
Hiking/ Hunting	5-7 m 2-5 m	Flat Terrain/ Rural	**VHF**				FULL SIZE				PL5161 MURS25 PL2415 MURS22
	.25-2 m 2-5 m	Varied Terrain	**VHF**				FULL SIZE				PL1145 PL5161 MURS25
	1-2 m	Difficult Terrain	**VHF**				FULL SIZE				PL5161 SP300 MURS25
Hunting/ Fishing	1-5 m	Varied Terrain	**UHF**				SHORT				GMRS-310
Family/ Small Groups	2-5 m	Varied Terrain	**VHF** **UHF**				FULL SIZE				MURS25 MURS22

A general note on radio communications: Although a license is required for normal use with some methods, *anybody* who knows how to operate one may do so in an emergency, at least in the U.S. and Canada. This is allowed only for the communications necessary to deal with the emergency.

For example in the very rural and wilderness areas of Alaska there are more unlicensed HAM and Shortwave radio operators than licensed. Since they only go on the air once a week or so for "check ins", the FCC currently leaves them alone.

"We have two ears and one mouth
so that we can listen twice as much as we speak."
Epictetus
(Greek philosopher associated with the Stoics, AD 55-c.135)

Which brings me to **Pirate Radio:** Typically these are people who are utilizing radio communication methods that require a FCC license, yet do not have one. As with all kinds of groups, there are extremists that are indeed; rude, crude, obnoxious and inconsiderate. Of all the Pirate Radio operators that I have met, NONE of them fell into this category. The people I met only went on the air every 3-4 months to

"check-in" and are of the belief that for this type of radio communication, no license is necessary – merely knowledge and common courtesy. I tend to agree.

The few rotten apples in Pirate Radio need a lesson in the Golden Rule – *Only be rude, crude, obnoxious and inconsiderate when some other radio operator is that way to you and only if you wish to lower yourself to their level.* Or just be a better human and ignore them until they are off the air. These types of "pirate radio operators" need to grow up and face the fact that not every radio operator desires to kick the "FCC's butt" in this fashion or wishes to trample over the average radio operator. The true way to get civilian radio back into civilian hands is to be adult, mature, responsible, considerate and courteous. Then and only then will the FCC stick to military, business/commercial and public safety "bands/frequencies" regulations.

"True eloquence consists in saying all that is necessary, and nothing but what is necessary."
Heinrich Heine

Methods of Communication for Very-local Group Communication

The following suggestions are for very-local neighborhood groups. Your implementation may vary depending upon colloquial circumstances. This is not a one-size fits all approach.

- You want to choose simple-language communication methods rather than try to teach ten-codes or other similar codes used by public safety communicators. The general public speaks in words so stick with plain language call signs also called tactical identifiers.
- Minimize future confusion by encouraging neighbors to use their radios for family use and events around the neighborhood.
- Make FRS radios and perhaps even GMRS a tool of your local Neighborhood Watch.

Mistakes to Avoid in Group Communications

- CERT organizations have no right under law to issue GMRS radios to unlicensed volunteers. There is a trend developing of jurisdictions purchasing the twenty-two channel bubble-pack GMRS radios and issuing these radios to volunteers. The uniformed believe these are FRS radios. Jurisdictions tell volunteers to use the channels that do not require a license and to avoid using the higher power GMRS channels unless told to do so. Some jurisdictions even make up their own rules to say when volunteers can use GMRS channels without license authority. This is inconsistent with the license requirements for these radios and is against FCC Rules. It is not good planning. Do not make this mistake or you will run afoul of the law. Read the GMRS Rules in FCC R&R Part 95. Observe the license requirements for radios certified as GMRS radios.
- Do not make the assumption that you have the right to do as you please with a GMRS radio because you represent a police, fire, or OEM agency. The Federal Communications Commission makes the rules and enforces the rules. You may not interpret the rules for your own benefit.

- Amateur Radio operators, public safety jurisdictions, nor OES/OEM's should assume that they have the right to use GMRS radios without a license or to issue GMRS radios to non Hams in order to outfit citizen ACS teams. (Auxiliary Communications Service teams.)
- Assume that your illegal operations on GMRS will be noticed. Do not break the law. There is an ever growing membership of the Personal Radio Association taking responsibility for monitoring GMRS nationwide. Unlicensed operation is reported to the Federal Communications Commission. You could find you or your agency having to explain to the FCC why you have ignored and operated outside of the FCC Rules.
- Do not permit Amateur Radio operators assisting as communications volunteers to use modified Amateur Radio equipment on GMRS frequencies. This is not allowed under FCC Rules. Permitting your volunteers to break the law is not the right thing to do. Local ARES/RACES leaders should certify that all Amateur Radio communications disaster service volunteers do not operate with modified equipment.
- Do not permit public safety employees to program GMRS channels in public safety radios or to use modified Amateur Radios on public safety frequencies.
- Do not assume that your organization has the right to commandeer a GMRS or FRS channel for your exclusive use.

Common Abbreviations

Common Abbreviations	
AM	Amplitude Modulation
Broadcast	to transmit like televison or commercial radio
CTCSS	Continuous Tone Coded Squelch System
DTMF	Dual Tone Multi-Frequency
FM	Frequency Modulation
Freq	radio frequency
GPRS	**General Packet Data Service** Is used for internet packet data for mobile devices.
GPS	**Global Positioning System** Works by connecting with satellites out in space. GPS is mainly used for guided navigation of roads, streets and terrain. It works anywhere in the world, even if you are in the middle of nowhere (provided your GPS device is fully charged).
Ham	an amateur radio operator licensed by the FC (T ech, General, Extra)
HT	means handheld transceiver or handy talkie
LSB	Lower Side Band
LTZ	Long Tone Zero - Transmission of a DTMF '0' for a long relative time (usually > 2-3 seconds) used for specific control of repeaters and related equipment.
Mic, Hand	a small microphone/speaker attached by a cord to your radio
Mic, Speaker	a small microphone/speaker attached by a cord to your radio
Mod	Modulation : The mechanism for impressing information (voice or data) onto a carrier frequency.
NET	Network
Receive	listen to a 2-way radio
SSB	Single Side Band
Sub-Aud	Sub-Audible: Refer to CTCSS
USB (radio not PC)	Upper Side Band

"The single biggest problem in communication is the illusion that it has taken place."
George Bernard Shaw

Miss-Communication

Any verbal communication, using any voice transmission method, leaves plenty of room to for "miss-communication". Letters and or words can be heard incorrectly or may sound the same and still make sense in the sentence being transmitted. For this reason the Phonetic Alphabets and "10 Codes" were created.

Phonetic alphabets In a noisy environment, phonetic spelling of certain words made be required for understanding. These are the standard phonetic alphabet utilized by civilian, military and aviation as specified by the International Administrative Radio Union, which is a international governing body on communications standards.

Letter	Military	Civilian
A	Alpha	Adam
B	Bravo	Boy
C	Charlie	Charles
D	Delta	David
E	Echo	Edward
F	Foxtrot	Frank
G	Golf	George
H	Hotel	Henry
I	India	Ida
J	Juliet	John
K	Kilo	King
L	Lima	Lincoln
M	Mike	Mary
N	November	Nora
O	Oscar	Ocean
P	Papa	Paul
Q	Quebec	Queen
R	Romeo	Robert
S	Sierra	Sam
T	Tango	Tom
U	Uniform	Unicorn
V	Victor	Victor
W	Whiskey	William

X	X-ray	X-ray
Y	Yankee	Young
Z	Zulu	Zebra

10, 11 & Q Codes

Ten-codes, or 10-codes, are codes used in two-way voice radio communication as numeric code words for frequently used messages.

Ten codes were invented to help reduce use of speech on the radio. Use of the codes was expanded in 1974 by the Association of Public Safety Communication Officials (APCO), allow for brevity and standardization of message traffic.

Ten-codes were used particularly by law enforcement and in Citizen's Band (CB) radio transmissions. They originated in the United States law enforcement community before World War II. The first set of 10-codes was published by the Association of Public-Safety Communications Officials in 1940.

There is no universal, official set of 10-codes, and the meanings of a particular 10-code can vary between one police jurisdiction and another.

CB 10 & HAM Q Codes

Amateur radio hams do not use ten-codes. Instead they use ***Q codes***, which are derived from Morse code. Ten codes are highly discouraged in amateur radio use, however many were quickly picked up by the **Citizen Band or CB radio** users. Many have similar meanings.

10 codes originated in the USA and are, apparently, only used in English-speaking countries. However, no matter which codes are used in your country, be aware that there are local dialects in every urban area and region. You have to listen to others to learn the phrases and codes in your area.

Be aware that the use of codes specifically to obscure the meaning of a transmission is probably illegal in most countries. *The difference is this - codes which are well known and make communications shorter or more efficient are normally allowed.*

CB 10-Codes

Code	Meaning
Yes	Affirmative
No	Negative
Right	Correct or Affirmative
10-1	Receiving Poorly
10-2	Receiving Well
10-3	Stop Transmitting
10-4	Message Received
10-5	Relay Message
10-6	Busy, Stand By
10-7	Out of Service, Leaving Air (you're going off the air)

10-8	In Service, subject to call (you're back on the air)
10-9	Repeat Message
10-10	Transmission Completed, Standing By (you'll be listening)
10-11	Talking too Rapidly
10-12	Visitors Present
10-13	Advise weather/road conditions
10-16	Make Pickup at...
10-17	Urgent Business
10-18	Anything for us?
10-19	Nothing for you, return to base
10-20	"What's your location?" or "My location is..." Commonly asked as "What's your 20?"
10-21	Call by Telephone. Before cell phones this meant Landline.
10-22	Report in Person too .....
10-23	Stand by
10-24	Completed last assignment
10-25	Can you Contact .....
10-26	Disregard Last Information/Cancel Last Message/Ignore
10-27	I am moving to Channel .....
10-28	Identify your station
10-29	Time is up for contact
10-30	Does not conform to FCC Rules
10-32	I will give you a radio check
10-33	Emergency Traffic at this station
10-34	Trouble at this station, help needed
10-35	Confidential Information
10-36	Correct Time is .....
10-38	Ambulance needed at .....
10-39	Your message delivered
10-41	Please tune to channel .....
10-42	Traffic Accident at .....
10-43	Traffic tie-up at .....
10-44	I have a message for you (or .....)
10-45	All units within range please report
10-50	Break Channel
10-62	Unable to copy, use phone
10-62sl	unable to copy on AM, use Sideband - Lower (not an official code)
10-62su	unable to copy on AM, use Sideband - Upper (not an official code)
10-65	Awaiting your next message/assignment
10-67	All units comply
10-70	Fire at .....
10-73	Speed Trap at .....
10-75	You are causing interference
10-77	Negative Contact
10-84	My telephone number is .....
10-85	My address is .....
10-91	Talk closer to the Mike
10-92	Your transmitter is out of adjustment

10-93	Check my frequency on this channel
10-94	Please give me a long count
10-95	Transmit dead carrier for 5 sec.
10-99	Mission completed, all units secure
10-100	Need to go to Bathroom
10-200	Police needed at .....

Q Codes

Q codes are used in many kinds of radio communications, including CB sideband but not typically on CB AM. (If your radio doesn't have sideband, don't worry about Q codes.) Q codes originated with amateur radio but their use in CB, even more so than 10 codes, can vary depending on who published the list.
Q codes may be used to ask questions (QTH?) or to answer them (QTH is 5th and Ivy Streets.)

The ARRL Handbook and the ARRL operating guides have more complete listings of those used for amateur radio. (ARRL is an amateur radio organization.) Historically, the Q signals were instituted at the 'World Administrative Radio Conference' (WARC) in 1912. Because of their international origin, Q codes may be more accepted outside English-speaking countries than 10 codes are.

The following is an abbreviated list of Q codes borrowed from Amateur Radio (HAM):

Code	Meaning
QRM	man made noise, adjacent channel interference
QRN	static noise
QRO	increase power
QRP	reduce power
QRT	shut down, clear
QSL	confirmation, often refers to confirmation cards exchanged by hams
QSO	conversation
QSX	standing by on the side
QSY	move to another frequency
QTH	address, location

The following is from a list of Q codes used by the X-Ray Club (a sideband-users club headquartered in Paradise, California):

QRL	Busy, Stand By
QRM	Man Made Interference
QRT	Stop Transmit or Shutting Down (same as 10-7 on AM)
QRX	Stop Transmit or Standing By
QRZ	Who is Calling?
QS	Receiving Well
QSB	Receiving Poorly
QSK	I have something to Say or Station breaking QSM Repeat Message
QSO	Radio Contact
QSP	Relay Message
QSX	Standing By (same as 10-10 on AM)
QSY	Changing Frequency
QTH	My Location is... or What's your location?

QTR	Correct Time

For a nice little nostalgic trip check out the downloadable PDF called *CB Lingo & Diner Information* @ http://gwally.com/directions/pdf/cblingo.pdf

Public Safety, Police, Fire Scanner 10, 11 & Penal Codes

Just like Citizens Band Radio, the Public Safety groups created numerical codes to reduce miss-communications, relay plenty of information with few words, as well as to camouflage the sometimes harsh realities that they face from civilian ears – like "dead body found", etc.

In a crisis situation if you have a scanner and listen in you can keep abreast of what is going on in your area.

While law enforcement "ten codes" were intended to be a concise, and standardized system*, the proliferation of different meanings has rendered it somewhat useless for situations where people from different agencies and jurisdictions need to communicate.* ***In 2005, the United States Federal Emergency Management Agency (FEMA) discouraged the use of ten-codes and other codes due to their high variability in meaning. The U.S. Department of Homeland Security reportedly has plans to do away with 10-codes as well.***

Some organizations and municipalities also use other codes in addition to ten-codes. For example, the California Highway Patrol uses "eleven-codes", and the Port Authority Police uses "eight codes".

Keep in mind that some localities may "alter" these codes, however for the most part this is what has been utilized.

Per several sites/sources this list is from: ***Official Ten-Code List*** **of the Association of Public Communications Officers (APCO).**

10 Code	Meaning	11 Code	Meaning
10-0	Caution	11-7	Prowler
10-1	Unable to copy -- change location	11-10	Take a report
10-2	Signal good	11-24	Abandoned vehicle
10-3	Stop transmitting	11-25	Traffic hazard
10-4	Acknowledgement (OK)	11-26	Disabled vehicle
10-5	Relay	11-27	Driver's license check, Rush
10-6	Busy -- stand by unless urgent	11-28	Vehicle registration check, Rush
10-7	Out of service	11-29	Clear, no warrants
10-8	In service	11-30	Missing person
10-9	Repeat	11-41	Ambulance
10-10	Fight in progress	11-44	Fatality
10-11	Dog case	11-45	Suicide
10-12	Stand by (stop)	11-48	Transport
10-13	Weather -- road report	11-50	Field interrogation
10-14	Prowler report	11-51	Security check
10-15	Civil disturbance	11-79	Traffic Collision - ambulance responding
10-16	Domestic disturbance	11-80	Traffic Collision - major injury

10-17	Meet complainant	11-81	Traffic Collision - minor injury
10-18	Quickly	11-82	Traffic Collision - non-injury
10-19	Return to ...	11-83	Traffic Collision - no details
10-20	Location	11-84	Direct traffic
10-21	Call ... by telephone	11-85	Tow truck
10-22	Disregard	11-86	Special assignment
10-23	Arrived at scene	11-98	Meet with...
10-24	Assignment completed	**11-99**	**Officer needs help**
10-25	Report in person (meet) ...		
10-26	Detaining subject, expedite		
10-27	Drivers license information		
10-28	Vehicle registration information		
10-29	Check for wanted		
10-30	Unnecessary use of radio		
10-31	Crime in progress		
10-32	Man with gun		
10-33	**Emergency**		
10-34	Riot		
10-35	Major crime alert		
10-36	Correct time		
10-37	(Investigate) suspicious vehicle		
10-38	Stopping suspicious vehicle		
10-39	Urgent -- use light, siren		
10-40	Silent run -- no light, siren		
10-41	Beginning tour of duty		
10-42	Ending tour of duty		
10-43	Information		
10-44	Permission to leave ... for ...		
10-45	Animal carcass at ...		
10-46	Assist motorist		
10-47	Emergency road repairs at ...		
10-48	Traffic standard repair at ...		
10-49	Traffic light out at ...		
10-50	Accident (fatal, personal injury, property damage)		
10-51	Wrecker needed		
10-52	Ambulance needed		
10-53	Road blocked at ...		
10-54	Livestock on highway		
10-55	Suspected DUI		
10-56	Intoxicated pedestrian		
10-57	Hit and run (fatal, personal injury, property damage)		
10-58	Direct traffic		
10-59	Convoy or escort		
10-60	Squad in vicinity		
10-61	Isolate self for message		
10-62	Reply to message		

10-63	Prepare to make written copy		
10-64	Message for local delivery		
10-65	Net message assignment		
10-66	Message cancellation		
10-67	Clear for net message		
10-68	Dispatch information		
10-69	Message received		
10-70	Fire		
10-71	Advise nature of fire		
10-72	Report progress on fire		
10-73	Smoke report		
10-74	Negative		
10-75	In contact with ...		
10-76	En route ...		
10-77	ETA (estimated time of arrival)		
10-78	Need assistance		
10-79	Notify coroner		
10-80	Chase in progress		
10-81	Breathalyzer		
10-82	Reserve lodging		
10-83	Work school xing at ...		
10-84	If meeting ... advise ETA		
10-85	Delayed due to ...		
10-86	Officer/operator on duty		
10-87	Pick up/distribute checks		
10-88	Present telephone number of ...		
10-89	Bomb threat		
10-90	Bank alarm at ...		
10-91	Pick up prisoner/subject		
10-92	Improperly parked vehicle		
10-93	Blockade		
10-94	Drag racing		
10-95	Prisoner/subject in custody		
10-96	Mental subject		
10-97	Check (test) signal		
10-98	Prison/jail break		
10-99	Wanted/stolen indicated		
10-100	dead body		
10-200	alarm		

Misc Public Safety Scanner Codes Commonly Used

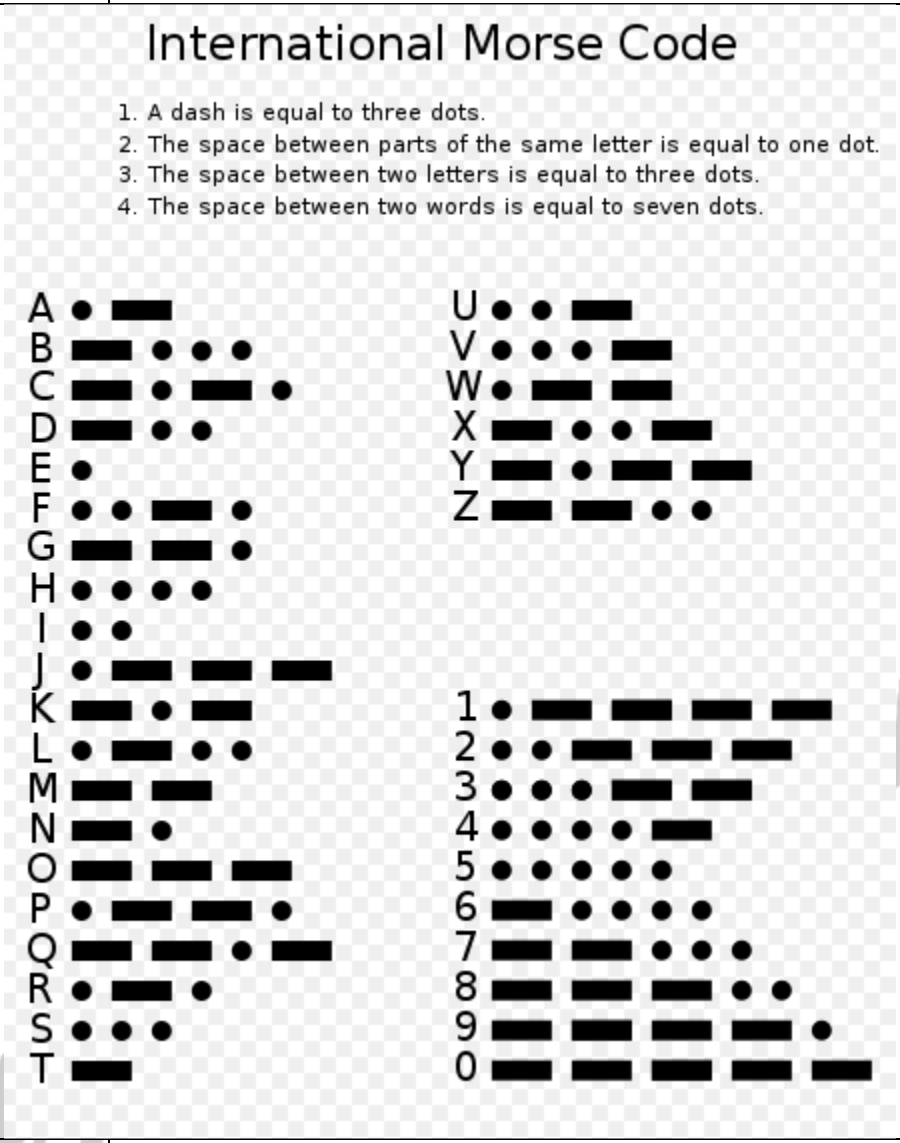
Code	Meaning	Code	Meaning
CODE 1	Low Priority Respond To This Call As Soon As Possible, NO Lights / Siren	CODE 2	Medium Priority Respond To This Call NOW, Using Lights / Siren IF NEEDED
CODE 3	Top Priority Respond To This Call NOW, LIGHTS / SIREN, EXPEDITE !	All Cars STOP TRANSMITTING or CODE 3 ON	An emergency on frequency. Also a "BOLO" refers to a BULLETIN being sent to all departments.

		FREQUENCY	
1	Criminal Homicide	2	Rape
3	Robbery	4	Assault
5	Burglary	6	Burglar Alarm At ____
7	Theft (and Theft of Services)	8	Criminal Mischief
9	Weapons Offence	10	Sex Offence
11	Suspicious Vehicle	12	Suspicious Person
13	Disorderly Conduct	14	Escort
15	Public Drunk	16	Domestic Violence
17	Juvenile Problem or Offence	18	Mentally Disturbed
19	Police Arrest	20	Missing Person
21	Ordinance Violation	22	Dog or Animal Complaint
23	Automobile Accident	25	Fire at Location ____
26	Injury or Death at ____	30	Check Wants and Warrants (Police Use The NCIC System and CLEAN Systems, plus SHERIFF)
31	Go To Channel 1	32	Go To Channel 2
33	Go To Channel 3	34	Go To Channel 4
40	DOA (Dead on Arrival or Dead at the Scene, also 10-7, 10-40, and Code F)	42	Metal Patient
48	Overdose	49	Suicide (Only Fatal when used with 10-7, 10-40, Code F, or Code 26)
51	Call by Telephone		
SIGNAL 13	**OFFICER DOWN, SEND IMMEDIATE HELP**		
By Fire / Rescue / Ambulance			
Code 10	Critical Trauma case	Code 20	Acute Trauma case
Code 30	Trauma case	Code 40	Serious case (IV started)
Code 50	Basic transport (not serious)	Code N	Newsworthy event

"The biggest mistake is believing there is one right way to listen, to talk, to have a conversation -- or a relationship." Deborah Tannen

Other Methods of Communication

Morse Code	Morse code is a method of transmitting textual information as a series of on-off tones, lights, or clicks that can be directly understood by a skilled listener or observer without special equipment. The International Morse Code encodes the Roman alphabet, the Arabic numerals and a small set of punctuation and procedural signals as standardized sequences of short and long signals called "dots" and "dashes" respectively, or "dits" and "dahs". Because many non-English natural languages use more than the 26 Roman letters, extensions to the Morse alphabet exist for those languages. Each character (letter or numeral) is represented by a unique sequence of dots and dashes. The duration of a dash is three times the duration of a dot. Each

	dot or dash is followed by a short silence, equal to the dot duration. The dot duration is the basic unit of time measurement in code transmission.
	
Semaphore	In the days before wired telegraphy, a code was used to send messages over long distances called a semaphore. Basically, the sender stood atop a hill holding a brightly colored flag in each hand. He would face the receiving station and raise his arms up out to his sides, and the angle at which he held his arms would signify a given numeral or letter. You can still see this in use (in a modified format) today with marine signal flags.
Sign Language - American	Sign language consists of an alphabet and a set of symbols each represented by a set of hand signals. This information is quiet, covert, and generally unknown within the non-hearing impaired community. Like Morse and Semaphore this could provide a clandestine and useful communications alternative with practice.
Smoke Signals	Not only were smoke signals used by natives on almost every continent, in the early years of the cross country auto racing smoke signals were a common means of communication. Smoke signals had many limitations including the necessity of carrying wood, visibility problems at night, wind, and the time necessary to generate a fire.

PA Systems	This is a one-way system. This involves a CB-like device on the inside and a speaker on the outside. Some are powered via 12V, some need to be wired to a battery. Here's a sample of one (http://www.radioshack.com/product/index.jsp?productId=2572006&cp=&pg=2&sr=1&origkw=pa+system&kw=pa+system&parentPage=search). These can also be somewhat effective for playing music though PA speakers usually aren't sufficient for music.
Bullhorn	This is a very simple PA system. Smaller ones may or may not work depending on the volume. Large ones are effective, but take up a lot of space. These can be anywhere from $25 to $100.

"When people talk, listen completely.
Most people never listen."
Ernest Hemingway

There is no getting around the fact that during a crisis you need some way to stay in touch with the world around you. Whether it's a $25.00 solar-powered radio or a $1,000-plus Amateur Radio system, you need a means of receiving information and if possible, a way of transmitting it (2-way communication). This is important not only for you and your family's personal safety, but also for your psychological well-being too.

My personal Emergency Radio favorite that has several power sources for hearing what is going on around me and it also lets me use short-range 2-way communications if my other systems are down is:

Midland XT511 2-Way Camp Radio w/emergency crank power

5 sources of power: dynamo Crank, AC/DC adapters, rechargeable and alkaline batteries
NOAA all hazard weather alert radio with override
AM/FM radio

- PLL drift free weather broadcast reception
- 1 2 1 privacy codes
- 22 channel 2-way radio w/mic
- channel scan
- auto squelch
- VOX
- hi/lo power settings
- large LCD with backlighting
- 3 LED flashlight
- water resistant
- clock with alarm
- USB connector

Shop around as I got this for $75.00 when on sale, otherwise can sell for up to $175.00.

This is for emergencies only and will NOT replace any other longer term and longer range 2-way communication system.

Recap

- Select the type of communications needed: One-way or Two-way
- Select the conditions which you will be transmitting and receiving in. (Terrain, distance, mobile, base, hand-held)
- Determine who you wish to talk with and where they are and what equipment they have.
- For two-way communications form a "listener network" of people and set a schedule to practice via pre-scheduled check-in exercises.
- Review your budget to determine the funds needed to obtain the knowledge, training, licensing (if necessary) and equipment to meet your crisis communication needs.

Remember no communication method is 100% perfect for 100% of the situations you may find yourself in. You may need more than one method.

Well that is it for now folks. Hope this helps you with your Crisis Communication planning.

TNT

PS- Resources follow

Resources

Note: Bolded titles are of particularly good quality.

Title	Link
10 Essentials Checklists	http://www.scribd.com/doc/50950295/10-Essentials-Checklists-Actions-Supplies-Items-Be-Wise-Evac-Kit-EspfocusORG-BepreparedHoustonCOM-Vr-2
1906-Wireless Telegraphy and Telephony Wireless Radio	http://www.scribd.com/doc/34755492/1906-Wireless-Telegraphy-and-Telephony-Wireless-Radio
1931-The Amateur Radio ARRL Handbook	http://www.scribd.com/doc/29177270/ARRL-Handbook-1931
2-Way Radio Model Selection Help & Applications for Handheld; CB & Amateur Radio Antenna Selector	http://www.rfwiz.com/Maxon/RadioSelectionHelp.htm
2-Way Radio Range-How Far Can Two-Way Radios Communicate?	http://www.docstoc.com/docs/70496988/2-Way-Radio-Range-How-Far-Can-Two-Way-Radios-Communicate
Abbreviations / Glossary	http://www.its.bldrdoc.gov/fs-1037/
All About Antennas	http://www.ac6v.com/cb.htm
Allocation of Radio Spectrum in the United States	http://www.jneuhaus.com/fccindex/spectrum.html
ALYX Antenna Guide	http://www.antenna.be/art4.html
Amateur Radio Emergency Communication (ARRLWeb: Backgrounder)	http://www.arrl.org/amateur-radio-emergency-communication
Amateur Radio QRP Calling Frequencies	http://www.smeter.net/spectrum/amateur-qrp.php
Antenna Dipole FAQs	http://www.varaces.org/techrefs/HamstickDipoleFactSheet.pdf
Antenna Selection and Installation Primer	http://www.warrenelectronics.com/antennas/antenna_guide.htm
Antenna Selection Guide AN058	http://focus.ti.com/lit/an/swra161b/swra161b.pdf
Architectural Issues for *Integrating Tactical Radio* Access Networks in *Civilian Infrastructure*	www.research.telcordia.com/society/TacCom/papers99/41_4.pdf http://www.research.telcordia.com/society/TacCom/papers99/41_4.pdf
Aviation Radio Bands and Frequencies	http://www.smeter.net/spectrum/aviation.php
Band Plan	http://www.arrl.org/band-plan-1

Bandwidth (signal processing)	http://en.wikipedia.org/wiki/Frequency_bandwidth
Basic Comms: Level 1 "Portable"	http://www.survivalmonkey.com/Basic%20Comms-Level%201-%20Portable.htm
Batteries for Emergency Communications	http://www.unitedstatesaction.com/batteries_for_emergency_communication.htm & http://www.k3emd.com/Technical%20References.htm
Best All Purpose Emergency Radio?	http://www.survivaltopics.com/forums/general-survival-gear/3088-best-all-purpose-emergency-radio.html & http://www.survivalistboards.com/showthread.php?t=67218
Best Emergency Radio	http://www.pcecg.org/BestEmergencyRadio.pdf
Best Emergency Radio	http://www.bestcovery.com/best-emergency-radio
Best Emergency Radio?	http://www.wastateares.org/articles/BestEmergencyRadioRev1Oct01.htm
Broadcast Radio Bands	http://www.smeter.net/spectrum/broadcast.php
Building the Highly-Versatile-Orange-Box HVOB Communications go-kit	http://home.comcast.net/~buck0/How_to_build_HVOB.pdf
Buying the right emergency radio	http://www.backwoodshome.com/articles2/yago98.html
CB FAQs – Modes, Features & Range	http://www.advancedspecialties.net/cb-radio-faq.htm
CB Radio, reception, models mods & More.	http://www.advancedspecialties.net/cb-radio-faq.htm
Communicating During Emergencies	http://www.fcc.gov/guides/emergency-communications
Communication for Survival	http://www.rogueturtle.com/articles/survcomm.php
Communications for the Wilderness	http://www.ssrsi.org/Onsite/PDFbin/Communications%20Equipment%20in%20the%20Wilderness.pdf
Difference between GPS and GPRS	http://recomparison.com/comparisons/100501/gps-vs-gprs-what-is-the-difference/
Difference Between RFID and NFC	http://www.differencebetween.net/technology/difference-between-rfid-and-nfc/
Difference between Satellite Radio, Ham Radio and Short Wave Radio	http://recomparison.com/comparisons/100279/satellite-radio-vs-ham-radio-vs-short-wave-radio/

Differences Between Radio Methods	http://www.ehow.com/facts_7255061_difference-wave-ham-radio-license.html
Differences Between Wideband and Narrowband NIFC Tutorial	www.npstc.org/download.jsp?tableId=37&column=217&id=526
Distress, Disaster, and Emergency Communications	edocket.access.gpo.gov/cfr_2007/octqtr/pdf/47cfr2.403.pdf
Electromagnetic Spectrum	http://imagine.gsfc.nasa.gov/docs/science/know_l1/emspectrum.html
Elements and Considerations of a Successful Disaster Preparedness Supplemental Communications Plan using the Personal Radio Services	http://modernsurvivalonline.com/Files/communication/disaster%20communications.pdf
Emergency Communication Disaster Response Plan	http://www.emergencycommunication.org/
Emergency Communication FAQ	http://www.ssrsi.org/Onsite/scomfaqs.htm
Emergency Communications	http://theepicenter.com/tow08147.html
Emergency Communications (an intro to CB, GMRS, and Ham radio)	http://theepicenter.com/tow08147.html
Emergency Communications Over Two-Way Radio	http://blogs.knoxnews.com/silence/archives/2005/09/emergencies_and.shtml
Emergency Radio Communications	http://www.emergencycommunication.org/
Emergency Radio Communications	http://www.hawaiirepeaters.net/emercom/emerfund.html
Family Radio Service (FRS)	http://wireless.fcc.gov/services/index.htm?job=service_home&id=family
FCC ONLINE TABLE OF FREQUENCY ALLOCATIONS	http://www.fcc.gov/oet/spectrum/table/fcctable.pdf
FCC Wireless Services at a Glance May 2011 (HAM, Shortwave, FRS, GMRS, MURS, CB, etc)	http://www.scribd.com/doc/56495877/FCC-Wireless-Services-at-a-Glance-May-2011
Four Levels of Communication Disruption (measures & countermeasures – looks at CB, MURS, GMRS, FRS)	http://www.remnantsaints.com/Disruption_Levels/
Frequently Asked Questions about the Multi-Use Radio Service (MURS)	http://home.provide.net/~prsg/murs_faq.htm
Fundamentals of radio communication	http://openbookproject.net/books/socratic/output/radio1.pdf
Glossary - Abbreviations	http://www.ac6v.com/morseaids.htm#CW

Glossary of Jargon, Abbreviations and Terminology for: Amateur Radio (HAM), Short Wave	http://www.ac6v.com/jargon.htm
GMRS	http://home.provide.net/~prsg/wi-gmrs.htm
Ham Band Plans and Operating Frequencies	http://ac6v.com/frequencies.htm#HF
Ham Radio Antenna Selection Tips	http://www.hamradiosecrets.com/ham-radio-antenna.html
Ham Radio/HAM vs SSB	http://en.allexperts.com/q/Ham-Radio-2161/ham-vs-ssb.htm
HAM Small Hand-Held - How much range can you get?	http://neufam.com/politics/whatsham.html
HAM Technician license **Tutorials**	search for HAM CRAM; http://www.dxzone.com/cgi-bin/dir/jump2.cgi?ID=20783; WWW.W9PE.US; KB6NU; cwt178b; HamElmer.com ; right-answers (great sample tests)
HF Multiband vertical antenna selection	http://www.iw5edi.com/ham-radio/82/hf-multiband-vertical-antenna-selection
HF Radios for much longer range	http://www.2wayradioslongrange.com/hf-radios-for-much-longer-range.htm
Homeland Security- Emergency Communications	http://www.nationalterroralert.com/communications/
How Radios Work	http://www.tech-faq.com/how-radios-work.html
How to Buy a 2-Way Radio	Modernsurvivalonline.COM
How to Get More Performance From Your Hand Held Radio	Modernsurvivalonline.COM
John Wagner's Shortwave Tips & Tricks	http://www.dxing.com/tips.htm
LAFD - Emergency Preparedness Booklet (great chapter on communications)	*lafd.org/eqbook.pdf*
Line-of-Sight Transmission	http://cnx.org/content/m0538/latest/
List of FCC Licenses	http://www.narte.org/h/fcc.asp?gclid=CKShut7DpKcCFQlPgwodHkEPBg
List of HAM Repeaters Across the US	http://www.artscipub.com/repeaters/
Low Power Radio Service (LPRS)	http://wireless.fcc.gov/services/index.htm?job=service_home&id=low_power
MARS Membership Eligibility Requirements and Responsibilities	http://www.mars.gen.ut.us/marsappins.pdf

Medical Device Radio communications Service	http://wireless.fcc.gov/services/index.htm?job=service_home&id=medical_implant
Multi-Use Radio Service (MURS)	http://wireless.fcc.gov/services/index.htm?job=service_home&id=multi_use
Narrowband Basics	www.megalink.net/~oxctyema/narrowband_basics_presentation.pdf
NOAA Nationwide Station Listing Using Broadcast Frequencies	http://www.nws.noaa.gov/nwr/nwrbro.htm
NOAA Station Listing and Coverage	http://www.nws.noaa.gov/nwr/listcov.htm
NOAA Weather Radio (NWR)	http://www.scribd.com/doc/50950894/NOAA-Weather-Radio-NWR-Handout
North American Center For Emergency Communications	http://www.nacec.org/
Overcoming Common Data Communication Problems	http://www.stevenswater.com/articles/overcoming_data_comm_problems.aspx
Personal Locator Beacons (PLB)	http://wireless.fcc.gov/services/index.htm?job=service_home&id=personal_locator
Personal Radio Services	http://wireless.fcc.gov/services/index.htm?job=service_home&id=personal_radio
Pirate Christian Radio	http://www.piratechristianradio.com/
Quick Guide to the Shortwave Spectrum	http://www.monitoringtimes.com/html/mtSW.html
RACES (Radio Amateur Civil Emergency Service)	http://www.usraces.org/
Radio Communications and ATC Light Signals VI - A Introduction	http://www.airscrew.dk/downloads/faa_cfi/vi_airport_operations.pdf

Radio Control Radio Service	http://wireless.fcc.gov/services/index.htm?job=service_home&id=radio_control
Radio Monitoring a How-to Guide	http://www.scribd.com/doc/31438430/Radio-Monitoring-a-How-to-Guide or http://www.naswa.net/images/Radio_Monitoring_A_How_To_Guide.pdf
Radios for power outages	http://www.consumerreports.org/cro/electronics-computers/news-electronics-computers/emergency-radios-805-power-outage-radios-battery-charger/overview/index.htm?EXTKEY=SG72E00&CMP=KNC-CROELECG&HBX_OU=50&HBX_PK=best_emergency_radio
Real World Ranges for CB, FRS, GMRS and MURS Radios	http://www.thetravelinsider.com/2003/0815.htm
Satellite Radio vs. Ham Radio vs. Short Wave Radio	http://recomparison.com/comparisons/100279/satellite-radio-vs-ham-radio-vs-short-wave-radio/
Scanner Radio Guide	http://advancedsurvivalguide.com/?p=1380
Short Wave Radio Review	http://www.seedforsecurity.com/article.php?articleid=21
Shortwave 101 How to Listen to World Radio	http://www.preppers.info/uploads/General_-_Shortwave_Radio_101.pdf or http://www.pioneerliving.net/Survival%20pdf/General%20-%20Shortwave%20Radio%20101.pdf
Shortwave Frequency List	http://www.ccrane.com/shortwave-frequency-list.aspx
Shortwave Radio - Learning The Basics	http://support.radioshack.com/support_electronics/doc66/66356.htm
Shortwave Radio Listen To The World Live With Your Receiver	http://www.hamuniverse.com/shortwave.html
Shortwave Radio FAQs	http://www.shortwave.org/faq.htm
Shortwave Radio Information for Beginners	http://web.archive.org/web/20080607023330/www.castino.com/radio.htm
Sign Language-The Universal Language of the Plains	http://www.ssrsi.org/Onsite/PDFbin/The%20Universal%20Language.pdf
Spectrum Chart Radio Frequency Bandwidth	http://www.adec.edu/tag/spectrum.html
Spectrum, the Life Blood of Amateur Radio	http://www.iaru.org/spectrum.html
Study of Civilian Radio Licensure and Certification for Veterans	http://www.dol.gov/vets/media/study.pdf

Survival Communications Primer	http://www.ssrsi.org/Onsite/PDFbin/Survival%20Communications%20Primer%203.0.pdf
Survival Radio 101	http://www.solareagle.com/PREP/RADIO101.HTM
Survival Radio 101 - Assata Speaks	http://www.assatashakur.org/forum/liberation-strategy/1851-survival-radio-101-a.html
Tactical Radio	http://www.ssrsi.org/Onsite/tacradio.htm
Tactical Radio Access Networks Based on Future Civilian Wireless	http://ftp.rta.nato.int/public/PubFullText/RTO/MP/RTO-MP-026/$MP-026-04.PDF
The Best Emergency Radios For Families	http://www.suite101.com/content/the-best-emergency-radios-for-families-a164496
The Considerate Operators Frequency Guide	http://www.arrl.org/files/file/conop.pdf
The Difference Between HAM Radio and CB	http://hamslife.com/?p=24
The Official Pirate Radio Kit Site	http://transmitters.tripod.com/
The Radio Spectrum	http://www.smeter.net/spectrum/spectrum.php
The Scoop on FRS & GMRS 2-Way Radios	Modernsurvivalonline.COM
The Shortwave Radio: Things to know before you buy	http://advancedsurvivalguide.com/?p=687
Two-Way Radio Range	http://plat4ma.com/ebaypages/motorola/range.htm
Two-way Radios	http://www.rei.com/expertadvice/articles/twoway+radios.html
Types of Radio Bands	http://www.parxy.com/types-radio-bands.html
Typical Antenna Selection Tips	http://www.locusinc.com/pdf/Antenna%20Selection%20Tips.pdf
US Amateur HAM Radio Bands	http://www.arrl.org/files/file/Hambands_color.pdf
US Army MARS Basic Training Course 12-10 rev 1 01b	http://www.armymars.net/ArmyMARS/MARS-Training/BTC%202010/BASIC%20Course%2012-10.pdf
US HF Amateur Bands	http://www.ke7hlr.com/hfbands/hfbandplan.pdf
US Radio Frequency Allocation Chart as of October 2003	http://www.ntia.doc.gov/osmhome/allochrt.pdf (in order for me to actually read the thing I view it at 100%)
USA Government emergency communications systems	http://transition.fcc.gov/cgb/consumerfacts/emergencies.html

What Are Different Types of Radio Operator Jobs?	http://www.wisegeek.com/what-are-different-types-of-radio-operator-jobs.htm
What is A.N.T.S. – Americans Networking To Survive?	http://www.scribd.com/doc/50950342/ANTS-%E2%80%93-Americans-Networking-To-Survive
What Is ARRL?	http://www.scribd.com/doc/53208556/What-is-ARRL
What is line of sight communication?	http://wiki.answers.com/Q/What_is_line_of_sight_communication
What is the difference between a VHF and UHF radio?	http://www.trendbreaking.com/radio-cb-ham-shortwave/uhf-whip/
Which Radio Is Best for Emergency Comms By Virginia RACES	http://www.pcecg.org/BestEmergencyRadio.pdf
Which Radio Services Require a License?	http://www.tech-faq.com/do-i-need-a-license-to-use-one-of-these-radios.html
Windup emergency radio - Grundig Radio FR200	http://articles-and-reviews.net/emergency-radio.htm & http://www.hamuniverse.com/emergencyradio.html
Wireless Medical Telemetry	http://wireless.fcc.gov/services/index.htm?job=service_home&id=wireless_medical_telemetry