EMERGENCY & RADIO COMMUNICATIONS

for Outdoor Guides and Leaders

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Version 2.4

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Introduction

This article was written as a result of the large number of inquiries that I have received in the past regarding radio communications, emergency signaling, emergency beacons and related technologies. To be honest I got tired of answering the same questions and providing the same answers. I also got tired of telling people that there are legal and non-legal ways to use radios, especially since many people are unaware of the rules and regulations regarding radio purchase and use. In fact, in my experience a number of retailers of radio equipment have ignored the regulations when selling equipment to unsuspecting consumers. In talking with a large number of people, it would appear that my experience is hardly an isolated occurrence. The consumer is sometimes left with a "buyer beware" situation in which they own a piece of radio equipment that they are not legally able to use. This article will hopefully provide a degree of education in that regard as well.

In addressing the issues related to communications and signaling I have broken this article into several sections. The first brief section is on "non-electronic" means of signaling or communicating in an emergency. It was added simply to remind people that radio and electronic devices are not the only solution in an emergency. In fact escaping the electronic jungle is why many people venture into the outdoors. Leaving your radio, cellular or satellite phone behind when traveling in the outdoors is still a viable way of escaping into a world in which we must be more self reliant rather than carrying our courage in our packs.

The second section contains terminology and abbreviations common to radio communications that may be helpful in understanding the remainder of the article.

The third section forms the bulk of the article on radio communications. It begins by addressing the great number of radio services that are available for use in the outdoors. The radio communication section is broken into three parts; 1) Radio Frequency Beacons, 2) Hassle Free Two Way Radio Transceivers and 3) Restricted Access Two Way Radio Transceivers.

The fourth section discusses the practical considerations associated with owning or operating a radio communications device. It discusses everything from licencing and fees to batteries and antennas.

The appendices contain interesting and useful information on regulations, priority of radio messages and the phonetic alphabet. The references provide a number of selected websites and books that can be consulted for further information.

I hope the article serves to provide a good overview of the world of signaling and communications. It is my intention to complete a second more technical article on radio communications in the near future. I welcome any constructive comments you may have. I will also consider adding additional informative websites in future revisions of this article.

Emergency Signaling

Prior to discussing the use of electronic beacons, transceivers and related devices, it is worthwhile to briefly review the more basic signaling techniques which may be used in case of emergency.

Use of audible signals may be appropriate when it is anticipated that other party members or simply other people may be within earshot. Shouting is always an option in these situations, but many people carry a loud whistle for just such occasions. Even whistles have improved in recent years and the highly touted Fox 40® whistle has received excellent reviews. A repeated series of three whistle blasts is a well known signal of distress. For those who may have a firearm, three shots repeated at intervals is equally valid. Be careful of using up all your ammunition needlessly. And please, watch where you are shooting!

When audible signals are inappropriate, visual signals can be attempted. Classically, flares have been employed in emergencies. Be sure if you are using flares that they are used when they may do the most good. Randomly deploying flares when there is no hope of anyone seeing them is not a particularly wise use of the resource. For example, small flares used during bright daylight may have limited value.

It may be more appropriate to use flares when you know attempts are being made to locate you or when reduced daylight may make them more noticeable. If you are going to use flares, it is best to have actually practiced with them on several occasions so you will be aware of what to expect and how they actually operate. Some flare pens / guns have smoke available as an alternative to a bright flare. This may be useful in some instances.

Smoke and fires have traditionally been used for signaling in days gone by. Remember to attempt to have three signal fires set up if possible, arranged in a triangle. In areas where forests are managed for harvestable timber, smoke and fires may be a very effective means of attracting attention.

Using a signal mirror, also called a heliograph, is a well known way of signaling once someone is looking for you. A proper signal mirror, the mirror on your compass, or any shiny surface can be used. Consult a survival text for how to do it properly.

In open ground, using contrast lettering to create signals visible from the air may be an appropriate use of your time if you feel a rescue agency may deploy an aerial search. Stamping out HELP or SOS in large letters in snow and lining the letters with dark sticks or rocks may make you an easily visible target. Similarly on dark ground, try to arrange lighter colored materials along the edge of your letters to make them most visible, or position a brightly colored tarp where it can be seen.

Once the emergency is over, remove any visible distress signals so that a further search is not made for your party months after you are home and safe!

Radio Terminology and Abbreviations

Electronics is like any other specialized vocation, it has it's own language. This page contains a short glossary that may help you understand the most common terms that are used.

Frequency – means how often something happens. In electronics, frequency means how often a circuit or radio signal oscillates or vibrates or changes in a given period of time. With ocean waves, the frequency of the waves would be how often a wave crest hits the shore in a given time. Radio frequencies are measured in Hertz (cycles per second), and abbreviated Hz. A thousand Hertz is called a kiloHertz, abbreviated kHz. A million Hertz is called a megaHertz, abbreviated MHz. When you tune in a radio you change the "frequency" that it is capable of receiving or transmitting. Avalanche beacons, for example, operate on a frequency of 457 kHz. Inside the antenna in an avalanche beacon, the signal goes back and forth 457,000 times per second!

Frequency	Classification or Band	Abbreviation
0.03 – 0.3 MHz (30 – 300 kHz)	Low Frequency	LF
0.3 – 3 MHz (300 – 3000 kHz)	Medium Frequency	MF
3 – 30 MHz	High Frequency	HF
30 – 300 MHz	Very High Frequency	VHF
300 – 3,000 MHz	Ultra High Frequency	UHF
3,000 – 30,000 MHz (3 – 30 GHz)	Super High Frequency	SHF

Table 1. Frequencies, Bands and Abbreviations

Channel – Sometimes, for the sake of convenience, we will use channel numbers instead of referring to the frequency of a signal. For example, it is much easier to refer to channel 2 on your television than it is to say you want to adjust your TV to receive a frequency of 55.25 MHz for the picture and 59.75 MHz for the sound. What a mouthful that would be. Channel 2 is simple.

Modulation – means modifying or altering a radio signal to carry your message, voice or whatever you want to transmit. There are many kinds of modulation. Some examples:

- **Amplitude modulation or AM** – is where we put our message on the radio signal by varying the amplitude or strength of a signal. With an ocean wave, amplitude modulation is like varying the height of the wave crests in order to send a message.
- **Single Side Band or SSB** – is a special kind of amplitude modulation. With ocean waves hitting a beach, it would be like deciding that you would only use a wave half the width of the beach instead of having a wave hit the whole beach. If the message is contained in the "height" of the wave you can get the same information on a single side of the beach!
- **Frequency Modulation or FM** – is where we put our message on the radio signal by varying it's frequency. With an ocean wave, frequency modulation is like repeatedly altering the distance between wave crests in order to send a message.

Propagation – refers to the way in which waves (or radio signals) behave when they travel through a medium such as air or space or water. The term is also used when discussing what blocks the wave, what bends the wave and how the wave reacts to other conditions or influences.

Radio Communications

The remainder of this short paper will focus on a survey of more common electronic devices for signaling and communication followed by practical considerations and appendices. The initial discussion will be broken down into two categories; beacons and two – way radio transceivers for voice communication. We will define beacons in this context as a radio transmitter:

a) which emits a signal with the intent of either notifying the authorities of an accident, or
b) which permits location of the transmitter through various homing or related techniques, or
c) both a & b above.

Radio transceivers, for the purposes of this paper, will be those devices which permit voice messages to be both transmitted and received. (Avalanche transceivers will be mentioned in the beacon category, although purely electronically speaking they are a type of "transceiver".)

Radio Services For Use Outdoors

Part 1: Radio Frequency Beacons

ELT - Emergency Locator Transmitters – Aircraft (VHF / UHF)

ELTs, or Emergency Locator Transmitters, are the first of the true emergency beacons we will discuss. Within the same category fall EPIRBs and PLBS to be discussed below. The photo at left shows a representative sampling of these various beacon types (*photo courtesy COSPAS / SARSAT*).

ELTs have been required in commercial aircraft for decades. Generally speaking all three of the beacons we will discuss emit a signal which is picked up by either satellites or passing aircraft or both. The very fact that a beacon signal is detected is notification to the rest of the world that an accident has potentially occurred.

Older versions of these beacons operate on a Very High Frequency (VHF) signal of 121.5 MHz and are designed to transmit a signal if the ELT is subjected to a force in excess of 5 Gs (five times the force of gravity) for a specified duration. The radio signal is modulated with a distinctive "warbling" tone. The ELT can be manually activated if it is not set off by the crash. NATO military aircraft also use a second ELT frequency of 243 MHz. *The 121.5 MHz and 243 MHz signals will no longer be picked up by satellites after February 1, 2009.*

In the past, ELT signals were generally picked up on these frequencies by passing aircraft. Commercial aircraft are required to constantly monitor emergency frequencies. These signals were then pinpointed by extensive searches using aircraft flying special grid search patterns with homing devices. In extreme cases, it would take as much as several days to locate a weak signal in a remote area. Now satellites do the job!

Once the satellites pick up the ELT signal, the information is relayed to a Local User Terminal on the ground where it is sent to the Mission Control Centre. 121.5 MHz beacons are located by using the Doppler effect. (For details on this process see the Mission Control Centre website.) The ELT can be pinpointed in a matter of hours rather than days. As part of the process, a Rescue Coordination Centre is contacted and the RCC puts a rescue plan into action. This ELT signal, as well as the newer Ultra High Frequency signal discussed below, is located by a group of satellites jointly put in place by the United States (SARSAT) and Russia (COSPAS) .

Newer ELTs use a new Ultra High Frequency (UHF) signal of 406.025 MHz. Rather than an audible tone it is capable of having a digitally encoded identifier as part of the signal. This signal is capable of being located even faster than the old signal and can often be pinpointed fairly accurately in under an hour. Older single frequency ELTs are still in use and dual frequency ELTs containing both old and new frequencies are still common.

Still newer 2nd generation beacons, now available, allow the use of GPS in coordination with ELTs to encode a signal containing the exact crash location. ELTs can only be legally used by aircraft and by international agreement 121.5 and 243 MHz ELTs will be phased out on February 1, 2009.

EPIRB - Electronic Position Indicating Radio Beacon – Marine (VHF / UHF)

A direct parallel can be drawn between the ELT for aircraft and the Electronic Position Indicating Radio Beacon or “EPIRB” for marine vessels. Commercial vessels are required to have an EPIRB much like aircraft are required to have an ELT. The frequencies currently used are identical to those used for aircraft and the technologies have evolved simultaneously. Some EPIRBS are designed to be automatically activated, released and float to the surface should the vessel sink. Any water going vessel, including sea kayaks, can legally carry an EPIRB. EPIRBs cannot technically be used for anything other than marine vessels.

PLB - Personal Locator Beacons (UHF)

Until recently, only aircraft and marine vessels were allowed to use ELTs, and EPIRBs. About a decade ago, a change in regulations allowed a personal version of these beacons, called a Personal Locator Beacon or “PLB”, to be produced and a number of firms now manufacture them. They operate on the 406.025 MHz frequency and have a unique digital identifier encoded into the signal. PLBs can be used to notify Search and Rescue resources put can only be used if a person is in “grave or imminent danger”.

Newer units use GPS technology to transmit location data as well. Some have a built in GPS, while others can be linked to a GPS. This dramatically reduce the time required to pinpoint the accident location. The Latitude and Longitude data is transmitted in the first burst of information after the unit is activated.

A typical PLB weighs under a pound (300 to 600 grams) and can be easily held in a person's hand.

The user of the PLB must register the beacon with the Beacon Registry:

- Canada - http://beacons.nss.gc.ca
- US - www.beaconregistration.noaa.gov
- Or the registry of the country in which the beacon is going to be operated primarily.

PLB registration is mandatory. After registration there is a record available to search and rescue authorities who can contact the registered owner or contact person to gather details of the possible nature of the emergency and to rule out a false alarm. It is best to leave a trip plan with your contact person. Registered users can update their information online via the internet. In Canada, this is done via the Search And Rescue Secretariat website. Updating contact information is vital for ensuring that emergency contact information is up to date. The technical aspects of the search for a PLB are the same as for an ELT or EPIRB search.

ELTs, EPIRBs and PLBs are rather expensive devices (>$600 - $1000 Canadian, circa 2008). The COSPAS/ SARSAT website lists half a dozen Canadian manufacturers and distributors of PLBs. PLBs can be rented for remote wilderness excursions. The National Search and Rescue Secretariat and the SARSAT Mission Control Centre maintain websites with links to beacon manufacturers.

SPOT – Satellite Personal Digital Messenger

NEW: A low cost technology called SPOT is available whereby you send a 'preprogrammed' SMS text or email message. A type of 911 service is available plus the ability to automatically encode your GPS location in your message. Three types of generic messages can be sent. The first is a "check-in" message that stipulates that you are OK plus your location and a link to Google maps. The second is a predetermined help message that is sent along with your coordinates to your specified contact person. The third is a "911" distress call along with your GPS coordinates sent to a central resource center as well as your contact person. You cannot send text messages, only the three preprogrammed messages mentioned above. Current Canadian Price is $179 plus $50 annual service fee (circa 2008). More info at: http://www.findmespot.ca or http://www.findmespot.com

Part 2: Avalanche Beacons / Transceivers (MF)

This is a MOST cursory overview of existing avalanche transceiver technologies. For detailed discussions of avalanche transceivers and search techniques, see avalanche related publications and the manufacturer's websites. Avalanche transceivers are a normal part of winter backcountry travel where snow and avalanche terrain may be encountered. They are an extremely low power, Medium Frequency (MF) transceiver which is usually limited to a range of 80 metres or less. Each transceiver is capable of transmitting and receiving a signal.

A decade ago an international frequency (457 kHz) for avalanche transceivers was agreed upon. All transceivers manufactured today should be made to operate solely on that frequency. If you purchase used equipment, be sure it is compatible with this frequency. In addition, test it for long distance receive and transmit range with several other transceivers as occasionally transceivers may be damaged. The ferrite bar type of antenna that is commonly used is subject to cracking with use or misuse. When the antenna is broken it may still be possible to receive its signal at short range but not at far range.

Newer technology dual antenna and digital avalanche transceivers are now available. The rapid change in transceiver technology has created a growing state of confusion among the potential buyers. These technologies are still in their infancy. You should evaluate all choices carefully before purchasing a new transceiver. One outstanding fact emerges. No transceiver, analog or digital, is capable of achieving it's full potential in the hands of an unskilled operator. Practice is vital. Optimal performance comes from both practice and understanding of the actual workings of current receiver technology. Know your own transceiver and know how to switch the transceivers of your companions on, off, into receive and into transmit. Then practice, practice, practice!

At present it is useful to discriminate between the five major different types of avalanche transceivers. Here are some typical differences. (Since models vary, these generalizations may not apply to all transceivers. Check specifications of each transceiver carefully.):

- Analog – The information is presented to the user in the form of an audible signal or LED style light display (or both) in which greater proximity to the buried person (transmitter) is shown by increasing sound levels and increasing intensity and number of lights displayed. Often capable of detecting a signal at greater distance than a digital beacon. Only has one antenna. <u>ALL beacons transmit an analog signal!</u>

- Digital / Single antenna - Information is presented to the user in the form of a digital display in which greater proximity to the buried person (transmitter) is shown by decreasing numerical values or increasing numbers of bars in a display screen. Typically has an LCD display screen which may be subject to failure at cold temperatures (less than minus 20 degrees C). May not be currently capable of detecting a weak signal as effectively as an analog beacon. (Note: Not all digital beacons have dual antennas. Some have only one.)

- Digital / Dual Antenna – In addition to providing information about distance / signal intensity, two antennas are able to provide better directional indications than single antenna transceivers. Current dual antenna transceivers also have digital readouts. Dual antenna transceivers must use signal processing which at present may reduce the capability of detecting a weak signal as effectively as an analog transceiver.

- Analog / Digital – Several transceivers currently available have the capability of switching from analog receive mode to digital / dual antenna mode as the signal changes from very weak to stronger, thus theoretically retaining the advantages of both technologies in one beacon. This has necessarily made for a more complicated but possibly more functional beacon.

- Digital / Multiple Antenna – Since about 2006 a number of digital transceivers with three antennas have hit the market. Features vary between manufacturers but may include:

    - Enhanced multiple burial capabilities,
    - the ability to block out a signal once it has been located, and/or
    - the ability to detect motion (breathing) on the victim while they are still buried in the snow.

IMPORTANT NOTICE: Digital cell phones may interfere with your transceiver which may make it impossible for you to search for a buried companion. In addition, your companions may NOT be able to locate you. A recent fatality in Europe brings this point home!

Part 3: Hassle Free Two Way Radio Transceivers

Transceivers are presented roughly in order of the ease with which they can be obtained. Those which are readily accessible are presented in Part 2. Those with licensing, certification examinations and other more stringent requirements are presented in Part 3.

Cellular phones (UHF)

Cellular phones have become unbelievably common. They are now relatively low cost and low weight. In 2002 one source proclaimed that "approximately 20% of American teens (more girls than boys) own a cell phone." Cell phones can be either very useful or very useless in a wilderness environment depending upon several important factors. Proximity to a cell site, intervening terrain, type of cell phone you are using and the country you are in are four of the more important considerations. Also, temperatures below minus 20 C will cause most LCD screens to go blank (temporarily). Current cell phones also incorporate GPS type technology and a cell phone call can now be traced to within about 100m or less of its originating location.

The original analog Cell Phones operate in the UHF or Ultra High Frequency band between 824 and 894 MHz. They are considered to be generally restricted to line of sight applications. In other words, if you cannot electronically "see" the cell site, you cannot make a phone call. UHF cellular signals can pass through walls of reasonable thickness, but they cannot pass through mountains or hills. Occasionally, they can even be blocked by dense trees.

Mobile cellular phones mounted in a vehicle can typically switch between a minimum power of 0.6 Watts and maximum power output of 3 Watts. Handheld cell phones are often designed to have low power output to conserve battery power. My original analog cell phone was fairly typical and could switch between several power settings varying from 0.006 watts at the low end to 0.6 Watts at the high end. Since handheld cell phones are used most in urban locations where cell sites are frequently spaced, having a weak signal is not usually a problem.

The cellular system is capable of measuring the signal strength of a cell phone signal and relaying a message back to the phone to increase power if the signal is weak. Alternatively, an attempt may be made to switch the phone to another cell site which may be in better position to receive the signal. Once the phone reaches it's maximum rated output and the cell system has attempted to link you with the best possible cell site, there can be no further enhancement of your signal's readability. In more remote areas, this may practically limit your communication distance to 3 miles / 5 km (or less). In optimal situations, such as high on a ridge-top where a cell is located in line of sight of your location, you may be able to communicate at a much greater distance with a weak signal, up to 20 km or more. There is no way of determining beforehand which of these two scenarios apply. Coverage maps distributed by your cell service provider may give you a baseline for what you can expect. Testing your phone in the field is the only way to know for sure if it will work.

It is possible to add a high gain directional antenna to some cell phones. These are expensive, difficult to obtain and not compatible with most new miniature handheld phones. A very lightweight antenna of this type can be constructed with minimal materials. It is debatable whether anyone would carry such an antenna in the wilderness. A higher gain antenna may be taken into a base camp setting. Digital power amplifiers are now also available (approx $600 circa 2004.)

Cell phones are often exceptionally reliable when near urban centres or major transportation corridors. Cell phones are best never relied upon as your sole means of emergency backup in the true wilderness, but they may surprise you! They have been used to good effect to initiate rescues from some pretty remote locations where a combination of terrain and other factors allowed the signal to propagate over greater than normal distances. They are always worth trying in an emergency if you know you are near an area where cellular coverage may exist. As of 2001, new cell phones will begin having GPS technology integrated in them so that a 911 emergency operator can locate you more precisely. This is not yet fully implemented in all phones.

Digital & PCS Cellular Phones

All was well and good with cellular phones until demand became monumental and technology rushed to keep ahead of demand. Digital transmission can have more than one user on the same channel at the same time, allowing more calls to be placed simultaneously. It claims to have a cleaner signal as well. Electronics firms also rushed to try to get a competitive edge in other ways. In technical discussions, acronyms like AMPS, FDMA, TDMA, CDMA, GSM, GPRS and PCS began flowing like water and the water became muddy!

Explanations of all of these terms and new technologies are way beyond the scope of this article. If you really want a good technical description of how the new relates to the old go to: http://www.howstuffworks.com/cell-phone.htm.

A lot of advertising dollars are spent these days to tell us about PCS (Personal Communications Services) phones operating on the 1.9 GHz (1900 MHz) frequency band. Why the new name and initials? They just want you to know their new service is more than just cell phone and can include email, caller ID, paging and more. *Microcell FIDO®* and *Clearnet® Digital* are examples of PCS phones that look like regular cell phones and use much of the same technology. They are much lower power and presently have limited coverage often restricted to large urban areas only. *Clearnet Mike®* is another variation working at 900 MHz which has similarly restricted coverage at present.

If you are going to use a newer digital or PCS cellular phone as a backup for a wilderness emergency you probably want a dual band or dual mode phone or, even better, a phone that is both (dual band / dual mode). A “dual band” phone often uses both 800 MHz and 1.9 GHz. A “dual mode” phone usually uses both analog and digital. The important things to look for in a phone that you may have a hope of using from the backcountry is that at least one of the bands or modes your phone can use is the more established analog 800 MHz system and that the phone has reasonable power output. Analog mode is often referred to as “AMPS 800 MHz”. Although analog is being phased out, there are still plenty of more remote locations where only analog

service is available. A phone that uses only the 1.9 GHz band is super in the city, but of limited use in the wilderness for the time being! Some newer phones are advertised as “tri-band” or “tri-mode”. There is no standard for what these terms mean. Best to check the actual specifications for any phone you are considering. Some manufacturers used tri-band to mean 800 / 900 / 1900 MHz but this is by no means universal.

If you are travelling overseas your North American phone may not operate in Europe. Cell phones are easily rented over in Europe for the duration of an overseas trip. A few very new cell phones have the ability to switch a small chip or card to enable European access or North American access. This is not available in most phones. Features vary widely between models so ask before you buy.

IMPORTANT NOTICE: Digital cell phones may interfere with your avalanche transceiver which may make it impossible for you to search for a buried companion. In addition, your companions may NOT be able to locate you. A recent fatality in Europe brings this point home! Turn off ALL cell phones when traveling in avalanche terrain. Once you have attempted to call for help on your cell phone, turn it off again so as not to interfere with on-going search efforts. Some manufacturers claim that not all combinations of beacons and cell phones interfere with each other to any great degree. This may be true, but are you willing to bet your life on it?

Satellite Cellular (UHF)

Satellite telephone or “satellite cell phone” is still an emerging and developing technology that may not yet have reached a stable state. Both the “Iridium®” satellite cellular system as well as the “GlobalStar®” network have undergone financial restructuring in the past few years. Things seem to have stabilized a bit in that regard in the last year or so, but in satellites and high finances nothing can ever be all that certain.

The Iridium® system consists of a constellation of 66 low earth orbiting satellites that claims to provide total global coverage, including the polar areas. Low earth orbiting satellites allow lower power handheld phones to be used, rather than requiring more bulky suitcase sized units that were the norm for satellite communications in the past. The Iridium system is a satellite only system of communication as opposed to the competing GlobalStar® which uses a combination of satellite and ground based cellular services.

GlobalStar® is a rising star that promises to provide reliable communications in the future. Comprised of a large group of corporations globally that have entered into cooperative agreements, this system is rapidly expanding its service base around the world. Accessing a constellation of 52 low earth orbiting satellites, the GlobalStar® system may soon reliably cover the globe with a combination of regular cellular and satellite access.

Closer to civilization, you access the lower priced cellular phone service first. Your signal is only routed through the

more expensive satellites when a ground based connection cannot be made. (The competing Iridium system is satellite based only at this time.)

North American Globalstar coverage was reportedly very good for a time but in 2006 / 2007 users began reporting problems that have persisted well into 2008 despite assurances that all would be back to near-normal soon. It seems that some of the Globalstar satellite were not living to the end of their predicted service life and as they died prematurely the system began having significant gaps in coverage that in some cases has been reported to last for hours or more. Globalstar is attempting to correct this problem by launching more satellites but this is an expensive and slow process. It is claimed that service should be back to normal by 2010.

The portable handheld satellite transceiver is reminiscent in size and shape of the original bulky handheld cell phones, but more streamlined and certainly far more capable, with both digital and analog modes as well as fax and data transmission.

The phone and battery should be kept as warm as possible as cold temperatures will decrease the battery strength. Also, the LCD screen will temporarily go blank at temperatures below –20 C. Date speeds are slow (the equivalent to 9600 baud.) GlobalStar® phones are advertised as being "tri-mode". In this case this means digital satellite phone / digital cell phone and analog cell phone modes are used depending upon your location.

Update on Recent Degradation of Globalstar Service: The following is extracted from a letter written by A.J. (Andrew) Bryan, Emergency Management Technology Specialist of the Provincial Emergency Program, Emergency Management British Columbia. It has been edited to provide only the salient points:

> *Many Globalstar users have noticed a substantial reduction in service in 2006/ 2007. The original Globalstar constellation of satellites consisted of 52 satellites. 9 satellites were affected by a problem referred to as an "S band anomaly" and could not be recovered. Effectively, this has reduced the number of satellites in the constellation from 52 to 43 causing service "gaps" for Globalstar users.*
>
> *Globalstar has undertaken a number of initiatives to address the service degradation resulting from the loss of 9 satellites. These efforts include reconfiguration of the satellite constellation to reduce coverage gaps. This effort has been underway over the last 18-24 months and was just recently completed during the first week of February 2007. Globalstar is proceeding with the launch of an additional 8 replacement satellites during 2007. It is expected that Globalstar service will steadily improve over the next 18 months as the replacement satellites are launched and moved into position within the constellation.*
>
> *The key "symptom" associated with the service degradation are periods of up to 10 minutes when satellite service is unavailable. Globalstar can predict both where and when these service gaps will occur. Globalstar has committed to providing a WEB site where users could enter their location (lat/long) and receive a report indicating expected service outages over the next 48 hours.*

Should you experience difficulty in making a Globalstar call it is recommended that you take the following action:

- *power down your Globalstar phone;*
- *power up your phone - this will initiate a process of reacquiring satellite service;*
- *remember that the service gaps are expected to be about 10 minutes in duration. If the above procedure does not work wait 10 - 15 minutes before powering up your Globalstar phone again.*

It is important to note that although new satellites are being added to the constellation it can be expected that older satellites in the constellation will continue to reach the end of their useful life. Given the current degradation rate for the Globalstar satellites it is anticipated that service levels will once again begin to degrade in late 2008.

Globalstar currently has agreements in place to proceed with launching the next generation of Globalstar satellites. These improved satellites will have a useful life in excess of 15 years. It is expected that 8 to 10 of the next generation satellites will be launched during the summer of 2009. It is expected that service levels comparable to the original constellation of 52 satellites will not be re-established until 1st quarter of 2010 following the initial launch of second generation satellites.

Satellite telephone is expensive when compared with regular cellular phones, but then regular cellular phones are incapable of being used in many remote areas. Current Canadian prices (circa 2008) are approximately $1,000 for purchase, plus connection fees (typically $75). Add to this a minimum monthly charge of about $40 or more and a $1 to $2 per minute airtime fee. A variety of other airtime plans are available. Refurbished phones have been available recently for as little as $600 plus monthly charges and airtime fees.

Only time will tell if prices will remain at this level or continue to drop as they have in the last few years. Rental may be a viable option for some extended remote trips. A large number of groups are now toting rental satellite phones on backcountry trips these days. Rental prices vary between $60 and $120 per week plus airtime fees. (circa 2008)

Other satellite based telephone systems exist, such as MSAT, INMARSAT and Skycom, and may be worth investigating as well. Technology here is also not standing still. In any case, if the expense does not deter you, check out the websites and talk with a local dealer.

Satellite communications have altered the world of wilderness communication and have made inroads into commercial backcountry operations. Remote paddling operations in Canada's far north have been using satellite phones for some time. For several years the helicopter skiing company that I work for has a handheld satellite phone in the pack of the lead guide plus one in each helicopter.

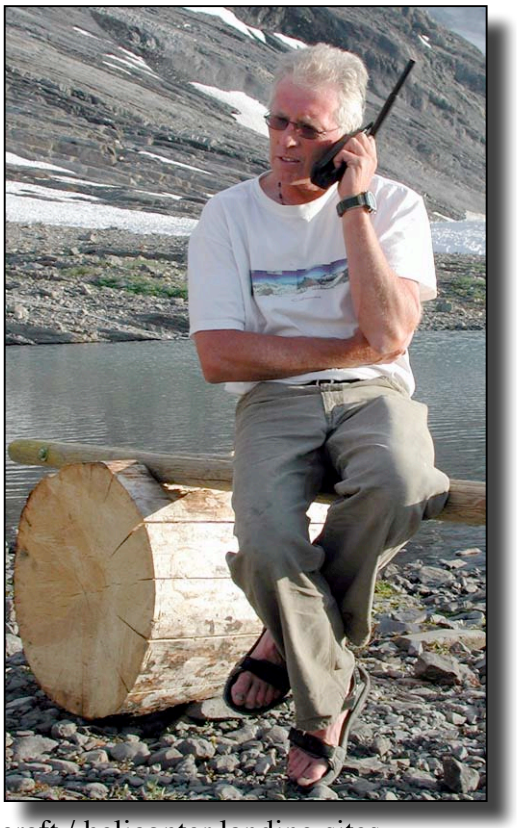
Previously we had a much larger suitcase sized satellite phone in the helicopter only. The older technology proved less than reliable in mountainous terrain and required the use of a compass to orient the large suitcase lid antenna properly! The new phones have far fewer problems. This technology is becoming ubiquitous as the price moves more into line with what non-commercial recreational groups can afford.

Since many groups may use this technology in future I have included the following practical advice for satellite phone use even though it may be duplicated in later radio related discussions:

- Store your phone and battery separately as this prevents accidental discharge.
- LCD screens may become blank at temperatures below –20 degrees C (keep the phone as warm as practical).
- Double waterproof your storage container.
- Pack waterproof instructions with the phone and
    - include your emergency response plan and
    - include a list of information to compile before calling for emergency assistance.
- Know your satellite phone number so you can be called back.
- Check into satellite phone to satellite phone communications as this may not be possible with some systems.
- If your phone has a lock/unlock code number, be sure it is either written down or known by all in your party.

Here is some information you should have gathered and written down when calling for assistance:

- Who you are
- Party size
- Your exact Location
    - Are you moving or staying in one location?
- Number of patients
- Names of patients
- Nature of accident / injury or illness
    - symptoms and vital signs of ill or injured persons
    - current and past condition
    - first aid administered and results
- Requirements
    - medical personnel
    - equipment (1st aid, oxygen, backboard, etc.)
    - transport you would like (rescue agency may decide for you)
    - food / water / shelter
- Weather
    - visibility (fog / cloud / rain / snow)
    - wind speed / direction / gusts
- Nature of terrain where you are and any possible aircraft / helicopter landing sites
- How to Communicate with you
- Name, address and phone numbers of other party members or their emergency contact numbers.



FRS / GMRS – Family Radio Service / General Mobile Radio Service (UHF)

A complete set of FRS radios with rechargeable batteries, charger and earbud microphone.

Recently the diminutive FRS handheld transceiver became a new addition to the publicly accessible radio market. FRS handhelds are low power 0.5 watt output FM or "Frequency Modulated" radios operating in the 462 – 467 MHz portion of the Ultra High Frequency (UHF) band. They have fourteen frequencies or "channels" which can be used, They are intended for communicating point to point with other similar non-commercial, personal transceivers and became legal in Canada in April 2000.

They are small and lightweight and can weigh less than 200 grams / 7 ounces. They are typically limited to a range of 2 miles / 3 kilometers. They are capable of operating on a total of 14 designated frequencies and enjoy relatively static – free reception. Unlike commercial and amateur VHF/UHF radios, they cannot be obtained in high power models nor can they currently access any repeaters. They are incapable of operation outside the FRS band and cannot be altered in the field or otherwise to do so.

They are best used when individuals are going to be in relatively close proximity and wish to maintain communication. For example, they can be used by the lead and sweep in a ski touring group or, increasingly commonly, by the lead and second in technical climbing environments. Many alpine climbers have already discovered that 60m ropes and wind make for poor communications and it is becoming common for ice climbers particularly to be using FRS radios for communications to and from the belayer. Their possible utility for mountain climbing parties communicating with a base camp is relatively untested at this time.

In September 2004, the latest greatest radios (General Mobile Radio Service / GMRS) became available. They have higher power and 16 new frequencies plus the capability to use seven of the existing FRS frequencies to increase the utility of this type of lightweight easily obtained radio. GMRS radios are now available with power outputs of up to 2 watts. The seven shared FRS channels are low power (0.5 watt). Of the 23 available GMRS channels, 16 can be higher power. Models are presently in stores with output powers of 0.5 watts, 1 watt and 2 watts. The range of these radios is approximately 3 km, 8km and 12km respectively. Since the price difference between FRS and GMRS radios is presently small, it is likely a better choice to purchase the highest power output GMRS unit available for use in outdoor and wilderness settings. To save

battery power, use the low power channels whenever possible.
Be aware that US made GMRS radios cannot be sold or used in Canada and vice versa. (GMRS radios in the US also require the user to obtain an FCC radio licence.) Be sure you obtain a GMRS radio designed for the country in which you will be using it. GMRS radios will be permitted to operate as licence-free devices in the frequencies set out in Table 2 in the range 462/467 MHz. Future radios of this type may be allowed with power outputs as high as 5 watts with the possibility of repeater operations being allowed at some point. Industry Canada states, "At this time, the use of GMRS repeaters to further extend the coverage of GMRS communications and devices that exceed 2 watts ERP, will not be permitted. The main reason is to facilitate the migration of land mobile users to other frequencies before GMRS repeaters and higher powered devices are given further consideration." The frequencies now used by this service were formerly used by commercial and business users.

Frequency	Channel	Service
462.5500		GMRS
462.5625	(1-FRS)	GMRS/FRS Shared
462.5750		GMRS
462.5875	(2-FRS)	GMRS/FRS Shared
462.6000		GMRS
462.6125	(3-FRS)	GMRS/FRS Shared
462.6250		GMRS
462.6375	(4-FRS)	GMRS/FRS Shared
462.6500		GMRS
462.6625	(5-FRS)	GMRS/FRS Shared
462.6750		GMRS
462.6875	(6-FRS)	GMRS/FRS Shared
462.7000		GMRS
462.7125	(7-FRS)	GMRS/FRS Shared
462.7250		GMRS
467.5500		GMRS
467.5625	(8-FRS)	FRS Only
467.5750		GMRS
467.5875	(9-FRS)	FRS Only
467.6000		GMRS
467.6125	(10-FRS)	FRS Only
467.6250		GMRS
467.6375	(11-FRS)	FRS Only
467.6500		GMRS
467.6625	(12-FRS)	FRS Only
467.6750		GMRS
467.6875	(13-FRS)	FRS Only
467.7000		GMRS
467.7125	(14-FRS)	FRS Only
467.7250		GMRS

Table 2. FRS and GMRS Radio Channels

Their low cost, ease of availability and light weight make them attractive for many of the types of applications mentioned and much more. Prices range from $40 to $300 Canadian (circa December 2004). Prices typically vary on the basis of number of features present and whether or not rechargeable batteries plus charger are included in the package.

Nickel Metal Hydride rechargeable batteries are a very good choice, but substantially raise the price above the baseline. You may want to consider whether the unit you intend to purchase uses AA or AAA batteries. AA batteries are slightly heavier but more readily obtainable and longer lasting. Most units use AAA batteries however.

Many optional features may be included with various units depending upon price. Most units have a "tone – coded squelch" type of feature in which you set your units and those of your companions to send a inaudible tone each time you transmit. Your companions radios will only let you hear a transmission when they detect this tone. In more crowded areas this option allows for more people to share channels without constant interference from each other.

"Vox" or voice activated transmission may be another useful but expensive addition for technical climbing scenarios. An external microphone or "earbud" microphone can be very handy so that the radio can be hidden away in a jacket or pack while only the microphone is outside. This is great for winter when batteries and LCD displays can freeze up. Some units will receive up to ten additional channels for weather radio broadcasts. This can be very useful in backcountry settings. Other units have options like altimeter / barometers and electronic compasses which may or may not be useful to you. One unit even has a built in GPS that allows units to relay positions to each other!

FRS frequencies are not anyone's exclusive property and therefore the available frequencies must be shared with anyone else who cares to use them. This may not be a problem in the wilderness, but in areas near larger urban centres it may be problematic once usage increases. Most units have a system of codes or tones that are used to help reduce interference from other users. If reported recent sales of the units are anything to go by, use is bound to increase. GMRS and FRS radios are available from a wide variety of consumer electronics and outdoor retail venders across North America. They are not subject to any connection or licensing fees.

GMRS / FRS radios should never be solely relied upon for communicating from a backcountry setting to the frontcountry due to their limited range. If you happen to have an GMRS / FRS radio in the backcountry, however, it is always worth a try just in case. One freak event in the US had an emergency "May Day" FRS radio signal propagate over more than 100km where it was picked up by a young boy whose parents contacted the authorities. A successful rescue ensued. This was an anomaly and should not be considered the norm in any way!

Low Power VHF (VHF)

Within the lower frequency part of the Very High Frequency (VHF) band there are a few frequencies set aside for VHF low power transceivers. These very inexpensive units are similar to FRS and are legally limited to 0.1 Watt. This is very low power and communications is

limited to very short distances. With the advent of FRS and GMRS these units are becoming less common or perhaps obsolete. Some of the inexpensive equipment available is not reliable for constant rugged outdoor use. These units are powered by a single small 9 volt battery in many cases. There are 5 available frequencies (49.8300, 49.8450, 49.8600, 49.8750, 49.8900 MHz). They are subject to frequent interference as this band is shared with baby monitors, cordless phones, children's walkie talkies, etc. Some units allow access to all five frequencies, while others are restricted to a single frequency. No license is required for the radio or user. These transceivers are best used for line of sight, person to person communications of less than 1 kilometer distance and may have some very limited applications for wilderness professionals. Their purchase price varies from $20 to $200. FRS equipment is far more reliable and rugged (albeit expensive) and should be considered first.

GRS CB – General Radio Service – Citizens Band (HF)

CB radio has been the general public's answer to radio communication for decades. Used by families, vacationers and truckers and even immortalized in an old popular song, they are readily available and affordable. The technology has remained stable for years, but the size of handheld CBs has dramatically improved recently. Some units allow access to as many as ten additional "receive – only" VHF channels to allow reception of weather radio broadcasts. Typical CB transceivers are similar in size and weight to a commercial VHF radio (<500 grams).

CB radios can be purchased in handheld, mobile and base station configurations. They output a 4 watt signal and have up to forty different channels. Typically a handheld CB's range is about 6 miles / 10 km. The allowed output power on CB is many times higher than in the FRS band. Using a high gain antenna, output can be increased further and the resultant effective radiated power can be appreciable.

CBs are technically AM (Amplitude Modulated) or SSB (Single Side Band) radios that operate in the High Frequency or HF band. They may be subject to static and interference, particularly when the ionosphere is active. CB signals can "skip" on ionized layers and be picked up thousands of miles away. While this may make for an interesting diversion, it is not a reliable phenomenon for daily long distance communication. It can plague local communication when "skip" is active, as many overlapping signals may be picked up simultaneously.

At one time, use of a CB radio required a license which had to be annually renewed. In April 1990, that restriction was removed and now anyone who possesses a CB radio is legally able to use it, given that they comply with other basic rules of radio use. In practice, it is nearly impossible to regulate a radio band that has no licensure requirements. Business use of CB is not allowed. Despite these problems, CB radios have been used for communication in urban and wilderness settings for decades. In some areas, police or local "REACT" groups monitor channel 9, the designated emergency frequency, for emergency radio traffic. Near highways there may be a reasonable probability of contacting a passing commercial truck. Like FRS, CB should not be

relied upon for communicating from a backcountry setting to the frontcountry even with their increased power output. Similarly, you cannot guarantee unfettered access to a given CB radio frequency as everyone who purchases a CB has the same right of access to the frequencies as you have. If you happen to have an CB radio in the backcountry, it too is worth a try however!

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
1	26.965	11	27.085	21	27.215	31	27.315
2	26.975	12	27.105	22	27.225	32	27.325
3	26.985	13	27.115	23	27.235	33	27.335
4	27.005	14	27.125	24	27.245	34	27.345
5	27.015	15	27.135	25	27.255	35	27.355
6	27.025	16	27.155	26	27.265	36	27.365
7	27.035	17	27.165	27	27.275	37	27.375
8	27.055	18	27.175	28	27.285	38	27.385
9	27.065	19	27.185	29	27.295	39	27.395
10	27.075	20	27.205	30	27.305	40	27.405

Table 3. CB Radio Channels

Part 4: Restricted Access Two Way Radio Transceivers

Within the VHF and UHF bands are a number of specific allocations to radio services. The individual band allocations which may be available to wilderness users will be discussed separately. In some services the radio operator must be certified: Marine, Aeronautical, Amateur (Ham) and GMRS HF being examples. In other services the radio may require a license: Marine, Aeronautical, GMRS (HF), Commercial VHF and UHF being typical. In still others, the individual frequencies you use and the geographical locations in which you are allowed to use them are stipulated on your license: Commercial HF, VHF and UHF being classic examples. For example, my radio has several frequencies licensed for use Canada–wide, one frequency I use while teaching rescue courses licensed only for Alberta and British Columbia and two frequencies licensed only for Jasper, AB. If you leave the country your radio may not be licensed at all. Some countries may not like you bringing your radios in without authorization.

Several segments of the Very High Frequency band are designated for public service (emergency services) and commercial use. The *VHF low band* runs from 30 to 50 MHz. Although it has potential for longer distance communication, this band sees limited use by wilderness professionals. It is subject to interference because these frequencies behave much like those in the High Frequency band and will occasionally skip in the ionosphere. It will not be discussed further. Table 4 shows the typical uses of various segments of the VHF band.

FREQUENCY IN MHZ	SERVICE ALLOCATION WITHIN VHF BAND
30 - 50	VHF low - commercial, public service
50 - 54	Ham 6 meter band
54 - 72	TV Broadcasts on Channels 2 - 4
76 - 88	TV Broadcasts on Channels 5 - 6
88 - 108	FM Radio Broadcast Band
108 - 118	Aeronautical Radionavigation
118 - 136	Aircraft (AM)
136 - 144	VHF high - commercial, public service
144 - 148	Ham 2 meter band
148 - 174	VHF high - commercial, public service, marine
174 - 216	TV Broadcasts on Channels 7 - 13
216 - 220	Fixed & Maritime Mobile
220 - 225	Ham 1.25 meter band
225 - 328	Government - Fixed & Mobile

Table 4. Typical VHF Band Allocations

Marine Radio Service (VHF)

The Very High Frequency / VHF Marine Service is restricted to water going vessels. Up to 55 channels are available for transmitting with 95 channels for receiving on the frequencies from 156 to 162 MHz. Some of the "receive only" channels are regular broadcasts of weather and navigation information, while others are receive frequencies of a duplex pair.

Marine channel 16 (156.8 MHz) is the designated VHF distress and calling frequency. Due to advances in other technologies (namely digital selective calling) for distress signaling the US Coast Guard has announced they will discontinue monitoring channel 16 in 2005 and will no longer require other vessels to monitor the channel as well. The Canadian Coast Guard has stated they will continue monitoring channel 16 for the foreseeable future as they cannot guarantee that all vessels will have switched over to newer technologies. Regardless of whether or not the Coast Guard is monitoring, with the large network established for marine communications, there is currently a good possibility of contact in an emergency. There are also channels designated as ship to ship, ship to shore, marine radiotelephone, etc.

Marine VHF Channels and frequency allocations vary across the country and between Canada, the US and other countries. Be sure you know the allowed frequencies in the area you are in. Appendix D contains a chart of Canadian Channels. For the most accurate and up to date information, visit the industry Canada website and download the document “RIC-13”.

Good quality handheld marine transceivers can be purchased for as little as $300. Full function, high power units for mounting in larger craft can have a price well in excess of $1000. For a handheld transceiver to be licensed for marine use, it must be switchable from high power to 1 watt, to avoid interfering with other stations or vessels while in port. Sea kayaks and the like are considered legitimate water going vessels and thus would be eligible to use such a radio.

Guides and leaders in marine environments would do well to consider the purchase of a handheld marine radio. Your communications will generally be limited to line of sight, but radio waves tend to travel fairly well across water. (Marine radios are not to be used for general land-based communications.)

Users must pass an examination which includes questions on radio operations, emergency procedures and radio regulations to obtain a radiotelephone operator’s restricted certificate (marine). “Radiotelephone operator's restricted certificates are issued for life and no revalidation is required” (*source – Industry Canada RIC-13*). In the past, the marine radio itself was required

to be licensed. Beginning in 1999, a marine radio that operates only on the marine band and is operated solely in Canadian or US coastal waters is no longer required to be licensed.

Contact Industry Canada or the Canadian Power or Sail Squadron for additional details on the Marine VHF Radio Service. Training and dissemination of information regarding licensure has now been turned over to the Power and Sail Squadron for administration.

Aeronautical Radio Service / Aircraft Band (VHF)

If you regularly fly balloons, para-gliders, parapents, hang-gliders or ultra-light aircraft, a VHF Aircraft band radio is a must to enable communication with other aircraft in your vicinity. Unless you are in the business of working with aircraft only, an aircraft band radio is not a likely candidate for wilderness use.

The Very High Frequency / VHF Aircraft band is restricted to use by aircraft and associated ground personnel. The aircraft band uses AM or "Amplitude Modulated" transmissions. (Ground based VHF radios use FM or "Frequency Modulated" transmissions.)

Note that VHF AM and VHF FM are incompatible! A commercial VHF radio or Ham radio are generally incapable of communicating with an aircraft unless the aircraft is also equipped with VHF FM communication equipment. Many radios are advertised as being able to *monitor* the aircraft bad. Don't misunderstand what is meant by the term *monitor*. This means you can listen to aircraft but <u>not</u> talk to them.

Helicopters which service the outdoor community commonly have both VHF FM and AM radios. This is not necessarily common in other types of light aircraft which may be used to access wilderness areas. Check with the pilots you intend to communicate with to be sure your equipment is compatible with theirs.

With a designated emergency frequency of 121.5 MHz and many persons and stations monitoring other set frequencies, there is a reasonable probability of contact for an aircraft in an emergency. Some radios are available for direction finding (VOR) and positioning as well as communication in this band. Many aircraft band radios also pick up weather-radio broadcasts as well.

Radio transceivers in this band tend to be expensive to purchase with prices starting at $500.

The radio operator must pass an examination which includes questions on radio operations, emergency procedures and radio regulations to obtain a radiotelephone operator's restricted certificate (aeronautical). "Radiotelephone operator's restricted certificates are issued for life and no revalidation is required" (*source – Industry Canada RIC-21*).

Similar to marine band, the aeronautical radio itself was required to be licensed in previous years. Starting in 1999, an aeronautical radio that operates only on the aircraft band and is operated solely in Canadian or US airspace is no longer required to be licensed. This is good news for small plane, balloon, hang-glider, para-glider and ultra-light aircraft owners and pilots. If you are using a handheld aeronautical radio that is not installed in an aircraft, it does require a license.

Contact Industry Canada directly or visit their extensive website to see if your radio requires a licence or not. (http://www.ic.gc.ca/epic/site/smt-gst.nsf/en/Home).

Amateur Radio Service – Ham (MF / HF / VHF / UHF / SHF)

Far and away the most diverse and interesting radio service is the Amateur Radio Service also known as *Ham Radio*. Licensed Ham radio operators have access to over twenty frequency bands including Medium Frequency (MF), High Frequency (HF), Very High Frequency (VHF), Ultra High Frequency (UHF), Super High Frequency (SHF) and beyond. The equipment available in these bands ranges from home built lightweight low power transceivers through inexpensive handheld units to large super sophisticated Earth Moon Earth rigs running with an output power of 1000 Watts!

Band	Band Wavelength	Frequency in MHz
MF	160m	1.800 - 2.000
HF	80m	3.500 - 4.000
HF	40m	7.000 - 7.300
HF	30m	10.100 - 10.150
HF	20m	14.000 - 14.350
HF	17m	18.068 - 18.168
HF	15m	21.000 - 21.450
HF	12m	24.890 - 24.990
HF	10m	28.000 - 29.700
VHF	6m	50.000 - 54.000
VHF	2m	144.00 - 148.00
VHF	1.25m	220.00 - 225.00
UHF	70cm	430.00 - 450.00
UHF	33cm	902.00 - 928.00
UHF	23cm	1215.0 - 1300.0
UHF	13cm	2300.0 - 2450.0
SHF	9cm	3300.0 - 3500.0
SHF	5cm	5650.0 - 5925.0
SHF	3cm	10,000 - 10,500
SHF	1.25cm	24,010 - 24,250

Table 5. Canadian Ham Radio Bands (U.S. allocations vary slightly, EHF band not shown)

Hams pass thousands of messages per day across the world in various forms. Personal computers linked to radios automatically relay packets of information. Morse code puts Hams in touch with other Hams around the globe. There are networks of literally thousands of local FM voice repeaters across North America in the VHF and UHF bands. (For further discussion of repeaters, see the VHF commercial section below.) Many repeaters have half duplex links to the telephone system called "autopatches" which allow you to directly dial local telephone numbers.

Repeaters can be linked in networks which allow communication over very great distances. For example from Edson, Alberta, Canada you can transmit using low power and reach a repeater in Hinton, Alberta, Canada approximately 100 km away. This repeater is linked to other repeaters, one of which is in Valemount, British Columbia, Canada You can then talk to people in Valemount which is hundreds of kilometers away, all using a handheld transceiver which weighs 500 grams. A licensed Ham radio operator can legally access any repeater operating within the Ham bands. Some repeaters require knowledge of specific codes and may use sub-audible tones (such as CTCSS) to restrict access and reduce interference.

Satellite links are now in place to link ground based repeaters. The probability of emergency contact on the Ham bands is often very good in many areas and Ham operators have a long history of public service and safety activity.

With all this going for it, there must be a reason that everyone hasn't jammed the Ham bands. First of all, in order to be a licensed operator, you must pass a test on electronics theory, radio regulations and procedures. Unfortunately, the thought of technical examinations has unduly frightened off many otherwise capable individuals. The basic examinations are not overly difficult but would probably require the technical newcomer to take a course or do a reasonable amount of home study to learn the required material. Recent changes in licencing requirements has made it far more straightforward to attain the basic license level. Ham operators subscribe to a rigorous set of operating procedures. Poor operating practices are often not suffered gladly.

Successful completion of the basic examination gives the new operator access to the VHF and UHF Ham bands for FM voice communications and other modes. Passing the exams gets you both an Amateur radio operators certificate and a station license which are both now valid for life! Morse code proficiency or testing is not required for access to the VHF or UHF bands.

Typical miniature 5 Watt VHF / UHF Amateur 3-band handheld transceiver with rechargeable battery, emergency AA battery pack and external microphone.

There are optional advanced exams and certificates which allow Hams to transmit at extremely high power levels and operate home built transmitters. In order to transmit on the HF bands however, the user must either:

- complete the Basic exam and achieve an honours mark of 80% or above; or
- complete the Advanced exam and achieve a pass mark of 70%; or
- complete the existing Morse code exam.

The other important point to note is that Ham radio bands are not to be used for commercial or business oriented activities and therefore are not a substitute for using commercial radio equipment for normal business communication or commercial outdoor operations. In a true life threatening emergency, where there is a “grave and imminent danger” present, it may be possible to program some Ham radios to contact nearby commercial operations using commercial repeaters to gain access to emergency services. This should be reserved for the most dire of emergencies where a significant threat to life or limb exists.

Ham radio is one of the most sensible ways of extending the link of possibilities for dealing with wilderness emergencies. If you are not in trouble but you just want to talk, Ham radio operators are always willing to do that. Hams come from all walks of life and I have talked to paddlers on

a river, backpackers in a distant valley and a family in a campground all within the space of ten minutes. At the same time I was busy ascending a technical rock climbing pitch on a high mountain peak. I have arranged for regular daily radio contacts, referred to as schedules or skeds, with other outdoor Hams during wilderness trips to update weather forecasts and current weather conditions.

Most portable VHF 2 meter Ham radios, the type most commonly taken on wilderness trips, can be programmed to receive the Weather Radio broadcasts as well, further enhancing their utility. Some portable handheld transceivers can operate on VHF and UHF bands simultaneously. This is more useful in an urban than a wilderness environment as most repeaters accessible from the backcountry are in the VHF 2 meter band using frequencies from 144 – 148 MHz.

If you do not allow the technology to scare you, the rewards may be worth your while. The best way to become involved in Amateur Radio is to contact one of the hundreds of amateur radio clubs across North America. As an alternative you can easily purchase a basic Ham radio study guide from the Radio Amateurs of Canada / RAC and study for the exams at home. In the process you will learn all about the radio technology you are about to depend upon!

General Mobile Radio Service – Commercial (VHF / UHF)

Commercial Very High Frequency Band (VHF)

Similar to the Very High Frequency / VHF low band mentioned briefly earlier, portions of the VHF high band are designated for public service, emergency services and commercial use. Licensing requirements can be more rigorous on this band. You must have a legitimate reason for requiring a commercial VHF or UHF license. “Just ‘cause I want a radio for emergencies” is not necessarily a valid reason from the perspective of regulators.

A word about licensing in this band: Use of commercial VHF frequencies does not require that the radio operator hold an operator’s certificate, but the radio itself must be licensed for the specific frequencies to be used. The license for the radio may also specifically limit the geographical area that each frequency can be used in. It is possible that each individual frequency in a radio is only to be used in a specified location. Be aware of the restrictions imposed by your license.

The VHF High band is not subject to the same kinds of interference as the VHF low band. It is often used by wilderness professionals and rescue agencies and includes frequencies from 136 -144 MHz plus 148 -174 MHz. Within these frequencies can be found mining, logging, exploration, heli-skiing, ski patrol, guiding, police, ambulance, ground to air, commercial repeaters plus hundreds of other groups and types of users. (The missing portion from 144 – 148 MHz is the 2 meter Ham band mentioned in the previous section.)

The equipment available for use on these frequencies is expensive, ranging

from $500 to $3000, although equipment can be inexpensive to rent. Renting makes all of the licensing requirements the responsibility of the dealer you rent from and not your problem, so this may be very viable in certain “protracted single trip” or expedition types of situations.

When purchasing a VHF handheld radio for wilderness use be sure to get a high capacity battery, an alphanumeric display, a rapid charger (as opposed to a cheap wall charger), a DTMF keypad (like the numeric keypad shown on the radio in the photo), CTCSS (tone coded squelch) capability and a high gain collapsible whip antenna (either 1/2 wave or 5/8 wave). A spare battery pack that can run on AA batteries and an external microphone are additional options to consider. A programmable radio with the capability of holding a large number of channels / frequencies is a real boon as well.

Cheaper and/or older radios may have limited frequency or channel capability with a "crystal" required for each channel. Many of these radios also have a narrow "bandwidth" or range of frequencies over which they can transmit and receive efficiently. Having only a small number of channels available may be good for point to point communication between two radios, but will limit your ability to have access to other services. More expensive mobile radios can have the capability of storing 100 or more "synthesized" frequencies, with a broad bandwidth covering from 136 - 174 MHz inclusive. Handheld radios of this type are now becoming more common among guides and outdoor agencies.

Power output may be switchable between low power (typically 0.5 watts) and a higher power setting. The high power setting on handheld radios is typically from 2 to 8 watts. The ability to switch between high and low power is desirable as it allows the user to operate at the lowest power necessary to maintain communication and thus save battery power and reduce possible interference with other stations.

Mobile and base units in these frequencies can be licensed for much higher power output of 25 – 50 Watts or more. Powered by solar cells, mobile units are often seen in backcountry lodges or huts and occasionally at wilderness base camps. They are often attached to a reasonably efficient and robust vertical antenna that is mounted outdoors in a suitable high location.

Somewhat similar to cellular, VHF high band communications are generally limited to line of sight. VHF communications over a long distance usually requires a repeater (see the discussion below).

Within the Very High Frequency band is *VHF Mobile (150) telephone*. Between 152 and 158 MHz there are 25 frequencies or channels used for directly accessing telephone lines via a system of repeaters. The area covered by this system of repeaters in North America was once the most extensive of all mobile telephone services. Coverage extended well into the wilderness in many areas. Due to the popularity of cellular phone services, many VHF 150 systems have now been dismantled across North America and most are slated to be decommissioned in the near future. In those limited areas where the service is still available, you simply contact a mobile telephone operator over the radio to place a telephone call. VHF Mobile is "half duplex" communication in which the transmit and receive frequencies are different, but the two parties communicating cannot be talking at the same time. One person must listen while the other talks. Special licensing applies. Users must have arranged and paid for a mobile telephone account and number through the appropriate telephone company. Due to changing technologies (primarily

cellular and satellite phones), this once tremendous boon to outdoor users is now almost completely gone.

New Interagency VHF Search & Rescue Frequency

Extensive discussions between the National Working Group for SAR Radio Communications and Industry Canada representatives culminated in a common dedicated frequency for initial response among diverse Search and Rescue agencies. In 2005, Industry Canada approved the use of the Search and Rescue Inter Agency National Frequency (SARIAN F) 149.080 MHz VHF FM as a means to establish initial contact between first responders involved in a ground search and rescue operation.

Commercial Ultra High Frequency Band (UHF)

Similar to VHF, there is a portion of the Ultra High Frequency (UHF) band between 450 and 470 MHz which is allocated to commercial and public service use. Very common in urban use, UHF is less subject to static than either HF or VHF bands. With the exception of the new FRS / GMRS band, UHF handheld or portable units are seldom used in the wilderness. In external appearance they are indistinguishable from VHF equipment. It's what's inside that counts! UHF is similar to cellular in that it is very short distance line of sight and UHF signals can be blocked by heavy foliage, mountains, hills, etc. UHF signals also propagate less effectively than VHF for wilderness types of communications. The VHF high band seems to offer a more practical alternative to UHF in the wilderness at this point. Search and rescue groups may want to investigate the use of the designated SAR frequencies in this band. Like commercial VHF, use of commercial UHF frequencies does not require that the radio operator hold a certificate. As above, the radio itself must be licensed for each specific frequency and/or geographic location.

VHF and UHF Repeaters (a semi-technical discussion)

A repeater is an intermediate receiver and transmitter usually located at some high point on a ridge or mountain top. A mountain repeater usually consists of two good antennas, a sensitive receiver, a powerful transmitter, a battery, a solar panel to keep the battery charged and a device called a duplexer to keep the transmitter and receiver from interfering with one another.

The repeater receives your signal and at the same time transmits it on a different frequency, often at a greatly increased power level. In some cases it may receive signals from stations up to 25 or more miles away and retransmits them so that they can be received an equal distance away. The person you are communicating with will actually listen to your transmission on a different frequency than the one you sent it on.

When you transmit and receive on different frequencies this is referred to as duplex communication. When you transmit and receive signals on the same frequency it is called simplex. You cannot automatically use any repeater that you choose. You must first obtain the permission of the repeater's owner AND then get a license to operate on their frequencies. Let's now look at how repeaters function.

You may transmit a message on a given frequency, let's say 150 MHz. The repeater receives your transmission, amplifies it and retransmits it simultaneously on a different frequency, for

example 160 MHz. The person you are talking to has her receiver set to receive on 160 MHz. When she talks to you, she transmits on 150 MHz. Her signal is also picked up and retransmitted by the repeater and you listen on 160 MHz. This is the most common means by which persons communicate great distances using VHF and UHF.

The difference between transmit and receive frequencies is known as the "offset". In this case the offset is 10MHz. The offset for your handheld radio must be known in order to program some Ham and commercial radios to work with repeaters. To calculate the offset you take the frequency YOUR RADIO receives on and subtract the frequency your radio transmits on. In this case the offset is actually negative 10 MHz (-10 MHz) often referred to as "down 10 MHz" from the receive frequency.

The offset may be "up" (positive) or "down" (negative). When the offset is up, it means that you transmit and the repeater receives above the frequency on which the repeater transmits and you receive. When it is down, you transmit below the frequency on which you listen. Getting this confused is easy and is a major reason why some radios will be programmed incorrectly and thus not work properly.

On the commercial radio bands the offset can be just about any number. In the Ham bands the offset is conventionally 600KHz on the 144Mhz band and 5MHz on the 440 MHz band. On the 2 meter (144MHz) band, repeaters with a transmit frequency below 147.00 MHz have a negative offset. Those at 147.00 and above are positive. Similar arrangements exist on 444 MHz where the offset is +5MHz.

Repeaters are often located at locations that are hard to access and some form of remote control is required. This is provided by a control board which is part of the repeater radio and responds to DTMF tones which instruct it to do such things as linking with other repeaters, connecting to phone lines (autopatch) or turning the repeater on and off. Best not to transmit tones from your keypad unless you know what you are doing. You may accidentally turn off the repeater.

There are a few things to consider when using a repeater. First, listen to be sure you are not going to interfere with a conversation already going on. If the channel is clear go ahead and identify yourself and make your transmission. If you want to break into a conversation, wait until one of the parties stops transmitting and in the pause politely announce your presence. If you have a true life threatening emergency you can use a May Day distress call. (On the Ham bands do NOT say "Break" unless you have a true emergency.)

Some repeaters have what is called an autopatch. An autopatch connects the repeater to the phone system allowing you to make local calls through your radio. You often need to know a special set of tones to turn the autopatch on and off. You use your DTMF pad to dial the access code followed by the phone number, keeping the transmit button pressed during the whole time you are dialing. When you are finished you must enter another code to disconnect the autopatch.

An autopatch is not the same as using a cell phone or regular phone because both parties cannot speak at the same time. At the beginning of the call you should explain to the person you are calling that when you have finished talking you should say "over" to indicate that it is the other person's turn to talk. People experienced with using radiotelephone can often dispense with this

formality. Remember that there is NO privacy on an autopatch and the whole world can be listening.

On Ham repeaters the procedure for each repeater varies, but you must first identify yourself with your callsign. For example you might say "VE6XXX accessing the autopatch" before beginning your call. When finished you disconnect the autopatch and identify yourself again.

Some repeaters require a tone at a particular frequency to access the repeater. This is known as CTCSS or tone coded squelch. The repeater's circuits will not operate unless the tone is present.

In winter when the daylight hours are short and the solar panel may be obstructed by snow it is best to keep your transmissions to a minimum in order to keep the battery from becoming drained. Once a batteries' voltage drops the battery is more likely to freeze and be ruined.

General Mobile Radio Service – Short-Wave / High Frequency (HF)

In the high north in places like the Yukon, Nunavut and the North West Territories there is still very limited access to VHF / UHF frequencies and satellite telephone has not yet completely taken hold. The only practical wilderness communication system in the absence of repeater networks is the use of High Frequency (HF) transceivers sometimes referred to as short-wave. Here the age old short-wave radio is still king.

Some suggest that satellite phones will eventually replace short-wave entirely (and it likely will) but as of today that has not quite happened. Some places in the far north have not yet made the leap to satellite phones. If you are going on an trip to a truly remote northern area consider short-wave as another communications option.

HF signals have the potential to travel great distances, but varying ionospheric conditions make contact with the outside world uncertain. This depends on the channel (frequency) you use and the time of day. In the far north a 10-watt signal in the 5 MHz portion of the land-mobile band transmitted through a portable dipole wire antenna can expect a range of about 200 miles during the daytime and about 500 miles at night. This depends to a large degree on radio propagation conditions at the time. Varying the time of day contact is attempted, the antenna location and antenna height can sometimes yield better results.

Antenna lengths for High Frequency (HF) transceivers will often range from 5 to 40 meters and will typically be a long wire attached to the radio at the end or perhaps in the middle. Lower frequencies use longer antennas, higher frequency antennas are shorter. This wire must be strung out above ground and anchored. The manner in which the wire is erected makes a difference in the strength of the resulting signal. In general the higher the antenna is above ground the better. In a portable situation in the high north, it may not be possible to erect the antenna much more than 3m / 10 feet off the ground. While not

very efficient, an antenna at that height may still give reliable communications to about 100 miles under normal propagation conditions. At a fixed base the antenna should be at least 30 feet above ground. In simpler cases the antenna is essentially a long vertical rod that must be attached to the radio. Some HF radios and antennas can be confusing for the uninitiated to set up and use, therefore a good understanding of how the radio functions is mandatory for optimal communications.

The radio pictured above in a padded insulated case is the PCX-250 manufactured by ParaComm Technologies. It is Canadian-designed for a harsh northern climate. The following paragraph is from the ParaComm Technologies website (circa 2004):

> *The radio will perform well down to -40°C with the weak link being the batteries. All types of batteries lose a degree of performance when very cold. In the arctic we tend to use alkaline batteries because of their easy availability and long life. However, alkaline batteries should be kept at temperatures no colder than -10°C, if at all possible, to achieve best performance. Hunters and trappers in the Canadian arctic often wrap their radio in their sleeping bag while travelling. This keeps the entire radio (as well as the batteries) reasonably warm for 24 hours of so. The batteries could be carried inside a parka and installed when the radio is used, but this should only be necessary under the most hostile of arctic conditions. Just remember that the performance of your radio is intimately tied to the condition of your batteries. Under the coldest conditions use fairly new batteries and keep them warm if at all possible. Alkaline batteries will freeze and become almost useless at temperatures below -30°C.*

Much of the communication on the High Frequency bands is AM single side band or SSB. This is just a special kind of AM (Amplitude Modulated) signal that makes more efficient use of the power put into the signal. Portable battery operated units weighing several pounds are in common use in some remote northern areas. HF SSB units often cost in excess of $1000, but can sometimes be rented at reasonable rates. Programmable transceivers with large channel capability are available, but are often quite costly. Lesser priced units require costly coils and crystals and can be limited to four or less channels.

Access via radio-telephone to regular landline telephone systems can occasionally be arranged with some HF radios, but such systems are being phased out as newer systems, particularly satellite, begin encroaching on the north. A mobile telephone operator is contacted who places the call for the user.

Like commercial VHF, use of HF frequencies no longer requires that the radio operator hold an Operator's certificate. The requirement for a radiotelephone operator's restricted certificate (land) was removed about 5 years ago. As with VHF, the radio itself must be licensed for each specific frequency and/or geographic location. Prior authorization of the telephone company is required if telephone contact is desired.

In less remote areas, the size, weight and operational considerations make HF systems less than desirable. It is included in this article more to complete the survey of available systems than for its practicality.

Addendum - Weather Radio Broadcasts (VHF)

Across North America, there are several standard VHF frequencies which are used to broadcast information regarding current weather conditions and weather forecasts. Marine radios almost always include these channels. Weather radio stations most commonly operate on 162.400, 162.475 and 162.550 MHz. There are several additional frequencies used across North America, particularly within the Marine band (162.425, 162.450, 162.500, 162.525, 161.650, 161.775, 163.275). In urban areas and many coastal areas, these stations broadcast information continuously. There are small weather radio receivers available that receive only these frequencies. In some areas, if a weather watch or warning is issued a unique 1050 Hz tone is broadcast which causes some special weather radios to set off an alarm and notify the owner of the potential or real hazard.

Some FRS, CB and Ham radios now also have these channels added, a worthwhile feature to consider. If you have unused channels on a Ham or commercial VHF handheld radio capable of holding many frequencies, you may consider the addition of one or more of these frequencies in receive only mode only, providing weather radio service is available in your area. In the mountains, distant weather broadcasts may often be picked up from more than 100 km away. Having these channels can provide helpful weather updates.

Practical Considerations

The Basics

There are a few things you must have worked out when you decide to buy. After you have decided which radio to purchase, read the following sections to be sure you have the proper licenses and will make a wise purchase. A few words of advice in advance are in order here (some of which are discussed in more detail in this section). You should purchase:

- the best radio you can afford (easiest to use / most features / rugged),
- a radio with capacity for as many frequencies as possible (avoids constant reprogramming),
- a radio with CTCSS or tone coded squelch capability (essential to use many repeaters),
- the best battery available (highest capacity),
- the best charger you can obtain (standup rapid charger / not cheap wall charger),
- a collapsible / extendable high gain whip antenna that is adjustable (tunable),
- a radio with a DTMF keypad,
- a radio with an alphanumeric display, and
- a radio that can be programmed by you (doesn't have to be taken in for programming).

Making Contact

Once you have decided to take the plunge and commit to purchasing a transceiver or two, you are still left with some very important questions. One of the chief questions is, "Once you are in the wilderness, who are you going to talk to?" Figuring out who you will communicate with requires research for each given area you will visit. Any radio transceiver is useless for emergency communication if no-one is listening. Plan months in advance to allow time for license processing.

If you are a Ham radio operator, contact the local Ham club, or better yet become a club member, and see if you can get information for locations of repeaters in the area you are about to visit. Repeater guides for North America are published annually by the American Radio Relay League. Try to find other Hams with outdoor interests and they may be able to help you with additional unpublished lists and practical suggestions.

If you intend to use commercial repeaters, be sure you have the appropriate letters of authorization and licenses in hand. This amounts to phoning and writing various agencies or repeater owners to request access to their equipment and/or frequencies. This would then be followed up by forwarding a letter from the agency / repeater owner, together with the proper forms, to Industry Canada requesting that the specific frequencies be added to your license. Once your amendment is verified, you can legally use the repeater in emergencies. This process may take weeks. It is becoming streamlined with some licensing procedures now possible on the internet. Plan ahead.

If you are using aircraft access to your wilderness site you may arrange with the air carrier to occasionally communicate with them on a regularly scheduled radio call (a sked) or perhaps a preplanned fly-over or rendezvous when a pilot is known to be in the vicinity doing other work.

Don't think that because you have a radio you can just use any old frequencies or repeaters you like. Unlike the unrestricted CB or FRS bands, this is the real thing we are talking about here. The Radiocommunication Act and General Radio Regulations allow for a certain degree of leniency for unauthorized use of certain frequencies in cases of true life – threatening emergency (often referred to as "grave and imminent danger"), but if you go too far, you may pay the price. A recent case in the US illustrates this point. A person accessed a sheriff's department frequency without prior authorization. Even though it was a serious emergency, the radio operator was fined for illegally accessing that frequency and had his radio equipment confiscated. In addition, the rescue fees were added to the bill. It all made for a successful rescue and a very, very expensive helicopter ride.

Licencing and Fees

Some radio services require licenses, some don't. Some require the payment of fees, some don't. How do you keep it all straight? Below is a simple chart that is current as of year end 2007. First a few fine points courtesy of a friend. "The radio licence is often a *station* license. Thus if a vehicle is fitted with 2 radios (say one UHF and one VHF) it would only require one license; however if a person had several handheld radios which could be used by separate individuals, then there should be a license for each. The licensing fee would not be dependent on the number of legal frequencies programmed in since these are *mobile*.

For any fixed station (such as a base station radio) the license fee would depend on the number of "frequency transmit/receive pairs" and the location of the radio." In regard to licenses and fees, the chart is a guideline only but Industry Canada has the final word on what is actually required in any particular case.

When in doubt, be sure to talk to a lot of people before committing to paying hundreds of dollars for a system that may eventually become an expensive paper-weight if you choose poorly. Never trust the advice of only one person when it comes to radio systems. Talk to radio users, telecommunications dealers and anyone else who may have a clue about what to buy. Search the internet for ideas. Most importantly, talk to those who are already using the system for your intended application. Contact several dealers before purchasing, renting or leasing.

Where appropriate, Contact Industry Canada (formerly Department of Communications) regarding frequency availability in your area and license requirements. Be sure Industry Canada and the supplier of your equipment are aware of your intended use, so the most realistic "street legal" system will be obtained.
(website: http://www.ic.gc.ca/epic/site/smt-gst.nsf/en/Home)

AVALANCHE BEACONS / TRANSCEIVERS				
	License?	***Examinations?***	***Fees?***	***Other Considerations***
Avalanche Transceiver	none	none	none	regular practice advised
ELT	none	none	none	only legal for aircraft
EPIRB	none	none	none	only legal for water craft
PLB	none	none	none	registration of beacon !
TRANSCEIVERS				
	Radio License required?	***Operator Certificate / Examination?***	***Fees Payable?***	***Other Considerations***
Cell Phones	none	none	airtime & connection	no special requirements
Satellite Phones	none	none	airtime & connection	no special requirements
FRS / GMRS	none	none	none	no special requirements
49 MHz low power	none	none	none	not recommended
CB	none	none	none	no special requirements
Marine Band	no (some exceptions)	yes one time exam	yes (some exceptions)	best for all coastal / water -based activities, semi - technical exams
Aircraft Band	no (some exceptions)	yes one time exam	yes (some exceptions)	limited utility, semi - technical exams
Ham Bands VHF and Above	yes one time	yes one time exam	yes one time	great utility, technical exams, license is for life of operator, NO Morse code
Ham Bands HF and below	yes one time	yes one time exam	yes one time	All VHF requirements plus: Morse code exam, or 70% on Advanced exam, or 80% on Basic exam.
Commercial HF / GMRS	yes annual	none	yes annual	utility is limited to Northern areas and marine applications
Commercial VHF / GMRS	yes annual	none	yes annual	great utility in many areas, difficult to obtain license
Commercial UHF / GMRS	yes annual	none	yes annual	limited utility in wilderness, difficult to obtain license

Table 6. Licencing, Examinations and Fees for various services

Making the most of the Technologies

Once you have figured out who you will communicate with, you need to be sure your equipment functions as intended. Practice using, assembling and disassembling (as necessary) and trouble-shooting your equipment well before your life or the lives of your party members depend upon it. Five common failings with radio equipment are:

a) battery (or power supply) problems,
b) antenna problems,
c) LCD (alphanumeric screens) and DTMF keypads,
d) lack of knowledge of equipment limitations and / or,
e) lack of knowledge regarding how the equipment works or improper setup.

Batteries

In regard to your battery, you need to balance the weight and size of your battery against its durability and longevity. Getting the longest period of operation out of the smallest and lightest

battery possible usually amounts to paying more money for a modern battery. NiCad or Nickel – Cadmium battery technology has been around for a long time but requires constant upkeep. Nickel Metal Hydride and Lithium Ion batteries are more common now and offer higher capacity in a smaller size. Battery characteristics are the subject of a more advanced follow – up to this article. Thoughtful inquiry is once again the answer. Some hints from the wise may help here as well:

Purchase the highest capacity battery you can afford. Consider carrying a backup battery. You may also want to consider a backup battery for your handheld radio that can accept typical AA cells if possible, so that an emergency power source can be made from available spare headlamp or avalanche beacon batteries.

Purchase the best quality charger available. In particular rapid chargers are quicker and a good charger automatically detects a full charge so your battery is not overcharged. A typical rapid charger is shown in the photo at left. Overcharging heats up and dries out your battery . This will eventually destroy it. Typical low cost "wall chargers" have no way of detecting when the battery is fully charged, take longer to charge your battery and risk destroying your battery if repeatedly left on for too long (over 30 hours). A typical wall charger is shown at right. Cheaper is not better.

If you typically use the radio daily and you may need to recharge the battery on a road trip it is a good idea to purchase a 12 volt auto charger that plugs into cigarette lighter receptacle. A typical car charger is shown on the right.

Be sure rechargeable batteries are fully charged before a trip begins. If you have NiCad batteries remember that they drain about 10 – 15% per month. Recharge them occasionally and every once in a while drain them completely then recharge them completely (called cycling your battery). Leaving a NiCad battery fully discharged for an extended time can result in a battery that will no longer accept a charge. Consider having your batteries reconditioned once every year to be sure they still have a reasonable capacity. The older the battery the more likely it should be reconditioned and the more often this may be necessary.

Store your battery and radio in a waterproof container and keep them at room temperature when stored. On winter trips consider carrying the radio or battery next to your body or wrapped up in your sleeping bag. Cold temperatures can kill a battery. Consider storing your battery disconnected so it can't accidentally get switched on or drained. Don't store your battery next to any metal objects that could short the terminals.

Antennas

A second common cause of grief with transceivers is the antenna. Be sure you have the right antenna for the radio and frequencies you will be using. Using the "off the rack" antenna provided with a handheld radio may be dooming your radio communications enterprise to failure. In wilderness activities, for example a VHF handheld radio should always be accompanied by a 1/2 wave or 5/8 wave "collapsible whip" antenna cut to the proper band or frequency. Bring your short antenna as a spare for short distance local communications or when a long antenna would be unwieldy.

A selection of antennas are shown at left. The leftmost antenna is a stock rubber duck antenna with typically low gain. The three antennae in the middle are sold as high gain antennas but really they should be sold as "slightly higher gain than your rubber duck you got with your radio". They are compromise antennas that are still small and increase your gain, but not to the true potential of a really good antenna. The antenna on the right is the 1/2 wave collapsible whip we have been talking about. In this case it is only extended to half its length so that it would fit better in the photograph. It is not flexible and can be easily broken which is why you use a rubber duck for day to day purposes. In a worst case scenario this long ungainly antenna can act as a lever and break your radio. Use due care when it is attached.

How much difference can the antenna make? An antenna rated with a "gain" of 3db (db = decibels) effectively doubles your effective radiated power. In essence, switching to a good antenna may actually *more than double* your power in many cases.

The stock antenna that comes with your radio often does not have any true gain and in actual fact may have a true "loss" of effective radiated power. Stock antennas with handheld radios are

usually short little rubber coated antennas, often referred to as “rubber ducks”. Don’t be fooled by db gain figures. In order to talk about gain you have to compare against some standard. Pretty much every antenna that you buy will state that it gives you great gain. (This is called good advertising.) You need to know “great gain compared to what?” If the gain figure is quoted in reference to something called an “isotropic radiator” that is pretty much like saying how much better gain does this antenna give me compared to no antenna at all. That is pretty tricky isn’t it.

When in doubt you need to specifically state that for the “wilderness” I want a *tunable 1/2 wave “collapsible whip antenna” that will work on the frequencies I am using*. If you get anything much less than a meter long then they have sold you something else. You may need to order a third party antenna via the internet.

If you are using a Ham radio and thinking in the back of your mind that you will use it for accessing a commercial repeater in a dire emergency, you may be in for a surprise (totally apart from the additional legal issues, of course). A typical handheld Ham radio is sold with an antenna optimized for the Ham band. Output power on anything other than that band will be marginalized instead of optimized. For example, a typical VHF 2 meter Ham radio is rated at 5 Watts output on frequencies between 144 MHz and 148 MHz. When used at a frequency of 165 MHz (typical frequency range used in emergencies) it may have an output as low as 1 Watt. That low output may then be channeled through an antenna that has a great amount of loss at that frequency. The result may be an effective radiated power of 0.1 Watt. This low output may not be enough to communicate beyond the valley you are located in.

In addition, your Ham radio may require an illegal modification that voids your warranty before you could even consider using it outside of the Ham band. Normally, neither of these two problems can be solved in the field, regardless of the nature of your emergency! You would have to bring along a previously modified radio with the proper antenna. This is now akin to carrying a sawed – off shotgun in case of rogue bears. Your intentions may be pure, but possession of the device may now be illegal. If you really need access to commercial frequencies for a longer trip where Ham repeaters may not be a viable option, consider renting a commercial radio or even a satellite phone for your trip.

For a base-camp or hut setup you may want a high gain external (expensive) antenna or in extreme settings a high gain directional (very expensive) antenna such as a “Yagi beam” shown in the photo at left. This is the real specialized stuff that radio geeks play with.

As a Ham radio operator, I own a 500gram / one pound high gain directional Yagi beam antenna that I occasionally take into remote areas. This antenna increases my power output almost ten times and allows me to pick up signals that are almost ten times weaker.

A more detailed discussion of antennas and gain is found in the follow-up to this article. Even a high gain antenna may not allow you to communicate if you are located in a canyon, deep valley or ditch and no repeater is nearby. If your first attempt at contact is not successful, get to the highest ground possible, free from intervening ridges and other obstructions. Be sure you are also clear of any other sources of interference like metal clad huts or buildings, generators or power lines.

LCD (alphanumeric) Displays and DTMF keypads

Earlier in this article it was stated that you should purchase a radio with an alphanumeric display and a DTMF keypad. Most alphanumeric displays on modern VHF radios are LCD or "liquid crystal diode" displays. These displays will go blank as temperatures approach –20 C. This is only temporary and the display will function again once it warms up but it should put you on guard that your radio is dangerously cold and the battery is bordering on failure. Warm the entire radio and battery and kept it inside your clothing when not in use.

When purchasing a radio with an LCD alphanumeric display there are several type of displays that give varying amounts of information. The more information the display provides the better, within reason.

The three radios above have three very different LCD displays. The one at left simply displays the channel number and nothing else. The user has no real choice in what is displayed. The radio in the center has eight alphanumeric characters that can be displayed. The user chooses what is displayed for each channel. In this case the display reads RESQ DYN which is short for Rescue Dynamics. The radio at right shows the actual frequency in the upper line (145.410). The second line has the channel number (119) plus eight characters chosen by the user (in this case Edmonton). The third line has a signal strength indicator and an indication of the mode the radio is currently in (in this case NFM means Narrow band FM). That is a lot of useful information if you know what it all means.

DTMF keypads are quite important for many modern VHF radios. In Ham radios the entire radio can often be reprogrammed in the field via the keypad. In both commercial and Ham radios the keypad can have many functions assigned to them such as priority channels, locking the keys to avoid accidentally changing settings and changing power output are just some examples.

The keypad is essential to make phone calls if you are using a repeater that has auto-patch capabilities. An auto-patch is simply a link between your radio and the telephone system. You usually need to know special access codes to turn an auto-patch on and off. For this you need to discuss getting permission to use the auto-patch from the owner of the repeater.

The biggest problems encountered with using the keypad is just that the user may have no idea what any of the keys do and how they are to be used. Ham radio keypads are far more complicated than the keypad on the commercial radio shown at the left. Familiarization is the key. Spend the time learning how your radio works! Many radio owners will carry an abbreviated copy of the radio instructions and functions of the various key on a laminated card or small booklet. This is a truly wise idea. The instructions should be written in such a manner that anyone can follow them in case the owner of the radio is incapacitated. It is also a good idea to have a short list of emergency procedures and emergency phone numbers and auto-patch codes if an auto-patch is available.

Equipment Operation and Limitations

Before heading on a trip, be sure you and the other party members know how the radio is properly used. Know how to change channels / frequencies and how to properly attach the battery and antenna. Carrying a laminated card with directions for use of the radio and who to contact in an emergency is a wise idea. Satellite phones should also have a laminated card with directions for use as well as the lock/unlock code written down or memorized by everyone in the party.

Knowing how to adjust power output may be critical. Some radios have high and low power settings. Low power is used to conserve batteries when communicating locally. High power is used when you really need to get your signal out to the rest of the world.

A half hour spent reviewing proper radio operation before a trip may make a world of difference in a crisis. You should also know what to expect of the equipment you have. Arrange to test the operation of the equipment in non-emergent situations before relying upon it during a trip as the ultimate backup.

Important Technical Issues

Since the first edition of this article came out I have received countless phone call and emails from climbers and guides, often asking for advice or help with fixing a problem. In at least three cases a radio did not work in situations where the operator thought that it should have. Two of these cases were real life and death emergencies.

Earlier in this article I enumerated five common failings with radio equipment that are worth restating here:

a) battery (or power supply) problems,
b) antenna problems,
c) LCD (alphanumeric screens) and DTMF keypads,
d) lack of knowledge of equipment limitations and / or,
e) lack of knowledge regarding how the equipment works or improper setup.

The first three issues were just dealt with in detail. Now let us discuss how lack of knowledge or improper setup of your radio can defeat your best efforts.

If you own a Ham radio you already know that they tend to be complicated. Practice and review the operation of the radio at least a few times a year if you do not regularly use the radio as a

hobby. Commercial radios tend to be a bit simpler to use with fewer fancy modes and function buttons.

As discussed in the section on antennas, Ham radios are not intended to be used on the commercial bands so their performance in those bands during an emergency tend to be dismal. Even commercial radios with a short "rubber duck" style antenna can have poor long-distance performance. Don't expect anything better, especially if you are not carrying a collapsible whip antenna that is optimized for the emergency frequencies you will be working on.

CTCSS / Tone Coded Squelch

Some companies and parks have now switched their radios over to using a "continuous tone-coded squelch system" also known as CTCSS. Their radios will not hear a signal and their repeaters will not relay a signal unless a special non-audible CTCSS signal is detected. If a system is using CTCSS you can here people talking but they cannot hear your transmissions. This is intended to reduce interference and in some cases to limit accidental access to repeaters. (Note: CTCSS tones are also known as "Motorola® PL tones" or "privacy tones" or simply "tone coded squelch".)

There are many CTCSS signals or "frequencies" that can be used. How do you find out what the proper CTCSS frequency is? You must contact the owner of the repeater or radio that you intend to communicate with. Then your radio must be properly programmed to encode this signal every time you transmit.

You do not have to have your radio set to decode the signal unless you want to eliminate the chance of hearing everyone else that may be using that frequency that doesn't have the proper code set. Best to leave the receive side of your radio with no code set. Only program in a code for the transmit side and ONLY if you know the repeater or radio actually requires it. If you don't understand this basic discussion of how CTCSS codes work, best to talk to someone who does.

Narrow Band Technology

Of significant interest to professional guides in the Canada's national parks is the impending shift of national park repeaters from wideband to narrowband VHF FM. In a nutshell this may mean that any older radios may have difficulty being able to access national park repeaters.

If you are using a radio older than 5 to 10 years old it stands a very good chance of operating very poorly or not at all on the new narrowband repeaters. The switch to narrowband technology all across the country is inevitable as many more users are now vying for the limited number of frequencies available. High population density centres will be targeted for the switch to narrowband sooner than more remote low population density areas. Government agencies will likely switch over before other users.

Narrowband will be phased in over a period of years in a couple of increments. The amount of "space" (bandwidth) your signal occupies will narrow allowing more users to share the same space. The first step will be to move from wideband (25 kHz) to a narrower bandwidth (12.5 kHz) and eventually to a much narrower bandwidth (6.25 kHz), possibly digital.

As a word of advice, if you are going to upgrade your radio as a result of this change I would highly suggest one of the many new, small, lightweight and relatively inexpensive multi-channel narrowband commercial radios now available.

Radio Programming for Repeater Use

The final common problem with using a radio involves having it improperly set up before you head on a trip. Frequencies must be entered precisely. If you are accessing repeaters, both the transmit and received frequencies must be know and programmed in because repeaters use two frequencies to operate on, not just one.

A fairly common problem with repeater frequencies is that the radio is accidentally programmed incorrectly. A repeater will have one frequency set to receive on but will transmit on a different frequency. You must transmit on the frequency that the repeater listens on and listen on the frequency that the repeater transmits on.

If you get the transmit/receive frequencies mixed up you will not be able to use the repeater even if you have the right frequency and the right CTCSS code programmed into your radio. Some radios require that you program in the receive and transmit frequencies separately while others require that you program in the receive frequency and then program in the difference between the two frequencies called the "offset".

It is important to note whether the result of your calculation is a (+) positive or a (-) negative number as this must be programmed into the radio as part of the offset. Bad math equals a bad offset and the result is no access to the repeater. Having this set of frequencies programmed in backwards or programming in a + offset when it should be a - offset is a very easy mistake to make and the best way to check in the field is to actually try to communicate on the repeater before it is an emergency. Of course you can only do this if you are properly licensed to use the repeater in question.

This covers most of the major operational issues that have come to light in recent years. A few additional field situations that have not already been discussed involve more technical issues that are best discussed with the firm that sells you your radio.

Good Advice

Here is some final practical advice for radio phone use:

- Store your radio and battery separately as this prevents accidental discharge.
- LCD screens may become blank at temperatures below –20 degrees C (keep the radio as warm as practical).
- Double waterproof your storage container.
- Pack waterproof instructions with the radio that anyone can follow and
    - include your emergency response plan and
    - include a list of information to compile before calling for emergency assistance.
- Have a printed list of your radio's frequencies.

Radio Etiquette

Be sure that everyone realizes that radio use is a privilege and not a right. Keep radio communications to a minimum to conserve batteries in case of emergency. Write down important things before you get on the radio so you know what you are going to do and say. Be

brief and concise. Keep your language simple and avoid jargon you don't understand. Profanity is forbidden. Try to avoid interfering with radio messages being sent by other parties on the same frequency. Monitor the frequency for several minutes first before transmitting. If you are having problems getting your message across, use the phonetic alphabet to spell things out. Keep a small card with the phonetic alphabet with your radio for such times. A copy of the phonetic alphabet is contained in the appendices. Here is some information you should have gathered and written down when calling for assistance:

- Who you are and the size of your party
- Your exact Location (Are you moving or staying in one location?)
- Number of patients
- Names of patients and nature of accident / injury or illness
    - symptoms and vital signs of ill or injured persons
    - current and past condition
    - first aid administered and results
- Requirements
    - medical personnel
    - equipment (1st aid, oxygen, backboard, etc.)
    - transport you would like (rescue agency may decide for you)
    - food / water / shelter
- Weather
    - visibility (fog / cloud / rain / snow), wind speed / direction / gusts
- Nature of terrain where you are and any possible aircraft / helicopter landing sites
- How to Communicate with you
- Name, address and phone numbers of other party members or their emergency contact numbers.

Appendices

Appendix A - Industry Canada – Rules & Regulations

Globally, the International Telecommunications Union creates international agreements on how radio frequencies will be regulated and allocated around the globe. In Canada we are governed by the Radiocommunication Act and the supporting General Radio Regulations. These Acts and regulations are administered by Industry Canada (formerly the Department of Communications). They have local offices in major centers across the country and maintain a website (http://www.ic.gc.ca/epic/site/smt-gst.nsf/en/Home) which can provide general information and many relevant circulars containing details of specific issues.

The Radiocommunication Act specifies that radio frequencies are public property in Canada and no-one "owns" a given frequency. We license the right to use a given frequency in a specific geographic area. Radio communications are considered to be privileged communications and any conversations you overhear on the radio are not to be divulged unless in emergencies or to proper authorities. Profanity is forbidden. Operators and radios may require certificates and licenses as discussed earlier in this article. When in doubt defer to Industry Canada for exact details.

Appendix B – Priority of Emergency Radio Messages

Within the radio communications world there is a well defined way of communicating the level of urgency of your emergency. What follows is a watered down version of the proper technique employed by professional radio operators to notify the world of emergencies and safety issues. If you are using marine or aircraft band radios, you should be well aware of these messages as they are required knowledge for your examinations. When in doubt, just use plain language and sort the details out later. The wording for the following is modified after Industry Canada circulars.

Distress Communications / Distress Call

A "Distress Call" is when a station / radio operator is threatened by grave & imminent danger and requires immediate assistance or when you are aware that a ship, aircraft or other vehicle is threatened by grave & imminent danger and requires immediate assistance. This is when you use the classic "MAYDAY, MAYDAY, MAYDAY this is… (call sign of aircraft or vessel or the name of the party spoken three times)." A Distress Call has absolute priority over all other transmissions. If you hear a distress call, you should stop all of your communication and monitor the frequency in case you can assist. A station may impose radio silence on stations interfering with distress communications by using the expressions "Stop Transmitting - Distress" or "Silence, Distress".

A proper distress message is comprised of:

- The actual Distress Call - MAYDAY, MAYDAY, MAYDAY this is…
- The call sign of the station in distress or the name of the party (i.e. Fairy Meadows Hut)
- The particulars of your position (location) plus your heading and speed if you are moving
- The nature of your distress and the kind of assistance required
- Other information necessary to facilitate rescue
- The message is repeated again if there is no contact.

If you are acknowledging a distress message you should forward any relevant information immediately to the nearest Search and Rescue organization. Continue to monitor the frequency and other appropriate frequencies and notify any other stations which may be of assistance. Stop all radio transmissions which may interfere with the distress communications.

Urgency Signal & Messages

If you are not in grave or imminent danger, but you have a very urgent message to transmit concerning the safety of a ship, aircraft, or other vehicle or of some person on board or within sight, you use what is called an "Urgency Signal". The urgency message begins with, "PAN PAN, PAN PAN, PAN PAN, this is… (call sign of aircraft or vessel or name of the party spoken three times)." The urgency signal has priority over all other communications except a distress call.

The Urgency Message consists of:

- The Urgency signal "PAN PAN, PAN PAN, PAN PAN, this is… the call sign of the station or the name of the party (i.e. Fairy Meadows Hut)" followed by a message giving further information of the incident in plain language.
- Stations hearing an urgency message are to discontinue communication for 3 minutes, after which, if no further urgency message has been heard, they may resume normal service.

Safety Communications & Messages

A "Safety Signal" is used when you are about to transmit a message concerning the safety of navigation or giving some other important meteorological warning. The safety signal has priority over all other communications except distress and urgency.

A Safety Message consists of:

- "SECURITY, SECURITY, SECURITY, this is… the call sign of the station or the name of the party (i.e. Fairy Meadows Hut)" followed by the message.
- Stations which hear the safety signal must take care not to interfere with the message which follows.

Appendix C – Phonetic Alphabet

When signals are weak, broken or difficult to copy due to static, interference or other problems, and communication is difficult, the Phonetic Alphabet may be used to spell out important words or phrases. The phonetic alphabet is actually a "standard" unlike what is occasionally done on television where people "make it up as they go along". If you regularly use radio communications either memorize the alphabet or copy it onto a laminated card kept alongside the radio.

A ALPHA
B BRAVO
C CHARLIE
D DELTA
E ECHO
F FOXTROT
G GOLF
H HOTEL
I INDIA
J JULIET
K KILO
L LIMA
M MIKE
N NOVEMBER
O OSCAR
P PAPA
Q QUEBEC
R ROMEO
S SIERRA
T TANGO
U UNIFORM
V VICTOR
W WHISKEY
X X-RAY
Y YANKEE
Z ZULU

Appendix D – Marine VHF Channels and Allocations

See attached chart.

About the Author

Cyril Shokoples is an internationally certified Mountain Guide and Past-President of the Association of Canadian Mountain Guides. He has been a member of the Alpine Club of Canada and Edmonton Section since 1975 and received the Silver Rope award in 1988 and the Distinguished Service Award in 2002. He also received the Distinguished Service Award from the Association of Canadian Mountain Guides in 2003. He is a registered Emergency Medical Technician and a life member of the National Association for Search and Rescue (US). He currently resides in Edmonton, Alberta, Canada and is the proprietor of the firm Rescue Dynamics, which is involved in climbing, rescue and safety instruction, as well as mountain guiding.

Cyril's interest in electronics and radio communications spans a period of more than 40 years. He built a crystal radio at age 8, his first short-wave receiver at age 12, his first low power transmitter at age 14 and his first "solid state Hi-Fi" stereo at age 16. He received the award for top marks in electronics studies for three consecutive years in high school, at a time "when a real radio still glowed in the dark". He holds an Advanced Amateur radio operators certificate and his call sign "VE6 MTN" is occasionally heard from the mountaintops on the 2 meter Ham band. His company holds licenses for handheld and mobile radio operation in the VHF commercial bands. He has used every type of communications device mentioned in this article from satellite to short-wave. In short, he is a self – described electronics "geek" and bears the title proudly.

Further information on courses as well as additional copies of this and other technical notes in this series can be obtained directly from Rescue Dynamics. On the internet, visit the Rescue Dynamics Website at – http://www.rescuedynamics.ca

References

Websites:

General
Rescue Dynamics: http://www.rescuedynamics.ca
Industry Canada: http://www.ic.gc.ca/epic/site/smt-gst.nsf/en/Home

Beacons ELT / PLB / EPIRB / SPOT
SARSAT / COSPAS: http://www.cospas-sarsat.org/
National Search and Rescue Secretariat: http://www.nss.gc.ca/
Canadian Mission Control Centre: http://gps1.cmcc.tren.dnd.ca/
Beacon Registries: Canada - http://beacons.nss.gc.ca / US - www.beaconregistration.noaa.gov
SPOT: http://findmespot.ca or http://findmespot.com

Avalanche Transceivers
Tracker DTS: http://www.bcaccess.com/ftrax.html
Ortovox: http://www.ortovox.com
SOS: http://www.sos-find.com/

Cell Phones
Motorola: http://www.motorola.com/General/index.html
Nokia: http: http://www.nokia.com
How Cell Phones Work: http://www.howstuffworks.com/cell-phone.htm

Satellite Phones
GlobalStar: http://www.globalstar.com
Iridium: http://www.iridium.com
Infosat: http://www.infosat.com

Radios
Cobra: http://www.cobra.com/
Icom: http://www.icomamerica.com/icom/
Yaesu: http://www.yaesu.com/
Kenwood: http://www.kenwood.net/
Motorola: http://www.motorola.com/General/index.html
ParaComm Technologies: http://www.hfradio.ca/
Radio Shack (US only after 2007): http://www.radioshack.com/
TAD Canada: http://www.tadradio.com/index.html
Uniden: http://www.uniden.com/

Ham Radio
Radio Amateurs of Canada: http://www.rac.ca/
American Radio Relay League: http://www.arrl.org/index.html

Books:
To be added in a later revision to this article. Check the Rescue Dynamics website for updates.