

HAM RADIO RELIABILITY AND NEW TECHNOLOGIES

Though ham radio operators usually communicate for leisurely chatting during their pastime and most of their radio contacts are just incidental, yet they have the capability to establish dedicated wireless links whenever they wish. They are capable of providing reliable communications to the people who are in desolation far away from the reach of all the modern communication amenities.

To accomplish reliability, some ham radio hobbyists establish dedicated networks of their own. Dedicated networks are usually automated networks. One needn't sit in front of the radio throughout the day to receive a message in such networks. Winlink 2000 (abbreviated WL2K) is such a dedicated worldwide network of participating amateur stations. By linking with any one of these stations messages can be exchanged with hams from remote locations where landline connectivity is not available.

Unlike the telephone, where we can dial numbers to establish a contact, in conventional ham radio voice communication, hams usually don't have the provision to dial numbers. To establish a radio contact, ham radio operators should keep their radio set 'ON' and one should know the 'frequency' in which the other station would transmit. It is just like listening to an ordinary broadcast radio station. Tuning our radio receivers to a particular frequency at the scheduled times enable us to listen to our favourite programmes from a particular radio station. If we change the frequency or listen at a different time, it would not be possible to listen to that particular station or a particular programme. So, hams have devised systems which can overcome this problem.

You may at the same time wonder whether you can talk to your family through ham radio if you are a ham and if you have two wireless transceiver sets (one kept at home) available! A ham can operate her/his station only from one location at a time identifying with a 'call-sign' allotted by the government. To talk to your home using ham radio frequencies, one of your family members should also be a licensed ham radio operator with a call-sign. A ham identifies with her/his call-sign when she/he wants to contact another ham. The name and address of a ham radio operator can be found in a directory known as the *call-book*. Unlike a telephone directory (which is brought out by the government), a ham *call-book* is usually brought out by ham radio clubs and organizations involved in ham radio (the on-line Internet call-sign database maintained by Vigyan Prasar can be accessed at <http://www.serc-dst.org/HamSearch.htm>). We can go through a call-book to find hams in different places of a country or the world. But it may not be possible for us to contact a particular ham radio operator instantly by just giving a call to him using a particular radio frequency. A ham can choose any frequency out of hundreds of different frequencies allotted by the government for their communication. Both the hams should be in the same frequency when they want to talk to each other and the transmitted radio signal also need to reach each other. It again depends upon various factors, which we have already discussed in the previous issues.

There are different sets of frequencies for covering different distances. The radio links employing Very High Frequencies (VHF) and Ultra High Frequencies (UHF) are the most reliable links, because these radio signals usually don't depend upon the ionosphere for their propagation. These are usually line-of-sight signals, i.e. they can reach only up to the visible horizon. Because of the Earth's natural curvature they can travel to a distance of 30-40 kilometers only depending upon the height of the antenna systems. Though the distance covered is limited, the advantage of line-of-sight radio signals is that they don't suffer due to the variations in the ionosphere. However, due to certain atmospheric changes, their propagation may sometime increase far beyond the line-of-sight distance. The signal strength and reliability remains almost constant once two VHF or UHF radio links are in line-of-sight. The hand-held type of ham radio transceivers (popularly called walkie-talkies) employ either VHF (144 MHz to 146 MHz) or UHF (434 MHz to 438 MHz) for short distance line-of-sight voice communication. In the urban environment with high-rise buildings, these walkie-talkies can be used to communicate to a distance of few kilometers only. Because the tall structures can obstruct the radio signals transmitted from the walkie-talkies. When there is a vast open space (e.g. the sea or rural areas) with no obstructions, the range of VHF & UHF radio signals may increase manifold. Ham radio operators employ VHF or UHF Repeater Stations to increase the coverage of these line-of-sight short distance signals. The repeater antenna is installed at a great height so that it can receive radio signals transmitted from a walkie-talkie located at the farthest distance possible. While receiving a weak signal, it also amplifies the signal and re-transmit it in another frequency so that the signal can be received by as many ham radio operators as possible. Vigyan Prasar maintains a VHF repeater station (Call-sign: VU2DLR) for the ham radio operators in Delhi.

We may wonder whether it is possible for us to connect to particular ham using such a walkie talkie as we do using our mobile telephone? Some ham radio walkie-talkies have inbuilt DTMF (Dual Tone Multi Frequency) or CTCSS (Continuous Tone Coded Squelch System) technology to provide paging facility, i.e. transmission from such a walkie-talkie set can be intended for another specific ham radio station only. DTMF technology is an invention of Bell Laboratories (USA). The AT&T trade name for DTMF is 'Touch Tone'. All the modern telephone sets (including mobile telephones) are also DTMF compatible, i.e. when we press a particular digit of the telephone key-pad, it generates two tones (a combination of 'two' out of 'eight' tones) within 50 millisecond (so that it sounds to us as a single tone). It is a technique, which enables you to listen only to a desired radio signal. If your Walkie-Talkie comes DTMF decoding enabled, you can set your radio to listen to a sequence of touch-tone digits. The 'receiving' of the 'right combination' of these tones would allow only a particular station's audio to be listened by you. Thus, you can silently monitor a busy channel for your desired station!

CTCSS is also a similar technology, which stands for Continuous Tone Coded Squelch System. The Motorola trade

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name for CTCSS is 'Private-Line'. CTCSS tones consist of 37 very specific audio frequencies between 67 to 250.3 Hz. Though the human ears can perceive these frequencies, they are called 'sub-audible', because the radio receiver's audio circuit filters them out so that we don't hear them! A CTCSS enabled receiver will remain silent to all the radio signals except a desired station with the correct tone. This facilitates the use of the same frequency by different services without disturbing each other.

Automated ham radio links

Ham radio operators use packet radio for automated operation, which is a digital mode of communication. This technology enables exchange of data from computer to computer employing the radio waves. A ham walkie-talkie (replacing the landline telephone) can be connected to a computer through a Terminal Node Controller (replacing the telephone modem). Data and radio mail sent by other hams can be received automatically which get stored in the computer. The first ham radio packet network was started in Montreal, Canada in 1978. The first Terminal Node Controller (a radio modem) was developed by Vancouver Amateur Digital Communication Group (VADCG).

Packet radio has many advantages over the conventional voice communication. To send a message to your friend, you can connect to your friends' TNC at any time you wish and leave a message for her/him even if she/he is not at home. Though hams normally use only VHF or UHF line-of-sight radio signals for this type of packet radio networking due to their extreme reliability and faster data exchange rate, they have also been experimenting with long distance packet radio communications employing Short Wave frequencies. Successful long distance data communication can be accomplished only if ham radio operators run dedicated stations. Such stations should operate round the clock and should have the provision for operating in different frequencies to overcome the problems of variable radio propagation conditions.

E-mailing through Short Wave (HF) Radio using PACTOR-III radio modem.

This is the latest state-of-the-art ham radio technology (Winlink 2000), which enables a ham radio operator to send e-mails from virtually anywhere in the world. E-mails can be sent through radio waves from locations where Internet connection is not available. At present, there are 35 voluntary ham radio Internet Ham Gateway Stations spread all over the globe (known as PMBO—Packet Mail Box Office Stations) through which such e-mails are routed to their destinations. The basic setup to operate this mode is a computer with PACTOR-II/III radio modem and a ham band short wave transceiver (transmitter+receiver). To send e-mail from sea, jungle or any remote location, the ham would need a laptop or desktop computer in her/his sailboat/vehicle and a HF Short Wave Radio (transceiver) with PACTOR modem and a software called 'Airmail'. Everything is automated. The e-mail sent from a remote location through a ham radio frequency is received by one of the PMBO ham radio stations. In fact the PMBO ham stations continuously scan certain spot frequencies in the short wave ham bands to receive incoming e-mail (radio mail). The e-mail is then automatically relayed by a software called Winlink 2000 to

the desired e-mail recipient through the Internet. Even images, documents, articles and virtually any computer files can be sent from sea to shore (or for that matter from any locations not connected by land line telephone) through such PACTOR-III wireless network. This can provide reliable communication in the event of emergencies.



A basic ham radio setup for HF E-mailing

Echolink

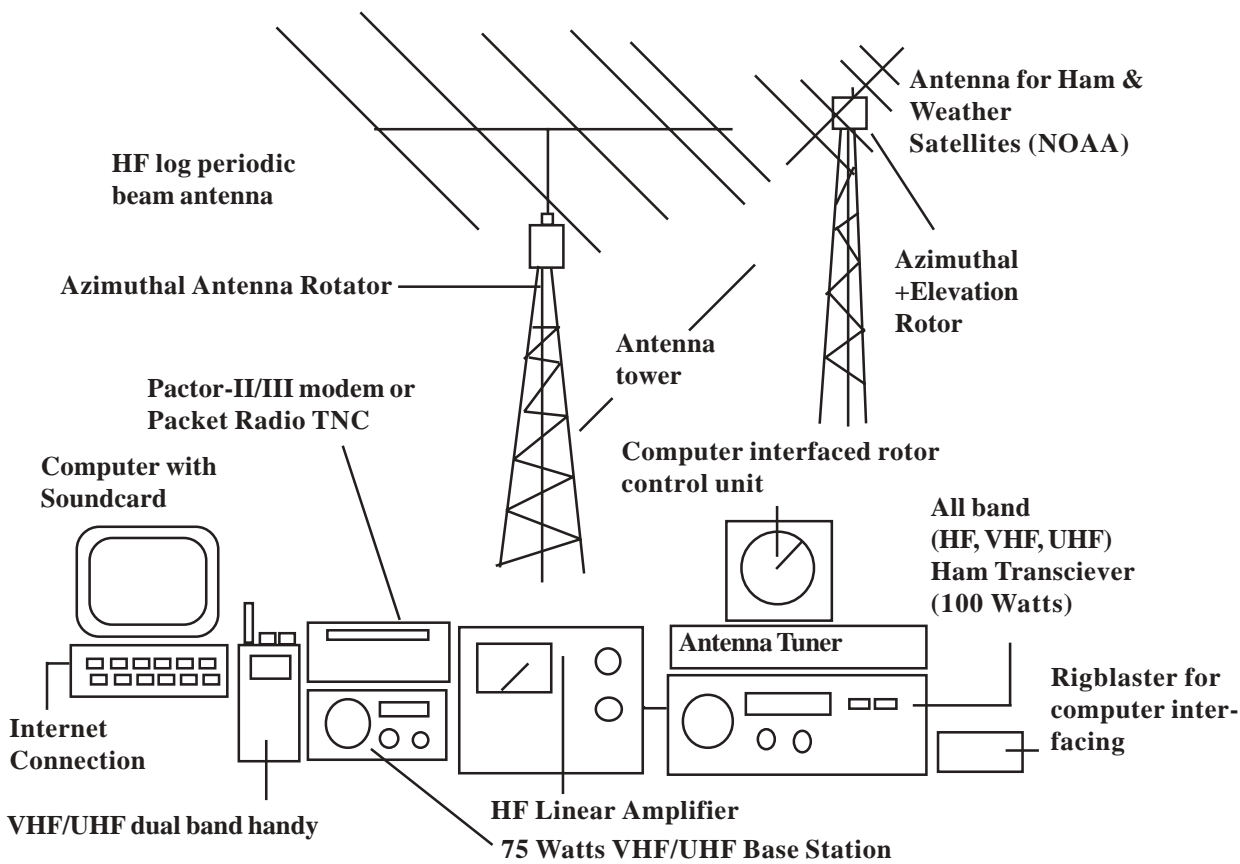
Echolink is a system of Internet Voice Radio Linking. A ham radio wireless transceiver can be interfaced to a computer connected to the Internet. Such a ham radio station is known as Internet 'Link' or 'Repeater' Station (Internet Ham Gateway). Through 'link/repeater stations', hams (who do not have Internet connection) can talk (voice communication) around the world using Internet VoIP (Voice over Internet Protocol) technology. A message transmitted from a ham walkie-talkie is received by the dedicated 'link radio station'; It would then relay the message over the Internet and vice-versa throughout the world. Employing another similar link station at the other end, the message can be listened/replied by a ham using a walkie-talkie. With a dedicated 'Link' or 'Repeater' station in your town, you can talk to hams around the world using a walkie-talkie! The Internet technology can thus complement ham radio technology!

Hundreds of dedicated Simplex and Repeater Echolink Internet Ham Gateway stations are located throughout the world.

D-Star

D-STAR Digital Communication Technology utilizing the 1.2 GHz ham band is considered as another revolutionary achievement in the field of ham radio, because ham radio operators can now do high speed digital data communication (at 128 kbps speed) through digital repeaters developed by ICOM (a member of Japan Amateur Radio Industries Association). Backbone RF interlink of the repeaters is possible at 10 mbps speed. This technology would enable a ham to:

- (i) Transmit digital audio (using International Telecommunications Union approved 8 kbps GMSK voice mode); Unlike the present limitation of Simplex operation, Full duplex voice communication would become possible. In the conventional wireless operation, both the hams can't talk at the same time. When one station transmits, the other station has to listen and vice-versa. To indicate the end of the transmission, the word 'OVER' is used. But in full duplex communication, both the station can transmit and receive at the same time.



A dedicated Ham Radio Station

- (ii) Do high speed (128 kbps GMSK) computer to computer data communication.
- (iii) Send streaming video (Amateur Digital TV) through camcorders connected to computer.
- (iv) 128 kbps Internet connectivity (open protocol TCP/IP). A digital repeater connected to the Internet can be accessed by the ham for other Internet activity through ham radio.
- (v) Plug and play (connected to the computer through USB port) the repeater/ham wireless equipment.

This technology is yet to be legalized in Japan. Legality in India is still a question.

PSK31

This new technique of ham radio transmission enables the ham radio operators to send and receive 'texts' on real time basis. Hams can 'chat' *on-the-air* through the computer 'keyboard' using soundcard enabled computers connected to the radio. PSK31 is extremely popular among the ham radio operators who have access to soundcard enabled computers. Even with a low cost low power short wave transceiver one can exchange written matters over the radio. A simple device popularly known as the 'rigblaster' makes the PSK31 operation more comfortable. This works as an interface for feeding the receiver's audio to the computer's 'Line In' or 'Mic In' jack and to feed the digital signal from

the computer's 'Line Out' to the transmitters microphone. It also facilitates automatic switching of the transmitter (In India, low cost *rigblaster* kit can be obtained from Shri Rahul Srivastava, VU3WJM, Jwala Building, 8 Lalbagh, Lucknow 226001).

Hams also can transmit pictures using SSTV (Slow Scan Television) mode of transmission. Most of the SSTV transmission are nowadays computer based, i.e. with the help of SSTV software hams can transmit pictures stored in their computers. There are some hams who can control their wireless equipment using the computer. The computer can be used to automatically control many ham radio accessories. The antenna rotator (Rotor) is such an accessory which is used to turn the highly reliable beam antenna systems to send a radio signal only to a particular direction so that it's signal can be received strongest at the other end. Using a computer one can precisely turn the rotator towards the desired direction. There are some hams who can track the Low Earth Orbiting (LEO) ham radio communication satellites (popularly known as 'Birds'). Using satellite tracking softwares they can precisely predict the path and visibility of these satellites. Some hams use Azimuthal and Elevation Antenna Rotors (Az-El Rotor) to precisely beam their weak radio signals towards an approaching orbital satellite. The relayed signal from these satellites can cover a wide area (called the 'footprint') for a particular duration of time.