

Using Your Multi-Mode Interface for VOIP Internet Linking in Amateur Radio

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I received a considerable number of inquiries from readers of my construction project "*A Multi-mode PC to Radio Interface*" which was published earlier in this site. Most queries were directed towards seeking information whether this interface can be used for Echolink VOIP service for linking a transceiver for simplex operation or linking it to an existing repeater to increase a wide coverage area. The answer is, Yes You Can!

To understand why this interface will work, we need to review the basic working principle of VOIP. There is no mumbo jumbo in this mode of communication. The acronym, VOIP, simply means "Voice Over Internet Protocol". This mode of communication is simply explained as a method of transmitting voice information by converting the audio signal (analog) into digital streams (packets) that are in turn transferred to the receiving end via the Internet. The receiving end process these digital signals through a computer and converts them back into analog signals. These analog signals are then processed by the computer's sound card, finally coming out as normal audio voice signals that goes out through the **LINE OUT** terminal of the sound card. The reverse process is true to the other transmitting and receiving end. The VOIP that we know today is the outcome of the experimental Network Voice Protocol, developed in 1973, for the Advanced Research Projects Agency (ARPANET) of the US Department of Defense. This protocol (IP) is the predecessor of the global Internet (world wide web). A portion of this Internet is assigned for public use and the rest is shared for Military, National defense and security purposes.

To this date, VOIP technology has significantly improved. The proliferation of affordable and high speed personal computers (PC) and availability of broadband Internet connectivity contributed to this 20th century revolution in telephony. Examples of modern and available VOIP services include Yahoo messenger, MSN, SKYPE, Vonage and many others. The use of these VOIP services allows anyone with a computer and internet connection to make PC to PC calls and or PC to Telephones (landlines and mobile phones) to anyone with the same facility anywhere in the world by merely using the computer's speaker/microphone. In many cases, these are free services which are extras or perks to their own primary products and services that are made available over the Internet. Digital signal processing and voice data packet (switching) is now becoming a standard for global communication. These are the commercial realizations of the original Network Voice Protocol for the ARPANET.

VOIP crawled into amateur radio when several hams started experiments to develop software programs with specific platforms that can be loaded into computers to be suitable for VOIP amateur radio use. These programs expanded the horizon of amateur radio which allowed the Ham to use his personal computer fitted with the software to communicate with other hams using the same system worldwide. Linking

the PC to an existing transceiver further expands the coverage area by allowing remote stations to access the VOIP amateur radio link via RF.

Development of VOIP in Amateur Radio

In recognition to their contribution in the development of VOIP in amateur radio, the following timeline diagram (see timeline table below) is presented based on my present knowledge of this technology. We say Kudos to these fellow Hams who exerted extra efforts and the usual Ham ingenuity for creating the state of the art in VOIP amateur radio that we Hams enjoy today.

Timelines

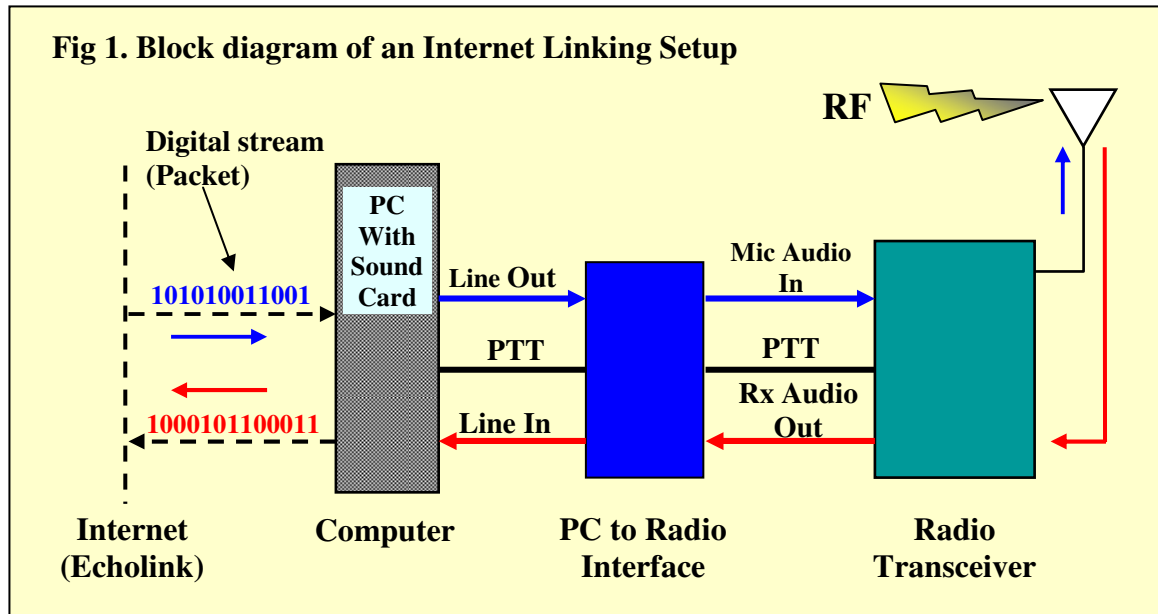
Year	VOIP	Program Compatibility	Developer
1995	Internet Phone	Windows	Vocaltec
1996	Repeater Link	Windows	N9YNQ
1997	Internet Radio Linking Project (IRLP)	Linux	VE7LTD
2001	iLink	Windows	MØCSH
2001	eQSO	Windows	MØZPD
2002	Wires II	Own Hardware and Software	YAESU
2002	Echolink	Windows	K1RFD

By 1995, the VOIP service for amateur radio has already taken a very fast start as the new programs with additional capabilities and features were made available. Today, these programs are used for PC to PC, Internet linking via simplex and repeater linking via duplex. Internet linking in Amateur Radio has even led some Hams to concoct their own term for this setup as "ROIP" (Radio Over IP). Present estimates show that there are about close to a quarter of a million registered Hams using this mode worldwide. For example, the popular software program "Echolink" alone brings up a list of more than 4,000 connected users at any one day. Of which, 1400 are repeater links and about 1,800 are simplex links. Present trends indicate that new Nodes are joining the system at a very rapid rate. This statistics indicate that Internet Linking continues to develop a bandwagon of hams wanting to join this Internet revolution in Ham Radio.

Internet Linking for Amateur Radio

To link the transceiver to the PC and extract the audio information from the RF received and, to transmit the audio information coming from the Internet via the PC

to the transceiver, you need to add a PC to Radio Interface circuit module. Below is the block diagram for the Internet – RF Linking setup (**See Fig 1.**).



Using the above setup, you are ready to use your existing transceiver to form a link in simplex mode. Remote Mobile and base stations that are able to access your station during receive and transmit will be able to share the QSO with connected stations via the Internet whether local or anywhere in the world. The same setup can be linked to an existing repeater by setting the transceiver to the frequency pair of the amateur repeater. In this way, the coverage will be extremely wide depending only on the capability of the repeater system and its service environment.

Echolink, and other VOIP software programs allows registered users to connect to extremely distant but VOIP linked repeaters by using their computers through the Internet instead of using a radio. On the other hand, Amateur Radio Operators can create large repeater networks and use VOIP to connect to other repeaters all over the world. Any Ham operator can access these VOIP equipped repeaters with actual radios and establish QSO's with Hams located worldwide. A typical setup of internet linking as described above is shown in **Fig. 2**. The setup can be modified into the following variations:

1. Location 1 and 2 maybe configured as a simplex link - The common practice is to install the link right at the home QTH of the system operator. Remote RF base stations and mobiles may access this link and connect to Dx VOIP stations and establish a QSO.
2. Location 1 and 2 may be configured as a duplex link but tuned to the frequency pair of an existing amateur repeater system in the vicinity of the operating area. This will enable all users of this repeater to contact Hams who are connected to the system, anywhere in our planet earth.
3. Location 1 and 2 maybe configured as a dedicated VOIP Repeater link system – This configuration requires that the computer and interface unit must be integrated in the repeater module at the repeater site. The

concern of this setup however is the availability of internet connection at the remote operating site.

Setups 1 and 2 are the most common configuration adopted by Philippine Hams.

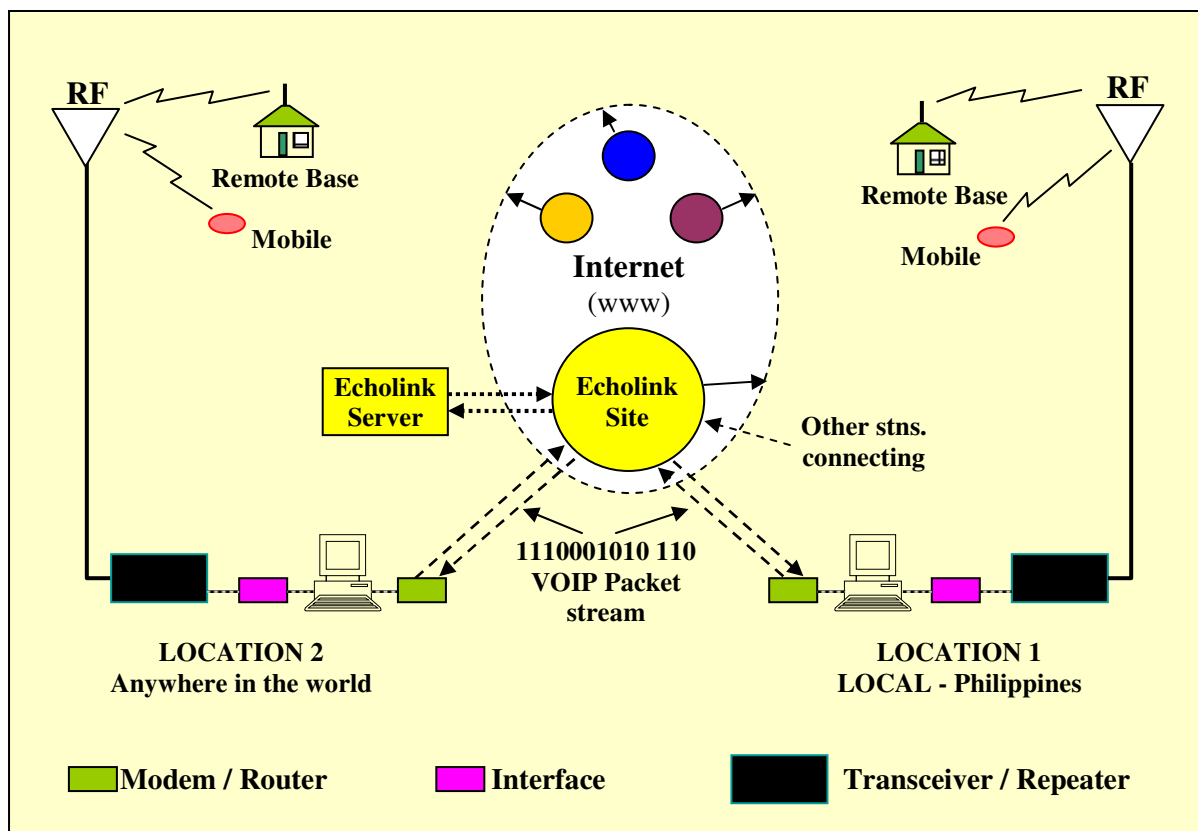


Fig 2. A complete VOIP internet linking setup for Amateur Radio. This system can be configured into several variations at the location of each link (see text).

The PC to Radio Linking Interface - This is the important component of the Internet linking setup. For clarity, it is commonly called the “PC to Radio Interface” or some times called “soundcard to radio interface” and simply as “Interface”. The multi-functions of this device are enumerated below:

1. It serves as a bridge to allow the computer software to detect the presence of incoming signal from the receiver of the radio link, including DTMF commands received by the Link’s receiver.
2. It accept commands from the VOIP software program in the computer to Key (transmit) and un-key (receive) the radio link (transceiver). This is the automatic **PTT** switch.
3. It transfers audio from the radio link’s receiver (**Ext. speaker out**) to the **LINE IN** of the computer’s soundcard.
4. It transfers audio from the **LINE OUT** of the computer’s soundcard to the **MIC INPUT** of the radio Link.

The above functions are shown in the block diagram in **Fig 1**. The arrows show the direction of the signals during receives and transmit modes.

The popularity of some VOIP programs for internet linking in amateur radio such as IRLP, iLink and Echolink has led to the commercialization of various interface models, both in kit or pre-assembled forms. The most popular was the Interface developed by WB2REM and another called "Rig Blaster". These interfaces, besides the basic functions, included additional design features (depending on the model) to remotely control the Link by the system operator (Sysop). Other interface circuits designed and constructed by Hams as homebrew projects will perform the same basic function such as the "DU1ANV multi-Mode PC to Radio Interface project". Less of course the added features of commercial units. Nevertheless, my design was focused to using the same interface as a stand alone multi-mode unit for working computer soundcard based CW, Packet, RTTY, PSK31 and VOIP amateur radio linking such as Echolink. This is the interface I use in my Ham Shack for all modes. By using the Echolink program, the remote access control aspect is addressed adequately by the built in DTMF decoder of this software.

Using the DU1ANV Multi-Mode PC to Radio Interface for Internet Linking

If you are already using this circuit for PSK31 work or a similar circuit, it is not surprising to note that the method of connection is basically the same for Echolink. There is no need to re-wire or change the connections between the radio transceiver and the computer soundcard. For the newcomer in Internet Linking who plans to use the Echolink software and the DU1ANV multi-mode Interface, he must read the article to become familiar with the circuit functions. There are two articles in the PARA website, one of which is a simple interface but both will work to perform the same basic function. The multi-mode interface version however has more features that include signal isolation between radio and computer and, independent controls for adjusting incoming and outgoing audio signals for proper level and balance without disturbing the pre-set control settings of the computer's soundcard which is usually being used for other purposes.

Using the DU1ANV multi-mode interface for VOIP Internet Linking - Described below is the step by step procedure to establish a VOIP link for amateur radio by using the Echolink software. The procedure is the same for other softwares but I chose Echolink because this is the software I am using. This is a procedure intended for newcomers in Internet linking and first time users of the multi-mode Interface.

Stage 1: The Echolink software, registration and authentication

1. Go to www.echolink.org and download the free Echolink software program (or ask a copy from another ham).
2. Load (install) the software to your computer.
3. The first time you open the program, you will be asked to register your callsign.
4. Go back to the homepage of Echolink and register your callsign. Follow the instructions on how to register (you need to submit a copy of your RSL).
5. Wait for the authentication advice (usually within a week, max).
6. Once confirmed, you will be given a password to be entered in the configuration file of the Echolink's program menu. Also, you will be given an assigned NODE NUMBER.

7. To establish a link you must enter your callsign with the letter "L" (example, DU1ANV-L). If the program will request a re-validation, then submit revalidation (Go back to the echolink home site and follow the instruction how to re-validate).
8. Once re-validated, you are ready to configure Echolink for internet linking. Links are assigned with a different NODE NUMBER.

Stage 2: Using the multi-mode Interface and configuring the Echolink program for Internet linking.

1. Build the Interface or have someone build it for you and connect it as described in the article.
2. Once the interface is connected between PC soundcard and the radio, turn ON your transceiver and Adjust your transceiver's audio volume control to 30% rotation.
3. Turn the selector switch of the interface to "**Interface ON**" and the Mode switch to "**PSK**"
4. Go to your computer's sound card mixer configuration menu and adjust the following slider controls:
 - LINE OUT ----- 70 %
 - RECORD (or LINE IN) ---- 70 %
 - MASTER VOL ----- 70 %
 - WAVE OUT ----- 70 %

The above will pre-set the soundcard's audio levels of the playback and recording mode to a conservative value to prevent distortion due to overload. Fine adjustments can be done later by using the "adjust sound device" menu in the echolink program and the volume controls of the interface.

5. Click the start menu of the Echolink program to open the main screen and then do the basic configurations for Internet Linking as follows:

Under "Tools":

Click "Setup" - Select **Sysop mode** then enter your authenticated callsign (example – DU1ANV-L), PASSWORD and other information.

Click "Sysop settings" – click "Rx ctrl" tab and select **VOX**, click "Tx ctrl" tab and select **RTS** for PTT control and under "serial port", enter the COM port used by the interface, usually **COM1**

This completes the basic configuration of your computer, the echolink software program, the multi-mode interface and the radio link. The basic setup should be up and running. You can test the setup by connecting to the Echolink server and fine tune the incoming and outgoing audio quality. Go to the main menu and click "Station". As the pop-up menu appears, click "Connect to test server" to connect your station to the server. This server will record your transmissions and plays them back to your system via the Internet. To use this facility, use a portable radio to access your radio link (via simplex). While you are speaking, watch the signal bar at the lower left bottom of the screen. Adjust the Rx level control of the Interface so that the yellow bar will just reach the RED area on occasional voice peaks. Release the PTT

of the portable and wait for the Echolink test server to playback your signal. If the audio is weak but not distorted, adjust the Tx level control of the interface to feed more audio to the radio link's microphone input. If this control is already at maximum rotation, rectify the situation by going to the main menu. Under "tools", point the mouse cursor to "adjust sound device" in the pop-up menu and select "Playback" to bring up the playback control of the soundcard. Adjust the slider control so that the signal of the test server during playback brings the yellow bar to just below the red mark. Make several tests until the incoming and outgoing audio are balanced with minimum distortion. You can request remote mobile stations to access the link and conduct transmitting and receiving tests. When satisfied, your station will now be ready for Internet linking service.

The basic configurations discussed are only the beginning portion to make your link start and connect for the first time. The Echolink program however incorporates many features that are beyond the scope of this article. You must download the user manual of this software program and read to discover its vast capability and versatility that can meet the differential needs and wants of the Amateur Radio community. After reading and understanding the user manual, you can continue configuring the additional program features to suit your needs such as; Remote control, DTMF commands, Remote access via the RF link to connect to the node numbers of active stations, Station Identification and other adjustments required by your operating conditions and setup.

Final Notes: If, for the first time, you cannot make the Echolink program up and running. You must consult the user manual under the subject "Troubleshooting". It is common to note that some Internet Service Providers (ISP's) have firewalls and some have the ports used by the Echolink program blocked. Echolink uses **UDP** (User Datagram Protocol) for the exchange of data (QSO). These ports are UDP port 5198 and UDP port 5199. You must un-block these ports by discussing the issue with your ISP. The subject on port forwarding and resolving firewall conflicts are clearly discussed by the Echolink user manual. Or, ask the assistance of your nearest Elmer.

Also, please remember that the quality of incoming and outgoing signals through your link depends on your careful adjustments of the various recording and playback controls. Keep occasional ocular inspections of your signal bar meter and tweak the controls of your Interface to bring the signal levels to reach 80 – 90 % of the yellow scale most of the time a QSO is in progress.

That's all fellows!..... Enjoy the exciting world of Internet linking!



"The Morse code was developed by Alfred Vail, the financier and partner of Samuel Morse"... However, by sheer admiration and the dedication of Samuel to develop Telegraphy, he allowed Mr. Morse to apply for the patent..... Mr. Vail died without demanding a share!