

I-Link the .WAV of the Future

A 222 or 440-MHz H-T can become your link to the world.

Once upon a time an Amateur Radio operator was on his 440-MHz H-T calling for anyone. To his surprise and amazement Terry, VK2JTP, in Sydney, Australia answered. He was loud and clear, as if he were a few blocks away. How could this be?

Worldwide communications via VHF/UHF was once considered a dream. Now it's a reality! There has been an emergence of different approaches to VHF/UHF linking. In December 1996, this author published an article in *QST* titled, "A New Band for Your Radio." It discussed an Internet linking system that utilized a program called *Repeater Link*. Since then, experimenters in the area of Internet remote linking such as Graeme, M0CSH, have taken this topic to a higher plateau.

M0CSH has designed a software Internet linking program specifically for Amateur Radio operators. *I-Link*, as it is called, is a free and versatile program that can be downloaded from www.aacnet.net. The program is less than 300 kbytes in size and will work on most Windows-based 486 or above computers with sound cards and microphones. An Internet connection is also necessary. There are three types of the software available for I-Link operators. They include the user, SysOp and conference server software.

The user software is for hams who want to contact repeaters, link stations or other Amateur Radio operators around

the world. The SysOp software allows individuals to connect I-Link remotely to their repeater or to transmit I-Link out of a simplex repeater. The conference server resembles a repeater with multiple amateurs participating in roundtable conversation.

Setup

In order to run the I-Link programs you'll need to make sure the speaker and microphone are working properly on your computer. If you can hear music from the CD player or other audio source, it is likely your speaker is working. However, during the setup of I-Link, you may need to adjust the volume control. To check your computer's microphone, go to the volume control and open "properties." Check the recording control area. Once in the recording control panel check the box below the microphone ("line-in" if this is a setup for the SysOp program). This will activate the microphone for use in the program. You may need to return here later once the I-Link program is running to adjust your microphone level. To help guide you through the process, Terry, VK2JTP, has set up additional audio-microphone help files on his Web site.¹

User Software

The user software—*Link.EXE*—can

be downloaded from www.aacnet.net. It will only work on a Windows-based platform. The higher the Internet connection speed that you have, the less likely that speech coming through the connection will be broken up. The disruption of speech is called "packet loss."

Once the software is downloaded, run the program. The first time you open the program you'll be asked to type in call letters, a location and a password. This information is placed in an ILINK.INI file in the Windows directory. If in the future, you would like to change location (QTH) information, you can do so. Changing the call will cause the program to malfunction. If the call needs to be changed, go to the Windows directory and carefully delete the ILINK.INI file. Restart the I-Link program and it will ask for new information.

After information is entered into the program, you'll be assigned a unique four-or-five digit number which will be your personal identifier. To activate the program, click on the I-Link icon and the following screen appears (see Figure 1).

Press BEGIN to open the main screen of the program (Figure 2). A listing of all stations that can be reached through I-Link will be shown. Stations are listed in three sections. Stations at the top of the screen with a gray background are link or repeater stations. If the link or repeater is in use, the print turns from



Figure 1—This screen appears when you first click on the I-Link icon.



Figure 2—The main screen of the User program.

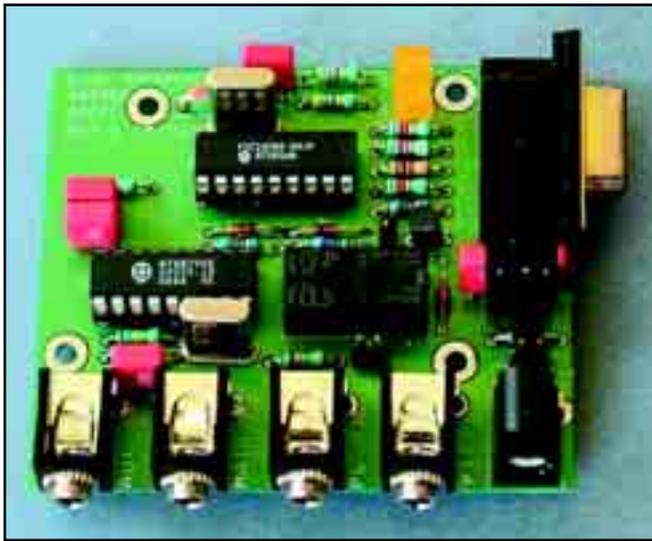


Figure 3—The assembled link board.



Figure 5—The Help section of the I-Link SysOp software.

white to yellow. Users looking for conversations can be found in the middle section and appear on a blue background. Conference servers are at the bottom with aqua print on a burgundy background.

To talk to any station listed, simply highlight the call sign and push OK. Once you've connected, the amateur's call sign will appear in the middle of the screen (Figure 1). Use the space bar on the computer to toggle between transmit and receive. Do not hold down the spacebar but lightly tap the spacebar once to transmit and once to go back to receive. The screen will change from receive to transmit after the spacebar is pushed.

Like radio, there is a protocol to operating I-Link. When connecting to a repeater or another on the air linking station, listen first for ongoing activity. Once it has been determined that no one is using the repeater, identify yourself and the link that you are transmitting through, call a station or give a general CQ. A slight delay should be left between transmissions to allow other repeater users to break in. To end a conversation, simply push END at the top of the screen.

When using I-Link, be careful—third-party rules still apply! A US amateur may not use Amateur Radio to send a message to or on behalf of an unlicensed third party in another country, unless that country has an agreement with the United States allowing such traffic (you'll find a list of these countries on *ARRLWeb* at www.arrl.org/FandES/field/regulations/io/3rdparty.html). This prohibition applies to *all* uses of Amateur Radio, including radio systems connected via the Internet.

Utilities

The Utilities area is the first section

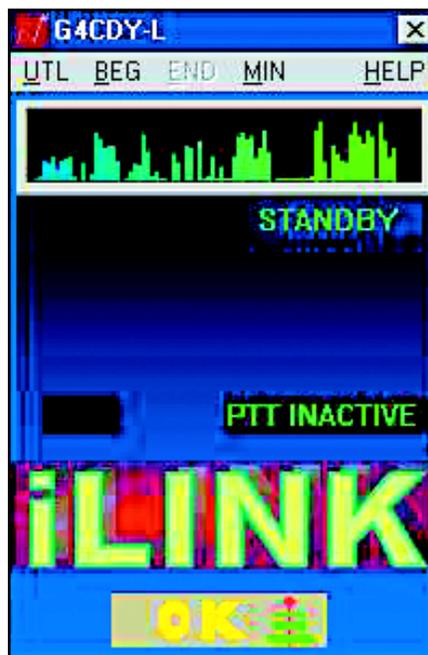


Figure 4—The opening screen of the I-Link SysOp software.

listed on the I-Link screen. Opening the utilities displays five areas:

Log-in—This area shows all stations connected with call signs shown in order of time called.

Server edit—The I-Link program relies on servers around the world. In this section there are up to four server addresses that can be listed. Multiple servers are used so that if one server goes down it will automatically switch over to another one. The servers will default sequentially according to the listing. The server listing can be edited manually in this area.

Edit info.txt file—In this area, a user can enter pertinent information about the

operation. This could include name, location and interests. When a station connects, they will be shown the info.txt file that was created.

Help/options—In this section there are boxes which can be checked off if you experience assorted problems or specialized needs related to the program. In general, the default settings are used. They include:

- **Full D (Full Duplex)**—This is used for full duplex operation
- **MMIO**—This can be applied if a sound card exists.
- **Sock**—This fixes network socket problems.
- **S. Dev1**—This is used when you have two sound cards and want to use one or the other.
- **Net**—This should be used only when you plan to use the system off line only.

Note: To make a change, check off the appropriate box and push OK. In order to make a change you must re-boot the program. However, in most cases, none of these areas will need to be checked.

Exit—Pressing exit terminates the program.

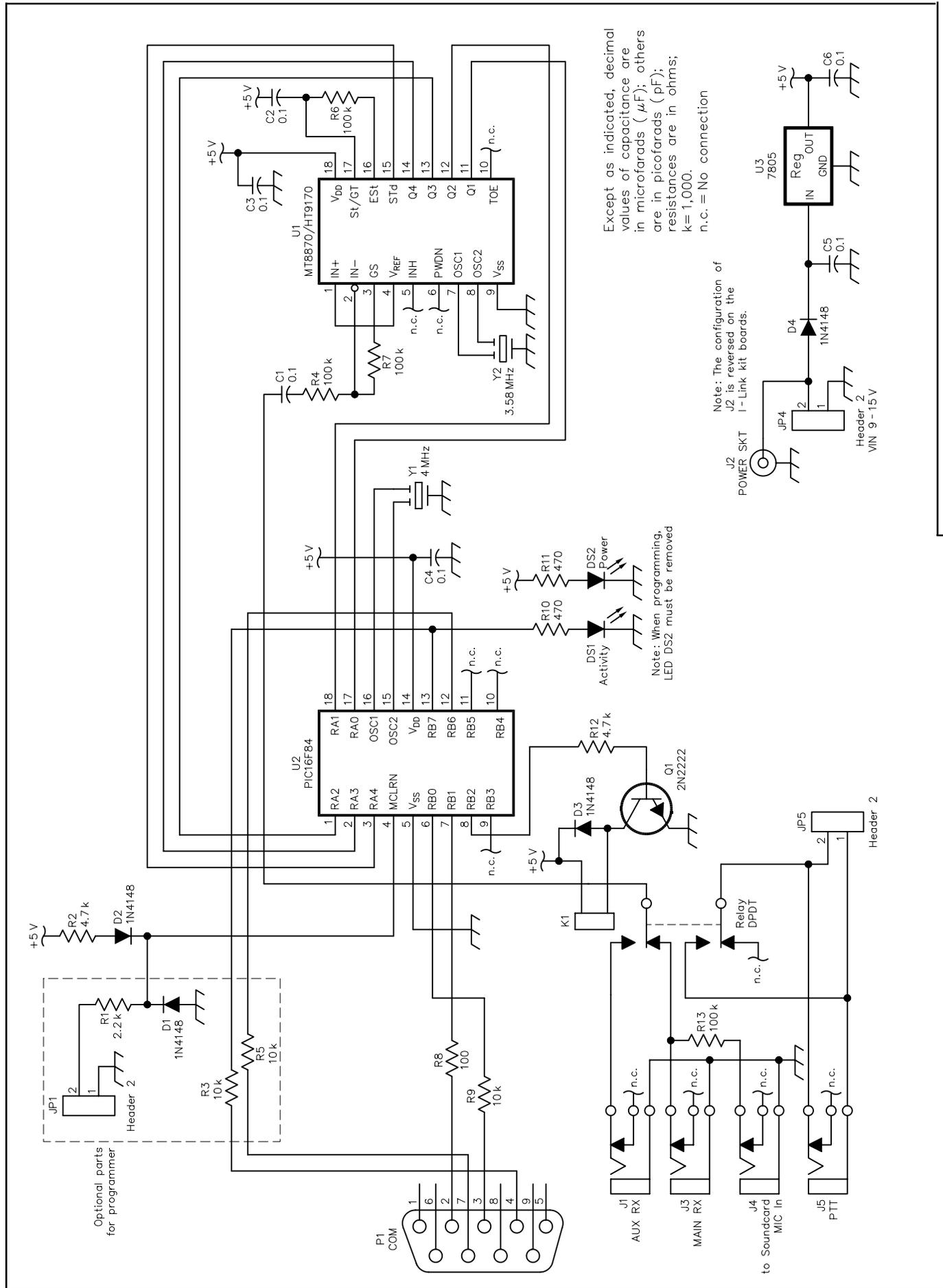
End: End terminates a conversation.

MIN: This is used to minimize the Screen.

INF: Accesses the information screen. This is where you view information about the other person. This area also shows transmit and receive packet information.

SysOp Software

The SysOp software is similar to the User software but requires an interface for it to be activated (see Figure 3). If the hardware is not present or recognized, the software will respond with the message



Except as indicated, decimal values of capacitance are in microfarads (μF); others are in picofarads (pF); resistances are in ohms; $k=1,000$.
n.c. = No connection

Note: The configuration of J2 is reversed on the I-Link kit boards.

Note: When programming, LED DS2 must be removed

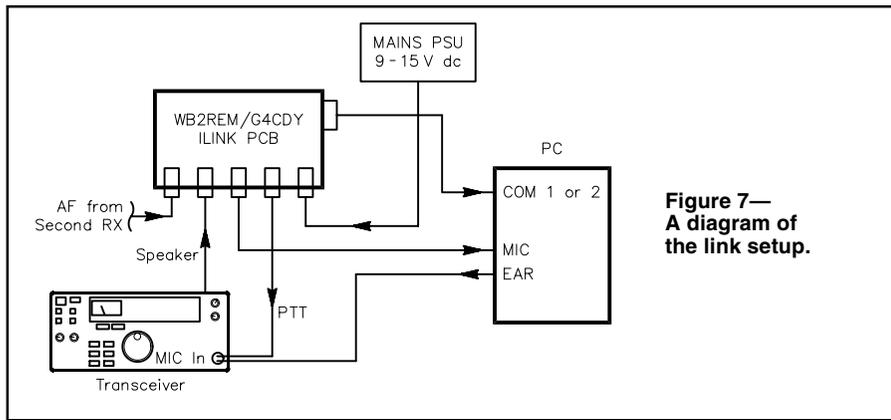


Figure 7—
A diagram of
the link setup.

As per the requirements of the FCC, control of a remote link needs to be done at 222.15 MHz or above (excluding 431-433 and 435-438 MHz), or through other control devices such as a telephone line.

“No Interface Board Found—Most Functions Disabled.” The I-Link hardware can be built or purchased as a kit or fully assembled.² We’ll discuss the hardware in more detail later.

The SysOp software allows I-Link to be interconnected to repeaters by trans-

mitting the link to the repeater site or can be its own simplex link. Pictured in Figure 4 is the opening screen of the I-Link SysOp software. The SysOp software can be downloaded from www.aacnet.net/.

The main screen of the SysOp program shows five items along the top. They perform the following functions:

UTL (UTILITIES)

Display Stats Window—This area is similar to the INF section of the user software. This area allows for typed conversations with other stations connected as well as the monitoring of packets.

System Log—The log is comparable to the log-in area of the user software. It keeps record of all stations and the time they connected to the link from the Internet.

Vox—The Vox setting controls the sensitivity of the audio in the software and determines the level of volume necessary to trigger the link into transmit.

Exit—Exit closes the program entirely.

BEG (Begin)

Push BEG to start a search for contacts. The same screen shown in Figure 2 appears.

END

To end a conversation, push this button.

MIN (minimize)

This minimizes the screen.

HELP

See Figure 5. Boxes in the help area are checked to fine tune the link.

Full D, MMIO, Sock—These boxes are used in the same manner as the User software. (Use no check as the default.)

Use Fast Baud Rate—Applies to older versions of the hardware and will not affect most users. (Use no check as the default.)

Interface on com port 2—Check this box if the hardware is placed on COM port 2.

Figure 6—Schematic diagram of the link board. The key components of the board are U2, the PIC16F84-04-P PIC and U1, the HT9170B or MT8870 DTMF decoder chip. The PIC chip can be programmed by downloading the HEX file from my site at www.ilinkboards.com and by using a PIC programmer or the onboard programming capabilities of the board itself. Terry, G4CDY, has set up a Web site at www.g4cdy.co.uk with full instructions on how to use the onboard programmer.

C1, C2, C3, C4, C5, C6—0.1µF polyester.

D1, D2, D3, D4—1N4148 diodes.

DS1, DS2—LEDs.

JP1, JP4, JP5—2-pin header connectors.

J1, J3, J4, J5—Phone jacks.

J2—Power jack.

K1—Relay, DPDT (DigiKey Z105-ND;

www.digikey.com), 5 V, 72-Ω PCB

mount.

P1—DB9 connector, PCB mount, female,

right angle.

Q1—2N2222 transistor.

R1—2.2 kΩ.

R12, R2—4.7 kΩ.

R3, R5, R9—10 kΩ.

R4, R6, R7, R13—100 kΩ.

R8—100 Ω.

R10, R11—470 Ω.

U1—MT8870/HT9170B, Holtek part number

HT9170B, www.holmate.com;

tel 510-252-9880.

U2—PIC16F84, Futulec part number

PIC16F84-04/P; www.futulec.com.

Must be programmed before use.

U3—7805, 1-A, 5-V voltage regulator

Y1—4-MHz ceramic resonator with caps,

DigiKey X902-ND.

Y2—3.58-MHz crystal, DigiKey X901-ND.

Prevent repeater bounce using—This control stops repeaters from keying each other up. It prevents beeps from being re-transmitted back and forth.

ID (Info.Wav) every ten minutes—This plays *info.wav* ID file every 10 minutes while the link is connected.

Even when not connected—When checked, this plays *info.wav* at 10-minute intervals, connected or not connected. This should be used for simplex operation.

Play IWelcome and Connect Wav files—You can create .wav files for many of the actions of the link. They are stored in the I-Link folder. Sample .wav files are provided and should be modified for the use of your system. These boxes are used to turn off the .wav files.

DTMF timer fine tune—This is adjusted to match the speed and sensitivity in which touchtones are decoded.

Shutdown code—Choose a code that can be used to shutdown the system if a problem occurs. Once touchtone entered codes are transmitted the system shuts down and cannot be brought back on line unless the computer is re-booted.

Packet keep alive timer—Despite packet loss, when this box is checked, the timer will be kept alive.

Require DTMF A to Decode—This prevents other stations from fishing for TouchTones and requires an “A” to be sent before the 4-digit access code will be connected to other stations.

Listen for DTMF when PTT is active—The hardware has the capability of accepting a second audio signal (on another frequency or band). This can be used to control the link even when the PTT has been engaged.

Use second sound card—As in the User software, this allows for a second sound card.

SysOp Hardware

The SysOp hardware used in conjunc-

tion with the software produces an excellent I-Link station that will work as a stand-alone simplex link or a repeater link. Figure 6 shows the complete I-Link hardware schematic.

As per the requirements of the FCC, control of a remote link needs to be done at 222.15 MHz or above (excluding 431-433 and 435-438 MHz), or through other control devices such as a telephone line.

The link board is connected to the serial port of the computer through a 9-pin DB9 female connector. This connector accepts a standard DB9 cable (male-female), which is attached to COM port 1 of the computer. Pin 2 of the serial port connector (TX) goes to pin 7 of the PIC chip, pin 3 of the connector (RX) to pin 6 of the PIC chip and pin 5 of the DB9 to ground of the board. A diagram of the link setup is shown in Figure 7.

Audio comes to the link board from the speaker jack of the radio. The same audio also goes into the LINE IN or MIC IN jack of the computer. The board has an audio in and audio out connector to accomplish this task. In order to reduce hum, place a 1:1 transformer (RadioShack 273-1374) between the audio out of the board and LINE or MIC IN.

Assemble a microphone connector for the link radio. Attach shielded wires to the PTT (push-to-talk) and ground, and the radio microphone audio and microphone ground leads. Like the other attachments to the computer, the RADIO MIC input should have a 1:1 transformer in line between it and the SPEAKER OUT of the computer. The PTT Line can either be connected to the relay on the board that places the PTT to ground when activated, or to other PTT systems that do not use a ground-going signal. The PTT can also be attached to the collector of the transistor (pin 2 of JP3), which produces a ground-going signal.

The link takes the audio from the radio and through a 0.1 μ F capacitor and 100-k Ω resistor and sends it to the DTMF decoder through pin 2. The DTMF decoder takes the audio and transfers it into a digital code. After a TouchTone is recognized, digital signals are sent to the PIC chip from pins 11, 12, 13, 14 and 15. The PIC chip is programmed to communicate with the software, taking the decoded numbers and triggering the link to transmit or receive and to send voice messages in response to commands. The PIC Chip produces a high-going signal at pin 8, which switches transistor Q1 to ground and activates the DPDT relay (K1), which in turn activates the PTT. It also switches the radio's audio to a secondary radio audio line. The secondary audio line can only be used when the PTT is active and the station on the Internet is in transmit.

In essence, if you have a secondary control frequency, it is then possible to disconnect the user if needed.

You'll notice that the board shown in Figure 3 uses two crystals rather than the ceramic resonators (Y1 and Y2) shown in the schematic. Most builders will discover that ceramic resonators are less expensive and easier to find. The choice is up to you. If you have the crystals at hand, you can use these as well. Note, however, that a crystal substituted for Y1 will also require 22 pF capacitors in parallel. See the revised schematic illustrating the crystal option on the Web at www.ilinkboards.com.

Other Options

Sample .wav files are produced when the SysOp software is downloaded and unzipped. Listen to them and use the sound recorder or other audio recorder software in the computer to create your own. It is not necessary to use all of them, but the *INFO.WAV* is more important than others. This IDs your station every 10 minutes. The ID, when played, doesn't interfere with the person talking. It inserts itself at the same time the audio of the person talking is buffered so that when the ID stops, the conversation is played in its entirety. The *IWELCOME* file, which has to be recorded in an 8-bit message format, should be no longer than 4 seconds. It identifies your station to the Internet station connecting to you. Other audio files that can be played are, disconnect, connect and no response.

The SysOp software also has the availability through TouchTone command to connect to random station by pressing 00 or to random repeaters by pressing 01. This is useful when you are mobile and do not know a repeater's access code. VK2JTP is maintaining a list of active I-Link repeaters that can be downloaded from his site at www.qsl.net/vk2jtp.

Conclusion

I-Link has been met with extreme excitement and pleasure as well as disdain and hatred. As with anything new and different, it is hard for people to accept change. Being a ham for almost 40 years, I have witnessed many technological transitions, all of which have been accompanied with a certain amount of angst. We are Amateur Radio operators who are also a part of the computer-Internet age. In order for us to survive we need to accept the technology, embrace and incorporate it in an effort to improve our hobby and the pleasure we obtain from it. We are communicators and whether we use the Internet as a backbone for RF communications or pure radio transmission, it is the pleasure of communicating with oth-

ers, experimenting and performing public service that can be accomplished through this new mode of operation.

Have an open mind and try it. Worldwide crystal-clear communications through I-Link is on the horizon.

I would like to thank Graeme, M0CSH, for the effort he has put forth to develop and support the I-Link program. I would also like to thank Terry, G4CDY, for his tremendous assistance in helping to produce the printed circuit board and schematic diagram. Lastly, I would like to thank JoAnn Lupo for editing assistance.

Jim Millner, WB2REM, is a Child Psychologist who has been a licensed amateur for nearly 40 years. His Amateur Radio interest began at age 11 and he currently holds an Amateur Extra Class license. Jim is a published QST author. His articles have included "A New Band for your Radio" (December 1996) and "The WB2REMote Link" (January 1995). Jim has also been published in 73 Magazine (September 1986) with an article titled "The Missing Link." He is active on CW, SSB, satellites and contesting.

You can contact Jim at 7 Winnipeg Ln, Lawrenceville, NJ 08648; wb2rem@amsat.org.

Notes

¹www.qsl.net/vk2jtp

²PC boards and kits can be purchased on line at www.ilinkboards.com. All items sold at my cost only. 

FEEDBACK

◇ The existing APCO25 and Iridium systems mentioned in my recent Digital Voice articles ("Digital Voice: The Next New Mode?" Jan 2002 *QST*, pp 28-32, and "Digital Voice: An Update and Forecast," Feb 2002 *QST*, pp 38-41, respectively) actually use improved multi-band excitation (IMBE) coding, not advanced multi-band excitation (AMBE). The two coding systems are similar but not identical. Both are from Digital Voice Systems, Inc (www.dvsinc.com). Thanks Mike Somers, KT4QF.—*Doug Smith, KF6DX*

◇ There is an error in the parts list for "Updating the W1FB 80-Meter Sardine Sender (Nov 2001 *QST*, p 55). The value of capacitors C6, C8, C9 and C12 should be 0.1 μ F.—*Erik Westgard, NY9D*

◇ In Figure 1 of "A CW Generator and Audio Distribution System for Students" (Feb 2002 *QST*, p 63), the top input terminals of the eight op-amps (U3A through U6B) should be marked with a plus sign (non-inverting input terminal), and the bottom terminals should be marked with a negative sign (inverting input terminals). In addition, pins 5 and 6 are reversed in the op-amps shown in Figure 1.—*Bill Rynone* 