

ARRL's

VoIP: Internet Linking for Radio Amateurs

Jonathan Taylor, K1RFD



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FOREWORD

When the Internet burst onto the public stage in the early 1990s, some amateurs were fearful. They worried that the Internet would somehow replace the avocation that they had grown to love.

In the years that followed, however, it quickly became clear that the Internet was *complementing* Amateur Radio, not replacing it. Hams put the Internet to work as a medium for rapid exchange of information and ideas. Advances in digital amateur communication and software-defined radio had their genesis in exchanges that took place on the Internet.

Amateurs also realized that the Internet could serve as a communications “pipeline” to link distant locations in a reliable manner that isn’t always possible with satellites or HF communication. Thanks to amateur ingenuity, we now have new communication systems that unite radio with the Internet in ways never imagined just a few years ago.

One system uses Voice Over Internet Protocol, or *VoIP*, to exchange voice communication using the Internet to bridge individual radio stations. By using VoIP networks, hams who were once limited to local communication because of antenna restrictions and other issues can now talk to the world.

VoIP: Internet Linking for Radio Amateurs is your guide to VoIP. The author is Jonathan Taylor, K1RFD, the creator of *EchoLink*, one of the most popular amateur VoIP networks. But Jonathan doesn’t confine this book to a discussion of *EchoLink*. On the contrary, *VoIP: Internet Linking for Radio Amateurs* explores other systems in detail, including the Internet Radio Linking Project, (*IRLP*), *eQSO* and *WIRES*.

VoIP: Internet Linking for Radio Amateurs is written in way that any amateur can understand, regardless of technical ability. In this book, you find a wealth of helpful information to make your VoIP experience as enjoyable as possible.

Please take a few minutes to give us your comments and suggestions on this book. There’s a handy Feedback Form for this purpose at the back, or you can send e-mail to: **pubsfdbk@arrl.org**.

David Sumner, K1ZZ
Executive Vice President
Newington, Connecticut
May 2009

ABOUT THE ARRL

The seed for Amateur Radio was planted in the 1890s, when Guglielmo Marconi began his experiments in wireless telegraphy. Soon he was joined by dozens, then hundreds, of others who were enthusiastic about sending and receiving messages through the air—some with a commercial interest, but others solely out of a love for this new communications medium. The United States government began licensing Amateur Radio operators in 1912.

By 1914, there were thousands of Amateur Radio operators—hams—in the United States. Hiram Percy Maxim, a leading Hartford, Connecticut inventor and industrialist, saw the need for an organization to band together this fledgling group of radio experimenters. In May 1914 he founded the American Radio Relay League (ARRL) to meet that need.

Today ARRL, with approximately 150,000 members, is the largest organization of radio amateurs in the United States. The ARRL is a not-for-profit organization that:

- promotes interest in Amateur Radio communications and experimentation
- represents US radio amateurs in legislative matters, and
- maintains fraternalism and a high standard of conduct among Amateur Radio operators.

At ARRL headquarters in the Hartford suburb of Newington, the staff helps serve the needs of members. ARRL is also International Secretariat for the International Amateur Radio Union, which is made up of similar societies in 150 countries around the world.

ARRL publishes the monthly journal *QST*, as well as newsletters and many publications covering all aspects of Amateur Radio. Its headquarters station, W1AW, transmits bulletins of interest to radio amateurs and Morse code practice sessions. The ARRL also coordinates an extensive field organization, which includes volunteers who provide technical information and other support services for radio amateurs as well as communications for public-service activities. In addition, ARRL represents US amateurs with the Federal Communications Commission and other government agencies in the US and abroad.

Membership in ARRL means much more than receiving *QST* each month. In addition to the services already described, ARRL offers membership services on a personal level, such as the Technical Information Service—where members can get answers by phone, email or the ARRL website, to all their technical and operating questions.

Full ARRL membership (available only to licensed radio amateurs) gives you a voice in how the affairs of the organization are governed. ARRL policy is set by a Board of Directors (one from each of 15 Divisions). Each year, one-third of the ARRL Board of Directors stands for election by the full members they represent. The day-to-day operation of ARRL HQ is managed by an Executive Vice President and his staff.

No matter what aspect of Amateur Radio attracts you, ARRL membership is relevant and important. There would be no Amateur Radio as we know it today were it not for the ARRL.

We would be happy to welcome you as a member! (An Amateur Radio license is not required for Associate Membership.) For more information about ARRL and answers to any questions you may have about Amateur Radio, write or call:

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Prospective new amateurs call (toll-free):

800-32-NEW HAM (800-326-3942)

You can also contact us via e-mail at [**newham@arrl.org**](mailto:newham@arrl.org)

or check out *ARRLWeb* at [**www.arrl.org/**](http://www.arrl.org)

ABOUT THIS BOOK

This book introduces Internet linking, and describes several of the most widely-used systems, with particular attention to *EchoLink* and the Internet Radio Linking Project, or *IRLP*. It gives some basic advice about how to operate an Internet link, how to plan, set up and customize your own. It also provides a peek into the innards of these systems, with some background on how Voice over Internet Protocol, or VoIP, works, and some of the digital magic that goes on behind the scenes.

Internet linking is a relatively new and fast-moving aspect of Amateur Radio, and I won't try to dive deeply into the details of how to set up and configure each individual system. At this level, each system is quite different, and software can change substantially with each new release. Fortunately, plenty of useful documentation is available online. See the "Resources" chapter at the end of the book for helpful links.

Chapter 1

Connecting the World

Hurricane Isabel slams into the coast of North Carolina, unleashing 95-knot winds and a six-foot storm surge, knocking out electric power and local telephone communications. Despite unfavorable HF propagation, local weather reports are relayed by Amateur Radio operators, using handheld radios, directly to the National Hurricane Center in Florida. Damage reports and health-and-welfare information is routed directly to emergency operations centers and Red Cross centers hundreds of miles away. Amateur Radio steps in when many other communications systems fail.

The space shuttle Columbia disintegrates over eastern Texas, scattering debris over a broad swath. Radio Amateurs spring into action, locating debris and exchanging precise location reports with hams in nearby counties, who are assisting local law enforcement and NASA. Questions about Columbia's demise are quickly getting answers.

A retired electrical engineer who had been an active member of his local radio club in the Northeast begins a new life in Florida, and faces the prospect of remaining out of touch with old friends because of strict outdoor antenna restrictions. But he still manages to check into his club's daily 2-meter net back home, just as if he'd never left. Friendships strengthened by Amateur Radio remain strong as ever.

All of this is made possible by an intriguing marriage of perhaps the two greatest communications inventions of the twentieth century: Radio and the Internet. Hams in the twenty-first century now find themselves in the perfect position to join these two technologies together. Through a technique called *Internet linking*, they are harnessing the immediacy and portability of radio communication to the global reach of the Internet, and all sorts of new possibilities are emerging.

STRANGE BEDFELLOWS?

Amateur Radio has more in common with the Internet than you might realize. Today's Internet began as the vision of DARPA, the U.S. Government's Defense Advanced Research Projects Agency. The idea was to create a coast-to-coast digital network which could route messages from anywhere to anywhere, with plenty of extra paths in place so that the whole thing would hold together even after a nuclear weapons strike, or a devastating natural disaster. Even back in the 1970s, the system worked well. Colleges and universities began hooking up their computers to ARPANET, finding it a cost-effective way to exchange research information. Large corporations began using the network — which now spanned the globe, and had become known

as the Internet — to exchange e-mail. Then, in the early 1990s, the invention of the graphical Web browser ignited an explosion of Internet usage. Millions and millions of computers are now interconnected, many of which are PCs in homes.

Amateur Radio, although it hasn't seen the same growth spurt (imagine the QRM!), is also global, immediate, and fault-tolerant. We already know that hams are sometimes the only link to the outside world from the site of a disaster, with mobile and portable stations often proving most valuable to relay traffic directly from the scene.

So why not experiment with connecting the two together?

Some enterprising hams had exactly this thought in the mid-1990s, when the Internet began coming into homes in earnest, and thus also into ham shacks. The idea was this: Using personal computers equipped with sound cards, connect the audio signals of two FM rigs to each other over the Internet. This allows mobile and portable stations in the coverage area of one station to establish voice communication with stations in the coverage area of the other, without limitations imposed by distance, terrain, or HF propagation (**Figure 1.1**).

Sending data (including voice signals) over the Internet is certainly nothing new. What makes this idea interesting is that Amateur Radio stations can harness this technology to produce a hybrid system that is part RF and part Internet, taking advantage of the inherent strengths of both techniques.

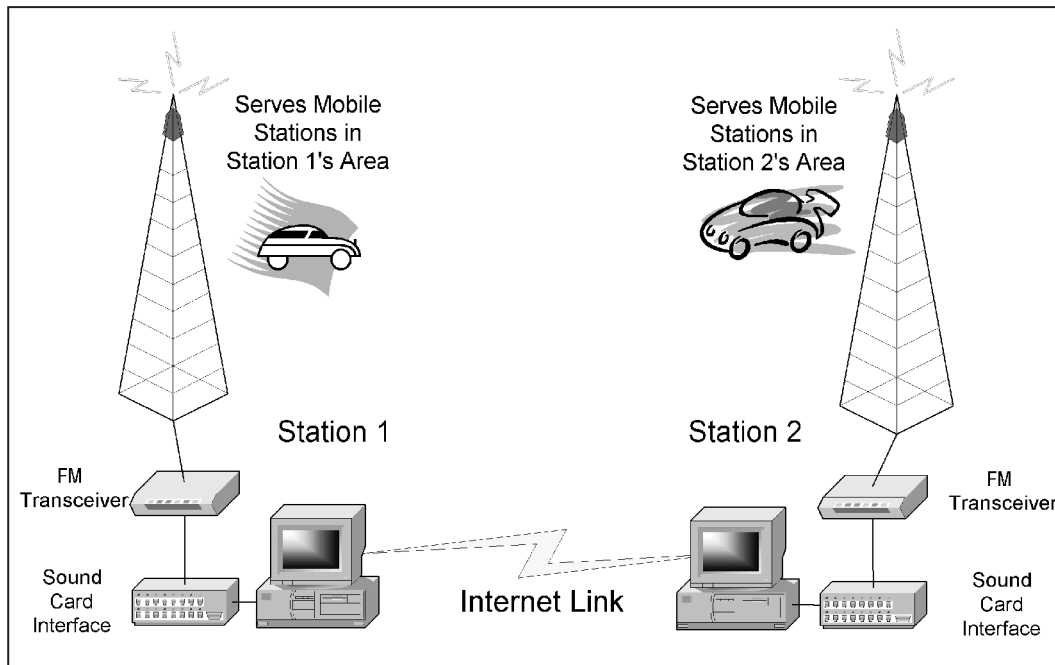


Figure 1.1 — By interconnecting two FM simplex stations over the Internet, the coverage areas of the two stations are effectively combined.

EARLY EXPERIMENTS

In the mid-1990s, a program called *Internet Phone* began to make the rounds. It was one of the first voice-over-IP (VoIP) programs widely available to the public. The idea was that you could use the microphone and speaker connected to your Internet-attached PC to make telephone calls to any similarly equipped computer anywhere in the world, for free! As long as you knew the Internet address of the computer you wanted to hook up with, you could simply type it in, establish a connection, and start talking. Sure, there were occasional “drop outs” (gaps in the audio) due to the slow modems at each end, but the experience of hearing someone else’s voice coming from the computer speakers was stunning.

Naturally, once a few enterprising hams began experimenting with *Internet Phone*, they got the idea that it could easily be adapted to join VHF-FM stations together. Rather than connecting a microphone and speakers to the computer’s sound card, why not connect the sound card to the microphone and speaker jacks of an FM transceiver? This would allow anyone within range of the transceiver connected to Computer A to communicate with anyone within range of the rig connected to Computer B. Sure enough, it worked (sort of), and one of the first Internet voice links between two Amateur stations was established.

The next logical step was to tune the “linked” transceiver to the frequency pair of a local repeater, rather than a simplex frequency. This opened up even more possibilities, since now any station in range of the repeater at either end could be part of the long-distance QSO. Things were starting to get interesting!

In 1996, Mark Brown, N9YNQ, developed a *Windows* program called *Repeater Link*. *Repeater Link* formed a software bridge between *Internet Phone* and an FM rig connected to the PC through a special hardware interface concocted by Jack Leverich, KC9KY. The *Repeater Link* system may have been the first PC-based Amateur Radio VoIP linking system. (Perhaps Mark and Jack can lay claim to being the Alexander Graham Bell and Thomas Watson of Internet linking.)

Unfortunately, like many early Internet experiments, technology took a while to catch up. There was plenty of talk about broadband Internet access in the mid-90s, and not very much action. (Remember ISDN service from the telephone company? The running joke was that ISDN actually stood for “It Still Does Nothing.”) Without reliable, dedicated Internet access coming into the ham shack or the repeater site, widespread Internet linking would have to wait.

Fortunately, broadband did finally arrive, and so did fast, cheap personal computers. Today, millions of Americans have Internet access in their homes delivered by TV cable, digital subscriber line (DSL), or satellite. Dial-up modems have improved, too, as have the quality of (some) phone lines. Coming from the opposite direction, audio and video compression technologies have improved, and personal computers are more efficient than ever before at processing this information, and quite a bit cheaper, cycle for cycle. See the sidebar, “**Moore’s Law.**”