By Stan Schretter, W4MQ, Brad Wyatt, K6WR, and Keith Lamonica, W7DXX

A Ham Radio Public Utility HF Station

Merging Internet technology with Amateur Radio holds great promise. This article discusses the authors' experiences in putting several Internet Remote Base stations on the air.

What is a Ham Radio Public Utility HF Station, and why should you be interested? Developing and operating this type of ham station is fun and provides a uniquely educational experience of combining Amateur Radio, computers and the Internet to achieve some very worthwhile objectives.

What is a Ham Radio Public Utility HF station?

A Ham Radio Public Utility HF station is an Internet Remote Base (IRB) HF station available for use by almost any licensed ham worldwide. For simplicity, we will use the term "Internet Remote Base" to describe the concept and the implementation of the actual station. The IRB is easy to install and operate and does not require expensive equipment or advanced computer skills. The IRB concept has been in use continuously, for over two years, at W7DXX, W4MQ and KA3ODJ. Literally scores of hams worldwide have made hundreds of DX and local contacts using these three stations. Each of these hams has made these contacts without the use of radios, antennas or towers—at their own locations. They controlled the radios, amplifiers and antennas at the IRB locations noted by operating their computer while connected to the Internet. A couple of examples from K6WR will give you the idea in actual QSO terms. K6WR has no radios or antennas at his condominium, but by using these three stations he has worked many DX stations worldwide. These include VP6DI (the recent Ducie Island DXpedition on 15 meter SSB), many SSB and CW US stations and DX stations on all bands. Also included were scores of European stations on 75 meters (quite a feat from the western United States).

Why should you be Interested?

- You'll have fun and enjoy a unique and instructive personal educational experience.
- Your operation will provide a facility for those less fortunate hams worldwide who do not have radios, antennas

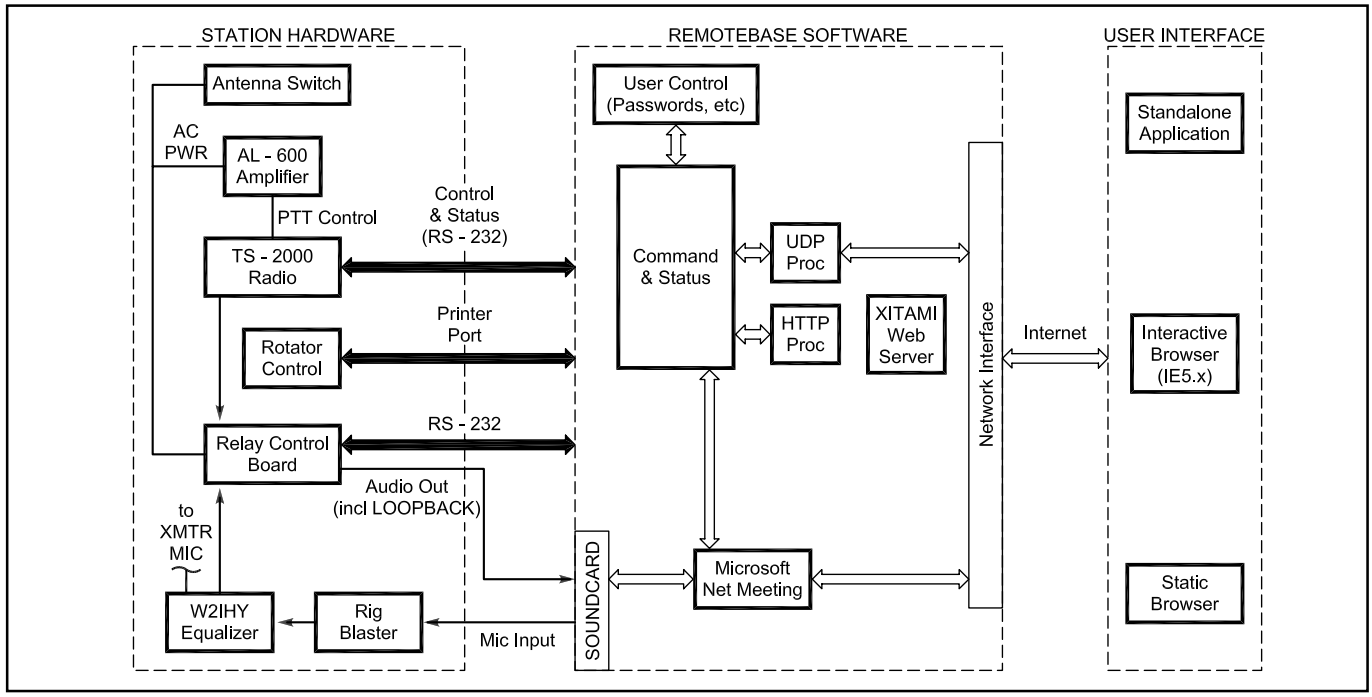

Figure 1—Block diagram of the W4MQ Internet remote base.

or towers for HF operation. This might be one solution to the current and growing restrictive covenant situation that some hams face.

- You will be able to expand the resources available to those blind or disabled amateurs who would otherwise not be able to operate.
- You will be able to provide a facility for both young and new hams to operate on HF. This is one of the key goals of the ARRL Education and Technology Program recently described in *QST* and on the ARRLWeb. The curriculum material for this program, as currently developed, includes references to the use of "IRB" in the first two chapters, currently entitled Unit 1, *Introduction to Wireless Communications* and Unit 2, *Methods of Communications*.

Before we get into a step-by-step approach of how to develop, install and operate an "Internet Remote Base," please refer to an earlier article in *QST*[1] for further details about the IRB concept and operation from the remote user's point of view. This article is available in reprinted form from the ARRL and on the *2001 ARRL Periodicals on CD-ROM*. It is also available on-line at **www.lamonica.com** and **www.w4mq.com**.

A word about the skill levels you will need to be successful in this exciting adventure. This article is designed to enable and encourage the amateur who is computer and Internet aware and already has an operating HF station to develop an IRB station.

In the over two years of continuous operation of these stations, W4MQ and K6WR have noticed that hams have used IRB stations for many different reasons, including: operating in spite of the inability to erect suitable antennas (due to restrictive covenants), rejoining a local 40 meter net after moving away, upgrading skills before purchasing new equipment and getting "on-air" temporarily after a move. For example, K6WR continued operating during a trip across country to a distant location for medical treatment. As a volunteer operator at the Smithsonian Institution Museum station in Washington, DC (NN3SI), W4MQ often demonstrates his IRB station using a small laptop via a dial-up Internet connection. It was interesting to note that while the older hams were curious (they still prefer to turn those knobs), younger hams were often very enthusiastic about operating a radio station via the Internet.

Figure 1 is a block diagram of the W4MQ station. W7DXX is similar, but not identical. This article does not discuss the basic computer or Internet issues in detail. These issues are well documented in available computer literature. It is assumed that a ham planning to develop an IRB station will already have these skills and that he or she has the resources to find the necessary references raised by the issues to be described. By following these guidelines, a ham with a fully functional HF station and basic computer skills should be successful in putting such a station on the air with minimum expense and effort.

Remote User Identity

Each potential remote end-user must register and receive an assigned unique identifier and password along with operating privileges based upon his license class and country. For hams not licensed in the US, operating privileges depend on the reciprocal agreement between their country and the US. The details of these reciprocal agreements and the privileges provided can be found on the FCC Web Page devoted to Amateur Radio, **www.fcc.gov**.

Registered ham remote users are considered to be "control operators" under FCC Part 97 Rules, since they have full capabilities to set all parameters of the station including frequency, mode and RF power, as well as the ability to transmit. The Internet acts, essentially, as a "long microphone cord" (or keying line for CW) between the remote user control operator and the IRB.

Computer Equipment

Any 300 MHz or faster IBM compatible system with a sound card, compatible microphone and headset, with at least a 5 GB hard disk and Windows 95 or later should suffice. Higher speed and greater capacity gear will help, but the equipment outlined will get the job done nicely.

Internet Connection

Ideally, the Internet connection should be a full time, broadband (DSL, Cable or ISDN) connection with a fixed Internet Protocol (IP) address (a commonly available feature with these services). This fixed IP address, which is obtained from your local Internet Service Provider (ISP), is necessary so that the remote user can find the IRB on the Internet. In reality, all Internet connective services above 28.8 kbit/s will support the IRB. If the IP address is not fixed (in dial-up or most new DSL installations), then you should virtually map the address to a fixed Universal Remote Locator address (URL) on the Internet using one of the available services such as DNS2Go (**www.dns2go.com**). Then, the virtual URL, for example, **w4mqremotebase.dns2go.com**, would be entered into the IRB setup instead of the direct IP address.

The Radio

Any radio that is controllable from a computer is acceptable for the IRB application. Many hams already use computers to support contesting, logging, and satellite operations. Most radios produced after 1990 support computer control. While the newer radios usually have a DB-9 plug (RS-232 interface) directly on the equipment, earlier radios may require special adapters to convert their digital signal (usually TTL levels) to RS-232. Various circuits are available on the Internet, *QST,* in *The Radio Amateur's Handbook* and from several *QST* advertisers.

The digital command structure for amateur transceivers should be documented in the radio's manual. It is usually ASCII character-based and can easily be verified using any standard ASCII terminal program such as *HyperTerm,* which is included with *Windows*. Unfortunately, the command structure is different among radio manufacturers and may even be different between radios within one manufacturer's line. The current W4MQ IRB software is written to support the Kenwood TS-2000 radio but is easily adaptable, with software modification, to earlier Kenwood radios and to other manufacturer's products.

The TS-2000 provides a very rich command set, since it was designed for full control via computer, so it is quite easy to program and control. Most high-end modern transceivers provide a similar command set.

The authors are currently working on the interface for other radios, including the Kachina 505DSP.

Auxiliary Equipment

In addition to the radio, many hams use multiple antennas with a switching arrangement, power amplifiers, and rotatable antennas. Each of these presents a unique challenge for remote control. Presently there is no standard interface for these elements, like the RS-232 protocol. The two stations currently using the W4MQ Internet RemoteBase software have totally different ways of dealing with these auxiliary control issues, and station specific software was written to handle them.

Antenna Switching Controls

There are several computer controllable boxes available for antenna control. The Internet RemoteBase software is capable of switching up to five antennas

[1]Notes appear on page 42.

based on a configurable set of rules and controllable from the remote interface. At W4MQ, an MFJ RCS-8 Remote Switch is controlled via a separate relay card interfaced to the computer through a USB port. At W7DXX, a similar MFJ RCS-8 Remote Switch is controlled with a Kachina 505AR controller connected through an RS232 serial port.

Rotator Control

There are several options for controlling rotators directly from the computer. Many of today's better rotators come with an external control interface. At W7DXX, the Kachina 505AR controller is used. At W4MQ, the Antenna Rotator System (ARS) developed by EA4TX is connected via the computer's parallel port to control a Yaesu 5400 az-el rotator.

Amplifier Control

Currently, there are few amplifiers that are directly controllable from a computer. At both W4MQ and W7DXX amplifier control is performed through relay control logic built into the TS-2000. The radio is commanded via the software to enable and disable the amplifier push-to-talk (PTT), depending on both amplifier availability and the privileges of the operator. This function is configurable via setup tables. At W4MQ, the amplifier ac power is also controllable from the computer to allow the amplifier ac power to be shut off when it is not in use. A settable software timer is used to prevent ac power cycling caused by inadvertent Internet link disconnects.

Server Software

The basic operation of the IRB is supported entirely by installation of the W4MQ Internet Remote Base software (downloadable from **www.w4mq.com**) and Microsoft NetMeeting software (**www.microsoft.com**), which is used for transmit and receive audio to and from the remote user.

Remote Base Setup

The IRB server software provides the following capabilities:

- Remote and Local Control of the radio with SSB, AM, FM, PSK and CW modes (CW via keyboard), from 160 meters though 70 cm.
- Verification of audio via loopback and transmission monitoring.
- Validating each user logon via a unique call sign and password.
- Controlling access (transmit frequency, mode, power) for up to 6 different license/user classes.
- Controlling amplifier access, including the limiting of frequency range and drive levels.
- Providing status to all users trying to access (busy, available, not connected).
- Logging each operation for system verification and traceback.

The IRB is configured via a set of setup screens, as illustrated in Figure 3. A default set of parameters is provided, but the host station owner is required to set up the call sign and IP address (or URL) of the station, as well as radio, amplifier and antenna parameters. A default set of user constraints (frequency limits, allowable modes), based on the FCC license classes, is provided. These parameters should be changed to reflect the allowed operations for the station environment.

Microsoft *NetMeeting* Setup

NetMeeting is a free application used to provide two way audio over the Internet connection between the remote user and the IRB. Through experimentation, we have determined that NetMeeting audio levels need to be set up carefully to minimize audio feedback and distortion at the remote and to provide optimum results over low rate dial up links in a congested Internet environment. This setup could the subject of an entire article; however, key information can be found in both the Help File and the additional NetMeeting notes at **www.w4mq.com**. Note that *NetMeeting* will not function properly when it is installed behind most hardware routers. Software firewalls and the use of the Microsoft Internet Connection Server (ICS) may also cause *NetMeeting* problems. Many of these issues and appropriate solutions are discussed on the Internet at **www.meetingbywire.com**.

Enhanced Features

In addition to the basic Internet Remote Base operation described above, several enhanced features are available:

- Remote control of the radio via an *Internet Explorer* or *Netscape* browser.
- A window updated by the RemoteBase control operator that can pro-

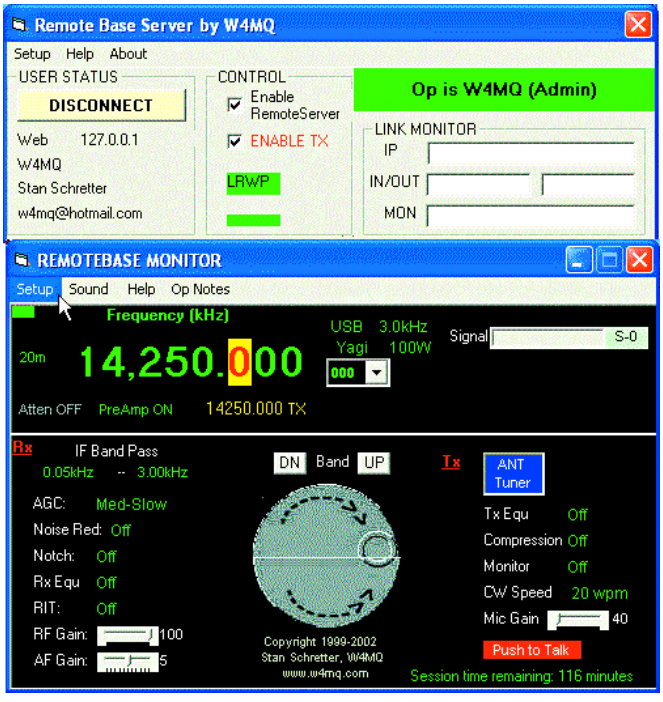

Figure 2—Operation displays used to set up, monitor and control the remote base server.

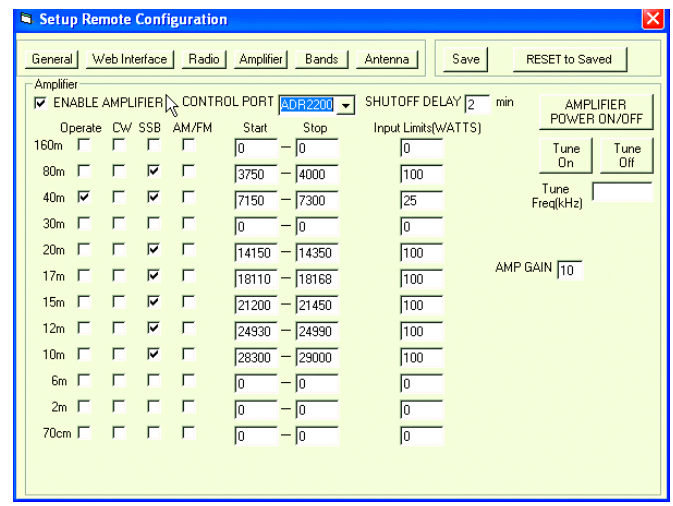

Figure 3—One of several menus (external amplifier setup) used to setup the remote base configuration.

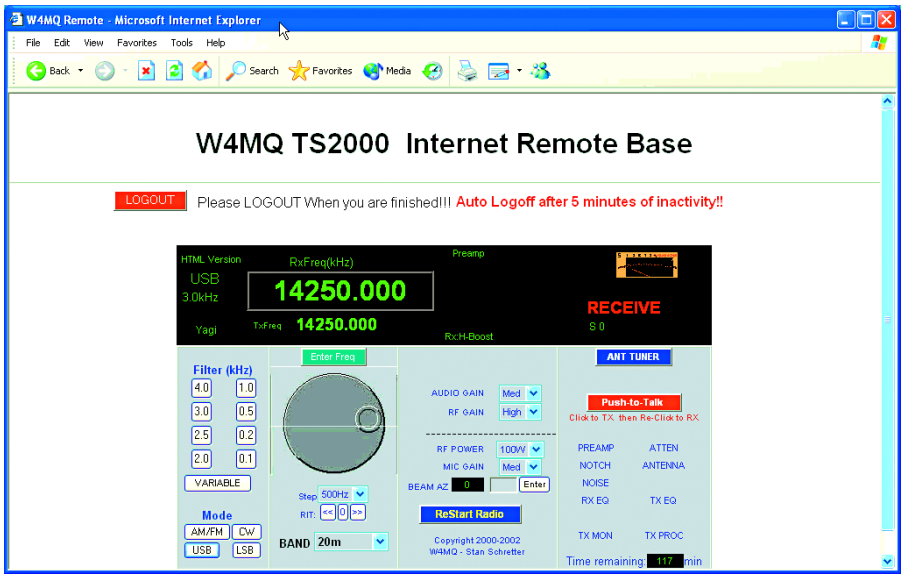

Figure 4—End-user browser interface. (Note separate standalone client application interface is similar to monitor shown in Figure 2.)

vide equipment and operational status or announcements of new features to all users when they log into the system.

- Semi-automatic support of user registration via a browser interface.
- Individual electronic logbooks for each user; allowing a single log, regardless of the end-user's location.

These additional services can be activated by installation of the freeware Web Server by Xitami (**www.xitami.com**). An example of how to implement user registration via the Internet can be seen at the W4MQ Web site. W4MQ has developed additional software to process these user registration requests, including the checking of call signs through various license databases and the automatic generation of response e-mails.

RFI

While RF energy getting into your equipment is problematic with a normal station, it can be catastrophic with an IRB station. Both W4MQ and W7DXX initially experienced many difficulties with RFI. Computer or DSL modem freezes may not only cause operation to cease, but may prevent its resumption; thus requiring control operator intervention to reset the equipment. For unattended operation, the recommendation is to install a separate device to reset the equipment (telephone controlled). The station must be RFI free prior to making it remote capable. All audio lines from the computer to the radio should be shielded. High quality filters (see **www.elect-spec.com/phone_w.htm#TURBO**) should be placed on the phone line for the DSL modem. The computer case should be properly closed and properly grounded.

Remote End-User Software

Although the initial W4MQ user interface was described in the earlier article,[2] available also online at **www.lamonica.com** and **www.w4mq.com**, much has changed since then. Both the downloadable application and the Web browser interfaces have been improved, mostly based upon user feedback. The Web browser interface (illustrated in Figure 4) provides a fully interactive radio control environment without any download to your computer. However, it supports only voice operations and has limited tuning and S-meter update rates as compared to the standalone version. The separate standalone user interface is similar to the Server Monitor illustrated in Figure 2 and provides full and rapid remote control features.

Conclusion

In addition to the W4MQ and W7DXX IRBs, another IRB is operated by KA3ODJ. This station is similar to those discussed, but uses a Ten-Tec Pegasus transceiver and custom software created by N2JEU and N4PY. It is controlled via a simple browser interface and supports VOX-controlled SSB operation only.

There are at least two "reflectors" on the Internet addressing issues dealing with the IRB concept. One of those reflectors is **RemoteBase@yahoo.com**. Those interested are invited to join in with suggestions, questions and comments. Another reflector is **TRX-Manager@yahoo.com**, which deals specifically with the use of a program called *TRX-Manager* by F6DEX, in primarily a single user environment.

Internet Remote Base operations may not be for everyone, but for many hams, it will provide a unique way to enjoy the hobby. It could also provide an easy entry point for new hams wishing to explore amateur radio without investing in radio equipment and antennas. Additionally, it supports one of the goals of the ARRL Education and Technology Program, the recruitment of new, young amateurs into the Amateur Service.

Notes

[1]B. Wyatt, K6WR, "Remote-Controlled HF Operation over the Internet," *QST*, Nov 2001, pp 47-48.
[2]See Note 1.

Stan Schretter, W4MQ, lives in Reston, Virginia and has been active in amateur radio since first licensed in 1957. He is a communications and computing system consultant and is a regular volunteer operator at NN3SI, the Smithsonian Institution in Washington DC. Stan may be contacted at **schrette@verizon.net**.

Keith Lamonica, W7DXX, has been a ham for almost 50 years. He prefers tinkering more than operating, but he does get on 75 meters occasionally. When not playing with new technology, Keith is a college professor teaching mass media courses. He also practices law and is involved with broadcast communication engineering. Keith says that his next project is putting a remote base in either geosynchronous orbit or on the moon. Keith can be contacted at **keith@lamonica.com**.

Brad Wyatt, K6WR (ex-W6VUW), lives in Los Gatos, California and was the ARRL Pacific Division Director from 1994-2000. He is a graduate of Stanford University with BA and MBA degrees. Brad can be contacted at **wyatt@attglobal.net**.

Brad was a student at Stanford University in the late 1940s and early '50s during the start of the SSB era in Amateur Radio. The Stanford University Radio Club station then consisted of a 1 kW AM and a 1 kW SSB rig (both described in QST *of the day) that could be operated on the same frequency into a 20 meter rhombic antenna, 80 feet high. One of his roles was to tell the story of SSB on the air using the following approach: He would call CQ on SSB in the middle of the 20 meter phone band with a tremendous signal. Eventually someone's carrier would help demodulate the SSB signal and a ham at the other end would come back, saying: "You are really loud, but something is terribly wrong with your signal". Having "hooked" the ham at the other end, he would switch on the AM rig and explain, in the terms of the day, how to listen to SSB… "Turn on your receiver's BFO, turn down your RF gain and tune your BFO until the signal sounds OK"… there were no product detectors in those days! Once this cycle was started, the pileup could go on for several hours. Brad feels that this current adventure with remote controlled Internet stations is a "replay," in a sense, of those early SSB days at Stanford.* QST