Remote operation

The recent Lifetime Licence paves the way for operating your station remotely.

THE NEW LICENCE. If you have read your new lifetime licence from cover to cover, you may have noticed Clause 10, Unattended and remote control operation. Subject to various conditions, this allows a UK amateur to "conduct Unattended Operation of Radio Equipment" and "Remote Control Operation of Radio Equipment". In this first of two parts I'll look at the system overview and what you need; next month we'll put it all together.

There are at least two ways that remote operation could be very useful. One is to make your home station remoteable so that you can use it when away on business or holiday, and the other is to set up an entirely independent remote station.

A remote station is an attractive proposition for those of us who live in urban environments and are battling against ever-increasing levels of man-made noise, space and planning restrictions, TVI etc. How wonderful it would be if one were able to sit at home and operate from a nice quiet location with some good aerials? Such a station is sometimes referred to as an IRB or Internet Remote Base.

Of course, the first requirement for establishing a remote station is to have a suitable location available to you, but if you have a weekend cottage or an auntie in the country, you're off to a good start. I have been operating such a station for the last year or so with no major problems (apart from mice!) and it has made a huge difference to my operating pleasure.

There are many ways of configuring a remote station and I offer the following description as one tried and tested option. At the end of the article next month are a few more sources of information.

BUILDING BLOCKS. At your remote-capable station you will need:

- A broadband internet connection with firewall router.
- A reliable and economical PC with serial and parallel ports if possible.
- Specialist software (it's all free!).
- An emergency shut down and reboot facility.
- A transceiver, audio interface and power supply.
- Aerials and tuners.

Internet connection. The internet is by far the easiest way to connect a remote station. With a suitable Wi-Fi equipped laptop you will be able to operate your station from hotels, cafes and anywhere else that offers a connection, as well as from the comfort of your home shack.

The connection at the remote site won't get a lot of traffic (unless teenagers live there!) so a cheap broadband package will be enough. Mine allows for 15GB of data transfer each month, which I have found to be sufficient. (If there is no phone line at the remote site you may be able to use one of the increasingly popular broadband 'dongles' that are available, but check the data allowance: some are much more generous than others. You'll also need a good firewall program on your PC.)

Many people worry about interference from the ADSL data on the telephone line spoiling their quiet receiving site but I have experienced no such problems with mine. The problem I have had has been in the reverse direction with a tendency for the ADSL router to drop the connection when I transmitted on Top Band. I have since fitted filters in the line between the micro-filter and the router, which has cured the problem – see **Photo 2**.

The internet can be a dangerous place and you need to keep your station secure from hackers. The easiest way to do this is to set up a "Virtual Private Network" or VPN. Some ADSL routers have VPN facilities built in, so if you are starting from scratch and only want to control the remote from one place it might be worth getting two identical routers that will have no trouble talking to each other. You may have to ask your ISP for a "static IP address" if you want to use the router's own VPN facility but it is not required for software solutions like Hamachi (see later).

The remote computer. The PC at the remote station needn't be fast; a 1GHz machine is fine. I use an old Dell 850MHz laptop that

PHOTO 1: The system as described. It lives in a wooden box in the utility room. The sweet tin next to the laptop contains the audio transformers.

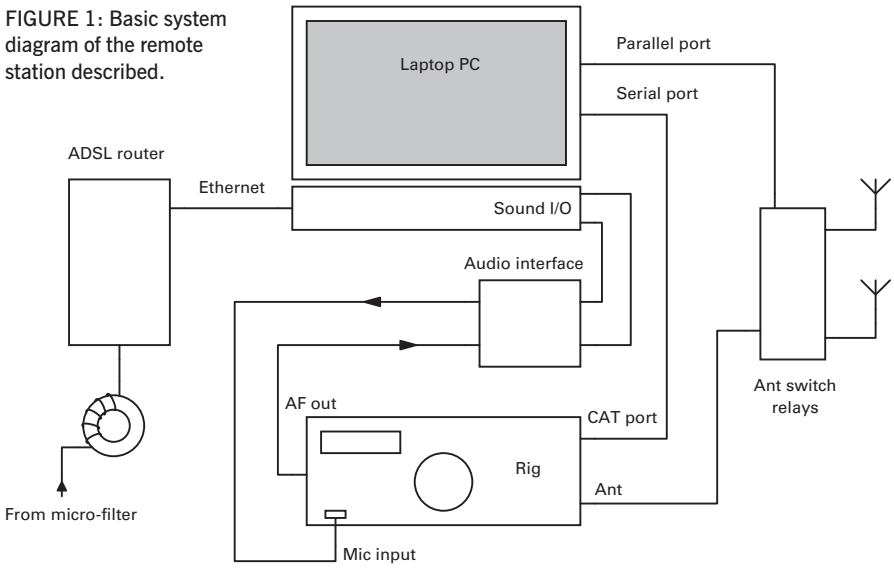
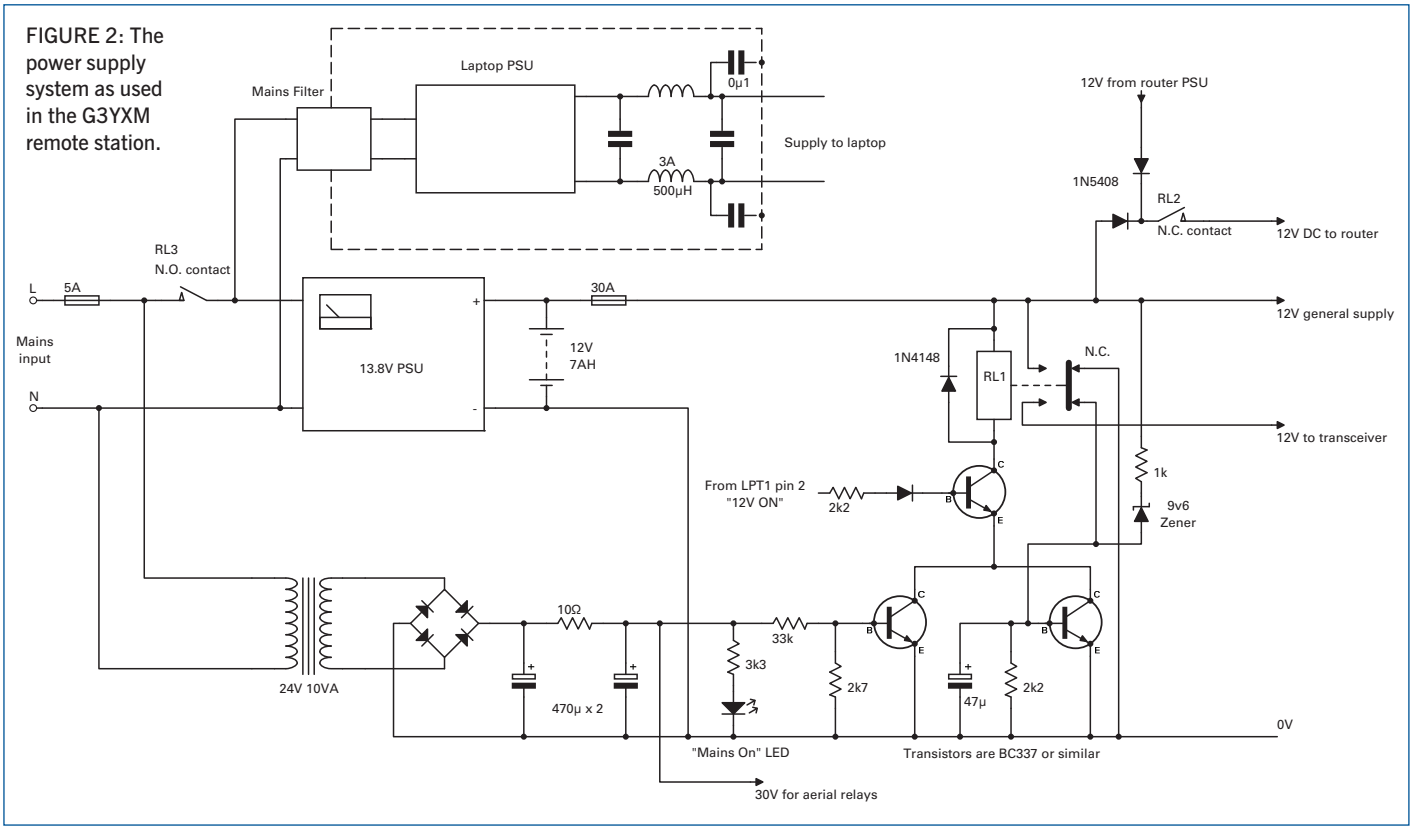


FIGURE 1: Basic system diagram of the remote station described.

FIGURE 2: The power supply system as used in the G3YXM remote station.



has serial and parallel ports (more on those later) and, being a laptop, it is compact, economical to run and has its own built-in backup battery! Search the rallies and auction sites for a suitable machine for £100 or less.

To be able to recover from the inevitable PC crashes, a remote restart facility needs to be added to the PC. On a laptop this can be a bit fiddly but the following method has proved successful: remove the trim at the rear of the keyboard to reveal the power button (note that this is NOT equivalent to the mains power switch on a desktop PC: leave that *well alone*). Measure the voltage at both sides of the switch with it open and with it pressed. This way you can work out whether it pulls the control line up to 5V or down to ground when pressed. Remove the laptop's battery and make a connection to the switching line as shown in **Photo 3**. The remote re-start should accept a 5V signal from the control logic.

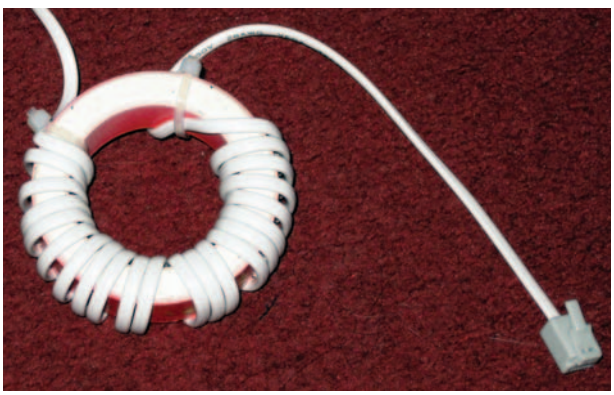


PHOTO 2: Many turns on a 58mm ferrite toroid are needed to keep top band out of the ADSL router.

At your nice quiet location you don't want interference from the laptop's power supply. I mounted mine in a diecast box with a mains filter on the input and a choke/capacitor filter in the DC output line (cut the output lead close to the PSU). It's probably a good idea to drill some holes in the metal box to allow air flow.

Software. Most of the software I use requires a 32 bit Windows operating system so Windows 98 or Me are no use. I run Windows 2000 on my remote machine because it is stable, not too bloated and it runs all the software required. It's also happy with 256MB of RAM. You can still get a genuine disk from eBay or computer fairs for about £30. *Win 2K* doesn't have a firewall, but XP's built-in one seems to create more problems than it solves. In any case, the remote PC will be protected by the hardware firewall in the router.

The amateur licence stipulates that the remote control link must be "adequately secure" to prevent unauthorised use. An easy way to achieve this is by setting up a password-protected virtual private network (VPN). Although some routers can provide this functionality it won't help you if you want to operate your remote station whilst sitting in a cafe in Paris or a pub in Preston. A simple solution (and one that's free for non-commercial purposes) is to download a program called Hamachi from www.Logmein.com and run a copy at each end of the link. This software sets up a private, pass-worded 'tunnel' through the internet, wherever you may log in, and allows you to treat your remote PC as if it were part of your home network.

In my system I use the following programs:

Hamachi (www.logmein.com) to provide the VPN.

Ham Radio Deluxe (www.ham-radio-deluxe.com) to allow remote control of your radio.

IP Sound by SM5VXC (www.wireless.org.uk/software.htm) to provide a good quality two-way audio link.

Lalim parallel port control software to switch aerials etc.

A VNC client such as *Real VNC* or *Tight VNC* for housekeeping of the remote PC.

Emergency shutdown system. One absolute essential at any remote station is a way of shutting it down if something goes wrong. If you lose the link or the PC crashes whilst you are on the air the transceiver might be left in transmit mode. Many radios have a pre-settable timeout that will prevent continuous transmission and this is worth setting up to suit your operating style, but if the computer crashes you don't want to have to travel miles to reset it. This is where the modification to the power button comes in.

In the system described, the power to the transceiver is supplied via a power relay operated from the PC's parallel port. This allows switching of the rig remotely but it

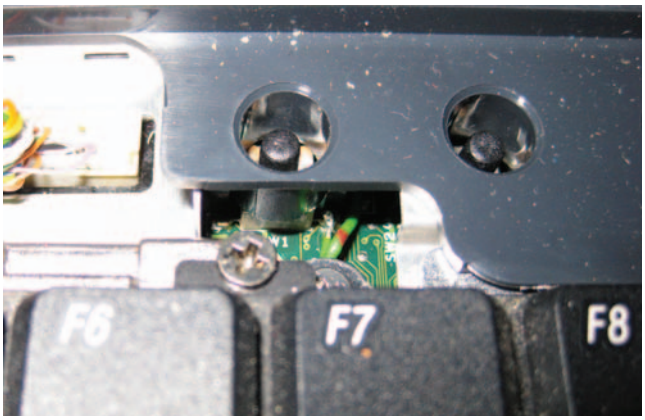


PHOTO 3: Look carefully and you can see a green wire connected to the switch.

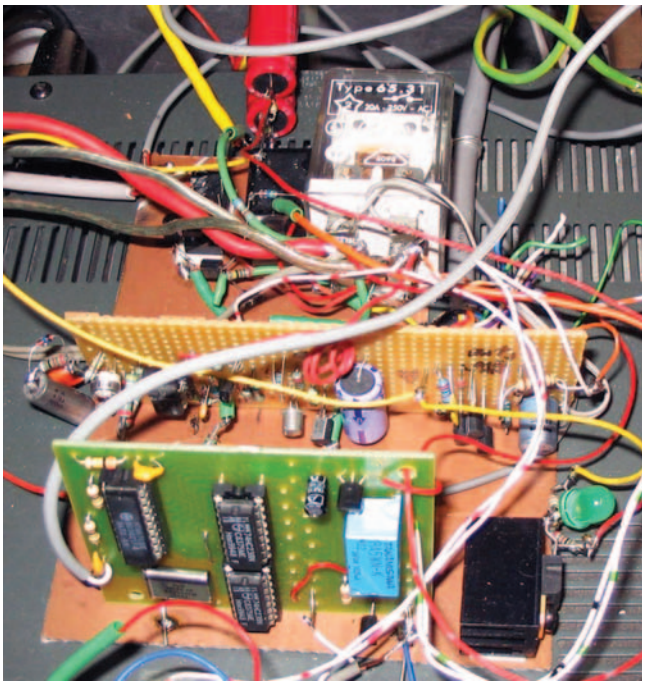


PHOTO 4: The DTMF decoder board at the front and the 20A relay is at the back. As this was the prototype there are a few more bits than we actually need.

also means that if the PC is off, the relay drops out and the rig is de-powered. I have also incorporated a backup battery (a surplus 7AH UPS gel type) to keep the system alive in the event of a power cut. The relay driver circuit features a low voltage trip that will protect it from too deep a discharge.

An old mobile phone with a pay as you go SIM card makes a good independent emergency channel. If it is configured to auto-answer you can dial into it from anywhere, listen to the receiver and send it DTMF tones that can be decoded and used to perform various tasks. In my system the mobile phone's audio jack is wired to a DTMF decoder card. One of the outputs is used to 'press' the laptop's power button, and another to momentarily interrupt the router's power supply in order to reset it. I used a kit from CPC (80-2100 board) based on the MT8870 chip. It's a bit of a lash-up but it's shown in **Photo 4**.

A PC will shut down if the power button is pressed for about 5 seconds, even it has completely crashed. Once it has turned off, a short 'press' of the button will start it up again. The DTMF controller card will output 5V to 'press' the re-start switch for as long as you are sending the appropriate DTMF tone.

The phone must be on charge all the time so do check that the charger doesn't cause interference to the remote receiver. If it does you may be able to use a similar filtering system as on the laptop PSU, or maybe use a car type charger fed from the 12V rail but be aware that most of these are switch-mode too!

Remember to make a call on the emergency phone every once in a while: most mobile phone companies will deactivate a number if no calls are made for a few months.

Transceiver and PSU.

This is largely up to you. Most modern transceivers can be CAT controlled but some are better than others. I started out with an old Icom 735 that worked quite well but needed a hardware PTT system as there is no CI-V command for TX/RX changeover. The cheapest new option is the Yaesu FT857 that can be made to do almost everything via CAT control except, for some bizarre reason, switching the attenuator/preamp or adjusting the squelch or RF gain. I use its big sister, the FT897, and got round the preamp problem by setting up one VFO with the preamp in, and one with it out.

The Kenwood TS2000, TS480 and TS570D work extremely well remotely and have two HF aerial sockets that may save an external aerial switch. The newer Icom radios are pretty good too. You pays your money and takes your choice! Do check that your chosen radio will come back on after the 12V supply is interrupted: some (like the Kenwoods) can be powered on and off with a CAT command.

You will need a lead to connect the transceiver to the PC serial port (if it doesn't have a serial port, a USB to serial converter will also be needed). These leads are easy to find on eBay or from other suppliers such as G4ZLP.

All I have to say about the 12V power supply is to recommend you choose a good one and be especially careful if you are considering using a switched-mode type as these will always produce a sprog just where you don't want it! The internal circuitry of the power supply I use seems quite happy to have the UPS backup battery wired straight across it. I set it to 14.2V, which keeps the battery topped up (recharge current being regulated by the PSU's current limit). The battery keeps all the internal systems powered including the router – I might as well enjoy the reduced noise level during a local power cut!

Aerial and tuner.

Again a matter of choice, but as the station may be unattended for long periods, the aerial should probably be built for longevity rather than for ultimate performance. The safety of other users of the remote site is obviously paramount so don't be tempted to erect any over-ambitious arrays that might come down in a gale. Ensure that all 'hot' parts of the aerial are out of reach. I use a large horizontal loop, an excellent receiving aerial on all bands, and a doublet.

My wire aerials are switched via a vacuum relay onto an auto-tuner housed in a box as near to the feed points as I can get it (**Photo 5**). Coax and power leads run underground from the tuner to the radio. Many rigs these days have built-in tuners but unless you have a trap-dipole or a similar multi-band aerial, you will find that these tuners are not usually capable of matching a non-resonant aerial on all bands. It's preferable to use an outboard tuner with a wider matching range mounted as near to the aerial as possible.

As the FT897 has VHF and UHF I have also erected a dual-band collinear. Most multiband transceivers have a separate socket for the VHF/UHF aerial so no extra switching is required.

Next month we will look at how to configure the hardware and software to get the system up and running.

PHOTO 5: The ATU in its tree-mounted box with the lid removed. The aerial relay is inside the pepper carton.

Remote operation

Part 2 - setting up your remote station

SETTING UP THE SYSTEM. The first thing to do is to start with the laptop computer. Re-format the machine and re-install Windows 2000 or XP, update it, then turn off all Windows auto-updates and get rid of any unnecessary programs. A useful utility to stop these loading is Starter by CodeStuff, but there are many other start-up managers available. Disable any hibernation or standby options but allow the screen to be shut off after a short while – after all, no-one is going to be looking at it! Allow the PC to boot straight into Windows (no login screen) so that a forced re-start will result in it all coming up. Set up the BIOS to disable shut-down when the laptop lid is closed. (Although I did this on my Dell, it still won't restart with the lid closed. I have propped it slightly open with Lego bricks as can be seen in Photo 2. Some laptops have a small plastic stud on the lid that operates a micro-switch when it closes. Cut it off!)

I don't run an anti-virus program on my remote PC because the updates kept causing problems; if anti-virus software isn't updated there's no point in having it. As the usual route for viruses is via browsing and e-mail (and you won't be doing that on an unattended remote PC), you should have no problems. If you feel you must have anti-virus software then try *Clamwin*. It's free and doesn't cause as much trouble as most of them.

On your main shack PC install *Hamachi* and create a network with a suitably impenetrable password. Next, install *Hamachi* on the remote PC and set it to run as a system service. This means that as soon as the PC has booted it will be running. Join your new network.

Now install *Ham Radio Deluxe* (HRD) on both PCs and set the HRD remote server to run on the remote PC. This is accessed from the Remote button on HRD's tool bar. You must set it up by editing the config file, in which you specify a user name and password, then set it to run. You will notice that there is a second serial port server that can be used for controlling additional remote equipment such as a rotator. You can then close HRD itself and the server should stay running. This can be checked by running *Starter* and making sure 'HRD remote server' is ticked.

PHOTO 2: Lego® bricks are great for propping the laptop lid open.

Connect your radio to the remote PC with the appropriate CAT lead and check that you can control it directly by running HRD on the remote PC. There are quite a few parameters to set up; speed, COM port etc so it's wise to take it one step at a time. If that works OK, quit HRD and run it on the shack PC. If the connection box isn't already on the screen, select Connect (top left). Choose a New connection and select the type of radio and the serial link speed. Choose Remote as the COM port. Next hit Connect and in the New Connection boxes, enter the *Hamachi* IP address of your remote PC (starting with a 5), the user name and password of your remote HRD server and leave the port setting at 7805. Then select Connect just underneath. You should get the welcome message that you set when configuring the HRD remote server. Hit OK. Some more COM port options then pop up. Un-check the optional PTT port box if you aren't using it and select the COM port that your remote PC uses to connect to the radio. Just one more "OK" button to press and you should get the HRD rig control screen and be able to tune your remote radio. This sounds like a convoluted procedure but you'll soon get used to it. HRD comes with a comprehensive manual on a PDF file, so if you have any trouble, please refer to that!

CONNECTING THE SOUND. Computers are generally pretty 'dirty', with all sorts of noise currents flowing in and out of every socket. The best way to prevent all this buzz and hum getting onto your audio lines is to isolate them with audio transformers. They will also reduce the likelihood of RF finding its way into the sound card. Suitable 1:1 transformers are available from many suppliers including RS and CPC but they can be pricey (about £10 each). If you are on a tight budget you should be able to find useable transformers in surplus equipment such as old transistor radios.

FIGURE 3: The Hamachi window with the "Create or Join Networks" dialogue box open.

The computer's headphone socket should be connected, via an attenuator and transformer, to the microphone input of the rig and, if so desired, to the mobile phone. I recommend using the radio's mic input because it allows use of the speech processor and VOX facilities, which usually don't work from the auxiliary audio socket.

The radio's audio output is best taken from the auxiliary, or accessory socket as it is unaffected by the volume control, so the levels should stay constant. Another transformer and attenuator are needed to feed the receiver audio into the mic socket of the PC. I have shown some resistor values for the attenuators but these may not be exactly right for your rig and sound card. Some experimentation will be needed. Of course, it would also be possible to use a commercial interface such as a 'Rigblaster' to interconnect the radio and the PC. Some of these devices come complete with the CAT control cables.

Install the *IP Sound* software on both PCs. On the remote PC it should be set to run on Windows start-up (Starter can be used to do this). With *IP Sound* as the active window, pressing CTRL-P brings up a properties box with various options; under the Access tab tick Auto answer and under the Sound tab select your inputs and outputs. Select G711 *μ*Law 8kHz as the sound codec.

On the shack PC you don't need auto answer but the inputs and outputs and the codec should be set. With the *IP Sound* window active, press the Insert key on your keyboard and the Client window will open. Here you enter the IP address of your remote PC (which will start with a 5). You can enter

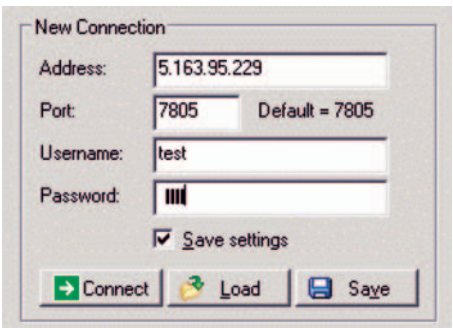


FIGURE 4: Part of the HRD remote login window. Here you enter the remote station IP address, username and password.

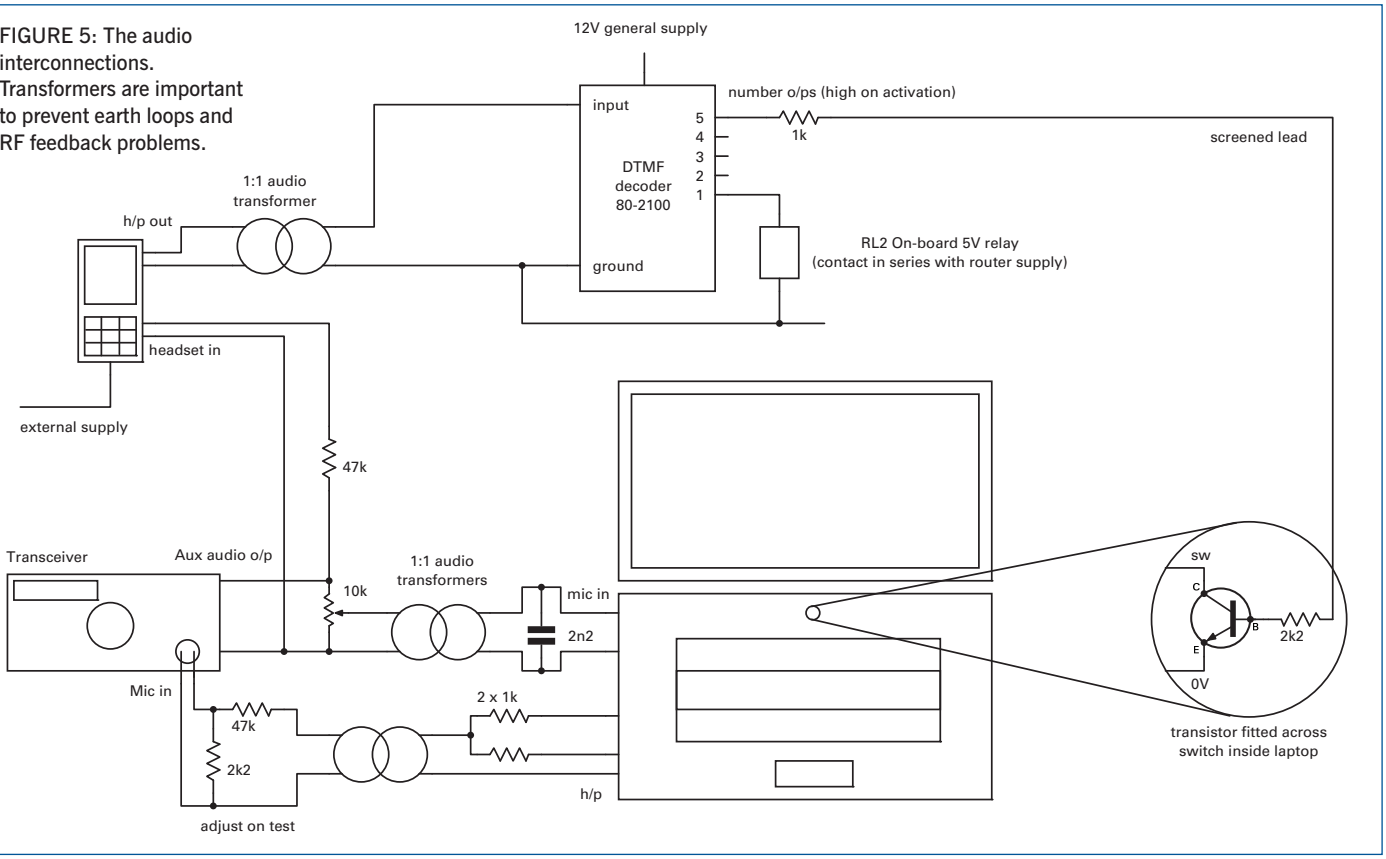


FIGURE 5: The audio interconnections. Transformers are important to prevent earth loops and RF feedback problems.

a name for it such as "G3QQQ Remote" in the Name/Host box and click "Add". The remote should now appear in the *IP Sound* main window with a green box next to it. If it's a red box the connection is not available, so check your set-up.

Assuming you've got a green box you can click on the name of your remote and hit the Play button to establish the two-way link.

I mentioned the audio codec G711 μLaw 8kHz earlier. This comes with *IP sound* and I have found it to be the best compromise between bandwidth and quality. The 8kHz referred to is the sample rate, giving nearly 4kHz audio bandwidth and, due to the 14 bit non-linear sampling it uses only 64kb/s in each direction. If I were to leave it running all day it would transfer just over a gigabyte of data. However, with my 15GB limit I can't afford to do that all day every day. Other useful codecs are the 'PCM 8kHz mono', which is about 128kb/s in each direction and the 'GSM 8kHz mono' codec, which can be used if the link is really bad. At only 16kb/s each way, it delivers acceptable voice quality but sounds terrible on CW. If you have unlimited bandwidth to play with, *IP Sound* will go up to full CD-quality stereo.

AUXILIARY CONTROLS. It is obviously desirable to be able to switch aerials, turn the system on and off and all sorts of other things to make your remote station more versatile. There are many ways to achieve this, such as relay cards accessed by a serial or USB port, or even a mini 'home automation' server such as the *NETIOM* on the remote network. The system I use is not ideal but I offer it as a basis for experimentation.

A free program called *Lalim Parallel Port Control* can be downloaded from its author (search for "Lalim software"). This gives control of the 8 data lines of the remote PC's parallel printer port. The help file provides interfacing information. With this you can easily operate up to 8 relays (or 255 if you decode the 8 bits!) and it is supposed to work over a network. I have had problems using the free version over *Hamachi* under XP but it seems to function under Windows 2000, if anyone can work that one out I'd be interested to know why!

All is not lost if you can't make it work remotely, as once you have your *Hamachi* network up and running you can use a VNC (Virtual network Control) program like Real VNC to control the remote PC as if you were sitting in front of it. Thus you can switch relays with Lalim by ticking the boxes on the remote desktop. Of course this allows you to do any other admin jobs on the remote PC such as re-starting various programs. Remember to set up the VNC server on your remote PC to run as a service.

HRD includes a second serial control channel that can be used for various things such as Winkeyer (to enable remote CW operation), serial rotator control, or any other device that can operate over a virtual serial port.

NICE TO HAVES. With a PC at the remote end you can extend the system as much as you like. Add a web cam or remote weather station if you want – the possibilities are endless.

A useful belt and braces backup I use is *Logmein* from the people who distribute *Hamachi*. This is another way of controlling the remote PC from any other PC and has got me out of trouble a few times. For instance, on rare occasions *Hamachi* may fail to connect to the network and just sit there reconnecting; on another occasion *Hamachi* might come up in Power Off mode after a crash re-start. *Logmein* allows me to re-start *Hamachi* and get the system up and running

FIGURE 6: The *IP Sound* main window. 'New Laptop' is online and has a green icon, but 'Fred's Laptop' is offline.

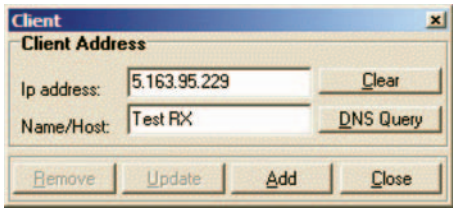
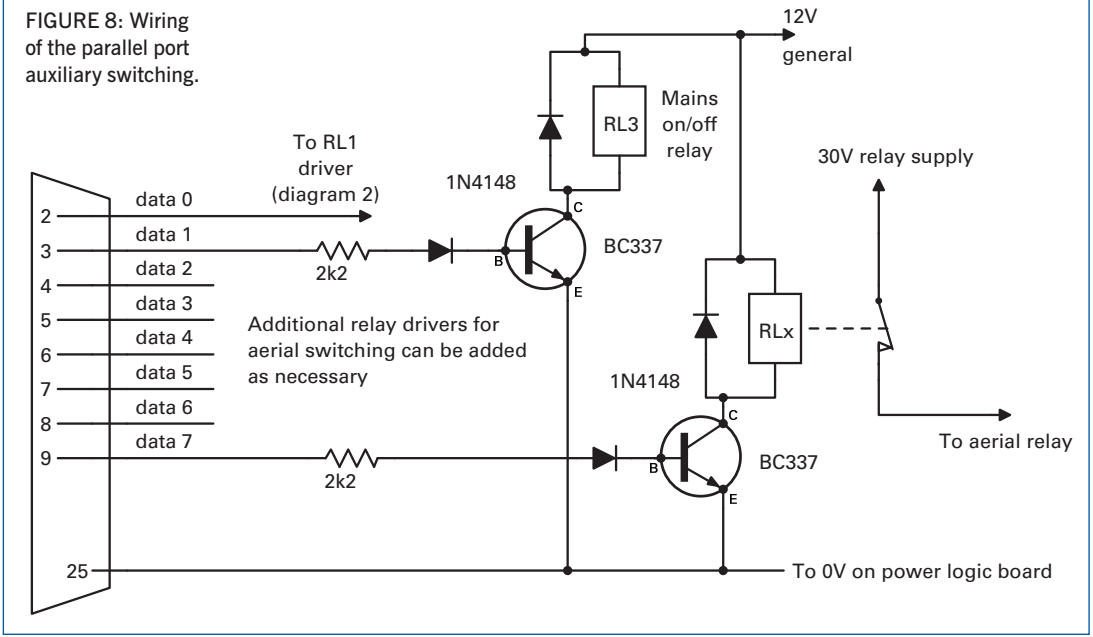


FIGURE 7: The *IP Sound* Add Client window, accessed by pressing the Insert key. You can right-click a network member in *Hamachi* and 'Copy address', then paste it into the IP Address box. Then add your own name for it in the Name/Host box.

again. It is also free for non-commercial use. *Logmein* does, however, eat bandwidth and that's why I don't use it to, say, directly control HRD on the remote PC.

MORE INFORMATION. To whet your appetite and help you set up a system I have put a receiver on a Hamachi network called 'REMOTE-RADIO'. If you join this network (password is "test123") you will be able to hear my Icom IC735 on *IP Sound* using the G711 codec, and control it with HRD. The HRD settings are: remote port COM4, speed 9,600 and tick both RTS and DTS boxes. Username and password are both "test". The IC735 will not TX so it's really just a remote receiver, not an amateur station, and anyone can use it. It is in Birmingham and connected to a Wellbrook wide-band loop. The network is limited to 16 users so please "Leave network" when you have finished testing. I will leave it running for a couple of months.

FIGURE 8: Wiring of the parallel port auxiliary switching.



Many people have trod this way before. *RadCom* ran a series of articles by G3UEG in 2005 and QST covered the subject as early as 2001. One of the authors of those QST articles is still developing software and has come up with some interesting alternatives at www.W4MQ.com.

There is also a Google Group called "Amateur Radio Station Remoting" which is frequented by many experienced amateur remote operators. Good luck!

Thanks to Mark G4FPH for his help and advice in the preparation of this article.