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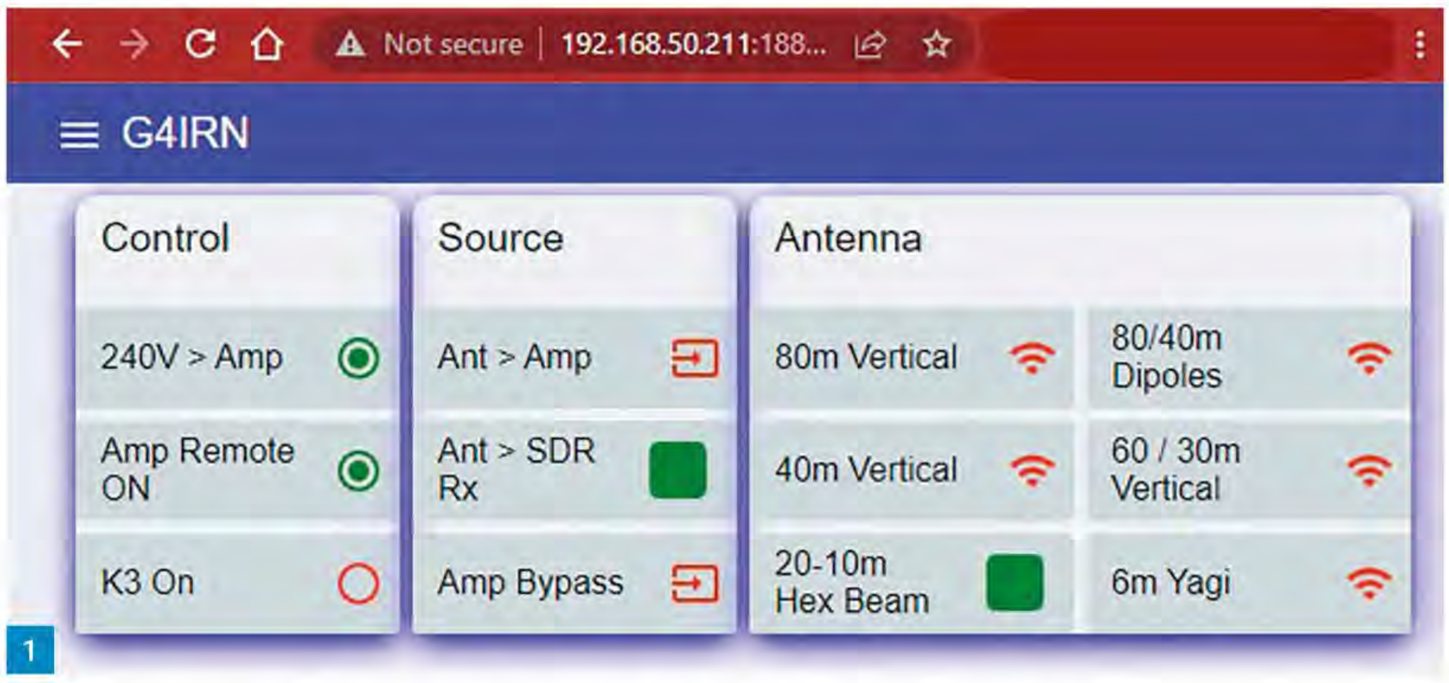

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Tips for Building a Remote Station

John Warburton G4IRN shares some ideas about how to set up and operate a remote station.

Modern connectivity and radio technology make the prospect of operating remotely a real possibility for radio amateurs. Being able to access a home station when travelling, accessing a friend's station, or building a station at a quiet rural location – there are lots of permutations but there are similar, underlying technical challenges needing consideration.

Following a house move two years ago, I decided the best way to have a reasonable HF DX and contesting station was to build a remote station away from home. After lots of hard work, I now have a station consisting of two radios, an amplifier, tower, various antennas and rotator, all operated by controls and switches over the internet and 4G (at the remote site), which essentially means I can operate from anywhere in the world. However, there is no single solution for remote operation and this article provides an overview of possibilities.

The first consideration when operating a remote station must be the licence conditions. The applicable rules will be those of the country where the remote station is located; you will need a valid callsign for that country. Note that CEPT does not allow the use of your callsign in a member country unless you are physically present, so that is not an option.

Essentials

Power and connectivity are needed as a minimum. A remote kill switch on the radio's power supply is essential and there is a wide choice of internet switches to choose from – just make sure you don't put the network equipment (providing connectivity) on the same kill switch as the radio equipment. Internet and 4G are widely available around the UK. However, there are two important factors to consider: network latency (delay) and network jitter (the variation in latency). Latency can cause Morse characters or spoken words to be missed on transmit changeover while jitter tends to cause momentary dropouts on the audio stream, therefore the audio stream needs to be buffered.

A point-to-point radio link is of course another option, though more complex, but do check your licence terms. Depending on the use, a network latency of 100mS is just about acceptable if the variation (jitter) is not too great, however the FT* modes are more forgiving since there is a pause between transmissions.

Controlling the radio

IP (Internet Protocol) devices, usually with an Ethernet port on the rear, are the easiest to operate remotely – they have an IP address and with some basic networking knowledge, remote operation is made easy. This is why the Flex radios have proved popular among the remote operating community. However, most of us still live in a world of serial ports, USB ports and analogue audio streams, so remote operation is more challenging.

For remote control there are several radio functions that need to be fulfilled, e.g. power on/off, frequency control, audio in, audio out, PTT and CW (e.g. Morse code keying). Most modern radios have a serial port and use a CAT protocol to provide control.

To operate the remote radio most users will either use a detachable, physical front panel, or a software 'soft-panel' on a PC. Dedicated front panels include the Flex Maestro, Icom IC-7100, Elecraft K3/0 and Yaesu FT-857 to name a few. Some radio manufacturers provide programs to remote control their radios, e.g. Yaesu SCU-LAN10, Icom RS-BA1, Flex SmartSDR etc. and there are several very good third party programs around too, e.g. HRD, Win4IcomSuite and Win4K3Suite for instance.

If you have a remote head for the radio, it will be likely to access the radio via Ethernet (with an IP address connected over the Internet) or there will be a serial port connection. For the latter, the Microbit 'Remote Rig' units have proved very popular; these days they are in short supply but there are alternative approaches to be explored.

Connectivity

Depending on your requirements, the general rule to operating remotely is transfer as little data as possible. If the radio does not provide IP connectivity (i.e. no Ethernet port), then the control-side 'soft-panel' running on a PC will usually need to connect to the radio via a serial port. This presents options:

Run a PC at the radio-side connected directly into the radio and use remote desktop software to access it from wherever you are, e.g. Google Desktop, AnyDesk, VNC, Team Viewer. You could also run your logbook, data-modes software (e.g. WSJT-X) and rotator control software etc. on the same PC, all accessed via the remote desktop program. Some remote desktop programs will transfer audio each way too, so voice modes can be used with a PC headset at the control side. This approach is the most favoured due to its relative simplicity, though CW will be restricted to sending pre-defined Macros or keyboard typing.

Run a PC and 'soft-panel' radio at the control-side and use 'serial port over IP' technology to connect to the radio. This will work but may present the challenge of transferring audio, PTT, radio on/off control and CW if required.

When the station increases in complexity, additional controls may be required, e.g. amplifier and rotators are often controlled by serial port or USB. Serial port over IP is addressed below but USB over internet can be more challenging – 'USB over Ethernet' software exists but I have not explored it; most people control USB devices through a radio-side PC and remote desktop software.

Read more radio news and reviews at www.radioenthusiast.co.uk/news

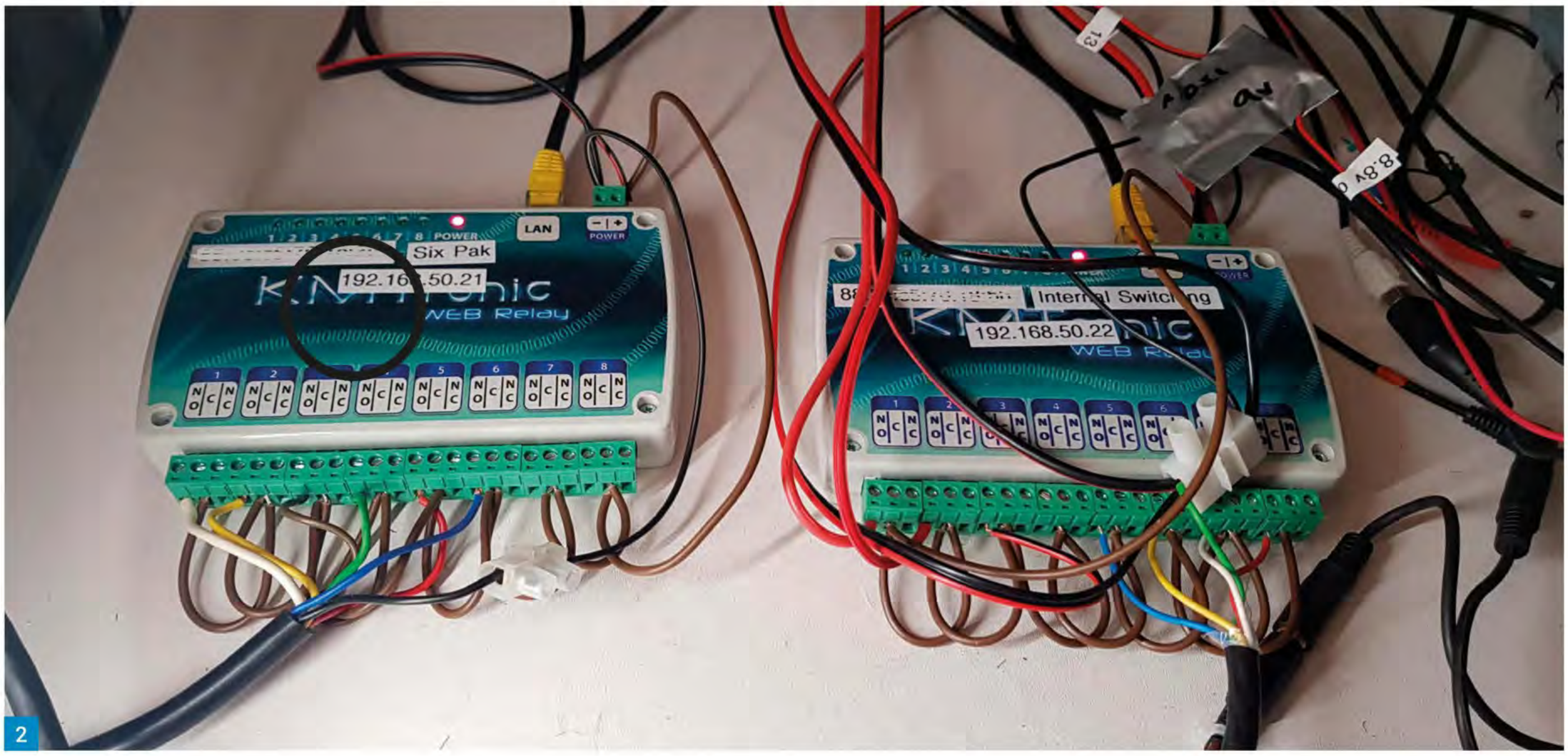

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Photo 1: Node Red dashboard.
Photo 2: Relay board.
Photo 3: G4IRN remote antennas.
Photo 4: G4IRN remote shack.

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Serial port over IP

To remotely access serial ports on the radio, rotator and amplifier I use two PUSR N510 Serial Port Servers but similar devices are available from other manufacturers. Programs such as VSPE by Eterlogic can provide a software client/server arrangement between the remote PC and the control PC, however I have not tried this over a remote link.

Audio over IP

If your radio and software solution do not transfer audio, then potential solutions can be found using Windows or Raspberry Pi programs at each end of the link. 'Remote Audio' by DH1TW is excellent and has very low latency, although a little technical to install. 'RemAud' by DF3CB is easy to install but comes with noticeable latency. Other low latency VoIP (Voice over IP) programs are available.

CW and keying

Character timing is essential for coherent Morse code. Remote links with network latency and jitter do not lend themselves to accurate transfer of CW, this is why many remote operators use remote desktop and send CW macros or typed CW from the radio-side PC. Potential solutions (not tried here) for hand sending CW from the control side are the WKRemote application by K1EL and RemoteCW by DF3CB; both use the K1EL WinKey device. These and other possibilities are listed under weblinks.

Switching

Aside from switching mains on and off, it's likely you'll want to enable PTT, switch antennas and devices on and off. For example, many radios have a remote On/Off socket at the rear. I've found the best approach is to use web-enabled relay boards like those available for the Raspberry Pi – these can be switched through a web interface at the control side, though as the station becomes more complex, dedicated and larger web-relay boards might be preferred.

Station dashboard

It helps to have a consolidated view of station controls and status. Node Red is a free programming framework using drag and drop functions to build automated process flows. It takes a little learning but there are lots of videos available on YouTube and a dedicated Groups.io email reflector for amateur radio users.

Overcoming 4G restriction

4G operators often use 'Carrier Grade Network Address Translation' (CGNAT). In these situations, a public IP address is not available to the user. If the remote station is using 4G, there are a few work-around solutions based on VPN software to overcome this, e.g. ZeroTier, TailScale and SoftEther are solutions I am aware of.

Top tips

- Document everything you do. When your radio is remote, it is 'out of sight and out of mind' – I guarantee you will forget how things are connected!

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- Minimise data transfer, e.g. better to decode data modes at the radio side than transfer the audio stream and decode at the control end.
- Choose your radio carefully if bandwidth is limited or costly. Spectrum displays consume lots of data.
- Remote CW is tricky – Remote Rig units provide a good solution but there are other solutions based on K1EL's WinKey or Arduino.
- The radio-side PC should always start up after loss of power or use 'wake on LAN' (BIOS settings).
- Don't put the network hardware on the same kill switch as the radio.
- Ideally, the radio side should regularly check for internet connectivity and reboot the router if lost.
- Network 'jitter' must be acceptable – check before you spend.
- Some remote desktop software is more reliable and less data hungry than others – I use TightVNC.
- Apply enhancements in small steps – big changes at a remote site often lead to return visits.
- Connect radio side and control side to the same NAS or Cloud storage drive so data is easily transferred.
- Never forget the risks to safety when at a remote site alone – I always share my location on WhatsApp with my wife.
- Remote operation gives a new perspective to our hobby - in my case I wanted more space for antennas but the option to operate while away from home or the prospect of lower noise may be an incentive for others to try this approach.

Websites

I am not particularly endorsing any of these products, use them at your own risk.

PUSR Serial Port Servers:
https://tinyurl.com/mryufa9t
Microbit Remote Rig:
www.remoterig.com/wp
Remote Audio by DH1TW:
https://github.com/dh1tw/remoteAudio
RemAud by DF3CB:
https://df3cb.com/remaud
K1EL WinKey:
www.k1elsystems.com/keyers.html
NB Winkey emulators are available from G4ZLP:
www.g4zlp.co.uk/unified/DigiMaster_CW.htm
K1EL Remote Control program:
https://hamcrafters2.com/WKremoteX.html
Remote Morse Key by IW7DMH:
https://tinyurl.com/3kmhyz5c
Local CW Keyer for Remote Keying:
https://tinyurl.com/39d8x4xv
RemoteCW by DF3CB:
https://df3cb.com/remotecw/documentation
Node Red email reflector:
https://groups.io/g/nodered-hamradio
Node Red tutorials by AA0Z:
www.youtube.com/@AA0Z/playlists

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