What is that CONFIG_HAMRADIO thing anyway ? - A Linux users guide to Ham Radio

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Abstract

This paper presents Ham Radio/Amateur Radio in a context that is relevant to Linux users. An introduction to the hobby, its origin and an overview of current areas of experimentation is provided. A quick tour of Linux/Open Source software of relevance to ham radio is presented. The emphasis is helping non-hams understand the hobby rather than hams understanding Linux though it is hoped this paper will benefit both groups.

Contents

1 Introduction

Ham Radio is about hobbyist experiments with radio. This experimentation takes many forms, seeing how far a signal can travel, building antennas, building radios, trying out new modulation modes and having some fun along the way.

In this paper the terms Ham Radio and Amateur Radio are used interchangably. One could argue that "Ham" is more common in North America. What follows is just one perspecitve on the hobby and the things that make it interesting.

2 History

Ham Radio can trace its roots to the earliest days of radio experimentation. Marconi, Hertz et. al. were the earliest experimenters and inventors in the field and could (perhaps at something of a stretch) be considered the first "hams". Amateur radio was first recognised by government agencies in the early 1900s when it became possible to apply for an experimental radio license. This in time turned into a specific Amateur Radio license for non-professional, non-broadcast oriented operation. More rigorous treatments on the history of the hobby abound on the web.[1]

3 The Cooks Tour

Like any hobby, Ham Radio has it's own jargon, terminology and quirky bits. To assist the reader in making sense of later sections a tour of same is provided.

3.1 Callsigns

Amateur callsigns follow an international convention whereby the prefix is based on letters/numbers assigned to the country, the remainder of the callsign by local regulation. For example, Australia is assigned the prefix group VA-VZ (that's why our aircraft have callsigns VH-XYZ) - Amateur licenses are allocated VK. The third digit is a number corresponding to the state of operation (0 - Antarctica, 1 - ACT, 2 - NSW, 3 - VIC, 4 - QLD, 5 - SA, 6 - WA, 7 - TAS, 8 - NT, 9 - Islands). The remaining two or three characters are letters according to the class of license. My callsign (VK1YYZ) identifies me as being in the ACT and holding a "Limited" license (VHF bands only)

[1] This site at the ARRL web page is just one example `http://www.arrl.org/tis/info/history.html`

Frequency	Band	Notes
1800-1875 kHz	160m (MF)	Large antennae sizes tends to limit number of active operators
3.5-3.8 MHz	80m (HF)	Popular but somewhat noisy long distance band
7.0-7.3 MHz	40m (HF)	Popular long distance band
14.0-14.35 MHz	20m (HF)	Arguably the most popular HF band
18.068-18.168 MHz	16m (HF)	Underutilised band but great for long distance work
28.0-29.7 MHz	10m (HF)	Last of the "HF" bands, popular for SSB and FM work
50.0-54.0 MHz	6m (VHF)	The "magic band" - good long distance performance at times
144.0-148.0 MHz	2m (VHF)	Popular band for local work, satellite, packet, APRS etc.
420.0-450.0 MHz	70cm (UHF)	Popular for local work as well as satellite, EME etc.
1240-1300 MHz	23cm (UHF)	Relatively little use but popular for higher bandwidth modes
2300-2450 MHz	12cm (UHF)	Shared w/ISM - same frequency range as 802.11 wireless
10.0-10.5 GHz	3cm (SHF)	Top end shared with ISM band
248.0-250.0 GHz	1mm (SHF)	Getting close to light...

Table 1: Sample of Bands allocated to Amateur Service in Australia

3.2 Frequencies and Bands

Hams have particular ranges of frequencies (or "bands") allocated for their use. For the most part the bands are common worldwide (or have reasonable amounts of overlap) and agreed upon by international treaty. Hams will tend to refer to bands by their wavelength such as 70cm, 80m, 40m etc. frequencies being referred to only when the specifics are important to the discussion. Some bands or sections of bands allocated to the amateur service are on a secondary basis, that is to say that hams must accept any interference from other users of the band.

Table 1 has a listing of some of the bands available to Australian amateurs.[2] There are half a dozen or so allocations in the SHF bands not shown - experimentation is done on these frequencies but it tends to be pretty specialist in nature due to the difficulties in fabricating circuitry for such short wavelengths.

3.3 Modulation methods

Modulation is the process of impressing information on a radio signal or carrier. A vast range of modulation techniques exist, most of which will have been tried by ham operators at some point. The more common modes include

- Continuous Wave (CW) - pretty much the original mode of communication and the "proper" name for Morse Code transmission. The carrier is modulated in an on-off fashion by the morse key or an electronic equivalent thereof. For reception by ear still the best mode in weak signal conditions, only bettered by some recent digital modes that rely on computer/DSP techniques, very low baud rates, forward error correction and esoteric but frightfully clever modulation schemes.
- Single Side Band (SSB) - most common for medium and long range communications. Characteristics of the transmitted signal make it particularly suitable for weak signal work. SSB is also the mode most commonly associated with ham radio by non-hams, it's the mode that has the whistling (hetrodynes) and squeaky voices. Used for both voice and data/digital modes.
- Frequency Modulation (FM) - more common for short range communication or working through repeaters. Most prevalent on VHF frequencies (50 MHz and up). In good signal conditions voice quality is similar to telephone but degrades quite markedly if signal conditions are poor. Like SSB, used for voice and digital modes.
- Amplitude Modulation (AM) - less common nowadays but a favourite on the low HF bands (3.5MHz and below)
- Spread Spectrum modulation in it's various forms has long been an area of experimentation on the UHF and SHF/Microwave bands. Undergoing something of a renaissance due to the interest in digital/software defined radio.

[2]Source - Wireless Institute of Australia (WIA) Callbook 2002

3.4 Operating Modes

Hams speak of particular operating modes which can mean the modulation mode in use or what they're doing in a more general sense.

3.4.1 DX

DX or long distance operation is one of the long standing modes of operation for hams. Frequencies of operation range from the low HF bands up to microwave. Within the spectrum of DX operation people may use voice, CW (Morse) or data modes. Stations may use high power (up to 1.5kW or more) or very low power (so called "QRP" operation) - below 5W.

At HF frequencies long range communication relies on radio waves being refracted by layers in the ionosphere allowing the signals to "skip" over great distances. Given the right conditions an operator in Australia can talk to fellow hams literally anywhere in the world. Antennae for HF work can range from simple random wire strung up between two trees through to large directional ("beam") antennas which may have multiple elements up to 20m long each.

At VHF frequencies the ionosphere doesn't tend to refract radio waves to the same degree so DX operation at these frequencies is usually reliant on other modes of signal propagation. Meteor scatter makes use of fortuitous changes to the ionosphere from meteor showers. Aircraft enhancement relies on brief periods when commercial aircraft are between two stations to bounce signals off the aircraft itself or the resulting temperature inversion from the exhaust gas.[3] Earth Moon Earth (EME) uses a mixture of high power, high gain antennae and sensitive receivers to bounce signals off the moon. Satellite operation makes use of man made amateur satellites which have transponders in them similar to commercial satellites in either low earth or geosynchronous orbits.

3.4.2 Voice

Voice is still the most common for ham operators. At one extreme you have people working DX using SSB through to "Rag Chewing" - talking about the weather and other fascinating subjects on FM through the local repeater on the way home from work.

As a weak signal mode voice does reasonably well, the human ear being well tuned to discerning speech in situations where there is a great deal of ambient noise.

3.4.3 CW

CW or Morse Code is the oldest mode of radio communication. It is still popular today both among die hard operators who wouldn't use anything else and newcomers who enjoy the challenge, romance or excellent weak signal performance CW affords.

Morse can be sent in many ways, a simple morse key, a paddle (or bug) which in conjunction with a "keyer" generates the dits and dahs automatically or via computer. Morse is usually received by ear though software and hardware/firmware based decoders are also widely used.

3.4.4 Digital/Data Modes

Digital or data based modes of operation have had their place in Ham radio from well before computers were commonplace and certainly before the Internet. The earliest data mode could be argued to be CW as it is binary in nature but most would consider Radio Teletype (RTTY) to be the first true digital mode. Since anything digital is likely to interest your average Linux hacker Digital/Data modes will be covered in more detail in the next section.

3.4.5 Mobile/Portable/Fixed operation

While not really different modes per se there is variety in how and where people set up their stations. Home or fixed operation is the most common, a corner of a bedroom or spare room/shed forming the ham's "shack" (originally from the maritime use of "radio shack" to mean the radio room on a vessel)

[3] I'm reliably informed that the actual cause of enhancement is a subject of ongoing debate...

Mobile operation is common, particularly on VHF bands and up using FM voice and repeaters. HF mobile isn't as common but there are folk around who even use CW while mobile (though presumably they're stationary at the time...).

Portable operation is popular - this may be as simple as using a small handheld transceiver or as complex as setting up a comprehensive DX station on top of a hill for a weekend contest.

3.4.6 Contests, Records, Honour Rolls & QSLing

There are many organised contests that run during the course of the year. The general concept is to make as many contacts as possible in an allotted time frame - usually these contacts are very brief consisting of a signal report and a serial number. There are CW only contests, mixed modes, HF only, VHF/UHF only etc. etc. Some contests award more points for contacts made from portable or mobile stations, others make no such distinction.

Alongside contests there are various records that are recognised on a local or worldwide basis for such things as the longest distance contact on a particular frequency and mode. For anyone who has dabbled with extending the range of 802.11 wireless links the UHF/microwave records are particularly interesting - the current record for the 2.4GHz band is 3,980km for terrestrial communications and 16,480km for EME.[4] To be fair this is for CW which has rather lower bandwidth and rather higher noise immunity than wireless ethernet...

Honour Rolls are a variation on contests/records - usually they are based on making contact with a certain number of different countries or callsign areas. One of the most well known, the DXCC (DX Century Club) is awarded for contacting more than 100 different countries/call areas. There are variations on the DXCC for contacts all being made using one band or mode of operation, CW or voice only etc, etc.

QSL cards are postcard sized cards that are optionally exchanged between hams to confirm a contact. Information about the frequency, mode, date, time of the contact are included along with (traditionally) details of the station, location etc. Electronic QSLs (such as confirming a contact by email) are becoming more common though these are not yet widely accepted for contests.

3.5 Licensing

Like most uses of the radio spectrum, amateur radio operators are required to obtain a license. There are different grades of license which dictate the frequencies/bands you are able to use as well as the operating modes. To obtain a license it is necessary to sit various exams that cover Regulations, one of two grades of theory and in some cases Morse Code reception though it is expected the latter will be withdrawn in the next few years.[5] The entry level ("Novice") theory exam should be within the capabilities of most people that have a background or hobby interest in electronics with a little revision on radio specific areas.

One of the few things you can't do with a ham license is use it for direct commercial gain, this is one of the basic tenets that distinguishes the hobby from commercial and broadcasting licenses.

4 Data/Digital Modes

Voice, CW and other analogue modes are still very popular. However, for the average Linux user digital or data modes are likely to hold the most interest. As it is based on on-off keying, CW can be argued to be a digital mode however I follow the more conventional view that it's analogue as it's usually received by ear.

4.1 Radio Teletype (RTTY)

Teletype is one of the oldest digital modes of communications, dating back to the early 1900s. Radio Teletype[6] seems to have originated around the 1920's though it did not become popular in Ham circles until the fifties or so. Early Ham Radio RTTY experiments made use of mechanical teletypes and were operated at 45 baud on HF frequencies using Frequency Shift Keying (FSK).

[4] Source G3PHO's site at `http://www.g3pho.free-online.co.uk/microwaves/records.htm`

[5] Andrew Davis' Australian Amateur Radio FAQ `http://members.ozemail.com.au/~andrewd/hamradio/hamfaq.html` is an excellent source of information on licensing and most other facets of Amateur Radio.

[6] `http://www.rtty.com`

RTTY is still in use today both in ham and commercial circles. It is one of the easier modulations to decode and there various Open Source packages that will do so - these will be covered in more detail in the next section.

4.2 Packet Radio (aka AX25)

Amateur Packet radio first saw the light of day in Montreal, Canada in 1978.[7] The AX25 (Amateur X-25) protocol[8] was quickly accepted as the standard protocol. The Vancouver Amateur Digital Communication Group (VADCG) developed a Terminal Node Controller (TNC) in 1980 which was built upon by the Tuscon Amateur Packet Radio Group[9] and others to arrive at the so-called TNC-2 standard used today. The TNC was designed to sit between a radio (usually an FM transceiver operating in the 2m band) and a dumb terminal or computer. These early TNCs were based around the Z-80 CPU and included a 1200 baud modem (7910 chips then TCM-3105 devices) and the required software stack for AX-25 protocol and various application layer functions. The availability of TNCs caused quite a flurry of activity despite the low (by today's standards) transfer rates. Bear in mind this predates widespread access to the Internet, the WWW and pervasive email by nearly ten years.

Hams rapidly set up packet radio networks that incorporated hierarchical addressing schemes so that packet messages could be sent over large geographical areas. In addition to real-time keyboard to keyboard communication, most TNCs incorporated a rudimentary mailbox system such that you could connect to a friend's TNC and leave a short message. In much the same way as we check for email when returning home today, in the mid-80s you'd stick your head into the shack to see if the yellow message LED was blinking. Cool stuff.

Bulletin boards became quite popular too, these were usually DOS based in the early days with JEAN-PAUL ROUBELAT'S famous F6FBB[10] package being by far the most popular.

Digipeaters became quite common allowing a station to connect in "realtime" much further afield. On a good day you could connect from Melbourne to Sydney entirely over the packet network. RTTs were pretty long though...

1200 baud is still the most common data rate today as it's easily accommodated on a standard FM channel and transceiver audio path. Standards exist for 4800, 9600 and higher speeds with a commensurate increase in the channel bandwidth required. Higher baud rates usually require modification to the transceiver itself to avoid the signal shaping done for voice by some radios.

TCP/IP has also been used with AX-25 as the transport layer. PHIL KARN'S KA9Q NOS package was in widespread use and was also one of the first implementations of TCP-IP on small systems.[11] Quite large packet based TCP/IP networks were built using the 44.0.0.0 class A network assigned to the Amateur Radio service worldwide - no packets were routed on/off the Internet to the 44 network however. There is also an ampr.org domain for ham use.

4.3 APRS

APRS(Automatic Position Reporting System) was developed by Bob Bruninga, WB4APR.[12] It makes use of the AX-25 broadcast frame to encapsulate position and other tactical/realtime data in a single packet which is transmitted as a broadcast packet. What this amounts to is that by combining a GPS receiver, 2m FM transceiver and an APRS encoder you can broadcast realtime status information for tracking vehicles and the like. This can be rather for fun [13] as well as being very useful when coordinating vehicles in civil emergency situations (this being one of the catalysts for APRS development).

A worldwide network has been set up that makes use of the Internet as a backbone and allows realtime APRS data to be gated from local radio channels to central servers that can be queried or connected to over TCP/IP[14]

As an aside, Bob Bruninga also oversaw the development of PC-Sat - a low cost Amateur Satellite that digipeats APRS data and by nature of it's low earth orbit can be accessed from quite modest equipment (5W

[7] `http://www.tapr.org/tapr/html/Fpktfaq.html`

[8] AX-25 is pretty much X-25 with larger address fields to allow a standard amateur callsign represented in ASCII to be used with room for a four bit Sub Station ID (hence VK1YYZ-1, VK1YYZ-15 etc.)

[9] `http://www.tapr.org`

[10] `http://www.f6fbb.org/`

[11] `http://people.qualcomm.com/karn/code/ka9qnos/`

[12] `http://web.usna.navy.mil/~bruninga/aprs.html`

[13] See where my car is - `http://www.findu.com/cgi-bin/find.cgi?VK1YYZ-7`

[14] try 'telnet aprs.net.au 10151' and/or software like Xastir - `http://www.xastir.org/`

handheld radio and small vertical antenna for example). It's antennae were constructed out of measuring tape blades.

4.4 PSK31

PSK31 is an increasingly popular mode for HF work. It stands for "Phase Shift Keying, 31 baud" but this really only tells part of the story.[15] Suffice to say it's proving very popular for long distance digital communications. You're not going to use it to pull down the latest Debian ISOs but for keyboard to keyboard work it takes some beating!

4.5 Amateur Satellites

The amateur fraternity have a long association with space. The first amateur satellite, OSCAR-1,[16] was launched in 1961 as a piggyback to a USAF satellite launch. This satellite like all amateur satellites was designed and built by hams and funded by donation. OSCAR-1 was a very simple device weighing some 4.5 kg and having a single antenna and battery powered transmitter that sent "HI-HI" in morse code on the 2m band. The speed at which the morse was transmitted varied according to the temperature of the SV forming a crude telemetry system. The transmitter output was a mere 140mW which drained the (non-rechargable) batteries in around 3 weeks. By that time more than 570 amateurs in 28 countries had reported hearing OSCAR-1.

Modern "AMSATS" are rather more sophisticated and include such things as:

- Computer control of major SV parameters which can be accessed by ground based controllers.
- Attitude and orbit control systems.
- Packet or data capable transponders that can operate in a store and forward or digipeater capacity.
- Earth pointing cameras.
- GPS receiver systems for space borne GPS experiments.
- Packet BBS.
- Smart transponders that can limit the amount of downlink power allocated to strong signals. Most AMSATs have several combinations of uplink/downlink frequencies.
- Sensitive receivers and relatively high power transmitters permit operation with some AMSATS with quite modest stations.

The International Space Station has a permanent APRS digipeater system as well as a modest ham shack so that astronauts that have their ham license can operate from space. It is also quite common for hams to be operational on Shuttle missions. Both these activities are coordinated by SAREX - Space Amateur Radio Experiment.[17]

A couple of pertinent URLs - AMSAT-VK `http://www.physics.usyd.edu.au/~ptitze/amsatvk/` and AMSAT-NA `http://www.amsat.org/`

4.6 IRLP

Internet Radio Linking Protocol[18] is a system developed by DAVID CAMERON, VE7LTD that allows voice band ham repeaters to be linked via the Internet. In Australia most repeaters linked by IRLP are in the 70cm FM band which has added a whole new facet to the morning drive in to work. It is not uncommon to hear local hams chatting with other stations on the other side of the world. For hams that are unable to operate on the HF bands this is quite a boon - I've had chats with people in Ottawa, Chicago and San Jose on the way in to work of a morning.

[15] For the complete story... `http://www.psk31.com`
[16] For Orbiting Satellites Carrying Amateur Radio
[17] `http://sarex.gsfc.nasa.gov/`
[18] `http://www.irlp.net`

4.7 Software Radio/Software Defined Radio

JOSEPH MITOLA III coined the term "Software Radio" in 1991 and defines it thus;

> A software radio is a radio whose channel modulation waveforms are defined in software. That is, waveforms are generated as sampled digital signals, converted from digital to analog via a wideband DAC and then possibly upconverted from IF to RF. The receiver, similarly, employs a wideband Analog to Digital Converter (ADC) that captures all of the channels of the software radio node. The receiver then extracts, downconverts and demodulates the channel waveform using software on a general purpose processor.[19]

What this means in practice is moving the digitisation process (or digital to analogue in the case of a transmitter) as close to the antenna as possible then doing all the demodulation and other clever things in software. In some respects this is an extension of what has happened with conventional telephone modems which moved from being a predominantly analogue device to more or less completely DSP based around the time rates greater than 2400 baud became commonplace.

The availability of cheap, high (computationally) powered processors has made software defined radio practical for even the home experimenter.

4.8 Others

There are many other modes of Digital/Data operation, too many to cover here in this overview. Google is your friend if you want to learn more.

5 Equipment

A basic ham station may consist of nothing more than an antenna, radio and associated cables. Like most hobbies there is a myriad of options available to fit different areas of interest, budget and the amount of room in your back yard. New versus secondhand, purpose built commercial gear versus "homebrew", basic versus sophisticated. There are many sites on the web that discuss all of these facets and more but a quick overview is in order.

5.1 New versus Secondhand

A good market in secondhand equipment exists and for the most part a 10 year old radio will perform just as well as it's contemporary equivalent just with less flashing lights or sophisticated features. It's worth enlisting the assistance of an experienced ham if considering secondhand gear - there are some dogs out there as well. Your local ham radio club is a good starting point here,[20] they may even run local classifieds or buy/sell nights. If you're based in Australia, the website run by VK2CA[21] is a great starting point for classifieds, in my experience.

If you're at the dipping your toe in the water stage secondhand can be a good way to go even if you just want to listen to begin with. It is legal to own transmitting equipment if you don't have a license provided you only use it to receive. Penalties are quite severe (AU$10,000 fines and more) for illegal transmission - in short, don't.

Surplus commercial equipment (e.g. ex-taxi two-way radios) can be a good buy too as they can often be re-programmed or re-tuned to suit ham bands. Newcomers will definitely need guidance here but don't be put off by the fact that these sorts of radios look quite utilitarian - their performance is often very very good indeed.

5.2 Radios

Your choice of radio will be dictated by your area(s) of interest and class of licence you have (or intend obtaining). If your interest is mostly in talking to local hams on VHF or data modes a modest handheld (walkie-talkie) style unit may be a reasonable starting point, these can be obtained secondhand for AU$200 and up, new starting at around AU$350.

[19] `http://ourworld.compuserve.com/homepages/jmitola/whatisas.htm`
[20] The Wireless Institute of Australia website maintains a list of clubs organised by state here `http://www.wia.org.au/aushams/`
[21] `http://www.vkham.com/`

Units designed for mobile operation can be pressed into service in a base station situation as well - you'll need to provide a suitable DC powersupply (13.8V @ 5A or more) again these can be purchased new or secondhand for HF, VHF and UHF bands.

There are many different options for home or base station radios as well. Some contemporary transceivers cover all the bands from 160m to 70cm and have so called multi-mode capability (SSB, FM, CW, data, etc.) Older base station rigs are still quite usable though you need to be wary of units that have valve finals as these can be somewhat temperamental for the uninitiated.

Many people still homebrew their own equipment, this can range from basic low power CW (Morse Code) transceivers through to exotic software defined radios.[22] If you're interested in the electronics side of things and are handy with a soldering iron this is a great way to go. Not so good for folk desiring instant gratification though...

5.3 Antennae

Like the choice of radio, your choice of antenna will depend on areas of interest but also the environment you want to operate from. Like choosing a radio soliciting advice from other hams in your area is well worthwhile.

For mobile operation the most common antenna are vertical designs that differ in the method of mounting and operating bands. Assuming you're wanting to operate only on the VHF/UHF bands a simple quarter wave vertical mounted in the middle of the roof is very effective. Magnetic mounts and other no-hole options are available if you don't want to drill (which is most often the case!). I've had a very good run with a through glass antenna similar to those used for mobile phones.[23]

For base station or home use your options are many and largely dictated by what your circumstances allow. If you're on a residential block long wire antennas are usually an option, depending on your neighbours and council planners 30ft towers may also be OK... If you're in an apartment your options are reduced somewhat but there are many people who have worked the world from small antennae on their balcony or strung up on a window. Once again some research on the web will turn up many options.

5.4 Feedline

Feedline is the term used for the cable between an antenna and a radio. In most cases this is a coaxial cable similar to that used for TV antennae and 10-Base-2 ethernet. Open wire or ladder feed is also used under certain circumstances but these are somewhat specialised.

You will need some amount of cable between your rig and antenna. If the run is short say two or three metres then the choice of cable doesn't become critical until you start getting into the higher frequencies (say 430MHz and up). If your run is more than this you need to consider the cable type a little more carefully.

The basic problem is signal loss, particularly at VHF frequencies and above. Coaxial cables are lossy such that the humble RG-58 coax as used for 10-Base-2 ethernet is losing around 3dB for a 10 metre run at 430MHz or nearly 7.5dB at 2.4GHz (important to note if you're doing wireless LAN work). If you're trying to receive signals that are even a little bit on the margin this sort of loss reduces your ability to resolve the signal correctly - a nuisance for data modes in particular. It is fair to say that a loss margin like this is sufficient to make the difference between getting a contact and not.

At HF things are a little more benign so for 10 metre runs at (say) 14MHz you're not losing much. That said RG-58 still isn't held in particularly high regard for HF due to it's (comparative) fragility and low power handling capability.

Some rules of thumb then are:

- For temporary installations or short runs up to 2m/144MHz, RG-58 is OK, RG-8 (higher diameter) is better.
- RG-8 should be considered a minimum for permanent or high power HF work and 2m/70cm work of any kind where cable runs exceed a few metres.
- Permanent installations or low signal strength setups for VHF/UHF should consider using more exotic cables such as LMR-400 for runs over a few metres.

[22] The "DSP-10" 2m transceiver described by Bob Larkin, W7PUA is just one example. `http://www.proaxis.com/~boblark/dsp10.htm`

[23] It's a dual band design (2m and 70cm) made by MFJ Enterprises. A re-mount kit is available so you can move it to a new vehicle. Part numbers MFJ-1734 and MFJ-94 respectively. Bit of black heatshrink around the loading coil reduces whistle.

- High UHF and Microwave operation LMR-400, LDF-550 etc. are a minimum no matter what the length.
- Use a cable loss calculator such as the online one at Times Microwave System's website `http://www.timesmicrowave.com/cgi-bin/calculate` to estimate likely loss figures

6 The Linux Connection

Ham radio has had a long association with Linux. A number of well known Linux kernel hackers and contributors to Open Source Software are also hams.[24]

6.1 Linux Kernel Support

Initial ham radio support for the AX25 protocol appeared in the early 1.0.x series Linux kernels. Hams had long been using computers to act as routers, gateways, BBS/mail systems and the like as part of packet radio stations. Most of this was DOS based. With the advent of Linux an affordable, open source multitasking operating system became available. Hams quickly seized on the opportunity to press Linux into service in these sorts of roles.

As a result, the Linux kernel has native support for AX25, NetROM, ROSE networking protocols as well as many Ham-specific device drivers. The support is very nicely integrated to the point where most networking utilities have support for Ham-specific functions. For example `ifconfig` can be used to configure the callsign of an AX-25 interface as well performing more familiar TCP/IP configuration.

6.2 Open Source Ham Software

There is a wide range of ham radio oriented Open Source Software available.[25] The following list is by no means exhaustive but gives an idea of what is out there.

6.2.1 APRS

- Xastir is a nice APRS tracking/base station package for X windows. It can connect to APRS servers or to local AX-25 interfaces and TNCs. You can import maps, download track information etc, etc.
- aprsd is a daemon to handle APRS traffic. It can handle both local (radio) ports as well as TCP/IP connections and does all the stuff required to gate between them, connect to upstream AX25 servers etc. HAMISH MOFFAT, VK3SB a ham based in Victoria contributed quite a bit of code to this daemon.

6.2.2 soundmodem

THOMAS SAILER'S soundmodem package allows you to use a standard Linux compatible sound card to send and receive packet radio signals using a variety of modulation standards. This is a nice way to tinker with packet with minimal outlay and can be used for receive only if you don't yet have a ham license. A simple interface circuit to isolate your computer from the radio is all that is required.[26]

6.2.3 gnuradio

gnuradio is an open source package that provides tools for constructing software defined radios as discussed above. Out of the box it provides support for FM demodulation and spectrum displays and has an API defined to allow user defined modules to be readily added. gnuradio is in it's early days to some degree but people are already using it for real world applications.

[24] Among the better known - Alan Cox (GW4PTS), Bdale Garbee (KB0G), Terry Dawson (VK2KTJ), Thomas Sailer (HB9JNX), Matthias Welwarsky (DG2FEF).

[25] One of the more comprehensive sites for Linux Ham Software is `http://radio.linux.org.au/` I've not provided specific URLs for the packages mentioned as they're either listed here and/or Google brings them up as the first or second hit.

[26] Ernie Mills, WM2U's site is nice and comprehensive for homebrew rig interface solutions `http://www.qsl.net/wm2u/interface.html`

6.2.4 g-psk31/kpsk

g-psk31 and it's successor kpsk provide transmit/receive functionality for the PSK31 mode under Linux. g-psk31 is GTK+ based. kpsk is based on Qt and seems to be the focus of ongoing development. kpsk amongst other things has a nice waterfall display and seems to be easy to get going. Like soundmodem it is soundcard based so you need only minimal additional hardware to interface with your radio.

6.2.5 predict

predict is a text based application for tracking satellites. It takes its input in the form of a text file containing Keplerian elements (keps) and allows satellite passes to be predict at arbitrary points in the future.

6.2.6 hamlib

Most contemporary commercial ham rigs have some form of serial port or remote control functionality. This ranges from basic programming of memory functions through to full remote panel operation. A group of open source developers have been working on a uniform library to provide control capabilities for a wide range of rigs.[27]

7 Do try this at home

Ham radio in Australia remains popular though the number of active operators is declining slowly, largely due to an aging ham population. Many new hams are licensed each year and the forgoing should show that there is a great deal of activity in leading edge areas.

Getting set up with a basic home station is quite straightforward and quite a lot of fun can be had with even a modest station and some tenacity.

For those with a technical/hacking bent ham radio can be a fascinating and rewarding hobby. I've been involved with it on and off now for nearly 20 years and still get a kick out of talking to another country, recovering a signal out of the noise or just yacking with friends on the local repeater.

Give it a go!

8 Close

Thanks to the Big Cool Guy (aka Martin Schwenke) for proof-reading, Rusty and sfr for suggestions about efficient ways of digging around in the kernel source for the early days of AX25 support, Chris Davis (VK1DO) for encouraging me to get involved in the first place and answering innumerable radio related questions over the years as a consequence. Finally but by no means least, thanks to Lucy and Rachael who make time not spent in front of radios so worthwhile.

Errata for this paper will appear at `http://misc.nu/hugh/ham4linux/errata.html`

[27] Some URLs for hamlib seem to be out of date relative to this one -`http://sourceforge.net/projects/hamlib`