

BDARS Club Remote HF Station

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Abstract.

The future of amateur radio is remote operating, ideally with your “shack” placed in a high, noise free location. Members of the Bayside District Amateur Radio Society, in Brisbane, enjoy such an HF station, equipped with a state of the art FlexRadio SDR transceiver.

A Dream HF Station

How would you fancy an HF station located on a hilltop, away from electrical noise, with a well located and broadbanded 80 to 6 metre dipole? Even better, its operable from your inner-city apartment or even when you are traveling interstate. And you do not have to pay for it!

That is the promise that modern remotely operable HF transceivers can offer in a club environment. And this is what the Bayside District Amateur Radio Society (BDARS) set out to deliver for its members in early 2019.

It took two years of solid work, but the outcome is fantastic. BDARS now has a FlexRadio 6400 SDR 100 watt transceiver installed at its Mt Cotton repeater site on the south-eastern outskirts of Brisbane. The antenna is a Bushcomm BBA 100CS broadband folded dipole, installed nice and high at 12 metres up, on top of Mt Cotton. Being semi-rural, the site is away from modern RF interference that plagues so many suburbs. This means the club’s new HF station has an RF performance that is hard for the average city dweller to match

Technical Specs of Our Club HF Station

The Bayside District Amateur Radio Society is a vibrant ham radio club, located in the Redlands area, a south eastern bayside suburb of Brisbane. In 2018, the club negotiated for the use of a disused 30 m ex-Motorola tower and radio hut near the crest of Mt Cotton. It is only approximately 200 metres above sea level, but this is still prominent against the largely flat topography of Brisbane.

The HF station was just one part of a much larger site re-development. All up, the club garnered close to \$40,000 in grant funding. The in-kind effort by members probably amounted

to a similar value. Distinct from the HF station, the club refurbished the hut and made it watertight and vermin proof, installed two new repeaters and antennae together with power supplies and a sophisticated network and control system.

The club assembled a small team of volunteers to design the station. We knew that we needed a multi-band HF antenna that was rugged and simple to use. The obvious choice was the Bushcomm BBA 100CS broadband folded dipole. This is a commercial grade product, made from stainless steel wire. It is 27 m long and the construction of three, spaced parallel wires gives the broadband behaviour with SWR of less than 2:1 from 2 MHz to 30 Mhz. It is installed in a slightly sloping fashion. The high end is fixed to the 30 metre communications tower, up at about 15 metres.

The other end is supported by a homebrew stayed galvanised steel mast constructed by a club member. This is bolted to a concrete base, 1 m deep and 400 mm x 400 mm wide with a steel reinforcing cage and tie-down bolts. Excavating this in the rocky terrain required jackhammering. Site access is only by 4WD so concrete mix, cement and water were all trucked up to site.

The Joy of FlexRadio for Remote Operation

Before seeking grant funding, we had to carefully define the full scope of works and budget. This meant we were faced with every amateur's dream dilemma – what HF transceiver to buy?

High on the list was the need for easy remote operation, but then most modern transceivers can be configured that way. However, we wanted ease of installation and operation in the user's "shack", not to mention low cost per user. FlexRadio scored high in this regard as the user software is free. And from the outset, the FlexRadio is designed for remote operation. It requires no PC in the remote "shack", just internet access.

For most of us, this would be our first introduction to contemporary SDR transceivers, providing a perfect learning experience. The Australian distributor based in Perth did an online demonstration of a Flex 6400 at a regular club meeting, which sealed the deal. This showed that we, in Brisbane, could make QSO's on a transceiver physically located in Perth. FlexRadio remote software SmartSDR is free and readily usable.

So our choice settled on the FlexRadio 6400. This is a 100 W HF and 6 metre all mode transceiver. It is a direct sampling software defined radio, the "gold standard" for SDR layout. Conceptually, it is a computer with RF capabilities, and this is most noticeable with the boot-up time, like a PC. We specified the optional ATU, as this would handle the modest SWR imbalance of our Bushcomm dipole.

In appearance, the 6400 looks like a PC – just a box. Some of us old-timer hams at first missed the knobs and readouts. However, all that functionality (plus more) is built into the Smart SDR software and is accessible with keyboard and mouse. Moreover, the waterfall display is a gamechanger. A user can see activity across the whole band.

However, that still left us with the issue of a booking and access system so that usage could be shared amongst club members equitably. After a good degree of scoping, our more IT-talented club members developed ShedWeb. This is an internet access system which allows members to book timeslots (up to two hours) for FlexRadio use. At the assigned time, the user can power on the FlexRadio and connect using SmartSDR. ShedWeb means that access is controlled by username/password and usage is monitored and recorded. At the conclusion of a user's booking, the FlexRadio is powered off, back to its normal state.

The BDARS FlexRadio combined with ShedWeb has allowed us to redefine the whole concept of a "radio shack". Our members use it from holiday destinations or from their iPhones.

We also have a couple of vision impaired members, who access the station using a screen reader and a refreshable Braille display. The software which provides this access is called JJFlex. The waterfall is displayed as a line of Braille, allowing the operator to identify the stronger signals across the band in much the same manner as a sighted user.

Network for Reliable and Redundant Control

In designing the remote control system, we had dual requirements of network security and statutory emergency radio shut down capability. At the outset, we had not tested suitable limits for reliable bandwidth. Our initial concept had triple redundancy with three Internet connection types - 4G, ADSL and a 900MHz LIPD class microwave link.

In normal mode, the system selects the best connection type according to an algorithm with automatic fail-over if necessary. After some months of operation, we found budget 4G data SIMS to provide adequate bandwidth at acceptable cost for primary traffic.

Inside the hut, the Local Area Network (LAN) is divided into two security branches. We have a Supervisory LAN (SLAN) and a Demilitarised Zone LAN (DMZ). The latter connects to all the third party devices such as the Flex Radio.

The SLAN is used for the command and control system. This is based on a Node-RED[®] based application and controls devices including a Power Distribution Unit. The PDU has 24 software driven AC mains switches. Node-RED also has some autonomous capabilities including an orderly command sequence to power off PC's after mains failure, and while a UPS is supplying temporary backup power.

Node-Red operates as a 'slave' for the most part. It runs a Command and Control dialogue with the primary 'ShedWeb' server housed in an off-site secure data centre. The communication protocol used is a simple, extensible design. The server acts as fast, stable Internet point of contact for users; it manages bookings and presents a web interface for users to control the shed radio hardware.

All user traffic including the FlexRadio SmartSDR traffic is routed through ShedWeb. This gives us the capability to enforce a gatekeeper such that we can intervene in an emergency and to direct the remote radio protocol traffic to the currently booked user exclusively.

How We Financed It

Right from the start, we knew this would be a big project. It involved refurbishing the hut to make it vermin and waterproof. Thereafter, we added two repeaters and one new high performance antenna for general club use, together with battery backup. The HF remote station was a smaller part of the entire project.

The key to obtaining grants was settling the scope of work to a reasonable degree of detail. This allowed us to obtain quotes and set an overall budget including contingency for unknown factors. We approached the Redland City Council under its Community Grants program, and Gambling Community Benefit Fund in Queensland, both with success. There is a large amount of detail required, and paperwork required in these programs. Both applications were successful which provided BDARS with almost \$40,000 in funding.

There is a modest annual cost in running this station – power, internet access and server time and insurance. BDARS covers these through its normal fundraising program and member's fees.

How We Built It

The hut was in a poor state of repair when we gained access to the site. This refurbishment required the club to engage a builder to effect repairs, the largest single cost of the whole project. We then undertook a series of club working bees to paint the interior, equip it with shelving and racks, a new smart metered switchboard, reconfigured electrical layout, a multi entry coax bulkhead and the new 12 metre dipole mast.

We were fortunate to have a qualified rigger volunteer his time to install the new VHF and UHF antenna and a pulley support of the HF dipole. Club members installed a 900 MHz Ubiquiti microwave link to provide internet access with an access point at a member's QTH eight km distant from the hut.

Once we started work on site, the project was completed and commissioned inside 9 months. However, like all “shacks”, the BDARS has a steady stream of upgrades and refinements ongoing, not to mention regular system maintenance.

Invitation to Join BDARS Club

All members of the Bayside District Amateur Radio Society have access to the FlexRadio remote HF station. A small number of our club members are located interstate and even overseas.

Provided they have valid Australian amateur licences, they can operate the HF station, in accordance with their licence privileges. There is scope for a limited number of additional interstate members. Those interested should contact secretary@bdars.org.au to arrange membership.

Acknowledgement Photos - Bambi Page VK4AYL

Photo Captions

1. BDARS Station Manager Russ VK4DCM with the equipment rack. The Flex 6400 is almost hidden on lower right
2. The BDARS hut and existing comms tower. Refurbishing the hut was the single biggest expense.
3. The homebrew self-supporting 12 m high steel tower at one end of the HF dipole.
4. Bushcomm BBA 100CS broadband folded dipole, 27 m long.