

A proposal to implement GPS locking of VK beacons

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The Wireless Institute of Australia (WIA) and the writer Alan VK3XPD have joined in a collaborative financial arrangement to implement GPS locking into the VK beacon network.

So, if you are beacon owner, would you like to improve amateur radio and receive \$200 for your efforts? Then read on...

In recent years, GPS technology has been adopted by numerous commercial service providers and RF networks around the world. However, for amateur radio, the early implementation costs of GPS locking remained high and the technology options limited. Several enterprising amateurs found they could make use of an alternate GPS locked source. The old analogue TV sound carriers from the commercial TV providers like 2, 7, 9, 10 and so on were often GPS locked. I know of several amateurs who built equipment to extract this 'sub' reference and use it to 'lock' an external shack based source – usually on 10 MHz.

With the passing of time and technological advances, we now have much improved GPS locking systems available. The on-going rapid penetration of GPS locking has resulted in significant cost reductions in the use of this technology. More importantly, there are now a myriad of options available to amateur radio enthusiasts to achieve GPS locking of frequency dependent applications. GPS locked 10 MHz sources are now common and quite cheap on eBay and elsewhere. The development of PLL hardware from inventive amateurs like Graham Byrnes VK3XDK means that GPS locking is now a cheap cost

effective solution available to all amateurs.

Amateur radio enthusiasts are renowned for their efforts in 'pushing the boundaries' of RF propagation. Consequently, many of us have already implemented GPS locking of their radio equipment. Several privately owned and WIA supported beacons are already GPS locked. The most obvious benefit to amateur operators of a GPS locked beacon is the total elimination of the frequency uncertainty issue of a non-locked beacon.

The original beacon concept was developed many decades ago for the sole purposes of propagation monitoring. However, this mostly non-GPS locked beacon hardware is now of limited use to many of us because of its frequency instability. With the passage of time and technology, it's become obvious that our beacon functionality needs to be upgraded to eliminate this frequency uncertainty issue.

Today, the vast majority of VK beacons around Australia, regardless of their ownership heritage, either privately owned or WIA supported, still remain crystal/PLL locked and therefore they have inferior frequency stability. These beacons can and usually do 'wander' all over the place due to daily thermal cycles. Consequently, they are rarely on their nominally 'listed' frequency as per any WIA *Callbook*.

As an active narrowband enthusiast, I would like to see this situation change for the benefit of amateur radio in Australia and hence I have initiated this funding proposal: To upgrade our VK beacons to GPS locking!

In recent years I have watched

and actively participated in the exponential growth in the number of amateurs experimenting in the narrowband modes, on microwave frequencies up to 78 GHz and beyond, aircraft enhancement, earth moon earth (EME) up to 24 GHz and the exciting digital modes under the WSJT package. The beacon is a critical indicator of long distance propagation but for the most part, these beacons are often inaudible. However, with WSJT, we can now 'see' these low level signals more than 20 dB below the normal audible threshold. This opens up a whole new world of monitoring and achieving long distance QSOs within the digital domain.

The majority of these modes cited above are critically dependent on GPS locking for their absolute frequency stability. Consequently, many amateurs have chosen to upgrade their equipment with GPS locking capabilities at their own personal cost.

Aside from their original intent of being 'only' a propagation indicator, a GPS locked beacon can also provide a definitive frequency reference for any amateur operator to 'check/calibrate' their home brew gear. These stable beacons also allow us to develop and enhance our operating skills with the WSJT package and plan for more complex long distance record attempts. We can now monitor weak signal beacon propagation but with the knowledge that we will now know exactly where to look in the frequency spectrum. So, no more guessing!

As an example, the development of a very small GPS locked PLL by Graham VK3XDK has simplified the approach to GPS locking immensely. Graham's

PLL synthesises a wide range of popular frequencies through the use of PICAXE programming and DIP Switches. In conjunction with his multiplier modules, a myriad of GPS locked injection LOs can be generated to suit his range of transverter products up to 10 GHz.

While there are many other providers of GPS locking solutions available, this is where it things get a whole lot more interesting!

With a bit of lateral thinking, David VK3HZ has developed PICAXE software to enable Graham's PLL to perform a complete beacon function. So, with a few exceptions, a single PLL board can now synthesise a GPS locked beacon frequency on 144 and 432 MHz, with CW identification (ident) for any unique call sign and grid locator.

For beacons 1296 MHz and above, it gets a little complicated. For example, the three GPS locked VK3RXX beacons at my QTH require a mixer arrangement because the PLL must synthesise two different frequencies that are mixed. The first is 432.530 MHz. This is the base identification frequency which when mixed with an LO delivers the 1296.530 or 2403.530 MHz beacon output. Similarly, for the VK3RXX 10 GHz beacon, the PLL generates two frequencies; the second frequency can be 1242 or 1656 MHz to feed an XDK multiplier board to give 9936 MHz. The identification and 9936 MHz feed a 10 GHz transverter board to deliver a 10 milliwatt beacon on 10368.530 MHz.

So, how easy is that?

Now, almost anyone can modify/update their existing beacon hardware with this extremely simple GPS locked beacon exciter on 144.xx0 MHz or 432.xx0 MHz with just one PLL board, programmed for your chosen beacon frequency. Feed the circa 10 milliwatt output to your own PA and antenna and wait for the positive feedback to roll in.

By upgrading our national beacon network to GPS locking, Australian amateur radio operators can continue to push the boundaries of propagation, building ever more complex RF and digital equipment to achieve what was previously impossible under a regime without GPS locking.

This proposal benefits all amateur radio enthusiasts and I urge you to take advantage of the \$200 funding offer to offset your upgrade costs. The eligibility criteria for receiving these funds can be found elsewhere/below.

Conditions

In making this donation available, we have stipulated the following conditions:

1. Alan VK3XPD and the WIA in a co-contribution arrangement will donate a maximum of \$5000 for the exclusive purposes of financing GPS locking upgrades to the VK beacon network. This means we will fund up to 25 beacon upgrades.
2. Alan VK3XPD will co-ordinate all financial matters regarding this proposal.

3. Any beacon, regardless of ownership heritage (private or WIA) is eligible to receive this funding.
4. Eligible beacons are only those that are actively radiating RF now as of the proposal date (1 June 2014), are not currently GPS locked and are operating on two metres (144 MHz) and higher in frequency.
5. A maximum of \$200 per beacon will be paid to the beacon owner on project completion. That is, a proven fully functional GPS locked beacon.
6. To assist with the coordination of this proposal, a/any beacon owner will be required to pre-register their intention to upgrade a/any beacon with the co-ordinator, Alan VK3XPD.
7. All beacon funding ceases 12 months from the date of issue of this proposal (that is, 1 June, 2015, or when all funds have been committed).
8. There are no restrictions on the hardware used to achieve GPS locking.
9. There will be no obligation for the provision of on-going technical support for any updated beacon.

To pre-register your intention to upgrade an eligible beacon or to discuss this proposal further, I can be contacted by an email to [alandevlin AT bigpond DOT com](mailto:alandevlin@bigpond.com) or telephone me on 03 9889 6101.



WWII Tidbits

Recognition for VK2AJI

Amongst those Mentioned in Despatches has been Vince Eagan VK2AJI, F/Sgt. In the RAAF, who was a member of a patrol which went up through Dutch New Guinea, all through unexplored territory, and maintained communications throughout the journey. So says the citation, and, as you know these citations are pretty bald kind of things. Vince is now somewhere up around the Phillipines.

[AR October 1945, p12, Hams on Service by Jim VK2YC]