

Passive Repeaters

A Joint Experiment Between Coventry RAYNET
And Walsall RAYNET
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What Is A Passive Repeater

- Two Antennas connected back-to-back via a length of coax
- Coax should be as short as practically possible, but does NOT need to be a quarter-wave length or multiple there of

What Can It Be Used For ?

- Typical commercial uses are at microwave frequencies
- Antenna on a roof top, basement operations via a handheld
- Locations A and C cannot hear each other, but Location B can hear both clearly
- Polarisation Switching

The Scenario

- Walsall RAYNET cover a health care walk every year, of which part of the route goes via a canal tow path,
- Control is located at The Dilke, PH. One of the outstations is located at The Lime Pits
- However comms are patchy at best between The Dilke and The Lime Pits
- But a second outstation, located at Riddian Bridge on the canal can hear both stations clearly
- But access is via the canal tow path, so it is difficult to haul batteries, talk through units, masts etc to the location

Map



The Equipment Used

- 2 Dual Band HB9CVs from Wimo. Selected Because:
 - Dual Band
 - Portable
 - 144MHz elements can be removed for easier transport
 - ~5.5dBd gain
- 2 2m Lengths of aircell 7 co-ax, Chosen for it's low loss, and low weight
- 2 Telescopic Fishing Poles

The Theory

	144 MHz	433 MHz
Path Loss Between “The Dilke” and “Riddian Bridge” (approx 750m)	-73.2	-82.7
Path Loss Between “Lime Pits” and “Riddian Bridge” (approx 500m)	-69.6	-73.2
Path Loss Between “The Dilke” and “Lime Pits” Direct (approx 1km)	-75.7	-85.2
Path Loss Between “The Dilke” and “Lime Pits” via “Riddian Bridge” (approx 1.25km)	-77.6	-87.1
Antenna Gain	10	10
Coax+Connector Loss (Worst Case)	-0.5	-0.5
Path Loss Via Riddian Bridge Plus Antenna Gain Minus Connector and Coax Loss	-68.1	-77.6
Delta between direct path and via passive repeater, taking into account antenna gain and connector plus coax loss	+ 7.6	+9.5

The Method

- Measured Signal Strengths on Both 144MHz and 433MHz between The Dilke, The Lime Pits, and Riddian Bridge
- We observed the usual difficulties between The Dilke and Lime Pits, but both locations had strong signals with Riddian Bridge
- Once the base line RF environment had been established, we mounted each of the HB9CVs onto it's telescopic fishing pole mast

The Method

- Once Mounted, We allocate each station to one antenna
- We then needed to align the antennas towards each of the remote stations
- This was done by rotating the antenna while monitoring signal strength from the remote station
- Once complete, the experiment was started in earnest by connecting the two antennas with the co-ax leads



The Results

- We first tried on 144MHz. The two antennas were connected on their 144MHz ports. Signals between The Dilke and The Lime Pits were worse than without the Passive Repeater!
- Having checked the cabling, and tried rotating the antennas slightly in case they had moved, we tried 433MHz by connecting the two antennas on their 433MHz ports
- 433 MHz provided the expected results. Signals were much stronger than without the Passive Repeater
- Disconnecting showed the expected signal loss and return to baseline signals, re-connecting showed the increased signal reports, and a return to enhanced signals

The Results

- We realised that the antennas had less than a quarter-wave separation on 144MHz
- Increased the vertical separation so that it was more than a quarter-wave
- Suddenly signals between The Dilke and The Lime Pits that traditionally have been S1-S3 at best, and unreadable at times were S9+
- Multiple disconnects and connects were done to prove that we were seeing consistent results.

Conclusions

- It Works
- But Antennas need to be a quarter wavelength apart
- Pointing the antennas is probably the hardest part

Future Possibilities

- Anywhere stations A and C can't communicate, but B can communicate with both
- Have a chain along the ancient beacons ?
 - Early planning has been done, but we need willing folks with antennas, co-ax, and masts
- As AN EXPERIMENT, Barr Beacon, with one antenna pointing back to Coventry, and a remote receiver ?
- Welsh Valleys ?
- Could it help stimulate activity on higher bands such as 1.2GHz ?
- Other Ideas ?

Implications

- These devices are not spot frequency like a traditional repeater
- They operate over the entire bandwidth and beamwidth of your antennas
- If you have one Vertical and the other Horizontal, a polarisation change will happen

Licencing Considerations

- As passive, you do not need a licence, or a NoV
- However, do think and plan. Putting one up on Barr Beacon with one antenna pointing towards Wales, and the other pointing South towards Coventry for a few hours as an experiment, people will most likely think there is a lift on!
- Putting one up there long term will most likely attract unwanted attention, and could cause future difficulties – even if it may be difficult to locate
- **You are still required not to cause undue interference to other legitimate users of the RF Spectrum**