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Date: Feb.25/19

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Pages: 2

Subject: Yagi interaction when stacked

I did some computed radiation patterns for our 9E166-\* 9-element yagi at 166.38MHz to see the effects of stacking a second antenna pointed in a different direction at spacings of 19" and 36".

Below are the computed patterns.

30° 20 Feet above ground 1. - Single yagi at 20' above ground. 9el Motus Yaqi OCF 330° Azimuth dΒ 300° -10 60° -20 -30 40 90° 270° 120° 240° 4.0° Elevation 0 dB = 18.23 dBi 210° 150° 166.380 MHz

2. - Two antennas with second yagi oriented 120° from the first antenna and spaced 19"(0.5m) above the other one up 20'. This shows the pattern change to the single yagi.



3. Two antennas with second yagi oriented 120° from the first antenna and spaced 36"(0.91m) above the other one up 20'.



Observations: Computed gains (includes ground reflections) for each are listed below.

1. Single Yagi – Gain = 18.23dBi (reference)

2. 2 yagis spaced 19" apart vertically – Gain = 17.90dBi ... difference = 0.33dB (7.3%)

3. 2 yagis spaced 36" apart vertically – Gain = 18.05dBi ... difference = 0.18dB (4%)

Sidelobes:

1. Single Yagi – All down >-20dB (100 times power) i.e. 100 times weaker than main lobe

2. 2 yagis spaced 19" apart vertically – -13dB (20 times weaker power)

3. 2 yagis spaced 36" apart vertically – -16dB to – 18dB (40 to 64 times weaker power)

With free space propagation, doubling the distance requires 4 times the power (6dB). if a tag could be detected at a distance of say 8km at the main lobe maximum where the single yagi was pointed, it could also detect a signal off to the sides or back (-20dB) at a distance of 0.8km or approx. 10% of the distance.

In the case of the 19" spaced yagis and -13dB sidelobe level, this side detection distance would be approx. 1.7km.

In the case of the 36" spaced yagis and -16dB to -18dB sidlobe levels, this side detection distance would be approx. 1.28km to 1.0km.

All the above calculations are computed free-space line-of-sight and will be reduced by any obstruction, including trees. The 8km detection distance is probably the maximum achievable under normal conditions with a 1.0 microwatt transmitter tag. I used this distance just as a reference value.

The 36" spacing is probably an acceptable distance unless more detailed directions of detection are required; in that case, going to a 2m(79") vertical spacing between yagis would be recommended.