ANGLE OF RADIATION AND YOU

by N.S. Harisankar VU3NSH

The speed of electromagnetic wave is the same as speed of light, light is also an electromagnetic wave. In empty space, the speed is 299, 799, 077 meteres per second. The Physical Length of a frequency λ= V/f, where 'V' is the Velocity, 'λ' is the wave length and 'f ' is the frequency. For example, if f = 145.000 MHz., then the Physical Length is (300 / 145) = 2.06896 meteres. Because of the velocity factor K of the conductor, the Physical Electrical Length is less than the Free Space Length. Normally, for practical purposes, K is taken as 0.95. To obtain Electrical length for practical applications, K is used as a multiplier, it will change as (300 x 0.95) / 145 = 1.96551 m. For a half - wave dipole, the equation is, (150 x 0.95) / 145 and it is 0.98275 m (98.275 cm). The Fig. E gives details of the (λ / 8) th combinations in vertical class. If the diameter of this circle is 1.96551 m, it comes as 1.96551 / 8 and it is 0.245688 m (24.568 cm). This value is equal to 45^0 wave. It is the (1/8)th length of 145 MHz. For getting the 5/8th Antenna, radiator length should be 24.568 cm x 5 and it is equal to 1.2284 m. Refer table 1 for getting λ/8th combinations at 145 MHz.

In Amateur Radio Terminology, the (5/8)th Antenna is known as 225^0 wave Antenna. In Fig. E, you can see the cycle starting from 0 to 360 degrees in clockwise direction and the position of 225^0. Therefore the ½ λ is known as 180^0 wave and (1/4)λ is known as 90^0 wave.

In some commercial antennas, the real length of the radiator is less than what they have specified. For Example, if the (5/8)th Antenna (225^0 wave) on 145 MHz. is 1.22 m long, the tolerance of the length is $\pm$ 1 cm, which is acceptable. If the length is 98.27 cm long, then it is a (4/8)th antenna, the radiation (gain) in such antenna is lower than 5/8th antenna.

Table 1

All Data for 145.000 MHz. VHF Amateur Radio Band

Type	Length	Degree Wave
1/8th	24.568 cm	45^0
2/8th	49.136 cm	90^0
3/8th	73.704 cm	135^0
4/8th	98.272 cm	180^0
5/8th	1.2284 m	225^0
6/8th	1.4740 m	270^0
7/8th	1.7197 m	315^0
8/8th	1.9655 m	360^0

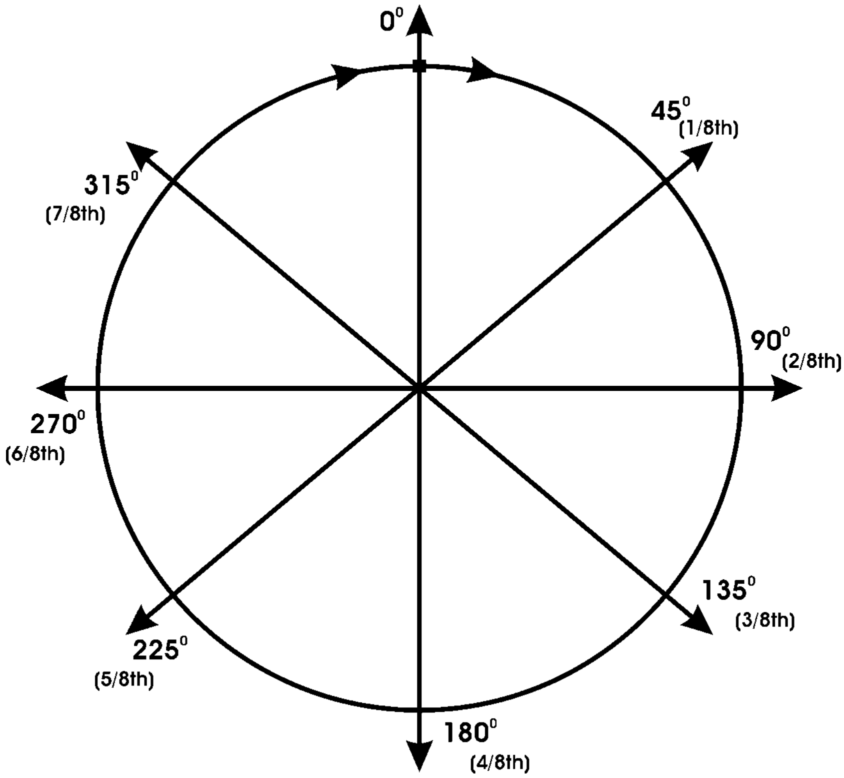


Fig. E

In Figure 1,2,3 and 4, you can see the radiation angles of vertical antennas and some analogies (Fig.2). Generally all vertical antennas radiate in 360^0, but the question is, in which angle the radiation is more in horizontal plane. It will produce useful angle of radiations for working long distances (refer Fig. 3 and Fig. 4). The 360^0 omni directional radiations from vertical antennas are not equal (Fig. 4). The vertical antennas has its own behaviors in gain, radiation angle, effective aperture etc. But you have to choose for the best antennas for your own purpose. ***"Whether we buy or build our antennas, we soon find out that is no one 'best' design for all purposes" - ARRL - 1978, Page 623 - Hi.***

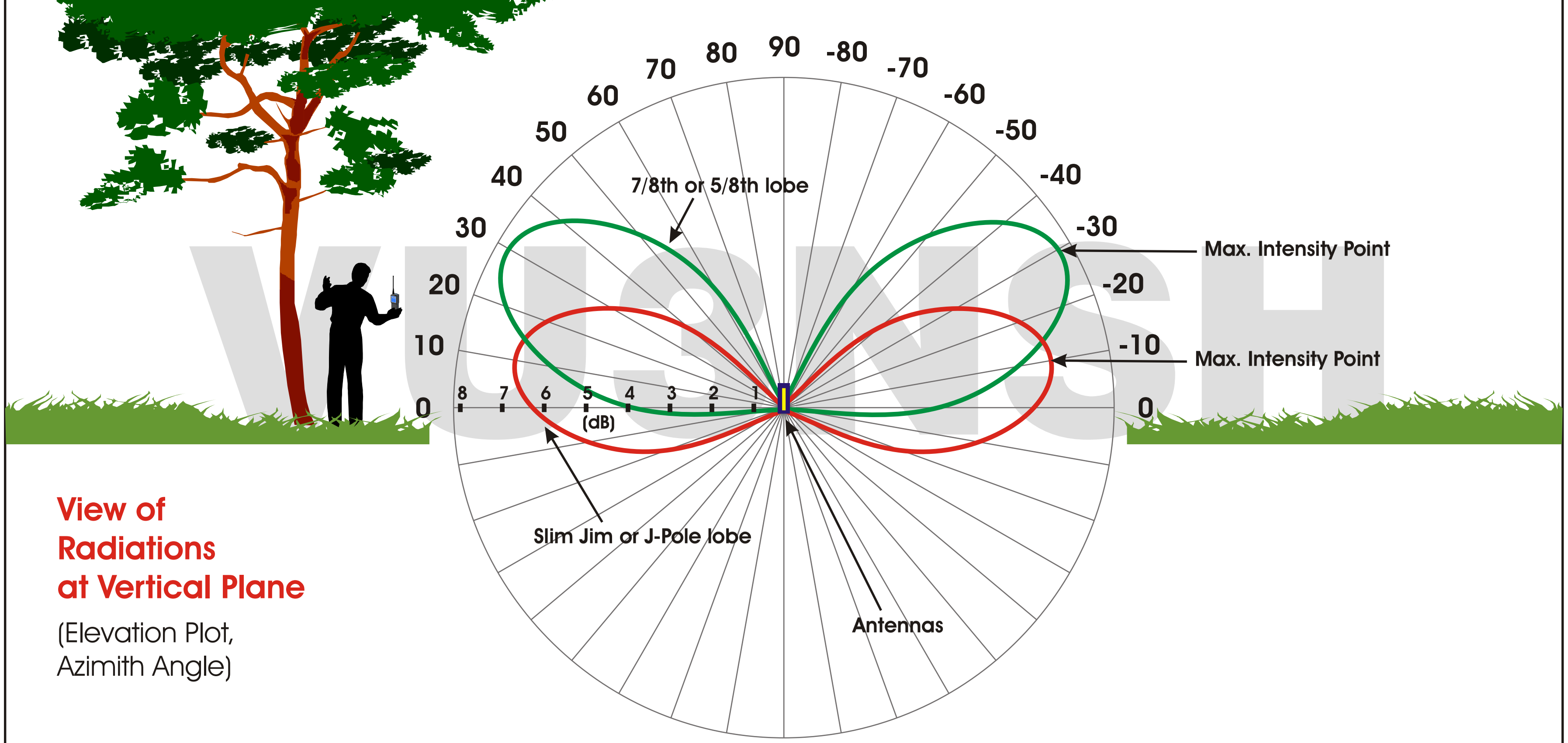
Testing of a new antenna with repeaters depends upon the conditions of the repeater performance, propagation conditions, reporting stations' capabilities of discriminating the signals with his set-up. ***"Some repeaters are known as 'alligators', all mouth, no ears, we need a good loud signal coming and going"*** - Mc Coy on ANTENNAS, Page 98 - CQ - Hi.

In most conditions, the 'user problems', misunderstood function of SWR, matching, propagation, doubtful coaxial or cable into which moisture has seeped (mismatch or high loss), 'free space' conditions, Rx-Tx antenna degrees of accuracy, distance in between stations and elevation, measuring equipment, reflection from other conductors or from large building, signal reports from other stations with 'S' meters (S meteres are not universally calibrated - Hi!), and so many variable factors involved. The only reliable test can be done by accurate measuring equipments. Using different types of vertical antennas in your QTH with different heights and place, to confirm, which is suitable for your local work (simplex) and for DXing with minimum TX power.

I hope this text, all figures and diagrams are sufficient for some basic knowledge about antennas. I thank OM VU2DX for the proof reading and Rejeesh (SWL) for making the illustrations for my article.

VU3NSH
7/01/2007

Two types of Vertical Antennas & degree of Radiations



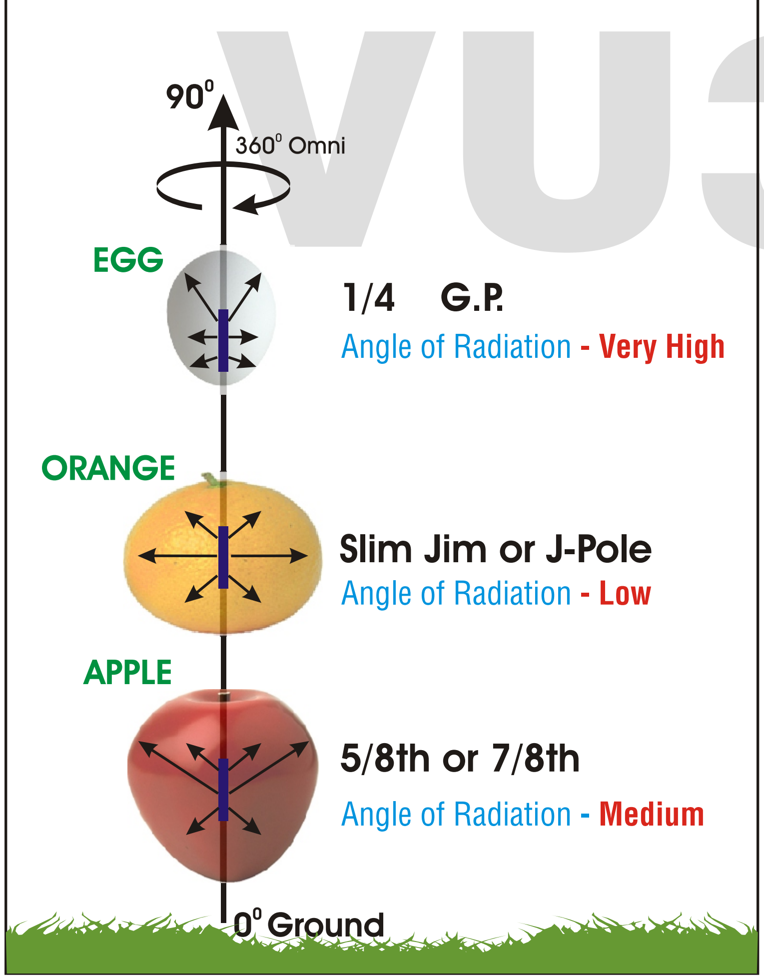
View of Radiations at Vertical Plane

(Elevation Plot, Azimith Angle)

Angle of Radiations (Take of Angle) of Slim Jim & 5/8th VHF Antenna. The 0^{0} depicted as ground.
The Angle of Radiations shown is from the Mid Position, where the antenna is located.
All patterns are sectional views. The lobe size is 100s and 1000s of miles.
The lobe size depends upon the Antenna Gain and TX input power to the Antenna.
This illustration establishes that the 5/8th or 7/8th Antenna is having more gain at high angle

Fig. 1

Optical Analogies to Vertical Antenna Patterns



Single Lobe Width, Maximum Intensity & the Degrees

VU3NSH
7/01/2007

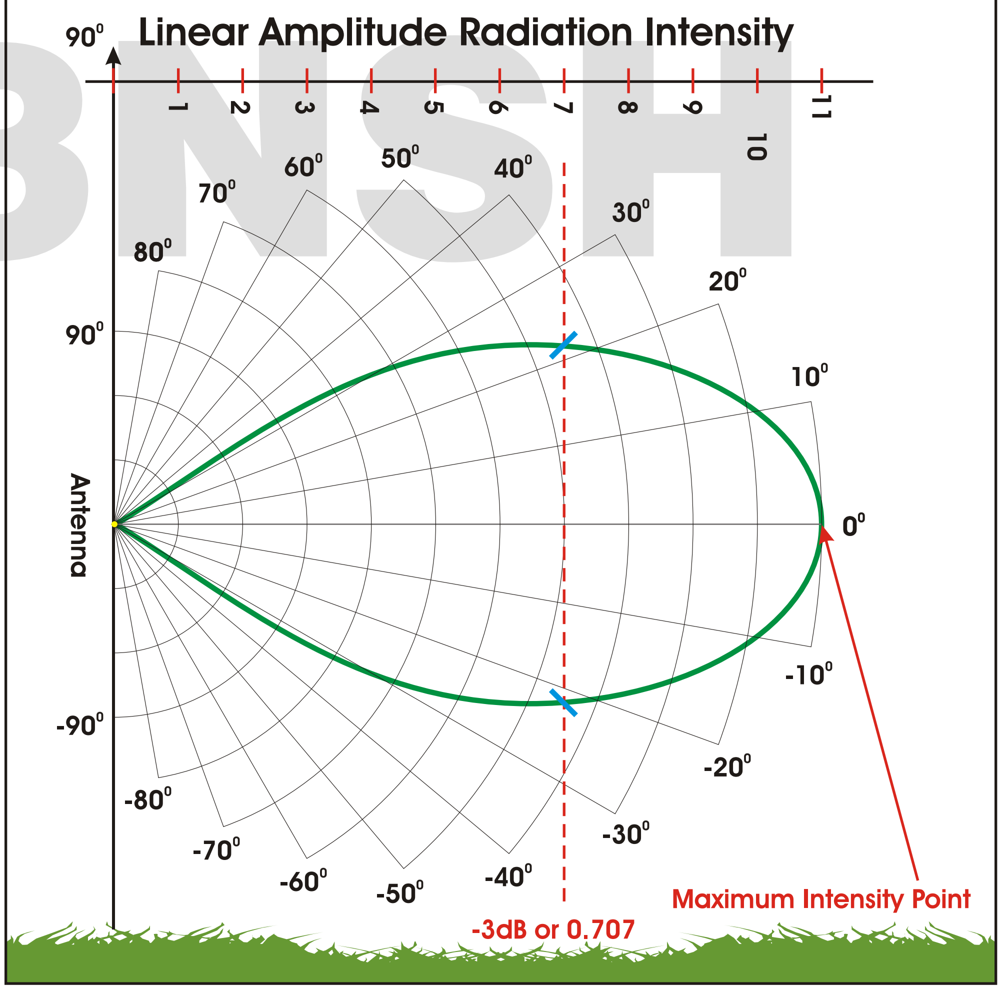
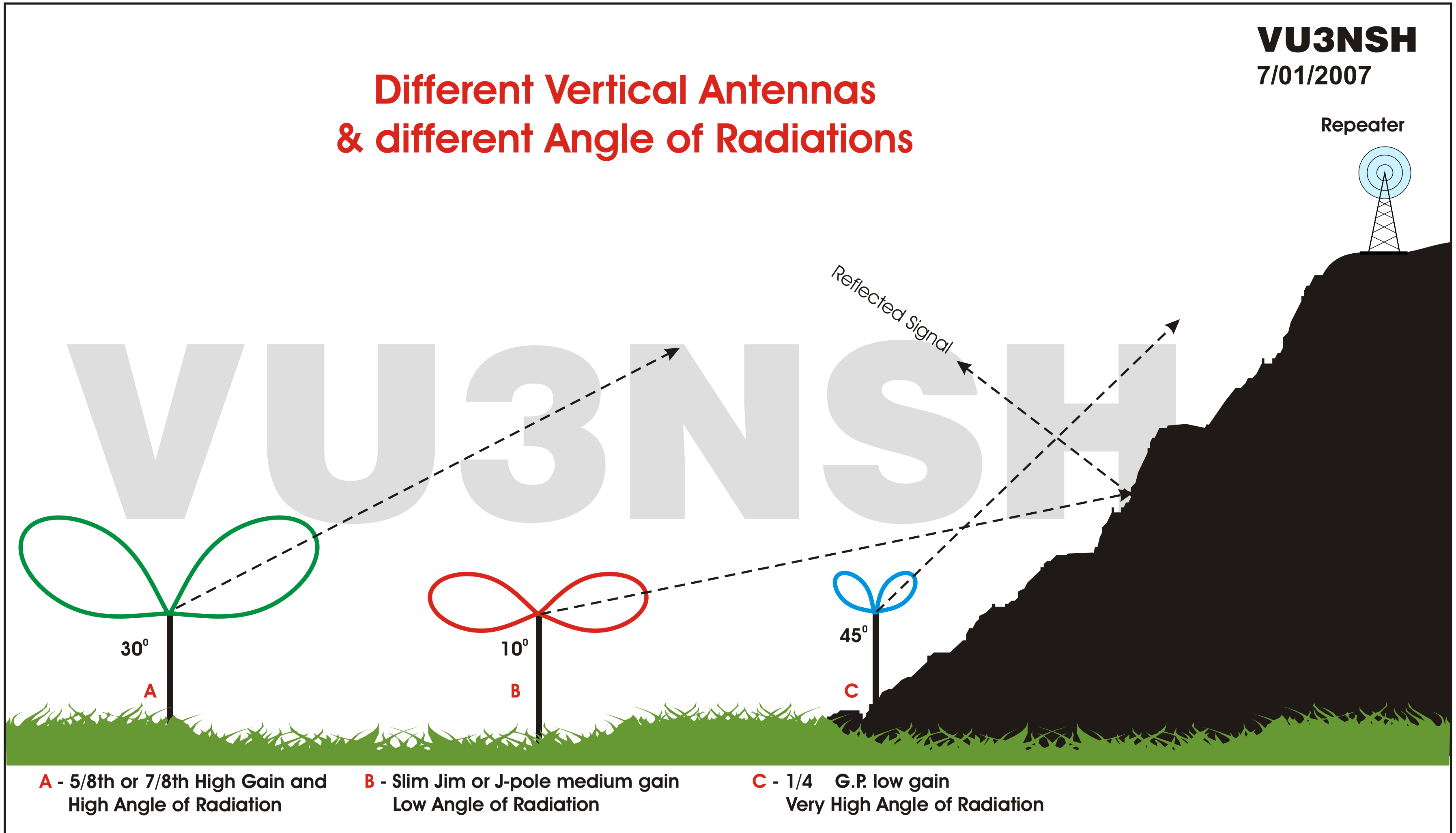


Fig. 2

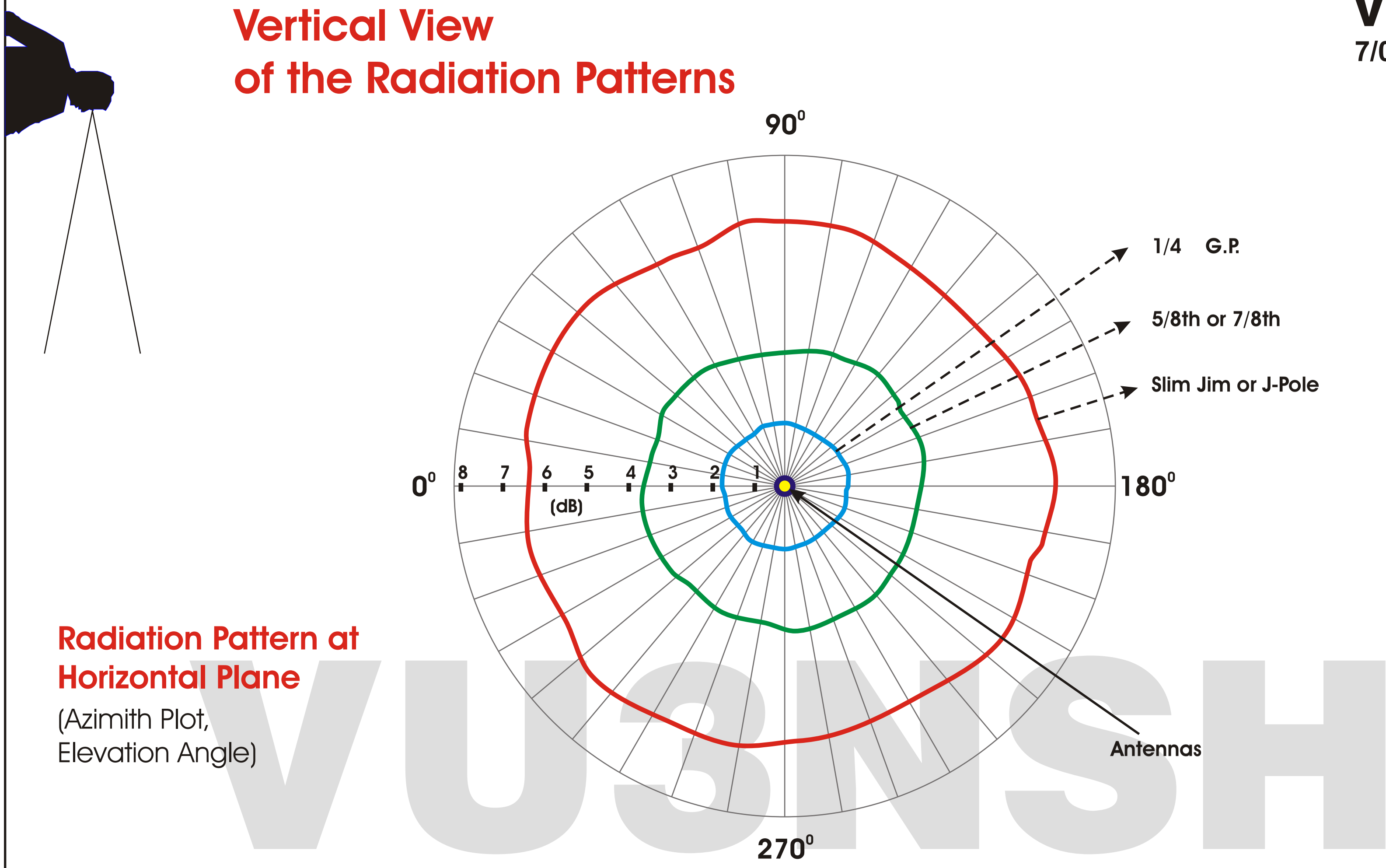


All these three Antennas are at the same height.
But due to different Angle of Radiations, the High Angle of Radiation of A & C are working very well through the Repeater at the Hill Top.
It does not mean that the 10^0 Antenna (B) will not work. Its gain will be in a minimum level.
In this situation, to improve the performance of Antenna B, the height of the Antenna should be as high as possible.
The two lobes (sectional view) in all antennas represent miles and miles of distance.

Fig. 3

Vertical View of the Radiation Patterns

VU3NSH
7/01/2007



In this 90° down view, you can see Slim Jim Antenna is having more radiation and it is parallel to the ground. In 5/8th Antenna the radiation is lower than Slim Jim. In the case of 1/4 G.P., it is very low. So this illustration establishes that the Slim Jim antenna is having more gain at low angle.

Fig. 4