Technical Innovations on Multi-Beam Antenna

The multi-beam antenna has obvious advantages in deployment, but it also has two significant technical challenges.

The first challenge is poor side lobes, as shown in the figure right. The higher side lobes are caused by the coupling between the dipoles and the addition of the different dipole energy on the side lobes pattern area.

The second challenge is that Horizontal Beam Width (Subsequent use abbreviate HBW) of 2600MHz in 1800–2300MHz wide-band multi-beam antenna is too narrow to have similar coverage with 1800MHz and 2100MHz, as figure 2 shown. The narrow HBW in HBW is due to the wide band nature of the 1800 – 2300MHz bands. 2600MHz unit dipole HBW is narrower than that of the 1800MHz and 2100MHz dipoles. Controlling the HBW through the array layout is difficult as the feeding network has a greater impact on the HBW. If the 2600MHz HBW is too narrow, it will cause a blind zone in coverage, as shown in the figure 3 below. The simulated blue area is the coverage blind zone, as figure 3 shown.

New Technology Applications on the Multi-Beam Antenna

Snake array design for better side lobe

The higher side lobes are caused by dipoles having energy superposition in the side lobe radiation region, as figure 4 shown. The dipole energy can be offset in the side lobe region by optimizing the layout of the dipoles. Snake Array 1.0 has equally spaced deployment of array row while the distance between dipoles on the same row is constant, as figure 5 shown, the side lobe has achieved a big improvement. Snake Array 2.0 design minimizes the overall side lobes by optimizing the distance between each dipole, makes sure side lobe is best, as figure 6 shown.

Feeding network design for 2300M excellent HBW

The biggest problem for wideband multi-beam antennas is the wide working frequency range. The HBW varies with frequency and at the highest frequency, e.g. at 2600MHz, the HBW is too narrow. Feeding network has a big effect on the HBW. HBW can be controlled by changing the amplitude and phase of the array by design of the feed network. If the amplitude and phase are changed by a fixed value as figure 7 shown, 2600MHz HBW can be wider, but the 1800MHz HBW will also be wider. To overcome this, the amplitudes and phases need to be changed non-linearly between different bands.

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