Technical Innovations on Multi-Beam Antenna

Technical Challenges 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 dipole and the addition of the different dipole energy on the side lobes pattern area.

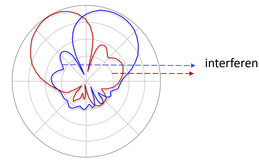

Figure 1 Poor side lobe

The second challenge is that Horizontal Beam Width (Subsequent use abbreviate HBW) of 2600MHz in 1800~2600MHz wide-band multi-beam antenna is too narrow to have similar coverage with 1800MHz and 2100MHz, as figure 2 shown. The narrow 2600MHz HBW is due to the wide band nature of the 1800 ~ 2600MHz antenna. 2600MHz unit dipole HBW is narrower than that of the 1800MHz and 2100MHz dipole. 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.

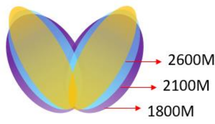

Figure 2 2600MHz HBW too narrow

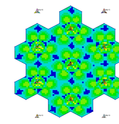

Figure 3 simulation on 2600MHz coverage

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 displacement of array rows while the distance between dipoles on the same row is constant, as figure 5 shown, the side lobe have 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 .

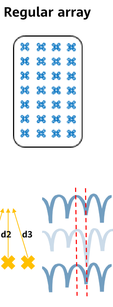

Figure 4
Peak value and peak value addition

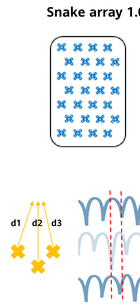

Figure 5
Peak value and bottom value addition

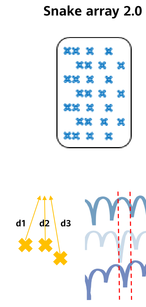

Figure 6
Optimal value addition

Feeding network design for 2600M 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 then the 1800MHz HBW will also be wider. To overcome this, the amplitudes and phases need to be changed non-linearly between different bands.

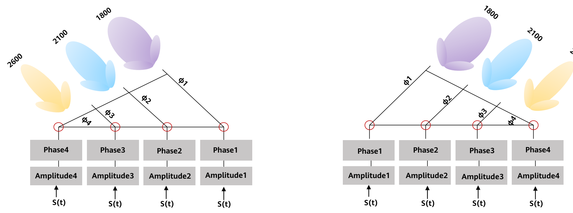

Figure 7 Traditional feeding network

Huawei uses advanced adaptive network technology, adding Compensation phase and Amplitude in different bands as figure 8 shown, to control the HBW of different bands. The HBWs of 1800/2100/2300~2600MHz is close to 33° . Thus the 1800/2100MHz and 2600MHz 4T4R 6-sector can be deployed by adopting one antenna.

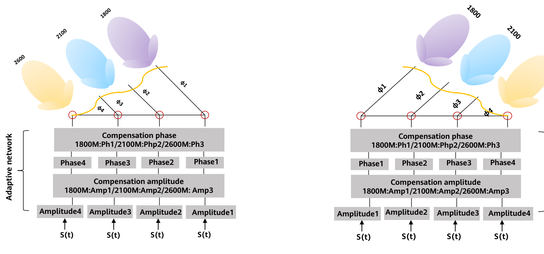

Figure 8 Huawei adaptive feeding network

Multi-Beam Antenna 4 Highlights

Base on new Technologies, Huawei's multi-beam antenna have big improvements on side lobe and HBW, meanwhile multi-beam antenna also can integrate with traditional 65° antenna. In general, Huawei's multi-beam antennas have the following highlights.

- 4T4R 6 sectors average network performance will increase about 70%~100% compared with 2T2R 3 sectors base on Huawei multi-beam antenna.
- Ture ultra-wideband for HBW of all bands is close to 33° . 1800/2100/2300~2600M 4T4R 6-sector can be deployed with one antenna.
- All in one to save site resource, for example one hybrid multi-beam antennas can support 1.8G & 2.1G 6-sector and 700~900MHz 3-sector and 2600MHz 3-sector 4T4R.
- Better in-depth coverage for gain of multi-beam antennas is 2dB higher than traditional 65° antenna.