Phase 4 Antennas

Phase 4 anticipates a 10MHz uplink within 5650-5660 MHz and a 10MHz downlink within the range of 10450 - 10460 MHz.

A figure of merit for the investigation of simultaneous feeds in two bands is the dual-band ratio. This is a ratio of the center frequency of the high band to the center frequency of the low band. For values within the range of 0.5 to 5, dual-band feeds are considered to be possible. For a dual-band ratio close to 1, single broadband antennas and feeds can often be used.

For Phase 4, the ratio is 1.85. A case study of a design for a dual-band system for a dual-band ratio of 2.15, as a reference, can be read here:

https://www.ll.mit.edu/publications/journal/pdf/vol04\_no1/4.1.4.EHFdualbandfeed.pdf

As the article from MIT describes, there are at least three design patterns for dealing with dual band systems. The three approaches, and relevant Phase 4 details, are outlined below.

Dual Antenna

Two dishes

This approach uses two entirely separate antennas. Each antenna is a single-band antenna. This is the baseline approach for Phase 4.

Patch antenna plus dish

An approach actively investigated involves using a patch array for 5GHz and a dish and feed horn for 10GHz. Kent Britain WA5VJB is “Designing 2 patch arrays for use as 5.7 GHz ground station TX antennas. One in the 16-17 dBi range that would be set and forget. And one in the 18-20 dBi range that would probably would need to be moved twice a day.”

Single Main Antenna with Two Single-band Feeds

This approach is best used in the case where the bands are sufficiently far enough apart to where the smaller feed, for the higher frequency, does not substantially interfere with the larger feed, for the lower frequency.

Single Antenna with Dual Band Feed

This approach uses a single antenna and one dual-band feed. This reduces the pointing effort at the cost of some loss in the duality of the feed. A successful 5Ghz/10GHz dual-band feed for terrestrial use in the coaxial style can be found here:

<http://www.ntms.org/files/Dual_Band_2_3_and_5_10GHz.pdf>

The isolation from 5700MHz to 10000MHz is -70dB. The isolation from 10000MHz to 5700MHz is -30dB. Tuning the feed requires care, as each tuning screw affects both bands. The feed, as designed, has the same polarization on both bands. Linear cross-polarization would increase isolation by approximately 20dB.

As a comparison, parabolic dish side lobes are on the order of -17dB to -30dB down. Isolation from one dish to another is not infinite.

Kent suggested diplexer filters as a “plan B”.